DUNIWAY
STOCKROOM CORP.

Terranova® 907

Dual Capacitance Diaphragm Gauge & Convection-enhanced Pirani Control Unit

Instructions Manual

Revision - 0917NC

TELEPHONE: 650-969-8811 **TOLL-FREE (US/Canada):** 800-446-8811 **FAX:** 650-965-0764 **EMAIL:** info@duniway.com
WEB: www.duniway.com

TABLE OF CONTENTS

Specifications

Operating Voltage	Universal	100 V to 240 V AC @ 50 Hz to 60 Hz; 40 VA 100 V to 240 V DC	
Pressure Display	4 Red LEDs – 4 digits (NNNN) with pressure unit auto ranging		
Pressure Units	Torr / mTorr (Default) mbar / µbar Pa / kPa		
Display Range	-0.20 mTorr to 1.5 x 10^4 Torr (-0.26 µbar to 2.0 x 10^4 mbar) (-0.026 Pa to 2033 kPa)		
Relay Rating	Varies	From: To:	2 A at 30 V DC (60 V AC) 0.4 A at 150 V DC (300 V AC)
	See **Appendix 5** for more details		
Temperature Range	2°C to 50°C (in operation)		
Weight	1 lb / 0.5 kg		
	Convection-enhanced Pirani		
Measuring Range	1 x 10^{-4} Torr to 1000 Torr (Air / Nitrogen) (1.3 x 10^{-4} µbar to 1333 mbar) (1.3 x 10^{-2} Pa to 133 kPa)		
Display Resolution	Varies	From: To: 	0.1 mTorr less than 100 mTorr (0.13 µbar less than 133 µbar) (0.01 Pa less than 13.3 Pa) 5 Torr greater than 100 Torr (6.7 mbar greater than 133 mbar) (0.7 kPa greater than 13.3 kPa)
Accuracy	Pressure calculation algorithm is accurate to ±1 % of published data for the MKS / HPS Series 317 and Granville-Phillips 275 Convectron® gauges (Accuracy does not include pressure gauge uncertainty)		
	Capacitance Diaphragm Gauge		
Measuring Range	Four pressure decades (or orders of magnitude) from full scale See **Appendix 3** for full scale range options		
Output Voltage	± 15 V DC at 0.75 A		

Accessories

Included	Instruction manual (Online) One power cord Two replacement fuses Two panel mount clips One unterminated male 15-pin D-sub connector	
Required (Sold separately)	**HYB-275**	Hybrid Granville-Phillips 275 Convectron® (or equivalent) & capacitance diaphragm gauge cable (10 ft)*
	HYB-CEP	Hybrid MKS / HPS Series 317 Convection-enhanced Pirani (or equivalent) & capacitance diaphragm gauge cable (10 ft)*
	See **Appendix 1** for a list of compatible pressure gauges	
Optional	**RS232-TN9DIN**	RS-232 serial communication cable (10 ft)*

* Custom cable lengths available upon request

Explosive Gases

Do not use the Terranova® 907 to measure the pressure of combustible gas mixtures. Although the pressure gauge normally operates at low temperatures, it is possible that momentary transients or controller malfunction can raise the pressure gauge above the ignition temperature of combustible mixtures. This, in turn, can create an explosion which can damage equipment and / or injure personnel.

Limitation on use of Compression Mounts

Do not use a compression port to connect pressure gauges to a vacuum system in applications that may develop above-atmospheric pressures. Pressures above atmospheric pressures may cause the pressure gauge to eject from a compression fitting and damage equipment and / or injure personnel.

Chemicals

Many organic cleaning solvents, such as acetone, produce fumes that are toxic and / or flammable. Such solvents should only be used in well-ventilated areas and away from electronic equipment, open flames, or other potential ignition sources.

Introduction

The Terranova® 907 Dual Gauge Controller is designed to simultaneously operate both a Granville-Phillips 275 Convectron® gauge, MKS / HPS Series 317 convection-enhanced Pirani gauge, or equivalent pressure gauge and a capacitance diaphragm gauge such as the MKS 722B Baratron® capacitance manometer. The Terranova® 907 covers the pressure range between 1 x 10^{-4} Torr to 1 x 10^{4} Torr. The control unit can operate both standard and heated capacitance diaphragm gauges with full scale ranges between 1 x 10^{4} Torr and 2 x 10^{-2} Torr that require a ± 15 V DC input and have a 0 V - 10 V DC output signal.

Installation

Mounting the Terranova® 907

The Terranova® 907 is housed in a standard 1/8 DIN box to allow for mounting on most equipment racks or cabinets. The dashed call-out dimensions in **Figure 1** illustrate the proper cutout dimensions for the 1/8 DIN box.

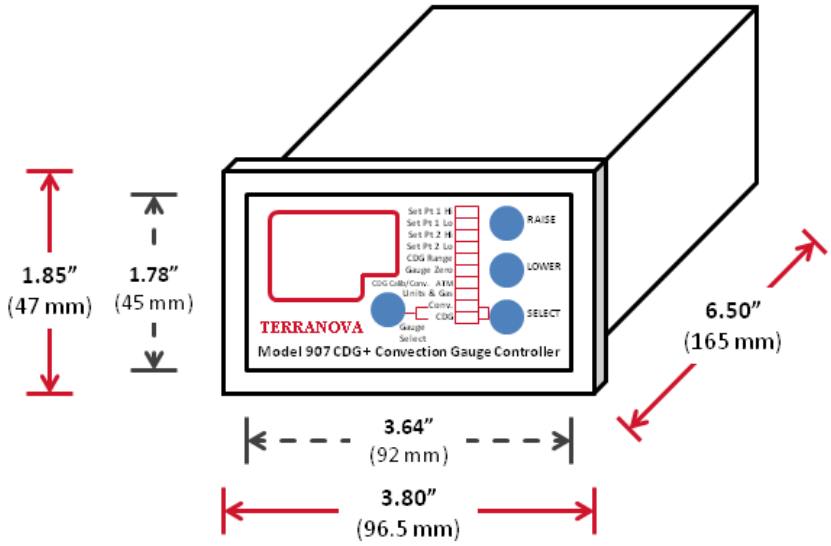

Figure 1. Terranova® 907 cutout and unit dimensions

To properly mount the unit:

1. Locate the mounting clips included with the control unit
2. With the square end of the mounting clip facing towards the front panel, slide the beveled surfaces of the clip under the cutout located on each side of the control unit
3. Push the clip toward the back of the unit until the central tongue locks the clip
4. Tighten the rod against the rack or panel to secure the unit

If successful, the clips should hold the Terranova® 907 in place. Installation must not block vent ports and should provide enough clearance to access rear cable connections.

