

GAS MASS FLOW CONTROLLERS

With RS485 Standard and Alarm Functions

For Clean Gases

FMA6500ST Series



- ✓ **Digital and Analog Modes Operate Simultaneously**
- ✓ **Programmable Flow Configurations**
- ✓ **RS485 Standard, Multi-Drop Capability of Up to 256 units**
- ✓ **Stores Calibration Data for Up to 10 Gases**
- ✓ **Totalizer Indicates Total Gas Quantity**
- ✓ **Alarm Limits for High and Low Gas Flow**
- ✓ **Conversion Factors for Up to 256 Gases**
- ✓ **Autotune Function for Optimum Control Response**
- ✓ **Self Diagnostic Tests**



FMA6502ST shown smaller than actual size.

Microprocessor driven digital flow controllers allow one to program, record, and analyze flow rates of various gases with a computer via an RS485 interface (optional RS232 is available).

Controllers can be programmed for various control functions including, flow setpoint, totalizer, stop totalizer, read totalizer, totalizer from preset flow, stop at preset total, auto zero, and more.

Principles of Operation

Metered gases are divided into two laminar flow paths, one through the primary flow conduit, and the other through a capillary sensor tube. Both flow conduits are designed to ensure laminar flow, therefore, the ratio of their flow rates remains constant. Two precision temperature sensing windings on the sensor

tube are heated, and when flow takes place, gas carries heat from the upstream to the downstream windings. The resultant temperature differential is proportional to the change in resistance of the sensor windings.

A Wheatstone bridge design is used to monitor the temperature dependent resistance gradient on the sensor windings which is linearly proportional to the instantaneous rate of flow. The output of the Wheatstone bridge is converted to digital format with a 12-Bit Adc (analog to digital converter).

An on-board microprocessor and nonvolatile memory store all calibration factors and directly control a proportional electromagnetic valve. The digital

closed loop control system continuously compares the mass flow output with the selected flow rate. Deviations from the setpoint are corrected by compensating valve adjustments, with PID algorithm, thus maintaining the desired flow parameters with a high degree of accuracy. Output signals of 0 to 5 Vdc or 4 to 20 mA are generated indicating mass molecular based flow rates of the metered gas.

Interface

The digital interface operates via RS485 (optional RS232) and provides access to applicable internal data including: flow setpoint, actual flow, zero adjustments, and linearization table adjustments. The analog interface provides 0 to 5 Vdc, 0 to 10 Vdc and 4 to 20 mA inputs and outputs.

Auto Zero

The FMA6500ST automatically nulls the sensor zero offset whenever the flow setpoint is below 2% FS. To accommodate this feature the control valve must fully close under that condition. Provisions are made to either disable, force, or store the current auto zero via digital commands.

Totalizer

The firmware for the FMA6500ST provides functions to register total gas quantity. The total mass of gas is calculated by integrating the actual gas flow rate with respect to time. Digital interface commands are provided to: set the totalizer to zero, start/stop totalizing the flow, read the totalizer, start the totalizer at a preset flow, and stop the flow at a preset total.

Multi-Gas Calibration Option

The FMA6500ST is capable of storing primary calibration data for up to 10 gases. This feature allows the same FMA6500ST to be calibrated for multiple gases while maintaining the rated accuracy on each.

Standard 10-Point NIST Calibration

Optional up to 9 additional 10-point calibration may be ordered at an additional cost per gas.

Conversion Factors

Conversion factors for up to 256 gases are stored in the FMA6500ST. Conversion factors may be applied to any of the ten gas calibrations via digital interface commands.

Flow Alarms

High and Low gas flow ALARM limits are programmed using the digital interface. Alarm conditions are reported via the digital interface or can activate the contact closure outputs.

Programmable Flow

OMEGA® software supports programmable flow modes, allowing execution of custom programming of up to ten steps. Various flow configurations include ramping, linearized increasing, and decreasing modes.

Autotune

The autotune function allows the FMA6500ST to automatically optimize control response for the gas under actual process conditions. During the autotune process, the instrument adjusts PID gains for optimum step response and determine key control valve characteristics (only available on units with less than 80 L/min maximum flow).

Contact Closure

Two sets of dry contact relay outputs are provided to actuate user supplied equipment. These are programmable via the digital interface such that the relays can be made to switch when a specified event occurs (e.g. when a low or high flow alarm limit is exceeded or when the totalizer reaches a specified value).

Valve Override

Means are provided to force the control valve fully open (purge) or fully closed via either the analog or digital interfaces.

