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Granville-Phillips®

Series 354

Quick Start Guide for Series 354 Micro-Ion® Gauge Modules with Analog Output or RS-485 Digital Interface, Tungsten or Yttria-coated Iridium filaments, and pressure readout in Torr, mbar, or Pascal

Quick Start Guide p/n 354079-Rev. D

NOTICE

More detailed instructions regarding installation, operation, and service of the Series 354 Micro-Ion Gauge Module are provided in the Instruction Manual, p/n 354004 for the Analog Output version, or 354008 for the RS-485 version, which can be downloaded from the MKS website. Go to: www.mksinst.com and search for 354004 or 354008.

This Quick Start Guide is for the following Series 354 Micro-Ion Modules:

Figure 1: Micro-Ion Module with Analog Output (p/n 354002 with digital display shown)

Figure 2: Micro-Ion Module with RS-485 Digital Interface (p/n 354005 shown)

Catalog Numbers for Micro-Ion Modules covered in this Quick Start Guide and Instruction Manuals 354004 & 354008

Modules with Analog Output:

- 354001-XX-X and 354002-XX-X
- 354019, 20354014, 20354015

Modules with RS-485 Digital Interface:

- 354005-XX-X, 354029-XX-X, 20354017-XX-X

General Description

The Series 354 Micro-Ion Gauge Modules, shown above, are modular instruments consisting of a Micro-Ion vacuum gauge and electronics enclosure capable of measuring vacuum pressures from 1 x 10⁻⁹ Torr to 5 x 10⁻² Torr (10⁻⁹ mbar, 10⁻⁷ Pa).

Benefits of the design include:

- Compact, Convenient, Cost Saving Vacuum Measurement
- Generates less heat than typical glass ionization gauges
- Dual filaments increase equipment uptime
- Rugged all-metal, RF and noise-immune module is CE compliant
- Gauge can easily be replaced

The RS-485 digital interface version provides industry-standard digital RS-485 communications over networks as well as direct connections to a personal computer. The setpoint relay can be easily controlled via the RS-485 digital interface.

The setpoint relay in the RS-485 version (354005) can be used to control various devices such as a 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.

Intended Use

The intended use of this instrument is to measure vacuum pressure in the range of 1 x 10⁻⁹ Torr to 5 x 10⁻² Torr. This device is to be used only in accordance with the instructions in this Quick Start Guide and the Instruction Manual, p/n 354004 or 354008.

Improper Use

- Removal of any factory installed components
- Modifying any factory installed components
- Removal of any labeling or warranty seals
- Operation of this device in any condensing vapor or liquid environment
- CE Conformity: The manufacturer's declaration becomes invalid if the operator modifies the original product or installs additional components.

Safety Notices

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

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, please contact MKS, Granville-Phillips Division at the address given on this instruction guide.

Safety Symbols

Figure 3: Safety Symbol on the Micro-Ion Module

CAUTION

General Safety Notices

Do not use this instrument to measure the pressure of flammable or explosive gases. Using the Micro-Ion Vacuum Gauge Module to measure the pressure of flammable or explosive gases can cause a fire or explosion resulting in severe property damage or personal injury.

Exposing the Micro-Ion Vacuum Gauge Module to moisture can cause fire or electrical shock resulting in severe property damage or personal injury.

To avoid exposing the Module to moisture, install it in an indoor environment. Do not install the Module in any outdoor environment.

To avoid measurement error or product failure due to over pressurization, install pressure relief valves or rupture disks in the system if pressure substantially exceeds 1000 Torr (1333 mbar, 133 kPa).

Improper grounding could cause product failure or personal injury. Follow ground network requirements for the facility. Maintain all exposed conductors at Earth ground. Make sure the vacuum port to which the module is mounted is properly grounded.

This document is not a substitute for complete safety and installation guidance. Consult the appropriate Instruction Manual (354004 or 354008) for safety notices and information regarding installation and use of this product.

High Voltage

WARNING

Electrical Shock or Personal Injury

The service and repair information in this instruction guide 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.

Grounding Requirements

WARNING

High Voltage and 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 Module 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.

Connect power cords only to properly grounded

Over-pressure Conditions

WARNING

Failure to install appropriate pressure relief devices for high-pressure applications can cause product damage or personal injury.