Connecting the Pressure Gauge

The Terranova® 907 has a female 9-pin D-sub port located on the back of the control unit labeled SENSOR(S) to connect the pressure gauge cable (see **Figure 2**). A special hybrid cable is required to simultaneously connect both the convection-enhanced Pirani and capacitance diaphragm gauge to the control unit. To connect both a Granville-Phillips 275 Convectron® gauge (or equivalent gauge) and a compatible capacitance diaphragm gauge, the user will require the Duniway gauge cable **HYB-275**. Similarly, the user will require the Duniway gauge cable **HYB-CEP** to connect the MKS / HPS Series 317 convection-enhanced Pirani gauge and compatible capacitance diaphragm gauge to the control unit.

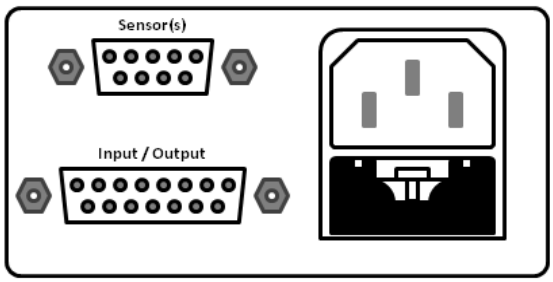

Figure 2. Terranova® 907 back view

Terranova® 907 should be OFF before connecting the pressure gauge(s). Plugging or unplugging the pressure gauge while the control unit is ON can damage pressure gauge internals.

To properly connect the Terranova® 907 to the respective pressure gauges:

1. Secure the pressure gauge cable ends to the sensors
2. Secure the male 9-pin D-sub connector of the cable to the SENSOR(S) port
3. Fasten retainer screws (where applicable) on all cable connections

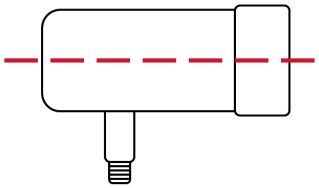

Figure 3. Pressure gauge orientation

The recommended convection-enhanced Pirani gauges should be installed with the axis horizontal as shown in **Figure 3** with the port pointing downward. Large errors can result at higher pressures if the axis is not horizontal. User should always ensure the pressure gauge is securely connected to the vacuum system before use.

Use of a pressure gauge other than the suggested types may lead to improper readings and / or cause damage to the pressure gauge.

Operation

Self-Test

The Terranova® 907 will perform a self-test at power ON. The self-test cycle is initiated by a BEEP sound followed by:

1. All pressure unit LEDs become illuminated
2. All function indicator LEDs become illuminated
3. All numeric display indicators become illuminated
4. Display reads the model number (i.e. 907)
5. Display reads the software version (e.g. 0.81)
6. Display reads the pressure gauge curve (e.g. 275)
7. Display reads the gas curve (e.g. AIR)

The control unit will commence normal operation if Self-Test is successful. Control unit fan will automatically start at power ON.

Setup Mode

The Terranova® 907 parameters can be set or modified by the following nine-step operation:

1. Press the **SELECT** button to set or adjust the relay deactivation pressure for SET POINT 1. Use the **RAISE** or **LOWER** button to increase or decrease the SET PT 1 HI pressure value shown on the display. Default value is OFF. SET PT 1 HI LED will illuminate during adjustment. See **Set Point Operation**
2. Press the **SELECT** button a second time to set or adjust the relay activation pressure for SET POINT 1. Use the **RAISE** or **LOWER** button to increase or decrease the SET PT 1 LO pressure value shown on the display. Default value is OFF. SET PT 1 LO LED will illuminate during adjustment. See **Set Point Operation**
3. Press the **SELECT** button a third time to set or adjust the relay deactivation pressure for SET POINT 2. Use the **RAISE** or **LOWER** button to increase or decrease the SET PT 2 HI pressure value shown on the display. Default value is OFF. SET PT 2 HI LED will illuminate during adjustment. See **Set Point Operation**
4. Press the **SELECT** button a fourth time to set or adjust the relay activation pressure for SET POINT 2. Use the **RAISE** or **LOWER** button to increase or decrease the SET PT 2 LO pressure value shown on the display. Default value is OFF. SET PT 2 LO LED will illuminate during adjustment. See **Set Point Operation**

Although the SET POINT HI and SET POINT LO parameter may be independently assigned to operate with either pressure gauge, both values will apply to the pressure gauge selected for the SET POINT LO value. Use the GAUGE SELECT button to choose between CEP / 275 or CDG.

5. Press the **SELECT** button a fifth time to set or adjust the full-scale range of the capacitance diaphragm gauge. Use the **RAISE** or **LOWER** button to select the proper CDG RANGE value shown on the display. Default full-scale range is 1.00 Torr. CDG RANGE LED will illuminate during adjustment. See **Appendix 3** for permissible pressure ranges.
6. Press the **SELECT** button a sixth time to zero-adjust the control unit. Use the **RAISE** or **LOWER** button to increase or decrease the GAUGE ZERO pressure value shown on the display. Default value is 0.0. GAUGE ZERO LED will illuminate during adjustment. See **Zero Adjustment**
7. Press the **SELECT** button a seventh time to adjust the atmospheric pressure value for the convection-enhanced Pirani gauge and upper range pressure value of the capacitance diaphragm gauge. Use the **RAISE** or **LOWER** button to increase or decrease the CDG CALIB / CONV ATM pressure value shown on the display. CDG CALIB / CONV ATM LED will illuminate during adjustment. See the **Pressure Adjustment** section

The GAUGE ZERO and CDG CALIB / CONV ATM pressure values may be independently modified for each sensor. Use the GAUGE SELECT button to choose between CEP / 275 and CDG.

8. Press the **SELECT** button an eighth time to set the pressure units for both pressure gauges and the gas response curve for the 275 / CEP. Use the **RAISE** or **LOWER** button to select the proper UNITS & GAS values shown on the display. User can select between torr, millibar, and Pascal pressure units and air and argon gas response curves. Default pressure unit and response curve is TORR / AIR. UNITS & GAS LED will illuminate during adjustment.
9. Press the **SELECT** button a ninth time to return the unit to normal operation.

User must press and hold the **RAISE** or **LOWER** button until value changes. Pressing and holding the **RAISE** or **LOWER** button during Setup Mode allows for faster value change. Display will flash during all Setup Mode steps. Unit will return to normal operation in approximately 60 seconds if left unattended during Setup Mode; any changes will be saved. Timer is reset if any button is pressed during the 60-second timeout.

Zero Adjustment

Zero adjustment is recommended when installing a new pressure gauge or to restore pressure output accuracy. The Terranova® 907 can be either zero adjusted or set to a specific low-pressure value via the GAUGE ZERO value. Zero adjustment should be conducted before the atmospheric pressure adjustment.

