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Series 355

Micro-Ion® Hot Cathode Transducer with Analog Output



Instruction Manual

Instruction manual part number 355204
Revision A - May 2017


mks
SERIES 355
HOT CATHODE
TRANSDUCER
Granville-Phillips®
Micro-Ion®

Series 355

Micro-Ion® Hot Cathode Transducer with Analog Output

This Instruction Manual is for use with Series 355 Micro-Ion Hot Cathode Transducers with analog output. A list of applicable catalog numbers is provided on the following page.



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Instruction Manual

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Series 355 Micro-Ion® Hot Cathode Transducer with Analog Output

Catalog numbers for Series 355 Micro-Ion Hot Cathode Transducers - CE Marked

Power supply and cable are not included.

Micro-Ion Hot Cathode Transducer . . . . . **355##0 - # - X X - X**

Display
- Without display 4
- With digital display. 6

Interface
- Analog 0
- RS-485 1
- DeviceNet 2
- Analog with remote filament switch 6

Relay Set Points
- Zero set points 0
- 1 relay set point 1
- 2 relay set points. 2

Sensor Type (Filaments)
- Yttria-coated Iridium. . . . . Y
- Tungsten . . . . . T
- .0055 Tungsten . . . . . W

Flange/Fitting
- NW16KF flange . . . . . D
- NW25KF flange . . . . . E
- NW40KF flange . . . . . K
- 1.33 inch (NW16CF) Conflat-type . . . . . F
- 2.75 inch (NW35CF) Conflat-type . . . . . G
- 1/2 inch VCR-type male . . . . . H
- NW40KF extended length without baffle L
- NW16KF extended length without baffle . . . . . M
- NW25KF extended length without baffle . . . . . N
- NW40KF extended length with baffle . . . . . R
- NW16KF extended length with baffle . . . . . S
- NW25KF extended length with baffle . . . . . T

Measurement Units
- Torr. . . . . T
- mbar. . . . . M
- pascal . . . . . P

NOTE:
Customer specific products may have a five-digit number following the catalog numbers shown above.

Example: 355400-2-YD-T-XXXXX, where -XXXXX represents a configuration outside of the standard catalog number.

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DeviceNet™ is a trademark of Open DeviceNet Vendor Association.

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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 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 2.3 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 355 Micro-Ion Transducer 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 2.3 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 Hot Cathode Transducer when the instrument is powered ON. Hazardous voltages may still be present in the instrument for some time after disconnecting power to the instrument. 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.

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.

This hazard is not unique to this product.



WARNING

High Voltage

Voltage inside the enclosure and the sensor can be as high as 200 volts. DO NOT apply power to the product if the enclosure is open for service. DO NOT insert anything into the enclosure or sensor.



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, and are listed on ThomasNet.com. ***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 355 Micro-Ion Transducer 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 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

If the product requires service, contact the MKS Technical Support Department at 1-303-652-4400 or 1-800-776-6543 for troubleshooting help over the phone.

If the product must be returned to the factory for service, request a Return Material Authorization (RMA) from MKS, which can be completed at https://www.mksinst.com/service/servicehome.aspx. *Do not return products without first obtaining an RMA.* In most cases a hazardous materials disclosure form is 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. Damaged returned products as a result of inadequate packaging is the Buyer's responsibility.

For Customer Service / Technical Support:
MKS Pressure and Vacuum Measurement Solutions
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Email: mks@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 the MKS web site at *www.mksinst.com*, or may be obtained by contacting a MKS Customer Service Representative.

1.10 FCC Verification

This equipment was 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 may 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

