

# Operating Instructions

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*Diaphragm Manometers and  
Dual Set Point Controllers*

**0.5 to 1200.0 Torr**

**0.1 to 160.00 kiloPascal**

**0.5 to 1600.0 mbar**

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# 1. INTRODUCTION

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The Vacuum Manometer Indicator and Dual Set-point Controller are compact vacuum measurement and control instruments that offer the precision and high resolution of digital electronics at the same price as analog controls. These instruments introduce a newly developed sensor comprised of an all-stainless steel diaphragm and housing.

The transducer is available with a variety of flanges including 1/4 inch NPT, NW16, NW25, VCR-4 and more. The transducer withstands overpressure to 45 PSIA. All "wetted" parts exposed to the system are #316 stainless steel.

While the instruments are not completely immune to shock and vibration, they do not have a delicate analog meter and therefore are considerably more rugged than analog types and much more resistant to pump vibration.

## 1.1. Instruments Covered By This Manual

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This manual covers the following instruments:

- **0.5 to 1200.0 Torr indicator**
- **0.5 to 1200.0 Torr indicator and controller**
- **0.1 to 160.00 kiloPascal indicator**
- **0.1 to 160.00 kiloPascal indicator and controller**
- **0.5 to 1600.0 mbar indicator**
- **0.5 to 1600.0 mbar indicator and controller**

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## 1.2. Vacuum Gauge Indicator

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The indicator instruments are rugged, digital vacuum gauges. They are small, compact instruments that power the transducer and condition the output signal. Life expectancy for the transducer is excellent.

Your instrument is ready to operate as received. Place the indicator in operation by installing the gauge tube and instrument, connecting the gauge tube cable and plugging the line cord into an AC power outlet. The instrument is powered from a 115 VAC or 230 VAC line as specified when ordering. Power consumption is about 1 Watt. Either 50 or 60 Hz power may be used. 24 VDC power is optional.

A 10 foot long gauge tube cable is attached. Extensions up to 500 feet (if using #18 wire) may be added without affecting calibration. See section on Cable Extensions for more information.

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## 1.3. Dual Set Point Controller

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The Dual Set Point Controller is an indicator, and it operates two control relays. Set point pressures are set 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.

The instrument is powered from a 115 VAC or 230 VAC line as specified when ordering. Power consumption is about 2 Watts. Either 50 or 60 Hz power may be used.

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. See section titled, "Cable Extensions" for more information.

Installation of the controller is identical to the Digital Indicator except for wiring the relay connectors for the control action. This is described in the section titled, "Relay Output Connector Wiring."

## 2. SPECIFICATIONS

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**Pressure Range:** 0.5 to 1200.0 Torr;  $\pm 0.1$  Torr , 0.1 to 160.0 kiloPascal, 0.5 to 1600.0 mbar.

**Resolution:**  $\pm 0.1$  Torr over entire range.

**Display:** 4 1/2 digit red LED; characters .47 in. (12 mm) high.

**Calibration:** Any gas, liquid or vacuum compatible with sensor materials.

**Accuracy:** 1% of reading or 1 Torr.

**Response Time:** Less than 400 msec. for response to a step change.

**Linearity:**  $\pm 0.15\%$  Full Scale. Sensitivity:  $\pm 0.1$  Torr

**Analog Output:** 0 to 10 Volt DC into 2000 Ohm load or higher. 2 pin connector included. 4 to 20 mA output in addition to 0 to 10 Volt D.C. available.

**Sensor Heads with Stainless Steel Diaphragm.** outer case and wetted parts 316 L stainless steel. Connector pins are nickel plated Kovar. Maximum bake-out temperature 100 °C. See page 19 for available flanges.

**Materials:** All parts in contact with process are 316 L Stainless Steel.

**Set Point Range:** Full Scale, 0.5 to 1200.0 Torr, 0.1 to 160.00 kilo Pascal, 0.5 to 1600.0 mbar. Repeatability:  $\pm 1$  Torr.

