

Instruction Manual

Terranova Model 970

Multi-Modular Gauge Control/Display

For Use With MKS/HPS Vacuum Transducers:

910-Dual Piezo-Pirani, 925-Micro Pirani,

972 Pirani-Cold Cathode, 979-Pirani-BAG

-and-

Inficon BPG-400 Combi-Gauge



Copyright 2006 Terranova Instruments Corp.

rev060109sr

Table of Contents

I Technical Specifications	p. 4
A. Description	
B. Controller/Display Specifications	
C. Transducer Specifications	
D. Front Panel Controls	
E. Rear Panel & Accessory Connections	
II Installation	p. 12
A. Unpacking the Controller	
B. Mounting the Controller	
C. Connecting the Vacuum Transducers	
D. Attaching the Transducer Cable	
E. Checking the Supply Voltage	
F. Attaching the Power Cord	
G. Setup Mode	
H. Measurement Mode	
III Operation/Protection	p. 16
A. Turn Power On	
B. Front Panel Controls	
C. Reading Pressure	
D. Analog Output	
E. Serial Interface	
F. Using the Model 970 with Other Gases	
G. Set Point Operation	
H. Set Point Relay Protective Circuits	
IV Maintenance	p. 27
A. Trouble Shooting	
B. Error Codes	
C. Accessories/ Part Replacement	
D. Changing Fuses	
E. Schematic Diagrams	
V Warranty & Declaration of Conformity	p. 29

List of Figures

Figure 1: Transducer Vacuum/Pressure Ranges and Configurations	p. 7
Figure 2: Photos of HPS/MKS Transducers	p. 7
Figure 3: Photo of Inficon BPG-400 with Model 970	p. 7
Figure 4: Front Panel of the Model 970	p.8
Figure 5: Model 970 Mounting Dimensions	p. 9
Figure 6: Rear Panel of the Model 970	p. 10
Figure 7: Transducer Connector - 9-pin D-sub Connector	p. 10
Figure 8: Accessory 15 Pin D-sub Connector Configuration	p. 11
Figure 9: Transducer Cable Table: 910, 972, 999	p. 13
Figure 10: Transducer Cable Table: 903	p. 13
Figure 11: Transducer Cable Table: 925	p. 13
Figure 12: Transducer Cable Table: 909A	p. 13
Figure 13: Transducer Cable Table: BPG-400	p. 13
Figure 14: Analog Out vs. Displayed Pressure	p. 22
Figure 15: Serial Interface Parameters	p. 23
Figure 16: Serial Cable - PC Computer to Model 970	p. 24
Figure 17: Protective Circuits - Set Point Relays	p. 25
Figure 18: Choosing Components - Protective Circuits	p. 26
Figure 19: Error Codes	p. 27

I Technical Specifications

A. Description

The Terranova Model 970 Vacuum Gauge Controller displays pressure from 5×10^{-10} Torr to 1500 Torr, as measured from the MKS/HPS Series 903, 909A, 910, 925, 972, 979, 999; Inficon BPG-400 and other modular vacuum transducers

NOTE" Other modular vacuum transducers using +24VDC power and returning an analog signal are potential candidates for operation/display with the Terranova 970. Please inquire if you would like to see such a vacuum transducer added to the supported list.

The Terranova Model 970 is a programmable, microprocessor controlled unit, which gives it great versatility in operation, display, control and data communication.

Some major features include:

- User may configure the 970 to operate many modular pressure transducers including the MKS/HPS 903-Cold Cathode, 909-Hot Cathode, 910-Dual Piezo-Pirani, 925-Micro Pirani, 972 Pirani- Cold Cathode, 979B Pirani-BAG, 999-Quattro, Inficon Pirani-Ion BPG400 and others.

- Autoranging display over the full range of pressure of the transducer selected.

