DUNIWAY STOCKROOM CORP.

Terranova® 924A

Single Thermocouple Gauge Control Unit

Instruction Manual

rev1016NC

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Specifications

Operating Voltage	Universal: 100V to 240V AC @ 50Hz to 60Hz; 40VA 100V to 240V DC
Pressure Display	3 Red LEDs - 3 digits (NNN) with pressure unit auto ranging
Pressure Units	Torr/mTorr [Default] ; mbar/µbar
Operating Range	1 x 10^{-3} Torr to 1000 Torr (Air/Nitrogen) (1 x 10^{-3} mbar to 1000 mbar)
Measuring Range	1 x 10^{-3} Torr to 1000 Torr (Air/Nitrogen) (1 x 10^{-3} mbar to 1000 mbar)
Display Range	-31 mTorr to 950 Torr (-43 µbar to 950 mbar)
Display Resolution	Varies From: 0.5 mTorr less than 100 mTorr (0.5 µbar less than 100 µbar) To: 50 Torr greater than 300 Torr (50 mbar greater than 300 mbar)
Relay Rating	Varies From: 2A at 30 VDC (60 VAC) To: 0.4A at 150 VDC (300 VAC) See Appendix 2 for more details
Temperature Range	2ºC to 50ºC (in operation)
Weight	1.0lb/0.5kg

Accessories

Included	Instruction Manual (can be accessed at www.duniway.com/documents/manuals) One power cord Two replacement fuses Two panel mount clips One unterminated male 15-pin D-sub connector	
Required (Sold Separately)	**DST-531**	Duniway thermocouple tube Nickel-plated/Mild steel 1/8" male NPT port
	DST-531S	Duniway thermocouple tube Stainless steel 1/8" male NPT port
	TC-924A-CBL-10	Varian type-531 & equivalent thermocouple gauge cable (10ft)*
Optional	**RS232-TN9DIN**	RS-232 serial communication cable (10ft)*

*Custom cable lengths available upon request

Explosive Gases

Do not use the Terranova® 924A 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® 924A Single Thermocouple Gauge Controller is designed to operate the industry-standard Type 531 or equivalent thermocouple gauges. The Terranova® 924A covers the pressure range between 1000 Torr to 1 x 10^{-3} Torr (1000 mbar to 1 x 10^{-3} mbar).

Installation

Mounting the Terranova® 924A

The Terranova® 924A 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.

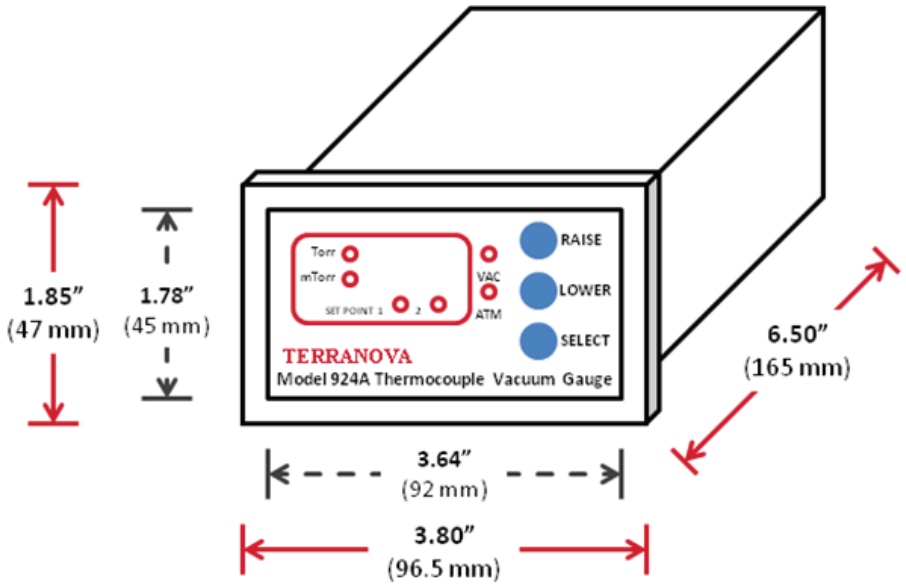

Figure 1 Terranova® 924A cutout and unit dimensions

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® 924A in place. User should provide enough clearance to access rear cable connections.

