ALICAT
SCIENTIFIC

A **Halma** company

OPERATING MANUAL
for LIQUID FLOW CONTROLLERS

Models LC · LCR · LCS · LCRS

Thank you for purchasing your liquid controller.

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Recalibrate your flow controller 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: _____

NIST This device comes with a NIST traceable calibration certificate.

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

CE 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

Rev. 0 • LIQUID FLOW CONTROLLER operating manual

Introduction

Your new flow controller 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 20**).
- **Log data to your PC**. Talk to the flow controller over a serial data connection to capture all flow data, for logging and analysis purposes (see **page 30**).

This manual covers the following instruments:

- Liquid flow controllers
- Flow controllers for aggressive liquids
- Devices labeled as approved for CSA Class 1 Div 2 and ATEX Class 1 Zone 2 hazardous environments. See **page 47** for special conditions regarding the use of CSA/ATEX labeled devices.

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 (previous page) 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.**

Contents

Getting Started
Getting to Know Your Liquid Flow Controller

Connectors and Buttons

The drawings below represent a typical configuration of a liquid flow controller. **Your device's appearance and connections may differ.**

DC In

I/O Port (shape varies)

Display

PSIG   °C   SETPT
+0.00   +22.73   +0.00

+0.00 CCM Water

Volu Flow

+0.00
CCM   MENU

Controls

Valve

Light Switch

Bleed Ports

Flow Body

Process Connections

Mounting Holes
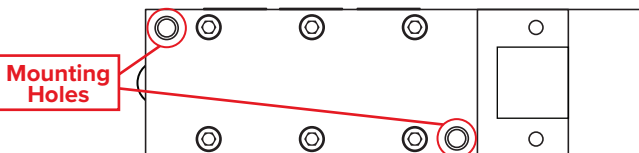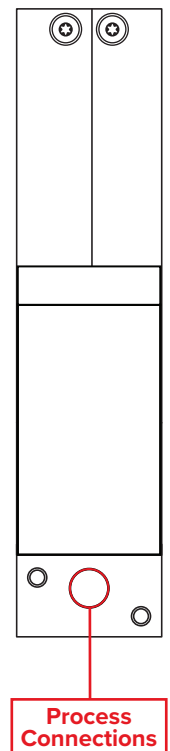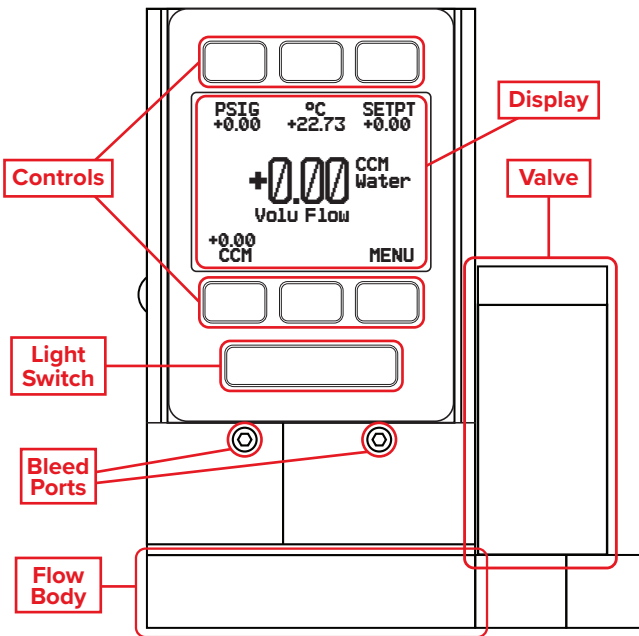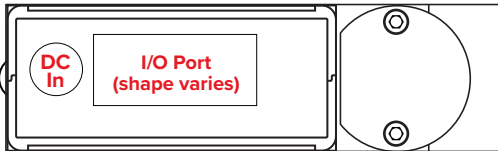
The Flow Controller Display

The figure below identifies the various features of the main flow controller 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 controller in its serial communications and calculations. These can be different from **button units**, which are the units being displayed. These are individually configurable (see **page 12**).

**①** Highlights **pressure** in the center of the controller. Push a second time to choose the pressure parameter (if available), or to select pressure engineering units (**page 12**).

② Highlights **temperature**. Push a second time to select temperature engineering units (**page 12**).

③ **SETPT** sets the **flow or pressure control setpoint** (see **page 21**).

④ Highlights **volumetric flow** rate. Push a second time to select volumetric flow rate engineering units (**page 12**).

Main Display

⑥ **TOTAL/MENU** accesses the optional **flow totalizer** (**page 13**). **MENU** enters the **menu system** (**page 17**).

⑦ Toggles the backlight. See more display options on **page 20**.
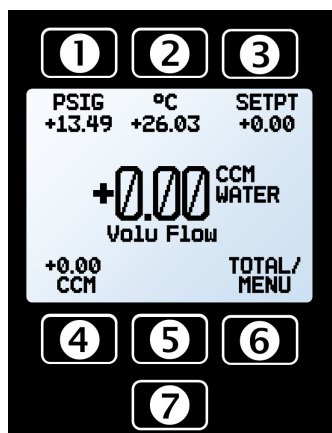
Status Messages

ADC	Analog-digital converter error	**POV**	Pressure over range of device
EXH	Exhaust mode active	**TMF**	Totalizer missed out of range flow
HLD	Valve hold active	**TOV**	Temperature over range of device
LCK	Front display is locked	**VOV**	Volumetric flow over range of device
OVR	Totalizer rolled over to zero		

Mounting

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

If air bubbles are continuously introduced to the flow upstream of the device, the device may be mounted upside down to prevent bubbles from being trapped in the 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!

Caution: *Flow controllers that use large Rolamite valves should be mounted with their valve oriented vertically (right-side up). If another orientation is desired, please contact support.*

Process Ports

Your flow controller 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 controllers have female inlet and outlet ports. Welded VCR® and other specialty fittings may have male connections.

- If you are using a fitting without a face seal, use thread-sealing 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 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 controller 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 controller. 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.

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

Bleed Ports

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

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

Bleed both of the ports as follows:

1. With the controller installed, and a >50% setpoint given, 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**, as it has pressure behind it, is very small, is easy to lose, and is delicate to rethread.

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.*

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 controller through either the power jack or the multi-pin connector on top of your device.