See "Transducer Ranges and Specification" Section I-C

- User Selectable Pressure Units: Torr, mBar, Pascal.
- 2 Programmable Process Control Set Points.
- RS 232 Serial I/O for Data Collection and Computer Control
- Analog Logarithmic Output for Monitoring Pressure
- CE Conformance for EMI, EMC and Safety
- Universal Power Supply: 90-240 Volts; 47-65 Hz or DC
- Compact, 1/8 DIN Packaging

B. Controller/Display Specifications

Display Resolution	2 digits with an exponent HI indicates overrange LO indicates underange
Input to the 970	Analog signals from the selected vacuum transducer
Units of Display	Torr, mBar, Pascal: user selectable
Calibration Adjust	The appropriate calibration routines are provided, depending upon which sensors are connected at power up. 910, 925C: Vacuum and Atmosphere adjustments 903, 909A, 999, BPG-400: Sensitivity adjustment from 0.5 to 2.0.
Process Control Set Points	Two relays; contacts rated at 240 VDC/300 VAC/2 amp; the relays are internally fused with 2 amp fuses.
Set Point Ranges	903 3.0×10^{-10} to 1.0×10^{-3} torr 909A 1.0×10^{-9} to 1.0×10^{-2} torr 910 1.0×10^{-4} to $7.6 \times 10^{+2}$ torr 925C 1.0×10^{-4} to $7.6 \times 10^{+2}$ torr 972 1.0×10^{-9} to $7.6 \times 10^{+2}$ torr 979 1.0×10^{-9} to $7.6 \times 10^{+2}$ torr 999 1.0×10^{-9} to $7.6 \times 10^{+2}$ torr BPG-400 9.0×10^{-10} to $6.0 \times 10^{+2}$ torr
Nonvolatile Memory	For all user specified parameters
Analog Output	Logarithmic, 0.5 volts / decade

Output Power	+24 volts@0.35 amp, sufficient to operate listed transducers
Mounting	The Model 970 may be used as a bench-top instrument or mounted in an instrument panel with clips provided.
RS-232 Output	Allows user to read pressure and set points; 9600 baud, 8-N-1; available through the accessory connector
Power Requirement	90 - 240 Volts; 47 - 65 Hz or DC
Weight	0.9 lb. /0.4 kg
Operating Temperature	0 to +40 degrees Celsius
Relative Humidity	0 -80%, non-condensing
Altitude	0-2000 m (6561 ft.) maximum

**Terranova Model 970 Multi Modular
Gauge Controller and Vacuum Sensors
are available from:**

**Duniway Stockroom Corp.
48501 Milmont Drive
Fremont, CA 94538 USA
Phone: 650-969-8811 and 1-800-446-8811
FAX: 650-965-0765
Internet: www.duniway.com**

**MKS/HPS Modular Vacuum Sensors
also available from:**

**HPS Division of MKS Instruments, Inc.
5330 Sterling Drive
Boulder, CO, 80301 USA
Phone: 303-449-9861 or 800-345-1967
FAX: 303-442-6880
Internet: www.mksinst.com**

**Inficon BPG400 Vacuum Sensors are
also available from:**

**Inficon, Inc.
Two Technology Place
East Syracuse, NY 13057-9714
Phone: 315-434-1100
FAX: 315-437-3803
Internet: www.inficon.com**

C. Transducer Specifications

<u>Vacuum Transducer</u>	<u>Measurement Range</u>	<u>Sensor Technology</u>
MKS/HPS 903	3×10^{-10} to 5×10^{-3} torr	Cold Cathode - Inverted Magnetron
MKS/HPS 909A	1×10^{-10} to 1×10^{-2} torr	Hot Cathode Ion
MKS/HPS 910	1×10^{-5} to $2 \times 10^{+3}$ torr	Pirani & Piezo
MKS/HPS 925	1×10^{-5} torr to ATM	Pirani
MKS/HPS 972	1×10^{-10} to ATM	Pirani & Cold Cathode
MKS/HPS 979	1×10^{-10} to ATM	Pirani & Hot Cathode Ion
MKS/HPS 999	1×10^{-10} to $5 \times 10^{+3}$ torr	Piezo (2), Pirani, Hot Cathode Ion
INFICON BPG-400	4×10^{-10} to $8.3 \times 10^{+2}$ torr	Pirani & Hot Cathode Ion

Figure 1: Transducer Vacuum/Pressure Ranges/Features



Figure 2: Photos of MKS/HPS Transducers



Figure 3: Inficon BPG400 Connected to the Terranova 970

D. Front Panel Controls



Figure 4: Model 970 Front Panel

Front Panel Controls

Normal Text describes Measurement Mode operation.

Italicized Text indicates Setup Mode operation.

Degas On/Off Button

Turns On and Off the Degas function when the selected sensor is a
979 or BPG-400

Select: Button

Places the controller in setup mode.

