Micro-Ion® Plus Module
With DeviceNet™ Protocol

GRANVILLE-PHILLIPS®
HELIX TECHNOLOGY CORPORATION

Instruction Manual

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Micro-Ion® Plus Module With DeviceNet™ Protocol

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Instruction Manual

Contents

Chapter 1 Before You Begin

1.1 About these instructions

These instructions explain how to install, operate, and maintain the Granville-Phillips® Micro-Ion® Plus vacuum gauge module. The module contains a Micro-Ion ionization gauge and a Conductron® heat-loss sensor, which working in combination provide pressure measurement from 1 x 10^{-9} to atmosphere.

- *This chapter* explains caution and warning statements, which must be adhered to at all times; explains your responsibility for reading and following all instructions; defines terms that are used throughout this manual; and tells you how to contact customer service.
- *Chapter 2* explains how to install the module.
- *Chapter 3* explains how to operate the module.
- *Chapter 4* explains how to read DeviceNet alarms and warning messages.
- *Chapter 5* explains troubleshooting; Micro-Ion gauge testing, removal and replacement; and module return procedures.
- *Appendix A* provides specifications for the module.
- *Appendix B* explains terminology and explains how the Micro-Ion gauge and Conductron heat-loss sensor measure pressure.
- *Appendix C* summarizes DeviceNet polled I/O and explicit messages.

1.2 Caution and warning statements

This manual contains caution and warning statements with which you *must* comply to prevent inaccurate measurement, property damage, or personal injury.

CAUTION

Caution statements alert you to hazards or unsafe practices that could result in minor personal injury or property damage.

Each caution statement explains what you must do to prevent or avoid the potential result of the specified hazard or unsafe practice.

⚠ WARNING

Warning statements alert you to hazards or unsafe practices that could result in severe property damage or personal injury due to electrical shock, fire, or explosion.

Each warning statement explains what you must do to prevent or avoid the potential result of the specified hazard or unsafe practice.

Caution and warning statements comply with American Institute of Standards Z535.1-2002 through Z535.5-2002, which set forth voluntary practices regarding the content and appearance of safety signs, symbols, and labels.

Each caution or warning statement explains:

a. The specific hazard that you *must* prevent or unsafe practice that you *must* avoid,

b. The potential result of your failure to prevent the specified hazard or avoid the unsafe practice, and

c. What you *must* do to prevent the specified hazardous result.

1.3 Reading and following instructions

You must comply with all instructions while you are installing, operating, or maintaining the module. Failure to comply with the instructions violates standards of design, manufacture, and intended use of the module. Granville-Phillips and Helix Technology Corporation disclaim all liability for the customer's failure to comply with the instructions.

- *Read instructions* – Read all instructions before installing or operating the product.
- *Retain instructions* – Retain the instructions for future reference.
- *Follow instructions* – Follow all installation, operating and maintenance instructions.
- *Heed warnings and cautions* – Adhere to all warnings and caution statements on the product and in these instructions.
- *Parts and accessories* – Install only those replacement parts and accessories that are recommended by Helix Technology. Substitution of parts is hazardous.

1.4 Definitions of terms

Table 1-1 lists terms describing the Micro-Ion Plus module and its components.

Table 1-2 lists terms describing DeviceNet protocol.

Table 1-3 lists terms describing DeviceNet data types.

Table 1-1 Terms describing Micro-Ion Plus module and components

Term	Description
Module	The Micro-Ion Plus module, which contains a hot filament Micro-Ion gauge (Bayard-Alpert type ionization gauge) and a Conductron heat-loss sensor.
Micro-Ion gauge	The Bayard-Alpert type ionization gauge, which indicates pressure by producing a current that is proportional to gas density.
Conductron sensor	The heat-loss sensor, which measures pressure as a function of heat loss through the gold-plated tungsten sensing wire.
Device	The Micro-Ion Plus module or another node in the network.

Table 1-2 Terms describing 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 Plus 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 Plus 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 Plus module or another node on the network. The module supports BOOL, BYTE, SSTRING, REAL, INT, UINT, USINT, EPATH, and WORD data types.
BOOL data	Data consisting of a single ON/OFF bit, where 1 = ON (true), 0 = OFF (false).
BYTE data	Data consisting of an 8-bit string, from most significant to least significant bit.
STRUCT data	Data consisting of a string of bits, each of which can be set to ON (true) = 1 or OFF (false) = 0.
SSTRING data	Data consisting of a character string, one byte per character, with one byte length indicator.
REAL data	Data consisting of a 32-bit floating point value in single precision IEEE 754 format.
INT data	Data consisting of a 2-byte (16-bit) integer value from –32768 to +32767.
UINT data	Data consisting of a 16-bit unsigned integer value from 0 to 655351.
USINT data	Data consisting of an 8-bit unsigned integer value from 0 to 255.
EPATH	Data consisting of a DeviceNet path segments requiring abstract syntax encoding.
WORD data	Data consisting of a 16-bit ASCII character string.

1.5 Customer service

For customer service:

- Phone **1–800–776–6543** within the U.S.A.
- Email *custserv@helixtechnology.com*.

Chapter 2 Installation

2.1 Module components

The Micro-Ion Plus module contains a a Micro-Ion gauge (Bayard-Alpert type ionization gauge) and a Conductron heat-loss sensor.

⚠ WARNING

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.

⚠ WARNING

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.

2.2 Installation procedure

The module installation procedure includes the following steps:

1. Installing appropriate pressure relief devices in the vacuum system.
2. Locating the module.
3. Attaching the module vacuum chamber fitting to its mate on the vacuum chamber.
4. Assembling and connecting module wiring.
5. Calibrating the Conductron sensor at atmospheric pressure.

This chapter also explains what to do if radio frequency interference (RFI) disrupts operation of the module.

Step 1 *Install pressure relief devices*

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

Helix Technology 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**
>
> **Operating the module above 1000 Torr (1333 mbar, 133 kPa) true pressure could cause pressure measurement error or product failure.**
>
> To avoid measurement error or product failure due to overpressurization, install pressure relief valves or rupture disks in the system if pressure exceeds 1000 Torr (1333 mbar, 133 kPa).

Step 2 *Locate the module*

To locate the module, refer to Figure 2-1 and Table 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 85 °C (185 °F) non-operating. Bakeout temperature for the Micro-Ion gauge and Conductron sensor, removed from the module, is 150 °C (302 °F).
- 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 normal vacuum chamber 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 Dimensions

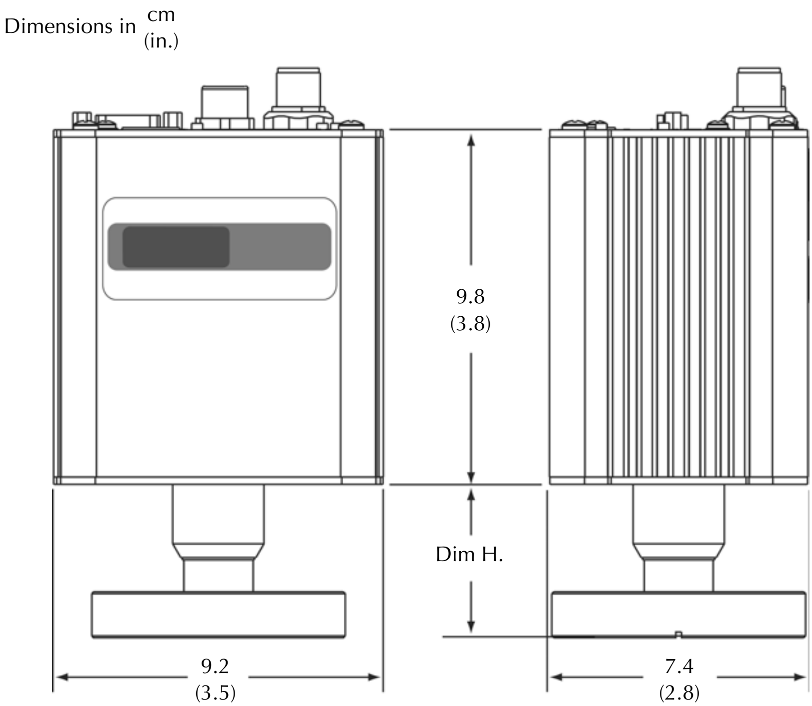
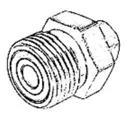
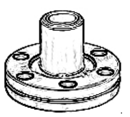


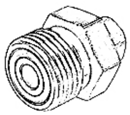
Table 2-1 Fittings for Micro-Ion Plus module

Fitting		Dim. H	
		cm	in.
	½–inch VCR-type male	5.8	2.3
	NW16KF	2.0	0.8
	NW25KF	2.0	0.8
	NW40KF	2.0	0.8
	1.33–inch (NW16CF) ConFlat	4.3	1.7
	2.75–inch (NW35CF) ConFlat	4.3	1.7

Step 3 *Attach module to vacuum chamber*

Attach the module vacuum chamber fitting to its mate on the vacuum chamber.

> **⚠ CAUTION**
>
> **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

a. Remove the plastic or metal bead protector cap from the fitting.

b. If a gasket is used, place the gasket into the female nut.

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

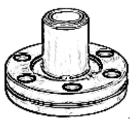
d. While holding a back-up wrench stationary, tighten the female nut 1/8 turn past finger-tight on 316 stainless steel or nickel gaskets, or 1/4 turn past finger-tight on copper or aluminum gaskets. *Do not twist the module to tighten the fitting*.

NW flange

The NW 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 stainless steel with OFHC copper gasket. Avoid scratching the seal surfaces.

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. Further tighten each bolt about 1/16 turn.

Step 4 *Assemble and connect wiring*

Connecting cable

Cable is user-supplied. Helix Technology does not supply cable. Install externally shielded cable. The DeviceNet connection is a standard 5-pin DeviceNet receptacle that accepts a standard micro 5-pin female cable connection.

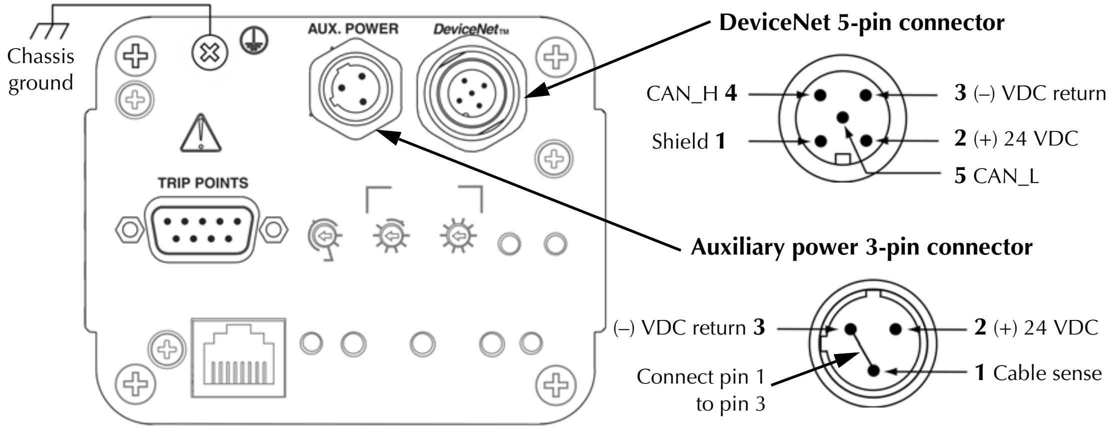
Power supply and DeviceNet wiring

The Micro-Ion Plus module can be powered through the 5-pin micro connector or the 3-pin auxiliary power connector and the 5-pin connector. Figure 2-2 illustrates the connectors.

- The module requires 24 VDC ±15% (1.5 A current at 20.4 V), 3.0 A current at 30 W peak.
- Inrush current can momentarily exceed the 3.0 A peak.
- Typical module operating power is 18 W for 4 mA emission when the Micro-Ion gauge is ON.
- Power inputs are reverse-bias protected.

To minimize amperage requirements on the DeviceNet network, connect a 24 VDC power supply to the 3-pin auxiliary power connector. Pin 1 (cable sense) must be connected to pin 3 (VDC return). With power supplied through the auxiliary power connection, the module will use the auxiliary power supply to operate the Micro-Ion gauge, and will use the DeviceNet power supply for network communication.

Figure 2-2 DeviceNet interface 5-pin micro connector and auxiliary power connector



DeviceNet 5-pin micro connector

The module has a DeviceNet 5-pin micro connector for interfacing through the customer supplied DeviceNet network cable.

Table 2-2 lists current requirements if the power supply is connected only to the 5-pin DeviceNet connector.

Table 2-2 Current requirements for module powered through the 5-pin DeviceNet connector

Connector (5-pin DeviceNet or 3-pin power)	Surge current	Operating current during Micro-Ion gauge degas	Operating current with Micro-Ion gauge ON, no degas	Input voltage from external power supply
DeviceNet	3 A	1.1 A	0.94 A	27.6 VDC
DeviceNet	3 A	1.5 A	1 A	20.4 VDC

Auxiliary power 3-pin connector

To minimize amperage requirements on the DeviceNet network, connect a 24 VDC power supply to the 3-pin auxiliary power connector. With power supplied through the auxiliary power connection, the module will use the auxiliary power supply to operate the Micro-Ion gauge, and will use the DeviceNet power supply for network communication.

To ensure adequate power for the Micro-Ion gauge, connect the wire for pin 1 (cable sense) in the power supply cable to the wire for pin 3 (–VDC return). Otherwise, the module will draw all power for the module from the DeviceNet power supply.

Table 2-3 lists current requirements if the power supply is connected to the 3-pin auxiliary connector.

If power to the auxiliary connection is interrupted or disconnected, the gauge ON command will fail and an error will be reported on the network.

Do not connect the auxiliary power supply return (–VDC return) to ground. Grounding the power supply return violates DeviceNet grounding requirements.

Table 2-3 Current requirements for module powered through the 3-pin power connector

Connector (5-pin DeviceNet or 3-pin power)	Operating current during degas	Operating current with Micro-Ion gauge ON, no degas	Input voltage from external power supply
DeviceNet	0.14 A	0.14 A	26 VDC
DeviceNet	0.3 A	0.3 A	11 VDC
Power	1 A	0.55 A	27.6 VDC
Power	1.35 A	1.2 A	20.4 VDC

Helix Technology offers an auxiliary 24 VDC power supply with the 3-pin micro connector. Table 2-4 lists catalog numbers and descriptions of the four available versions.

Table 2-4 Power-supply catalog numbers and descriptions

Catalog Number	Description
347039–1	North America, 115 VAC power cord
347039–2	North America, 220 VAC power cord
347039–3	Universal European, 220 VAC power cord
347039–4	United Kingdom, 240 VAC power cord

Trip point relay wiring

The module has two trip point relays. The contacts are silver alloy-gold clad, rated for 1 A at 30 VDC. The relays can handle resistive or non-inductive loads.

- Figure 2-3 illustrates the 9-pin trip point connector.
- Table 2-5 lists pin connections for the 9-pin male D connector.

Figure 2-3 Trip point relay 9-pin connector

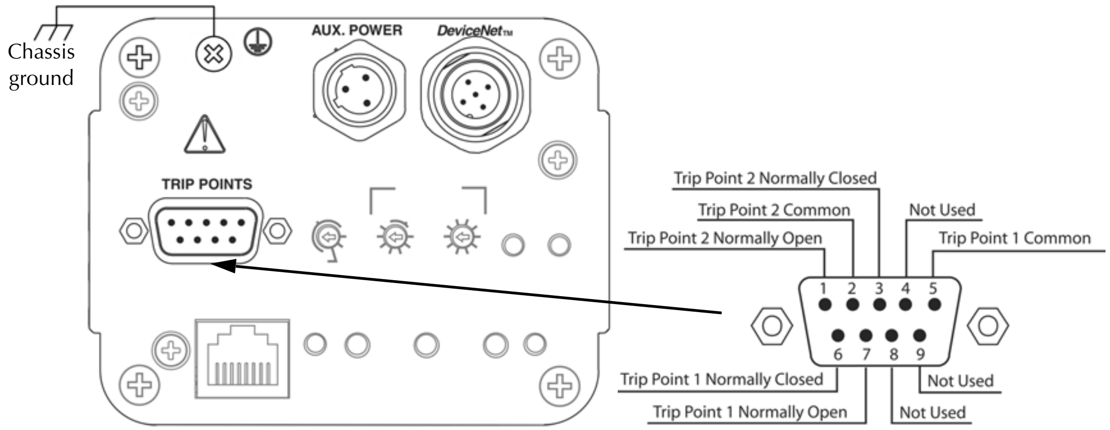


Table 2-5 Trip point relay 9-pin connector pins

Pin number	Function	Input/output	Voltage level
These voltage levels apply ONLY for resistive or non-inductive loads.			
Pin 1	Relay 2: Normally open	Output	0 to 30 VDC, 1 A
Pin 2	Relay 2: Common	Output	0 to 30 VDC, 1 A
Pin 3	Relay 2: Normally closed	Output	0 to 30 VDC, 1 A
Pin 4	Not used		No connection
Pin 5	Relay 1: Common	Output	0 to 30 VDC, 1 A
Pin 6	Relay 1: Normally closed	Output	0 to 30 VDC, 1 A
Pin 7	Relay 1: Normally open	Output	0 to 30 VDC, 1 A
Pin 8	Not used		No connection
Pin 9	Not used		No connection

Grounding

The module contains two separate and isolated grounds: the DeviceNet ground and the chassis ground. Figure 2-4 illustrates the DeviceNet (VDC return) and chassis ground connections.

