



# ALICAT PROFINET MANUAL

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# Alicat Instruments with PROFINET

This manual is to assist in using a PROFINET-configured Alicat instrument. Instructions for connecting an instrument to TIA portal can be found in this manual as well (page 48). Alicat PROFINET instruments use DCP to obtain their IP address.

Alicat PROFINET instruments are certified by PROFIBUS. Alicat instruments function as Conformance Class B devices and are Netload Class III.

For setup, Alicat provides a GSDML file that can be found at [alicat.com/profinet](http://alicat.com/profinet).

## Instrument Body

Alicat PROFINET instruments are available with two RJ45 ethernet ports, or two M12 connections and an M8 connection.

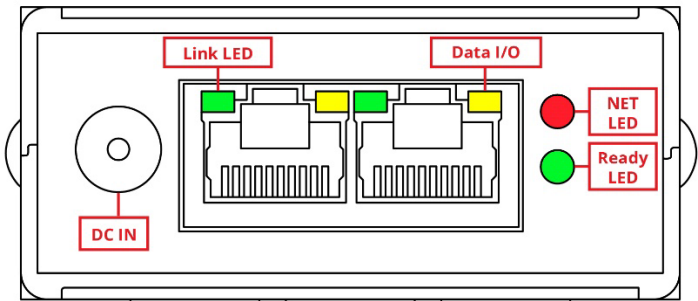
### RJ45 Ethernet Ports

Alicat PROFINET instruments that are produced with two RJ45 ports have each port labeled as P1 (right-hand port next to the LEDs) and P2 (left-hand port next to the power).

Each RJ45 port has two LED lights to show when the port is actively connected to the network and when it is transmitting or receiving data. The **Link LED** (green light) shows as a solid green when the port is connected to the network. If the **Link LED** is off, the instrument cannot connect to the network. The data **IO LED** (yellow light) blinks as data packets are transmitted or received.

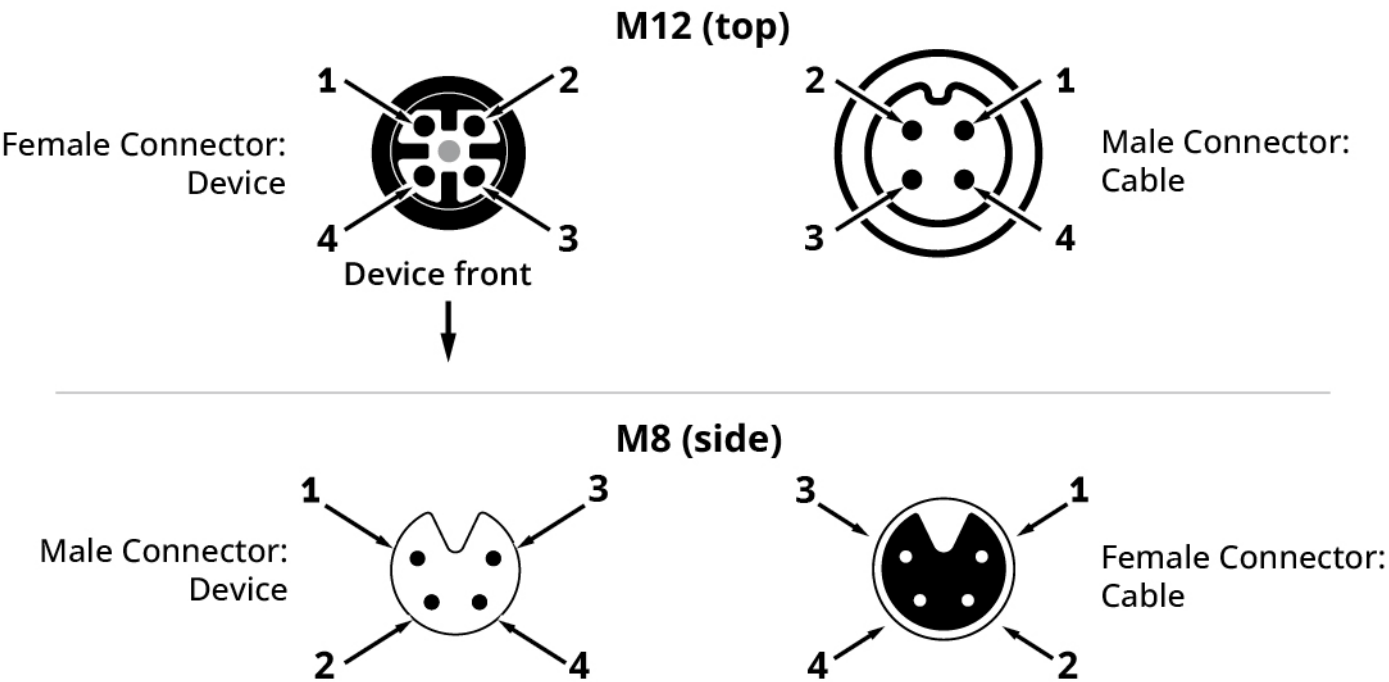
To the right of the two RJ45 ports are the **NET LED** and **Ready LED**. The **NET LED** (the light closer to the back of the instrument) shows when the instrument is connected to a PLC. The **Ready LED** (the light closer to the display or front of the instrument) shows the instrument's operation status. For more information, refer to the following table.

LED Status	Ready LED	NET LED
Off	Startup	Startup
Blinking Red	N/A	No active data exchange
Blinking Green	Flash LED command active	N/A
Solid Green	Configuration complete	Active data exchange



M12 and M8 Pinouts

Alicat PROFINET instruments produced with the M12 configuration have the following pinouts.

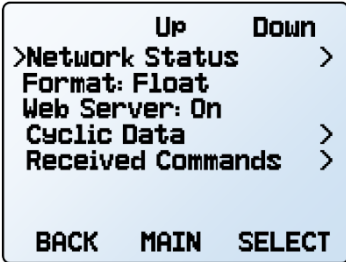


Pin	4-Pin M12
1	Tx+: Send data +
2	Rx+: Receive data+
3	Tx-: Send data -
4	Rx-: Receive data -

Pin	4-Pin M8
1	Reserved. Do not connect.
2	Power in: powers the instrument.
3	Reserved. Do not connect.
4	Ground: common ground for power & digital communications.

Network Configuration Menu

Instruments with a display can view their assigned IP address from the menu. Navigate to **MENU > Setup > Network > Network Status**. The MAC address is printed on the instrument to help with IP assignments.



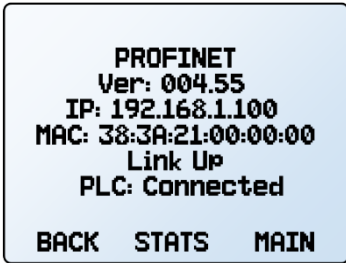
Communications status menu

Communication Status Menu

Alicat PROFINET instruments with a display have an extra communications menu that is not covered in the standard instrument menu. To access the screen, select **MENU > SETUP > Network**. The menu then has the option for **Network Status, Module Format, Cyclic Data, and Received Commands**.

Network Status

The **Network Status** page is used to diagnose any communication issues by displaying:



Network status



Format

The **Format** option controls how the data values are displayed, in either integer or floating point. Changes to the format take effect after 15 seconds.

For more information on the module format, see page 10.

Web Server

The **Web Server** option either enables or disables the embedded web server.

Cyclic Data

The **Cyclic Data** screen displays the number of times the instrument has updated the cyclic data readings. Pressing **Clear** sets the count to 0. For more information on cyclic data, see page 10.

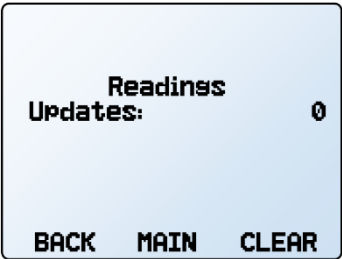
Received Commands

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 20.

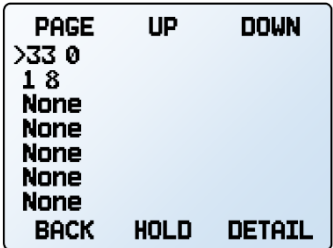
**HOLD:** Stops the screen from updating any new commands that may be sent to the instrument.

**UPDATE:** This option is only present when **HOLD** has been selected. Pressing **UPDATE** restores the instrument to refreshing the list with new commands.

