# Operating Instructions

## *Digital Convection Gauges*

- *1 mTorr to Atmosphere*
- *.001 mbar to Atmosphere*
- *0.1 Pascal to Atmosphere*

p/n V795024

Price: $10.00
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# 1. INTRODUCTION

The Convection Gauge is the lowest cost instrument that can provide continuous monitoring and control of your vacuum system from atmosphere all the way down to one mTorr, the gauge tube is all stainless steel and is very rugged and reliable.

An internal temperature compensator virtually eliminates the errors due to ambient temperature changes that are so troublesome with other convection gauges. Mercury and Fluorine vapors are no problem for the Convection Gauge. Our filament is a platinum alloy which operates below 125 oC and all other gauge tube components exposed to vacuum are 300 series stainless steel. For outdoor applications, or for corrosive environments, gauge tubes with stainless steel connector pins should be used.

Your instrument is ready to operate as received. Simply install the gauge tube so that the body of the tube is horizontal, connect the gauge tube cable, and plug the line cord into an AC power outlet to place the instrument in operation.

The instrument is powered from a 115 VAC or 230 VAC, 50/60 line as specified when ordering. (Line voltage can be changed by moving jumpers on the circuit board.)

A 10 foot long gauge tube cable is attached and extensions up to 500 feet (if using #18 wire) may be added without affecting calibration.

The Convection Gauge Controller instrument operates two or four control relays. Set point pressures are adjusted from the front panel and displayed on the meter. Push-to-set switches simplify display of the set points. Relays have 3 amp contacts, form C, and are terminated in screw terminal connectors on the rear. The mating half of the relay connector is provided.

## 2. SPECIFICATIONS

| | |
|---|---|
| **Sensor Type:** | Thermal convection. |
| **Resolution and Repeatability:** | ± 1 milliTorr from 1 to 2000 milliTorr<br>± 1Torr from 2 Torr to atmosphere. |
| **Response Time:** | Less than 1 second for 90% of an increase in pressure, less than 4 secs. for a decrease in pressure from atmosphere to 1 mTorr. |
| **Hysteresis:** | Minimum hysteresis is less than 2 mTorr from 1 to 2000 mTorr and less than 2 Torr from 2 Torr to atmosphere. To prevent relay chatter hysteresis is adjustable to as high as 5% of full range. |
| **Analog Outputs:** | 3 simultaneous outputs. |
| If Calibrated in Torr | 1 mTorr to 2000 mTorr<br>(0 to 2 VDC Linear, 1 mV per mTorr)<br>2 Torr to 20 Torr<br>(0.2 to 2 VDC Linear, 100 mV per Torr)<br>20 Torr to 760 Torr<br>(0.02 to 0.760 VDC Linear, 1 mV per Torr) |
| If Calibrated in mbar | 0 to 2 mbar (0 to 2 VDC Linear)<br>2 to 20 mbar (0.2 to 2 VDC Linear)<br>20 to 1020 mbar<br>(0.02 to 1.020 VDC Linear) |
| If Calibrated in Pascals | 0.1 Pa to 200 Pa<br>(0 to 2 VDC Linear, 1 mV per 0.1 Pa)<br>0.2 to 2 KPa<br>(0.2 to 2 VDC Linear, 100 mV per KPa)<br>2 KPa to 102.0 KPa<br>(0.02 to 1.020 VDC Linear,<br>1 mV per 0.1 KPa) |
| **Maximum Pressure:** | 1250 PSIG |
| **Maximum Gauge Tube Temperature:** | 100 °C (212 °F) maximum<br>bake out of gauge tubes in air or vacuum. |
| **Display:** | 3 digit, LED char. height 11 mm (.43 in.)<br>3 ranges: 1 - 2000 mTorr, 2 - 20 Torr,<br>and 20 - 760 Torr. |

| | |
|---|---|
| **Optional Units of Measure:** | 001 to 1020 mbar (decimal point moves)<br>0.1 Pa to 102.0 KPa. |
| **Set Points and Relays** | (optional): 2 independent set points with front panel LED indicators and 2 SPDT relays 3 amp @ 220 VAC, non-inductive. Front panel adjustable over 100% of range. |
| **Gauge Tube Orientation:** | Axis of tube must be horizontal. |
| **Line Voltage & Power:** | 115V, 50/60 Hz standard; 220 V, 50/60 Hz optional.<br>5 watts with both relays energized, approximately 1 watt for indicator. |
| **Line Cord:** | 1.7 meter (65 inch) attached, 3 conductor. |
| **Mounting:** | Bench or 1/4 DIN panel mount, jack screws included. |
| **Gauge Tube Cable:** | 3 m (10 ft.) attached, use up to 500 ft. without affecting calibration. |
| **Weight:** | Including Gauge Tube<br>Net weight: 4 lbs. (8.8 kg);<br>Shipping weight 3 lbs. (11 kg.) |

# 3. INSTALLATION

## 3.1. Unpacking Instructions

The instruments and gauge tubes are carefully packaged to protect them during shipment. Use reasonable care when removing them from the shipping box.

