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# PT DIGITAL INDICATOR

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# OPERATING MANUAL

REVISION 3.2 3/2004



**ISO 9001**  
REGISTERED FIRM

I&M002-10110 (PT-Man)

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## SAFETY PRECAUTIONS

A few general guidelines for the selection of pressure measurement instrumentation follow:

**Pressure** – Select a range so that the maximum applied pressure will never exceed the upper range limit.

**Vibration** – Excessive vibration could cause loosening of components resulting in loss of instrument accuracy or failure to provide valid data.

**Pulsation** – Excessive pressure pulsation could result in fatigue failure of the pressure element.

**Temperature** – Operation of the instrument in an environment where temperatures are in excess of design ratings may result in loss of accuracy and failure.

**Process** – Some of the sensor types available for the indicator are designed for use on clean dry air. Use of instruments equipped with these type of sensors on liquids, wet gases or corrosive gases will reduce system accuracy and may cause irreparable sensor damage.

**Hazardous Location** – Only approved explosion proof or intrinsically safe instruments should be used in hazardous locations.

**Electro-Magnetic Interference** – Instruments should not be used in locations where EMI/RFI conditions may cause erroneous performance.

Electronic pressure instruments must be selected in accordance with industry codes and safety practices to avoid the possibility of misuse or misapplication which could result in personal injury or property damage. Personnel responsible for selection and installation should also be familiar with the safety recommendations of ASME B40.100, that apply to elastic pressure elements and their application in general and specific services. ASME B40.100 is available from:

ASME  
345 47th Street  
New York, NY 10017

## SECTION 1.0 GENERAL PRODUCT OVERVIEW

Congratulations! Your new digital pressure indicator provides a wide array of pressure measurement and test capabilities. These products have been designed to furnish individuals responsible for pressure measurement and test activities a powerful tool capable of satisfying the requirements of both field and lab type applications.

This digital indicator incorporates the latest in pressure measurement technology. Each instrument is comprised of a base display unit and either one or two factory installed pressure measurement assemblies.

The base display electronics provide:

- 1) The user interface, via a combination of a liquid

crystal display and a 10 key elastomeric keypad.

- 2) Interface connections for two pressure measurement assemblies. These connections provide an interface capable of communicating with any of the various sensor types and ranges available.
- 3) Digital interface capability via the full function RS232 interface.

Pressure sensor assemblies are available in two basic configurations. These include:

- 1) Specialized low pressure sensing units based on micro-machined variable capacitance sensors. These sensor assemblies are available in ranges from 0.25 inches of water through 200 inches of water in gauge, differential and compound pressure types.
- 2) Piezo resistive strain gauge based sensor assemblies covering ranges from 5 through 10,000 psi. These assemblies are available for the measurement of gauge, absolute, compound pressure types as well as vacuum.

The instruments are powered via an AC adapter provided which each unit. An optional built-in nickel cadmium rechargeable power pack is available for application in which AC power is not available.

The instruments are housed in a custom manufactured, injection molded case. The case is constructed of high impact ABS plastic. This material is non-conductive and is resistant to both chipping and cracking. Panel and bench mount configurations are available.

## 1.1 Product Capabilities Overview

Each Indicator is a fully equipped pressure measurement instrument. Standard product features include the ability to:

**Display:** Single, or optionally dual range pressure measurement display.

**Zero:** Zero displayed pressure measurement value(s) at the push of a button.

**Engineering unit selection:** Select from any of 8 factory programmed engineering units. Dual sensor units can simultaneously display both measurement values in independent engineering unit.

**Programmable damping:** Activate any of 3 factory programmed levels of damping.

**Tare:** Tare the displayed measurement for either one of two installed sensors or both sensors simultaneously.

**Minimum and maximum recall:** Display minimum and maximum pressure value(s) at the push of a button.

**RS232 interface:** RS232 interface can be configured for compatibility with most any application requirement. Allows transmission of measurement data as well as set up the instrument configuration over the RS232 interface.

**Display hold:** Freeze the measurement values on the display at the push of a button.

**Push to print:** Print the pressure measurement value(s) at the push of a key over the standard RS232 interface.

Additional capabilities for instruments equipped with the optional second installed pressure sensor assemblies:

**Dual Measurement Display:** Display the measured values of one or both sensors simultaneously.

**Dual Measurement/Dual Engineering Unit Display:** Display measurement data from two sensors in the same or different engineering units.

**Dual Sensor Differential:** Provide dual sensor differential pressure by automatically subtracting the measurement value of one sensor from the other.

**Two Sensor Addition:** Sum the measurement values of two installed sensors. Allows unit with single absolute pressure sensor assembly to provide measurement data for both sensors in terms of absolute pressure.

## 1.2 Optional Product Features

As previously outlined, the pressure indicator is a fully equipped pressure measurement instrument. Three optional product features are available to enhance the capabilities of the unit. These are:

- 1) **Second Sensor Assembly:** A second sensor assembly can be specified as an option. Any combination of sensors may be specified.
- 2) **Back-lighting of the display:** The liquid crystal display can be provided with back-lighting to enhance readability in low light and high glare areas.
- 3) **Built in rechargeable batteries.** These batteries are capable of powering the instrument for up to 25 hours without use of the back lighting option or for up to 5 hours with continuous use of back lighting.

## SECTION 2.0 THEORY OF OPERATION

The indicator incorporates the latest in electronic, micro-processor and sensor technologies. This combination produces an instrument with extremely versatile performance capabilities. The indicator consists of a host or main unit and either one or optionally two installed pressure measurement assemblies.

### 2.1 Theory of Operation – Base (Display) Unit

The instrument includes one or, optionally, two calibrated sensor assemblies as well as calibrated front end electronics. All pressure measurement calibration data is stored in EEPROM (Electrically Erasable Programmable Read Only Memory) located within the pressure sensor assembly. The pressure sensor assembly produces an output from 0-1 Vdc for pressure inputs from the minimum to the maximum measurement rating of the pressure sensor assembly. The

front end electronics of the main unit “read” the voltage output from the pressure sensor assembly, and then, query the EEPROM in the sensor assembly for the correction factors required to convert the voltage measurement into the appropriate pressure measurement value. Correction factors in the EEPROM correct for non-linearity and thermal effects.

In addition, the main unit provides the application oriented user interface to simplify the use of indicator. All higher level functions, such as: unit select, tare, max/min recall, push to print and so forth are provided for by the capabilities of the microprocessor in the main unit.

### 2.2 Theory of Operation – Low Pressure Sensor Assemblies (Inches of Water Column)

The inches of water pressure measurement assemblies provide specialized low pressure measurement capabilities. These pressure measurement assemblies incorporate a micro-machined silicon variable capacitance sensor. Inside the sensor there is a micro-machined silicon diaphragm. This diaphragm is between two non-moving plates on which metal has been sputtered. The air between the diaphragm and the non-moving plates acts as an insulator.

As pressure or vacuum is applied to the sensor, the diaphragm moves changing the distance between the diaphragm and the fixed plates. This change in distance changes the capacitance of the sensor. It is this variable capacitance that is measured and correlated to pressure or vacuum during the calibration process.

The sensor is connected to an Application Specific Integrated Circuit (ASIC). This ASIC generates linear signal ramp and applies this signal to the top plate of the sensor while a signal of equal intensity but with opposite polarity is applied to the bottom plate.

When the measured pressure is balanced, for example when both ports are opened to atmosphere, the distance between the diaphragm and both of the fixed plates is the same. When this is case, the signal to the top plate is capacitively coupled to the equal and opposite signal applied to the bottom plate. As a result, no signal current will flow through the center plate (diaphragm). When the diaphragm is moved off center by the application of either pressure or vacuum, the excess current flows through the center plate to an input differentiator in the ASIC. The differentiator translates the frequency of the sensor output into a voltage which is scaled over the full scale range of the sensor assembly.

Low pressure sensing assemblies incorporating the micro-machined silicon variable capacitance sensor are available in ranges from 0.25 inches of water through 200 inches of water. These sensors can be configured to provide differential/gauge or compound pressure measurement capabilities. They are designed for use on clean, dry, non-corrosive and non-conductive gases. A complete listing of



the available low pressure sensor assemblies is provided in Appendix C- Product Specifications.

### 2.3 Theory of Operation-Medium and High Pressure (Single Port Sensor Assemblies)

The PSI pressure measurement assemblies incorporate a piezoresistive strain gauge sensor. This technology takes advantage of the fact that, when put under stress, (as with the flexing of a diaphragm under pressure or vacuum) the resistive properties of a piece of silicon will change. In the manufacturing process resistors are deposited in a silicon substrate. The resistors are typically configured in a wheatstone bridge orientation. When positioned in this fashion, the output will be near zero when no pressure (stress) is applied and will increase in a near linear fashion with the application of pressure or vacuum. The reverse side of the substrate is etched to provide the required diaphragm thickness for the given pressure range.

When power is applied to the sensor the level of resistance across the wheatstone bridge will change in proportion to the level of pressure or vacuum applied. The output from the sensor is extremely repeatable and has minimal hysteresis due to the fact that the sensor substrate is silicon. The sensor output is then amplified by circuitry within the pressure sensor assembly to a level of 0-1 Vdc for the full span of the sensor assembly. The amplified output is then calibrated over the operating range of the sensor module. Calibration coefficients for the pressure sensor assembly are stored in EEPROM (Electrically Erasable Programmable Read Only Memory) within the pressure sensor assembly.

Pressure sensor assemblies for PSI measurement ranges are available in ranges from 5 psi through 10,000 psi. These pressure sensor assemblies can be configured to provide the capability to measure gauge, absolute and compound pressures as well as vacuum. PSI sensor assemblies in ranges up to 300 psi are designed for use on clean, dry, non-corrosive and non-conductive gases. Optional 316 stainless steel sensor isolation is available for ranges from 0/10 through 0/300 psi. Ranges from 500 psi through 10,000 psi are provided with 316 stainless steel isolation as standard. A complete listing of the available PSI pressure sensor assemblies is provided in Appendix C- Product Specifications.

### 2.4 Temperature Measurement with Standard RTD Probes

The RTD interface assembly allows the base unit, when used with RTD temperature probes, to provide precision temperature measurement data. The interface assembly is directly compatible with the electronics, replacing or in addition to, a pressure measurement interface. Any standard RTD probe with a Switchcraft TA4M can be plugged into the Switchcraft TA4F connector on the module. The RT1 assembly comes factory programmed with the curves for Pt 100 (385 & 392), Cu 10 and Ni 120 RTD probes. It

supports RTDs with outputs in the range of 0/400 ohms. The RT2 assembly is supplied factory programmed to support the Pt1000 ( 385 & 392) RTD. This module will support RTDs through an output up to 4000 ohms. The RT assemblies can be programmed with coefficients for other RTD probes of interest and specific characteristics of a probe already included in the on-board library can be programmed into the RT assembly to provide enhanced accuracy. Each RT module can accommodate up to 8 different programmed RTD calibration curves. Programming of the RT module is accomplished via an optional software package ( part number 838X014-01 for the 3 1/2 inch disk and any PC compatible computer with an available standard serial communication port.

### SECTION 3.0 UNPACKING

Prior to removing the indicator from the packaging material inspect all cartons for shipping damage. Document any damage evident in the event that a damage claim must be made against the shipper. After inspection, remove the instrument, AC adapter, manual and any accessories purchased from the packaging material. Retain the packaging for use in returning the indicator to the factory for future recalibration or repair.

### SECTION 4.0 SYSTEM START-UP

**Step 1** Locate, unpack and untie the AC adapter.

**Step 2** Looking at the back of the indicator, locate the AC adapter jack on the top right hand corner (looking from the back of the instrument) of the rear panel.

**Step 3** Plug the AC adapter jack into the back of the indicator.

**Step 4** Plug the transformer into an outlet providing the appropriate electrical power. The power requirement is provided on the label of the AC adapter.

**Step 5** Press the Power key on the far left side of the row of keys. The indicator will respond by scrolling through the following start up screens as it performs the initial start up self tests.

