



## 1640

### PRESSURE-BASED MASS FLOW CONTROLLER FOR ION IMPLANT APPLICATIONS

The 1640 Pressure-based Mass Flow Controller is a metal-sealed instrument designed to meter and control gas flows in low-line pressure applications where thermal mass flow controllers are limited in their ability to accurately measure flow. The 1640 utilizes the principle of sonic flow through an orifice, a condition met when the upstream control pressure is at least twice the downstream pressure. Under these conditions, mass flow is proportional to the control pressure.

In the 1640, as illustrated in Figure 1, a Baratron® capacitance manometer monitors the pressure upstream of the critical orifice. This pressure is proportional to mass flow. The measured pressure is compared in the control electronics to the flow set point. A control signal is then generated to drive the proportional control valve to the conductance required to bring the actual control pressure (flow) into agreement with the flow set point.

### Features & Benefits

#### Maximize Gas Utilization

- Control of gas flow at pressures below 10 Torr improves SDS® gas utilization and reduces frequency of source bottle changes

#### Ease-Of-Use

- Same footprint and electrical specifications as thermal Mass Flow Controllers allows for straight forward integration

#### Robust

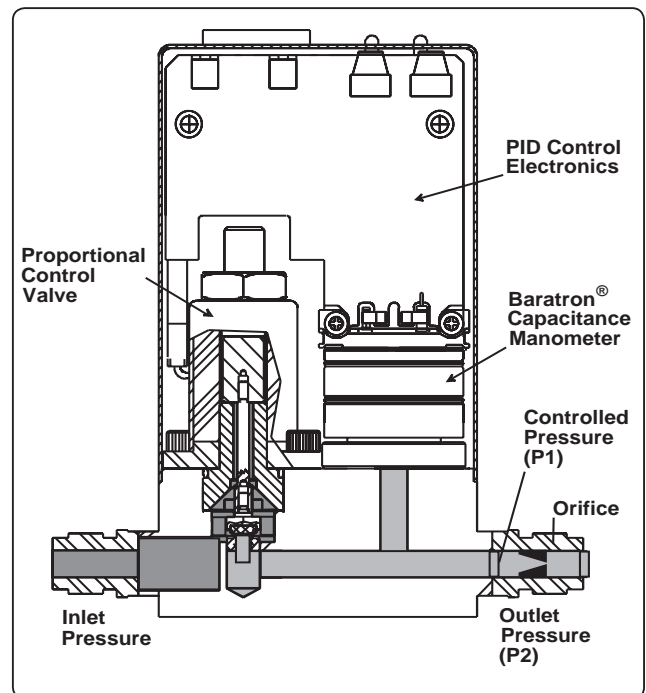
- Pressure-based flow measurement with Baratron® pressure transducer provides repeatable flow measurement and control over full inlet pressure spectrum
- Rigorous metal-sealed design and STRIFE testing ensures long term reliability



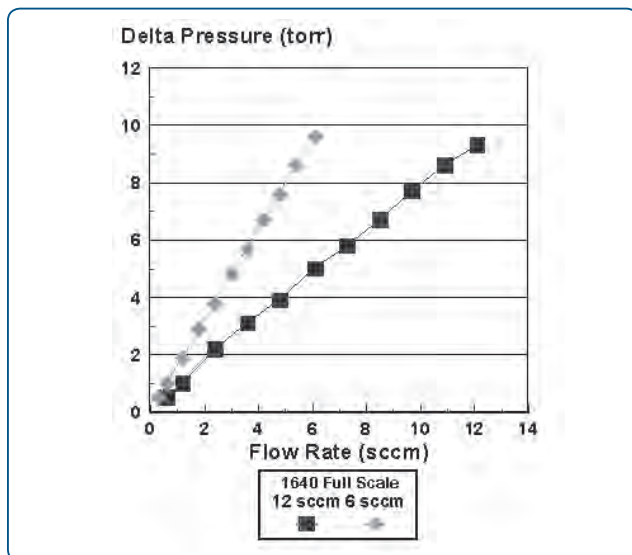
## Safe Delivery System (SDS®) Applications

The 1640 was the first MFC to enable SDS gas utilization at source pressures below 10 Torr. Configurations of the 1640 have been designed specifically for the requirements needed for flow control in ion implanters utilizing SDS dopant sources. The SDS source pressure is typically at 650 Torr when the source is full, and drops as the source gas is extracted. The 1640 PMFC is designed to extract gas below source pressures of 10 Torr (see Figure 2). The 1640 PMFC thus improves source utilization and reduces the frequency of source bottle changes (see Figure 3).

