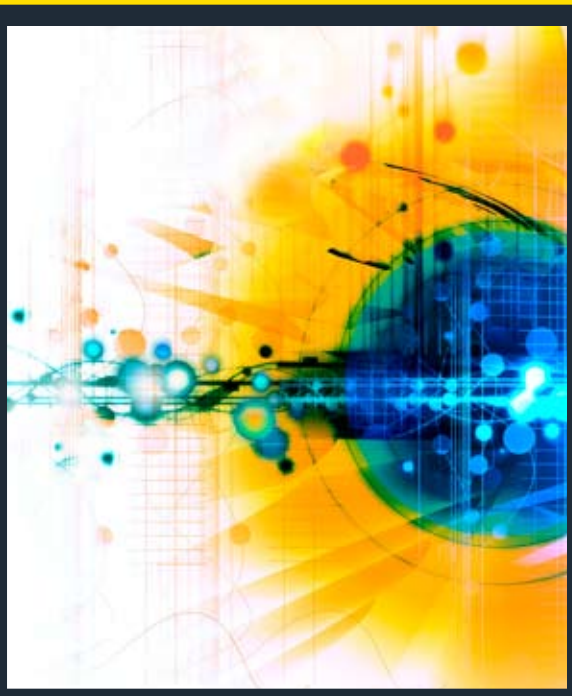
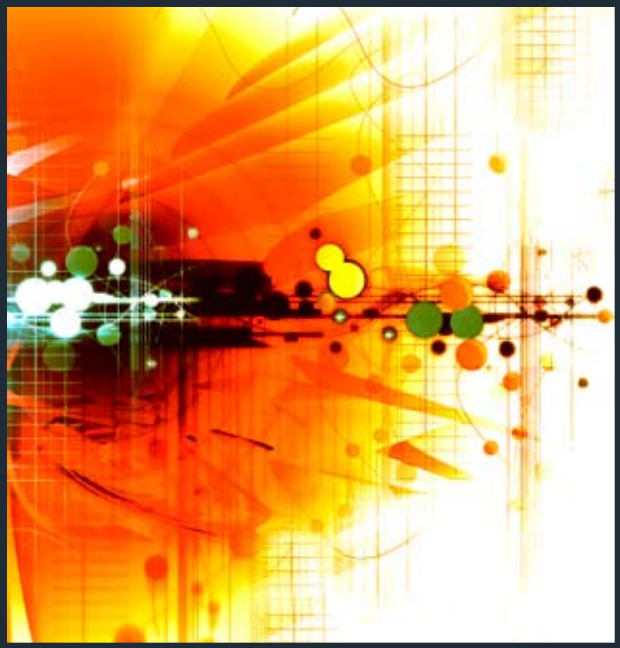
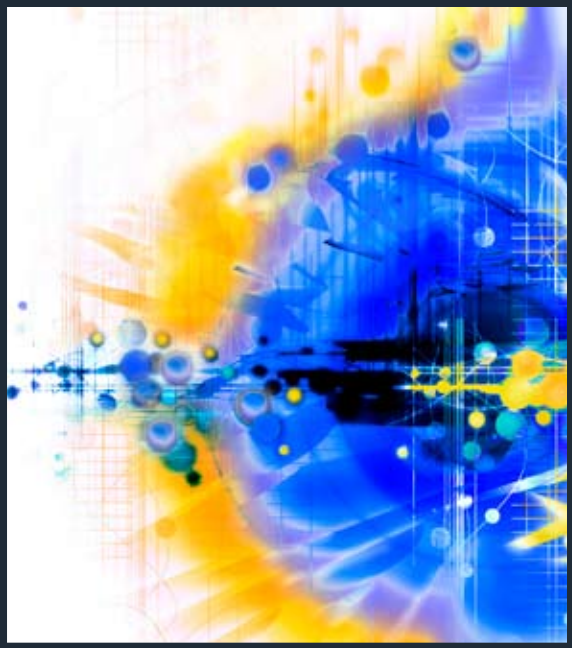
Alicat Scientific







COMPLETE PRODUCT & TECHNICAL GUIDE

Have You Considered Cost of Ownership?

Before purchasing anything, you need to be concerned about the cost of ownership along with the cost of the product itself.

If two different MFCs from two different manufacturers have similar technological attributes, you might be persuaded to purchase the less expensive of the two. But is that always the right choice? ***How long do you expect to use the product and how much support will it require to maintain?***

At Alicat, all we ask is that you consider the whole package before making a decision.

Alicat products are affordable ***with quick delivery*** ***(2 weeks or less)***. We are well known for our ***excellent technical support***. But you may not be aware of our ***low cost recalibration and short turnaround*** ***(repairs usually shipped within 3-5 days of receipt)***. How much will that save you over the life of your instrument? Combine that with unparalleled standard features and you have an impressive package.

And we back our products with the industry's first lifetime warranty!

Call us today, we'll help you choose the device that will work for you now and into the future.

Alicat Scientific, Inc.'s Wide-Range Laminar Flow Element Patent:
The wide-range laminar flow element and products using the wide-range laminar flow element are covered by U.S. Patent Number: 5,511,416. Manufacture or use of the wide-range laminar flow element in products other than Alicat Scientific products or other products licensed under such patents will be deemed an infringement.

NIST All Alicat products are calibrated with NIST traceable certification.

CE Alicat products in compliance with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC (including 93/68/EEC) carry the CE Mark.

Alicat Scientific, Inc.
7641 N Business Park Drive
Tucson AZ 85743 USA

Alicat Scientific, Inc. is ISO 9001:2000 certified.

tel. 888. 290. 6060
fax. 520. 290. 0109
www.AlicatScientific.com

What's New at Alicat?

ATEX & CSA CLASS 1 DIVISION 2

Alicat has attained ATEX and CSA approval for the use of our Mass Flow Meters, Mass Flow Controllers and Pressure Equipment in Class 1 Division 2 hazardous environments for Europe, Canada and the United States.
See page 42.

LYNX™

Coming late 2009, Alicat's new line of Lynx™ instruments.
Featuring:

- **High Accuracy: +/- (0.4% of Reading + 0.15% of Full Scale)**
- **Available Ranges: 5 SCCM to 10 SLPM**
- **Color LCD display**
- **And much more!**

MORE COMMUNICATION OPTIONS

You can now order any Alicat instrument with PROFIBUS DP-V1 compatible communications!

RS-485 is also available as an option for all standard devices!

DeviceNet: coming soon!

See pages 9 and 10.

FLOW VISION™ SC

Now, get even more functionality out of your Alicat equipment with Flow Vision™ SC.
Flow Vision™ SC makes automating and monitoring your flow and pressure applications easier and more effective than ever!
See page 11.

MODEL MCV *MASS FLOW CONTROLLER FOR THE VACUUM COATING INDUSTRY*

Our model MCV mass flow controller is built for applications that require tight shut-off such as vacuum coating and sputtering processes.

An integrated pneumatic shut-off valve provides positive shut-off of 1 x 10^{-9} atm sccm/sec Helium max. **See page 23.**

4000 SLPM MASS FLOW METER and 4000 SLPM MASS FLOW CONTROLLERS

Alicat's versatile 16 Series mass flow meters and controllers are now available in a 4000 SLPM full scale range.
See pages 12 and 20.

Innovative Flow and Pressure Solutions

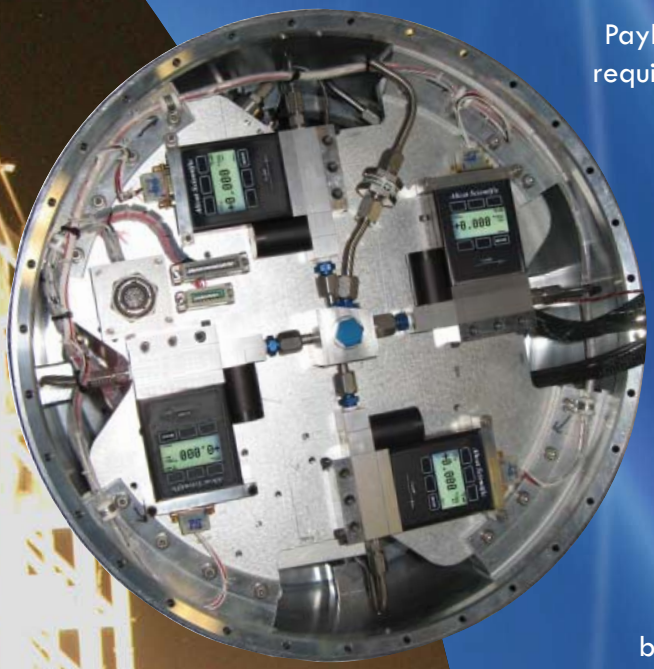
Alicat Scientific™

Alicat Scientific, Inc.
7641 N Business Park Drive
Tucson, AZ 85743 USA
Phone: 888 290 6060
Fax: 520 290 0109

Alicat Scientific

SMALL DEVICES FOR BIG PROJECTS!

NASA Payload Attitude Control System Uses Alicat Pressure Controllers



Payload sections of some NASA rockets are required to achieve pointing accuracies finer than one arc second (1/3600 degree). Conventional attitude control systems introduce too much shock and vibration to be used with delicate instruments.

Alicat Scientific was asked to help solve this problem. The solution utilizes modified Alicat PC Series absolute pressure controllers to directly feed the attitude control jets. Alicat's standard multi-drop RS-232 is used to send set-point commands to the controllers.

The spacecraft's attitude is adjusted by modulating the pressure commands to the controllers. Pressures can be changed in increments as small as 0.00234 PSI or as large as 150 PSI.

Crucial to the success of the system is the speedy response of the Alicat instruments. NASA tests showed that the controllers accurately track a 5 Hz sign wave – a response faster than 32 mS.

The controllers also passed NASA testing for vibration, shock, thermal cycling and exposure to vacuum.

The first flight took place in June 2007. The controllers performed perfectly.

For more about Alicat Pressure Measurement and Control Instruments turn to pages 29 to 35.

Alicat's PC Series Pressure Controller

www.AlicatScientific.com

Contents

ALICAT TECHNOLOGY

Alicat Laminar Mass Flow devices address many of the drawbacks to classic orifice plate type volumetric flow measurement as a basis for mass flow calculations.

They also address limitations of thermal flow technology in regards to hot-wire drift, micro-flow calculations and response time.

Alicat mass flow meters and mass flow controllers operate on the same principles as many larger, laminar transfer standards, but in a small, easily integrated package.

Theory of Operation: Volumetric Flow Base

The operating principle of the volumetric unit is based on the physics of the Poiseuille Equation (Equation 1). The Poiseuille Equation quantifies the relationship between pressure drop and flow.

In its simplified form (Equation 2), K is a constant factor determined by the geometry of the restriction.

It shows the linear relationship between volumetric flow rate (Q), differential pressure (ΔP), and absolute viscosity (η).

Equation 1: $Q = (P_1 - P_2)\pi r^4/8\eta L$

Where:
Q = Volumetric Flow Rate
P_1 = Static Pressure at Inlet
P_2 = Static Pressure at Outlet
r = Hydraulic Radius of Restriction
η = (eta) Absolute Viscosity of Fluid
L = Length of Restriction

Equation 2: $Q = K(\Delta P/\eta)$

Where:
K = constant dependent upon the geometry of the LFE.

To use the Poiseuille Equation, an internal restriction is created. This restriction is known as a Laminar Flow Element (LFE), represented by r and L in Equation 1.

The LFE forces the gas molecules to move in parallel paths along the length of the passage, eliminating flow turbulence and creating a state of laminar gas flow beneath the Reynolds threshold of 2000. (The Reynolds number of 2000 is commonly accepted as the theoretical threshold. This number will vary depending on surface characteristics.)

Next the differential pressure drop is measured within the laminar region.

Finally, the viscosity of the gas (η) must be determined as affected by gas temperature.

This procedure is performed internally by the microprocessor.

Theory of Operation: Mass Flow Conversion

Alicat mass flow devices start with the volumetric flow rate calculation as previously described. Additional measurements and calculations are incorporated to determine the actual mass flow rate of the gas.

Ideal gas laws show us that the density of a gas is affected by its temperature and absolute pressure.

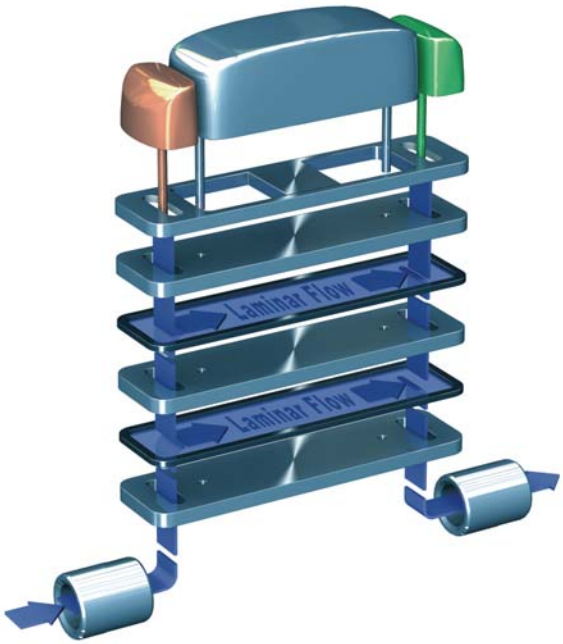
Using ideal gas laws requires a reference to a standard temperature and pressure (STP) condition for “normalizing” the mass flow calculation.

Essentially this is a determination of the density of the gas at sea level and a predetermined temperature as related to the actual flow conditions.

In order to determine the mass flow rate, two correction factors must be applied to volumetric flow rate: temperature effect on density and absolute pressure effect on density (Equation 3).

Equation 3: $M = Q(T_s / T_a)(P_a / P_s)$

Where:
M= Mass Flow
Q = Volumetric Flow (From Equation 2)
T_s = Absolute Temperature @ Standard Condition in Kelvin
T_a = Absolute Temperature @ Flow Condition in Kelvin
P_a = Flow Absolute Pressure
P_s = Absolute Pressure @ Standard Condition



In an Alicat mass flow instrument, a discrete absolute pressure sensor and a temperature sensor are placed in the laminar region of the flow stream.

The sensors send information to the microprocessor which determines mass flow.

A series of calculations is performed and flow rate data is updated an average of 1,200 times/second.

This allows for extremely fast, real time measurements of flow that are sensitive enough to report pulsations in flow, as well as step changes.

ADVANTAGES & BENEFITS

Warm-Up Time
Less than one second, ready in an instant!

Speed of Response & Control
10 milliseconds to read! 100 milliseconds to control!

Gas Select™
You can use your device with any of 30 precalibrated gases from the gas select menu on the display or via RS-232 communication. You no longer need to purchase a different meter for each gas (page 8).

Dynamic Digital Display w/ Push Button Interface
All Alicat instruments include a display with a push button membrane switch. All process parameters that the device measures can be viewed on the main display. A mode button allows you to move from screen to screen to set control data, select gas type or view and reset the optional totalizer.

Stand Alone "Smart" Devices
Once an Alicat controller is powered, the control functions can be actuated through the membrane buttons and display screen. No input signal is required. The controller will hold a set-point and control at a given flow rate or pressure until the set-point is changed or power lost. The set-point is maintained even after a power outage and reboot.

Programmable Geometric Running Average
Because the instrument's response time – 10ms or less in some instances – may be too fast, we provide an averaging function to help smooth the signal output for applications such as data recording and trending.

Field Adjustable PID Loop Tuning
All controllers have a field adjustable PID loop which can be tuned via the push button interface on the display, or via RS-232 communication. You have the ability to adjust the tuning to exactly match your process requirements.

Multiple Analog Outputs
All Alicat instruments have both an analog output and RS-232 input/output. An optional second analog output is available that can be used for any parameter that meter is measuring (page 9).

Tare Function: Automatic, Push Button or Remote
All flow meters with display include a push button tare you can use to zero the meter when no flow is present. On controllers, the tare is automatic when the set-point is at zero for longer than two seconds. A remote tare (ground to tare) is also included for meters in integrated applications.

Mass Flow Controllers can Control Absolute Pressure or Volumetric Flow
Field selectable loop closure allows a mass flow controller to control absolute pressure or volumetric flow rate. This saves in component and design costs, as the mass controller can be used as a pressure controller that also provides information on the actual mass and volumetric flow rates.

Customization
Alicat is well known for its ability to modify our core products to fit a customer's needs. This includes special engineering, units of measure, different body materials, end fittings, special gas mixtures, alarm output drivers and more.

Please, don't be afraid to ask if you don't see it! See page 46 for more ideas.

Technology Comparison

SPECIFICATION	ALICAT PRODUCTS	COMPETITOR PRODUCTS
Sensor	Solid-State Silicon Based Differential Pressure (allows nearly instantaneous response times)	RTD or Thermocouple
Response Speed	10 milliseconds (time constant) (no software corrections required—reduces over & undershooting of flow)	0.5-3.0 seconds (no software), 500 milliseconds (software corrections predict flow)
Display	Standard, Integrated (no extra cost for stand alone abilities)	Optional if available, External Mount
Warm-up Time	< 1 Second (cycle times can be reduced)	8—30 minutes
Totalizer	Optional, Integrated (maintain stand alone functionality) or Remote	Optional if available, External Mount
Process Data	Integrated Display shows Mass Flow Rate, Volumetric Flow Rate, Line Temperature and Line Absolute Pressure (reduce system components)	Mass flow rate
Output Options	Standard integrated display, analog (either 0-5 Vdc, 0-10 Vdc, 1-5 Vdc, or 4-20mA), and Standard RS-232 (no special software required) Optional 2nd analog output for volumetric flow, temperature, or absolute pressure. (reduce system components & save integration time)	Standard analog, optional display if available, optional digital output if available
Digital Output	Standard output includes mass flow rate volumetric flow rate, line temperature, line absolute pressure, selected gas, AND total if ordered with Totalizer option. Muti-drop RS-232 standard. (standard features reduce costs for everyone)	Digital output of mass flow if available. Multi-drop not available
Power	7-30 Vdc, 35mA. Standard AC/DC adapter jack AND cable connector pins. Can run off anything from a standard 9 Volt battery to 12 or 24 volt systems. (reduce current & power draw)	Special supply with + and – regulated 15 Vdc Higher supply current required
Fittings	Standard NPT or miniature fittings. Optional SAE, BSPP, etc threads available. (inexpensive, adaptable to common components)	Specialized Swagelok®, VCR, etc.
Multi-Gas Versatility	Gas Select™ Standard 30+ gas select menu from integrated display. (reduce inventory requirements with 1 off the shelf device)	Single gas, conversion charts
Inherent Linearity	Yes	No
Documentation	Integrated display with model number, serial number, date of manufacture, calibration technician, and software revision number. Identification label also standard. (device info is always with the device)	On paper included with unit, sticker
Flow Ranges	Ranges available from full scales of 0.5 standard ml/minute to full scales of 1500 standard liters/min. (cover every required flow range with one manufacturer)	Ranges available from 10 ml/minute to 50 standard liters/min full scale.

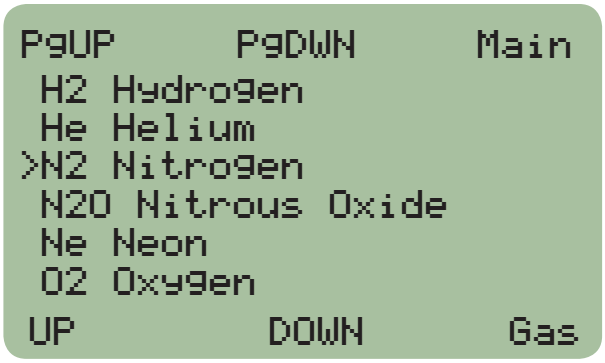
Suitable Applications

As part of our mission, we strive to provide the correct instrument for every application. Alicat flow devices are a good choice for applications that involve clean, dry gases. We recommend a filter upstream of the flow inlet (usually 20-50microns). Typically Alicat's flow devices should be used with operating pressures below 145PSIG (100PSIG for liquids). Alicat flow devices are not recommended for dirty gases or slurries. They are also not well suited for applications with temperatures above 50° Celsius. Customized products for line temperatures of up to 100° Celsius are available. Alicat engineers will be happy to discuss exceptions to the above limitations in detail.

THIRTY GAS SELECT™ STANDARD

All Alicat gas flow meters and controllers come with Gas Select™ and can be used with any of 20 common gases and 10 gas mixtures!

Selectable Gases	Selectable Gas Mixtures
Acetylene	75% Argon / 25% CO2
Air	90% Argon / 10% CO2
Argon	92% Argon / 8% CO2
iso-Butane	98% Argon / 2% CO2
normal-Butane	75% CO2 / 25% Argon
Carbon Dioxide	75% Argon / 25% Helium
Carbon Monoxide	75% Helium / 25% Argon
Ethane	90% Helium / 7.5% Argon / 2.5% CO2
Ethylene	(Praxair - Helistar® A1025)
Helium	90% Argon / 8% CO2 / 2% Oxygen
Hydrogen	(Praxair - Stargon® CS)
Krypton	95% Argon / 5% Methane
Methane	
Neon	
Nitrogen	
Nitrous Oxide	
Oxygen	
Propane	
Sulfur Hexafluoride	
Xenon	



Simply Scroll the Display and Select a Gas!

If your application calls for a gas or gas mixture not on this list, please let us know. Alicat Scientific can calibrate to a wide variety of complex gas mixtures involving up to four gas constituents. The percentage of each gas is required at the time of order for the calculation of the mixture's viscosity and temperature curve characteristics. The gas mixture will then be added to the device's gas calibration list. The mix can be selected via RS-232 or local display. Alternately, we can suppress the 30 gas selection and default a device to a specific gas mixture calibration, please consult factory for cost.

COMMUNICATIONS

At Alicat, we strive to offer communications options that fit your needs! Whether through our standard integrated display or your PC, digital or analog, a single device or multi-drop system, you can easily communicate with any Alicat.

Interactive Local Display An easy to use local display is standard on all Alicat units (a no-display option is available for OEMs). The display mode is changed via the membrane switches located on the front of the unit.

All units in "Main Mode" provide information on their appropriate process parameters.

All gas units are provided with a "Gas Select Mode" that includes the standard 30 gas calibrations.

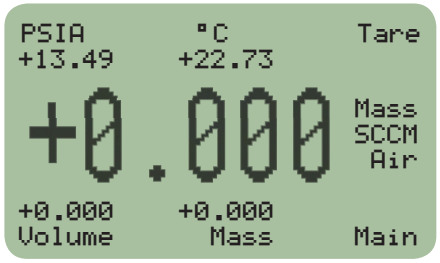
All units come with "Communication Select Mode", allowing you to assign a Unit ID, select Baud and data rate.

All controllers have a "Control Setup Mode" which lets you to select to control one parameter such as volumetric flow or pressure, while still reading the unit's other parameters like mass flow and temperature. You can also adjust the PID control algorithm specifically for your application requirements.

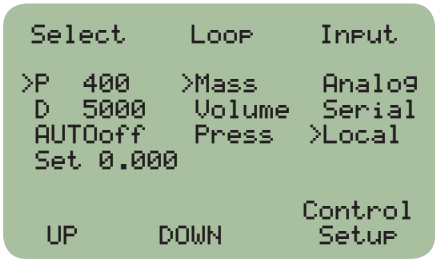
All units provide model number, serial number and manufacturer information in the "Manufacturer Data Mode".

All units come with a "Miscellaneous Mode" that permits adjustments to the LCD contrast, display zero deadband, pressure averaging and flow averaging functions.

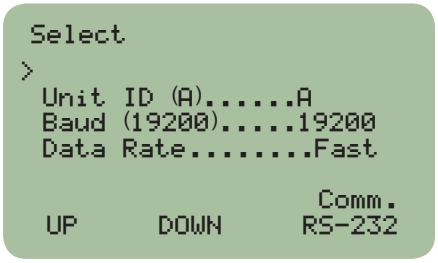
Any flow meter or flow controller may also be ordered with an integrated "Totalizer Mode" (page 45).



