



A Halma company



# OPERATING MANUAL

## FOR STANDARD FLOW AND PRESSURE DEVICES

Models M · MC · P · PC · L · LC

## Thank you for purchasing your Alicat device.

If you have any questions, or if something is not working as expected, please contact us. We are eager to help you in any way possible.

## Contact Information

### World Headquarters, Tucson, Arizona, USA

[info@alicat.com](mailto:info@alicat.com)  
[alicat.com](http://alicat.com)  
7641 N Business Park Dr.,  
Tucson, AZ 85743 USA  
**+1 888-290-6060**

### China & SE Asia

[info-cn@alicat.com](mailto:info-cn@alicat.com)  
[alicat.com.cn](http://alicat.com.cn)  
2nd Floor, Block 63, No. 421,  
Hong Cao Rd,  
Shanghai 200233  
PRC  
**+86-21-60407398 ext. 801**

### Europe

[europa@alicat.com](mailto:europa@alicat.com)  
Geograaf 24  
6921 EW Duiven  
The Netherlands  
**+31 (0)26 203.1651**

### India

[india@alicat.com](mailto:india@alicat.com)  
Alicat Scientific India Pvt. Ltd.  
101, Hamilton A Bldg,  
Near Hiranandani Hospital,  
Hiranandani Estate, Patli Pada,  
Ghodbunder Road,  
Thane West-400607  
Maharashtra, India  
GST No.: 27AAWCA5866D1Z6  
**+91-22-46081434**

## Recalibrate your device every year.

Annual calibration is necessary to ensure the continued accuracy of readings, and to extend the Limited Lifetime Warranty. Fill out the Service Request Form at [alicat.com/service](http://alicat.com/service), or contact us directly when it is time to send in your device for recalibration.

For devices ordered with CSA, ATEX, ISO 17025, or other certifications, please visit [alicat.com/certifications](http://alicat.com/certifications). For information about our limited lifetime warranty, visit [alicat.com/warranty](http://alicat.com/warranty).

Serial #: \_\_\_\_\_

Next Calibration: \_\_\_\_\_

**NIST** This device comes with a NIST-traceable calibration certificate.



This device conforms to the European Union's Restriction of Use of Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive 2011/65/EU.



This device complies with the requirements of the Low Voltage Directive 2014/35/EU and the EMC Directive 2014/30/EU and carries the CE Marking accordingly.

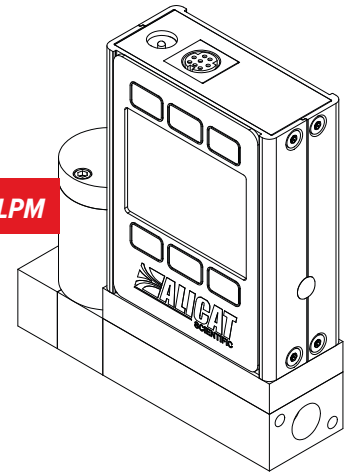


This device complies with the requirements of the Electrical Equipment (Safety) Regulations 2016 and the Electromagnetic Compatibility Regulations 2016 and carries the UKCA marking accordingly.

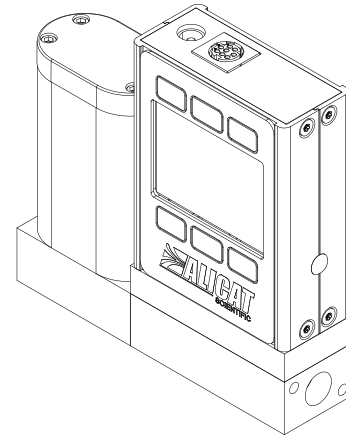


This device complies with the requirements of the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC

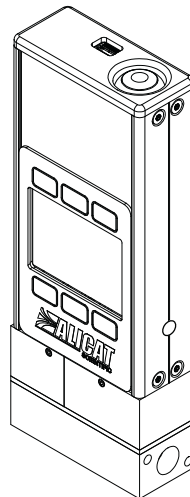
MC-10SLPM



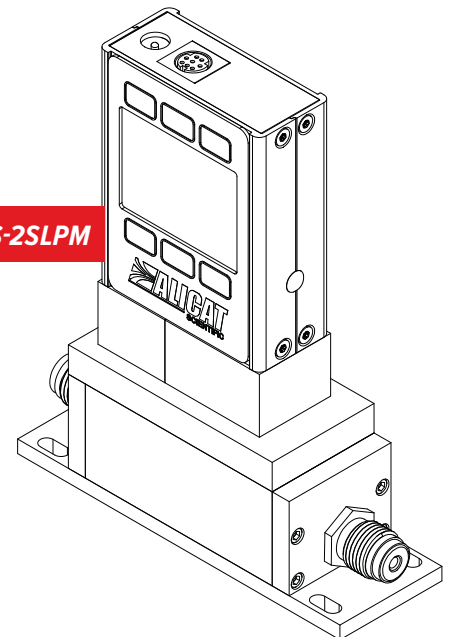
PC-PSIG



LB-1LPM



MCES-2SLPM



# Contents

<b>Introduction</b>	<b>5</b>	<b>Device Setup</b>	<b>23</b>
<b>Quick Start Guide</b>	<b>6</b>	<b>Gas Selection</b> Mass Flow Devices	<b>23</b>
<b>Installation and Startup</b>	<b>7</b>	Gas Select™	<b>23</b>
Safety Warnings	7	COMPOSER™ Gas Mixes	<b>23</b>
Installation	7	Creating New Mixes in COMPOSER™	<b>24</b>
Filters	8	Viewing, Deleting, and Creating Similar Mixes	<b>24</b>
<b>Power and Signal Connections</b>	<b>8</b>	<b>Sensor Setup</b>	<b>24</b>
Analog Signals	9	Engineering Units	<b>24</b>
<b>Option: Charging a Portable Meter or Gauge</b>	<b>9</b>	STP/NTP Reference Values Mass Flow Devices	<b>25</b>
<b>Bleed Ports</b> Liquid Devices	<b>10</b>	Flow and Pressure Averaging	<b>25</b>
<b>Basic Operations</b>	<b>11</b>	Zero Band	<b>25</b>
Viewing Live Data	11	<b>Totalizer Options</b> Flow Devices	<b>25</b>
Interacting with the Device	11	Totalizer Mode	<b>25</b>
Taring the Device	12	Totalizer Limit and Format	<b>25</b>
How to Tare	12	Totalizer Display	<b>26</b>
When to Tare	12	Totalizer Digital Data	<b>26</b>
<b>Changing the Setpoint</b> Controllers	<b>12</b>	Restore Totalizer Value on Power-up	<b>26</b>
<b>Selecting Gas</b> Mass Flow Devices	<b>13</b>	Totalizer while Controlling Pressure	<b>26</b>
<b>Data Screens</b>	<b>14</b>	Batches Mass Flow and Liquid Controllers	<b>26</b>
Live Screen	14	<b>Serial Communications Configurations</b>	<b>27</b>
Min/Max Screen	14	Unit ID	<b>27</b>
<b>Totalizer Screens</b> Flow Devices	<b>14</b>	Modbus RTU Configuration	<b>27</b>
Option: Color TFT Display	15	Manage Setpoint when Connection is Idle	<b>27</b>
<b>Device Information</b>	<b>16</b>	Baud Rate	<b>27</b>
Basic Device Information	16	<b>Display Setup</b>	<b>27</b>
Device Full Scale Ranges	16	Data Screens	<b>27</b>
Manufacturer Information	16	Screen Lighting	<b>28</b>
<b>Process Control</b> Controllers	<b>17</b>	Display Rotation	<b>28</b>
Setpoint	17	<b>Advanced Setup</b>	<b>28</b>
<b>Setpoint Options</b>	<b>17</b>	<b>Serial ASCII Communication</b>	<b>29</b>
Auto-tare and Zero Setpoint Options	17	Establishing Communication	<b>29</b>
Setpoint Source	17	<b>Communication Modes</b>	<b>29</b>
Idle Connection Response	18	Polling Mode	<b>29</b>
Setpoint on Power-Up	18	Streaming Mode	<b>30</b>
Setpoint Limits	18	<b>Taring Commands</b>	<b>30</b>
<b>Setpoint Ramping</b>	<b>18</b>	<b>Data Collection</b>	<b>30</b>
Ramp Rate	18	<b>Setpoint</b> Controllers	<b>31</b>
Ramping Options	19	<b>Gas Select™ and COMPOSER™</b> Mass Flow Devices	<b>31</b>
<b>Batch Dispensing</b> Flow Controllers	<b>19</b>	<b>Quick Command Reference</b>	<b>32</b>
Start a Batch	19	General Commands for All Devices	<b>32</b>
Repeat a Batch	20	Controller Commands	<b>32</b>
Pause or Cancel a Batch	20	Mass Flow Gas Select™ and COMPOSER™ Commands	<b>32</b>
<b>Valve Drive Percentage Display</b>	<b>20</b>		
<b>Control Loop</b>	<b>20</b>		
Controlled Variable	20		
PD/PDF or PD <sup>2</sup> I Control Algorithms	21		
Flow Limit while Controlling Pressure Flow Controllers	21		
Control Deadband for Pressure Control	22		

<b>Modbus RTU Communication</b>	<b>33</b>
<b>Establishing Communication</b>	<b>33</b>
Multidrop Information	33
<b>Modbus RTU Serial Protocol</b>	<b>33</b>
Process Data	33
<b>Writing Control and Configuration Information</b>	<b>34</b>
Status Flags	34
Modbus Reading and Status Registers	34
<b>Special Commands</b>	<b>34</b>
Custom Gas Mixtures	34
Special Commands and Arguments	35
Special Command Result Status Codes	35
<b>Troubleshooting</b>	<b>36</b>
<b>Mass Flow Devices</b>	<b>37</b>
<b>Maintenance</b>	<b>38</b>
<b>Cleaning</b>	<b>38</b>
<b>Repair</b>	<b>38</b>
<b>Recalibration</b>	<b>38</b>
<b>Appendix A: Pinouts</b>	<b>39</b>
8-Pin Mini-DIN (Default)	39
Locking Industrial Connector Pinout	39
9-Pin D-Sub Connector Common Pinouts	40
15-Pin D-Sub Connector Common Pinouts	40
M12 Connector Common Pinouts	41
<b>Appendix B: Reference Information</b>	<b>42</b>
<b>Engineering Units</b>	<b>42</b>
Gas List by Number	43
Gas List by Category	44
<b>Appendix C: Application Setup</b>	<b>45</b>
<b>MCV Controller Operating Notes</b>	<b>45</b>
<b>Pressure Controller Applications</b>	<b>45</b>
Forward (Downstream) Pressure Control	45
Back Pressure Control	46
Dual Valve Pressure Control	46
Differential Pressure Control	46
Remote-Sensing Controller	47
Integrated Vacuum Controllers (IVC)	47

# Introduction

Depending on the model, Alicat devices have a variety of features:

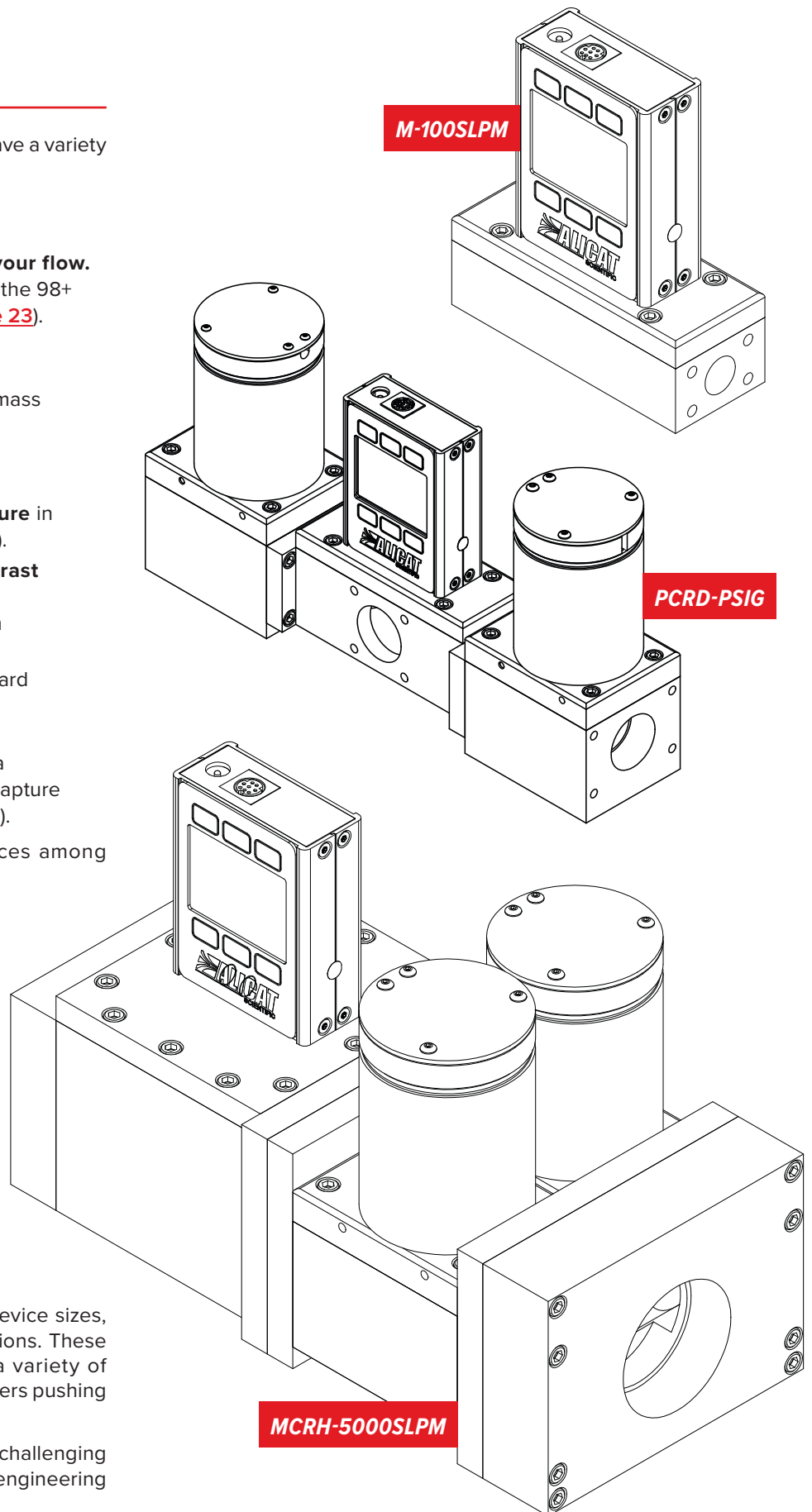
- **1000 readings per second** guarantees high resolution data.
- **High-accuracy performance for all your flow.** Use the mass flow devices with any of the 98+ gases included with Gas Select™ ([page 23](#)).
- **Control pressure while monitoring flow rate.** Set the closed loop control algorithm to pressure control on your mass flow or liquid controller ([page 20](#)).
- **Control either gas or liquid** with your pressure controller.
- **Monitor live pressure and temperature** in mass flow or liquid processes ([page 11](#)).
- **Backlit display with adjustable contrast** is easy to read even in direct sunlight. In dimly lit areas, press the logo to turn on the backlight ([page 11](#)).
- **Change your STP** to match any standard temperature and pressure reference for your mass flow ([page 25](#)).
- **Log data to your PC** with a serial data connection to control the device and capture data for logging and analysis ([page 29](#)).

This manual covers the following devices among others:

- **Standard:** M, MC, P, PC, L, LC
- **Low pressure (Whisper™):** MW, MWB, MCW
- **High pressure:** MQ, MBQ, MCQ
- **Anti-corrosive:** MS, MBS, MCS, PS, PBS, PCS, LS, LBS, LCS
- **Portable battery-powered:** MB, MBS, MWB, MBQ, PB, PBS, LB, LBS
- **Dual valve:** MCD, PCD
- **Other variants:** MCE, MCV, PCP, PC3, IVC

Alicat offers countless combinations of device sizes, accessories, connections, and configurations. These custom solutions are offered to meet a variety of application challenges brought forth by users pushing the boundaries of our standard offerings.

If you have an idea for a new process or a challenging application, contact Alicat for specialized engineering and application support ([page 2](#)).

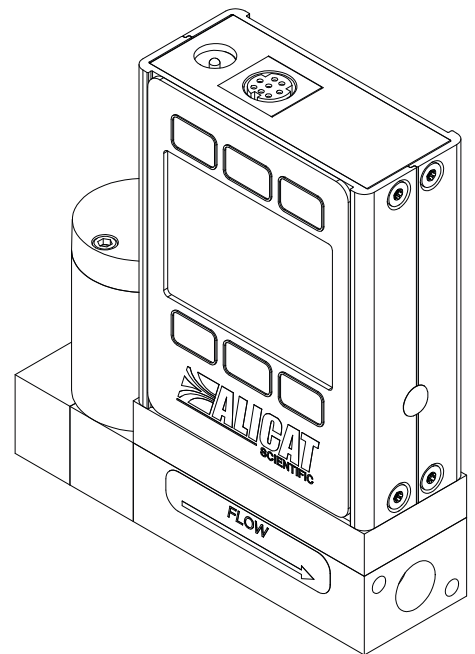


# Quick Start Guide

## Setup

- **Connect your device.** Ensure that flow passes through your device in the same direction as the arrow on the flow body (usually left to right). Application setup examples can be found in Appendix C ([page 45](#)).
- **Choose your engineering units.** You can choose the measurement units by selecting **MAIN MENU** → **SETUP** → **Sensor** → **Engineering Units**. See [page 24](#) for more details.

*This MC-1SLPM-D model mass flow controller is a typical unit. The flow body and the valve sizes can vary significantly.*



## Operation: Flow Verification

- **Monitor live flow, temperature, and pressure readings.** Readings are updated and displayed on your device in real time. See [page 11](#).
- **Capture totalized readings.** The totalizer option displays the total flow that has passed through the device since the last time the totalizer was reset. To enable the totalizers, press **MENU** → **SETUP** → **Sensor** → **Totalizer 1** or **Totalizer 2**. See [page 25](#).

## Connectors and Buttons

The drawing to the right represents a typical configuration of a standard controller. **Your device's appearance and connections may differ.**

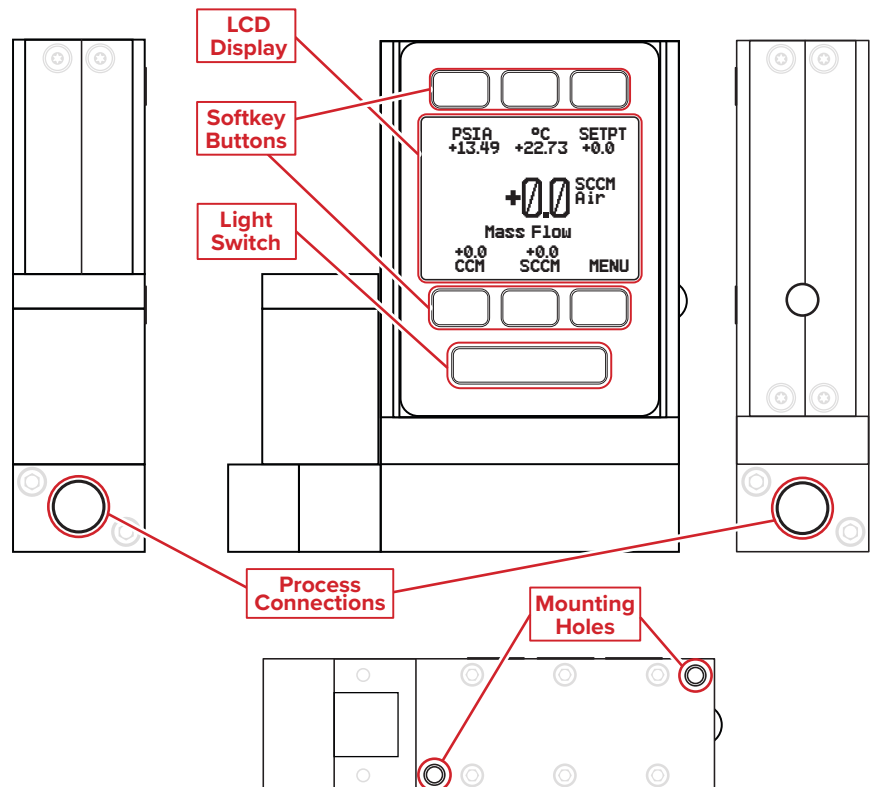
## Backlight

The monochrome display comes equipped with a backlight. **To toggle the backlight power, press the logo on the front of your device.**

For optional color TFT displays, pressing this button turns off the display to conserve power. See [page 15](#).

## Maintenance and Care

- Gas devices do not require cleaning when flowing clean, dry gases. Liquid devices require minimal cleaning when flowing clean liquids ([page 38](#)).
- Calibrate your device annually. To schedule a calibration, please contact support ([page 2](#)).