- Typical isolation between the two grounds is 1 mΩ, up to 26 VDC, if the DeviceNet drain is grounded.
- Above 30 Vdc the isolation approaches 0 Ω.
- The module generates 180 VDC during normal operation and 250 VDC during Micro-Ion gauge degas.

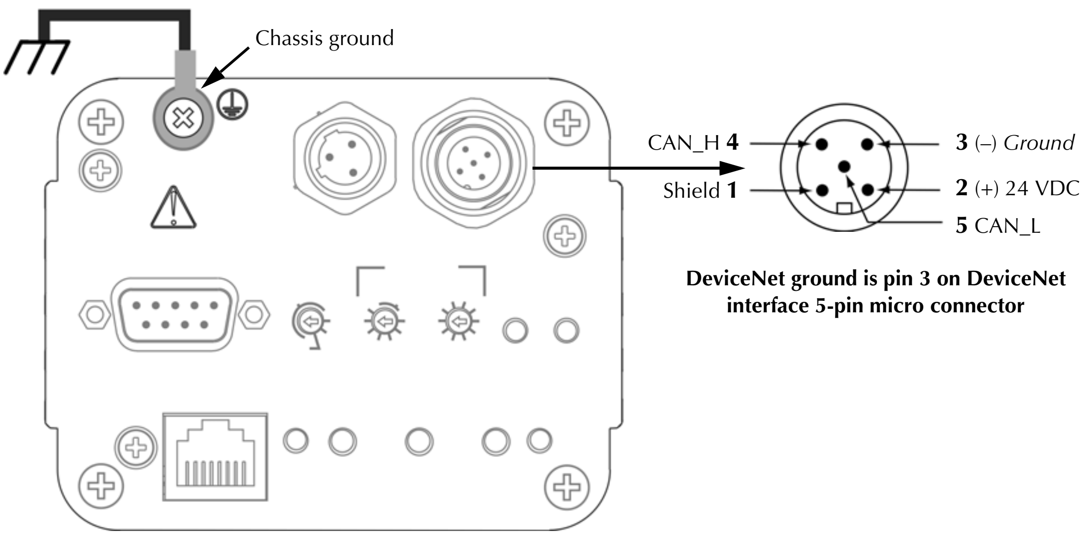
⚠ WARNING

Improper grounding could cause severe product failure or personal injury.

Follow ground network requirements for the facility.

- Maintain all exposed conductors at earth ground.
- Ground the module chassis and DeviceNet wiring as illustrated below.
- Make sure the vacuum port to which the module is mounted is properly grounded.

Figure 2-4 DeviceNet and chassis ground connections



Step 5 *Calibrate the Conductron sensor at atmospheric pressure*

To calibrate the Conductron sensor at atmospheric pressure, see page 45.

An atmospheric calibration is performed on the Conductron sensor, using room-temperature air, at the factory before the module is shipped. The factory calibration sets the atmospheric calibration point to approximately 635 Torr (846 mbar, 84.6 kPa).

Because atmospheric pressure varies according to location, you should set the atmospheric calibration point before putting the module into operation. Periodic resets of the atmospheric calibration point also improve the accuracy and repeatability of the Conductron sensor.

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 and, if not installed and used in accordance with the instructions in this manual, may cause harmful interference to radio and television communications. However, there is no guarantee that interference will not occur in a particular installation. If operating the module in a residential area causes interference, the customer will be required to eliminate the interference at the customer's own expense. If the module causes interference to radio or television reception, which can be determined by turning the module OFF and ON, use one of the following methods to eliminate the interference:

- Reorient or relocate the receiving antenna.
- Increase the separation between the module and the receiver.
- Connect the module into an outlet on a circuit that is *not* the circuit to which the receiver is connected.
- Consult an experienced radio or television technician for help.

Chapter 3 Operation

3.1 Performance with DeviceNet protocol

Table 3-1 lists performance characteristics for the Micro-Ion Plus module using DeviceNet protocol.

Table 3-1 Micro-Ion Plus 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)	

3.2 DeviceNet protocol for the Micro-Ion Plus module

The Micro-Ion Plus module is based on the Open DeviceNet Vendors Association (ODVA) and S-Analog Sensor Object Class Subclass 01 (Instance Selector) standards. The Micro-Ion Plus 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 Micro-Ion Plus 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 *Appendix C*. The instructions in this chapter explain how to use the Micro-Ion Plus module command set to operate the module. For information about DeviceNet programming, see the Helix Technology DeviceNet Programmer's Guide. To obtain the programmer's guide:

- Phone **1–303–652–4400** or **1–800–776–6543** within the U.S.A.
- Email *custserv@helixtechnology.com*.
- Visit the Helix Technology website at *www.helixtechnology.com*.

DeviceNet protocol conveys two types of messages, as defined in Table 3-2.

Table 3-2 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
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

3.3 DeviceNet switches and indicators

The 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.

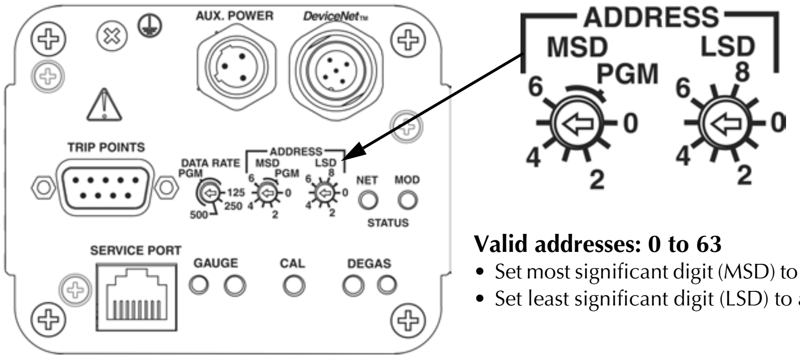
- Set the switch on the left, labeled “MSD,” to a value of 0 to 6 for the most significant (first) digit.
- Set the switch on the right, labeled “LSD,” to a value of 0 to 9 for the least significant (second) digit.

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 and the NET status indicator will turn red.
- 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. When the connection is established and everything is working properly, the net status indicator will turn solid green.

Figure 3-1 Address switches



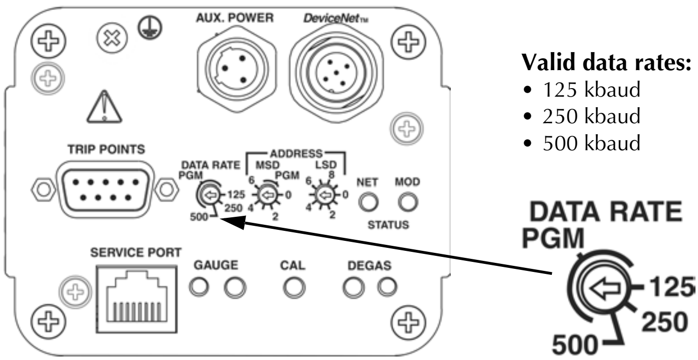
Data rate switch

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

- You may select a data rate of 125, 250, or 500 kbaud.
- When the device powers up or is reset by the network, the device firmware will read the data 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 data rate switch is set to the PGM setting, the firmware will use the data rate that is stored in NVRAM.

Figure 3-2 Data rate switch



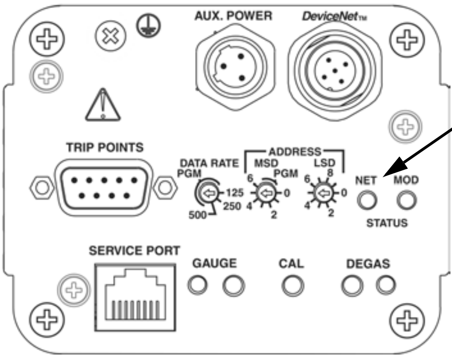
3.4 Status LEDs

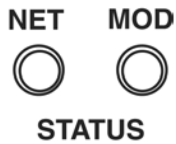
Figure 3-3 illustrates the two status LEDs, labeled NET and MOD.

- 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 3-3 and Table 3-4 list states for each LED and the corresponding network or module status.

Figure 3-3 Network and module status LEDs





- MOD status LED indicates if module has power or is functioning properly
- NET status LED indicates if network has power or is functioning properly

Table 3-3 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
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 3-4 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

3.5 DeviceNet communication configuration

1. Turn the external power supply OFF.
2. Set the address switches to the desired address (0 to 63). See page 18.
3. Set the data rate switch to the desired setting (125, 250, or 500 kbaud). See page 19.
4. Turn the external power supply ON.
5. Refer to Table 3-5 and Table 3-6 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 3-5 Network master connection

Function	Service	Class	Instance	Attribute	STRUCT data: Allocation choice bits	Master ID
Connection	$4B_{hex}$	3	1	None	0 = Explicit message 1 = Polled 2 = Bit strobed 3 = Reserved[a] 4 = Change of state[b] 5 = Cyclic[b] 6 = Acknowledge suppression[a] 7 = Connection[a]	0 to 63

[a] Not supported, value = 0.
[b] Supported, but value should always = 0 to perform tasks explained in this chapter.

Table 3-6 Network master connections allocation choice bits

Assembly number	STRUCT data: One byte format							
1	Bit 7 Connection	Bit 6 Acknowledge suppression	Bit 5 Cyclic	Bit 4 Change of state	Bit 3 Reserved	Bit 2 Bit strobed	Bit 1 Polled	Bit 0 Explicit message

Operation

6. Refer to Table 3-7 to configure the expected packet rate for DeviceNet 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 DeviceNet 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 3-7 Expected packet rate

Expected packet rate for explicit messaging

Function	Service	Class	Instance	Attribute	UINT data
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)	10_{hex}	5	1	9	2500 msec; *UINT data such as* 09 $C4_{hex}$ (default)

Expected packet rate for polled I/O

Function	Service	Class	Instance	Attribute	UINT data
Disable expected packet rate	10_{hex}	5	2	9	0

7. *If the connection allocation bit 1 (polled) is set at Step 5 on page 21,* refer to Table 3-8 to configure the polled data input format and status byte and to Table 3-9 to configure the polled data output format.

- You may configure the module to send data to the network in integer (INT) or floating point data (REAL) formats, with or without a status data byte.
- The default configuration sends pressure in floating point data format with one byte of status data.

Table 3-8 Configuring polled input I/O data format

Format	Service	Class	Instance	Attribute	UINT data
Default configuration: • 1 BYTE status • 4 bytes REAL pressure	10_{hex}	5	2	$0E_{hex}$	20 04 24 **05** 30 03 $_{hex}$
4 bytes REAL pressure	10_{hex}	5	2	$0E_{hex}$	20 04 24 **04** 30 03 $_{hex}$
• 1 BYTE status • 2 bytes INT pressure	10_{hex}	5	2	$0E_{hex}$	20 04 24 **02** 30 03 $_{hex}$
2 bytes INT pressure	10_{hex}	5	2	$0E_{hex}$	20 04 24 **01** 30 03 $_{hex}$

Table 3-9 Configuring polled output I/O data format

Format	Service	Class	Instance	Attribute	UINT data
1 BYTE control (default)	10_{hex}	5	2	10_{hex}	20 04 24 **01** 30 03 $_{hex}$
0 BYTE control	10_{hex}	5	2	10_{hex}	20 04 24 **00** 30 03 $_{hex}$

8. *If the connection allocation bit 1 (polled) is set at Step 5*, you may configure the module to receive one byte of input data that controls the Micro-Ion gauge, as listed in Table 3-10.
   - The default setting in the one byte format is bit 1, which should always be set to 0 (zero). The input data will not control gauge or sensor status.
   - Bit 6 in the one byte format turns the Micro-Ion gauge ON or OFF. If bit 6 is set to 1, the gauge and sensor will turn ON. See Table 3-11.

Table 3-10 Writing gauge and sensor ON/OFF bits

Assembly number	USINT data: One byte format							
1	Bit 7 0	Bit 6 Gauge ON or OFF	Bit 5 0	Bit 4 0	Bit 3 0	Bit 2 0	Bit 1 0	Bit 0 Initiate or terminate Micro-Ion gauge degas

Table 3-11 Gauge and sensor ON/OFF bits

Bit	Gauge control function	Description
Bits 0, 1, 2, 3, 4, 5, and 7	Reserved	Must be set to 0 (zero)
Bit 6	Micro-Ion gauge ON/OFF	• If bit 6 is set to 1, gauge will turn ON • If a fault occurs, gauge will turn OFF and an alarm will generate (see page 49) • After the alarm has been cleared, set this bit to 0, then reset to 1 to restart gauge

3.6 Communication options

You have four options for accessing data from or communicating data to the module: explicit messages, polled I/O, the optional numeric display, or buttons and LEDs on the control panel.

For a complete list of DeviceNet messages used by the module, see *Appendix C*.

Explicit messages

If the connection allocation bit 0 (explicit message) is set at Step 5 on page 21, you may use DeviceNet explicit messages to perform these functions:

- Turning the Micro-Ion gauge ON or OFF.
- Initiating the Micro-Ion gauge degas cycle.
- Reading the measured pressure value.
- Changing pressure measurement units.
- Configuring trip points.
- Locking or unlocking the keyboard.
- Performing atmospheric pressure and vacuum pressure calibration of the Conductron sensor.
- Overriding Micro-Ion gauge filament mode defaults.
- Overriding Micro-Ion gauge emission current defaults.

Polled I/O

If the connection allocation bit 1 (polled) is set at Step 5 on page 21, you may use DeviceNet polled I/O messages to perform these functions:

- Turning the Micro-Ion gauge ON or OFF.
- Initiating the Micro-Ion gauge degas cycle.
- Reading the measured pressure value.

Optional numeric display

Regardless of the connection allocation that has been set at Step 5 on page 21, you may use the optional numeric display to perform these functions:

- Reading the measured pressure value.
- Configuring trip points.

Control panel

Regardless of the connection allocation that has been set at Step 5 on page 21, you may use the buttons and LEDs on the control panel to perform these functions:

- Turning the Micro-Ion gauge ON or OFF.
- Initiating the Micro-Ion gauge degas cycle.
- Performing atmospheric pressure and vacuum pressure calibration of the Conductron sensor.

3.7 Gauge and sensor ON/OFF

When the module starts up, the Conductron sensor is ON. As pressure decreases to a level that allows the Micro-Ion gauge to operate, the Conductron sensor turns the Micro-Ion gauge ON. An LED on the control panel of the module is green when the Conductron sensor and Micro-Ion gauge are ON.

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

Using DeviceNet explicit messages:
Use the explicit commands listed in Table 3-12 to turn the Micro-Ion gauge OFF or ON.

Table 3-12 Micro-Ion gauge ON/OFF commands

Function	Service	Class	Instance	Attribute	USINT or BOOL data
Turn Micro-Ion gauge ON or OFF	62_{hex}	31_{hex}	2	None	USINT data 0 = Turn gauge ON 1 = Turn gauge OFF
Get ON/OFF state of Micro-Ion gauge	$0E_{hex}$	31_{hex}	2	$5D_{hex}$	BOOL data 0 = Gauge is ON 1 = Gauge is OFF

Using DeviceNet output polled I/O:
The master can input data to the device to turn the Micro-Ion gauge OFF or ON. See Table 3-10 and Table 3-11 on page 24.