M Series Main Display



MC & MCR Control Setup Display



Communication Select Display

RS-232 Serial Output

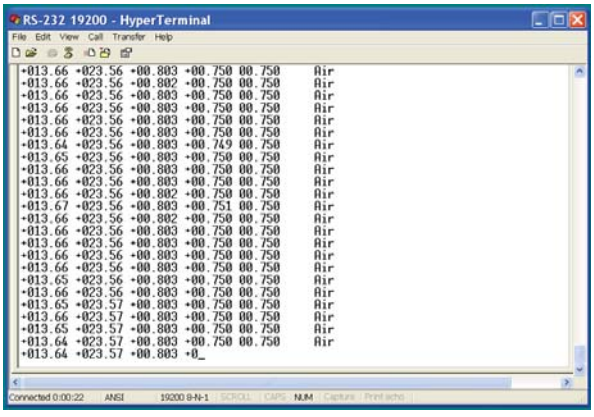
RS-232 Serial output is standard on all Alicat products.

No special software is required to use Alicat's digital RS-232 input & output communication.

Any device with a terminal program such as HyperTerminal® found on all Windows® operating systems will work with our instruments.

The RS-232 allows you to digitally perform all the same functions as are available through the local display (tare the unit, change gas calibration reference, etc).

The process parameters displayed will be identical to the unit's local display capabilities. All units are capable of field configuration to streaming or polling mode, depending on your preference.



M Series Streaming Mode Example:
PSIA, ºC, Volumetric Flow, Mass Flow, Gas Selected

Multi-Drop Capable RS-232

Address up to 26 units, mix & match meters, controllers and pressure units!

While no additional software is required to use the RS-232 communication feature, Alicat Scientific offers ***Flow Vision™ SC*** to simplify device monitoring and data capturing (page 11).

You can also download the following drivers for Alicat meters and controllers:
LabVIEW 6i.; LabVIEW 7.1; LabVIEW 8.0.

NEW! ***We now offer RS-485 Serial Output as a communication option for all standard Alicat instruments. Please contact us for more information.***

Analog Communication

Along with the standard digital communications, all Alicat instruments include analog capabilities.

The standard is 0-5Vdc for both the input and output signal. A 0-10Vdc. You may also request a 1 to 5Vdc signal or if you prefer current, Alicat can provide a 4-20mA signal.

Secondary Analog Output Option

In some applications, a second analog output signal may be required. The Alicat mass flow meters and controllers are measuring multiple parameters and therefore can provide you with an optional second analog output for any of these parameters, including the primary parameter.

Any of the existing analog signal type options can be selected. You can request a primary mass flow output of 0-5Vdc and a secondary pressure output of 0-10Vdc or two mass flow outputs of 0-5Vdc.

When ordering, please contact your sales engineer for other available options.

The **Model BB-9 Multi-Drop Box** makes it easy to connect multiple flow and/or pressure devices to a single RS-232 port. 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. (See page 45 for dimensions.)

*The **BB-9** is also available with 6 pin locking industrial connector ports.*

PROFIBUS Communications

PROFIBUS DP-V1 compatibility is now available for any Alicat device.

- ► PROFIBUS DP-V1 slave
- ► Power over PROFIBUS connector option
- ► Two DB-9 connectors
  - — Female (std PROFIBUS)
  - — Male (Power and Ground)
- ► Auto Baud Rate Detect
- ► Easy integration into your PROFIBUS systems.

Please see page 18 for PROFIBUS specifications

Connector and Pin-out Options

- ► Standard 8 pin DIN connector.
- ► Six pin locking industrial connector (page 46).
- ► DB-15 pin connector — available in a variety of configurations (page 42).
- ► and DB-9 pin PROFIBUS as seen above.

Available Soon — **DeviceNet** Contact Alicat for more information.

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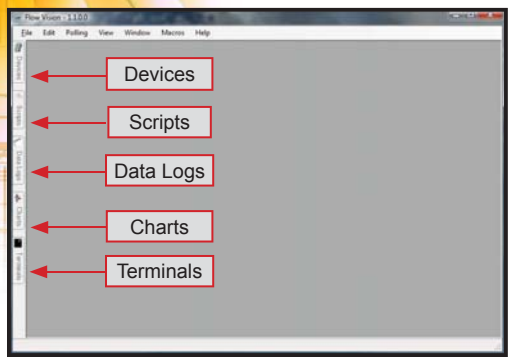
FLOW VISION™ SC



Flow Vision™ SC is an intuitive software interface to help your test cycles run smoother and shorten your engineering time!

Flow Vision™ SC lets you connect to and communicate with multiple Alicat units simultaneously. Now you can view virtual displays, control tabs, charts and data lines from every connected Alicat device on the same screen.

Flow Vision™ SC supports all RS-232 Serial communication functions, including: **gas selection, tareing, set-point control, valve tuning and flow averaging.**

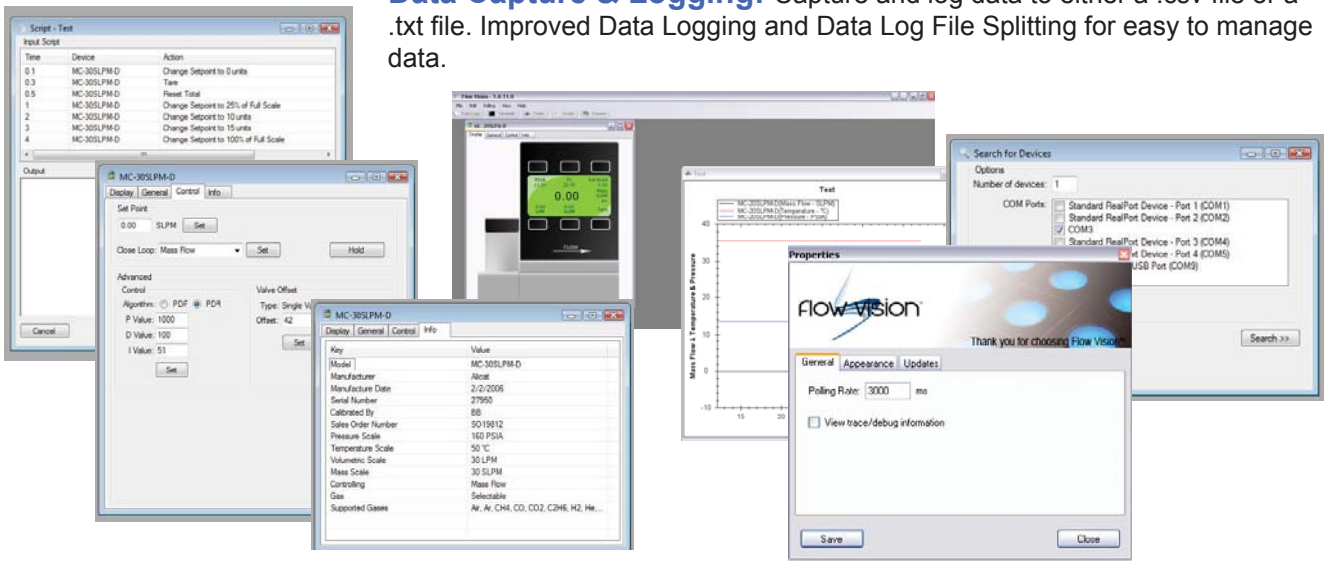
Session Saving: Save and reload your configuration data with confidence.

Script Building: Create scripts to adjust a controller's set-point value at variable specified time intervals.

Charting: Chart as many parameters as you want off as many devices as you want, with color coding, zooming, and printing functionality.

Alarms: Create software alarms that will notify you of given parameter conditions.

Data Capture & Logging: Capture and log data to either a .csv file or a .txt file. Improved Data Logging and Data Log File Splitting for easy to manage data.



Flow Vision™ SC **supports multiple devices** connected to the same RS-232 port.

Simply connect each device to a ***BB-9 Multi-Drop Box***, then using device addressability, assign an identifier to each instrument.

Now you can easily monitor and control multiple Alicat instruments from your computer.

***Flow Vision™ SC* System Requirements:**

- Microsoft® Windows® XP® or VISTA®
- Microsoft® .NET Framework Version 3.0
- 18 MB hard disk space
- Available COM port that supports 19200 baud communications*

* Note: Some laptops are not equipped with serial ports. A virtual serial port can be created using a USB to Serial adapter.

MASS FLOW METERS

Alicat Scientific's M Series Mass Flow Meters Ready in an Instant to Respond in 10 milliseconds or Less!

- The innovative features built into every Alicat mass flow meter are there to save you time and money.
- Unlike traditional mass flow meters, Alicat mass flow meters utilize laminar flow and differential pressure technology.
- The result is an extremely fast, accurate meter with no warm-up time and unparalleled versatility.

M 20SLPM

Multi-gas Selectivity

All Alicat flow meters come with Gas Select™. They are calibrated and ready for use with *20 gases* and *10 gas blends*. You select the gas via the display or through the RS-232 interface. See page 8 for gas list.

In addition, Alicat can calibrate your meter for gas mixtures specific to your applications.

High Accuracy and 100:1 Turndown

Alicat mass flow meters have a standard accuracy of ± (0.8% of reading +0.2% of full scale).

We also offer a high accuracy calibration of ± (0.4% of reading + 0.2% of full scale) for flow meters ranging from 5SCCM to 1000SLPM with a 100:1 turndown.

This makes it possible to use a single Alicat meter to measure an operating flow range that would normally require two typical mass flow meters — and still maintain your required accuracy!

Multiple Parameter Measurement & Optional Alarm Set-Point

All Alicat mass flow meters measure *mass flow, volumetric flow, absolute pressure* and *temperature!*

This unique feature will save money by eliminating extra transmitters and their cost of installation. The additional process information is invaluable for troubleshooting or to alert you of upsets before they become catastrophic. (Monitoring of critical parameters can be further simplified with an optional alarm set-point for temperature, pressure or flow.)

M 50SLPM

No Warm-Up Time!

Thermal type mass flow meters need anywhere from 10 to 30 minutes of warm-up time before they become stable. The Alicat pressure based technology needs less than one second to reach stability. A time delay of 30 minutes could be critical if your meter is being used for process tuning, monitoring or control.

With an Alicat mass flow meter, in less than a second after power up, you are ready to begin accurate measurement and control of your process.

Now Available: **ATEX / CSA** Class 1 Division 2 hazardous environment for Europe, Canada and the U.S.

PROFIBUS DP-V1 compatible. See pages 18 and 42 for more information.

RS-485 Serial Output. Please contact Alicat for more information.

M Series: Meters in any flow range from 0 to 0.5SCCM full scale through 0 to 4000SLPM full scale.

Are you aware that "Standard Conditions" aren't always standard?

Have you ever tested two different meters on the same flow rate only to get two different readings? That's probably because the meters were calibrated using different standard conditions. This can be quite a problem if you need both meters to read the same.

With an Alicat meter, you can simply change the standard condition parameters via RS-232 communication and you're up and running.

No need to send it back to the factory for recalibration — saving both time and money!

M 2000SLPM

Low Power Operation

If you're concerned with power consumption, Alicat's mass flow meters have the lowest power requirements in the industry.

Any M Series meter can run on 7 to 30 Vdc and consumes only 0.035 Amps!

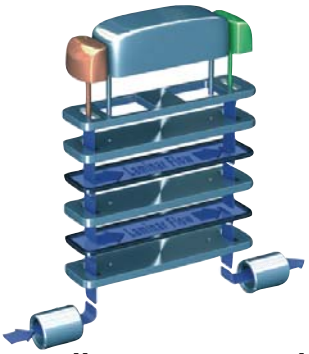
You could even use a small solar panel for power in a remote operation.

No Straight Runs Necessary

If your space is limited, Alicat combines a small footprint with the ability to connect from an elbow directly into and out of the flow body.

Because our unique design creates laminar flow within the flow body —

No straight runs of pipe are required.



Alicat's Patented Flow Technology

Digital and Analog Communication Included on All Alicat Products

All Alicat instruments come with analog and digital communication. No special software is needed to communicate digitally with your Alicat mass flow meter.

Alicat provides free LabView® drivers or you can connect directly through HyperTerminal® which is standard with Windows XP® operating systems. Alicat can also provide the Flow Vision™ SC software program — designed specifically for Alicat flow and pressure products (page 11).

Lifetime Warranty

Alicat not only brings you excellent products, we back them with a lifetime warranty, engineering support, quick delivery and low cost recalibration.

Our new order lead time is typically two weeks. Recalibrations are normally on their way back to you within three business days!

Class1 Div2

Looking for More?

PROFIBUS DP-V1

Alicat Scientific, Inc.
7641 N Business Park Drive
Tucson AZ 85743 USA

tel: 888 290 6060
fax: 520 290 0109
www.AlicatScientific.com

Technical Data for Micro-Flow and Ultra-Low Flow Mass Flow Meters

0-0.5SCCM Full Scale through 0-50SCCM Full Scale

The following specifications are for the standard configuration of the Alicat product. There are many low-cost customization options available.

Specification	Mass Meter	Description
Accuracy	± (0.8% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
High Accuracy Option	± (0.4% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
Accuracy: Bi-directional Meters Only	± (0.8% of reading + 0.2% of total span positive full scale to negative full scale)	At calibration conditions after tare
Repeatability	± 0.2%	Full Scale
Operating Range	1% to 100% Full Scale	Measure
Typical Response Time	10	Milliseconds (Adjustable)
Standard Conditions (STP)	25ºC & 14.696PSIA	Mass Reference Conditions
Operating Temperature	−10 to +50	ºCelsius
Zero Shift	0.02%	Full Scale / ºCelsius / Atm
Span Shift	0.02%	Full Scale / ºCelsius / Atm
Humidity Range	0 to 100%	Non–Condensing
Measurable Flow Rate	128%	Full Scale
Maximum Pressure	145	PSIG
Output Signal Digital	Mass Flow, Volumetric Flow, Pressure & Temperature	RS-232 Serial or PROFIBUS[1]
Output Signal Analog	Mass Flow	0-5Vdc
Optional Output Signal Secondary Analog	Mass Flow, Volumetric Flow, Pressure or Temperature	0-5 Vdc or 0-10Vdc or 4-20mA
Electrical Connections	8 Pin Mini-DIN or DB-15	
Supply Voltage	7 to 30 Vdc (15-30Vdc for 4-20mA outputs)	
Supply Current	0.035Amp (+ output current on 4-20mA)	
Mounting Attitude Sensitivity	0%	Tare after installation
Warm-up Time	< 1	Second
Wetted Materials[2]	303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, Silcon, Glass.	

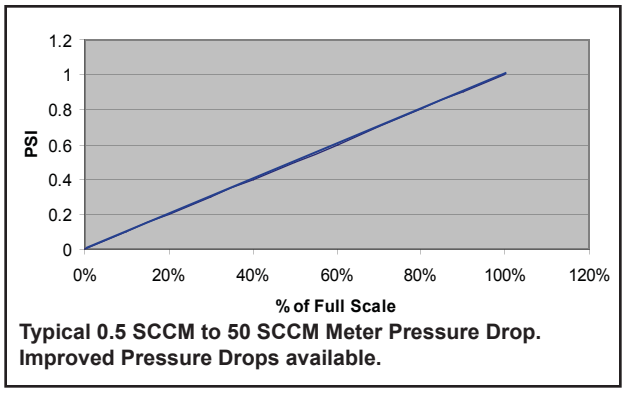
1. If selecting PROFIBUS no analog signal is available. PROFIBUS units do not have the display. See PROFIBUS specifications for PROFIBUS supply voltages and currents.
2. If your application demands a different material, please contact Application Assistance for available options.

Mechanical Specifications

Full Scale Flow Mass Meter	Mechanical Dimensions	Process Connections[1]	Pressure Drop[2] (PSID)
0.5SCCM to 50SCCM	3.9"H x 2.4"W x 1.1"D	**M5 (10-32) Female Thread***	1.0

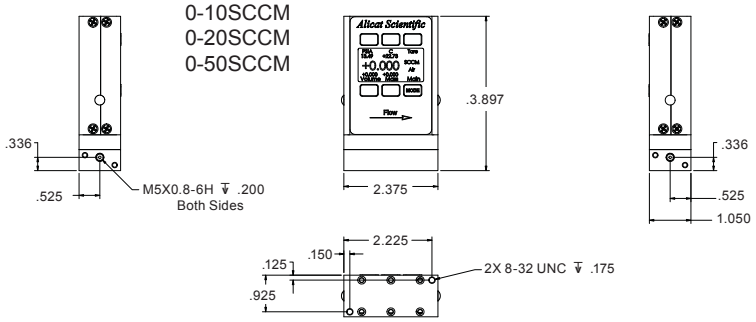
Units ≤50SCCM F.S. are shipped with M5 (10-32) Male Buna-N O-ring face seal to 1/8" Female NPT adapters.
These adapter fittings were selected for customer convenience in process connection. It should be noted that the 1/8" Female NPT introduces additional dead volume. To minimize dead volume, please see page 45 for M5 (10-32) compression fittings.

1. Compatible with Beswick®, Swagelok® tube, Parker®, face seal, push connect and compression adapter fittings.
2. Venting to atmosphere. Lower Pressure Drops Available, Please contact Application Assistance.



Typical 0.5 SCCM to 50 SCCM Meter Pressure Drop. Improved Pressure Drops available.

M Series
0-0.5SCCM
0-1SCCM
0-2SCCM
0-5SCCM
0-10SCCM
0-20SCCM
0-50SCCM



0.5SCCM to 50SCCM approximate shipping weight: 0.8lb

Technical Data for Low Flow Mass Flow Meters

0 to 100 SCCM Full Scale through 0 to 20 SLPM Full Scale

The following specifications are for the standard configuration of the Alicat product. There are many low-cost customization options available.

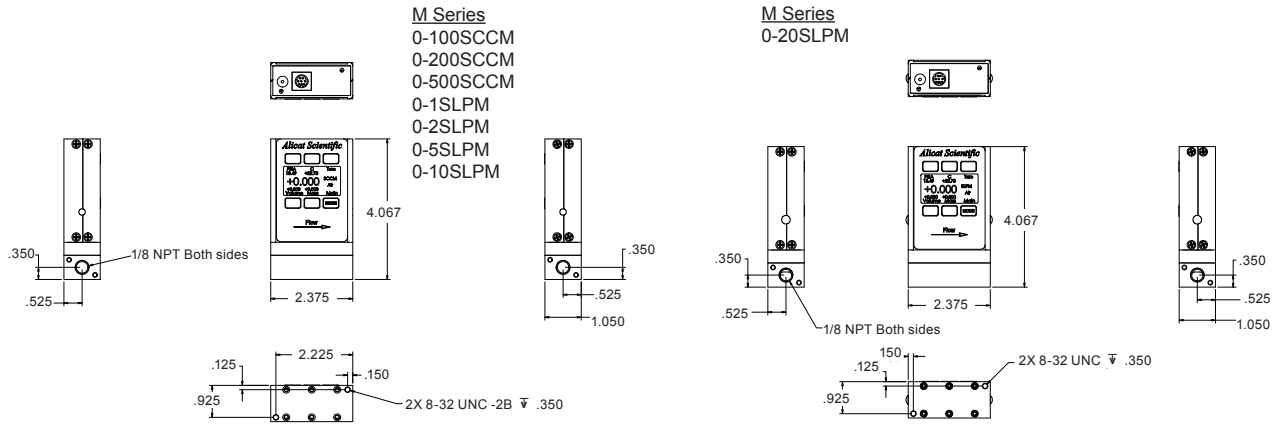
Specification	Mass Meter	Description
Accuracy	± (0.8% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
High Accuracy Option	± (0.4% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
Accuracy: Bi-directional Meters Only	± (0.8% of reading + 0.2% of total span positive full scale to negative full scale)	At calibration conditions after tare
Repeatability	± 0.2%	Full Scale
Operating Range	1% to 100% Full Scale	Measure
Typical Response Time	10	Milliseconds (Adjustable)
Standard Conditions (STP)	25ºC & 14.696PSIA	Mass Reference Conditions
Operating Temperature	−10 to +50	ºCelsius
Zero Shift	0.02%	Full Scale / ºCelsius / Atm
Span Shift	0.02%	Full Scale / ºCelsius / Atm
Humidity Range	0 to 100%	Non–Condensing
Measurable Flow Rate	128%	Full Scale
Maximum Pressure	145	PSIG
Output Signal Digital	Mass Flow, Volumetric Flow, Pressure & Temperature	RS-232 Serial or PROFIBUS[1]
Output Signal Analog	Mass Flow	0-5Vdc
Optional Output Signal Secondary Analog	Mass Flow, Volumetric Flow, Pressure or Temperature	0-5 Vdc or 0-10Vdc or 4-20mA
Electrical Connections	8 Pin Mini-DIN or DB-15	
Supply Voltage	7 to 30 Vdc (15-30Vdc for 4-20mA outputs)	
Supply Current	0.035Amp (+ output current on 4-20mA)	
Mounting Attitude Sensitivity	0%	Tare after installation
Warm-up Time	< 1	Second
Wetted Materials[2]	303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, Silcon, Glass.	

1. If selecting PROFIBUS no analog signal is available. PROFIBUS units do not have the display. See PROFIBUS specifications for PROFIBUS supply voltages and currents.
2. If your application demands a different material, please contact Application Assistance for available options.

Mechanical Specifications

Full Scale Flow Mass Meter	Mechanical Dimensions	Process Connections[1]	Pressure Drop[2] (PSID)
100SCCM to 20SLPM	4.1"H x 2.4"W x 1.1"D	1/8" NPT Female	1.0

1. Compatible with Beswick®, Swagelok® tube, Parker®, face seal, push connect and compression adapter fittings. See page 45 for fittings.
2. Venting to atmosphere. Lower Pressure Drops Available, Please contact Application Assistance.



100SCCM to 20SLPM approximate shipping weight: 1.0lb

Technical Data for Moderate Flow Mass Flow Meters

0 to 50 SLPM Full Scale through 0 to 250 SLPM Full Scale

The following specifications are for the standard configuration of the Alicat product. There are many low-cost customization options available.

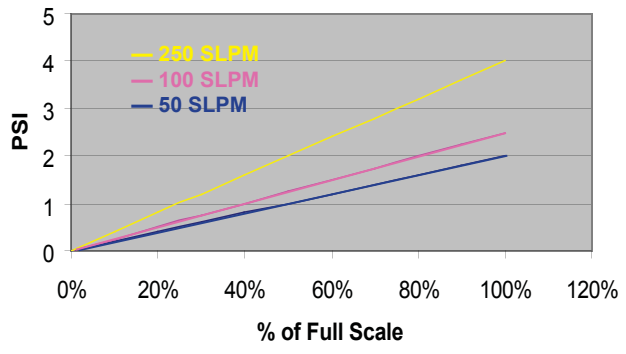
Specification	Mass Meter	Description
Accuracy	± (0.8% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
High Accuracy Option	± (0.4% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
Accuracy: Bi-directional Meters Only	± (0.8% of reading + 0.2% of total span positive full scale to negative full scale)	At calibration conditions after tare
Repeatability	± 0.2%	Full Scale
Operating Range	1% to 100% Full Scale	Measure
Typical Response Time	10	Milliseconds (Adjustable)
Standard Conditions (STP)	25ºC & 14.696PSIA	Mass Reference Conditions
Operating Temperature	−10 to +50	ºCelsius
Zero Shift	0.02%	Full Scale / ºCelsius / Atm
Span Shift	0.02%	Full Scale / ºCelsius / Atm
Humidity Range	0 to 100%	Non–Condensing
Measurable Flow Rate	128%	Full Scale
Maximum Pressure	145	PSIG
Output Signal Digital	Mass Flow, Volumetric Flow, Pressure & Temperature	RS-232 Serial or PROFIBUS[1]
Output Signal Analog	Mass Flow	0-5Vdc
Optional Output Signal Secondary Analog	Mass Flow, Volumetric Flow, Pressure or Temperature	0-5 Vdc or 0-10Vdc or 4-20mA
Electrical Connections	8 Pin Mini-DIN or DB-15	
Supply Voltage	7 to 30 Vdc (15-30Vdc for 4-20mA outputs)	
Supply Current	0.035Amp (+ output current on 4-20mA)	
Mounting Attitude Sensitivity	0%	Tare after installation
Warm-up Time	< 1	Second
Wetted Materials[2]	303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, Silcon, Glass.	

