P2A

Mass Flow Controller for Ion Implant Applications

The P2A, low pressure mass flow controller provides maximum utilization of Safe Delivery Source gases. Implementation of the Low Pressure P2A increases tool uptime by reducing the frequency of source gas cylinder changes. It offers accurate and precise control of low gas flows over a wide pressure range with source gas delivery pressure as low as 4 Torr.

This P2A is designed specifically for SDS and VAC® source gases serving the ion implantation industry. The patented valve and sensor designs offer exceptional zero stability and accuracy for all flow conditions while maintaining the ability to rapidly achieve set point and repeatably control the gas flow. Standard-sized MFC footprint and control I/O are compatible with existing gas lines for easy integration and operation.

Product Features

- Maximizes SDS source gas utilization reducing bottle changes resulting in higher tool uptime and lower cost-of-ownership
- Repeatedly controls low gas flows allowing for reduced gas consumption using parameters optimized for implanter source applications
- Digital control loop provides rapid response to set point minimizing process cycle time
- Configuration and diagnostics through Ethernet interface
  - —Uses standard web browser – no special software required

Key Benefits

- Reduces MFC inventory through its multi-gas/ multi-range capability
- Easy viewing of flow rate, gas type and Full Scale flow with its bright, self orienting LED display

Protected under one or more of the following U.S. patents: No. 6,668,641, No. 6,668,642, No. 6,779,394, No. 6,868,862, No. 6,810,308, No. 7,004,191 or International Patents and Patents pending.

Most gases used in the semiconductor industry are supplied at a constant pressure, typically above atmosphere, and are delivered to a process at or below atmosphere. Ion implant gases are now mostly supplied at sub-atmospheric pressure using SDS or VAC source gas technology.

These SDS gases are supplied at a sub-atmospheric pressure that decreases as the gas is consumed. This is a critical difference for the mass flow controller, as inlet pressure, was typically constant. Changing inlet pressure can impact an MFC's capability to both meter and control flow accurately, as well as achieve set-point within an allowable time. The wider the range of inlet pressure that an MFC can control and meet performance criteria is critical to SDS gas utilization and tool uptime.

The P2A was specifically designed for SDS source gases and similar applications. It controls rapidly and accurately from initial SDS pressures of 650 Torr down to pressures well below 10 Torr at the MFC. The digital control electronics have been tuned to provide typical response times of less than 2 seconds. With its ability to accurately meter and control gas flow over this wide pressure range, the SDS source utilization is maximized resulting in fewer bottle changeouts, increased up-time and ultimately lower cost of ownership. See Figure 1 for typical SDS gas utilization as a function of pressure.

The P2A multi-gas feature allows the user to configure an MFC off-the-shelf for its intended gas further lowering costs through reduced inventory requirements. This feature is enabled through a web browser utility accessed through the device's Ethernet port. The configuration utility uses a standard web browser – no special software is required.

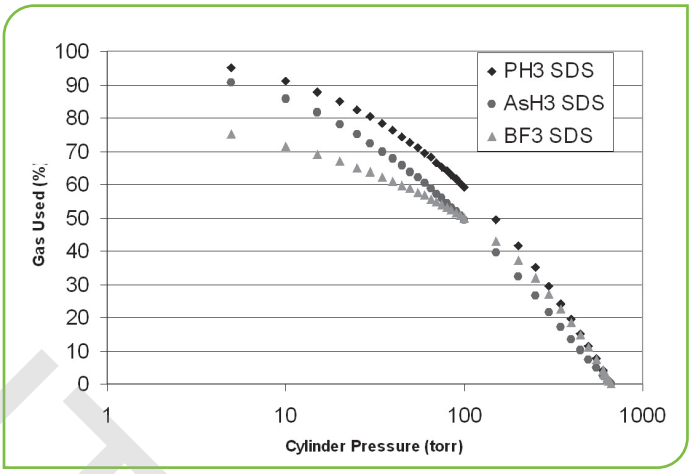
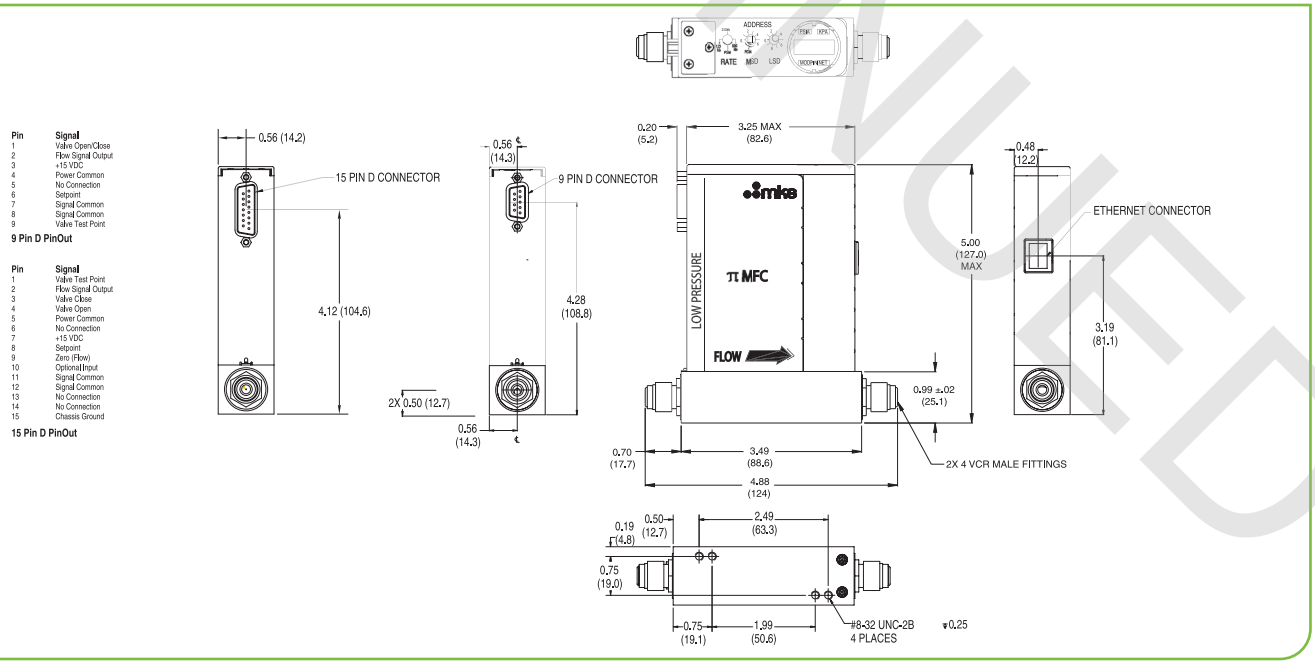


