



A Halma company

OPERATING MANUAL *for* **LIQUID FLOW METERS**

Models L · LB · LS · LBS

Thank you for purchasing your liquid meter.

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Recalibrate your flow meter every year.

Annual calibration is required to ensure the continued certainty of readings and to extend the Limited Lifetime Warranty. Fill out the Service Request Form at alicat.com/service, or contact us directly.

Serial #: _____ Next Calibration: _____



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 European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC

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LIQUID FLOW METER operating manual

Using Laminar Liquid Flow Devices

THE DEVICE IS CONFIGURED FOR ONE TYPE OF LIQUID, AND MUST USE ONLY THAT LIQUID TO FUNCTION PROPERLY.

By default, liquid devices are configured only for use with pure water, such as distilled, de-ionized, Type I (Ultrapure), Type II, and Type III. If the device was specifically engineered for use with a different liquid, any other liquid will produce incorrect readings. Contact support ([page 2](#)) with any questions.

Ensure minimal contaminants or liquid variations. For water devices, **DO NOT** use tap water or water with any biological components, minerals, or oils. Any of these substances will affect the viscosity of the liquid, creating flow measurement inaccuracies. More importantly, **these impurities will quickly build up in the laminar flow zone, cause corrosion, and degrade the measurement accuracy of the device.**

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Introduction

Your new flow meter has a variety of innovative features:

- **1000 readings per second** ensures high resolution data.
- **Monitor pressure and temperature** during flow measurement. View internal stream gauge pressure and temperature.
- **Backlit display with adjustable contrast** is easy to read in direct sunlight. In dimly lit areas, press the bottom-center logo to turn on the backlight (see [page 8](#)).
- **Log data to your PC**. Talk to the flow meter over a serial data connection to capture all flow data, for logging and analysis purposes (see [page 23](#)).

This manual covers the following instruments:

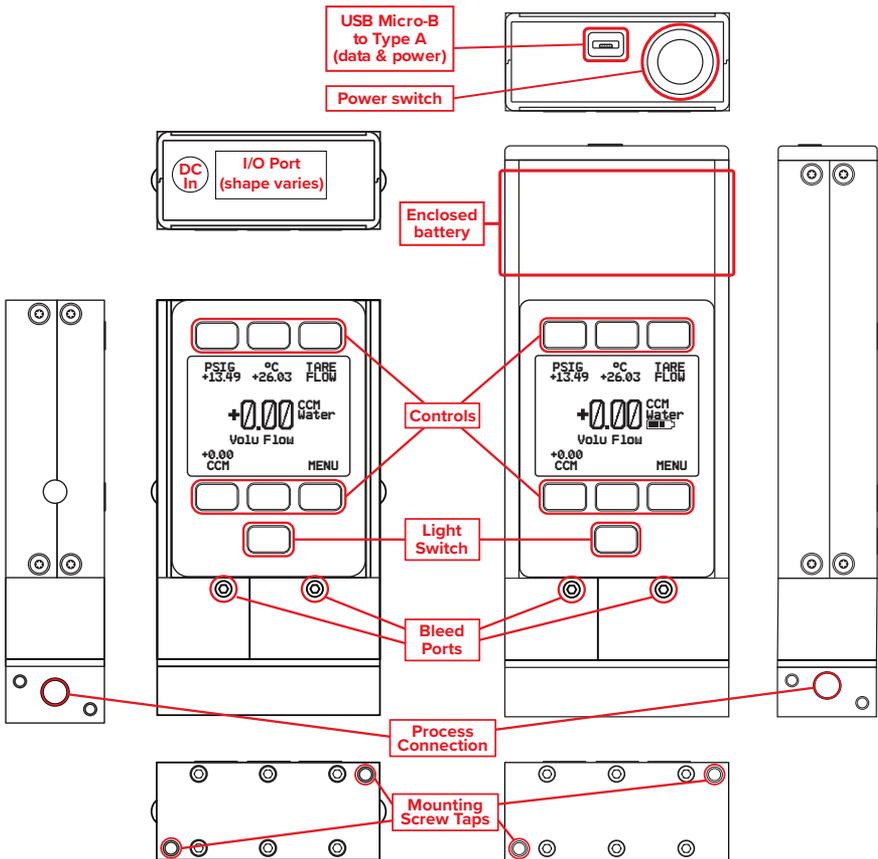
- Liquid flow meters
- Portable liquid flow meters
- Flow meters for aggressive liquids
- Portable flow meters for aggressive liquids
- Devices labeled as approved for CSA Class 1 Div 2 and ATEX Class 1 Zone 2 hazardous environments. See [page 38](#) for Special Conditions regarding the use of CSA/ATEX labeled devices.

Getting Started

Getting to Know Your Liquid Flow Meter

Connectors and Buttons

The drawings below represent a typical configuration of a standard liquid flow meter, and a standard battery-powered liquid flow meter. **Your flow meter's appearance and connections may differ.**



The Flow Meter Display

The figure below identifies the various features of the flow meter display. **Press the button behind the Alicat logo to toggle the backlight** on and off.

Live data is measured 1000 times per second and typically displayed 10 times per second on the device LCD screen.

Engineering units are used by the meter in its serial communications and calculations. These can be different from **button units**, which are the units being displayed. These are individually configurable.

1 Highlights **pressure** in the center of the meter. Push a second time to choose the pressure parameter (if available), or to select pressure engineering units ([page 13](#)).

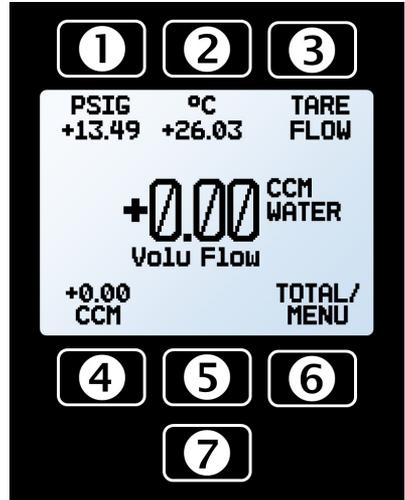
2 Highlights **temperature**. Push a second time to select temperature engineering units ([page 13](#)).

3 **TARE FLOW** tare the flow rate (see [page 17](#)).

4 Highlights **volumetric flow** rate. Push a second time to select volumetric flow rate engineering units ([page 13](#)).

6 **TOTAL/MENU** Accesses the optional **flow totalizer** ([page 14](#)). **MENU** enters the Menu system ([page 17](#)).

7 Toggles the backlight. See more display options on [page 22](#).



Status Messages

ADC Analog-digital converter error

TMF Totalizer missed out of range flow

LCK Front display is locked

TOV Temperature over range of device

OVR Totalizer rolled over to zero

VOV Volumetric flow over range of device

POV Pressure over range of device

Mounting

All liquid meters have mounting holes for convenient attachment to flat panels. No straight runs of pipe are required upstream or downstream. Meters are position insensitive and can be mounted in any orientation.



For applications that may continuously introduce occasional air bubbles to the flow stream upstream of the device, the device may be mounted upside down to prevent the bubbles from becoming trapped in the differential pressure sensor ports. Tare the device after changing its position or orientation.



If the device has been installed upside down, avoid using the bleed screws as liquid may leak into the electronics housing causing permanent damage that is not covered under warranty!

Process Ports

Your flow meter has been shipped with plastic plugs fitted into its ports. To lessen the chance of contaminating the flow stream, do not remove these plugs until you are ready to install the device.

Standard liquid flow meters have female inlet and outlet ports. Welded VCR® and other specialty fittings may have male connections.