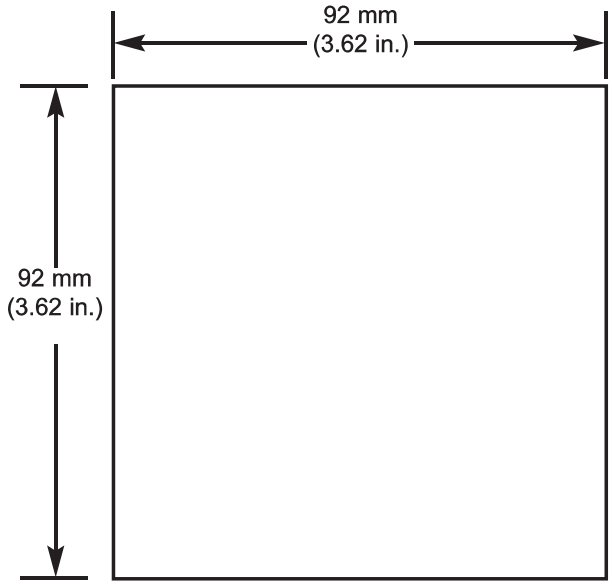
Inspect the instruments and gauge tubes carefully when you receive them. Should either the instruments or the gauge tubes show any signs of damage, file a claim with the carrier immediately. Do not destroy the shipping container. It will be required by the carrier as evidence to support claims. Call the factory immediately for instructions on return and repair of the instruments.

Please fill out and return the Warranty Registration card so that we can register your instrument in our warranty records.

## 3.2. Panel Mounting

This instrument may be operated while sitting on a bench or table or may be installed in a panel. For panel mounting, prepare a hole 92 mm X 92 mm (3.62 in. X 3.62 in.)

Remove the jack screws from the sides of the the display unit and slide the display unit into the hole from the front. While holding the display unit in place, install the jack screws and tighten sufficiently to hold the display unit in the panel. Be careful not to over-tighten or damage to the instrument may result.




**Panel Cutout**

## 3.3. Gauge Tube Installation

1. Thread the gauge tube into a 1/8 inch NPT female fitting (or other fitting or flange as per your gauge tube), in the vacuum system. The radial stem of the tube should be vertical to insure that the tube stays horizontal. The axis of the tube must be horizontal.

2. An appropriate thread sealant is required to insure that the threaded connection will not leak. Teflon thread tape may be used to seal the threads if care is used so it will not shred off and get inside the tube or vacuum system. It is better to use mini-seal or an epoxy sealer on the threads.

3. An excellent mounting system is to use an O-ring quick connect to install the gauge tube. These may be permanently installed in the system by welding, brazing or soldering. The quick connects are available from vacuum equipment suppliers.

4. Another alternative is to use quick flange adapters. Gauge tubes can be ordered with QF, VCR,Conflat, and other flanges.

## 3.4. Maximize Gauge Tube Life

To avoid damage and possible premature gauge tube burnout always turn the instrument power off before plugging the tube into the cable.

# 4. OPERATING INSTRUCTIONS

## 4.1. Readings On The Display

When the power is applied and the gauge tube connection is made, your instrument is in operation. After a short time period for stabilization, the digital display will show a reading of vacuum pressure.
The instrument displays vacuum pressure in straight digital format or in an exponential format depending on the range ordered. The front panel lens on the instrument's LED display indicates the range.
At pressures above the designed range of the instrument, the display will show a “1" at the left side of the display with the other digits blanked out. This indicates amplifier saturation. After the saturation condition has subsided (pressure drops below full scale), the instrument will resume reading vacuum pressure.

## 4.2. Set Point Operation

To set the control points in instruments with 2 set points, press in either the Low or High “Push To Set” push-button on the front panel. This will display that set point on the digital meter. Adjust the front panel multi-turn pot that corresponds to the displayed set point (Low or High) until the desired pressure for the control action displays on the meter.
Release the “Push To Set” push-button and the instrument will again read pressure.

If the meter saturates and reads 1xxx with the right-most digits (xxx) blanked out, the control pressure setting is still correctly displayed when either of the push-buttons are depressed.

The Low and High Alarm LED's show control action in the following manner:

Relay energized, LED is ON; de-energized, LED is OFF

Relays are de-energized when pressure is above the set-point (on atmospheric pressure side of set point.)