**First Screen:**

```
INDICATOR
Mfg Date XX/XX/XX
```

**Second Screen:**

```
range range
xxxxx EUxxxxx EU
```

where:

xxxxx = the full scale range of the sensor assembly installed in the corresponding side of the indicator

EU = the primary or default engineering unit for the sensor assembly installed in the corresponding side of the indicator.

**Notes:**

1- If your indicator has a single installed pressure sensor assembly the pressure measurement data and the engineering unit data will appear centered on the display during normal instrument pressure measurement operations.

2- If your instrument is equipped with the optional rechargeable nickel cadmium batteries the battery pack was charged prior to shipment. While in storage, nickel cadmium batteries have a discharge rate of approximately 1% per day. If your instrument has been in storage for any extended period prior to being unpacked it is recommended that the nickel cadmium batteries be recharged prior to use of the indicator. When the indicator is connected to line power through the AC adapter the batteries will automatically recharge. While connected to line power, the batteries will be recharged whether the instrument is in use or not. Battery recharge time is 12-14 hours from a completely discharged state to a fully charged state. The instrument can be left connected to line power indefinitely without damaging the batteries.

**SECTION 5.0 SHIFT FUNCTIONS (Shift Key)**

There are two classes of functions accessible through the front panel of the indicator. These are primary functions and secondary functions. Due to the extensive capabilities of the indicator four keys are dual function keys, providing access to two capabilities. Secondary functions are accessed by pressing the shift key prior to pressing the key that will activate the desired secondary function. In all cases, the primary function of a key is the function performed when the key is pressed without first pressing the shift key. Single function keys and the primary position on dual function keys are used for the most frequently required digital indicator functions. Functions are accessed by pressing the key or combination of keys indicated below.

**Note:**

The shift key need only be pressed once during a given set up activity. Once the desired set up function has been activated via the shift key, selection of the desired menu option is done simply by pressing the function key, as required, to highlight the desired set up configuration. The indicator will stay in the shift mode until the desired selection is made through the use of the enter key.

Function	Activity	Accessed By Pressing Key
Power	Turn unit on	POWER
Zero	Zero sensor(s)	ZERO
Shift	Access secondary functions	SHIFT

Unit	Select engineering unit(s)	UNIT/PORT
Port Select	Select port configuration	SHIFT then UNIT/PORT
Tare	Tare pressure preload	TARE/DAMP
Damp	Set Level of Damping	SHIFT then TARE/DAMP
Max/Min	Recall Max/Min values	MAX/MIN OUTPUT
Output	Setup output configuration	SHIFT then MAX/MIN/OUTPUT
Backlight Display	Lighting display	LITE
Battery Check	Checking battery power level	SHIFT then BATT/LITE
Enter	accepting set up option highlighted on display	ENT
Freezing Display	Locking measured values on display	HOLD
Push To Print	Printing measured values on demand	PRINT

\* The RS232 interface must be configured in the print protocol and the indicator must be configured in the same communications format as the recorder to print the measurement data for the push to print function to operate. Details on setting up the push to print function are included in Section 13.3 Set Up for Print Protocol.

**SECTION 6.0 THE ENTER FUNCTION (ENT Key)**

There are various set up functions which require a selection from a menu of available performance parameters. These set up functions include selection of the desired:

- Engineering Unit(s)
- Port or Display Configuration
- Level of Damping
- Configuration of RS232 Interface

The ENT key is used to select the highlighted configuration or operating parameter. Proper use of the ENT key is included, as required, in each of the following sections.

**SECTION 7.0 THE PORT SELECT FUNCTION (PORT Key)**

As an optional feature the indicator can be equipped with two pressure sensor assemblies.

**NOTE: The PORT select function is a secondary set up function and requires that the shift key be pressed**



**prior to pressing the UNIT/PORT key to activate the port selection function.**

In units with the dual installed sensor option the UNIT/PORT key allows the operator to configure the instrument display to show either sensor, independently on the display, or to simultaneously display the measured values from both sensors. For use of the PORT function in indicators with two installed sensors proceed to Section 7.1 Setting Instrument Configuration with the Port key.

The standard indicator is supplied with a single pressure sensor assembly. In these instruments, if the SHIFT key is pressed followed by pressing the PORT key the indicator will display:

```
2nd Pressure
Module Required
```

After displaying the above message the indicator will automatically resume pressure measurement.

### 7.1 Setting Instrument Configuration with the Port Select Key (PORT Key)

This section only applies to indicators equipped with the optional second sensor assembly.

**Step 1** Press the SHIFT key one time. After pressing the shift key an upward pointing arrow will appear on the display as follows.

```
^
```

**Step 2** Press the PORT key. If the indicator has the optional 2nd installed pressure sensor assembly pressing the PORT key will result in the following message display:

```
Left Right Both
L-R R-L L+R
```

**Note:** The current configuration will be the default configuration and will flash on the display.

**Step 3** Press the PORT key the number of times required to activate the desired measurement display configuration. The SHIFT key should not be pressed after the port selection menu has been activated. Each time the PORT key is pressed the next port configuration will be highlighted on the display and will flash.

#### Selection Result

- Left: activates the left sensor and side of the indicator display.
- Right: activates the right sensor and side of the indicator display.
- Both: activates both sensors and both sides of the display.
- L-R: produces display of the differential of the left minus the right measured values.

R-L: produces display of the differential of the right minus the left measured values.

R+L produces the display of the sum of the measurements of the two installed sensors.

**Step 4** With the desired display configuration flashing press the enter key (ENT). After pressing the enter key the indicator will begin displaying the measurement values in the desired configuration.

**Note:** The left side of the display presents the pressure measurement data generated from the pressure sensor assembly installed in the left side of the indicator. The right side of the display presents the pressure measurement data from the sensor assembly installed in the right side of the indicator.

## SECTION 8.0 ZEROING THE INSTRUMENT

Upon instrument start up it is possible that gauge, compound, differential and vacuum measurement sensor assemblies may display a slight zero offset. In most cases this offset will diminish or even disappear as the instrument warms up. **Therefore, it is recommended that the instrument be zeroed prior to use or calibration.** Upon power up, absolute pressure sensors will display measured values representing the current barometric pressure. Resetting zero for pressure sensor assemblies can be accomplished by adhering to the methods detailed in the subsequent sections.

**Step 1** Gauge, vacuum, compound and differential sensors must be vented to atmosphere prior to initiating the zero process. Be certain any pressure connections to the sensor to be zeroed are vented to atmosphere prior to zeroing the pressure sensor assembly.

Absolute sensors must be connected to an evacuated reference. It is recommended that a reference pressure of less than 50 microns be generated for zeroing absolute sensor assemblies. A vacuum pump and a vacuum gauge are required to accurately zero an absolute pressure sensor assembly.

**Note: The zero key can zero out as much as a  $\pm 4\%$  deviation from initial calibration parameters. If zero is attempted with a zero offset greater than  $\pm 4\%$  present the following error message will appear.**

```
TOO MUCH
Offset
```

This protects from accidental zeroing of absolute pressure sensor assemblies. If this message appears and the sensor is appropriately vented to atmosphere (for gauge, vacuum, compound and differential sensors) or connected to an evacuated reference for absolute sensors, the sensor may have been damaged due to exposure to improper media or over pressure. In this case the sensor should be recalibrated, if possible, or returned to the factory for evaluation and repair.

The zero procedures for the different display configura-

tions of the indicator appear in the sections as shown below. In order for these procedures to provide the desired results the operator must have already set up the instrument sensor assemblies to be zeroed in accordance with the instructions outlined in the appropriate subsection of Section 8.

Section	Description
8.1	For zeroing any installed sensors on power up.
8.2	Zeroing any installed sensor assemblies in normal operation.
8.3	Zeroing either one of two installed sensors in indicator.

**Important Note: The zero key will zero any sensor assemblies that are active on the display. The Zero key must be pressed and held for 2 seconds to zero the indicator. If the instrument has two installed pressure sensor assemblies, and the measurement values from both of the installed assemblies are displayed on the indicator, pressing the zero key will simultaneously zero both measurement values. Section 8.3 details how to zero either one of two installed sensor assemblies.**

### 8.1 Zeroing All Installed Pressure Sensor Assemblies On Power UP

When initially turned on the indicator will commence measuring pressure from any installed pressure sensor assemblies. The sensor assembly is installed in the left side of the instrument if one sensor assembly is ordered. As such, on initial power up when the instrument begins displaying pressure measurement data, the display will look as follows.

```

PSI
+12345
(centered on display)

```

If the indicator was purchased with the optional second pressure sensor assembly the display, on power up, will look as follows.

```

PSI      PSI
+12345  +12345

```

**Note:** The indicator will always commence pressure measurement in the default engineering unit(s) for any installed pressure measurement assembly. Default engineering units are; psi for all medium and high pressure ranges (single pressure port) and inches of water column for low pressure sensor assemblies (dual pressure port).

**Step 1** To zero all installed pressure sensor assemblies press the ZERO key and hold for 2 seconds after the initial start-up sequence is completed. As shown below, the indicator will respond by zeroing out any displayed pressure measurement.

```

PSI      PSI
00000  00000

```

### 8.2 Zeroing All Installed Pressure Sensor Assemblies In Normal Operation

This section only applies to indicators equipped with the optional second sensor.

As outlined in Section 8.0, the measured values of a sensor must be shown on the display of the indicator in order for the sensor assembly to be zeroed. If one of the two installed sensors has been de-activated the deactivated sensor must be reactivated (returned to the display) in order for the zero procedure to work for that sensor.

The following procedure details the method used to restore both installed sensor assemblies to the display for zeroing.

**Step 1** Press the SHIFT key one time. After pressing the shift key an upward pointing arrow will be added to the display as follows.

```

^

```

**Step 2** Press the PORT key. If the indicator has the optional 2nd installed pressure sensor assembly pressing the PORT key will result in the following message display.

```

Left Right Both
L-R  R-L  L+R

```

**Note:** The current configuration will be the default configuration and will flash on the display. In this example the indicator is only displaying the measurement data from the pressure sensor assembly installed in the left side of the indicator.

**Step 3** Press the PORT key the number of times required to highlight the word “both” in the configuration menu. In this example the PORT key would be pressed two times. The word both will flash when highlighted. Each time the PORT key is pressed the next display configuration will be highlighted on the display and will flash.

```

Left Right Both
L-R  R-L  L+R

```

**Step 4** With the word both flashing on the display press the enter key (ENT). After pressing the enter key the indicator will begin displaying the measurement for both installed sensor assemblies as shown.

```

PSI      PSI
+12345  +12345

```

**Step 5** To zero both installed pressure sensor assemblies, press the ZERO key and hold for 2 seconds while the measured outputs from both sensors are shown on the display. Pressing the zero key with the output from both installed sensors shown on the display will simultaneously zero both sensors as shown below.

```

PSI PSI
0.0000 0.0000

```

After the zero procedure has been completed the indicator will automatically resume pressure measurement activities.

### 8.3 Zeroing Either of Two Installed Pressure Sensor Assemblies

The following section applies only to indicators equipped with the optional second pressure sensor assembly.

The zero function will only zero the measurement values that are shown on the display. If the objective is to zero one of two installed pressure sensor assemblies it will be necessary to deactivate (remove from the instrument display) the measured values for the sensor assembly not being zeroed. The following steps detail the methodology for zeroing one of two installed pressure sensor assemblies.

**Step 1** Determine which sensor assembly is to be zeroed.

**Note:** The measured value from a sensor assembly always appears on the side of the display that corresponds to the side of the instrument in which the sensor assembly is installed.

**Step 2** Press the Shift key to allow access to the port select function. After the Shift key has been pressed the indicator will respond by adding an upward pointing arrow to the display as follows.

```

^ PSI PSI
0.0000 0.0000

```

**Step 3** Press the PORT key to activate the port select function. Pressing the PORT key will result in the following configuration options being displayed on the indicator.

```

Left Right Both
L-R R-L L+R

```

Since the indicator is set up to display the measurement values from both installed pressure sensor assemblies the word “both” will flash on the display.