*Allows the user to scroll through the setup parameters that can be adjusted,
e.g. Set Points.*

Raise: Button

Increments parameter values when the controller is in the Setup Mode.

Lower: Button

Decrements parameter values when the controller is in the Setup Mode.

Gauge On/Off: Button

Turns On and Off the filament when the selected transducer is a **979** or **BPG-400**.

Turns On and Off the high voltage when the selected transducer is a **903**.

Gauge Select: Button

Allows the user to select which transducer is to be controlled by the 970.

Front Panel Displays

Pressure Display

MSD, LSD and sign with exponent using 7-segment bright red LED, 10mm high.
The display is steady state when indicating pressure measurements.

The display flashes on and off with parameter values in Setup Mode.

LED Indicators

Bright red individual LEDS for miscellaneous indicators

Dimensions – standard 1/8 DIN enclosure



Figure 5: Model 970 (1/8 DIN) Dimensions

E. Rear Panel & Accessory Connections

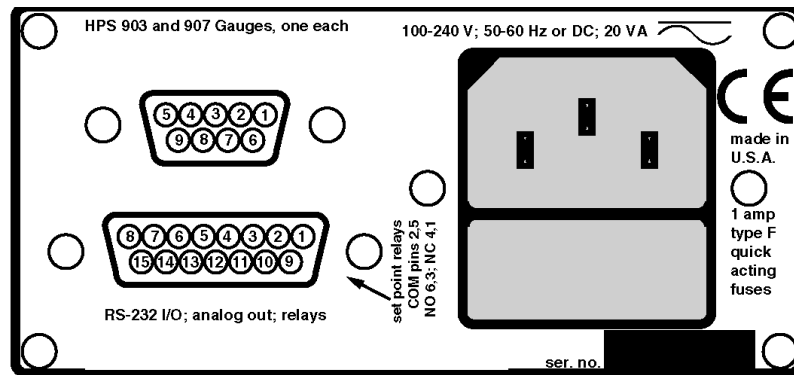


Figure 6: Model 970 Rear Panel

1. Power Input Module

The Power Input socket is a standard IEC 320 instrument power input receptacle. Replacement fuses are 2 amp type F quick acting fuses. The 970 has a universal power supply which accepts 100 - 240 Volts, 50-60 Hz or DC.

2. Transducer Connector

<u>Pin</u>	<u>Function</u>
pin 1	Analog input voltage (+) from transducer 1
pin 2	Degas.L Sense Line from transducer
pin 3	no connection
pin 4	Degas.L Control Line from transducer
pin 5	+24 Volt, 0.35 amp Power supply to transducer
pin 6	Filament.L or HighVolt.L Control Line to transducer
pin 7	Filament.L Sense Line from transducer
pin 8	Analog input voltage return (-) from transducer
pin 9	Common/Ground

Figure 7: Transducer Connector - 9-pin D-sub Connector

2. RS-232, Analog Out, Relays - 15-pin D-sub Accessory Connector

The 15-pin D-sub Accessory Connector is on the rear panel of the Model 970, see Figure 4. 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

The following are the pin assignments for the 15 Pin Accessory Connector

<u>Pin</u>	<u>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; 9600-N-8-1
pin 8	Rx, RS-232
pin 9	Ground, RS-232 and processed analog ground
pin 10	buffered analog ground
pin 11	buffered analog signal; 1K output
pin 12	no connection
pin 13	processed analog output, 1K output, 0.5 volts/decade
pin 14	no connection
pin 15	no connection

**Figure 8: RS-232, Analog Out, Relays -
15-pin D-sub Accessory Connector Pin Assignments**

II Installation

A. Unpacking the Controller

Carefully unpack the Model 970 Controller. The shipment includes these components:

- controller unit
- power cord
- mounting clips
- D-sub 15 accessory connector
- this instruction manual

If your controller does not have all of these items, contact Duniway Stockroom Corp.

If anything appears to have been damaged in shipment, contact the shipper.

Transducers and cables are sold separately.

Do not plug the power cord in yet.

B. Mounting the Controller

You can rest the controller unit 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 1.78 inch by 3.60 inch (45.2 mm by 91.4mm). 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. Be sure to leave enough clearance at the back of the controller unit for easy access to cable connections.

