

## Series 354

Granville-Phillips Series 354 Micro-Ion<sup>®</sup>  
Vacuum Gauge Module with  
RS-485 Digital Interface



## Instruction Manual

*Instruction manual part number 354008  
Revision 04 - February 2008*



## Series 354

# Granville-Phillips Series 354 Micro-Ion<sup>®</sup> Vacuum Gauge Module with RS-485 Digital Interface

This Instruction Manual is for use with all Granville-Phillips Series 354 Micro-Ion Vacuum Gauge Modules with RS-485 Digital Interface. A list of applicable catalog numbers is provided on the following page.



### ***Customer Service/Support***

For customer service, 24 hours per day, 7 days per week, every day of the year including holidays, toll-free within the USA, phone 1-800-367-4887

For customer service within the USA, 8 AM to 5 PM, weekdays excluding holidays:

- Toll-free, phone: 1-800-776-6543
- Phone: 1-303-652-4400
- FAX: 1-303-652-2844
- Email: [co-csr@brooks.com](mailto:co-csr@brooks.com)
- World Wide Web: [www.brooks.com](http://www.brooks.com)

## Instruction Manual

# Granville-Phillips Series 354 Micro-Ion<sup>®</sup> Vacuum Gauge Module with RS-485 Digital Interface

**Catalog numbers for Series 354 Micro-Ion Modules**

Power supply and cable are not included.

**RS-485 interface, 1 setpoint relay:**

Same as 354005, but with Varian Syntax (Torr only) 354029 - Y E - T

**RS-485 interface, 1 setpoint relay:**

Same as 354005, but with 90 Degree elbow (Torr only) 20354017 - Y D - T

**RS-485 interface, 1 setpoint relay:**

No digital display (Torr Only) 354005 - X X - T

**Filaments:**

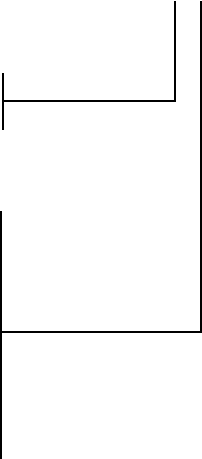
dual yttria-coated iridium  
dual tungsten

Y  
T

**Flange/Fitting:**

NW16KF  
NW25KF  
NW40KF  
1.33 inch (NW16CF) Conflat-type  
2.75 inch (NW35CF) Conflat-type  
1/2 inch VCR-type male  
NW16L  
40KFL

D  
E  
K  
F  
G  
H  
M  
L



Conflat is a registered trademark of Varian Associates  
VCR, VCO are registered trademarks of Cajon Co.

# Table of Contents

Chapter 1 General Information	7
1.1 Receiving Inspection	7
1.2 International Shipment	7
1.3 Warranty	7
1.4 Certification	7
1.5 Service Guidelines	8
1.6 FCC Verification	8
Chapter 2 Safety	9
2.1 General Cautions and Warnings	9
Chapter 3 Introduction	13
3.1 General Description	13
3.2 Dimensions	13
3.3 Specifications	14
3.4 Power Supply Requirements	15
3.5 Component Description	16
3.5.1 Power Indicator Lamp	16
3.5.2 Address Selector Switch	16
3.5.3 Input/Output Connector	16
3.5.4 Mounting Flange	17
3.6 Theory of Operation	17
3.7 Emission Current	18
3.8 Overpressure Shutdown	18
3.9 Degas Cycle	18
Chapter 4 Installation and Configuration	19
4.1 Introduction	19
4.2 Grounding	19
4.3 I/O Cable Connections	19
4.4 Installation	21
4.4.1 Firmware Configuration	22
4.4.1.1 Resetting the Data Communication Parameters	23
4.5 Calculating a Gas Sensitivity Correction	24
4.6 Very-High and Ultra-High Vacuum Measurement	24
4.6.1 Micro-Ion Vacuum Gauge Module Process Chamber Baking	25
Chapter 5 RS-485 Digital Interface Specifications and Protocol	27
5.1 Introduction	27
5.2 Interface Configuration	27
5.3 Receive/Transmit Timing	32
Chapter 6 Troubleshooting	33
6.1 Introduction	33
6.2 Troubleshooting Procedures	33
Chapter 7 Service	35
7.1 Introduction	35
7.2 Micro-Ion Vacuum Gauge (with Digital Interface) Module Initialization	35
7.2.1 Initialization	35
7.3 Degas Cycle	37
7.3.1 Digital Interface	37
7.4 Fuse Replacement	37
7.5 Micro-Ion Gauge Replacement	38
7.6 Ion Gauge Continuity Test	39
7.7 Service Form	42



## Chapter 1

### General Information

#### 1.1 Receiving Inspection

On receipt of the equipment, inspect all material for damage. Confirm that the shipment includes all items ordered. If items are missing or damaged, submit a claim as stated below for a domestic or international shipment, whichever is applicable.

If materials are missing or damaged, the carrier that made the delivery must be notified within 15 days of delivery, or in accordance with Interstate Commerce regulations for the filing of a claim. Any damaged material including all containers and packaging should be held for carrier inspection. Contact Brooks Automation, Inc./Granville-Phillips Customer Support for assistance if your shipment is not correct for reasons other than shipping damage.

#### 1.2 International Shipment

Inspect all materials received for shipping damage and confirm that the shipment includes all items ordered. If items are missing or damaged, the airfreight forwarder or airline making delivery to the customs broker must be notified within 15 days of delivery. The following illustrates to whom the claim is to be directed.

- If an airfreight forwarder handles the shipment and their agent delivers the shipment to customs, the claim must be filed with the airfreight forwarder.
- If an airfreight forwarder delivers the shipment to a specific airline and the airline delivers the shipment to customs, the claim must be filed with the airline.

Any damaged material including all containers and packaging should be held for carrier inspection. Contact Brooks Automation, Inc./Granville-Phillips Customer Support for assistance if your shipment is not correct for reasons other than shipping damage.

#### 1.3 Warranty

Brooks Automation, Inc. provides an eighteen (18) month warranty from the date of shipment for new Brooks Automation, Inc./Granville-Phillips Products. The Brooks Automation, Inc. General Terms and Conditions of Sale provides the complete and exclusive warranty for Brooks Automation, Inc./Granville-Phillips products. This document is located on our web site at [www.brooks.com](http://www.brooks.com), or may be obtained by contacting a Brooks Automation, Inc./Granville-Phillips Customer Service Representative.

#### 1.4 Certification

Brooks Automation, Inc. certifies that this product met its published specifications at the time of shipment from the factory. Brooks Automation, Inc. further certifies that its calibration measurements are traceable to the National Institute of Standards and Technology to the extent allowed by the Institute's calibration facility.

## 1.5 Service Guidelines

Some minor problems are readily corrected on site. If the product requires service, please contact our Customer Service Department at 1-303-652-4400 for troubleshooting help over the phone. If the product must be returned for service, request a Return Authorization (RA) from Brooks Automation, Inc./Granville-Phillips. Do not return products without first obtaining an RA.

See the Service Form on page 42 at the end of Chapter 7.

Shipping damage on returned products as a result of inadequate packaging is the Buyer's responsibility.

When returning equipment to Brooks Automation, Inc./Granville-Phillips, please use the original packing material whenever possible. Otherwise, contact your shipper or Brooks Automation, Inc./Granville-Phillips for safe packaging guidelines. Circuit boards and modules separated from the controller chassis must be handled using proper anti-static protection methods and must be packaged in anti-static packaging. Brooks Automation, Inc./Granville-Phillips will supply return packaging materials at no charge upon request.

## 1.6 FCC Verification

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio or television technician for help.

## Chapter 2

### Safety

#### 2.1 General Cautions and Warnings

##### WARNING SYMBOLS

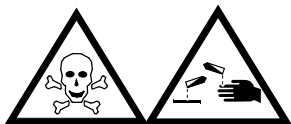
Read this instruction manual before installation, using, or servicing this equipment. If you have any doubts about how to use this equipment safely, call the Customer Support Center for assistance.



This symbol is associated with high voltage hazards. Follow all local and state codes when working with high voltage equipment.



This symbol is associated with handling of combustible materials. Follow all local and state codes when working with flammable materials and liquids.



These symbols are associated with the handling of poisons and acids. Follow all local and state codes when working with caustic materials and liquids.



These symbols are associated with situations that may cause equipment to burst violently due to excessive pressures. Make sure systems are de-presurized before attempting to work on them.

### WARNING

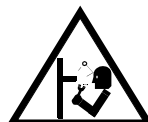


Voltages (up to 250 Vdc) capable of causing injury or death are present in the power supply. Avoid touching the connector sockets, tube pins, and other high voltage conductors. Servicing should be performed by qualified personnel only.

### WARNING



Do not turn on the ionization gauge when there is danger of explosion from explosive or combustible gases, or gas mixtures. Ionization gauge filaments operate at temperatures sufficiently high to cause ignition.



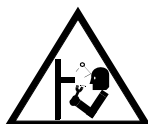
Install suitable devices that will limit the pressure from external gas sources to the level that the vacuum system can safely withstand. In addition, install suitable pressure relief valves or rupture discs that will release pressure at a level considerably below that pressure which the system can safely withstand.



Danger of injury to personnel and damage to equipment exists on all vacuum systems that incorporate gas sources or involve processes capable of pressurizing the system above the limits it can safely withstand.

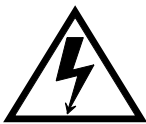
For example, danger of explosion in a vacuum system exists during backfilling from pressurized gas cylinders because many vacuum devices such as ionization gauge tubes, glass windows, glass bell jars, etc., are not designed to be pressurized.

