ALICAT SCIENTIFIC

A Halma company

IO-Link

ALICAT IO-LINK MANUAL

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Contents

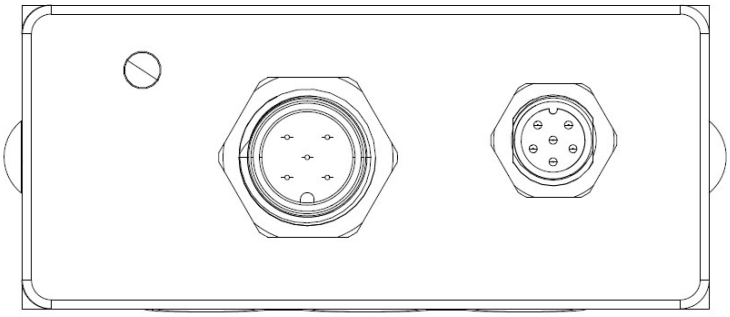
Alicat IO-Link Instruments

This manual is to assist in using an IO-Link-enabled Alicat instrument. Instructions for connecting an instrument to an IO-Link network can be found on page 9.

For setup, Alicat provides a series of IODD files for its various instrument series (M, P, L, MC, PC, LC, etc.). The IODD files can be found at alicat.com/iolink or by searching ioddfinder.io. The IODD file is used with the IO-Link master or can be read with the IODD Viewer, available at io-link.com/en/Download/Download.php.

Instrument Body

Alicat IO-Link instruments are equipped with one M12 port and one M8 port. Alicat EP/EPC instruments include a 5-pin M12 port and no M8 port.



The M12 port is an IO-Link port class A with 4 pins or an IO-Link port class B with 5 pins. Port class B uses the isolated power supply for valve power, most commonly for instruments with large valves.

The **LED** on the top of the instrument indicates the instrument status, per the following table:

LED Color	Status	Device Status	Description
Green	Normal Operation	0	Normal function
Red	Failure	4	The instrument has detected a sensor or other malfunction.
Orange	Check Function	3	The instrument is in a mode other than normal operation.
Yellow	Out of Specification	2	At least one reading is outside its specified measuring range or environmental conditions.
Blue	Maintenance required	1	Maintenance required

These colors and definitions follow the NAMUR NE 107 recommendation. These values correspond to the definitions in the Device Status standard variable (see page 14).

Class A vs Class B Devices and Masters

An IO-Link instrument and master may be designated Class A or Class B.

A **Class A master** supplies sufficient power for Alicat Class A instruments (meters and small-valve controllers).

A **Class B master** provides an additional, isolated power supply on Pin 5 (see pinout below). Alicat Class B instruments (e.g., controllers with large Rolamite valves) require a Class B master.

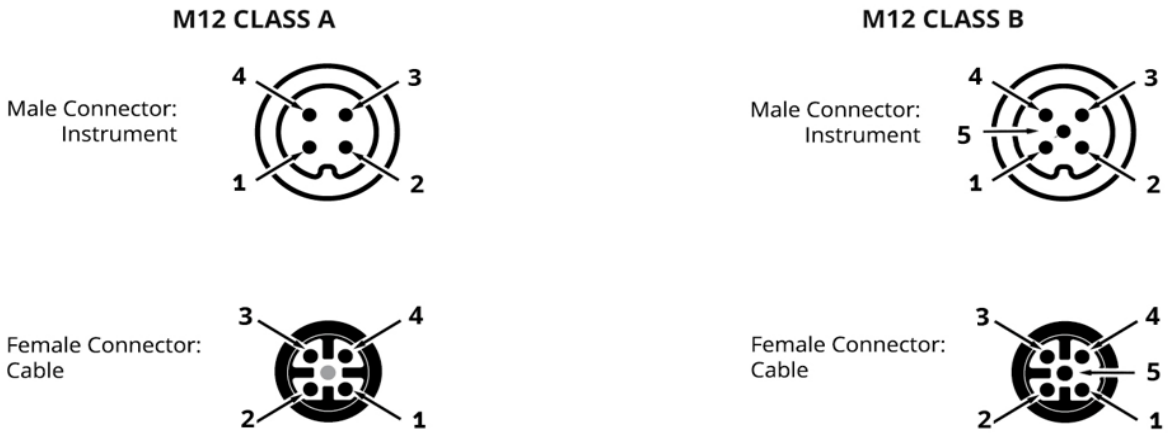
Class B masters can also support Alicat Class A instruments. Using a Class B master may be preferable in some cases in order to keep controller valves on a separate, isolated, power supply, even with smaller valves which could be driven by a Class A master.

✓ ***Note**: Many class A masters provide sufficient current to support Alicat controllers with large Rolamite valves. However, because a master's power is shared across all devices, this arrangement may reduce the number of IO-Link devices that a single master can support.*

Pinouts

M12 Connector Pinouts

The primary IO-Link connectors for most instruments have the following pinouts:



Pin	4-Pin M12 CLASS A
1	24 V power supply (L+)
2	Not connected
3	24 V power supply (L -)
4	IO-Link data (C/Q)

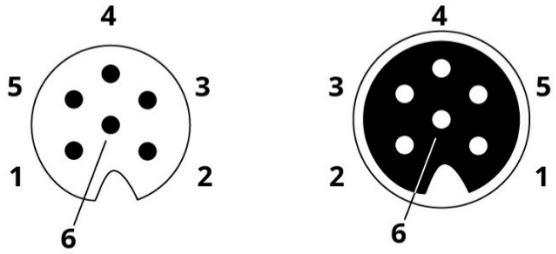
Pin	5-Pin M12 CLASS B
1	24 V power supply (L+)
2	Valve power supply (P24)
3	24 V power supply (L-)
4	IO-Link data (C/Q)
5	Valve power supply (N24)

For EP/EPC instruments, M12 pinout is as follows:

Pin	5-Pin M12
1	24 V power supply (L+)
2	MFG 1 reserved (compatible with Class A or Class B)
3	24 V power supply (L-)
4	IO-Link data (C/Q)
5	MFG 2 reserved (compatible with Class A or Class B)

M8 Factory Connector Pinout

A factory M8 connector is included on most instruments for applications preferring RS-232 or RS-485 serial communication or requiring an analog interface.



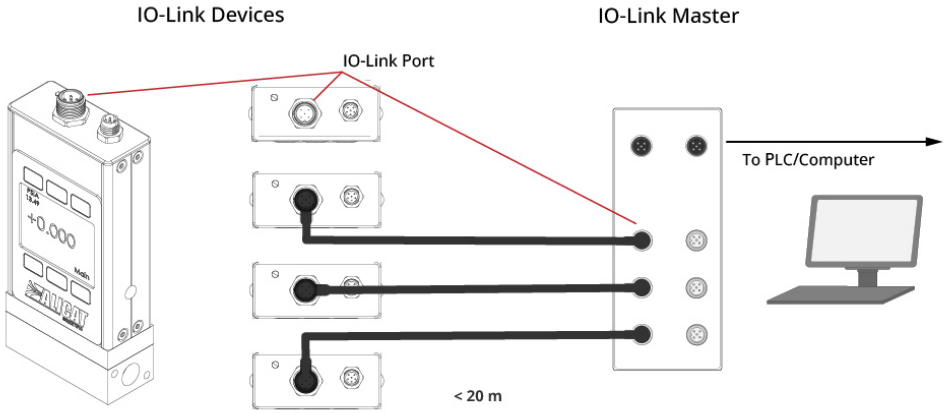
Pin	6-Pin M8
1	Power in (see warning below): powers the instrument, see the instrument specification sheet for details.
2	Analog out: 0–5 Vdc output signal. Optional: 1–5 Vdc, 0–10 Vdc, 4–20 mA.
3	Ground: common ground for power, digital communications, analog signals, and alarms.
4	RS232 Tx: sends RS-232 (Tx) or RS-485 A (–) signals from the instrument.
5	RS232 Rx: receives RS-232 (Rx) or RS-485 B (+) signals to change the instrument's settings.
6	For meters, ground to tare. For controllers, analog in: 0–5 Vdc analog DC input defining the setpoint. Optional: 1–5 Vdc, 0–10 Vdc, or 4–20 mA.

WARNING: ***Do not connect power to the instrument via both the M12 and M8 connector simultaneously, which may damage the instrument.***

Connecting to an IO-Link Master

The IO-Link master acts as a bridge between IO-Link devices and the rest of the process automation network. To connect an Alicat instrument to an IO-Link master:

1. Supply an IO-Link Class A or Class B Master (see page 8).
2. Connect the Alicat instrument(s) to the IO-Link master and network per the diagram below:

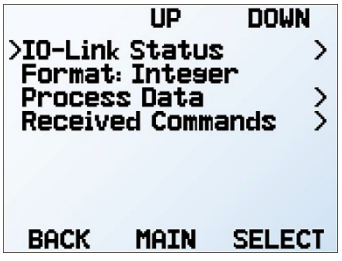


3. An IODD file with setup information for the specific IO-Link device is required. There are several ways to obtain the IODD file:
    a. Some IO-Link master software will automatically locate and acquire the correct IODD file for a device when the device is detected (provided an internet connection is available).
    b. If the master application cannot automatically find the IODD file, the file can be downloaded at alicat.com/iolink.
    c. The IODD can also be found by searching ioddfinder.io.