✓ *Controller power jacks require a 9–24 Vdc power supply with a 2.1 mm female positive center plug capable of supplying at least 250 mA, with an additional 40 mA for a color display. 4–20 mA analog outputs require at least 12 Vdc and 290 mA, and 0–10 Vdc outputs require at least 12 Vdc.*

✓ *Large valve controllers (LCR models) require a 24 Vdc power supply with a 2.1 mm female positive center plug capable of supplying at least 1 A.*

Standard 8-Pin Mini-DIN Pinout
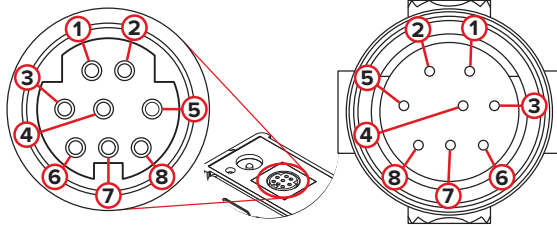
Female Connector: Device   Male Connector: Cable

For 6-pin locking industrial connector, M12, DB9, and DB15 pinouts, see or visit alicat.com/pinouts.

| Pin	Cable Color	Function
1	Black	Not connected *Optional: 4–20 mA primary output signal*
2	Brown	Static 5.12 Vdc *Optional: Secondary analog output (4–20 mA, 0–5 Vdc, 1–5 Vdc, 0–10 Vdc) or basic alarm*
3	Red	Serial RS-232RX input signal *Optional: RS-485 A*
4	Orange	Analog setpoint input
5	Yellow	Serial RS-232TX output signal *Optional: RS-485 B*
6	Green	0–5 Vdc *Optional: 1–5 Vdc or 0–10 Vdc) output signal*
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. Permanent damage can occur. Pin 2 (5.12 Vdc Output) is often mistaken for the standard 0–5 Vdc analog output signal. Pin 2 is normally a constant 5.12 Vdc that reflects 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 for details on serial communication and 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
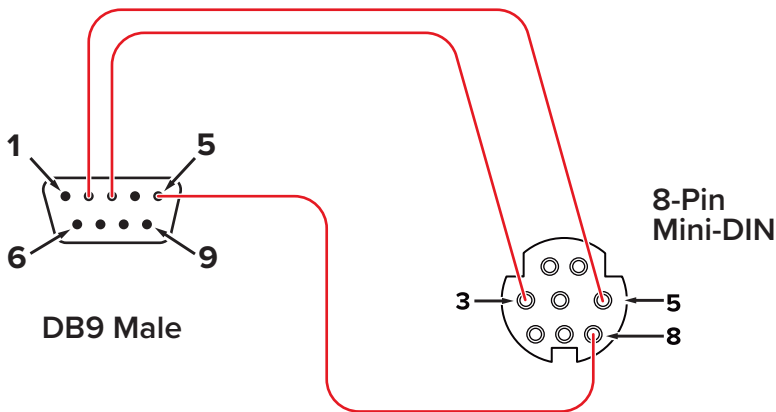
Analog Signals

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

Engineering Units

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

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

Device engineering units are the units of measurement used for calculation and sent through a serial data connection. **Optionally, these may be different from the displayed button engineering units**.
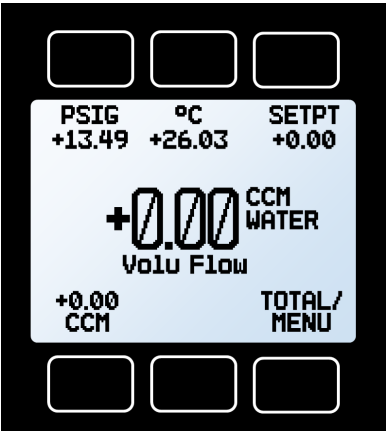
Main Display

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), the menu will offer to change button engineering units or device engineering units. Device engineering units can also be set in the Basic Configuration Menu ().

If device and button engineering units differ (below right), the menu will offer to change button engineering units (**Set button eng units**), or to match button units to device engineering units (**Show device units**).
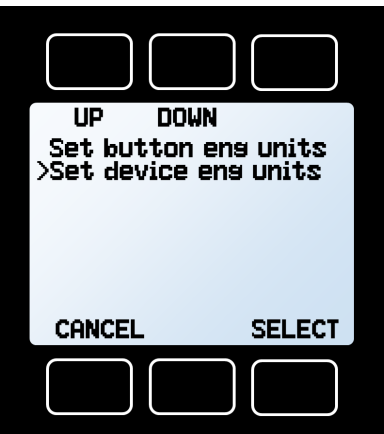
This will show if the front display units (button engineering units) are the same as serial data (device engineering units).
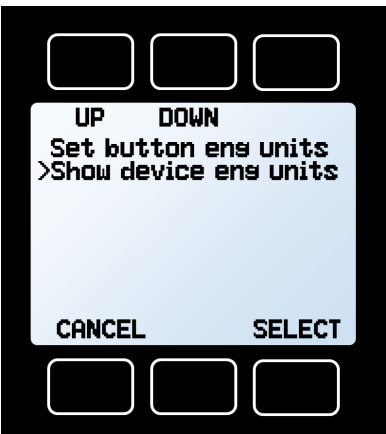
This will show if the front display units (button engineering units) are the same as serial data (device engineering units).

Option: Collecting Totalized Flow Data

Controllers with a flow totalizer display the total 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 **SETPT** displays current setpoint. Press to set a new setpoint or to clear the setpoint.

③ Displays live flow rate. Press to select engineering units.

④ **BATCH** sets up flow batches (page 14), shows a remaining batch amount, **–DONE–**, or **–NONE–**.

⑤ **RESET** clears all totalized data and immediately resets the timer to zero while totalization continues.

⑥ **TOTAL/MENU** enters the menu system (page 17). Then, press **MAIN** to exit to the Main Display.

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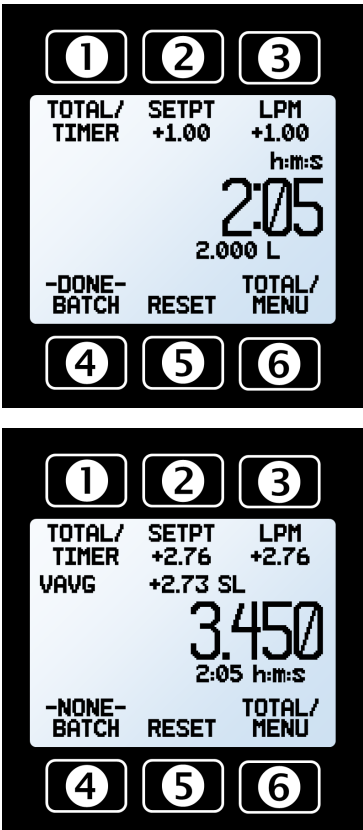
Totalizer showing time (top) and total flow (bottom)

Totalizer Rollover Functions

The totalizer will report up to 7 digits.

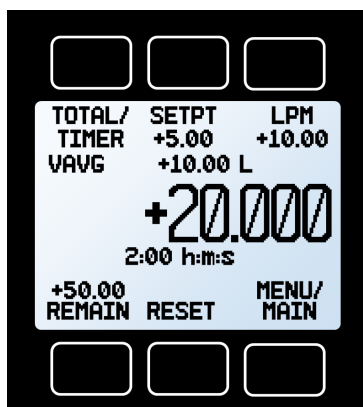| **Rollover (default):**	**Freeze:**	**Error (default):** Displays
Totalizer resumes counting from zero as soon as the maximum count has been reached.	Totalizer stops counting at max count, until it is reset manually.	**OVR** when maximum count has been reached; compatible with Rollover and Freeze.

The maximum elapsed time is 9999:59:59 (h:m:s) (416⅓ days). At that point, the timer freezes, regardless of rollover settings.

Dispensing Liquid in Batches

Batch dispensing allows you to choose a desired total volume to flow, after which the valve closes. You can repeat batches with a single button press.

Totalizer – Batch Mode

- **TOTAL/TIMER** opens the totalizer?

- **SETPT** displays the current setpoint. Batch dispensing can begin only when there is a non-zero setpoint.

- **LPM +10.00** is the instantaneous (non-averaged) flow rate, in this example 10 LPM.

Totalizer showing a running batch, with 11.25 SL yet to be dispensed.