Suppliers of pressure relief valves and pressure relief discs are listed in Thomas Register under "Valves, Relief", and "Discs, Rupture".



Confirm that these safety devices are properly installed before installing the Micro-Ion Gauge. In addition, check that (1) the proper gas cylinders are installed, (2) gas cylinder valve positions are correct on manual systems, and (3) the automation is correct on automated systems.

## WARNING



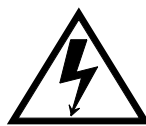
Safe operation of ion producing equipment, including the Micro-Ion Gauge, requires grounding of both its power supply and the vacuum chamber. **Lethal voltages** may be established under some operating conditions unless correct grounding is provided.

Research at Granville-Phillips has established that ion producing equipment, such as ionization gauges, mass spectrometers, sputtering systems, etc., from many manufacturers may, under some conditions, provide sufficient conduction via a plasma to couple a high voltage electrode to the vacuum chamber. If conductive parts of the chamber are not grounded, they may attain a potential near that of the high voltage electrode during this coupling.

Potentially fatal electrical shock could then occur because of the high voltage between these chamber parts and ground.

During routine pressure measurement, using ionization gauge controllers from any manufacturer, about 160 V may become present on ungrounded chambers at pressures near  $10^{-3}$  Torr. All isolated or insulated conductive parts of the chamber must be grounded to prevent these voltages from occurring.

## WARNING



Grounding, though simple, is very important! Please be certain that the ground circuits are correctly used, both on your ion gauge power supplies and on your vacuum chambers, regardless of their manufacturer, for this phenomenon is not peculiar to Granville-Phillips equipment. Refer to Chapter 4 - Installation, for additional information. If you have questions, or need additional labels or literature, contact the Customer Support Center.



## Chapter 3

### Introduction

#### 3.1 General Description

The Model 354 Micro-Ion Vacuum Gauge Module, shown in Figure 3-1, is a modular instrument that is capable of measuring vacuum pressures from less than  $1 \times 10^{-9}$  Torr to  $5 \times 10^{-2}$  Torr -  $N_2$  equivalent (or air).

The 354 Micro-Ion Vacuum Gauge Module is a small rugged unit that has a wider measurement range, more burnout resistance, and generates less heat than typical glass gauges. Additional benefits include:

- Compact, Convenient, Cost Saving Vacuum Measurement
- Rugged Metal Construction
- Robust Filament Design
- Increased Uptime
- Rapid response during Pumpdown
- Cooler Operation
- Easy Compatibility with Computer Controlled Processes

The RS-485 digital interface version provides industry-standard digital RS485 communications over networks as well as direct connections to a personal computer. The setpoint relay, filament, and degassing of the gauge tube can be easily selected via the RS-485 digital interface.

The setpoint relay can be used to control various devices such as; safety interlock, valve, digital input for a scanner, or programmable logic controller. The setpoint relay trip points can be set to customized pressure settings to turn power ON or OFF to the appropriate device.

#### 3.2 Dimensions

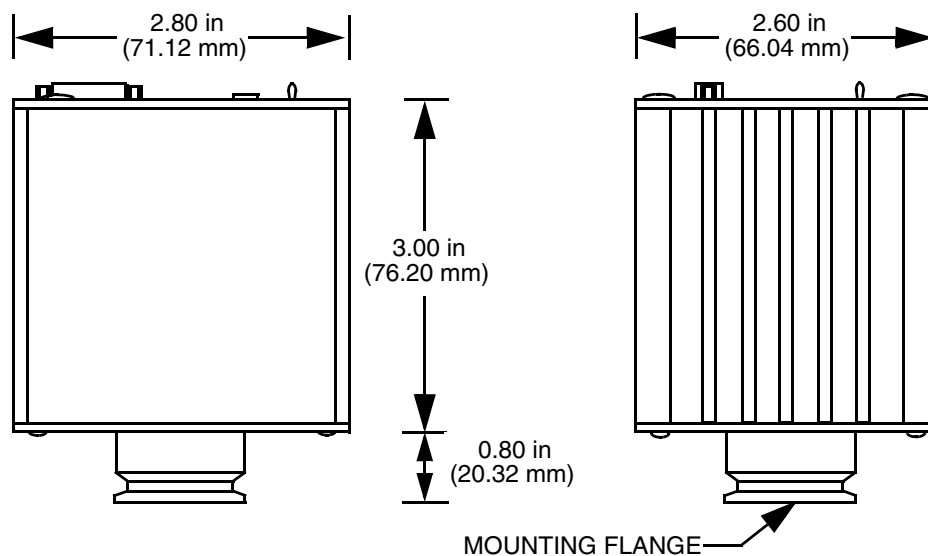


Figure 3-1: Series 354 Micro-Ion Vacuum Gauge Dimensions

### 3.3 Specifications

Refer to Table 3-1, Table 3-2 and Table 3-3 for performance and physical specifications of the 354 Micro-Ion Vacuum Gauge.

Table 3-1: Vacuum Connection Fitting Dimensions



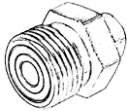
Fitting	Description	Dimension
	NW16KF flange NW25KF flange NW40KF flange	2.0 cm (0.8 in.) 2.0 cm (0.8 in.) 2.0 cm (0.8 in.)
	1.33 in. (NW16CF) ConFlat-type 2.75 in. (NW35CF) ConFlat-type	4.3 cm (1.7 in.) 4.3 cm (1.7 in.)
	1/2 inch VCR-type male	5.8 cm (2.3 in.)

Table 3-2: Performance Specifications

Parameter	Specification
Measurement Range	1 x 10 <sup>-9</sup> to 5 x 10 <sup>-2</sup> Torr for N <sub>2</sub> or air <b>NOTE:</b> For use below 1 x 10 <sup>-7</sup> Torr, use a flange with a metal seal
Overpressure Protection	Gauge tube turns off if pressure rises above 5 x 10 <sup>-2</sup> Torr at 100 microamperes or 1.3 x 10 <sup>-3</sup> Torr at 4 milliamperes emission
Emission Current	100 μA, 4 mA
Operating Voltage and Power	+24 VDC, ±15%, 0.5 Amperes, 12 Watts maximum. <b>NOTE:</b> Customer supplied power supply
Degas	Electron bombardment, approximately 4 watts with 2 minute timer
Filament Selection	Programmed through the digital interface
Setpoint Relay	Single pole-double throw relay (SPDT) Silver alloy-gold clad contacts 1A, 30 VDC, resistive load or AC non-inductive

Table 3-3: Physical Specifications

Parameter	Specification
Vacuum Connections	O-ring - NW16KF flange O-ring - NW25KF flange Metal Seal - 1-5/16 inches Metal Seal - 2-3/4 inches 1/2 in. 8-VCR male fitting
Electrical Connection	9 pin D connector
Weight	13 oz
Case Material	Aluminum extrusion
Gauge Tube Replacement	Field replaceable using a Phillips screwdriver
Electrical Safety	Metal enclosure which houses 180 V supply will require use of a metal flange clamp to assure ground continuity to system
Operating Temp Range	0 °C to 40 °C
Non-operating Temp Range	-40 °C to 70 °C

Table 3-4: RS-485 Communication Parameters

Parameter	Default Value	Range of Values
Baud Rate	19,200	300, 600, 1200, 2400, 4800, 9600, 14,400, 19,200, 28,000
Data Format	8 bits	8
Parity	None	none
Stop Bits	1	N/A

### 3.4 Power Supply Requirements

The customer supplied power supply should provide operating voltage and current to the 354 Micro-Ion Vacuum Gauge Module as specified in Table 3-2.

### 3.5 Component Description

The top plate of the 354 Micro-Ion Vacuum Gauge Module with RS-485 Digital Interface is shown in Figure 3-2 and described in the following paragraphs.

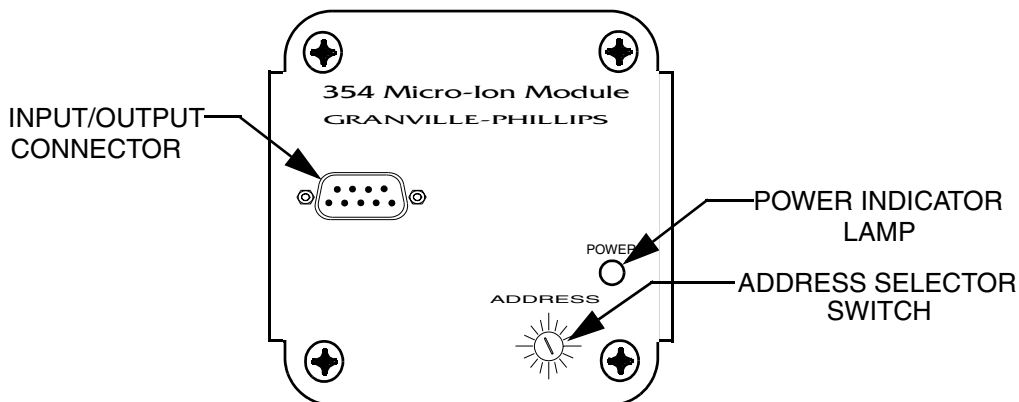


Figure 3-2: 354 Micro-Ion Vacuum Gauge Module Top Plate

#### 3.5.1 Power Indicator Lamp

The Power Indicator lamp illuminates when 24 VDC is applied to the Micro-Ion Vacuum Gauge Module from a customer supplied power source.

