Flow Monitors for Photoresist Dispense Verification

Model U709 LIQUID FLO-MONITORS

UHP LIQUID

APPLICATION IDEAS

Verifying photoresist pump dispenses

Reducing photoresist usage by setting accurate low flow alarms

PRODUCT DESCRIPTION

McMillan Model U709 UHP FLO-MONITORS 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 by using a patented* microturbine flow sensor design. This design, unlike traditional paddlewheel designs, provides accurate flow measurement with no particle generation or elemental contamination. PTFE, perfluoroelastomers, and sapphire wetted parts ensure compatibility with chemicals commonly found in microelectronics manufacturing processes, including deionized water, CMP slurries, acids, solvents, and photoresist.

These FLO-MONITORS integrate the sensing element with advanced electronics to provide output signals proportional to flow rate. Each unit is individually calibrated before shipment, and a certificate of calibration accompanies all FLO-MONITORS. The reliable technology used reassures process engineers of consistent results.

PRINCIPLE OF OPERATION

The Model U709 Liquid FLO-MONITOR for photoresist dispense applications provides a proportional pulse output based on volumetric flow rate.

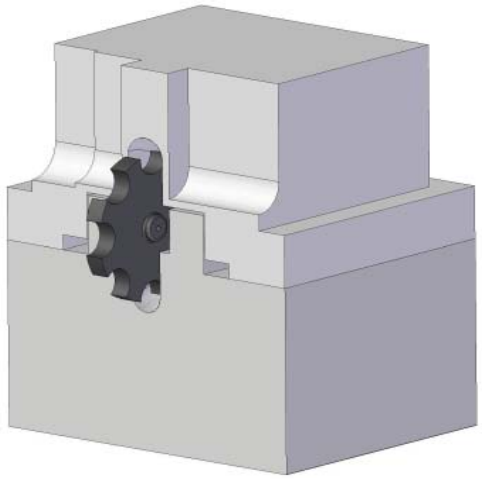


Figure 1. Cutaway of sensor technology.

McMillan's patented* microturbine wheel technology utilizes the Pelton turbine wheel concept. This design allows for use of a minature microturbine wheel. The wheel is supported on a very small sapphire shaft, held in position by two sapphire bearings. Due to the light weight of both the wheel and the shaft, the microturbine wheel virtually floats in the liquid. This flotation effect causes the turbine wheel to be suspended in the middle of the bearings and thus eliminates shaft and bearing wear. Therefore, no particles are generated.

As flow passes through the FLO-MONITOR, it is directed onto the very small teeth of the wheel using a precision-machined nozzle. 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 features small teeth evenly spaced around the outside of the wheel. As the wheel rotates, a light beam is projected through the wheel. A light detector on the other side of the wheel detects each tooth and translates those signals into pulses. As the wheel spins faster, pulse rate increases. When the wheel stops (under zero flow conditions), no pulses are generated. Consequently, zero drift is not possible and zero adjustments are never required. Processing circuitry provides a pulse output that is linearly proportional to the flow rate.

Figure 2: Wheel and bearing assembly.

McMillan UHP

* US Patents 5,542,302; 7,426,875; 7,051,757. Other patents pending.

FEATURES AND OPTIONS

FLOW RANGES
Continuous flow ranges from 7-50 mLpm up to 100-1,000 mLpm are available. See the Ordering Information section for proper sizing for various dispense cycles. Consult the factory for custom requirements.

POWER
Units may be specified to operate with either 12 VDC or 24 VDC power.

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 ±3.0% full scale or better (including linearity) for stable viscosities.

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.

FLUID CONNECTIONS
All units have male Flaretek® compatible connections. Non-standard connection types may be available upon request.

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

WETTED MATERIALS
All units have only PTFE, perfluoroelastomers, and sapphire as wetted parts.

