

**HIGH PERFORMANCE CLAMP-ON ULTRASONIC FLOWMETER INTENDED FOR SINGLE PHASE  
FLOW MEASUREMENT USING THE TRANSIT-TIME DIFFERENCE TECHNIQUE & ADVANCED DIGITAL  
SIGNAL PROCESSING.**





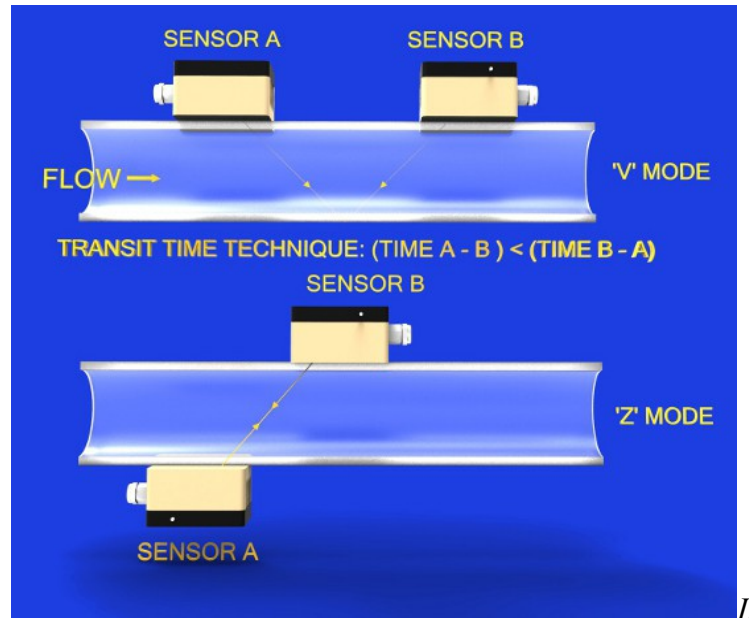
## SPECIFICATIONS

- High performance correlation Transit-time Digital Signal Processing flowmeter
- Rugged IP67 Housing and IP68 Sensors – optimised for the water industry
- Rechargeable lithium polymer batteries
- Very large Lithium Ion battery (17 W/hour battery (4 hour Recharge)) with custom low power logging mode
- USB Connection, Charger, 5 V, 1 A
- Remote Firmware update,
- USB logged data transfer (flow meter appears as a USB disk on PC)
- 32Mbit Data Logger with power saving mode
- High contrast 128 x 64 pixel back lit LED display
- Lightweight, (890 g excluding sensors)
- Auto-sensor recognition – no need to enter sensor type number

### Introduction to the transit-time difference technique.

The flowmeter uses the transit-time difference technique that is a well proven pulse-echo system, where ultrasonic pulses are transmitted between two clamp-on sensors. In a flowing pipe, the downstream pulse-echo travels faster than the upstream echo and a small time shift is measured by state of the art digital electronics. This small time shift or transit-time difference is then translated into the flow based on the information provided by the operator. If the sensors are on the same side of the pipe the ultrasonic wave pulse travels to the far side of the pipe and back, tracing a V shape - V mode and on opposite sides of the pipe, where the pulse travels directly between opposing sensors – Z mode. When setting up you need to know the pipe material, the diameter, the fluid & the pipe wall thickness (you can measure the circumference and use a thickness gauge to measure wall thickness). The flow meter will then calculate the

separation of the sensors and they then need to be installed. The meter will then do all the necessary calculations and measure & log the flow rates.



*Illustration 1: Sensor Configuration*

The transit-time equation is;

$$Flow = \frac{\Delta * t * c^2 * K}{2 * D * \tan(\theta)}$$

$\Delta t$  is the transit-time difference

c – Fluid sound speed (calculated by the flow meter)

K – Flow profile correction factor based on the Reynolds number, fluid viscosity & density

D – Internal pipe diameter

$\theta$  – Angle from the pipe normal (90° to the flow).

