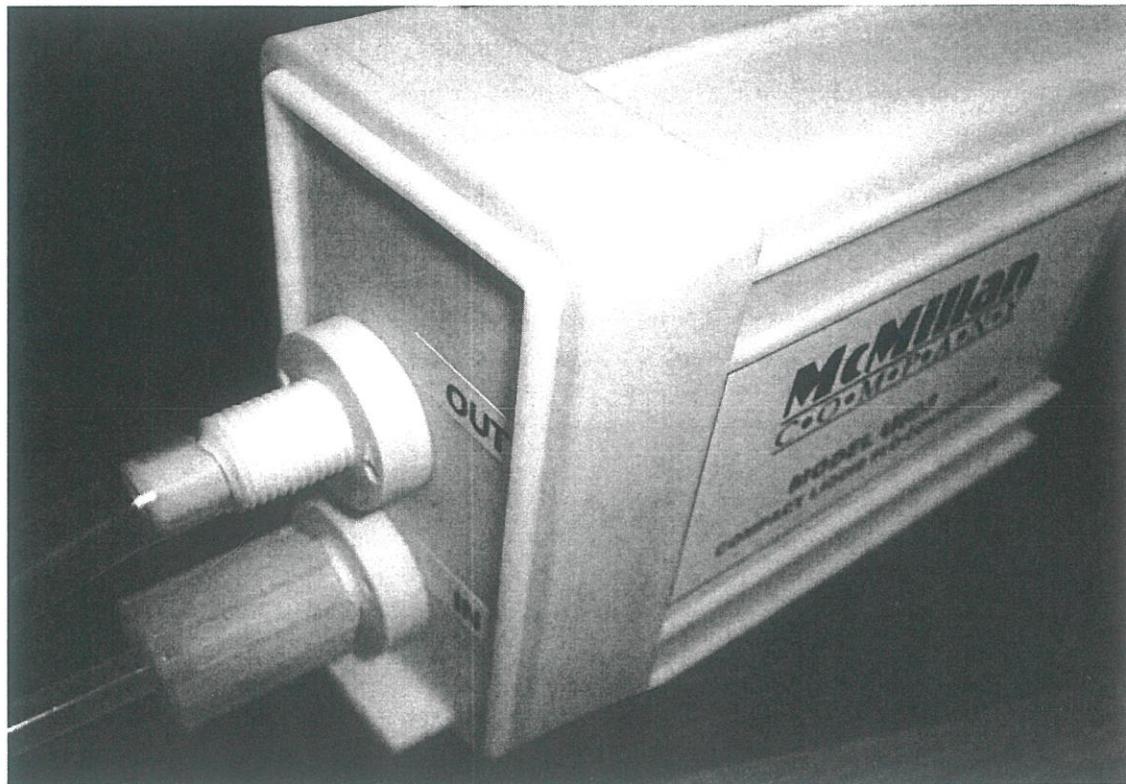




Manual 803-4-M001
SEPT 2010
Revision C
www.mcmflow.com



**MODEL U803 or U804
Liquid Flo-Controllers**

Installation Manual & Operating Instructions



READ THIS MANUAL COMPLETELY BEFORE ATTEMPTING
TO CONNECT OR OPERATE YOUR FLO-CONTROLLER.
FAILURE TO DO SO MAY RESULT IN INJURY TO YOU OR
DAMAGE TO THE FLO-CONTROLLER.

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A. Introduction

1. Unpacking the Flo-Controller

The Flo-Controller was packed by the manufacturer in such a way that you should receive it with no damage. If external damage is noted upon receipt of the package, please contact *the shipping company* immediately. McMillan Company is not liable for damage to the device once it has left the manufacturing premises.

After external inspection of the package, proceed to open the package from the top, taking care not to cut too deeply into the package. Remove all documentation. Inspect all products for concealed shipping damage. If any damage is noted, please contact the shipping company and/or McMillan Company to resolve the problem.

While unpacking the products from the shipment, please take extra care to remove all enclosed devices and documentation. Check thoroughly for cables, adapters, and other options listed on the packing slip.

2. Caution

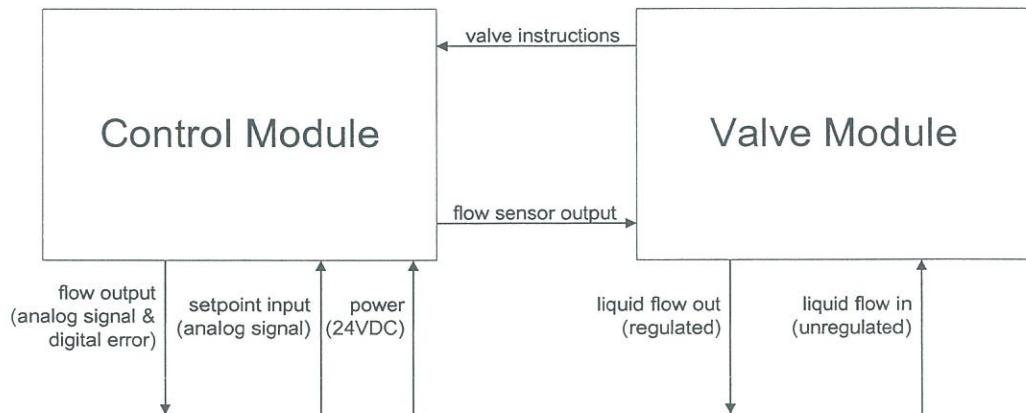
Take care not to ***drop*** your Flo-Controller. Read the installation section before providing power or tubing connections to the unit. Any damage caused by improper installation or careless handling will not be repaired under warranty (see limited warranty on page X for more details).