    The IODD file can be read with the IODD Viewer, available at io-link.com/en/Download/Download.php.
4. Verify that the master is communicating with the Alicat instrument.
    a. Some IO-Link masters include an indicator light that will reflect the presence of a valid device. Refer to the documentation for the master to determine the meaning of various colors and modes.
    b. Open the master application. If the instrument and master are communicating, information from the instrument should appear and update in the master application.
    c. If a connection cannot be established, contact Alicat support (see page 2).

IO-Link Menu

Alicat IO-Link instruments with a display have an extra configuration menu that is not covered in the standard instrument menu. To access the screen, choose **MENU > SETUP > IO-Link**. This menu displays the Process Data **Format** (Floating Point or Integer, see page 12) and provides the following options.

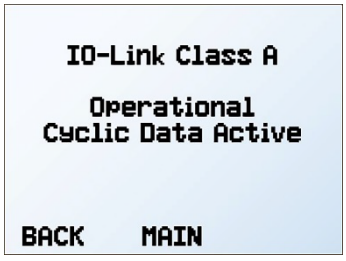


IO-Link menu

IO-Link Status

The **IO-Link Status** screen displays:

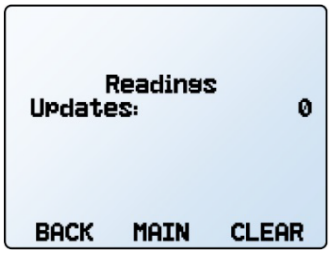
- whether the instrument is Class A or Class B (see page 8)
- the state of the IO-link connection
- whether Process Data (cyclic data) is being actively exchanged between the IO-Link master and the Alicat instrument (see page 12).



IO-Link status screen

Process Data

The **Process Data** screen displays the number of times the instrument has updated the process data (cyclic data) readings. Press **Clear** to set the count to 0. For more information on process data, see page 12.



Process data screen

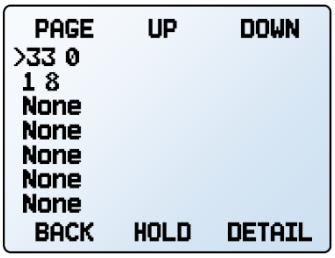
Received Commands

The **Received Commands** screen shows the ten most recent commands written to the instrument with the most recent at the top. For more information on commands, see page 22.

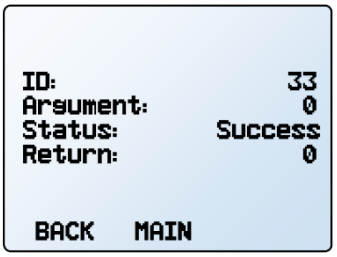
HOLD: Stops the screen from updating any new commands that may be sent to the instrument.

UPDATE: When **HOLD** has been selected, the option will be replaced with **UPDATE**. Press **UPDATE** to restore the instrument to refresh the list with new commands.

DETAIL: Opens the currently designated command (see page 22) and displays more details about the command. The screen shows the numerical value of the command ID written to the instrument, the argument used, the numerical status of the command, and the value of the information returned if applicable.



Received commands screen



Details of received command

IO-Link Interface

Alicat IO-Link enabled instruments interact with IO-Link systems using both cyclic Process Data and acyclic Variables.

Process Data

Alicat IO-Link instruments support process data in Floating Point (Float32) or Integer (Integer32) format values. Only one format can be active at a time. The format can be changed from the instrument screen or over IO-Link, using the Process Data Format variable (page 14). The functions between the two modules do not change. The only difference is how the modules present their readings in either Float32 or Integer32 formats.

Floating Point (Float32) Format

See the following table for the format and description of the Process Data In record. Invalid values are read as hex FFFFFFFF, a floating point NaN.

Integer (Integer32) Format

When this format is selected, invalid readings are read as −2147483648. See the following table for the format and description of the Process Data In record. To obtain the value in their engineering units, multiply the value by 10^ (- the number of decimal places). Obtain the number of decimal places from Subindex 9 of the listed variable index.

Process Data In

The input process data are the values that the device sends to the master, per the table below.

Sub-index	Bit Offset	Variable Index	Readings					
			M Series	MC Series	P/EP Series	PC/EPC Series	L Series	LC Series
1	0	67	Pressure	Pressure	Pressure	Pressure	Pressure	Pressure
2	32	68	Secondary Pressure	2nd Pressure	2nd Pressure	2nd Pressure	2nd Pressure	2nd Pressure
3	64	69	Temperature	Temperature	Bar. Pressure	Bar. Pressure	Bar. Pressure	Bar. Pressure
4	96	70	Volumetric Flow	Vol. Flow	Temperature	Temperature	Temperature	Temperature
5	128	71	Mass Flow	Mass Flow	N/A	Setpoint	Vol. Flow	Vol. Flow
6	160	72	Totalizer 1	Totalizer 1	N/A	Valve Drive	Totalizer 1	Totalizer 1
7	192	73	Barometric Pressure	Setpoint	N/A	N/A	Totalizer 2	Setpoint
8	224	74	Humidity	Valve Drive	N/A	N/A	N/A	Valve Drive

Process Data Out

Process Data Out is defined for controllers only. The requested setpoint is four octets long. The type of the setpoint is Integer32 or Float32, depending on the currently active format.

Communication Timeout Behavior

A master may disconnect from the Alicat instrument, either deliberately or due to a communication interruption.

When a disconnect occurs with a meter, the instrument simply continues metering.

Communication Timeout options

When a controller detects a disconnect or invalid process data out, one of two options can be selected by choosing **MENU > CONTROL > Setpoint Setup > On Comm Timeout** on the instrument display:

1. select **Maintain last Setpt** to keep controlling to the last setpoint received.
2. select **Set Zero Setpt** to force the setpoint to zero until the connection is reestablished.

The timeout behavior can also be changed using Variable 81 (see page 16).

Standard Variables

Alicat instruments follow the IO-Link Common Profile. As a part of the profile, the following standard variables are implemented. For more information see the "IO-Link Interface and System Specification" and the "IODD Common Profile" specifications at io-link.com/en/Download/Download.php.

Index ID	Variable Name
0	Direct Parameter Page 1
2	System Command
3	Data Storage Index
12	Device Access Locks
13	Profile Characteristic
14	PDInput Descriptor
15	PDOutput Descriptor
16	Vendor Name
18	Product Name
19	Product ID
21	Serial Number
22	Hardware Revision
23	Firmware Revision
24	Application Specific Tag
25	Function Tag
26	Location Tag
36	Device Status (see below)
37	Detailed Device Status (see below)

Device Status and Detailed Device Status

The **detailed device status** is a standard variable that provides information about currently pending events. The Status column shows the value of the **device status** associated with that event.

Event Code	Type	Status	Name	Description
6145	Warning	2	Comms Error	A timeout was detected on a communication protocol.
6147	Error	4	ADC Error	There is an internal hardware error, and the instrument requires service.
6148	Warning	2	Mass Flow Out of Range	The current mass flow is larger than the overrange value.
6149	Warning	2	Volumetric Flow Out of Range	The current volumetric flow is larger than the overrange value.
6151	Warning	2	Abs Pressure Out of Range	The current absolute primary pressure is outside the instrument specifications.
6152	Warning	2	Gauge Pressure Out of Range	The current gauge primary pressure is outside the instrument specs.
6153	Warning	2	Diff Pressure Out of Range	The current differential primary pressure is outside the instrument specs.
6154	Warning	2	Abs Secondary Pressure Out of Range	The current absolute secondary pressure is outside the instrument specs.
6155	Warning	2	Gauge Secondary Pressure Out of Range	The current gauge secondary pressure is outside the instrument specs.
6156	Warning	2	Diff Secondary Pressure Out of Range	The current differential secondary pressure is outside the instrument specs.
6157	Warning	2	Temperature Out of Range	The current temperature is outside the instrument specs.
6159	Warning	2	Totalizer 1 Missed Flow	Flow was out of range while Totalizer 1 was active; some volume may be missing.
6160	Warning	2	Totalizer 1 Overflow	Totalizer 1 has exceeded the maximum volume.
6161	Warning	2	Totalizer 2 Missed Flow	Flow was out of range while Totalizer 2 was active; some volume may be missing.
6162	Warning	2	Totalizer 2 Overflow	Totalizer 2 has exceeded the maximum volume.
6166	Warning	3	Control Hold	Control is set to hold; closed loop control is not active.
6167	Warning	3	Control Optimization Active	Control optimization is in progress; user setpoints are not honored.
6168	Warning	3	Over Pressure Limit	If configured, the pressure has exceeded the pressure limit.