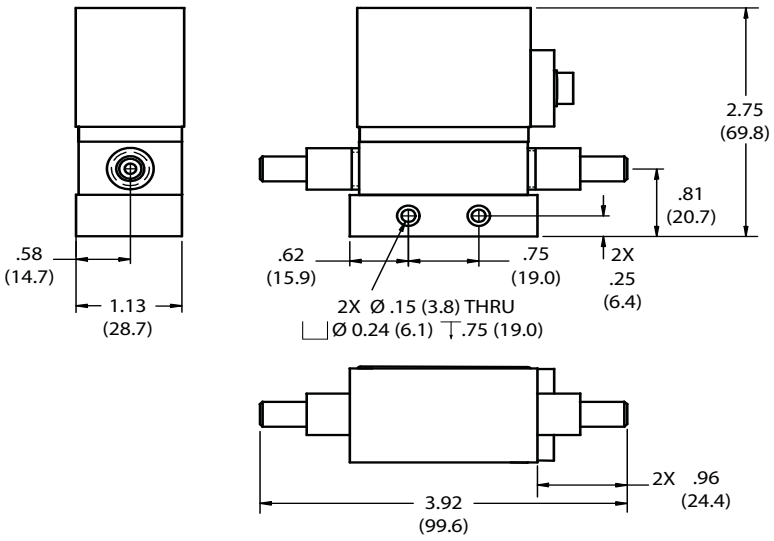
DISPLAYS
McMillan has a comprehensive range of remote displays for use with UHP FLO-MONITORS. Please request further information from the factory.

SPECIFICATIONS

	U709
Accuracy (including linearity, best fit straight line)	±3.0% Full Scale[1]
Repeatability	up to ±0.2% Full Scale (based on an average of multiple readings)
Pressure Rating	80 psig (5.4 bar) working 100 psig (6.8 bar) overpressure
Temperature Rating (Fluid)	Standard: 5 to 45ºC
Temperature Rating (Environmental)	Operating: 5 to 45ºC Storage: 0 to 70ºC
Wetted Materials	PTFE, Sapphire
O-Ring Material	Perfluoroelastomer[2]
Exterior Surfaces	PTFE, Polypropylene, Polyester, Viton®, Epoxy
Recommended Filtration	20 microns or less
Compatible Fluids	Minimum amount of entrained air, optimum performance with stable liquid viscosities <80 cS
Pulse Output	Square-wave Collector output Pulls up to V+ Frequency output at maximum flow varies from 300-500 Hz depending on the orifice and media
Zero Drift	None
Warm-Up Time	None
Calibration Interval	Calibration should typically be verified once every 12 months
Power Requirements	12-15 VDC Units: 12-15 VDC, 50 mA typical 22-25 VDC Units: 22-25 VDC, 50 mA typical
Electrical Connections	7-pin connector Nylon housing when used with CPx cables
Response Time	Typically <300 milliseconds for 97% of final value
Reliability	100,000 Hours MTBF(testing ongoing)
Certifications	CE Approved 89/336/EEC (EN 55011 & EN 50082-1) 73/23/EEC Low Voltage Directive
Ratings	IP64 (NEMA 4X)

1. Accuracy specification is for water. Linearity will vary with viscosity of liquid.
2. Contact factory for current compound.

DIMENSIONS

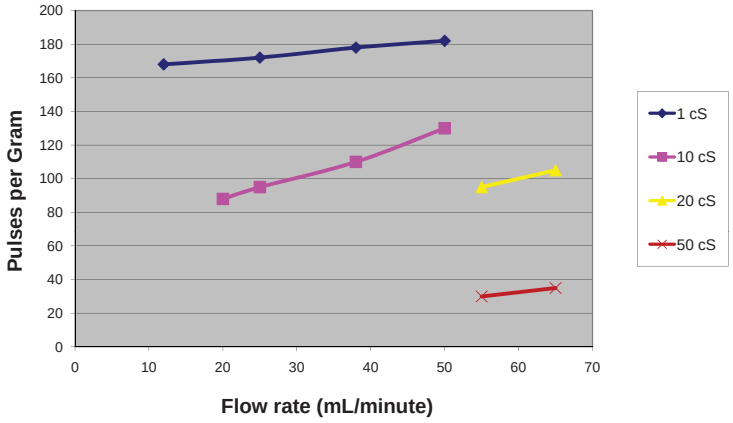


Dimensions shown are in inches(mm). All dimensions shown are for Model U709 FLO-MONITOR with 1/4” male flare fittings (F4) and are similar for other models. Specific model dimensional drawings may be requested from the factory.