# Installation and Startup

## Safety Warnings

- For assistance in performing any disassembly of the device, please contact Alicat support ([page 2](#)) for assistance.
- Operating this device under conditions which exceed the specifications noted in the manual or specification sheet could lead to equipment damage or injury.

## Installation

The device does not require straight runs of pipes either upstream or downstream of the device. It can operate in any orientation whether it's on its side, laid on its back, or inverted and operating upside down. The only exception to this are controllers with Rolamite valves. Rolamite valves need to be oriented vertically, but it can be configured so that the flow body is connected in a different direction.

Be sure to reference your device dimensions to determine the size and positions of the mounting holes on the bottom of the device.

1. Mount the device so that flow passes through the flow body as indicated by the arrow or left to right if an arrow is not present. Refer to the device specifications at [alicat.com/specs](http://alicat.com/specs) for dimensions and mounting options.
2. Remove any plastic plugs from the inlet, outlet, or process connections.
3. Plumb appropriate lines to the inlet and outlet connections (and process connection, if present). For pressure controllers, refer to Appendix C ([page 45](#)) for diagrams on plumbing specific controllers.

Face seal fittings do not need Teflon tape applied to the threads.



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

If you are using a fitting that does not have a face seal, use thread-sealing Teflon tape to prevent leakage around the connections.



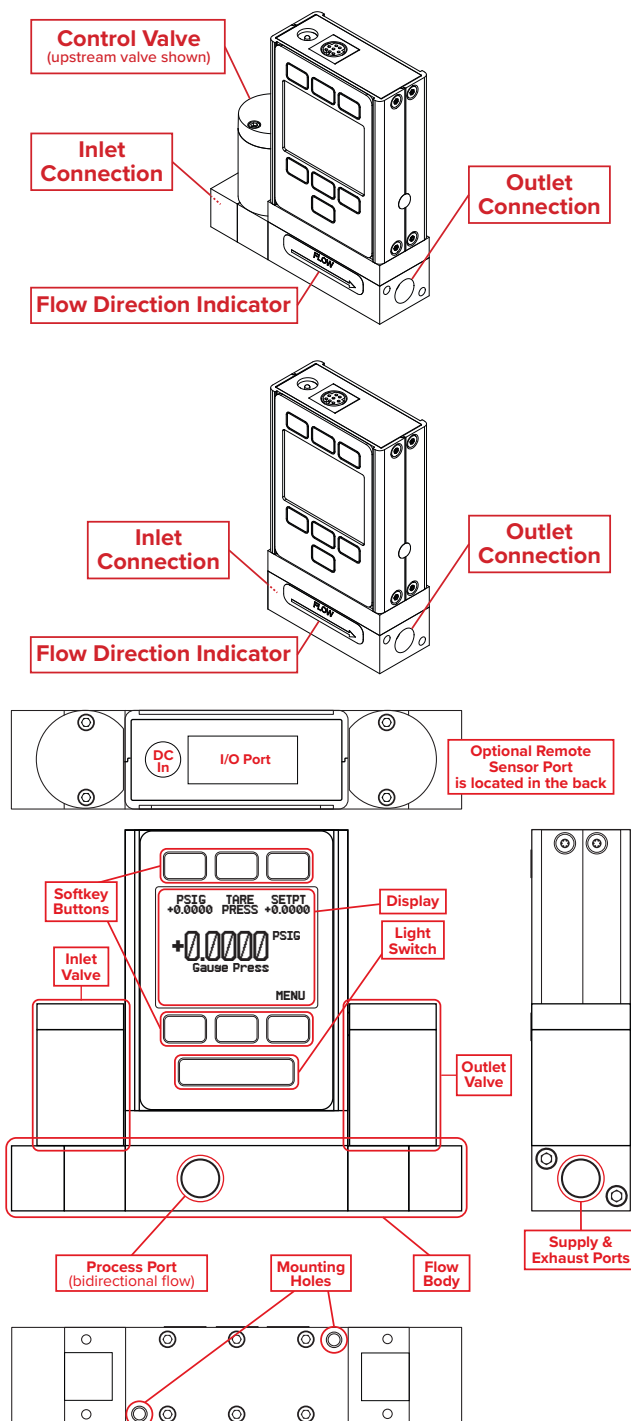
*Do not wrap the first two threads entering the device. This minimizes the possibility of getting tape into the flow stream and clogging or damaging the device.*

4. Connect cables to the power and signal connectors (may not be applicable to battery devices).
5. Enable power to the device. The device automatically turns on once the device is connected to power.



*Do not enable power to the device until all necessary pins have been confirmed to be properly connected.*

The device is now ready for use. For further instruction and operation of your device, please read further.



# Filters

When pressure drop is not a concern, use in-line sintered filters to prevent large particulates from entering the flow body of the controller. Suggested maximum particulate sizes are as follows

### Mass Flow:

- **5 microns** for devices with flow ranges  $\leq 1$  SCCM.
- **20 microns** for devices with flow ranges between 1 SCCM and 1 SLPM.
- **50 microns** for devices with flow ranges  $\geq 1$  SLPM.

### Liquid:

- **20 microns** for devices with flow ranges  $\leq 100$  CCM.
- **40 microns** for devices with flow ranges  $> 100$  CCM.

### Pressure:

- Maximum **40 microns** for all gauges.
- **20 microns** for PC, PCD, PCP, PCPD, PCH, PCHD, PC3, PCD3
- **40 microns** for PCR, PCRD, PCR3, PCR3D

# Power and Signal Connections

Power can be supplied to your device through either the power jack or the multi-pin connector on top of your device.

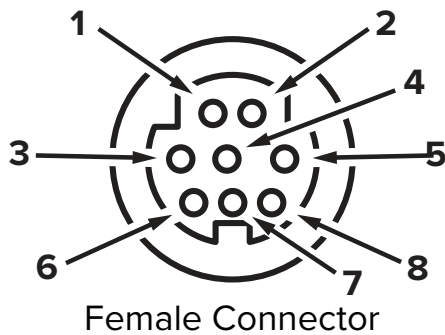
For more pinout configurations, see [page 39](#).



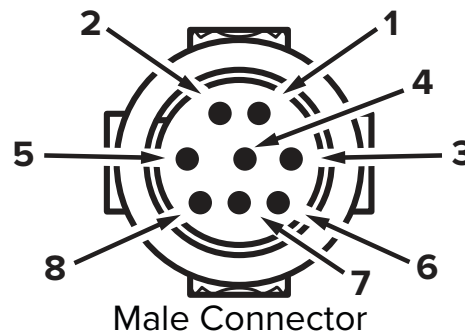
**Note:** Power requirements vary based on analog configuration and valve type. Please reference the associated specification sheet at [alicat.com/specs](http://alicat.com/specs) for power requirements.



**Warning:** Do not connect power to pins 1 through 6, as permanent damage can occur. It is common to mistake pin 2 (labeled 5.12 Vdc Output) as the standard 0–5 Vdc analog output signal. Pin 2 is normally a constant 5.12 Vdc.



Female Connector



Male Connector

## Controller 8-Pin Mini-DIN Pinout

Pin	Function
1	Not Connected <i>Optional: 4–20 mA primary output signal</i>
2	Static 5.12 Vdc by default. <i>Optional: secondary analog output (4–20 mA, 0–5 Vdc, 1–5 Vdc, 0–10 Vdc) or alarm</i>
3	Serial RS-232 RX / RS-485(-) Input Signal (receive)
4	Analog Setpoint Input
5	Serial RS-232 TX / RS-485(+) Output Signal (send)
6	0–5 Vdc <i>Optional: 1–5 Vdc or 0–10 Vdc output signal</i>
7	Power In (as described above)
8	Ground (common for power, digital communications, analog signals, and alarms)

## Meter and Gauge 8-Pin Mini-DIN Pinout

Pin	Function
1	Not connected <i>Optional: 4–20 mA primary output signal</i>
2	Static 5.12 Vdc <i>Optional: secondary analog output (4–20 mA, 0–5 Vdc, 1–5 Vdc, 0–10 Vdc) or alarm</i>
3	Serial RS-232RX / RS-485(-) input signal (receive)
4	Remote tare (ground to tare)
5	Serial RS-232TX / RS-485(+) output signal (send)
6	0–5 Vdc <i>Optional: 1–5 Vdc or 0–10 Vdc output signal</i>
7	Power in (as described above)
8	Ground (common for power, digital communications, analog signals, and alarms)

The above pinouts are applicable to all devices with the mini-DIN connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.



## Analog Signals

### Primary Analog Output Signal

Most devices include a primary analog output signal that is linear over its entire range. For ranges that start at 0 Vdc, a zero-pressure or no-flow condition is indicated at approximately 0.010 Vdc. Full scale of the device is indicated by the top of the range: 5 Vdc for 0–5 Vdc, 20 mA for 4–20 mA signals, and so on.

### Option: Secondary Analog Output Signal

The default 8-pin mini-DIN connector places the secondary analog output on pin 2 for both voltage and current signals. Your device's secondary analog signal may differ from its primary output signal.

A calibration sheet ships with the device showing which output signals were ordered.

### Option: 4–20 mA Current Output Signal

**Controllers:** If the controller has a primary or secondary 4–20 mA current output signal, it requires 15–30 Vdc power.

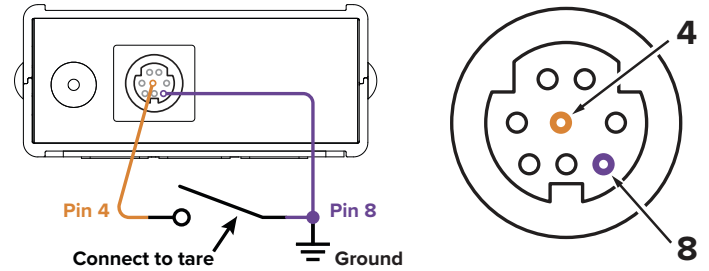
**Meters and gauges:** If the meter or gauge has a 4–20 mA current primary or secondary output signal, it requires 12–24 Vdc power.



**Warning:** Do not connect 4–20 mA devices to “loop powered” systems, as this damages portions of the circuitry beyond repair and voids the warranty. If the device must interface with existing loop powered systems, use a signal isolator and a separate power supply.

## Using Ground to Tare (Meters and Gauges)

You can tare your meter or gauge remotely by momentarily grounding pin 4. When the switch is closed, the device tares. Operation resumes when the switch is released. You can also tare with the front controls ([page 12](#)) or serial commands ([page 30](#)). Taring flow should only be done in a true zero-flow condition and taring pressure should be done when the device is open to the atmosphere.



## Option: Charging a Portable Meter or Gauge

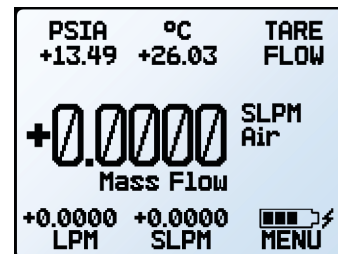
Portable batteries are partially charged before shipping. When fully charged, the typical battery life is 18 hours with a monochrome display, or 8 hours with a TFT color display. Dimming the backlight increases battery life. When the battery indicator displays as completely empty, about 15 minutes of battery life remain.

Charge the device using the supplied USB cable (micro-B to type A) or a similar cable. Any USB outlet on a computer or portable power supply may be used, but charging is fastest (approximately 3.5 hours) when using the supplied 2.0 A power supply.

The red indicator LED on top of the device lights up to indicate that the unit is charging, and turns off when the battery is fully charged.

Your meter may be used while it is charging. If the battery has been fully depleted, you may need to charge the meter for a full minute before the device can be turned on.

**Warning:** The safe charging temperature range is 0–45°C (32–113°F). If internal sensors detect temperatures outside of this range, the battery will not charge.



Main display with battery information and an active charging indicator (lightning bolt).

## Bleed Ports Liquid Devices

Liquid devices include bleed ports (8-32 Nylon-tipped screw) on the front for the removal of air bubbles.



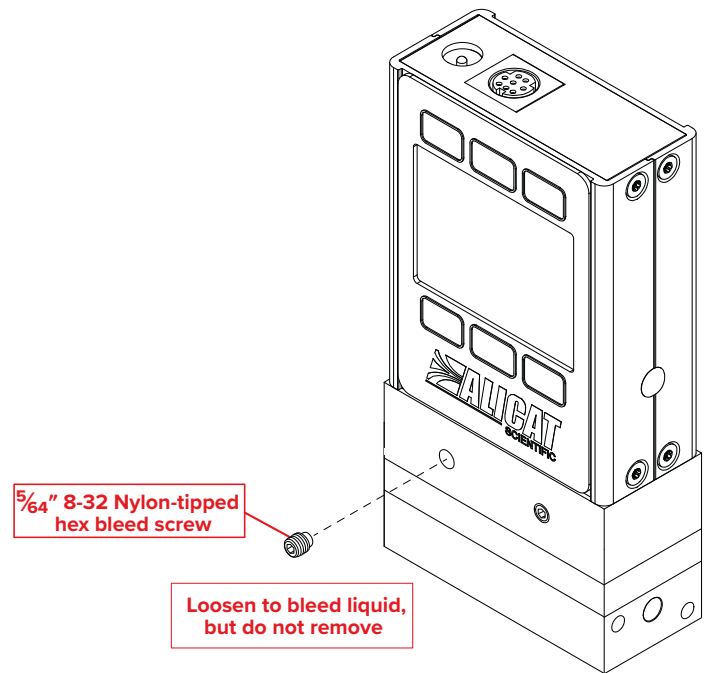
**Note:** A small amount of liquid will leak from the device during this procedure. Take necessary precautions to prevent damage to anything nearby.

### Bleed both of the ports as follows:

1. With the device installed, start a flow greater than 50% of full flow. Gently loosen the upstream bleed port screw 1 to 2 turns, or until liquid begins to leak from the threads. **Do not remove the screw**, as it has pressure behind it, is very small, easy to lose, and delicate to rethread.
2. Gently tap the flow body to remove air bubbles (screwdriver handles work well). This may not be visible or audible.
3. Gently tighten the screw until the leakage stops, taking care not to crush the nylon tip.
4. Repeat steps 1–3 with the downstream port.



**Note:** If your device is mounted in an inverted position, avoid using the bleed screws, as liquid may leak and cause permanent damage.



# Basic Operations

This section covers the most common functions of your device. Settings for more specialized needs can be found after this section. Some information found in this section may be repeated in other sections for ease of section navigation.

## Viewing Live Data

The display screen has a number of options for displaying live data. There are various ways to modify the display screen functions, brightness, or orientation. Refer to **display setup** ([page 27](#)).

The display screen displays live data for all parameters measured by the device simultaneously. Sensors measure data 1000 times per second and the LCD display updates 10 times per second. The measured data is displayed in the units designated by the device ([page 24](#)).

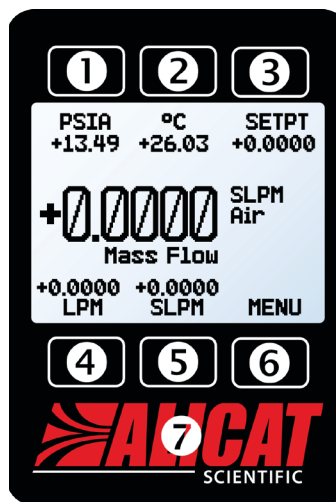
## Interacting with the Device

The images to the right show the buttons of the device display. These images compare the differences between a mass flow controller, a pressure controller, and a liquid meter.

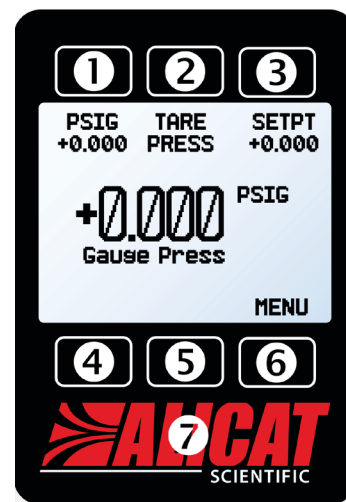
Below are the default button functions and their locations on a given device. Pressing a button to highlight a reading changes what is centered in the display.

- **Highlight pressure:** all devices use **button 1**.
- **Highlight volumetric flow:** mass flow and liquid devices use **button 4**. Pressure devices do not measure volumetric flow.
- **Highlight mass flow:** mass flow devices use **button 5**. Pressure and liquid devices do not measure mass flow.
- **Highlight temperature:** mass flow and liquid devices use **button 2**. Pressure devices do not measure temperature.
- **Changing the setpoint:** controllers use **button 3**. Meters and gauges do not have a setpoint function. Refer to [page 12](#) for more information on changing the setpoint.
- **Taring the device:** meters and gauges use **button 3** (**TARE FLOW** for meters and **TARE PRESS** for gauges). Pressure controllers use **button 2**. Mass flow controllers and liquid controllers do not have a tare button on the default display. Refer to [page 12](#) for further information on taring.
- **Enter the menu or move to the next screen:** all devices use **button 6**.
- **Enable/Disable the backlight:** all devices use **button 7**.

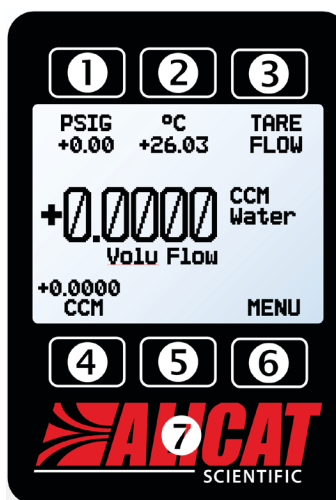
Some devices don't use all 7 buttons. If an unused button is pressed, nothing happens. Button functions can be modified under **display setup** ([page 27](#)).



Main display of a mass flow controller measuring the mass flow of air.



Main display of a pressure controller measuring gauge pressure.



Main display of a liquid meter measuring the volumetric flow of water.

### Status Messages

Status messages are shown to the right of the highlighted central measurement:

- |   |   |
|---|---|
| <b>ADC</b> Analog-digital converter error           | <b>OVR</b> Totalizer rolled over to zero        |
| <b>EXH</b> Exhaust mode active (Controllers only)   | <b>POV</b> Pressure over range of device        |
| <b>HLD</b> Valve hold active (Controllers only)     | <b>TMF</b> Totalizer missed out-of-range flow   |
| <b>LCK</b> Front display is locked                  | <b>TOV</b> Temperature over range of device     |
| <b>MOV</b> Mass flow over range of mass flow device | <b>VOV</b> Volumetric flow over range of device |

# Taring the Device

Taring is an important practice that ensures your device provides its most accurate measurements. This function gives a zeroed reference point for measurements. For devices installed with a barometer, the absolute pressure reading can be tared when venting to the local barometric pressure.

On mass flow meters, liquid meters, and pressure controllers/gauges, the tare button is found on the main screen. **Button 3** for meters and gauges and **button 2** for pressure controllers. To access taring for mass flow and liquid controllers, press the **MENU** button and then the **TARE FLOW** option.

Depending on the device, there may be options for multiple tares (usually flow and liquid devices with a barometer). In these instances, the button displays as **TARES** and provides a screen with the available measurements to tare.

It is also possible for controllers to auto-tare when the setpoint is at zero for a designated time ([page 17](#)).

## How to Tare

### Taring Flow (Mass Flow and Liquid Devices)

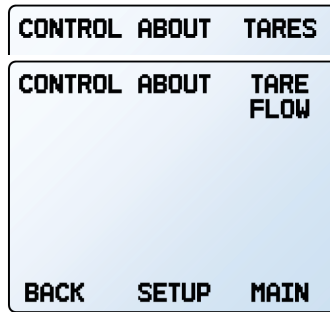
**TARE FLOW** or **MENU** → **TARES** → **TARE FLOW**

Taring flow should take place at the expected process pressure with no active flow. When **Tare Flow** is pressed, a message, “**ENSURE NO FLOW BEFORE PRESSING TARE**” may display on some devices. If so, press **TARE** to confirm taring the flow.

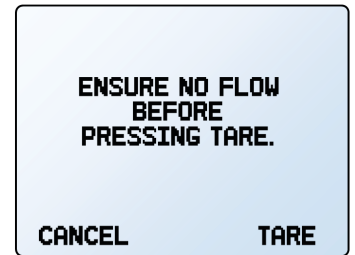
### Taring Pressure

**TARE PRESS** or **MENU** → **TARES** → **TARE PRESS**

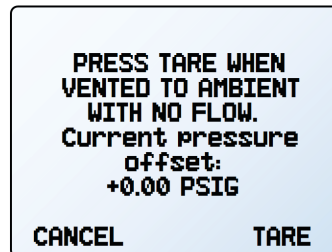
Taring pressure requires the device to be open to atmosphere. Absolute pressure tares also require an optional barometer installed at production. When pressed, a message, “**PRESS TARE WHEN VENTED TO AMBIENT WITH NO FLOW. Current pressure offset:**” displays. Press **TARE** to confirm taring the pressure.