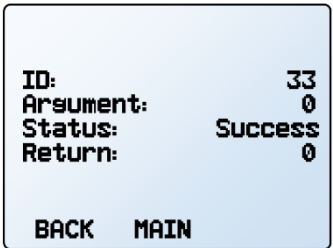
**DETAIL:** Opens the currently designated command and displays more details about the command. The screen shows the numerical value of the command ID written to the instrument, what argument was used, the numerical value of the status of the command, and the value of the information returned if applicable.



Cyclic data



Received commands



Details of received command

# PROFINET Interface

Alicat PROFINET instruments interact with PROFINET systems using both cyclic and acyclic data.

## Cyclic Data

Alicat PROFINET instruments provide cyclic data in two separate formats, Floating Point (Float32) or Integer (Integer32) values. Only one format can be active at a time and can be changed from the device screen (page 8). 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. The module slots are fixed and cannot be changed. The overall packet size is fixed because of this.

### Floating Point (Float32) Format

When this module is selected, invalid readings are read as 0xFFFFFFFF. All modules, except the setpoint, are input only. The setpoint module is both input and output. See the following table for the module slots and their descriptions.

Module	Slot	Type	Description
0x1101	1	Float32	The setpoint, both output and input. Output is the requested setpoint, input is the current setpoint.
0x1102	2	Float32	Current valve drive
0x1103	3	Float32	Current pressure reading. This reads the primary pressure if there is a secondary pressure.
0x1104	4	Float32	Current secondary pressure reading. This may be from a second pressure sensor or using a barometer.
0x1105	5	Float32	Current barometric pressure reading
0x1106	6	Float32	Current temperature reading
0x1107	7	Float32	Current volumetric flow reading
0x1108	8	Float32	Current mass flow reading
0x1109	9	Float32	Current totalizer 1 reading
0x110A	10	Float32	Current totalizer 2 reading
0x110B	11	Float32	Current humidity reading
0x1301	12	Unsigned32	Instrument status
0x1302	13	Unsigned16	Current gas number
0x1303	14	Unsigned16	Alarm outputs state

### Integer (Integer32) Format

When this format is selected, invalid readings are read as -2147483648. All modules, except the setpoint, are input only. The setpoint module is both input and output. See the following table for the module slots, their description, and the data record that contains the number of decimal places for each value. To obtain the value in their engineering units, multiply the value by  $10^{(\text{negative of the number of decimal places})}$ .

Module	Slot	Type	Description	Decimal Places Location
0x1201	1	Integer32	The setpoint, both output and input. Output is the requested setpoint, input is current setpoint.	Index 5, Offset 22 (page 13)
0x1102	2	Integer32	Current valve drive	Index 6, Offset 22 (page 14)
0x1103	3	Integer32	Current pressure reading. This reads the primary pressure if there is a secondary pressure.	Index 7, Offset 22 (page 14)
0x1104	4	Integer32	Current secondary pressure reading. This may be from a second pressure sensor or using a barometer.	Index 8, Offset 22 (page 15)
0x1105	5	Integer32	Current barometric pressure reading.	Index 9, Offset 22 (page 15)
0x1106	6	Integer32	Current temperature reading	Index A, Offset 22 (page 16)
0x1107	7	Integer32	Current volumetric flow reading	Index B, Offset 22 (page 16)
0x1108	8	Integer32	Current mass flow reading	Index C, Offset 22 (page 17)
0x1109	9	Integer32	Current totalizer 1 reading	Index D, Offset 22 (page 17)
0x110A	10	Integer32	Current totalizer 2 reading	Index E, Offset 22 (page 18)
0x110B	11	Integer32	Current humidity reading	Index F, Offset 22 (page 18)
0x1301	12	Unsigned32	Instrument status	
0x1302	13	Unsigned16	Current gas number	
0x1303	14	Unsigned16	Alarm outputs state	

## Acyclic Data

There are two possible acyclic write data records and thirteen possible acyclic read data records. All records are in slot 1 (decimal address 270).

Not all acyclic data records are present on every instrument. It's possible to view the records available on an instrument by navigating to the **Acyclic Read/Write Data** page of the web server (page 46).

## Send Command

**Index:** 0x0001

The **send command** data record is one of two possible write data records. It is used to command the instrument to perform actions like taring, setting the gas, or locking the display. For more information on sending commands, see the **Commands** section (page 19).

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

## Write Gas Mix

**Index:** 0x0002

The **write gas mix** data record is the second of two write data records. Only mass flow instruments have this record enabled. 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 data record (starting with byte offset 0) followed by its percentage of the mix in the corresponding byte offset. Please refer to the gas index on page 59 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 being used, write a value of 0 to the remaining byte offsets. Percentages written to this index must sum 100% or creating the gas mixture fails.

Byte Offset	Type	Description
0	Unsigned16	Gas ID of gas number 1
2	Unsigned16	Gas number 1's percentage. 1 count = 0.01%
4	Unsigned16	Gas ID of gas number 2
6	Unsigned16	Gas number 2's percentage. 1 count = 0.01%
8	Unsigned16	Gas ID of gas number 3
10	Unsigned16	Gas number 3's percentage. 1 count = 0.01%
12	Unsigned16	Gas ID of gas number 4
14	Unsigned16	Gas number 4's percentage. 1 count = 0.01%
16	Unsigned16	Gas ID of gas number 5
18	Unsigned16	Gas number 5's 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 43). 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 no argument is written, or 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.

## Command Status

**Index:** 0x0003

The **command status** data record is a read record that contains information on the currently executing or last completed command. This includes the command ID, the argument used in the command, the status of the command, and what value the command returned, if any. For more information on commands and the command statuses, see the **Commands** section (page 19).

Byte Offset	Type	Description
0	Unsigned32	ID of the current or last completed command
4	Integer32	Argument for the current or last completed command
8	Unsigned32	Numerical value of the status of the current or last completed command (see the following table)
12	Integer32	Value returned by the command.

## Instrument Firmware Version

**Index:** 0x0004

The **instrument firmware version** data record is a read record that provides information on the current firmware installed on the instrument.

Byte Offset	Type	Description
0	Unsigned16	The number indicating which major firmware release the instrument has installed. Example: the 10 in 10v05.0.
2	Unsigned16	The number indicating which minor release the instrument has installed. Example: the 05 in 10v05.0.
4	Unsigned16	The number indicating which version of the custom firmware is installed, if any. This is usually 0. Example: the .0 in 10v05.0.
6	Unsigned16	Reserved for internal Alicat use. This will always be 0.

## Setpoint Information

**Index:** 0x0005

The **setpoint information** data record is a read record that provides information about the setpoint. This includes which variable is being controlled, the source of that variable's reading, the minimum and maximum valid values, what units the setpoint is in, and where the decimal is in the setpoint reading.

Byte Offset	Type	Description
0	Unsigned16	Setpoint type. Indicates the variable being controlled. See Appendix A (page 50).
2	Unsigned16	Setpoint source. Indicates the source of the variable's reading. See Appendix C (page 58).
4	Float32	Minimum value of the setpoint, without overrange
8	Float32	Maximum value of the setpoint, without overrange
12	Integer32	Minimum value of the setpoint, without overrange. Scale the integer by $10^{(\text{negative of byte offset } 22)}$ for the value in engineering units.
16	Integer32	Maximum value of the setpoint, without overrange. Scale the integer by $10^{(\text{negative of byte offset } 22)}$ for the value in engineering units.
20	Unsigned16	Setpoint units. See Appendix B (page 53).
22	Unsigned16	Setpoint decimal places. The number of digits after the decimal place in the current value, minimum value, and maximum value.

## Valve Drive Information

**Index:** 0x0006

The **valve drive information** data record is a read record that provides information on the valve drive. This includes what the valve drive is controlling, what source the valve drive gets its setting from, the possible minimum and maximum values, what units the valve drive is in, and where the decimal is in the valve drive reading.

Byte Offset	Type	Description
0	Unsigned16	Valve drive type. Indicates what the valve drive is controlling. See Appendix A-3 (page 52).
2	Unsigned16	Valve drive source. Indicates where the valve obtains its setting. See Appendix C (page 58).
4	Float32	Minimum value of the valve drive, without overrange.
8	Float32	Maximum value of the valve drive, without overrange.
12	Integer32	Minimum value of the valve drive, without overrange. Scale integer by $10^{(\text{negative of byte offset } 22 \text{ value})}$ for the value in engineering units.
16	Integer32	Maximum value of the setpoint, without overrange. Scale integer by $10^{(\text{negative of byte offset } 22 \text{ value})}$ for the value in engineering units.
20	Unsigned16	Valve drive units. See Appendix B (page 53).
22	Unsigned16	Valve drive decimal places. The number of digits after the decimal place in the current value, minimum value, and maximum value.

