ALICAT KC Coda-Series Coriolis Mass Flow Controller User Manual

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ALICAT KC Coda-Series Coriolis Mass Flow Controller

Getting Started

Getting to Know Your CODA KC-Series Coriolis Mass Flow Controller

Connectors and Buttons

The drawing on the following page represents a typical KC-Series mass flow controller. Your device's appearance and connections may differ.

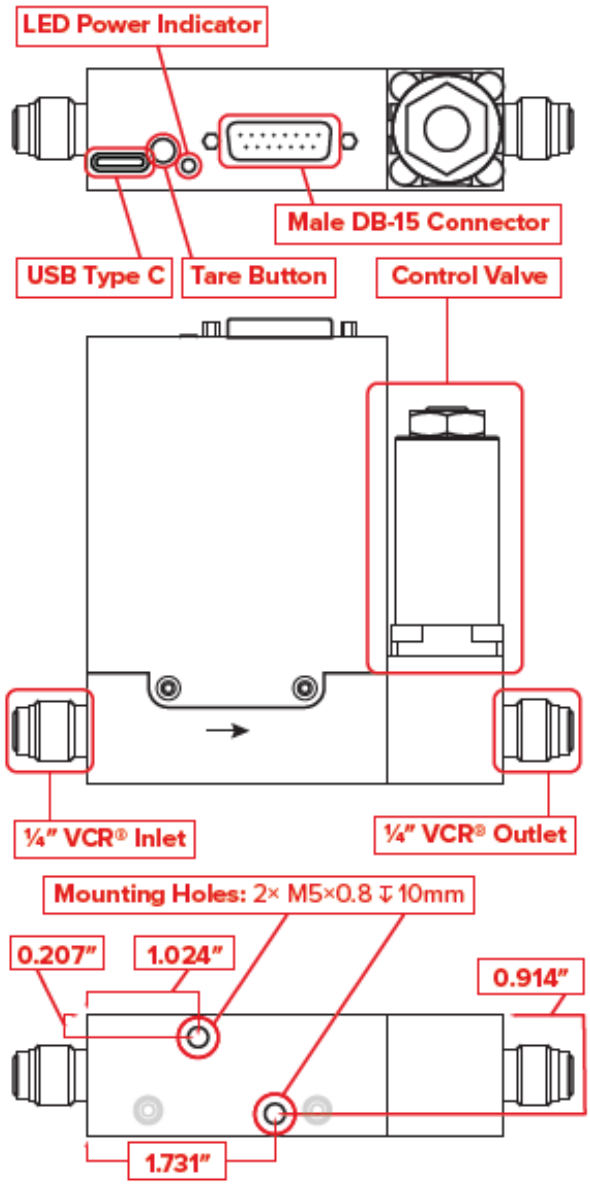
Mounting

All CODA KC-Series mass flow controllers have mounting holes on the bottom for convenient attachment to flat panels. No straight runs of pipe are required upstream or downstream. These devices are position insensitive and can be mounted in any orientation.

Note: Tare the controller after changing its position or orientation.

LED Indicator

The multicolor LED indicator light continuously displays green when power is supplied to the instrument. The LED light will also show red when transmitting or receiving through serial communication.



Plumbing

Process Ports

Your CODA KC-Series Coriolis mass flow controller has been shipped with ¼" VCR®-compatible male process connections. Use in-line filters to prevent large particulates from entering the device. The suggested maximum particulate size is 1 micron for controllers.

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.

Maximum Pressure

The maximum operating pressure for KC-Series controllers is dependent on the installed valve. Each device includes a calibration sheet that lists its maximum operating pressure. Above the maximum operating pressure, the valve may fail to open when commanded.
The device specification sheet will also list the burst pressure. Operating above the burst pressure, even briefly, will result in the device rupturing.

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

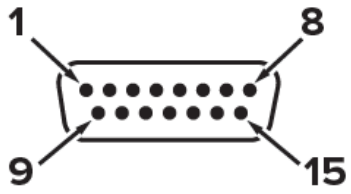
Connecting Plumbing

Ensure that flow through your controller is in the same direction as the arrow on the flow body (usually left to right).

