Series 354

Granville-Phillips® Series 354 Micro-Ion® Vacuum Gauge Module with DeviceNet™

Instruction Manual

Instruction manual part number 354020
Revision F - July 2017

Series 354

Granville-Phillips® Series 354 Micro-Ion® Vacuum Gauge Module with DeviceNet™

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

Customer Service / Technical Support:

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Instruction Manual

Granville-Phillips® Series 354 Micro-Ion® Vacuum Gauge Module with DeviceNet™

Catalog numbers for Series 354 Micro-Ion Modules
Power supply and cable are not included.

Module with DeviceNet Interface and 2 setpoint relays:

Module with DeviceNet Interface with no display:	354009 - # # - #
Module with DeviceNet Interface with 3-digit display:	354006 - # # - #

Ion Gauge Filaments:

Yttria-coated iridium	Y
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

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Chapter 1 Safety & Introduction

1.1 About These Instructions

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

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

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

Notice

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

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

⚠ WARNING

Safety Precautions

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

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

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

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

WARNING

Electrical Shock or Personal Injury

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

WARNING

Electrical Shock or Fire

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

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

1.2 Grounding Requirements

See Grounding on page 24 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 page 24 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, 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 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

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 4.1 for detailed information regarding how to contact 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 Granville-Phillips for service and repair to ensure that safety features are maintained. Do not use this product if it has unauthorized modifications.

Notice

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

Notice

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

1.8 Service Guidelines

Some minor problems are readily corrected on site. If the product requires service, contact the MKS Technical Support Department at 1-303-652-4400 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. Shipping damage on returned products as a result of inadequate packaging is the Buyer's responsibility.

For Customer Service / Technical Support:
MKS Pressure and Vacuum Measurement Solutions
MKS Instruments, Inc.
6450 Dry Creek Parkway
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Tel: 303-652-4400
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MKS Corporate Headquarters
MKS Instruments, Inc.
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1.9 Warranty Information

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

1.11 Definitions of Terms

Table 1-1 Terms Describing the Micro-Ion ATM Module and Components

Term	Description
Module	The entire Micro-Ion product, which includes the housing, gauge assembly, and electronics assembly.
Gauge assembly	A removable assembly that contains a hot filament Micro-Ion gauge (Bayard-Alpert type ionization gauge) and the vacuum chamber connection.
Electronics assembly	An assembly that contains the electronic circuitry, signal processing microcircuitry, and atmospheric pressure diaphragm sensor.
Micro-Ion gauge	The Bayard-Alpert type ionization gauge, which indicates pressure by producing a current that is proportional to gas density.

Table 1-2 Terms Describing the DeviceNet Protocol

Term	Description
Class	Referred to in DeviceNet language as an “object”. The DeviceNet protocol is divided into various objects that describe behaviors, attributes, or information. For example, class 1 is the identity object that includes information about the identity of the product, such as the vendor identification, product type, product ID, serial number, and firmware revisions.
Instance	Within a class there may be multiple instances. Within the Micro-Ion ATM module there are four possible I/O instances (1–4). For example, the format for polled I/O data is instance 2 in class 5.
Attribute	Data that can be read from the device or written to the DeviceNet network. Attributes exist for each instance within a class. For example, the serial number is attribute 6, instance 1 in class 1 (the identity object).
Master data	The messages sent from the network to the device to set conditions or values in the device.
Device data	The messages sent from the Micro-Ion ATM module to the network to communicate values, attributes, or other information.
Data rate	The rate at which data is transmitted (125, 250, or 500 kbaud, switch selectable).
Explicit messages	Messages that are used for request/response communications enabling module configuration and problem diagnosis. Explicit messages provide multi-purpose, point-to-point communication paths between two modules or other devices.
Polled I/O messages	Messages that are used for time-critical, control-oriented data. Polled I/O messages provide a dedicated, special-purpose communication path between a producing application (host) and one or more consuming applications (modules or other devices).
Address	The address of a device on the DeviceNet network.

Table 1-3 Terms Describing DeviceNet Data Types

Term	Description
Data type	The form of the data communicated from the Micro-Ion ATM module or another node on the network. The module supports BOOL, BYTE, SSTRING, REAL, INT, UINT, USINT, EPATH, and WORD data types.
BOOL data	A single ON/OFF bit, where 1 = ON (true), 0 = OFF (false).
BYTE data	An 8-bit string, from most significant to least significant bit.
STRUCT data	A string of bits, each of which can be set to ON (true) = 1 or OFF (false) = 0.
SSTRING data	A character string, one byte per character, with one byte length indicator.
REAL data	A 32-bit floating point value in single precision IEEE 754 format.
INT data	A 2-byte (16-bit) integer value from –32767 to +32767.
UINT data	A 16-bit unsigned integer value from 0 to 65535.
USINT data	An 8-bit unsigned integer value from 0 to 255.
EPATH	DeviceNet path segments requiring abstract syntax encoding.
WORD data	A 16-bit string.

1.12 Specifications

Pressure Measurement

Absolute Pressure for N_2 or Air
Measurements will change with different gases and mixtures.

Absolute Pressure Range
1×10^{-9} to 5×10^{-2} Torr

X-ray Limit
The X-ray limit is the absolute lowest indication from the gauge. It is not possible to make repeatable measurements near the x-ray limit.

3×10^{-10} Torr

Temperature

Operating Temperature
10 to 40 º C (50 to 104 º F), non-condensing

Storage Temperature
-40 to +70 º C (-40 to +158 º F)

Bakeout Temperature
200 º C (392 º F) maximum with electronics removed

DeviceNet

DeviceNet Output
The Micro-Ion Module has one DeviceNet output.

Messaging
Polled I/O and explicit

Communications Format
BOOL, BYTE, STRUCT, SSTRING, REAL, INT, UINT, USINT, EPATH, and WORD data

Data Rates
125, 250, or 500 kbaud, switch selectable

Address
0–63, selected by using data rate switch

I/O Slave Messaging
Polling, COS, cyclic

NET Status LED Indicator
The NET status LED lights up to indicate if the DeviceNet network has power and is functioning properly.

MOD Status LED Indicator
The MOD status LED lights up to indicate if the module has power or is functioning properly.

Trip Point Relays

Relay Type
Two single-pole double-throw (normally open/normally closed) relays. Each relay can be independently assigned to vacuum or differential pressure.

Relay Contact Ratings
Relay contacts are silver alloy-gold clad, rated for 1 A at 30 Vdc. The relays can handle resistive loads.

Maximum
1 A at 30 Vdc resistive, load

Minimum
5 mA at 5 Vdc resistive, load

Relays Assigned to Vacuum Pressure

Minimum Hysteresis
5%

Range
1.0×10^{-9} to 5 x 10-2 Torr

Micro-Ion Sensor

Emission Current
0.02 mA, 1.0 mA or 4 mA, automatically set

Use RS-485 commands to set switch point for high and low emission currents.

Default Control Settings

Switch to high Emission
1×10^{-5} Torr with decreasing pressure

Switch to Low Emission
5×10^{-5} Torr with increasing pressure

Gauge Degas
Electron bombardment; 3 W for default time of 2 minutes.

Filaments
Solid tungsten or yttria-coated iridium

Electrical Connectors

I/O Connector
9-pin subminiature D male connector has terminals for the module relays.

Cable Type
For cable that connects to the 9-pin I/O connector, install shielded cable with aluminum jacket and a tinned copper braid

with a minimum of 65% coverage.

On the module end of the cable, install a metal housing so the shield is continuous from the cable to the gauge housing. Do not ground the shield at the system end.

DeviceNet Micro Connector
DeviceNet 5-pin micro connector has terminals for a standard micro 5-pin female cable connection.

Cable Type
Install raw cable that has a braided shield over the aluminum foil-shielded signal and power wires.

On the module end of the cable, install a metal housing so the shield is continuous from the cable to the gauge housing. Do not ground the shield at the receiver or output device.

DeviceNet Power Supply
24 Vdc, 0.9 A , 24 Watts maximum.

Ion Gauge Power Connector
Provides power to the ion gauge sensor within the Module. Should be used if the load on the DeviceNet power bus is too high. 24 Vdc.

Physical Specifications

Weight
368.5 g (13 oz.)

Case Material
Powder-coated extruded aluminum

Materials Exposed to Vacuum
304 stainless steel, tantalum, tungsten, yttria-coated iridium, alumina, CuAg eutectic, Kovar, gold-plated and nickel-plated Kovar.

IP Rating
IP20

1.13 Optional Digital Display

The optional digital display for the Series 354 vacuum gauge module is a 7-segment LED that indicates vacuum pressure. The display pressure range is 0.1 x 10^{-10} to 9.9^{-1} Torr. The display is OFF when power is OFF or the Micro-Ion gauge is OFF.

Figure 1-1Micro-Ion Module Optional Digital Display

Notes:

Chapter 2 Installation

The Series 354 Micro-Ion Module contains a Bayard-Alpert type Micro-Ion Gauge.

WARNING

Electrical Shock or Personal Injury

Exposing the 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 the module in an indoor environment. Do not install the module in any outdoor environment.

WARNING

Fire or Explosion

Using the module to measure the pressure of flammable or explosive gases can cause a fire or explosion resulting in severe property damage or personal injury.

Do not use the module to measure the pressure of flammable or explosive gases.

2.1 Pressure Relief Devices

Before you install the module, you should install appropriate pressure relief devices in the vacuum system.

Granville-Phillips does not supply pressure relief valves or rupture disks. Suppliers of pressure relief valves and rupture disks are listed in the *Thomas Register* under “Valves, Relief” and “Discs, Rupture.

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.

2.2 Installation Procedure

The module installation procedure includes the following steps:

1. Determine the location of the module on the vacuum chamber.
2. Attach the module's flange/ fitting to its mating fitting on the vacuum chamber.
3. Assemble and connect the module wiring.

Step 1 Location of the Module

CAUTION

Filament Life

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

WARNING

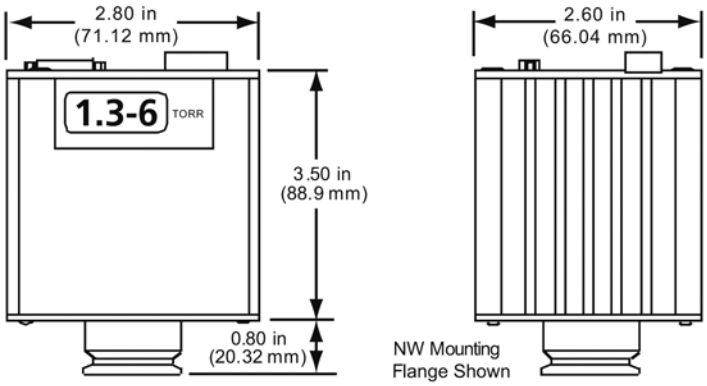
High Voltage

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

To determine the best location for the module, refer to Figure 2-1 and follow the guidelines below.

- 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 non-operating. Bakeout temperature with the electronics removed from the module is 200 °C.
- Locate the module away from internal and external heat sources and in an area where ambient temperature remains reasonably constant.
- 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 2-1 Micro-Ion Module Dimensions



Step 2 Attach the Module to the Vacuum Chamber

Attach the module's flange/fitting to its mating fitting on the vacuum chamber.

