Cole-Parmer®

Precision Mass Flow Controller Operating Manual

Note: Although we provide assistance on our products both personally and through our literature, it is the complete responsibility of the user to determine the suitability of any product to their application.

The manufacturer does not warrant or assume responsibility for the use of its products in life support applications or systems.

Warranty

This product is warranted to the original purchaser for a period of one year from the date of purchase to be free of defects in material or workmanship. Under this warranty the product will be repaired or replaced at manufacturer's option, without charge for parts or labor when the product is carried or shipped prepaid to the factory together with proof of purchase. This warranty does not apply to cosmetic items, nor to products that are damaged, defaced or otherwise misused or subjected to abnormal use. See "Application" under the Installation section. Where consistent with state law, the manufacturer shall not be liable for consequential economic, property, or personal injury damages. The manufacturer does not warrant or assume responsibility for the use of its products in life support applications or systems.

Conformity / Supplemental Information:

The product complies with the requirements of the Low Voltage Directive 2006/95/EC and the EMC Directive 2004/108/EC and carries the CE Marking accordingly. Contact the manufacturer for more information.

Thank you for purchasing an Cole-Parmer Gas Flow Controller.

Please take the time to read the information contained in this manual. This will help to ensure that you get the best possible service from your instrument. This manual covers the following Cole-Parmer instruments:

MC-Series Mass Gas Flow Controllers

MCR-Series Mass Gas Flow Controllers

MCW-Series Low Pressure Drop Mass Flow Controllers

MCS-Series Mass Gas Flow Controllers

MCRS-Series Mass Gas Flow Controllers

MCS and MCRS-Series Flow Controllers are for use with certain aggressive gases (see page 67)

This includes MC and MCR-Series devices labeled as approved for CSA Class 1 Div 2 and ATEX Class 1 Zone 2 hazardous environments. See pages 74 and 75 for Special Conditions regarding the use of CSA/ATEX labeled devices.

MCV-Series Mass Gas Flow Controllers

MCV-Series Flow Controllers have an integrated shut-off valve and are built for use with applications that require tight shut-off (see pages 29 and 63).

MCP-Series Mass Gas Flow Controllers

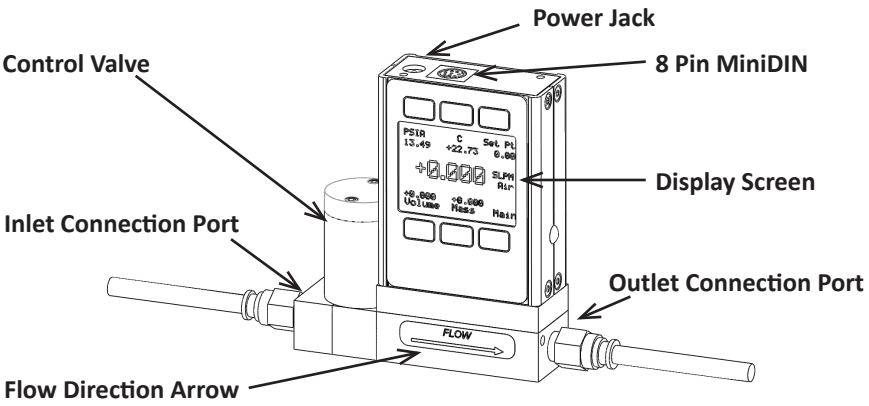
MCP-Series Flow Controllers are built with a high performance control valve for use with certain lower pressure applications (see page 65)

Full specifications for each device can be found on pages 54 through 70.

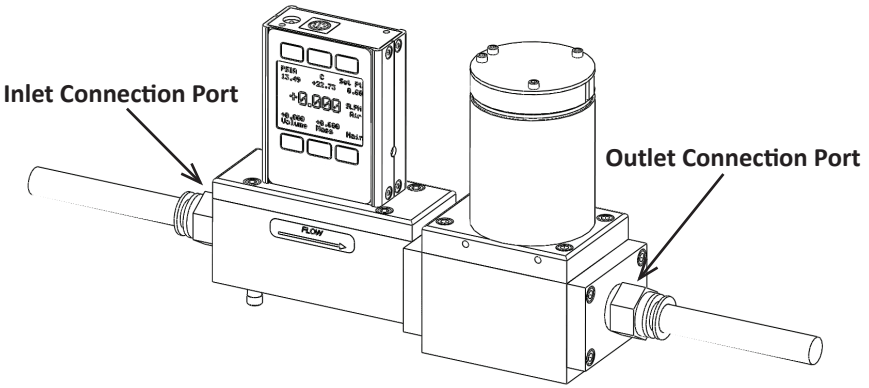
Please contact Cole-Parmer if you have any questions regarding the use or operation of this device.

Many Cole-Parmer instruments are built for specific applications. Two instruments with the same flow range and part number may look and act quite differently depending upon the application the instrument was built for. Care should be taken when moving an instrument from one application to another.

GETTING STARTED



Small Valve Mass Flow Controller shown with an upstream valve configuration and connection port fittings



Large Valve Mass Flow Controller shown with a downstream valve configuration and connection port fittings

MOUNTING

MC-Series Gas Flow Controllers have holes on the bottom for mounting to flat panels. See pages 54 - 71.

Small valve controllers (MC-Series) can usually be mounted in any position.

Large valve controllers (MCR-Series) should be mounted so that the valve cylinder is vertical and upright. Mounting a large valve controller in another position increases the risk of leakage when the controller is being held closed by the spring force.

No straight runs of pipe are required upstream or downstream of the controller.

PLUMBING

Your controller is shipped with plastic plugs fitted in the port openings. To lessen the chance of contaminating the flow stream do not remove these plugs until you are ready to install the device.

Make sure that the gas will flow in the direction indicated by the flow arrow.

Standard MC-Series Gas Flow Controllers have female inlet and outlet port connections. Welded VCR and other specialty fittings may have male ports.

The inlet and outlet port sizes (process connections) for different flow ranges are shown on pages 54 - 71.

Controllers with M5 (10-32) ports have O-ring face seals and require no sealant or tape. Do not use tape with welded or o-ring fittings.

For non M5 (10-32) ports use thread sealing Teflon® tape to prevent leakage around the port threads.
Do not wrap the first two threads. This will minimize the possibility of getting tape into the flow stream and flow body.

Do not use pipe dopes or sealants on the process connections as these compounds can cause permanent damage to the controller should they get into the flow stream.

When changing fittings, carefully clean any tape or debris from the port threads.
We recommend the use of in-line sintered filters to prevent large particulates from entering the measurement head of the instrument. Suggested maximum particulate sizes are as follows:

5 microns for units with FS flow ranges of 0-1 sccm or less.
20 microns for units with FS flow ranges between 0-2 sccm and 0-1 slpm.
50 microns for units with FS flow ranges of 0-1 slpm or more.

PRESSURE

Maximum operating line pressure is 145 psig (1 MPa).

If the line pressure is higher than 145 psig (1 MPa), use a pressure regulator upstream from the flow controller to reduce the pressure to 145 psig (1 MPa) or less.

Cole-Parmer **MCP** mass flow controllers are fitted with a high performance valve for low pressure applications.

MCP mass flow controllers have a maximum operating line pressure of 80 psig. See page 65.

CAUTION! ***EXCEEDING THE MAXIMUM SPECIFIED LINE PRESSURE MAY CAUSE PERMANENT DAMAGE TO THE SOLID-STATE DIFFERENTIAL PRESSURE TRANSDUCER.***

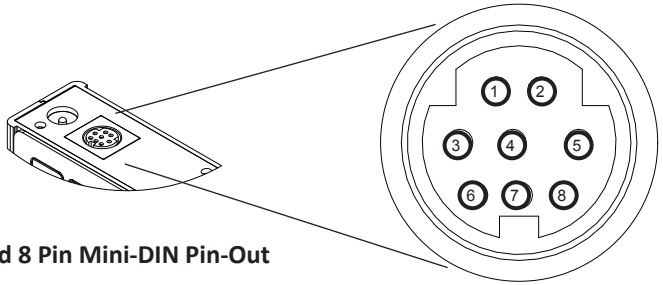
POWER AND SIGNAL CONNECTIONS

Power can be supplied to your controller through either the power jack (power jack not available on CSA/ATEX approved devices) or the 8 pin Mini-DIN connector.

An AC to DC adapter which converts line AC power to DC voltage and current as specified below is required to use the power jack.

Small Valve controllers require a 12-30Vdc power supply with a 2.1 mm female positive center plug capable of supplying 250 mA. **NOTE:** 4-20mA analog output requires at least 15 Vdc.

Large Valve controllers require a 24-30 Vdc power supply with a 2.1 mm female positive center plug capable of supplying at least 750mA.



Standard 8 Pin Mini-DIN Pin-Out

Pin	Function	Mini-DIN cable color
1	Not Connected (or optional 4-20mA Primary Output Signal)	Black
2	Static 5.12 Vdc [or optional Secondary Analog Output (4-20mA, 5Vdc, 10Vdc) or Basic Alarm]	Brown
3	Serial RS-232RX (receive) Input Signal	Red
4	Meters/Gauges = Remote Tare (Ground to Tare) Controllers = Analog Set-Point Input	Orange
5	Serial RS-232TX (send) Output Signal	Yellow
6	0-5 Vdc (or optional 0-10 Vdc) Output Signal	Green
7	Power In (as described above)	Blue
8	Ground (common for power, communications and analog signals)	Purple
Note: The above pin-out is applicable to all the flow meters and controllers with the Mini-DIN connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.		

CAUTION! ***DO NOT CONNECT POWER TO PINS 1 THROUGH 6 AS PERMANENT DAMAGE CAN OCCUR!***

It is common to mistake Pin 2 (labeled 5.12 Vdc Output) as the standard 0-5 Vdc analog output signal. In fact Pin 2 is normally a constant 5.12 Vdc that reflects the system bus voltage and can be used as a source for the set-point signal.

For 6 Pin Locking Industrial Connector pin-outs see page 73.

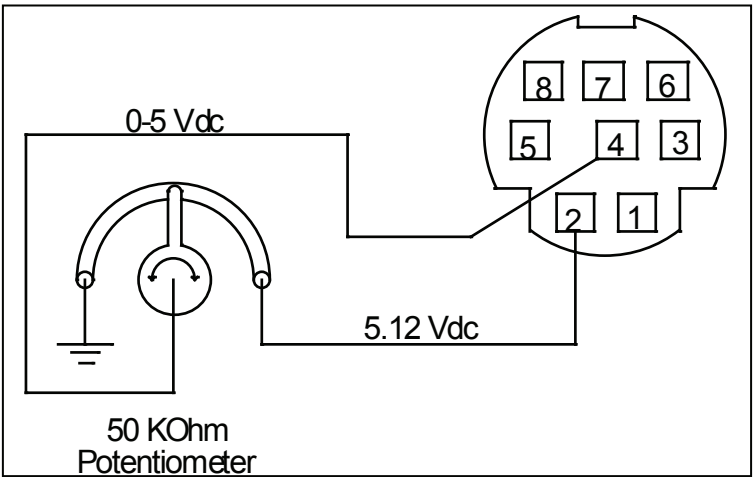
INPUT SIGNALS

Analog Input Signal

Apply analog input to Pin 4 as shown on page 8.

For 6 Pin Locking Industrial Connector pin-outs see page 73.

Standard 0-5 Vdc is the standard analog input signal. Apply the 0-5 Vdc input signal to pin 4, with common ground on pin 8. The 5.12 Vdc output on pin 2 can be wired through a 50K ohm potentiometer and back to the analog input on pin 4 to create an adjustable 0-5 Vdc input signal source as shown below.



Simple method for providing set-point to controllers

Optional 0-10 Vdc: If specified at time of order, a 0-10 Vdc input signal can be applied to pin 4, with common ground on pin 8.

Optional 4-20 mA: If specified at time of order, a 4-20 mA input signal can be applied to pin 4, with common ground on pin 8.

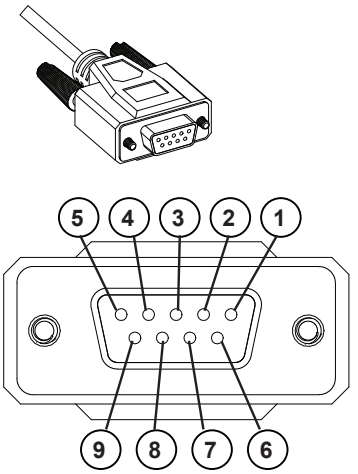
NOTE: This is a current sinking device. The receiving circuit is essentially a 250 ohm resistor to ground.

NOTE: 4-20mA output requires at least 15 Vdc power input.

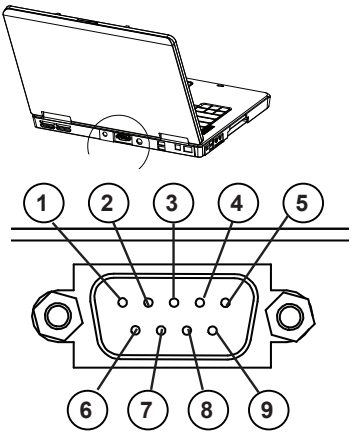
CAUTION! ***DO NOT CONNECT THIS DEVICE TO "LOOP POWERED" SYSTEMS, AS THIS WILL DESTROY PORTIONS OF THE CIRCUITRY AND VOID THE WARRANTY. IF YOU MUST INTERFACE WITH EXISTING LOOP POWERED SYSTEMS, ALWAYS USE A SIGNAL ISOLATOR AND A SEPARATE POWER SUPPLY.***

RS-232 Digital Input Signal

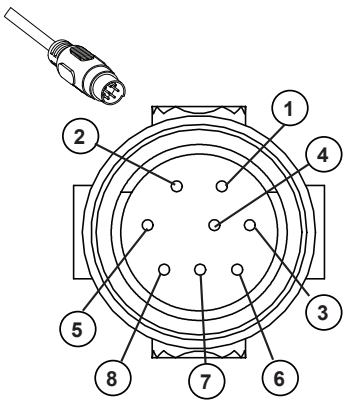
To use the RS-232 input signal, connect the RS-232 Output Signal (Pin 5), the RS-232 Input Signal (Pin 3), and Ground (Pin 8) to your computer serial port as shown below. (See page 30 for details on accessing RS-232 input.)



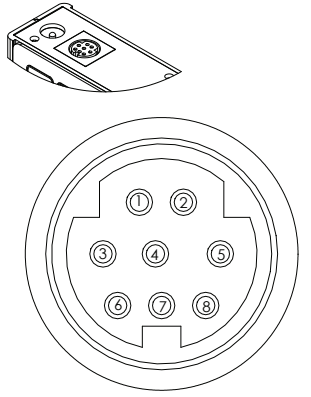
Serial Cable End



PC Serial Port



8 Pin MiniDIN Cable End



8 Pin MiniDIN Connector

9 Pin Serial Connection		8 Pin MiniDIN Connection	
Pin	Function	Function	Pin
5	Ground	Ground	8
3	Transmit	Receive	3
2	Receive	Transmit	5

DB9 to Mini-DIN Connection for RS-232 Signals

OUTPUT SIGNALS

RS-232 Digital Output Signal

To use the RS-232 output signal, it is necessary to connect the RS-232 Output Signal (Pin 5), the RS-232 Input Signal (Pin 3), and Ground (Pin 8) to your computer serial port as shown on page 8. (See page 30 for details on accessing RS-232 output.)

Standard Voltage (0-5 Vdc) Output Signal

MC-Series flow controllers equipped with a 0-5 Vdc (optional 0-10 Vdc) will have this output signal available on Pin 6. This output is generally available in addition to other optionally ordered outputs. This voltage is usually in the range of 0.010 Vdc for zero flow and 5.0 Vdc for full-scale flow. The output voltage is linear over the entire range. Ground for this signal is common on Pin 8.

Optional 0-10 Vdc Output Signal

If your controller was ordered with a 0-10 Vdc output signal, it will be available on Pin 6. (See the Calibration Data Sheet that shipped with your controller to determine which output signals were ordered.) This voltage is usually in the range of 0.010 Vdc for zero flow and 10.0 Vdc for full-scale flow. The output voltage is linear over the entire range. Ground for this signal is common on Pin 8.

Optional Current (4-20 mA) Output Signal

If your controller was ordered with a 4-20 mA current output signal, it will be available on Pin 1. (See the Calibration Data Sheet that shipped with your controller to determine which output signals were ordered.) The current signal is 4 mA at 0 flow and 20 mA at the controller's full scale flow. The output current is linear over the entire range. Ground for this signal is common on Pin 8. (Current output units require 15-30Vdc power.)

Optional 2nd Analog Output Signal

You may specify an optional 2nd analog output on Pin 2 at time of order. (See the Calibration Data Sheet that shipped with your controller to determine which output signals were ordered.) This output may be a 0-5 Vdc, 0-10 Vdc, or 4-20 mA analog signal that can represent any measured parameter. With this optional output, a controller could output the mass flow rate (0-5 Vdc on pin 6) and the absolute pressure (0-5 Vdc on pin 2).

If your device is CSA/ATEX approved or equipped with the optional six pin industrial connector, please contact Cole-Parmer.

CAUTION! ***DO NOT CONNECT THIS DEVICE TO "LOOP POWERED" SYSTEMS, AS THIS WILL DESTROY PORTIONS OF THE CIRCUITRY AND VOID THE WARRANTY. IF YOU MUST INTERFACE WITH EXISTING LOOP POWERED SYSTEMS, ALWAYS USE A SIGNAL ISOLATOR AND A SEPARATE POWER SUPPLY.***

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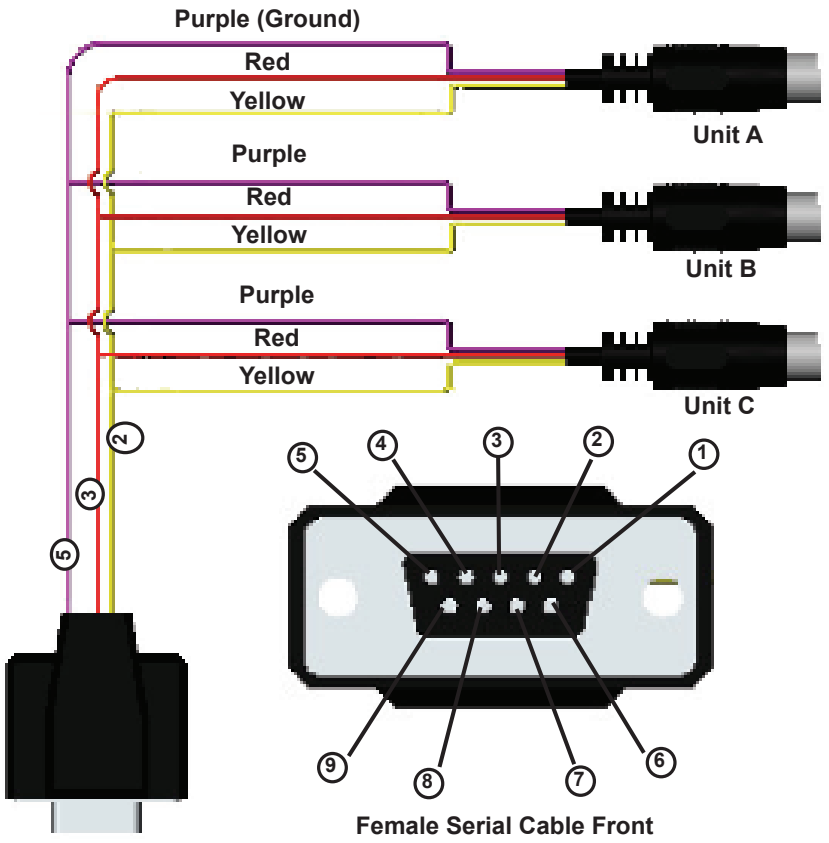


Typical Multiple Device (Addressable) Wiring Configuration

The easiest way to connect multiple devices is with a Multi-Drop Box (see page 51).

Information for TFT (Color Display) Instruments

TFT (color display) instruments have a high contrast back-lit LCD display. TFT instruments operate in accordance with Cole-Parmer standard operating instructions for our monochrome menus and displays with the following differences.

Multi-Color Display Color Codes:

GREEN: Green labels identify the parameters and/or adjustments associated with the button directly above or below the label.

WHITE: The color of each parameter is displayed in white while operating under normal conditions.

RED: The color of a parameter is displayed in red when operating conditions for that parameter exceed 128% of the device's specifications.

YELLOW: Yellow is the equivalent of the selection arrow on the monochrome display.

LCD Contrast:
LCD contrast is ranged from 1 to 11 on color displays with 11 being the greatest contrast.

Display On/Off:
Pushing the button under the Cole-Parmer name will turn the device display on or off. This feature is not available on monochrome displays.

Technical Data for TFT (Color Display) Meters, Gauges and Controllers

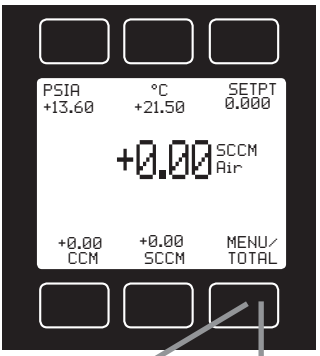
The following specifications are applicable to Cole-Parmer **TFT** (color display) meters, gauges and controllers only. All other operating specifications are shown in the Technical Data page for standard Cole-Parmer instruments. All standard device features and functions are available and operate in accordance with the Cole-Parmer operating manual provided with the device.

Specification	Meter or Gauge	Small Valve Controller	Large Valve Controller
Supply Voltage	7 to 30 Vdc	12 to 30 Vdc	24 to 30 Vdc
Supply Current	80 mA @ 12Vdc 70 mA @ 24Vdc	290 mA @ 12Vdc 200 mA @ 24Vdc	780 mA @ 24Vdc

DISPLAYS AND MENUS

The device screen defaults to **Main** display as soon as power is applied to the controller. Note: See page 28 to rotate the display 180°.