Pressure reading range will shift if user accidentally changes the GAUGE ZERO value during use. If this occurs, user should reset the Terranova® 907 and redo both the zero and atmospheric pressure adjustment.

Negative pressure readings during use or zero adjustment may indicate the control unit requires further adjustment. Negative pressure readings are to be used only as an indication of vacuum.

Convection-enhanced Pirani Gauge

Pressure reading must be less than approximately 50 mTorr (or 68 µbar) at initial set-up to adjust the GAUGE ZERO value; otherwise, error code ER11 will be output on the display. For zero adjustment, GAUGE ZERO value should be set to approximately 0.0 mTorr and system pressure must be less than 1 x 10^{-4} Torr (1 x 10^{-4} mbar) to display accurate pressure measurements. The control unit may also be set to a specific pressure value. For example, if system pressure is indicated to be at 10 mTorr by a secondary pressure gauge, the unit can also be set to agree with said value. Although the GAUGE ZERO value is stored by the control unit, it will not be displayed in subsequent adjustments. The GAUGE ZERO value is appropriately converted when switching between pressure units.

Capacitance Diaphragm Gauge

Zero adjustment can be conducted through a combination of the Terranova® 907 and capacitance diaphragm gauge. To zero-adjust the unit, system pressure must be less than 10% full scale of the capacitance diaphragm gauge. Otherwise, error code ER21 will be output on to the display. Through a combination of the GAUGE ZERO value and zero adjustment of the pressure gauge, pressure value should be set to approximately 0.0 mTorr. The control unit may also be set to a specific pressure value. For example, if system pressure is indicated to be at 10 mTorr by a secondary pressure gauge, the unit can also be set to agree with said value. Heated or temperature-controlled capacitance diaphragm gauges should be at their regulated temperatures when zero adjusting for accurate pressure readings. Although the GAUGE ZERO value is stored by the control unit, it will not be displayed in subsequent adjustments. The GAUGE ZERO value is appropriately converted when switching between pressure units.

Upper Range Pressure Adjustment

Convection-enhanced Pirani Gauge

Atmospheric pressure adjustment is recommended when installing a new pressure gauge or to restore pressure output accuracy. The Terranova® 907 can be set to either local atmospheric pressure – 760 Torr (1013 mbar) at sea level – or a specific high-pressure value via the CDG CALIB / CONV ATM pressure value. To set or adjust the atmospheric pressure value, pressure reading must be greater than approximately 270 Torr (or 360 mbar). Otherwise, error code ER12 will be output on to the display. Although the CDG CALIB / CONV ATM value is stored by the control unit, it will not be displayed in subsequent adjustments. The CDG CALIB / CONV ATM value is appropriately converted when switching between pressure units. Zero adjustment should be conducted before the atmospheric pressure adjustment.

Pressure reading range will shift if user accidentally changes the CDG CALIB / CONV ATM value during use. If this occurs, user should reset the Terranova® 907 and redo both the zero and atmospheric pressure adjustment.

Capacitance Diaphragm Gauge

The upper range of the capacitance diaphragm gauge may be modified via the CDG CALIB / CONV ATM value. This feature should only be used to calibrate a capacitance diaphragm gauge when reliable calibration data is available. Pressure reading must be greater than 50% of the full-scale pressure value to adjust the value. Otherwise, error code ER22 will be output on to the display. The CDG CALIB / CONV ATM value may be used to set the atmospheric pressure value for 1000 Torr full scale pressure gauges. Although the CDG CALIB / CONV ATM value is stored by the control unit, it will not be displayed in subsequent adjustments. The CDG CALIB / CONV ATM value is appropriately converted when switching between pressure units. Zero adjustment should be conducted before upper range pressure adjustment.

Pressure reading range will shift if user accidentally changes the CDG CALIB / CONV ATM value during use. If this occurs, user should reset the Terranova® 907 and redo both the zero and atmospheric pressure adjustment.

Changing Pressure Gauge Curves

The Terranova® 907 is able to output pressure readings based on the pressure curve of either the Granville-Phillips 275 Convectron® gauge (i.e. 275) and equivalent sensors or the MKS / HPS Series 317 (i.e. CEP) sensor. The default pressure gauge curve is CEP.

To change pressure gauge curves:

1. Remove power from the control unit
2. Simultaneously depress the **RAISE** and **SELECT** buttons while restoring power to the control unit
3. Release the buttons once the Self-Test has initiated

If pressure gauge curve change is successful, two BEEPs will be emitted and the corresponding pressure curve code will appear on the unit display. Thereafter, the Terranova® 907 will resume normal operation.

Pascal Mode

Pascal Mode disables the ability to change pressure units via the front panel and strictly outputs pressure measurement in Pascal units. The Pascal mode only applies to the capacitance diaphragm pressure gauge.

To enter or exit Pascal Mode:

1. Remove power from the control unit
2. Simultaneously depress the **RAISE**, **LOWER**, and **SELECT** buttons while restoring power to the control unit
3. Release all three buttons after the Self-Test has initiated

If Pascal Mode is entered successful, two BEEPs will be emitted and the model number will be output with an appended letter J (i.e. 907J). Once the front panel buttons are released, the Self-Test will continue and the Terranova® 907 will resume normal operation. See **Appendix 3** for Pascal unit display format.

Restoring Default Values

Restoring default parameters provides a starting point for control unit re-adjustment in the event pressure measurements become unreliable. To restore Terranova® 907 default parameters:

1. Remove power from the control unit
2. Simultaneously depress the **RAISE** and **LOWER** buttons while restoring power to the control unit
3. Release the buttons once the Self-Test has initiated

If reset process is successful, two BEEPs will be emitted and the code RST will appear on the unit display. Once the front panel buttons are released, the Self-Test will continue and the Terranova® 907 will resume normal operation. Restoring default parameters does not exit Pascal Mode.

Pressure Measurement

Terranova® 907 operation is almost automatic and will commence after a successful Self-Test. Pressure unit will auto range during use as system pressure increases or decreases. Although the control unit is able to simultaneously operate both types of pressure gauges, only one pressure gauge reading will be output onto the display at a time. User can select between the CEP / 275 and CDG pressure gauge via the **GAUGE SELECT** button to display the corresponding pressure readings. The selected pressure gauge LED will illuminate during use.

Due to a number of system variables, pressure differences may result with each subsequent pressure measurement and/or between different pressure gauges.

Convection-enhanced Pirani Gauge

The Terranova® 907 may be set to output pressure readings based on either air / nitrogen or argon. If gases other than air / nitrogen or argon are to be used, **Appendix 4** provides corrected pressure values for a number of gases including helium with respect to air / nitrogen. For example, if the vacuum system is backfilled with helium and the Terranova® 907 reads a vacuum pressure of 13.2 Torr, true system pressure is approximately 5 Torr.