**Step 4** With the port select configuration options displayed, press the port key the number of times required to leave only the measured output for the sensor assembly to be zeroed visible on the display. For example, if the left side of the display is to be zeroed and the right side is not to be zeroed press the PORT key four (4) times, the number of times necessary to highlight the word left from a starting configuration of both.

```

Left Right Both
L-R R-L L+R

```

**Step 5** With the appropriate selection highlighted and flashing (left in this example) press the enter key (ENT). The indicator will respond by changing the display so that only the measured value from the sensor in the left side of the indicator is displayed.

```

PSI -----
+12345 -----

```

**Step 6** With the measurement data for the pressure sensor assembly to be zeroed displayed and the other side of the display blanked out, press the ZERO key and hold for 2 seconds.

The indicator will respond by zeroing the displayed pressure reading as shown below.

```

PSI-----
00000-----

```

**Step 7** To return the measurement values for the sensor installed in the right side of the instrument case to the display, press the shift key once. The indicator will respond by adding the upward pointing arrow to the display as follows.

```

^ PSI -----
00000-----

```

**Step 8** With the shift function active, as shown by the display of the upward pointing arrow, press the PORT key once. The indicator will respond by displaying the port select configuration menu:

```

Left Right Both
L-R R-L L+R

```

**Step 9** Press the PORT key the number of times required to highlight the word “both”. When highlighted the word “both” will flash.

```

Left Right Both
L-R R-L L+R

```

**Step 10** With the word “both” flashing press the enter key (ENT). The indicator will respond by displaying the measured values from both installed sensor assemblies. The measured value from the left sensor will be zeroed and the value from the right sensor assembly will retain the previous zero offset.

```

PSI PSI
+00000 +12345

```

### SECTION 9.0 SELECTING ENGINEERING UNITS

The digital pressure indicator provides the ability to choose any of the 12 factory programmed engineering units. As with the zero function, the engineering unit selection function will only effect the measured values shown on the display. To change the engineering unit for a given pressure sensor assembly measurement the sensor assembly must be active (shown on the display). For units with the optional second sensor this allows for simultaneous change of the displayed engineering unit for both installed sensor assemblies as well as for the selection of different engineering units for each installed pressure sensor assembly.

## 9.1 Changing the Engineering Unit On Indicators with One Installed Pressure Sensor

The following procedure should be followed for changing the engineering unit of measure in indicators that have one installed pressure sensor assembly.

**Step 1** With the indicator on and displaying pressure measurement data press the key labeled PORT/UNIT. The indicator will respond by displaying the factory programmed engineering unit library as follows.

```
PSi  "HG  "WC  ftSW
BAR  mBAR  kPa  MPa
```

the second screen accessed after scrolling through the first engineering units follows as:

```
mmHg  cmWC  mmWC  KSCM
```

where:

Unit	Description
psi	pounds per square inch
"Hg	inches of mercury (@ 0°C)
"W	Cinches of water (@ 20°C)
ftSW	feet of seawater Bar Bar
mBar	millibar
kPa	kilopascals
mPa	megapascal
mmHg	millimeters of mercury (@ 0°C)
cmWC	centimeters of Water (@ 20°C)
mmWC	centimeters of Water (@ 20°C)
Kgcm	kilograms per square centimeter

The engineering unit library is automatically presented with the current engineering unit highlighted (flashing) on the display of the indicator. In this example the engineering unit currently in use is psi.

**Step 2** To select the desired engineering unit, repeatedly press the UNIT key to scroll through the on-board engineering unit library. In this example, we will change from psi to inches of water by pressing the unit key three times to highlight the text "'WC".

**1st screen**

```
PSi  "HG  "WC  ftSW
BAR  mBAR  kPa  MPa
```

**2nd screen**

```
mmHg  cmWC  mmWC  KSCM
```

**Step 3** With the text "'WC" flashing press the enter key. The indicator will respond by resuming the function of pressure measurement in the selected engineering unit.

```
"WC
+12345
```

(centered on display)

## 9.2 Simultaneously Changing the Engineering Unit for Two Installed Pressure Sensor Assemblies.

This section applies only to indicators equipped with the optional second pressure sensor assembly.

If the measured values from both installed pressure sensor assemblies are active (shown on the display) selecting a new engineering unit will simultaneously change both sides of the pressure display to the new unit of measure.

If either of the installed sensor assemblies has been deactivated (removed from the display via the port select function) it must be restored prior to initiating the change of engineering unit function. Follow the steps below to restore both measured values to the display and simultaneously change the engineering unit for both pressure sensor assemblies. If both sensors are active (measurement values shown on the display) skip to step 4.

**Step 1** With the indicator on and displaying pressure measurement data, press the SHIFT key to activate the shift function and allow access to secondary functions. The indicator will respond by adding an upward pointing arrow to the data currently seen on the display.

```
^ PSi
+XXXXXX
```

**Step 2** With the upward pointing arrow visible on the display of the indicator press the PORT key to activate the port select function. Pressing the Port key will result in the following configuration options being displayed on the indicator.

```
Left  Right  Both
L-R   R-L    L+R
```

The current configuration in use will automatically flash when the port select menu is activated. In this example, the measurement values from the left pressure sensor are being displayed on the indicator.

**Step 3** Once the port select function is activated press the PORT key the required number of times to highlight the word both from the list of port select options.

For this example the PORT key would be pressed two times to highlight the word "both".

```
Left  Right  BOTH
L-R   R-L    L+R
```

**Step 4** With the word "both" highlighted and flashing press the enter key (ENT). The indicator will respond by displaying the measured outputs from both of the installed sensor assemblies in the engineering unit(s) that are currently in use. In this case, the measurement values from both of the installed pressure sensor assemblies are being displayed in terms of psi.

```
PSi      PSi
+12345   +12345
```

**Step 5** To change the engineering unit for both the displayed values press the key designated UNIT with both measured outputs shown on the display. The indicator will respond by displaying the factory programmed engineering unit library as follows.

**1st screen**

```
PSI  "HG  "WC  ftSW
BAR  mBAR  kPa  MPa
```

**2nd screen**

```
mmHg  cmWC  mmWC  K9cm
```

where:

Unit	Description
psi	pounds per square inch
"Hg	inches of mercury (@ 0° C)
"WC	inches of water (@ 20° C)
ftSW	feet of seawaterBarBar
mBar	millibar
kPa	kilopascals
mPa	megapascal
mmHg	millimeters of mercury (@ 0° C)
cmWC	centimeters of Water (@ 20° C)
mmWC	centimeters of Water (@ 20° C)
Kgcm	kilograms per square centimeter

The unit currently in use will flash on the display. In this example the unit psi will flash on the display.

**Step 6** With the engineering unit library activated select the desired unit of measure by pressing the UNIT key the number of times necessary to highlight the engineering unit of choice. When highlighted the unit of measure will flash. Each time the UNIT key is pressed the next unit on the list will be highlighted.

For the example here we will select "Hg as the engineering unit of choice. The UNIT key would be pressed one time to change from psi to "Hg.

**1st screen**

```
PSI  "HG  "WC  ftSW
BAR  mBAR  kPa  MPa
```

**2nd screen**

```
mmHg  cmWC  mmWC  K9cm
```

**Step 7** With the desired engineering unit highlighted, "Hg in this example, and flashing, press the enter (ENT) key. As shown, the indicator will respond by altering the display to present pressure measurement data for both sensors in terms of "Hg.

```
"HG      "HG
+12345  +12345
```

**9.3 Changing the Engineering Unit for Either of Two Installed Sensor Assemblies**

This section only applies to indicators equipped with the optional 2nd pressure sensor assembly.

**Step 1** With the indicator on and displaying pressure measurement data, determine which sensor assembly is to be changed to the new unit of measure.

**Note:** The measured value from a sensor always appears on the side of the display that corresponds to the side of the instrument in which the sensor assembly is installed.

**Step 2** Press the SHIFT key to activate the shift function and allow access to secondary functions. The indicator will respond by adding an upward pointing arrow to the data currently seen on the display.

```
^ PSI      PSI
+XXXXXXX +XXXXXXX
```

**Step 3** Press the PORT key to activate the port select function. Pressing the PORT key will result in the following configuration options being displayed on the indicator.

```
Left Right Both
L-R  R-L  L+R
```

In this example, since the measurement values from both pressure sensor assemblies are actively being shown on the display the word both will automatically flash when the port select menu is activated.

**Step 4** With the port select function activated, press the PORT key the required number of times to deactivate (remove from the display) the measured output from the sensor assembly that is to remain in the current engineering unit.

For example, if the left side of the display is to be changed from psi to kPa and the right side is to remain in psi the PORT key would be pressed three times (the number of times necessary to change the highlighted word from the word "both" to the word left from the list of port select options.

```
Left Right Both
L-R  R-L  L+R
```

**Step 5** With the appropriate selection highlighted and flashing (left in this example) press the enter key (ENT). The indicator will respond by displaying following.

```
PSI  -----
+12345 -----
```

**Step 6** With the side of the display to be changed to the new engineering unit active (shown on the display) and the other side of the display deactivated (blanked out) press the UNIT key. The indicator will respond by displaying

**1st screen**



```
PSI 449 4WC ftSW
BAR MBAR KPA MPA
```

## 2nd screen

```
MMH3 CMWC MMWC KSCM
```

**Note:** when activated, the engineering unit in effect for the active sensor will flash in the engineering unit library.

**Step 7** With the engineering unit library on the display continue to press the UNIT key until the engineering unit to be selected is highlighted. In this case pressing the UNIT key 4 times will change the highlighted engineering unit from psi to Bar.

## 1st screen

```
PSI 449 4WC ftSW
BAR MBAR KPA MPA
```

## 2nd screen

```
MMH3 CMWC MMWC KSCM
```

**Step 8** With the desired engineering unit high-lighted (flashing) on the display press the enter (ENT) key. The indicator will respond by converting the pressure displayed on the left side of the display to kPa as shown below.

```
BAR -----
+12345 -----
```

**Step 9** To restore the right side of the display to the active state, in the original psi unit press the SHIFT key once to provide access to the secondary set up functions. The indicator will respond by adding an upward pointing arrow to the previous screen as shown here.

```
^ BAR-----
+12345 -----
```

**Step 10** Press the PORT key. The indicator will respond by displaying.

```
Left Right Both
L-R R-L L+R
```

Since the left port is the only one active it will be high-lighted and flashing when the port configuration menu is displayed.

**Step 11** Press the PORT key the number of times required to activate the desired display configuration (2 times in this case to highlight the word both).

```
Left Right Both
L-R R-L L+R
```

**Step 12** With the desired configuration displayed press the enter (ENT) key. The indicator will respond by displaying the following.

```
BAR PSI
+12345 +12345
```

Using the engineering unit and the port select functions in tandem any combination of available units and display location can be arranged.

## SECTION 10.0 THE TARE FUNCTION

Use of the tare function allows the indicator to be set up to subtract a pressure pre-load from the measured value. This is often used for applications such as:

- weighing applications where the pressure exerted by the platform or container is to be subtracted from the measurement
- Where an absolute pressure measurement sensor is to be used for short term gauge pressure measurement activities.

As with the zero function, the tare function will only effect the measured values shown on the display. To tare out a pressure preload the pressure sensor measuring the preload must be active (shown on the display). This allows for simultaneous taring of both installed sensor assemblies as well as for the taring of either one of two installed pressure sensor assemblies.

**Important Note:** The full scale range of a sensor is not changed when a sensor assembly is in the tare mode. For example, if a 100 psi sensor is tared with a pressure preload of 15 psi the remaining usable measurement span is 85 psi. With 15 psi tared out on a 100 psi sensor the measured values will exceed the rated range of the sensor at 85 psi. Since all sensors are programmed to display OR when the measured pressure exceeds 110% of the sensor span in this case the indicator will read OR when the measured value exceeds 95 psi (85 psi + 10% of the 100 psi range of the sensor which is 10 psi).