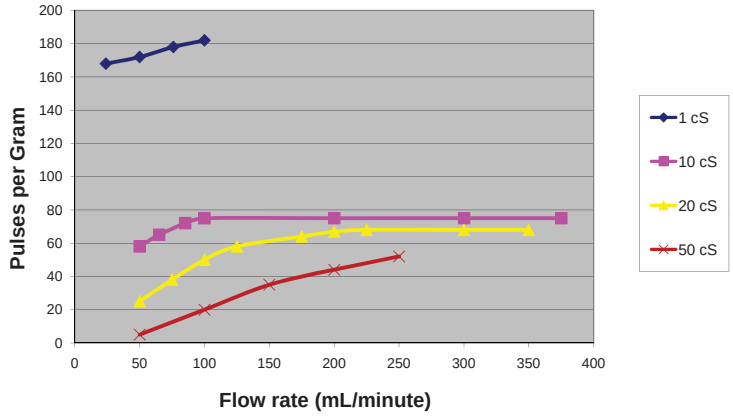
TYPICAL RESPONSE

The following charts show the typical response at varying viscosities. Data shown is for the Model U709 FLO-MONITOR with 1/4" male flare fittings (F4). 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.

0.021" Orifice



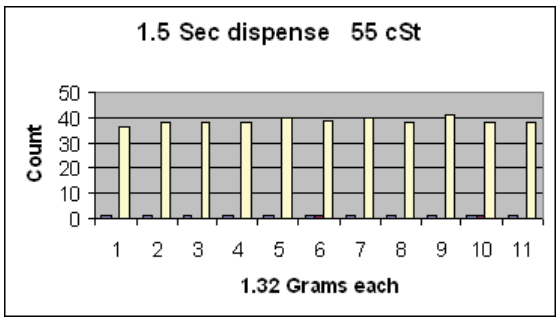
0.035" Orifice

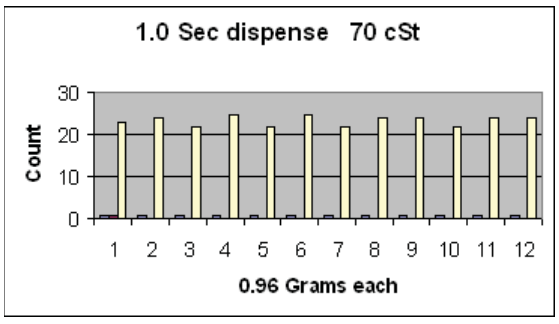


Example: A unit with a 0.035" orifice flowing a liquid with viscosity of 50 cS at 200 ml/min would have an output of 44 pulses / gram. For a 1 second dispense time at 200 ml/min you will receive 3.5 grams and 145 pulses. For a 1/3 second dispense at 200 ml/min you will receive 1 gram and 45 pulses.

TYPICAL REPEATABILITY

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





ORDERING INFORMATION

Form part number: (Model Code) - (Flow Range)-(Power/Signal) - (Fittings) - (Options) - (Mating Cable).	Code
U709 UHP Liquid FLO-MONITOR	U709
Orifice Size (Flow range in mLpm of H_2O)	
0.021" (7-50)	2
0.025" (15-100)	3
0.035" (20-200)	4
0.048" (50-500)	5
0.070" (100-1000)	6
Power / Signal Configuration	
12-15 VDC Power / Pulse Output	A
22-25 VDC Power / Pulse Output	E
Fittings	
1/4" male flare (Flaretek® compatible)	F4
Options	
Include Pair of PVDF Flare Nuts	FN
Mating Cable	
None (not recommended)	C0
PVC-jacketed, 6 feet long (1.85 m)	CP6
PVC-jacketed, 12 feet long (3.7 m)	CP12
ACCESSORIES	
Displays	
(Order Separately, More Information Available)	
220 Rate/Total Display, 8 digit, battery powered	220
251 Multi-Function Display, 115 VAC Power	251
251E Multi-Function Display, 230 VAC Power	251E

Example:

U709-3-A-F4-CP6 would give you a U709 FLO-SENSOR rated for 15-100 mLpm. The power required would be 12-15VDC, and the output would be pulse. Fluid connections would be ¼" male flare fittings. A PVC-jacketed 6 foot (1.85 m) cable would be included.

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Viton – Reg TM E.I. DuPont Dow Elastomers LLC

Flaretek – Reg TM Entegris, Inc.

Bulletin U709-S001

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