Connecting the Pressure Gauge

The Terranova® 924A has a female 9-pin D-sub connection located on the back of the control unit labeled SENSOR(S) to connect the pressure gauge cable (See Figure 2). User will require the Duniway gauge cable **TC-924A-CBL-10** to connect the Varian Type 531 and equivalent gauges to the control unit.

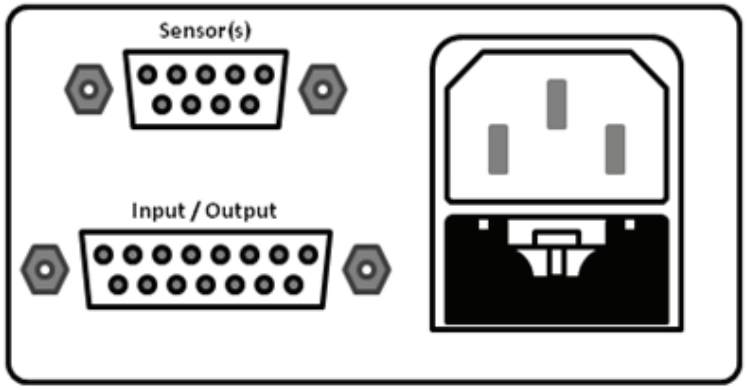

Figure 2 Terranova® 924A back panel

The Terranova® 924A should be OFF before connecting the pressure gauge. Plugging or unplugging the pressure gauge while the control unit is ON can damage internal parts of the pressure gauge.

To connect the Terranova® 924A to the respective pressure gauge:

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

Figure 3 Pressure gauge orientation

The recommended thermocouple gauges should be installed with the axis vertical, as shown in Figure 3, and the port pointing downward. Large errors can result at higher pressures if the axis is not vertical. 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® 924A will perform a self test at power ON. The Self Test cycle is initiated by a BEEP sound followed by:

1. All LED and display indicators will become illuminated
2. Display reads the software version (e.g. 2.15)
3. Display reads the pressure units (e.g. TOR)

The control unit will commence normal operation if Self Test is successful.

Setup Mode

Terranova® 924A unit parameters can be set or modified by the following five-step operation:

1. Press the **SELECT** button to zero-adjust the control unit. Use the **RAISE** or **LOWER** button to increase or decrease the VAC pressure value shown on the display. VAC LED will flash during adjustment. See **Zero Adjustment**.

2. Press the **SELECT** button a second time to adjust the atmospheric pressure value. Use the **RAISE** or **LOWER** button to increase or decrease the ATM pressure value shown on the display. ATM LED will flash during adjustment. See **Atmospheric Pressure Adjustment**.

Display will read HI during Zero and Atmospheric Pressure Adjustment if gauge is disconnected.

3. Press the **SELECT** button a third time to set or adjust the SET POINT 1 pressure value. Use the **RAISE** or **LOWER** button to increase or decrease the pressure value shown on the display. Pressure value range is from 500 Torr to 3 x 10^{-3} Torr. Default value is OFF. SET POINT 1 LED will flash during adjustment. See **Set Point Operation**.

4.Press the **SELECT** button a fourth time to set or adjust the SET POINT 2 pressure value. Use the **RAISE** or **LOWER** button to increase or decrease the pressure value shown on the display. Pressure value range is from 500 Torr to 3 x 10^{-3} Torr . Default value is OFF. SET POINT 2 LED will flash during adjustment. See **Set Point Operation**.

Pressure unit LED does not illuminate if set point value is set to OFF.

5.Press the **SELECT** button a fifth time to return the unit to normal operation.

User must press and hold the **RAISE** or **LOWER** button until pressure value changes. Unit display will flash and pressure unit LED will illuminate during all four 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® 924A can be either zero adjusted or set to a specific low pressure value via the VAC pressure value. Pressure reading must be less than approximately 50 mTorr (67 µbar) at initial set-up to adjust the VAC value. A long BEEP will be emitted if pressure reading is greater than 50 mTorr (67 µbar). Zero adjustment should be conducted before the atmospheric pressure adjustment.

