# User's Guide




# FMA-7400/7500 Series

## MultiGas/MultiRange
## Digital Thermal Mass Flow Devices

omega.com®
ΩOMEGA®

| OMEGAnet® Online Service<br>omega.com | Internet e-mail<br>info@omega.com |
|---|---|

## Servicing North America:

**U.S.A.:**
ISO 9001 Certified
Omega Engineering, Inc., One Omega Drive, P.O. Box 4047
Stamford, CT 06907-0047 USA
Toll Free: 1-800-826-6342 TEL: (203) 359-1660
FAX: (203) 359-7700 e-mail: info@omega.com

**Canada:**
976 Bergar
Laval (Quebec), Canada H7L 5A1
Toll-Free: 1-800-826-6342 TEL: (514) 856-6928
FAX: (514) 856-6886 e-mail: info@omega.ca

## For immediate technical or application assistance:

**U.S.A. and Canada:** Sales Service: 1-800-826-6342/1-800-TC-OMEGA®
Customer Service: 1-800-622-2378/1-800-622-BEST®
Engineering Service: 1-800-872-9436/1-800-USA-WHEN®

**Mexico:**
En Español: 001 (203) 359-7803 FAX: (001) 203-359-7807
info@omega.com.mx e-mail: espanol@omega.com

## Servicing Europe:

**Benelux**:
Managed by the United Kingdom Office
Toll-Free: 0800 099 3344 TEL: +31 20 347 21 21
FAX: +31 20 643 46 43 e-mail: sales@omega.nl

**Czech Republic:**
Frystatska 184
733 01 Karviná, Czech Republic
Toll-Free: 0800-1-66342 TEL: +420-59-6311899
FAX: +420-59-6311114 e-mail: info@omegashop.cz

**France:**
Managed by the United Kingdom Office
Toll-Free: 0800 466 342 TEL: +33 (0) 161 37 29 00
FAX: +33 (0) 130 57 54 27 e-mail: sales@omega.fr

**Germany/Austria:**
Daimlerstrasse 26
D-75392 Deckenpfronn, Germany
Toll-Free: 0 800 6397678 TEL: +49 (0) 7059 9398-0
FAX: +49 (0) 7056 9398-29 e-mail: info@omega.de

**United Kingdom:**
ISO 9001 Certified
OMEGA Engineering Ltd.
One Omega Drive, River Bend Technology Centre, Northbank
Irlam, Manchester M44 5BD England
Toll-Free: 0800-488-488 TEL: +44 (0)161 777-6611
FAX: +44 (0)161 777-6622 e-mail: sales@omega.co.uk

---

It is the policy of OMEGA Engineering, Inc. to comply with all worldwide safety and EMC/EMI regulations that apply. OMEGA is constantly pursuing certification of its products to the European New Approach Directives. OMEGA will add the CE mark to every appropriate device upon certification.


**WARNING:** These products are not designed for use in, and should not be used for, human applications.

The Omega product you have just received is of the highest quality available, offering superior performance, reliability and value to the user. It is designed with the ever changing process conditions, accuracy requirements and hostile process environments in mind to provide you with a lifetime of dependable service.

We recommend that you read this manual in its entirety. Should you require any additional information concerning Omega products and services, please contact your local Omega Engineering office listed on the inside front cover of this manual or visit www.Omega.com.

# Essential Instructions
## Read before proceeding!

Omega Engineering designs, manufactures and tests its products to meet many national and international standards. These products must be properly installed, operated and maintained to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, operating and maintaining Omega Engineering products.

- To ensure proper performance, use qualified personnel to install, operate, update, program and maintain the product.
- Read all instructions prior to installing, operating and servicing the product. If this instruction manual is not the correct manual, please see back cover for local sales office contact information. Save this instruction manual for future reference.

**⚠ WARNING: Do not operate this instrument in excess of the specifications listed in the Instruction and Operation Manual. Failure to heed this warning can result in serious personal injury and / or damage to the equipment.**

- If you do not understand any of the instructions, contact your Omega Engineering representative for clarification.
- Follow all warnings, cautions and instructions marked on and supplied with the product.
- Install your equipment as specified in the installation instructions of the appropriate instruction manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- Operation: (1) Slowly initiate flow into the system. Open process valves slowly to avoid flow surges. (2) Check for leaks around the flow meter inlet and outlet connections. If no leaks are present, bring the system up to the operating pressure.
- Please make sure that the process line pressure is removed prior to service. When replacement parts are required, ensure that qualified people use replacement parts specified by Omega Engineering . Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look-alike substitutions may result in fire, electrical hazards or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place to prevent electrical shock and personal injury, except when maintenance is being performed by qualified persons.

**⚠ WARNING: For liquid flow devices, if the inlet and outlet valves adjacent to the devices are to be closed for any reason, the devices must be completely drained. Failure to do so may result in thermal expansion of the liquid that can rupture the device and may cause personal injury.**

## European Pressure Equipment Directive (PED)

All pressure equipment with an internal pressure greater than 0.5 bar (g) and a size larger than 25mm or 1" (inch) falls under the Pressure Equipment Directive (PED).

- The Specifications Section of this manual contains instructions related to the PED directive.
- Meters described in this manual are in compliance with EN directive 97/23/EC.
- All Omega Engineering Flowmeters fall under fluid group 1.
- Meters larger than 25mm or 1" (inch) are in compliance with PED category I, II or III.
- Meters of 25mm or 1" (inch) or smaller are Sound Engineering Practice (SEP).

## European Electromagnetic Compatibility (EMC)

The Omega Engineering (electric/electronic) equipment bearing the CE mark has been successfully tested to the regulations of the Electro Magnetic Compatibility (EMC directive 2004/108/EC).

Special attention however is required when selecting the signal cable to be used with CE marked equipment.

**Quality of the signal cable, cable glands and connectors:**

Omega Engineering supplies high quality cable(s) which meets the specifications for CE certification.

If you provide your own signal cable you should use a cable which is overall completely screened with a 100% shield.

"D" or "Circular" type connectors used should be shielded with a metal shield. If applicable, metal cable glands must be used providing cable screen clamping.

The cable screen should be connected to the metal shell or gland and shielded at both ends over 360 Degrees.

The shield should be terminated to an earth ground.

Card Edge Connectors are standard non-metallic. The cables used must be screened with 100% shield to comply with CE certification.

The shield should be terminated to an earth ground.

For pin configuration : Please refer to the enclosed Instruction Manual.

## ESD (Electrostatic Discharge)

**⚠ CAUTION: This instrument contains electronic components that are susceptible to damage by static electricity. Proper handling procedures must be observed during the removal, installation or other handling of internal circuit boards or devices.**

**Handling Procedure:**

1. Power to unit must be removed.
2. Personnel must be grounded, via a wrist strap or other safe, suitable means before any printed circuit card or other internal device is installed, removed or adjusted.
3. Printed circuit cards must be transported in a conductive container. Boards must not be removed from protective enclosure until immediately before installation. Removed boards must immediately be placed in protective container for transport, storage or return to factory.

**Comments**

This instrument is not unique in its content of ESD (electrostatic discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, SMOS, etc.). Experience has proven that even small amounts of static electricity can damage or destroy these devices. Damaged components, even though they appear to function properly, exhibit early failure.

## Contents

# FMA-7400/7500 Series Devices

## 1-1 Introduction

The FMA-7400/7500 Series is a performance/value MFC platform designed for OEM applications, delivering the following class leading features:

- Process gas and flow range programmability, enabling customers to re-configure the MFC for new gases and full scale flow rates for unparalleled process flexibility.
- A high-performance, corrosion-resistant flow measurement sensor delivers improved reproducibility and stability.
- Elastomer (FMA-7400) and metal seal (FMA-7500) options enable customers to select the optimum and most cost effective mix of products for their application.
- An independent service/diagnostic port enables on-tool reconfiguration/optimization, data logging, and troubleshooting without having to remove the MFC from the gas line.

## 1-2 How to Use This Manual


*Figure 1-1 FMA-7400/7500 Series Digital Thermal Mass Flow Device*

This manual is intended to provide the user with all the information necessary to install, operate, troubleshoot and maintain these thermal mass flow devices. The manual is organized in the following sections:

Section 1 Introduction

Section 2 Installation

Section 3 Operation

Section 4 Maintenance and Troubleshooting

Section 5 Product Description Code

Appendix A FMA-7400/7500 Series Gas Table

Warranty, Local Sales/Service Contact Information

It is recommended that this manual be read in its entirety before attempting to operate or repair these devices.

# FMA-7400/7500 Series Devices

## 1-3 Product Support References

Refer to www.Omega.com for Omega sales and service locations and to obtain other documents that support the FMA-7400/7500 Series.

## 1-4 Warning, Caution and Notice Statements

Warning, caution and notice statements are located throughout this manual in the ANSI format. A WARNING statement indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury. A CAUTION statement indicates a potentially hazardous situation which, if not avoided, MAY result in minor or moderate injury. It may also be used to alert against unsafe practices. A NOTICE statement describes specific information that requires special attention.

## 1-5 Product Warranty

Product warranty information can be found on the inside back cover of this manual.

## 1-6 How to Order an FMA-7400/7500 Series Device

Refer to Section 5.

## 1-7 Industry Standard References

Refer to Table 1-1.

## 1-8 FMA-7400/7500 Series Gas Table

Refer to Appendix A.

## 1-9 Glossary of Terms and Acronyms

Refer to Table 1-2

*Table 1-1 Industry Standard References*

| Reference Number | Reference Description |
|---|---|
| MIL-STD-810 | Method 514.4, Category 1, Transportation Requirement<br>Method 516.4, Procedure 1, Functional Shock Test Requirement |
| SEMI E12 | Standard temperature and pressure |
| SEMI E16 | Guideline for determining and describing MFC leak rates |
| SEMI E17 | Guideline for MFC transient characteristics tests |
| SEMI E18 | Guideline for temperature specifications of the MFC |
| SEMI E27 | Standard for MFC and MFM linearity |
| SEMI E28 | Guideline for pressure specifications for the MFC |
| SEMI E52 | Practice for referencing gases used in digital MFCs |
| SEMI E54 | Sensor actuator network connections for DeviceNet |
| SEMI E56 | Test method for detemining accuracy, linearity, repeatability, short-term reproducibility, hystereses of thermal MFCs |
| SEMI E66 | Test method for determining particle contribution by MFCs |
| SEMI E67 | Test method for determining reliabilty of MFCs |
| SEMI E68 | Test method for determining warm-up time of MFCs |
| SEMI E69 | Test method for reproducibilty and zero drift for thermal MFCs |
| SEMI E80 | Test method for determining attitude sensitivity of MFCs |
| SEMI E16-90 | Guidelines for determining and describing mass flow controllers leak rates |
| SEMI F36 | Guide for dimensions and connections of gas distribution components |
| SEMI F44 | Guideline for standardization of machined stainless steel weld fittings |
| SEMI F45 | Guideline for standardization of machined stainless steel reducing fittings |
| SEMI F47 | Specifications for semiconductor processing equipment<br>voltage sag immunity |
| SEMI S2 | Environmental, Health and Safety Guidelines |
| SEMI S9 | Dielectric testing |
| SEMI S10 | Risk assessment |
| SEMI S12 | Decontamination of fielded products |

## 1-10 Description

### Control

The FMA-7400/7500 Series brings together Omega high-performance, ultra-fast T-rise flow sensor, high-speed ARM based digital architecture, and a fast-acting diaphragm-free solenoid valve to deliver:

- Fast reproducible transitions between setpoints without overshoot or ringing
- User-programmable ramp functions for processes requiring a slow-ramp in flow or time critical transitions
- Optional bubble tight shut down (elastomer valve seat)

### MultiGas and MultiRange Configurability

The Omega MultiGas/MultiRange technology delivers exceptional improvement in process gas accuracy for linear and non-linear gases. This is achieved through advanced gas modeling and optimized through actual gas testing. Omega MultiGas/MultiRange allows the device to be quickly and easily configured for another gas and/or flow range without sacrificing accuracy or rangability. Selecting a new gas automatically creates a new calibration curve, establishes optimized PID settings for dynamic control, automatically compensates for gas density effects, and ensures smooth overshoot-free transitions between flow rates with excellent steady-state

## FMA-7400/7500 Series Devices

*Table 1-2 Terms and Acronyms*

| Term or Acronym | Definition |
|---|---|
| CSR | Customer Special Requirement. |
| CVD | Chemical Vapor Deposition. |
| DSP | Digital Signal Processor. |
| EPI Epitaxy (EPI). | A process technology where a pure silicon crystalline structure is deposited or “grown” on a bare wafer, enabling a high-purity starting point for building the semiconductor device. |
| HBD | Horizontal Base Down. |
| HLD | Horizontal Label Down. |
| HLU | Horizontal Label Up. |
| HUD | Horizontal Upside Down. |
| FMA-7400/7500 Series | Multigas/MultiRange capable digital device. |
| F.S. | Full Scale. |
| LED | Light Emitting Diode. |
| MFC | Mass Flow Controller. |
| Configurator | I/O communication software package that configures gas and flow ranges. |
| MultiGas/MultiRange Technology | A physics-based calibration methodology that enables gas and flow range configuration within a defined standard configuration. |
| PID | Proportional Integral Derivative Controller. |
| PSIA | Pounds per Square Inch Absolute. |
| PSID | Pounds per Square Inch Differential. |
| PSIG | Pounds per Square Inch Gauge. |
| ROR | As pressure increases, flow increases at a pressure rate of rise, or ROR. |
| HC | Standard Configuration w/ Hastelloy® sensors (to reduce reaction to corrosive gases). |
| S.P. | Setpoint. |
| Step Technology | Enables fast set point control through a high speed DSP. |
| VID | Vertical mounting attitude with inlet side facing down. |
| VIU | Vertical mounting attitude with inlet side facing up. |

stability. Omega MultiGas/MultiRange technology offers unparalleled flexibility. An extensive gas database is provided and a single device can be quickly programmed for thousands of different gas and flow range combinations. Process benefits achieved include:

- Mass flow controller full scale full range can be rescaled down typically by a factor of 3:1 with no impact on accuracy, turndown or leak by specifications
- Optimum process and inventory flexibility resulting in dramatically reduced inventory costs
- Fewer configurations/bin sizes required to support many different processes
- Less down-time with rapid process recovery

**Configurator Accessory Kits:**

**FMA745-CK** **Basic Configurator Kit**

(Includes software, Configurator Cable Assembly 2.5 mm, Converter 232/485)

**FMA745-CK-P** **Basic Configurator Kit w/Power Supply and Adaptor Cables**

(Includes software, Configurator Cable Assembly 2.5 mm, Converter 232/485, Power Supply, 24 Vdc with DB-15 female)

**Advanced Thermal Measurement Sensor**

Omega's high-performance thermal flow sensor brings together key design elements to deliver the accurate, repeatable measurement under challenging process conditions:

- Improved accuracy at elevated temperatures through isothermal packaging and ambient temperature sensing and compensation
- Enhanced signal-to-noise performance enables improved low setpoint accuracy
- A large bore, corrosion resistant, Hastelloy® C-22 sensor tube ensures long life and reliability
- Optimized temperature profile for gases prone to thermal decomposition
- Onboard electronics store sensor calibration data for ease of service

## FMA-7400/7500 Series Devices

**Enhanced Diagnostics and User Interface**

The mass flow controller is typically the most complex and critical component in a gas delivery system, When dealing with toxic or reactive gases, removing the MFC to access its functionality should be the last resort. To address this, Omega FMA-7400/7500 Series devices include self-diagnostics and an independent service port for in-situ device evaluation and troubleshooting:

- Embedded self-test routines at power-up
- Independent RS485 service port that can be accessed while the MFC is in operation for data logging and troubleshooting
- A convenient Zero button to enable easy re-zeroing during scheduled maintenance

**Communication Interfaces**

The FMA-7400/7500 Series supports 0-5 Vdc communication protocol. RS485 is a multi-drop connection that allows a maximum of 32 devices for RS485 on the same network.