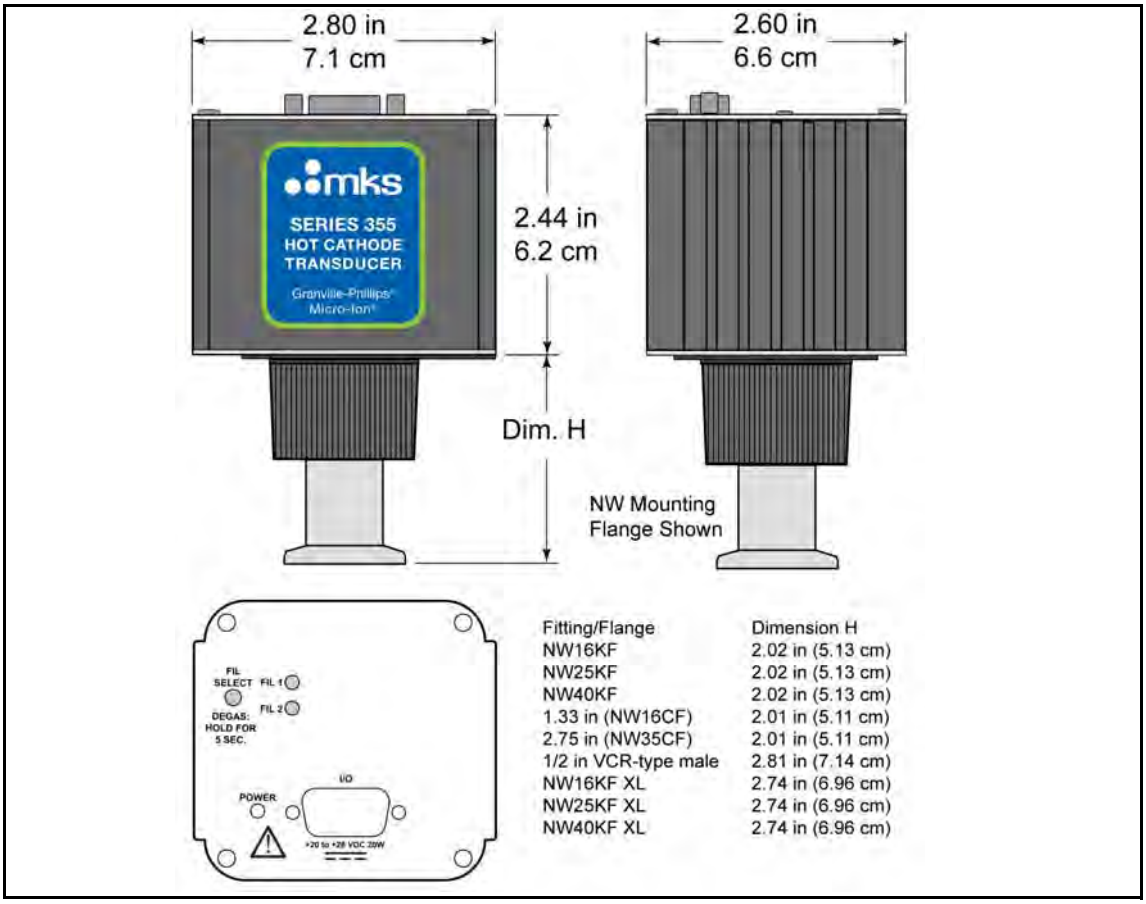
The Micro-Ion Hot Cathode Transducer measures pressures from less than 1 x 10^{-9} Torr to 5 x 10^{-2} Torr, N_2 equivalent (or air). Pressure readout is via a logarithmic analog voltage on the I/O connector on all models and digital readout for models with that option. The gauge has redundant filaments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

The Micro-Ion Transducer 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 Transducer 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 Transducer 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.



Fitting/Flange	Dimension H
NW16KF	2.02 in (5.13 cm)
NW25KF	2.02 in (5.13 cm)
NW40KF	2.02 in (5.13 cm)
1.33 in (NW16CF)	2.01 in (5.11 cm)
2.75 in (NW35CF)	2.01 in (5.11 cm)
1/2 in VCR-type male	2.81 in (7.14 cm)
NW16KF XL	2.74 in (6.96 cm)
NW25KF XL	2.74 in (6.96 cm)
NW40KF XL	2.74 in (6.96 cm)

Figure 2-1 *Series 355 Micro-Ion Hot Cathode Transducer Dimensions.*

2.3 Grounding

The Micro-Ion Transducer 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 NW16KF, NW25KF, and NW40KF flanges. Due to the "O" ring seal, grounding cannot be assumed through the fitting.

See Section 1.2 for safety guidelines regarding grounding requirements, and Section 1.3 for safety guidelines regarding high voltages. Also, see Section 2.4.1.1.