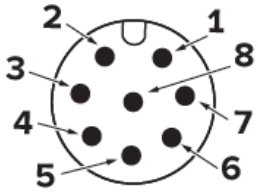
Power and Signal Connections

The USB-C connector on top of the device provides a serial interface to CODA KC-Series mass flow controllers. Controllers require power via either the DB-15 or the M12 connector. The USB-C connector is not available on IP67-rated devices. By default, CODA instruments have a male DB-15 connector.

Note: The DB-15 and M12 pinouts for CODA differ from those of standard Alicat products



Male DB-15 on the device



Male M12 on the device

Pin	Male DB-15 on the device Function	Male M12 on the device Function
1	Analog setpoint input	0–5 Vdc output of mass flow rate *Optional: 0–10 Vdc or 4–20 mA*
2	Ground (analog setpoint)	Power in (9–33V)
3	0–5 Vdc output of mass flow rate *Optional: 0–10 Vdc or 4–20 mA*	Serial RS-232 RX *Optional: RS-485 (—)*
4	0–5 Vdc output of density *Optional: 0–10 Vdc or 4–20 mA*	Remote tare (ground to tare)
5	Ground (analog signals)	Serial RS-232 TX *Optional: RS-485 (+)*

6	Not connected	Analog setpoint input (0–5V)
7	Not connected	Ground (common for power and digital communications)
8	Valve drive control (Vdc)	Ground (analog setpoint and signal)
9	Power in	—
10	Ground (common for power and digital communications)	—
11	Not connected	—
12	Remote tare (ground to tare)	—
13	Not connected	—
14	Serial RS-232 TX *Optional: RS-485 (+)*	—
15	Serial RS-232 RX *Optional: RS-485 (—)*	—

Taring your Device

Taring ensures accurate measurements by giving the device a zero reference. The taring process takes 10 seconds

to complete once it begins. Prior to taring, flow fluid through the device and then stop flow to establish a no-flow condition while there is fluid present throughout the instrument. For best results, allow the electronics and the flow 15 minutes to reach a steady state temperature before taring.

How to Tare
There are three ways to communicate a tare command to a CODA KC-Series mass flow controller.

Tare via Analog
Every KC-Series controller has one pin that can be grounded to tare the device. Simply apply a good ground to this pin for at least 5 seconds to initiate the 10-second taring process (page 7).

Tare via Serial
CODA KC-Series controllers can be tared by pushing the “Zero Device” button in Alicat’s CODA View program (page 15). Once this button is pressed, the program will indicate that a tare is in progress. Do not start flow again until this process is complete. For taring via Modbus RTU serial protocol, please see Table 4 (page 14).

Tare via Button
While not recommended, the device can also be tared by pressing the tare button on the top of the device for 5 seconds to begin the 10-second taring process.

- **Warning:** Tare via the top button may result in an improper tare due to disturbance of the measurement tube caused by pressing the button.
- **Note:** Devices with an IP67 rating will not have a tare button.

When to Tare

- After installing the controller in a different orientation.
- After a significant impact to the flow controller.
- After changing fluid.

Communication

Analog Communication
KC-Series mass flow controllers with a DB-15 connector include an analog output for both mass flow and density. CODA instruments with the optional 8-pin M12 connector have a single analog output for mass flow (page 7). Both of these 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:	**0–5V**	**0–10V**	**4–20mA**
Maximum Overrange	+1V	+2V	+4mA
Input Impedance	200 kΩ	200 kΩ	250 Ω
Nominal Source Impedance	<1 kΩ	< 1 kΩ	–
Nominal Source Voltage	—	—	0–5V+
ADC Sampling Rate	50 Hz	50 Hz	50 Hz
ADC resolution	16 bit	16 bit	16 bit
Outputs:	**0–5V**	**0–10V**	**4–20mA**
Maximum Overrange	+1V	+2V	+4mA
Nominal Circuit Resistance	<500Ω	<1kΩ	<500Ω*
Output Impedance	1 kΩ	1kΩ	—
DAC Update Rate	50 Hz	50 Hz	50 Hz
DAC Resolution	14 bit	14 bit	14 bit

Analog I/O Data Ranges
Analog inputs and outputs for your device were calibrated at the factory. By default, the full-scale flow range maps

1:1 to the full-scale voltage or current range of your device with a small over range allowed.
Custom analog ranges may also be set from the factory. Factory custom analog ranges will be listed on the calibration sheet.
The full-scale range for density on CODA devices is 0–2000 kg/m ^{3}. The CODA device is not sensitive enough to detect most gas densities, so it will always output a density reading of 99 kg/m ^{3} or higher.