- **REMAIN** shows quantity remaining in the batch. Press to select a new quantity. Flow stops when the batch completes. **–DONE– BATCH** appears when the batch is done, or **–NONE– BATCH** appears or no batch is set. Press to select a new batch quantity.

- **RESET** clears all totalized data, resets the timer, and begins the next batch immediately.

- Menu/Main returns to the Main Display ().

How to start batch dispensing

1. From the totalizer screen, press **BATCH**. Choose the amount to be dispensed in each batch. Press **SET** to accept the new batch size.

2. From the totalizer screen, press **SETPT** to choose a non-zero setpoint. Flow begins as soon as you press **SET**.

3. While a new batch is being dispensed, the **BATCH** button changes to show the quantity that remains to be dispensed. When the batch size has been achieved, the **BATCH** button displays **–DONE–** and flow stops automatically.

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

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

How to repeat a batch

- For a new batch of identical size, simply press **RESET**. Flow begins immediately.

- For a new batch of a different size, press **BATCH**, and then select the new batch size. Flow begins as soon as you press **SET**.

How to cancel a batch

- To pause a batch in progress, set the flow setpoint to zero by pressing **SETPT** → **CLEAR** → **SET**. Resume with a non-zero set point.

To remove a batch setting, press **TOTAL/MENU** → **BATCH** → **CLEAR** → **SET** to set a batch size of zero. Deleting the batch has no effect on the flow setpoint, so the controller will continue to allow flow at the setpoint's rate.

Caution: *If your controller has a non-zero setpoint when batch dispensing is turned off, flow will resume immediately at the current setpoint.*

Note: *The batch size is retained across power cycles of your flow controller. It must be manually cleared when no longer desired.*

When batch mode is off, **–NONE–** appears above the **BATCH** button.

Ensuring Measurable Flow While Controlling Pressure

Making an abrupt change while using a flow controller in pressure control mode may cause the flow rate to exceed the maximum measurable flow (128% of full scale). In this case, the totalized flow value will flash, and the controller will report a **TMF** message to indicate that the totalizer missed flow data. Reset the totalizer to clear the incomplete data.

Setting an upper flow limit (page 24) within the readable range will avoid this error; however, the device may not control to the given pressure setpoint to avoid exceeding the flow limit.

In certain situations, it is possible to exceed the desired batch size. For example, if the feed pressure is too low to achieve the flow setpoint and then pressure is suddenly increased, the batch size may be exceeded before the valve reacts to the sudden burst of pressure.
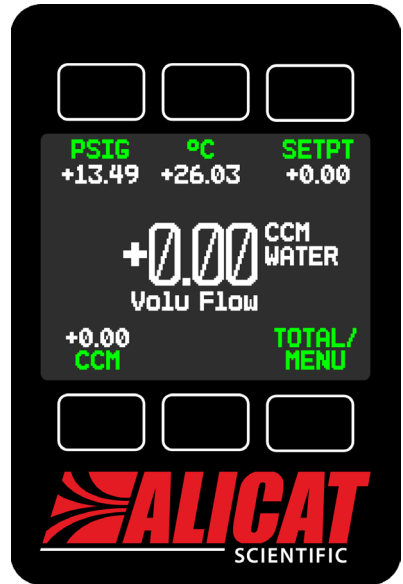
Option: Color TFT Display

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.

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

A TFT screen under normal conditions

LCD Contrast

LCD contrast is ranged from 0 to 11 on color displays, with 11 indicating the greatest contrast. See for additonal information about display options.

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.
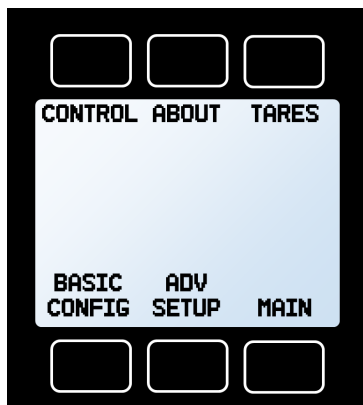
Navigation & Customization

Main Menu

The Main Menu system is accessed by pressing the **MENU** button from the Main Display ().

- **CONTROL** () **ABOUT** (), **TARES** (see below), **BASIC CONFIG** (), and **ADV SETUP** () enter their menus.
- **MAIN** exits to the Main Display ().

Taring Your Flow Controller

Taring ensures accurate measurements by giving the device a zero reference.

When auto-tare is **-ON-**, your flow controller automatically tares its flow rate whenever it has a zero setpoint for a short time, at least two seconds.

How to Manually 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 controller open to atmosphere.
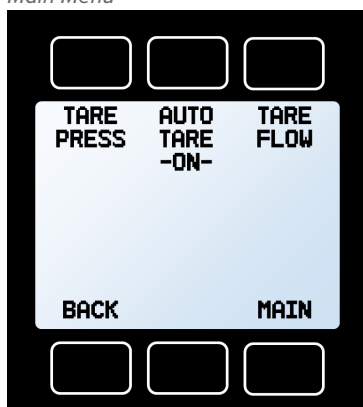
When to Tare

- After significant changes in temperature or pressure
- After dropping or bumping the flow controller
- After installing the controller in a different orientation

Main Menu

Tares Menu

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 controller has been configured with a flow totalizer, this screen will also include units for totalized volumetric flow, and elapsed time.
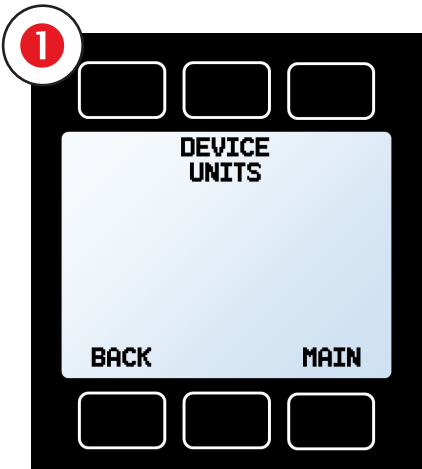
Basic Configuration Menu
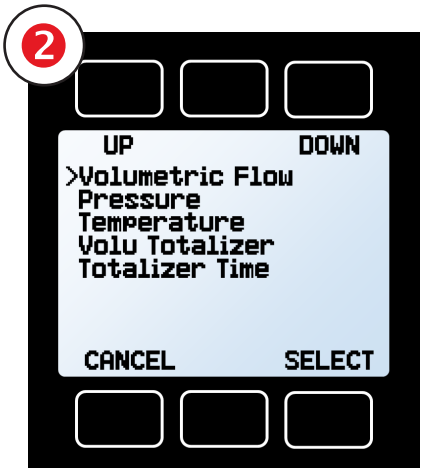
Parameters in Device Units Menu
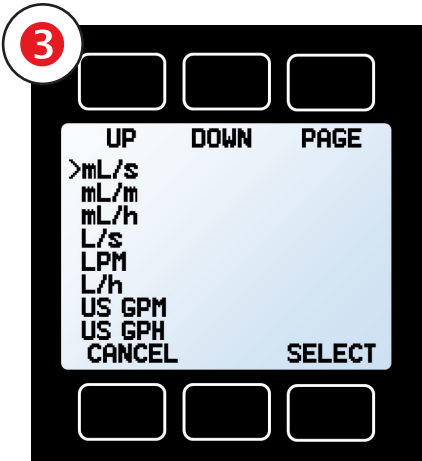
Available flow engineering units
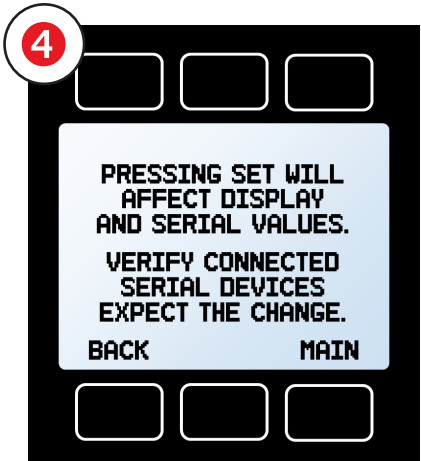
Confirming device engineering units

Navigation and Customization

Advanced Setup

Menu → **Advanced Setup**

- **SENSOR SETUP** (see below), **COMM SETUP** (**page 30**), and **DISP SETUP** (**page 20**) enter their respective menus.