For zero adjustment, VAC value should be set to approximately 0.0 mTorr and system pressure must be lower than 1 x 10^{-3} Torr (1.3 x 10^{-3} mbar) to display accurate pressure measurements. If millibar units are to be used, VAC value adjustment should be conducted in Torr units. VAC value is appropriately converted when switching between pressure units. Although VAC pressure value is stored by the control unit, it will not be displayed in subsequent adjustments.

Pressure reading range will shift if user accidentally changes VAC value during use. If this occurs, user should reset the Terranova® 924A 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.

Atmospheric Pressure Adjustment

Atmospheric pressure adjustment is recommended when installing a new pressure gauge or to restore pressure output accuracy. The Terranova® 924A can be set to either local atmospheric pressure – 760 Torr (1013 mbar) at sea level – or a specific high pressure value via the ATM pressure value. Pressure reading must be greater than approximately 600 Torr (800 mbar) at initial set-up to adjust the ATM value. Zero adjustment should be conducted before the atmospheric pressure adjustment.

If millibar units are to be used, ATM value adjustment should be conducted in Torr units. ATM value is appropriately converted when switching between pressure units. Although ATM pressure value is stored by the control unit, it will not be displayed in subsequent adjustments.

Pressure reading range will shift if user accidentally changes ATM value during use. If this occurs, user should reset the Terranova® 924A and redo both the zero and atmospheric pressure adjustment.

Changing Pressure Units

The Terranova® 924A is able to output pressure readings in Torr/mTorr or mbar/µbar. Default pressure units for the Terranova® 924A are Torr/mTorr.

To change between pressure units:

1. Disconnect AC power cord from control unit
2. Simultaneously depress the **SELECT**, **RAISE**, and **LOWER** buttons
3. Reconnect AC power cord to control unit

Once power is restored, the unit will commence the Self Test. If pressure unit change is successful, two BEEPs will be emitted and the corresponding pressure units will appear on the display. Thereafter, the Terranova® 924A will resume normal operation.

Restoring Default Values

Restoring default parameters provides a starting point for control unit readjustment in the event pressure measurements become unreliable.

To restore Terranova® 924A default parameters:

1. Disconnect AC power cord from unit
2. Simultaneously depress the **RAISE** and **LOWER** buttons
3. Reconnect AC power cord to unit

Once power is restored, the unit will commence the Self Test. If reset process is successful, two BEEPs will be emitted and the code “RST” will appear on the display. Thereafter, the Terranova® 924A will resume normal operation.

Restoring default parameters will not affect the selected pressure unit

Pressure Measurement

Terranova® 924A operation is almost automatic and will commence after a successful Self Test. The Terranova® 924A is set to output pressure readings based on air/nitrogen. Although the type-531 thermocouple gauges have an upper reading range of 2 Torr, increasing the supplied current helps extend its pressure reading range. Pressure units will auto range during use as system pressure increases or decreases. The unit display will read OFF if the thermocouple tube or gauge cable is disconnected. Display will read HI only in millibar units if system pressure is greater than 950 mbar. Terranova® 924A pressure display resolution is as follows:

Step	Range
50 Torr	greater than 300 Torr
20 Torr	60 Torr to 300 Torr
10 Torr	20 Torr to 60 Torr
5 Torr	10 Torr to 20 Torr
0.05 Torr	1 Torr to 10 Torr
5 mTorr	200 mTorr to 1000 mTorr
1 mTorr	100 mTorr to 200 mTorr
0.5 mTorr	less than 100 mTorr

Display resolution also applies to millibar units in the respective pressure ranges.

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

Set Point Operation

The Terranova® 924A 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. Set point pressure value is 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 value. The corresponding set point LED will become illuminated once the relay is active. The relay will deactivate once the pressure reading is greater than 5% of its set point value plus 1 mTorr (or 1 µbar).

