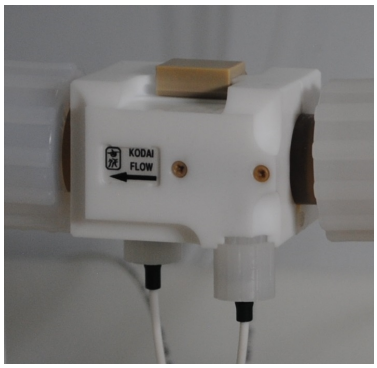

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EXTREME FLUID MEASUREMENT SYSTEM

Product Introduction

The EFMS is a digital flow measurement system designed specifically for the aggressive fluids used in semiconductor, MEMS, and pharmaceutical productions. The EMFS is a combination of a fluoropolymer sensor mounted on existing tubing and remote digital processing electronics. This allows the sensor to be located inside a processing tool despite having a high-temperature and corrosive environment. The digital transmitter can be mounted in the electronics cabinet convenient to the other controls and power supply.

The EFMS uses an ultrasonic time-of-flight method to measure the flow of the liquid. Since the sensor elements are mounted externally to the process tube, the units can be installed without any interruption to the process. This also eliminates any chance for leaks or contamination of ultra-pure fluids.

Sensors are available in these standard sizes for high purity PFA tubing:

Type 16 (25.4 mm OD 1.59 mm Wall)
Type 12 (19.1 mm OD 1.59 mm Wall)
Type 8 (12.7 mm OD 1.59 mm Wall) **pre-production*
Type 6 (9.53 mm OD 1.59 mm Wall) **pre-production*
Type 4 (6.23 mm OD 0.08 mm Wall) **pre-production*

Advantages

* Leak Free, Zero Possible Contamination
* High Stability, Low Drift
* Smart Meter w/ Process Diagnostics
* Digital Output, Internal logging
* Stable Under Pulsating Flow
* High Temperature Operation
* Retrofit Installation without Interruption
* Easy, Snap-on Sensor Installation

Applications

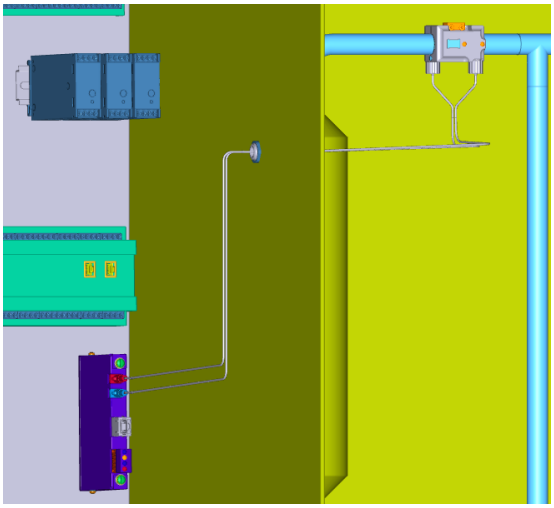
* Wet Etch Processes
* CMP Slurries
* Ultra Pure Fluids
* Un-Damped Pulsating Flow
* Upgrade Tools for Digital Monitoring
* Reducing Operator Maintenance
* Tool Life Monitoring

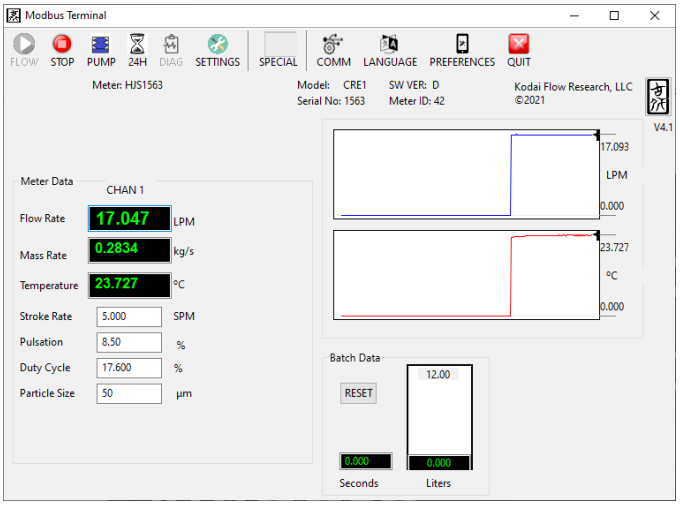
Theory of Operation

The EFMS uses the principle of ultrasonic time-of-transit to measure the rate of flow for liquid suspensions. This method transmits short pulses (>4µs) of high frequency acoustic energy and measures the time it takes for the pulse to transit across the fluid. The flow rate is calculated by the difference in the transit time with or against the flow. KFR has advanced this proven technique by introducing the use of wavelet-based signal processing. This digital processing overcomes the limitations of spread-spectrum devices in highly attenuation fluids and viscous-elastic materials common to semiconductor processes.