Unit display will read OFF if gauge cable is not connected. Unit display will read HI if system pressure is greater than 995 Torr or if the pressure gauge is disconnected, but the gauge cable is connected to the unit. Unit display will read LO if system pressure is less than the lowest displayable value. Display resolution is converted from torr to millibar or Pascal units. For example, 20.0 mTorr will be converted to 26.7 µBar and 2.7 Pa, respectively. Terranova® 907 pressure display resolution is as follows:

Step	Range
5 Torr	greater than 100 Torr
0.5 Torr	10 Torr to 100 Torr
0.05 Torr	5 Torr to 10 Torr
0.02 Torr	1 Torr to 5 Torr
1 mTorr	100 mTorr to 1000 mTorr
0.1 mTorr	less than 100 mTorr

Capacitance Diaphragm Gauge

Appendix 3 shows pressure display format for Torr / millibar and Pascal units. Pressure readings are reliable to approximately 0.05 % of full scale. Display resolution is converted from torr to millibar units in the respective pressure ranges. Unit display will read OFF if gauge cable is connected or disconnected. The display will also read OFF if the pressure gauge is out of range. Display will read LO if system pressure is less than the lowest displayable value. Display will flash if pressure reading is greater than the full-scale value.

Control unit may become warm during operation; this is normal

Set Point Operation

The Terranova® 907 can be utilized for process control functions through the use of two independent, programmable set points, SET POINT 1 and SET POINT 2, and corresponding relays. Each set point has an adjustable activation (i.e. SET POINT LO) and deactivation (i.e. SET POINT HI) pressure value that allows the user to modify the relay hysteresis. SET PT 1 HI and SET PT 1 LO correspond to SET POINT 1; SET PT 2 HI and SET PT 2 LO correspond to SET POINT 2. Set point pressure values are adjusted via the front panel; relay output is accessible through the INPUT / OUTPUT 15-pin D-sub connector port located in the back of the control unit. See **Table 1** for relay pin configuration.

Each relay will independently activate once the pressure reading is less than its corresponding SET POINT LO value. The relay will deactivate once the pressure reading is greater than its corresponding SET POINT HI value. Relays will be disabled if set point value is OFF. The Terranova® 907 will automatically increase the SET POINT HI value to the next pressure step from the SET POINT LO value if SET POINT LO is adjusted greater than SET POINT HI and vice versa. For example, if SET POINT HI is set to 100 Torr and SET POINT LO is set to 110 Torr, the SET POINT HI value will automatically be adjusted to 115 Torr. See **Appendix 5** for relay use with inductive or capacitive load switching.

Convection-enhanced Pirani Gauge

Terranova® 907 set point pressure display resolution is as follows:

Step	Range
5 Torr	greater than 100 Torr
0.5 Torr	10 Torr to 100 Torr
0.05 Torr	5 Torr to 10 Torr
0.02 Torr	1 Torr to 5 Torr
1 mTorr	less than 1000 mTorr

Display resolution steps are converted from torr to millibar or Pascal units.

Capacitance Diaphragm Gauge

The Terranova® 907 SET POINT HI pressure value can range from 0.20% to 99.9% of full scale value. The SET POINT LO pressure value can range from 0.19% to 99.8% of full scale value. Set point resolution steps (in torr units) are as follows:

Step	Pressure Range
0.01 % of full scale	less than 10% of full scale
0.1 % of full scale	greater than 10% of full scale

For example, a 1000 Torr full scale sensor has a SET POINT HI pressure range from 2.0 Torr to 999 Torr; the SET POINT LO pressure range is from 1.9 Torr to 998 Torr. Values will be displayed in 0.1 Torr steps for pressures less than 100 Torr and 1 Torr steps for pressures greater than 100 Torr. The Terranova® 907 converts the set point resolution from torr to millibar or Pascal pressure units, rounding pressure values to the next resolution step. For example, for a 1333 mbar full scale sensor, values will be displayed in 0.13 mbar steps for pressures less than 133 mbar and 1.33 mbar steps for pressures greater than 133 mbar.

PIN	Function	Output	Description
1	SET POINT 1 Relay	Normally closed (NC)	See **Set Point Operation**
2	SET POINT 1 Relay	Common	See **Set Point Operation**
3	SET POINT 1 Relay	Normally open (NO)	See **Set Point Operation**
4	SET POINT 2 Relay	Normally closed (NC)	See **Set Point Operation**
5	SET POINT 2 Relay	Common	See **Set Point Operation**
6	SET POINT 2 Relay	Normally open (NO)	See **Set Point Operation**
7	Tx		See **Serial Communication**
8	Rx		See **Serial Communication**
9	Common Ground		See **Serial Communication**
10	N/A	N/A	N/A
11	CDG Analog Output		See **NOTES**
12	N/A	N/A	N/A
13	Analog Output		See **Analog Output**
14	N/A	N/A	N/A
15	CEP Analog Output		See **NOTES**

Table 1. I/O port pin configuration

NOTES

PIN 11 Buffered signal; 1kΩ output impedance

PIN 15 Buffered signal; 1kΩ output impedance

Serial Communication

The INPUT / OUTPUT 15-pin D-sub port allows the user to remotely query the Terranova® 907 to read unit parameter values. The serial communication standard used for data transmission is RS-232. The RS-232 format for communication with the Terranova® 907 unit is as follows:

RS-232 Settings
9600 baud
No parity
8 bits
1 stop bit
Full duplex

Figure 4 shows the pin configuration for RS-232 communication. User will have to utilize Duniway cable **RS232-TN9DIN** and a separate program, such as HyperTerminal, to send query characters and read output from the control unit. Query applies to both pressure gauges regardless of which gauge is selected on the control unit display. **Table 2** lists the characters used by the Terranova® 907 to return unit parameters.

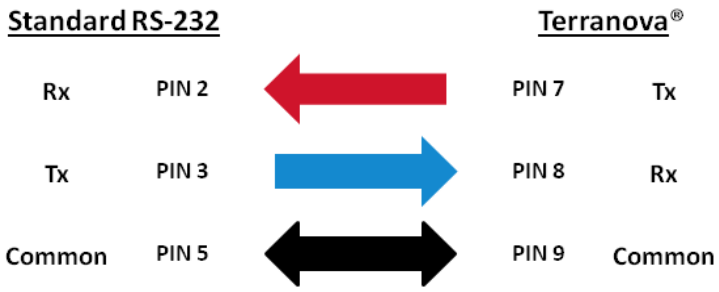

Figure 4. Terranova® 907 RS-232 pin configuration

The Terranova® 907 outputs pressure values in the following scientific notation format

AeB, XeY

in which *A* and *X* are the significand and *B* and *Y* are the exponent. When character p is transmitted to the unit, *A* and *B* values correspond to the convection-enhanced Pirani gauge and *X* and *Y* values correspond to the capacitance diaphragm gauge. The control unit also utilizes the same format to output set point pressure values. However, two values are appended to the output

AeB, XeY, R, G

in which *R* indicates the set point relay state and *G* indicates the pressure gauge to which the set point applies. If the relay is active, *R* = 1; otherwise, *R* = 0. *G* = CDG corresponds to the capacitance diaphragm gauge; *G* = PIR corresponds to the convection-enhanced Pirani gauge. When character 1 or 2 is transmitted to the control unit, pressure values correspond to SET POINT HI and SET POINT LO, respectively.