### 1-11 Specifications for FMA-7400/7500 Series Devices

**⚠ WARNING**

**Do not operate this instrument in excess of the specifications listed below. Failure to heed this warning can result in serious personal injury and/or damage to the equipment.**

**⚠ CAUTION**

**It is the user's responsibility to select and approve all materials of construction. Careful attention to metallurgy, engineered materials and elastomeric materials is critical to safe operation.**

See Table 1-3 for specifications for the FMA-7400/7500 Series.

See Figures 1-2 and 1-3 for dimensions for the FMA-7400/7500 Series.

*Table 1-3 Specifications for FMA-7400/7500 Series*

| Performance | FMA-7400/7500 | FMA-7400/7500-SS |
|---|---|---|
| **Full Scale Flow Range ($N_2$ Eq.)** | 3 sccm to 50 slm | |
| **Flow Accuracy** | ±1% S.P. 35-100%, ±0.35% F.S. 2-35% | |
| **Repeatability & Reproducibility** | < ± 0.2% S.P. | |
| **Linearity** | ± 0.5% F.S. (included in accuracy) | |
| **Response Time (Settling Time)** | Normally Closed Valve < 1 sec. (within 2% for steps 0-10 through 0-100%) | |
| **Control Range** | 2-100% | |
| **Multi Flow** | optional | |
| **Number of Bins** | 10 bins | |
| **Valve Shut Down** | < 1% of F.S. | |
| **Zero Stability** | < ± 0.5% F.S. per year | |
| **Pressure Coefficient** | 0.03% per psi (0-50psi $N_2$) | |
| **Attitude Sensitivity** | <0.25% span change @ 90° after rezeroing ($N_2$ @ 50 psi) | |
| **Auto Zero:** | Optional: (When Auto Zero is enabled the device performs the zero function once every time the set point returns to zero. To accomplish, simply provide a zero set point.) | |
| **Auto shut-off:** | The Auto Shut-off feature closes the valve when the set point drops below 1.5% of full scale | |
| **Ratings** | | |
| **Operating Temperature Range** | 5-50°C (41-122°F) | |
| **Maximum Operating Pressure** | 150 psig (10 bar) | |
| **Design Proof Pressure** | 4000 psig (275 bar) | |
| **Differential Pressure Range** | 3-860 sccm = 7-45 psid, 861-7200 sccm = 15-45 psid, 7201-50000 sccm = 25-45 psid<br>Typical pressure drop, high density gases like Argon gas applications require an additional 10 psid differential pressure | |
| **Leak Integrity (External)** | $1x10^{-9}$ atm. cc/sec He | $1x10^{-10}$ atm. cc/sec He |
| **Mechanical** | | |
| **Valve Type** | Normally Closed, No Valve (Meter) | Normally Closed, No Valve (Meter) |
| **Primary Wetted Materials** | 316 Stainless Steel, Hastelloy C-22, 17-7 PH, 430SS | |
| **External Seals** | FKM | Metal |
| **Internal Seals/Valve Seat** | FKM | PFA |
| **Electrical** | | |
| **Diagnostic / Service Port** | All variations have an RS485 Diagnostic/Service port via 2.5mm jack | |
| **In Rush Current/Power** | 3.0A/8 Watts | |

# FMA-7400/7500 Series Devices

*Table 1-3 Specifications for FMA-7400/7500 Series (Continued)*

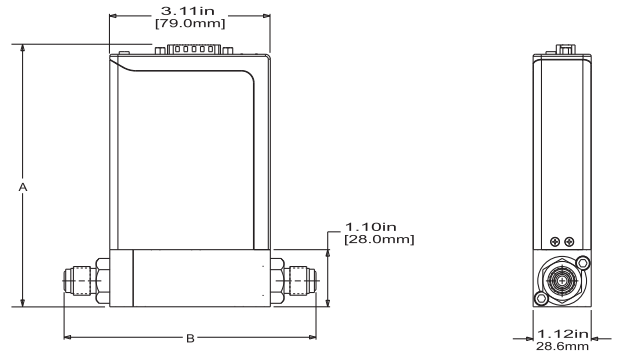
| RS485/Analog | FMA-7400/7500 | FMA-7400/7500-SS |
|---|---|---|
| Digital Communication Protocol: | S-Protocol (proprietary protocol based on HART command set) | |
| Electrical Connection: | 1 x 15-pin Male Sub-D, (A) | |
| Analog I/O: | 0-5 V | |
| Power: | +12 Vdc to +24 Vdc / normal operation 7 Watt max, Purge 8 Watt | |
| **Voltage Setpoint Input Specifications** | | |
| Nominal Range: | 0-5 Vdc | |
| Full Range: | 0-11 Vdc | |
| Absolute Max.: | 25 V (Without damage) | |
| Input Impedence: | 192 kOhms | |
| Required Maximum Sink Current: | 0.002 mA | |
| **Flow Output (Voltage) Specifications** | | |
| Nominal Range: | 0-5 Vdc | |
| Full Range: | -0.5 - 11 Vdc | |
| Min. Load Resistance: | 1 kOhms | |
| **Alarm Output (Analog I/O versions only)*** | | |
| Type: | Open Collector | |
| Max. Closed (ON) Current: | 25 mA | |
| Max. Open (off) Leakage: | 1µA | |
| Max. Open (off) Voltage: | 30 Vdc | |
| **Valve Override Signal (Analog I/O version only)** | The Valve Override Signal (VOR) is implemented as an analog input which measures the voltage at the input and controls the valve based upon the followingcriteria: | |
| Valve Override Signal Drive Settings (Analog I/O versions only) | | |
| Floating/Unconnected: | Instrument controls valve to command setpoint | |
| VOR< 1.40 Vdc: | Valve Closed | |
| 1.70 Vdc< VOR< 2.90 Vdc: | Valve Normal | |
| VOR>3.20 Vdc: | Valve Open | |
| **Valve Override Signal Specifications (Analog I/O versions only)** | | |
| Input Impedence: | 800 kOhms | |
| Absolute Max. input: | -25 Vdc<VOR<25 Vdc (Without damage) | |

| Diagnostics & Display | |
|---|---|
| Status Lights: | MFC Health, Network Status |
| Alarms**: | Sensor Output, Control Valve Output, Over Temperature, Power Surge/Sag, Network Interruption |
| Diagnostic / Service Port: | RS485 via 2.5mm jack |

| Compliance | |
|---|---|
| Environmental Compliance: | CE: EN61326: 2006 (FCC Part 15 & Canada IC-subset of CE testing) |
| | Safety EN61010-1 |
| | RoHS |
| | General, Calibration Traceability |

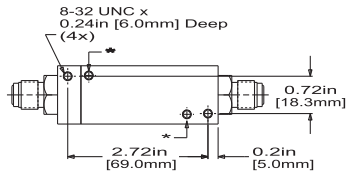
*The Alarm Output is an open collector or "contact type" that is CLOSED (on) whenever an alarm is active. The Alarm Output may be set to indicate any one of various alarm conditions.

**Alarm modes are dependant on the communications interface. These are described in the corresponding digital communication interface manual.



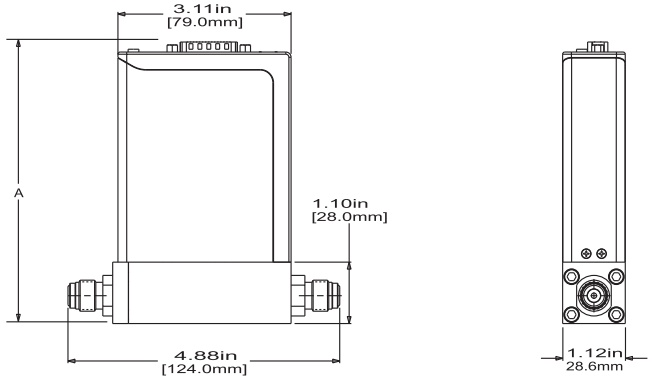

| | Dim "A" in[mm] |
|---|---|
| Analog/RS485 | 5.06 [128.5] |

| Conn. Type | Dim "B" in[mm] |
|---|---|
| 1/4 in TC | 4.94 [125.5] |




*: FOR POSITIONING OF THESE HOLES SEE FMA-7400/7500-SS

*Figure 1-2 Dimensions - FMA-7400/7500*




| | Dim "A" in [mm] |
|---|---|
| Analog / RS485 | 5.06 [128.5] |

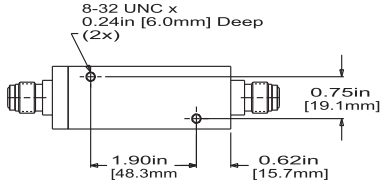



*Figure 1-3 Dimensions - FMA-7400-SS/7500-SS*

*THIS PAGE WAS INTENTIONALLY LEFT BLANK*

## 2-1 General

This section provides installation instructions for the Omega FMA-7400/7500 Series Thermal Mass Flow Devices. The installation process consists of purging the gas supply line prior to installation, unpacking and inspecting the device, connecting the device to the gas supply line and testing for leaks.

## 2-2 Receipt of Equipment

When the instrument is received, the outside packing case should be checked for damage incurred during shipment. If the packing case is damaged, the local carrier should be notified at once regarding their liability. A report should be submitted to your nearest Product Service Department. See inside front cover for contact information for all Omega service centers.

Remove the envelope containing the packing list. Outside of your clean area, carefully remove the equipment from the packing case. Make sure spare parts are not discarded with the packing material. Inspect the contents for damaged or missing parts.

## 2-3 Recommended Storage Practice

If intermediate or long-term storage of the device is required, it is recommended that it be stored in accordance with the following conditions:

- Within the original shipping container.
- Ambient temperature 21°C (70°F) nominal, 32°C (90°F) maximum, 7°C (45°F) minimum.
- Relative humidity 45% nominal, 60% maximum, 25% minimum.

## 2-4 Return Shipment

Prior to returning the device, it must be purged in accordance with the following:

**⚠ WARNING**

**Before returning the device purge thoroughly with a dry inert gas such as Nitrogen before disconnecting gas connections. Failure to correctly purge the instrument could result in fire, explosion or death. Corrosion or contamination may occur upon exposure to air.**

See inside back cover of this manual for additional information.

## 2-5 Transit Precautions

To safeguard against damage during transit, transport the device to the installation site in the same container used for transportation from the factory, if circumstances permit.

# FMA-7400/7500 Series Devices

## 2-6 Removal from Storage

Upon removal of the device from storage, a visual inspection should be conducted to verify its "as-received" condition. If the device has been subject to storage conditions in excess of those recommended (refer to "2-3 Recommended Storage Practice" on p. 2-1), it should be subjected to a pneumatic pressure test in accordance with applicable vessel codes. To maintain a device's clean integrity, this service should be performed by the factory or one of the certified service centers.

## 2-7 Gas Connections

Prior to installation, ensure that all piping is clean and free from obstructions. Install piping in such a manner that permits easy access to the device if removal becomes necessary.

## 2-8 In-Line Filter

It is recommended that an in-line filter be installed upstream from the device to prevent the possibility of any foreign material entering the flow sensor or control valve. The filtering element should be replaced periodically or ultrasonically cleaned.

## 2-9 Mechanical Installation

**⚠ CAUTION**

**When installing the Mass Flow Controller or Meter, care should be taken that no foreign materials enter the inlet or outlet of the instrument. Do not remove the protective end caps until the time of installation.**

The recommended installation procedure guidelines are as follows:

- The device should be located in a clean, dry atmosphere relatively free from shock and vibration.
- Leave sufficient room for access to the user interface and MAC ID and baud rate switches (if equipped) at the top of the device.
- Install the device in such a manner that permits easy purge and removal if the device requires servicing.

**⚠ CAUTION**

**When used with a reactive (sometimes toxic) gas, contamination or corrosion may occur as a result of plumbing leaks or improper purging. Plumbing should be checked carefully for leaks and the instrument purged with clean, dry $N_2$ before use.**

The FMA-7400/7500 Series also utilizes MultiGas/MultiRange technology that allows the user to configure standard configurations ("SAs") or "blanks" for a variety of pure gases and mixtures. As a result, MultiGas/MultiRange technology enables the user to reduce unique inventory requirements.

