

1660 Series

Standard Mass Flow Controllers/Meters

- » 1% digital setpoint accuracy and <1 second response
- » High reliability and repeatability
- » MultiFlo™ technology
- » Digitals are backward-compatible to analog MFCs



Advanced control systems

The 1660 Series mass flow controllers/meters offer state-of-the-art, advanced control systems unequalled in the market today. The underlying algorithms provide the best-in-class accuracy of $\pm 1\%$ set-point and response of <1 second. The 1660 Series can meet specifications for any gas over a large inlet/outlet pressure range, over a wide temperature range, and over a large range of flow rates.

MultiFlo™ technology



MultiFlo™

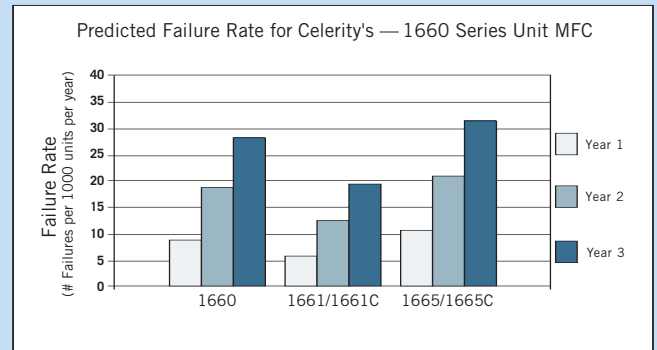
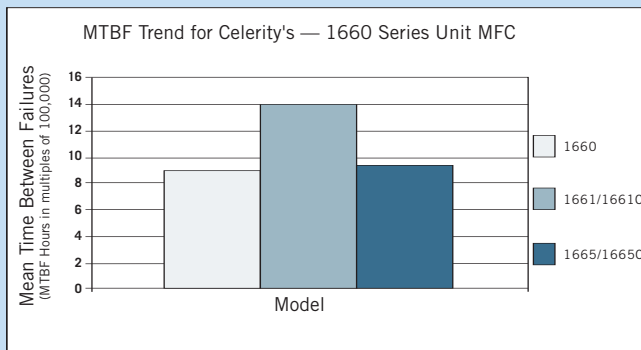
Unit digital mass flow controllers and meters with MultiFlo technology are the industry's most accurate mass flow devices offering $\pm 1\%$ of setpoint accuracy.

Other mass flow controllers and meters measure accuracy in percentage of full scale. The high resolution calibration control utilizes a 32 point calibration table for each gas, resulting in a ten-fold improvement in accuracy. We guarantee a zero drift to less than 0.6% per year, reducing the number of periodic calibrations needed.

Each MultiFlo digital device can be field programmed for unlimited process gases with a programmable full scale from 33% to 100% of the maximum specified range. This eliminates the need to purchase spares for each application and lowers the cost of ownership. In addition, it reduces costs associated with change of gas and range. The response time can be programmed from less than 1 second up to 20 seconds to meet process requirements. Further, real time in situ calibration, monitoring, diagnostics, and trouble-shooting reduce equipment down-time and cost of ownership.

MultiFlo™ benefits

- Replacement MFCs are available in only a few minutes
- Nine standard MFC part numbers cover 85% of all applications
- Enables on-site gas and range changes with no surrogate gas requirements
- Enables last minute changes in gas panel integration without impacting on-time delivery
- Dramatically reduces inventory requirements
- Increases tool uptime



Digital model 1661C with MultiFlo has a dual connector and can be operated in either RS485 or analog mode. When operating in the analog mode, the RS485 port can still be used to read flow and change gases and ranges. The DeviceNet and PROFIBUS model 1665C utilize either the PROFIBUS or Open DeviceNet Vendors Association (ODVA) compliant interfaces.

Better by design

The Unit 132 valve incorporated within the 1660 Series is the premier proportional control valve in the market today. Its unique design has been optimized to eliminate threads and shims that can trap dirt and moisture. In testing, it is subjected to over 8 million cycles with no degradation in performance. The electromagnetic actuator is proven to have superior reliability to piezo actuators and can also operate over a larger pressure range. This design has been used in over 200,000 precision mass flow controllers demonstrating unmatched reliability.