Note that your Model U80x Flo-Controller has been assembled, tested, and sealed under cleanroom conditions. To maintain that clean condition, only open under cleanroom conditions and with appropriate equipment.

3. Product Overview and Principle of Operation

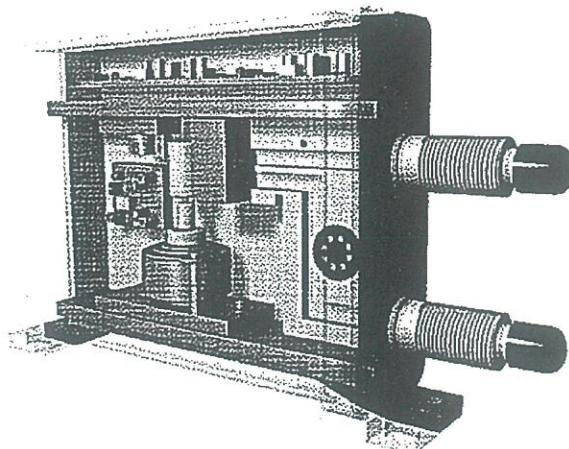
The Model U803 (and U804) Liquid Flo-Controllers provide precision flow rate control for many low viscosity liquids.

For applications where a flow rate needs to be automatically maintained regardless of small pressure changes, flow controllers save users time and money. A flow controller combines a control valve and flow sensor with smart electronics that compare the setpoint vs. actual flow and then adjusts the valve automatically to maintain the flowrate.



The above diagram shows the logic used by the Flo-Controller to measure and control flow rate as desired.

Several liquid Flo-Controllers can be used together for precise mixing and blending of corrosive and pure liquids. Higher yields result when blending and dispensing are consistently monitored and controlled.



The Flo-Controller requires a 24VDC power supply. The 24VDC input is protected from accidental polarity reversal. Internal circuitry provides a flow sensor output which is compared to the setpoint, supplied by the user. The flow control is provided

automatically by means of a precision servo valve. When the setpoint is approx. 5% or lower (control input) the normal control function stops and the unit is in "Standby" – where flow control is frozen and the unit simply acts as a flow sensor. This is called **AUTO-STANDBY Mode**

4. What is the difference between the U802 and U803 and U804?

U802 – This larger product is primarily designed for control of many industrial, and UHP liquid chemicals and some abrasive low viscosity fluids. Several ranges **up to 10 L/min** and numerous options are provided.

U803 – This small product is specifically designed for lower flow ultra-high-purity (UHP) applications. It is much smaller than U802 yet features the same advanced stepper-motor-controlled diaphragm valve for reliable performance on abrasive media, including CMP slurry. It is also suitable for concentrated acids and alkalis, as well as solvents or other UHP fluids. Range of flow is best for applications of from **10 mL/min to 1.5 L/min**

U804 is the "straight Thru" Flow path version of the **U803**
cost of the U804 is higher than U803, up to 1 L/min ranges
[For the U804 only → **Inlet is in back & Outlet in front**]

B. Installation

1. Tubing Connections

The Flo-Controller U803 provides male flare connections. Flare nuts are required to facilitate installation – they may be ordered as options from McMillan or may be provided by the customer.

The **inlet** and **outlet** of the flow controller are clearly marked next to the appropriate connection. These connections are either 1/4", or 3/8", depending on flow range (see specifications for size). Flare connections are designed to mate to standard Fluoroware/Entegris-type PFA flare fittings.
The Inlet is the fitting nearest the front mounting ear.

For best results, keep inlet and outlet pressure fluctuations to a minimum.

The outlet tubing should be elevated above the outlet port to allow any air that may accumulate inside the valve to escape. For this reason, the flow connections should not be pointed down where air may be trapped, but either level or at an upward angle from the ground.

As long as the outlet tubing is elevated to allow for air to escape from the device, the Flo-Controller can be mounted in any orientation. Straight lengths of tubing are not required before or after the Flo-Controller.

Care should be taken to eliminate as much air from the system as possible during installation. Once the unit is connected in the flow path, air should be removed from the controller by alternately blocking and releasing the outlet (to build pressure in the lines and then release it). It may be possible to either pinch or kink the outlet tubing for 5 seconds, then release for 5 seconds, and so on until no more air bubbles are released from the unit.

The maximum system pressure the Flo-Controller can safely handle is 80 psig. Any pressure higher than 80 psig could result in leakage and injury to the operator.

For best results, keep the differential pressure within the recommended range (see chart below). Differential pressure can be determined by measuring the upstream pressure and subtracting the downstream pressure. To reduce differential pressure, apply a flow restriction downstream from the controller. To increase differential pressure, increase the supply pressure or reduce flow rate.