CAUTION

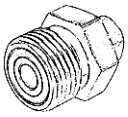
Damage to Module

Twisting the module to tighten the fitting to the vacuum chamber can damage the module's internal connections.

Do not twist the module to tighten the fitting.

Use appropriate tools to tighten the fitting.

VCR type fitting



VCR Type Fitting:

a. Remove the bead protector cap from the fitting.

b. Place the gasket into the female nut.

c. Assemble the components and tighten them to finger-tight.

d. 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 module to tighten the fitting*.

KF flange

The KF mounting system requires O-rings and centering rings between mating flanges.

a. Tighten the clamp to compress the mating flanges together.

b. Seal the O-ring.

ConFlat flange

To minimize the possibility of leaks with ConFlat® flanges, use high strength stainless steel bolts and a new, clean OFHC copper gasket. Avoid scratching the seal surfaces. To avoid contamination, install new metal gaskets.

a. Finger tighten all bolts.

b. Use a wrench to continue tightening 1/8 turn at a time in crisscross order (1, 4, 2, 5, 3, 6) until flange faces make contact.

c. Further tighten each bolt about 1/16 turn.

Step 3 Assemble and Connect the Wiring

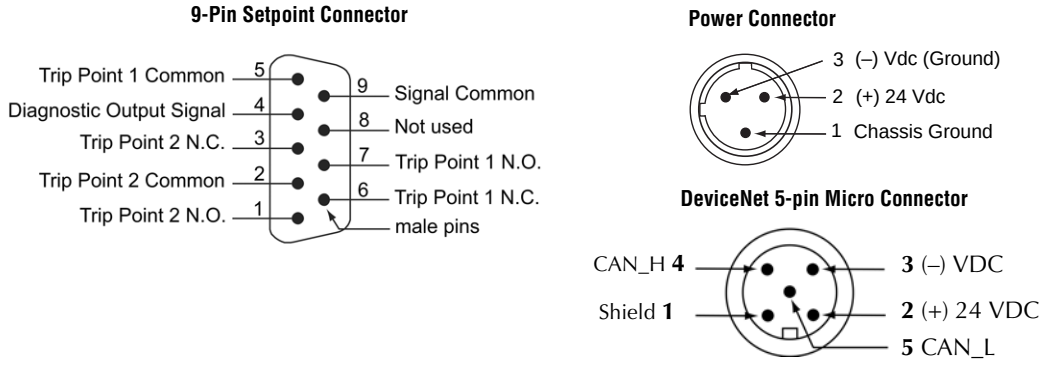
Connecting Cables

The cables are user-supplied. Granville-Phillips does not supply cables. Install externally shielded cables.

Wiring connects to the power connector, the 9-pin I/O connector, and the DeviceNet 5-pin micro connector. See Figure 2-2, Table 2-1, and Table 2-2.

- Connect the module power-supply wiring and the relay wiring to the 9-pin I/O connector. See Figure 2-2
- Connect the DeviceNet power-supply and network wiring to the DeviceNet 5-pin micro connector. See Figure 2-2

Figure 2-2 Power, Input/Output, and DeviceNet Connectors



Cable to 9-pin I/O connector

For the cable that connects to the 9-pin I/O connector, install shielded cable with aluminum jacket and a tinned copper braid with a minimum of 65% coverage.

On the module end of the cable, install a metal housing, so the shield is continuous from the cable to the gauge housing. Do not ground the shield at the receiver or output device.

Acceptable raw cable parts:

- Belden cable 9947.
- Alpha cable 5110/15C SL005.

Acceptable connector:

- Tyco series ADK for standard 9-pin subminiature-D connectors.

DeviceNet Cable

For the DeviceNet cable, install raw cable that has a braided shield over the aluminum foil-shielded signal and power wires.

On the module end of the cable, install a metal housing, so the shield is continuous from the cable to the gauge housing. Do not ground the shield at the receiver or output device.

- Acceptable raw cable is DeviceNet shielded cable type 578 from Turck.
- Acceptable connector is CM 8151-0 metal connector from Turck.

Module Power Supply

The customer supplied power supply should provide operating voltage and current to the Series 354 Micro-Ion Vacuum Gauge Module as specified in Table 2-1 and Table 2-2. Surge current is the maximum momentary current when power is first applied before the ion gauge is turned ON. 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.

Table 2-1 Ion Gauge Powered by DeviceNet

Connector	Surge Current	Operating Current	Input Voltage
DeviceNet	2.0 A 8 ms	0.65 A	26 Vdc
DeviceNet	1.5 A 8 ms	1.2 A	16 Vdc*

Table 2-2 Ion Gauge Powered by Separate Power Connector

Connector	Surge Current	Operating Current	Input Voltage
DeviceNet	1.3 A 20ms	0.1 A	26 Vdc
DeviceNet	1.0 A 20 ms	0.2 A	11 Vdc
Power	0.5 A 20 ms	0.55 A	26 Vdc
Power	0.5 A 10 ms	1.0 A	16 Vdc*

*Voltage must be $\geq$20 Vdc to run degas function.

DeviceNet Wiring

The module has a DeviceNet 5-pin micro connector for interfacing through the customer supplied DeviceNet network cable. See Figure 2-2. The DeviceNet connection is a standard 5-pin DeviceNet receptacle that accepts a standard micro 5-pin female cable connection.

Use terminals 2 (Vdc return) and 3 (24 Vdc) on the 5-pin DeviceNet micro connector for the network power supply.

- The DeviceNet interface requires 24 Vdc (16 to 26.4) at 0.2 A maximum.
- Maximum inrush current is 0.25 A.
- Power inputs are reverse-bias protected.

Grounding

The module contains three separate and isolated grounds: the DeviceNet ground, the analog ground, and the chassis ground. Typical isolation between DeviceNet and chassis grounds is 1 MΩ.

The module generates 180 Vdc during normal operation and 250 Vdc during Micro-Ion gauge degas.

WARNING

High Voltage

The Micro-Ion Vacuum Gauge Module grid supply voltages reach 180 Vdc during operation and 250 Vdc during degas cycles.

Improper grounding could cause severe product failure or personal injury. Follow ground network requirements for the facility. Maintain all exposed conductors at Earth ground.

DeviceNet Grounding

The DeviceNet wiring will be properly grounded via the DeviceNet 5-pin micro connector.

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.

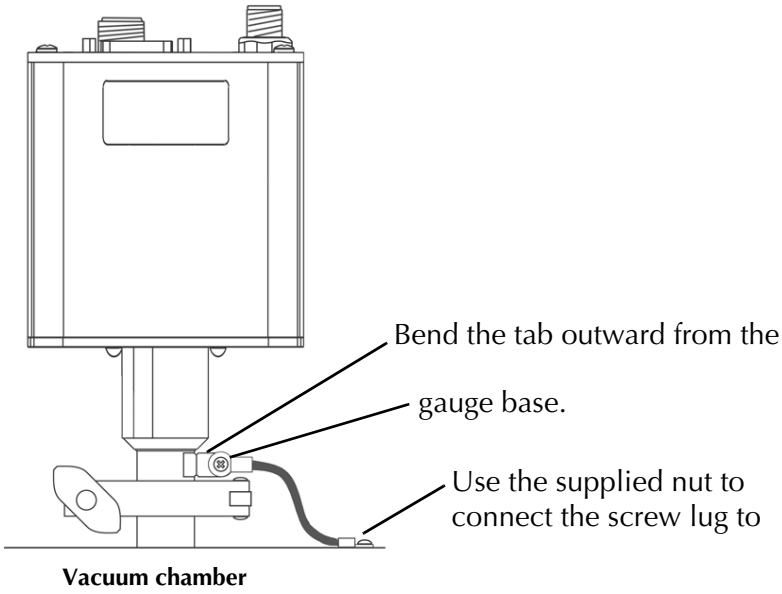
If the module has a KF flange, the module is shipped with a 3-foot length of braided copper wire, which has a screw lug on each end, and a screw and nut for connecting the copper wire to the gauge base. If a metal clamp and metal gasket will not be installed, follow this procedure to ground the module:

a. The gauge base has a tab that allows a connection to the copper wire. Bend the tab outward from the gauge base (see Figure 2-3).

b. Use the supplied screw and nut to connect one screw lug on the braided copper wire to the tab.

c. Connect the other screw lug to an appropriately grounded point on the vacuum system.

Figure 2-3 Vacuum Chamber Ground Connections



2.3 Eliminating Radio Frequency Interference

The module has been tested and found to comply with U.S. Federal Communications Commission (FCC) limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits provide reasonable protection against harmful interference when the module operates in a commercial environment.

The module generates and can radiate radio frequency energy. If not installed and used in accordance with the instructions in this manual, the module may cause harmful interference to other electrical equipment.

Notes:

Chapter 3 DeviceNet Operation

3.1 DeviceNet Operation

The Series 354 Micro-Ion Module has one DeviceNet output and two trip point relays.

You may use polled I/O or explicit messages to read vacuum pressure or differential pressure, assign trip point relays to vacuum pressure or differential pressure, and configure the module

- Table 3-1 lists tasks that may be performed using DeviceNet polled I/O.
- Table 3-2 lists tasks that may be performed using DeviceNet explicit messages.
- For a complete list of DeviceNet messages used by the module, see Messaging Summary beginning on page 47 of this Chapter.

Table 3-1 Tasks and page references for DeviceNet polled I/O

Task	Instructions:
Read vacuum pressure	Page 34
Read differential pressure	Page 34
Turn OFF the Micro-Ion gauge	Page 39
Initiate or terminate Micro-Ion gauge degas	Page 40

Table 3-2 Tasks and page references for DeviceNet explicit messages

Task	Instructions:
Configure DeviceNet communications	Page 31
Set or get pressure unit	Page 33
Get vacuum pressure	Page 34
Set relay trip points	Page 35
Set relay activation direction	Page 35
Set relay hysteresis	Page 35
Set relay assignments	Page 35
Set disabled/enabled state of relays	Page 35
Get relay trip points	Page 38
Get disabled/enabled state of relays	Page 38
Get activation or deactivation status of relays	Page 38
Get relay hysteresis	Page 39
Set or get Micro-Ion gauge ON/OFF state	Page 39
Get Micro-Ion gauge active filament	Page 40
Set or get Micro-Ion gauge degas ON/OFF state	Page 40
Set or get emission current switch point for Micro-Ion gauge	Page 41
Reset module to power-up state	Page 43
Get firmware version for module	Page 43
Get software and hardware revisions for module	Page 43
Get status alarms and warnings	Page 59

3.2 Preparing to Operate the Micro-Ion Gauge Module

Before putting the module into operation, you must perform the following procedures:

1. Install the module per Chapter 2.
2. Develop a logic diagram of the process control function.
3. Develop a circuit schematic that specifies exactly how each piece of system hardware will connect to the module relays.
4. Attach a copy of the process control circuit diagram to this manual for future reference and troubleshooting.

If you need application assistance, phone a Granville-Phillips application engineer at 1-303-652-4400.

3.3 Performance with DeviceNet Protocol

Table 3-3 lists performance characteristics for the Micro-Ion module using DeviceNet protocol.

