



Compact Liquid Flow Controllers for UHP Applications

Model U802 INTEGRATED LIQUID FLO-CONTROLLER®



UHP LIQUID

APPLICATION IDEAS

Upgrading peristaltic-pump based chemical delivery systems

Automated online blending, spiking, and dosing

Precision batching and dispensing



PRODUCT DESCRIPTION

McMillan Model U802 UHP FLO-CONTROLLER® will precisely measure and control flow rates of virtually any fluid as low as 15 mLpm or as high as 10 Lpm. 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. An integrated proportional control valve is utilized to regulate flow rate. 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.

Each unit is individually calibrated before shipment, and a certificate of calibration accompanies all FLO-CONTROLLERS. A repeatability specification of $\pm 0.2\%$ full scale reassures process engineers of consistent results.

PRINCIPLE OF OPERATION

The U802 Liquid FLO-CONTROLLER integrates the sensing element with an advanced proportional control valve to regulate flow rate. This concept is very similar to the operation of mass flow controllers (MFC's) for gases. An analog signal is provided to the FLO-CONTROLLER as a set point. That signal is processed and compared to the actual flow rate, which is provided in realtime by the integrated sensor. Any difference between the two signals results in adjustments to the internal valve, thus automatically maintaining the requested flow rate.

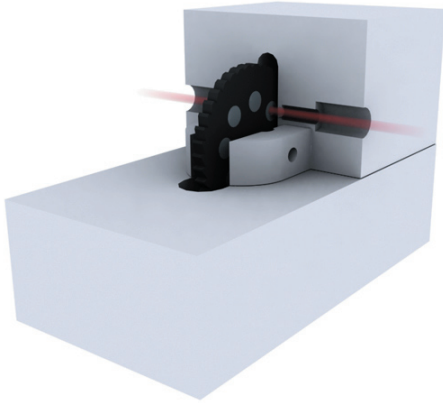


Figure 1. Cutaway of sensor technology.

As flow passes through the FLO-SENSOR, 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 8 small windows, evenly spaced around the center of the wheel. As the wheel rotates, a light beam is projected through a PTFE window and onto the wheel. A light detector on the other side of the wheel detects each window 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.

McMillan's patented* microturbine technology utilizes the Pelton turbine wheel concept. This design allows for use of a miniature microturbine wheel about 0.8 inches (20 mm) in diameter. The wheel is supported on a small sapphire shaft, held in position by two sapphire bearings. Due to the low mass 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.

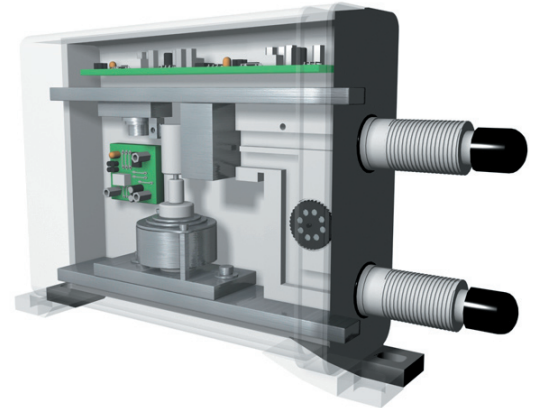


Figure 2. Interior side view.

Processing circuitry provides an analog output that is linearly proportional to the flow rate. If the set point differs from the actual flow rate, the amount of error is assessed and the valve opens or closes accordingly. If the FLO-CONTROLLER cannot reach the set point, it will provide an alarm.



* US Patents 4,467,660; 5,542,302; 5,728,949. Other patents pending.

FEATURES AND OPTIONS

FLOW RANGES

Flow ranges from 15-100 mLpm up to 1,000-10,000 mLpm are available. Consult the factory for custom requirements.

POWER

Units operate with 24 VDC power.

SIGNAL CONFIGURATION

Units may be ordered with a 4-20 mA, 0-5 VDC, or 0-10 VDC configuration.

ACCURACY/LINEARITY

All models have an accuracy specification of $\pm 1.0\%$ full scale (including linearity).

CALIBRATION

All units are calibrated at the factory using deionized water. Calibration curves may be requested for fluids with viscosities differing from water.

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. An additional 12-pin connector is fitted for custom configurations and factory programming.

WETTED MATERIALS

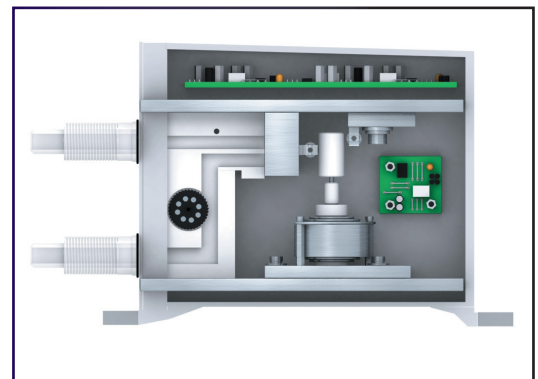
All units have only PTFE, perfluoroelastomers, and sapphire as wetted parts.

