Series 354

Vacuum Gauge Module with Analog Output

Instruction Manual

Instruction manual part number 354004
Revision F - March 2020

Series 354

Vacuum Gauge Module with Analog Output

This Instruction Manual is for use with all Series 354 Micro-Ion Vacuum Gauge Modules with analog output. A list of applicable catalog numbers is provided on the following page.

Customer Service / Technical Support:

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Instruction Manual

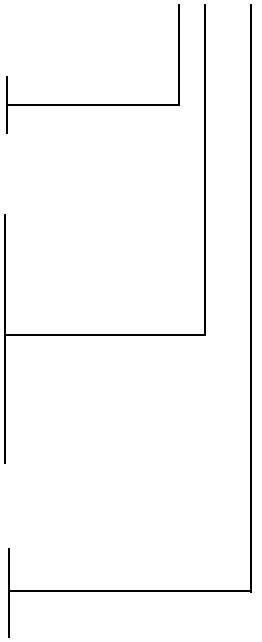
Series 354 Micro-Ion®
Vacuum Gauge Module with Analog Output

Catalog numbers for Series 354 Micro-Ion Modules

Power supply and cable are not included.

Analog output, no setpoint relays:

No digital display	354001 - X X - X
3-digit display	354002 - X X - X
No digital display, with manual degas (with no overpressure shutdown)	20354014 - X X - X
No digital display, with manual degas	354019 - X X - X



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

Measurement Units:

Torr	T
mbar	M
pascal	P

Table of Contents

Chapter 1

Safety Instructions

1.1 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 MKS, Granville-Phillips Division 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.

1.2 Grounding Requirements

See Grounding, Section 2.4 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 2.4 for detailed grounding instructions.

Connect power cords only to properly grounded outlets or sources.

1.3 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.

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.

1.4 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.

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 disks that will release pressure at a level considerably below that pressure which the system can safely withstand. Suppliers of pressure relief valves and pressure relief disks can be located via an on-line search. ***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.

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.

1.5 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

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.

1.6 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 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 MKS literature including, but not limited to, manuals, instructions, bulletins, communications, and recommendations.

For emergencies and for product safety related matters, contact the MKS Customer Service Department. See Section 1.8 or Section 4.7 for detailed information regarding how to contact MKS Customer Service Representatives.

1.7 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 MKS 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.

1.8 Service Guidelines

Some minor problems are readily corrected on site. If the product requires service, contact the MKS Technical Support Department at +1-833-986-1686. If the product must be returned to the factory for service, request a Return Material Authorization (RMA) from MKS. Do not return products without first obtaining an RMA. In some cases a hazardous materials disclosure form may be required. The MKS Customer Service Representative will advise you if the hazardous materials document is required.

When returning products to MKS, be sure to package the products to prevent shipping damage. Shipping damage on returned products as a result of inadequate packaging is the Buyer's responsibility.

For Customer Service / Technical Support:
MKS Global Headquarters
2 Tech Drive, Suite 201
Andover MA, 01810 USA
Phone: +1-833-986-1686
Email: insidesales@mksinst.com
Visit our website at www.mksinst.com

1.9 Warranty Information

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

1.10 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

Installation

2.1 Introduction

The Micro-Ion Gauge Module measures pressures from less than 1 x 10^{-9} Torr to 5 x 10^{-2} Torr, N_2 equivalent (or air). Pressure readout is via a logarithmic analog voltage on the I/O connector on all models and digital readout for models with that option. The gauge has redundant filaments with filament selection via a selector switch adjacent to the "D" connector.

The Micro-Ion Gauge Module is a modular instrument intended for computer control only with no external controls or adjustments. The power supply voltage required for operation is 24 Vdc, ±15%, 12 watts.

2.2 Mounting

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

The Micro-Ion Gauge Module is mounted to the vacuum system by the flange only. Reasonable care should be taken to install the device where it is protected from physical damage.

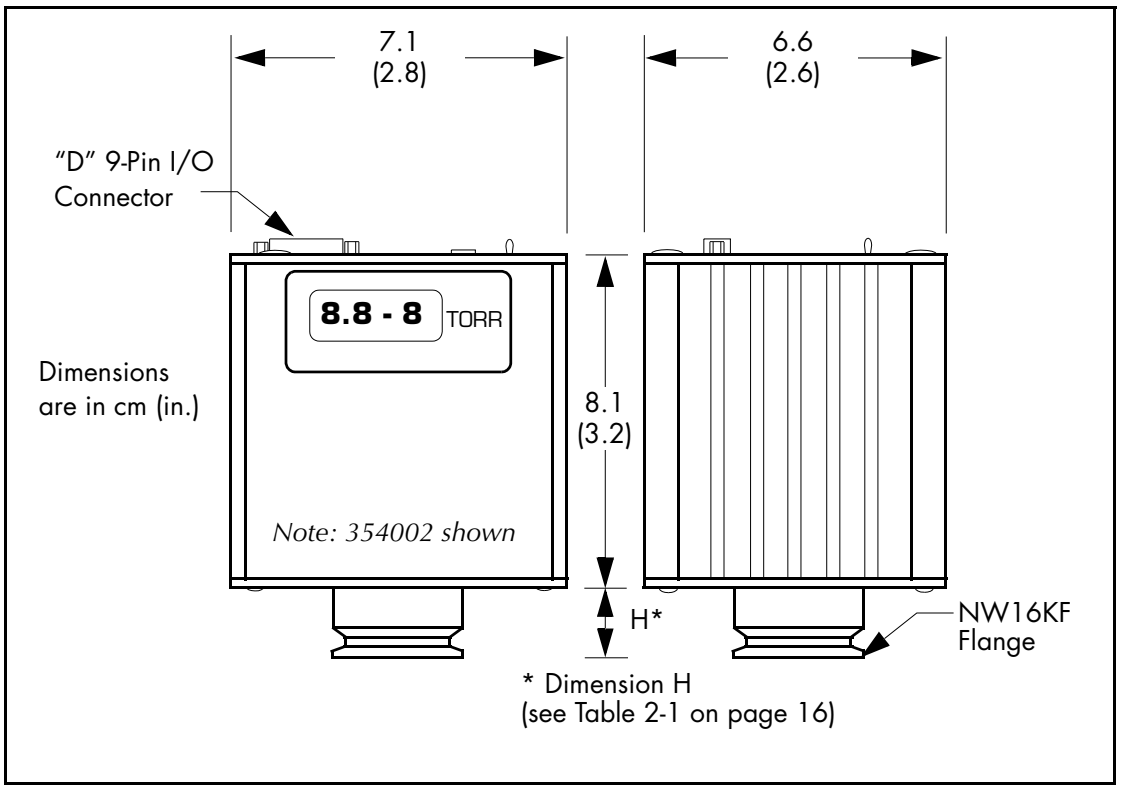
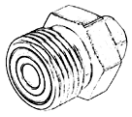


Figure 2-1 *Micro-Ion Gauge Module Dimensions.*

2.3 Fittings

Table 2-1 *Fittings for Micro-Ion Gauge Module.*

Fitting	Description	Dimension H
	NW16KF flange NW25KF flange NW40KF flange NW16KFL flange NW25KFL flange	2.0 cm (0.8 in.) 2.0 cm (0.8 in.) 2.0 cm (0.8 in.) 4.0 cm (1.6 in.) 4.0 cm (1.6 in.)
	1.33 in. (NW16CF) ConFlat-type flange 2.75 in. (NW35CF) ConFlat-type flange	4.3 cm (1.7 in.) 4.3 cm (1.7 in.)
	1/2 inch VCR-type male	5.8 cm (2.3 in.)
All dimensions are nominal. For tolerances, contact Granville-Phillips.		

