



VACUUM TECHNOLOGY  
I N C O R P O R A T E D

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# AERO VAC TORRCON Convection Gauge Controller

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Instruction and Users Manual

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# Vacuum Technology, Inc. AERO VAC TORRCON Convection Gauge Controller

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# Explosive Gases

## **Warning!**

Do not use the VTI TORRCON Convection Gauge Controller to measure the pressure of combustible gas mixtures. The gauge normally operates at low temperatures, but it is possible that momentary transients or controller malfunction can raise the gauge above the ignition temperature of combustible mixtures, which then might explode and cause damage to equipment and injury to personnel.

# Limitation on use of Compression Mounts

## **Warning!**

Do not use a compression mount (quick-connect) for attaching the gauge tube to the vacuum system in applications that may develop positive pressures. Positive pressures may cause the tube to be blown out of a compression fitting and damage equipment and injure personnel.

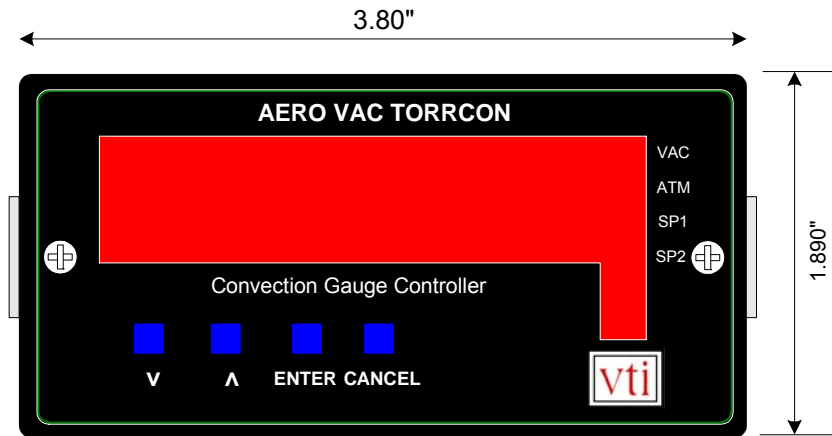
# Chemicals

## **Warning!**

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

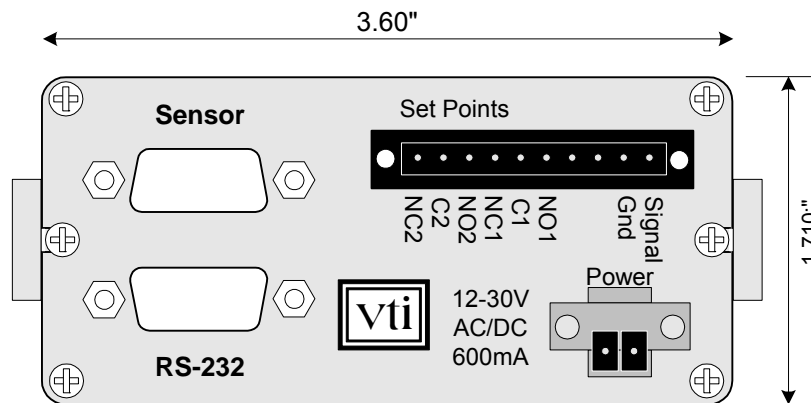
# PANEL ILLUSTRATIONS

## Front Panel



Front View

## Rear Panel



Rear View

(With Set Point, I/O Screw Terminal  
and Power Input Screw Terminal plugs removed).

# INTRODUCTION AND GENERAL DESCRIPTION

Congratulations on your purchase of a VTI AERO VAC TORRCON Convection Gauge Controller.

## A. General Description

The VTI AERO VAC TORRCON Convection Gauge Controller measures vacuum pressure when attached to a Granville-Phillips Model 275 CONVECTRON® gauge tube, InstruTech, Inc. Model CVG101GA Convection gauge tube or equivalent.

The VTI AERO VAC TORRCON displays vacuum measurements from 0.01 E-3 Torr (0.01mTorr) to over 900 Torr based on the thermal conductivity of air/nitrogen and controls two relays with independent set points. This is a state-of-the-art controller utilizing a PIC Micro-Controller as the heart of the unit.

