Titan

INSTRUCTION MANUAL

metraflow

Breakthrough Flowmeter Technology

Ultrasonic Flowmeter Range

metraflow

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1 General

The Atrato Metraflow meter represents a new generation of through bore time of flight ultrasonic flowmeters that uses breakthrough technology to offer a wide ranging yet accurate meter. It is ideal for any application which requires a truly non-contact high purity fluid path.

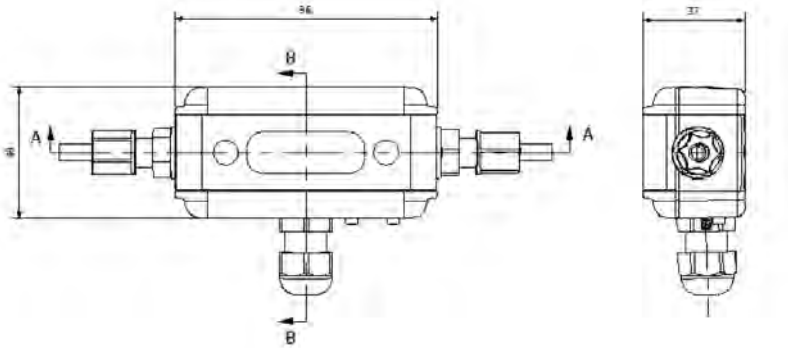
The user must make sure that the flowmeter selected is suitable for the application and that the chemical compatibility, temperature and pressure requirements are within the Metraflow's operating range. Please check the model number before proceeding. All meters can be programmed and monitored via the USB connection.

2 Order codes

240-020 1/8" PFA tube	20 to 1000 ml/min	20 Bar	60°C
240-025 1/4" PFA tube	100 to 5000 ml/min	15 Bar	60°C

3 Installation

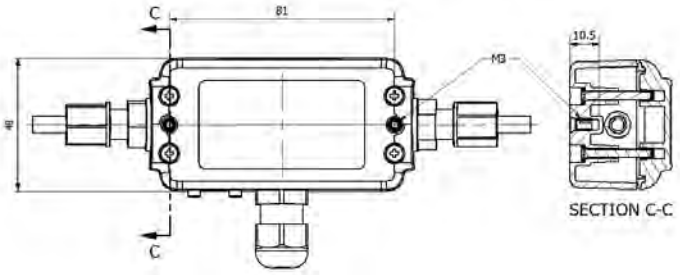
Dimensions



Standard units supplied with:

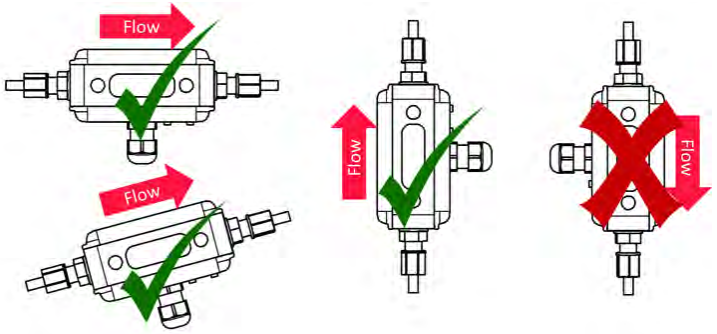
150mm PFA hose ends
1.0m length 8 way cable

Mounting can be done using two M3 threaded ports on the rear of the flow meter



Position the meter either in a horizontal pipe or if in a vertical pipe with the flow in an upward direction. This will ensure that any bubbles automatically clear the meter.

In a horizontal pipe confirm that the system has no air trapped in it. If vertical is not possible an angle of more than 10 degrees from the horizontal may be acceptable.



Due to ultrasound algorithms used straight upstream and downstream pipes are not necessary. It is however good practice to install the device well away from valves, regulators elbows and other components that could cause random turbulence or gas break-out on the fluid entering or leaving the meter. If necessary use spacer blocks and mounting clips to raise the pipe work away from surfaces. It is good practice to use upstream and downstream isolating full bore ball valves to facilitate easy meter installation or removal.

The Metraflow must be installed in a positive pressure system. Ensure that there is enough back pressure on the flowmeter to keep any gas in solution. We recommend 500mbar plus two times the fluid vapour pressure.