2.4 Grounding

The Micro-Ion 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 strap for the NW16KFL and NW25KFL flanges. Due to the "O" ring seal, grounding cannot be assumed through the fitting. The groove in the KF flange of the Micro-Ion Gauge Module is designed to prevent the use of a non-metallic type flange clamp. Do not alter either the groove or a non-metallic flange clamp to attempt use with the Micro-Ion Gauge Module.

See Section 1.2 for safety guidelines regarding grounding requirements and Section 1.3 for safety guidelines regarding high voltages.

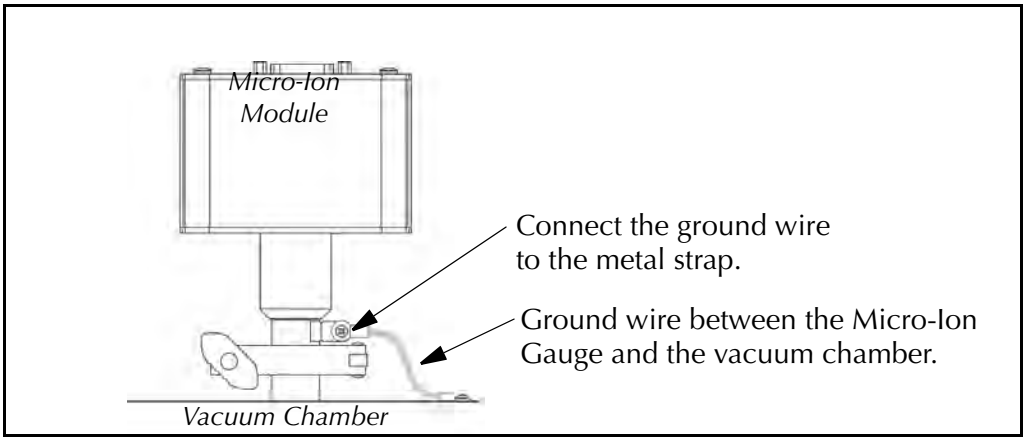


Figure 2-2 *Grounding the Micro-Ion Gauge Module*

2.5 I/O Cable Connections

The I/O connector is illustrated in Figure 2-3.

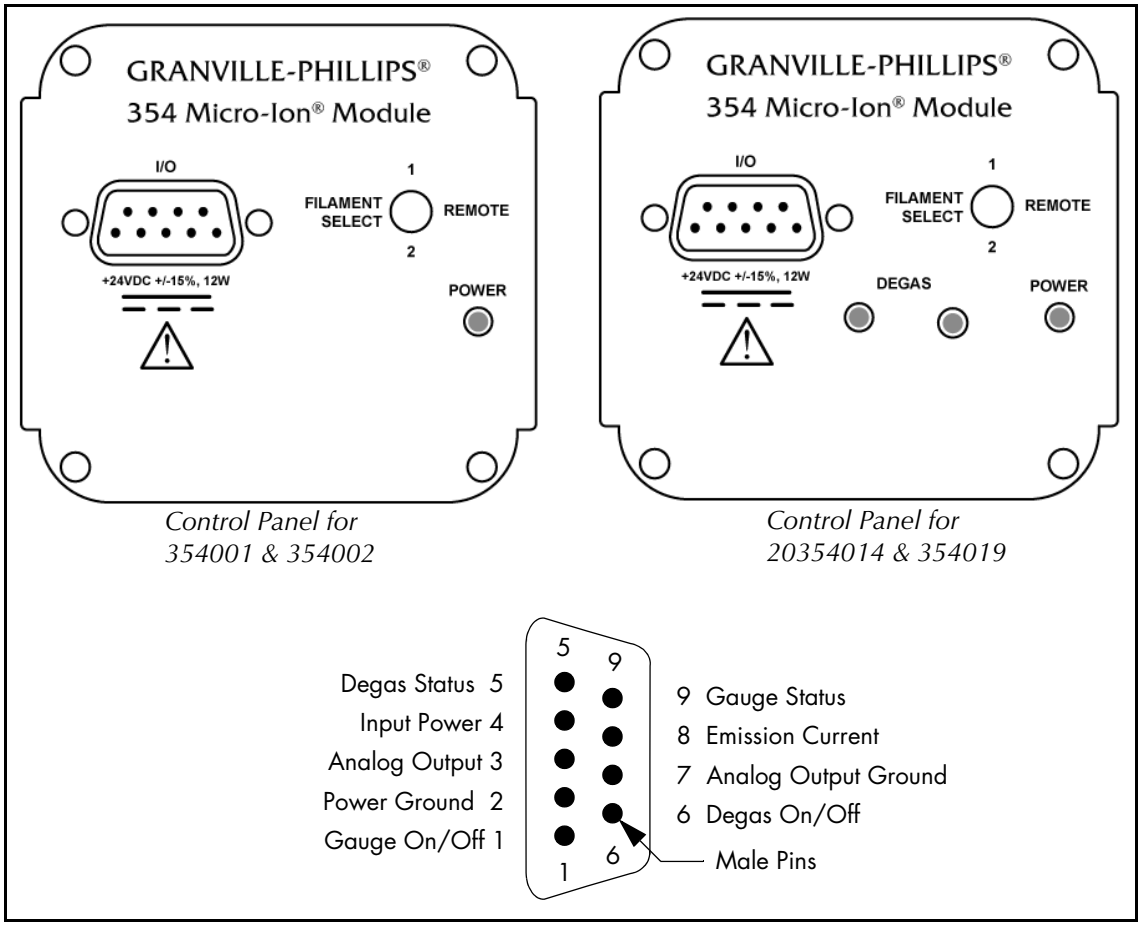


Figure 2-3 *Micro-Ion Gauge Module Analog Connector.*

Table 2-2 *I/O Connector Pin Descriptions.*

Pin	Description	Function
1	Gauge On/Off	The application of a continuous ground is required for an "ON" condition. Removal of the ground turns the gauge off.
2	Power Ground	Use for input power return, IG ON/OFF, Degas ON/OFF, and status outputs.
3	Analog Output	Used in conjunction with Pin 7, Analog Output Ground.
4	Input Power	+24 Vdc ±15%, 12 watts max. Protected against reversal and overvoltage.
5	Degas Status	Open collector transistor (grounded emitter) rated at VCE ≤40 V, 50 mA max. Transistor OFF = degas OFF, transistor ON = degas ON.
6	Degas ON/OFF	Application of Ground turns degas "ON".
7	Analog Output Ground	Use in conjunction with the analog output only.
8	Emission Current	Application of a ground increases emission current from 100 µA to 4 mA.
9	Gauge Status	Open collector transistor (grounded emitter) rated at VCE ≤40 V, 50 mA max. Transistor OFF = Gauge OFF, transistor ON = Gauge ON. NOTE: For Catalog Numbers 20354014 and 354019, Pin 9 is for FILAMENT SELECT. Assert low (to Power Ground, Pin 2) to select FILAMENT 2. Allow this pin to float high or pull to logic high level for FILAMENT 1 to be selected. This function is active only if the FILAMENT SELECT switch is in the REMOTE position. No Gauge Status line is provided for these products.