Main

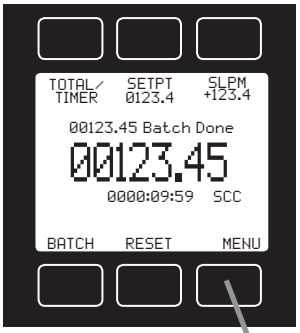


The **Main** display shows pressure, temperature, set-point, volumetric flow and mass flow.

Pressing the button adjacent to a parameter will make that parameter the primary display unit.

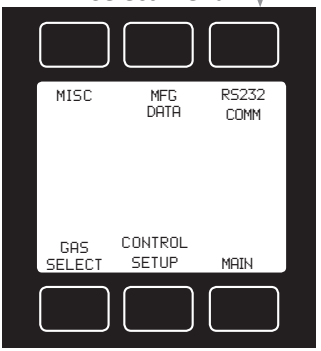
By hitting the **MENU** button at the bottom right of the screen you will enter the **Select Menu** display.

Totalizer (option only)



If your controller was ordered with the **Totalizer** option (page 49), pushing the **TOTAL** button once will bring up the **Totalizing Mode** display. Pushing **MENU** will bring up the **Select Menu** display.

Select Menu

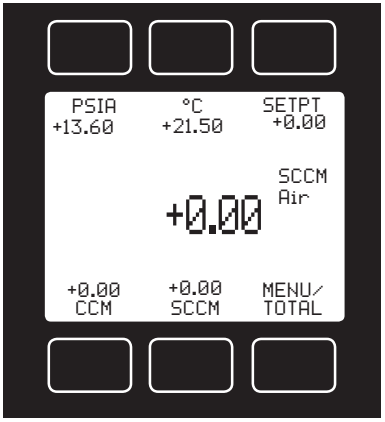


Select Menu

From **Select Menu** you can change the selected gas, interact with your RS-232 settings, read manufacturer's data or access the control set-up display.

Push **MAIN** to return to the Main display.

MAIN



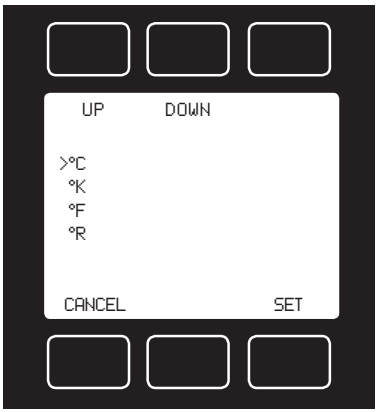
This mode defaults on power up, with mass flow as the primary displayed parameter.

The following parameters are displayed in the Main mode.

Gas Absolute Pressure: This sensor references hard vacuum and reads incoming pressure both above and below local atmospheric pressure. This parameter is moved to the primary display by pushing the button above **PSIA**.

The engineering unit associated with absolute pressure is pounds per square inch absolute (psia). This can be converted to gage pressure (psig) by subtracting local atmospheric pressure from the absolute pressure reading:

PSIG = PSIA – (Local Atmospheric Pressure)



Gas Temperature: MC-Series flow controllers measure the incoming temperature of the gas flow. The temperature is displayed in degrees Celsius (°C). This parameter is moved to the primary display by pushing the button above **°C**.

Pushing the button again allows you to select ºC (Celsius), ºK (Kelvin), ºF (Fahrenheit) or ºR (Rankine) for the temperature scale.

To select a temperature scale, use the UP and DOWN buttons to position the arrow in front of the desired scale.

Press SET to record your selection and return to the MAIN display. The selected temperature scale will be displayed on the screen.

Set Point: The set-point (**SETPT**)is shown in the upper right of the display.

For information on changing the set-point see SETPT SOURCE, page 18.

Volumetric Flow Rate: This parameter is located in the lower left of the display. It is moved to the primary display by pushing the button below **CCM** in this example. Your display may show a different unit of measure.

When using a mass flow controller as an absolute pressure controller, the mass flow rate may momentarily exceed the flow measurement capability (full scale + 28%) of the unit. This may occur when the unit is asked to make an abrupt pressure change. **If the optional totalizer is in use at that time**, the totalized value will necessarily become incorrect. Please reset the totalizer if such an 'over-flow' condition has occurred.

Mass Flow Rate: The mass flow rate is the volumetric flow rate corrected to a standard temperature and pressure (typically 14.696 psia and 25 °C).

This parameter is located in the lower middle of the display. It can be moved to the primary display by pushing the button below **SCCM** in this example. Your display may show a different unit of measure preceded by the letter **S**.

To get an accurate volumetric or mass flow rate, the gas being measured must be selected. See Gas Select, page 22.

MENU: Pressing **MENU** switches the screen to the **Select Menu** display.

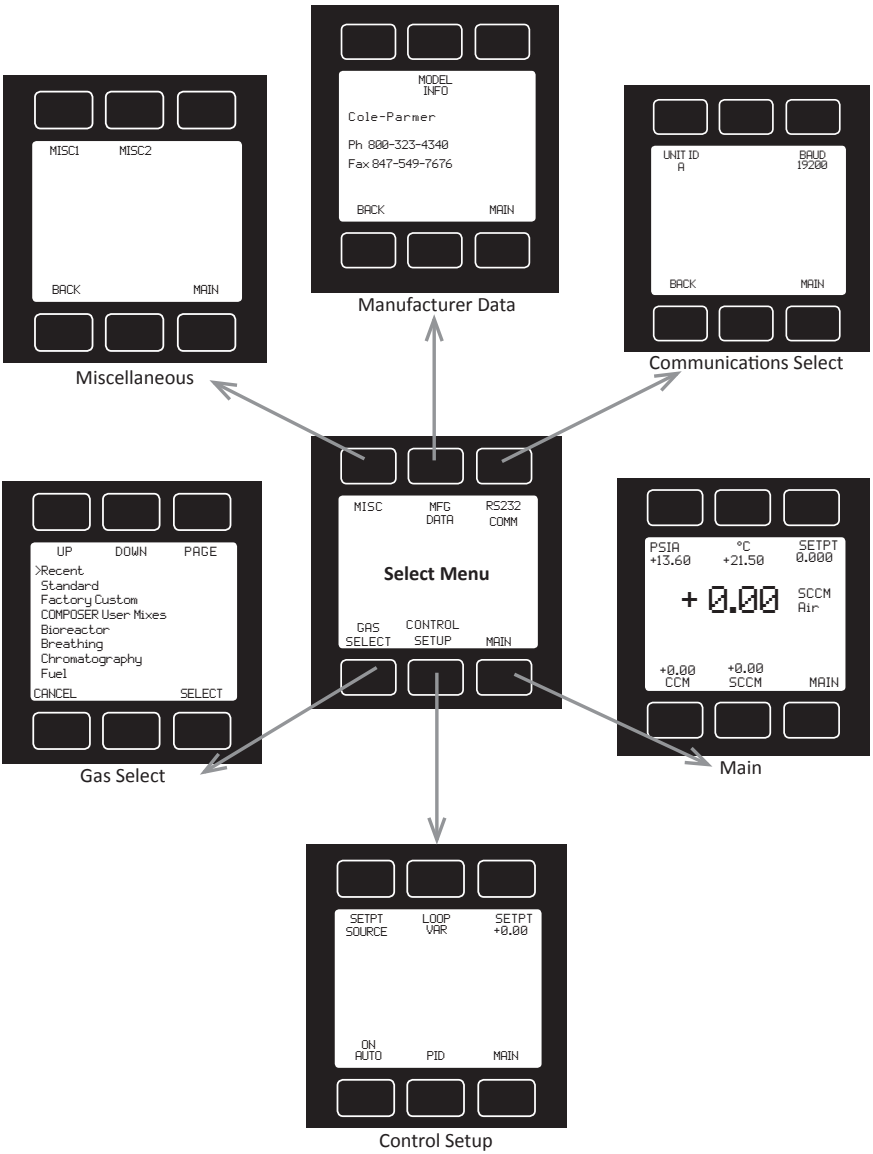
Flashing Error Message: An error message (**MOV** = mass overrange, **VOV** = volumetric overrange, **POV** = pressure overrange, **TOV** = temperature overrange) flashes when a measured parameter exceeds the range of the sensor. When any item flashes, neither the flashing parameter nor the mass flow measurement is accurate. Reducing the value of the flashing parameter to within specified limits will return the unit to normal operation and accuracy.

If the unit does not return to normal operation contact Cole-Parmer.

SELECT MENU

From Select Menu you can change the selected gas, interact with your RS-232 settings, read manufacturer's data and access the control setup and miscellaneous screens.

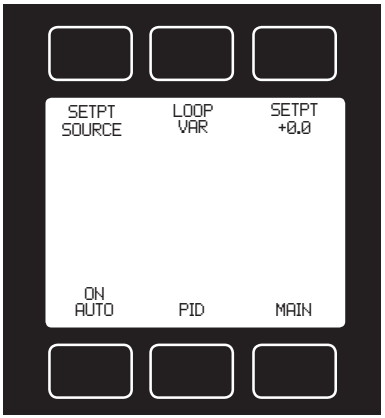
Press the button next to the desired operation to bring that function to the screen.



An explanation for each screen can be found on the following pages.

CONTROL SETUP

Control Setup is accessed by pressing the button below Control Setup on the Select Menu display. From this screen you can select your set-point source, choose a loop variable and adjust the PID terms.



Press BACK to return to the Select Menu display.

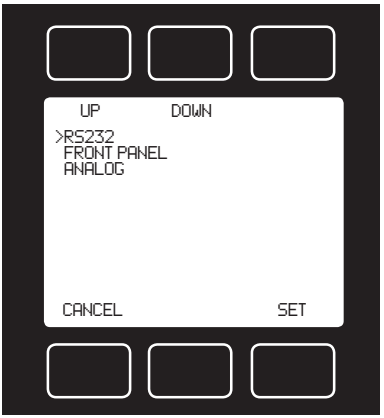
Press MAIN to return to the MAIN display

SETPT SOURCE – Pressing the button above SETPT SOURCE will allow you to select how the set point will be conveyed to your controller.

Use the line-up and line-down buttons to move the arrow in front of the desired option. Then press SET.

Press CANCEL to return to the previous display.

The controller will ignore any set-point except that of the selected set-point source and it will remember which input is selected even if the power is disconnected.



RS-232 refers to a remote digital RS-232 set-point applied via a serial connection to a computer or PLC as described in the installation and RS-232 sections of this manual.

Front Panel refers to a set-point applied directly at the controller.

Front Panel input must be selected prior to changing the set-point at the device.

Analog refers to a remote analog set-point applied to Pin 4 of the Mini-DIN connector as described in the installation section of this manual. ***The standard analog input is 0-5 Vdc.***

To determine what type of analog set-point your controller has, refer to the Calibration Data Sheet that was included with your controller.

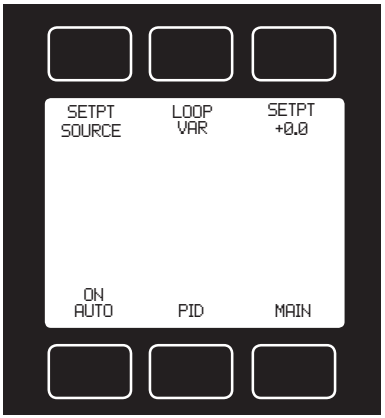
If nothing is connected to Pin 4, and the controller is set for analog control, the device will generate random set-point values.

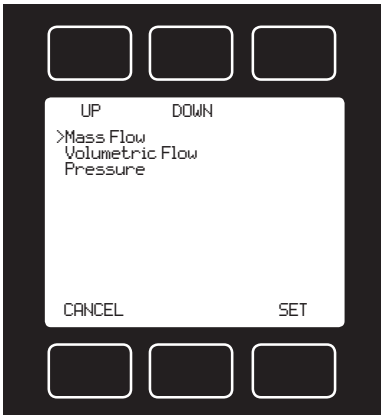
NOTE: If your controller has the **IPC** (Integrated Potentiometer Control) option, the IPC dial will operate with the ANALOG set-point source selected.

SETPT refers to the **set-point**. This parameter may be changed using the display only if **FRONT PANEL** is selected as the Input. Press **SETPT.** Then use SELECT to choose the decimal with the arrow and the UP and DOWN buttons to change the value. Press SET to record your value. Press CLEAR to return to zero.

CAUTION! ***Never leave a Controller with a non-zero set-point if no pressure is available to make flow. The controller will apply full power to the valve in an attempt to reach the set-point. When there is no flow, this can make the valve very HOT!***

CONTROL SETUP (continued)





LOOP VAR—The selection of what variable to close the loop on is a feature unique to Cole-Parmer mass flow controllers.

Pressing the **LOOP VAR** button on the Control Setup screen will allow you to change what variable is controlled.

Use the line-up and line-down buttons to move the arrow in front of the desired option.

When the mass flow controller is supplied with the **control valve upstream** of the electronics portion of the system, the unit can be set to control on outlet pressure (absolute pressures only) or volumetric flow rate, instead of mass flow rate.

The change from mass to volume can usually be accomplished without much, if any, change in the P and D settings.

When you change from controlling flow to controlling pressure, sometimes fairly radical changes must be made to the P & D variables. *See page 20* – **PID TUNING**.
Contact Cole-Parmer if you are having difficulties with this procedure.

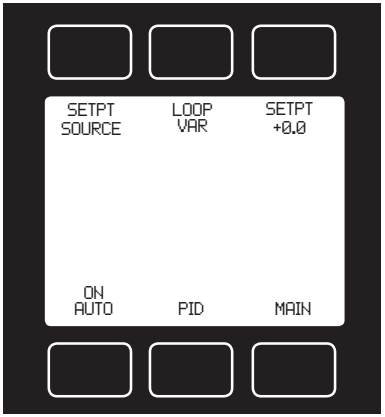
ON AUTO / OFF AUTO—refers to the standard auto-tare or "auto-zero" feature.

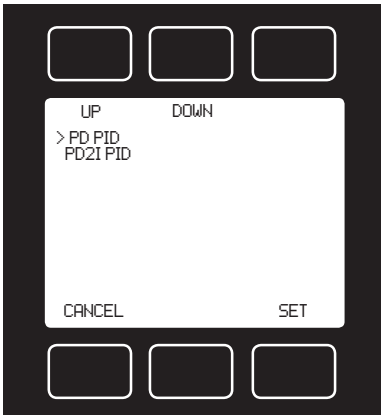
The auto-tare feature automatically tares (takes the detected signal as zero) the unit when it receives a zero set-point for more than two seconds.

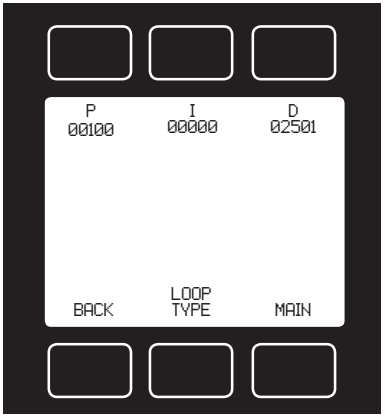
A zero set-point results in the closing of the valve and a known "no flow" condition. This feature makes the device more accurate by periodically removing any cumulative errors associated with drift.

It is recommended that the controller be left in the default auto-tare ON mode unless your specific application requires that it be turned off.

PID TUNING







PID Values determine the performance and operation of your proportional control valve. These terms dictate control speed, control stability, overshoot and oscillation. All units leave the factory with a generic tuning designed to handle most applications. If you encounter issues with valve stability, oscillation or speed, fine tuning these parameters may resolve the problem.

Cole-Parmer controllers allow you to adjust the Proportional, Integral and Differential terms of the PID control loop.

To change the PID loop parameters, push the button below **PID**.

Press **LOOP TYPE.** Then use the UP and DOWN buttons to select the appropriate PID control algorithm. Press SET.

See the following page for descriptions of the PID Loop Types (PID Control Algorithms).

P refers to the Proportional term of the PID loop.

I refers to the Integral term of the PID loop.

D refers to the Differential term of the PID loop.

Press P, I or D. Then use SELECT to choose the digit with the arrow and the UP and DOWN buttons to change the value. Press SET to record your value. Press CLEAR to return to zero.

Before changing the P, I or D parameter, please record the initial value so that it can be returned to the factory setting if necessary.

Valve tuning can be complex. If you would like assistance, please contact Cole-Parmer for technical support.

The* PD *algorithm is the PID algorithm used on most Cole-Parmer controllers.

It is divided into two segments:

The first compares the process value to the set-point to generate a proportional error. The proportional error is multiplied by the 'P' gain, with the result added to the output drive register.

The second operates on the present process value minus the process value during the immediately previous evaluation cycle. This 'velocity' term in multiplied by the 'D' gain, with the result subtracted from the output drive register.

The above additions to and subtractions from the output drive register are carried over from process cycle to process cycle, thus performing the integration function automatically.

Increasing the 'P' gain will **promote** the tendency of the system to overshoot, ring, or oscillate.

Increasing the 'D' gain will **reduce** the tendency of the system to overshoot.

The* PD2I *algorithm is a PID algorithm used primarily for high performance pressure and flow control applications.

It exhibits two basic differences from the PD algorithm that most controllers utilize.

1. Instead of applying a damping function based upon the rate of change of the process value, it applies a damping function based upon the square of the rate of change of the process value.

2. The damping function is applied directly to the proportional error term before that term is used in the proportional and integral functions of the algorithm. This provides a certain amount of 'look ahead' capability in the control loop.

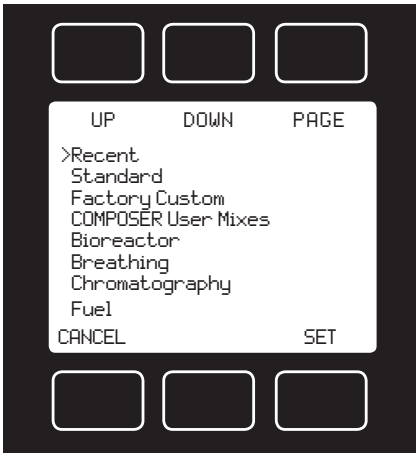
Because of these differences, you will note the following:

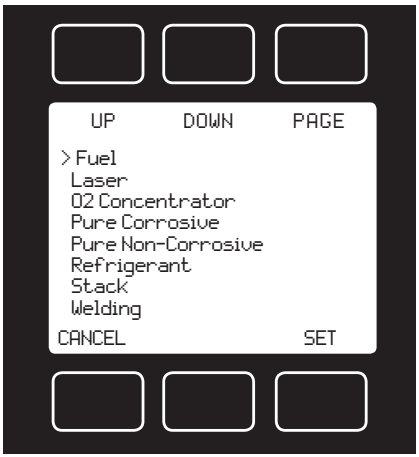
1. Increasing 'P' gain can be used to damp out overshoot and slow oscillations in pressure controllers. You will know that 'P' gain is too high, when the controller breaks into fast oscillations on step changes in set-point. On flow controllers, too high a 'P' gain results in slower response times. Too low a 'P' gain results in overshoot and/or slow oscillation. A good starting value for 'P' gain is 200.

2. If the unit was originally shipped with the PD2I algorithm selected, the 'D' gain value should be left at or near the factory setting because it relates primarily to the system phase lags. If you are changing from the default algorithm to the PD2I algorithm, you should start with a 'D' gain value of 20.

3. The 'I' gain is used to control the rate at which the process converges to the set-point, after the initial step change. Too low a value for 'I' gain shows up as a process value that jumps to near the set-point and then takes awhile to converge the rest of the way. Too high a value for 'I' gain results in oscillation. A good starting value for the 'I' gain is 200.

GAS SELECT™





Gas Select allows you to set your device to up to 150 standard gases and mixes. You can also use **COMPOSER** to program and store up to 20 additional gas mixes.

Gas Select is accessed by pressing the button below **GAS SELECT** on the Select Menu display.

To select a gas, use the UP and DOWN buttons to position the arrow in front of the desired gas category.

» Recent: Eight most recent selections
» Standard: Gases and mixes standard on earlier Cole-Parmer instruments (page 40)
» Factory Custom: Present only if customer requested gases were added at the factory
» COMPOSER User Mixes: Gas mixes programmed by the user (page 23)
» Bioreactor (page 42)
» Breathing (page 43)
» Chromatography (page 45)
» Fuel (page 44)
» Laser (page 44)
» O2 Concentrator (page 45)
» Pure Corrosive* (page 39)
» Pure Non-Corrosive (page 38)
» Refrigerant* (page 40)
» Stack (page 45)
» Welding (page 41)

Press PAGE to view a new page in the gas category list.

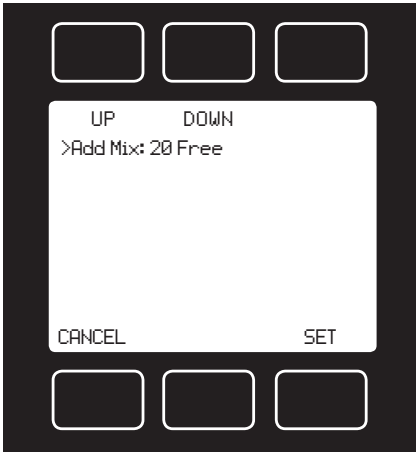
Press SELECT to view the gases in the selected category. Align the arrow with the desired gas. Press SET to record your selection and return to the MAIN display. The selected gas will be displayed on the screen.

***** Pure Corrosive and Refrigerant gases are only available on **S-Series** instruments that are compatible with these gases.

Note: Gas Select may not be available on units ordered with a custom gas or blend.

See pages 38 -45 for a full list of gases in each category.