- If you are using a fitting that does not have a face seal, use thread-sealing Teflon tape to prevent leakage around the port threads, but **do not wrap the first two threads**. This will minimize the possibility of getting tape into the flow stream and clogging the laminar flow elements (LFE).
- If you are using a fitting that has a face seal, there is no need to apply Teflon tape to the threads.
- When changing fittings, carefully clean the port threads.



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

Filters

When pressure drop is not an issue, use in-line sintered filters to prevent large particulates from entering the flow meter. Suggested maximum particulate sizes are as follows:

≤100 ccm flow range: **20 microns**

>100 ccm flow range: **40 microns**



Avoiding long runs of small-diameter tubing upstream or downstream of the device will reduce liquid hammer.

Operating Pressure

Maximum operating line pressure is **100 PSIG**. If the line pressure is higher than 100 PSIG, use a pressure regulator upstream to reduce the pressure. Maximum proof pressure is 200 PSIG; above this pressure the device may be permanently damaged. Although the meter's operation is unidirectional, reversing the flow direction will inflict no damage as long as the maximum specified limits are not exceeded.



CAUTION! Exceeding the maximum specified line pressure may cause permanent damage to the solid-state differential pressure transducer.

Optimizing Pressure

Smooth and consistent source pressure is highly preferable, as fluctuations in pressure may cause readings to jump. A volume partially filled with air placed between the pressure source and flow meter will often help dampen oscillations in feed pressure.

Bleed Ports

Liquid flow meters include bleed ports (8-32 Nylon tapped screw) on the front for the removal of air bubbles. Bleed both of the ports as follows:



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

1. With the meter installed and line pressure applied, gently loosen the upstream bleed port screw 1 or 2 turns, or until liquid begins to leak from the threads. **Do not remove the screw.**
2. Gently tapping the flow body (screwdriver handles work well) will bump air bubbles out, though it may not be visible or audible.
3. Gently tighten the screw until the leakage stops, taking care not to crush the nylon tip.

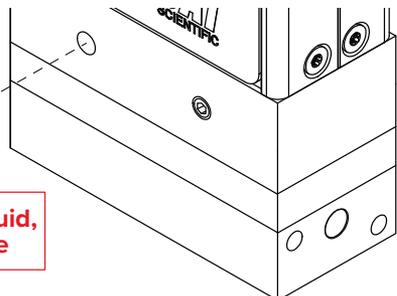


If your device is mounted in an inverted position, avoid using the bleed screws as liquid may leak and cause permanent damage.

$\frac{5}{64}$ " 8-32 Nylon-tipped hex bleed screw



Loosen to bleed liquid, but do not remove



Power and Signal Connections

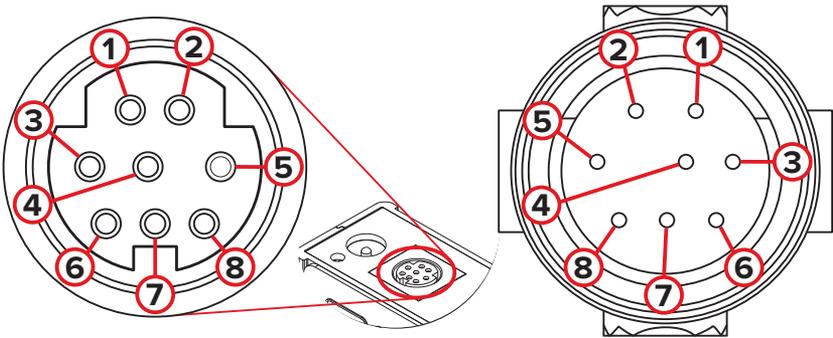
Power can be supplied to your meter through either the power jack or the multi-pin connector on top of your device.



Meter power jacks require a 9–24 Vdc power supply with a 2.1 mm female positive center plug capable of supplying at least 40 mA, with an additional 40 mA for a color display. 4–20 mA analog signal outputs require at least 12 Vdc and 80 mA, and 0–10 Vdc outputs require at least 12 Vdc.

Standard 8-Pin Mini-DIN Pinout

For 6-pin locking industrial connector, M12, DB9, and DB15 pinouts, see [page 33](#) or visit alicat.com/pinouts.



Female Connector: Device

Male Connector: Cable

Pin	Cable Color	Function
1	Black	Not connected <i>Optional: 4–20 mA primary output signal</i>
2	Brown	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	Red	Serial RS-232RX input signal <i>Optional: RS-485 A</i>
4	Orange	Remote tare (ground to tare)
5	Yellow	Serial RS-232TX output signal <i>Optional: RS-485 B</i>
6	Green	0–5 Vdc <i>Optional: 1–5 Vdc or 0–10 Vdc) output signal</i>
7	Blue	Power in (as described above)
8	Purple	Ground (common for power, digital communications, analog signals, and alarms)



Caution: Do not connect power to pins 1 through 6, as permanent damage can occur. It is common to mistake Pin 2 (5.12 Vdc Output) as the standard 0–5 Vdc analog output signal. Pin 2 is normally a constant 5.12 Vdc that reflects the system bus voltage.

RS-232 or RS-485 Digital Signals

To use the RS-232 or RS-485 digital signal, connect the Output Signal (Pin 5), the Input Signal (Pin 3), and Ground (Pin 8) to your serial port as shown below. See [page 23](#) for details on how to use the data connection to issue commands.

DB9 to 8-Pin Mini-DIN Connection for RS-232 or RS-485 Signals

9-Pin Serial Connection		8-Pin Mini-DIN Connection	
Pin	Function	Pin	Function
5	Ground	8	Ground
3	Transmit	3	Receive
2	Receive	5	Transmit

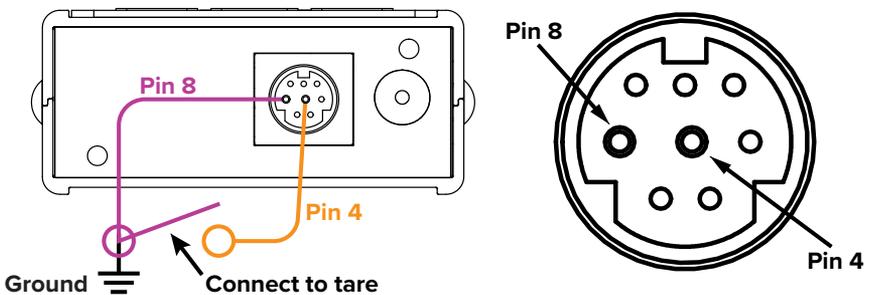
Analog Signals

Primary Analog Output Signal

Most devices include a primary analog output signal, which is linear over its entire range. For ranges that start at 0 Vdc, a zero-flow condition is indicated at approximately 0.010 Vdc. Full scale flow is indicated by the top of the range: 5 Vdc for 0–5 Vdc, 20 mA for 4–20 mA signals, and so on.

Using Ground to Tare

You can tare your liquid flow meter remotely by momentarily grounding Pin 4, as shown below. When the switch is closed, the device will tare, and resume operation once the switch has been released. You can also tare with the front controls ([page 17](#)) or serial commands ([page 25](#)).



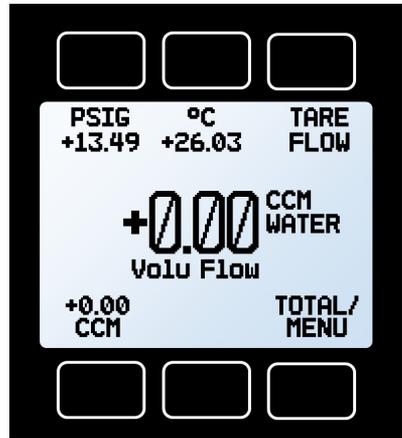
DB9 and other pinouts can be found on [page 33](#).