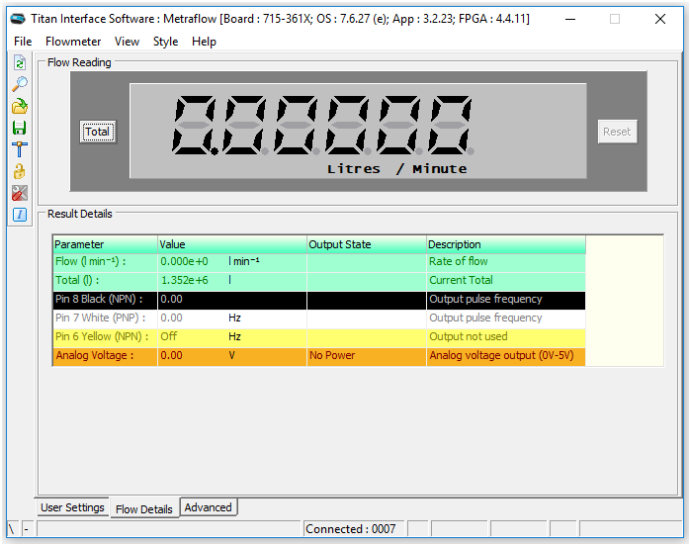
The Metraflow can be operated entirely from a computer using the USB connection. This gives local computer display and an NPN pulse output. This may not be acceptable in many situations where remote operation or further functions are required. The unit will work with systems from Windows XP onwards. Connect to the computer with the supplied 1.0m cable any suitable USB lead, do not exceed 5Metres as this may cause data loss. Run the 1 metre output cable to a suitable terminal box or instrument. This cable can be lengthened if required, up to 20m.

The Metraflow is also supplied with an 8 core flying lead for standard remote connection. The cable assignments are displayed below:

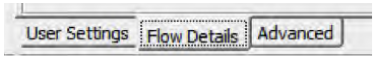
Wire Colour (PIN)	Assignment	System
Brown	+12 to 24V DC	Power
Blue	0V	Ground
Yellow (PIN6)	NPN Transistor	Input/Output
White (PIN7)	PNP Transistor	Input/Output
Black (PIN8)	NPN Transistor	Input/Output
Red	4-20mA	Analogue output (mA)
Orange	0-5 or 0-10 Vdc	Analogue output (V)
Green	Analogue Common Ground	Analogue ground

4 Setup

Before use, download and install Atrato Metraflow software from memory stick or website. The Metraflow ultrasonic flowmeter should be setup using the USB interface and a suitable computer. Below is a screen shot of the Configuration screen as it typically opens with the flowmeter connected.



The three tabs at the bottom of the display are, “User Settings”, “Flow Details” and “Advanced”.



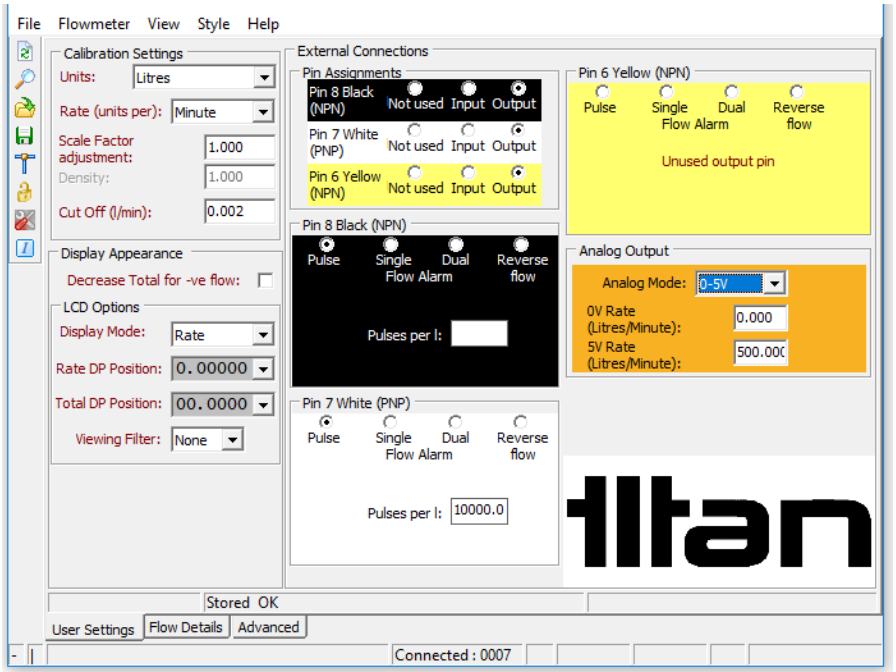
The panel (left) shows the functions of the panel on the top left of the screen. Control buttons to apply the settings and recover previously set parameters.

