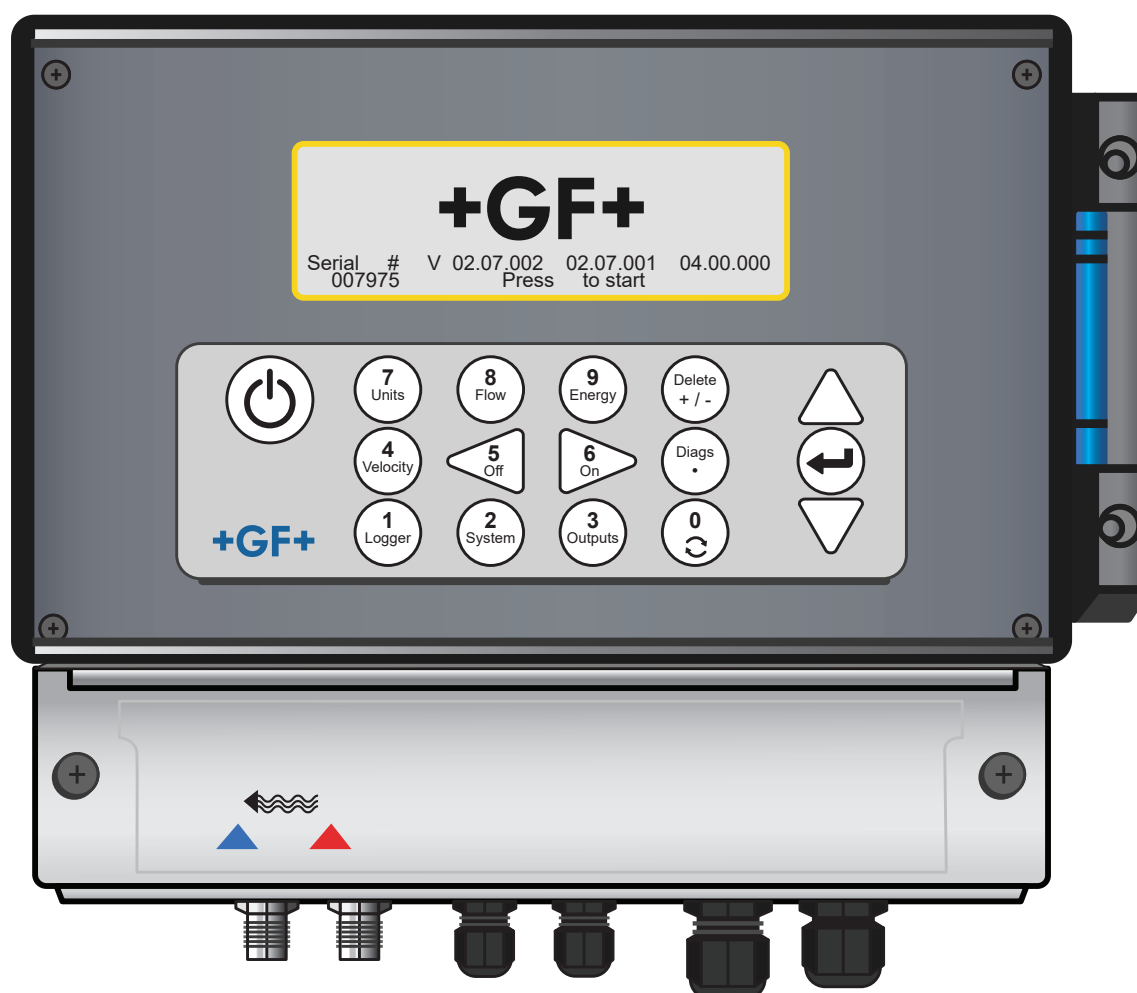


User Manual

GF U3000 V2 Ultrasonic Flowmeter

GF U3000 V2 HM Ultrasonic Heatmeter



Original instruction manual

Follow the instruction manual

The instruction manual is part of the product and an important element within the safety concept.

- ▶ Read and observe instruction manual.
- ▶ Always have instruction manual available at the product.
- ▶ Pass on instruction manual to all subsequent users of the product.

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1 Intended use

The flowmeter is designed to work with 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 flowmeter 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 2000mm and constructed of almost any material. The instrument will also operate over a wide range of fluid temperatures.

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 demineralized water.

Typical applications

- ▶ River water
- ▶ Seawater
- ▶ Potable water
- ▶ Demineralized water
- ▶ Treated water

2 About this document

This document contains all necessary information for the installation, operation and service of the product.

2.1 Warnings

In this instruction manual, warnings are used, which shall warn you of death, injuries or material damage. Always read and observe these warnings!



WARNING

Risk of fatal or serious injury!

There is a risk of fatal or serious physical injury if warnings are ignored!

NOTICE

Risk of damage to property!

Failure to comply leads to a risk of damage to property (loss of time, loss of data, machine fault etc.)!

Further labels

Symbol	Meaning
1.	Call for action in a certain order: Here, you have to do something.
▶	Call for action: Here, you have to do something
•	Listing

2.2 Other related documents

- Georg Fischer planning fundamentals

These documents are available via the agency of GF Piping Systems or at www.gfps.com.

2.3 Abbreviations

Abbreviation	Description
ABS	Acrylonitrile-butadiene-styrene
DA	Double acting function
EMC	Electromagnetic Compatibility
FC	Fail safe to close function
FO	Fail safe to open function
LCD	Liquid crystal display
LED	Light-emitting diode
MOSFET	Metal oxide semiconductor field effect transistor
PB-INSTAFLEX	Polybutene plastic piping system
PE-ELGEF	Polyethylene plastic piping system
PP-PROGEF	Polypropylene plastic piping system
PVDF-SGEF	PVDF (polyvinylidene fluoride) plastic piping system
SPNO MOSFET	Single-pole normally open metal oxide semiconductor field effect transistor
VC-U-PVC	Polyvinyl chloride

3 Safety and responsibility

- ▶ Only use the product for the intended purpose, see Intended Use.
- ▶ Do not use any damaged or faulty product. Sort out any damaged product immediately.
- ▶ Make sure that the piping system has been installed professionally and that it is inspected regularly.
- ▶ Have the product and accessories installed only by persons who have the required training, knowledge or experience.
- ▶ Regularly train personnel on all questions regarding the locally regulations applying to occupational safety and environmental protection, especially for pressurized pipelines.

4 Transport and storage

- ▶ Protect the product against external forces during transport (impacts, knocks, vibrations etc.).
- ▶ Transport and / or store the product unopened in its original packaging.
- ▶ Protect the product from dust, dirt, moisture as well as heat and ultraviolet radiation.
- ▶ Ensure that the product is not damaged either by mechanical or thermal influences.
- ▶ Before assembling, check the product for damage during transport.

5 Design and function

5.1 Packaging contents

Standard equipment

- GF U3000 V2 head unit
- Flow sensors / transducers
- Sensor cable (2pcs, each 5 m length)
- Gel pads
- Guide rail
- S/steel hose-clips for guide rail
- Ultrasonic coupling grease
- Earthing cable
- User manual
- Calibration certificate

Supplied with GF U3000 V2 HM models only:

- Heatsink compound (HM models only)
- Pt100 temperature probes incl. cable (3 m length) (HM models only)
- S/steel hose-clip for temperature probes (HM models only)

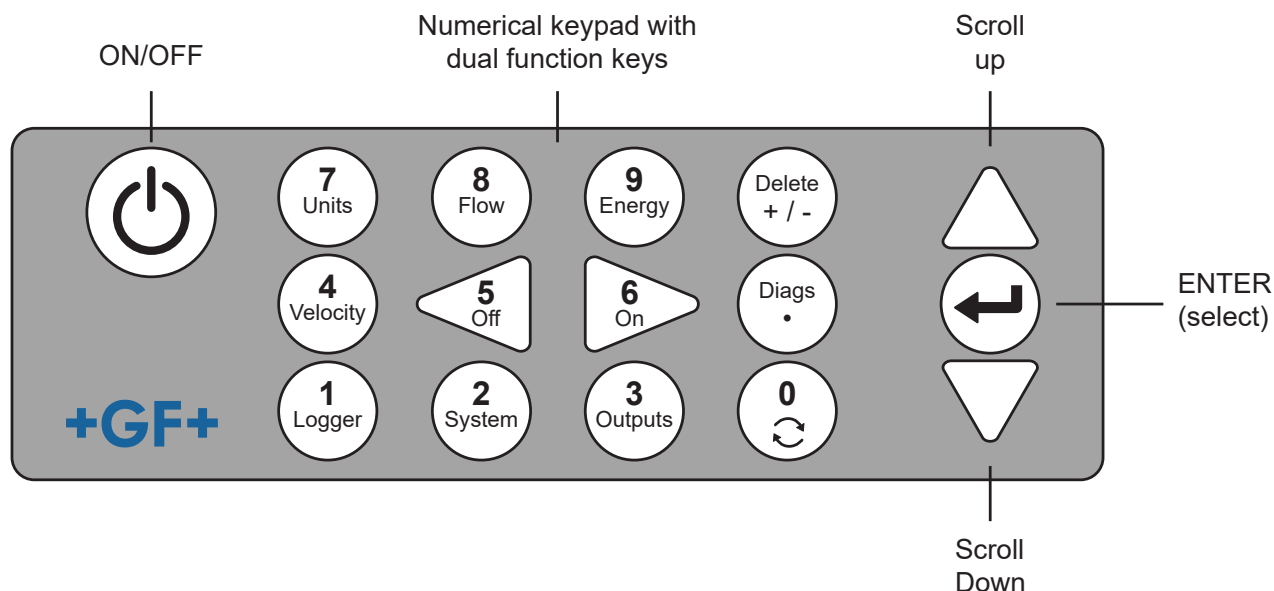
5.2 Functional description

The GF U3000 V2 (HM) is a microprocessor controlled instrument operated through a menu system using an inbuilt LCD display and keypad. It can be used to display the instantaneous fluid flow rate or velocity, together with totalized values, or act as a datalogger (models with datalogger option only). When operating in the data logger mode, the logged data can be stored in the instrument's non-volatile memory for downloading to a USB key at a later time. Up to 100 million logging events can be stored internally.

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.

Measurement data can be transmitted to higher-level systems via digital Modbus communication as well (models with Modbus option only). GF U3000 V2 HM units can be used to measure energy and power. They are supplied with RTD probes which, when properly placed, can be used to calculate energy lost or absorbed in a heater or chiller circuit. It does this by measuring the difference in temperature between the probes, which are usually placed on the flow and return pipes at the point of source.

5.3 Keypad



Legend

Key	Use
0	Circulate between flow, velocity and optionally energy screens (via a short press when reading flow, energy or velocity), enter the zero-flow setting screen (long press when reading flow), or freeze and un-freeze diagnostic values in the Diagnostic screen
1	GF U3000 V2 HM models only: Display the Logger menu
2	Display the System Settings menu
3	Display the Output Board Setup menu
4	Switch to the Read Velocity display from the Read Flow display or Read Energy display (GF U3000 V2 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 (GF U3000 V2 models only)
9	GF U3000 V2 HM: 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. Deletes alarms when activated, or return to the MAIN MENU from the Summary screen
Diags	Display the Diagnostics screen

ON/OFF Key

The ON/OFF key is shown on the top left of the keypad. When turned ON an initialization 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.

Menus and the menu selection keys

The GF U3000 V2 (HM) menus are arranged hierarchically with the MAIN MENU being at the top level. Menu navigation is achieved by three keys on the right hand side of the keypad which are used to scroll UP and DOWN a menu list and SELECT a menu item. When scrolling through a menu an arrow-shaped cursor moves up and down the left hand side of the screen to indicate the active menu choice which can then be selected by pressing the ENTER (SELECT) key.

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 DOWN past the bottom visible item. Menus generally 'loop around' if you scroll beyond the first or last items.

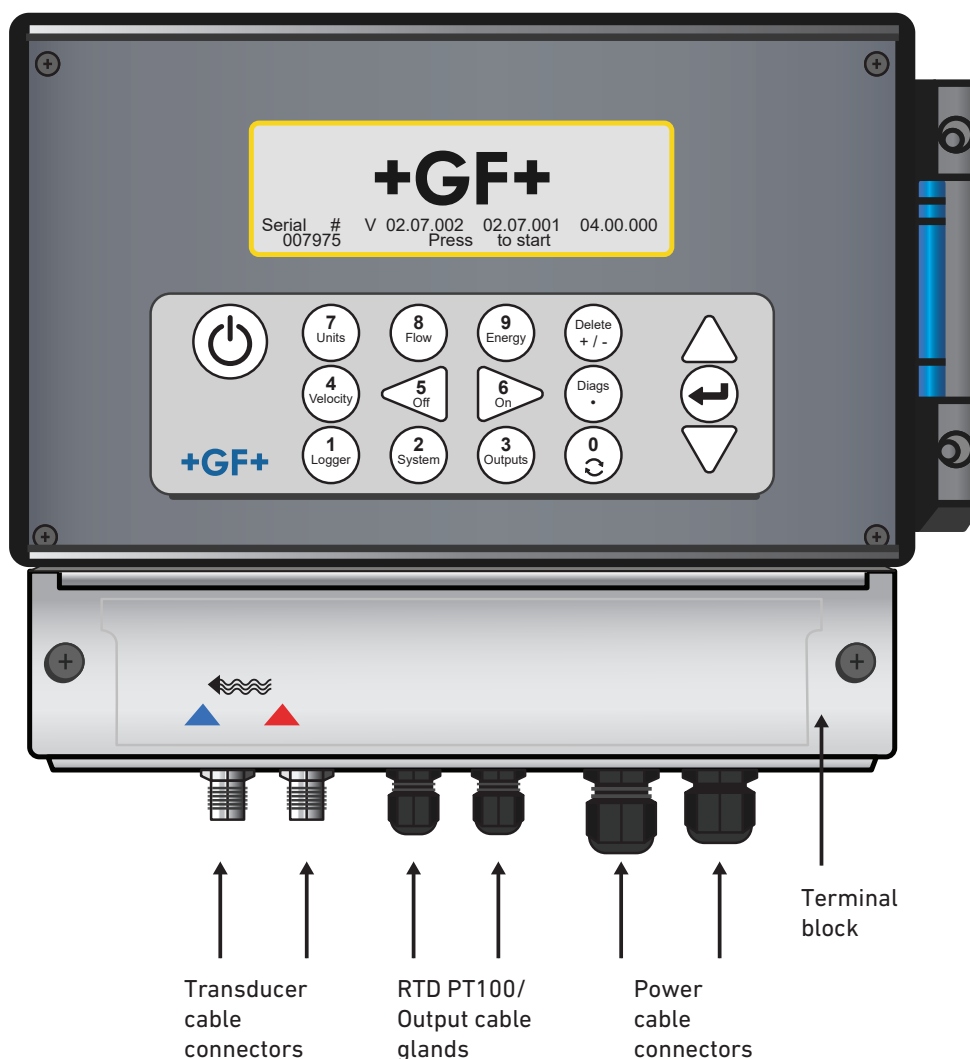
If you select Exit it usually results in taking you back one level in the menu hierarchy, but in some cases it may go directly to the 'Flow Reading' screen.

Some screens require you to move the cursor left and right along the display as well as up and down. This is achieved using keys 5 (scroll LEFT) and 6 (scroll RIGHT).

Dual function numerical keypad

The block of keys shown in the centre of the keypad in the figure below are dual function keys. They can be used to enter straight-forward numerical data, select the displayed flow units or provide quick access to frequently required control menus.

5.4 Connectors



5.5 Transducers

Two sets of ultrasonic transducers are provided as standard. When setting up the instrument it will indicate the appropriate transducer set to use for a particular application, depending on data entered by the user. Default pipe ranges are programmed into the instrument and most of the time there will be no need to use an alternative transducer set to the one suggested by the instrument. However, if circumstances dictate that a different set must be used it is possible to manually programme the instrument to accept the alternative set.

Transducer set 'A'

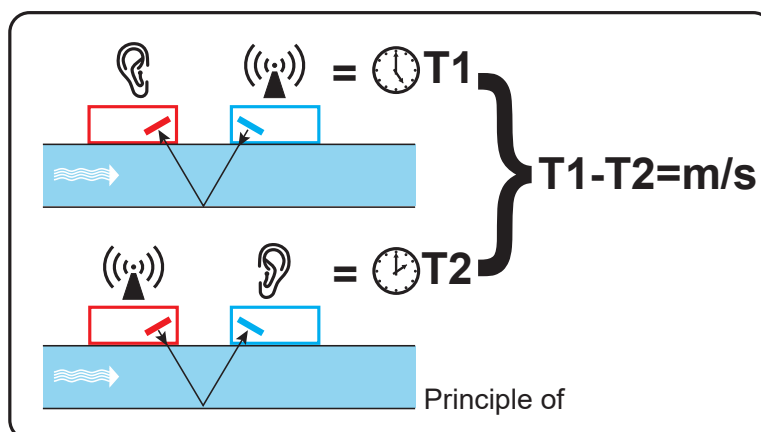
Supplied as standard for use on pipes 13mm to 115mm outside diameter.

Transducer set 'B'

Supplied as standard for use on pipes 50mm to 2000mm outside diameter.

