ALICAT SCIENTIFIC

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OPERATING MANUAL

FOR CODA-SERIES CORIOLIS MASS FLOW INSTRUMENTS

Models K · KC · KF · KG

Thank you for purchasing your CODA series Coriolis mass flow instrument.

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This instrument comes with a NIST-traceable calibration certificate.

This instrument conforms to the European Union's Restriction of Use of Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive 2015/863/EU.

This instrument complies with the requirements of the EMC Directive 2014/30/EU: EN 61326-1:2013 and the RoHS Directive 2011/65/EU: EN 63000:2018 and carries the CE Marking accordingly.

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

This instrument complies with the requirements of the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2012/19/EU.

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Installation and Connections

This manual is for all CODA series Coriolis meters (K), controllers (KC), pump controllers (KF), and the full CODA pump system (KG).

The drawings on this page represent a typical CODA series mass flow controller and meter. A pump controller is shown on the following page. These drawings represent typical instrument configurations. **Your instrument's appearance and connections may differ.**

Connectors

Controllers and meters have either one or two connectors at the top of the instrument for power and communication. CODA pumps have an additional connector on the side which provides power to the pump and communication between it and the instrument. See the power and signal connection section (page 9) for the pinouts.

Mounting

All CODA series mass flow instruments have mounting holes on the bottom for attachment to flat panels. The instrument does not require straight run pipes upstream or downstream. The instrument can be mounted in any orientation.

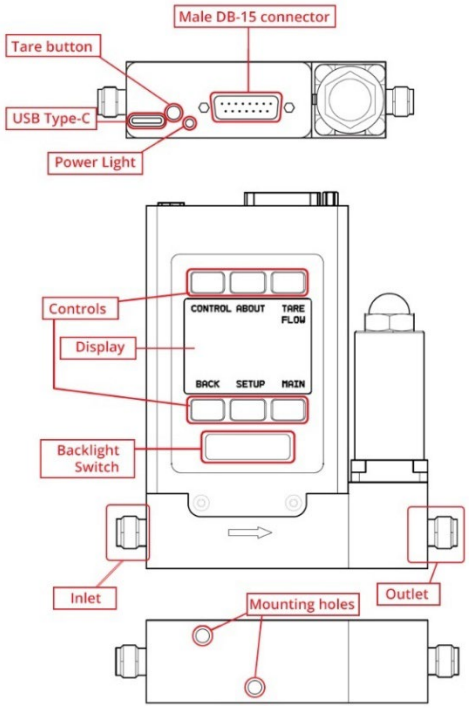
For CODA pump controllers, the pump must be installed upstream of the controller. Installing the pump downstream of the controller may result in bubbles entering the controller body and creating inaccurate measurements.

Instrument Ports

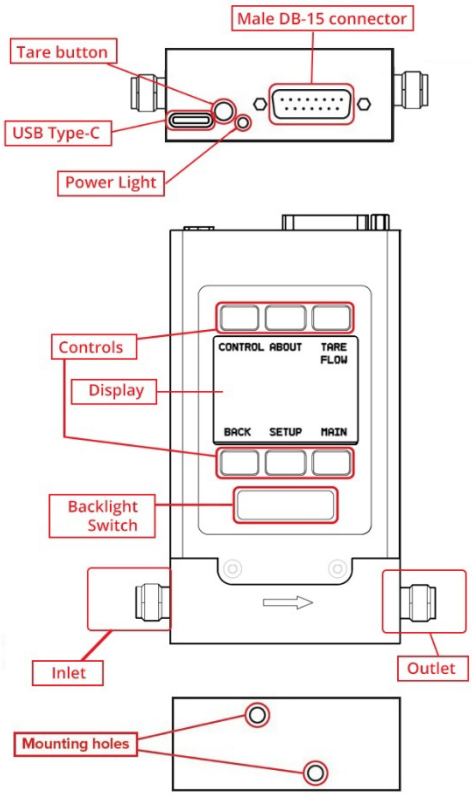
Ensure that flow passes through the instrument in the direction of the arrow on the flow body (usually left to right). See page 7 for in-depth setup instructions.

Instruments ship with plastic plugs seated in the process ports. To decrease the chance of contaminating the flow stream, do not remove these plugs until you are ready to install the instrument.

CODA instruments come with connection options that are determined at time of production. Confirm the inlet and outlet fittings of your instrument and plumb them to the process appropriately.



CODA KC controller.



CODA K meter.

- On fittings that require thread-sealing Teflon tape, such as NPT fittings, do not wrap the first two threads entering the instrument. This minimizes the possibility of getting tape into the flow stream and clogging the instrument.
- Face seal and compression fittings do not need Teflon tape applied to the threads.

WARNING: ***Do not use pipe dopes or sealants on the process connections. These compounds can cause permanent damage to the instrument if they enter the flow stream.***

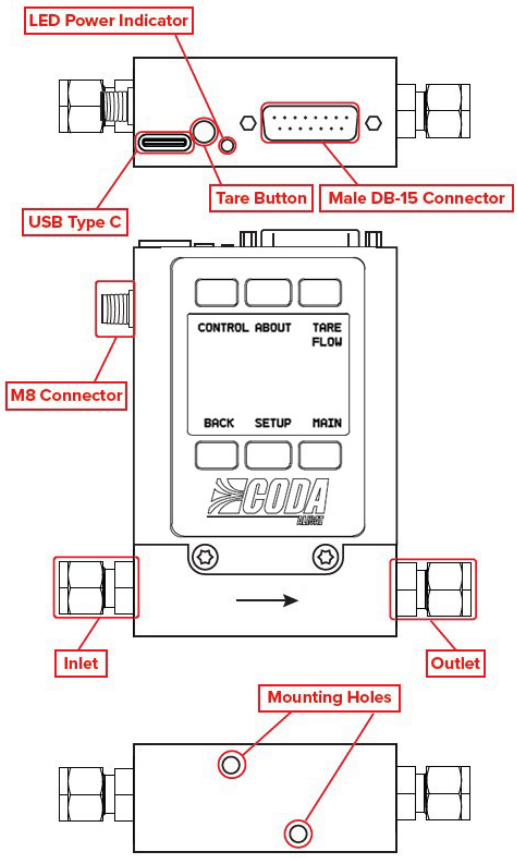
Maximum Pressure

Each instrument includes a calibration sheet listing its maximum operating pressure and maximum burst pressure.

WARNING: ***Instruments exposed to pressures above the burst pressure listed in the instrument's specifications sheet, even for short periods, may leak or fail catastrophically, injuring persons or equipment.***

CODA controllers also have a maximum differential operating pressure that is dependent on the installed valve or pump. Exceeding the maximum differential pressure can damage the components.

WARNING: ***The reverse differential pressure (i.e., the differential back-pressure) must not exceed 500 PSI, or the maximum allowable forward pressure, whichever is lower.***



CODA KF pump controller.

CODA Pump Manual Bypass

A CODA pump system is produced with a manual bypass between the pump and the controller. This bypass provides the ability to reduce the flow range below what the pump is rated for and to help smooth flow rates.

When installing the CODA pump system, plumb the bypass to either return fluid to the reservoir or another location outside the process. The bypass should not direct flow back into the system beyond the controller as it would not be measured.

If the process requires a flow range lower than the pump allows for, open the bypass to divert flow either back to the fluid reservoir or another location.

If flow rates are fluctuating and not stabilizing, open the bypass to divert flow.

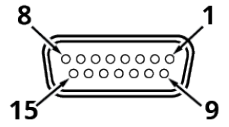
Power and Signal Connections

On CODA meters, the USB-C connector on top of the instrument can provide power and a communication interface to the meter.

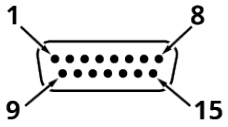
CODA controllers and pump controllers require power via a DB-15, M12, or power jack connector (power jack is only available on RJ-45 units). The USB-C connection can be used to communicate with the controller. The USB-C connector is absent on instruments with the M12 connector, including IP67-rated instruments.

When using ASCII serial communication, the USB-C connection can be used with any ID. When using Modbus as the communication protocol, the USB-C connection acts as a debug port and only responds to Modbus ID 1. For more information, see the Modbus RTU Communication section (page 30).