Engineering Units

The flow meter's units of measurement are handled in two ways:

Button engineering units are the units of measurement shown on the front display. At right, they are **PSIG** (pressure), **°C** (temperature), and **CCM** (flow rate).

Device engineering units are the units of measurement used for calculation and sent through a serial data connection. **These may be different from the displayed button engineering units**, if the user so chooses.



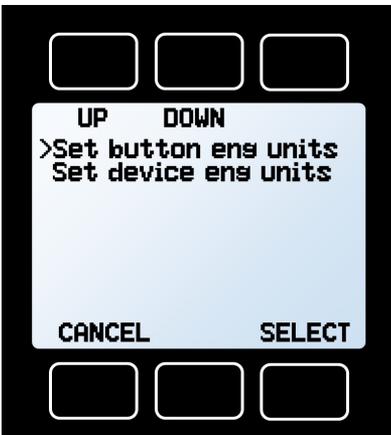
Main Display

Selecting Engineering Units

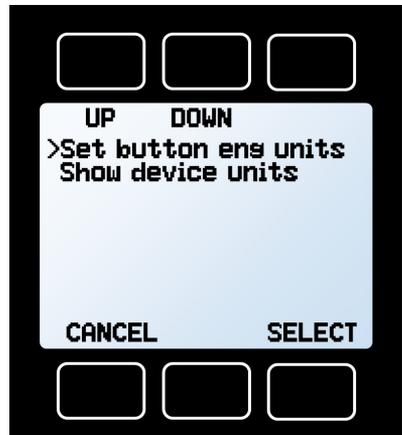
If a parameter is already highlighted in the center of the screen, pressing that measurement's button again will bring up a menu to modify either the button engineering units or the device engineering units.

If the device and button engineering units are the same (below left) when entering the Engineering Units menu, it will offer to change button engineering units or device engineering units. Device engineering units can also be set in the Basic Configuration menu ([page 19](#)).

If the device and button engineering units are different (below right) when entering the menu, it will offer to change the button engineering units (**Set button eng units**), or to change the button units to match the device engineering units (**Show device units**).



This will show if the front display units (button engineering units) are the same as serial data (device engineering units).



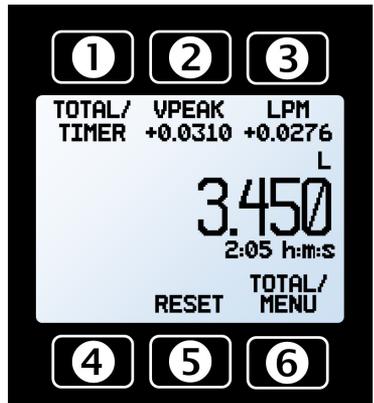
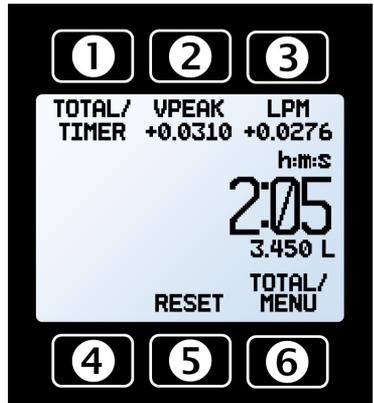
This will show if the button engineering units are the different than the device engineering units.

Option: Collecting Totalized Flow Data

Your liquid flow meter may have been purchased with a flow totalizer. It displays the total amount of volume that has flowed through the instrument since its last reset, like a gasoline pump. You can access the totalizer screen by pressing **TOTAL/MENU** on the Main Display.

Totalizer (Optional)

- 1** **TOTAL/TIMER** toggles totalized flow and elapsed time as the parameter highlighted in the center.
- 2** **VPEAK** displays the maximum flow rate since the last reset. Press to select engineering units.
- 3** Displays live flow rate. Press to select engineering units.
- 5** **RESET** clears all totalized data and immediately resets the timer to 0 while totalization continues.
- 6** **TOTAL/MENU** enters the menu system (page 17). Then, press **MAIN** to exit to the Main Display of live data.
 - The main display shows either time since reset, or totalized flow.
 - VAVG**: Optionally shows the live average flow rate since the last reset, just above the main display.



Totalizer showing time (top) and total flow (bottom)

Totalizer Rollover Functions

The totalizer is configured to report up to 7 digits. By default, the placement of the decimal is the same as the live flow rate, but can be configured at the time of order for the following behaviors.

- Rollover (default):** Totalizer resumes counting from 0 as soon as the maximum count has been reached.
- Freeze:** Totalizer stops counting at max count, until it is reset manually.
- Error (default):** Displays **OVR** when maximum count has been reached; compatible with Rollover and Freeze.

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 behavior chosen above for the totalized flow readings.

Option: Charging Your Portable Flow Meter

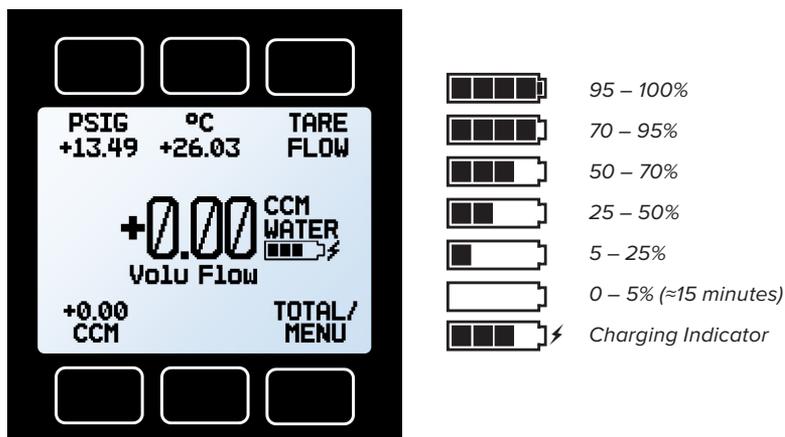
Portable meters' batteries are partially charged before shipping. When fully charged, and with the backlight set to 10, typical battery life is 18 hours with a monochrome display, or 8 hours with a TFT color display. Dimming the backlight will increase battery life.

When the battery indicator is completely empty, about 15 minutes of battery life remains.

Charge the liquid flow meter using the supplied USB cable (micro-B to type A) or a similar cable. You may charge the liquid flow meter using any USB outlet on a computer or portable power supply, but charging will be fastest (approximately 3.5 hours) when connected to the supplied 2.0A power supply.

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

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

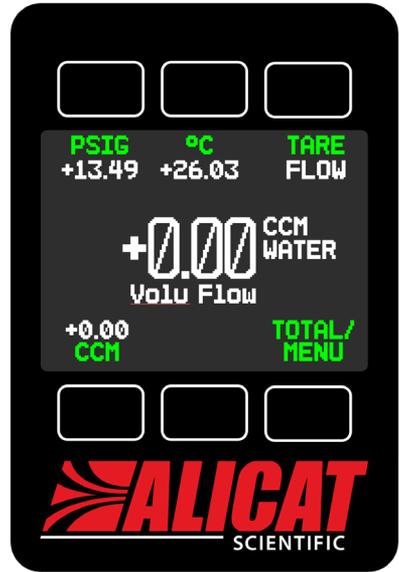


Warning: The safe charging temperature range is 0–45°C (32–113°F). If internal sensors detect temperatures outside of this range, the battery will not charge.

Option: Color TFT Display

Multi-Color Display Indicators

- **GREEN:** Parameter labels and adjustments associated with the button directly above or below the label are presented in green.
- **WHITE:** Parameters operating under normal conditions.
- **RED:** Parameters with values exceeding 128% of the device's specifications.
- **YELLOW:** Menu items that are ready to be selected appear in yellow. This color replaces the symbol (>) in selections on monochrome display.



