ALICAT SCIENTIFIC

# Operating Manual


## Portable Calibration Unit

*The Fastest Flow Controller Company in the World!*

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# RECALIBRATION

**Your Alicat instrument is a precision device and Alicat strongly recommends that you send it to us on a yearly basis for recalibration.**

**A yearly recalibration does a few things:**

- **It insures that your unit is functioning according to specification.**
- **Contamination may cause the instrument to measure flow improperly. Recalibration insures the instrument is clean and free from debris.**
- **Recalibration maintains your LIFETIME WARRANTY!**

**Sending your unit for recalibration is easy and inexpensive. Recalibrations are usually shipped within five days of receipt, so it's fast too.**

**Please keep the original box to return your Alicat instrument for recalibration.**

**For more information regarding recalibration see page 38.**

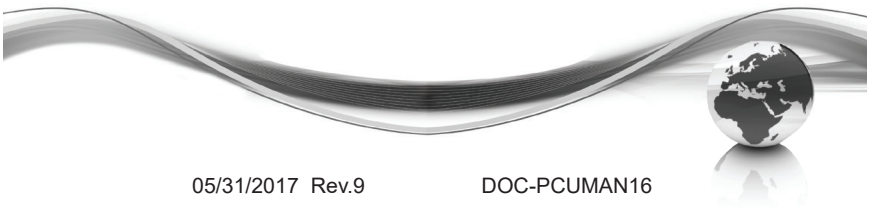
# ACCESSORIES

**Now that you have your Alicat instrument are you sure you've got everything you need? Alicat accessories can make your job easier.**

**Many of our customers also order:**

- **Power Supplies — A universal wall power supply that makes it easy to power your Alicat unit just about anywhere in the world.**
- **BB9 — Alicat's multi-drop box that allows easy connection of up to nine Alicat instruments to a single USB, RS-232 port.**
- **MD8DB9 — An RS-232 to 8 pin Mini-DIN cable to connect your Alicat instrument to a computer. A variety of other cables are also available.**
- **Flow Vision™ SC — A GUI based Windows®program that allows easy computer access and control for one or multiple Alicat instruments.**
- **Fittings and filters — Keep your instrument properly connected to your process and free from harmful contamination.**

**See pages 40 - 42 for a complete description and list of Alicat accessories.**



**Thank you for purchasing an Alicat Scientific Portable Calibration Unit (PCU).**

Please take the time to find and read the information contained in this manual. This will help to ensure that you get the best possible service from your instrument.

The Alicat Scientific Portable Calibration Unit (**PCU**) is designed to accurately measure gas flow rates of common gases with up to three separate flow meters with ranges determined by your needs.

The laminar flow, differential pressure flow meters housed in the PCU are accurate and exceptionally repeatable devices, making the PCU an excellent portable secondary standard for field flow meter calibration.

Each of the PCU's three separate displays allow you to monitor Mass Flow Rate, Absolute Pressure, Volumetric Flow Rate, and Temperature simultaneously. The PCU is also equipped with an RS-232 output port that can be connected to a computer or other data-logging device.

A USB "B" connector allows direct connection to a computer. This USB connection automatically creates a virtual Com Port, which then replicates the function of a standard serial port.

The PCU is a USB 2.0 full speed device.

If a Windows® computer is connected to the internet it should be able to find and automatically install the required drivers. For Linux, Mac OS 10.3, or Windows® drivers visit: http://www.ftdichip.com/Drivers/VCP.htm

***The Alicat PCU is designed for CLEAN, DRY, NON-CORROSIVE gases.***

***Please contact Alicat at 1-888-290-6060 or info@alicat.com if you have any questions regarding the use or operation of this device.***


You can find a number of instructional videos related to the operation of this device by visiting the Alicat web site or scanning the QR code below.
http://www.alicat.com/support/instructional-videos/

## CONNECTING THE PCU

The inlet and outlet connections to the PCU are located below the displays for their respective flow ranges.

Inlet connections are located on the left and the outlet connections are located on the right (see page 6)

The connections are either 1/8", 1/4", 3/8", 1/2" or 6mm, 10mm, 12mm push-connect style tubing fittings with each fitting corresponding to a single flow range.

Use appropriately sized plastic tubing to connect the flow source to the corresponding inlet fitting.

If necessary, connect the corresponding outlet fitting to the original source destination with proper tubing.

**CAUTION:** Push-connect fittings are easy to use, as no special tools are required to make the joints. However, special attention must be paid when cutting the tube — as the O-ring inside of the fittings can easily be damaged.

*It is essential to use the correct cutter such as a pipe slice for copper pipe or dedicated plastic pipe cutters for plastic tube — Do not use a saw because any burrs left on the tube can damage the O-ring and cause the joint to leak!*

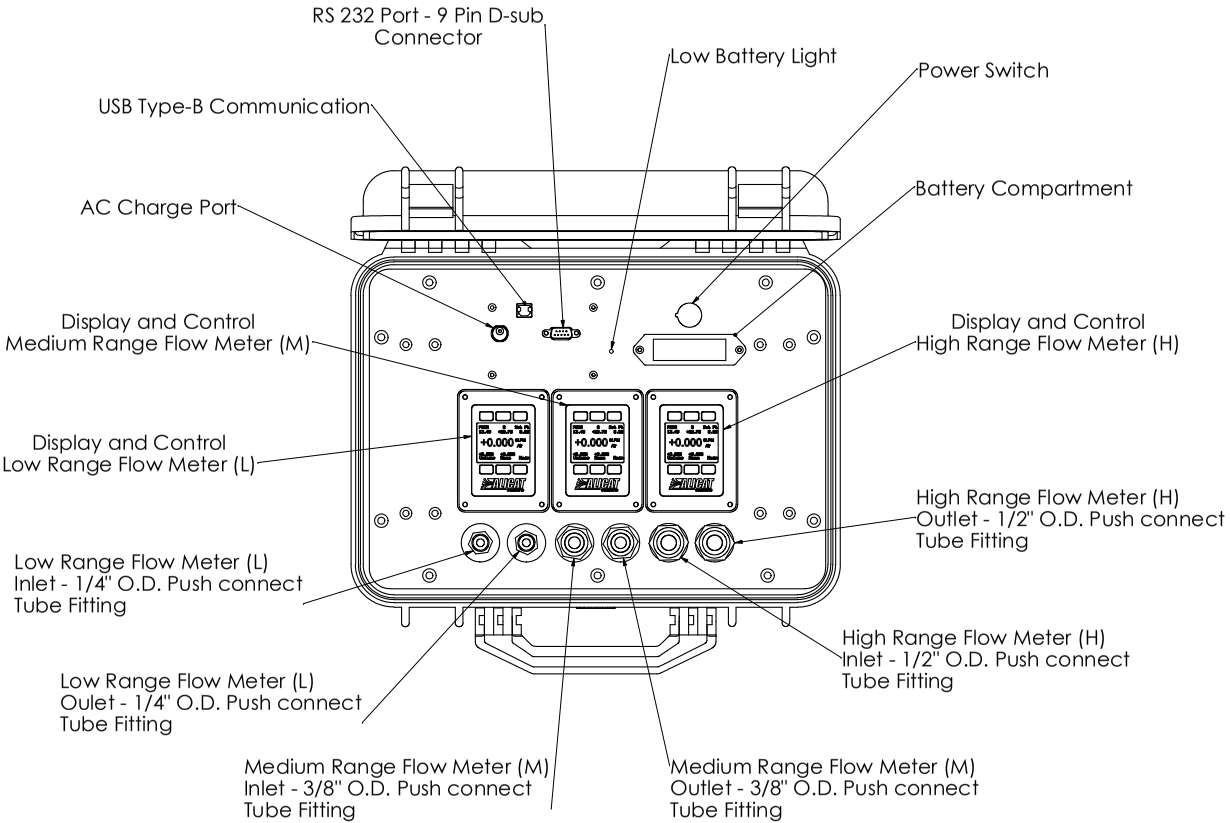
Cut your tube to the required length using the dedicated plastic pipe cutters, making sure you have a straight cut with no burrs. Then push the tubing carefully into the fitting on the bulkhead panel.

Softer polyurethane tubing will work best, as opposed to some of the harder plastic tubings available. It decreases the chances of damaging the O-rings.


**IF THE OUTLET FITTINGS ARE NOT CONNECTED TO YOUR PIPING, THE GAS BEING MEASURED WILL VENT TO ATMOSPHERE AT THE OUTLET FITTINGS!**

**USE PROTECTIVE EYEWEAR!**

**NEVER VENT FLAMMABLE GASES TO ATMOSPHERE!**




**PCU Controls and Connections**

## POWER

The PCU is designed to operate on either four AA Alkaline batteries or via a 9-30 Vdc power supply (minimum 150 mA @ 24Vdc). The batteries will operate the PCU for about 8 hours under normal usage.

If the batteries drop below 7 volts, the low battery light will come on and the batteries should be replaced or alternate power should be applied.

When the replace battery light is on the accuracy of the meters' readings cannot be guaranteed.