DB-15 Connector



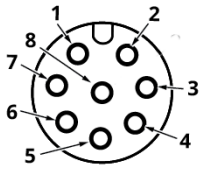
Female Connector



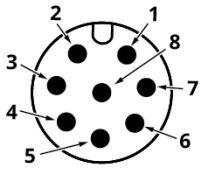
Male Connector

	METERS			CONTROLLERS	
Pin	**Label**	**DB-15**	**Pin**	**Label**	**DB-15**
1	NC	Not connected	**1**	Analog Input	0–5 Vdc analog setpoint input. Optional: 0–10 Vdc or 4–20 mA
2	NC	Not connected	**2**	Ground (SP)	Ground for analog setpoint
3	Analog Output, Mass Flow	0–5 Vdc output signal for mass flow rate. Optional: 0–10 Vdc or 4–20 mA	**3**	Analog Output, Mass Flow	0–5 Vdc output signal for mass flow rate. Optional: 0–10 Vdc or 4–20 mA
4	Analog Output, Density	0–5 Vdc output signal for density. Optional: 0–10 Vdc or 4–20 mA	**4**	Analog Output, Density	0–5 Vdc output signal for density. Optional: 0–10 Vdc or 4–20 mA
5	Ground (Output)	Ground for analog output	**5**	Ground (Output)	Ground for analog output
6	NC	Not connected	**6**	NC	Not connected
7	NC	Not connected	**7**	NC	Not connected
8	NC	Not connected	**8**	Valve Drive	Direct valve drive control, 0-20 Vdc (not connected on pump controllers)
9	Power In	+Vdc	**9**	Power In	+Vdc
10	Ground (Power/Comms)	Ground for power and digital communications	**10**	Ground (Power/Comms)	Ground for power and digital communications
11	Ground (Power/Comms)	Ground for power and digital communications	**11**	Ground (Power/Comms)	Ground for power and digital communications
12	Tare	Ground to tare	**12**	Tare	Ground to tare
13	Ground (Power/Comms)	Ground for power and digital communications	**13**	Ground (Power/Comms)	Ground for power and digital communications
14	Serial Tx or A (−)	RS-232 Tx or RS-485 A (−) serial communications	**14**	Serial Tx or A (−)	RS-232 Tx or RS-485 A (−) serial communications
15	Serial Rx or B (+)	RS-232 Rx or RS-485 B (+) serial communications	**15**	Serial Rx or B (+)	RS-232 Rx or RS-485 B (+) serial communications

M12 Connector



Female Connector



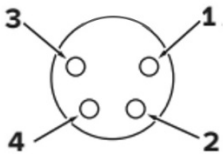
Male Connector

	METERS			CONTROLLERS	
Pin	**Label**	**M12**	**Pin**	**Label**	**M12**
1	Analog Output, Mass Flow	0–5 Vdc output signal for mass flow rate. Optional: 0–10 Vdc or 4–20 mA	**1**	Analog Output, Mass Flow	0–5 Vdc output signal for mass flow rate. Optional: 0–10 Vdc or 4–20 mA
2	Power In	+Vdc	**2**	Power In	+Vdc
3	Serial Rx or B (+)	RS-232 Rx or RS-485 B (+) serial communications	**3**	Serial Rx or B (+)	RS-232 Rx or RS-485 B (+) serial communications
4	Tare	Ground to tare	**4**	Tare	Ground to tare
5	Serial Tx or A (−)	RS-232 Tx or RS-485 A (−) serial communications	**5**	Serial Tx or A (−)	RS-232 Tx or RS-485 A (−) serial communications
6	Analog Output, Density	0–5 Vdc output signal for density. Optional: 0–10 Vdc or 4–20 mA	**6**	Analog Input	0–5 Vdc analog setpoint input. Optional: 0–10 Vdc or 4–20 mA
7	Ground (Power/Comms)	Ground for power and digital communications	**7**	Ground (Power/Comms)	Ground for power and digital communications
8	Ground (Output)	Ground for analog output	**8**	Ground (Analog)	Ground for analog setpoint and analog output

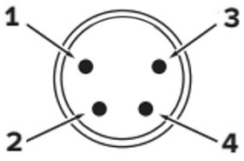
CODA Pump M8 Side Connection

CODA pump controllers have an additional 4-pin M8 connection on the side of the instrument. This connection powers and controls the pump. The power for the pump runs directly from the top DB-15 or M12 connection to this M8 connection. When wiring a CODA pump instrument, connect the pump to the controller according to the following pinout.

WARNING*: Do not connect the power source directly to this connection. Use this connection to run power from the instrument to the pump.*



Female Connector (Cable)



Male Connector (device)

Pin	4-pin M8	Description
1	Pump control	Pump control output signal
2	Power out	Pump power connection (+Vdc), shared with main CODA power
3	Not connected	Not connected
4	Ground	Pump ground connection, Shared with main CODA power and digital communications

Quick Start Guide

To begin using the instrument, mount the instrument and connect it to the process per the instructions above. In most cases you should be able to begin using the instrument once these steps are complete.

Interacting with the instrument

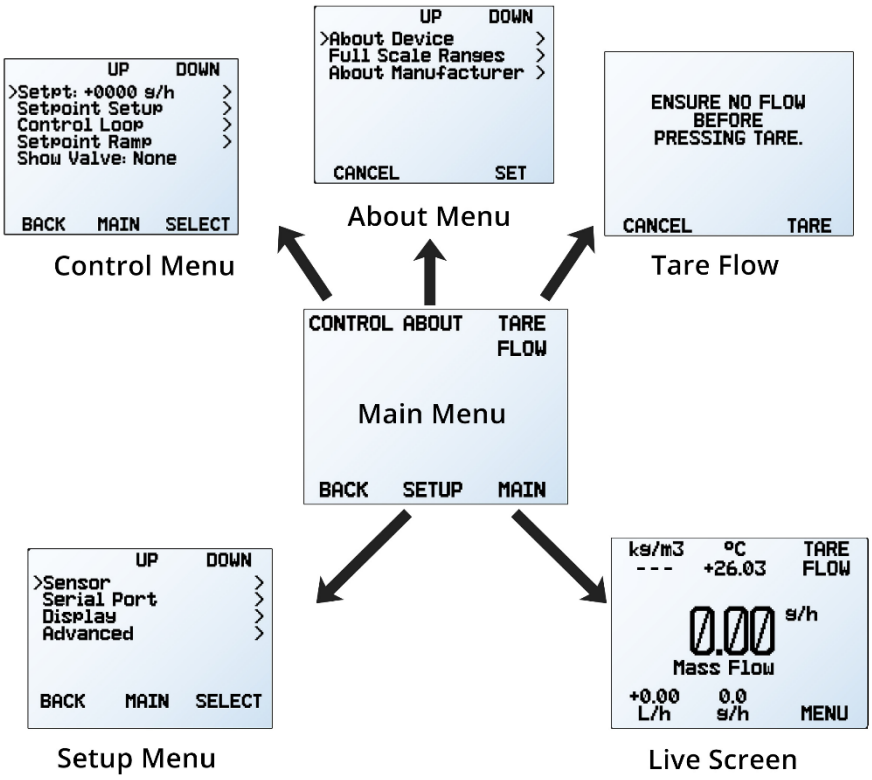
LED

The multicolor LED indicator light will be solid green when power is supplied to the instrument. The LED will change to red when transmitting or receiving through serial communication.

Instrument Display

The instrument display is the primary means of controlling the unit. You can also control the instrument using several digital communication protocols (page **24**).

The image below shows a map of the primary display screens.



Map of instrument display screens.

Throughout this manual, the steps through menus to reach a setting are described as follows:

MENU → SETUP → Sensor → Totalizer

This indicates that from the Live Screen you would:

1. Press **MENU** to access the Main Menu
2. Press **SETUP** to access the **Setup** screen
3. Select **Sensor**, then press **SELECT** to view the Sensor Setup options
4. Select **Totalizer**, then press **SELECT** to view the Totalizer Setup options.

The buttons above and below the display allow you to access and select most functions. These buttons will be described in the next few sections.

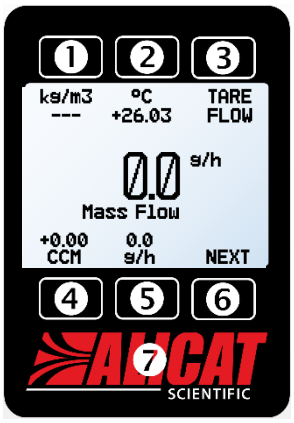
Viewing Live Data

The default view for the instrument display is the **Live Screen**, which shows live data for all parameters measured by the instrument. Sensors measure data 50 times per second and updates 10 times per second. The measured data is displayed in the units designated by the instrument.

The images to the right show the instrument display and buttons for a mass flow meter and a mass flow controller.

The main screen can show Totalizer data (page 17) instead of live data. The choice for main screen content, display contrast, and other display setup options can be changed in the **Display Setup** (page 22).

Pressing the **NEXT** button cycles between the Live Data and Totalizer screens.

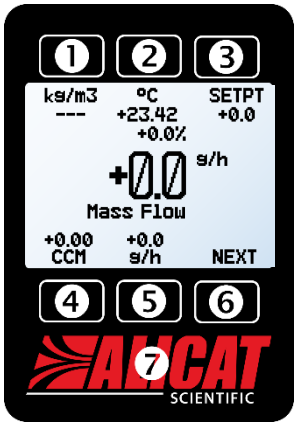


Main display of a meter measuring mass flow.

Status Messages

Status messages are shown to the right of the central measurement and indicate the following:

DOV	Density exceeds measurable range
DUV	Density is below measurable range
EXH	Exhaust mode active (Controllers only)
HLD	Valve hold active (Controllers only)
MOV	Mass flow over range of mass flow instrument
OVR	Totalizer rolled over to zero
TMF	Totalizer missed out-of-range flow
TOV	Temperature over range of instrument
VOV	Volumetric flow over range of instrument
ZRO	Zeroing (tare) currently in progress



Main display of a mass flow controller.

Button Functions

By default, pressing Buttons 1, 2, 4, and 5 will display these process variables in the center of the display:

- **Button 1: density**
- **Button 2: temperature**

- **Button 4: volumetric flow;** Not applicable for fluids with density below 100 kg/m3 (most gases)
- **Button 5: true mass flow**

Press **Button 3 to change the setpoint** on controllers (page 14). Meters do not have a setpoint function. For meters, pressing **Button 3** will tare the instrument (page 13).

Press **Button 6** to open the menu or move to the next screen.

Press **Button 7** to Enable/Disable the backlight.