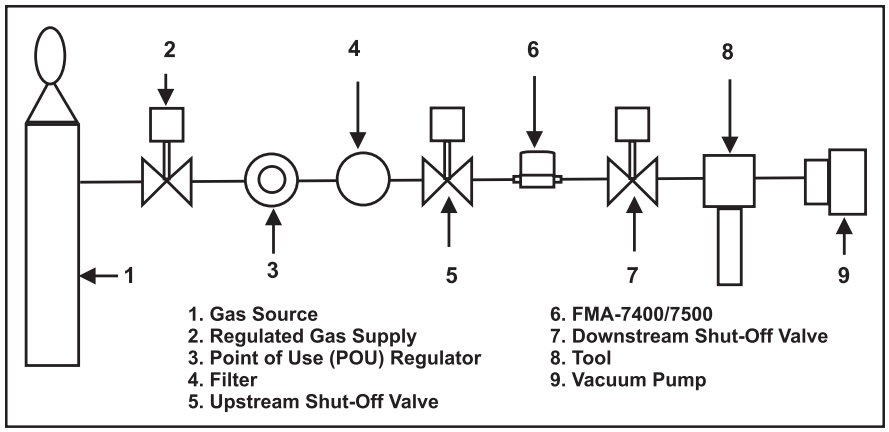



*Figure 2-1 Typical Gas Supply Arrangement*

## 2-10 Flow Controller Installation Arrangement

Typical gas supply arrangements are shown in Figure 2-1. FMA-7400/7500 Series devices are often arranged inside a gas panel. Configure standard configurations ("SAs") or "blanks" for a variety of pure gases and mixtures. As a result, MultiGas/MultiRange technology enables the user to reduce unique inventory requirements

## 2-11 Purge the Gas Supply Line Before FMA-7400/7500 Series Installation

**⚠ CAUTION**

**For additional safety, it is recommended to close the two valves between the charged gas line and the FMA-7400/7500 Series to be installed. See Figure 2-1 for more details.**

**⚠ NOTICE**

**It is recommended to archive service and calibration documentation for the FMA-7400/7500 Series in order to determine the contamination state of each gas line and to assist service personnel.**

**⚠ CAUTION**

**DO NOT remove the shipping caps covering the inlet/outlet for VCR fittings, or DO NOT remove the blue tape on the bottom of the device for downported fittings before the FMA-7400/7500 Series is actually being installed. Failure to comply will introduce contaminants into the FMA-7400/7500 Series.**

Before operating the FMA-7400/7500 Series, the gas supply line must be completely purged with nitrogen or argon to ensure the line is free from

toxic or flammable gases, contaminants, moisture, and oxygen. The purge gas must be free of moisture and oxygen to less than 100 ppb. Purge the gas lines as follows or in accordance with prescribed company and safety procedures.

1. Shut off the process gas supply valve(s) upstream of the FMA-7400/7500 Series. If such a valve is not available, shut the valve on the gas panel. Tag the valve at this point to prevent accidental re-exposure of the process gas to the gas line.
2. Cycle purge the gas line with dry nitrogen or argon to fully flush out the process gas. Cycle purging consists of evacuating to a low pressure adequate to induce out-gassing and then purging to remove adhered moisture and oxygen. If a toxic or reactive gas is present and a clogged FMA-7400/7500 Series is suspected, then proceed with caution. Pump down and purge the FMA-7400/7500 Series from both downstream and upstream lines. If check valves are present in the gas line, both pumping down and purging are required. Pumping down without purging is inadequate. If a good vacuum source is not available, the FMA-7400/7500 Series can be decontaminated by purge only.
3. Repeat the purge cycle several times within 2-4 hours to complete the cleaning. For toxic and corrosive gasses, it is recommended to use 100-120 cycles.

### 2-12 Position and Mount the FMA-7400/7500 Series

It is recommended that the MFC is re-zeroed with process gas following the recommended procedure refer to Sections 2-15 and 2-16 for zeroing process.

If your FMA-7400/7500 Series is configured with in-line fittings, secure the FMA-7400/7500 Series block to the gas panel with two, 8-32-UNC-2B" screws. Then connect the inlet/ outlet fittings to the gas supply line using two wrenches. Tighten the fittings to manufacturer recommendations.

### 2-13 Perform a Leak Test

**⚠WARNING**

**Before operating the flowmeter, ensure all fluid connections have been properly tightened and, where applicable, all electrical connections have been properly terminated.**

It is critical to leak test the gas supply lines and FMA-7400/7500 Series connections before turning on the process gas supply after any new installation. Check for leaks using a helium leak detector or any other appropriate leak test method. Follow leak test specifications as defined by integrator.

## 2-14 Performance Checks

This section describes how to zero and sequence the FMA-7400/7500 Series devices for proper operation.

**⚠ NOTICE**

**If the FMA-7400/7500 Series has been in the purge mode for a long period of time, wait until the FMA-7400/7500 Series has cooled down before zeroing. The cool down period should be ~30 minutes for purges up to five minutes and at least 60 minutes after longer purging.**

- The FMA-7400/7500 Series must be warmed up for at least 45 minutes.
- The active gas page must be correct.

## 2-15 Zeroing Setup Process

The following steps are required before the FMA-7400/7500 Series is zeroed.

1. Place the FMA-7400/7500 under normal inlet operating pressure.
2. Make sure that the FMA-7400/7500 Series has been installed inside the equipment (panel) for at least four hours and powered up at least one hour prior to zeroing. This insures that the FMA-7400/7500 Series is in its "use attitude" and is operating at normal temperature. If the FMA-7400/7500 Series is subjected to a vacuum purge for more than one minute, turn off the FMA-7400/7500 Series (i.e., provide a zero setpoint) for a time period of twice the vacuum purge time.
3. Refer to Figure 2-1. Open the upstream shut-off valve (5) and close the downstream shut-off valve (7). This eliminates a pressure drop across the FMA-7400/7500 Series and subsequent leakage from the PID control valve inside the FMA-7400/7500 Series.
4. Provide a 100% setpoint to the FMA-7400/7500 Series for no longer than 30 seconds. This equalizes the pressure across the PID control valve.
5. Refer to Figure 2-1. Close the upstream shut-off valve (5) to prevent any pressure effects from the regulator (3).
6. Close the FMA-7400/7500 Series and wait two minutes.
7. Read the output signal of the FMA-7400/7500 Series in percent of full scale. This output signal is the initial flow. The output signal should be 0.0 (± 0.1%). If the output signal is too high, re-zero the FMA-7400/7500 Series as described in Section 2-16.

# FMA-7400/7500 Series Devices

## 2-16 Zeroing the FMA-7400/7500 Series

**⚠ NOTICE**

**Make sure you perform the zeroing set-up process outlined in Section 2-15 before zeroing the FMA-7400/7500 Series.**

1. Allow time for gas pressure to equalize across the MFC's internal control valve to ensure gas movement.
2. Press and hold down the Zero button, shown in Figure 2-2, for a minimum of 5 seconds.

## 2-17 Auto Shut-Off

The Auto Shut-off feature closes the FMA-7400/7500 Series' valve when the set point drops below 1.5% of full scale. When the Auto Shut-off feature is NOT chosen, then the FMA-7400/7500 Series' valve will shut off when the set point drops below 0.5% of full scale.

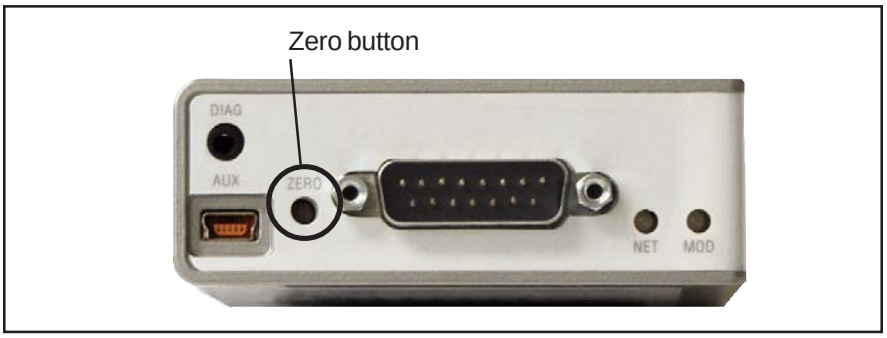



*Figure 2-2 Zero Button Accessible at Top of Device*

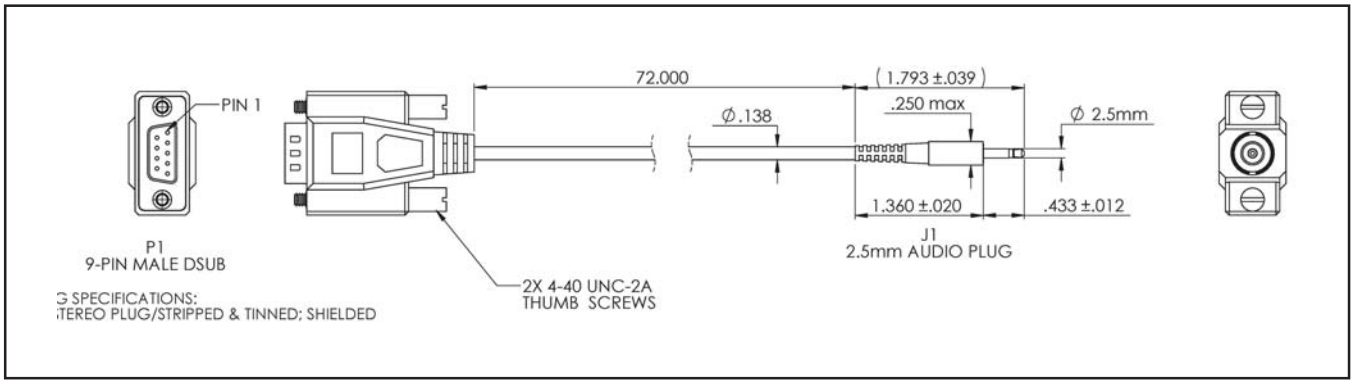



*Figure 2-3 Cable Adaptor*

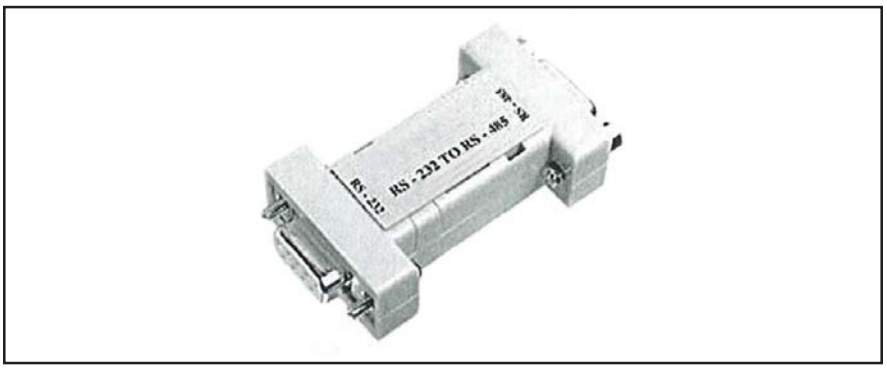



*Figure 2-4 RS232/RS485 Converter*


*Figure 2-5 Diagnostic Port*

## 2-18 Using the Configurator

The Configurator application is used to configure the gas and range of the FMA-7400/7500 Series devices.

The Configurator application allows communication to FMA-7400/7500 Series devices through personal computer with serial COM Port and a Windows XP or Windows 7 operating system. It's primary function is to configure gas and flow ranges within defined standard configurations. Flow ranges are configured to the Nitrogen equivalent.

Using the Configurator software, configure the gas and flow rate according to Table 2-2.

The Configurator interfaces to the FMA-7400/7500 Series device through RS485. There are various ways to connect the device regardless of device configuration. Devices may be connected through the diagnostic port using cables in one of the two Basic Configurator Kits.

**Configurator Accessory Kits:**

**FMA745-CK** **Basic Configurator Kit**

(Includes software, Configurator Cable Assembly 2.5 mm, Converter 232/485)

**FMA745-CK-P** **Basic Configurator Kit w/Power Supply and Adaptor Cables**

(Includes software, Configurator Cable Assembly 2.5 mm, Converter 232/485, Power Supply, 24 Vdc with DB-15 Female)

## FMA-7400/7500 Series Devices

Connect the cable adapter 2.5-mm jack to the diagnostic port on the top of the device. See Figure 2-5.

Connect the RS485 end of the converter to the 15-pin RS485 end of the Cable Adapter.

Connect the RS232 end of the converter to the Serial Port of a laptop or PC.

The latest Configurator Software and Databases and Configurator manual are available on the Omega Engineering website at: www.Omega.com/ftp/FlowGroup/Products/. Please reference the Configurator manual for installation and operation details. Download the Configurator software into your computer from the Omega Engineering website www.Omega.com/ftp/FlowGroup/Products/. Install the Configurator as described in the Configurator manual and use the guide as a reference for operation details.

**⚠ CAUTION**

**DO NOT make any connections to unlabeled connector pins. Any failure to comply could damage the FMA-7400/7500 Series and/or the mating electrical device. Before connecting the cable, make sure that all pin connections of the mating cable have the same pin out connections. When installing and removing cables to and from your computer, make sure the power is turned off on your computer. This will prevent damage to your computer and associated equipment.**

*Table 2-1 Gas and Flow Ranges - Configurable - N2 Equivalent*

| Standard MG-MR Bin Configurations | Flow Range Code | Gas Flow Range (N2 Equivalent) | FMA Model |
|---|---|---|---|
| SA40 | 010C | 3-10 sccm | 7402/7502 |
| SA41 | 030C | 11-30 sccm | 7403/7503 |
| SA42 | 092C | 31-92 sccm | 7404/7504 |
| SA43 | 280C | 93-280 sccm | 7405/7505 |
| SA44 | 860C | 281-860 sccm | 7406/7506 |
| SA45 | 2.6L | 861-2600 sccm | 7407/7507 |
| SA46 | 7.2L | 2601-7200 sccm | 7408/7508 |
| SA47 | 015L | 7201-15000 sccm | 7409/7509 |
| SA48 | 030L | 15001-30000 sccm | 7410/7510 |
| SA50 | 050L | 30001-40000 sccm | 7411/7511 |

### 2-19 Electrical Connections

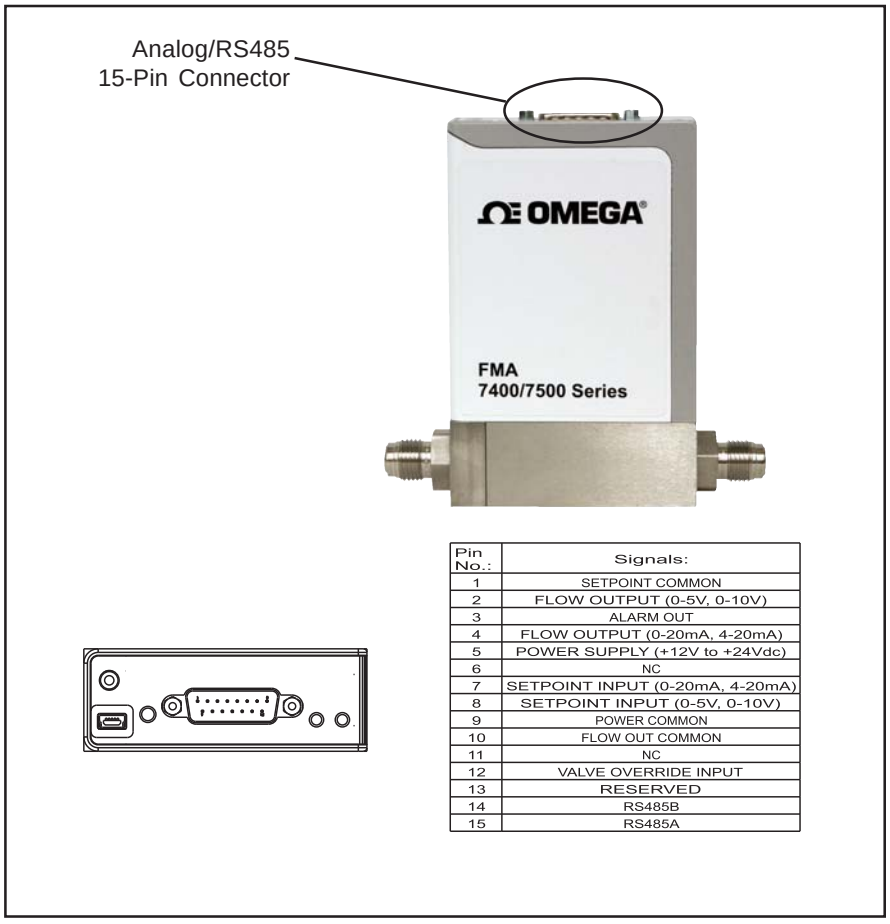
**⚠ CAUTION**

**DO NOT apply more than 10 Inch-Pounds of torque to the cable coupling when connecting the cable to the device or damage may result to the connector.**

### 2-19-1 Analog/RS485 Connections

The FMA-7400/7500 Series devices are available with the Analog/RS485 15-Pin D-Connector shown in Figure 2-6.