Table 3-3 Micro-Ion Module Performance Characteristics with DeviceNet Protocol

Network Feature	Performance	
Network size	Up to 64 nodes (00 to 63)	
Network length	End-to-end network distance varies with speed	
	Baud rate • 125 kbaud • 250 kbaud • 500 kbaud	Distance • 1,640 feet (500 m) • 820 feet (250 m) • 328 feet (100 m)
Bus topology	• Linear (trunkline/dropline) • Power and signal on the same network cable	
Bus addressing	• Peer-to-peer with multi-cast (one-to-many) • Multi-master and master/slave special case • Polled or change-of-state (exception-based)	
System features	• Module can be removed and replaced while network power supply is ON • Module can be programmed while network power supply is ON (program changes will take effect after power has been cycled)	

3.4 DeviceNet Protocol for the Micro-Ion Module

The Micro-Ion Module is based on the Open DeviceNet Vendors Association (ODVA) and S-Analog Sensor Object Class Subclass 01 (Instance Selector) standards. The Micro-Ion Module command set includes public and vendor-specific classes, services, and attributes.

DeviceNet communication requires identifier fields for the data. The use of identifier fields provides the means for multiple priority levels, efficient transfer of I/O data, and multiple consumers. As a node in the network, the module produces data on the network with a unique address. All devices on the network that need the data listen for messages. When other devices on the network recognize the module's unique address, they use the data.

For a complete list of DeviceNet messages used by the module, see *Messaging Summary* on page 47. The instructions in this chapter explain how to use the module command set to operate the module.

3.5 Operational Tasks

DeviceNet protocol conveys three types of messages, as defined in Table 3-4.

Once the module is operating, you may use polled I/O or explicit messages to perform the tasks listed in Table 3-4 and Table 3-5.

Table 3-4 DeviceNet Message Types

Message Type	Message Purpose
Polled I/O messages	• Used for time critical, control oriented data • Provide a dedicated, special purpose communication path between a producing application and one or more consuming applications
Change of state I/O messages	• Used for time critical, control oriented data • Data transfer initiated by the producing application • Provide a dedicated, special purpose communication path between a producing application and one or more consuming applications
Explicit messages	• Provide multipurpose, point-to-point communication paths between two devices • Provide typical request/response oriented network communications used for performing node configuration and problem diagnosis

3.6 DeviceNet Switches and Indicators

The Micro-Ion Module has address switches for setting the network address and a data rate switch for setting the baud rate.

Address Switches

Use the address switches to set the media access control identifier (MAC ID), which the network master uses to address the module. When the device powers up or is reset by the network, the device firmware will read the address switch settings. Figure 3-1 illustrates the address switches.

Specific address values range from 0 to 63.

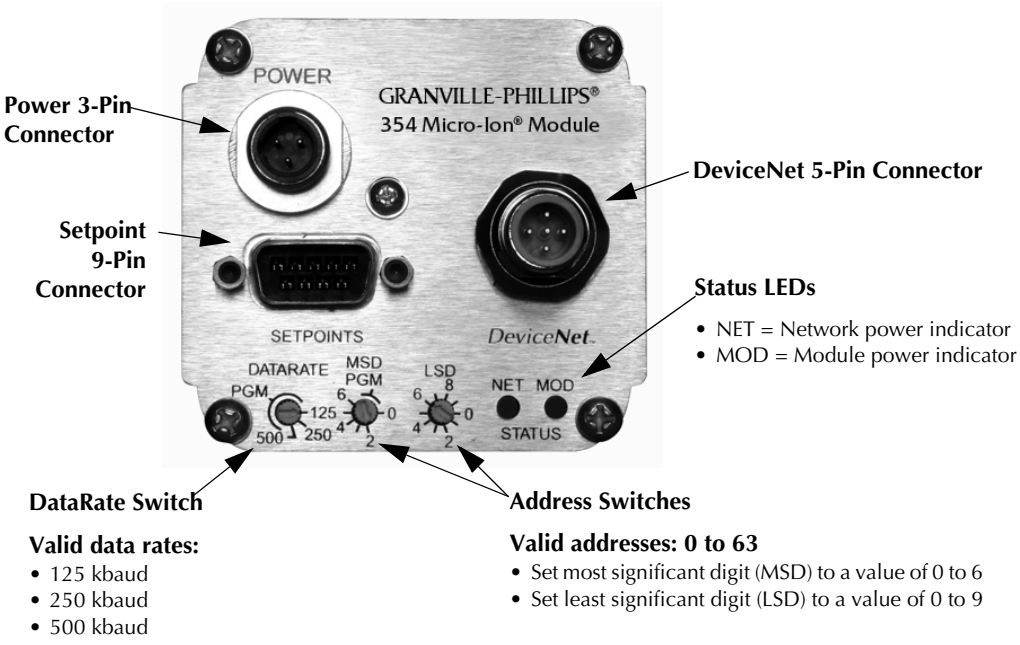
- Set the switch labeled “MSD,” to a value of 0 to 6 for the most significant (first) digit.
- Set the switch labeled “LSD,” to a value of 0 to 9 for the least significant (second) digit.

If a valid address between 0 and 63 is set, and it differs from the current address stored in non-volatile RAM (NVRAM), the new address will be saved in memory. If the data rate switch is set to the PGM setting, the firmware will use the data rate that is stored in NVRAM.

Upon connection to the DeviceNet network, the module requests a duplicate address check.

- If another device on the network has the same address as the module, the module will not join the network.
- If the address is unique, the module will join the network and the net status indicator will blink green until a connection to the master node is established.

Figure 3-1 Address Switches and Status LEDs



DataRate Switch

Use the DataRate switch to select the rate at which data is sent and received on the network.

- You may select a data rate of 125 kbaud, 250 kbaud, or 500 kbaud.
- When the device powers up or is reset by the network, the device firmware will read the rate switch setting.

If the selected data rate differs from the value stored in NVRAM, the new data rate will be saved in memory. If the rate switch is set to the PGM setting, the firmware will use the data rate that is stored in NVRAM.

3.7 Status LEDs

Figure 3-1 illustrates the two status LEDs, labeled NET and MOD.

- The MOD (module) status LED indicates if the module has power or is functioning properly.
- The NET (DeviceNet network) status LED indicates if the DeviceNet network has power and is functioning properly.

Table 3-5 and Table 3-6 list states for each LED and the corresponding network or module status.

Table 3-5 NET (DeviceNet Network) LED Status

NET LED State	Network Status	Description
OFF	Not powered	• The module is not on line • The module has not completed the DUP_MAC_ID test
Blinking green/red	Self test	Module is in self test
Blinking green	On line, not connected	The module has passed the DUP_MAC_ID test and is on line, but has not established connection with master node

Table 3-5 NET (DeviceNet Network) LED Status

NET LED State	Network Status	Description
Solid green	On line, connected	• The module is allocated to a master • The device is operating normally
Blinking red	Connection time out	All connections have timed out
Solid red	Critical link failure	The module has detected an error that has made it incapable of communicating on the network

Table 3-6 MOD (Module) LED Status

MOD LED State	Module Status	Description
OFF	Power OFF	No power applied to module
Blinking green/red	Self test	Module is in self test
Solid green	Operational	Module is operating normally
Solid red	Unrecoverable fault	Module has detected a fault

3.8 DeviceNet Communication Configuration

1. Turn OFF the external power supply.
2. Set the address switches to the desired address (0 to 63).
3. Set the data rate switch to the desired setting (125, 250, or 500 kbaud).
4. Turn ON the external power supply.
5. Refer to Table 3-7 and Table 3-8 to allocate a connection for the module to the network master. ***You must set the bit to 1 (polled) or 0 (explicit messages) to perform tasks explained in this chapter.***
   - Set the bit contents to 1 to enable polled I/O.
   - Set the bit contents to 0 to enable explicit messages.

Table 3-7 Network Master Connection

Service	Class	Instance	Attribute	Data Type	Allocation Choice Bits
$4B_{hex}$	3	1	None	STRUCT	0=Explicit message 1=Polled 2=Bit strobed[(a)] 3=Reserved[(a)] 4=Change of state[(a)] 5=Cyclic[(a)] 6=Acknowledge suppression[(a)] 7=Connection[(a)]

[(a)] Not supported, value = 0.

Table 3-8 Network master connections allocation choice bits

Assembly Number	STRUCT Data: One Byte Format							
1	Bit 7 Connection	Bit 6 Acknowledg e suppression	Bit 5 0	Bit 4 0	Bit 3 Reserved	Bit 2 Bit strobed	Bit 1 Polled	Bit 0 Explicit message

6. Refer to Table 3-9 to configure the expected packet rate for messages. The expected packet rate is the rate at which the module expects to send data to and receive a packet of data from the network.
   - The default expected packet rate for explicit messaging is 2500 msec (2.5 sec.).
   - For polled I/O, set the expected packet rate to 0 (none).
   - If data will be requested at a rate slower than every 2500 msec, you must change or disable the expected packet rate to prevent the connection from timing out.

Table 3-9 Expected Packet Rate

Expected Packet Rate for Explicit Messaging

Service	Class	Instance	Attribute	Master Data	Data type	Description
10_{hex}	5	1	9	*data such as* 09 $C4_{hex}$ (default)	UINT	Rate at which module sends data to and receives data from network • Default is 2500 msec (2.5 sec.) • Valid time is ≤ 2500 msec (2.5 sec.)

Expected packet rate for polled I/O

Service	Class	Instance	Attribute	Master Data	Data Type	Description
10_{hex}	5	2	9	00 00	UINT	Disable expected packet rate

7. *If the connection allocation bit 1 (polled) is set (see Step 5 on page 31)*, refer to Table 3-10 to configure the polled data input format and status byte and Table 3-11 to configure the polled data output format.
   - You may configure the module to send data to the network in unsigned integer (UINT), or floating point data (REAL) formats, with or without a status byte.
   - The default configuration sends pressure in floating point data format with one byte of status data.

Table 3-10 Configuring Polled Input I/O Data Format

Format	Service	Class	Instance	Attribute	UINT Data
2 bytes UINT vacuum pressure	**10_{hex}**	4	0	65_{hex}	**01** hex
1 BYTE exception status 2 bytes UINT vacuum pressure	**10_{hex}**	4	0	65_{hex}	**02** hex
4 bytes REAL vacuum pressure	**10_{hex}**	4	0	65_{hex}	**04** hex
Default configuration: 1 BYTE exception status 4 bytes REAL vacuum pressure	**10_{hex}**	4	0	65_{hex}	**05** hex

Table 3-11 Configuring Polled Output I/O Data Format

Format	Service	Class	Instance	Attribute	UINT data
1 BYTE control (**default**)	$0E_{hex}$	4	0	66_{hex}	**01** hex
0 BYTE control	$0E_{hex}$	4	0	66_{hex}	**00** hex

8. *If the connection allocation bit 1 (polled) is set (see Step 5 on page 31)*, you may configure the module to receive one byte of input data that controls the Micro-Ion Gauge, as listed in Table 3-12.

Bit 6 in the one byte format turns the Micro-Ion gauge ON or OFF. If bit 6 is set to 1, the gauge will turn ON. See Table 3-13.