## Pressure Information

**Index:** 0x0007

The **pressure information** data record is a read record that provides information on pressure readings. This includes the type of pressure being read (absolute, gauge, or differential), the source of the reading, the possible minimum and maximum values, the engineering units, and where the decimal is in the pressure reading.

Byte Offset	Type	Description
0	Unsigned16	Pressure type. Indicates the pressure being read. See Appendix A-2 (page 51). Value is 0 if the reading is not available.
2	Unsigned16	Pressure source. Indicates where the pressure is being read. See Appendix C (page 58). Value is 0 if the reading is not available.
4	Float32	Minimum value of the pressure reading, without overrange.
8	Float32	Maximum value of the pressure reading, without overrange.
12	Integer32	Minimum value of the pressure reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset } 22 \text{ value})}$ for the value in engineering units.
16	Integer32	Maximum value of the pressure reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset } 22 \text{ value})}$ for the value in engineering units.
20	Unsigned16	Pressure units. Indicates the engineering units of the reading. See Appendix B-6 (page 56).
22	Unsigned16	Pressure decimal places. The number of digits after the decimal place in the current value, minimum value, and maximum value.

## Secondary Pressure Information

**Index:** 0x0008

The **secondary pressure information** data record is a read record that provides information on any secondary pressure readings, including the type of pressure being read (absolute, gauge, or differential), the source of the reading, the possible minimum and maximum values, the engineering units, and where the decimal is in the pressure reading. Secondary pressure readings are not always present.

Byte Offset	Type	Description
0	Unsigned16	Secondary pressure type. Indicates the pressure being read. See Appendix A-2 (page 51). Value is 0 if the reading is not available.
2	Unsigned16	Secondary pressure source. Indicates where the pressure is being read. See Appendix C (page 58). Value is 0 if the reading is not available.
4	Float32	Minimum value of the pressure reading, without overrange.
8	Float32	Maximum value of the pressure reading, without overrange.
12	Integer32	Minimum value of the pressure reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset } 22 \text{ value})}$ for the value in engineering units.
16	Integer32	Maximum value of the pressure reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset } 22 \text{ value})}$ for the value in engineering units.
20	Unsigned16	Secondary pressure units. Indicates the engineering units of the reading. See Appendix B-6 (page 56).
22	Unsigned16	Secondary pressure decimal places. The number of digits after the decimal place in the current value, minimum value, and maximum value.

## Barometric Pressure Information

**Index:** 0x0009

The **barometric pressure information** data record is a read record that provides information on barometric pressure readings. This includes the type of pressure being read, the source of the reading, the possible minimum and maximum values, the engineering units, and where the decimal is in the pressure reading.

Byte Offset	Type	Description
0	Unsigned16	Barometric pressure type. Indicates the pressure being read. See Appendix A-2 (page 51). Value is 0 if the reading is not available.
2	Unsigned16	Barometric pressure source. Indicates where the pressure is being read. See Appendix C (page 58). Value is 0 if not available.
4	Float32	Minimum value of the barometric pressure reading, without overrange.
8	Float32	Maximum value of the barometric pressure reading, without overrange.
12	Integer32	Minimum value of the barometric pressure reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset } 22 \text{ value})}$ for the value in engineering units.
16	Integer32	Maximum value of the barometric pressure reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset } 22 \text{ value})}$ for the value in engineering units.
20	Unsigned16	Barometric pressure units. Indicates what engineering units the reading is in. See Appendix B-6 (page 56).
22	Unsigned16	Barometric pressure decimal places. The number of digits after the decimal place in the current value, minimum, and maximum value.

## Temperature Information

Index: 0x000A

The **temperature information** data record is a read record that provides information on temperature readings. This includes the type of pressure being read, the source of the reading, the possible minimum and maximum values, the engineering units, and where the decimal is in the temperature reading.

Byte Offset	Type	Description
0	Unsigned16	Temperature type. Indicates what temperature is being read. See Appendix A-3 (page 52) to determine what the value indicates. Value is 0 if the reading is not available.
2	Unsigned16	Temperature source. Indicates where the temperature is being read. See Appendix C (page 58) to determine what the value indicates. Value is 0 if the reading is not available.
4	Float32	Minimum value of the temperature reading, without overrange
8	Float32	Maximum value of the temperature reading, without overrange
12	Integer32	Minimum value of the temperature reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset } 22 \text{ value})}$ for the value in engineering units.
16	Integer32	Maximum value of the temperature reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset } 22 \text{ value})}$ for the value in engineering units.
20	Unsigned16	Temperature units. Indicates what engineering units the reading is in. See Appendix B-7 (page 57) to determine what the value indicates.
22	Unsigned16	Temperature decimal places. The number of digits after the decimal place in the current, minimum, and maximum values.

## Volumetric Flow Information

Index: 0x000B

The **volumetric flow information** data record is a read record that provides information on the volumetric flow readings. This includes the type of volumetric flow being read, the source of the reading, the possible minimum and maximum values, the engineering units, and where the decimal is in the volumetric flow reading.

Byte Offset	Type	Description
0	Unsigned16	Volumetric flow type. Indicates which volumetric flow is being read. See Appendix A-1 (page 50). 0 if reading not available.
2	Unsigned16	Volumetric flow. Indicates where the volumetric flow is being read. See Appendix C (page 58). Value is 0 if the reading is not available.
4	Float32	Minimum value of the volumetric flow reading, without overrange.
8	Float32	Maximum value of the volumetric flow reading, without overrange.
12	Integer32	Minimum value of the volumetric flow reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset } 22 \text{ value})}$ for the value in engineering units.
16	Integer32	Maximum value of the volumetric flow reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset } 22 \text{ value})}$ for the value in engineering units.
20	Unsigned16	Volumetric flow units. Indicates the reading's engineering units. See Appendix B-4 (page 55).
22	Unsigned16	Volumetric flow decimal places. The number of digits after the decimal place in the current, minimum, and maximum values.



## Mass Flow Information

**Index:** 0x000C

The **mass flow information** data record is a read record that provides information on the mass flow readings. This includes the type of mass flow being read, the source of the reading, the possible minimum and maximum values, the engineering units, and where the decimal is in the mass flow reading.

Byte Offset	Type	Description
0	Unsigned16	Mass flow type. Indicates which mass flow is being read. See Appendix A-1 (page 50). Value is 0 if the reading is not available.
2	Unsigned16	Mass flow. Indicates where the mass flow is being read. See Appendix C (page 58). Value is 0 if the reading is not available.
4	Float32	Minimum value of the mass flow reading, without overrange.
8	Float32	Maximum value of the mass flow reading, without overrange.
12	Integer32	Minimum value of the mass flow reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset 22 value})}$ for the value in engineering units.
16	Integer32	Maximum value of the mass flow reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset 22 value})}$ for the value in engineering units.
20	Unsigned16	Mass flow units. Indicates what engineering units the reading is in. See Appendix B-1 (page 53).
22	Unsigned16	Mass flow decimal places. The number of digits after the decimal place in the current, minimum, and maximum values.

## Totalizer 1 Information

**Index:** 0x000D

The **totalizer 1 information** data record is a read record that provides information on the totalizer readings. This includes the type of reading for the totalizer, the source of the reading, the possible minimum and maximum values, the engineering units, and where the decimal is in the totalizer reading.

Byte Offset	Type	Description
0	Unsigned16	Totalizer 1 type. Indicates which reading is being totaled. See Appendix A-1 (page 50). Value is 0 if the reading is not available.
2	Unsigned16	Totalizer 1. Indicates where the reading is being read. See Appendix C (page 58). Value is 0 if the reading is not available.
4	Float32	Minimum value of the totalizer 1 reading, without overrange.
8	Float32	Maximum value of the totalizer 1 reading, without overrange.
12	Integer32	Minimum value of the totalizer 1 reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset 22 value})}$ for the value in engineering units.
16	Integer32	Maximum value of the totalizer 1 reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset 22 value})}$ for the value in engineering units.
20	Unsigned16	Totalizer 1 units. Indicates what engineering units the reading is in. See Appendix B-3 (page 54) for totalizing mass flow and Appendix B-5 (page 55) for totaling volumetric flow.
22	Unsigned16	Totalizer 1 decimal place. The number of digits after the decimal place in the current, minimum, and maximum values.

## Totalizer 2 Information

**Index:** 0x000E

The **totalizer 2 information** data record is a read record that provides information on the totalizer readings. This includes the type of reading for the totalizer, the source of the reading, the possible minimum and maximum values, the engineering units, and where the decimal is in the totalizer reading.