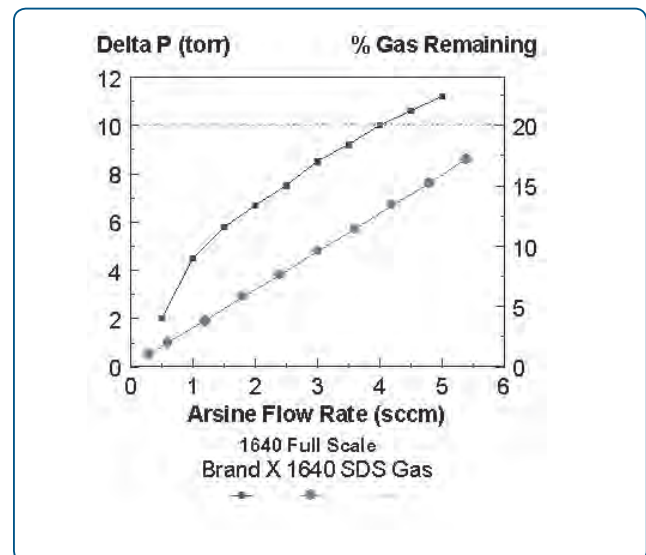
The 1640 for SDS applications is designed to function over the wide SDS source pressure range from 650 Torr to below 10 Torr and provide Full Scale dopant flows as high as 10 sccm. Since flow is controlled by controlling pressure there is not as much pressure coefficient effect as there is with most thermal MFCs. The 1640 is in use today on medium and high current as well as high energy implanters throughout the world. 1640s are also available for high pressure implant gases.



**Figure 1 —**  
A cross-section view of the 1640 pressure-based Mass Flow Controller.



**Figure 2 —**  
This graph shows pressure drop versus flow rate for two 1640 MFCs: one with 12 sccm Full Scale, the other with 6 sccm Full Scale.



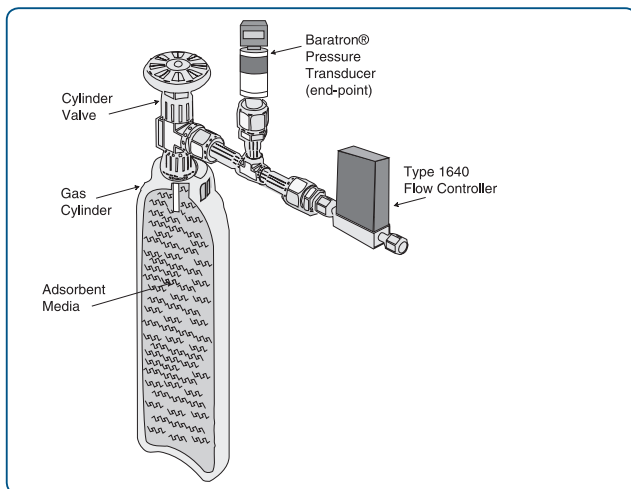
**Figure 3 —**  
The 1640 design allows for gas extraction to source pressures below 10 Torr depending on flow rate and gas line conductance. A 1640 designed for 6 sccm Full Scale has the potential to extract 5% more SDS source gas than a competitor's thermal MFC.