C. Connecting the Vacuum Transducers

Make sure the transducer is securely connected to the vacuum system, using good vacuum practice. The set point adjustments on the transducer should be set to the minimum possible value. If necessary, refer to the appropriate User's Manual for the selected transducers.

D. Attaching the Transducer Cable

The cable has a 9-pin D-sub connector on one end, which plugs into the Model 970. Connect the 9-pin D-sub plug of the gauge cable to the 9-pin connector on the back of the Model 970 controller unit. Push the plug onto the connector until it is firmly in place. Tighten the retaining screws to make certain the connector remains in place. Loose connections can cause faulty readings.

Terra-970 End Male Pins	Signal Name	Cable Belden 9535	Sensor End Female Pins
D9-5	+supply	red	D15-3
D9-9	supply com	black	D15-4
D9-1	analog sig	white	D15-5
D9-6	fil control		D15-10
D9-2	degas sense		D15-9
D9-4	degas control		D15-13
D9-8	analog sig com	brown	D15-6

**Fig. 9. Cable Pin Connection for Transducers:
910 pirani/piezo, 972 piezo-cold cathode and 999 quattro
Cable PN 97015-10-900**

Terra-970 End Male Pins	Signal Name	Cable Belden 9535	Sensor End Female Pins
D9-5	+supply	red	D9-3
D9-9	supply com	black	D9-4
D9-6	hv control	green	D9-9
D9-1	analog sig	white	D9-5
D9-8	analog sig com	brown	D9-8

**Fig. 10. Cable Pin Connection for Transducers:
903
Cable Part Number 9709-10-903**

Terra-970 End Male Pins	Signal Name	Cable Belden 9535	Sensor End Female Pins
D9-5	+supply	red	D9-3
D9-9	supply com	black	D9-4
D9-1	analog sig	white	D9-5
D9-8	analog sig com	brown	D9-8

**Fig. 11. Cable Pin Connection for Transducers:
925 (9 pin connector)
Cable Part Number 9709-10-925**

Terra-970 End Male Pins	Signal Name	Cable Belden 9535	Sensor End Female Pins
D9-5	+supply	red	D9-4
D9-9	supply com	black	D9-2
D9-1	analog sig	white	D9-3
D9-6	fil control		D9-1
D9-7	fil sense		D9-9
D9-2	degas sense		D9-5
D9-4	degas control		D9-6
D9-8	analog sig com	brown	D9-7

**Fig. 12. Cable Pin Connection for Transducers:
909A
Cable Part Number 9709-10-909**

Terra 970 End Male Pins	Signal Name	Cable Belden 9535	Sensor End Female Pins
D9-5	+supply	red	D-15 8
D9-8	analog signal com	black	D-15-12
D9-4	degas ON	brown	D 15--7
D9-1	analog sig	white	D-15-2
D9-9	supply com	green	D-5 & 15

**Fig. 13. Wire/Pin Connections for the Model 970 to BPG400 Sensor
Cable (8100-990-00)**

E. Checking the Supply Voltage

The Model 970 incorporates a universal power supply. This allows controller to operate on any input voltage from 90 VAC to 240 VAC, 47 to 65 Hz.

F. Attaching the Power Cord

Plug the power cord into the receptacle in the power module on the rear of the Model 970.

G. Set-Up Mode

In Set-Up mode, the user configures the operation of the controller. For example, in Set-Up Mode the user assigns set point values, calibrates the unit for specific gasses or selects autoranging for dual transducers. The user cycles through the set up parameters by pressing the Select button. The user adjusts the parameter values by pressing the Raise and Lower buttons. The parameter values flash on and off on the digital display, indicating the controller is in the set up mode. WHITE silk screening identifies the Set-Up parameter indicators and controls on the Model 970 front panel.

H. Measurement Mode

In Measurement Mode, the controller displays the current pressure measurement as a steady state (non-flashing) value on the digital display.

III Operation/Protection

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, PASCAL
 9 LED indicators for set points and other functions
 all digit segments will light, including decimal points
 display shows the model number of the instrument, **970**.
 display shows software version, e.g. **1.00**
 display shows transducer selected, e.g. **903**

The Model 970 will go into normal operation and begin measuring pressure.
 (see Section IV-B for error codes and interpretation.)