#### 3.5.2 Address Selector Switch

The Address Selector Switch determines the network address for the Micro-Ion Vacuum Gauge Module. The switch position must be set to the appropriate network address for each Micro-Ion Vacuum Gauge Module on the network.

#### 3.5.3 Input/Output Connector

The Input/Output Connector provides a connection to the Micro-Ion Vacuum Gauge Module for 24 VDC Input power and various gauge signals. See Figure 3-3 for pin assignments.

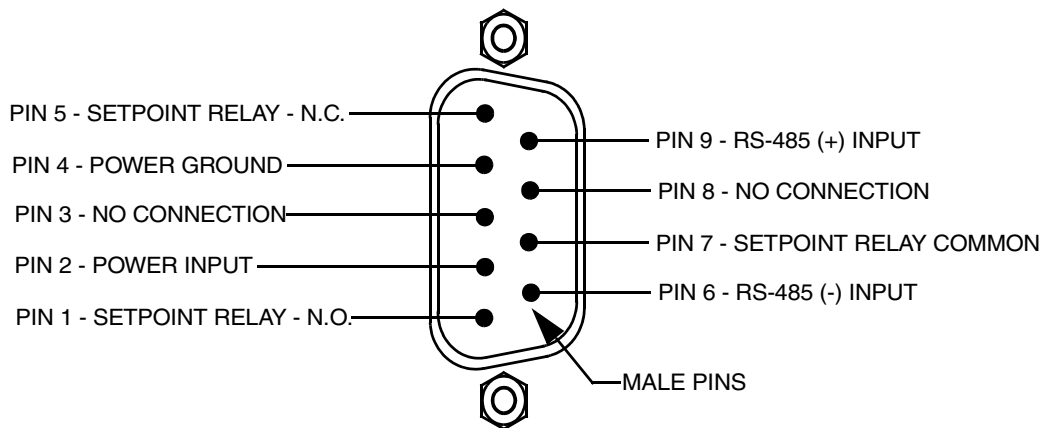


Figure 3-3: Input/Output Connector Pin Assignments

### 3.5.4 Mounting Flange

The Micro-Ion Vacuum Gauge Module can be equipped with a metal seal, O-ring, or VCR type mounting flange as listed in Table 3-1. The type of flange must be specified when ordering the Micro-Ion Vacuum Gauge Module.

### 3.6 Theory of Operation

The functional parts of a typical ionization gauge are the filament (cathode), grid (anode) and ion collector, which are shown in Figure 3-4. These electrodes are maintained by the gauge controller at +30, +180, and 0 volts, relative to ground, respectively.

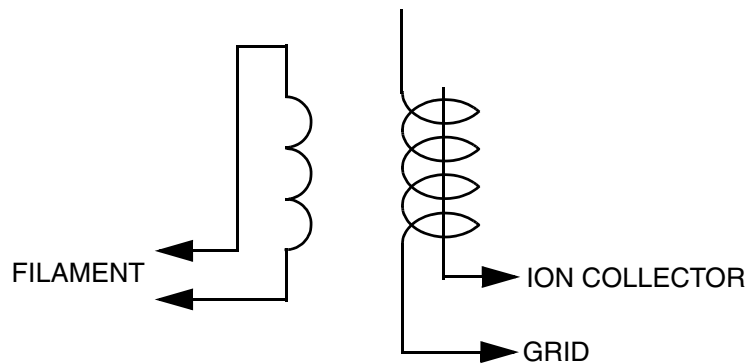


Figure 3-4: Ion Gauge Schematic

The filament is heated to such a temperature that electrons are emitted, and accelerated toward the grid by the potential difference between the grid and filament. Most of the electrons eventually collide with the grid, but many first traverse the region inside the grid many times.

When an energetic electron collides with a gas molecule an electron may be dislodged from the molecule leaving it with a positive charge. Most ions are then accelerated to the collector.

The rate at which electron collisions with molecules occur is proportional to the density of gas molecules, and hence the ion current is proportional to the gas density (or pressure, at constant temperature).

The amount of ion current for a given emission current and pressure depends on the ion gauge design. This gives rise to the definition of ion gauge *sensitivity*, frequently denoted by  $K$ :

$$K = \text{ion current} / (\text{emission current} \times \text{pressure})$$

The Micro-Ion Vacuum Gauge typically has a sensitivity of 20/Torr when used with nitrogen or air. Refer to Chapter 4 - Installation and Configuration for more information.

The Micro-Ion Vacuum Gauge controller varies the heating current to the filament to maintain a constant electron emission, and measures the ion current to the collector. The pressure is then calculated from these data.

The Micro-Ion Vacuum Gauge degas cycle is accomplished by increasing the emission current to 15 mA and raising the grid bias to 250 VDC resulting in an increased temperature of the grid to drive off contaminants.

## 3.7 Emission Current

There are two ranges of emission current available. Either 100 microamperes or 4 milliamperes are available as determined by the digital interface. While either range can be used continuously, the following guidelines are suggested. For operation in the higher pressure ranges with a clean system 100 microamperes emission is satisfactory. This will give a theoretical longer filament life and allows usage to where the gauge pressure reading overlaps with other type transducers such as the Convectron or capacitance manometer. For operation in the lower pressure ranges the 4 milliamperes range should be used to give a more accurate pressure reading.

Internal circuitry corrects the pressure output data for the emission current selected. There is a problem with all ion gauges when used in systems which have the potential for diffusion pump oil vapor to enter the gauge tube.

This oil vapor deposits on the grid forming an insulator and preventing emission resulting in higher and higher filament power being required and ultimate inability to control emission. In this situation the 4 milliamperes position is recommended.

## 3.8 Overpressure Shutdown

Overpressure shutdown is programmable by use of the computer interface. This has been preset at  $5 \times 10^{-2}$  Torr when operating at 100  $\mu$ A emission or  $1.3 \times 10^{-3}$  Torr at 4 mA emission.

## 3.9 Degas Cycle

Pump oil, other organic compounds, or metal coatings from a sputtering process can cause electrical current leakage between the ion gauge tube elements. When contamination occurs, system base pressure readings may begin to rise which is an indication that a degas cycle will have to be performed.

The removal of gas from the gauge tube is accomplished by electron bombardment (EB) heating of the grid. Pressure reading during a degas cycle is provided. Note that in order to activate the degas circuit, the IG ON circuit must be first activated. This assures that there is a vacuum in the system prior to the degas cycle. Also note that the degas circuit will turn off if the IG ON circuit is turned off.

Due to the small size of the gauge, power during a degas cycle is approximately 4 watts above operating power and is turned off automatically after a two minute period.

Refer to Chapter 7 - Service for more information on performing a degas cycle.

### CAUTION

To obtain optimum filament life, Micro-Ion Vacuum Gauges equipped with tungsten filaments should not be operated above  $5 \times 10^{-3}$  Torr in air.

## Chapter 4

### Installation and Configuration

#### 4.1 Introduction

This section provides the information required to install the RS-485 digital interface version of the Micro-Ion Vacuum Gauge Module.

The flowchart in Table 4-1 highlights the major tasks for installing the Micro-Ion Vacuum Gauge Module (with RS-485 digital interface) and refers to the appropriate installation procedures within this section.

The Micro-Ion Vacuum Gauge Module can be mechanically mounted anywhere in a system, and in any attitude. It should be mounted in a location with free air flow and ambient temperature less than 40 °C.

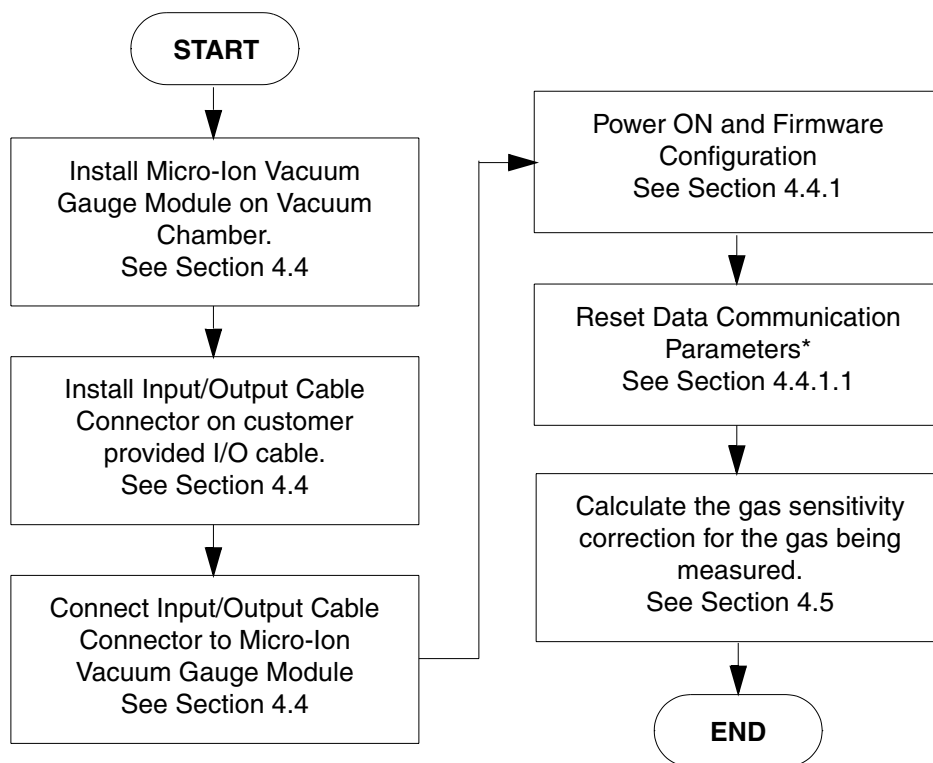
#### 4.2 Grounding

The Micro-Ion Vacuum Gauge Module converts the input power to +180 VDC for the grid supply (+250 VDC during degas). For safety, the outer housing of the gauge must be grounded to the vacuum chamber. This is accomplished by the use of a metal flange clamp for the NW type flanges. Due to the O-ring seal, grounding cannot be assumed through the fitting. The groove in the KF flange of the 354 Micro-Ion Vacuum Gauge has been designed to prevent the use of a non-metallic type of flange clamp. Do not alter the groove or a non-metallic flange clamp to attempt usage.