Table 3-12 Writing Micro-Ion Gauge Control Data - Polled I/O

Assembly Number	USINT Data: One Byte Format							
1	Bit 7 High Emissio n	Bit 6 Ion Gauge	Bit 5 Medium Emissio n	Bit 4 0	Bit 3 0	Bit 2 Enable Filame nt 2	Bit 1 Enable Filame nt 1	Bit 0 Initiate or terminate Micro-Ion gauge degas

Table 3-13 Micro-Ion Gauge Control Bits

Parameter	Description
Degas	When Bit 0 is set to 1, degas will begin if the ion gauge is ON
Enable Filament 1	When Bit 1 is set to 1, filament 1 will turn on if the ion gauge is ON
Enable Filament 2	When bit 2 is set to 2, filament 1 will turn on when the gauge is ON. If both bits 1 and 2 are set to 1, both filaments will turn on when the gauge is ON. If both bits 1 and 2 are set to 0, the last programmed value will be used to turn on the filaments.
Bits 3 and 4	Reserved - should always be set to 0
Medium Emission	When bit 5 is set to 1, the ion gauge will operate at medium emission when the gauge is ON.
Ion Gauge	When bit 6 is set to 1, the ion gauge will be ON and allow a reading of pressure. If a fault condition occurs, the state of the ion gauge will be OFF and the fault condition must be cleared before pulling this bit to 0, then 1 again to light the ion gauge.
High Emission	When bit 7 is set to 1, the ion gauge will operate at high emission when the gauge is ON. The state of bit 5 is irrelevant when bit 7 is set to 1. If both bits 5 and 7 are set to 0, the ion gauge will operate at low emission.

3.9 Pressure Units and Values

You may use explicit messages to set the pressure unit.

You may use explicit messages or input polled I/O to read values that represent measured pressure. You must calculate measured pressure from the values represented by the explicit message or input polled I/O.

If you get pressure using input polled I/O or from the assembly object using explicit messaging, values are available with or without warning and alarm status or trip point status.

Set or Get Pressure Unit

Use the explicit messages listed in Table 3-14 to set or get the unit of pressure.

Table 3-14 Pressure Measurement Units

Service	Class	Instance	Attribute	Typical Device Data	Data Type	Description
$0E_{hex}$	31_{hex}	1	4	01 03	UINT	Get pressure unit

Table 3-14 Pressure Measurement Units

10_{hex}	31_{hex}	1	4	01 03	UINT	Set pressure unit • 769 = Torr • 776 = mbar • 777 = pascal

Data Conversion

Refer to Table 3-15 to convert explicit message or input polled I/O data to meaningful values representing exception status, trip point status, vacuum pressure, or differential pressure.

Table 3-15 Converting BYTE, UINT, INT, or REAL Data to Exception Status, Trip Point Status, or Pressure Values

Represented Value	Data Type	Converting Data to Exception Status, Trip Point Status, or Pressure Value
Exception status	BYTE	8-bit string, from most significant to least significant bit: • Bit 1 = Alarm • Bit 5 = Warning
Trip point status	BYTE	8-bit string, from most significant to least significant bit: • Bit 0 = Relay 1 is activated • Bit 1 = Relay 2 is activated • Bit 2 = Micro-Ion gauge emission current is 4.0 mA (high emission)
Vacuum pressure	UINT	16-bit unsigned integer value from 0 to 65535, from integer count: $\text{Vacuum pressure} = 10^{(\text{Integer counts}/406.25) - 12.699}$
Vacuum pressure	REAL	32-bit floating point value in single precision IEEE 754 format, in pressure unit defined by the user (Torr, mbar, or pascal).

Get Vacuum Pressure

You may use explicit messages or input polled I/O to read values that represent measured pressure. You must calculate measured pressure from the values represented by the explicit message or input polled I/O.

If you get pressure using input polled I/O or from the assembly object using explicit messaging, values are available with or without warning and alarm status or trip point status.

- The explicit messages for each object are listed in Table 3-16.
- You *must* refer to Table 3-15 to convert the BYTE, UINT, INT, or REAL data to meaningful values representing exception status, trip point status, vacuum pressure, or differential pressure.

Table 3-16 Explicit Messages for Measured Pressure Values

Pressure values are transmitted in low byte to high byte order.

Service	Class	Instance	Attribute	Typical Device Data	Data Type	Description
$0E_{hex}$	31_{hex}	1	6	BD 37 86 35_{hex}	REAL	Get REAL vacuum pressure from Micro-Ion gauge (1 x 10^{-6} Torr)
$0E_{hex}$	4	1	3	A1 $0A_{hex}$	UINT	Get UINT vacuum pressure (1x10^{-6} Torr)
$0E_{hex}$	4	2	3	00 A1 $0A_{hex}$	STRUCT	Get BYTE exception status Get UINT vacuum pressure
$0E_{hex}$	4	4	3	BD 37 86 35_{hex}	REAL	Get REAL vacuum pressure (1x10^{-6} Torr)
$0E_{hex}$	4	5	3	00 BD 37 86 35_{hex}	STRUCT	Get BYTE exception status Get REAL vacuum pressure

Using input polled I/O:

When a master polls the module for measured pressure, the format of the returned pressure value depends on the data type. See Table 3-17.

- To configure the data format for input polled I/O, see Step 7 on page 32.
- You *must* refer to Table 3-15 to convert the BYTE, UINT, INT, or REAL data to meaningful values representing exception status, trip point status, vacuum pressure, or differential pressure.

Table 3-17 Input Polled I/O for Pressure Values

Pressure values are transmitted in low byte to high byte order.

Instance	Typical device data	Data type	Description
1	A1 $0A_{hex}$	UINT	UINT vacuum pressure (1x10^{-6} Torr)
2	00 A1 $0A_{hex}$	STRUCT	BYTE exception status UINT vacuum pressure
4	BD 37 86 35_{hex}	REAL	REAL vacuum pressure
5 (**Default**)	00 BD 37 86 35_{hex}	STRUCT	BYTE exception status REAL vacuum pressure(1x10^{-6} Torr)

3.10 Process Control Relays

You may use explicit messages to perform the following tasks:

- Setting or getting relay trip points
- Setting or getting relay activation direction (polarity)
- Setting or getting relay hysteresis
- Setting or getting relay assignments
- Setting or getting disabled/enabled state of relays

The module has two single-pole double-throw (normally open/normally closed) relays. Each relay can be independently assigned to vacuum or differential pressure. Each relay has a programmable activation direction and trip point. The trip point is a value representing pressure at which the relay activates.

- When the module is shipped from the factory, relay trip points are out of range, disabled, and will not operate.

- You must configure relays to make them operable.

In default mode, trip point relays activate with decreasing pressure and deactivate at a higher pressure than the activation pressure, as illustrated in Figure 3-2.

You can reverse relay polarity, so trip point relays activate with increasing pressure and deactivate at a lower pressure than the activation pressure, as illustrated in Figure 3-3.

- You may change the deactivation pressure by entering REAL data that represents hysteresis as a percentage of the activation pressure.
- Valid hysteresis values are any activation pressure percentage, from 5% to 100%, that is divisible by 5.

Use the explicit messages listed in Table 3-19 to configure trip point relays.

Figure 3-2 Default Behavior of Relays Activating with Decreasing Pressure

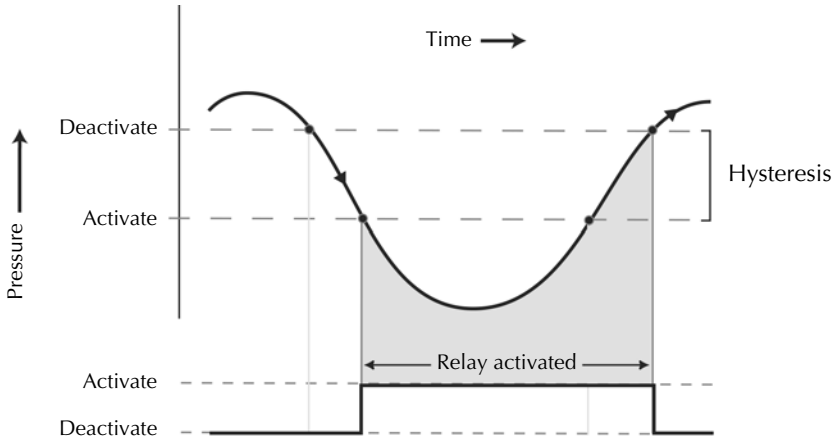


Figure 3-3 Default Behavior of Relays Activating with Increasing Pressure

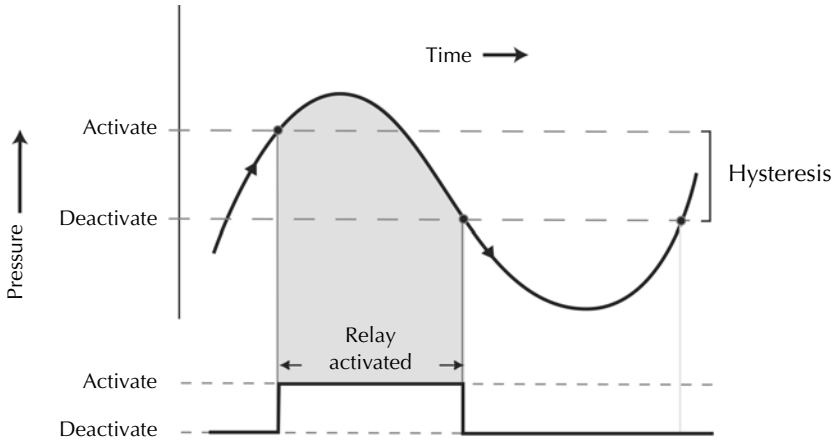


Table 3-18 lists minimum hysteresis for trip point relays based on the relay assignment.

Table 3-18 Relay Assignments and Minimum Hysteresis

Relay Assignment	Minimum Hysteresis
Vacuum pressure	5%

You can change the deactivation pressure by entering REAL data that represents hysteresis as a percentage of the activation pressure.

Use the explicit messages listed in Table 3-19 to configure trip point relays.

Table 3-19 Trip Point Relay Configuration Commands

Trip Point Relay 1

Service	Class	Instance	Attribute	Typical Master Data	Data Type	Description
10_{hex}	35_{hex}	1	5	BD 37 86 35_{hex} (1×10^{-6})	REAL	Set pressure at which relay 1 activates
10_{hex}	35_{hex}	1	6	0	BOOL	1=Enable relay 1 0=Disable relay 1
10_{hex}	35_{hex}	1	8	0	BOOL	0 = Activate with decreasing pressure 1 = Activate with increasing pressure
10_{hex}	35_{hex}	1	$0A_{hex}$	00 00 70 41_{hex} (15%)	REAL	Set hysteresis • Percentage of activation pressure
$0E_{hex}$	35_{hex}	1	$0E_{hex}$	24 00	EPATH	Get relay 1 assignment • 24 00=Vacuum pressure
Trip Point Relay 2						
10_{hex}	35_{hex}	2	5	BD 37 86 35_{hex} (1×10^{-6})	REAL	Set pressure at which relay 2 activates
10_{hex}	35_{hex}	2	6	0	BOOL	1=Enable relay 2 0=Disable relay 2
10_{hex}	35_{hex}	2	8	0	BOOL	0 = Activate with decreasing pressure 1 = Activate with increasing pressure
10_{hex}	35_{hex}	2	$0A_{hex}$	00 00 70 41_{hex} (15%)	REAL	Set hysteresis • Percentage of activation pressure
$0E_{hex}$	35_{hex}	2	$0E_{hex}$	24 00	EPATH	Get relay 2 assignment • 24 00=Vacuum pressure

Get Relay Trip Points

Use the explicit messages listed in Table 3-20 to get the pressure value at which a relay activates.

