INSTRUCTION MANUAL

atrato™

Breakthrough Flowmeter Technology

Ultrasonic Flowmeter Range

atrato™

CONTENTS Page No

Revision No 2 - 1/5/2013

1 General

The Atrato range 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 many process control, instrumentation and laboratory applications. 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 Atrato's operating range. Please check the model number before proceeding. All meters can be programmed and monitored via the USB connection.

First 3 digits Flow range
710 = 2 - 500 mL/min
720 = 0.01 - 1.7 L/min
740 = 0.02 - 5 L/min
760 = 0.1 - 20 L/min
Fourth digit seal material
V = Viton®
N = Nitrile
E = EPDM
S = Silicon
Fifth digit end fittings
0 = 3/8" John Guest 10 bar
1 = 1/2" BSP PEEK 10 bar
2 = 1/2" NPT 316 St St 30 bar
3 = 1/2" BSP 316 St St 30 bar
Sixth digit Wetted materials
0 = PEEK/316 St St
1 = PEEK / Borosilicate glass
Seventh/eighth digit Electronics package
A = Analogue output
D = Display & analogue output
RA = 110°C Sensor remote electronics analogue output
RD = 110°C Sensor remote electronics display & analogue output

For example

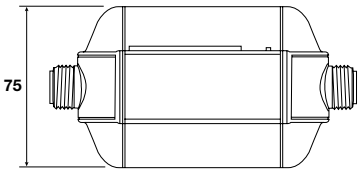
760 – V10 – D

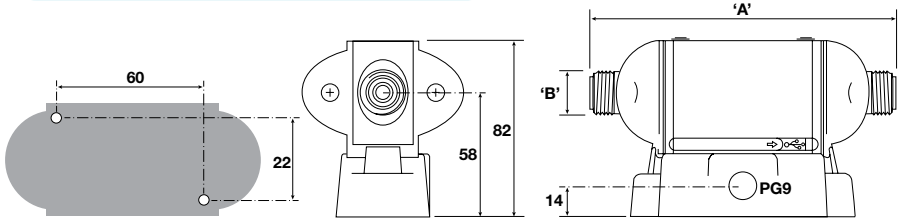
This is a 20 L/Min flowmeter with Viton seals, half inch BSP fittings and a 316 stainless steel flow tube with PEEK end fittings, fitted with a local digital display and an analogue output.

2 Installation

- Locate the flowmeter in a sheltered position away from falling water.
- Care must be taken to ensure that the end fittings on the meter are not stressed during use. Ideally, flexible tubes should be used.
- Ideally the meter should be installed with straight lengths of tube either side for a distance of 10 pipe diameters upstream and 5 downstream.
- Install the device well away from valves, regulators bends and other components that could cause excessive turbulence on the fluid entering or leaving the meter.
- If necessary use spacer blocks and mounting clips to raise the pipe work centre line 58mm above the surface.
- It is good practice to use upstream and downstream isolating full bore ball valves to facilitate easy meter installation or removal.
- If push-in 3/8" John Guest fittings are used, clip the pipes to the mounting surface 300mm upstream and 150 downstream.
- The Atrato must be installed in a positive pressure system. Ensure that there is sufficient back pressure on the flowmeter to keep any gas in solution. We recommend 500mbar plus two times the fluid vapour pressure.
- If there is any chance of air passing through the system mount the Atrato in a vertical pipe with the flow in an upward direction otherwise air can remain trapped in the meter and affect it's performance.

End fitting 'B'	Order code	Dimension 'A' mm
3/8" John Guest	0	145
1/2" BSP PEEK	1	142
1/2" NPT	2	180
1/2" BSP stainless	3	180