# Specifications

<b>Full Scale Ranges For Implant Applications</b> (N <sub>2</sub> equivalent)	2 sccm to 20 sccm
<b>Maximum Operating Inlet Pressure</b>	5 psig
<b>Minimum Operating Inlet Pressure</b> (typical)	below 10 Torr
<b>Overpressure Limit</b>	45 psia
<b>Control Range</b> (typical)	5% to 100% of F.S.
<b>Flow Accuracy</b> (including non-linearity, hysteresis, and non-repeatability referenced to 760 mmHg and 0°C)	Gas/flow rate dependent
<b>Repeatability</b>	± 0.2% of F.S.
<b>Resolution</b>	0.1% of F.S.
<b>Temperature Coefficients</b>	
Zero	< 0.02% of F.S./°C
Span	< 0.2% of Rdg./°C
<b>Warm-up Time</b>	< 30 min (to within 0.2% of F.S. of steady state performance)
<b>Controller Settling Time to 100% of F.S.</b>	< 5 sec (typical per SEMI Guideline E17-91)
<b>Normal Operating Temperature Range</b>	0°C to 50°C
<b>Input Voltage Required</b>	
Max. current at start-up (first 2 sec)	± 15 VDC (± 5%) @ 200 mA
Typical current at steady state	± 15 VDC (± 5%) @ 100 mA
<b>Set Point Command Signal</b>	0 to 5 VDC from < 20K Ω
<b>Output Signal</b>	0 to 5 VDC into > 10K Ω
<b>Output Impedance</b>	< 1 Ω
<b>Connector Types</b>	15-pin Type "D"
<b>Wetted Materials</b>	
Standard wetted components	316L S.S., nickel, Inconel®
Valve seat only	Kel-F®, Chemraz® or Kalrez® (gas/application dependent)
<b>Leak Integrity</b>	
External (scc/sec He)	< 1 x 10 <sup>-9</sup>
Through closed valve <sup>1</sup>	1% of F.S. (nitrogen) at 15 psig inlet to atmosphere
<b>Fittings Compatible With</b>	Swagelok® 4 VCR®
<b>Compliance</b>	CE

<sup>1</sup> To assure no flow-through, a separate positive shut-off valve is required.



## Safe Delivery Source (SDS)<sup>®</sup>

The SDS delivers gas based on the differential pressure between the source gas cylinder (at less than 0 psig) and the implanter ion source. An MKS Baratron pressure transducer with an LDM (Local Display Module) may be used to sense source pressure along with the 1640 pressure-based MFC to control flow.



# Ordering Information

Ordering Code Example: 1640AXXX	Code	Configuration
1640A Pressure Based Mass Flow Controller	1640A	1640A

MKS will configure the 1640 to meet your specific needs for gas type and flow rates. Please contact the MKS Applications Engineering Group at (800) 227-8766 with your requirements and allow them to determine an appropriate 1640 configuration.

XXX

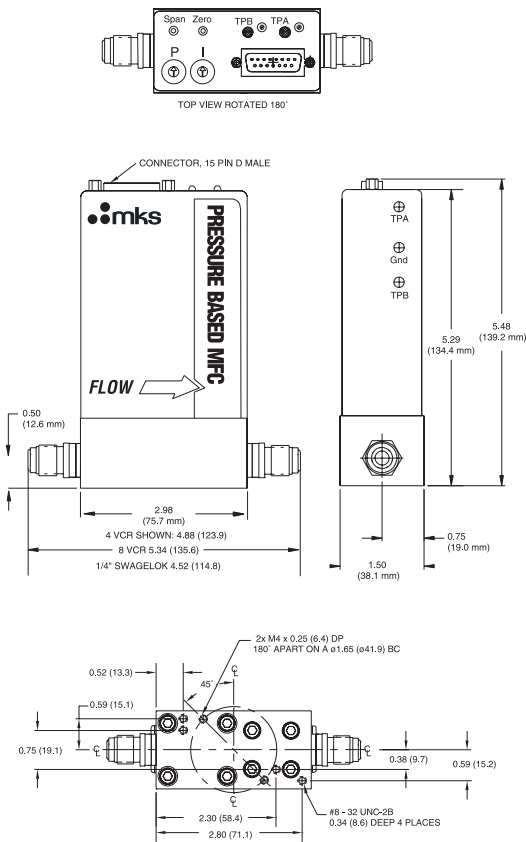
### Optional Accessories

750 Baratron Capacitance Manometer: to monitor the gas source pressure  
 LDM: A local display module that, when mounted with the 750, provides a local pressure readout

### Cabling for 1640A:

CB259-5-10 for 1640 15-pin Type "D" to 246, 247  
 CB147-1-10 for 1640 15-pin Type "D" to 647

Contact Applications Engineering for shielded cables required for CE Compliance.



### Dimensional Drawing —

Note: Unless otherwise specified, dimensions are nominal values in inches (mm referenced).



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