DISPLAYS

An external control module is available that displays current settings, programs special features and options, and allows for calibration adjustments. Please request further information from the factory.



Model U802 FLO-CONTROLLER



Model U802 CUTAWAY

SPECIFICATIONS

	U802
Accuracy (including linearity, best fit straight line)	±1.0% Full Scale
Repeatability	±0.20% Full Scale
Pressure Rating	80 psig (5.4 bar) maximum working 100 psig (6.8 bar) overpressure
Temperature Rating (Fluid)	Standard: 0 to 55°C "HT" Suffix: 0 to 90°C
Temperature Rating (Environmental)	Operating: 0 to 50°C Storage: 0 to 70°C
Wetted Materials	PTFE Sapphire
O-Ring Material	Perfluoroelastomer*
Exterior Surfaces	PTFE Polypropylene PVC Epoxy Viton® Polyester
Recommended Filtration	20 microns or less
Compatible Fluids	Low viscosity (<10 cS) Minimum amount of entrained air
Valve	PTFE cam-driven diaphragm Not recommended for positive shutoff
0-5 VDC Output	0 VDC at zero flow 2.5 Kohm or greater output load Not isolated
0-10 VDC Output	0 VDC at zero flow 5 Kohm or greater output load Not isolated
4-20 mA Output	4 mA at zero flow 500 ohm maximum current loop Not isolated
0-5 VDC Input	0 VDC at zero flow Input load is 100 Kohms Isolated From Ground
0-10 VDC Input	0 VDC at zero flow Input load is 100 Kohms Isolated From Ground
4-20 mA Input	4 mA at zero flow Input load is less than 50 ohms Isolated From Ground
Standby Mode	Disables valve (freezes) Automatically engaged when set point is <5% of full scale
Error Output	Activated when controller cannot achieve setpoint Error condition=high (V+) Normal condition=low Automatically resets upon normal condition Typical delay before activated: 8-10 seconds
Zero Drift	None
Warm-Up Time	None
Calibration Interval	Calibration should typically be verified once every 12 months
Power Requirements	22-25 VDC 250 mA typical (1 A peak)
Electrical Connections	7-pin connector PTFE housing when used with CFx cables Nylon housing when used with CPx cables
Response Time	Typically <3 seconds 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)

* contact factory for current compound



ORDERING INFORMATION

Form part number: (Model Code) - (Flow Range) - (Power/Signal) - (Fittings) - (Mating Cable) - (Options).	Code
U802 UHP Liquid FLO-CONTROLLER®	U802
Flow Range (mLpm of H ₂ O) 15-100 20-200 50-500 100-1000 200-2000 500-5000 1000-10000	3 4 5 6 7 8 9
Power / Signal Configuration 22-25 VDC Power / 0-5 VDC I/O 22-25 VDC Power / 0-10 VDC I/O 22-25 VDC Power / 4-20 mA I/O	B J C
Fittings (see Fitting Chart for available sizes based on flow range) 1/4" male flare (Flaretek® compatible) 3/8" male flare (Flaretek® compatible) 1/2" male flare (Flaretek® compatible)	F4 F6 F7
Differential Pressure Configuration 2-10 psid 4-20 psid 5-40 psid 7-50 psid 10-60 psid	P5 P10 P20 P25 P40
Mating Cable None (not recommended) FEP-jacketed, splashproof, 3 feet (0.92 m) FEP-jacketed, splashproof, 6 feet (1.85 m) FEP-jacketed, splashproof, 12 feet (3.7 m) FEP-jacketed, splashproof, 25 feet (7.7 m) PVC-jacketed, 6 feet (1.85 m) PVC-jacketed, 12 feet (3.7 m)	C0 CE3 CE6 CE12 CE25 CV6 CV12
Options High Temperature Operation Include Pair of PVDF Flare Nuts	HT FN
ACCESSORIES Control Module Display Unit Secondary Output Cable, 3 feet (0.92 m) Secondary Output Cable, 6 feet (1.85 m) Secondary Output Cable, 12 feet (3.7 m) Secondary Output Cable, 25 feet (7.7 m)	402-CM 402-CBL2-3 402-CBL2-6 402-CBL2-12 402-CBL2-25

Example #1:

U802-5-J-F4-P20-CE12 would give you a U802 FLO-CONTROLLER rated for 50-500 mLpm. The input/output signals would be 0-10VDC. Fluid connections would be 1/4" male flare fittings. A FEP-jacketed 12 foot (3.7 m) cable would be included.