Tare mass flow by selecting **TARE FLOW** from the **main menu** (top), or **TARES** if the device has a barometer (above).



Tare flow confirmation screen.



Tare pressure confirmation screen.

## When to Tare

- Before every new measurement cycle.
- After significant changes in temperature or pressure.
- After dropping or bumping the device.
- After changing the device's orientation.

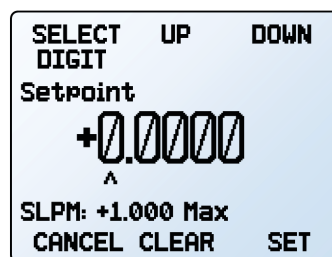
# Changing the Setpoint Controllers

Setpoints manage how much flow passes through the device or the pressure level in the system. Pressing the setpoint button from the main screen (**button 3**) moves the screen to the setpoint selection screen.

The setpoint selection screen indicates the engineering units and maximum allowable setpoint (e.g., **SLPM: +1.000 Max**). To establish a setpoint, enter the desired value and press **SET**. The device immediately begins to control the flow or pressure.

To give a zero setpoint, press **CLEAR** and then **SET**.

For more detailed options and settings, including setpoint ramping, see [page 17](#).



Setpoint selection screen.

## MENU → SETUP → Active Gas

In most cases, mass flow devices are physically calibrated at the factory using air. Gas Select™ allows you to reconfigure the device to flow a different gas without any need to send it back for a physical recalibration.

Gas selection is found in the setup menu. To access the menu, press **MENU** and then **SETUP**. When the cursor is pointing at **Active Gas**, press **SELECT**.

Within this menu, there are a variety of gas categories, recent selections, and COMPOSER™ mixes. Each category lists a subset of available gases and preconfigured mixtures. Note that not all gases are available on all devices. Corrosive gases and refrigerants are only available on the anti-corrosive line of mass flow devices.

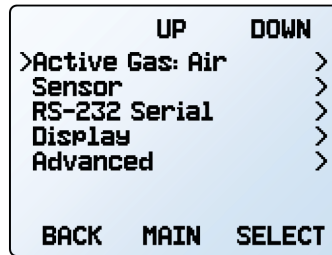
As soon as you press **SET** from the gas list, your device reconfigures its flow rate calculations to the newly selected gas properties. There is no need to restart the device or perform any other action.

Your current gas selection appears just below the unit's indicator on the right side of the **main display**.

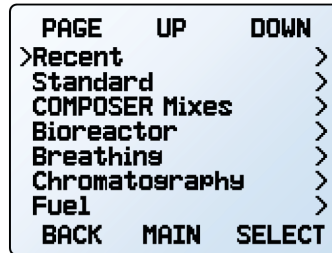
It is also possible to program the device to calculate the mass flow of a custom gas mixture (COMPOSER™ mixes). The device can have up to twenty of these mixtures saved at a time. For more information and instructions on creating custom gas mixing, see [page 23](#).

## Category and Gas List Controls

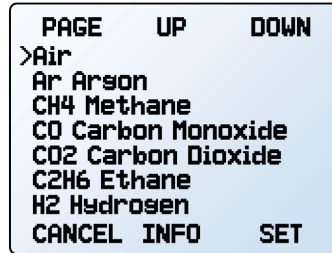
- **PAGE** advances the view to the next page of categories or gases.
- **SELECT** (in the category list) opens a list of gases in that category.
- **SET** (in the gas list) immediately loads the gas measurement properties and exits to the **setup menu**.



Setup menu.



First page of the Gas Select™ category list.



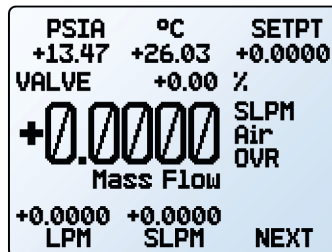
First page of the Gas Select™ standard category.

# Data Screens

Depending on the device, there can be up to four screens providing different information based on your needs. Further settings for the data screens can be found on [page 27](#).

## Live Screen

The **live screen** is the default data screen of the device. This provides access to the different measurements that a device may be taking. For more information, see the **Viewing Live Data** section under the **Basic Operations** on [page 11](#).



Live screen

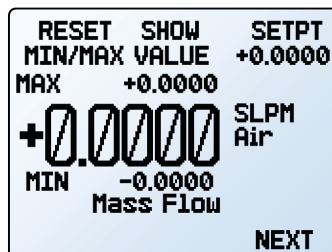
## Min/Max Screen

MENU → SETUP → Display → Data Screens → Min/Max Screen

The **Min/Max screen** displays the current selected measurement value as well as the minimum and maximum measurement of that value since the last reset. To enable the screen, change the option from **Hide** to **Show**.

On the **Min/Max Screen screen** are four options:

- **RESET** erases the current measured minimum and maximum and returns them to zero.
- **SHOW VALUE** provides possible measurements to display on the screen, along with their minimum and maximum values.



Min/Max screen.

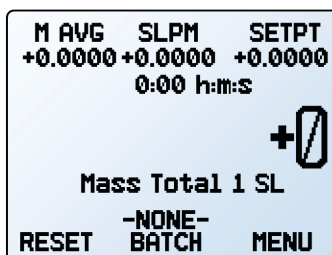
- **SETPT** is only available on controllers. It displays the current setpoint. Press to set or clear a setpoint. See [page 17](#) for setpoint instructions.
- **NEXT** moves to the totalizer screen (if enabled) or **MENU** opens the device menu.

## Totalizer Screens Flow Devices

MENU → SETUP → Sensor → Totalizer → Totalizer 1 or Totalizer 2

Mass flow and liquid devices have optional totalizers that can be configured on the device. To enable the totalizer and configure its settings, see [page 25](#). The Totalizer displays the total amount of mass or volume that has flowed through the instrument since its last reset. It also enables batch dispensing for controllers ([page 19](#)).

- **M AVG** or **V AVG** shows totalizer averaging, which displays average flow rate since last reset, updated live.
- **SLPM** (or another measurement of mass flow) displays the live flow rate. Press to change engineering units.
- **SETPT** displays the current setpoint on controllers. Press to set or clear a setpoint ([page 17](#)).
- **PEAK** displays the peak flow rate since the last totalizer reset.
- **BATCH** selects the quantity to be dispensed in each batch. **-NONE-** appears if the batch mode is off. Only available on controllers.



Totalizer displaying a mass flow average without a batch.

- **RESET** clears all totalized data and immediately resets the timer to **0**. Starts a new batch immediately, if the controller has a non-zero setpoint.
- **MENU** enters the main menu.
- **NEXT** moves to the second totalizer (if enabled).



# Option: Color TFT Display

Instruments ordered with a color display are functionally the same as standard backlit monochrome instruments. The color enables additional on-screen information.

## Multi-Color Display Indicators

- **GREEN:** Parameter labels and adjustments associated with the button directly above or below the label are presented in green.
- **WHITE:** Parameter are displayed in white when the device is operating within device specifications.
- **RED:** Parameters are displayed in red when its value exceeds 128% of the device's specifications.
- **YELLOW:** Menu items that are ready to be selected appear in yellow. The color replaces the > symbol in selections on monochrome display.



**Note:** Press the logo to turn off the color display backlight. The flow controller remains in operation while the backlight is off.

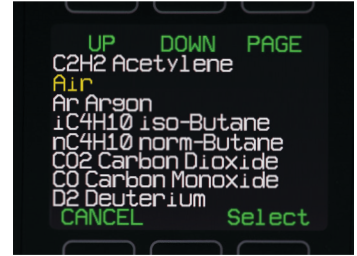


**Note:** Color displays will require an additional 40 mA when using a 12 Vdc power supply. All other device specifications from your device's specification sheet remain in effect.

To modify the display screen functions, the brightness, or orientation refer to **display setup** ([page 27](#)).



TFT display.



TFT display with air currently selected in yellow.

# Device Information

---

The **ABOUT** menu (**MENU** → **ABOUT**) contains information for setup, configuration, and troubleshooting.

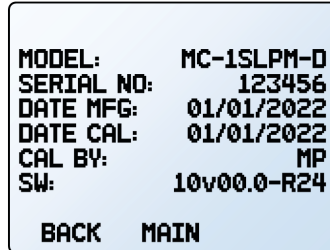
## Basic Device Information

---

### MENU → ABOUT → About Device

This includes information on the following:

- **MODEL:** Device model
- **SERIAL NO:** Serial number
- **DATE MFG:** Manufacturing date
- **DATE CAL:** Most-recent calibration date
- **CAL BY:** Initials of the person who calibrated the device
- **SW:** Firmware version



*About device screen.*

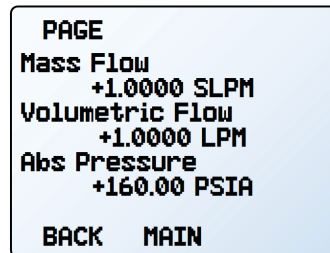
## Device Full Scale Ranges

---

### MENU → ABOUT → Full Scale Ranges

This displays the maximum calibrated range of available flow and pressure readings.

- **Mass flow devices** include mass flow, volumetric flow, and pressure.
- **Liquid devices** include volumetric flow and pressure.
- **Pressure devices** include the various pressures that it can measure.



*Full scale ranges screen.*

## Manufacturer Information

---

### MENU → ABOUT → About Manufacturer

**About Manufacturer** includes:

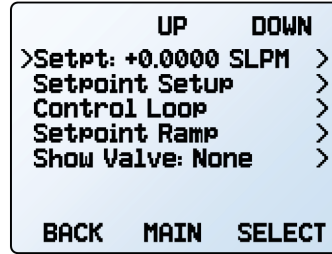
- Manufacturer name
- Web address
- Phone number
- Email address



*About menu.*

# Process Control Controllers

For a controller to regulate the flow or pressure, it needs to have a setpoint established. The setpoint is the amount of flow or the pressure that the controller attempts to achieve in a process line.



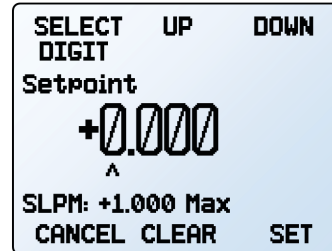
Control menu.

## Setpoint

SETPT or MENU → CONTROL → Setpt

The **setpoint selection screen** indicates the engineering units and maximum allowable setpoint (e.g., SLPM: +1.000 Max).

To establish a setpoint, enter the desired value and press **SET**, the device immediately begins to control the flow or pressure. A zero setpoint can be established by selecting **CLEAR** and then **SET**.



Setpoint screen.

## Setpoint Options

The setpoint can be configured with a few options to better control your process based on your needs. Below are various setpoint options and functions.

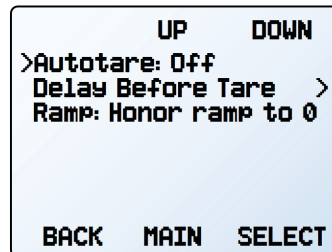
### Auto-tare and Zero Setpoint Options

MENU → CONTROL → Setpoint Setup → Zero Setpoint

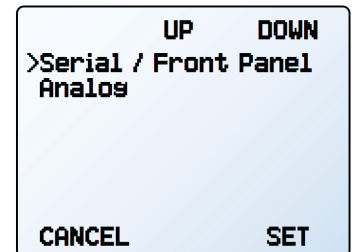
A controller can automatically tare itself when it has a zero setpoint. Once the setpoint is given, the device waits a specified amount of time before taring. **Delay Before Tare** manages how much time the controller waits before taring. Make sure the delay provides enough time for the process to stop flow and settle.

**!** **Caution:** Auto-tare typically is not recommended for pressure controllers.

**Ramp** controls whether the device honors setpoint ramping down ([page 18](#)) or immediately goes to the zero setpoint. If set as **Honor ramp to 0**, the controller moves down to a zero setpoint at the specified ramp rate. If set as **Instantly to 0**, the controller immediately moves the process to zero when a zero setpoint is given.



Zero setpoint (auto-tare) menu.



Setpoint source menu.

### Setpoint Source

MENU → CONTROL → Setpoint Setup → Setpoint Source

Controllers with RS-232 or RS-485 communication accept setpoints from the front panel and serial commands ([page 29](#)). Alternatively, an analog source can be used instead.

- When the source is set to **Serial/Front Panel**, the controller accepts input from either the front panel or an RS-232/RS-485 connection. Neither source is a slave of the other, and the controller accepts the most recent command from either source.
- When the source is set to **Analog**, the device ignores serial setpoint commands and prevents setpoint input from the front panel.

## Idle Connection Response

MENU → CONTROL → Setpoint Setup → On Comm Timeout

If the communication connection is timed out, the controller can either set a zero setpoint, or maintain the last setpoint given. The timeout time is infinite by default and can be manually defined ([page 27](#)).

## Setpoint on Power-Up

By default, the controller remembers its last setpoint across power cycles, but a specific setpoint can be configured to be used on every power-up. It is possible to also configure the power-up setpoint to follow the ramp rate.

### Power-Up Setpoint Value

MENU → CONTROL → Setpoint Setup →

Power Up Setpoint → Value

By selecting **Fixed Setpoint** and entering a value, the device moves to the same setpoint every time after power-up, ignoring whatever the setpoint was before being powered off.

If the setpoint is digitally provided more than every few minutes, use a fixed setpoint on power-up to avoid wearing out non-volatile memory in the device.

### Power-Up Setpoint with Ramping

MENU → CONTROL → Setpoint Setup →

Power Up Setpoint → Ramp

This designates if the device follows the ramp rate or not after powering on. The device can either honor the ramp rate and ramp up (**Honor from 0**) or jump immediately to the power-up setpoint (**Jump from 0**).

For more information on ramping, see **Setpoint Ramping** ([page 18](#)). This functions the same as the power-up option in **Ramping Options**. Changing one overwrites the other.

## Setpoint Limits

MENU → CONTROL → Setpoint Setup → Setpoint Limits

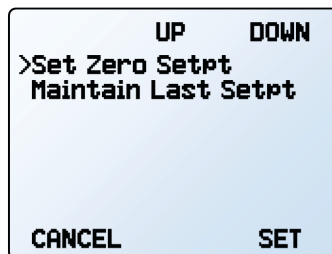
The **setpoint limits menu** configures upper and lower limits for selecting a setpoint. By default, the limits are the controller's measuring range, but more strict limits may be beneficial in certain applications.

## Setpoint Ramping

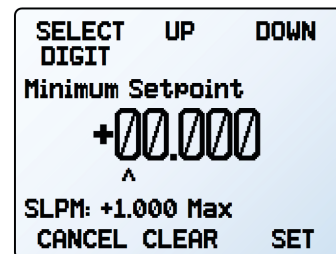
MENU → CONTROL → Setpoint Ramp

Setpoint ramping regulates how quickly the controller reaches a new setpoint. It is often used to prevent bursts of pressure or flow from damaging delicate instruments at the start of a process.

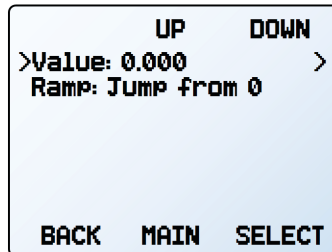
To activate setpoint ramping, set a maximum ramp rate and configure when to enable the ramping function.



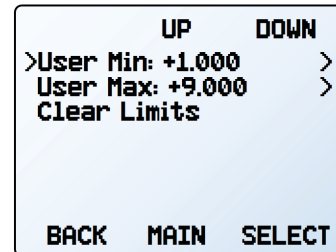
Communication timeout menu.



Setting a minimum setpoint.



Power-up setpoint menu.



Setpoint limits menu.

Over a serial connection, the controller rejects requests of a setpoint outside the limit and an error is returned. When using an analog setpoint signal, setpoints that are outside of the setpoint limits are treated as if they were at the nearest limit. For example, if you request a setpoint via analog that is below the lower limit, the controller sets the setpoint at the lower limit.



**Caution:** Flow controllers that have non-zero lower setpoint limits cannot be set to stop flow until the lower limit has been cleared.

**Note:** When changing from one control loop variable to another, the controller remembers setpoint limits as percentages of full scale. For example, a 10-SLPM limit on a 20-SLPM controller (50% of full scale) will become a limit of 80 PSIA (50% of 160 PSIA) if the control loop is changed to absolute pressure.

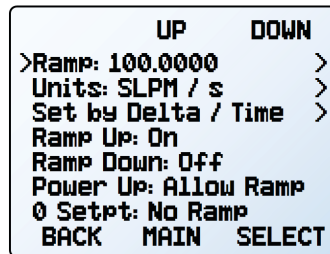
## Ramp Rate

- **Ramp** changes the maximum rate of change.
- **Units** changes the engineering units used.
- **Set By Delta / Time** allows for more detailed control of the ramp rate including changing the value of the time period.

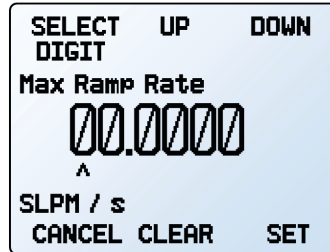
## Ramping Options

Ramping options control when ramping occurs. This can be when the setpoint changes, when the device powers on, or when setting a zero setpoint.

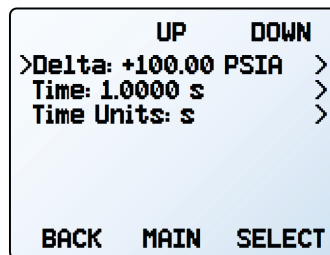
- **Ramp Up** can toggle between on and off. When off, the ramp rate will not be honored when increasing flow or pressure to reach a given setpoint.
- **Ramp Down** can toggle between on and off. When off, the ramp rate will not be honored when decreasing flow or pressure to reach a given setpoint.
- **Power Up** toggles between **Allow Ramp** and **No Ramp**. If set to **No Ramp**, the device ignores the ramp rate just after powering on, otherwise it honors the ramp rate starting at a zero setpoint. This functions the same as **power-up setpoint with ramping** (page 18). Changing one overwrites the other.
- **0 Setpt** determines if the controller ramps when a zero setpoint is set. If this setting is set to **No Ramp** when given a zero setpoint, the controller immediately moves to the zero setpoint. Otherwise, the controller ramps at the selected rate.



Setpoint ramping menu.



Setting a maximum ramp rate.



Configuring delta / time ramping.

✓ **Note:** Setpoint ramping can be used with flow or pressure setpoints, depending on the control loop selected. Ramping for pressure control limits how quickly pressure changes before reaching the setpoint. To limit flow rates directly while controlling pressure, see page 21.

## Batch Dispensing Flow Controllers

### BATCH or MENU → CONTROL → Batch 1 or Batch 2

Batch dispensing flows a set volume of gas. Once that volume of gas flows through the controller, the valve closes and flow stops. You can repeat batches with a single button press.

To utilize batching, at least one totalizer must be enabled. The **BATCH** button can be found on the totalizer screen (page 14). When selecting from the **CONTROL** menu, **Batch 1** is for totalizer 1 and **Batch 2** is for totalizer 2. Only set one batch at a time to avoid premature stoppage in flow.

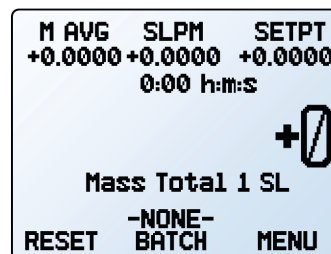
### Start a Batch

1. Choose the total quantity to be dispensed in each batch. Press **SET** to accept the new batch size.
2. Once a batch size has been set, give the controller a setpoint (page 17). Flow begins as soon as you press **SET**.

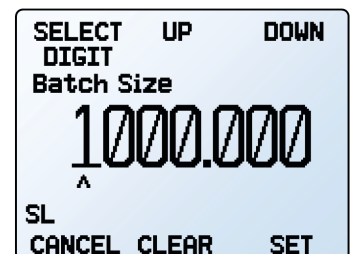
✓ **Note:** Batch dispensing requires an active batch size and a non-zero setpoint. If your controller already has a non-zero setpoint, batching begins as soon as you press **SET** from the batch size screen.

While a batch is being dispensed, the remaining quantity of to be dispensed is displayed about the **RESET** and **BATCH** buttons. When the batch is complete, **-DONE-** displays just above the **BATCH** button and flow stops automatically. The setpoint is not cleared and remains the same.

The batch size can be changed while a batch is in progress. If the new batch size is larger than the current totalized flow, then flow continues until the new value is reached. If the new batch size is smaller than the current totalized flow, then the flow stops immediately. Press **RESET** to start the new batch.



Totalizer displaying a mass flow average without a batch, with a batch in progress, and with a finished batch.



Selecting a batch size of 1000 SL.