Note: The density readings and accuracy are independent of mass flow readings and accuracy.
Warning: Do not connect this device 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.

Serial Communication
All CODA devices come with a digital serial interface in addition to the analog interface. Modbus RTU is the default communications protocol for KC-Series controllers. You can read and log sensor data, switch between analog and digital control modes, adjust device settings, and control the device over this serial interface.

Establishing Communication
You can access the CODA serial interface through the USB port, 15-pin, or 8-pin connectors on top of the device. Consult the pinouts on page 7 for information on how to wire a connector for CODA.

- If you have used a USB cable to connect your device to a computer running Windows 10, it should recognize your USB as a virtual COM port automatically. If not, please ensure it has the latest updates.
- Once you have physically connected your device to a Windows PC, you can check which COM port number it is using by opening the Windows Device Manager and expanding “Ports (COM & LPT)”.
- The CODA device will be configured with 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 pre-configured with a baud rate of 19.2 kbps. The USB-C serial interface will autodetect and accept any arbitrary rate from 9.6 kbps to 12 Mbps.

Reading Process Data
Alicat CODA KC-Series mass flow controllers make no distinction between “Input” and “Holding” registers. Modbus function codes FC03 and FC04 can be used interchangeably to read data from the device.
Sensor and process values are stored as big-endian, 32-bit IEEE-754 floating-point numbers spanning two registers. Your control system will need to concatenate these into a single value to interpret them correctly.
Alternate registers intended to simplify the re-use of code written for non-CODA Alicat devices are included in parentheses. You can use either or both.

Writing Control and Configuration Information
All command and control requests to a CODA instrument are issued with Modbus function code FC16: “write multiple registers”. For PID tuning assistance, please contact Alicat.

Modbus Reading and Status Registers

Note: All parameters in this table are read-access only.

Parameter	Register	Data Format	Data Units
Status Flags (next table)	1201..1202	Binary Array	Boolean
Density	1203..1204 (2041..2042)	Float	kg/m³
Temperature	1205..1206 (2043..2044)	Float	°C
Volumetric Flow*	1207..1208 (2045..2046)	Float	m³/h
Mass Flow*	1209..1210 (2047..2048)	Float	g/h
Total Flow	1211..1212 (2051..2052)	Float	g
Mass Flow Setpoint	1213..1214	Float	g/h
Totalizer Time	1215..1216	Float	s
Percent Setpoint	2049..2050	Float	% Full Scale
Modbus ID	2053	Unsigned Int	N/A (1–247 Accepted)
Volume Over-range	2055	Unsigned Int	Boolean
Mass Flow Over-range	2056	Unsigned Int	Boolean
Temperature Over-range	2057	Unsigned Int	Boolean
Totalizer Rollover	2058	Unsigned Int	Boolean

Status Flags

Bit	Interpretation
0	Tare in progress
1	Density under-range
2	Density over-range
3–31	Reserved

Modbus Control Registers

Note: All parameters in this table are both read and write access.

Parameter	Register	Data Format	Data Units
Command ID & Argument	1000..1001	2× Unsigned Int	N/A (See Special Command Result Status Codes table)
Controller Setpoint as % of Full Scale	1010..1011	Float	% Full Scale
Controller Setpoint as g/h*	1012..1013	Float	g/h
Full Scale Flow*	1108.1109	Float	g/h
Single Exponential Filter Alpha Gain	1110..1111	Float	0.0–1.0
Proportional Gain	1120..1121	Float	0.0–1.0
Derivative Gain	1122..1123	Float	0.0–1.0
Integral Gain	1124..1125	Float	0.0–1.0
Valve Offset	1126..1127	Float	0.0–1.0

* Other default units are available by custom order. Please confirm units on the calibration sheet.