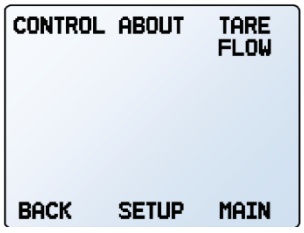
Taring the Instrument

Taring ensures your instrument gives a zero reference point for measurements to provide the most accurate measurements.

When to Tare

The instrument should be tared:

- After installation
- When changing the instrument's orientation
- If the instrument is hit with any significant impact
- After changing fluid
- After any significant changes to the temperature or pressure
- After changes to fluid density or viscosity.



Tare mass flow by pressing the **TARE FLOW** *button*

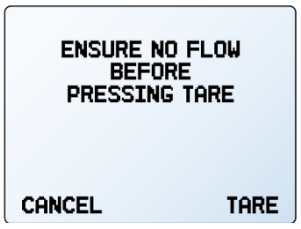
How to Tare

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

On CODA meters, press **Button 3** on the Main screen to tare. On controllers, press **MENU**, then press the **TARE FLOW** button.

Taring should be done at the expected process pressure with no active flow. When **Tare Flow** is pressed, a message, "**Ensure no flow before pressing TARE**" is displayed on some instruments. If so, press **TARE** to confirm taring the flow.

Taring typically takes 10 seconds to complete. Prior to taring, begin flow through the instrument to introduce fluid to the system and then stop flow to establish a no-flow condition. For the best results, wait 15 minutes for the electronics and the flow to reach operational temperature before taring.



Tare flow confirmation screen.

Changing the Setpoint

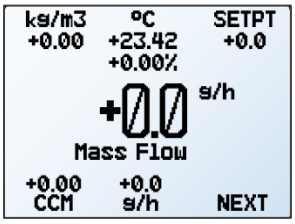
▶ Controllers

The Setpoints manage the amount of flow passing through the instrument. Pressing the setpoint button from the Live Screen (**Button 3**) moves the screen to the setpoint selection screen.

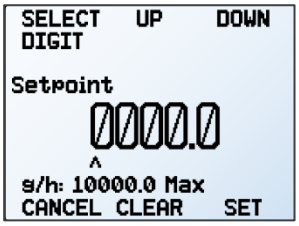
The Setpoint Selection screen indicates the engineering units and maximum allowable setpoint (e.g., **kg/h: 1.000 Max**). To establish a setpoint, enter the desired value and press **SET**. The instrument immediately begins to control the flow.

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

For more detailed options and settings, including setpoint ramping, see page 16.



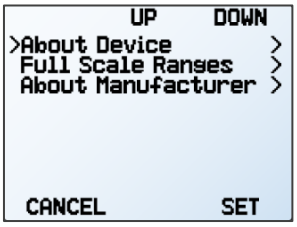
Main screen with SETPT button



Setpoint selection screen.

Instrument Information

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



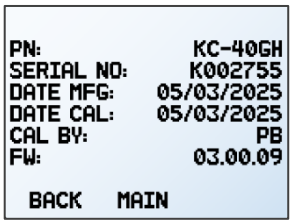
About menu.

Basic Instrument Information

MENU → ABOUT → About Device

This data list shows:

- **PN:** Instrument part number
- **SERIAL NO:** Serial number
- **DATE MFG:** Manufacturing date
- **DATE CAL:** Most recent calibration date
- **CAL BY:** Initials of the person who calibrated the instrument
- **FW:** Firmware version

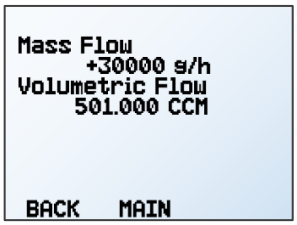


About Device information.

Full Scale Ranges

MENU → ABOUT → Full Scale Ranges

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



Full scale ranges.

Manufacturer Information

MENU → ABOUT → About Manufacturer

About Manufacturer includes information for contacting Alicat.



About information.

Maintenance and Care

CODA instruments require minimal maintenance. If necessary, the outside of the instrument may be cleaned with a soft dry cloth. Avoid excess moisture or solvents.

CODA mass flow instrument used with gas require no periodic cleaning, provided they have been flowing clean, dry gas.

CODA mass flow instruments used with liquids require some precautions to avoid contamination and/or corrosion damage. Liquids should be filtered for particulates or biological materials that may grow in the instrument. When removing these instruments from the line for any extended period, remove all liquid as deposits of calcium or other soluble minerals can affect the accuracy.

CODA instruments are calibrated to NIST-traceable standards at the time of manufacture. Though the Coriolis technology has a low tendency to drift, other factors can affect your results. Consequently, Alicat's limited lifetime warranty requires that an annual recalibration cycle is maintained. To review current warranty terms go to alicat.com/warranty/.

Recalibration can be requested at your discretion/requirement by submitting a form with the instrument serial number at alicat.com/service (page **2**).

Process Control

Setpoint

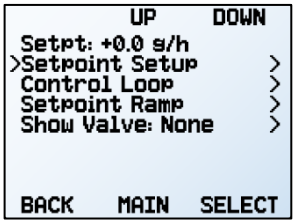
▶ Controllers

MENU → CONTROL → Setpt

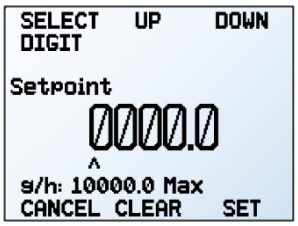
For a controller to regulate the flow, it needs to have a setpoint established. The setpoint is the amount of flow that the controller attempts to achieve in a process.

The **setpoint selection screen** indicates the engineering units and maximum allowable setpoint (e.g., **g/h: 30000 Max**).

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



Control menu.



Setpoint screen.

Setpoint Setup

The setpoint can be configured for specific process needs.

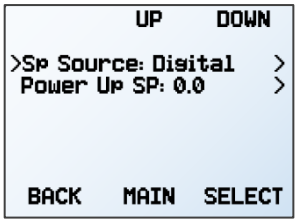
Setpoint Source

MENU → CONTROL → Setpoint Setup → SP Source

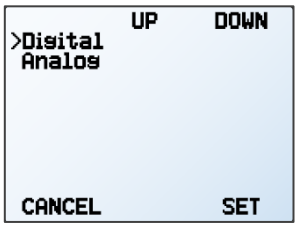
Controllers with RS-232 or RS-485 communication accept setpoints from the front panel and serial commands (page 25). Alternatively, an analog source can be used instead.

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

Power Up SP opens the Boot Setup screen. The Boot Setpoint is the setpoint that the instrument will attempt to reach at startup. The maximum value is displayed as a percent of full scale range for that variable (PCT).



Setpoint Setup screen.

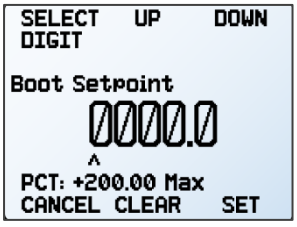


Setpoint Source screen.

Boot Setpoint

MENU → CONTROL → Setpoint Setup → Power Up SP

The boot setpoint is the setpoint that the instrument will attempt to achieve when the instrument starts up. To set the value, choose **Power Up SP** from the Setpoint Setup screen.



Boot Setpoint screen.

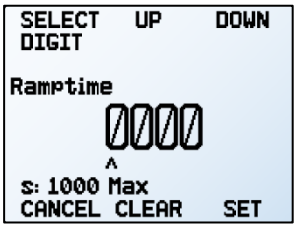
The maximum boot setpoint will be shown after PCT (the value is shown a percentage of full scale for that variable). Select a new value by changing the large, central number.

Setpoint Ramping

MENU → CONTROL → Setpoint Ramp

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

Ramptime: the duration of the ramp function.



Configuring setpoint ramp time.

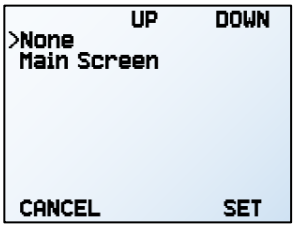
Show Valve Percentage

MENU → CONTROL → Show Valve

The valve drive can be displayed on the main screen as a percentage of the total possible valve drive voltage. While drive percentage does not directly correlate with percentage open, a drive percentage of 0% indicates the valve is not open. Choose either:

None: No valve information is displayed.

Main Screen: Valve drive displayed on the main display.



Show valve percentage.

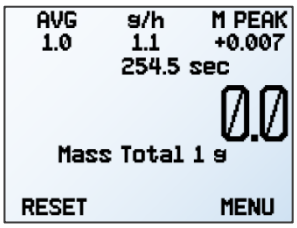
Totalizer

▶ Flow Instruments

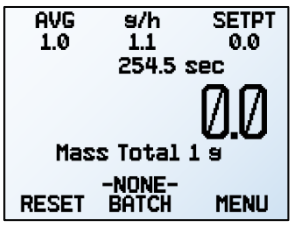
The totalizer measures the total flow over a given time. The current total values are shown in the Totalizer data screen.

Totalizer Data

- **AVG** displays the totalizer average mass or volumetric flow rate since the last reset, updated live.
- **g/h** (or another measurement of flow) displays the live flow rate.
- **SETPT** displays the current setpoint on controllers. Press to set or clear a setpoint (page 16).
- **M PEAK** or **V PEAK** displays the peak flow rate since the last totalizer reset (meters).
- **RESET** clears all totalized data and immediately resets the timer to 0. This starts a new batch immediately, if the controller has a non-zero setpoint and has a batch set.
- **BATCH** selects the quantity to be dispensed in each batch (controllers). **-NONE-** appears if the batch mode is off (page 17). Controllers only.
- **MENU** returns to the main menu.



