mainstream™
MEASUREMENTS LTD

WORLD CLASS FLOWMETERS

USER MANUAL

Velocity Transmitter
Flow Transmitter
COMPACT Fixed AV-Flowmeter
PREMIER Fixed AV-Flowmeter
Portable AV-Flowmeter

Warranty

Mainstream Measurements Ltd warrants that the Mainstream flowmeters are free from defects in material and workmanship and operate substantially as described in this manual. If, during the warranty period specified below, the Mainstream flowmeter is shown to the reasonable satisfaction of Mainstream Measurements Ltd to be faulty and not to operate substantially as described in this manual, Mainstream Measurements Ltd will repair or replace the flowmeter. Mainstream Measurements Ltd will not be responsible for any failure of the Mainstream flowmeter caused by incorrect installation or extreme operating conditions and will not in any event be liable for any loss consequential or otherwise, caused by any error, defect, or failure of the Mainstream flowmeter, howsoever arising, including but not limited to loss of use, loss of data, loss of profit or loss of contract. The warranty period is 12 months from the date of shipment.

This manual is an integral part of the equipment and should be kept with it until the equipment is destroyed.

Before carrying out any operation on, or with, the equipment, all functional characteristics and instructions outlined in this manual should be read and fully understood.

It is advisable to follow all instructions carefully, as good operation and duration of the equipment over time depend primarily on correct installation, suitable electrical connections and correct programming for the actual operating conditions required.

Keep this manual in good condition and where it can be easily accessed by operators.

WARNING FOR ALL MAINSTREAM ATEX CERTIFIED PRODUCTS

ATEX INSTRUCTIONS (EHSR 1.0.6) FOR USE WITH MAINSTREAM VELOCITY SENSORS

The following instructions shall accompany each product. These instructions may be contained in a discrete section within an operation manual or similar document.

Instructions specific to hazardous area installations
(reference European ATEX Directive 94/9/EC, Annex II, 1.0.6.)

The following instructions apply to the Mainstream Velocity Sensors covered by certificate number Sira 05ATEX2159X. The wording and format may be altered provided the meaning remains unchanged.

1. The equipment may be used with flammable gases and vapours with apparatus Gas Groups IIA, IIB and IIC in Zone 0, 1 or 2 locations.

2. The equipment Temperature Class is T5 certified for use in ambient temperatures in the range -20°C to +40°C, or Temperature Class T4 certified for use in ambient
temperatures in the range -20°C to +80°C and should not be used outside this range.

3. Installation shall be carried out in accordance with the applicable code of practice by suitably-trained personnel.

4. Repair of this equipment shall be carried out in accordance with the applicable code of practice.

5. The X suffix to the certificate number is to indicate that there is a special condition for safe use, which is regarding the potential build-up of static electricity and the precautions to be taken.

6. If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.

Aggressive substances e.g. acidic liquids or gases that may attack metals, or solvents that may affect polymeric materials.

Suitable precautions e.g. regular checks as part of routine inspections or establishing from the material's data sheet that it is resistant to specific chemicals.

1 Your Product

1.1 Delivery Checkout

Unpack your Mainstream flowmeter. Do not discard any packaging until you have located all the items you ordered.

Your delivery will normally contain all of the following items -
System Unit.

Velocity Sensor - this is the ultrasonic sensor that measures the speed of the flowing liquid.

Level Sensor - this is the device that measures the level of the liquid flowing in the pipe or channel. It may be supplied fitted to the Velocity Sensor.

Comms Cable - this is the cable that connects the Mainstream system unit to a PC. It can be either RS232 or USB

USB Flash Drive - this contains the Mainstream Communicator UI software and user manual.

Your delivery may also contain some of the following optional items -

Portable only - Internal Battery if ordered; this is a 12V, 7.5Ah deep discharge battery and is normally shipped with the system unit, fully charged, and ready for operation.

Portable only - Spare Batteries; these are 12V, 7.5Ah deep discharge batteries identical to the battery fitted in the Mainstream system unit.

Portable only - Spare Internal battery.

Portable only - Fast Battery Charger this recharges the Mainstream battery. The battery must be removed from the Mainstream system unit for fast charging. The charge time is circa 8 hours.

Portable only - External Power Supply Adapter this is used to operate the Mainstream system unit from a mains supply. If an internal battery is fitted in the Mainstream whilst it is powered by the external power supply adapter, the internal battery will be trickle recharged.

Switch Cable - this is used when the Mainstream is to control additional equipment, typically a sampler.

Portable only - Auxiliary Cable this is used when the Mainstream is to control additional equipment, typically a sampler. It also allows for external power input.

Once you have identified all the components of your Mainstream flowmeter, install the Mainstream documentation and UI software on your PC.

1.2 Installing the Mainstream UI Software

The Mainstream USB Flash drive supplied contains the flowmeter documentation, the Mainstream Communicator UI software and also the drivers for the USB comms cable.

To install the Mainstream UI software and documentation, select menu.exe on the flash drive and follow the instructions. This will install all software and create relevant folders as well as shortcuts on the desktop.

1.3 Communicating with the Mainstream Flowmeter

The communications connector on your Mainstream system unit is located externally with the sensor and power connectors.

The Comms Cable supplied with your flowmeter can be either USB or RS232 depending on the ports on the PC.

The Mainstream Portable system unit detects when your PC is connected and shows that the connection is valid by switching ON the LED indicator lamp. Check the LED to confirm that your Comms Cable is fitted correctly.

Start the Mainstream Communicator UI by clicking on the PC Start button. Move your mouse to All Programs then, when the Start Menu appears, move your Mouse to Mainstream. Click on Mainstream Communicator to start the UI. The UI button bar will appear at the top of the screen. Only the Connection button is enabled.

Click the Connection button to open the Connection Form. Under the Local tab are Comm Port and Baud Rate drop-down list boxes. The Comm Port list contains all the available Comm ports on your PC. Select the port that your Comms Cable is using from the drop-down list. The connection process is then automatic. The Comms Diagnostics list box shows a summary of the activity.

If communication is not established within a few seconds it may be that you have selected the wrong comm port. Use the Comm Port drop-down list box to change your selection.

When communication between the PC and the Mainstream system unit is established all buttons on the UI button bar are enabled.

2 OVERVIEW

2.1 Applications

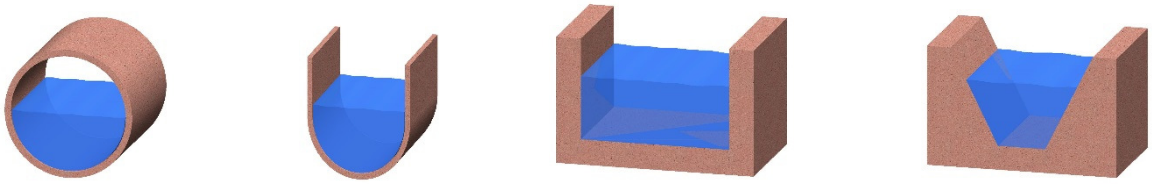
The Mainstream flowmeter is designed to measure the flow of liquids in open channels and part-filled pipes. Applications include sewer and effluent flow monitoring, river and stream flow measurement, waste water treatment, industrial flow metering and irrigation systems.

The Mainstream flowmeter uses Mainstream Communicator software which supplies functions to configure the Mainstream flowmeter according to the requirements of the measurement application, to test the flowmeter and associated equipment, to extract diagnostic information from the flowmeter, to view flow measurement data in real time, and to retrieve recorded data,

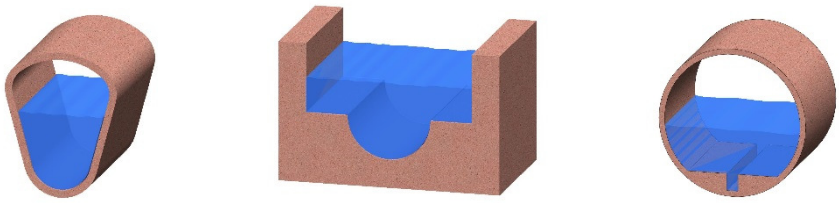
The Mainstream flowmeter can be configured for use in:

- circular, rectangular and oval pipes;
- semi-circular, rectangular, trapezoidal, triangular channels;
- complete and/or mixed sections.

Immediate installation of the sensor is possible under any existing conditions, and a high level of measurement precision and reliability is guaranteed, completely eliminating costs for modelling the section to be measured.



CIRCULAR **SEMI-CIRCULAR/U-CHANNEL** **RECTANGULAR** **TRAPEZOIDAL**



OVAL

RECTANGULAR CHANNEL WITH SEMI-CIRCULAR PIPE SECTION

MIXED SECTION PIPE

2.2 Mainstream Products

Mainstream is now produced in 5 main versions with varying functionality, ranging from the Velocity Transmitter to the Premier Fixed AV-Flowmeter.

VELOCITY TRANSMITTER

FLOW TRANSMITTER

COMPACT FIXED AV-FLOWMETER

PREMIER FIXED AV-FLOWMETER

PORTABLE AV-FLOWMETER

All of the instruments intended for fixed installation have a system unit housed in an aluminium enclosure with IP66 protection. The system unit contains power supply conditioning circuits, Level Sensor and Velocity Sensor control and interface circuits, a flow computer, LCD, data logger, two opto-isolated switch outputs and a serial communications interface.

The portable instrument is constructed from a rugged, high impact structural copolymer. The system unit is water tight and contains Level Sensor and Velocity Sensor control and interface circuits, a flow computer, LCD, data logger, two opto-isolated switch outputs and serial communications interface.

- Velocity sensor with a standard 10 metre cable (length optional);
- Level sensor with a standard 10 metre cable (length optional);
- RS232 interface cable to connect to the PC with 9 pin D-type connector (USB converter available)
- Comms cable to interface with a PC, either RS232 or USB
- USB Flash drive with user manual and Mainstream Communicator software

Additional accessories can be provided which vary for each solution on the basis of user and installation requirements.

2.2.1 System Unit for Fixed Installation

The system units for the Mainstream flowmeters and transmitters for fixed installation are all housed in a hardwearing aluminium enclosure and are designed for wall installation.

The flowmeter incorporates the system power supply circuits, the velocity sensor control, and the measurement processing computer. Depending upon the version, it is also possible to take level measurements from passive and active transmitters with relevant interfaces, and provide analogue and digital output signals for remote measurement relay.

Flowmeters also have a data logger to log all measurements taken, with a programmable time interval ranging from 15 seconds up to an hour.

On the front of the flowmeter instrument, there is an liquid crystal display which shows all *real time* instantaneous measurements taken sequentially, in addition to displaying totals. All electrical connections are made using suitable terminal boards inside the system unit.

Every Mainstream flowmeter can be identified by a unique serial number in the microprocessor memory.

2.2.2 Portable system unit

The flow rate converter in the portable Mainstream meter is housed completely in a shockproof plastic mini-case.

The Portable flowmeter is housed completely in a shockproof plastic mini-case.

The flowmeter incorporates all the circuits and has the same functionality as the flowmeter designed for fixed installation, with the exception of the analogue outputs which are not available. The standard 7.5AH removable battery is also incorporated into the instrument. The ON/OFF switch and liquid crystal display are under the case lid. On the outside of the case there are four rapid connection fittings to connect the level and velocity sensors, and the series communication and auxiliary signals.

2.3 Measurement sensors

All Mainstream flowmeters and velocity/flow transmitters have a velocity immersion sensor, whereas for the level measurement and resulting calculation of the wet area, every instrument can be equipped with a high precision pressure immersion transmitter, or an ultrasonic, radar, or other type of Level Sensor with an active or passive 4:20 mA output signal, duly connected to the flowmeter or transmitter.

2.3.1 Velocity Sensor

The velocity sensor comprises a streamline injection moulded µPVC body 105 mm long by 50 mm wide by 20mm high. The probe operates immersed in the flowing liquid. At the front of the probe facing into the flow are two "eyes" which use ultrasound to interrogate the moving liquid. The probe body contains the electronic circuits which generate this ultrasound and process the ultrasonic signals. The maximum working temperature of the probe is 85°C.

The velocity sensor is connected to the Mainstream system unit via a reinforced cable. This cable supplies power to the Velocity Sensor and carries data back to the system unit. The power supply to the sensor, and transmits the measured signals that have already been processed to the system unit.

The standard Velocity Sensor cable length is 10 metres. Probes can be supplied with longer cable lengths up to a maximum of 500 metres. For ATEX approved velocity sensors the maximum cable length is 300 metres.

2.3.2 Level Sensor

Mainstream flowmeters can operate with any Level Sensor capable of generating a 4:20 mA signal.

In many applications, the liquid level is determined by means of a pressure transmitter which uses a vented cable to provide an atmospheric reference. This vented cable terminates inside the Mainstream fixed installation flowmeter system unit which is equipped with a breather port to access the atmospheric pressure.

Pressure transmitters supplied by Mainstream Measurements Ltd may be equipped with an optional adapter which attaches to a mounting point at the rear of the Velocity Sensor. This combines the pressure transmitter and Velocity Sensor into an easy-to-install level-velocity sensor.

2.3.3 Mainstream Communicator

The Mainstream fixed installation system unit has a serial port connector located adjacent to the cable glands. This serial port links the Mainstream to a local PC using the comms cable supplied with the flowmeter.

Each Mainstream portable flowmeter is supplied with a Mainstream Communicator software package that operates on PC platforms. This software is an integral part of the Mainstream product and enables the user to exploit all the features of the Mainstream flowmeter. Where functionality is not available with the equipment purchased, then the relevant options are automatically disabled.

Mainstream Communicator provides functions for flow measurement system configuration, pipe/channel cross-section definition, calibration of Level Sensors, flow measurement diagnostics, configuration and testing of the flowmeter outputs, display of flow measurement data in real time, and retrieval of data from the Mainstream logger.

2.4 Operating Principle

Mainstream uses the area-velocity method to measure the liquid flow rate.

A submerged pressure transmitter or ultrasonic sensor determines the liquid level and Mainstream calculates the flow cross-sectional area using a stored description of the pipe or channel geometry.

The Mainstream Velocity Sensor operates immersed in the flow and projects two ultrasonic grid patterns into the moving liquid. Bubbles and solid particles carried by the flow act as tracers, reflecting ultrasound back to the probe as they pass through the two grids.

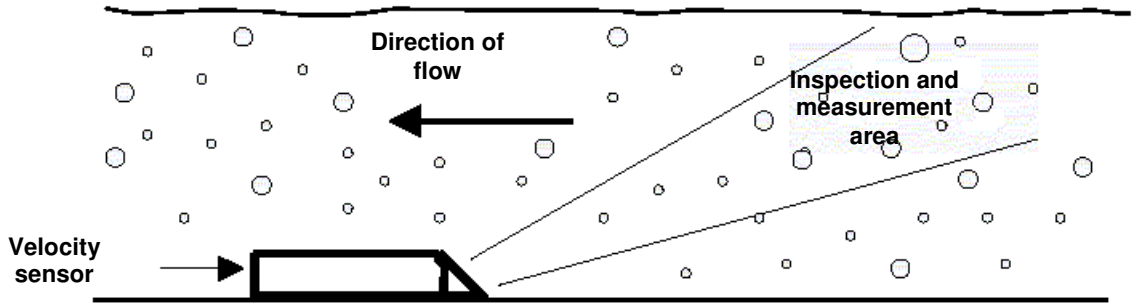
Mainstream measures the time for tracers to travel between the two grids. Dividing the grid separation by the travel time gives the tracer velocity.

The liquid flow rate is the man flow velocity multiplied by the flow cross-sectional area.

A unique feature of the Mainstream is its signal quality reading. This shows the percentage of the tracer data that Mainstream is able to process into velocity measurements. A high signal quality confirms the measurement integrity. The signal quality is a valuable metric for the flowmeter condition monitoring.

2.4.1 Velocity Measurement

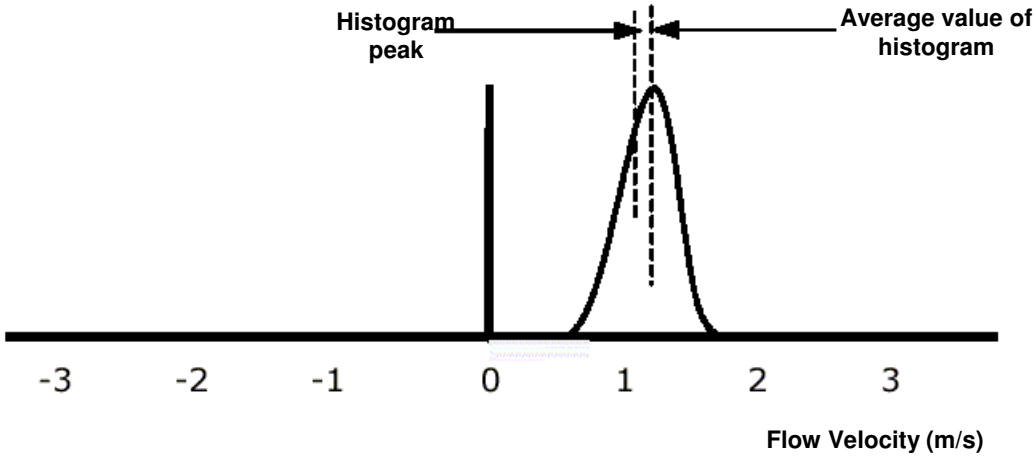
The Mainstream velocity sensor transmits ultrasonic signals in the fluid in order to create a wide inspection and measurement area. Particles and air bubbles suspended in fluid in the inspection area reflect the ultrasonic signal that goes back to the sensor.



The signals that are reflected and go back to the sensor are processed via advanced phase coherence technology (patented processing system), which makes it possible to produce an average velocity histogram, determine the relative flow direction, and most of all, formulate a highly reliable and reiterative measurement.

The quality of the signal represents the percentage of ultrasonic signals that contain verified velocity information. A high level of signal quality confirms the validity of the measurement.

The velocity histogram highlights the quantity of ultrasonic signals relative to the different velocities present in the flow. A typical histogram for a positive velocity value greater than 1 m/sec is shown below:



The direction and velocity of the flow are determined by the velocity histogram.

The Average Value is formulated from the histogram and represents the measurement of the weighted average of all the velocities measured in the sensor inspection area.

2.4.2 Measurement of the Liquid Head

Apart from the system adopted to measure the liquid head, Mainstream measures the value of the current (mA) transmitted by the Level Sensor, converting it into a level measurement using a calibration table.

The level calibration details are memorised in a tabular form, for a maximum of 25 points, where there is a direct relationship between the current loop transmitted by the level logger and the liquid head present. Automatic interpolation between the calibration points is effective in removing any non-linearity inherent in the Level Sensor.

2.4.3 Flow Rate and Quantity Calculation

The liquid flow rate is determined by multiplying together the measured velocity and the effective flow cross-sectional area deduced from the liquid level measurement.

Mainstream also calculates two flow quantities - the quantity in the last hour and the total quantity. The quantity in the last hour is continuously updated by integrating the measured flow rate.

Note: If the flow rate is negative, because the measured velocity is negative, the quantity in the last hour remains unchanged.

Every hour, on the hour, the hour quantity value is added to the total quantity and the quantity in the last hour is reset to zero.

2.5 Displaying, re-transmitting and logging measurements

When provided, the display is an LCD backlit, two line X 16 character alphanumerical display, and sequentially displays the date, time, and required configurable combination of all instantaneous measurements taken and processed directly in the units.

The following parameters can be displayed:

- Level;
- Level Sensor loop current;
- Wet Area;
- Average velocity;
- Signal quality;
- Instantaneous flow rate;
- Direct and reverse total and partial hourly unit of volume;
- Power supply voltages, backup battery, internal battery and external source;
- Battery charge current if present.

With a PC connected to the flowmeter via a serial port and the Mainstream Communicator software, all the measurements taken simultaneously with real time updates can be displayed on a single screen.

All measurements taken can be logged on the incorporated data logger, and the logged details can be downloaded to a PC, using the Mainstream Communicator software, generating a *.CSV file which is compatible with the most common spreadsheets, for additional or future analysis.

Depending on the version, the Mainstream flowmeters and transmitters have analogue and digital output signals for the transmission of measurements or alerts to remote equipment.

With the flowmeters two programmable switch outputs enable the control of an automatic sampler proportional to the unit of volume measured, in addition to the activation of alert signals.

Connection to remote monitoring, supervisory or logging apparatus is possible via the 4:20 mA analogue outputs. The outputs are freely programmable to be proportional to the logged values.

3 System Unit Familiarisation

3.1 Portable AV-Flowmeter

The flowmeter system unit has a replaceable internal battery, an ON/OFF switch, an LED indicator lamp, an LCD display, and a number of connectors to attach a communication cable, optional external power supplies, a level sensor and a Velocity Sensor.

Start by opening the hinged system unit lid to locate the internal battery, ON/OFF switch and LCD.

Press the ON/OFF for 2-3 seconds to power up the flowmeter.