***If your unit has color displays please see page 43.***

## PRESSURE

**Maximum operating line pressure for PCUs with M-Series units is 145 psig (1 MPa).**

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

**Maximum operating line pressure for PCUs with WHISPER units is 50 psig.**

***Exceeding the maximum specified line pressure may cause permanent damage to the solid-state differential pressure sensor.***

STOP

**DO NOT SUBJECT AN *M-SERIES* DIFFERENTIAL PRESSURE SENSOR TO UPSTREAM-DOWNSTREAM PRESSURE DIFFERENTIALS EXCEEDING 75 PSID.**

**DO NOT SUBJECT A *WHISPER* DIFFERENTIAL PRESSURE SENSOR TO UPSTREAM-DOWNSTREAM PRESSURE DIFFERENTIALS EXCEEDING 15 PSID.**

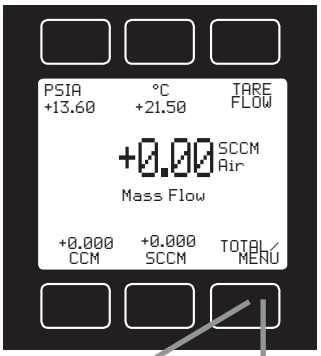
**While high static pressure will typically not damage the dp sensor, sudden pressure "spikes" can result in complete failure of the sensor.**

**A common cause of this problem is instantaneous application of high-pressure gas as from a snap acting solenoid valve either upstream or downstream of the meter. If you suspect that your pressure sensor is damaged please discontinue use of the meter and contact Alicat.**

## DISPLAYS AND MENUS

The device screen defaults to **Main** display as soon as power is applied to the meter.

**Main**

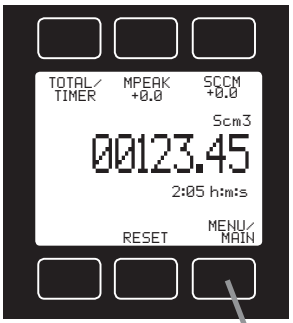



The **Main** display shows pressure, temperature, volumetric flow and mass flow.

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

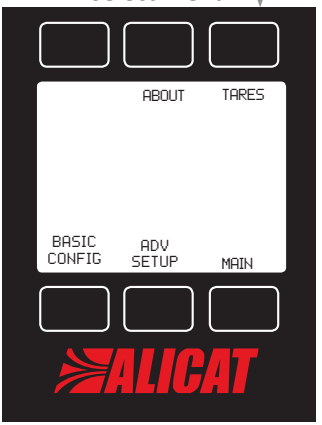
By hitting the **MENU** button at the bottom right of the screen you will enter the **Select Menu** display.

**Totalizer** (option only)




If your meter was ordered with the **Totalizer** option (page 39), pushing the **TOTAL/MENU** button once will bring up the **Totalizing Mode** display. Pushing **MENU** will bring up the **Select Menu** display.

**Select Menu**




**Select Menu**

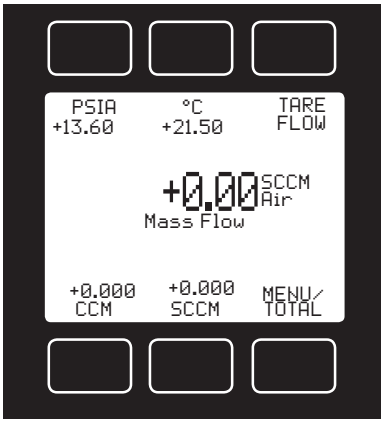
From **Select Menu** you can change the selected gas, interact with your RS-232 settings or read manufacturer's data.

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

**Display On/Off:**

Pushing the button under the Alicat name will turn the device display back light on or off.

## MAIN




The following parameters are displayed in the **Main** mode: Pressure; Temperature; Volumetric Flow and Mass Flow.

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

Pressing the button next to the parameter will put that parameter in the primary display.

Press the button a second time to change the engineering unit associated with the device display (button units) and /or the data feed (device units). See page 17.

**Gas Pressure:** This sensor references hard vacuum and reads incoming pressure both above and below local atmospheric pressure. This parameter is moved to the primary display by pushing the button above **PSIA**. Pushing this button again will allow you to show Absolute Pressure, Gauge Pressure or Barometric Pressure in devices that have a barometer.

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

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

**Tare:** Pushing the **TARE FLOW** button tares the flow meter and provides it with a reference point for zero flow. This is an important step in obtaining accurate measurements. It is best to zero the flow meter each time it is powered up. If the flow reading varies significantly from zero after an initial tare, give the unit a minute or so to warm up and re-zero it.

If possible, zero the unit near the expected operating pressure by positively blocking the flow downstream of the flow meter prior to pushing the TARE button.

***Zeroing the unit while there is any flow will directly affect the accuracy by providing a false zero point.*** If in doubt about whether a zero flow condition exists, remove the unit from the line and positively block both ports before pressing the TARE button. If the unit reads a significant negative value when removed from the line and blocked, it was given a false zero. It is better to zero the unit at atmospheric pressure and a confirmed no flow condition than to give it a false zero under line pressure.

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

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

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

***To get an accurate volumetric or mass flow rate, the gas being measured must be selected. See Gas Select, page 14.***

***Mass flow in units preceded by an S or N is impacted by the STP / NTP. See page 18.***

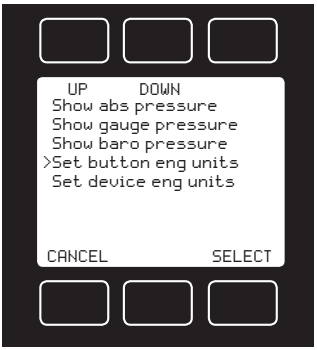
**MENU:** Pressing **MENU** switches the screen to the **Select Menu** display.

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

**If the unit does not return to normal operation contact Alicat.**

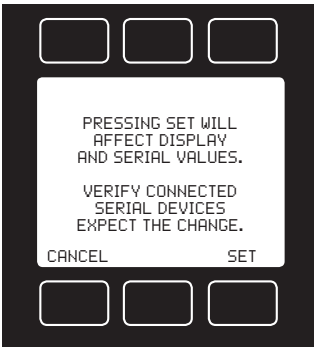
## Choosing Engineering Units from Main Mode

Press the button above or below any of the four flow parameters twice to enter its unit selection menu. You can change units in two ways:




**Button engineering units** alter the display only, not the RS-232 data frame:

• Select Set button eng units and press SELECT to change the engineering unit on the display only. Use the UP and DOWN keys to move the > cursor to the desired unit, and then press SET. This does not alter the data frame.

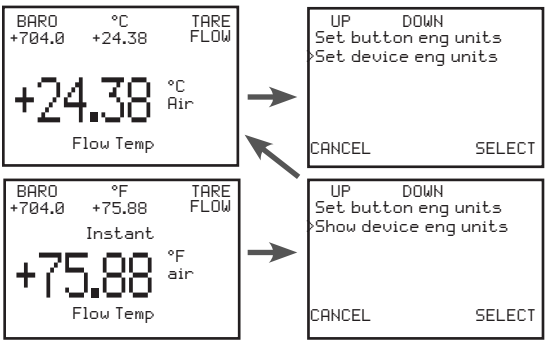



**Device engineering units** alter both the display and the data frame:

• Select Set device eng units and then choose the engineering unit as above. An additional confirmation screen asks you to confirm the RS-232 change.

• If the button engineering unit is different than the device engineering unit, Set device eng units will not appear. First select Show device eng units to return the button unit to the existing device unit, and then enter the unit selection menu again to change the device engineering unit.

**Examples of changing device engineering units:**



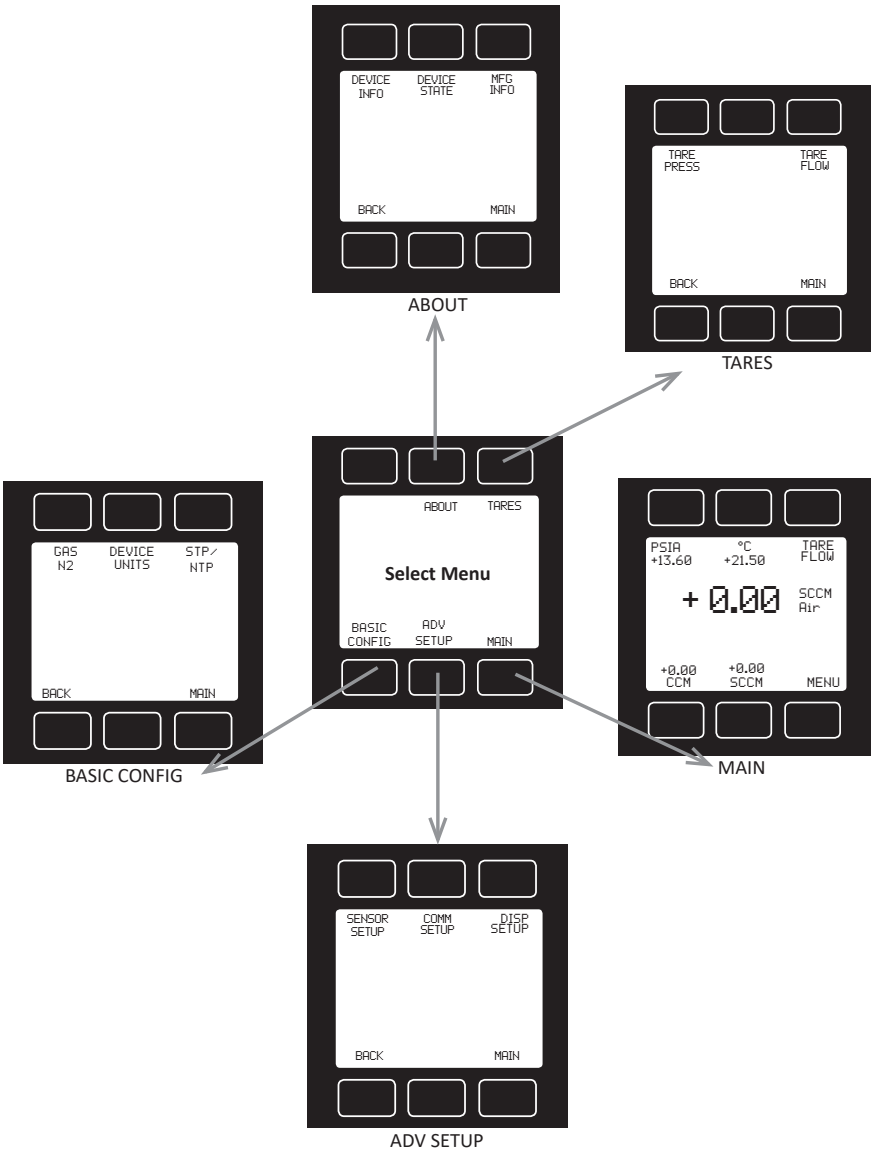

**Changing device units:**
°C is the existing device engineering unit, so the unit selection menu displays Set device eng units.