**Relays:** Controller model includes 2 relays; SPDT contacts rated 3A @ up to 220 VAC non-inductive.

**Sensor Internal Volume:** 1.25 ml for stainless steel sensor.

**Line Power:** 115 VAC, 50/60 Hz; 230 VAC or 24 VDC optional at no additional cost.

**Wattage:** Less than 1 Watt for indicator; 2 Watts for controller.

**Line Regulation:**  $\pm 20\%$  change in line voltage produces less than 1% change in reading.

**Temperature Effects:** When changes occur in ambient temperature between 0 °C and 50 °C, reading will change no more than  $\pm 0.02\%$  per °C.

**Bakeout Temperature:** Sensor can be baked to 100 °C (212 °F) in air or vacuum.

**Dimensions:** See page 20.

**Mounting:** Panel mounting hardware is standard. Bench mount and portable cabinets are also available, see page 20.

**Sensor Cables:** 10 ft. (3m) attached.

**Extension Cables:** Change sensor cable length without recalibration. Extensions to 250 ft. (75 m) can be used. See page 38.

**Line Cord:** 3 wire, 65 inch (170 cm) attached.

**Net Weight:** Indicator 1 lb., 2 oz. (0.5 kg); Controller 1 lb., 6 oz. (0.6 kg)

**Shipping Weight:** Indicator 2 lbs., 8 oz. (1.1 kg); Controller: 3 lbs. (1.3 kg)

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## **3. INSTALLATION**

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### **3.1. Unpacking Instructions**

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

Inspect the instruments and sensors carefully when you receive them. Should either the instruments or the sensors 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**

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Both the digital indicators and dual set-point controllers mount in a single panel cut out.

Instruments provided in "standard enclosures" fit the same 2.75" (70 mm) round hole as used by Hastings, Televac, Lesker, Varian and other analog meter instruments. A 'U' shaped panel mounting clip is included with the instrument. Instruments provided in 1/4 DIN Enclosures fit a 92 mm x 92 mm cut out. Jack screws are included with 1/4 DIN instruments.

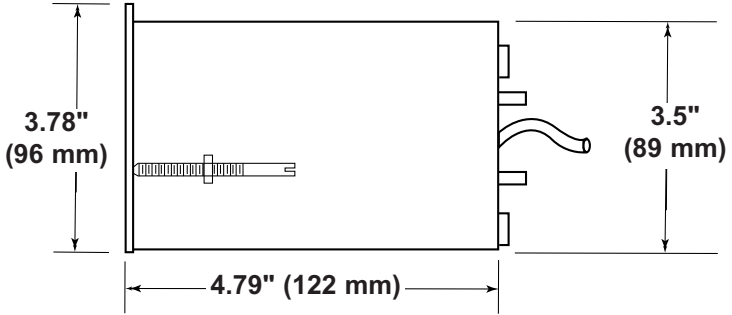
1. Loosen the screws and remove the 'U' shaped bracket from the standard enclosure or the 2 jack screws from the sides of the 1/4 DIN enclosure. Feed the power and gauge tube cables through the panel cutout and hold the instrument flush against the panel.

2. Reinstall the 'U' clip or jack screws. Lightly tighten (finger tight) the jack screws against back of the panel.

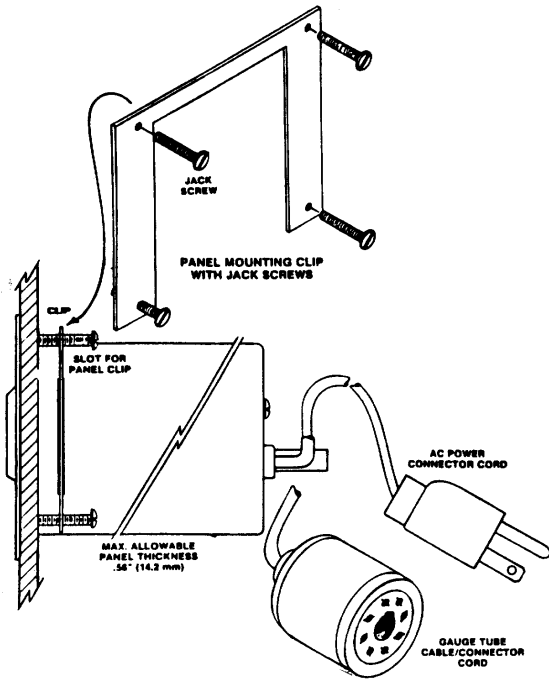
3. Adjust the front panel of the instrument to be square and level and tighten jackscrews snugly. Do not over-tighten.

