

MASS FLOW CONTROLLERS FOR GAS APPLICATIONS

RHODIUM Series
MEMS-Based Flow Controllers



APPLICATION IDEAS

- Active Gas Dilution & Blending
- Carrier Gas Regulation in Mass Chromatography
- Oxygenation For Medical Devices
- Precision Gas Injection for Bioreactors and Fermentors

Product Description

McMillan RHODIUM Series Flow Controllers are capable of measuring and controlling virtually any clean, dry gas as low as 0-50 sccm or as high as 0-20 Lpm. Repeatable results are achieved using a platinum-based micro-electromechanical system (MEMS) flow rate sensor device that is manufactured with extreme precision to ensure consistent results from unit to unit.

To actively control flow rate, RHODIUM units leverage a high precision PID controller to control a fast-acting solenoid valve. Analog inputs enable direct, fast, and accurate control of the gas flow. Integrated analog outputs report current flow rate for monitoring and control verification.

Compared to conventional mass flow controllers, RHODIUM Series Flow Controllers offer smaller size, higher accuracy, larger turn-down ratios, and faster response times.

Principle of Operation

Thermal mass flow controllers feature fast response, virtually zero maintenance, and precise measurement. These are all very important qualities among today's variety of applications.

The McMillan RHODIUM Series Mass Flow Controllers utilize MEMS thermal sensing technology.

MEMS technology utilizes a compact, reliable CMOS (Complementary Metal Oxide Semiconductor) sensor. This no-drift sensor module is comprised of both the electronic and mechanical elements on a single silicon chip, similar to the process used for integrated circuits.

Flow enters the unit, and a portion of the flow is redirected into a chamber and across the MEMS device. This device has two temperature sensors, one downstream from the other. Between the coils sits a small heating element, as shown in Figure 1. As the gas passes through the device, the smart electronics sense the difference in heat between the two sensors, since the upstream coil is not exposed to the heated gas. The downstream coil senses the heated gas and McMillan's advanced sensing algorithm calculates the flow rate based on the difference in value.

The precision manufacturing and compact size of the MEMS device insure that the zero remains stable and the sensor is extremely repeatable.