**Changing device units:**
°F is not the existing device engineering unit, so the unit selection menu displays Show device eng units.
Enter the unit selection menu again to change the device engineering units.

## SELECT MENU

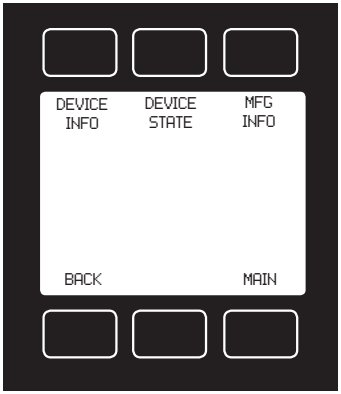
From Select Menu you can change the selected gas, interact with your RS-232 settings or read manufacturer's data.

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




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

## ABOUT




**ABOUT**

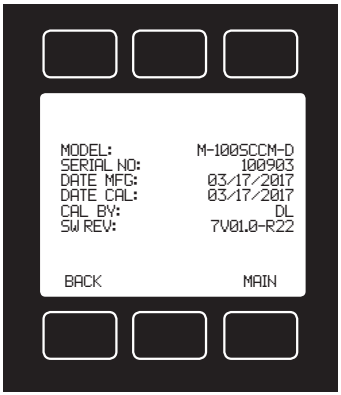
Press **DEVICE INFO** to show important information about your flow device including the model number, serial number, and date of manufacture.

Press BACK to return to the About display.

Push MAIN to return to the Main display.

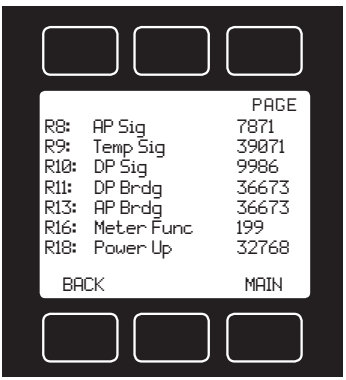
Manufacturer information is accessed by pressing the **MFG INFO** button on the About Menu display.

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




**DEVICE INFO**


**MFG INFO**



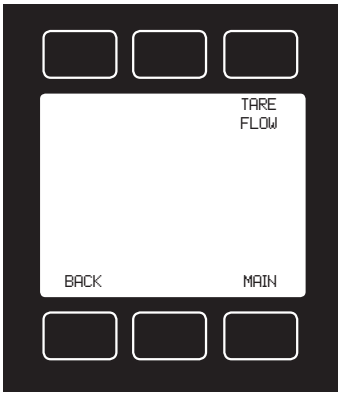

**DEVICE STATE**

**DEVICE STATE:** This diagnostic screen displays the current internal register values, which is useful for noting factory settings prior to making any changes. It is also helpful for troubleshooting with Alicat customer service personnel.

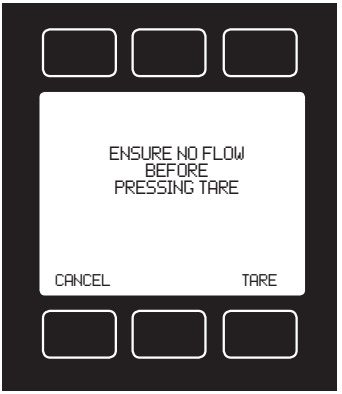
Select the **DEVICE STATE** button from the **ABOUT** screen to view a list of select register values.

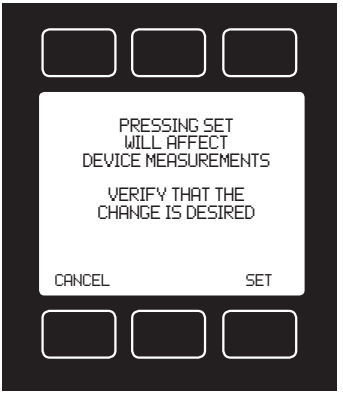
Pressing the **PAGE** button will cycle the display through the register screens. An example screen is shown at left.

**TARES**



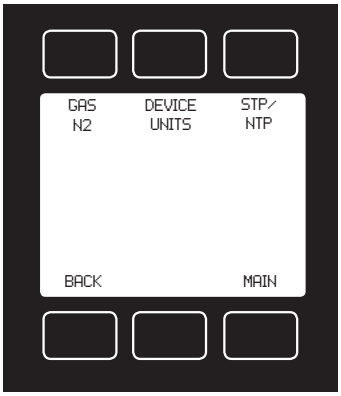

Press **TARES** to access and **TARE FLOW**.
Press BACK to return to the Tares display.
Push MAIN to return to the Main display.




**TARE FLOW**

## BASIC CONFIG



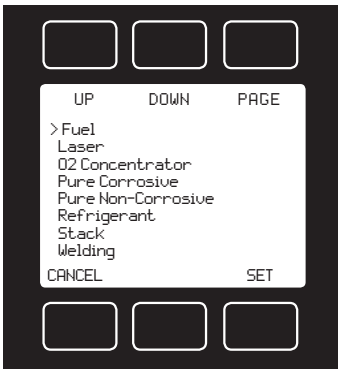

Press **BASIC CONFIG** to select gases, device units, and change STP and NTP references.
Press **BACK** to return to the Select Menu display. Push **MAIN** to return to the Main display.

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

**Gas Select** is accessed by pressing the button above **GAS** on the **BASIC CONFIG** display.


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

» Recent: Eight most recent selections
» Standard: Gases and mixes standard on earlier Alicat instruments (page 26)
» Factory Custom: Present only if customer requested gases were added at the factory
» COMPOSER User Mixes: Gas mixes programmed by the user (page 15)
» Bioreactor (page 30)
» Breathing (page 31)
» Chromatography (page 33)
» Fuel (page 32)
» Laser (page 32)
» O2 Concentrator (page 33)
» Pure Corrosive* (page 27)
» Pure Non-Corrosive (page 26)
» Refrigerant* (page 28)
» Stack (page 33)
» Welding (page 29)




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

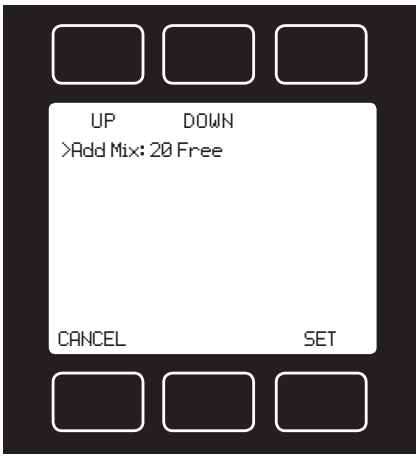
Press SELECT to view the gases in the selected category. Align the arrow with the desired gas. Press SET to record your selection and return to the MAIN display. The selected gas will be displayed on the screen.

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

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

***See pages 26 -33 for a full list of gases in each category.***

## COMPOSER

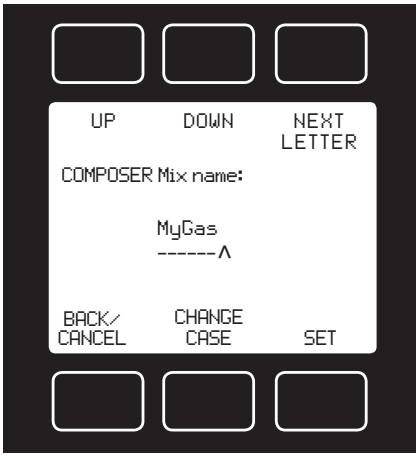



**Composer** allows you to program and save up to 20 custom gas mixes containing 2 to 5 component gases found in the gas lists (pages 32-39). The minimum resolution is 0.01%.

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

Press SET when the arrow is aligned with Add Mix.

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

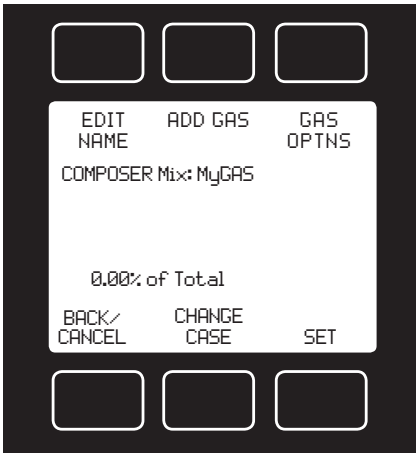



**CHANGE CASE** – Toggles the letter case. Letters remain in selected case until CHANGE CASE is pushed again.

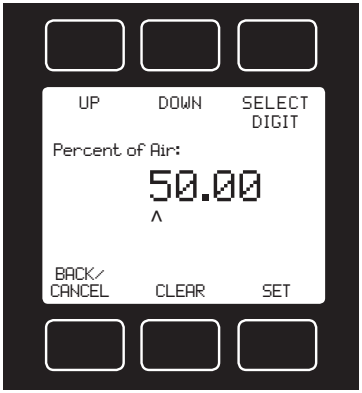
Press SET to save the name.