COMPOSER™

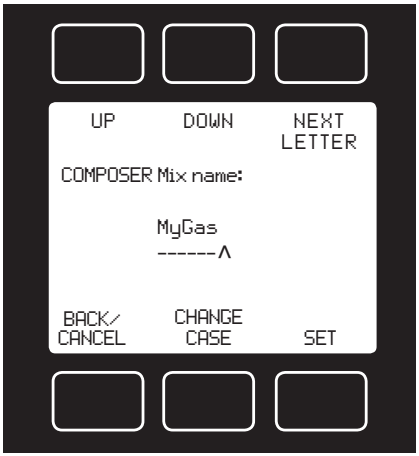


COMPOSER™ allows you to program and save up to 20 custom gas mixes containing 2 to 5 component gases found in the gas lists (pages 38-45). The minimum resolution is 0.01%.

COMPOSER is accessed by selecting **COMPOSER User Mixes** on the GAS SELECT display.

Press SET when the arrow is aligned with Add Mix.

Name the mix by pressing the UP and DOWN buttons for letters, numerals and symbols.

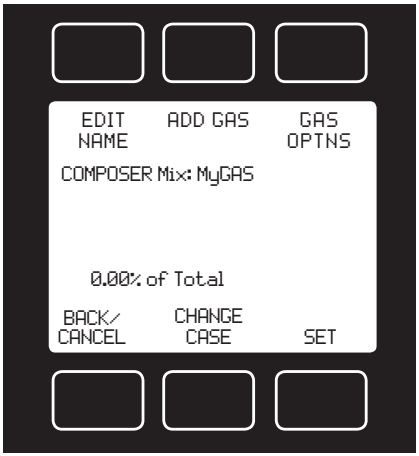


CHANGE CASE – Toggles the letter case. Letters remain in selected case until CHANGE CASE is pushed again.

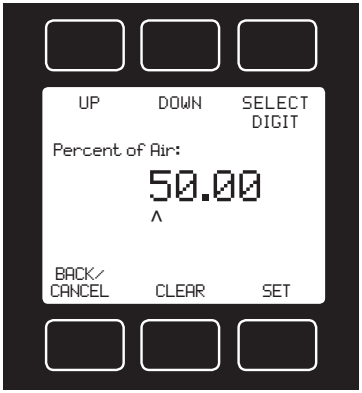
Press SET to save the name.

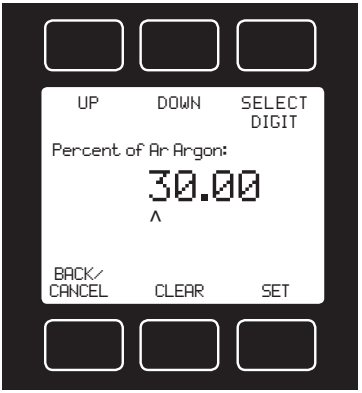
After naming the mix, press **ADD GAS** and select the gas category and the component gas.

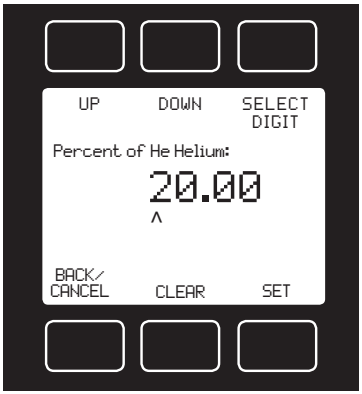
Select the digit with arrow and adjust the % with the UP and DOWN buttons. Press set to save. Add up to 4 more gases as needed. The total must equal 100% or an error message will appear.

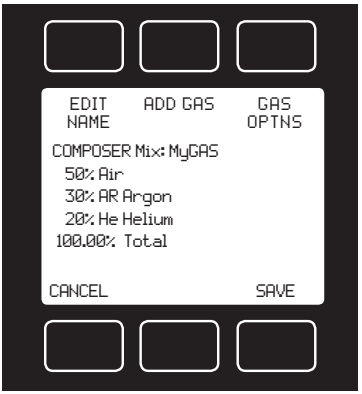


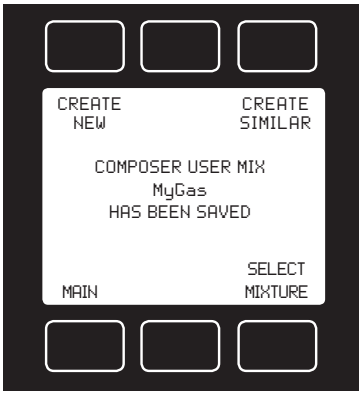
GAS OPTNS allows you to adjust the percentage of the constituents or delete a gas from the mix. Gas mixes cannot be adjusted after they have been saved.









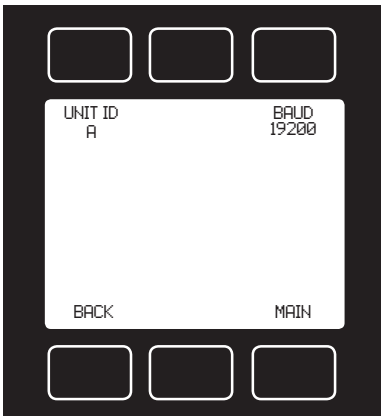


Once the mix has been saved, you may press **CREATE SIMILAR** to compose an additional mix based on the mix you have just saved. <u>This CREATE SIMILAR option is not available after leaving this screen.</u>

Press **CREATE NEW** to add a completely new mix.

Press **SELECT MIXTURE** to bring the custom mix onto the MAIN display.

COMMUNICATION SELECT



Access **Communication Select** by pressing the button above **RS232 COMM** on the **Select Menu** display.

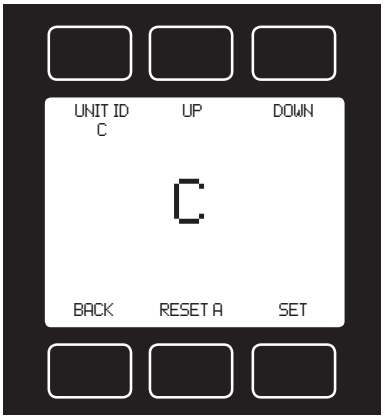
Unit ID – Valid unit identifiers are the letters A-Z and @. The identifier allows you to assign a unique address to each device so that multiple units can be connected to a single RS-232 computer port.

Press **UNIT ID**. Use the UP and DOWN buttons to change the Unit ID. Press SET to record the ID. Press Reset to return to the previously recorded Unit ID.

Any Unit ID change will take effect when Communication Select is exited.

If the symbol @ is selected as the Unit ID, the device will enter streaming mode when Communication Select is exited.

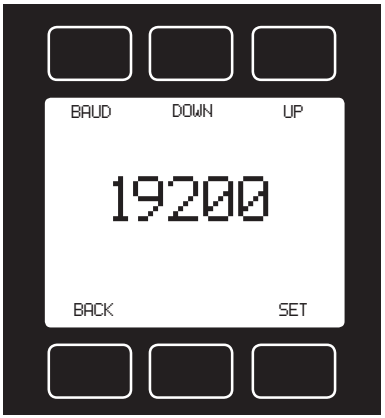
See RS-232 Communications (page 30) for information about the streaming mode.



Baud – Both this instrument and your computer must send/receive data at the same baud rate. The default baud rate for this device is 19200 baud.

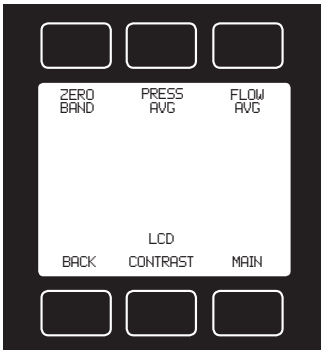
Press **BAUD**. Use the UP and DOWN buttons to select the baud rate that matches your computer. The choices are 38400, 19200, 9600, or 2400 baud. Press SET to record the baud rate.

Any baud rate change will not take effect until power to the unit is cycled.



MISCELLANEOUS

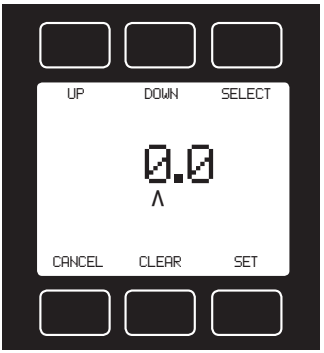
Miscellaneous is accessed by pressing the **MISC** button on the Select Menu display. Next select either **MISC1** or **MISC2.**



MISC1 will display as shown at left.

ZERO BAND refers to Display Zero Deadband. Zero deadband is a value below which the display jumps to zero. This deadband is often desired to prevent electrical noise from showing up on the display as minor flows or pressures that do not exist. Display Zero Deadband does not affect the analog or digital signal outputs.

ZERO BAND can be adjusted between 0 and 3.2% of the sensor's Full Scale (FS).



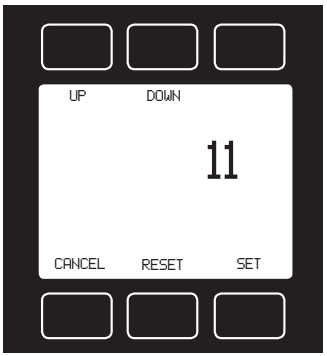
Press **ZERO BAND.** Then use SELECT to choose the digit with the arrow and the UP and DOWN buttons to change the value. Press SET to record your value. Press CLEAR to return to zero.

Pressure Averaging and Flow Averaging may be useful to make it easier to read and interpret rapidly fluctuating pressures and flows. Pressure and flow averaging can be adjusted between 1 (no averaging) and 256 (maximum averaging).

These are geometric running averages where the number between 1 and 256 can be considered roughly equivalent to the response time constant in milliseconds.

This can be effective at "smoothing" high frequency process oscillations such as those caused by diaphragm pumps.

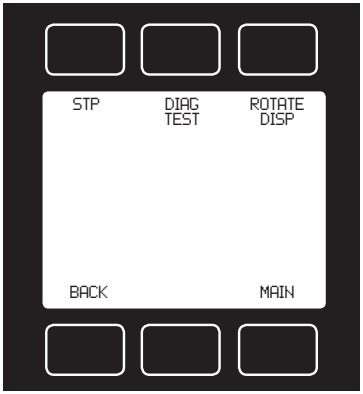
Press **PRESS AVG.** Then use SELECT to choose the digit with the arrow and the UP and DOWN buttons to change the value. Press SET to record your value. Press CLEAR to return to zero.

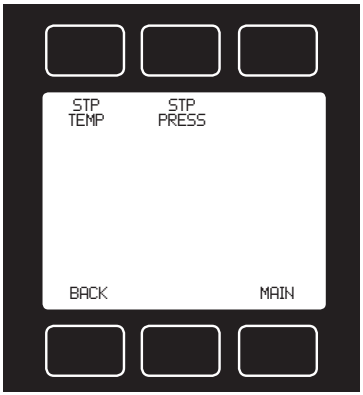


Press **FLOW AVG**. Then use SELECT to choose the digit with the arrow and the UP and DOWN buttons to change the value. Press SET to record your value. Press CLEAR to return to zero.

Setting a higher number will equal a smoother display.

LCD CONTRAST: The display contrast can be adjusted between 0 and 30, with zero being the lightest and 30 being the darkest. Use the UP and DOWN buttons to adjust the contrast. Press SET when you are satisfied. Press CANCEL to return to the MISC display.





MISC2 will display as shown at left.

STP refers to the functions that allow your selection of standard temperature and pressure conditions. This feature is generally useful for comparison purposes to other devices or systems using different STP parameters.

The **STP** menu is comprised of the **STP TEMP** and **STP PRESS** screens.

STP TEMP allows you to select from seven standard temperature protocols. The arrow position will automatically default to the currently stored value.

Once a selection has been made and recorded using the **SET** button, a change acknowledgement message will be displayed on screen.

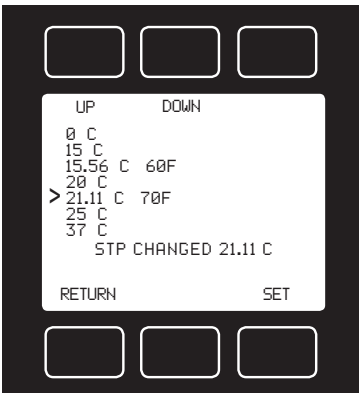
Selecting **RETURN** will revert screen to the Main display. If the **SET** selection is already the currently stored value, a message indicating that fact will appear.

STP PRESS enables you to select from one of two standard pressure settings.

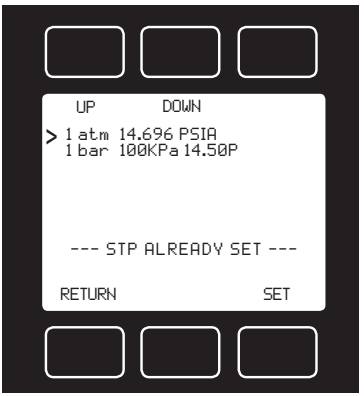
The arrow position will automatically default to the currently stored value.

Once a selection has been made and recorded using the **SET** button, a change acknowledgement message will be displayed on screen.

Selecting **RETURN** will revert screen to the Main display. If the **SET** selection is already the currently stored value, a message indicating that fact will appear.



STP TEMP Display



STP PRESS Display

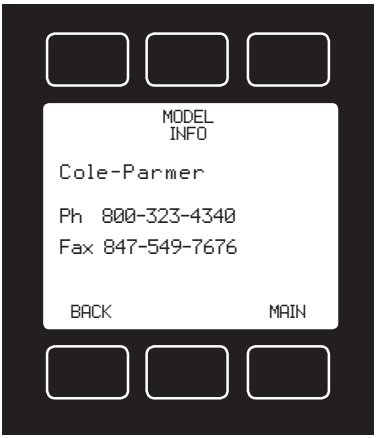
DIAG TEST: This diagnostic screen displays the initial register values configured by the factory, which is useful for noting factory settings prior to making any changes. It is also helpful for troubleshooting with Cole-Parmer customer service personnel.

Select the **DIAG TEST** button from the **MISC2** screen to view a list of select register values.

Pressing the **SCROLL** button will cycle the display through the register screens. An example screen is shown at left.

Press **ROTATE DISP** and SET to **Inverted 180°** if your device is inverted. The display and buttons will rotate together.

MANUFACTURER DATA



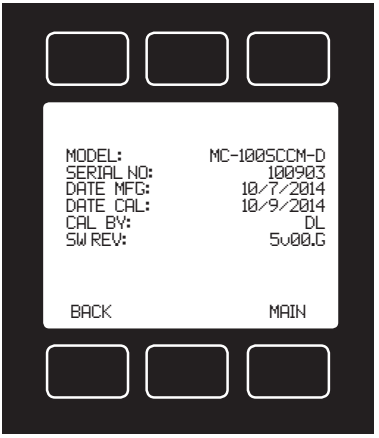
Manufacturer Data is accessed by pressing the **MFG DATA** button on the Select Menu display.

The initial display shows the name and telephone number of the manufacturer.

Press **MODEL INFO** to show important information about your flow device including the model number, serial number, and date of manufacture.

Press BACK to return to the MFG DATA display.

Push MAIN to return to the Main display.



MCV Controller Operating Notes

Cole-Parmer's MCV mass flow controller is equipped with an integrated Swagelok® positive shutoff valve.

The normally closed valve is air actuated and will remain closed until it is connected to an air source supplying between 60 and 120 psig of air pressure.

Once the appropriate amount of air pressure is supplied to the shutoff valve, it will open, allowing flow through the mass controller. Air pressure must be removed from the shutoff valve in order for the valve to close.

A common method for actuating the shutoff valve incorporates a three-way solenoid valve (below).

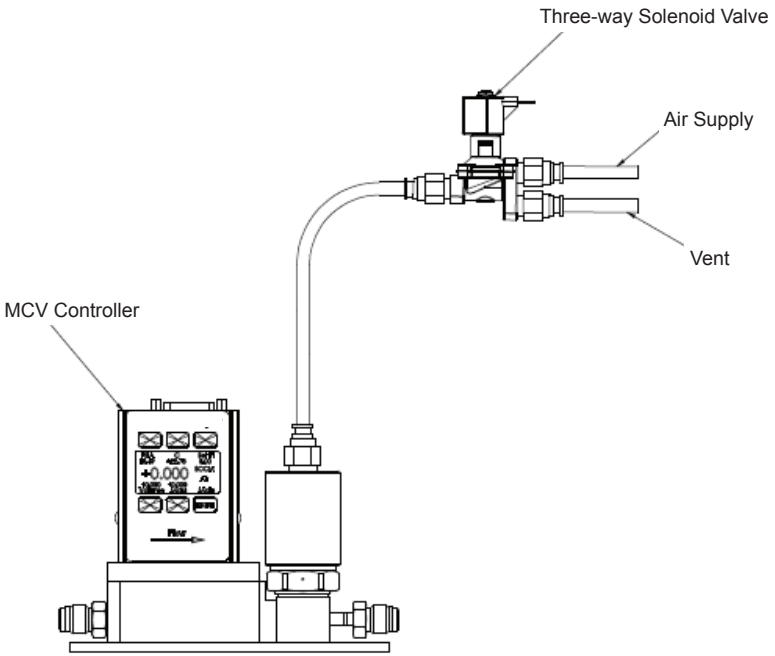
Air pressure is applied to one side of the solenoid valve while the other side of the solenoid is left open to atmosphere.

When the solenoid is energized, air pressure is delivered to the shutoff valve, allowing it to open.

When the solenoid is returned to a relaxed state, air pressure is removed from the shutoff valve, allowing it to close. The air pressure is vented to atmosphere.

Solenoid valves for use with the MCV mass flow controller can be ordered from Cole-Parmer.

Note: All standard MC-Series device features and functions are available on the MCV-Series and operate in accordance with the standard MC-Series operating instructions.



MCV controller and three-way solenoid valve.

Configuring HyperTerminal®:

1. Open your HyperTerminal® RS-232 terminal program (installed under the "Accessories" menu on all Microsoft Windows® operating systems).
2. Select "Properties" from the file menu.
3. Click on the "Configure" button under the "Connect To" tab. Be sure the program is set for: 19,200 baud (or matches the baud rate selected in the RS-232 communications menu on the meter) and an 8-N-1-None (8 Data Bits, No Parity, 1 Stop Bit, and no Flow Control) protocol.
4. Under the "Settings" tab, make sure the Terminal Emulation is set to ANSI or Auto Detect.
5. Click on the "ASCII Setup" button and be sure the "Send Line Ends with Line Feeds" box is not checked and the "Echo Typed Characters Locally" box and the "Append Line Feeds to Incoming Lines" boxes are checked. Those settings not mentioned here are normally okay in the default position.
6. Save the settings, close HyperTerminal® and reopen it.

Streaming Mode

In the **default** Polling Mode, the screen should be blank except the blinking cursor. In order to get the data streaming to the screen, hit the "Enter" key several times to clear any extraneous information. Type "*@=@" followed by "Enter" (or using the RS-232 communication select menu, select @ as identifier and exit the screen). If data still does not appear, check all the connections and COM port assignments.

Streaming Mode – Advanced

The streaming data rate is controlled by register 91. The recommended default rate of data provision is once every 50 milliseconds and this is suitable for most purposes.

If a slower or faster streaming data rate is desired, register 91 can be changed to a value from 1 millisecond to 65535 milliseconds, or slightly over once every minute.

Below approximately 40 milliseconds, data provision will be dependent upon how many parameters are selected. Fewer data parameters can be streamed more quickly than more. It is left to the user to balance streaming speed with number of parameters streamed.

To **read** register 91, type "*r91" followed by "Enter".

To **modify** register 91, type "*w91=X", where X is a positive integer from 1 to 65535, followed by "Enter".

To **return** to the recommended factory default streaming speed, type "*w91= 50".

Changing From Streaming to Polling Mode:

When the meter is in the Streaming Mode, the screen is updated approximately 10-60 times per second (depending on the amount of data on each line) so that the user sees the data essentially in real time. It is sometimes desirable, and necessary when using more than one unit on a single RS-232 line, to be able to poll the unit.

In Polling Mode the unit measures the flow normally, but only sends a line of data when it is "polled". Each unit can be given its own unique identifier or address.

Unless otherwise specified each unit is shipped with a default address of capital A. Other valid addresses are B thru Z.

Once you have established communication with the unit and have a stream of information filling your screen:

1. Type *@=A followed by “Enter” (or using the RS-232 communication select menu, select A as identifier and exit the screen) to stop the streaming mode of information. Note that the flow of information will not stop while you are typing and you will not be able to read what you have typed. Also, the unit does not accept a backspace or delete in the line so it must be typed correctly. If in doubt, simply hit enter and start again. If the unit does not get exactly what it is expecting, it will ignore it. If the line has been typed correctly, the data will stop.
2. You may now poll the unit by typing A followed by “Enter”. This does an instantaneous poll of unit A and returns the values once. You may type A “Enter” as many times as you like. Alternately you could resume streaming mode by typing *@=@ followed by “Enter”. Repeat step 1 to remove the unit from the streaming mode.
3. To assign the unit a new address, type *@=New Address, e.g. *@=B. Care should be taken not to assign an address to a unit if more than one unit is on the RS-232 line as all of the addresses will be reassigned. Instead, each should be individually attached to the RS-232 line, given an address, and taken off. After each unit has been given a unique address, they can all be put back on the same line and polled individually.

Sending a Set-point via RS-232: To send a set-point via RS-232, “Serial” must be selected under the “Input” list in the control set up mode.

Method 1: Set-point may be set in floating point in serial communication using serial command (UnitID)SX.YZ

Example: AS4.54 results in Unit ID A changing set-point to 4.54.

Method 2: Type in a number between 0 and 65535 (2% over range), where 64000 denotes full-scale flow rate, and hit “Enter”.