Model	Suffix	Recommended Diff. Pressure at 100% rated flow^{1F}
U803	P5	5-10 psid
	P10	10-20 psid
	P20	20-40 psid
	P25	25-50 psid
	P40	40-60 psid

1F. See below for minimum required differential pressure at flow rates below 100% of rated flow. Best control at full flow will be generally in middle to high end of listed psid.

2F. unless otherwise indicated on calibration data sheet

3F. unless otherwise indicated on valve module label (near cable port)

Required differential pressure decreases exponentially with decrease in flow rate; to calculate minimum required differential pressure at a certain flow rate, use the formula:

$$DP = (\text{YourFlow} \div \text{MaxFlow})^2 \times \text{MinDP} \quad \text{where:}$$

DP = minimum required differential pressure at YourFlow

YourFlow = flow rate (in mLpm or Lpm) where you wish to calculate DP

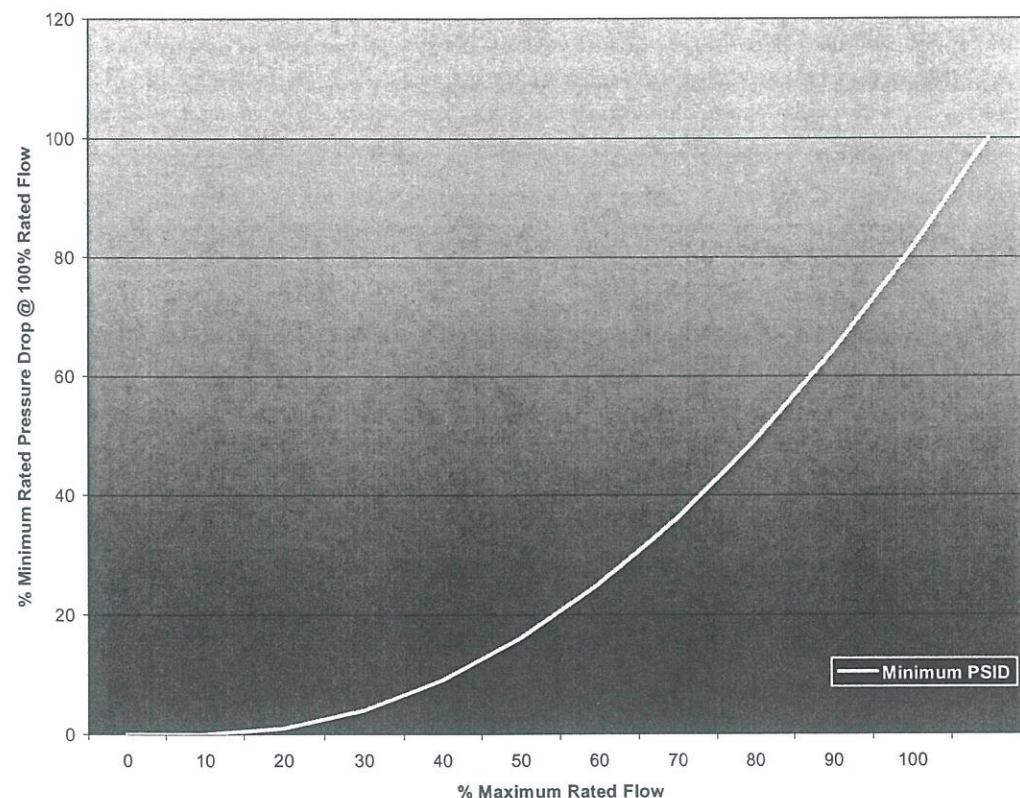
MaxFlow = 100% rated flow rate for your Flo-Controller (in same units as

YourFlow)
MinDP = Minimum differential pressure required at 100% rated flow (see chart above) in psid

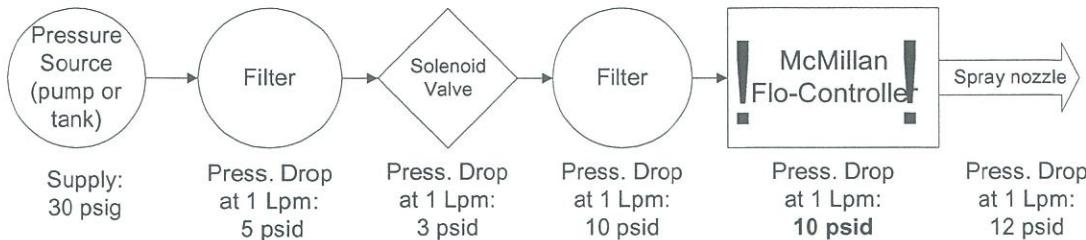
For example: You have a Flo-Controller with a 100-**1000** mLpm range. The recommended differential pressure, according to the chart above, is **15-35** psid. You wish to calculate the minimum pressure drop at **200** mLpm. Your formula would be:

$$DP = (200 \div 1000)^2 \times 15 \quad \text{or} \quad DP = 0.6 \text{ psid} @ 200 \text{ mLpm}$$