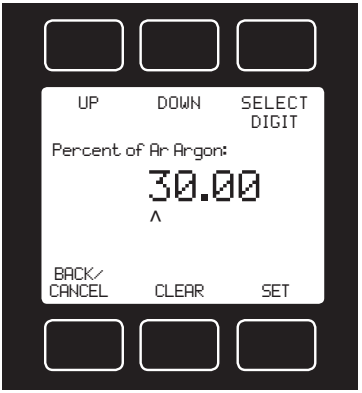
After naming the mix, press **ADD GAS** and select the gas category and the component gas.

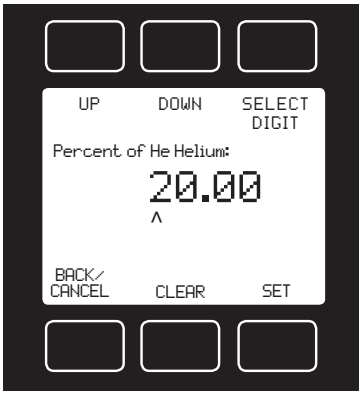
Select the digit with arrow and adjust the % with the UP and DOWN buttons. Press set to save. Add up to 4 more gases as needed. The total must equal 100% or an error message will appear.

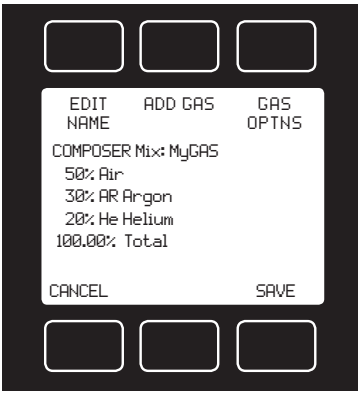


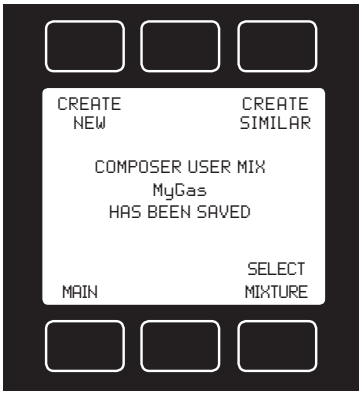

**GAS OPTNS** allows you to adjust the percentage of the constituents or delete a gas from the mix. Gas mixes cannot be adjusted after they have been saved.



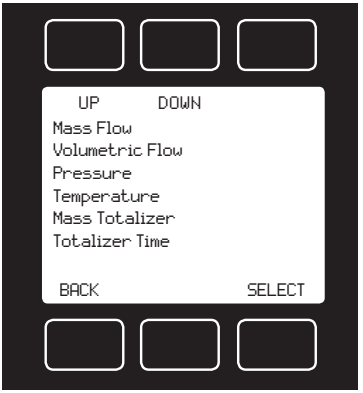




Once the mix has been saved, you may press **CREATE SIMILAR** to compose an additional mix based on the mix you have just saved. <u>This CREATE SIMILAR option is not available after leaving this screen.</u>

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

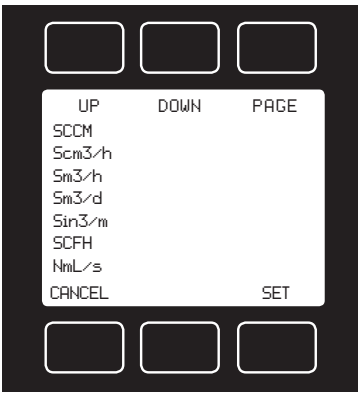
Press **SELECT MIXTURE** to bring the custom mix onto the MAIN display.

## DEVICE UNITS

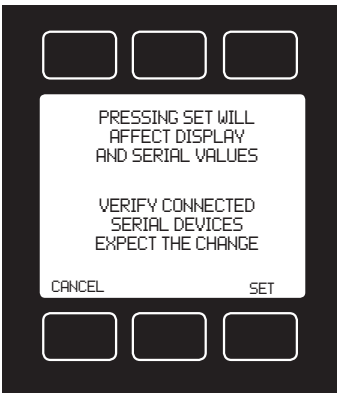



**DEVICE UNITS**

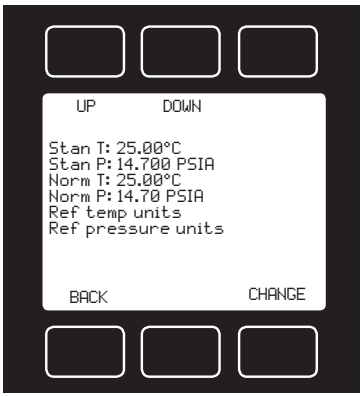
Press **DEVICE UNITS** to access menus of units of measure for each parameter (and totalizer if so equipped).
Scroll to the desired unit and press select. Once selected, you will see the message shown below. Verify that all connected devices expect the change.
See pages 34 and 35 for a full list of available units.




**MASS FLOW UNITS**



## STP/NTP




**STP/NTP** allows selection of the temperature and pressure reference condition for mass flow. For standardardized flow (when using mass flow units that begin with S), Stan T and Stan P define the reference temperature and pressure. For normalized flow (when using mass flow units that begin with N), Norm T and Norm P define the reference temperature and pressure.

This feature is generally useful for comparing to other devices or systems that may be at a different temperature or pressure standard. The same flow, when referenced to different temperatures and/or pressures, will result in different reported values.

Standardized and normalized flow references define the temperature and pressure conditions for which the flow is calculated; this allows flows measured under different conditions to be compared by calculating them using a common set of conditions.

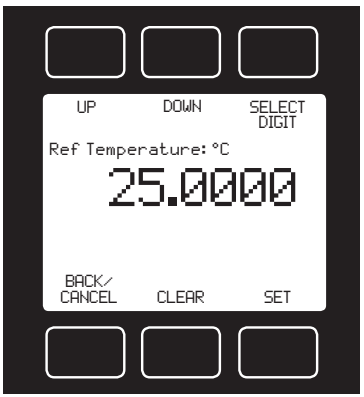
Use the UP/DOWN buttons to select a catagory from the displayed list as shown.

Press **CHANGE** to access the parameter's display. Now use the **SELECT DIGIT** and UP/DOWN buttons to make your changes and press **SET**.

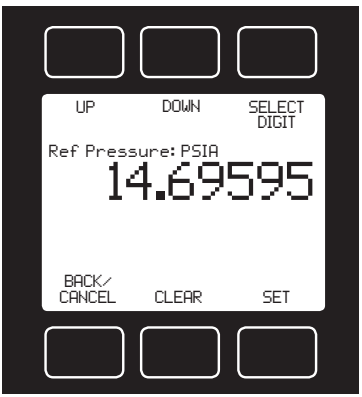
Once a selection has been made and recorded using the **SET** button, a change acknowledgement message will be displayed on screen.

Selecting "Ref temp units" or "Ref pressure units" will allow changing of the temperature or pressure unit for the reference.

Press **BACK** to return to the **BASIC CONFIG** screen.

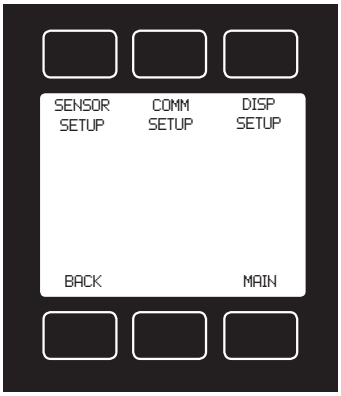



**Std T**




**Std P**

## ADV SETUP




**ADV SETUP**

Press **ADV SETUP** to adjust the sensor settings, unit ID, baud rate, or display settings.

Press **BACK** to return to the Select Menu display. Push **MAIN** to return to the Main display.

**SENSOR SETUP**

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

**ZERO BAND** can be adjusted between 0 and 6.3% of the sensor's Full Scale (FS).

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

**Pressure Averaging and Flow Averaging** may be useful to make it easier to read and interpret rapidly fluctuating pressures and flows. Pressure and flow averaging can be adjusted between 1 (no averaging) and 255 (maximum averaging).

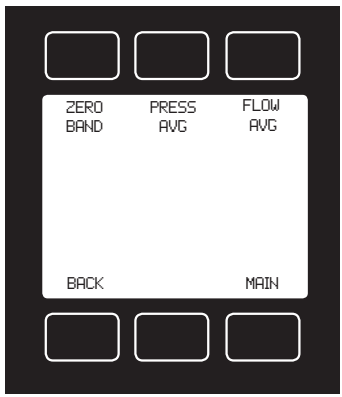
These are geometric running averages where the number between 1 and 255 can be considered roughly equivalent to the response time constant in milliseconds.

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

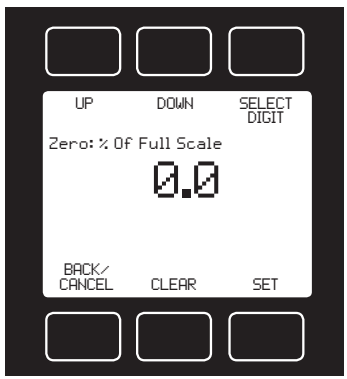
Press **PRESS AVG.** Then use SELECT to choose the digit with the arrow and the UP and DOWN buttons to change the value. Press SET to record your value. Press CLEAR to return to zero.

