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# atrato

## Ultrasonic Inline Liquid Flow Meter Series 700

### A breakthrough in flowmeter technology

Utilizing patented technology that enables it to operate with excellent accuracy over very wide flow ranges, across the whole span, the Atrato range of inline flowmeters is a genuine breakthrough in flowmeter technology. Its rugged, clean bore construction makes the Atrato ideal for a whole range of low-flow applications, and its USB port allows software connectivity at literally the touch of a button. Its signal processing system permits flow measurement across the whole range of the Reynolds number, allowing both viscous and non-viscous liquids to be metered accurately. The Atrato can handle low flows from laminar to turbulent and is largely immune from viscosity. It has excellent turndown, repeatability, and linearity and can monitor flow over a range of 250:1. Accuracy is better than  $\pm 1.0\%$  of reading.

The USB connection permits the user to monitor the rate and total on their laptop directly and alter some operating parameters, such as the pulse resolution and units. The time of flight measuring system measures both the upstream and downstream flight times, and half the difference is the velocity of the fluid. The patented system measures these time differences to an accuracy of better than 250 picoseconds, giving excellent meter performance. As the pipe geometry is known, the resulting pulse output is accurate for the volume passed. This performance is further enhanced by the primary signal-to-noise ratio, which is typically 2000:1 and at times as high as 3000:1.



### Features



- Measurement down to 2 ml/min (0.032 gph) of liquid flow
- Accuracy better than  $\pm 1.0\%$  of reading over the entire flow range
- Repeatability  $\pm 0.1\%$  over 25 - 100% of the flow range
- Turndown ratio up to 250 : 1
- Through bore, no moving parts
- Wetted materials PEEK® / 316L Stainless Steel or PEEK® / Borosilicate Glass
- Pulse and analog outputs, hardwired relay, and liquid crystal display
- USB interface for configuration and real-time view
- Pressure rating 10 bar (145 psi) and 30 bar (435 psi)
- Temperature rating up to 110 °C (230 °F)



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## How it works

The Atrato Series 700 system uses the well-proven time of flight measuring method, which is far more reliable and accurate than Doppler shift measurement, where reflected signals are required from irregularities in the liquid. The MetraFlow crystals are plain disks with a hole in the center forming a washer, which are excited in such a way that they oscillate radially as opposed to the normal mode of excitement, which is across the thickness of the ceramic. This strong radial signal sends symmetrical pulses directly into the tube.

Because of these annular ring crystals, the sound traveling down the pipe can be considered as a plane wave. The signal-to-noise ratio is remarkable as there is little background noise and high signal strengths. As the system is fully balanced at zero flows, the two signals are identical and cancel each other out. This gives a very stable zero flow condition and is the basis of the flowmeters high ratio between minimum and maximum flows. As the flow increases, these signals go out of phase, and this phase shift is measured to an accuracy equivalent to 250 picoseconds.

In addition, the sound waves traveling down the tube in the Atrato's operating system are symmetrical. As a result, any changes in the fluid's velocity profile across the tube diameter will be averaged out by the signal as it passes from the transmitter to the receiver. Therefore, whether the fluid velocity profile is fully formed with turbulent flow or completely laminar with a classic parabolic shape is irrelevant. This gives the Atrato an excellent immunity to Reynolds number changes and good high viscosity performance.

