ALICAT SCIENTIFIC

# Operating Bulletin


## PROFIBUS

*Innovative Flow and Pressure Solutions*

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The product complies with the requirements of the Low Voltage Directive 2006/95/EC and the EMC Directive 2004/108/EC and carries the CE Marking accordingly. Contact the manufacturer for more information.

# 1.1 PROFIBUS

Alicat units can be optionally configured with a PROFIBUS communication interface. PROFIBUS communications are done with telegrams. The following is presented to an audience that is informed on the details of the PROFIBUS specification. Details about connections and specifications are found in the standard Alicat Operating Manual and on pages 10-11 of this bulletin.

## 1 GSD Configuration File

The latest GSD file can be downloaded from the Alicat website (*www.alicatscientific.com*) or requested and sent via email. It is a text based document that allows easy configuration of a PROFIBUS Alicat meter/controller onto a PROFIBUS network. The GSD file takes precedence over this document in any discrepancy.

## 2 PROFIBUS Operation

The PROFIBUS equipped unit does not have a termination resistor built in. The user cabling must ensure that there is a terminator at the end of their bus. Connection to a PROFIBUS unit is done through the female DB9 connector on the top of the unit. This connector can optionally provide power to the unit.

There is a green LED on the top of the unit, it indicates if proper communication is occurring. Upon connection to a bus, the unit goes through the following: Auto Baud Rate Detect; optional Set Slave Address; Wait Parameterization; Wait Configuration; and Data Exchange.

## 3 Auto Baud Rate Detect

At power up, a PROFIBUS equipped Alicat meter/controller will initialize its PROFIBUS interface and enter baud rate detect mode. The unit supports all standard baud rates given in the PROFIBUS specification. These baud rates are listed in the GSD file. Once the baud rate is detected, the unit will be ready to be parameterized or a new slave address can be set.

## 4 Set Slave Address

PROFIBUS equipped units, unless otherwise specified, are set at address 125. The address can be changed with the set slave address telegram as specified in the PROFIBUS Specification. The customer can order PROFIBUS unit(s) to be set at a different address from the factory.

The set slave address function can only be done before the unit has been parameterized. After parameterization the unit will ignore set slave address requests. The change of address is done immediately and it is stored into nonvolatile memory.

Alternatively, the user can connect the unit to a serial port and change the address which is stored in register 65. The details of reading and writing register values are included in the standard Alicat Operating Manual. Please note that an invalid address can be entered in this fashion and the user is cautioned to use only addresses from 1-125.

## 4.1 Wait Parameterization

After baud rate detection, or if PROFIBUS communications have been stopped and restarted, the unit will be in wait parameterization state. Items that are parameterized are gas select and error mode for the totalizer (if totalizer equipped).

### 4.1.1 Gas Select

The default gas select in the GSD file is “keep current.” This particular gas select tells the unit not to change the gas select that the unit had the last time it was powered up. Therefore, if the user wants to keep the factory default gas of the unit as it was ordered, leaving this at “keep current” will achieve that.

All Alicat standard gases are available in the parameterization section. If the user wishes to change the gas select “on the fly”, this can be done via the command word and is described in the data exchange section.

### 4.1.2 Totalizer Rollover

If a unit is equipped with a totalizer, the way the unit will respond to a rollover event can be modified with this parameter. The error mode parameter for the totalizer allows the user to set one of three modes for the totalizer.

These modes are: No Rollover with Error, Rollover with Error, and Rollover with No Error.

**It is important that this parameter is set if a mode other than the default set by the GSD is desired.**

This is required because every Alicat unit that is configured on the network will take on the default setting in the GSD file. PROFIBUS equipped units that are not equipped with totalizer function will ignore this parameter.

## 4.2 Wait Configuration

To allow user flexibility, all PROFIBUS equipped Alicat units are modular on a PROFIBUS network. The user can pick and choose which input(s)/output(s) to/from the master are desired. These modules can be configured in any order and number as long as the total number of bytes does not exceed the maximum set in the GSD file.