Install appropriate pressure relief devices for automatic backfilling or other applications in which malfunction or normal process conditions can cause high pressures to occur.

Suppliers of pressure relief valves or disks can be located via an online search and are listed on Thomas.net under "Relief Valves" and "Rupture Disks".

Confirm that these safety devices are properly installed before installing and operating the Micro-Ion Module.

Location of the Micro-Ion Gauge Module on the Vacuum Chamber

Use the following the guidelines to determine the best location for the Micro-Ion Module on your vacuum system.

- For greatest accuracy and repeatability, locate the Module in a stable, room-temperature environment. Ambient temperature should never exceed 40 °C (104 °F) operating, non-condensing, or 70 °C (158 °F) non-operating.
- Locate the Module away from internal and external heat sources and in an area where ambient temperature remains reasonably constant. Do not mount the Module above other equipment that generates excessive heat.
- Do not locate the Module near the pump, where gauge pressure might be lower than system vacuum pressure.
- Do not locate the Module near a gas inlet or other source of contamination, where inflow of gas or particulates causes atmospheric pressure to be higher than system atmosphere.
- Do not locate the Module where it will be exposed to corrosive gases such as mercury vapor or fluorine.

Figure 4: Dimensions of the Micro-Ion Module

Attach the Micro-Ion Module to the Vacuum Chamber

Connect the Micro-Ion Gauge to the vacuum system flange using the appropriate gasket and mounting hardware.

Orient the Micro-Ion Module to prevent condensation of process vapors on the internal surfaces through line-of-sight access to its interior. If vapor condensation is likely, orient the port downward to help liquids drain out.

Do not use a compression mount/quick connect fitting for positive pressure applications.

For an NW16KF, NW25KF or NW40KF flange:

The NW##KF style flange requires a self-centering O-ring between mating flanges. Use a metal clamp and tighten the clamp to compress the mating flanges together. Do Not use a plastic clamp. See the Grounding Requirements.

Attach the Micro-Ion Gauge to the mating NW-style connector on the vacuum chamber. Use a new seal and the appropriate tools to tighten the metal clamp.

For an NW16CF (1.33 inch) or NW35CF (2.75 inch) flange:

Attach the gauge to the mating 2-3/4 inch flange on the vacuum chamber. Use a new copper seal between the flanges - do not use a previously used seal. If the flanges have leak test grooves, be sure they are properly aligned.

Finger tighten all 6 bolts.

Use the appropriate tools to tighten the 6 bolts. Tighten the bolts in a circular pattern (such as 1, 3, 5, 2, 6, 4, 1, 3, 5, 2, 6, 4) until the flanges are in contact. After contact, torque each bolt to 12 lb ft.

For a VCR-type fitting:

Remove the bead protector cap from the fitting.

Place the gasket into the female nut.

Assemble the components and tighten them to finger-tight.

While holding a back-up wrench stationary, tighten the female nut 1/8 turn past finger-tight on 316 stainless steel or nickel gaskets, or 1/4 turn past finger-tight on copper or aluminum gaskets. **Do not twist the gauge to tighten the fitting.**

Figure 5: Common Vacuum Connection

Grounding Requirements

WARNING

Improper grounding could cause product failure, property damage, or serious personal injury.

To reduce the risk of product failure, property damage, or serious personal injury, follow the ground network requirements for the facility.

- Maintain all exposed conductors at Earth ground.
- Ground the module housing to the vacuum chamber as instructed below.
- Make sure the vacuum port to which the module is mounted is properly grounded.

The module generates 180 Vdc internally during normal operation and up to 250 Vdc during Micro-Ion gauge degas. It is essential for personnel safety and proper operation of the module that the envelope of the gauge be properly connected to a facility ground.

Chassis Ground

If the module has a VCR type fitting or ConFlat flange, the module chassis will be properly grounded via the vacuum chamber connection.

If the gauge has an NWxxKF flange, check continuity between the gauge and the vacuum chamber.

If the fitting requires a rubber gasket, rubber O-ring, Teflon tape, or other material that prevents metal-to-metal contact between the base of the gauge and the vacuum chamber, attach a ground connection between the Micro-Ion Gauge and the vacuum chamber.