The set-point column and flow rates should change accordingly. If they do not, try hitting “Enter” a couple of times and repeating your command. The formula for performing a linear interpolation is as follows:

Value = (Desired Set-point X 64000) / Full Scale Flow Range

For example, if your device is a 100 slpm full-scale unit and you wish to apply a set-point of 35 slpm you would enter the following value:

22400 = (35 slpm X 64000) / 100 slpm

If the controller is in polling mode as described in *Changing from Streaming Mode to Polling Mode*, the set-point must be preceded by the address of the controller. For example, if your controller has been given an address of D, the set-point above would be sent by typing:

D22400 followed by “Enter”

To adjust the Proportional and Differential (P&D) terms via RS-232:

Type *@=A followed by “Enter” to stop the streaming mode of information.

To adjust the “P” or proportional term of the PID controller, type *R21 followed by “Enter”.

The computer will respond by reading the current value for register 21 between 0-65535. It is good practice to write this value down so you can return to the factory settings if necessary. Enter the value you wish to try by writing the new value to register 21. For example, if you wished to try a “P” term of 220, you would type *W21=**220** followed by “Enter” where the bold number denotes the new value.

The computer will respond to the new value by confirming that 21=220. To see the effect of the change you may now poll the unit by typing A followed by “Enter”. This does an instantaneous poll and returns the values once. You may type A “Enter” as many times as you like. Alternately you could resume streaming mode by typing *@=@ followed by “Enter”. Repeat step 3 to remove the unit from the streaming mode.

To adjust the “D” or proportional term of the PID controller, type *R22 followed by “Enter”.

The computer will respond by reading the current value for register 22 between 0-65535. It is good practice to write this value down so you can return to the factory settings if necessary. Enter the value you wish to try by writing the new value to register 22. For example, if you wished to try a “D” term of 25, you would type *W22=**25** followed by “Enter” where the bold number denotes the new value.

The computer will respond to the new value by confirming that 22=25. To see the effect of the change you may now poll the unit by typing A followed by “Enter”. This does an instantaneous poll and returns the values once. You may type A “Enter” as many times as you like. Alternately you could resume streaming mode by typing *@=@ followed by “Enter”. Repeat.

You may test your settings for a step change by changing the set-point. To do this type A32000 (A is the default single unit address, if you have multiple addressed units on your RS-232 line the letter preceding the value would change accordingly.) followed by “Enter” to give the unit a ½ full scale set-point. Monitor the unit’s response to the step change to ensure it is satisfactory for your needs. Recall that the “P” term controls how quickly the unit goes from one set-point to the next, and the “D” term controls how quickly the signal begins to “decelerate” as it approaches the new set-point (controls the overshoot).

Gas Select – The selected gas can be changed via RS-232 input. To change the selected gas, enter the following commands:

In Polling Mode: Address$$#<Enter> (e.g. B$$#<Enter>)

Where # is the number of the gas selected from the table below. Note that this also corresponds to the gas select menu on the flow controller screen (the **Standard** gas category is shown in the example below):

#	GAS	
0	Air	Air
1	Argon	Ar
2	Methane	CH4
3	Carbon Monoxide	CO
4	Carbon Dioxide	CO2
5	Ethane	C2H6
6	Hydrogen	H2
7	Helium	He
8	Nitrogen	N2
9	Nitrous Oxide	N2O
10	Neon	Ne
11	Oxygen	O2
12	Propane	C3H8
13	normal-Butane	n-C4H10
14	Acetylene	C2H2
15	Ethylene	C2H4
16	iso-Butane	i-C2H10
17	Krypton	Kr
18	Xenon	Xe
19	Sulfur Hexafluoride	SF6
20	75% Argon / 25% CO2	C-25
21	90% Argon / 10% CO2	C-10
22	92% Argon / 8% CO2	C-8
23	98% Argon / 2% CO2	C-2
24	75% CO2 / 25% Argon	C-75
25	75% Argon / 25% Helium	HE-75
26	75% Helium / 25% Argon	HE-25
27	90% Helium / 7.5% Argon / 2.5% CO2 (Praxair - Helistar® A1025)	A1025
28	90% Argon / 8% CO2 / 2% Oxygen (Praxair - Stargon® CS)	Star29
29	95% Argon / 5% Methane	P-5

For example, to select Propane, enter: $$12<Enter>

Creating and Deleting Gas Mixtures with COMPOSER™ using RS-232

Note: All commands must be prefixed with the unit ID if the unit is not in streaming mode.

You may create and store up to 20 gas mixtures containing up to five constituent gases each.

Create a Gas Mixture

To create a gas mixture, enter a single-line command according to the following formula: [Unit ID]**GM** [Gas Name] [Gas Mix Number] [Percent 1] [Gas Number 1] [Percent 2] [Gas Number 2] …

Gas Name: Name your mixture using a maximum of 6 characters.

Gas Mix Number: COMPOSER™ user mixes have gas numbers between 236 and 255. You can assign any number in this range to your new mixture. If another mixture with the same number exists, it will be overwritten, even if that gas is currently selected on the unit. If you enter a 0 here, the new mix will be assigned the next available number between 236 and 255.

Percent 1: The percentage of the first constituent gas. The percentage of each constituent must be between 0.01 and 99.99. Values entered beyond two decimal points will be rounded to the nearest 0.01%.

Gas Number 1: The gas number of the first constituent gas.

Percent 2: The percentage of the first constituent gas. Values entered beyond two decimal points will be rounded to the nearest 0.01%.

Gas Number 2: The gas number of the first constituent gas.

Additional Gases: (Optional) The above pattern of [Percent] + [Gas Number] may be repeated for additional constituent gases up to a total of 5 constituents. The sum of all percentages must be 100.00.

On success, the unit ID (if set) is returned followed by a space. The number of the gas mixture is then returned, followed by the percentages and names of each constituent in the mix. If the gas is not successfully mixed, a "**?**" is returned.

Delete a Gas Mixture

To delete a gas mixture, enter:

[Unit ID]**GD [Gas Number]:** The number of the COMPOSER™ user mixture you wish to delete from the unit

Only COMPOSER™ user mixtures can be deleted with this command.

On success, the unit ID (if set) is returned followed by a space and the number of the gas deleted. If the gas is not successfully deleted, a "**?"** is returned.

Collecting Data:

The RS-232 output updates to the screen many times per second. Very short-term events can be captured simply by disconnecting (there are two telephone symbol icons at the top of the HyperTerminal® screen for disconnecting and connecting) immediately after the event in question. The scroll bar can be driven up to the event and all of the data associated with the event can be selected, copied, and pasted into Microsoft® Excel® or other spreadsheet program as described below.

For longer term data, it is useful to capture the data in a text file. With the desired data streaming to the screen, select "Capture Text" from the Transfer Menu. Type in the path and file name you wish to use. Push the start button. When the data collection period is complete, simply select "Capture Text" from the Transfer Menu and select "Stop" from the sub-menu that appears.

Data that is selected and copied, either directly from HyperTerminal® or from a text file can be pasted directly into Excel®. When the data is pasted it will all be in the selected column. Select "Text to Columns..." under the Data menu in Excel® and a Text to Columns Wizard (dialog box) will appear.

Make sure that "Fixed Width" is selected under Original Data Type in the first dialog box and click "Next". In the second dialog box, set the column widths as desired, but the default is usually acceptable. Click on "Next" again. In the third dialog box, make sure the column data format is set to "General", and click "Finish". This separates the data into columns for manipulation and removes symbols such as the plus signs from the numbers. Once the data is in this format, it can be graphed or manipulated as desired. ***For extended term data capture see page 38.***

Data Format:

The data stream on the screen represents the flow parameters of the main mode in the units shown on the display.

For mass flow controllers, there are six columns of data representing pressure, temperature, volumetric flow, mass flow, set-point, and the selected gas

The first column is absolute pressure (normally in psia), the second column is temperature (normally in °C), the third column is volumetric flow rate (in the units specified at time of order and shown on the display), the fourth column is mass flow (also in the units specified at time of order and shown on the display), the fifth column is the currently selected set-point value, the sixth column designates the currently selected gas. For instance, if the controller was ordered in units of scfm, the display on the controller would read 2.004 scfm and the last two columns of the output below would represent volumetric flow and mass flow in cfm and scfm respectively.

+014.70	+025.00	+02.004	+02.004	2.004	Air
+014.70	+025.00	+02.004	+02.004	2.004	Air
+014.70	+025.00	+02.004	+02.004	2.004	Air
+014.70	+025.00	+02.004	+02.004	2.004	Air
Pressure	Temp	Vol. Flow	Mass Flow	Set Point	Gas

MC-Series Mass Flow Controller Data Format

Note: On units with the totalizer function, the sixth column will be the totalizer value, with gas select moving to a seventh column.

Sending a Simple Script File to HyperTerminal®

It is sometimes desirable to capture data for an extended period of time. Standard streaming mode information is useful for short term events, however, when capturing data for an extended period of time, the amount of data and thus the file size can become too large very quickly. Without any special programming skills, the user can use HyperTerminal® and a text editing program such as Microsoft® Word® to capture text at user defined intervals.

1. Open your text editing program, MS Word for example.

2. Set the cap lock on so that you are typing in capital letters.

3. Beginning at the top of the page, type A<Enter> repeatedly. If you're using MS Word, you can tell how many lines you have by the line count at the bottom of the screen. The number of lines will correspond to the total number of times the flow device will be polled, and thus the total number of lines of data it will produce.

For example:
A
A
A
A
A
A

will get a total of six lines of data from the flow meter, but you can enter as many as you like.

The time between each line will be set in HyperTerminal.

4. When you have as many lines as you wish, go to the File menu and select save. In the save dialog box, enter a path and file name as desired and in the "Save as Type" box, select the plain text (.txt) option. It is important that it be saved as a generic text file for HyperTerminal to work with it.

5. Click Save.

6. A file conversion box will appear. In the "End Lines With" drop down box, select CR Only. Everything else can be left as default.

7. Click O.K.

8. You have now created a "script" file to send to HyperTerminal. Close the file and exit the text editing program.

9. Open HyperTerminal and establish communication with your flow device as outlined in the manual.

10. Set the flow device to Polling Mode as described in the manual. Each time you type A<Enter>, the meter should return one line of data to the screen.

11. Go to the File menu in HyperTerminal and select "Properties".

12. Select the "Settings" tab.

13. Click on the "ASCII Setup" button.

14. The "Line Delay" box is defaulted to 0 milliseconds. This is where you will tell the program how often to read a line from the script file you've created. 1000 milliseconds is one second, so if you want a line of data every 30 seconds, you

would enter 30000 into the box. If you want a line every 5 minutes, you would enter 300000 into the box.

15. When you have entered the value you want, click on OK and OK in the Properties dialog box.

16. Go the Transfer menu and select “Send **Text** File…” (NOT Send File…).

17. Browse and select the text “script” file you created.

18. Click Open.

19. The program will begin “executing” your script file, reading one line at a time with the line delay you specified and the flow device will respond by sending one line of data for each poll it receives, when it receives it.

You can also capture the data to another file as described in the manual under “Collecting Data”. You will be simultaneously sending it a script file and capturing the output to a separate file for analysis.

Operating Principle

All M-Series Gas Flow Meters (and MC-Series Gas Flow Controllers) are based on the accurate measurement of volumetric flow. The volumetric flow rate is determined by creating a pressure drop across a unique internal restriction, known as a Laminar Flow Element (LFE), and measuring differential pressure across it. The restriction is designed so that the gas molecules are forced to move in parallel paths along the entire length of the passage; hence laminar (streamline) flow is established for the entire range of operation of the device. Unlike other flow measuring devices, in laminar flow meters the relationship between pressure drop and flow is linear.

STANDARD GAS DATA TABLES: Those of you who have older Cole-Parmer products may notice small discrepancies between the gas property tables of your old and new units. Cole-Parmer has incorporated the latest data sets from NIST (including their REFPROP 9 data where available) in our products’ built-in gas property models. Be aware that the calibrators that you may be using may be checking against older data sets such as the widely distributed Air Liquide data. This may generate apparent calibration discrepancies of up to 0.6% of reading on well behaved gases and as much as 3% of reading on some gases such as propane and butane, unless the standard was directly calibrated on the gas in question.

As the older standards are phased out, this difference in readings will cease to be a problem. If you see a difference between the Cole-Parmer meter and your in-house standard, in addition to calling Cole-Parmer at, call the manufacturer of your standard for clarification as to which data set they used in their calibration. This comparison will in all likelihood resolve the problem.

GAS SELECT > Standard:

MC Controllers will display: Acetylene, Air, Argon, Butane, Carbon Dioxide, Carbon Monoxide, Ethane, Ethylene (Ethene), Helium, Hydrogen, Iso-Butane, Krypton, Methane, Neon, Nitrogen, Nitrous Oxide, Oxygen, Propane, Sulfur Hexafluoride, Xenon, HE-25, HE-75, A1025, C-2, C-8, C-10, C-25, C-75, P-5, Star29.

MCS and **MCRS Controllers** add the following: Ammonia, Hydrogen Sulfide, Nitric Oxide, Nitrogen Triflouride, Propylene, Nitrogen Dioxide to 0.5% in an inert carrier, Refrigerant gases.

PURE NON-CORROSIVE GASES			25°C			0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA
14	C2H2	Acetylene	104.44800	1.07200	0.9928000	97.374	1.1728	0.9905
0	Air	Air	184.89890	1.18402	0.9996967	172.574	1.2930	0.9994
1	Ar	Argon	226.23990	1.63387	0.9993656	210.167	1.7840	0.9991
16	i-C4H10	i-Butane	74.97846	2.44028	0.9735331	68.759	2.6887	0.9645
13	n-C4H10	n-Butane	74.05358	2.44930	0.9699493	67.690	2.7037	0.9591
4	CO2	Carbon Dioxide	149.31840	1.80798	0.9949545	137.107	1.9768	0.9933
3	CO	Carbon Monoxide	176.49330	1.14530	0.9996406	165.151	1.2505	0.9993
60	D2	Deuterium	126.59836	0.16455	1.0005970	119.196	0.1796	1.0006
5	C2H6	Ethane	93.54117	1.23846	0.9923987	86.129	1.3550	0.9901
15	C2H4	Ethylene (Ethene)	103.18390	1.15329	0.9942550	94.697	1.2611	0.9925
7	He	Helium	198.45610	0.16353	1.0004720	186.945	0.1785	1.0005
6	H2	Hydrogen	89.15355	0.08235	1.0005940	83.969	0.0899	1.0006
17	Kr	Krypton	251.32490	3.43229	0.9979266	232.193	3.7490	0.9972
2	CH4	Methane	110.75950	0.65688	0.9982472	102.550	0.7175	0.9976
10	Ne	Neon	311.12640	0.82442	1.0004810	293.822	0.8999	1.0005
8	N2	Nitrogen	178.04740	1.14525	0.9998016	166.287	1.2504	0.9995
9	N2O	Nitrous Oxide	148.41240	1.80888	0.9945327	136.310	1.9779	0.9928
11	O2	Oxygen	205.50210	1.30879	0.9993530	191.433	1.4290	0.9990
12	C3H8	Propane	81.46309	1.83204	0.9838054	74.692	2.0105	0.9785
19	SF6	Sulfur Hexafluoride	153.53200	6.03832	0.9886681	140.890	6.6162	0.9849
18	Xe	Xenon	229.84830	5.39502	0.9947117	212.157	5.8980	0.9932

PURE CORROSIVES*			25°C			0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA
32	NH3	Ammonia	100.92580	0.70352	0.9894555	91.930	0.7715	0.9848612
80	1Butene	Butylene (1-Butene)	81.62541	2.35906	0.9721251	74.354	2.6036	0.9614456
81	cButene	Cis-Butene (cis-2-butene)	79.96139	2.36608	0.9692405	Liquid	Liquid	Liquid
82	iButene	Iso-Butene	80.84175	2.35897	0.9721626	73.640	2.6038	0.9613501
83	tButene	Trans-Butene	80.28018	2.36596	0.9692902	Liquid	Liquid	Liquid
84	COS	Carbonyl Sulfide	124.09600	2.48322	0.9888443	113.127	2.7202	0.985328
33	Cl2	Chlorine	134.56600	2.93506	0.9874470	125.464	3.1635	0.98407
85	CH3OCH3	Dimethylether	90.99451	1.91822	0.9816453	82.865	2.1090	0.9745473
34	H2S	Hydrogen Sulfide (H2S)	123.86890	1.40376	0.9923556	112.982	1.5361	0.9898858
31	NF3	NF3 (Nitrogen Trifluoride)	175.42500	2.91339	0.9963859	162.426	3.1840	0.9951506
30	NO	NO (Nitric Oxide)	190.05950	1.22672	0.9997970	176.754	1.3394	0.9995317
36	C3H6	Propylene (Propylene)	85.59895	1.74509	0.9856064	78.129	1.9139	0.9809373
86	SiH4	Silane (SiH4)	115.94400	1.32003	0.9945000	107.053	1.4433	0.99282
35	SO2	Sulfur Dioxide	127.83100	2.66427	0.9828407	116.717	2.9312	0.9750866

***Pure Corrosive gases are only available on S-Series instruments that are compatible with these gases. Gas numbers 33 and 35 are not available on controllers**

REFRIGERANTS*			25°C			0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA
100	R-11	Trichlorofluoromethane	101.60480	5.82358	0.9641448	Liquid	Liquid	Liquid
101	R-115	Chloropentafluoroethane	125.14780	6.43293	0.9814628	114.891	7.0666	0.9752287
102	R-116	Hexafluoroethane	137.81730	5.70097	0.9895011	126.635	6.2458	0.9858448
103	R-124	Chlorotetrafluoroethane	115.93110	5.72821	0.9738286	105.808	6.3175	0.963807
104	R-125	Pentafluoroethane	129.61740	4.98169	0.9847599	118.793	5.4689	0.979137
105	R-134A	Tetrafluoroethane	118.18820	4.25784	0.9794810	108.311	4.6863	0.9713825
106	R-14	Tetrafluoromethane	172.44680	3.61084	0.9962553	159.688	3.9467	0.9948964
107	R-142b	Chlorodifluoroethane	104.20190	4.21632	0.9742264	95.092	4.6509	0.9640371
108	R-143a	Trifluoroethane	110.86600	3.49451	0.9830011	101.344	3.8394	0.9765755
109	R-152a	Difluoroethane	100.81320	2.75903	0.9785245	91.952	3.0377	0.9701025
110	R-22	Difluoromonochloromethane	126.30390	3.58679	0.9853641	115.325	3.9360	0.9801128
111	R-23	Trifluoromethane	149.13160	2.88404	0.9922734	136.997	3.1568	0.9895204
112	R-32	Difluoromethane	126.13140	2.15314	0.9875960	115.303	2.3619	0.9827161
113	RC-318	Octafluorocyclobutane	115.04690	8.42917	0.9700156	104.785	9.3017	0.9594738
114	R-404A	44% R-125 / 4% R-134A / 52% R-143A	120.30982	4.18002	0.9836342	111.584	4.5932	0.9770889
115	R-407C	23% R-32 / 25% R-125 / 52% R-134A	123.55369	3.95268	0.9826672	112.698	4.3427	0.9762849
116	R-410A	50% R-32 / 50% R-125	130.24384	3.56538	0.9861780	122.417	3.9118	0.9811061
117	R-507A	50% R-125 / 50% R-143A	121.18202	4.23876	0.9838805	112.445	4.6573	0.9774207

***Refrigerant gases are only available on S-Series instruments that are compatible with these gases.**

WELDING GASES			25°C			0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA
23	C-2	2% CO2 / 98% Ar	224.71480	1.63727	0.9993165	208.673	1.7877	0.998993
22	C-8	8% CO2 / 92% Ar	220.13520	1.64749	0.9991624	204.199	1.7989	0.9987964
21	C-10	10% CO2 / 90% Ar	218.60260	1.65091	0.9991086	202.706	1.8027	0.9987278
140	C-15	15% CO2 / 85% Ar	214.74960	1.65945	0.9989687	198.960	1.8121	0.9985493
141	C-20	20% CO2 / 80% Ar	210.86960	1.66800	0.9988210	195.198	1.8215	0.9983605
20	C-25	25% CO2 / 75% Ar	206.97630	1.67658	0.9986652	191.436	1.8309	0.9981609
142	C-50	50% CO2 / 50% Ar	187.53160	1.71972	0.9977484	172.843	1.8786	0.9969777
24	C-75	75% CO2 / 25% Ar	168.22500	1.76344	0.9965484	154.670	1.9271	0.995401
25	He-25	25% He / 75% Ar	231.60563	1.26598	0.9996422	216.008	1.3814	0.9999341
143	He-50	50% He / 50% Ar	236.15149	0.89829	0.9999188	220.464	0.9800	1.00039
26	He-75	75% He / 25% Ar	234.68601	0.53081	1.0001954	216.937	0.5792	1.000571
144	He-90	90% He / 10% Ar	222.14566	0.31041	1.0003614	205.813	0.3388	1.00057
27	A1025	90% He / 7.5% Ar / 2.5% CO2	214.97608	0.31460	1.0002511	201.175	0.3433	1.000556
28	Star29	Stargon CS 90% Ar / 8% CO2 / 2% O2	219.79340	1.64099	0.9991638	203.890	1.7918	0.998798