While waiting for configuration, the meter/controller will accept and verify the configuration telegram. If an incorrect configuration is attempted, it will be immediately rejected.

Note that at this time all configurations that are valid in structure are accepted as being valid. Any input value to the master that is not supported by the unit will always input a zero. All outputs from the master that are not supported by a particular meter/controller configuration will be ignored.

After power cycle a unit will default to the following configuration:

**Reading:** 0x42,0xA4,0xA4,0x01

**Set-point:** 0x82,0x03,0x3,0x0B

**Control Register:** 0x82,0x00,0x00,0x0C

At power up, if a user does a configuration read before sending a configuration as is the case when auto configuring the network, this default configuration will be sent.

If during operation, after the unit has been configured, the unit is queried for its configuration it will send the current configuration. If a power cycle occurs the unit will return to the default configuration until it is again configured.

## 4.3 Data Exchange

Once a correct configuration telegram has been received the unit will enter data exchange mode. In this mode input telegrams will be sent whenever new data is available and output telegrams will be processed as they are received. If communication is lost during data exchange, the unit will return to wait parameterization mode.

### 4.3.1 Data In Telegram (To Master)

The data in telegram from the unit can contain any combination of process variables, gas string, and status byte. In the case of a controller, the PID variables can be configured to be read to allow tuning of the control loop.

#### 4.3.1.1 Process variables

Each of the process variables are 4 bytes long and formatted in big endian IEEE 32 floating point. If the meter/controller doesn't support a value it will always be zero.

All the reading values are in the engineering units specified at time of order (for example: with a 200SLPM controller the mass flow will be SLPM).

#### 4.3.1.2 Gas String

Gas is a null terminated string that has 8 bytes. If the gas specified is less than 7 characters long, the gas string will be in the leading octets and be followed by zeros (nulls).

#### 4.3.1.3 Status Byte

The status is a byte that contains active high bits in the following bit format: 0000TMVP

Where:

**T** – Totalizer Rollover

**M** – Mass Over Range

**V** – Volumetric Over Range

**P** – Pressure Over Range

#### 4.3.1.4 PID variables

For controllers, a special tuning configuration could be made and the values for the PID loop gains will be reported here. They can be set using the command module of the data out telegram.

Once a unit is tuned to the current process input pressures, a run time configuration would be used that did not include the PID variable as they take up system bandwidth.

### 4.3.2 Data Out Telegram (From Master)

The data out telegram from the master can be configured to contain any combination of Set-point, Control Register, and Command.

#### 4.3.2.1 Set-point

The format for a set-point is a 4 byte IEEE 32 big endian floating point number. The set-point is in the same units as the controlled variable specified at time of order.

An example would be a 200SLPM controller — if the user wanted to set it at 100.2SLPM the set-point would be 100.2 (0x42C8999A).

#### 4.3.2.2 Control Register

The control register controls 4 different aspects of an Alicat Unit.

Each bit in this register only applies to the unit if it makes sense for the unit to respond. Example if the unit is not equipped with a totalizer the Tare Totalizer bit will not do anything.

Register Bit Description:

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| Control Register | 0 | 0 | 0 | 0 | E | P | V | T |

T : Tare Totalizer

V: Tare Volumetric

P: Tare Pressure

E: Write Set-point to EEPROM

Logically, the bit works as a return to zero control. This means that once it is set, in order for another reset to be applied, the control has to set to logic low and then set to logic high again.

### 4.3.2.3 Command

The command consists of four octets — where the first two octets are the command and last two octets are the data that applies to the command. Both the command and data are 16 bit unsigned integers that are in big endian format.

