ALICAT SCIENTIFIC

SERIAL COMMUNICATIONS PRIMER

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Introduction

The **Serial Communications Primer** is intended to provide information on the RS-232/485 communications of Alicat devices. Only the most common features and settings are covered in this manual. If your application would benefit from a feature or setting not found in this guide, please contact Alicat technical support for assistance (page 2).

Firmware Versions

As Alicat devices have evolved over the years, so too has the firmware. Each new version allows the device to hold more information and utilizes commands with greater functionality. To determine the firmware installed on your device, either check the device info via the display screen or use the firmware version command provided in **Device Setup** (page 22).

The following is an overview of firmware versions by order of release from oldest to newest.

- **GP:** Devices that have a firmware version beginning with “GP” have the oldest circuit boards. Due to hardware incompatibility, it is not possible to upgrade GP devices to a more recent firmware version. GP firmware devices require extra characters (**$$**) placed directly after the ***unit_id*** in the command prompt.
- **1v–7v:** Devices that have firmware versions beginning with 1v through 7v have a different circuit board from the GP firmware. Devices with a serial number of less than 135,000 have an older processing chip allowing upgrades to only 6v firmware. Devices with serial numbers above 135,000 can upgrade to 7v as they have a newer processing chip installed.
- **8v–9v:** Devices with a firmware version beginning with 8v or 9v have comparable circuit boards. 7v and lower cannot upgrade to 8v or higher. Older serial commands did not change, but new commands and greater functionality were added.
- **10v:** Devices with 10v firmware have the newest circuitry. As of March 2022, this is the newest firmware available. The serial commands did not change, but new commands and features were added. Due to hardware incompatibility, 9v devices and below cannot upgrade to 10v firmware.

For more information on firmware versions and the changes in each version, please see alicat.com/support/knowledge-base/.

Quick Command Reference

The following is a quick reference for those already familiar with Alicat serial commands. For further explanations and possible variable options, see **Basic Commands** (page 9) and **Additional Commands** (page 13). Commands are formatted bold black and capitalized (**EXAMPLE**) while variables are blue and italicized lowercase (*example*).

Action	Applicable Devices	Firmware Introduction	Command
DATA READINGS:			
Auto-tare	Controllers	10v05	*unit_id***ZCA** *enable delay*
Data frame configuration	All	6v00	*unit_id***FDF** *format*
Data frame query	All	6v00	*unit_id***??D***
Engineering units: query or change	All	10v05	*unit_id***DCU** *statistic_value group unit_value override*
Flow or pressure average query	All	10v05	*unit_id***DCA** *statistic_value average_timing*
Full-scale values	All	6v00	*unit_id***FPF** *statistic_value unit_value*
Poll device data	All		*unit_id*
Power-up tare	All	10v05	*unit_id***ZCP** *enable*
Request data	All	6v00	*unit_id***DV** *time statistic1 statistic2 … statistic13*
Start streaming	All		*unit_id***@ @**
STP/NTP pressure change	Mass Flow	10v05	*unit_id***DCFRP** *stp_or_ntp unit_value pressure*
STP/NTP temperature change	Mass flow	10v05	*unit_id***DCFRT** *stp_or_ntp unit_value temperature*
Stop streaming	All		**@@** *new_unit_id*
Zero band: query or change	All	10v05	*unit_id***DCZ 0** *zero_band*
GAS:			
Active gas	Mass flow	10v05	*unit_id***GS**
Available gases	Mass flow		*unit_id***??G***
Set gas	Mass flow		*unit_id***G** *gas#*
SETPOINT:			
Change setpoint	Controllers	4v33	*unit_id***S** *setpoint_value*
Query/Change setpoint	Controllers	9v00	*unit_id***LS** *setpoint_value units_value*
Power-up setpoint	Controllers	8v04	*unit_id***SPUE** *setpoint_value*
Setpoint source	Controllers	10v05	*unit_id***LSS** *mode*
GAS AND COMPOSER™ MIXTURES:			
Create COMPOSER™ gas mixture	Mass flow	5v00	*unit_id***GM** *mix_name mix_number gas1% gas1# gas2% gas2# … gas5% gas5#*
Delete gas mixture	Mass flow	5v00	*unit_id***GD** *gas#*
Query gas mixture	Mass flow	9v00	*unit_id***GC** *gas#*
TARES:			
Tare absolute pressure	Devices with barometer	6v00	*unit_id***PC**
Tare flow	Flow		*unit_id***V**
Tare gauge/differential pressure	All		*unit_id***P**
TOTALIZER:			
Configuration totalizer	Flow	10v00	*unit_id***TC** *totalizer1_or_totalizer2 flow_statistic_value mode limit_mode number_of_digits decimal_place*
Reset totalizer	Flow	8v00	*unit_id***T** *totalizer1_or_totalizer2*
Reset totalizer peak	Flow	8v00	*unit_id***TP** *totalizer1_or_totalizer2*
Save totalizer	Flow	10v05	*unit_id***TCR** *enable_or_disable*

Action	Applicable Devices	Firmware Introduction	Command
VALVE CONTROL:			
Cancel valve hold	Controllers		*unit_id*C
Exhaust (open downstream valve)	Multi-valve controllers	4v37	*unit_id*E
Hold current valve(s) position	Controllers	5v07	*unit_id*HP
Hold valve(s) closed	Controllers	5v07	*unit_id*HC
Query valve drive state	Controllers	8v18	*unit_id*VD
CONTROL SETUP:			
Batching	Controllers	10v00	*unit_id*TB *totalizer1_or_2 batch_volume unit_value*
Deadband limit	Controllers	10v05	*unit_id*LCDB *save deadband_limit*
Deadband mode	Controllers	10v05	*unit_id*LCDM *mode*
Loop control algorithm	Controllers	10v05	*unit_id*LCA *algorithm*
Loop control range	Controllers	9v00	*unit_id*LR *loop_variable unit_value*
Loop control variable	Controllers	9v00	*unit_id*LV *loop_variable*
Max ramp rate	Controllers	7v11	*unit_id*SR *max_ramp_rate unit_time*
PD/PDF gains	Controllers	10v05	*unit_id*LCGD 0 *save p_gain d_gain*
PD²I gains	Controllers	10v05	*unit_id*LCG 0 *save p_gain i_gain d_gain*
Overpressure limit	Controllers	5v09	*unit_id*OPL *pressure_limit*
Ramping options	Controllers	10v05	*unit_id*LSRC *ramp_up ramp_down zero_ramp power_up_ramp*
Valve offset	Controllers	10v05	*unit_id*LCVO 0 *save initial_offset closed_offset*
Zero pressure control	Controllers	10v05	*unit_id*LCZA *enable_or_disable*
DEVICE SETUP:			
Analog output source	All	10v05	*unit_id*ASOCV *output_source value unit_value*
Baud rate settings	All	10v05	*unit_id*NCB *new_baud_rate*
Blink display	Devices with displays	8v28	*unit_id*FFP *duration*
Change unit ID	All		*unit_id*@ *new_unit_id*
Firmware version	All		*unit_id* VE
Lock device display	Devices with displays		*unit_id*L
Manufacturing info	All	8v28	*unit_id*??M*
Remote tare settings	All	10v05	*unit_id*ASRCA *action*
Restore factory settings*	All	7v00	*unit_id*FACTORY RESTORE ALL
Streaming rate settings	All	10v05	*unit_id*NCS *interval*
Unlock device display	Devices with displays		*unit_id*U
User data	All	8v24	*unit_id*UD *slot value*

**Command must be capitalized*

Connecting and Setup

Alicat's RS-232/485 communication structure can operate with up to 26 different Alicat devices over a single COM port or virtual COM port. When connecting your devices, note which COM port they are connected to.

To determine the COM port in use, check the ports section in the computer's device manager. If there is any trouble determining the COM port, a troubleshooter can be downloaded from alicat.com/support/software-drivers.

Unit ID

Each Alicat device must have a unique single letter ID using the standard 26-letter English alphabet such as "A", "B", "C", etc. The default ID is "A". When connecting multiple devices on the same COM port, change the IDs using the device screen before attempting to communicate via the serial terminal. Instructions to do so can be found in your device's manual.

If using a device screen is not an option, it is possible to change the unit ID via the change unit ID command (page 21). When doing so, connect one device to the COM port and change the unit ID before connecting the next device. If two devices have the same unit ID, disconnect one and change the unit ID of the device that is still connected.

Polling

When the unit ID is set to a letter ID, it is in polling mode. This is the default mode for all devices. In polling mode, a device waits for input and requests before providing any responses. The most common use is to query the device for its current measurements. See the poll device data command for further information (page 10). When queried in this manner, the device returns a data frame with information on current measurements (page 8). Be sure to wait for a response before attempting further commands, as command input in quick succession may result in data being intermixed with other responses.

Streaming

The exception to the standard English character rule is the at sign (**@**). An Alicat unit id set to **@** is in streaming mode. In this mode, the device continuously sends lines of data frames (page 8) without prompting. A device in streaming mode can receive and understand incoming commands even though the command prompt may not be visible due to the streaming data.

When there are multiple units connected to the same COM port, all devices must be in polling mode to interact with them. A streaming device disrupts communication with other devices on the port. Just as with the letter IDs, only one device with the **@** ID may be connected on a COM port at a time.

Note: *the default streaming interval is 50 ms, but this can be increased or decreased by using the* **change streaming rate** *command* (page 22).

The Alicat Data Frame

As a response to most commands, the device returns a data frame. The data frame parameters, units of measure, and layout all change depending on the device model and configuration.

Furthermore, the data frame can be adjusted via serial commands to fit the application's needs (page 19). The following are examples of various default frames for devices.

Example 1: A mass flow controller with a totalizer and set to valve drive hold (**HLD**).

A	+087.59	+025.00	+164.7	+981.6	985.0	022741.4	Air	HLD
Unit ID	Absolute pressure	Temperature	Volumetric flow	Mass flow	Setpoint	Totalized flow	Gas	Status code

Example 2: A mass flow meter with unit ID "B" and measuring Helium.

B	+010.02	+025.00	+128.0	+87.2	He
Unit ID	Absolute pressure	Temperature	Volumetric flow	Mass flow	Gas

Example 3: A liquid flow meter.

C	+042.45	+018.66	+56.7
Unit ID	Gauge pressure	Temperature	Volumetric flow

Example 4: A differential pressure gauge. The negative value indicates that there are higher pressures downstream.

D	-05.62
Unit ID	Differential pressure

Note: *the engineering units are not transmitted with the data frame to cut down on data bandwidth usage. If the front of the device is not visible, the units of measure can be confirmed using the query data frame command* (page 19).

Status/Error Codes

If a status is present, the corresponding status code appears in the last columns of the data frame (see example 1 in the previous section). These indicate a special status, warning, or fault noted by the device. Multiple codes appear as needed.