Chapter 3

Operation

3.1 Theory of Operation

The functional parts of a typical ionization gauge are the filament (cathode), grid (anode) and ion collector, which are shown schematically in Figure 3-1. These electrodes are maintained by the gauge controller at +30, +180, and 0 volts, relative to ground, respectively.

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. All of the electrons eventually collide with the grid, but many first traverse the region inside the grid many times.

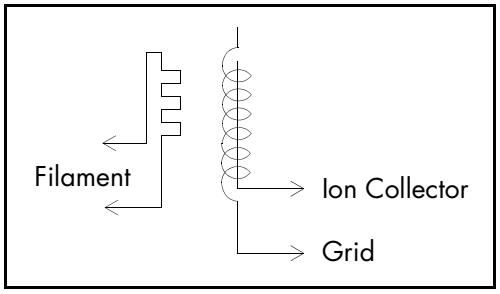


Figure 3-1 *Ion Gauge Schematic.*

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 collectors. The rate at which electron collisions with molecules occurs 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, giving rise to the definition of ion gauge "sensitivity", frequently denoted by "K":

K = ion current/(emission current x pressure)

Micro-Ion Gauges have a sensitivity of 20/Torr when used with nitrogen or air.

The ion 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.

Ion gauge degas 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 adsorbed gases.

3.2 Gauge ON/OFF

To turn the gauge ON, it is required that pin 1 be grounded to pin 2 of the I/O connector. To turn the gauge OFF, remove the ground. Note that the application of the ground will only try once to turn ON the gauge. If, for any reason, this is not successful, input be cycled back to OFF and then ON again.

Possible reasons for an unsuccessful turn-ON include:

1. Slow voltage rise from the power supply to the unit.
2. Attempt made to turn on the gauge at a pressure where emission could not be established.
3. An overpressure shutdown where system pressure exceeded the overpressure shutdown level.

3.3 Power Indicator LED

The power indicator LED on Micro-Ion modules shows the status of power, ion gauge, and operating pressure.

The power indicator LED states for all Micro-Ion modules are given in Table 3-1 (*with the exceptions* of Catalog Numbers 20354014 and 354019, which are stated in Table 3-2).

Table 3-1 *Power Indicator Status LED for Micro-Ion Modules Catalog Numbers 354001 and 354002).*

LED Status	Description
OFF	Module not powered.
Steady GREEN	Power applied, ion gauge ON.
Blinking GREEN	Electronics Failure.

Table 3-2 *Power Indicator Status LED for Micro-Ion Modules Catalog Numbers 20354014 and 354019.*

LED Status	Description
OFF	Module not powered.
Steady RED	Power applied, ion gauge OFF.
Steady ORANGE	Ion gauge ON, and in Degas mode
Steady GREEN	Ion gauge ON, pressure below 1×10^{-4} Torr.

3.4 Emission Current

There are two values of emission current available: either 100 microamperes or 4 milliamperes as determined by the status of pin 8 of the I/O connector. While either value can be used continuously, the following guidelines are suggested: (1) for operation in the higher pressure ranges with a clean system, 100 microamperes emission is satisfactory, (2) operation in the lower pressure ranges the 4 milliampere setting should be used to give a more accurate pressure reading. Internal circuitry corrects the analog output voltage to pressure relationship curve for the emission current selected.

There is a problem with all ion gauges used in systems that have the potential for oil vapor from a diffusion pump to enter the gauge volume. The oil vapor deposits on the grid, forming an insulator that impedes electron emission, resulting in higher and higher filament power required to emit electrons, and ultimate inability to control emission. In this situation, the 4 milliampere position is recommended.

3.5 Analog Output

The analog output for all Micro-Ion Gauge Modules (*with the exceptions* of Catalog Numbers 20354014, 20354015, and 354019) is a 0-9 Vdc signal proportional to the logarithm of the pressure with 0 volts at 1 x 10^{-10} Torr.

NOTE: Refer to Section 3.5.2 on page 24 for the analog output for Micro-Ion module Catalog Number 20354015.

NOTE: Refer to Section 3.5.1 on page 23 for the analog output for Micro-Ion module Catalog Number 354019 and 20354014.

With a 0-9 Vdc output, the equation for pressure is:

Pressure = $10^{(volts-10)}$

- When the Micro-Ion gauge is turned OFF, the output will switch to slightly over +10 Vdc.
- During an overpressure shutdown, the output will also switch to slightly over +10 Vdc.
- During degas, the overpressure shutdown occurs at 3 x 10^{-4}.
- At 4mA emission, the overpressure shutdown occurs at 1.5 x 10^{-3}.
- At 100 µA emission, the overpressure shutdown occurs at 5 x 10^{-2}.

Figure 3-2 on page 22 shows the standard Micro-Ion Modules' pressures for Degas, 4 mA Emission, and 100 µA Emission, where the overpressure shutdown occurs.