Byte Offset	Type	Description
0	Unsigned16	Totalizer 2 type. Indicates which reading is being totaled. See Appendix A-1 (page 50). Value is 0 if the reading is not available.
2	Unsigned16	Totalizer 2. Indicates where the reading is being read. See Appendix C (page 58). Value is 0 if the reading is not available.
4	Float32	Minimum value of the totalizer 2 reading, without overrange.
8	Float32	Maximum value of the totalizer 2 reading, without overrange.
12	Integer32	Minimum value of the totalizer 2 reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset 22 value})}$ for the value in engineering units.
16	Integer32	Maximum value of the totalizer 2 reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset 22 value})}$ for the value in engineering units.
20	Unsigned16	Totalizer 2 units. Indicates what engineering units the reading is in. See Appendix B-3 (page 54) for totalizing mass flow and Appendix B-5 (page 55) for totalizing volumetric flow.
22	Unsigned16	Totalizer 2 decimal places. The number of digits after the decimal place in the current, minimum, and maximum values.

## Humidity Information

**Index:** 0x000F

The **humidity information** data record is a read record that provides information on the humidity readings. This includes the type of reading for the humidity, the source of the reading, the possible minimum and maximum values, the engineering units, and where the decimal is in the humidity reading.

Byte Offset	Type	Description
0	Unsigned16	Humidity type. Indicates which humidity is being read. See Appendix A-3 (page 52). Value is 0 if the reading is not available.
2	Unsigned16	Humidity. Indicates where the reading is being read. See Appendix C (page 58). Value is 0 if the reading is not available.
4	Float32	Minimum value of the humidity reading, without overrange.
8	Float32	Maximum value of the humidity reading, without overrange.
12	Integer32	Minimum value of the humidity reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset 22 value})}$ for the value in engineering units.
16	Integer32	Maximum value of the humidity reading, without overrange. Scale the integer by $10^{(\text{negative of byte offset 22 value})}$ for the value in engineering units.
20	Unsigned16	Humidity units. Indicates the engineering units of the reading. See Appendix B (page 53).
22	Unsigned16	Humidity decimal places. The number of digits after the decimal place in the current, minimum, and maximum values.

# Commands

Commands require a command ID and argument written to the **send command** data record (index 0x0001). To send a command, write the command ID and the argument to byte offsets 0 and 4, 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 to byte offset 4.

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 **Command Status** section (page 12).

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 all commands 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

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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

---

The data readings commands provide information on the readings an instrument can have. This includes the reading types, source, minimum and maximum values, engineering units, and the number of decimal places.

The return values for these commands often return a numerical value that is associated with a specific reading type, reading source, or engineering unit. Where noted, refer to the appropriate appendix (page 50) to determine the association of the given return value.

### Query Reading Type

**Firmware:** 10v07

**Command ID:** 32

**Query reading type** sends a request the statistic of the reading noted in the argument.

**Argument:** Use the value for the desired reading from the following table.

Value	Reading
0	Setpoint
1	Valve drive
2	Pressure
3	Secondary pressure
4	Barometric pressure
5	Temperature
6	Volumetric flow
7	Mass flow
8	Totalizer 1
9	Totalizer 2
10	Humidity

**Command response:** A SUCCESS status is set if the instrument has a reading associated with the request argument. The return value is the value of the statistic of the requested reading. Refer to **Appendix A** (page 50) for the value's associated statistic.

An INVALID\_ARGUMENT status is set if the instrument has no reading associated with the requested argument.

## Query Reading Source

**Firmware:** 10v07

**Command ID:** 27

**Query reading source** requests the source of the reading noted in the argument.

**Argument:** Use the value for the desired reading from the following table.

Value	Reading
0	Setpoint
1	Valve drive
2	Pressure
3	Secondary pressure
4	Barometric pressure
5	Temperature
6	Volumetric flow
7	Mass Flow
8	Totalizer 1
9	Totalizer 2
10	Humidity

**Command response:** A SUCCESS status is set if the instrument has a reading associated with the requested argument. The return value is the value for the source for the requested reading. Refer to **Appendix C** (page 58) for the value's associated source.

An INVALID\_ARGUMENT status is set if the instrument has no reading associated with the requested argument.

## Query Reading Minimum (Integer)

**Firmware:** 10v07

**Command ID:** 65538

**Query reading minimum (integer)** requests the minimum value the reading noted in the argument can have. This value does not include overrange.

**Argument:** Use the value for the desired reading from the following table.

Value	Reading
0	Setpoint
1	Valve drive
2	Pressure
3	Secondary pressure

4	Barometric pressure
5	Temperature
6	Volumetric flow
7	Mass Flow
8	Totalizer 1
9	Totalizer 2
10	Humidity

**Command response:** A SUCCESS status is set if the instrument has a reading associated with the requested argument. The return value is the minimum value of the reading as an integer. Scale this integer by  $10^{(\text{reading decimal places})}$  for the minimum in the reading's engineering units.

An INVALID\_ARGUMENT status is set if the instrument has no reading associated with the requested argument.

## Query Reading Minimum (Float)

**Firmware:** 10v07

**Command ID:** 65536

**Query reading minimum (float)** requests the minimum value the reading noted in the argument can have. This value does not include overrange.

**Argument:** Use the value for the desired reading from the following table.

Value	Reading
0	Setpoint
1	Valve drive
2	Pressure
3	Secondary pressure
4	Barometric pressure
5	Temperature
6	Volumetric flow
7	Mass Flow
8	Totalizer 1
9	Totalizer 2
10	Humidity

**Command response:** A SUCCESS status is set if the instrument has a reading associated with the requested argument. The return value is the minimum value of the reading as an IEEE-754 single precision floating point value. This value is in the reading's engineering units.

An INVALID\_ARGUMENT status is set if the instrument has no reading associated with the requested argument.

## Query Reading Maximum (Integer)

**Firmware:** 10v07

**Command ID:** 65539

**Query reading minimum (integer)** requests the maximum value the reading noted in the argument can have. This value does not include overrange.

**Argument:** Use the value for the desired reading from the following table.

Value	Reading
0	Setpoint
1	Valve drive
2	Pressure
3	Secondary pressure
4	Barometric pressure
5	Temperature
6	Volumetric flow
7	Mass Flow
8	Totalizer 1
9	Totalizer 2
10	Humidity

**Command response:** A SUCCESS status is set if the instrument has a reading associated with the requested argument. The return value is the maximum value of the reading as an integer. Scale this integer by  $10^{\text{(reading decimal places)}}$  for the maximum in the reading's engineering units.

An INVALID\_ARGUMENT status is set if the instrument has no reading associated with the requested argument.

## Query Reading Maximum (Float)

**Firmware:** 10v07

**Command ID:** 65537

**Query reading maximum (float)** requests the maximum value the reading noted in the argument can have. This value does not include overrange.

**Argument:** Use the value for the desired reading from the following table.

Value	Reading
0	Setpoint
1	Valve drive
2	Pressure
3	Secondary pressure

Value	Reading
4	Barometric pressure
5	Temperature
6	Volumetric flow
7	Mass Flow
8	Totalizer 1
9	Totalizer 2
10	Humidity

**Command response:** A SUCCESS status is set if there is a reading associated with the requested argument. The return value is the maximum value of the reading as an IEEE-754 single precision floating point value. This value is in the reading's engineering units.

An INVALID\_ARGUMENT status is set if the instrument has no reading associated with the requested argument.

## Query Reading Engineering Units

**Firmware:** 10v07

**Command ID:** 29

**Query reading engineering units** requests the current engineering units of the reading noted in the argument.

**Argument:** Use the value for the desired reading from the following table.

Value	Reading
0	Setpoint
1	Valve drive
2	Pressure
3	Secondary pressure
4	Barometric pressure
5	Temperature
6	Volumetric flow
7	Mass Flow
8	Totalizer 1
9	Totalizer 2
10	Humidity

**Command response:** A SUCCESS status is set if the instrument has a reading associated with the requested argument. The return value is the value for the engineering units of the requested reading. Refer to **Appendix B** (page 53) for the value's associated engineering units.

An INVALID\_ARGUMENT status is set if the instrument has no reading associated with the requested argument.



## Set Reading Engineering Units

**Firmware:** 10v07

**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). For example, to change the engineering unit of the pressure reading, use 65302 as the command ID.

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 53).

### Offset Reading

0	Setpoint
1	Valve drive
2	Pressure
3	Secondary pressure
4	Barometric pressure
5	Temperature
6	Volumetric flow
7	Mass Flow
8	Totalizer 1
9	Totalizer 2
10	Humidity

**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.

## Query Reading Decimal Places

**Firmware:** 10v07

**Command ID:** 30

**Query reading decimal places** sends a request to the instrument for the number of digits after the implicit decimal place in the requested reading's current, minimum, and maximum values.