## 1/4 DIN Enclosure

## 1/4 DIN Enclosure



## Standard Mounting With Clip



4. Connect the power cord to an AC line power outlet of the appropriate voltage. Power consumption is approximately 2 watts.

5. Unless tagged, the instrument is shipped ready for operation on 115 VAC. If modified at the factory for 230/240 volt use, the 115 volt connector will be removed and the instrument tagged or marked for 230 volt operation. The customer will then be required to wire the power cord to his connector as follows:

Black = Line    White = Neutral    Green = Ground  
Brown = Line    Blue = Neutral    Green = Ground

6. After the transducer is installed in the vacuum system, connect the transducer cable to transducer (See the following section, "Transducer Installation", for more information on installing the transducer).

7. For controllers, please refer to the section titled, "Relay Output Connector Wiring" for information on connecting the output relays. Information on connecting the analog output signal for both the indicator and the controller instruments is contained in the section titled, "Analog Output Signal".

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### **3.3. Transducer Installation**

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1. Thread the transducer into a 1/4 inch NPT female fitting (or other fitting or flange as per your gauge tube), in the vacuum system. The preferred mounting is with the open end pointing down so as to be self draining to any condensation. However, mounting in any position is acceptable.

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.

## 4. OPERATING INSTRUCTIONS

### 4.1. Readings On The Display

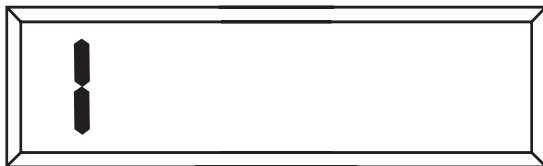
When the power is applied and the gauge tube connection is made, your instrument is in operation. After a short time period for stabilization, the digital display will show a reading of vacuum pressure.

If exposed to atmospheric pressure the instrument will read barometric pressure. It will read your pressure altitude - referred to as "station pressure" by the weather bureau (See calibration section.)

The display will indicate absolute pressure from 0.5 to 1200.0 Torr, (0.1 to 160.00 kiloPascal, 0.5 to 1600.0 mbar). If subjected to overpressure above the operating range of the instrument, the display will show a "1" with the other digits blanked out. This indicates saturation. After saturation, when the pressure drops below full scale, the instrument will resume reading vacuum pressure.



**NORMAL DISPLAY**



**SATURATION**

## 4.2. Setting the Control Points

To set the control points, press in either the Low or High “Push To Display” push-button on the front panel. This will display that set point on the digital meter. Adjust the multi-turn pot that corresponds to that set point until the desired pressure for the control action is read on the meter. The set point adjustment pots are located on the front panel on either side of the LEDs. Release the “Push To Display” push-button and the instrument will again read pressure.

If the meter saturates and reads 1 xxx 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 LED's show control action in the following manner: Relay energized, LED is ON; de-energized, LED is OFF

Relays are de-energized (normal) when pressure is above the set-point (on atmospheric pressure side of set point.) or when there is no power to the instrument.

## 4.3. Relay Output Connector Wiring

Contact Rating:

