

## Instruction Manual

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# Terranova Model 990

## Combi-Gauge Control/Display

For Use With Inficon BPG400 Hot Ion Combi Gauge



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rev120407sr

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## I Technical Specifications

### A. Description

The Terranova Model 990 Vacuum Gauge Controller displays pressure from  $5 \times 10^{-10}$  mBar to 1000 mBar, as measured from the Inficon BPG400 Hot Ion Combi Gauge. The Model 990 precisely measures the analog signal from the transducer to determine pressure. When autoranging, the Model 990 automatically smooths the pressure reading over the range of overlapping pressures.

The Terranova Model 990 is a programmable, microprocessor controlled unit, which gives it great versatility in operation, display, control and data communication. Some major features include:

- Operates the Inficon BPG400 Hot Ion Combi Gauge transducer.
- Autoranging display of 13 decades of pressure with one vacuum connection.

$5 \times 10^{-10}$ mbar	to	$1.1 \times 10^{+3}$ mbar.
$4 \times 10^{-10}$ torr	to	$8.3 \times 10^{+2}$ torr
$5 \times 10^{-8}$ pascal	to	$1.1 \times 10^{+5}$ pascal

- Gauge combines two proven sensor technologies in compact, rugged package:

Long-life Bayard-Alpert, hot filament sensor  
Fast-response double Pirani sensor

- 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: 90-265 Volts; 47-65 Hz or DC
- Compact, 1/8 DIN Packaging

**B. Specifications**

**Measuring Range**

$5 \times 10^{-10}$  mbar to  $1.1 \times 10^{+3}$  mbar.  
 $4 \times 10^{-10}$  torr to  $8.3 \times 10^{+2}$  torr  
 $5 \times 10^{-8}$  pascal to  $1.1 \times 10^{+5}$  pascal  
 HI indicates overrange  
 LO indicates underrange

**Display Resolution** 2 digits with a two digit exponent

**Units of Display** Torr, mBar, Pascal: user selectable

**Calibration Adjust** +/- 20% for calibration purposes.

**Operating Temperature** 0 to +40 degrees Celsius

**Process Control Set Points** Two relays may be independently set from:

$1 \times 10^{-9}$  mbar to  $8 \times 10^{+2}$  mbar  
 $8 \times 10^{-10}$  torr to  $6 \times 10^{+2}$  torr  
 $1 \times 10^{-7}$  pascal to  $8 \times 10^{+4}$  pascal  
 Contacts rated at 60 VDC or 30 VAC at 2 amp;  
 the relays are internally fused with 2 amp fuses.

**Nonvolatile Memory** For all user specified parameters

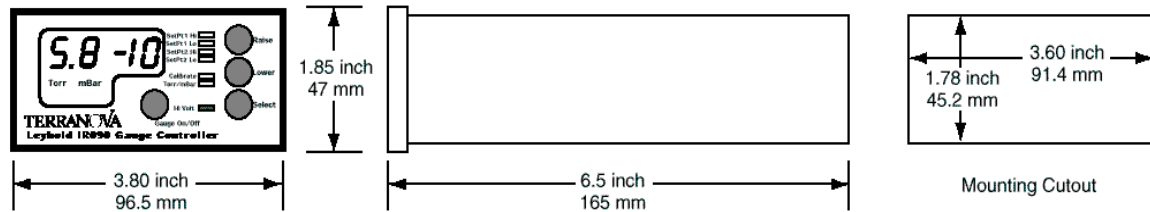
**Analog Output** Logarithmic, 0.5 volts / decade

**Output Power** +24 volts at 0.35 amp, sufficient to operate the Inficon BPG400 Hot Ion Combi Gauge.

**Mounting** The Model 990 may be used as a bench-top instrument or it may be mounted in an instrument panel with clips provided.