- Send settings to system
- Retrieve Settings from meter
- Open settings file on the computer
- Save settings to a file on the computer
- Test outputs
- Unlock/Lock User Settings
- Diagnostic Tools
- Software Information

Software Information panel

To modify the configuration click “User Settings” tab at the bottom of the screen and ensure the system is unlocked for editing.

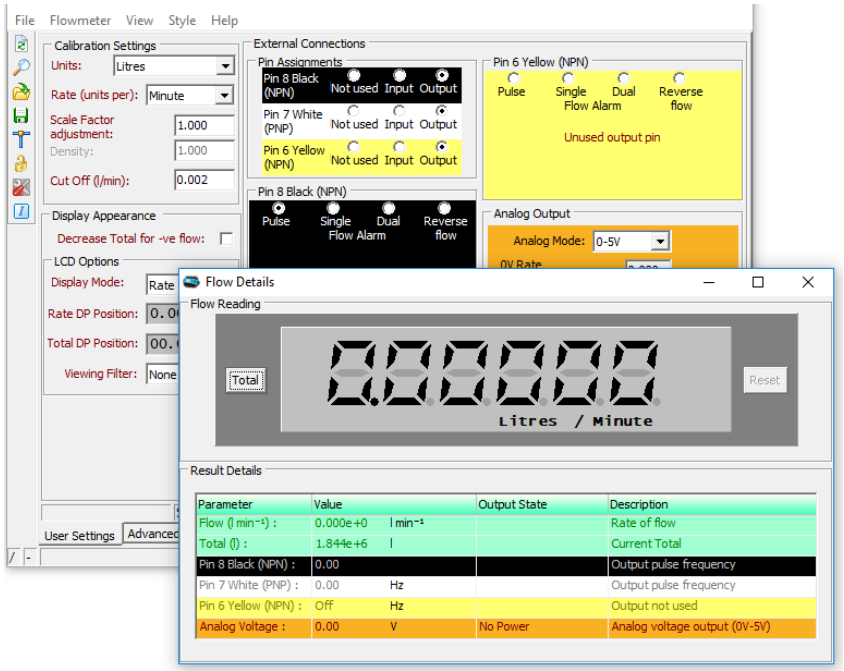
Screen shot of the “User Settings” screen:



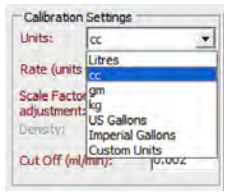
Multiple Window Operation:

To aid set up whilst operating the meter it is possible to detach the Flow Details and Advanced windows by dragging and dropping the bottom tabs away from the main window. This allows the user to view those tabs whilst adjusting the User Settings.

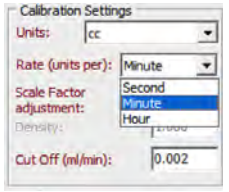
The Flow Details window may be further reduced or expanded using the minimise and maximise icons respectively in the top right hand of the window.



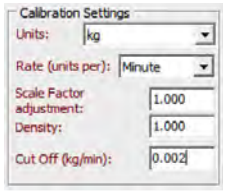
User Settings Tab:
Calibration Settings:



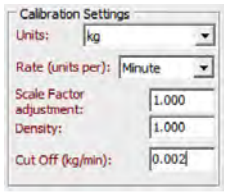
Units: A drop down menu offers the choice of - Litres, cc, gms, kg, US gallon, Imperial gallon or Custom units i.e. blank.



Rate (units per): This is the time base for the flow rate and has the option of Second, Minute or Hour.

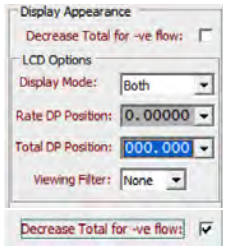


Scale Factor Adjustment: This is a fine tune adjustment on the signal to compensate for errors introduced by erratic flow or other system irregularities DENSITY: The flowmeter is fundamentally a volumetric device but a density figure can be entered here if one of the mass units are selected. Caution must be used however as there is no temperature/density correction.

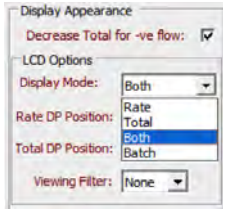


Cut Off: Flow values below this level will be set to zero.