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

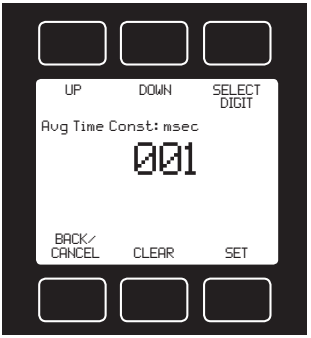
Setting a higher number will equal a smoother display.



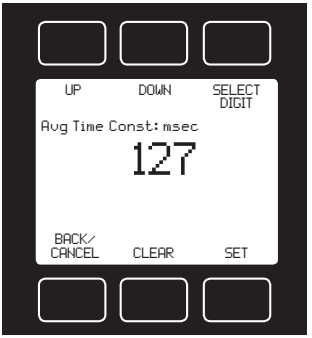

**SENSOR SETUP**




**ZERO BAND**



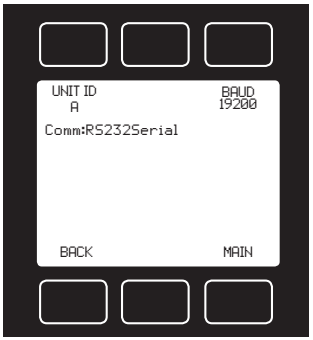

**PRESS AVG**




**FLOW AVG**

**COMM SETUP**

Press **COMM SETUP** to adjust the unit ID or baud rate.




**COMM SETUP**

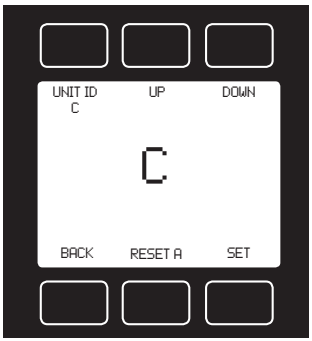
**UNIT ID** – Valid unit identifiers are the letters A-Z and @. The identifier allows you to assign a unique address to each device so that multiple units can be connected to a single RS-232 computer port.

Press **UNIT ID**. Use the UP and DOWN buttons to change the Unit ID. Press SET to record the ID. Press Reset to return to the previously recorded Unit ID. **Any Unit ID change will take effect when SET is pressed.**

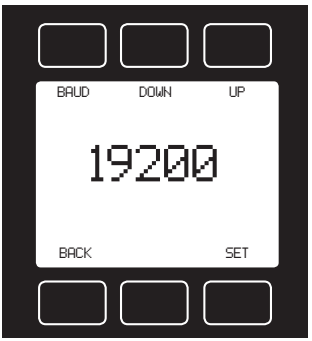
***If the symbol @ is selected as the Unit ID, the device will enter streaming mode when SET is pressed.*** *See RS-232 Communications (page 23) for information about the streaming mode.*

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

Press **BAUD**. Use the UP and DOWN buttons to select the baud rate that matches your computer. The choices are 57600, 38400, 19200, 9600, or 2400 baud. Press SET to record the baud rate. **Any baud rate change will take effect when SET is pressed..**



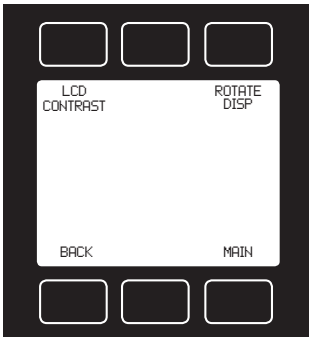

**UNIT ID**




**BAUD**

**DISP SETUP**

Press **DISP SETUP** to adjust the LCD contrast or rotate the display.

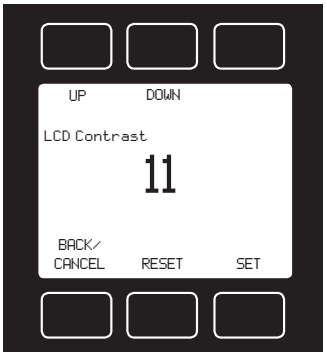



**DISP SETUP**

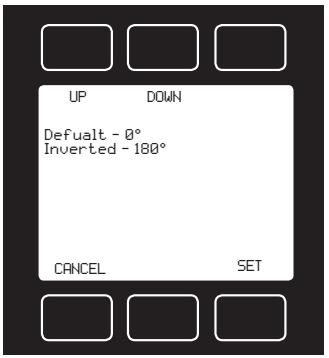
**LCD CONTRAST:** The display contrast can be adjusted between 0 and 28, with zero being the lightest and 31 being the darkest. Use the UP and DOWN buttons to adjust the contrast. Press SET when you are satisfied. Press BACK to return to DISP SETUP.

Press **RESET** to revert to the default contrast level (10)

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




**LCD CONTRAST**




**ROTATE DISPLAY**

## RS-232 Output and Input

Connect the male RS-232 DB9 port of the PCU to the serial port of your computer or data logger. This will normally require a female/female DB9 cable (included).

**Alicat's Flow Vision Software**

Flow Vision is an affordable software program that interfaces with RS-232 and is compatible with most Alicat flow and pressure instruments. The graphical user interface (GUI) provides automatic configuration, session saving for easy configuration and experiment setup reloads, data capturing and logging (including a graphing tool), simple script building for automating meter and control command sequences, software alarms, and support for multiple devices.

*Flow Vision SC™* is for general use with up to 26 different Alicat devices, while *Flow Vision MX™* is specifically designed for gas mixing applications.

**Alicat's Free Serial Terminal Application**

Serial Terminal was written by Alicat as a preconfigured program for RS-232 communication with Alicat devices and can be downloaded from www.alicat.com/support/software-drivers. Serial Terminal requires a Microsoft® .Net Framework to run properly which is usually preinstalled on the PC.

Once downloaded, simply run SerialTerminal.exe and enter the COM port number and baud rate of your Alicat device as prompted. The COM port number may be determined using the Device Manager on the computer, and the default baud rate of an Alicat device is 19200.

**Additional Programs that are compatible with Alicat products**

Alicat products are compatible with many serial communication type software packages including PuTTy and LabVIEW. A brief set of instructions for each of these programs is available at www.alicat.com/support/software-drivers.

Many other programs are also compatible with Alicat devices. To set up serial communication it is important to note which COM port the Alicat is connected to and the communication settings required. The default communication settings are as follows: baud rate = 19200, data bits = 8, stop bits = 1, parity = none, and flow control = none. Not all programs have these options and care should be taken to determine the proper communication setup with the desired program.

Alicat has written drivers specifically for LabVIEW which are available for download at www.alicat.com/support/software-drivers.

**Sending a Command**

In this section, a command will be denoted with a different font. For example, `command<CR>`. `<CR>` will be used to symbolize a carriage return. How a carriage return is entered is dependent on the serial communication program being used. With Serial Terminal, this can commonly be accomplished by pressing "Enter" or "Return".

Parenthesis denote a value that must be filled in by the user. For example, `(unit ID)<CR>` should be changed to `A<CR>` when using a device with Unit ID "A". It may also be useful to note that commands are case insensitive. For example, `A<CR>` is equivalent to `a<CR>`.

**Polling Mode**

All Alicat devices are sent in Polling Mode with Unit ID A unless otherwise requested. Polling a device will return a data frame of the current measurements in the device in units shown on the display. See Data Format, later in this section, for more information. Each unit may be polled individually using the command `(unit ID)<CR>`.

A device's Unit ID may be changed using the command `(current unit ID)@=(desired unit ID)<CR>`. The Unit ID can also be changed via the front panel using the RS-232 communication select menu.

Care should be taken not to assign the same unit ID to more than one device on a single COM port. Up to 26 units may be connected simultaneously as Unit IDs between A and Z are allowed.

**Streaming Mode**

In Streaming Mode, a device will automatically output the data stream at a pre-determined rate. The default rate is set to 50 ms and can be changed via register values for units with software version 4v30 or newer. Only one unit on a given COM port may be in streaming mode at a time.

To change a unit from Polling Mode to Streaming Mode, type `(unit ID)@=@<CR>`. This is equivalent to changing the unit ID to "@". If data does not appear, check all the connections and COM port settings.

When sending a command to a unit in streaming mode, the flow of information will not stop while the user is typing; and the typed text may not be readable depending on the terminal settings.

If the unit does not receive a valid command, it will ignore it. If in doubt, simply perform another carriage return and start again.

To change a unit from Streaming Mode to Polling Mode, type `@@=(unit ID)<CR>`. If entered correctly, the data stream will stop and the device will now be in polling mode.


***Communication Set Up***
**http://www.alicat.com/support/instructional-videos/**

**Data Format**

The data frame on the screen represents the current measurements in the device in the units shown on the display. By default, mass flow meters are configured to output six columns of data.

All data is displayed in the "device units" selected on the unit. Devices come standard with units of PSIA, °C, and either SLPM/LPM or SCCM/CCM, depending on the flow range of the device.

Note that the "button units" available on portable units will not affect the serial output. The first column is the unit ID. This column will be excluded if the device is in streaming mode. The next columns are absolute pressure, temperature, volumetric flow rate, mass flow rate, and selected gas, respectively.