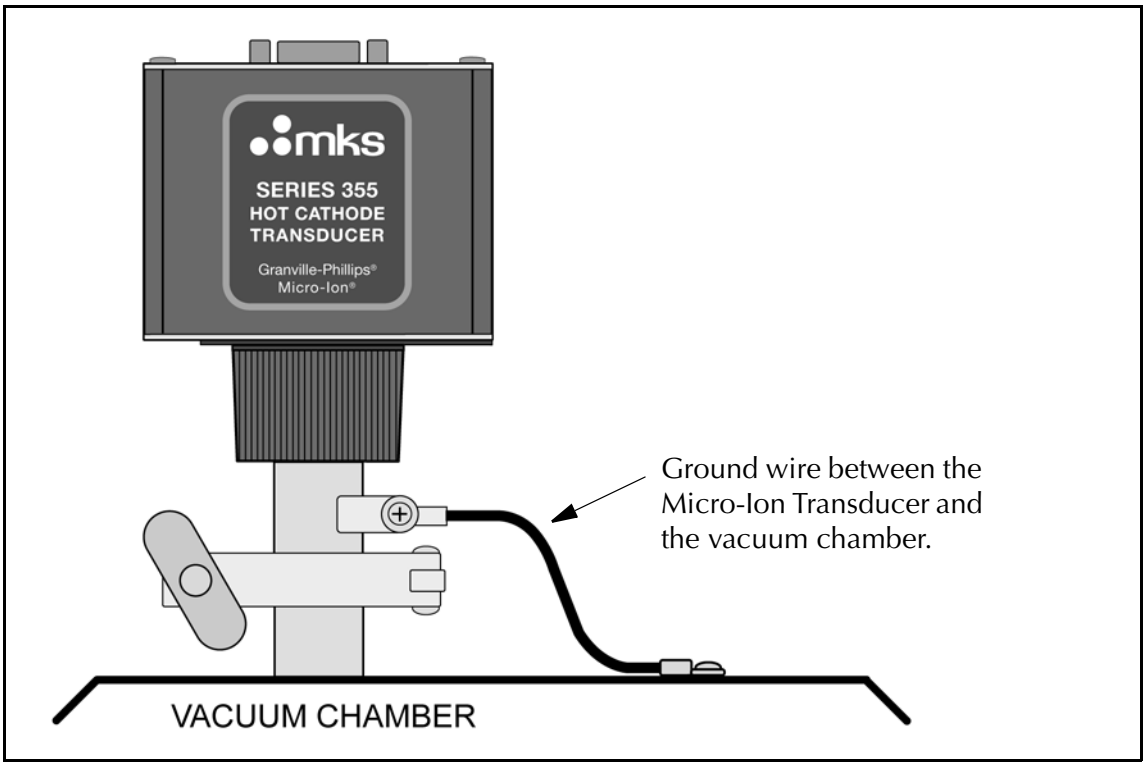


Figure 2-2 *Grounding the Micro-Ion Transducer*

2.4 I/O Cable Connections

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

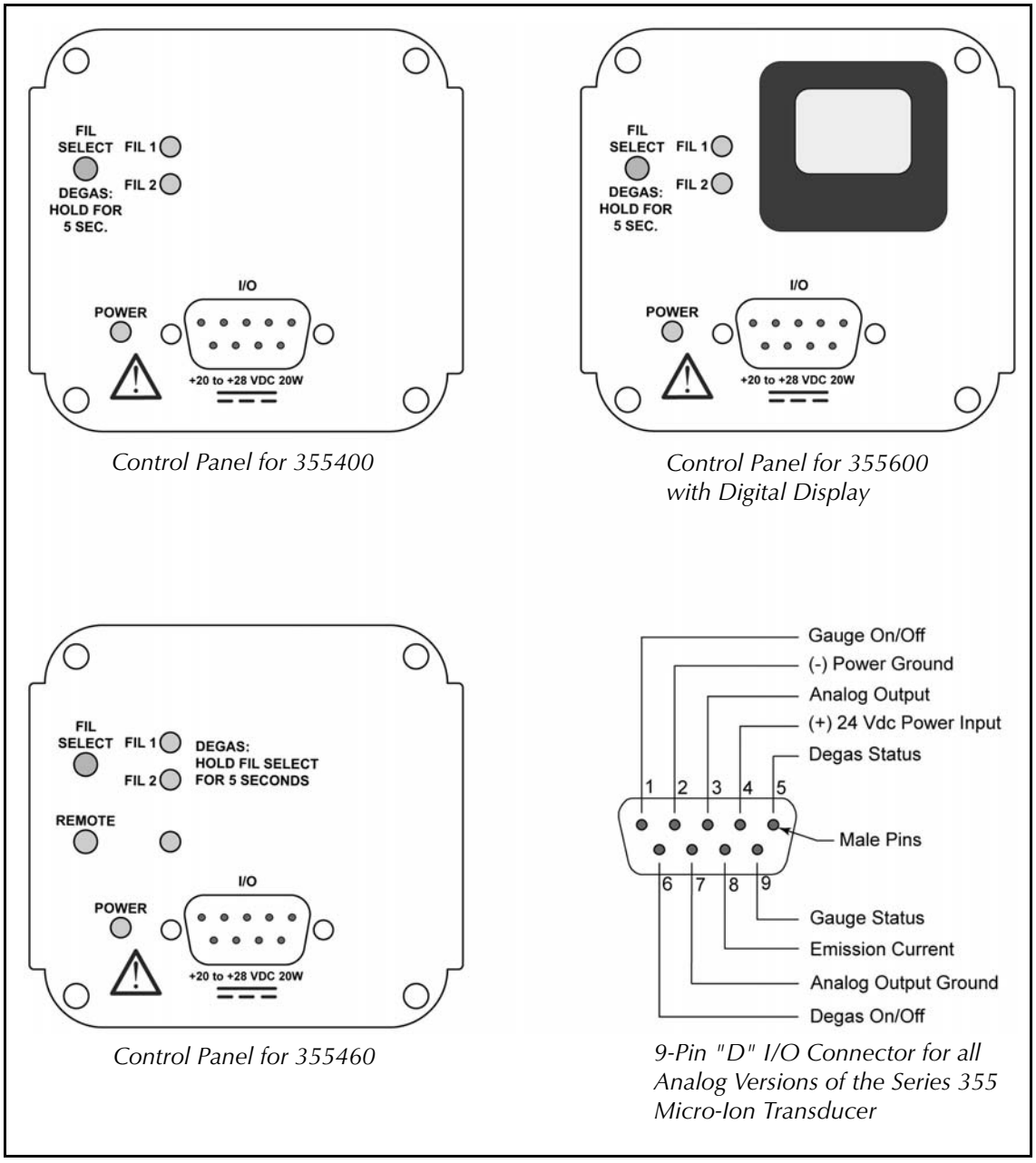


Figure 2-3 *Micro-Ion Transducer Control Panel and Electrical Connector (Analog Version)*