Character	Query	Output format	Notes
1	SET POINT 1 values	AeB, XeY, R, G	ASCII value 49
2	SET POINT 2 values	AeB, XeY, R, G	ASCII value 50
f	Full-scale range	AeB	ASCII value 102
p	Pressure reading	AeB, XeY	ASCII value 112
u	Pressure units	Torr / mBar / Pascal	ASCII value 117
v	Model number; Software version	907[J], ver N.NN	ASCII value 118
x	Gauge curve	275, CEP	ASCII value 120

Table 2. Serial communication query characters

Pressure output is in the selected units of the UNITS & GAS parameter

Examples		
CDG pressure:	2.340 Torr	**p**
275 / CEP pressure:	HI	
Output:		2.340e+0, HI
CDG pressure:	OFF	**p**
275 / CEP pressure:	OFF	
Output:		OFF, HI
SET POINT 1 is assigned to 275 / CEP (Relay ON)		
SET POINT 1 HI pressure:	60 mTorr	**1**
SET POINT 1 LO pressure:	57 mTorr	
Output:		60.0e-3, 57.0e-3, 1, PIR
SET POINT 2 is assigned to CDG (Relay OFF)		
SET POINT 2 HI pressure:	OFF	**2**
SET POINT 2 LO pressure:	OFF	
Output:		0.00, 0.00, 0, CDG

Control unit will output LO for either pressure gauge if display reads LO.

Analog Output

The Terranova® 907 has a calibrated, 12-bit resolution, logarithmic analog output available for use as a secondary method to read measured pressure values. Analog output voltage can be accessed through the INPUT / OUPUT 15-pin D-sub connector port. The unit outputs 0.50 V per pressure decade (or order of magnitude). LO pressure value corresponds to 0.00 V; HI / OFF pressure value corresponds to approximately 4.52 V. Analog output is valid only for the selected gauge on the control unit. See **Table 1** for pin configuration.

The analog output voltage can be approximated using the displayed pressure measurement by

$$V = 0.50 * \log_{10}(100 * P)$$

where *P* is the pressure reading in mTorr and *V* is the analog output in volts. For example, if *P* is equal to 10 mTorr, *V* (rounded to the nearest hundredth) is equal to 1.50 V. **Table 3** lists sample analog output and corresponding pressure values. For example, if analog output is 3.00 V, the corresponding pressure reading is 10.0 Torr.

Analog Output [V]	Pressure
0.00	LO / $P \leq 0$ mTorr
0.50	0.10 mTorr
1.00	1.0 mTorr
1.50	10.0 mTorr
2.00	100 mTorr
2.50	1.00 Torr
3.00	10.0 Torr
3.50	100 Torr
4.00	1000 Torr
4.52	HI / OFF / $P \geq 1 \times 10^4$ Torr

Table 3. Analog output with displayed pressure values

Pressure as a function of the analog output can be approximated by

$$P = 0.01 * 10^{2V}$$

where V is the analog output in volts and P is pressure in mTorr. For example, if V is equal to 3.50 V, P is approximately 100 Torr. Pressure values are converted from torr to millibar or Pascal units.

1 kΩ source impedance for analog output

Troubleshooting

Problem	Possible Cause	Diagnostic
Unit fails Self-Test	N/A	Restart unit; if restart fails, contact Duniway Stockroom
Fuse(s) repeatedly burn out	Incorrect AC input voltage	Verify AC voltage; if unit fails, contact Duniway Stockroom
Display is dim and reads incorrect pressure values	Incorrect AC input voltage	Verify AC voltage; if unit fails, contact Duniway Stockroom
Incorrect VAC / ATM values	Faulty pressure gauge	Verify pressure gauge is operational
Incorrect VAC / ATM values	Faulty power supply	Verify unit output voltage

Error Code	Description
ER01	Operation not allowed
ER02	Parameter at limit
ER03	Timeout during Setup Mode
ER11	275 / CEP zero adjustment not allowed
ER12	275 / CEP ATM adjustment not allowed
ER21	CDG zero adjustment not allowed
ER22	CDG ATM adjustment not allowed

Pressure Gauge

The Granville-Phillips 275 Convectron® gauge and MKS / HPS Series 317 gauge have internal resistance values indicative of an operational pressure gauge. User should first reset the Terranova® 907 to correct any controller problems. If resetting does not resolve the problem, user may clean the inside of the pressure gauge. A cleaning agent such as acetone or toluene may be used to carefully clear away any contaminants. The pressure gauge should be replaced if resistances greatly deviate or if cleaning does not provide reasonable pressure readings.

Chemicals

Many organic cleaning solvents, such as acetone, produce fumes that are toxic and/or flammable. Such solvents should only be used in well-ventilated areas and away from electronic equipment, open flames, or other potential ignition sources.

Granville-Phillips 275 Convectron® Gauge

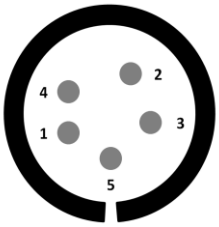

Figure 5. Granville-Phillips 275 Convectron® gauge pin configuration

PIN	Resistance [Ω]
1 & 2	18 to 23
2 & 3	50 to 60
1 & 5	180 to 185

Table 4. Granville-Phillips 275 Convectron® gauge resistance values

If the measured resistance values significantly differ from those provided in **Table 4**, the pressure gauge may be damaged, contaminated, or defective. If the resistance between PIN 1 and PIN 2 is approximately 800 Ω, the sensor wire in the gauge is broken. If the resistance values are correct but the pressure gauge does not output proper measurements, the gold plating on the tungsten sensor wire may have eroded. For all instances, the pressure gauge should be replaced.[1]

To prevent damage to the sensor wire, tests should not be performed with instruments that apply voltages greater than 0.1 V at vacuum or 2.0 V at atmospheric pressure.

MKS / HPS Series 317 Convection-enhanced Pirani Gauge

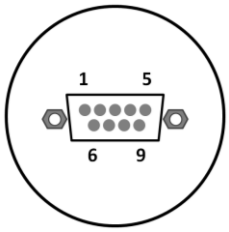

Figure 6. MKS / HPS Series 317 pin configuration

PIN	Resistance [Ω]
1 & 7	20
1 & 8	184
5 & 7	48

Table 5. MKS / HPS Series 317 resistance values

If the measured resistance values significantly differ from those provided in **Table 5**, the pressure gauge may be damaged, contaminated, or defective. Tests should be performed at atmospheric pressure and room temperature (i.e. 20 °C). [2]

Tests should not be performed with instruments which output greater than 5 mA.