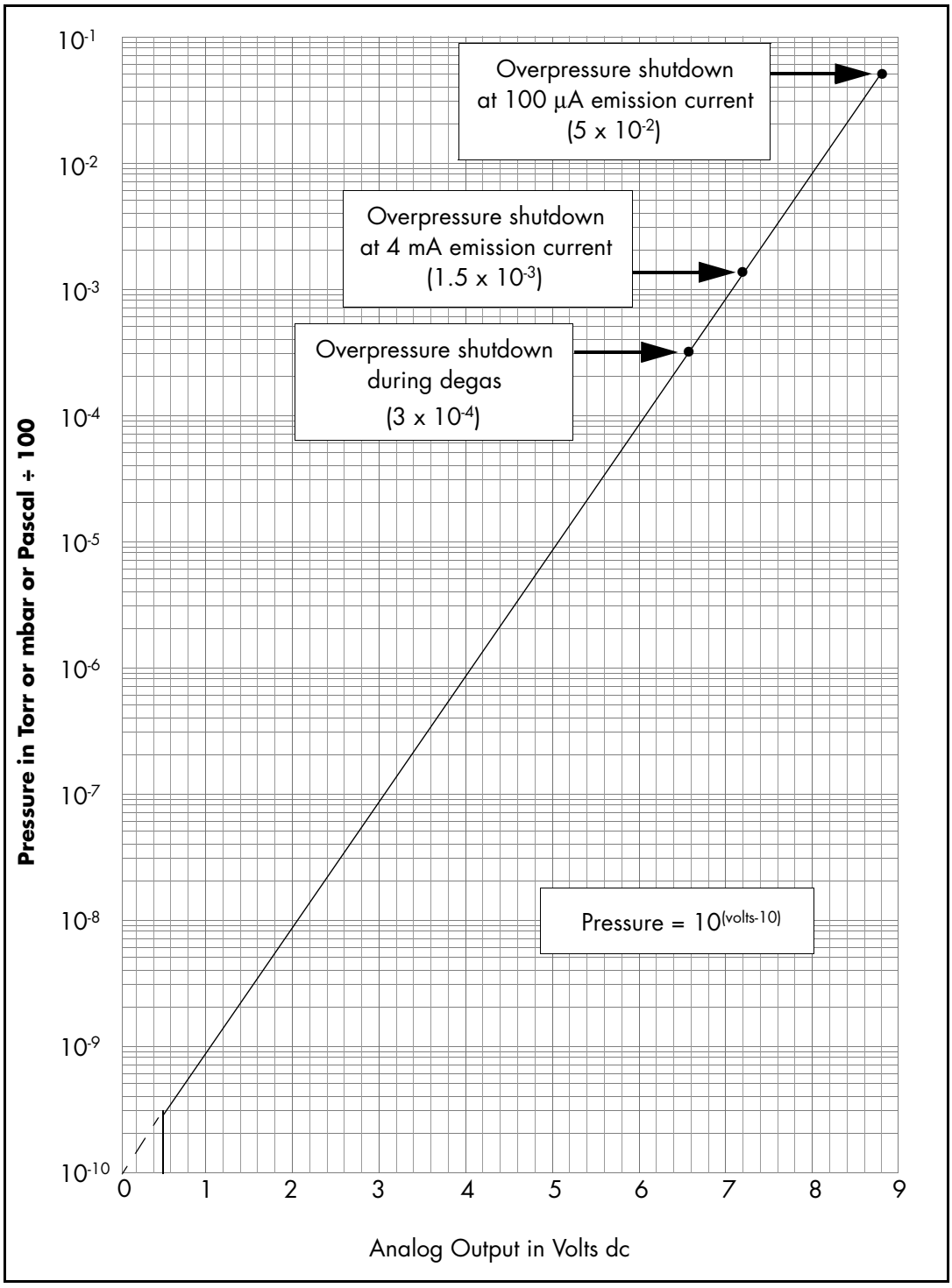


Figure 3-2 *Analog Output Curve for Standard Micro-Ion Modules.*

3.5.1 Analog Output for Catalog Numbers 354019 and 20354014

The analog output for Catalog Numbers 354019 and 20354014 is a 0-9 Vdc signal proportional to the logarithm of the pressure with 0 volts at 1 x 10^{-11} Torr. Figure 3-3 shows the pressures for Degas, 4 mA Emission, and 100 µA Emission, where the overpressure shutdown occurs.
Note: The overpressure shutdown feature for the 20354014 is disabled.
The equation for pressure is:

Pressure = $10^{(volts-11)}$

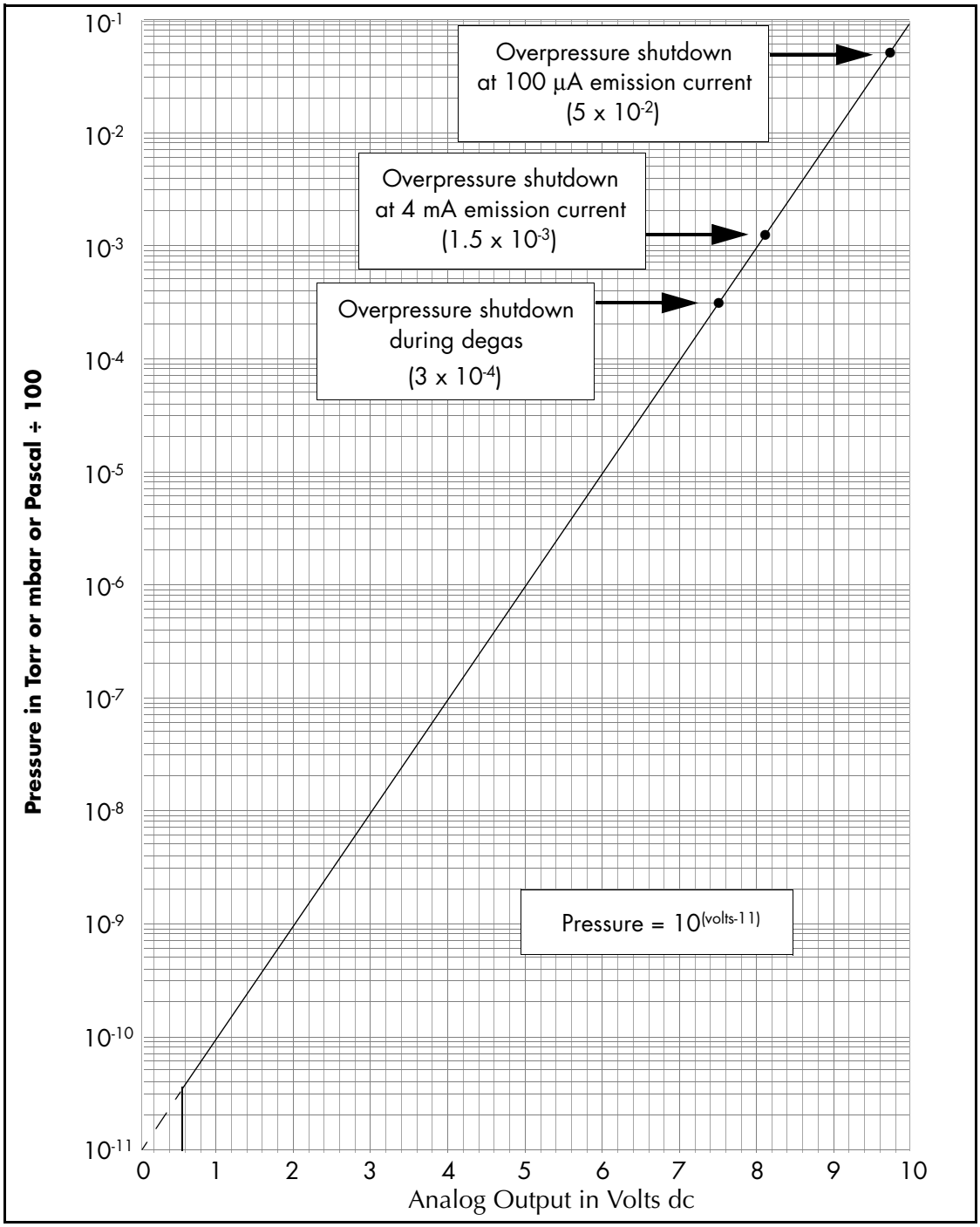


Figure 3-3 *Analog Output Curve for Module 354019 and 20354014.*

3.5.2 Analog Output for Catalog Number 20354015 (Discontinued)

The analog output for Catalog Number 20354015 is a 0-8 Vdc signal proportional to the logarithm of the pressure with 0 volts at 1 x 10^{-9} Torr. Figure 3-4 shows the pressures for Degas, 4 mA Emission, and 100 µA Emission, where the overpressure shutdown occurs. With the 0-8 Vdc output the equation for pressure is:

Pressure = $10^{(volts-9)}$

- When the Micro-Ion gauge is turned OFF, the output will switch to slightly over +10 Vdc.
- During an overpressure shutdown, the output will also switch to slightly over +10 Vdc.
- During degas, the overpressure shutdown occurs at 3 x 10^{-4}.
- At 4mA emission, the overpressure shutdown occurs at 1.5 x 10^{-3}.
- At 100 mA emission, the overpressure shutdown occurs at 5 x 10^{-2}.