Special Commands
You can access special control functions on CODA KC-Series mass flow controllers with an FC16 write to registers 1000..1001. Special commands consist of a Command ID and a Command Argument written in a single pass to these registers. Each command/argument pair is issued as a set of two 16-bit unsigned integers. Commands are started by a write to register 1000. If you send a command to register 1000 without sending an argument to 1001 the CODA instrument will interpret the command with a default argument of 0.
At any time after sending a special command to registers 1000..1001 you can perform a read of the same registers to determine the success or failure of the last command. Register 1000 will store the last Command ID sent to the device, and register 1001 will return a status code indicating the command result. The Special Command Result Status Codes table below lists these codes.

Special Commands and Arguments

Command Name	Command ID (Register 1000)	Command Argument (Register 1001)	Notes
Tare Flow	4	0: Abort tare 1: Start tare	Tare takes ≈ 10 seconds
Reset Totalizer Value	5	0: Reset totalizer	
Change Control Loop Variable	11	0: Control Mass Flow 1: Control Volumetric Flow	Volumetric flow control is nonfunctional while density reading is out of range

Save Current Setpoint to Memory	12	0: Save setpoint	Saved setpoint will be loaded on device power-up.
Pause Totalizer	15	0: Pause totalizer 1: Resume totalizer	
Valve Control Override	16	0: Cancel override 1: Close valve 2: Open valve	
Save Control Gains to Memory	17	1: Save Gains	Gain values are adjusted via registers 1100–1105. Unsaved gains will be lost on power interruption
Change Setpoint Source	18	0: Digital setpoint 1: Analog setpoint	
Change Modbus ID	32767	1–247 = New ID	Requires a power cycle to take effect
Change Serial Bitrate	32768	0: Auto select 1: 9600, 2: 19200 3: 38400 4: 57600 5: 115200	Requires a power cycle to take effect

Special Command Result Status Codes

Status Code	Result
0	Success
32769	Invalid command ID
32770	Invalid setting
32771	The requested feature is unsupported

Alicat's CODA View Interface

Alicat's CODA View is a pre-configured LabVIEW program for digital communications with CODA-Series devices only (other Alicat models will not communicate through this program). It is available as a stand-alone executable that only requires the free LabVIEW 2018 and NI-VISA 2018 runtime engines built by National instruments.

- Download CODA View and the required runtime engine installers for free from **alicat.com/CODAView**.
- After opening the CODA View program, select the COM port your device is connected to in the top left corner, and click “Connect”.
- If connecting via the USB-C connection on the CODA instrument, please ensure that the computer recognizes the device’s USB port as a valid device. If it is plugged in after the program was launched, the “Refresh” option may need to be selected in the COM port dropdown.
- Once the device is connected, the graph will populate immediately.
- To log data, first, choose your logging rate (1 second by default).
- Then, click “Start log” to begin logging data. A blue indicator will appear next to “Logging” once logging has begun, and the auto-generated file path for the data log will be displayed in the “Log file path” indicator.

Maintenance

Cleaning

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

CODA KC-Series mass flow controllers used with gas require no periodic cleaning, provided they have been flowing clean, dry gas.

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

Recalibration

CODA instruments are calibrated to NIST traceable standards at the time of manufacture. Due to the Coriolis technology, there is not a factory-recommended periodic recalibration cycle. Recalibration can be requested at the user’s discretion/requirement by submitting a form with the device serial number at alicat.com/service.

Replacement Accessories

Accessories are available through support (page 2), or on our website at **alicat.com/accessories**.

For repair, recalibration, or recycling of this product contact us

Technical Specifications and Dimensional Drawings

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

Limited Lifetime Warranty

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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 the expiration of the applicable warranty period stated above shall be conclusive evidence that the warranty is fulfilled to the full satisfaction of the 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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Documents / Resources

ALICAT KC Coda-Series Coriolis Mass Flow Controller [pdf] User Manual
KC, Coda-Series Coriolis Mass Flow Controller, KC Coda-Series Coriolis Mass Flow Controller

References

- **Alicat | - -**