Series 354

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

Instruction Manual

Instruction manual part number 354008
Revision C - September 2014

Series 354

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

This instruction manual is for use with 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.

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Instruction Manual

Granville-Phillips® Series 354 Micro-Ion®
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:

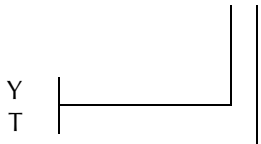
Same as 354005, but with Varian Syntax (Torr only) — 354029 - Y E - T

RS-485 interface, 1 setpoint relay:

Same as 354005, but with 90 Degree elbow (Torr only) — 20354017

RS-485 interface, 1 setpoint relay:

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



Filaments:

dual yttria-coated iridium	Y
dual tungsten	T

Flange/Fitting:

NW16KF	D
NW25KF	E
NW40KF	K
1.33 inch (NW16CF) Conflat-type	F
2.75 inch (NW35CF) Conflat-type	G
1/2 inch VCR-type male	H
NW16KFL	M
NW40KFL	L
NW25KFL	N

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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 MKS, Granville-Phillips Division 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 Granville-Phillips Customer Support for assistance if your shipment is not correct for reasons other than shipping damage.

1.3 Warranty

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

1.4 Certification

MKS Instruments, Inc. certifies that this product met its published specifications at the time of shipment from the factory. MKS Instruments, 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, contact the MKS, Granville-Phillips Division Customer Service Department at +1-800-227-8766 or +1-303-652-4691 for troubleshooting help over the phone.

If the product must be returned to the factory for service, request a Return Material Authorization (RMA) from Granville-Phillips. Do not return products without first obtaining an RMA. In some cases a hazardous materials document may be required. The MKS/Granville-Phillips Customer Service Representative will advise you if the hazardous materials document is required.

When returning a products to Granville-Phillips, be sure to package the products to prevent shipping damage. Circuit boards and modules separated from the gauge assembly must be handled using proper anti-static protection methods and must be packaged in anti-static packaging. Granville-Phillips will supply return packaging materials at no charge upon request. Shipping damage on returned products as a result of inadequate packaging is the Buyer's responsibility.
For Customer Service or Technical Support 24 hours per day, 7 days per week, every day of the year including holidays:
Phone: +1-800-227-8766 or +1-303-652-4691
Email: gp-csr@mksinst.com

MKS, Granville-Phillips Division
6450 Dry Creek Parkway
Longmont, CO 80503 USA
Phone: 1-303-652-4691 or 1-800-776-6543
FAX: 1-303-652-2844

1.6 FCC Verification

This equipment was tested and complies 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 Safety Introduction

START BY READING THESE IMPORTANT SAFETY INSTRUCTIONS AND NOTES collected here for your convenience and repeated with additional information at appropriate points throughout this instruction manual.

These safety alert symbols in this manual or on the Product mean caution - personal safety, property damage or danger from electric shock. Read these instructions carefully.

⚠ DANGER	Danger indicates a hazardous situation which, **if not avoided, will result in death or serious injury.**
⚠ WARNING	Warning indicates a hazardous situation which, if not avoided, **could result in death or serious injury**.
⚠ CAUTION	Caution indicates a hazardous situation or unsafe practice which, if not avoided, **may result in minor or moderate personal injury**.
NOTICE	Indicates a situation or unsafe practice which, if not avoided, **may result in equipment damage**.

Notice

These instructions do not and cannot provide for every contingency that may arise in connection with the installation, operation, or maintenance of this product. If you require further assistance, contact Granville-Phillips at the address on the title page of this instruction manual.

This product was designed and tested to offer reasonably safe service provided it is installed, operated, and serviced in strict accordance with these safety instructions.

⚠ **WARNING**

Safety Precautions

Failure to comply with these instructions may result in serious personal injury, including death, or property damage.

Always observe and follow all safety notices that are provided throughout this instruction manual and on the product.

These safety precautions must be observed during all phases of operation, installation, and service of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. MKS Instruments, Inc. disclaims all liability for the customer's failure to comply with these requirements.

- *Read Instructions* – Read all safety and operating instructions before operating the product.
- *Retain Instructions* – Retain the Safety and Operating Instructions for future reference.
- *Heed Warnings* – Adhere to all warnings on the product and in the operating instructions.
- *Follow Instructions* – Follow all operating and maintenance instructions.
- *Accessories* – *Do not* use accessories not recommended in this manual as they may be hazardous.

WARNING

Electrical Shock or Personal Injury

The service and repair information in this manual is for the use of Qualified Service Personnel. To avoid possible electrical shock or personal injury, do not perform any procedures in this manual or perform any servicing on this product unless you are qualified to do so.

WARNING

Electrical Shock or Fire

To reduce the risk of fire or electric shock, do not expose this product to rain or moisture.

Objects and Liquid Entry - Never push objects of any kind into this product through openings as they may touch dangerous voltage points or short out parts that could result in a fire or electric shock. Be careful not to spill liquid of any kind onto the products.