## Technical Specifications

|                      |                                                                                                                                                                                           |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Accuracy:            | ± 1.0% of reading over entire flow range                                                                                                                                                  |
| Repeatability:       | ± 0.1% over 25 - 100% of the flow range<br>± 0.5% over 0 - 25% of the flow range                                                                                                          |
| Flow ranges:         | see table 1                                                                                                                                                                               |
| K-factor:            | see table 1, adjustable with configuration software                                                                                                                                       |
| Pulse output:        | NPN, PNP and relay – 24 Vdc / 100 mA, non-inductive                                                                                                                                       |
| Analog output:       | 4 – 20 mA, 0 – 5 V and 0 – 10 V selectable                                                                                                                                                |
| Display:             | Liquid Crystal, 6 x 18 mm characters, 2.5 mm enunciators (optional)                                                                                                                       |
| Temperature range:   | -10 – +60 °C (14 – 140 °F) – non-condensing<br>-10 – +110 °C (14 – 230 °F) – separate, almost identical enclosures, electronics/display and flow tube; max. 5 m (16 ft.) cable in between |
| Pressure range:      | up to 10 bar (145 psi) and 30 bar (435 psi) for stainless steel fittings only                                                                                                             |
| Flow tube material:  | PEEK® / 316L Stainless Steel or PEEK® / Borosilicate Glass <sup>1)</sup>                                                                                                                  |
| Seal:                | Viton, Nitrile, EPDM, Silicone or Kalrez                                                                                                                                                  |
| Wetted materials:    | 316L Stainless Steel or Borosilicate Glass, PEEK®, choice of seal                                                                                                                         |
| Process connections: | 3/8" John Guest or 1/2" BSPP in PEEK® - pressure rating 10 bar (145 psi)<br>1/2" NPT Stainless Steel – pressure rating 30 bar (435 psi) <sup>1)</sup>                                     |
| Enclosure:           | aluminum and PEEK® end caps; IP54 / NEMA 3                                                                                                                                                |
| USB Interface:       | incl. software and cable; Windows XP or later                                                                                                                                             |
| Power supply:        | 10 – 24 Vdc (15 - 24 Vdc when using analogue outputs)                                                                                                                                     |
| Calibration:         | for water @ 20 °C (68 °F), incl. calibration certificate with K-factors                                                                                                                   |

<sup>1)</sup> pressure rating 30 bar (435 psi) for PEEK® / 316L Stainless Steel flow tube with stainless steel fittings only!!



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## Flow Ranges and Pulses

| Model | Range<br>liter/min | Range<br>gal/min | Max. Freq.<br>Hz | Set K-factor<br>1/liter *) | Set K-factor<br>1/gallon *) |
|-------|--------------------|------------------|------------------|----------------------------|-----------------------------|
| 710   | 0.002.....0.500    | 0.0005.....0.132 | 1000             | 40000                      | 151400                      |
| 720   | 0.007.....1.70     | 0.0019.....0.450 | 1000             | 10000                      | 37854                       |
| 740   | 0.02.....5.00      | 0.005.....1.32   | 1000             | 4000                       | 15140                       |
| 760   | 0.1.....20.0       | 0.026.....5.28   | 1000             | 1000                       | 3785                        |

\*) the flowmeter will be set for the K-factor in 1/liter as listed; the user can adjust it up to the max. K-factor. [Table 1](#)

## Outputs, Display and Engineering Units

The Atrato provides standard a scalable analog output, a hardwired relay, and NPN and PNP pulse outputs. The pulse outputs are available if the Atrato has to replace and mimic a standard turbine or another flowmeter with pulse output. The K-factor – the number of pulses per unit of volume – can be set for the desired value, up to the listed maximum in Table 1. A pull-up resistor must be used with a current-sinking output (NPN) and a pull-down resistor for a current sourcing output (PNP). The transistors can also be used as a flow switch.

The free-scalable analog output can be selected to be 0 – 5 V, 0 – 10 V, or 4 – 20 mA. The minimum and maximum value of the output can be set with the standard configuration software for any flow rate within the range.

The hardwired relay is suitable for 24 Vdc, 100 mA, non-inductive, and as a flow switch, it allows for an adjustment of the setpoint and the hysteresis for any flow rate within the range. Alternatively, the relay can be set to operate in batch mode, allowing switching at a total value of the volume flow.

The large liquid crystal display is an optional feature. The software allows the setting of the display mode to be rate, total, both, or batch. Any selection will alter the dialog box accordingly to the available settings and choices.

The software allows for selecting a time base and one of the most common engineering units for volume and mass flow; if the engineering unit of choice is not available, "Custom Units" can be selected.

## Considerations

The Atrato is an ultrasonic flowmeter using the time of flight measuring method, which puts limits on the presence of particles and gas bubbles. A rule of thumb is a maximum of 5 – 10 % in volume. The Atrato is a through bore, and there are no moving parts, no obstacles; however, an inevitable pressure drop is created by the increase resp. decrease of the connected process pipes or tubing. Click [here](#) to see guidelines for the pressure drop over the Atrato.