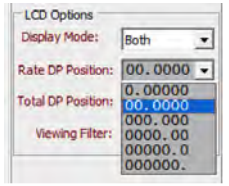
Display Appearance:



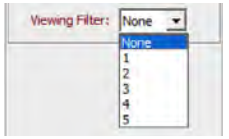
Decrease Total for -ve flow: The meter will not register negative flow unless this box is checked.
For reverse flow the rate will show a "-" sign before the rate and the total will be reduced accordingly. One of the transistor outputs (PNP or NPN on Pin 6,7 or Pin 8) could be configured to give a logic level when reverse flow is detected.



Display Mode: The down arrow selects from the various display and Metraflow functions.
The options are:-
Rate – The display will show flow rate only.
Total – The display will show total flow only.
Both – The display can be cycled from rate to total using the left hand button on the Atrato or the left button in the "Real time window". A remote input can be used if either pin 6 or pin 7 has been utilised.

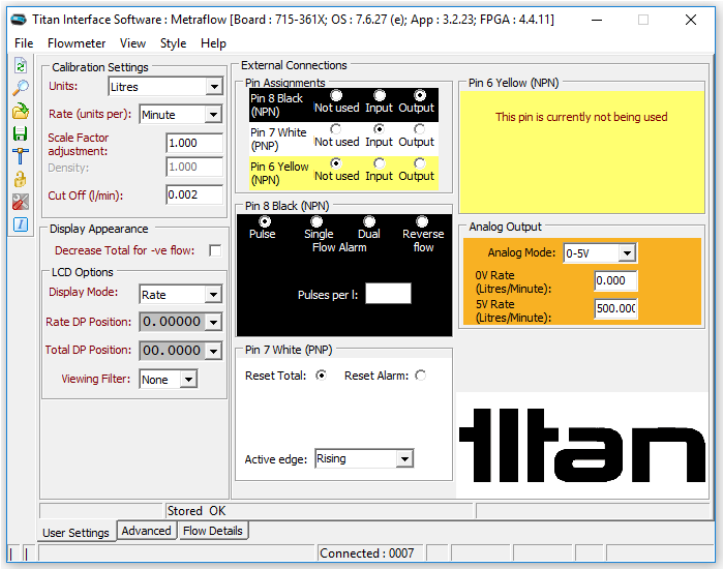


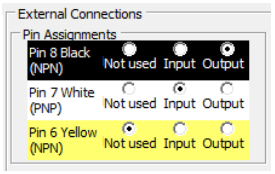
Rate DP Position: Use the drop down menu to choose the required decimal point position.
Total DP Position: Use the drop down menu to choose the required decimal point position.
If the decimal point is set too low and the display value exceeds the setting capacity the display will show ----oF----.



Viewing Filter: This prevents the display, flow switches and analogue outputs from jittering with irregularities in the flow from say a peristaltic pump. The increments are arbitrary with the degree of damping approximately doubling with each level. Increments go up to 5, which may take up to a minute to stabilise.

External Connections

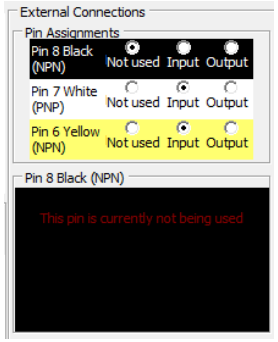




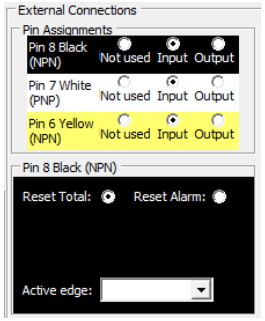
Pin Assignments:

"Each of the PIN Assignments can be adjusted as either and input or an output function. The operation to modify PIN 6, PIN 7 and PIN 8 are identical within the software, with the exception of the type of transistor pulse output. PIN 6 and PIN 8 are both NPN, whilst PIN 7 is a PNP type.

The options for each PIN (or wire), are: Not Used ◉ Input ◉ or Output ◉



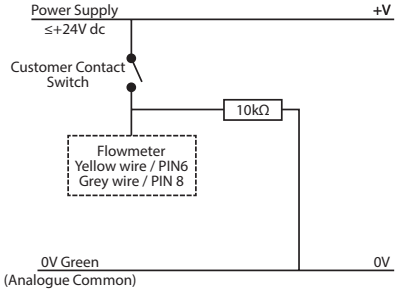
Not used: The assigned PIN / WIRE is unused.