1. If selecting PROFIBUS no analog signal is available. PROFIBUS units do not have the display. See PROFIBUS specifications for PROFIBUS supply voltages and currents.
2. If your application demands a different material, please contact Application Assistance for available options.

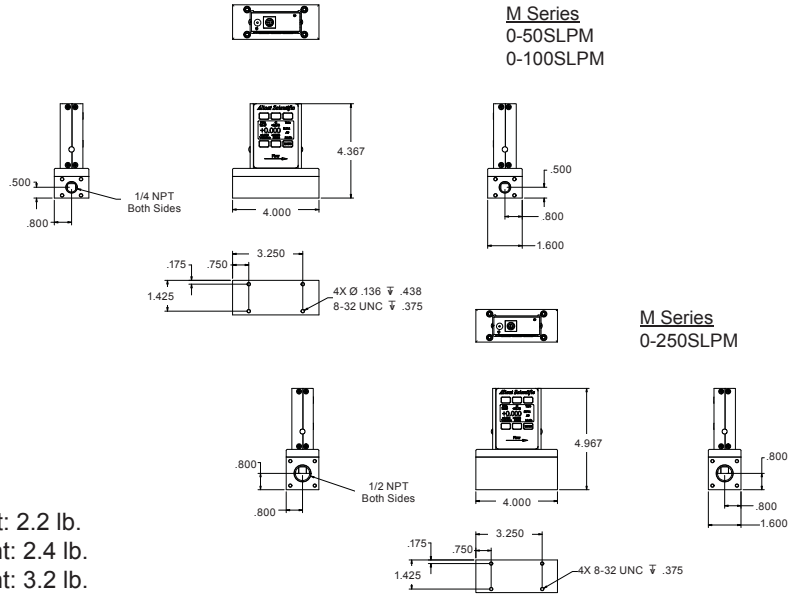
Mechanical Specifications

Full Scale Flow Mass Meter	Full Scale Flow Volumetric Meter	Mechanical Dimensions	Process Connections[1]	Pressure Drop[2] (PSID)
50SLPM	50LPM	4.4"H x 4.0"W x 1.6"D	1/4" NPT Female	2.0
100SLPM	100LPM			2.5
250SLPM	250LPM	5.0"H x 4.0"W x 1.6"D	1/2" NPT Female	4.0

1. Compatible with Beswick®, Swagelok® tube, Parker®, face seal, push connect and compression adapter fittings. See page 45 for fittings.
2. Venting to atmosphere. Lower Pressure Drops Available, please contact Application Assistance.



Typical 50 SLPM, 100 SLPM and 250 SLPM Meter Pressure Drop. Improved Pressure Drops available.



50SLPM approximate shipping weight: 2.2 lb.
100SLPM approximate shipping weight: 2.4 lb.
250SLPM approximate shipping weight: 3.2 lb.

Technical Data for High Flow Mass Flow Meters

0 to 500 SLPM Full Scale through 0 to 4000 SLPM Full Scale

The following specifications are for the standard configuration of the Alicat product. There are many low-cost customization options available. For meters above 2000SLPM, please contact Alicat.

Specification	Mass Meter	Description
Accuracy	± (0.8% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
High Accuracy Option[1]	± (0.4% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
Accuracy: Bi-directional Meters Only	± (0.8% of reading + 0.2% of total span positive full scale to negative full scale)	At calibration conditions after tare
Repeatability	± 0.2%	Full Scale
Operating Range	1% to 100% Full Scale	Measure
Typical Response Time	10	Milliseconds (Adjustable)
Standard Conditions (STP)	25ºC & 14.696PSIA	Mass Reference Conditions
Operating Temperature	−10 to +50	ºCelsius
Zero Shift	0.02%	Full Scale / ºCelsius / Atm
Span Shift	0.02%	Full Scale / ºCelsius / Atm
Humidity Range	0 to 100%	Non–Condensing
Measurable Flow Rate	128%	Full Scale
Maximum Pressure	145	PSIG
Output Signal Digital	Mass Flow, Volumetric Flow, Pressure & Temperature	RS-232 Serial or PROFIBUS[2]
Output Signal Analog	Mass Flow	0-5Vdc
Optional Output Signal Secondary Analog	Mass Flow, Volumetric Flow, Pressure or Temperature	0-5 Vdc or 0-10Vdc or 4-20mA
Electrical Connections	8 Pin Mini-DIN or DB-15	
Supply Voltage	7 to 30 Vdc (15-30Vdc for 4-20mA outputs)	
Supply Current	0.035Amp (+ output current on 4-20mA)	
Mounting Attitude Sensitivity	0%	Tare after installation
Warm-up Time	< 1	Second
Wetted Materials[3]	303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, Silcon, Glass.	

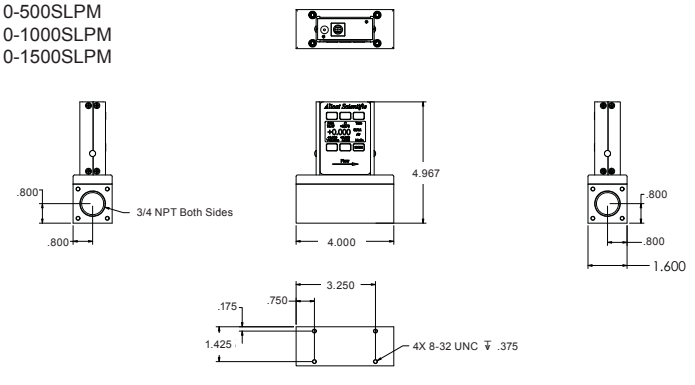
1. High Accuracy option not available for 2000SLPM units.
2. If selecting PROFIBUS no analog signal is available. PROFIBUS units do not have the display. See PROFIBUS specifications for PROFIBUS supply voltages and currents.
3. If your application demands a different material, please contact Application Assistance for available options.

Mechanical Specifications

Full Scale Flow Mass Meter	Mechanical Dimensions	Process Connections[1]	Pressure Drop[2] (PSID)
500SLPM	5.0"H x 4.0"W x 1.6"D	3/4" NPT Female	5.5
1000SLPM			6.0
1500SLPM			9.0
2000SLPM	5.0"H x 5.2"W x 2.9"D		5.0

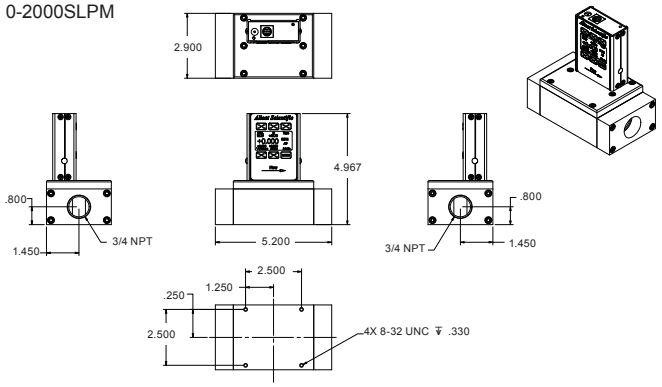
1. Compatible with Beswick®, Swagelok® tube, Parker®, face seal, push connect and compression adapter fittings. See page 45 for fittings.
2. Venting to atmosphere. Lower Pressure Drops Available, Please contact Application Assistance.

M Series
0-500SLPM
0-1000SLPM
0-1500SLPM



500SLPM to 1500SLPM approximate shipping weight: 3.5lb

M Series
0-2000SLPM



2000SLPM approximate shipping weight: 4.5lb

Technical Data for **PROFIBUS** Mass Flow Meters and Controllers

The following specifications are applicable to Alicat PROFIBUS enabled mass meters and mass controllers only. For PROFIBUS pressure or liquid instruments please contact application assistance. PROFIBUS devices do not have a display. All other standard device features and functions are available and operate in accordance with the Alicat Scientific device operating manual provided with the device.

Specification	Mass Meter	Mass Controller	Description
Accuracy	± (0.8% of Reading + 0.2% of Full Scale)		At calibration conditions after tare
High Accuracy Option	± (0.4% of Reading + 0.2% of Full Scale)		At calibration conditions after tare
Repeatability	± 0.2%		Full Scale
Operating Range	1% to 100% Full Scale		Measure and Control
Typical Response Time	10	100	Milliseconds (Adjustable)
Standard Conditions (STP)	25ºC & 14.696PSIA		Mass Reference Conditions
Operating Temperature	−10 to +60		ºCelsius
Zero Shift	0.02%		Full Scale / ºCelsius / Atm
Span Shift	0.02%		Full Scale / ºCelsius / Atm
Humidity Range	0 to 100%		Non–Condensing
Measurable Flow rate	128%		Full Scale
Controllable Flow Rate		102.4%	Full Scale
Maximum Pressure	145		PSIG
Input /Output Signal Digital	Mass, Volumetric, Pressure & Temperature		RS-232 Serial, PROFIBUS DP
Electrical Connections	DB9		
Supply Voltage:			
Meters	7 to 30 Vdc		
Small Valve Controllers		12 to 30 Vdc	
Large Valve Controllers		24 to 30 Vdc	
Supply Current	80mA @ 12Vdc 65mA @ 24Vdc	295mA @ 12Vdc 280mA @ 24Vdc	
Mounting Attitude Sensitivity	None		
Warm-up Time	< 1		Second
Wetted Materials[1]	303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, Brass, 410 & 416 Stainless Steel.		

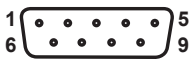
1. If your application demands a different material, please contact Application Assistance for available options.

Power and Signal Connections:
Connect to the device using two DB9 connectors.
The female top connection is PROFIBUS.
The male connection on the side is power and RS-232.
Pin out diagrams for all PROFIBUS enabled Alicat devices are shown below:

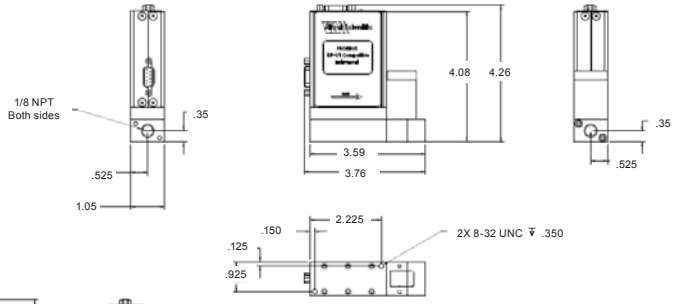
TOP

1. NC
2. OPT GND
3. DP
4. RTS
5. DGD
6. VP
7. OPT 7 to 30VDC
8. DN
9. NC

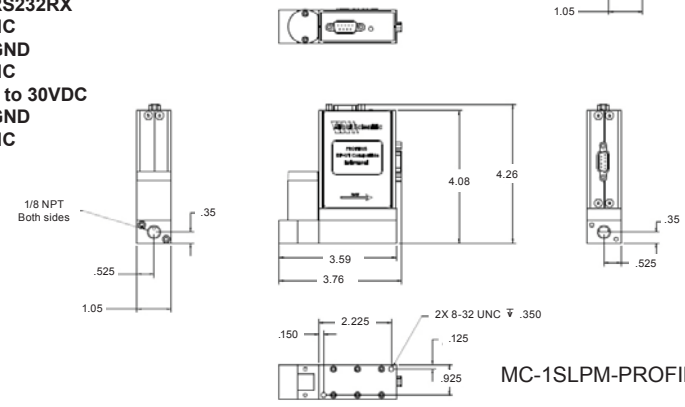
SIDE



1. NC
2. RS232TX
3. RS232RX
4. NC
5. GND
6. NC
7. 7 to 30VDC
8. GND
9. NC



MC-1SLPM-DS-PROFIBUS



MC-1SLPM-PROFIBUS

Flow body dimensions will vary with range. Please see Alicat's device specifications for flow body dimensions.

THE PRIDE OF ALICAT

Your Solution for Measuring and Controlling

• MASS FLOW • PRESSURE • WATER

Featuring the Industry's Only Lifetime Warranty!

Whether your application calls for precision, speed or flexibility, let Alicat make your job easier.

- **You'll get quick delivery with outstanding standard features and a wide choice of custom options.**
- **Our engineers have what it takes to ensure you are getting the most from your device and more importantly your application.**
- **Our service department promises low cost recalibrations and quick turnaround.**

Give us a call (888) 290-6060 or visit our web site to learn more about Alicat's unique line of flow and pressure products.

Alicat Scientific™

www.AlicatScientific.com

Alicat Scientific is ISO 9001:2000 certified

MASS FLOW CONTROLLERS

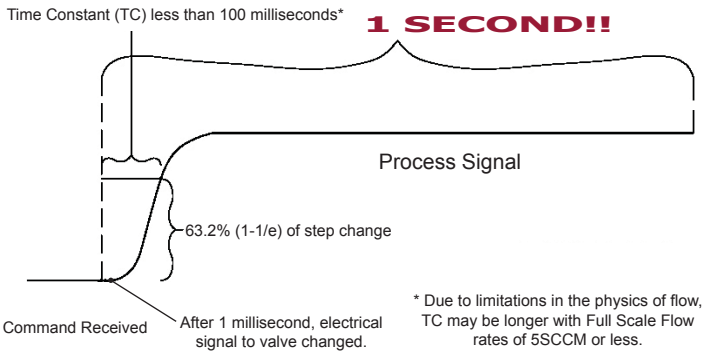
Process Control Faster than the Process!

Alicat Scientific's MC and MCR Series Mass Flow Controllers Deliver Improved Quality Control and Reduced Process Costs.

Fast!

Alicat's mass flow controllers incorporate an extremely fast responding true proportional valve and PID loop control – resulting in unsurpassed flow control for even the smallest flow rate and low pressure processes.

Control response time ranges from 30 to 100ms with very little overshoot, depending on the size of controller and tuning.



* Due to limitations in the physics of flow, TC may be longer with Full Scale Flow rates of 5SCCM or less.

MC 10SLPM

Field Adjustable PID

Although the instruments come well-tuned from the factory, you can optimize your Alicat mass flow controller's performance in the field by adjusting the P or D via the front panel display or through RS-232.

Alicat's larger mass flow controllers (MCR Series) use unique low pressure drop valves to control flow or pressure. This can be critical in gas blending or other processes where precise gas volumes are essential.

Multi-gas Selectivity

All Alicat flow controllers come with Gas Select™. They are calibrated and ready for use with *20 gases* and *10 gas blends*. You select the gas via the display or through the RS-232 interface.

In addition, Alicat can calibrate your controller for gas mixtures specific to your applications. See page 8 for gas list.

MC 20SLPM

No Warm-Up Time!

Thermal type mass flow controllers need anywhere from 10 to 30 minutes of warm-up time before they become stable.

Alicat's pressure based technology needs less than one second to reach stability.

A time delay of 30 minutes could be critical when your meter is being used for process tuning, monitoring or control. With an Alicat mass flow controller, in less than a second after power up you can begin accurate measurement and control of your process.

Multiple Parameter Measurement & Optional Alarm Set-Point

All Alicat mass flow controllers measure *mass flow, volumetric flow, absolute pressure* and *temperature!*

This unique feature saves money by eliminating extra transmitters and their cost of installation.

The additional process information is invaluable for troubleshooting or to alert you of upsets before they become catastrophic. (Monitoring of critical parameters can be further simplified with an optional alarm set-point for temperature, pressure or flow.)

High Accuracy and 100:1 Turndown

Alicat mass flow controllers have a standard accuracy of ± (0.8% of reading + 0.2% of full scale).

We also offer a high accuracy calibration of ± (0.4% of reading + 0.2% of full scale) for flow controllers ranging from 5SCCM to 1000SLPM with a 100:1 turndown.

You may be able to use a single Alicat controller to control an operating flow range that would normally require two typical mass flow controllers — and still maintain your required accuracy!

MCR 500SLPM

Stand Alone Operation

All Alicat controllers have the ability to operate without a control set-point input signal.

Once the Alicat controller is powered, the control functions can be actuated through the membrane buttons and display screen or through RS-232.

No input set-point signal is required.

The controller will hold the set-point and control at a given flow rate or pressure until loss of power or the set-point is changed.

The set-point is maintained even after a power outage and reboot.

Low Power

Alicat mass flow controllers use significantly less power than most other MFCs in the same flow range. This makes the controllers ideal for limited power applications.

Low power also means low heat – this saves money in multi-unit applications that require the controllers to be placed in tight-fitting enclosures.

Now Available: **ATEX / CSA** Class 1 Division 2 hazardous environment for Europe, Canada and the U.S.

PROFIBUS DP-V1 compatible. See pages 18 and 42 for more information.

RS-485 Serial Output. Please contact Alicat for more information.

Lifetime Warranty

Alicat not only brings you excellent products, we back them with a lifetime warranty, engineering support, quick delivery and low cost recalibration.

Our new order lead time is typically two weeks. Recalibrations are normally on their way back to you within three business days!

MC & MCR Series: Controllers in any flow range from 0 to 0.5SCCM full scale through 0 to 4000SLPM full scale.

MASS FLOW CONTROLLERS

Measure the Mass Flow While Controlling Pressure

Alicat controllers are continuously measuring mass flow, volumetric flow, absolute pressure and temperature – all of which are visible on the display or through the digital output signal.

This unique design lets you alter its function by selection of the closed loop parameter.

You can change the control loop on a mass flow controller to control on pressure rather than mass flow. This makes it possible to measure the mass flow rate while controlling the pressure.

Please contact our support staff for more information concerning this application.

MC 10SLPM w/Downstream valve

Pump and Compressor Flow Characterization under Back Pressure

In this application a mass flow controller is utilized as a back pressure controller. The mass flow controller performs a flow characterization on the air compressor under test by reading mass flow at absolute specified pressures.

In other configurations (control valve upstream of measurement head), similar tuning can be used to perform exit pressure control for a downstream process instead of back pressure control.

Typical applications include testing absorbtion, atomizers and spray processes.

MC Series Controller
Downstream Valve

Digital and Analog Communication Included on All Alicat Products

All Alicat instruments come with analog and digital communication. No special software is needed to communicate digitally with your Alicat mass flow meter.

Alicat provides free LabView® drivers or you can connect directly through HyperTerminal® which is standard with Windows XP® operating systems. Alicat can also provide the Flow Vision™ SC software program — designed specifically for Alicat flow and pressure products (page 11).

Multi-drop Capable

All Alicat instruments are multi-drop capable using the RS-232 digital communication.

You can link up to 26 separate Alicat instruments – each with its own addressable code.

To simplify things, use our Model BB-9 Multi-Drop Box.

This lets you easily link up to 9 units at each location and supply the necessary power through the BB-9 (page 44).

MC & MCR Series: Controllers in any flow range from 0 to 0.5SCCM full scale through 0 to 2000SLPM full scale.

New from Alicat!

MODEL MCV *MASS FLOW CONTROLLER*

FOR THE VACUUM COATING INDUSTRY

The Alicat model **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 sccm/sec Helium max.

The **MCV** uses the same patented laminar flow differential pressure (DP) technology as all Alicat Scientific flow instruments. The result is unparalleled accuracy and response time in applications where speed and accuracy really count.

The Alicat **MCV** will accurately control gas flow rates as low as 0.5 sccm or as high as 20 slpm with ***response times of 50 to 100 milliseconds***. — Response times that can greatly improve your end product and help eliminate target poisoning.

Every **MCV** is pre-programmed with calibrations for 30 gases and displays mass flow, volumetric flow, absolute pressure and temperature. The Alicat **MCV** may be programmed directly through the instrument's keypad or remotely via RS-232. Using RS-232 you can communicate with up to 26 units over a single pair of wires.

The **MCV** is powered with a 12 to 30Vdc power supply. Signal input and outputs include 0-5 Vdc, 0-10Vdc, 4-20mA and RS-232 (PROFIBUS option available).

FEATURES & BENEFITS

- Response time of 50 to 100 milliseconds
- Flow range from 0.5 sccm to 20 slpm
- Analog and digital communication standard (PROFIBUS optional)
- 30 pre-programmed gas calibrations standard
- Accuracy of +/- 0.8% of reading +/- 0.2% full scale
- Optional HIGH ACCURACY of +/- 0.4% of reading +/- 0.2% full scale
- Operating range of 1% to 100%
- Digital display showing mass flow, volumetric flow, absolute pressure and temperature.
- NO WARM UP TIME
- compact footprint designed for drop-in replacement of other devices
- Pneumatic shut-off valve provides positive shut-off to 1 x 10^{-9} atm sccm/sec Helium max
- ***LIFETIME WARRANTY***

Technical Data for MCV Mass Flow Controller for Vacuum Applications

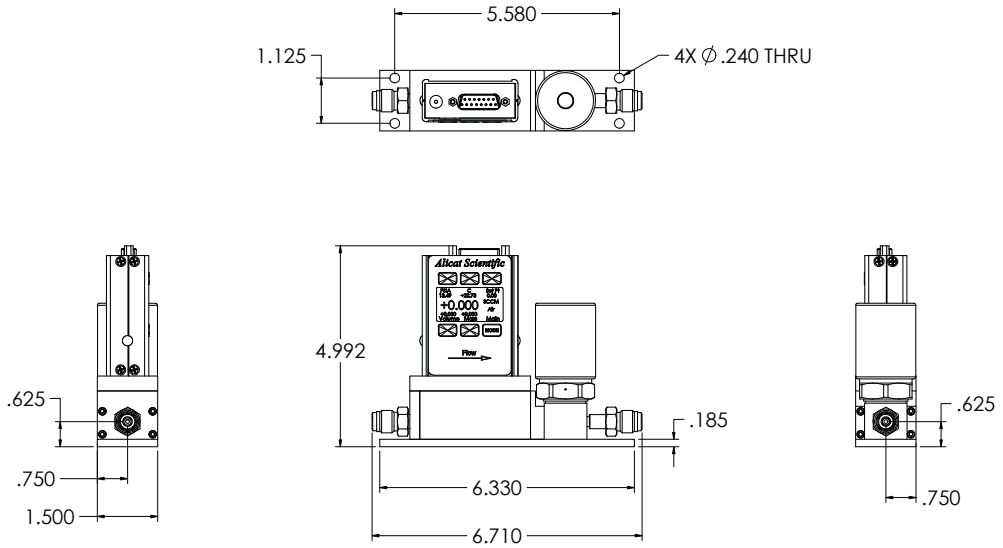
0 to 0.5SCCM Full Scale through 0 to 20SLPM Full Scale

Specification	MCV Mass Controller	Description
Accuracy	± (0.8% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
High Accuracy Option[1]	± (0.4% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
Repeatability	± 0.2%	Full Scale
Operating Range	1% to 100% Full Scale	Measure and Control
Typical Response Time	100	Milliseconds (Adjustable)
Standard Conditions (STP)	25ºC & 14.696PSIA	Mass Reference Conditions
Operating Temperature	−10 to +50	ºCelsius
Zero Shift	0.02%	Full Scale / ºCelsius / Atm
Span Shift	0.02%	Full Scale / ºCelsius / Atm
Humidity Range	0 to 100%	Non–Condensing
Controllable Flow Rate	102.4%	Full Scale
Maximum Pressure	145	PSIG
Input /Output Signal Digital	Mass Flow, Volumetric Flow, Pressure & Temperature	RS-232 Serial or PROFIBUS[2]
Input / Output Signal Analog	Mass Flow	0-5Vdc
Optional Input / Output Signal Secondary Analog	Mass Flow, Volumetric Flow, Pressure or Temperature	0-5 Vdc or 0-10Vdc or 4-20mA
Electrical Connections	8 Pin Mini-DIN or DB-15	
Supply Voltage	12 to 30 Vdc (15-30Vdc for 4-20mA outputs)	
Supply Current	0.300Amp	
Mounting Attitude Sensitivity	None	
Warm-up Time	< 1	Second
Integrated Valve Leak Integrity	1 x 10^{-9} atm sccm/sec Helium max	
Wetted Materials[3]	316L,303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, Brass, 410 Stainless Steel, Silicon, Glass, PCTFE.	