5.6 Principle of operation

The flowmeter takes accurate flow measurements by determining the difference between the transmission times of two ultrasonic signals



A periodic voltage pulse acts on the transducer crystals and produces an ultrasonic beam at a certain frequency. The beam is first transmitted by the downstream transducer (blue) to the upstream transducer (red).

The beam is then sent in the opposite direction, i.e. from the upstream transducer (red) to the downstream transducer (blue). The time taken for the ultrasonic to pass through the liquid in this direction is slightly shortened by the speed at which the liquid flows through the pipe.

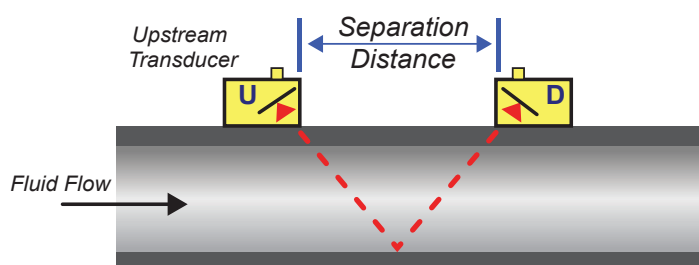
The resulting time difference $T1 - T2$ is directly proportional to the speed at which the liquid flows through the pipe.

In addition to the flow rate, a flowmeter with heat meter option measures the temperature difference between the flow and return of the system via two PT100 temperature sensors.

The difference in temperature between the flow and the return, in combination with the volume of water that has passed through the system, is used to calculate the energy difference in the medium.

5.7 Operation modes

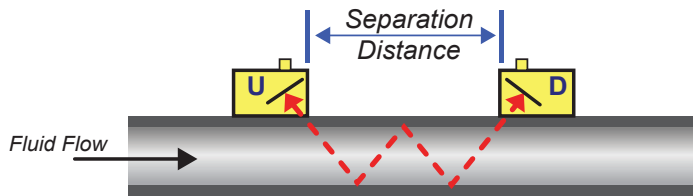
The flowmeter can be set up to operate in one of four modes determined mainly by the pipe diameter and the type of transducer set in use. The diagram below illustrates the importance of applying the correct separation distance between the transducers to obtain the strongest signal.



Reflex mode

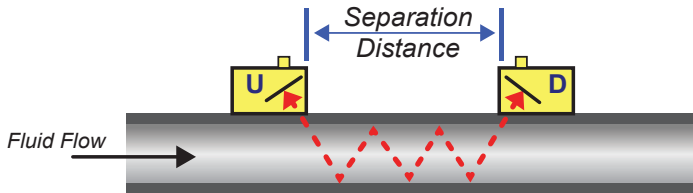
This is the mode most commonly used. The two transducers (U & D) are attached to the pipe in line with each other and the signals passing between them are reflected by the opposite pipe wall.

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



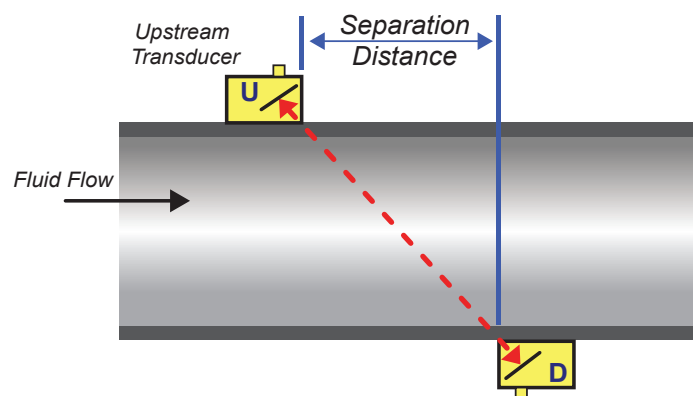
Reflex mode (double bounce)

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 mode 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.

*In general, it should be noted that errors accumulate as the number of bounces increase. Units are calibrated using single reflex mode. Any inherent inaccuracy will be amplified by using higher order modes such as triple and quadruple bounce. In addition to this, as the path length is longer, the signal will also be more attenuated with higher order operating modes. Attenuation is also greater with sensors using higher operating frequencies. (E.g. Signals from A sensors will be more attenuated than with B sensors.)

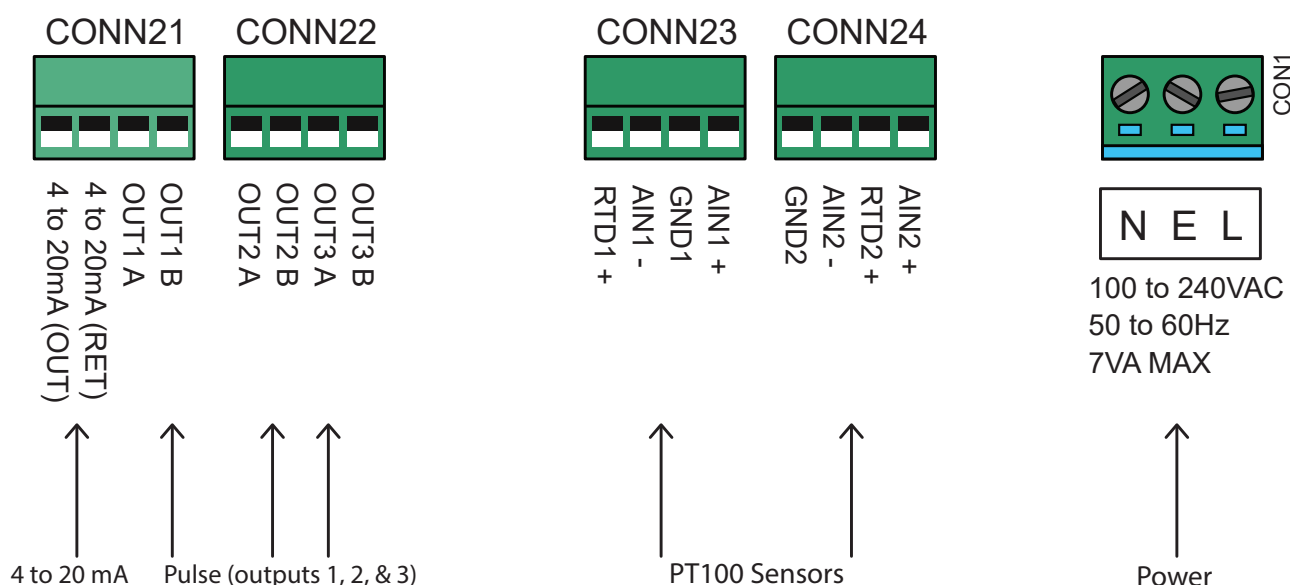
5.8 Terminal blocks

This section explains how to connect power and signal cables to the terminal blocks inside the wall mount unit. The transducer cables attach to sockets on the left side of the terminal block. Other cables enter the instrument through the four cable glands provided and are connected to terminal blocks which are located behind a safety cover.

To make power, PT100 and output connections:

1. Remove the terminal block cover by unfastening the two retaining screws.
2. Route the control and monitoring cables through the two smaller cable glands.
3. Cut the wires to length, strip back the insulation by approximately 10mm and connect them into the required terminals as described above and identified in the figure below.
4. On completion, tighten the cable glands to ensure the cables are held securely.
5. Refit the terminal block cover.

4-20mA Pulse(outputs 1, 2 & 3) PT100 Sensors Power



5.8.1 Power Supply

The instrument can be powered from a mains supply (100 - 240V AC., 50/60Hz) or from a 24V AC/DC supply if it is fitted with a 24V supply module.

1. Route the power cable through one of the two cable glands on the right hand side of the instrument, below the power connection terminals, using the gland most suitable for the cable diameter.
2. Cut the wires to length, strip back the insulation by approximately 10mm and connected to them into the correct power supply terminals identified in the figure above.
3. On completion, tighten the cable glands to ensure the cables are held securely.



WARNING

LETHAL VOLTAGES! ENSURE THE POWER CABLE IS ISOLATED FROM THE MAINS SUPPLY. DO NOT APPLY MAINS VOLTAGE WITH THE TERMINAL COVER REMOVED. EXTERNAL POWER SUPPLY MUST BE CLASS 2 RATED.

**WARNING**

IMPORTANT: IT IS THE RESPONSIBILITY OF THE INSTALLER TO CONFORM TO THE REGIONAL VOLTAGE SAFETY DIRECTIVES WHEN CONNECTING THE GF U3000 V2 TO A POWER SUPPLY USING A MAINS-RATED TRANSFORMER.

**WARNING**

SUPPLY EARTHING. IF THE EQUIPMENT IS POWERED FROM A 24V AC SUPPLY THEN THE SUPPLY MUST BE ISOLATED FROM EARTH.

5.8.2 Control & monitoring cables

Depending on the fitted options, any of the following control and monitoring cables may be required:

- **Current Output**

A 4-20mA, 0-16mA, or 0-20mA monitoring signal output at terminal mA+ and mA-.(mA+ is the current output terminal and mA- is the return terminal).

- **Pulse Output**

An opto-isolated pulse output is available at terminals PULSE+ and PULSE- (PULSE+ is the pulse output terminal and PULSE- is the return terminal).

- **Alarm Outputs**

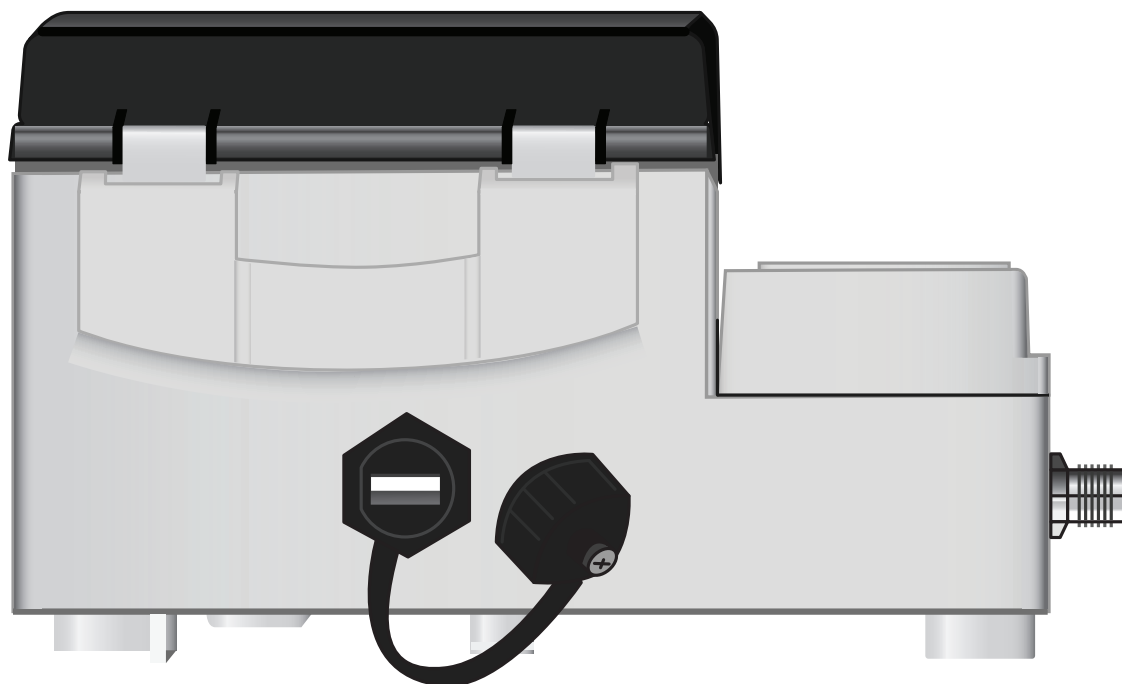
Two programmable, multifunction alarm outputs are available using MOSFET, SPNO relays. The relays are rated at 48V/500mA continuous load, and are connected to terminals ALARM1+, ALARM1-, ALARM2+ and ALARM2- respectively.

Using the instrument's menu system (see page 44), you can:

- Select the current output function **Off/On**
- Select the current output range (set the current range, where 4-20mA, 0-20mA, 0-16mA are common ranges), but the device is capable of generating currents of up to 24mA
- Calibrate the current output signal to a required flow range
- Select the alarm cause (and alarm current for the current output)
- Set a trigger value for the alarm when it is associated with Under Value or Exceeds Value
- Set current trim values to accommodate any inaccuracies in the user's system

5.8.3 USB Connector

A USB connector is available at the left-hand side of the enclosure. This can be used to download logged data onto a USB memory stick



6 Installation

6.1 Positioning the head unit

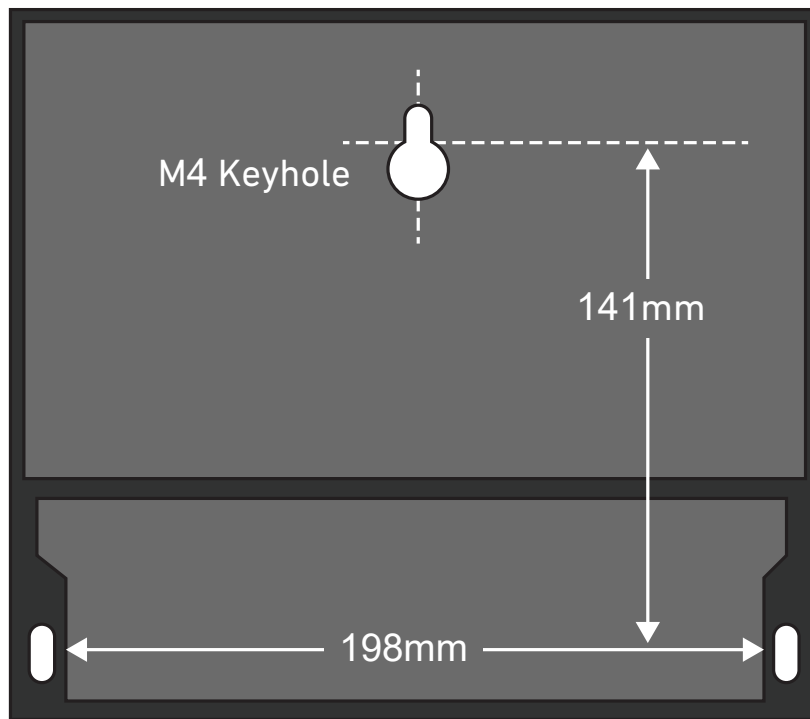
The head unit should be installed as close as conveniently possible to the pipe-mounted ultrasonic sensors. Standard transducer cables are 5 meters in length with 10 meter cables being optionally available. Where, for operational reasons, it is not possible to mount the instrument this close to the sensors, bespoke cables of up to 100m can be provided – consult your GF sales representative for further information and availability.

A suitable mains supply must be available to power the instrument (an optional 24V AC/DC. supply module is available). The external supply must be suitably protected and connected via an identifiable isolator. A 500mA fuse is fitted internally in the instrument's input supply line.

6.2 Mounting the head unit

Ideally the head unit enclosure should be fixed to a wall using three M4 screws.

1. Remove the head unit terminal cover.
2. Fix a screw into the wall at the required point to align with the mounting keyhole on the back of the enclosure.
3. Attach the enclosure to the wall using the keyhole screw mounting.
4. Align the enclosure then mark out the positions for the two remaining screw fixings through the slots near the bottom corners of the enclosure. Then remove the enclosure, and drill (and plug) the fixing points.
5. Clear the site of any dust/debris then mount the enclosure on the wall.



6.3 Positioning the transducers

The flowmeter requires an even and uniform flow profile, since distortions in the flow can cause unpredictable measurement errors. In many applications, however, it is not possible to have a uniform flow rate through 360°. This may be, for example, because there are air bubbles inside the top of the pipe, or turbulence in the pipe, or sludge at the bottom of the pipe.

Experience has shown that the most accurate results are obtained if the guide rail of the transducers is not mounted vertically to the pipe, but turned at an angle of about 45° to the right or left on the pipe.

Incorrect measurements

Measurements can be distorted if the transducers are positioned close to upstream pipe components and fittings such as pipe bends, T-branches, valves, pumps and similar obstacles.

To ensure that the flowmeter is positioned at a place that has an undistorted flow profile, the transducers must be mounted sufficiently far from possible sources of distortion to prevent these from having any effect on the measurement.

- Install a straight section of pipe with length 10 times the diameter on the upstream side of the transducer.
- Install a pipe section with length 5 times the diameter on the downstream side of the transducer. In exceptional cases, a pipe with length 5 times the diameter may be sufficient.

6.4 Attaching the transducers

Type 'A' or 'B' transducers are attached to the pipe using the adjustable guide rail assembly shown below. The guide rail itself is secured to the pipe using two wrap-around steel bands. For convenience, an imperial (inches) and metric (millimeters) ruler is attached to the side plate of the guide rail. Once the guide rail assembly is fully assembled the transducers are locked into position by tightening the transducer clamp.