For example, suppose a meter with unit ID A was ordered with units of SCFM or the "device units" are currently selected as SCFM. If air is selected, at atmospheric temperature, the data frame may read:

| A | +014.70 | +025.00 | +02.004 | +02.004 | Air |
|---|---|---|---|---|---|
| Unit ID | Pressure | Temp | Vol. Flow | Mass Flow | Gas |

M-Series Mass Flow Meter Data Format

On units with the totalizer function, the totalized flow will be displayed in column six, with the selected gas moving to column seven. Additional columns, including status codes, may be present to the right of the gas selection column.

**Changing the gas selection using Gas Select via RS-232**

To change the selected gas, type `(unit ID)G(gas number)<CR>`. For a complete list of gas numbers available on the device, see "Gas Lists with Viscosities, Densities and Compressibilities" in this manual.

This list is also available on the gas select menu on the unit. For example, Helium has a gas number of 7. To change the selected gas on unit "A" to Helium, type `AG7<CR>`. On devices with GP software, use the command `(unit ID)$$G(gas number)<CR>` instead.

**Additional Serial Commands**

For more advanced serial communication commands, please contact Alicat or view the ***User's Guide to Advanced Serial Programming*** at Alicat.com/knowledge/documents-resources

## Operating Principle

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

***Please visit the Alicat web site for a detailed explanation this principle. http://www.alicat.com/technical-information/theory-of-operation/***

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

As the older standards are phased out, this difference in readings will cease to be a problem. If you see a difference between the Alicat meter and your in-house standard, in addition to calling Alicat Scientific at (520) 290-6060, call the manufacturer of your standard for clarification as to which data set they used in their calibration. This comparison will in all likelihood resolve the problem.

**GAS SELECT > Standard:**
**M Meters** will display: Acetylene, Air, Argon, Butane, Carbon Dioxide, Carbon Monoxide, Ethane, Ethylene (Ethene), Helium, Hydrogen, Iso-Butane, Krypton, Methane, Neon, Nitrogen, Nitrous Oxide, Oxygen, Propane, Sulfur Hexafluoride, Xenon, A-25, A-75, A1025, C-2, C-8, C-10, C-25, C-75, P-5, Star29.

**MS Meters** add the following: Ammonia, Chlorine Gas, Hydrogen Sulfide, Nitric Oxide, Nitrogen Triflouride, Propylene, Sulfur Dioxide, and Nitrogen Dioxide to 0.5% in an inert carrier, Refrigerant gases.

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

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

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

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

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

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

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

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

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

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

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

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

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

**Supported Units:** This device supports many different units. You may select the desired units (see page 17). Note that only units appropriate to this device are available for selection.

**Pressure Units**

| Absolute | Gauge | Differential | Notes |
|---|---|---|---|
| PaA | PaG | PaD | pascal |
| hPaA | hPaG | hPaD | hectopascal |
| kPaA | kPaG | kPaD | kilopascal |
| MPaA | MPaG | MPaD | megapascal |
| mbarA | mbarG | mbarD | millibar |
| barA | barG | barD | bar |
| g/cm2A | g/cm2G | g/cm2D | gram force per square centimeter |
| kg/cmA | kg/cmG | kg/cmD | kilogram force per square centimeter |
| PSIA | PSIG | PSID | pound force per square inch |
| PSFA | PSFG | PSFD | pound force per square foot |
| mTorrA | mTorrG | mTorrD | millitorr |
| torrA | torrG | torrD | torr |
| mmHgA | mmHgG | mmHgD | millimeter of mercury at 0 C |
| inHgA | inHgG | inHgD | inch of mercury at 0 C |
| mmH2OA | mmH2OG | mmH2OD | millimeter of water at 4 C (NIST conventional) |
| mmH2OA | mmH2OG | mmH2OD | millimeter of water at 60 C |
| cmH2OA | cmH2OG | cmH2OD | centimeter of water at 4 C (NIST conventional) |
| cmH2OA | cmH2OG | cmH2OD | centimeter of water at 60 C |
| inH2OA | inH2OG | inH2OD | inch of water at 4 C (NIST conventional) |
| inH2OA | inH2OG | inH2OD | inch of water at 60 C |
| atm | | | atmosphere |
| m asl | | | meter above sea level (only in /ALT builds) |
| ft asl | | | foot above sea level (only in /ALT builds) |
| V | volt; no conversions are performed to or from other units | | |
| count | count | count | setpoint count, 0 – 64000 |
| % | % | % | percent of full scale |

**Flow Units**

| Volumetric | Standard | Normal | Notes |
|---|---|---|---|
| uL/m | SuL/m | NuL/m | microliter per minute |
| 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 |
| cm3/h | Scm3/h | Ncm3/h | cubic centimeter per hour |
| m3/m | Sm3/m | Nm3/m | cubic meter per minute |
| m3/h | Sm3/h | Nm3/h | cubic meter per hour |
| m3/d | Sm3/d | Nm3/d | cubic meter per day |
| in3/m | Sin3/m | | cubic inch per minute |
| CFM | SCFM | | cubic foot per minute |
| CFH | SCFH | | cubic foot per hour |
| | 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 |
| These can be used for mass flow on gas devices. These can also be used for volumetric flow on liquid devices calibrated in one of these units (liquid density is not yet supported). | |

### Totalizer Units

| Volumetric | Standard | Normal | Notes |
|---|---|---|---|
| uL | SuL | NuL | microliter |
| mL | SmL | NmL | milliliter |
| L | SL | NL | liter |
| US GAL | | | US gallon |
| cm3 | Scm3 | Ncm3 | cubic centimeter |
| m3 | Sm3 | Nm3 | cubic meter |
| in3 | Sin3 | | cubic inch |
| ft3 | Sft3 | | cubic foot |
| | kSft3 | | 1000 cubic feet |
| uP | micropoise, a measure of viscosity; no conversions are performed to or from other units | | |

### Total Mass Units

| Label | Notes |
|---|---|
| mg | milligram |
| g | gram |
| kg | kilogram |
| oz | ounce |
| lb | pound |
| These can be used for totalized mass on gas devices. These can also be used for totalized volume on liquid devices calibrated in one of these units (liquid density is not yet supported). | |

### Temperature Units

| Label | Notes |
|---|---|
| °C | degree Celsius |
| °F | degree Farenheit |
| K | Kelvin |
| °R | degree Rankine |

### Time Units

| Label | Notes |
|---|---|
| h:m:s | Displayed value is hours:minutes:seconds |
| ms | millisecond |
| s | second |
| m | minute |
| hour | hour |
| day | day |

**TROUBLESHOOTING**

***Display does not come on or is weak.***
Check power and ground connections.

***Flow reading is approximately fixed either near zero or near full scale regardless of actual line flow.***
Differential pressure sensor may be damaged. Avoid installations that can subject sensor to pressure drops in excess of 10 psid. A common cause of this problem is instantaneous application of high-pressure gas as from a snap acting solenoid valve upstream of the meter. If you suspect that your pressure sensor is damaged please discontinue use of the meter and contact Alicat.

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

***Meter reads negative flow when there is a confirmed no flow condition.***
This is an indication of an improper tare. If the meter is tared while there is flow, that flow is accepted as zero flow. When an actual zero flow condition exists, the meter will read a negative flow. Simply re-tare at the confirmed zero flow condition. Also note that while the meter is intended for positive flow, it will read negative flow with reasonable accuracy, but not to the full scale flow rate (it is not calibrated for bi-directional flow) and no damage will result.

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

***Flow flutters or is jumpy.***
The meters are very fast and will pick up any actual flow fluctuations such as from a diaphragm pump, etc. Also, inspect the inside of the upstream connection for debris such a Teflon tape shreds.
Note: PCU meters feature a programmable geometric running average (GRA) that can aid in allowing a rapidly fluctuating flow to be read (see "Pressure Averaging" and "Flow Averaging" page 19).

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

***RS-232 Serial Communications is not responding.***
Check that your meter is powered and connected properly. Be sure that the port on the computer to which the meter is connected is active. Confirm that the port settings are correct per the RS-232 instructions in this manual (Check the RS-232 communications select screen for current meter readings). Close Hyperterminal® and reopen it. Reboot your PC. See pages 22 - 24 for more information on RS-232 signals and communications.

***Slower response than specified.***
PCU Meters feature a programmable Geometric Running Average (GRA). Depending on the full scale range of the meter, it may have the GRA set to enhance the stability/readability of the display, which would result in slower perceived response time. Please see "Pressure Averaging" and "Flow Averaging" on page 19.

***Jumps to zero at low flow.***
PCU Meters feature a programmable zero deadband. The factory setting is usually 0.5% of full scale. This can be adjusted between NONE and 6.3% of full scale. See page 19.

***Discrepancies between old and new units.***
Please see "Standard Gas Data Tables" explanation on page 25.

## Maintenance and Recalibration

**General:** Portable Calibration Units require minimal maintenance. They have no moving parts. The single most important thing that affects the life and accuracy of these devices is the quality of the gas being measured. The meters are designed to measure CLEAN, DRY, NON-CORROSIVE gases.

**Moisture, oil and other contaminants can affect the laminar flow elements.**

**Recalibration:** The recommended period for recalibration is once every year. A label located on the PCU lists the most recent calibration date. The PCU should be returned to the factory for recalibration within one year from the listed date. Before calling to schedule a recalibration, please note the serial number on the back of the meter. The Serial Number, Model Number, and Date of Manufacture are also available on the Model Info display (page 12).

