

# 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.

### Product Features

- Control of gas flow at pressures below 10 Torr improves SDS® gas utilization and reduces frequency of source bottle changes
- Pressure-based flow measurement with Baratron pressure transducer provides repeatable flow measurement and control over full inlet pressure spectrum
- Suitable for other low pressure materials such as water vapor and dilute ozone, in addition to SDS applications



### Key Benefits

- Rigorous metal-sealed design and STRIFE testing ensures long term reliability
- Same footprint and electrical specifications as thermal Mass Flow Controllers allows for straight forward integration

## 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. The 1640 PMFC thus improves source utilization and reduces the frequency of source bottle changes (see Figure 2).

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. The 1640s are also available for high pressure implant gases.

The 1640 is also used for other low pressure, low temperature applications such as water vapor, dilute ozone, organic materials, and silicon and metal precursors. Since water has a sea-level vapor pressure of 17 Torr at room temperature, the 1640 is often used for delivery of water vapor up to 100 sccm into vacuum processes. Ozone mixtures can cause problems with thermal flow controllers, and the 1640 with special non-nickel-plated parts is a popular choice for flows up to 1 slm. For other materials, our MKS team will model a 1640 to assess the feasibility and offer solutions to your needs.

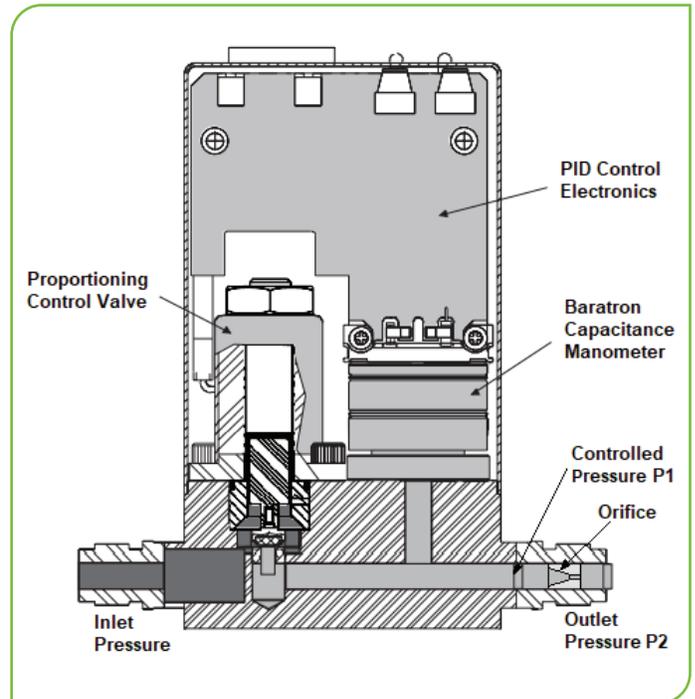


Figure 1 — A cross-section view of the 1640 pressure-based Mass Flow Controller.

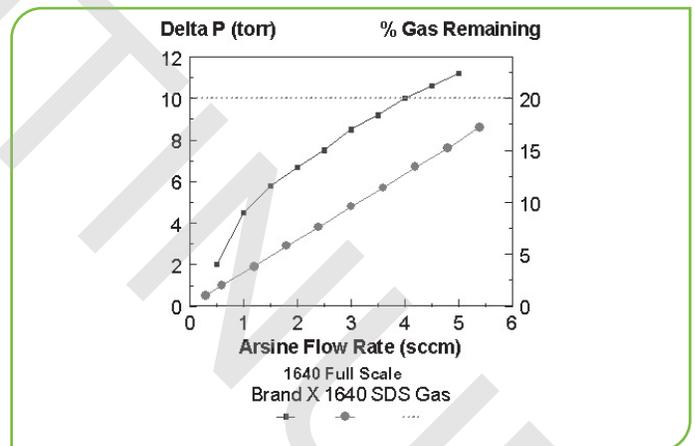
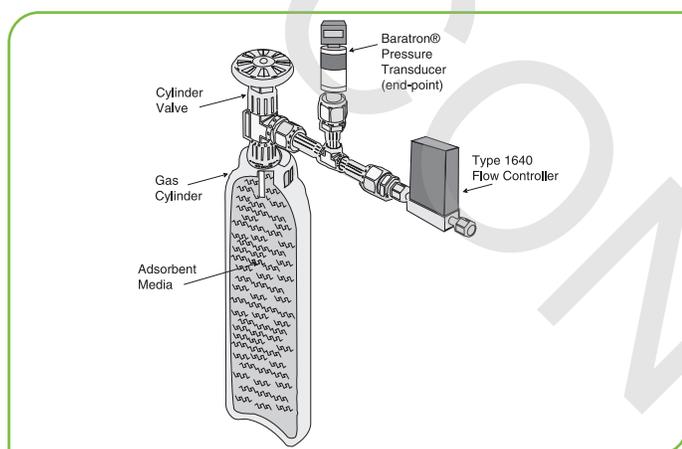


Figure 2 — The 1640 design allows for gas extraction to source pressures below 10 Torr depending on flow rate and gas line conductance. A 1640 designed for 6 sccm Full Scale has the potential to extract 5% more SDS source gas than a competitor's thermal MFC.