A TFT screen under normal conditions



Press the bottom-central button to turn off the color display backlight, located below the row of three buttons under the screen. The flow meter remains in operation while the backlight is off.

LCD Contrast

LCD contrast is ranged from 0 to 11 on color displays, with 11 indicating the greatest contrast. See [page 22](#).

Specifications for Instruments with Color Displays

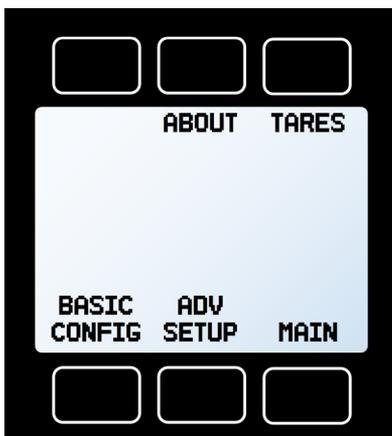
Color displays will require an additional 40 mA when using a 24 Vdc power supply. All other specifications from your device's specification sheet remain in effect.

Navigation & Customization

Main Menu

The Main Menu system is accessed by pressing the **MENU** button from the Main Display ([page 8](#)).

- **ABOUT** ([page 18](#)), **TARES** (see below), **BASIC CONFIG** ([page 19](#)), and **ADV SETUP** ([page 20](#)) enter their respective menus.
- **MAIN** exits to the Main Display ([page 8](#)).



Main menu

Taring Your Flow Meter

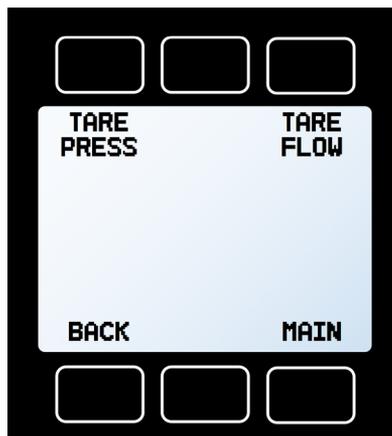
Taring ensures that your liquid flow meter is providing the most accurate measurements possible, by giving it a good zero reference.

How to Tare

1. Ensure that nothing is flowing through the device.
2. **MENU** → **TARE** → **TARE FLOW**. Flow tares should occur at the expected process pressure, as long as there is no flow.
3. **MENU** → **TARE** → **TARE PRESS**. Gauge pressure tares must be done with the meter open to atmosphere.

When to Tare

- Before every new flow measurement cycle
- After significant changes in temperature or pressure
- After dropping or bumping the flow meter
- After installing the meter in a different orientation

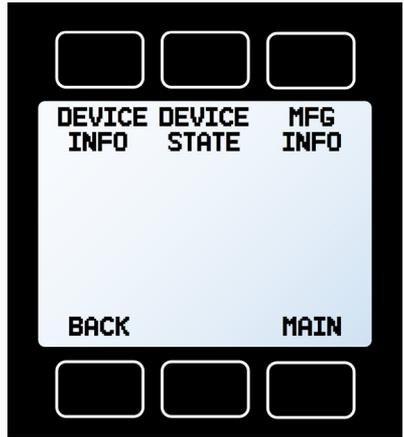


Tares menu

Device Information

Menu → About

- **DEVICE INFO** displays serial number, firmware revision, and calibration information.
- **DEVICE STATE** displays diagnostic information for troubleshooting (see below).
- **MFG INFO** displays contact information.
- **BACK** returns to the main menu ([page 17](#)).
- **MAIN** exits to the Main Display ([page 8](#)).

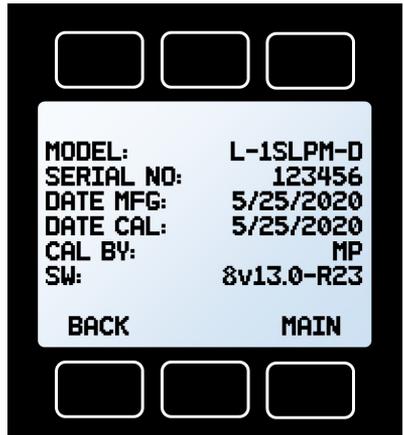


About menu

Menu → About → Device State

Diagnostic Information

The **DEVICE STATE** screen displays live values for the internal device registers. Many of these values can help support engineers diagnose operational issues over the phone. On the **DEVICE STATE** screen, **PAGE** displays the next page of register values.

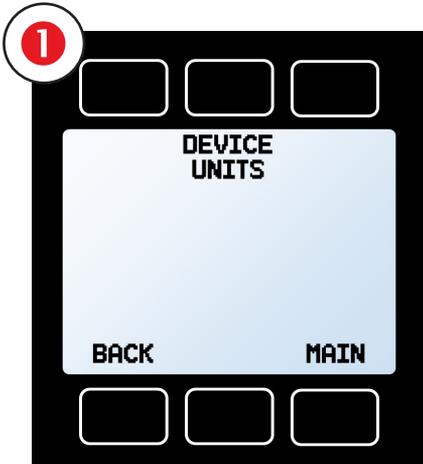


Device information

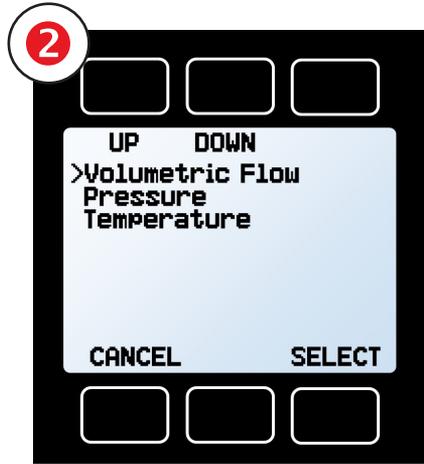
Basic Configuration Menu

Engineering Units

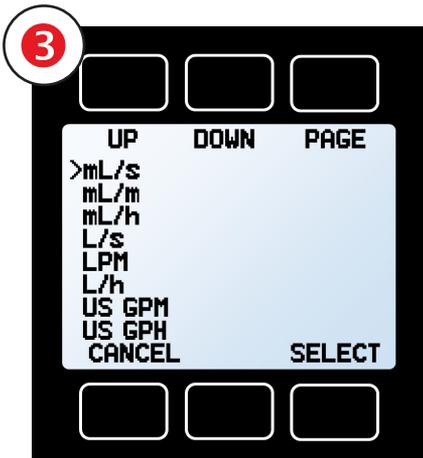
Changing device engineering units alters both the display and the serial data frame. First, choose the parameter whose unit you want to change, then select your desired engineering unit, and lastly confirm the change. If your meter has been configured with a flow totalizer, this screen will also include units for totalized volumetric flow, plus elapsed time.