If it does not power up check the battery or external power supply. Battery replacement is described in section 7.2. When the flowmeter starts to operate, the LCD cycles through several pages of information, showing the Mainstream system Unit ID and product type, followed by the date, time, power supply voltages, and measurement data. Each page is displayed for 2.5 seconds. The LCD page sequence can be set by the user.

View the LED indicator on the outside of the system unit. During normal operation this emits a short flash every 10 seconds. Use this for a quick check of the system unit status without opening the system unit case to view the LCD or connecting the unit to a computer.

The LED also relays other messages. It switches on for five seconds when the system unit starts up, and is on continuously whilst a communication device (e.g. a PC) is connected to the serial port. If the system unit shuts down because the battery is flat, the LED emits three short flashes every ten seconds.

To shut down the Mainstream system unit, depress the ON/OFF switch for ten seconds. The Mainstream stops measuring and closes the active data logger file, the LCD displays a Power Down message, and the processor goes into sleep mode.

3.2 Velocity Transmitter

The Mainstream ™Velocity Transmitter uses a submerged ultrasonic sensor to measure the velocity of a liquid flowing in an open channel or closed pipe. The measured velocity is output as a 4:20 mA signal. The velocity transmitter is contained in a rugged aluminum housing measuring 220 mm wide x 120 mm high x 80 mm deep. The housing seals to IP67. The electronics within the housing are encapsulated to exclude moisture.

For terminal board connection details refer to Section 6.1.

3.3 Flow Transmitter

The Mainstream Flow Transmitter uses a submerged ultrasonic sensor to measure the velocity of the liquid flowing in an open channel or part-filled pipe, and a level sensor to determine the flow cross-sectional area. The flow rate, calculated by multiplying the area by the velocity, is output as a 4:20 mA signal.

The flow transmitter is contained in a rugged aluminum housing measuring 220 mm wide x 120 mm high x 80 mm deep. The housing seals to IP67. The electronics within the housing are encapsulated to exclude moisture. The Flow Transmitter can be supplied pre-configured for the user's application – pip/channel dimensions and flow output signal scaling. Mainstream Communicator provides flow transmitter diagnostics and allows the user to set configuration options.

For terminal board connection details refer to Section 6.2.

3.4 COMPACT AV-Flowmeter

The Mainstream COMPACT AV-Flowmeter uses a submerged ultrasonic sensor to measure the velocity of the liquid flowing in an open channel or part-filled pipe, and a level sensor to determine the flow cross-sectional area. The flow rate, calculated by multiplying the area by the velocity, is output as a 4:20 mA signal.

The AV-Flowmeter is contained in a rugged aluminium housing measuring 220 mm wide x 120 mm high x 80 mm deep. The housing seals to IP67. The electronics within the housing are encapsulated to exclude moisture. The AV-Flowmeter can be supplied pre-configured for the user's application – pipe/channel dimensions and flow output signal scaling. Mainstream Communicator provides flow transmitter diagnostics and allows the user to set configuration options.

For terminal board connection details refer to Section 6.3.

3.5 PREMIER AV-Flowmeter

The Mainstream COMPACT AV-Flowmeter uses a submerged ultrasonic sensor to measure the velocity of the liquid flowing in an open channel or part-filled pipe, and a level sensor to determine the flow cross-sectional area. The flow rate, calculated by multiplying the area by the velocity, is output as a 4:20 mA signal.

The AV-Flowmeter is contained in a rugged aluminium housing measuring 260 mm wide x 160 mm high x 90 mm deep. The housing seals to IP67. The electronics within the housing are encapsulated to exclude moisture. The AV-Flowmeter can be supplied pre-configured for the user's application – pipe/channel dimensions and flow output signal scaling. Mainstream Communicator provides flow transmitter diagnostics and allows the user to set configuration options.

For terminal board connection details refer to Section 6.4.

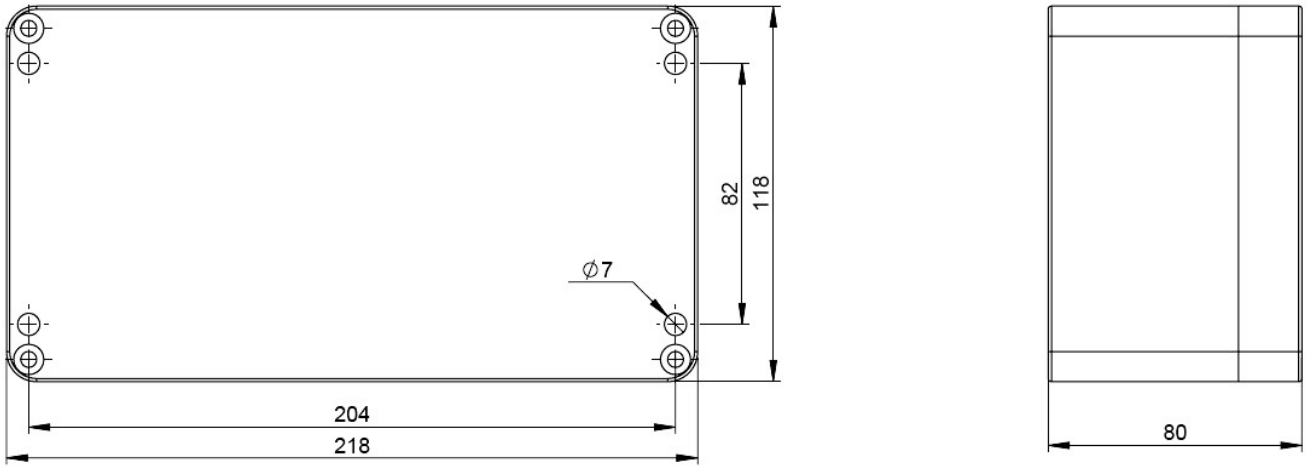
4 INSTALLATION OF THE SYSTEM UNIT

The system units for the Mainstream flowmeters and transmitters designed for fixed installation are all housed in hardwearing aluminium enclosures designed for wall installation. Outlined below are the external dimensions of the system units, in addition to drilling centre distances for fitting to the wall.

4.1 VT, QT & COMPACT Fixed AV-Flowmeter Unit Dimensions

Outlined below are the overall dimensions of the system unit, with drilling centre distances for wall installation of the following instruments:

- Velocity Transmitter
- Flow Rate Transmitter
- COMPACT AV-Flowmeter

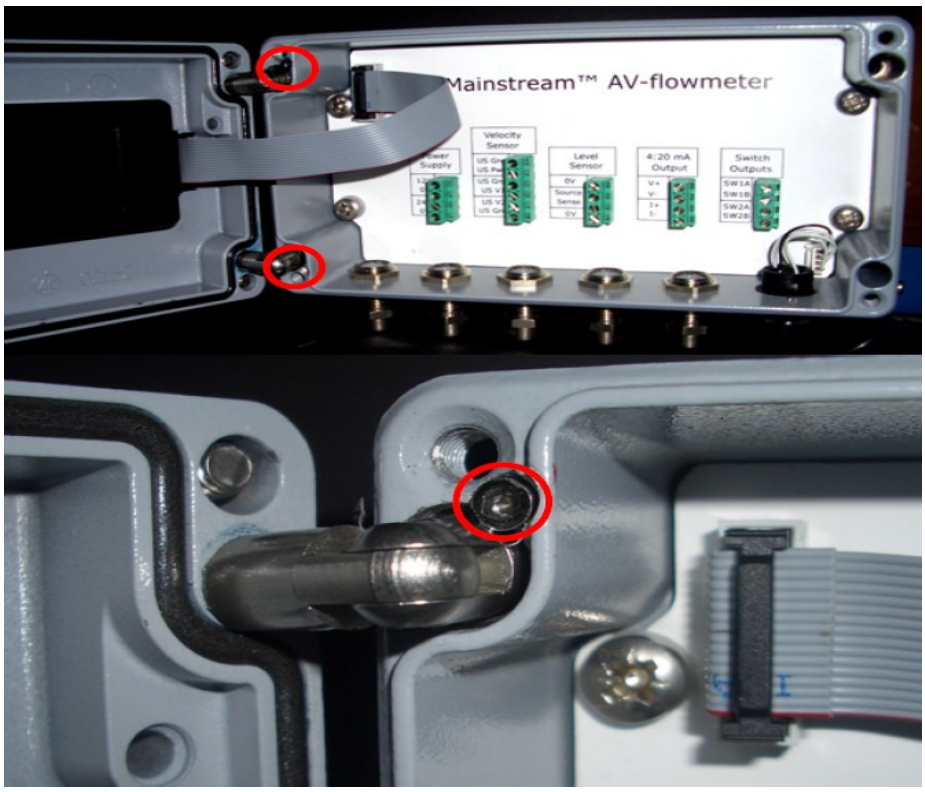


4.1.1 Access to fixing holes for COMPACT and PREMIER Fixed AV-Flowmeter

The Mainstream units which are equipped with a display have a ribbon cable between the display and the motherboard. To protect the cable and the related connections from being accidentally pulled when opening the enclosure cover, there are two steel hinges that prevent the total removal of the cover. To access the fixing holes on the left side of the enclosure the hinges must be removed. The hinges are attached to the base of the enclosure with two M3 threaded screws.

To remove the hinges proceed as follows:

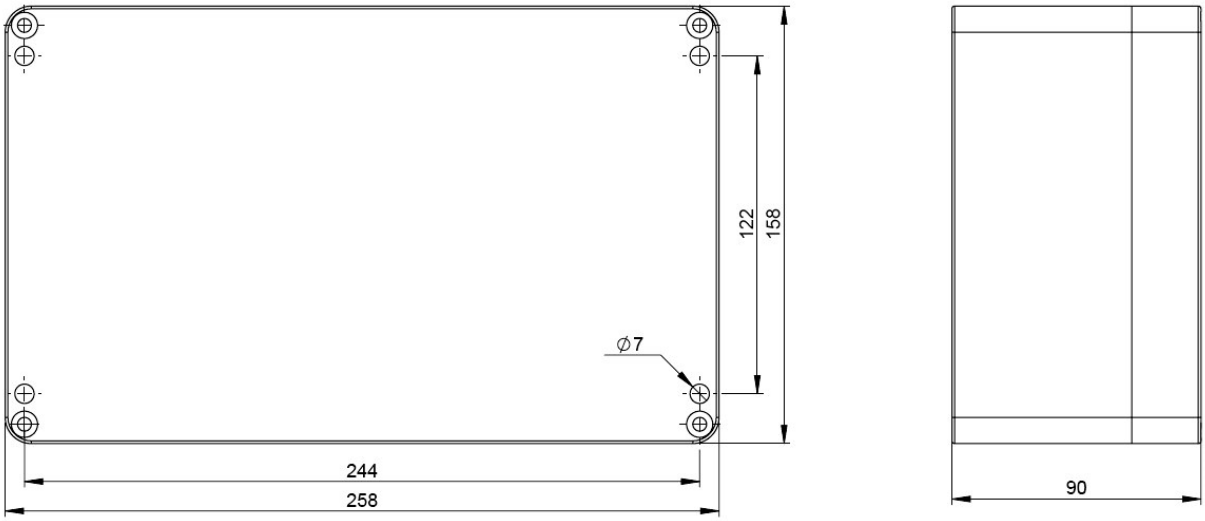
1. Remove the display ribbon cable from the processor board.
2. Remove the two fixing screws on the upper and lower hinges.
3. The hinges are now freed from the base of the box and the cover with the display can be removed.
4. Use the 4 fixing holes to fit the enclosure to the wall or support with 6 mm screws
5. Fasten the enclosure; screw the hinges back into their holes and block by re-inserting the two M3 screws.
6. Connect the display ribbon cable to the Mainstream processor board again.



4.2 PREMIER Fixed AV-Flowmeter unit dimensions

Outlined below are the overall dimensions of the system unit, with drilling centre distances for wall installation of the following instrument:

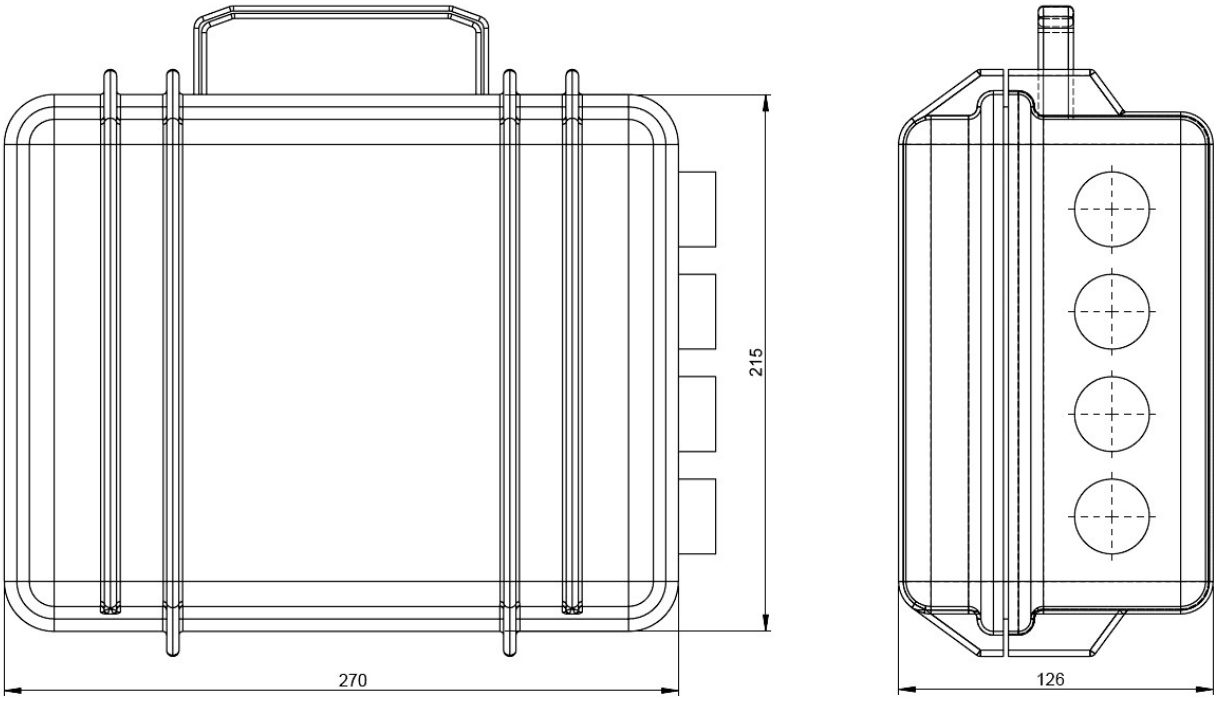
- PREMIER Fixed AV Flowmeter



4.3 Portable AV-Flowmeter unit dimensions

Outlined below are the overall dimensions of the system unit for the following instruments:

1. Portable AV Flowmeter



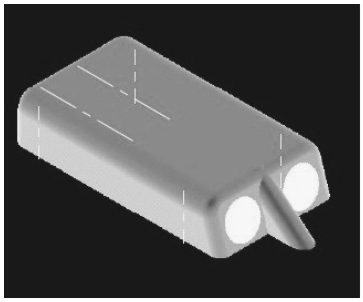
5 INSTALLATION OF THE VELOCITY SENSOR

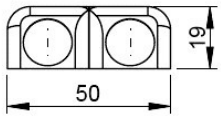
The Mainstream velocity sensor consists of a streamlined injection moulded µPVC body 105 mm long x 50 mm wide x 19 mm high. The sensor operates immersed in the flowing liquid. The maximum working temperature of the sensor is 85°. At the front of the sensor facing in to the flow are two "eyes" which use ultrasound to interrogate the moving liquid. The sensor body contains circuits to generate this ultrasound and process the ultrasonic signals. The Mainstream velocity sensor is connected to the system unit via a reinforced cable that supplies electrical power to the velocity sensor and carries data back to the system unit. The standard length of velocity sensor cable is 10 metres. Sensors can be supplied with longer cable lengths up to a maximum of 500 metres. Increasing the length of the velocity sensor cable does not degrade flow measurement performance.

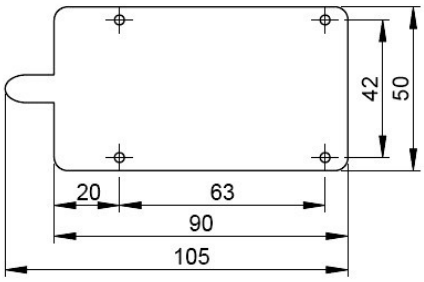
For ATEX approved velocity sensors the maximum cable length is 300 metres.

5.1 Dimensions and fixing template

Below are the dimensions of the velocity sensor in addition to centre distances for the M3 threaded inserts for fixing the sensor to the support used for installation. The M3 fixing screws for the sensor should of a length not greater than 4-5 mm + the thickness of the support plate used.







5.2 Installation

The velocity sensor is designed to operate immersed in liquid; therefore it is usually installed at the bottom of the channel or pipe where the measurement is to be taken. To this effect there are supports and accessories available depending on the installation required, i.e. for circular pipe sections, semi-circular pipe sections, and rectangular or trapezoidal channel sections.

5.2.1 Equipment for installing the sensor

To install the sensor in a flat-bottomed rectangular or trapezoidal channel, support plates are fixed to the bottom of the channel using bolts or brackets that meet the specific requirements.

To install the sensor in channels or pipes where it is not possible to stop flow, a support bracket can be used for the velocity sensor. The sensor is anchored to a square tube which will ensure the correct positioning of the sensor with respect to the flow and which can be easily removed for maintenance purposes.

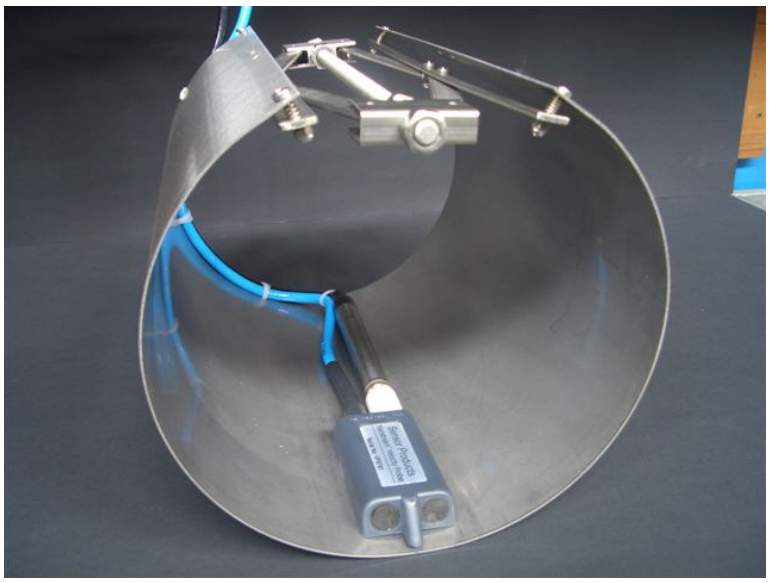
5.2.2 Equipment for installing the sensor in circular pipe sections

To install the velocity sensor in circular pipe sections, suitable ring supports in stainless steel can be used, complete with an upper expander which allows the ring to be expanded against the internal walls of the pipe. (Please note we do not supply these)

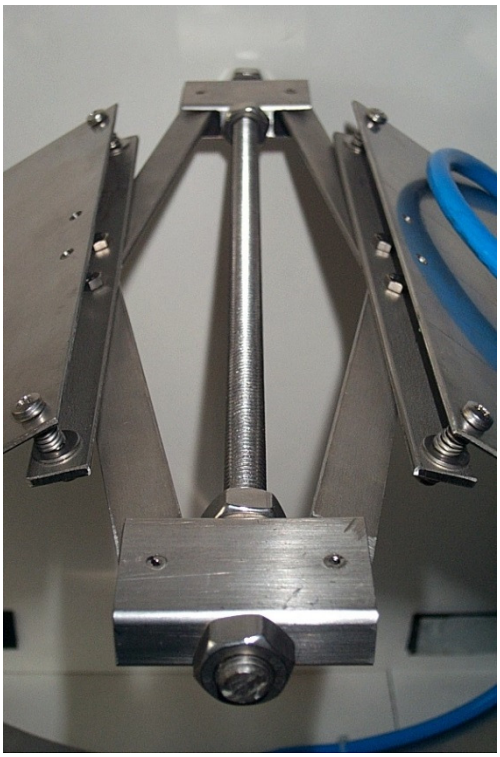
The lower base of the ring has the sensor anchoring holes, and the cable should be fastened with cable ties along the ring perimeter, which exit from the upper part of the pipe, to avoid the creation of any obstructions to flow.

It is advisable to cover the semi-section of the ring where the cable passes with high strength adhesive tape, to protect the cable better and increase the hydrodynamics of th e support.

The upper expander makes it possible to reduce the ring diameter for easy insertion into the pipe. Subsequently opening it provides a high level of strength combined with increased grip against the internal pipe surfaces. This makes it possible to keep the sensor in the correct position, with as little obstruction as possible in the pipe.