- **ADC** Internal communication error (not common – please contact Alicat for assistance).
- **EXH** Manual exhaust valve override is enabled (max opening on the downstream valve).
- **HLD** Valve drive hold enabled (bypass active loop control).
- **LCK** Display buttons are disabled.
- **MOV** Mass flow rate overage (flow is outside the measurable range, including the uncalibrated range).
- **OPL** The overpressure limit is enabled.
- **OVR** Totalizer has rolled over at least once or frozen at max value.
- **POV** Pressure reading overage (pressure is outside the measurable range, including the uncalibrated range).
- **TMF** Totalizer missed some flow data (due to a MOV or VOV error).
- **TOV** Temperature reading overage (temperature is outside measurable range).
- **VOV** Volumetric flow rate overage (Volumetric flow is outside the measurable range, including the uncalibrated range).

Basic Commands

The commands in this section are the most common serial commands used with Alicat devices. A list of these commands and a brief description of each follows.

For more information on the command and how to implement its variables, follow the page number provided for each section. Individual command sections contain the command name, the command itself, and the firmware version it was implemented in. When no firmware is noted, it's a command that is present in all firmware versions. If a command does not work, confirm that the firmware version of your device either matches or is greater than the firmware in which the command was implemented.

Command variables are presented in lowercase and italicized (***example***). These variables are to be replaced by the information outlined within that command's section.

The commands themselves are presented as bold and capitalized (**EXAMPLE**). Unless specified, commands are not case-sensitive. They are presented capitalized here to help differentiate the commands from the command variables.

Unless otherwise specified, if a command fails, the device responds with a question mark (**?**).

Additional commands are found on page 13.

Command Description Format

Command format:

Command Name Applicable hardware or firmware

▶ ***variable*COMMAND *variable***

A description of what the command does.

variable: A description of how to format the variables. These include the values to use when typing the command in the serial terminal or where to find them.

Example:

Set Gas

▶ ***unit_id*G *gas#***

Set gas is for changing the current gas of a mass flow device.

gas#: Use the number value for the desired gas. Gas number values can be found in **Appendix C** (page 30).

Basic Command Reference

Data Reading Page 10

Poll device	Obtain a data frame.
Request data	Obtain data on defined statistics.
Start streaming	Start streaming data from a device.
Stop streaming	Stop steaming data from a device.

Gas Mass flow devices Page 11

Active gas	Query, change, or save active gas.
Available gases	Obtain a list of available gases installed on the device.
Set gas	Change current active gas.

Setpoint Controllers Page 11

Change setpoint	Change the current setpoint.
Query/Change Setpoint	Query, change, or save the current setpoint

Tares Page 12

Tare absolute pressure	Barometer required. Create a zero absolute pressure reference point.
Tare flow	Create a zero flow reference point.
Tare gauge/differential pressure	Create a zero gauge or differential pressure reference point.

Data Readings

The following commands regard data gathered by the device sensors and how that information is presented. The command responses of theses commands are often in the format of a data frame. Please refer to page 8 for more information on data frames.

Poll Device Data

▶ *unit_id*

Poll device data sends a request to the device for the current measurements. Use the unit ID of the device as the command.

Successful command response: the device responds with a data frame. The data frame varies based on your device, but the most common variations are outlined on page 8. It is possible to modify how these data frames are returned using the **configure data frame** command (page 19).

Request Data 6v00

▶ *unit_id*DV *time statistic1 statistic2 … stastic13*

Request data obtains the average value of specified statistics over a given period of time. Use this command to read data that is not normally found in the data frame.

time: use the number of milliseconds for the device to measure the given statistics. The device takes a sample every millisecond and provides the average of those samples in its response.

statisticN: use the values of the desired statistics as outlined in the following table. The command can request up to 13 different statistics and at least one statistic is needed for the command to be successful. The statistics can be in any order.

Value	Description
0–700	The desired statistic to average. Refer to **Appendix A** (page 26)to determine the value of the statistic.
700	The unit ID of the requested device
701 or 702	701 indicates any current errors while 702 indicates the current status of the device. It is advised to only use one of these numbers in the request and as the last desired statistic of the request.
703	The currently selected gas of the device. This is always 6 characters long. (Only on mass flow devices)

Successful command response: the device responds with the average of requested statistics in the same order that the command requested them.

Start Streaming

▶ *unit_id*@ @

Start streaming changes the device from polling mode to streaming mode. The command changes the unit ID to @ and the device begins sending data frames at regular intervals.

Successful command response: the device immediately begins streaming data frames (page 8).

While a device is streaming, the data does not stop, but the data stream does not interrupt the command prompt. Depending on the streaming rate, the command prompt may not be visible, but the serial terminal still accepts commands. If you're unsure what is being typed, press backspace a number of times and then enter to clear anything previously typed, and start again.

Stop Streaming

▶ @@ *new_unit_id*

Stop streaming changes the device from streaming mode to polling mode (page 7).

new_unit_id: use a single English alphabet letter (A-Z) with a different letter than any other Alicat device on the COM port.

Successful command response: the device stops streaming and now responds to its new unit ID.

Gas Mass flow devices

These commands manage the current gas a mass flow device measures. If these commands are sent to a liquid or pressure device, they are ignored.

Active Gas 10v05

▶ *unit_id*GS *gas# save*

Active gas is used to manage the current active gas as well as the gas used on power-up.

To query the current active gas, use *unit_id*GS as the command.

gas#: use the number value for the desired gas is found in **Appendix C** (page 30). Not all gases are available on all devices. Corrosive gases and refrigerants are only available on anti-corrosive devices.

If you are unsure of what gases are compatible with your device, see the **available gases** command to obtain a list of available gases installed on the device.

save: use either a 0 or a 1. If 0, the power-up gas remains unchanged. If 1, the *gas#* used in the command is saved as the new power-up gas. When the device is powered on, it defaults to the power-up gas. If neither values are entered, the command defaults to saving the new gas as the power-up gas.

Successful command response: the device responds with the unit ID, the gas number, the short name of the gas, and the long name of the gas.

Available Gases

▶ *unit_id*??G*

Available gases provides the list of gases installed on your mass flow device. If a gas is not found within the provided list, the device is unable to properly measure the gas. Corrosive gases and refrigerants are not available on standard devices and only available on anti-corrosive devices. Each gas is also listed with its gas number value to be used in other gas commands. Any gas mixture saved using the create gas mixture (page 22) is present in this list with its assigned number value.

The gas list can also be referenced under **Appendix C** (page 30) of this manual, but it is not indicative of what a device may or may not have installed.

Successful command response: the device returns the full list of available gases along with their numbers.

Set Gas

▶ *unit_id*G *gas#*

> *Devices on 10v05 or above should use the* **Active Gas** *command.*

Set gas is for changing the current gas of a mass flow device.

gas#: use the number for the desired gas. Gas numbers can be found in **Appendix C** (page 30). Not all gases are available on all devices. Corrosive gases and refrigerants are only available on anti-corrosive devices.

If you are unsure of what gases are compatible with your device, see the **available gases** command to obtain a list of gases installed on the device.

Successful command response: the device returns a data frame that contains the newly selected gas.

Setpoint Controllers

Setpoint commands manage the flow rate or pressure that a controller attempts to achieve. If these commands are sent to a meter or gauge, they are ignored.

Change Setpoint 4v33

▶ *unit_id*S *setpoint_value*

Change setpoint provides the controller with a new setpoint to adjust flow or pressure to.

setpoint_value: use the number value of the desired setpoint within the range of the controller. The controller reads this value using the current engineering units. These units can be modified with the **engineering units** command (page 19).

On a mass flow controller, a setpoint of 0 stops flow and closes all valves. A setpoint of 0 on pressure controllers instructs the device to attempt to control to a pressure of 0. To modify how a pressure controller handles a 0 setpoint, see the **zero setpoint control** command (page 16).

Negative setpoints are possible on bidirectional controller.

Successful command response: the controller returns a data frame with the new setpoint.

> *Devices on firmware 9v00 and greater should use the* **Query/Change Setpoint** *command.*

Query/Change Setpoint 9v00

▶ *unit_id*LS *setpoint_value units_value*

Query/Change setpoint can either request the current setpoint from the controller or modify the setpoint along with the units the setpoint uses.

To query the setpoint, use *unit_id*LS.

setpoint_value: use the desired setpoint for the controller within the range of the device.

On a mass flow controller, a setpoint of 0 stops flow and closes all valves. A setpoint of 0 on pressure devices instructs the controller to attempt to control to a pressure of 0. To modify how a pressure controller handles a 0 setpoint, see the **zero setpoint control** command (page 16).

Negative setpoints are possible on bidirectional controllers.

unit_value: use the value of the corresponding engineering unit found under **Appendix B** (page 28). For the desired engineering unit, use the value found there. If you do not wish to use different setpoint units, this variable can be left blank and the controller will read the command using the current engineering units. These units can be modified with the **engineering units** command (page 19).

Successful command response: the controller responds with the unit ID, the current setpoint, the requested setpoint, the unit's number value, and then the unit's label in that order. The setpoint is limited to the controller range limits and may differ from the requested setpoint if the requested setpoint is out of range.

Tares

Taring a device zeroes out the specified reading to create a no-flow, zero gauge pressure, or zero absolute pressure reference point. Tares should be performed before any new process begins and if the device is moved or bumped.

Tare Absolute Pressure Devices with barometers

▶ *unit_id*PC

Tare absolute pressure is only available on a device that has an internal barometer installed at production. The command should only be used when there is no flow and the process line is not pressurized.

Successful command response: the device responds with a data frame where the absolute pressure reading is zero.

If the device does not have a barometer, the command is ignored and the device responds with a question mark (**?**).

Tare Flow Flow devices

▶ *unit_id*V

Tare flow creates a no-flow reference point for more accurate measurements.

When taring for mass flow or volumetric flow, make sure the process line is at the intended operational pressure and that there is no flow moving through the device.

Successful command response: the device responds with a data frame where the flow reading is zero.

Tare Gauge/Differential Pressure

▶ *unit_id*P

Tare gauge/differential pressure provides a device measuring gauge or differential pressure a zero reference point to measure the line's gauge or differential pressure from.

When taring gauge pressure, there must be no flow and the device must be open to the atmosphere.

When taring a differential device, the device requires zero differential pressure between P1 and P2 and the device ports need to be open to the atmosphere or connected to the same pressure source.

Successful command response: the device responds with a data frame where the gauge pressure reading is zero.

Additional Commands

The following sections outline the less common commands and how they operate. For information on the command layout and how to read the commands as they are written here, see **Basic Commands** (page 9).

Command Reference

Control Setup Controllers Page 14

Batching	Query, change, or disable batching.
Deadband limit	Query, change, or disable the allowable drift from the setpoint.
Deadband mode	Query or change how the device acts when within deadband limits.
Loop control algorithm	Query or change the algorithm used to control the process.
Loop control range	Query or change the possible setpoints for a controlled variable.
Loop control variable	Query or change what variable the controller manages.
Max ramp rate	Query, change, or disable the ramp rate to new setpoints.
PD/PDF gains	Query or change PD/PDF gain values if PD/PDF is enabled.
PID/PD^{2}I gains	Query or change PID/PD^{2}I gain values if PID/PD^{2}I is enabled.
Power-up setpoint	Change, or disable an automatic setpoint on power-up.
Overpressure limit	Query or change pressure limit that, if breached, stops flow.
Ramping options	Query, change, or disable when ramping occurs.
Setpoint source	Query or change how setpoints are controlled.
Valve offset	Query or change the offsets of the valve(s) in the closed-loop control.
Zero setpoint control	Query, change, or disable controlling a zero pressure setpoint.