Current commands are:

| Command | Action |
|---|---|
| 0 (0x0000) | Do Nothing |
| 21 (0x0015) | Change P in PID loop |
| 22 (0x0016) | Change D in PID loop |
| 23 (0x0017) | Change I in PID loop |
| 46 (0x002E) | Change Gas Select |
| 65 (0x0041) | Change Power Up Set-point Configuration |

**Note:** Command values not listed in the above table are reserved for factory use only and can cause undesired effects if utilized.

For the data bytes the following are valid:

| Valid Values | Data Type |
|---|---|
| 0 to 65535 (0x0000 to 0xFFFFF) | PID Parameters |
| 0 to 29 (0x0000 to 0x001D) | Gas Parameter |
| 0, 32768, or 49152 (0x0000,0x8000, or 0xC0000) | Power Up Set-point Configuration |

Description of power up set-point configuration bits:

| Valid Values | Meaning |
|---|---|
| 0 (0x0000) | Unit will go to zero set-point at power up or loss of Profibus communication.<br>Also the unit will respond to set-points given over the Profibus |
| 32768 (0x8000) | Unit will maintain last set-point saved to nonvolatile memory at power up or loss of Profibus communication (see section 4.3.2.2 Control Register) |
| 49152 (0xC000) | Same as 32768 with the addition that unit will ignore Profibus set-points. |

## 4.4 Diagnostic

The PROFIBUS unit will send a diagnostic telegram if an over range condition is encountered. A diagnostic telegram with extended diagnostics will be output.

Following the standard six octet header will be two octets. The first is the number of the extended diagnostic octets (0x02). The second octet will be a copy of the status byte that is in the reading and has the same interpretation.

# 5 RS-232 Port

In all states of PROFIBUS communications, the RS-232 port is available to allow access for simple diagnostics or to query state. There are two types of commands available to the user through the RS-232 diagnostic port: Escape Commands and Unit Commands.

Note: The RS-232 port is not needed for PROFIBUS communication and is only provided for convenience.

## 5.1 Configuration

Although the connector on the side of the PROFIBUS unit looks like a standard RS-232 DB9, it is not. The connections to this connector are detailed in the standard Alicat operating manual and on pages 9-10 of this bulletin. Configuration of the computer port is also described in the standard Alicat Manual. Basic configuration is repeated here for convenience.

| **Baud Rate** | **19200** |
|---|---|
| Stop Bits | 1 |
| Data Bits | 8 |
| Stop Bits | 1 |

## 5.2 Escape Commands

Escape commands begin with the escape key and end with a return. The three escape commands are: version; print current data frame; and return PROFIBUS state.

The version command is executed with <esc><v><rtn>. This will return the revision, date and time that the software in the interface was last compiled.

The print current data frame command is executed with <esc><p><rtn>. This will return the last streamed data frame.

The <esc><rtn>, or any other escape command executed, will return the state of the PROFIBUS interface.

## 5.3 Unit Commands

Unit commands are commands that go directly to the meter/controller and include all commands that an Alicat meter/controller will normally respond to.

It is important to note that when the PROFIBUS interface is in Data Exchange mode, the unit acts as is if it were in a streaming mode and does not output data frames to the RS-232 port.

Because the meter/controller is in streaming mode, unit commands must be in the format for a streaming meter/controller.

An example for reading registers: *R65 will return the contents of register 65 (R65 = ######).

Because the meter/controller is in streaming mode when it is communicating on the PROFIBUS it cannot participate in a multi-drop RS-232 network of Alicat meter/controllers.

However, if the unit is not communicating on the PROFIBUS, its address can be set and it will be able to participate normally in a multi-drop RS-232 network of Alicat meter/controllers.