SCISSOR JACK BAND



Visit the following URL link for examples of sensor installation and where to install the sensor.

http://mainstream-measurements.com/wp-content/uploads/2015/02/Example-of-Sensor-Installation.pdf

6 FIXED INSTALLATION ELECTRICAL CONNECTIONS

To use a Mainstream flowmeter or transmitter the following power-up and power-down voltages are shown in the table below.

	12 V Battery		12 V External		24V External	
	Power Down	Power Up	Power Down	Power Up	Power Down	Power Up
Portable	9.5V	11V	9.5V	11V	12V	15V
Velocity Trans			9.5V	11V	16V	18V
Flow Trans			9.5V	11V	16V	18V
COMPACT			9.5V	11V	12V	15V
PREMIER			9.5V	11V	11V	12V

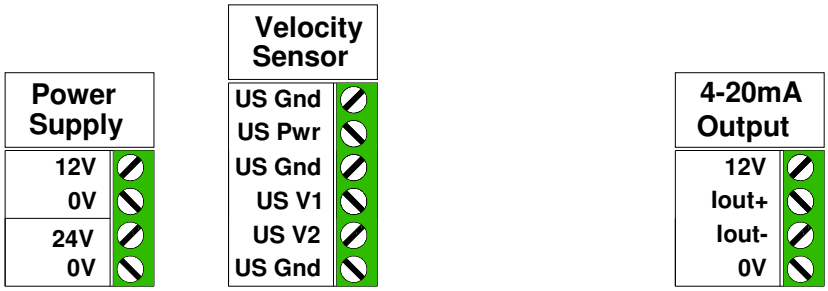
Connections for the velocity transmitter; flow transmitter; COMPACT and PREMIER system units are shown below.

To access the electrical connection terminal board, remove the front cover of the system unit.

6.1 Mainstream Velocity Transmitter

The complete terminal board for the velocity transmitter is illustrated below.

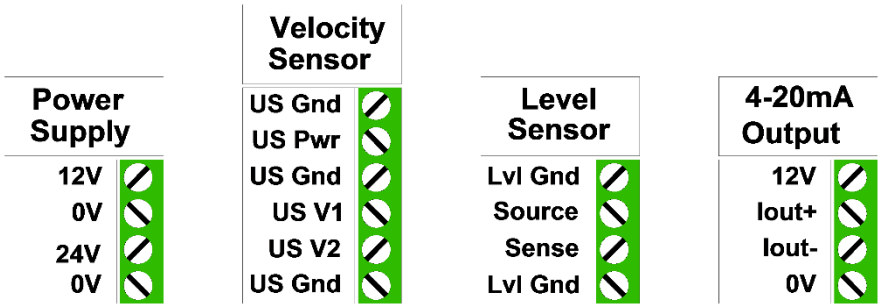
Connection details for individual terminal boards are described and illustrated in the following paragraphs in this section.



6.2 Mainstream Flow Transmitter

The complete terminal board for the flow rate transmitter is illustrated below.

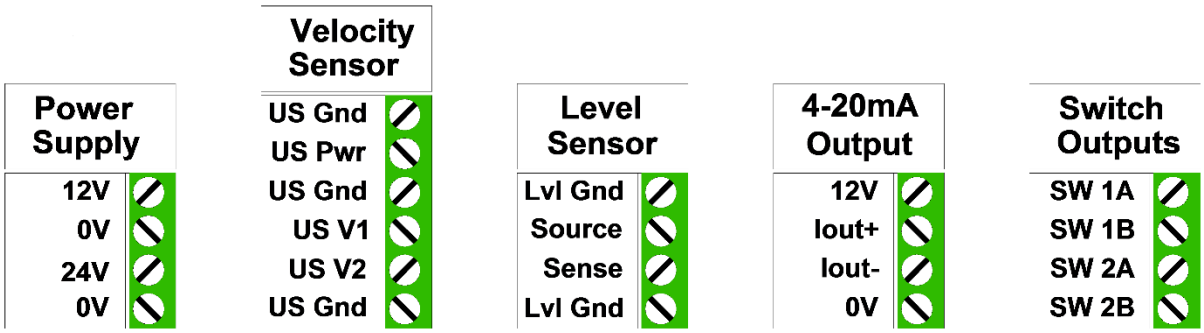
Connection details for individual terminal boards are described and illustrated in the following paragraphs in this section.



6.3 Mainstream COMPACT Fixed AV-Flowmeter

The complete terminal board for the COMPACT fixed AV-flowmeter is illustrated below.

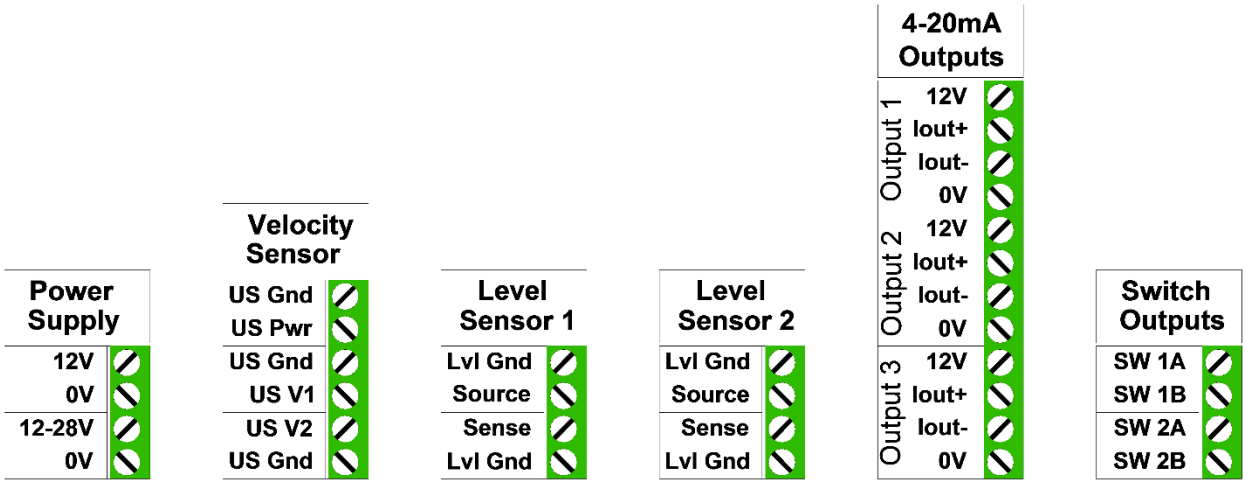
Connection details for individual terminal boards are described and illustrated in the following paragraphs in this section.



6.4 Mainstream PREMIER Fixed AV-Flowmeter

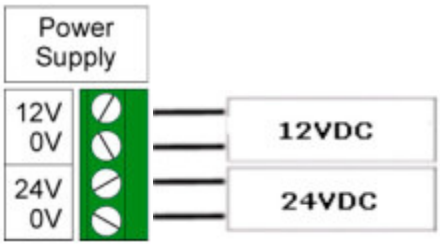
The complete terminal board for the PREMIER fixed AV-flowmeter is illustrated below.

Connection details for individual terminal boards are described and illustrated in the following paragraphs in this section.



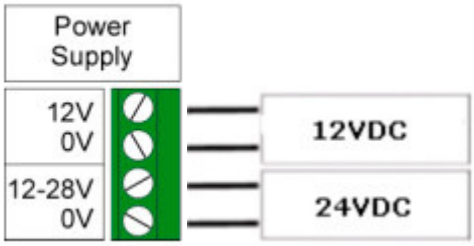
6.5 Power Supply

Connections for Mainstream Velocity and Flow Transmitter and the Mainstream COMPACT Fixed AV-flowmeter should be made as illustrated in the following diagram, according to the requirements of use of the instrument.



The terminals marked **12V** and **24V** are the positive poles relating to the two power supply voltages. The **0V** terminals are the negative poles.

Connections for the Mainstream PREMIER Fixed AV-flowmeter should be made as illustrated in the following diagram, according to the requirements of use of the instrument.



The terminals marked **12V** and **12-28V** are the positive poles relating to the two power supply voltages. The **12V** and **12-28V** are two independent power inputs.

The **0V** terminals are the negative poles. Note these two OV terminals must not be connected together i.e. not shorted.

The 12VDC power input in the flowmeter is designed to be connected to a backup battery in the event of power failure. This battery is maintained by the 24VDC input.

In the absence of the 24VDC input, the instrument will revert to the battery power supply.

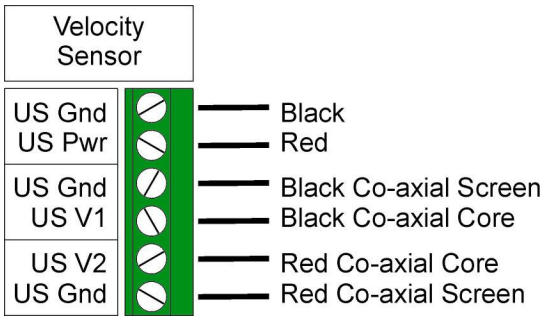
The maximum current load is 200 mA with the 24VDC power supply.

The maximum current load is 50 mA with the 12VDC power supply. In energy saving mode this decreases to 1 mA.

6.6 VELOCITY SENSOR

The terminal board for the velocity sensor has 6 terminals. The velocity sensor cable has two individual conductors, black and red respectively. It also has two coaxial conductors, black and red respectively.

Velocity sensor connections should be carried out as illustrated in the following diagram:



NB: The shields on the two coaxial conductors to be connected on the US GND terminals are common in the instrument. They can both be connected to one or the other dedicated terminals without distinction.

6.6.1 Velocity Sensor Power Supply

The Mainstream flowmeter or transmitter provides the sensor with power via US PWR and US GND terminals to which the red (US Power) and black (US Ground) conductors should be connected respectively.

6.6.2 Velocity Sensor Measurement Signals

The measurement signals processed by the sensor are transmitted to the Mainstream system unit via two coaxial conductors. The shields on the two coaxial conductors should be connected to the relevant US GND terminals.

HINT: Under special circumstances it may be advantageous to mount the Velocity Sensor with the ultrasonic 'eyes' facing downstream. Ordinarily this would lead to an incorrect (reverse) indication of the flow direction. This can be overcome by reversing the connections of co-axial cable cores to terminals US V1 and US V2.

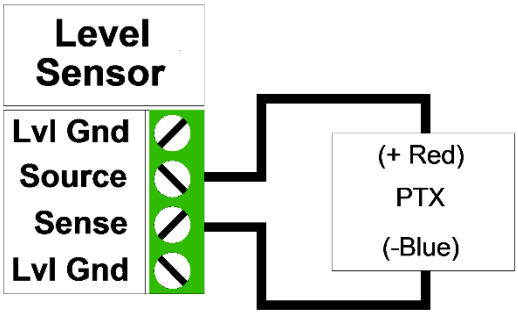
.

6.7 Level Sensor

The terminal board for connecting the Level Sensor has 4 terminals marked as follows: Lvl Gnd, Source, Sense and Lvl Gnd. The Level Sensor can be active or passive, i.e. self-powered or powered by Mainstream.

When connected to Mainstream the Level Sensor can be PASSIVE (pulse powered by the Mainstream) or in ACTIVE mode (continuously powered by an external supply). The Level Sensor connections to terminals Lvl Gnd, Source and Sense therefore depend on the type of transmitter used and the possible alternatives are illustrated below.

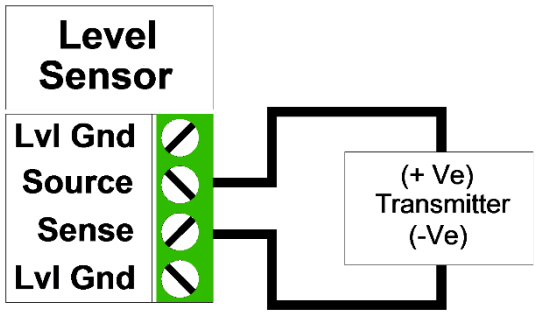
In the most common instrument configuration, with the use of a relative pressure immersion transmitter for the level measurement, connection is via two conductors only, as illustrated below:



NB: The connections outlined above are only valid for pressure transmitters with an original two-wire specification.

6.7.1 Connecting to a Passive Level Sensor

Connections for a passive Level Sensor are illustrated below:

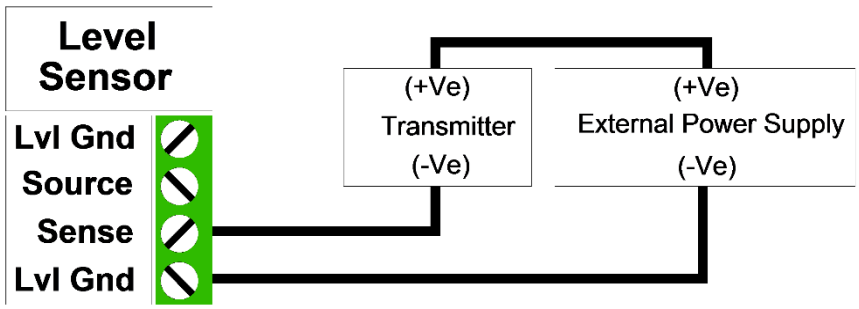


With these connections the Mainstream delivers approximately 10.5 Volts, current limited to less than 30 mA, from the Level Source (+) terminal to the Level Sense (-) terminal. Any screen on the Level Sensor cable should be connected to the Ground or Level Ground terminal as appropriate.

CAUTION: It is not uncommon for pressure transmitter manufacturers to use a Black lead to indicate the positive connection and a Red lead to indicate the negative connection. Always check the manufacturer's data for the correct colour code.

6.7.2 Connecting to an Active Level Sensor

Connections for an active Level Sensor are illustrated below:



Active Level Sensors will normally be continuously powered from an external supply. The positive side of the supply is connected to the Level Sensor and the negative side of the supply is connected to the Level Ground terminal. The Level Source terminal is unused.

WARNING: Mainstream is fitted with protection circuits to guard against incorrect transmitter installation and fault conditions. (e.g. short circuit transmitter driven by a low impedance supply). These circuits are capable of sinking currents up to 1A for a limited duration only. The user should take adequate precautions to prevent sustained fault conditions.

6.8 Connecting the 4:20 mA Outputs

With regard to the analogue outputs, all the instruments have 4 connection terminals for each output. This enables use in PASSIVE mode (pulse powered by the Mainstream) or in ACTIVE mode (continuously powered by an external supply).

NB: 4:20mA outputs maybe configured to any measurand using Mainstream Communicator software.

CAUTION: Connection diagrams on the terminal board vary according to the type of instrument. The following sections are repeated and highlighted by connection type for the relevant Instrument.

WARNING: Pay particular attention to compliance of the diagram with the terminal board of the respective instrument.

6.8.1 Passive 4:20mA Output Connection for COMPACT AV-Flowmeter & Transmitters

In passive mode the signal loop is powered by an external voltage applied across the +VE and -VE terminals. The auxiliary 12V power source is not used and the 12V and 0V terminals are left open circuit.

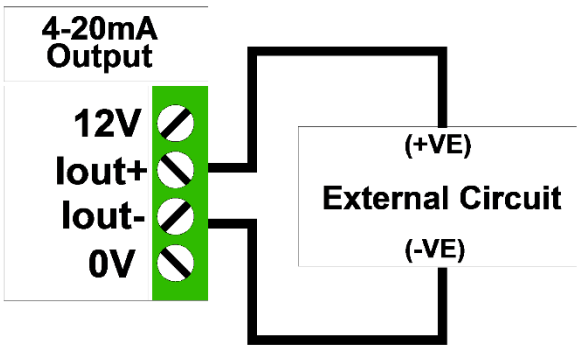
The voltage across the +VE and -VE terminals after allowing for all components in the signal loop must be at least 5V.

If using 12V power input, the connection must be in PASSIVE mode only.

If using 24V power input, the connection can be ACTIVE or PASSIVE mode.

CAUTION: the 4:20mA output circuits are protected against transients, reverse polarity and over voltage supplies. However, the user should take adequate precautions to prevent sustained fault conditions.

The electrical connections for an analogue output in passive mode are illustrated below:



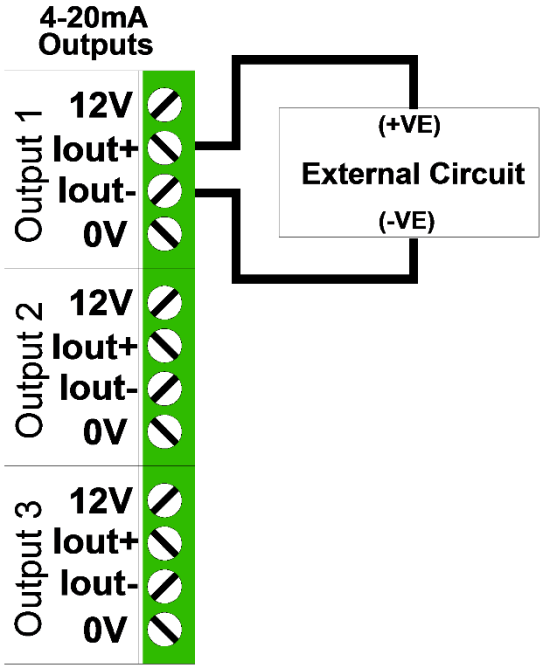
6.8.2 Passive 4:20mA Output Connection for PREMIER AV-Flowmeter

In passive mode the signal loop is powered by an external voltage applied across the +VE and -VE terminals. The auxiliary 12V power source is not used and the 12V and 0V terminals are left open circuit.

The voltage across the +VE and -VE terminals after allowing for all components in the signal loop must be at least 5V.

CAUTION: the 4:20mA output circuits are protected against transients, reverse polarity and over voltage supplies. However, the user should take adequate precautions to prevent sustained fault conditions.

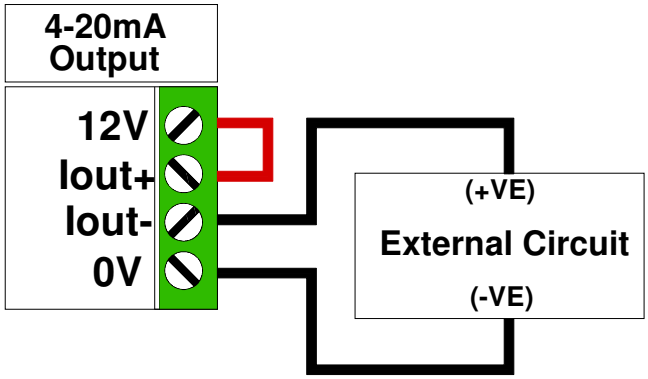
The electrical connections for an analogue output in passive mode are illustrated below:



CAUTION: For correct operation the minimum voltage applied to the +VE and -VE terminals should not be less than 5V. The maximum voltage applied to the same terminals should not be greater than 30V.

6.8.3 Active 4:20mA Output Connection for COMPACT AV-Flowmeter & Transmitters

The electrical connections for an analogue output in active mode are illustrated below:

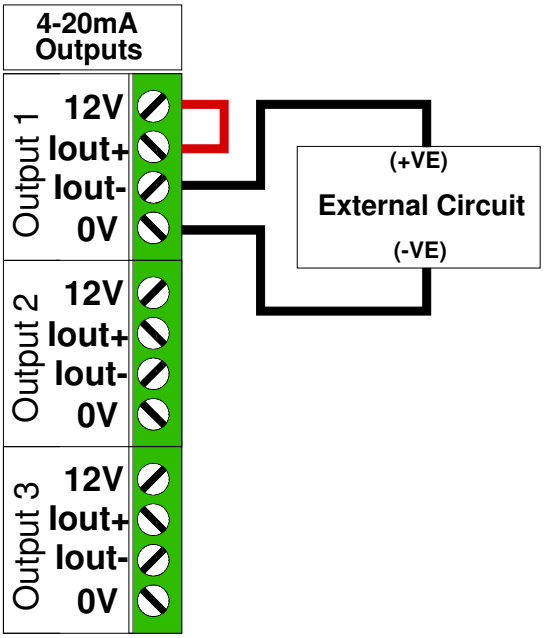


In active mode, the 12V and +VE terminals are connected by a link (shown in red). The signal current is derived from the auxiliary 12V supply and is routed through the current regulator terminals –VE and 0V into the external circuit.

The resistance of the external circuit should not exceed 200 ohm.

6.8.4 Active 4:20mA Output Connection for PREMIER AV-Flowmeter

The electrical connections for an analogue output in active mode are illustrated below:



In active mode, the 12V and +VE terminals are connected by a link (shown in red). The signal current is derived from the auxiliary 12V supply and is routed through the current regulator terminals –VE and 0V into the external circuit.

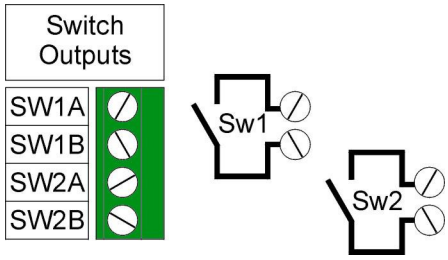
The resistance of the external circuit should not exceed 200 ohm.

NB: The same 12V power source is used for all analogue outputs. By connecting the three active outputs there will be no isolation between them, even though the outputs remain isolated from the Mainstream system unit, and any output connected in passive mode.