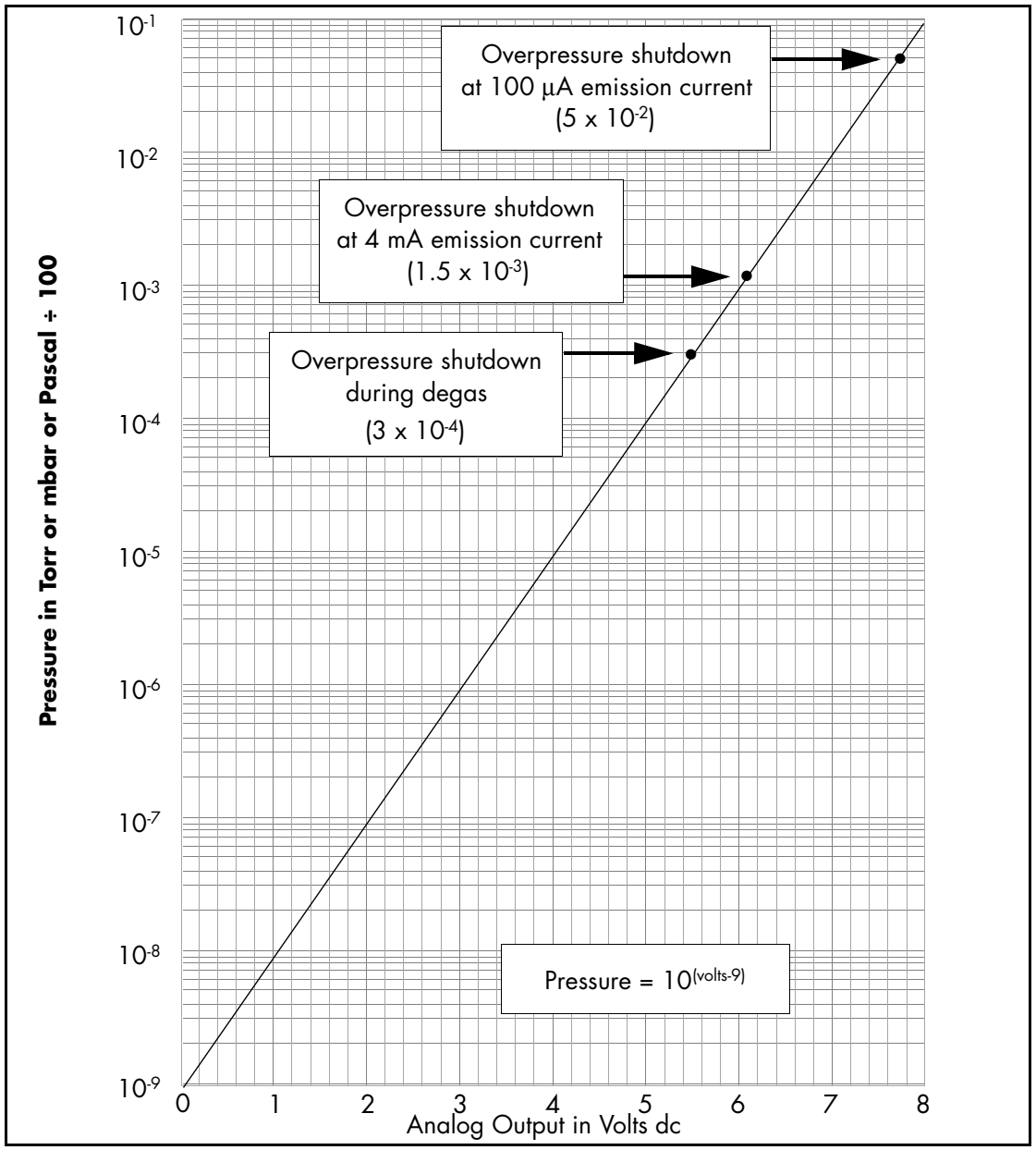


Figure 3-4 *Analog Output Curve for Module 20354015.*

3.6 Gas Sensitivity Correction

The Micro-Ion Gauge Module is calibrated to read pressure for nitrogen or air. The analog output voltage to pressure reading must be corrected for other gases. Table 3-3 gives some typical sensitivity ratios. To correct the analog output to pressure curve reading, divide the indicated pressure reading by the sensitivity ratio.

Ion gauge sensitivity ratios, r, derived from data obtained by NASA Technical Note TND5285, "Ionization Gauge Sensitivities as Reported in the Literature," by Robert L. Summers, Lewis Research Center, National Aeronautics and Space Administration are shown in Table 3-3.

Table 3-3 *Ion Gauge Sensitivity Ratios (r).*

Gas	He	Ne	D_2	H_2	N_2	Air	O_2	CO
r	0.18	0.30	0.35	0.46	1.00	1.00	1.01	1.05

Gas	H_2O	NO	Ar	CO_2	Kr	SF_6	Xe	Hg
r	1.12	1.16	1.29	1.42	1.94	2.50	2.87	3.64

3.6.1 Example

The analog output voltage is measured and found to be 5.80 Vdc which, for air or nitrogen, indicates a pressure of 5×10^{-5} Torr. If the gas type in the system is known to be neon, then

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

3.7 Overpressure Shutdown

The Micro-Ion Gauge Module is preset by fixed component values to shut down the ion gauge should pressure rise above 5×10^{-2} Torr of nitrogen at 100 microamperes emission or 1.3×10^{-3} Torr of nitrogen at 4 milliamperes emission. Additionally, the overpressure shutdown of the 20354014 has been eliminated to meet a specific customer application.

3.8 Very-High and Ultra-High Vacuum Measurement

For best results when measuring vacuum pressures below 1×10^{-7} Torr:

- Use only all-metal vacuum fittings.
- Degas the grid. See degas instructions following this section.
- A chamber bake of 100 to 150 °C is often required. When baking the chamber, be sure the temperature of the gauge tube and the vacuum plumbing to the gauge tube is raised at least as much as the chamber. The electronics module must be removed from the gauge if the bake-out temperature exceeds 70 °C. This can be done without breaking vacuum by removing the four screws securing the front plate to the aluminum extrusion enclosure. Pull the module away from the plate after the 4 screws are removed. The plate will stay attached to the gauge tube (see Figure 4-1). Do not exceed 200 °C.