**Argument:** Use the value for the desired reading from the following table.

Value	Reading
0	Setpoint
1	Valve drive
2	Pressure
3	Secondary pressure
4	Barometric pressure
5	Temperature
6	Volumetric flow
7	Mass Flow
8	Totalizer 1
9	Totalizer 2
10	Humidity

**Command response:** A SUCCESS status is set if the instrument has a reading associated with the requested argument. The return value is the number of decimal places available for the reading.

An INVALID\_ARGUMENT status is set if the instrument has no reading associated with the requested argument.

## 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:** 7v05

**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:** 10v07

**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
00% of full scale every millisecond	1000000000
% of full scale every millisecond	10000000
00% of full scale every second	1000000
00% of full scale every minute	16667
% of full scale every second	10000
00% of full scale every hour	278
% of full scale every minute	167
0% 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:** 10v07

**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:** 7v05

**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.
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:** 7v16

**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. <i>Added in 10v11.0.</i>
3	The second auxiliary valve. <i>Added in 10v11.0.</i>
65535	Query the currently active valve. <i>Added in 10v11.0.</i>

**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 Loop Control Variable

► Controllers

**Firmware:** 7v05

**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 50).

**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:** 7v08

**Command ID:** 13

**Set loop control algorithm** selects either PDF or PD<sup>2</sup>I 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 <sup>2</sup> I 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:** 7v08

**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 <sup>2</sup> I
1	Derivative gain (d gain) for PDF or PD <sup>2</sup> I
2	Integral gain (I gain) for PD <sup>2</sup> I

**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 Proportional Closed-Loop Control Gain

► Controllers

**Firmware:** 7v05

**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:** 7v05

**Command ID:** 9

**Set derivative close loop control gain** changes the derivative gain value (D 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 Integral Closed-Loop Control Gain

► Controllers

**Firmware:** 7v05

**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 Inverse Pressure Control

► Controllers

**Firmware:** 7v18

**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:** 10v07

**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  $10^{(\text{negative totalizer decimal places})}$ . 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:** 10v07

**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 an IEEE-754 single precision floating point 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:** 10v07

**Command ID:** 65544

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

**Argument:** Use the desired batch size multiplied by  $10^{(\text{totalizer decimal places})}$ .

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:** 10v07

**Command ID:** 65541

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

**Argument:** Use the desired batch size formatted as an IEEE-754 single precision floating point 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:** 10v07

**Command ID:** 65545

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

**Argument:** Use the desired batch size multiplied by  $10^{(\text{totalizer decimal places})}$ .

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:** 10v07

**Command ID:** 65542

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

**Argument:** Use the desired batch size formatted as an IEEE-754 single precision floating point 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 1 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:** 10v13.0

**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.

## Check Setpoint Response Test Setpoint (Setpoint Counts)

► Controllers

**Firmware:** 10v13.0

**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:** 10v13.0

**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  $10^{(\text{setpoint decimal places})}$ . 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  $10^{-(\text{setpoint decimal places})}$  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:** 10v13.0

**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 an IEEE-754 single precision floating point 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 an IEEE-754 single precision floating point 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:** 10v13.0

**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:** 10v13.0

**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 analog the analog setpoint is enabled) 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:** 10v13.0

**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:** 10v13.0

**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:** 10v13.0

**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  $10^{-(\text{setpoint decimal places})}$  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:** 10v13.0

**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 an IEEE-754 single precision floating point value, in the setpoint engineering units.

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

# Control Response Analysis

## Check Setpoint Response Timing Results

► Controllers

**Firmware:** 10v13.0

**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)

► Controllers

**Firmware:** 10v13.0

**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:** 10v13.0

**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  $10^{(\text{setpoint decimal places})}$ . 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  $10^{-(\text{setpoint decimal places})}$  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:** 10v13.0

**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 current the maximum flow. This is formatted as an IEEE-754 single precision floating point 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 an IEEE-754 single precision floating point 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:** 10v13.0

**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:** 10v13.0

**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

□ Controllers

**Firmware:** 10v13.0

**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:** 10v13.0

**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:** 10v13.0

**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 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. Please notify Alicat of how to reproduce this.
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.

### Perform Tare

**Firmware:** 7v05

**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:** 10v07

**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:** 10v07

**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:** 10v07

**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:** 7v05

**Command ID:** 5

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

**Argument:** No argument is used for this command

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

## Set Gas

► Mass flow instruments

**Firmware:** 7v05

**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 59.

**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:** 7v05

**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 12 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:** 7v05

**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.

## Set Relative Humidity Percentage

► Instruments with humidity sensor

**Firmware:** 10v07

**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:** 10v07

**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.

## Lock/Unlock Display

**Firmware:** 7v05

**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:** 8v28

**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. A value of 0 stops 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:** 10v07

**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.

## Read Configuration Checksum

**Firmware:** 8v24

**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.

# Embedded Web Server

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All Alicat PROFINET instruments have an embedded web server. The contents of the web server include instrument and networking information as well as setting configurations. The web server can be accessed by navigating to the IP address of the instrument using your computer's web browser.

## Device Summary

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The first page of the web server is the **Device Summary**. This page provides information on the instrument and the status of the network connection.

**Application Firmware:** The current firmware version of the instrument. This determines what commands are available on the instrument, as well as controls how the instrument operates and the menu structure of the instrument display. See [alicat.com/firmware](http://alicat.com/firmware) for more information.

**Adapter Firmware:** The communication protocol that is configured on the instrument and its firmware. This should display as PROFINET. If it does not, please contact Alicat support for assistance (page 2).

**Serial Number:** The serial number of the instrument. This number never changes and is the same number as the number found on the back of the instrument.

**Port 1 MAC Address:** The physical address of Ethernet port 1.

**Port 2 MAC Address:** The physical address of Ethernet port 2.

**IP Address:** The current IP address assigned by the DCP.

**Subnet Mask:** The subnet mask of the network the instrument is connected to. Assigned by the DCP.

**Gateway:** The address of the gateway to which the instrument is connected. Assigned by the DCP.

## IO Modules

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The **IO Modules** page contains information about the input and output of the modules of the instrument. The modules provide information on the instrument readings including their module ID, readings format, engineering units, and current readings. All modules are input except for the Requested Setpoint.

There are two possible modules, one for floating point values (Float32) and one for integer values (Integer32). Both modules work the same, the only difference is how the readings are formatted. It is possible to select either module using the display panel (page 8). After changing the setting, wait at least 15 seconds for the change to take effect. If the instrument does not have a display, contact Alicat for assistance in changing the module format.

## Read/Write Data Records

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The **Read/Write Data Records** page contains information on what acyclic indexes are available on the instrument. There are two possible write indexes and thirteen possible read indexes. This is referential to help determine what the instrument is capable of and what the current readings are. The information includes minimum and maximum values of readings, the engineering units of the reading values, and where the decimal is in the reading. If an index is present on this page, the instrument is capable of either reading or writing to that index.

For more information on the acyclic read/write indexes, see page 11.

# Internal Configuration

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The **Internal Configuration** page is used for troubleshooting the instrument. This page can read and write to instrument registers that control different settings of the instrument. Do not attempt to write to registers without knowing how that register works. Overwriting register values may invalidate the instrument's calibration, disable communication, or permanently damage the instrument. Please contact Alicat for support (page 2) before attempting to interact with this page.

# TIA Portal Setup

When adding an Alicat instrument to a TIA Portal project, the GSDML file must first be installed. The GSDML file is available for download from [alicat.com/profinet](http://alicat.com/profinet). After obtaining the file, continue with the setup process.