NB: Each output is protected by a 50mA fuse at the 12V auxiliary power source. Therefore any fault which causes excessive demand can cause malfunctioning of all the outputs in active mode.

6.9 Connecting Switch Outputs for COMPACT and PREMIER AV-Flowmeters

The two switch outputs are accessible via terminal pairs marked SW1 and SW2.



CAUTION: Each switch is protected with 100mA fuse.

NB: 4:20mA outputs maybe configured to any measurand using Mainstream Communicator software.

7 PORTABLE UNIT ELECTRICAL CONNECTIONS

The portable instrument has rapid connection fittings with IP 67 protection positioned externally on one side of the system unit's case.

7.1 Fittings on the portable unit

On the side of the portable unit there are 4 connectors for the Level Sensor, Velocity Sensor, Auxiliary and Serial respectively.

LEVEL SENSOR **VELOCITY SENSOR** **AUXILIARY CONNECTOR** **SERIAL/DATA COMMUNICATIONS**

NB: In order to preserve the connectors, the dust cap covers should be used when the instrument is not in use.

7.2 Portable Unit Power Supply

The power supply to the portable unit is provided by a rechargeable battery within the instrument. Mainstream uses a deep discharge gel battery 12VDC 7.5 Ah.

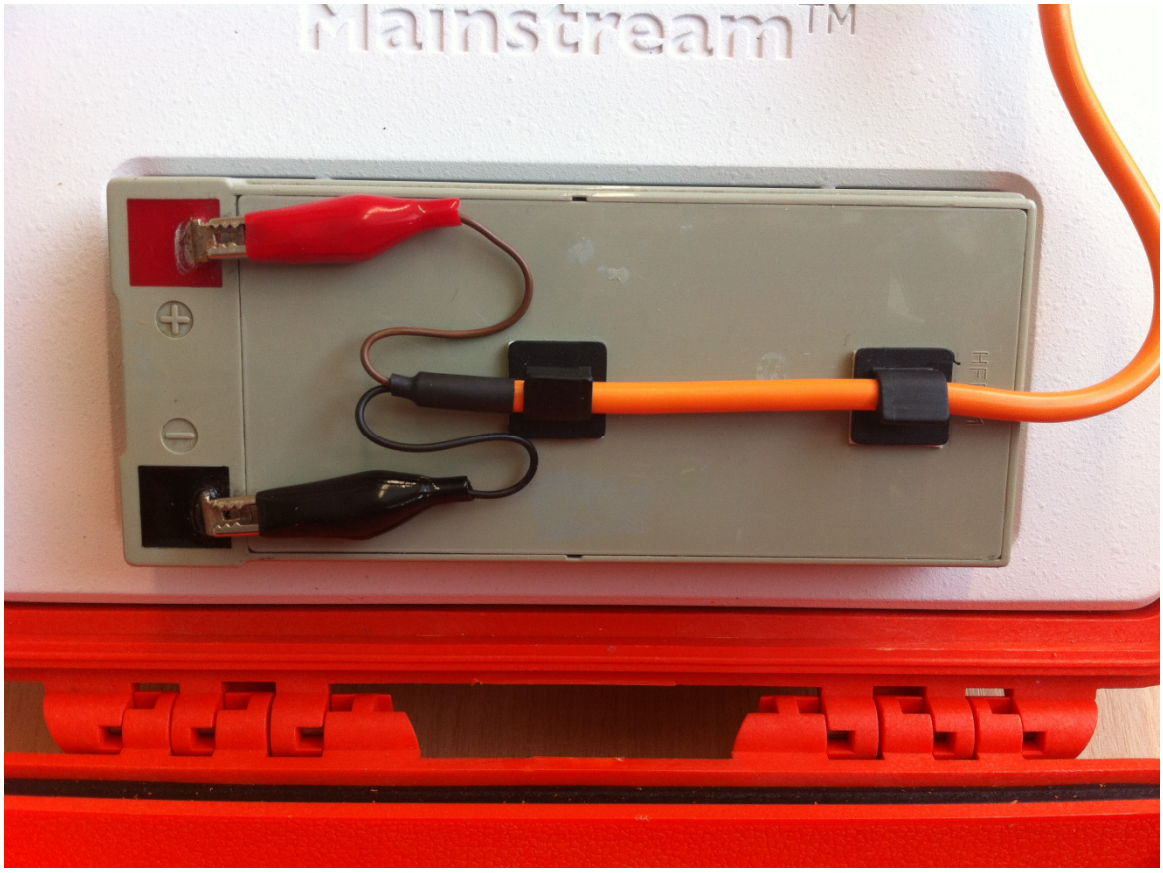
The instrument's internal battery is sealed and removable; therefore it can be changed for recharging.

The battery is connected via crocodile clips, red (+) and black (-) respectively. Position and fit the crocodile cable clips to the battery as shown in the photo.

- Red to Red (+VE Postive)
- Black to Black (-VE Negative)

Affix the cable clips with adhesive backing to the battery

Guide the cable through the cable clips for secure fastening. See the illustration below:



There are 2 types of battery charger available for use with the portable:

- a power supply which can be connected to the **Auxiliary Connector**; this will charge the 12V via circuitry within the Mainstream (maximum 50mA)
- a remote charger where the battery is removed and charged independently of the unit

Using the **Auxiliary Connector** fitting it is possible to connect a 24VDC or 12VDC external fixed power supply.

8 CONFIGURATION SOFTWARE

Mainstream Communicator runs on PC platforms under 2000, XP, Vista, Windows 7 and Windows 8.

Communication between the PC and the Mainstream flowmeter is via a data link using serial or USB. A data cable is supplied with each Mainstream flowmeter.

The Mainstream Communicator software supplies functions to configure the Mainstream flowmeter according to the requirements of the measurement application, to test the flowmeter and associated equipment, to extract diagnostic information for the flowmeter, to view flow measurement data in real time and to retrieve recorded data.

The Velocity Transmitter is pre-configured by the manufacturer.

The Flow Transmitter is pre-configured and calibrated by the manufacturer.

The software and Mainstream User Manual are provided on a USB flash.

8.1 Mainstream Communicator UI Overview

On launch of the software application a horizontal bar appears on the upper part of the monitor, with an active ***Connection*** button, which enables connection to the Mainstream system unit.

The Mainstream Communicator UI is controlled using the button bar in the window located at the top of the PC screen. The control buttons are only enabled when communication with the Mainstream flowmeter system unit is established.

Clicking a control button opens the associated form. A second click closes the form. Clicking the button twice moves an open form to the front.

Each form contains a group of related functions. The individual functions are accessed using tabs on the form. The main functions in each group are as follows -

Connection - this form handles the details of the communication between the Mainstream Communicator UI on your PC and the Mainstream flowmeter system unit hardware.

System Unit - this form identifies the Mainstream flowmeter and the resources it contains. It also provides functions to monitor the system unit power supply and operating status, to start and stop the Mainstream system unit (equivalent to pressing the ON/OFF switch).

Application - this form includes a site data entry for measurement traceability, and tools to define the geometry of the pipe or channel in which the flow is being measured.

Sensors - this form handles the detailed configuration of the Level Sensor and Velocity Sensor that are used to make the flow measurement. It also provides facilities for calibrating the level sensor and diagnostics for the Velocity Sensor.

Measurements - this form displays measurements made. Select the measurement units and number format used to display the measurements.

Data Logger - this form handles configuration of the data logger and management of the files of logged data stored in the Mainstream system unit. Logger configuration functions specify the measurement items to be recorded in the data logger, the default content of retrieved data files, file size configuration, and the action when the data logger memory becomes full. Data logger file manager functions permit the selective retrieval, synchronisation and destruction of data files stored

in the Mainstream. The Data Logger also allows you to synchronise the flowmeter date- time to that of the PC.

Outputs - this form has controls to set the LCD display sequence and to configure how the two switch outputs respond. It also allows for configuration of the 4:20 mA outputs.

Clicking the Refresh button reads information from the Mainstream system unit and displays the information on the form. The previous contents of the form are lost.

Clicking the Apply button transfers the information on the form to the Mainstream system unit. The information previously in the Mainstream system unit is overwritten and destroyed.

8.2 Mainstream Communicator UI - Setting the Time

Mainstream needs to know the date and time so that data in the logger is time-stamped correctly.

The date and time are set using the Mainstream Communicator UI.

Click the Data Logger screen on the UI button bar, and then click the Date-Time tab. This opens the Date-Time form.

The PC and Mainstream date and time are displayed. Clicking the Set Clock button synchronises the Mainstream flowmeter clock to that of the PC.

View the LCD on the Mainstream system unit to check the updated time.

8.3 Mainstream Communicator Software Installation

If the software application has no connectivity with the flowmeter all configuration functionalities will be inactive.

In the route directory of the PC, all relevant folders will be created during the installation.

Installing Mainstream Communicator will not overwrite any previous versions of the software.

The following sub-directories will be created when the functions are used.

C:\Mainstream\Backup – this contains stored Mainstream configuration data. Installing the Mainstream Communicator software may create this directory if it does not exist. Installation will not modify or delete any backup information.

C:\Mainstream\Data – this contains the .CSV data files downloaded from the data logger are stored in the Data subfolder. Additional subfolders are created and named in a cascading fashion automatically with configured information by **Project Name** and **Site Name** in the **Applications\Site Data** menu. The file created following a data download has a .CSV extension and can be opened with any spreadsheet editor.

The name of the data file is automatically created as follows:

Mainstream_AV-flowmeter_C0xxx_100120_095002.CSV

Instrument name: **Mainstream_AV-flowmeter**

Instrument serial number; **C0xxx**

Measurement commencement date (yymmdd) **100120**

Measurement commencement time (hhmmss) **095002**

C:\Mainstream\Archive – this contains information retrieved from the Mainstream flowmeter data logger and held in the form of compressed binary files for processing. Installing the Mainstream Communicator software may create this directory if it does not exist. Installation will not modify or delete any archive files. These files contains an .AV1 extension.

C:\Mainstream\Diagnostics – this contains the comms log file saved in the **Diagnostics** subfolder, and holds a record of all the operations carried out by the operator whilst the instrument was connected, and is displayed in the Connection Diagnostics in the **Local Connection** window when the **Save** button is activated. The file created has a *'log'* extension and can be opened, viewed and saved with a new filename via Windows Notepad.

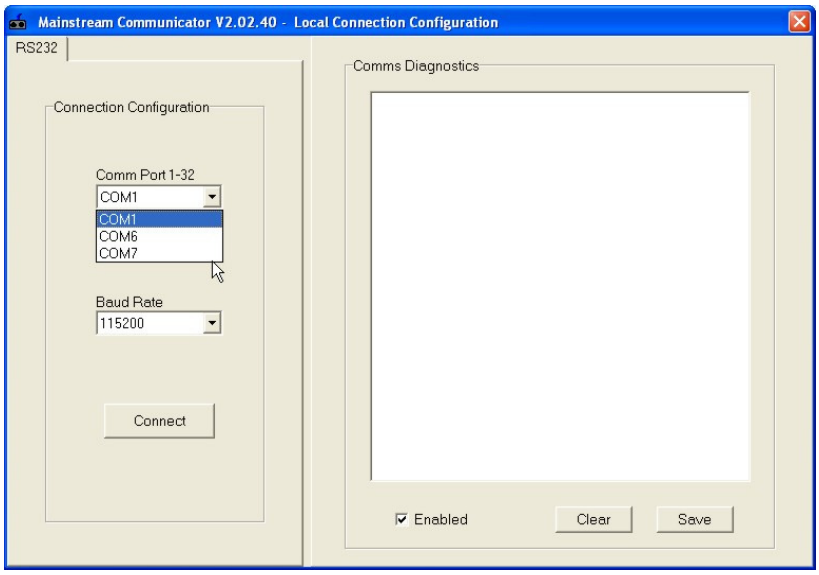
8.4 Mainstream Software Connection

The Mainstream AV-Flowmeter is configured via a serial or USB connection to a PC.

Start the Mainstream Communicator program on the PC.

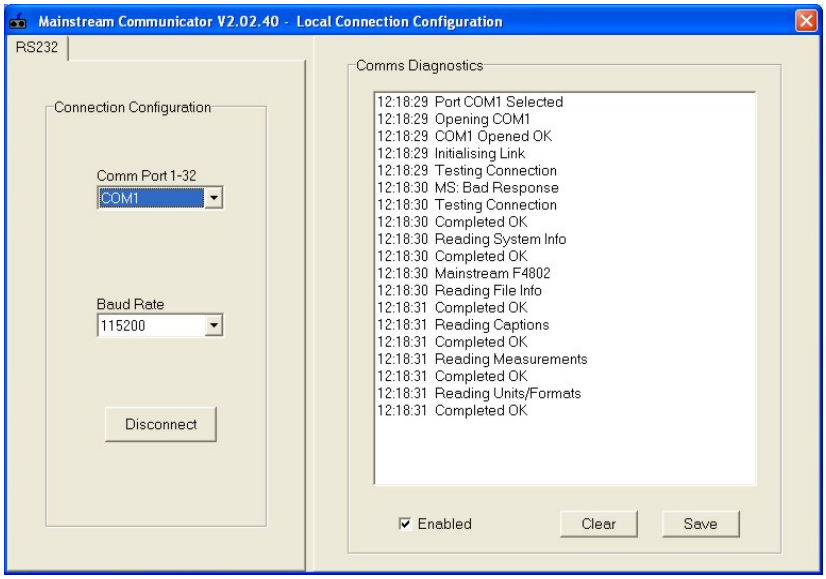
Select the **Connection** button, this will open the window where the appropriate serial port used on the PC (COM1….COM32) must be specified. Choose the correct serial port and select the Connect button. Mainstream Communicator automatically detects the serial ports available on the PC and suggests only those Comm ports from 1 to 32 which are present and not in use by another piece of hardware or application.

The Mainstream baud rate controls the communication speed over the serial port which is enabling the instrument and PC to communicate. This speed can be set to values of 1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600, 115200. The standard serial communication speed with any PC is 115200 baud.



Details relating to the communication in progress between the PC and the Mainstream unit are displayed at the right hand side of the window. The software automatically collects data from the system unit for processing.

It is at this point that the relevant Mainstream Communicator menus are active. This allows instrument configuration setup.



CAUTION: After programming; checking or downloading data it is advisable to disconnect to avoid possible damage to the PC serial port or the Mainstream unit. To do this select the **Disconnect** option on the Connection screen.

There are 6 options available from the main menu when the connection is active. If a menu is selected using the appropriate button, an independent interface window opens:

1. SYSTEM UNIT

Product

Measurands

PSU

Comms

Logger

Outputs
Status

2. APPLICATION
Site Data
Configuration
Pipe/Channel Section

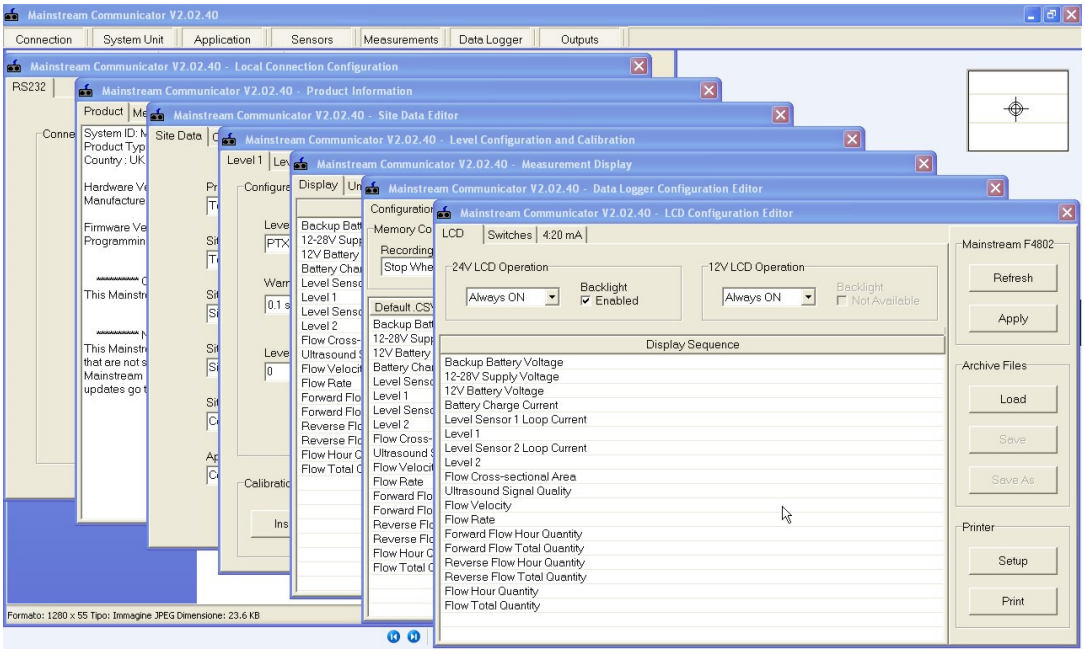
3. SENSORS
Level
Velocity

4. MEASUREMENTS
Display
Unit

5. DATA LOGGER
Configuration
Date-Time
File Manager

6. OUTPUTS
LCD
Switches
4:20mA

Depending upon the instrument in use, not all software options are active and available. The software automatically recognises the hardware performance of the connected system unit at the first connection, and as a result activates those options that can be configured and used.



8.5 System Functions

All pages have a toolbar on the right, which makes it possible to update instrument settings. These functions include:

REFRESH – retrieves current information applicable to the data functionality screen

APPLY - transfers new configuration values edited in the software

LOAD - load previously saved configuration settings

SAVE/SAVE AS

SETUP - setup the default printer setting

PRINT - print the current page

8.5.1 Refresh

The Refresh button calls for communication with the instrument and an update of current instrument settings or readings on the screen. Any application page opened has default values that are updated with instrument information via the Refresh button only.

8.5.2 Apply

When software configuration changes are made, they are not simultaneously and immediately active in the instrument. The changes must be transferred to the Mainstream unit using the Apply button.

8.5.3 Load

This allows previously saved configuration settings to be loaded.

8.5.4 Printer Setup

All pages can be printed to keep a record of instrument programming. The Setup button opens a new dialogue window that allows the selection of the desired PC printer.

8.5.5 Print

The current window containing all relevant information can be printed at any time by selecting the print button.

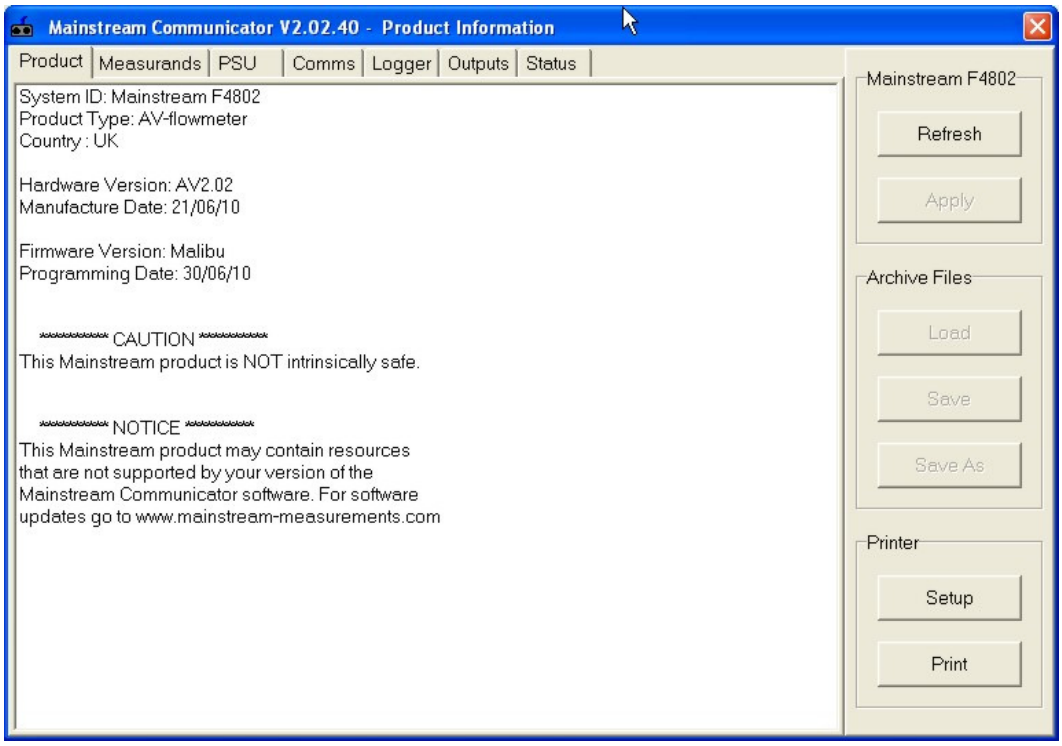
8.6 SYSTEM UNIT

The **System Unit** menu enables access to the following screens which provide all the information relating to the connected Mainstream flowmeter.