Variables

Alicat provides a number of informational and configuration acyclic variables. Not all acyclic variables are present on every instrument.

Process Data Format

Index: 66

Type: UInteger8

Access: rw

The **Process data format** variable indicates the format of the cyclic process data. The value will be 0 for floating point format or 1 for integer format (see page 12).

Process Data Information (Setpoint, Pressure, Temperature, Etc.)

Index: 67–74

Type: Record

Access: ro

The **process data information** variables describes the values in the Process Data In record (see page 12). These will either be floating point or integer values, depending on the Process Data Format (see page 12).

The table below indicates which process data value each variable represents, for each series of Alicat instruments:

Variable Index	Process Data Value					
	M Series	MC Series	P/EP Series	PC/EPC Series	L Series	LC Series
67	Pressure	Pressure	Pressure	Pressure	Pressure	Pressure
68	Secondary Pressure	2nd Pressure	2nd Pressure	2nd Pressure	2nd Pressure	2nd Pressure
69	Temperature	Temperature	Barometric Pressure	Bar. Pressure	Bar. Pressure	Bar. Pressure
70	Volumetric Flow	Volumetric Flow	Temperature	Temperature	Temperature	Temperature
71	Mass Flow	Mass Flow		Setpoint	Volumetric Flow	Volumetric Flow
72	Totalizer 1	Totalizer 1		Valve Drive	Totalizer 1	Totalizer 1
73	Barometric Pressure	Setpoint			Totalizer 2	Setpoint
74	Humidity	Valve Drive				Valve Drive

The table below indicates the data which is available for each process data value in the table above:

Subindex	Bit Offset	Type	Description
1	0	UInteger16	Process data value type. Indicates the reading reported in this process data subindex. See Appendix A (page 44).
2	16	UInteger16	Process data value source. See Appendix C (page 51).
3	32	Float32	Minimum value of the process data value, without overrange
4	64	Float32	Maximum value of the process data value, without overrange
5	96	Integer32	Minimum value of the process data value, without overrange. Scale the integer by 10^ (- subindex 9 value) for the value in engineering units.
6	128	Integer32	Maximum value of the process data value, without overrange. Scale the integer by 10^ (- subindex 9 value) for the value in engineering units.
7	160	UInteger8	Process data value engineering units. See Appendix B (page 46).
8	168	String6	Label for the engineering units, using US-ASCII encoding.
9	216	UInteger8	The number of digits after the decimal place in the current process data value, min value, and max value.

Gas Number

- Mass flow instruments

Index: 75

Type: UInteger16

Access: rw

The **gas number** is the number of the gas being used to calculate the mass flow (see Appendix D on page 52).

Closed Loop Control Variable

▶ Controllers

Index: 76

Type: UInteger16

Access: rw

The **closed loop control variable** is the statistic number of the **setpoint** variable that drives closed loop control. Valid values are setpoint numbers (see Appendix A on page 44).

P Gain

▶ Controllers

Index: 77

Type: UInteger32

Access: rw

The **P Gain** is the closed loop control P gain. Valid values are from 0 – 65535.

I Gain

▶ Controllers

Index: 78

Type: UInteger32

Access: rw

The **I Gain** is the closed loop control I gain. Valid values are from 0 – 65535.

D Gain

▶ Controllers

Index: 79

Type: UInteger32

Access: rw

The **D Gain** is the closed loop control D gain. Valid values are from 0 – 65535.

Closed Loop Control Algorithm

▶ Controllers

Index: 80

Type: UInteger8

Access: rw

The **closed loop control variable** indicates the algorithm used for closed loop control.

Value	Description
1	PD/PDF
2	PD^2I

Communication Timeout Behavior

▶ Controllers

Index: 81

Type: UInteger8

Access: rw

An IO Link master may disconnect from the Alicat instrument, either deliberately or due to a communication interruption. The **communication timeout behavior** determines how a controller will respond when it detects a disconnect or invalid process data out.

Value	Description
0	Force the setpoint to zero until the connection is reestablished.
1	Continue controlling to the last setpoint received.

The timeout behavior can also be set from the display screen (see page 12).

Flow Averaging Time Constant

▶ Flow instruments

Index: 82

Type: UInteger16

Access: rw

The **flow averaging time constant** is the time constant of the geometric running average applied to the flow, in milliseconds. Valid values are from 0 – 9999.

Primary Pressure Averaging Time Constant

Index: 83

Type: UInteger16

Access: rw

The **primary pressure averaging time constant** is the time constant of the geometric running average applied to the primary pressure, in milliseconds. Valid values are from 0 – 9999.

Secondary Pressure Averaging Time Constant

Index: 84

Type: UInteger16

Access: rw

The **secondary pressure averaging time constant** is the time constant of the geometric running average applied to the secondary pressure, in milliseconds. Valid values are from 0 – 9999.

Totalizer 1 Flow Type

▶ Flow Instruments

Index: 85

Type: UInteger16

Access: rw

The **totalizer 1 flow type** is 0 to disable the totalizer or one of the flow statistic numbers in appendix A (page 44).

Totalizer 1 Flow Accumulation Mode

▶ Flow Instruments

Index: 86

Type: UInteger8

Access: rw

The **totalizer 1 flow accumulation mode** indicates how to accumulate flow into the totalizer.

Value	Description
0	Accumulate only positive flow.
1	Accumulate only negative flow.
2	Add positive and subtract negative flow.
3	Accumulate positive flow, resetting after flow ceases.

Totalizer 1 Limit Mode

▶ Flow Instruments

Index: 87

Type: UInteger8

Access: rw

The **totalizer 1 limit mode** indicates what will occur when the totalizer limit is reached.

Value	Description
0	Hold value at the maximum limit and do not generate an event.
1	Set value to zero and do not generate an event.
2	Hold value at the maximum limit and generate an event.
3	Set value to zero and generate an event.

Totalizer 2 Flow Type

▶ Liquid Meters

Index: 88

Type: UInteger16

Access: rw

The **totalizer 2 flow type** is 0 to disable the totalizer or one of the flow statistic numbers in appendix A (page 44).

Totalizer 2 Flow Accumulation Mode

▶ Liquid Meters

Index: 89

Type: UInteger8

Access: rw

The **totalizer 2 flow accumulation mode** indicates how to accumulate flow into the totalizer.

Value	Description
0	Accumulate only positive flow.
1	Accumulate only negative flow.
2	Add positive and subtract negative flow.
3	Accumulate positive flow, resetting after flow ceases.

Totalizer 2 Limit Mode

▶ Liquid Meters

Index: 90

Type: UInteger8

Access: rw

The **totalizer 2 limit mode** indicates what will occur when the totalizer limit is reached.

Value	Description
0	Hold value at the maximum limit and do not generate an event.
1	Set value to zero and do not generate an event.
2	Hold value at the maximum limit and generate an event.
3	Set value to zero and generate an event.

Asynchronous Command Request

Index: 91

Type: Record

Access: rw

The **asynchronous command request** variable is an asynchronous request used to command the instrument to perform actions such as taring, setting the gas, or locking the display. For more information on sending commands, see the **Commands** section (page 22).

Subindex	Bit Offset	Type	Description
1	0	Unsigned32	ID of the desired command
2	32	Integer32	Argument of the desired command

Asynchronous Command Status

Index: 92

Type: Record

Access: ro

The **asynchronous command status** variable contains information on the currently executing or last completed command. For more information on commands and the command statuses, see the **Commands** section (page 15).

Subindex	Bit Offset	Type	Description
1	0	Unsigned32	ID of the current or last completed command
2	32	Integer32	Argument for the current or last completed command
3	64	Unsigned32	Numerical value of the status of the current or last completed command (see page 22)
4	96	Integer32	Value returned by the command

COMPOSER™ Gas Mix Data

- Mass flow instruments

Index: 93

Type: Record

Access: rw

The **COMPOSER gas mix** variable gives the COMPOSER gas mix constituents. Using this index, the instrument can save a custom mix to accurately report the mass flow of up to 5 gases mixed together.

Note*: This does not command the instrument to physically mix the gases. The gases must be mixed in their desired quantities before reaching the instrument for it to read the mixture properly.*

To use the index, write the desired gas numbers into the variable (starting with bit offset 0) followed by its percentage of the mix in the corresponding byte offset. Please refer to the gas index on page 52 to determine the number associated with the desired gas. Percentages are read as 1 count equals 0.01%. For example, 5000 is read as 50%. If less than 5 gases are in use, write a value of 0 to the remaining byte offsets. Percentages written to this index must sum to 100% or creating the gas mixture fails.