Data Readings Page 18

Auto-tare	Query or change automatic taring. Controllers
Configure data frame	Change how content is presented in the data frame.
Engineering units	Query or change the engineering units used by the device.
Flow/Pressure average	Query or change the length of time when averaging measurements.
Full-scale values	Query the device measurement limits.
Power-up tare	Query, enable, or disable device to tare on power-up.
Query data frame	Query the data frame contents.
STP/NTP pressure	Query or change the pressure reference points. Mass flow devices
STP/NTP temperature	Query or change the temperature reference points. Mass flow devices
Zero band	Query or change the amount of flow or pressure reported above 0.

Device Setup Page 20

Analog output source	Query or change the analog output.
Baud rate	Query or change the baud rate of the device.
Blink display	Blink the display backlight for a set amount of time.
Change Unit ID	Set device unit ID.
Firmware version	Obtain firmware version information.
Lock display	Disable display buttons.
Manufacturing info	Obtain info on Alicat and device manufacturing.
Remote Tare	Change how the device reacts to remote tare pin being grounded.
Restore factory settings	Revert device settings to defaults.
Save or read user data	Save or read user-defined data on the device storage.
Start streaming	Change the device to stream data.
Stop streaming	Stop steaming device from streaming further data.
Streaming rate	Query or change the streaming rate.
Unlock display	Enable display buttons.

Gas and COMPOSER™ Mixtures Mass flow devices Page 22

Active gas	Query, change, and/or save current active gas.
Available gases	Obtain the list of available gases installed on the device.
Create gas mixture	Define a custom mixture of installed gases.
Delete gas mixture	Remove a custom gas mixture from the device.
Set gas	Change the current active gas.
Query gas mixture	Obtain the composition of a previously defined custom gas mixture.

Totalizers Flow devices Page 23

Configure totalizer	Query, change, or disable either totalizer.
Reset totalizer	Clear the current total of measured flow.
Reset totalizer peak	Clear the highest flow rate measured since the last reset.
Save totalizer	Query, enable, or disable the totalizer to restore value on power-up.

Valve Control Controllers Page 24

Cancel valve hold	Remove all valve holds and resume loop control.
Exhaust	Dual valve controllers. Stop new flow and clear process.
Hold valve(s)	Hold valve(s) at their current position.
Hold valve(s) closed	Close valve(s).
Valve(s) drive state	Obtain information on current valve drive status.

Control Setup Controllers

Batching Flow controllers, 10v00

▶ *unit_id*TB *totalizer1_or_2 batch_volume unit_value*

Batching directs the controller to flow a set amount and then stop. Once the designated batch amount has flowed, the controller closes the valve(s). To restart a batch, run the totalizer reset command (page 24).

totalizer1_or_2: use a value of either 1 for totalizer 1, or 2 for totalizer 2. This command must specify which totalizer.

To query the current batch value of either totalizer, use *unit_id*TB *totalizer1_or_2* as the command.

batch_volume: use the size of the desired flow batch. This is also used to disable the batch by using a value of 0.

unit_value: use the value of the desired volume units of the batch. Refer to **Appendix B-3** (page 29) or **Appendix B-5** (page 29) to determine the value of the desired units. This variable is optional and if left out, the controller uses the current engineering units.

Successful command response: the device responds with the unit ID, the totalizer used, the desired batch size (0 if disabled), the unit's value, and the unit's label in that order.

> ! *To restart a batch of the same size, use the reset totalizer command (*unit_id**T** *totalizer1_or_2) (*page 24*).*

Deadband Limit

▶ *unit_id*LCDB *save deadband_limit*

Control deadband limit sets the range around the setpoint that the controller allows for the process to drift. Deadband limits are usually only used for dual valve controllers that are controlling pressure. When outside of the deadband, the controller returns the process to the setpoint before allowing for drift again.

To query the current deadband, use *unit_id*LCDB as the command.

save: use a value of either 0 or 1. If 0, the device does not save the deadband limit used in this command, and the limit is lost on a power cycle. If 1, the device saves the limit across power cycles. To save room on the controller memory, only save the value that you are certain obtains the desired effects.

deadband_limit: use the amount of acceptable drift above or below the setpoint that the controller allows before acting to correct the process. For example, if the value used is .5 and the setpoint is 20 PSIA, the controller only acts when the pressure reaches 20.51 PSIA or 19.49 PSIA. The controller would then attempt to achieve the 20PSIA setpoint before allowing the process to drift within the deadband again.

Successful command response: the controller responds with the unit ID, the current deadband, the unit number (see appendix B on page 28), and the unit label in that order.

Deadband Mode 10v05

▶ *unit_id*LCDM *mode*

Deadband mode queries or modifies how the controller reacts when the controlled variable is within the deadband limits.

To query the current settings, use *unit_id*LCDM as the command.

mode: use a value of either 1 or 2. If 1, the device holds the valves at their current position and does not act until the controlled variable is outside of the deadband limits. If 2, the controller closes the valve(s) and does not open until the controlled variable is outside of the deadband limits.

Successful command response: the device responds with the unit ID and the mode number (1 or 2) in that order.

Loop Control Algorithm 10v05

▶ *unit_id*LCA *algorithm*

Loop control algorithm queries or changes whether the controller uses the PD/PDF or the PD²I algorithm.

To query which algorithm is being used, use *unit_id*LCA only.

algorithm: use a value of either 1 or 2. Use 1 to use the PD/PDF algorithm. Use 2 to use the PD²I algorithm.

Successful command response: the device responds with the unit ID and the current algorithm value in that order. 1 indicates the PD/PDF algorithm. 2 indicates the PD²I algorithm.

Loop Control Variable 9v00

▶ *unit_id*LV *loop_variable*

Set loop control variable manages the statistic that the setpoint controls.

loop_variable: the desired statistic value for the device to control. Refer to the following table for the value of possible statistics.

loop_variable

Statistic	Value	Description
Absolute pressure	34	
Second absolute pressure	345	For devices with a pressure sensor in a second location.
Pressure differential	39	
Second pressure differential	361	For devices with a pressure sensor in a second location.
Gauge pressure	38	
Second gauge pressure	353	For devices with a pressure sensor in a second location.
Mass flow	37	Mass flow controllers only
Volumetric flow	36	Mass flow and liquid controllers only

Successful command response: the device responds with the unit ID and the new value of the loop variable.

Loop Control Variable Setpoint Range

▶ *unit_id*LR *loop_variable unit_value* 9v00

▶ *unit_id*LR *loop_variable unit_value min_limit max_limit* 10v05

Loop control variable setpoint range queries the valid control range that a loop control variable can accept.

To query the current loop variable, use *unit_id*LR as the command. On 10v05 and above this also queries the current minimum and maximum setpoints.

loop_variable: use the value for the statistic to be queried or modified. Refer to the table under **loop control variable** to determine the value.

unit_value: the value of the desired engineering units of the requested statistic. Refer to **Appendix B** (page 28) for the values of these units. This is an optional parameter and is not needed in the command. Use 0 or 1 to use the default values of the loop-control variable.

On controllers with firmware 10v05 or grater this command can set a minimum and maximum setpoint range. For all 10v04 firmware devices and below, ignore the *min_limit* and *max_limit* variables and leave them blank in the command.

min_limit: the value of the desired minimum allowable setpoint on the controller. If this is larger than the maximum limit, the limits are reset to all possible values.

max_limit: the value of the desired maximum allowable setpoint on the controller. If this is smaller than the minimum limit, the limits are reset to all possible values.

Successful command response: the device responds with the unit ID, the requested loop variable, the unit's value, and the unit's label in that order. On 10v05 and above the response adds the minimum setpoints and the maximum setpoints accepted at the end.

Max Ramp Rate 7v11

▶ *unit_id*SR *max_ramp unit_time*

Max ramp rate details how quickly a controller moves to a new setpoint.

To query the current ramp rate, use *unit_id*SR as the command.

max_ramp: use a value that indicates the desired step size the controller takes towards a new setpoint. The command reads this number in the current engineering units of the device. Use the engineering units command to change these units (page 19).

unit_time: the rate at which a controller reaches each step as it moves towards a new setpoint. The controller can step in intervals of a millisecond, a second, a minute, an hour, or a day. Use a value the following table to determine the *unit_time* value to use.

Unit	Value	Description
ms	3	Millisecond
s	4	Second
m	5	Minute
Hour	6	Hour
Day	7	Day

To disable the ramping, use 0 as the *max_ramp* value. When the max ramp is disabled, the controller instantly moves to a new setpoint when given. A *unit_time* value is still needed in the command when disabling ramping.

Successful command response: the controller returns with the new max ramp rate, the setpoint engineering unit's value (**Appendix B**, page 28), the time, and the units-over-time label.

See the **ramping options** command (page 16) to define when the controller ramps and does not ramp to a new setpoint.

PD/PDF Gains 10v05

▶ *unit_id*`LCGD 0` *save p_gain d_gain*

PD/PDF gains is used on controllers that have the PDF algorithm enabled (page 15). The command modifies the integral gain and the proportional gain,

To query the current values, use *unit_id*`LCGD` as the full command.

save: use a value of either 0 or 1. If 0, the device does not save the gain values used in this command, and the values are lost on a power cycle. If 1, the device saves the gain values across power cycles. To save room on the controller's memory, only save values that you are certain obtain the desired effects.

p_gain: use the desired value of the integral closed loop gain. This can be a number between 0 and 65,535.

d_gain: use the desired value of the proportional closed loop gain. This can be a number between 0 and 65,535.

Successful command response: the device responds with the unit ID followed by the current P and D gains and the number 0. The number 0 does not currently signify anything and is there to reserve a position within the command for any future functions.

PD²I Gains 10v05

▶ *unit_id*`LCG 0` *save p_gain i_gain d_gain*

PD²I gains is used on controllers that have the PD²I algorithm enabled (page 15). The command modifies the values of the proportional gain, the integral gain, and the derivative gain.

To query the current values, use *unit_id*`LCG` as the full command.

save: use a value of either 0 or 1. If 0, the device does not save the gain values used in this command, and the values are lost on a power cycle. If 1, the device saves the gain values across power cycles. To save room on the EEPROM, only save values that you are certain obtain the desired effects.

p_gain: use the desired value of the proportional closed loop gain. This can be a number between 0 and 65,535.

i_gain: use the desired value of the integral closed loop gain. This can be a number between 0 and 65,535.

d_gain: use the desired value of the derivative closed loop gain. This can be a number between 0 and 65,535. The derivative gain value is optional and can be left blank in the command.

Successful command response: the device responds with the unit ID followed by the current P, I, and D gains and the number 0. The number 0 does not currently signify anything and is there to reserve a position within the command for any future functions.

