

Instruction Manual

Terranova Scientific Model 921 Cold Cathode Gauge Controller for use with HPS Inverted Magnetron Vacuum Gauges



TERRANOVA

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Safety Information

High Voltage

WARNING!

The Terranova 921 Cold Cathode Gauge Controller supplies a high voltage of 4,000 volts to the HPS Inverted Magnetron Gauge Head when the “Hi Volt Gauge on” is activated. Be sure that the Hi Volt light is off and/or that the power is removed from the Terranova 921 Controller before connecting or disconnecting either end of the gauge cable.

Combustible Gases

WARNING!

Do not use the Terranova 921 Cold Cathode Gauge Controller / Display to measure the pressure of combustible gas mixtures. The gauge operates with an ionized gas discharge, and it is possible that this discharge may cause ignition of combustible mixtures, which then might explode and cause damage to equipment and injury to personnel.

Chemicals

WARNING!

Many organic cleaning solvents, such as acetone, produce fumes that are toxic or flammable. Use such solvents only in areas that are well ventilated to the outdoors and away from electronic equipment, open flames, or other potential ignition sources.

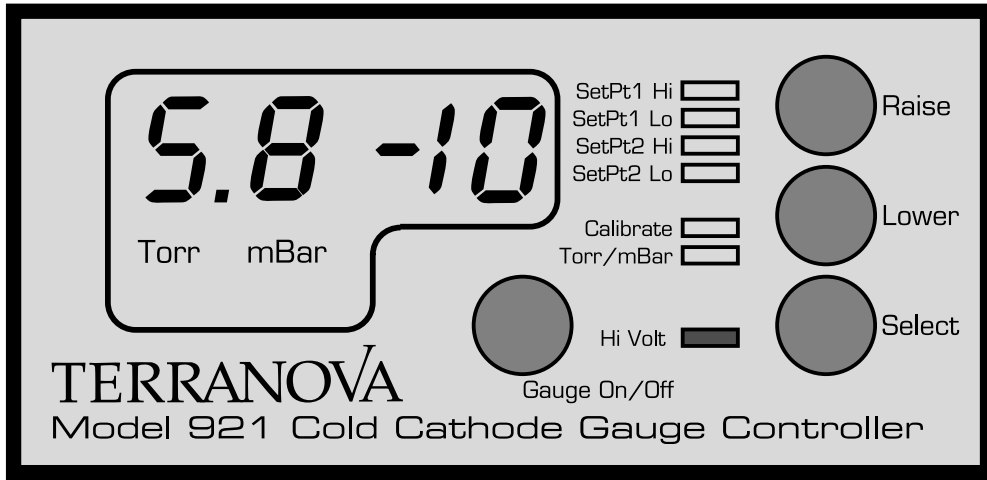


Figure 1: Model 921 Front Panel

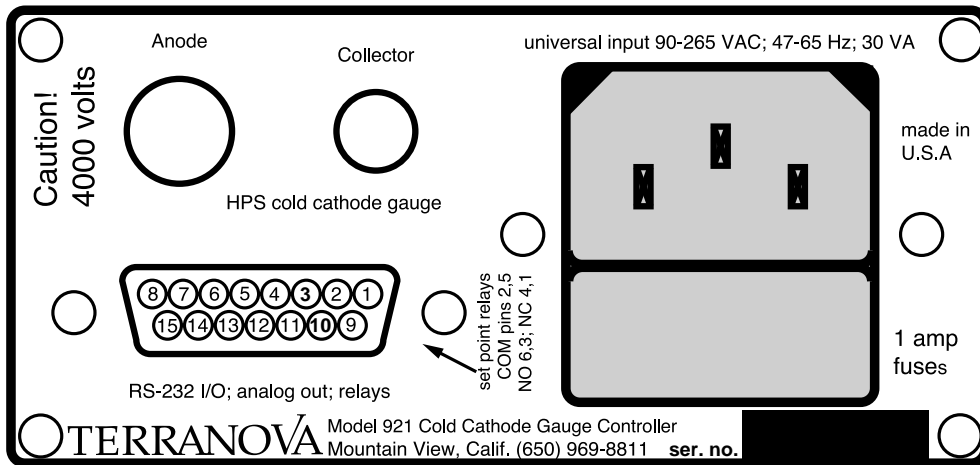


Figure 2: Model 921 Rear Panel

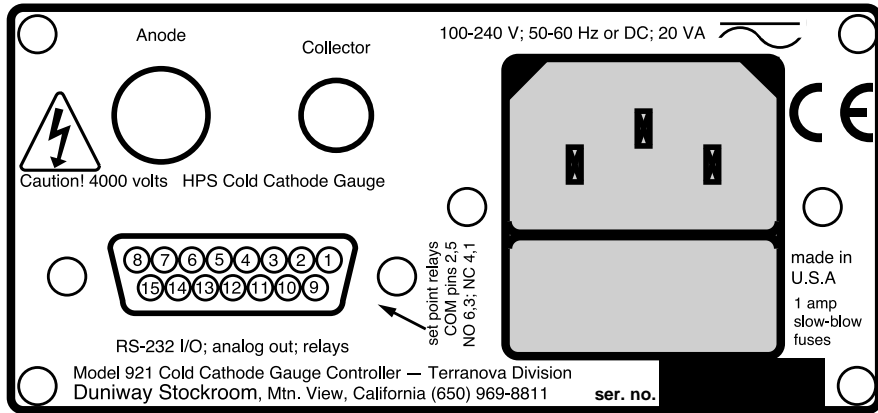