System Detail

The EFMS is a combination of a digital-flow transmitter and remote sensor frame. The sensor frame contains two ultrasonic transducers at an exact position and keeps the tubing straight and concentric over the measurement path. It also provides insulation to minimize heat loss. The frame contains no active electronics, exposed metals, and can be used up to 150 °C. It is IP67 compliant and connected to the transmitter with FEP jacketed high-temperature cable. This allows the active electronics to be installed in adjacent safe area designated for electronics.



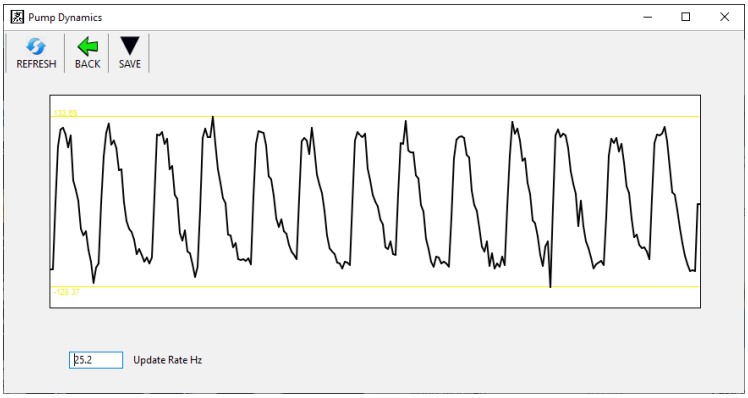


Data Management

Besides the isolated pulse and current loop outputs, the EFMS has a suite of process and fluid data available via the Modbus-RTU or CANbus interfaces. In addition to flow rate, the meter can provide mass flow, estimated fluid temperature, and detect particle clumps or bubbles in the fluid. KFR provides a application to log and monitor the data on PC, Linux, and Mac. Example C code is also provided to retrieve the data directly using 256-byte packets with an CRC-16 wrapper.

Process Health Monitoring

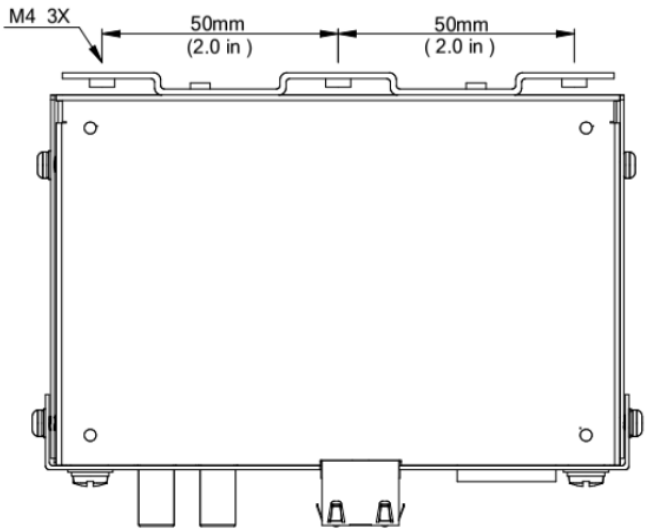
The CRE1 transmitter is equipped with ample internal memory so it keeps a circular log of 24 hours of flow statistics. It also keeps a running buffer of instantaneous fluid flow rates. This provides valuable data into the health of the pump and valve system. An example of a double diaphragm pump operating at 50 strokes per minute is shown.

