

# Ultra-High Pressure Digital Gas Mass Flow Meters & Controllers

## FEATURES

- Ideal for pilot plants, hydrogenation reactors, and autoclave processes
- Measure and control gas mass flow rates over an inlet pressure range of 500 to 5000 psig (34.5 to 345 barg)
- Flow ranges from 100 sccm to 20 slpm
- High accuracy +/- 1.0% of full scale; repeatability +/- 0.2% of full scale
- Wide differential pressure range from 0.345 bard (5 psid) to 345 bard (5000 psid)
- Innovative new ValFlex™ control valve design for precision control over a wide range of pressures and flow rates
- Leak-by of as little as 4 sccm at 5000 psid (345 bard), depending on orifice
- Inert, carbon-reinforced polyamide valve seat increases valve durability and precision
- Special high pressure rated seals minimize gas permeability
- Add Sierra's Compod™ to run small-scale pilot plants or control high pressure reactors and autoclave processes without the expense of DCS or PLC systems.
- Proprietary high pressure calibration facility, directly traceable to NIST
- 24 VDC input power reduces installation cost and complexity
- Unique Pilot Module (mounted or hand-held) lets you view and change critical control functions
- Choose from multiple analog or digital signals
- Supports Modbus, Profibus DP, Foundation Fieldbus
- CE approved



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SmartTrak 100HP



## DESCRIPTION

**P**recision flow measurement and control at very high gas pressures is among the most challenging applications in the flow industry. Leaks, gas behavioral changes, and unpredictable valve control can all lead to reduced performance.

Designed to overcome these challenges, the 100HP combines the high performance of the SmartTrak® with a wider, more robust flow body, all-welded sensor seals, an innovative new valve design called ValFlex™, and a state-of-the-art high pressure calibration facility. The result is an instrument with increased application flexibility and accuracy in high pressure gas flow control applications.

To increase valve performance and accuracy under high pressures, Sierra's proprietary ValFlex™ valve seat technology uses a flexible, high-impact, carbon-reinforced polyamide valve seat material to assure smooth interaction with the valve orifice. The result is precision control over a wide range of flows from 100 sccm to 20 slpm with an industry leading leak-by as little as 4 sccm at 5000 psid (345 bard), dependant on the orifice used.

Because traditional valve seat elastomers like Viton, Neoprene and Kalrez swell and deform under high pressures, the 100HP uses harder, denser seals to minimize gas permeability.

To ensure the 100HP delivers precise, high pressure measurement and control, each unit is calibrated on our proprietary NIST traceable high-pressure calibration facility using a gas booster, high-pressure accumulator tanks, and mirrored precision pressure gauges, yielding highly accurate inlet and outlet pressures to match the customer's application perfectly.

An instrument designed with purpose, the 100HP is a versatile solution for the most challenging high-pressure gas mass flow applications.

## PERFORMANCE SPECIFICATIONS

### Accuracy

± 1.0% of full scale including linearity under calibration conditions

### Repeatability

± 0.2% of full scale

### Temperature Coefficient

± 0.025% of full scale per °F (± 0.05% of full scale per °C)

### Pressure Coefficient

± 0.01% of full scale per psi (± 0.15% of full scale per bar), or better

### Response Time

5 seconds (typical) to within ± 2% of final value

## OPERATION SPECIFICATIONS

### Mass Flow Rates

C100L High Pressure Full Scale: 100 sccm to 20 slpm  
Flow ranges specified are for an equivalent flow of nitrogen at 760 mm Hg and 21 °C (70°F); other ranges in other units are available (e.g., nlpm, scfh, nm<sup>3</sup>/h, kg/h)

For measuring and controlling a wide range of flow rates, please consider the SmartTrak 100 series.

For measuring or controlling flows below 5 sccm, please consider the MicroTrak™ 101.

For controlling flows requiring ultra low pressure drop, please consider SmartTrak® 140.

For controlling flows in industrial (IP67) applications, please consider the MaxTrak® 180.

### Control Range

5–100% of full scale flow; automatic shut-off at 4.9%.

### Gases

All clean gases including corrosives and toxics; specify when ordering.

Maximum Gas Flow Rates	
Gas	Max Flow Rate (slpm)
Air	20
Argon (Ar)	27.96
Carbon Dioxide (CO <sub>2</sub> )	14.74
Carbon Monoxide (CO)	20
Methane (CH <sub>4</sub> )	15
Helium (He)	27.96
Hydrogen (H <sub>2</sub> )	20
Nitrogen (N <sub>2</sub> )	20
Nitrous Oxide (N <sub>2</sub> O)	14.32

### Gas and Ambient Temperature

32°F to 122°F (0°C to 50°C)

### Warranty

1 year

## PRESSURE SPECIFICATIONS

### Gas Inlet Pressure

500 to 5000 psig (34.5 to 345 barg); See the SmartTrak 100 series for pressures up to 500 psig (34.5 barg).