2.2 Grounding Requirements

See Grounding, Section 4.2 in the Installation chapter for more detailed requirements regarding gauge and system grounding.

WARNING

Proper Grounding

All components of a vacuum system used with this or any similar high voltage product must be maintained at Earth ground for safe operation.

Be aware that grounding this product does not guarantee that other components of the vacuum system are maintained at Earth ground.

Verify that the vacuum port to which the Series 354 Micro-Ion Gauge is mounted is electrically grounded. It is essential for personnel safety as well as proper operation that the envelope of the gauge be connected to a facility ground. See Section 4.2 for detailed grounding instructions.

Connect power cords only to properly grounded outlets or sources.

2.3 High Voltage

High Voltage is present in the Micro-Ion Gauge Module when the module is powered ON. Hazardous voltages may still be present in the module for some time after disconnecting power to the module. Refer to the Installation and Service chapters for more information.

WARNING

High Voltage

Be aware that when high voltage is present in any vacuum system, a life threatening electrical shock hazard may exist unless all exposed conductors are maintained at Earth ground.

This hazard is not unique to this product.

WARNING

High Voltage

All conductors in, on, or around the vacuum system that are exposed to potential high voltage electrical discharges must either be shielded at all times to protect personnel or must be connected to Earth ground at all times.

Ion producing equipment, such as ionization gauges, mass spectrometers, sputtering systems, etc., 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.

WARNING

High Voltage

Be aware that an electrical discharge through a gas may couple dangerous high voltage directly to an ungrounded conductor almost as effectively as would a copper wire connection. A person may be seriously injured or even killed by merely touching an exposed ungrounded conductor at high potential.

This hazard is not unique to this product.

2.4 Over-Pressure Conditions

CAUTION

Over-Pressure Conditions

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

Suppliers of pressure relief valves and pressure relief disks can be located via an online search, and are listed in the *Thomas Register* under "Valves, Relief", and "Discs, Rupture". Confirm that these safety devices are properly installed before installing the product.

Ensure the following precautions are complied with at all times:

(1) the proper gas cylinders are installed

(2) the gas cylinder valve positions are correct on manual systems

(3) the automation is correct on automated gas delivery systems

Vacuum gauges with compression fittings may be forcefully ejected if the vacuum system is pressurized.

2.5 System and Environment

WARNING

Explosive Environment

Do not use the Series 354 Micro-Ion Gauge in an environment of explosive or combustible gases or gas mixtures. Operation of any electrical instrument in such an environment constitutes a definite safety hazard. Do not use the product to measure the pressure of explosive gases or gas mixtures.

WARNING

Chemical Fumes / Explosive Environment

The fumes from solvents such as trichloroethylene, perchloroethylene, toluene, and acetone can be dangerous to health if inhaled. Use only in well ventilated areas exhausted to the outdoors.

Acetone and toluene are highly flammable and should not be used near an open flame or energized electrical equipment.

WARNING

Potential Automatic Operation

It is the installer's responsibility to ensure that the automatic signals provided by the product are always used in a safe manner. Carefully check the system programming before switching to automatic operation.

WARNING

Vacuum Chamber High Pressures

Where an equipment malfunction could cause a hazardous situation, always provide for fail-safe operation. As an example, in an automatic backfill operation where a malfunction might cause high internal pressures, provide an appropriate pressure relief device.

2.6 Responsibility

It is the responsibility of the Customer to comply with all local, state, and federal ordinances, regulations, and laws applicable to the installation, operation and service of this equipment.

It is the responsibility of the end user to provide sufficient lighting at work to meet local regulations.

Operation and Service of this equipment in strict accordance with the methods and procedures supplied by MKS, Granville-Phillips Division is the responsibility of the Customer.

MKS Instruments, Inc. assumes no liability, whatsoever, for any personal injuries or damages resulting from the operation or service of this equipment in any manner inconsistent or contrary to the methods supplied in Granville-Phillips literature including, but not limited to, manuals, instructions, bulletins, communications, and recommendations.

For emergencies and for product safety related matters, contact Granville-Phillips Customer Service Department. See Section 1.5 or Section 7.7 for detailed information regarding how to contact Granville-Phillps Customer Service Representatives.

2.7 Damage Requiring Service

Disconnect the product from all power sources and refer servicing to Qualified Service Personnel under the following conditions:

- **a.** When any cable or plug is damaged.
- **b.** If any liquid has been spilled onto, or objects have fallen into the product.
- **c.** If the product has been exposed to rain or water.
- **d.** If the product does not operate normally even if you follow the operating instructions. Adjust only those controls that are covered by the operation instructions. Improper adjustment of other controls may result in damage and will often require extensive work by a qualified technician to restore the product to its normal operation.
- **e.** If the product has been dropped or the enclosure has been damaged.
- **f.** When the product exhibits a distinct change in performance. This indicates a need for service.