Self Diagnostics

Whenever power is first applied, the FMA6500ST runs a series of self diagnostic tests to ensure that it is in optimum working condition.

Engineering Units

The flow setpoint, measured gas flow and associated totalizer data is scaled directly in engineering units via digital interface commands. The following units of measure are supported: % of FS, mL/min, mL/hr, scfm, scfh, sL/min, sL/hr, lbs/hr, lbs/min, and one user defined unit of measure.

Leak Integrity

1 x 10⁻⁹ sml/sec of helium maximum to the outside environment.

Balanced Power Supply

The FMA6500ST operates on ±15 Vdc. The current requirements for the positive and negative power supplies are balanced such that the current in the power supply common connection is minimized. Maximum power consumption is 13.5 watts at ±15 Vdc.

SPECIFICATIONS

Accuracy (including linearity):

15 to 25°C (59 to 77°F) and 0.7 to 4 bar (10 to 60 psia): ±1% of FS, 0 to 50°C (32 to 122°F) and 0.3 to 10 bar (5 to 150 psia): ±2% of FS, ±1% of FS at a specific temperature and pressure with special calibration

Repeatability: ±0.15% FS

Turndown Ratio: 50:1

Response Time: 0.6 to 1.0 s to within ±2% of setpoint over 20% to 100% FS

Temperature Coefficient:

0.05% of full scale/°C or better

Pressure Coefficient: 0.01% FS/psi (0.07 bar) or better

Leak Integrity:

1 x 10⁻⁹ sml/sec Helium maximum to the outside environment

Optimum Gas Pressure:

1.73 bar (25 psig)



FMA6502ST, shown smaller than actual size.

Maximum Gas Pressure: 34.5 bar (500 psig)

Maximum Diff. Pressure: 3.4 bar (50 psig) for up to 10 LPM, 2.8 bar (40 psig) for 15 LPM and greater

Gas and Ambient Temperature: 5 to 50°C (41 to 122°F)

Output Signals: Linear 0 to 5 Vdc (2000 Ω min load impedance); 0 to 10 Vdc (4000 Ω min impedance); 4 to 20 mA optional (0 to 500 Ω loop resistance)

Communication Interface:

RS485, standard; RS232, optional

Transducer Input Power:

±15 Vdc, 450 mA maximum

Wetted Parts: 316 stainless steel, 416 stainless steel, FKM O-rings Neoprene or Perfluoroelastomer O-rings optional

Connections: Standard 1/4" compression fittings up to 30 LPM models; for 60 LPM models and greater: 3/8" compression fittings

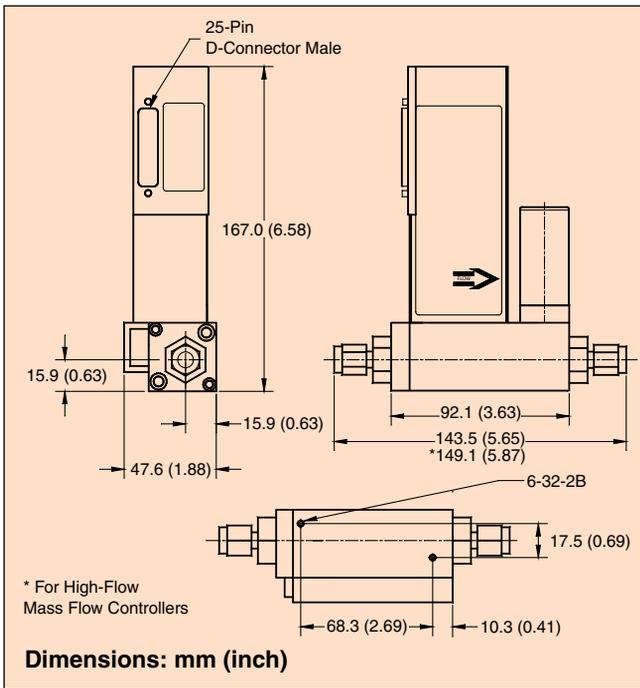
Circuit Protection:

Circuit boards have built-in polarity reversal protection; resettable fuses provide power input protection