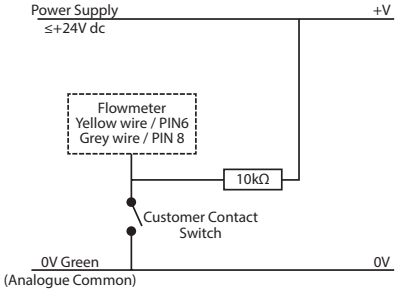
Input: Select this checkbox to use the PIN assigned as a TTL digital input for remote control, either for Resetting the Total Count or Resetting an Alarm

Notes on using electrical inputs:

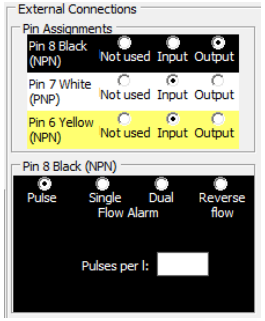
PIN 6 & 8: In input mode, the NPN (NFET) open drain output is disabled, and the input pin responds to an external input voltage which may be in the range of 0V to 30V. The logic threshold is at 2V so this input can be driven directly from a logic signal at TTL levels or CMOS at 3.3V or 5.0V levels. Alternatively, if this input is provided by a switch, then an example circuit is given below:



PIN 7: In input mode, the PNP (PFET) open drain output is disabled, and the input pin responds to an external input voltage which may be in the range of 0V to 30V. The logic threshold is at 2V so this input can be driven directly from a logic signal at TTL levels or CMOS at 3.3V or 5.0V levels. Warning: because of the potential for conflict should the PNP output be activated accidentally, Titan Enterprises Ltd recommend a series resistor and Zener be fitted to safeguard any connected circuitry operating at logic levels. Alternatively, if this input is provided by a switch, then an example circuit is given below:



WARNING:
INCORRECT ELECTRICAL INSTALLATION CAN CAUSE DAMAGE TO USERS ELECTRONICS

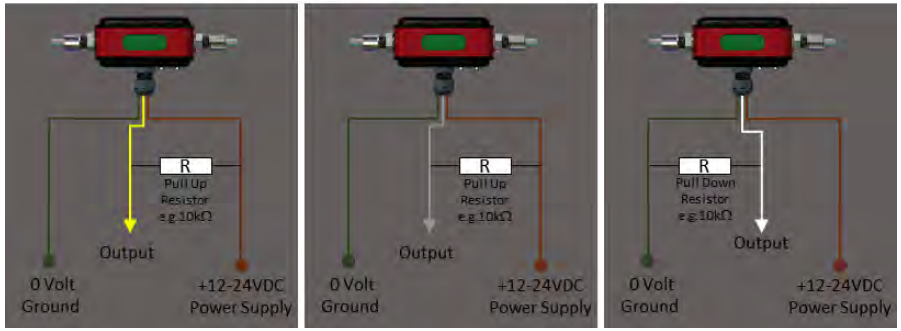


Output: Select this check box to use the PIN assigned as a PULSE; FLOW ALARM (SINGLE OR DUAL) or REVERSE FLOW output signal.

Pulse: The Metraflow has two options for Pulse output configuration depending on which PIN (Wire colour), is chosen. PIN 6/Yellow and PIN 8/Grey are both NPN pulse outputs; whilst PIN 7 is a PNP.

NPN
(PIN 6/Yellow & PIN 8/ Grey)

PNP
(PIN 7/White)



PULSE per: Enter the number of pulses per unit volume required. This figure can be adjusted to suit the application and the flow range required from the meter.

The maximum output frequency is 10 kHz. So care must be taken to ensure that this pulse rate is not exceeded.

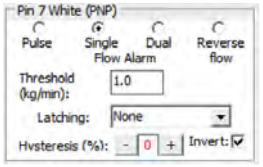
E.g. 5 L/Min at 10 Kilohertz equals (10,000 x 60)/5 = 120,000.Therefore 120,000 pulses per litre is the maximum resolution for 5 litres per minute assuming maximum frequency output. If the meter is being used up to 1 L/Min the pulse output and so resolution could be increased to five times this, 600,000P/L.

It is possible to send a test signal at varying Hz for each of the pulse output PIN/Wires.

Clicking  opens a menu where you can choose a rate of Hz of pulse outputs which will be automatically sent for approximately 30 seconds.

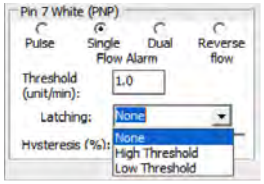
NOTE: ABOVE 1KHZ IT IS RECOMMENDED THAT THE SYSTEM WIRING IS REVIEWED TO ENSURE IT IS ADEQUATE FOR THE SAMPLING RATE.