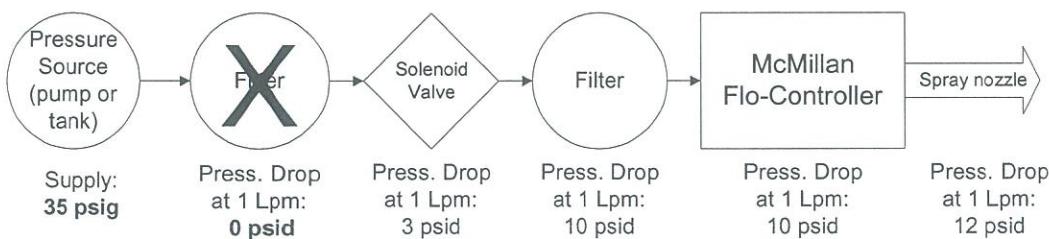
All Flo-Controllers follow this graph for minimum pressure drop (minimum differential pressure required) vs. flow:



Differential pressure, or pressure drop, in a system is cumulative. For instance, consider this system:



Though it starts with 30 psig of supply pressure, other components (minus the Flo-Controller) total 30 psid – leaving no pressure for the Flo-Controller. Either the supply pressure would have to be increased, and/or a source of pressure drop (such as the post-pump filter) would have to be eliminated:



2. Electrical Connections

CAUTION: Mis-wiring the Flo-Controller may cause damage to the unit . Please read instructions carefully!

Be careful to avoid pigtail wire leads touching each other when power is applied.

The Flo-Controller requires a **24VDC power supply**. Average current draw is approx. 0.25 amps at 24V in actual operation.

It is good to have a conservative amount of extra power available to assure best performance. Please consider these current requirements when selecting wire gauge and power supply type. Size the power supply to provide at least 0.5 amps per controller.

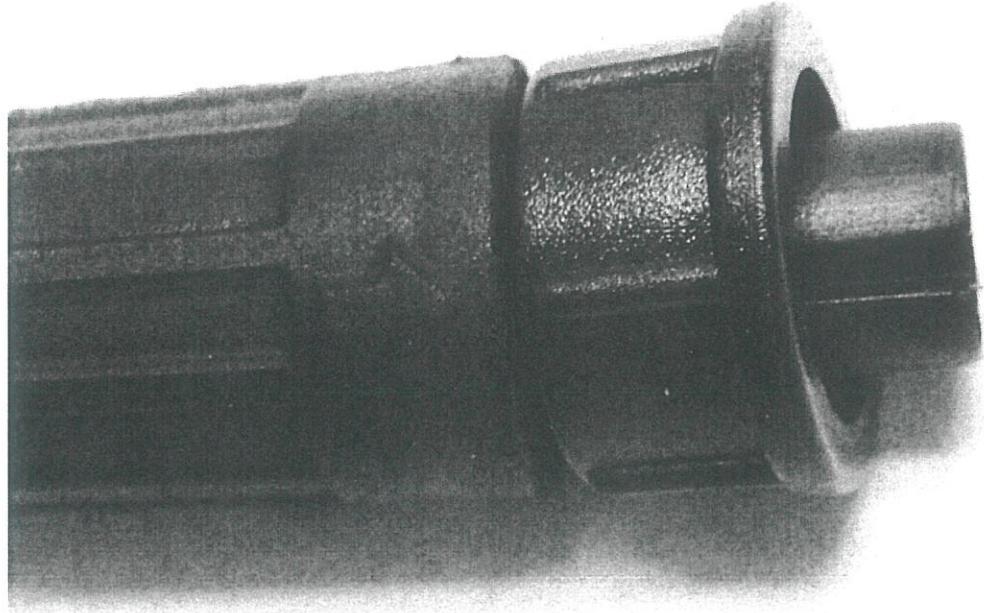
Connections are made with an optional Cable , 7 Wires. The cable plugs to the upper back end of the flow controller. It has a key to install in one orientation only.

NEW 7 PIN Connector System –

For M803 [starting mid 2013]
CABLE WIRE COLORS REMAIN THE SAME

NEW CONNECTOR:

Connections are made with an optional Cable , 7 Wires. The cable plugs to the upper back end of the flow controller. It has a key/slot to install in one orientation only. A round nut can be turned clockwise after install to pull the cable connector fully into place. An arrow is indicating location of the guide slot for orientation. SEE PHOTO BELOW

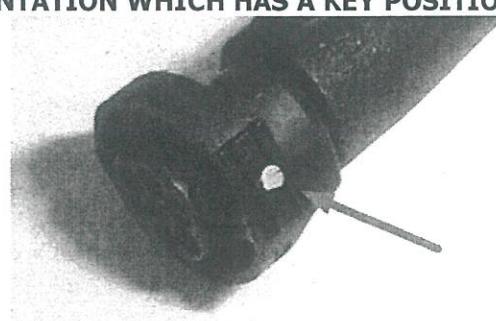


To remove the connector shown above – first turn round nut counter clockwise then pull back straight back until released.