1. Brooks Automation, Inc. 'Granville-Phillips® Series 475 Convectron® Vacuum Measurement Controller Instruction Manual'. 2009. 81.
2. MKS Instruments. 'HPS Series 947 Digital Convection Enhanced Pirani (CEP) Vacuum Sensor System Operation and Maintenance Manual'. 1999. 25.

Capacitance Diaphragm Gauge

If the Terranova® 907 consistently outputs LO, OFF, or HI codes, the internal power supply may have removed power to the pressure gauge. The power supply should output low or zero voltage if defective – output voltage range is approximately 14.5 V to 15.5 V for both positive and negative polarity. If zero or low voltage is present, user should remove power from the Terranova® 907 and allow the control unit to cool. If the cooling period does not resolve the issue, contact Duniway Stockroom.

Changing Fuses

The Terranova® 907 contains two Type F, regular (or slow-blow) 1 A fuses. As shown in **Figure 7**, both fuses are held in the fuse assembly located on the back panel of the unit.

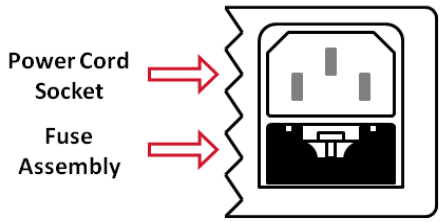

Figure 7. Terranova® 907 power module

To change fuses:

1. Unplug the line cord from the unit power module
2. Locate the fuse block immediately below the power cord socket
3. Press the tab of the fuse block and withdraw the assembly
4. Inspect and replace faulty fuse(s)
5. Reinsert fuse assembly into power module
6. Push fuse assembly into place until assembly tabs “click”

Recommended Fuses
Bussman GDB-1A
Bussman GDC-1A
Littelfuse 217 001
Littelfuse 218 001

Warranty

Duniway Stockroom Corporation ("DSC") warrants all Terranova® products 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 item(s). Shipping damage is excluded from the scope of this warranty. Pressure gauges 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 DSC receives notice of such defects during the warranty period, DSC will repair or replace firmware that does not execute its programming instruction due to such defects. DSC does not warrant that the operation of the firmware or hardware will be uninterrupted or error-free.

If this product is returned to DSC for warranty service, Buyer will prepay shipping charges and pay all duties and taxes for products returned to DSC. DSC will pay for the 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 the 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. DSC 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 DSC be liable for direct, indirect, special, incidental, or consequential damages, including loss of profits, whether based on contract, tort, or any other legal theory.

Please contact your Duniway Stockroom customer service representative for a Return Merchandise Authorization (RMA) number if you need to return a Terranova® product.

Declaration of Conformity

Duniway Stockroom Corp. declares under its sole responsibility that the following product

Terranova® 907 Dual Hybrid Gauge Controller

which displays the CE mark to which this declaration relates is in conformity with the following standards or normal documents:

EMC Directive (89/336/EEC//93/68/EEC)
Electromagnetic Compatibility Standards: EN 50081-1, -2: 1992, EN 50082-1, -2: 1993

CENELEC EN61326
Electrical Equipment for Measurement, Control and Laboratory Use
RMC Requirements Part 1: General Requirements
IEC 61326; 1997 + A1: 1998

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

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

July 1, 2001

Appendix 1. Terranova® 907 compatible pressure gauges

Convection-enhanced Pirani Gauge		
Part No.	**Description**	**Fitting***
GP275-071	Granville-Phillips 275 Convectron® gauge[1]	1/8" Male NPT
CVT-275-101	Duniway Convection-enhanced Pirani gauge[2]	¼" Female VCR
CVT-275-133	Duniway Convection-enhanced Pirani gauge[2]	1/8" Male NPT
CVT-275-KF25	Duniway Convection-enhanced Pirani gauge[2]	KF25
CVT-275-VCR-4	Duniway Convection-enhanced Pirani gauge[2]	1.33" CF
CEP-HPS-SH	MKS / HPS Series 317 Shielded Convection-enhanced Pirani[3] gauge	1/8" Male NPT
CEP-HPS-KF16SH	MKS / HPS Series 317 Shielded Convection-enhanced Pirani[3] gauge	KF16

* Other fittings available upon request
[1] Bakeable up to 150°C (non-operating)
[2] Compatible, plug-in replacement for Granville-Phillips 275 Convectron® gauge
[3] UHV compatible materials; bakeable up to 200°C

Capacitance Diaphragm Gauge			
Part No.	**Description**	**Full Scale**	**Fitting***
722B-1000	MKS 722B Baratron® Absolute Capacitance gauge	1000 Torr	1" OD Tube
722B-100	MKS 722B Baratron® Absolute Capacitance gauge	100 Torr	1" OD Tube
722B-10	MKS 722B Baratron® Absolute Capacitance gauge	10 Torr	1" OD Tube
722B-1	MKS 722B Baratron® Absolute Capacitance gauge	1 Torr	1" OD Tube
808-1000-NPT	Duniway Terranova® 808 Diaphragm gauge	1000 Torr	1/8" Male NPT
808-100C-NPT	Duniway Terranova® 808 Diaphragm gauge	100 Torr	1/8" Male NPT

* Other fittings available upon request

Appendix 2. Gauge Cable Diagrams

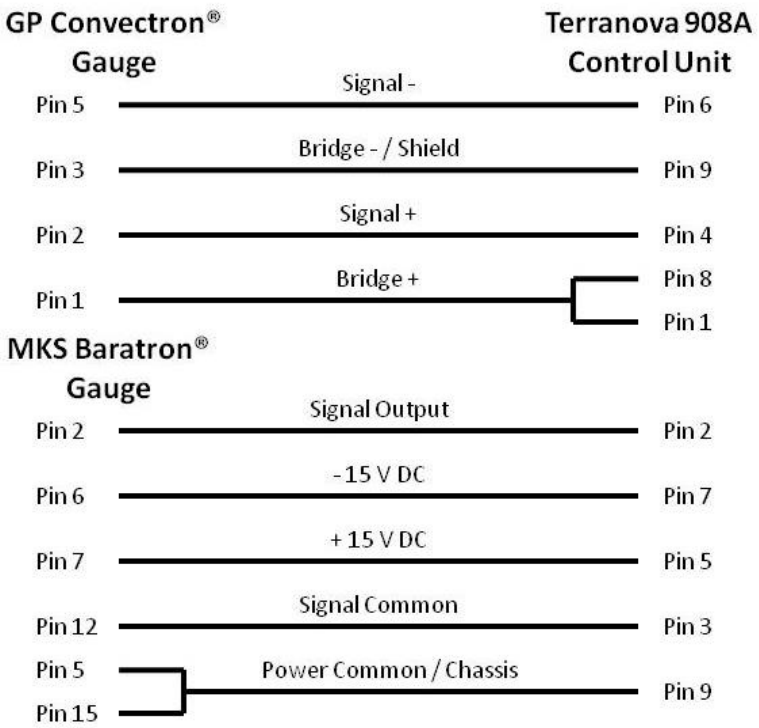

Figure 1. Terranova® 907 to MKS Baratron® 15-pin D-sub connector & Granville-Phillips 275 Convectron® cable configuration