Using the module gauge button:

Figure 3-4 illustrates the gauge button and gauge LED on the module control panel. Press the gauge button to turn the Micro-Ion gauge OFF or ON.

If the gauge is manually turned OFF, the optional numeric display on the module indicates pressure as measured by the Conductron sensor and the gauge status indicator turns to blinking amber.

Detailed status is reported to the DeviceNet communications interface so the host computer can monitor the full status of the module. Table 3-13 describes the gauge status and corresponding LED states.

Figure 3-4 Micro-Ion gauge button and LED on module control panel

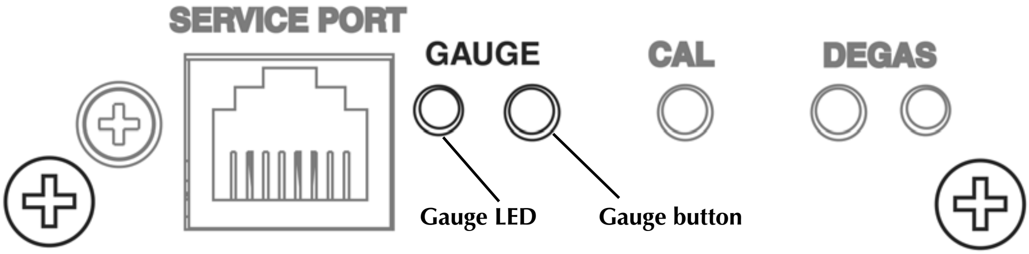


Table 3-13 Micro-Ion gauge status LED

Gauge status	LED state
Micro-Ion gauge and Conductron sensor ON, both gauge filaments OK	Solid green
Micro-Ion gauge and Conductron sensor ON, one gauge filament is inoperative	Blinking green
Micro-Ion gauge is OFF, pressure > turn-on point	Solid amber
• Operator used switch or command to switch Micro-Ion gauge sensor OFF • No pressure output from Micro-Ion gauge • Optional numeric display indicates pressure as measured by Conductron sensor	Blinking amber
• Micro-Ion gauge is OFF, both filaments are open • Conductron sensor failure • Micro-Ion gauge will not turn ON • Electronics sensed failure	Solid red
• Micro-Ion gauge is OFF, primary filament failure • if operating in manual filament mode, press gauge button to turn Micro-Ion gauge ON	Blinking red

Operation

3.8 Micro-Ion gauge degas

You may use DeviceNet explicit messages, polled I/O, or the module degas button to activate the Micro-Ion gauge degas cycle.

- Pressure must be lower than 5×10^{-6} Torr (6.66×10^{-6} mbar, 6.66×10^{-4} Pa) for the degas to initiate.
- After activation, the degas cycle will run for two minutes.

Using DeviceNet explicit messages:
Use the commands listed in Table 3-14 to initiate a degas cycle. The degas cycle will end immediately if you press the module degas button during a degas cycle.

Table 3-14 Degas commands

Function	Service	Class	Instance	Attribute	USINT or BOOL data
Initiate or terminate Micro-Ion gauge degas	61_{hex}	31_{hex}	2	None	USINT data 0 = Terminate degas 1 = Initiate degas
Get Micro-Ion gauge degas state	$0E_{hex}$	31_{hex}	2	58_{hex}	BOOL data 0 = Degas not in progress (OFF) 1 = Degas in progress (ON)

Using DeviceNet output polled I/O:
The master can input data to the device to turn the degas function ON or OFF. Table 3-15 displays the polled output I/O one byte format. Table 3-16 lists degas control bits. The degas cycle will end immediately if you press the module degas button during a degas cycle.

Bit 0 in the one byte format starts the Micro-Ion gauge degas cycle. If bit 0 is set to 1, degas will start when the gauge is ON and pressure is lower than 5×10^{-6} Torr (6.66×10^{-6} mbar, 6.66×10^{-4} Pa).

Table 3-15 Writing Micro-Ion gauge degas bits

Assembly number	USINT data: One byte format							
1	Bit 7 0	Bit 6 Gauge ON or OFF	Bit 5 0	Bit 4 0	Bit 3 0	Bit 2 0	Bit 1 0	Bit 0 Initiate or terminate Micro-Ion gauge degas

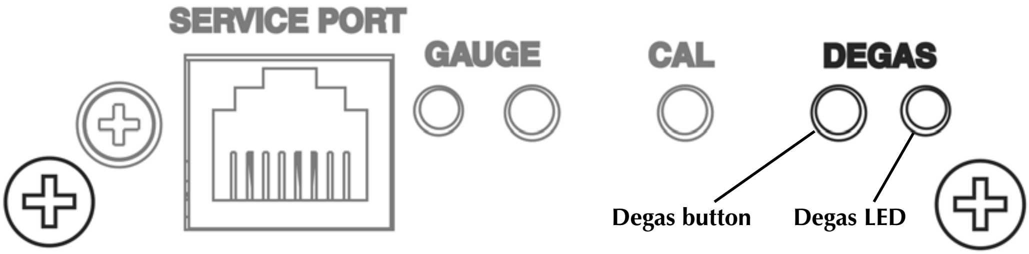
Table 3-16 Micro-Ion Plus degas control bits

Bit	Gauge control function	Description
Bits 0 and 6	Degas	• Set bit 6 to 1 to turn ON gauge (gauge *must* be ON to initiate gauge degas) • If bit 0 is set to 1, degas will initiate if Micro-Ion gauge is ON and pressure is lower than 5×10^{-6} Torr (6.66×10^{-6} mbar, 6.66×10^{-4} Pa)
Bits 1, 2, 3, 4, 5, and 7	Reserved	Should always be 0 (zero)

Using the module degas button:

Figure 3-5 illustrates the degas button and LED on the module control panel. Press the degas button to initiate or terminate the degas cycle. The degas LED turns solid amber to indicate degas in progress.

Figure 3-5 Degas button and LED on module control panel



3.9 Filament mode

The Micro-Ion gauge contains two filaments. The filaments can operate in automatic, alternating, or manual mode. Pages 30–34 contain figures and tables that explain the operation of the filaments in automatic, alternating, and manual modes.

- Figure 3-6 illustrates the gauge LED indicator and gauge button.
- Table 3-17 describes operation of the filaments in automatic, alternating, and manual modes.
- Table 3-18 describes the states of the Micro-Ion gauge, gauge LED, and filaments in automatic or alternating mode.
- Table 3-19 describes the states of the Micro-Ion gauge, gauge LED, and filaments in manual mode.
- Figure 3-7, Figure 3-8, and Figure 3-9 on pages 32–34 are flow charts showing switching patterns for each mode.

Figure 3-6 Gauge LED

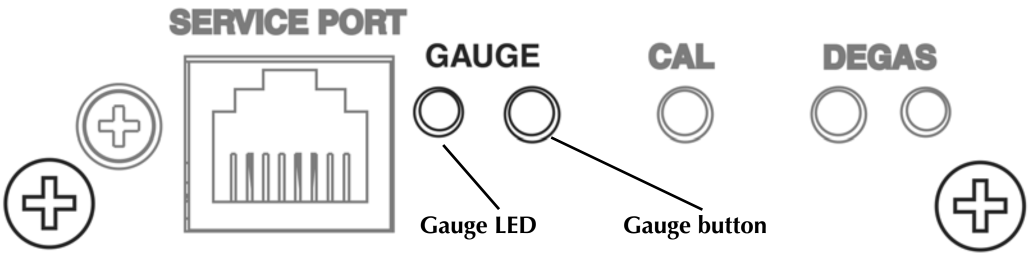


Table 3-17 Micro-Ion filament operation modes

Mode	Description
Automatic	• Filament logic operates filament 1 each time Micro-Ion gauge turns ON • If filament 1 becomes inoperable, Micro-Ion gauge switches to filament 2
Alternating (default for Micro-Ion gauge with yttria-coated iridium filaments)	• Filament logic alternates between filament 1 and filament 2 each time Micro-Ion gauge turns ON • If a filament becomes inoperable, module switches to the operable filament
Manual (default for Micro-Ion gauge with tungsten filaments)	• Filament logic operates filament 1 each time the Micro-Ion gauge turns ON • If filament 1 becomes inoperable, press gauge button to turn filament 2 ON (gauge LED will flash red) • After gauge button has been pressed, filament 2 turns ON each time Micro-Ion gauge turns ON (each time power to the module is cycled)

Table 3-18 Micro-Ion gauge, gauge LED, and filament states in automatic or alternating mode

Micro-Ion gauge state	Gauge LED state	Filament state
OFF automatically	Amber	Micro-Ion gauge has automatically turned OFF
OFF and disabled	Flashing amber	Micro-Ion gauge is disabled
ON	Green	• Filament 1 or 2 is ON • Both filaments are operable
ON attempt	Flashing green	Filament 1 or 2 is inoperable
OFF	Red	Filaments 1 and 2 are inoperable

Table 3-19 Micro-Ion gauge, gauge LED, and filament states in manual mode

Micro-Ion gauge state	Gauge LED state	Filament state
OFF automatically	Amber	Micro-Ion gauge has automatically turned OFF
OFF and disabled	Flashing amber	Micro-Ion gauge is disabled
ON	Green	Filament 1 is ON
ON attempt	Flashing green	Filament 2 is ON
OFF	Flashing red	• Filament 1 is inoperable • Press gauge button to switch to filament 2
OFF	Red	Filaments 1 and 2 are inoperable

Figure 3-7 Automatic filament switching flow chart

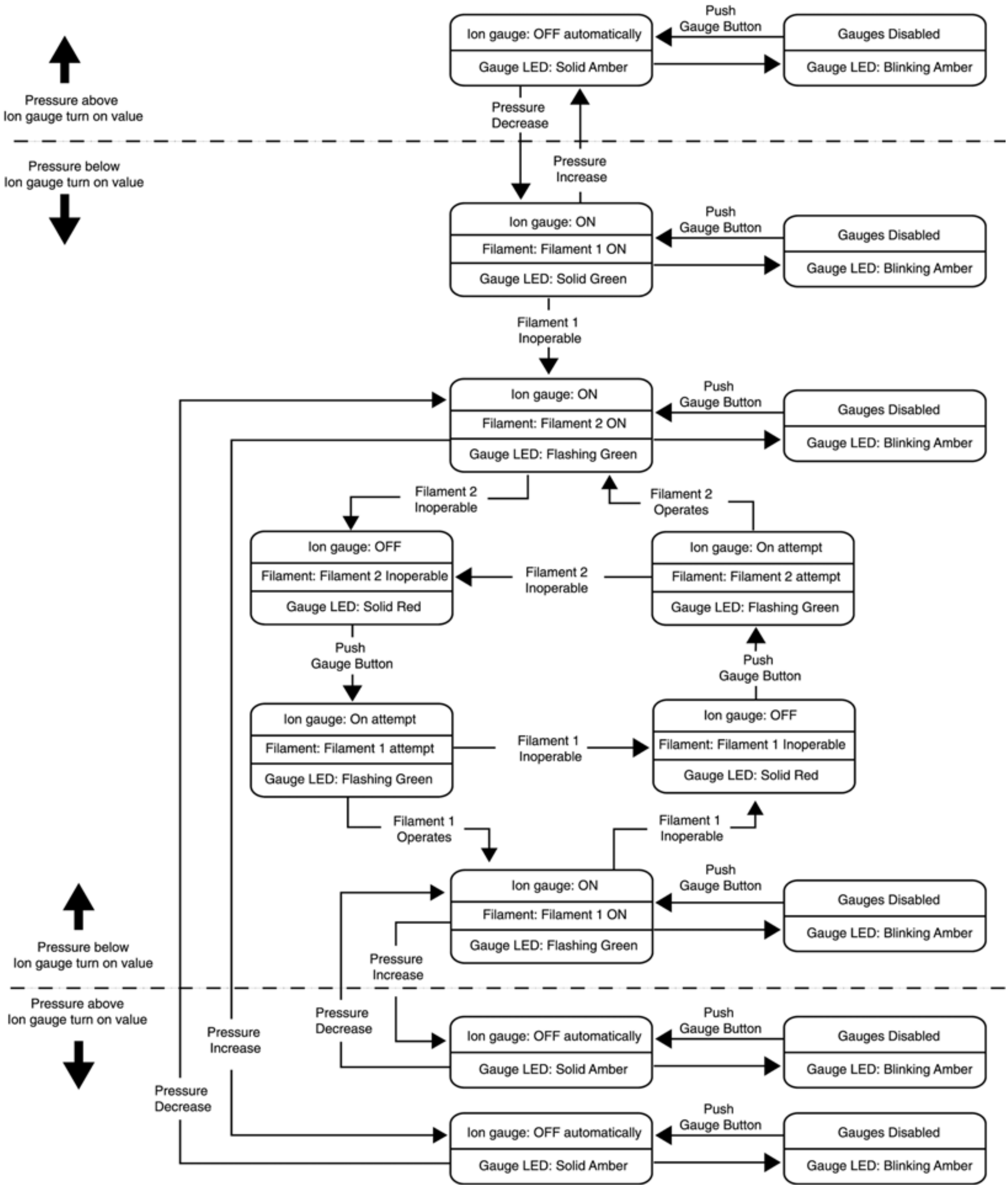
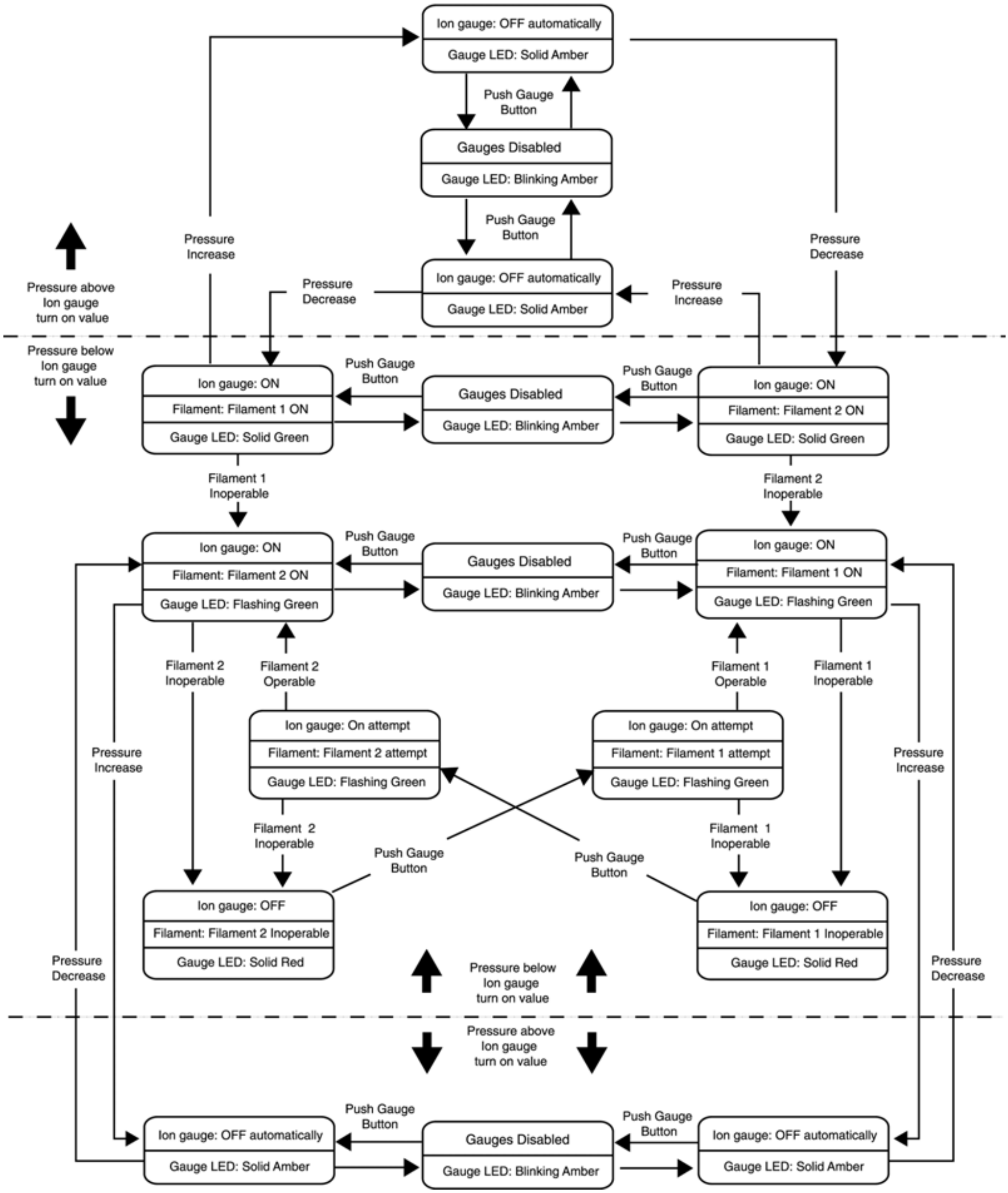
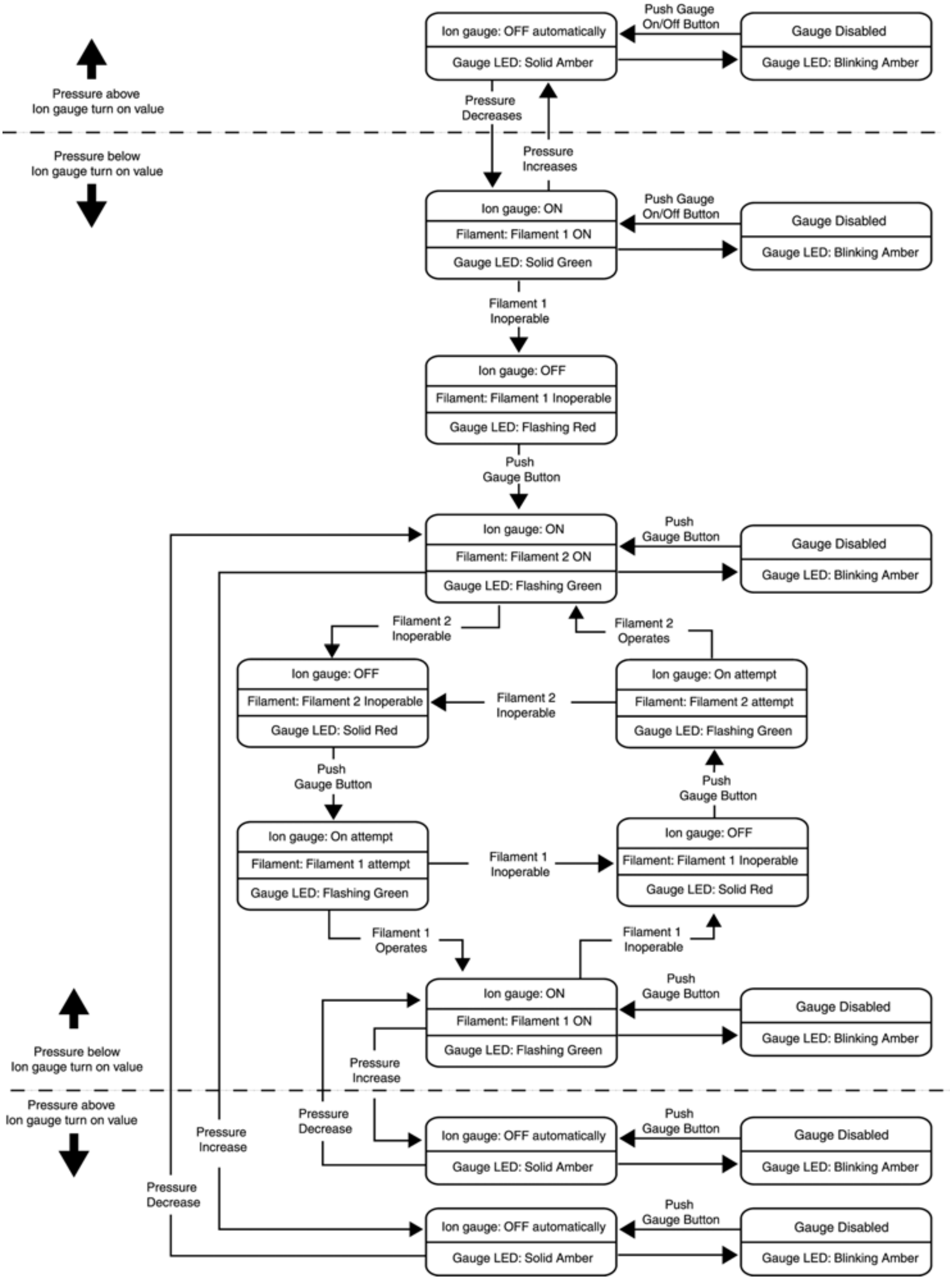