## Repeat a Batch

- For an identical batch, press **RESET**. Flow begins immediately.
- For a new batch of a different size, press **BATCH**, and select the new batch size. If there is a non-zero setpoint, flow begins as soon as **SET** is pressed.

## Pause or Cancel a Batch

- To pause flow while a batch is in progress, change the setpoint to **0** by pressing **SETPT** → **CLEAR** → **SET** within the **totalizer menu**. This does not stop the timer. To resume, change the setpoint to a non-zero setpoint.
- To remove a batch setting, press **BATCH** → **CLEAR** → **SET**. Deleting the batch does not affect the setpoint. Flow will continue at the setpoint rate.



**Warning:** Flow resumes immediately at the current setpoint when batch dispensing is turned off.

**Note:** The controller retains batch size across power cycles. The batch size must be manually cleared to remove it.

## Valve Drive Percentage Display

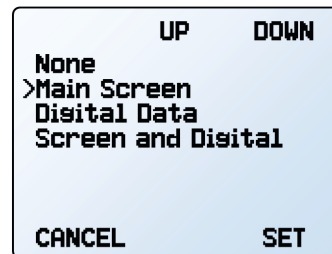
### MENU → CONTROL → Show Valve

The valve drive is represented as a percentage of the total possible voltage driven to the valve. While drive percentage does not directly correlate with percentage open, a drive percentage of 0% indicates the valve is not open.

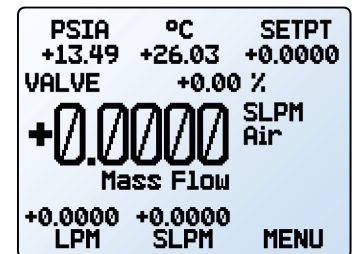
Viewing the valve drive percentage can be helpful for troubleshooting. An increase in percentage over time likely indicates a blockage in the system where more voltage is required to drive the valve to attain the same amount of flow.

This information may be displayed on the **main display** and/or as part of transmitted serial data. There are four valve display options:

- **None:** No valve information is displayed.
- **Main Screen:** Only on the main display.
- **Digital Data:** Only in the serial data frame.
- **Screen and Digital:** Both the main display and serial data frame.



Valve display menu



Valve percentage on the *main display*, above the large numbers.

## Control Loop

The control loop manages what parameter a controller controls as well as how the controller reacts to changes within the system.

### Controlled Variable

#### MENU → CONTROL → Control Loop → Control

The controlled variable is the measurement the controller attempts to regulate to the given setpoint. Controllers can only control one measurement at a time, but they still measure the other variables during that time. Below are the lists of possible variables each controller can control.

### Mass Flow Controllers

Mass flow controllers can control mass flow, volumetric flow, pressure (absolute or gauge) and the valve drive.

### Liquid Controllers

Liquid controllers can control volumetric flow, gauge pressure, and the valve drive.

### Pressure Controllers

Pressure controllers can only control the pressure of the device. Selectable control loop variables include pressure (absolute, gauge, or differential) and valve drive.



**Note:** When pressure is the selected variable, all controllers with upstream valves control the outlet pressure. Those with downstream valves control upstream back pressure, but these devices must be configured for this type of control.



**Warning:** When changing the control loop, the PID settings may need adjusting for optimal stability and speed of response.



## PD/PDF or PD<sup>2</sup>I Control Algorithms

MENU → CONTROL → Control Loop → Loop Type

Your controller uses an electronic closed loop controller to determine how to actuate its valve(s) in order to achieve the commanded setpoint. These settings are tuned at production for your specific operating conditions, but changes sometimes require on-site adjustments to maintain optimal control performance. Fine-tuning your closed loop control may help correct issues with control stability, oscillation, or speed of response.

For most applications, the PD/PDF algorithm is recommended. When controlling pressure with a dual valve controller (MCD or PCD devices), the PD<sup>2</sup>I algorithm is recommended.

### Tuning the PD/PDF Control Algorithm

The controller's default control algorithm (PD) employs pseudo-derivative feedback (PDF) control, which uses two editable variables:

- The larger the **D** gain, the faster the controller corrects errors between the commanded setpoint and the measured process value. This is equivalent to the **P** variable in common PDF controllers.
- The larger the **P** gain, the faster the controller will correct for offsets based on the size of the errors and the amount of time they have occurred. This is equivalent to the **I** variable in common PDF controllers.



**Note:** The **D** and **P** variables in the PD/PDF control algorithm are more typically referred to as **P** and **I**, respectively, in PDF controllers.

### Tuning the PD<sup>2</sup>I Control Algorithm

PD<sup>2</sup>I usually provides a faster response in dual-valve flow and pressure controllers. This algorithm uses typical PI terms and adds a squared derivative term (D):

- The larger the **P** gain, the more aggressively the controller will correct errors between the commanded setpoint and the measured process value.
- The larger the **I** gain, the faster the controller will correct for offsets based on the size of the errors and the amount of time they have occurred.
- The larger the **D** gain, the faster the controller will predict needed future corrections based on the current rate of change in the system. This often results in slowing the system down to minimize overshoot and oscillations.

### Troubleshooting Valve Performance with PID Tuning

The following issues may be resolved by adjusting the PID gain values for your controller.

Fast oscillation around the setpoint:

- **PD:** Reduce the **P** gain in decrements of 10%.
- **PD<sup>2</sup>I:** Increase the **P** gain in increments of 10%, and then adjust the **I** gain to fine-tune.

Overshot setpoint:

- **PD:** Reduce the **P** gain in decrements of 10%.
- **PD<sup>2</sup>I:** Increase the **P** gain in increments of 10%.

Delayed or Unattained Setpoint:

- **PD:** Increase the **P** gain in increments of 10%, and then decrease the **D** gain by small amounts to fine-tune.
- **PD<sup>2</sup>I:** Increase the **P** gain in increments of 10%, and then increase the **I** gain to fine-tune.



Valve tuning can be complex. More detailed information is available at [alicat.com/pid](http://alicat.com/pid).

```

      UP      DOWN
>Control: Mass Flow >
Loop Type: PD2I    >
P Gain: 2000       >
I Gain: 2000       >
D Gain: 10         >
Flow Limiter       >
Control Deadband   >
BACK MAIN SELECT
  
```

The control loop menu in PD<sup>2</sup>I control mode.

```

SELECT UP      DOWN
DIGIT
P Gain
 00167
  ^
0 - 65535
CANCEL CLEAR  SET
  
```

Setting a P Gain.

## Flow Limit while Controlling

Pressure Flow Controllers

MENU → CONTROL → Control Loop → Flow Limiter

Limiting the flow rate while controlling pressure can help to avoid exceeding the measurable range of the device as well as prevent damage of sensitive devices later in the process. To limit flow:

1. Choose either mass flow or volumetric flow to limit by selecting **TYPE**.
2. Set the maximum value of flow rate desired by selecting **MAX FLOW** and entering the maximum value in the engineering units displayed.
3. Set the **Limiter Gain** to 500 and adjust as needed. **Limiter Gain** determines how aggressively the proportional control function corrects the error when the flow rate exceeds the maximum flow setting. A higher value corrects more aggressively, but it is also more likely to oscillate near the flow limit.



**Note:** If both flow limiting and pressure setpoint ramping are active when controlling pressure, the more restrictive function regulates the controller's operation as it attempts to attain the setpoint.



**Note:** For bidirectional controllers, the flow limit will be symmetric. For example an MCD-20SLPM with a maximum set to 10 SLPM will be limited to between -10 SLPM and 10 SLPM.

```

      UP      DOWN
>Type: Mass Flow   >
Max Flow: None     >
Limiter Gain: 0    >
BACK MAIN SELECT
  
```

Flow limiter menu.

```

SELECT UP      DOWN
DIGIT
Max Flow Limit
 +0.0000
  ^
SLPM: +1.0000 Max
CANCEL CLEAR  SET
  
```

Setting a maximum flow limit.

## Control Deadband for Pressure Control

MENU → CONTROL → Control Loop → Control Deadband

The control deadband is designed to minimize the amount of gas exhausted and improve stability. There is no active control within the deadband setting.



**Note:** A control deadband cannot be set when the device is configured to control flow (page 20). If control is set to mass flow, the error "Only active when controlling pressure" displays instead of the *deadband menu*.

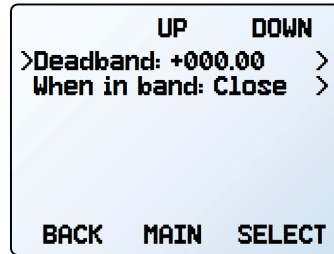
To turn on the control deadband, enter a non-zero value in CONTROL → Control Deadband → Deadband. The controller must first reach the setpoint for the deadband to engage. If the process variable drifts outside a deadband limit, active control resumes until the setpoint is reached again.

The controller can be set to either hold the current valve position or close the valve(s) in CONTROL → Control Loop → Control Deadband → When in Band. It is recommended to hold the current position on single valve controllers and close valves for dual valve controllers.

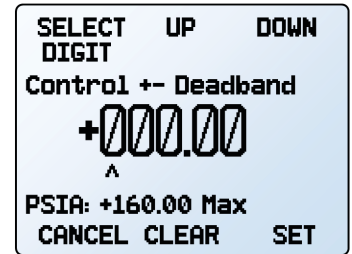
**Example:** With a setpoint of 30 PSIA, a deadband of  $\pm 0.25$  PSIA allows absolute pressure to vary between 29.75 and 30.25 PSIA.



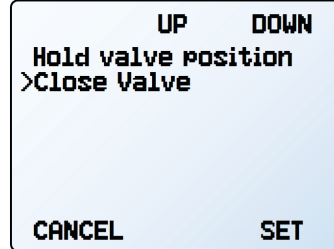
**Caution:** MC-Series devices do not have an exhaust valve to reduce pressure when pressure exceeds the deadband.



Deadband menu.



Choosing deadband size.



Choosing deadband options.

# Device Setup

## Gas Selection Mass Flow Devices

In most cases, your mass flow device was physically calibrated at the factory using air. Gas Select™ allows you to reconfigure the device to flow a different gas without any need to send it back for a physical recalibration. The device is also able to be programmed to measure custom mixtures of gases.

### Gas Select™

MENU → SETUP → Active Gas

Within this menu, there are a variety of categories (such as **Standard**, **Chromatography** and **Welding**), as well as recent selections, and COMPOSER™ mixes (see next page). Each category lists a subset of available gases and preconfigured mixtures.

As soon as you press **SET** from the gas list, your device reconfigures its flow rate calculations to the newly selected gas's properties. There is no need to restart the device.

Your current gas selection appears just below the engineering units on the right side of the **main display** (see [page 11](#)).

### Category and Gas List Controls

- **PAGE** advances the view to the next page of categories or gases.
- **SELECT** (in the category list) opens a list of gases in that category.
- **SET** (in the gas list) immediately loads the gas measurement properties and exits to the **setup** menu.

### COMPOSER™ Gas Mixes

MENU → SETUP → Active Gas → COMPOSER Mixes

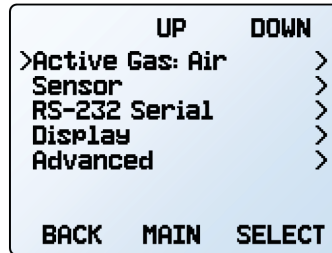
To remain accurate, your mass flow device needs to reference the viscosity of the gas you are flowing through it. The more closely you can define your actual gas composition, the more accurate your flow readings will be. COMPOSER™ is an included feature of Gas Select™ that lets you define new mixed gas compositions to reconfigure your flow controller on the fly.

Wilke's semi-empirical method is used to define a new gas mixture based on the molar (volumetric) ratios of the gases in the mixture. You can define these gas compositions to within 0.01% for each of up to five constituent gases in the mixture. Once you define and save a new COMPOSER™ gas mix, it becomes part of the Gas Select™ system and is accessible under the gas category **COMPOSER User Mixes**. You can store up to 20 COMPOSER™ gas mixes on your flow controller.

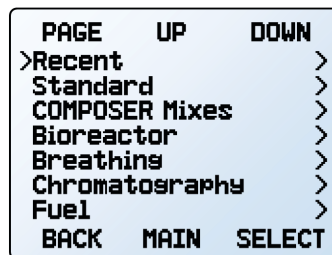


**Note:** The COMPOSER™ is device firmware, and does not physically mix gases. It only configures the device's calculations to report flow readings more accurately based on the constituent gases of your defined mixture.

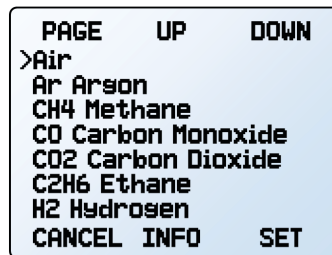
Select any existing mix and press **SET** to immediately configure your device to measure that gas mixture. To create new mixes, see the next section.



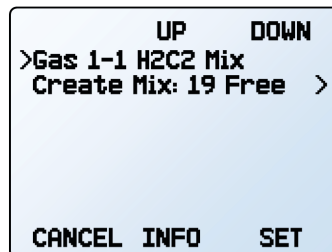
Setup menu.



First page of the Gas Select™ category list.



Gas Select™ standard gas list.



The COMPOSER™ menu with the new custom mix.

## Creating New Mixes in COMPOSER™

MENU → SETUP → Active Gas →  
COMPOSER Mixes → Create Mix

### Give the Mix a Short and Long Name

UP/DOWN changes the character. Valid characters include A–Z, 0–9, punctuation (., -), and space. CANCEL exits to the mix settings menu. SET accepts the name.



**Note:** Using a space in the short name can cause the serial data frame to be read incorrectly by some programs.

### Define the Mix.

- **Add Gas to Mix** enters the Gas Select™ category listing. Once you find the correct gas, press **SET**. Enter the composition percentage and press **SET**.
- As gases are added, the total used percentage updates on the **mix settings menu**.
- Once gases have been added, COMPOSER™ can change the gas percentage to fill the remaining portion to 100% by selecting the component gas, then selecting **Set % to Balance**.
- The sum percentage of gases must total 100% to select **Save Mix**. Selecting **BACK** will permanently discard the mix.
- Mixes that contain several gases push the menu to a second page; use the **PAGE** button to see the remaining list.

## Viewing, Deleting, and Creating Similar Mixes

MENU → SETUP → Active Gas → COMPOSER Mixes → [Select mix] → INFO

The current configuration of any existing COMPOSER™ mix can be viewed by selecting **INFO** instead of **SET** in the mix list. It will show:

- Options to delete the mix.
- Create a similar mix.
- Short and long names.
- The gas number.
- The composition, which may extend to a second page. Pressing the **PAGE** button will move to the next page.

## Sensor Setup

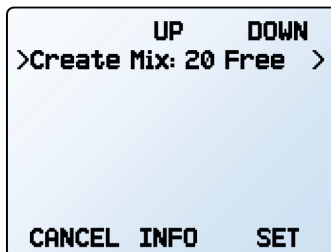
MENU → SETUP → Sensor

Sensor setup controls how measurements are calculated and communicated by the device. These are factors like what engineering units are used and the standard or normal reference points for flow.

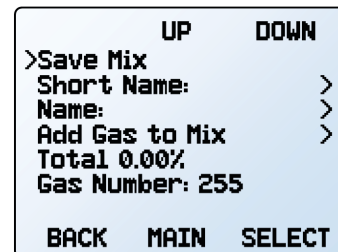
### Engineering Units

MENU → SETUP → Sensor → Engineering Units

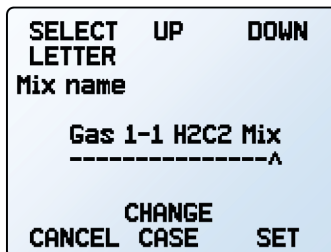
Changing engineering units alters both the display and the data frame. Choose the parameter whose unit you want to change, and then choose an engineering unit, confirming the change on the last screen.



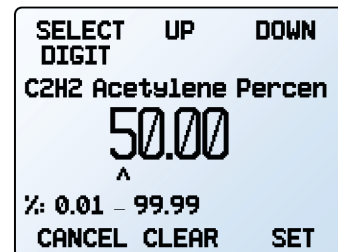
COMPOSER™ menu without existing mixes.



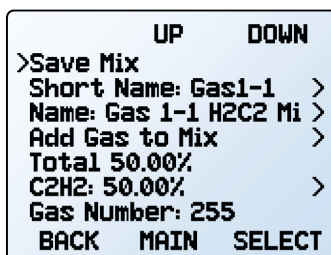
Mix settings menu.



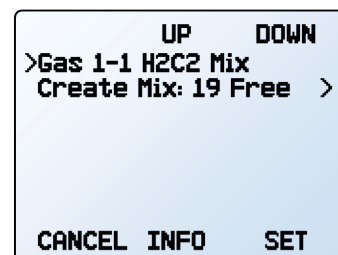
Defining a mixture's long name.



Setting the percentage of a constituent gas C<sub>2</sub>H<sub>2</sub>.



Results of adding of C<sub>2</sub>H<sub>2</sub>.



COMPOSER™ menu with the new custom mix.

## STP/NTP Reference Values Mass Flow Devices

MENU → SETUP → Sensor → STP

Flow Ref or NTP Flow Ref

A mass flow device references a given temperature and pressure combination to calculate flow. Standard mass flow uses an STP (standard temperature and pressure) reference point and normal mass flow uses an NTP (normal temperature and pressure) reference point. Depending on the engineering units selected, either STP or NTP will be editable from this menu. For example, if SLPM (Standard liters per minute) is selected, STP is editable. If NLPM (normal liters per minute) is selected, NTP is editable.

### Reference options:

- **Stan T:** Standard Temperature
- **Stan P:** Standard Pressure
- **Norm T:** Normal Temperature
- **Norm P:** Normal Pressure
- **Ref temp units** changes the temperature units used for STP and NTP calculations.
- **Ref pressure units** changes the pressure units used for STP and NTP calculations

Unless otherwise requested, your flow controller ships with a default STP of 25°C and 1 atm (which affects flow units beginning with “S”), and an NTP of 0°C and 1 atm (which affects flow units beginning with “N”).



**Caution:** Changes to STP or NTP references alters your mass flow readings.

## Totalizer Options Flow Devices

The totalizer measures the total flow over a given time and is one of the display screens. For more information on the totalizer display, see [page 14](#).

### Totalizer Mode

MENU → SETUP → Sensor → Totalizer →

Totalizer 1 or Totalizer 2 → Mode

All devices have 2 options for calculating flow:

- **Positive Flow Only:** The totalizer only counts flow that passes left to right through the flow body of the device. If any negative flow (right to left) moves through the system, it is not counted.
- **Reset After No Flow:** When flow is completely stopped, the totalizer holds the current value of the measured flow until flow begins again. Once flow begins, the totalizer resets to zero.

Bidirectional dual valve controllers can have 2 further options for calculating flow:

- **Negative Flow Only:** The totalizer only counts negative flow (flow that passes right to left through the flow body of the device). Positive flow (left to right) is not counted.
- **Bidirectional:** The totalizer adds flow that moves positively through the system and subtracts flow that moves negatively.

## Flow and Pressure Averaging

MENU → SETUP → Sensor → Flow Averaging

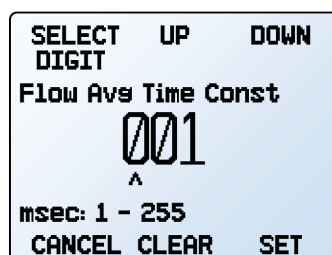
MENU → SETUP → Sensor → Pressure Averaging

Averaging the flow over a longer time may be useful in smoothing fluctuating readings. This menu changes the time constants of the geometric running averages for flow and pressure. Values roughly correspond to the time constant (in milliseconds) of the averaged values. Higher numbers generate a greater smoothing effect. The device is capable of a maximum 255 ms.

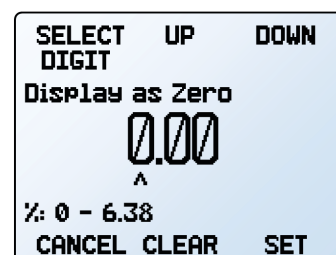
### Zero Band

MENU → SETUP → Sensor → Zero Band

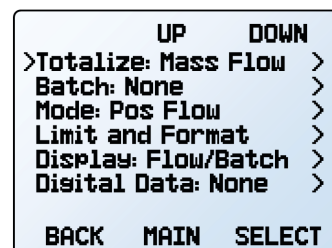
The zero band threshold is an amount of flow or pressure under which measurements are displayed as 0. The maximum zero band is 6.38%. For example, a 20 SLPM controller with a zero band value of 0.25% displays as 0 SLPM for all readings below 0.05 SLPM. This function also applies to gauge pressure readings when using the optional barometer.



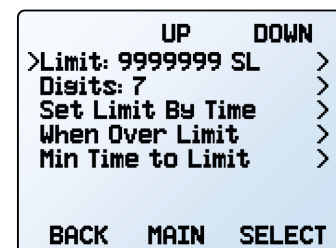
Adjusting the flow averaging time constant.