Power-Up Setpoint 8v04

▶ *unit_id*`SPUE` *setpoint_value*

Power-up setpoint enables a controller to immediately have a setpoint when it's powered on.

setpoint_value: use the desired power-up setpoint. This is read using the current units of the device.

To disable the power-up setpoint, use 0 as the *setpoint_value*.

Successful command response: a data frame returns with the current setpoint of the device, not the requested power-up setpoint.

Overpressure Limit 5v09

▶ *unit_id*`OPL` *pressure_limit*

Overpressure limit creates an upper threshold that stops flow if the pressure goes above it. The device closes all valves and may open a purge valve if the controller has one. Stoppage occurs the moment the pressure exceeds this limit for 1 millisecond. To begin operation after the stoppage, the controller needs to be issued a new setpoint.

pressure_limit: use the desired upper limit of pressure that can be present within the process. If the value is above the pressure full scale or 0 and below, the limit is disabled.

Successful command response: the controller responds with a data frame.

Ramping Options 10v05

▶ *unit_id*`LSRC` *ramp_up ramp_down zero_ramp power_up_ramp*

Ramping options controls when the ramp rate is applied to changes in the setpoint. These are things like if the device ramps up, ramps down, or if it instantly jumps to zero.

To query the current ramp configuration, use *unit_id*`LSRC` as the command.

ramp_up: use a value of either 0 or 1. If 0, ramping is disabled when the setpoint is changed to be higher than the current setpoint, and the device immediately moves to higher setpoints. If 1, the device follows the ramp rate as it moves to higher setpoints.

ramp_down: use a value of either 0 or 1. If 0, ramping is disabled when the setpoint is changed to be lower than the current setpoint, and the device immediately drops to lower setpoints. If 1, the device follows the ramp rate as it moves to lower setpoints. This includes setpoints below 0 on bidirectional devices.

zero_ramp: use a value of either 0 or 1. If 0, the ramping is disabled for when a zero setpoint is established. The device immediately drops to any zero setpoint. If the value is 1, the device follows the ramp rate to the zero setpoint.

power_up_ramp: use a value of either 0 or 1. If 0, ramping is disabled when the device has a power-up setpoint enabled and it is powered on. The device immediately moves to the power-up setpoint if one is configured. If 1, the device follows the ramp rate up to the power-up setpoint. See the power-up setpoint command for more information (page 16).

Successful command response: the device returns the unit ID and each variable as a 0 or a 1, 0 for that function being disabled and 1 for that function being enabled. The order of the response is *ramp_up ramp_down zero_ramp power_up_ramp*.

Setpoint Source 10v05

▶ *unit_id*`LSS` *mode*

Setpoint source queries or modifies how the setpoint is given to the controller. The source can either be the analog connection or through both the front panel and serial connection.

To query the current mode being used by the controller, use *unit_id*`LSS` as the command.

mode: use a letter value of either `A`, `S`, or `U`. Refer to the following table to determine the desired mode.

Value	Mode Description
`A`	Setpoint source is analog. The setpoint cannot be changed by the display nor through serial communications. Some controllers do not have an analog input. Refer to alicat.com/pinout to determine your controller's capabilities.
`S`	Setpoint source is either the display or serial communications. When this mode is active, setpoint changes are saved and restored on power-up. It is advised not to use this mode if the setpoint changes often to avoid overusing the controller's memory.
`U`	Setpoint source is either the display or serial communications. When this mode is active, setpoint changes are not saved and the setpoint is `0` on power-up. It is advised to use this mode when the setpoint changes often.

Successful command response: the controller responds with the unit ID and current setpoint source mode.

Valve Offset 10v05

▶ *unit_id*`LCVO 0` *save initial_offset closed_offset*

Valve offset controls how much power is driven to the valve when it first opens or when the valve is considered closed. The percentage is not how open the valve actually is, but only a percentage of the possible voltage that can be driven to the valve.

To query the current valve offsets, use *unit_id*`LCVO` as the full command.

save: use a value of either 0 or 1. If 0, the device does not save the offset percentages used in this command, and the percentages are lost on a power cycle. If 1, the device saves the percentage values across power cycles. To save room on the EEPROM, only save offset percentages that you are certain perform the desired effects.

initial_offset: use a value between 0 and 100. Thisvalue is the percentage of the total possible electricity driven to the valve. When the controller first opens a previously closed valve, it begins by driving the valve to this percentage. The default is 0.

closed_offset: use a value between 0 and 100. This value is a percentage of the total possible electricity driven to the valve. When the electricity driven to the valve is below this percentage, the algorithm considers the valve closed. If this value is higher than the *initial_offset*, the controller uses the *initial_offset* to determine when a valve is closed. This variable is optional and is not required in the command.

Successful command response: the controller responds with the unit ID followed by the initial offset percentage and then the closed offset percentage.

Zero Pressure Control 10v05

▶ *unit_id*`LCZA` *enable_or_disable*

Zero pressure control queries or manages how the controller reacts when it has a 0 pressure setpoint. Depending on the device, it either completely opens the valve(s) or close the valve(s).

> ! *If the device is controlling flow, the controller always closes the valve(s) when it has a 0 flow setpoint.*

To query if active control is enabled or disabled currently, use *unit_id*`LCZA` as the command.

enable_or_disable: use a value of either a 0 or a 1. If a 0, the active control is disabled and the valves either open or close completely (see the following table to determine your device's reaction). If 1, active pressure control is enabled and the device uses the normal closed-loop control to achieve the 0 setpoint.

Dual valve?	Inverse pressure control?	Negative pressure?	Valve state at zero setpoint if control is disabled.
No	No	No	Close valve
No	No	Yes	Open valve
No	Yes	No	Open valve
No	Yes	Yes	Close valve
Yes		No	Open downstream valve. Close upstream valve.
Yes		Yes	Open upstream valve. Close downstream valve.

Successful command response: the controller responds with the unit ID followed by if the active control is active or not. 0 indicates that active control is disabled. 1 indicates that active control is enabled.

Data Readings

Auto-Tare Controllers, 10v05

▶ ***unit_id*ZCA *enable delay***

Auto-tare configuration either queries or modifies the auto-tare function. When enabled, the controller automatically tares when it has a zero setpoint and waits the specified delay time.

To query the current auto-tare configuration, use ***unit_id*ZCA** as the command.

enable: use a value of either 0 or 1. Use 0 to disable auto-tare. Use 1 is to enable auto-tare.

delay: use the desired amount of time in seconds the controller waits after receiving a zero setpoint to begin the taring process. This can be any value between .1 second and 25.5 seconds. When taring flow, any time less than 1 second may not be appropriate as the process may not settle fast enough to provide a proper no-flow reference point. When taring pressure, delaying is even more necessary as the pressure needs to stabilize to the zero pressure level.

Successful command response: the device responds with the unit id, either a 0 (if auto-tare is disabled) or a 1 (if power-up tare is enabled), and the delay length in seconds (this is 0 if auto-tare is disabled).

Configure Data Frame 6v00

▶ ***unit_id*FDF *format***

Configure data frame changes the way the device responds when it responds with a data frame. There are three options for this command.

format: use a value found in the following table:

Format Value	Description
0	The default data frame format. Values have 5 digits total (Totalizer has 7) and setpoint and totalizer are unsigned by any positive or negative signs.
1	Setpoint and totalizer are signed with positive and negative signs.
2	(8v00) Signs setpoint and totalizer similar to format 1. The total number of digits changes based on the device's range and calibration resolution. Exponential notation is also supported.

Successful command response: the device responds with a data frame in its new format.

Engineering Units 10v05

▶ ***unit_id*DCU *statistic_value group unit_value override***

Engineering units queries or modifies what measurement units are used for a desired statistic or group of statistics.

statistic_value: use the numerical value of the desired statistic. These values can be found in **Appendix A** (Page 26).

To query the engineering units of a statistic, use ***unit_id*DCU *statistic_value***.

group: determines if the command applies only to the desired statistic or the entire group that the statistic is part of. Use 0 to have it apply only to the statistic and 1 to apply to the group. As an example, use 0 to only change the primary gauge pressure engineering units or use 1 to change all pressure engineering units.

unit_value: use the numerical value of the desired engineering units. This value can be found in **Appendix B** (Page 28).

override: overwrites any special rules that do not change when a group changes. Use 0 to not change any of these special rules. This parameter can also be left blank and no special rules will be overwritten. Use 1 to apply the new units to all places of the statistic or group. Using 1 eliminates any special rules.

Successful command response: the device responds with the unit id, the engineering unit numerical value, and the engineering unit label.

Flow/Pressure Average 10v05

▶ *unit_id*DCA *statistic_value average_timing*

Flow/Pressure average controls the length of time a statistic measurement is averaged over. Measurements are taken once every millisecond, but the measurement reading on the display or data frame is only updated as often as the time set in this command.

statistic_value: use the value of one of the readings the device averages. Refer to the following table to determine what measurement to query or change.

Value	Device reading
1	All pressures and pressure sensors
2	Absolute pressure
4	Volumetric flow
5	Mass flow
6	Gauge pressure
7	Differential pressure
17	External volumetric flow: volumetric flow referenced to external conditions.
344	Absolute pressure: secondary sensor
352	Gauge pressure: secondary sensor
360	Differential pressure: secondary sensor

Not all devices have a secondary pressure sensor. Devices without a secondary pressure sensor ignore those values.

To query the current average of a given reading, use *unit_id*DCA *statistic_value* as the command.

average_timing: use the desired time in milliseconds for the device to average its measurements over. This can be anything from 0 to 9,999 milliseconds. If 0, the device updates its measurement reading every millisecond.

Successful command response: the device responds with the unit ID, the value of the reading queried or modified, and the average time constant.

Full-Scale Values 6v00

▶ *unit_id*FPF *statistic_value unit_value*

Full-scale values queries the measurement range of the given statistic.

statistic_value: use the number value of the desired statistic found in **Appendix A** (page 26).

unit_value: use the number value of the desired engineering unit found in **Appendix B** (Page 28) to have the statistic range reported in. This can be left blank and the range will be reported in the units defined by the **engineering units** command (page 18)

Successful command response: the device provides the maximum measurement of the requested statistic as well as its unit value and the unit's label.

Power-Up Tare 10v05

▶ *unit_id*ZCP *enable*

Power-up tare controls if the device automatically tares once it is powered on. If enabled, the device performs a .25 second tare after sensors are stable. If enabled on a controller, the closed-loop control is delayed and the valves remain closed until the tare is complete.

To query of if power-up tare is enabled or disabled, use *unit_id*ZCP as the command.

enable: use a value of either 0 or 1. 0 is used to disable power-up tare. 1 is used to enable power-up tare.

Successful command response: the device responds with the unit id and either a 0, if power-up tare is disabled, or a 1, if power-up tare is enabled.

Query Data Frame 6v00

▶ *unit_id*??D*

Query data frame provides information about the current data frame and what each section entails.

Successful command response: the device responds with a table that outlines what is within a data frame. The top of the table correlates with the leftmost portion of the data frame and then each following row is for the next data point in the frame moving from left to right. If an asterisk (*) precedes a name, the field with the asterisk only appears in a data frame when certain conditions are met. This is usually attributed to status and error messages that only appear when they are present on the device.