----- Reference information -----

OLDER 7 PIN CONNECTOR SYSTEM (Prior to mid 2013)
(this older connector has the SQUEEZE Release)

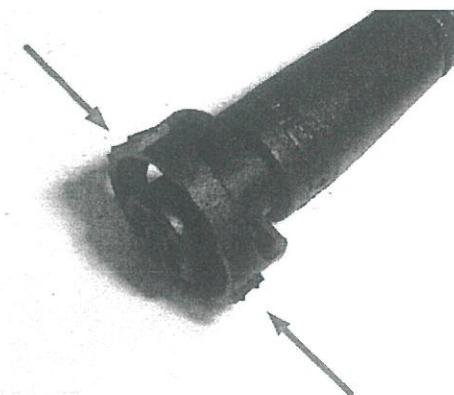
**THE MATING CABLE HAS A PUSH ON SELF LOCK SYSTEM.
TAKE NOTE OF THE ORIENTATION WHICH HAS A KEY POSITION AT THE TOP.**



Near 1 O'clock position.
OLD CONNECTOR – Continued

DO NOT TRY TO ROTATE AFTER IT IS LOCKED ON!

**TO RELEASE THE CABLE SIMPLY DEPRESS CABLE CONNECTOR AT THE TOP and BOTTOM at the same time
[1 o'clock and 7 o'clock positions] and then pull cable away gently.**



SQUEEZE POINTS

The attach cable [using either NEW or Older connector system] provides Power, Output, and Control (SETPOINT) Input connections using 6 wires.

A 7th wire is available for extra cost options. It is not connected in most cases.

CUSTOMER ORDER specifies type on Input/Output:

Label will indicate the configuration-

- 1) 0-5 VDC
- 2) 0-10 VDC
- 3) 4 – 20 mA

CABLE WIRING - 7 PIN Connector

Description	Notes
RED -- Power + 24VDC BLK – Power Gnd	Power IN + POWER GROUND or Common
ORG or WHT -- Output + GRN -- Output Common	Flow Rate Output Output Common
YEL -- SET Point In + BRN – SET Point In -	Control Input + Control Input -
BLU -- OPTIONAL use	(Usually is ERROR output) ERROR Connects by switch to Power Gnd when activated

On 4-20 mA units, 4 mA represents zero flow; 20 mA represents 100% rated flow. On 0-5 VDC units, 0 VDC represents zero flow and 5 VDC represents 100% rated flow. On 0-10 VDC units, 0 VDC represents zero flow and 10 VDC represents 100% rated flow.

3. Mounting the Flo-Controller

See section B.1 above for orientation considerations.

Mounting the unit (see dimension drawings in Section D for panel drilling):

The outer case (Polypro) of the Flo-Controller may resist being lightly sprayed or rinsed with compatible liquids, but should never be submerged.

C. Operation

Standby mode occurs when the external setpoint falls below 5% of full scale. Standby will be disengaged when the setpoint rises above that point.

When the unit is in Auto-Standby mode (see A.3) , all control functions are disabled, only flow output signals are provided. The unit freezes the valve in its current position.

Standby mode should be used any time the control function is not required to extend the life of the controller and speed recovery times. Since the valve is frozen, it will already be closer to the correct place when control function is resumed. Standby mode also consumes less power (<0.12 A).

1. Error Conditions

The Flo-Controller will be in the error mode which will occur when the Flo-Controller is unable to reach the setpoint due to these factors:

- The pressure is too low, and even with the valve fully open the requested flow rate cannot be achieved.
- The unit has been wired incorrectly.
- The lines may be clogged or blocked – make sure that the flow is not restricted. Verify all filters.
- Make sure all fittings are tight and no leaking is occurring.
- Doublecheck all cables are tight and secure.
- Setpoint below controllable flow range (i.e. <10% of rated flow)
- Flo-Controller failure

When the condition is corrected, the Flo-Controller will immediately resume normal operation. No user reset is required.

2. Calibrating for liquids other than water

All Flo-Controllers come pre-calibrated from the factory for deionized water.

If you will be measuring a fluid other than deionized water, to obtain maximum accuracy you must determine the error when flowing that fluid.

The unit should be set to control flow at 100% rated flow. Once the flow rate has stabilized, use a primary standard (i.e., accumulation over time with stopwatch and graduated cylinder, or total weight over time with stopwatch and weight scale) to establish error. Repeat test at 20% of rated flow. Using these two values, calculate the error of the unit across the full scale and adjust your setpoints accordingly.

Recalibration of the Flo-Controller itself is not recommended. Doing so will void the warranty and may cause linearity problems and other issues.

D. **Specifications**

1. Specifications

Accuracy, including Linearity & Hysteresis

±1.0% Full Scale*

Repeatability

±0.20% Full Scale* (based on data accumulated over thousands of cycles)

Power Requirements

20 -25 VDC; 0.5 A peak, 200 to 250 mA typical

Pressure Rating

Max. pressure is 80 psig (5.4 bar).

Recommended maximum pressure is 60 psig (4.08 bar)

Temperature Rating

Standard fluid temperature range (internal): 0 to 55°C **

(Non-condensing)

Ambient environment range (external): 0 to 50°C

Storage range: -10 to 70°C

Materials of Construction

Wetted parts - PTFE, sapphire, Kal-Rez®

Exterior surfaces - PTFE, polypropylene

Recommended Filtration

25 microns or less

Compatible Fluids

Most low viscosity liquids compatible with wetted materials.

Contact the factory for calibration information on fluids with high viscosities.

Input/Output

OPTION (0-5VDC)

Analog voltage input/output, 0-5 VDC. Voltage level is proportional to flow rate (zero VDC is zero flow). Input load approximately 100 Kohms; output load should be at least 2.5 Kohms.