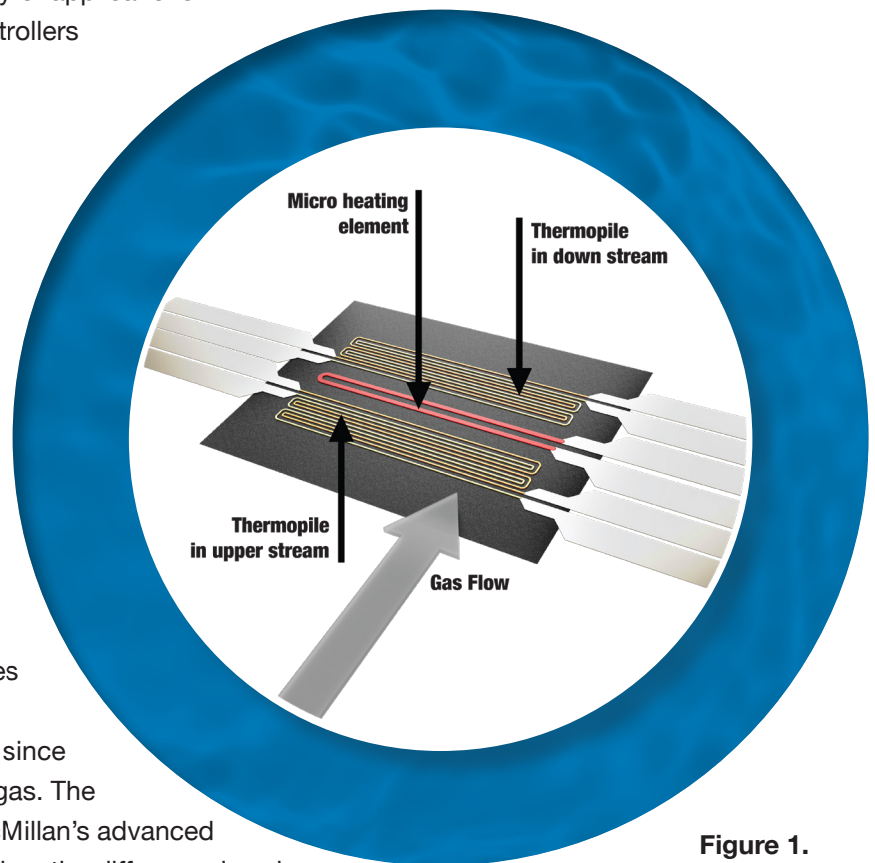


Figure 1.
Representation of MEMS flow sensing technology

Flow then passes into the proportional solenoid valve. This valve is controlled by the active servo electronics, which compare a setpoint (supplied via analog input signal) to the actual flow rate provided by the flow sensor and adjust the valve accordingly.

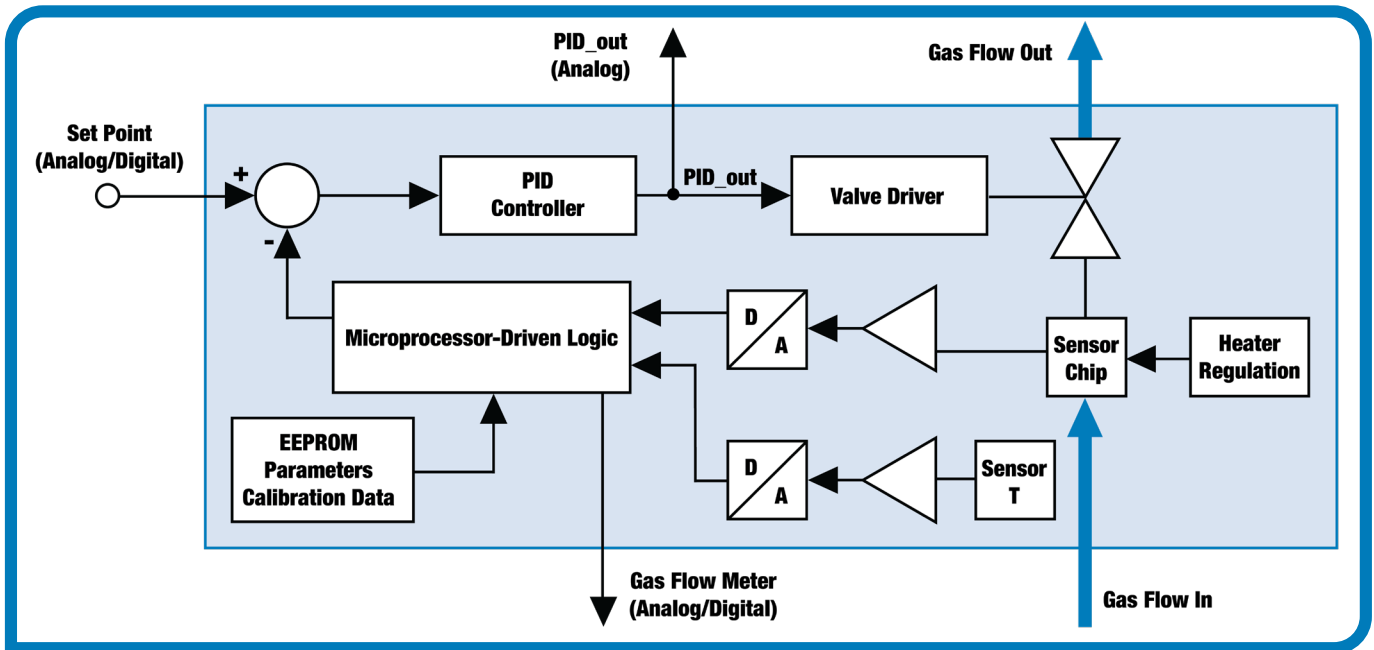


Figure 2. Block diagram of the RHODIUM Series mass flow controller

Features and Options

MOUNTING

The RHODIUM Series has two female threaded ports on the bottom of the device that accept M4 bolts. An optional mounting plate is available to accommodate installation from the top side.