STP/NTP Pressure Mass flow devices, 10v05

▶ *unit_id*DCFRP *stp_or_ntp unit_value pressure*

STP/NTP pressure is used to modify either the standard pressure or normal pressure reference point used to calculate flow rates. The reference point provides the density of a gas at a certain pressure and temperature to calculate the flow at actual conditions. Standard pressure is used when calculating standard volume rates like standard liters per minute (SLPM) or standard cubic feet per minute (SCFM). Normal pressure is used when calculating normal volume rates like liters per minute (LPM) or cubic feet per minute (CFM). The default pressure for Alicat devices is 14.696 PSIA.

stp_or_ntp: dictates either the standard pressure or the normal pressure. For standard pressure, use **S**. For normal pressure, use **N**.

To query the current standard pressure or normal pressure, use *unit_id*DCFRP *s_or_n* as the command.

units_value: use the number value of the desired engineering units. found in **Appendix B** (page 28). If you do not want to change the units of the reference point, use 0 for the variable.

pressure: use the numerical value of the new desired pressure reference point.

Successful command response: the device responds with the unit ID, the current pressure reference point, the unit value number, and the engineering unit's label.

STP/NTP Temperature Mass flow devices, 10v05

▶ *unit_id*DCFRT *stp_or_ntp unit_value temperature*

STP/NTP temperature is used to query or modify either the standard temperature or normal temperature reference point used to calculate flow rates. The reference point provides the density of a gas at a certain pressure and temperature to calculate the flow at actual conditions. Standard temperature is used when calculating standard volumes like standard liters per minute (SLPM) or standard cubic feet per minute (SCFM). Normal temperature is used when calculating normal volumes like liters per minute (LPM) or cubic feet per minute (CFM). The default temperature for Alicat devices is 25˚ Celsius.

stp_or_ntp: dictates either the standard temperature or the normal temperature. For standard measurements, use **S**. For normal temperature, use **N**.

To query the current standard temperature or normal temperature, use *unit_id*DCFRT *s_or_n* with the intended reference to query in *s_or_n*.

units_value: use the number value of the desired engineering units found in **Appendix B** (Page 28). If you do not want to change the units of the reference point, use 0 for the variable

temperature: use the numerical value of the desired new temperature reference point.

Successful command response: the device responds with the unit ID, the temperature reference point, the unit value number, and the engineering unit's label.

Zero band 10v05

▶ *unit_id*DCZ 0 *zero_band*

Zero band queries or modifies how much flow or pressure needs to be present before the device reports it. Any readings below the zero band are reported as 0.

To query the current zero band, use *unit_id*DCZ as the command.

zero_band: the percentage of full-scale readings that the process must exceed before the device reports its readings. This can be a percentage value anywhere from 0 to 6.38. Using 0 disabled the zero band.

Successful command response: the device responds with the unit ID, the number 0, and the current zero band as a percentage of full-scale readings. The zero band may not match exactly the requested value due to internal programming, but the device still follows the requested zero band setting.

Device setup

Analog Output Source 10v05

▶ *unit_id*ASOCV *primary_or_secondary value unit_value*

Analog output source either queries or changes the value tracked by the given analog output.

primary_or_secondary: use a value of either 0 or 1. Use 0 to indicate the primary analog output. Use 1 to indicate the secondary output, if available.

To query the device, use *unit_id*ASOCV *primary_or_secondary* as the command.

value: use the numerical value of either the statistic being tracked or one of the outputs the device can produce. Refer to the following table to determine the necessary value.

value	Description
0	The output is fixed at the minimum possible value of the output. In the case of a 4-20mA output, this would produce a constant 4 mA signal.
1	The output is fixed at the maximum possible value of the output. In the case of a 4-20mA output, this would produce a constant 20 mA signal.
other	This is the statistic number of the reading that the analog output is to track. The values are found in **Appendix A** (page 26). Not all statistic readings can be tracked by the output.

units_value: use the number value of the desired engineering units found in **Appendix B** (Page 28). This is an optional variable and can be left blank in the command if you don't wish to change the engineering units.

Successful command response: the device responds with the unit id, the value (either 0, 1, or the statistic value), the unit value used, and the unit label. If the source is generating the minimum or maximum, the unit value is 1 and is followed by --- for the label.

Baud Rate 10v05

▶ *unit_id*NCB *new_baud_rate*

Baud rate is used to either query the current baud rate or set a new baud rate. When changing the baud rate, ensure the COM part the device is being connected to can obtain the same baud rate.

To query the baud rate of the device, use *unit_id*NCB as the command.

new_baud_rate: use one of the following 6 numbers as the value:

- 2400
- 9600
- 19200
- 38400
- 57600
- 115200

Successful command response: the device responds with its unit ID and the baud rate. In the case of a query command, the device provides the current baud rate. If the baud rate is being changed, then the device responds with the new baud rate before performing the change to confirm that the baud rate has been accepted.

After the successful response is sent, the connection is lost and the device must be connected to again using the new baud rate. If a connection cannot be reestablished, or if the wrong baud rate was used, refer to the device's operation manual for instructions on how to revert the baud rate using the device screen. If there is no device screen, contact Alicat technical support for assistance (page 2).

Blink Display 8v28

▶ *unit_id*FFP *duration*

Blink display instructs the device to flash the backlight for a given amount of time in seconds.

To query if the display is currently flashing, use *unit_id*FFP as the command.

duration: use the desired number of seconds for the backlight to flash as the value. A value of 0 stops a flashing device. A value of –1 instructs the device to flash indefinitely.

Successful command response: the device's backlight immediately begins to flash. A line also responds with a binary response of the unit ID followed by 1 to indicate the backlight is flashing or 0 to indicate it is not flashing.

Change Unit ID

▶ *unit_id*@ *new_unit_id*

Change unit ID is used to give a new unit ID to a device. The device accepts any of the 26 letters in the English alphabet.

new_unit_id: use a Standard English letter between A-Z.

Successful command response: there is no response from the device but now responds to the new unit ID.

Firmware Version

▶ *unit_id*VE

Query firmware version provides the current firmware version installed on the device. See page 4 for more information on device firmware.

Successful command response: the device responds with the unit ID, the current firmware version, and the date of the firmware creation.

Lock Device Display

▶ *unit_id*L

Lock device display disables the buttons on the front of the device. When locked, the only way to modify the device is via the serial terminal or other connections.

To unlock the display, use the **unlock device display** command (*unit_id*U) (Page 22).

Successful command response: the device returns a data screen with the LCK status enabled.

Manufacturing info

▶ *unit_id*??M*

Query manufacturing info provides information on contacting Alicat as well as the configuration of the device itself.

Successful command response: the response returns 10 lines of data that contain:

- Alicat's email, website, and phone number
- The device model
- Serial number
- Manufacturing date
- The last calibration date
- The initials of the calibration tech
- The software version

Remote Tare 10v05

▶ *unit_ID*ASRCA *action*

Remote tare is only available on devices with an available remote tare pin. This pin is usually only on meters and gauges, **controllers rarely have this availability**. If you are unsure whether your device has this configuration, please refer to the pinouts on alicat.com/pinout.

To query the current remote tare value, use *unit_id*ASRCA as the command.

action: use the value of the desired effect for when the pin is grounded. Refer to the following table to determine the value for the desired effect.

Value	Action
+1	Tare the primary pressure sensor when the pin is active. If the sensor measures absolute pressure, a barometer is required. If there is no barometer installed, the device ignores the tare primary pressure request.
+2	Tare secondary pressure sensor when the pin is active. If the sensor measures absolute pressure, a barometer is required. If there is no barometer installed, the device ignores the tare secondary pressure request.
+4	Tare flow while the pin is active. If the device cannot measure flow, the device ignores the tare flow request.
+8	Reset totalizer 1 to zero until the pin is no longer active. If totalizer 1 is not enabled, the device ignores the request to rest totalizer 1.
+16	Reset totalizer 2 to zero until the pin is no longer active. If totalizer 2 is not enabled, the device ignores the request to rest totalizer 2.

These actions can be enabled simultaneously to tare and reset as many items as desired. To activate more than one action, add the values together and use the summed value as the value in the *action* parameter. For example, to tare primary pressure and tare flow while the pin is active, use *unit_ID*ASRCA 5 as the command. An *action* value of 0 disables all actions.

Successful command response: the device returns a response with the unit ID and the total value of the active actions. If nothing is active, the value is 0.

Restore Factory Settings 7v00

▶ *unit_id*`FACTORY RESTORE ALL`

Restore factory settings returns all settings to their default values. This command requires all letters to be capitalized to be successful. Once the command executes, it is advised to perform a power cycle on the device.

> *Restoring factory settings removes any 3rd party calibrations. Before performing this command, please contact Alicat support for assistance (page 2).*

Successful command response: the device responds by displaying, "*unit_id* `factory values have been restored.`"

Save and Read User Data 8v24

▶ *unit_id*`UD` *slot value*

Store and read user data allows you to save a string of up to 32-characters to a save slot on the device.

slot: use a value between 0-3. Each of these 4 slots can save a 32-character string.

To read the data saved on a given slot, use *unit_id*`UD` *slot* as the command.

value: a 32-character string that can contain ASCII characters. To store binary data, it must be encoded. Decimal or Hexadecimal notation for numbers or hex64 for arbitrary data.

Successful command response: if the command is to save the data, the device responds with the unit ID and the newly written value. If the command is to read a slot, the device responds with the unit ID and the value currently written to that slot.

Start Streaming

▶ *unit_id*`@ @`

Please see page 10 under **Basic Commands** for further information on the start streaming command.

Stop Streaming

▶ `@@` *unit_id*

Please see page 10 under **Basic Commands** for further information on the stop streaming command.

Streaming Rate 10v05

▶ *unit_id*`NCS` *interval*

Streaming rate is used to either query or change the current streaming rate.

To query the current streaming rate, use *unit_id*`NCS` as the command.

interval: use the desired time in milliseconds the device waits before sending another data frame. If the interval is smaller than the time it takes to complete transmitting a data frame, the next frame begins immediately after the previous frame completes.

Successful command response: the device responds with the unit ID and the interval in milliseconds.

Unlock Device Display

▶ *unit_id*`U`

Unlock device display removes the **LCK** status from a device and enables the buttons on the display. The device is locked via the **lock device display** command (page 21).

If you have lost communication with the device and need to unlock the display, simultaneously press and hold the 4 corner buttons for 5 seconds. If successful, the **LCK** status disappears from the device screen.

Successful command response: the device returns a data line without the **LCK** status.

Gas and COMPOSER™ Mixtures Mass flow devices

Active Gas 10v05

▶ *unit_id*`GS` *gas# save*

Please see page 11 under **Basic Commands** for further information on the active gas command.

Available gases

▶ *unit_id*`??G*`

Please see page 11 under **Basic Commands** for further information on the available gases command.