Notice

Do not substitute parts or modify the instrument.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to a service facility designated by Granville-Phillips for service and repair to ensure that safety features are maintained. Do not use this product if it has unauthorized modifications.

Notice

Safety Check - Upon completion of any service or repairs to this product, ask the Qualified Service Person to perform safety checks to determine that the product is in safe operating order.

Notice

Finite Lifetime - After ten years of normal use or even non-use, the electrical insulation in this product may become less effective at preventing electrical shock. Under certain environmental conditions which are beyond the manufacturer's control, some insulation material may deteriorate sooner. Therefore, periodically inspect all electrical insulation for cracks, crazing, or other signs of deterioration. Do not use if the electrical insulation has become unsafe.

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 1 x 10^{-9} Torr to 5 x 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 controlled 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

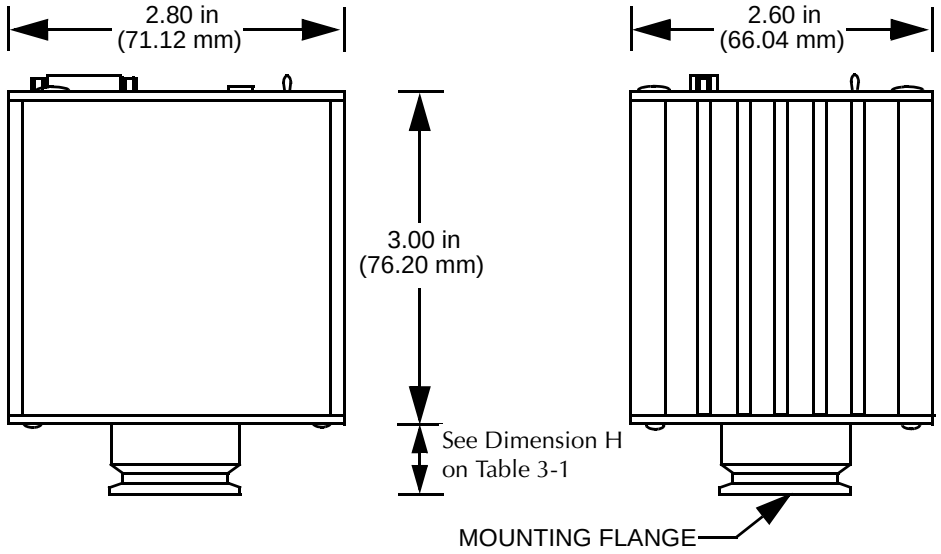


Figure 3-1: Series 354 Micro-Ion Vacuum Gauge Dimensions

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

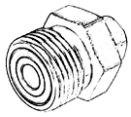
Fitting	Description	Dimension H
	NW16KF flange NW25KF flange NW40KF flange	2.0 cm (0.8 in.) 2.0 cm (0.8 in.) 2.0 cm (0.8 in.)
	1.33 in. (NW16CF) ConFlat-type 2.75 in. (NW35CF) ConFlat-type	4.3 cm (1.7 in.) 4.3 cm (1.7 in.)
	1/2 inch VCR-type male	5.8 cm (2.3 in.)

Table 3-2: Performance Specifications

Parameter	Specification
Measurement Range	1×10^{-9} to 5×10^{-2} Torr for N_2 or air **NOTE:** For use below 1×10^{-7} Torr, use a flange with a metal seal
Overpressure Protection	Gauge tube turns off if pressure rises above 5×10^{-2} Torr at 100 microamperes or 1.3×10^{-3} Torr at 4 milliampere emission
Emission Current	100 µA, 4 mA
Operating Voltage and Power	+24 Vdc, ±15%, 0.5 Amperes, 12 Watts maximum. **NOTE:** 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 ^{o}C to 40 ^{o}C
Non-operating Temp Range	-40 ^{o}C to 70 ^{o}C
IP Rating	IP20

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, 28,800
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.

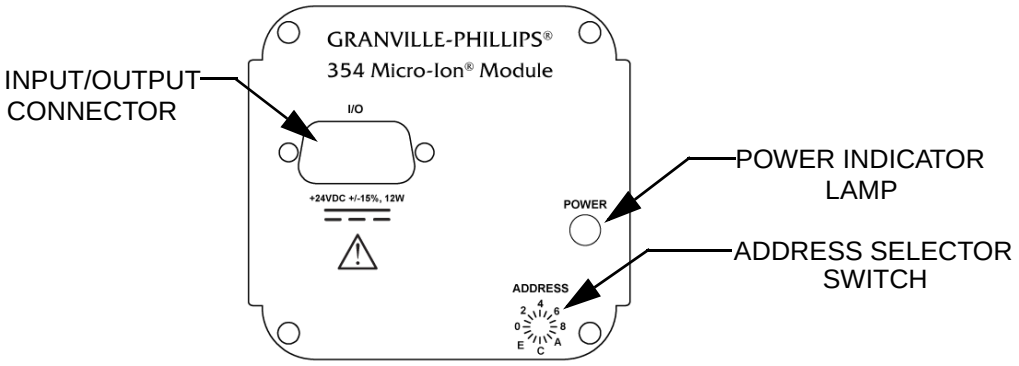


Figure 3-2: 354 Micro-Ion Vacuum Gauge Module Top Plate

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.

