EFMS
External Flow Measurement System for Aggressive and High Purity Fluids

Background
The EFMS is an external device that measures the flow of critical fluids without the risk of contamination and leaks. The system is comprised of TWD series sensor packages remotely connected to the DIN32 signal processing unit via chemically resistant cables. Splitting the system allows the use of remote sensor which is compatible with aggressive environments and elevated temperatures, while still using a sophisticated and feature-rich signal processing controller. The DIN32USFT is a compact transmitter, designed to be installed in a tool’s electrical cabinet. It can interface with legacy analog control, digital PLC, or advanced HMI tool panels. Besides the average flow rate, the system also measures batch totals, the velocity of sound of the fluid, and pump dynamics. The system has digital outputs to use as alarms or as direct controls in the absence of a PLC.

TWD Series Ultrasonic Sensors
The TWD series sensors are comprised of a pair of refracting ultrasonic transducers in a fixed frame which supports the semi-rigid tubing. All exposed surfaces are made of PTFE and PEEK with fluoro-silicone seals to prevent damage from ozone and corrosive fluids. The body is safe for water wash down and fluid temperatures up to 110C and ambient conditions up to 70C. It is available in a range of tubing sizes from ¼ inch to 1 inch. The unique slide lock (patent pending) allows for a fast, positive mount with anti-vibration locks. The system is metal free and corrosion resistant and easy to install even when wearing multiple layers of gloves. No gels or films have to be applied to the tube to make the measurement work.
DIN32 USFT

The DIN32USFT is a compact two-channel signal processor and flow transmitter. Instead of sending a voltage or current through the sensors, the DIN32USFT sends short electrical pulses at a high frequency and very low duty cycle. These milliwatt signals are translated into ultrasound by the sensors that are guided through the fluid. The DIN32USFT digitizes the returned pulse and precisely measures the time for the signals to pass through the sensors. From this information, it calculates the velocity of the fluid and the speed of sound of the fluid. From these, the volume and mass flow rate of the liquid is calculated. Batch totals of volume and mass are also tracked.

The DIN32USFT can operate two separate sets of sensors. This can be used to make two independent flow measurements or combine the measurements to find a sum or difference.

The DIN32USFT delivers flow data using a Modbus-RTU command syntax over either a RS232 or RS485 link. It can also indicate flow by pulse on the optically isolated digital outputs or as a current on one of two analog outputs.

Modification to be system configuration can be made over the Modbus port or using a field programmer attached to the HMI/AUX port. This port contains a UART and a CAN interface so the unit can be integrated into a tool’s existing control panel.

The DIN32USFT also is equipped with two optically isolated digital inputs and two analog inputs from an externally biased loop sensor. The digital inputs can be used to clear totals and disable totalizers for batching and calibration processes. They are self biased and can be activated by passively providing a low impedance. The loop inputs can be used to digitize and log extra temperature or pressure sensors. This data can also be used by the meter for custom equations of state.

The DIN32USFT has adapters to be fitted to a standard DIN rail or customized to be mounted in any cabinet. The case is NEMA 1 compatible and provides solid thermal ties to the mount points to prevent system temperature rise.
Applications
The EFMS system is ideal for measuring fluids where high purity must be maintained; the fluids are extremely aggressive and leaks pose a safety risk; and where crevices voids and flow restrictions must be avoided. As the sensors mount directly to outside of an existing tubing, there is no chance for leaks or contamination. It makes it ideal for retrofitting into existing applications or in locations too tight to swage or weld in a conventional meter.

The powerful signal processing capability of the unit allows it to work on unstable flows with high levels of en-trained solids and gasses.

Examples of industries and processes where the EFMS system could be useful are:

➢ Semiconductor Production
  ♦ SPM1 and SPM2 etch removal chemicals
  ♦ CMP slurry
  ♦ Saturated ozone/DI solution

➢ Food And Beverage
  ♦ Cellulose pulp slurry
  ♦ Concentrated acidic additives
  ♦ Emulsions

➢ Chemical Processing
  ♦ Hydrofluoric condensate
  ♦ Concentrated sulfuric acid

Specifications
The following is a breakdown of the specifications for each part of the system.

TWS sensor pair

<table>
<thead>
<tr>
<th>Standard Tube Sizes</th>
<th>25.4 mm</th>
<th>19.1 mm</th>
<th>12.7 mm</th>
<th>6.3 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Flow</td>
<td>70 l/m</td>
<td>40 l/m</td>
<td>15 l/m</td>
<td>3.5 l/m</td>
</tr>
<tr>
<td>Minimum Flow</td>
<td>2 l/m</td>
<td>1 l/m</td>
<td>0.5 l/m</td>
<td>0.1 l/m</td>
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<tr>
<td>Maximum Void Fraction*</td>
<td>5 %</td>
<td>5 %</td>
<td>5 %</td>
<td>5 %</td>
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<tr>
<td>Repeatablity</td>
<td>1 %</td>
<td>1 %</td>
<td>1 %</td>
<td>3 %</td>
</tr>
</tbody>
</table>

* Higher void fractions can be measured but repeatability and stability are reduced.

DIN32USFT

Input Voltage        18-36VDC
Maximum Power        10 Watts
Channels             2 Independent or 1 Composite Output
Primary Comm         RS232/RS485 Modbus RTU CRC16
Logic Outputs        4 Optically-Isolated, Open-Drain 40mA maximum
                     Configurable as Pulse, Alarm, and Batch Control
Logic Inputs         Hi-Z 10kΩ Output Impedance
                     Configurable as Clear Total, Error Blanking, and Calibration Sync
Analog Output        2 4-20mA Isolated Current Loop: Mapped to Flow, Mass-Flow, and Fluid VOS
Analog Input         2 4-20mA Current Loop (Referenced to Supply):
                     Mapped to Channel Temperature and Pressure