Figure 3: Model 921 Rear Panel, CE Model

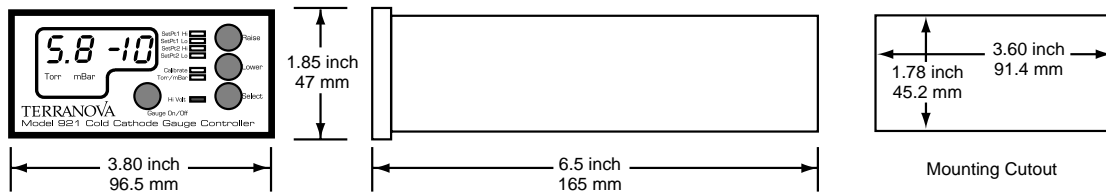


Figure 4: Model 921 Dimensions

I Overview

A. General Description

The Terranova Scientific Model 921 Cold Cathode Gauge Controller displays vacuum pressure as measured from an HPS inverted magnetron gauge tube. It displays vacuum measurements based on ionization of the residual gas. The Model 921 controller covers the range from 3×10^{-10} Torr (mbar) to 10^{-2} Torr (mBar), and controls two relays with independent set points.

B. Specifications

1. Useful Measuring Range
 3×10^{-10} Torr (mBar) to 10^{-2} Torr (mBar), for air or nitrogen; range selection is automatic
2. Display Range
 3×10^{-10} Torr (mBar) to 10^{-2} Torr (mBar)
3. Units of Display
 torr or mBar; user selectable
4. Vacuum Gauge
 HPS Inverted Magnetron gauges, series 421 or I-Mag®, series 423.
5. Operating Temperature Range
 +2 to +50 deg. Celsius
6. Pressure Display
 4-digit bright LED, 10 mm high
7. Display Indicators
 red LED for set points and other parameters
8. Process Control Set Points
 two, adjusted by front panel push-button
9. Process Control Relays
 two relays, 2 amp, 240 VAC contacts; independent Normally Open and Normally Closed; +5 volts is provided for TTL applications; available through the D15 accessory connector
10. Nonvolatile Memory
 for all user adjusted parameters

I-Mag® is a registered trademark of MKS Instruments Inc.