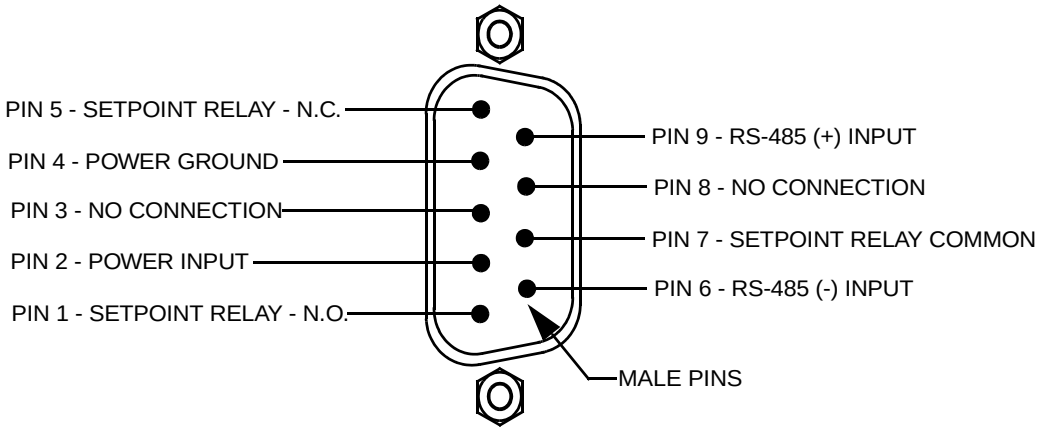


Figure 3-3: Input/Output Connector Pin Assignments

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.

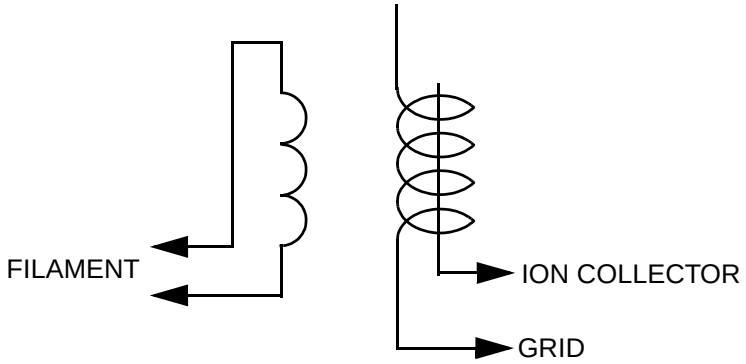


Figure 3-4: Ion Gauge Schematic

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 = ion current/(emission current x 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 milliampere 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 milliampere position is recommended.

3.8 Overpressure Shutdown

Overpressure shutdown is programmable by use of the computer interface. This is preset at 5×10^{-2} Torr when operating at 100 µA emission or 1.3×10^{-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 should 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. To activate the degas circuit, the IG ON circuit must first be activated. This assures that there is a vacuum in the system prior to the degas cycle. 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

Filament Life

To obtain optimum filament life, Micro-Ion Vacuum Gauges equipped with tungsten filaments should not be operated above 5×10^{-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 ^{o}C.