BIOREACTOR GASES			25°C			0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA
145	Bio-5M	5% CH4 / 95% CO2	148.46635	1.75026	0.9951191	136.268	1.9134	0.9935816
146	Bio-10M	10% CH4 / 90% CO2	147.54809	1.69254	0.9952838	135.383	1.8500	0.993893
147	Bio-15M	15% CH4 / 85% CO2	146.55859	1.63484	0.9954484	134.447	1.7867	0.9941932
148	Bio-20M	20% CH4 / 80% CO2	145.49238	1.57716	0.9956130	133.457	1.7235	0.994482
149	Bio-25M	25% CH4 / 75% CO2	144.34349	1.51950	0.9957777	132.407	1.6603	0.9947594
150	Bio-30M	30% CH4 / 70% CO2	143.10541	1.46186	0.9959423	131.290	1.5971	0.9950255
151	Bio-35M	35% CH4 / 65% CO2	141.77101	1.40424	0.9961069	130.102	1.5340	0.9952803
152	Bio-40M	40% CH4 / 60% CO2	140.33250	1.34664	0.9962716	128.834	1.4710	0.9955239
153	Bio-45M	45% CH4 / 55% CO2	138.78134	1.28905	0.9964362	127.478	1.4080	0.9957564
154	Bio-50M	50% CH4 / 50% CO2	137.10815	1.23149	0.9966009	126.025	1.3450	0.9959779
155	Bio-55M	55% CH4 / 45% CO2	135.30261	1.17394	0.9967655	124.462	1.2821	0.9961886
156	Bio-60M	60% CH4 /40% CO2	133.35338	1.11642	0.9969301	122.779	1.2193	0.9963885
157	Bio-65M	65% CH4 /35% CO2	131.24791	1.05891	0.9970948	120.959	1.1564	0.9965779
158	Bio-70M	70% CH4 / 30% CO2	128.97238	1.00142	0.9972594	118.987	1.0936	0.9967567
159	Bio-75M	75% CH4 / 25% CO2	126.51146	0.94395	0.9974240	116.842	1.0309	0.9969251
160	Bio-80M	80% CH4 / 20% CO2	123.84817	0.88650	0.9975887	114.501	0.9681	0.9970832
161	Bio-85M	85% CH4 / 15% CO2	120.96360	0.82907	0.9977533	111.938	0.9054	0.9972309
162	Bio-90M	90% CH4 / 10% CO2	117.83674	0.77166	0.9979179	109.119	0.8427	0.9973684
163	Bio-95M	95% CH4 / 5% CO2	114.44413	0.71426	0.9980826	106.005	0.7801	0.9974957

BREATHING GASES			25°C			0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA
164	EAN-32	32% O2 / 68% N2	186.86315	1.19757	0.9996580	174.925	1.3075	0.9993715
165	EAN	36% O2 / 64% N2	187.96313	1.20411	0.9996401	175.963	1.3147	0.9993508
166	EAN-40	40% O2 / 60% N2	189.06268	1.21065	0.9996222	176.993	1.3218	0.9993302
167	HeOx-20	20% O2 / 80% He	217.88794	0.39237	1.0002482	204.175	0.4281	1.000593
168	HeOx-21	21% O2 / 79% He	218.15984	0.40382	1.0002370	204.395	0.4406	1.000591
169	HeOx-30	30% O2 / 70% He	219.24536	0.50683	1.0001363	205.140	0.5530	1.000565
170	HeOx-40	40% O2 / 60% He	218.59913	0.62132	1.0000244	204.307	0.6779	1.000502
171	HeOx-50	50% O2 / 50% He	216.95310	0.73583	0.9999125	202.592	0.8028	1.000401
172	HeOx-60	60% O2 / 40% He	214.82626	0.85037	0.9998006	200.467	0.9278	1.000257
173	HeOx-80	80% O2 / 20% He	210.11726	1.07952	0.9995768	195.872	1.1781	0.9998019
174	HeOx-99	99% O2 / 1% He	205.72469	1.29731	0.9993642	191.646	1.4165	0.9990796
175	EA-40	Enriched Air-40% O2	189.42518	1.21429	0.9996177	177.396	1.3258	0.9993261
176	EA-60	Enriched Air-60% O2	194.79159	1.24578	0.9995295	182.261	1.3602	0.9992266
177	EA-80	Enriched Air-80% O2	200.15060	1.27727	0.9994412	186.937	1.3946	0.9991288
178	Metabol	Metabolic Exhalant (16% O2 / 78.04% N2 / 5% CO2 / 0.96% Ar)	180.95936	1.20909	0.9994833	170.051	1.3200	0.9992587

FUEL GASES			25°C			0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA
185	Syn Gas-1	40% H2 + 29% CO + 20% CO2 + 11% CH4	155.64744	0.79774	0.9989315	144.565	0.8704	0.9992763
186	Syn Gas-2	64% H2 + 28% CO + 1% CO2 + 7% CH4	151.98915	0.43715	1.0001064	142.249	0.4771	1.000263
187	Syn Gas-3	70% H2 + 4% CO + 25% CO2 + 1% CH4	147.33686	0.56024	0.9991225	136.493	0.6111	0.9997559
188	Syn Gas-4	83% H2 + 14% CO + 3% CH4	133.63682	0.24825	1.0003901	125.388	0.2709	1.000509
189	Nat Gas-1	93% CH4 / 3% C2H6 / 1% C3H8 / 2% N2 / 1% CO2	111.77027	0.70709	0.9979255	103.189	0.7722	0.9973965
190	Nat Gas-2	95% CH4 / 3% C2H6 / 1% N2 / 1% CO2	111.55570	0.69061	0.9980544	103.027	0.7543	0.9974642
191	Nat Gas-3	95.2% CH4 / 2.5% C2H6 / 0.2% C3H8 / 0.1% C4H10 / 1.3% N2 / 0.7% CO2	111.49608	0.68980	0.9980410	102.980	0.7534	0.9974725
192	Coal Gas	50% H2 / 35% CH4 / 10% CO / 5% C2H4	123.68517	0.44281	0.9993603	115.045	0.6589	0.996387
193	Endo	75% H2 + 25% N2	141.72100	0.34787	1.0005210	133.088	0.3797	1.000511
194	HHO	66.67% H2 / 33.33% O2	180.46190	0.49078	1.0001804	168.664	0.5356	1.000396
195	HD-5	LPG 96.1% C3H8 / 1.5% C2H6 / 0.4% C3H6 / 1.9% n-C4H10	81.45829	1.83428	0.9836781	74.933	2.0128	0.9784565
196	HD-10	LPG 85% C3H8 / 10% C3H6 / 5% n-C4H10	81.41997	1.85378	0.9832927	74.934	2.0343	0.9780499

LASER GASES			25°C			0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA
179	LG-4.5	4.5% CO2 / 13.5% N2 / 82% He	199.24300	0.36963	1.0001332	187.438	0.4033	1.000551
180	LG-6	6% CO2 / 14% N2 / 80% He	197.87765	0.39910	1.0000471	186.670	0.4354	1.00053
181	LG-7	7% CO2 / 14% N2 / 79% He	197.00519	0.41548	0.9999919	186.204	0.4533	1.000514
182	LG-9	9% CO2 / 15% N2 / 76% He	195.06655	0.45805	0.9998749	184.835	0.4997	1.000478
183	HeNe-9	9% Ne / 91% He	224.68017	0.22301	1.0004728	211.756	0.2276	1.000516
184	LG-9.4	9.4% CO2 / 19.25% N2 / 71.35% He	193.78311	0.50633	0.9998243	183.261	0.5523	1.000458

O2 CONCENTRATOR GASES			25°C			0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA
197	OCG-89	89% O2 / 7% N2 / 4% Ar	204.53313	1.31033	0.9993849	190.897	1.4307	0.9990695
198	OCG-93	93% O2 / 3% N2 / 4% Ar	205.62114	1.31687	0.9993670	191.795	1.4379	0.9990499
199	OCG-95	95% O2 / 1% N2 / 4% Ar	206.16497	1.32014	0.9993580	192.241	1.4414	0.99904

STACK GASES			25°C			0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA
200	FG-1	2.5% O2 / 10.8% CO2 / 85.7% N2 / 1% Ar	175.22575	1.22550	0.9992625	165.222	1.3379	0.9990842
201	FG-2	2.9% O2 / 14% CO2 / 82.1% N2 / 1% Ar	174.18002	1.24729	0.9991056	164.501	1.3617	0.9989417
202	FG-3	3.7% O2 / 15% CO2 / 80.3% N2 / 1% Ar	174.02840	1.25520	0.9990536	164.426	1.3703	0.9988933
203	FG-4	7% O2 / 12% CO2 / 80% N2 / 1% Ar	175.95200	1.24078	0.9991842	166.012	1.3546	0.9990116
204	FG-5	10% O2 / 9.5% CO2 / 79.5% N2 / 1% Ar	177.65729	1.22918	0.9992919	167.401	1.3419	0.9991044
205	FG-6	13% O2 / 7% CO2 / 79% N2 / 1% Ar	179.39914	1.21759	0.9993996	168.799	1.3293	0.9991932

CHROMATOGRAPHY GASES			25°C			0°C		
Gas Number	Short Name	Long Name	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA	Absolute Viscosity	Density 14.696 PSIA	Compressibilty 14.696 PSIA
29	P-5	5% CH4 / 95% Ar	223.91060	1.58505	0.9993265	207.988	1.7307	0.9990036
206	P-10	10% CH4 90% Ar	221.41810	1.53622	0.9992857	205.657	1.6774	0.99895

TROUBLESHOOTING

Display does not come on or is weak.
Check power and ground connections. Please reference the technical specifications (pages 54 - 71) to assure you have the proper power for your model.

Flow reading is approximately fixed either near zero or near full scale regardless of actual line flow.
Differential pressure sensor may be damaged. A common cause of this problem is instantaneous application of high-pressure gas as from a snap acting solenoid valve upstream of the meter. If you suspect that your pressure sensor is damaged please discontinue use of the controller and contact Cole-Parmer.

Displayed mass flow, volumetric flow, pressure or temperature is flashing and message MOV, VOV, POV or TOV is displayed:
Our flow meters and controllers display an error message (MOV = mass overrange, VOV = volumetric overrange, POV = pressure overrange, TOV = temperature overrange) when a measured parameter exceeds the range of the sensors in the device. When any item flashes on the display, neither the flashing parameter nor the mass flow measurement is accurate. Reducing the value of the flashing parameter to within specified limits will return the unit to normal operation and accuracy. If the unit does not return to normal contact Cole-Parmer.

After installation, there is no flow.
Cole-Parmer MC controllers incorporate normally closed valves and require a set-point to operate. Check that your set-point signal is present and supplied to the correct pin and that the correct set-point source is selected under the SETPT SOURCE list in the control set up display. Also check that the unit is properly grounded.

The flow lags below the set-point.
Be sure there is enough pressure available to make the desired flow rate. If either the set-point signal line and/or the output signal line is relatively long, it may be necessary to provide heavier wires (especially ground wiring) to negate voltage drops due to line wire length. An inappropriate PID tuning can also cause this symptom if the D term is too large relative to the P term. See pages 20 and 21 for more information on PID tuning.

Controller is slow to react to a set-point change or imparts an oscillation to the flow.
An inappropriate PID tuning can cause these symptoms. Use at conditions considerably different than those at which the device was originally set up can necessitate a re-tuning of the PID loop. See pages 20 and 21 for more information on PID tuning.

The output signal is lower than the reading at the display.
This can occur if the output signal is measured some distance from the meter, as voltage drops in the wires increase with distance. Using heavier gauge wires, especially in the ground wire, can reduce this effect.

Meter does not agree with another meter I have in line.
Volumetric meters are affected by pressure drops. Volumetric flow meters should not be compared to mass flow meters. Mass flow meters can be compared against one another provided there are no leaks between the two meters and they are set to the same standard temperature and pressure. Both meters must also be calibrated (or set) for the gas being measured. M-Series mass flow meters are normally set to Standard Temperature and Pressure conditions of 25 ° C and 14.696 psia. Note: it is possible to special order meters with a customer specified set of standard conditions. The calibration sheet provided with each meter lists its standard conditions.
When performing this comparison it is best to use the smallest transition possible between the two devices. Using small transitions will minimize lag and dead volume.

RS-232 Serial Communications is not responding.
Check that your meter is powered and connected properly. Be sure that the port on the computer to which the meter is connected is active. Confirm that the port settings are correct per the RS-232 instructions in this manual (Check the RS-232 communications select screen for current meter readings). Close Hyperterminal® and reopen it. Reboot your PC. See pages 10, 11 and 30 for more information on RS-232 signals and communications.

Slower response than specified.
MC-Series Controllers feature a programmable Geometric Running Average (GRA). Depending on the full scale range of the meter, it may have the GRA set to enhance the stability/readability of the display, which would result in slower perceived response time. Please see “Pressure Averaging” and “Flow Averaging” on page 26.

Jumps to zero at low flow.
MC-Series Controllers feature a programmable zero deadband. The factory setting is usually 0.5% of full scale. This can be adjusted between NONE and 3.2% of full scale. See page 26.

Discrepancies between old and new units.
Please see “Standard Gas Data Tables” explanation on page 37.

Maintenance and Recalibration

General: MC-Series Flow Controllers require minimal maintenance. They have no moving parts. The single most important thing that affects the life and accuracy of these devices is the quality of the gas being measured. The controller is designed to measure CLEAN, DRY, NON-CORROSIVE gases.

Moisture, oil and other contaminants can affect the laminar flow elements. We recommend the use of in-line sintered filters to prevent large particulates from entering the measurement head of the instrument. Suggested maximum particulate sizes are as follows:

5 microns for units with FS flow ranges of 0-1 sccm or less.
20 microns for units with FS flow ranges between 0-2 sccm and 0-1 slpm.
50 microns for units with FS flow ranges of 0-1 slpm or more.

Recalibration: The recommended period for recalibration is once every year. A label located on the back of the controller lists the most recent calibration date. The controller should be returned to the factory for recalibration within one year from the listed date. Before calling to schedule a recalibration, please note the serial number on the back of the instrument. The Serial Number, Model Number, and Date of Manufacture are also available on the Model Info display (page 28).

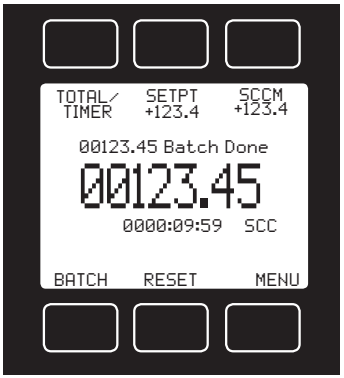
Cleaning: MC-Series Flow Controllers require no periodic cleaning. If necessary, the outside of the controller can be cleaned with a soft dry cloth. Avoid excess moisture or solvents.

For repair, recalibration or recycling of this product contact:

Cole-Parmer Instrument Co.
625 E. Bunker Court
Vernon Hills, IL 60061
USA
Ph. 800-323-4340
Fax 847-549-7676
email: info@coleparmer.com
Website: www.coleparmer.com

Option: Totalizing Mode - Controllers

Controllers can be purchased with the Totalizing Mode option. This option adds an additional mode screen that displays the total flow (normally in the units of the main flow screen) that has passed through the device since the last time the totalizer was cleared. The Totalizing Mode screen is accessed by pushing the TOTAL button on the MAIN display.



TOTAL/TIMER: Pushing the TOTAL/TIMER button will cycle the large numbers on the display between total mass and time elapsed.

Rollover – The customer can also specify at the time of order what the totalizer is to do when the maximum count is reached. The following options may be specified:

No Rollover – When the counter reaches the maximum count it stops counting until the counter is cleared.

Rollover – When the counter reaches the maximum count it automatically rolls over to zero and continues counting until the counter is cleared.

Rollover with Notification – When the counter reaches the maximum count it automatically rolls over to zero, displays an overflow error, and continues counting until the counter is cleared.

TOTAL MASS: The counter can have as many as seven digits. At the time of order, the customer must specify the range. This directly affects the maximum count. For instance, if a range of 1/100ths of a liter is specified on a meter which is totalizing in liters, the maximum count would be 99999.99 liters. If the same unit were specified with a 1 liter range, the maximum count would be 9999999 liters.

ELAPSED TIME: The small numbers below the mass total show the elapsed time since the last reset in hours, minutes and seconds. The maximum measurable elapsed time is 9999 hours 59 minutes 59 seconds. The hours count resets when RESET is pushed, an RS-232 clear is executed or on loss of power. Press ELAPSED TIME to show this as the primary display.

SETPT: Pushing SETPT will allow you to change the controller's set-point.

RESET – The counter can be reset to zero at any time by pushing the RESET button. To clear the counter via RS-232, establish serial communication with the meter or controller as described in the RS-232 section of the manual. To reset the counter, enter the following commands:

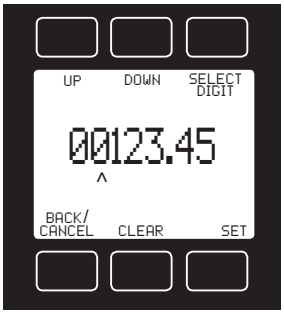
In Polling (addressable) Mode: Address$$T <Enter> (e.g. B$$T <Enter>)

When using a mass flow controller as an absolute pressure controller, the mass flow rate may momentarily exceed the flow measurement capability (full scale + 28%) of the unit. This may occur when the unit is asked to make an abrupt pressure change.

If the totalizer is in use at that time, the totalized value will necessarily become incorrect. Please reset the totalizer if such an 'over-flow' condition has occurred.

BATCH PROCESSING MODE – CONTROLLERS ONLY

Batch mode is a function within the optional Totalizing mode. Batch mode is designed to provide repeatable, finite flow quantities.



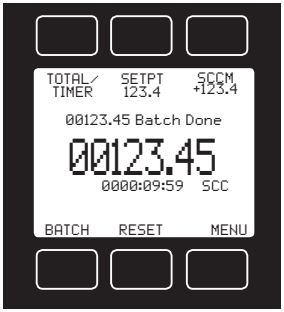
To activate Batch Mode: Press **BATCH**. Then use **SELECT DIGIT** to move the arrow to the desired digit, and the UP and DOWN buttons to change the value. Press **CLEAR** to return to zero. Press **SET** to record your value. If the controller has a non-zero Set-Point, flow will start immediately. If not, press **SETPT** to select a Set-Point.

Batch values can also be established via RS-232 communication using Register 92. (See RS-232 Section of this manual for serial communication methods.)

Note: While the Totalizer counter will still reset across power cycles, the Batch process value is stored in EEPROM and will remain valid until updated by the user.

While the Batch is processing, the desired Batch value is displayed above the totalizing counter on the Totalizer screen. Time elapsed during the Batch processing is displayed below the totalizing counter. Press **TOTAL/TIMER** to toggle these values.

When the active Totalizer reaches the preset Batch value, flow ceases, and the display updates to “Batch Done”. The Totalizer timer also pauses.



- To start a new batch of the same size, simply press RESET. The Totalizer can reproduce any number of fixed Batches in this manner.

- To start a smaller batch, decrease the Batch value. The new batch begins when you press RESET.

- To continue the existing batch to a larger total volume, increase the Batch value. Flow resumes as soon as you press OK in the Batch Value screen.

- To start a larger batch from scratch, first clear the flow Set-Point to zero to prevent unwanted flow. Then increase the Batch value, and select a flow Set-Point. Flow will begin when you press **SET** in the Set-Point screen.

- To cancel a batch in progress, clear the Set-Point and press **SET**.

Note: Batch mode operates independently of the desired flow rate, but requires a non-zero flow rate to run. The rate of flow is determined by the controller Set-Point value, which is established by the user via analog, front panel or serial communication methods. Batches can be produced more slowly or more rapidly as determined by the user-selected Set-Point flow rate.

To turn off Batch Mode: Set the Batch value to zero (0.0) via the front panel or RS-232 communication using Register 92. If there is a non-zero flow Set-Point, flow will immediately resume, and the Totalizer counter will continue per the user established Set-Point flow rate.

Accessory: Multi-Drop Box

The **Multi-Drop Box** makes it convenient to wire multiple flow and/or pressure devices to a single RS-232 port. ***Now available with a USB interface!***

The Multi-Drop Box has nine 8 pin mini-DIN ports available. The ports are to be used with a standard double ended 8 pin mini-DIN (DC-62) style cable going from the box to each flow or pressure device.

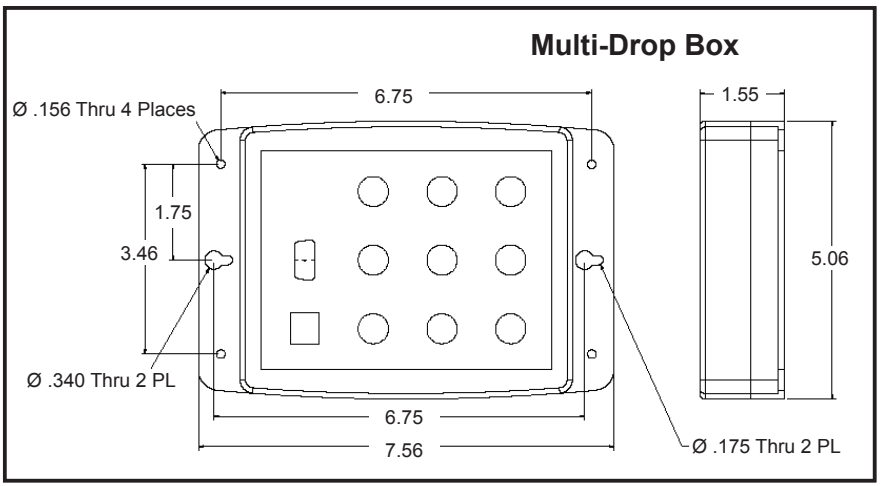
A single DB9 D-SUB type connector (COM PORT) connects, using the included cable, to the serial connector on a PC or laptop.

All of the flow and/or pressure devices are powered via a terminal block on the front of the box.

If more than nine devices will be required, additional Multi-Drop Boxes can be daisy chained together with a double ended 8 pin mini-DIN cable plugged into any receptacle on both boxes.

Multi-Drop Box Power Supply for Large Valve Controllers: The PS24VHC (Power Supply 24Vdc High Current) is a 6.5Amp 24Vdc power supply designed for running multiple large controllers on a Multi-Drop Box.

The 6.5Amp power supply can run as many as 8 large valve controllers, which makes it ideal for the Multi-Drop Box and multiple large valve (or small valve / large valve combination) controllers on a Multi-Drop Box.