Subindex	Bit Offset	Type	Description
1	0	UInteger16	Gas ID of gas number 1
2	16	UInteger16	Gas number 1 percentage. 1 count = 0.01%
3	32	UInteger16	Gas ID of gas number 2
4	48	UInteger16	Gas number 2 percentage. 1 count = 0.01%
5	64	UInteger16	Gas ID of gas number 3
6	80	UInteger16	Gas number 3 percentage. 1 count = 0.01%
7	96	UInteger16	Gas ID of gas number 4
8	112	UInteger16	Gas number 4 percentage. 1 count = 0.01%
9	128	UInteger16	Gas ID of gas number 5
10	144	UInteger16	Gas number 5 percentage. 1 count = 0.01%

Once all the desired gases and their percentages have been written to the index, perform the **Create/Update Gas Mix** command (page 39). The argument for the command sets what the gas number of the new mixture is and can be any number between 236 and 255. If the argument is 0, the mixture is written to the first available gas number starting with 255 and decreasing. If there are no available gas numbers, the command fails, and an error is returned. To update a gas mixture, use the gas number of the mixture as the argument.

Commands

Commands require a command ID and argument written to the **asynchronous command request** variable (index 91, see page 20). To send a command, write the command ID and the argument to bit offsets 0 and 32, respectively. For example, to command the instrument to tare the flow, a command ID of 33 is written to offset 0 and the desired time to tare is written, in milliseconds, starting at bit offset 32.

Byte Offset	Type	Description
0	Unsigned32	The ID of the desired command
4	Integer32	The argument of the desired command

After an instrument runs a command, it sets a command status and reports that status with a numerical value. Refer to the following table to determine the associated status with the given numerical value.

Status Value	Status Name	Description
0	SUCCESS	The last command completed successfully.
1	IN_PROGRESS	A command is currently executing.
2	INVALID_ID	The ID of the last command is invalid.
3	INVALID_ARGUMENT	The argument of the last command is invalid.
4	UNSUPPORTED	The last command is not supported by the instrument.
5	INVALID_MIX_IDX	The requested gas mix number is invalid.
6	INVALID_MIX_GAS	A gas used in the mix does not exist on the instrument.
7	INVALID_MIX_PCT	The gas mix fractions do not sum to 100%.

Some commands provide a return value. The command descriptions in this manual outline the meaning of any return value the command may provide. If a command does not define a return value, the command places a 0 in the return value field. For more information on where the status and return values are located, see the **Asynchronous Command Status** section (page 20).

It is not possible to repeat a command multiple times in a row. If repetition is necessary, run a **no operation** command between the repeated commands. Running a **no operation** command before or after each command can prevent any issues with an unintended command repeating.

The following commands outline what firmware version they were first introduced in, their command ID, the command's function, their possible arguments, and the results of a successful command.

Command Function

The command function is used to ensure commands run as intended.

No Operation

Command ID: 0

This command does nothing. It is required to separate identical command IDs and arguments. This command may be used before every command or at any time.

Argument: This command ignores any argument.

Data Readings

Use variables 67–74 (see page 15) to obtain information about a reading type, source, min/max values, units, decimal places for scaling integer values, etc.

Set Reading Engineering Units

Firmware: 10v18.0

Command ID: 65300 + offset

Set reading engineering units changes the engineering units of the desired reading. When writing the command ID, add the offset of the reading to the command ID (65300).

	Description					
Offset	**M Series**	**MC Series**	**P/EP Series**	**PC/EPC Series**	**L Series**	**LC Series**
0	Pressure	Pressure	Pressure	Pressure	Pressure	Pressure
1	Secondary Pressure	Secondary Pressure	Secondary Pressure	Secondary Pressure	Secondary Pressure	Secondary Pressure
2	Temperature	Temperature	Barometric Pressure	Barometric Pressure	Barometric Pressure	Barometric Pressure
3	Volumetric Flow	Volumetric Flow	Temperature	Temperature	Temperature	Temperature
4	Mass Flow	Mass Flow		Setpoint	Volumetric Flow	Volumetric Flow
5	Totalizer 1	Totalizer 1		Valve Drive	Totalizer 1	Totalizer 1
6	Barometric Pressure	Setpoint			Totalizer 2	Setpoint
7	Humidity	Valve Drive				Valve Drive

For example, use 65302 as the command ID to change the engineering unit of the temperature of an M Series instrument or the barometric pressure reading of a P instrument.

Not all readings are independent of each other. Changing the engineering units of the pressure reading also changes the secondary pressure and barometric pressure.

Argument: Use the value of the associated desired engineering units found in **Appendix B** (page 46).

Command response: A SUCCESS status is set if the reading's engineering units are changed. The return value is the value of the requested engineering units.

An UNSUPPORTED status is set if the offset in the command ID is not associated with the instrument.

An INVALID_ARGUMENT status is set if engineering units are not valid for the reading.

Control

The control commands are commands for Alicat controllers only. These commands manage the setpoint, valve, and totalizer batches.

Set Power-up Setpoint

▶ Controllers

Firmware: 10v18.0

Command ID: 12

Set power-up setpoint stores the current setpoint to be immediately used the next time the controller is powered.

Argument: this command ignores the argument value.

Command Response: A SUCCESS status is set, and the instrument saves the current setpoint as the power-up setpoint.

Setpoint Maximum Ramp (Saved)

▶ Controllers

Firmware: 10v18.0

Command ID: 65546

Setpoint maximum ramp (saved) sets the maximum ramp rate of the setpoint and saves it across power cycles. This command should not be used more often than every few minutes.

Argument: To query the current maximum ramp rate, use a negative value.

To disable the maximum ramp rate, use a value of 0.

To set a maximum ramp rate, determine the desired rate of full-scale percentage change per millisecond and then multiply that value by 10,000,000. For example, if a controller were to ramp to a setpoint by 1% of full scale every second, the instrument would ramp 0.001% every millisecond. Multiply that 0.001% by 10,000,000 to obtain a value of 10,000. Refer to the following table for further example values.

Maximum Ramp Rate	Value
100% of full scale every millisecond	1000000000
1% of full scale every millisecond	10000000
100% of full scale every second	1000000
00% of full scale every minute	16667
1% of full scale every second	10000
100% of full scale every hour	278
1% of full scale every minute	167
10% of full scale every hour	28

Command Response: A SUCCESS status is set after the command is completed. The return value is the current maximum ramp rate. Multiply the value by 0.0000001 to obtain the ramp rate in percent of full scale per millisecond.

Setpoint Maximum Ramp (Temporary)

▶ Controllers

Firmware: 10v18.0

Command ID: 65547

Setpoint maximum ramp (temporary) sets the maximum ramp rate of the setpoint. This command does not save the maximum ramp rate and it is lost when the instrument loses power.

Argument: To query the current ramp rate, use a negative value.

To disable the ramp rate, use a value of 0.

To set a maximum ramp rate, determine the desired rate of full-scale percentage change per millisecond and then multiply that value by 10,000,000. For example, if a controller were to ramp to a setpoint by 1% of full scale every second, the instrument would ramp 0.001% every millisecond. Multiply that 0.001% by 10,000,000 to obtain a value of 10,000. Refer to the following table for further example values.

Maximum Ramp rate	Value
100% of full scale every millisecond	1000000000
1% of full scale every millisecond	10000000
100% of full scale every second	1000000
100% of full scale every minute	16667
1% of full scale every second	10000
100% of full scale every hour	278
1% of full scale every minute	167
10% of full scale every hour	28

Command Response: A SUCCESS status is set after the command is completed. The return value is the current maximum ramp rate. Multiply the value by 0.0000001 to obtain the ramp rate in percent of full scale per millisecond.

Hold Valve(s)

▶ Controllers

Firmware: 10v18.0

Command ID: 6

Hold valve(s) pauses the controller valve(s) and stops any further control of the process. The command can also cancel a current hold.

Argument: Use the value for the desired effect found in the following table:

Value	Description
0	Cancel valve hold and resume normal closed-loop control.
1	Hold all valves closed.

Value	Description
2	Hold valves at their current positions.
3	Exhaust: Close the upstream valve and fully open the downstream valve. Only supported on dual valve controllers.

Command Response: A SUCCESS status is set if the command sets the valve to the desired argument mode.

An UNSUPPORTED status returns if the requested mode is not supported by the instrument.

An INVALID_ARGUMENT status is set if the argument value is not valid.

Set Active Valve

▶ Controllers

Firmware: 10v18.0

Command ID: 15

Set active valve is only available on MCT stream-switching controllers. The command controls which valve is the active valve that controls the process.

Argument: Use the value for the desired valve found in the following table.

Value	Description
0	Upstream valve or only valve
1	Downstream valve or auxiliary valve wired in the downstream location.
2	The first auxiliary valve.
3	The second auxiliary valve.
65535	Query the currently active valve.

Command Response: A SUCCESS status is set if the active valve changes. The return value is the currently active control valve (0 to 3), if the argument is 65535, or 0 otherwise.

An UNSUPPORTED status is set if the instrument is not an MCT controller.

An INVALID_ARGUMENT status is set if the value used is not valid.

Set Proportional Closed-Loop Control Gain

▶ Controllers

Firmware: 10v18.0

Command ID: 8

Set proportional close loop control gain changes the proportional gain value (P gain) to the value in the argument.

Argument: Use a value between 0 – 65535.