The 3 sigma guarantee

At Celerity, we stand behind our specifications. While others give only a one or two sigma limits (66.7% or 95%), Celerity guarantees 3 sigma limits, or 99.7% confidence, on critical parameters.

CrossChek™ metrology system



Celerity's world-class CrossChek calibration methodology maintains SPC-verified calibration accuracy with ± 3 sigma limit (99.7% confidence level) compared to ± 1 or 2 sigma limits (67% to 95% confidence level) for other manufacturers.

CrossChek calibration methodology provides ongoing verification of production calibration standards. This ensures consistent and repeatable accuracy performance within ± 3 sigma of published specifications. No other flow control company offers the same guarantee.

Communications options

All Unit digital products have the ability to communicate via analog, RS485, DeviceNet and PROFIBUS. A variety of connector options are available to meet the interface requirements.

Flexible design

Mechanical connector options are available to support both welded and modular gas system requirements.

1600 Series Ultra-High Purity Mass Flow Controller/Meters

Performance*

Settling time (to within 2% of setpoint):

Fast start ≤ 1.0 sec per (SEMI E17-91)
Soft start Linear 20% per sec (0-100% in 5 sec)

Accuracy ($\pm 3\sigma$)

$\leq 35\%$ full scale $\pm 0.35\%$ full scale

$> 35\%$ full scale $\pm 1\%$ setpoint

Model 1660 only $\pm 1\%$ full scale

Repeatability (full scale) $\pm 0.15\%$ (per SEMI E56-96)

Linearity (full scale) $\pm 0.5\%$ (per SEMI E27-92)

Inlet pressure coefficient 0.007% per psi (N_2)

Ambient temp. coefficient: Zero: 0.05% full scale per $^{\circ}C$; Span: 0.1% full scale per $^{\circ}C$

Leak integrity 1×10^{-10} atm-cc/sec (He) (per SEMI E16-90)

Automatic zero Standard on 1661/1665
(customer programmable); optional on 1660

Zero drift $\leq 0.6\%$ per year without auto zero

Thermal siphoning and
altitude sensitivity $< 0.1\%$ full scale (30 psi SF_6)

Operating limits

Standard flow range 3 sccm to 30 slm (N_2 equivalent)

Control range (full scale) 2-100%

Valve leak rate $\leq 1\%$ full scale

Gases All

Ambient temp. range 0-50 $^{\circ}C$ (32-122 $^{\circ}F$)

Max. operating pressure 3,500 kPa (500 psi)

Proof pressure 10,500 kPa (1,500 psi)

Pressure differential range 6.65 to 350 kPa (50 torr to 50 psid¹)

¹Lower limit depends on gas density and flow range

Warm-up period 30 minutes

Mounting position HOV or HOS

Valve Normally closed or normally open solenoid

Electrical characteristics

Input/Output signal:

Setpoint input 0-5 VDC linearly proportional to required flow

Output monitor 0-5 VDC linearly proportional to flow rate Valve off

External: TTL signal

Auto shut-off Setpoint $< 2\%$ full scale commands valve off

Power controller:

1660 (analog) +15 VDC (100 mA max.), -15 VDC (200 mA max.)

1661 (RS485) +15 VDC (160 mA max.), -15 VDC (160 mA max.)

1665 (DeviceNet) +11-25 VDC per ODVA requirements:

600 mA at 12 VDC, 300mA at 24 VDC

1665 (PROFIBUS) +15 VDC (500 mA max.), -15 VDC (500 mA max.)

Power meter (analog) +15 VDC (50 mA max.), -15 VDC (50 mA max.)

Power consumption 1660 = 4.5 watts max., 1661 = 5 watts max.,
1665 = 7.2 watts max.