## B. Specifications

### 1. Pressure Range

0.01 E-3 Torr (0.01mTorr) to 999 Torr for Air or Nitrogen. Display range is automatic. (Torr units only). Displayed as 0.01 -3 to 999.

### 2. Pressure Display

3 digit bright LED, 1/2" tall with 1/2" tall exponent bright LED.

### 3. Display Indicators

Four Red LED's indicate VAC, ATM, SET POINT 1 and SET-POINT 2.

### 4. Process Control Set Points

Two independent set-points each with:

- a. Range 0 to 999 Torr
- b. Independent Relay Output (1A, 30V contacts) C, NO, NC
- c. Screw terminal connections

### 5. VAC, ATM and Set-point adjustment

4 Pushbuttons are provided to input data

- a. Increment Up - ATM, VAC and Set Points
- b. Increment Down - ATM, VAC and Set Points
- c. Enter - choose settings and enter settings
- d. Cancel - cancels settings or changes

### 6. Memory

Non-volatile for ATM, VAC and Set Points.

### 7. Vacuum Gauge

Granville-Phillips Model 275 CONVECTRON® gauge tube, InstruTech, Inc. Model CVG101GA Convection gauge tube or equivalent.

### 8. Connection Error Detection

Unit auto-detects missing cable and displays "CbL" on read-out.

Unit auto-detects open gauge tube and displays "EPH" on read-out.

## 9. Operating Temperature Range

+2 to +50 deg. Celsius

## 10. Analog Output

Provides 1 channel Analog Output—0 to 5.0V range, Log (0.5V/decade)

- a. 999 Torr = 3.0V
- b. 100 Torr = 2.5V
- c. 10.0 Torr = 2.0V
- d. 1.00 Torr = 1.5V
- e. 100 -3 Torr = 1.0V
- f. 10.0 -3 Torr = 0.5V
- g. 1.00 -3 Torr = 0.0V

## 11. RS-232 Interface

Currently displays Firmware Version. Future expansion may allow remote reading of gauge, remote set point programming and remote atmosphere & vacuum constant adjustment.

## 12. Mounting

1/8 DIN Enclosure— approximate 6" depth

## 13. Power Requirements

12-28V AC/DC (non-polarized) input power (at about 600mA)

## 14. Self Test feature

Unit performs self test routine automatically at Power-Up

## 15. Environmental Considerations

Not for use with Explosive or Corrosive gases.

# INSTALLATION

## 1. Unpack the Controller

Carefully unpack the Aero Vac TORRCON gauge controller which includes the following items:

- Controller (120VAC model – VTI Part Number **V-G-CV-0015**)  
(24VDC model – VTI Part Number **V-G-CV-0017**)
- DC Adapter (120VAC model only – VTI Part Number **V-G-CV-A-0007**)
- Gauge Cable (10 ft) – VTI Part Number **V-G-CV-A-0006**
- Set Point, I/O Screw Terminal (Black) and Power Input Screw Terminal (Green) plugs
- Mounting jacks and screws
- Instruction manual

If your shipment does not include all the requisite items notify the factory immediately. If there appears to be damage caused in transit, please contact the shipper.

## 2. Mounting the controller



**TIP...**

***Replacing an alternative controller with the TORRCON?***

***If you are using the TORRCON controller as a replacement for an existing unit please refer to appendix A for specific connection/adaptor cable details.***

For the initial set up it is best to mount the unit on a bench, table top or shelf.

If the controller is to be mounted in a panel, the cutout dimensions are **3.625"x1.725"**. To mount the TORRCON, slide the unit into the panel, slide the mounting jacks into the groove on each side of the TORRCON and secure with 4-40 screws provided. Leave space at the back of the controller for access to power and accessory connections.

## 3. Gauge Tube

The TORRCON operates the Granville-Phillips Model 275 CONVECTRON gauge tube, the InstruTech Model CVG101GA convection gauge tube or an equivalent. A variety of vacuum connections are available on the InstruTech gauge tube from VTI to suit your application.