### Rated Burst Pressure

7500 psig (517 barg)

### Pressure Drop Across a Meter

Typical Pressure Drop for Nitrogen Mass Flow Meters Pressure Differential in psi (mbar)	
Flow Rate (slpm)	¼-inch Fittings
0.1	0.36 (24.5)
0.5	0.36 (24.5)
1	0.37 (25.4)
10	0.46 (31.7)
20	0.66 (45.7)

Note: Tested at 21°C, outlet at ambient pressure

### Differential Pressure Requirement for Controllers

Minimum Differential Pressure Requirement for Mass Flow Controllers Pressure Differential in psi (mbar)	
Flow Rate (slpm)	¼-inch Fittings
0.1	5 (345)
1	7.5 (517)
10	30 (2068)
20	60 (4137)

Note: Tested at 21°C, outlet at ambient pressure

### Leak Integrity

5 X 10<sup>-9</sup> atm cc/sec of helium or better

### Maximum Differential Pressure (ΔP)

345 bard (5000 psid) to atmosphere

## VALVE DESIGN

### Proprietary ValFlex™ Valve Design

Assures valve seat/orifice compliance for smooth control. Inert, carbon-reinforced Polyamide material (compatible with most gases) increases valve durability and precision.

Industry best, leak-by of as little as 4 sccm at 5000 psid (345 bard), depending on the orifice used.

## PHYSICAL SPECIFICATIONS

### Dimensions

Height: 5.40 in (137.2 mm)  
 Width: 6.06 in (154 mm\*)  
 Depth: 1.47 in (37.3 mm)  
 \*with ¼-inch compression fittings

### Weight

4 lbs 3 oz (1.9 kg)

### Wetted Material

316 stainless steel or equivalent; 416 stainless steel  
 90A Viton® seals and Polyamide valve seat (MFC only)

### Approvals

CE approved

## POWER REQUIREMENTS

### Input Power

(ripple should not exceed 100 mV peak-to-peak)  
 For meter: 15-24 VDC  $\pm$ 10% (230 mA, regulated)  
 For controller: 24 VDC  $\pm$ 10% (500 mA, regulated)

## ANALOG AND DIGITAL OUTPUTS

### Analog Output Signal

Linear 0/4–20 mA, 500 ohms maximum loop resistance  
 and one of the following (user selectable):  
 Linear 0–5 VDC, 1000 ohms minimum load resistance  
 Linear 0–10 VDC, 1000 ohms minimum load resistance  
 Linear 1–5 VDC, 1000 ohms minimum load resistance

### Command Signal

Analog (choice of one):  
 Linear 0–20 mA, 0/4–20 mA, 0–5 VDC, 0–10 VDC, 1–5 VDC

### Digital Communication

RS-232 standard, RS-485 optional  
 Pilot Module Display optional

### Digital Communication Protocols

Profibus DP  
 Modbus  
 Foundation Fieldbus

## OPTIONAL COMPOD

### Sierra's Compod™

Add Sierra's Compod™ to run small-scale pilot plants or control high pressure reactors and autoclave processes without the expense of DCS or PLC systems.

Fully, network-enabled RS-485 communication with Modbus RTU protocol allows digital multi-drop networks; optional LCD display and flow totalizer with adjustable pulse output; two configurable digital outputs & one analog input.

## SOFTWARE

Free user software to allow for full configuration and readout of the instrument.

## HIGH PRESSURE CALIBRATION

### High Pressure Calibration Facility

Each unit is calibrated on our proprietary NIST traceable high pressure calibration facility using laboratory grade nitrogen gas. The facility consists of a gas booster, high-pressure accumulator tanks, a burst test outlet manifold, and a calibration outlet manifold.



### High-Pressure Accumulator Tank and Burst Test Manifold

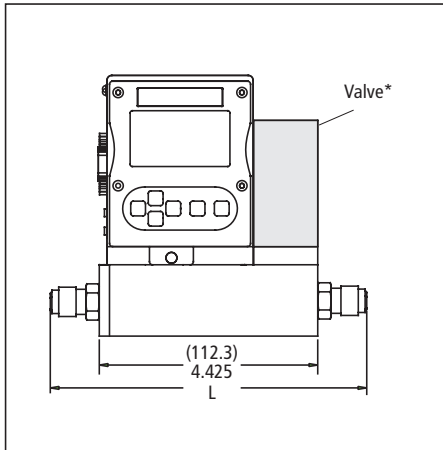
The facility features the highest quality regulators to minimize the droop effect, providing flat pressure profiles across a large flow range. The burst test outlet manifold is rated to and able to produce pressures at or above the 100HP rated burst pressure of 7500 psig (517 barg).