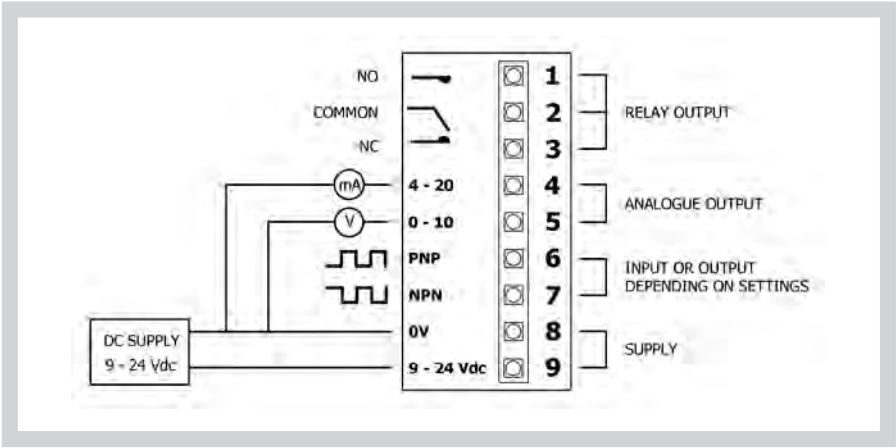




Using suitable fixings, mount the connection box onto a rigid surface with the cable entry preferably at the bottom. The mounting screw centres are shown in the diagram on the right. The flowmeter should be clipped into place with the terminal screws positioned at the lower edge. Note that the rubber strip covering the terminals on the meter will not seal if water is persistently present in this area. Ensure the meter is not pressure washed. The Atrato can easily be dismounted by inserting a screwdriver under the mounting clip and gently unclipping it to release the main body. The PG9 thread can be either connected to suitable flexible conduit or may be fitted with the supplied cable gland.

3 Electrical

The Atrato can be used entirely from a computer using the USB connection but 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. The maximum connector cable size is 2.5mm (22-14AWG), for ease of assembly we recommend 1mm maximum. Care should be taken when terminating the wires as the conductors should be stripped to 4 to 5mm maximum and the wire ends must be pushed fully into the connector before tightening. These cables pass through a slot cut in the aluminium housing please ensure that no bare conductors are clear of the surface of the connector strip prior to closing the housing.



= Operates on External Power **or** USB = Operates on External Power only

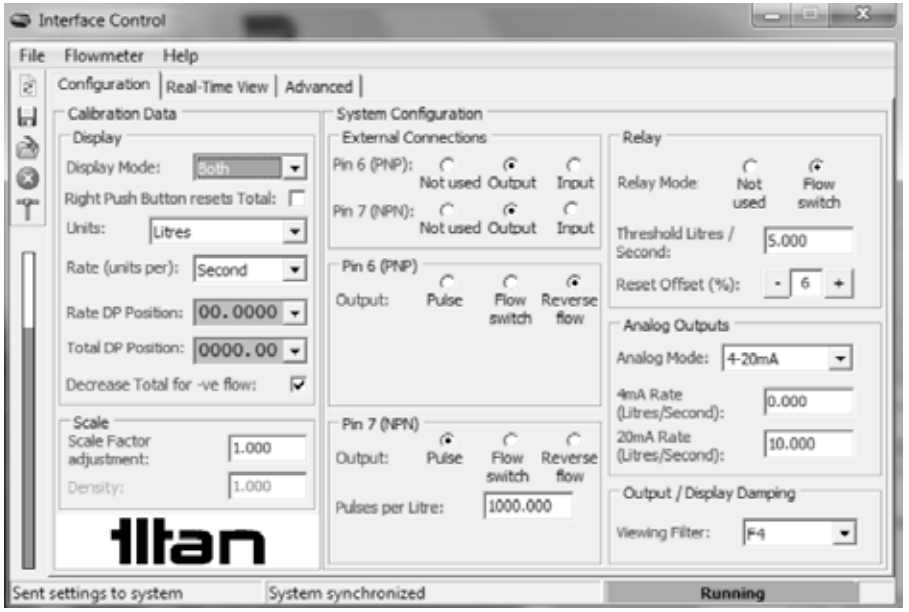
Atrato Connector Assignments

Pin	No	Label Function
1	Relay NO	Isolated relay contact; normally closed contact 24V 100mA
2	Relay Common	Isolated relay contact; change over contact 24V 100mA
3	Relay NC	Isolated relay contact; normally open contact 24V 100mA
4	4-20mA	Analogue current (4-20mA) output (reference to 0V)
5	0-5/10V	Analogue voltage (0-5/10V) output (reference to 0V)
6	PNP	Output 1 open collector PNP OR Input 1 (5-24V dc) e.g. switch to pin 9
7	NPN	Output 2 open collector NPN OR Input 2 (5-24V dc) e.g. switch to pin 8
8	0V	External ground; common for PNP, NPN and Analogue outputs
9	+9 -24V dc	External power; 9V ~24V (> 12V for Analogue output)

4 Setup

Before use, download and install Atrato software from memory stick or website.