It is recommended that when using -15 Vdc & 0, the wiring hook-up should be: -15V is connected to Pin 9 (POWER COMMON) and 0 is connected to Pin 5 (POWER SUPPLY(+12 to +24 VDC)).




| Pin No.: | Signals: |
|---|---|
| 1 | SETPOINT COMMON |
| 2 | FLOW OUTPUT (0-5V, 0-10V) |
| 3 | ALARM OUT |
| 4 | FLOW OUTPUT (0-20mA, 4-20mA) |
| 5 | POWER SUPPLY (+12V to +24Vdc) |
| 6 | NC |
| 7 | SETPOINT INPUT (0-20mA, 4-20mA) |
| 8 | SETPOINT INPUT (0-5V, 0-10V) |
| 9 | POWER COMMON |
| 10 | FLOW OUT COMMON |
| 11 | NC |
| 12 | VALVE OVERRIDE INPUT |
| 13 | RESERVED |
| 14 | RS485B |
| 15 | RS485A |

*Figure 2-6 FMA-7400/7500 Series with 15-Pin Analog Connector and Pinouts*

*THIS PAGE WAS INTENTIONALLY LEFT BLANK*

## 3-1 General

After the device has been properly installed in the process, it is ready for operation. When initiating flow, slowly open any upstream shutoff valve to avoid a flow surge. A bypass is helpful in bringing the flow on smoothly. Avoid starting a pump to supply the device without the use of a valve upstream of the device.

**⚠ CAUTION**

**Any sudden change in system pressure may cause mechanical damage to elastomer materials. Damage can occur when there is a rapid expansion of fluid that has permeated elastomer materials. The user must take the necessary precautions to avoid such conditions.**

**⚠ WARNING**

**Before operating the flow controller, ensure all gas connections have been properly tightened and, where applicable, all electrical connections have been properly terminated.**

## 3-2 Theory of Operation for Flow Measurement

The thermal mass flow measurement system consists of two components: the restrictor or bypass and the flow sensor. Figure 3-1 is a diagram of the flow stream through the device, with an enlarged view of the flow sensor. Gas flow entering the device is separated into two paths; one straight through the restrictor and the other through the flow sensor.

The separation of the flow streams is caused by the restrictor. During flow conditions, there will be a pressure differential across the restrictor that forces gas to flow in the sensor.

The pressure difference caused by the restrictor varies linearly with total flow rate. The sensor has the same linear pressure difference versus flow relationship. The ratio of sensor flow to the flow through the restrictor remains constant over the range of the device. The full scale flow rate of the device is established by selecting a restrictor with the correct pressure differential for the desired flow.

The flow sensor is a very narrow, thin-walled Hastelloy tube. This tube has upstream and downstream temperature sensing and heating elements. During no-flow conditions, the amount of heat reaching each temperature sensor is equal, so temperatures T1 and T2 (Figure 3-1) are equal. Gas flowing through the tube carries heat away from the upstream temperature sensor and toward the downstream sensor. The temperature difference, T2 – T1, is directly proportional to the gas mass flow.

## FMA-7400/7500 Series Devices

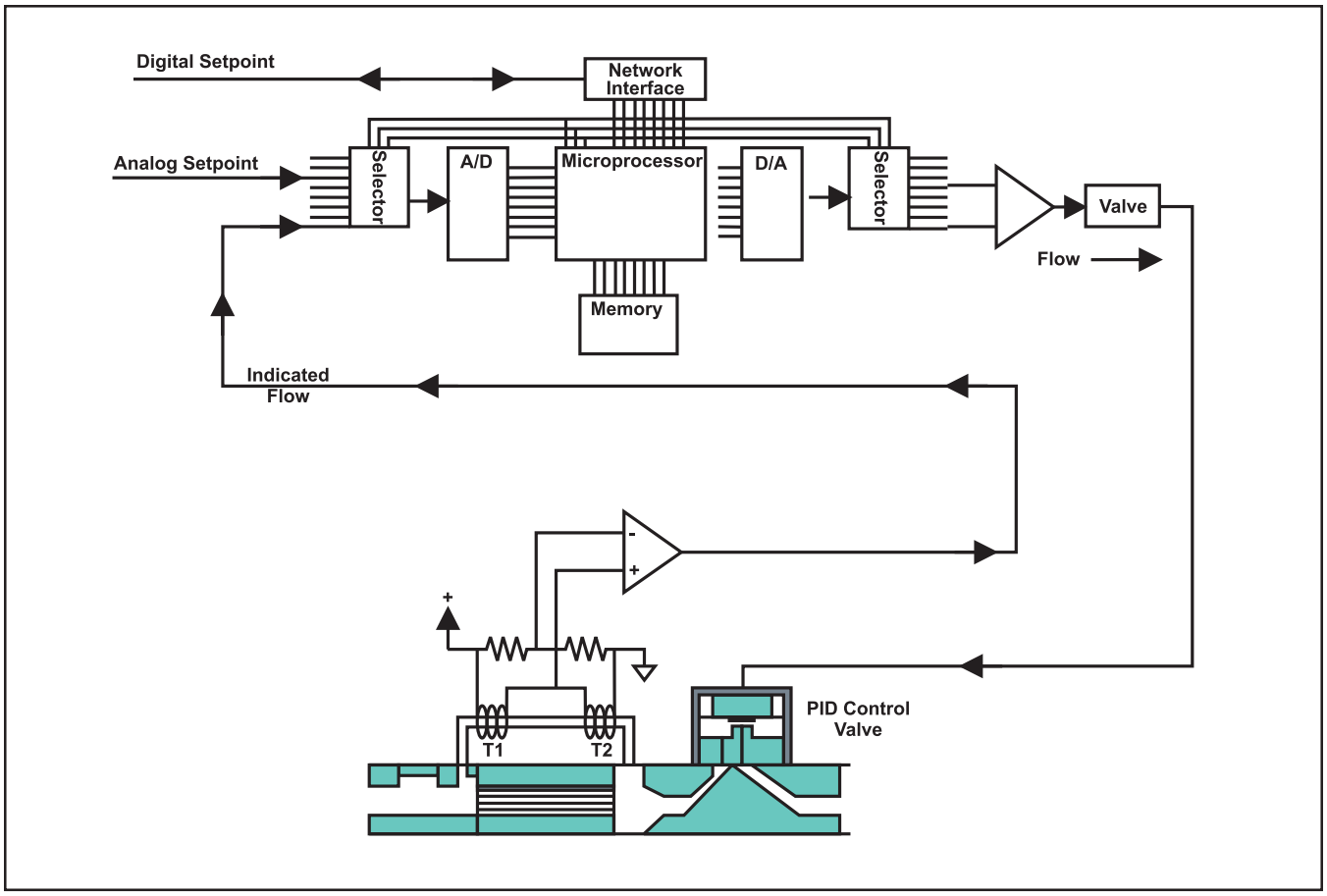
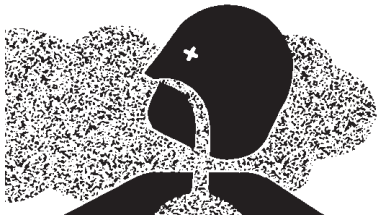



*Figure 3-1 FMA-7400/7500 Series Operating Principles*

## 4-1 Overview

No routine maintenance is required on the Omega FMA-7400/7500 Series devices. If an in-line filter is used, the filtering elements should be periodically replaced or cleaned. Any precision unit such as a flow controller requires occasional servicing, especially if it has been operating for an extended period of time. If reactive gases are being used, it is recommended that you send the device to Omega Engineering for cleaning and recalibration. Please follow the instructions for removal, product packaging and product return instructions found in Section 2 - Installation. All active process instrumentation and equipment is subject to aging and wear from their environment. This includes temperature, mechanical stress, component tolerance shift, contaminant buildup, oxidation, and other influences. The effects are gradual, but over time the changes can affect the accuracy of even the best equipment. Therefore, it is recommended to re-zero the device at 6 month intervals. Refer to Section 2-14 Performance Checks for re-zeroing instructions.

## 4-2 Maintenance



**⚠ WARNING**

**METER/CONTROLLER SEAL COMPATIBILITY**

**Products in this manual may contain metal or elastomeric seals, gaskets, O-rings or valve seats. It is the "user's" responsibility to select materials that are compatible with their process and process conditions. Using materials that are not compatible with the process or process conditions could result in the Meter or Controller leaking process fluid outside the pressure boundary of the device, resulting in personnel injury or death.**

**It is recommended that the user check the Meter or Controller on a regular schedule to ensure that it is leak free as both metal and elastomeric seals, gaskets, O-rings and valve seats may change with age, exposure to process fluid, temperature, and /or pressure.**

## FMA-7400/7500 Series Devices

**⚠ WARNING**

**If it becomes necessary to remove the controller from the system after exposure to toxic, pyrophoric, flammable or corrosive gas, purge the controller thoroughly with a dry inert gas such as Nitrogen before disconnection the gas connections. Failure to correctly purge the controller could result in fire, explosion or death. Corrosion or contamination of the mass flow controller, upon exposure to air, may also occur.**

**⚠ WARNING**

**If it becomes necessary to remove the instrument from the system, power to the device must be disconnected.**

**⚠ CAUTION**

**It is important that this device only be serviced by properly trained and qualified personnel.**

**⚠ CAUTION**

**This instrument contains electronic components that are susceptible to damage by static electricity. Proper handling procedures must be observed during the removal, installation or other handling of internal circuit boards or devices.**

### 4-3 Troubleshooting

This section includes a Troubleshooting Checklist and a FMA-7400/7500 Series Troubleshooting Guide that identifies symptoms, possible causes, and corrective actions.

**⚠ NOTICE**

**OEM tool problems are often caused by something other than the FMA-7400/7500 Series. Therefore, it is recommended that you review both the Troubleshooting Checklist and the FMA-7400/7500 Series Troubleshooting Guide before removing the FMA-7400/7500 Series from your system. It is also suggested to contact your Omega Engineering Service representative before removing the FMA-7400/7500 Series from your system.**

## 4-4 Troubleshooting Checklist

1. Check environmental factors that could affect changes to FMA-7400/7500 Series performance. The most common environmental factors are listed in Table 4-1.
2. Check supply voltage and check for a consistent ground.
3. Verify isolations valves are open and the gas supply is turned on. Then verify operating pressures are within operating ranges.
4. Check FMA-7400/7500 Series voltage response by moving the setpoint back and forth.
   Observe for voltage changes.

*Table 4-1 Environmental Factors*

| **FMA-7400/7500 Series Performance** | **Possible Causes** |
|---|---|
| Inaccurate flow. | Temperature shift (steady state or transient).<br>Inlet pressure shift (steady state or transient).<br>Power supply problem.<br>Electrical interference<br>Dirty gas chamber<br>Changes in gas. |
| Control problems. Can not reach setpoint.<br>Oscillation. | Differential pressure not within operating range<br>Inlet pressure not stable |
| Zeroing problems, Indicated zero is not stable. | Temperature shift (steady state or transient).<br>Inlet pressure shift (steady state or transient).<br>Power supply problem.<br>Electrical interference |

# FMA-7400/7500 Series Devices

### 4-5 FMA-7400/7500 Series Troubleshooting Guide

*Table 4-2 FMA-7400/7500 Series Troubleshooting Guide*

| Symptoms & Possible Causes | Corrective Action |
|---|---|
| **1. No gas flow.** | |
| Is the gas supply turned on? | Check shut-off valve and pressure readout. Open the gas supply. |
| Is the regulator turned on at the correct operating pressure? | Turn off the regulator and reset it to the recommended pressure as described in the Data Sheet. |
| Are any upstream or downstream shut-off valves closed, either by the system or because of failure? | Verify that the valves are open and operating properly. |
| Is the MOD LED light on the FMA-7400/7500 lit solid green? | Observe the LED display panel on top of the FMA-7400/7500 device to verify. If the LED light is not lit, cycle power the to reboot device. |
| Is the commanded setpoint at 0.00 Vdc? | Verify. |
| Has the valve been commanded off by an active “valve closed” input? | Verify.<br>Confirm that pin 12 is not connected to DC common. |
| **2. Flow out of range.** | |
| Is the gas inlet/outlet pressure differential either too high or too low?<br><br>NOTE: If the differential pressure is too high, voltage to the valve will be zero, which is abnormally low for the setpoint. If the differential is too low, voltage to the valve will be at its maximum value, which is abnormally high for the set-point. | Verify that the pressure is correct for the gas and range. If required, adjust inlet/outlet pressure to achieve proper pressure reading. |
| Is the MOD LED light on the FMA-7400/7500 lit solid green? | Observe the LED at the top of the FMA-7400/7500 device. If the LED light is not lit, cycle power the device to reboot. |
| Is the setpoint correct for the required gas flow? | Verify the analog signal. |
| Is the device calibrated for the particular gas? | Check the device side label. Run a flow check to verify. |