Command Response: A SUCCESS status is set when the command completes, and the gain value is set.

Set Derivative Closed-Loop Control Gain

▶ Controllers

Firmware: 10v18.0

Command ID: 9

Set derivative close loop control gain changes the derivative gain value (D gain) to the desired value in the argument.

Argument: Use a value between 0 – 65535.

Command Response: A SUCCESS status is set when the command completes, and the gain is set.

Set Integral Closed-Loop Control Gain

▶ Controllers

Firmware: 10v18.0

Command ID: 10

Set integral close loop control gain changes the integral gain value (I gain) to the desired value used in the argument.

Argument: Use a value between 0 – 65535.

Command Response: A SUCCESS status is set when the command completes, and the gain is set.

Set Loop Control Variable

▶ Controllers

Firmware: 10v18.0

Command ID: 11

Set loop control variable changes the statistic that the controller actively controls. That means a mass flow controller can be changed to control pressure or volumetric flow if needed.

Argument: Use the value for the desired statistic found in the following table.

Value	Description
0	Mass flow
1	Volumetric flow
2	Differential pressure
3	Absolute pressure
4	Gauge pressure
...	Any setpoint value that is found in Appendix A (page 44).

Command Response: A SUCCESS status is set if the loop control variable changes.

An INVALID_ARGUMENT is set if the statistic is not available on the instrument (e.g., trying to control mass flow on a pressure controller).

Set Loop Control Algorithm

▶ Controllers

Firmware: 10v18.0

Command ID: 13

S**et loop control algorithm** selects either PDF or PD^2I algorithm for the controller. Only one algorithm can be active at a time.

Argument: Use the value of the desired algorithm found in the following table.

Value	Description
1	PDF closed-loop control algorithm
2	PD^2I closed-loop control algorithm

Command Response: A SUCCESS status is set if the desired loop control algorithm is selected.

An INVALID_ARGUMENT status is set if the value is not for a valid algorithm.

Read Closed-Loop Gain

▶ Controllers

Firmware: 10v18.0

Command ID: 14

Read closed-loop gain returns the current value of the desired loop gain in the loop control algorithm.

Argument: Use the value of the desired closed-loop gain found in the following table.

Value	Description
0	Proportional gain (P gain) for PDF or PD^2I
1	Derivative gain (D gain) for PDF or PD^2I
2	Integral gain (I gain) for PD^2I

Command Response: A SUCCESS status is set if the argument is a valid choice. The return value is the gain value of the requested closed-loop gain. The value can be between 0 – 65535.

An INVALID_ARGUMENT is set if the gain requested is not a valid choice for the loop control algorithm.

Set Inverse Pressure Control

▶ Controllers

Firmware: 10v18.0

Command ID: 16

Set inverse pressure control manages how the controller controls pressure. It can be set to control pressure normally or to control the inverse pressure (usually back pressure). This command also sets whether the control mode is saved across power cycles.

Argument: Use the value for the desired setting found in the following table.

Value	Description
0	Enable normal pressure control, not saved across power cycles.
1	Enable inverse pressure (usually back pressure) control, not saved across power cycling.
3	Enable normal pressure control, saved across power cycles.
4	Enable inverse pressure (usually back pressure) control, saved across power cycling.

Command Response: A SUCCESS status is set if the pressure mode has changed.

An INVALID_ARGUMENT status is set if the argument used is not available on the instrument or does not have an associated pressure control mode.

Query Totalizer Batch (Integer)

▶ Flow Controllers

Firmware: 10v18.0

Command ID: 65543

Query totalizer batch (integer) requests the total size of the batch from one of the two totalizers.

Argument: Use a value of 1 to query totalizer 1. Use a value of 2 to query totalizer 2.

Command Response: A SUCCESS status is set if the requested totalizer is enabled. The return value is the total size of the batch of the requested totalizer. To obtain the volume in the requested totalizer's engineering units, multiply the value by 10^(- totalizer decimal places). The instrument returns a 0 if batching is disabled.

An INVALID_ARGUMENT status is set if the requested totalizer is not enabled.

Query Totalizer Batch (Float)

▶ Flow Controllers

Firmware: 10v18.0

Command ID: 65540

Query totalizer batch (float) requests the total size of the batch from one of the two totalizers.

Argument: Use a value of 1 to query totalizer 1. Use a value of 2 to query Totalizer 2.

Command Response: A SUCCESS status is set if the requested totalizer is enabled on the instrument. The return value is the total size of the batch in the requested totalizer in a Float32 formatted value. This value uses the engineering units of the totalizer. The instrument returns a 0 if batching is disabled.

An INVALID_ARGUMENT status is set if the requested totalizer is not enabled.

Set Totalizer Batch 1 (Integer)

▶ Flow Controllers

Firmware: 10v18.0

Command ID: 65544

Set totalizer batch 1 (integer) manages the batch size of Totalizer 1.

Argument: Use the desired batch size multiplied by 10^(totalizer decimal places).

To disable batching, use a value of 0.

Command response: A SUCCESS status is set if Totalizer 1 is enabled and the size of the batch is valid. The return value is the batch size.

An UNSUPPORTED status is set if Totalizer 1 is not enabled.

An INVALID_ARGUMENT status is set if the volume of the batch is larger than what Totalizer 1 can hold.

Set Totalizer Batch 1 (Float)

▶ Flow Controllers

Firmware: 10v18.0

Command ID: 65541

Set totalizer batch 1 (float) manages the batch size of Totalizer 1.

Argument: Use the desired batch size formatted as a Float32 value in the engineering units of Totalizer 1.

To disable batching, use a value of 0.

Command response: A SUCCESS status is set if totalizer 1 is enabled and the batch size is valid. The return value is the requested batch volume.

An UNSUPPORTED status is set if Totalizer 1 is not enabled.

An INVALID_ARGUMENT status is set if the volume of the batch is larger than what Totalizer 1 can hold.

Set Totalizer Batch 2 (Integer)

▶ Flow Controllers

Firmware: 10v18.0

Command ID: 65545

Set totalizer batch 2 (integer) manages the batch size of Totalizer 2.

Argument: Use the desired batch size multiplied by 10^(totalizer decimal places). To disable batching, use a value of 0.

Command response: A SUCCESS status is set if Totalizer 2 is enabled and the size of the batch is valid. The return value is the batch size.

An UNSUPPORTED status is set if Totalizer 2 is not enabled.

An INVALID_ARGUMENT status is set if the volume of the batch is larger than what Totalizer 2 can hold.

Set Totalizer Batch 2 (Float)

▶ Flow Controllers

Firmware: 10v18.0

Command ID: 65542

Set totalizer batch 2 (float) manages the batch size of Totalizer 2.

Argument: Use the desired batch size formatted as a Float32 value in the engineering units of Totalizer 2. To disable batching, use a value of 0.

Command response: A SUCCESS status is set if Totalizer 2 is enabled and the batch size is valid. The return value is the requested batch volume.

An UNSUPPORTED status is set if Totalizer 2 is not enabled.

An INVALID_ARGUMENT status is set if the volume of the batch is larger than what Totalizer 2 can hold.

Control Gain Gas Compensation

▶ Mass Flow Controllers

Firmware: 10v18.0

Command ID: 62

Control gain gas compensation sets or queries if gas compensation is enabled for closed loop control gains.

Argument: Use the desired mode from the table below for closed loop gain gas compensation.

Value	Description
0	Do not change the current gas compensation; this is only a query.
1	Disable gas compensation for closed loop gains.
2	Enable gas compensation for closed loop gains.
3	Enable gas compensation for closed loop gains until a closed loop control gain is changed by the user.

Command Response: A SUCCESS status is set if the instrument supports gas compensation of closed loop control gains. The return value is the current mode for closed loop gain gas compensation.

An UNSUPPORTED status is set if the instrument is not a controller or does not support setting the active gas properties.

An INVALID_ARGUMENT status is set if the mode is not one of the valid values.

Control Response Analysis

Check Setpoint Response Test Setpoint (Setpoint Counts)

▶ Controllers

Firmware: 10v18.0

Command ID: 63

Check setpoint response test setpoint (setpoint counts) sets or queries the value to which the setpoint will change when checking the setpoint response.

Argument: Use the desired setpoint value in setpoint counts, 0 – 65534. To query the test setpoint, use 65535.

Completion Response: A SUCCESS status is set if the test setpoint was successfully set or queried. The return value is the test value that will be used in the setpoint response check, in setpoint counts.

An UNSUPPORTED status is set if the instrument is not a controller.

An INVALID_ARGUMENT status is set if the test setpoint is outside of the range 0 – 65535.

Check Setpoint Response Test Setpoint (Integer)

▶ Controllers

Firmware: 10v18.0

Command ID: 65565

Check setpoint response test setpoint (integer) sets or queries the value to which the setpoint will change when checking the setpoint response.

Argument: Use the desired setpoint value, scaled in setpoint engineering units by 10^(setpoint decimal places). Use -2147483648 to query the test setpoint.