Totalizer screen (meters).



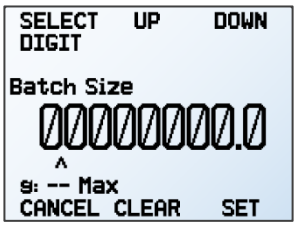
Totalizer screen (controllers).

You can select whether the **Totalizer screen** will show the total amount of **Mass** or **Volume** (page 20). You can also choose to show Totalizer data on the Main Screen instead of Live Data (page 22).

Batch Dispensing

▶ Flow Controllers

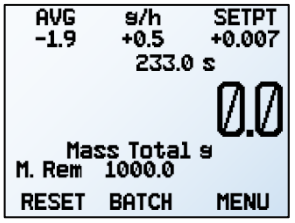
Batch dispensing flows a discrete amount of gas. Once that amount flows through the controller, the valve will close and the flow will stop. You can repeat batches with a single button press.



Batch screen (controllers).

Start a Batch

1. Click the **BATCH** button on the Totalizer screen.
2. Choose the total quantity to be dispensed.
3. Press **SET** to accept the new batch size.
4. Once a batch size has been set, give the controller a setpoint (page 16). Flow begins as soon as you press **SET**.



Totalizer screen with batch displayed (controllers).

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

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

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

Repeat a Batch

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

Pause or Cancel a Batch

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

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

Control Loop

▶ Flow Controllers

MENU → CONTROL → Control Loop

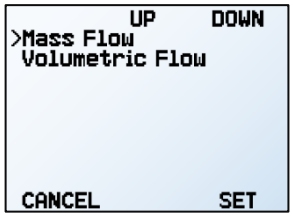
The control loop manages which parameter is controlled and how the controller reacts to system changes. If a particular response profile is required, or when multiple instruments need to provide the same response, tuning can be completed as described below.

Control Variable

MENU → CONTROL → Control Loop → Control

The controlled variable is the measurement the controller attempts to regulate to the given setpoint. Choose between **Mass Flow** or **Volumetric Flow**.

Controllers can only control one variable at a time, but they still measure the other variables during that time.



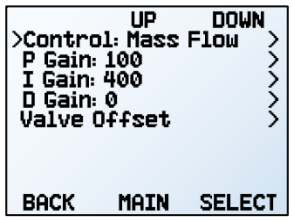
Control variable settings.

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

PID Control Algorithm

Once you select the flow type you can adjust the variables for the PID control algorithm. In general:

- The larger the P gain, the faster the controller corrects errors between the commanded setpoint and the measured 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 more the controller resists sudden changes in error, slowing down the response to help dampen oscillations and prevent overshoot. D gain is typically set to 0 by default.



Control loop settings.

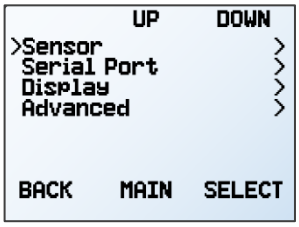
Valve Offset

Valve offset is the amount of valve drive required before the valve just opens and begins to flow a small amount. It may change with the pressure and/or temperature to which a valve is subjected, and it is expected to differ for different valve or flowing amounts.

Instrument Setup

Setup Screen

The setup screen shows a number of options for how the instrument is controlled and displays data.

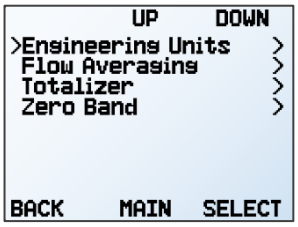


Setup menu.

Sensor Setup

MENU → SETUP → Sensor

Sensor setup options control how measurements are calculated and communicated by the instrument.

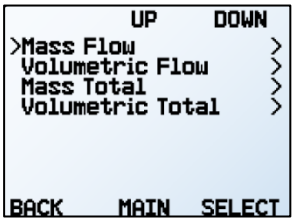


Sensor setup menu.

Engineering Units

MENU → SETUP → Sensor → Engineering Units

Choose the parameter and press **SELECT**. Then, choose an engineering unit and press **SET** to confirm.

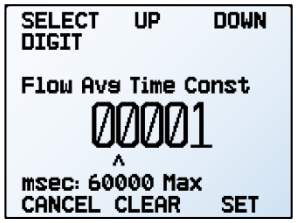


Engineering Units screen.

Flow Averaging

MENU → SETUP → Sensor → Flow Averaging

Averaging the flow over a longer time may be useful in smoothing fluctuating readings. This menu changes the time constants of the geometric running averages for flow. Values are the time constant (in milliseconds) of the averaged values. Higher numbers generate greater smoothing. The instrument is capable of a maximum 60000 ms (1 minute).



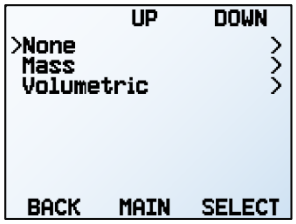
Adjusting the flow averaging time constant.

Totalizer

▶ Flow Instruments

MENU → SETUP → Sensor → Totalizer

The totalizer measures the total flow over a given time. The current total values are shown on the Totalizer data screen (**page** 17).



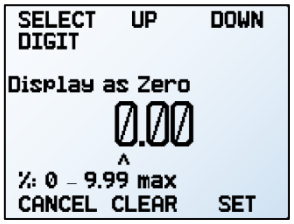
Totalizer On/Off screen.

Choose **Mass** or **Volumetric** to display the flow in mass or volume units on the Totalizer screen, in place of the Live screen (**page** 12). Choose **NONE** to stop showing Totalizer data; the Main screen will display Live Data instead.

Zero Band

MENU → SETUP → Sensor → Zero Band

The zero band threshold is an amount of flow below which measurements are displayed and reported as 0. The maximum zero band is 9.99% of full scale.



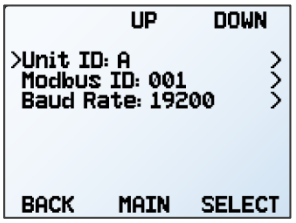
Zero Band screen.

Serial Communication Setup

MENU → SETUP → Serial Port

The data connection allows you to operate the instrument and to stream and log data. The options in this menu ensure that the instrument is ready to communicate.

For more on how to issue commands over serial communications, see page 25.



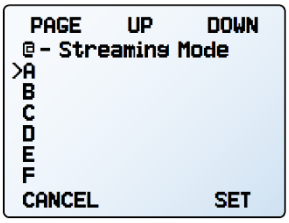
Serial communication menu.

Unit ID

MENU → SETUP → Serial Port → Unit ID

The unit ID identifies the instrument and distinguishes it to a networked computer. Using the unit ID letters **A–Z**, you can connect up to 26 instruments to a computer at the same time via a single COM port. This is called **polling mode**, which returns a single line of data each time you request it from the instrument. Unit ID changes take effect when you select **SET**.

If you select "**@**" as the Unit ID, the instrument enters **streaming mode**, in which the instrument automatically sends a line of live data at regular intervals.

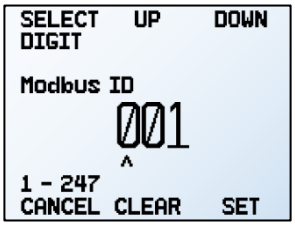


Choosing a unit ID, or streaming.

Modbus Address

MENU → SETUP → Serial Port→ Modbus ID

The Modbus RTU address is the identifier that a computer or programmable logic controller (PLC) uses to distinguish your instrument from others in a Modbus network. Usable values are 1–247.

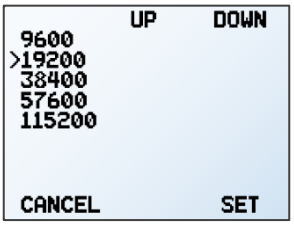


Modbus address menu.

Baud Rate

SETUP → Serial Port → Baud Rate

Baud rate is the speed at which digital instruments transfer information over a serial connection. The instrument has a default baud rate of 19200 baud (bits per second). If your computer or software uses a different baud rate, you must change the instrument's baud rate in the **BAUD menu** to ensure they match. Alternatively, you can change your computer's



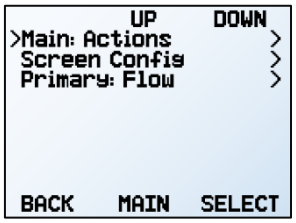
Baud rate screen.

baud rate (use Windows® Device Manager for most applications). Baud rate changes take effect once you press **SET**, but you may need to restart any software for it to recognize the change.

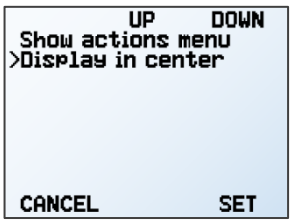
Display Setup

MENU → SETUP → Display

The options in the **display setup menu** control the general behavior of the display.



Display setup menu.



Main screen button behaviors.