CE certified Immune to radiated energy 10 V/m, 30-850 mHz

Mechanical characteristics

Surface finish 16 μ inch Ra standard (10 μ inch Ra optional)

Fittings 1/4" VCR[®], downported B, C, or W fittings

Valve position Downstream or upstream (optional)

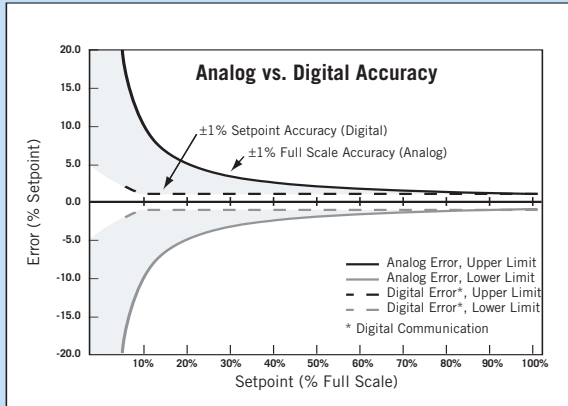
Materials Wetted components: 316L SS/K-M43/304/7MO

Weight 1.2 kg (2.65 lbs)

Calibration references

Traceability National Institute of Standards and Technology
(N.I.S.T.)

Standard temperature and pressure 0 $^{\circ}C$ and 760 mm Hg (per SEMI E12-96)



At 10% setpoint, digital MFCs are ten times more accurate than analog models.
(Accuracy chart reflects primary standard calibration option.)**

Model description

1660	Analog control	Analog interface
1661 MultiFlo	Digital control	Analog and RS485 interfaces
1665 MultiFlo	Digital control	DeviceNet
1665	Digital control	PROFIBUS

24/7 service and support

Celerity is unmatched in the industry for service and support. We have worldwide service locations with calibration, application support, and repair capabilities, operating 24 hours a day, 7 days a week. Celerity's website also provides updated application and technical support.

Visit us at www.celerity.net.

Warranty

- 3 year standard warranty
- Extended warranty option available

Specifications and features are subject to change without notice.

*All specifications reflect nitrogen calibration using Molbloc/Molbox[™] transfer standards.

**Calibration by primary standards and surrogate gases is available as an additional charge option.

CrossChek[™] calibration methodology maintains SPC-verified calibration accuracy with $\pm 3\sigma$ limit (99.7% confidence level).

1660 Series Product Configuration

C	1660	Mass Flow Controller, High Purity, Metal Seals, Analog Interface (Select Analog Connector Below)
M	1660	Mass Flow Meter, High Purity, Metal Seals, Analog Interface (Select Analog Connector Below)
C	1661	Mass Flow Controller, High Purity, Metal Seals, RS485 Digital and Analog Interface (Select Analog Connector Below)
C	1661C	Mass Flow Controller, High Purity, Metal Seals, Configurable MultiFlo, RS485 Digital and Analog Interface (Select Analog Connector Below)
M	1661	Mass Flow Meter, High Purity, Metal Seals, RS485 Digital and Analog Interface (Select Analog Connector Below)
C	1665	Mass Flow Controller, High Purity, Metal Seals, Network Interface (Select DeviceNet or PROFIBUS Below)
C	1665C	Mass Flow Controller, High Purity, Metal Seals, Configurable MultiFlo, Network Interface (Select DeviceNet or PROFIBUS Below)
M	1665	Mass Meter Meter, High Purity, Metal Seals, Network Interface (Select DeviceNet or PROFIBUS Below)

A	Auto Shut-off
X	No Auto Shut-off

F	Fast Start < 1 Second Response
S	5 Second Linear Soft Start
T	6-10 Second Soft Start
V	10-15 Second Soft Start
X	No Valve (Mass Flow Meter)

Specify Pre-programmed Gas and Full Scale Range (example: Argon="0004" and 30 sccm="030C")

SC10	010C	Configurable MultiFlo. 3-10 sccm N ₂ Equivalent
SC11	030C	Configurable MultiFlo. 11-30 sccm N ₂ Equivalent
SC12	090C	Configurable MultiFlo. 31-90 sccm N ₂ Equivalent
SC13	250C	Configurable MultiFlo. 91-250 sccm N ₂ Equivalent
SC14	750C	Configurable MultiFlo. 251-750 sccm N ₂ Equivalent
SC15	002L	Configurable MultiFlo. 751-2,000 sccm N ₂ Equivalent
SC16	006L	Configurable MultiFlo. 2,001-6,000 sccm N ₂ Equivalent
SC17	015L	Configurable MultiFlo. 6,001-15,000 sccm N ₂ Equivalent
SC18	030L	Configurable MultiFlo. 15,001-30,000 sccm N ₂ Equivalent