FITTING CHART

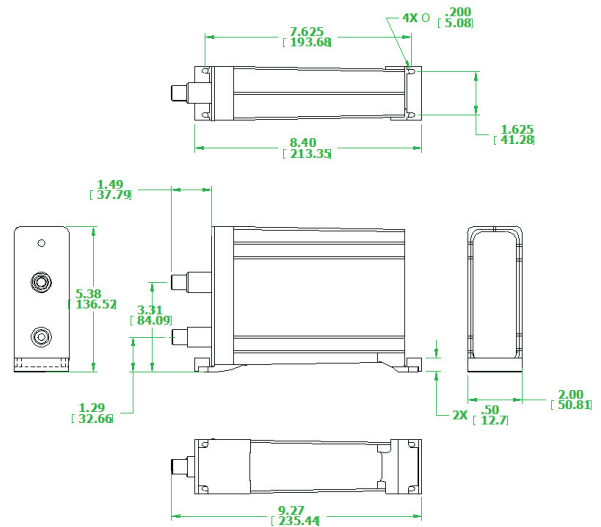
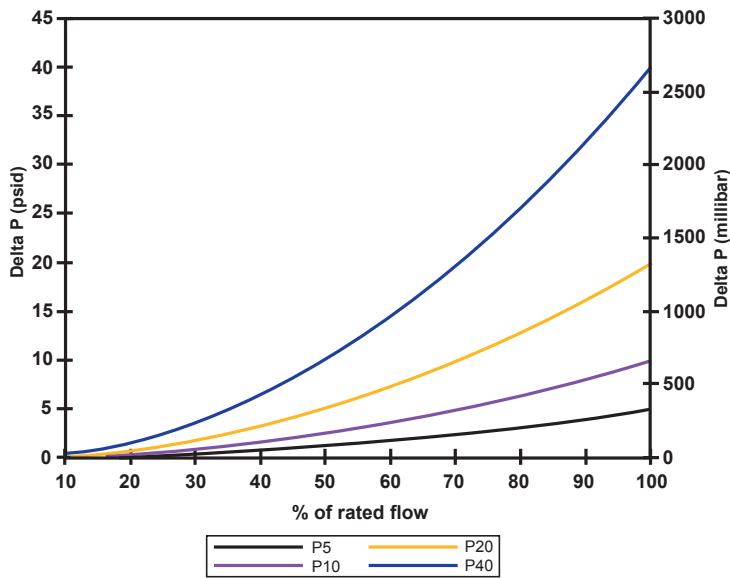
Flow Range	F4	F6	F7
3	✓	✓	
4	✓	✓	
5	✓	✓	
6	✓	✓	✓
7		✓	✓
8			✓
9			✓



PRESSURE DROP

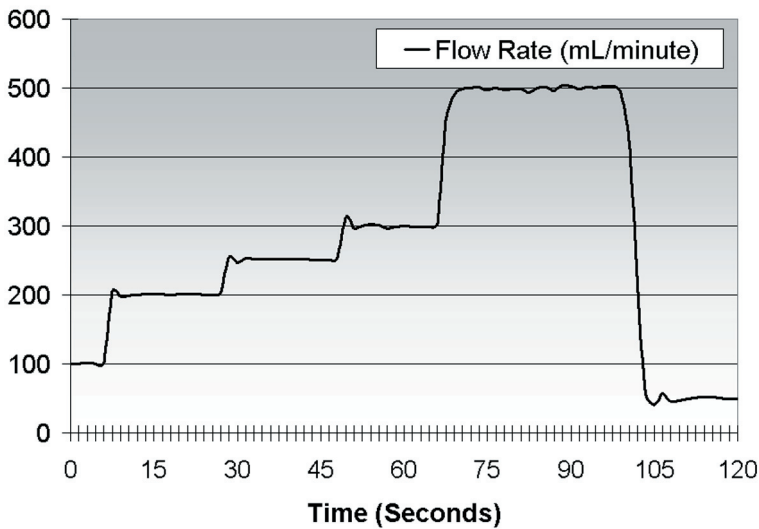
DIMENSIONS

Maximum Pressure Drop for Different Valve Configurations
(may vary +10% of indicated value)



Dimensions shown are in inches(mm). All dimensions shown are for Model U802 FLO-CONTROLLER with 3/8" male flare fittings (F6) and are similar for other models. Specific model dimensional drawings may be requested from the factory.

RESPONSE TIME EXAMPLE



Typical data from a 500 mLpm U802 FLO-CONTROLLER with P20 valve configuration. Other configurations may increase or decrease response time.



Viton – Reg TM E.I. DuPont Dow Elastomers LLC
FLO-CONTROLLER – Reg TM McMillan Co
Flaretek – Reg TM Entegris, Inc.

Bulletin U802-S001

Specifications subject to change without notice.

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