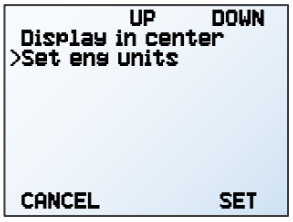
Actions Menu (Engineering Units)

MENU → SETUP → Display → Main

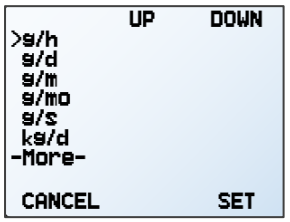
Buttons 4 and 5 can either display the process variable in the center of the screen, or they can be set to open the Actions Menu, allowing you to set the engineering units for mass or volumetric flow. From the Display Screen choose **Main**, then:

- choose **Display in center** to display that measurement in the center of the screen.
- choose **Show actions menu** to open the Actions menu when buttons 4 or 5 on the Main screen are pressed. The Actions Menu a

When **Show actions menu** is selected, pressing buttons 4 or 5 will open the Actions menu. Here, you can choose to display the variable in the center of the display or select **Set eng units** to choose the engineering units for that variable (page 20).



Actions menu.



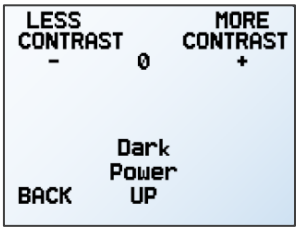
Engineering Units menu.

Screen Config

MENU → SETUP → Display → Screen Config

Press **LESS CONTRAST** or **MORE CONTRAST** to adjust the contrast levels.

Press **POWER UP** to toggle whether the backlight of the unit will be **Lit** or **Dark** when the instrument powers on.

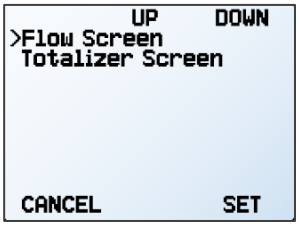


Display lighting options.

Primary

MENU → SETUP → Display → Primary

Select whether the **Flow Screen** (page 12) or **Totalizer** data (page 17) will be shown on the Main Screen when the instrument powers up.

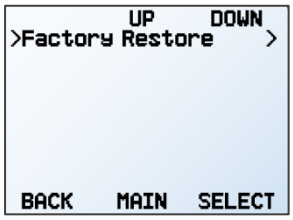


Select the Main screen content.

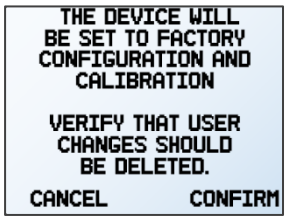
Factory Restore

MENU → SETUP → Advanced → Factory Restore

If something is not acting as expected, please contact an applications engineer prior to doing a **Factory Restore** to help confirm a restore is necessary. Choosing **Factory Restore** will return the instrument to its factory configuration and calibration. A warning will be displayed asking you to confirm the operation, which cannot be undone. Upon confirmation, all settings and registers will be returned to their default settings.



Advanced Setup screen.



Factory Reset warning.

Digital Control

CODA Series controllers and meters can be operated using digital or analog communication. Digital communication can be performed using Alicat FlowVision™ 2.0 software, ASCII serial commands, Modbus RTU, or analog signals.

- **FlowVision 2.0**: page 24
- **ASCII Serial Communication**: page 25
- **Modbus RTU**: page 30
- **Analog Communication**: page 36

FlowVision 2.0

FlowVision™ 2.0 is Windows-based software that enables easy collection and analysis of data from Alicat controllers and meters. FlowVision controls the instrument, runs scripts, and logs and charts data. It also provides easy access to select the gas, amount of flow averaging, and PID loop tuning to adjust response speed and stability for some applications.

Establishing Communication

To connect your instrument to FlowVision 2.0:

1. Download FlowVision 2.0 from alicat.com/flowvision and install.
2. With the instrument turned on and connected to the computer, start FlowVision 2.0.
3. Click Devices in the top left corner.
4. Click the green plus sign to add your instrument.
5. Select Wired for the connection type.
6. Specify the connection settings. By default, the Device ID is 1, and the Baud Rate is 19200. The Port is dependent on which COM port the instrument is connected to.
7. Specify a Name if desired. FlowVision 2.0 generates a name if the field is blank.
8. Click Add to complete the process.

FlowVision 2.0 contains several features for use with your CODA instrument. For more detailed instructions, please see the FlowVision 2.0 manual at alicat.com/flowvision.

Serial ASCII Communication

CODA instruments can use RS-232/485 serial communication for transmitting ASCII commands and data. This can be done using the Alicat serial terminal from alicat.com/drivers. Terminal is also available within FlowVision 2.0 (page 24).

Establishing Communication

Access the CODA ASCII serial interface through the USB port, DB-15 or M12 connectors on top of the instrument. Consult the pinouts on page 5 for information on how to wire a connector for CODA.

- When using a USB cable to connect your instrument to a Windows 10 computer, it should recognize your USB as a virtual COM port automatically. If not, please ensure the computer has the latest updates and drivers. If needed, links to USB drivers that can create virtual COM ports are found at alicat.com/drivers.
- After physically connecting your instrument to a Windows PC, you can check which COM port number it uses by opening the Windows Device Manager and expanding "Ports (COM & LPT)".
- The USB-C serial interface auto-detects and accepts any rate from 9.6 kbps to 12 mbps. The DB-15 and M12 connectors are configured with a baud rate of 19.2 kbps.

Unit ID

Each instrument has a unique, single-letter ID using the standard 26-letter English alphabet (e.g., A, B, C, etc.). The default ID is “A”. If more than one instrument has the same ID, data and commands become corrupted and do not report or execute properly. When connecting multiple instruments on the same COM port, connect one instrument at a time. Provide a unit ID command for each instrument before connecting the next instrument.

To give the most recently connected instrument an unused ID:

Change the unit id: *unit_id*@ *desired_id* ↵

Multi-drop Information

CODA instruments that are equipped with an RS-485/RS-232 interface can operate on networks with other instruments. The CODA RS-485 transceiver is a 1/2 unit-load transceiver. When deploying CODA instruments in an RS-485 network with multiple types of instruments, confirm that the total load of all instruments does not exceed 32 units on an unrepeated network segment. Consult the EIA-485 standard for more information.

Taring the Instrument

Taring ensures accurate measurements by giving the instrument a zero-reference point to measure from. See page 14 for more information on taring the instrument.

Tare the instrument: *unit_id* **V**↵

Do not start the flow again until the 10-second taring process is complete.

Measuring Total Flow

CODA instruments include a totalizer that can measure the total amount of flow that has passed through the instrument. The flow is measured until the totalizer is reset. Once the totalizer is reset, the measured flow begins measuring again from zero.

Reset the totalizer to zero: *unit_id* **T**↵

Analog Mass Flow Scale Factor

Analog mass flow outputs can be scaled up or down as needed. This means that the full-scale flow rates can correspond to a value above or below the maximum analog output of the instrument. The analog scaling factor affects the analog flow output in the following way:

$$ASF = \frac{MF \times MAO}{FSF \times AFO}$$

where **ASF** is the analog scale factor, **MF** is the mass flow, **MAO** is the maximum analog output, **FSF** is the full-scale flow, and **AFO** is the analog flow output.

For example, say a 10 kg/h full-scale instrument has a full-scale range of 0–5V analog I/O. To make 5V correspond to 5 kg/h:

$$ASF = \frac{5\ kg/h \times 5V}{10kg/h \times 5V} = 0.5$$

Modify the analog scale factor: (*unit_id* **CFG ASF** *new_parameter_value*↵).

The *new_parameter_value* is the analog scale factor, which can be any value from 0.0 to 5.0 (default is 1.0).

Volumetric Flow

Volumetric flow is calculated using the measured density. The instrument calculates the volumetric flow using the mass flow and the measured density (rather than the STP density). If the density is out of range, then volumetric flow cannot be measured.

The volumetric flow reading is useful if the flow liquid changes frequently, or if you do not know the exact density of the fluid. The downside of volumetric flow is that it is calculated from the mass flow and density readings, and thus errors are stacked from both of these readings.

If you know the density of your fluid, and the fluid will not change frequently, use standardized volumetric flow readings instead (see the following section).

Standardized Volumetric Flow

Standardized volumetric flow always uses the input STP density—the measured density does not affect it.

Standardized volumetric flow is the most common method for measuring gas flow. It is similar to, but more common than, using a true mass measurement. The density is calculated using the known density at the current standard temperature and standard pressure. By default, the standard temperature is 25°C and the standard pressure is 1 atmosphere (ATM).

Standardized volumetric flow can also be used for a liquid, when the liquid does not change and has a constant, known density. When the density of the flowing liquid is known, use its known density as the STP density.

In general, standardized volumetric flow will give the same results as volumetric flow for incompressible liquids, since the density will change very little with temperature and pressure conditions. Nevertheless, using standardized volumetric flow removes any error introduced by the density measurement used to calculate the volumetric flow reading.

If the liquid changes frequently, or the density is unknown, volumetric flow should be used (see above).

Set the STP Density: *unit_id* **CFG GASID** *new_parameter_value*↵

The *new_parameter_value* is the gas index number.

If a gas is not found in the index, its density can also be set manually.

Set the fluid density manually: *unit_id* **CFG DENS** *new_parameter_value*↵

The *new_parameter_value* is the new density value, in kg/m^3. See the parameter command table (page 28) for more information.

Changing the Setpoint

▶ Controllers

The setpoint is the flow rate that controllers attempt to achieve and maintain. A standard CODA controller does this by opening and closing the valve. A CODA pump controller does it by increasing and decreasing the power to the pump.

Change the setpoint: *unit_id* **S** *new_setpoint_value*↵

✓ ***Note**: The controller Setpoint Source must be set to Digital (See page 27) to change the setpoint using ASCII communication.*

Changing the Setpoint Source

The setpoint can either be controlled by analog or digital.