11. Analog Output

calibrated, 12-bit resolution, logarithmic, 0.50 volts/decade

12. RS-232 Input/Output

allows user to read pressure and set points; 9600 baud, 8-N-1; available through the D15 accessory connector

13. Operating Voltage

the Model 921 has a universal power supply, which operates on input voltages from 85 VAC to 265 VAC 50/60 Hz; standard IEC 320 instrument power input receptacle on rear panel; replacement fuse type: 5 mm X 20 mm, regular 1 amp

<u>manufacturer</u>	<u>fuse type</u>
Bussman	GDB-1A or GDC-1A
Littlefuse	217 001 or 218 001

14. Weight

1 lb. / 0.5 kg

15. Mounting

Side clips are provided for panel mounting in standard 1/8 DIN cutout.

16. Environmental Considerations

not for use with explosive or corrosive gases

17. Vacuum gauge tube:

the HPS Cold Cathode (Inverted Magnetron) and cable are available from Duniway Stockroom or HPS:

Duniway Stockroom

tel (800) 446-8811 or (650) 969-8811 (California)

Facsimile (650) 965-0764

Inverted Magnetron Gauge: Duniway part no. IMAG-CFF

Inverted Magnetron Cable: Duniway part no. IMAG-CBL

HPS Division of MKS Instruments

tel. (800) 345-1967; (303) 449-9861 (Colorado)

Facsimile (303) 442-6880

II Installation

A. Unpack the Controller

Carefully unpack the Model 921 Gauge Controller.
The gauge controller shipment includes these components:

- controller unit
- power cord
- mounting clips
- D15 accessory connector
- this instruction manual

If your controller does not have all of these items, call Duniway Stockroom. If it appears to have been damaged in shipment, contact the shipper.

B. Mount the Controller

You can mount the controller unit freestanding on a bench, table top, or shelf, or you can mount it in a rack or cabinet. The controller unit is housed in a standard 1/8 DIN box.

If you are mounting the unit in a panel, the cutout dimensions are 44 mm by 92 mm. One mounting clip attaches to each of the sides of the controller unit. To attach the clip, slide the beveled surfaces of the clip under the cutout on the side of the box and push the clip toward the back of the unit until the central tongue locks the clip in place. Then slide the unit into the panel; the clips will hold the unit in place.

Be sure to leave enough clearance at the back of the controller unit for easy access to cable connections.

C. Select the Gauge Tube

The Model 921 controller is designed to work with the HPS Inverted Magnetron gauge tube, series 421 or I-Mag. See **Specifications** for availability of gauges. If you have difficulty obtaining a gauge, please contact us at Duniway Stockroom.

CAUTION

Use of a gauge tube other than those listed above may cause improper readings, and may cause damage to the gauge tube.

D. Connect the Gauge Tube

Make sure that the gauge tube is securely connected to the vacuum system, using good vacuum practice.

E. Attach the Gauge Cable

The gauge cable has a two coaxial connectors for the gauge. One is a high voltage BNC (SH-VBNC); this connector is for the 4000 volt anode excitation of the gauge. The smaller connector is an SMB coaxial connector, for the collector signal.

Connect both connectors of the gauge cable to the gauge tube and to the 921 controller.

NOTE

If you have an HPS cable for this series of gauges, you may use it with your Model 921 gauge controller, since connectors are the same as for the HPS instruments.

F. Make Relay Connections

You can set two process control set points from the front panel of the controller (SET PT 1) and (SET PT 2). The set points control two relays that are accessible through the connector on the back of the controller. SET PT 1 controls relay #1, and SET PT 2 controls relay #2. Relay contacts are available through the D15 Accessory Connector. See Table 1, below on page 11.

G. Make Accessory Connections

The 15-pin D-sub Accessory Connector is on the rear panel of the 921, see Table 1, below on page 11. The connector has female pins; the mating connector must have male pins. Mating D-sub 15 connectors are available from many of the normal electronic sources. If you need help identifying a source, please contact us.

H. Check Supply Voltage

The Model 921 incorporates a universal power supply. This allows the 921 to operate on any input voltage from 90 VAC to 265 VAC, 47 to 65 Hz.