The calibration outlet manifold features mirrored precision pressure gauges, yielding highly accurate inlet and outlet pressures to match each application.

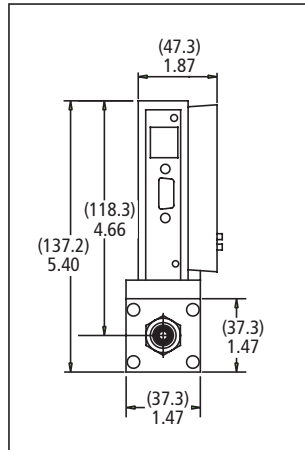
**DIMENSION L**

Fittings	Length with Fittings in Inches (mm)
¼ compression	6.02 (154)
¼ VCO	5.56 (143)
¼ VCR	5.88 (151)
6 mm compression	6.04 (156)

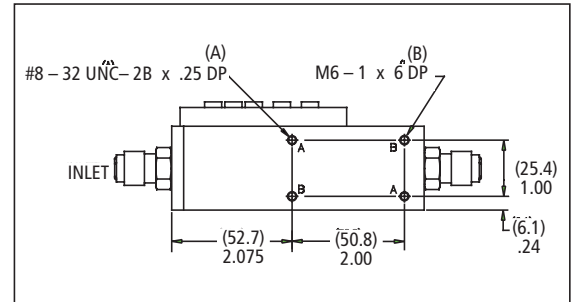
**M100HP-L & C100HP-L Front View**



**M100HP-L & C100HP-L Inlet View**

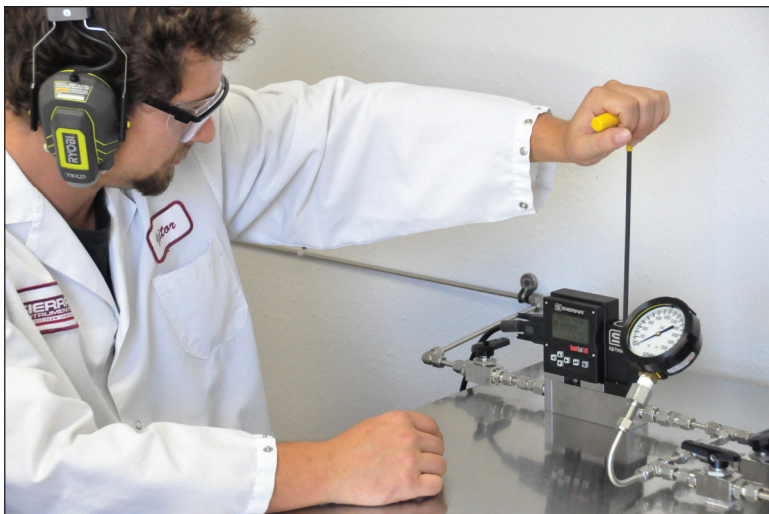


**M100HP-L & C100HP-L Bottom View**



\*Valve on C100HP-L controller only; not present on M100HP-L meter

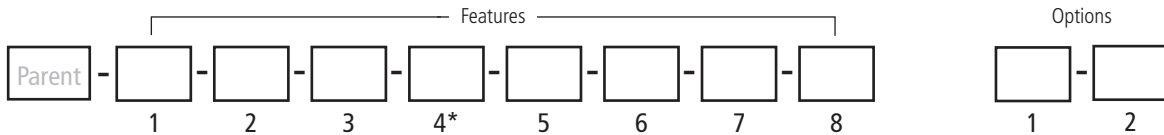
All dimensions are in inches with (mm) in brackets. Certified drawings are available on request.



**Mass Flow Controller Calibration: Valve Adjustment**



**Gauge for High-Pressure Accumulator Tank Used During Calibration**



Instructions: To order a 100HP-L, please fill in each number block by selecting the codes from the corresponding features below. \*MFC only