Table 3-20 Relay Trip Points

Service	Class	Instance	Attribute	Typical Device Data	Data Type	Description
$0E_{hex}$	35_{hex}	1	5	BD 37 86 35_{hex} (1×10^{-6})	REAL	Get pressure at which relay 1 activates
$0E_{hex}$	35_{hex}	2	5	BD 37 86 35_{hex} (1×10^{-6})	REAL	Get pressure at which relay 2 activates

Get Enable/Disable Status of Relays

Use the explicit messages listed in Table 3-21 to get the enabled or disabled status of a relay.

After relays have been made operable, you may use explicit messages to disable any specified relay. If you disable a relay, you must re-enable it to make it operable. You must reconfigure the relay to re-enable it.

Table 3-21 Relay Enabled/Disabled Status

Service	Class	Instance	Attribute	Typical Device Data	Data Type	Description
$0E_{hex}$	35_{hex}	1	6	0	BOOL	0 = Relay 1 is disabled 1 = Relay 1 is enabled
$0E_{hex}$	35_{hex}	2	6	0	BOOL	0 = Relay 2 is disabled 1 = Relay 2 is enabled

Get Activation or Deactivation Status of Relays

Use the explicit messages listed in Table 3-22 to get the activation or deactivation state of a relay.

Table 3-22 Relay Activation/Deactivation Status

Service	Class	Instance	Attribute	Typical Device Data	Data Type	Description
$0E_{hex}$	35_{hex}	1	7	0	BOOL	0 = Relay 1 is deactivated 1 = Relay 1 is activated
$0E_{hex}$	35_{hex}	2	7	0	BOOL	0 = Relay 2 is deactivated 1 = Relay 2 is activated

Get Relay Hysteresis

Use the explicit messages listed in Table 3-23 to get the hysteresis for a relay. The returned value is a percentage of activation pressure.

Table 3-23 Relay Hysteresis

Service	Class	Instance	Attribute	Typical device data	Data type	Description
$0E_{hex}$	35_{hex}	1	$0A_{hex}$	00 00 70 41_{hex} (15%)	REAL	• Percentage of activation pressure
$0E_{hex}$	35_{hex}	2	$0A_{hex}$	00 00 70 41_{hex} (15%)	REAL	• Percentage of activation pressure

3.11 Micro-Ion Gauge Controls

You may use explicit messages to perform the following tasks:

- Turn the Micro-Ion gauge ON or OFF
- Get the Micro-Ion gauge ON/OFF state
- Set or get the Micro-Ion gauge active filament
- Set or get the Micro-Ion gauge degas ON or OFF state
- Set the emission current switch point for Micro-Ion gauge

You may use polled I/O to perform the following tasks:

- Turn the Micro-Ion gauge OFF/ON
- Initiate or terminate the Micro-Ion gauge degas
- Select filament 1 or 2
- Select emission level

Turn the Micro-Ion Gauge ON or OFF

You may use explicit messages or polled I/O to turn the Micro-Ion gauge OFF or ON.

Using DeviceNet explicit messages:

Use the explicit message listed in Table 3-24 to turn the Micro-Ion gauge OFF or ON.

Table 3-24 Micro-Ion Gauge ON/OFF Command

Service	Class	Instance	Attribute	Typical master data	Data type	Description
62_{hex}	31_{hex}	1	None	0	USINT	Set Micro-Ion gauge ON/OFF state • 0 = Turn Micro-Ion gauge OFF • 1 = Turn Micro-Ion gauge ON

Using input polled I/O:

The master can input data to the device to turn the Micro-Ion gauge OFF or ON. See Table 3-12 and Table 3-13 on page 33.

Get Micro-Ion gauge ON/OFF Status

Use the explicit message listed in Table 3-25 to get the Micro-Ion gauge ON/OFF status.

Table 3-25 Micro-Ion Gauge ON/OFF Status

Service	Class	Instance	Attribute	Typical device data	Data type	Description
$0E_{hex}$	31_{hex}	1	$5D_{hex}$	0	BOOL	0 = Micro-Ion Gauge is OFF 1 = Micro-Ion Gauge is ON

Get or Set Active Filament

Use the explicit message listed in Table 3-26 to get or set the active filament.

Table 3-26 Active Filament

Service	Class	Instance	Attribute	Typical Device Data	Data Type	Description
$0E_{hex}$	31_{hex}	1	59_{hex}	1	USINT	Bit 0 = Get Filament 1 Bit 1 = Get Filament 2
Service	**Class**	**Instance**	**Attribute**	**Typical Master Data**	**Data Type**	**Description**
10_{hex}	31_{hex}	1	59_{hex}	1	USINT	Bit 0 = Set Filament 1 Bit 1 = Set Filament 2

Initiate or Terminate Micro-Ion Gauge Degas

You may use explicit messages or polled I/O to initiate or terminate the Micro-Ion gauge degas cycle.

Using DeviceNet explicit messages:

To degas the Micro-Ion Gauge, follow these steps:

1. Turn ON the Micro-Ion Gauge. (See page 39.)
2. Make sure vacuum pressure is lower than 5×10^{-5} Torr (6.66×10^{-5} mbar, 6.66×10^{-3} pascal).
3. Refer to Table 3-27 and set the command bit to 1 (ON) to initiate the degas cycle. The time for gauge degas is two minutes.
4. *If you want to terminate the Micro-Ion Gauge degas cycle before it is completed,* set the command bit to 0 (OFF).

Table 3-27 Micro-Ion Gauge Degas Commands

Service	Class	Instance	Attribute	Typical Master Data	Data Type	Description
61_{hex}	31_{hex}	2	None	0	USINT	Set Micro-Ion degas state • 0=Terminate degas cycle • 1=Initiate degas cycle

Using output polled I/O:
The master can input data to the device to turn the degas function ON or OFF. Table 3-13 lists degas control bit.

Get Micro-Ion Gauge Degas ON/OFF State

Use the explicit message listed in Table 3-28 to get the Micro-Ion gauge degas state.

Table 3-28 Micro-Ion Gauge Degas State

Service	Class	Instance	Attribute	Typical Device Data	Data Type	Description
$0E_{hex}$	31_{hex}	2	58_{hex}	0	USINT	• 0=Degas is ON (in progress) • 1=Degas is OFF

Set or Get Micro-Ion Gauge Emission Current

The Micro-Ion gauge can operate at three emission current levels.

- In low-emission mode, the current level is 0.02 mA.
- In medium-emission mode, the current level is 1 mA.
- In high-emission mode, the current level is 4 mA.

When vacuum pressure is low enough, set the gauge status to ON. The Micro-Ion gauge turns ON at the low emission current level (0.02 mA).

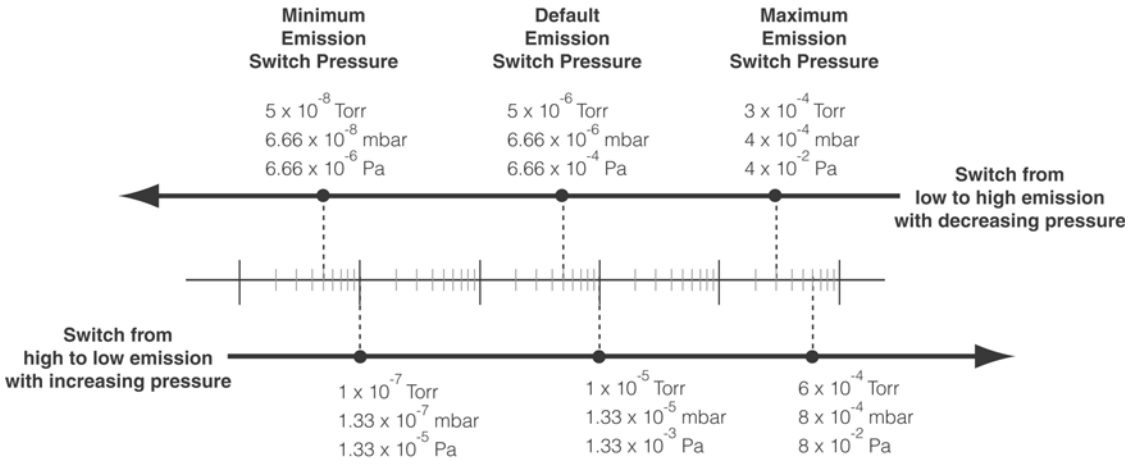
As pressure continues to decrease, the Micro-Ion gauge switches from low emission current to high emission current (4 mA). If pressure increases after the current level has gone from low to high, the gauge switches back to low emission current. Table 3-29 lists default, minimum, and maximum pressure values at which the gauge switches emission current levels.

Table 3-29 Micro-Ion Gauge Emission Current Pressure Values

Emission Current Setting	Default Switch Points
Switch to high emission current (4 mA) with decreasing pressure	1×10^{-5} Torr 6.66×10^{-6} mbar 6.66×10^{-4} pascal
Switch to low emission current (0.02 mA) with increasing pressure	5×10^{-5} Torr 1.33×10^{-5} mbar 1.33×10^{-3} pascal

The switch back to low emission current with increasing pressure is 500% greater than the switch to high emission current with decreasing pressure, as illustrated in Figure 3-4. For example, in default mode, the current level switches from low to high emission at 1×10^{-5} Torr (6.66×10^{-6} mbar, 6.66×10^{-4} pascal), then switches back to low emission at 5×10^{-5} Torr (1.33×10^{-5} mbar, 1.33×10^{-3} pascal).

Figure 3-4Example Emission Current Switch Points



Use the explicit message listed in Table 3-30 to adjust the pressure value at which the Micro-Ion gauge switches from high emission (4.0 mA) to low emission (0.02 mA) with increasing pressure.

Table 3-30 Emission Current Switch Point Command

Service	Class	Instance	Attribute	Typical Master Data	Data Type	Description
10_{hex}	35_{hex}	3	5	AC C5 A7 36_{hex} (5×10^{-6} Torr)		SET emission current switch point, emission ranging (5×10^{-6} Torr)

Use the explicit command listed in Table 3-31 to get the emission current switch point.

Table 3-31 Emission Current Switch Point

Service	Class	Instance	Attribute	Typical Device Data	Data Type	Description
$0E_{hex}$	35_{hex}	3	5	AC C5 A7 36_{hex} (5×10^{-6} Torr)	REAL	GET emission current switch point, emission ranging (5×10^{-6} Torr)

3.12 Reset Module to Power-up State

Use the explicit message listed in Table 3-32 to reset the module to power-up status.

Resetting the module to power-up status has the same effect as cycling power to the module. Communication is re-enabled two seconds after you've sent the explicit message.

Table 3-32 Reset to Power-up State Command

Service	Class	Instance	Attribute	Master Data	Data Type	Description
05_{hex}	1	1	None	None	None	Reset module to power-up state

3.13 Get Firmware Version

Use the explicit messages listed in Table 3-33 to get the firmware version for the module.

Table 3-33 Firmware Version Command

Service	Class	Instance	Attribute	Device Data	Data Type	Description
$0E_{hex}$	1	1	4	01 01	None	Get firmware version

3.14 Get Software and Hardware Revision Levels

Use the explicit messages listed in Table 3-34 to get the software and hardware revision levels for the module.