<b>RS-232 Output</b>	Allows user to read pressure and set points; 9600 bps, 8-N-1; available through the accessory connector
<b>Power Requirement</b>	90 - 265 Volts; 47 - 65 Hz or DC
<b>Weight</b>	0.9 lb. /0.4 kg
<b>Repeatability</b>	Approximately +/- 5%
<b>Relative Humidity</b>	0 -80%, non-condensing
<b>Altitude</b>	0-2000 m (6561 ft.) maximum

Dimensions – standard 1/8 DIN enclosure



**Figure 1: Terranova 990 Exterior Dimensions**

**Terranova Model 990 Combi Gauge Controller and Inficon BPG400 Vacuum Sensors are available from:**

**Duniway Stockroom Corp.  
48501 Milmont Drive  
Fremont, CA 94538 USA Phone:  
650-969-8811 or 800-446-8811  
FAX: 650-965-0764  
Internet: [www.duniway.com](http://www.duniway.com)**

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

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

### C. Front Panel Controls



Figure 2: Model 990 Front Panel

#### Select: Button

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

#### Raise: Button

Increments parameter values in the Setup Mode.

#### Lower: Button

Decrements parameter values in the Setup Mode.

#### Degas On/Off: Button

Turns Ion Gauge Degas On and Off if pressure range is below  $7.2 \times 10^{-6}$  mbar ( $5.4 \times 10^{-6}$  torr,  $7.2 \times 10^{-4}$  pascal). Degas shuts off automatically after 2.5 minutes.

### 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.

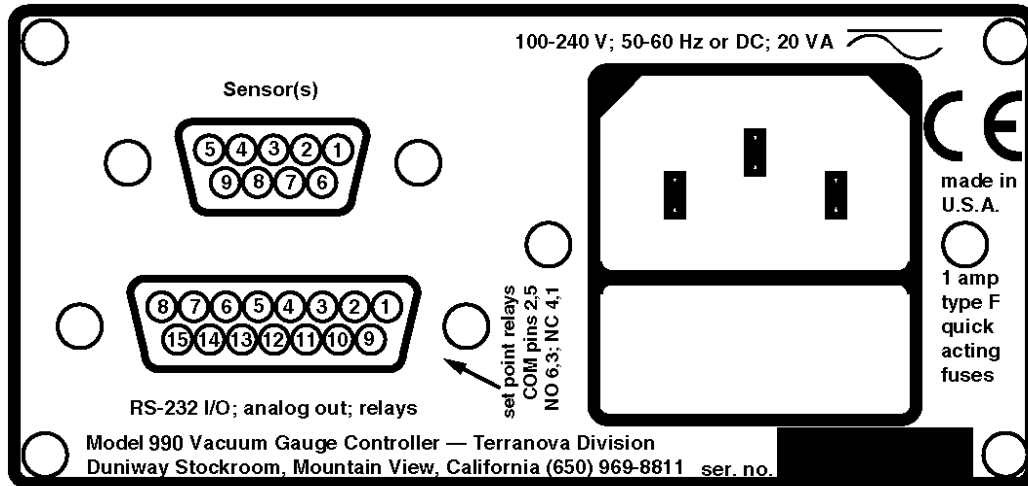
*The display flashes on and off with parameter values in Setup Mode.*

#### LED Indicators

Bright red individual LEDs for miscellaneous indicators

(Setpt1 Hi, Setpt1 Lo, Setpt2 Hi, Setpt2 Lo, Calibrate, Units, Degas On)

## D. Rear Panel & Accessory Connections

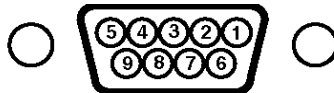


**Figure 3: Model 990 Rear Panel**

### 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 Model 990 has a universal power supply which accepts 100 - 240 Volts, 50-60 Hz or DC.