Figure 3-8 Alternating filament switching flow chart



Operation

Figure 3-9 Manual filament switching flow chart



To set the filament to automatic, alternating, or manual mode, use the DeviceNet explicit commands listed in Table 3-20.

- If the Micro-Ion gauge has yttria-coated iridium filaments, the default filament mode is alternating.
- If the Micro-Ion gauge has tungsten filaments, the default filament mode is manual.

Use the explicit commands listed in Table 3-20 to select alternating, automatic, or manual filament mode.

Table 3-20 Filament mode commands

Function	Service	Class	Instance	Attribute	BYTE data
Automatic filament mode	10_{hex}	31_{hex}	2	69_{hex}	0 = Alternating mode 1 = Automatic mode (default for yttria-coated iridium filaments) 2 = Manual mode (default for tungsten filaments)

3.10 Micro-Ion gauge emission current

The Micro-Ion gauge can operate at either of two emission current levels.

- In low-emission mode, the emission current is 0.1 mA.
- In high-emission mode, the emission current is 4 mA.

As the vacuum pump removes gas from the system, the Conductron sensor measures pressure until it has decreased to a pressure at which the Micro-Ion gauge can operate. At this pressure, the Conductron sensor turns the Micro-Ion gauge ON at the low emission current (0.1 mA).

As pressure continues to decrease, the Micro-Ion gauge switches from low emission to high emission (4 mA). If pressure increases after the emission current has gone from low to high, the gauge switches back to low emission. Table 3-21 lists default, minimum, and maximum pressure values at which the gauge switches emission current.

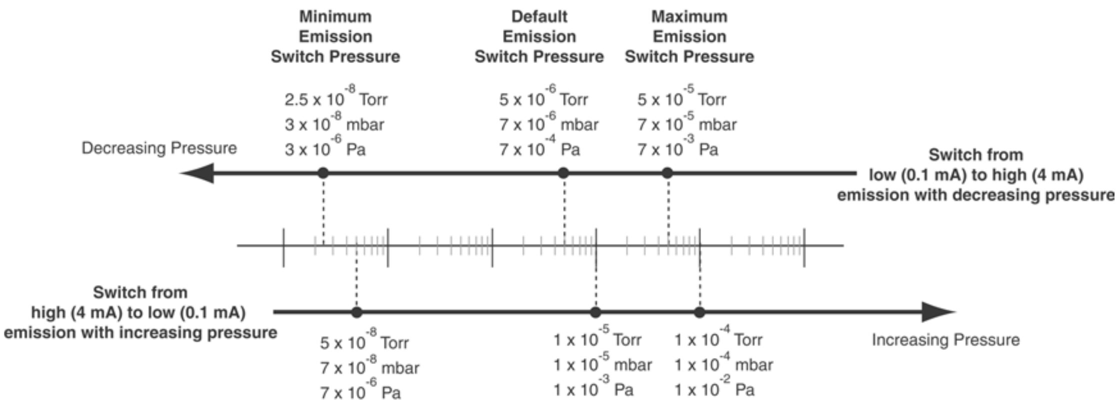
Table 3-21 Micro-Ion gauge emission current pressure values

Emission current setting	Minimum switch points	Default switch points	Maximum switch points
Switch to high emission current (4 mA) with decreasing pressure	2.5×10^{-8} Torr 3×10^{-8} mbar 3×10^{-6} Pa	5×10^{-6} Torr 7×10^{-6} mbar 7×10^{-4} Pa	5×10^{-5} Torr 7×10^{-5} mbar 7×10^{-3} Pa
Switch to low emission current (0.1 mA) with increasing pressure	5×10^{-8} Torr 7×10^{-8} mbar 7×10^{-6} Pa	1×10^{-5} Torr 1×10^{-5} mbar 1×10^{-3} Pa	1×10^{-4} Torr 1×10^{-4} mbar 1×10^{-2} Pa

The switch back to low emission current with increasing pressure is 200% greater than the switch to high emission current with decreasing pressure, as illustrated in Figure 3-10.

For example, in default mode, the emission current switches from low to high emission at 5×10^{-6} Torr (7×10^{-6} mbar, 7×10^{-4} Pa), then switches back to low emission at 1×10^{-5} Torr (1×10^{-5} mbar, 1×10^{-3} Pa).

Figure 3-10 Emission current switch points



Use the DeviceNet command listed in Table 3-22 to adjust the pressure value at which the Micro-Ion gauge switches from high emission (4.0 mA) to low emission (0.1 mA) with increasing pressure.

Table 3-22 Configuring emission current switch point

Function	Service	Class	Instance	Attribute	Example REAL data
Pressure at which current switches from high (4.0 mA) to low (0.1 mA) with increasing pressure	10_{hex}	35_{hex}	3	5	*REAL data such as* 38 D1 B7 17 $_{hex}$ (1.0×10^{-4})

3.11 Reading measured pressure

You may use DeviceNet explicit messages, polled I/O, or the optional numeric display to read measured pressure.

Using DeviceNet explicit messages:

You may read measured pressure in the assembly object, analog sensor object (instance 0), analog sensor object Conductron sensor (instance 1), or analog sensor object Micro-Ion gauge (instance 2).

The explicit messages for each object are shown in Table 3-23.

Table 3-23 Measured pressured values

Function	Service	Class	Instance	Attribute	REAL data
Measured pressure	$0E_{hex}$	31_{hex}	0	$5E_{hex}$	Measured pressure
System pressure	$0E_{hex}$	31_{hex}	1	6	Pressure from Micro-Ion gauge
System pressure	$0E_{hex}$	31_{hex}	2	6	Pressure from Micro-Ion gauge

Using DeviceNet input polled I/O:

When a master polls the module for measured pressure, the format of the returned pressure value depends on the data format configuration.

- To configure the data format for input polled I/O, see Step 7 on page 23.
- The default format is instance 5 of the polled I/O data, which inputs status (one byte) and pressure (floating point).
- Table 3-24 lists formats available for pressure data.

Table 3-24 Available pressure data formats

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Values are transmitted in low byte to high byte order.									
1	0	INT pressure value (low byte)							
	1	INT pressure value (high byte)							
Values are transmitted in low byte to high byte order.									
2	0	0	0	Warning status	0	0	0	Alarm status	0
	1	INT pressure value (low byte)							
	2	INT pressure value (high byte)							
Values are transmitted in low byte to high byte order.									
4	0	REAL pressure value (low byte)							
	1	REAL pressure value							
	2	REAL pressure value							
	3	REAL pressure value (high byte)							
Values are transmitted in low byte to high byte order.									
5 (default)	0	0	0	Warning status	0	0	0	Alarm status	0
	1	REAL pressure value (low byte)							
	2	REAL pressure value							
	3	REAL pressure value							
	4	REAL pressure value (high byte)							

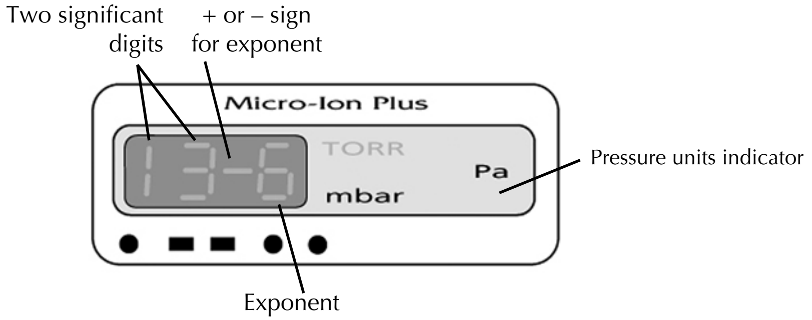
Using the optional module display:

The optional numerical display is a 7-segment, green LED display. See Figure 3-11. The display shows 2 significant digits, 1-digit exponent, and a ± sign for the exponent, allowing for an XX±Y display.

The displayed pressure range is 0.1×10^{-9} to atmosphere (“At”) as measured by the Conductron sensor.

If the display reads “At+,” pressure is higher than 760 Torr (1013 mbar, 1.01×10^{5} Pa), and calibration at atmospheric pressure might be required. See page 45.

Figure 3-11 Optional numeric display



Pressure values in the 10^{-10} range (such as 6×10^{-10}) will be displayed as “0.6–9”. The resolution of the numeric display changes over the operating range of the module. See Table 3-25.

Pressure can be displayed in units of Torr, mbar or Pa. The selected unit of measure is illuminated on the display panel. The units indicator is always ON when the module is powered.

Table 3-25 Display resolution versus Conductron sensor pressure

Measured pressure			
Torr	**mbar**	**Pa**	**Display resolution**
Less than 50	Less than 66	Less than 6.6×10^{3}	Two digits
50 to 100	66 to 133	6.6×10^{3} to 13.3×10^{4}	10 pressure units
100 to 400	133 to 533	13.3×10^{4} to 53.3×10^{4}	100 pressure units
400 to 760	533 to 1.01×10^{3}	53.3×10^{4} to 1.01×10^{5}	Display reads “At”
Greater than 760	Greater than 1.01×10^{3}	Greater than 1.01×10^{5}	Display reads “At+”

3.12 Changing pressure measurement unit

To change the unit of measure, use the DeviceNet explicit commands listed in Table 3-26.

Table 3-26 Pressure measurement units

Function	Service	Class	Instance	Attribute	Master data
Set pressure unit to Torr	10_{hex}	31_{hex}	1	4	$01\ 03_{hex}$
Set pressure unit to mbar	10_{hex}	31_{hex}	1	4	$08\ 03_{hex}$
Set pressure unit to Pa	10_{hex}	31_{hex}	1	4	$09\ 03_{hex}$

3.13 Trip points

The Micro-Ion Plus module has two trip point relays. For trip point relay wiring, see page 14.

When the module is shipped from the factory, trip point relays are set to 0 Torr (0 mbar, 0 Pa). The relays will not operate until they have been adjusted for the application.

Pressure unit

If you change the pressure measurement unit, the display indicates pressure in the measurement unit that you've selected. To change the measurement unit, see Table 3-26.

Threshold and hysteresis

The trip point threshold may be set from 1×10^{-9} to 1000. The pressure measurement unit restricts the usefulness of trip points at the extremes of the measurement range. A built-in hysteresis of 10% prevents oscillation around the trip point.

Polarity

In default mode, trip point relays activate with decreasing pressure and deactivate at a 10% higher pressure than the activation pressure, as illustrated in Figure 3-12.

You can reverse relay polarity, so trip point relays activate with increasing differential pressure and deactivate at a 10% lower pressure than the activation pressure, as illustrated in Figure 3-13.