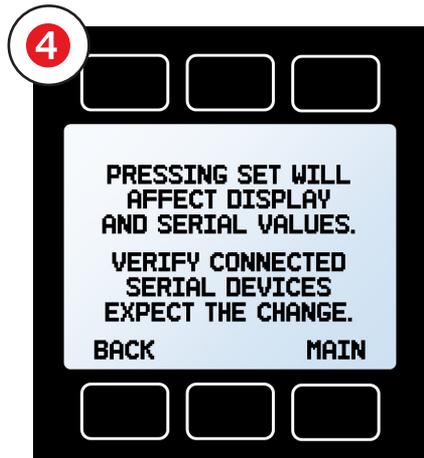
Basic Configuration Menu



Parameters in Device Units Menu



Available flow engineering units



Confirming device engineering units

Advanced Setup

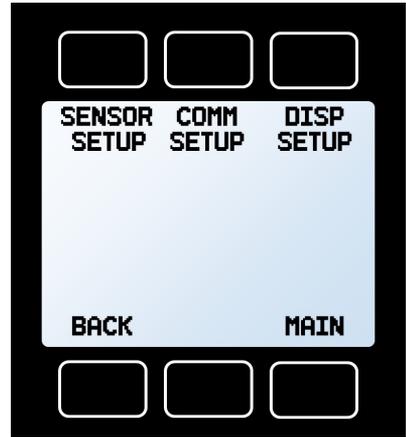
Menu → Advanced Setup

- **SENSOR SETUP** (see below), **COMM SETUP** (page 21), and **DISP SETUP** (page 22) enter their respective menus.
- **BACK** returns to the top-level main menu (page 17).
- **MAIN** exits to the Main Display (page 8).

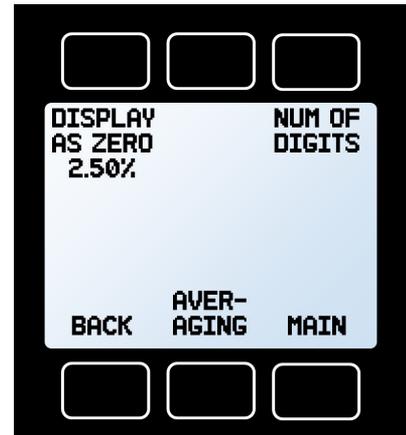
Menu → Advanced Setup

→ Sensor Setup

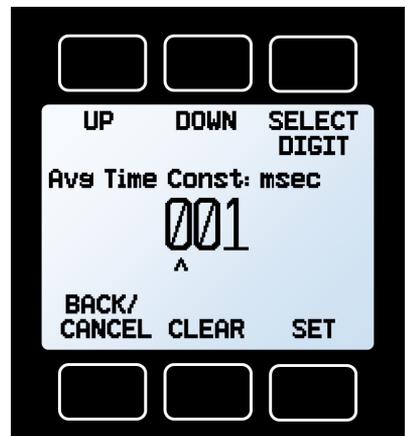
- **DISPLAY AS ZERO** defines a flow rate under which values are displayed as 0. The maximum zero band is 6.38%.
Example: A 10-LPM meter with a 0.25% zero band would display 0 LPM for all readings below 0.025 LPM.
- **NUM OF DIGITS** sets the number of digits of flow readings to display on-screen, and in the serial data frame. Older devices typically had one less significant digit, and newer devices can be set to match.
- **BACK** returns to the advanced setup menu.
- **AVERAGING** adjusts the time constants of the geometric running averages for flow and pressure. These are changed independently via **PRESS AVG** and **FLOW AVG** in the Averaging Menu. Values roughly correspond to the time constant (in ms) of the averaged values. Higher numbers have a greater smoothing effect on fluctuating readings (255 ms max).
- **MAIN** exits to Main Display (page 8).



Parameters in the Basic Configuration



Sensor Configuration Menu



Averaging Configuration Screen

Configuring Serial Communications

Menu → Advanced Setup
→ **Comm Setup**

Unit ID

The unit ID is the identifier that a computer uses to distinguish your flow meter from other 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 24](#)). Unit ID changes take effect when you select SET.

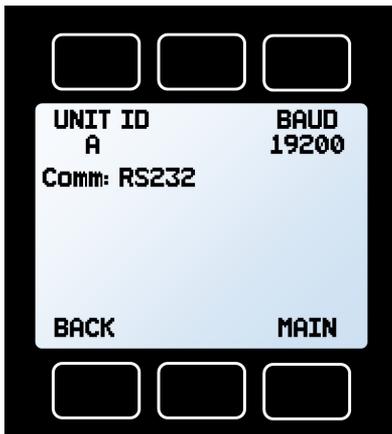
If you select @ as the Unit ID, the flow meter enters streaming mode when you exit the menu ([page 24](#)).



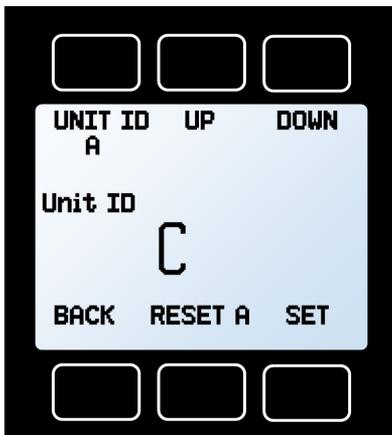
NOTE: Devices equipped with Modbus RTU will also have a Modbus ID that can be set separately from the unit ID.

Baud Rate

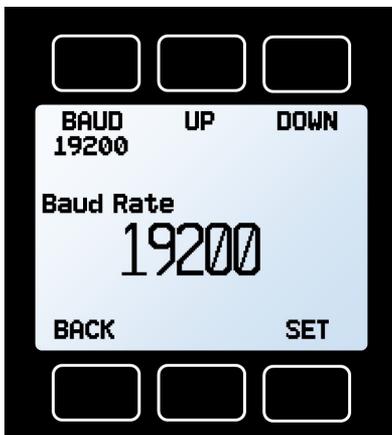
Baud rate is the speed at which digital devices transfer information. The flow meter has a default baud rate of 19200 baud (bits per second). Baud rate changes take effect once you press SET. The computer, device, and software must all have the same baud rate.



Serial Communications Menu



Setting the serial unit ID



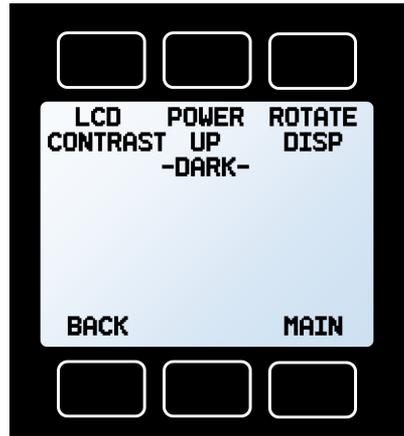
Setting the baud (bits per second) rate

Display Setup

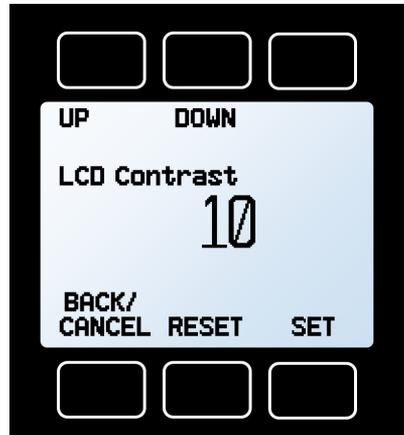
Menu → Advanced
Setup → **Disp Setup**

The options in the Display Setup Menu adjust the contrast of the display and enable screen rotation.

- **LCD CONTRAST** sets the contrast level of the display, ranging from 0–31 on monochrome displays, and 0–11 on color displays. Press reset to revert to the default contrast level.
- **POWER UP -DARK-** or **-LIT-** toggles whether the back light of the unit will be on or off when the device powers on. This is not available on color displays.
- **ROTATE DISP** displays a sub-menu to change the screen orientation, by rotating it 180°.
- **BACK** returns to the Advanced Setup menu ([page 20](#)).
- **MAIN** exits to the Main Display ([page 8](#)).