### 2. Model 990 Sensor Connector - 9-Pin Female D-Sub Connector



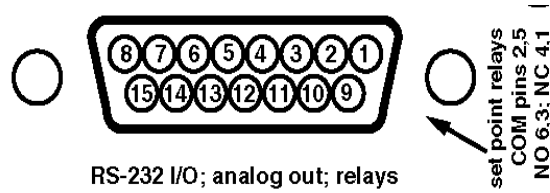
pin 1	Analog Input Signal (+) from transducer
pin 2	Not Used
pin 3	Not Used
pin 4	Degas On, High Active
pin 5	Supply 24 Volts
pin 6	Not Used
pin 7	Not Used
pin 8	Signal Common Ground
pin 9	Supply Common Ground

**Figure 4: Sensor Connector Pin Assignments**



### 3. RS-232, Analog Out, Relays - 15-Pin Female D-Sub Accessory Connector

The 15-pin D-sub Accessory Connector is on the rear panel of the Model 990, 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



<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	No connection
pin 11	Buffered analog sensor output; 0 to 10 volts, 1K source impedance
pin 12	No connection
pin 13	Logarithmic analog output, 1K source impedance, 0.5 volts/decade
pin 14	No connection
pin 15	No connection

**Figure 5: Pin Assignments for the Accessory Connector**

## **II Installation**

### **A. Unpacking the Controller**

Carefully unpack the Model 990 Controller. The shipment includes these components:

- controller unit
- power cord
- sensor cable (8100-990-00)
- 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 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.

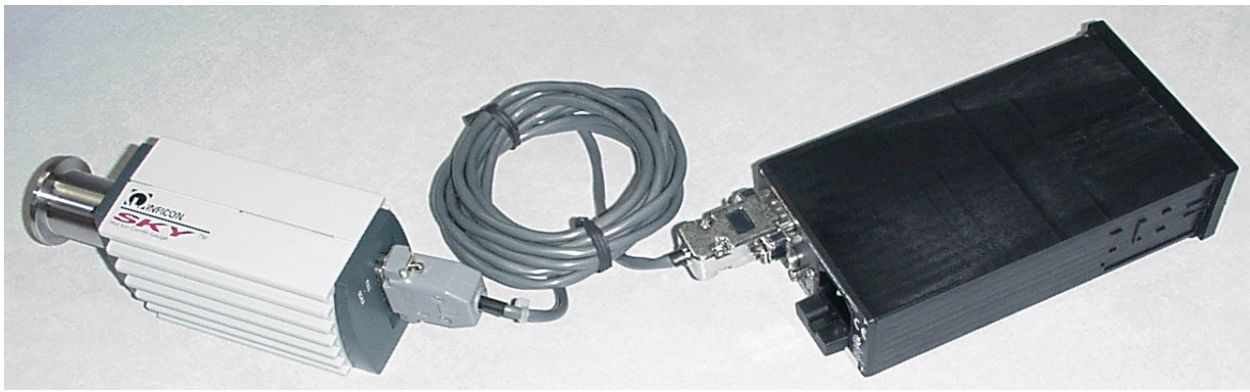
### **C. Connecting the Vacuum Sensor**

Make sure the transducer is securely connected to the vacuum system, using good vacuum practice. If necessary, refer to the BPG400 Operating Manual.

#### D. Attaching the Sensor Cable

The cable has a 9-pin D-sub connector on one end, which plugs into the Model 990. Connect the 9-pin D-sub plug of the gauge cable to the 9-pin connector on the back of the Model 990 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.

The Inficon BPG400 has a 15-pin D-sub connector. Follow the same instructions above to connect this connector.



**Figure 6: BPG400 Connected to the Terranova 990**

<u>BPG400 D-15 Pin</u>	<u>Description</u>	<u>Color</u>	<u>990 D-9 Pin</u>
2	Sensor Signal	White	1
5	Supply Common	Green	9
7	Degas On	Brown	4
8	24 Volt Supply	Red	5
12	Signal Common	Black	8
15	Supply Common	Drain	9

**Fig. 7. Wire/Pin Connections for the Model 990 Sensor Cable (8100-990-00)**

### **E. Checking the Supply Voltage**

The Model 990 incorporates a universal power supply. This allows controller to operate on any input voltage from 90 VAC to 265 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 990.