If there is no backpressure (e.g., an open connection downstream), the vapor pressure will create elongated gas bubbles in the flow tube, attenuating the ultrasound and resulting in erroneous measurements. To avoid the creation of gas bubbles, a backpressure must be introduced. A rule of thumb is to have a backpressure of 2 times the vapor pressure plus 7 psi. Please note that temperature can considerably influence the vapor pressure, and the vapor pressure of different liquids can differ significantly. It does not mean it has the same properties if it looks like water.



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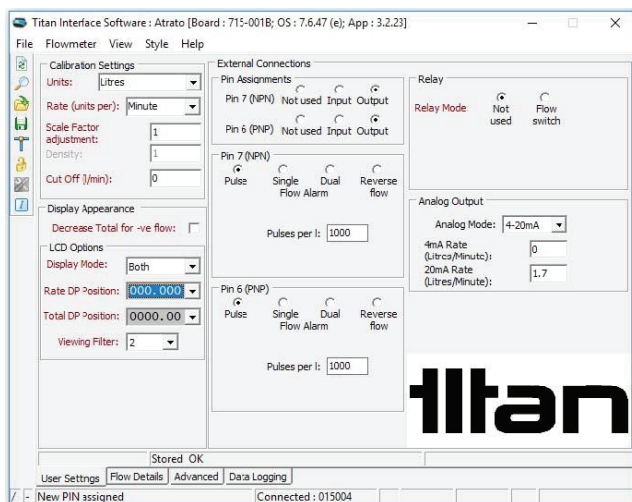
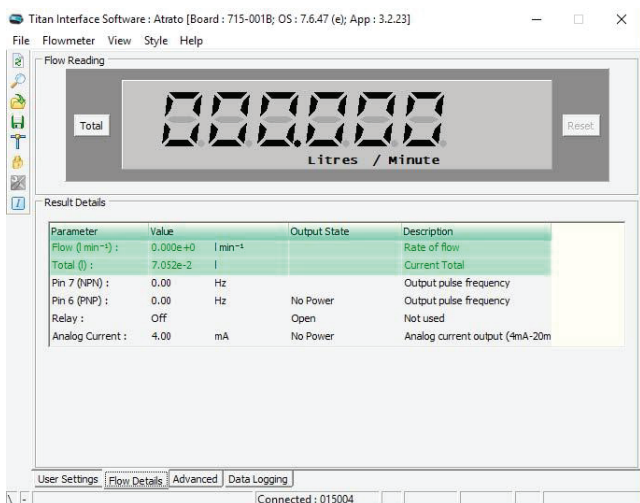
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## Interface Software

The interface software comes standard with the Atrato, delivered on a USB stick together with relevant literature and graphs. The software will easily install on any Windows computer (Windows XP and later). The Atrato is available for configuration, real-time view, and data logging when the connection is made. The interface software dialog box shows four tabs, the settings, flow details, advanced, and data logging. On the Advanced tab, a Signal Position graph is provided, indicating the proper functioning of the Atrato. The graph changes color if the ultrasonic sound signal is severely attenuated, for instance, because of an overload of gas bubbles.

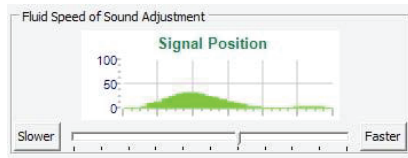


The configuration dialog box allows for all obvious settings, like the display mode, engineering units, number of significant digits, the use and settings of both pulse outputs, and an adjustable K-factor if used as a pulse output flowmeter. The selection of the analog output and the scaling versus the flow rate. The hardware relay settings and a viewing filter complete the configuration's dialog box.

The Real-Time View tab is precisely what the title entails. It shows the display, even when the Atrato itself is blind, and a list of real-time values and the setting of several parameters. The Atrato can be operated from the computer on the USB power supply (5 V) alone. Not all functions will