CALIBRATION

The RHODIUM Series is calibrated in the vertical position. All other positions can cause offset depending on pressure and gas conditions. Flow is unidirectional and must pass through the unit as indicated on the device. All units are calibrated with and for dry nitrogen (N₂). Calibration for other gases may be available – please contact the factory.

WIRING

A male 9-pin D-sub connector is provided for all power and signal connections. Optional accessories include a mating cable with pigtail leads (9941-1-2M), a connection block that provides screw-down terminals and a port for a power adapter (9941-3), and 120/240 VAC power adapters that can be used with the connection block (9681-4 or 9691-4).

POWER

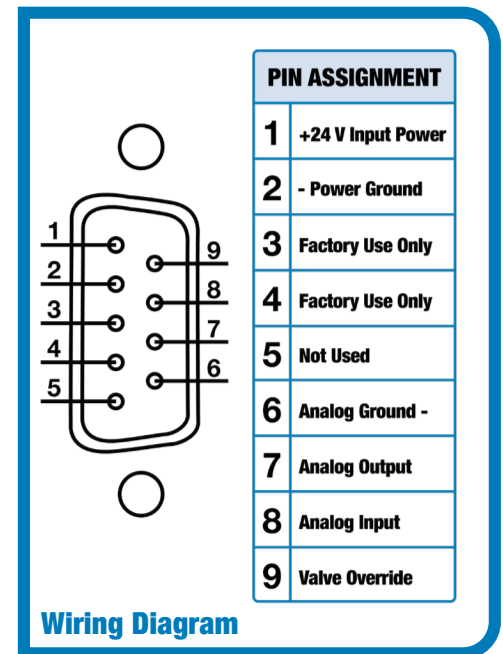
RHODIUM Series units require 24VDC power and typically draw less than 250 mA of current.

SIGNAL

Two I/O signal configurations are available: 0-5 VDC or 4-20mA. In either case, the lower end of the range represents zero flow (0 VDC or 4 mA) and the high end of the range represents 100% rated flow (5 VDC or 20 mA).

FLUID CONNECTIONS

Each unit features female SAE 9/16-18 straight thread ports for the inlet and outlet. Optional fittings are available with either 1/4" or 3/8" stainless steel (316L) tube connections.



Specifications

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

1. Flow Performance & Hardware

Gas	
Flow Ranges	See Ordering Information for Flow Range Options
Gas Type	N ₂
Calibration Conditions	
Standard Cubic Centimeters Per Minute	Reference Conditions:
	T = 0° C
	P = 760 mmHG
Performance	
Accuracy	± 1.0 % F.S.
Repeatability	± 0.015 % F.S.
Response Time	4 ms
Settling Time	150 ms
Control Range	2% – 100%
Operating Conditions	
Temperature	0 – 50° C
Humidity	5 – 95 % R.H.
Pressure Range	0 – 9 Bar (Operating) 30 Bar (Burst)
Differential Pressure	0.5 – 3 Bar (Min) 7 Bar (Max)
Gas Compatibility	Non-aggressive Gases
Electronic Interface	
Analog Input	0–5 VDC or 4–20 mA
Analog Output	0–5 VDC or 4–20 mA
Fluid	
Leak Tightness	1 x 10 ⁸ mBar l/s He
Wetted Materials	
Aluminum, Silicon, Silicon Nitride, Gold, Platinum, Silicone Die-attach, Epoxy, Stainless Steel, Brass, Viton®	
Fittings	
Stainless Steel	9/16-18 SAE – 1/4" or 3/8" Tube Fitting with O-Ring Seal

2. Electrical Conditions

Voltage Supply DC	Nominal	24 V ± 10 %
	Ripple	< 50 mV
Current Supply DC	Typical	< 200 mA
	Maximum	< 250 mA
Warm-Up Time	Deviation < ± 0.1% F.S.	3 sec
	Optimum Accuracy	15 min
Analog Output	Resistive Load	> 2 K Ω
	Capacitive Load	< 100 nF

