Operating Bulletin

DeviceNet™

RECALIBRATION

Your Alicat instrument is a precision device and Alicat strongly recommends that you send it to us on a yearly basis for recalibration.

A yearly recalibration does a few things:

- ► **It ensures that your unit is functioning according to specification.**

- ► **Contamination may cause the instrument to measure flow improperly. Recalibration ensures the instrument is clean and free from debris.**

- ► **Recalibration maintains your LIFETIME WARRANTY!**

Sending your unit for recalibration is easy and inexpensive. Recalibrations are usually shipped within five days of receipt, so it's fast too.

Please keep the original box to return your Alicat instrument for recalibration.

ALICAT DeviceNet™ OPERATING BULLETIN

1   DeviceNet™ Communication

Alicat devices support the Group 2-only Predefined Master/Slave Connection Set defined in Chapter 2 of the DeviceNet™ specification. Explicit and Polled I/O connections are supported.

1.1   Explicit Messaging I/O

The following objects and attributes are supported. All objects support the Get_Attribute_Single and Set_Attribute_Single service.

Identity Object - Class 1, Instance 1				
Attrib	Name	Type	Access	Comment
1	Vendor ID	UINT	Get	1174
2	Device Type	UINT	Get	12
3	Product Code	UINT	Get	
4	Revision	STRUCT	Get	Major.Minor
5	Status	WORD	Get	
6	Serial Number	UDINT	Get	
7	Product Name	STRING	Get	

DeviceNet™ Object - Class 3, Instance 1				
Attrib	Name	Type	Access	Comment
1	MAC ID	USINT	Get/Set	See section 2.1
2	Baud Rate	USINT	Get/Set	See section 2.1
4	Allocation Info	STRUCT	Get	

Assembly Object - Class 4				
Attrib	Name	Type	Access	Comment
3	Data	ARRAY	Get/Set	See instance descriptions below
4	Size	USINT	Get	Size of attrib 3

DeviceNet™ is a trademark of ODVA. For more information regarding ODVA, visit www.odva.org.

Connection Object - Class 5 Explicit Conn – Instance 1, Polled Conn – Instance 2				
Attrib	**Name**	**Type**	**Access**	**Comment**
1	State	USINT	Get	
2	Instance_type	USINT	Get	
3	TransportClass Trigger	BYTE	Set*	
4	DeviceNet™ Produced Connection Id	UINT	Get	
5	DeviceNet™ Consumed Connection Id	UINT	Get	
6	DeviceNet™ Initial Comm Char	BYTE	Get	
7	Produced size	UINT	Set*	
8	Consumed size	UINT	Get	
9	Expected Pkt Rate	UINT	Set	
12	Watchdog TO Action	USINT	Set	
13	Produced Conn Path Length	UINT	Get	
14	Produced Conn Path	EPATH	Set*	
15	Consumed Conn Path Length	UINT	Get	
16	Consumed Conn Path	EPATH	Set*	
17	Production Inhibit Time	UINT	Set	
* Attributes are only settable on the Polled I/O connection while in the configuring state.				

1.2 Polled I/O

Alicat devices support the DeviceNet™ polled I/O connection (Connection Object Class 5, Instance 2). Upon establishing a Polled I/O connection, the device will default to consuming assembly 100 and producing assembly 101. If a different configuration is desired, the client should write the desired path into the Connection Object.

Supported Produce Assemblies (Slave->Client):

Instance	Path	Description
101	20 04 24 65 30 03	Device Readings. See section 1.4.
103	20 04 24 67 30 03	Device Command Result. See section 1.1.

Supported Consume Assemblies (Client->Slave):

Instance	Path	Description
100	20 04 24 64 30 03	Setpoint. See section 1.3.
102	20 04 24 66 30 03	Device Command Request. See section 1.1.

1.3 Assembly 100 - Setpoint

The device setpoint should be sent as a 32-bit IEEE floating point value. Setpoint is ignored on devices without a controller.