The relay deactivation pressure value can be determined by the following:

$$S + 0.05*S + 1 \text{ mTorr}$$

in which S is the set point pressure value in millitorr (or µbar). For example, if SET POINT 1 is 30 mTorr, its corresponding relay will activate once the pressure reading is below 30 mTorr and deactivate once the pressure reading is greater than 32.5 mTorr. If set point value is **OFF**, the respective relay will be disabled. Terranova® 924A set point pressure display resolution is as follows:

Step	Range
50 Torr	greater than 300 Torr
20 Torr	60 Torr to 300 Torr
10 Torr	20 Torr to 60 Torr
5 Torr	10 Torr to 20 Torr
0.05 Torr	1 Torr to 10 Torr
5 mTorr	200 mTorr to 1000 mTorr
1 mTorr	less than 200 mtorr

Display resolution also applies to millibar units in the respective pressure ranges. See Appendix 2 for relay use with inductive or capacitive load switching.

Pin	Function	Description	Notes
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	Analog Common		See **Serial Communication**
10	Digital Common		
11	Digital Common		
12	Voltage Output	+5 V	See **Notes**
13	Analog Output		See **Analog Output**
14	Digital Common		
15	Digital Common		

Table 1 INPUT/OUTPUT port pin configuration

Notes

PIN 12: Nominal voltage output available for external use; 1 kΩ source impedance

Serial Communication

The INPUT/OUTPUT 15-pin D-sub port allows the user to remotely query the Terranova® 924A 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® 924A unit is as follows:

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

Figure 4 illustrates the pin configuration for RS-232 communication. User will require the Duniway cable **RS232-TN9DIN** and a separate program, such as HyperTerminal, to send query characters and read output from the control unit. Table 2 lists the characters used by the Terranova® 924A to return unit parameters.

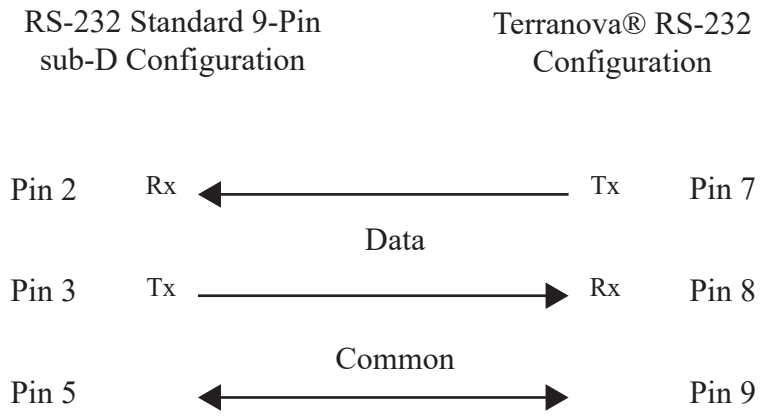

Figure 4 Terranova® 924A RS-232 pin configuration

The Terranova® 924A outputs pressure values in the following scientific notation format:

XeY

in which X is the significand and Y is the exponent. The control unit also utilizes the same format to output set point values. However, a third digit, R, is appended to the output which indicates the set point relay state. If the relay is active, R = 1; otherwise, R = 0. Depending on the selected pressure units, output pressure values are in either Torr or mbar.

Character	Query	Output Format	Notes
p	Pressure reading	XeY	ASCII Value 112
1	SET POINT 1 Value	XeY R	ASCII Value 49
2	SET POINT 2 Value	XeY R	ASCII Value 50
u	Pressure units	Torr/mBar	ASCII Value 117

Table 2 Serial Communication query characters

Examples	
Pressure: 2.35 mbar	p
Output:	2.35e+0
Pressure: HI	p
Output:	999e+0
Pressure: OFF	p
Output:	-9.9e-3
SET POINT 1 pressure: 57 mTorr (Relay ON)	1
Output:	57.0e-3 1
SET POINT 2 pressure: OFF (Relay OFF):	2
Output:	0.00e+0 0

Analog Output

The Terranova® 924A 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). Pressures less than 0 mTorr (0 µBar) correspond to 0.000 V; OFF/HI pressure values correspond to approximately 3.00 V. See Table 1 for pin configuration.

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

$$V = 0.50 * \log_{10} P$$

where P is the pressure reading in mTorr (or µbar) and V is the analog output in volts. For example, if P is equal to 10.0 mTorr, V (rounded to nearest hundredth) is equal to 0.50 V. Table 3 lists sample analog output and corresponding pressure values. For example, if analog output is 2.00 V, the corresponding pressure reading is 10 Torr.