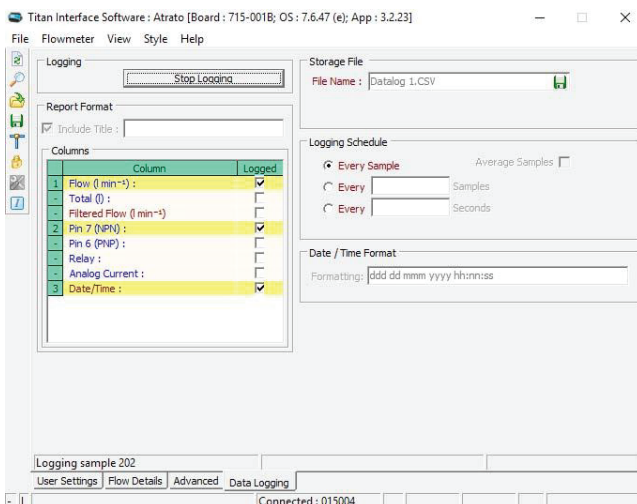
be available; for instance, there will be no analog output – an overview table is listed in the manual.

The Advanced tab allows for adding PIN protection and other settings obviously for the advanced user. The Speed of Sound (SoS) is an essential property



for an ultrasonic flowmeter, and the Atrato is suited for a wide range of Speed of Sounds. It is calibrated with water, with an SoS of 1,484 m/s (4869 ft/s). For other fluids, the user might adjust the SoS if it differs roughly  $\pm 30\%$  or more.

The Data Logging permits the external storage of the flow rate data, total flow, and many other parameters. Users can select from various functions and periods over which to store results. Flow data sets are saved as .csv files on the external computer.







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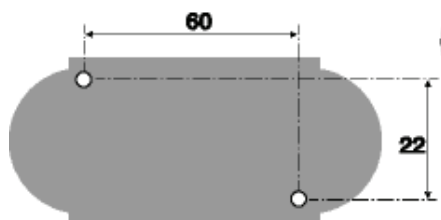
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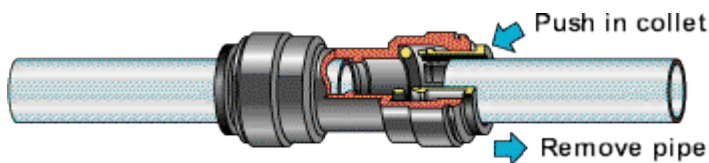
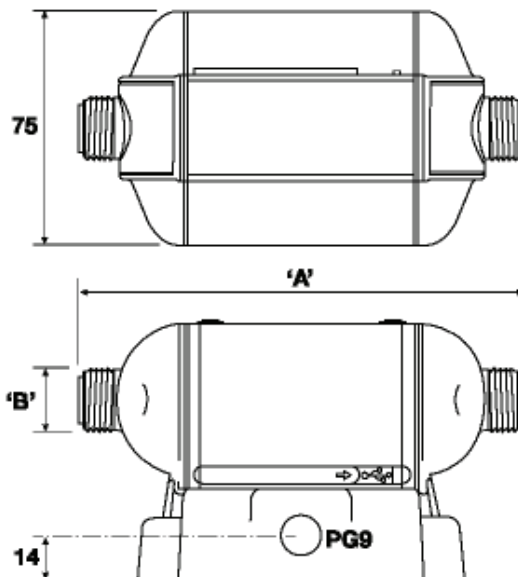
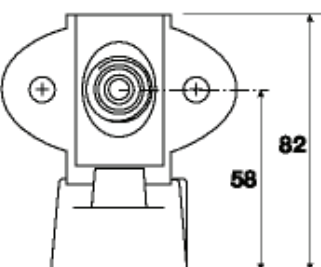
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## Dimensions and Connections

| 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              |



Dimensions in mm



John Guest fittings

| Wetted Parts        | Atrato Series 700 Wetted Materials Combinations |         |      |                    |        |
|---------------------|-------------------------------------------------|---------|------|--------------------|--------|
| Process connections | PEEK                                            |         |      | Stainless steel    |        |
| Joint component     | PEEK                                            |         |      |                    |        |
| Seal                | Viton                                           | Nitrile | EPDM | Silicone           | Kalrez |
| Flow tube           | Stainless steel                                 |         |      | Borosilicate glass |        |



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## Pictures of Different Models



1/2" BSPP Connections in PEEK



3/8" John Guest Fittings, mounting bracket, display, and USB



1/2" NPT Stainless Steel Connections



Flow tube enclosure for remote electronics, 110 °C (230 °F) and 1/2" BSPP PEEK



Remote electronics enclosure with display and mounting bracket



Bottom, screw terminals for power supply and outputs.