### 10.1 Using the Tare Function On An Indicator with a Single Installed Pressure Sensor

**Step 1** With the indicator on and displaying pressure measurement data press the key labeled DAMP/TARE. The indicator will respond by adding a small T to the display to indicate that the instrument is in the tare mode. When initially placed in the tare mode, the display of the indicator will show a "zero" pressure measurement until the measured value changes from the measurement value at the time the tare function was activated.

```
T PSI
+000000
```

**Step 2** To exit the tare mode press the TARE key again. The indicator will resume the function of basic pressure measurement (untared).

### 10.2 Using the Tare Function to Simultaneously Tare Two Installed Pressure Sensors

This section only applies to instruments with the optional 2nd pressure sensor installed.

If the measured values from both installed pressure sensor



assemblies are active (shown on the display) pressing the TARE key one time will simultaneously tare both sides of the pressure display.

If either of the installed sensor assemblies have been deactivated (removed from the display via the port select function) it must be restored prior to initiating the tare function. Follow the steps below to restore both measured values to the display and simultaneously tare both sensor assemblies. If both pressure sensor assemblies are active (measurement values are visible on the display) skip to step 5 of this procedure.

**Step 1** With the indicator on and displaying pressure measurement data press the SHIFT key to activate the shift function and allow access to secondary functions. The indicator will respond by adding an upward pointing arrow to the data currently seen on the display.

**Step 2** Press the PORT key to activate the port select function. Pressing the PORT key will result in the following configuration options being displayed on the indicator.

```

Left  Right  Both
L-R   R-L   L+R

```

**Step 3** With the port select function activated press the PORT key the required number of times to highlight the word both from the list of port select options. Each time the PORT key is pressed the next port select configuration will be highlighted and be available for selection.

```

Left  Right  Both
L-R   R-L   L+R

```

**Step 4** With the word "both" highlighted and flashing press the enter key (ENT). The indicator will respond by displaying the measured outputs from both of the installed sensor assemblies as shown below.

```

PSI      PSI
12345    12345

```

**Step 5** To tare both the displayed values press the TARE key with both measured outputs shown on the display. The will respond by displaying.

```

^ PSI    ^ PSI
+00000  +00000

```

**Note:** The T will appear to the upper left of the pressure measurement being conducted in the tare mode for as long as the indicator is in the tare mode.

**Step 6** To discontinue the tare mode of operation press the TARE key a second time. The tare function will be discontinued and the indicator will discontinue subtracting the value of the pressure preload from the displayed pressure measurement.

```

PSI      PSI
+12345   +12345

```

### 10.3 Taring Either of Two Installed Pressure Sensor Assemblies

This section only applies to indicators equipped with the optional 2nd pressure sensor assembly.

**Step 1** Determine which sensor assembly is to be tared.

**Note:** The measured value from a sensor always appears on the side of the display that corresponds to the side of the instrument in which the sensor assembly is installed.

**Step 2** With the indicator on and displaying pressure measurement data press the SHIFT key to activate the shift function and allow access to secondary instrument functions. The indicator will respond by adding an upward pointing arrow to the data currently seen on the display.

**Step 3** With the upward pointing arrow visible on the display press the PORT key to activate the port select function. Pressing the Port key will result in the following configuration options being displayed on the indicator.

```

Left  Right  Both
L-R   R-L   L+R

```

**Step 4** With the port select function activated press the PORT key the required number of times to leave activated (on the display) only the measured output from the sensor assembly that is to be tared. For example, if the left side of the display is to be tared and the right side is not to be tared press the PORT key the number of times necessary to highlight the word left from the list of port select options.

```

Left  Right  Both
L-R   R-L   L+R

```

**Step 5** With the appropriate selection highlighted and flashing (left in this example) press the enter key (ENT). The indicator will respond by displaying following.

```

PSI      -----
+12345   -----

```

**Step 6** With the measurement value to be tared on the display and the other side of the display deactivated (blanked out) press the TARE key. The indicator will respond by taring out the displayed value. The tared value will flash on the display.

```

^ PSI -----
+00000 -----

```

**Note:** The T will appear to the left of the pressure measurement being conducted in the tare mode. If desired, the pressure measurement value from the right sensor can be returned to the display untared through the following process.

**Step 7** Press the SHIFT key to activate the shift function and allow access to secondary instrument functions. The

indicator will respond by adding an upward pointing arrow to the data currently seen on the display.

```

^ PSI -----
+00000 -----

```

**Step 8** With the upward pointing arrow visible on the display press the PORT key to activate the port select function. Pressing the Port key will result in the following configuration options being displayed on the indicator. In this example, the word "left" will be highlighted and flash on the display because when we entered this process only the left pressure sensor assembly was active (measurement values visible on the display)

```

Left Right Both
L-R  R-L  L+R

```

**Step 9** With the port select function activated press the PORT key the required number of times, 2 for this example, to highlight the word "both".

```

Left Right Both
L-R  R-L  L+R

```

**Step 10** To activate (bring to the display) the measurement values from both installed pressure sensor assemblies with the word "both" flashing, press the enter key (ENT). The indicator will respond by displaying the following information.

```

^ PSI     PSI
+00000  +12345

```

**Step 11** When exiting the tare mode, only the measured values currently being tared can be on the display. Therefore, to exit the tare mode, when one of two installed sensor assemblies is in the tare mode the measured value that is not being tared must be disabled (removed from display) using the PORT function. When, only the measurement value that is in the tare mode is active, press the TARE key. As shown below, the indicator will disable the tare function, including removing the T from upper left hand corner of the display.

```

PSI     -----
+12345  -----

```

After the tare function has been disabled the second sensor can be restored to the display in the untared mode by selecting "both" from the PORT function setup menu.

**SECTION 11.0 DAMPING FUNCTION**

The damping function provides the ability to stabilize the displayed or transmitted pressure value by minimizing the effects of low level pressure transients and electronic instability. Damping is a secondary function and, therefore, requires the use of the shift key to set up and implement.

The level of damping is set up through a damping menu activated by pressing the shift key and then pressing the TARE/DAMP key.

Damping accomplishes the stabilization of the pressure measurement value by producing an averaged pressure value which is shown on the display and available for transmission over the RS232 interface. When damping is not activated the indicator takes a new pressure value over 130 mS (7.5 times per second) and updates the display. If required, this same measurement data is also available for transmission over the RS232 interface.

When damping is activated the measurement value displayed and/or transmitted is an average value. With damping invoked the displayed value will be the average measured value over either the last 4, 8 or 16 consecutive readings.

The following are the available levels of damping.

Level	Effect
OFF	Zero damping no effect New every 130 mS, not averaged
LOW	Averages 4 consecutive readings Represents readings over 0.4 seconds
MEDIUM	Averages 8 consecutive readings Represents readings over 0.8 seconds
HIGH	Averages 16 consecutive readings Represents readings over 1.6 seconds

Programming and initiating the damping function is accomplished as detailed in Section 11.1

**NOTE:** This note only applies to instruments equipped with the optional 2nd pressure sensor assembly.

Damping is a universal function. This means that the level of damping in use will be applied to any pressure measurement value transmitted or displayed by the indicator. Damping cannot be enabled for one of two installed pressure sensor assemblies. In addition, different levels of damping cannot be programmed for each installed sensor.

**11.1 Setting, Activating & Disabling The Damping Function**

**Step 1** Press the SHIFT key one time. The indicator will respond by adding an upward pointing arrow to whatever information is currently presented on the display of the indicator. For example, if the indicator is a dual sensor instrument with the measurement values of both sensors active on the display in psi, the display will look as follows when the shift function is activated.

```

^ PSI     PSI
+12345  +12345

```

**Step 2** Press the TARE/DAMP key to activate the damping menu. The indicator will respond by displaying the programmable levels of damping allowed.

```

OFF LOW
MEDIUM HIGH

```

where:

Off = damping disabled  
 Low = averaging of 4 consecutive readings  
 Medium = averaging of 8 consecutive readings  
 High = averaging of 16 consecutive readings

When the damping menu is activated the current level of damping in effect will flash. In this example, currently damping is off.

**Step 3** Press the DAMP key, as required, to highlight the desired level of damping. In this example, the DAMP key was pressed 2 times to highlight the medium damping level.

```

OFF LOW
MEDIUM HIGH

```

**Step 4** With the desired level of damping highlighted (flashing) press the enter key (ENT). The indicator will resume the function of pressure measurement with the desired level of damping applied to the displayed measurement value. Damping is also applied to any pressure measurement values transmitted over the RS232 interface.

**NOTE: The programmed level of damping will remain in effect until damping is turned off as detailed in Step 5 or until the indicator is turned off. Upon power up the indicator will default to damping off.**

**Step 5** To disable damping press the SHIFT key one time. The indicator will respond by adding an upward pointing arrow to the display as shown.

```

^ PSI PSI
+12345 +12345

```

**Step 6** Press the DAMP key to activate the damping menu. The indicator will respond by displaying the programmable levels of damping allowed. The damping level in effect, if any, will flash. In this case, medium damping is in effect.

```

OFF LOW
MEDIUM HIGH

```

**Step 7** Press the DAMP key, as required, to highlight the desired level of damping. In this example the DAMP key was pressed 2 times to highlight off damping.

```

OFF LOW
MEDIUM HIGH

```

**Step 8** With the word "off" highlighted and flashing press the enter (ENT) key. Damping has now been disabled. The indicator will resume normal (undamped) pressure measurement.

**Note on Damping:** The level of damping invoked applies to any displayed pressure measurement value. In indicators with two sensor assemblies the programmed level of damping will apply to each of the displayed installed sensor assemblies. Damping cannot be programmed to effect the displayed pressure value of one of two installed pressure sensor assemblies.

## SECTION 12.0 MAX/MIN TRACKING FUNCTION (Maximum & Minimum Pressure Measurement Tracking)

When measuring pressure the indicator constantly tracks the minimum and maximum pressure measurement values for each active pressure port. At the end of each measurement cycle, after the electrical measurement from the pressure sensor has been corrected for non-linearity and thermal errors, the indicator compares the measured value with those stored in both minimum and maximum memory locations maintained for each active pressure port.

If the measured value is found to exceed the previous maximum value the reading is stored in memory, over-writing the last stored value. Likewise, if the value, when compared with the minimum value, is found to be lower it will be stored in the memory over-writing the previous minimum value for the given pressure port.

The values stored in the maximum and minimum memory locations for each installed sensor can be reviewed at any time by pressing the MIN/MAX/OUTPUT key. The following sections detail the method for reviewing and discarding as well as reviewing and maintaining in memory the current maximum and minimum pressure values for each port.

### 12.1 Recalling and Maintaining Stored Max/Min Values

**Note:** The illustrations of displayed information shown below assume the indicator has two installed pressure sensor assemblies. If the indicator has only one installed pressure sensor assembly the measurement values for that sensor will appear in the center of the indicator display.

**Step 1** Press the MAX/MIN/OUTPUT key. The indicator will respond by displaying the maximum pressure and minimum pressures measured since the memory locations were cleared for each active sensor. The display will look as follows:

```

+12345 +12345
-12345 -12345

```

**Note:** If the indicator is equipped with only one pressure sensor assembly or, only one pressure sensor assembly is active (measured outputs appearing on the display) the indicator will display the maximum and minimum values for a single sensor assembly. If a pressure sensor assembly is not active minimum and maximum pressure measurement data are not tracked and will not be displayed when the MAX/MIN key is pressed.

**Step 2** To return to pressure measurement *without* erasing the values stored in the maximum/minimum memory locations press any key other than the enter (ENT) key. The indicator will respond by returning to the basic pressure measurement mode of operation.

```
PSIFSI
+12345 +12345
```

**12.2 Recalling Stored Max/Min Values and Erasing After Review**

**Note:** The illustrations of displayed information Shown below assume the indicator has two installed pressure sensor assemblies. If the indicator has only one installed pressure sensor assembly the measurement values for that sensor will appear in the center of the indicator display.