After baking, re-install the electronics module by reversing the above procedure, being careful that the gauge pins line up with the sockets on the PC board.

3.9 Degas

Degassing of the gauge tube is accomplished by electron bombardment (EB) heating of the grid. Pressure reading during degas is provided. To activate the degas circuit, the IG ON circuit must be activated to assure there is a vacuum in the system prior to degas. Also note that the degas circuit will turn OFF if the IG ON circuit is turned OFF. Power during degas is approximately 4 watts above operating power and is turned OFF automatically after a two minute period.

3.9.1 Degas for Catalog Numbers 20354014 and 354019

For Catalog Numbers 20354014 and 354019, there are two user inputs to activate degassing of the ion gauge tube. The DEGAS button on the panel near the I/O connector can be used to manually activate degas or the I/O connector Pin 6 asserted low can be used to activate degas. The degas period is two minutes unless terminated sooner by another push of the button or I/O connector Pin 6 un-asserted. The DEGAS INDICATOR glows ORANGE during the degas cycle. Degas is disabled at pressures above 1 x 10^{-4} Torr.

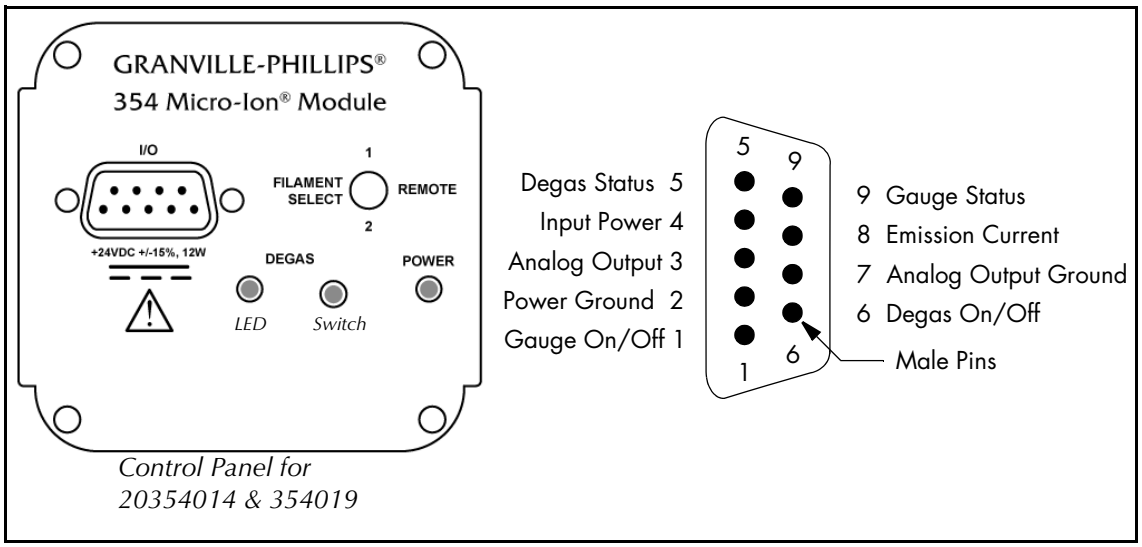


Figure 3-5 *Micro-Ion Gauge Module Analog Connector.*

3.10 Filament Selection

The Micro-Ion Gauge Module is equipped with a filament select switch adjacent to the I/O connector which allows the user to switch between the two filaments of the gauge tube. It is recommended that the gauge be turned OFF before switching to the other filament.

3.10.1 Filament Selection for Catalog Numbers 20354014 and 354019

Catalog Numbers 20354014 and 354019 are equipped with a FILAMENT SELECT switch near the I/O connector, which allows the user to switch between the two filaments of the gauge tube. If the switch is set to REMOTE, center position, filament selection will be determined by the I/O connector Pin 9. It is recommended that the gauge be turned OFF before switching filaments. This will prevent nuisance gauge shutdowns and premature wear of electrical contacts.

(See Table 2-2 on page 18, Pin 9 Gauge Status.)

3.11 Specifications for the Micro-Ion Gauge Module

Table 3-4 *Specifications for the Micro-Ion Gauge Module.*

Performance	
Measurement Range	1 x 10^{-9} to 5 x 10^{-2} Torr for N_2 or air. For use below 1 x 10^{-7} Torr the use of a Conflat flange or other type metal seal is recommended.
Analog Output	Logarithmic, 1 Vdc/decade.
Digital Display Update Rate	0.5 sec.
Overpressure Protection	Gauge tube turns off if pressure rises above 5 x 10^{-2} Torr at 100 microamperes or 1.3 x 10^{-3} Torr at 4 milliampere emission.
Emission Current	2 values: 100 µA, 4 mA.
Operating Voltage & Power	+24 Vdc, ±15%, 12 watts max.
Degas	Electron bombardment, approximately 4 watts with 2 minute timer.
Physical	
Vacuum Connection	NW16KF flange, NW25KF flange, NW40KF flange, 1-5/16 in. Conflat, 2-3/4 in. Conflat or 1/2 in. 8-VCR male fitting.
Electrical Connection	9 pin "D" connector.
Filament Selection	2 position switch.
Weight	13 oz.
Case Material	Aluminum extrusion.
Gauge Tube Replacement	Field replaceable using only Phillips type 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 Temperature Range	0 °C to 40 °C.
Non-operating Temperature Range	-40 °C to 70 °C.
IP Rating	IP20

NOTES

Chapter 4

Service and Maintenance

4.1 Service Guidelines

Some minor difficulties are readily corrected in the field.

Because the Micro-Ion Module contains static-sensitive electronic parts, the following precautions must be followed when troubleshooting:

- Use a grounded, conductive work surface. Wear a high impedance ground strap for personnel protection.
- Use conductive or static dissipative envelopes to store or ship static sensitive devices or printed circuit boards.
- Do not operate the product with static sensitive devices or other components removed from the product.
- Do not handle static sensitive devices more than absolutely necessary, and only when wearing a ground strap.
- Do not use an ohmmeter for troubleshooting MOS circuits. Rely on voltage measurements.
- Use a grounded, electrostatic discharge safe soldering iron.

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

WARNING

High Voltage

High voltages present within the Power Supply are capable of causing injury or death. To avoid electric shock, wait 3 minutes after power is removed before touching any component within the Power Supply. This will permit charged capacitors to discharge.

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

CAUTION

Product Modifications

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 MKS for service and repair to ensure that safety features are maintained. Do not use this product if it has unauthorized modifications.

4.2 Damage Requiring Service

Disconnect this product from all power sources, and refer servicing to Qualified Service Personnel if any the following conditions exist:

- The gauge cable, power-supply cord, or plug is damaged.
- Liquid has been spilled onto, or objects have fallen into, the product.
- The product has been exposed to rain or water.
- The product does not operate normally even if you have followed the Operation Instructions. Adjust only those controls that are covered in the instruction manual. Improper adjustment of other controls may result in damage and require extensive work by a qualified technician to restore the product to its normal operation.
- The product has been dropped or the enclosure has been damaged.
- The product exhibits a distinct change in performance. This may indicate a need for service.