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## Model Numbering System

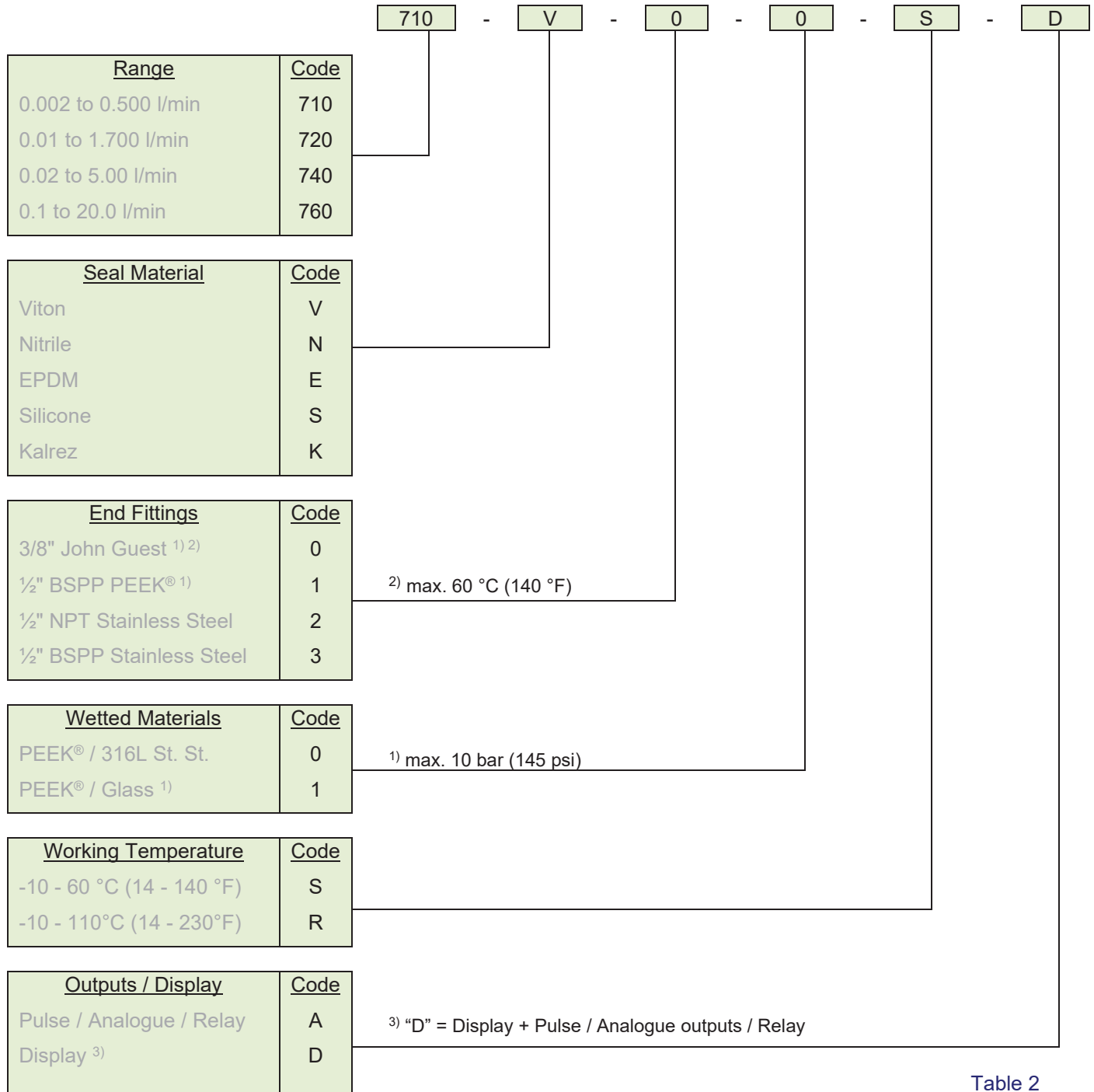


Table 2

### Order example: 760-V-0-0-SD

Range 0.1 to 20 lpm, with Viton seal, 3/8" John Guest fittings, PEEK® / 316L St. St. wetted material, standard temperature range and pulse/analog outputs, and liquid crystal display.