**Step 1** Press the MAX/MIN/OUTPUT key. The indicator will respond by displaying the maximum pressure and minimum pressures measured since the memory locations were cleared for each active sensor. The display will look as follows:

```
+12345 +12345
-12345 -12345
```

**Step 2** To erase the stored maximum and minimum values and return to basic pressure measurement press the enter key (ENT). The indicator will resume basic pressure measurement

```
PSI PSI
+12345 +12345
```

If the indicator is equipped with only one sensor or only one sensor is active (measured outputs appearing on the display) the indicator will display the maximum and minimum values for a single sensor assembly. If a pressure sensor assembly is not active minimum and maximum pressure measurement data will not tracked or displayed when the MAX/MIN key is pressed.

**Notes on MAX/MIN Function:**

- 1- Max/Min values are reset on power-up. Therefore any values stored in the max/min memory locations will be lost when the instrument is turned off.
- 2- When recalling the max/min values to the display, zero will not appear even if checked immediately after clearing the max/min memory locations. These values are reset to +999999 for the minimum value and -999999 for the maximum value when the memory location is cleared. As a result, the first measurement(s) taken 130 mS after the memory has been cleared will produce a new value in these memory locations. Even with no pressure applied to a gauge, compound, vacuum or differential pressure sensor assembly the high resolution of the indicator will display slight zero offsets as measurable maximum and minimum values.

**3-** Damping will not effect the speed with which maximum or minimum pressure levels are detected. Whereas, damping will slow down the response rate of the indicator to a true pressure change, the averaging software used for damping is bypassed for the capture of maximum and minimum pressure values.

**SECTION 13.0 RS232 OUTPUT FUNCTION**

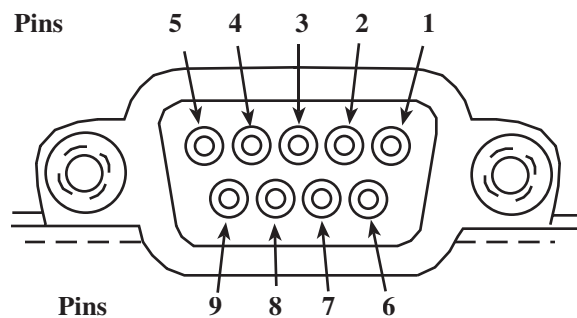
The output key provides access to the RS232 set up menus. Configuring the output is a secondary function and, therefore, requires the use of the shift key to initiate. The calibrator supports 3 communications protocols (print, remote and ISO 1745) and 5 different baud rates (300, 600, 2400, 4800 & 9600).

Operator usable RS232 protocols are limited to the remote and print modes. The ISO 1745 protocol is used for factory testing and calibration and is not documented for customer use. The following sections detail the set up of the remote and print modes of operation of the RS232 interface.

**Note:** When the RS232 interface is not in use it should be disabled by selecting the word “off” from the RS232 protocol menu. When the off option is selected the circuitry that supports the interface is powered down. This conserves on power consumption. Reducing power consumption is particularly important for instruments being powered by the optional built-in nickel cadmium batteries. Activating the RS232 interface results in an approximately 20-25% increase in power consumption. This increase in power consumption will produce a corresponding 20-25% decrease in battery life.

Following, is detailed information on the RS232 interface. The interface as defined here is standard on all indicators.

**13.1 RS232 Connector**



Pin	Function
2	Transmit data
3	Receive data
5	Ground

**13.1.1 Connecting the RS232 Interface**

The RS232 requires a straight through cable type. This will provide a 9 pin connector to the serial port on the



computer, acquisition system or recorder. To adapt to a 25 pin serial port purchase Dresser industries part number 838X012-01. The serial port of your computer, recorder or acquisition device should be configured as follows:

**Step 1** Select the baud rate for your device. Be certain to select the same baud rate on the device as that to be selected on the indicator. The indicator supports baud rates of 300, 1200, 2400 and 9600.

**Step 2** Select COM port 1 or 2. This is the designation for the COM port on the computer, recorder or acquisition device to which the is to connected

**Step 3** Select/enter 8 for the data bits

**Step 4** Select/enter 1 for the number of stop bits

**Step 5** For parity select none

**Step 6** For flow control select none

To summarize:

<b>Baud Rate:</b>	Select 300, 1200, 2400 or 9600	<b>Stop Bit:</b>	1
<b>COM Port:</b>	Select 1 or 2	<b>Flow Control:</b>	none
<b>Parity:</b>	none	<b>Data Bits:</b>	8
		<b>Cable Type:</b>	Straight through

### 13.1.2 The Remote Protocol

The remote protocol allows the operator to query instrument status and configure the indicator remotely over the RS232 interface. When set up in the remote protocol mode the operator can query and/or change the following instrument set up and operating parameters over the RS232 interface. See Appendix A for remote communication protocol.

	Query	Set Up
Current Pressure	yes	n/a
Measurement value(s)	yes	n/a
Max/Min	yes	n/a
Last Error	yes	n/a
Battery Power Level	yes	n/a
Level Damp	yes	yes
Engineering Unit	yes	yes
Hold	yes	yes
Port Selection	yes	yes
Tare	yes	yes

### 13.1.3 The Print Protocol

The print protocol simplifies the process of configuring the indicator for communication with an RS232 compatible printer, dumb terminal or data acquisition system. Through the print protocol the indicator can be set up to print (to paper, memory or screen) when: the print key on the instrument front panel is pressed, at one of the factory preprogrammed print intervals or when a CR (carriage return) signal is received.

The set up function for the print protocol provides the abil-

ity to select the desired baud rate as well as the content of each "package" of data to be printed.

### 13.2 Set Up of the Remote Protocol

The following procedure details how to set the indicator up for use in the remote mode.

**Step 1** With the indicator on and displaying pressure measurement value(s) press the shift key. In response to pressing the shift key the indicator will display an upward pointing arrow.

^

**Step 2** With the upward pointing arrow visible on the display press the Output/max/min key. The indicator will respond by displaying the following.

```
OFF      REMOTE
ISO1745  PRINT
```

The RS232 configuration currently in use will flash on the display.

**Step 3** With the selection of available interface protocols displayed, press the Output key to scroll through the protocol options. Each time the Output key is pressed the next interface option will be highlighted (flash). With the word "remote" flashing press the enter key. The indicator will respond by displaying.

```
300    600    2400
4800   9600
```

These numbers represent the baud rates (communication speeds) supported by The indicator. The baud rate must be selected to be compatible with the rate set for the device with which the indicator is to communicate. As with the RS232 protocol menu, the current baud rate selection will automatically flash on the display.

**Step 4** Press the Output key the required number of times to highlight the desired baud rate. Each time the Output key is pressed the next baud rate option will be highlighted (flash). In this example, the OUTPUT key was pressed two times to change the baud rate from 2400 to 9600. With the desired baud rate flashing press the enter key.

```
300    600    2400
4800   9600
```

The indicator will display the eight available end of message characters. As with the baud rate the end of message character must be selected to be consistent with that which is set for the device. The display of the available end of message characters looks as follows.

```
CRLF CR EOT ;
ETX HTAB ; NULL
```

The decimal and hexadecimal representations of each of the available end of text characters are provided in Appendix B.

**Note:** The indicator will automatically display the available end of message characters with the selection currently active flashing.

**Step 5** Press the Output key, as required, to highlight the desired end of text selection. In this example the end of text character is being changed from CRLF (carriage return with a line feed) to a CR (carriage return only). With the end of text character to be used flashing press the enter key. Although it is difficult to see, the indicator will briefly display:

```
Storing
Data
```

This appears as the indicator writes the selected configuration data to the Electrically Erasable Programmable Read Only Memory chip (EEPROM) resident on the main board of the unit. After the data has been written to EEPROM the indicator will resume pressure measurement activities with the display configured as it was prior to entering the output set up function.

```
PSI      PSI
+12345   +12345
```

**Note:** The setup configuration, since it is stored in EEPROM, will be retained in memory until a new configuration is programmed into the indicator.

The indicator is now ready for use in the remote communication mode. The complete command structure, including notation conventions and numeric formatting, is provided in Appendix A of this manual.

### 13.3 Set Up of the Print Protocol

The following steps should be followed to use the indicator for use with an RS232 compatible printer, dumb terminal or data acquisition system.

**Step 1** With the indicator on and displaying pressure measurement value(s) press the shift key. In response to pressing the shift key the indicator will display an upward pointing arrow.

```
^
```

**Step 2** With the upward pointing arrow visible on the display press the OUTPUT/MAX/MIN key. The indicator will respond by displaying the following.

```
OFF      REMOTE
ISO1745  PRINT
```

**Note:** The indicator will automatically display the protocol selection with the selection currently in use flashing.

**Step 3** With the selection of available interface protocols displayed, press the OUTPUT key to scroll through the protocol options. Each time the OUTPUT key is pressed the next interface option will be highlighted (flash). In this example the OUTPUT key will be pressed three times to

scroll from the word “off” to the word “print”.

```
OFF      REMOTE
ISO1745  PRINT
```

**Step 4** With the word “print” flashing press the enter key. The indicator will respond by displaying.

```
300  600  2400
4800 9600
```

These numbers represent the baud rates (communication speeds) supported by the indicator. The baud rate must be selected to be compatible with the rate set for the device with which the indicator is to communicate. As with the RS232 protocol menu, the current baud rate selection will automatically flash on the display.

**Step 5** Press the OUTPUT key the required number of times to highlight the desired baud rate. Each time the OUTPUT key is pressed the next baud rate option will be highlighted (flash). In this example the OUTPUT key will be pressed four times to scroll from 300 baud to 9600 baud. With the desired baud rate flashing press the enter key.

```
300  600  2400
4800 9600
```

After the desired baud rate has been entered, the indicator will display the eight available end of message characters. As with the baud rate the end of message character must be selected to be consistent with the requirements of the device or software package with which the indicator is to communicate. The display of the available end of message characters looks as follows.

```
CRLF CR EOT ;
ETX HTAB ; NULL
```

The decimal and hexadecimal representations of each of the available end of text characters are provided in Appendix B.

**Note:** The indicator will automatically display the available end of message characters with the selection currently active flashing.

**Step 6** Press the OUTPUT key as required, to highlight the desired end of text selection. In this example the OUTPUT key will be pressed seven times to scroll from CR (carriage return) to CRLF (carriage return with a line feed).

```
CRLF CR EOT ;
ETX HTAB ; NULL
```

**Step 7** With the end of text character to be used flashing press the enter key (ENT). The indicator will respond by displaying the following.

```
All PRES+EU
Pressure
```

This allows for the selection of the content to be included



in the data string transmitted by the indicator. As with the RS232 protocol menu, baud rate and end of text character the data string content command currently in use will automatically flash on the display. The data stream has the following format: hold, damp, left tare, left data, left units, right tare, right data, right units, end of message

Each field can have the following data:

Function	Data Stream Component with Function	
	Disabled	Invoked
hold	blank space	“H”
damp	“0”	1 for low 2 for medium 3 for high
left tare	blank space	“T”
left data	no data with sensor inactive	displayed value for left port
left units	no data with sensor inactive	engineering unit of left port
right tare	blank space	“T”
right data	no data with sensor inactive	displayed value for left port
right units	no data with sensor inactive	engineering unit of left port
End of message	n/a	end of text character selected

**Important Note:** No data will be transmitted for an inactive port. If the indicator is configured for differential pressure measurement, tare data and engineering units will be replaced with the differential measurement indication for that port.

**Selecting: Data Output String:**

All: The indicator will include all the above parameters in the data string to be transmitted.

Pres+EU: The indicator will transmit only the numeric pressure value and the current engineering unit in use.

Pressure: The indicator will only transmit the numeric value of the pressure measurement values.