NOTICE

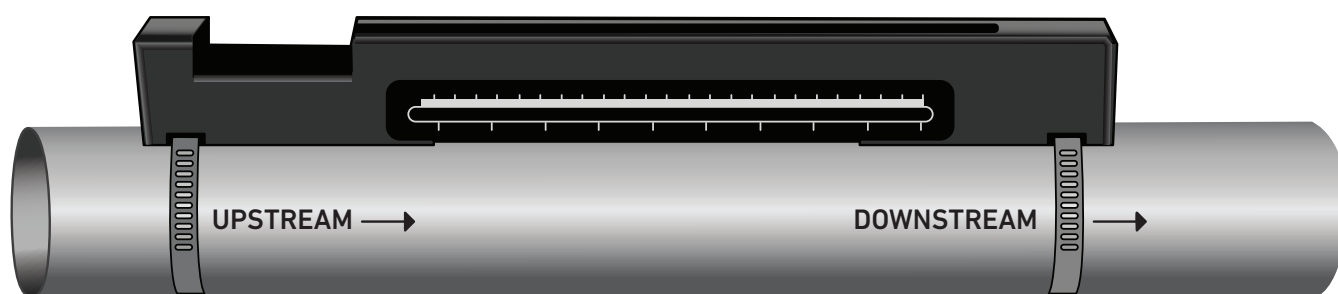
When using the flowmeter in the 'diagonal' mode, or in 'reflex' mode on pipes over 350 mm diameter, two guide rails are required with a transducer mounted in each one – refer to correct section (6.4.4. in this document).

6.4.1 Cleaning the contact area.

Type 'A' or 'B' transducers are attached to the pipe using the adjustable guide rail assembly shown in Figure below. The guide rail itself is secured to the pipe using two wrap-around steel bands. For convenience, an imperial (inches) and metric (millimetres) ruler is attached to the side plate of the guide rail. Once the guide rail assembly is fully assembled the transducers are locked into position by tightening the transducer clamp.

6.4.2 Attaching the Guide Rail to the Pipe

Position the guide rail horizontally on the pipe at 45° with respect to the top of the pipe and secure it in position using the supplied stainless steel banding, as shown in below.

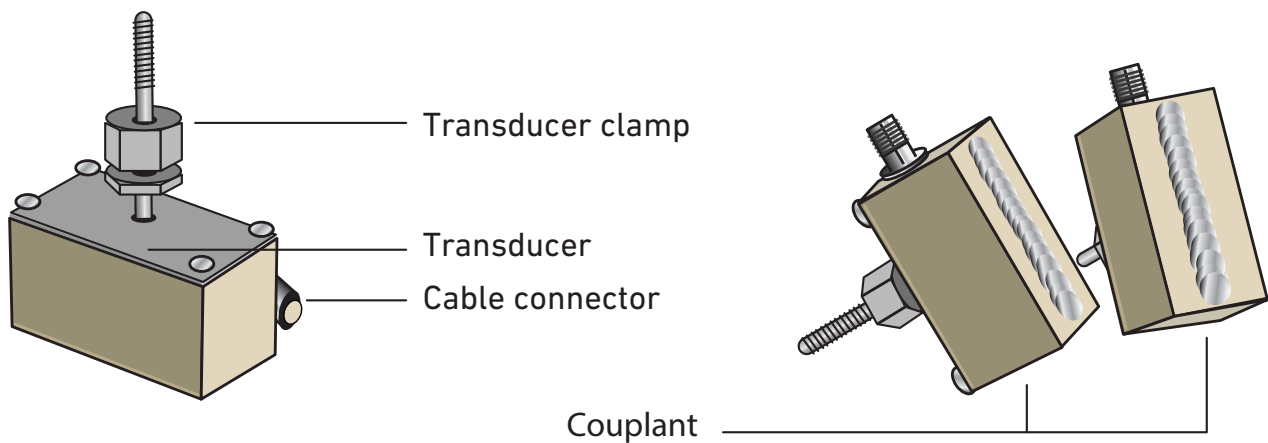


NOTICE

In the following procedure the guide rail is installed with the rectangular opening facing towards the upstream end of the pipe

6.4.3 Fitting the Transducers

1. Tighten each transducer clamp clockwise until it is close to the top of the transducer (figure below, left). This is necessary in order to prevent the acoustic couplant touching the pipe when the transducer is initially inserted into the guide rail – as described below.
2. Using the supplied syringe applicator, apply a 3mm bead of acoustic couplant to the base of both transducers (figure below, right).



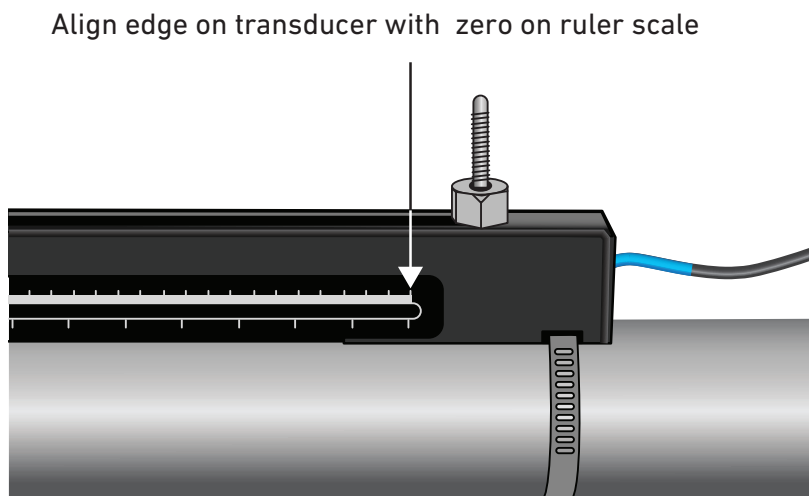
3. Thread the downstream transducer cable (blue) through the right-hand end of the guide rail and up through the rectangular opening at the top left-hand end of the guide rail, as shown in figure below.
4. Connect the downstream cable (blue) to one of the transducers.

NOTICE

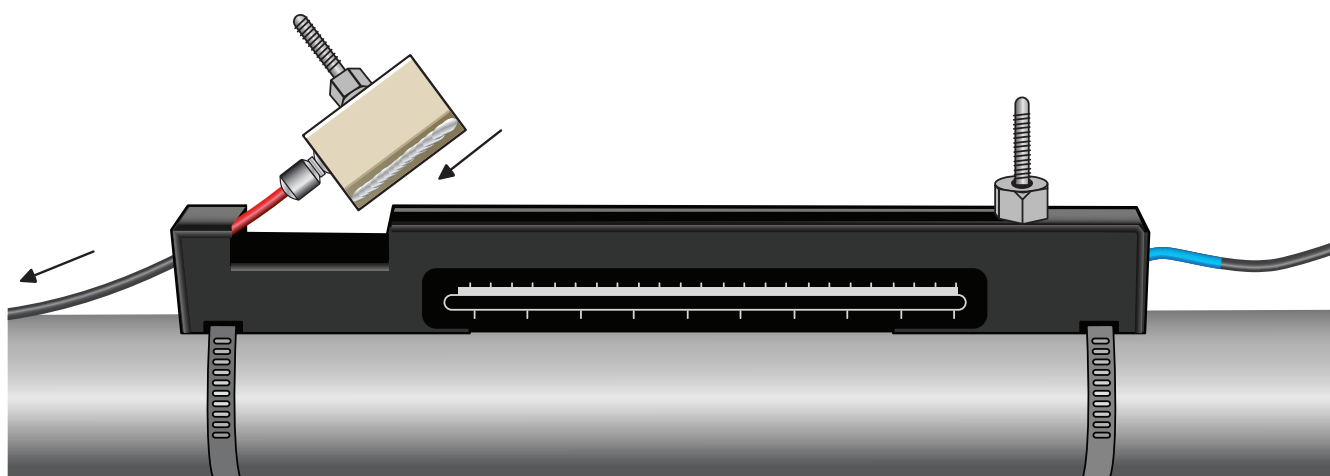
When carrying out the following steps handle the transducer assembly with care to avoid smearing the acoustic couplant on the pipe whilst attaching the transducer to the guide rail.



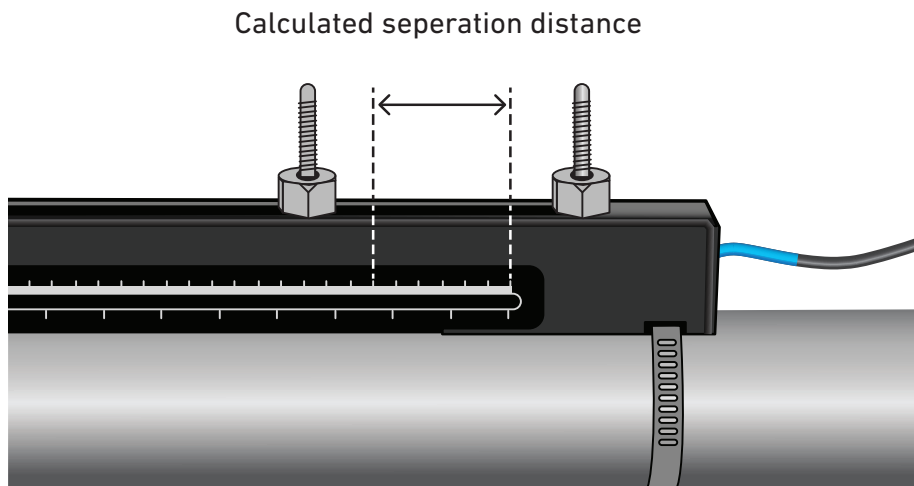
5. Carefully slide the downstream transducer assembly along the guide rail until the inner face of the transducer is aligned with the '0' mark on the ruler scale (figure below).



6. Lower the transducer onto the pipe by turning the transducer clamp anti-clockwise until it is 'finger tight' (do not use a spanner).
7. Thread the upstream signal cable (red) through the left-hand end of the mounting rail and connect it to the second transducer (figure below).
8. Carefully lower the transducer assembly through the rectangular opening until the slots in the side of the transducer clamp align with the edges on the top of the guide rail.



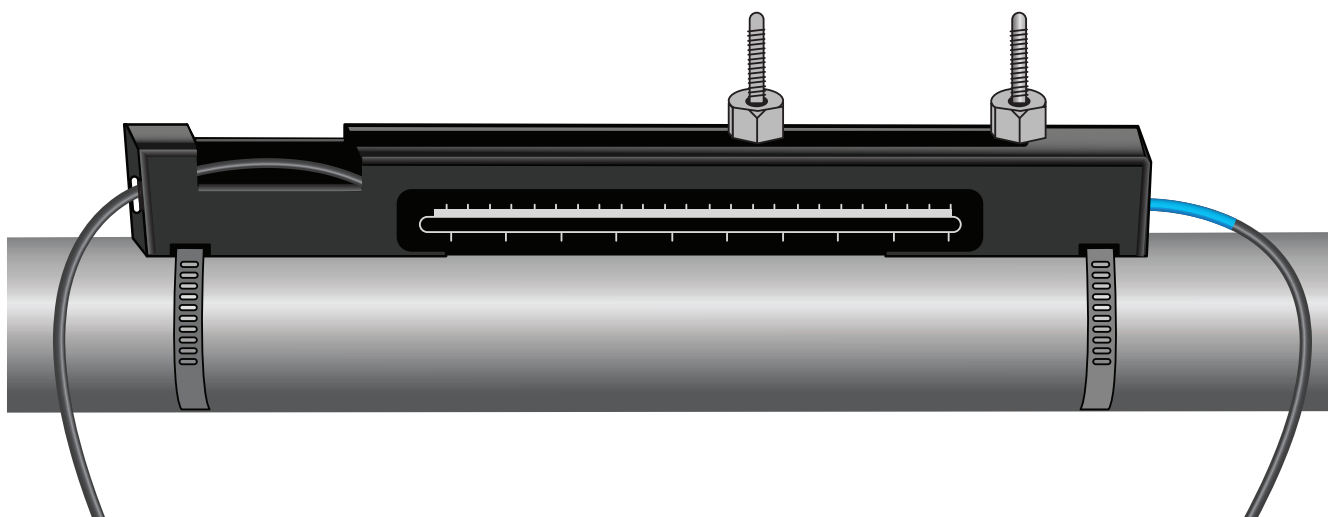
9. Position the upstream transducer so that the inner face of the transducer is set to the required separation distance on the ruler, as shown in figure below.



NOTICE

The separation distance for a particular application can be found using the 'Quickstart' menu see 7.1 'Using the quick start menu'

10. Lower the transducers onto the pipe by turning each transducer clamp anti-clockwise until it is 'finger tight' (do not use a spanner). The figure below shows the final position of the transducers when the transducer clamps are fully tightened.



11. Connect the transducer signal cables to the U3000 V2 instrument – i.e. with the RED cable connected to the upstream transducer connector and the BLUE cable to the downstream transducer connector.

NOTICE

If you observe negative flow, swap the red and blue cables at the sensor end

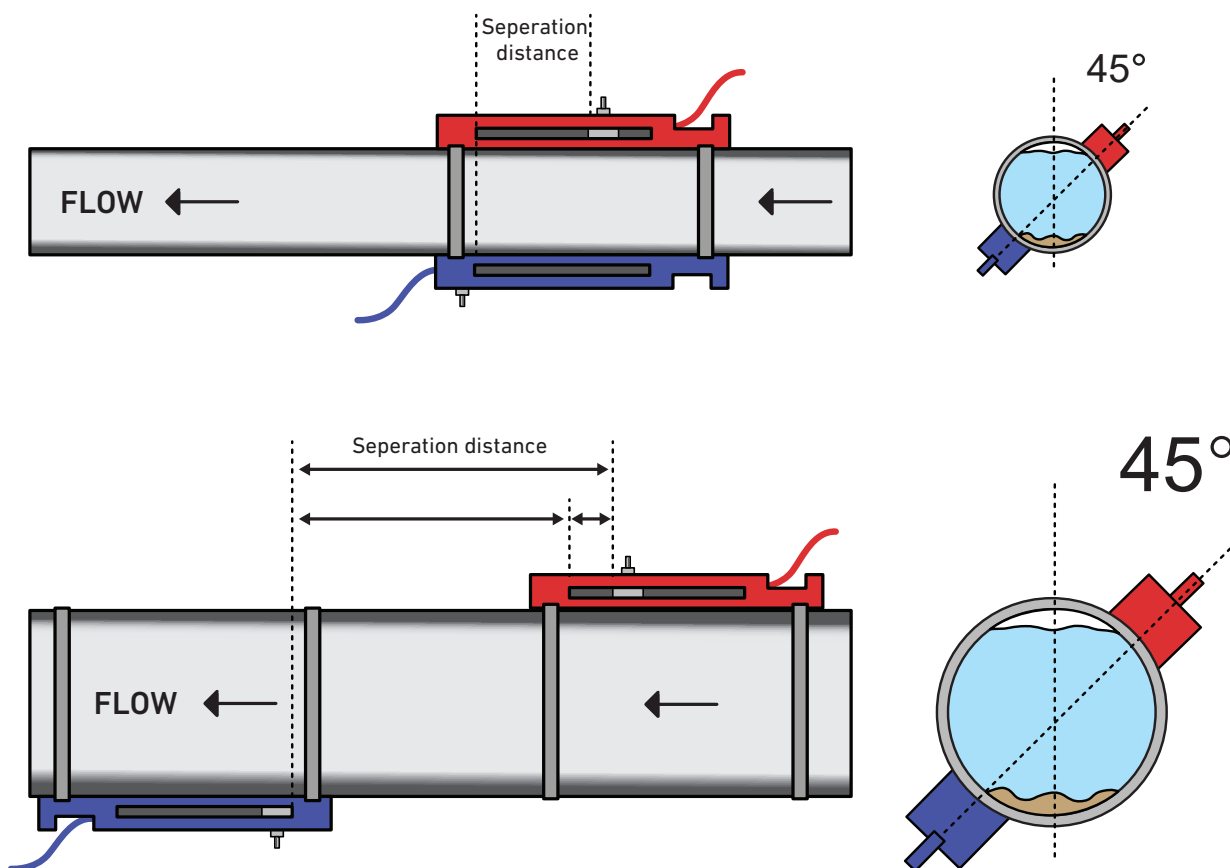
6.4.4 Attaching the transducers in diagonal mode

This mode of operation requires two transducer guide rails fitted on opposite sides of the pipe (fitted on a 45° axis with respect to the top of the pipe as in Reflex Mode). If the required transducer separation is 230mm or less, the guide rails can be fitted using the same stainless steel bands (see Figure below). For greater transducer separation, the guide rails may need to be installed separately (see Figure below). In this case, it is necessary to accurately mark out the required positions to ensure that the transducers are correctly positioned and aligned along the axis of the pipe, directly opposite each other on a 45° axis with respect to the top of the pipe, and at the required separation.

To position the transducers, obtain and note the separation distance between the transducers using the Quick Start menu (see section 7.1 'Using the quick start menu'). Prepare the transducers with couplant as described in section before.