CAUTION

Replacement Parts

When replacement parts are required, be certain to use the replacement parts that are specified by MKS, or that have the same characteristics as the original parts. Unauthorized substitutions may result in fire, electric shock or other hazards.

CAUTION

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.

CAUTION

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.

4.3 Troubleshooting

Table 4-1 *General Symptoms/Possible Causes.*

Symptom	Possible Causes
Power indicator does not illuminate.	Power supply disconnected, OFF, or inadequate for load. A switching supply may shut down from the current surge upon power-up. If a switching power supply is used, size current limit to two times working load. See Table 3-4 on page 27 for power requirements. The connector may be wired incorrectly. See Section 2.5 I/O Cable Connections on page 17. Blown fuse. This could be caused by wrong wiring. Replace the fuse with the following fuse: 1 ampere, slow blow, 2AG, Granville-Phillips p/n 012084 (see Fuse Replacement on page 33).
Ion gauge will not stay ON.	Overpressure condition. 50 milliTorr at 100 µA emission, 1.3 milliTorr at 4mA emission. Emission control failure. Causes include gauge failure due to broken filament, contamination, or pressure over 1 Torr. High voltage power to gauge failure. Causes include gauge failure due to mechanical damage or leakage due to contamination.
Inaccurate pressure reading.	Organic seals. If the ion gauge connection to the vacuum system is sealed with an organic O-ring, the gauge will not read accurately below 1e-7 Torr. Use a metal seal. 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. Replace the ion gauge tube. Contamination. Pump oil and other organic compounds, or metal coating from a sputtering process can cause electrical current leakage between ion gauge elements. Degas the ion gauge by connecting Pin 6 (Degas ON/OFF) on the I/O connector to Pin 2 (Power Ground) (see Figure 2-3 on page 17). Degas will operate for up to two minutes. Disconnect Pin 6 from Pin 2 to allow another degas cycle.

4.4 Ion Gauge Continuity Test

WARNING

High Voltage

To prevent electrical shock, turn OFF electrical power before servicing the Micro-Ion Module. Do not touch any gauge pins while the gauge tube is under vacuum.

This test should only be performed while the ion gauge is exposed to atmospheric pressure and the 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 4-1.

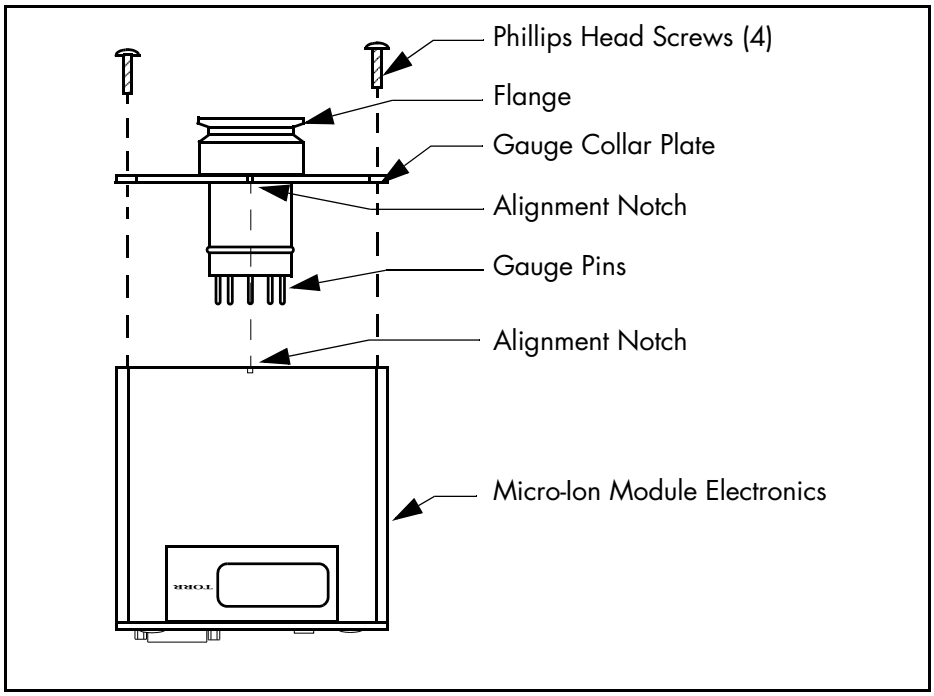


Figure 4-1 *Micro-Ion Gauge Removal.*

5. While holding the flange, *gently* pull the Micro-Ion Vacuum Gauge Module away from the gauge collar plate as shown in Figure 4-1. The gauge tube and plate will disconnect from the module.
6. Use a digital multimeter to measure the resistance of the left and right filament pins as illustrated in Figure 4-2 on page 33. The reading should be approximately 0.2 Ω.

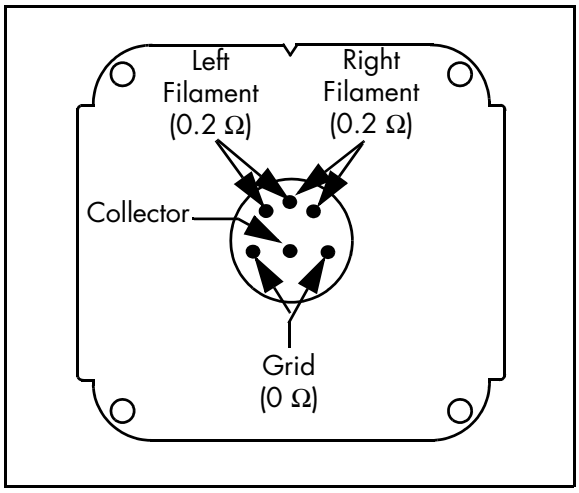


Figure 4-2 *Micro-Ion Gauge Pin Identification.*

7. Measure the resistance of filament pins to any other pin or gauge case as shown in Figure 4-2. The reading should be infinity.

8. Measure the resistance between Grid pins as shown in Figure 4-2. 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 4-2. The reading should be infinity.

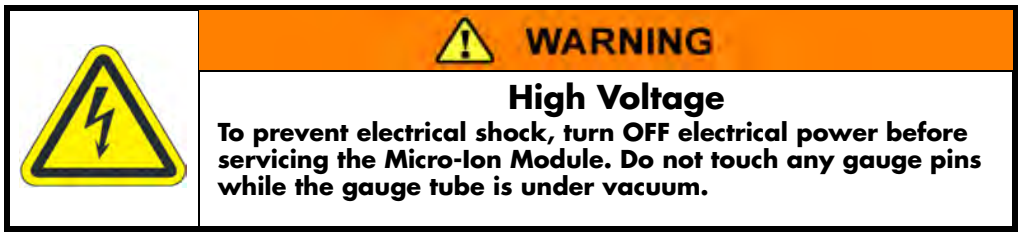
10. Measure the resistance of Collector pin to any other pin or gauge case as shown in Figure 4-2. The reading should be infinity.