Display Setup Menu



LCD Contrast Configuration Screen

Serial Communication

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

Establishing Communication

After connecting your flow meter 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. This can be found in Windows® Device Manager.
- If you have used a USB cable to connect your device to your computer, the computer in most cases will recognize your device as a virtual COM port. If it does not, download the appropriate USB device driver at alicat.com/drivers and note the COM port number as found in Windows® Device Manager.

The meter will be configured with the following settings:

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

Serial Terminal Application

Alicat's Serial Terminal is a preconfigured program for serial communications that functions much like the older Windows® HyperTerminal.

Download Serial Terminal for free at 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 flow meter. The default baud rate is 19200, but this is adjustable by entering the **SERIAL COMM** menu on your flow meter: **MENU** → **ADV SETUP** → **COMM SETUP** → **BAUD** (page 21).



Note: In what follows,  indicates an ASCII carriage return (decimal 13, hexadecimal D). Serial commands are not case-sensitive.

Polling Mode

Meters are shipped in polling mode with a unit ID of A, unless requested otherwise. Each poll returns one line of data. To poll, simply 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)

The front panel menu can also be used to change the unit ID: **MENU** → **ADV SETUP** → **COMM SETUP** → **UNIT ID** (page 21). Valid IDs are letters A–Z. Up to 26 devices may be connected at a time, as long as each unit ID is unique.

Streaming Mode

In streaming mode, your device continuously and automatically sends a line of live data at regular intervals. Only one unit on a COM port may be in streaming mode at a time.



Note: Streaming mode cannot be used with the Serial Terminal application. It is compatible with many terminal programs such as PuTTY or HyperTerminal®.

To put your flow meter into streaming mode, type:

Begin streaming: `[unit ID]@=@`

Example: `A@=@` (Begins streaming unit A)

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

Stop streaming: `@@=[desired unit ID]`

Example: `@@=a` (stops and assigns unit ID of A)

When sending a command 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. If in doubt, simply hit  and start again.

The default streaming interval is 50 ms, but this can be increased by changing Register 91 while the device is in polling mode:

Set streaming interval: `[unit ID]w91=[time in milliseconds]`

Example: `aw91=500` (streams new data every 500 ms)

Taring

Taring flow sets the zero flow reading and must be done when no flow is passing through the flow meter:

Tare flow: `[unit ID]v`

Example: `av` (sets flow reading to zero)

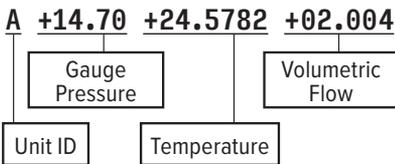
Taring pressure aligns the internal gauge pressure sensor with the current barometric pressure, and must be done with the flow meter open to atmosphere:

Tare gauge pressure: `[unit ID]p`

Example: `ap`

Collecting Flow Data

Collect live flow data by typing the `[unit ID]` command or by setting your flow meter to streaming. Each line of data for live flow measurements appears in the format below, but Unit ID is not present in streaming mode.



Single spaces separate each parameter, and each value is displayed in the chosen device engineering units, which may differ from the engineering units visible on the flow meter display (see [page 13](#)). 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 messages ([page 8](#)), may be present after the volumetric flow begins.

Quick Command Guide



Note: *Serial commands are not case-sensitive.*

In these examples, the unit ID of the flow meter is a.

Change unit ID: [current unit ID]@[desired unit ID]↵

Tare flow: av↵

Tare pressure: apc↵ (optional)

Poll the live data frame: a↵

Begin streaming data: [unit ID]@=@↵

Stop streaming data: @@=[desired unit ID]↵

Set streaming interval: aw91=[number of milliseconds]↵

Query live data info: a??d*↵

Manufacturer info: a??m*↵

Firmware version: a??m9↵

Lock the front display: al↵

Unlock front display: au↵

Additional information can be found on our online Serial Primer document, at:

Alicat.com/drivers

If you have need of more advanced serial communication commands, please contact support ([page 2](#)).

Troubleshooting

If you run into trouble with your device's installation or operation, please get in touch with us by phone, chat, or email (see [page 2](#)). You'll also find help on our website alicat.com and in the pages that follow.

General Use

Issue: My meter does not turn on or has trouble staying on.

Action: Check power and ground connections. Please reference the technical specifications to assure you have the proper power for your model.

Portable flow meters run on a rechargeable battery, but you can also connect to a wall outlet or computer using a micro-USB cable. If the battery has been fully depleted, it may take a minute or so to acquire enough charge to turn back on. If your flow meter will not power on after being plugged in for at least 5 minutes, contact support ([page 2](#)).

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

Action: The flow meter buttons were locked out via a serial command. 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 (**MENU** → **ADV SETUP** → **DISP SETUP** → **LCD CONTRAST**). If you are working under low-light conditions, push the logo button located below the display to turn on the backlight (see [page 8](#)).

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 liquid meter?

Action: Annual recalibrations are recommended. Check your flow meter's last calibration date by selecting **MENU** → **ABOUT** → **DEVICE INFO**. If it is time to recalibrate, request a recalibration at alicat.com/service or get in touch with support (see [page 2](#)).

Issue: I dropped my meter. 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, 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 temperature, pressure, or flow in different units?

Action: From the main menu, select **BASIC CONFIG** → **DEVICE UNITS**. From this menu, you can adjust temperature, pressure, or flow units. For more information, see [page 13](#).

Flow Readings

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

Action: The flow meter is very fast, so it can detect subtle variations in flow that may go unnoticed by your other flow devices. This sensitivity can help detect problems with pumps or flow controllers. You can lessen this sensitivity by increasing the flow averaging press **MENU** → **ADV SETUP** → **SENSOR SETUP** → **FLOW AVG**. See [page 20](#). This may also be the result of air bubbles, which can be fixed by using the bleed ports (see [page 10](#)),.

Issue: My flow readings are negative.

Action: Under conditions of no flow, a negative flow reading can indicate a poor tare. Ensure that the flow meter has no flow passing through it, and select **TARE FLOW** from the Main Display to give it a fresh tare ([page 17](#)).

Issue: My flow readings jump to 0 when flow rates are low.

Action: Your flow instrument is equipped with a programmable zero band that is preset at the factory. Reduce your deadband threshold by selecting **MENU** → **ADV SETUP** → **SENSOR SETUP** → **DISPLAY AS ZERO**. Note: The zero band threshold has no effect upon the serial data.

Issue: Does the meter work if it is laying down? Will it be accurate?

Action: Yes, but it should be tared after changing their orientation. See [page 17](#) for more on how to tare your device.

Issue: Can I put the meter on top of a vibrating device? Will it be accurate?

Action: Yes, and yes! The flow meter is internally compensated for any changes in orientation, including rapid vibrations. Noise will increase if the flow meter is vibrating.

Issue: My meter does not agree with another meter I have in line.

Action: Liquid flow meters can normally be compared against one another provided there are no leaks between the two meters. One common cause of inaccuracy, inconsistency, or unusual readings is air bubbles trapped in one or both of the legs of the differential pressure sensor. Bleed the ports (see [page 10](#)) to remove this possibility. Another possibility is that the liquid has some contaminant or additive, such as antifreeze, that affects the viscosity of the liquid. A third possibility is an improper tare error (see [page 17](#)).

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

Action: If your flow readings won't change regardless of actual flow, check that the tare pin hasn't been accidentally grounded ([page 12](#)). If not, your flow sensor may be damaged. Please contact support ([page 2](#)) to troubleshoot.

Serial Communications

Issue: I can't communicate to the meter when it is connected to my computer.

Action:

1. Make sure the baud rate and other serial settings such as the COM port number is the same one your meter is using (see [page 21](#)).
2. Check the flow meter unit ID (also [page 23](#)).
3. Check the pinout (see [page 33](#) or alicat.com/pinouts).
4. Make sure the COM number matches the one your software is using to connect to the flow meter ([page 23](#)).