Change the setpoint source: *unit_id* **SPS** *new_setpoint_value*↵

Where *new_setpoint_value* is **0** for digital or **1** for analog.

Power-Up Setpoint

▶ Controllers

It is possible to save a setpoint the controller moves to whenever it is powered on. Analog does not have a power-up setpoint option.

Update the power-up settings: *unit_id* **CFG PUSP** *new_parameter_value*↵

Where *new_parameter_value* is 0–100% of current control variable range (values are 0–1.00). See the parameter command table (page 28) for more information.

Dispensing Flow in Batches

▶ Controllers

A CODA controller can dispense fluid in a user-defined batch, as a function of the totalizer. To set a batch, define the batch size, then choose a setpoint to begin flowing the batch. After the desired amount of fluid passes through the controller, the flow will stop. Flow can be restarted by removing the batch size or resetting the totalizer.

Define the batch size: *unit_id* **TB 1** *batch_volume*↵

Repeat a Batch

▶ Controllers

After the desired batch has flowed through the controller, the flow stops.

Perform another batch of the same size: reset the totalizer using *unit_id* **T**

Command Reference

Serial commands are not case-sensitive.

Change the unit ID:	*unit_id* **@** *new_unit_id*↵
Poll the live data frame:	*unit_id*↵
Tare flow:	*unit_id* **V**↵
New setpoint:	*unit_id* **S** *new_setpoint_value*↵
Reset totalizer:	*unit_id* **T**↵
Query batch size:	*unit_id* **TB 1**↵
Set totalizer batch**:**	*unit_id* **TB 1** *batch_volume*↵
Hold valve at current position:	*unit_id* **H**↵
Hold valve closed:	*unit_id* **HC**↵
Exhaust:	*unit_id* **E**↵
Resume closed loop control:	*unit_id* **C**↵
Firmware version:	*unit_id* **VE**↵
Configure parameter:	*unit_id* **CFG** *parameter_id new_parameter_value*↵

Parameters

When using the Configure Parameter command *unit_id* ***CFG*** *parameter_id new_parameter_value*↵, use the ID from the following table in place of *parameter_id* and the desired value in place of *new_parameter_value*. For example, to change the setpoint source to digital on an instrument with an ID of **A**, use **ACFG SPS 0** as the command. The following tables outline the different possible parameters that can be used with the configure parameter command.

Parameter	ID	Read/Write	Values
Serial number	SN	Read	Integer value
Modbus ID	MID	Read/Write	1–247 (Default is 1)
Baud rate	BAUD	Read/Write	RS-232/RS-485 baud rate 0: Auto-baud 1: 9600 2: 19200 3: 38400 4: 57600 5: 115200
Data frame	DATA	Read/Write	Configures the frame format for general query bit masks: 1: Density 2: Temperature 4: Volumetric flow rate 8: Mass flow rate 16: Setpoint (controllers only) 32: Total flow 64: Total time 128: Totalizer batch remaining (controllers only) 256: Valve drive (controllers only) 512: STP volumetric flow rate 32768: Status (see status table)

			By default, the parameter value starts at 33407. All statistics except for totalizer batch remaining and valve drive are enabled. If a statistic is enabled on an instrument that is not supported, (e.g., setpoint on a meter) the statistic is omitted from the data frame. To disable certain statistics in the data frame, subtract their value from the current parameter value (e.g., to disable total flow, subtract 64 from 33407 to obtain 33343). To enable a statistic, add its value to the current parameter value.
Power-up setpoint	PUSP	Read/Write	Floating point number: 0–100% of current control variable range
Setpoint source	SPS	Read/Write	0: Digital 1: Analog (Default)
Analog scale factor	ASF	Read/Write	0.0–5.0 (Default is 1.0)
Streaming speed	STR	Read/Write	Not applicable for RS-485 Integer ms value: 20–65535
Totalizer variable	TOTV	Read/Write	0: Mass flow rate (Default) 1: Volumetric flow rate
STP density	DENS	Read/Write	Manual density input using standard temperature and standard pressure. Floating point value.
Gas number ID	GASID	Read/Write	The identifier for the gas.
P gain	PGAIN	Read/Write	Floating point: normalized gain value from 0.0–1.0
I gain	IGAIN	Read/Write	Floating point: normalized gain value from 0.0–1.0
D gain	DGAIN	Read/Write	Floating point: normalized gain value from 0.0–1.0
Valve offset	VOFF	Read/Write	Floating point: normalized gain value from 0.0–1.0
Control loop variable	LVAR	Read/Write	0: Mass flow (Default) 1: Volumetric flow 2: Standardized volumetric flow
Mass flow unit	UOMM	Read/Write	See Appendix A (page 41) for available units and their corresponding value.
Volumetric flow unit	UOMV	Read/Write	See Appendix B (page 41) for available units and their corresponding value.
Totalizer unit	UOMT	Read/Write	See Appendix C (page 42) for available units and their corresponding value.

Status Codes

Commands that return a data frame can return one or more status codes. The *unit_id* **??D**↵ command also provides the possible status codes of the firmware currently installed.

Parameter	ID	Read/Write
MOV	Error	Mass flow over range. Reported mass flow value exceeds the valid range.
OVR	Warning	The totalizer rolled over or is stuck at maximum value.
TMF	Warning	Totalizer missed some flow due to flow over range. Total volume, totalizer average, and totalizer peak are not accurate.
TOV	Error	Temperature over range. The reported temperature exceeds the range in which mass flow is valid.
VOV	Error	Volumetric flow over range. The reported volumetric flow value exceeds the valid range.
ZRO	Status	Zeroing (tare) currently in progress.
DUV	Error	Density under range. Density is below measurable range.

DOV	Error	Density over range. Density exceeds measurable range.
EXH	Status	Exhaust. The controller is holding the valve open to clear the process.
HLD	Status	Valve Hold. The controller is holding the valve position and not actively controlling the process.

Modbus RTU Communication

All CODA instruments come with a digital serial interface in addition to the analog interface. Modbus RTU is available on all RS-232/RS-485 CODA instruments. You can read and log sensor data, switch between analog and digital control modes, adjust instrument settings, and control the instrument.

Establishing Communication

Depending on its configuration, you can access the CODA serial interface through the 15-pin or 8-pin connectors on top of the instrument. Consult the pinouts on page 9 for information on how to wire a connector for CODA. The USB-C port is reserved as a debug port and always has the default configuration to be used if communication to the instrument is lost. If connecting multiple instruments to the same port, do not use the USB-C port, use the 15-Pin or 8-Pin connectors instead.

When using a USB cable to connect your instrument to a Windows computer, it should recognize your USB as a virtual COM port automatically. If not, please ensure it has the latest updates.

After physically connecting your instrument to a Windows PC, you can check which COM port number it uses by opening the Windows Device Manager and expanding "Ports (COM & LPT)".

The default CODA Modbus configuration has the following settings:

- Data Bits: 8
- Stop Bits: 1
- Parity: None
- Flow Control: None
- Modbus ID: 1

The 15-Pin and 8-Pin connectors come configured with a baud rate of 19.2 kbps. The USB-C serial interface auto-detects and accepts any arbitrary rate from 9.6 kbps to 12 mbps.

Multidrop Information

CODA instruments equipped with an RS-232/RS-485 interface can operate on networks with other instruments. The CODA RS-485 transceiver is a 1/2 unit-load transceiver. When deploying CODA instruments in an RS-485 network with multiple types of instruments, confirm that the total load of all instruments does not exceed 32 units on an unrepeated network segment. Consult the EIA-485 standard for more information.

Modbus RTU Serial Protocol

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

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

Reading Process Data

Alicat CODA series mass flow instruments make no distinction between “Input” and “Holding” registers. Modbus function codes FC03 and FC04 can be used interchangeably to read data from the instrument.

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

Writing Control and Configuration Information

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

Taring the Instrument

Taring ensures accurate measurements by giving the instrument a zero-reference measurement point (see page 13).

Tare the instrument: write to registers 1000 and 1001 with command ID 4 and argument 1 to start the taring process. See the Special Commands table of the Modbus RTU section (page 30).

Do not start flow again until the 10-second taring process is complete.

Measuring Total Flow

CODA instruments include a totalizer that can measure the total amount of flow that has passed through the instrument. The flow is measured until the totalizer is reset. Once reset, the measured flow clears and begins measuring the new flow.

Reset the totalizer: write to registers 1000 and 1001 with command **`ID 5`** and argument **`0`**. See the Special Commands table of the Modbus RTU section (page 30).

Analog Mass Flow Scale Factor

Analog mass flow outputs can be scaled up or down as needed. This means that the full-scale flow rates can correspond to a value above or below the maximum analog output of the instrument.

The analog scaling factor affects the analog flow output in the following way:

$$ASF = \frac{MF \times MAO}{FSF \times AFO}$$

where **ASF** is the analog scale factor, **MF** is the mass flow, **MAO** is the maximum analog output, **FSF** is the full-scale flow, and **AFO** is the analog flow output.

For an example of calculating the analog mass flow scale factor see page 26.

Modify the analog scale factor: write the desired factor to registers 1142–1143.

The analog scale factor can be any value from 0.0 to 5.0 (default is 1.0).

Volumetric Flow

Volumetric flow is calculated using the measured density. The instrument calculates the volumetric flow using the mass flow and the measured density (rather than the STP density). If the density is out of range, then volumetric flow cannot be measured.