**Step 8** In this example, the data string will be changed from All to pressure plus engineering unit. Therefore, the OUTPUT key will be pressed one time to highlight the selection “Pres+EU”.

```
All Pres+EU
Pressure
```

**Step 9** With the desired data string output highlighted and flashing press the enter (ENT) key. The indicator will respond by displaying the menu of available output frequency options. The output frequency menu will appear as follows.

```
Man Pace 1S 15S
1m 15m 1h Cont
```

As with the RS232 protocol menu, baud rate, end of text character and data string content command the output frequency currently in use will automatically flash on the display

where:

Selection	Result
Man	the indicator will transmit the programmed data string whenever the PRINT key is pressed
Pace	the indicator will transmit the programmed data string whenever a CR (carriage return) signal is received.
1s	the indicator will transmit the programmed data string every 1 second
15s	the indicator will transmit the programmed data string every 15 seconds
1m	the indicator will transmit the programmed data string every 1 minute
15m	the indicator will transmit the programmed data string every 15 minutes
1h	the indicator will transmit the programmed data string every 1 hour
Cont	the indicator will continuously transmit the programmed data string.

**Step 10** Press the OUTPUT key to scroll through the available output frequency rates. In this example, the OUTPUT key will be pressed seven times to change the output frequency from manual (Man) to continuous (Cont).

```
Man Pace 1S 15S
1m 15m 1h Cont
```

**Step 11** With the desired output frequency highlighted and flashing on the display press the enter key (ENT). The indicator will briefly display:

```
Storing
Data
```

This appears as the indicator writes the selected configuration data to the Electrically Erasable Programmable Read Only Memory chip (EEPROM) resident on the main board of the unit. After the data has been written to EEPROM the indicator will resume pressure measurement activities with the display configured as it was prior to entering the output set up function.

```
PSi PSi
+12345 +12345
```

The indicator is now ready for use in the print mode.

**Section 14.0 The Back Light Function (Optional)**

The indicator can, optionally, be equipped with a back-lit liquid crystal display. The back lit display provides enhanced visibility of displayed data under low light and

high glare conditions.

**Important Note:** Use of the backlighting option greatly increase the power consumption of the indicator. The useful life of the optional built-in nickel cadmium power pack will be greatly reduced by continuous use of the back light function. It is estimated that the power pack will provide 5 hours of operation with continuous use of the back lighting function.

The operation of the back lighting option is included in the following two sections.

### 14.1 Timed Back Light Function

The back light function can be initiated so that it will automatically turn off after a timed interval of one minute. To use the timed back light function, with the indicator on and displaying measurement data, simply press the BATT/LITE key once. The back light will be turned on and will stay on for 1 minute. After the 1 minute interval is completed the indicator will automatically disable the back light function and return to displaying data and measurement information in the standard non-backlit mode.

### 14.2 Continuous Back Light Function

The back light function can be initiated so that it will stay on until disabled by the operator. To use the back light function in the continuous mode the following procedure should be used.

**Step 1** With the indicator on and displaying pressure measurement data press the BATT/LITE key once. The indicator will respond by lighting the liquid crystal display.

**Step 2** To implement continuous back lighting, press the LITE key while the back light is on. The back light function will now stay on until turned off by the operator.

**Step 3** In order to disable continuous back lighting simply press the LITE key again. The indicator will disable the back light function and return to displaying data and measurement information in the standard non-backlit mode.

## SECTION 15.0 BATTERY CHECK FUNCTION (for use in indicators with optional built-in batteries)

The battery check function provides a means to determine the remaining power level of the nickel cadmium power pack. In addition, the battery check function provides a means at looking at the internal voltage regulation of the indicator when the instrument is being powered off the standard ac adapter. The battery check function is a secondary function and, therefore, requires the use of the SHIFT key to implement.

### 15.1 Using Battery Check Function

To use the battery check function follow the procedure below.

**Step 1** With the indicator on and displaying pressure measurement data press the SHIFT key. The indicator will respond by adding an upward pointing arrow to the display to indicate the instrument is in the shift mode.

```
^ PSI PSI
+12345 +12345
```

**Step 2** With the upward pointing arrow visible on the display press the BATT/LITE key once. The indicator will respond by displaying the current battery voltage. The battery voltage measurement will look as follows.

```
Battery Voltage
+X.XX
```

The voltage measurement will remain on the display for approximately 2 seconds, after which the indicator will automatically resume pressure measurement activities with the display configuration that was in use prior to performing the battery voltage check.

### 15.2 Low Battery Indicator

A low battery icon is provided on indicators equipped with the battery option. The unit will display a flashing battery icon indicating that the batteries have discharged to the point of having insufficient voltage (5.6 Vdc) to operate the unit.

## Section 16.0 The Hold Function

The hold function allows the operator to freeze the displayed measurement data at the push of a key. The hold function is considered an “immediate need” function. As such it has a dedicated key on the front panel. The use of a dedicated key allows the operator to quickly freeze the displayed measurement information whenever the need to do so arises.

**Note:** The hold function is a universal function. Use of the hold function freezes the entire display of the indicator. The indicator cannot freeze the data for one of two displayed pressure measurement assemblies.

### 16.1 Using The Hold Function

The following procedure details the use of the hold function.

**Step 1** With the indicator on and displaying pressure measurement data, to freeze the displayed data simply press the HOLD key one time. The indicator will respond by adding a small “H” to the upper left side of the display. When in the hold mode the displayed data will look as follows.

```
H PSI PSI
+12345 +12345
```

**Step 2** To exit the hold mode press any key.

**Note:** The indicator will remain in the hold mode until a key is pressed.

## SECTION 17.0 THE PRINT FUNCTION

The print key, when used with the RS232 interface allows the operator to print, on command, pressure measurement data.

**Note:** The indicator must be set up as outlined in section 13.3 Print Mode Protocol, in order for the print key to function. If the indicator is not set up in the print mode the instrument will display the following error message when the PRINT key is pressed.

```
Unit must be in
PRINT Protocol
```

After displaying the above error message the indicator will resume basic pressure measurement activities. If it is desired to use the push to print function proceed to section 13.3 for instructions on setting up the RS232 interface for this operation.

### 17.1 Using The Print Key

To print pressure measurement data follow the steps below.

**Step 1** Configure the RS232 interface in the print protocol as outlined in section 13.3

**Important Note:** Be certain the configuration settings are consistent with the printer, dumb terminal or data acquisition system with which the indicator is to communicate.

**Step 2** With the measurement data to be “printed” press the PRINT key. The measurement data as configured in section 13.3 will automatically be transmitted to the receiving device.

As long as the indicator is set up with the RS232 interface in the print protocol it will remain ready to transmit measurement data, on demand, to an appropriately set up receiving device.

**Important Note:** When the RS232 interface is not in use it should be disabled by selecting the word “off” from the RS232 protocol menu. When the off option is selected the circuitry that supports the interface is powered down. This conserves on power consumption. Reducing power consumption is particularly important for instruments being powered by the optional built-in nickel cadmium batteries. Activating the RS232 interface results in an approximately 20-25% increase in power consumption. This increase in power consumption will produce a corresponding 20-25% decrease in battery life. See section 13.0 for instruction on disabling the RS232 interface.

## SECTION 18.0 TEMPERATURE MEASUREMENT USING RTD PROBES

The system can be used with most standard RTDs (Resistance Temperature Detectors) to provide precision temperature measurements. An RTD interface assembly must be installed in one of the sensor assembly positions in order for the system to perform temperature measurement with

an RTD. The RT-1 and RT-2 provide the interface between the system base unit and the RTD probe.

The capabilities of the interface assemblies are summarized below:

### RT1 Quick Select Module

#### Pt 100 (385 & 392)

-200 to 550° C:±0.15° C 550 to 850° C:±0.2° C

**Ni 120** 80 to 260° C:±0.1° C

**Cu 10** 70 to 150° C:±0.6° C

**Ohms** +0.01% reading +0.02 ohms

### RT2 Quick Select Module

**Pt 1000** 184 to 275° C:±0.15° C

**Ohms** \_\_+0.01% reading +0.2 ohms

### Engineering Units:

Fahrenheit, Celsius, Kelvin, Rankine or ohms

### Ohms Measurement Range:

RT1 module:0/400 ohms

RT2 module: 0/4000 ohms

The interface assembly incorporates a Switchcraft TA4M type connector and requires an RTD with the appropriate Switchcraft TA4F mating connector. The part number for the appropriate mating connector is part number 828X136-01. The pinout assignments are as follows:

## 18.1 Setting Up the System for Temperature Measurement

**Step 1** Connect the desired RTD probe to the Switchcraft connector on the module

**Step 2** Turn the system on by pressing the On/Off key.

Pin	Function
1	2 Wire +
2	4 Wire +
3	4 Wire -
4	2 Wire -

**Step 3** To access the temperature setup menu press the shift key to access the port select function.

The will respond by displaying the following:

```
^
```

**Step 4** With the upward pointing arrow displayed press the PORT/UNIT key one time to activate the port select function. The indicator will respond by displaying:

```
Left Right Both
```

**Note:** The Left minus right (L-R), right Minus left (R-L) and left plus right functions (L+R) found in indicators

with two installed pressure sensors are disabled when a temperature measurement assembly is installed in one of the two sensor locations.

**Step 5** As required, press the PORT/UNIT key until the port that the RT interface assembly is installed in flashes on the display. In this example the RT assembly is installed in the left sensor location.

```
Left Right Both
```

**Step 6** With the text “Left” flashing press the enter key enter key (ENT)

The system will respond by displaying:

```
Probe Connection
2W 3W 4W
```

This represents the configuration of the RTD to be used, where the number equals the number of wires the RTD uses.

**Note:** The use of a 4 wire RTD is recommended for optimum accuracy.

**Step 7** Using the PORT/UNIT key select the appropriate configuration for the RTD probe to be used. In the example below the 4 wire configuration was selected.

```
Probe Connection
2W 3W 4W
```

**Step 8** With the desired wiring configuration selected press the enter key (ENT).

The system will respond by displaying the available units of measure as follows:

```
Engineering Units:
°C °F K °R W
```

**Step 9** Using the PORT/UNIT key select the desired engineering unit for the measurements to be made. In the example here the measurements will be made in degrees Celsius.

```
Engineering Units:
°C °F K °R W
```

**Step 10** With the desired engineering unit selected and flashing press the enter key (ENT).

The system will respond by displaying the following:

```
Probe: 12345678
3385 -200/850
```

On initial use the first selection and the corresponding probe will appear selected. Use the PORT/UNIT key to select the desired coefficients/RTD probe from the available factory programmed curves. The RT1 is pre-programmed for the following RTDs.

#### Position Probe

- |     |  |                    |
|-----|--|--------------------|
| 1   | 385  | -200/850 degrees C |
| 2   | α392   | -200/850 degrees C |
| 3   | Ni Minco   |                    |
| 4   | Cu 10 ohm  |                    |
| 5-8 | available for programming using the optional calibration and programming software for the RT1 module, part number 838X014-01 for 3 ½ inch disks. |                    |

**Important Note:** The RT1 is compatible with RTD probes with output resistance values of 0 to 400 ohms. Use of the module with higher resistance RTD probes will result in diminished accuracy and possible damage to the module electronics.

The RT2 is pre-preprogrammed for the following RTDs

#### Position Probe

- |     |  |  |
|-----|--|--|
| 1   | Pt 1000  |  |
| 2-8 | available for programming using the optional calibration and programming software for the RT2 module, part number 838X014-01 for 3 ½ inch disks. |  |

**Important Note:** The RT2 is compatible with RTD probes with output resistance values of between 1000 and 4000 ohms. Whereas this module will function with lower resistance RTDs accuracy will be greatly diminished. In addition, use of the module with higher resistance RTD probes will result in diminished accuracy and possible damage to the module electronics.

**Step 11** Using the left/right arrow keys select the RTD probe type for the measurements to be made. In the example here the measurements will be made in using the PT 100 type 385

```
Probe: 12345678
3385 -200/850
```

**Step 12** With the desired probe type selected and flashing press the enter key (ENT).

The system will respond by displaying the following:

```
Resolution:
1 .1 .01 0.001
```

The maximum resolution that the combination of the indicator system base unit, RTD interface module and probe can support can be determined as follows: The resolution of the RTD module is 0.001% of the full scale resistance of the reference resistor used in the module. The RT1 incorporates a 400 ohm reference resistor and the RT2 incorporates a 4000 ohm reference resistor.