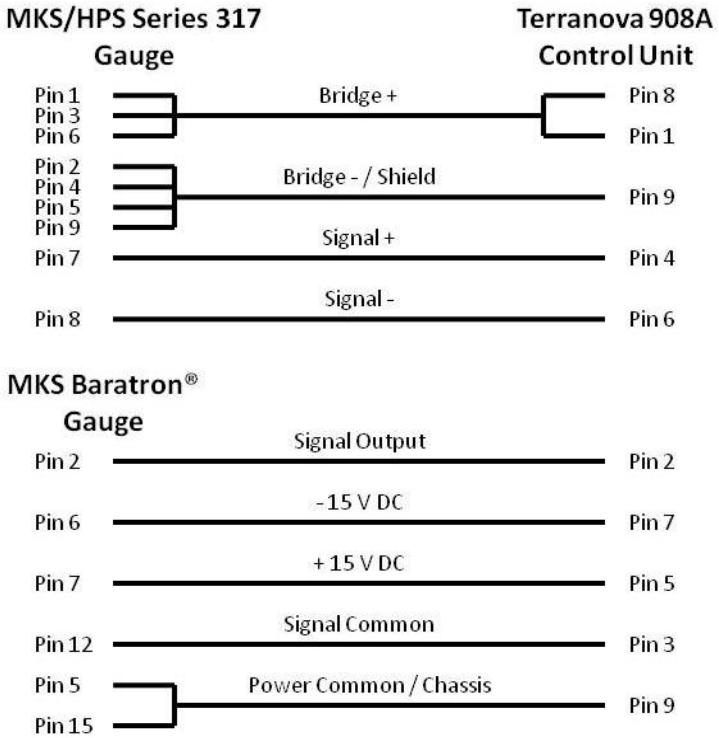

Figure 2. Terranova® 907 to MKS Baratron® 15-pin D-sub connector & MKS / HPS Series 317 cable configuration

Appendix 3. Full Scale Range Options

Full Scale		Display Format [Torr/mBar]*	
Torr	mBar	Upper Range	Lower Range
1×10^{4}	1.33×10^{4}	NNNN	N
5000	6650	NNNN	N.N
2000	2660	NNNN	N.N
1000	1330	NNN.N	N.N
500	665	NNN.N	N.NN
200	266	NNN.N	N.NN
100	133	NN.NN	N.NN
50	66.5	NN.NN	N.NNN
20	26.6	NN.NN	N.NNN
10	13.3	N.NNN	N.NNN
5	6.65	N.NNN	N.N [mTorr / µBar]
2	2.66	N.NNN	N.N [mTorr / µBar]
1	1.33	NNN.N	N.N [mTorr / µBar]
1×10^{-1}	1.33×10^{-1}	NN.NN [mTorr / µBar]	N.NN [mTorr / µBar]
5×10^{-2}	6.65×10^{-2}	NN.NN [mTorr / µBar]	N.NN [mTorr / µBar]
2×10^{-2}	2.66×10^{-2}	NN.NN [mTorr / µBar]	N.NN [mTorr / µBar]

Table 1. Torr / mBar display format

Full Scale	Display Format [Pa]*	
Pascal	Upper Range	Lower Range
1.33×10^{6}	NNNN [kPa]	N.N [kPa]
6.65×10^{5}	NNN.N [kPa]	N.NN [kPa]
2.66×10^{5}	NNN.N [kPa]	N.NN [kPa]
1.33×10^{5}	NNN.N [kPa]	N.NN [kPa]
6.65×10^{4}	NN.NN [kPa]	N
2.66×10^{4}	NN.NN [kPa]	N
1.33×10^{4}	NN.NN [kPa]	N
6650	NNNN	N.N
2660	NNNN	N.N
1330	NNNN	N.N
665	NNN.N	N.NN
266	NNN.N	N.NN
133	NNN.N	N.NN
13.3	NN.NN	N.NNN
6.65	N.NNN	N.NNN
2.66	N.NNN	N.NNN