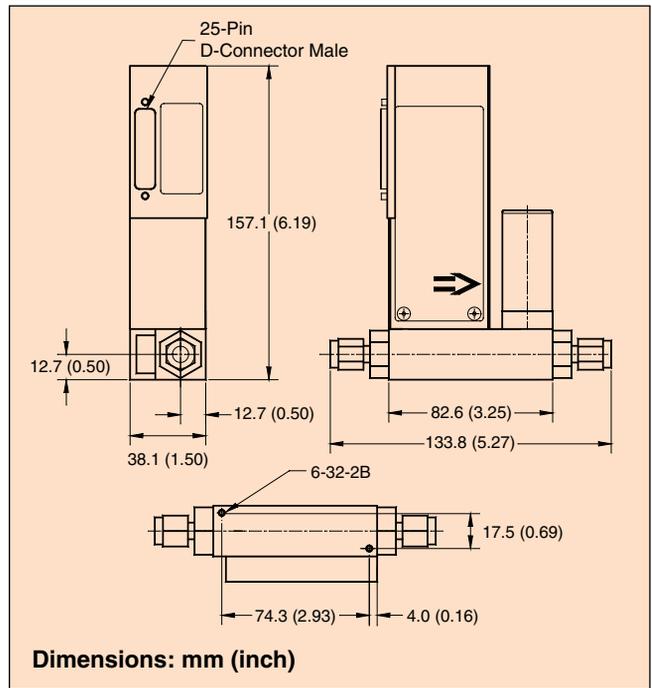
Calibration Options:

Standard 10-point NIST calibration optional up to 9 additional 10-point calibrations may be ordered for an additional cost per gas

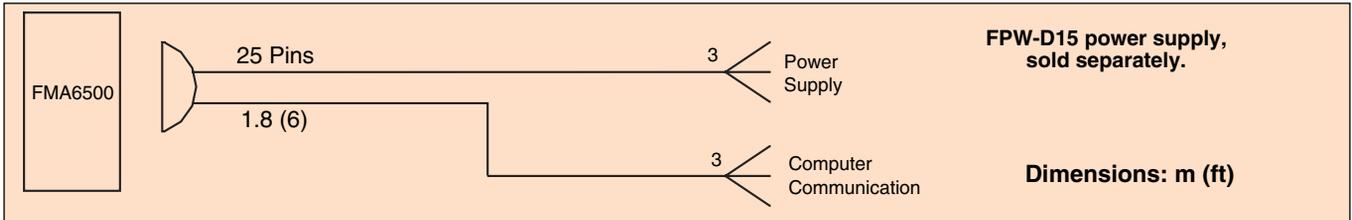
FMA6500ST Controller Dimensions 15 LPM and Greater



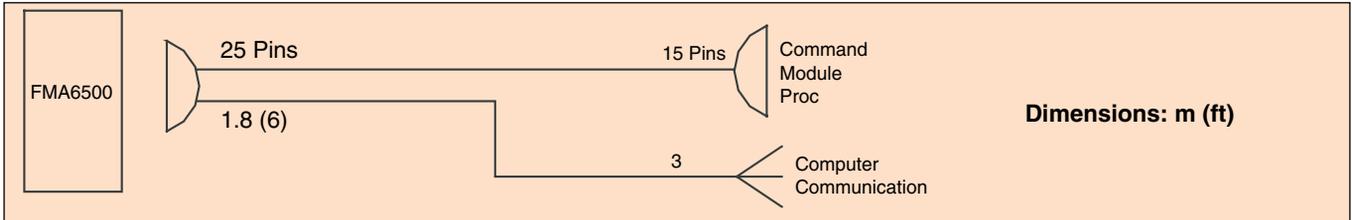
FMA6500ST Controller Dimensions Up to 10 LPM



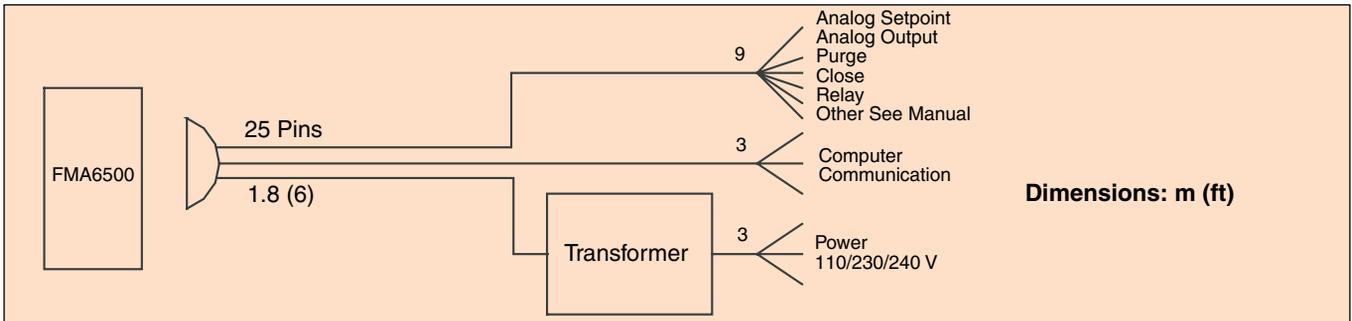
Standard Cable (Supplied with FMA6500ST) FMA65-C