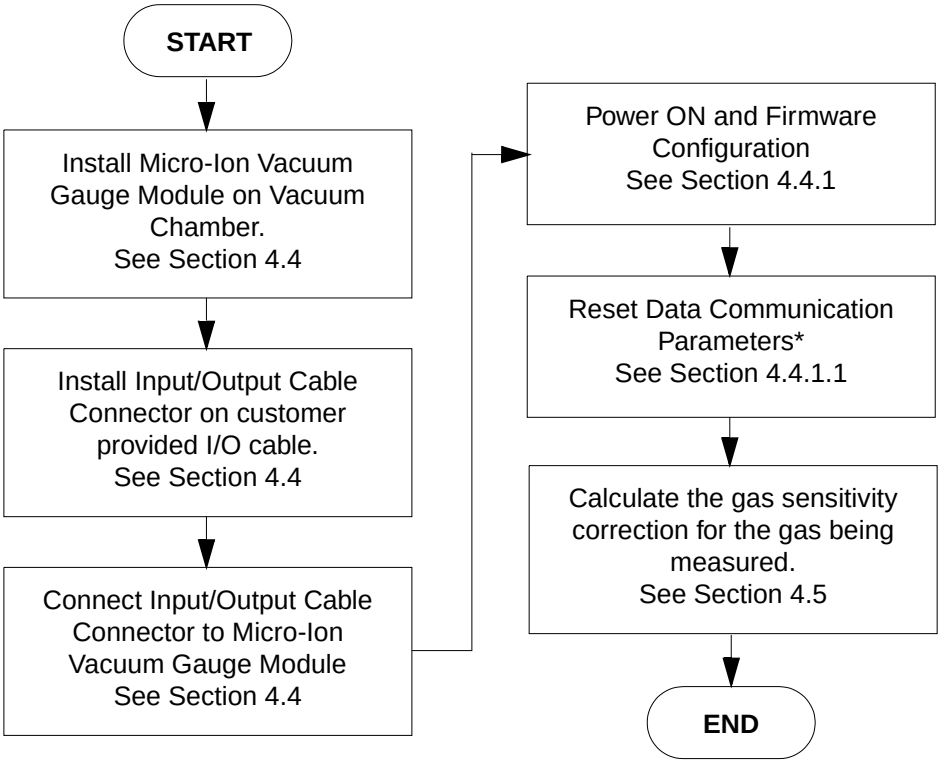
4.2 Grounding

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

Filament Life

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

⚠ WARNING

High Voltage

The Micro-Ion Vacuum Gauge Module grid supply voltages reach 250 Vdc during degas cycles. Ensure the product and the vacuum system are properly grounded to an Earth ground.

See Section 4.2 and Section 2.2.

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 ±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-IonVacuum Gauge Module default settings as shown in Table 3-4 on page 17.

> ***NOTE:*** *The* Micro-IonVacuum 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 milliampere emission current.
- **b.** Enter **#01SE0** - for 0.1 milliampere 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.

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 28,800. 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_2	1.00
H_e	0.18
N_e	0.30
A_r	1.29
K_r	1.94
X_e	2.87
H_2	0.46

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

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

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 1×10^{-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 ºC 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

Over-Temperature Condition

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

High Voltage

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.

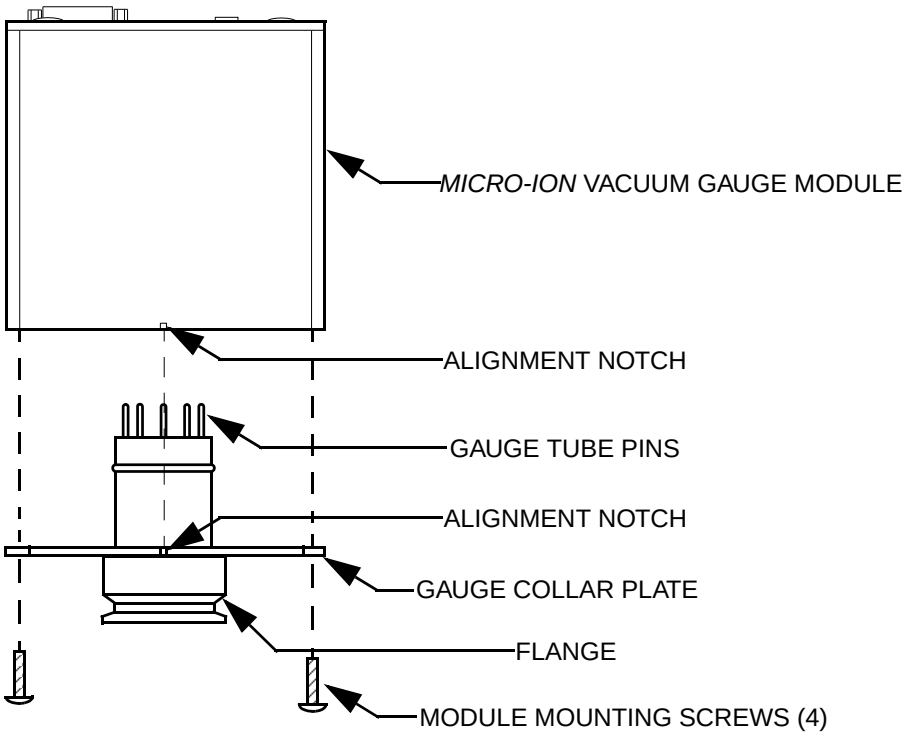


Figure 4-2: Module Removal for Baking Process Chamber

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 ºC***.

5. Bake the process chamber at the desired temperature (200 ºC max) for the specified period of time. Once the chamber has cooled to below 70 ºC, 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_SYNTX_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	Read Micro-IonVacuum Gauge Module pressure response. Example:From host:#01RD CR From Micro-Ion Vacuum Gauge Module: *01_9.34E-06 CR 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.
IG	Control Micro-Ion Vacuum Gauge Module status. Example:From host:#01IG1 CR From *MICRO-ION* Vacuum Gauge Module: *01_PROGM_OK CR 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.
DG	Control degas (15 mA) status. Example:From host:#01DG1 CR From Micro-Ion Vacuum Gauge Module: *01_PROGM_OK CR 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.
SE	Control emission status. Example:From host:#01SE1 CR From Micro-Ion Vacuum Gauge Module: *01_PROGM_OK CR 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.
SF	Control filament state. Example:From host:#01SF2 CR From Micro-Ion Vacuum Gauge Module:*01_PROGM_OK CR 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.