#### 4.3 I/O Cable Connections

The I/O connector is used to operate the Micro-Ion Vacuum Gauge and provide connections for the setpoint relay. Refer to Table 4-1 for RS-485 connector pin assignments.

When no device is transmitting, the state of the RS-485 network will be indeterminate if no bias resistors exist because all RS-485 outputs will be tri-stated. To prevent potential problems with induced noise from external sources, bias resistors should be added somewhere on the RS-485 network. A 4.7K ohm resistor from the (-) RS-485 line to power ground and 4.7K ohm resistor from the (+) RS-485 line to a 5 VDC source will force the network into a known state while outputs are tri-stated.



*\* Should be performed ONLY if the host computer and gauge data communication parameters are not the same.*

Figure 4-1: Micro-Ion Vacuum Gauge Module Installation (RS-485 Digital Interface)

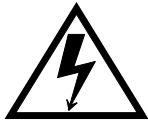
## 4.4 Installation

Use the following procedure to install the Micro-Ion Vacuum Gauge (with RS-485 digital interface) on the vacuum system.

### CAUTION

Reasonable care should be taken to install the Micro-Ion Vacuum Gauge Module where it is protected from physical damage.

### WARNING



The Micro-Ion Vacuum Gauge Module grid supply voltages reach 250 VDC during degas cycles. Use a metal flange clamp for NW type flanges to ensure the exterior module housing is grounded to the vacuum chamber.

**NOTE:** If an NW type flange is being used, ground the Micro-Ion Vacuum Gauge Module to the vacuum chamber with a metal flange clamp.

1. Connect the Micro-Ion Vacuum Gauge Module to the vacuum system flange using the appropriate gasket and mounting hardware.
2. Install the supplied connector on the customer supplied Input/Output cable according to the pin assignments in Table 4-1.

Table 4-1: RS-485 Digital Interface I/O Connector Pin Assignments

Pin	Function
1	Setpoint relay - N. O.
2	Input power 24 VDC $\pm$ 15%, 12 W max.
3	No connection
4	Power ground
5	Setpoint relay - N. C.
6	RS485 (-)
7	Setpoint relay - common
8	No Connection
9	RS 485 (+)

3. Connect the Input/Output cable to the connector on the Micro-Ion Vacuum Gauge Module.
4. Proceed with the Firmware Configuration.

### 4.4.1 Firmware Configuration

Use the following procedure to configure the Micro-Ion Vacuum Gauge Module (with RS-485 digital interface) and obtain a vacuum chamber pressure reading.

1. Set the address switch on the Micro-Ion Vacuum Gauge Module to the correct position for the vacuum chamber on which it is installed.
2. Turn the Micro-Ion Vacuum Gauge Module power supply ON.
3. If required, change the host computer data communication parameters to the Micro-Ion Vacuum Gauge Module default settings as shown in Table 3-4 on page 15.

**NOTE:** The Micro-Ion Vacuum Gauge Module communication parameters can be changed later to match those of the host computer. Refer to *Resetting Communication Data Parameters* in this section for more information.

4. Allow the vacuum chamber to acclimate to the correct vacuum pressure.

**NOTE:** Refer to Chapter 5 - RS-485 Digital Interface Specifications and Protocol for additional information on the commands entered in steps 7 - 10.

**NOTE:** The address switch is set to the 01 position for demonstration purposes.

5. Enter the *SE* command at the host computer for the desired emission current setting as follows:
  - a. Enter **#01SE1** - for 4.0 milliamperes emission current.
  - b. Enter **#01SE0** - for 0.1 milliamperes emission current.

The Micro-Ion Vacuum Gauge Module should respond with *\*01\_PROGM\_OK*.

**NOTE:** The values (*1.00E-04* and *2.00E-04*) in step 6 are for demonstration purposes only. Substitute the appropriate values for your relay setpoints.

6. Enter the appropriate *SL* command at the host computer to establish the setpoint at which the setpoint relay will turn ON or OFF as follows:
  - a. Enter **#01SL+1.00E-04** - to turn the setpoint relay ON when the pressure is less than  $1.00E^{-04}$  Torr.
  - b. Enter **#01SL-2.00E-04** - to turn the setpoint relay OFF when the pressure is more than  $2.00E^{-04}$  Torr.

The Micro-Ion Vacuum Gauge Module should respond with *\*01\_PROGM\_OK*.

7. Enter the *IG* command at the host computer to turn the Micro-Ion Vacuum Gauge Module ON as follows:
  - a. Enter **#01IG1** to turn the gauge ON.
  - b. Enter **#01IG0** to turn the gauge OFF.

The MICRO-ION Vacuum Gauge Module should respond with *\*01\_PROGM\_OK*.

8. Enter the *RD* command at the host computer to read the Micro-Ion Vacuum Gauge Module pressure response as follows:
  - a. Enter **#01RD** - the response will be  $9.99E+09$  for 3 seconds after the ion gauge is turned on, then a valid pressure response will be sent.

**CAUTION**

Overpressure shutdown parameters should not be changed from the default value. If set too low, the Micro-Ion Vacuum Gauge Module might turn off below chamber operating pressure. If set too high, inaccurate readings or Micro-Ion Vacuum Gauge Module damage may occur.

**4.4.1.1 Resetting the Data Communication Parameters**

**NOTE:** This procedure should only be performed if the default Micro-Ion Vacuum Gauge Module communication parameters are the same as the host computer.

Use the following procedure to change the data communication parameters of the Micro-Ion Vacuum Gauge Module to match the host computer.

- 9.** Enter the *SB* command at the host computer to change the baud rate as follows:
  - a.** Enter **#01SBXXXX**

Where XXXX equals one of the following baud rates: 300,600, 1200, 2400, 4800, 9600, 14,400, 19,200, or 28,000. The Micro-Ion Vacuum Gauge Module should respond with *\*01\_PROGM\_OK*.

**NOTE:** Only perform step 9 based upon the data format of the host computer.

**NOTE:** The Micro-Ion Vacuum Gauge Module must be reset or the power must be cycled ON/OFF to begin using the new data communication values.

- 10.** To reset the Micro-Ion Vacuum Gauge Module, enter the *RST* command at the host computer as follows:
  - a.** Enter **#01RST**

The Micro-Ion Vacuum Gauge Module will be reset and there will be no response.

- 11.** Proceed with Calculating a Gas Sensitivity Correction.

## 4.5 Calculating a Gas Sensitivity Correction

1. If measuring a gas other than nitrogen or air, refer to Table 4-2 and the following example to calculate the gas sensitivity correction for the gas being used.

Table 4-2: Ion Gauge Sensitivity Ratios

Gas	Ratio
N <sub>2</sub>	1.00
He	0.18
Ne	0.30
A <sub>r</sub>	1.29
K <sub>r</sub>	1.94
X <sub>e</sub>	2.87
H <sub>2</sub>	0.46

The 354 Micro-Ion Module indicates a pressure of  $5 \times 10^{-5}$  Torr. If the gas type is known to be neon, then perform the following calculation:

$$\frac{5 \times 10^{-5} \text{ Torr}}{0.30} = 1.67 \times 10^{-4} \text{ Torr of Neon}$$

2. Enter the calculated gas sensitivity correction into the host computer.

## 4.6 Very-High and Ultra-High Vacuum Measurement

To obtain the best results, the following suggestions are recommended when measuring vacuum pressures below  $1 \times 10^{-7}$  Torr:

- Use only all-metal vacuum fittings
- Degas the Micro-Ion Vacuum Gauge Module grid. Refer to Chapter 7 - Service for more information.
- A process chamber bake to 100 to 150 °C is often required. Refer to Micro-Ion Vacuum Gauge Module Process Chamber Baking for more information.

### 4.6.1 Micro-Ion Vacuum Gauge Module Process Chamber Baking

**NOTE:** The Micro-Ion Vacuum Gauge tube can be removed from the module without interrupting the vacuum within the process chamber.

#### CAUTION

The temperature of the Micro-Ion Vacuum Gauge Module cannot exceed 70 °C. The electronics module must be removed from the gauge tube before baking the chamber at temperatures higher than 70 °C.

#### WARNING



To prevent electrical shock, turn OFF electrical power before servicing the Micro-Ion Vacuum Gauge Module. Do not touch any gauge pins while the gauge tube is under vacuum or connected to a controller.

