



The Fastest Flow Controller Company in the World!

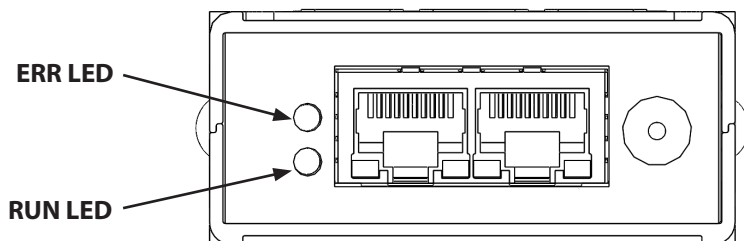


EtherCAT Operating Bulletin

An explanation of the ERR LED and RUN LED signals is shown below.

ERR LED	EtherCAT State
Off	No Error
Blinking	Invalid Configuration
Single Flash	Unsolicited State Change
Double Flash	Application Watchdog Timeout
Flickering	Booting Error
On	PDI Watchdog Timeout

RUN LED	EtherCAT State
Off	Init
Blinking	Pre-Operational
Single Flash	Safe-Operational
Flashes	Initialization or Bootstrap
On	Operational



Top View Of Device

ALICAT EtherCAT OPERATING BULLETIN

1 EtherCAT Communication

Alicat devices support the EtherCAT protocol as modular device. The following sections describe the data available as cyclic process data or through the CoE mailbox. The ESI for your Alicat device can be downloaded from the Alicat website.

1.1 Process Data Object (PDO) Mappings

EtherCAT organizes input and output data into Process Data Objects (PDOs). RxPDOs refer to data transferred from the Master to the device while TxPDOs refer to data transferred from the device to the Master.

1.2 RxPDO Mapping

The following lists the available output RxPDOs the master can write to the device. Setpoint is an IEEE floating point value and only applies to controllers. It is ignored in meters. Command ID and Argument are used to send asynchronous commands to the device. See section 1.5 for more information.

PDO Index	PDO Entry	Type	Parameter
0x1600:01	0x7000:01	REAL	Setpoint
0x1601:01	0x7010:01	UINT	Command ID
0x1601:02	0x7010:02	UINT	Command Argument

1.3 TxPDO Mapping

The following lists the available input TxPDOs the master can read from the device. Device readings are described in section 1.4. Section 1.5 describes the asynchronous command interface.

PDO Index	PDO Entry	Type	Parameter
0x1A00:01	0x6000:01	UINT	Gas Index
0x1A00:02	0x6000:02	BITARR32	Device Status
0x1A00:03	0x6000:03	REAL	Device Reading 1
0x1A00:04	0x6000:04	REAL	Device Reading 2
0x1A00:05	0x6000:05	REAL	Device Reading 3
0x1A00:06	0x6000:06	REAL	Device Reading 4
0x1A00:07	0x6000:07	REAL	Device Reading 5
0x1A00:08	0x6000:08	REAL	Device Reading 6
0x1A00:09	0x6000:09	REAL	Device Reading 7
0x1A00:10	0x6000:10	REAL	Device Reading 8
0x1A00:11	0x6000:11	REAL	Device Reading 9
0x1A00:12	0x6000:12	REAL	Device Reading 10
0x1A00:13	0x6000:13	REAL	Device Reading 11
0x1A00:14	0x6000:14	REAL	Device Reading 12
0x1A00:15	0x6000:15	REAL	Device Reading 13
0x1A00:16	0x6000:16	REAL	Device Reading 14
0x1A01:01	0x6010:01	UINT	Last Command ID
0x1A01:02	0x6010:02	UINT	Last Command Status

1.4 Device Readings

Your Alicat device can output up to 14 different configurable data statistics through TxPDO 0x6000. The default statistics for each device type are specified in the sections below.

The configured data readings and units for TxPDO 0x6000 can be viewed by directly connecting to the embedded webserver of the device and clicking on the “Data IO” tab. See section 2 for information on assigning an IP and connecting to the webserver.

If you wish to customize the output of your device please speak to an Alicat applications engineer.

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

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	Statistic
1	Pressure
2	Flow Temperature
3	Volumetric Flow
4	Mass Flow
5	Mass Flow Set-point
6	Mass Total*

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

1.4.2 Mass Flow Meter

Reading	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	Statistic
1	Pressure

1.4.4 Pressure Controller

Reading	Statistic
1	Pressure
2	Pressure Setpoint

1.5 Device Commands

Commands can be issued to the Alicat device through RxPDO 0x7010 sub index 0x01 & 0x02. The result of a requested command can be read from TxPDO 0x6010. Commands take effect on change to the RxPDO. To re-issue the same command with a different argument you must send an ID value of zero followed by the requested command ID.