Figure 3-12 Trip point relay behavior with decreasing pressure

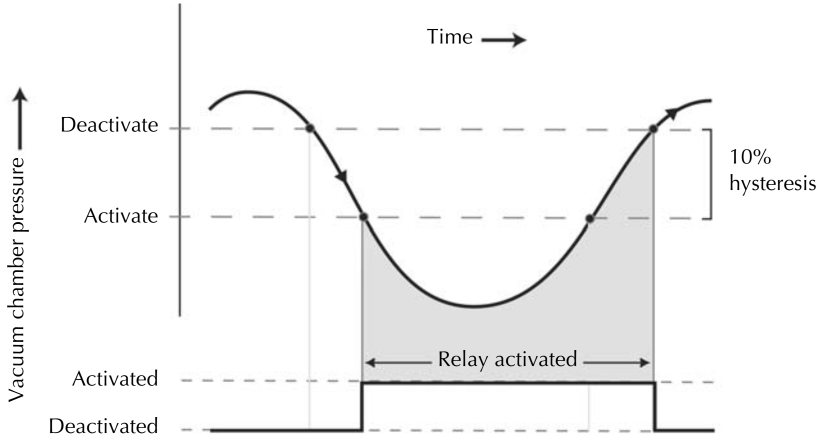
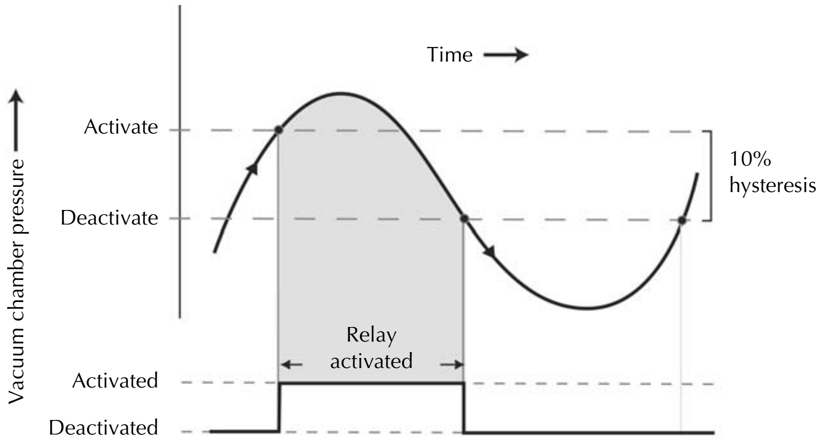


Figure 3-13 Trip point relay behavior with increasing pressure



Configuration procedure

Use DeviceNet explicit messages or the module trip point indicators and switches to configure trip points.

Using DeviceNet explicit messages:
Use the explicit commands listed in Table 3-27 to configure trip point relays.

Table 3-27 Trip point relay configuration commands

Trip point relay 1

Function	Service	Class	Instance	Attribute	Example BOOL data
Enable or disable trip point relay 1	10_{hex}	35_{hex}	1	6	1 = Enable relay 1 0 = Disable relay 1
Trip point 1 polarity	10_{hex}	35_{hex}	1	8	0 = Activate with decreasing pressure 1 = Activate with increasing pressure
Function	**Service**	**Class**	**Instance**	**Attribute**	**Example REAL data**
Trip point 1 pressure	10_{hex}	35_{hex}	1	5	*REAL data such as* 35 86 37 BD $_{hex}$ (1 x 10^{-6})

Trip point relay 2

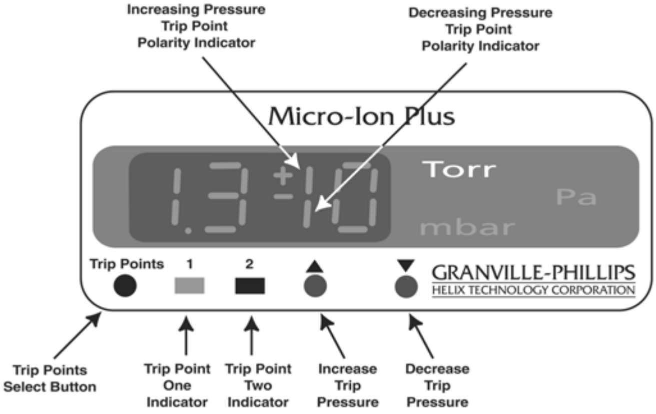
Function	Service	Class	Instance	Attribute	Example BOOL data
Enable or disable trip point relay 2	10_{hex}	35_{hex}	2	6	1 = Enable relay 2 0 = Disable relay 2
Trip point 2 polarity	10_{hex}	35_{hex}	2	8	0 = Activate with decreasing pressure 1 = Activate with increasing pressure
Function	**Service**	**Class**	**Instance**	**Attribute**	**Example REAL data**
Trip point 2 pressure	10_{hex}	35_{hex}	2	5	*REAL data such as* 35 86 37 BD $_{hex}$ (1 x 10^{-6})

Using the module trip point indicators and switches:
Use the optional display LEDs and recessed interface buttons to configure trip points. Use the trip points button to activate the configuration mode and select the desired trip point for configuration.

Figure 3-14 illustrates the trip point buttons and LEDs. The corresponding LED flashes to indicate the selected trip point.

- Use the up and down arrows to set the trip point polarity and trip point vacuum pressure.
- The display indicates the trip point polarity (activate on increasing or decreasing pressure) and the trip point vacuum pressure.

Figure 3-14 Trip point buttons and LEDs



Press the trip points button once to active the configuration mode and select trip point 1 (LED 1 will flash). Push the trip points button again to select trip point 2 (LED 2 will flash).

The “1” digit in the exponent location of the display indicates trip point polarity. You can set trip point polarity for increasing or decreasing pressure.

- The top half of the “1” will flash if polarity is set for increasing pressure.
- The bottom half of the “1” will flash if polarity is set for decreasing pressure.

To change polarity, continuously scroll the pressure value beyond the upper pressure limit (1000) or the lower pressure limit (1 x 10^{-9} Torr), then cross through the “0.0+0” value on the display.

To store the settings, push the trip points button until the trip point indicator stops flashing.

1. *Activate the trip point configuration mode and select the desired trip point relay*. Press the trip points button.
   - The first press of the button activates the configuration mode and selects trip point one (LED 1 flashes).
   - Pushing the button a second time selects trip point two (LED 2 flashes).
2. *Set the trip point vacuum pressure value*. Press the up or down arrow to set the desired trip point value.
3. *If desired, select the appropriate polarity for the trip point*. If you wish to change the trip point polarity, press the up arrow or down arrow to scroll the display through the “0.0+0” display value. The upper segment of the exponent “1” digit flashes for increasing pressure, or the lower segment flashes for decreasing pressure.
4. *Return the display to the measured vacuum pressure reading*. Push the trip points button a third time to set the configuration values, deactivate the trip point configuration mode, and return the display to the measured vacuum pressure reading.

Table 3-28 indicates the status of trip point LEDs during operation of trip point 1, trip point 2, and trip point configuration.

Table 3-28 Trip point LED status

State	LED
Trip point relay activated	Solid green
Trip point relay deactivated	OFF
Configuration mode	Flashing green

3.14 Locking the keyboard

When the keyboard is locked, the buttons on the control panel cannot be used. To lock or unlock the keyboard, use the explicit commands listed in Table 3-29:

- To lock the keyboard, set the command bit to 0.
- To unlock the keyboard, set the command bit to 1.

Table 3-29 Keyboard lock/unlock commands

Function	Service	Class	Instance	Attribute	BOOL data
Lock or unlock keyboard	44_{hex}	$C4_{hex}$	1	None	0 = Lock 1 = Unlock

3.15 Conductron sensor calibration

You may calibrate the Conductron sensor at atmospheric or vacuum chamber pressure.

An atmospheric pressure calibration of the Conductron sensor is performed with air at the Helix Technology Longmont facility prior to shipment. The factory calibration sets the atmospheric calibration point (“At”) to approximately 635 Torr (846 mbar, 8.46×10^4 Pa).

To ensure proper performance, the atmospheric pressure calibration of the Conductron sensor should be reset, using the process gas, once the module has been installed and is still at atmospheric pressure. Periodic resets of the atmospheric pressure calibration point will improve the accuracy and repeatability of the Conductron sensor near atmospheric pressure.

If an accurate atmospheric pressure calibration has been performed, the Micro-Ion gauge will automatically set the vacuum pressure calibration for the Conductron sensor.

Vacuum pressure calibration enables the Micro-Ion gauge to turn ON if the atmospheric pressure calibration has shifted to a pressure value that is too low or if the Micro-Ion gauge has been replaced.

To perform the atmospheric pressure or vacuum pressure calibration, use DeviceNet explicit messages or press the CAL momentary button on the module control panel.

Using DeviceNet explicit messages:
To perform the atmospheric pressure or vacuum pressure calibration, use an explicit command listed in Table 3-30.

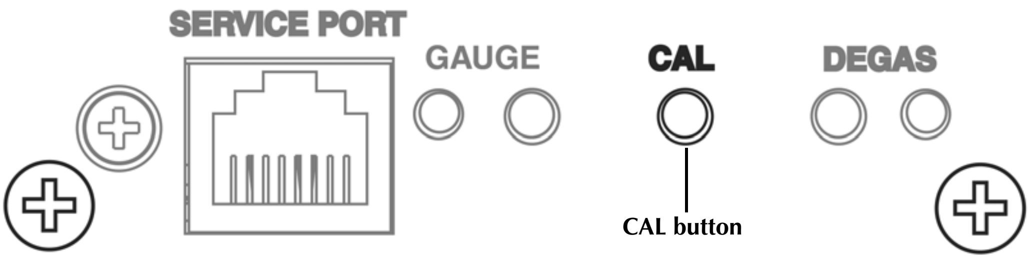
- For the atmospheric pressure calibration, set the command bit to 1.
- For the vacuum pressure calibration, set the command bit to 0.

Table 3-30 Conductron sensor calibration command

Function	Service	Class	Instance	Attribute	Device data
Calibrate Conductron sensor at atmospheric pressure	$4C_{hex}$	31_{hex}	1	None	None
Calibrate Conductron sensor at vacuum chamber pressure	$4B_{hex}$	31_{hex}	1	None	None

Using the module CAL momentary button:
Figure 3-15 Illustrates the CAL button on the module control panel. To perform the atmospheric pressure or vacuum pressure calibration, press the CAL button.

Figure 3-15 CAL button on module control panel



3.16 DeviceNet messaging summary

For a complete list of DeviceNet messages used by the module, see *Appendix C*.

3.17 Factory defaults

Micro-Ion Plus modules are shipped with the default settings listed in Table 3-31. If options in your application require settings different from the factory defaults listed in Table 3-31, 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 3-31 Default settings

Function	Default state
Micro-Ion gauge ON/OFF button	Button enabled
Micro-Ion gauge degas button	Button enabled
Auto emission threshold pressure and emission current	4 mA = 5 x 10^{-6} Torr (7 x 10^{-6} mbar, 7 x 10^{-4} Pa) 0.1 mA = 1 x 10^{-5} Torr (1 x 10^{-5} mbar, 1 x 10^{-3} Pa)
Trip point 1 pressure	0 Torr (0 mbar, 0 Pa)
Trip point 2 pressure	0 Torr (0 mbar, 0 Pa)
Trip point polarity	• 0 Torr (0 mbar, 0 Pa) with 10% hysteresis (see page 40) • Polarity default set for decreasing pressure
Micro-Ion gauge filament selection	• Alternating for yttria-coated iridium filaments • Manual for tungsten filaments
Micro-Ion gauge emission current switch point	• 50% hysteresis • With decreasing pressure: 5 x 10^{-6} Torr 7 x 10^{-6} mbar 7 x 10^{-4} Pa • With increasing pressure: 1 x 10^{-5} Torr 1 x 10^{-5} mbar 1 x 10^{-3} Pa
Unit of measure	As specified by the catalog number: • T = Torr • M = mbar • P = Pa

4.1 Error codes

Table 4-1 lists failure symptoms, causes, and solutions indicated by an "Er#" DeviceNet code or optional display message.

Table 4-1 DeviceNet and display error codes

Error #	Display	Cause	Solution
1	"Er 1"	Conductron sensor has failed	Replace gauge assembly (see page 59)
5	"Er 5"	Micro-Ion gauge has failed	Replace gauge assembly (see page 59)
6	"Er 6"	• If filament mode is alternating or automatic, both filaments are inoperable • If filament mode is manual, one filament is inoperable	• If filament mode is alternating or automatic, replace gauge assembly (see page 59) • If filament mode is manual, press gauge button to select other filament (see page 30)

4.2 Alarm and warning status

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 21.

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 4-2.

Table 4-2 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

Alarm and warning status is in the device supervisor object. The bit is 1 if an alarm has been reported or 5 if a warning has been reported, as listed in Table 4-3.

Table 4-3 Module alarm and warning status for explicit messages

Parameter	Service	Class	Instance	Attribute	USINT data
Alarm or warning status	$4D_{hex}$	30_{hex}	2	$0C_{hex}$	1 = Alarm reported 5 = Warning reported

If an alarm or warning has been reported, you may use explicit messages to get details regarding the alarm or warning. Details are in the identity object, the analog sensor object, instance 1, or the analog sensor object, instance 2.

- Table 4-4 lists status and fault information in the identity object.
- Table 4-5 lists status, alarm, and warning information in the analog sensor object, instance 1 (Conductron sensor).
- Table 4-6 lists status, alarm, and warning information in the analog sensor object, instance 2 (Micro-Ion gauge).

Table 4-4 Status and fault information in identity object

Service	Class	Instance	Attribute	Bit/definition	Solution
$0E_{hex}$	1	1	5	0 = An object is allocated	No action necessary
				2 = Module is configured	No action necessary
				8 = Recoverable fault	Cycle power to module
				11 = Unrecoverable fault	Replace gauge assembly (see page 59)

Table 4-5 Status, alarm, and warning information in analog sensor object, instance 1 (Conductron sensor)

Service	Class	Instance	Attribute	Bit/definition	Solution
$0E_{hex}$	31_{hex}	1	5	0 = Pressure reading is valid, no errors reported	No action necessary
				1 = Pressure reading is invalid, errors reported	Get data from analog sensor object, service $0E_{hex}$, class 31_{hex}, instance 1, attribute 7
$0E_{hex}$	31_{hex}	1	7	0 = Conductron sensor has failed	Replace gauge assembly (see page 59)
				1 = Low-level alarm	No action necessary
				2 = Pressure is higher than 760 Torr (1013 mbar, 1.01 x 10^5 Pa)	Calibrate conductron sensor at atmospheric pressure (see page 45)
				3 = Low-level warning	No action necessary

Table 4-6 Status, alarm, or warning information in analog sensor object, instance 2 (Micro-Ion gauge)

<table>
<tr><th>Service</th><th>Class</th><th>Instance</th><th>Attribute</th><th>Bit/definition</th><th>Solution</th></tr>
<tr><td rowspan="2">$0E_{hex}$</td><td rowspan="2">31_{hex}</td><td rowspan="2">2</td><td rowspan="2">5</td><td>0 = Pressure reading is valid, no errors reported, Micro-Ion gauge is ON</td><td>No action necessary</td></tr>
<tr><td>1 = Pressure reading is invalid, errors reported, Micro-Ion gauge is OFF</td><td>Get data from analog sensor object, service $0E_{hex}$, class 31_{hex}, instance 2, attribute 7</td></tr>
<tr><td>$0E_{hex}$</td><td>31_{hex}</td><td>2</td><td>7</td><td rowspan="2">0 = Filament 1 is open
1 = Filament 2 is open</td><td rowspan="4">• If filament mode is alternating or automatic, replace gauge assembly (see page 59)
• If filament mode is manual, press gauge button to select other filament (see page 30)</td></tr>
<tr><td>$0E_{hex}$</td><td>31_{hex}</td><td>2</td><td>$5E_{hex}$</td></tr>
<tr><td rowspan="3">$0E_{hex}$</td><td rowspan="3">31_{hex}</td><td rowspan="3">2</td><td rowspan="3">$5F_{hex}$</td><td>Byte 0, bit 0 = A filament is inoperable or both filaments are inoperable</td></tr>
<tr><td>Byte 1, bit 0 = A filament is inoperable or both filaments are inoperable</td></tr>
<tr><td>Byte 1, bit 4 = Micro-Ion gauge has failed</td><td>Replace gauge assembly (see page 59)</td></tr>
</table>

4.3 Overpressure shutdown

To prevent ion gauge damage, the module uses the Conductron sensor as an overpressure sensor for Micro-Ion gauge shutdown. The Micro-Ion gauge shuts OFF at 3×10^{-2} Torr (3.99×10^{-2} mbar, 3.99 Pa).

You cannot adjust the overpressure shutdown value.

4.4 Overpressure or fault condition

An alarm or warning is reported, and the optional display will read "At+", if the module measures a pressure greater than 1000 Torr (1333 mbar, 133 kPa) or if the module shuts OFF due to a fault condition.

Chapter 5 Maintenance

5.1 Customer service

For customer service:

- Phone **1–800–776–6543** within the U.S.A.
- Email *custserv@helixtechnology.com*.

Damage requiring service

Shut off power to the module and refer servicing to qualified service personnel under the following conditions:

- The product has been exposed to rain or water.
- The product does not operate normally, even if you have followed the operation instructions. Operate only those controls that are covered in the instruction manual.
- The product has been dropped or the module enclosure has been damaged.
- The product exhibits a distinct change in performance.