If you would like additional information regarding the use of this product, please contact:


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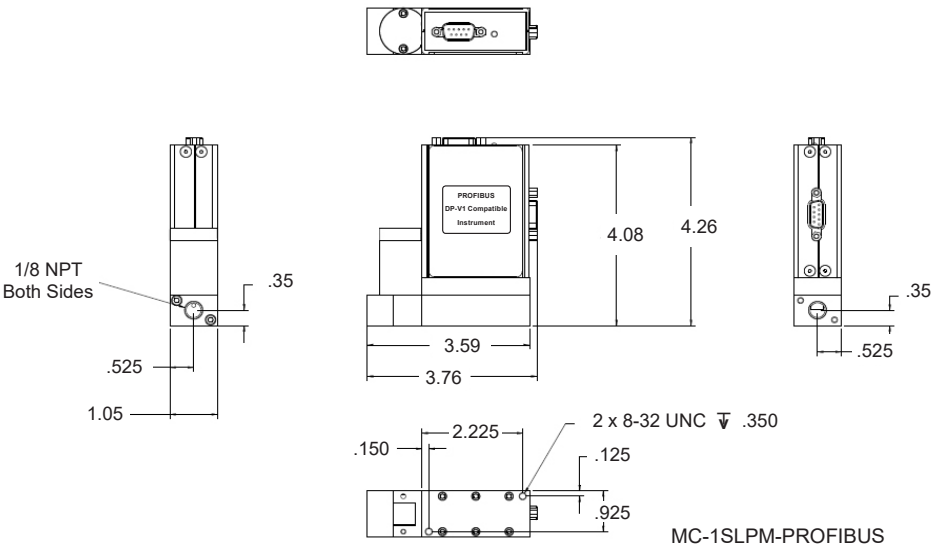
# Technical Data for **PROFIBUS** Meters, Gauges and Controllers

**NOTICE:** The following specifications are applicable to Alicat PROFIBUS enabled meters, gauges and controllers only.

All other operating specifications are shown in the Technical Data for standard Alicat instruments.

All standard device features and functions are available and operate in accordance with the Alicat operating manual provided with the device.

| Specification | Meter or Gauge | Small Valve Controller | Large Valve Controller | Description |
|---|---|---|---|---|
| Input /Output Signal Digital | | | | PROFIBUS DP |
| Electrical Connections | DB9 | | | |
| Supply Voltage: | 7 to 30 Vdc | 12 to 30 Vdc | 24 to 30 Vdc | |
| Supply Current | 80mA @ 12Vdc<br>65mA @ 24Vdc | 295mA @ 12Vdc<br>280mA @ 24Vdc | 780mA @ 24Vdc | |




MC-1SLPM-PROFIBUS

PROFIBUS MC-1SLPM shown to provide PROFIBUS connector dimensions only. Flow body and valve dimensions will vary with range. Please see Alicat's device specifications for complete dimensions. PROFIBUS units do not have a display screen.

# PROFIBUS Pin-Outs

**If your Alicat Instrument was ordered with a PROFIBUS connection, please be sure to reference the following pin-out diagram.**

**Power and Signal Connections:**

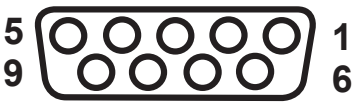
Connect to the device using two DB9 connectors.

The female top connection is PROFIBUS.

The male connection on the side is power and RS-232 or RS-485.

Pin out diagrams for all PROFIBUS enabled Alicat devices are shown below.

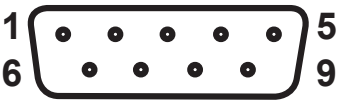
**TOP**




1. Not Connected
2. PoP Ground
   (Power over Profibus option)
3. Rx/Tx Data-P
4. Request To Send
5. Data Ground
6. Voltage Plus
7. PoP 7 to 30VDC
8. Rx/Tx Data-N
9. Not Connected

**TOP: Pins 3, 5 & 8 are required**. All other pin connections are optional.

**SIDE**




1. Not Connected
2. RS-232 RX
3. RS-232 TX
4. Not Connected
5. Ground
6. No Connected
7. 7 to 30VDC
8. Ground
9. Not Connected