Figure 1 —
SDS Gas Use Rate Efficiency



Dimensional Drawing and PinOuts—Swagelok® 4 VCR® Version with Analog 9 Pin D
Note: Unless otherwise specified, dimensions are nominal values in inches (mm referenced).

Performance		
Full Scale Ranges (N_2 equivalent)		2 – 20 sccm
Inlet Pressure Range		4 – 1200 Torr (with vacuum at the outlet)
Normal Operating Pressure Differential (N_2 equivalent)		<10 Torr at Full Scale flow (with vacuum at the outlet)
Maximum Purge Pressure		150 psig
Burst Pressure		1500 psig
Control Range		2 to 100% of Full Scale
Typical Accuracy		±1% of set point for >10 to 100% Full Scale and ±0.2% of Full Scale for 2 to 10% of Full Scale at inlet pressures >20 Torr
Repeatability		0.2% of Full Scale
Resolution		0.1% of Reading
Temperature Coefficients	Zero Span	• ±0.08% of Full Scale/°C • ±0.08% of Reading/°C
Controller Settling Time (per SEMI Guideline E17-0600)		<2 sec. typical above 10% of Full Scale at inlet pressures >10 Torr
Warm-up Time (to within 0.2% of Full Scale of steady state performance)		<30 min.
Normal Operating Temperature		10 to 50°C
Storage Humidity		0 to 95% Relative Humidity, no condensing
Storage Temperature		-20 to 65°C
Temperature Display		0 to 100°C
Temperature Readout Units		°C
Temperature Accuracy		±2°C
Temperature Resolution		0.1°C
Mechanical		
Fittings		Swagelok® 4 VCR®
Display		4 digits for value, 4 characters for unit
Leak Integrity	External (scc/sec He) Through Closed Valve	• <1 x 10^{-10} • < 1.0% of Full Scale at 25 psig inlet to atmosphere
Wetted Materials	Standard	316 S.S. VAR (equivalent to 316 S.S. SCQ for semiconductor quality),316 S.S., Elgiloy, KM-45, NiTi
Surface Finish		5 microinch average Ra
Weight		<2 lbs. (0.9 kg)
Electrical Analog I/O		
Analog (power & I/O)		9 pin D male or 15 pin D male
Diagnostics		Ethernet
Input Voltage		15-24 VDC ±5%VDC @ 350mA peak, 250 mA steady state
Set Point Command Signal		0 to 5 VDC
Output Signal		0 to 5 VDC

Ordering Code Example: P2A035500RAT2	Code	Configuration
Model		
P2A Mass-Flo Controller (multi-gas, multi-range)	P2A	P2A
Gas		
013 = Nitrogen = N_2 096 = Arsenic Pentaflouride = AsF_5 035 = Arsine = AsH_3 048 = Boron Triflouride = BF_3 099 = Germanium Tetraflouride = GeF_4 023 = Hydrogen Selenide = H_2Se 031 = Phosphine = PH_3 062 = Phosphorus Triflouride = PF_3 088 = Silicon Tetraflouride = SiF_4 Based on 100% gas concentration, for other gases or mixtures, consult factory.	013 096 035 048 099 023 031 062 088	035
Flow Range Full Scale*		
2 sccm 5 sccm 10 sccm 20 sccm	Consult Factory 500 101 201	500
Fittings (compatible with)		
Swagelok 4 VCR male	R	R
Connector		
9 pin D 15 pin D	A B	A
Valve		
Normally Closed, Teflon®	T	T
Flow Orientation		
Vertical Horizontal	1 2	2

** The Full Scale flow rate is designated by a 3 digit number. The first two digits represent the significant digits of the Full Scale flow rate separated by a decimal point. The third digit is the exponent of the power of ten.*

500 is 5.0 x 10^0 or 5 sccm *151 is 1.5 x 10^1 or 15 sccm*

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