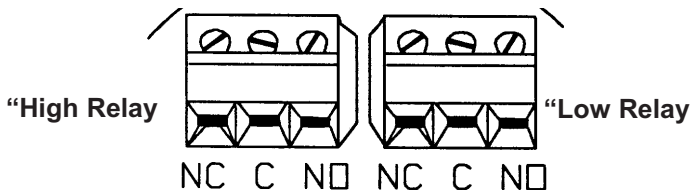
3 amps, 120 VAC, resistive

1.5 amp, 230 VAC, resistive

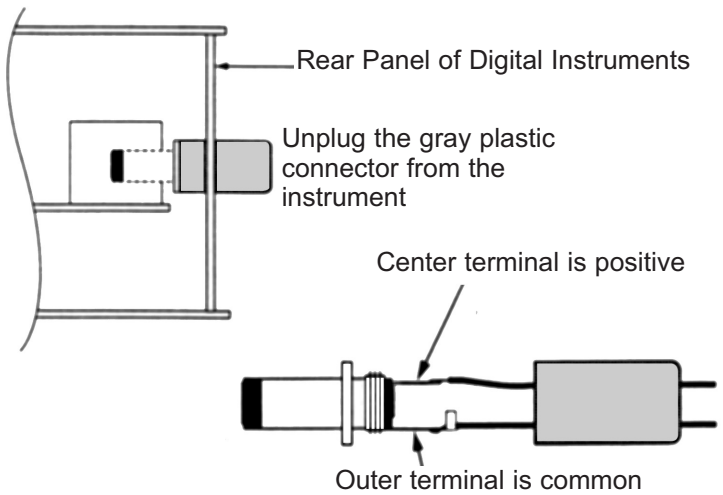
1.5 amp, 28 VDC, inductive

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

### Relay Connectors On Rear Of Controller



## 4.4. Analog Output Signal



Vacuum gauges are shipped with a removable connector for analog output plugged into the rear panel of the instrument. Follow the steps below to wire the connector for output to remote recorders, dataloggers, etc.

1. Unplug the gray connector from the rear panel.
2. Unscrew the gray plastic connector cover.
3. Feed your analog output wires through this cover.
4. Solder the positive wire to the center terminal.
5. Solder common or negative wire to the outer terminal.
6. Reinstall the connector cover and plug into the gauge.

**Analog Output:** 0 to 10 Volt DC into 2000 Ohm load or higher. 2 pin connector included. 4 to 20 mA output in addition to 0 to 10 Volt D.C. available.

#### 4.4.1 Optional 4-20 mA and 0-5 or 0-10 VDC Output

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Gauges provided with an optional output are built in 1/4 DIN size cabinets which mount in 92 mm square panel cut-outs.

On the rear panel of the instrument you will find a section identified as “analog output” which includes the zero and span adjustment potentiometers and a male connector for the 4-20 mA, 0-5 or 0-10 VDC outputs.

Unplug this connector and unscrew the gray plastic shroud. Feed a shielded wire through this shroud and solder the shield to the outside lug and the center conductor to the inner lug. The shield is the circuit common or zero and the center conductor is 20 mA, 5 or 10 volts. The output is floating. The resistance in the mA output loop can be up to 1000 ohms. The 5 or 10 VDC output should have loads of 2000 ohms or higher.

Before being shipped from the factory the 4 mA is scaled to the low end of the instrument range (or zero pressure) and the 20 mA is adjusted to coincide with the full scale instrument reading of 1200.0 Torr. Instruments built with 5 or 10 VDC outputs are also scaled before shipping. Rear panel zero and span adjustments are provided with all output ranges should fine tuning in the field be required.

The standard analog output voltage signal described previously in this manual continues to function even when these optional outputs are provided.

## 4.5. Calibration

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There are only 2 calibration adjustments that are normally necessary to re-standardize the instrument. One is an off-set adjustment. The second is a span adjustment to set up scale tracking at some known pressure. The adjustment pots are located on the rear of the instrument and are clearly marked. Plug in the power cord of the instrument for at least 30 minutes before calibrating.

### 4.5.1 Offset & Span Adjustment

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1. Pump the transducer to “hard vacuum” ( The term “hard vacuum” refers to any pressure lower than .1 Torr (100 mT). This is a “relative zero” below which the transducer no longer changes output. It need not be known as long as you are sure it is this low.) Adjust the OFFSET pot until the meter reads 0.

2. Vent the transducer to atmosphere. Call the nearest airport weather station and obtain the immediate barometric pressure. Ask for “station pressure” not altimeter setting. Multiply the figure you are given for barometric pressure by 25.4 to convert to mmHg (Torr) from inches Hg. Then, adjust the SPAN pot until the display reads that pressure.

For example, if you are in Pittsburgh and you are at 636 ft. altitude on a standard day the following is true: at sea level the Std. Barometer is 29.92 in Hg = 760 Torr (29.92 X 25.4 = 759.968 Torr).

This is the altimeter setting for an aircraft, so that at landing the plane’s altimeter reads 636 ft. (At sea level the altimeter reads 000.)