Accessories

Description
9 position Multi-Drop Box
9 position Multi-Drop Box, Industrial connectors
Universal 100-240 VAC to 24 Volt DC Power Supply Adapter
High current power supply for Multi-Drop Box use with Large Valve Controllers
Industrial carry and storage case for portable meters/gauges
8 Pin Male Mini-DIN connector cable, single ended, 6 foot length
8 Pin Male Mini-DIN connector cable, single ended, 25 foot length
8 Pin Male Mini-DIN connector cable, single ended, 30 foot length
8 Pin Male Mini-DIN connector cable, single ended, 50 foot length
8 Pin Male Mini-DIN connector cable, single ended, 75 foot length
8 Pin Male Right Angle Mini-Din Cable, single ended, 6 foot length
8 Pin Male Mini-DIN connector cable, double ended, 6 foot length
8 Pin Male Mini-DIN connector cable, double ended, 25 foot length
8 Pin Male Mini-DIN connector cable, double ended, 50 foot length
8 Pin Male Mini-DIN connector cable, double ended, 60 foot length
8 Pin Male Mini-DIN to DB9 Female Adapter, 6 foot length
DB15 cable, single ended, 25 foot length
Industrial cable, 6 Pin, single ended, 10 foot length
18 gauge industrial cable, 6 Pin, single ended, 10 foot length
Industrial cable, 6 Pin, single ended, 20 foot length
18 gauge industrial cable, 6 Pin, single ended, 24 foot length
Industrial cable, 6 Pin, single ended, 50 foot length
Industrial cable, 6 pin double ended, 10 foot length
RS-232 to USB Converter

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Technical Data for Cole-Parmer MC and MCR Mass Flow Controllers
0 to 0.5 sccm Full Scale through 0 to 3000 slpm Full Scale

Standard Operating Specifications (Contact Cole-Parmer for available options)

Performance	MC & MCR Mass Flow Controller
Accuracy at calibration conditions after tare	± (0.8% of Reading + 0.2% of Full Scale)
High Accuracy at calibration conditions after tare	± (0.4% of Reading + 0.2% of Full Scale) High Accuracy option not available for units ranged under 5 sccm or over 500 slpm.
Repeatability	± 0.2% Full Scale
Zero Shift and Span Shift	0.02% Full Scale / ºCelsius / Atm
Operating Range / Turndown Ratio	0.5% to 100% Full Scale / 200:1 Turndown
Maximum Controllable Flow Rate	102.4% Full Scale
Typical Response Time	100 ms (Adjustable)
Warm-up Time	< 1 Second

Operating Conditions	MC & MCR Mass Flow Controller	
Mass Reference Conditions (STP)	25ºC & 14.696 psia (standard — others available on request)	
Operating Temperature	−10 to +50 ºCelsius	
Humidity Range (Non–Condensing)	0 to 100%	
Maximum Pressure	145 psig	
Mounting Attitude Sensitivity	**MC:** None	**MCR:** Mount with valve cylinder vertical & upright
Valve Type	Normally Closed	
Ingress Protection	IP40	
Wetted Materials	**MC:** 303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, Brass, 430FR Stainless Steel, Silicon, Glass. **MCR:** 303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, 416 Stainless Steel, Nickel, Silicon, Glass. If your application demands a different material, please contact Cole-Parmer.	

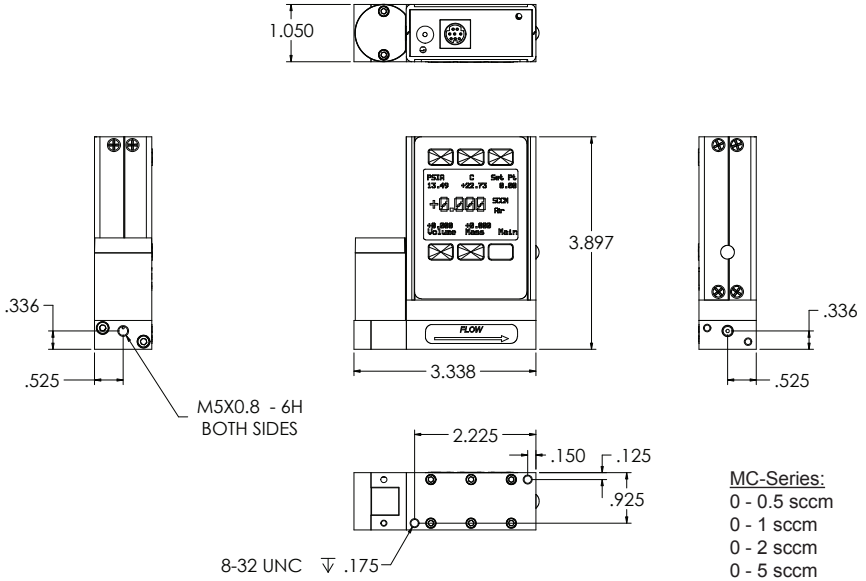
Communications / Power	MC & MCR Mass Flow Controller	
Monochrome LCD or Color TFT Display with integrated touchpad	Simultaneously displays Mass Flow, Volumetric Flow, Pressure and Temperature	
Digital Input/Output Signal[1] Options	RS-232 Serial	
Analog Input/Output Signal[2] Options	0-5 Vdc / 1-5 Vdc / 0-10 Vdc / 4-20 mA	
Optional Secondary Analog Input/Output Signal[2]	0-5 Vdc / 1-5 Vdc / 0-10 Vdc / 4-20 mA	
Electrical Connection Options	8 Pin Mini-DIN 15-pin D-sub (DB15) / 6 pin locking	
Supply Voltage	**MC:** 12 to 30 Vdc (15-30 Vdc for 4-20 mA outputs)	**MCR:** 24 to 30 Vdc
Supply Current	**MC**: 0.250 Amp	**MCR:** 0.750 Amp

1. The **Digital Output Signal** communicates Mass Flow, Volumetric Flow, Pressure and Temperature
2. The **Analog Output Signal** and **Optional Secondary Analog Output Signal** communicate your choice of Mass Flow, Volumetric Flow, Pressure or Temperature

Range Specific Specifications

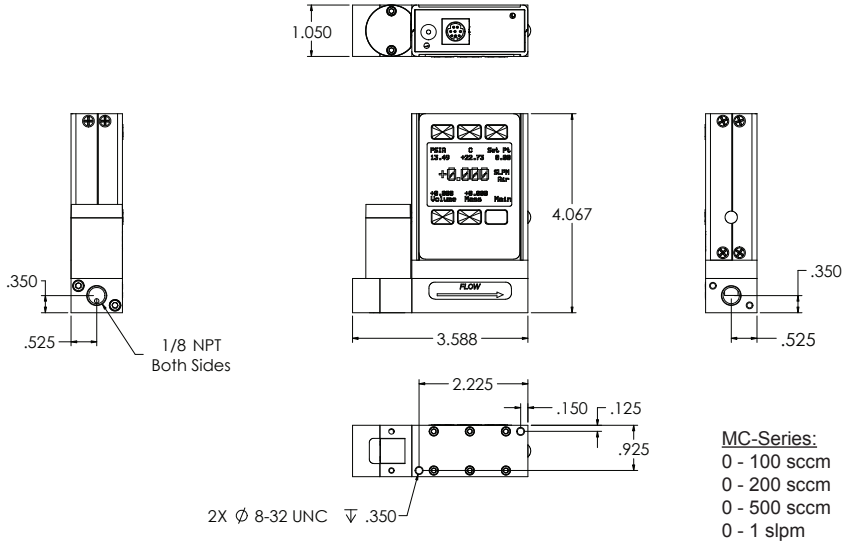
Full Scale Flow Mass Controller	Pressure Drop[1] at FS Flow (psid) venting to atmosphere	Mechanical Dimensions	Process Connections[2]
MC 0.5 sccm to 50 sccm	1.0	3.9”H x 3.4”W x 1.1”D	M-5 (10-32) Female Thread
MC 100 sccm to 500 sccm	1.0	4.1”H x 3.6”W x 1.1”D	1/8” NPT Female
MC 1 slpm	1.5		
MC 2 slpm	3.0		
MC 5 slpm	2.0		
MC 10 slpm	5.5		
MC 20 slpm	20.0		
MCR 50 slpm	2.0	5.5”H x 7.7”W x 2.3”D	1/4” NPT Female
MCR 100 slpm	3.2		
MCR 250 slpm	2.4	5.5”H x 7.7”W x 2.3”D	1/2” NPT Female
MCR 500 slpm	6.5	5.5”H x 7.4”W x 2.3”D	3/4” NPT Female (A 1-1/4” NPT Female process connection is available for 2000 slpm controllers.)
MCR 1000 slpm	14.0		
MCR 1500 slpm	17.0		
MCR 2000 slpm	28.6	5.5”H x 8.1” W x 2.9” D	
MCR 3000 slpm	16.8	5.5”H x 8.9” W x 2.9” D	1-1/4” NPT Female

1. Lower Pressure Drops Available, please see our **MCW-Series** mass flow controllers.
2. Compatible with Beswick®, Swagelok® tube, Parker®, face seal, push connect and compression adapter fittings. VCR and SAE connections upon request.



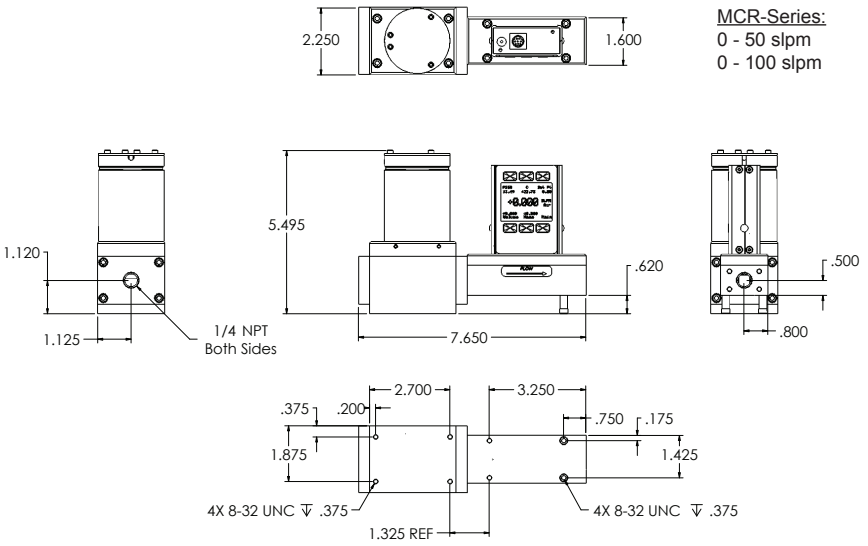
MC-Series:
0 - 0.5 sccm
0 - 1 sccm
0 - 2 sccm
0 - 5 sccm
0 - 10 sccm
0 - 20 sccm
0 - 50 sccm

0.5 sccm to 50 sccm approximate shipping weight: 1.1 lb.

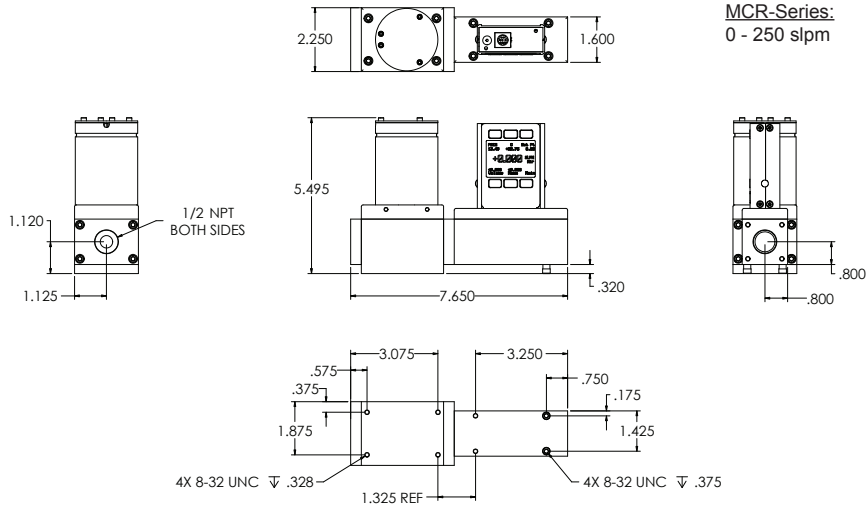


MC-Series:
0 - 100 sccm
0 - 200 sccm
0 - 500 sccm
0 - 1 slpm
0 - 2 slpm
0 - 3 slpm
0 - 5 slpm
0 - 10 slpm
0 - 20 slpm

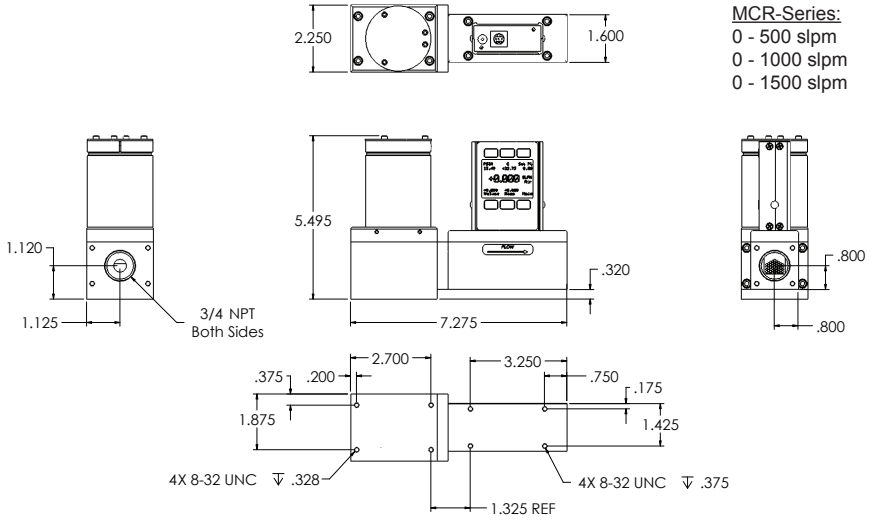
100 sccm to 20 slpm approximate weight: 1.2lb



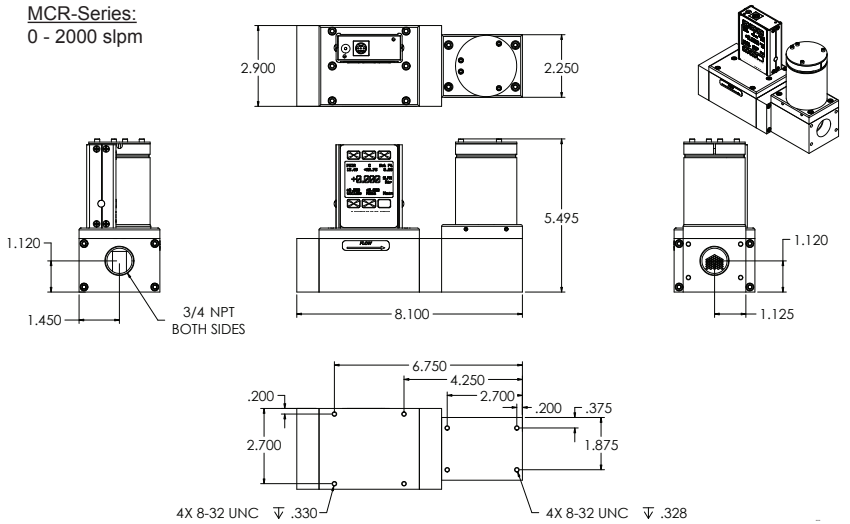
MCR 50 slplm to 100 slplm approximate weight: 9.0 lb.



MCR 250 slplm approximate weight: 9.0 lb.

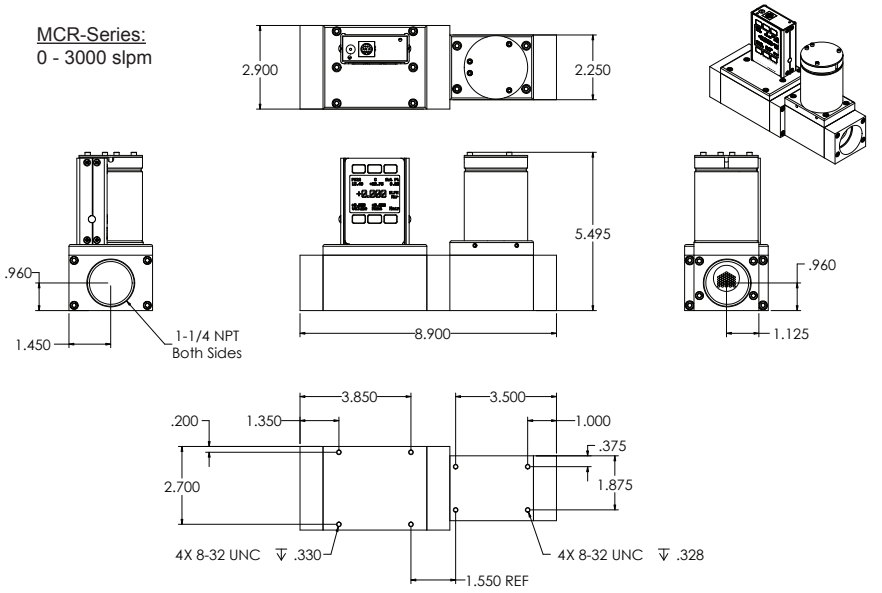


MCR 1500 slpm approximate weight: 9.0 lb.



MCR 2000 slpm approximate weight: 12.0 lb.

MCR-Series:
0 - 3000 slpm



MCR 3000 slpm approximate weight: 12.0 lb.

Technical Data for MCW Low Pressure Drop Mass Flow Controllers
0 to 0.5 sccm Full Scale through 0 to 500 slpm Full Scale

Standard Specifications (Contact Cole-Parmer for available options.)

Performance	MCW & MCRW Mass Flow Controller
Accuracy at calibration conditions after tare	± (0.8% of Reading + 0.2% of Full Scale)
High Accuracy at calibration conditions after tare	± (0.4% of Reading + 0.2% of Full Scale) High Accuracy option not available for units ranged under 5 sccm or over 500 slpm.
Repeatability	± 0.2% Full Scale
Zero Shift and Span Shift	0.02% Full Scale / ºCelsius / Atm
Operating Range / Turndown Ratio	0.5% to 100% Full Scale / 200:1 Turndown
Maximum Controllable Flow Rate	102.4% Full Scale
Typical Response Time	100 ms (Adjustable)
Warm-up Time	< 1 Second
Operating Conditions	**MCW & MCRW Mass Flow Controller**
Mass Reference Conditions (STP)	25ºC & 14.696 psia (standard — others available on request)
Operating Temperature	−10 to +50 ºCelsius
Humidity Range (Non–Condensing)	0 to 100%
Maximum Pressure	50 psig Higher line pressures available, please contact Cole-Parmer.
Mounting Attitude Sensitivity	**MCW:** None / **MCRW:** Mount with valve cylinder vertical & upright
Valve Type	Normally Closed
Ingress Protection	IP40
Wetted Materials	**MCW:** 303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, Brass, 430FR Stainless Steel, Silicon, Glass. **MCRW:** 303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, 416 Stainless Steel, Nickel, Silicon, Glass. If your application demands a different material, please contact Cole-Parmer.