If the module requires repair:

- See pages 59–60,
- Phone **1–800–776–6543** within the U.S.A., or
- Email *custserv@helixtechnology.com*.

5.2 Troubleshooting

If any of the conditions described on page 53 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.

> **⚠ WARNING**
>
> **Substitution or modifying parts can result in severe product damage or personal injury due to electrical shock or fire.**
>
> - Install only those replacement parts that are specified by Helix Technology.
> - Do not install substitute parts or perform any unauthorized modification to the module.
> - Do not use the module if unauthorized modifications have been made.

> **⚠ WARNING**
>
> **Failure to perform a safety check after the module has been repaired can result in severe property damage or personal injury due to electrical shock or fire.**
>
> If the module has been repaired, before putting it back into operation, make sure qualified service personnel perform a safety check.

Symptoms, causes, and solutions

Table 5-1 lists failure symptoms, causes, and solutions indicated by something other than a DeviceNet error message from the module.

Table 5-1 Troubleshooting symptoms and causes

Symptom	Causes	Solutions
Power indicator does not illuminate.	• Power supply is disconnected, OFF, or inadequate for load. • A switching power supply may have shut down due to current surge during power-up. • Power supply wiring is faulty. • Power supply connector is wired incorrectly.	• Make sure power supply is ON. • Make sure power supply can withstand startup inrush current (see page 11). • Replace or repair power supply wiring (see page 11). • Reconnect wiring to power supply connector (see page 12).
Module does not respond to DeviceNet communication from master but MOD Indicator is solid green.	• Incorrect address switch settings. • Incorrect data rate setting.	• Change address (see page 18). • Change data rate (see page 19). • Reconfigure DeviceNet communications (see page 21).
Process control trip point does not function properly.	• Trip point connector is wired incorrectly. • Trip points are set to invalid values.	• Reconnect wiring to trip point connector (see page 14). • Reconfigure trip points (see page 40).
Micro-Ion gauge will not stay on.	• Overpressure condition. • Er #6: Gauge failure due to broken filament, contamination, or pressure over 3 x 10^{-2} Torr (3.99 x 10^{-2} mbar, 3.99 Pa). • Er #5: Gauge failure due to damage, contamination, or power supply failure.	• If overpressure condition exists, decrease system pressure. • If filament is broken or mechanical damage has occurred, replace gauge assembly (see page 59). • If contamination is present, degas Micro-Ion gauge (see page 28).
Pressure reading is inaccurate.	• Fitting to vacuum chamber has an elastomer O-ring. • Mechanical damage has occurred. • Contamination is present.	• Replace elastomer O-ring on vacuum chamber fitting with metal seal. • If mechanical damage has occurred, return module (see page 59). • If contamination is present, degas Micro-Ion gauge (see page 28) or remove gauge and sensor (see page 59) and bake out to 150 °C (302 °F).
Display reads "OFF".	• Gauge button has been pressed, Micro-Ion gauge is OFF. • "IG OFF" command has been sent by DeviceNet communications.	• Press gauge button to turn Micro-Ion gauge ON (see page 27). • Use DeviceNet explicit messages or polled I/O to turn Micro-Ion gauge ON (see page 27).
Module LED is solid red.	Power supply amperage is too low.	Install power supply with a higher current rating (see page 11).

5.3 Micro-Ion gauge continuity test

If a problem with pressure measurement is traced to the module, the Micro-Ion gauge can be tested with an ohmmeter. This test can detect open filaments or shorts between gauge elements, but may not detect inaccurate pressure measurement associated with vacuum leaks or other materials within the gauge.

The gauge may be left on the system for the test. The module electronics will be removed to gain access to the pins on the gauge.

1. Turn OFF power and disconnect all electrical connectors to the Micro-Ion Plus module.
2. Unscrew the four captive Phillips-head screws until they disengage from the gauge. See Figure 5-1.
3. *Carefully* unplug the module electronics from the gauge to expose the gauge and end plate assembly. See Figure 5-2 and Figure 5-3.

Figure 5-1 Removing the gauge, Step 2

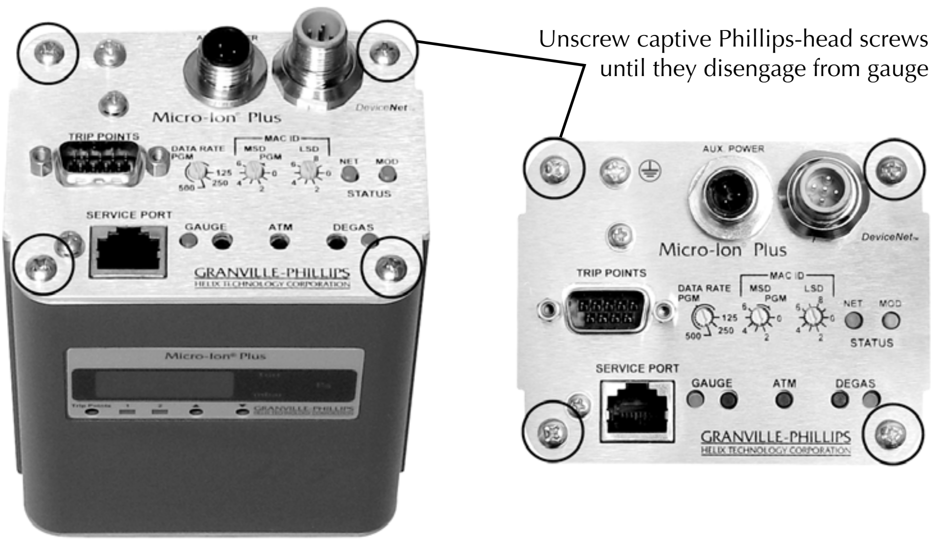


Figure 5-2 Removing the gauge, Step 3

Carefully unplug module electronics from gauge

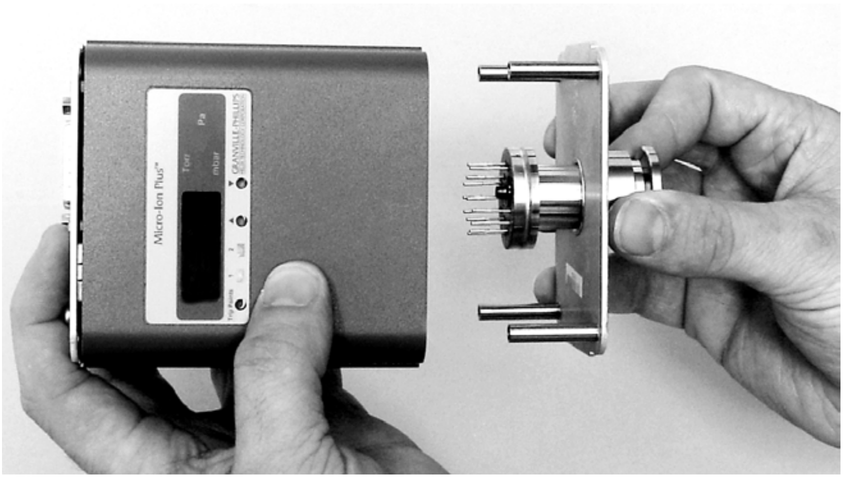


Figure 5-3 Micro-Ion Plus replacement gauge

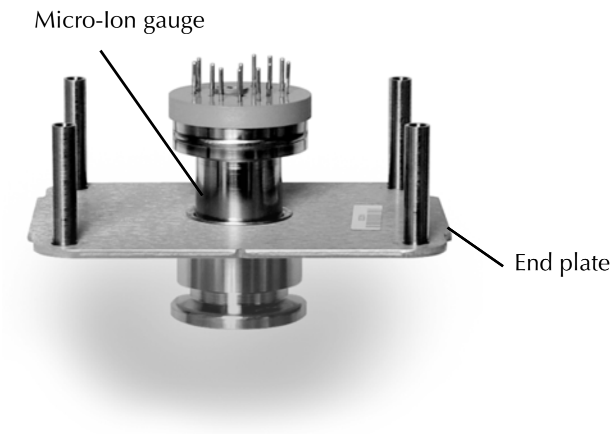
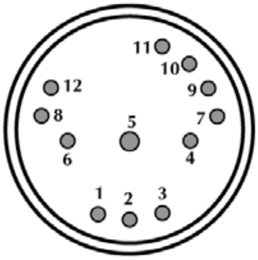


Figure 5-4 Micro-Ion gauge pins



Pin No.	Function
1	Filament #2
2	Filament Common
3	Filament #1
4	Grid
5	Collector
6	Grid
7	Heat-loss Sensor Current
8	Heat-loss Sensor Common
9	Heat-loss Sensor Voltage
10	Heat-loss Compensator Voltage
11	Heat-loss Compensator Current
12	Heat-loss Sensor Common

4. Use a digital multimeter to measure the resistance between pins 2 and 3 (the filament pins), and between pins 1 and 2. See Figure 5-4. The readings should be < 0.2 Ω.
5. Measure the resistance of filament pins 1, 2, or 3 to any of pins 4, 5, or 6, or the gauge case. The reading should be > 100 MΩ.
6. Measure the resistance between pins 4 and 6 (the grid pins). The reading should be < 0.1 Ω.
7. Measure the resistance of the grid pins to any of pins 1, 2, 3, or 5, or to the gauge case. The reading should be > 100 MΩ.
8. Measure the resistance of pin 5 (the collector pin) to the gauge case. The reading should be > 100 MΩ.
9. If any of the tests result in different readings than listed above, Contact Helix Technology customer service to order a replacement gauge.

Table 5-2 Test resistance values

Pins	Normal values
1 to 2 or 2 to 3	< 0.2 Ω
1, 2 or 3 to pins 4, 5, or 6	> 100 MΩ
4 to 6	< 0.1 Ω
4 or 6 to pins 1, 2, 3, or 5	> 100 MΩ
pin 5 to case	> 100 MΩ

5.4 Replacing the Micro-Ion gauge

Do not plug in or unplug any connectors with power applied to the module. Disconnect power from the module before replacing the Micro-Ion gauge.

1. Turn OFF power and disconnect all electrical connectors to the module.
2. Remove the module from the vacuum system.
3. Unscrew the four Phillips-head screws until they disengage from the gauge. See Figure 5-1.
4. While holding the vacuum connection flange, gently unplug the gauge and end plate out of the module as shown in Figure 5-2. The gauge and end plate are shown in Figure 5-3.
5. Insert the new gauge into the module by gently inserting the gauge pins into the socket on the circuit board. Look at the gauge pin arrangement to be sure you do not have the replacement gauge and end plate assembly improperly rotated.
6. Tighten the four Phillips-head screws.
7. Install the module on the vacuum system.
8. Calibrate the Conductron sensor at atmospheric pressure (see page 45).

5.5 Returning a damaged module

- If the module must be returned to the factory for service, request a Return Authorization (RA) from Helix Technology.
- Do not return products without first obtaining an RA.

When returning equipment to Helix Technology, if possible, use the original packaging. Otherwise, contact your shipper or Helix Technology for safe packaging guidelines. Use conductive or static dissipative envelopes to store or ship static sensitive devices or printed circuit boards.

Helix Technology will supply return packaging materials at no charge upon request. Shipping damage on returned products as a result of inadequate packaging is the customer's responsibility.

Photocopy the service form, fill it out, and return it with the module. A module that is returned without a service form (including the RA number) will be sent back to the customer at the customer’s expense.

Before you return the module, obtain an RA number by phoning Helix Technology Customer Service at **1–800–776–6543** within the U.S.A. or by emailing *custserv@helixtechnology.com*.

Service Form

RA number ________________________________ Model number ______________________________

Serial number ____ Date ____________

Name ____________________________________ Phone number ______________________________

Company ____

Street address ____

City _____________________________________ State _______________ ZIP ________________

Please help Helix Technology provide the best possible service by giving us information that will help us determine the cause of the problem and protect our analysis and calibration equipment from contamination.

Problem description: ____

____

____

____

Application description: ____

____

____

____

Has this product been used with
high vapor pressure or hazardous materials? Yes ❑ No ❑

If Yes, please list the types of gas, chemicals (common names, specific chemical,) biological materials, or other potentially contaminating or harmful materials exposed to the product during its use.

____

____

____

PRODUCTS EXPOSED TO RADIOACTIVE MATERIAL CANNOT BE ACCEPTED BY HELIX TECHNOLOGY UNDER ANY CIRCUMSTANCES.

Corporate officer signature ____

Contact name ______________________________ Phone number ______________________________

Appendix A Specifications

Measurement range for air and N_2

Measurements will change with different gases and gas mixtures. Micro-Ion Plus gauges are not intended for use with flammable or explosive gases. Atmospheric pressure value is based on calibration at time of use.

Torr	1 x 10^{-9} Torr to atmosphere ("At")
mbar	1 x 10^{-9} mbar to atmosphere ("At")
Pa	1 x 10^{-7} Pa to atmosphere ("At")

Micro-Ion gauge emission current

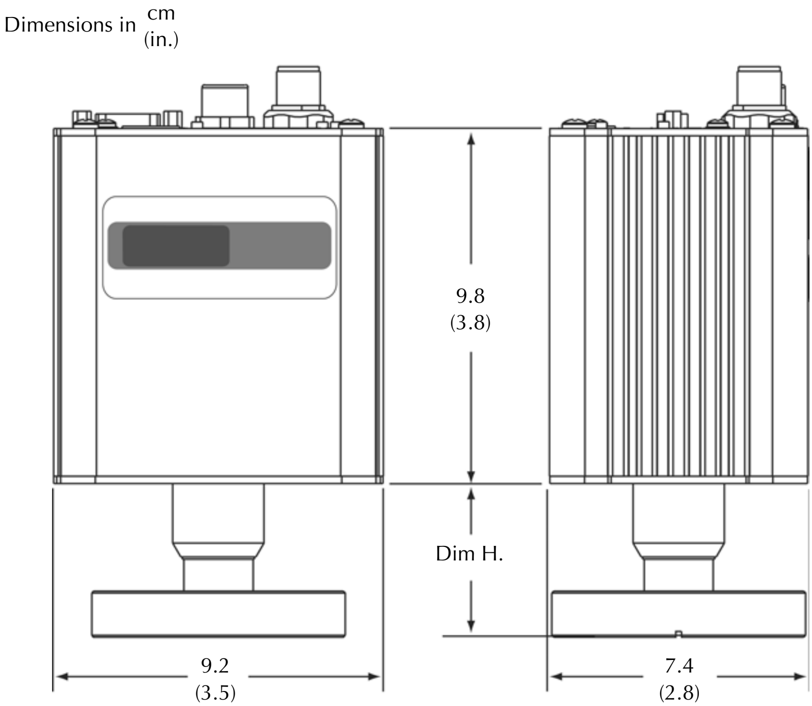
Emission current	0.1 and 4 mA, autoranging
Auto ranging (default values)	The default switching points for emission switching can be adjusted through the DeviceNet interface.
Ion gauge auto on	2 x 10^{-2} Torr, 2.66 x 10^{-2} mbar, 2.66 Pa, with decreasing pressure
Ion gauge auto off	3 x 10^{-2} Torr, 3.99 x 1^{-2} mbar, 3.99 Pa, with increasing pressure
Ion gauge degas	Electron bombardment, 3.75 W with 2-minute timer
Default switch to high (4.0 mA)	5 x 10^{-6} Torr, 7 x 10^{-6} mbar, 7 x 10^{-4} Pa, with decreasing pressure
Default switch to low (0.1 mA)	1 x 10^{-5} Torr, 1 x 10^{-5} mbar, 1 x 10^{-3} Pa, with increasing pressure, adjustable, 50% hysteresis (automatically set)
Filament selection	Alternating, automatic, or manual modes

- For a Micro-Ion gauge with yttria-coated iridium filaments, default is alternating
- For a Micro-Ion gauge with tungsten filaments, default is manual

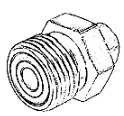
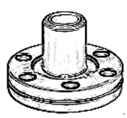
Physical characteristics