Still experiencing issues?

Issue: None of the above helped.

Action: See [page 2](#) for contact information, or visit alicat.com/support.

Maintenance

Cleaning

This device requires minimal maintenance. If necessary, the outside of the device can be cleaned with a soft dry cloth. Avoid excess moisture or solvents.

The primary cause of damage and/or long-term inaccuracy in these devices is contamination and/or corrosion damage. Liquid should be filtered for particulates or biological materials that may grow in the device. When removing these units from the line for any extended period of time, make an effort to remove all of the liquid from the device, as deposits of calcium or other soluble minerals can affect the accuracy of the device.



If you suspect that debris or other foreign material has entered your device, do not take apart the flow body to clean it, as this will negate its NIST-traceable calibration. Please contact us for cleaning.

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 meter and is visible by selecting **MENU → ABOUT → DEVICE INFO**.

When it is time for your flow meter's annual recalibration, contact us (see [page 2](#)) with your serial number.

Replacement Accessories

Accessories are available through support (see [page 2](#)), or visiting our website at alicat.com/accessories.

For repair, recalibration, or recycling of this product contact us ([see page 2](#)).

Technical Specifications and Dimensional Drawings

Please visit alicat.com/specs to find complete operating specifications and dimensional drawings.

Engineering Units

Flow Units

Label	Notes
$\mu\text{L}/\text{m}$	microliter per minute*
mL/s	milliliter per second
mL/m	milliliter per minute
mL/h	milliliter per hour
L/s	liter per second
LPM	liter per minute
L/h	liter per hour
US GPM	US gallon per minute
US GPH	US gallon per hour
CCS	cubic centimeter per second
CCM	cubic centimeter per minute
cm^3/h	cubic centimeter per hour*
m^3/m	cubic meter per minute*
m^3/h	cubic meter per hour*
m^3/d	cubic meter per day*
in^3/m	cubic inch per minute*
CFM	cubic foot per minute
CFH	cubic foot per hour
CFD	cubic foot per day
count	setpoint count, 0–64000
%	percent of full scale

Totalizer Units

Label	Notes
μL	microliter
mL	milliliter
L	liter
US GAL	US gallon
cm^3	cubic centimeter*
m^3	cubic meter*
in^3	cubic inch*
ft^3	cubic foot*
μP	micropoise, a measure of viscosity*

True Mass 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
$\text{h}:\text{m}:\text{s}$	hours:minutes:seconds
ms	milliseconds
s	seconds
m	minutes
hour	hours
day	days

Temperature Units

Label	Notes
$^{\circ}\text{C}$	degrees Celsius
$^{\circ}\text{F}$	degrees Fahrenheit
K	Kelvin
$^{\circ}\text{R}$	degrees Rankine

Pressure Units

Label	Notes
PaG	pascal
hPaG	hectopascal
kPaG	kilopascal
MPaG	megapascal
mbarG	millibar
barG	bar
g/cm ² G	gram force per square centimeter [*]
kg/cm ² G	kilogram force per square centimeter [†]
PSIG	pound force per square inch
PSFG	pound force per square foot
mTorrG	millitorr
torrG	torr
mmHgG	millimeter of mercury at 0°C
inHgG	inch of mercury at 0°C
mmH ₂ O _G	millimeter of water at 4°C (NIST conventional) [*]
mmH ₂ O _G	millimeter of water at 60°C [*]
cmH ₂ O _G	centimeter of water at 4°C (NIST conventional) [*]
cmH ₂ O _G	centimeter of water at 60°C [*]
inH ₂ O _G	inch of water at 4°C (NIST conventional) [*]
inH ₂ O _G	inch of water at 60°C [*]
atm	atmosphere
count	setpoint count, 0–64000
%	percent of full scale

[†] Displayed as kg/cmG

^{*} Instances of μ are displayed as a lower-case u; superscript and subscript numerals are displayed as lining (normal) numerals.



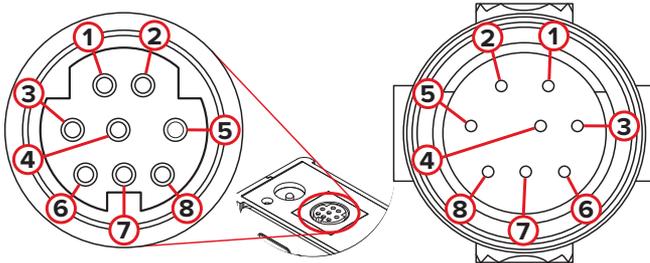
Note: Not all units are available on all devices

Pinouts

Check the calibration data sheet and pinout for your device. Individual pinouts available at alicat.com/pinout.

See [page 11](#) for additional important information about connecting your device to a computer for serial commands.

8-Pin Mini-DIN (Default)



Female Connector: Device

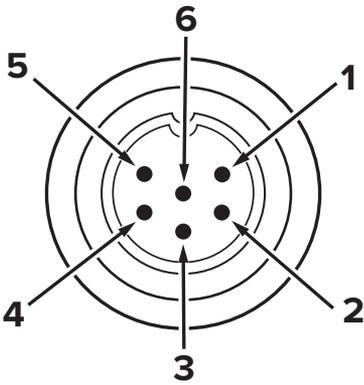
Male Connector: Cable

Pin	Cable Color	Function
1	Black	Not connected <i>Optional: 4–20 mA primary output signal</i>
2	Brown	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	Red	Serial RS-232RX input signal <i>Optional: RS-485 A</i>
4	Orange	Remote tare (ground to tare)
5	Yellow	Serial RS-232TX output signal <i>Optional: RS-485 B</i>
6	Green	0–5 Vdc <i>Optional: 1–5 Vdc or 0–10 Vdc output signal</i>
7	Blue	Power in (as described above)
8	Purple	Ground (common for power, digital communications, analog signals, and alarms)

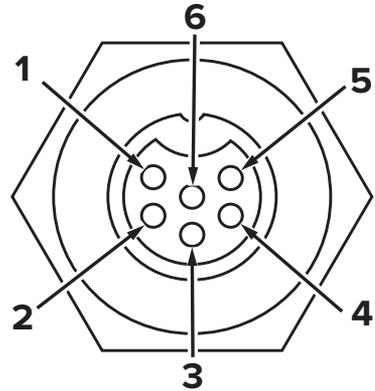


Caution: Do not connect power to pins 1 through 6, as permanent damage can occur. It is common to mistake Pin 2 (labeled 5.12 Vdc Output) as the standard 0–5 Vdc analog output signal. Pin 2 is normally a constant 5.12 Vdc that reflects the system bus voltage.

Locking Industrial Connector Pinout



Male Connector: Cable



Female Connector: Device

Pin	Function
-----	----------

1	Power In (+)
---	--------------

2	RS-232TX / RS-485 B
---	---------------------

3	RS-232RX / RS-485 A
---	---------------------

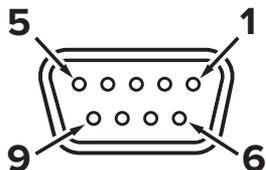
4	Remote Tare (ground to tare)
---	------------------------------

5	Ground (common for power, communications, and signals)
---	--

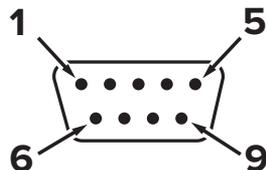
6	Signal Out (Voltage or Current as ordered)
---	--

The availability of different output signals depend on the options ordered.