Flow alarm outputs:



Single flow alarm:
Checking this option opens up input boxes for THRESHOLD; LATCHING and INVERT

Set the **Threshold** to the flow value you require the transistor to operate. The logic of operation can be adjusted with the INVERT check box (see left).



The **Latching** box gives the user three options of None; High Threshold and Low Threshold.

- "None" will cause the alarm to be triggered when the threshold flow is met. The alarm state will then reset in accordance with the user set Hysteresis.
- "High Threshold" will cause an alarm signal to Latch on when flow is seen above the set value
- "Low Threshold" will cause an alarm signal to Latch on when flow is seen below the set value

Hysteresis (%): This is used when Latching is Set to NONE to prevent "fluttering" of the alarm signal when flow is around the threshold level.

LATCHED alarms will remain Active and the Local Display will show "LATCH" until they are reset. RESET LATCH ALARMS by either a signal Input on one of the other Input/ Output PINS, or by Pressing and Holding the Left Hand Button on the Local Display on the Flow meter for 3 seconds.

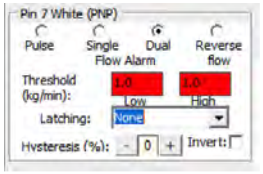
Note the alarm points are driven by the display value on the "flow reading" screen. Any changes to the filter value of the display will affect the response time of the alarm points so there are two adjustable parameters to ensure "fluttering" does not happen with small flow fluctuations - response time and hysteresis.

INVERT – This Check box allows the user to invert the operation of the signal

- Invert: ☑ Checked – Alarm output logic HIGH

For details see the Alarm logic table or hover mouse over the set point to see the action of the output with the chosen settings.

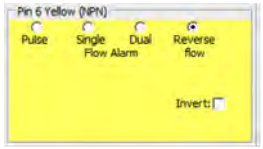
Dual Flow Alarm:



Checking this will enable a range of flow to be entered. When the flow is outside/inside of this range the alarm will be triggered.
The remaining settings in the input box are the same as for Single Flow alarms.

- When no Latching is chosen the alarm will automatically reset in proportion to the user set Hysteresis.
- The Latched Alarm can be reset by a signal Input on one of the other Input/Output PINS, or by Pressing and Holding the Left Hand Button on the Local Display on the Flow meter for 3 seconds.
- The INVERT checkbox will reverse the action of the alarm output. (see the Alarm Logic Table).

Reverse flow:



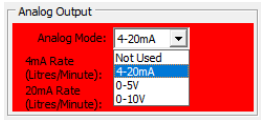
This option allows the user to send a signal from the assigned wire/PIN when reverse flow is seen.
Selecting INVERT will reverse the action of the signal.

Alarm Logic Table

Flow Alarm	Latching	Invert	Alarm Action Below Threshold	Alarm Action Above Threshold
Single	None	Unticked	OFF	ON
Single	None	Ticked	ON	OFF
Single	High Threshold	Unticked	OFF	ON
Single	High Threshold	Ticked	ON	OFF
Single	Low Threshold	Unticked	ON	OFF
Single	Low Threshold	Ticked	OFF	ON
			In Range	**Outside Range**
Dual	None	Unticked	OFF	ON
Dual	None	Ticked	ON	OFF
Dual	Out of Range	Unticked	OFF	ON
Dual	Out of Range	Ticked	ON	OFF
			Forward Flow	**Reverse Flow**
Reverse Flow	n/a	Unticked	OFF	ON
Reverse Flow	n/a	Ticked	ON	OFF

Analogue Output

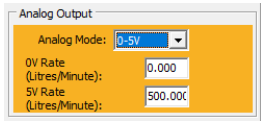
There are four options on the drop down menu: Not Used, 4-20mA, 0-5 Volt and 0-10 Volt.



When an analogue output is assigned the appropriate wire will then be activated:

- 4-20mA – Pink Wire
- 0-5Vdc – Red
- 0-10Vdc - Red

Once the selection has been made a further two boxes for entry of the analogue output at zero flow and full scale appear. These are numeric entries in the units and time base selected in calibration settings.