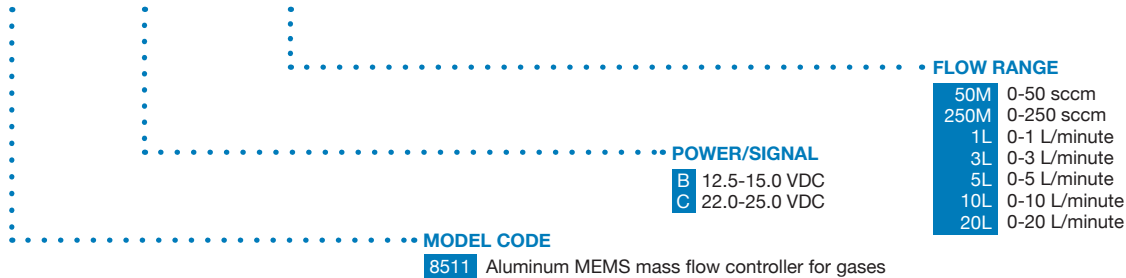
Ordering Information

Form part number as follows:

(Base Model) - (Power/Signal) - (Flow Range)

Examples: 8511-B-1L or 8511-C-50M

8511 - _____ - _____



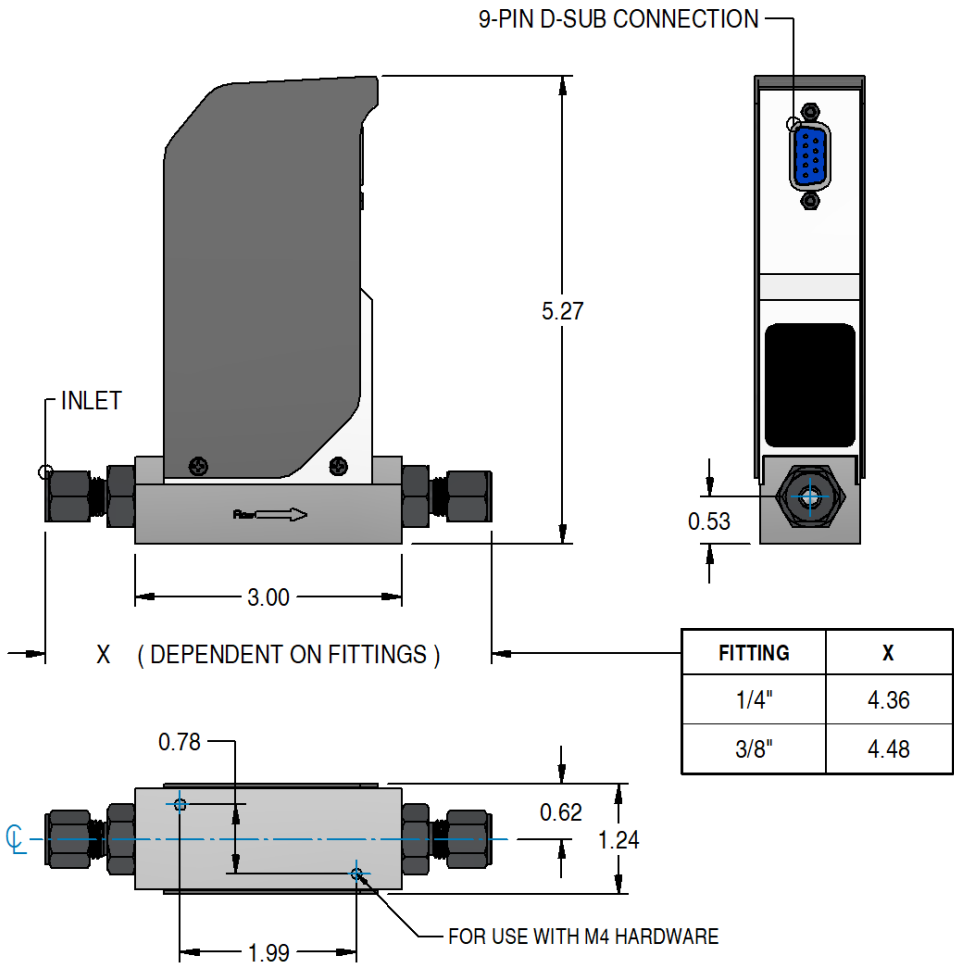
EXAMPLES

8511-B-1L would provide an aluminum-bodied mass flow controller configured for analog 0-5 VDC input and output signals, requires 24 VDC power, and would measure and control from 0 to 1 L/minute of Nitrogen (N₂).