The volumetric flow reading is useful if the flow liquid changes frequently, or if you do not know the exact density of the fluid. The downside of volumetric flow is that it is calculated from the mass flow and density readings, and thus errors are stacked from both of these readings.

If you know the density of your fluid, and the fluid will not change frequently, use standardized volumetric flow readings instead (see the following section).

Standardized Volumetric Flow

Standardized volumetric flow always uses the input STP density—the measured density does not affect it.

Standardized volumetric flow is the most common method for measuring gas flow. It is similar to, but more common than, using a true mass measurement. The density is calculated using the known density at the current standard temperature and standard pressure. By default, the standard temperature is 25°C and the standard pressure is 1 atmosphere (ATM).

Standardized volumetric flow can also be used for a liquid, when the liquid does not change and has a constant, known density. When the density of the flowing liquid is known, use its density as the STP density.

In general, standardized volumetric flow will give the same results as volumetric flow for incompressible liquids, since the density will change very little with temperature and pressure conditions. Nevertheless, using standardized volumetric flow removes any error introduced by the density measurement used to calculate the volumetric flow reading.

If the liquid changes frequently, or the density is unknown, volumetric flow should be used (see previous section).

Set the STP Density: *unit_id* **CFG GASID** *new_parameter_value*↵

The *new_parameter_value* is the gas index number.

If a gas is not found in the index, its density can also be set manually.

Set the fluid density manually: *unit_id* **CFG DENS** *new_parameter_value*↵

The *new_parameter_value* is the new density value, in kg/m^3. See the parameter command table (page 28) for more information.

Changing the Setpoint

▶ Controllers

The setpoint is the flow rate that controllers attempt to achieve and maintain. A standard CODA controller does this by opening and closing the valve. A CODA pump controller does it by increasing and decreasing the power to the pump.

Change the setpoint: use either registers 1010–1011 or 1012–1013.

✓ ***Note**: The controller setpoint Source must be set to Digital to set the setpoint digitally. See page 32.*

Changing the Setpoint Source

The setpoint can either be controlled by analog or digital.

Change the setpoint source: write either 0 for digital, or 1 for analog, to register 18.

Power-Up Setpoint

▶ Controllers

It is possible to save a setpoint the controller moves to whenever it is powered on. Analog does not have a power-up setpoint option.

Set the power-up setpoint: use registers 1128–1129.

Dispensing Flow in Batches

▶ Controllers

A CODA controller can dispense fluid in a user-defined batch. Batching is a function of the totalizer on controllers. Once the batch size is defined, give the controller a setpoint to begin flowing the batch. After the desired amount of fluid passes through the controller, the controller stops the flow. Flow can be restarted by removing the batch size or resetting the totalizer.

Define the batch size: use registers 1015–1016. See the Modbus Control Registers table (page 34) for more.

Repeat a Batch

▶ Controllers

After the desired batch has flowed through the controller, the flow stops.

Perform another batch of the same size: reset the totalizer by writing to registers 1000 and 1001 with command ID 5 and argument 0. See the Special Commands table of the Modbus RTU section (page 35).

Modbus Reading and Status Registers

All parameters in this table are read-only access.

Register	Parameter	Data Format	Data Units	Firmware Version
1106–1107	Full scale mass flow	Float	Uses mass flow units (register 1134)	
1114–1115	Volumetric flow full scale	Float	Uses volumetric flow units (register 1135)	
1116–1117	Instrument native range	Float	g/h	2.22.3 / 4.2.3
1118–1119	Standardized volumetric full-scale flow	Float	Dependent on register 1135, volumetric flow units (page 34)	2.26.3
1150	Major firmware revision	UINT16	N/A	
1151	Minor firmware revision	UINT16	N/A	
1152	Firmware revision patch	UINT16	N/A	
1155–1156	Serial number	UINT32	N/A	
1201–1202	Status flags	Binary Array	See the status flags table in the following section.	
1203–1204	Density	Float	kg/m^3	
1205–1206	Tube temperature	Float	Degrees Celsius	
1207–1208	Volumetric flow	Float	Dependent on register 1135, volumetric flow units (page 34).	
1209–1210	Mass flow	Float	Dependent on Register 1134, mass flow units (page 34).	
1211–1212	Total flow	Float	Dependent on register 1138, total flow units (page 34).	
1213–1214	Mass flow setpoint (controllers)	Float	Dependent on register 1134, mass flow units (page 34).	
1215 – 1216	Totalizer time	Float	Seconds	

1217–1218	Batch remaining (controllers)	Float	Dependent on the units of the control loop variable (special command 11 (page 35).	2.21.18 / 4.01.01
1219–1220	Valve drive (controllers)	Float	0.0-1.0 (indicates the percentage of the drive's current voltage).	2.21.21 / 4.01.05
1229–1230	STP Volumetric Flow	Float	Dependent on register 1144, STP volumetric flow units and STP settings (page 34).	2.26.0 / 4.06.0
2049–2050	Mass flow percentage setpoint (controllers)	Float	% of full scale	
2053	Modbus ID	UINT16	N/A (1-247 accepted)	
2055	Volumetric flow over range	UINT16	0: False 1: True	
2056	Mass flow over range	UINT16	0: False 1: True	
2057	Temperature over range	UINT16	0: False 1: True	
2058	Totalizer rollover	UINT16	0: False 1: True	

Status Flags

When reading registers 1201 and 1202, the response provides a status, if one is present, and then a bit of what status is present. Refer to the following table to determine the cause of any status.

Bit	Interpretation	Firmware Version
0	Tare in progress	
1	Density under range	
2	Density over range	
3	Batch control active	2.26.0 / 4.06.0
4	Mass flow over range	2.26.0 / 4.06.0
5	Totalizer over range	2.26.0 / 4.06.0
6	Totalizer missed flow	2.26.0 / 4.06.0
7	Temperature over range	2.26.0 / 4.06.0
8	Volumetric flow over range	2.26.0 / 4.06.0
9	Invalid control variable	2.26.0 / 4.06.0
10	Valve in hold state	2.26.0 / 4.06.0
11-31	Reserved	

Modbus Control Registers

All parameters in this table are both read and write accessible.

Register	Parameter	Data Format	Data Units	Firmware Version
1000–1001	Command ID & argument	UINT16	N/A (see special command results status codes table page 35)	
1010–1011	Setpoint as % of full scale (controllers)	Float	Dependent on the loop control variable (special command 11, page 35) and full-scale flow.	
1012–1013	Setpoint (controllers)	Float	Dependent on the loop control variable (special command 11, page 35). Uses the controlled variable's unit (register 1134 or 1135).	
1015–1016	Batch size	Float	Dependent on the control variable	21.21.18 / 4.01.01
1018–1019	Direct valve drive	Float	0.0–1.0 (Requires direct valve drive engaged via special command 16, page 35.)	2.21.21 / 4.01.05
1021–1022	Flow reading gain	Float	0.1–10 (New flow = gain * base flow)	2.26.3
1026–1027	Ramp Time	UINT32	Value in milliseconds	2.26.3
1110–1111	Single exponential filter alpha gain	Float	0.0–1.0	
1112–1113	STP density	Float	kg/m^3	
1120–1121	Proportional gain	Float	0.0–1.0	
1122–1123	Integral gain	Float	0.0–1.0	
1124–1125	Derivative gain	Float	0.0–1.0	
1126–1127	Valve offset	Float	0.0–1.0	
1128–1129	Power-up setpoint	Float	% of controlled loop variable full scale (0.0–100.0). Dependent on loop control variable (special command 11, page 35) and full-scale flow.	
1134	Mass flow units	UINT16	N/A (Values found in Appendix A on page 41)	
1135	Volumetric flow units	UINT16	N/A (Values found in Appendix B on page 41)	
1137	Totalizer select	UINT16	0: Mass flow 1: Volumetric flow 2: Standardized volumetric flow	
1138	Totalizer units	UINT16	N/A (Values found in Appendix C on page 42)	
1139–1140	STP temp	Float	°C	2.26.3
1141	Gas number	UINT16	N/A	2.26.3
1142–1143	Analog scale factor	Float	0.0–5.0 (Default is 1.0)	2.26.3
1144	STP volumetric flow units	UINT16	N/A (Values found in Appendix B on page 41)	2.26.3
1145	Save totalizer to NV storage	UINT8	0: Save to volatile 1: Save to non-volatile	2.26.3

Special Commands

Access special control functions on CODA instruments with an FC16 write to registers 1000 and 1001. Special commands consist of a Command ID and a Command Argument written in a single pass to these registers. Each command/argument pair transmits as a set of two 16-bit unsigned integers. Commands start by a write to register

1000. If you send a command to register 1000 without sending an argument to 1001 the CODA instrument interprets the command with a default argument of 0.

Command Name	Command ID	Command Argument	Notes
Tare flow	4	**0:** Abort tare **1:** Start tare	Tare takes about 10 seconds to complete.
Reset totalizer value	5	**0:** Reset totalizer	
Change control loop variable	11	**0:** Control mass flow **1:** Control volumetric flow **2:** Standardized volumetric flow	Volumetric flow control does not function when density reading is out of range.
Save current setpoint	12	**0:** Save setpoint	Saved setpoint is loaded on power-up.
Valve control override	16	**0:** Cancel override **1:** Close valve **2:** Open valve **3:** Hold **5:** Direct drive	
Change setpoint source	18	**0:** Digital/serial setpoint **1:** Analog setpoint	
Change Modbus ID	32767	**1–247:** New ID	
Change serial baud rate	32768	**0:** Auto select **1:** 9600 **2:** 19200 **3:** 38400 **4:** 57600 **5:** 115200	

Special Command Result Status Codes

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

Download Serial Terminal for free at alicat.com/drivers. Once downloaded, simply run SerialTerminal.exe. Enter the COM port number to which your instrument is connected and the baud rate of the instrument. The default baud rate is 19200, but this is adjustable in the **`RS-232 Serial` menu** on your instrument (page 30).