- **BACK** returns to the top-level Main Menu (**page 17**).

- **MAIN** exits to the Main Display (**page 7**).

Menu → Advanced Setup → **Sensor Setup**

- **DISPLAY AS ZERO** defines a flow rate under which values are displayed as zero. The maximum zero band is 6.38%. **Example:** A 10-lpm controller 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 (above).

- **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 7**).
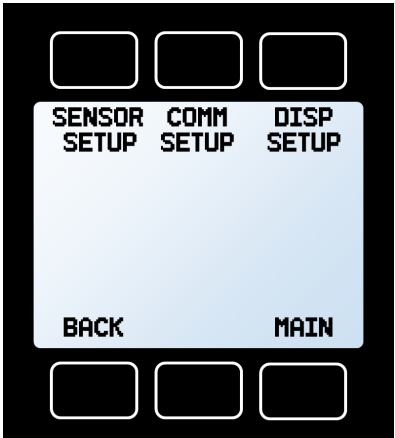
Parameters in the Advanced Config.
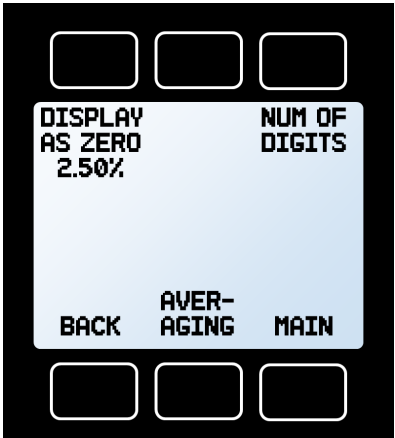
Sensor Configuration Menu
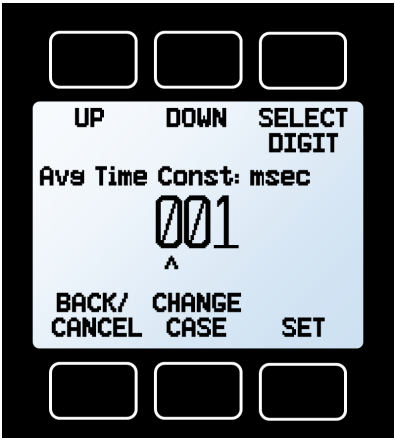
Averaging Configuration Screen

Display Setup

Menu ➜ Advanced Setup ➜ Disp Setup

- **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 (previous page).

- **MAIN** exits to the Main Display ().
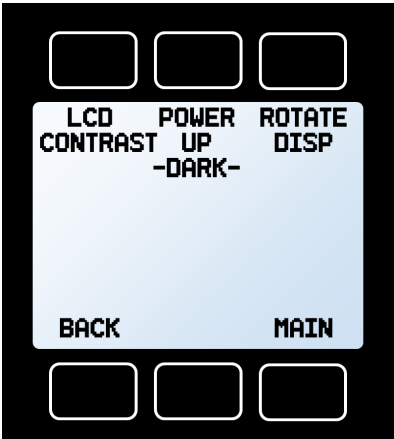
Display Setup Menu
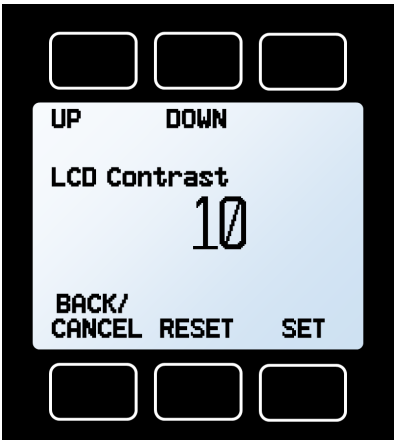
LCD Contrast Configuration Screen

Control Menus

The **CONTROL** and **ADV CONTROL** menus allow you to command new setpoints, change the setpoint control loop, and adjust proportional, integral, and derivative (PID) control settings, among other options.

Menu → Control

Control Menu

- **SETPT RAMP** activates and sets the speed of setpoint ramping (**page 25**)

- **SETPT** displays the current setpoint. Press to command a new setpoint or clear the existing one. Setpoints are not editable via the front panel if the source is analog.

- **BACK** returns to the top-level Menu (**page 17**).

- **ADV CONTROL** moves to the Advanced Control menu (below).

- **MAIN** exits to the Main Display (**page 7**).
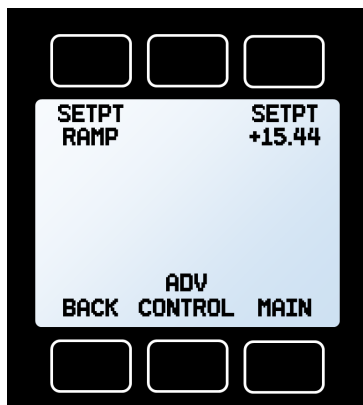
Changing the Setpoint

A setpoint is the amount of flow the controller will attempt to match by opening or closing its valve.

Press the **SETPT** button on the Main Display (**page 7**) or Control Menu (**MENU → CONTROL**, **page 21**) to choose a new setpoint. The setpoint selection screen indicates the engineering units and maximum allowable setpoint (*e.g.*, **LPM 10.00 Max**). To cancel a setpoint, press **CLEAR**.

Menu → Control → Advanced Control

- **SETPT SOURCE** selects setpoint input from either serial data and the front panel, or analog sources.

- **LOOP SETUP** selects the type of closed loop control and adjusts PID settings (**page 23**).

- **BACK** returns to the Control Menu (**above**).

- **CONTROL OPTS** sets options for setpoint ramping and limits, and flow limiting for pressure control (starting **page 25**)

- **MAIN** exits to the Main Display (**page 7**).
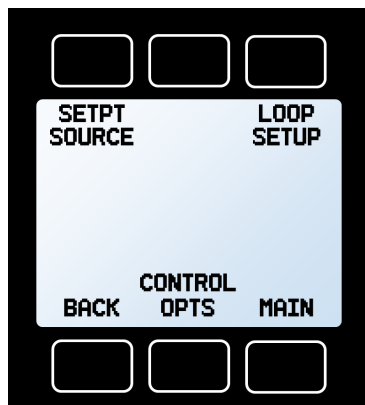
Advanced Control Menu

Using Setpoint Ramping

Setpoint ramping regulates how quickly your flow controller will reach the requested flow or pressure setpoint. This is used to prevent sudden bursts of pressure or flow from hitting delicate instruments when you start up your process.

