



A **Halma** company

OPERATING MANUAL

CODA-SERIES CORIOLIS

MASS FLOW CONTROLLER

Model KC

**Thank you for purchasing your
CODA-Series Coriolis mass flow controller.**

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This device comes with a NIST traceable calibration certificate.



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



This device complies with the requirements of the Low Voltage Directive 2014/35/EU and the EMC Directive 2014/30/EU and carries the CE Marking accordingly.



This device complies with the requirements of the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC

Rev. 2 • 2021-01-21 • DOC-MANUAL-KC

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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

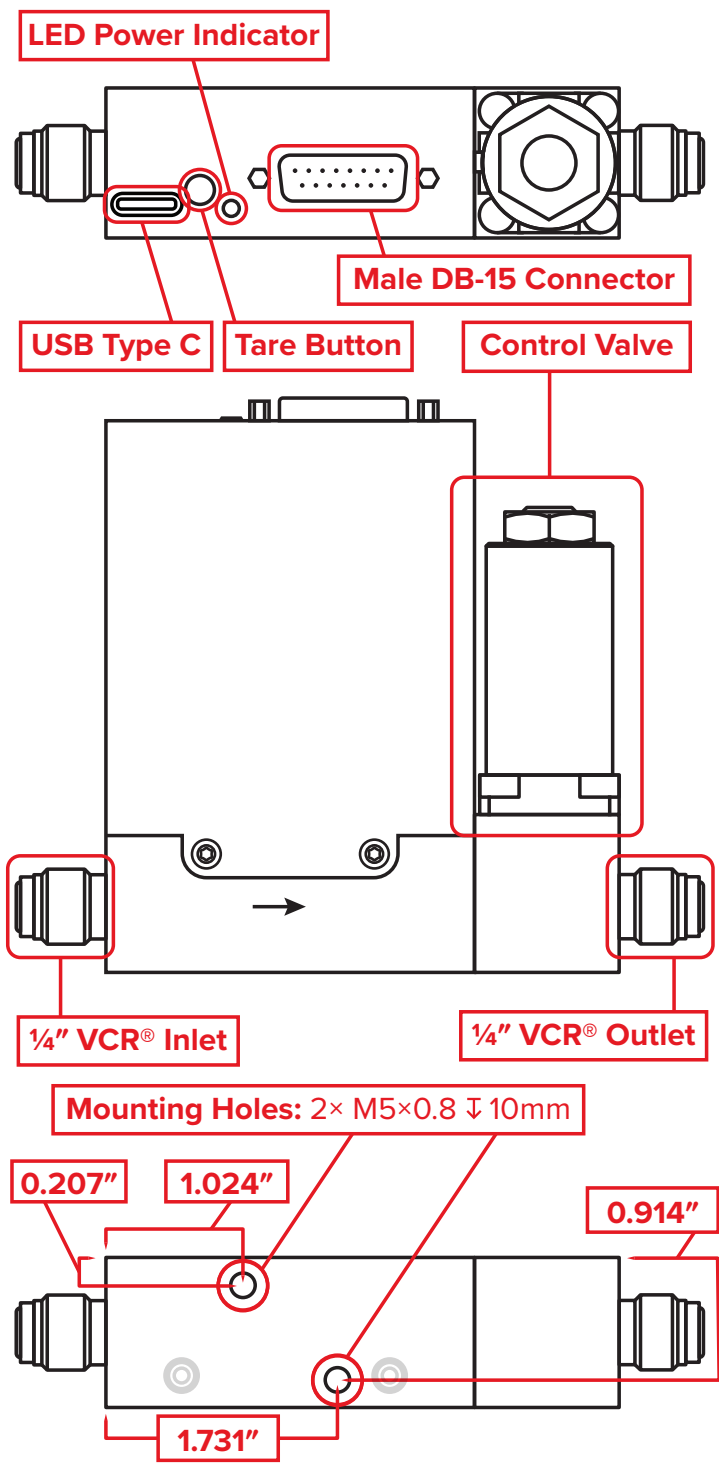
All CODA KC-Series mass flow controllers have mounting holes on the bottom for convenient attachment to flat panels. No straight runs of pipe are required upstream or downstream. These devices are position insensitive and can be mounted in any orientation.