Table 2-1 *I/O Connector Pin Descriptions*

Pin	Description	Function
1	Gauge On/Off	Connection to Power 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	Use in conjunction with Pin 7, Analog Output Ground.
4	Input Power	+24 Vdc ±15%, 20 W max., protected against reverse voltage.
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	Connection to Power Ground turns degas "ON".
7	Analog Output Ground	Use in conjunction with the analog output only.
8	Emission Current	Connection to Power Ground increases emission current from LOW to HIGH.
9	Gauge Status	Open collector transistor (grounded emitter) rated at VCE ≤40 V, 50 mA max. Transistor OFF = Gauge OFF; transistor ON = Gauge ON.

2.4.1 CE Mark Compliance

For CE Mark compliance, connect the D-shaped metal shield of the 9-pin I/O connector that plugs into the electronics enclosure, to the vacuum system ground.

2.4.1.1 Cable to 9-pin I/O connector

Use the following cable types, or equivalent:
Shielded cable with aluminum jacket and a tinned copper braid with a minimum of 65% coverage.

Acceptable raw cable parts: Belden cable 9947 or Alpha cable 5110/15C SL005.
Acceptable connector: Tyco series ADK for standard 9-pin subminiature-D.

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.

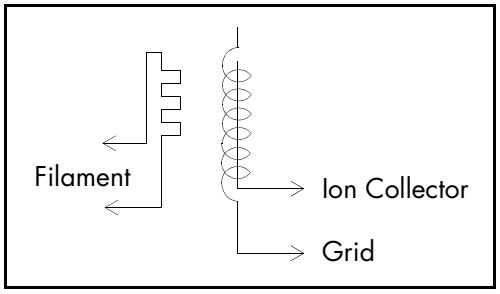


Figure 3-1 *Ion Gauge Schematic.*

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 Transducers 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.

Degas of the Micro-Ion gauge is accomplished by electron bombardment to drive adsorbed gases off the grid.

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, cycle the input 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 Transducers shows the status of power, ion gauge, and operating pressure.

The power indicator LED states for Micro-Ion Transducers are given in Table 3-1 (*with the exception of Catalog Number 355460, which is stated in* Table 3-2).

Table 3-1 *Power Indicator Status LED for Micro-Ion Transducer Catalog Numbers 355400 and 355600.*

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

Table 3-2 *Gauge Filament Status LED for Micro-Ion Transducer Catalog Number 355460*

LED Status	Description
OFF	Transducer not powered.
Steady RED	Power applied, ion gauge OFF.
Steady ORANGE	Ion gauge ON, and in Degas mode
Steady GREEN	Ion gauge ON

3.4 Emission Current

There are two choices of emission current available:

1.) 0.02 mA & 0.1mA for Low emission

or

2.) 0.1 mA & 4 mA for High emission

While any of the 3 emission currents can be used continuously, the following guidelines are recommended:

(1) for operation in the higher pressure ranges with a clean system, either the 0.02 or 0.1 mA emission is satisfactory, or

(2) for operation in the lower pressure ranges the 4 mA setting should be used to give a more accurate pressure reading. Internal circuitry corrects the analog output voltage-to-pressure relationship for the emission current selected.

For 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, which forms an insulator that impedes electron emission, resulting in higher filament power required to emit electrons, and ultimate inability to control emission. In this situation, the 4 mA emission current is recommended.

Using a lower emission current, when possible, usually provides longer filament life.

3.5 Analog Output

The analog output for all Micro-Ion Gauge Transducers is a 0-9 Vdc signal proportional to the logarithm of the pressure with 0 volts at 1 x 10^{-10} Torr.

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

$$\textbf{Pressure} = \mathbf{10}^{(\text{volts}-10)}$$

3.6 Over-pressure Shutdown

- When the Micro-Ion gauge is turned OFF, the output will switch to > +10 Vdc.
- During an over-pressure shutdown, the output will switch to > +10.5 +10 Vdc.
- At 4 mA emission, the over-pressure shutdown occurs at 1.3 x 10^{-4}
- At 0.1 mA emission, the over-pressure shutdown occurs at 5 x 10^{-2}
- At 0.02 mA emission, the over-pressure shutdown occurs at 5 x 10^{-2}
- During degas, the degas over-pressure turn OFF occurs at 3 x 10^{-4}