Required transducer separation 230mm or less:

1. Position the two guide rails horizontally on the pipe at 45° with respect to the top and bottom of the pipe and secure in position using the supplied stainless steel banding (see Figure below).
2. Follow the instructions provided for Reflex Modes, fitting the downstream transducer in the lower guide rail and the downstream transducer in the top guide rail



1. Position the upstream guide rail horizontally on the pipe at 45° with respect to the top of the pipe and secure it in position using the supplied stainless steel banding.
 2. Fit the upstream transducer into the guide rail but do not fasten it in position yet.
 3. Position the downstream guide rail at the approximate location to give the required separation under the pipe. For example, if the required separation is 450mm, align the guide rail so that the zero marks on the two guide rails are 400mm apart. The remainder can then be accounted for by sliding the upstream transducer to the 50mm mark (see Figure above). This allows for any fine adjustments that may be necessary during use.
 4. Fit the downstream transducer so that the inner face is aligned with the zero mark on the guide rail.
 5. Adjust the position of the upstream transducer so that the overall separation distance is correctly achieved.
 6. Lower the two transducers onto the pipe by turning the transducer clamps anti-clockwise.
-

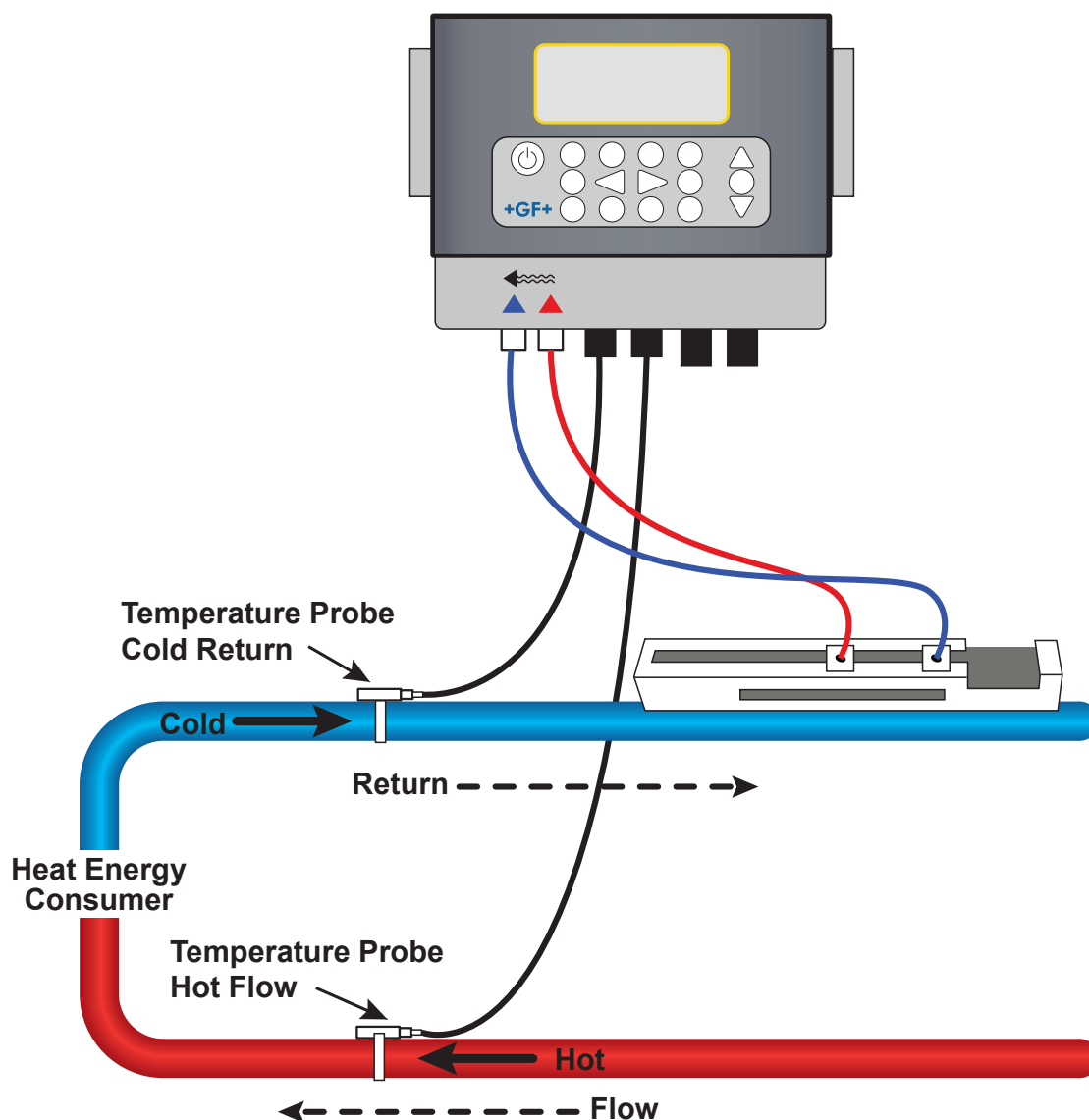
NOTICE

An easy way to draw a perpendicular circumference around a large pipe is to wrap a length of material such as a chart paper around the pipe, aligning the edges of the paper precisely at the overlap. with the edge of the chart paper being parallel, either Edge describes a circumference around the pipe that is perpendicular to the pipe axis. Mark the chart paper exactly where it overlaps. Then, after removing the paper from the pipe, fold the measured length in half keeping the edges parallel. The fold line now marks a distance exactly halfway around the pipe. Put the paper back on the pipe and use the fold line to Mark the opposite side of the pipe.

6.5 Connecting temperature probes (HM versions only)

The temperature sensors must be located at the flow and return 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.

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.



NOTICE

It must be kept in mind that this is the reading on the outside of the pipe, which may vary significantly from the actual fluid temperature, especially if the pipe material is of some type of insulating material. This does not necessarily invalidate energy readings since the readings are dependent on the temperature differential, not the absolute temperature. It is the responsibility of the installer to ensure the differential temperature readings are as accurate as possible. This may necessitate covering the sensors with insulating material to ensure drafts and differences in ambient temperature are minimized for both sensors.

6.5.1 Calibrate the Pt100 Sensors (HM versions only)

NOTICE

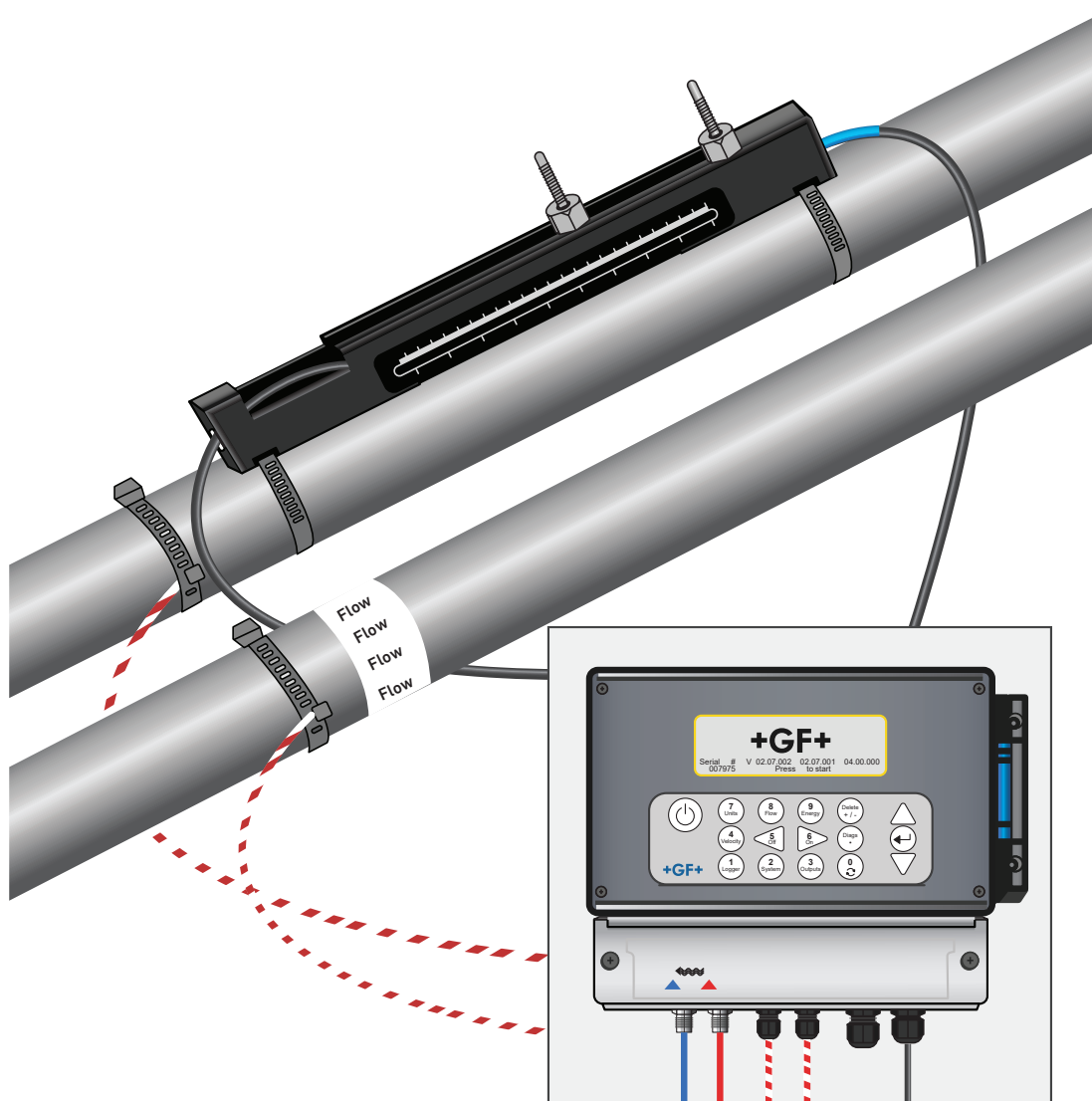
The Pt100 sensors must be balanced before initial use, using the procedure described below and used with the cable length supplied. Extending or shortening the cables will negate the calibration of the sensors.

Please refer to section 10.1 'Calibrate temperature sensors'.

6.5.2 Attach the Pt100 Sensors (HM versions only)

The Pt100 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.

Clamp the sensors in position using the supplied stainless-steel cable ties.



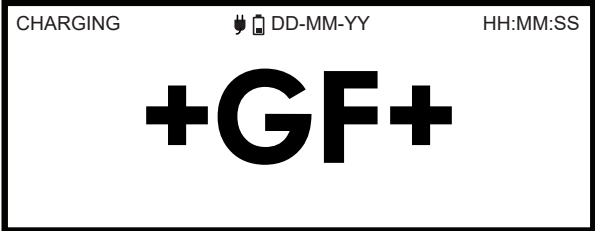
6.6 First-time use

When power is applied, the unit passes through its initial booting sequence and then displays the flow screen.

Press the ENTER key to display the Main menu.

6.6.1 Checking system health

This operation should be checked after powering up the unit for the first time, but it is useful to check periodically that all systems are operating properly, especially if errors were reported when entering the Main menu.

	1. From the Main menu, use the Up and Down scroll keys to select Setup Instrument. Press the ENTER Key. 2. A list of options will be displayed depending on the flowmeter model. It should be noted that a status message will appear to the right of the option name. If the sub-system implementing the option is working correctly, the status will read "OK". If any subsystem has a fault, two dashes will be visible. 3. If a subsystem is NOT reading OK at start-up, try restarting the flowmeter by turning it off then on again. If the error persists, contact your distributor or return the item for repair
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6.6.2 Selecting a language

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

U3000 MAIN DD-MM-YY HH:MM:SS Quick start.. View / Edit Site Data.. - > Setup Instrument.. Data Logger.. Read Flow.. Read Energy..	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. 2. Alternatively, from a Read Flow/Velocity/Energy screen, press the SYSTEM key (2). The System Settings menu is displayed. 3. Use the UP/DOWN arrow keys to select Language. Press the ENTER key. 4. Use the UP/DOWN arrow keys to scroll through the available options. 5. With the required language highlighted, press the ENTER key 6. Use the UP/DOWN arrow keys to select Save Setup & Exit. Press the ENTER key. 7. The selected language is now active for all screens.
Options DD-MM-YY HH:MM:SS - > System.. Power.. Output.. Heat-Meter.. Logger.. Primary Flow..	

6.6.3 Setting Date & Time

System Settings DD-MM-YY HH:MM:SS Lock-screen Timeout 90 sec Back - light mode ON Back - light Timeout 75 sec - > Set Date & Time.. Reset Totals.. Damping 10 sec	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. 3. The Set Date & Time menu is displayed. 4. 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. 5. Use the UP/DOWN arrow keys to select Mode. Press the ENTER key. 6. Use the UP/DOWN arrow keys to choose the required format: DD-MM-YY or MM-DD-YY. Press the ENTER key. The date and time format will immediately be updated. 7. 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. 8. Scroll down and select Exit then press the ENTER key to return to the MAIN menu.
Set Date & Time DD-MM-YY HH:MM:SS - > Set Date & Time DD-MM-YY.HH:MM:SS Mode DD-MM-YY Exit	

NOTICE

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.

6.6.4 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 or use the TIMED option to prolong the battery discharge time.

System Settings	DD-MM-YY	HH:MM:SS
. . Lock-screen Timeout	90	sec
-> Back - light mode	ON	
Back - light Timeout	75	sec
Set Date & Time..		
Reset Totals..		
Damping	10	sec

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

6.6.5 Enabling/Disabling Audible Keypress

When enabled, the Audible keypress option provides feedback that a key has been released:

- When a key is pressed for a short period of time, a very short beep will be heard.
- When a key is pressed for a long time, a beep of up to half a second will be heard.

To change the Audible keypress option:

	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. 2. Alternatively, from a Read Flow/Velocity/Energy screen, press the SYSTEM key (2). The System Settings menu is displayed. 3. Use the UP/DOWN arrow keys to select Audible keypress. Press the ENTER key. 4. Use the UP/DOWN arrow keys to scroll through the available options: On/Off. 5. With the chosen mode selected, press the ENTER key. 6. Note that key beeps will be active immediately 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
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7 Operation of the device

7.1 Using the quick start menu

The quickest way to set up the flowmeter 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 flowmeter, which then stores the site parameters.

Before you can use the flowmeter 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.

7.1.1 Entering the site data

PF330 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	PVC-U	
Continue..		
Main Menu..		

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
If the material is not listed, select Other (m/s) and enter the propagation rate of the pipe wall material in meters/sec. Contact GF if this is not known.
Select CONTINUE and press the ENTER key.
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 meters/sec.
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 fluid is not listed, select Other (m/s) and enter the propagation rate of the fluid in metres/sec.
Note: If Other is selected, enter the speed of sound (SoS) in metres per second, of the wall material. After entry of the SoS, the user will be taken to the following screen as would have been the case if another selection was made.

Pipe Lining	DD-MM-YY	HH:MM:SS
- > Lining material	Glass	
Continue..		
Main Menu..		

Pipe Lining Thick	DD-MM-YY	HH:MM:SS
- > Pipe Lining thickness	1.0	mm
Continue..		
Main Menu..		

Fluid Type	DD-MM-YY	HH:MM:SS
- > Select fluid type	Water	
Continue..		
Main Menu..		

Fluid Temperature	DD-MM-YY	HH:MM:SS
- > Fluid Temperature	14.0°C	
Continue..		
Main Menu..		

Heat Meter	DD-MM-YY	HH:MM:SS
- > Installation Side	Hot Sensor	
Sensor Type	PT100	
Continue..		
Main Menu..		

Summary	DD-MM-YY	HH:MM:SS
- > Site: Quickstart		
Sensor separation: 69.9mm		
Pipe OD: 114.3mm, ID 98.3mm		
Sensor type A-ST, Mode: Reflex		
Fluid type: Water @14.0°C		
Press < - to continue, <> to select sens.		

ATTACH SENSORS	DD-MM-YY	HH:MM:SS
Attach Sensor Set		
Red Connector UpStream		
Press ← Key to go to Flow Reading		

8. Select CONTINUE and press the ENTER key. Enter the fluid temperature (-30 – 135.0 °C) at the point the meter is installed. Select CONTINUE and press the ENTER key.
9. HM versions only: Specify how the Heat meter is configured: Hot Sensor/ Cold Sensor/ Fluid Temperature. Program the unit with the temperature of the fluid at the point where the flow meter is installed to account for any variations in relative density and specific heat capacity. If the meter is installed at a point some way from either the hot of cold sensor, select the temperature entered in the previous step. 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. If the data contains a mistake, press the delete key to return to the main menu and restore the previous settings.
11. If you prefer to use a different configuration, press the UP or DOWN arrow key to select a different sensor set and mode

NOTICE

The SENSOR SELECTION menu can be entered by use of the Up/Down 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.

NOTICE

Do not press the enter key until the correct transducers are fitted and connected to the instrument. If the data contains a mistake, press the delete key to return to the main menu and restore the previous settings.

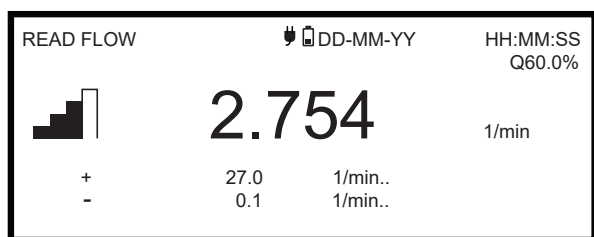
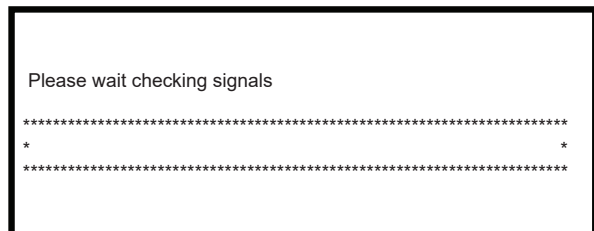
NOTICE

The sensors screen will be displayed automatically if the entered pipe od and/or temperature are not valid for the currently selected sensors.

7.1.2 Attaching and connecting the transducers

1. Fit the designated sensors to the pipe using the appropriate guide rails as described in section 6.2 Attaching the transducers. 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.