Analog Output [V]	Pressure
0.02	p ≥ 0 mTorr
0.50	10 mTorr
1.00	100 mTorr
1.50	1 Torr
2.00	10 Torr
2.50	100 Torr
3.00	OFF/HI

Table 3 Analog output and calculated pressure values

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

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

where V is the analog output in volts and P is pressure in mTorr (or µbar). For example, if V is equal to 2.00 V, P (rounded to the nearest one) is equal to 10 Torr.

Source impedance for analog output is 1 kΩ

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	Replace pressure gauge

Pressure Gauge

The type-531 thermocouple tube has internal resistance values indicative of an operational pressure gauge. User should first reset the Terranova® 924A 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.

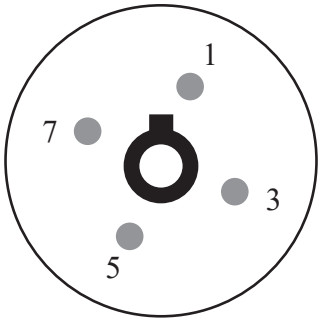

Figure 5 Type-531 Thermocouple tube pin configuration

Pin	Resistance [Ω]
1 & 3	1.5
3 & 5	1.5
5 & 7	1.5
7 & 1	1.5

Table 4 Type-531 thermocouple tube resistance values

If the measured resistance values significantly differ from those provided in Table 4, the pressure gauge may be damaged, contaminated, or defective. The resistance between any pin and tube housing should be at least 1MΩ. If the resistance values are correct but the pressure gauge does not output proper measurements, the pressure gauge should be replaced.

To prevent damage to the sensor wire, tests should only be performed at atmospheric pressure and with an instrument that applies less than 100 mA.

Changing Fuses

The Terranova® 924A contains two Type F, regular (or slow-blow) 1 A fuses. As shown in Figure 6, both fuses are held in the fuse assembly located on the back panel of the unit.

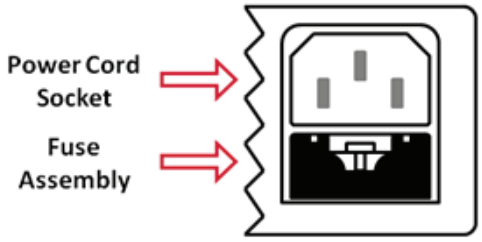

Figure 6 Terranova® 924A power module

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”

The following is a list of suggested replacement fuses:

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

Legacy Terranova® 924

The legacy Terranova® 924 model has been discontinued and replaced by the Terranova® 924A to improve the durability of the thermocouple gauge connector on the control unit. While the Terranova® 924 had a white four-pin Molex connector, the Terranova® 924A has a 9-pin D-sub connector. Replacement legacy gauge cables are available to order. Although the Terranova® 924 has been discontinued, the control unit may still be sent to Duniway Stockroom for repairs. Contact your Duniway Stockroom customer service representative for further details.

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
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 products:

Terranova® 924A Single Thermocouple Gauge Controller

which displays the CE mark 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
EN 61326: 1997/A1: 1998/A2: 2002

Low Voltage Directive (73/23/EEC//93/68/EEC)
Electrical / Technical Safety Standard: EN 61010-1: 1993/A2: 1995: 2001