Configuring the zero band.



Totalizer options.



Totalizer **Limit and Format** screen.

### Totalizer Limit and Format

MENU → SETUP → Sensor → Totalizer →

Totalizer 1 or Totalizer 2 → Limit and Format

The totalizer can report up to a maximum of 10 digits. By default, it uses 7 digits and the placement of the decimal is the same as the live flow rate.

The limit of the totalizer sets where the decimal is placed in the total amount of measured flow. Most devices can be configured to measure to the hundredths position. It is possible to limit measurement to a length of time. The options allow for as little as 10 minutes to as long as 10 years. When set, the totalizer measures the flow for that length of time and then stops until reset. How the totalizer reacts is based on the **Totalizer Limit** settings.



## Totalizer Limit

There are 4 options for how the totalizer reacts when it reaches its limit:

- **Zero and Set OVR:** Totalizer resets to zero and continues once the maximum count is reached. The **OVR** status message is active to indicate maximum count has been reached ([page 11](#)).
- **Set to Zero:** Totalizer resets and continues counting from zero once the maximum count is reached. No error status is displayed.
- **Hold and Set OVR:** Totalizer stops counting at max count until it is reset manually. Displays **OVR** status message to indicate maximum count has been reached ([page 11](#)).
- **Hold:** Totalizer stops counting at max count until it is reset manually. No error is displayed.

The totalizer also calculates the minimum time the totalizer will run before it reaches the totalizer limit. Once all the settings have been confirmed, selecting **Min Time to Limit** shows how long the totalizer can run at full flow before the limit is reached. Increasing the number of digits and moving the decimal to the right will increase this time.

The elapsed time counter has a maximum value of 9999:59:59 (h:m:s) (416 days, 16 hours). If flow is still being totalized at that point, the timer freezes, regardless of the options chosen for the totalized flow readings.

## Totalizer Display

MENU → SETUP → Sensor → Totalizer → Totalizer 1 or Totalizer 2 → Display

Totalizers have 3 options to display on the main screen.

- **Flow and Batch (Default):** View as described above with options for batching, flow averaging, and setpoint.
- **Detailed Flow:** Similar to Flow and Batch but without batching. Provides information focuses more on flow rates, total flow, and average flow.
- **Multi-variable:** Screen that resembles the main display ([page 11](#)).

## Totalizer Digital Data

MENU → SETUP → Sensor → Totalizer → Totalizer 1 or Totalizer 2 → Digital Data

This setting enables the device to report the totalizer value whenever it is polled by the serial terminal ([page 29](#)). There are two options available.

- **None:** The totalizer value is not displayed when the device is polled.
- **Volume:** The totalizer reports the current value of the totalized volume when the device is pulled.

## Restore Totalizer Value on Power-up

MENU → SETUP → Sensor → Totalizer → Power Up Restore

Turning this option on sets the device to retain the totalized value between power cycles. The device continues to count from its previous totalized amount when power is restored.

If this setting is off, the totalizer resets when the device is powered off.

## Totalizer while Controlling Pressure

While using a mass flow or liquid controller to control pressure, the flow rate may exceed the maximum measurable flow (128% of full scale) with an abrupt pressure change. In this case, the totalized value flashes and the **TMF** error appears. The **TMF** error indicates that the totalizer missed flow data. Reset the totalizer to clear the error message.

Setting an upper flow limit ([page 21](#)) within the readable range prevents this error, but the flow limit would be given preference over reaching the pressure setpoint.

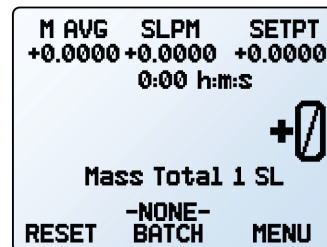


**Warning:** In certain situations, it is possible to exceed the batch size when controlling pressure. As an example, if the feed pressure is too low to achieve the flow setpoint and then pressure suddenly increases, the batch size may exceed its limit before the valve reacts to the sudden burst of pressure.

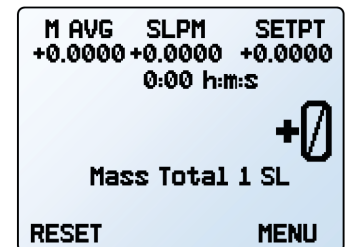
## Batches Mass Flow and Liquid Controllers

BATCH or MENU → CONTROL → Batch 1 or Batch 2

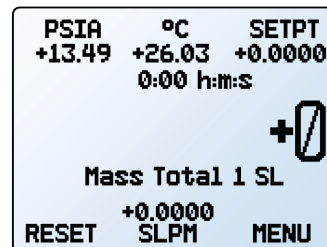
Batching is only possible when a totalizer is enabled and works in concert with the setpoint. For more information on batching flow, see the batch section on [page 19](#).



Totalizer *Flow and Batch* view.



Totalizer *Detailed Flow* view.



Totalizer *Multivariable* view.



# Serial Communications Configurations

## MENU → SETUP → RS-232 Serial or RS-485 Serial

You can operate your device via its data connection for easy streaming and logging of all data. Before connecting the device to a computer, ensure that it is ready to communicate by checking the options in this menu.

For more on how to issue commands from over serial communications, see [page 29](#).

### Unit ID

#### MENU → SETUP → RS-232 Serial or RS-485 Serial → Unit ID

The unit ID is the identifier that a computer uses to distinguish your device from other, similar devices when it is connected to a network. Using the unit ID letters A–Z, you can connect up to 26 devices to a computer at the same time via a single COM port. This is called **polling mode** ([page 29](#)). Unit ID changes take effect when you select **SET**.

If you select “@” as the Unit ID, the device enters **streaming mode** ([page 30](#)).

### Modbus RTU Configuration

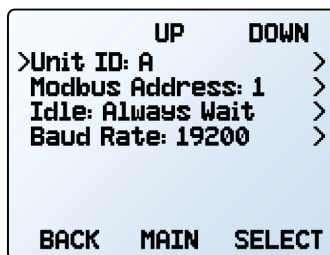
#### MENU → SETUP → RS-232 Serial or RS-485 Serial → Modbus Address

The Modbus address is the identifier that a computer or programmable logic computer (PLC) uses to distinguish your device from other devices when connected to a Modbus network. Values of 1–247 are available for use.

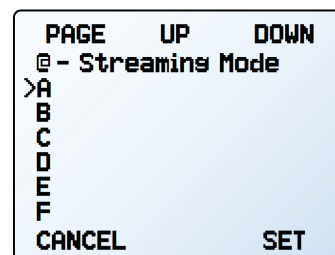
### Manage Setpoint when Connection is Idle

#### MENU → SETUP → RS-232 Serial or RS-485 Serial → Idle:

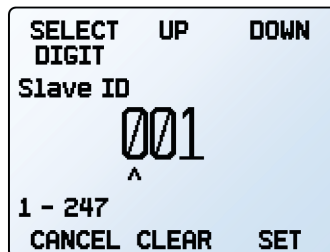
If a connection is idle for a specified amount of time, the controller can either move to a zero setpoint, or maintain the previous setpoint. The idle time will be infinite by default (**Idle: Always Wait**) and can be set in seconds up to 99999.9 seconds (1 day, 3 hours, 46 minutes, 39.9 seconds).



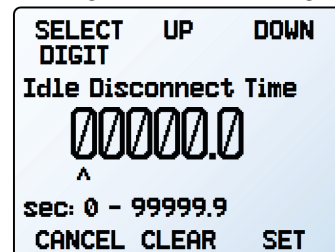
Serial communication menu.



Choosing a unit ID, or streaming.



Modbus address menu.



Setting a Modbus idle disconnect time.

### Baud Rate

#### SETUP → RS-232 Serial or RS-485 Serial → Baud Rate

Baud rate is the speed at which digital devices transfer information. The device has a default baud rate of 19200 baud (bits per second). If your computer or software uses a different baud rate, you must change the device's baud rate in the **BAUD** menu to ensure they match. Alternatively, you can change your computer's baud rate (use Windows® Device Manager for most applications). Baud rate changes take effect once you press **SET**, but you may need to restart any software for it to recognize the change.

## Display Setup

The options in the **display setup** menu adjust the contrast/brightness of the display and enable screen rotation.

### Data Screens

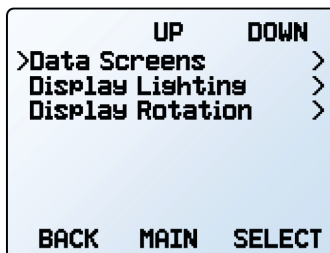
#### MENU → SETUP → Display → Data Screens

The data screens menu provide options for the various screens of the device. For more information on the contents of the screens and their functions, see the **Data Screens** section ([page 14](#)).

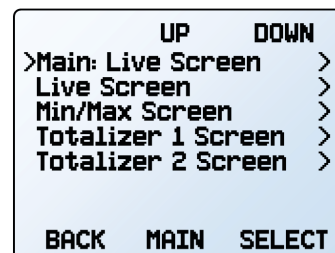
### Main Screen

#### MENU → SETUP → Display → Data Screens → Main:

To select which screen displays when **MAIN** is pressed, select from one of the options in this menu. Only screens that have been enabled are available for selection. If the live screen is not selected, it can be reached by pressing **NEXT** on the main screen.



Display setup menu.



Data screens menu.

### Live Screen Options

#### MENU → SETUP → Display → Data Screens → Live Screen

- **Any Key Press** changes what happens when any of the parameter buttons on the **main display** ([page 11](#)) are pressed (pressure or temperature, for example). By default, these buttons highlight

their measurement in the center of the display. If this option is set to **Show Actions Menu**, an option to change that parameter's engineering units is shown, as well as an option to highlight the parameter.

- **Show Valve Drive** shows or hides the valve's drive percentage on controllers. See [page 20](#).
- **Top Left Key Value** configures which type of pressure (barometric, gauge, absolute) is displayed when an optional barometer is installed in the device.

### Enable Min/Max Screen

MENU → SETUP → Display → Data Screens → Min/Max Screen

- **Show** enables the min/max screen.
- **Hide** disables the min/max screen.

### Totalizer 1 and Totalizer 2 Screen Options

MENU → SETUP → Display → Data Screens → Totalizer 1 or Totalizer 2

The totalizer screen options behave in the same manner as outlined in the **Totalizer Display** section ([page 26](#)). Performing changes in this menu performs the same change in the totalizer display menu. The opposite is true as well where changes in the totalizer display menu is reflected in this menu.

- **Flow and Batch (Default):** View as described in the Totalizer Display ([page 26](#)), with options for batching, flow averaging, and setpoint.
- **Detailed Flow:** Similar to Flow and Batch, but without batching. Provides information focuses more on flow rates, total flow, and average flow.
- **Multi-variable:** Screen that resembles the live screen ([page 11](#)).

## Advanced Setup

MENU → SETUP → Advanced

The **advanced setup** menu contains useful settings and information for troubleshooting with customer support.

### Factory Restore

MENU → SETUP → Advanced → Factory Restore

If something is not acting as expected, please contact an applications engineer prior to doing a **Factory Restore** to help confirm a restore is necessary. This immediately prompts a confirmation screen. Upon confirmation, all settings and registers are returned to their default settings.

**!** **Caution:** Performing a factory restore removes any and all 3rd party calibrations.

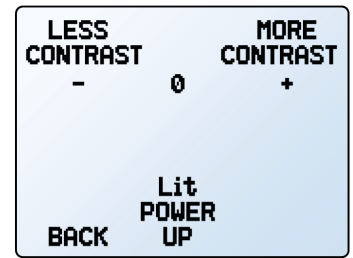
### Register Status

MENU → SETUP → Advanced → Register Status

The **Register Status** screen displays live values for the internal device registers. Many of these values can help an applications engineer diagnose operational issues during technical support. Some register values clearly distinguish between hardware and operational problems, which speeds up the troubleshooting process.



Options for pressing buttons on the **Live Screen**.



Monochrome contrast menu.

### Screen Lighting

MENU → SETUP → Display → Display Lighting

The options and wording in the screen lighting menu varies between monochrome and color displays.

- On monochrome displays, press **LESS CONTRAST** or **MORE CONTRAST** to adjust the contrast levels. **POWER UP Lit** or **Dark** toggles whether the backlight of the unit will be on when the device powers on.
- On color displays, press **LESS BRIGHT** or **BRIGHTER** to adjust the brightness level.

### Display Rotation

MENU → SETUP → Display → Display Rotation

The device has the option of inverting (flipping) the screen upside-down, as configured in this menu. Use this if the device is installed upside down.

### Edit Register and Device Properties

MENU → SETUP → Advanced → Edit Register

MENU → SETUP → Advanced → Device Properties

Editing registers and device properties allows technical support to fine tune device functions. These functions are best left alone, and used only when working with Alicat to diagnose or correct an issue. If your device is not functioning as expected, please contact Alicat support for assistance ([page 2](#)).

**!** **Caution:** Editing these settings may cause the device to become inoperable. Do not modify them without working with an applications engineer.

# Serial ASCII Communication

---

Connecting your device to a computer allows you to log the data that it generates. The device communicates digitally through its communications connector and a cable using a real or virtual COM port on your computer. This section of the manual shows you how to operate the device using ASCII commands.

## Establishing Communication

---

After connecting your device using a communications cable, you will need to establish serial communications through a real or virtual COM port on your computer or programmable logic computer (PLC).

- If you have connected your device to a serial port, note its COM port number, which can be found in the Windows® Device Manager program.
- If you have used a USB cable to connect your device to your computer, then in most cases it will recognize your USB as a virtual COM port. If it does not, download the appropriate USB device driver at [alicat.com/drivers](http://alicat.com/drivers) and note the COM port number as found in Windows® Device Manager.

The controller has the following default settings:

- **Baud:** 19200 (by default; others can be used if the computer, software, and the controller are all set to the same rate)
- **Data bits:** 8
- **Parity:** none
- **Stop bits:** 1
- **Flow control:** none

### Flowvision 2.0™

Flowvision 2.0™ is a graphics based interface for use with all Alicat devices. Within its features is a terminal that allows for direct serial communication with connected devices. Flowvision 2.0™ can be downloaded along with its user manual from [alicat.com/flowvision](http://alicat.com/flowvision).

### Alicat's Serial Terminal Application

Alicat's Serial Terminal is a preconfigured program for serial communications. It functions much like the older Windows® HyperTerminal with plain text in a command-line format.

Download Serial Terminal for free at [alicat.com/drivers](http://alicat.com/drivers). Once downloaded, simply run SerialTerminal.exe. Enter the COM port number to which your device is connected and the baud rate of the device. The default baud rate is 19200, but this is adjustable in the **RS-232 Serial** menu on your device ([page 27](#)).



**Note:** In the following, ↵ indicates an ASCII carriage return (decimal 13, hexadecimal D). For many devices, this is the same as hitting the Enter key. Serial commands are not case-sensitive.

## Communication Modes

---

### Polling Mode

Your device was shipped in polling mode with a unit ID of **A**, unless requested otherwise. Polling the device returns a single line of data each time you request it. To poll your device, enter its unit ID.

**Poll the device:** `unit_id↵`  
**Example:** `A↵` (polls unit A)

You can change the unit ID of a polling device by typing:

**Change the unit ID:** `current_unit_id@ desired_unit_id↵`  
**Example:** `A@ B↵` (changes unit A to unit B)

This can also be achieved via the device's front panel menu ([page 27](#)). Valid unit IDs are letters A–Z, and up to 26 devices may be connected at any one time to a single COM port, as long as each unit ID is unique.

## Streaming Mode

In streaming mode, your device automatically sends a line of live data at regular intervals. Only one unit on a given COM port may be in streaming mode at a time. To put your device into streaming mode, type:

**Begin streaming:** `unit_id@ @`  
**Example:** `A@ @` (puts device A into streaming mode)

This is equivalent to changing the unit ID to “@”. To take the device out of streaming mode, assign it a unit ID by typing:

**Stop streaming:** `@@ desired_unit_id`  
**Example:** `@@ a` (stops streaming and assigns unit ID of A)

When sending a command to a device in streaming mode, the flow of data will not stop while the user is typing. This may make the commands you type unreadable. If the device does not receive a valid command, it will ignore it. In doubt, press Backspace a number of times, then `←`, and start again.

The default streaming interval is 50 ms. This can be increased by using the set streaming interval command:

**Set streaming interval:** `unit_idNCS number_of_ms`  
**Example:** `ANCS 500` (streams new data every 500 ms)

## Taring Commands

Before collecting flow data, be sure to tare your device. If auto-tare is enabled on a controller ([page 17](#)), this can be accomplished by providing a setpoint of 0 for at least 2 seconds.

Manual taring can be accomplished through two separate commands for flow and pressure. Taring flow sets the zero flow reading and must be done when no flow is passing through the device:

**Tare flow:** `unit_idV`  
**Example:** `AV` (sets flow reading to zero)

Taring a gauge or differential pressure sensor must be performed when the device is open to atmosphere.

**Tare pressure:** `unit_idP`  
**Example:** `AP`

For devices equipped with a barometer, the second tare aligns the internal absolute pressure sensor with the current barometer reading and must be done with the device open to atmosphere:

**Tare absolute pressure:** `unit_idPC`  
**Example:** `APC`

## Data Collection

Collect live flow data by typing the `unit_id` `←` command or by setting your device to streaming. Each line of data for live measurements appear in the format below. The measurements present are dictated by the type of device. Meters and gauges do not show a setpoint.

### Mass Flow Controller

A	+15.542	+24.57	+16.667	+15.444	+15.444	22741.4	N2
ID	Abs. Pressure	Temperature	Vol. Flow	Mass Flow	Setpoint	Totalizer	Gas

### Gauge Pressure Controller

A	+20.00	+20.00
ID	Gauge Pressure	Setpoint

### Liquid Controller

A	14.70	+24.57	+02.004	+02.004
ID	Gauge Pressure	Temperature	Vol. Flow	Setpoint

Single spaces separate each parameter, and each value is displayed in the chosen device engineering units ([page 24](#)). You can query the engineering units of the serial data frame by typing:

**Query live data info:** `unit_id??D*`  
**Example:** `A??D*` (returns the data frame descriptions)

Additional columns, including status codes ([page 11](#)), may be present to the right of the gas label column. The unit ID appears in the data frame only when the device is in polling mode.

## Setpoint Controllers

Before attempting to send a setpoint to your controller serially, confirm that its setpoint source is set to **Serial/Front Panel** ([page 17](#)).

When sending a new setpoint, the data frame returns the new setpoint value when it has been accepted as a valid setpoint. The controller reads the requested setpoint using the current engineering units that have been selected ([page 24](#)).

**New setpoint:** `unit_idSfloating_point_number_setpoint↵`  
**Example:** `AS 15.44↵` (setpoint of +15.44 SLPM)

When using a bidirectional controller, negative setpoints are sent by adding a hyphen for the minus sign (-):

**Example:** `AS -15.44↵` (setpoint of -15.44 SLPM)

## Gas Select™ and COMPOSER™ Mass Flow Devices

To reconfigure your flow devices to flow a different gas, look up its gas number ([page 43](#)). For more information on how Gas Select™ and COMPOSER™ work, see [page 23](#).

**Choose a gas:** `unit_idG gas_number↵`  
**Example 1:** `AG 8↵` (reconfigures to flow nitrogen)  
**Example 2:** `AG 206↵` (reconfigures to flow P-10)

User mixes are selected in the same way. All COMPOSER™ gas mixes have a mix number between 236 and 255.

**Choose a user mix:** `unit_idG Gas Number↵`  
**Example:** `AG255↵` (reconfigures for user mix 255)

Defining a new COMPOSER™ gas mix is faster using serial commands than using the front panel. The basic formula for this is:

`unit_idGM mix_name mix_number gas1_% gas1_number gas2_% gas2_number...↵`

**Mix\_Name** Use a maximum of 6 letters (upper and/or lower case), numbers and symbols (period or hyphen only). This is equivalent to the short name when creating a mix via the front panel ([page 23](#)).

**Mix\_Number** Choose a number from 236 to 255. If a user mix with that number already exists, it will be overwritten. Use the number 0 to assign the next available number to your new gas. Gas numbers are assigned in descending order from 255.

**Gas1\_% Gas1\_Number...** For each gas, enter its percentage of the mixture up to 2 decimal places, then its gas number ([page 43](#)). 2–5 gases are required, and the sum of all gas constituent percentages must equal 100.00%. After creating a mix, the controller will confirm the new gas:

**Example 1:** Create a mix of 71.35% helium, 19.25% nitrogen, and 9.4% carbon dioxide as Gas 252, called “MyGas1”.

**Command:** `agm MyGas1 252 71.35 7 19.25 8 9.4 4↵`  
**Response:** `A 252 71.35% He 19.25% N2 9.40% C02`

**Example 2:** Create a mix of 93% methane, 3% ethane, 1% propane, 2% nitrogen, and 1% carbon dioxide, using the next available gas number, called “MyGas2”.