Table 3-34 Software and Hardware Revision Commands

Service	Class	Instance	Attribute	Device Data	Data Type	Description
$0E_{hex}$	30_{hex}	1	7	"1.01"	SSTRING	Get software revision level
$0E_{hex}$	30_{hex}	1	8	"1.01"	SSTRING	Get hardware revision level

3.15 Factory Defaults

Micro-Ion Modules are shipped with the default settings listed in Table 3-35. If options in your application require settings different from the factory defaults listed in Table 3-35, you may change the settings.

- Some settings can be changed only through the DeviceNet interface.
- You may reconfigure options before or after completing the basic setup procedures described in this chapter.

Table 3-35 Factory Default Settings

Parameter	Default Setting
Digital communication	Baud rate: 500 kbaud
Relay 1 trip point	Disabled
Relay 2 trip point	Disabled
Trip point polarity	• 20% hysteresis • Polarity default set for decreasing pressure
Micro-Ion gauge emission current switch point	• 500% hysteresis • With decreasing pressure: 1×10^{-5} Torr 6.66×10^{-6} mbar 6.66×10^{-4} pascal • With increasing pressure: 5×10^{-5} Torr 1.33×10^{-5} mbar 1.33×10^{-3} pascal
Unit of measure	As specified by the catalog number: • T = Torr • M = mbar • P = pascal

3.16 DeviceNet Error Codes

You may use DeviceNet explicit messages or polled I/O to find out if an alarm or warning has been reported. To select polled I/O or explicit messages, see page 31.

Using Polled I/O

An alarm or warning is indicated by the status byte in the input assembly, instance 2 or instance 5. An alarm is bit weight 1, and a warning is bit weight 5, as listed in Table 3-36.

Table 3-36 Module Alarm and Warning Status for Polled I/O

Instance	BYTE Data: One Byte Format							
2 or 5	Bit 7 0	Bit 6 0	Bit 5 Warning	Bit 4 0	Bit 3 0	Bit 2 0	Bit 1 Alarm	Bit 0 0

Using Explicit Messages

Alarms, warnings, and status messages are available from the objects listed in Table 3-37.

Table 3-37 DeviceNet Explicit Messages Indicating Alarms, Warning, or Status

Object	Service	Class	Instance	Attribute
Identity object	$0E_{hex}$	1	1	5
Device supervisor object	$0E_{hex}$	30_{hex}	1	$0C_{hex}$
Analog sensor object, instance 1, Micro-Ion gauge	$0E_{hex}$	31_{hex}	1	5
Analog sensor object, instance 1, Micro-Ion gauge	$0E_{hex}$	31_{hex}	1	7
Analog sensor object, instance 1, Micro-Ion gauge	$0E_{hex}$	31_{hex}	1	$5F_{hex}$
Analog sensor object, instance 1, Micro-Ion gauge	$0E_{hex}$	31_{hex}	1	60_{hex}

Table 3-38 Status and Fault Information from Identity Object

Service	Class	Instance	Attribute	Typical Device Data	Data Type	Description
$0E_{hex}$	1	1	5	00 00	WORD	Status and fault information
Troubleshooting status and fault information						
Instance	**Attribute**	**Bit**	**Cause**		**Solution**	
1	5	0	An object is allocated		No solution necessary	
1	5	2	Device is configured		No solution necessary	
1	5	8	Low electrometer reading		Module electronics failure or the gauge needs to be degassed	
1	5	11	Unrecoverable fault		Replace the module assembly or send it to the factory for repair	

Table 3-39 Exception Status from Device Supervisor Object

Service	Class	Instance	Attribute	Typical Device Data	Data Type	Description
$0E_{hex}$	30_{hex}	1	$0C_{hex}$	0	BYTE	Get exception status
Troubleshooting Exception Status						
Instance	**Attribute**	**Bit**	**Cause**		**Solution**	
1	$0C_{hex}$	1	Analog sensor alarm		Replace the module assembly or send it to the factory for repair	
1	$0C_{hex}$	5	Low electrometer reading		Module electronics failure or the gauge needs to be degassed	

Table 3-40 Reading Valid, Status, Alarm, and Warning Information from Analog Sensor Object, Instance 1

Service	Class	Instance	Attribute	Typical Device Data	Data Type	Description
$0E_{hex}$	31_{hex}	1	5	1	BOOL	Get reading valid, 0 or 1
$0E_{hex}$	31_{hex}	1	7	0	BYTE	Get status, alarm or warning
$0E_{hex}$	31_{hex}	1	$5F_{hex}$	0	WORD	High-voltage or emission failure
$0E_{hex}$	31_{hex}	1	60_{hex}	0	BYTE	Reading invalid • 0=No solution necessary • 1=Get status from instance 1, attribute 7
Troubleshooting reading valid, status, alarm, and warning information						
Instance	**Attribute**	**Bit**	**Cause**		**Solution**	
1	5	0	Reading is valid, Micro-Ion gauge is ON and operating normally		No solution necessary	
1	7	0	Micro-Ion gauge grid voltage or emission failure		Cycle power to module	
1	$5F_{hex}$	Byte 0, bit 0	Micro-Ion gauge filament 1failure		Switch to filament 2	
1	$5F_{hex}$	Byte 0, bit 1	Micro-Ion gauge filament 2 failure		Switch to filament 1	
1	$5F_{hex}$	Byte 1, bit 2	Micro-Ion gauge high-voltage failure		Cycle power to module	
12	60_{hex}	0	Reading invalid		0=No solution necessary 1=Get status from instance 2, attribute 7	
1	$5F_{hex}$	Byte 1, bit 4	Overpressure shutdown		Reduce system pressure	

3.17 Messaging Summary

This messaging summary lists all of the possible DeviceNet Communications, including I/O and Explicit messages. Required, optional, and device specific objects are included.

Table 3-41 Input I/O (to Master)

Instance	Master Data	Device Data	Data Type	Description	Type
1	None	00 00	UINT	UINT vacuum pressure	Open
2	None	00 00 00	STRUCT	BYTE exception status UINT vacuum pressure	Open
4	None	00 00 00 00	REAL	REAL vacuum pressure	Open
5	None	00 00 00 00 00	STRUCT	BYTE exception status REAL vacuum pressure	Open

Table 3-42 Output I/O (from Master)

Instance	Master Data	Device Data	Data Type	Description	Type
1	00	None	BYTE	Bit 1 = Fi11 enable Bit 2 = Fil 2 enable Bit 5 = Medium emission Bit 6 = Micro-Ion gauge ON Bit 7 = High emission Bit 0 = Degas ON	Vendor

3.18 Explicit Message Summary

Table 3-43 Identity Object

Service	Class	Instance	Attribute	Master Data	Device Data	Data type	Description	Type
$0E_{hex}$	1	1	1	None	00 $5C_{hex}$	UINT	Vendor identification	Open
$0E_{hex}$	1	1	2	None	00 $1C_{hex}$	UINT	Product type	Open
$0E_{hex}$	1	1	3	None	01 00	UINT	354 product ID	Open
$0E_{hex}$	1	1	4	None	01 01	STRUCT	Firmware revision	Open
$0E_{hex}$	1	1	5	None	00 00	WORD	Status and fault information	Open
$0E_{hex}$	1	1	6	None	00 00 00 00	UDINT	Serial number	Open
$0E_{hex}$	1	1	7	None	“GP354”	S_STRING	Identification	Open
05_{hex}	1	1	None	None	None		Reset module to power-up state	Open

Table 3-44 DeviceNet Object

Service	Class	Instance	Attribute	Master Data	Device Data	Data Type	Description	Type
$0E_{hex}$	3	0	1	None	00 02	UINT	Object revision	Open
$0E_{hex}$	3	1	1	None	0	USINT	Get node address, range 0–63	Open
10_{hex}	3	1	1	0	Success		Set node address if switch set to “PGM”	Open
$0E_{hex}$	3	1	2	None	0	USINT	Get baud rate, range 0–2	Open
10_{hex}	3	1	2	0	Success		Set baud rate if switch set to “PGM”	Open
$0E_{hex}$	3	1	3	None	0	BOOL	Get bus-off interrupt, range 0–1	Open
$0E_{hex}$	3	1	4	None	0	USINT	Get bus-off counter, range 0–255	Open
10_{hex}	3	1	4	0	Success		Set bus-off counter	Open
$0E_{hex}$	3	1	5	None	00 00	STRUCT	Get allocation choice, range 0–3 Get master ID, range 0–63	Open
$4B_{hex}$	3	1	None	03 00	Success	STRUCT	Set allocation choice, range 0–3 Set master ID, range 0–63	Open
$4C_{hex}$	3	1	None	3	Success	BYTE	Release allocation, range 0–3	Open

Table 3-45 Assembly Object

Service	Class	Instance	Attribute	Master Data	Device Data	Data Type	Description	Type
$0E_{hex}$	4	0	65_{hex}	None	5	USINT	Get I/O produced instance selection, range 1–20	Vendor
10_{hex}	4	0	65_{hex}	5	Success	USINT	Set I/O produced instance selection, range 1–20	Vendor
$0E_{hex}$	4	0	66_{hex}	None	1	USINT	Get I/O consumed instance selection, range 0 or 1	Vendor
10_{hex}	4	0	66_{hex}	1	Success	USINT	Set I/O consumed instance selection, range 0 or 1	Vendor
$0E_{hex}$	4	1	3	None	00 00	UINT	Get UINT vacuum pressure	Open
10_{hex}	4	2	3	00	Success	STRUCT	Set IG state	Vendor
$0E_{hex}$	4	2	3	None	00 00 00	STRUCT	Get BYTE exception status Get UINT vacuum pressure	Open
$0E_{hex}$	4	4	3	None	00 00 00 00	REAL	Get REAL pressure	Open
$0E_{hex}$	4	5	3	None	00 00 00 00 00	STRUCT	Get BYTE exception status Get REAL vacuum pressure	Open

Table 3-46 Connection Object, Explicit Message Connection

Service	Class	Instance	Attribute	Master Data	Device Data	Data Type	Description	Type
$0E_{hex}$	5	1	1	None	3	USINT	Get state of the object, range 0–5	Open
$0E_{hex}$	5	1	2	None	0	USINT	Get instance type, explicit	Open
$0E_{hex}$	5	1	3	None	83_{hex}	BYTE	Get transport class trigger	Open
$0E_{hex}$	5	1	4	None	FB 05	UINT	Get produced connection ID	Open
$0E_{hex}$	5	1	5	None	FC 05	UINT	Get consumed connection ID	Open
$0E_{hex}$	5	1	6	None	21_{hex}	BYTE	Get initial communication characteristics	Open
$0E_{hex}$	5	1	7	None	18 00	UINT	Get produced connection size	Open
$0E_{hex}$	5	1	8	None	18 00	UINT	Get consumed connection size	Open
0Ehex	5	1	9	None	$C4_{hex}$ 09	UINT	Get expected packet rate, range 0–65535	Open
10_{hex}	5	1	9	00 00	Success	UINT	Set expected packet rate	Open
$0E_{hex}$	5	1	$0C_{hex}$	None	1	USINT	Get watchdog timeout action, 1 or 3	Open
10_{hex}	5	1	$0C_{hex}$	0	Success	UINT	Set watchdog timeout action	Open
$0E_{hex}$	5	1	$0D_{hex}$	None	00 00	UINT	Get produced connection path length	Open
$0E_{hex}$	5	1	$0E_{hex}$	None	4	EPATH	Get produced connection path	Open
$0E_{hex}$	5	1	$0F_{hex}$	None	00 00	UINT	Get consumed connection path length	Open
$0E_{hex}$	5	1	10_{hex}	None	4	EPATH	Get consumed connection path	Open
$0E_{hex}$	5	1	11_{hex}	None	00 00	UINT	Get production inhibit time	Open
05_{hex}	5	1	None	None	Success	None	Reset inactivity/watchdog timer	Open