<b>Vacuum Connection</b>	<b>VTI Part Number</b>
Convection Gauge Tube with ¼" Female VCR-Type Fitting.	<b>V-G-CV-0014</b>
Convection Gauge Tube with ¼" Male VCR-Type Fitting.	<b>V-G-CV-0016</b>
Convection Gauge Tube with ⅛" MNPT connection.	<b>V-G-CV-0008</b>
Convection Gauge Tube with QF16 Flange Fitting.	<b>V-G-CV-0012</b>
Convection Gauge Tube with QF25 Flange Fitting.	<b>V-G-CV-0011</b>
Convection Gauge Tube with 2 ¾" Conflat®-type Flange.	<b>V-G-CV-0013</b>



**TIP...**

#### **Gauge Tube Mounting ...**

**The gauge tube must be mounted with its axis horizontal and the inlet port should not point up. Measurement errors are possible at higher pressures if the gauge is not horizontal.**

Mount the gauge tube to the vacuum system using normal vacuum techniques associated with the vacuum fitting ordered.

#### **4. Gauge Cable**

Connect the gauge cable to the tube. There is a key way to align the connector with the gauge tube – see diagram on page 14. Push the connector onto the pins until it seats firmly. Connect the 9 pin plug of the gauge tube to the sensor jack on the back upper left of the controller. It is a good idea to tighten the retaining screws to assure good contact.



**Caution...**

**Always disconnect the power from the controller before connecting the gauge tube to the controller. Damage may occur to the tube and control unit if the tube is connected with the power on.**

#### **5. Attach the Power Cord**

Plug the DC power adapter cord into the back of the controller (lower right). Plug the transformer into a standard 120 VAC outlet when you are ready to apply power to the unit. **There is no separate power switch on the TORRCON controller.** If the DC adapter model was not ordered then connect the unit into a 12 to 24 VDC supply.

# OPERATION

## 1. Applying Power to the Controller

There is no on/off switch on the TORRCON. When power is applied, the unit performs a self test during which all the digits will light for a few seconds. After this:-

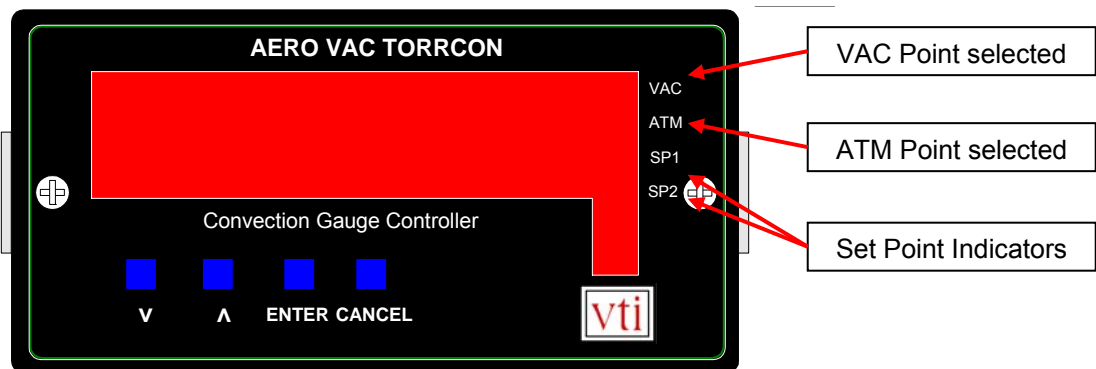
- A number will be displayed giving the current version of the unit software.
- If the gauge cable is missing **CbL** will be displayed on the front panel.
- If **EPH** or **EPL** are displayed, this would indicate a defective gauge tube.
- Also check that the gauge tube is mounted with it's axis horizontal.
- If **HHH** is displayed, this would indicate that the TORRCON **ATM** settings are too high (above 999 Torr) or that the gauge tube is connected to a system pressurized above 999 Torr. Verify that the gauge tube is at atmosphere then adjust the ATM reading within the range of the unit as shown below under **Calibration**.