The Atrato low-flow ultrasonic flowmeter should be setup using the USB interface and a suitable computer. Below is a screen shot of the Configuration screen.



The 3 tabs at the top of the display are, “Configuration, “Real Time-View” and “Advanced”.

The panel below 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

Save settings to a file on the computer

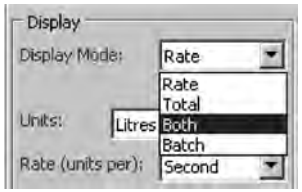
Open settings file on the computer

Operate or stop flowmeter. PAuSEd shows in the real time view the meter is stopped

Test full scale analogue output

DISPLAY

DISPLAY MODE: The down arrow selects from the various display and Atrato functions.



The options are:-

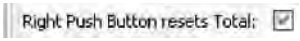
RATE – The display will show flow rate only.

TOTAL – The display will show total flow only.

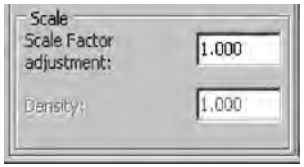
BOTH – The display can be cycled from rate to total using the left hand button on the Atrato or the left button in the "Real time window". A remote input can be used if either pin 6 or pin 7 has been utilised.

BATCH – This is a separate function and several selection parameters change once this is chosen. See batching option on page 15.

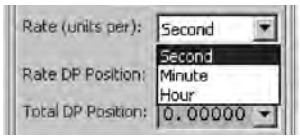
RIGHT PUSH BUTTON RESETS TOTAL: Check this box if you require the total resettable by either the right push button or remotely through pin 6 or 7. Selectable only in "Total" or "Both" modes.



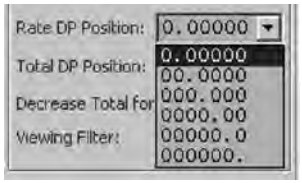
UNITS: A drop down menu offers the choice of - Litres, cc, gms, kg, US gallon, Imperial gallon or Custom units. Selecting Custom Units leaves the Units area blank.

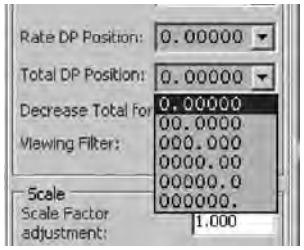


RATE (units per): This is the time base for the flow rate and has the option of Second, Minute or Hour.

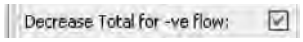


RATE DP POSITION: Use the drop down menu to choose the required decimal point position.



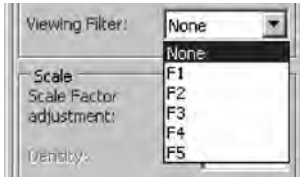


TOTAL DP POSITION: Use the drop down menu to choose the required decimal point position.



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 or Pin 7) could be configured to give a logic level when reverse flow is detected.

SCALE



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.

EXTERNAL CONNECTIONS

PIN 6 (NPN): Pin 6 can be configured as either an output or an input but not both simultaneously. If one input and one output is required the user must determine whether they require a NPN or PNP output and use the appropriate terminal for each action. The options are – Not used ⦿ Output ⦿ Input ⦿.

PIN 7 (PNP): Pin 7 can be configured as either an output or an input but not both simultaneously. If one input and one output is required the user must determine whether they require a NPN or PNP output and use the appropriate terminal for each action. The options are – Not used ⦿ Output ⦿ Input ⦿.

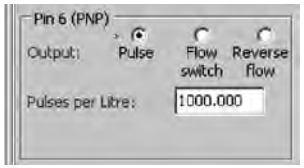
NOTE: the operation for Pin 6 and Pin 7 are identical with the exception of the type of transistor output. These instructions are the same for Pin 7 except the Pin 6 (PNP) would read Pin 7 (NPN).

PIN 6 (PNP)/PIN 7 (NPN)

The contents of this box will change depending on the selection made in the **External connection** box.

If **OUTPUT** is selected the check box options are:-
Pulse ⦿ Flow switch ⦿ Reverse flow ⦿

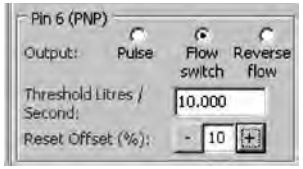
PULSE: Enter the number of pulses per unit volume required. This figure can be adjusted to suit the application and the flow range required from the meter. The maximum output frequency is 400 Hz. So care must be taken to ensure that this pulse rate is not exceeded.