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

Command	Description
SO	Set over pressure setpoint. Example:From host:#01SO5.00e-02 CR From Micro-Ion Vacuum Gauge Module: #01_PROGM_OK CR 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_SYNTX_ERR. This is caused by the use of the wrong notation in the command data field.  **⚠ CAUTION** **Gauge Filament Life** **To obtain optimum filament life, 354 Micro-Ion Vacuum Gauges equipped with tungsten filaments should not be operated above $5x10^{-3}$ Torr in air.**
SA	Set offset address Example:From host:#01SA20 CR From Micro-Ion Vacuum Gauge Module: *01_PROGM_OK CR 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.
SL	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 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.
RL	Read setpoint 1 trip point. Example:From host:#01RL-CR From Micro-Ion Vacuum Gauge Module:*01-9.80E-02 CR RL+ reads setpoint ON value. The value begins with a plus sign. RL- reads setpoint OFF value. The value begins with a minus sign.

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

Command	Description
IGS	Read Micro-Ion Vacuum Gauge Module Status. Example:From host:#01IGS CR From Micro-Ion Vacuum Gauge Module:*01_0_IG_OFF CR From host:#01IGS CR From Micro-Ion Vacuum Gauge Module:*01_1_IG_ON_ CR
DGS	Read Micro-Ion Vacuum Gauge Module Degas Status. Example:From host:#01DGS CR From Micro-Ion Vacuum Gauge Module:*01_0_DG_OFF CR From host:#01DGS CR From Micro-IonVacuum Gauge Module:*01_1_DG_ON CR
SES	Read Emission Status. Example:From host:#01SES CR From Micro-Ion Vacuum Gauge Module:*01_0.1MA_EM CR From host:#01SES CR From Micro-Ion Vacuum Gauge Module:*01_4.0MA_EM CR
RS	Read Controller Status. Example:From host:#01RS CR From Micro-Ion Vacuum Gauge Module:*01_00_ST_OK CR Note:The response is dependent on the cause of gauge shutdown. 00_ST_OK indicates normal user control. 01_OVPRS indicates overpressure condition caused gauge shutdown. See SO command to control overpressure setpoint. 02_EMISS indicates emission control failure. Causes include gauge failure due to broken filament or contamination or pressure over 1 Torr. 04_HIVLT indicates high voltage power to gauge failed. Causes include gauge failure due to mechanical damage or electrical leakage current due to contamination. 08_POWER indicates power to controller was interrupted. 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.

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

Command	Description
VER	Read Micro-Ion Vacuum Gauge Module firmware version. Example:From host:#01VER CR From Micro-Ion Vacuum Gauge Module:*01_13715-00 CR In this example, 13715 is the Granville-Phillips internal part number, 00 is the revision. Larger revision numbers indicate newer versions of firmware.
FAC	Set factory default Example:From host:#01FAC CR From Micro-IonVacuum Gauge Module: *01_PROGM_OK CR 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: Base Address = 00 Zero and span are set to default values Baud rate = 19200, data format = 8 bits, no parity, 1 stop bit, RS485 operation.
SB	Set baud rate Example:From host:#01SB2400 CR From Micro-Ion Vacuum Gauge Module: *01_PROGM_OK CR 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: 28800, 19200, 14400, 9600, 4800, 2400, 1200, 600, 300.
RST	Reset module Example:From host: #01RST CR 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.
UNL	Unlock Interface Speed and Framing Programming From Host: #01UNL CR From Micro-Ion: 01_PROGM_OK_CR 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_SYNTX_ER.

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

Command	Description
TLU	Toggle UNL Function From Host: #01TLU CR From Micro-Ion: *01_1_UL_ON_CR From Host: #01TLU CR From Micro-Ion: *01_1_UL_OFF_CR 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 repsonse is UL_OFF, then UNL is not required and any attempt to execute UNL will generate a ?01_SYNTX_ER. TLU programming is non-volatile, the setting selected will remain in effect even if power is cycled.

5.3 Receive/Transmit Timing

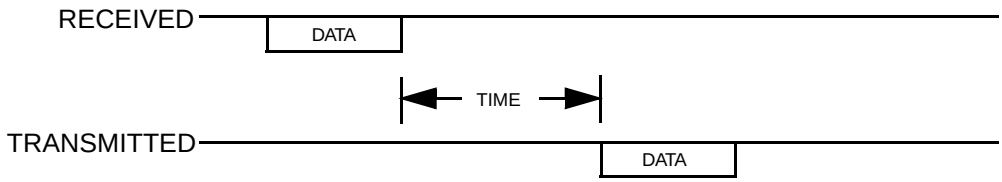


Figure 5-1: Receive/Transmit Timing

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.