7.1.3 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. The Q value indicates the signal quality and should have a value of 60% or greater. Signal Q is a mixture of the Signal to Noise Ratio (SNR) and signal timing accuracy. This is the best measure of system performance

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 +/-99999 in the selected units then the display will change to exponential (or scientific) notation. This is used in Microsoft™ Excel™ and many other software packages.

For example, if the display reads 1.0109E5 l/min, this represents 101,090 l/min ($1.0109 \times 100,000$). Note the number of zeros in the multiplier corresponds to the number following the E on the display. Alternatively, you may select another unit by pressing the UNITS (7) key. With units of l/sec, the previous example would read 1684.8 l/sec, hence scientific notation would not be required. There are no limitations on the use of these larger flow values with regards to logging of data and setting the current and digital outputs. Values are automatically saved in scientific form in any case.

7.1.4 Flow / energy / velocity monitoring

From the READ FLOW, READ ENERGY or VELOCITY 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.
- Switch between valid screens every 10 seconds by briefly pressing key 0. Pressing 0, 4, 8 or 9 stops this action.
- Enter the zero-flow screen by a long press of the 0 key.
- Change the display units by pressing key 7.

7.1.5 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:

Options	DD-MM-YY	HH:MM:SS
System..	OK	
Power..	OK	
Output..	OK	
Heat-Meter..	OK	
Logger..	OK	
-> Primary Flow..	OK	

Primary Flow Se	DD-MM-YY	HH:MM:SS
-> Display Total		Both
Damplng		10 sec
Signal-loss Timeout		3 sec
Flow Direction		Normal
Exit		

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.

Calculating the Average Flow or Power

To calculate the average flow, wait for the allotted monitoring period to expire then divide the indicated total volume or energy by the time taken. This will give you the average flow in m/s, gals/hour or whatever units you select. Follow the same procedure for average power, taking note of the issue below.

NOTICE

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.

NOTICE

If flow is reversed, then normally energy might be considered reversed, however, as the systems under measurement do not behave in this way, when flow is reversed, the power is set to zero, irrespective of the magnitude of flow. The period of flow reversal would have to be taken into account if an average power is calculated.

Resetting Totals

System Settings	DD-MM-YY	HH:MM:SS
Back-light Timeout	60	sec
Audible Keypress	ON	
Set Date & Time. .		
Display Total	Both	
- >Reset Totals. .		
Damping Mode	Fixed	

System Settings	DD-MM-YY	HH:MM:SS
Set Energy Total	0	kJ
- >Set Fwd Volume Total	0	1
Set Rev Volume Total	0	1
Reset Energy. .		
Reset Volume. .		
Exit		

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 71360. The Reset Total screen is displayed.
4. Set the reset values for Energy Total, Fwd Volume Total and Rev Volume Total as required. The totals can be set to any value, but most commonly the reset value will be zero.
5. Select **Reset Energy** or **Reset Volume**.
6. Select **Yes** to confirm the action (or **No** to cancel).
7. If Yes was selected, the total will be reset and the word "Done.." appears against the quantity that was reset.
8. Reset the remaining quantity (Energy or Volume) if required.
9. Select **Exit** and press the ENTER key to return to the MAIN menu.

7.2 Managing named sites

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

If you want to monitor a particular site location frequently you can set up a named 'Site' to store the installation details, such as pipe dimensions and material, required to set-up the flowmeter. These parameters can then be recalled later when revisiting that particular location. The instrument can store up to 12 sites, the first site is reserved for QUICK START and cannot be renamed; subsequent sites are initially named EmptySite1 through to EmptySite12.

7.2.1 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:

U3000 MAIN DD-MM-YY HH:MM:SS Quick start.. - > View / Edit Site Data.. Setup Instrument.. Data Logger.. Read Flow.. Read Energy..	- Manage site names. The instrument can store up to 12 sites, the first site is reserved for the default QuickStart site and cannot be renamed; subsequent sites are initially named Site01 through to Site11. - Edit key parameters such as pipe outside diameter and wall thickness. - Change calibration factors including Cut-off Velocity and Roughness Factor.
View/Edit Sit DD-MM-YY HH:MM:SS - >Choose from list of sites.. Add new site.. Site name.. Quickstart Pipe outside diameter 114.30 mm Pipe circumference 359.08 mm Pipe wall material Plastic Pipe Wall thickness 8.00 mm Lining material None Pipe lining thickness 0.0 mm Sensor set A-ST Sensor mode Reflex Fluid Type Water Fluid Temperature 14.0 °C Cutoff Velocity 0.010 m/sec Roughness factor 00.0150 mm Zero Flow Velocity -0.0140 m/sec Zero Flow Offset -5.1437 1/min Calibration factor 1.000 RTD Settings.. Read flow using selected sensor.. Read flow using recommended sensor.. Delete this site.. Exit	

7.2.2 Selecting an existing site

View/Edit Sit	DD-MM-YY	HH:MM:SS
- > Choose from list of sites..		
Add new site..		
Site name..	Site01	
Pipe outside diameter	114.30	mm
Pipe circumference	359.08	mm
Pipe wall material	Plastic	

Summary	DD-MM-YY	HH:MM:SS
Site: Quickstart		
Sensor separation 69.9mm		
Pipe OD: 114.3mm, ID 98.3mm		
Sensor Type A-ST, Mode: Reflex		
Fluid type: Water @14.0°C		
Press < - to continue > to select sens.		

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 or change any data that might have changed since the last time the site was accessed (see Managing Named Sites, page 29). Changes are saved automatically only when entering the READ FLOW screen.
5. **Select Read flow using selected sensor or Read flow using recommended sensor.**
6. The Summary screen now displays some of the parameters you may 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.
7. Press the ENTER key to display the READ FLOW screen.

NOTICE

The sensors screen can be entered by pressing either of the scroll keys. This allows the type and mode of the sensors being used to be selected. Ensure that the sensors are connected properly.

NOTICE

Do not press the enter key until the transducers are fitted and connected to the instrument.

View/Edit SitDD-MM-YYHH:MM:SS

Choose from a list of sites..

- > Add new site..

Site name..Site01

Pipe outside diameter114.30 mm

Pipe circumference359.08 mm

Pipe wall materialPlastic

View/Edit SitDD-MM-YYHH:MM:SS

IInput: Site01

0- / . 0ABC 1DEF 2 'delete'

GHI 3ABC 1DEF 2 'delete'

PQRS 6TUV 7WXYZ 8 9_

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 Site11 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 select the current character in the cycle. Punctuation and special characters (such as “\$”, “-”, “/”, “.”, “_”, “:”, “#”, “~”, and more) can be accessed via the “0” key, and spaces via the “9” key. Site names are limited to 8 characters, must contain no punctuation, and be unique.
4.

A new site with the name supplied will be created using default values for all parameters.

NOTICE

This menu allows you to choose a sensor set, unlike the quick start wizard, which 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 and you will be unable to start reading flow.

7.2.4 Changing a site name

To change a site, select **Choose from list of sites** from the **View / Edit Site Data** menu. Select the required site from the displayed list of current sites. Select the site name and press ENTER. You will be prompted to confirm your choice to modify the name or exit the process. When changing the name, the same rules apply for the name as when adding a new site

7.2.5 Editing Site Data

View/Edit Sit	DD-MM-YY	HH:MM:SS
- >Choose from list of sites..		
Add new site..		
Site name..		
Pipe outside diameter	114.30	mm
Pipe circumference	359.08	mm
Pipe wall material	Plastic	
Pipe Wall thickness	8.00	mm
Lining material	None	
Pipe lining thickness	0.0	mm
Sensor set	A-ST	
Sensor mode	Reflex	
Fluid Type	Water	
Fluid Temperature	14.0	°C
Cutoff Velocity	0.010	m/sec
Roughness factor	00.0150	mm
Zero Flow Velocity	-0.0140	m/sec
Zero Flow Offset	-5.1437	1/min
Calibration factor	1.000	
RTD Settings..		
Read flow using selected sensor..		
Read flow using recommended sensor..		
Delete this site..		
Exit		

1. Having selected the appropriate site, 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
2. When all the data is correct, choose one of the following options:
 - a. Select **RTD Settings** to view the RTD configuration (GF U3000 V2 HM 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 from the site list. 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.

NOTICE

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 135 °C. If this occurs, ignore the warning as it will disappear when you enter a temperature in the correct range for new sensors.

7.3 Changing calibration parameters

The flowmeter 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 the user's 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.

7.3.1 Adjusting the zero cut-off

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.

FLOW READING OPTION  DD-MM-YY HH:MM:SS Data review Zero cutoff (m/s) : 0.00 Set zero flow (m/s) : 0.00 Damping (secs) : 10 Totaliser : Run Reset + Total	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
---	--

7.3.2 Adjusting the set zero flow offset

The flowmeter 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.

The sign of the zero-flow volumetric reading or the velocity is always the same irrespective of the direction of flow because the ZFO is a function of the sensor match. If the ZFO offset is significant, and the sensor leads are reversed, one of the following procedures must be followed again to ensure continued accurate results.

NOTICE

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.

There are two methods for setting the zero-flow offset: the in-built Zero Flow Offset feature (ZFO) or by manual intervention.

Method 1: Using the Zero Flow Offset (ZFO)

Using this method, the unit runs for a period of time and collates the data and averages it over this period. The zero-flow cut-off is automatically removed while running the test and returned to its previous value afterwards. Likewise, it will remove any existing ZFO automatically and either replace or restore it. To use the ZFO feature:

Setting Zfo  DD-MM-YY HH:MM:SS ↑ Running Average Time Remaining Set Zero Flow. . Exit -2.24 0 1/min sec	1. Stop the liquid flow. 2. With the instrument in FLOW READING mode, press and hold the 0 (zero) key for at least two seconds. 3. In the Set Zero Flow screen, set the damping time and the measurement time. The recommended measurement time should be in the region of 60 to 120 seconds, but much longer periods are possible if significant drift in measurements have been noted over a longer period. 4. Select Continue.. 5. On the Setting Zfo screen, the Running Average is updated every second. When the measurement has completed, a loud ½ second beep will be heard and the countdown will stop. 6. You may now select Set Zero Flow.. if desired. It should be noted that you may select this setting at any time before the measurement is complete if you are satisfied that the average reading is sufficiently accurate.
--	--

Method 2: Manual intervention

To manually adjust the zero flow offset:

	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 ± 0.005 m/s (possibly higher with 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 Read flow using selected sensor and press the ENTER key. 8. Check that the flowmeter is now reading zero correctly. 9. Restart the fluid flow.
--	---

NOTICE

In order to cancel any applied offset you must either read flow via quick start or switch the flowmeter off & on. Any value that you trim-out using the offset adjustment will be added/subtracted from the flow reading across the whole range.

7.3.3 Adjusting the calibration factor

NOTICE

USE THIS FACILITY WITH CARE & ONLY WHERE NECESSARY

The flowmeter 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 flowmeter's totaliser and zero it (see section 7.1.5 Total flows).
2. Start the flowmeter reading flow. Use the flowmeter 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 flowmeter and reference meters. If the error is greater than $\pm 1\%$ calibrate the flowmeter 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 flowmeter was reading 1% high, decrease the Calibration factor value by approximate this amount. Since that start value is 1.00, the calibration value should be 0.99. Conversely, if the reading is 1% low then increase the calibration factor to 1.01. 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.
--	---

7.3.4 Adjusting the roughness factor

The roughness factor compensates for the condition of the internal pipe wall, as a rough surface will cause turbulence and affect the flow profile of the liquid. The unit of roughness is mm or inches, depending on the current setting. The value represents the worst height difference between a pit and a peak in the pipe wall. 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 for pipes in good condition:

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

When a new site is added to the system a default value for roughness will be set depending on the pipe material. 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.

7.3.5 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 and prevent large fluctuations in the displayed flow value. It has a range of 0 to 50 s, with a default setting of 10s. The damping time is defined as the time required for a step change in flow to reach 98.2% of its final value.

FLOW READING OPTION	DD-MM-YY	HH:MM:SS
Data review		
Zero cutoff (m/s)	:	0.00
Set zero flow (m/s)	:	0.00
Damping (secs)	:	10
Totaliser	:	Run
Reset + Total		
Reset -Total		
Calibration factor	:	1.000
Roughness factor	:	0.01
Diagnostics		
Exit		

DAMPING OPTIONS	DD-MM-YY	HH:MM:SS
1 second		
10 seconds		
15 seconds		
20 seconds		
30 seconds		
50 seconds		

1. From the Main menu, use the Up and Down scroll keys to select **Setup Instrument**. Press the ENTER Key. With System or Primary Flow 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 Time**. Press the ENTER key.
3. Enter the value of the Damping Time (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. Not all values of damping in the range are valid. The instrument will set the damping time to the nearest valid time, which may not be exactly as entered. Note that zero seconds is a totally undamped response.
5. Select the desired Damping Mode. Fixed mode strictly follows the damping period as initially described in this paragraph. Dynamic mode

switches off damping if the magnitude of change in flow velocity exceeds a certain predefined value. Once the change in velocity drops below this threshold, damping time is reset to the value selected.

6. Return to the **System menu**.
7. Select **Exit** and press the ENTER key to return to the Main menu.

NOTICE

If the damping factor is, set high the value displayed may appear stable but flow readings may respond very slowly to large step changes. In this case, consider using dynamic damping.

7.4 Logging Functions (models with datalogger option only)

NOTICE

This chapter only applies to GF U3000 V2 (HM) models with datalogger option.

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 copied to a USB flash drive as a CSV (Comma Separated Values) file at a later time. Date, Time, Flow Rate, Forward (+) and Reverse (-) totals, Velocity, Signal Q(quality), SNR and general signal status are logged automatically. If the unit has a Heat meter fitted, the Hot, Cold and the Temperature difference values are logged in addition to instantaneous power, and a total energy figure. Logging writes to internal memory, which may then be copied to a USB flash drive at a later date.

7.4.1 Manual logging

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

Real Time Logge	DD-MM-YY	HH:MM:SS
Site name	Site03	
File name	Site03.csv	
Logging Interval	5.0 min	
Units	mins	
Line ending format	Unix	
Flow Units	l/min	
Power Units	MW	
->Start NOW. .		
Set Auto Start. .		
Exit		

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). Note that the

	Minimum logging period is 10 seconds and the maximum is 28 days (4 weeks). 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, the current run will be appended to the existing data. Each time a new run is started, a new header will be observed in the CSV file.
--	---

7.4.2 Scheduling logging

To set a schedule for data logging:

Schedule login DD-MM-YY HH:MM:SS - >Start Date & Time Stop Date & Time Duration Save Setup & Exit. . Exit DD-MM-YY.HH:MM:SS DD-MM-YY.HH:MM:SS 5.0 min	1. Select Set Auto Start on the Real Time Logger screen. 2. Select Start Date & Time. A flashing cursor will appear under the first date number. Enter the date and time sequence in dd-mm-yy:hh-mm-ss or mm-dd-yy:hh-mm-ss order depending on the current time and date format. Then press the ENTER key. 3. Select Stop Date & Time in the same way. NOTE: This must be later than the start time and provide at least a two minute buffer when exiting the schedule log screen. 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.
---	---

7.4.3 Stopping logging

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

Real Time Logge DD-MM-YY HH:MM:SS Site name File name Logging Interval Units Line ending format Flow Units Power Units - >Stop NOW. . Set Auto Start. . Exit Site03 Site03.csv 5.0 min mins Unix 1/min MW	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.
--	--

The logged data will remain stored in the instrument's memory and can be accessed at any time as described below.

7.4.4 Copying logged data to a USB memory stick

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

Data Logger DD-MM-YY HH:MM:SS Choose from list of sites. . Site name Quickstart Logger Status. . ->Copy Log. . Clear Log. . List all Logs. .	1. Connect a suitable USB memory stick to the flowmeter USB socket. 2. Access the MAIN menu. 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 will now be copied to the USB memory stick. 7. Upon completion select Exit to return to the MAIN menu.
--	---

NOTICE

The logger uses an MS-DOS compatible 8.3 file name format for the CSV files. It may be possible that the name of the file is not exactly as you expect. For example, the Quickstart site is saved in a file called QUICKSRT.CSV. Also note that for very large files the copy process may take some time, so please be patient. If the copy process take > 2 minutes, the unit may abort the copy. In this case, please contact your GF sales representative.

7.4.5 Clearing log files

Data Logger DD-MM-YY HH:MM:SS Choose from list of sites. . Site name Quickstart Logger Status. . Copy Log. . ->Clear Log. . List all Logs. .	1. Access the MAIN menu. 2. Select Data Logger from the MAIN menu. 3. Select Choose from list of sites and select the name of the site to clear. 4. Delete logged data for the selected site by selecting Clear log. 5. Upon completion select Exit to return to the MAIN menu.
--	---

To view the current setup, memory usage and availability for data logging:

Logger Status DD-MM-YY HH:MM:SS ↑ Site Internal Storage Key Used Free Status Exit Quickstart Inserted 45.056 Kb 3.924 Kb Ready to log	1. Access the MAIN menu. 2. Select Data Logger from the MAIN menu. 3. Select Logger Status (also accessed from the Options screen by selecting Logger..).
--	---

8 **Outputs**

8.1 **Current loop**

8.1.1 **Setup**

The flowmeter allows you to set a current output between zero and 24mA. Standard ranges include 4-20mA, 0-16mA and 0-20mA. The current range can be used to represent only positive flow, or negative flow ranging into positive flow, or simply negative flows.