- Product
- Measurands
- PSU
- Comms
- Logger
- Outputs
- Status

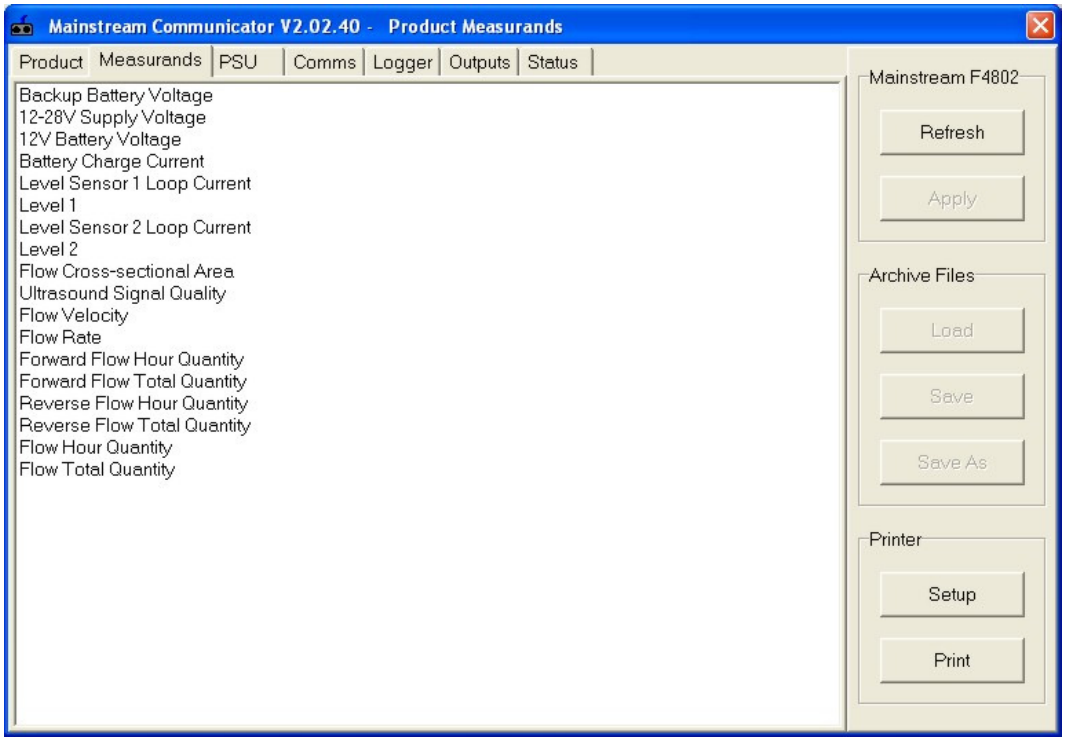
8.6.1 Product

This screen displays the data unique to the Mainstream instrument.



8.6.2 Measurands

This screen describes all the possible measurands available.



8.6.3 PSU

This screen describes all possible power inputs.

8.6.4 Comms

This screen shows communication and denotes all possible baud rates.

8.6.5 Logger

This screen illustrates memory availability and capacity for logging data.

8.6.6 Outputs

This screen opens a further three screens of information describing LCD, Switch and 4:20mA. Each will give data on relative outputs.

8.6.7 Status

This screen describes the current information relating to the power supply. This screen also allows for the unit to be switched on or off.

8.7 APPLICATION

- Site Data
- Configuration
- Pipe/Channel Section

The Mainstream flowmeter is versatile and can be configured to suit a wide range of applications. The configuration process entails loading all the information relating to the specific application into the Mainstream memory.

All configuration details are saved in Mainstream in non-volatile memory areas, so that a loss of power cannot alter or change the configuration. Normal operation resumes automatically when power is restored to the instrument.

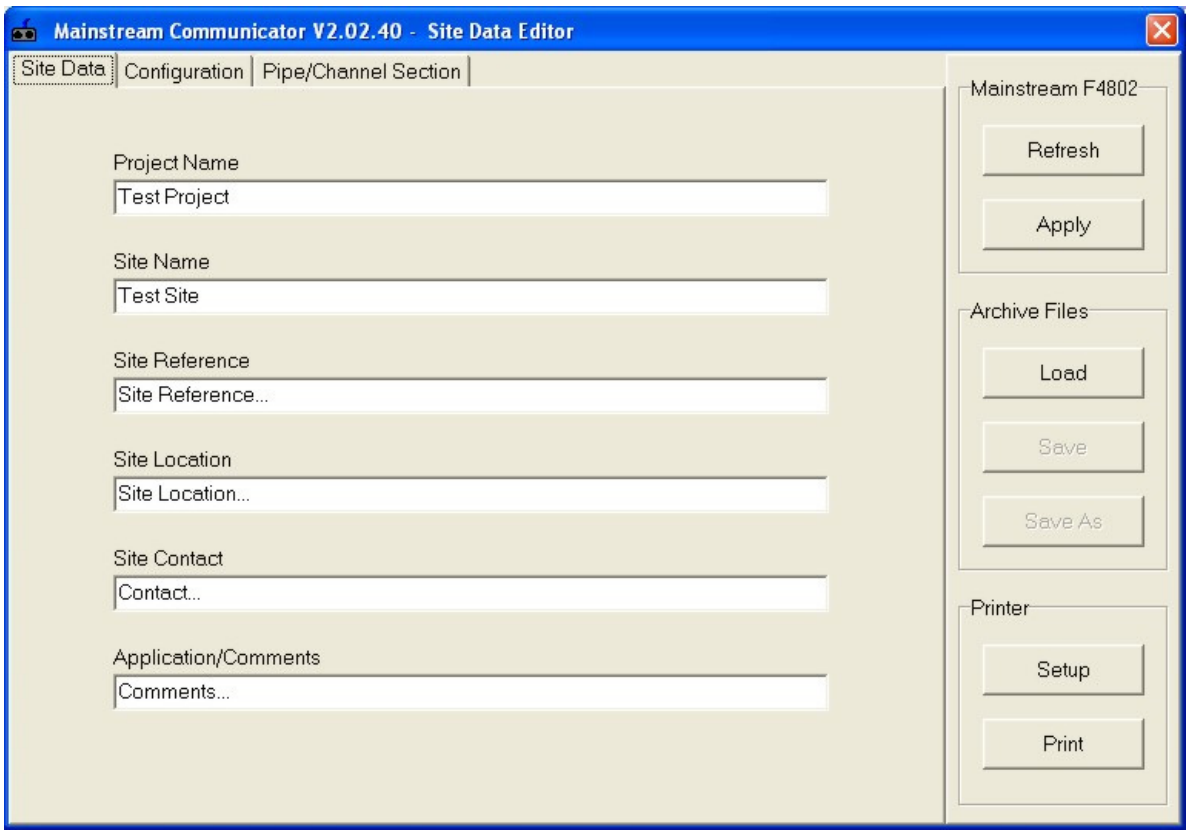
8.7.1 Site Data

On this screen there are information fields that allow the identification of a specific installation. The information inserted into the Site Data page is reported as a folder on all the files downloaded, providing precise location of the measurements logged.

Please note that the **Project Name** and **Site Name** are details that, when downloading data, determine the automatic creation of subfolders in the path:

C: \ Mainstream \ Data \ ….. with the same name as the Project Name and Site Name where the .CSV files will then be stored.

C:\ Mainstream \ Archive \.... with the same name will be replicated as above, where the .AV1 files will be stored.



EXAMPLE: if the Site Data page is compiled as above, Mainstream Communicator creates the following C folders when data is downloaded:

\ Mainstream \ Data \ ***Project Name*** **** ***Site Name***

Data files will be saved in the last folder.

HINT: Whilst the completion of the various fields is not compulsory it can be useful to store relevant notes in the instrument relating to the specific installation; configuration or calibration; and details on how, when, and by whom the instrument was configured.

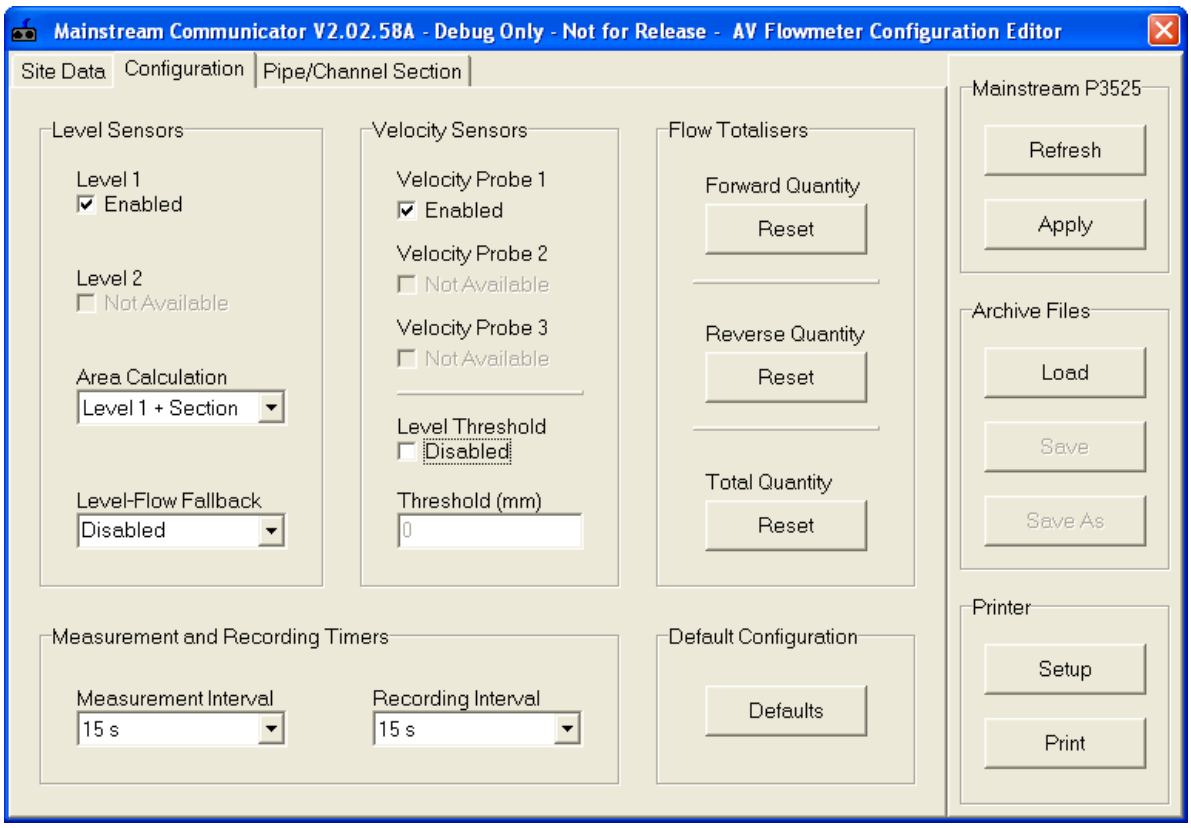
8.7.2 Configuration

This screen provides options for enabling or disabling individual sensors which, as a result, determine the instrument's operating mode.

The **Level/Flow Fallback** option and **Velocity Sensors 2 and 3** are disabled.

Selection of the Area Calculation sensor does not allow changes, unless it is PREMIER Fixed AV-Flowmeter which has two 4:20 mA inputs that can be used for level sensors.

This screen also allows for the totalisers to be reset.



8.7.2.1 Level Sensor

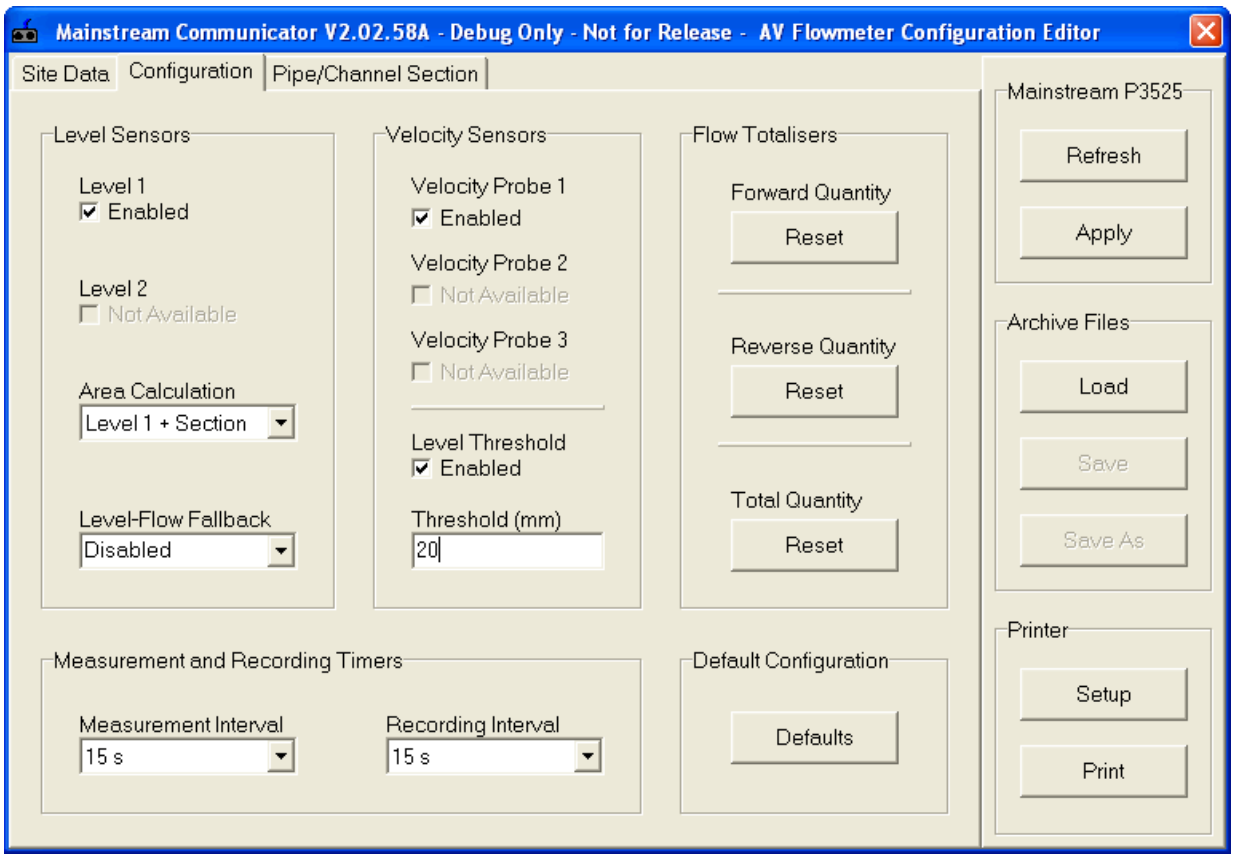
Level 1 corresponds to the level sensor that is included with the Flow Transmitter and the COMPACT Fixed AV-Flowmeter.

If the instrument is only used for velocity measurement, or for flow measurement in full pipes, Level 1 can be **Disabled** and with offset (Level Sensor configuration section).

The measurement procedure for the velocity value only is provided for particular applications where the measurement of only one parameter is required; or where the flow rate is determined on the basis of the variation in velocity only.

In Velocity Only mode, Mainstream operates as a velocity gauge and recorder, and is suitable for applications such as the monitoring of completely full pipe sections, or the study of sewage retention times in sewer systems.

NB: During normal use as an Area-Velocity flowmeter, Level 1 should be **Enabled**, otherwise this will result in a flow value of 0 (zero).

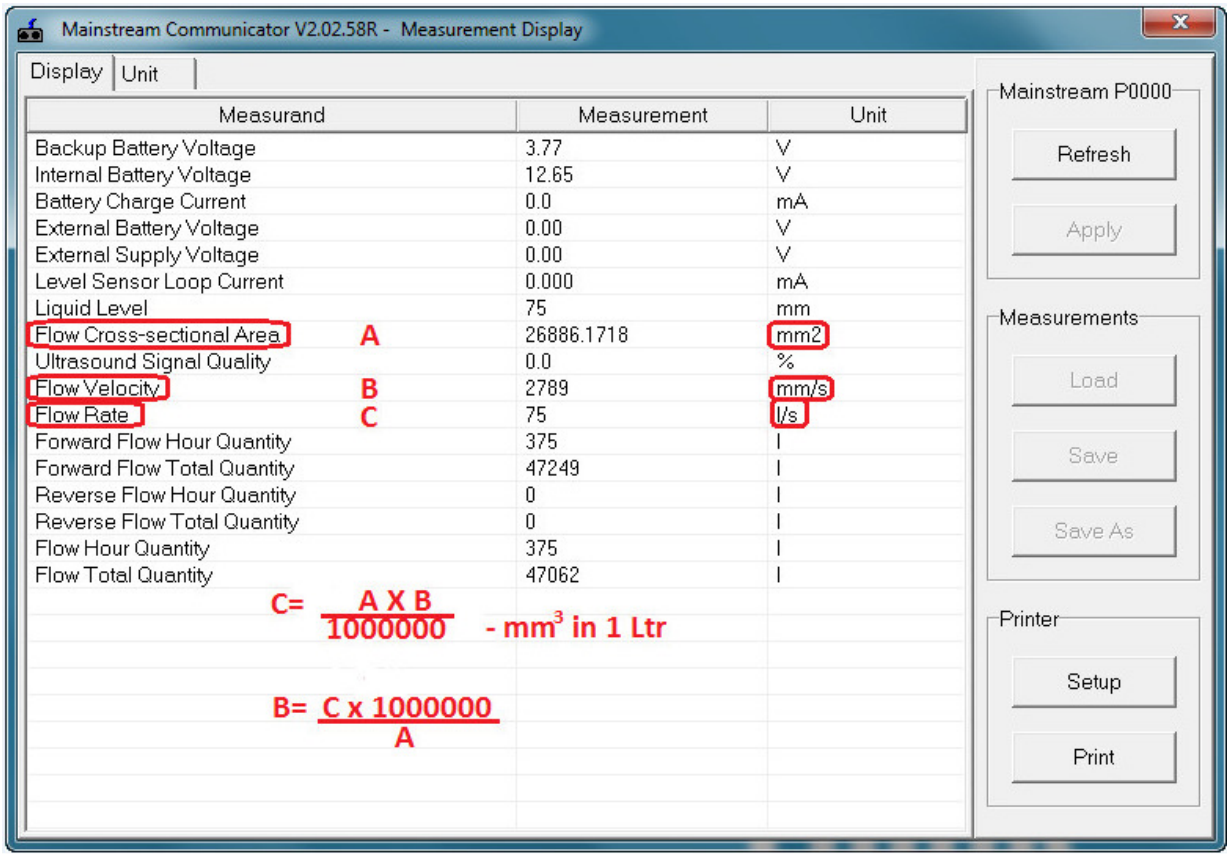


Level Threshold can be disabled.

If the Level Threshold is enabled, for example, level threshold is set at 20mm this sets the table so that the flow show zero. Thus, when the level is above the threshold value, Mainstream operates normally. When the level is below the threshold value, the flow is zero.

8.7.2.2 Level to Flow Fallback

This facility applies when no velocity sensor is connected. The level reading refers to an integrated table and calculates a flow rate. See the diagram below with details of the calculation.



8.7.2.3 Velocity Sensors

Velocity Sensor 1 corresponds to the sensor generally provided with all instruments.

If the instrument is only used for level measurement, Velocity Sensor 1 can be **Disabled.** The instrument will not perform any velocity measurement and electrical power consumption is minimised.

The measurement procedure for just the Velocity value is provided for particular applications where the measurement of only one parameter is required. In Level Only mode Mainstream operates as a level gauge and recorder for use in applications such as river monitoring.

NB: During normal use as an Area-Velocity flowmeter, Velocity Sensor 1 should be **Enabled,** otherwise this will result in a flow value of 0 (zero).

8.7.2.4 Measurement and Recording Timers

The measurement interval is the time period between one measurement and the next. This value can be programmed continuously, or at intervals of 2.5, 5, 10, 15, 20, 30 seconds or 1, 2, 3, 5, 6, 10, 12, 15, 20, 30 minutes and 1 hour. For recording purposes the minimum interval is 15 seconds up to one hour.

Where the power supply comes from the grid, most Mainstream fixed AV-flowmeter installations' measurement interval is generally set at 2 minutes.

An ongoing measurement interval (continuous) means that measurements are taken without an interval i.e. when one measurement has been processed the next one starts.

Operation with different measurement intervals is useful and advisable in cases where it is important to save energy or limit power consumption. In the case of a battery power supply, for example, where the instrument is in sleep mode between one measurement and another, this minimises power consumption. Incrementing the measurement interval uses more power, however a lower response to flow velocity variations is obtained.

NB: Variation in the measurement interval can also involve automatic variation in the logging interval, as logging must always be equal to or greater than the measurement interval.