Command Status: A SUCCESS status is set if the test setpoint was successfully set or queried. The return value is the test value that will be used in the setpoint response check. Scale this integer by 10^ (-setpoint decimal places) for the value in setpoint engineering units.

An UNSUPPORTED status is set if the instrument is not a controller.

An INVALID_ARGUMENT status is set if the test setpoint is outside of the valid range.

Check Setpoint Response Test Setpoint (Float)

▶ Controllers

Firmware: 10v18.0

Command ID: 65564

Check setpoint response test setpoint (float) sets or queries the value to which the setpoint will change when checking the setpoint response.

Argument: Use the desired setpoint value, in the setpoint engineering units. To query the test setpoint, use -3.40282346639e+38 (hexadecimal value ff7fffff). It is formatted as a Float32 value.

Command Status: A SUCCESS status is set if the test setpoint was successfully set or queried. The return value is the test value that will be used in the setpoint response check, formatted as a Float32 value, in the setpoint engineering units.

An UNSUPPORTED status is set if the instrument is not a controller.

An INVALID_ARGUMENT status is set if the test setpoint is outside of the valid range.

Check Setpoint Response Collection Time

▶ Controllers

Firmware: 10v18.0

Command ID: 64

Check setpoint response collection time sets or queries the amount of time a setpoint response check collects data after changing the setpoint.

Argument: Use the amount of collection time, in seconds, 1 – 65535. To query the collection time, use 0.

Command Status: A SUCCESS status is set if the collection time was successfully set or queried. The return value is the amount of time a setpoint response check collects process data after the setpoint is changed, in seconds.

An UNSUPPORTED status is set if the instrument is not a controller.

An INVALID_ARGUMENT status is set if the collection time is outside of the range 0 – 65535.

Check Setpoint Response Run Status

▶ Controllers

Firmware: 10v18.0

Command ID: 66

Check setpoint response run status queries the execution state of the setpoint response check, and possibly start or abort the response check.

Argument: Use the amount of collection time, in seconds, 1 – 65535. To query the collection time, use 0.

Value	Notes
0	This is only a query of the check setpoint response state; take no action.
1	Begin a check setpoint response. The instrument will change the setpoint (overriding the analog setpoint if the setpoint source is analog) and collect data for the specified amount of time. The setpoint will return to normal once data collection is complete.
2	Abort a currently executing check setpoint response. If a check is not currently executing, this does nothing.

Command Status: A SUCCESS status is set if the action, if any, was successfully executed. The return value is the status of the currently executing or last completed check setpoint response:

Value	Notes
0	The last check setpoint response has successfully completed and the results calculated.
1	No check setpoint response has been executed since power up.
2	Unable to start a check setpoint response, due to closed loop control gain tuning or another check setpoint response being active.
3	Check setpoint response is currently executing.
4	The data collection was aborted early by user action; the returned values are all zero.
5	The data collection terminated early due to oscillation; the returned values are all zero.

An UNSUPPORTED status is set if the instrument is not a controller.

An INVALID_ARGUMENT status is set if the action is not one of the listed values.

Check Setpoint Response Results Notes

▶ Controllers

Firmware: 10v18.0

Command ID: 67

Check setpoint response results notes queries any notes about unusual circumstances observed during the last completed check setpoint response.

Argument: Always use 0.

Command Status: A SUCCESS status is set if the action, if any, was successfully executed. The return value will be notes regarding unusual circumstances that may affect the accuracy of the results (see the table below). Multiple values in the following table may be added together as a single data collection.

Value	Notes
0	There are no notes on the calculated results; the process data showed typical patterns.
+1	The data collection time was not long enough to ensure reliable calculated results; the values may change with a longer data collection time.
+2	The process variable oscillated significantly. Control was not stable and the calculated results are not reliable.
+4	The process variable moved a small amount compared to the noise observed in the system, so the calculated results may not be reliable. This most commonly happens when the setpoint change is too small or when the process variable oscillated in a manner that was not caught by the oscillation detection algorithm.
+8	A previously closed valve opened during data collection. The results are computed correctly, but the performance will be significantly different from situations that only move an already open valve.
+16	A valve was opened as far as it could go during data collection. The results are computed correctly, but the performance is likely limited by the size of the valve, not the control loop configuration.

An UNSUPPORTED status is set if the instrument is not a controller.

Check Setpoint Response Overshoot (Setpoint Counts)

▶ Controllers

Firmware: 10v18.0

Command ID: 68

Check setpoint response overshoot (setpoint counts) queries the overshoot of the last completed setpoint response check.

Argument: Always use 0.

Command Status: A SUCCESS status is set if the overshoot was successfully queried. The return value is the overshoot measured in the last completed setpoint response check, in setpoint counts.

An UNSUPPORTED status is set if the instrument is not a controller.

Check Setpoint Response Overshoot (Integer)

▶ Controllers

Firmware: 10v18.0

Command ID: 65567

Check setpoint response overshoot (integer) queries the overshoot of the last completed setpoint response check.

Argument: Always use 0.

Command Status: A SUCCESS status is set if the overshoot was successfully queried. The return value is the overshoot measured in the last completed setpoint response check. Scale this integer by 10^ (-setpoint decimal places) for the value in setpoint engineering units.

An UNSUPPORTED status is set if the instrument is not a controller.

Check Setpoint Response Overshoot (Float)

▶ Controllers

Firmware: 10v18.0

Command ID: 65566

Check setpoint response overshoot (float) queries the overshoot of the last completed setpoint response check.

Argument: Always use 0.

Command Status: A SUCCESS status is set if the overshoot was successfully queried. The return value is the overshoot measured in the last completed setpoint response check, formatted as a Float32 value, in the setpoint engineering units.

An UNSUPPORTED status is set if the instrument is not a controller.

Check Setpoint Response Timing Results

▶ Controllers

Firmware: 10v18.0

Command ID: 69

Check setpoint response timing results queries the timings measured in the last completed check setpoint response.

Argument: Use the timing parameter to query from the table below:

Value	Notes
0	Query the measured time constant of the last completed check.
1	Query the measured dead time of the last completed check.
2	Query the measured rise time of the last completed check.
3	Query the measured bandwidth of the last completed check.

Command Status: A SUCCESS status is set if the action, if any, was successfully executed. The return value is the timing value requested in the argument:

Value	Notes
0	The closed loop time constant (T63) measured from the trial, in milliseconds. This is appropriate for use in a first-order-plus-dead-time (FOPDT) model of the instrument.
1	The system dead time or delay measured from the control trial, in milliseconds. This is appropriate for use in a first-order-plus-dead-time (FOPDT) model of the instrument.
2	The time required for the closed loop response to go between 10% of the step and 90% of the step during the trial, in milliseconds.
3	The estimated bandwidth of the closed loop response, calculated from the rise time; multiply the number by 0.01 for the bandwidth in hertz.

An UNSUPPORTED status is set if the instrument is not a controller.

An INVALID_ARGUMENT status is set if the value is not one of the values in the table above.

Control Optimization

Control Optimization Max Flow (Setpoint Counts)

▶ Flow Controllers

Firmware: 10v18.0

Command ID: 70

Control optimization max flow (setpoint counts) sets or queries the maximum flow that control optimization will intentionally flow, in setpoint counts.

Argument: Use the maximum desired flow in setpoint counts, 1 – 64000. Use 0 to set the limit to full scale flow. Use 65535 to query the current maximum flow.

Command Status: A SUCCESS status is set if the maximum flow was successfully set or queried. The return value is the current maximum desired flow, in setpoint counts.

An UNSUPPORTED status is set if the instrument is not a controller.

An INVALID_ARGUMENT status is set if the maximum flow is outside the range 0 – 64000 and is not 65535, or if the maximum flow is less than 20% of the full scale flow.

Control Optimization Max Flow (Integer)

▶ Flow Controllers

Firmware: 10v18.0

Command ID: 65569

Control optimization max flow (integer) sets or queries the maximum flow that control optimization will intentionally flow, as an integer.

Argument: Use the maximum desired flow, scaled to the desired value in setpoint engineering units by 10^(setpoint decimal places). Use 0 to set the limit to full scale flow. Use a value < 0 to query the current maximum flow.

Command response: A SUCCESS status is set if the maximum flow was successfully set or queried. The return value is the current maximum desired flow. Scale this integer by 10^ (-setpoint decimal places) for the value in setpoint engineering units.

An UNSUPPORTED status is set if the instrument is not a controller.

An INVALID_ARGUMENT status is set if the maximum flow is less than 20% of the full scale flow and is not 0.

Control Optimization Max Flow (Float)

▶ Flow Controllers

Firmware: 10v18.0

Command ID: 65568

Control optimization max flow (float) sets or queries the maximum flow that control optimization will intentionally flow, in a floating-point format.

Argument: Use the maximum desired flow, in the setpoint engineering units. Use 0 to set the limit to full scale flow. Use a value < 0 to read the current maximum flow. This is formatted as a Float32 value.