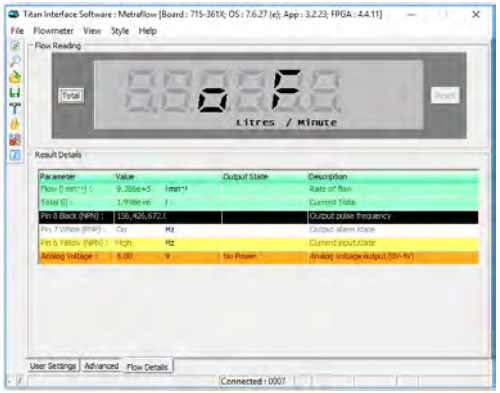


It is possible to send a test signal at mA/V for each of the analogue output PIN/Wires.

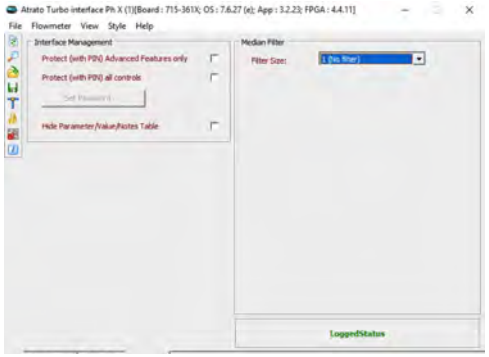
Clicking  opens a menu where you can choose a % analogue output value which will be automatically sent for approximately 30 seconds.

Flow Details Tab

The large display reflects the meter readings showing on the Metraflow LCD Display.
The RESULT DETAILS window below the large rate and total display shows the flow and total readings and the assignment of PIN6,7&8 whilst the meter is operational.



Advanced User Tab



Interface Management

Protect (with PIN) Advanced Features Only: Allows users to restrict access to advanced pages.

Protect (with PIN) all controls: Allows users to restrict all configuration modifications to the system.

To use these features it is first necessary to create a PIN. This is a four digit number in the range 0001 to 9999. Setting a value of 0000 tells the software there is no PIN and this is how to remove the PIN. After allocating a PIN these check boxes can lock all of the settings or just the advanced user.

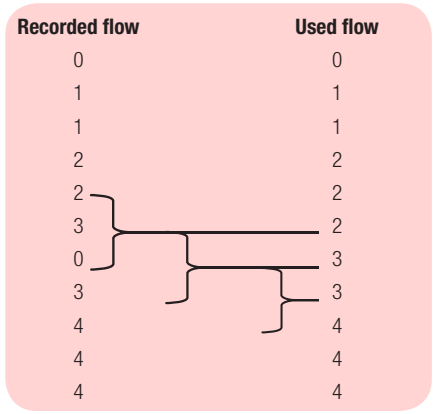
If you forget your PIN please contact you supplier for the default value. Once entered, all the setting parameters remain visible. In the 'Help' menu, the user can 'Log On using PIN...' but the user will be prompted for the PIN prior to making any changes. If the display version of the meter is being used and the display is set to view totals or rate and total the left hand button will cycle through the various options

Median filter

This filter removes short term anomalies in the recorded flow e.g. an air bubble passing through. It should be used with caution as it is theoretically possible that over use of this feature could lead to incorrect results in certain circumstances. Under normal operating conditions the meter returns around 25 results per second and a regular occurrence at this frequency could be completely ignored thus causing problematic readings.

The filter is a moving window taking the middle number from an odd number of results selectable between 1 and 21. It is not an average or mean and it is designed to totally ignore one or more results. A simple example is shown on page 18 for a median value of “3”.

Recorded flow used flow



Recorded and numerical order

2 3 0	0 2 3	2 is used
3 0 3	0 3 3	3 is used
0 3 4	0 3 4	3 is used

The seventh flow in the table above is zero. This could have been a small bubble passing through the 240-020 meter which has a 1mm bore which could completely absorb the ultrasound. The median filter completely ignores this reading and for the zero reading returns the value of 3 from the results either side. This filter is particularly useful at low flows where a small dip in value could drop a result below the internal cut off levels.

Local Display

The Metraflow has local indication which is mimicked on the user interface software FLOW DETAILS tab and limited PUSH BUTTON interface ability.

The left hand button scrolls between TOTAL and RATE on the display. Press and Hold for 3 Seconds will RESET a LATCHED ALARM

Pressing the Right hand button will RESET the TOTAL FLOW Value.