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

Setting a Maximum Ramp Rate

With ramping enabled in at least one direction, configure the maximum ramp rate by selecting **MENU → CONTROL → SETPT RAMP**. Press **DELTA** to define the maximum allowable change in flow rate or pressure. Press **TIME** to define the amount of time within which that change occurs. The flow controller will display the resulting maximum ramp rate in the center of the display.

> **Note:** *Setpoint ramping can be used with flow or pressure setpoints, depending on the control loop selected. Ramping pressure control limits how quickly pressure changes before reaching the setpoint. To limit flow rates directly while controlling pressure, see* page 26.

Menu → Control → Setpoint Ramp

- **DELTA** sets the change in flow rate or pressure that will be allowed in the time interval.

- **TIME UNITS** selects the unit of time to be used in calculating the ramp rate.

- **TIME** sets the time interval over which the flow or pressure can change by the given delta.

- **BACK** returns to the Control Options Menu (page 21).

- **MAIN** exits to the Main Display (page 7).
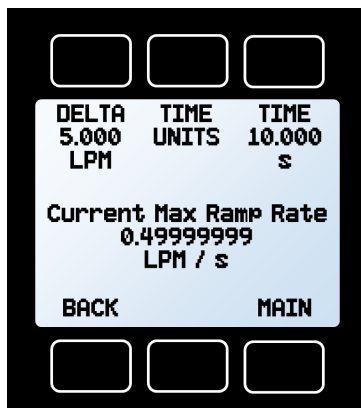
Setpoint Ramp Menu

> *Setpoint ramping in either direction can be toggled while keeping settings as configured above, see* page 25.

Changing Between Setpoint Sources

Liquid flow controllers with RS-232/RS-485 and/or Modbus RTU communication will accept setpoints from the front panel, a serial connection, or an analog signal.

- When the source is set to `Serial/Front Panel`, the controller will accept input from either the front panel, or an RS-232/RS-485 connection. Neither source is a slave of the other, so the controller will accept the most recent command from either source.

- When the source is set to `Analog`, the controller will ignore serial setpoint commands and will prevent input from the front panel.

Adjusting the setpoint with the optional IPC (Integrated Potentiometer Control)

If your controller has been ordered with a potentiometer control knob (IPC), the setpoint source must be set to Analog for the controller to accept setpoint commands from the IPC.

> *When using a serial setpoint signal with a controller that has an IPC, leave the IPC knob at the midpoint when it is not in use.*

Menu ➜ Control ➜ Advanced Control ➜
Loop Setup ➜ **Loop Variable**

Changing the Control Loop Variable

Your flow controller can control the flow rate or the pressure in your process. Loop variables include volumetric flow and gauge pressure.

> **Note:** *When pressure is selected as the control loop variable, flow controllers with upstream valves will control the outlet pressure. Those with downstream valves can control upstream backpressure, but these must be configured for this type of control.*

> *When changing the control loop from flow to pressure, you may need to adjust the PID settings for optimal stability and speed of response (see PID on* *).*

Establishing Setpoint Limits

The Setpoint Limits Menu configures upper and lower limits for selecting a flow or pressure control setpoint.

- When using the front panel, if you try to command a new setpoint that is outside of the upper and lower limits, the display notifies you that the requested setpoint is out of range.

- Over a serial connection, a setpoint outside the limit will be rejected with an error.

- When using an analog setpoint signal, setpoints that are outside of the setpoint limits are treated as if they were at the nearest limit. If you request a setpoint that is below the lower limit, the controller sets the setpoint at the lower limit. Likewise, a setpoint above the upper limit sets the setpoint at the upper limit.

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

✓ **Note:** *When changing from one control loop variable to another, the flow controller remembers setpoint limits as percentages of full scale. For example, a 1-LPM limit on a 2-LPM controller (50% full scale) will become a limit of 50 psig (50% of 100 psig) if the control loop is changed to gauge pressure.*

Menu ➜ Control ➜ Advanced Control ➜ Control Options ➜ Setpoint Limits

- **USER MIN** sets the lower (minimum) setpoint limit.

- **REMOVE LIMITS** clears the minimum and maximum setpoint limits.

- **USER MAX** sets the upper (maximum) setpoint limit.

- **BACK** returns to the Control Options Menu (above).

- **MAIN** exits to the Main Display (page 7).
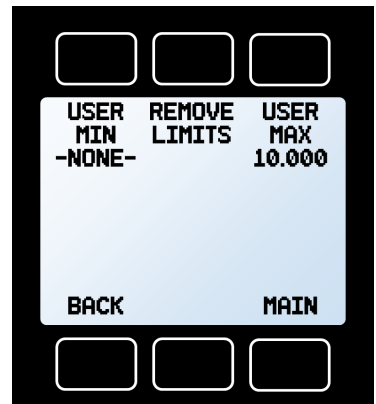
Setpoint Limits Menu

Enabling the Setpoint Ramping Function

Your flow controller enables the ramping function independently for changes that require increases or decreases to achieve the new setpoint. For example, you can enable ramping up to a flow setpoint to prevent flow from building too quickly, but disable ramping down so that you can stop flow immediately. Each direction toggles on and off.

Menu → Control → Advanced Control → Control Options → Ramp Enable

- **RAMP UP** toggles ramping up to the flow setpoint.

- **RAMP DOWN** toggles ramping down to the flow setpoint.

- **BACK** returns to the Control Options Menu (**page 21**).

- **MORE OPTS** enables overrides for power on and zero setpoint scenarios.

- **MAIN** exits to the Main display (**page 7**).
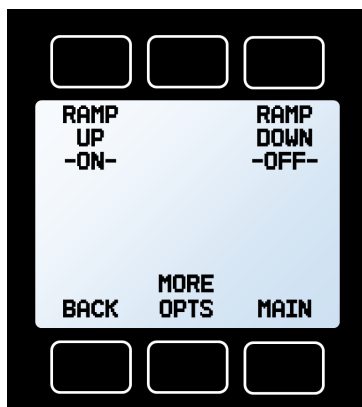
Setpoint Ramp Enable Menu

Enabling Setpoint Ramping Overrides

The **MORE OPTS** button in the Ramp Enable Menu lets you configure overrides for the ramping function for two independent scenarios:

- **POWER ON** applies an override where the controller ignores any enabled ramping whenever it is powered on. If it had a non-zero setpoint when it was turned off, it immediately reapplies this former setpoint. All setpoints after power up honor the enabled ramping options. This override is indicated by "Setpt at power on is instantly applied".

- **ZERO CMD** applies an override where controller ignores any enabled ramping whenever a zero setpoint has been commanded. This override is indicated by "Zero setpt command instantly zeroes".

Note: *The two ramping options above either honor or override the ramp settings established in the Ramp Enable Menu. If ramping is not enabled for either direction, the override options have no effect.*

Limiting Flow Rate While Controlling Pressure

To limit flow rates directly while controlling pressure, configure flow limiting for pressure control by selecting **MENU** ➜ **CONTROL** ➜ **ADV CONTROL** ➜ **CONTROL OPTS** ➜ **CLP MAX FLOW**. Press **CLP MAX FLOW** to set the desired maximum flow rate.

