

# COMPACT FLOW METERS FOR PHOTORESIST LIQUID APPLICATIONS

U70X Series

Microturbine Flow Sensor

Model U709



## APPLICATION IDEAS

Analysis sample rate verification

Totalizing chemical injection streams

Test stand flow monitoring

Upgrading rotameters to monitor flow rate

# Product Description

McMillan U70X Series Flow Sensors are capable of measuring extremely low flow rates. Model U709 will precisely measure flow rates of virtually any photoresist chemical, whether a short burst of flow or a continuous flow. Dispenses as short as 500 milliseconds and volumes as low as 0.1 grams can be detected repeatably.

Repeatable results are achieved using a patented Pelton-type microturbine wheel. This proven design has been providing precision results since 1988 and has developed a well-deserved reputation for continuous operational service for many years without failure.

Because of its compact size and affordable cost, McMillan's Model U709 Flow Sensor is suitable for a wide variety of industrial, commercial, laboratory and OEM applications. PTFE, FFKM, and Sapphire wetted parts ensure compatibility with chemicals commonly found in microelectronics manufacturing processes, including deionized water, CMP slurries, acids, solvents, and photoresist.

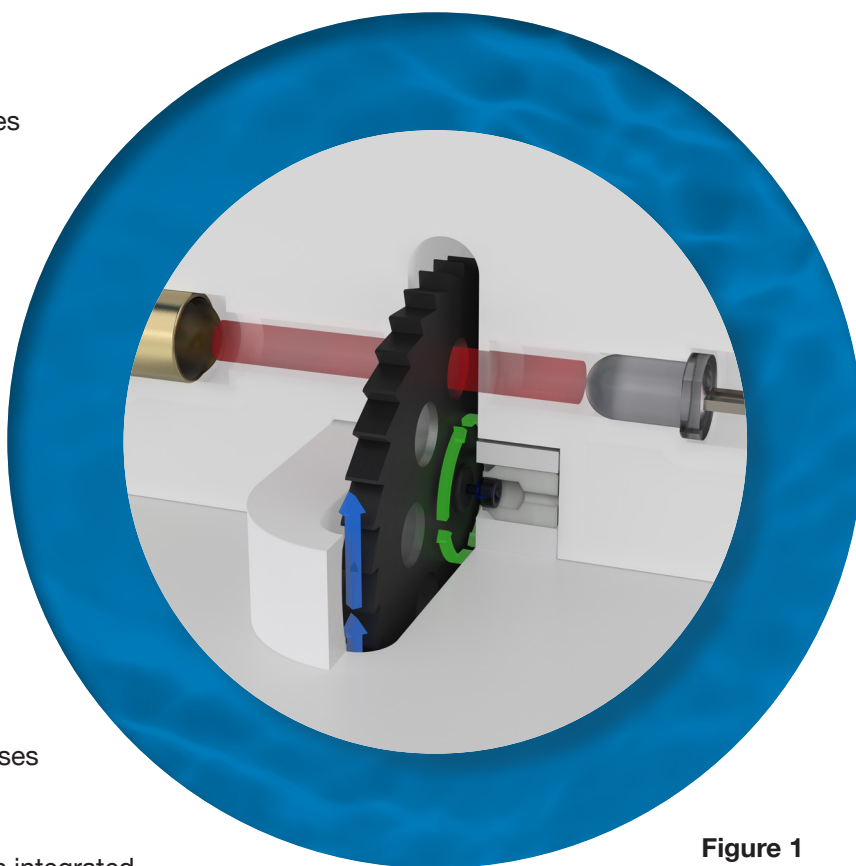
## Principle of Operation

McMillan's microturbine wheel technology utilizes the Pelton turbine wheel concept. This design allows for use of a miniature turbine wheel to measure flow. The wheel is supported on a very small sapphire shaft, held in position by two maintenance-free bearings. Due to the light weight of both the wheel and the shaft, the microturbine wheel is virtually suspended in the flow path. This suspension effect relieves force on the shaft and bearings, eliminating wear.

As flow passes through the flow sensor, it is directed onto the very small teeth of the wheel using a precision-machined nozzle. (As shown with blue arrows in Figure 1) This nozzle is sized according to the flow range of the unit. The rotational speed of the turbine wheel increases proportionally to the volumetric flow rate.