E.g. 10 L/Min at 400 Hertz equals (400 x 60)/10 = 2400

Therefore 2400 pulses per litre is the maximum resolution for 10 litres per minute assuming maximum frequency output. If the meter is being used up to 5 L/Min the pulse output and so resolution could be doubled to 4800 P/L.

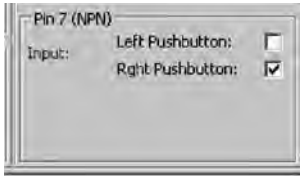
FLOW SWITCH: The lower area of the section changes so that the user can enter the Threshold at which the transistor is to operate.



THE RESET OFFSET (%): (Hysteresis) is either negative or positive depending on whether a falling or rising alarm is required. This is to prevent output flutter if the flow is cycling around the set point value. To reduce power consumption the transistor is off if positive hysteresis is selected and only powers when the threshold is exceeded. If negative hysteresis is chosen the transistor is on up to the set point. The increments are preset and can be cycled through using the + &- buttons. If more than one set point is required either both transistors must be used or one transistor and the relay. The right hand push button (or pin 7 set as an input) temporarily cancels the relay and resets the system.

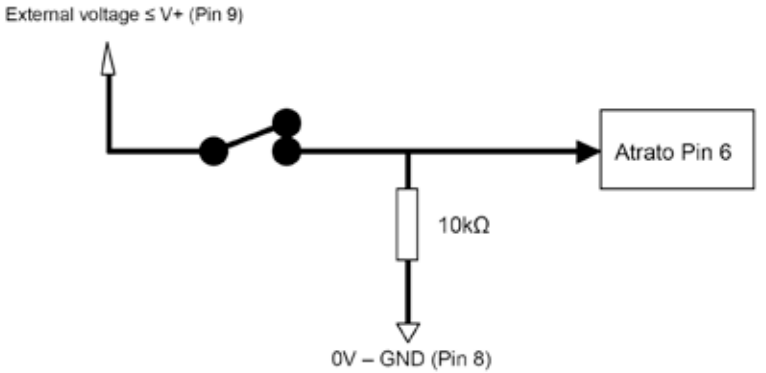
EXTERNAL CONNECTIONS

If **INPUT** ⦿ is selected either the left or right push button function can be operated remotely by using a switch and resistor to apply a suitable voltage (between 5 and 24 Vdc) to either Pin 6 or Pin 7 as described on page 11.



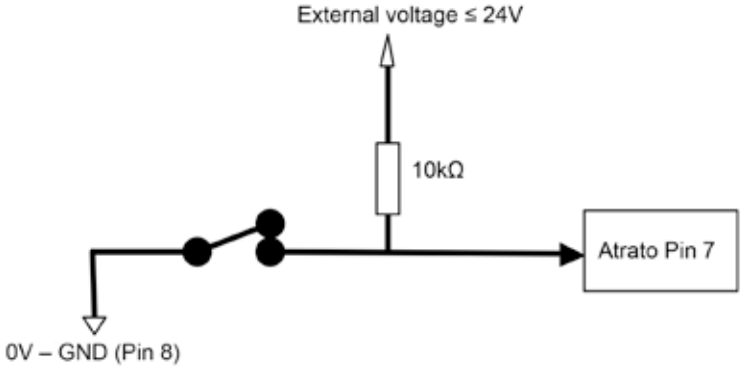
Notes on using electrical inputs to the Atrato

Pin 6 : In input mode, the PNP open collector output is disabled, and the input pin responds to an external input voltage at TTL levels (VinH ≥ 2.4V; VinL ≤ 0.8V). This input must to be driven by an external voltage supply which can safely be in the full range of zero to the external supply voltage. Because of the potential for conflict should the PNP output be activated accidentally, Titan Enterprises Ltd recommend a resistor so that the sink current cannot exceed 5mA. An example circuit is given below:



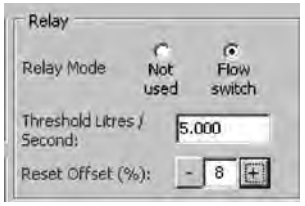
Example Input to Pin 6

Pin 7 : In input mode, the NPN open collector output is disabled, and the input pin responds to an external input voltage at TTL levels (VinH ≥ 2.4V; VinL ≤ 0.8V). This input must to be driven by an external voltage supply which can safely be in the range of zero to 24V. Because of the potential for conflict should the NPN output be activated accidentally, Titan recommend a resistor so that the source current cannot exceed 5mA. An example circuit is given below:



Example Input to Pin 7

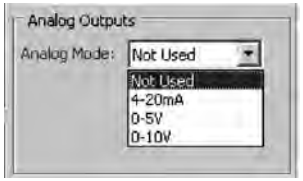
RELAY



RELAY MODE: If the relay is required for a flow switch check the flow switch box and a further set of options for set point and hysteresis will appear.