OPTION (4-20 mA)

Analog current input/output, 4-20 mA. Current level is proportional to flow rate (4 mA is zero flow).

Input load loop is approx. 200 ohms; output current loop should not exceed 500 ohms.

NOTES: Input (Setpoint) is a passive resistive mA loop, and if loop source voltage exceeds 24VDC then add additional loop resistor 250 to 500 ohms. The output loop (Flow Output) is a fully active and powered 4-20 mA loop source. **Do**

not use a powered loop to attach to this output, or damage may result!

This output can drive a passive load device of up to 500 ohms.

OPTION " (0-10 VDC)

Analog voltage input/output, 0-10 VDC. Voltage level is proportional to flow rate (zero VDC is zero flow). Input load is approximately 100 Kohms; output load should be at least 5 Kohms.

Reliability

Testing shows no valve performance degradation with over 1 million full cycles on deionized water at room temperature.

At a typical rate of 0.5 million cycles per year, units in similar installations should perform well for at least two years before service. Longer valve life will be experienced in many applications.

Reliability tests are ongoing. Microturbine flow sensor life is over 50,000 hours MTBF (tests ongoing).

Flow Connections

PTFE male flare-type connections on all units. If PVDF flare nuts are required, add option code "FN". For alternative nut materials, or to specify other connection types, please contact the factory.

Electrical Connections - pigtail leads and 7 Pin Connector

Connections between flo-controller- OPTIONS

Length determined by part number - contact factory for custom cable lengths.

PVC molded cable assembly 6 or 12 feet standard items.

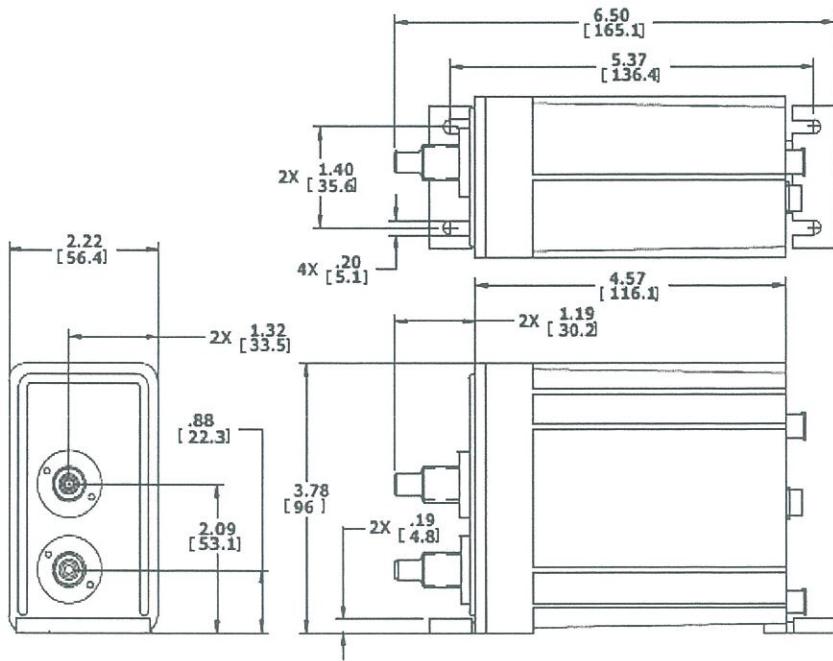
Standby Mode

Standby mode inhibits the valve function upon command. Flow sensor output continues, but all controller functions (including error output and control functions) are disabled. Standby mode may be activated automatically when the supplied setpoint falls below 5% of full scale – This is defines as "Auto Standby".

*Full Scale is from 10% to 100% of rated flow . Linearity is best fit straight line. All calibrations performed with deionized water. P5 performance is 20% to 100%

**Temperature affects fluid viscosity, and changes in viscosity will have effect on full scale output

2. Dimensions



E. Limited Warranty

DURATION OF LIMITED WARRANTY, MATERIALS & WORKMANSHIP

R.D. McMillan Co., Inc., hereinafter referred to as "McMillan", warrants these products and their associated standard accessories manufactured by McMillan and supplied hereunder, to be free from defects in materials and workmanship for a period of twelve (12) months from the date of shipment to the customer when installed, serviced and operated in its recommended environment. This warranty is not affected in any part by McMillan providing technical support or advice.

Replacement parts are warranted to be free from defects in material or workmanship for ninety (90) days or for the remainder of the Limited Warranty period of the McMillan product in which they are installed, whichever is longer. Parts not installed by factory authorized service centers may void the warranty.

PRODUCT RETURNS

(a) General Policy:

Any product or parts determined by McMillan's inspection to have failed per this warranty, will at McMillan's option, be repaired or replaced with an equivalent or comparable product without charge. McMillan's obligation hereunder shall be limited to such repair and/or replacement and shall be conditional upon McMillan's receiving written notice of any alleged defect within ten (10) days of its discovery. The customer will, however, be responsible for returning the product to McMillan's manufacturing facility in Georgetown, Texas, U.S.A., and for assuming the cost of removing the original product and reinstalling the repaired or replaced product. A written specific explanation of the problem

must be included with each returned product. Returned goods should be properly packaged to prevent shipping damage and shipped prepaid to McMillan.