1. Turn OFF power to the Micro-Ion Vacuum Gauge Module.
2. Remove the Input/Output connector from the module.

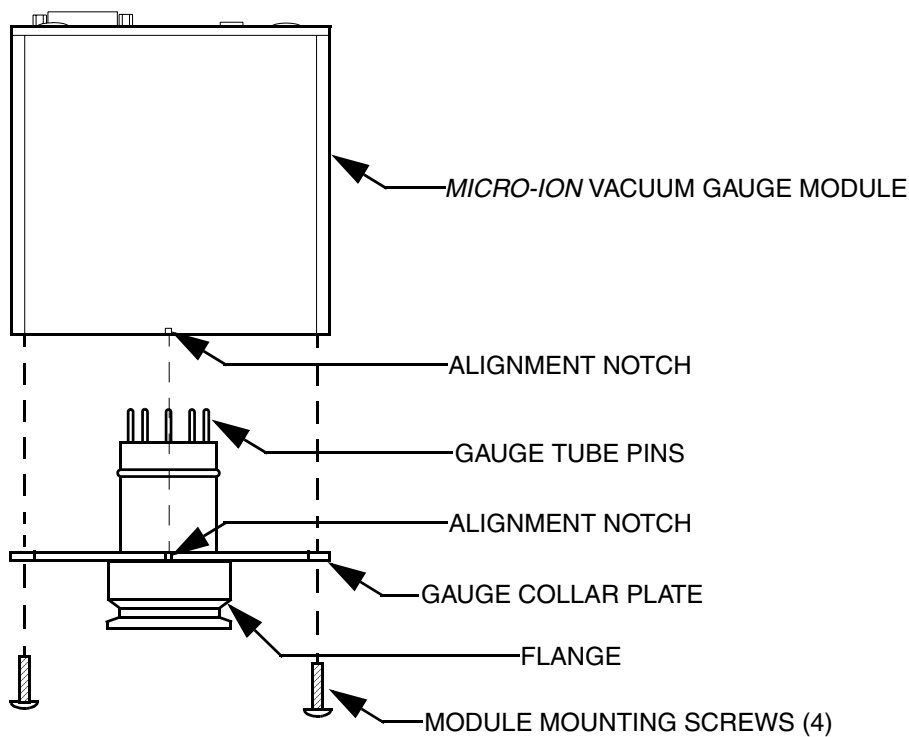


Figure 4-2: Module Removal for Baking Process Chamber

3. Remove the four Phillips head screws from the gauge collar plate as shown in Figure 4-2.
4. While holding the flange, *gently* pull the Micro-Ion Vacuum Gauge Module away from the gauge collar plate as shown in Figure 4-2. The gauge tube and plate will disconnect from the module.

***NOTE:** When baking the process chamber, make sure the temperature of the Micro-Ion Vacuum Gauge Module tube and the associated vacuum plumbing is raised to the same temperature as the process chamber. **Do not exceed 200 °C.***

5. Bake the process chamber at the desired temperature (200 °C max) for the specified period of time. Once the chamber has cooled to below 70 °C, perform steps 6 - 11.
6. Align the notches on the gauge collar plate and the Micro-Ion Vacuum Gauge Module as shown in Figure 4-2.
7. *Gently* insert the gauge and collar plate into the Micro-Ion Vacuum Gauge Module until the tube pins are inserted into the tube socket.
8. Insert and tighten all four Phillips head screws.
9. Install the Micro-Ion Vacuum Gauge Module onto the vacuum system.
10. Connect the Input/Output connector to the Micro-Ion Vacuum Gauge Module.
11. Turn ON power to the Micro-Ion Vacuum Gauge Module and verify communication.

## Chapter 5

### RS-485 Digital Interface Specifications and Protocol

#### 5.1 Introduction

The information in Table 5-1 provides the syntax and description of the commands used in the Micro-Ion Vacuum Gauge Module (p/n 354005) with RS-485 digital interface.

#### 5.2 Interface Configuration

Default - 19.2 KB 8 bits,

1 stop bit, no parity

Address = 01

Command from host must include a start character, address, data and terminator.

(Start character)(address)(data)(terminator)

The start character is #. The address is two ASCII digits representing the Hex address of the module. Example: 0F is address 15. The data field is explained in the command descriptions. All alpha characters can be upper or lower case. The terminator character is control M or Hex 0D for a carriage return, signified by CR. A space character is signified by \_.

All data fields responses will contain 13 characters, upper case alpha characters. A response of ?01\_SYNTAX\_ER CR is caused by an incorrect character string from the host.

**NOTE:** *The speed of the response from the Micro-Ion Vacuum Gauge Module varies depending on the type of command being carried out. refer to Receive/Transmit Timing in this section.*

Table 5-1: Command Description and Examples

Command	Description
RD	<p>Read Micro-Ion Vacuum Gauge Module pressure response.</p> <p>Example: From host: #01RD CR</p> <p>From Micro-Ion Vacuum Gauge Module: *01_9.34E-06 CR</p> <p>The response will be 9.99E+09 for 3 seconds after the gauge is turned on then valid pressures will be sent. A response of 9.99E+09 will be sent if the ion gauge is off.</p>
IG	<p>Control Micro-Ion Vacuum Gauge Module status.</p> <p>Example: From host: #01IG1 CR</p> <p>From MICRO-ION Vacuum Gauge Module: *01_PROGM_OK CR</p> <p>IG1 = turn on Micro-Ion Gauge, IG0 = turn off Micro-Ion Gauge. Initial RD reading will be 9.99E+09 for 3 seconds then valid pressure readings will be received if emission status is OK.</p>
DG	<p>Control degas (15 mA) status.</p> <p>Example: From host: #01DG1 CR</p> <p>From Micro-Ion Vacuum Gauge Module: *01_PROGM_OK CR</p> <p>DG1 = turn on degas, DG0 = turn off degas. Another possible response is ?01_COM_ERR CR. This response occurs if the Micro-Ion Gauge is off. The Micro-Ion Gauge must be on before starting degas. Degas will run for a maximum of 2 minutes then turn off automatically.</p>
SE	<p>Control emission status.</p> <p>Example: From host: #01SE1 CR</p> <p>From Micro-Ion Vacuum Gauge Module: *01_PROGM_OK CR</p> <p>SE1 = 4 mA emission, SE0 = 0.1 mA emission. Any character besides '1' will set 0.1 mA emission. 4 mA emission is used to get accurate readings at pressures below 1e-6 Torr, 0.1 mA emission is used to get extended gauge life above 2e-4 Torr. This programming is non-volatile, the setting selected will remain in effect even if power is cycled.</p>
SF	<p>Control filament state.</p> <p>Example: From host: #01SF2 CR</p> <p>From Micro-Ion Vacuum Gauge Module: *01_PROGM_OK CR</p> <p>SF2 = Filament 2 will light when the Micro-Ion Gauge is on, SF1 = Filament 1 will light when Micro-Ion Gauge is on. If the filament state is requested to be changed while Micro-Ion Gauge is on, filament state will change after Micro-Ion Vacuum Gauge Module is turned off. If the host does not set the filament number, the Micro-Ion Vacuum Gauge Module will respond with *01_2_F_STAT CR or *01_1_F_STAT CR. This programming is non-volatile, the setting selected will remain in effect even if power is cycled.</p>

Table 5-1: Command Description and Examples (Continued)

Command	Description
SO	<p>Set over pressure setpoint.                      Example:From host:#01SO5.00e-02 CR                      From Micro-Ion Vacuum Gauge Module: #01_PROGM_OK CR</p> <p>The Micro-Ion Gauge will turn off if the pressure is greater than this value. The factory setting for a 354 Micro-Ion Gauge is 5.00e-2 Torr. This programming is non-volatile, the setting selected will remain in effect even if power is cycled. Another possible response is ?01_SYNTAX_ERR. This is caused by the use of the wrong notation in the command data field.</p> <div style="border: 1px solid black; padding: 10px; text-align: center;"> <p><b>CAUTION</b></p> <p>To obtain optimum filament life, 354 Micro-Ion Vacuum Gauges equipped with tungsten filaments should not be operated above <math>5 \times 10^{-3}</math> Torr in air.</p> </div>
SA	<p>Set offset address                      Example:From host:#01SA20 CR                      From Micro-Ion Vacuum Gauge Module: *01_PROGM_OK CR</p> <p>The address switch setting is added to this Hex value. Example: address switch is set at 2 and offset value is 20 Hex then the module address is 22 Hex. The operating address will not change until the power is cycled or RST is sent.</p>
SL	<p>Set setpoint 1 trip point.                      Example:From host:#01SL+1.00E-04 CR                      From Micro-Ion Vacuum Gauge Module:*01_PROGM_OK CR                      From host:#01SL-2.00E-04 CR                      From Micro-Ion Vacuum Gauge Module:*01_PROGM_OK CR</p> <p>The above example will turn on or energize the relay when the pressure is less than 1.00E-04 TORR, for nitrogen. The relay will turn off when the pressure goes above 2.00E-04 TORR. The '-' value from the host sets the relay OFF point and the '+' value set the relay ON point. The above example turns on the relay below the setpoint. To turn on the relay above the setpoint, the '-' value must be lower than the '+' value. SL+ SL- may be set for the same pressure. If this is done, the second SL_ command will determine the relay logic. SL+ sent last will generate a *01+_MIN_HYS response and the relay will energize BELOW the setpoint. SH- sent last will generate a *01_-MIN_HYS response and the relay will energize ABOVE the setpoint.</p>
RL	<p>Read setpoint 1 trip point.                      Example:From host:#01RL-CR                      From Micro-Ion Vacuum Gauge Module:*01-9.80E-02 CR</p> <p>RL+ reads setpoint ON value. The value begins with a plus sign.                      RL- reads setpoint OFF value. The value begins with a minus sign.</p>

Table 5-1: Command Description and Examples (Continued)