B. Front Panel Controls

The Model 970 allows flexible configuration of operation using simple entry from the front panel buttons labeled SELECT, RAISE and LOWER and Degas. Parameters which you may adjust are selected by scrolling through a list. 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 detailed description of the parameter selection and adjustment:

1. Set Pt 1 Hi

Default: **OFF**

This sets the high limit of the set point. Above this pressure, the set point will be de-energized. Press the RAISE or LOWER button to enter the value desired. The minimum value is **OFF**; this shuts the set point off. 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 Hi operates in conjunction with Set Pt 1 Low

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 described above in “Set Pt 1 Hi”. The minimum value is **OFF**; this shuts the set point off.

Set Pt 1 Low operates in conjunction with Set Pt 1 High

NOTE: The High and Low set point settings 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 falls below Set Point 1 Low. The relay will remain energized until the pressure rises above Set Point 1 High. It is not possible to adjust Set point 1 High to be lower than Set Point 1 Low. If you adjust the Set Point 1 High to be lower than the previously selected for Set Point 1 Low, the 970 will automatically reduce the value of Set Point 1 Low so that it will be the next increment lower than Set Point 1 High.

Set point Range

903	1.0×10^{-9} to 1.0×10^{-3} Torr
909A	1.0×10^{-9} to $7.6 \times 10^{+2}$ Torr
910	1.0×10^{-4} to $7.6 \times 10^{+2}$ Torr
925C	1.0×10^{-4} to 7.6×10^{-2} Torr
999, 979, 972	1.0×10^{-9} to $7.6 \times 10^{+2}$ Torr
BPG-400	8.0×10^{-10} to $6.0 \times 10^{+2}$ Torr

3. Set Pt 2 Hi

This operates in the same manner as Set Point 1 High described above.

4. Set Pt 2 Lo

This operates in the same manner as Set Point 1 High described above.

NOTE: Additional information on Set Point Operation and Set Point Relay Protection is included in Sections III-G and III-H, pages 26 and following.

5. Calibrate (for 903, 909, 972, 979, 999 and BPG-400 Transducers)

Default value: 1.00 (Internal Value)

Range: 0.50 to 2.00

This allows the user to modify the reading of the selected transducer by multiplying by a value between 0.50 and 2.00. This is convenient for calibration of the transducer. We suggest that 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 Calibrate multiplier. To repeat, the value of the calibration factor is not displayed, only the current reading from the transducer times the value of the Calibrate factor is displayed. For example, if the reading from the transducer is 7.6×10^2 Torr, and you are in the CALIBRATE position of the SELECT mode, you could adjust the displayed reading upward by pressing RAISE or downward by pressing LOWER. During the adjustment, the display will show the calibration factor in the range 0.50 to 2.00.

NOTE: ATMOSPHERIC PRESSURE

You can use this function to set the correct atmospheric pressure for the higher pressure sensors; you should know the local barometric pressure before proceeding; your local airport may have this information. Normal atmospheric pressure at sea level is approximately 760 Torr (1000 mBar).

6. Units

Default: Torr

This allows selection of the displayed units. Press either the RAISE or LOWER buttons scroll through Torr, mBar and Pascal. The indicators will be alternately lit as you scroll through the options. All pressure values displayed will be in the units selected.

7. Degas ON/OFF: Button

Turns the Ion Gauge Degas On and Off if the pressure is below 5.4×10^{-6} Torr (7.6×10^{-6} mBar, 7.2×10^{-4} Pascal). Degas shuts off automatically after 2.5 minutes.

8. 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, power up the Model 970 while simultaneously pressing the RAISE and LOWER push buttons. 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. After a reset, the Model 970 is in the following state:

Set Points are OFF.
Units set to Torr.
Calibrate set to 1.0.

9. Selecting Transducers

This button allows you to select the proper operational parameters for the Model 970 to match the installed transducer.

To display the currently selected transducer, press the GAUGE SELECT button.

To change the selected sensor:

Remove the AC power from the 970

While pressing the GAUGE SELECT button, apply AC power.

After the display finishes its initial startup sequence, it will show the currently selected transducer as a flashing display.

To change the selected transducer, press RAISE or LOWER until the desired transducer is displayed (903, 909, 910, 925, 972, 979, 999 or 400).

Press SELECT to exit transducer selection.

10. Gauge On/Off

This button turns On and Off the filament when the selected transducer is a **909, 979, 999 or BPG-400**;
or turns On and Off the High Voltage when the selected transducer is a **903**.