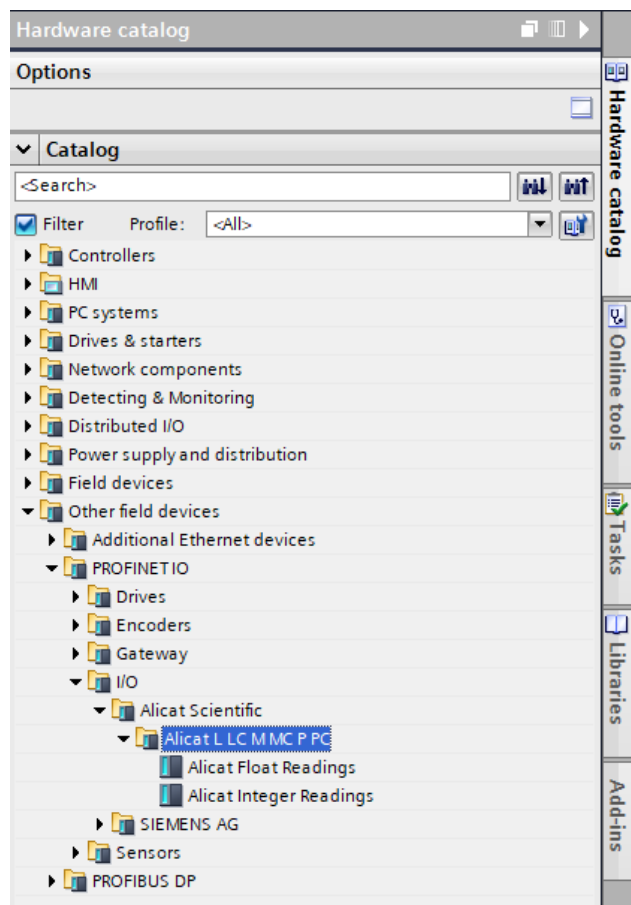
The GSD file installs two modules, Alicat Float Readings and Alicat Integer Readings. Alicat Float Readings module provides cyclic data floating point (Float32) format. The Alicat Integer Readings module provides cyclic data in an integer (Integer32) format. The modules operate the same, the only difference is how readings are displayed. For more information on the modules see page 10.

After installing the GSD file, the two Alicat modules are in the hardware catalog under **Other Field devices > PROFINET IO > I/O > Alicat Scientific > Alicat L LC M MC P PC**.

Be sure to use the module that is the same format the instrument is set to. This can be confirmed through the instrument's display (page 8) or using the instrument's embedded web server (page 46).

When adding the instrument, if you need assistance confirming the instrument location, the **Flash LED** setting can be used. The Alicat's display screen and Ready LED flash for 15 seconds after selecting the setting.

Use the instrument view to determine the slot and address of different portions of the module.



Hardware catalog location

Device overview									
	Module	Rack	Slot	I address	Q address	Type	Article no.	Firmware	Comment
	▼ alicat	0	0			Alicat Float Readings	L LC M MC P PC	v6.0.0	
	▶ Internal	0	0 Float			alicat			
	Setpoint_1	0	1	68...71	64...67	Setpoint			
	Valve Drive_1	0	2	72...75		Valve Drive			
	Primary Pressure_1	0	3	76...79		Primary Pressure			
	Secondary Pressure_1	0	4	80...83		Secondary Pressure			
	Barometric Pressure_1	0	5	84...87		Barometric Pressure			
	Temperature_1	0	6	88...91		Temperature			
	Volumetric Flow_1	0	7	92...95		Volumetric Flow			
	Mass Flow_1	0	8	96...99		Mass Flow			
	Totalizer 1_1	0	9	100...103		Totalizer 1			
	Totalizer 2_1	0	10	104...107		Totalizer 2			
	Relative Humidity_1	0	11	108...111		Relative Humidity			
	Device Status_1	0	12	1...4		Device Status			
	Gas Number_1	0	13	112...113		Gas Number			
	Active Alarms_1	0	14	5...6		Active Alarms			

Device overview





# 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. The firmware version in parentheses indicates when the statistic was added. If no version is present, the statistic is available on all instruments. 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
Batch mass remaining	12	Remaining mass in the totalizer batch
Batch volume remaining	11	Remaining volume, referenced to flow conditions, in the totalizer batch.
Mass flow	5	Current mass flow
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	Setpoint for mass flow
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.
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.

## Appendix A-2: Pressure Statistics

Pressure Statistic	Value	Notes
Pressure, absolute	2	Current absolute pressure
Pressure, absolute maximum (8v32)	151	Highest absolute pressure since reset
Pressure, absolute minimum (8v32)	150	Lowest absolute pressure since reset
Pressure, absolute setpoint	34	Setpoint for absolute pressure
Pressure, absolute setpoint error (8v00)	149	Absolute pressure minus the ramp-limited setpoint.
Pressure, barometric	15	Barometer reading
Pressure, barometric maximum (8v32)	255	Highest barometric pressure since reset
Pressure, barometric minimum (8v32)	254	Lowest barometric pressure since reset
Pressure, differential	7	Current differential pressure reading
Pressure, differential maximum (8v32)	191	Highest differential pressure since reset
Pressure, differential minimum (8v32)	190	Lowest differential pressure since reset
Pressure, differential setpoint	39	Setpoint for differential pressure
Pressure, differential setpoint error (8v00)	189	Differential pressure minus the ramp-limited setpoint
Pressure, gauge	6	Current gauge pressure reading
Pressure, gauge maximum (8v32)	183	Highest gauge pressure since reset
Pressure, gauge minimum (8v32)	182	Lowest gauge pressure since reset
Pressure, gauge setpoint	38	Setpoint for gauge pressure
Pressure, gauge setpoint error (8v00)	181	Gauge pressure minus the ramp-limited setpoint
Pressure, second absolute (7v01)	344	For instruments with a second pressure sensor, 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	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 instruments with a second pressure sensor, 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	Setpoint for the second differential pressure
Pressure, second differential setpoint error (8v00)	365	Second differential pressure minus the ramp-limited setpoint

Pressure Statistic	Value	Notes
Pressure, second gauge (7v01)	352	For instruments with a pressure sensor in a second location, the gauge pressure of the second sensor. For DIL0, 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	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: usually implies an empty location.
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 instrument. This is typically only used internally.
Temperature, stream	3	Current stream temperature
Temperature, stream maximum (8v32)	159	Highest stream temperature since reset.
Temperature, stream minimum (8v32)	158	Lowest stream temperature since reset
Valve drive	13	Valve drive signal
Valve drive setpoint (8v00)	45	The setpoint directly drives the currently selected valve.
Vapor fraction (Percent water vapor)	488	The molecular fraction of vapor in gas. When water is the vapor used, this is the percentage of water vapor.
Vapor fraction maximum	495	Highest vapor fraction since reset
Vapor fraction minimum	494	Lowest vapor fraction since reset
Vapor saturation (relative humidity)	25	The fraction of complete saturation the instrument 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 vapor saturation since reset
Vapor saturation, minimum (8v32)	334	Lowest vapor saturation since last reset
Vapor saturation, peak	121	Peak vapor saturation over the time of totalizing
Vapor saturation, temperature (dew point)	496	Temperature that would result in complete vapor saturation. When water is the vapor, this is the dew point.
Vapor saturation, temperature, maximum	503	Highest vapor saturation temperature since reset
Vapor saturation, temperature, minimum	502	Lowest vapor saturation temperature since reset

## 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.
<b>SμL/m</b>	2	Standard microliter per minute
<b>SmL/s</b>	3	Standard milliliter per second
<b>SmL/m</b>	4	Standard milliliter per minute
<b>SmL/h</b>	5	Standard milliliter per hour
<b>SL/s</b>	6	Standard liter per second
<b>SLPM</b>	7	Standard liter per minute
<b>SL/h</b>	8	Standard liter per hour
<b>SCCS</b>	11	Standard cubic centimeter per second
<b>SCCM</b>	12	Standard cubic centimeter per minute
<b>Scm<sup>3</sup>/h</b>	13	Standard cubic centimeter per hour
<b>Sm<sup>3</sup>/m</b>	14	Standard cubic meter per minute
<b>Sm<sup>3</sup>/h</b>	15	Standard cubic meter per hour
<b>Sm<sup>3</sup>/d</b>	16	Standard cubic meter per day
<b>Sin<sup>3</sup>/m</b>	17	Standard cubic inch per minute
<b>SCFM</b>	18	Standard cubic foot per minute
<b>SCFH</b>	19	Standard cubic foot per hour
<b>SCFD</b>	21	Standard cubic foot per day Added in 6v08.0.
<b>kSCFM</b>	20	1000 standard cubic feet per minute
<b>NμL/m</b>	32	Normal microliter per minute
<b>NmL/s</b>	33	Normal milliliter per second
<b>NmL/m</b>	34	Normal milliliter per minute
<b>NmL/h</b>	35	Normal milliliter per hour
<b>NL/s</b>	36	Normal liter per second
<b>NLPM</b>	37	Normal liter per minute
<b>NL/h</b>	38	Normal liter per hour
<b>NCCS</b>	41	Normal cubic centimeter per second
<b>NCCM</b>	42	Normal cubic centimeter per minute
<b>Ncm<sup>3</sup>/h</b>	43	Normal cubic centimeter per hour