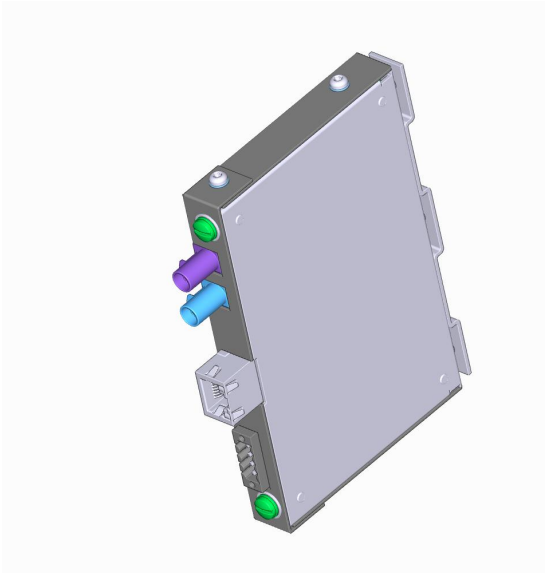


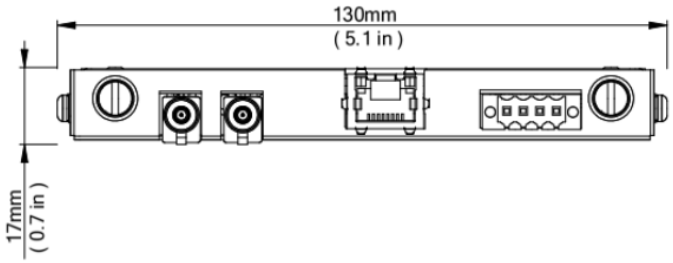
Component Specifications

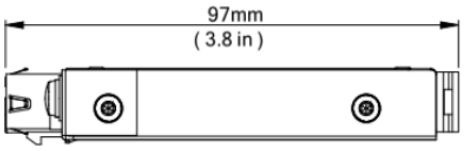
CRE1 Flow Transmitter

Input Power:	22-26VDC (4 Watts MAX)
Analog Output:	1 ea. 4-20mA Current Loop
Digital Output:	1 ea. Isolated Ext. Bias OC 50ms Pulse Width
Digital Inputs:	2 ea. Isolated Self Biased
Communication:	RS485 +A/-B MODBUS RTU
Enclosure:	IP10 (NEMA 1 STYLE)
Cooling:	Passive Mini-Blade or Convection
Mounting:	3 ea. M4 Screws



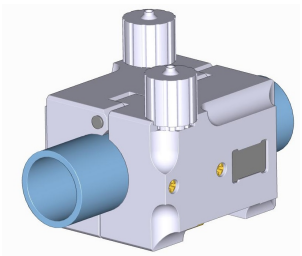


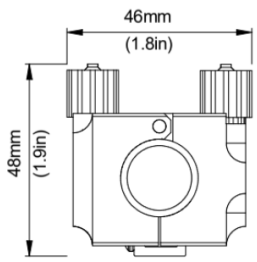


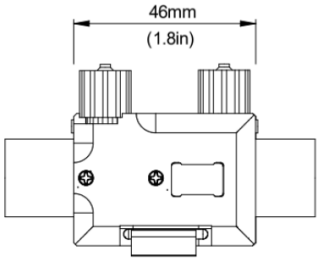


TWD20 Sensor

Tube Size:	Type 12 PFA Tube (19.1mm OD 1.59 mm Wall)
Housing:	Metal-Free, Chemical Resistant, IP67 Compliant
Cables:	Fixed, Twin Coax w/ FEP Jacket, Flouro Seal, FAKRA Termination
Ambient Temperature:	Minimum 10 ˚C – Maximum 50 ˚C
Fluid Temperature:	Minimum 10 ˚C – Maximum 150 ˚C
Measurement Range:	5 *lpm* to 100 *lpm* with 0.05 *lpm* Resolution
Uncertainty:	+/-3% of reading ♦
Repeatability:	+/-1% of reading ♦♦

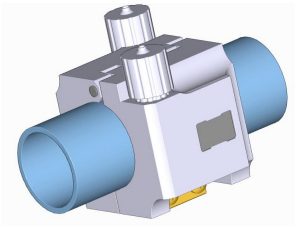


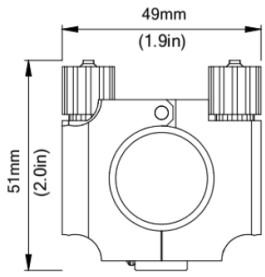


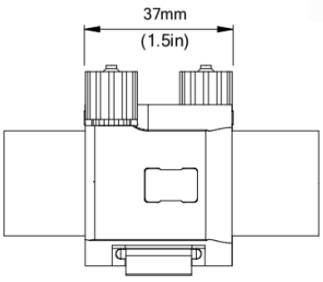


TWD25A Sensor

Tube Size:	Type 16 PFA Tube (25.4 *mm* OD 1.59 *mm* Wall)
Housing:	Metal-Free, Chemical Resistant, IP67 Compliant
Cables:	Fixed, Twin Coax w/ FEP Jacket, Flouro Seal, FAKRA Termination
Ambient Temperature:	Minimum 10 ˚C – Maximum 50 ˚C
Fluid Temperature:	Minimum 10 ˚C – Maximum 150 ˚C
Measurement Range:	10 *lpm* to 200 *lpm* with 0.1 *lpm* Resolution
Uncertainty:	+/-3% of reading ♦
Repeatability:	+/-1% of reading ♦♦







♦ *Performance evaluated in water, from 20 ˚C to 40 ˚C, with recommended installation conditions. Consult factory for other viscosity and temperatures.*

♦♦ *Repeatability degrades for pulsating flow with less than 30% duty cycle. Avoid operation at laminar transition zone. Consult factory for detailed installation recommendations.*