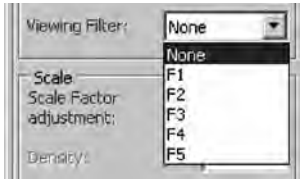
THRESHOLD: Set the required flow rate for the flow switch. The Reset Offset (%) (Hysteresis) is either negative or positive depending on whether a falling or rising alarm is required. The relay has change over contacts but to reduce power consumption the relay is off if positive hysteresis is selected and only powers when the threshold is exceeded. If negative hysteresis is chosen the relay is on up to the set point. The increments are preset and can be cycled through using the + &- buttons. If more than one set point is required either both transistors must be used or one transistor and the relay.

ANALOGUE OUTPUTS



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

OUTPUT/DISPLAY DAMPING



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 F8, which may take up to a minute to stabilise.

REAL TIME VIEW TAB: The large display reflects the meter readings showing on the Atrato LCD Display, if fitted and will mimic that display. The buttons either side have the functions selected on the 'Configuration' screen and also work in parallel with the buttons on the Atrato flowmeter unit itself. The small window below the rate and total display shows various relevant operational parameters whilst the unit is operating e.g. relay status and frequency output if these options are selected; and overfill or under fill if in batch mode.

FLOW RATE: This is the instantaneous flow rate and is updated approximately every 100 milliseconds.

FILTERED FLOW RATE: This is the filtered flow rate and is identical to the LCD display on the flowmeter (if fitted) and the speed of change will depend on the filter setting. The filter will also affect the response time for the analogue outputs and the flow switches.

TOTAL: The total liquid passed since the last reset.

PIN 6 & 7: If no selection is made "Not used" will be in the Notes column. See following text and chart for the display legends.

OR:- When Pin 6 or 7 is set to "Output" and set to "Pulse" this will display the frequency of the running output and the number of pulses per litre selected.

OR:- If it is selected to "Output" and set to "Flow switch" the Value column will show the transistor status either "low" or "high" and the notes will show the selected switch points.

OR:- If "Output" and "Reverse Flow" are selected the Value column will show either "low" or "high" depending on forward or reverse flow.

OR:- If "Input" is selected the Value column will show "high" or "low" depending on the switch condition and "Input Logic level" in the Notes column.

The chart below shows the various display messages for various operating functions. During operation only one message will be shown for each parameter.

Parameter	Value	Notes	Function
Flow rate	2.5000	Litres per minute	Units selected in configuration
Filtered flow rate	2.4981	Litres per minute	This will lag flow rate
Total	16.95	Litres	Total passed since last reset
Pin 6.	Off	Pin not being used	
	152.1Hz	Output Pulses (2000 per Litre)	Frequency output for current flow rate @ 2000 pulses/Litre
	On	Will turn off when rate below 2.7	Flow switch set to 3 L/Min 10% -ve flow.
	Off	Will turn on when rate above 3.3	Flow switch set to 3 L/Min 10% +ve flow.
	Forward	Direction of flow	Reverse flow tab selected
	Low	Input logic level	Left push button selected will momentarily show high when remotely operated
	Low	Input logic level	Right push button selected will momentarily show high when remotely operated
Pin 7.	Off	Pin not being used	
	152.1Hz	Output Pulses (2000 per Litre)	Pulse output selected
	On	Will turn off when rate below 2.7	Flow switch set to 3 L/Min 10% -ve flow.
	Off	Will turn on when rate above 3.3	Flow switch set to 3 L/Min 10% +ve flow.
	Forward	Direction of flow	Reverse flow tab selected
	High	Input logic level	Left push button selected will momentarily show low when remotely operated
	High	Input logic level	Right push button selected will momentarily show low when remotely operated
Relay	Off	Relay not being used	
	On	Will turn off when rate below 2.8	Flow switch set to 3 L/Min 10% -ve flow.
	Off	Will turn on when rate above 3.4	Flow switch set to 3 L/Min 10% +ve flow.
	Off	Total is reset	Batching awaiting start command.
	On	Running	Starts when Left button is pressed
	Batch 0.00	0% will run to > selected volume	When valve opens the volume will count up
	Relay off	Done	This indicates the batch is complete
	Batch (Vol)	Total fluid delivered	This shows the actual delivery volume
	Relay off	Paused	This is if pause (LH) button is pressed during dispense.
			Pressing the button again continues the dispense.
			Pressing restart (RH) button starts the batch again.