Table 2. Pascal display format

***Except where stated otherwise**

Appendix 4. Corrected Pressure Values for Various Gases

True Pressure [Torr]	Indicated Pressure [Torr]								
	CO_2	Deuterium	Freon-12	Freon-22	He	Kr	Methane	Ne	Oxygen
1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	2×10^{-4}	1×10^{-4}	1×10^{-4}
2×10^{-4}	2×10^{-4}	2×10^{-4}	3×10^{-4}	2×10^{-4}	2×10^{-4}	2×10^{-4}	3×10^{-4}	1×10^{-4}	2×10^{-4}
5×10^{-4}	6×10^{-4}	5×10^{-4}	8×10^{-4}	7×10^{-4}	4×10^{-4}	3×10^{-4}	8×10^{-4}	3×10^{-4}	5×10^{-4}
1×10^{-3}	1.1×10^{-3}	1.9×10^{-3}	1.5×10^{-3}	1.4×10^{-3}	8×10^{-4}	5×10^{-4}	1.8×10^{-3}	7×10^{-4}	1.0×10^{-3}
2×10^{-3}	2.3×10^{-3}	2.4×10^{-3}	3.0×10^{-3}	2.9×10^{-3}	1.6×10^{-3}	1.0×10^{-3}	3.2×10^{-3}	1.4×10^{-3}	2.0×10^{-3}
5×10^{-3}	5.5×10^{-3}	6.0×10^{-3}	7.5×10^{-3}	6.8×10^{-3}	4.0×10^{-3}	2.3×10^{-3}	7.7×10^{-3}	3.5×10^{-3}	4.9×10^{-3}
1×10^{-2}	1.09×10^{-2}	1.20×10^{-2}	1.47×10^{-2}	1.35×10^{-2}	8.0×10^{-3}	4.6×10^{-3}	1.52×10^{-2}	7.0×10^{-3}	9.7×10^{-3}
2×10^{-2}	2.20×10^{-2}	2.40×10^{-2}	3.00×10^{-2}	2.70×10^{-2}	1.60×10^{-2}	9.0×10^{-3}	3.10×10^{-2}	1.40×10^{-2}	2.00×10^{-2}
2×10^{-2}	5.50×10^{-2}	6.00×10^{-2}	7.30×10^{-2}	6.90×10^{-2}	4.10×10^{-2}	2.40×10^{-2}	7.70×10^{-2}	3.50×10^{-2}	4.90×10^{-2}
1×10^{-1}	1.07×10^{-1}	1.20×10^{-1}	1.42×10^{-1}	1.36×10^{-1}	8.20×10^{-2}	4.60×10^{-2}	1.58×10^{-1}	7.00×10^{-2}	9.70×10^{-2}
2×10^{-1}	2.08×10^{-1}	2.47×10^{-1}	2.70×10^{-1}	2.59×10^{-1}	1.63×10^{-1}	8.50×10^{-2}	3.10×10^{-1}	1.40×10^{-1}	1.92×10^{-1}
5×10^{-1}	4.94×10^{-1}	6.73×10^{-1}	5.99×10^{-1}	5.82×10^{-1}	4.27×10^{-1}	2.14×10^{-1}	7.64×10^{-1}	3.53×10^{-1}	4.77×10^{-1}
1	9.30×10^{-1}	1.52	1.04	1.02	9.20×10^{-1}	3.90×10^{-1}	1.56	7.30×10^{-1}	9.50×10^{-1}
2	1.68	4.02	1.60	1.62	2.16	6.80×10^{-1}	3.24	1.60	1.90
5	3.24	260	2.38	2.54	13.0	1.26	13.5	5.10	4.86
10	4.84		2.86	3.30		1.74	28.5	21.5	10.0
20	6.40		3.22	3.62		2.24	360	585	22.5
50	8.00		3.68	4.02		2.50	845		86.0
100	9.00		4.56	4.78		2.66			225
200	12.0		5.80	6.25		3.08			305
300	17.0		6.70	7.30		3.50			385
500	29.5		8.05	9.00		4.10			605
700	49.0		9.20	10.5		4.60			860
760	56.0		9.50	11.0		4.64			945
900	88.5		10.0	12.0					
1000	130		11.0	12.5					

Data was compiled from a number of sources and is provided as a guide. If pressure readings are critical to application, user should consult a vacuum pressure gauge calibration specialist.

Appendix 5. Notes on Terranova® Set Point Relays

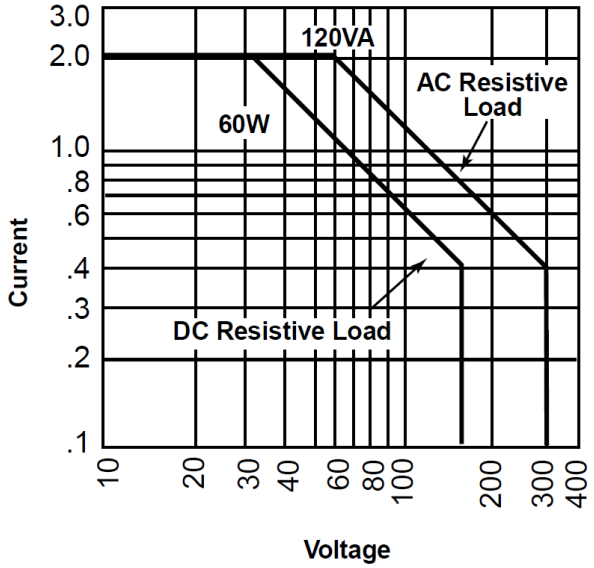

Figure 1. Heavy Duty Type AZ5 relay voltage-current relationship

The Heavy Duty Type AZ5 relay is used in the Terranova® 907 to control external functions. As shown in **Figure 1**, maximum current varies from 2 A at 30 V DC (60 V AC) to 0.4 A at 150 V DC (300 V AC) for resistive loads.

Protective Circuits for Inductive Loads

A protective circuit or component is recommended when switching inductive loads to suppress sudden voltage spikes. One method to suppress high voltage spikes in an AC circuit is through the use of a “snubber” circuit. A “snubber” circuit consists of a capacitor and resistor across an inductive load. As shown in **Figure 2**, the “snubber” circuit is parallel to the load.

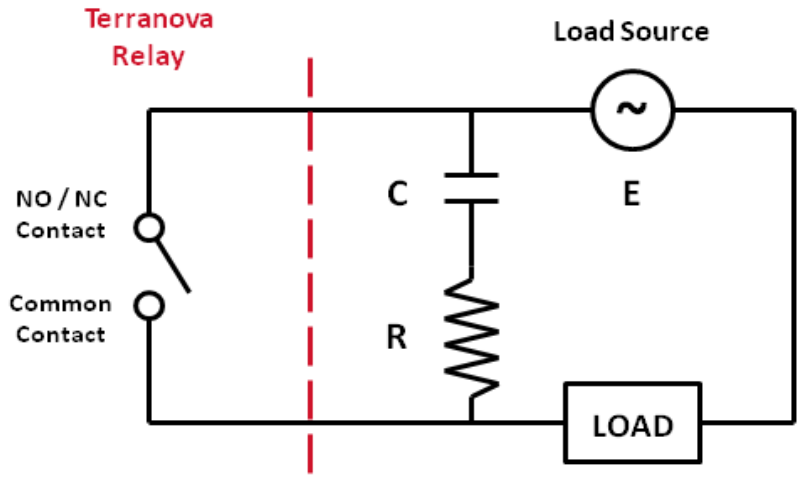

Figure 2. Example of a "snubber" circuit

To calculate the appropriate capacitor C in microfarads [µF] and resistor R in ohms [Ω] to use in the "snubber" circuit, Paktron Capacitors' Quencharc® technical note[1] suggests the following empirical equations

$$C = \frac{I^2}{10} \quad (1), \text{ and}$$

$$R = \frac{E}{10I\left(1+\frac{50}{E}\right)} \quad (2),$$

where *I* is the load current prior to contact opening in amperes [A] and *E* is the source voltage in volts [V]. For example, if **Figure 2** shows a 1 A LOAD with a 110 V AC source connected in series with the Terranova® relay, *I* = 1 A and *E* = 110 V AC. Therefore, Equation 1 provides a capacitance value of 0.1 µF; Equation 2 provides a resistance value of approximately 8 Ω. Thus, a 0.1 µF capacitor and a 10 Ω resistor should be used for the "snubber" circuit. However, the voltage and power rating of the capacitor and resistor, respectively, must be taken into consideration to meet circuit requirements. User should also consider similar protective circuits or components to suppress current spikes in capacitive loads.

1. Pancon Corporation. '2012 Catalog'. 2012. 18-19. Web. http://www.panconcorp.com/PDFs/Catalogs/Paktron_2012catalog.pdf