1. High Accuracy Option not available for ranges below 5SCCM.
2. If selecting PROFIBUS no analog signal is available. PROFIBUS units do not have the display. See PROFIBUS specifications for PROFIBUS supply voltages and currents.
3. If your application demands a different material, please contact Application Assistance for available options.

Mechanical Specifications

Full Scale Flow MCV Controller	Mechanical Dimensions	Process Connections
0.5SCCM to 20SLPM	4.992”H x 6.710”W x 1.50”D	1/4” VCR® Male
Welded VCR® fittings (process connections) are recommended for MCV applications. See page 42		



Technical Data for Micro-Flow and Ultra-Low Flow Mass Flow Controllers

0 to 0.5SCCM Full Scale through 0 to 50SCCM Full Scale

The following specifications are for the standard configuration of the Alicat product. There are many low-cost customization options available.

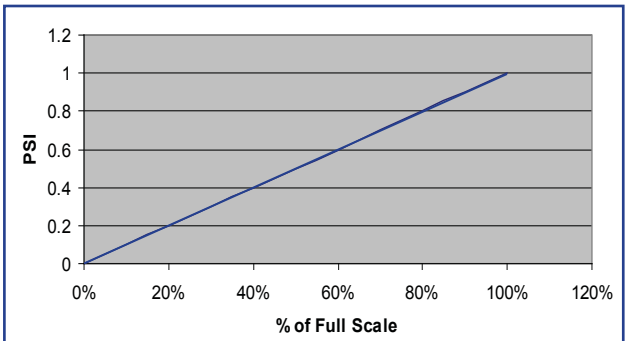
Specification	Mass Controller	Description
Accuracy	± (0.8% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
High Accuracy Option	± (0.4% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
Repeatability	± 0.2%	Full Scale
Operating Range	1% to 100% Full Scale	Measure and Control
Typical Response Time	100	Milliseconds (Adjustable)
Standard Conditions (STP)	25ºC & 14.696PSIA	Mass Reference Conditions
Operating Temperature	−10 to +50	ºCelsius
Zero Shift	0.02%	Full Scale / ºCelsius / Atm
Span Shift	0.02%	Full Scale / ºCelsius / Atm
Humidity Range	0 to 100%	Non–Condensing
Controllable Flow Rate	102.4%	Full Scale
Maximum Pressure	145	PSIG
Input /Output Signal Digital	Mass Flow, Volumetric Flow, Pressure & Temperature	RS-232 Serial or PROFIBUS[1]
Input / Output Signal Analog	Mass Flow	0-5Vdc
Optional Input / Output Signal Secondary Analog	Mass Flow, Volumetric Flow, Pressure or Temperature	0-5 Vdc or 0-10Vdc or 4-20mA
Electrical Connections	8 Pin Mini-DIN or DB-15	
Supply Voltage	12 to 30 Vdc (15-30Vdc for 4-20mA outputs)	
Supply Current	0.250Amp	
Mounting Attitude Sensitivity	None	
Warm-up Time	< 1	Second
Wetted Materials[2]	303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, Brass, 410 Stainless Steel, Silicon, Glass.	

1.If selecting PROFIBUS no analog signal is available. PROFIBUS units do not have the display. See PROFIBUS specifications for PROFIBUS supply voltages and currents.
2. If your application demands a different material, please contact Application Assistance for available options.

Mechanical Specifications

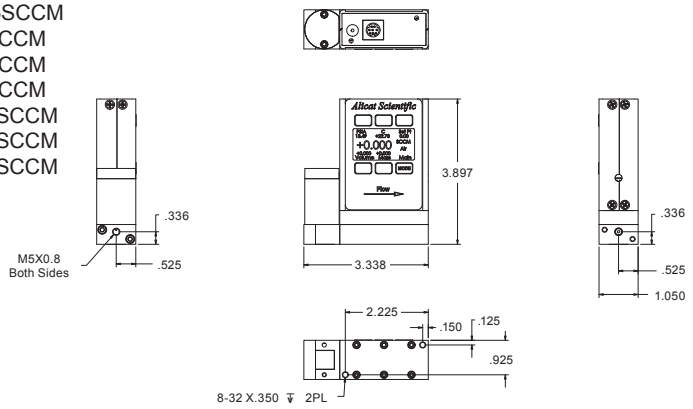
Full Scale Flow Mass Controller	Mechanical Dimensions	Process Connections[1]	Pressure Drop[2] (PSID)
0.5SCCM to 50SCCM	3.9"H x 3.4"W x 1.1"D	**M5 (10-32) Female Thread***	1.0

Units ≤50SCCM F.S. are shipped with M5 (10-32) Male Buna-N O-ring face seal to 1/8" Female NPT adapters.
These adapter fittings were selected for customer convenience in process connection. It should be noted that the 1/8" Female NPT introduces additional dead volume. Please see page 45 for M5 (10-32) male compression fittings.
1. Compatible with Beswick®, Swagelok® tube, Parker®, face seal, push connect and compression adapter fittings.
2. Venting to atmosphere. Lower Pressure Drops Available, Please contact Application Assistance.



Typical 0.5 SCCM to 50 SCCM Controller Pressure Drop. Improved Pressure Drops available.

MC Series
0-0.5SCCM
0-1SCCM
0-2SCCM
0-5SCCM
0-10SCCM
0-20SCCM
0-50SCCM



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

Alicat Scientific, Inc.
7641 N Business Park Drive
Tucson AZ 85743 USA
tel: 888 290 6060
fax: 520 290 0109
www.AlicatScientific.com

Technical Data for Low Flow Mass Flow Controllers
0 to 100SCCM Full Scale through 0 to 20SLPM Full Scale

The following specifications are for the standard configuration of the Alicat product. There are many low-cost customization options available.

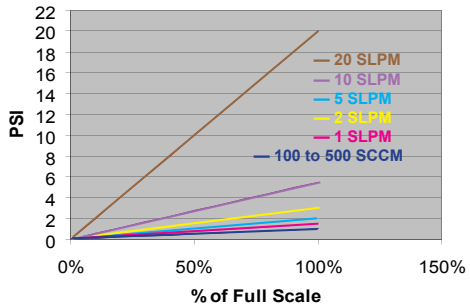
Specification	Mass Controller	Description
Accuracy	± (0.8% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
High Accuracy Option	± (0.4% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
Repeatability	± 0.2%	Full Scale
Operating Range	1% to 100% Full Scale	Measure and Control
Typical Response Time	100	Milliseconds (Adjustable)
Standard Conditions (STP)	25ºC & 14.696PSIA	Mass Reference Conditions
Operating Temperature	−10 to +50	ºCelsius
Zero Shift	0.02%	Full Scale / ºCelsius / Atm
Span Shift	0.02%	Full Scale / ºCelsius / Atm
Humidity Range	0 to 100%	Non–Condensing
Controllable Flow Rate	102.4%	Full Scale
Maximum Pressure	145	PSIG
Input /Output Signal Digital	Mass Flow, Volumetric Flow, Pressure & Temperature	RS-232 Serial or PROFIBUS[1]
Input / Output Signal Analog	Mass Flow	0-5Vdc
Optional Input / Output Signal Secondary Analog	Mass Flow, Volumetric Flow, Pressure or Temperature	0-5 Vdc or 0-10Vdc or 4-20mA
Electrical Connections	8 Pin Mini-DIN or DB-15	
Supply Voltage	12 to 30 Vdc (15-30Vdc for 4-20mA outputs)	
Supply Current	0.250Amp (at 12 Vdc, declining with increased supply voltage)	
Mounting Attitude Sensitivity	0%	
Warm-up Time	< 1	Second
Wetted Materials[2]	303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, Brass, 410 Stainless Steel, Silicon, Glass.	

1. If selecting PROFIBUS no analog signal is available. PROFIBUS units do not have the display. See PROFIBUS specifications for PROFIBUS supply voltages and currents.
2. If your application demands a different material, please contact Application Assistance for available options.

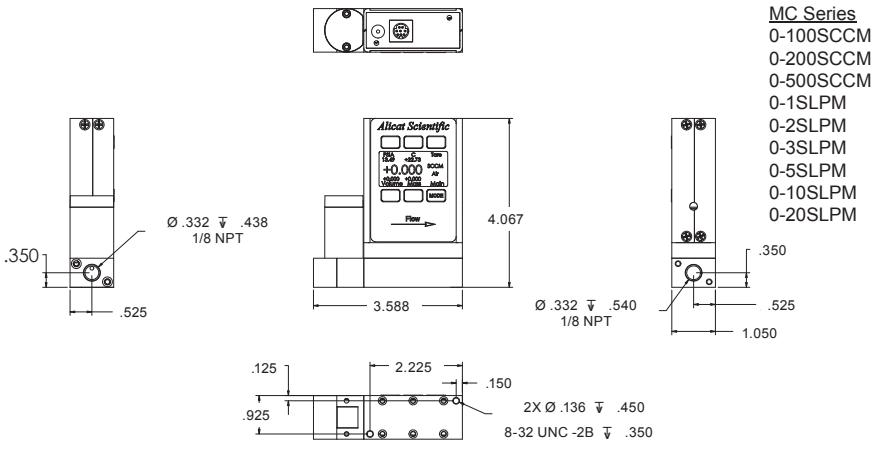
Mechanical Specifications

Full Scale Flow Mass Controller	Mechanical Dimensions	Process Connections[1]	Pressure Drop[2] (PSID)
100SCCM to 500SCCM	4.1"H x 3.6"W x 1.1"D	1/8" NPT Female	1.0
1SLPM			1.5
2SLPM			3.0
5SLPM			2.0
10SLPM			5.5
20SLPM			20.0

1. Compatible with Beswick®, Swagelok® tube, Parker®, face seal, push connect and compression adapter fittings. See page 45 for fittings.
2. Lower Pressure Drops Available, Please contact Application Assistance.



Typical 100 SCCM to 20 SLPM Controller Pressure Drop.
Improved Pressure Drops available.



100SCCM to 20SLPM approximate weight: 1.2lb

Technical Data for Moderate Flow Mass & Volumetric Flow Controllers

0 to 50SLPM Full Scale through 0 to 100SLPM Full Scale

The following specifications are for the standard configuration of the Alicat product. There are many low-cost customization options available.

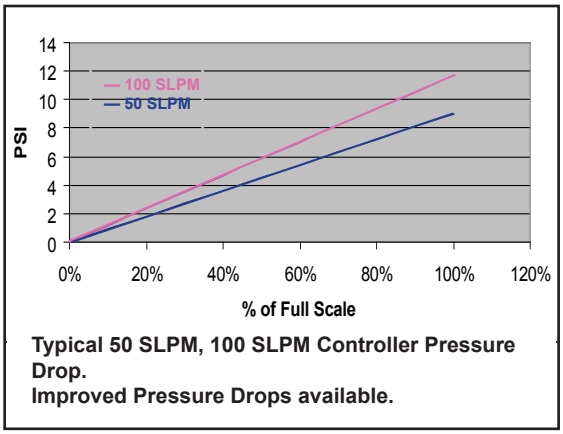
Specification	Mass Controller	Description
Accuracy	± (0.8% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
High Accuracy Option	± (0.4% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
Repeatability	± 0.2%	Full Scale
Operating Range	1% to 100% Full Scale	Measure and Control
Typical Response Time	100	Milliseconds (Adjustable)
Standard Conditions (STP)	25ºC & 14.696PSIA	Mass Reference Conditions
Operating Temperature	−10 to +50	ºCelsius
Zero Shift	0.02%	Full Scale / ºCelsius / Atm
Span Shift	0.02%	Full Scale / ºCelsius / Atm
Humidity Range	0 to 100%	Non–Condensing
Controllable Flow Rate	102.4%	Full Scale
Maximum Pressure	145	PSIG
Input /Output Signal Digital	Mass Flow, Volumetric Flow, Pressure & Temperature	RS-232 Serial or PROFIBUS[1]
Input / Output Signal Analog	Mass Flow	0-5Vdc
Optional Input / Output Signal Secondary Analog	Mass Flow, Volumetric Flow, Pressure or Temperature	0-5 Vdc or 0-10Vdc or 4-20mA
Electrical Connections	8 Pin Mini-DIN or DB-15	
Supply Voltage	24 to 30 Vdc	
Supply Current	0.750Amp	
Mounting Attitude Sensitivity	Control response somewhat sensitive to inverted operation.	
Warm-up Time	< 1	Second
Wetted Materials[2]	303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, 410 &416 Stainless Steel, Nickel, Silicon, Glass.	

1. If selecting PROFIBUS no analog signal is available. PROFIBUS units do not have the display. See PROFIBUS specifications for PROFIBUS supply voltages and currents.
2. If your application demands a different material, please contact Application Assistance for available options.

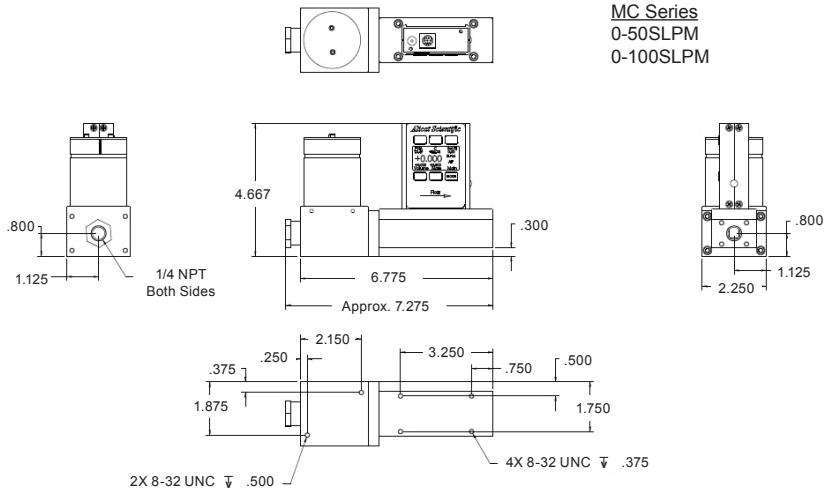
Mechanical Specifications

Full Scale Flow Mass Controller	Mechanical Dimensions	Process Connections[1]	Pressure Drop[2] (PSID)
50SLPM	4.7"H x 7.3"W x 2.3"D	1/4" NPT Female	9.0
100SLPM			11.7

1. Compatible with Beswick®, Swagelok® tube, Parker®, face seal, push connect and compression adapter fittings. See page 45 for fittings.
2. Lower Pressure Drops Available, Please contact Application Assistance.



Typical 50 SLPM, 100 SLPM Controller Pressure Drop.
Improved Pressure Drops available.



50SLPM to 100SLPM approximate weight: 6.4 lb.

Technical Data for High Flow Mass & Volumetric Flow Controllers

0 to 250SLPM Full Scale through 0 to 4000SLPM Full Scale

The following specifications are for the standard configuration of the Alicat product. There are many low-cost customization options available. For controllers above 2000SLPM please contact Alicat.

Specification	Mass Controller	Description
Accuracy	± (0.8% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
High Accuracy Option[1]	± (0.4% of Reading + 0.2% of Full Scale)	At calibration conditions after tare
Repeatability	± 0.2%	Full Scale
Operating Range	1% to 100% Full Scale	Measure and Control
Typical Response Time	100	Milliseconds (Adjustable)
Standard Conditions (STP)	25ºC & 14.696PSIA	Mass Reference Conditions
Operating Temperature	−10 to +50	ºCelsius
Zero Shift	0.02%	Full Scale / ºCelsius / Atm
Span Shift	0.02%	Full Scale / ºCelsius / Atm
Humidity Range	0 to 100%	Non–Condensing
Controllable Flow Rate	102.4%	Full Scale
Maximum Pressure	145	PSIG
Input /Output Signal Digital	Mass Flow, Volumetric Flow, Pressure & Temperature	RS-232 Serial or PROFIBUS[2]
Input / Output Signal Analog	Mass Flow	0-5Vdc
Optional Input / Output Signal Secondary Analog	Mass Flow, Volumetric Flow, Pressure or Temperature	0-5 Vdc or 0-10Vdc or 4-20mA
Electrical Connections	8 Pin Mini-DIN or DB-15	
Supply Voltage	24 to 30 Vdc	
Supply Current	0.750Amp	
Mounting Attitude Sensitivity	Control response somewhat sensitive to inverted operation.	
Warm-up Time	< 1	Second
Wetted Materials[3]	303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum, 410 & 416 Stainless Steel, Nickel, Silicon, Glass.	

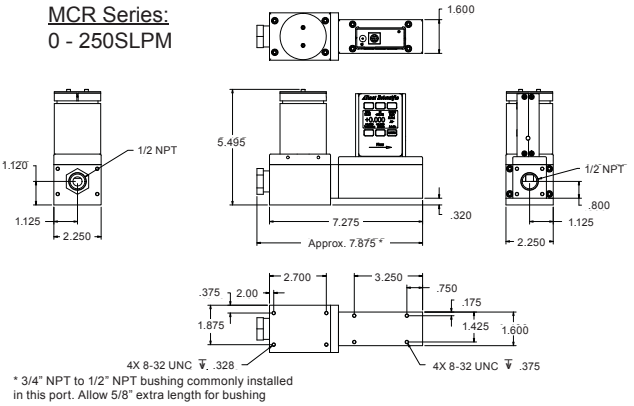
1. High Accuracy option not available for 2000SLPM units.
2. If selecting PROFIBUS no analog signal is available. PROFIBUS units do not have the display. See PROFIBUS specifications for PROFIBUS supply voltages and currents.
3. If your application demands a different material, please contact Application Assistance for available options.

Mechanical Specifications

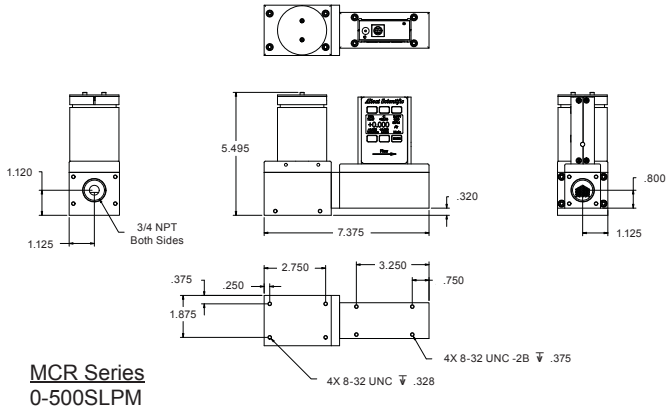
Full Scale Flow Mass Controller	Mechanical Dimensions	Process Connections[1]	Pressure Drop[2] (PSID)
250SLPM	5.5”H x 7.9”W x 2.3”D	1/2” NPT Female	4.6
500SLPM	5.5”H x 7.4”W x 2.3”D	3/4” NPT Female	6.5
1000SLPM			14.0
1500SLPM			17.0
2000SLPM	5.5”H x 8.1” W x 2.9” D		30.0

1. Compatible with Beswick®, Swagelok® tube, Parker®, face seal, push connect and compression adapter fittings. See page 45 for fittings.
2. Venting to atmosphere. Lower Pressure Drops Available, Please contact Application Assistance.

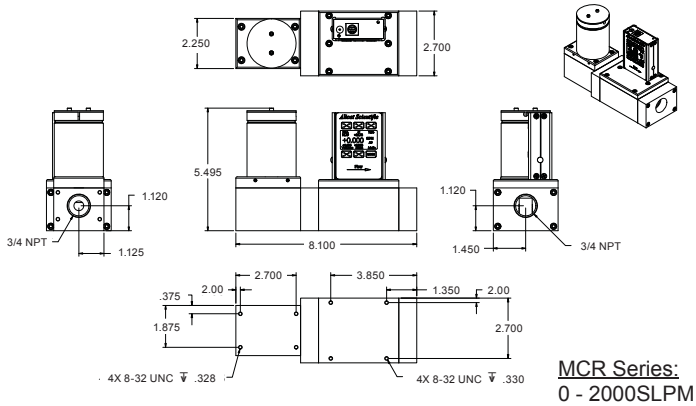
MCR Series:
0 - 250SLPM



* 3/4" NPT to 1/2" NPT bushing commonly installed in this port. Allow 5/8" extra length for bushing



MCR Series
0-500SLPM
0-1000SLPM
0-1500SLPM



MCR Series:
0 - 2000SLPM

MCR-250SLPM to 1500SLPM approximate weight: 9.0 lb.

MCR-2000SLPM approximate weight: 11.0 lb.

DIGITAL PRESSURE CONTROLLERS AND GAUGES FOR GAS AND WATER

Extraordinary Pressure Measurement and Control!

Alicat digital pressure gauges and controllers utilize multiple configurations to perform and solve pressure needs in all types of gas and water applications.

Our pressure instruments are designed specifically for demanding applications like vacuum coating or leak testing, where accuracy and stability of pressure measurement and control can make the difference between success and failure.

Whether you are controlling low vacuum, measuring pressures up to 300 PSI, working with closed volumes, flow through pressure or performing back pressure control – *the versatility of Alicat pressure instruments means that one of our devices can be custom-tailored to fit your needs and resolve your process concerns.*

Because water is about 50 times more viscous than air, please consult our engineers for sizing and PID tuning specifics if you intend to use your pressure device with water or another fluid.

PCR Series

Accurate, Repeatable and Fast

Alicat pressure gauges and controllers are an economical answer to form, fit and function — with ±0.25% or ±0.5% accuracy (depending on range), ±0.08% repeatability and a control response time of 100ms or less.

Alicat's impressive input/output options let you regulate processes with simple digital or analog signals. via the onboard PID loop controller

Although the instruments come well-tuned from the factory, you can optimize performance in the field by adjusting the P and D through either the front panel display or through RS-232 which is standard on all Alicat instruments.

Digital Pressure Control in Place of Pneumatic Pressure Control Valves

Alicat's pressure controllers use true, highly efficient proportional control valves.

Unlike traditional pneumatic pressure control valves, our digital pressure controllers give you precise control of your process.

These valves adjust to the exact position necessary to achieve the desired pressure set-point and they will maintain that pressure for extended periods of time.

Their low-friction, fast-moving design achieves set-point changes in 100ms or less.

PCD Series

Alicat Pressure Devices Are Available In Any of Nine Different Units Of Measure!								
PSIA	**PSIG**	**mmHG**	**inHG**	**inH_2O**	**mBar**	**Atm**	**Torr**	**kPa**

DIGITAL PRESSURE GAUGES AND CONTROLLERS

Stand Alone Operation

All Alicat pressure controllers have the ability to operate without a control set-point input signal.

Once the controller is powered, the control functions can be actuated through the membrane buttons and display screen or through RS-232.

No input set-point signal is required.

The controller will hold the set-point and control at a given flow rate or pressure until loss of power or the set-point is changed.

The set-point is maintained even after a power outage and reboot.

PC Series

Digital and Analog Communication Included on All Alicat Products

All Alicat instruments come with analog and digital communication. No special software is needed to communicate digitally with your Alicat mass flow meter.

Alicat provides free LabView® drivers or you can connect directly through HyperTerminal® which is standard with Windows XP® operating systems. Alicat can also provide the Flow Vision™ SC software program — designed specifically for Alicat flow and pressure products (page 11).

Multi-drop Capable

All Alicat instruments are multi-drop capable using the RS-232 digital communication.

You can link up to 26 separate Alicat instruments – each with its own addressable code.

To really simplify things, use our Model BB-9 Multi-Drop Box (page 44).

Easily Integrated into OEM Systems

Alicat's small footprint and multiple communication platforms make it the perfect device for OEM applications that require vacuum and/or positive pressure measurement and control.

Your Alicat pressure controller can be ordered with an external pressure sense port – allowing the device to measure and control pressure at any point in your system. This may permit measurement and control in areas that would otherwise be impossible to maintain.