Atmospheric pressure = de-energized = loss of power

“NORMAL” = de-energized relay

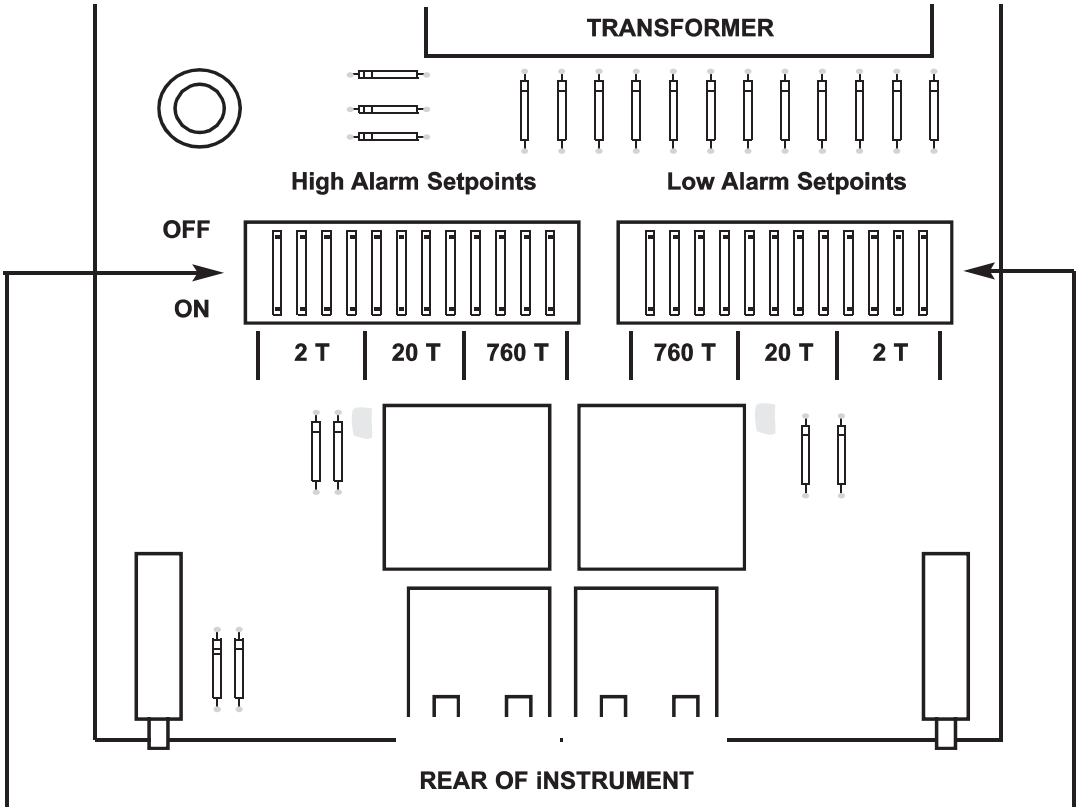
No Power = in no power state relays are de-energized

### 4.2.1.Changing the Control Setpoint Range

The convection gauge has a very wide span, approximately 760.000 to 1. To provide the best stability for the setpoints this span is broken down into 3 ranges:

.001 to 2 Torr, .01 to 20 Torr, and 1 to 760 Torr

The range that each of the setpoints are assigned to is controlled by settings on two DIP Switches located inside the instrument on the Power Supply/Alarm Circuit Board. When shipped from the factory the low setpoint is assigned to the .001 to 2 Torr range, and the high setpoint is assigned to the .01 to 20 Torr range. Any setpoint can be assigned to any range and both can be assigned to the same range. The drawing below shows the location of the dip switches and the tables show the DIP switch settings for each range.




| High Alarm Set Point | | |
|---|---|---|
| **Range** | **ON** | **OFF** |
| 2 Torr | 9 to 12 | 1 to 8 |
| 20 Torr | 5 to 8 | 1-4, 9-12 |
| 760 Torr | 1 to 4 | 5 to 12 |

| Low Alarm Set Point | | |
|---|---|---|
| **Range** | **ON** | **OFF** |
| 2 Torr | 1 to 4 | 5 to 12 |
| 20 Torr | 5 to 8 | 1-4, 9-12 |
| 760 Torr | 9 to 12 | 1 to 8 |

## 4.3 Relay Output Connector Wiring

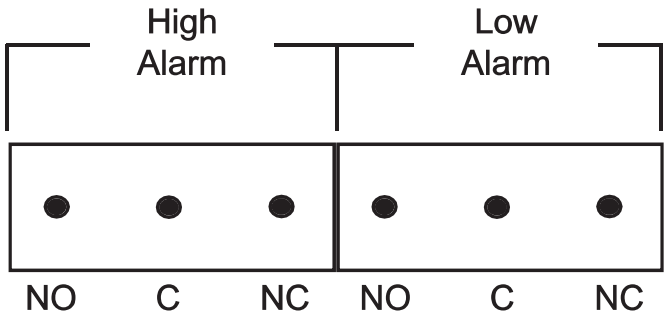
Contact Rating:

3 amps, 120 VAC, resistive

1.5 amp, 230 VAC, resistive

1.5 amp, 28 VDC, inductive

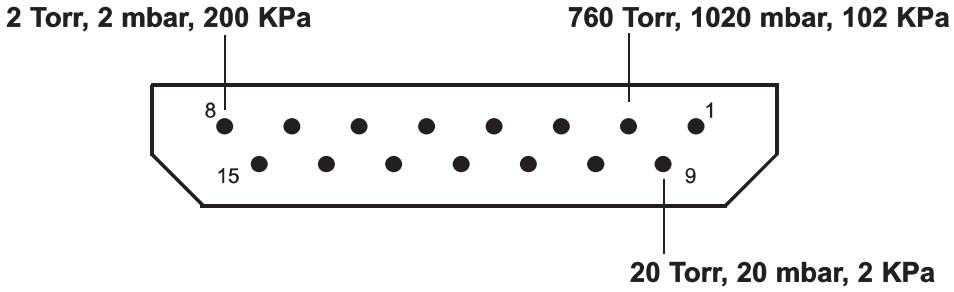
Gently pull the connectors and they will detach from their sockets for wiring. Plug back in after the connections are made. The “Low” set point relay is on the right side when looking at the instrument from the rear.



## 4.4. Analog Output Signal

For computer interface and process control, the Convection Gauge provides several alternatives. All Convection Gauges have 3 linear outputs for data acquisition or vacuum system computer control.

A 15 pin “D” type connector is provided on the rear of the Convection Gauge for output to remote recorders, dataloggers, etc. The pin out




| Output Connector Pin Out Details | |
|---|---|
| Pin Number | Output |
| 1 | Test Point |
| 2 | 760 Torr Linear Output |
| 3 | Test Point |
| 4, 5, 7 | Signal Ground |
| 6 | Test Point |
| 8 | 2 Torr Linear Output |
| 9 | 20 Torr Linear Output |
| 10 | 760 Torr Logic |
| 11, 12, 13 | not used |
| 14 | 2 Torr Logic |
| 15 | 20 Torr Logic |

details are described on the rear panel of the instrument, and shown in detail below.

| Linear Analog Outputs | | | |
|---|---|---|---|
| | Torr | mbar | Pascals |
| Pin 2 | 20 to 760 Torr,<br>0.02 to 0.760 VDC | 20 to 1020 mbar,<br>0.02 to 1.020 VDC | 2 to 102 KPa,<br>0.02 to 1.020 VDC |
| Pin 9 | 2 to 20 Torr,<br>0.2 to 2 VDC | 2 to 20 mbar,<br>0.2 to 2 VDC | 0.2 to 2 KPa,<br>0.2 to 2 VDC |
| Pin 8 | 0 to 2 Torr,<br>0.002 to 2 VDC | 0 to 2 mbar,<br>0.002 to 2 VDC | 0 to 200 Pa,<br>0.002 to 2 VDC |
| Pins 4, 5, 7 | Common Output Signal Ground | | |

Because these output signals are so large and linear, virtually any data system can handle them directly without addtional amplification. However, for applications that require highest performance, the 15 pin

| Output Signal Logic | | | |
|---|---|---|---|
| | 2 Torr<br>Logic<br>Pin 14 | 20 Torr<br>Logic<br>Pin 15 | 760 Torr<br>Logic<br>Pin 10 |
| 2 Torr<br>2000 X $10^{-3}$ mbar<br>200 Pa | + 9 Volts | - 9 Volts | - 9 Volts |
| 20 Torr<br>20 mbar<br>2 KPa | - 9 Volts | + 9 Volts | - 9 Volts |
| 760 Torr<br>1020 mbar<br>102.0 KPa | - 9 Volts | - 9 Volts | + 9 Volts |

connector offers 9 VDC logic outputs to designate which analog output provides the highest precision at any point in time.

## 4.5. Calibration

Your convection gauge is extremely stable and should operate for years without a complete recalibration. Recalibration is usually performed only at our factory because the equipment required is seldom available at facilities not dedicated to vacuum metrology.

When installing a new gauge tube, or whenever verification of calibration seems appropriate, you should perform the adjustments for High Vacuum and Atmospheric Pressure below. If you have purchased a Convection Gauge Calibrator from the manufacturer, see below.

### 4.5.1. Adjustment For High Vacuum

1. Be sure the sensor is at pressure of 1 X $10^{-4}$ Torr or less for at least thirty (30) minutes.

**CAUTION!**

**Please do not attempt this procedure if a manometer with a current certification is not available.**

2. Adjust the rear panel potentiometer labeled “2 Torr Offset” until the meter reads zero.

### 4.5.2. Adjustment For Atmospheric Pressure

1. Raise the pressure of the vacuum chamber to atmosphere and allow at least thirty (30) minutes for thermal equilibrium.
2. Use a certified manometer to determine the atmospheric pressure at your facility.
3. Adjust the potentiometer in the center of the front panel until the meter agrees with your certified manometer.
4. Please do not attempt this procedure if a manometer with a current certification is not available.