Command	Description
IGS	<p>Read Micro-Ion Vacuum Gauge Module Status.</p> <p>Example:From host:#01IGS CR</p> <p>From Micro-Ion Vacuum Gauge Module:*01_0_IG_OFF CR</p> <p>From host:#01IGS CR</p> <p>From Micro-Ion Vacuum Gauge Module:*01_1_IG_ON_ CR</p>
DGS	<p>Read Micro-Ion Vacuum Gauge Module Degas Status.</p> <p>Example:From host:#01DGS CR</p> <p>From Micro-Ion Vacuum Gauge Module:*01_0_DG_OFF CR</p> <p>From host:#01DGS CR</p> <p>From Micro-IonVacuum Gauge Module:*01_1_DG_ON CR</p>
SES	<p>Read Emission Status.</p> <p>Example:From host:#01SES CR</p> <p>From Micro-Ion Vacuum Gauge Module:*01_0.1MA_EM CR</p> <p>From host:#01SES CR</p> <p>From Micro-Ion Vacuum Gauge Module:*01_4.0MA_EM CR</p>
RS	<p>Read Controller Status.</p> <p>Example:From host:#01RS CR</p> <p>From Micro-Ion Vacuum Gauge Module:*01_00_ST_OK CR</p> <p>Note:The response is dependent on the cause of gauge shutdown.</p> <p>00_ST_OK indicates normal user control.</p> <p>01_OVPRS indicates overpressure condition caused gauge shutdown. See SO command to control overpressure setpoint.</p> <p>02_EMISS indicates emission control failure. Causes include gauge failure due to broken filament or contamination or pressure over 1 Torr.</p> <p>04_HIVLT indicates high voltage power to gauge failed. Causes include gauge failure due to mechanical damage or electrical leakage current due to contamination.</p> <p>08_POWER indicates power to controller was interrupted.</p> <p>The number value for each status indication represents a bit weight in the hexadecimal representation of this binary number. It is possible to have multiple bits set and cause a response like 06 EMISS. This indicates a HIVOLT and a EMISS failure. The status will remain the same with repeated queries from the host until the Micro-Ion Gauge is turned on. Turning on the Micro-Ion Gauge will cause the status to be reset to 00.</p>

Table 5-1: Command Description and Examples (Continued)

Command	Description
VER	<p>Read Micro-Ion Vacuum Gauge Module firmware version.</p> <p>Example:From host:#01VER CR</p> <p>From Micro-Ion Vacuum Gauge Module:*01_13715-00 CR</p> <p>In this example, 13715 is the Granville-Phillips internal part number, 00 is the revision. Larger revision numbers indicate newer versions of firmware.</p>
FAC	<p>Set factory default</p> <p>Example:From host:#01FAC CR</p> <p>From Micro-IonVacuum Gauge Module: *01_PROGM_OK CR</p> <p>This can be used when a Micro-Ion Vacuum Gauge Module is not responding properly. Cycle power or send RST after doing this function. FAC will cause default communication and transducer parameters to be programmed:</p> <p>Base Address = 00</p> <p>Zero and span are set to default values</p> <p>Baud rate = 19200, data format = 8 bits, no parity, 1 stop bit, RS485 operation.</p>
SB	<p>Set baud rate</p> <p>Example:From host:#01SB2400 CR</p> <p>From Micro-Ion Vacuum Gauge Module: *01_PROGM_OK CR</p> <p>Will continue to operate at old baud rate until power is cycled or RST command is sent. Max. baud rate is 28000. Allowable baud rates are: 28000, 19200, 14400, 9600, 4800, 2400, 1200, 600, 300.</p>
RST	<p>Reset module</p> <p>Example:From host: #01RST CR</p> <p>The RST command will reset the module as if the power had been cycled. RST has no response. Communication is re-enabled in 2 seconds.</p>
UNL	<p>Unlock Interface Speed and Framing Programming</p> <p>From Host: #01UNL CR</p> <p>From Micro-Ion: 01_PROGM_OK_CR</p> <p>If the UNL command is enabled by the TLU command, the UNL command must be executed in sequence prior to any of these commands; SB, SPN, SPO and SPE. If any of these commands are attempted without the UNL command, a response of ?01_COM-ERR CR will be generated. If UNL is not enabled by TLU command, response to UNL will be ?01_SYNTAX_ER.</p>

Table 5-1: Command Description and Examples (Continued)

Command	Description
TLU	<p>Toggle UNL Function</p> <p>From Host: #01TLU CR</p> <p>From Micro-Ion: *01_1_UL_ON_CR</p> <p>From Host: #01TLU CR</p> <p>From Micro-Ion: *01_1_UL_OFF_CR</p> <p>The TLU command will toggle the state of the UNL function. When response is UL_ON, then UNL is required to execute SPN, SPO, SPE, or SB functions. When response is UL_OFF, then UNL is not required and any attempt to execute UNL will generate a ?01_SYNTAX_ER. TLU programming is non-volatile, the setting selected will remain in effect even if power is cycled.</p>

### 5.3 Receive/Transmit Timing

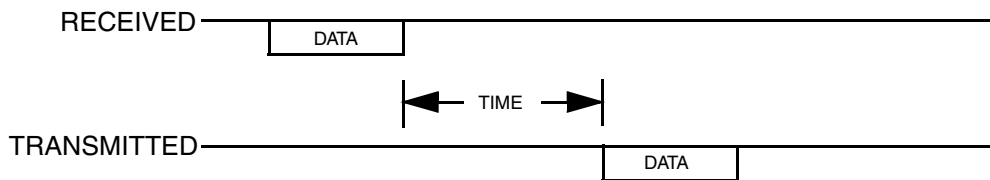


Figure 5-1: Receive/Transmit Timing

**NOTE:** The Micro-Ion Vacuum Gauge Module will shut off it's driver 80 micro-seconds after sending data to the host.

Table 5-2: Receive/Transmit Timing

Baud Rate	Time (milli-seconds)
28,800	3.3
19,200	3.9
9600	5.1
4800	7.5
2400	13
1200	22
300	79

Table 5-3: Additional Times Added

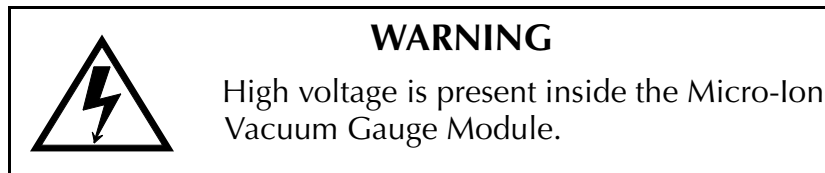
Command	Time Added (milli-seconds)
FAC	105
RD	0
RST	No Response
All Others	17

## Chapter 6

### Troubleshooting

#### 6.1 Introduction

The problems presented in Table 6-1 are followed by possible causes and corrective actions.



#### 6.2 Troubleshooting Procedures

Table 6-1: RS-485 Digital Interface Troubleshooting Procedures

Problem	Possible Cause	Corrective Action
Unit does not respond to RS-485 communication from a host but the Power Indicator illuminates	<ol style="list-style-type: none"> <li>1. The I/O connector may be wired incorrectly.</li> <li>2. No bias resistors.</li> <li>3. Address rotary switch set to incorrect address position.</li> <li>4. Incorrect baud rate or data format programmed.</li> </ol>	<ol style="list-style-type: none"> <li>1. Reverse the RS485 (+) and (-) connections.</li> <li>2. Bias resistors are missing. Refer to Section 4.3 I/O Cable Connections on page 19 in Chapter 4, Installation.</li> <li>3. Set the switch in the correct address position.</li> <li>4. Refer to Micro-Ion Vacuum Gauge Module Initialization in Chapter 7.</li> </ol>
Power indicator does not illuminate	<ol style="list-style-type: none"> <li>1. Power supply disconnected, off, or inadequate for load.</li> <li>2. The I/O connector may be wired incorrectly.</li> <li>3. Blown fuse.</li> </ol>	<p>A switching supply may shut down from the current surge upon power up. If a switching power supply is used, size the current limit to two times the working load. See Table 3-2 on page 14 in Chapter 3.</p> <ol style="list-style-type: none"> <li>2. Refer to Section 4.3 I/O Cable Connections on page 19 in Chapter 4, Installation.</li> <li>3. This could be caused by wrong wiring or low power supply voltage. Replace the fuse with a 1 ampere, slow blow, Granville-Phillips p/n 012084.</li> </ol>

Table 6-1: RS-485 Digital Interface Troubleshooting Procedures

Problem	Possible Cause	Corrective Action
Micro-Ion Vacuum Gauge will not stay on (always read 9.99e+09, response to IGS always 0)	1. Fault condition indicated by reading response to RS.	1. Refer to the RS Command in Table 5-1 of Chapter 5.
Inaccurate pressure reading:	<p>1. Organic seals. If the Micro-Ion Vacuum Gauge connection to the vacuum system is sealed with an organic O-ring the gauge will not read accurately below 1e-7 Torr.</p> <p>2. Mechanical damage. If the unit is dropped or excessive force is applied to the vacuum connection during installation, gauge elements may be damaged or pin leaks may occur.</p> <p>3. Contamination. Pump oil and other organic compounds or metal coating from a sputtering process can cause electrical current leakage between Micro-Ion Vacuum Gauge elements.</p>	<p>1. Replace O-ring with a metal seal.</p> <p>2. Replace the Micro-Ion Vacuum Gauge tube.</p> <p>3. Degas the Micro-Ion Vacuum Gauge by executing the DG command. Several degas cycles may be required to clean up the Micro-Ion Vacuum Gauge. If this does not work, the gauge may be heated externally with the electronics module removed.</p>
Process control setpoint does not function as expected.	<p>1. The I/O connector may be wired incorrectly.</p> <p>2. Wrong setpoint values programmed.</p> <p>NOTE: The process control setpoint will always have the COMMON contact connected to the N.C. contact when the Micro-Ion Vacuum Gauge is off or when the unit is not powered.</p>	<p>1. Refer to Section 4.3 I/O Cable Connections on page 19 in Chapter 4, Installation.</p> <p>2. Read SL+ and SL- data. If returned values are wrong, program SL+ and SL- with proper values. Refer to the SL Command in Table 5-1 of Chapter 5.</p>

## Chapter 7

### Service

#### 7.1 Introduction

The procedures in this section provide instructions for normal service issues that may be required during use of the Series 354 Micro-Ion Vacuum Gauge Module.