Using the RT1 as the example the maximum resolution is:

$$\begin{aligned} & \mathbf{0.001\% \text{ of } 400 \text{ ohms}} \\ & = \mathbf{0.00001 \times 400 = 0.004 \text{ ohms}} \end{aligned}$$

For a Pt 100 the temperature resolution can be determined as follows:

$$0.004 \text{ ohms} / (100 \text{ ohms} \times 0.00385 \text{ ohms/degree C}) = 0.008 \text{ degrees C (approx } 0.005 \text{ degrees F)}$$

Therefore, rounding to the next highest digit results in a resolution of 0.01 degrees C.

The resolution supported for the factory programmed RTDs can be found below:

#### Using the RT1

Probe type	Resolution
Pt 100 (385 & 392)	0.01 degrees C or F
Ni 120	0.1 degrees C or F
Cu 10	0.1 degrees C or F

#### Using the RT2

Probe type	Resolution
Pt 100	01.0 degrees C or F

Resolution must be selected in conjunction with the full scale ohms output for the RTD probe to be used.

**Step 13** Select the desired resolution using the PORT/UNIT key. In this case, since we are using the Pt100 RTD with a maximum resolution of 0.01 degrees C the 0.01 option has been selected

```
RESOLUTION:
1.1.01 0.001
```

**Step 14** With the desired resolution selected and flashing press the enter key (ENT).

The system will briefly show internal limit settings and will then commence temperature measurement.

The measurement parameters can be changed at any time through the activation of the RT set up menu via selection of the port select function.

### 18.2 Calibrating/Programming the RT RTD Assemblies

The RT can be programmed in the field. Programming, calibration adjustment or recertification can be accomplished with the Calibration Programming Utility disk part number 838X014-01 (3 1/2 inch disk). Please note, in order to improve the accuracy of the measurement system it will be necessary to generate a significant number of very accurate temperature calibration points using precision temperature baths. In general, the simplest way to enhance the accuracy of the temperature measurement is to simply re-zero the probe while immersed in an ice bath.

## SECTION 19.0 CALIBRATING THE INDICATOR

The indicator provides the ability to perform calibration zero and span of any installed sensors without the use of an external communications device. A computer or terminal is required to perform a complete recalibration (including linearization) due to the need to input numeric values. In most cases zero and span adjustment will be all that is required to recalibrate the instrument.

The following sections detail the methodologies for zero/span adjustment and complete recalibration of installed sensors.

### 19.1 Adjusting Calibration Zero and Span Settings

This procedure details the method for performing a calibration level zero and span of any installed pressure sensor assembly.

#### Step 1 \*\*\*\*\*Important\*\*\*\*\*

Be certain that the indicator is set up in accordance with the requirements outlined in Section 8 Zeroing Indicator for the pressure sensor assembly to be zeroed and spanned.

**Step 2** With the indicator off press and hold the PRINT key. While holding the PRINT key press the POWER key. After the unit begins the start up process the PRINT key can be released. If the indicator is equipped with two pressure sensor assemblies, after the start up screens have scrolled by the indicator will respond by displaying the following.

```
Calibrate Port?
Left Right
```

The left port will be the default calibration port and will automatically flash when the port selection is presented.

**Note:** If the indicator is equipped with a single pressure sensor assembly it will automatically skip to step 4.

**Step 3** To select:

The Left Port (sensor assembly in left side of indicator): Press the enter key (ENT)

The Right Port (sensor assembly in left side of indicator): Press the PRINT key one time. The indicator will respond by changing the highlighted port selection to the right port. Pressing the PRINT key a second time will return the left selection to the highlighted state.

With the port corresponding to the pressure sensor to be calibrated highlighted on the display press the enter key (ENT).

The indicator will respond by displaying the following.

#### 1st screen

```
PSI  *HG  *WC  ftsW
BAR  mBAR  kPa  MPa
```



## 2nd screen

```
MMH3 CMWC MMWC K3CM
```

**Step 4** The indicator will automatically default to the primary engineering unit for the pressure sensor to be calibrated. The sensor assembly may be calibrated in any of the factory programmed engineering units. To select an engineering unit other than the default unit press the UNIT key until the desired unit is flashing on the display. With the desired unit flashing on the display press the enter key (ENT).

The indicator will respond by displaying the following:

```
ZERO/FULL SCALE  
CALIBRATE REMOTE
```

The zero/full scale option allows for re-zeroing and re-spanning the unit via the front panel keypad. The Calibrate REMOTE option provides the ability to re-zero, re-span and re-linearize the indicator using a terminal or computer. The Calibration Remote option is detailed in the next section of this manual.

To perform a re-zero and re-spanning of the pressure sensor assembly, with the text Zero/Full scale flashing press the enter key (ENT). The indicator will respond by displaying the following.

```
Unit    CAL  
X.XX    MODE
```

where:

X.XX: represents the zero offset.

Unit: represents the engineering unit select

**Step 5** To re-zero the pressure sensor assembly apply zero pressure. (vent a gauge, differential, compound or vacuum sensor to atmosphere or pull a hard vacuum for an absolute pressure sensor assembly).

**Important Note:** Be certain a proper zero is being applied.

With the proper zero applied press the ZERO key. The indicator will respond by displaying the following

```
Unit    CAL  
000     MODE
```

Indicating that any zero offset has been eliminated

**Step 6** Apply full scale pressure and allow the measured value shown below the engineering unit designation to stabilize.

**Note: the applied pressure should be as close as possible to the full scale range of the pressure sensor being calibrated.**

**Step 7** Adjust the displayed pressure measurement value to equal that of the applied pressure.

Use the:

TARE key: To decrease the displayed pressure value.

MAX/MIN Key: To increase the displayed pressure value.

The required key should be pressed the number of times required to make the displayed pressure value equal that of the applied pressure value.

**Step 8** When the displayed pressure value and the applied pressure input are the same press the enter key (ENT).

The indicator will respond by displaying:

```
Storing Data
```

This will appear on the instrument display for approximately 5 seconds

Next, the indicator will display:

```
Calibration done  
YES NO
```

Use the PRINT key to make the desired selection. With the desired selection flashing press the enter key (ENT)

**Selecting yes-** returns indicator to pressure measurement activities

**Selecting no-** returns the indicator to the main calibration selection menu.

## 19.2 Performing A Complete Recalibration

This section details the process for performing a complete recalibration of the indicator.

### IMPORTANT NOTE

If the pressure sensor assembly has not been zeroed and spanned as outlined in section 18.1 the first linearization point should be the zero pressure input and the last pressure input should be the full scale input. If the unit has just been re-zeroed and re-spanned, per the instructions in section 18.1, then these points can be omitted from the linearization process. In this case the first linearization point will be the first non-zero pressure input and the last linearization point will be the pressure input prior to the full scale input.

The following are the minimum recommended number of linearization points:

#### For $\pm 0.25\%$ pressure sensors:

3 including zero, midpoint and full scale

#### For $\pm 0.1\%$ pressure sensors:

6 including zero, typically at 20% increments

#### For $\pm 0.05\%$ & 0.1% enhanced temperature performance pressure sensors:

11 including zero, typically at 10% increments

#### For $\pm 0.05\%$ and 0.025% pressure sensors with enhanced temperature performance

20 including zero and span



The indicator can accommodate a maximum of 20 calibration points, including zero and span. Enhanced temperature performance sensors meet accuracy specification though temperature range of 20-120 degrees F. Temperature error will not result in instrument performance exceeding rated accuracy.

**19.2.1 Terminal Requirements for Performing A Complete Recalibration**

In order to calibrate pressure sensors in the indicator the indicator must be connected to a terminal for data entry and review. Terminal settings should be as follows:

- Baud Rate: 2400
- Data Bits: 8
- Stop Bits: 2
- Parity: None
- Flow Control: Xon/Xoff
- Comm Port: per port being used

In addition the indicator RS232 Remote interface should be set up as follows:

- Baud Rate: 2400
- End of Text Message: CRLF

The RS232 interface does not have to be active in the remote mode when initiating the calibration function as the indicator will activate the Remote mode operation when the Calibration-REMOTE selection is made from the main calibration menu.

This procedure details the method for performing a calibration zero and span of any installed pressure sensor assembly.

With the indicator off, prior to initiating the calibration process, connect the indicator to the desired serial port of the computer or terminal device to be used. Dresser cable (part number 838X011-01) will connect the indicator to a standard 9 pin serial port. Dresser (part number 838X012-01) is available to adapt the cable for connection to a 25 pin serial port connector on the terminal or computer.

**19.2.2 Performing A Recalibration/ Relinearization of the Indicator**

**Step 1 \*\*\*\*\*Important\*\*\*\*\***

Be certain that the indicator is set up in accordance with the requirements outlined in Section 8, Zeroing Indicator, for the pressure sensor assembly to be zeroed and spanned.

**Step 2** Be certain the indicator has been connected to the terminal or computer prior to powering up the indicator

**Step 3** With the indicator off press and hold the PRINT key. While holding the PRINT key press the POWER key. After the unit begins the start up process the PRINT key can be released. If the indicator is equipped with two pressure sensor assemblies, after the start up screens have scrolled by the indicator will respond by displaying the

following.

```
Calibrate Port?
Left Right
```

**Note:** If the indicator is equipped with a single pressure sensor assembly it will automatically skip to step 4.

**Step 4** To select:

The Left Port (sensor assembly in left side of indicator):

Press the enter key (ENT)

The Right Port (sensor assembly in left side of indicator):

Press the PRINT key one time. The indicator will respond by changing the highlighted port selection to the right port. Pressing the PRINT key a second time will return the left selection to the highlighted state.

With the port corresponding to the pressure sensor to be calibrated highlighted on the display press the enter key (ENT).

The indicator will respond by displaying the following.

**1st screen**

```
PS1 449 4WC ftSW
Bar mBar kPa MPa
```

**2nd screen**

```
mmHg cmWC mmWC kSCM
```

**Step 5** The indicator will automatically default to the primary engineering unit for the pressure sensor to be calibrated. The sensor assembly may be calibrated in any of the factory programmed engineering units. To select an engineering unit other than the default unit press the UNIT key until the desired unit is flashing on the display. With the desired unit flashing on the display press the enter key (ENT).

The indicator will respond by displaying the following:

```
ZERO/FULL SCALE
Calibrate REMOTE
```

The zero/full scale option allows for re-zeroing and re-spanning the unit via the front panel keypad. The Calibrate REMOTE option, as detailed in this section provides the ability to re-zero, re-span and re-linearize the indicator using a terminal or computer. The Zero/Span option is detailed in section 18.1 of this manual.

To perform a complete recalibration/relinearization of the selected pressure sensor assembly use the Print key to highlight the text "Calibration- REMOTE". With the text Calibration- REMOTE flashing press the enter key (ENT).

**Step 6** After pressing the enter key the following text will appear on the screen of the terminal.

## Remote Calibration Menu

Z zero  
F full scale  
L linearity  
X exit

**Note:** In some cases the indicator may miss getting the entire menu list upon initial start up. If this is the case, access to the desired function can still be attained by typing the letter for the desired selection and pressing the ENTER key on the computer/terminal keyboard.

The procedures for performing each of these functions appear in the sections listed below:

Function	Section
Remote Zero:	19.2.3
Remote Span:	19.2.4
Remote Linearity:	19.2.5

### 19.2.3 Remote Zero Adjustment

The indicator must be connected to the computer or terminal being used for data input and review as outlined in Section 19.2.1

**Note:** If the indicator is already in the Remote Calibration mode skip directly to step 6

**Step 1** With indicator off connect unit to a computer or terminal as outlined in section 18.2.1

**Step 2** Press the PRINT key on the indicator and while holding the PRINT key press the POWER key. After the start up sequence has commenced the PRINT key

can be released. At the end of the start up sequence the indicator display will show the following query.

```
Calibrate  
Left Right
```

**Step 3** Using the PRINT key highlight the sensor to be calibrated. With the port corresponding to the pressure sensor to be calibrated highlighted on the display press the enter key (ENT).