The **LIMIT GAIN** option determines how aggressively the proportional control function will correct the error when the flow rate exceeds the defined maximum flow setting. Be sure to record the initial value before attempting any changes to this variable.

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

Menu ➜ Control ➜ Advanced Control ➜ Control Options ➜ CLP Max Flow

- **CLP MAX FLOW** sets the maximum flow rate limit during pressure control.
- **LIMIT GAIN** adjusts the gain of the proportional control function for flow limiting. Contact support about adjusting this (**page 2**).
- **BACK** returns to the Control Options Menu (**page 21**).
- **MAIN** exits to the Main Display (**page 7**).
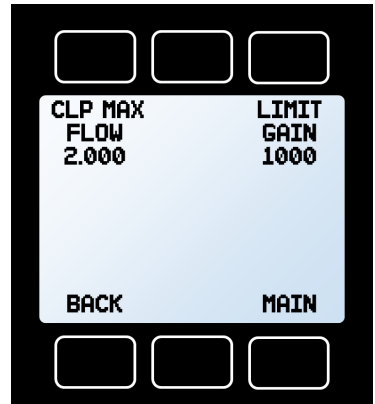
CLP Max Flow (maximum flow rate during pressure control) Menu

Adjusting the Closed Loop Controller

Your flow controller uses an electronic closed loop controller to determine how to actuate its valve in order to achieve the commanded setpoint. We have tuned these settings for your specific operating conditions, but changes to your process sometimes require on-site adjustments to maintain optimal control performance. If you encounter issues with control stability, oscillation, or speed of response, fine-tuning your closed loop control may help.

The **LOOP SETUP** Menu (**MENU → CONTROL → ADV CONTROL → LOOP SETUP**) lets you choose the closed loop control algorithm and adjust the gain settings for the proportional, integral, and derivative variables.

Tuning the PD/PDF control algorithm

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

- The larger the **D** gain, the slower the controller will correct errors between the commanded setpoint and the measured process value. This is equivalent to the P variable in common PDF controllers.

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

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

Menu → Control → Advanced Control → Loop Setup

- **LOOP VAR** sets the controller's closed loop to control for flow or pressure.
- **LOOP TYPE** sets the control algorithm for PD/PDF or PD^{2}I.
- **LOOP GAINS** adjusts the gain settings for the proportional, integral, and derivative (PID) control functions.
- **BACK** returns to the Advanced Control Menu ().
- **MAIN** exits to the Main Display ().

Loop Setup Menu

Tuning the PD^{2}I control algorithm

The controller's PD^{2}I control algorithm (also called PDDI) is used to provide faster response, most commonly in dual-valve flow and pressure controllers.
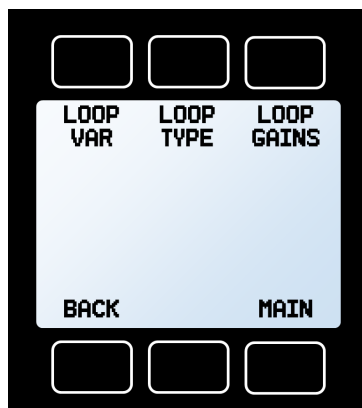
- The larger the **P** gain, the more aggressively the controller will correct errors between the commanded setpoint and the measured process value.
- The larger the **I** gain, the faster the controller will correct for offsets based on the size of the errors and the amount of time they have occurred.
- The larger the **D** gain, the faster the controller will predict needed future corrections based on the current rate of change in the system. This often results in slowing the system down to minimize overshoot and oscillations.

Troubleshooting valve performance with PID tuning

The following issues can often be resolved by adjusting the PID gain values for your flow controller.

Fast oscillation around the setpoint

- **PD:** Reduce the P gain in decrements of 10%
- **PD^{2}I:** Increase the P gain in increments of 10%, and then adjust the I gain to fine-tune

Overshot setpoint

- **PD:** Reduce the P gain in decrements of 10%
- **PD^{2}I:** If D is not zero, increase the P gain in increments of 10%

Delayed or unattained setpoint

- **PD:** Increase the P gain in increments of 10%, and then decrease the D gain by small amounts to fine-tune
- **PD^{2}I:** Increase the P gain in increments of 10%, and then increase the I gain to fine-tune

Valve tuning can be complex. If you have any trouble, please call support to guide you through the process. Or, visit alicat.com/pid for more detailed instructions.

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 manufacturer contact information.

- **BACK** returns to the Main Menu (page 17).

- **MAIN** exits to the Main Display (page 7).
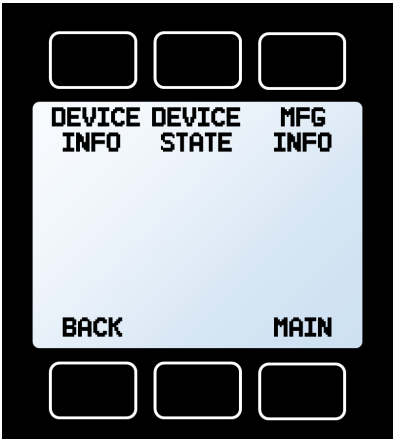
About Menu

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.
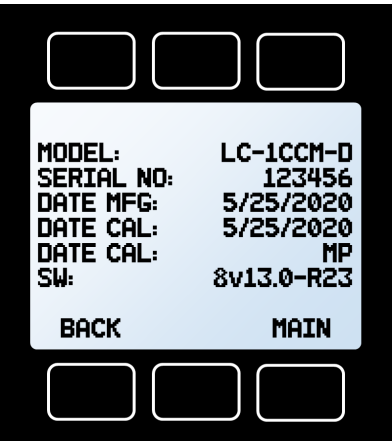
Device general information
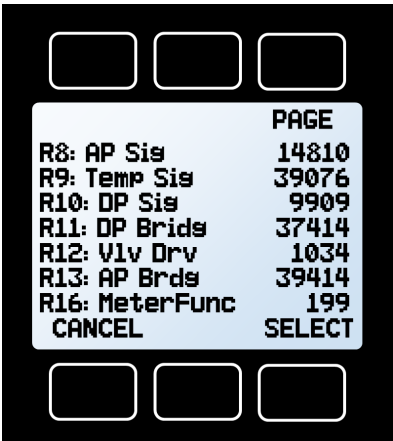
Device state information

Serial Communication
Configuring Serial Communications

Menu ➜ Advanced Setup ➜ Comm Setup

Connecting your device to a computer allows you to log the data that it generates. The flow controller 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 controller using ASCII commands.

Unit ID

The unit ID is the identifier that a computer uses to distinguish a controller 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 32**). Unit ID changes take effect when **SET** is selected.

If you select @ as the Unit ID, the flow controller enters streaming mode when you exit the menu (**page 32**).

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

Serial Communications Menu

Setting the serial unit ID

Baud Rate

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

Establishing Communication

After connecting your flow controller 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).

Setting the baud (bits per second) rate

- 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 controller will be configured with the following settings:

- **Baud:** 19200 (by default; others can be used if the computer, its software and the controller 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 controller. The default baud rate is 19200, but this is adjustable by entering the **SERIAL COMM** Menu on your flow controller: **MENU ➜ ADV SETUP ➜ COMM SETUP ➜ BAUD** (previous page).

Polling Mode

Controllers 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 30). 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.