#### 7.2 Micro-Ion Vacuum Gauge (with Digital Interface) Module Initialization

The Micro-Ion Vacuum Gauge Module may have been set to incorrect communication parameters which may cause communication problems. When these problems occur, the Micro-Ion Vacuum Gauge Module communication parameters should be initialized to the factory set default values listed in Table 7-1.

*Table 7-1: Micro-Ion Vacuum Gauge Module Default Communication Parameters*

Parameter	Default Value
Baud Rate	19,200
Data Format	8 bits
Parity	None
Stop Bits	1

##### 7.2.1 Initialization

Use the following procedure to initialize the Micro-Ion Vacuum Gauge Module.



#### **WARNING**

To prevent electrical shock, turn OFF electrical power before servicing the Micro-Ion Vacuum Gauge Module.

1. Turn OFF power to the Micro-Ion Vacuum Gauge Module.
2. Disconnect I/O cable from the connector.
3. Remove the I/O cable connector jack posts from the connector.
4. Remove the four screws from the Micro-Ion Vacuum Gauge Module top cover and remove the cover.

#### **CAUTION**

Make sure the jumper is installed ONLY between the pins shown in Figure 7-1. Otherwise, damage to the Micro-Ion Vacuum Gauge Module may occur.

5. Connect a jumper wire to the pins as shown in Figure 7-1.

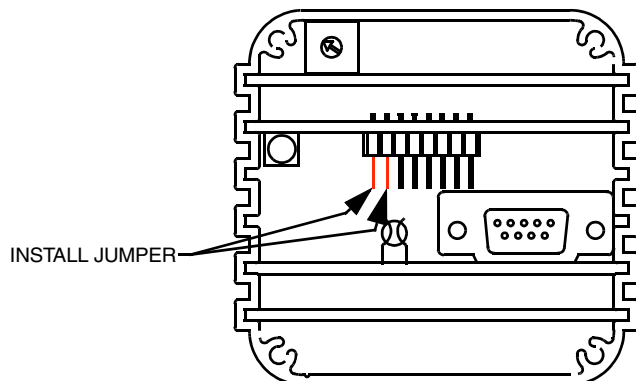


Figure 7-1: Jumper Installation Location (Cover Removed)

6. Reconnect the I/O cable.
7. Turn power ON. The Micro-Ion Vacuum Gauge Module will initialize to the parameters in Table 7-1.  
*NOTE: The Micro-Ion Vacuum Gauge Module will not read pressure while the jumper is installed.*
8. Make sure the address rotary switch on the Micro-Ion Vacuum Gauge Module is set to the correct address position.
9. From the host computer, send the following commands to the Micro-Ion Vacuum Gauge Module:
  - a. Enter the **#XX** command (where XX depends upon the switch position).
  - b. Enter the **FAC** command.*NOTE: The Micro-Ion Vacuum Gauge Module should respond with \*0X\_PROGM\_OK which indicates it is communicating properly with the host computer.*
10. Turn OFF power to the Micro-Ion Vacuum Gauge Module.
11. Remove the jumper.
12. Disconnect the I/O cable from the connector.
13. Install the Micro-Ion Vacuum Gauge Module top cover with the previously removed four screws.
14. Install the I/O cable connector jack posts on the connector.
15. Connect the I/O cable to the connector.
16. Turn power ON to the Micro-Ion Vacuum Gauge Module. It is now ready to be used.

### 7.3 Degas Cycle

Pump oil, other organic compounds, or metal coatings from a sputtering process can cause electrical current leakage between the ion gauge tube elements. When contamination occurs, system base pressure readings may begin to rise which is an indication that a degas cycle will have to be performed.

Once initiated, the degas cycle will apply approximately 4 watts of power to the ion gauge for two minutes and turn OFF automatically.

**NOTE:** Depending upon the level of contamination, several degas cycles may be required to remove the contamination from the ion gauge tube.

Use the appropriate procedure to remove contamination from the ion gauge tube for the digital or analog interface Micro-Ion Vacuum Gauge Module.

#### 7.3.1 Digital Interface

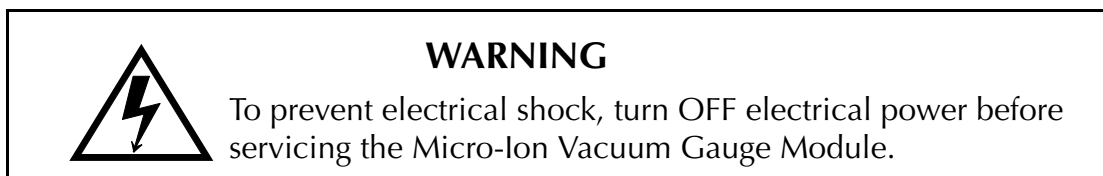
1. Turn ON the Micro-Ion Vacuum Gauge Module.
2. Enter the *DG* command at the host computer to start a degas cycle on the Micro-Ion Vacuum Gauge Module as follows:
  - a. Enter **#01DG1** to initiate a degas cycle.
  - b. Enter **#01DG0** to abort a degas cycle.

The Micro-Ion Vacuum Gauge Module should respond with *\*01\_PROGM\_OK*.

3. Once the degas cycle is complete, check the system base pressure reading again. If the reading is still high, repeat this procedure until the system base pressure is within its normal range.

### 7.4 Fuse Replacement

Use the following procedure to replace the fuse in the Micro-Ion Vacuum Gauge Module.



1. Turn power OFF to the Micro-Ion Vacuum Gauge Module.
2. Disconnect I/O cable from the connector.
3. Remove the I/O cable connector jack posts from the connector.
4. Remove the four screws from the Micro-Ion Vacuum Gauge Module top cover and remove the cover.
5. Locate the defective fuse as shown in Figure 7-2 and replace it with a new 1 amp, slow blow fuse.
6. Install the Micro-Ion Vacuum Gauge Module top cover with the previously removed four screws.
7. Install the I/O cable connector jack posts on the connector.

8. Connect the I/O cable to the connector.
9. Turn power ON to the Micro-Ion Vacuum Gauge Module. It is now ready to be used.

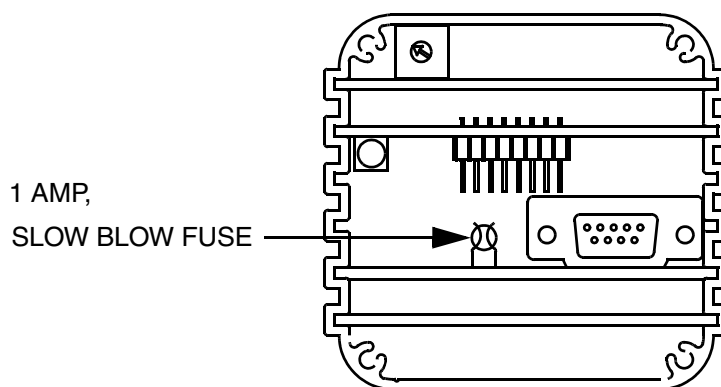
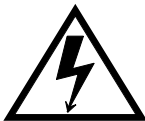


Figure 7-2: Fuse Location (Cover Removed)

## 7.5 Micro-Ion Gauge Replacement

<b>WARNING</b>	
	To prevent electrical shock, turn OFF electrical power before servicing the Micro-Ion Vacuum Gauge Module. Do not touch any gauge pins while the gauge tube is under vacuum or connected to a controller.

1. Turn OFF power to the module.
2. Remove the Input/Output connector from the module.
3. Remove the Micro-Ion Vacuum Gauge Module from the vacuum system.
4. Remove the four Phillips head screws from the gauge collar plate as shown in Figure 7-3.
5. While holding the flange, *gently* pull the Micro-Ion Vacuum Gauge Module away from the gauge collar plate as shown in Figure 7-3. The gauge tube and plate will disconnect from the module.
6. Align the notches on the replacement gauge collar plate and the Micro-Ion Vacuum Gauge Module as shown in Figure 7-3.
7. *Gently* insert the replacement gauge and collar plate into the Micro-Ion Vacuum Gauge Module until the tube pins are inserted into the tube socket.
8. Insert and tighten all four Phillips head screws.
9. Install the Micro-Ion Vacuum Gauge Module to the vacuum system.
10. Connect the Input/Output connector to the Micro-Ion Vacuum Gauge Module.
11. Turn ON power and verify communication to the Micro-Ion Vacuum Gauge Module.