WARNING

High Voltage

Be aware that when high voltage is present in the Micro =Ion Gauge Module.

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	1. The I/O connector may be wired incorrectly. 2. No bias resistors. 3. Address rotary switch set to incorrect address position. 4. Incorrect baud rate or data format programmed.	1. Reverse the RS485 (+) and (-) connections. 2. Bias resistors are missing. Refer to Section 4.3 I/O Cable Connections on page 21 in Chapter 4, Installation. 3. Set the switch in the correct address position. 4. Refer to Micro-Ion Vacuum Gauge Module Initialization in Chapter 7.
Power indicator does not illuminate	1. Power supply disconnected, off, or inadequate for load. 2. The I/O connector may be wired incorrectly. 3. Blown fuse.	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 16 in Chapter 3. 2. Refer to Section 4.3 I/O Cable Connections on page 21 in Chapter 4, Installation. 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.

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:	1. Organic seals. If theMicro-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. 2. Mechanical damage. If the unit is dropped or excessive force is applied to the vacuum connection during installation, gauge elements my be damaged or pin leaks may occur. 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.	1. Replace O-ring with a metal seal. 2. Replace the Micro-Ion Vacuum Gauge tube. 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.
Process control setpoint does not function as expected.	1. The I/O connector may be wired incorrectly. 2. Wrong setpoint values programmed. 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.	1. Refer to Section 4.3 I/O Cable Connections on page 21 in Chapter 4, Installation. 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.

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 VacuumGauge 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

High Voltage

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

Possible Product Damage

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.

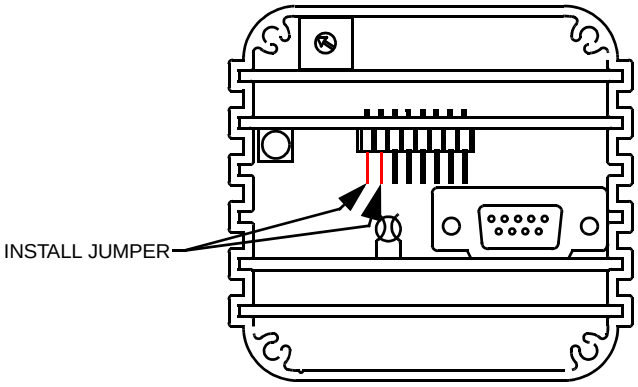


Figure 7-1: Jumper Installation Location (Cover Removed)

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 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.

WARNING

High Voltage

To prevent electrical shock, turn OFF electrical power before servicing 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.

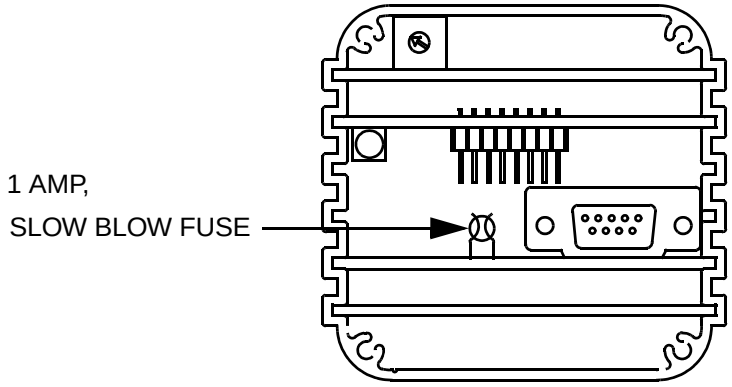


Figure 7-2: Fuse Location (Cover Removed)

7.5 Micro-Ion Gauge Replacement

WARNING

High Voltage

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.