The microturbine wheel has translucent sections integrated into the wheel. An infrared emitter (as shown with red in Figure 1) is located on one side of the wheel, and a sensor on the other. As the wheel rotates, (as shown with green arrows in Figure 1) the infrared beam is alternately interrupted and passed through, detecting wheel speed, and generating a pulse based on flow.

Increased flow causes the wheel to spin faster, increasing the pulse rate. When the wheel stops (under zero flow conditions), no pulses are generated. This eliminates the possibility of "zero drift" and the need for adjustments to the instrument's zero reading. Processing circuitry provides analog and/or pulse outputs that are linearly proportional to the flow rate.



**Figure 1**  
Representation of  
microturbine technology

# Features and Options

## FLOW RANGES

Continuous flow ranges from 7 – 50 mL/min up to 100 – 1,000 mL/min are available. See the Ordering Information section for proper sizing for various dispense cycles. Consult the factory or an authorized representative for custom requirements.

## POWER

Units may be specified to operate with either 12 VDC or 24 VDC power. Various power adapters are also available for use with 12 VDC versions.

## SIGNAL OUTPUTS

The Model U709 features a pulse output, typically 0-200 Hz up to 0-800 Hz (consult the unit's calibration certificate for the exact frequency output).

## ACCURACY/LINEARITY

Pulse output models have an accuracy specification of  $\pm 3.0\%$  full scale or better (including linearity) for stable viscosities.

## FLUID CONNECTIONS

All units have PFA Male Flare connections as standard.

## CALIBRATION

All units are calibrated at the factory using deionized water and a calibration certificate is supplied with each unit. For fluids with viscosities different to water please contact the factory for further information.

## ELECTRICAL CONNECTIONS

All units have an integrated 7-pin connector. Several mating cable options are available.

## WETTED MATERIALS

All units have only PTFE, FFKM, and Sapphire as wetted parts.

## DISPLAYS

McMillan has a comprehensive range of remote displays for use with U70X Flow Sensors. For further information, please contact the factory or an authorized representative.



# Specifications

Except where noted all specifications apply to operation at +25°C

	U709
<b>Accuracy</b> (including linearity, best fit straight line)	± 3.0% full scale *
<b>Repeatability</b>	up to ±0.2% full scale (based on an average of multiple readings)
<b>Pressure Rating</b>	Working Pressure: 60 psig [ 4 barg ]* Overpressure Limit: 85 psig [ 5.8 barg ]
<b>Temperature Rating (Fluid)</b>	41 to 113 °F [ 5 to 45 °C ]
<b>Temperature Rating (Environment)</b>	Operating Range: 41 to 113 °F [ 5 to 45 °C ] Storage Range: 32 to 158 °F [ 0 to 70 °C ]
<b>Wetted Materials</b>	PTFE Sapphire
<b>Seal Material</b>	FFKM
<b>Recommended Filtration</b>	25 microns or less
<b>Compatible Media</b>	Optimum performance with stable liquid viscosities (< 80 cS), degassed
<b>Power Requirements</b>	12-15 VDC Units: 12-15 VDC, 50 mA typical 22-25 VDC Units: 22-25 VDC, 50 mA typical
<b>Electrical Connections</b>	7-pin connector Nylon housing
<b>Pulse Output</b>	Square-wave Collector output Pulls up to V+ Frequency output at maximum flow varies from 300-500 Hz depending on the orifice and media
<b>Zero Drift</b>	None
<b>Warm-Up Time</b>	None
<b>Response Time</b>	Typically < 300 milliseconds for 97% of final value
<b>Calibration Interval</b>	Calibration should typically be verified once every 12 months
<b>Reliability</b>	100,000 Hours MTBF (testing ongoing)
<b>Certifications</b>	CE Approved; 89/336/EEC (EN 55011 & EN 50082-1) 73/23/EEC Low Voltage Directive
<b>Ratings</b>	IP64 (NEMA 4X)
<b>Warranty</b>	1 Year Limited