Create Gas Mixture 5v00

▶ *unit_id*`GM` *mix_name mix_number gas1% gas1# gas2% gas2#...gas5% gas5#*

Create gas mixture programs a custom gas mixture on your Alicat mass flow device. This allows the device to properly measure and custom mixtures that you might use in your process. The command allows for up to five different gases to be used in the custom mix. A device can hold up to 20 different custom gas mixtures.

> *The device does not physically mix the gases. The mixture must be mixed before they reach the device for the device to measure it accurately.*

mix_name: use a custom name for the mixture that contains up to six letters. This is the equivalent of the short names used for other gases.

mix_number: use any number between 236 and 255. The gas mix is saved to that number and used in **active gas**, **set gas**, **delete gas mixture**, and **query gas mixture** commands. If a custom gas mix already exists on the number used in the command, the previous gas mixture is overwritten.

Use 0 to automatically select the next available gas number starting with 255 and counting down to 236. If there are no available gas numbers when using 0, the command fails and the device provides an error.

gasN%: use the molar percentages up to two decimal places that the immediately following gas encompasses within the mixture. The total percentage of all the gases in the command must reach 100.00% or else the command fails.

gasN#: use the numerical value of the desired gas found in **Appendix C** (page 30) or the **available gases** command (page 11).

Successful command response: the device responds with a line containing the unit ID and the gas number of the custom gas followed by the percentages and short name of each gas used.

Delete Gas Mixture 5v00

▶ *unit_id* **GD** *gas#*

Delete gas mixture is used to delete custom gases that are no longer wanted or needed.

gas#: use the desired custom gas number (236-255) to delete from the device.

Successful command response: the device responds with the unit ID and the deleted custom gas number (236–255).

Query Gas Mixture 9v00

▶ *unit_id* **GC** *gas#*

Query gas mixture asks the device for the percentages of gases that make up a previously created custom gas mixture.

gas#: the custom gas's number (236–255). If there is no gas saved to the given gas number, then the device responds with a question mark (**?**).

Successful command response: the device responds with the unit ID and then the gas numbers with their percentages of the mixture. Refer to the gas list in **Appendix C** (Page 31) to determine which gas corresponds with which gas number.

Set Gas

▶ *unit_id* **G** *gas#*

Please see page 11 under **Basic Commands** for further information on the **set gas** command.

> *Devices on 10v05 or above should use the* **active gas** *command (Page 11).*

Totalizers Flow devices

Configure Totalizer 10v00

▶ *unit_id* **TC** *totalizer1_or_2 flow_statistic_value mode limit_mode number_of_digits decimal_place*

Configure totalizer is used to enable or disable a totalizer. It also dictates how the totalizer operates and how it displays measured flow.

totalizer1_or_2: use either 1 (for totalizer 1) or 2 (for totalizer 2).

To query the current totalizer configuration, use *unit_id* **TC** *totalizer1_or_2* as the command.

flow_statistic_value: use the numerical value of the desired flow statistic to measure found in **Appendix A** (page 26). This enables a disabled totalizer. If the totalizer is already enabled, and you don't want to change the statistic, use a value of –1.

To disable a totalizer, use a value of 1 for the *flow_statistic_value* and leave the subsequent parameters blank.

mode: this variable manages how the totalizer accumulates flow. See the following table to determine the value for the desired feature. Positive flow is defined as flow that moves forward through the device body (usually left to right). Negative flow is flow that moves backward (usually right to left).

mode Value	*mode* Function
–1	Do not change the current totalizer mode
0	The totalizer adds positive flow to the total but ignores negative flow.
1	The totalizer adds negative flow to the total but ignores positive flow.
2	The totalizer adds positive flow and subtracts negative flow from the total.
3	The totalizer adds positive flow until flow stops. Once positive flow resumes, the totalizer resets to 0.

limit_mode: this variable manages what the totalizer does when it reaches its maximum allowed value. Use a value from the following table to enable the desired function. Some functions set the **TOV** status error. Please see page 8 for further information on device statuses.

limit_mode Value	*limit_mode* Function
–1	Do not change the current totalizer limit mode.
0	Stop count and leave the totalizer at its maximum value. Does not set the **TOV** status error.
1	Reset the totalizer to zero and continues to count. Does not set the **TOV** status error.
2	Stop the count and leave the totalizer at its maximum value. Sets the **TOV** status error.
3	Reset the totalizer to zero and continue to count. Sets the **TOV** status error.

number_of_digits: use a numerical value between 7 and 10 to set how many digits are used in the totalizer value. 7 is the default value.

decimal_place: use a number between 0 and 9 to set how many digits are after the decimal point. Not all requested digits may be available on a device due to resolution limits. The maximum number of digits available is used if the requested amount exceeds those available.

Successful command response: the device responds with the unit ID followed by the configuration of the totalizer. The configuration is in the same order as the command (*which flow_statistic_value mode limit_mode number_of_digits decimal_place*) and are the numerical values of each parameter's configuration. See the preivous table to determine which value corresponds to which function. If *flow_unit* reports as 1, the totalizer is disabled.

Reset Totalizer 8v00

▶ *unit_id***T** *totalizer1_or_2*

Reset totalizer returns the totalizer count to zero and restarts the timer. If there is flow moving through the device at the time of the command, the totalizer instantly begins counting that flow starting from zero. This command also resets the totalizer peak and restarts batching (Page 16).

totalizer1_or_2: use a value of either 1 (for totalizer 1) or 2 (for totalizer 2). If no number is specified, the command defaults to resetting totalizer 1.

Successful command response: the device responds with a data frame containing the totalizer reset to zero.

Reset Totalizer Peak 8v00

▶ *unit_id***TP** *totalizer1_or_2*

Reset totalizer peak resets only the peak flow rate that has been measured since the last reset. The measured volume and timer are left unchanged by the command.

totalizer1_or_2: use a value of either 1 (for totalizer 1) or 2 (for totalizer 2). If no number is specified, the command defaults to resetting totalizer 1's peak.

Successful command response: the device responds with a data frame.

Save Totalizer 10v05

▶ *unit_id***TCR** *enable_or_disable*

Save totalizer enables or disables the device from saving the totalizer values at regular intervals. If enabled, the device restores the last saved totalizer values before being powered off. If disabled, the device powers on with the totalizers reset to zero.

This applies to both totalizers if both are enabled. If only one totalizer is enabled, it only applies to that one totalizer.

To query if the function is enabled, use *unit_id***TCR** as the command.

enable_or_disable: use a value of either 1 or 0. Use 1 to enable the save totalizer function. Use 0 to disable the save totalizer function.

Successful command response: the device responds with the unit ID, and either a 1 to indicate the function is enabled or a 0 to indicate the function is disabled.

Valve control Controllers

Cancel Valve Hold

▶ *unit_id***C**

Cancel valve hold removes any valve holds placed on the device. The controller resumes closed loop control as well.

Successful command response: the device responds with a data frame and without the **HLD** status. Even if the device does not have a hold at the time of command, the device responds with this data frame on a successful command.

Exhaust Multi-valve controllers; 4v37

▶ *unit_id***E**

Exhaust closes the upstream valve and opens the downstream valves to 100%. This stops any new flow from entering the system and allows all flow currently in the process to leave. This command is ignored on single valve devices.

Successful command response: the device responds with a data frame and the **HLD** is status active.

To cancel a hold, use the **cancel valve hold** command (*unit_id***C**).

Hold Valve(s) 5v07

▶ *unit_id*HP

Hold valve(s) tells a controller to maintain valves at their current position until the hold is canceled. The closed-loop control is paused until the hold command is canceled.

Successful command response: the device responds with a data frame and the **HLD** status is active.

To cancel a hold, use the cancel valve hold command (*unit_id*C).

Hold Valves Closed 5v07

▶ *unit_id*HC

Hold valves closed closes all valves until the hold is canceled. The closed-loop control is paused until the hold command is canceled.

Successful command response: the device responds with a data frame and the **HLD** status is active.

To cancel a hold, use the **cancel valve hold** command (*unit_id*C).

Query Valve Drive State 8v18

▶ *unit_id*VD

Query valve drive state is used to obtain the information about the current percentage of possible voltage being driven to the valve(s). The percentage presented is not how open the drive is, but how much of the total possible electricity is being sent to that valve. The higher the percentage the more open the valve should be. If this value increases over time with the same setpoint, the controller is using more power to achieve the same results and may indicate a problem within the process (i.e. debris or a clog).

Successful command response: the controller responds with its unit ID and the valve drive percentages. On dual-valve controllers, the first percentage is the upstream valve and the second percentage is the downstream valve. On devices with three valves, the third number is usually the valve that exhausts the process.

Appendices

Appendix A: Statistics

Statistics are readings and measurements that devices provide. Use the following values in commands where indicated to apply the desired statistic to the command.

Specific devices and configurations can restrict what statistics are available. Please contact Alicat support for any assistance if there are any questions in determining if the desired statistic works with your device.

Appendix A-1: Flow Statistics

Flow statistic	Value	Notes
Batch mass remaining	**12**	The remaining mass in the totalizer batch.
Batch volume remaining	**11**	Remaining volume, referenced to flow conditions, in the totalizer batch.
Batch volume, external remaining	**19**	Remaining volume, referenced to external conditions, in the totalizer batch.
Mass flow	**5**	
Mass flow, average	**69**	Average mass flow over the time of totalizing.
Mass flow, maximum (8v32)	**175**	Highest mass flow since reset.
Mass flow, minimum (8v32)	**174**	Lowest mass flow since reset.
Mass flow, peak	**101**	Peak mass flow during the time of totalizing.
Mass flow setpoint	**37**	
Mass flow setpoint error (8v00)	**173**	Mass flow minus the ramp-limited setpoint.
Time, totalizing	**10**	Amount of time that the totalizer has been running.
Total mass	**9**	Totalized mass.
Total volume	**8**	Totalized volume, referenced to flow conditions.
Total volume, external	**18**	Totalized volume, referenced to external conditions.
Volumetric flow	**4**	Volumetric flow referenced to flow conditions.
Volumetric flow, average	**68**	Average volumetric flow, referenced to flow conditions, over the time of totalizing.
Volumetric flow, maximum (8v32)	**167**	Highest volumetric flow since reset.
Volumetric flow, minimum (8v32)	**166**	Lowest volumetric flow since reset.
Volumetric flow, peak	**100**	Peak volumetric flow, referenced to flow conditions, during the time of totalizing.
Volumetric flow setpoint	**36**	The setpoint for volumetric flow referenced to flow conditions.
Volumetric flow setpoint error (8v00)	**165**	Volumetric flow minus the ramp-limited setpoint.
Volumetric flow, external	**17**	Volumetric flow referenced to external conditions.
Volumetric flow, external average	**81**	Average volumetric flow, referenced to external conditions, over the time of totalizing.
Volumetric flow, external maximum (8v32)	**271**	Highest volumetric flow since reset.
Volumetric flow, external minimum (8v32)	**270**	Lowest volumetric flow since reset.
Volumetric flow, external peak	**113**	Peak volumetric flow referenced to external conditions during the time of totalizing.
Volumetric flow, external setpoint	**49**	The setpoint for volumetric flow referenced to external conditions.
Volumetric flow external setpoint error (8v00)	**268**	Volumetric flow, referenced to external conditions, minus the ramp-limited setpoint.