Setpoint - Class 4, Instance 100, Attribute 3		
Parameter	Type	Comment
Setpoint	REAL	

1.4 Assembly 101 - Device Readings

Your Alicat device can output 20 different configurable data statistics. The default statistics for each device type are specified in the sections below. The actual statistic and units output on your device can be determined by issuing the Alicat data frame query command (*??D*) on the RS-232 debug port. If you wish to customize the output of your device please speak to an Alicat applications engineer.

When opening a polled I/O connection to the device, the connection object's produced_connection_size will default to the number of bytes required to output all configured statistics. For example, if your device is a standard mass flow controller with totalizer described in section 1.4.1 there would be 30 bytes produced – 2 bytes for gas number, 4 bytes for status, and 24 bytes for 6 device readings. The number of bytes in the poll response can be changed by writing Object 5, Instance 2, Attribute 9 to the desired size.

The value returned for a pressure reading can be absolute pressure, gauge pressure or differential pressure depending on your device's configuration.

Device Readings - Class 4, Instance 101, Attribute 3		
Parameter	**Type**	**Comment**
Gas number	UINT	
Device Status	UDINT	See table below
Reading 1	REAL	
Reading 2	REAL	
Reading 3	REAL	
Reading 4	REAL	
Reading 5	REAL	
Reading 6	REAL	
Reading 7	REAL	
Reading 8	REAL	
Reading 9	REAL	
Reading 10	REAL	
Reading 11	REAL	
Reading 12	REAL	
Reading 13	REAL	
DeReading 14	REAL	
Reading 15	REAL	
Reading 16	REAL	
Reading 17	REAL	
Reading 18	REAL	
Reading 19	REAL	
Reading 20	REAL	

Device status conditions in the device are specified below. Values in parenthesis are the front-panel display of the corresponding condition.

Bit	Description
0	Temperature Overflow (TOV)
1	Temperature Underflow (TOV)
2	Volumetric Overflow (VOV)
3	Volumetric Underflow (VOV)
4	Mass Overflow (MOV)
5	Mass Underflow (MOV)
6	Pressure Overflow (POV)
7	Totalizer Overflow (OVR)
8	PID Loop in Hold (HLD)
9	ADC Error (ADC)
10	PID Exhaust (EXH)
11	Over pressure limit (OPL)
12	Flow overflow during totalize (TMF)
13	Measurement was aborted

1.4.1   Mass Flow Controller

Reading Number	Statistic
1	Pressure
2	Flow Temperature
3	Volumetric Flow
4	Mass Flow
5	Mass Flow Setpoint
6	Mass Total*

* Mass Total is only available on units with the Totalizer option.

1.4.2   Mass Flow Meter

Reading Number	Statistic
1	Pressure
2	Flow Temperature
3	Volumetric Flow
4	Mass Flow
5	Mass Total*

* Mass Total is only available on units with the Totalizer option.

1.4.3   Pressure Gauge

Reading Number	Statistic
1	Pressure

1.4.4   Pressure Controller

Reading Number	Statistic
1	Pressure
2	Pressure Setpoint

1.5   Assembly 102-104 - Device Commands

Commands can be issued to the Alicat device through assembly instance 102 and 103. A command is initiated on a client write to instance 102. The result of the command can be read in instance 103.

Command Request - Class 4, Instance 102, Attribute 3		
Parameter	**Type**	**Comment**
Command ID	UINT	See valid values below.
Command Argument	UINT	

Command Result - Class 4, Instance 103, Attribute 3		
Parameter	**Type**	**Description**
Command ID	UINT	ID of last command.
Command Status	UINT	Status of last command.

List of supported commands:

Command ID	Action	Data
1	Change gas number	Gas Table Index
2	Mix gas	Gas mixture index or 0 to create a new mix.
3	Delete gas mixture	Gas mixture index
4	Tare	0 = Pressure 1 = Abs Pressure 2 = Volume
5	Totalizer reset	None
6	Valve setting Exhaust is only supported on dual-valve devices.	0 = Cancel 1 = Hold close 2 = Hold current 3 = Exhaust
7	Display lock Only supported on devices with a display.	0 = Unlock 1 = Lock
8	Change P in PID Loop	0-65535
9	Change D in PID Loop	0-65535
10	Change I in PID Loop	0-65535
11	Change PID Loop Variable	0 – Mass Flow 1 – Volumetric Flow 2 – Differential Press 3 – Absolute Press 4 – Gauge Press