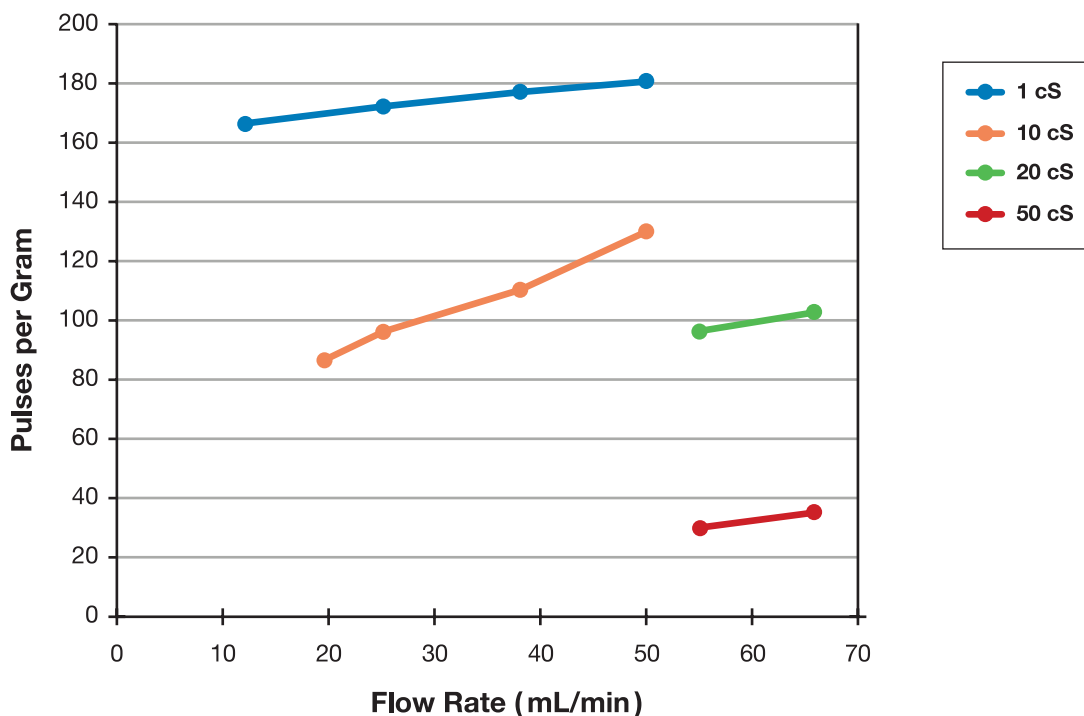
\* Accuracy specification is for water. Linearity will vary with viscosity of liquid.

# Specifications

Except where noted all specifications apply to operation at +25°C

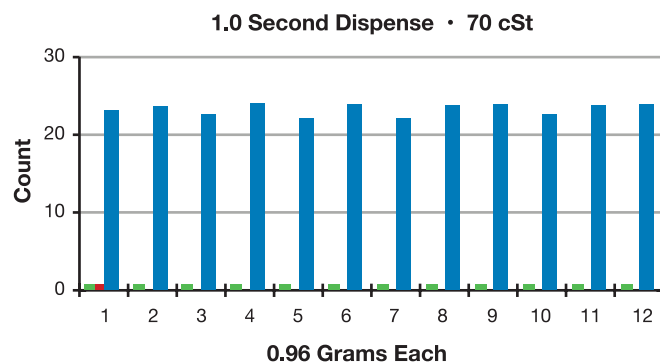
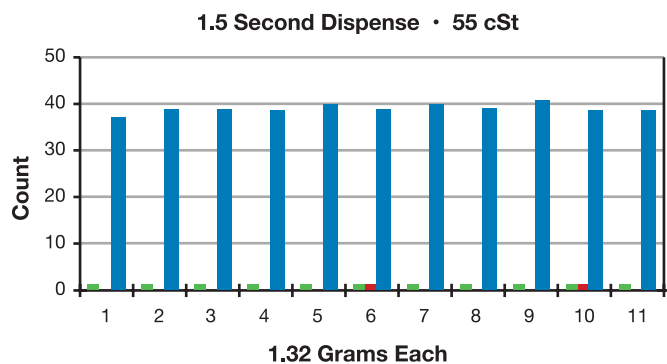
## Typical Response

The following chart shows the typical response of the U709 at varying viscosities. The results detailed illustrate the best range range for optimum performance. Data may be obtained outside these ranges with varying success. Further data may be requested from the factory.



## Typical Repeatability

The following charts show the typical repeatability and average fluid dispense. The results show combined real data including valve dispense variation, flow sensor accuracy and pulse data resolution effects.