Unit Label	Value	Notes
<b>Nm<sup>3</sup>/m</b>	44	Normal cubic meter per minute
<b>Nm<sup>3</sup>/h</b>	45	Normal cubic meter per hour
<b>Nm<sup>3</sup>/d</b>	46	Normal cubic meter per day
<b>Count</b>	62	Setpoint count, 0–64000
<b>%</b>	63	Percent of the full scale

## Appendix B-2: True Mass Flow Units

Unit Label	Value	Notes
<b>mg/s</b>	64	Milligram per second
<b>mg/m</b>	65	Milligram per minute
<b>g/s</b>	66	Gram per second
<b>g/m</b>	67	Gram per minute
<b>g/h</b>	68	Gram per hour
<b>kg/m</b>	69	Kilogram per minute
<b>kg/h</b>	70	Kilogram per hour
<b>oz/s</b>	71	Ounce per second
<b>oz/m</b>	72	Ounce per minute
<b>lb/m</b>	73	Pound per minute
<b>lb/h</b>	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.
<b>SμL</b>	2	Standard microliter
<b>SmL</b>	3	Standard milliliter
<b>SL</b>	4	Standard liter
<b>Scm<sup>3</sup></b>	6	Standard cubic centimeter
<b>Sm<sup>3</sup></b>	7	Standard cubic meter
<b>Sin<sup>3</sup></b>	8	Standard cubic inch
<b>Sft<sup>3</sup></b>	9	Standard cubic foot
<b>kSft<sup>3</sup></b>	10	1000 standard cubic feet
<b>NμL</b>	32	Normal microliter
<b>NmL</b>	33	Normal milliliter
<b>NL</b>	34	Normal liter
<b>Ncm<sup>3</sup></b>	36	Normal cubic centimeter
<b>Nm<sup>3</sup></b>	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
$\mu\text{L}/\text{m}$	2	Microliter per minute
$\text{mL}/\text{s}$	3	Milliliter per second
$\text{mL}/\text{m}$	4	Milliliter per minute
$\text{mL}/\text{h}$	5	Milliliter per hour
$\text{L}/\text{s}$	6	Liter per second
<b>LPM</b>	7	Liter per minute
<b>L/h</b>	8	Liter per hour
<b>US GPM</b>	9	US gallon per minute
<b>US GPH</b>	10	US gallon per hour
<b>CCS</b>	11	Cubic centimeter per second
<b>CCM</b>	12	Cubic centimeter per minute
$\text{cm}^3/\text{h}$	13	Cubic centimeter per hour
$\text{m}^3/\text{m}$	14	Cubic meter per minute
$\text{m}^3/\text{h}$	15	Cubic meter per hour
$\text{m}^3/\text{d}$	16	Cubic meter per day
$\text{in}^3/\text{m}$	17	Cubic inch per minute
<b>CFM</b>	18	Cubic foot per minute
<b>CFH</b>	19	Cubic foot per hour
<b>CFD</b>	21	Cubic foot per day Added in 6v08.0.
<b>count</b>	62	Setpoint count, 0–64000
<b>%</b>	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
$\mu\text{L}$	2	Microliter
<b>mL</b>	3	Milliliter
<b>L</b>	4	Liter
<b>US GAL</b>	5	US gallon
$\text{cm}^3$	6	Cubic centimeter
$\text{m}^3$	7	Cubic meter
$\text{in}^3$	8	Cubic inch

Unit Label	Value	Notes
<b>ft<sup>3</sup></b>	9	Cubic foot
<b>μP</b>	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
<b>Pa</b>	2	Pascal
<b>hPa</b>	3	Hectopascal
<b>kPa</b>	4	Kilopascal
<b>MPa</b>	5	Megapascal
<b>mbar</b>	6	Millibar
<b>bar</b>	7	Bar
<b>g/cm<sup>2</sup></b>	8	Gram force per square centimeter
<b>kg/cm</b>	9	Kilogram-force per square centimeter
<b>PSI</b>	10	Pound-force per square inch
<b>PSF</b>	11	Pound-force per square foot
<b>mTorr</b>	12	Millitorr
<b>torr</b>	13	Torr
<b>mmHg</b>	14	Millimeter of mercury at 0 °C
<b>inHg</b>	15	Inches of mercury at 0 °C
<b>mmH<sub>2</sub>O</b>	16	Millimeter of water at 4 °C (NIST conventional)
<b>mmH<sub>2</sub>O</b>	17	Millimeter of water at 60 °F
<b>cmH<sub>2</sub>O</b>	18	Centimeter of water at 4 °C (NIST conventional)
<b>cmH<sub>2</sub>O</b>	19	Centimeter of water at 60 °F
<b>inH<sub>2</sub>O</b>	20	Inch of water at 4 °C (NIST conventional)
<b>inH<sub>2</sub>O</b>	21	Inch of water at 60 °F
<b>atm</b>	22	Atmosphere (absolute pressure only, no A/G/D suffix is applied)
<b>V</b>	61	Volt: no conversions are performed to or from other units (intended only for log-linear absolute pressure)
<b>count</b>	62	Setpoint count, 0–64000
<b>%</b>	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: Instrument Data Sources

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

Data Source Value Notes		
Instant display	1	Data source on the instrument. Smoothed for front panel display.
Instant serial	2	Data source on the instrument. 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)
8	Ar	Argon
2	CH <sub>4</sub>	Methane
3	CO	Carbon Monoxide
4	CO <sub>2</sub>	Carbon Dioxide
5	C <sub>2</sub> H <sub>6</sub>	Ethane
6	H <sub>2</sub>	Hydrogen
7	He	Helium
8	N <sub>2</sub>	Nitrogen
9	N <sub>2</sub> O	Nitrous Oxide
10	Ne	Neon
11	O <sub>2</sub>	Oxygen
12	C <sub>3</sub> H <sub>8</sub>	Propane
13	nC <sub>4</sub> H <sub>10</sub>	Normal Butane
14	C <sub>2</sub> H <sub>2</sub>	Acetylene
15	C <sub>2</sub> H <sub>4</sub>	Ethylene (Ethene)
16	iC <sub>4</sub> H <sub>10</sub>	Isobutane
17	Kr	Krypton
18	Xe	Xenon
19	SF <sub>6</sub>	Sulfur Hexafluoride <sup>1</sup>
20	C-25	25% CO <sub>2</sub> , 75% Ar
21	C-10	10% CO <sub>2</sub> , 90% Ar
22	C-8	8% CO <sub>2</sub> , 92% Ar
23	C-2	2% CO <sub>2</sub> , 98% Ar
24	C-75	75% CO <sub>2</sub> , 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 <sub>2</sub>
28	Star29	Stargon CS (90% Ar, 8% CO <sub>2</sub> , 2% O <sub>2</sub> )
29	P-5	5% CH <sub>4</sub> , 95% Ar
30	NO	Nitric Oxide <sup>2</sup>
31	NF <sub>3</sub>	Nitrogen Trifluoride <sup>2</sup>
32	NH <sub>3</sub>	Ammonia <sup>2</sup>
33	Cl <sub>2</sub>	Chlorine <sup>2</sup>
34	H <sub>2</sub> S	Hydrogen Sulfide <sup>2</sup>
35	SO <sub>2</sub>	Sulfur Dioxide <sup>2</sup>
36	C <sub>3</sub> H <sub>6</sub>	Propylene <sup>2</sup>
80	1Buten	1-Butylene <sup>2</sup>
81	cButen	Cis-Butene (cis-2-Butene) <sup>2</sup>
82	iButen	Isobutene <sup>2</sup>
83	tButen	Trans-2-Butene <sup>2</sup>
84	COS	Carbonyl Sulfide <sup>2</sup>
85	DME	Dimethylether (C <sub>2</sub> H <sub>6</sub> O) <sup>2</sup>
86	SiH <sub>4</sub>	Silane <sup>2</sup>
100	R-11	Trichlorofluoromethane (CCl <sub>3</sub> F) <sup>2,3</sup>
101	R-115	Chloropentafluoroethane (C <sub>2</sub> ClF <sub>5</sub> ) <sup>2,3</sup>
102	R-116	Hexafluoroethane (C <sub>2</sub> F <sub>6</sub> ) <sup>2</sup>