Command response: A SUCCESS status is set if the maximum flow was successfully set or queried. The return value is the current maximum desired flow, formatted as a Float32 value, in the setpoint engineering units.

An UNSUPPORTED status is set if the instrument is not a controller.

An INVALID_ARGUMENT status is set if the maximum flow is less than 20% of the full scale flow and is not 0.

Control Optimization Speed Mode

▶ Flow Controllers

Firmware: 10v18.0

Command ID: 71

Control optimization speed mode sets or queries the configured speed mode for control optimization.

Argument: Use the speed mode from the table below.

Value	Notes
0	Queries the speed mode.
1	Targets the most versatile usage, which will have the slowest speed of response.
2	Emphasizes versatility over speed of response.
3	Emphasizes faster speed of response over versatility.
4	Maximizes the speed of response (minimize the control loop response time constant). A small amount of overshoot in the response is allowed.

Command response: A SUCCESS status is set if the speed mode has been successfully set or queried. The return value is the current speed mode, per the table above.

An UNSUPPORTED status is set if the instrument is not a controller.

An INVALID_ARGUMENT status is set if the speed mode is not listed in the table above.

Control Optimization Goal Time

▶ Flow Controllers

Firmware: 10v18.0

Command ID: 72

Control optimization goal time sets or queries the goal response time used by control optimization.

Argument: Use the desired control response time constant in milliseconds. Use 0 to use the fastest possible time constant (the same as the fastest speed mode). Use 65535 to query the goal response time.

The control response after optimization will have a time constant close to this value for the tested setpoints, if the system can support it. If the requested time constant is smaller than the system can reasonably accommodate, optimization will find the gains with the shortest time constant.

If during optimization one of the gains becomes 1 and therefore cannot become smaller to increase the time constant, the resulting time constant may be faster than requested.

Command response: A SUCCESS status is set if the goal response time has been successfully set or queried. The return value is the current desired response time, in milliseconds. If a speed mode is active, the return value will be 0.

An UNSUPPORTED status is set if the instrument is not a controller.

An INVALID_ARGUMENT status is set if the goal time is negative.

Control Optimization Control Algorithm

▶ Flow Controllers

Firmware: 10v18.0

Command ID: 73

Control optimization control algorithm sets or queries the control algorithm that control optimization will use to determine gains.

Argument: Use the desired closed loop control algorithm from the table below:

Value	Notes
0	This only a query; do not change the configured mode.
1	Control optimization chooses the most appropriate control algorithm based on instrument configuration and optimization parameters. Note that the algorithm chosen for a particular situation and configuration may change across firmware versions.
2	Force use of the PDF control algorithm. Speed modes will be 2x – 3x slower than for other values of algorithm.
3	Force use of the PD2I control algorithm.

Command response: A SUCCESS status is set if the control algorithm has been successfully set or queried. The return value is the current control algorithm from the table above.

An UNSUPPORTED status is set if the instrument is not a controller.

An INVALID_ARGUMENT status is set if the algorithm is not a valid value from the table above.

Control Optimization Run State

▶ Flow Controllers

Firmware: 10v18.0

Command ID: 74

Control optimization run state queries the current execution state of control optimization, and possibly take an action.

Argument: Use the desired closed loop control algorithm from the table below:

Action	Notes
0	Only query the current state of execution, take no action.
1	Abort any current control optimization.
2	Begin a new control optimization with the current settings values. Any running control optimization will be aborted before starting the new one.
3	The same as action 2, but pause the optimization procedure at each possible point, closing the valve(s).
4	Request that optimization pause and close the valves at the next possible point. A pause is most commonly used to allow a restricted volume that was filled during the optimization process to bleed off to more normal pressure levels. If there is no currently paused optimization, this does nothing.
5	Resume a currently paused optimization.

Command response: A SUCCESS status is set if the requested action, if any, has been performed successfully. The return value is the current activity of the control optimization algorithm:

Mode	Notes
0	Control optimization is not active.
1	Control optimization is actively driving the valves in the instrument.
2	Control optimization is active but has been paused. The valves are closed until this command is issued with a resume argument.
3	An abort has been requested, but control optimization is still active.

An UNSUPPORTED status is set if the instrument is not a controller.

An INVALID_ARGUMENT status is set if the action is not in the table of valid values.

Control Optimization Result

▶ Flow Controllers

Firmware: 10v18.0

Command ID: 75

Control optimization result queries the result of the last completed control optimization.

Argument: Always use 0.

Command response: A SUCCESS status is set if the optimization result has been returned. The return value is the result of the last control optimization:

Result	Notes
0	A control optimization is in progress.
1	The last control optimization completed successfully.
2	The last control optimization was aborted by the user or due to an error.
3	There was an unexpected state during the last control optimization.
4	The maximum flow allowed for optimization is too small.
5	A valve requested to be used for control optimization is not configured for closed loop control.
6	The instrument had no closed loop control configured at the time of the last control optimization.
7	There was not enough flow to successfully complete the last control optimization. Check the feed and outlet pressures.
8	The last control optimization could not find any gains that yielded acceptable performance.

An UNSUPPORTED status is set if the instrument is not a controller.

Administrative

Administrative commands are used to perform actions such as taring the instrument sensors, creating gas mixes, controlling the display, and restoring factory settings.

Set Gas

▶ Mass flow instruments

Firmware: 10v18.0

Command ID: 1

Set gas manages what gas a mass flow instrument is calibrated to read. The gas must be set to accurately read the mass flow of the process gas.

Argument: Use the index number of the desired gas to measure. The gas index can be found on page 52.

Command response: A SUCCESS status is set if the gas has changed.

An INVALID_ARGUMENT status is set if the requested gas number does not exist.

Create/Update Gas Mix

▶ Mass flow instruments

Firmware: 10v18.0

Command ID: 2

Create/update gas mix writes a new gas mix to the gas index on the instrument. Before running this command, the custom gas and its properties must be written to the instrument first. See page 20 for more information on how to write the gas mixture to the instrument.

Argument: Use 0 or 236 - 255. This is the gas index number of the new mixture. A value of 0 instructs the instrument to write to the first available gas index number starting with 255 and moving down. If no gas index numbers are available, then the command will fail.

To update or overwrite a prior custom gas mix, using its gas index number here will overwrite the old mixture.

Command response: A SUCCESS status is set if the gas has changed. The return value is the index number of the gas mix created or updated.

An INVALID_MIX_IDX status is set if the gas index number in the argument is outside of the 236 - 255 range.

An INVALID_MIX_GAS status is set if one or more gases in the mix do not exist on the instrument.

An INVALID_MIX_PCT status is set if the percentages of the gases that make up the mixture do not sum 100%.

Delete Gas Mix

▶ Mass Flow instruments

Firmware: 10v18.0

Command ID: 3

Delete gas mix removes the specified custom gas mix from the instrument.

Argument: Use the index number of the desired gas to delete.

Command response: A SUCCESS status is set if the gas mix was deleted.

An INVALID_MIX_IDX status is set if the requested gas mix does not exist.

Perform Tare

Firmware: 10v18.0

Command ID: 4

Perform tare instructs the instrument to use the current reading as the zero reading.

When performing gauge pressure tares, the sensor must be open to the atmosphere.

Differential pressure tares require a common pressure from which to measure. Absolute pressure tares require an equipped barometer.

Flow tares must be performed when there is no current flow through the process. Flow tares are also best when at the process pressure, or as close to it as possible.

Argument: Use the value of the desired tare found in the following table.

Value	Description
0	Tare gauge or differential pressure
1	Tare absolute pressure
2	Tare mass and/or volumetric flow

Command response: A SUCCESS status is set if the requested tare is performed.

An UNSUPPORTED status is set if the requested tare does not apply (e.g., a mass flow tare on a pressure instrument).

Perform Pressure Sensor Tare

Firmware: 10v18.0

Command ID: 31

Perform pressure sensor tare instructs the instrument to use the current gauge or differential pressure reading as the zero reading. An absolute pressure tare uses the barometer's zero reading as the zero reading.

When performing gauge pressure tares the sensor must be open to the atmosphere.

Differential pressure tares require a common pressure to measure from.

Absolute pressure tares require an equipped barometer**.**

Argument: Use the desired time in milliseconds for the tare to take. This can be a value of 0 – 32767. If a value of 0 is used, a default of 256 milliseconds is used.

Command response: A SUCCESS status is set if the tare is performed.

An UNSUPPORTED status is set if the pressure sensor cannot be tared. This is usually due to trying to tare absolute pressure without a barometer.

An INVALID_ARGUMENT status is set if the argument value is less than 0 or greater than 32767.

Perform Secondary Pressure Sensor Tare

Firmware: 10v18.0

Command ID: 32

Perform secondary pressure sensor tare instructs the instrument to use the current pressure reading on the secondary pressure sensor as the zero reading. An absolute pressure tare uses the barometer's zero reading as the zero reading. Not all instruments have a secondary pressure sensor.

When performing gauge pressure tares the sensor must be open to the atmosphere.