8511-C-50M would provide an aluminum-bodied mass flow controller configured for analog 4-20 mA input and output signals, requires 24 VDC power, and would measure and control from 0 to 50 sccm of Nitrogen (N₂).

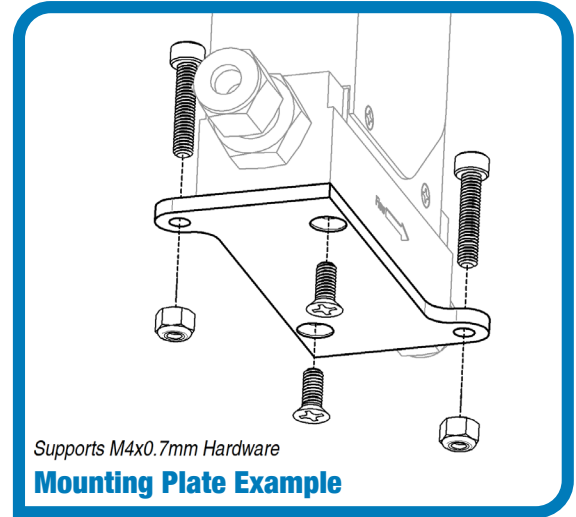
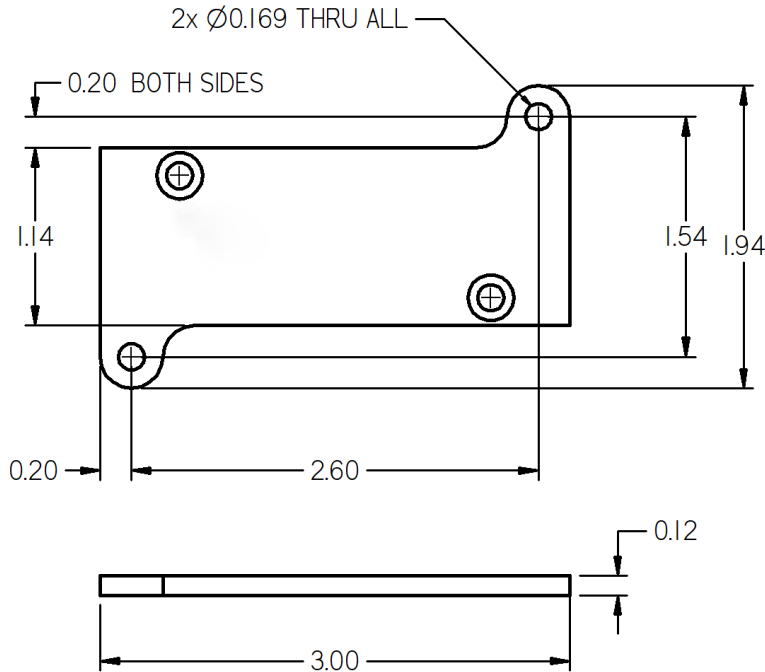
Dimensions

8511



Standard unit shown with optional tube fittings.

Optional Mounting Plate:



Related Accessories

CODE	DESCRIPTION
8511-MP	Mounting plate for 8511
9941-1-2M	Mating cable, 9-pin female D-SUB terminated with pigtail leads, 2m length
9941-3	Mating termination block, 9-pin female D-SUB terminal block & power receptacle for 24V
9941-2-2M	Extension cable for 8511, 9-pin female D-SUB to male D-SUB, 2m length
9681-4	120VAC Power adapter - also requires 9941-3
9691-4	240VAC Power adapter - also requires 9941-3
9853-9-T4	316L SS 1/4" tube fittings with SAE 9/16-18 threads for 8511 (pair)
9853-9-T6	316L SS 3/8" tube fittings with SAE 9/16-18 threads for 8511 (pair)

All dimensions shown in inches unless otherwise noted.



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
Website: www.mcmflow.com