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

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

Appendix 1 Gauge Cable Diagram

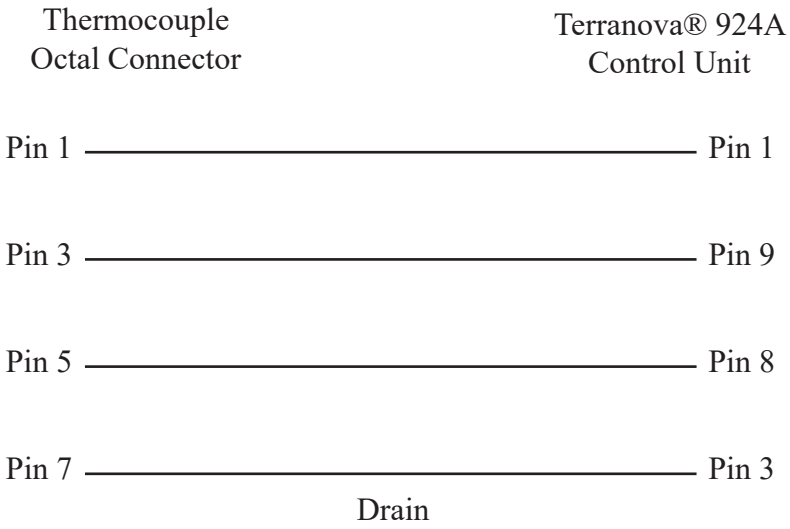

Figure 1 Terranova® 924A to thermocouple gauge cable configuration

Appendix 2 Notes on Terranova® Set Point Relays

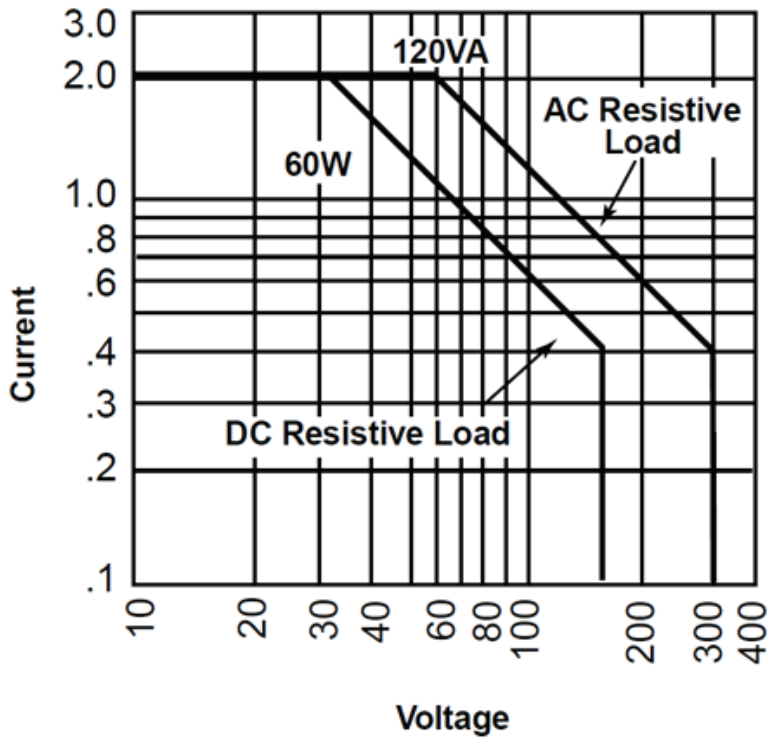

Figure 1 Heavy Duty Type AZ5 relay voltage-current relationship

The Heavy Duty Type AZ5 relay is used in the Terranova® 924A 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 high-current relay.

Appendix 2 Notes on Terranova® Set Point Relays

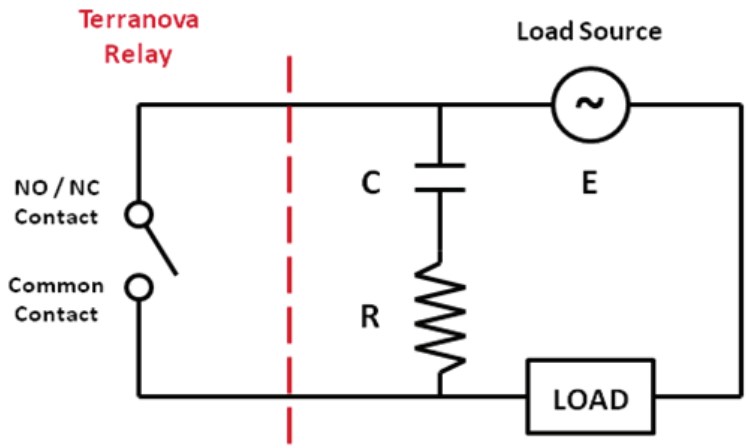

Figure 2 Example of a "snubber" circuit

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:

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

$$R=E/10I(1+50/E) \quad (2),$$

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 high-current relay 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, user must take into consideration the voltage and power rating of the capacitor and resistor, respectively, to meet the requirements of the circuit. Similar protective circuits or components should be considered 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