Differential pressure tares require a common pressure to measure from.

Absolute pressure tares require an equipped barometer.

Argument: Use the desired time in milliseconds for the tare to take. This can be a value of 0 – 32767. If a value of 0 is used, a default of 256 milliseconds is used.

Command response: A SUCCESS status is set if the tare is performed.

An UNSUPPORTED status is set if the pressure sensor cannot be tared. This is usually due to attempting to tare absolute pressure without a barometer or not having a secondary pressure sensor.

An INVALID_ARGUMENT status is set if the argument value is less than 0 or greater than 32767.

Perform Flow Tare

▶ Flow instruments

Firmware: 10v18.0

Command ID: 33

Perform flow tare instructs the instrument to use the current flow reading as the zero reading. This command is used for both volumetric and mass flow.

Argument: Use the desired time in milliseconds for the tare to take. This can be a value of 0 – 32767. If a value of 0 is used, a default of 256 milliseconds is used.

Command response: A SUCCESS status is set if the tare is performed.

An UNSUPPORTED status is set if the pressure sensor cannot be tared. This is usually due to the instrument not reading volumetric or mass flow.

An INVALID_ARGUMENT status is set if the argument value is less than 0 or greater than 32767.

Reset Totalizer

▶ Flow instruments

Firmware: 10v18.0

Command ID: 5

Reset totalizer instructs the instrument to clear the current totalizer 1 count.

Argument: No argument is used for this command

Command response: A SUCCESS status is set if the reset is complete.

Set Relative Humidity Percentage

▶ Instruments with humidity sensor

Firmware: 10v18.0

Command ID: 24

Set relative humidity percentage manages the relative humidity level used for gas corrections.

Argument: Use a value between 0 – 10000. 1 count in the value is equal to 0.01% humidity. For example, use 100 for 1% or 10000 for 100%.

Command response: A SUCCESS status is set if the relative humidity percentage is changed.

An UNSUPPORTED status is set if the relative humidity cannot be set on the instrument.

An INVALID_ARGUMENT status is set if the argument value is outside of 0 – 10000.

Set Relative Humidity Reference Temperature

▶ Instruments with humidity sensor

Firmware: 10v18.0

Command ID: 25

Set relative humidity reference temperature manages the relative humidity reference temperature used for gas corrections. This temperature is Celsius.

Argument: Use a value between −3000 – 10000. This value should match the relative humidity percentage.

The range starts at −30°C and reaches 100°C. 1 count in the value is equal to 0.01°C. For example, a value of −3000 is −30°C and a value of 10000 is 100°C.

Command response: A SUCCESS status is set if the relative humidity reference temperature is changed.

An UNSUPPORTED status is set if the relative humidity cannot be set on the instrument.

An INVALID_ARGUMENT status is set if the argument value is outside of −3000 – 10000.

Read Configuration Checksum

Firmware: 10v18.0

Command ID: 17

Read configuration checksum computes and returns a checksum of the instrument's calibration and configuration. The checksum is computed at the time of the command initiation and may take 300 milliseconds to complete. A timeout of over 500 milliseconds is recommended.

Any setting that is retained across power cycles is included. Values that may or may not be retained are also included.

Because calibration information is included, two instruments with identical configurations may have different checksums. If an instrument is recalibrated, the checksum may change as well. Changing the instrument firmware may or may not change the checksum.

Any parameter that changes during routine operation (e.g., setpoint) should be set to a known configuration before reading the checksum.

Argument: Must always be 0.

Command response: A SUCCESS status is set when the checksum is complete, and the argument value is 0. The return value is the checksum of the entire instrument configuration. This is a value of 0 – 65535.

An INVALID_ARGUMENT status is set when the argument value is not 0.

Lock/Unlock Display

Firmware: 10v18.0

Command ID: 7

Lock/unlock display instructs the instrument to either lock or unlock the display on the front of the instrument. When locked, the instrument still responds to button presses, but settings cannot be changed using the display.

Argument: Use a value of 0 to unlock the display. Any other value locks the display.

Command response: A SUCCESS status is set if the display is locked or unlocked as requested.

Flash Display

Firmware: 10v18.0

Command ID: 20

Flash display instructs the instrument to flash its backlight indefinitely or for a set amount of time.

Argument: Use a number between 1 – 65534 to instruct the instrument to flash the backlight for that number of seconds. Use 0 to stop the backlight from flashing. Use 65535 to flash the backlight indefinitely.

Command response: A SUCCESS status is set if the backlight is flashing or stopped as requested.

An UNSUPPORTED status is set if no display is connected to the instrument.

Restore Factory Settings

Firmware: 10v18.0

Command ID: 26

Restore factory settings reverts all the instrument settings and configurations to their values when the instrument was last at Alicat.

! WARNING: This command should only be used when trying to troubleshoot issues with Alicat support (page 2). All third-party calibrations are removed by performing this command.

The instrument needs to be power cycled after performing the restore.

Argument: Use a value of 49374 to confirm that a factory restore is the desired result of the command.

Command response: A SUCCESS status is set if the factory restore completes. This may only be available to read briefly before the restore removes the status.

An UNSUPPORTED status is set if there is an error during the restore process.

An INVALID_ARGUMENT status is set if the argument value is not 49374.

Appendices

Appendix A: Statistics

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

Some statistics are restricted to specific instruments and configurations. Please contact Alicat support (page 2) with any questions about a statistic and how it may work with your instrument.

Appendix A-1: Flow Statistics

Flow Statistic	Value	Notes
Mass flow	5	Current mass flow
Mass flow setpoint	37	Setpoint for mass flow
Total mass	9	Totalized mass
Total volume	8	Totalized volume, referenced to flow conditions.
Volumetric flow	4	Volumetric flow, referenced to flow conditions.
Volumetric flow setpoint	36	The setpoint for volumetric flow referenced to flow conditions.

Appendix A-2: Pressure Statistics

Pressure Statistic	Value	Notes
Pressure, absolute	2	Current absolute pressure
Pressure, absolute setpoint	34	Setpoint for absolute pressure
Pressure, barometric	15	Barometer reading
Pressure, differential	7	Current differential pressure reading
Pressure, differential setpoint	39	Setpoint for differential pressure
Pressure, gauge	6	Current gauge pressure reading
Pressure, gauge setpoint	38	Setpoint for gauge pressure
Pressure, second absolute	344	For instruments with a second pressure sensor, the absolute pressure of the second sensor
Pressure, second absolute setpoint	345	Setpoint for the second absolute pressure.
Pressure, second differential	360	For instruments with a second pressure sensor, the differential pressure of the second sensor
Pressure, second differential setpoint	361	Setpoint for the second differential pressure

Pressure Statistic	Value	Notes
Pressure, second gauge	352	For instruments 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 setpoint	353	Setpoint for the second gauge pressure

Appendix A-3: Other Statistics

Other Statistic	Value	Notes
None	1	No statistic: usually implies an empty location.
Relative humidity	25	The fraction of complete saturation the instrument is currently using. When the vapor used is water, this is relative humidity.
Temperature, stream	3	Current stream temperature
Valve drive	13	Valve drive signal
Valve drive setpoint	45	The setpoint directly drives the currently selected valve.

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
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

Unit Label	Value	Notes
NCCS	41	Normal cubic centimeter per second
NCCM	42	Normal cubic centimeter per minute
Ncm³/h	43	Normal cubic centimeter per hour
Nm³/m	44	Normal cubic meter per minute
Nm³/h	45	Normal cubic meter per hour
Nm³/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
Scm³	6	Standard cubic centimeter
Sm³	7	Standard cubic meter
Sin³	8	Standard cubic inch
Sft³	9	Standard cubic foot

Unit Label	Value	Notes
kSft³	10	1000 standard cubic feet
NµL	32	Normal microliter
NmL	33	Normal milliliter
NL	34	Normal liter
Ncm³	36	Normal cubic centimeter
Nm³	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
cm³/h	13	Cubic centimeter per hour
m³/m	14	Cubic meter per minute
m³/h	15	Cubic meter per hour
m³/d	16	Cubic meter per day
in³/m	17	Cubic inch per minute
CFM	18	Cubic foot per minute
CFH	19	Cubic foot per hour
CFD	21	Cubic foot per day
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.
L	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
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

Unit Label	Value	Notes
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)
V	61	Volt: no conversions are performed to or from other units (intended only for log-linear absolute pressure sensors)
count	62	Setpoint count, 0–64000
%	63	Percent of full scale

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 C: Instrument Data Sources

Use the following table to determine the data source of a given value.

Data Source	Value	Notes
Instant display	1	Current readings, smoothed for front panel display.
Instant serial	2	Current readings, smoothed for serial values.
Totalizer 2	25	Readings taken from the second totalizer.

Appendix D: Gas Numbers

#	Short Name	Long Name
0	Air	Air (Clean Dry)
1	Ar	Argon
2	CH_4	Methane
3	CO	Carbon Monoxide
4	CO_2	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} 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 using these gases, in addition to R113, R-123, and R-141b.