### 4.5.3. Convection Gauge Calibration with Convection Gauge Calibrator (p/n: 912170)

Before attempting calibration of convection gauge remove (6) 6-32X1/4 slot head screws that attach the outer cover assembly to the instrument chassis; two (2) screws on the top front and 4 screws on the bottom of

the instrument. Do not remove the outer cover assembly at this time.

1. Connect the DB 15 and the octal connector from the calibrator to the convection gauge.

2. Set the calibrator to position #3 Gain 1863.

3. Power up the calibrator and gauge for a minimum of 1 hour before checking or adjusting calibration. When checking or adjusting the calibration of the gauge, allow adequate time between switch positions for gauge and calibrator readings to stabilize.

| Sequence | Gauge Adj. Pot. Label | Calibrator Display | Convection Gauge Display |
|---|---|---|---|
| 1 | 8.8 V | 1500 | -198 to -200 |
| 2 | Zero | 000 | 000 |
| 3 | Gain | 1863 | 700 |
| 4 | 2 Torr Offset | 000 | 000 |
| 5 | 2 Torr Span | 1895 | 1883 to 1895 |
| 6 | 20 Torr Offset | 000 | 000 |
| 7 | 20 Torr Span | 1950 | 19.48 to 19.50 |
| 8 | 760 Torr Offset | 000 | 000 |
| 9 | Front Panel Adj. | 700 | 700 |

4. See the table below. Locate the pots identified in column 2, Gauge Adj. Pot. Label, on the rear of the Convection Gauge. The calibrator display will show an actual reference value. Adjust the pots on the Convection Gauge in the sequence listed so that the gauge display agrees with the values in the right hand column of the table.

5. In sequence 9, adjust the pot located at the front panel (in the middle of the gauge face) so display reads 700. Let readings stabilize for 10 to 15 minutes.

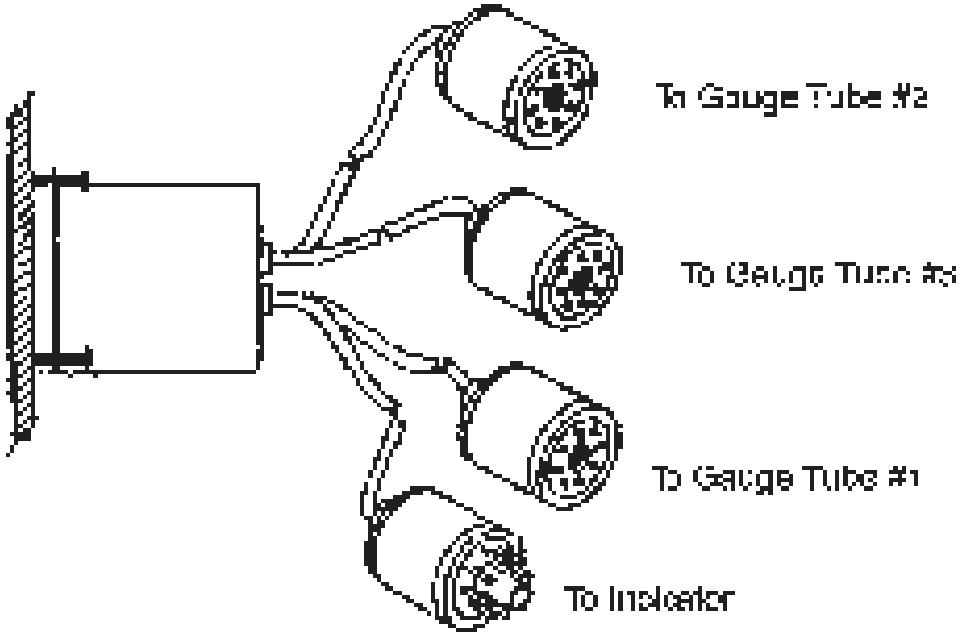
If the calibrator and convection gauge displays do not agree, for example the calibrator display reads 700 but the convection gauge display reads 670, slide the Convection Gauge outer cover toward the rear of the instrument and locate the trim pot on the top PCB assembly (6 screws have been removed connecting the cover to chassis) . The cover should

need to slide towards the read of the instrument only about 1 1/2 inches. Adjust the trim pot so that the convection gauge display agrees with the calibrator display.

## 4.6. Three or Five Position Gauge Tube Selector Switch Operation

Use the 3 or 5 Position Gauge Tube Selector Switch as an accessory with the indicator instruments. Plug the male connector of the Selector Switch into the gauge tube cable of the indicator. Then connect one, two, three, four or five separate gauge tubes to the gauge tube cables of the switch.

The front panel switch settings of 1, 2, 3, 4, or 5 correspond to the gauge tube #1, gauge tube #2 and gauge tube #3, etc. marked on rear panel identifying the gauge tube cables.



The Selector Switch is intended for use with the indicator instruments. If used with the Dual Set Point Controllers, the signal may trip relays when switching between gauge tubes. If that does not present a problem with your application in using the controller, then the switch may be used with the controller also.