The flowmeter works best on single phase fluids, but will tolerate entrained particulates and air. The device has powerful transmit and receive electronics and advanced sensors that recover very small signals. The overall accuracy tends to be 2-3 % in most installations, but results of 1% are possible with in-situ calibration. Sensors are handcrafted and built into pairs that have excellent long term stability and zero error has been minimised through careful design and manufacture. The best materials are used throughout, starting with the PEEK transducer bodies. This material is exceptionally rugged, having one of the highest strengths & melting points of any thermoplastic available today.

#### 400-PF Connections

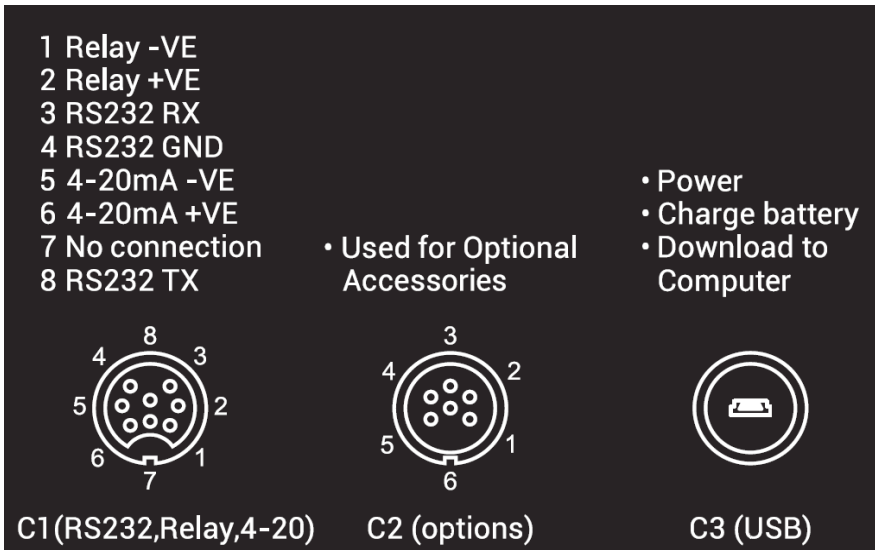


Illustration 2: 400-PF Connections

CONNECTOR	DESCRIPTION
S1	Sensor 1
S2	Sensor 2 (& Thickness gauge)
C1	Communications 1 x Current Output (Scalable Isolated 4-20mA), 1 x Comms (Relay and RS232) 1 x Configurable Opto-Isolated Relay.
C2	Reserved for optional plug in components such as the dual temperature board (for energy flow)
C3	Power & data download - Mini USB (type B) Charge and Download

**Performance Specifications**

Flow Measuring principle: Complete coded signal correlation measuring transit time difference

Range Bi-directional up to 25 m/sec

Processor electronics resolution: Typically  $0.01 \times 10^9$  seconds For water and different pipe bores this equates to:

Pipebore[mm]	50	200	1000
Velocity[mm/sec]	0.300	0.075	0.015
Flow[litre/sec]	0.001	0.003	0.012

Overall resolution: Defined as still water noise time difference, typically  $0.2 \times 10^9$  seconds to peak. For water and different pipe bores this equates to:

Pipe bore [mm]	50	200	1000
Velocity [mm/sec]	6	1.5	0.3

Flow rate [litre/sec]	0.01	0.05	0.23
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Zero bias: Time difference for zero flow with internally smooth pipes typically better than 1 x 10<sup>9</sup> seconds For water and different pipe bores this equates to:

Accuracy without process calibration	±1 - 2% of reading + zero bias
Accuracy with process calibration	±0.5% of reading + zero bias

Speed of Sound Measuring principle: Completed coded signal correlation measuring mean transit time during normal operation.

Range 800 to 2,000 m/sec	Accuracy <0.25% read value	Resolution 2 mm/sec
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Wall thickness Gauge

Measuring principle Complete coded signal correlation measuring echo reflection times. Uses separate (optional) thickness transducer.

Range Metallic pipe: 2 - 50 mm	Plastic pipe: 2 - 30 mm	Accuracy 0.1 mm	Resolution 0.05 mm
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Temperature Measuring principle: External input from 2 channel 4 - 20mA temperature sensors

Range -40 to 150°C	Accuracy 1% of reading	Resolution 0.1°C
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Factory Calibration available. This function (Energy flow measurement) is available separately using the options port and using the Two channel RTD Input Board (OPB2RTD).