Weight	567 gm (20 oz.) with NW16KF fitting
Power required	24 Vdc ±15%, 26 W maximum
Operating environment	+10 °C to +40 °C ambient, non-condensing, indoor use only, ordinary protection for moisture, maximum altitude 3000 meters
Operating conditions	Suitable for continuous operation. Category 1 for installation over voltage. Pollution degree 2, Class 1 The 24 Vdc input power must be supplied from a power supply certified to IEC standard with a safety extra low voltage classified output.
Non-operating temperature	–40 °C to +70 °C
Case material	Aluminum extrusion
Connectors	5-pin DeviceNet connector for network communications and power supply 3-pin auxiliary connector for power (used for minimizing power required for network operations) 9-pin subminiature-D male for trip point relays
Materials exposed to gas	Yttria-coated iridium, gold-plated tungsten, 304 stainless steel, tantalum, tungsten, nickel iron alloy, nickel, borosilicate glass
CE compliance	
EMC Directive	89/336/EEC; EN 50081–2, EN 50082–2
Low Voltage Directive	73/23/EEC; EN61010–1
Display (optional)	2 digits plus exponent, green LED

Dimensions



Fittings for Micro-Ion Plus module

Fitting		Dim. H	
		cm	in.
	½–inch VCR-type male	5.8	2.3
	NW16KF	2.0	0.8
	NW25KF	2.0	0.8
	NW40KF	2.0	0.8
	1.33–inch (NW16CF) ConFlat	4.3	1.7
	2.75–inch (NW35CF) ConFlat	4.3	1.7

Trip point relays

Relay type	Two single-pole, double-throw relays (SPDT)
Relay contact rating	1 A at 30 Vdc resistive or non-inductive
Range	1 x 10^{-9} to 1000

Digital communication

Adjustable parameters	Atmospheric calibration, trip points (value, direction and hysteresis), gauge on/off, degas on/off, ion gauge emission switch point, filament mode, measurement units, keyboard lock/unlock
Messaging	Polled I/O and explicit
Data rate	125, 250, or 500 kbaud, switch selectable
Address	0–63
I/O slave messaging	Polling, COS, cyclic
Configuration method	Hardware switches, EDS, custom software
Connector	5-pin micro

Micro-Ion Plus module

Ion gauge sensitivity	
At 4 mA emission (high)	18 $Torr^{-1}$, 13.5 $mbar^{-1}$, 0.135 Pa^{-1}
At 0.1 mA emission (low)	20 $Torr^{-1}$, 15 $mbar^{-1}$, 0.15 Pa^{-1} (± 15% variation)
X-ray limit	< 3 x 10^{-10} Torr, < 3.99 x 10^{-10} mbar, < 3.99 x10^{-8} Pa
	The x-ray limit is the absolute lowest indication from the gauge. It is not practical to make repeatable measurements near the x ray limit
Micro-Ion gauge filament material	Tungsten or yttria-coated iridium
Conductron sensing wire material	Gold-plated tungsten
Internal volume	10.8 cm^3, (0.67 $in.^3$) to the port screen

B.1 Theory of operation

The Micro-Ion Plus vacuum gauge module consists of two separate pressure measuring devices: a hot filament Micro-Ion gauge (Bayard-Alpert type ionization gauge), and a Conductron heat-loss sensor. Whenever power is applied to the module, the Conductron sensor is ON. As the system is pumped down, the Conductron sensor turns ON the Micro-Ion gauge at the pressure switch point. As pressure increases, the Micro-Ion gauge is turned OFF by the Conductron sensor. The measurement range of the Micro-Ion gauge and the Conductron sensor overlap. When pressure is within the measurement range of the gauge and the sensor, the pressure output is a blended signal in the “transition range” between the gauge and the sensor.

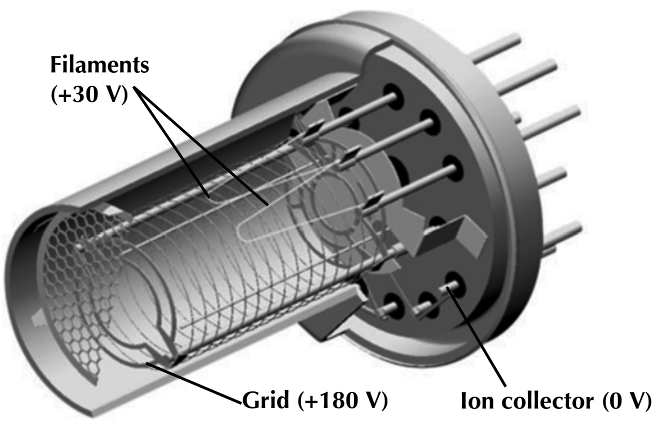
B.2 Micro-Ion gauge operation

The functional parts of the Micro-Ion gauge are the filaments (cathodes), grid (anode) and an ion collector, as illustrated in Figure B-1. These electrodes are maintained by the controller at +30, +180, and 0 volts, relative to ground, respectively.

The filaments are heated to such a temperature that electrons are emitted and accelerated toward the grid by the potential difference between the grid and filaments. All of the electrons eventually collide with the grid, but many first traverse the region inside the grid many times.

When an electron collides with a gas molecule, an electron is dislodged from the molecule, leaving it with a positive charge. Most ions are then accelerated to the ion collectors. The rate at which electron collisions with molecules occur is proportional to the density of gas molecules, and hence the ion current is proportional to the gas density (or pressure, at constant temperature).

Figure B-1 Micro-Ion gauge



The amount of ion current for a given emission current and pressure depends on the Micro-Ion gauge design. This gives rise to the definition of ionization gauge sensitivity, frequently denoted by “S”:

$$S = \frac{\text{Ion current}}{\text{Emission current} \times \text{Pressure}}$$

When used with N_2 or air, the ionization gauge has a nominal sensitivity of 20 $Torr^{-1}$ (15 $mbar^{-1}$, 0.15 Pa^{-1}) at high emission current or 18 $Torr^{-1}$ (13.5 $mbar^{-1}$, 0.135 Pa^{-1}) at low emission current.

The module electronics for the gauge varies the heating current to the filament to maintain a constant electron emission and measures the ion current to the ion collectors. The pressure is then calculated from these data.

Micro-Ion gauge degas is accomplished by increasing the emission current to 15 mA and raising the grid bias to 250 Vdc, resulting in an increased temperature of the grid to drive off adsorbed gases.

B.3 Conductron sensor operation

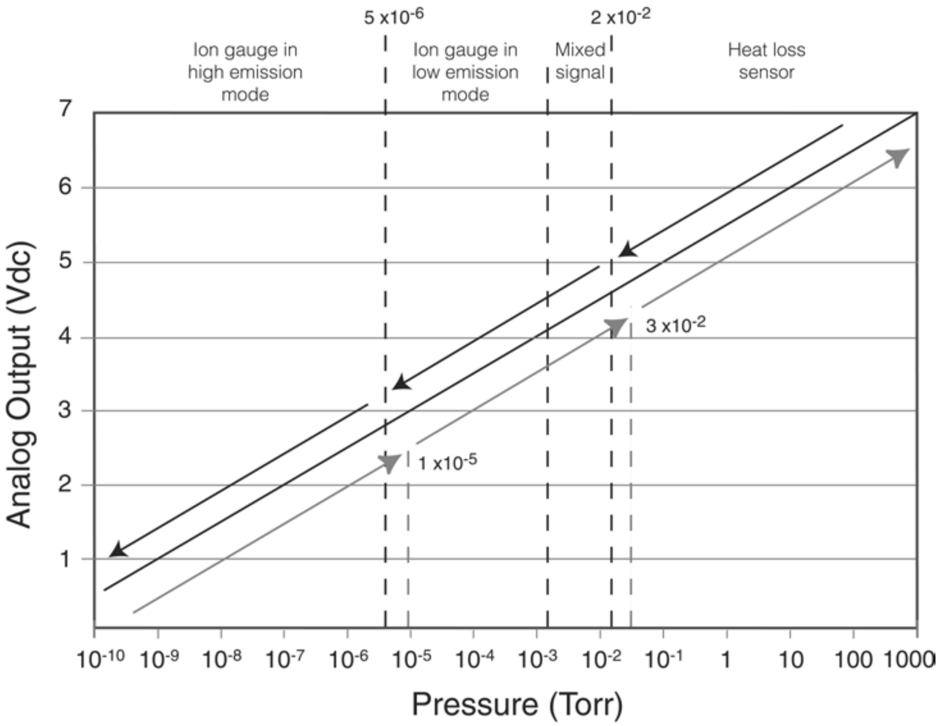
The Conductron heat-loss sensor uses Helix Technology’s Conductron sensor proprietary geometry and control circuitry. The sensor is comprised of two coplaner wire elements, a sensing wire, and a compensating wire that corrects for ambient conditions. The resistance of the sensing wire increases as its temperature increases. The controller continually adjusts a heating current that flows through the sensing wire to keep the sensor at a regulated temperature.

If pressure increases, the heat loss through gas conduction from the sensor increases, and the sensor temperature decreases, causing the resistance of the sensor to decrease. As this occurs, an error amplifier senses a change in the resistance differential between the sensor element and the compensation element, and generates an increase in the heating current through the sensor. The increased current through the sensor increases its temperature (and its resistance), and the resistance differential between the two elements is reestablished at a higher sensor input voltage and current. When calibrated, using a series of pressures and ambient temperatures, the input voltage and current are measured as an indication of the system pressure.

B.4 Auto ranging

As the vacuum system pumps down from atmosphere, the Conductron sensor measures pressure until a sufficiently low pressure level is achieved, then automatically turns ON the Micro-Ion gauge in the low emission mode. During the first decade that both sensors are operating, the control electronics mixes the signals. As the pressure is further reduced, the Micro Ion gauge switches from low emission to high emission. As pressure increases, the opposite occurs at slightly higher pressures. This sequence is illustrated in Figure B-2.

Figure B-2 Auto ranging actuation points



C.1 Polled I/O messaging summary

Input I/O (to master)

Instance	Data type	Data units
1	2 bytes, INT	Pressure = 10^((INT/6500)–12.699)
2	1 byte, BYTE and 2 bytes, INT	Exception status and pressure - 10^((INT/6500)–12.699)
4	4 bytes, REAL	Pressure
5	1 byte, BYTE and 4 bytes, REAL	Exception status and pressure (default)

Output I/O (from master)

Instance	Data type	Data units
1	1 byte, BYTE	Structure of bits: Bit 7 = high emission, Bit 6 = Gauge and sensor ON/OFF, Bit 2 = enable filament 2, Bit 1 = enable filament 1, Bit 0 = Micro-Ion gauge degas

C.2 Explicit message summary

Identity object

Service	Class	Instance	Attribute	Master data	Device data	Data type	Description	Type
$0E_{hex}$	1	1	1	None	5C 00	UINT	Vendor identification (92)	Open
$0E_{hex}$	1	1	2	None	1C 00	UINT	Product type (28)	Open
$0E_{hex}$	1	1	3	None	04 00	UINT	Product ID (4)	Open
$0E_{hex}$	1	1	4	None	01 0E	STRUCT	Firmware revision (14)	Open
$0E_{hex}$	1	1	5	None	00 00	WORD	Status and fault information (0)	Open
$0E_{hex}$	1	1	6	None	9B 33 42 15	UDINT	Serial number	Open
$0E_{hex}$	1	1	7	None	"GP356"	SSTRING	Identification	Open
5	1	1	None	None	None		Reset service	Open

DeviceNet object

Service	Class	Instance	Attribute	Master data	Device data	Data type	Description	Type
$0E_{hex}$	3	0	1	None	02 00	UINT	GET object revision (2)	Open
$0E_{hex}$	3	1	1	None	3F	USINT	GET node address, range 0–63 (63)	Open
10_{hex}				3E	Success		SET node address if switch is set to "PGM" (62)	
$0E_{hex}$	3	1	2	None	02	USINT	GET baud rate, range 0–2 (500 kbaud)	Open
10_{hex}				01	Success		SET baud rate if switch is set to "PGM" (250 kbaud)	
$0E_{hex}$	3	1	3	None	00	BOOL	GET bus-off interrupt, range 0–1	Open
10_{hex}				01	Success		SET bus-off interrupt, range 0–1	
$0E_{hex}$	3	1	4	None	00	USINT	GET bus-off counter, range 0–255	Open
10_{hex}				00	Success		SET bus-off counter, range 0–255	
$0E_{hex}$	3	1	5	None	03 00	STRUCT	GET allocation choice and master 10, 0–63 1 = polled 0 = explicit 4 = COS	Open
$4B_{hex}$	3	1	None	03 00	Success	STRUCT	SET allocation choice and master 10, 0–63 1 = polled 0 = explicit 4 = COS	
$4C_{hex}$	3	1	None	03 00	Success	STRUCT	Release allocation 1 = polled 0 = explicit 4 = COS	Open

Assembly object

Service	Class	Instance	Attribute	Master data	Device data	Data type	Description	Type
$0E_{hex}$	4	0	65_{hex}	None	05	USINT	GET I/O instance selection, range 1,2, 4 or 5	Vendor
10_{hex}				02	Success		SET I/O instance selection, range 1,2, 4 or 5	
$0E_{hex}$	4	0	66_{hex}	None	64	USINT	GET consumed instance selection, 0 or 100 (100)	Vendor
10_{hex}				00	Success		SET consumed instance selection, 0 or 100	
$0E_{hex}$	4	1	3	None	4F 83	UINT	GET INT pressure data (131)	Open
$0E_{hex}$	4	2	3	None	00 4F 83	STRUCT	GET BYTE status and UINT pressure data 0 state (131)	Open
$0E_{hex}$	4	4	3	None	65 3D C2 41	REAL	GET REAL pressure data (24.3)	Open
$0E_{hex}$	4	5	3	None	00 65 3D C2 41	STRUCT	GET BYTE status and REAL pressure data (24.3)	Open
$0E_{hex}$	4	64_{hex}	3	None	00	BYTE	GET gauge status	Vendor
10_{hex}				00	Success		SET gauge status	

Connection object, explicit message connection

Service	Class	Instance	Attribute	Master data	Device data	Data type	Description	Type
$0E_{hex}$	5	1	1	None	03	USINT	GET state of the object, range 0–5	Open
$0E_{hex}$	5	1	2	None	00	USINT	GET instance type, explicit	Open
$0E_{hex}$	5	1	3	None	83	BYTE	GET transport class trigger	Open
$0E_{hex}$	5	1	4	None	04	USINT	GET produced connection ID	Open
$0E_{hex}$	5	1	5	None	04	USINT	GET consumed connection ID	Open
$0E_{hex}$	5	1	6	None	21	BYTE	GET initial comm characteristics	Open
$0E_{hex}$	5	1	7	None	18 00	UINT	GET produced connection size (24)	Open
$0E_{hex}$	5	1	8	None	18 00	UINT	GET consumed connection size (24)	Open
$0E_{hex}$	5	1	9	None	C4 09	UINT	GET expected packet rate (2500 msec)	Open
10_{hex}				D0 07	Success		SET expected packet rate, range 0–65535 (2000 msec)	
$0E_{hex}$	5	1	$0C_{hex}$	None	01	USINT	GET watchdog timeout action	Open
10_{hex}				03	Success		SET watchdog timeout action, 1 or 3	
$0E_{hex}$	5	1	$0D_{hex}$	None	04 00	UINT	GET produced connection path length	Open
$0E_{hex}$	5	1	$0E_{hex}$	None	20 04 24 01 30 03	EPATH	GET produced connection path	Open
$0E_{hex}$	5	1	$0F_{hex}$	None	04 00	UINT	GET consumed connection path length	Open
$0E_{hex}$	5	1	10_{hex}	None	20 04 24 01 30 03	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

Connection object, polled I/O connection

Service	Class	Instance	Attribute	Master data	Device data	Data type	Description	Type
$0E_{hex}$	5	2	1	None	03	USINT	GET state of the object, range 0–5	Open
$0E_{hex}$	5	2	2	None	01	USINT	GET instance type, I/O	Open
$0E_{hex}$	5	2	3	None	82	BYTE	GET transport class trigger (130)	Open
$0E_{hex}$	5	2	4	None	05	USINT	GET produced connection ID, 1 or 2 or 4 or 5	Open
$0E_{hex}$	5	2	5	None	01	USINT	GET consumed connection ID, 0 or 1	Open
$0E_{hex}$	5	2	6	None	01	BYTE	GET initial comm 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	C4 09	UINT	GET expected packet rate (2500 msec)	Open
10_{hex}				D0 07	Success		SET expected packet rate, range 0–65535 (2000 msec)	
$0E_{hex}$	5	2	$0C_{hex}$	None	00	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	20 04 24 05 30 03	EPATH	GET produced connection path (05 = REAL)	Open
10_{hex}				20 04 24 02 30 03	Success		SET produced connection path, 1 or 2 or 4 or 5 (02 = status + integer)	
$0E_{hex}$	5	2	$0F_{hex}$	None	06 00	UINT	GET consumed connection path length	Open
$0E_{hex}$	5	2	10_{hex}	None	20 04 24 01 30 03	EPATH	GET consumed connection path, 0 or 1	Open
$0E_{hex}$	5	2	11_{hex}	None	00 00	UINT	GET production inhibit time	Open
$0E_{hex}$	5	2	11_{hex}	None	00 00	UINT	GET production inhibit time or COS	Open
10_{hex}				00 00	Success		SET production inhibit time or COS	
05_{hex}	5	2	None	None	Success	None	RESET inactivity/ Watchdog timer	Open