The Alicat pressure controller can receive analog signals from other pressure or vacuum sensing devices. An example of this would be high vacuum control in an ion chamber using the output signal from an existing ion high vacuum gauge.

Separated sensor and valve configurations can be provided to overcome spatial restrictions in high flow pressure control applications.

Now Available: **ATEX / CSA** Class 1 Division 2 hazardous environment for Europe, Canada and the U.S.

PROFIBUS DP-V1 compatible. See pages 18 and 42 for more information.

RS-485 Serial Output. Please contact Alicat for more information.

Lifetime Warranty

Alicat not only brings you excellent products, we back them with a lifetime warranty, engineering support, quick delivery and low cost recalibration.

Our new order lead time is typically two weeks. Recalibrations are normally on their way back to you within three business days!

Alicat Scientific, Inc.
7641 N Business Park Drive
Tucson AZ 85743 USA

tel. 888. 290. 6060
fax. 520. 290. 0109
www.AlicatScientific.com

PRESSURE DEVICE CAPABILITIES		P	PC	PCR	PC3	PCR3	PCD	PCM	MC*	MCR*
Differential Pressure		♦	♦				♦	♦		
Vacuum		♦	♦	♦	♦	♦	♦			
Back Pressure			♦	♦					♦	♦
Gauge Pressure		♦	♦	♦	♦	♦	♦	♦		
Absolute Pressure		♦	♦	♦	♦	♦	♦	♦	♦	♦
Flow Through Pressure		♦	♦	♦	♦	♦		♦	♦	♦
Closed System — Pressure or Vacuum		♦					♦			
Remote Pressure (External Feedback)					♦	♦				
Portable Digital Gauging		♦								
High Flow >20LPM				♦		♦				♦

*Alicat's MC & MCR mass gas flow controllers can function as pressure controllers in applications where users are concerned with monitoring mass or volumetric flow rate while controlling pressure. Please see page 22.

P Series
Digital Pressure Gauges

Pressure measurements as low as –30inHG full scale to as high as 300PSI.

Alicat manufactures low power Pressure gauges ranging from –30inHG full scale to as high as 300PSIA that can operate on 7 to 30Vdc. All gauges include a display combined with analog and digital output communication.

The gauges are designed to seamlessly integrate with our flow products on one RS-232 line. This decreases time and expense in applications that require flow and pressure measurement in different physical locations of the system, but with the same Programmable Logic Controller (PLC).

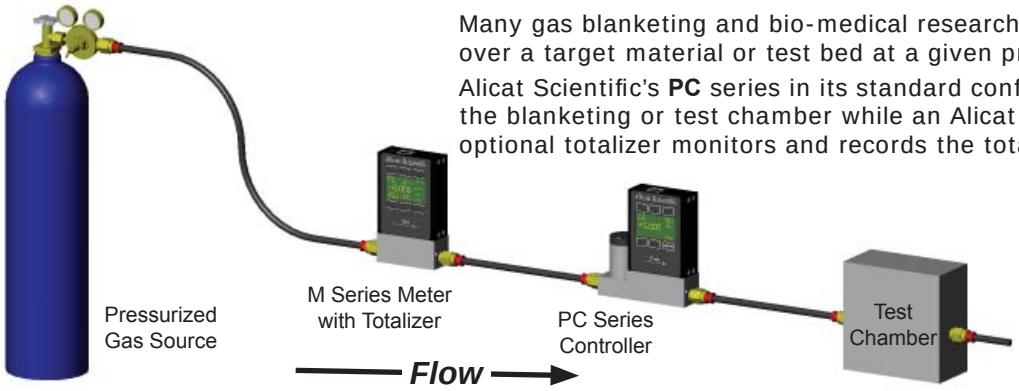
A portable pressure gauge which operates on a standard 9Vdc battery is also available (see page 40).

PC Series
Single Valve Pressure Controllers

Available in multiple configurations, the versatility of the **PC** Series allows you to control absolute pressures, gauge pressures, back pressures, and vacuum pressures.

The speed of response and stability of these digital devices offer many advantages over more common mechanical controllers. Like all Alicat instruments analog and digital communication is standard.

With 1/8th inch female NPT connection ports, the **PC** performs in-line flow through pressure control with typical ±.25% or ±.5% full scale accuracy, depending on pressure range.



Many gas blanketing and bio-medical research applications require gas flow over a target material or test bed at a given pressure.

Alicat Scientific's **PC** series in its standard configuration controls pressure in the blanketing or test chamber while an Alicat **M** series mass flow meter with optional totalizer monitors and records the total flow rate through the test area.

DIGITAL PRESSURE GAUGES AND CONTROLLERS

P & PC Series:Differential Pressure Gauges and Controllers

Differential pressure gauges measure a pressure ratio between two points in a process line.

Differential pressure controllers increase or restrict the flow in a process in order to control the pressure ratio between two points in the line.

There are a variety of applications for these devices. One of the most common is to measure or control the difference in pressure across a filter element over time or to test the filter element efficiency.

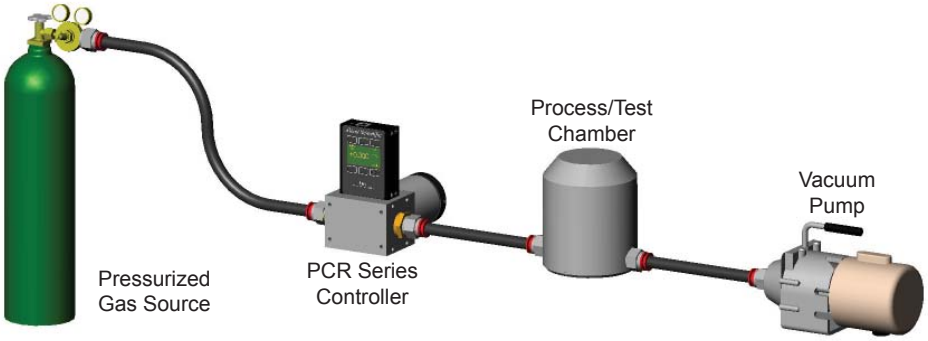
Please contact Applications Assistance for more differential pressure information.

PCR Series: High Flow Pressure Controllers

PCR Series single valve pressure controllers perform flow through pressure control in high flow applications (flows greater the 20 LPM).

The **PCR** series utilizes the Alicat **LRV** (low pressure drop valve) which is specially designed for applications requiring high mass flow rates at positive pressure or in vacuum applications with inflated volumetric flow rates.

With 3/4 inch female NPT connection ports, the **PCR** performs in-line flow through pressure control with typical ±.5% full scale accuracy and fast response.



High Flow Vacuum & Positive Pressure Control with Alicat PCR Series

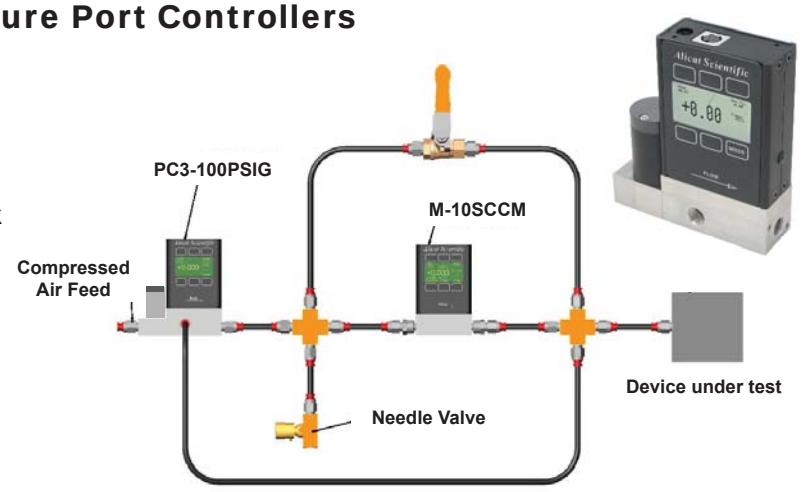
PC3 & PCR3 Series: External Pressure Port Controllers

PC3 Series single valve pressure controllers are fitted with an external pressure port for sensing and controlling pressures at a remote point in the system.

A very common application for the **PC3**, is as a leak checking instrument where maintaining a precise pressure at the testing orifice is critical.

In another application of the **PC3**, Alicat utilized multiple pressure sensors in various ranges, performing the functions of a vacuum gauge and a positive pressure controller in one device.

For High flow rates Alicat offers the **PCR3** Series which utilizes the Alicat **LRV** control valve.



Leak Test with Alicat PC3 and M Series

DIGITAL PRESSURE GAUGES AND CONTROLLERS

PC Series: External Ion Gauge Vacuum Controllers

The *External Ion Gauge Vacuum Controller* was designed specifically for the vacuum coating industry.

This innovation circumvents the low end range of our pressure sensors and allows for control of extreme vacuum conditions in the coating chamber.

The controller provides lightning fast control based on data provided by an ion gauge vacuum sensor with a linear 0-10 volt output of pressure. The controller translates the signal and precisely controls extreme vacuum pressures within the process chamber. Please see page 50 for more information.

PCD Series: Dual Valve Pressure Controllers

The **PCD** Dual Valve Pressure Controller accurately and efficiently controls pressure within a closed system with minimum loss of expensive gases through the exhaust process.

Gases are exhausted only when over pressurization is detected and released with little or no waste. This is critical when trying to maintain precise and repeatable pressure on valves or fittings during leak tests and is crucial for extending the life of your bottle gas supply.

PCD's can be used for pressure loading on fluid dispensers such as paint manufacturing processes or systems that require precise application of forces for pressure controlled actuation.

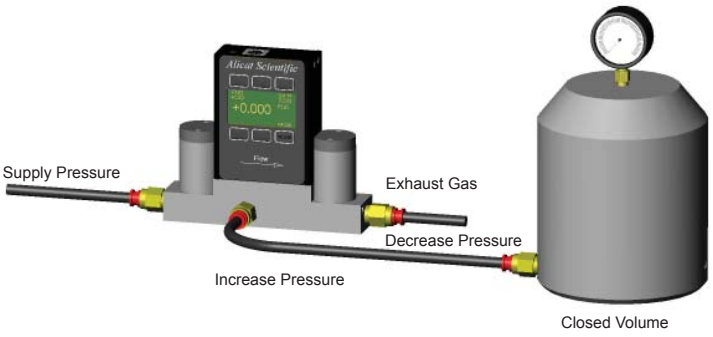
Additionally, all feed and exhaust valve adjustments are done internally through the **PCD** logic reducing processing time. This can help to free up control requirements on higher level PLCs or DCS systems, increasing speed and efficiency, while still allowing them to access data for monitoring, logging and recording of the process.

PCD for Closed Volume Pressure Control

The dual valve pressure controller is maintaining a precise pressure of medical grade helium within a closed volume.

Product within the chamber is undergoing a coating process which requires a specific pressure set-point at different intervals.

The **PCD** maintains the set-point while reducing the use of helium. The ability to reliably and consistently maintain specific pressures within the chamber increases yields and improves the quality of the end product.



The reduction in gas usage translates directly into significant savings, especially in expensive bottled gas systems.

PCM Series: Manifold Pressure Controllers

PCM Series manifold pressure controllers are custom-built for multiple pressure control OEM applications.

The **PCM** manifold incorporates an array of dual-valve pressure controllers of up to 11 units per system.

These unique custom-built devices have been utilized by bio-medical researchers and semi-conductor equipment manufacturers for precise proportional based pressure control of fluidic movement through micro-flow channels or chambers.

The mechanics of the **PCM** simplifies plumbing, while the RS-232 communication protocol consolidates electronic communications into a single simple RS-232 transmit and receive connection that communicates with all of the individual pressure controllers simultaneously.

Other configurations of **PCM's** incorporate pressure gauges in place of some of the pressure controllers for monitoring pressure at non-control points in the system.

All units in a **PCM** are configured to the volumes being controlled and the pressure ranges required (as compatible with specs on **PCD** series: Dual Valve Pressure Controllers and **P** series: Pressure Gauges).

Technical Data for Pressure Gauges & Single Valve Pressure Controllers

The following specifications are for the standard configuration of the Alicat product as shipped from the factory. PCR Series high flow pressure controllers are available for applications with required flows above 20LPM. Please contact Application Assistance for PCR specifications.

Specification	P Series	PC & PCR Series	Description
Accuracy: Full scale pressure < 2" H2O	Consult Factory		Full Scale
Accuracy: Full scale pressure ≥ 2" H2O	± 0.25%		Full Scale
High Accuracy Option: FS press ≥ 2" H2O	± 0.125%		Full Scale
Repeatability	± 0.08%		Full Scale
Turndown Ratio	200:1		
Adjustable Response Time[1]	5	100	Milliseconds
Operating Temperature	−10 to +50		Degree Celsius
Zero Shift	0.02%		Full Scale / °Celsius
Span Shift	0.02%		Full Scale / °Celsius
Excess Pressure	128% Measurable	102.4% Controllable	Full Scale
Burst Pressure	3X		Full Scale
Supply Current Peak	0.035	0.250 (***PCR: 0.750***)	Amp
Supply Voltage	7 – 30	12 – 30 (***PCR Series = 24 – 30***)	Volts dc
Input /Output Signal Standard	RS-232 Serial & 0-5Vdc or PROFIBUS[2]		
Electrical Connections	8 Pin Mini-DIN or DB-15		
Wetted Materials[3]	302 & 303 Stainless Steel, Viton®. Silicone RTV, Silicon, Glass. All Controllers add: 400 Series Stainless Steel. PC Series Controllers only add: Brass		

1. Volumes, feed pressures, exhaust pressures and line sizing will determine the limits of response times
2. If selecting PROFIBUS no analog signal is available. PROFIBUS units do not have the display. See PROFIBUS specifications for PROFIBUS supply voltages and currents.
3. If your application demands a different material, please contact Application Assistance for available options.

Select One Unit of Measure when Ordering				
PSIA	PSIG	mmHG	inHG	inH_2O
mBar	Atm	Torr	kPa	

Mechanical Specifications

Pressure Product	Mechanical Dimensions	Process Connections[1]
P Series Gauges	4.1"H x 2.4"W x 1.1"D	1/8" NPT Female
PC Series Controllers	4.1"H x 3.6"W x 1.1"D	1/8" NPT Female
PCR Series Controllers	5.5"H x 3.0"W x 5.5"D	3/4" NPT Female

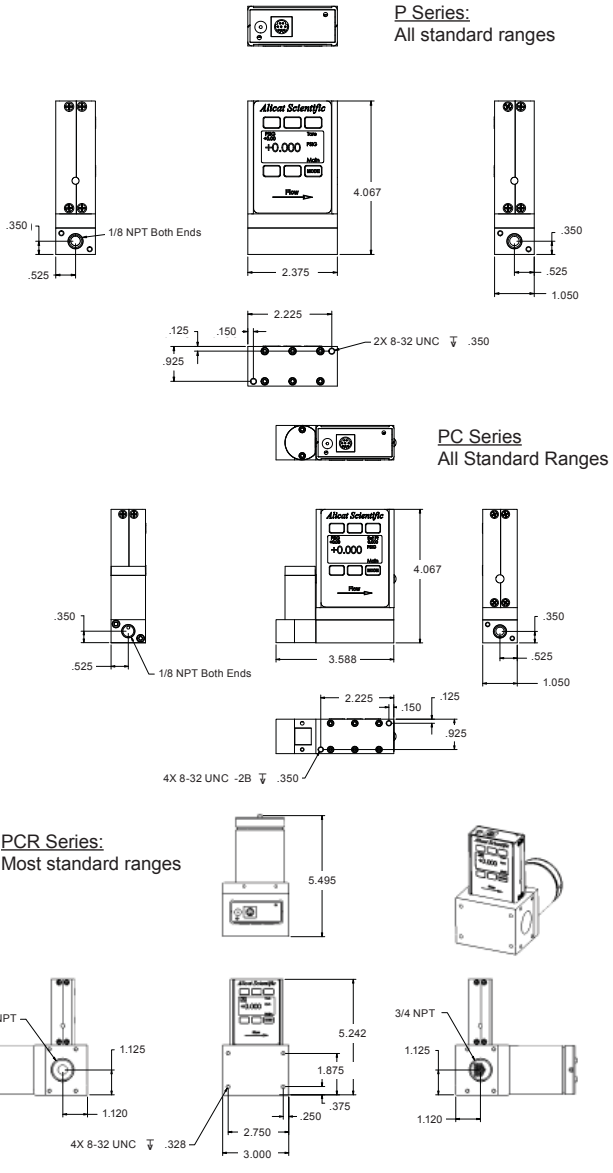
1) Compatible with Swagelok® tube, Parker®, face seal, push connect & compression fittings. Alternates available. See page 45 for fittings.

P Series Gauges			PC, PCR Series Controllers		
-15PSIG to 0PSIG			-15PSIG to 0PSIG		
2inH_2OD	2inH_2OG		2inH_2OD	2inH_2OG	
4inH_2OD	4inH_2OG		4inH_2OD	4inH_2OG	
1PSID	1PSIG		1PSID	1PSIG	
5PSID	5PSIG		5PSID	5PSIG	
15PSID	15PSIG	15PSIA	15PSID	15PSIG	15PSIA
30PSID	30PSIG	30PSIA	30PSID	30PSIG	30PSIA
100PSID	100PSIG	100PSIA	100PSID	100PSIG	100PSIA
150PSID		300PSIA	150PSID		300PSIA
Other ranges available. Please contact Application Assistance.					

P Series Gauges All Standard Ranges approximate weight: 1.0 lb.

PC Series Controllers All Standard Ranges approximate weight: 1.2 lb

PCR Series Controllers All Standard Ranges approximate weight: 4.8 l



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Technical Data for Dual Valve Pressure Controllers

The following specifications are for the standard configuration of the Alicat product as shipped from the factory.

Specification	PCD Series	Description
Accuracy: Full scale pressure < 2" H2O	Consult Factory	Full Scale
Accuracy: Full scale pressure ≥ 2" H2O	± 0.25%	Full Scale
High Accuracy Option: FS press ≥ 2" H2O	± 0.125%	Full Scale
Feed Valve Orifice	0.050	Inches
Exhaust Valve Orifice	0.050	Inches
Alternate Valve Orifices Available	0.010 or 0.030	Inches
Repeatability	± 0.08%	Full Scale
Turndown Ratio	200:1	
Adjustable Response Time[1]	≤100	Milliseconds
Operating Temperature	−10 to +50	Degree Celsius
Zero Shift	0.02%	Full Scale / °Celsius
Span Shift	0.02%	Full Scale / °Celsius
Excess Pressure	102.4% Controllable	Full Scale
Burst Pressure	≥3X	Full Scale
Supply Current Peak	0.250	Amp
Supply Current Average	0.050	Amp
Supply Voltage	12 – 30	Volts dc
Input /Output Signal Standard	RS-232 Serial & 0-5Vdc or PROFIBUS[2]	
Electrical Connections	8 Pin Mini-DIN or DB-15	
Wetted Materials[3]	302 & 303 Stainless Steel, Viton®, Silicone RTV, Brass, 400 Series Stainless Steel (standard units are for non-corrosive gases), Silicon, Glass.	

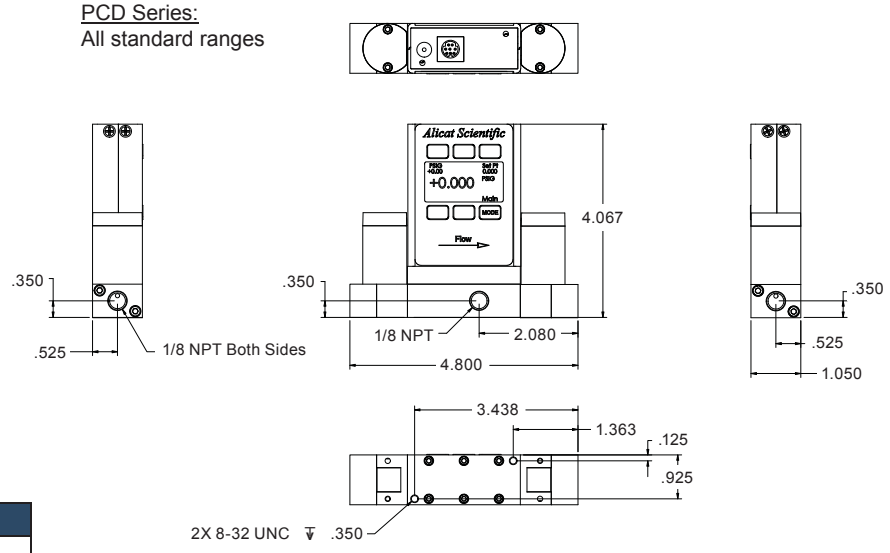
1. Volumes, feed pressures, exhaust pressures and line sizing will determine the limits of response times
2. If selecting PROFIBUS no analog signal is available. PROFIBUS units do not have the display. See PROFIBUS specifications for PROFIBUS supply voltages and currents. Please contact Applications Assistance for PCD - PROFIBUS options.
3. If your application demands a different material, please contact Application Assistance for available options.

Mechanical Specifications PCD Series Dual Valve Controller	Mechanical Dimensions	Process Connections[1]
All Standard Ranges	4.1"H x 4.8"W x 1.1"D	1/8" NPT Female

1. Compatible with Swagelok® tube, Parker®, face seal, push connect and compression fittings. Alternates available. See page 45 for fittings.

PCD Series Pressure Controllers		
-15PSIG to 0PSIG		
2inH2OD	2inH2OG	
4inH2OD	4inH2OG	
1PSID	1PSIG	
5PSID	5PSIG	
15PSID	15PSIG	15PSIA
30PSID	30PSIG	30PSIA
100PSID	100PSIG	100PSIA
150PSID		300PSIA
Other ranges available. Please contact Application Assistance.		

PCD Series:
All standard ranges



Select One Unit of Measure when Ordering		
PSIA	inHG	Atm
PSIG	inH_2O	Torr
mmHG	mBar	kPa

All Standard Ranges approximate weight: 1.4 lb.

METERS AND CONTROLLERS FOR WATER

Differential Pressure Laminar Flow Measurement

Alicat liquid meters and controllers operate on the same patented laminar differential pressure technology as found in all Alicat flow products.

In large scale industrial applications, differential pressure technology accounts for over 50% of liquid flow measurement. Now, Alicat allows you to benefit from this proven method of measurement in your very low flow water metering and control applications.

Alicat instruments measure differential pressure within a laminar flow region to determine volumetric flow rate. Flow is inherently linear in the laminar region so no linearization curve is required.

By measuring the temperature, viscosity of the water is calculated. Using differential pressure to determine velocity and knowing the viscosity, the internal microprocessor calculates the volumetric flow rate within ±2.0% of full scale.

Low Flow and High Turndown with Laminar Technology

Alicat **L** series meters can measure flow rates as low as 0.5CCM full scale through flow rates as high as 10LPM full scale with a turndown ratio of 50:1 and ±2% accuracy of full scale!

LC series controllers will control liquid flows from 50CCM full scale through 5LPM full scale with a turndown ratio of 50:1 while still maintaining an accuracy of + 2.0% full scale.

The **LCR** is the high flow controller with a range of 1LPM to 5LPM and utilizes Alicat's LRV control valve designed for high flow and low pressure drop.

Both meters and controllers are equipped with bleed ports so that air may be easily removed.

No special plumbing, straight runs of pipe or reference charts are required to operate the Alicat meters and controllers.

L Series

Multiple Parameter Measurement

A discrete pressure sensor lets you read three independent pieces of information:
water flow, water temperature and water pressure — in one compact device.

No Warm-Up Time!

In less than one second after power up, you are ready to begin accurate measurement and control of your process.

Now Available:

ATEX / CSA Class 1 Division 2 hazardous environment for Europe, Canada and the U.S.

PROFIBUS DP-V1 compatible. See pages 18 and 42 for more information.

RS-485 Serial Output. Please contact Alicat for more information..

LC Series

Field Adjustable PID

Although the instruments come well-tuned from the factory, you can optimize your Alicat Liquid flow controller performance in the field by adjusting the P or D via the front panel display or through RS-232.