Appendix A-2: Pressure Statistics

Pressure statistic	Value	Notes
Pressure, absolute	**2**	
Pressure, absolute average	**66**	Average absolute pressure over the time of totalizing.
Pressure, absolute maximum (8v32)	**151**	Highest absolute pressure since reset.
Pressure, absolute minimum (8v32)	**150**	Lowest absolute pressure since reset.
Pressure, absolute peak	**98**	Peak absolute pressure over the time of totalizing.
Pressure, absolute setpoint	**34**	
Pressure, absolute setpoint error (8v00)	**149**	Absolute pressure minus the ramp-limited setpoint.
Pressure, barometric	**15**	Barometer reading.
Pressure, barometric average	**79**	Average barometer reading over the time of totalizing.
Pressure, barometric maximum (8v32)	**255**	Highest barometric pressure since reset.
Pressure, barometric minimum (8v32)	**254**	Lowest barometric pressure since reset.
Pressure, barometric peak	**111**	Peak barometer reading over the time of totalizing.
Pressure, differential	**7**	

Pressure statistic	Value	Notes
Pressure, differential maximum (8v32)	**191**	Highest differential pressure since reset.
Pressure, differential minimum (8v32)	**190**	Lowest differential pressure since reset.
Pressure, differential setpoint	**39**	
Pressure, differential setpoint error (8v00)	**189**	Differential pressure minus the ramp-limited setpoint.
Pressure, gauge	**6**	
Pressure, gauge average	**70**	Average gauge pressure over the time of totalizing.
Pressure, gauge maximum (8v32)	**183**	Highest gauge pressure since reset.
Pressure, gauge minimum (8v32)	**182**	Lowest gauge pressure since reset.
Pressure, gauge peak	**102**	Peak gauge pressure over the time of totalizing.
Pressure, gauge setpoint	**38**	
Pressure, gauge setpoint error (8v00)	**181**	Gauge pressure minus the ramp-limited setpoint.
Pressure, second absolute (7v01)	**344**	For devices with a pressure sensor in a second location, the absolute pressure of the second sensor.
Pressure, second absolute maximum (8v32)	**351**	Highest second absolute pressure since reset.
Pressure, second absolute minimum (8v32)	**350**	Lowest second absolute pressure since reset.
Pressure, second absolute setpoint (7v01)	**345**	The setpoint for the second absolute pressure.
Pressure, second absolute setpoint error (8v00)	**349**	Second absolute pressure minus the ramp-limited setpoint.
Pressure, second differential (7v01)	**360**	For devices with a pressure sensor in a second location, the differential pressure of the second sensor.
Pressure, second differential maximum (8v32)	**367**	Highest second differential pressure since reset.
Pressure, second differential minimum (8v32)	**366**	Lowest second differential pressure since reset.
Pressure, second differential setpoint (7v01)	**361**	The setpoint for the second differential pressure.
Pressure, second differential setpoint error (8v00)	**365**	Second differential pressure minus the ramp-limited setpoint.
Pressure, second gauge (7v01)	**352**	For devices with a pressure sensor in a second location, the gauge pressure of the second sensor. For DILO, this is the pressure upstream of the orifice.
Pressure, second gauge maximum (8v32)	**359**	Highest second gauge pressure since reset.
Pressure, second gauge minimum (8v32)	**358**	Lowest second gauge pressure since reset.
Pressure, second gauge setpoint (7v01)	**353**	The setpoint for the second gauge pressure.
Pressure, second gauge setpoint error (8v00)	**357**	Second gauge pressure minus the ramp-limited setpoint.

Appendix A-3: Other Statistics

Other statistic	Value	Notes
None	**1**	No statistic; generally implies an empty location.
Date, user (7v01)	**400**	The current date of the device or the start date of the measurement.
Fluid name (7v01)	**703**	The short name of the gas/liquid being used by the device.
Measurement id (7v01)	**801**	The ID of the measurement. Unique for the measurement over the life of the device.
Measurement status (7v01)	**802**	The status of the measurement, A: aborted, C: complete, M: in progress, -: not a valid measurement.
Setpoint	**32**	The current ramp-limited setpoint. When specified in a location, the currently active setpoint statistic replaces this statistic.
Setpoint error (8v00)	**133**	Current process value minus the ramp-limited setpoint.
Status	**26**	The status of the device. This is typically only used internally.
Temperature, external	**16**	Temperature probe reading.
Temperature, external maximum (8v32)	**263**	Highest external temperature since reset.
Temperature, external minimum (8v32)	**262**	Lowest external temperature since reset.
Temperature, stream	**3**	
Temperature, stream maximum (8v32)	**159**	Highest stream temperature since reset.
Temperature, stream minimum (8v32)	**158**	Lowest stream temperature since reset.
Temperature, stream average (7v18)	**67**	

Other statistic	Value	Notes
Temperature, external volumetric flow reference	**20**	The reference temperature for external volumetric flow; temperature probe reading if available, flow temperature reading otherwise.
Temperature, external volumetric flow reference average	**84**	Average reference temperature for external volumetric flow over the time of totalizing.
Temperature, external volumetric flow reference maximum (8v32)	**295**	Highest external volumetric flow reference temperature since reset.
Temperature, external volumetric flow reference minimum (8v32)	**294**	Lowest external volumetric flow reference temperature since reset.
Temperature, external volumetric flow reference peak	**116**	Peak reference temperature for external volumetric flow over the time of totalizing.
Temperature, external volumetric flow reference source	**21**	Probe (or P) if using temperature probe for external volumetric temperature reference, Stream (or S) otherwise.
Temperature, external volumetric flow reference source average (7v01)	**85**	Probe (or P) if the temperature probe was used for external volumetric temperature reference over the entire measurement, Stream (or S) if the probe was never used, St+Pr (or M) if the probe was sometimes used.
Time, measurement remaining	**14**	Amount of time remaining before the currently executing measurement completes normally.
Time, user (7v01)	**392**	The amount of time that has elapsed since power-up (or the time of the device clock), or the start time of the measurement.
Valve drive	**13**	The valve drive signal.
Valve drive setpoint (8v00)	**45**	The setpoint directly drives the currently selected valve.
Vapor saturation (relative humidity)	**25**	The fraction of complete saturation the device is currently using. When the vapor used is water, this is relative humidity.
Vapor saturation, average	**89**	Average vapor saturation over the time of totalizing.
Vapor saturation, maximum (8v32)	**335**	Highest external temperature since reset.
Vapor saturation, minimum (8v32)	**334**	Lowest external temperature since reset.
Vapor saturation, peak	**121**	Peak vapor saturation over the time of totalizing.

Appendix B: Engineering Units

The following tables provide the values for engineering units for use in commands. The table to refer to is dependent on the statistic that is being modified. For example, use Appendix B-3 when modifying the engineering units for a totalizer measuring standard or normal volumes.

Appendix B-1: Standard and Normal Flow Units

Unit Label	Value	Notes
	0	Unit not specified; use default values.
---	**1**	Unknown unit; no conversions are performed to other units. If calibrated with different units, the value is displayed in those units.
SµL/m	**2**	Standard microliter per minute
SmL/s	**3**	Standard milliliter per second
SmL/m	**4**	Standard milliliter per minute
SmL/h	**5**	Standard milliliter per hour
SL/s	**6**	Standard liter per second
SLPM	**7**	Standard liter per minute
SL/h	**8**	Standard liter per hour
SCCS	**11**	Standard cubic centimeter per second
SCCM	**12**	Standard cubic centimeter per minute
Scm^3/h	**13**	Standard cubic centimeter per hour
Sm^3/m	**14**	Standard cubic meter per minute
Sm^3/h	**15**	Standard cubic meter per hour
Sm^3/d	**16**	Standard cubic meter per day
Sin^3/m	**17**	Standard cubic inch per minute
SCFM	**18**	Standard cubic foot per minute
SCFH	**19**	Standard cubic foot per hour
SCFD	**21**	Standard cubic foot per day Added in 6v08.0.
kSCFM	**20**	1000 standard cubic feet per minute
NµL/m	**32**	Normal microliter per minute
NmL/s	**33**	Normal milliliter per second
NmL/m	**34**	Normal milliliter per minute
NmL/h	**35**	Normal milliliter per hour
NL/s	**36**	Normal liter per second
NLPM	**37**	Normal liter per minute
NL/h	**38**	Normal liter per hour
NCCS	**41**	Normal cubic centimeter per second
NCCM	**42**	Normal cubic centimeter per minute
Ncm^3/h	**43**	Normal cubic centimeter per hour
Nm^3/m	**44**	Normal cubic meter per minute
Nm^3/h	**45**	Normal cubic meter per hour
Nm^3/d	**46**	Normal cubic meter per day
Count	**62**	Setpoint count, 0–64000
%	**63**	Percent of the full scale

Appendix B-2: True Mass Flow Units

Unit Label	Value	Notes
mg/s	64	Milligram per second
mg/m	65	Milligram per minute
g/s	66	Gram per second
g/m	67	Gram per minute
g/h	68	Gram per hour
kg/m	69	Kilogram per minute
kg/h	70	Kilogram per hour
oz/s	71	Ounce per second
oz/m	72	Ounce per minute
lb/m	73	Pound per minute
lb/h	74	Pound per hour

Appendix B-3: Total Standard and Normal Volume Units

Unit Label	Value	Notes
	0	Unit not specified; use default values.
---	1	Unknown unit; no conversions are performed to other units. If calibrated with different units, the value is displayed in those units.
SµL	2	Standard microliter
SmL	3	Standard milliliter
SL	4	Standard liter
Scm^3	6	Standard cubic centimeter
Sm^3	7	Standard cubic meter
Sin^3	8	Standard cubic inch
Sft^3	9	Standard cubic foot
kSft^3	10	1000 standard cubic feet
NµL	32	Normal microliter
NmL	33	Normal milliliter
NL	34	Normal liter
Ncm^3	36	Normal cubic centimeter
Nm^3	37	Normal cubic meter

Appendix B-4: Volumetric Flow Units

Unit Label	Value	Notes
	0	Unit not specified; use default values.
---	1	Unknown unit; no conversions are performed to other units. If calibrated with different units, the value is displayed in those units.
µL/m	2	Microliter per minute
mL/s	3	Milliliter per second
mL/m	4	Milliliter per minute
mL/h	5	Milliliter per hour
L/s	6	Liter per second
LPM	7	Liter per minute
L/h	8	Liter per hour
US GPM	9	US gallon per minute
US GPH	10	US gallon per hour
CCS	11	Cubic centimeter per second
CCM	12	Cubic centimeter per minute
cm^3/h	13	Cubic centimeter per hour
m^3/m	14	Cubic meter per minute
m^3/h	15	Cubic meter per hour
m^3/d	16	Cubic meter per day
in^3/m	17	Cubic inch per minute
CFM	18	Cubic foot per minute
CFH	19	Cubic foot per hour
CFD	21	Cubic foot per day Added in 6v08.0.
count	62	Setpoint count, 0–64000
%	63	Percent of full scale