Parent Number	
<b>C100HP-L</b>	High pressure mass flow controller, digital high performance with pressure 500 to 5000 psig (34.5 to 345 barg); flow 100 sccm to 20 slpm. Standard configuration includes: flow body and sensor constructed of 316 stainless steel, electromagnetic valve, digital electronics mounted on flow body, 90A Viton® "O"-rings and polyamide valve seats. Linear analog and RS-232 output signals; miniature 15-pin D electrical connector; requires 24 VDC and a command signal. This signal can come from the Pilot Module Display/Interface, the RS-232 port or any external 0-5, 0-10, 1-5 VDC or 0/4-20 mA source. SmartTrak® Software available <a href="http://www.sierrainstruments.com/products/100_software/st2_v2.52.zip">http://www.sierrainstruments.com/products/100_software/st2_v2.52.zip</a> . Note: No Dial-A-Gas available.
<b>M100HP-L</b>	High pressure mass flow meter pressure 500 to 5000 psig (34.5 to 345 barg); flow 100 sccm to 20 slpm. Standard configuration includes: flow body and sensor constructed of 316 stainless steel, digital electronics mounted on flow body, 90A Viton® "O"-rings. Linear analog and RS-232 output signals; miniature 15 pin D electrical connector; requires 15-24 VDC. SmartTrak® Software available <a href="http://www.sierrainstruments.com/products/100_software/st2_v2.52.zip">http://www.sierrainstruments.com/products/100_software/st2_v2.52.zip</a> . Note: No Dial-A-Gas available.

Note: All slpm flow ranges are also available in nlpm

Feature 1: Pilot Module Display	
<b>NR</b>	No display/interface. If option 2 digital communications are selected, NR must be selected
<b>DD</b>	Pilot module display/Interface mounted on the enclosure
<b>RD</b>	Remote display pilot module display/interface. Includes 10 foot (3 meter) CAT 5 cable. Optional cables up to 50 feet (15 meters) may be used. May be used with digicomms but not simultaneously
<b>CMNR</b>	Compod with RS-485 Modbus communication mounted on the enclosure
<b>CMDD</b>	Compod with RS-485 Modbus communication and display mounted on the enclosure
<b>CMNRRelays</b>	CMNR with 2 analog relays; installed in the Compod
<b>CMDDRelays</b>	CMDD with 2 analog relays; installed in the Compod

Note: Only one option may be selected for Feature 1.

Feature 2: Inlet/Outlet Fittings	
<b>2</b>	1/4-inch compression (standard).
<b>5</b>	1/4-inch VCO
<b>8</b>	1/4-inch VCR
<b>10</b>	6 mm compression

Feature 3: Flow Body Elastomers (required for MFM and MFC)	
<b>OV1</b>	90A Viton® elastomers
<b>OV1-F</b>	Viton® (For phosphine only)

Feature 4: Valve Seat (required MFC only)	
<b>VX1</b>	ValFlex™ inert, carbon-reinforced Polyamide

Feature 5: Input Power	
<b>PV1M</b>	15-24 VDC for meters (optional)
<b>PV2</b>	24 VDC for all instruments (standard)

Feature 6: Output Signal	
<b>V1</b>	0-5 VDC and 0/4-20 mA linear output signals
<b>V2</b>	1-5 VDC and 0/4-20 mA linear output signals
<b>V3</b>	0-10 VDC and 0/4-20 mA linear output signals

Feature 7: External Setpoint Signals (MFC only)			
<b>S0</b>	Pilot Module/RS-232 (standard for Pilot Module/digital operation)	<b>S3</b>	0-10 VDC, linear (MFC only)
<b>S1</b>	0-5 VDC, linear, standard for analog operation	<b>S4</b>	4-20 mA, linear (MFC only)
<b>S2</b>	1-5 VDC, linear (MFC only)	<b>S5</b>	0-20 mA, linear (MFC only)

Note: Alternate among V1, V2, V3 with Pilot Module display/interface or SmartTrak Software

Feature 8: Electrical Connection			
<b>C0</b>	15-pin mating connector with no cable	<b>C10</b>	10-foot (3 m) 100-Analog Cable. 15 conductor cable with D-connector on one end, fly leads on the other.
<b>C1</b>	1-foot (300 mm) 100-Analog Cable. 15 conductor cable with D-connector on one end, fly leads on the other.	<b>C25</b>	25-foot (8 m) 100-Analog Cable. 15 conductor cable with D-connector on one end, fly leads on the other.
<b>C3</b>	3-foot (1 m) 100-Analog Cable. 15 conductor cable with D-connector on one end, fly leads on the other.	<b>C ( )</b>	100-Analog Cable ( ): Custom length communication cable. Specify cable length in feet in parenthesis. Maximum length 50 feet (16 meters). Fixed price any length.

Option 1: Digital Communications			
<b>MB</b>	See Compod options under Feature 2	<b>FF</b>	Foundation Fieldbus full device description (NR only)
<b>DP</b>	Profibus DP (NR Only)		

Option 2: Certificates	
<b>MC</b>	Material certificates--US Mill certs on all wetted flow body parts
<b>CC</b>	Certificate of Conformance

Note: Pilot Module not available with digital communications





High-Pressure Mass Flow Controller – Actual Size

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