Multiply the station pressure by 25.4 to convert inches Hg. to Torr and adjust the span to read the calculated number which in the above example is 743 Torr.

To obtain this information, look in the phone book under US Government, Transportation Dept., and call the number for "Pilot One Call Briefing." Ask for the "Station Pressure". Tell them your application is for industrial calibration purposes.

#### 4.5.1 Using the Optional Calibrator

Purchase a reference gauge tube calibrator from the manufacturer or your supplier. The calibrator is marked with the three proper settings for adjustment of zero, span, and offset. A simple toggle switch selects the "zero" and "span" and "offset" circuits so that you can make the proper adjustments using the associated zero, span and offset pot. All three adjustment pots are located on the rear of both the indicator and controller instruments. The pots are clearly marked.



Make the adjustments in the following sequence:

- 1) Adjust offset (A calibrator must be connected to the gauge to make this adjustment.)
- 2) Adjust zero
- 3) Adjust span

Please note that the "zero" adjustment is not truly a zero setting, but a power adjustment at which a gauge tube will read zero when pumped to a pressure below its sensitive range. This is usually referred to as "hard vacuum." For the gauge tubes supplied with these instruments, hard vacuum is any pressure one decade below the lowest reading for that range, or lower.

## 4.6. Cable Extensions

The indicator and controller models are unique in their ability to change cable lengths without requiring recalibration. Typically, a 500 foot cable of #18 wire may be added with less than 1 Torr error.

If factory cables are purchased with the instrument, it will be calibrated with that cable. Customers making their own cables may do so to any length, provided the wire resistance is kept at 3.2 ohms or less per lead, e.g. 500 feet of #18 wire is 3.19 ohms. We suggest using 8-wire #22 for up to 200 foot lengths. Beyond this, we recommend going to larger size wire. Wire all pins since all are used for the various tube types (except pin 2). Be sure to make good solder joints. Crimped connections are not recommended. For long cable extensions, shielded wire may be desirable and is a good precaution against stray electrical noise.

There are no simple connections for this, so tie the shield to pin #3 which is unused and bring an extra wire from pin 3 to the output minus terminal of the output connector. There are 6 operating pins for the tube as listed in the table below:

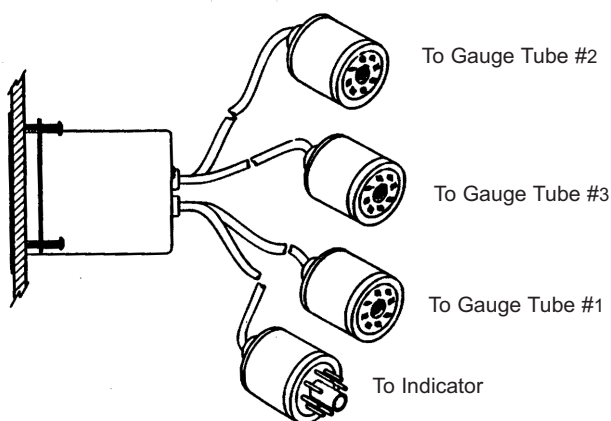
Pin #	Function	Color
1	Signal	White
2	N/C	
3	N/C	
4	Gain Res.	Yellow
5	Signal	Green
6	Power +	Red
7	Power Return	Black
8	Gain Res.	Brown

## 4.7. Three or Five Position Transducer 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 (depending on model of selector) separate gauge tubes to the cables of the switch.

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

The 3 or 5 Position 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.



**Color Codes For Extension Cables and Switching Attachment Cables**

Pin 1	BROWN	Pin 5	GREEN
Pin 2	—	Pin 6	BLUE
Pin 3	ORANGE	Pin 7	BLACK
Pin 4	YELLOW	Pin 8	WHITE

## 5. TROUBLESHOOTING AND REPAIR

It is strongly recommended that every customer keep a small stock of spare transducers on hand along with a Reference Gauge Tube Calibrator.

Always try a new transducer before considering circuit failures. The Reference Transducer Calibrator may be connected to the circuit to prove whether the problem is a transducer or circuit failure. If the instrument works properly with the Calibrator circuit, then transducer failure is a certainty.