I. Attach the Power Cord

Plug the power cord into the receptacle in the power module on the rear of the 921.

Table 1 Accessory Connector Pin Assignments

Following are the pin assignments for the Accessory Connector:

<u>15-Pin-D</u>	<u>Signal Function</u>
pin 1	Set Point #1 relay, normally closed
pin 2	Set Point #1 relay, common
pin 3	Set Point #1 relay, normally open
pin 4	Set Point #2 relay, normally closed
pin 5	Set Point #2 relay, common
pin 6	Set Point #2 relay, normally open
pin 7	Tx, RS-232 signal out of the 921, 9600-N-8-1
pin 8	Rx, RS-232 signal into the 921
pin 9	Ground, RS-232 and analog common
pin 10	no function
pin 11	no function
pin 12	no function
pin 13	Analog Output, 1Kohm, 0.5 volts per decade
pin 15	no function
pin 16	no function

III Operation

A. Turn Power On

Plug the AC power end of the power cord into an electrical outlet. The loudspeaker will “beep” and test all indicators while the controller executes its self test. After being turned on, the instrument will go through the following sequence:

- “beeper”
- indicators for TORR, MBAR
- 10 LED indicators for set points and other functions
- all four digits will light, including decimal points
- display shows the model number of the instrument, **921**
- display shows software version, e.g. **1.01**

Following the initial self-test, the display will show **OFF**. This indicates the high voltage for the anode has not been applied.

B. Front Panel Controls

The Model 921 allows flexible configuration of operation using simple entry from the front panel buttons labeled GAUGE ON/OFF, SELECT, RAISE and LOWER. Parameters which you may adjust are selected by scrolling through the list which begins with SET PT 1 HIGH. Each time the SELECT button is pushed, the led indicator advances to the next parameter. The LED indicators will be lit to indicate which parameter is being adjusted, and the digital display will flash to indicate the value of the parameter being adjusted.

Each push of a button will give a short “beep” from the loudspeaker to confirm the button was pushed. If you have reached the limit of adjustment or if the button push is not allowed, the loudspeaker will give a long “beep”.

Following is detail description of the parameter selection and adjustment:

1. Set Pt 1 High

This sets the high limit of the set point. Above this pressure, the set point relay will be de-energized. Press the RAISE and LOWER buttons to enter the value desired. The minimum value is OFF; this shuts the set point off. The next increment is to 1.1×10^{-9} Torr.

When the RAISE or LOWER buttons are pressed, the display will change slowly at first. If you hold the button down for a few seconds, the rate of change will increase to allow you to make large changes more quickly.

SET PT 1 HIGH operates in conjunction with SET PT 1 LOW. While the 921 is in this mode, the set point may be assigned to either GAGE 1 or GAGE 2 by pressing the GAUGE SELECT button.

2. Set Pt 1 low

This sets the low limit of the set point. This is the pressure at which the set point relay will be energized. Operation is similar to that of SET PT 1 HIGH above. The minimum value is OFF; this

shuts the set point off. The next increment is to 1.0×10^{-9} Torr.
SET PT 1 LOW operates in conjunction with SET PT 1 HIGH.

NOTE

The High and Low set point allow the user to set the hysteresis of the set point operation. As the system is pumped down, the set point relay will be energized (set point turns on) as the pressure drops below SET PT 1 LOW. The relay will remain energized until the pressure rises above SET PT 1 HIGH.

It is not possible to adjust the High set point to be lower than the Low set point. If you adjust the High set point below the pressure previously selected for the Low set point, the 921 will automatically reduce the value for the Low set point so that it is the next increment lower than that of the High set point.

3. Set Pt 2 High

This operates in the same manner as SET PT 1 HIGH, described above.

4. Set Pt 2 Low

This operates in the same manner as SET PT 1 LOW, described above.

5. Torr/mBar

This allows selection of the units to be used in display of the pressure. Press either the RAISE or LOWER buttons to alternate between Torr and mBar.