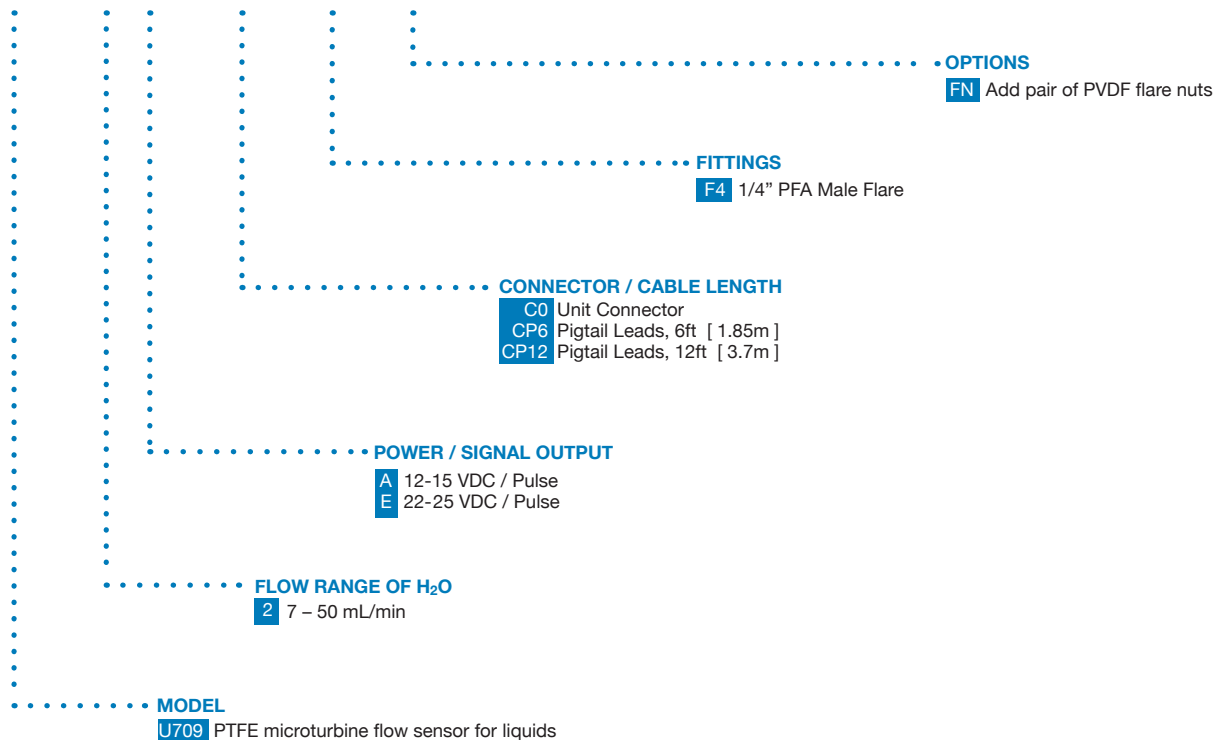


# Ordering Information

## Form part number as follows:

(Model) - (Flow Range)(Power/Signal) - (Cable/Connector) - (Fittings) - (Options)