C. Reading Pressure

903 Cold-Cathode Condition

Not connected

$P < 1.0 \times 10^{-10}$ Torr

$P = 1.0 \times 10^{-10}$ to 1.0×10^{-3} Torr

$P > 1.0 \times 10^{-3}$ Torr

Display

OFF

LO

MSD.LSDsignEXP (e.g. 2.5-8= 2.5×10^{-8})

HI

909 Ion Condition

Not connected

$P < 1.0 \times 10^{-10}$ Torr

$P = 1.0 \times 10^{-10}$ to 1.0×10^{-2} Torr

$P > 1.0 \times 10^{-2}$ Torr

Display

OFF

LO

MSD.LSDsignEXP (e.g. 2.5-8= 2.5×10^{-8})

HI

910 Piezo-Pirani Condition

Not connected

$P < 1.0 \times 10^{-5}$ Torr

$P = 1.0 \times 10^{-5}$ to $1.0 \times 10^{+3}$ Torr

$P > 1.0 \times 10^{+3}$ Torr

Display

OFF

LO

MSD.LSDsignEXP (e.g. 2.5-2= 2.5×10^{-2})

HI

925 Pirani Condition

Not connected

$P < 1.0 \times 10^{-5}$ Torr

$P = 1.0 \times 10^{-5}$ to $7.6 \times 10^{+2}$ Torr

$P > 7.6 \times 10^{+2}$ Torr

Display

OFF

LO

MSD.LSDsignEXP (e.g. 2.5-2= 2.5×10^{-2})

HI

972, 979, 999 Piezo-Pirani-Ion Condition

Not connected

$P < 1.0 \times 10^{-10}$ Torr

$P = 1 \times 10^{-10}$ to $1 \times 10^{+3}$ Torr

$P > 1.0 \times 10^{+3}$ Torr

Display

OFF

LO

MSD.LSDsignEXP

HI

BPG-400 Pirani-Ion Condition

Display

Not connected	OFF
$P < 4.0 \times 10^{-10}$ Torr	LO
$P = 4.0 \times 10^{-10}$ to $8.3 \times 10^{+2}$ Torr	MSD.LSDsignEXP (e.g. $2.5 \cdot 10^{-2}$)
$P > 8.3 \times 10^{+2}$ Torr	HI

D. Analog Output

The Processed 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 signal appears on pin 13 of the Accessory Connector. It is only valid during Measurement Mode. In Setup Mode, it remains at the last measured pressure value. The output voltage is calculated from:

$$V = 0.50 * (\log_{10} (\text{Pressure}) + 12)$$

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

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

$$P = 10^{(2V - 12)}$$

where P is pressure in Torr.

The units selected does not affect this output.

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

Display Information	Analog Output - volts
OFF/OPEN/LO/EO1/EO2	0.0
1x10 ⁻¹⁰	1.0
1x10 ⁻⁹	1.5
1x10 ⁻⁸	2.0
1x10 ⁻⁷	2.5
1x10 ⁻⁶	3.0
1x10 ⁻⁵	3.5
1x10 ⁻⁴	4.0
1x10 ⁻³	4.5
1x10 ⁻²	5.0
1x10 ⁻¹	5.5
1x10 ⁰	6.0
1x10 ⁺¹	6.5
1x10 ⁺²	7.0
1x10 ⁺³	7.5
HI	8.5

Figure 14: Analog Output vs. Displayed Pressure

E. 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 Figure 8, page 12.

<u>Parameter</u>	<u>Command</u>	<u>Response Syntax</u>	<u>Response Values</u>
pressure	"p"	090_val, <cr>	msd.lsdE+/-exp nogauge; LO,HI
units of measurement	"u"	Units<cr>	Torr, mBar, Pascal
relay 1 status	"1"	SP1_hi, SP1_lo,status	msd.lsdE+/-exp msd.lsdE+/-exp 1 energized. 0 OFF
relay 2 status	"2"	SP2_val,status,xdcer 1 indicates relay energized	msd.lsdE+/-exp msd.lsdE+/-exp 1 energized. 0 OFF
version	"v"	model, version	900,verx.xx
degas status	"d"	on, off for 909 & 999, Er for other transducers	
turn degas "ON"	"o"	OK, or Er if ON, pressure out of range, not supported	
turn degas "OFF"	"f"	OK, or Er if OFF or not supported	
show transducer state	"g"	on, off for 903 & 909; Er for other transducers.	
turn gauge "ON"	"r"	OK, or Er if ON, pressure out of range, not supported	
turn gauge "OFF"	"s"	OK, or Er if OFF or not supported	
transducer selected	"x"	xxx\r, 910\r, 999\r, 903\r, 925\r, 909\r, 400\r	