# 5. TECHNICAL DATA

## 5.1. Troubleshooting

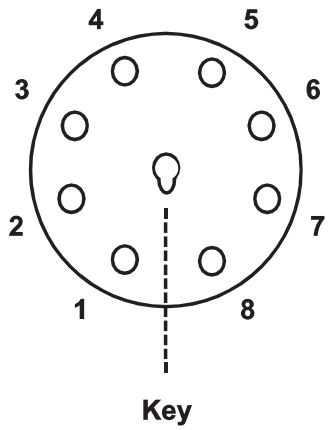
It is strongly recommended that every customer keep a small stock of spare gauge tubes on hand. Always try a new tube before considering circuit failures.

| Gauge Tube Pins Approximate Resistance Values | |
|---|---|
| Pin No. | Approximate Resistance |
| 1 to 5 | 9 ohms |
| 3 to 5 | 4 ohms |
| 3 to 8 | 200 ohms |
| 1 to 8 | 207 ohms |
| 6 to 7 | 12 Kohms +/- 3 K |

## 5.2. Gauge Tube Check

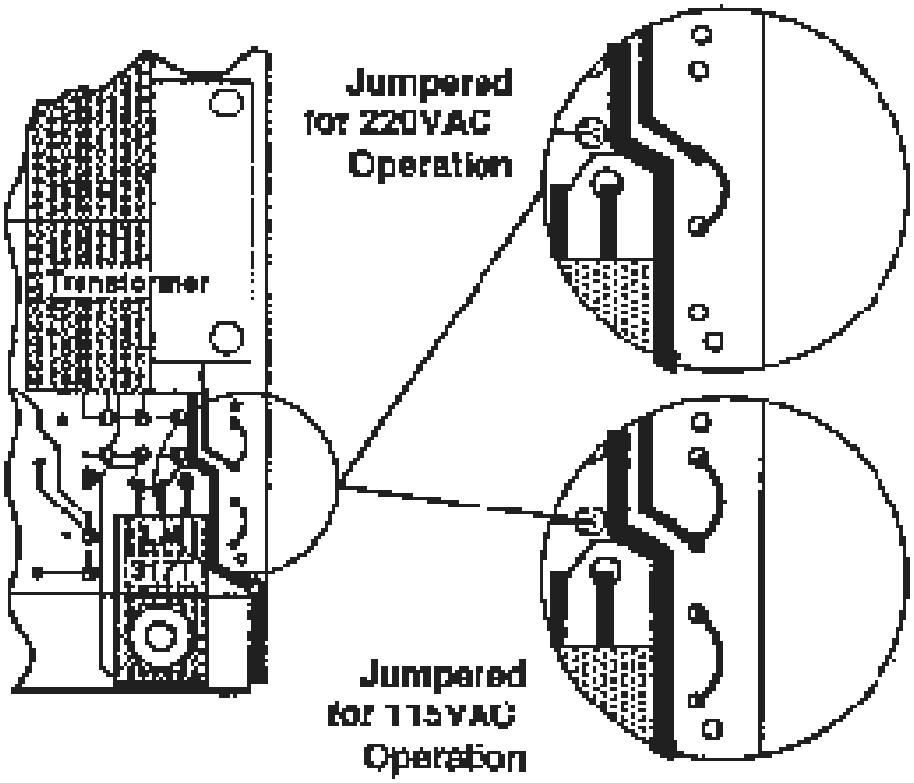
The gauge tube can be checked with an ohmmeter to verify that the sensor is good.

Approximate resistance values between several pin combinations are listed below.