NOTE: If the readings obtained during this procedure are not within the values specified, the gauge should be replaced. Contact an MKS Customer Service Representative to order a replacement gauge.

11. Once the replacement Micro-Ion Gauge is received, refer to Section 4.6 Gauge Replacement on page 34 to install the gauge.

4.5 Fuse Replacement

Use the following procedure to replace the fuse in the Micro-Ion module.



1. Turn OFF power to the Micro-Ion Module.

2. Disconnect the 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 Module top cover and remove the cover.

5. Locate the defective fuse as shown in Figure 4-3 and replace it with a new 1 amp, slow blow fuse.

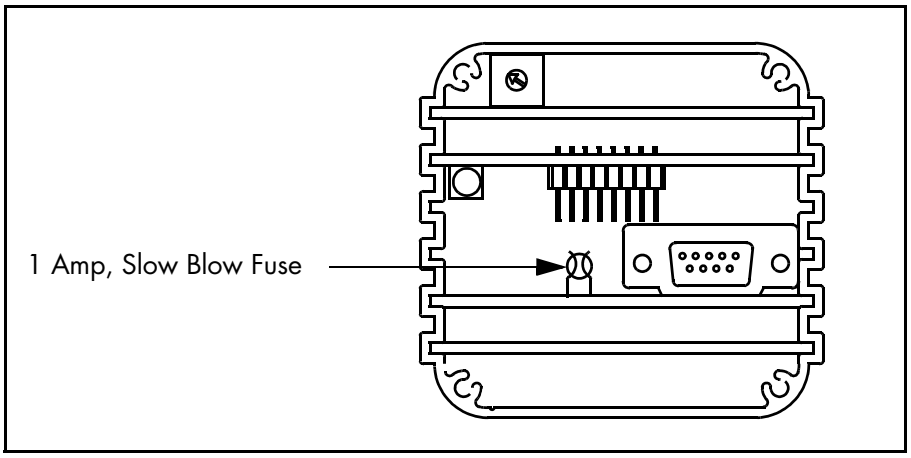


Figure 4-3 *Position of 1 Amp, Slow Blow Fuse.*

6. Install the Micro-Ion 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 ON power to the Micro-Ion Module. It is now ready to be used.

4.6 Gauge Replacement

The Micro-Ion Module replacement gauge is double-packaged at the factory for cleanroom compatibility. Handle the gauge carefully to avoid damaging the vacuum port screen after the cap plug is removed. To reduce the chance of contamination, do not remove a Micro-Ion Module replacement gauge from its inner bag until moments before it is to be connected to the module and vacuum system.

Avoid contaminating the Micro-Ion Module replacement gauge. Do not touch the vacuum connection port. Follow good vacuum practice. To minimize the possibility of leaks, do not scratch the vacuum connection seal surfaces.

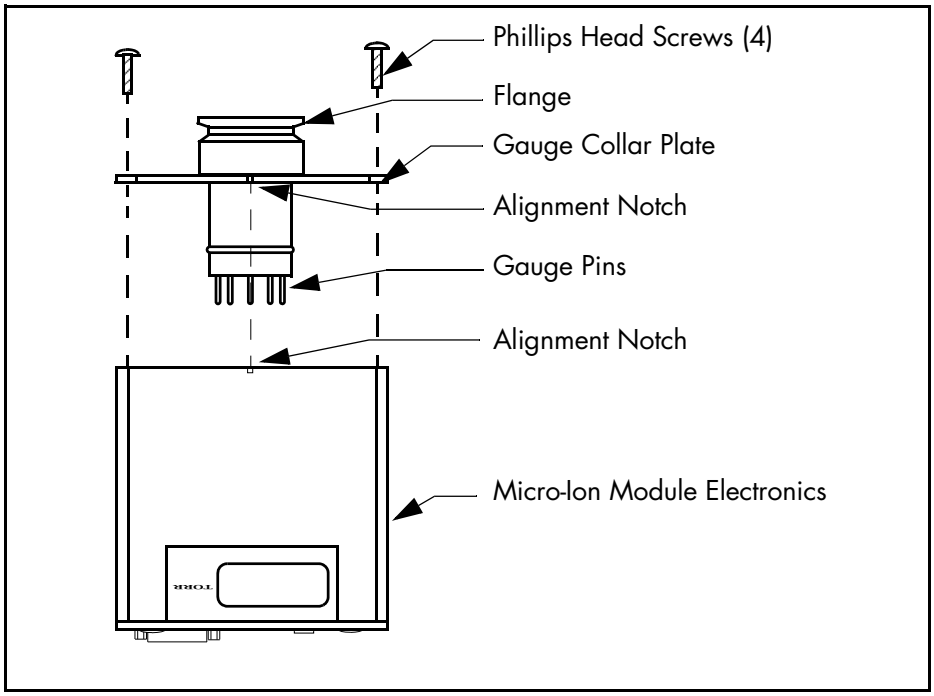


Figure 4-4 *Micro-Ion Gauge Removal.*

Use the following step-by-step procedure to replace the Micro-Ion Module gauge:

1. Turn OFF power to the Micro-Ion Module and unplug the electrical connector.
2. Remove the Micro-Ion Module from the vacuum system.
3. Remove the four Phillips head screws from the plate that attaches the gauge to the module.
4. Gently pull (unplug) the gauge from the module.
5. Insert the replacement gauge in the module by aligning the notch on the replacement gauge plate with the notch in the module body. Gently insert the gauge by engaging the pins into the socket on the module circuit board.
6. Replace the four Phillips head screws and tighten.
7. Reinstall the Micro-Ion Module on the vacuum system.
8. Plug in the electrical connector and restore power to the module.

⚠ 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 peculiar 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 be shielded at all times to protect personnel or must be connected to earth ground at all times. Verify that the vacuum port to which the 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. Use a ground lug on a flange bolt if necessary.

Do not touch the Micro-Ion Gauge during degas operation. Burns can occur.

4.7 Returning a Micro-Ion Module for Service

Notice

Return Policy

The Micro-Ion Gauge cannot be returned to MKS for credit if the inner bag seal is broken.

Some minor problems are readily corrected on site. If the product requires service, contact the MKS Technical Support Department at +1-833-986-1686. If the product must be returned to the factory for service, request a Return Material Authorization (RMA) from MKS. Do not return products without first obtaining an RMA. In some cases a hazardous materials disclosure form may be required. The MKS Customer Service Representative will advise you if the hazardous materials document is required.

When returning products to MKS, be sure to package the products to prevent shipping damage. Shipping damage on returned products as a result of inadequate packaging is the Buyer's responsibility.

For Customer Service / Technical Support:
MKS Global Headquarters
2 Tech Drive, Suite 201
Andover MA, 01810 USA
Phone: +1-833-986-1686
Email: insidesales@mksinst.com
Visit our website at www.mksinst.com

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Series 354

Vacuum Gauge Module with Analog Output

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Instruction Manual

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