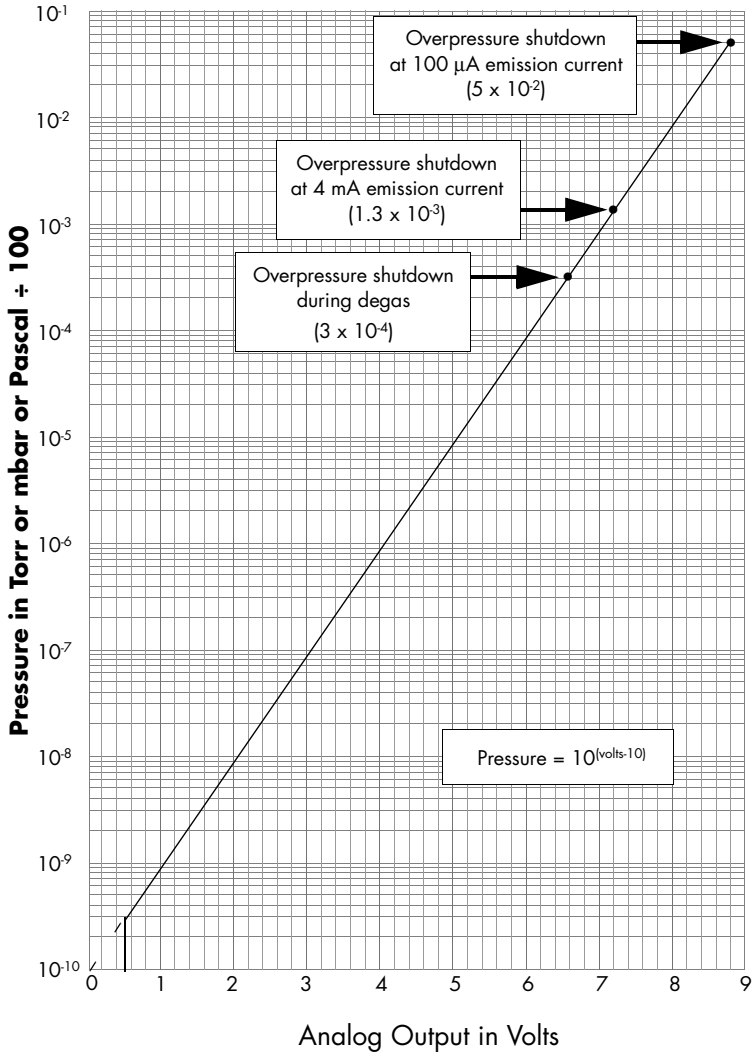


Figure 3-2 *Analog Output Signal for Micro-Ion Transducers.*

3.7 Gas Sensitivity Correction

The Micro-Ion Gauge Transducer 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

3.7.1 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

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

3.8 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 the degas instructions in Section 4.4.
- A chamber bake of 100 to 150 °C is often required. Do not exceed 200 °C. ***The electronics enclosure must be removed from the gauge if the bake-out temperature exceeds 40 °C while the gauge is operating, or 70 °C while not operating.***

  See Section 4.5 for detailed instructions to remove the electronics enclosure from the gauge.
- 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.
- After baking, re-install and latch the electronics enclosure, being careful that the gauge pins line up with the sockets on the PC board.

3.9 Filament Selection

The Series 355 Micro-Ion Transducers are equipped with a FILAMENT SELECT button on the control panel, which allows the user to select between the two filaments of the gauge tube. While the gauge is ON, push the button to select a filament. The appropriate LED will illuminate, indicating the selected filament.

NOTE: Holding the button for 5 seconds or more turns ON the degas function.

3.9.1 Filament Select LED Status

Table 3-4 *Filament Select Status LED for Micro-Ion Transducers*

LED #	LED Color	Description
FIL 1	OFF	Filament 1 not active
	Solid Green	Filament 1 active, normal
	Solid Amber	Filament 1 degassing
	Blinking Amber	Filament 1 degas restart period violation
	Solid Red	Filament 1, failed
FIL 2	OFF	Filament 2 not active
	Solid Green	Filament 2 active, normal
	Solid Amber	Filament 2 degassing
	Blinking Amber	Filament 2 degas restart period violation
	Solid Red	Filament 2, failed

3.10 Specifications for the Micro-Ion Transducer

Table 3-5 *Specifications for the 355 Micro-Ion Transducer*

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, 0 to 9 V
Digital Display Update Rate	0.5 sec
Overpressure Protection	Gauge tube turns OFF if pressure rises above 5 x 10^{-2} Torr at 0.02 mA or 0.1 mA emission, or 1.3 x 10^{-3} Torr at 4 mA emission.
Emission Current	0.02 mA, 0.1 mA, or 4 mA
Operating Voltage & Power	+24 Vdc, ±15%, 17 W max., protected against reverse voltage
Degas	Electron bombardment, approximately 4 watts with 2 minute timer
Physical	
Vacuum Connection	NW16KF flange, NW25KF flange, NW40KF flange, 1.33 in. Conflat, 2.75 in. Conflat or 1/2 in. 8-VCR male fitting
Electrical Connection	9 pin “D” connector
Filament Selection	Push button on the control panel
Weight	280 g / 10 oz
Case Material	Aluminum extrusion
Gauge Tube Replacement	Field replaceable
Electrical Safety	Metal enclosure which houses 180 V supply requires 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
CE Compliance	
EMC	EN61326-1
Safety	EN61010-1
IP Rating	IP20

Chapter 4

Service and Maintenance

4.1 Service Guidelines

Some minor difficulties are readily corrected in the field.