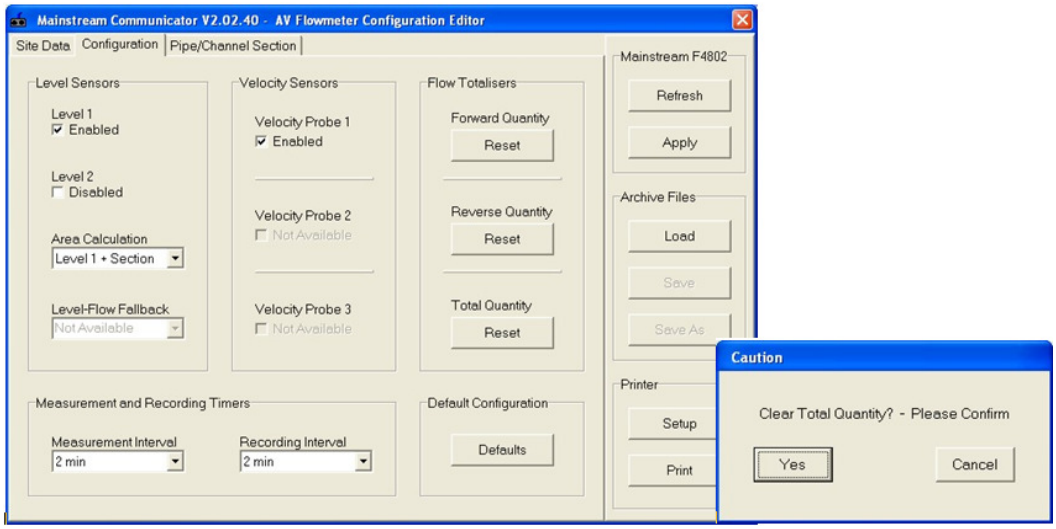
8.7.2.5 Flow Totalisers

Mainstream flowmeters have independent totalling facilities:

- Forward/reverse flow hour quantity
- Forward/reverse flow total quantity
- Flow hour quantity
- Flow total quantity

Totals can be reset using the Reset buttons, which are distinct and independent for totals relating to Forward, Reverse and Total quantity.

Use of the reset opens a pop-up window requesting confirmation of action.



8.7.2.6 Pipe/Channel Section

The geometry and dimensions of the pipe or channel are entered using the Mainstream Communicator software supplied with the flowmeter.

The simplest input procedure involves selecting a standard pipe or channel cross-section and filling in table of the relevant dimensions.

For non-standard pipes or channels, the cross-section may be defined explicitly as a level-to-area conversion table. Data for the conversion table may be entered directly by the user, or read from .CSV spreadsheet created by the user.

Alternatively, the cross-section data can be entered as a drawing of the pipe or channel using the Mainstream Communicator drawing tool.

Regardless of the method of data entry, the raw data is stored in non-volatile memory in the Mainstream system unit, and the cross-section definition is automatically converted into a level-to-area conversion table that is also stored in the flowmeter. This table may contain up to 120 points.

Liquid level measurements are converted into cross-sectional area values by reference to this stored level-to-area conversion table.

On the **Standard Sections** screen the application has an intuitive graphical interface for selecting and sizing standard shapes. Shapes are split under the **Installation** option into:

- Full Pipe
- Partially Full Pipe
- Open Channel

The open channel allows additional choices under the **Section** option, which are:

- Rectangular
- Trapezoidal
- Semi-Circular

Using the **Units of Measurement** and **Format** options, it is possible to choose the dimensional units of measurement and the number of decimal points required.

It is sufficient to select the correct shape and enter the relevant dimensional parameters.

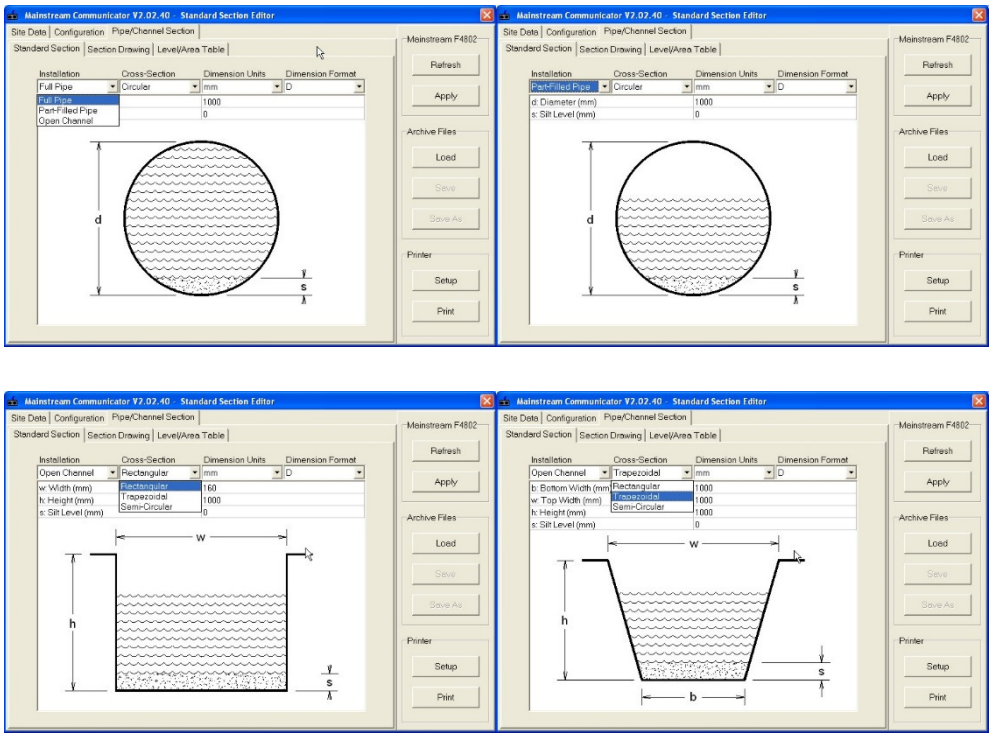
8.7.2.7 Silt Level and Area Correction

The area of the pipe or channel carrying the flow is reduced when silt is accumulated.

Each method of entering the description of the pipe or channel cross-section also contains an option to enter a user defined silt level. Mainstream uses this silt level to correct the flow cross-sectional area calculation.

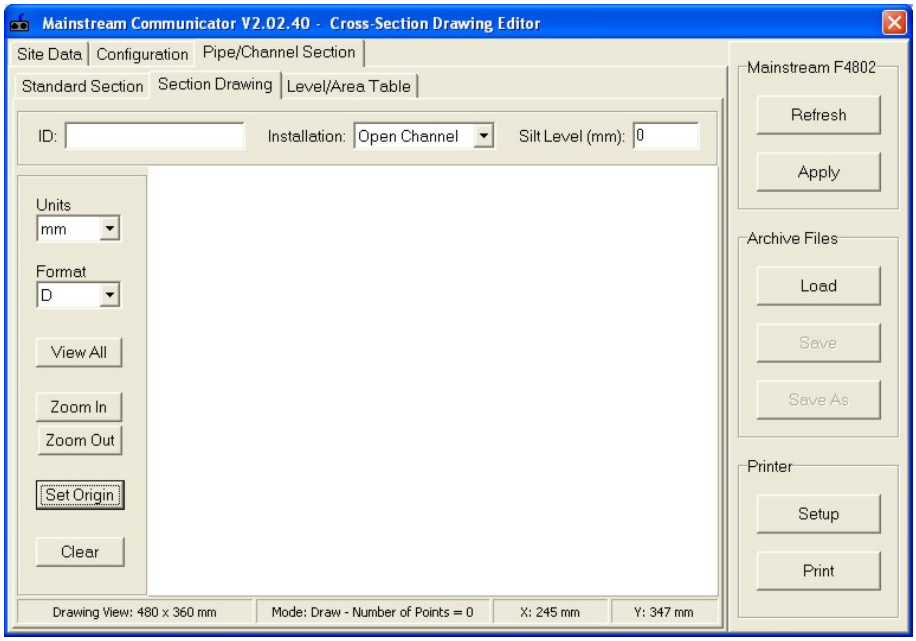
When the liquid level is less than the silt level, the flow cross-sectional area is zero.

When the liquid level is greater than the silt level, the flow cross-sectional area is equal to the area of the pipe or channel cross-section, minus the cross-sectional area of the silt.



When graphical and dimensional configuration has been carried out, the **Apply** button should be selected to transmit the pipe/channel configuration to the flowmeter, which the software generates.

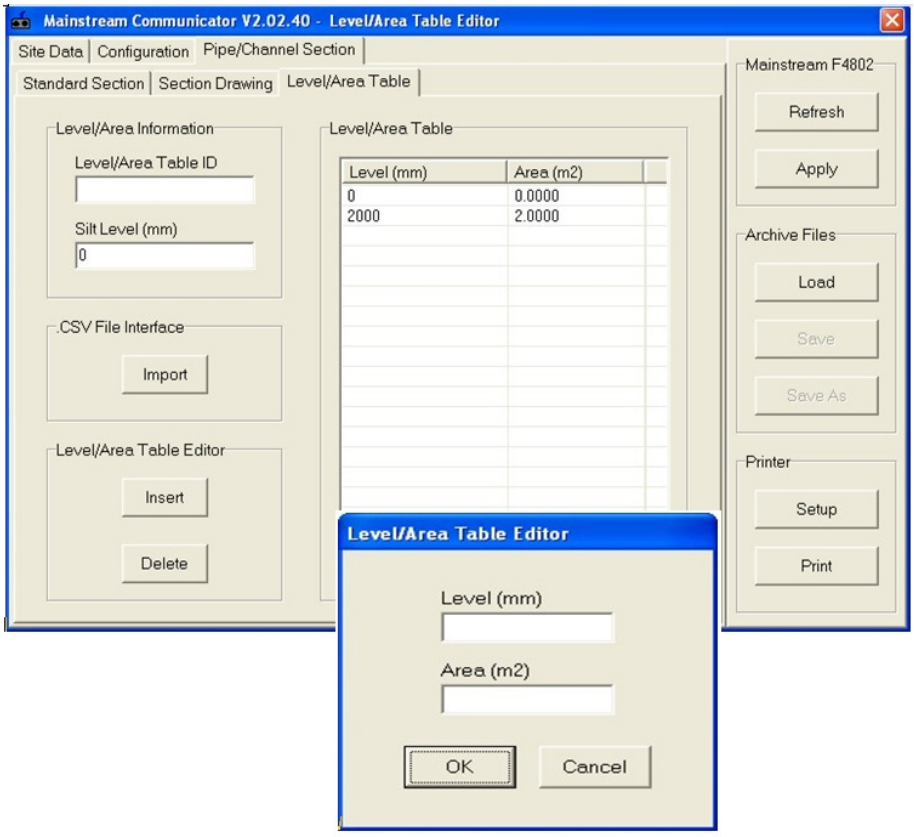
Previous configurations that have been stored in the flowmeter may be recovered by selecting the **Load** option.



There is a facility to draw a freehand sectional drawing for irregularly shape channel sections, where none of the preconfigured sections meets the user's requirements.

For further information please refer to Case Studies at www.mainstream-measurements.com.

An additional option for certain cases where it is necessary to configure the AV-Flowmeter for irregularly shaped measurement sections, is available on the **Level/Area Table** page.



Level/Area Table Editor permits the generation of a table directly in the Mainstream Communicator software. By selecting the **Insert** button a pop-up window opens where it is possible to enter **Level values in mm** and the corresponding **Area in m².**

Every pair of values inserted is transferred into the table displayed on the page.

By clicking any row in the table, and using the **Remove** button, it is possible to remove individual values from the generated table.

When the table has been completed the **Apply** button should be selected to transmit the pipe/channel configuration to the instrument, which the software generates automatically.

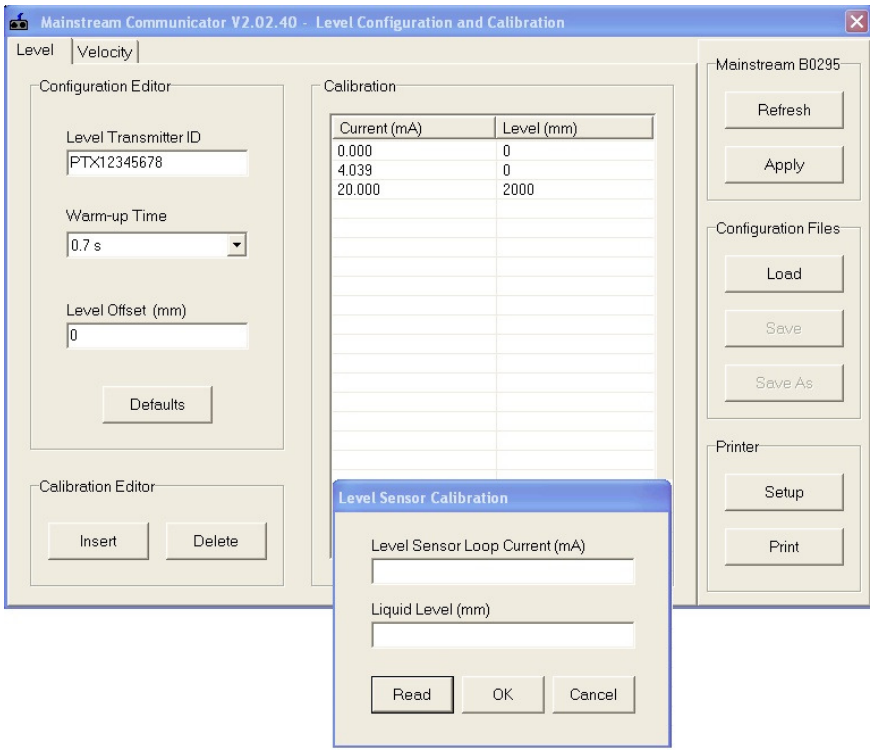
The configuration previously stored and present in the flowmeter is retrieved with the **Load** button.

A Level to Area table can also be generated using a spreadsheet and imported in to the flowmeter using the **Import** button.

NB: The maximum number of pipe/channel configurations permitted in a table is 99 rows.

8.8 SENSORS

There are two pages for the configuration and calibration of the Level Sensor and velocity sensor.



8.8.1 Level

On the Level screen it is possible to configure the transmitter warm-up time and any measurement offset value, and to calibrate the transmitter used.

Level Sensor ID denotes the model and serial number relating to the Level Sensor used and can be stored in the window.

Warm-up Time allows for the Level Sensor to stabilise before taking a reading. With a standard piezoresistive immersion Level Sensor the default value is 0.7 seconds.

A short warm-up time saves energy but also requires a rapid response from the Level Sensor. The default values refer to pressure transmitters in the PTX 1730 series.

Level offset is a value defined by the user and is added to the level measured by the sensor. This allows for compensation for an installation imperfection. For example it may be necessary to install the sensor at a higher or lower level with respect to effective zero of the pipe or channel. This level can be integrated into the software and defined the **Level Offset**.

The offset value can be positive or negative. Mainstream detects the level measured by the Level Sensor, adding or subtracting the offset value to obtain the actual liquid head.

A positive offset value can be used if the base of the structure is not suitable for the correct or reliable installation of the level sensor. For example it should therefore be positioned at a higher level, or the assembly structure requires an offset value to be used.

A negative offset value can be used when the sensor is positioned lower than the effective detection point, for example when dealing with a weir crest.

Defaults resets the **Warm-up** and **Offset** values relating to normal manufacturer's settings, which are generally suited to most applications.

NB: The Defaults button reports the value for warm-up time at standard values suitable for standard piezoresistive transmitters.

Calibration displays a table of calibration data which links the data from the level signal analog to digital conversion processing in the Mainstream system unit to the level measurement. The function also provides the means to delete old calibration points and insert new calibration data in to the table.

Mainstream performs a linear interpolation between the various stored calibration points, to re-establish the measurements acquired over the entire scale of the Level Sensor.

When using a pressure transmitter it is appropriate to check the calibration every six months minimum, in order to recalibrate as a function of the normal deviation of the transmitter itself.

Calibration is normally performed by checking each previously stored value, or by taking a series of readings over the instrument operating scale. In the event of a reading which differs from the stored calibration value, it will be necessary to proceed with a calibration correction.

Calibration is performed, regardless of the type of transmitter used, by simulating the level measurement over very precise reading values.

With the Level Sensor placed to read a determined value, and after verification, select the **Insert** option.

A new dialogue window opens that allows Mainstream to read the current value received over the Level Sensor loop and assign it an exact liquid level expressed in millimetres. The exact level value in millimetres should be entered into the Liquid Level (mm) field.

When you select **OK** a new calibration point is added to the table with the exact reference points of the entered level and acquired corresponding loop current.

Using the **Remove** button it is possible to remove individual calibration values that might be obsolete or incorrect.

It is always appropriate, regardless of the Level Sensor used, for there to be at least two points corresponding to zero in the calibration table; and one point at 20 mA.

After completing a significant number of calibration points, the new calibration table can only be transferred to Mainstream and become operational by selecting **Apply**.

NB: The number of calibration points entered must not exceed 23.

8.8.2 Velocity

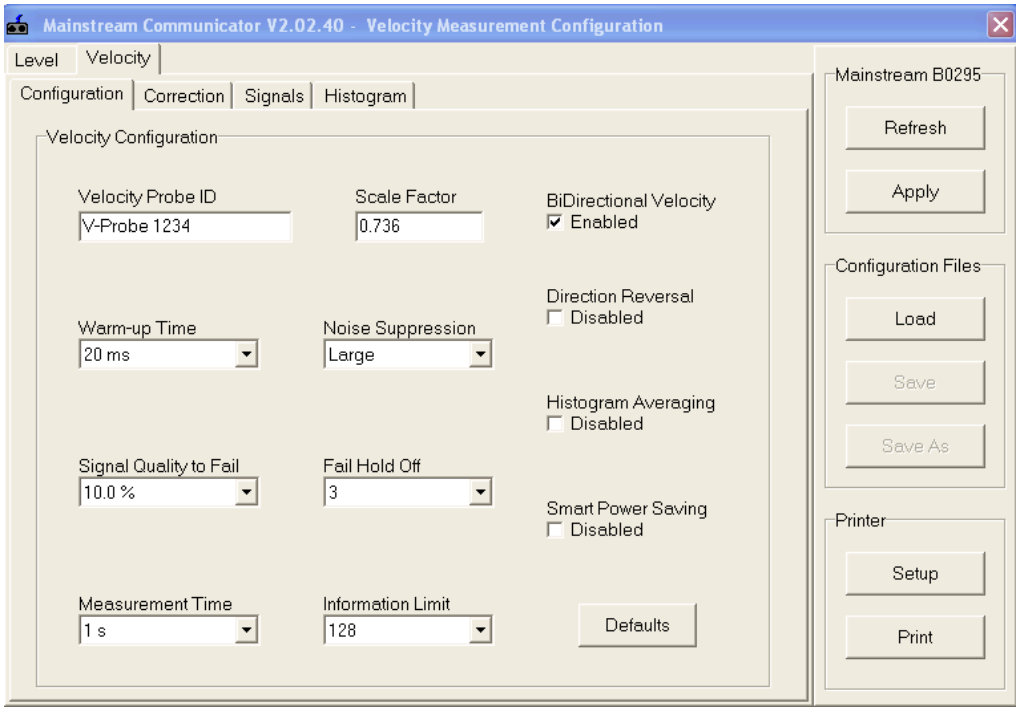
In the **Velocity** sub menu there are 4 screens to enable the setting of a series of advanced parameters relating to the velocity measurement; the programming of velocity and flow rate measurement correction coefficients. These can be useful for solving measurement issues in extreme hydraulic conditions. Also available are the display of transmitted and received ultrasound signals, and the velocity histogram generated, in order to understand the existing measurements and water conditions.

-

8.8.2.1 Configuration

In most applications the default values already configured by the manufacturer are suitable for correct velocity measurement.

The change in the various parameters described below is generally reserved for expert personnel, who are qualified to interpret particular water conditions and consequently adapt measurement configuration to the existing field situation.



Scale Factor translates the Doppler frequency data generated by the Enhanced Phase Coherence Processing algorithm in the flow velocity. The probe scale factor is fixed at manufacture. The normal probe scale factor is 0.736 (mm/S)/Hz.

For applications with particular hydraulic conditions the default value could be changed on the basis of the actual field situation

Warm-up Time is the time required for the velocity sensor to acquire a reliable measurement from the time at which it is powered. The default value is 20 ms.

Noise suppression allows for optimisation of flowmeter performance as the phase coherence advanced technology uses a filter to suppress interference. The default value is Medium, but can be varied in five steps to suit particular hydraulic conditions, from Very Low to Very High.

Signal Quality to Fail is the minimum quality of the velocity sensor ultrasound signal value below which the measurement itself is not considered reliable. The default value is generally fixed at 10%. When signal quality falls lower than the minimum value set, and the reading value is repeated consecutively for the number of times set in the Fail Hold Off Error parameter; Mainstream indicates and logs the velocity value as equal to zero. Minimum quality can be set from 1% up to 50% in eight different stepped values.

Fail Hold Off is a parameter that allows the filtering of 1 to 5 consecutive error situations to exceed the minimum signal quality threshold.

Measurement time represents the time allowed for the instrument to process a velocity measurement. The default value is equivalent to 1 second but it can be reduced to 100 ms or incremented up to 10 seconds where there are particularly demanding measuring situations.