Command status values:

Status	Description
0	Success
0x8001	Invalid command ID
0x8002	Invalid setting
0x8003	Requested feature is unsupported
0x8004	Invalid gas mix index
0x8005	Invalid gas mix constituent
0x8006	Invalid gas mix percentage

1.5.1   COMPOSER Gas Mixing

Creating a new COMPOSER gas mix can be performed with 2-5 gases using the mix assembly. The mix is a two-step process. First, the desired gas indexes and percentages must be written to the mix assembly followed by a write of the Mix Gas command (ID 2) into command assembly.

Gas mix percentages are interpreted as integer hundredths of a percent and the total percentage must sum to 100%. For example, to specify a mix of 50%, a value of 5000 should be written into the gas percentage register. The mix will be performed with the first N gases that have a non-zero percentage.

If the command argument passed to the mix command is 0, a new gas mix index will be allocated. Otherwise, the mixture with the specified index will be updated. If the specified index does not exist, an error will be returned.

Upon completion of mixing, the command data register will be updated with the mix result. If the mix was valid, the index of the mixed gas will be returned. If one of the requested mix gases did not exist or the percentage does not add to 100%, an error value will be returned.

Gas Mix - Class 4, Instance 104, Attribute 3		
Parameter	**Type**	**Comment**
Mixture Gas 1 Index	UINT	
Mixture Gas 1 Pct	UINT	
Mixture Gas 2 Index	UINT	
Mixture Gas 2 Pct	UINT	
Mixture Gas 3 Index	UINT	
Mixture Gas 3 Pct	UINT	
Mixture Gas 4 Index	UINT	
Mixture Gas 4 Pct	UINT	
Mixture Gas 5 Index	UINT	
Mixture Gas 5 Pct	UINT	

2   MAC ID AND BAUD RATE

Unless otherwise requested, your Alicat device will ship with a default MAC ID of 63 and baud rate of 125kbps. These values are stored in NVRAM and can be changed via DeviceNet™ explicit messaging or using an Alicat serial command through the RS-232 debug port.

The MAC ID can set to any value between 0-63. Changes the MAC ID will take effect immediately.

DeviceNet™ baud rates of 125, 250 and 500kbps are all supported. Changes to the baud rate take effect after a power cycle of the device.

2.1   Setting through DeviceNet™

The MAC ID and baud rate settings can be set through instance 1 of the DeviceNet™ object:

MAC ID - Class 3, Instance 1, Attribute 1

   Valid values: 0-63

Baud rate – Class 3, Instance 1, Attribute 2

   Valid values: 0=125kbps, 1=250kbps, 2=500kpbs

2.2   Setting Serially

The MAC ID and baud rate can be configured through the Alicat network address register (R65):

Bit	Description
15:14	Baud rate (0-2)
13:8	Reserved
7:0	MAC ID (0-63) Note: If an invalid value is written it will be reset to 63.

To read the network address (where A is the Alicat device ID):   AR65

To write the network address (where A is the Alicat device ID):   AW65=63

The value in the register should be the MAC ID + 0 (for a DeviceNet™ baud rate of 125kbps) or the MAC ID + 16384 (for a DeviceNet™ baud rate of 250kbps) or the MAC ID + 32768 (for a DeviceNet™ baud rate of 500kbps).

3   RS-232 DEBUG PORT

Your Alicat device is equipped with a RS-232 debug port available for device diagnostics or configuration. See the pin-out section below for information on how to connect to the debug port. See your Alicat operating manual for a description of commands available over the debug port.