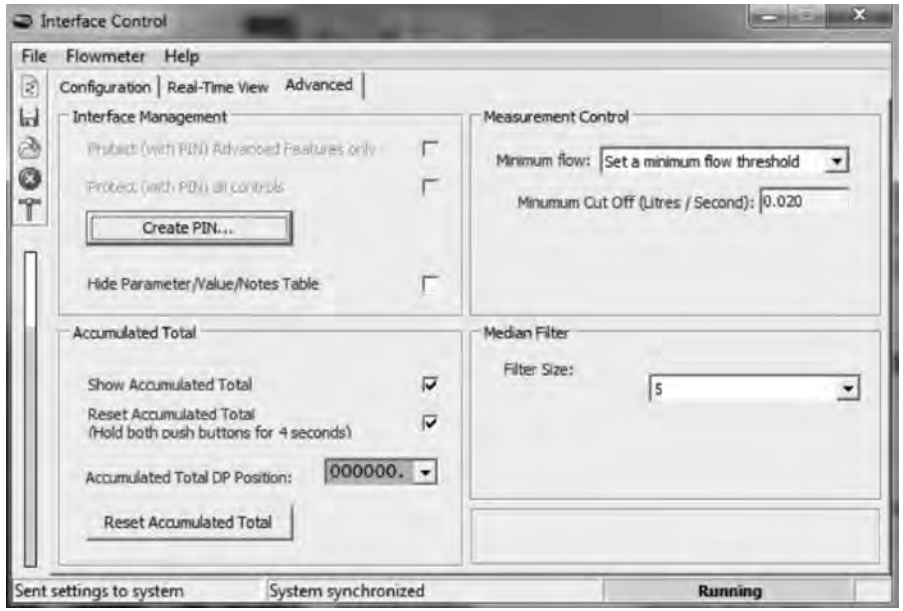
PIN 7: The display for “Pin 7” will function the same as “Pin 6” (see page 13).

RELAY: If no function is set for the relay the Value column will show “Off” otherwise it will display the function and its operating parameters.

BATCHING OPTION: If Batch is selected in the “Display mode” the relay is automatically assigned to the total display for batching pre-set volumes of liquid. The preset batch size can be entered in the relay box. This value will be seen on the LCD display and will count down when the left hand start button is pressed. The batch can be interrupted by pressing the right hand button, in the paused state a further press of the right button cancels the batch. If you wish to continue the batch from the paused state the left hand button continues the dispense from the point it was interrupted.

If an alternative batch size is required after the unit is disconnected from the computer pressing both buttons together for 3 seconds will permit the batch size to be altered by using the right hand key to increment the digit that is flashing and the left hand button to advance to the next digit. Holding the left button for 3 seconds enters the selected numbers and the meter is ready to begin batching. Both buttons can be operated remotely if required e.g. for remote start/stop signals.

ATRATO ADVANCED USER TAB



PIN protection: This is for both the advanced and standard features.

Accumulated total: Accessible and resettable from both the front panel and through the software.

Minimum flow cut-off: This is to ensure that inaccurate low flow measurements are not recorded or returned. This is normally set to the minimum flow for the meter.

Median filter: This is a filter that will remove short term erroneous flow results.

Signal quality: The bar graph should be green, orange is a low signal quality and red is very poor. This usually signifies gas break-out in the fluid or a system not fully bled.

PIN protection.

There are 2 possibilities for the PIN protection:-

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, including the accumulated total reset. 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.

Rate The display shows units and time base e.g. 1.0 Ltr/min.

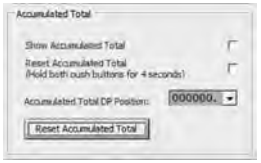
Total The display is static with just the volume e.g. 10.3Ltr.

Accumulated total The display cycles "Ac tot" and the volume e.g. 120.3Ltr.