### **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 and chooses the units of measure. The user cycles through the set up parameters by pressing the Select button. The user adjusts the parameter values by pressing the Raise or Lower buttons. The parameter values flash on and off on the digital display, indicating the controller is in the set up mode.

If the unit is inadvertently left in the Set-Up mode, it will automatically revert to the Measurement Mode after a few minutes, emitting a beep as it does.

### **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, **990**.  
 display shows software version, e.g. **1.00**

The Model 990 will then go into normal operation and begin measuring pressure.

(See section IV-B for error code interpretation.)

### B. Front Panel Controls

The Model 990 allows flexible configuration of operation using simple entry from the front panel buttons labeled SELECT, RAISE, 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 relay will be de-energized. Press the RAISE or LOWER buttons 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 HIGH operates in conjunction with SET PT 1 LOW.

## 2. Set Pt 1 low

Default Value: OFF

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.

*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 990 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 point Range

$1.0 \times 10^{-9}$ Torr	to	$8.0 \times 10^{+2}$ Torr
$1.5 \times 10^{-9}$ mBar	to	$1.1 \times 10^{+3}$ mBar
$1.3 \times 10^{-7}$ Pascal	to	$1.1 \times 10^{+5}$ Pascal

Set points will not operate while the Model 990 is in Set-Up Mode.

## 4. Set Pt 2 High

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

## 5. Set Pt 2 Low

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

## 6. Calibrate

Default Value: 1.00 (Internal value)

This allows the user to modify the reading for either gauge by multiplying by a value between 0.80 and 1.20 (-/+ 20%). This is convenient for calibration of the sensor. 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.

To repeat, the value of the calibration factor is not itself displayed; only the current reading from the sensor times the calibration factor is displayed.

For example, if the current reading from the sensor was 7.6+2 torr (760 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. All subsequent readings would then be multiplied by the same factor that had been entered.

If you had pressed RAISE to increase the display from 7.6+2 torr by 20% to 9.1+2 torr, (+20% or a calibration factor of 1.20) then all subsequent readings would be multiplied by the internal calibration factor of 1.20.

### *NOTE — ATMOSPHERIC PRESSURE*

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

## 7. 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 numerics displayed will be in the units selected. When the units are changed, the numeric values will be changed leaving the actual pressure value unchanged.

**8. Degas On/Off: Button**

Turns Ion Gauge Degas On and Off if pressure range is below  $7.2 \times 10^{-6}$  mbar ( $5.4 \times 10^{-6}$  torr,  $7.2 \times 10^{-4}$  pascal). Degas shuts off automatically after 2.5 minutes.

**9. Reset of Stored Values**

This allows you to recover the factory settings for all stored values and resets the set points and protect pressure 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 990 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 990 is in the following state:

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

**C. Reading Pressure**

<u>Sensor Condition</u>	<u>Display</u>
Disconnected Sensor	Er 2
$P < 5 \times 10^{-10}$ mbar	LO
$P = 5 \times 10^{-10}$ mbar to $1.1 \times 10^{+3}$ mbar	MSD.LSDsignEXP e.g.: 3.5-2 equals $3.5 \times 10^{-2}$ Torr 7.5+2 equals 750 Torr
$> 1000$ mbar	HI



#### D. Logarithmic 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:

$$V=0.5*((\log 10 (\text{Pressure}))+12)$$

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:

**Figure 8: Analog Output vs. Displayed Pressure**

<u>Display Information</u>	<u>Analog Output - volts</u>
OFF/LO/Er 2	0.0
1x10 <sup>-10</sup>	1.0
1x10 <sup>-9</sup>	1.5
1x10 <sup>-8</sup>	2.0
1x10 <sup>-7</sup>	2.5
1x10 <sup>-6</sup>	3.0
1x10 <sup>-5</sup>	3.5
1x10 <sup>-4</sup>	4.0
1x10 <sup>-3</sup>	4.5
1x10 <sup>-2</sup>	5.0
1x10 <sup>-1</sup>	5.5
1x10 <sup>0</sup>	6.0
1x10 <sup>+1</sup>	6.5
1x10 <sup>+2</sup>	7.0
1x10 <sup>+3</sup>	7.5
HI, Er 5	8.5

**E. Serial Interface**

The RS-232 serial port provides pressure readings when requested by the terminal. The interface is standard RS-232 format; 9600 bps, 8-bits, noparity, 1 stop bit. The interface is through the 15-pin D-sub accessory connector.

The serial port allows reading pressure and other parameters of the Model 990; it is not possible to modify stored parameters over the serial port.

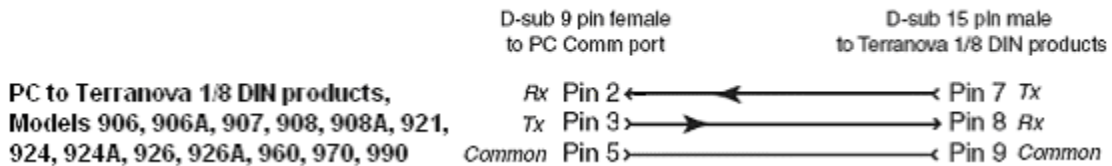
The serial port is only active in Measurement Mode.

**Figure 9: Serial Interface Parameters, Syntax and Response**

<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_hi, SP2_lo, status	msd.lsdE+/-exp, msd.lsdE+/-exp 1 energized, 0 Off
version	"v"	model, version	990,verx.xx
degas status	"d"	on, off	
turn degas 'ON'	"o"	OK, or Er if ON or pressure out of range	
turn degas 'OFF'	"f"	OK, or Er if OFF	

**NOTE:** The commands are a single character. There is no carriage return after the command character. The Model 990 returns "%Error" when an invalid (e.g. incorrect syntax) or unrecognized (e.g. wrong parity or baud rate) command is received.

**Serial Interface Cable: PC Serial Port to Terranova 9XX Products**



## 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 Corp.

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 Corp.

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. Normal range for the voltages are 23.5 to 24.5 volts. +24 V may be measured on the red wire; power return is on the black wire. If the power supply 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 990 will protect itself if it finds excessive power draw again.

It is normal for the Model 990 to feel warm to touch along the left side of the case.

If the trouble appears to be related to the sensor tube, please refer to the appropriate users manual which is included with the transducer.

## B. Error Codes

<u>Error Code</u>	<u>Condition</u>
Er 0	Action not allowed at this time
Er 1	Not implemented
Er 2	Defective cable, cable disconnected, sensor disconnected
Er 3	Hot cathode gauge error
Er 4	Pirani gauge error
Er 5	Pressure exceeds range
Er 6	Pressure below range
Er 7	Pressure below range
Er 8	Pressure too high for hot cathode gauge degas
Er 9	Pressure too high for calibration adjustment

**Figure 10: Model 990 Error Codes**

## C. Accessories / Part Replacement

If you need to return the gauge controller to Duniway Stockroom Corp. for service, first contact Customer Service at Duniway Stockroom Corp. 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 990; 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 & CE Declaration

*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.*

*If this product is returned to Duniway Stockroom for warranty service, Buyer will prepay 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

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**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 906 Convection Gauge Controller  
Model 908A Dual Capacitance Diaphragm Gauge Controller  
Model 921 Cold Cathode Gauge Controller  
Model 924 Thermocouple Vacuum Gauge  
Model 926 Dual Convection Gauge Controller  
Model 990 Combi Gauge Controller  
Model 741 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)**

October, 1999

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