6. Calibrate

This allows the user to modify the reading for either gauge by multiplying by a value between 0.500 and 2.000. This is convenient for calibration of the gauge or for making adjustments for different gas factors. We suggest you use this adjustment only if you have reliable calibration data. The multiplier is internal, and is not seen by the user. The digital display shows the result of the pressure multiplied by the internal multiplier.

7. Reset of Stored Values

This allows you to recover the factory settings for all stored values and resets the SET POINTS to off. For a system that is far out of calibration, the factory settings provide a good starting point for re-calibrating or adjusting the gauge controller. To recover the factory settings, unplug the 921 from its power source. Press and hold RAISE and LOWER buttons at the same time; while holding the RAISE and LOWER buttons depressed, plug the power cord in. You will hear a few short 'chirps' from the loudspeaker confirming the factory settings have been entered. The digital display will show RST to confirm the reset has been entered.

8. Set Point Operation

See description of operation under **Front Panel Controls**.

9. Reading Pressure

Pressure display and ranging are automatic in the 921. Most readings will take place between zero pressure and the full scale of the 921. For pressure lower than the minimum capability of the 921, the display will show -LO. For pressure greater than the maximum full scale of the 921, the display will show HI.

C. Analog Output

The analog output is calculated from the value of the digital display. The output is logarithmic, 0.5 volt/decade; the source impedance for the output is 1 K ohm. The output voltage is calculated from:

$$V=0.50*(\log_{10}(10^{10}*Pressure))$$

where V is the Analog Output in volts; P is the pressure in Torr or mbar.

Some examples follow; because of normal tolerances in the electronics, there may be minor differences in the values you observe compared to those shown:

<u>displayed pressure</u>	<u>Analog Output - volts</u>
OFF or OP	0.00
1.0 x 10 ⁻¹⁰ Torr (mBar) or less	0.00
1.0 x 10 ⁻⁹ Torr (or mBar)	0.50
3.0 x 10 ⁻⁹	0.74
1.0 x 10 ⁻⁸	1.00
1.0 x 10 ⁻⁷	1.50
1.0 x 10 ⁻⁶	2.00
1.0 x 10 ⁻⁵	2.50
1.0 x 10 ⁻⁴	3.00
1.0 x 10 ⁻³	3.50
1.0 x 10 ⁻²	4.00

The pressure as a function of the Analog Output voltage is:

$$P=10^{-10}*\log^{-1}(2V)\text{or}$$

$$P=10^{-10}*10^{(2V)} \text{ Torr (or mbar)}$$

where P is pressure in mTorr or µbar; V is the Analog Output in volts.

<u>Analog Output - volts</u>	<u>pressure</u>
0.10	1.6×10^{-10} Torr (or mbar)
0.50	1.0×10^{-9}
1.00	1.0×10^{-8}
1.10	1.6×10^{-8}
2.00	1.0×10^{-6}
3.50	1.0×10^{-3}
4.00	1.0×10^{-2}

NOTE

The analog output is valid for the gauge which is selected on the display.

D. Serial Interface

The RS-232 serial port gives pressure readings when requested by the terminal. The interface is standard RS-232 format; 9600 baud, 8-bits, no parity, 1 stop bit. The interface is through the 15-pin D-sub accessory connector, see fig. 2, page 4 and fig. 3, page 5.

pin 7 is Tx (signal from the 921 to the terminal)
 pin 8 is Rx (signal from the terminal to the 921)
 pin 9 is return (ground).

The serial port allows reading pressure and other parameters of the 921; it is not possible to modify stored parameters over the serial port.