## Gas Viscosity, Density and Compressibility:

| # | Gas | | Absolute Viscosity* 25°C | Density ** 25°C 14.696PSIA | Compressibility 25°C 14.696PSIA |
|---|---|---|---|---|---|
| 0 | Air | Air | 184.8989 | 1.1840 | 0.9997 |
| 1 | Argon | Ar | 226.2399 | 1.6339 | 0.9994 |
| 2 | Methane | CH4 | 110.7595 | 0.6569 | 0.9982 |
| 3 | Carbon Monoxide | CO | 176.4933 | 1.1453 | 0.9996 |
| 4 | Carbon Dioxide | CO2 | 149.3184 | 1.8080 | 0.9950 |
| 5 | Ethane | C2H6 | 93.5412 | 1.2385 | 0.9924 |
| 6 | Hydrogen | H2 | 89.1535 | 0.08235 | 1.0006 |
| 7 | Helium | He | 198.4561 | 0.16353 | 1.0005 |
| 8 | Nitrogen | N2 | 178.0474 | 1.1453 | 0.9998 |
| 9 | Nitrous Oxide | N2O | 148.4124 | 1.8089 | 0.9945 |
| 10 | Neon | Ne | 311.1264 | 0.8244 | 1.0005 |
| 11 | Oxygen | O2 | 205.5021 | 1.3088 | 0.9994 |
| 12 | Propane | C3H8 | 81.4631 | 1.8320 | 0.9838 |
| 13 | normal-Butane | n-C4H10 | 74.0536 | 2.4493 | 0.9699 |
| 14 | Acetylene | C2H2 | 104.4480 | 1.0720 | 0.9928 |
| 15 | Ethylene | C2H4 | 103.1839 | 1.1533 | 0.9943 |
| 16 | iso-Butane | i-C4H10 | 74.7846 | 2.4403 | 0.9735 |
| 17 | Krypton | Kr | 251.3249 | 3.4323 | 0.9979 |
| 18 | Xenon | Xe | 229.8483 | 5.3950 | 0.9947 |
| 19 | Sulfur Hexafluoride | SF6 | 153.5320 | 6.0383 | 0.9887 |
| 20 | 75%Ar / 25% CO2 | C-25 | 206.9763 | 1.6766 | 0.9987 |
| 21 | 90% Ar / 10% CO2 | C-10 | 218.6026 | 1.6509 | 0.9991 |
| 22 | 92% Ar / 8% CO2 | C-8 | 220.1352 | 1.6475 | 0.9992 |
| 23 | 98% Ar / 2% CO2 | C-2 | 224.7148 | 1.6373 | 0.9993 |
| 24 | 75% CO2 / 25% Ar | C-75 | 168.2250 | 1.7634 | 0.9966 |
| 25 | 75% Ar / 25% He | HE-75 | 231.6056 | 1.2660 | 0.9997 |
| 26 | 75% He / 25% Ar | HE-25 | 234.6860 | 0.5308 | 1.0002 |
| 27 | 90% He / 7.5% Ar / 2.5% CO2 Helistar® A1025 | A1025 | 214.9760 | 0.3146 | 1.0003 |
| 28 | 90% Ar / 8% CO2 / 2% O2 Stargon® CS | Star29 | 219.7934 | 1.6410 | 0.9992 |
| 29 | 95% Ar / 5% CH4 | P-5 | 223.9106 | 1.5850 | 0.9993 |

*in micropoise (1 Poise = gram / (cm) (sec)) **Grams/Liter
Reference: NIST REFPROP 9 Database

### Flow Conversions:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SCFM | 1.00 | = 28.3160 | SLPM | SLPM | 100.00 | = 3.5316 | SCFM |
| SCFH | 1.00 | = 0.4719 | SLPM | SLPM | 100.00 | = 211.9093 | SCFH |
| SCIM | 100.00 | = 1.6390 | SLPM | SLPM | 1.00 | = 61.0128 | SCIM |
| SCIH | 1000.00 | = 0.2732 | SLPM | SLPM | 1.00 | = 3660.7688 | SCIH |

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