RxPDO 0x7010		
Parameter	Type	Comment
Command ID	UINT	See valid values below.
Command Argument	UINT	

TxPDO 0x6010		
Parameter	Type	Description
Command ID	UINT	ID of last command.
Command Status	UINT	Status of last command.

List of supported commands:

Command ID	Action	Argument
1	Change gas number	Gas Table Index
2	Mix gas	Gas mixture index (236-255) or 0 to use next available.
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 control loop variable.	0 – Mass Flow 1 – Volumetric Flow 2 – Diff Pressure 3 – Absolute Pressure 4 – Gauge Pressure
12	Save current set-point as power-up value.	None

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 Gas Mixing

Gas mixing can be performed with 2-5 gases using the mix configuration. The mix is a two-step process.

First, the desired constituent gas indexes and percentages must be written to the mix configuration registers followed by a write of the Mix Gas command (ID 2) into command RxPDO. The mix configuration is accessible through the CoE mailbox.

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 in the next empty gas mix index starting at 255 and working down to 236.

If no user mix indices are unused, the command will not be successfully completed and an error will be returned in the command result TxPDO.

If the command argument passed is between 236 and 255, the mixture with the specified index will be either created or updated to the new composition.

If the specified index is not valid (the command argument is neither 0 nor 236-255), an error will be returned.

Upon completion of mixing, the command result TxPDO 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 gas constituents did not exist or the percentage does not add to 100%, an error value will be returned and the mix will not be created.

Index	Type	Parameter
0x8000:01	UINT	Mixture Gas 1 Index
0x8000:02	UINT	Mixture Gas 1 Pct
0x8000:03	UINT	Mixture Gas 2 Index
0x8000:04	UINT	Mixture Gas 2 Pct
0x8000:05	UINT	Mixture Gas 3 Index
0x8000:06	UINT	Mixture Gas 3 Pct
0x8000:07	UINT	Mixture Gas 4 Index
0x8000:08	UINT	Mixture Gas 4 Pct
0x8000:09	UINT	Mixture Gas 5 Index
0x8000:10	UINT	Mixture Gas 5 Pct

2 Network Configuration

Alicat devices have two 10/100Mbps Ethernet ports. The ports are designated as Input (from Master) and Output (to next device), allowing the creation of a chain of devices.



Upper Back Label

The device supports the Ethernet over EtherCAT (EoE) protocol allowing standard Ethernet communication with the device. The IP address is set by the EtherCAT master during initialization. See your master device documentation for the procedure to assign an IP address to the device.

2.1 Data IO

The device readings available through the Rx/TxPDOs can be read from the embedded webserver running on your device after assigning it an IP address through EoE and clicking the “Data IO” tab on the left:



Home

Data IO

Network Config

Device Config

EtherCAT™ Rx/Tx PDOs

RxPDOs

Index	Name	Type	Description
7000.01	Set-point	REAL	Requested control set-point

NOTE: Set-point is only applicable to controllers.

TxPDOs

Index	Name	Type	Description
6000.01	Gas Index	UINT	Gas Index Number
6000.02	Status	UDINT	See bitmask below
6000.02	Absolute Pressure	REAL	Reading in PSI
6000.03	Flow Temperature	REAL	Reading in °C
6000.04	Volumetric Flow	REAL	Reading in LPM
6000.05	Mass Flow	REAL	Reading in SLPM

Device Status

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
14:31	Reserved

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

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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.

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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	Compressibility 25°C
0	Air	184.918	1.1840	0.9997
1	Argon	225.593	1.6339	0.9994
2	Methane	111.852	0.6569	0.9982
3	Carbon Monoxide	176.473	1.1453	0.9997
4	Carbon Dioxide	149.332	1.8080	0.9949
5	Ethane	93.540	1.2385	0.9924
6	Hydrogen	89.153	0.08235	1.0006
7	Helium	198.457	0.16353	1.0005
8	Nitrogen	178.120	1.1453	0.9998
9	Nitrous Oxide	148.456	1.8088	0.9946
10	Neon	311.149	0.8246	1.0005
11	Oxygen	204.591	1.3088	0.9994
12	Propane	81.458	1.8316	0.9841
13	normal-Butane	74.052	2.4494	0.9699
14	Acetylene	104.448	1.0720	0.9928
15	Ethylene	103.177	1.1533	0.9943
16	iso-Butane	74.988	2.4403	0.9728
17	Krypton	251.342	3.4274	0.9994
18	Xenon	229.785	5.3954	0.9947
19	Sulfur Hexafluoride	153.532	6.0380	0.9887

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 = 3660.7668	SCIH

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#	Gas	Absolute Viscosity* 25°C	Density ** 25°C	Compressibility 25°C
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 Hellstar® 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))
Reference: NIST REFPROP 7 Database

**Grams/Liter



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