Analog Signals

CODA mass flow instruments with a DB-15 connector include an analog output for both mass flow and density.

CODA controllers with an 8-pin M12 connector have a single analog output for mass flow. CODA meters with an 8-pin M12 connector have two outputs, one for mass flow and one for density (page 9).

The outputs are linear across the entire range, provided the load impedance is within the nominal values specified in the table below.

Analog I/O Electrical Characteristics

Inputs	0–5 V	0–10 V	4–20 mA
Maximum over range	+1 V	+2 V	+4 mA

Input impedance	200 kΩ	200 kΩ	250 Ω
Nominal source Impedance	<1 kΩ	< 1 kΩ	-
Nominal source voltage	—	—	0–5 V+
ADC sampling rate	50 Hz	50 Hz	50 Hz
ADC resolution	16 bit	16 bit	16 bit

Outputs	**0–5 V**	**0–10 V**	**4–20 mA**
Maximum over range	+1 V	+2 V	+4 mA
Minimum load impedance	>50 kΩ	>50k Ω	<500 Ω*****
Output impedance	10 kΩ	10 kΩ	—
DAC update rate	50 Hz	50 Hz	50 Hz
DAC resolution	14 bit	14 bit	14 bit

***** *Including sense resistor and wiring*

Analog I/O Data Ranges

Analog inputs and outputs for your instrument are calibrated at the factory. By default, the full-scale flow range maps 1:1 to the full scale voltage or current range of your instrument with a small over range allowed.

The full-scale range for density on CODA instruments is 0–2000 kg/m³. The CODA instrument is not sensitive enough to detect most gas densities, so it always outputs a density reading of 99 kg/m³ or higher.

Custom analog ranges may also be set by request at the factory. Factory custom analog ranges are listed on the calibration sheet.

WARNING*: Do not connect this instrument to "loop powered" systems, as this will destroy portions of the circuitry. If you must interface with existing loop powered systems, always use a signal isolator and a separate power supply.*

***Note**: The accuracy of the density readings is independent of the accuracy of the mass flow readings.*

Taring the Instrument

Taring ensures accurate measurements by giving the instrument a zero-reference measurement point (see page 13). CODA series instruments with analog connections have one pin that can be grounded to tare the instrument (page 9). Ground this pin for at least 5 seconds to initiate the 10-second taring process.

Tare Button

While not recommended, the instrument can be tared by pressing the tare button on the top of the instrument. Press and hold the button for 5 seconds. Once the process begins, release the button and allow 10 seconds for the process to complete.

WARNING*: Pressing the top button may disturb the process line, resulting in an improper tare.*

***Note**: Instruments with IP67 rating, and instruments with an M12 connector do not have a tare button.*

Changing the Setpoint

▶ Controllers

The setpoint is the flow rate that controllers attempt to achieve and maintain. A standard CODA controller does this by opening and closing the valve. A CODA pump controller does it by increasing and decreasing the power to the pump.

Refer to the Power and Signal Connections (page 9) and Analog Communication (page 36) section for the setpoint pins and connections

Troubleshooting

If you run into trouble with installation or operation, contact support (page 2).

Issue: **I can't communicate with the instrument when it's connected to my PC.**

Action: 1. Ensure the baud rate of the software being used matches the baud rate of the instrument.
2. Check the unit ID and confirm it's the expected ID. This can be done by connecting to the USB-C port as it is always Modbus ID 1.
3. Ensure you are connecting to the same COM port as the instrument.
4. Confirm the external serial communications instrument (computer, PLC, etc.) flow control settings are set to on.
5. Check the pinout of the instrument and confirm the correct pin is connected (page 9).

Issue: **I updated the Modbus ID and now I can't communicate with the instrument.**

Action: The ID may have been improperly updated and has a different ID than intended. Connect to the instrument using the USB-C connection and try to communicate with the instrument using ID A. The USB-C connection always communicates on Modbus ID 1 and does not update when the ID updates.

Issue: **My controller won't reach its setpoint, or the readings aren't as high as I expect.**

Action: This can be caused by not enough supply pressure in the system. Increase the inlet pressure to see if measurements improve.
If increasing the pressure doesn't help, check the system for a clog. Teflon tape can get trapped in the system and block flow if not applied properly. Clear out any debris that may be found and attempt the process again. If needed, a CODA instrument can have flow pass through it in reverse (right to left) to help diagnose a possible blockage.

Issue: **My controller doesn't maintain its setpoint and may fluctuate up or down.**

Action: Controllers use a PID control loop algorithm (with the D term set to 0) to reach the given setpoints. If you are familiar with PID algorithms, the parameters can be adjusted using Modbus registers 1120–1125 or in FlowVision 2.0. If you are not familiar with the algorithm, please contact Alicat support for assistance before performing any modifications (page 2).

? *Still experiencing issues? Please contact support. See page 2.*

Maintenance

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

Wetted Materials

The wetted materials incorporated in Alicat's CODA instruments are compatible with media and conditions, such as pressure and temperature, which were specified at the time they were ordered. If you are planning to use the instrument with other media or in other conditions, or with third party components, always check the wetted materials compatibility, including seals materials. Wetted materials lists are found in the CODA technical specifications. Consult third party documentation, if applicable, to check the incorporated materials.

Cleaning

This instrument requires minimal maintenance. If necessary, the outside of the instrument may be cleaned with a soft dry cloth. Avoid excess moisture or solvents. CODA mass flow instruments used with gas require no periodic cleaning, provided they have been flowing clean, dry gas.

CODA mass flow instruments used with liquids require some precautions to avoid contamination and/or corrosion damage. Liquid should be filtered for particulates or biological materials that may grow in the instrument. When removing these units from the line for any extended period, remove all liquid from the instrument, as deposits of calcium or other soluble minerals can affect the accuracy of the instrument.

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

Repair

For repair or recycling of this product contact Alicat support (page 2).

Recalibration

CODA instruments are calibrated to NIST-traceable standards at the time of manufacture. Though the Coriolis technology has a low tendency to drift, other factors can affect your results. Consequently, Alicat's limited lifetime warranty requires that an annual recalibration cycle is maintained. To review current warranty terms go to alicat.com/warranty/.

Recalibration can be requested at your discretion/requirement by submitting a form with the instrument serial number at alicat.com/service. (page 2).

Replacement Accessories

Accessories are available through Alicat support (page 2) or at alicat.com/accessories.

Technical Specifications and Dimensional Drawings

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

Appendices

Appendix A: Mass Flow Unit Values

Changes to the mass flow units will affect the setpoint units. When using FlowVision (see page **24**), the screen must be refreshed to reflect the new units.

Mass Flow Unit	Command Value
Milligrams per second (mg/s)	17
Milligrams per minute (mg/m)	14
Grams per second (g/s)	5
Grams per minute (g/m)	2
Grams per hour (g/h)	0
Kilograms per second (kg/s)	11

Appendix B: Volumetric Flow Unit Values

Changes to the volumetric flow units will affect the setpoint units. When using FlowVision (see page **24**), the screen must be refreshed to reflect the new units.

Volumetric Flow Unit	Standard Volumetric Flow Unit	Command Value
Milliliters per second (mL/s)	Standard milliliters per second (SmL/s)	29
Liters per second (L/s)	Standard liters per second (SL/s)	28
Liters per minute (LPM)	Standard liters per minute (SLPM)	27
Liters per hour (L/h)	Standard liters per hour (SL/h)	0
US gallons per minute (US GPM)	Standardized US gallons per minute (Standardized US GPM)	25
US gallons per hour (US GPH)	Standardized US gallons per hour (Standardized US GPH)	24
Cubic centimeters per second (CCS)	Standard cubic centimeters per second (SCCS)	9
Cubic centimeters per minute (CCM)	Standard cubic centimeters per minute (SCCM)	8
Cubic centimeters per hour (cm3/h)	Standard cubic centimeters per hour (Scm3/h)	7
Cubic meters per minute (m3/m)	Standard cubic meters per minute (Sm3/m)	16
Cubic meters per hour (m3/h)	Standard cubic meters per hour (Sm3/h)	15
Cubic meters per day (m3/d)	Standard cubic meters per day (Sm3/d)	14
Cubic inches per minute (in3/m)	Standard cubic inches per minute (Sin3/m)	12
Cubic feet per minute (CFM)	Standard cubic feet per minute (SCFM)	10

Appendix C: Totalizer Unit Values

Mass Flow Totalizer Unit	Volumetric Totalizer Unit	Command Value
Grams (g)	Liters (L)	0
US ton (t)	US gallon (US G)	27
Milligrams (mg)	cubic centimeters (cm3)	11
Pounds (lb)	cubic meters (m3)	16
Kilograms (kg)	N/A	10
US ounce (US oz)	N/A	12
N/A	Cubic inches (in3)	14
N/A	Cubic feet (ft3)	13
N/A	Milliliters (mL)	34
N/A	Microliters (µL)	33