9-pin D-Sub Connector Pinouts



Female Connector



Male Connector

Common 9-pin D-Sub Pinouts

Pin	DB9 (Female) DB9M (Male)	DB9A / DB9K	DB9R	DB9T	DB9U
1	Current Out	NC	TX or B	TX or B	RX or A
2	Analog Out 2	Analog Out	Analog Out	Analog Out	Analog Out
3	RX or A	Power In	Analog In	Power In	Power In
4	Analog In	Ground	Ground	Ground	Ground
5	TX or B	TX or B	NC	NC	NC
6	Analog Out	Analog In	RX or A	Analog In	Analog In
7	Power In	Ground	Power In	Ground	Ground
8	Ground	Ground	Ground	Ground	Ground
9	Ground	RX or A	Ground	RX or A	TX or B

Pin	DB9B	DB9G	DB9H	DB9I	DB9N
1	Analog Out 2	RX or A	TX or B	NC	Power In
2	Analog Out	Analog Out	Analog Out	Analog Out	Analog In
3	Power In	Ground	Analog In	Power In	Analog Out
4	Ground	Power In	RX or A	Ground	NC
5	Ground	Ground	Analog Out 2	NC	Ground
6	Analog In	TX or B	NC	Analog In	Ground
7	Ground	Analog In	Power In	Ground	RX or A
8	TX or B	Current Out	Ground	RX or A	TX or B
9	RX or A	Ground	Ground	TX or B	NC5

Key of Terms:

Current Out

Not Connected

Analog In

Remote tare function for meters

Analog Out

0–5 Vdc Output Signal
(1–5, 0–10 Vdc optional)

Analog Out 2

5.12 Vdc or Optional
Secondary Analog Output

TX or B

Serial RS-232TX or RS-485 B

RX or A

Serial RS-232RX or RS-485 A

NC Not Connected

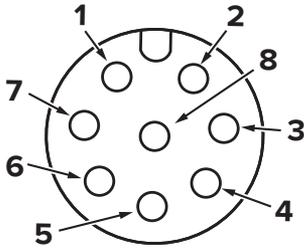
Power In (+Vdc)

Ground

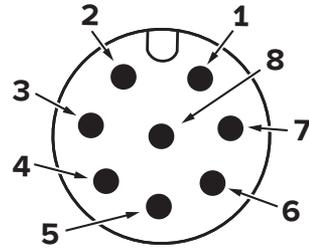
Common for power,
digital communications,
analog signals, alarms

M12 Connector Pinouts

If your device ordered with an M12 connection, please be sure to reference the following pin-out diagram.



Female Connector: Cable



Male Connector: Device

Common M12 Pinouts

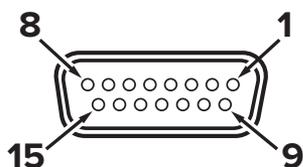
Pin	M12	M12MD
1	0–5 Vdc output signal <i>Optional: 1–5 or 0–10 Vdc</i>	Not connected <i>Optional: 4–20 mA primary output signal</i>
2	Power in	Static 5.12 Vdc <i>Optional: Secondary analog output (4–20 mA, 0–5 Vdc, 1–5 Vdc, 0–10 Vdc) or basic alarm</i>
3	Serial RS-232 RX signal <i>Optional: RS-485 A</i>	Serial RS-232 RX signal <i>Optional: RS-485 A</i>
4	Remote tare (ground to tare)	Remote tare (ground to tare)
5	Serial RS-232 TX signal <i>Optional: RS-485 B</i>	Serial RS-232 TX signal <i>Optional: RS-485 B</i>
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 Optionally 4–20 mA primary output signal	Ground (common for power, digital communications, analog signals, and alarms)



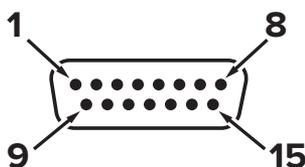
Due to variance in cable manufacturing, please identify proper wiring/pins via continuity check & color when using blunt cut multi-strand cables.

15-pin D-Sub Connector Pinouts

If your instrument was ordered with a DB15 connection, be sure to check the calibration label on the device or the calibration data sheet and reference the appropriate pinout diagram.



Female Connector: Cable



Male Connector: Device

Common 15-pin D-Sub Pinouts

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	NC	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



Due to variance in cable manufacturing, please identify proper wiring/pins via continuity check & color when using blunt cut multi-strand cables.

Key of Terms:

Current Out

Not Connected

Analog In

Remote tare function for meters

Analog Out

0–5 Vdc Output Signal
(1–5, 0–10 Vdc optional)

Analog Out 2

5.12 Vdc or Optional
Secondary Analog Output

TX or B

Serial RS-232TX or RS-485 B

RX or A

Serial RS-232RX or RS-485 A

NC Not Connected

Power In (+Vdc)

Ground

Common for power, digital communications, analog signals, and alarms

Additional Information for CSA and ATEX Approved Devices



Ex ec IIC T4 Gc
Sira 19ATEX4045X
Class I, Division 2, Group A, B, C and D, T4
24 Vdc, 0.800A maximum • Tamb -40°C to +60°C

Ex ec IIC T4 Gc
Class 1, Zone 2 AEx ec IIC T4 Gc
CSA 08CA2009485X

CSA and ATEX approved devices are equipped with a 6-pin locking industrial connector, but may be ordered with a different locking connector. Please see the pinouts (starting [page 33](#)) for your device's power and signal connections.

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

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

ATEX certification is indicated by the product label, and not by the statements in this, or any accompanying documentation. To comply with CSA and ATEX certification, devices have special required conditions to stay in compliance:

- When equipment is properly labeled, it is suitable in Class I, Division 2, Group A, B, C, and D, T4.
- Equipment is only certified for use in ambient temperatures from -40°C to +60°C.
- Electrical Rating 24 Vdc, 0.800A max.
- Instruments shall be powered by a CSA certified, UL listed, Class II external power supply suitable for the application.
- Instruments shall be housed in an enclosure with a minimum IP54 rating or location providing equivalent protection.
- Instrument's final approval shall be provided by the local authority having jurisdiction.

WARNINGS:



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

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

Limited Lifetime Warranty

Notice: Alicat Scientific, Inc. reserves the right to make any changes and improvements to the products described in this manual at any time and without notice. This manual is copyrighted. This document may not, in whole or in part, be copied, reproduced, translated, or converted to any electronic medium or machine readable form, for commercial purposes, without prior written consent from the copyright holder.

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.

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.

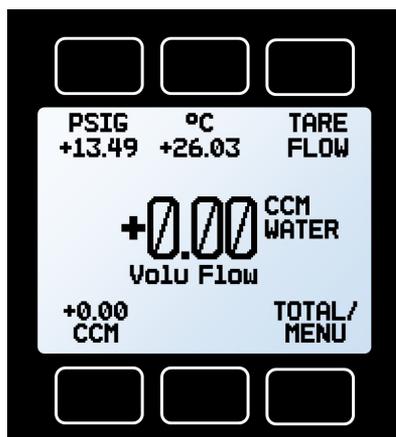
Accessories purchased from Alicat are not covered by this warranty.

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.

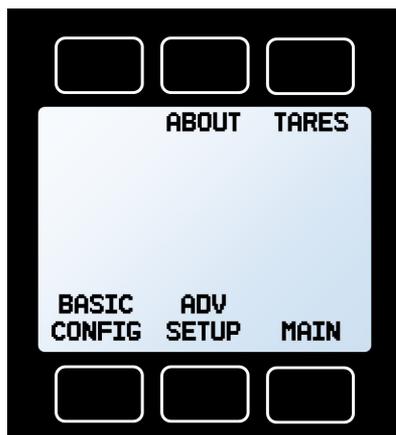
Main Menu

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Main Display



Main Menu