## 2. Calibration

The Atmospheric Pressure and Zero point settings of the display can be calibrated as follows:-

### A - Setting Atmosphere

Barometric pressure at zero altitude (sea level) is 760 torr. Unless the TORRCON is to be used at high altitudes, (Denver, for example, has an atmospheric pressure of approximately 632 torr) it is usually sufficient to set atmosphere at 760 torr or slightly less. Most radio stations give the atmospheric pressure daily, so exact readings can be obtained if desired. With the power on and the gauge tube connected to a vented system press **ENTER** until the **ATM** LED lights on the front panel. See Figure 2.



Front View

Figure 2

Press the **Raise (^)** or **Lower (v)** buttons, lower left of the controller, until the desired pressure is displayed.

**Note: the display will move slowly at first and then faster the longer the Raise or Lower buttons are pressed.**

Once the display shows the desired pressure, press **ENTER** to set the Atmospheric Pressure point.

## B. Setting Vacuum



### CAUTION

Do not turn the control on while the system is at low pressure. (Lower than 10 Torr). This will damage the gauge tube and eventually destroy it. Always turn the gauge tube on at or near to atmospheric pressure before the system is pumped down. Once this has been done then the TORRCON can be left on while the system is being vented and pumped down.

Once atmosphere has been set (A above), the system can be pumped down with the gauge on and operating. The Vacuum zero adjustment can be set once the pressure is less than 1 mTorr i.e. 1.00E-3 Torr. Press the **ENTER** button until the **VAC** LED is selected on the front panel. (See figure 2). Press the **Raise** (^) or **Lower** (v) buttons, lower left of the controller, until the desired pressure is displayed. Pressing **ENTER** again accepts the pressure that is displayed as the Vacuum offset. If you wish to exit the setting procedure without accepting the display pressure press **CANCEL**. The above procedure can then be repeated to start again. On systems where a high vacuum pump, such as a turbo-molecular or diffusion pump are employed, the vacuum set point can be accurately set. On systems where an oil sealed mechanical pump is used, setting the vacuum set point is more approximate.

## 3. Operation of set points

When the pressure in the system is less than the value of a particular set point, the relay for that point is turned on, and the appropriate LED display is illuminated for either **SP1** or **SP2**. This shows the relay is energized.

The relay will be de-energized when the pressure rises 1 mTorr plus 5% above the set point.

To review the settings of the two set points, press **ENTER** until either the **SP1** or **SP2** LED is illuminated. The value of that set point will then be displayed.

### A- Adjusting the Set Points

Two process control points can be set from the front panel of the controller. The set points control two relays that are accessible through the connector on the upper right of the back of the unit.

With the gauge tube connected and the power on push the **ENTER** button three times until the **SP1** light flashes. Press and hold the **Raise** (^) or **Lower** (v) buttons until the desired set point is displayed. Press enter again to establish the set point. Press enter one more time until **SP2** flashes and press **Raise** (^) or **Lower** (v) buttons to establish a second set point.

**Note: the digital set points move very slowly at first. You will have to press and HOLD the up or down buttons for several seconds.**

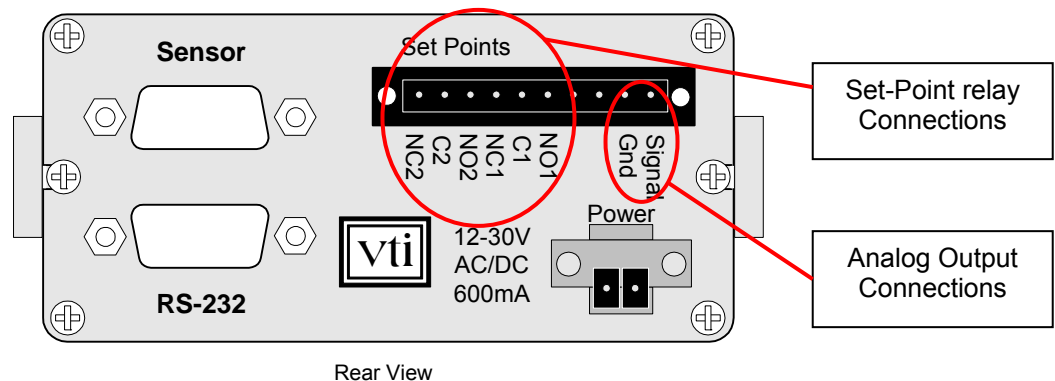
### B- Electrical connections to the Set Point relays

The two process control points trigger two independent relays for process control purposes. Connections to these are made on the rear panel.