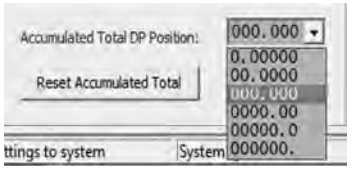
If the accumulated total is displayed and "right button resets totals" is selected in the configuration screen it can be reset by pressing both buttons simultaneously for 4 seconds. If PIN protection is selected the display will change to a flashing curser awaiting the pass word. The left button increments the value and the right button advances to the next digit. After all 4 numbers are entered pressing and holding the right key for 4 seconds resets the Accumulated Total.

If a computer is being used for the reset simply press the "reset accumulated total" box.

Accumulated total.



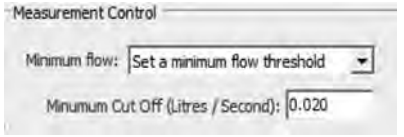
Accumulated total DP position.



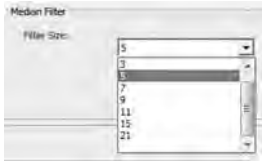
The chevron in the decimal point box calls a drop down selection showing the possible decimal point positions. Please ensure that the value selected has sufficient resolution for your anticipated accumulation period.

This resets the accumulated total. If PIN protection is selected a PIN will be required.

Measurement control.



This sets the minimum flow for the meter. The default is the normal minimum under ideal conditions for the size of meter. This value can be adjusted to suit the operating conditions.



e.g. If the automatic gain control is working hard with an attenuating (ultrasound absorbing) fluid the threshold of operation is automatically raised assuming that the background noise will also be higher. This may not be the case and the meter may perform reliably at a lower flow. One method of establishing a safe minimum flow is to set a low minimum cut off value with no flow and a full pipe. Check the totaliser or rate meter to see if any flow is being recorded if yes increase the minimum flow value and repeat until no flow is seen with zero flow in the pipe.

Median filter.

This filter removes short term anomalies in the recorded 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
0	0
1	1
1	1
2	2
2	2
3	2
0	3
3	3
4	4
4	4
4	4

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 710 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.

5 Technical Specification

Linearity	±1.0% of reading over flow range
Repeatability	±0.1% from 25% to 100% ±0.5% from 0 to 25%
Housing	IP54
Temperature range or	-10 to 60°C assembly with enclosed electronics -10 to 110°C sensor only (for use with remote electronics) -10 to 60°C remote electronics
Fluid temperature range	-10 to 60°C or -10 to 110°C with remote electronics
Storage temperature	-20 to 110°C
Pressure rating	10 bar standard, 30 bar with stainless steel end fittings
Pulse output	PNP or NPN maximum frequency 400 Hz
Relay	24 Vdc 500mA max non inductive
PIN 6 transistor output	PNP 24 V @ 20mA maximum
Input	Pull down resistor required (10K ohm)
PIN 7 transistor output	NPN 24 V @ 20mA maximum
Input	Pull up resistor required (10K ohm)
LCD display	Reflective 6 x 8mm high main characters 2.5mm enunciators Gal. cc. Kg. gms. Ltr. /min /Hr /Sec
4 – 20mA output	into 250 ohm maximum 14 bit resolution ±0.1% linearity (plus flowmeter accuracy)
0 – 10 Volt output	14 bit resolution (14 Vdc min supply voltage) ±0.1% linearity (plus flowmeter accuracy)
0 – 5 Volt output	12 bit resolution
USB	TypeA connector Windows XP or later
Wiring terminals	1mm maximum
Power supply	10 – 24 Vdc (15 -24 Vdc for 4-20mA or 0-10 V)
Power consumption	110mA (plus analogue output current)
Connections	1/2" BSP male PEEK or 1/2" NPT or BSP 316 stainless steel. 3/8" John Guest push-in

MATERIALS OF CONSTRUCTION	
End fittings	PEEK, food and medical grade or 316 Stainless steel
Flow tube	316 Stainless steel as standard Alternative – Borosilicate glass
Seals	Viton as standard Alternative – Nitrile, EPDM, Silicon
Housing	Aluminium extrusion
End caps	ABS
Mounting bracket	ABS
Ext. elastomeric seals	PTE

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TITAN ENTERPRISES LTD.
Coldharbour Business Park, Sherborne, Dorset DT9 4JW
Phone: +44 (0)1935 812790 Fax: +44 (0)1935 812890
Email: sales@atratoflowmeters.com
www.atratoflowmeters.com