Connection object, COS I/O connection, acknowledged

Service	Class	Instance	Attribute	Master data	Device data	Data type	Description	Type
$0E_{hex}$	5	4	1	None	03	USINT	GET state of the object, range 0–5	Open
$0E_{hex}$	5	4	2	None	01	USINT	GET instance type, COS	Open
$0E_{hex}$	5	4	3	None	12	BYTE	GET transport class trigger	Open
$0E_{hex}$	5	4	4	None	05	USINT	GET produced connection ID, 1 or 2 or 4 or 5	Open
$0E_{hex}$	5	4	5	None	00	USINT	GET consumed connection ID, master COS Ack message, 0 or 1	Open
$0E_{hex}$	5	4	6	None	01	BYTE	GET initial comm characteristics	Open
$0E_{hex}$	5	4	7	None	05 00	UINT	GET produced connection size	Open
$0E_{hex}$	5	4	8	None	00 00	UINT	GET consumed connection size	Open
$0E_{hex}$	5	4	9	None	00 00	UINT	GET expected packet rate	Open
10_{hex}				00 00	Success		SET expected packet rate, range 0–65535	
$0E_{hex}$	5	4	$0C_{hex}$	None	00	USINT	GET watchdog timeout action	Open
$0E_{hex}$	5	4	$0D_{hex}$	None	06 00	UINT	GET produced connection path length	Open
$0E_{hex}$	5	4	$0E_{hex}$	None	20 04 24 05 30 03	EPATH	GET produced connection path, 1 or 2 or 4 or 5	Open
$0E_{hex}$	5	4	$0F_{hex}$	None	04 00	UINT	GET consumed connection path length	Open
$0E_{hex}$	5	4	10_{hex}	None	20 2B 24 01	EPATH	GET consumed connection path, 0 or 1	Open
$0E_{hex}$	5	4	11_{hex}	None	00 00	UINT	GET production inhibit time	Open
10_{hex}				00 00	Success		SET production inhibit time	
05_{hex}	5	4	None	None	Success	None	RESET inactivity/ Watchdog timer	Open

Acknowledge handler object

Service	Class	Instance	Attribute	Master data	Device data	Data type	Description	Type
$0E_{hex}$	$2B_{hex}$	1	1	None	18 00	UINT	GET acknowledge timer (values limited by resolution)	Open
10_{hex}				18 00	Success + data		SET acknowledge timer, range 1–65535	
$0E_{hex}$	$2B_{hex}$	1	2	None	01	USINT	GET acknowledge retry limit	Open
10_{hex}				02	Success		SET acknowledge retry limit	
$0E_{hex}$	$2B_{hex}$	1	3	None	04 00	UINT	GET producing connection instance	Open

Device supervisor object

Service	Class	Instance	Attribute	Master data	Device data	Data type	Description	Type
$0E_{hex}$	30_{hex}	1	3	None	"CG"	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	"356005"	SSTRING	GET mfg. model number	Open
$0E_{hex}$	30_{hex}	1	7	None	"1.14"	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	00	USINT	GET device status	Open
$0E_{hex}$	30_{hex}	1	$0C_{hex}$	None	00	BYTE	GET exception status	Open
$0E_{hex}$	30_{hex}	1	$0F_{hex}$	None	01	BOOL	GET alarm enable	Open
10_{hex}				00	Success		SET alarm enable	
$0E_{hex}$	30_{hex}	1	10_{hex}	None	00	BOOL	GET warning enable 1 = warrning reported 0 = warning not reported	Open
10_{hex}				00	Success		SET warning enable	
05_{hex}	30_{hex}	1	None	None	Success	None	RESET object	Open
06_{hex}	30_{hex}	1	None	None	Success	None	Start device execution	Open
$4B_{hex}$	30_{hex}	1	None	None	Success	None	Abort device activity, no effect on device, gauge OFF	Open
$4C_{hex}$	30_{hex}	1	None	None	Success	None	Recover from abort state, no effect on device, gauge ON	Open
$4D_{hex}$	30_{hex}	1	None	None	Success	None	Perform diagnostics, no effect on device	Open

Analog sensor object, instance 0

Service	Class	Instance	Attribute	Master data	Device data	Data type	Description	Type
$0E_{hex}$	31_{hex}	0	$5E_{hex}$	None	65 3D C2 41	REAL	GET active value (24.3)	Open
$0E_{hex}$	31_{hex}	0	$5F_{hex}$	None	01 00	UINT	GET active instance number, 1 or 2	Open
$0E_{hex}$	31_{hex}	0	60_{hex}	None	02	USINT	GET number of gauges, 2	Open
$0E_{hex}$	31_{hex}	0	63_{hex}	None	01 00	UINT	GET subclass, 1 for combination gauge	Open

Analog sensor object, instance 1, Conductron sensor

Service	Class	Instance	Attribute	Master data	Device data	Data type	Description	Type
0E$_{hex}$	31$_{hex}$	1	3	None	CA	USINT	GET data type	Open
0E$_{hex}$	31$_{hex}$	1	4	None	01 03	UINT	GET data units (769 = Torr)	Open
10$_{hex}$				08 03	Success		SET data units, 769 or 776 or 777 769 = Torr 776 = mbar 777 = Pa	
0E$_{hex}$	31$_{hex}$	1	5	None	01	BOOL	GET reading valid, 0 or 1	Open
0E$_{hex}$	31$_{hex}$	1	6	None	65 3D C2 41	REAL	GET pressure reading (25.3)	Open
0E$_{hex}$	31$_{hex}$	1	7	None	00	BYTE	GET status, alarm or warning	Open
0E$_{hex}$	31$_{hex}$	1	22$_{hex}$	None	00 00 A0 41	REAL	GET produce trigger delta, 20% of reading	Open
10$_{hex}$				00 00 20 41	Success		SET produce trigger delta, 10% of reading	
0E$_{hex}$	31$_{hex}$	1	24$_{hex}$	None	01	USINT	GET produce trigger delta data type	Open
0E$_{hex}$	31$_{hex}$	1	63$_{hex}$	None	02 00	UINT	GET subclass number	Open
0E$_{hex}$	31$_{hex}$	1	67$_{hex}$	None	46 00	UINT	GET maximum internal temperature (70° C)	Vendor
0E$_{hex}$	31$_{hex}$	1	68$_{hex}$	None	41 00	UINT	GET current internal temperature (65° C)	Vendor
4B$_{hex}$	31$_{hex}$	1	None	None	None	None	SET offet zero adjust, heat-loss gauge	Open
4C$_{hex}$	31$_{hex}$	1	None	None	None	None	SET gain adjust, heat-loss gauge	Open

Analog sensor object, instance 2, Micro-Ion gauge

Service	Class	Instance	Attribute	Master data	Device data	Data type	Description	Type
0E$_{hex}$	31$_{hex}$	2	3	None	CA	USINT	GET data type	Open
0E$_{hex}$	31$_{hex}$	2	4	None	01 03	UINT	GET data units (769 = Torr)	Open
10$_{hex}$				08 03	Success		SET data units, 769 or 776 or 777 769 = Torr 776 = mbar 777 = Pa	
0E$_{hex}$	31$_{hex}$	2	5	None	01	BOOL	GET reading valid, 0 or 1	Open
0E$_{hex}$	31$_{hex}$	2	6	None	AC C5 A7 36	REAL	GET pressure reading (5E^{-6})	Open
0E$_{hex}$	31$_{hex}$	2	7	None	00	BYTE	GET status, alarm or warning	Open
0E$_{hex}$	31$_{hex}$	2	22$_{hex}$	None	00 00 A0 41	REAL	GET produce trigger delta	Open
10$_{hex}$				00 00 20 41	Success		GET produce trigger delta (20% of reading)	
0E$_{hex}$	31$_{hex}$	2	24$_{hex}$	None	01	USINT	SET produce trigger delta, 10% of reading	Open
0E$_{hex}$	31$_{hex}$	2	59$_{hex}$	None	01	BOOL	GET active filament Bit 0 = filament 1 Bit 1 = filament 2	Open

Analog sensor object, instance 2, Micro-Ion gauge (continued)

Service	Class	Instance	Attribute	Master data	Device data	Data type	Description	Type
$0E_{hex}$	31_{hex}	2	58_{hex}	None	00	BOOL	GET degas state	Open
10_{hex}	31_{hex}	2	58_{hex}	00	Success	USINT	SET gauge degas state, 0 = OFF, 1 = ON	Vendor
$0E_{hex}$	31_{hex}	2	$5B_{hex}$	None	6F 12 83 3B	REAL	GET emission current (4 mA)	Open
$0E_{hex}$	31_{hex}	2	$5D_{hex}$	None	00	BOOL	GET gauge state	Open
10_{hex}	31_{hex}	2	$5D_{hex}$	01	Success	USINT	SET gauge state, 0 = OFF, 1 = ON	Vendor
0Ehex	31hex	2	$5E_{hex}$	None	00	BOOL	GET sensor warning	Open
$0E_{hex}$	31_{hex}	2	$5F_{hex}$	None	00	BOOL	GET sensor alarm	Open
$0E_{hex}$	31_{hex}	2	60_{hex}	None	00	BOOL	GET device exception status	Open
$0E_{hex}$	31_{hex}	2	63_{hex}	None	05 00	UINT	GET subclass number	Open
$0E_{hex}$	31_{hex}	2	67_{hex}	None	46 00	UINT	GET maximum internal temperature (70° C)	Vendor
$0E_{hex}$	31_{hex}	2	68_{hex}	None	41 00	UINT	GET current internal temperature (65° C)	Vendor
$0E_{hex}$	31_{hex}	2	69_{hex}	None	02	USINT	GET filament mode (manual)	Vendor
10_{hex}				01	Success	USINT	SET filament mode 0 = automatic 1 = alternating 2 = manual	
$0E_{hex}$	31_{hex}	2	$6A_{hex}$	None	00 00	UINT	GET gauge delay time	Vendor
10_{hex}				0A 00	Success		SET gauge delay time, 0–600 seconds (10 seconds)	
$0E_{hex}$	31_{hex}	2	$6B_{hex}$	None	02	USINT	GET filament type	Vendor
10_{hex}				02	Success		SET filament type, 2 = yttria, 3 = tungsten	
61_{hex}	31_{hex}	2	None	00	Success	USINT	SET degas state, 0 = OFF, 1 = ON	Open
62_{hex}	31_{hex}	2	None	00	Success	USINT	SET gauge state, 0 = OFF, 1 = ON	Open
63_{hex}	31_{hex}	2	None	None	Success	None	Clear emission OFF alarm	Open

Trip point object, 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 trip point value, relay 1 (00)	Open
10_{hex}				17 B7 D1 38	Success		SET trip point value, relay 1 ($1E^{-4}$)	
$0E_{hex}$	35_{hex}	1	6	None	00	BOOL	GET trip point enable, relay 1	Open
10_{hex}				01	Success		SET trip point enable, relay 1, 0 = disabled, 1 = enabled	
$0E_{hex}$	35_{hex}	1	7	None	00	BOOL	GET trip point status, relay 1	Open
$0E_{hex}$	35_{hex}	1	8	None	00	BOOL	GET polarity, relay 1	Open
10_{hex}				01	Success		SET polarity relay 1, 0 = normal, 1 = reversed	
$0E_{hex}$	35_{hex}	1	9	None	00	USINT	GET override status, 0 = normal, 1 = force false	Open
$0E_{hex}$	35_{hex}	1	$0A_{hex}$	None	00 00 20 41	REAL	GET relay 1 hysteresis as percentage of pressure (10%)	Open
10_{hex}				00 00 A0 41	Success		SET relay 1 hysteresis as percentage of pressure (20%)	
$0E_{hex}$	35_{hex}	1	$0C_{hex}$	None	24 01	EPATH	GET destination path, 01, 02, 03	Open
$0E_{hex}$	35_{hex}	1	$0D_{hex}$	None	01	BOOL	GET output to output object	Open
$0E_{hex}$	35_{hex}	1	$0E_{hex}$	None	24 01	EPATH	GET source path from analog object	Open
$0E_{hex}$	35_{hex}	1	$0F_{hex}$	None	AC C5 A7 36	REAL	GET input data from analog sensor object ($5E^{-6}$)	Open
$0E_{hex}$	35_{hex}	1	11_{hex}	None	CA	USINT	GET data type, CA_{hex} or $C3_{hex}$	Open

Trip point object, 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 trip point value, relay 2 (00)	Open
10_{hex}				17 B7 D1 38	Success		SET trip point value, relay 2 ($1E^{-4}$)	
$0E_{hex}$	35_{hex}	2	6	None	00	BOOL	GET trip point enable, relay 2	Open
10_{hex}				01	Success		SET trip point enable, relay 2, 0 = disabled, 1 = enabled	
$0E_{hex}$	35_{hex}	2	7	None	00	BOOL	GET trip point status, relay 2	Open
$0E_{hex}$	35_{hex}	2	8	None	00	BOOL	GET polarity, relay 2	Open
10_{hex}				01	Success		SET polarity relay 2, 0 = normal, 1 = reversed	
$0E_{hex}$	35_{hex}	2	9	None	00	USINT	GET override status, 0 = normal, 1 = force false	Open
$0E_{hex}$	35_{hex}	2	$0A_{hex}$	None	00 00 20 41	REAL	GET relay 2 hysteresis as percentage of pressure (10%)	Open
10_{hex}				00 00 A0 41	Success		SET relay 2 hysteresis as percentage of pressure (20%)	
$0E_{hex}$	35_{hex}	2	$0C_{hex}$	None	24 02	EPATH	GET destination path, 01, 02, 03	Open
$0E_{hex}$	35_{hex}	2	$0D_{hex}$	None	01	BOOL	GET output to output object	Open
$0E_{hex}$	35_{hex}	2	$0E_{hex}$	None	24 02	EPATH	GET source path from analog object	Open
$0E_{hex}$	35_{hex}	2	$0F_{hex}$	None	AC C5 A7 36	REAL	GET input data from analog sensor object ($5E^{-6}$)	Open
$0E_{hex}$	35_{hex}	2	11_{hex}	None	CA	USINT	GET data type, CA_{hex} or $C3_{hex}$	Open

Trip point object, emission range pressure

Service	Class	Instance	Attribute	Master data	Device data	Data type	Description	Type
$0E_{hex}$	35_{hex}	3	5	None	AC C5 A7 36	REAL	GET trip point value emission ranging ($5E^{-6}$)	Open
10_{hex}				95 BF 56 33	Success		SET trip point value, emssion ranging ($5E^{-8}$)	
$0E_{hex}$	35_{hex}	3	6	None	01	BOOL	GET trip point enable, emission ranging	Open
$0E_{hex}$	35_{hex}	3	7	None	00	BOOL	GET trip point status, emission ranging	Open
$0E_{hex}$	35_{hex}	3	9	None	00	USINT	GET override status, 0 = normal, 1 = force false	Open
$0E_{hex}$	35_{hex}	3	$0C_{hex}$	None	24 03	EPATH	GET destination path, 01, 02, 03	Open
$0E_{hex}$	35_{hex}	3	$0D_{hex}$	None	01	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	AC C5 A7 36	REAL	GET REAL pressure data from analog sensor object ($5E^{-6}$)	Open
$0E_{hex}$	35_{hex}	3	11_{hex}	None	CA	USINT	GET data type, CA_{hex} or $C3_{hex}$	Open

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Micro-Ion® Plus Module With DeviceNet™ Protocol

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Instruction Manual

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