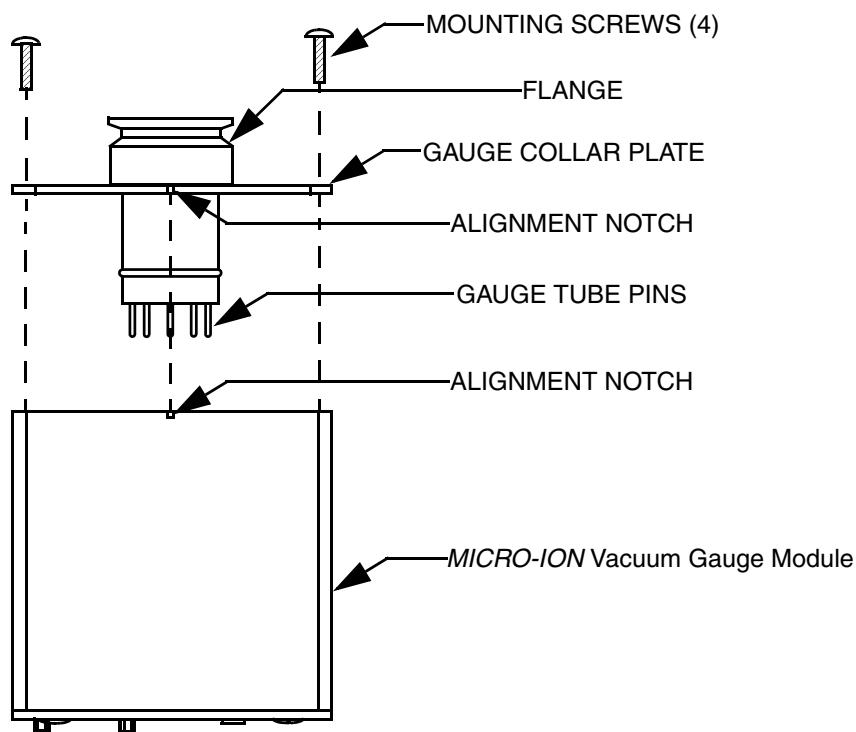
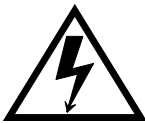


Figure 7-3: Micro-Ion Gauge Replacement

## 7.6 Ion Gauge Continuity Test

<b>WARNING</b>	
	<p>To prevent electrical shock, turn OFF electrical power before servicing the Micro-Ion Vacuum Gauge Module.</p> <p>Do not touch any gauge pins while the gauge tube is under vacuum or connected to a controller.</p>

This test should only be performed while the ion gauge is exposed to atmospheric pressure and the 354 electronics is removed from the gauge. If a problem with pressure measurement is traced to the Micro-Ion Module, the gauge may be tested with an ohm meter. This test can detect open filaments or shorts between gauge elements. This test may not detect inaccurate pressure measurement due to gauge contamination or vacuum leaks.

1. Turn OFF power to the module .
2. Remove the I/O connector from the module.
3. Remove the Micro-Ion Module from the vacuum system.

4. Remove the four Phillips head screws from the gauge collar plate as shown in Figure 7-4.

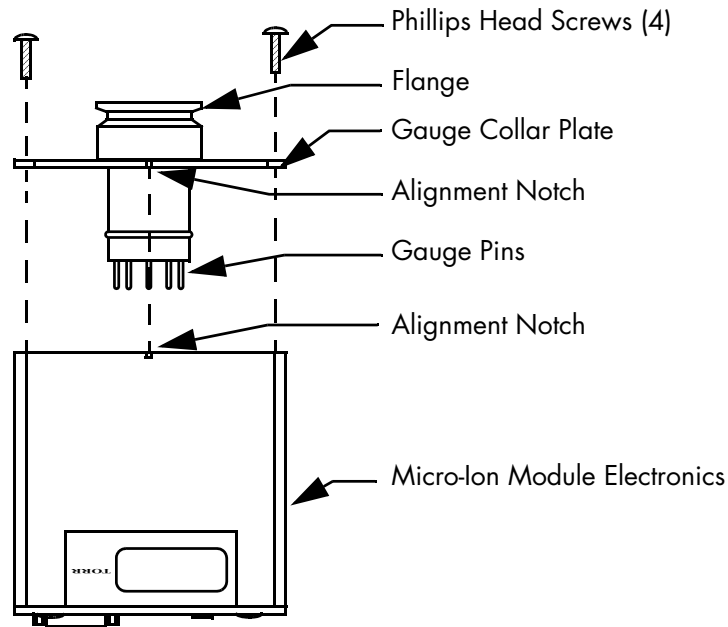


Figure 7-4: 354 Micro-Ion Gauge Removal.

5. While holding the flange, *gently* pull the Micro-Ion Vacuum Gauge Module away from the gauge collar plate as shown in Figure 7-4. The gauge tube and plate will disconnect from the module.

- Using a digital multimeter, measure the resistance of the left filament and the right filament between filament pins as shown in Figure 7-5. The reading should be approximately  $0.2 \Omega$ .

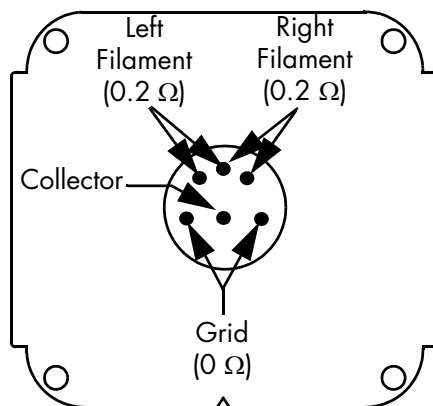


Figure 7-5: 354 Micro-Ion Gauge Pin Identification

- Measure the resistance of filament pins to any other pin or gauge case as shown in Figure 7-5. The reading should be infinity.
- Measure the resistance between Grid pins as shown in Figure 7-5. The reading should be approximately  $0 \Omega$ .
- Measure the resistance of Grid pins to any other pin or gauge case as shown in Figure 7-5. The reading should be infinity.
- Measure the resistance of Collector pin to any other pin or gauge case as shown in Figure 7-5. The reading should be infinity.

**NOTE:** If the readings obtained during this procedure are not within the values specified, the gauge should be replaced. Contact Brooks Automation, Inc./Granville-Phillips Customer Service to order a replacement gauge.

- Once the replacement 354 Micro-Ion Gauge has been received, follow the instructions in Section 7.5, steps 6 - 11 to install the new gauge.

### 7.7 Service Form

Please photocopy this form, fill it out, and return it with your equipment:

RA No. \_\_\_\_\_ Contact Granville-Phillips Customer Service at **1-303-652-4400**,  
or **1-800-776-6543 in the USA**; FAX: **1-303-652-2844** or  
email: **co-csr@brooks.com**

Model No. \_\_\_\_\_ Serial No. \_\_\_\_\_ Date \_\_\_\_\_

Name \_\_\_\_\_ Phone No. \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Please help Granville-Phillips continue to provide the best possible service by furnishing information that will help us determine the cause of the problem, as well as protect our analysis and calibration equipment from contamination.

Problem description: \_\_\_\_\_

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Application description: \_\_\_\_\_

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Has this product been used with high vapor pressure or hazardous materials?  Yes  No

If Yes, please list the types of gas, chemicals (common names, specific chemical), biological materials, or other potentially contaminating or harmful materials exposed to the product during its use.

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**NOTE: PRODUCTS EXPOSED TO RADIOACTIVE MATERIAL CANNOT BE ACCEPTED BY GRANVILLE-PHILLIPS UNDER ANY CIRCUMSTANCES.**

Corporate Officer signature: \_\_\_\_\_

Contact Name \_\_\_\_\_ Phone No. \_\_\_\_\_

<b>A</b>	
Address Selector Switch . . . . .	16
<b>C</b>	
Calculating a Gas Sensitivity Correction . . . .	24
<b>D</b>	
Degas Cycle . . . . .	18
<b>E</b>	
Emission Current . . . . .	18
<b>F</b>	
Firmware Configuration . . . . .	22
<b>G</b>	
Grounding . . . . .	19
<b>I</b>	
I/O Cable Connections . . . . .	19
Input/Output Connector . . . . .	16
Installation . . . . .	21
Ion gauge continuity test . . . . .	34
<b>M</b>	
Micro-Ion Module	
Component Description . . . . .	16
Dimensions . . . . .	13
General Description . . . . .	13
Power Supply Requirements . . . . .	15
Specifications . . . . .	14
Theory of Operation . . . . .	17
Module Process Chamber Baking	25
Mounting Flange . . . . .	17
<b>O</b>	
Overpressure Shutdown . . . . .	18
<b>P</b>	
Power Indicator Lamp . . . . .	16
<b>R</b>	
Resetting the Data Communication Parameters . . . . .	23
RS-485	
Command Descriptions . . . . .	28
Interface Configuration . . . . .	27
Receive/Transmit Timing. . . . .	32
<b>S</b>	
Safety	
General Cautions and Warnings . . . . .	9
Warning Symbols . . . . .	9
Service	
Degas Cycle . . . . .	37
Fuse Replacement . . . . .	37
Gauge Replacement . . . . .	38
Ion Gauge Continuity Test . . . . .	39
Module Initialization. . . . .	35
Service form . . . . .	42
<b>T</b>	
Test, ion gauge continuity . . . . .	34
Troubleshooting . . . . .	33
tungsten filaments . . . . .	18
<b>V</b>	
Very-High and Ultra-High Vacuum Measurement . . . . .	24
<b>W</b>	
Warning Symbols . . . . .	9





## Series 354

# Granville-Phillips Series 354 Micro-Ion<sup>®</sup> Vacuum Gauge Module with RS-485 Digital Interface



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(Adobe<sup>®</sup> Reader<sup>®</sup> version 5.0 or higher required)  
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## Instruction Manual

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