(b) Safety Requirements:

For safety reasons, McMillan must be advised of any hazardous fluid or toxic materials that were in or on the product to be returned. Customer must certify in writing that all such hazardous, corrosive or toxic substances have been completely removed, cleaned or neutralized from the returned product prior to shipment to McMillan. McMillan shall hold the returned items pending receipt of customer's statement for defect and certification of cleanliness of returned items, provided that, prior to such receipt, risk of loss of returned items shall remain with customer. Flow sensors, flow meters and flow controllers must be thoroughly cleaned to remove any toxic, corrosive or hazardous fluids that may internally remain therein before shipping product to McMillan.

(c) Shipping Requirements:

Customer is responsible for all shipping charges (except for those products under warranty, in which cases customer shall bear the cost of inbound shipping as described herein below, and McMillan shall bear the cost of outbound shipping). Customer is responsible for the costs of out of warranty repairs and/or recalibration. McMillan will ship items repaired under warranty back to customer by the most economical shipping means. Expedited shipping methods may be available at customer's expense. All returned items shall be returned to a McMillan authorized service center, freight prepaid, accompanied or preceded by a particularized statement of the claimed defect and with a clearly readable Returned Material Authorization ("RMA") number affixed to the shipping label. Contact McMillan Customer Service Department for RMA number. Warranty claims shall be made only by using the McMillan's Returned Material Authorization form, completely filled out and returned to McMillan in accord with McMillan's Product Return Policy and Procedure Form.

Contact McMillan's Customer Service Department as follows for instructions:

Telephone calls in U.S.A. (CST) 1-800-861-0231 or Outside U.S.A. 512-863-0231

Or Fax: 1-512-863-0671 or e-mail: sales@mcmflow.com

DESIGN, PROCESS and MANUFACTURING CHANGES

McMillan may make changes in the design or manufacture of any products sold hereunder without incurring any obligation to incorporate such changes into products manufactured prior to incorporation of such design or manufacturing changes. McMillan reserves the right to make design or manufacturing changes without prior notice. McMillan products and replacement parts are manufactured using new materials or new and equivalent to new in appearance, performance and reliability. Due to continuous research, testing, product improvements and enhancements, McMillan reserves the right to change product specifications without notice, except to the extent an outstanding bid obligation exists.

LIMITATION of LIABILITY

Except as expressly set forth in this limited warranty, McMillan makes no other warranties or conditions, express or implied, including any implied warranties of merchantability and fitness for a particular purpose. McMillan expressly disclaims all warranties and conditions not stated in this limited warranty. Any implied warranties that may be imposed by law are limited in duration to the limited warranty period. Buyer/customer agrees that models or samples shown to buyer/customer were merely used to illustrate the purchased product and not to represent, promise or guarantee that any purchased products delivered hereunder would conform to such models or samples. McMillan's distributors or sales representatives have no authority to give warranties beyond those provided in this limited warranty.

If customer's product fails to work as warranted herein, customer's sole and exclusive remedy shall be the repair or replacement at McMillan's option. McMillan is not liable for any damages caused by the product or the failure of the product to perform, including any lost profits or savings, incidental or consequential damages. McMillan is not liable for any claim made by a third party or made by a buyer for a third party. No actions arising out of sale of the products sold hereunder or this limited warranty may be brought by either party more than two (2) years after the cause of action accrues. This limitation of liability applies whether damages are sought, or a claim made, under this limited warranty or as a tort claim (including negligence and strict product liability), a contract claim, or any other claim. This limitation of liability cannot be waived or amended by any person. This limitation of liability will be effective even if customer has advised McMillan or an authorized representative or distributor of McMillan of the possibility of any such damages. This limited warranty gives customer specific legal rights. Customer may also have other rights that may vary from state to state or country to country. Customer is hereby advised to consult applicable state or country laws for a full determination of customer's rights.

EXCLUSIONS FROM WARRANTY

this limited warranty provided herein shall not apply to any product which:

- (1) has been repaired or altered outside of McMillan's factory (or authorized service center) in any way so as, in McMillan's judgment, to affect such purchased item's reliability or performance.

- (2) has been subject to misuse, mishandling, negligence, accident, or acts of God.
- (3) has been operated other than in accordance with the printed instructions prepared by McMillan and provided by McMillan with the product.
- (4) has been returned to McMillan after more than thirty (30) days following the date of the alleged product failure.
- (5) has been returned to McMillan without complying with the Safety Requirements or the Shipping Requirements contained herein.
- (6) requires calibration and/or routine maintenance, unless this calibration or routine maintenance is required as a result of a product failure that is covered under terms of this warranty.
- (7) are consumable parts, such as filter elements, batteries or tube fittings.
- (8) requires replacement or repairs resulting from buyer's improper choice of product flow range, or require repair or replacement due to buyer subjecting product to corrosive fluids or other fluids not suited for use in product
- (9) has flow passages clogged due to failure to use a filter to protect product from particulates in fluid flow stream, or other cause to produce clogged passages
- (10) has been operated outside of recommended specifications (such as voltage, temperature, or flow range, etc.)
- (11) has been damaged as a result of gross over-speeding, or prolonged over-speeding of the micro-turbine wheel
- (12) has been damaged as a result of severe sudden impact forces (example: dropping the product)

METHOD OF SETTLEMENT OF ANY CLAIMS, DISPUTES AND CONTROVERSIES

The provisions of this warranty are severable and if one or more provisions are deemed invalid, the remaining provisions shall remain in effect. Further, in the event that any provision is held to be over broad as written, such provision shall be deemed amended to narrow its application to the extent necessary to make the provision enforceable according to applicable law and shall be enforced as amended. This warranty shall be construed and interpreted in English.