### 5.1. Transducer Wiring

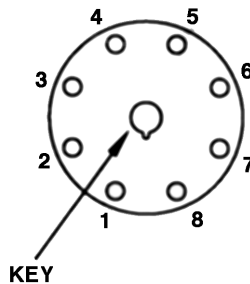
The transducer can be checked with an ohmmeter to verify that the sensor is good. Approximate values are shown below. If they vary widely or are open the transducer may be bad.

between pins 4 & 8      3K to 8K

between pins 6 & 7      4K  $\pm$  1K

between pins 1 & 5      5K  $\pm$  2K

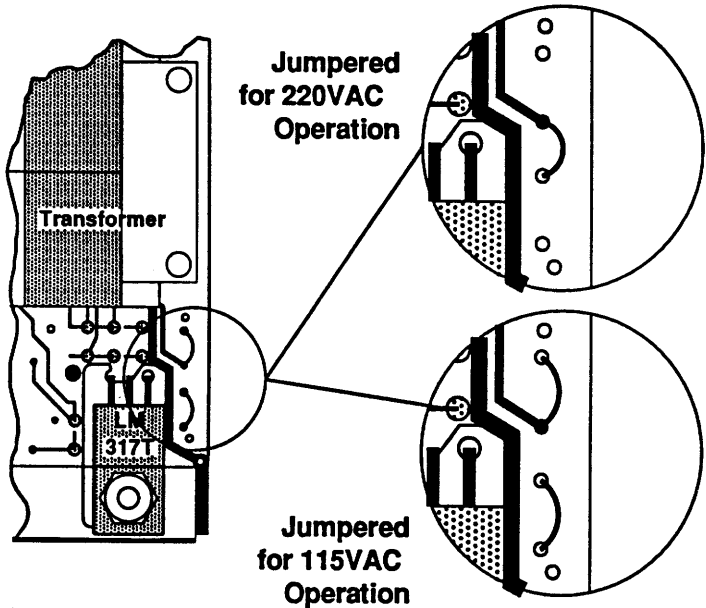
View of Transducer Pins



## 5.2. 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 2 screws in rear of the cylindrical outer cover. Slide the cover back, completely away from the circuit boards. Locate the four pads on the edge of the circuit board where the power cord comes to the circuit board.

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.



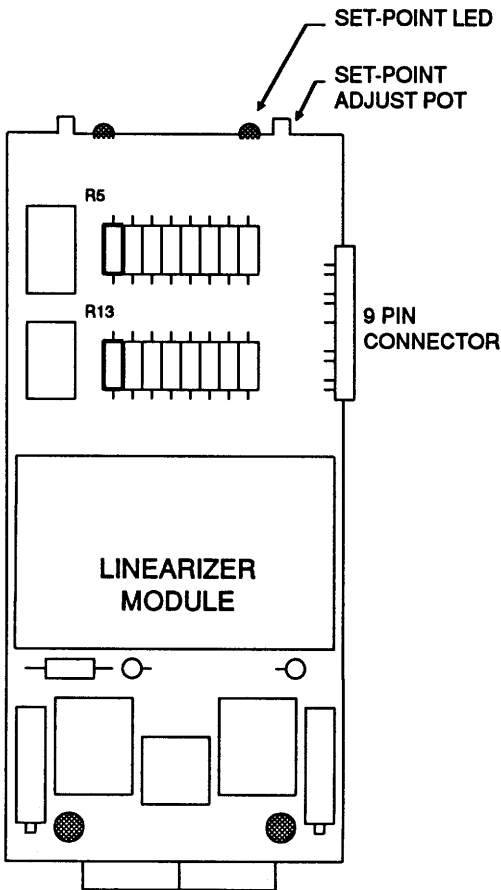
Clip the jumpers close to the pads and install new jumper(s) to change to the desired configuration.

## 5.3. 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.

Our standard gauges are shipped without a resistor in the R-5 position in the high relay circuit and without a resistor in the R-13 position in the low relay circuit. This produces about  $\pm 1$  digit hysteresis.