**Command:** `agm MyGas2 0 93 2 3 5 1 12 2 8 1 4↵`  
**Response:** `A 253 93.00% CH4 3.00% C2H6 1.00% C3H8 2.00% N2 1.00% C02`

# Quick Command Reference

Serial commands are not case-sensitive, but are presented here as capitalized to help differentiate them from command variables.

## General Commands for All Devices

Change the unit ID: `unit_id@ desired_id`  
Tare flow: `unit_idV`  
Tare gauge pressure: `unit_idP`  
Tare absolute pressure  
with optional barometer: `unit_idPC`  
Poll the live data frame: `unit_id`  
Begin streaming data: `unit_id@ @`  
Stop streaming data: `@@ desired_unit_id`  
Set streaming interval: `unit_idNCS number_of_ms`  
Query live data info: `unit_id??D*`  
Manufacturer info: `unit_id??M*`  
Firmware version: `unit_idve`  
Lock the front display: `unit_idL`  
Unlock the display: `unit_idU`

## Controller Commands

New setpoint: `unit_idS setpoint_value`  
Hold valve(s) at current position: `unit_idHP`  
Hold valve(s) closed: `unit_idHC`  
Cancel valve hold: `unit_idC`

## Mass Flow Gas Select™ and COMPOSER™ Commands

Query gas list info: `unit_id??G*`  
Choose a different gas: `unit_idG gas_number`  
New COMPOSER mix: `unit_idGM mix_name mix_# gas1_% gas1_# gas2_% gas2_#...`  
Delete COMPOSER mix: `unit_idGD Mix_#`



For more information on our serial communication commands, please see the serial primer at [alicat.com/manuals](http://alicat.com/manuals).



# Modbus RTU Communication

---

Modbus RTU can be used to read and log sensor data, switch between analog and digital control modes, adjust device settings, and control the device.

## Establishing Communication

---

The device can communicate via the input/output port on the device.

- When using a USB cable to connect your device to a Windows 10 computer, it should recognize your USB as a virtual COM port automatically.
- After physically connecting your device to a Windows PC, you can check which COM port number it uses by opening the Windows Device Manager and expanding "Ports (COM & LPT)".
- The default Modbus configuration has the following settings:
  - **Baud Rate:** 19200
  - **Data Bits:** 8
  - **Stop Bits:** 1
  - **Parity:** None
  - **Flow Control:** None

## Multidrop Information

Devices can operate on networks with other devices. When installing devices in an RS-485 network with multiple types of devices, confirm that the total load of all devices does not exceed 32 units on an unrepeatable network segment. Consult the EIA-485 standard for more information.

## Modbus RTU Serial Protocol

---

Alicat uses the Modbus standard of offsetting registers by 1 from addresses, meaning register 1 is equivalent to address 0. However, some systems expect data to be mapped as 0-indexed addresses. Different Modbus control systems may refer to registers, offsets, or addresses in their documentation without clarifying their meaning. If your control system uses a 0-indexed numbering scheme then decrement all register references in this manual by 1.

If you are unsure of which addressing scheme your control system uses, perform a test read of register 1200. If the device responds with Error code 2: "Illegal Data Address", then your system is using the standard 1-indexed numbering system and the values in this manual can be used as-is. If the device returns a value of 0 instead of an error, decrement all registers listed in this section by 1 to arrive at the correct offset.

## Process Data

Alicat devices make no distinction between "Input" and "Holding" registers. Modbus function codes FC03 and FC04 can be used interchangeably to read data from the device.

Sensor and process values are stored as big-endian, 32-bit IEEE-754 floating point numbers spanning two registers. Your control system will need to chain these into a single value to interpret them correctly.

# Writing Control and Configuration Information

All command and control requests to a Device are issued with Modbus function code FC16: “write multiple registers”.

## Modbus Reading and Status Registers

Parameter	Register	Access	Devices
Command ID	1000	Read/Write	All
Command Argument	1001	Read/Write	All
Setpoint	1010–1011	Read/Write	Controllers
Mixture Gas 1 Index	1050	Read/Write	Mass Flow
Mixture Gas 1 Percent	1051	Read/Write	Mass Flow
Mixture Gas 2 Index	1052	Read/Write	Mass Flow
Mixture Gas 2 Percent	1053	Read/Write	Mass Flow
Mixture Gas 3 Index	1054	Read/Write	Mass Flow
Mixture Gas 3 Percent	1055	Read/Write	Mass Flow
Mixture Gas 4 Index	1056	Read/Write	Mass Flow
Mixture Gas 4 Percent	1057	Read/Write	Mass Flow
Mixture Gas 5 Index	1058	Read/Write	Mass Flow
Mixture Gas 5 Percent	1059	Read/Write	Mass Flow
Gas Number	1200	Read/Write	Mass Flow
Status Flags (next table)	1201–1202	Read	All
Pressure Statistic	1203–1204	Read	All
Flow Temperature	1205–1206	Read	Mass Flow and Liquid
Volumetric Flow	1207–1208	Read	Mass Flow and Liquid
Mass Flow	1209–1210	Read	Mass Flow

## Status Flags

Bit	Interpretation	Devices
0	Temperature Overflow (TOV)	Mass Flow and Liquid
1	Temperature Underflow (TOV)	Mass Flow and Liquid
2	Volumetric Overflow (VOV)	Mass Flow and Liquid
3	Volumetric Underflow (VOV)	Mass Flow and Liquid
4	Mass Overflow (MOV)	Mass Flow
5	Mass Underflow (MOV)	Mass Flow
6	Pressure Overflow (POV)	All
7	Totalizer Overflow (OVR)	Mass Flow and Liquid
8	PID Loop in Hold (HLD)	Controllers
9	ADC Error (ADC)	All
10	PID Exhaust (EXH)	Dual Valve Controllers
11	Over pressure limit (OPL)	Custom OPL devices
12	Flow overflow during totalize (TMF)	Mass Flow and Liquid
13	Measurement was aborted	All

## Special Commands

You can access special control functions on devices with an FC16 write to registers 1000–1001. Special commands consist of a Command ID and a Command Argument written in a single pass to these registers. Each command/argument pair issues as a set of two 16-bit unsigned integers. Commands start by a write to register 1000. If you send a command to register 1000 without sending an argument to 1001 the device will interpret the command with a default argument of 0.

At any time after sending a special command to registers 1000..1001 you can perform a read of the same registers to determine the success or failure of the last command. Register 1000 will store the last Command ID sent to the device, and register 1001 will return a status code indicating the command result.

### Custom Gas Mixtures

Custom gas mixtures can be saved with 2–5 gases using the mix registers 1050–1059. This does not instruct the device to mix the gas, it programs it to be able to measure a premixed custom gas blend.

Saving the mix is a two-step process. First, the desired constituent gas indexes and percentages must be written to the mix registers (1050–1059). Then, a write of the **Create Custom Gas Mixture** command (ID 2) into command register 1000 (with the command argument being optional).

Gas mix percentages are interpreted as integer hundredths of a percent and the total percentage must sum to 100%. For example, to specify a mix of 50%, a value of 5000 is written into the gas percentage register.

The mix is performed with the first N gases that have a non-zero percentage. As an example, if you wish to use a mixture of 3 gases, write the index and percentage for those gases into registers 1050–1055 and write a value of zero into 1057–1059.

If the command argument is 0 or is omitted, the custom gas mixture is allocated in the next empty gas mix index starting at 255 and working down to 236. If no user mix indexes are available, the command fails and an error is returned in the command argument register.

To specify which index to write the custom gas mixture to, use a command argument between 236 and 255. The specified index either creates or updates to the new composition. If the specified index is not valid (the command argument is neither 0 nor 236–255), an error is returned.

Upon completion, the command argument register is updated with the new mixture. If the mix is valid, the index of the mixed gas is returned. If one of the requested mix gas constituents did not exist, or the percentage does not add to 100%, an error value is returned and the mixture is not saved.

All gas mixtures are accessible via Gas Select™ on the front panel.

## Special Commands and Arguments

Command Name	Command ID (Register 1000)	Command Argument (Register 1001)	Devices
Change Gas Number	1	Gas Table Index	Mass Flow
Create Custom Gas Mixture	2	Gas mixture index (236–255) or 0 to use next available.	Mass Flow
Delete Custom Gas Mixture	3	Gas mixture index	Mass Flow
Tare	4	<b>0:</b> Pressure <b>1:</b> Absolute Pressure <b>2:</b> Volume (Mass Flow and Liquid Devices)	All
Reset Totalizer Value	5	<b>0:</b> Reset totalizer	Mass Flow and Liquid
Valve Setting	6	<b>0:</b> Cancel <b>1:</b> Hold Close <b>2:</b> Hold Current <b>3:</b> Exhaust (Dual valve controllers)	Controllers
Display Lock	7	<b>0:</b> Unlock <b>1:</b> Lock	All
Change P in PID Loop	8	0–65535	Controllers
Change D in PID Loop	9	0–65535	Controllers
Change I in PID Loop	10	0–65535	Controllers
Change Control Loop Variable	11	<b>0:</b> Control Mass Flow <b>1:</b> Control Volumetric Flow <b>2:</b> Differential Pressure <b>3:</b> Absolute Pressure  <b>4:</b> Gauge Pressure	<b>0:</b> Mass Flow Controllers <b>1:</b> Mass Flow and Liquid Controllers <b>2:</b> PSID Controllers <b>3:</b> Abs Press Controllers and Mass Flow Controllers <b>4:</b> Gauge Pressure Controllers, Mass Flow Controllers with barometer, Liquid Controllers
Save Current Setpoint to Memory	12	<b>0:</b> Save setpoint for power-up	Controllers
Change Loop Control Algorithm	13	<b>1:</b> PD <b>2:</b> PDDI	Controllers
Read PID Value	14	<b>0:</b> PID P <b>1:</b> PID D <b>2:</b> PID I	Controllers
Change Modbus ID	32767	1–247 = New ID	All

## Special Command Result Status Codes

Status Code	Result
0	Success
32769	Invalid command ID
32770	Invalid setting
32771	Requested feature is unsupported
32772	Invalid Gas Mix Index (Mass Flow Devices)
32773	Invalid Gas Mix Constituent (Mass Flow Devices)
32774	Invalid Gas Mix Percentage (Mass Flow Devices)

# Troubleshooting

---

If you run into trouble with installation or operation, get in touch with support ([page 2](#)).

## General Use

---

**Issue:** *The buttons do not work, and the screen shows LCK.*

**Action:** The flow controller buttons were locked out via a serial command (*unit\_idL*←). Press and hold all four outer buttons to unlock the interface.

**Issue:** *I can't read the display easily.*

**Action:** During the day, you can increase the visibility of the display by increasing the contrast or brightness ([page 28](#)). For monochrome displays under low-light conditions, push the bottom central button (located below the display) to turn on the backlight.

**Issue:** *The analog output signal indicates values lower than what appears on my instrument's display.*

**Action:** Analog signal voltage degrades over long distances. You can minimize this effect by using wires with a heavier gauge, especially in the ground wire.

**Issue:** *How often do I need to calibrate my device?*

**Action:** Annual recalibration is recommended. Check your device's last calibration date by selecting **MENU** → **ABOUT** → **About Device**. If it is time to recalibrate, request a recalibration from customer support ([page 2](#)).

**Issue:** *I dropped my device. Is it OK? Do I need to recalibrate?*

**Action:** If it turns on and appears to respond normally, then it is probably OK. It may or may not need a recalibration. Give it a tare ([page 12](#)), and compare it against a known good flow standard. If it checks out, keep using it, but tell us about the drop at your next annual recalibration so we can check it out for you.

**Issue:** *How can I see readings in different units?*

**Action:** From the main menu, select **SETUP** → **Sensor** → **Engineering Units**. From this menu, you can adjust any variable's units. For more information, see [page 24](#).

**Issue:** *My controller won't reach its setpoint.*

**Action:** This is often caused by not enough supply pressure in the system. Increasing the inlet pressure regularly fixes this issue.

If increasing the pressure doesn't help, check to see if there is a clog. Teflon tape can often get stuck in the flow channel and block flow. Clean out any loose Teflon tape and never tape the first two threads entering the device to help avoid this issue.

## Flow Readings

---

**Issue:** *The live flow readings won't settle down.*

**Action:** The device is very fast, so it can detect subtle variations in flow that may go unnoticed by your other devices. This sensitivity can help detect problems with pumps or flow controllers. You can lessen this sensitivity by increasing the flow averaging ([page 25](#)). Controllers use PD or PD<sup>2</sup>I control loop algorithms to reach the setpoint given. These parameters are adjustable in the field. See [page 21](#) for a quick guide on tuning.

**Issue:** *My flow readings are negative.*

**Action:** Set a zero setpoint to see if the flow returns to 0 after 2 seconds. Under conditions of no flow, a negative flow reading can indicate a poor tare. If using a controller, ensure that auto tare is enabled and give the controller a zero setpoint for at least 2 seconds.

**Issue:** *My device does not agree with another flow device I have in line.*

**Action:** Check the STP or NTP settings (**MENU** → **SETUP** → **Sensor** → **STP / NTP Flow Ref**) to ensure that your standardized temperature and pressure references match those of your other flow calibrator. Also check that your device's Gas Select™ is set to the right gas or mixture.

**Issue:** *My flow readings won't change when flow changes.*

**Action:** If your flow readings won't change regardless of actual flow, your flow sensor may be damaged. Please contact support to troubleshoot ([page 2](#)).

## Mass Flow Devices

---

**Issue:** *Can I use my mass flow device with other gases?*

**Action:** Yes mass flow devices are designed to work with many different gases. Gas Select™ includes up to 130 preloaded gases and gas mixes ([page 23](#)). You can also define your own mixture using COMPOSER™ ([page 23](#)).

## Pressure Readings

---

**Issue:** *My pressure readings are negative.*

**Action:** If a negative reading is not expected, your device may need to be tared ([page 12](#)). Ensure pressure is at zero, and tare it.

**Issue:** *My pressure readings jump to zero when pressures are low.*

**Action:** Your device is equipped with a programmable zero band that is preset at the factory. Reduce your deadband threshold by selecting **SETUP** → **Sensor** → **Zero Band**.

**Issue:** *My pressure device disagrees with another device I have in line.*

**Action:** Pressure devices can normally be compared against one another provided there are no leaks between the two devices. Another possibility is an improper tare error ([page 12](#)).

**Issue:** *Can I use my pressure device with other gases or liquids?*

**Action:** Yes for gases, maybe for liquids. Pressure devices are designed to operate independent of the media being used.

One thing to check before changing gases or liquids is the chemical and material compatibility of the gas being used with the wetted materials inside the controller. We also recommend contacting support ([page 2](#)) before switching a gas pressure device over to liquid pressure device as some modification may be necessary.

## Liquid Devices

---

**Issue:** *Can I use the meter with other liquids?*

**Action:** No. Your flow meter is designed specifically to work with only one liquid, typically water. For use with a different liquid, the device will require recalibration. Please contact us to submit a service request at [alicat.com/service](http://alicat.com/service).

## Serial Communications

---

**Issue:** *I can't communicate to the device when it is connected to my PC.*

**Action:** **1.** Make sure the baud rate your software and COM port required is the one your flow controller is using (**MENU** → **SETUP** → **RS-232 Serial** or **RS-485 Serial** → **Baud Rate**).

**2.** Check the unit ID (**MENU** → **SETUP** → **RS-232 Serial** or **RS-485 Serial** → **Unit ID**) to make sure you are addressing it properly with your serial commands.

**3.** Make sure the COM number matches the one your software is using to connect to the flow controller.

**4.** On the external serial communications device (computer, PLC, etc.), Be sure that the flow control (handshaking) settings are set as on [page 29](#).

**5.** Check the pinout of your device to confirm the connection is on the right pin ([page 39](#))



*Still experiencing issues?  
Please contact support. See [page 2](#).*

# Maintenance

---



**Warning:** Do not attempt to disconnect this device from any system which has been pressurized without independently confirming that all pressure has been safely released and that any hazardous gases which remain in that system have been purged.

## Cleaning

---

**Mass flow** and **pressure devices** do not require cleaning, provided that they flow clean, dry gas.

**Liquid devices** should have filters in place to remove particulates or biological materials that may grow in the device. When removing liquid devices from the line for an extended period of time, remove all liquid from the device to ensure no deposits of calcium or other soluble minerals can affect the device.

If necessary, the outside of any device can be cleaned with a soft dry cloth.



**Warning:** If you suspect that debris or other foreign material has entered your device, do not take apart the flow body to clean it. Please contact support for cleaning ([page 2](#)).

## Repair

---

If you find your device has malfunctioned in some way or appears to no longer work as intended, please contact Alicat support ([page 2](#)) to perform maintenance. This device may only be serviced by certified Alicat personnel. Any attempt to improperly dismantle and repair the device may void the warranty and may cause further device failure.

## Recalibration

---

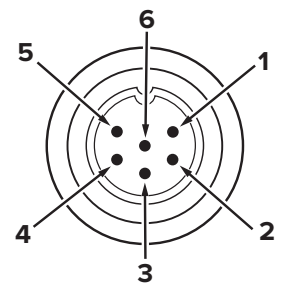
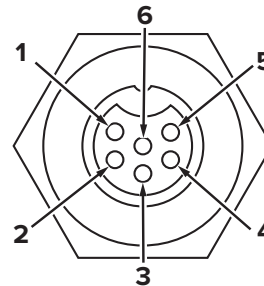
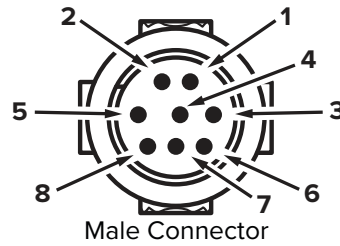
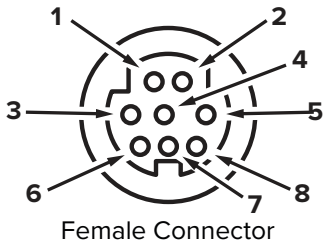
The recommended period for recalibration is once every year. A label located on the back of the device lists the most recent calibration date. This date is also stored inside your flow controller and is visible by selecting **MENU** → **ABOUT** → **About Device**. When it is time for your device's annual recalibration, contact support ([page 2](#)) with your device's serial number and your contact information.



# Appendix A: Pinouts

## Check the calibration data sheet and pinout for your device.

See [page 29](#) for additional important information about connecting your device to a computer for serial commands. Individual pinouts available at [alicat.com/pinout](http://alicat.com/pinout). The availability of different output signals depend on the options ordered.



## 8-Pin Mini-DIN (Default)

Pin	Function
1	Not Connected <i>Optional: 4–20 mA primary output signal</i>
2	Static 5.12 Vdc <i>Optional: secondary analog output (4–20 mA, 0–5 Vdc, 1–5 Vdc, 0–10 Vdc) or basic alarm</i>
3	Serial RS-232 RX / RS-485(-) Input Signal (receive)
4	Analog Setpoint Input (Controllers) Remote Tare (Meters and Gauges)
5	Serial RS-232TX / RS-485(+) output signal (send)
6	0–5 Vdc Analog Out <i>Optional: 1–5 Vdc or 0–10 Vdc output signal</i>
7	Power In
8	Ground (common for power, digital communications, analog signals, and alarms)

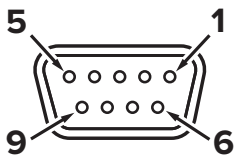


**Warning:** Do not connect power to pins 1 through 6, as permanent damage can occur. It is common to mistake pin 2 (labeled 5.12 Vdc Output) as the standard 0–5 Vdc analog output signal. Pin 2 is normally a constant 5.12 Vdc.