All claims, disputes and controversies arising out of or relating in any way to claims under any warranties, either express or implied (including implied warranty of merchantability), or claims based on any consumer protection act or deceptive trade practice act, contract, tort, statute, or common law, or any alleged breach, default, and/or misrepresentation, will be resolved by means of final and binding arbitration. This limited warranty, including any contests to the validity or enforceability of this limited warranty, shall be finally settled by arbitration under the Rules of Conciliation and Arbitration of the International Chamber of Commerce by one or more of its arbitrators appointed in accordance with the Rules, and judgment upon award rendered may be entered in any court having jurisdiction thereof. The place of arbitration shall be Austin, Texas U.S.A., and the Texas Uniform Commercial Code, as then enacted shall govern the rights and duties of the parties of this agreement without regard to conflicts-of-law principles. The arbitration shall be conducted in English. The UN Convention on Contracts for the International Sale of Goods shall not apply to this Limited Warranty.

F. Contacting McMillan

Website: www.mcmflow.com

Email: tech@mcmflow.com

Mailing address:

P.O. Box 1340
Georgetown, TX 78627
U.S.A.

Shipping address:

7075 RR 2338
Georgetown, TX 78633
U.S.A.

Phone: (512) 863-0231

Fax: (512) 863-0671

For repairs and/or return information, please contact our service department any of the ways shown above.

G. Quick Reference

4-20 mA units

<i>Current Input/Output</i>	<i>% of rated flow</i>
4.0 mA	0
5.6 mA	10
7.2 mA	20
8.8 mA	30
10.4 mA	40
12.0 mA	50
13.6 mA	60
15.2 mA	70
16.8 mA	80
18.4 mA	90
20.0 mA	100

0-5 VDC units

<i>Voltage Input/Output</i>	<i>% of rated flow</i>
0 VDC	0
0.5 VDC	10
1.0 VDC	20
1.5 VDC	30
2.0 VDC	40
2.5 VDC	50
3.0 VDC	60
3.5 VDC	70
4.0 VDC	80
4.5 VDC	90
5.0 VDC	100

0-10 VDC units

<i>Voltage Input/Output</i>	<i>% of rated flow</i>
0 VDC	0
1.0 VDC	10
2.0 VDC	20
3.0 VDC	30
4.0 VDC	40
5.0 VDC	50
6.0 VDC	60
7.0 VDC	70
8.0 VDC	80
9.0 VDC	90
10.0 VDC	100

H. Troubleshooting Guide

Symptom	Possible Cause	Method of Correction
The flow controller indicates no flow (4 mA or 0 VDC) even when flow is passing through unit.	<p>The current loop on your 4-20 mA model is not connected.</p> <p>The output is shorted. Current meter fuse is open.</p>	<p>If your unit has 4-20 mA inputs/outputs, check to make sure wiring is correct</p> <p>Check wiring as instructed in instruction manual.</p>
The analog output and/or display are fluctuating (bouncing) up and down.	<p>The actual fluid flow conditions are fluctuating rapidly. Too much pressure applied, or pressure is too unstable. Lines may have too much restriction. Entrapped gas or air needs to be eliminated from the liquid flow lines.</p> <p>Some noise is normal.</p>	<p>Ensure pressure supply is stable and all fluid components are operating within range.</p> <p>Certain pumps, such as peristaltic or diaphragm, may be inherently noisy. With pulse dampeners installed, the Flo-Controller will try to overcome those pulses by opening and closing, but may be unsuccessful at higher frequency pulses. Installing pulse dampeners in the line may improve Flo-Controller performance.</p>
	The differential pressure (PSID) across the Flo-Controller exceeds the recommended amount.	Reduce differential pressure by reducing supply pressure or increasing back pressure on outlet of Flo-Controller.
The unit will not control below 10% of rated flow.	The unit is not designed to control flow rates below 10% of rated flow.	Increase setpoint, or contact factory for a Flo-Controller with a lower operating flow range.
The unit will not shut flow completely off.	The unit is not designed to be a positive shutoff valve.	Add a solenoid valve upstream of the Flo-Controller to perform the positive shutoff functions.
Valve does not regulate flow even when flow rates obviously change.	<p>The unit is in Standby mode.</p>	See instruction manual for tips on how to use standby. For models with Auto Standby, increase setpoint above 5% of rated flow to resume normal operation.
The Flo-Controller is taking a long time to achieve the setpoint.	Under large flow changes, the Flo-Controller may take a few seconds to adjust.	Higher differential pressures (as long as they are within recommended range) will improve response time. Smaller flow adjustments, along with the use of the Standby function, will also result in improved response.