To put your flow controller 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 controller 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 illegible. If the device does not receive a valid command, the command will be ignored. If in doubt, simply hit ↵ and start again.

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

Set streaming interval:	[unit ID]w91=[time in milliseconds]↵
Example:	aw91=500↵ (streams data every 500 ms)

Taring

Tare your flow controller before collecting flow data. If auto-tare is enabled, provide a zero setpoint until auto-tare activates, usually after a few seconds, depending on the device's full-scale flow rate.

The controller can also be tared automatically using auto-tare, or manually from the front panel. See **page 17**.

Two serial commands can be used to manually tare the device:

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

> **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 controller 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 controller to streaming. Each line of data for live flow measurements appears in the format below, but Unit ID is not present in streaming mode.

A	14.70	+24.5782	+02.004	+02.004
ID	Gauge Pressure	Temperature	Volumetric Flow	Setpoint

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 controller display (see **page 12**). 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 7**), may be present at the end of the line.

Commanding a New Setpoint

Before attempting to send setpoints to your flow controller serially, confirm that its setpoint source is set to **Serial/Front Panel** by selecting **MENU ➜ CONTROL ➜ ADV CONTROL ➜ SETPT SOURCE**.

There are two ways to command a new setpoint over a serial connection, as described below. In either of these methods, the data frame returns the new setpoint value when it has been accepted as a valid setpoint.

Sending Setpoints as Floating Point Numbers

This is how to send the desired setpoint value as a floating point number in the selected engineering units:

New setpoint: [unit ID]s[floating point number setpoint]↵
Example: as5.44↵
(setpoint of +5.44 LPM)

Sending Setpoints as Integers

In this method, your controller's **full scale range (FS)** is represented by a value of 64000, and a zero setpoint is represented by 0. To calculate your intended setpoint, use the following formula:

Integer value = 64000 × [desired setpoint]/[device FS]

Example: A desired setpoint of +5.44 LPM on a 10-LPM flow controller is calculated as 64000 × 5.44/10.00 = **32704**. The command to assign the setpoint based on this integer value is:

New setpoint: [unit ID][setpoint as integer where 64000 is FS]↵
Example: a32704↵
(setpoint of +5.44 LPM)

Quick Command Guide

Note: *Serial commands are not case-sensitive.*
In these examples, the unit ID of the flow controller is a.

Change unit ID:	`[current unit ID]@=`**`[desired unit ID]`**↵
Tare flow:	`av`↵
Tare pressure:	`ap`↵
Poll the live data frame:	`a`↵
Begin streaming data:	`a@=@`↵
Stop streaming data:	`@@=[desired unit ID]`↵
Set streaming interval:	`aw91=[number of milliseconds]`↵
New setpoint:	`as[setpoint as floating point #]`↵
New setpoint:	`a[setpoint as integer where 64000 is full scale]`↵
Hold valve(s) at current position:	`ahp`↵
Hold valve(s) closed:	`ahc`↵
Cancel valve hold:	`ac`↵
Query live data info:	`a??d*`↵
Manufacturer info:	`a??m*`↵
Firmware version:	`a??m9`↵
Lock the front display:	`al`↵
Unlock front display:	`au`↵

More 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 (see **page 2**). You'll also find help on our website alicat.com and in the pages that follow.

General Use

Issue: *My controller does not turn on or has trouble staying on.*
Action: Check power and ground connections. Please reference the technical specifications to ensure you have the proper power for your model.

Issue: *The buttons do not work, and the screen shows* `LCK.`
Action: The flow controller 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 daytime, increase the visibility of the display by increasing the contrast (`MENU` ➜ `ADV SETUP` ➜ `DISP SETUP` ➜ `LCD CONTRAST`). For low-light conditions, push the logo button located below the display to turn on the backlight (see **page 20**).

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 controller?*
Action: Annual recalibrations are recommended. Check your flow controller'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 controller. 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 12**.

Flow Readings

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

Action: The flow controller 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 . This may also be the result of air bubbles, which can be fixed by using the bleed ports (see). As a third possibility, flow controllers also use PD or PD^{2}I control loop algorithms to reach the setpoint given. These parameters are adjustable in the field. See for a quick guide on tuning.

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

Action: The flow rate is related linearly to the pressure drop across the device. If there isn't enough of a pressure difference between the inlet and outlet, the controller may not be able to reach setpoint. Often, increasing the inlet pressure will fix this issue.

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

Issue: *My flow readings are negative.*

Action: If there is no flow, a negative flow reading can indicate a poor tare (see). Ensure that auto-tare is enabled, and give the controller a zero setpoint for at least 2 seconds.

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

Action: Check the dead band (or "display as zero") settings, which will round down all values below a specified point to zero (see).

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

Action: Yes to both for small valve controllers! The flow controller is internally compensated for any changes in orientation, so you can use it sideways, on its back, or upside-down. However, they should be tared again after changing their orientation. Large-valve controllers should be operated with the valve cylinder vertical and upright.

Issue: *Can I attach the controller to a vibrating device? Will it be accurate?*

Action: Yes, and yes! The flow controller is internally compensated for any changes in orientation, including rapid vibrations. Noise will increase if the flow controller is vibrating. Large-valve controllers are not recommended for use on vibrating surfaces.

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

Action: Liquid flow controllers can normally be compared against one another provided there are no leaks between the two controllers.

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 9**) 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: *Can I use the controller with other liquids?*

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

Serial Communications

Issue: *My computer can't communicate with the controller.*

Action: **1.** Make sure the baud rate and other serial settings such as the COM port number are the same as your controller (see **page 30**).

2. Check the flow controller unit's serial ID (also on **page 30**).

3. Check the pinout (see **page 42,** or online at alicat.com/pinouts).

4. Make sure the COM number matches the one your software is using to connect to the flow controller (**page 31**).

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 (see page 8). 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 (see page 2) 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 by your flow controller and is visible by selecting `MENU ➜ ABOUT ➜ DEVICE INFO`.

When it is time for your flow controller'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
µL∕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
uL	microliter
mL	milliliter
L	liter
US GAL	US gallon
cm^3	cubic centicontroller*
m^3	cubic controller*
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
h:m:s	hours:minutes:seconds
ms	milliseconds
s	seconds
m	minutes
hour	hours
day	days

Temperature Units

Label	Notes
°C	degrees Celsius
°F	degrees Fahrenheit
K	Kelvin
°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 centicontroller*
kg/cm^{2}G	kilogram force per square centicontroller*†
PSIG	pound force per square inch
PSFG	pound force per square foot
mTorrG	millitorr
torrG	torr
mmHgG	millicontroller of mercury at 0°C
inHgG	inch of mercury at 0°C
mmH$_2$OG	millicontroller of water at 4°C (NIST conventional)*
mmH$_2$OG	millicontroller of water at 60°C*
cmH$_2$OG	centicontroller of water at 4°C (NIST conventional)*
cmH$_2$OG	centicontroller of water at 60°C*
inH$_2$OG	inch of water at 4°C (NIST conventional)*
inH$_2$OG	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. See **page 30** for additional important information about connecting your device to a computer for serial commands. Individual pinouts available at **alicat.com/pinout**.