The multi-pin socket on the upper left of the rear panel provides three connections for each relay. A screw terminal plug facilitates connection.

- The **C – Common** contact for the set-point relay.
- The **NC – Normally Closed** contact is connected to the **Common** contact when the measured pressure is above the set-point. When the pressure goes below the set point, the **NC to C** connection is disconnected.
- The **NO – Normally Open** contact is disconnected from the **Common** contact when the measured pressure is above the set-point. When the pressure goes below the set point, the **NO to C** connection is connected
- The number after the contact label refers to the relevant set-point relay number, **1 or 2**.

These connections can be seen on the diagram below.



#### 4. Analog Output

Connections for the Analog Output are found on the same multi-pin connector as those for the Set Point relays. See the illustration above. These are self explanatory. This output is calculated from the value indicated on the digital display and is a 0 to 5V signal. The table below shows the voltage level to expect at given pressures although there will be slight variations due to electrical tolerances.

Displayed Pressure	Analog Output – Volts
999 Torr	3.0
100 Torr	2.5
10.0 Torr	2.0
1.00 Torr	1.5
100 -3 Torr	1.0
10.0 -3 Torr	0.5
1.00 -3 Torr	0.0

## 5. Measuring the pressure of gases other than air

There may be occasions when the pressure of gases other than air needs to be measured. The instrument is calibrated assuming the 'ionization efficiency' of the gas being measured is that value associated with Air. Pure gases have different ionization efficiencies and therefore will give different readings – sometimes to quite a marked effect. The table below shows some examples to illustrate this, typically however, the residual gases in a system are not that dissimilar to air.

True Pressure	Indicated Pressure on the TORRCON Controller			
	Torr	Argon	CO2	Helium
0	0	0	0	0
0.0001	0.0001	0.0001	0.0001	0.0000
0.0002	0.0001	0.0002	0.0002	0.0002
0.0005	0.0003	0.0006	0.0006	0.0004
0.001	0.0007	0.0011	0.0011	0.0008
0.002	0.0013	0.0023	0.0023	0.0016
0.005	0.0033	0.0055	0.0055	0.0040
0.01	0.0065	0.0109	0.0109	0.0080
0.02	0.014	0.022	0.022	0.016
0.05	0.033	0.055	0.055	0.041
0.1	0.064	0.107	0.107	0.082
0.2	0.126	0.208	0.208	0.163
0.5	0.307	0.494	0.494	0.427
1	0.59	0.93	0.93	0.92
2	1.12	1.67	1.67	2.61
5	2.36	3.24	3.24	13.2
10	3.86	4.84	4.84	
20	5.67	6.39	6.39	
50	7.72	8.00	8.00	
100	8.71	9.02	9.02	
200	9.65	12.0	12.0	
300	11.1	16.8	16.8	
500	15.9	29.4	29.4	
700	21.9	48.8	48.8	
760	23.9	56.0	56.0	
900	29.2	88.2	88.2	
1000	33.8	129	129	

As an example, if you are measuring the pressure of pure Argon – say the system has been backfilled – then the TORRCON will indicate a pressure of 23.9 Torr when the true pressure is 760 Torr which is atmospheric pressure.

Every effort has been made to ensure the data compiled above is accurate, however, VTI takes no responsibility for any errors in the data. For critical applications where gas concentrations are an issue, VTI can calibrate the gauge and controller to suit your specific application requirements.

## MAINTENANCE

The TORRCON is designed for many years of trouble free operation and contains no user serviceable items. If you experience any problems with the instrument, refer first to the trouble-shooting section below or contact VTI for further advice.

Due to the proprietary nature of the instrument and absence of user serviceable items, VTI does not supply schematic diagrams or software listings. Again, in case of difficulty, please contact VTI directly for further advice.