**U709 - 2 - - F4 -**



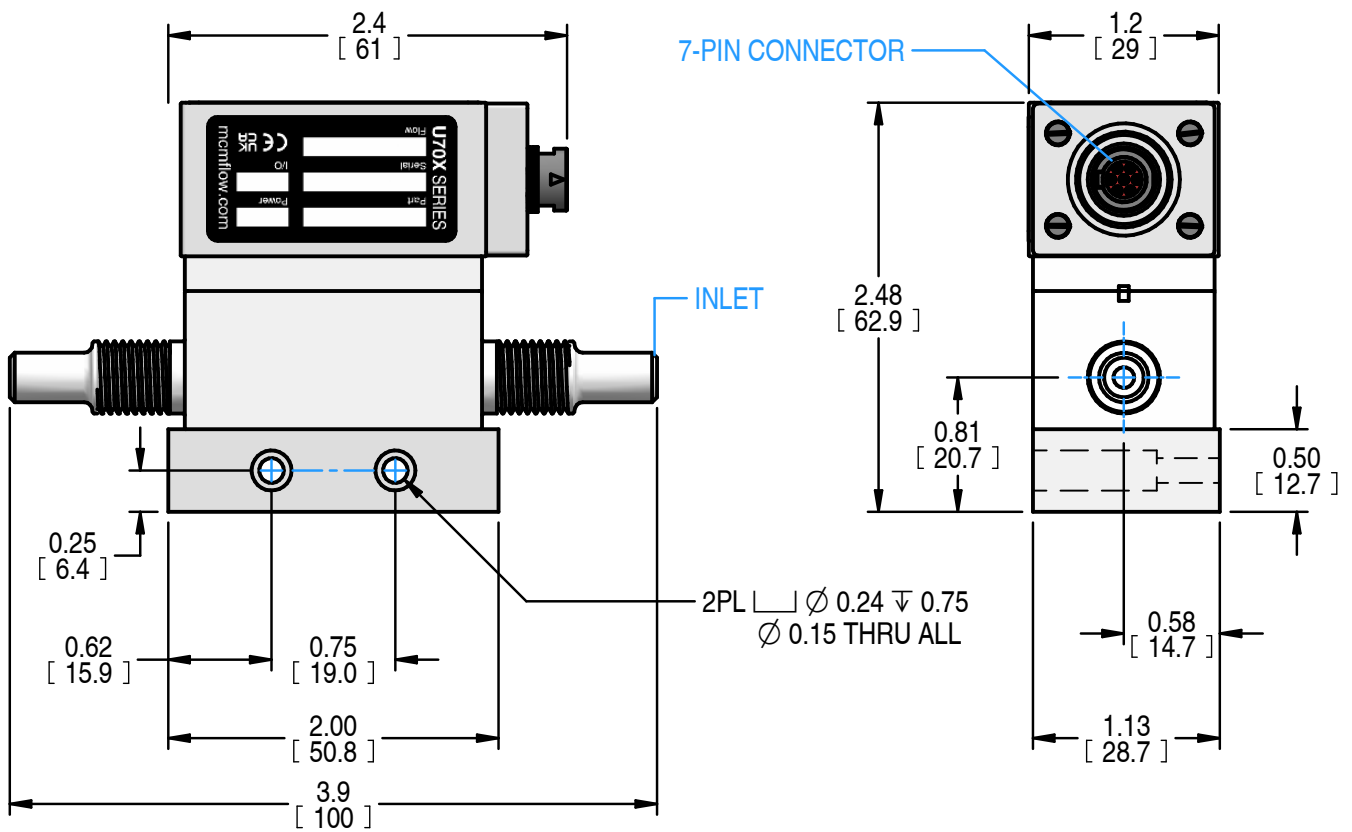
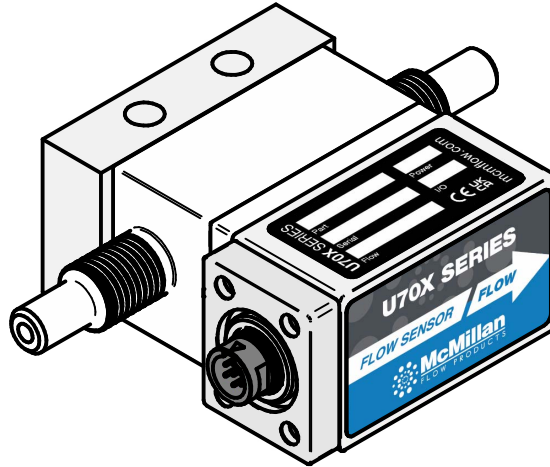
## EXAMPLE

U709-2A-CP6-F4 would give you a U709 flow sensor rated for 7 – 50 mL/min of water or similar fluid. The power required would be 12-15 VDC, and the output would be pulse. Fluid connections would be 1/4" male flare fittings. A PVC-jacketed 6 foot [ 1.85 m ] cable would be included.

# Dimensions

All dimensions shown in inches [mm] unless otherwise noted.

## U709



## Related Products



### IRIDIUM Flow Controllers

Modular flow controller platform  
for liquid applications



### U80X Series Flow Controllers

Integrated microturbine  
Liquid Flow Controllers



### Model 275 Display

Digital panel display for use  
with the U70X Series



McMillan Flow Products  
P.O. Box 1340  
Georgetown, Texas 78627  
Toll-Free: (800) 861-0231 (U.S.A. only)  
Direct: +1 (512) 863-0231  
Email: [sales@mcmflow.com](mailto:sales@mcmflow.com)  
Website: [www.mcmflow.com](http://www.mcmflow.com)