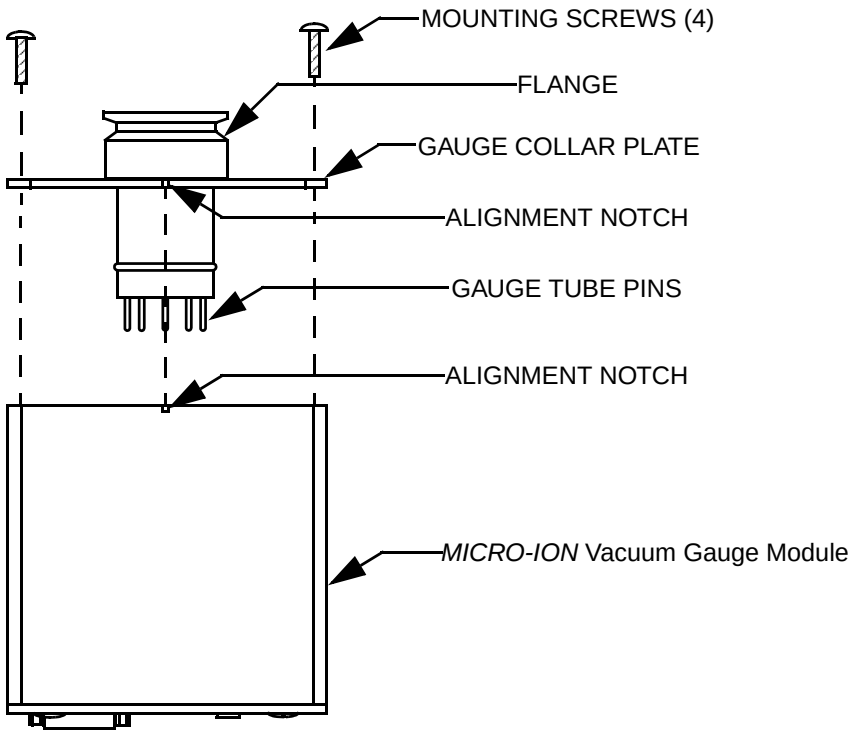


Figure 7-3: Micro-Ion Gauge Replacement

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.

7.6 Ion Gauge Continuity Test

WARNING

High Voltage

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.

This test should be performed ONLY 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.

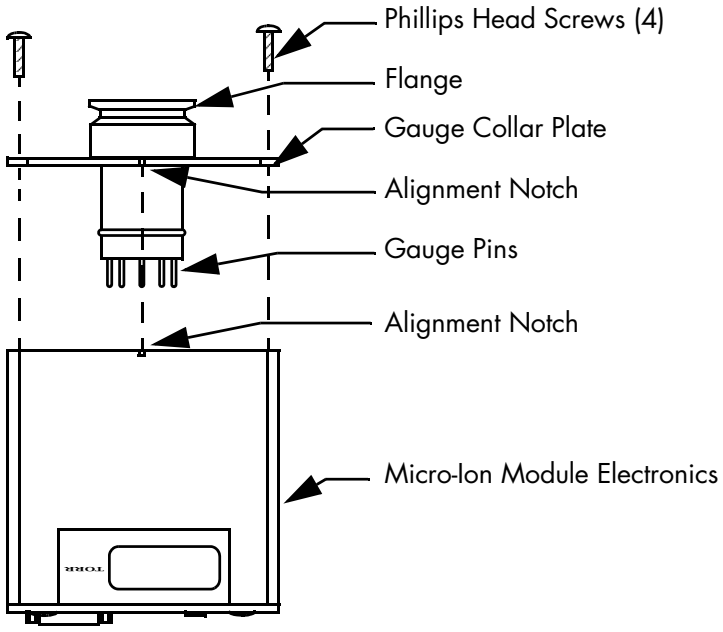


Figure 7-4: 354 Micro-Ion Gauge Removal.

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.

6. 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 Ω.

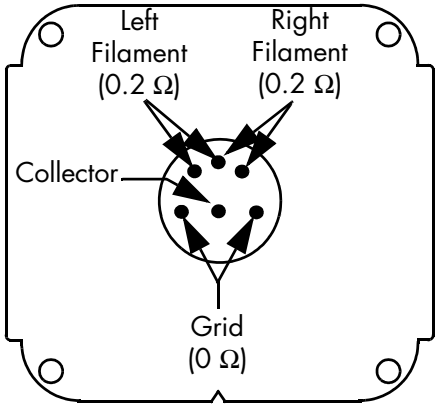


Figure 7-5: 354 Micro-Ion Gauge Pin Identification

7. Measure the resistance of filament pins to any other pin or gauge case as shown in Figure 7-5. The reading should be infinity.

8. Measure the resistance between Grid pins as shown in Figure 7-5. The reading should be approximately 0 Ω.

9. Measure the resistance of Grid pins to any other pin or gauge case as shown in Figure 7-5. The reading should be infinity.

10. 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 Granville-Phillips Customer Service to order a replacement gauge.*

11. 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 Guidelines

If a qualified service person makes repairs at the component level, repairs properly made with equivalent electronic parts and rosin core solder do not void the warranty.

If the product requires service, contact the MKS, Granville-Phillips Division Customer Service Department at +1-800-227-8766 or +1-303-652-4691 for troubleshooting help over the phone.

If the product must be returned to the factory for service, request a Return Material Authorization (RMA) from Granville-Phillips. Do not return products without first obtaining an RMA. In some cases a hazardous materials document may be required. The MKS/Granville-Phillips Customer Service Representative will advise you if the hazardous materials document is required.

When returning a products to Granville-Phillips, be sure to package the products to prevent shipping damage. Circuit boards and modules separated from the gauge assembly must be handled using proper anti-static protection methods and must be packaged in anti-static packaging. Granville-Phillips will supply return packaging materials at no charge upon request. Shipping damage on returned products as a result of inadequate packaging is the Buyer's responsibility.

For Customer Service or Technical Support 24 hours per day, 7 days per week, every day of the year including holidays:
Phone: +1-800-227-8766 or +1-303-652-4691
Email: gp-csr@mksinst.com

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Series 354

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

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Instruction Manual

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