The following commands are used in the 921:

1. Pressure

To read the pressure:

Send "p" (ASCII value 112); the 921 sends pressure to the terminal. Output is in the format:

A.Be-C

where *A.B* is the multiplier and *-C* is the exponent

Some examples follow:

<u>displayed pressure</u>	<u>Serial Output</u>
OFF	Off
OP	Open (<i>lower than 1.0×10^{-10}</i>)
1.0×10^{-9} Torr	1.0e-9
3.4×10^{-8} Torr	3.4e-8

2. Units of Measurement

To read the chosen units of measure for the gauge:

Send “u” (ASCII value 117); the 921 returns
Torr or **mBar**

3. Set Point #1

To read the setting and status of set point #1

Send “1” (ASCII value 49); the 921 returns information for set point #1 in the format:

STUeV WXYeZ A B

where:

STU is the multiplier and *V* is the exponent for set point #1 high

WXY is the multiplier and *Z* is the exponent for set point #1 low

A is the gauge to which the set point #1 has been assigned: either 1 or 2

B is set point relay status; 0= relay is not energized, 1=relay is energized

4. Set Point #2

To read the setting and status of set point #2

Send “2” (ASCII value 50); the 921 returns information for set point #2 in the same format as for set point #1, above.

5. Model and Software Revision

To read software identification.

Send “v” (ASCII value 118); the 921 returns the model number of the instrument and the revision number, as in the following example:

921 ver 1.02

6. High Voltage Control: ON (version 1.08 and later only)

To turn the High Voltage On:

Send “n” (ASCII value 110); the 921 returns “OK” to acknowledge receipt of the command. The 921 turns the high voltage on and begins measurement of pressure in the same manner as if the front panel High Voltage button had been pressed.

7. High Voltage Control: OFF (version 1.08 and later only)

To turn the High Voltage Off:

Send “f” (ASCII value 102); the 921 returns “OK” to acknowledge receipt of the command. The 921 turns the high voltage off in the same manner as if the front panel High Voltage button had been pressed. The 921 display will show “OFF”.

IV Maintenance

A. Changing Fuses

The controller contains two fuses. Both fuses are held in the fuse assembly that is part of the power module located on the back panel of the controller. To change fuses, unplug the line cord from the power entry module at the rear of the 921; locate the fuse block immediately below the line cord socket. Press the tab of the fuse assembly and withdraw the fuse assembly from the power module.

Turn the fuse assembly around so that the fuses are facing you. Check both fuses; replace the burnt-out fuse with a fuse of the appropriate rating (refer to **Specifications** section). Reinsert the fuse assembly into the power module; push it in until the ears click into place.

Replacement fuse type: 5 mm X 20 mm, regular 1 amp

<u>manufacturer</u>	<u>fuse type</u>
Bussman	GDB-1A or GDC-1A
Littlefuse	217 001 or 218 001

B. Schematic Diagrams

Because of the proprietary nature of our products, we do not supply schematic diagrams or software listings. If you have any problem with operation or interface to any of our products, please contact us; we will do everything we can to serve your needs.

V Troubleshooting

If the self-test fails, run the self-test again by turning the power off and then on again. If it fails again, call Duniway Stockroom.

If fuses burn out, check to see that the proper voltage has been supplied to the power input module.

If fuses burn out repeatedly call Duniway Stockroom.

VI Return Procedure

If you need to return the gauge controller for service, first contact Duniway Stockroom to get authorization. Then pack the instrument securely. Use the original packaging if it is available. If you do not have appropriate packing materials, a commercial packing and shipping firm can provide them.

Notes

VII Warranty

Terranova products of Duniway Stockroom Corp. are warranted to be free of defects in material and workmanship for a period of one year from the date of shipment. At our option, we will repair or replace products which prove to be defective during the warranty period. Liability under this warranty is limited to repair or replacement of the defective items. Shipping damage is excluded from the scope of this warranty. Gauge tubes of all types are excluded from this warranty.

Terranova products are warranted not to fail to execute programming instructions due to defects in materials and workmanship. If Duniway Stockroom receives notice of such defects during the warranty period. Duniway Stockroom will repair or replace firmware that does not execute its programming instruction due to such defects. Duniway Stockroom does not warrant that the operation of the firmware or hardware will be uninterrupted or error-free.