- Attach a metal hose clamp or other metal clamp to the gauge stem.
- Install a 3.31 mm² (12 AWG) or larger copper wire between the clamp and a metal ground lug, bolt, or stud on the vacuum chamber.

Figure 6: Ground the Micro-Ion Gauge to the Vacuum Chamber

Power Supply Requirements

Provide power as specified below and in Figure 7. Operating current is the steady-state current during normal operation with the ion gauge ON. The Micro-Ion gauge will not activate and an emission error will occur if insufficient power is supplied during Micro-Ion gauge activation.

Required input power is 24 Vdc, ±15%, 12 W max.

Table 1: Analog Output version with 9-pin Connector

Connector Pin	Input Voltage	Operating Power
4	24 Vdc (±15%)	12 W max

Table 2: RS-485 version with 9-pin Connector

Connector Pin	Input Voltage	Operating Power
2	24 Vdc (±15%)	12 W max

Electrical Connections and Power Requirements

Analog Output version 9-pin I/O connector

RS-485 Interface version 9-pin I/O connector

Figure 7: 9-pin I/O Connectors

Table 3: Analog Output version 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 40 V max. VCE, 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 40 V max. VCE, 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.

Table 4: RS-485 Digital Interface version I/O Connector Pin Descriptions

Pin #	Description
1	Setpoint relay Normally Open
2	Input Power 24 Vdc ±15%, 12 W max, protected against reversal and over-voltage
3	No connection
4	Power ground
5	Setpoint relay Normally Closed
6	RS-485 (-)
7	Setpoint relay Common
8	No connection
9	RS-485 (+)

- Use the supplied connector(s) on the customer supplied Input/Output cables according to the pin assignments in Figure 7 and Table 3. The cable is user-supplied; Granville-Phillips does not supply the interconnect cable.
- CE Mark compliance requires metal connector housings and cable with a braided shield.
- To prevent ground loops, connect the cable's shield to the outer shell of the female "D" connector on the Micro-Ion Module. "Do NOT" connect the shield to the receiver side, the side that receives the Module Electronics signal outputs.
- Provide 24 Vdc, 12 Watts power to pin 4 for the Analog Output version, or pin 2 for the RS-485 Digital Interface version. See Figure 7.
NOTE: The input power must be protected against reversal and over-voltage.

RS-485 Network Wiring

Connection between multiple controllers can easily be made by daisy chaining gauge controllers together with the signal from the host computer going into one connector then out to another gauge controller.

- The maximum total cable length is 4,000 ft.
- No more than 32 devices can be connected to one RS-485 communications line.

When an RS-485 network is in an idle state, all nodes are in listen (receive) mode. Under this condition there are no active drivers on the network. To maintain the proper idle voltage state, bias resistors must be applied to force the data lines to the idle condition. Figure 8 illustrates the placement of bias resistors on a host computer for typical 5 volt and 24 volt systems.

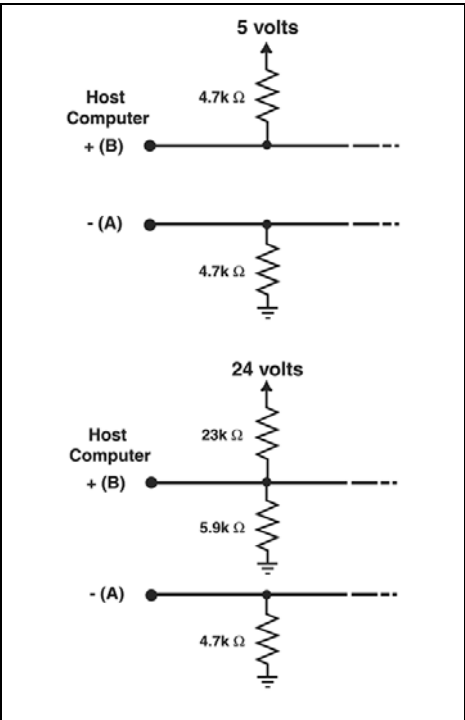


Figure 8: Bias Resistor Placement on the Host Computer

Operation: Analog Output Versions

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, the input must be cycled back to OFF and then ON again.