*Table 4-2 FMA-7400/7500 Series Troubleshooting Guide (Continued)*

| **Symptoms & Possible Causes** | **Corrective Action** |
|---|---|
| **2. Flow out of range (Continuted).** | |
| Is the device zero correct? | Zero the device according to zeroing procedure in Section 2-16. Verify leak check rates are OK. |
| **3. No gas control; flow is at or above maximum.** | |
| Is the gas pressure across the device too high? | Verify that the pressure is correct for the gas and range. If required, adjust inlet/outlet pressure to achieve proper pressure reading. |
| Are system valves open, or is the purge input activated? | Verify.<br>Confirm that pin 12 is not connected to an active voltage source. |
| Is the setpoint correct for the required flow? | Verify. |
| **4. No gas flow above some setpoint.** | |
| NOTE: When the setpoint is increased beyond this point, the FMA-7400/7500 Series signal remains at some value lower than the set-point. | |
| Is the gas inlet/outlet differential pressure sufficient?<br><br>NOTE: If the pressure is too low, the valve voltage to the FMA-7400/7500 Series will be at its maximum output. This condition will cause internal FMA valve heating and inability to properly reach desired flow setpoints. | Verify that the pressure is correct for the gas and range. If required, adjust regulator to achieve proper pressure. |
| Is the FMA-7400/7500 Series calibrated for the gas flow? | Check FMA-7400/7500 Series side label. Run a flow check to verify. If flow is incorrect, replace the FMA-7400/7500 Series with a unit that is calibrated properly. |

## FMA-7400/7500 Series Devices

*Table 4-2 FMA-7400/7500 Series Troubleshooting Guide (Continued)*

| Symptoms & Possible Causes | Corrective Action |
|---|---|
| **5. No gas flow below some setpoint.** | |
| NOTE: When the setpoint is decreased below this point, the FMA-7400/7500 Series signal remains at some value higher than the setpoint.<br><br>Is the gas inlet/outlet differential pressure too high? | Verify that the pressure is correct for regulator to achieve proper pressure. |
| Is the FMA-7400/7500 Series leaking? | Check for contamination. Test the FMA-7400/7500 Series for leak integrity. Replace the FMA-7400/7500 Series if leakage is detected. |
| **6. Gas flow oscillates.** | |
| Is the FMA-7400/7500 Series calibrated for the gas flowing? | Check the FMA-7400/7500 Series side can label. Run a flow check to verify. If flow is incorrect, replace the FMA-7400/7500 Series. |
| Is there too much gas pressure across the FMA-7400/7500 Series? | Verify that the pressure is correct for this gas and range. If required, adjust regulator to achieve proper pressure reading. |
| Are inlet and outlet pressures stable? | If outlet pressure is unstable, check for (no oscillation or hunting) a faulty vacuum pump, or hunting at a downstream valve.<br><br>Check inlet pressure. A faulty pressure regulator can make the FMA-7400/7500 Series appear to oscillate.<br><br>Adjust inlet pressure up or down by 2 psig increments until hunting disappears. Verify common gas pressure is within range.<br><br>NOTE: Hunting or oscillation can be contributed to multiple FMA-7400/7500 Series sharing a common gas manifold. Therefore, inspect gas delivery sources to the gas box (for example; sharing a common gas bottle and calling for gas at the same time). Valve leak. Unregulated gas pressure from Facilities. |

*Table 4-2 FMA-7400/7500 Series Troubleshooting Guide (Continued)*

| Symptoms & Possible Causes | Corrective Action |
|---|---|
| **7. Does not read correct FMA-7400/7500 Series zero reading.** | |
| Is the differential pressure across the FMA-7400/7500 Series really zero? Is the supply voltage within specified range? Is the FMA-7400/7500 Series mounted in the proper attitude? Is the flow output signal of the FMA-7400/7500 Series really zero? | FMA-7400/7500 Series valve leakage. Incorrect MFC zero. |
| **8. Zero Drift.** | |
| Improper zero of the FMA-7400/7500 Series? Excessive Valve leakage? **9. Calibration Drift.** | FMA-7400/7500 Series aging or sensor stabilization. Zero is not correct. |
| Gas box temperature too high? Is it linear offset? | Zero is not correct. |
| **10. FMA-7400/7500 Series indicates Overshoot.** | |
| If idle for an extended period of time, high inlet pressure or contamination will cause overshoot on first use. | Purge the line before operating. |
| **11.Indicates the wrong full scale value for FMA-7400/7500 Series.** | |
| Older version of Configurator used to program FMA-7400/7500 Series. | Update Configurator. Refer to Section 2-18. |
| **12. FMA-7400/7500 Series dumps large volume of gas into chamber when setpoint is commanded.** | |
| FMA-7400/7500 Series and pneumatic timing may be offset. FMA-7400/7500 Series overshoots | Change the sequence. |
| **13. Display output doesn't match FMA-7400/7500 Series flow output.** | |
| Cable resistance or read-out impedance causing offset in the display. | Check cables and read out. Eliminate any ground loops. |

*THIS PAGE WAS INTENTIONALLY LEFT BLANK*

## 5-1 Product Description Code

*Table 5-1 FMA-7400/7500 Series Product Description Code Table*

| Omega Model # | Description | Full Scale | Valve | SealSeat | Bin Size |
|---|---|---|---|---|---|
| FMA-7502 | Mass flow meter | 3 to 10 sccm | None | FKM/FKM | SA40 |
| FMA-7503 | Mass flow meter | 11 to 30 sccm | None | FKM/FKM | SA41 |
| FMA-7504 | Mass flow meter | 31 to 92 sccm | None | FKM/FKM | SA42 |
| FMA-7505 | Mass flow meter | 93 to 280 sccm | None | FKM/FKM | SA43 |
| FMA-7506 | Mass flow meter | 281 to 860 sccm | None | FKM/FKM | SA44 |
| FMA-7507 | Mass flow meter | 0.86 to 2.6 lpm | None | FKM/FKM | SA45 |
| FMA-7508 | Mass flow meter | 2.6 to 7.2 lpm | None | FKM/FKM | SA46 |
| FMA-7509 | Mass flow meter | 7.2 to 15 lpm | None | FKM/FKM | SA47 |
| FMA-7510 | Mass flow meter | 15 to 30 lpm | None | FKM/FKM | SA48 |
| FMA-7511 | Mass flow meter | 30 to 50 lpm | None | FKM/FKM | SA50 |
| FMA-7402 | Mass flow controller | 3 to 10 sccm | Normally Closed | FKM/FKM | SA40 |
| FMA-7403 | Mass flow controller | 11 to 30 sccm | Normally Closed | FKM/FKM | SA41 |
| FMA-7404 | Mass flow controller | 31 to 92 sccm | Normally Closed | FKM/FKM | SA42 |
| FMA-7405 | Mass flow controller | 93 to 280 sccm | Normally Closed | FKM/FKM | SA43 |
| FMA-7406 | Mass flow controller | 281 to 860 sccm | Normally Closed | FKM/FKM | SA44 |
| FMA-7407 | Mass flow controller | 0.86 to 2.6 lpm | Normally Closed | FKM/FKM | SA45 |
| FMA-7408 | Mass flow controller | 2.6 to 7.2 lpm | Normally Closed | FKM/FKM | SA46 |
| FMA-7409 | Mass flow controller | 7.2 to 15 lpm | Normally Closed | FKM/FKM | SA47 |
| FMA-7410 | Mass flow controller | 15 to 30 lpm | Normally Closed | FKM/FKM | SA48 |
| FMA-7411 | Mass flow controller | 30 to 50 lpm | Normally Closed | FKM/FKM | SA50 |
| **Standard: 1/4" Compression fitting, atmosphere downstream, RS485 0 to 5 V input/output and Ref Temperature 0C** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| FMA-7502-SS | Mass flow meter | 3 to 10 sccm | None | 316SS/PTFE | SA40 |
| FMA-7503-SS | Mass flow meter | 11 to 30 sccm | None | 316SS/PTFE | SA41 |
| FMA-7504-SS | Mass flow meter | 31 to 92 sccm | None | 316SS/PTFE | SA42 |
| FMA-7505-SS | Mass flow meter | 93 to 280 sccm | None | 316SS/PTFE | SA43 |
| FMA-7506-SS | Mass flow meter | 281 to 860 sccm | None | 316SS/PTFE | SA44 |
| FMA-7507-SS | Mass flow meter | 0.86 to 2.6 lpm | None | 316SS/PTFE | SA45 |
| FMA-7508-SS | Mass flow meter | 2.6 to 7.2 lpm | None | 316SS/PTFE | SA46 |
| FMA-7509-SS | Mass flow meter | 7.2 to 15 lpm | None | 316SS/PTFE | SA47 |
| FMA-7510-SS | Mass flow meter | 15 to 30 lpm | None | 316SS/PTFE | SA48 |
| FMA-7511-SS | Mass flow meter | 30 to 50 lpm | None | 316SS/PTFE | SA50 |
| FMA-7402-SS | Mass flow controller | 3 to 10 sccm | Normally Closed | 316SS/PTFE | SA40 |
| FMA-7403-SS | Mass flow controller | 11 to 30 sccm | Normally Closed | 316SS/PTFE | SA41 |
| FMA-7404-SS | Mass flow controller | 31 to 92 sccm | Normally Closed | 316SS/PTFE | SA42 |
| FMA-7405-SS | Mass flow controller | 93 to 280 sccm | Normally Closed | 316SS/PTFE | SA43 |
| FMA-7406-SS | Mass flow controller | 281 to 860 sccm | Normally Closed | 316SS/PTFE | SA44 |
| FMA-7407-SS | Mass flow controller | 0.86 to 2.6 lpm | Normally Closed | 316SS/PTFE | SA45 |
| FMA-7408-SS | Mass flow controller | 2.6 to 7.2 lpm | Normally Closed | 316SS/PTFE | SA46 |
| FMA-7409-SS | Mass flow controller | 7.2 to 15 lpm | Normally Closed | 316SS/PTFE | SA47 |
| FMA-7410-SS | Mass flow controller | 15 to 30 lpm | Normally Closed | 316SS/PTFE | SA48 |
| FMA-7411-SS | Mass flow controller | 30 to 50 lpm | Normally Closed | 316SS/PTFE | SA50 |
| **Standard for -SS: 1/4 VCR fitting, atmosphere downstream, RS485 0 to 5 V input/output and Ref Temperature 0C** | | | | | |

**Options: Fitting size/type, vacuum or Positive pressure downstream, different communications or input/outputs,**
**Auto shut-off, Auto-zero, Non-standard ref temperature.**