Because the Micro-Ion Transducer 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.



⚠ WARNING

High Voltage

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

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.

Voltage inside the enclosure and the sensor can be as high as 200 volts. DO NOT apply power to the product if the enclosure is open for service. DO NOT insert anything into the enclosure or sensor.

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.

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.



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 a Qualified Service Person to perform safety checks to determine that the product is in safe operating order.

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 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.



Figure 4-1 *Components of the Micro-Ion Transducer Assembly*

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 3-5 on page 24 for power requirements. The connector may be wired incorrectly. See Section 2.4 I/O Cable Connections on page 17.
Ion gauge will not stay ON.	Overpressure condition. 50 milliTorr at 100 µA emission, 1.5 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. See Section 4.4 to Degas the ion gauge.

4.4 Degas the Micro-Ion Gauge

Degassing of the ion gauge tube is accomplished by electron bombardment (EB) heating of the grid. Pressure reading during degas is provided. To activate the degas circuit, the ion gauge (IG) ON circuit must be activated to assure there is a vacuum in the system prior to degas. Degas is disabled at pressures above 1 x 10^{-4} Torr or 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.

1. Press the filament select button on the control panel for 5 seconds. The Micro-Ion gauge will degas for 2 minutes and turn OFF. Another degas cycle can be run by pressing the filament select button again for 5 seconds.
A short push of the filament select button during the degas cycle will stop degas.

4.5 Bake the Micro-Ion Gauge

- A chamber bake of 100 to 150 °C is often required. Do not exceed 200 °C. ***The electronics enclosure must be removed from the gauge if the bake-out temperature exceeds 40 °C while the gauge is operating, or 70 °C while not operating.***

  See Section 4.5.1 for detailed instructions to remove the electronics enclosure from the gauge.
- When baking the chamber, be sure the temperature of the gauge tube and the vacuum plumbing to the gauge tube is at least as high as the chamber.
- After baking, re-install and latch the electronics enclosure, being careful that the gauge pins line up with the sockets on the PC board inside the electronics enclosure.

4.5.1 Remove the Electronics Enclosure



WARNING

High Voltage

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

1. Leave the gauge tube mounted to the vacuum chamber.

2. Turn OFF power to the Micro-Ion Transducer and disconnect the power cable from the electronics enclosure.

3. Rotate the latch in the direction indicated on the latch until it stops. When in the unlocked position, the unlocked indicator flag is visible. See Figure 4-2.