## 5.3. Changing Operating Line Voltage

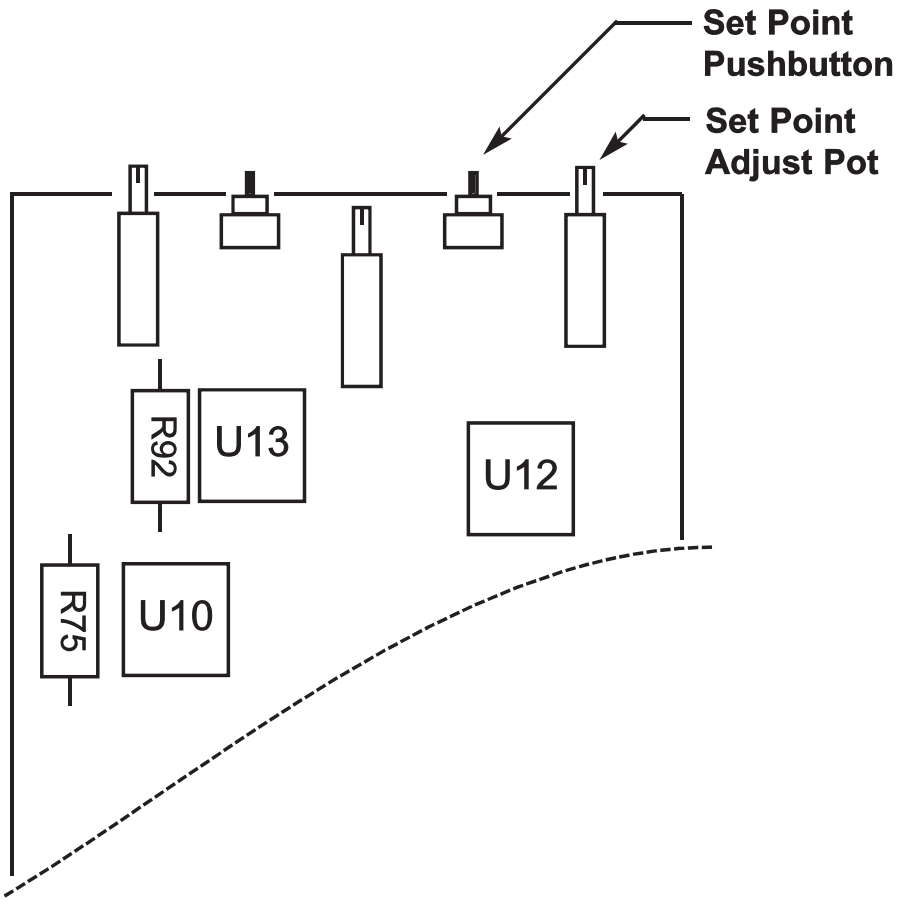
The operating voltage for instruments can be changed in the field by changing the connection across four pads on one of the circuit boards.




For access to these pads, remove the 2 screws on the top of the outer wrap and the 4 screws holding the outer wrap to the bottom of the instrument. Carefully slide the outer wrap toward the rear and remove it from the instrument. Locate the power transformer and position the adjacent jumpers in the circuit board for 115 or 220 VAC operation as required.

Instruments set for operation at 115 VAC have jumpers connecting the outside pairs of the four pads. Instruments set for operation at 220 VAC have jumpers connecting the inside pair of the four pads. See illustration below.

Clip the jumpers close to the pads and install new jumper(s) to change to the desired configuration.




**Partial Detail of Alarm Relay Circuit Board**

## 5.4. Set Point Hysteresis

In some vacuum or pressure control systems the system performance can be improved and "chatter" around the set point eliminated if some amount of hysteresis is added to the set point control circuit.

The high alarm hysteresis is controlled by resistor R-92. The alarm hysteresis is controlled by resistor R-75. The value of these resistors can be varied from 150 Kohms to 2 Megohms with 150 Kohms giving the lowest hysteresis.

# 6. WARRANTY AND RETURN PROCEDURE

## 6.1. Warranty Statement

The manufacturer warrants all instruments for a period of two years against defects of material and workmanship subject to the terms and conditions set forth below:

1. The warranty is in effect at date of shipment from the manufacturer to the original purchaser.

2. Expendables such as gauge tubes, etc. are not covered by this warranty.

3. Claims against this warranty for replacement parts and/or service shall be limited to defects in materials and workmanship. Malfunctions attributable to neglect, abuse, or repair and operational procedures not specifically recommended by the manufacturer are not warranted.

4. Service repairs and/or piece part replacement shall be warranted for a period of ninety (90) days commencing on date of return shipment or until expiration of the remaining term of original instrument warranty, whichever is later.

5. The manufacturer shall not be liable for consequential damages nor for labor, loss or expenses directly or indirectly arising from use of their products or equipment.

6.This warranty does not apply to shipping damage. Claims for damage incurred while products are in transit rest with purchaser. Said claims are to be levied against the carrier.

7. Amendments, assumed corollaries or statements contrary to the terms of this warranty shall not be binding upon the manufacturer unless stated in writing and approved by an officer of the manufacturer.

8. THE MANUFACTURER MAKES NO OTHER WARRANTY, EXPRESSED OR IMPLIED, AND MAKES NO WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR ANY PARTICULAR PURPOSE.

9. Warranty service is F.O.B. point of manufacture. All transportation charges to and from the manufacturer's plant shall be the responsibility of the purchaser.

### 6.2. Return Shipment Procedure

If repairs are required, return the instrument with cables and gauge tube to the manufacturer, pre-paid. Include a purchase order and a statement as to the nature of the problem.

## 7. PARTS AND ACCESSORIES

**Dual Set Point Convection Gauge Controller** with digital display, 1/4 DIN enclosure with jack screws for panel mounting. All cables included. Gauge tube not included.

1 mT to atmosphere

.001 mbar to atmosphere

0.1 Pascal to atmosphere

**Digital Convection Gauge Indicator** without setpoints in 1/4 DIN enclosure with jack screws for panel mounting. All cables included. Gauge tube not included.

1 mT to atmosphere

.001 mbar to atmosphere

0.1 Pascal to atmosphere

**3 and 5 Position Gauge Tube Selector**

**Standard Convection Gauge Tube**

Gauge Tube body and all wetted parts are 303 SS. Connector pins are solder plated 52 alloy.