*THIS PAGE WAS INTENTIONALLY LEFT BLANK*

## A-1 FMA-7400/7500 Series Gas Table

*Table A-1 FMA-7400/7500 Series Gas Table - Codes 1-99, Bins SA40 to SA43*

| Gas Symbol | Gas Code | Gas Name | Elastomer seal FMA | Min inlet pressure for vac. exhaust (PSIA) | | | Min inlet pressure for atm. exhaust (PSIA) | | | SA40 | | SA41 | | SA42 | | SA43 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SA40-SA47 | SA48 | SA50 | SA40-SA47 | SA48 | SA50 | Low | High | Low | High | Low | High | Low | High |
| He | 1 | Helium | FKM | 19.7 | 24.7 | 29.7 | 21.3 | 25.1 | 29.7 | 5 | 14 | 15 | 42 | 43 | 128 | 129 | 400 |
| Ne | 2 | Neon | FKM | 24.7 | | | 25.1 | | 14.7 | 5 | 14 | 15 | 42 | 43 | 129 | 130 | 400 |
| Ar | 4 | Argon | FKM | 24.7 | 29.7 | 44.7 | 25.1 | 29.7 | 44.7 | 5 | 14 | 15 | 42 | 43 | 130 | 131 | 400 |
| Kr | 5 | Krypton | FKM | 29.7 | | | 29.7 | | | 4 | 11 | 12 | 32 | 33 | 100 | 101 | 300 |
| Xe | 6 | Xenon | FKM | 24.7 | | | 25.1 | | | 3 | 6 | 7 | 19 | 20 | 58 | 59 | 178 |
| H2 | 7 | Hydrogen | FKM | 14.7 | 14.7 | 19.7 | 18.4 | 18.4 | 21.3 | 3 | 10 | 11 | 30 | 31 | 92 | 93 | 280 |
| Air | 8 | Air | FKM | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 10 | 11 | 30 | 31 | 92 | 93 | 280 |
| CO | 9 | Carbon Monoxide | FKM | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 10 | 11 | 30 | 31 | 92 | 93 | 280 |
| HBr | 10 | Hydrogen Bromide | FKM | 24.7 | | | 25.1 | | | 3 | 8 | 9 | 25 | 26 | 77 | 78 | 235 |
| HCl | 11 | Hydrogen Chloride | EPDM | 24.7 | 40.0 | | 25.1 | 40.0 | | 3 | 10 | 11 | 30 | 31 | 92 | 93 | 280 |
| N2 | 13 | Nitrogen | FKM | 24.7 | 29.7 | 32.7 | 25.1 | 29.7 | 32.7 | 3 | 10 | 11 | 30 | 31 | 92 | 93 | 280 |
| D2 | 14 | Deuterium | FKM | 14.7 | 14.7 | | 18.4 | 18.4 | | 3 | 10 | 11 | 30 | 31 | 94 | 95 | 280 |
| O2 | 15 | Oxygen | FKM | 24.7 | 29.7 | 34.7 | 25.1 | 29.7 | 34.7 | 3 | 10 | 11 | 30 | 31 | 92 | 93 | 280 |
| NO | 16 | Nitric Oxide | FKM,Perfluoroelastomer | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 10 | 11 | 30 | 31 | 92 | 93 | 280 |
| HI | 17 | Hydrogen Iodide | Perfluoroelastomer | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 5 | 6 | 15 | 16 | 46 | 47 | 141 |
| F2 | 18 | Fluorine | - | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 9 | 10 | 27 | 28 | 83 | 84 | 254 |
| Cl2 | 19 | Chlorine | FKM | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 6 | 7 | 19 | 20 | 57 | 58 | 173 |
| H2S | 22 | Hydrogen Sulfide | Perfluoroelastomer | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 8 | 9 | 25 | 26 | 76 | 77 | 232 |
| H2Se | 23 | Hydrogen Selenide | Perfluoroelastomer | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 7 | 8 | 22 | 23 | 66 | 67 | 202 |
| CO2 | 25 | Carbon Dioxide | Buna | 24.7 | 29.7 | 29.7 | 25.1 | 29.7 | 29.7 | 3 | 7 | 8 | 22 | 23 | 69 | 70 | 209 |
| N2O | 27 | Nitrous Oxide | FKM,Buna | 24.7 | 29.7 | 29.7 | 25.1 | 29.7 | 29.7 | 3 | 7 | 8 | 21 | 22 | 65 | 66 | 200 |
| CH4 | 28 | Methane | FKM,Buna | 24.7 | 24.7 | 29.7 | 25.1 | 25.1 | 29.7 | 3 | 8 | 9 | 23 | 24 | 71 | 72 | 215 |
| NH3 | 29 | Ammonia | Neoprene,EPDM | 24.7 | 24.7 | 29.7 | 25.1 | 25.1 | 29.7 | 3 | 8 | 9 | 24 | 25 | 73 | 74 | 223 |
| PH3 | 31 | Phosphine | Perfluoroelastomer | 19.7 | 24.7 | | 21.3 | 25.1 | | 3 | 7 | 8 | 22 | 23 | 67 | 68 | 205 |
| SO2 | 32 | Sulfur Dioxide | EPDM | 19.7 | 24.7 | | 21.3 | 25.1 | | 3 | 6 | 7 | 17 | 18 | 52 | 53 | 157 |
| CH3F | 33 | Methyl Fluoride | FKM | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 7 | 8 | 22 | 23 | 67 | 68 | 204 |
| COS | 34 | Carbonyl Sulfide | FKM | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 7 | 8 | 20 | 21 | 60 | 61 | 183 |
| AsH3 | 35 | Arsine | Perfluoroelastomer | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 6 | 7 | 18 | 19 | 55 | 56 | 170 |
| ClCN | 37 | Cyanogen Chloride | Perfluoroelastomer | 14.7 | 21.7 | | 18.4 | 22.7 | | 3 | 5 | 6 | 15 | 16 | 46 | 47 | 142 |
| C2H4 | 38 | Ethylene | FKM | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 6 | 7 | 17 | 18 | 54 | 55 | 163 |
| SiH4 | 39 | Silane | Perfluoroelastomer | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 6 | 7 | 18 | 19 | 56 | 57 | 170 |
| C2H2 | 42 | Acetylene | FKM | 16.7 | 19.7 | | 19.4 | 21.3 | | 3 | 6 | 7 | 18 | 19 | 57 | 58 | 170 |
| GeH4 | 43 | Germane | - | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 6 | 7 | 17 | 18 | 53 | 54 | 161 |
| COF2 | 46 | Carbonyl Fluoride | FKM | 19.7 | 19.7 | 21.7 | 21.3 | 21.3 | 22.7 | 3 | 5 | 6 | 17 | 18 | 53 | 54 | 160 |
| BF3 | 48 | Boron Trifluoride | Perfluoroelastomer | 19.7 | 24.7 | | 21.3 | 25.1 | | 3 | 5 | 6 | 16 | 17 | 50 | 51 | 150 |
| CHF3 | 49 | Fluoroform (Freon-23) | FKM,Perfluoroelastomer | 24.7 | 24.7 | 26.7 | 25.1 | 25.1 | 26.8 | 3 | 5 | 6 | 16 | 17 | 48 | 49 | 145 |
| NF3 | 53 | Nitrogen Trifluoride | PFA | 24.7 | 29.7 | 26.7 | 25.1 | 29.7 | 26.8 | 3 | 5 | 6 | 15 | 16 | 46 | 47 | 140 |
| B2H6 | 58 | Diborane | Perfluoroelastomer | 19.7 | 19.7 | | 21.3 | 21.3 | | 3 | 4 | 5 | 12 | 13 | 38 | 39 | 116 |
| COCl2 | 60 | Phosgene | Perfluoroelastomer | 12.7 | 14.7 | | 17.4 | 18.4 | | 3 | 3 | 4 | 11 | 12 | 35 | 36 | 106 |
| PF3 | 62 | Phosphorus Trifluoride | - | 19.7 | 24.7 | | 21.3 | 25.1 | | 3 | 4 | 5 | 14 | 15 | 42 | 43 | 129 |
| CF4 | 63 | Carbon Tetrafluoride (Freon-14) | FKM | 24.7 | 24.7 | 26.7 | 25.1 | 25.1 | 26.8 | 3 | 4 | 5 | 13 | 14 | 40 | 41 | 121 |
| SiH2Cl2 | 67 | Dichlorosilane | Perfluoroelastomer | 14.7 | 19.7 | | 18.4 | 21.3 | | 3 | 3 | 4 | 10 | 11 | 29 | 30 | 89 |
| C3H6-b) | 69 | Propylene | FKM | 19.7 | 19.7 | | 21.3 | 21.3 | | 3 | 4 | 5 | 12 | 13 | 36 | 37 | 110 |
| BCl3 | 70 | Boron Trichloride | Perfluoroelastomer | 11.7 | 14.7 | | 17.0 | 18.4 | | 3 | 3 | 4 | 10 | 11 | 31 | 32 | 94 |
| ClO3F | 72 | Perchloryl Fluoride | - | 14.7 | 20.7 | | 18.4 | 22.0 | | 3 | 4 | 5 | 12 | 13 | 38 | 39 | 114 |
| ClF3 | 77 | Chlorine Trifluoride | Perfluoroelastomer | 14.7 | 20.7 | | 18.4 | 22.0 | | 3 | 4 | 5 | 11 | 12 | 35 | 36 | 107 |
| C2H7N | 85 | Dimethylamine | FKM,Perfluoroelastomer | 9.7 | 14.7 | | 16.3 | 18.4 | | 3 | 3 | 4 | 11 | 12 | 34 | 35 | 101 |
| SiF4 | 88 | Silicon Tetrafluoride | - | 19.7 | 24.7 | | 21.3 | 25.1 | | 3 | 4 | 5 | 11 | 12 | 34 | 35 | 103 |
| C3H8 | 89 | Propane | FKM | 9.7 | 11.7 | | 16.3 | 17.0 | | 3 | 3 | 4 | 10 | 11 | 32 | 33 | 100 |
| C2F4 | 94 | Tetrafluoroethylene | FKM,Buna | 19.7 | 19.7 | | 21.3 | 21.3 | | 3 | 3 | 4 | 10 | 11 | 31 | 32 | 100 |
| Si2H6 | 97 | DISILANE | - | 19.7 | 19.7 | | 21.3 | 21.3 | | 3 | 3 | 4 | 10 | 11 | 30 | 31 | 92 |
| GeF4 | 99 | Germanium Tetrafluoride | - | 20.7 | 24.7 | | 22.0 | 25.1 | | 3 | 3 | 4 | 10 | 11 | 30 | 31 | 92 |

For reference only, consult Omega Engineering.

# Appendix A: FMA-7400/7500 Series Gas Table

## FMA-7400/7500 Series Devices

*Table A-2 FMA-7400/7500 Series Gas Table - Codes 108-5022, Bins SA40 to SA43*

| | | | | Min inlet pressure for vac. exhaust (PSIA) | | | Min inlet pressure for atm. exhaust (PSIA) | | | SA40 | | SA41 | | SA42 | | SA43 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gas Symbol | Gas Code | Gas Name | Elastomer seal FMA | SA40-SA47 | SA48 | SA50 | SA40-SA47 | SA48 | SA50 | Low | High | Low | High | Low | High | Low | High |
| SiCl4 | 108 | Silicon Tetrachloride | Perfluoroelastomer | 8.7 | | | 16.0 | | | 0 | 0 | 3 | 6 | 7 | 18 | 19 | 56 |
| C3H9N | 109 | Trimethylamine | Perfluoroelastomer | 6.7 | 8.7 | | 15.5 | 16.0 | | 0 | 0 | 3 | 8 | 9 | 25 | 26 | 78 |
| SF6 | 110 | Sulfur Hexafluoride | FKM,EPDM | 19.7 | 19.7 | 20.7 | 21.3 | 21.3 | 22.0 | 0 | 0 | 3 | 8 | 9 | 25 | 26 | 77 |
| C2F6 | 118 | Hexafluoroethane (Freon-116) | FKM,Buna | 19.7 | 19.7 | | 21.3 | 21.3 | | 0 | 0 | 3 | 8 | 9 | 23 | 24 | 71 |
| WF6 | 121 | Tungsten Hexafluoride | - | 9.7 | 11.7 | | 16.3 | 17.0 | | 0 | 0 | 3 | 5 | 6 | 16 | 17 | 50 |
| C3F8 | 128 | Perfluoropropane | FKM | 19.7 | 19.7 | | 21.3 | 21.3 | | 0 | 0 | 3 | 5 | 6 | 16 | 17 | 50 |
| C4F8 | 129 | Octafluorocyclobutane | FKM | 19.7 | 19.7 | | 21.3 | 21.3 | | 0 | 0 | 3 | 5 | 6 | 16 | 17 | 50 |
| C3F6 | 138 | Hexafluoropropylene | FKM,Buna | 19.7 | 19.7 | | 21.3 | 21.3 | | 0 | 0 | 3 | 6 | 7 | 20 | 21 | 60 |
| C2HF5 | 155 | PENTAFLUOROETHANE (FREON-125) | FKM | 19.7 | 19.7 | | 21.3 | 21.3 | | 0 | 0 | 3 | 8 | 9 | 25 | 26 | 77 |
| CH2F2 | 160 | Difluoromethane | FKM | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 6 | 7 | 19 | 20 | 57 | 58 | 174 |
| CH6Si | 185 | Methylsilane (MONO) | - | 9.7 | 14.7 | | 16.3 | 18.4 | | 3 | 4 | 5 | 12 | 13 | 37 | 38 | 111 |
| (CH3)3SiH | 190 | Trimethylsilane (TMSi) | - | 6.7 | | | 15.5 | | | 0 | 0 | 3 | 7 | 8 | 20 | 21 | 62 |
| C5F8 | 266 | Octafluorocyclopentene | - | 9.7 | 14.7 | | 16.3 | 18.4 | | 0 | 0 | 3 | 5 | 6 | 14 | 15 | 44 |
| C4F6 | 270 | Hexafluoro-2-butyne | - | 9.7 | | | 16.3 | | | 0 | 0 | 3 | 6 | 7 | 19 | 20 | 57 |
| C4F6-q) | 297 | Hexafluoro Butadiene-1-3 | - | 14.7 | 14.7 | | 18.4 | 18.4 | | 0 | 0 | 3 | 6 | 7 | 17 | 18 | 52 |
| C5F8O | 354 | Epoxyperfluorocyclopentene | - | 19.7 | 19.7 | | 21.3 | 21.3 | | 0 | 0 | 3 | 4 | 5 | 13 | 14 | 40 |
| Si3H9N | 368 | Trisilylamine (TSA) | - | 6.0 | 7.2 | | 15.3 | 15.6 | | 0 | 0 | 3 | 6 | 7 | 20 | 21 | 60 |
| 10%GeH4/H2 | 509 | 10%Germane/Hydrogen | MIX-Check components | 20.7 | 20.7 | | 22.0 | 22.0 | | 3 | 9 | 10 | 28 | 29 | 86 | 87 | 260 |
| 10%PH3/H2 | 516 | 10%Phosphine/Hydrogen | MIX-Check components | 14.7 | 14.7 | | 18.4 | 18.4 | | 3 | 9 | 10 | 28 | 29 | 90 | 91 | 275 |
| 4.5%PH3/N2 | 528 | 4.5%Phosphine/Nitrogen | MIX-Check components | 20.7 | 29.7 | | 22.0 | 29.7 | | 3 | 10 | 11 | 30 | 31 | 94 | 95 | 280 |
| 20%O2/He | 536 | 20%Oxygen/Helium | MIX-Check components | 19.7 | 29.7 | | 21.3 | 29.7 | | 4 | 13 | 14 | 38 | 39 | 120 | 121 | 360 |
| 5%H2/N2 | 542 | 5%Hydrogen/Nitrogen | MIX-Check components | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 10 | 11 | 30 | 31 | 92 | 93 | 280 |
| 1%B2H6/H2 | 557 | 1%Diborane Hydrogen | MIX-Check components | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 10 | 11 | 30 | 31 | 91 | 92 | 270 |
| 1%PH3/H2 | 563 | 1%Phosphine/Hydrogen | MIX-Check components | 19.7 | 19.7 | | 21.3 | 21.3 | | 3 | 10 | 11 | 30 | 31 | 90 | 91 | 273 |
| 3%B2H6/N2 | 595 | 3%Diborane/Nitrogen | MIX-Check components | 20.7 | 29.7 | | 22.0 | 29.7 | | 3 | 9 | 10 | 29 | 30 | 90 | 91 | 270 |
| 3%H2/N2 | 597 | 3%Hydrogen/Nitrogen | MIX-Check components | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 10 | 11 | 30 | 31 | 92 | 93 | 280 |
| 30%He/O2 | 603 | 30%Helium/Oxygen | MIX-Check components | 24.7 | 29.7 | | 25.1 | 29.7 | | 4 | 11 | 12 | 33 | 34 | 100 | 101 | 301 |
| 30%O2/He | 604 | 30%Oxygen/Helium | MIX-Check components | 19.7 | 29.7 | | 21.3 | 29.7 | | 4 | 12 | 13 | 37 | 38 | 113 | 114 | 345 |
| 4%H2/He | 606 | 4%Hydrogen/Helium | MIX-Check components | 19.7 | 19.7 | | 21.3 | 21.3 | | 5 | 14 | 15 | 41 | 42 | 126 | 127 | 400 |
| 4%H2/N2 | 607 | 4%Hydrogen/Nitrogen | MIX-Check components | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 10 | 11 | 30 | 31 | 92 | 93 | 280 |
| 5%B2H6/Ar | 615 | 5%Diborane/Argon | MIX-Check components | 24.7 | | | 25.1 | | | 4 | 12 | 13 | 38 | 39 | 116 | 117 | 353 |
| 50%PH3/SiH4 | 632 | 50%Phosphine/Silane | MIX-Check components | 16.7 | 24.7 | | 19.4 | 25.1 | | 3 | 6 | 7 | 20 | 21 | 62 | 63 | 190 |
| 10%O2/He | 649 | 10%Oxygen/Helium | MIX-Check components | 19.7 | 24.7 | | 21.3 | 25.1 | | 5 | 13 | 14 | 41 | 42 | 123 | 124 | 380 |
| 2%SiH4/N2 | 653 | 2%SILANE/NITROGEN | MIX-Check components | 19.7 | 24.7 | | 21.3 | 25.1 | | 3 | 10 | 11 | 30 | 31 | 93 | 94 | 280 |
| 5%B2H6/N2 | 654 | 5%Diborane/Nitrogen | MIX-Check components | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 9 | 10 | 28 | 29 | 86 | 87 | 262 |
| .8%B2H6/N2 | 662 | .8%Diborane/Nitrogen | MIX-Check components | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 10 | 11 | 30 | 31 | 93 | 94 | 280 |
| 10%PH3/He | 674 | 10%Phosphine/Helium | MIX-Check components | 14.7 | 19.7 | | 18.4 | 21.3 | | 4 | 13 | 14 | 40 | 41 | 120 | 121 | 370 |
| 2%B2H6/N2 | 695 | 2%Diborane/Nitrogen | MIX-Check components | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 10 | 11 | 30 | 31 | 93 | 94 | 280 |
| 10%GeH4/Ar | 698 | 10%Germane/Argon | MIX-Check components | 24.7 | 29.7 | | 25.1 | 29.7 | | 4 | 12 | 13 | 38 | 39 | 114 | 115 | 350 |
| 5%H2/He | 762 | 5%Hydrogen/Helium | MIX-Check components | 19.7 | 19.7 | | 21.3 | 21.3 | | 5 | 14 | 15 | 41 | 42 | 125 | 126 | 400 |
| 5%B2H6/He | 766 | 5%Diborane/Helium | MIX-Check components | 14.7 | 16.7 | | 18.4 | 19.4 | | 4 | 12 | 13 | 38 | 39 | 115 | 116 | 350 |
| 15%B2H6/H2 | 820 | 15%Diborane/Hydrogen | MIX-Check components | 14.7 | 14.7 | | 18.4 | 18.4 | | 3 | 8 | 9 | 25 | 26 | 76 | 77 | 230 |
| 3%C2H4/He | 878 | 3%Ethylene/Helium | MIX-Check components | 19.7 | 19.7 | | 21.3 | 21.3 | | 4 | 13 | 14 | 40 | 41 | 125 | 126 | 375 |
| 10%B2H6/Ar | 881 | 5%Diborane/Argon | MIX-Check components | 24.7 | 29.7 | | 25.1 | 29.7 | | 4 | 11 | 12 | 35 | 36 | 105 | 106 | 320 |
| 2.7%C2H4/He | 897 | 2.7%Ethylene/Helium | MIX-Check components | 19.7 | 19.7 | | 21.3 | 21.3 | | 4 | 13 | 14 | 40 | 41 | 125 | 126 | 377 |
| 1%GeH4/H2 | 898 | 1%Germane/Hydrogen | MIX-Check components | 20.7 | 20.7 | | 22.0 | 22.0 | | 3 | 10 | 11 | 30 | 31 | 91 | 92 | 275 |
| .5%GeH4/H2 | 910 | 0.5%Germane/Hydrogen | MIX-Check components | 20.7 | 20.7 | | 22.0 | 22.0 | | 3 | 10 | 11 | 30 | 31 | 92 | 93 | 280 |
| 2%PH3/H2 | 916 | 2%Phosphine/Hydrogen | MIX-Check components | 21.7 | 21.7 | | 22.7 | 22.7 | | 3 | 10 | 11 | 30 | 31 | 91 | 92 | 275 |
| 3.9%H2/N2 | 930 | 3.9%Hydrogen/Nitrogen | MIX-Check components | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 10 | 11 | 30 | 31 | 92 | 93 | 280 |
| 10%B2H6/He | 939 | 10%Diborane/Helium | MIX-Check components | 19.7 | 19.7 | | 21.3 | 21.3 | | 4 | 11 | 12 | 34 | 35 | 103 | 104 | 314 |
| 30%C2H4/He | 946 | 30%Ethylene/Helium | MIX-Check components | 19.7 | 24.7 | | 21.3 | 25.1 | | 3 | 10 | 11 | 30 | 31 | 90 | 91 | 275 |
| 10%H2/He | 950 | 10%Hydrogen/Helium | MIX-Check components | 19.7 | 19.7 | | 21.3 | 21.3 | | 4 | 13 | 14 | 40 | 41 | 125 | 126 | 380 |
| 15%H2/B2H6 | 953 | 15%Hydrogen/Diborane | MIX-Check components | 19.7 | 19.7 | | 21.3 | 21.3 | | 3 | 4 | 5 | 14 | 15 | 42 | 43 | 130 |
| 17%CH4/CO2 | 958 | 17%Methane/Carbon Dioxide | MIX-Check components | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 7 | 8 | 23 | 24 | 70 | 71 | 210 |
| 20%CH6Si/H2 | 962 | 20%Methylsilane (MONO)/Hydrogen | MIX-Check components | 14.7 | 19.7 | | 18.4 | 21.3 | | 3 | 7 | 8 | 23 | 24 | 71 | 72 | 212 |
| 50%CH3SiHCl2/H2 | 965 | 50%Dichloromethylsilane/Hydrogen | MIX-Check components | 11.7 | 13.7 | | 17.0 | 17.9 | | 3 | 4 | 5 | 14 | 15 | 42 | 43 | 130 |
| 20%GeH4/H2 | 978 | 20%Germane/Hydrogen | MIX-Check components | 19.7 | 24.7 | | 21.3 | 25.1 | | 3 | 8 | 9 | 26 | 27 | 81 | 82 | 241 |
| 0.5%B2H6/He | 979 | 0.5%Diborane/Helium | MIX-Check components | 14.7 | 19.7 | | 18.4 | 21.3 | | 5 | 14 | 15 | 42 | 43 | 130 | 131 | 400 |
| COS-Special | 5022 | Carbonyl Sulfide (Special) | - | 24.7 | 29.7 | | 25.1 | 29.7 | | 3 | 7 | 8 | 20 | 21 | 60 | 61 | 183 |