Fluids Types

Sonically Conductive

Sediment/Air levels < 20% but volumetric fluid flow will not be accurate with entrained sediment/air

Pipe Material Metals, glass, and sonically conductive homogeneous polymers/plastics

Lining Bitumen, glass, epoxy paint and most concrete liners. Excludes loose liners

Operational

Languages [Programmable through new software update – please consult factory for new translations]:English. Distributors can often translate into local languages, and then that can be software updated.

Units Selectable: Feet, meters, ml, litres, m<sup>3</sup>, ft<sup>3</sup>, pints, gallons, US gallons, seconds, minutes, hours, days. Plus user defined units and time. Input units in metric and Imperial.

Power Supply: 3.7V 10Ah Internal Battery Rechargeable (5 hour recharge) - lithium polymer batteries  
 Battery life, (nominal) Standard: 32 hours continuous use (LCD on, back-light on).

Low power mode.

This minimises power consumption. The LCD and all other outputs are shutdown and the device goes into a low power mode, except when it is sampling. Therefore the battery life depends very much on how often readings are taken.

Logging Interval

<b>Logging Interval</b>	<b>Normal Operation (backlight off)</b>	<b>Low Power Mode</b>
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1 per second	48 hours	Log interval 2 seconds minimum
1 per 30 seconds	48 hours	11 days
1 per minute	48 hours	21 days
1 per 5 minutes	48 hours	80 days
1 per 10 minutes	48 hours	160 days

\* For 'special' logging requirements please contact the factory.

External Controls: RS232 (8 data, 1 stop bit, none] baud rate up to 115200  
 Inputs Transit Time Sound Speed 2 sensors, single channel

1 x Analogue 4-20mA isolated current output. Choice of output under software control so can be set to any parameter measured by flowmeter, range, scale and window

Totaliser (pulse) Alarm 1 x opto-isolated relay. 60 V, 1500 V isolation. Choice of output under software control, 1 KHz maximum.

Site Information: 16 separate sites. Data rate, start/stop times, RTC setting

Settings: 4 Hz standard update rate, with user set moving average (1 - 360 seconds).

Logging interval: User set from 1 - 9999 seconds and average over period is logged

Display Type: 128 x 64 pixel LCD graphic. Blue LED Back-light.

Data Points: Alpha-numeric and Graphics display output, graphs and logging traces

Logging 32 Mbit: Universal multi-point data-logger, 416,900 records  
 e.g. flow and Date/time

Keypad: 9 keys, On/Off on Keypad

External Connections:

Military & Industrial Specification connectors are used throughout – Ensure protective caps are fully screwed on with when a connector is not used.

Physical

<b>TEMPERATURE SPECIFICATION</b>		
Temperature Range	Low Temperature [°C]	High Temperature [°C]
Transducer (Standard SENS-STD-XXX, Mini, SENS-MINI-XXX) * Note: Pipe Temperature, with ambient surroundings can then be +200°C (maximum).	-40	+120 * Note.
Sensor Cable	-20	+80
400-PF Electronics unit	-10	+50
Storage Temperature Transducers	-40	+120
Storage 400-PF Electronics unit	-20	+50
<b>INGRESS PROTETION RATING SPECIFICATION</b>		