In addition to this, you may set an out-of-band value to represent an error current. For example, with a 4-20mA loop, it is common to use either 2.5mA or 22.5mA as an error current. Nevertheless, you may set the error current to be any value that is not within the valid measurement range. An error current can be used to indicate a number of causes including: exceeding a predetermined value, being under a predetermined value, being out-of-bounds (value is below the minimum or above the maximum), or a loss-of-signal condition. In addition, inhibiting the generation of an error current can be achieved by selecting the no error condition.

NOTICE

The 4-20ma current output is set in hardware to be accurate to +/- 0.3%. If you require greater accuracy than this or if there are known inaccuracies in the measurement system, which may require compensation, then calibration values may be set at the low and high ends of the current loop range. These values are linearly interpolated over the range of the current loop.

The default current loop setting is OFF.

To change any of these settings:

Output Board Se DD-MM-YY HH:MM:SS ↑ Current Loop Setup. . Digital Device 1 Setup. Digital Device 2 Setup. Digital Device 3 Setup. Exit. .	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
---	---

Current Loop Se	DD-MM-YY HH:MM:SS
Current Loop Status. .	Off
Measurement Source	Flow
Value at min output	0 1/min
Min output current	4.00 m/A
Calibrate min current	0.00 m/A
Value at max output	1000 1/min
Max output current	20.00 m/A
Calibrate max current	0.00 m/A
Output error current	0.00 m/A
Error current source	None
Alarm trigger point	500 1/min
Save setup & exit. .	
Exit	

2. Alternatively, from a Read Flow/Velocity/Energy screen, press the **OUTPUTS key (3)**. The Output Board menu is displayed.
3. Use the UP/DOWN arrow keys to select **Current Loop Setup**. Press the ENTER key. The Current Loop Setup menu is displayed.
- Edit the settings as required (see next page). 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	0 l/min	0 kW
Imperial	0 gal/min	0 BTU/hr
US Imperial	0 US gal/min	0 BTU/hr
Min output current	0.00 mA	
Calibrate min current	0.00 mA	
Value at max output		
Metric	2000 l/min	0.033333 kW
Imperial	439.939 gal/min	113.738 BTU/hr
US Imperial	528.344 USgal/min	113.738 BTU/hr
Max output current	24.00 mA	
Calibrate max current	0.00 mA	
Output error current	2.50 mA	
Error Current Source	Exceeds Value/Under Value/Signal Loss/Out of Bounds/None	
Alarm trigger point		
Metric	2000 l/min	0.033333 kW
Imperial	439.939 gal/min	113.738 BTU/hr
US Imperial	528.344 USgal/min	113.738 BTU/hr

8.1.2 Example

A simple example of a current output representing a specific range with errors and alarm is shown below:

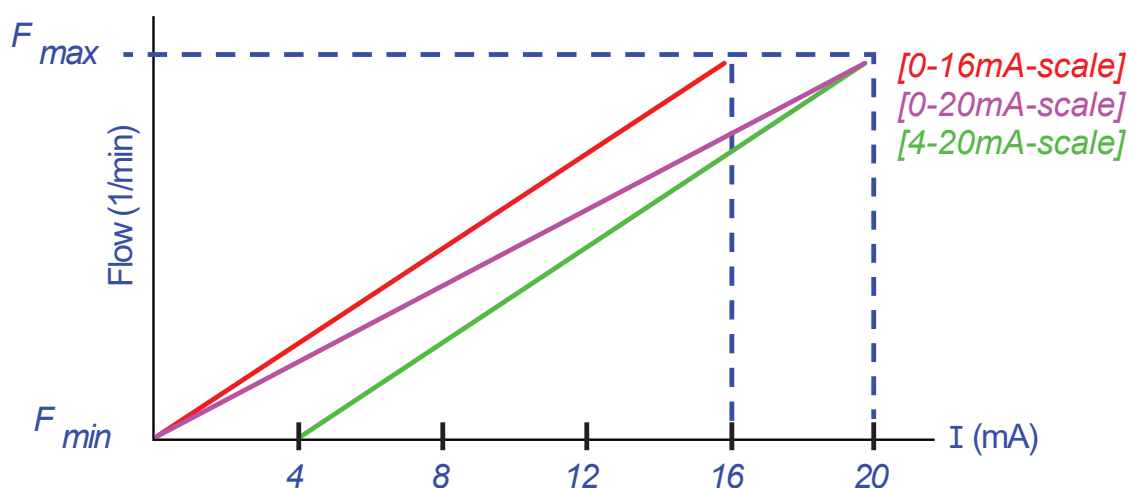
- Current Range: 4-20mA
- Flow: @4mA, 0 l/min; @20mA, 500 l/min
- Error current: 2.5 mA
- Error source: Exceeds value
- Alarm trigger point: 450 l/min

To implement this example:

1. **Set Current Loop Status to On**
2. Set Measurement Source to Flow
3. Set Value at min output to 0 l/min
4. Set Min Output Current to 4.0mA
5. Set Calibrate min current to 0mA
6. Set Value at max output to 500 l/min
7. Set Max output current to 20mA
8. Set Calibrate max current to 0mA

Converting 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:

Current range	Flow rate formula
0 – 20 mA	Flow rate = $I \times ((F_{max} - F_{min}) / 20) + F_{min}$
0 – 16 mA	Flow rate = $I \times ((F_{max} - F_{min}) / 16) + F_{min}$
4 – 20 mA	Flow rate = $(I - 4) \times ((F_{max} - F_{min}) / 16) + F_{min}$

8.2 Digital outputs

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

- Current Range: 4-20mA
- Pulse Output (set to Normally Open or Normally Closed contact types)
- Alarm Output (set to trigger on Rising or Falling conditions)
- 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)

There are no limitations on the combinations of these modes and their assignment to each of the three outputs. For example, the digital outputs could be configured as three alarms attached to the same flow reading with different trigger points, or perhaps two alarms – one attached to Volume and one attached to Power – and one frequency output connected to flow.

To configure any of the digital outputs:

FLOW READING OPTION	DD-MM-YY	HH:MM:SS
Data Review		
Zero Cutoff (m/s)	:	0.00
Set zero flow (m/s)	:	0.00
Damping (secs)	:	10
Totaliser	:	Run
Reset +Total		
Reset -Total		
Calibration factor	:	1.000
Roughness factor	:	0.01
Diagnostics		
Exit		

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 below).

Pulse output		Pulse output		Pulse output	
Setting	Option / default	Setting	Option / default	Setting	Option / default
Quantity per Pulse	Volume:1.000 m3 Energy:3600.0kJ	Quantity per Pulse	Volume:1.000 m3 Energy:3600.0kJ	Quantity per Pulse	Volume:1.000 m3 Energy:3600.0kJ

Pulse output		Pulse output		Pulse output	
Pulse Duration	50ms	Activation Level	Volume: 0.5m ³ Flow: 30000 l/min Energy:1800 kJ Power: 2.5kW Signal: 0.5	Low Value	Flow:0.00 l/min Power: 0 kW Signal:0
Contact Type	Normally Open/ Normally Closed	Deactivation Level	Volume 0.475m ³ Flow: 28500 l/min Energy:1710 kJ Power: 2.375 kW Signal: 0.5	High Freq.	200 Hz
				High Value	Flow: 1000.00 l/min Power: 5.00 kW Signal: 1

8.2.1 Pulse output

Select **Pulse Output** to measure Volume or Energy and then press **Continue**. Any other selection of Measurement Source will result in an error.

The default pulse width is set to 50ms which represents half of a one pulse cycle. A 50ms pulse width is required for most mechanical counters, but the width can be set as low as 10ms.

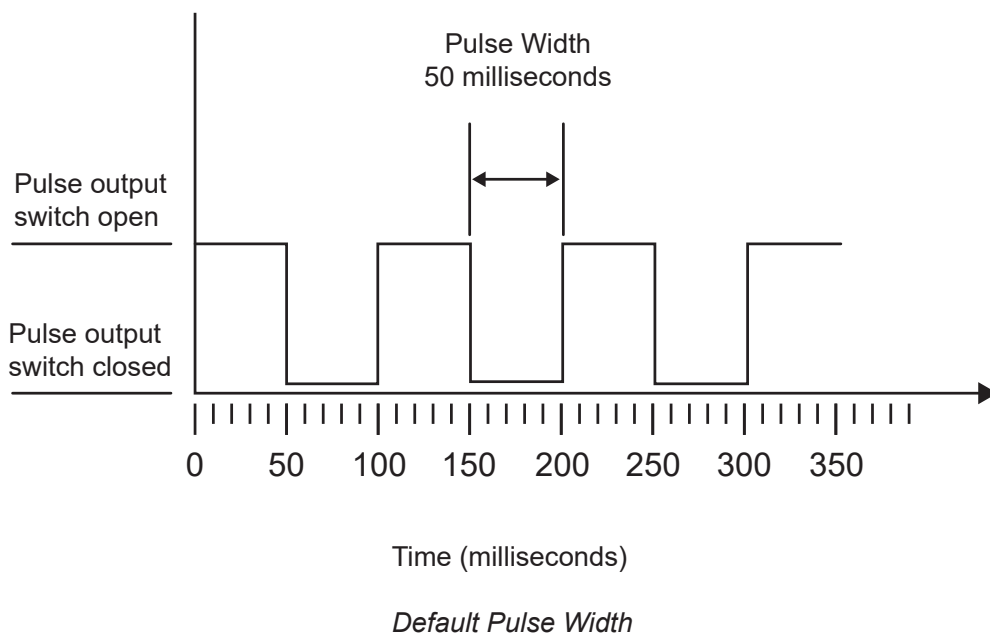
Volumetric Pulse

The quantity per pulse is usually set to a value that makes it easy to read an external pulse counter. For example, the value could be 10 litres per pulse, which means that for every 10 litres of fluid measured by the meter, a pulse is generated. If the total rises by 25 litres in a second, two pulses will be generated and the remainder of 5 litres will be held over. If, in the next second, another 25 litres are measured, this will be added to the remainder making a total of 30 litres. This will result in the meter generating 3 pulses.

A minimum idle time equal to the pulse-width, follows the pulse. There is a maximum pulse rate and hence maximum volumetric flow that the pulse output can represent.

For the scenario mentioned above, if the volume per pulse is ϑ and the pulse width is p (ms), then the maximum flow rate is $500 \vartheta / p$. In the example above, ϑ is 10 l/pulse and p is 50 ms, the maximum average flow rate is $500 * 10 / 50 = 100$ l/s. This limit comes from the inability to generate more than 10 pulses per second due to the 50ms pulse width and minimum 50ms idle time. Because each pulse represents 10 litres, the output can only represent 100 l/s.

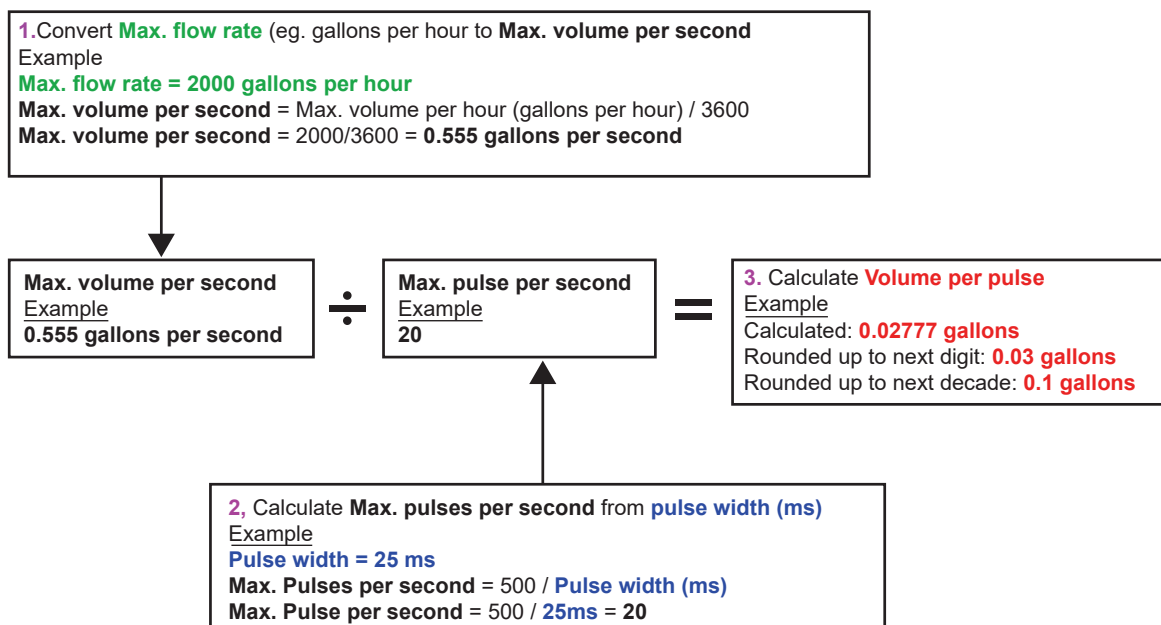
While this is the maximum average flow, it does not mean that transient flows of greater than this amount cannot be handled. The flow meter can accommodate up to 1000 outstanding pulses. If this amount is exceeded, then an error will be generated. If the flow rate is below the average, the pulse tally can be made up by a burst of pulses.



Using our example once again, if the flow rate is 150 l/s, 15 pulses would be required to represent it. Since the flow meter can only generate 10 per second, the other 5 must held as an outstanding count. Since the flow meter can store up to 1000 outstanding pulses, it can tolerate a flow rate of 150 litres/second for $1000/5=200$ seconds before an error is generated. At some stage however, the flow rate must drop below 100 litres per second for the outstanding pulse total to be diminished.

Determining a Suitable Volume per Pulse Value

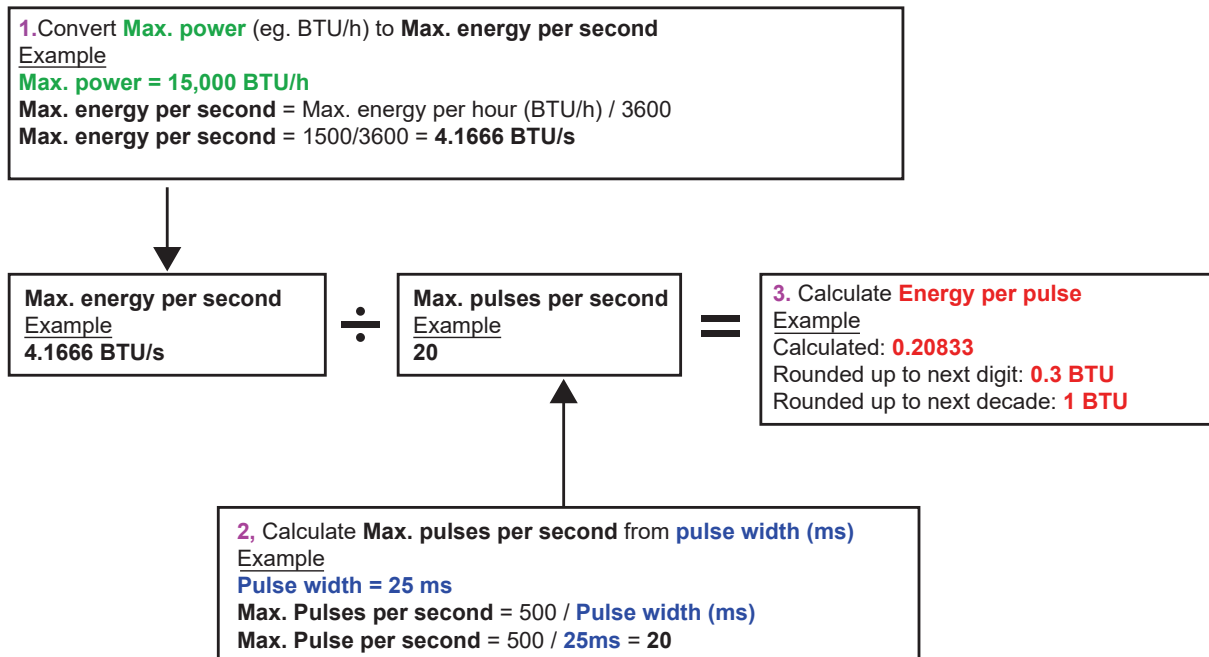
How to calculate a suitable **Volume per pulse** value from **Maximum flow rate** and **Pulse width** (Imperial)



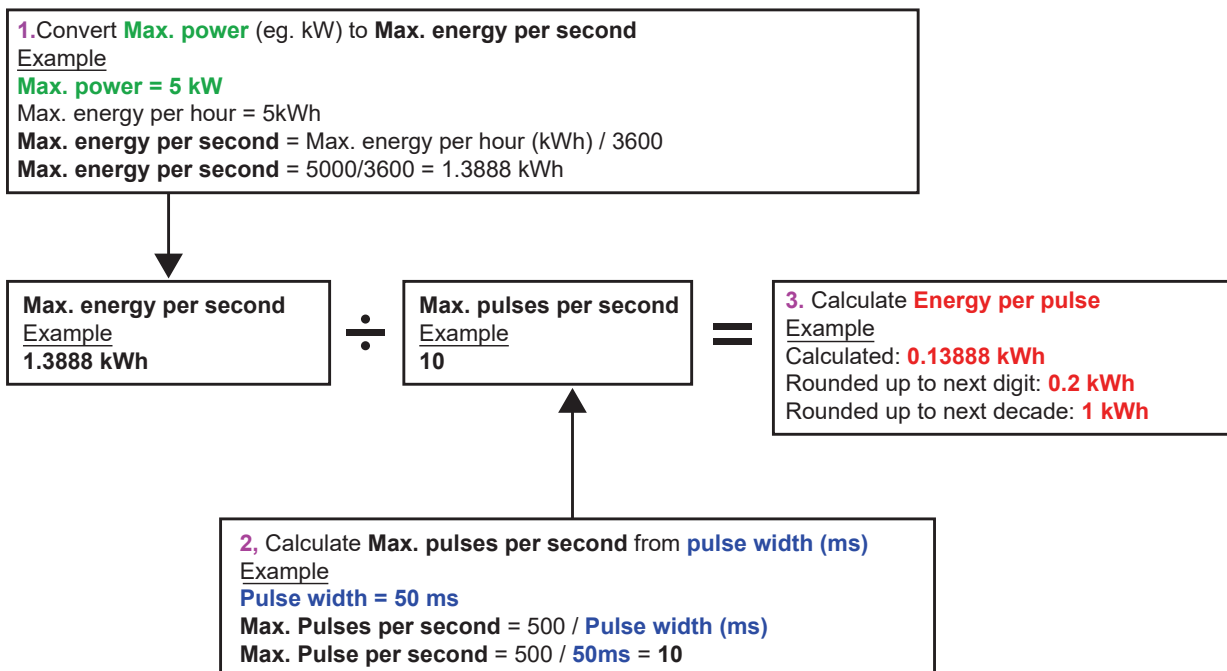
Energy Pulse (HM versions only)

Each pulse represents an amount of energy, for example 1kWh. With a limitation on the maximum pulse rate (as described in the previous section) a larger unit of energy per pulse or a smaller pulse width may be required to represent the range of possible values.