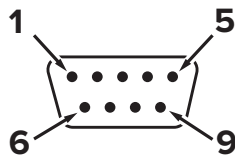
## Locking Industrial Connector Pinout

Pin	Function
1	Power In
2	Serial RS-232TX / RS-485(+) output signal (send)
3	Serial RS-232 RX / RS-485(-) Input Signal (receive)
4	Analog Setpoint Input (Controllers) Remote Tare (Meters and Gauges)
5	Ground (common for power, digital communications, analog signals, and alarms)
6	Analog Out (voltage or current as ordered)

## 9-Pin D-Sub Connector Common Pinouts



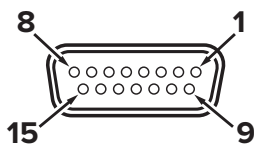
Female Connector



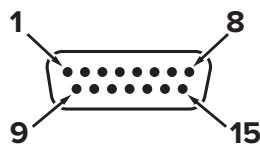
Male Connector

Pin	DB9 (F) DB9M (M)	DB9A and DB9K	DB9R	DB9T	DB9U	DB9B	DB9G	DB9H	DB9I	DB9N
1	Analog Current	NC	TX or B	TX or B	RX or A	Analog Out 2	RX or A	TX or B	NC	Power In
2	Analog Out 2	Analog Out	Analog Out	Analog Out	Analog Out	Analog Out	Analog Out	Analog Out	Analog Out	Analog In
3	RX or A	Power In	Analog In	Power In	Power In	Power In	Ground	Analog In	Power In	Analog Out
4	Analog In	Ground	Ground	Ground	Ground	Ground	Power In	RX or A	Ground	NC
5	TX or B	TX or B	NC	NC	NC	Ground	Ground	Analog Out 2	NC	Ground
6	Analog Out	Analog In	RX or A	Analog In	Analog In	Analog In	TX or B	NC	Analog In	Ground
7	Power In	Ground	Power In	Ground	Ground	Ground	Analog In	Power In	Ground	RX or A
8	Ground	Ground	Ground	Ground	Ground	TX or B	Analog Current	Ground	RX or A	TX or B
9	Ground	RX or A	Ground	RX or A	TX or B	RX or A	Ground	Ground	TX or B	NC

## 15-Pin D-Sub Connector Common Pinouts



Female Connector



Male Connector

Pin	DB15	DB15A	DB15B	DB15H	DB15K	DB15O	DB15S
1	Ground	Ground	Ground	NC	NC	Ground	Ground
2	Analog Out	Analog Out	Analog Out	RX or A	Analog Out	NC	Analog Out
3	Ground	Analog In	NC	NC	NC	Ground	NC
4	NC	Ground	NC	NC	NC	Analog Out	NC
5	Power In	Ground	Power In	Ground	Ground	Power In	Ground
6	NC	Ground	NC	Analog Out	NC	NC	NC
7	NC	Power In	NC	Ground	Power In	Analog In	NC
8	Analog In	TX or B	Analog In	NC	Analog In	NC5	Analog In
9	Ground	Ground	Ground	NC	Analog Out 2	Ground	Ground
10	Ground	NC	Ground	Analog Out 2	NC	Ground	Ground
11	Analog Out 2	NC	Analog Out 2	Power In	Ground	Analog Out 2	Analog Out 2
12	NC	Analog Out 2	NC	Ground	Ground	NC	RX or A
13	RX or A	NC	NC	NC	RX or A	NC	Power In
14	Ground	NC	RX or A	Analog In	TX or B	RX or A	TX or B
15	TX or B	RX or A	TX or B	TX or B	Ground	TX or B	Ground

### Key of Terms:

#### Analog In

Analog setpoint input for controllers  
Ground to Tare on meters and gauges

#### Analog Out

0–5 Vdc output signal (1–5,  
0–10 Vdc optional)

#### Analog Out 2

5.12 Vdc or optional  
secondary analog output

#### Analog Current

Not connected by default. If not  
present, **Analog Out** includes current.  
Optional 4-20mA analog output signal

#### NC

Not connected

#### Power In

(+Vdc)

#### RX or A

Serial RS-232RX or RS-485 (–)

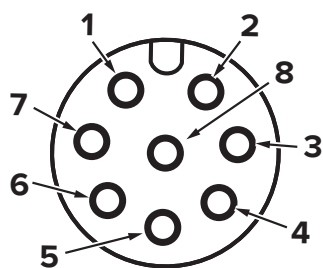
#### TX or B

Serial RS-232Tx or RS-485 (+)

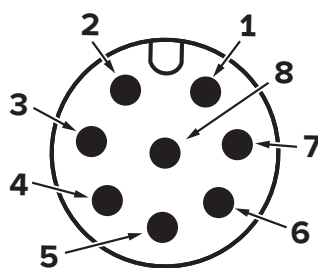
#### Ground

Common for power, digital  
communications, analog  
signals, alarms

## M12 Connector Common Pinouts



Female Connector



Male Connector

Pin	M12	M12MD
1	0–5 Vdc Output Signal <i>Optional: 1–5 or 0–10 Vdc</i>	Not Connected <i>Optional: 4–20 mA primary output signal</i>
2	Power In	Static 5.12 Vdc <i>Optional: Secondary analog output (4–20 mA, 0–5 Vdc, 1–5 Vdc, 0–10 Vdc) or basic alarm</i>
3	Serial RS-232 RX / RS-485(-) Input Signal (receive)	Serial RS-232 RX / RS-485(-) Input Signal (receive)
4	Analog Setpoint Input (Controllers) Ground to Tare (Meters and Gauges)	Analog Setpoint Input (Controllers) Ground to Tare (Meters and Gauges)
5	Serial RS-232TX / RS-485(+) output signal (send)	Serial RS-232TX / RS-485(+) output signal (send)
6	Static 5.12 Vdc <i>Optional: Secondary analog output (4–20 mA, 0–5 Vdc, 1–5 Vdc, 0–10 Vdc) or basic alarm</i>	0–5 Vdc Output Signal <i>Optional: 1–5 or 0–10 Vdc</i>
7	Ground (common for power, digital communications, analog signals, and alarms)	Power in
8	Inactive <i>Optional: 4–20 mA primary output signal</i>	Ground (common for power, digital communications, analog signals, and alarms)

# Appendix B: Reference Information

## Engineering Units

For more information on engineering units, see the engineering units section ([page 24](#)).

### Pressure Units

Absolute or Barometric	Gauge	Notes
PaA	PaG	Pascal
hPaA	hPaG	Hectopascal
kPaA	kPaG	Kilopascal
MPaA	MPaG	Megapascal
mbarA	mbarG	Millibar
barA	barG	Bar
g/cm <sup>2</sup> A	g/cm <sup>2</sup> G	Gram force per square centimeter <sup>†</sup>
kg/cm <sup>2</sup> A	kg/cm <sup>2</sup> G	Kilogram force per square centimeter*
PSIA	PSIG	Pound force per square inch
PSFA	PSFG	Pound force per square foot
mTorrA	mTorrG	Millitorr
torrA	torrG	Torr
mmHgA	mmHgG	Millimeter of mercury at 0°C
inHgA	inHgG	Inch of mercury at 0°C
mmH <sub>2</sub> O A	mmH <sub>2</sub> O G	Millimeter of water at 4°C (NIST conventional) <sup>†</sup>
mmH <sub>2</sub> O A	mmH <sub>2</sub> O G	Millimeter of water at 60°C <sup>†</sup>
cmH <sub>2</sub> O A	cmH <sub>2</sub> O G	Centimeter of water at 4°C (NIST conventional) <sup>†</sup>
cmH <sub>2</sub> O A	cmH <sub>2</sub> O G	Centimeter of water at 60°C <sup>†</sup>
inH <sub>2</sub> O A	inH <sub>2</sub> O G	Inch of water at 4°C (NIST conventional) <sup>†</sup>
inH <sub>2</sub> O A	inH <sub>2</sub> O G	Inch of water at 60°C <sup>†</sup>
atm		Atmosphere
m asl		Meter above sea level
ft asl		Foot above sea level
V		Volt
count	count	Setpoint count, 0–64000
%	%	Percent of full scale

### Temperature Units

Label	Notes
°C	Degrees Celsius
°F	Degrees Fahrenheit
K	Kelvin
°R	Degrees Rankine

\* Displayed as kg/cmA and kg/cmG.

<sup>†</sup> Superscript and subscript numerals are displayed as lining (normal) numerals.

<sup>‡</sup> Instances of μ are displayed as a lower-case u.

### Flow Units

Volumetric	Standard	Normal	Notes
μL/m	SμL/m	NμL/m	Microliter per minute <sup>‡</sup>
mL/s	SmL/s	NmL/s	Milliliter per second
mL/m	SmL/m	NmL/m	Milliliter per minute
mL/h	SmL/h	NmL/h	Milliliter per hour
L/s	SL/s	NL/s	Liter per second
LPM	SLPM	NLPM	Liter per minute
L/h	SL/h	NL/h	Liter per hour
US GPM			US gallon per minute
US GPH			US gallon per hour
CCS	SCCS	NCCS	Cubic centimeter per second
CCM	SCCM	NCCM	Cubic centimeter per minute
cm <sup>3</sup> /h	Scm <sup>3</sup> /h	Ncm <sup>3</sup> /h	Cubic centimeter per hour <sup>†</sup>
m <sup>3</sup> /m	Sm <sup>3</sup> /m	Nm <sup>3</sup> /m	Cubic meter per minute <sup>†</sup>
m <sup>3</sup> /h	Sm <sup>3</sup> /h	Nm <sup>3</sup> /h	Cubic meter per hour <sup>†</sup>
m <sup>3</sup> /d	Sm <sup>3</sup> /d	Nm <sup>3</sup> /d	Cubic meter per day <sup>†</sup>
in <sup>3</sup> /m	Sin <sup>3</sup> /m		Cubic inch per minute <sup>†</sup>
CFM	SCFM		Cubic foot per minute
CFH	SCFH		Cubic foot per hour
CFD	SCFD		Cubic foot per day
	kSCFM		1000 cubic feet per minute
count	count	count	Setpoint count, 0–64000
%	%	%	Percent of full scale

### True Mass Flow Units

Label	Notes
mg/s	Milligram per second
mg/m	Milligram per minute
g/s	Gram per second
g/m	Gram per minute
g/h	Gram per hour
kg/m	Kilogram per minute
kg/h	Kilogram per hour
oz/s	Ounce per second
oz/m	Ounce per minute
lb/m	Pound per minute
lb/h	Pound per hour

### Time Units

Label	Notes
h:m:s	Hours:Minutes:Seconds
ms	Milliseconds
s	Seconds
m	Minutes
hour	Hours
day	Days

### Total Units

Label	Notes
μL	MicroLiter <sup>‡</sup>
mL	MilliLiter
L	Liter
US GAL	US gallon
cm <sup>3</sup>	Cubic centimeter <sup>†</sup>
m <sup>3</sup>	Cubic meter <sup>†</sup>
in <sup>3</sup>	Cubic inch <sup>†</sup>
ft <sup>3</sup>	Cubic foot <sup>†</sup>
μP	Micropoise, a measure of viscosity*
mg	Milligrams
g	Grams
kg	Kilograms
oz	US ounces
lb	US pounds

## Gas List by Number

To use any of these gases in your device, use Gas Select™  
(page 23).

#	Short Name	Long Name
0	Air	Air (Clean Dry)
1	Ar	Argon
2	CH <sub>4</sub>	Methane
3	CO	Carbon Monoxide
4	CO <sub>2</sub>	Carbon Dioxide
5	C <sub>2</sub> H <sub>6</sub>	Ethane
6	H <sub>2</sub>	Hydrogen
7	He	Helium
8	N <sub>2</sub>	Nitrogen
9	N <sub>2</sub> O	Nitrous Oxide
10	Ne	Neon
11	O <sub>2</sub>	Oxygen
12	C <sub>3</sub> H <sub>8</sub>	Propane
13	nC <sub>4</sub> H <sub>10</sub>	Normal Butane
14	C <sub>2</sub> H <sub>2</sub>	Acetylene
15	C <sub>2</sub> H <sub>4</sub>	Ethylene (Ethene)
16	iC <sub>4</sub> H <sub>10</sub>	Isobutane
17	Kr	Krypton
18	Xe	Xenon
19	SF <sub>6</sub>	Sulfur Hexafluoride <sup>1</sup>
20	C-25	25% CO <sub>2</sub> , 75% Ar
21	C-10	10% CO <sub>2</sub> , 90% Ar
22	C-8	8% CO <sub>2</sub> , 92% Ar
23	C-2	2% CO <sub>2</sub> , 98% Ar
24	C-75	75% CO <sub>2</sub> , 25% Ar
25	He-25	25% He, 75% Ar
26	He-75	75% He, 25% Ar
27	A1025	90% He, 7.5% Ar, 2.5% CO <sub>2</sub>
28	Star29	Stargon CS (90% Ar, 8% CO <sub>2</sub> , 2% O <sub>2</sub> )
29	P-5	5% CH <sub>4</sub> , 95% Ar
30	NO	Nitric Oxide <sup>2</sup>
31	NF <sub>3</sub>	Nitrogen Trifluoride <sup>2</sup>
32	NH <sub>3</sub>	Ammonia <sup>2</sup>
33	Cl <sub>2</sub>	Chlorine <sup>2</sup>
34	H <sub>2</sub> S	Hydrogen Sulfide <sup>2</sup>
35	SO <sub>2</sub>	Sulfur Dioxide <sup>2</sup>
36	C <sub>3</sub> H <sub>6</sub>	Propylene <sup>2</sup>
80	1Buten	1-Butylene <sup>2</sup>
81	cButen	Cis-Butene (cis-2-Butene) <sup>2</sup>
82	iButen	Isobutene <sup>2</sup>
83	tButen	Trans-2-Butene <sup>2</sup>
84	COS	Carbonyl Sulfide <sup>2</sup>
85	DME	Dimethylether (C <sub>2</sub> H <sub>6</sub> O) <sup>2</sup>
86	SiH <sub>4</sub>	Silane <sup>2</sup>
100	R-11	Trichlorofluoromethane (CCl <sub>3</sub> F) <sup>2,3</sup>
101	R-115	Chloropentafluoroethane (C <sub>2</sub> ClF <sub>5</sub> ) <sup>2,3</sup>

#	Short Name	Long Name
102	R-116	Hexafluoroethane (C <sub>2</sub> F <sub>6</sub> ) <sup>2</sup>
103	R-124	Chlorotetrafluoroethane (C <sub>2</sub> HClF <sub>4</sub> ) <sup>2,3</sup>
104	R-125	Pentafluoroethane (CF <sub>3</sub> CHF <sub>2</sub> ) <sup>2,3</sup>
105	R-134A	Tetrafluoroethane (CH <sub>2</sub> FCF <sub>3</sub> ) <sup>2,3</sup>
106	R-14	Tetrafluoromethane (CF <sub>4</sub> ) <sup>2</sup>
107	R-142b	Chlorodifluoroethane (CH <sub>3</sub> CClF <sub>2</sub> ) <sup>2,3</sup>
108	R-143a	Trifluoroethane (C <sub>2</sub> H <sub>3</sub> F <sub>3</sub> ) <sup>2,3</sup>
109	R-152a	Difluoroethane (C <sub>2</sub> H <sub>4</sub> F <sub>2</sub> ) <sup>2</sup>
110	R-22	Difluoromonochloromethane (CHClF <sub>2</sub> ) <sup>2,3</sup>
111	R-23	Trifluoromethane (CHF <sub>3</sub> ) <sup>2,3</sup>
112	R-32	Difluoromethane (CH <sub>2</sub> F <sub>2</sub> ) <sup>2,3</sup>
113	R-318	Octafluorocyclobutane (C <sub>4</sub> F <sub>8</sub> ) <sup>2</sup>
114	R-404A	44% R-125, 4% R-134A, 52% R-143A <sup>2,3</sup>
115	R-407C	23% R-32, 25% R-125, 52% R-143A <sup>2,3</sup>
116	R-410A	50% R-32, 50% R-125 <sup>2,3</sup>
117	R-507A	50% R-125, 50% R-143A <sup>2,3</sup>
140	C-15	15% CO <sub>2</sub> , 85% Ar
141	C-20	20% CO <sub>2</sub> , 80% Ar
142	C-50	50% CO <sub>2</sub> , 50% Ar
143	He-50	50% He, 50% Ar
144	He-90	90% He, 10% Ar
145	Bio5M	5% CH <sub>4</sub> , 95% CO <sub>2</sub>
146	Bio10M	10% CH <sub>4</sub> , 90% CO <sub>2</sub>
147	Bio15M	15% CH <sub>4</sub> , 85% CO <sub>2</sub>
148	Bio20M	20% CH <sub>4</sub> , 80% CO <sub>2</sub>
149	Bio25M	25% CH <sub>4</sub> , 75% CO <sub>2</sub>
150	Bio30M	30% CH <sub>4</sub> , 70% CO <sub>2</sub>
151	Bio35M	35% CH <sub>4</sub> , 65% CO <sub>2</sub>
152	Bio40M	40% CH <sub>4</sub> , 60% CO <sub>2</sub>
153	Bio45M	45% CH <sub>4</sub> , 55% CO <sub>2</sub>
154	Bio50M	50% CH <sub>4</sub> , 50% CO <sub>2</sub>
155	Bio55M	55% CH <sub>4</sub> , 45% CO <sub>2</sub>
156	Bio60M	60% CH <sub>4</sub> , 40% CO <sub>2</sub>
157	Bio65M	65% CH <sub>4</sub> , 35% CO <sub>2</sub>
158	Bio70M	70% CH <sub>4</sub> , 30% CO <sub>2</sub>
159	Bio75M	75% CH <sub>4</sub> , 25% CO <sub>2</sub>
160	Bio80M	80% CH <sub>4</sub> , 20% CO <sub>2</sub>
161	Bio85M	85% CH <sub>4</sub> , 15% CO <sub>2</sub>
162	Bio90M	90% CH <sub>4</sub> , 10% CO <sub>2</sub>
163	Bio95M	95% CH <sub>4</sub> , 5% CO <sub>2</sub>
164	EAN-32	32% O <sub>2</sub> , 68% N <sub>2</sub>
165	EAN-36	36% O <sub>2</sub> , 64% N <sub>2</sub>
166	EAN-40	40% O <sub>2</sub> , 60% N <sub>2</sub>
167	HeOx20	20% O <sub>2</sub> , 80% He
168	HeOx21	21% O <sub>2</sub> , 79% He
169	HeOx30	30% O <sub>2</sub> , 70% He
170	HeOx40	40% O <sub>2</sub> , 60% He
171	HeOx50	50% O <sub>2</sub> , 50% He
172	HeOx60	60% O <sub>2</sub> , 40% He
173	HeOx80	80% O <sub>2</sub> , 20% He
174	HeOx99	99% O <sub>2</sub> , 1% He

#	Short Name	Long Name
175	EA-40	Enriched Air-40% O <sub>2</sub>
176	EA-60	Enriched Air-60% O <sub>2</sub>
177	EA-80	Enriched Air-80% O <sub>2</sub>
178	Metab	Metabolic Exhalant (16% O <sub>2</sub> , 78.04% N <sub>2</sub> , 5% CO <sub>2</sub> , 0.96% Ar)
179	LG-4.5	4.5% CO <sub>2</sub> , 13.5% N <sub>2</sub> , 82% He
180	LG-6	6% CO <sub>2</sub> , 14% N <sub>2</sub> , 80% He
181	LG-7	7% CO <sub>2</sub> , 14% N <sub>2</sub> , 79% He
182	LG-9	9% CO <sub>2</sub> , 15% N <sub>2</sub> , 76% He
183	HeNe-9	9% Ne, 91% He
184	LG-9.4	9.4% CO <sub>2</sub> , 19.25% N <sub>2</sub> , 71.35% He
185	SynG-1	40% H <sub>2</sub> , 29% CO, 20% CO <sub>2</sub> , 11% CH <sub>4</sub>
186	SynG-2	64% H <sub>2</sub> , 28% CO, 1% CO <sub>2</sub> , 7% CH <sub>4</sub>
187	SynG-3	70% H <sub>2</sub> , 4% CO, 25% CO <sub>2</sub> , 1% CH <sub>4</sub>
188	SynG-4	83% H <sub>2</sub> , 14% CO, 3% CH <sub>4</sub>
189	NatG-1	93% CH <sub>4</sub> , 3% C <sub>2</sub> H <sub>6</sub> , 1% C <sub>3</sub> H <sub>8</sub> , 2% N <sub>2</sub> , 1% CO <sub>2</sub>
190	NatG-2	95% CH <sub>4</sub> , 3% C <sub>2</sub> H <sub>6</sub> , 1% N <sub>2</sub> , 1% CO <sub>2</sub>
191	NatG-3	95.2% CH <sub>4</sub> , 2.5% C <sub>2</sub> H <sub>6</sub> , 0.2% C <sub>3</sub> H <sub>8</sub> , 0.1% C <sub>4</sub> H <sub>10</sub> , 1.3% N <sub>2</sub> , 0.7% CO <sub>2</sub>
192	CoalG	50% H <sub>2</sub> , 35% CH <sub>4</sub> , 10% CO, 5% C <sub>2</sub> H <sub>4</sub>
193	Endo	75% H <sub>2</sub> , 25% N <sub>2</sub>
194	HHO	66.67% H <sub>2</sub> , 33.33% O <sub>2</sub>
195	HD-5	LPG: 96.1% C <sub>3</sub> H <sub>8</sub> , 1.5% C <sub>2</sub> H <sub>6</sub> , 0.4% C <sub>3</sub> H <sub>6</sub> , 1.9% n-C <sub>4</sub> H <sub>10</sub>
196	HD-10	LPG: 85% C <sub>3</sub> H <sub>8</sub> , 10% C <sub>3</sub> H <sub>6</sub> , 5% n-C <sub>4</sub> H <sub>10</sub>
197	OCG-89	89% O <sub>2</sub> , 7% N <sub>2</sub> , 4% Ar
198	OCG-93	93% O <sub>2</sub> , 3% N <sub>2</sub> , 4% Ar
199	OCG-95	95% O <sub>2</sub> , 1% N <sub>2</sub> , 4% Ar
200	FG-1	2.5% O <sub>2</sub> , 10.8% CO <sub>2</sub> , 85.7% N <sub>2</sub> , 1% Ar
201	FG-2	2.9% O <sub>2</sub> , 14% CO <sub>2</sub> , 82.1% N <sub>2</sub> , 1% Ar
202	FG-3	3.7% O <sub>2</sub> , 15% CO <sub>2</sub> , 80.3% N <sub>2</sub> , 1% Ar
203	FG-4	7% O <sub>2</sub> , 12% CO <sub>2</sub> , 80% N <sub>2</sub> , 1% Ar
204	FG-5	10% O <sub>2</sub> , 9.5% CO <sub>2</sub> , 79.5% N <sub>2</sub> , 1% Ar
205	FG-6	13% O <sub>2</sub> , 7% CO <sub>2</sub> , 79% N <sub>2</sub> , 1% Ar
206	P-10	10% CH <sub>4</sub> 90% Ar
210	D-2	Deuterium

<sup>1</sup> Sulfur hexafluoride is a highly potent greenhouse gas monitored under the Kyoto Protocol.