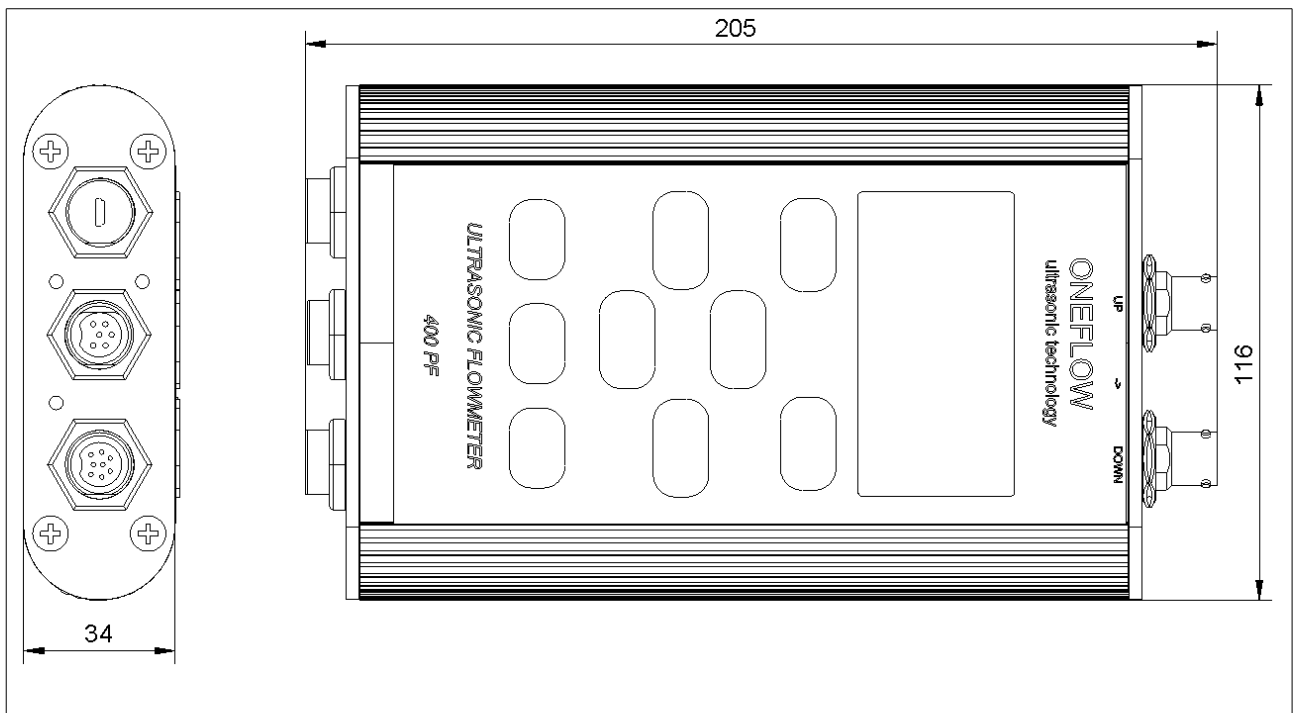
Transducer & Cable	IP68
400-PF Electronics Unit & Connectors	IP67 (ensure caps are tightened)
<b>CABLE LENGTHS</b>	
Standard Sensor length	2.9 metres
Optional length (specify when ordering) SENS-STD-1MHz-XXM (where XX = length in metres)	5m, 10m, 15m, 25m to to a maximum of 100m. (consult factory for any other special requirements)
<b>TRANSDUCER MOUNTING OPTIONS</b>	
Rail mounting with chains for from 13mm diameter up to 2000+ mm. Chains for larger pipes with alternative magnetic blocks for ferrous metal pipes. Permanent rail (with protective cover) also available using 'jubilee' permanent straps.	
<b>PHYSICAL DIMENSIONS</b>	
Dimensions 400 Series Control Unit	182 x 115 x 34 mm
Shipping Weight	2 kg.
<b>PHYSICAL MATERIALS</b>	
400-PF unit: Anodised aluminium, stainless steel (304L). Transducers PEEK and Acetal with aluminium/stainless steel mounting block/rails. All materials corrosion resistant in most outdoor applications (not Marine).	

Kit contents supplied in carrying case.

- 1 x Main Electronics units
- 1 x pair of sensors
- 1 x clamping rail
- 1 x 250 mL water based couplant
- 1 x 4GB USB stick with manuals and calibration certificate.
- 1 x bubble level
- 1 x 5 metre retractable tape measure
- 1 x Universal 80-240 V Charging adapter
- 1 x 8 way communications lead



Main unit Dimensions.



*Many thanks for taking the time to read this data-sheet and considering a ONEFLOW Technologies product. Please contact us or one of our representatives for further information.*