Information limit defines the quantity of data processed to re-establish each velocity measurement. The default value is 128, but can be varied from 64 to 2048. The increase in this value improves

measurement reproducibility but there is a slower response to flow variations and increased energy consumption. By reducing the default value, the response to flow variations is quicker and less energy is consumed, but measurement reproducibility is reduced.

Bi-directional Velocity can be **Enabled** or **Disabled** without distinction. It is **Enabled** under normal conditions of use. By disabling the bi-directional velocity measurement, the measurement will always have a positive value, regardless of the actual direction of flow.

Direction Reversal can be useful for avoiding changes to electrical connections if the velocity sensor is fitted in flow. Measuring velocity with the sensor in the same direction as water flow will produce a negative default measurement. Enabling the reverse direction reverses the positive and negative direction measured. It is **Disabled** under normal conditions of use.

Histogram Average can be **Enabled** or **Disabled** without distinction. It is **Disabled** under normal conditions of use. If the histogram average is **Disabled**, every reading is processed independently and corresponds to the measurement taken in the interval which has passed since the previous measurement. When the histogram average is **Enabled**, some information relating to previous measurements is used to process the new one.

Smart Power Saving can be **Enabled** or **Disabled** without distinction. It is **Disabled** under normal conditions of use. Enabling this option can be useful when the instrument is powered by a battery; takes measurements over long intervals; or when velocity variations are expected in the water flow. In this case all the information used to determine flow velocity is acquired in a brief period before the reading interval is selected. After processing the measurement the system unit goes into sleep mode until the next measurement. When this function is Enabled the information used to determine flow velocity is acquired without any interruption during the reading interval, and in this case the velocity histogram represents the velocity average over the entire interval period between one reading and the next. Measurement time for high flow velocities or high signal quality is reduced, whereas measurement time for low velocities or low signal quality is increased. This intelligent use of power ensures consistent measurement performance over all flow conditions, and delivers increased battery life.

Defaults reset all values relating to normal manufacturer settings, which are generally suited to most applications.

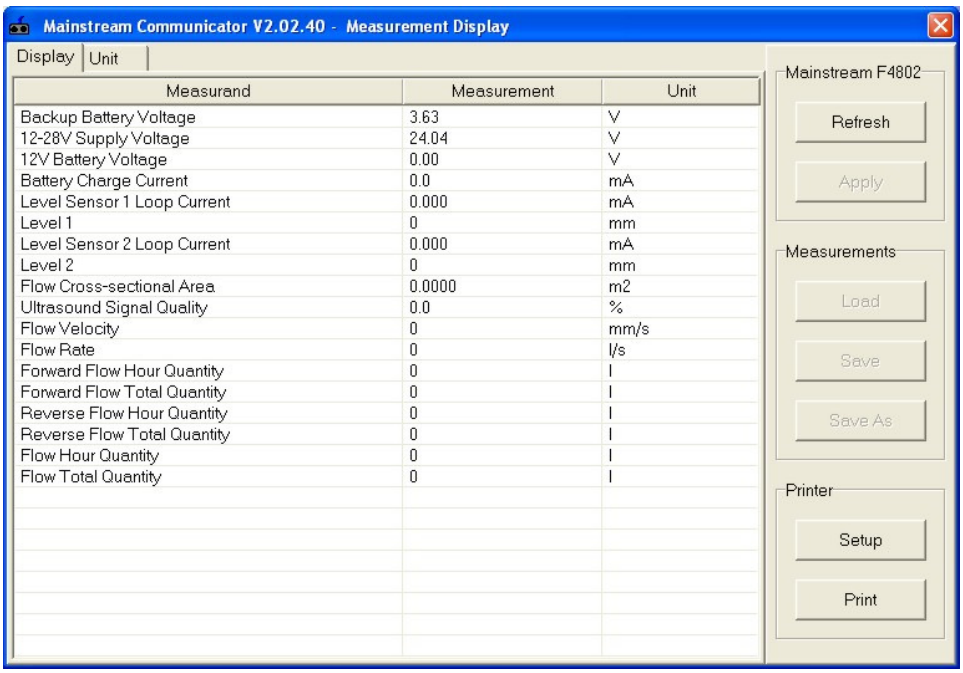
8.9 MEASUREMENTS

There are two screens in the Measurements section; Display and Units. They are dedicated to the instantaneous display of all measurements taken and processed by the instrument, in addition to the desired scientific units and the relevant number of decimals.

8.9.1 Display

The **Display** screen displays all the measurements taken and processed by the instrument simultaneously, in real time.

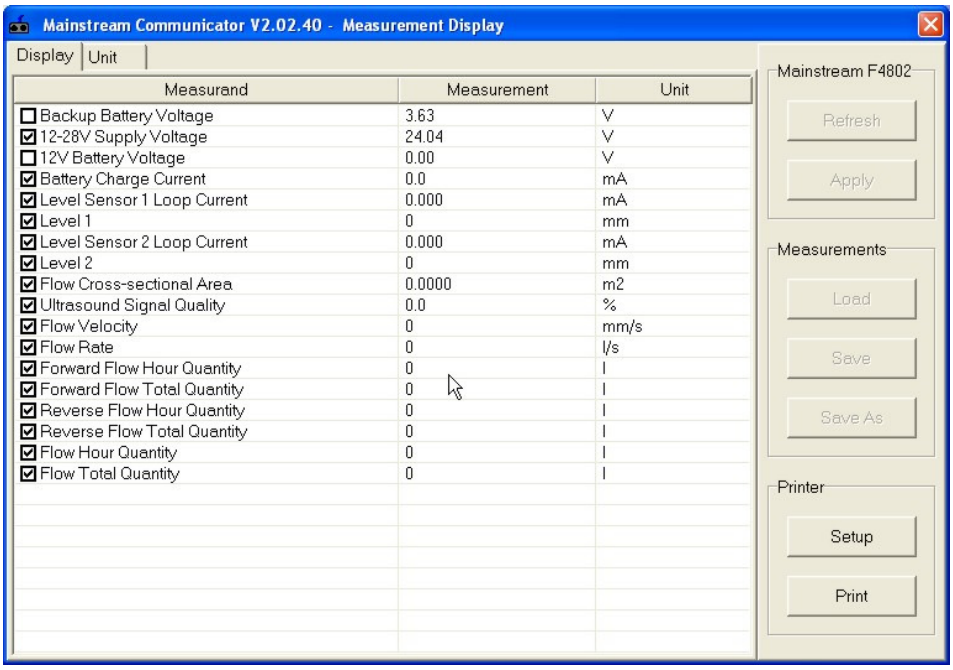
Depending upon the characteristics of the instrument in use, the parameters outlined below for example can all be present or only partially present. With active measurements it is also possible to enable or disable the display depending on user preferences.



Selecting the header bar **Measurand** highlights checked or unchecked parameters.

Selecting individual tick boxes enables or disables the display of parameters. If a parameter is checked it will be displayed, if unchecked it will not be displayed. This allows for customisation of the display screen.

Clicking the header bar labelled **Measurand** again causes the symbols to disappear and only the checked measurements remain active.



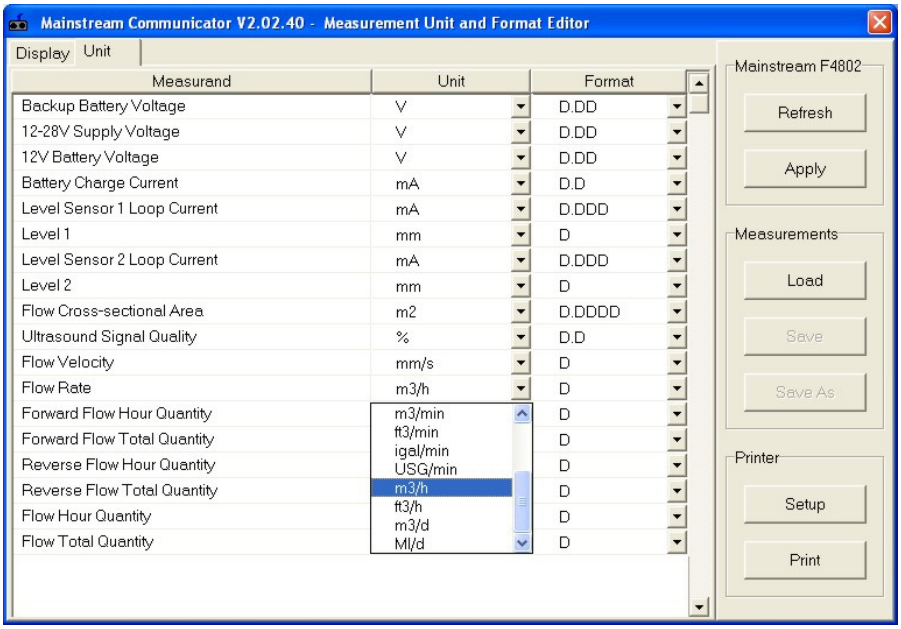
NB: Once the required variations are introduced, the new settings are transferred to the flowmeter and become operational using the **Apply** option.

8.9.2 Units of Measurement

This screen enables the configuration of the **Units** of measurement and the **Format** of each measurement in terms of number of decimal places.

The button with the downward arrow to the right of each unit of measurement and format opens a new pull-down menu containing the alternative measurement options available for selection.

The scientific units and number of decimal places selected and configured are used for all instrument functionalities, including display visualisation where provided, and in the event of a change the conversion is performed automatically.



NB: Once the required variations are selected, the new settings become active on selecting the ***Apply*** option.

8.10 DATA LOGGER

There are three pages in the ***Data Logger*** section

- Configuration
- Date-Time
- File Manager

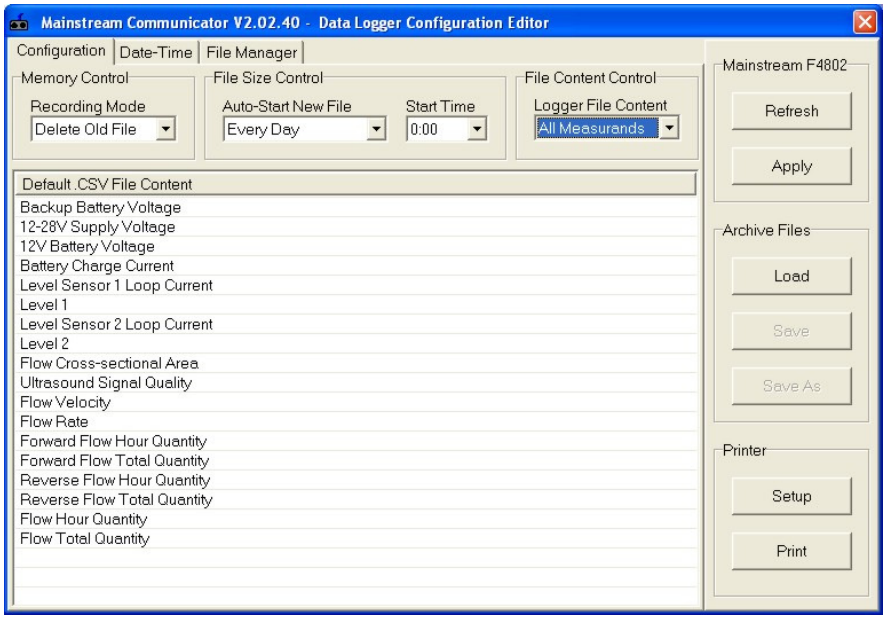
These are dedicated to the configuration of the parameters to be logged; related procedures, synchronisation of the instrument clock with the PC, and the download of logged data.

8.10.1 Configuration

This screen has some options relating to data logger operating modes, which are described individually below.

Recording Mode is enabled by selecting the arrow for a drop down screen. Two options are available for managing the data logger memory:

- *Stop When Full* – this option stops logging so that older data is not lost
- *Delete Old File* – continues logging when the data logger is full (i.e. available memory is full) by overwriting the older data which in turn is automatically deleted



Auto-Start New File is enabled by selecting the arrow for drop down screen. Four options are available for selection depending upon operator requirements and preferences:

- *Never* - this option creates a unique file which is not interrupted other than when there is a loss of power or different instrument configuration. **This option is not normally used.**
- *When Record Count* **-** makes it possible to define the size of the file by the number of logged measurements, with a choice of seven options ranging from 1000 to 64000.
- *Every Day* generates a new data file daily at a set time; this is certainly the simplest solution for searching for data relating to specific days or short periods.
- *Every Month* generates a new data file on the first day of each month.

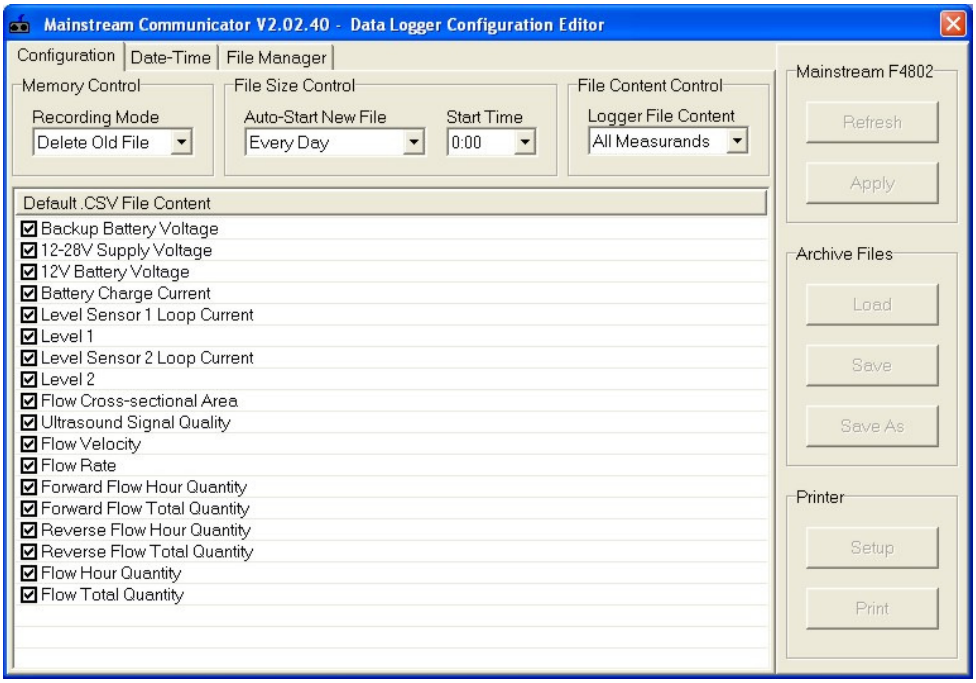
Every data file has a description that contains the main information regarding the data contained i.e. site and project name, measurement date, start and end time, and file size.

Select the required parameters and **Apply**. The new settings are transferred to Mainstream and become operational.

Logger File Content provides two options that outline which information is stored in the data logger:

- .CSV Data Only - this data logs the measurements relating to only those parameters chosen by the operator.
- All Measurands - the values for all measurements taken by the instrument are automatically logged.

The parameters to be logged can be selected by clicking on the header bar **Default .CSV File Content**. Checked or unchecked symbols become active to the right of each measurement that the instrument is scheduled to take or process.



Selecting the tick boxes enables or disables the logging of parameters; if a parameter is checked it will be logged, if it is unchecked the parameter will not be included in logged data.

Logging can be customised to include only measurements of interest.

By selecting the header bar **Default .CSV File Content** again, hides the tick boxes and only the checked measurements remain active.

8.10.2 Date/Time

Mainstream AV-Flowmeter has an internal clock operating in real time. The clock is used to:

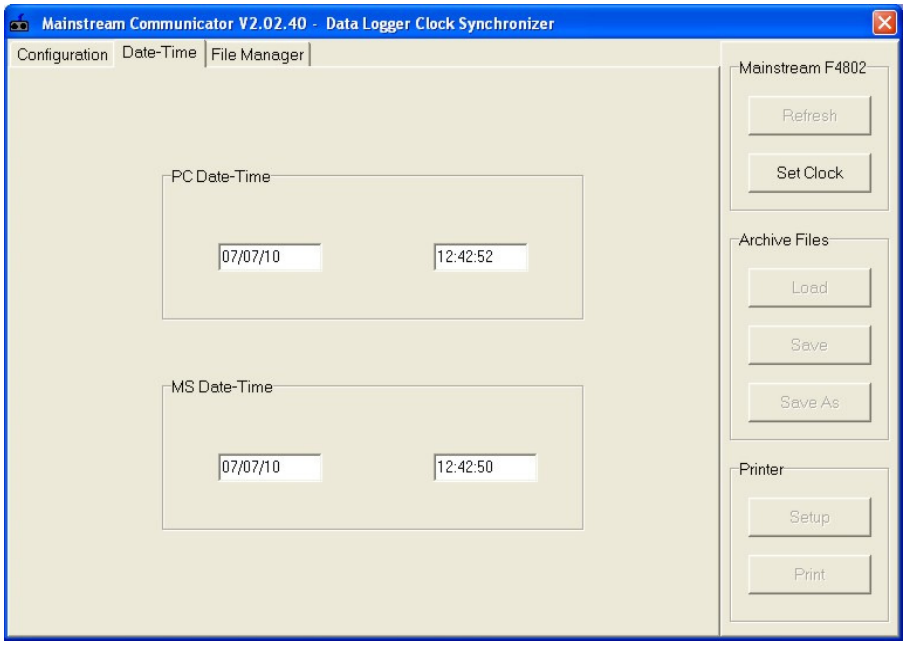
- calculate hourly totals
- check time measurements, such as pulse outputs proportional to flow
- provide correct references to data logged in the data logger and the relevant transfer to memory.

The **Date/Time** screen displays the PC and flowmeter date and time simultaneously. The **Set Clock** button synchronises the flowmeter calendar and clock to the PC values.

This facility makes it possible to update multiple flowmeter units at the same time, using the PC as a synchronous stopwatch.

CAUTION: If fully charged, a backup battery in the instrument makes it possible to keep the clock up-to-date for at least 48 hours in the event of a power failure. If the instrument is without power for longer periods it may be necessary to synchronise the clock again.

NB: To fully charge the backup battery, Mainstream must be powered continuously at 24V or 12V for at least 24 hours.

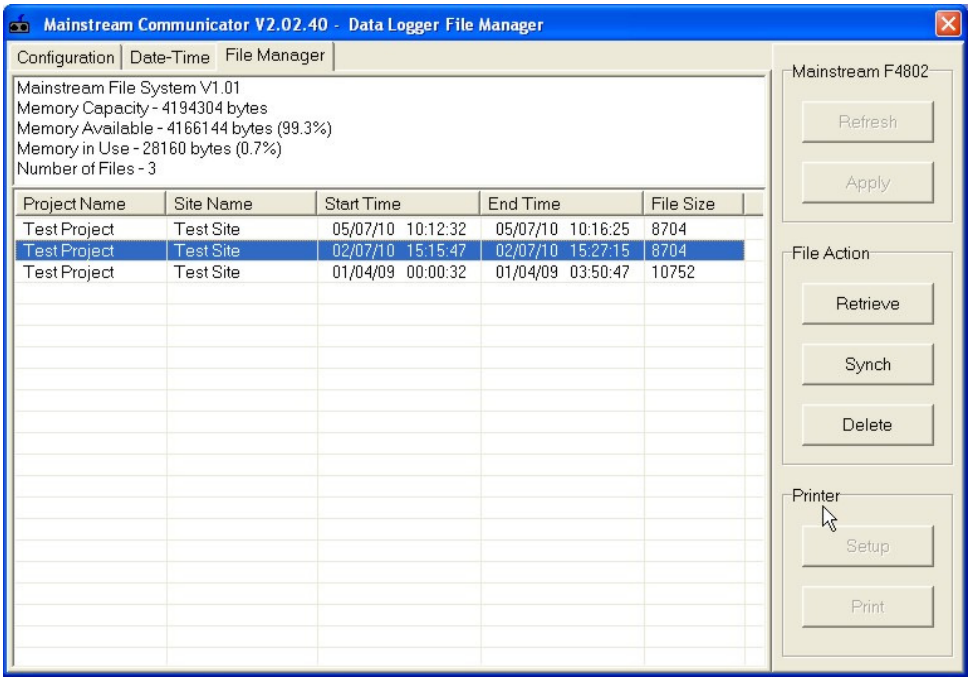


8.10.3 File Manager

This screen displays all files in the data logger memory. It is possible to retrieve the full data logger memory i.e. all logged files, or download each individual file required.

An additional option is synchronisation that only updates the PC with data logger details that are not on the PC hard disk.

All files have the Project Name and Site Name, in addition to measurement start and end dates, and file size.



Data downloads - clicking any file in the list, activates buttons relating to **File Action**. These options include **Retrieve**, **Synch** and **Delete** of individual files or file groups selected.

The data files required can be selected using the **Retrieve** option, and transferred from the flowmeter. Once downloaded the data is decompressed and transferred into a text file (*.CSV), which is compatible with most spreadsheets. The compressed data is deleted simultaneously.