## TROUBLE-SHOOTING

### 1) If the Self-Test fails -

Run the self test a further time by removing power, waiting 5-10 seconds and then re-applying power. If the unit continues to fail please contact VTI directly. If the unit seems to start but displays a fault code, refer to the list below for these:

- i. If the gauge cable is missing **CbL** will be displayed on the front panel.
- ii. If **EPH** or **EPL** are displayed, this would indicate a defective gauge tube.
- iii. If **HHH** is displayed, this would indicate that the TORRCON **ATM** settings are too high (above 999 Torr) or the gauge tube is connected to a system under pressure. Adjust the ATM reading within the range of the unit as shown under **Calibration** on page 9 of this manual.

### 2) If pressure readings are unreliable or noisy –

Check all electrical connections to the gauge tube. It is also possible that the gauge tube may have become contaminated – be aware of the nature of the installation when considering this. Check for contamination and use an Ohmmeter to check that none of the gauge pins are shorted to the case.

### 3) If VAC or ATM readings are incorrect -

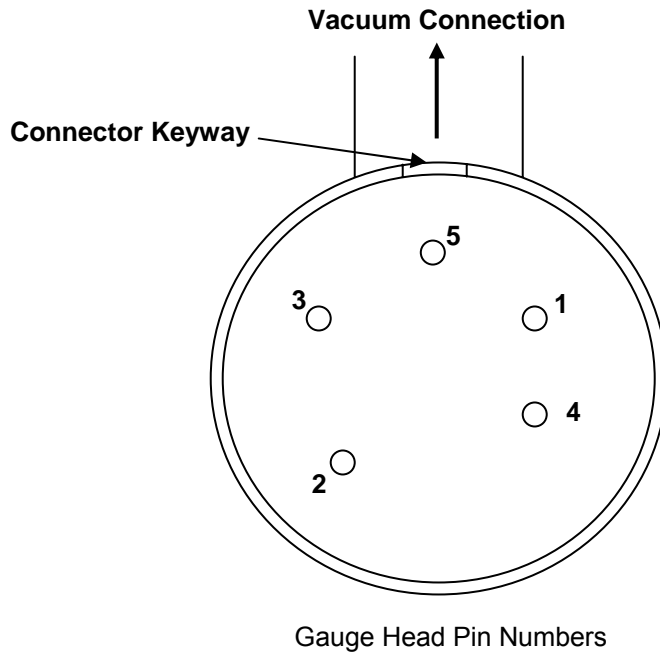
New gauges are calibrated to be within 5 mTorr of true zero at Vacuum and within 20 Torr at 760 Torr. If this is not achieved, again, the gauge may have become damaged or contaminated. Check with an Ohmmeter as in 2 above. You may also try cleaning the gauge head using Acetone or TriChloroEthylene (TCE), however, we would suggest you read the documentation accompanying the gauge head before undertaking this. Be careful when using flammable solvents to avoid the risk of explosion of the flammable vapors.

#### 4) Resistance Readings for a Convection Tube

You can measure to check that the internal resistance of the tube components is correct using a method which does not apply more than 10mA. This will avoid damage to the internal components. You must only make these measurements when the tube is at atmospheric pressure. The pin numbers on the 9 way connector are illustrated below. Resistance reading for a GOOD tube will be:

Between Pins:-	Resistance:-
1 and 2	20 to 30 Ohms
2 and 3	50 to 60 Ohms
1 and 5	175 to 190 Ohms

Should the resistance between pins 1 and 2 be approximately 800 Ohms, then there is an internally broken connection and the gauge head will need to be replaced.



## VTI TORRCON CONVECTION GAUGE CONTROLLER, GAUGE HEAD & ACCESSORY PART NUMBERS

Please use the following part numbers when ordering replacement parts or additional units. VTI staff are always available to answer any questions you may have and provide helpful advice.