Figure 15: Serial Interface Parameters, Syntax and Response

NOTE: The commands are a single character. There is no carriage return after the command character. The Model 970 returns "%Error" when an invalid (e.g. incorrect syntax) or unrecognized (e.g. wrong parity or baud rate) command is received.

The serial port allows reading pressure and other parameters of the 970-; it is not possible to modify stored parameters over the serial port.

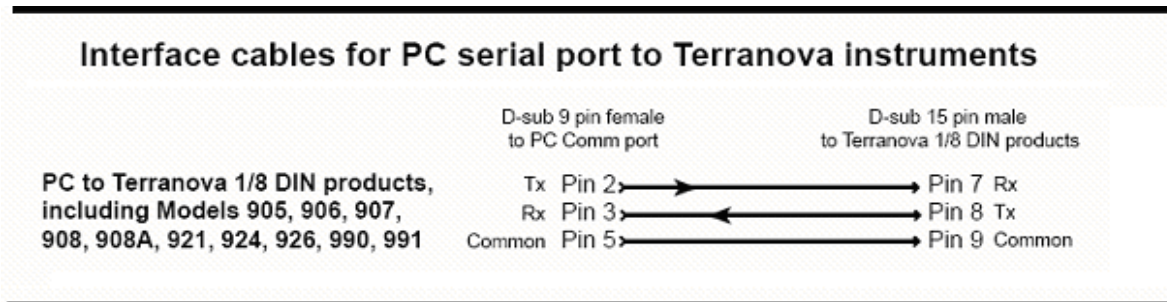


Figure 16: Serial Interface Cables from PC to Terranova 908A

F. Using the Model 970 with Other Gases

Please consult the Gas Correction Factor data for the transducer being used.

G. Set Point Operation

When pressure values have been entered for a set point (1 or 2) and assigned to a gauge (1 or 2), the set point relay operates as follows:

As the pressure on the assigned gauge falls through the chosen "Set Point N Low" pressure, the relay actuates, either opening (if the Normally Closed pin has been used on the Auxiliary I/O connector) or closing (if the Normally Open pin has been used on the Auxiliary I/O connector).

Likewise, as the pressure on the assigned gauge rises through the chosen "Set Point N High" pressure, the relay de-actuates, either closing (if the Normally Closed pin has been used on the Auxiliary I/O connector) or opening (if the Normally Open pin has been used on the Auxiliary I/O connector).