Installing resistor values as shown in the table will increase the hysteresis. Keep in mind that these are digits, not mTorr, Torr, or any other pressure unit.  $\pm 10$  digits is  $\pm 10$  mTorr on a 2000 mTorr full scale instrument. On an instrument with full scale of 20.00 Torr  $\pm 10$  digits is  $\pm 1.0$  Torr. The set point is always in the middle of the hysteresis band. For example, a 20.00 Torr gauge with a set point of 15.00 Torr and a hysteresis of  $\pm 10$  digits would cause the relay to change state at 15.10 Torr and 14.90 Torr.



R-5 and/or R-13 Resistors	
Resistance Value	Hysteresis Band Width
2 megohm	$\pm 2$ digits
1 megohm	$\pm 3$ digits
700 K ohm	$\pm 5$ digits
500 K ohm	$\pm 7$ digits
365 K ohm	$\pm 10$ digits
250 K ohm	$\pm 15$ digits
200 K ohm	$\pm 20$ digits
160 K ohm	$\pm 50$ digits
80 K ohm	$\pm 100$ digits

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## 6. WARRANTY AND RETURN PROCEDURE

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### 6.1. Warranty Statement

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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

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

## 7. PARTS AND ACCESSORIES

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### Digital Indicator and Controller

**Dual Set Point Controller With Digital Display** in *1/4 DIN enclosure*. Included are 2 adjustable set points with SPDT relays. Contacts rated 3 Amps up to 220 VAC non-inductive. 10 ft (3 m) sensor head cable, power line cord jack screws for panel mounting. 0 to 10 VDC analog output. Built to CSA standards. Sensor not included. P/N:902226

**Digital Indicator only** in *1/4 DIN enclosure*. Includes 10 ft (3 m) sensor head cable, power line cord, jack screws for panel mounting. 0 to 10 VDC analog output. Built to CSA standards. Sensor not included. P/N: 902225

**4 to 20 mA Output** in addition to 0 to 10 VDC analog output. P/N: V801082

**Calibrator for 0.5 to 1200 Torr Instruments** . P/N:912300

### 1200 Torr Sensor Heads, 316 SS Diaphragms

**Sensor Heads with Stainless Steel Diaphragm**. outer case and wetted parts 316 L stainless steel. Connector pins are nickel plated Kovar. Maximum bake-out temperature 100 °C.

**1200 Torr Head, SS Diaphragm, 1/4 in. NPT**. P/N:912261

**1200 Torr Head, SS Diaphragm, VCR-8 Female**, P/N:912262

**1200 Torr Head, SS Diaphragm, VCR-4 Female**, P/N: 912263

**1200 Torr Head, SS Diaphragm, NW-16 Flange**, P/N:912264

**1200 Torr Head, SS Diaphragm, NW-25 Flange**, P/N:912265

**1200 Torr Head, SS Diaphragm, 1.33 in. Conflat®**, P/N:912266

**1200 Torr Head, SS Diaphragm, 1/2 in. OD Tube**, P/N:912267

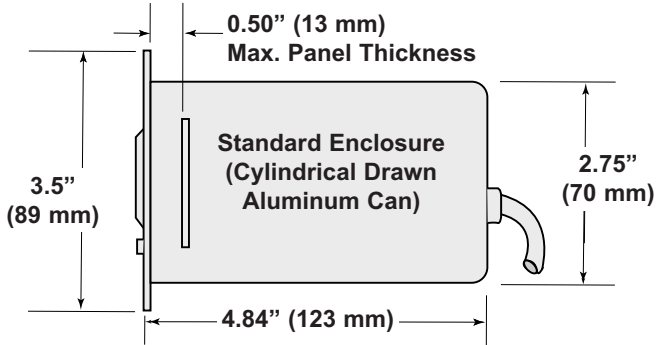
#### **1200 Torr Head with All Stainless External Parts**

for outdoor applications or wherever the use of all stainless steel is appropriate. All external parts are 316 SS except connector pins which are 304 SS. Add SS suffix to sensor P/N