Power Indicator LED

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

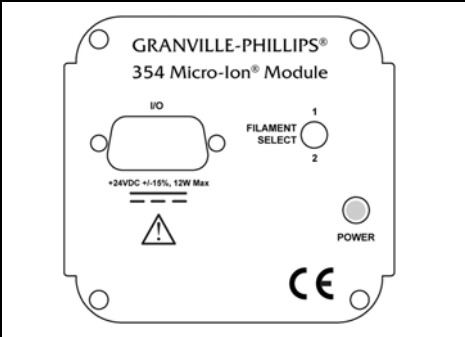


Figure 9: Control Panel on Micro-Ion Gauge Module with Analog Output

Table 5: Power Indicator LED Status on Analog Output Micro-Ion Modules 354001-XX-X & 354002-XX-X

LED Status	Description
OFF	Module not powered
Steady Green	Power applied, ion gauge ON
Blinking Green	Electronics failure

Table 6: Power Indicator LED Status on Analog Output Micro-Ion Modules 354019, 29354014 & 20354015

LED Status	Description
OFF	Module not powered
Steady Red	Power applied, ion gauge OFF
Steady Orange	Ion gauge ON, pressure above 1 x 10 ⁻⁴ Torr
Steady Green	Ion gauge ON, pressure below 1 x 10 ⁻⁴ Torr

Analog Output Graphs

The Analog Output signal differs for different models of the analog output versions of the Micro-Ion Module. Refer to Chapter 3 of the Instruction Manual 345004 for detailed information regarding each model.

Gas Sensitivity, Overpressure Shutdown, Vacuum Measurement, Degas, and Filament Selection

Detailed information for each of these subjects is provided in Chapter 3 of the Instruction Manual 354004.

Operation: RS-485 Interface Versions

Refer to Chapter 4, Installation and Configuration, in Instruction Manual 354008 for detailed instructions regarding the necessary connections and setup requirements for the RS-485 version of the Micro-Ion Module.

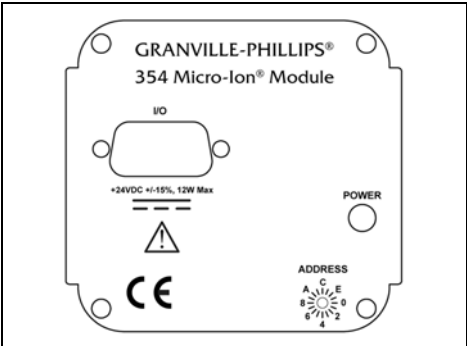


Figure 10: Control Panel on Micro-Ion Gauge Module with RS-485 Digital Interface

Power Indicator LED

The power indicator LED illuminates when 24 Vdc power is applied to the Micro-Ion Module.

Address Selector Switch

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

Firmware Configuration

See Chapter 4 of the Instruction Manual 354008 for detailed instructions regarding the firmware configuration, calculating a gas sensitivity correction, and high vacuum measurement.

RS-485 Specifications and Protocol

See Chapter 5 of the Instruction Manual 354008 for detailed instructions regarding the specifications and protocol of the RS-485 version of the Micro-Ion Module.

Table 7: Summary of RS-485 Commands

Command	Description
<i>The following commands affect the values and operation of the Micro-Ion Module</i>	
SA	Set address offset
SB	Set baud rate
SE	Set emission status
SF	Set Micro-Ion Gauge filament mode
SL	Set setpoint 1 trip point
SO	Set over-pressure setpoint
IG	Turn ion gauge ON/OFF
DG	Turn Degas ON/OFF
RST	Reset Module to power-up state
FAC	Reset to factory defaults
UNL	Unlock interface
TLU	Toggle UNL function
<i>The following commands return data but do not affect the operation of the Micro-Ion Module</i>	
Command	Data Returned
RD	Read 6Vacuum pressure
SES	Read Emission status
RL	Read setpoint trip point
IGS	Read Ion gauge ON/OFF state
DGS	Read Degas ON/OFF state
RS	Read module status
VER	Read Software version

NOTE: See the Instruction Manual (354008) for detailed descriptions of the RS-485 commands.