For reference only, consult Omega Engineering.

*Table A-3 FMA-7400/7500 Series Gas Table - Codes 1-99, Bins SA44 to SA50*

| Gas Symbol | Gas Code | Gas Name | Elastomer seal FMA | SA44 | | SA45 | | SA46 | | SA47 | | SA48 | | SA50 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Low | High | Low | High | Low | High | Low | High | Low | High | Low | High |
| He | 1 | Helium | FKM | 401 | 1194 | 1195 | 3609 | 3610 | 11100 | 11101 | 23100 | 23101 | 47000 | 47001 | 90900 |
| Ne | 2 | Neon | FKM | 401 | 1207 | 1208 | 3650 | 3651 | 10700 | 10701 | 22100 | x | x | x | x |
| Ar | 4 | Argon | FKM | 401 | 1214 | 1215 | 3671 | 3672 | 10000 | 10001 | 20200 | 20201 | 41000 | 41001 | 50001 |
| Kr | 5 | Krypton | FKM | 301 | 930 | 931 | 2800 | 2801 | 7160 | 7161 | 14901 | x | x | x | x |
| Xe | 6 | Xenon | FKM | 179 | 546 | 547 | 1651 | 1652 | 4210 | 4211 | 8761 | x | x | x | x |
| H2 | 7 | Hydrogen | FKM | 281 | 860 | 861 | 2600 | 2601 | 8000 | 8001 | 16400 | 16401 | 33000 | 33001 | 66301 |
| Air | 8 | Air | FKM | 281 | 860 | 861 | 2600 | 2601 | 7400 | 7401 | 15000 | 15001 | 30001 | x | x |
| CO | 9 | Carbon Monoxide | FKM | 281 | 860 | 861 | 2600 | 2601 | 7300 | 7301 | 15000 | 15001 | 30001 | x | x |
| HBr | 10 | Hydrogen Bromide | FKM | 236 | 723 | 724 | 2187 | 2188 | 5610 | 5611 | 11701 | x | x | x | x |
| HCl | 11 | Hydrogen Chloride | EPDM | 281 | 860 | 861 | 2600 | 2601 | 6900 | 6901 | 14200 | 14201 | 29001 | x | x |
| N2 | 13 | Nitrogen | FKM | 281 | 860 | 861 | 2600 | 2601 | 7200 | 7201 | 15000 | 15001 | 30000 | 30001 | 50001 |
| D2 | 14 | Deuterium | FKM | 281 | 880 | 881 | 2600 | 2601 | 8100 | 8101 | 16500 | 16501 | 33001 | x | x |
| O2 | 15 | Oxygen | FKM | 281 | 860 | 861 | 2600 | 2601 | 7200 | 7201 | 15000 | 15001 | 30000 | 30001 | 50001 |
| NO | 16 | Nitric Oxide | FKM,Perfluoroelastomer | 281 | 860 | 861 | 2600 | 2601 | 7200 | 7201 | 15000 | 15001 | 30001 | x | x |
| HI | 17 | Hydrogen Iodide | Perfluoroelastomer | 142 | 432 | 433 | 1305 | 1306 | 3340 | 3341 | 6960 | 6961 | 13901 | x | x |
| F2 | 18 | Fluorine | - | 255 | 780 | 781 | 2358 | 2359 | 6700 | 6701 | 14000 | 14001 | 28001 | x | x |
| Cl2 | 19 | Chlorine | FKM | 174 | 531 | 532 | 1604 | 1605 | 4850 | 4851 | 10100 | 10101 | 20201 | x | x |
| H2S | 22 | Hydrogen Sulfide | Perfluoroelastomer | 233 | 713 | 714 | 2155 | 2156 | 5900 | 5901 | 12100 | 12101 | 24101 | x | x |
| H2Se | 23 | Hydrogen Selenide | Perfluoroelastomer | 203 | 620 | 621 | 1874 | 1875 | 4770 | 4771 | 10000 | 10001 | 20001 | x | x |
| CO2 | 25 | Carbon Dioxide | Buna | 210 | 642 | 643 | 1942 | 1943 | 5300 | 5301 | 11000 | 11001 | 22000 | 22001 | 35401 |
| N2O | 27 | Nitrous Oxide | FKM,Buna | 201 | 611 | 612 | 1849 | 1850 | 5100 | 5101 | 10400 | 10401 | 21000 | 21001 | 33601 |
| CH4 | 28 | Methane | FKM,Buna | 216 | 660 | 661 | 2000 | 2001 | 5800 | 5801 | 12000 | 12001 | 24000 | 24001 | 41801 |
| NH3 | 29 | Ammonia | Neoprene,EPDM | 224 | 685 | 686 | 2072 | 2073 | 6000 | 6001 | 12200 | 12201 | 25000 | 25001 | 41801 |
| PH3 | 31 | Phosphine | Perfluoroelastomer | 206 | 629 | 630 | 1901 | 1902 | 5200 | 5201 | 10700 | 10701 | 21301 | x | x |
| SO2 | 32 | Sulfur Dioxide | EPDM | 158 | 483 | 484 | 1459 | 1460 | 3800 | 3801 | 7920 | 7921 | 15801 | x | x |
| CH3F | 33 | Methyl Fluoride | FKM | 205 | 625 | 626 | 1890 | 1891 | 5200 | 5201 | 10600 | 10601 | 21201 | x | x |
| COS | 34 | Carbonyl Sulfide | FKM | 184 | 562 | 563 | 1700 | 1701 | 4500 | 4501 | 9400 | 9401 | 18301 | x | x |
| AsH3 | 35 | Arsine | Perfluoroelastomer | 171 | 510 | 511 | 1550 | 1551 | 4000 | 4001 | 8500 | 8501 | 17001 | x | x |
| ClCN | 37 | Cyanogen Chloride | Perfluoroelastomer | 143 | 435 | 436 | 1320 | 1321 | 3400 | 3401 | 7060 | 7061 | 14101 | x | x |
| C2H4 | 38 | Ethylene | FKM | 164 | 501 | 502 | 1516 | 1517 | 4400 | 4401 | 9300 | 9301 | 18201 | x | x |
| SiH4 | 39 | Silane | Perfluoroelastomer | 171 | 523 | 524 | 1581 | 1582 | 4400 | 4401 | 9300 | 9301 | 18201 | x | x |
| C2H2 | 42 | Acetylene | FKM | 171 | 530 | 531 | 1600 | 1601 | 4400 | 4401 | 9300 | 9301 | 18201 | x | x |
| GeH4 | 43 | Germane | - | 162 | 495 | 496 | 1500 | 1501 | 4000 | 4001 | 8400 | 8401 | 16401 | x | x |
| COF2 | 46 | Carbonyl Fluoride | FKM | 161 | 500 | 501 | 1500 | 1501 | 4000 | 4001 | 8400 | 8401 | 16500 | 16501 | 19001 |
| BF3 | 48 | Boron Trifluoride | Perfluoroelastomer | 151 | 457 | 458 | 1381 | 1382 | 3800 | 3801 | 7900 | 7901 | 15501 | x | x |
| CHF3 | 49 | Fluoroform (Freon-23) | FKM,Perfluoroelastomer | 146 | 445 | 446 | 1344 | 1345 | 3600 | 3601 | 7600 | 7601 | 15000 | 15001 | 23601 |
| NF3 | 53 | Nitrogen Trifluoride | PFA | 141 | 430 | 431 | 1300 | 1301 | 3600 | 3601 | 7500 | 7501 | 15000 | 15001 | 23601 |
| B2H6 | 58 | Diborane | Perfluoroelastomer | 117 | 358 | 359 | 1082 | 1083 | 3100 | 3101 | 6400 | 6401 | 12601 | x | x |
| COCl2 | 60 | Phosgene | Perfluoroelastomer | 107 | 325 | 326 | 1000 | 1001 | 2520 | 2521 | 5250 | 5251 | 10501 | x | x |
| PF3 | 62 | Phosphorus Trifluoride | - | 130 | 400 | 401 | 1200 | 1201 | 3200 | 3201 | 6800 | 6801 | 13301 | x | x |
| CF4 | 63 | Carbon Tetrafluoride (Freon-14) | FKM | 122 | 372 | 373 | 1123 | 1124 | 3010 | 3011 | 6400 | 6401 | 12600 | 12601 | 20001 |
| SiH2Cl2 | 67 | Dichlorosilane | Perfluoroelastomer | 90 | 273 | 274 | 824 | 825 | 2140 | 2141 | 4450 | 4451 | 8901 | x | x |
| C3H6-b) | 69 | Propylene | FKM | 111 | 338 | 339 | 1022 | 1023 | 2800 | 2801 | 5900 | 5901 | 11701 | x | x |
| BCl3 | 70 | Boron Trichloride | Perfluoroelastomer | 95 | 289 | 290 | 874 | 875 | 2230 | 2231 | 4650 | 4651 | 9301 | x | x |
| ClO3F | 72 | Perchloryl Fluoride | - | 115 | 350 | 351 | 1060 | 1061 | 2800 | 2801 | 5800 | 5801 | 11501 | x | x |
| ClF3 | 77 | Chlorine Trifluoride | Perfluoroelastomer | 108 | 327 | 328 | 1000 | 1001 | 2560 | 2561 | 5340 | 5341 | 10701 | x | x |
| C2H7N | 85 | Dimethylamine | FKM,Perfluoroelastomer | 102 | 310 | 311 | 960 | 961 | 2530 | 2531 | 5400 | 5401 | 10601 | x | x |
| SiF4 | 88 | Silicon Tetrafluoride | - | 104 | 316 | 317 | 1000 | 1001 | 2600 | 2601 | 5400 | 5401 | 10601 | x | x |
| C3H8 | 89 | Propane | FKM | 101 | 300 | 301 | 910 | 911 | 2420 | 2421 | 5100 | 5101 | 10101 | x | x |
| C2F4 | 94 | Tetrafluoroethylene | FKM,Buna | 101 | 300 | 301 | 900 | 901 | 2300 | 2301 | 4900 | 4901 | 9801 | x | x |
| Si2H6 | 97 | DISILANE | - | 93 | 282 | 283 | 853 | 854 | 2300 | 2301 | 4900 | 4901 | 9801 | x | x |
| GeF4 | 99 | Germanium Tetrafluoride | - | 93 | 282 | 283 | 860 | 861 | 2200 | 2201 | 4700 | 4701 | 9401 | x | x |

For reference only, consult Omega Engineering.