Specifications	
<b>Full Scale Ranges (typical) (N<sub>2</sub> equivalent)</b>	<ul style="list-style-type: none"> <li>• 2 sccm to 20 sccm (SDS materials)</li> <li>• 10 sccm to 1000 sccm (other materials)</li> </ul>
<b>Maximum Operating Inlet Pressure (typical)</b>	5 psig
<b>Minimum Operating Inlet Pressure (typical)</b>	Below 10 Torr
<b>Overpressure Limit</b>	45 psia
<b>Control Range (typical)</b>	5% to 100% of Full Scale
<b>Flow Accuracy (including non-linearity, hysteresis, and non-repeatability referenced to 760 mmHg and 0°C)</b>	Gas/flow rate dependent
<b>Repeatability</b>	±0.2% of Full Scale
<b>Resolution</b>	0.1% of Full Scale
<b>Temperature Coefficients</b>	
<b>Zero Span</b>	<ul style="list-style-type: none"> <li>• &lt;0.02% of Full Scale/°C</li> <li>• &lt;0.2% of Reading/°C</li> </ul>
<b>Warm-up Time</b>	<30 min (to within 0.2% of Full Scale of steady state performance)
<b>Controller Settling Time to 100% of Full Scale</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>	
<b>Max. at start-up (first 2 sec)</b>	• ±15 VDC (± 5%) @ 200 mA
<b>Typical at steady state</b>	• ±15 VDC (± 5%) @ 100 mA
<b>Set Point Command Signal</b>	0 to 5 VDC from <20K Ω
<b>Output Impedance</b>	<1 Ω
<b>Connector Type</b>	15-pin Type "D"
<b>Wetted Materials</b>	
<b>Standard Valve Seat Only</b>	<ul style="list-style-type: none"> <li>• 316L S.S., nickel, Inconel®</li> <li>• Kel-F®, Chemraz® or Kalrez® (gas/application dependent)</li> </ul>
<b>Leak Integrity</b>	
<b>External (scc/sec He) Through closed valve<sup>1</sup></b>	<ul style="list-style-type: none"> <li>• &lt;1 x 10<sup>-9</sup></li> <li>• 1% of Full Scale (nitrogen) at 15 psig inlet to atmosphere</li> </ul>
<b>Fittings (compatible with)</b>	Swagelok® 4 VCR®

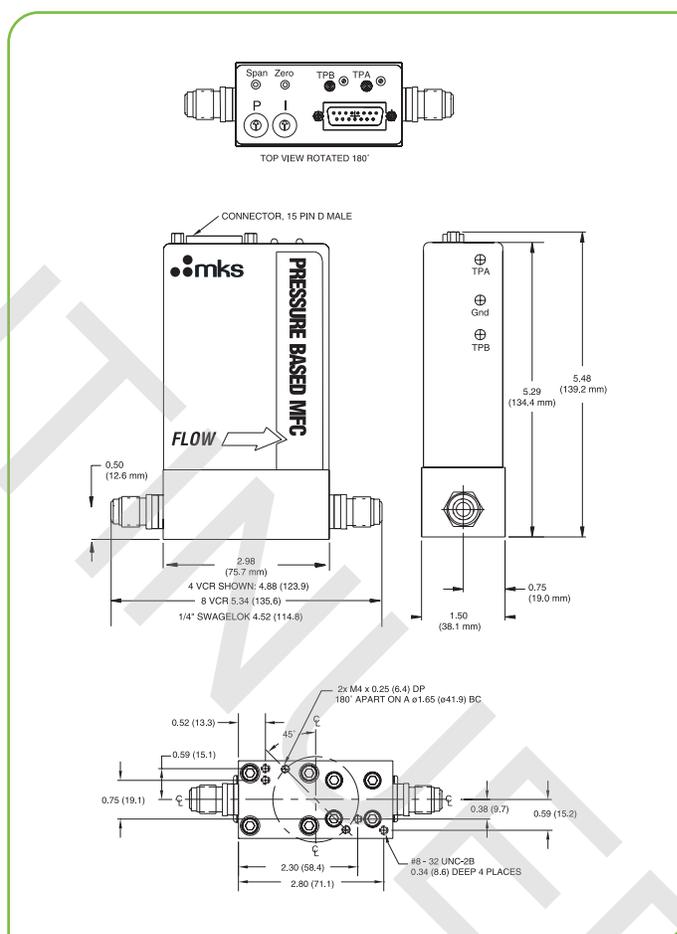
<sup>1</sup>To assure no flow-through, a separate positive shut-off valve is required.

Ordering Code Example: 1640AXXX	Code	Configuration
Model		
1640A Pressure Based Mass Flow Controller	1640A	1640A
Configuration		
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.		XXXX
Optional Accessories		
722 Baratron Capacitance Manometer: to monitor the gas source pressure		
Cabling		
100016744 for 1640 15-pin Type "D" to 946		



**Safe Delivery Source (SDS®)**

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.



Dimensional Drawing — Unless otherwise specified, dimensions are nominal values in inches (millimeters referenced).