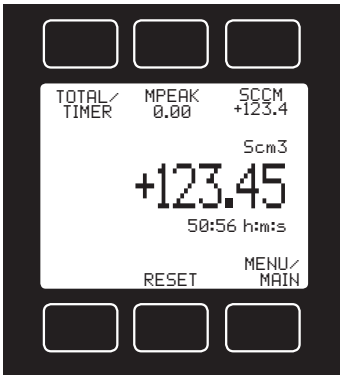
**Cleaning:** PCU meters require no periodic cleaning. If necessary, the outside of the meter can be cleaned with a soft dry cloth. Avoid excess moisture or solvents.

For repair, recalibration or recycling of this product contact:

Alicat Scientific, Inc.
7641 N Business Park Drive
Tucson, Arizona 85743
USA
Phone: 520-290-6060
Fax: 520-290-0109
e-mail: service@alicat.com
Web site: www.alicat.com

**Option: Totalizing Mode - Meters**

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




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

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

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

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

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

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

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

**MPEAK:** MPEAK will display the most recent peak flow rate until totalizer is reset.

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

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

## Accessory: Flow Vision™ SC Software

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

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

***Flow Vision™ SC*** supports all RS-232 and RS-485 Serial communication functions, including: **gas selection, tareing, set-point control, valve tuning and flow averaging.**

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

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

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

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

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

## Accessory: Flow Vision™ MX Software

***Alicat's Flow Vision™ MX software gives you an easy way to do GAS BLENDING using Alicat Mass Flow Controllers and your own PC.***

***Flow Vision™ MX*** software is a simple way to connect up to six Alicat mass flow controllers and create your own gas mix concentrations.

Using our inexpensive ***BB9-USB*** and a single USB connection you can:

- **Create** your own gas blends
- **Adjust** flow rates
- **Save** your specific blend formulas.

All the controllers can be powered through the BB9-USB with a single power supply.

Just connect your unique gases to each controller, select the gas type either locally on the controller or through Flow Vision™ MX, manifold the flow outputs and create your gas mix.

# Accessories

| Part Number | Description |
|---|---|
| FLOWVISIONSC | Flow Vision™ SC software for interface with all Alicat instruments |
| FLOWVISIONMX | Flow Vision™ MX software for gas blending |
| BB9 | 9 position Multi-Drop Box |
| BB9-I | 9 position Multi-Drop Box, Industrial connectors |
| PVPS24U | Universal 100-240 VAC to 24 Volt DC Power Supply Adapter |
| PS24VHC | High current power supply for BB9 use with Large Valve Controllers |
| PCASE | Industrial carry and storage case for portable meters/gauges |
| DC-61 | 8 Pin Male Mini-DIN connector cable, single ended, 6 foot length |
| DC-251 | 8 Pin Male Mini-DIN connector cable, single ended, 25 foot length |
| DC-301 | 8 Pin Male Mini-DIN connector cable, single ended, 30 foot length |
| DC-501 | 8 Pin Male Mini-DIN connector cable, single ended, 50 foot length |
| DC-751 | 8 Pin Male Mini-DIN connector cable, single ended, 75 foot length |
| DC-6RT | 8 Pin Male Right Angle Mini-Din Cable, single ended, 6 foot length |
| DC-62 | 8 Pin Male Mini-DIN connector cable, double ended, 6 foot length |
| DC-252 | 8 Pin Male Mini-DIN connector cable, double ended, 25 foot length |
| DC-502 | 8 Pin Male Mini-DIN connector cable, double ended, 50 foot length |
| DC-602 | 8 Pin Male Mini-DIN connector cable, double ended, 60 foot length |
| MD8DB9 | 8 Pin Male Mini-DIN to DB9 Female Adapter, 6 foot length |
| DBC-251 | DB15 cable, single ended, 25 foot length |
| 510199 | DB9 cable, double-ended female, 3 meter length |
| IC10 | Industrial cable, 6 Pin, single ended, 10 foot length |
| IC10-18G | 18 gauge industrial cable, 6 Pin, single ended, 10 foot length |
| IC20 | Industrial cable, 6 Pin, single ended, 20 foot length |
| IC24-18G | 18 gauge industrial cable, 6 Pin, single ended, 24 foot length |
| IC50 | Industrial cable, 6 Pin, single ended, 50 foot length |
| IC-102 | Industrial cable, 6 pin double ended, 10 foot length |
| USB-RS232 | RS-232 to USB Converter |

# Accessories

| MNPT to Compression Fittings | |
|---|---|
| 10-32 - 1/8” | SS-200-1-0157 |
| 10-32 - 1/4” | SS-400-1-0256 |
| 1/8” - 1/8” | SS-200-1-2 |
| 1/8” - 1/4” | SS-400-1-2 |
| 1/8” - 3/8” | SS-600-1-2 |
| 1/8” - 1/2” | SS-810-1-2 |
| 1/8” - 3mm | SS-3M0-1-2 |
| 1/8” - 4mm | SS-4M0-1-2 |
| 1/8” - 6mm | SS-6M0-1-2 |
| 1/8” - 8mm | SS-8M0-1-2 |
| 1/8” - 12mm | SS-12M0-1-2 |
| 1/4” - 1/8” | SS-200-1-4 |
| 1/4” - 1/4” | SS-400-1-4 |
| 1/4” - 3/8” | SS-600-1-4 |
| 1/4” - 1/2” | SS-810-1-4 |
| 1/4” - 3mm | SS-3M0-1-4 |
| 1/4” - 4mm | SS-4M0-1-4 |
| 1/4” - 6mm | SS-6M0-1-4 |
| 1/4” - 8mm | SS-8M0-1-4 |
| 1/4” - 12mm | SS-12M0-1-4 |
| 1/2” - 1/8” | SS-200-1-8 |
| 1/2” - 1/4” | SS-400-1-8 |
| 1/2” - 3/8” | SS-600-1-8 |
| 1/2” - 1/2” | SS-810-1-8 |
| 1/2” - 3/4” | SS-1210-1-8 |
| 1/2” - 6mm | SS-6M0-1-8 |
| 1/2” - 8mm | SS-8M0-1-8 |
| 1/2” - 12mm | SS-12M0-1-8 |
| 1/2” - 16mm | SS-16M0-1-8 |
| 3/4” - 1/4” | SS-400-1-12 |
| 3/4” - 1/2” | SS-810-1-12 |
| 3/4” - 3/4” | SS-1210-1-12 |
| 3/4” - 12mm | SS-12M0-1-12 |
| 3/4” - 16mm | SS-16M0-1-12 |

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

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

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

## Information for Alicat TFT (Color Display) Instruments

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

**Multi-Color Display Color Codes:**

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

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

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

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

**LCD Contrast:**
LCD contrast is ranged from 0 to 11 on color displays with 11 being the greatest contrast.

**NOTE:** A color display will result in significantly reduced battery life in PCU and portable instruments. Turning the display off for meters not in use will help prolong battery life.

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

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

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

# Technical Data for Alicat PCU Mass Flow Meters

## M Series 0 to 0.5 sccm Full Scale through 0 to 1500 slpm Full Scale

## Whisper 0 to 0.5 sccm Full Scale through 0 to 250 slpm Full Scale

### Standard Operating Specifications (Contact Alicat for available options)

| Performance | PCU Mass Flow Meter |
|---|---|
| Accuracy at calibration conditions after tare | ± (0.8% of Reading + 0.2% of Full Scale) |
| High Accuracy at calibration conditions after tare | ± (0.4% of Reading + 0.2% of Full Scale)<br>High Accuracy option not available for units ranged under 5 sccm or over 500 slpm. |
| Repeatability | ± 0.2% Full Scale |
| Zero Shift and Span Shift | 0.02% Full Scale / ºCelsius / Atm |
| Operating Range / Turndown Ratio | 0.5% to 100% Full Scale / 200:1 Turndown |
| Maximum Measurable Flow Rate | 128% Full Scale |
| Typical Response Time | 10 ms (Adjustable) |
| Warm-up Time | < 1 Second |

| Operating Conditions | PCU Mass Flow Meter | |
|---|---|---|
| Mass Reference Conditions (STP) | 25 ºC & 14.696 psia (standard — others available on request) | |
| Operating Temperature | −10 to +60 ºCelsius | |
| Humidity Range (Non–Condensing) | 0 to 100% | |
| Maximum Internal Pressure (Static) | **M Series:** 145 psig | **Whisper:** 45 psig |
| Maximum Allowable Instantaneous Differential Pressure Across Device (Inlet to Outlet) | **M Series:** 75 psid | **Whisper:** 15 psid |
| Proof Pressure | 175 psig | |
| Ingress Protection | IP40 | |
| Wetted Materials | 303 & 302 Stainless Steel, Viton®, Heat Cured Silicone Rubber, Glass Reinforced Polyphenylene Sulfide, Heat Cured Epoxy, Aluminum, Gold, Silicon, Glass.<br>If your application demands a different material, please contact Alicat. | |

| Features | M-Series Mass Flow Meter |
|---|---|
| **Gas Select™ 5.0** | **Gas Select™ 5.0** provides **98 Preloaded Gas Calibrations: See the following page for a complete list.**<br>If your application calls for a gas not on this list, please let us know. We can also calibrate to a wide variety of complex gas mixtures involving up to eight gas constituents.<br>**For corrosive gases and refrigerants see Alicat's MS-Series meters** (***www.alicat.com/ms***). |
| **COMPOSER™** | **COMPOSER™ is a feature of Gas Select™ 5.0 that allows users to defines up to 20 user gas compositions with up to 5 constituent gases per mix** (***www.alicat.com/composer)***. |

| Communications / Power | PCU Mass Flow Meter | |
|---|---|---|
| Monochrome LCD Display with integrated touchpad | Each display simultaneously displays Mass Flow, Volumetric Flow, Pressure and Temperature | |
| Digital Output Signal[1] | RS-232 Serial | |
| Electrical Supply | Four AA Vdc batteries[2] | 9-30 Vdc wall outlet adaptor (minimum 150 mA @ 24 Vdc) |

1. The **Digital Output Signal** communicates Mass Flow, Volumetric Flow, Pressure and Temperature
2. Four AA 1.5 Vdc Alkaline, Zinc-Carbon or Lithium Ion batteries. Use of 1.2 Vdc rechargeable batteries is not recommended.