Appendix B-5: Total Volume Units

Unit Label	Value	Notes
	0	Unit not specified; use default values.
---	1	Unknown unit; no conversions are performed to other units. If calibrated with different units, the value is displayed in those units.
µL	2	Microliter
mL	3	Milliliter
L	4	Liter
US GAL	5	US gallon
cm^3	6	Cubic centimeter
m^3	7	Cubic meter
in^3	8	Cubic inch
ft^3	9	Cubic foot
µP	61	Micropoise, a measure of viscosity; no conversions are performed to or from other units

Appendix B-6: Pressure Units

Unit Label	Value	Notes
	0	Unit not specified; use default values.
---	1	Unknown unit; no conversions are performed to other units. If calibrated with different units, the value is displayed in those units.
Pa	2	Pascal
hPa	3	Hectopascal
kPa	4	Kilopascal
MPa	5	Megapascal
mbar	6	Millibar
bar	7	Bar
g/cm^2	8	Gram force per square centimeter
kg/cm	9	Kilogram-force per square centimeter
PSI	10	Pound-force per square inch
PSF	11	Pound-force per square foot
mTorr	12	Millitorr
torr	13	Torr

Unit Label	Value	Notes
mmHg	14	Millimeter of mercury at 0 °C
inHg	15	Inches of mercury at 0 °C
mmH_2O	16	Millimeter of water at 4 °C (NIST conventional)
mmH_2O	17	Millimeter of water at 60 °F
cmH_2O	18	Centimeter of water at 4 °C (NIST conventional)
cmH_2O	19	Centimeter of water at 60 °F
inH_2O	20	Inch of water at 4 °C (NIST conventional)
inH_2O	21	Inch of water at 60 °F
atm	22	Atmosphere (absolute pressure only, no A/G/D suffix is applied)
V	61	Volt; no conversions are performed to or from other units (intended only for log-linear absolute pressure sensors, no A/G/D suffix is applied)
count	62	Setpoint count, 0–64000
%	63	Percent of full scale (no A/G/D suffix is applied)

Appendix B-7: Temperature Units

Unit Label	Value	Notes
	0	Unit not specified; use default values.
---	1	Unknown unit; no conversions are performed to other units. If calibrated with different units, the value is displayed in those units.
°C	2	Degree Celsius
°F	3	Degree Fahrenheit
°K	4	Kelvin
°Ra	5	Degree Rankine

Appendix B-8: Time Interval Units

Unit Label	Value	Notes
	0	Unit not specified; use default values.
---	1	Unknown unit; no conversions are performed to other units. If calibrated with different units, the value is displayed in those units.
h:m:s	2	The value displayed as hours:minutes:seconds.
ms	3	Millisecond
s	4	Second
m	5	Minute
hour	6	Hour
day	7	Day

Appendix C: Gas Numbers

#	Short Name	Long Name
0	Air	Air (Clean Dry)
1	Ar	Argon
2	CH_4	Methane
3	CO	Carbon Monoxide
4	CO2	Carbon Dioxide
5	C_2H_6	Ethane
6	H_2	Hydrogen
7	He	Helium
8	N_2	Nitrogen
9	N_2O	Nitrous Oxide
10	Ne	Neon
11	O_2	Oxygen
12	C_3H_8	Propane
13	nC_4H_{10}	Normal Butane
14	C_2H_2	Acetylene
15	C_2H_4	Ethylene (Ethene)
16	iC_4H_{10}	Isobutane
17	Kr	Krypton
18	Xe	Xenon
19	SF_6	Sulfur Hexafluoride[1]
20	C-25	25% CO_2, 75% Ar
21	C-10	10% CO_2, 90% Ar
22	C-8	8% CO_2, 92% Ar
23	C-2	2% CO_2, 98% Ar
24	C-75	75% CO_2, 25% Ar
25	He-25	25% He, 75% Ar
26	He-75	75% He, 25% Ar
27	A1025	90% He, 7.5% Ar, 2.5% CO_2
28	Star29	Stargon CS (90% Ar, 8% CO_2, 2% O_2)
29	P-5	5% CH_4, 95% Ar
30	NO	Nitric Oxide[2]
31	NF_3	Nitrogen Trifluoride[2]
32	NH_3	Ammonia[2]
33	Cl_2	Chlorine[2]
34	H_2S	Hydrogen Sulfide[2]
35	SO_2	Sulfur Dioxide[2]
36	C_3H_6	Propylene[2]
80	1Buten	1-Butylene[2]
81	cButen	Cis-Butene (cis-2-Butene)[2]
82	iButen	Isobutene[2]
83	tButen	Trans-2-Butene[2]
84	COS	Carbonyl Sulfide[2]
85	DME	Dimethylether (C_2H_6O)[2]
86	SiH_4	Silane[2]
100	R-11	Trichlorofluoromethane (CCl_3F)[2,3]
101	R-115	Chloropentafluoroethane (C_2ClF_5)[2,3]
102	R-116	Hexafluoroethane (C_2F_6)[2]
103	R-124	Chlorotetrafluoroethane (C_2HClF_4)[2,3]
104	R-125	Pentafluoroethane (CF_3CHF_2)[2,3]
105	R-134A	Tetrafluoroethane (CH_2FCF_3)[2,3]
106	R-14	Tetrafluoromethane (CF_4)[2]
107	R-142b	Chlorodifluoroethane (CH_3CClF_2)[2,3]
108	R-143a	Trifluoroethane ($C_2H_3F_3$)[2,3]
109	R-152a	Difluoroethane ($C_2H_4F_2$)[2]
110	R-22	Difluoromonochloromethane ($CHClF_2$)[2,3]
111	R-23	Trifluoromethane (CHF_3)[2,3]
112	R-32	Difluoromethane (CH_2F_2)[2,3]
113	R-318	Octafluorocyclobutane (C_4F_8)[2]
114	R-404A	44% R-125, 4% R-134A, 52% R-143A[2,3]
115	R-407C	23% R-32, 25% R-125, 52% R-143A[2,3]
116	R-410A	50% R-32, 50% R-125[2,3]
117	R-507A	50% R-125, 50% R-143A[2,3]
140	C-15	15% CO_2, 85% Ar
141	C-20	20% CO_2, 80% Ar
142	C-50	50% CO_2, 50% Ar
143	He-50	50% He, 50% Ar
144	He-90	90% He, 10% Ar
145	Bio5M	5% CH_4, 95% CO_2
146	Bio10M	10% CH_4, 90% CO_2
147	Bio15M	15% CH_4, 85% CO_2
148	Bio20M	20% CH_4, 80% CO_2
149	Bio25M	25% CH_4, 75% CO_2
150	Bio30M	30% CH_4, 70% CO_2
151	Bio35M	35% CH_4, 65% CO_2
152	Bio40M	40% CH_4, 60% CO_2
153	Bio45M	45% CH_4, 55% CO_2
154	Bio50M	50% CH_4, 50% CO_2
155	Bio55M	55% CH_4, 45% CO_2
156	Bio60M	60% CH_4, 40% CO_2
157	Bio65M	65% CH_4, 35% CO_2
158	Bio70M	70% CH_4, 30% CO_2
159	Bio75M	75% CH_4, 25% CO_2
160	Bio80M	80% CH_4, 20% CO_2
161	Bio85M	85% CH_4, 15% CO_2
162	Bio90M	90% CH_4, 10% CO_2
163	Bio95M	95% CH_4, 5% CO_2
164	EAN-32	32% O_2, 68% N_2
165	EAN-36	36% O_2, 64% N_2
166	EAN-40	40% O_2, 60% N_2
167	HeOx20	20% O_2, 80% He
168	HeOx21	21% O_2, 79% He
169	HeOx30	30% O_2, 70% He
170	HeOx40	40% O_2, 60% He
171	HeOx50	50% O_2, 50% He
172	HeOx60	60% O_2, 40% He
173	HeOx80	80% O_2, 20% He
174	HeOx99	99% O_2, 1% He
175	EA-40	Enriched Air-40% O_2
176	EA-60	Enriched Air-60% O_2
177	EA-80	Enriched Air-80% O_2
178	Metab	Metabolic Exhalant (16% O_2, 78.04% N_2, 5% CO_2, 0.96% Ar)
179	LG-4.5	4.5% CO_2, 13.5% N_2, 82% He
180	LG-6	6% CO_2, 14% N_2, 80% He
181	LG-7	7% CO_2, 14% N_2, 79% He
182	LG-9	9% CO_2, 15% N_2, 76% He
183	HeNe-9	9% Ne, 91% He
184	LG-9.4	9.4% CO_2, 19.25% N_2, 71.35% He
185	SynG-1	40% H_2, 29% CO, 20% CO_2, 11% CH_4
186	SynG-2	64% H_2, 28% CO, 1% CO_2, 7% CH_4
187	SynG-3	70% H_2, 4% CO, 25% CO_2, 1% CH_4
188	SynG-4	83% H_2, 14% CO, 3% CH_4
189	NatG-1	93% CH_4, 3% C_2H_6, 1% C_3H_8, 2% N_2, 1% CO_2
190	NatG-2	95% CH_4, 3% C_2H_6, 1% N_2, 1% CO_2
191	NatG-3	95.2% CH_4, 2.5% C_2H_6, 0.2% C_3H_8, 0.1% C_4H_{10}, 1.3% N_2, 0.7% CO_2
192	CoalG	50% H_2, 35% CH_4, 10% CO, 5% C_2H_4
193	Endo	75% H_2, 25% N_2
194	HHO	66.67% H_2, 33.33% O_2
195	HD-5	LPG: 96.1% C_3H_8, 1.5% C_2H_6, 0.4% C_3H_6, 1.9% n-C_4H_{10}
196	HD-10	LPG: 85% C_3H_8, 10% C_3H_6, 5% n-C_4H_{10}
197	OCG-89	89% O_2, 7% N_2, 4% Ar
198	OCG-93	93% O_2, 3% N_2, 4% Ar
199	OCG-95	95% O_2, 1% N_2, 4% Ar
200	FG-1	2.5% O_2, 10.8% CO_2, 85.7% N_2, 1% Ar
201	FG-2	2.9% O_2, 14% CO_2, 82.1% N_2, 1% Ar
202	FG-3	3.7% O_2, 15% CO_2, 80.3% N_2, 1% Ar
203	FG-4	7% O_2, 12% CO_2, 80% N_2, 1% Ar
204	FG-5	10% O_2, 9.5% CO_2, 79.5% N_2, 1% Ar
205	FG-6	13% O_2, 7% CO_2, 79% N_2, 1% Ar
206	P-10	10% CH_4 90% Ar
210	D-2	Deuterium

1 *Sulfur hexafluoride is a highly potent greenhouse gas monitored under the Kyoto Protocol.*

2 *Corrosive-resistant units only*

3 *Under the Montreal Protocol and Kigali Amendment, the production and consumption of these ozone-depleting substances (ODS) is being or has been phased out. It is recommended you ensure compliance with this universally ratified treaty before attempting to use these gases, in addition to R113, R-123, and R-141b.*


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