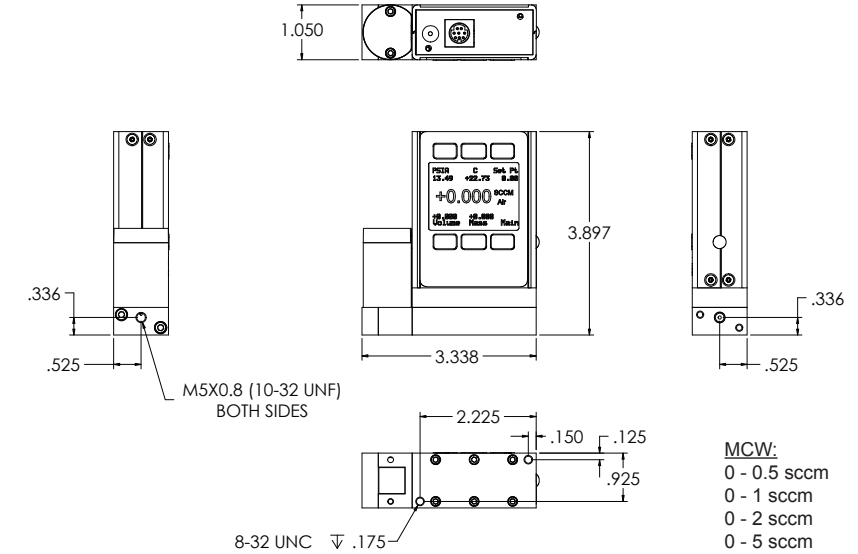
Communications / Power	MCW & MCRW Mass Flow Controller	
Monochrome LCD or Color TFT Display with integrated touchpad	Simultaneously displays Mass Flow, Volumetric Flow, Pressure and Temperature	
Digital Input/Output Signal[1] Options	RS-232	
Analog Input/Output Signal[2] Options	0-5 Vdc / 1-5 Vdc / 0-10 Vdc / 4-20 mA	
Optional Secondary Analog Input/Output Signal[2]	0-5 Vdc / 1-5 Vdc / 0-10 Vdc / 4-20 mA	
Electrical Connection Options	8 Pin Mini-DIN / 6 pin locking	
Supply Voltage	**MCW:** 12 to 30 Vdc (15-30 Vdc for 4-20 mA outputs)	**MCRW:** 24 to 30 Vdc
Supply Current	**MCW**: 0.250 Amp	**MCRW:** 0.750 Amp

1. The **Digital Output Signal** communicates Mass Flow, Volumetric Flow, Pressure and Temperature
2. The **Analog Output Signal** and **Optional Secondary Analog Output Signal** communicate your choice of Mass Flow, Volumetric Flow, Pressure or Temperature

Range Specific Specifications

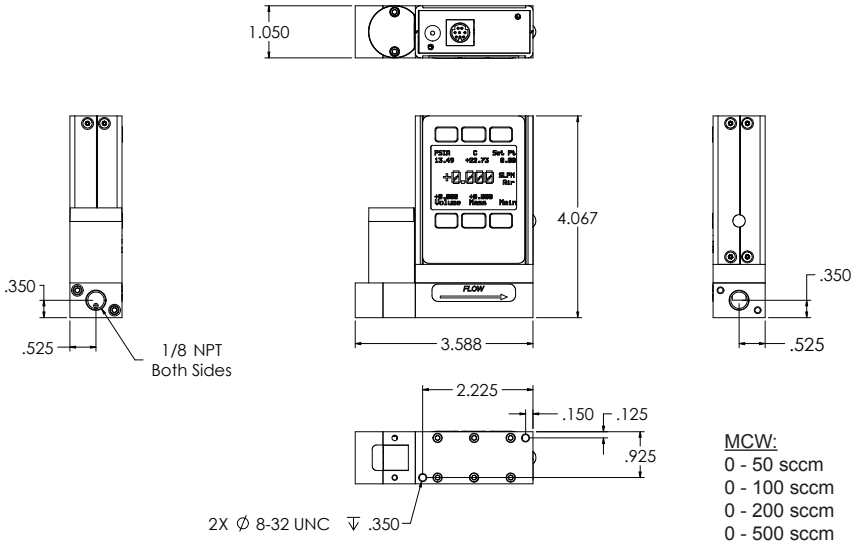
Full Scale Flow Mass Controller	Pressure Drop at FS Flow (psid) venting to atmosphere	Mechanical Dimensions	Process Connections[1]
MCW 0.5 sccm to 2 sccm	0.06	3.9”H x 3.4”W x 1.1”D	**M-5 (10-32) Female Thread**
MCW 5 sccm to 10 sccm	0.08		
MCW 20 sccm	0.07		
MCW 50 sccm to 200 sccm	0.07	4.1”H x 3.6”W x 1.1”D	1/8” NPT Female
MCW 500 sccm	0.08		
MCW 1 slpm	0.10		
MCW 2 slpm	0.18		
MCRW 5 slpm	0.10	5.5”H x 7.7”W x 2.3”D	1/4” NPT Female
MCRW 10 slpm	0.12		
MCRW 20 slpm	0.26		
MCRW 40 slpm	0.14	5.5”H x 7.7”W x 2.3”D	1/2” NPT Female
MCRW 50 slpm	0.17	5.5”H x 7.3”W x 2.3”D	3/4” NPT Female
MCRW 100 slpm	0.30		
MCRW 250 slpm	0.69		
MCRW 500 slpm	0.69	5.5”H x 8.1”W x 2.7”D	3/4” NPT Female

1. Compatible with Beswick®, Swagelok® tube, Parker®, face seal, push connect and compression adapter fittings. VCR and SAE connections upon request.



MCW:
0 - 0.5 sccm
0 - 1 sccm
0 - 2 sccm
0 - 5 sccm
0 - 10 sccm
0 - 20 sccm

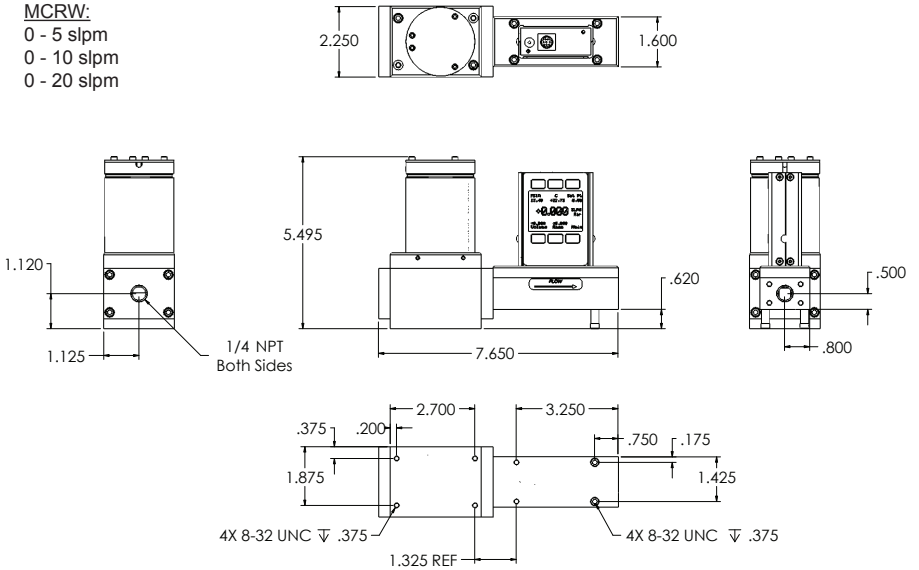
MCW 0.5 sccm to 20 sccm approximate shipping weight: 1.1 lb.



MCW:
0 - 50 sccm
0 - 100 sccm
0 - 200 sccm
0 - 500 sccm
0 - 1 slpm
0 - 2 slpm

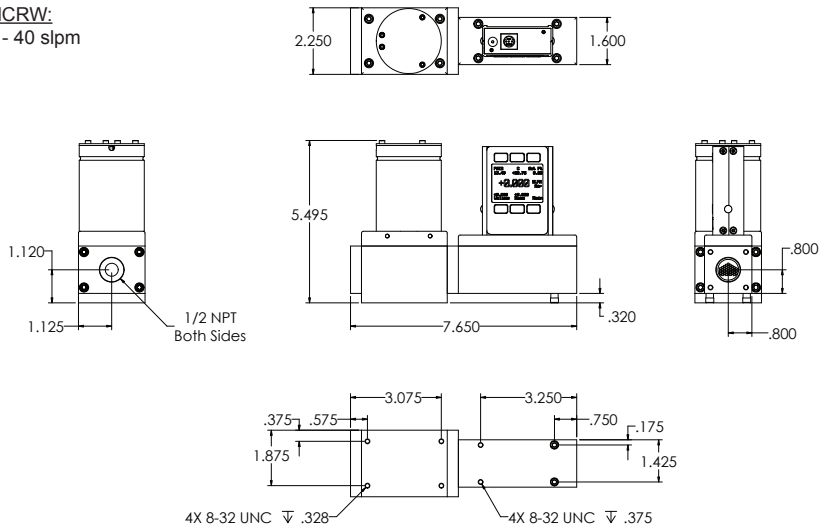
MCW 50 sccm to 2 slpm approximate weight: 1.2lb

MCRW:
0 - 5 slpm
0 - 10 slpm
0 - 20 slpm



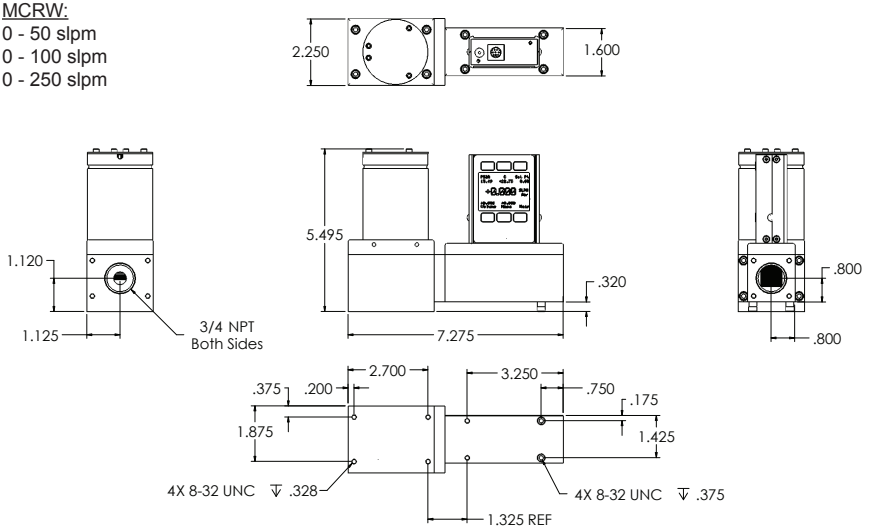
MCRW 5 slpm to 20 slpm approximate weight: 6.4 lb.

MCRW:
0 - 40 slpm



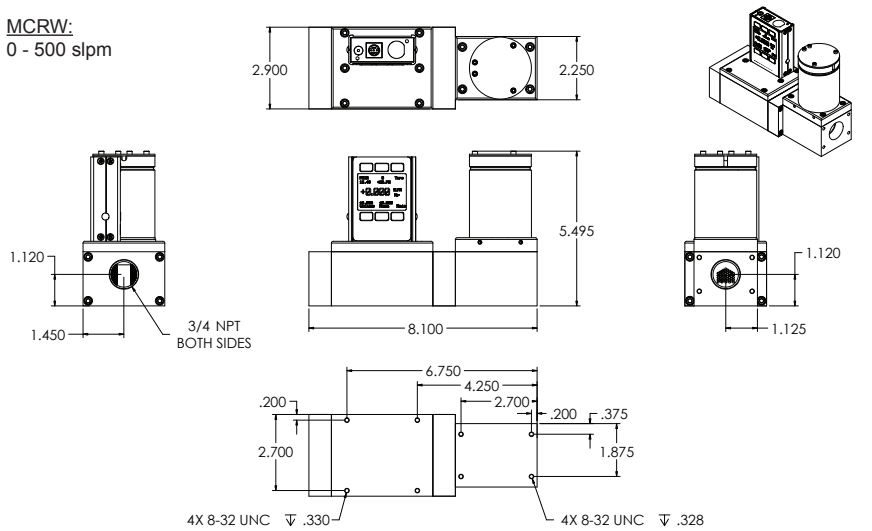
MCRW 40 slpm approximate weight: 9.0 lb.

MCRW:
0 - 50 slpm
0 - 100 slpm
0 - 250 slpm



MCRW 50 slpm to 250 slpm approximate weight: 9.0 lb.

MCRW:
0 - 500 slpm



MCRW 500 slpm approximate weight: 11.0 lb.

Technical Data for MCV & MCVS Mass Flow Controllers

0 to 0.5 sccm Full Scale through 0 to 20 slpm Full Scale

The Cole-Parmer **MCV** mass flow controller is designed for applications that require tight shut-off such as vacuum coating and sputtering processes. An integrated pneumatic shut-off valve is normally closed and provides positive shut-off of 1 x 10^{-9} atm scc/sec Helium max.
MCVS controllers are for use with aggressive gases.

Standard Specifications (Contact Cole-Parmer for available options.)

Performance	MCV Mass Flow Controller	MCVS Mass Flow Controller
Accuracy at calibration conditions after tare	± (0.8% of Reading + 0.2% of Full Scale)	
High Accuracy at calibration conditions after tare	± (0.4% of Reading + 0.2% of Full Scale) High Accuracy option not available for units ranged under 5 sccm.	
Repeatability	± 0.2% Full Scale	
Zero Shift and Span Shift	0.02% Full Scale / °Celsius / Atm	
Operating Range / Turndown Ratio	0.5% to 100% Full Scale / 200:1 Turndown	1% to 100% Full Scale / 100:1 Turndown
Maximum Controllable Flow Rate	102.4% Full Scale	
Typical Response Time	100 ms (Adjustable)	
Warm-up Time	< 1 Second	
Integrated Valve Leak Integrity	1 x 10^{-9} atm scc/sec Helium max	

Operating Conditions	MCV Mass Flow Controller	MCVS Mass Flow Controller
Mass Reference Conditions (STP)	25ºC & 14.696 psia (standard — others available on request)	
Operating Temperature	−10 to +50 ºCelsius	
Humidity Range (Non–Condensing)	0 to 100%	
Maximum Pressure	145 psig	
Mounting Attitude Sensitivity	None	
Valve Type	Normally Closed	
Ingress Protection	IP40	
Wetted Materials	**MCV:** 316L,303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, Brass, 430FR Stainless Steel, Silicon, Glass, PCTFE. **MCVS:** 316LSS, 303SS, 430FRSS, FFKM (Kalrez) standard, Viton, EPDM, Buna, Neoprene as needed for some gases. If your application demands a different material, please contact Cole-Parmer.	

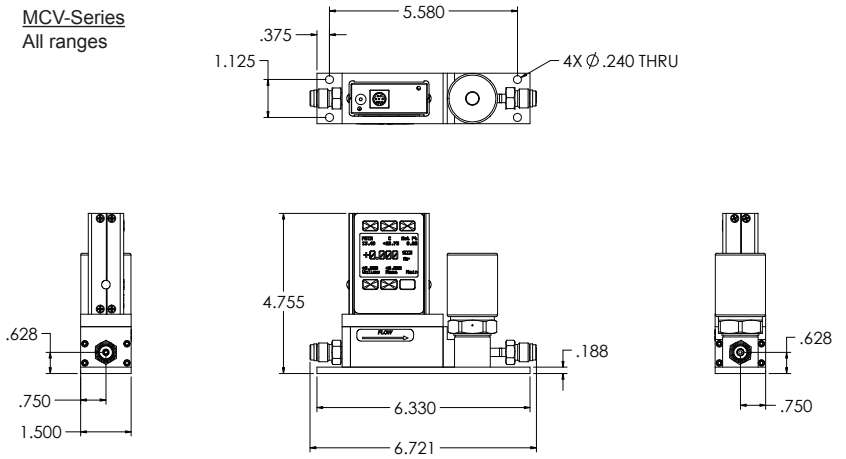
Communications / Power	MCV & MCVS Mass Flow Controller
Monochrome LCD or Color TFT Display with integrated touchpad	Simultaneously displays Mass Flow, Volumetric Flow, Pressure and Temperature
Digital Input/Output Signal[1] Options	RS-232
Analog Input/Output Signal[2] Options	0-5 Vdc / 1-5 Vdc / 0-10 Vdc / 4-20 mA
Optional Secondary Analog Input/Output Signal[2]	0-5 Vdc / 1-5 Vdc / 0-10 Vdc / 4-20 mA
Electrical Connection Options	8 Pin Mini-DIN / 6 pin locking
Supply Voltage	12 to 30 Vdc (15-30 Vdc for 4-20 mA outputs)
Supply Current	0.250 Amp

1. The **Digital Output Signal** communicates Mass Flow, Volumetric Flow, Pressure and Temperature
2. The **Analog Output Signal** and **Optional Secondary Analog Output Signal** communicate your choice of Mass Flow, Volumetric Flow, Pressure or Temperature

Range Specific Specifications

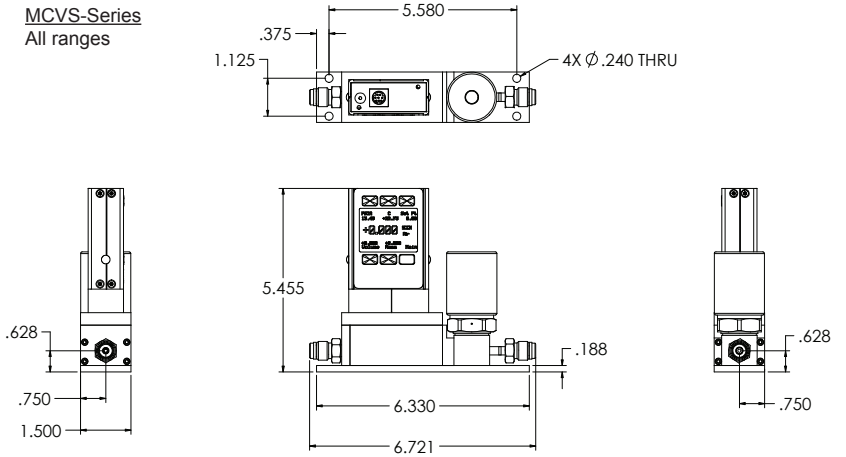
Full Scale Mass Flow Controller	Mechanical Dimensions	Process Connections
MCV 0.5SCCM to 20SLPM	4.8”H x 6.8”W x 1.5”D	1/4” VCR® Male
MCVS 0.5SCCM to 20SLPM	5.5”H x 6.8”W x 1.5”D	1/4” VCR® Male
Welded VCR® process connections are recommended for MCV and MCVS applications. Please contact Cole-Parmer.		

MCV-Series
All ranges



MCV approximate weight: 3.0 lb.

MCVS-Series
All ranges



MCVS approximate weight: 3.2 lb.

Technical Data for MCP Moderate Flow Mass Flow Controllers
0 to 50 slpm Full Scale through 0 to 250 slpm Full Scale

Cole-Parmer **MCP** mass flow controllers are fitted with a high performance valve for low pressure applications. The following specifications are applicable to MCP-Series Mass Flow Controllers only. **Please Note Maximum Pressure of 80 psig.**

Standard Operating Specifications (Contact Cole-Parmer for available options)

Performance	MCP Mass Flow Controller
Accuracy at calibration conditions after tare	± (0.8% of Reading + 0.2% of Full Scale)
High Accuracy at calibration conditions after tare	± (0.4% of Reading + 0.2% of Full Scale)
Repeatability	± 0.2% Full Scale
Zero Shift and Span Shift	0.02% Full Scale / ºCelsius / Atm
Operating Range / Turndown Ratio	0.5% to 100% Full Scale / 200:1 Turndown
Maximum Controllable Flow Rate	102.4% Full Scale
Typical Response Time	100 ms (Adjustable)
Warm-up Time	< 1 Second

Operating Conditions	MCP Mass Flow Controller
Mass Reference Conditions (STP)	25ºC & 14.696 psia (standard — others available on request)
Operating Temperature	−10 to +50 ºCelsius
Humidity Range (Non–Condensing)	0 to 100%
Maximum Pressure	80 psig
Mounting Attitude Sensitivity	None
Valve Type	Normally Closed
Ingress Protection	IP40
Wetted Materials	303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, Brass, 410 &416 Stainless Steel. If your application demands a different material, please contact Cole-Parmer.

Communications / Power	MCP Mass Flow Controller
Monochrome LCD or Color TFT Display with integrated touchpad	Simultaneously displays Mass Flow, Volumetric Flow, Pressure and Temperature
Digital Input/Output Signal[1] Options	RS-232
Analog Input/Output Signal[2] Options	0-5 Vdc / 1-5 Vdc / 0-10 Vdc / 4-20 mA
Optional Secondary Analog Input/Output Signal[2]	0-5 Vdc / 1-5 Vdc / 0-10 Vdc / 4-20 mA
Electrical Connection Options	8 Pin Mini-DIN 6 pin locking
Supply Voltage	12 to 30 Vdc (15-30 Vdc for 4-20 mA outputs)
Supply Current	0.250 Amp

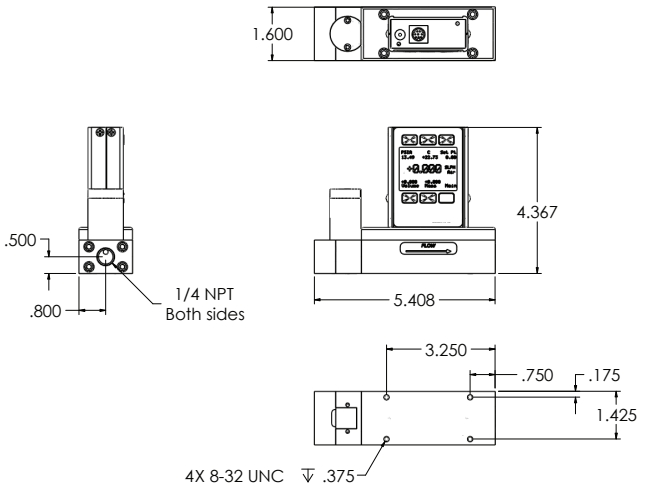
1. The **Digital Output Signal** communicates Mass Flow, Volumetric Flow, Pressure and Temperature
2. The **Analog Output Signal** and **Optional Secondary Analog Output Signal** communicate your choice of Mass Flow, Volumetric Flow, Pressure or Temperature

Range Specific Specifications

Full Scale Flow Mass Controller	Pressure Drop[1] at FS Flow (psid) venting to atmosphere	Mechanical Dimensions	Process Connections[2]
MCP 50 slpm	7	4.4"H x 5.4"W x 1.6"D	1/4" NPT Female
MCP 100 slpm	20		
MCP 250 slpm	60	5.0"H x 6.3"W x 1.6"D	1/2" NPT Female

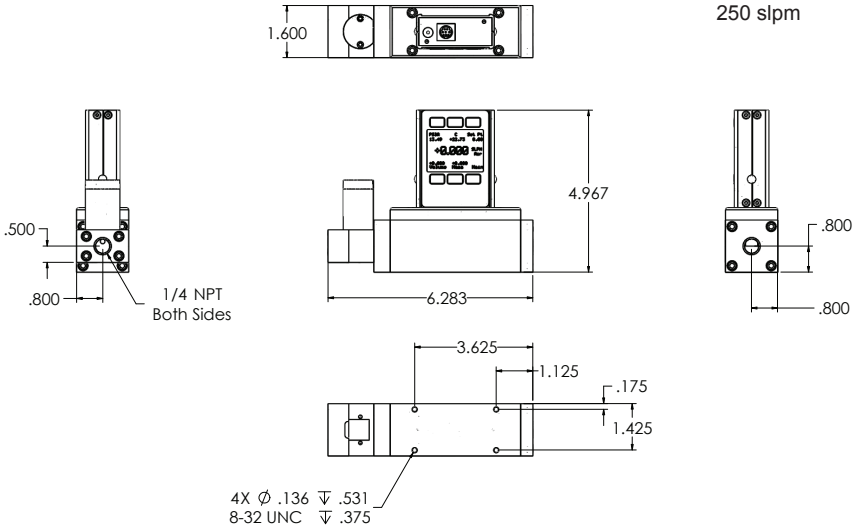
1. Lower Pressure Drops Available, please see our **MCW-Series** mass flow controllers.
2. Compatible with Beswick®, Swagelok® tube, Parker®, face seal, push connect and compression adapter fittings. VCR and SAE connections upon request.