### Range Specific Specifications

| FS Flow M-Series Meter | Pressure Drop at FS Flow (psid)* |
|---|---|
| 0.5 sccm to 1 sccm | 1.0 |
| 2 sccm to 50 sccm | 1.0 |
| 100 sccm to 20 slpm | 1.0 |
| 50 slpm | 2.0 |
| 100 slpm | 2.5 |
| 250 slpm | 2.1 |
| 500 slpm | 4.0 |
| 1000 slpm | 6.0 |
| 1500 slpm | 9.0 |
| ***Venting to atmosphere** | |

| FS Flow Whisper Meter | Pressure Drop at FS Flow (psid)* |
|---|---|
| 0.5 sccm to 2 sccm | 0.06 |
| 5 sccm to 20 sccm | 0.07 |
| 50 sccm | 0.07 |
| 100 sccm to 200 sccm | 0.06 |
| 500 sccm | 0.07 |
| 1 slpm to 5 slpm | 0.07 |
| 10 slpm | 0.08 |
| 20 slpm | 0.25 |
| 40 slpm | 0.12 |
| 50 slpm | 0.14 |
| 100 slpm | 0.24 |
| 250 slpm | 0.60 |
| ***Venting to atmosphere** | |

**Weight:** 12 - 20 lb depending on configuration

**PCU Case Dimensions:** 16" L x 13" W x 7" H

**Process Connections:** 1/8", 1/4", 3/8", 1/2", 6mm, 10mm, or 12mm push-connect style tubing fittings

## Serial Number: _____

## Model Number: _____



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

### Limited Lifetime Warranty

Alicat Scientific, Inc. warrants to the original purchaser (hereinafter referred to as “Buyer”) that instruments manufactured by Alicat Scientific (hereinafter referred to as “Product”) shall be free from defects in materials and workmanship for the life of the Products.

Under this warranty, the Products will be repaired or replaced at manufacturer’s option, without charge for parts or labor when the Product is carried or shipped prepaid to the factory together with proof of purchase. The foregoing shall constitute the exclusive and sole remedy in lieu of other remedies of the Buyer for any breach by Alicat Scientific of this warranty to the maximum extent permitted by law.

This warranty does not apply to any Product which has not been installed or used in accordance with the Product operation and installation specifications provided to Buyer verbally or in writing by Alicat Scientific for the proper and normal use of the Product.

Buyer agrees hereunder that Alicat reserves the right to void any warranty, written or implied, if upon Alicat’s examination of Product shall disclose to Alicat’s satisfaction that the Product failure was due solely, or in part, to accident, misuse, neglect, abuse, alteration, improper installation, unauthorized repair or improper testing by Buyer or agent of Buyer.

Alicat Scientific shall not be liable under any circumstances for indirect, special, consequential, or incidental damages in connection with, or arising out of, the sale, performance, or use of the Products covered by this warranty.

Alicat Scientific does not recommend, warrant or assume responsibility for the use of the Products in life support applications or systems.

Alicat’s warranties as herein above set forth shall not be enlarged, diminished or affected by, and no obligation or liability shall arise or grow out of Alicat’s rendering of technical advice in connection with Buyer’s order of the Products furnished hereunder.

If Product becomes obsolete, Alicat Scientific, at its own discretion, reserves the right to repair the Product with available replacement parts or upgrade the Product to a current, commercially available version of the original Product. Should upgrading the Product be deemed necessary by Alicat, Buyer hereby agrees to pay an upgrade fee equal to seventy percent of the retail value of the replacement Product. Alicat Scientific hereunder makes no claim that replacement Products will look, function or operate in the same or similar manner as the original product.

When a Product is returned to Alicat Scientific for recalibration this service is considered normal preventative maintenance. Recalibration of Product shall not be treated as a warranty service unless recalibration of Product is required as the result of repairs to Product pursuant to this Warranty. Failure of Buyer to send Product to Alicat Scientific for recalibration on a yearly basis after a period of 36 months from date of manufacture will remove any and all obligations regarding repair or replacement of Product as outlined by this Warranty to Buyer from Alicat Scientific.

This Warranty is in lieu of all other relevant warranties, expressed or implied, including the implied warranty of merchantability and the implied warranty of fitness for a particular purpose, and any warranty against infringement of any patent.

Continued use or possession of Products after expiration of the applicable warranty period stated above shall be conclusive evidence that the warranty is fulfilled to the full satisfaction of Buyer.

Alicat makes no warranty as to experimental, non-standard or developmental Products.

Accessories purchased from Alicat are not covered by this warranty.

The product complies with the requirements of the Low Voltage Directive 2014/35/EU, the EMC Directive 2014/30/EU and the RoHS Directive 2011/65/EU and carries the CE Marking accordingly. Contact the manufacturer for more information.

## Gas Viscosity, Density and Compressibility:

| # | Gas | | Absolute Viscosity* 25°C | Density ** 25°C 14.696PSIA | Compressibility 25°C 14.696PSIA |
|---|---|---|---|---|---|
| 0 | Air | Air | 184.8989 | 1.1840 | 0.9997 |
| 1 | Argon | Ar | 226.2399 | 1.6339 | 0.9994 |
| 2 | Methane | CH4 | 110.7595 | 0.6569 | 0.9982 |
| 3 | Carbon Monoxide | CO | 176.4933 | 1.1453 | 0.9996 |
| 4 | Carbon Dioxide | CO2 | 149.3184 | 1.8080 | 0.9950 |
| 5 | Ethane | C2H6 | 93.5412 | 1.2385 | 0.9924 |
| 6 | Hydrogen | H2 | 89.1535 | 0.08235 | 1.0006 |
| 7 | Helium | He | 198.4561 | 0.16353 | 1.0005 |
| 8 | Nitrogen | N2 | 178.0474 | 1.1453 | 0.9998 |
| 9 | Nitrous Oxide | N2O | 148.4124 | 1.8089 | 0.9945 |
| 10 | Neon | Ne | 311.1264 | 0.8244 | 1.0005 |
| 11 | Oxygen | O2 | 205.5021 | 1.3088 | 0.9994 |
| 12 | Propane | C3H8 | 81.4631 | 1.8320 | 0.9838 |
| 13 | normal-Butane | n-C4H10 | 74.0536 | 2.4493 | 0.9699 |
| 14 | Acetylene | C2H2 | 104.4480 | 1.0720 | 0.9928 |
| 15 | Ethylene | C2H4 | 103.1839 | 1.1533 | 0.9943 |
| 16 | iso-Butane | i-C4H10 | 74.7846 | 2.4403 | 0.9735 |
| 17 | Krypton | Kr | 251.3249 | 3.4323 | 0.9979 |
| 18 | Xenon | Xe | 229.8483 | 5.3950 | 0.9947 |
| 19 | Sulfur Hexafluoride | SF6 | 153.5320 | 6.0383 | 0.9887 |

| # | Gas | | Absolute Viscosity* 25°C | Density ** 25°C 14.696PSIA | Compressibility 25°C 14.696PSIA |
|---|---|---|---|---|---|
| 20 | 75%Ar / 25% CO2 | C-25 | 206.9763 | 1.6766 | 0.9987 |
| 21 | 90% Ar / 10% CO2 | C-10 | 218.6026 | 1.6509 | 0.9991 |
| 22 | 92% Ar / 8% CO2 | C-8 | 220.1352 | 1.6475 | 0.9992 |
| 23 | 98% Ar / 2% CO2 | C-2 | 224.7148 | 1.6373 | 0.9993 |
| 24 | 75% CO2 / 25% Ar | C-75 | 168.2250 | 1.7634 | 0.9966 |
| 25 | 75% Ar / 25% He | HE-75 | 231.6056 | 1.2660 | 0.9997 |
| 26 | 75% He / 25% Ar | HE-25 | 234.6860 | 0.5308 | 1.0002 |
| 27 | 90% He / 7.5% Ar / 2.5% CO2 Helistar® A1025 | A1025 | 214.9760 | 0.3146 | 1.0003 |
| 28 | 90% Ar / 8% CO2 / 2% O2 Stargon® CS | Star29 | 219.7934 | 1.6410 | 0.9992 |
| 29 | 95% Ar / 5% CH4 | P-5 | 223.9106 | 1.5850 | 0.9993 |

*in micropoise (1 Poise = gram / (cm) (sec)) **Grams/Liter
Reference: NIST REFPROP 9 Database

### Flow Conversions:

| | | | | | | |
|---|---|---|---|---|---|---|
| SCFM | 1.00 = 28.3160 | SLPM | SLPM | 100.00 = 3.5316 | SCFM |
| SCFH | 1.00 = 0.4719 | SLPM | SLPM | 100.00 = 211.9093 | SCFH |
| SCIM | 100.00 = 1.6390 | SLPM | SLPM | 1.00 = 61.0128 | SCIM |
| SCIH | 1000.00 = 0.2732 | SLPM | SLPM | 1.00 = 3660.7688 | SCIH |

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A HALMA COMPANY