Table 3-47 Connection Object, I/O Connection

Service	Class	Instance	Attribute	Master Data	Device Data	Data Type	Description	Type
$0E_{hex}$	5	2	1	None	3	USINT	Get state of the object, range 0–5	Open
$0E_{hex}$	5	2	2	None	1	USINT	Get instance type, I/O	Open
$0E_{hex}$	5	2	3	None	82_{hex}	BYTE	Get transport class trigger	Open
$0E_{hex}$	5	2	4	None	FF 03	UINT	Get produced connection ID	Open
$0E_{hex}$	5	2	5	None	FD 05	UINT	Get consumed connection ID	Open
$0E_{hex}$	5	2	6	None	01_{hex}	BYTE	Get initial communication characteristics	Open
$0E_{hex}$	5	2	7	None	05 00	UINT	Get produced connection size	Open
$0E_{hex}$	5	2	8	None	01 00	UINT	Get consumed connection size	Open
$0E_{hex}$	5	2	9	None	00 00	UINT	Get expected packet rate, range 0–65535	Open
10_{hex}	5	2	9	00 00	Success	UINT	Set expected packet rate	Open
$0E_{hex}$	5	2	$0C_{hex}$	None	0	USINT	Get watchdog timeout action	Open
$0E_{hex}$	5	2	$0D_{hex}$	None	06 00	UINT	Get produced connection path length	Open
$0E_{hex}$	5	2	$0E_{hex}$	None	5	EPATH	Set produced connection path length, 1–5 or 15–20	Open
$0E_{hex}$	5	2	$0F_{hex}$	None	06 00	UINT	Get consumed connection path length	Open
$0E_{hex}$	5	2	10_{hex}	None	1	EPATH	Set consumed connection path length, 0 or 1	Open
05_{hex}	5	1	None	None	Success	None	Reset inactivity/watchdog timer	Open

Configuring Polled Output I/O Data Format

The Micro-Ion Module can receive one byte of output data from the network to control the status of the ion gauge. In the default setting, this path does not exist.

Table 3-48 Configuring Polled Output I/O Data Format

Parameter	Service	Class	Instance	Attribute	Data
NULL	10_{hex}	5	2	10_{hex}	None
1 byte structure	10_{hex}	5	2	10_{hex}	20 04 24 01 30 03_{hex}

Table 3-49 Device Supervisor Object

Service	Class	Instance	Attribute	Master Data	Device Data	Data Type	Description	Type
$0E_{hex}$	30_{hex}	1	3	None	"VG"	SSTRING	Get device type, combination gauge	Open
$0E_{hex}$	30_{hex}	1	4	None	"E54-0997"	SSTRING	Get revision level, SEMI S/A standard	Open
$0E_{hex}$	30_{hex}	1	5	None	""	SSTRING	Get manufacturer's name, "GRANVILLE-PHILLIPS"	Open
$0E_{hex}$	30_{hex}	1	6	None	"354XXX"	SSTRING	Get manufacturer's model number	Open
$0E_{hex}$	30_{hex}	1	7	None	"1.01"	SSTRING	Get software revision level	Open
$0E_{hex}$	30_{hex}	1	8	None	"1.01"	SSTRING	Get hardware revision level	Open
$0E_{hex}$	30_{hex}	1	$0B_{hex}$	None	4	USINT	Get device status	Open
$0E_{hex}$	30_{hex}	1	$0C_{hex}$	None	0	BYTE	Get exception status	Open
$0E_{hex}$	30_{hex}	1	$0F_{hex}$	None	0	BOOL	Get alarm enable	Open
10_{hex}	30_{hex}	1	$0F_{hex}$	0	Success		Set alarm enable	
$0E_{hex}$	30_{hex}	1	10_{hex}	None	0	BOOL	Get warning enable	Open
10_{hex}	30_{hex}	1	10_{hex}	0	Success		Set warning enable	
05_{hex}	30_{hex}	1	None	None	Success	None	Reset object service	Open
06_{hex}	30_{hex}	1	None	None	Success	None	Start device execution (No effect on device)	Open
$4B_{hex}$	30_{hex}	1	None	None	Success	None	Abort device activity (No effect on device)	Open
$4C_{hex}$	30_{hex}	1	None	None	Success	None	Recover from abort state (No effect on device)	Open
$4D_{hex}$	30_{hex}	1	None	None	Success	None	Perform diagnostics (No effect on device)	Open

Table 3-50 Analog Sensor Object, Instance 1, Micro-Ion Gauge

Service	Class	Instance	Attribute	Master Data	Device Data	Data Type	Description	Type
$0E_{hex}$	31_{hex}	1	4	None	01 03	UINT	Get pressure unit, 769 = Torr 776 = mbar, 777 = pascal	Open
$0E_{hex}$	31_{hex}	1	5	None	1	BOOL	Get reading valid, 0 or 1	Open
$0E_{hex}$	31_{hex}	1	6	None	00 00 00 00	REAL	Get pressure reading (Value)	Open
$0E_{hex}$	31_{hex}	1	7	None	0	BYTE	Get status, alarm or warning	Open
$0E_{hex}$	31_{hex}	1	$0B_{hex}$	None	CA_{hex}	USINT	Get offset A data type	Open
$0E_{hex}$	31_{hex}	1	$0C_{hex}$	None	00 00 00 00	REAL	Get offset A - an amount added prior to gain to derive value	Open
10_{hex}	31_{hex}	1	$0C_{hex}$	00 00 00 00	Success	REAL	Set offset A - Do Not change this attribute	Open
$0E_{hex}$	31_{hex}	1	$0D_{hex}$	None	CA_{hex}	USINT	Get gain data type	Open
$0E_{hex}$	31_{hex}	1	$0E_{hex}$	None	00 00 00 00	REAL	Get gain - an amount scaled to derive value	Open
10_{hex}	31_{hex}	1	$0E_{hex}$	00 00 00 00	Success	REAL	Set gain - Do Not change this attribute	Open
$0E_{hex}$	31_{hex}	1	$0F_{hex}$	None	00 00 00 00	REAL	Get unity gain resequence - value of gain attribute equal to gain of 1.0	Open
$0E_{hex}$	31_{hex}	1	11_{hex}	None	AC C5 A7 37	REAL	Get alarm trip point high - the ion current value above which an alarm will occur and turn OFF the IG	Open
$0E_{hex}$	31_{hex}	1	23_{hex}	None	00	UINT	Get gas calibration object instance 0 = disabled	Open
$0E_{hex}$	31_{hex}	1	58_{hex}	None	0	BOOL	Get degas state	Open
10_{hex}	31_{hex}	1	58_{hex}	0	Success	BOOL	Set degas state 0 = Degas is OFF, 1 = Degas is ON	Vendor
$0E_{hex}$	31_{hex}	1	59_{hex}	None	0	USINT	Get active filament Bit 01 = filament 1, Bit 02 = filament 2 Bit 03 = both filaments	Open
10_{hex}	31_{hex}	1	59_{hex}	01	Success	USINT	Set active filament Bit 01 = filament 1, Bit 02 = filament 2 Bit 03 = both filaments	Open
$0E_{hex}$	31_{hex}	1	$5A_{hex}$	None	00 00 A0 41	REAL	Get sensitivity - Range 2 to 128 - Default = 20	Open
10_{hex}	31_{hex}	1	$5A_{hex}$	00 00 A0 41	Success	REAL	Set sensitivity	Open
$0E_{hex}$	31_{hex}	1	$5B_{hex}$	None	6F 12 83 3A	REAL	Get emission current Example, 1 mA	Open
10_{hex}	31_{hex}	1	$5B_{hex}$	6F 12 83 3B	Success	REAL	Set emission current 20µA, 1mA, 4mA	Open
$0E_{hex}$	31_{hex}	1	$5D_{hex}$	None	0	BOOL	Get Micro-Ion gauge ON/OFF state	Open
10_{hex}	31_{hex}	1	$5D_{hex}$	0	Success	BOOL	Set Micro-Ion gauge ON/OFF state 0 = Turn gauge OFF 1 = Turn gauge ON	Open
$0E_{hex}$	31_{hex}	1	$5F_{hex}$	None	00 00	UINT	Get sensor alarm	Open
$0E_{hex}$	31_{hex}	1	60_{hex}	None	1	BYTE	Get status extension	Open
$0E_{hex}$	31_{hex}	1	63_{hex}	None	05 00	UINT	Get subclass number	Open
61_{hex}	31_{hex}	1	None	0	Success	USINT	Set degas state 0 = Degas is OFF, 1 = Degas is ON	Open
62_{hex}	31_{hex}	1	None	0	Success	USINT	Set Micro-Ion gauge ON/OFF state 0 = Turn gauge OFF 1 = Turn gauge ON	Open
63_{hex}	31_{hex}	1	None	None	Success	None	Clear emission OFF alarm	Open

Table 3-51 S-Gas Calibration Object

Service	Class	Instance	Attribute	Master Data	Device Data	Data Type	Description	Type
$0E_{hex}$	34_{hex}	1	3	None	$0D_{hex}$	UINT	Gas type number	Open
$0E_{hex}$	34_{hex}	1	4	None	1	UINT	S-Analog Sensor object instance ID for which this object instance is valid.	Open

Gas Standard Number

Used to identify a gas standard number, for which the object instance is currently calibrated. See Instance Application Example below.

The actual coding of the values are described in the following publication:

See introduction section for reference to “Practice for Referencing Gases Used in Digital Mass Flow Controllers”.

Common Services

The S-Gas Calibration Object provides the following Common Services:

Table 3-52 Common Services

Service Code	Service Name	Description of Service
14 (0Ex)	Get_Attribute_Single	Returns the contents of the specified attribute.
16 (10x)	Set_Attribute_Single	Modifies an attribute value.

See the DeviceNet Communication Model and Protocol for definitions of these common services.

Object-Specific Services

Table 3-53 Object Specific Services

Service Code	Service Name	Description of Service
4BX	Get All Instances	Return numbers of gas calibration (0) since this is the only one.