How to calculate a suitable **Energy per pulse** value from **Maximum power** and **Pulse width** (Imperial)



How to calculate a suitable **Energy per pulse** value from **Maximum power** and **Pulse width** (Metric)



8.2.2 Alarm output

An Alarm Output generates an alert when a predetermined value is exceeded or receded for Volume, Flow, Energy or Power, or when Signal is lost or gained. When an alarm is activated

a message is generated on the status line and the corresponding output alarm symbol will flash.

1. Select **Output..** from the Options menu.
 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. Select **Alarm Output**.
 5. Use the UP/DOWN arrow keys to select **Measurement Source**.
 6. Choose from Volume, Flow, Energy, Power or Signal.
 7. Use the UP/DOWN arrow keys to select **Continue..**
 8. According to your choice in step 6, complete the alarm configuration as described in the following sections.
- Volume Alarm**
9. Use the UP/DOWN arrow keys to select **Direction**. You may select a Rising or Falling value (as volumes generally only rise until reset, Rising is the usual choice).
 10. Use the UP/DOWN arrow keys to select **Activation Level**. Set the volume limit for the alarm on this output.
 11. If required, set a **Deactivation Level** although this has no effect until the volume totals are reset.
 12. Use the UP/DOWN arrow keys to select **Save Setup and Exit..**
- Energy Alarm**
9. Use the UP/DOWN arrow keys to select **Direction**. Select Rising. The device only supports positive energy (an energy loss if operating as a heater, or an energy gain if operating as a chiller).
 10. Use the UP/DOWN arrow keys to select **Activation Level**. Set the energy limit for the alarm on this output.
 11. If required, set a **Deactivation Level** although this has no effect until the energy total is reset.

	12. Use the UP/DOWN arrow keys to select Save Setup and Exit.. Flow Alarm 9. Use the UP/DOWN arrow keys to select Direction. Select Rising to trigger an alarm when a certain flow is exceeded or Falling to trigger an alarm when a certain flow is not achieved. 10. Use the UP/DOWN arrow keys to select Activation Level. Set the flow limit for the alarm on this output. 11. Set a Deactivation Level (the value at which an alarm is canceled). • If the direction is set to Rising, the alarm is triggered when the flow exceeds the Activation Level. The Deactivation Level must be a value less than or equal to the Activation Level. • If the direction is set to Falling, an alarm is triggered when the flow drops below the Activation Level. The Deactivation Level must be a value greater than or equal to the Activation Level. 12. Use the UP/DOWN arrow keys to select Save Setup and Exit.
--	--

Example

To generate an alarm when flow exceeds 300 l/min, and reset it when the flow drops below 280 l/min, set Direction to Rising, Activation Level to 300 l/min and Deactivation Level to 280 l/min.

About Negative Flows

While operating on negatives flows is possible, it is not recommended because of the potential confusion it can cause. A larger negative flow is actually smaller number. For example, a Falling value always refers to a number that is becoming smaller, hence -280 falls to -300.

To generate an alarm when the flow exceeds 300 l/min in the reverse (negative) direction and have it reset only when the volume drops below 280 l/min in the reverse direction then set the Direction to Falling Activation Level to -300 l/min and Deactivation Level to -280 l/min. Note the negative signs. A useful configuration of the alarm mode could be to set two outputs to Alarm Mode using the same Flow Measurement Source. One could be set to be an over-value alarm (no hysteresis) and one an under-value alarm (again, with no hysteresis). If the corresponding outputs are wired in parallel, then the resulting alarm will activate when flow is above a certain threshold OR when it is below a certain threshold.

Power Alarm

	1. Use the UP/DOWN arrow keys to select Direction. Select Rising to trigger an alarm when a certain power is exceeded or Falling to trigger an alarm when a certain power is not achieved. 2. Use the UP/DOWN arrow keys to select Activation Level. Set the power limit for the alarm on this output. 3. Set a Deactivation Level (the value at which an alarm is canceled). 4. If the direction is set to Rising, the alarm is triggered when the power exceeds the Activation Level. The Deactivation Level must be a value less than or equal to the Activation Level. 5. If the direction is set to Falling, an alarm is triggered when the power drops below the Activation Level. The Deactivation Level must be a value greater than or equal to the Activation Level. 6. Use the UP/DOWN arrow keys to select Save Setup and Exit.
--	--

Signal Alarm

The Signal alarm ties an output to the loss or reacquisition of a signal. When signal is lost the screen on the flow will read “-----” instead of a valid flow number. Signal is deemed to have been lost when the power and SNR ratio is out-of-bounds for longer than the time set in the **Signal Loss Time-out** field of the Primary Flow screen (see page 54). The default value is 3 seconds. When the signal is lost it is deemed to have a value of zero, otherwise it has a value of 1. To generate an alarm when signal is lost set the **Direction** to Falling and set the **Activation Level** and **Deactivation Level** to 0.5. These values are set automatically when Signal is selected as the Measurement Source.

8.2.3 Frequency output

The output frequency is proportional to the flow rate or power within a specified frequency range of 0 – 200Hz. With the exception of the Measurement Source being Signal, it only makes sense to measure derivative quantities such as Power and Flow. In these cases, the instantaneous frequency is directly proportional to the instantaneous flow or power.

Both the lower and upper frequency as well as the values they represent can be set in the **Freq Output** screen. It is usual to set the frequency range to the default of 0 and 200Hz. At 0Hz, the associated output switch is closed continuously. The lowest longest waveform period is 60 second, hence the lowest non-zero frequency that can be generated is $1/60 = 0.01667$ Hz. The precision of the generated frequency averages $\pm 1\%$.

Generally, 0Hz represents zero flow or zero power, so the only selection that needs to be made is the maximum flow or power to be accommodated at 200Hz

As mentioned in the previous section on **Alarm Mode**, the value of Signal can only be zero (no signal) or 1 (signal present). This could be used to generate an audible alarm if the signal is lost. To do this, set the lower frequency to be 100Hz and lower value to be 0 and the upper value to be 1 at a frequency of 0Hz. This will cause the output to be steady when a signal is present and to be 100Hz when signal is lost.

9 Status screens

9.1 Primary flow

The Primary Flow screen summarises the flow totals and provides options for their display on the Flow Reading screen. To view the Primary Flow screen:

	1. From the Main menu, use the Up and Down scroll keys to select Setup Instrument . Press the ENTER Key. The Options screen is displayed.
	2. Use the Up and Down scroll keys to select Primary Flow.. Press the ENTER Key. The Primary Flow screen is displayed. The screen displays the forward and reverse flow totals: Fwd Total and Rev Total . To change the display of forward and reverse totals on the Flow Reading screen, select Display Total . The options are: Both, None, Fwd Total and Rev Total.

Damping Time and Damping Mode are duplicates of the setting found in the System menu.
Signal-loss Timeout: Once a signal has been acquired, it is deemed to have been lost when the power and SNR ratio are insufficient for longer than the Signal Loss Time-out setting.
Flow Direction allows you to reverse the sensor direction assignments. Changing flow direction may result in a small difference in the magnitude of the reading observed.

10 Heat meter (HM versions only)

NOTICE

This chapter applies to GF U3000 V2 HM models only.

Rtd Board DD-MM-YY HH:MM:SS PT100 Sensors Hot46 °C Cold19 °C Energy5.2107e+01 KJ Power2.1784e+01 KW ->Calibrate Temperature Sensors. . Exit <tr><td>1. From the Main menu, use the Up and Down scroll keys to select Setup Instrument. Press the ENTER Key. The Options screen is displayed. 2. Use the Up and Down scroll keys to select Heat-Meter.. Press the ENTER Key. The Rtd-Board screen is displayed. If sensors are connected, Hot and Cold temperatures will be displayed. A display of “****” indicates no connection or a broken sensor. The screen also displays the current total Energy and the last measured instantaneous Power level.</td></tr>	1. From the Main menu, use the Up and Down scroll keys to select Setup Instrument . Press the ENTER Key. The Options screen is displayed. 2. Use the Up and Down scroll keys to select Heat-Meter.. Press the ENTER Key. The Rtd-Board screen is displayed. If sensors are connected, Hot and Cold temperatures will be displayed. A display of “****” indicates no connection or a broken sensor. The screen also displays the current total Energy and the last measured instantaneous Power level.
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10.1 Calibrate temperature sensors

Connect the temperature sensors and check that the displayed values are reasonable.

	1. Clamp the sensors together and allow the readings to stabilise. 2. The sensors should be reading approximately the same temperature. However, because of
	small errors in the system, the values from each probe may be fractionally different. If this is the case, the sensors require calibration. To calculate power, it is the difference in temperature that is important, rather than the absolute temperature, although small differences in relative density and specific heat capacity, which are a function of absolute temperature are accounted for in the calculations. 3. Select Calibrate Temperature Sensors... 4. Enter the user PIN code (71360). The Calibrate Sensors screen is displayed. 5. For Use for Reference, select one of the following: • Hot Difference in readings between the two sensors is applied as an offset to the Cold sensor. • Cold Difference in readings between the two sensors is applied as an offset to the Cold sensor. • Set Value If you have an existing temperature measurement system and trust its temperature reading. In this case, the Hot and Cold sensors not only have to be clamped together, but they have to be clamped to the point at which the existing equipment is measuring temperature. Ensure that the temperatures have stabilised. • None Remove any offsets. If the temperature difference between the two probes is more than 0.5 °C, a power offset will be seen in subsequent measurements. 6. Select Calibrate.. The RTD Board screen is displayed. Check that the temperature values now read the same value. A  symbol is shown against the temperature reading that has an offset associated with it and indicates that the probes have already been calibrated.

11 Maintenance and Repair

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



WARNING

Do not disassemble this unit unless advised by GF. 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 GF.
7. Ensure the person who services your instrument is qualified to do so. If in doubt, return the instrument to GF 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 GF or your local GF partner for details.
10. When returning product to GF make sure it is clean and please notify GF 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.

12 Troubleshooting

12.1 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.

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.

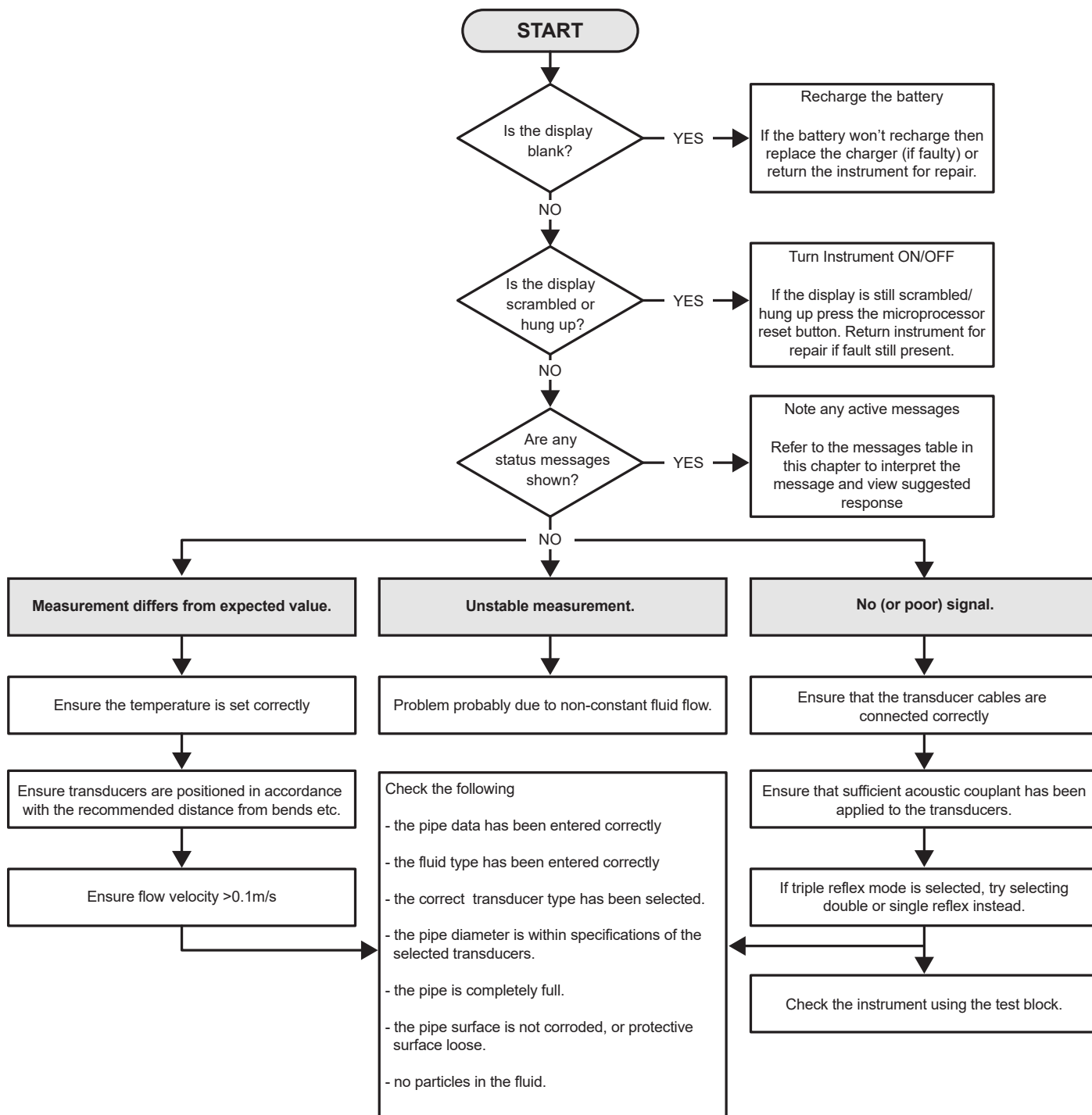
Low fluid flow within the pipe

- 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.

12.2 General Troubleshooting Procedure



12.3 Warning & Status Messages

Warnings, errors and status messages appear on the second top line of the display. When there is more than one message to be displayed then the display will cycle between them, unless an error is URGENT. Urgent may need user intervention and can only be cleared by pressing 'delete' or the cause of the error being remedied. URGENT errors are marked as such in the interpretation.

Status messages may be hidden until normal and urgent errors are redressed. Normal errors, such as "Code is invalid", are automatically removed after a period of time. All errors can be removed by pressing 'delete' but with most serious and urgent errors, they may be generated again after a minute or so.

Please check the Response associated with the given error and perform any required actions before contacting your GF sales representative.

Flow rate errors & messages	
No flow signal	Interpretation: URGENT: The transducers cannot send or receive signals. 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 computation fault	Interpretation: URGENT: An internal error occurred when computing flow. Response: Restart the flowmeter. If the problem persists, contact your GF sales representative.
Velocity Out of Range	Interpretation: The instantaneous flow velocity has, at least temporarily, exceeded a specified maximum. Response: This is an unusual condition. It is not fatal and may occur sporadically. If it persists, check your installation.
Separation distance impossible	Interpretation: The calculated sensor separation was less than zero. Response: Check all the site parameters and the sensor chosen.