H. Set Point Relay Protective Circuits

Protective Circuits for connecting loads to Terranova 9XX Set Point Relays

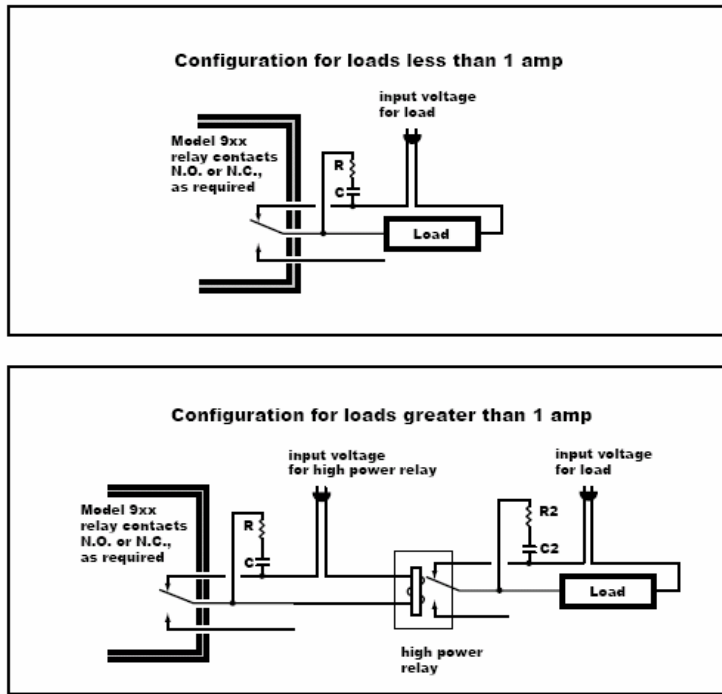


Figure 17: Protective Circuits for Connecting Loads to Set Point Relays

Snubber equations courtesy of CDE

$C = \frac{I^2}{10}$	$R = \frac{E}{10 \cdot I \left(1 + \frac{50}{E}\right)}$
<p>Where: C = capacitance, in uF I = load current in amperes prior to contact opening R = resistance in series with capacitor, in ohms E = source voltage</p>	

For 1 amp load and 110 VAC, C and R calculate to:
C=0.1 uF and R=6 ohm (use 10 ohm)

For 0.1 amp and 110 VAC...
C=0.001 uF and R=60 ohm (use 100 ohm)

Common practice is to use 0.01 and 100 ohm for many types of load. These values are intended as guidelines only; your application may require experimentation to determine the best values of R and C or use of other snubber configurations.

Be certain to select C with a voltage rating equal to or greater than the input voltage. R is typically 1/2 watt rating for most applications.

For additional information visit the paper by Tyco Relays (formerly Potter & Brumfield):
http://www.pandbrelays.com/app_pdfs/13c3311.pdf

Figure 18: Choosing Component Values for Set-Point Protective Circuits

IV Maintenance

A. Trouble shooting

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

If the digital display consistently shows LO, OFF or HI, it may be that one of the internal power supply protection devices has removed power to the transducer. You may check this by measuring the voltage at the connector or cable for the unaffected gauge. Since power for both gauges use the same protection device, either connector will show the power supply voltages. Normal range for the voltages are 23.5 to 24.5 volts. +24 may be measured on the red wire; power return is on the black wire. If the powersupply protection has shut the power off, you will typically measure less than 4 volts on the affected supply.

If you verify that either power supply is shut off, remove power from the transducer for a few minutes to allow the protection device to reset itself. The protection device does not need to be replaced; it is a reusable thermal fuse.

You may wish to determine the cause for the loss of power supply voltage before applying power again. The Model 970 will protect itself if it finds excessive power draw again.

It is normal for the Model 970 to feel warm to touch along the left side of the case.

B. Error Codes

<u>Error Code</u>	<u>Cause</u>
Er0	ATM adjustment at limits, or action not allowed at this time
E2	Sensor cable defective or not connected
E3	Sensor error, defective hot cathode filament (BPG-400)
E4	Sensor error, pirani sensor defective (BPG-400)
E5	Sensor error, undefined
E6	Sensor error, undefined
E7	Sensor error, undefined
E8	Degas not allowed when pressure > 5×10^{-6} or < 1×10^{-10} Torr
E9	ATM adjustment not allowed

Figure 19: Model 970 Error Codes

C. Accessories / Part Replacement

If you need to return the gauge controller to Duniway Stockroom for service, first contact Customer Service at Duniway Stockroom to obtain an RMA number. Then pack the instrument securely and place the RMA number on the outside of the package where it is easily seen. 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.

D. 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 Model 970; 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. 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, Fast-blow 1 amp

<u>Manufacturer</u>	<u>Fuse Type</u>
Bussman	GDB-1A
Little fuse	217 001

E. 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 Warranty & Declaration of Conformity

Terranova products of Duniway Stockroom 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 905 Dual Modular Gauge Control/Display
Model 906A Convection Gauge Controller
Model 908A Dual Capacitance Diaphragm Gauge Controller
Model 921 Cold Cathode Gauge Controller
Model 924 Thermocouple Vacuum Gauge
Model 926A Dual Convection Gauge Controller
Model 990 Hybrid Gauge Control
Model 970 Multiple Modular Gauge Control
Model 751 Ion Pump Power Supply

**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)
UL and CSA Listing**

Safety of Electrical Equipment for Laboratory Use
UL61010A-1, Issued 2002/01/30
CAN/CSA C22.2 No. 1010.1-92, 97



October, 2006

by: Sherman Rutherford

Compliance Manager

Duniway Stockroom Corp.
48501 Milmont Drive
Milmont, CA 94538

rev060109sr