8-Pin Mini-DIN (Default)
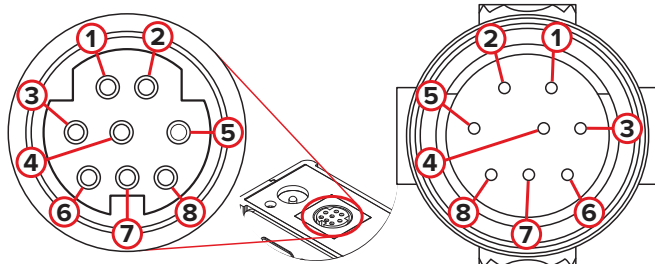
Female Connector: Device   Male Connector: Cable

Pin	Cable Color	Function
1	Black	Not connected *Optional: 4–20 mA primary output signal*
2	Brown	Static 5.12 Vdc Optional: Secondary analog output *(4–20 mA, 0–5 Vdc, 1–5 Vdc, 0–10 Vdc) or basic alarm*
3	Red	Serial RS-232RX input signal *Optional: RS-485 A*
4	Orange	Analog Setpoint Input
5	Yellow	Serial RS-232TX output signal *Optional: RS-485 B*
6	Green	0–5 Vdc *Optional: 1–5 Vdc or 0–10 Vdc) output signal*
7	Blue	Power In
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
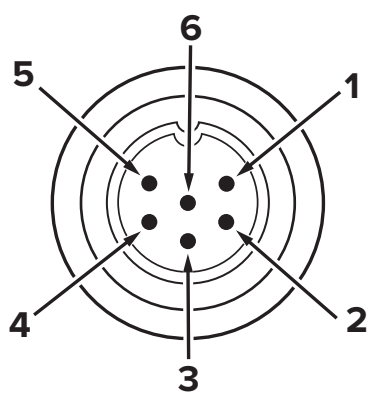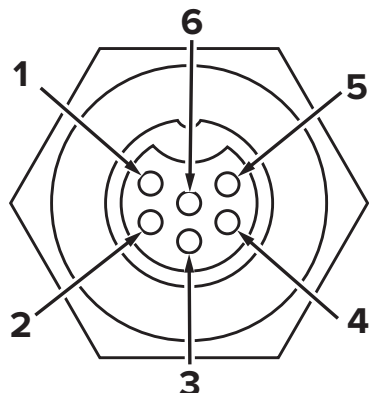
Male Connector: Cable   **Female Connector: Device**

Pin	Function
1	Power In (+)
2	RS-232TX / RS-485 B
3	RS-232RX / RS-485 A
4	Analog Setpoint Input
5	Ground (common for power, communications, and signals)
6	Signal Out (voltage or current as ordered)

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

9-pin D-Sub Connector Pinouts

Female Connector

Male Connector
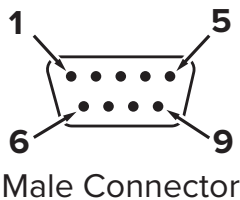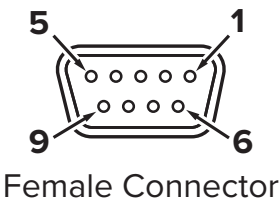
Common 9-pin D-Sub Pinouts

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
Analog Setpoint Input

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

M12 Connector Pinouts

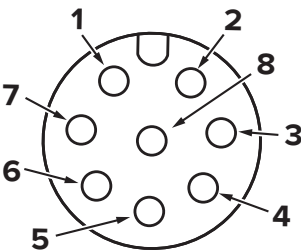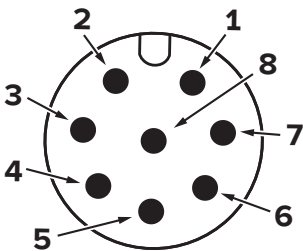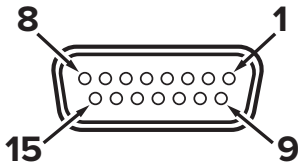Female Connector: Cable
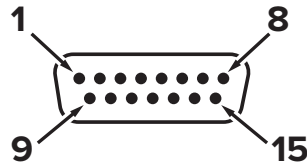

Male Connector: Device

Common M12 Pinouts

Pin	M12	M12MD
1	**0–5 Vdc output signal** *Optional: 1–5 or 0–10 Vdc*	**Not connected** *Optional: 4–20 mA primary output signal*
2	**Power in**	**Static 5.12 Vdc** *Optional: Secondary analog output (4–20 mA, 0–5 Vdc, 1–5 Vdc, 0–10 Vdc) or basic alarm*
3	**Serial RS-232 RX signal** *Optional: RS-485 A*	**Serial RS-232 RX signal** *Optional: RS-485 A*
4	Analog Setpoint Input	Analog Setpoint Input
5	**Serial RS-232 TX signal** *Optional: RS-485 B*	**Serial RS-232 TX signal** *Optional: RS-485 B*
6	**Static 5.12 Vdc** *Optional: Secondary analog output (4–20 mA, 0–5 Vdc, 1–5 Vdc, 0–10 Vdc) or basic alarm*	**0–5 Vdc Output Signal** *Optional: 1–5 or 0–10 Vdc*
7	**Ground** (common for power, digital communications, analog signals, and alarms)	**Power in**
8	**Inactive** *Optional: 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 and pins via continuity check & color when using blunt cut multi-strand cables.

15-Pin D-Sub Connector Pinouts

8   **1**

15   **9**

1   **8**

9   **15**

Female Connector: Device   Male Connector: Cable

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
Analog Setpoint Input

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

C E Ex **II 3 G** CSA_{US}

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) 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 certi-fied, 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

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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.

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

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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.
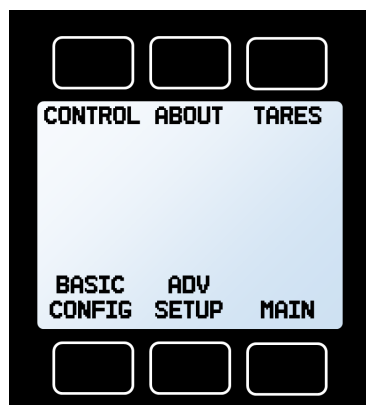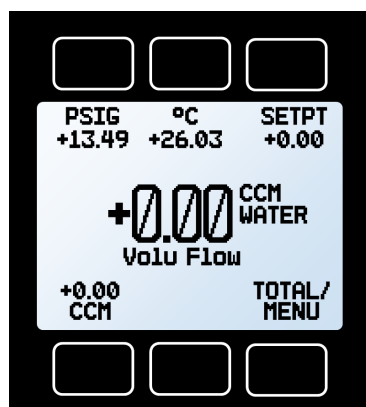
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Main Menu

Accessible from MENU on the Main Display

- **Control (page 21)**
  - Setpoint ramping
  - Setpoint setting
  - Advanced Control
    - Setpoint source
    - Loop setup
    - Control options

- **About** (page 29)
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  - Manufacturer information
  - Device state
  - Diagnostic Information

- **Tares** (page 17)
  - How and when to tare
  - Tare pressure
  - Tare flow

- **Basic config** (page 18)
  - Device units
    - Volumetric flow
    - Pressure
    - Temperature

- **Advanced setup** (page 19)
  - Sensor setup
    - Display as zero (dead band)
    - Number of digits
    - Flow and pressure averaging
  - Communication setup
    - Unit ID
    - Baud
  - Display setup
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    - Power-up light
  - Display rotation

- **Main display** (page 7)

Main Menu

Main Display