If this product is returned to Duniway Stockroom for warranty service, Buyer will pre-pay shipping charges and will pay all duties and taxes for products returned to Duniway Stockroom. Duniway Stockroom will pay for return of products to Buyer, except for products returned to a Buyer from a country other than the United States.

LIMITATION OF WARRANTY:

The foregoing warranty does not apply to the defects resulting from:

- 1. Improper or inadequate maintenance by Buyer;*
- 2. Buyer-supplied interfacing;*
- 3. Unauthorized modification or misuse;*
- 4. Operation outside of the environmental specifications of the product; or*
- 5. Improper site preparation and maintenance.*

THE WARRANTY SET FORTH ABOVE IS EXCLUSIVE AND NO OTHER WARRANTY, WHETHER WRITTEN OR ORAL, IS EXPRESSED OR IMPLIED. DUNIWAY STOCKROOM DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES: *The remedies provided herein are Buyer's sole and exclusive remedies. In no event will Duniway Stockroom be liable for direct, indirect, special, incidental, or consequential damages, including loss of profits, whether based on contract, tort, or any other legal theory.*

DECLARATION OF CONFORMITY

**We, Duniway Stockroom Corp., declare under our sole responsibility,
that the following products, displaying the CE mark on the rear panel:**

Model 906 Convection Gauge Controller
Model 908 Dual Capacitance Diaphragm Gauge Controller
Model 921 Cold Cathode Gauge Controller
Model 924 Thermocouple Vacuum Gauge
Model 926 Dual Convection Gauge Controller

**to which this declaration relates, are in conformity with the following
standards or normal documents**

EMC Directive (89/336/EEC//93/68/EEC)
Electromagnetic Compatibility
Standards: EN 50081-1: 1992, EN 50082-1: 1993



Low Voltage Directive (73/23/EEC//93/68/EEC)
Electrical/Technical Safety
Standard: EN 61010-1: 1993/A2: 1995

following the provisions of the EMC directive (89/336/EEC)

August 30, 1998

Duniway Stockroom Corp.
48501 Milmont Drive
Fremont, California 94538

by: Sherman Rutherford
Compliance Manager

rev092399sr

Application Alert: High Voltage “ON” at Atmospheric Pressure

Terranova 921 -- I-Mag Inverted Magnetron Cold Cathode Discharge Gauge

Under certain unusual circumstances, the Terranova Model 921 Cold Cathode Gauge Controller with an MKS/HPS I-Mag Cold Cathode Gauge can give incorrect indications of pressure. The two related situations are as follows:

1. **High Voltage Turned on at Atmospheric Pressure:**

If the gauge is at or near atmospheric pressure, and the high voltage is inadvertently turned on, an erratic pressure reading of approximately 3×10^{-8} Torr will be indicated. This happens because at atmospheric pressure there is a corona discharge between the anode and the case of the gauge; some charged particles are produced and the collection of these particles leads to a pressure indication which is incorrect. There is no hazard inherent to this operation, but if set-points are utilized, there might be unintentional actuation of the controlled process.

1. **Rapid Venting to Atmosphere with Gauge On:**

If the vacuum system is vented rapidly from vacuum to atmospheric pressure, such as in an accidental ‘dumping’ of the system, while the 921/I-Mag is operating, automatic shut-off of the high voltage may not occur. The pressure can move so rapidly through the range where the gauge would normally turn off automatically, that the correct sample is not collected for high pressure shut-off of the control unit. Again, an erratic pressure reading of 3×10^{-8} Torr will be indicated. There is no hazard inherent to this operation, but if set-points are utilized, there might be unintentional actuation of the controlled process.

Recovery:

Recovery from either of these situations is simple: Turn off the high voltage on the 921 control unit. The unit will function normally when the correct operating pressure range is achieved.

Avoidance:

For applications where set points will be utilized, it is advisable to incorporate a second pressure gauge, such as a Convection Enhanced Pirani gauge, to sense the higher pressures, and then turn on the 921/I-Mag high voltage only in the appropriate range.