The *.CSV text file is always created in the following directory:

C:\Mainstream\Data**Project Name****Site Name** and is called

Mainstream_AV-flowmeter_Xxxxx_FileStartDate_ FileStartTime.CSV where Xxxxx represents the serial number of the Mainstream unit which created the file.

Archive files will be stored under the **Archive** directory in a similar format. These files have a **.AV1 extension** and may be required by the manufacturer for fault analysis.

If the C:\Mainstream\Data directory is not present on the PC it will be created automatically by the application when the data is first downloaded.

Data files can be opened directly in Excel, or with other spreadsheet applications.

NB: To obtain automatic separation in data columns, a comma (,) must be set as a **list separator**.

Opening the Mainstream AV-Flowmeter. Xxxxx.CSV file in Excel obtains the information outlined in the example below.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Original File Name :		c:\Mainstream\Data\Project Name P000\Site Name P000\Mainstream_AV-flowmeter_P0000_121109_111057.CSV																	
2																				
3	Project Name :		Project Name P000																	
4	Site Name :		Site Name P000																	
5	Site Reference :		Site Reference P000																	
6	Site Location :		Site Location P000																	
7	Site Contact :		Site Contact P000																	
8	Comments :		Application Comments P000																	
9																				
10	Product Type: :		AV-flowmeter																	
11	Product ID :		Mainstream P0000																	
12																				
13	Level Sensor ID :		PTX12345678																	
14	Velocity Sensor ID :		V-Probe 1234																	
15																				
16	Installation :		Circular Pipe (Part-Filled)																	
17	Diameter :		1000 mm																	
18	Silt Level :		0 mm																	
19																				
20																				
21	Date	Time	Backup Ba	Internal Ba	Battery Ch	External B	External S	Level Sens	Liquid Leve	Flow Cross	Ultrasound	Flow Veloc	Flow Rate	Forward Fl	Forward Fl	Reverse Fl	Reverse Fl	Flow Hour	Flow Total	Quantity
22	dd/mm/yy	hh:mm:ss	V	V	mA	V	V	mA	mm	m2	%	mm/s	l/s	l	l	l	l	l	l	
23																				
24	09/11/2012	11:11:00	3.49	12.29	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	
25	09/11/2012	11:11:15	3.46	12.29	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	
26	09/11/2012	11:11:30	3.41	12.29	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	
27	09/11/2012	11:11:45	3.82	12.26	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	
28	09/11/2012	11:12:00	3.87	12.28	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	
29	09/11/2012	11:12:15	3.79	12.29	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	
30	09/11/2012	11:12:30	3.7	12.29	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	
31	09/11/2012	11:12:45	3.64	12.29	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	
32	09/11/2012	11:13:00	3.59	12.29	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	
33	09/11/2012	11:13:15	3.54	12.29	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	
34	09/11/2012	11:13:30	3.5	12.29	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	
35	09/11/2012	11:13:45	3.46	12.29	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	
36	09/11/2012	11:14:00	3.41	12.29	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	
37	09/11/2012	11:14:15	3.68	12.24	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	
38	09/11/2012	11:14:30	3.89	12.27	0	0	0	0	0	0	0	0	0	0	-3.402823	0	4.3582373	0	0	

In file the first 20 rows show the main information on the configuration that was programmed into the instrument prior to measurement. Following on the measurements taken and stored and separated into columns, show the date, time and the configured values. The units of measurement and number of decimal places are those configured for the display.

The data **Retrieve** function is not destructive i.e. the downloaded information remains in the Mainstream memory and can be downloaded several times.

The data **Delete** function allows for files that have been used and are no longer required in the data logger to be deleted.

To remove the data select the file to be deleted with the mouse and select the **Delete** function.

A security window requests confirmation of the operation, and once the operation is confirmed the data is permanently deleted. By selecting **Yes** to confirm, the selected files will be removed from the File Manager list.

CAUTION: Once **Delete** has been selected all deleted files are permanently destroyed and can no longer be retrieved.

9 OUTPUTS

There are three screens in the Outputs section, LCD, Switches and 4:20 mA:

- the configuration of the parameters to be displayed sequentially on the instrument display
- the configuration of the 2 switch outputs
- the configuration of the 4:20 mA outputs respectively.

9.1 LCD

9.1.1 24V or 12V LCD Operation

Portable AV Flowmeters have an alpha-numeric liquid crystal display that can be configured to be on continually; or off (preferred option) or turned on manually when required. To do this use the LCD button on the front panel of the instrument.

Fixed AV Flowmeters' display operates as follows:

- **Always On** for **Operation at 24VDC**, and
- **Manual** for **Operation at 12VDC**. In the event of a power cut the display automatically changes mode, reduces energy consumption and ensures greater battery life. This does not change the measurement or data logging procedures.

NOTE: With the 24VDC supply it is also possible to enable/disable the display back light.

9.1.2 Display Sequence

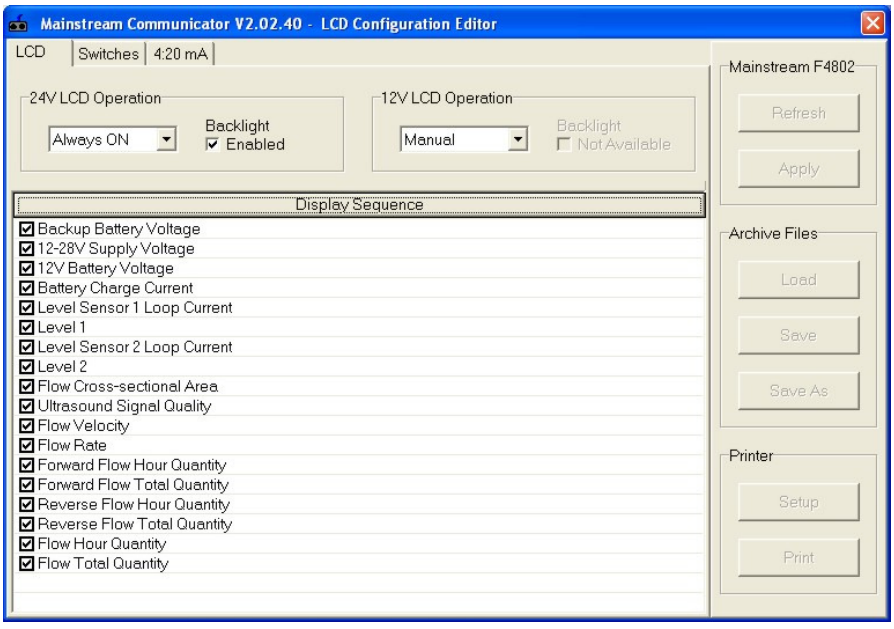
Measurements taken and processed can be displayed in full sequentially or partially, as preferred.

Displaying the header bar **Display Sequence** highlights checked or unchecked boxes to the left of each description.

Selecting the tick box alongside the descriptions enables or disables the display of parameters. If a parameter is checked it will be displayed, if unchecked it will not be displayed.

Parameters can be customised and displayed sequentially during instrument operation.

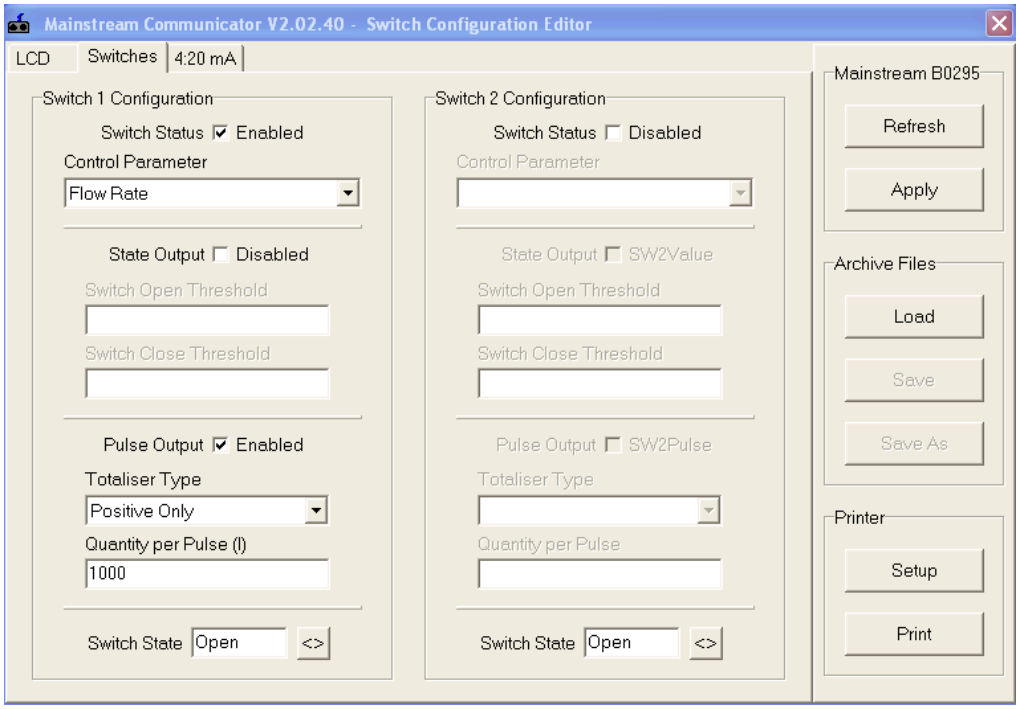
Selecting the header bar **Display Sequence** again results in the symbols disappearing and only the checked measurements remain active.



NB: Once the required variations are introduced, the new settings are transferred to Mainstream and will only become effective once the **Apply** button is used.

9.2 SWITCHES for Pulse Output and Alert Thresholds

The Mainstream AV-Flowmeter has two switch outputs that make it possible to control remote instruments e.g. automatic samplers or alert systems.

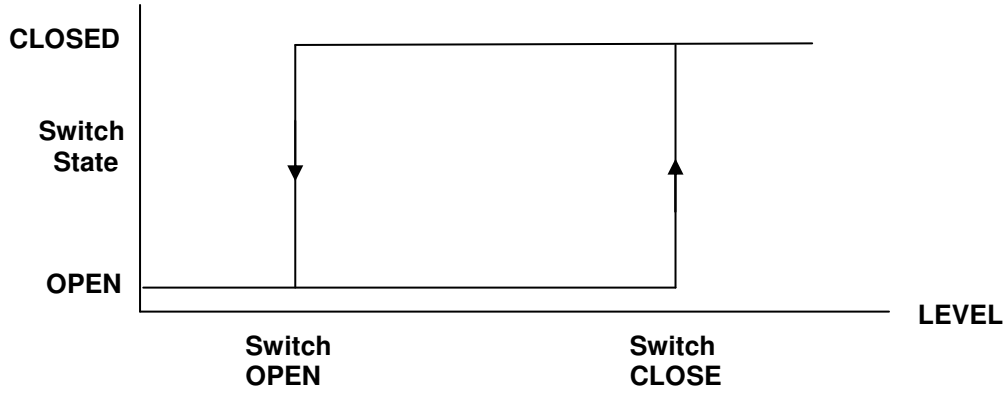


Each of the outputs can be configured independently and proportionally to one of the measurements taken or processed, with independent enabling/disabling thresholds, and proportionally to the unit of volume.

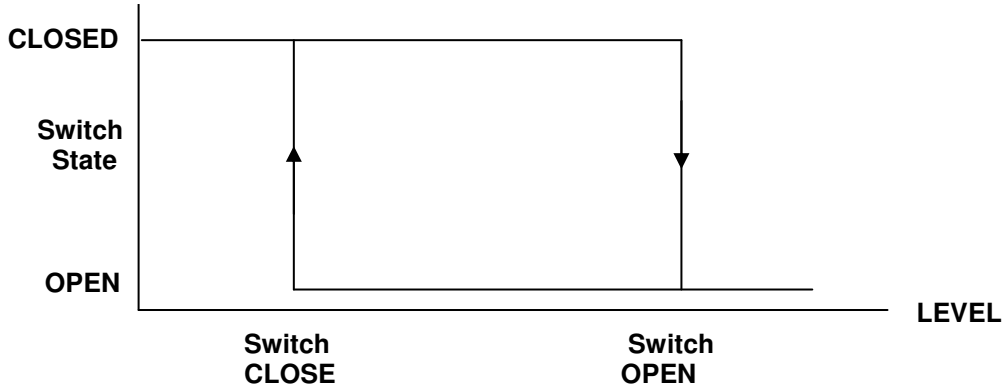
The effect of using different switch Open and switch Close values is to provide hysterisis. This is illustrated below for a switch configured to respond to the liquid level.

The use of enabling/disabling thresholds makes it possible to programme the amount of lag required, as shown in the example illustrated below for the level measurement.

Enabling the output at a value greater than the disabling value.



If the Switch Close level is greater level than the Switch Open level, the switch will close when the level rises above the Switch Close level and open when the level falls below the Switch Open level. When the level is between the Switch Open and Switch Close levels, the switch state on entering this region is maintained.



If the Switch Close level is less than the Switch Open level, the switch will open when the level rises above the Switch Open level and close when the level falls below the Switch Close level. When the level is between the Switch Open and Switch Close levels the switch state on entering this region is maintained.

CAUTION: When both Switch Open and Switch Close are configured with equal values, the switch behaves as if the Switch Close value is greater than the Switch Open value. To avoid unexpected switch operation, it is recommended that the switches are always configured with a small amount of hysterisis.

NOTE: The switch configuration data is stored in the Mainstream system unit in non-volatile memory and is not affected by failure of the power supply. However, failure of the power supply causes the switches to open. Normal operation will resume automatically after the first measurement following restoration of the power supply.

HINT: By configuring a switch so that it remains closed under all operating conditions, the switch can be used as a power supply failure indicator.

9.3 4:20 mA (Analogue output)

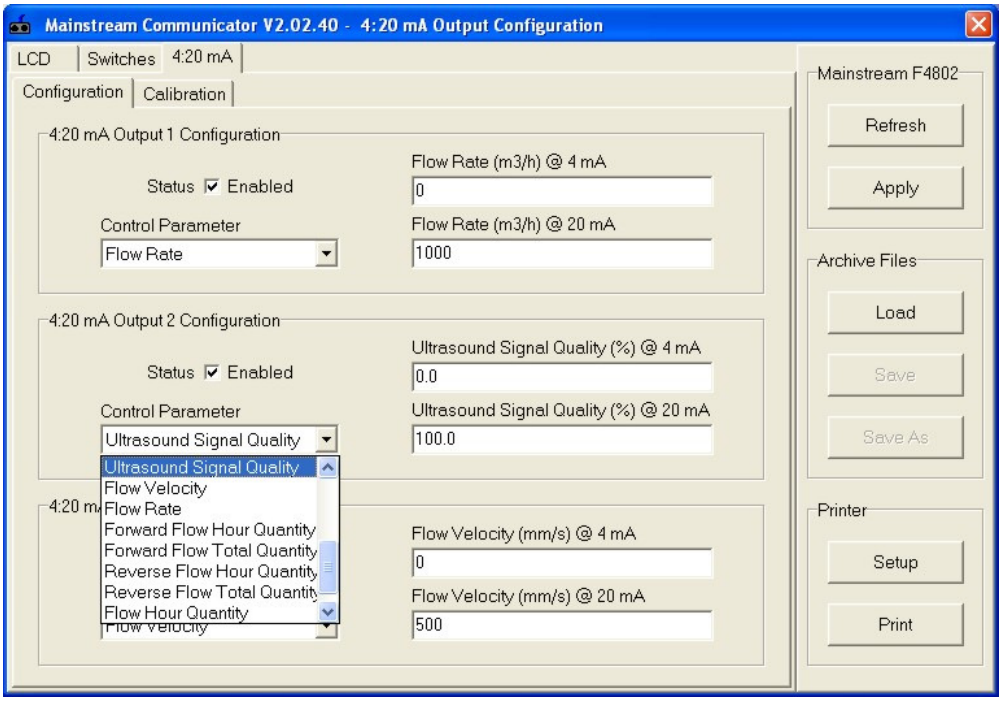
Mainstream Velocity and Flow transmitters and COMPACT Fixed AV-flowmeter have one 4:20 mA analogue output. The Mainstream PREMIER Fixed AV-flowmeter has three 4:20 mA outputs.

The 4:20 mA section has two screens, **Configuration** and **Calibration**, which is used to define the operating characteristics of the Mainstream system unit current outputs

9.3.1 4:20 mA Output 1, 2, 3 Configuration

The **Configuration** page makes it possible to define the Status of the output, which can be **Enabled** or **Disabled** and the **Control Parameter** i.e. the required measurement that is transmitted with the related scale start and end values.

The example screen below shows a configuration of 4:20 mA output enabled for the transmission of flow values with a scale from 0 to 1000 m^3/h.



9.3.2 Calibration

See Video on the manufacturer's web page

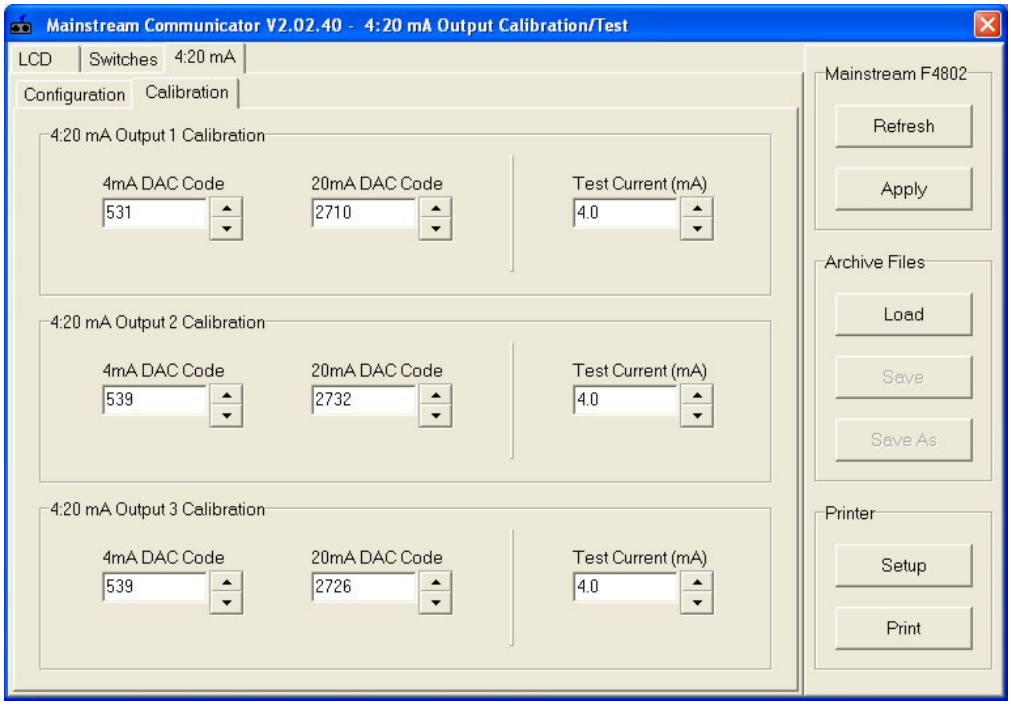
The Calibration function for 4:20mA outputs, provides the mechanism to calibrate the 4mA and 20mA output currents and check the linearity.

DAC (Digital Analogue Conversion) codes are the calibration values that generate the 4 mA and 20 mA current signals.

The default calibration values, if required, to align the measurements with the signal acquisition equipment, can be changed by increasing or decreasing the DAC codes with the up/down arrows, to obtain the required output values for the scale start and end values.

A correct calibration procedure can be carried out as follows:

1. Disconnect any instrument connected to the 4:20 mA to be calibrated and connect a ammeter with a live connection, or alternatively connect the ammeter in series to the current loop.
2. Change the **4 mA DAC** code to obtain the correct reference point for the 4 mA value.
3. Change the **20 mA DAC** code to obtain the correct reference point for the 20 mA value.
4. Check the scale using the **Current Test (mA)** function and the relevant arrows that enable an increase or decrease in the current value. Do this in steps of 0.5 mA to check that the output values are linear over the entire scale. The value read should be equivalent to that set ± 0.02 mA, as accuracy is typically 0.1%.
5. Remove the ammeter and restore the original connections.


Mainstream Communicator V2.02.40 - 4:20 mA Output Calibration/Test
LCD
Switches
4:20 mA
Configuration
Calibration
4:20 mA Output 1 Calibration
4mA DAC Code
531
20mA DAC Code
2710
Test Current (mA)
4.0
4:20 mA Output 2 Calibration
4mA DAC Code
539
20mA DAC Code
2732
Test Current (mA)
4.0
4:20 mA Output 3 Calibration
4mA DAC Code
539
20mA DAC Code
2726
Test Current (mA)
4.0
Mainstream F4802
Refresh
Apply
Archive Files
Load
Save
Save As
Printer
Setup
Print

10 TECHNICAL SPECIFICATIONS

Please view the web page www.mainstream-measurements.com for up-to-date datasheets for:

Velocity Transmitter
Av Flow Transmitter
Compact AV Flowmeter
Premier AV Flowmeter
Portable AV Flowmeter