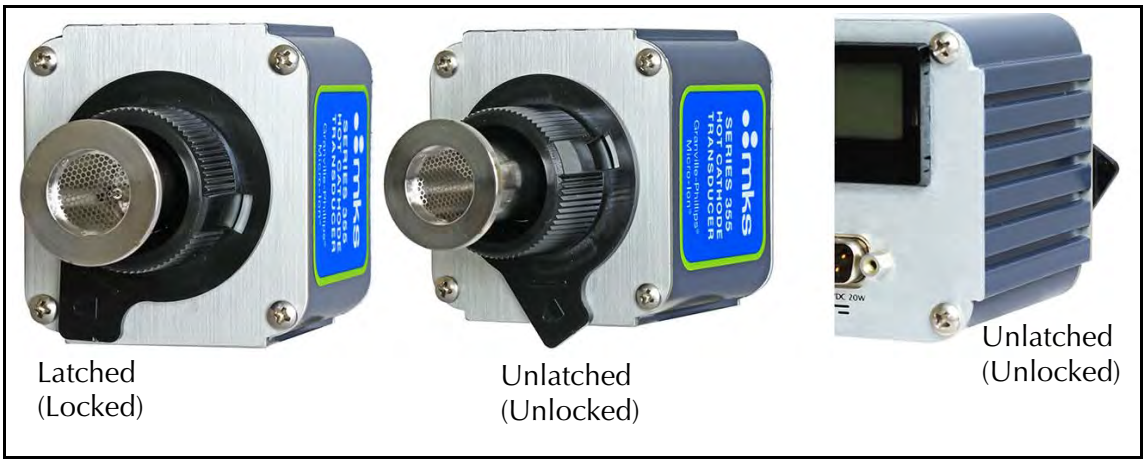


Figure 4-2 *Unlatch the Gauge to Remove the Electronics Enclosure*

4. Carefully pull the electronics enclosure away from the gauge tube with a steady force.

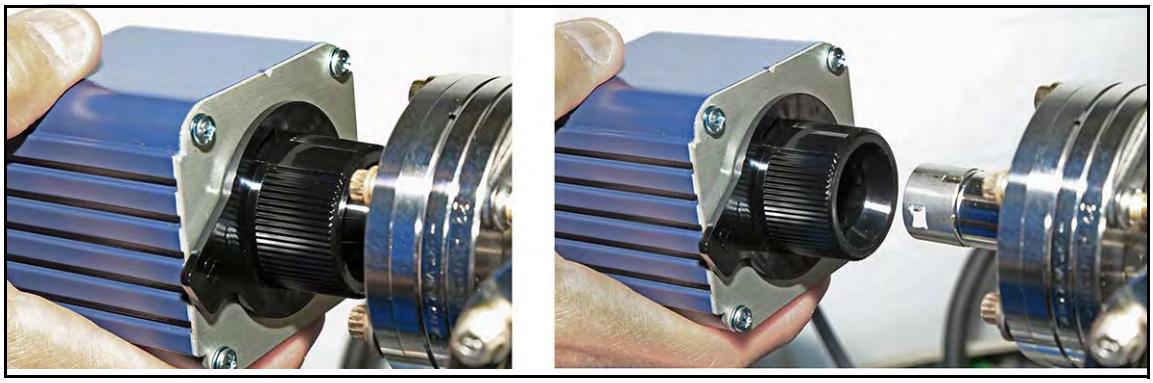


Figure 4-3 *Electronics Enclosure Removal*

5. Perform the bakeout procedure.

6. Reconnect the electronics enclosure.

a. Check to be sure the latch in the unlocked position. See Figure 4-2.

b. Align the axes of the electronics enclosure and the gauge tube (sensor) that is still mounted on the vacuum chamber. See Figure 4-4.

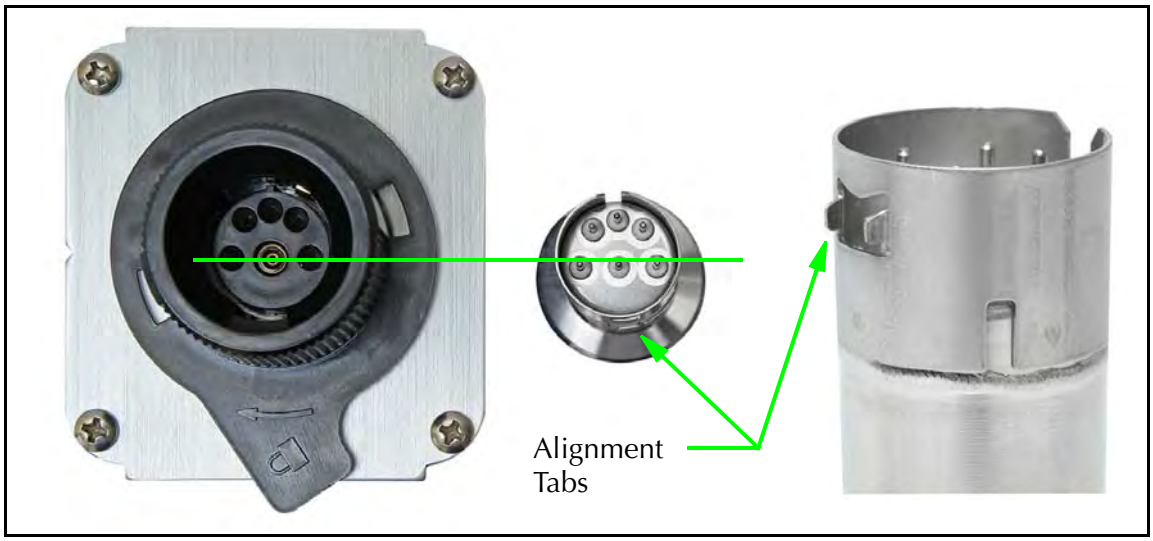


Figure 4-4 *Alignment of the Electronics Enclosure and Gauge Tube*

c. Carefully place the electronics enclosure over the gauge tube, making sure the enclosure slides over the alignment tabs on the gauge tube.

d. Gently press the electronics enclosure onto the gauge tube until it fully seats into position.

e. Rotate the latch to the locked position. See Figure 4-5.