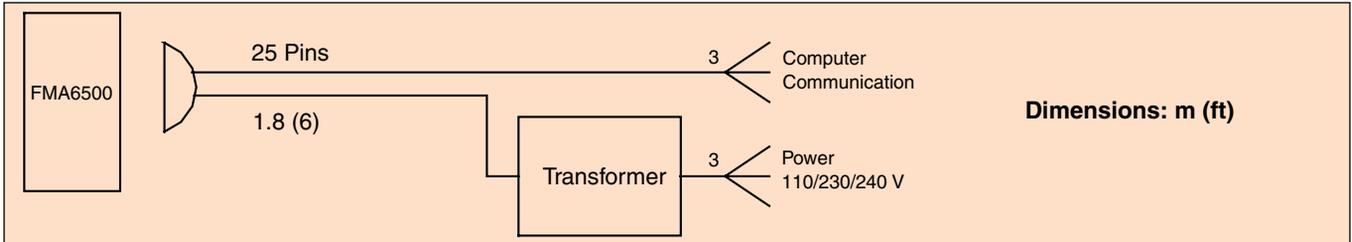
FMA65-C15



FMA65PWA



FMA65PWC



To Order			
Model No.	Maximum Flowrate**	Compression Fitting	Maximum Pressure Drop (psid)
FMA6502ST	10 SCCM	1/4"	1.06
FMA6504ST	20 SCCM	1/4"	1.06
FMA6506ST	50 SCCM	1/4"	1.06
FMA6508ST	100 SCCM	1/4"	1.06
FMA6510ST	200 SCCM	1/4"	1.06
FMA6512ST	500 SCCM	1/4"	1.06
FMA6514ST	1 SLM	1/4"	1.06
FMA6516ST	2 SLM	1/4"	1.06
FMA6518ST	5 SLM	1/4"	1.06
FMA6520ST	10 SLM	1/4"	3.87
FMA6523ST	15 SLM	1/4"	2.00
FMA6524ST	20 SLM	1/4"	3.50
FMA6526ST	30 SLM	1/4"	8.00
FMA6528ST	50 SLM	1/4"	8.00
FMA6540ST	60 SLM	3/8"	18.9
FMA6541ST	80 SLM	3/8"	18.9
FMA6542ST	100 SLM	3/8"	18.9

Accessories

Model No.	Description
FMA65-C	Replacement cable 25 pin D-conn with 1.8 m (6') wire, branch to power supply
FMA65PWC	Power supply with 25 pin female D-conn 110 Vac (± 15 Vdc) branch 1.8 m (6') wire to computer port, stripped
FMA65PWA	Power supply with 25 pin female D-conn 110 Vac (± 15 Vdc) branch 1.8 m (6') wire to analog interface
FMA65EPWC	European power supply with 25 pin female D-conn 230 Vac (± 15 Vdc) branch 1.8 m (6') wire to computer port, stripped
FMA65UKPWC	UK power supply with 25 pin female D-conn 230 Vac (± 15 Vdc) branch 1.8 m (6') wire to computer port, stripped
FMA65-C15	25 pin D-conn with 1.8 m (6') wire to 15 pin DM, branch 1.8 m (6') wire to computer port, stripped
FMA65-CAL-(*)	10-point NIST calibration per gas; specify up to 9 gases (specify primary gas on FMA6500, inlet/outlet, and temperature)

Comes complete with operator's manual, software, cable (FMA65-C), and NIST certificate. Power supply sold separately.

* Specify gas or gases and inlet/outlet pressure. Calibrations done at ambient [20°C (70°F)] temperature only.

** Flow ranges specified are for nitrogen or air at 20 psig inlet (up to 50 SLM) or 25 psig inlet (60 to 100 SLM units) and 0 psig outlet, see above ordering chart.

For RS232 communications (replaces RS485), add suffix "-RS232" to model number, no additional cost.

For 4 to 20 mA output (replaces 0 to 5V), add suffix "-I" to model number, no additional cost.

For Perfluoroelastomer O-rings (replaces FKM O-rings), add suffix "-K" to model number, for additional cost.

Ordering Examples: FMA6512ST, mass flow controller, and FMA65PWC power supply.

FMA6542ST, mass flow controller, and FMA65PWC power supply.



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