Stand Alone Operation

All Alicat controllers have the ability to operate without a control set-point input signal.

Once the Alicat controller is powered, the control functions can be actuated through the membrane buttons and display screen or through RS-232.

No input set-point signal is required.

The controller will hold the set-point and control at a given flow rate or pressure until loss of power or the set-point is changed.

The set-point is maintained even after a power outage and reboot.

LCR Series

Pressure Gauges and Pressure Controllers for Water

Alicat **P** and **PC** series pressure instruments are perfect for many water pressure applications. Please see pages 25-31 and contact our engineers for details.

Digital and Analog Communication Included on All Alicat Products

All Alicat instruments come with analog and digital communication. No special software is needed to communicate digitally with your Alicat mass flow meter.

Alicat provides free LabView® drivers or you can connect directly through HyperTerminal® which is standard with Windows XP® operating systems. Alicat can also provide the Flow Vision™ SC software program — designed specifically for Alicat flow and pressure products. flow and pressure products (page 11).

You can also use our BB-9 Multi-Drop Box (page 44) to integrate up to 26 Alicat devices via a single RS-232 signal line.

Lifetime Warranty and Quick Turnaround

Alicat not only brings you excellent products, we back them with a lifetime warranty, engineering support, quick delivery and low cost recalibration.

Our new order lead time is typically two weeks. Recalibrations are normally on their way back to you within three business days!

Technical Data for Water Flow Meters & Water Flow Controllers

The following specifications are for the standard configuration of the Alicat product. There are many low-cost customization options available.

Basic Specification	L Series	LC Series	LCR Series	Description
Available Ranges	0.5CCM to 10LPM	5CCM to 500CCM	1LPM to 5LPM	Full Scale
Accuracy	±2%			Full Scale
Repeatability	± 2%			Full Scale
Operating Range	2% to 100% Full Scale			Measure or Control
Typical Response Time	20	100		Milliseconds (Adjustable)
Operating Temperature	+10 to +50			ºCelsius
Zero Shift	0.02%			Full Scale / ºCelsius / Atm
Span Shift	0.02%			Full Scale / ºCelsius / Atm
Flow Rate	128% Measurable	102.4% Controllable		Full Scale
Common Mode Pressure	100			PSIG
Input /Output Signal Digital	Pressure & Temperature or Flow			RS-232 Serial
Input / Output Signal Analog	Volumetric Flow			0-5Vdc
Optional Input / Output Signal Secondary Analog	Pressure or Temperature or Flow			0-5 Vdc or 0-10Vdc or 4-20mA
Electrical Connections	8 Pin			Mini-DIN
Supply Voltage	7 to 30[1]	12 to 30[1]	24 to 30	Vdc
Supply Current	0.035	0.250	0.750	Amp
Mounting Attitude Sensitivity	None	Control response somewhat sensitive to inverted operation.		Tare after installation
Warm-up Time	< 1			Second
Wetted Materials[2]	303 & 302 Stainless Steel, Viton®, Polyethermide, Silicon, Glass. LC and LCR Controllers Add: 400 Series Stainless Steel, Nickel. LC Controllers only also add Brass.			

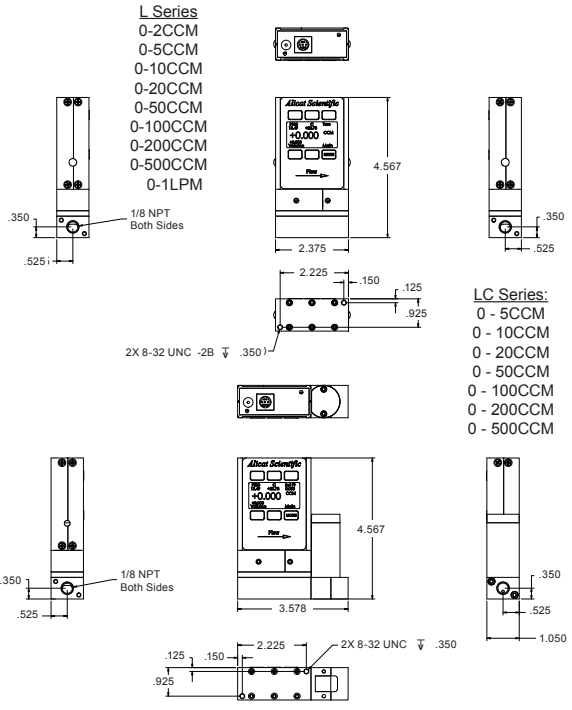
1. 15 volts required for 4-20mA output.
2. If your application demands a different material, please contact Application Assistance for available options.

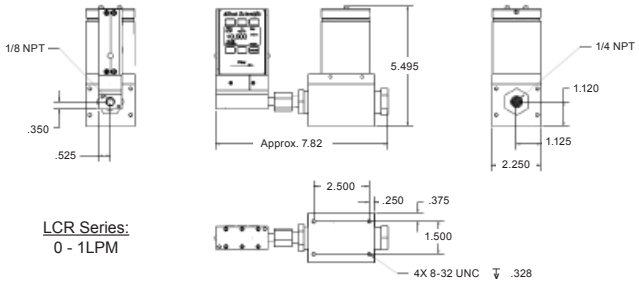
Mechanical Specifications

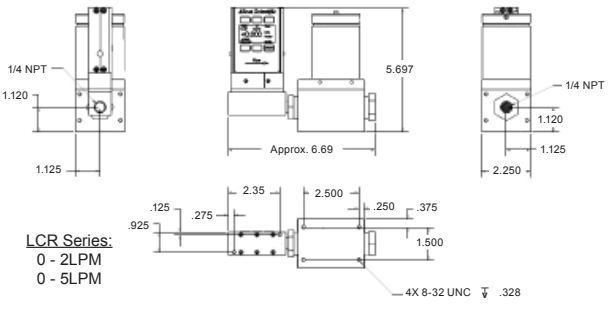
Full Scale Flow	Mechanical Dimensions	Process Connections[1]	Pressure Drop[2] (PSID)
L Series			
0.5CCM to 1CCM	4.4"H x 2.4"W x 1.1"D	**M5 (10-32) Female***	2.0
2CCM to 500CCM	4.6"H x 2.4"W x 1.1"D	1/8" NPT Female	2.0
1LPM			4.0
2LPM	4.8"H x 2.7"W x 1.1"D	1/4" NPT Female	4.0
5LPM			10.0
10LPM			20.0
LC Series			
5CCM to 100CCM	4.6"H x 3.6"W x 1.1"D	1/8" NPT Female	5.0
200CCM to 500CCM			7.5
LCR Series			
1LPM	5.5"H x 7.9"W x 2.3"D	1/8" & 1/4"NPT Female	4.0
2LPM	5.7"H x 6.7"W x 2.3"D	1/4" Female	4.0
5LPM			10.0

Units ≤1CCM F.S. are shipped with M5 (10-32) Male Buna-N O-ring face seal to 1/8" Female NPT adapters. To minimize dead volume, see page 45 for the M5 (10-32) Male to 1/8"OD compression fitting.

1. Compatible with Beswick®, Swagelok® tube, Parker®, face seal, push connect and compression fittings.
2. Lower Pressure Drops Available, Please contact Application Assistance.







L Series 0.5CCM to 1CCM approx. 1.0 lb; 2CCM to 1LPM ≈ 1.3lb; 2LPM to 10LPM ≈ 2.2 lb. **LC Series** 0.50CCM to 500CCM ≈ 1.2 lb. **LCR Series** 1-5LPM ≈ 6.8 lb.

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FLUID DENSITY METER

Alicat Scientifc's Fluid Density Meter is for use with liquids having densities of 0.7000 to 2.000 g/cc and viscosity of less than 50 cP such as water-methanol mixtures and liquid fuels.

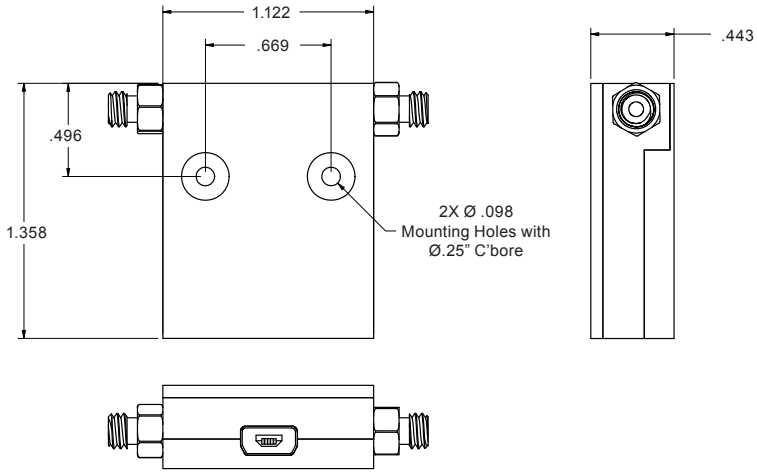
Model FD-20CCM-B

- ► Extremely Accurate at Low Concentrations
- ► Excellent Temperature Stability
- ► Small Size (34.5mm x 28.5mm x 10mm)
- ► 0-2V Analog Output Option
- ► Concentration or Density Outputs Available
- ► 3.5 Digit Accuracy @ 10 samples/second
- ► Static and Continuous Flow Capable

APPLICATIONS

- ► Fuel Cell Monitoring
- ► Alcohol Concentration / Dilution Levels
- ► Chemical Mixtures

Actual Size



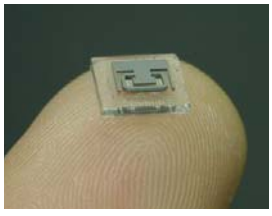


Photo of MEMS Microfluidic Density Sensor
(topcap removed to show detail)

PORTABLE
FLOW METERS AND PRESSURE GAUGES

Laboratories, industrial plants, process facilities and field technicians have all gained substantial advantages from Alicat portable flow meters and pressure gauges.

Instead of spending your time finding (or hard wiring) a power source, you can utilize our portable meter with gas selection and multiple parameter measurement features to:

Verify proper operation of equipment, *including* other manufacturer's flow meters and flow controllers

Maintain proper equipment settings as components within the system wear down

Search for leaks in the system utilizing the pressure reading or the flow reading

Install equipment and perform initial tuning and adjustments in the field

Perform periodic system checks for quality control and verification

A common 9Vdc battery powers one of our portable M Series meters for 8 - 10 hours!

This affordable device displays mass flow & volumetric flow along with process temperature and pressure for 30 field selectable gases.

The unit can also be powered with an optional AC/DC plug-in adaptor.

Many of our customization features are compatible with our Portable Meters, including:

- Alternate STPs to simplify comparisons to other flow devices
- High accuracy calibration
- Gas mixture calibrations or special gases
- Integrated Totalizer for tests that require long term averaging.

Industrial Carrying Case

The industrial case is a rugged and attractive storage accessory that complements your portable meter or any Alicat device. These molded plastic cases are gasket sealed, providing an air and watertight closure. Alicat industrial cases have a barometric relief valve to prevent damage to the case or to the Alicat flow instrument inside when the air pressure in the environment changes.

Approximate case dimensions: 10.5" L x 9.5" W x 5" H

PORTABLE CALIBRATION UNIT

MOBILE SECONDARY CALIBRATION STANDARD

Alicat's **Portable Calibration Unit (PCU)** is a self contained, portable secondary calibration standard that is easy to transport and use.

You don't have to waste engineering time or lose revenue for equipment downtime while verifying calibration on in-service flow equipment.

The Alicat PCU is built into an industrial Pelican® case and can be taken anywhere you need it!

Unlike typical secondary standards, **the PCU is fully self-contained and requires no additional support equipment or line power**.

It is as simple as having your technician arrive on site, plug the unit into the system and take readings.

The PCU also has **on-board digital output** enabling it to send flow data to your laptop or computer system.

The PCU is comprised of three Alicat M series flow meters powered by two common 9Vdc batteries or a 9-20Vdc wall outlet adaptor.

Like Alicat's standard line of flow devices the PCU has no moving parts to service or fail.

You specify the ranges of the flow meters when ordering the PCU.

Approximate case dimensions: 16' L x 13' W x 7'H

Approximate weight: 12 - 20 lb depending on configuration

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CUSTOM OPTIONS

ATEX AND CSA CLASS 1 DIVISION 2

Continuing Alicat's mission of providing equipment to fit a wider range of customer requirements, Alicat has attained ATEX and CSA approval for the use of Alicat Mass Flow Meters, Mass Flow Controllers and Pressure Equipment in Class 1 Division 2 hazardous environments for Europe, Canada and the United States.

In an expanding alternative energy industry, and an increasingly safety concerned manufacturing industry, the Class 1 Division 2 rating makes Alicat's precision devices even easier to integrate into your factory or research application.

Alicat devices can be ordered in the approved configuration with no extension of lead time. All Alicat ATEX/CSA approved devices have group ABCD approval.

C US

PROFIBUS

PROFIBUS DP-V1 compatibility is now available for any Alicat device.

- ► PROFIBUS DP-V1 slave
- ► Power over PROFIBUS connector option
- ► Two DB-9 connectors
  - — Female (std PROFIBUS)
  - — Male (Power and Ground)
- ► Auto Baud Rate Detect
- ► Easy integration into your PROFIBUS systems.

Please see page 18 for PROFIBUS specifications

DB15 CONNECTOR

The **DB15** style electrical connector is available as an alternative to Alicat's standard 8-pin mini-din connection or optional 6-pin locking industrial connection.

The **DB15** pin-outs can be configured to easily integrate with many existing 15-pin cabling set-ups.

WELDED FITTINGS

For high purity applications in which cleanliness of the gas stream is paramount, Alicat offers welded VCR® and VCO® style fittings.

VCR® and VCO® fittings are commonly used in vacuum and low pressure processes.

Welded fittings are available on almost all Alicat products and can be ordered in a variety of configurations. Please contact the factory for more information.

REMOTE DISPLAY

Embed Alicat measurement technology without losing the functionality of our dynamic display!

Our Remote Display (RD) option **offers the flexibility of using Alicat's display with units that are embedded inside processes**. The RD retains all of the same features as our standard display.

The RD option is available for any Alicat flow or pressure device. A cable as long as 12 feet can be used between the flow body and the display. *(For applications requiring longer cables please contact Alicat)*

Our digital display allows you to monitor flow, temperature and pressure data in real time. Depending on the device, the display also permits you to easily select a gas, control set-point or activate tare.

The Remote Display is ideal for:

- ► OEMs Remote Panel mounting
- ► Gas panels
- ► Leak detection systems
- ► Embedded systems
- ► Fuel cell test stations
- ► Artifical environments

REMOTE ELECTRONICS
FOR HIGH TEMPERATURE APPLICATIONS

Some applications involve ambient and operating temperatures outside the standard Alicat device specifications. Our Remote Electronics option addresses this dilemma.

Relocating the electronics allows for installation of the flow body in ambient temperatures as high as 85° Celsius with gas temperatures up to 100° Celsius.

In these applications, we recommend our custom calibration at gas temperatures up to 70° Celsius. This will reduce measurement errors that occur when actual gas flow temperatures deviate substantially from the gas calibration temperature.

Remote Electronics can also be useful in applications that require the installation of a compact flow package.

NESSI COMPATIBLE

Alicat Scientific is a proud participant in **NeSSI** (**Ne**w **S**ampling/**S**ensor **I**nitiative).

Many Alicat instruments are now available in a **NeSSI** compatible design.

If your application calls for a **NeSSI** device, please let us know. We are committed to providing superior instruments that will meet your requirements.

ACCESSORIES

BB-9 Multi-Drop Box makes it convenient to wire multiple flow and/or pressure devices to a single RS-232 port.

The Multi-Drop Box has nine 8 pin mini-DIN ports. Standard double ended 8 pin mini-DIN (DC-62) style cables go from the box to each flow or pressure device.

A single DB9 D-SUB type connector (COM PORT) connects to the serial connector on your PC or laptop. Each of the flow and/or pressure devices is powered via the terminal block.

If more than nine devices are required, up to three Multi-Drop Boxes can be daisy chained with double ended 8 pin mini-DIN cables.

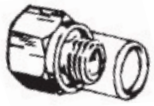
*The **BB-9** is also available with 6-pin locking industrial connector ports.*

Power Supply

Power supplies are typically ordered to facilitate “out of box” use of Alicat devices when it is inconvenient or impossible to provide DC power to a device through the electrical connector.

PVPS24U: This universal power adapter accepts 100 to 240 VAC 50/60 Hz power and changes it to a regulated 24 Vdc capable of producing 1000mA. The adapter includes five interchangeable AC plugs for convenient use world-wide.

Fittings, Filters, Adapters



We carry a full line of Swagelok® compression fittings in 316 stainless steel. Other fittings and filters are available upon request.

MNPT to Compression Fittings	
10-32 - 1/8”	SS-200-1-0157
10-32 - 1/4”	SS-400-1-0256
1/8” - 1/8”	SS-200-1-2
1/8” - 1/4”	SS-400-1-2
1/8” - 3/8”	SS-600-1-2
1/8” - 1/2”	SS-810-1-2
1/8” - 3mm	SS-3M0-1-2
1/8” - 4mm	SS-4M0-1-2
1/8” - 6mm	SS-6M0-1-2
1/8” - 8mm	SS-8M0-1-2
1/8” - 12mm	SS-12M0-1-2
1/4” - 1/8”	SS-200-1-4
1/4” - 1/4”	SS-400-1-4
1/4” - 3/8”	SS-600-1-4
1/4” - 1/2”	SS-810-1-4
1/4” - 3mm	SS-3M0-1-4
1/4” - 4mm	SS-4M0-1-4
1/4” - 6mm	SS-6M0-1-4
1/4” - 8mm	SS-8M0-1-4

MNPT to Compression Fittings	
1/4” - 12mm	SS-12M0-1-4
1/2” - 1/8”	SS-200-1-8
1/2” - 1/4”	SS-400-1-8
1/2” - 3/8”	SS-600-1-8
1/2” - 1/2”	SS-810-1-8
1/2” - 3/4”	SS-1210-1-8
1/2” - 6mm	SS-6M0-1-8
1/2” - 8mm	SS-8M0-1-8
1/2” - 12mm	SS-12M0-1-8
1/2” - 16mm	SS-16M0-1-8
3/4” - 1/4”	SS-400-1-12
3/4” - 1/2”	SS-810-1-12
3/4” - 3/4”	SS-1210-1-12
3/4” - 12mm	SS-12M0-1-12
3/4” - 16mm	SS-16M0-1-12

Filters & Elements FNPT-MNPT	
10-32 5µ	510053
10-32 20µ	510054
1/8” 20µ	ILF-1/8-20
1/4” 40µ	ILF-1/4-40
1/2” 40µ	ILF-1/2-40*
3/4” 40µ	ILF-3/4-40*
20µ element	ILFE20
40µ element	ILFE40
40µ element	ILFE40L*

Filters & Elements FNPT-FNPT*	
10-32 5µ	CF-303-20-316
*requires MNPT to MNPT coupler to interface with Alicat flow bodies	

10-32 Male UNF to 1/8 FNPT Adapter
410133
Male M5 (10-32) Buna-N O-ring face seal to 1/8”Female NPT

*Our micro-flow devices (i.e. gases ≤50SCCM full scale and water ≤1CCM full scale) utilize an M5 (10-32) thread female process connection. This connection was chosen to provide a thread that is compatible with miniature process fittings.

Connecting Cables - Recommended Accessory

The electrical connector on all Alicat units is female. A male connecting cable can be ordered:
to provide power to the unit from a customer supplied dc voltage source;
to access output and input signals in communication;
to activate remote tare.

DC-61: 8-pin circular mini-din connector cable. 6' long with one male connector. The opposite end is blunt cut with color-coded wires.

DC-251: Identical to DC-61, except 25' long cable.

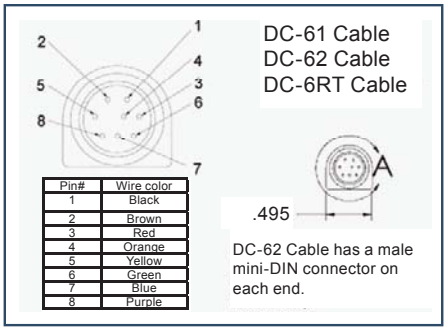
DC-6RT: Lower profile alternative. This is a right angle, 8-pin circular mini-din connector cable at 6' long with one male connector. The opposite end is blunt cut with color-coded wires.

DC-62: Double-ended male 8-pin circular mini-din connector cable in 6' length. It is a straight pin-to-pin cable.

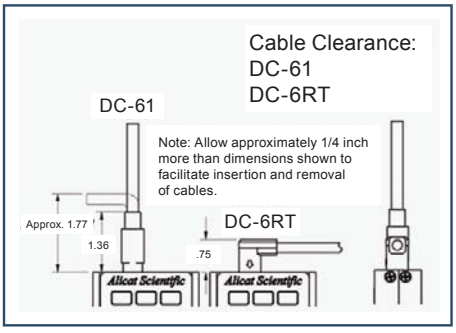
DC-252: Identical to DC-62, except 25' long cable.

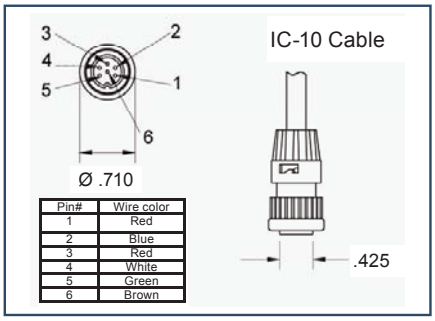
IC-10: 6-pin industrial style locking cable, 10' long with one male connector. Opposite end is blunt cut with color-coded wires. This cable reduces the number of optional signal configurations.

MD8DB9: Male 8-pin circular din to female DB9 adapter cable, 6" long, typically used to simplify connection direct to a PC. *It will not pass through power to the unit*.

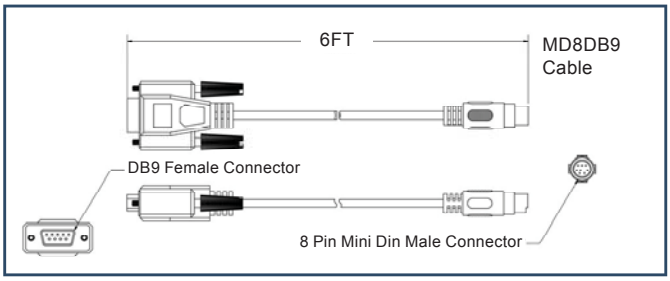


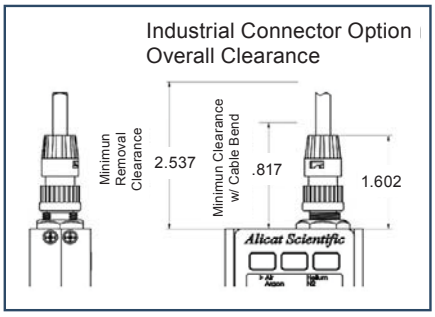
Pin#	Wire color
1	Black
2	Brown
3	Red
4	Orange
5	Yellow
6	Green
7	Blue
8	Purple

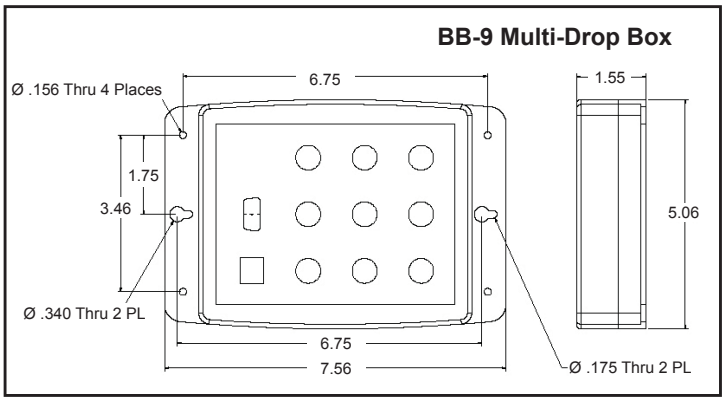




Pin#	Wire color
1	Red
2	Blue
3	Red
4	White
5	Green
6	Brown







CUSTOMIZATION

There are many ways our units may be tailored to fit your specific application, typically for a low fee. Our engineers are available to assist you with any questions you may have regarding the optimal configuration for your application. Please call us or contact an engineer at info@alicatscientific.com for further information.