4R	1/4" VCR
DB	Downported—C Seal
DW	Downported—W Seal

HOV	Horizontal or Vertical Mounting Attitude (Standard)
HOS	Horizontal or Side

A	Atmospheric Downstream Pressure
V	Vacuum Downstream Pressure

M	F	Metal O-Ring/Kel-F Seat
M	M	Metal O-Ring/Metal Seat
M	X	Metal O-Ring—No Valve (Mass Flow Meter)

B	15 Pin "D" Connector (UDB15) Brooks Pin-out 0-5 VDC (1660 only)
D	DeviceNet Connector (1665 only)
E	Cardedge Connector 0-5 VDC (1660 and 1661 only)
I	15 Pin "D" Connector (UDI15) 4-20mA (1660 only)
K	15 Pin "D" Connector (UDK15) MKS Pin-out 0-5 VDC (1660 only)
L	Cardedge Lockdown Connector 0-5 VDC (1660 and 1661 only)
P	PROFIBUS Connector (1665 only)
S	9 Pin "D" Connector (UDS9) STEC Pin-out 0-5 VDC
T	9 Pin "D" Connector (UDU9) Unit 0-5 VDC (1660 and 1661)
U	15 Pin "D" Connector (UDU15) 0-5 VDC (1660 and 1661 only)
V	9 Pin "D" Connector (UDV9) 0-10 VDC (1660 only)
XXX	Customer Special Request (CSR) Consult Factory

O	Normally Open
C	Normally Closed (Standard)
X	No Valve (Mass Flow Meter)

S	Standard (Valve Downstream)
B	Buffered (Valve Upstream)
X	No Valve (Mass Flow Meter)

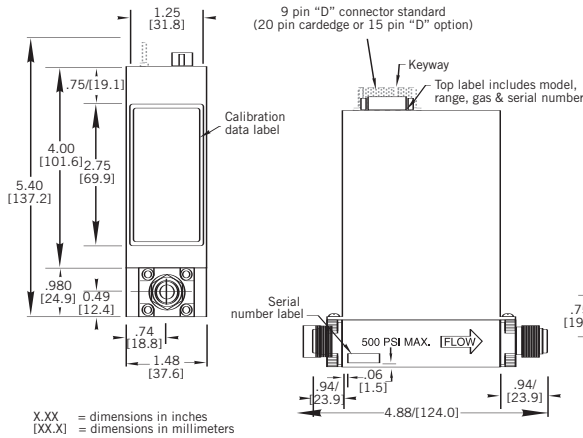
A	Auto-Zero Enabled
X	Auto-Zero Disabled

16X	16μ inch Ra Finish (Standard)
10E	10μ inch Ra Finish

00	0°C Reference Calibration (Standard)
XX	Custom Reference Calibration (20°C=20)

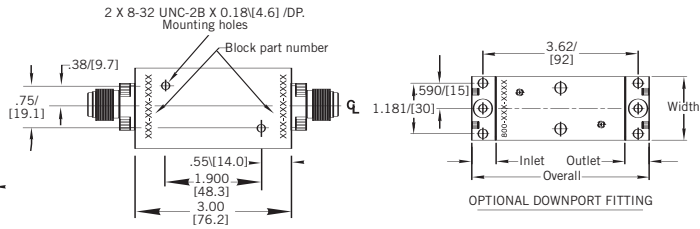
Example:

C	1660	A	F	0013	100C	4R	HOV	A	M	M	U	XXX	C	S	X	16X	00
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X.XX = dimensions in inches
 [XX.X] = dimensions in millimeters

Fitting type	Overall	Inlet	Outlet
1/4 VCR fitting	4.88 in./124.0 mm	0.94 in./23.9 mm	0.94 in./23.9 mm
Downport 'C'	4.14 in./105.2 mm	0.57 in./14.5 mm	0.57 in./14.5 mm
Downport 'W'	4.14 in./105.2 mm	0.57 in./14.5 mm	0.57 in./14.5 mm



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