# Appendix A: FMA-7400/7500 Series Gas Table

## FMA-7400/7500 Series Devices

*Table A-4 FMA-7400/7500 Series Gas Table - Codes 108-5022, Bins SA44 to SA50*

| | | | | SA44 | | SA45 | | SA46 | | SA47 | | SA48 | | SA50 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gas Symbol | Gas Code | Gas Name | Elastomer seal FMA | Low | High | Low | High | Low | High | Low | High | Low | High | Low | High |
| SiCl4 | 108 | Silicon Tetrachloride | Perfluoroelastomer | 57 | 172 | 173 | 520 | 521 | 1320 | 1321 | 2751 | x | x | x | x |
| C3H9N | 109 | Trimethylamine | Perfluoroelastomer | 79 | 240 | 241 | 720 | 721 | 1910 | 1911 | 4000 | 4001 | 8101 | x | x |
| SF6 | 110 | Sulfur Hexafluoride | FKM,EPDM | 78 | 237 | 238 | 715 | 716 | 1900 | 1901 | 4000 | 4001 | 8000 | 8001 | 12101 |
| C2F6 | 118 | Hexafluoroethane (Freon-116) | FKM,Buna | 72 | 218 | 219 | 658 | 659 | 1750 | 1751 | 3700 | 3701 | 7401 | x | x |
| WF6 | 121 | Tungsten Hexafluoride | - | 51 | 150 | 151 | 460 | 461 | 1200 | 1201 | 2500 | 2501 | 5001 | x | x |
| C3F8 | 128 | Perfluoropropane | FKM | 51 | 154 | 155 | 465 | 466 | 1200 | 1201 | 2500 | 2501 | 5101 | x | x |
| C4F8 | 129 | Octafluorocyclobutane | FKM | 51 | 154 | 155 | 465 | 466 | 1170 | 1171 | 2430 | 2431 | 4901 | x | x |
| C3F6 | 138 | Hexafluoropropylene | FKM,Buna | 61 | 184 | 185 | 556 | 557 | 1470 | 1471 | 3050 | 3051 | 6111 | x | x |
| C2HF5 | 155 | PENTAFLUOROETHANE (FREON-125) | FKM | 78 | 235 | 236 | 711 | 712 | 1900 | 1901 | 4000 | 4001 | 8001 | x | x |
| CH2F2 | 160 | Difluoromethane | FKM | 175 | 533 | 534 | 1612 | 1613 | 4300 | 4301 | 9000 | 9001 | 18001 | x | x |
| CH6Si | 185 | Methylsilane (MONO) | - | 112 | 340 | 341 | 1050 | 1051 | 2800 | 2801 | 5900 | 5901 | 11601 | x | x |
| (CH3)3SiH | 190 | Trimethylsilane (TMSi) | - | 63 | 189 | 190 | 572 | 573 | 1530 | 1531 | 3200 | x | x | x | x |
| C5F8 | 266 | Octafluorocyclopentene | - | 45 | 134 | 135 | 406 | 407 | 1050 | 1051 | 2200 | 2201 | 4501 | x | x |
| C4F6 | 270 | Hexafluoro-2-butyne | - | 58 | 176 | 177 | 533 | 534 | 1400 | 1401 | 2900 | x | x | x | x |
| C4F6-q) | 297 | Hexafluoro Butadiene-1-3 | - | 53 | 160 | 161 | 500 | 501 | 1270 | 1271 | 2640 | 2641 | 5271 | x | x |
| C5F8O | 354 | Epoxyperfluorocyclopentene | - | 41 | 122 | 123 | 369 | 370 | 1000 | 1001 | 2100 | 2101 | 4201 | x | x |
| Si3H9N | 368 | Trisilylamine (TSA) | - | 61 | 181 | 182 | 560 | 561 | 1410 | 1411 | 3000 | 3001 | 6001 | x | x |
| 10%GeH4/H2 | 509 | 10%Germane/Hydrogen | MIX-Check components | 261 | 800 | 801 | 2400 | 2401 | 7200 | 7201 | 15000 | 15001 | 30001 | x | x |
| 10%PH3/H2 | 516 | 10%Phosphine/Hydrogen | MIX-Check components | 276 | 813 | 814 | 2500 | 2501 | 7600 | 7601 | 15500 | 15501 | 31001 | x | x |
| 4.5%PH3/N2 | 528 | 4.5%Phosphine/Nitrogen | MIX-Check components | 281 | 880 | 881 | 2600 | 2601 | 7200 | 7201 | 15000 | 15001 | 30001 | x | x |
| 20%O2/He | 536 | 20%Oxygen/Helium | MIX-Check components | 361 | 1102 | 1103 | 3331 | 3332 | 10000 | 10001 | 21000 | 21001 | 42001 | x | x |
| 5%H2/N2 | 542 | 5%Hydrogen/Nitrogen | MIX-Check components | 281 | 860 | 861 | 2600 | 2601 | 7400 | 7401 | 15100 | 15101 | 31001 | x | x |
| 1%B2H6/H2 | 557 | 1%Diborane Hydrogen | MIX-Check components | 271 | 850 | 851 | 2510 | 2511 | 7900 | 7901 | 16100 | 16101 | 33001 | x | x |
| 1%PH3/H2 | 563 | 1%Phosphine/Hydrogen | MIX-Check components | 274 | 850 | 851 | 2531 | 2532 | 7800 | 7801 | 16000 | 16001 | 32001 | x | x |
| 3%B2H6/N2 | 595 | 3%Diborane/Nitrogen | MIX-Check components | 271 | 850 | 851 | 2500 | 2501 | 7100 | 7101 | 14500 | 14501 | 29001 | x | x |
| 3%H2/N2 | 597 | 3%Hydrogen/Nitrogen | MIX-Check components | 281 | 860 | 861 | 2600 | 2601 | 7400 | 7401 | 15100 | 15101 | 30101 | x | x |
| 30%He/O2 | 603 | 30%Helium/Oxygen | MIX-Check components | 302 | 950 | 951 | 2800 | 2801 | 8100 | 8101 | 17000 | 17001 | 34001 | x | x |
| 30%O2/He | 604 | 30%Oxygen/Helium | MIX-Check components | 346 | 1060 | 1061 | 3203 | 3204 | 9700 | 9701 | 20000 | 20001 | 40001 | x | x |
| 4%H2/He | 606 | 4%Hydrogen/Helium | MIX-Check components | 401 | 1200 | 1201 | 3600 | 3601 | 11000 | 11001 | 23000 | 23001 | 46001 | x | x |
| 4%H2/N2 | 607 | 4%Hydrogen/Nitrogen | MIX-Check components | 281 | 860 | 861 | 2600 | 2601 | 7400 | 7401 | 15100 | 15101 | 30101 | x | x |
| 5%B2H6/Ar | 615 | 5%Diborane/Argon | MIX-Check components | 354 | 1084 | 1085 | 3278 | 3279 | 8900 | 8901 | 18201 | x | x | x | x |
| 50%PH3/SiH4 | 632 | 50%Phosphine/Silane | MIX-Check components | 191 | 580 | 581 | 1730 | 1731 | 4800 | 4801 | 10000 | 10001 | 20001 | x | x |
| 10%O2/He | 649 | 10%Oxygen/Helium | MIX-Check components | 381 | 1150 | 1151 | 3500 | 3501 | 10500 | 10501 | 22000 | 22001 | 44001 | x | x |
| 2%SiH4/N2 | 653 | 2%SILANE/NITROGEN | MIX-Check components | 281 | 870 | 871 | 2600 | 2601 | 7300 | 7301 | 15000 | 15001 | 30001 | x | x |
| 5%B2H6/N2 | 654 | 5%Diborane/Nitrogen | MIX-Check components | 263 | 804 | 805 | 2500 | 2501 | 7000 | 7001 | 14100 | 14101 | 28101 | x | x |
| .8%B2H6/N2 | 662 | .8%Diborane/Nitrogen | MIX-Check components | 281 | 870 | 871 | 2600 | 2601 | 7300 | 7301 | 15000 | 15001 | 30001 | x | x |
| 10%PH3/He | 674 | 10%Phosphine/Helium | MIX-Check components | 371 | 1100 | 1101 | 3400 | 3401 | 10000 | 10001 | 21000 | 21001 | 43001 | x | x |
| 2%B2H6/N2 | 695 | 2%Diborane/Nitrogen | MIX-Check components | 281 | 870 | 871 | 2600 | 2601 | 7200 | 7201 | 15000 | 15001 | 30001 | x | x |
| 10%GeH4/Ar | 698 | 10%Germane/Argon | MIX-Check components | 351 | 1070 | 1071 | 3300 | 3301 | 8700 | 8701 | 18000 | 18001 | 36001 | x | x |
| 5%H2/He | 762 | 5%Hydrogen/Helium | MIX-Check components | 401 | 1200 | 1201 | 3600 | 3601 | 11000 | 11001 | 23000 | 23001 | 46001 | x | x |
| 5%B2H6/He | 766 | 5%Diborane/Helium | MIX-Check components | 351 | 1100 | 1101 | 3300 | 3301 | 10000 | 10001 | 21000 | 21001 | 42001 | x | x |
| 15%B2H6/H2 | 820 | 15%Diborane/Hydrogen | MIX-Check components | 231 | 710 | 711 | 2120 | 2121 | 6500 | 6501 | 13300 | 13301 | 27001 | x | x |
| 3%C2H4/He | 878 | 3%Ethylene/Helium | MIX-Check components | 376 | 1150 | 1151 | 3500 | 3501 | 10700 | 10701 | 22100 | 22101 | 45001 | x | x |
| 10%B2H6/Ar | 881 | 5%Diborane/Argon | MIX-Check components | 321 | 1000 | 1001 | 3000 | 3001 | 8100 | 8101 | 17000 | 17001 | 34001 | x | x |
| 2.7%C2H4/He | 897 | 2.7%Ethylene/Helium | MIX-Check components | 378 | 1158 | 1159 | 3502 | 3503 | 10700 | 10701 | 22200 | 22201 | 45001 | x | x |
| 1%GeH4/H2 | 898 | 1%Germane/Hydrogen | MIX-Check components | 276 | 850 | 851 | 2530 | 2531 | 8000 | 8001 | 16200 | 16201 | 33001 | x | x |
| .5%GeH4/H2 | 910 | 0.5%Germane/Hydrogen | MIX-Check components | 281 | 860 | 861 | 2600 | 2601 | 8000 | 8001 | 16300 | 16301 | 33001 | x | x |
| 2%PH3/H2 | 916 | 2%Phosphine/Hydrogen | MIX-Check components | 276 | 850 | 851 | 2530 | 2531 | 8000 | 8001 | 16200 | 16201 | 33001 | x | x |
| 3.9%H2/N2 | 930 | 3.9%Hydrogen/Nitrogen | MIX-Check components | 281 | 860 | 861 | 2600 | 2601 | 7400 | 7401 | 15100 | 15101 | 30101 | x | x |
| 10%B2H6/He | 939 | 10%Diborane/Helium | MIX-Check components | 315 | 965 | 966 | 2918 | 2919 | 9000 | 9001 | 18400 | 18401 | 37001 | x | x |
| 30%C2H4/He | 946 | 30%Ethylene/Helium | MIX-Check components | 276 | 850 | 851 | 2551 | 2552 | 7800 | 7801 | 16000 | 16001 | 32001 | x | x |
| 10%H2/He | 950 | 10%Hydrogen/Helium | MIX-Check components | 381 | 1200 | 1201 | 3500 | 3501 | 10700 | 10701 | 22200 | 22201 | 45001 | x | x |
| 15%H2/B2H6 | 953 | 15%Hydrogen/Diborane | MIX-Check components | 131 | 400 | 401 | 1200 | 1201 | 3400 | 3401 | 7100 | 7101 | 14001 | x | x |
| 17%CH4/CO2 | 958 | 17%Methane/Carbon Dioxide | MIX-Check components | 211 | 650 | 651 | 2000 | 2001 | 5400 | 5401 | 11000 | 11001 | 22001 | x | x |
| 20%CH6Si/H2 | 962 | 20%Methylsilane (MONO)/Hydrogen | MIX-Check components | 213 | 660 | 661 | 2000 | 2001 | 5900 | 5901 | 12000 | 12001 | 24001 | x | x |
| 50%CH3SiHCl2/H2 | 965 | 50%Dichloromethylsilane/Hydrogen | MIX-Check components | 131 | 400 | 401 | 1200 | 1201 | 3100 | 3101 | 6600 | 6601 | 13001 | x | x |
| 20%GeH4/H2 | 978 | 20%Germane/Hydrogen | MIX-Check components | 242 | 750 | 751 | 2240 | 2241 | 6600 | 6601 | 13500 | 13501 | 27001 | x | x |
| 0.5%B2H6/He | 979 | 0.5%Diborane/Helium | MIX-Check components | 401 | 1200 | 1201 | 3700 | 3701 | 11000 | 11001 | 23000 | 23001 | 47001 | x | x |
| COS-Special | 5022 | Carbonyl Sulfide (Special) | - | 184 | 562 | 563 | 1700 | 1701 | 4500 | 4501 | 9400 | 9401 | 18301 | x | x |

For reference only, consult Omega Engineering.

# WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

**OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.**

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

# RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

OMEGA is a registered trademark of OMEGA ENGINEERING, INC.

# Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

## *Shop online at omega.com℠*

### TEMPERATURE

- Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

### PRESSURE, STRAIN AND FORCE

- Transducers & Strain Gages
- Load Cells & Pressure Gages
- Displacement Transducers
- Instrumentation & Accessories

### FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

### pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

### DATA ACQUISITION

- Data Acquisition & Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
- Recorders, Printers & Plotters

### HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

### ENVIRONMENTAL MONITORING AND CONTROL

- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments

541B161AAO-12-12
M-5293/0513