<b>Controllers / Accessories</b>	<b>VTI Part Number</b>
VTI TORRCON Convection Gauge Controller/Readout. Includes Gauge Cable and 110VAC-24VDC power adapter (Wall Style).	V-G-CV-0015
VTI TORRCON Convection Gauge Controller/Readout. Requires 24VDC power for operation. Includes Gauge Cable.	V-G-CV-0017
Upgrade Kit to replace model 906 controller with a VTI TORRCON Convection Gauge Controller. Includes Controller/Readout, V-G-CV-A-0008 and V-G-CV-A-0009 Adapter cables and V-G-CV-A-0010 110VAC-24VDC power adapter (In-Line Style).	V-G-CV-0020
Gauge cable for VTI TORRCON Convection Gauge Controller	V-G-CV-A-0006
Gauge Head adapter cable for VTI TORRCON Convection Gauge Controller. Used when upgrading from Terranova 906 controller to a TorrCon controller. Adapts between the 9 pin connector on the TorrCon Controller and the existing 15 pin gauge head cable which may be part of system wiring.	V-G-CV-A-0008
Relay Contact adapter cable for VTI TORRCON Convection Gauge Controller. Used when upgrading from Terranova 906 controller to a TorrCon controller. Adapts between the screw terminal connector on the TorrCon Controller and the existing 15 pin connector which may be part of system wiring.	V-G-CV-A-0011
24VDC Wall Type Power Supply for the VTI TorrCon Convection Gauge Controller.	V-G-CV-A-0007
24VDC In-Line Type Power Supply for the VTI TorrCon Convection Gauge Controller.	V-G-CV-A-0010
Convection Gauge Tube with 2-3/4" Conflat®-type Flange.	V-G-CV-0013

<b>Gauge Heads</b>	
Convection Gauge Tube with 1/4" Female VCR-Type Fitting.	V-G-CV-0014
Convection Gauge Tube with 1/4" Male VCR-Type Fitting.	V-G-CV-0016
Convection Gauge Tube with 1/8" MNPT connection.	V-G-CV-0008
Convection Gauge Tube with QF16 Flange Fitting.	V-G-CV-0012
Convection Gauge Tube with QF25 Flange Fitting.	V-G-CV-0011
Convection Gauge Tube with 2-3/4" Conflat®-type Flange.	V-G-CV-0013

**Call Toll-Free 1-800-704 4774  
with any questions.**

## APPENDIX A – REPLACING AN ALTERNATIVE CONTROLLER

VTI systems have used Terranova Model 906A controllers in some applications and it is quite possible that you may have to replace one of these older models with a new TORRCON instrument. There is a difference in rear panel connectors but VTI produces adapter cables to allow for a simple installation. Follow the instructions below to complete this operation.

- 1) Make a note of the set-point values on the old controller before you start the replacement process.
- 2) Shut the system down and vent to atmosphere – or at least ensure the portion of the system to which the gauge head is connected is at atmospheric pressure if it can be isolated. Power can only be applied to the new controller with the gauge at or near to atmospheric pressure.
- 3) After ensuring the power has been isolated, disconnect the power, process control relay connector and analog output connections (if used) carefully noting the colors / labeling.
- 4) Disconnect the 15 pin gauge head cable.
- 5) Remove the old control unit from the rack / panel.
- 6) The new TORRCON controller will fit directly into the panel hole left by the old unit. To mount the TORRCON, slide the unit into the panel, slide the mounting jacks into the groove on each side of the TORRCON and secure with 4-40 screws provided. Leave space at the back of the controller for access to power and accessory connections.
- 7) Carefully reconnect the process control relay connector and analog signal wires using the adapter cable V-G-CV-A-0009.
  
- 8) Gauge Head Cable connection

If the older unit used a 15 pin connector you have two options to effect this part of the installation. You can:-

- a) Use the VTI cable, part number V-G-CV-A-0006 to replace the existing cable  
or
  - b) In the case where the old cable is 'hard wired' into a system harness, use an adapter, part number V-G-CV-A-0008, to connect the 15 pin connector on the end of the old cable to the 9 pin connector on the rear of the TORRCON control unit.
- 
- 9) Power Cable Supply connection

The TORRCON uses 24VDC power. This can be provided from the system if it is available or by using a power supply (Part Number V-G-CV-A-0010) which will provide 24VDC when connected to the 120VAC line supply previously used to power the 906.

The installation is now complete, power may be applied to the TORRCON unit and the system restarted. At this point you will need to calibrate and set the process set-points to the values you noted down from the old controller at the beginning of this procedure.

If you have any questions do not hesitate to call VTI staff for further advice.