#	Short Name	Long Name
103	R-124	Chlorotetrafluoroethane (C <sub>2</sub> HClF <sub>4</sub> ) <sup>2,3</sup>
104	R-125	Pentafluoroethane (CF <sub>3</sub> CHF <sub>2</sub> ) <sup>2,3</sup>
105	R-134A	Tetrafluoroethane (CH <sub>2</sub> FCF <sub>3</sub> ) <sup>2,3</sup>
106	R-14	Tetrafluoromethane (CF <sub>4</sub> ) <sup>2</sup>
107	R-142b	Chlorodifluoroethane (CH <sub>3</sub> CClF <sub>2</sub> ) <sup>2,3</sup>
108	R-143a	Trifluoroethane (C <sub>2</sub> H <sub>3</sub> F <sub>3</sub> ) <sup>2,3</sup>
109	R-152a	Difluoroethane (C <sub>2</sub> H <sub>4</sub> F <sub>2</sub> ) <sup>2</sup>
110	R-22	Difluoromono-chloromethane (CHClF <sub>2</sub> ) <sup>2,3</sup>
111	R-23	Trifluoromethane (CHF <sub>3</sub> ) <sup>2,3</sup>
112	R-32	Difluoromethane (CH <sub>2</sub> F <sub>2</sub> ) <sup>2,3</sup>
113	R-318	Octafluorocyclobutane (C <sub>4</sub> F <sub>8</sub> ) <sup>2</sup>
114	R-404A	44% R-125, 4% R-134A, 52% R-143A <sup>2,3</sup>
115	R-407C	23% R-32, 25% R-125, 52% R-143A <sup>2,3</sup>
116	R-410A	50% R-32, 50% R-125 <sup>2,3</sup>
117	R-507A	50% R-125, 50% R-143A <sup>2,3</sup>
140	C-15	15% CO <sub>2</sub> , 85% Ar
141	C-20	20% CO <sub>2</sub> , 80% Ar
142	C-50	50% CO <sub>2</sub> , 50% Ar
143	He-50	50% He, 50% Ar
144	He-90	90% He, 10% Ar
145	Bio5M	5% CH <sub>4</sub> , 95% CO <sub>2</sub>
146	Bio10M	10% CH <sub>4</sub> , 90% CO <sub>2</sub>
147	Bio15M	15% CH <sub>4</sub> , 85% CO <sub>2</sub>
148	Bio20M	20% CH <sub>4</sub> , 80% CO <sub>2</sub>
149	Bio25M	25% CH <sub>4</sub> , 75% CO <sub>2</sub>
150	Bio30M	30% CH <sub>4</sub> , 70% CO <sub>2</sub>
151	Bio35M	35% CH <sub>4</sub> , 65% CO <sub>2</sub>
152	Bio40M	40% CH <sub>4</sub> , 60% CO <sub>2</sub>
153	Bio45M	45% CH <sub>4</sub> , 55% CO <sub>2</sub>
154	Bio50M	50% CH <sub>4</sub> , 50% CO <sub>2</sub>
155	Bio55M	55% CH <sub>4</sub> , 45% CO <sub>2</sub>
156	Bio60M	60% CH <sub>4</sub> , 40% CO <sub>2</sub>
157	Bio65M	65% CH <sub>4</sub> , 35% CO <sub>2</sub>
158	Bio70M	70% CH <sub>4</sub> , 30% CO <sub>2</sub>
159	Bio75M	75% CH <sub>4</sub> , 25% CO <sub>2</sub>
160	Bio80M	80% CH <sub>4</sub> , 20% CO <sub>2</sub>
161	Bio85M	85% CH <sub>4</sub> , 15% CO <sub>2</sub>
162	Bio90M	90% CH <sub>4</sub> , 10% CO <sub>2</sub>
163	Bio95M	95% CH <sub>4</sub> , 5% CO <sub>2</sub>
164	EAN-32	32% O <sub>2</sub> , 68% N <sub>2</sub>
165	EAN-36	36% O <sub>2</sub> , 64% N <sub>2</sub>
166	EAN-40	40% O <sub>2</sub> , 60% N <sub>2</sub>
167	HeOx20	20% O <sub>2</sub> , 80% He
168	HeOx21	21% O <sub>2</sub> , 79% He
169	HeOx30	30% O <sub>2</sub> , 70% He
170	HeOx40	40% O <sub>2</sub> , 60% He
171	HeOx50	50% O <sub>2</sub> , 50% He

#	Short Name	Long Name
172	HeOx60	60% O <sub>2</sub> , 40% He
173	HeOx80	80% O <sub>2</sub> , 20% He
174	HeOx99	99% O <sub>2</sub> , 1% He
175	EA-40	Enriched Air-40% O <sub>2</sub>
176	EA-60	Enriched Air-60% O <sub>2</sub>
177	EA-80	Enriched Air-80% O <sub>2</sub>
178	Metab	Metabolic Exhalant (16% O <sub>2</sub> , 78.04% N <sub>2</sub> , 5% CO <sub>2</sub> , 0.96% Ar)
179	LG-4.5	4.5% CO <sub>2</sub> , 13.5% N <sub>2</sub> , 82% He
180	LG-6	6% CO <sub>2</sub> , 14% N <sub>2</sub> , 80% He
181	LG-7	7% CO <sub>2</sub> , 14% N <sub>2</sub> , 79% He
182	LG-9	9% CO <sub>2</sub> , 15% N <sub>2</sub> , 76% He
183	HeNe-9	9% Ne, 91% He
184	LG-9.4	9.4% CO <sub>2</sub> , 19.25% N <sub>2</sub> , 71.35% He
185	SynG-1	40% H <sub>2</sub> , 29% CO, 20% CO <sub>2</sub> , 11% CH <sub>4</sub>
186	SynG-2	64% H <sub>2</sub> , 28% CO, 1% CO <sub>2</sub> , 7% CH <sub>4</sub>
187	SynG-3	70% H <sub>2</sub> , 4% CO, 25% CO <sub>2</sub> , 1% CH <sub>4</sub>
188	SynG-4	83% H <sub>2</sub> , 14% CO, 3% CH <sub>4</sub>
189	NatG-1	93% CH <sub>4</sub> , 3% C <sub>2</sub> H <sub>6</sub> , 1% C <sub>3</sub> H <sub>8</sub> , 2% N <sub>2</sub> , 1% CO <sub>2</sub>
190	NatG-2	95% CH <sub>4</sub> , 3% C <sub>2</sub> H <sub>6</sub> , 1% N <sub>2</sub> , 1% CO <sub>2</sub>
191	NatG-3	95.2% CH <sub>4</sub> , 2.5% C <sub>2</sub> H <sub>6</sub> , 0.2% C <sub>3</sub> H <sub>8</sub> , 0.1% C <sub>4</sub> H <sub>10</sub> , 1.3% CO <sub>2</sub>
192	CoalG	50% H <sub>2</sub> , 35% CH <sub>4</sub> , 10% CO, 5% C <sub>2</sub> H <sub>4</sub>
193	Endo	75% H <sub>2</sub> , 25% N <sub>2</sub>
194	HHO	66.67% H <sub>2</sub> , 33.33% O <sub>2</sub>
195	HD-5	LPG: 96.1% C <sub>3</sub> H <sub>8</sub> , 1.5% C <sub>2</sub> H <sub>6</sub> , 0.4% C <sub>3</sub> H <sub>6</sub> , 1.9% n-C <sub>4</sub> H <sub>10</sub>
196	HD-10	LPG: 85% C <sub>3</sub> H <sub>8</sub> , 10% C <sub>3</sub> H <sub>6</sub> , 5% n-C <sub>4</sub> H <sub>10</sub>
197	OCG-89	89% O <sub>2</sub> , 7% N <sub>2</sub> , 4% Ar
198	OCG-93	93% O <sub>2</sub> , 3% N <sub>2</sub> , 4% Ar
199	OCG-95	95% O <sub>2</sub> , 1% N <sub>2</sub> , 4% Ar
200	FG-1	2.5% O <sub>2</sub> , 10.8% CO <sub>2</sub> , 85.7% N <sub>2</sub> , 1% Ar
201	FG-2	2.9% O <sub>2</sub> , 14% CO <sub>2</sub> , 82.1% N <sub>2</sub> , 1% Ar
202	FG-3	3.7% O <sub>2</sub> , 15% CO <sub>2</sub> , 80.3% N <sub>2</sub> , 1% Ar
203	FG-4	7% O <sub>2</sub> , 12% CO <sub>2</sub> , 80% N <sub>2</sub> , 1% Ar
204	FG-5	10% O <sub>2</sub> , 9.5% CO <sub>2</sub> , 79.5% N <sub>2</sub> , 1% Ar
205	FG-6	13% O <sub>2</sub> , 7% CO <sub>2</sub> , 79% N <sub>2</sub> , 1% Ar
206	P-10	10% CH <sub>4</sub> 90% Ar
210	D-2	Deuterium

<sup>1</sup> Sulfur hexafluoride is a highly potent greenhouse gas monitored under the Kyoto Protocol.

<sup>2</sup> Corrosive-resistant units only

<sup>3</sup> 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.