Gas Mixtures

Available on M, MC, and MCR units, Alicat Scientific can calibrate to a wide variety of complex gas mixtures involving up to four gas constituents. The percentage of each gas is required at the time of order for the calculation of the mixture's viscosity vs. temperature curve characteristics. The gas mixture will then be added to the device's gas calibration list. The mix can be selected via RS-232 or local display. Alternately, we can suppress the 30 gas selection and default a device to a specific gas mixture calibration.

Industrial Connector, 6-pin locking

A locking 6-pin industrial connector can be added to any device. The industrial connector has a limited number of total output options in comparison to the standard 8-pin DIN connector.

Customized Pressure Drops

The M, MC, MCR, and LC units may be customized for lower pressure drops. Depending on the range, a 50% or greater reduction in pressure drop is obtainable. However, as the pressure drop decreases it is possible the accuracy of the device will also degrade by as much as ± 2% of full scale. When low-drop device part numbers are provided, revised accuracy specifications are included.

Vacuum Applications

Standard Alicat M Series flow meters will work with vacuum applications down to 11.5 PSIA without changes to ordered part. Lower pressures (to 1.5 PSIA) are possible with customization.

Alicat MC and MCR controllers can also be utilized for both positive and vacuum applications. It is strongly encouraged that at time of order you request a downstream valve. There is no charge for this option.

Alternate STPs (Standard Temperature and Pressure)

Alicat M, MC & MCR devices use a default STP of 25°C and 14.696PSIA in flow calibration. We have designed our units so that at no cost you may order an alternate STP. The device STP is stated on the calibration sheet. Other common STPs include 0°C & 14.696PSIA and 20°C & 14.696PSIA.

Low Pressure Drop Meters and Controllers

Alicat mass flow meters and controllers have one of the lowest pressure drops in the industry, still there are applications where pressure drop across a device is critical. For those applications Alicat can provide a specially designed body with more sensitive pressure sensors and in many instances cut the pressure drop in half. For more information, please contact the factory or your local representative.

Bi-Directional Flow Readings

Alicat M Series gas meters can be ordered with a full scale calibration in both directions. Display and RS-232 mass flow outputs indicate direction of flow with "+" and "-" signs. Includes NIST traceable calibration in both directions. Note, device accuracy is based on total span; ± (0.8% of reading + 0.2% of total span positive full scale to negative full scale), e.g. a 2SLPM meter with bi-directional flow @ +1SLPM reading or @ -1SLPM reading has an accuracy specification of ±0.016SLPM. 0-5Vdc and 0-10Vdc analog bi-directional outputs available, for example:

5BDM	0-5Vdc bi-directional output of mass flow.	Zero flow point at 2.5Vdc
10BDM	0-10Vdc bi-directional output of mass flow.	Zero flow point at 5Vdc
CBDV	4-20mA bi-directional output of volumetric flow.	Zero flow point at 12mA

Totalizer

Flow meters and controllers can be ordered with the Totalizing 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 meter or controller since the last time the Totalizer was cleared. The counter resolution is six digits (leading zeroes supressed).

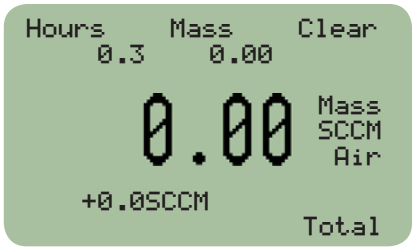
At the time of order, you specify the resolution of the count. For instance, if a resolution of 1/100ths of a liter is specified for a meter, which is totalizing in liters, the maximum count would be 9999.99 liters. If the same unit were specified with a 1 liter resolution, the maximum count would be 999999 liters.

You will also choose what the Totalizer is to do when the maximum count is reached:

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 rollover error (OVR) and continues counting until the counter is cleared.



Mass Device Totalizer Display

The display shows the elapsed time since the last reset in 0.1 hour increments. The maximum measurable elapsed time is 6553.5 hours (about nine months). The hours count resets when the “Clear” button is pushed, an RS-232 clear is executed, or on loss of power (a battery back-up can prevent Totalizer clear when power is lost). The counter can be reset to zero at any time by pushing the “Clear” button or via an RS-232 serial command.

Pulse Output (PUL: Flow):

Available on all flow devices, the pulse output option is a simplified totalizer. It is available on pin 2 of the 8-pin mini din connector. Units with the pulse output function do not have the static 5.12Vdc output, the option for a secondary analog output or alarm. The parameters for the pulse output are factory set and must be requested at time of order. This option will create a state change on pin 2 from 0Vdc to 5Vdc (or 5Vdc to 0Vdc on alternate periods) each time the total amount of predefined flow passes through the unit. For example:

M-10SLPM-D /5M, PUL:0.1SL

Every time a total flow of 0.1 standard liter passes through the unit, Pin 2 will go from 0 to 5Vdc.

Alarms

Alicat M, L or P Series meters and gauges can be ordered with a simple alarm. You can program in the field the alarm set-point via the local display, RS-232 or analog input. There are two types of alarms available. Both types operate on pin 2 of the 8-pin mini-din connector (detailed diagram page 10). Units with the alarm function do not have the static 5.12Vdc output, the option for a secondary analog output or the pulse ability.

ALH: This alarm format, which is programmed by the factory, will cause pin 2 to go from a 0Vdc output directly to a 5Vdc output when the alarm set-point is exceed. For example, a 0-20SLPM mass meter (M) is programmed by the user with an alarm condition of 13.75SLPM. When the flow exceeds 13.75SLPM, pin 2 will change state to a 5Vdc output. For a pressure gauge (P) series, the alarm state change will occur when the pressure exceeds the set-point .

ALL: This alarm format is similar to the ALH option, except the state change to 5Vdc occurs when the process parameter (flow or pressure) is under the set-point .

Alternate Units of Measure

All devices are listed in full-scale ranges of cubic centimeters/minute, liters/minute or pounds/square inch. Alternate units of measure are available at no additional cost. Commonly requested alternate units of measure include SCFM, SCFH, mmHG, and inH_2O.

Please consult the factory for additional customization options, including:

Customized process connections
Alternate materials of construction (e.g. aluminum bodies to reduce weight)
Complete private label package (labels, software, manuals, etc.)

HIGH FLOW, LOW PRESSURE DROP VALVES

With a Turndown of 1000 to 1 or Better!

Originally designed for use with Alicat control products, our high flow, low pressure drop **LRV** valves are now available for other applications.

The **LRV** valves are proportional control valves, but they are "flow blind" devices that must receive continuous updates in control voltages.

These valves are designed for processes that can provide the loop closure (e.g. a process feedback driven PID controller).

In integrated systems that provide a closed-loop feed back system, these valves bring substantial advantages through their flow versus pressure profile as seen below (air at 21° Celsius).

LRV Basic Operating Specifications

Orifice Diameter:
49 0.063" orifices

Power Requirements:
24-30Vdc, 1Amp

Control Signal:
0-2.5 Vdc

Max. Operating Temperature:
85° Celsius

Min. Operating Temperature:
-10° Celsius

Max. Operating Pressure:
200PSIG

Min. Forward Pressure to Assure Seal:
1PSI

Overall Dimensions:
5.5"H x 3.0"W x 2.25"D

Mechanical Connections:
3/4" NPT Female (SAE available)

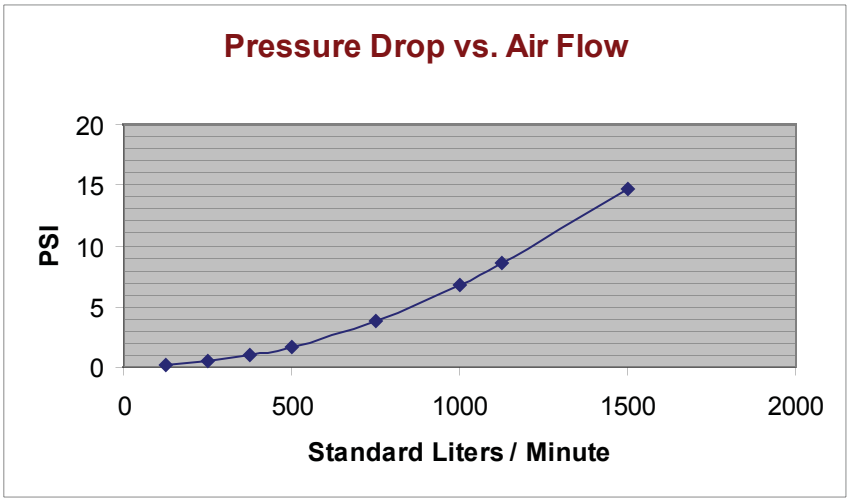
Weight:
4.8lbs.

Valve Type:
Normally Closed Proportional

Response Time (Off-Full Open-Off):
8Hz (operating pressure independent)

Acceptable Media:
All gases and liquids compatible with the wetted materials

Wetted Materials:
303 & 410 stainless steel, nickel, Viton®, Anodized Aluminum, Delrin®, 18-8 stainless steel



Faster Leak Checking

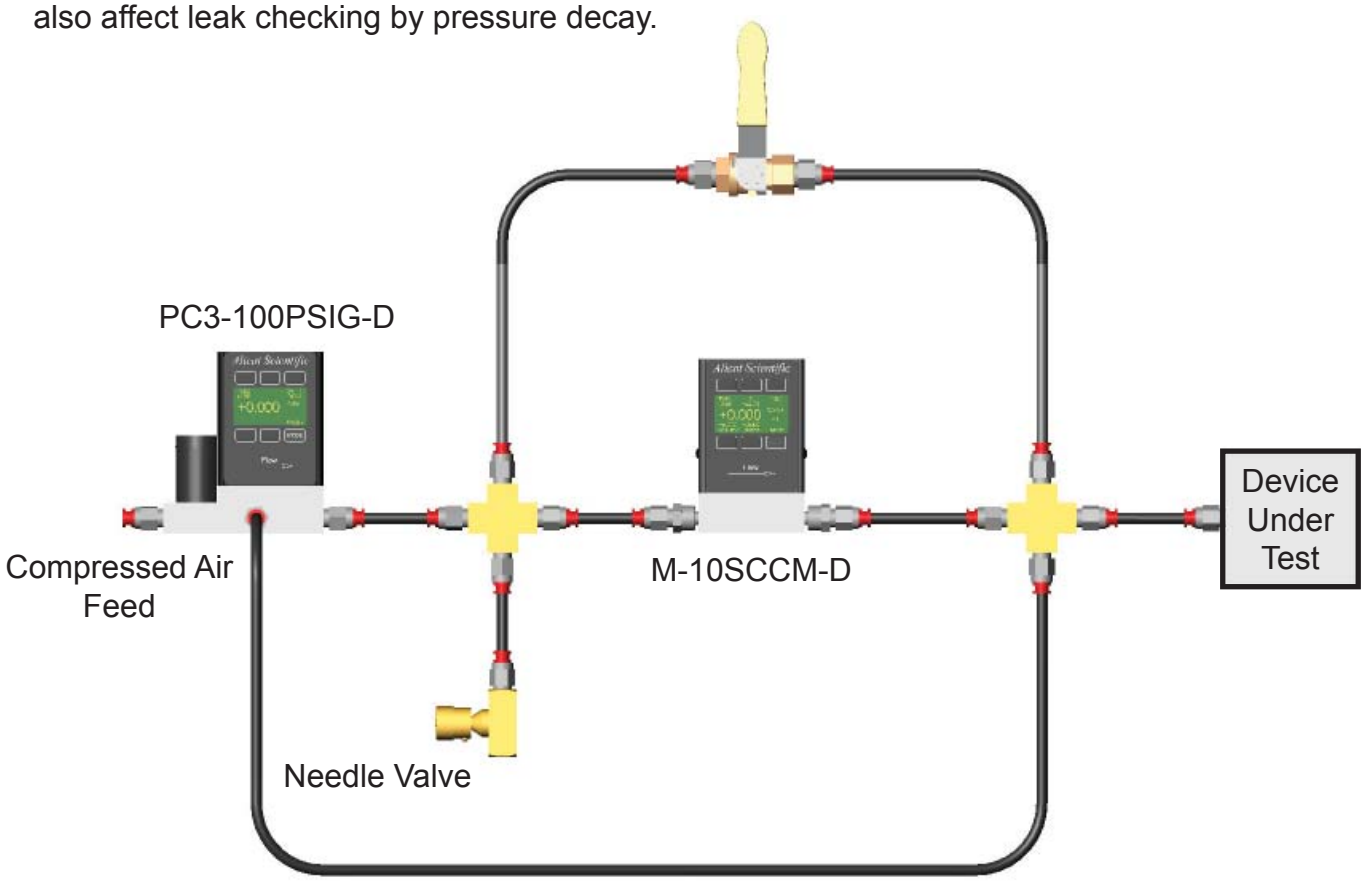
Many processes require a fast, accurate and reliable method for leak checking components. This can be accomplished by utilizing an Alicat Scientific M Series mass flow meter sized appropriately for the expected leak rate and an Alicat Scientific PC3 Series remote sensing pressure controller sized for the required pressure.

Alicat Scientific M Series mass flow meters are available with full scale ranges as small 0.5 SCCM with true 100:1 turndown ratio, meaning that flows as low as 5 microliters (0.005 SCCM) can be resolved.

If plumbed as shown in the diagram, the pressure is controlled at the entrance to the Device Under Test (DUT). A constant bleed though the needle valve allows the pressure controller to precisely hold the pressure at the DUT, ensuring that any flow through the meter after the bypass valve is closed is due either to leakage or to a cooling of the volume of the DUT.

Providing the temperature of the DUT is constant, the flow reported at the meter will be the leak rate of the DUT. Reducing dead volume between the flow meter and the DUT and the volume of the DUT itself will reduce the effects of temperature change and make the leak checking process faster.

Note: This process may not be suitable for leak tests on larger volumes where the allowable leakage is near zero because minute temperature differences on large volumes can produce actual flows that are greater than the allowed leakage rate. This same problem of physics would also affect leak checking by pressure decay.



Sputtering Flow Control

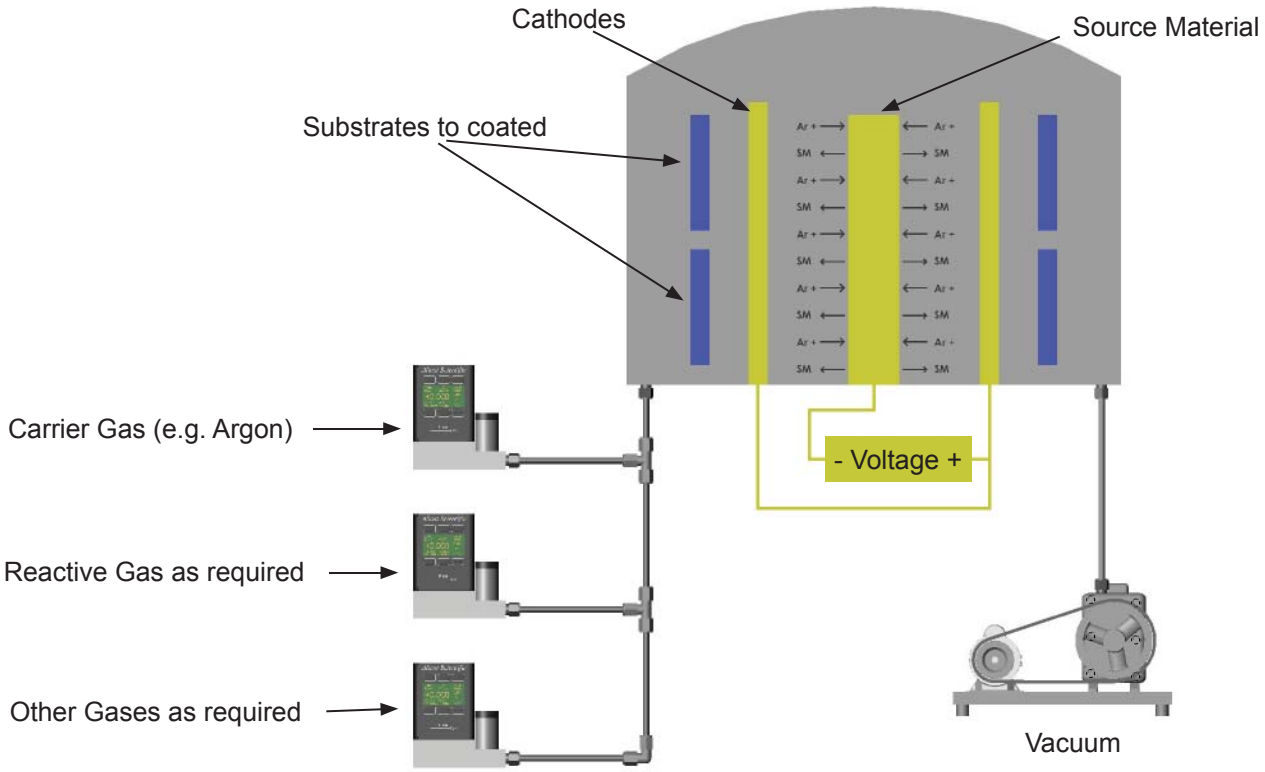
In the process of sputtering, a plasma gas (typically argon) is used to fill a vacuum chamber which contains a target lattice and a substrate. The amount of plasma gas within the chamber is critical to control of the number of atoms released from the target lattice.

In reactive sputtering, reactive gasses like oxygen and nitrogen are added to the chamber (usually for coating substrates with compound atoms like titanium oxide).

Proper partial pressures of reactive gasses must be maintained within the chamber to prevent target poisoning.

Fast response times and low flow resolution are crucial to this application.

For longer cathode arrays and sputtering applications using multiple gas sources, multiple mass flow controllers can be controlled from one serial connection or through analog input/output.



Alicat Advantages:

Relative Insensitivity to Process & Ambient Temperature and Pressures Changes.

Downstream Valves provide full compatibility with High Vacuum Process Chambers.

25-100 millisecond control times.Tune the PID in the field for your specific application.

Selectable Loop controls allow you to control Mass Flow, Volumetric flow, or Absolute Pressure with the same device, while simultaneously measuring Mass Flow, Temperature, Volumetric Flow, and Absolute Pressure.

Multi-Drop RS-232 communications allows communication and set-point control with up to 26 Alicat devices from a single computer serial port.

Gas Select™ field selectabilty for more than 20 of the most common gases

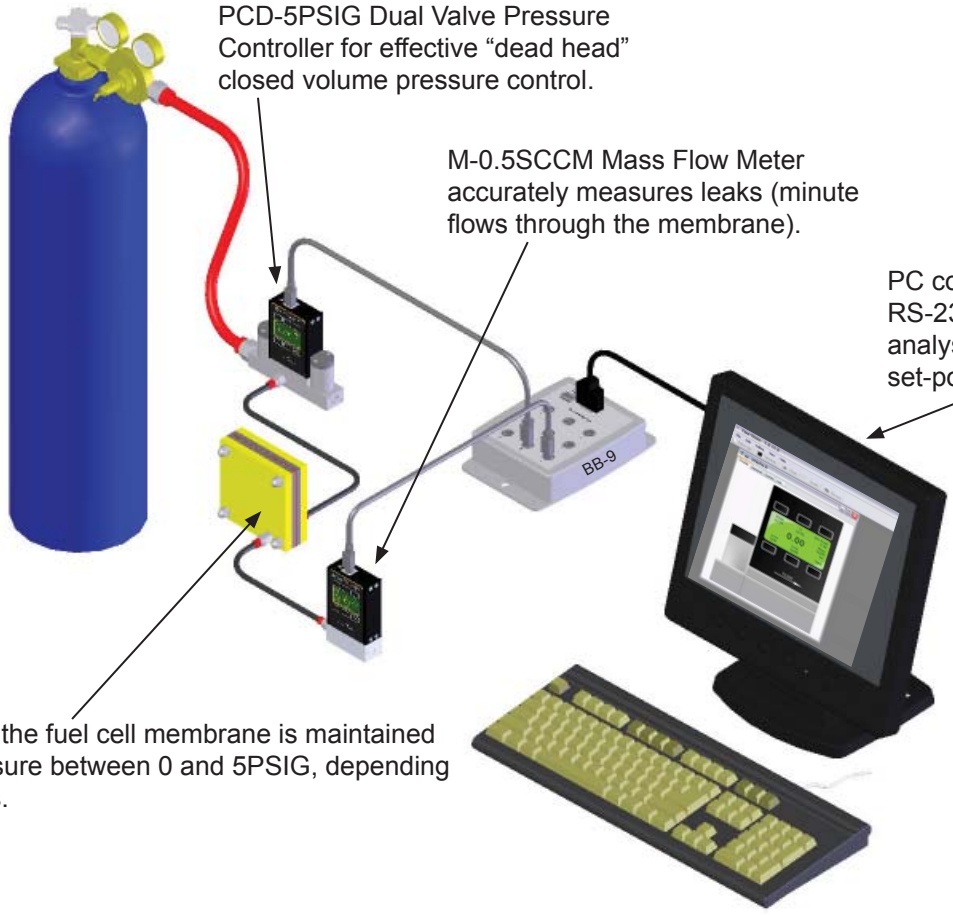
Fuel Cell Testing

This system is used to increase reliability, repeatability and speed of leak tests on Solid Oxide Fuel Cell (SOFC) membranes. The test is performed with helium gas.

The dual valve pressure controller (PCD) replaces the manual pressure regulator. With the automatic adjustments for line pressure changes, the PCD introduced precise pressure control that is highly repeatable between facilities.

The micro flow mass flow meter (MFM) was installed in place of a bubble meter. Using a MFM allows for automatic compensation for density effects due to line pressure and temperature changes which isn't possible with bubble meters. The fast 10ms response also allows for significant time savings over the bubble meter system for determining and isolating leak size.

Data communication for the PCD and MFM with a single PC allows for easy automation. This customer uses intuitive Flow Vision™ SC software to design automated set-point tests and to automatically store the test data for reference.

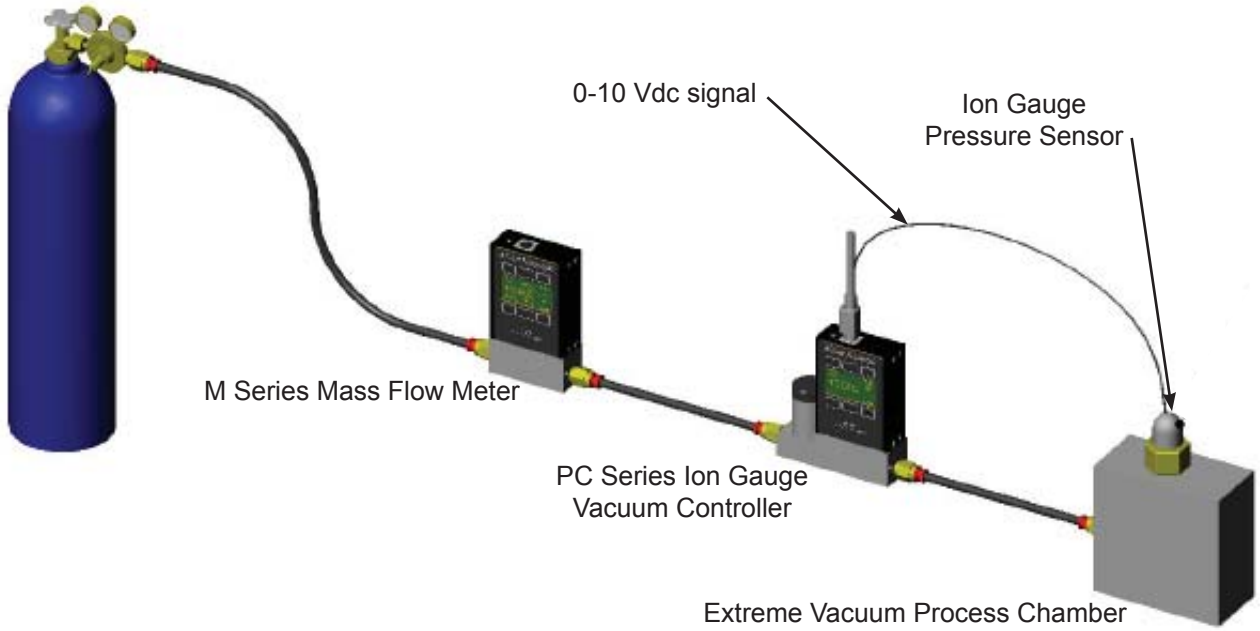


External Ion Gauge Vacuum Control System

The external ion gauge vacuum control system uses a special configuration of the Alicat single valve pressure controller. Alicat's **External Ion Gauge Vacuum Controller** was designed specifically for the vacuum coating industry.