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

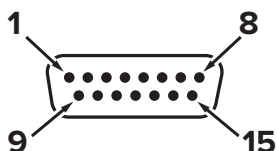
Ensure that flow through your controller is in the same direction as the arrow on the flow body (usually left to right).

Power and Signal Connections

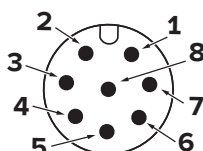
The USB-C connector on top of the device provides a serial interface to CODA KC-Series mass flow controllers. Controllers require power via either the DB-15 or the M12 connector. The USB-C connector is not available on IP67-rated devices. By default, CODA instruments have a male DB-15 connector.



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	Function	Function
1	Analog setpoint input	0–5 Vdc output of mass flow rate <i>Optional: 0–10 Vdc or 4–20 mA</i>
2	Ground (analog setpoint)	Power in (9–33V)
3	0–5 Vdc output of mass flow rate <i>Optional: 0–10 Vdc or 4–20 mA</i>	Serial RS-232 RX <i>Optional: RS-485 (–)</i>
4	0–5 Vdc output of density <i>Optional: 0–10 Vdc or 4–20 mA</i>	Remote tare (ground to tare)
5	Ground (analog signals)	Serial RS-232 TX <i>Optional: RS-485 (+)</i>
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 <i>Optional: RS-485 (+)</i>	–
15	Serial RS-232 RX <i>Optional: RS-485 (–)</i>	–

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 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 k Ω	200 k Ω	250 Ω
Nominal Source Impedance	<1 k Ω	< 1 k Ω	-
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	<500 Ω	<1k Ω	<500 Ω *
Output Impedance	1 k Ω	1k Ω	—
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 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 overrange 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/m³. The CODA device is not sensitive enough to detect most gas densities, so it will always output a density reading of 99 kg/m³ 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
 - Parity: None
 - Modbus ID: 1
 - Stop Bits: 1
 - Flow Control: None
- 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.

Multidrop Information

CODA devices equipped with an RS-485 interface can operate on networks with other devices. The CODA RS-485 transceiver is a ½ unit-load transceiver. When deploying CODA devices in an RS-485 network with multiple types of devices be sure to confirm that the total load of all devices does not exceed 32 unit loads on an unrepeat network segment. Consult the EIA-485 standard for more information.

CODA KC-Series devices equipped with an RS-232 interface do not have a multidrop capable RS-232 transceiver.

If a CODA device is plugged into an RS-232 network with other devices which have been adapted to support multidrop communication over RS-232 it will load the bus excessively and prevent other devices from communicating on that network. This includes other Alicat M-Series, L-Series, and P-Series devices.

Modbus RTU Serial Protocol

Alicat uses the Modbus standard in which registers are offset by 1 from addresses, meaning register 1 is equivalent to address 0, but 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 then decrement all register references 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 the manual can be used as-is. If the device returns a value of 0 instead of an error, decrement all registers listed in this section by 1 to arrive at the correct offset.

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 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/m ³
Temperature	1205..1206 (2043..2044)	Float	°C
Volumetric Flow*	1207..1208 (2045..2046)	Float	m ³ /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

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

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 accessible.

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 available by custom order. Please confirm units on 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 Birtate	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	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. 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 ([page 2](#)).

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

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

Under this warranty, the Products will be repaired or replaced at manufacturer's option, without charge for parts or labor when the Product is carried or shipped prepaid to the factory together with proof of purchase.

The foregoing shall constitute the exclusive and sole remedy in lieu of other remedies of the Buyer for any breach by Alicat Scientific of this warranty to the maximum extent permitted by law.

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

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

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

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

Alicat's warranties as herein above set forth shall not be enlarged, diminished or affected by, and no obligation or liability shall arise or grow out of Alicat's

rendering of technical advice in connection with Buyer's order of the Products furnished hereunder.

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

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

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

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

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

Accessories purchased from Alicat are not covered by this warranty.

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



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