5 Technical Specification

Range max flows (100%)	1.0 L/Min 5.0 L/Min
Linearity	±1.0% of reading
Turndown	100:1
Repeatability	±0.1% plus ±0.02% FSD
Housing	IP63
Temperature range	-10 to +60°C non-condensing
Power	10 to 24V ac/dc 100mA typical
Process connections	1/8” and 1/4” PFA tubes
Outputs	2 x NPN pulse 5KHz. max (Configurable In/out) 20mA max PNP pulse 10KHz. max (Configurable In/out) 20mA max 4 – 20mA Analogue into 250 Ohm max 0 – 10 V Analogue 14 bit resolution 0 – 5 V Analogue 12 bit resolution USB (setting & monitoring). Software supplied On board or external data logging
Display	6 digit LCD with annunciators
Inputs	NPN pulse (Configurable In/out) PNP pulse (Configurable In/out)
Electrical	8 Wire 1M lead PU jacket 32 x 0.1 conductors Programming - USB lead
Fluid velocity of sound	The meter has an automatic velocity of sound detection
Signal strength monitor	The meter continuously monitors the signal strength and increases the sensitivity should the received ultrasound signal be below acceptable levels

Low flow measurement and temperature effects

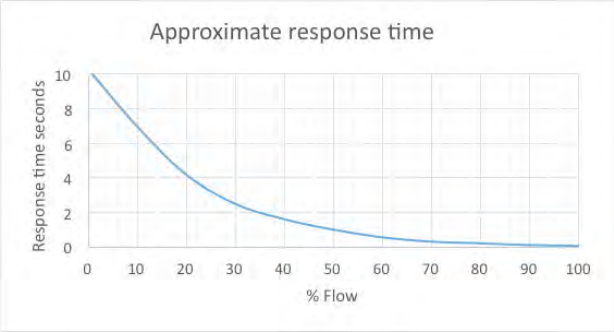
There will always be a small amount of “background noise” due to ultrasound remaining within the tube between successive pings. This should be zeroed for best accuracy.

The noise affects low end performance and accuracy across the whole temperature range. The meter is calibrated at ambient temperature, typically 21 to 25°C. To zero the background noise fill the meter with fluid under pressure at the desired metering temperature. Stop the flow and press the two buttons on the top of the meter simultaneously for 5 seconds. The display will change to a flashing “------“ while the measurements are being taken. When the measurement is complete the display will change to “ZERO”. This cannot be done if liquid is flowing and the display will show “Flo” to indicate this. This zeroing will affect future calculations and the meter will give the best accuracy over the whole flow range for the temperature at which the system was zeroed. If the temperature of the tube changes, the position of the noise and its effect on the calculation will change. This is in the order of ±0.25 to 0.5% FSD if the system is not “zeroed” at the actual fluid running temperature. If measurements are required over a temperature range we would recommend stopping the flow and nulling the system at a mid-point in the desired temperature range. This will reduce the FSD error considerably.

After the unit is zeroed lower flows than specified can be registered but the accuracy is likely to be poor. To register these lower flows the “Cut off” in the “Calibrations settings box” should be set to just above 0.00 and at a flow rate above the point the meter records flow when none is happening but below the minimum flow specified for the meter. If it is set to 0.000 residual background noise will cause small readings even when there is no flow. If readings are seen increase the value sequentially until no output is recorded. Typically around 0.002 l/min.

Response time

The response time of the meter is not constant and is slower with lower flow rates. At full flow it is in the order of 50ms but at lower flows several seconds. This improves repeatability for the digital outputs and is similar in effect to the viewing filter when using the analogue outputs.



Pulsating Flow

If the meter is subjected to heavy pulsations in the flow, for example from a diaphragm pump, it is recommended that a pressure regulator and a pulsation damper are installed upstream of the flowmeter. A length of flexible tubing with an in-line restrictor towards the end are often effective. The median filter should be set to 1 and it may be necessary to set the display filter to a high value. The Metraflow’s internal cycle time is not adjustable, is independent of the response time and should this measurement period coincide with, or be close to, the pulsations in the flow, very large errors in the flow calculations will occur.

Gas Entrainment or Modulating Fluids

Fluids which entrap gasses or seriously modulate the ultrasound will cause problems with the time of flight measurement. This might include viscous fluids being re-circulated from a small volume reservoir or Glycol type fluids.

Gasses seriously affect the ultrasound and should be avoided. It is recommended that the meter is always installed in a positive pressure system with a back pressure of at least 0.5 Bar plus 2 times the fluid vapour pressure. It is preferable to install the meter in a way that any trapped vapour can escape the flow measurement section. i.e. in a vertical line with the flow upwards.

The meters are calibrated on water at ambient temperature typically 21 to 25°C.

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