<sup>2</sup> Corrosive-resistant units only

<sup>3</sup> Under the Montreal Protocol and Kigali Amendment, the production and consumption of these ozone-depleting substances (ODS) is being or has been phased out. It is recommended you ensure compliance with this universally ratified treaty before attempting to use these gases, in addition to R113, R-123, and R-141b.

## Gas List by Category

See previous page for Gas Select™ index numbers.

### Pure Non-Corrosive Gases

Acetylene (C<sub>2</sub>H<sub>2</sub>)  
Air (clean, dry)  
Argon (Ar)  
Isobutane (i-C<sub>4</sub>H<sub>10</sub>)  
Normal Butane (n-C<sub>4</sub>H<sub>10</sub>)  
Carbon dioxide (CO<sub>2</sub>)  
Carbon monoxide (CO)  
Deuterium (D<sub>2</sub>)  
Ethane (C<sub>2</sub>H<sub>6</sub>)  
Ethylene (Ethene) (C<sub>2</sub>H<sub>4</sub>)  
Helium (He)  
Hydrogen (H<sub>2</sub>)  
Krypton (Kr)  
Methane (CH<sub>4</sub>)  
Neon (Ne)  
Nitrogen (N<sub>2</sub>)  
Nitrous Oxide (N<sub>2</sub>O)  
Oxygen (O<sub>2</sub>)  
Propane (C<sub>3</sub>H<sub>8</sub>)  
Sulfur Hexafluoride (SF<sub>6</sub>)<sup>1</sup>  
Xenon (Xe)

### Breathing Gases

Metabolic Exhalant  
EAN-32  
EAN-36  
EAN-40  
EA-40  
EA-60  
EA-80  
Heliox-20  
Heliox-21  
Heliox-30  
Heliox-40  
Heliox-50  
Heliox-60  
Heliox-80  
Heliox-99

### Bioreactor Gas Mixes

5%–95% CH<sub>4</sub>/CO<sub>2</sub> in 5% increments

### Refrigerants<sup>2</sup>

R-11<sup>3</sup>  
R-14  
R-22<sup>3</sup>  
R-23<sup>3</sup>  
R-32<sup>3</sup>  
R-115<sup>3</sup>  
R-116  
R-124<sup>3</sup>  
R-125<sup>3</sup>  
R-134a<sup>3</sup>  
R-142b<sup>3</sup>  
R-143a<sup>3</sup>  
R-152a  
R-318  
R-404A<sup>3</sup>  
R-407C<sup>3</sup>  
R-410A<sup>3</sup>  
R-507A<sup>3</sup>

### Welding Gases

C-2  
C-8  
C-10  
C-15  
C-20  
C-25  
C-50  
C-75  
He-25  
He-50  
He-75  
He-90  
A 1025  
Stargon CS

### Chromatography Gas Mixes

P-5  
P-10

### Oxygen Concentrator Gas Mixes

89% O<sub>2</sub>, 7.0% N<sub>2</sub>, 4.0% Ar  
93% O<sub>2</sub>, 3.0% N<sub>2</sub>, 4.0% Ar  
95% O<sub>2</sub>, 1.0% N<sub>2</sub>, 4.0% Ar

### Stack/Flue Gas Mixes

2.5% O<sub>2</sub>, 10.8% CO<sub>2</sub>, 85.7% N<sub>2</sub>, 1.0% Ar  
2.9% O<sub>2</sub>, 14% CO<sub>2</sub>, 82.1% N<sub>2</sub>, 1.0% Ar  
3.7% O<sub>2</sub>, 15% CO<sub>2</sub>, 80.3% N<sub>2</sub>, 1.0% Ar  
7.0% O<sub>2</sub>, 12% CO<sub>2</sub>, 80% N<sub>2</sub>, 1.0% Ar  
10% O<sub>2</sub>, 9.5% CO<sub>2</sub>, 79.5% N<sub>2</sub>, 1.0% Ar  
13% O<sub>2</sub>, 7.0% CO<sub>2</sub>, 79% N<sub>2</sub>, 1.0% Ar

### Laser Gas Mixes

4.5% CO<sub>2</sub>, 13.5% N<sub>2</sub>, 82% He  
6.0% CO<sub>2</sub>, 14% N<sub>2</sub>, 80% He  
7.0% CO<sub>2</sub>, 14% N<sub>2</sub>, 79% He  
9.0% CO<sub>2</sub>, 15% N<sub>2</sub>, 76% He  
9.4% CO<sub>2</sub>, 19.25% N<sub>2</sub>, 71.35% He  
9.0% Ne, 91% He

### Fuel Gas Mixes

Coal Gas 50% H<sub>2</sub>, 35% CH<sub>4</sub>, 10% CO, 5% C<sub>2</sub>H<sub>4</sub>  
Endothermic Gas 75% H<sub>2</sub>, 25% N<sub>2</sub>  
HHO 66.67% H<sub>2</sub>, 33.33% O<sub>2</sub>  
LPG HD-5 96.1% C<sub>3</sub>H<sub>8</sub>, 1.5% C<sub>2</sub>H<sub>6</sub>, 0.4% C<sub>3</sub>H<sub>6</sub>, 1.9% n-C<sub>4</sub>H<sub>10</sub>  
LPG HD-10 85% C<sub>3</sub>H<sub>8</sub>, 10% C<sub>3</sub>H<sub>6</sub>, 5% n-C<sub>4</sub>H<sub>10</sub>

### Natural Gases

93.0% CH<sub>4</sub>, 3.0% C<sub>2</sub>H<sub>6</sub>, 1.0% C<sub>3</sub>H<sub>8</sub>, 2.0% N<sub>2</sub>, 1.0% CO<sub>2</sub>  
95.0% CH<sub>4</sub>, 3.0% C<sub>2</sub>H<sub>6</sub>, 1.0% N<sub>2</sub>, 1.0% CO<sub>2</sub>  
95.2% CH<sub>4</sub>, 2.5% C<sub>2</sub>H<sub>6</sub>, 0.2% C<sub>3</sub>H<sub>8</sub>, 0.1% C<sub>4</sub>H<sub>10</sub>, 1.3% N<sub>2</sub>, 0.7% CO<sub>2</sub>

<sup>1</sup> Sulfur hexafluoride is a highly potent greenhouse gas monitored under the Kyoto Protocol.

<sup>2</sup> Corrosive-resistant units only

<sup>3</sup> Under the Montreal Protocol and Kigali Amendment, the production and consumption of these ozone-depleting substances (ODS) is being or has been phased out. It is recommended you ensure compliance with this universally ratified treaty before attempting to use these gases, in addition to R113, R-123, and R-141b.

### Synthesis Gases

40% H<sub>2</sub>, 29% CO, 20% CO<sub>2</sub>, 11% CH<sub>4</sub>  
64% H<sub>2</sub>, 28% CO, 1.0% CO<sub>2</sub>, 7.0% CH<sub>4</sub>  
70% H<sub>2</sub>, 4.0% CO, 25% CO<sub>2</sub>, 1.0% CH<sub>4</sub>  
83% H<sub>2</sub>, 14% CO, 3.0% CH<sub>4</sub>

### Pure Corrosive Gases<sup>2</sup>

Ammonia (NH<sub>3</sub>)  
Butylene (1-Buten)  
Cis-Butene (c-Buten)  
Isobutene (i-Buten)  
Trans-Butene (t-Buten)  
Carbonyl Sulfide (COS)  
Chlorine (Cl<sub>2</sub>)  
Dimethylether (DME)  
Hydrogen Sulfide (H<sub>2</sub>S)  
Nitrogen Trifluoride (NF<sub>3</sub>)  
Nitric Oxide (NO)  
Propylene (C<sub>3</sub>H<sub>6</sub>)  
Silane (SiH<sub>4</sub>)  
Sulfur Dioxide (SO<sub>2</sub>)



# Appendix C: Application Setup

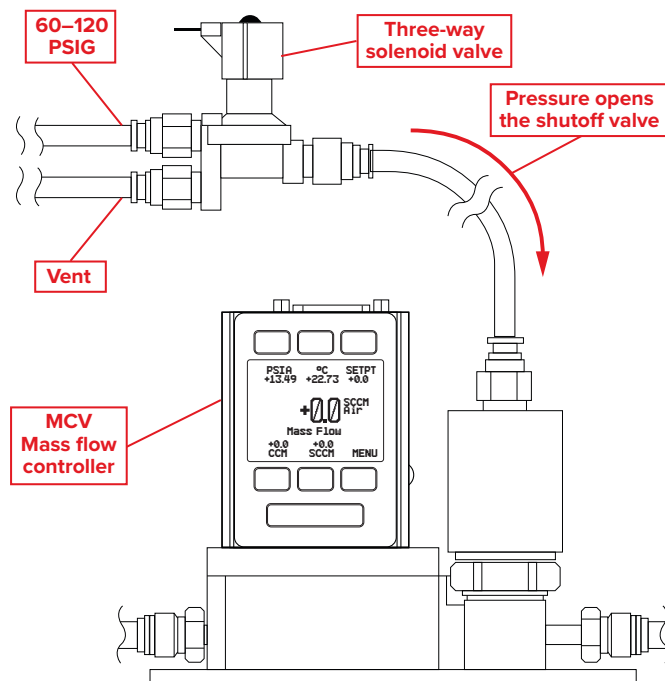
## MCV Controller Operating Notes

Alicat's MCV mass flow controller is equipped with an integrated Swagelok® positive shutoff valve. This valve is normally closed, but can be opened by supplying 60–120 PSIG of air pressure. The shut-off valve closes again when this pressure is reduced below 60 PSIG.

A common method for actuating the shutoff valve incorporates a three-way solenoid valve (shown to the right). Pressure is applied to one side of the solenoid valve while the other side of the solenoid is left open to atmosphere. When the solenoid is energized, pressure is delivered to the shutoff valve, causing it to open. When the solenoid is returned to a relaxed state, the gas vents to atmosphere, allowing the shut-off valve to close.



MCV-1SLPM-D mass flow controller.

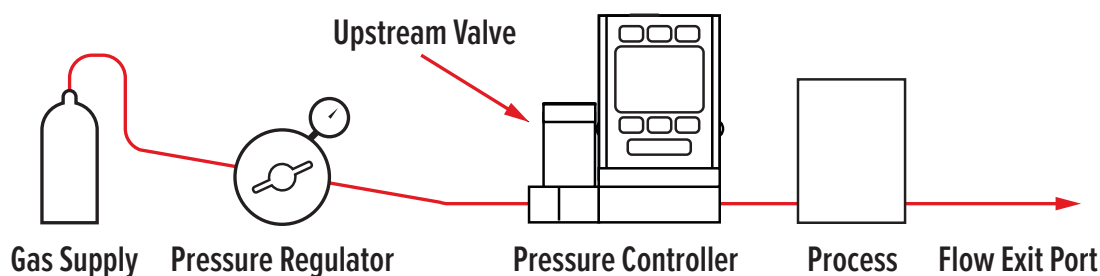


Typical MCV configuration.

## Pressure Controller Applications

### Forward (Downstream) Pressure Control

When the valve is located on the upstream side (direct control), the sensor controls pressure downstream. This configuration follows our standard pressure control algorithm. The valve opens to increase pressure, and closes to decrease pressure.

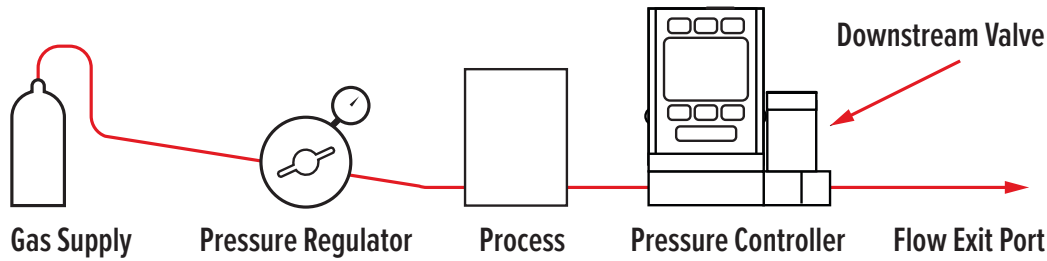


## Back Pressure Control

When the valve is located on the downstream side (inverse control), the sensor controls pressure upstream. This configuration is referred to as a back pressure controller. This configuration follows our inverse pressure control algorithm. The valve closes to increase pressure, and opens to decrease pressure.

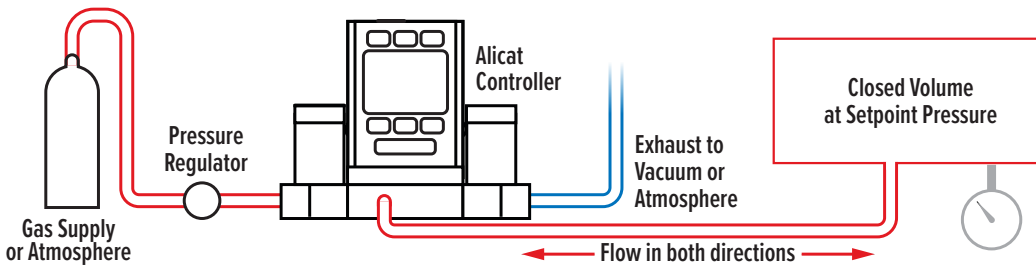


**Note:** Back pressure controllers include “DS,” for downstream valve, in their part codes.



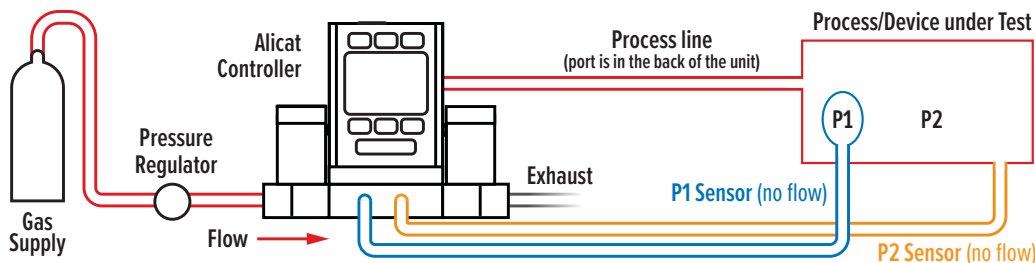
## Dual Valve Pressure Control

The port on the face of the PCD unit is connected to the closed volume you want to control pressure in. The valve on the supply side opens to increase the pressure in the closed volume, and the valve on the exhaust side opens to decrease pressure.



## Differential Pressure Control

Differential pressure controllers have two ports for connecting to points in the system where the differential pressure is measured. The upstream port is for the higher pressure, and the downstream port is for the lower pressure. In these devices, the differential pressure ports have no flow and are not connected to the flow path. A PCD-Series is used in closed volume applications.

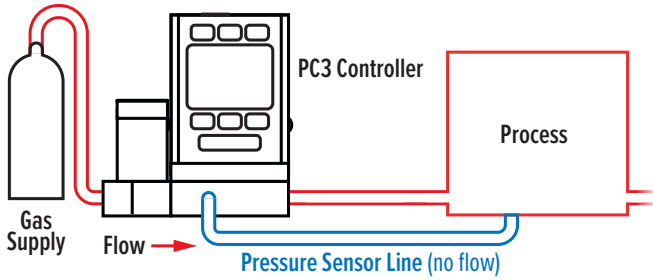


15PSID pressure controller with two differential pressure detector ports in front and a DB-9 serial connector.

## Remote-Sensing Controller

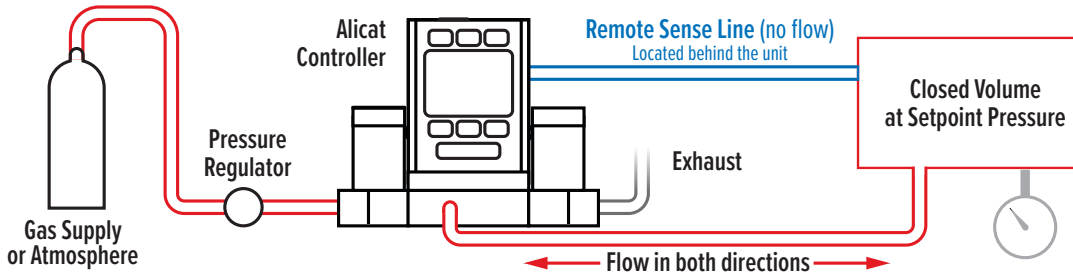
The PC3-Series senses and controls the pressure at a point in the system outside of the pressure controller itself. All PC-Series controllers can be ordered with an additional NPT port that connects to the pressure sensor in the device. The pressure sensor is isolated from the flow path within the device. The PCD3-Series is used for closed volumes.

### PC3 Controller:



PC3-Series 15PSIG pressure controller with remote sensing port in front, and mini-DIN serial connector.

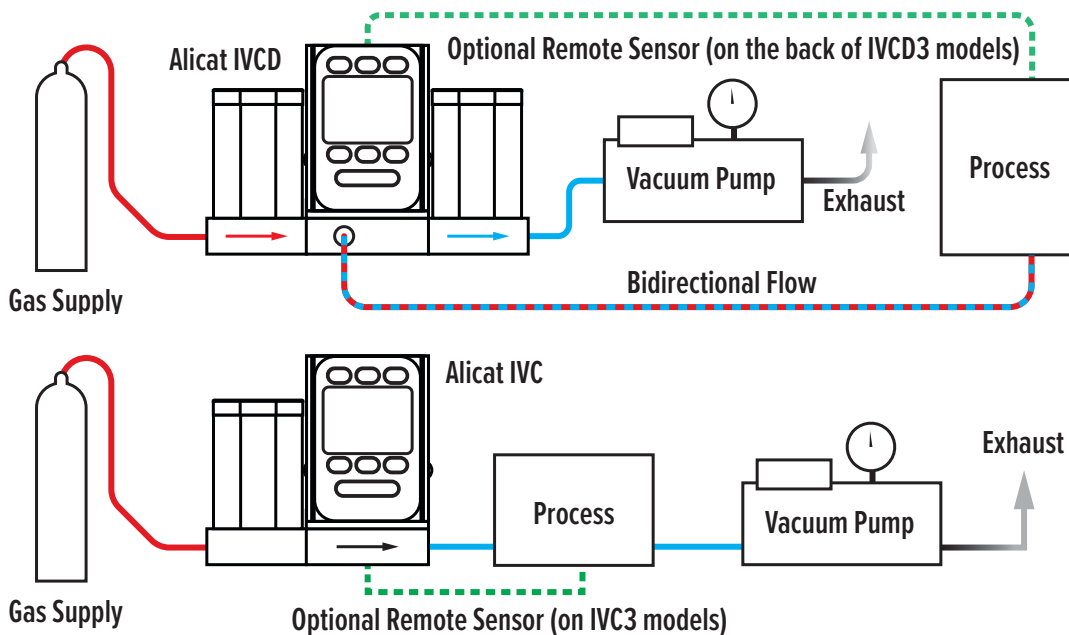
### PCD3 Controller:



## Integrated Vacuum Controllers (IVC)

IVC and IVCD devices are used in applications where precise control of vacuum is required, and are available in 10 TorrA, 100 TorrA, or 1000 TorrA sensors. The IVC and IVCD-Series are similar to the PC and PCD absolute pressure controllers in functionality and in the navigation menus available on the screen.

Integration of the vacuum sensor, control valve, and PID algorithm in a single device eliminates the need for an external vacuum sensor and throttle valve in your system. These devices can have SAE ports, compression ports, VCR®-compatible fittings, or VCO®-compatible fittings. Process port sizes may change depending on the valve on your device.



IVC-Series absolute (vacuum) pressure controller.