MCP-Series:
50 slpm
100 slpm



10 slpm to 50 slpm approximate shipping weight: 3.0 lb.

MCP-Series:
250 slpm



100 slpm to 250 slpm approximate shipping weight: 4.4 lb.

Technical Data for MCS and MCRS-Series Mass Flow Controllers

Cole-Parmer MCS and MCRS instruments are built for use with aggressive gases. For the most part, these instruments maintain the specifications of equivalently ranged MC and MCR-Series devices.

Standard Compatible Gas List for MCS and MCRS Controllers

0	Air	Air
1	Argon	Ar
2	Methane	CH4
3	Carbon Monoxide	CO
4	Carbon Dioxide	CO2
5	Ethane	C2H6
6	Hydrogen	H2
7	Helium	He
8	Nitrogen	N2
9	Nitrous Oxide	N2O
10	Neon	Ne
11	Oxygen	O2
12	Propane	C3H8
13	normal-Butane	n-C4H10
14	Acetylene	C2H2
15	Ethylene	C2H4
16	iso-Butane	i-C4H10
17	Krypton	Kr
18	Xenon	Xe
19	Sulfur Hexafluoride	SF6
20	75%Ar / 25% CO2	C-25
21	90% Ar / 10% CO2	C-10
22	92% Ar / 8% CO2	C-8
23	98% Ar / 2% CO2	C-2
24	75% CO2 / 25% Ar	C-75
25	75% Ar / 25% He	HE-75
26	75% He / 25% Ar	HE-25
27	90% He / 7.5% Ar / 2.5% CO2 Helistar® A1025	A1025
28	90% Ar / 8% CO2 / 2% O2 Stargon® CS	Star29
29	95% Ar / 5% CH4	P-5
30	Nitric Oxide	NO
31	Nitrogen Triflouride	NF3
32	Ammonia	NH3
34	Hydrogen Sulfide	H2S
36	Propylene	C3H6
In addition, the following gases are available upon request:		
Nitrogen Dioxide to 0.5% in an inert carrier		NO2
Refrigerant gases to 100%		
Other gases to 1000 ppm in an inert carrier		

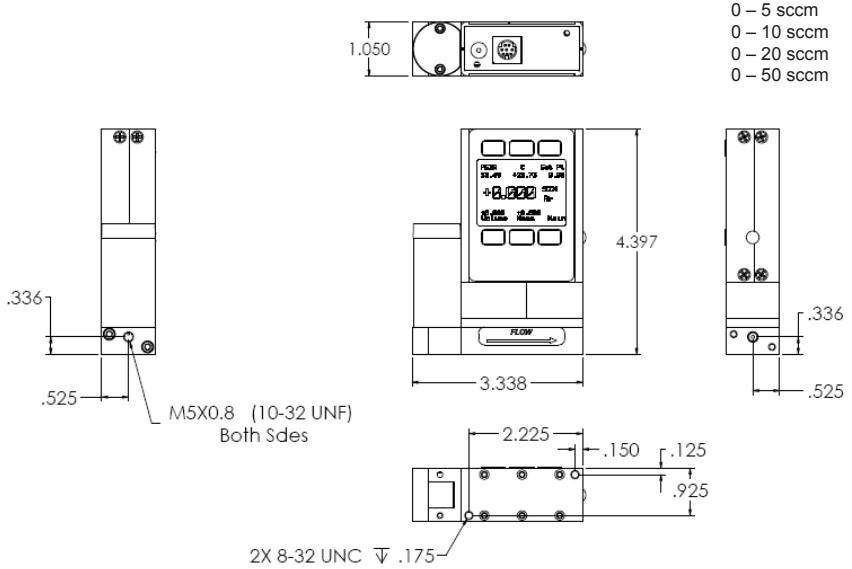
If your application requires another gas or gas mixture, please contact Cole-Parmer.

Please refer to Cole-Parmer's Technical Data and Specifications for the equivalently ranged MC and MCR-Series instrument for all operating specifications except:

Operating Range	1% to 100% Full Scale
Turndown Ratio	100 : 1
Wetted Materials	316LSS, 303SS, 430FRSS, FFKM (Kalrez) standard, Viton, EPDM as needed for some gases.

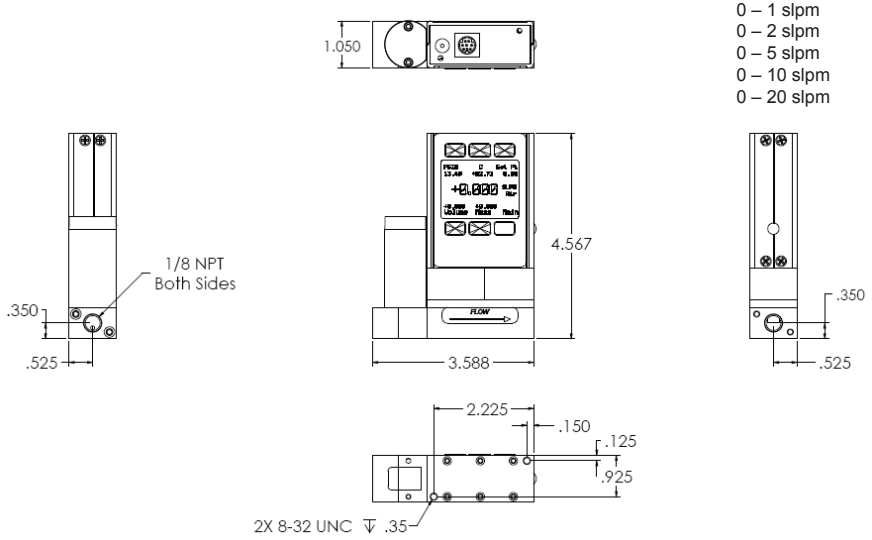
The dimensions of MCS and MCRS instruments may vary from their standard MC and MCR-Series counterparts. Dimensional drawings for MCS and MCRS instruments are shown on pages 68 -71

MCS-Series:
0 – 0.5 sccm
0 – 1 sccm
0 – 2 sccm
0 – 5 sccm
0 – 10 sccm
0 – 20 sccm
0 – 50 sccm



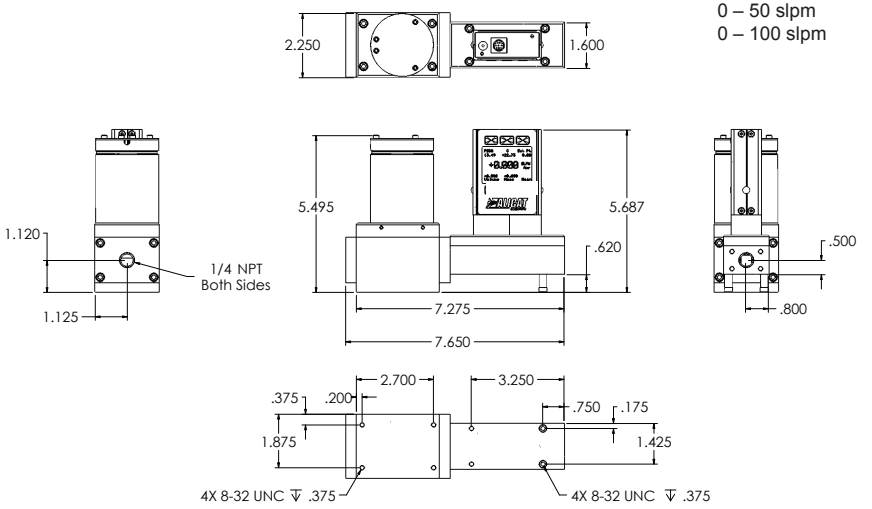
0.5 sccm to 50 sccm approximate shipping weight: 1.1 lb.

MCS-Series:
0 – 100 sccm
0 – 200 sccm
0 – 500 sccm
0 – 1 slpm
0 – 2 slpm
0 – 5 slpm
0 – 10 slpm
0 – 20 slpm



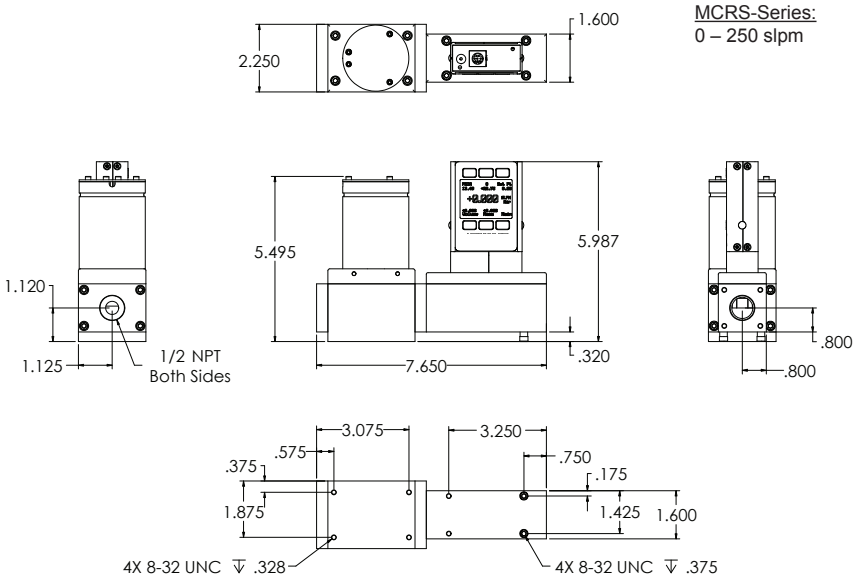
100 sccm to 20 slpm approximate weight: 1.2 lb

MCRS-Series:
0 – 50 slpm
0 – 100 slpm



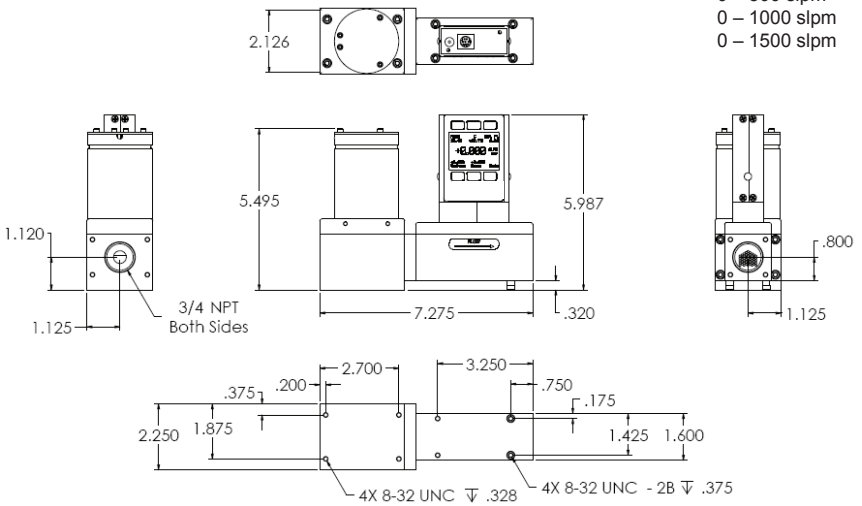
MCRS 50 slpm to 100 slpm approximate weight: 9.0 lb.

MCRS-Series:
0 – 250 slpm



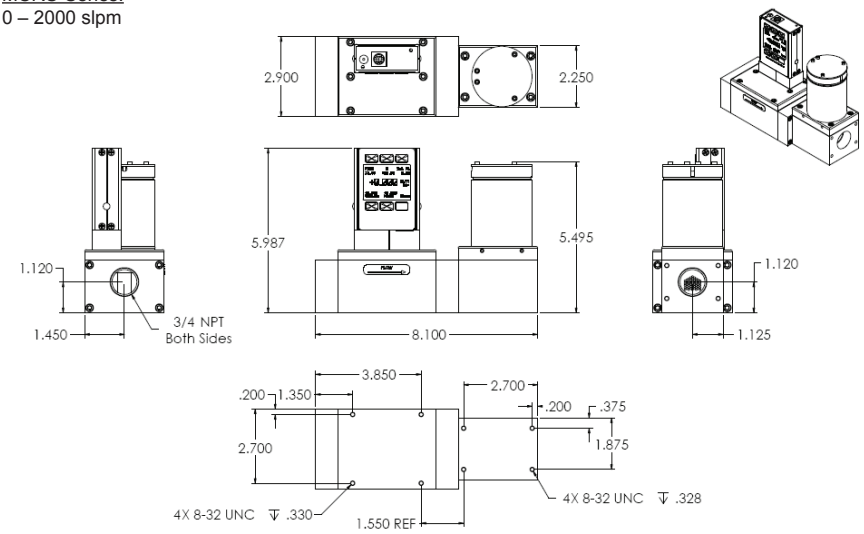
MCRS 250 slpm approximate weight: 9.0 lb.

MCRS-Series:
0 – 500 slpm
0 – 1000 slpm
0 – 1500 slpm



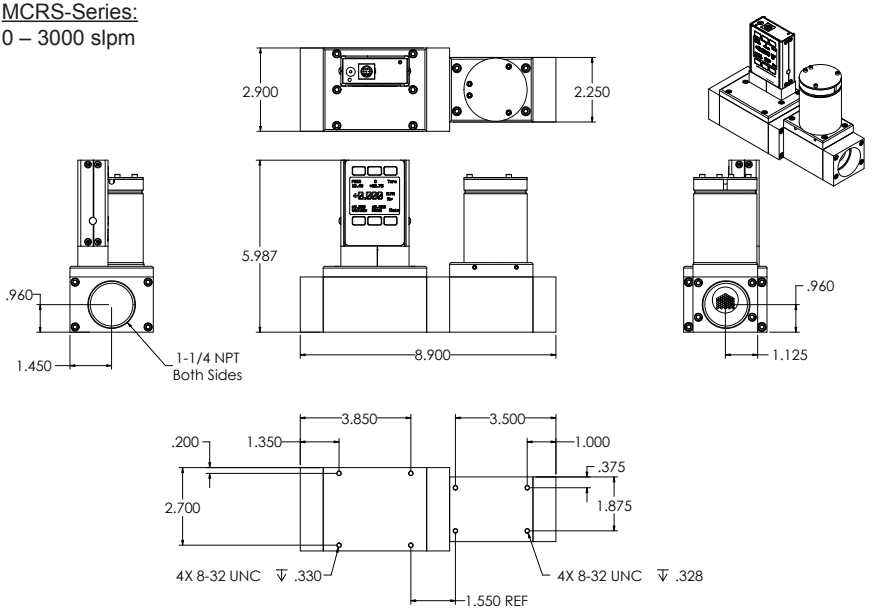
MCRS 500 slpm to 1500 slpm approximate weight: 9.0 lb.

MCRS-Series:
0 – 2000 slpm



MCRS 2000 slpm approximate weight: 12.0 lb.

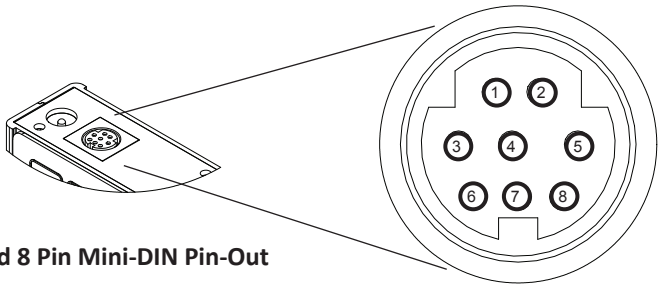
MCRS-Series:
0 – 3000 slpm



MCRS 3000 slpm approximate weight: 12.0 lb.

Eight Pin Mini-DIN Connector Pin-Outs

If your instrument was ordered with the standard Eight Pin Mini-DIN connection, please be sure to reference the following pin-out diagram.

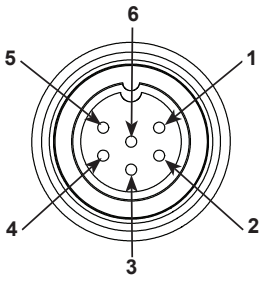


Standard 8 Pin Mini-DIN Pin-Out

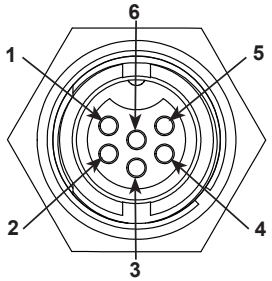
Pin	Function	Mini-DIN cable color
1	Inactive (or optional 4-20mA Primary Output Signal)	Black
2	Static 5.12 Vdc [or optional Secondary Analog Output (4-20mA, 5Vdc, 10Vdc) or Basic Alarm]	Brown
3	Serial RS-232RX (receive) Input Signal	Red
4	Meters/Gauges = Remote Tare (Ground to Tare) Controllers = Analog Set-Point Input	Orange
5	Serial RS-232TX (send) Output Signal	Yellow
6	0-5 Vdc (or optional 0-10 Vdc) Output Signal	Green
7	Power In (as described above)	Blue
8	Ground (common for power, digital communications, analog signals and alarms)	Purple
Note: The above pin-out is applicable to all the flow meters and controllers with the Mini-DIN connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.		

Locking Industrial Connector Pin-Outs

If your instrument was ordered with a Six Pin Locking Industrial connection, please be sure to reference the following pin-out diagram.



Male Connector: Cable



Female Connector: Device

Pin	Function
1	Power In (+)
2	RS-232TX
3	RS-232RX
4	Meters/Gauges = Remote Tare (Ground to Tare) Controllers = Analog Set-Point Input
5	Ground (common for power, communications and signals)
6	Signal Out (Voltage or Current as ordered)

The above pin-out is applicable to all the flow meters and controllers ordered with the industrial connector. The availability of different output signals depends on the flow meter options ordered.

The locking industrial connector is standard on all CSA/ATEX approved devices.

Additional Information for CSA and ATEX Approved Devices

See the following page for Special Conditions regarding the use of these units!

CE Ex II 3 G

C SA® US

EEx nA IIC T4

Class I, Div. 2 Group A, B, C and D T4

24 Vdc, 0.800A max

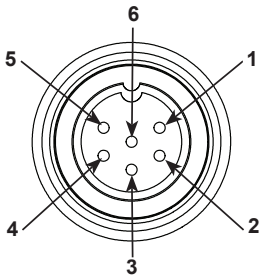
Class I, Zone 2 AEx nA IIC T4

WARNINGS:

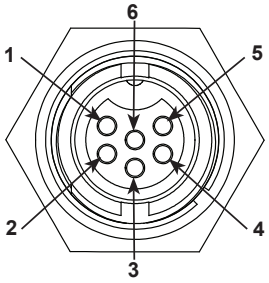
EXPLOSION HAZARD – DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS.

EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.

All CSA / ATEX approved devices are equipped with a locking 6 pin industrial connector. The power and signal connections are shown below.

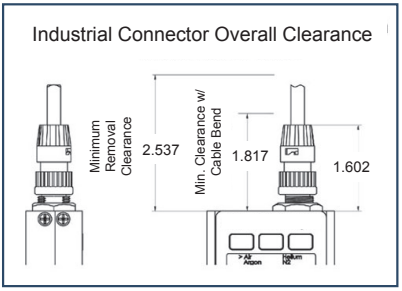


Male Connector: Cable



Female Connector: Device

Pin	Function
1	Power In (+)
2	RS-232TX
3	RS-232RX
4	Remote Tare Meters (Ground to Tare) Analog Set-Point Input (Controllers)
5	Ground (common for power, communications and signals)
6	Signal Out (Voltage or Current as ordered)



Clearance Requirements for Industrial Connector

USE of instruments (M, MW, MS, MC, MCW, MCS, MCR, MCRW, MCRS, P, PS, PC, PCS, PCR and PCRS product families only) in Class 1 Division 2 applications.

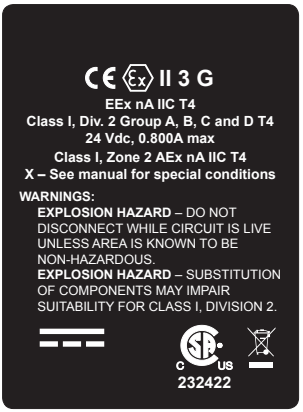
CSA certifies the use of this product for general use as well as use in hazardous locations as defined by Class 1 Division 2 Group A, B, C and D T4.

CSA certification is indicated by the product label as shown below and not by the statements in this, or any accompanying documentation.

Special Conditions:

To comply with CSA certification the following information is included in the product literature:

- When equipment is properly labeled, it is suitable in Class I, Division 2, Group A, B, C and D, T4
  - Tamb. -40°C to +50°C
- Electrical Rating 24Vdc, 0.800A max
- Instruments shall be powered by a CSA certified, UL listed, Class II external power supply suitable for the application
- Instruments shall be housed in an enclosure with a minimum IP54 rating or location providing equivalent protection
- Instrument's final approval shall be provided by the local authority having jurisdiction



USE of instruments (M, MS, MC, MCS, MCR, MCRS, P, PS, PC, PCS, PCR and PCRS product families only) in applications requiring ATEX Certification.

Properly labeled instruments comply to the following ATEX standard:

II 3 G EEx nA IIC T4 (-40°C ≤ Ta ≤ +50°C)

The examination certificate was issued by the CSA in accordance with accepted practices and procedures. This confirms compliance with the European ATEX Directive or Group II Category 3G equipment.

ATEX certification is indicated by the product label as shown above and not by the statements in this, or any accompanying documentation.

Special Conditions:

- Properly labeled equipment is only certified for use in ambient temperatures in the range of -40°C to +50°C only
- Electrical Rating 24Vdc, 0.800A max
- Instruments shall be powered by a CSA certified, UL listed, Class II external power supply suitable for the application
- Instruments shall be housed in an enclosure with a minimum IP54 rating or location providing equivalent protection
- Instrument's final approval shall be provided by the local authority having jurisdiction

Serial Number: _____

Model Number: _____