## 8. DIMENSION DRAWINGS

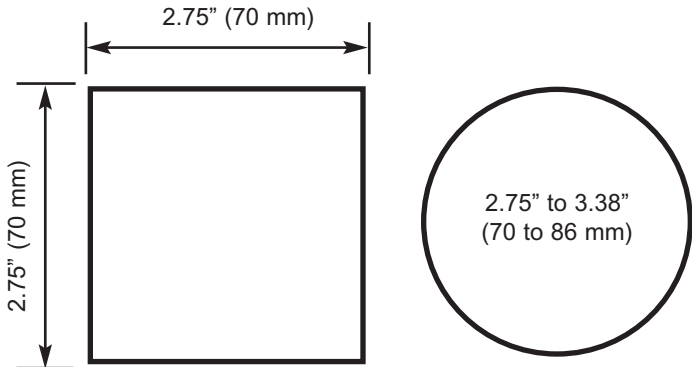
### Standard Enclosure

The standard enclosure has a cylindrical body that fits the same 2.8 inch diameter panel cutout as Hastings, Televac, and other gauges. Panel mounting hardware is included with standard enclosure.



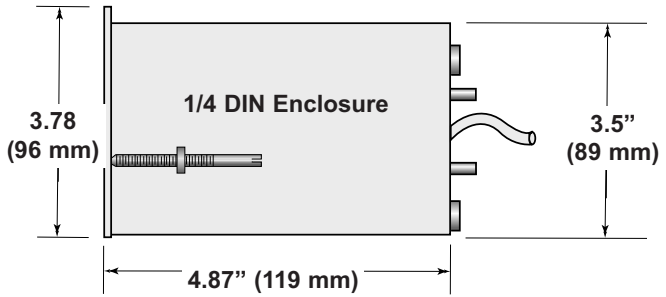
### Panel Cut-out dimensions for

Indicator, Dual Set-Point Controller, and 3 or 5 Position Switch in standard enclosure.



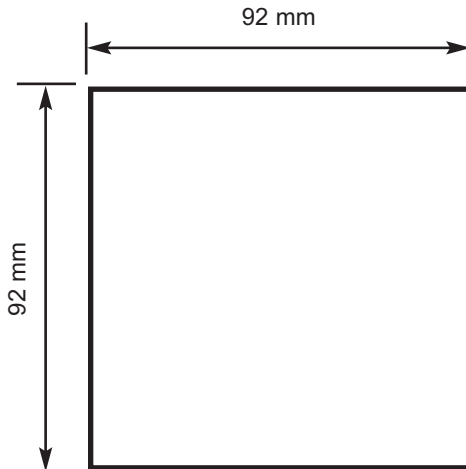
## 1/4 DIN Enclosure

The 1/4 DIN enclosure is rectangular and fits the standard 92mm x 92mm panel cutout. Panel mounting jackscrews are included with 1/4 DIN enclosure.

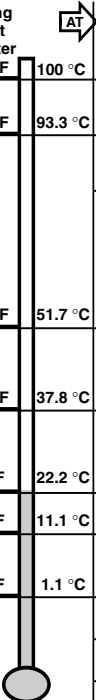


## Panel Cut-out dimensions

for Indicator, Dual Set-Point Controller, and 3 or 5 Position Switch in 1/4 DIN enclosure.



## Vacuum / Dehydration Chart

Boiling Point of Water		Inches Hg Vacuum*	MICRONS (milliTorr) (Absolute)	Torr & mm Hg (Absolute)	mbar (Absolute)	Pascal (Absolute)	PSIA (Absolute)
		(Gauge)	(Absolute)	(Absolute)	(Absolute)	(Absolute)	(Absolute)
212 °F	100 °C	0	760,000.	760.	1013	101,357	14.70
200 °F	93.3 °C	6.50	600,000.	600.	800.	80,032	11.50
		15.00	400,000.	400.	533	53,349	7.50
125 °F	51.7 °C	26.00	100,000.	100.	133.3	13,336	2.00
100 °F	37.8 °C	28.00	50,000.	50.	67	6,666	.97
72 °F	22.2 °C	29.00	20,000.	20.	27	2,666	.39
52 °F	11.1 °C	29.46	10,000.	10.	13.3	1,333	
34 °F	1.1 °C	29.69	5,000.	5.	6.6	666.6	
		29.74	1,000.	1.	1.33	133.3	.02
		29.93	1.	.001	.0013	.1333	.0005

\*Because "Inches Hg" is a "Gauge" measurement which uses atmospheric pressure as its reference, the readings at "hard vacuum" change with the local barometric pressure

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