Product Specifications

Parameter	Specification
Measurement Range for N ₂ / Air	See notes 1 and 2, below
Torr	1 x 10 ⁻⁹ to 5 x 10 ⁻² Torr
mbar	1 x 10 ⁻⁹ to 7 x 10 ⁻² mbar
pascal	1 x 10 ⁻⁷ to 7 Pa
Emission current	0.1 or 4 mA
Degas	Electron Bombardment, approximately 4 watts with 2 minute timer
Over pressure protection	Gauge turns OFF if the pressure rises above 5 x 10 ⁻² Torr at 100 microamperes or 1.3 x 10 ⁻³ Torr at 4 milliampere emission
Input power	24 Vdc ±15%, 12 W max, protected against reversal and over-voltage
Electrical connection	9-pin "D" connector
Operating temperature	0 °C to +40 °C (32 °F to 104 °F) ambient, indoor use only, ordinary protection from moisture
Operation humidity	0 to 90% (accuracy may be affected below 1x10 ⁻⁸ Torr)
Non-operating temperature	-40 °C to +70 °C (-40 °F to 158 °F)
Weight	368 gr. (13 oz.)
Case material	Aluminum extrusion
CE Compliance	
EMC	EN61326-1
Safety	EN61010-1
IP rating	IP20
Micro-Ion Gauge	
Sensitivity	20/Torr, 15/mbar, 0.15/Pa
X-ray limit ³	<3x10 ⁻¹⁰ Torr, <4x10 ⁻¹⁰ mbar, <4x10 ⁻¹⁰ Pa
Filament materials	Yttria-coated Iridium or Tungsten ⁴
Other materials exposed to gas	304 stainless steel, alumina, tantalum, tungsten, CuAg eutectic, Kovar
Internal gauge volume	10.8 cm ³ (0.66 in. ³) to the port screen
Gauge bakeout temperature	200 °C maximum with the electronics enclosure removed
Vacuum connection	NW16KF, NW25KF, NW40KF, 1.33 inch Conflat, 1.75 inch Conflat, or 1/2 inch 8-VCR male fitting
Gauge tube replacement	Field replaceable using only a Phillips screwdriver
Analog Output Version	Logarithmic, 1 Vdc/decade, 0 to 9 V
Filament selection	Two position switch on the top of the module
Input signals	Filament ON/OFF, degas ON/OFF, and emission current are set to continuity to ground
Output signals	Filament ON/OFF, degas ON/OFF status are determined by and open collector transistor
Display	Two digits plus exponent, green LEDs
RS-485 Communication Interface	
Adjustable parameters	Filament ON/OFF, degas ON/OFF, emission current select, filament select, setpoint (value, direction, and hysteresis)
Data format	ASCII, 8 bits, no parity, 1 stop bit, no handshake
Baud rate	Software selectable, 300 to 28000
Setpoint relay	One, single-pole, double-throw (SPDT)
Contact rating	1 A @ 30 Vdc resistive load, 0.5 A at 125 VAC non-inductive
Filament selection	Programmed through the digital interface
Specifications and dimensions are subject to change without notice.	

NOTES:

1. Measurements will change with different gases and mixtures. Correction parameters must be used for gases other than N₂ or Air.
2. Do NOT use Micro-Ion Gauges with flammable or explosive gases.
3. The X-ray limit is the absolute lowest indication from the gauge. It is not practical to make repeatable measurements near the X-ray limit.
4. Tungsten filaments are for applications involving gases containing fluorine, chlorine, or other gas species that poison yttria-coated iridium filaments. Tungsten filaments are not recommended for general vacuum applications because they may burn out when exposed high pressures, including H₂O.

Service / Maintenance

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

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 product to Granville-Phillips, be sure to package the product 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. Shipping damage on returned products as a result of inadequate packaging is the Buyer's responsibility.

Service / Maintenance Procedures

Troubleshooting and gauge replacement instructions are given in the Instruction Manual, p/n 354004 (Analog Output version) or 354008 (RS-485 version), which can be downloaded at: www.mksinst.com.

Customer Service / Technical Support

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Notice

More detailed instructions regarding installation, operation, and service of the Series 354 Micro-Ion Module are provided in the Instruction Manual, p/n 354004 or 354008, available online at www.mksinst.com/Granville-Phillips.

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