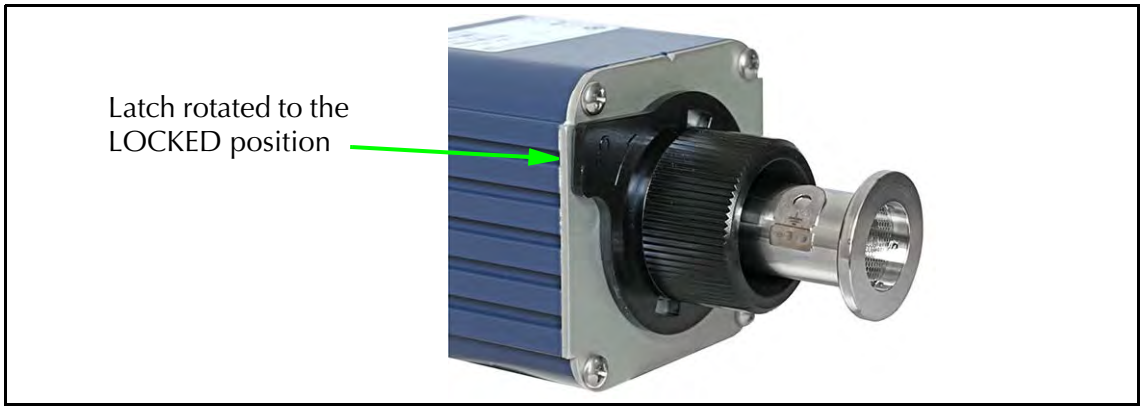


Figure 4-5 *Electronics Enclosure Latched*

4.6 Ion Gauge Continuity Test

WARNING

High Voltage

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

Perform the continuity test ONLY while the ion gauge is OFF and the electronics enclosure is removed from the gauge. If a problem with pressure measurement is traced to the Micro-Ion Transducer, 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 electronics enclosure.
2. Disconnect the I/O connector from the electronics enclosure.
3. Remove the Micro-Ion Transducer assembly from the vacuum system.
4. Rotate the latch in the direction indicated on the latch until it stops. When in the unlocked position, the unlocked indicator flag is visible. See Figure 4-2.



Figure 4-6 *Micro-Ion Gauge Removal*

5. Carefully pull the gauge tube out of the electronics enclosure.
6. Use a digital multimeter to measure the resistance of the left and right filament pins as illustrated in Figure 4-7. The reading should be approximately 0.2 Ω.

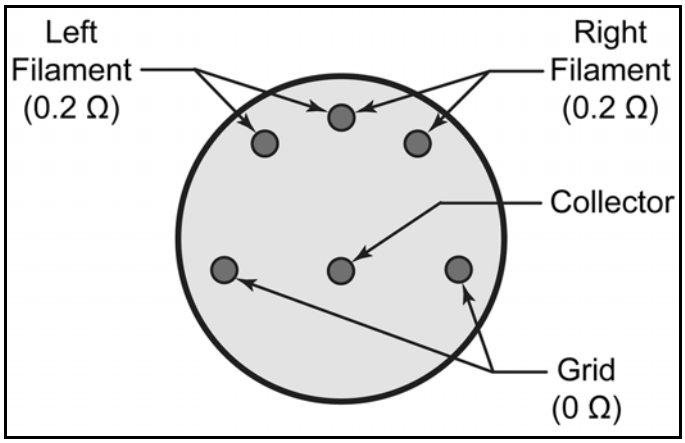


Figure 4-7 *Micro-Ion Gauge Pin Identification*

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

8. Measure the resistance between Grid pins.The reading should be approximately 0 Ω.

9. Measure the resistance of Grid pins to any other pin or gauge case. The reading should be infinity.

10. Measure the resistance of the Collector pin to any other pin or gauge case. The reading should be infinity.

11. If the measurements are correct as listed above, and the pressure readings are believed to be incorrect, the gauge tube may be contaminated. See Section 4.4 to degas the gauge tube, and Section 4.5 to bake the gauge tube.

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.

12. Once the replacement Micro-Ion gauge is received, refer to Section 4.7 to install the gauge.

4.7 Ion Gauge Replacement

The Micro-Ion 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 replacement gauge from its inner bag until it is to be connected to the electronics enclosure and vacuum system.

Avoid contaminating the Micro-Ion 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.



WARNING

High Voltage

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

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

1. Turn OFF power to the Micro-Ion Transducer and unplug the electrical connector.
2. Remove the Micro-Ion Transducer assembly from the vacuum system.
3. Rotate the latch in the direction indicated on the latch until it stops. When in the unlocked position, the unlocked indicator flag is visible. See Figure 4-2.
4. Remove (unplug) the gauge from the electronics enclosure. See Figure 4-3.
5. Insert the replacement gauge into the electronics enclosure. Align the axes of the electronics enclosure and the gauge tube (sensor). See Figure 4-4.
6. Rotate the latch to the locked position. See Figure 4-5.
7. Reinstall the Micro-Ion Transducer on the vacuum system.
8. Plug in the electrical connector and restore power to the electronics enclosure.

4.8 Returning a Micro-Ion Transducer for Service

Notice

Return Policy

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

If the product requires service, contact the MKS Technical Support Department at 1-303-652-4400 for troubleshooting help over the phone.

If the product must be returned to the factory for service, request a Return Material Authorization (RMA) from MKS, which can be completed at https://www.mksinst.com/service/servicehome.aspx. *Do not return products without first obtaining an RMA*. In most cases a hazardous materials disclosure form is 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. Damaged returned products as a result of inadequate packaging is the Buyer's responsibility.

For Customer Service / Technical Support:
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Series 355

Micro-Ion® Hot Cathode Transducer with Analog Output

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Instruction Manual

Instruction manual part number 355204
Revision A - May 2017

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