RS-232 serial communication defaults to the following settings:

Baud Rate	19200
Stop Bits	1
Data Bits	8
No Parity	

NOTE: This DeviceNet device contains a non-isolated physical layer. Any external devices connected to the serial port must be properly ground isolated as described in The DeviceNet™ Specification, Volume 3, Edition 1.14, page 8-100, ©ODVA, Inc. 2013. For more information regarding ODVA, visit www.odva.org.
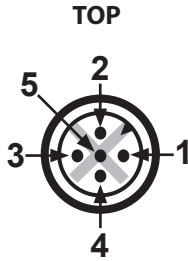
DeviceNet™ Pin-Outs

If your Alicat Instrument was ordered with a DeviceNet™ connection, please be sure to reference the following pin-out diagram.
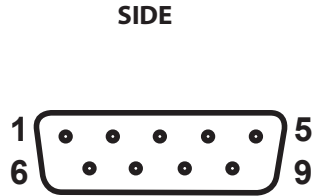
Power and Signal Connections:

The male top connection is DeviceNet™.

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

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

TOP   **SIDE**

1. DRAIN
2. V+
3. V-
4. CAN_H
5. CAN_L

1. NC
2. RS232RX
3. RS232TX
4. NC
5. GND
6. NC
7. 7 to 30VDC
8. GND
9. NC

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

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Limited Lifetime Warranty

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

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

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

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

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

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

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

Alicat's warranties as herein above set forth shall not be enlarged, diminished or affected by, and no obligation or liability shall arise or grow out of Alicat's rendering of technical advice in connection with Buyer's order of the Products furnished hereunder.

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

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

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

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

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

Accessories purchased from Alicat are not covered by this warranty.

Conformity / Supplemental Information:

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.

Gas Viscosity, Density and Compressibility:

#	Gas		Absolute Viscosity* 25°C	Density ** 25°C 14.696PSIA	Compressibility 25°C 14.696PSIA
0	Air	Air	184.918	1.1840	0.9997
1	Argon	Ar	225.593	1.6339	0.9994
2	Methane	CH4	111.852	0.6569	0.9982
3	Carbon Monoxide	CO	176.473	1.1453	0.9997
4	Carbon Dioxide	CO2	149.332	1.8080	0.9949
5	Ethane	C2H6	93.540	1.2385	0.9924
6	Hydrogen	H2	89.153	0.08235	1.0006
7	Helium	He	198.457	0.16353	1.0005
8	Nitrogen	N2	178.120	1.1453	0.9998
9	Nitrous Oxide	N2O	148.456	1.8088	0.9946
10	Neon	Ne	311.149	0.8246	1.0005
11	Oxygen	O2	204.591	1.3088	0.9994
12	Propane	C3H8	81.458	1.8316	0.9841
13	normal-Butane	n-C4H10	74.052	2.4494	0.9699
14	Acetylene	C2H2	104.448	1.0720	0.9928
15	Ethylene	C2H4	103.177	1.1533	0.9943
16	iso-Butane	i-C4H10	74.988	2.4403	0.9728
17	Krypton	Kr	251.342	3.4274	0.9994
18	Xenon	Xe	229.785	5.3954	0.9947
19	Sulfur Hexafluoride	SF6	153.532	6.0380	0.9887

#	Gas		Absolute Viscosity* 25°C	Density ** 25°C 14.696PSIA	Compressibility 25°C 14.696PSIA
20	75%Ar / 25% CO2	C-25	205.615	1.6766	0.9987
21	90% Ar / 10% CO2	C-10	217.529	1.6509	0.9991
22	92% Ar / 8% CO2	C-8	219.134	1.6475	0.9992
23	98% Ar / 2% CO2	C-2	223.973	1.6373	0.9993
24	75% CO2 / 25% Ar	C-75	167.451	1.7634	0.9966
25	75% Ar / 25% He	HE-75	230.998	1.2660	0.9997
26	75% He / 25% Ar	HE-25	234.306	0.5306	1.0002
27	90% He / 7.5% Ar / 2.5% CO2 Helistar® A1025	A1025	214.840	0.3146	1.0003
28	90% Ar / 8% CO2 / 2% O2 Stargon® CS	Star29	218.817	1.6410	0.9992
29	95% Ar / 5% CH4	P-5	223.483	1.5850	0.9993

*in micropoise (1 Poise = gram / (cm) (sec))
**Grams/Liter
Reference: NIST REFPROP 7 Database

Flow Conversions:

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

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