This innovation circumvents the low end range of our pressure sensors and allows for control of extreme vacuum conditions in the coating chamber.

The controller provides lightning fast control based on data provided by an ion gauge vacuum sensor with a linear 0-10 volt output of pressure. The controller translates the signal and precisely controls extreme vacuum pressures within the process chamber.



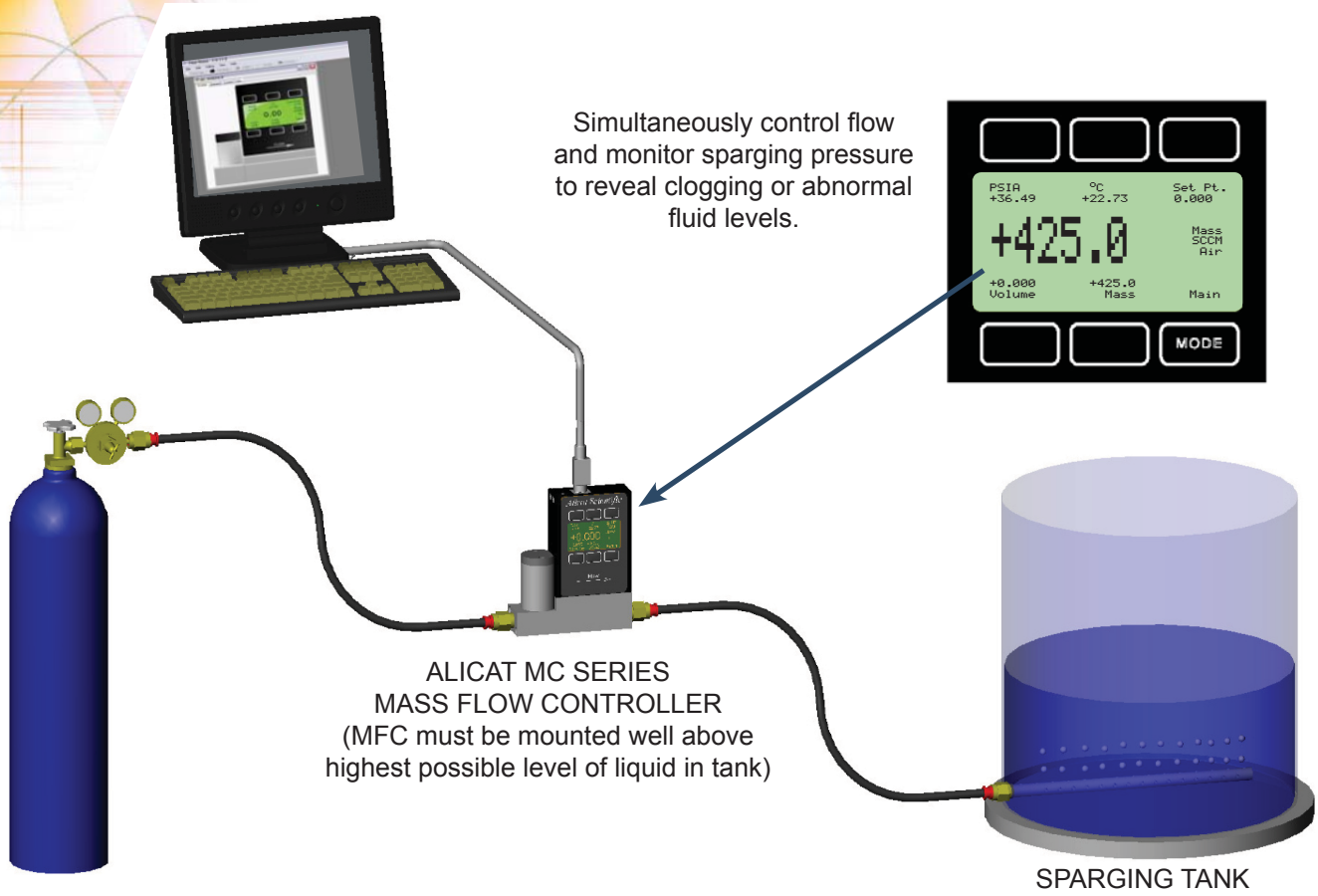
In this application, the 0-10V signal correlates to 0-0.5 Torr. The controller utilizes the pressure signal from the ion gauge to precisely control extreme vacuum conditions in the coating chamber.

The mass flow meter upstream of the pressure controller is unaffected by the vacuum conditions and measures precise mass flow, volumetric flow and the totalized mass of gas into the chamber.

Set-points can be delivered to the controller locally with an analog signal or via the RS-232 serial connection.

Please contact a sales engineer to discuss your external ion gauge system application.

Product Sparging



Sparging is a process where a gas is injectes into a liquid to achieve a variety of results. The sparging bar has many fine holes through which the gas is transferred into the product in the sparging tank.

Maintaining a constant flow rate is crucial in order to obtain the desired results. A mass flow controller can insure a constant flow rate as the level of product changes or the sparging bar becomes clogged, allowing a high level of quality to be maintained.

Sparging is done with many different gases:

Air (to increase volume)
Nitrogen (to remove water)
Carbon Dioxide (to carbonate or decrease Ph)
Hydrogen (to hydrogenate)
Oxygen (to oxidize)

Alicat's MC Series Mass Flow Controllers are highly suitable for each of these purposes. The MCs provide local control and read out or they can interface directly with recording or control hardware via RS-232.

Reliable Air Delivery
for
Automated Liquid Paint Application

Robotic painting, one of the sectors within the Coatings Industry, has several applications in which mass flow is critical to paint application and control. In a typical application, paint is dispensed at the end of a robotic painting arm that articulates close to the surface, following the contours of the paint target (e.g. truck or car bodies). Spinning bells and pressurized guns are the final step in dispensing of the paint.

The liquid paint is atomized using a jet of air. The ratio of air to paint affects the atomization of the spray pattern, its consistency in application and the overall finish. The control of shaping air is critical to control of the pattern. Maintaining accurate, repeatable and fast response control over the air flow is essential to the overall paint job quality and minimizing over painting, thereby reducing costs on every part painted.

Alicat Scientific has products both for use in automated paint applications and as field tools when installing or trouble shooting an existing system. The multiple parameter outputs of Alicat instruments, either via RS-232 or secondary analog, are available for integration into the PLC operating parameters. This information can be used within the PLC to provide additional functions and to eliminate the cost of additional components.

For example, monitoring line pressure can be critical to proper operation of the robots and for an early indication of a failure in the delivery system. The Alicat mass flow meter's pressure signal eliminates the cost and maintenance of a separate pressure gauge. To further facilitate the use of these units as a replacement component, they may also be configured to provide a secondary parameter via an independent, digital or analog output signal.

The most popular models for this use are:

M Series Meters:

Guns: M-250SLPM-D-I /5CM
M-500SLPM-D-I /5CM

Bells: M-500SLPM-D-I /5CM
M-1000SLPM-D-I /5CM

MC Series Controllers: MC-250SLPM-D-I /5CIN
MC-1000SLPM-D-I /5CIN

In-House Check of Gas Chromatograph Operation

Gas chromatographs (GCs) detect materials at molecular level by preparing a sample of the material that is "carried" on a gas stream into the GC. The carrier gas flow stream is sent into small capillary flow tubes and then into detectors to sense and quantify the suspected materials.

These carrier and capillary flow rates are critical to the correct performance of the gas chromatograph. The flow rates and pressures through the various gas flow paths vary by manufacturer's specifications.

Alicat Scientific has recognized the need for an accurate and versatile device that is capable of verifying these critical aspects of a GC's performance. The Alicat portable mass flow meter performs multiple tasks:

- Verification of mass measurement on the input and vent of the GC
- Verification of volumetric measurement on the vent of the GC
- Verification of the pressure on the inlet and vent of the GC

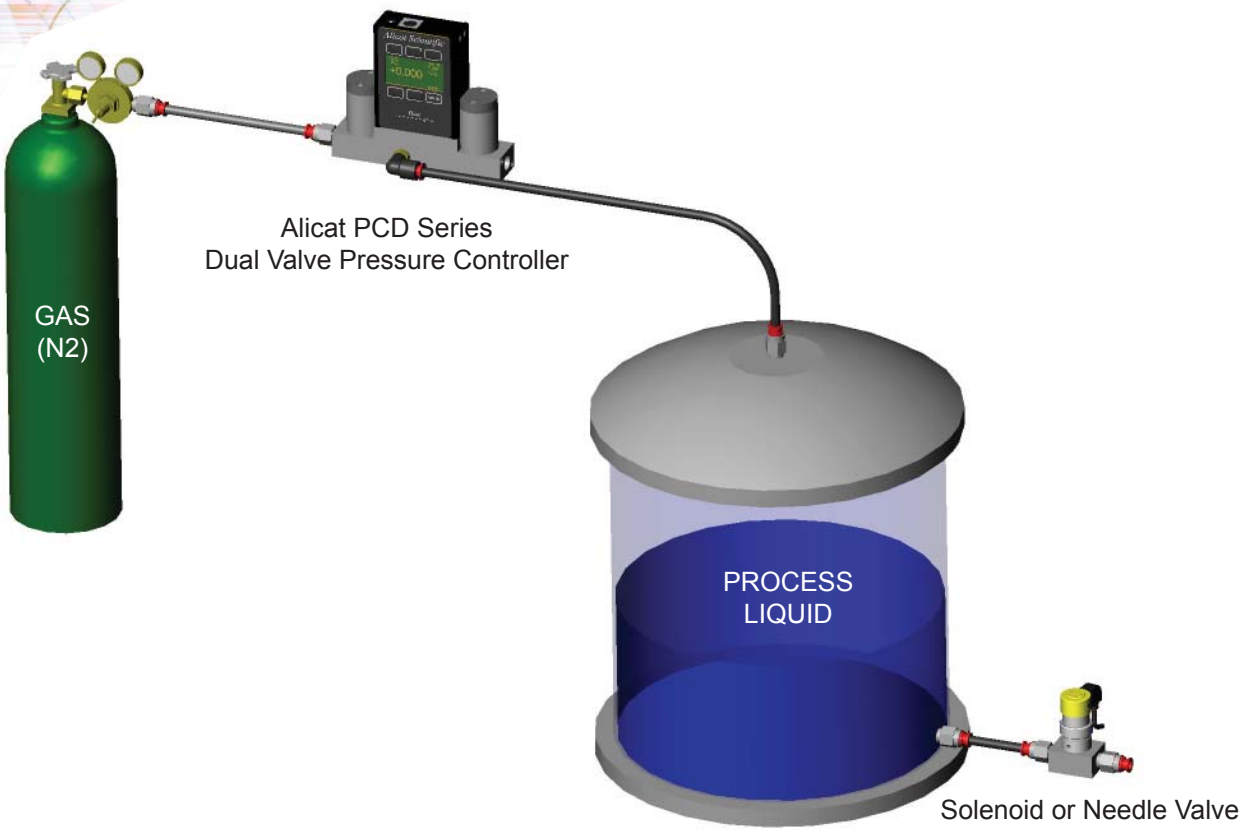
You will also benefit from:

- **Gas Select™** field selectabilty for more than 20 of the most common gases
- ± (0.8% of Reading + 0.2% of Full Scale) Accuracy for precise measurements
- ± 0.2% Full Scale Repeatability for consistent measurements
- 10mS or faster response to changes in flow, pressure and temperature
- 100:1 Turndown Ratio allows one unit to cover both the capillary and carrier gas flow ranges
- RS-232 Serial Output of all four parameters and selected gas for data logging to any PC, PDA or other device with HyperTerminal® capacity.

These multiple features, built into one, compact, portable instrument, give you an invaluable tool for the verification of GC operation.

Alicat Portable M-20SCCM-D

Fluid Dispensing Using Pressure Control



In this application, precise control of delivery of a fluid is accomplished through control of the head pressure on a liquid chamber using an Alicat Dual Valve Pressure Controller.

Typically, Nitrogen is used as the process gas and is vented to atmosphere through the downstream valve of the PCD. The pressure applied to the liquid allows for precision dispensing through activation of a solenoid or needle valve. Stability as high as 1 part in 5000 (.02% of FS) can be attained.

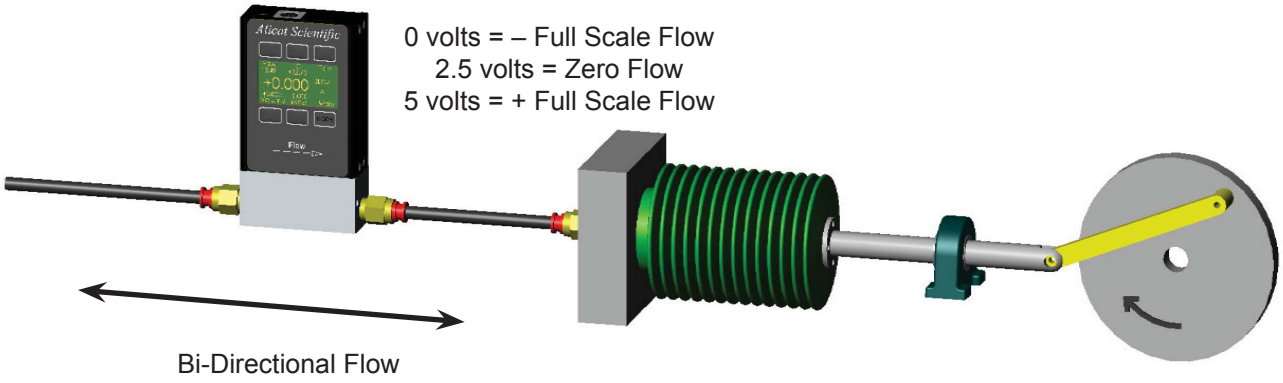
With Alicat's "RAM only" option, users can continually increase the head pressure in the chamber as the fluid level is decreasing. With processing times in the 400 microsecond range, very precise pressure changes can be applied.

This process is often used in silicon wafer polishing systems for the semiconductor industry as well as in some biotech applications.

Bi-Directional Mass Flow Meters

Bi-Directional Flow — Bellows Application

The flow meter is measuring the air flow to and from a contained furnace to help in maintaining consistent temperatures. Using the bi-directional meter allows for the replacement of two individual flow meters and all the associated plumbing. The temperature and pressure signals are also incorporated as safety checks.
Device accuracy is based on total span: ± (0.8% of reading + 0.2% of total span positive full scale to negative full scale)



20SLPM FS Mass Flow Meter (shown with opt. fittings)

COMMON APPLICATIONS

Respiration Modeling:
Determining healthy lung volumes for research base lines

Veterinary Drug Research:
Calculating dosage recommendations based on lung volume x animal weight

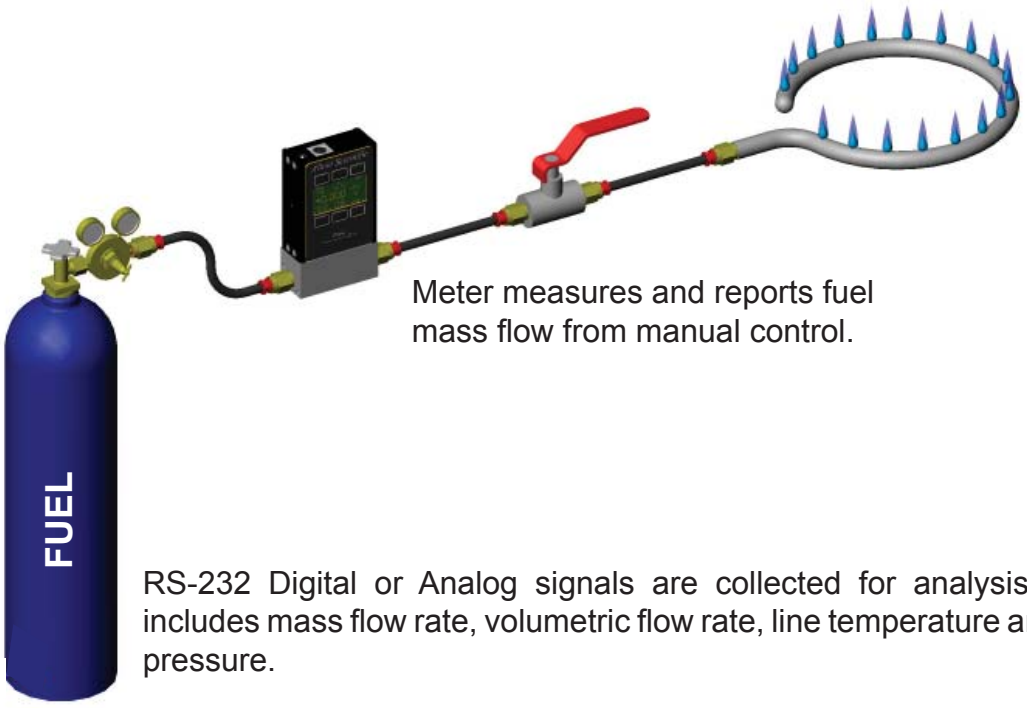
Gas Mask Quality Checks:
Assuring capacity and throughput of protective masks

Order any Alicat M Series Mass Flow Meter with Bi-Directional Calibration and Receive:

- **RS-232 Digital Output for Flow with a "–" to indicate reverse flow and "+" to indicate forward flow**
- **0-5Vdc Analog Output of Flow with Direction Indication**
- **Local LCD with "–" and "+" Flow Direction Indication**
- **NIST Traceable Calibration**

Flame and Burner Monitoring

The flow meter is used to measure the flow of fuels such as Propane, Butane, Acetylene, or Methane (Natural Gas) to a burner or flame head. Oxygen or Air flow can also be easily measured in the same device. Mass flow measurements are used to determine and regulate the theoretical energy content of the flame, and the combination of the flow and pressure measurements are useful for diagnosing system leaks or blockages on the burner orifice(s).



Meter measures and reports fuel mass flow from manual control.

RS-232 Digital or Analog signals are collected for analysis. Digital signal includes mass flow rate, volumetric flow rate, line temperature and line absolute pressure.

COMMON APPLICATIONS

Real-time Appliance Development

10 millisecond metering time of flow, pressure and temperature simplifies the development process

Size Checking

Ensure that your appliance orifices are correctly sized by monitoring flow changes

Reliability Testing:

With **Accuracy**, **Repeatability** and **Streaming Data Acquisition**, you can verify that your gas flow remains constant

TIG (Tungsten Inert Gas) Welding

In the TIG (tungsten inert gas) welding process, a tungsten electrode is used to provide an electric arc for welding. A sheath of inert gas surrounds the electrode, the arc and the area to be welded. This gas shielding process prevents any oxidization of the weld and allows for the production of neat, clean welds.

TIG welding differs from MIG (metal inert gas) welding in that the electrode is not consumed in the weld. TIG welding is the preferred method for welding aluminum.

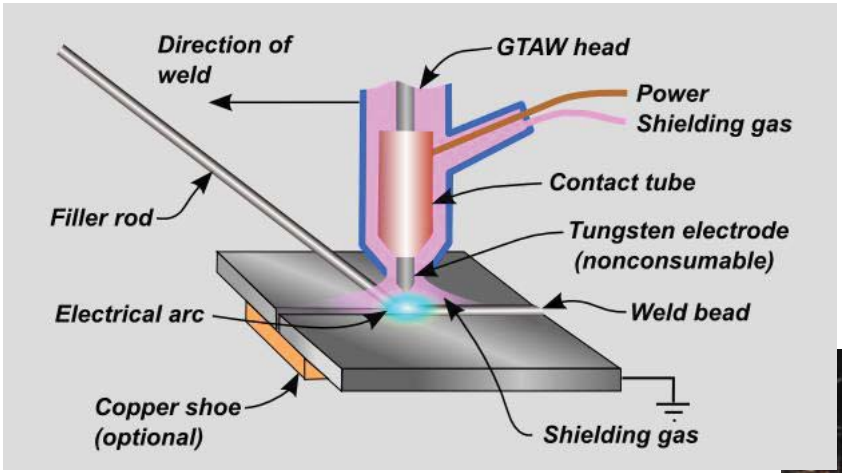
The shielding gas used in TIG welding can be argon, helium or a mixture. Argon is usually a better choice because it is heavier than air and therefore tends to provide a better blanket over the weld.

The flow from the gas supply is controlled by the Mass Flow Controller (MC-20SLPM-D) which is connected to the top of the tank.

The flow rate of the shielding gas varies by the material being welded. Aluminum requires 7-13 SLPM of Argon, while Stainless Steel requires 5-7 SLPM of Argon.

Popular gas blends for welding applications, such as Praxair's Helistar A1025® and Stargon CS®, are included as selections in Alicat's Gas Select™ feature.

In addition, Alicat's MFC's are highly resistant to electrical noise and other disturbances present in TIG welding environments.



MC-20SLPM-D

Approximate Weights

For approximate shipping weight add 0.2lb to each unit for packaging.

Description	Weight		Description	Weight
M Series Meters			**LC & LCR Series Controllers**	
0.5SCCM to 50SCCM	0.8lb		50CCM to 500CCM	1.2lb
100SCCM to 20SLPM	1.0lb		1LPM to 5LPM	6.8lb.
50SLPM	2.2lb		**P Series Gauges**	
100SLPM	2.4lb		All Standard Ranges	1.0lb
250SLPM	3.2lb		**PC Series Controllers**	
500SLPM to 1500SLPM	3.5lb		All Standard Ranges	1.2lb
2000SLPM	4.5lb		**PCR Series Controllers**	
MC & MCR Series Controllers			All Standard Ranges	4.8lb
0.5SCCM to 50SCCM	1.1lb		**PCD Series Controllers**	
100SCCM to 20SLPM	1.2lb		All Standard Ranges	1.4lb
50SLPM	6.4lb		**Accessories**	
100SLPM	6.4lb		universal power supply PVPS24U	1.8lb
250SLPM	8.3lb		Cables DC-61, DC-62, DC-6RT	0.2lb
500SLPM to 1500SLPM	9.0lb		Cables DC-251, DC-252	0.6lb
2000SLPM	11.0lb		Cable MD8DB9	0.1lb
MCV Controllers	3.0lb		Industrial Connector Cable IC10	0.2lb
L Series Meters			BB-9 Multi-Drop Box	1.0lb
0.5CCM to 1CCM	1.0lb		Flow Vision™ SC	0.4lb
2CCM to 1LPM	1.3lb			
2LPM to 10LPM	2.2lb			

Alicat Instruments— Simply the Most Standard Features

- **Four instruments for the price of one!** Mass flow, Volumetric flow, Pressure & Temperature.
- Control pressure while monitoring mass flow!
- Fast: ≤ 100 millisecond control response (typical).
- Accurate.
- No warm-up delays.
- **Gas Select™** with 30 field selectable gases, No charts to reference.
- RS-232 & Analog Input/Output.
- Multiple drop capable RS-232.
- Stand-Alone control.
- Simple, position insensitive installation.
- No straight runs of pipe required!
- Low sensitivity to ambient pressure and temperature changes.
- Easy integration and bench top versatility.
- Support a wide range of options without extra software or components.

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