Table 3-54 Trip Point Object, Instance 1, Relay 1

Service	Class	Instance	Attribute	Master data	Device data	Data Type	Description	Type
$0E_{hex}$	35_{hex}	1	5	None	00 00 00 00	REAL	Get pressure at which relay 1 activates	Open
10_{hex}	35_{hex}	1	5	00 00 00 00	Success	REAL	Set pressure at which relay 1 activates	Open
$0E_{hex}$	35_{hex}	1	6	None	0	BOOL	Get relay 1 enabled/disabled status 0 = Relay 1 is disabled 1 = Relay 1 is enabled	Open
10_{hex}	35_{hex}	1	6	0	Success	BOOL	Set relay 1 enabled/disabled status	Open
$0E_{hex}$	35_{hex}	1	7	None	0	BOOL	Get relay 1 activation/deactivation status 0 = Relay 1 is deactivated 1 = Relay 1 is activated	Open
$0E_{hex}$	35_{hex}	1	8	None	0	BOOL	Get relay 1 polarity 0 = Activate with decreasing pressure 1 = Activate with increasing pressure	Open
10_{hex}	35_{hex}	1	8	0	Success	BOOL	Set relay 1 polarity	
$0E_{hex}$	35_{hex}	1	9	None	0	USINT	Get override status 0 = Normal 2 = Force false	Open
$0E_{hex}$	35_{hex}	1	$0A_{hex}$	None	00 00 00 00	REAL	Get relay 1 hysteresis as a percentage of pressure.	Open
10_{hex}	35_{hex}	1	$0A_{hex}$	0	Success	REAL	Set relay 1 hysteresis	Open
$0E_{hex}$	35_{hex}	1	$0C_{hex}$	None	24 01	EPATH	Get destination path, 01	Open
$0E_{hex}$	35_{hex}	1	$0D_{hex}$	None	0	BOOL	Get output to output object	Open
$0E_{hex}$	35_{hex}	1	$0E_{hex}$	None	24 00	EPATH	Get source path from analog object	Open
$0E_{hex}$	35_{hex}	1	$0F_{hex}$	None	00 00 24 00	REAL	Get input data from analog sensor object	Open
$0E_{hex}$	35_{hex}	1	11_{hex}	None	CA_{hex}	USINT	Get data type, CA_{hex}	Open

Table 3-55 Trip Point Object, Instance 2, Relay 2

Service	Class	Instance	Attribute	Master Data	Device Data	Data Type	Description	Type
$0E_{hex}$	35_{hex}	2	5	None	00 00 00 00	REAL	Get pressure at which relay 2 activates	Open
10_{hex}	35_{hex}	2	5	00 00 00 00	Success	REAL	Set pressure at which relay 2 activates	Open
$0E_{hex}$	35_{hex}	2	6	None	0	BOOL	Get relay 2 enabled/disabled status 0 = Relay 2 is disabled 1 = Relay 2 is enabled	Open
10_{hex}	35_{hex}	2	6	0	Success	BOOL	Set relay2 enabled/disabled status	Open
$0E_{hex}$	35_{hex}	2	7	None	0	BOOL	Get relay 2 activation/deactivation status 0 = Relay 2 is deactivated 1 = Relay 2 is activated	Open
$0E_{hex}$	35_{hex}	2	8	None	0	BOOL	Get relay 2 polarity 0 = Activate with decreasing pressure 1 = Activate with increasing pressure	Open
10_{hex}	35_{hex}	2	8	0	Success	BOOL	Set relay 2 polarity	Open
$0E_{hex}$	35_{hex}	2	9	None	0	USINT	Get override status 0 = Normal 2 = Force false	Open
$0E_{hex}$	35_{hex}	2	$0A_{hex}$	None	00 00 00 00	REAL	Get relay 2 hysteresis as a percentage of pressure.	Open
10_{hex}		2	$0A_{hex}$	0	Success	REAL	Set relay 2 hysteresis	Open
$0E_{hex}$	35_{hex}	2	$0C_{hex}$	None	24 02	EPATH	Get destination path, 01	Open
$0E_{hex}$	35_{hex}	2	$0D_{hex}$	None	0	BOOL	Get output to output object	Open
$0E_{hex}$	35_{hex}	2	$0E_{hex}$	None	24 00	EPATH	Get source path from analog object	Open
$0E_{hex}$	35_{hex}	2	$0F_{hex}$	None	00 00 24 00	REAL	Get input data from analog sensor object	Open
$0E_{hex}$	35_{hex}	2	11_{hex}	None	CA_{hex}	USINT	Get data type, CA_{hex}	Open

Table 3-56 Trip Point Object, Instance 3, Emission Range

Service	Class	Instance	Attribute	Master Data	Device Data	Data Type	Description	Type
$0E_{hex}$	35_{hex}	3	5	None	38 D1 B7 17_{hex}	REAL	GET trip point value emission ranging ($5E^{-6}$)	Open
10_{hex}	35_{hex}	3	5	38 D1 B7 17_{hex}	Success	REAL	SET trip point value, emission ranging ($5E^{-6}$)	Open
$0E_{hex}$	35_{hex}	43	6	None	0	BOOL	GET trip point enable, emission ranging	Open
$0E_{hex}$	35_{hex}	3	7	None	0	BOOL	GET trip point status, emission ranging	Open
$0E_{hex}$	35_{hex}	3	9	None	0	USINT	GET override status, 0 = normal, 1 = force false	Open
$0E_{hex}$	35_{hex}	3	$0C_{hex}$	None	24 04	EPATH	GET destination path, 01, 02, or 03	Open
$0E_{hex}$	35_{hex}	3	$0D_{hex}$	None	0	BOOL	GET output to output object	Open
$0E_{hex}$	35_{hex}	3	$0E_{hex}$	None	24 02	EPATH	GET source path from analog object	Open
$0E_{hex}$	35_{hex}	3	$0F_{hex}$	None	00 00 00 00	REAL	GET REAL pressure data from analog sensor object ($5E^{-6}$)	Open
$0E_{hex}$	35_{hex}	3	11_{hex}	None	CA_{hex}	USINT	GET data type, CA_{hex} or $C3_{hex}$	Open

Chapter 4 Service & Maintenance

4.1 Service & Maintenance 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.

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

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 Granville-Phillips 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 Granville-Phillips, 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

If any of the conditions described above have occurred, troubleshooting is required to determine the repairs that are necessary.

Precautions

Because the module contains static-sensitive electronic parts, follow these precautions while troubleshooting:

- Use a grounded, conductive work surface. Wear a high impedance ground strap for personal protection.
- Do not operate the module 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.
- Rely on voltage measurements for troubleshooting module circuitry. Do not use an ohmmeter.
- Use a grounded, electrostatic discharge safe soldering iron.

Table 4-1 Failure Symptoms, Causes, and Solutions

Symptom	Possible Causes	Solution
Pressure reading is too high.	Plumbing to module leaks or is contaminated. Chamber pressure is too high due to leak, contamination, or pump failure. Power supply or output cable is improperly connected or faulty.	If plumbing leaks or is contaminated, clean, repair or replace plumbing. If pump failed, repair or replace it. If cable is improperly connected or faulty, repair or replace cable (see page 23).
Pressure reading is inaccurate.	Micro-Ion gauge is contaminated. Micro-Ion gauge is damaged (for example, by reactive gas) or contaminated. Temperature or mechanical vibration is extreme.	If Micro-Ion gauge is contaminated, degas the gauge or replace gauge assembly. If temperature or vibration is extreme, relocate module or eliminate source of heat or vibration.
Indicated pressure is different than pressure indications from other measurement devices.	Micro-Ion gauge is defective	Replace the gauge assembly.
Module LED status indicator is solid Red.	A fault caused the Module to stop reading pressure.	See the DeviceNet Error Codes in Section 3.16 DeviceNet Error Codes on page 44.
Relay will not activate	The set point not programmed. A circuit board is faulty.	See Section 3.10 Process Control Relays on page 35. Return module to factory.

4.4 DeviceNet Error Codes

You may use DeviceNet explicit messages or polled I/O to find out if an alarm or warning has been reported. To select polled I/O or explicit messages, see pages 32 - 33.

4.5 Ion Gauge Continuity Test and Replacement

WARNING

High Voltage

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

Do not touch any gauge pins while the gauge tube is under vacuum or connected to a controller.

WARNING

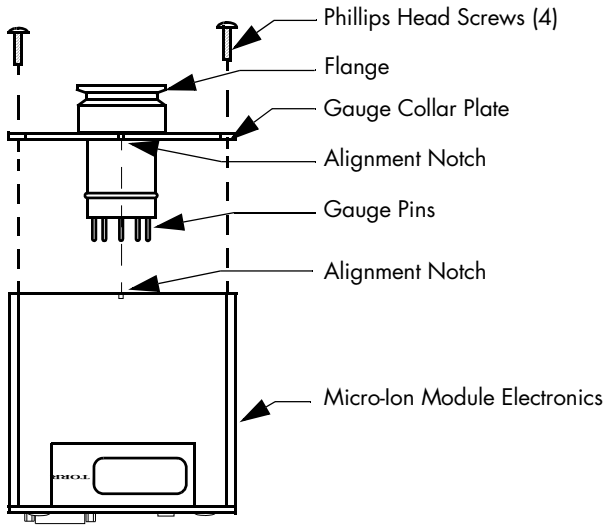
High Voltage

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.

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.

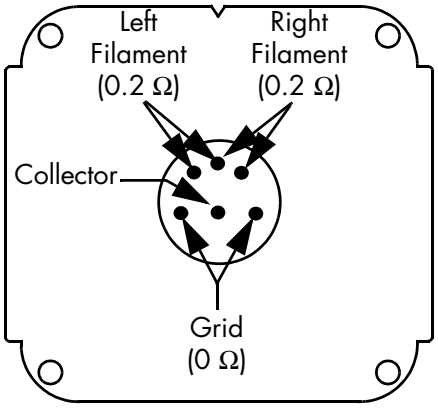
1. Turn OFF power to the module.
2. Disconnect the cables from the module.
3. Remove the Micro-Ion Module from the vacuum system.
4. Remove the four Phillips head screws from the gauge collar plate as shown in Figure 4-1.

Figure 4-1 Micro-Ion Gauge Disassembly/Reassembly



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. Using a digital multimeter, measure the resistance of the left filament and the right filament between filament pins as shown in Figure 4-2. The reading should be approximately 0.2 Ω.

Figure 4-2 Micro-Ion Gauge Continuity Check



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 a Granville-Phillips Customer Service Representative to order a replacement gauge. See Section 4.1 Service & Maintenance Guidelines on page 57 at the beginning of this chapter.

To Reassemble the Micro-Ion Gauge/Module

If the continuity check proves that the gauge is good, reassemble the gauge/module as outlined below.

If replacement of the gauge is necessary, install the replacement gauge as outlined below.

NOTE: 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 the replacement gauge from its inner bag until you are ready to install it and connect the module to the vacuum system. Avoid contaminating the 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.

1. Align the notches on the replacement gauge collar plate and the Micro-Ion Vacuum Gauge Module as shown in Figure 4-1.
2. *Gently* insert the replacement gauge and collar plate into the Micro-Ion Vacuum Gauge Module until the tube pins are inserted into the tube socket.
3. Insert and tighten all four Phillips head screws.
4. Install the Micro-Ion Vacuum Gauge Module onto the vacuum system.
5. Connect the cables to the Module.
6. Turn ON power and verify communication to the Micro-Ion Vacuum Gauge Module.

4.6 Service Guidelines

Notice

Return Policy

The Micro-Ion Gauge cannot be returned to Granville-Phillips 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 1-303-652-4400 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. Shipping damage on 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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Tel: 303-652-4400
Fax: 303-652-2844
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List of Tables

Series 354

Granville-Phillips® Series 354 Micro-Ion® Vacuum Gauge Module with DeviceNet™

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Instruction Manual

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