Heat Meter Errors & Messages	
RTD Cold Sensor fault	Interpretation: URGENT: The cold sensor probe is either not connected or is faulty. Response: Check the probe is connected. If you are running a unit containing a heat-meter and the probe is not connected, you may simply delete the error and

Heat Meter Errors & Messages	
	continue. This error may be observed at start-up with no RTD probes connected. In this case the error will be automatically deleted after 30 seconds.
RTD Hot Sensor fault	Interpretation: URGENT: The hot sensor probe is either not connected or is faulty. Response: Check the probe is connected. If you are running a unit containing a heat-meter and the probe is not connected, you may simply delete the error and continue. This error may be observed at start-up with no RTD probes connected. In this case the error will be automatically deleted after 30 seconds
Current Loop and Digital Output Errors & Messages	
[measurement source] not compatible with [function]	Interpretation: The [measurement source] chosen is not compatible with the desired output [function]. Response: Choose another (compatible) measurement source and / or function.
[internal] board failed to report.	Interpretation: The [internal] board failed to respond to a discovery message and has been taken offline momentarily. Response: This error may be the result of a temporary computational overload. Go to the Options screen and check the board status. Try first to restart and if the error still persists, reset the flowmeter. If after reset, all boards do not report as "OK", note the failing board and call your distributor.
Current loop open or short	Interpretation: The current loop is either open circuit (not connected) or possibly a short circuit resulting in internal components overheating. Response: Either turn the current loop off if it not required, or connect it as needed. Ensure a suitable load is being placed on the current loop and it is not driving into a direct short circuit. The alarm can be cleared by pressing delete, but if the condition is not rectified, it will return in approximately one minute.
Current loop alarm activated	Interpretation: This message is for information only. It is generated when alarm conditions have been met for the current loop. Response: Clear the alarm by deleting it and attend to the fault. Deleting the alarm does not stop the error current being generated as long as the fault remains.
Alarm on output [n] activated	Interpretation: This message is informative only. It is generated when alarm conditions have been met for digital output [n].

Current Loop and Digital Output Errors & Messages

	Response: Clear the alarm by deleting it and attend to the fault. Deleting the alarm does not stop the output generating the alarm as long as the fault remains.
Error current out-of-bounds	Interpretation: An attempt was made to define the error current within the normal working range of the current loop. For example, this error would be generated if the working range were 0 to 16mA and the error current was set to any value below 16mA. The flowmeter will try to redefine a valid error current. Response: Redefine the error current or change the working range if the calculated value is not desirable.
Error current invalid. Source disabled	Interpretation: The entire range of the current loop (0 to 24mA) has been defined as valid, so an error current is not possible. In this case the alarm function is disabled. Response: If an error current is required, redefine the working region to be a smaller range.

Data logging errors & messages	
USB drive not inserted	Interpretation: A USB drive must be inserted into the external port before the desired operation can proceed. Response: Insert a USB drive into the external port.
Could not copy CSV file	Interpretation: An error occurred copying the CSV from the internal storage to the external flash drive. Response: Try the operation again. If this fails, turn the flowmeter off and then on again. Select the site whose log you wish to obtain and attempt to copy the file again.
Could not delete index file.	Interpretation: This file is an internal file which is associated with the CSV file for each site. The file could not be deleted. Response: Try the operation again. If this fails, turn the flowmeter off and then on again. Select the site whose log you wish to remove and attempt to clear the log again.
Could not delete CSV file.	Interpretation: The internal CSV file associated with the site could not be deleted. Response: Try the operation again. If this fails, turn the flowmeter off and then on again. Select the site whose log you wish to remove and attempt to clear the log again.
Badly formatted date or time	Interpretation: The format of the date and time field is invalid. Response: Re-enter the time and date in the correct format.

Data logging errors & messages	
	Response: Re-enter the time and date in the correct format.
Date or time is out of bounds	Interpretation: The scheduled date and time entered is more than a year in advance. Response: Re-enter a time and date that is not so far into the future.
Start time too close	Interpretation: The scheduled logging start time must be at least two minutes into the future. Response: Re-enter a start time more than two minutes in advance of current time.
Logging period too short	Interpretation: The minimum logging period for a scheduled start is 60 seconds. Response: Entered a logging stop time that is more than 60 seconds beyond the logging start time.
Start or stop time invalid	Interpretation: The date entered is not valid. For example: 31 June or 30 February, or 25:00:00 Response: Enter a valid date and time.
Operation timed-out	Interpretation: An internal error occurred, and the operation timed out. Response: Try the operation again and if the result is the same, try switching the flowmeter off and then on again. Retry the operation and if it is still failing then contact your distributor or return the item for repair.
Log drive full	Interpretation: URGENT: The internal storage is full. Response: Delete some logs.
Stopping Logging	Interpretation: URGENT: The internal storage is full so logging will be stopped. Response: Delete some logs.
Battery errors	
Battery critically low!	Interpretation: URGENT: The internal battery voltage is less than 6.1 volts. Response: Connect the external charger. Press 'delete' to remove this error.
BATTERY EXHAUSTED! Shut down in [n] sec!	Interpretation: The internal battery voltage is less than 5.25 volts. The flowmeter will perform a controlled shutdown in 15 seconds if an external charger is not connected. The time to shutdown is [n] seconds. Response: Connect the external charger. Press 'delete' to remove this error.

Set-up and other errors & messages	
Too many errors	Interpretation: The flowmeter generated too many errors as a result of a fault and some errors may not have been reported. Response: Respond to the errors highlighted.
Too many urgent errors	Interpretation: The flowmeter has generated too many urgent errors as a result of a fault and some errors may not have been reported. Response: Delete urgent errors before continuing. Urgent errors are displayed before normal errors, so they are cleared first by pressing the 'delete' key.
Poorly formatted error message	Interpretation: Internal, NON- FATAL System error. Response: Delete the error. Take note of the current situation that lead to this error and report it when convenient.
Site DB is full	Interpretation: The number of sites has exceeded the maximum of 12. Response: Delete a site.
Site name illegal or duplicate	Interpretation: Site names must be unique and contain eight or fewer characters comprising letters, numbers dashes or underscores. Response: Enter a site name that complies with the interpretation above. Note that names are case insensitive, for example, site ELY is a duplicate of site Ely.
Energy calculations unreliable	Interpretation: The temperature used in heat-meters calculations is outside that which can be accurately calculated. Response: This is a NON-FATAL error. If the error is persistent, check your installation for temperatures that are out-of-bounds, and check the leads to the temperature probes.
RTD Board fault Power Board fault Logger Board fault Output Board fault Flow Board fault	Interpretation: URGENT: The respective board has not reported to the central controller in the last minute. Response: Try restarting the flowmeter. If the board is still reported as missing or faulty, call your distributor or return your device for repair. You may press 'delete' to remove this error but some or all functionality may be lost if this error is persistent and you continue operate the device.

Set-up and other errors & messages	
Limits are xx.x [text] to yy.y [text]	Interpretation: The values entered were out of bounds for this setting. The smallest value allowed is xx.x and the largest is yy.y. Optional units [text] may accompany this message. If not, then it is implied that the units are those currently set. Response: Enter a value within the specified limits. Note that the limits quoted may be dependent on other parameters already set.
Site DB failure. Restoring default values.	Interpretation: When reading parameters from the database, some site parameters appeared corrupted, so all parameters have been restored to initial values. Response: Re-enter parameters for this site. Press 'delete' to remove this error.
Code is invalid	Interpretation: Either the user or factory pin code is incorrect. Response: Try again.
Unknown product	Interpretation: The board count for product does not match the product type specified. Response: This is a serious error. Restart the flowmeter. If the problem persists, contact your distributor for further advice
Illegal to edit or delete this information	Interpretation: This field cannot be modified or deleted. This usually occurs when trying to edit or delete the Quickstart site. Response: None required.
ERR: unknown board type	Interpretation: Flowmeter internal error. The controller has attempted to request a board that does not exist. Response: Reset the flowmeter to be safe. Record the conditions under which the error occurred and report them to the distributor when convenient.

Set-up and other errors & messages
Value out of bounds

Interpretation: The values entered were out of bounds for this variable. This error is similar to the error “Limits are xx.x [text] to yy.y [text]”.

Response: Enter a valid value.

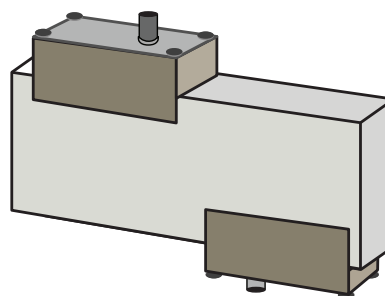
System Error [nnnn]

Interpretation: A serious internal error occurred. This indicates an error condition that should not be possible. It may or may not be fatal.

Response: Record the error number and conditions that lead to the error. Ideally turn the flowmeter off then on. When convenient report the error number and conditions to your distributor.

12.4 Test Block

A test block is included with the flowmeter 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	PVDF-SYGEF	
Fluid type	Water	
Mode	Diagonal	
Temp	20°C	

3. At the end of the Quick Start procedure, the Summary screen is displayed. Press the UP or DOWN arrow button. The Sensors screen is displayed.
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.
8. Check that the 3 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 above, and temporarily secure them in place using elastic bands or tape.
10. Connect the sensors to the flowmeter using the cables provided (see page 5).
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.

Summary

HH:MM:SS

DD-MM-YY

Site: TESTBLK

Sensor separation: 2.0mm

Pipe OD: 50.0mm, ID 6.0mm

Summary

HH:MM:SS

DD-MM-YY

↗ Sensor set

Sensor mode

Return to Summary Screen. .

B-HT

Diagnol

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.

12.5 Reset

To reset the flowmeter, carefully insert 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.

Note

If the instrument is reset while logging, it is likely that at least some log data will be lost. In addition to this it may also be possible that some user settings may be corrupted. These settings will be reset to default value when the unit is repowered.

12.6 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 or ENERGY READING modes you can access a diagnostics screen by pressing the Diags function key. This will display the operating values for the following parameters.

Basic diagnostics	
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	The time the upstream wave spends in the fluid in μsecs .
Delta T (ΔT in ns)	The difference between the upstream and downstream time in nano-seconds.
Instantaneous Velocity (m/sec)	Instantaneous fluid velocity.
Cut-off Velocity (m/sec)	The current cut-off velocity

Basic diagnostics	
Flow (m/s)	Instantaneous volumetric flow in m ³ /s to 3 decimal places.
SNR (dB)	Signal to Noise ratio in decibels (dB). A strong signal will generally exhibit an SNR of greater than 45 dB. A good signal will generally exhibit an SNR of greater than 40 dB. SNR is literally the difference between the Signal level and the Noise level in dB.
Signal (dBV)	The unreferenced signal level (in dBV) of the received signal.
Noise (dBV)	The unreferenced background noise level (in dBV) of the received signal.
Gain (dBV)	The gain value (in dBV) represents the amount of amplification that the received signal has undergone before signal analysis is undertaken. A large gain figure can indicate that the ultrasonic signal is being strongly attenuated by something in its path. This could be because of the lack of couplant, poor sensor alignment or other factors.
Pipe Bore (mm)	The pipe bore (always in mm)
Advanced Diagnostics..	Display the Advanced Diagnostics (see below)

Advanced diagnostics	
LFF (ns/m/s)	Linear Flow Factor in nano seconds per metre per second.
Average Velocity (m/sec)	A rolling average raw velocity over the last 25 seconds
Average delta t (ns)	A rolling average ΔT over the last 25 seconds
Reynolds Number	The calculated Reynolds number
Roughness factor (mm)	The current roughness factor (always in mm)
Zero Flow Offset (m/sec)	The currently set zero flow offset velocity being used
Calibration factor	The currently set user calibration
Separation distance (mm)	The computed separation distance (always in mm) as seen on the Summary screen before flow reading began.
Solid time (μ s)	The amount of time that the ultrasonic wave spends in solid materials.
Flow Side Temperature (°C)	The flow side temperature (if a Heat meter board is fitted)
Return Side Temperature (°C)	The return side temperature (if a Heat meter board is fitted)
Sensor Set	The type of sensor
Sensor Mode	The current operating mode
Correction Factor	The current correction factor

13 Specification

General		
Measurement Method	Ultrasonic transit-time measurement	
Flow Range	0.1 m/s to 20 m/s	
Accuracy	Pipe ID >75 mm	±0.5% to ±3 % of flow reading for flow rate >0.2 m/s
	Pipe ID 13 mm to 75 mm	±3% of flow reading for flow rate >0.2 m/s
	All pipe ID's	±6% of flow reading for flow rate <0.2 m/s
Repeatability	±0.5% of measured value or ±0.02 m/s whichever is the greater	
Response Time	< 500 ms 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 Total Volume Units	liter, gallon, US gallons, Barrel, m ³	
Total Volume	12 digits	
Menu Languages	EN, DE, FR, RU, SWE, IT, SP, P, NO, DEN (user selectable)	

Environmental		
Operating Temperature	-20 °C to +50 °C	-4 °F to +122 °F
Storage Temperature	-25 °C to +75 °C	-13 °F to +167 °F
Pipe Wall Temperature	-20 °C to +135 °C	-4 °F to +275 °F
Operating Humidity	Max. 90% relative humidity @ +50 °C (+122 °F)	

Suitable Pipe Types		
Pipe Materials	PVDF, PP-H, PE, PB, ABS, UPVC, CPVC, construction steel, iron, stainless steel, copper	
Pipe Diameter (OD)	13 mm to 2000 mm	0.5 inch to 78 inch
Pipe Wall Thickness	1 mm to 75 mm	0.04 inch to 3 inch
Pipe Lining	Applicable pipe linings include Rubber, Glass, Concrete, Epoxy, Steel	
Pipe Lining Thickness	0 mm to 25 mm	0 inch to 1 inch

Electronics		
Power Supply		12 V to 24 V AC/DC, 1A max. or 86 V to 264 V AC (47 Hz to 63 Hz)
Power Consumption		Max. 10.5 W

Outputs		
Analog Output	Range	4 to 20 mA, 0 to 20 mA, 0 to 16 mA
	Resolution	0.1% of full scale
	Load Max.	620 Ω
	Isolation	1500 V Opto-isolated
	Alarm Current	Adjustable between 0 to 26mA
Pulse Output	Type	3x Opto-isolated MOSFET volt free contact (NO/NC)
	Options	Flow totals, energy (HM version only), loss of signal, low flow alarms
	Pulse Sequence	Volumetric mode: 1 to 50 pulses/sec user-programmable Frequency mode: 200Hz max. pulse frequency
	Pulse Width	50 ms standard value, 3 to 99 ms user-programmable
	Max. Voltage	48 V
	Max. Current	150 mA
	Isolation	>110 V AC/DC
Modbus Output	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
USB Interface (Optional)	Protocol	Supports full speed (12Mbits/sec) data connection
	Software	USB driver software is provided with the package
	Connector	Mini USB

Data Logger (models with datalogger option only)

Data Logged	application details, time, date, flowrate, forward total, reverse total, flow velocity, flow side temperature, return side temperature, temperature difference, power, total energy, signal quality, signal SNR, signal status
Number of Data Points	100 million
Number of Data Sites	12
Number of Data Points per Site	No limit
Programmable Logging Interval	5 s to 1 h
Start / Stop	Manually or timer controlled
Data Download	USB interface

Transducer Sets

Type A	13 to 114 mm (1/2 inch to 4.5 inch) pipe OD (2MHz)
Type B	50 to 2000 mm (2 inch to 40 inch) pipe OD (1MHz)

Enclosure and Display

Material	ABS and aluminium	
Dimensions	230 x 180 x 120 mm	9.0 x 7.1 x 4.7 inch
Weight	1.2 kg	2.65 lb
Keypad	15 key tactile feedback membrane keypad	
Display	Type	240 x 64 pixel graphic display, high contrast black-on-white, with backlight.
	Viewing angle	Min. 30°, typically 40°
	Active area	127 x 34 mm 5 x 1.3 inch
Protection Class	IP 65	

Shipping Information

Packaging Dimensions	480 x 320 x 230 mm	19 x 12.5 x 9 inch
Weight	4.8 kg	10.6 lb
Volume Weight	5.8 kg	12.8 lb

Standards and Approvals

	CE, RoHS compliant	
	Safety	BS EN 61010-1:2010
	EMC	BS EN 61326-1:2013 BS EN 61326-2-3:2013
	Environmental	BS EN 60068-1:2014
		BS EN 60068-2-1:2007 BS EN 60068-2-2:2007

Temperature sensors (Heatmeter models only)

Operating Temperature	0 °C to 50 °C	32 °F to 122 °F
Storage Temperature	-10 °C to +60 °C	14 °F to 140 °F
Temperature of Pipe Wall	-20 °C to +85 °C	-4 °F to +185 °F
Accuracy	Pt100 Class B 4-wire	
Resolution	0.1 °C (0.2 °F)	
Humidity During Operation	Max. 90% relative humidity at +50 °C (122 °F)	

Mechanical

Carrying case	
Rating	All components are contained in a hard-wearing IP67 rated carrying case with a protective molded foam insert
Enclosure	
Material	Flame retardant injection molded 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°

GF reserves the right To alter any specification without notification.

14 Disposal

- ▶ Before disposing of the different materials, separate them by recyclables, normal waste and special waste.
- ▶ Comply with local legal regulations and provisions when recycling or disposing of the product, the individual components and the packaging.
- ▶ Comply with national regulations, standards and directives.



A product marked with this symbol must be taken to a separate collection point for electrical and electronic devices.

If you have any questions regarding disposal of the product, please contact your national agent for GF Piping Systems.

If you have questions regarding the disposal of your product, please contact your national GF Piping Systems representative.