With 1/8 in. NPT and 1/2 inch OD Tube

With KF-16 Flange

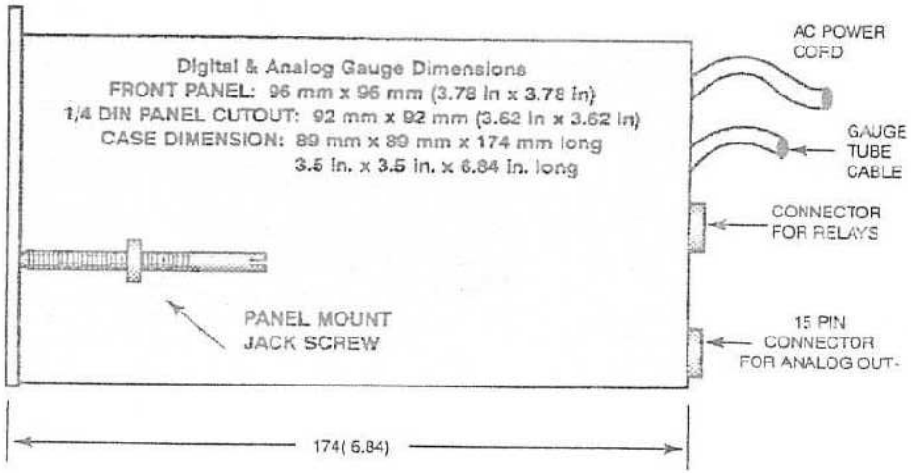
With 1.33 in. OD Conflat® (non-rotatable)

With 2.75 in. OD Conflat® (non-rotatable)

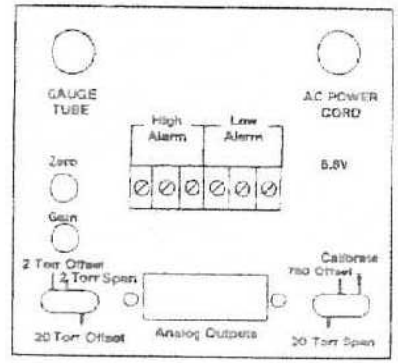
With VCR-8 Female

**All Stainless Steel Gauge Tubes** for outdoor applications or wherever the use of 303 SS is appropriate. All wetted parts as well as all external parts and connector pins are 303 SS. 1/8 NPT, KF-16, Conflat, VCR-8 and special flanges can be provided. Add SS prefix to tube P/N when ordering.

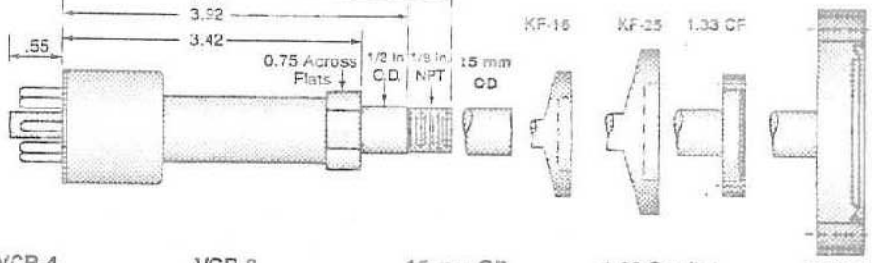
## Convection Gauge



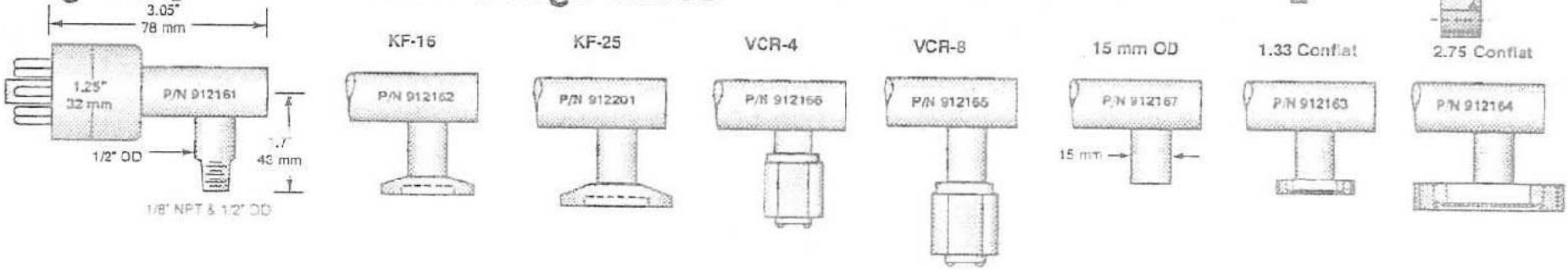

## Rear Panel Digital Convection Gauge




## Inline Style Convection Gauge Tubes




## Angle Style Convection Gauge Tubes



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