The indicator will respond by displaying the following.

#### 1st screen

```
PSI 4493 4WC ftSW  
BAR MBAR KPA MPa
```

#### 2nd screen

```
MMHG CMWC MMWC KSCM
```

**Step 4** The indicator will automatically default to the primary engineering unit for the pressure sensor to be calibrated. The sensor assembly may be calibrated in any of the factory programmed engineering units. To select an engineering unit other than the default unit press the UNIT key until the desired unit is flashing on the display. With

the desired unit flashing on the display press the enter key (ENT).

The indicator will respond by displaying.

```
ZERO/FULL SCALE  
CALIBRATE REMOTE
```

**Step 5** To adjust the calibration zero via the remote mode press the PRINT key one time to highlight the text "Calibrate REMOTE".

**Step 6** With the text "Calibrate REMOTE" flashing press the ENTER key. The indicator will respond by transmitting the main calibration menu to the computer/terminal display as follows.

## Remote Calibration Menu

Z zero  
F full scale  
L linearity  
X exit

**Step 7** On the keyboard of the computer or terminal type the letter Z. With the letter Z typed, pressed the Enter key on the keyboard. The will respond by transmitting the following information for display on the screen.

Apply ZERO pressure and press ENTER

Apply the appropriate zero pressure. Be certain a good evacuated reference is supplied if the sensor to be zeroed is an absolute unit.

With the correct zero pressure applied press the Enter key on the keyboard of the computer/terminal device being used.

The will respond by transmitting the following information for display on the screen of the computer/terminal.

The indicator will respond by displaying 8 readings. These readings represent the amplified voltage output of the sensor assembly at the applied pressure or vacuum. The nominal amplified output range for all sensor assemblies is 0/1 Vdc for zero to full scale pressure. After the completion of the eight readings the indicator will use the average value of the reading to establish the new correction value for the zero linearization point.

The sequence of events will appear as follows.

```
+0.000002  
+0.000001  
+0.000002  
-0.000000  
+0.000001  
+0.000001  
+0.000000  
+0.000000  
  
SENSOR ZEROED
```

After completion of the zeroing procedure the indicator

will once again display the main calibration menu as follows.

### Remote Calibration Menu

Z zero  
F full scale  
L linearity  
X exit

**Step 8** To complete the zero adjustment process and exit the calibration menu Type X on the keypad and press the Enter key. For information on adjusting the full scale value proceed to Section 19.2.4

The computer/terminal will respond by displaying:

```
save calibration data?  
y- yes  n-no
```

**Step 9** To Save calibration data type "y" and press the enter key on the computer/terminal keyboard. The will respond by displaying

```
storing data
```

### 19.2.4 Remote Full Scale Adjustment

The indicator must be connected to the computer or terminal being used for data input and review as outlined in Section 19.2.1.

**Note:** If the indicator is already in the Remote Calibration mode skip directly to step 6

**Step 1** With indicator off, connect the unit to a computer or terminal as outlined in section 19.2.1

**Step 2** Press the PRINT key on the indicator and while holding the PRINT key press the POWER key. After the start up sequence has commenced the PRINT key can be released. At the end of the start up sequence the indicator display will show the following query.

```
Calibrate  
Left Right
```

Using the PRINT key highlight the sensor to be calibrated.

**Step 3** With the sensor to be calibrated flashing on the display press the ENTER key. The indicator will respond by displaying.

```
zero/full scale  
calibrate REMOTE
```

**Step 4** To adjust the calibration zero via the remote mode press the PRINT key one time to highlight the text "Calibrate REMOTE".

**Step 5** With the text "Calibrate REMOTE" flashing press the ENTER key. The indicator will respond by transmitting the main calibration menu to the computer/terminal display as follows.

### Remote Calibration Menu

Z zero  
F full scale  
L linearity  
X exit

**Step 6** On the keyboard of the computer or terminal type the letter F. With the letter F typed, pressed the Enter key on the keyboard. The will respond by transmitting the following information for display on the screen.

Apply FULL-SCALE pressure and then enter applied pressure and press Enter.

Apply the appropriate full scale pressure to the sensor being adjusted.

**Step 7** With the correct full scale pressure applied to the sensor and the corresponding value typed into the computer/terminal press the Enter key on the keyboard of the computer or terminal device being used. The indicator will respond by transmitting for display measurement 8 measurement readings for the applied full scale pressure. These readings represent the amplified voltage output of the sensor assembly at the applied pressure or vacuum. The nominal amplified output range for all sensor assemblies is 0/1 Vdc for zero to full scale pressure. After the completion of the 8 readings the indicator will use the average value of the reading to establish the new correction value for the full scale linearization point. The sequence of events will appear as follows.

```
+1.000000  
+1.000001  
+1.000002  
+1.000000  
+1.000000  
+1.000001  
+1.000000  
+1.000001  
SENSOR FULL-SCALE  
Corrected
```

After the above message has been displayed the indicator will then return to the main calibration menu as follows.

### Remote Calibration Menu

Z zero  
F full scale  
L linearity  
X exit

**Step 8** To complete the full scale adjustment process and exit the calibration menu type X on the keypad and press the Enter key. For information on adjusting the linearization values proceed to section 18.2.6. Resetting of calibration zero was covered in Section 19.2.4.

The computer/terminal will respond by displaying:

```
save calibration data?  
y- yes n-no
```

**Step 9** To Save calibration data type "y" and press the enter key on the computer/terminal keyboard. The will respond by displaying

```
storing data
```

### 19.2.5 Remote Adjustment of Linearization Values

The indicator must be connected to the computer or terminal being used for data input and review as outlined in Section 19.2.1

#### IMPORTANT NOTES

If the pressure sensor assembly has not been zeroed and spanned as outlined in Section 19.1 the first linearization point should be the zero pressure input and the last pressure input should be the full scale input. If the unit has just been re-zeroed and re-spanned, per the instructions in Section 19.1, than these points can be omitted from the linearization process. In this case the first linearization point will be the first non-zero pressure input and the last linearization point will the pressure input prior to the full scale input.

The Following are the minimum recommended number of linearization points:

**For  $\pm 0.25\%$  pressure sensors:**

3 including zero, midpoint and full scale

**For  $\pm 0.1\%$  pressure sensors:**

6 including zero, typically at 20% increments

**For  $\pm 0.05\%$  &  $0.1\%$  enhanced temperature performance pressure sensors:**

11 including zero, typically at 10% increments

**For  $\pm 0.05\%$  and  $0.025\%$  pressure sensors with enhanced temperature performance**

20 including zero and span

The indicator can accommodate a maximum of 20 calibration points, including zero and span. Enhanced temperature performance sensors meet accuracy specification though temperature range of 20-120 degrees F. Temperature error will not result in instrument performance exceeding rated accuracy.

The indicator must be connected to the computer or terminal being used for data input and review as outlined in Section 19.2.1.

**Note:** If the indicator is already in the Remote Calibration mode skip directly to step 6

**Step 1** With indicator off connect unit to a computer or terminal as outlined is section 19.2.1

**Step 2** Press the PRINT key on the indicator and while holding the PRINT key press the POWER key.

After the start up sequence has commenced the PRINT key can be released. At the end of the start up sequence the indicator display will show the following query.

```
calibrate  
Left Right
```

Using the PRINT key highlight the sensor to be calibrated.

**Step 3** With the sensor to be calibrated flashing on the display press the ENTER key. The indicator will respond:

```
zero/full scale  
calibrate REMOTE
```

**Step 4** To adjust the calibration zero via the remote mode press the PRINT key one time to highlight the text "Calibrate REMOTE".

**Step 5** With the text "Calibrate REMOTE" flashing press the ENTER key.

**Step 6** On the keyboard of the computer or terminal type the letter L. With the letter L typed, press the Enter key on the keyboard. The indicator will display the following information for display on the screen.

```
clear Old linearity data?  
C- cancel  
P- proceed
```

Typing "C" on the keyboard of the computer/terminal and pressing will result in escaping from the linearization process and returning to main calibration menu.

Typing "P" on the keyboard of the computer/terminal will allow for entry into the relinearization process. To proceed with the relinearization process type P and press the Enter key on the keyboard of the computer or terminal. In response to the "P" entry the indicator will transmit the following information for display on the screen of the computer/terminal.

Linearity point 1:

Apply pressure then enter applied pressure and press Enter.

The first applied pressure can be either zero or, if the indicator has just been rezeroed and respanded, can be the first non-zero calibration point. In general, it is recommended that both zero and full scale calibration points be incorporated in the linearization process.

In response to the request for the first linearity point the operator should:

- 1- Apply the appropriate pressure to the sensor being calibrated.
- 2- Key in on the keyboard of the computer/terminal the exact value for the pressure being applied.
- 3- With the appropriate pressure applied and entered into the terminal/computer press the Enter key on the

keyboard. If zero is used the indicator will respond by displaying 8 readings.

These readings represent the amplified voltage output of the sensor assembly at the applied pressure or vacuum. The nominal amplified output range for all sensor assemblies is 0/1 Vdc for zero to full scale pressure. After the completion of the eight readings the indicator will use the average value of the reading to establish the new zero correction. The sequence of events will appear as follows.

```
+0.000000
+0.000001
+0.000000
-0.000001
+0.000002
+0.000001
+0.000002
+0.000001
```

If the first linearization point is zero the displayed voltage values will be close to zero. The voltage output displayed will increase in direct proportion to the level of applied pressure or vacuum as a percent of the full scale range of the sensor assembly. After presenting the 8 readings the indicator will calculate the average value and use it to generate the required correction factor. When complete, the indicator will display the following requesting the next linearization point.

Linearity point 2: Apply pressure then enter applied pressure and press Enter.

**Step 7** In response to the request for the second linearity point the operator should:

- 1- Apply the appropriate pressure to the sensor being calibrated.
- 2- Key in on the keyboard of the computer/terminal the exact value for the pressure being applied.
- 3- With the appropriate pressure applied and entered into the terminal/computer press the Enter key on the Keyboard. At a minimum the following linearization points should be used for:

**For ±0.25% pressure sensors:**  
3 including zero, midpoint and full scale

**For ±0.1% pressure sensors:**  
6 including zero, typically at 20% increments

**For ±0.05% & 0.1% enhanced temperature performance pressure sensors:**  
11 including zero, typically at 10% increments

**For ±0.05% and 0.025% pressure sensors with enhanced temperature performance**  
20 including zero and span

In the case where the first non-zero linearization point is taken at 10% of the sensors range the indicator will

respond by displaying 8 readings of approximately 10% of the 1 Vdc full scale output or 0.10000. After the completion of the eight readings the indicator will use the average value of the reading to establish the new correction value for the second linearization. The sequence of events will appear as follows.

**Note:** The difference between the displayed measured voltage and the ideal voltage of 0.100000 represents the non-linearity of the sensor. This linearization process will generate compensation factors to correct sensor non-linearity.

```
+0.100020
+0.100021
+0.100023
-0.100021
+0.100022
+0.100021
+0.100021
```

Linearity point 3: Apply pressure then enter applied pressure and press Enter.

**Step 8** Repeat the process, as outlined in step 7, for each linearization point to be done. To optimize measurement accuracy, the last linearization point correction should be very close the full scale range of the sensor being calibrated.

If the last linearization point is done at the full scale value of the indicator sensor assembly being calibrated (within ±0.1% of the full scale value) will use the this point as a new span setting. If the point is not within ±0.1% of full scale the indicator will retain the last span setting conducted. For the indicator to operate to the highest level of accuracy it is recommended that the last linearization point be within +0.1% of the full scale range of the sensor assembly being calibrated

To complete the calibration process, without entering a numeric value for a new linearization point, press the enter key on the keyboard of the terminal/computer being used as the calibration interface. The indicator will respond by transmitting the following information to the screen of the terminal/computer.

```
Linearization Done
S- SAVE
C- Cancelled
```

Selecting SAVE will result in the following data being transmitted to the screen of the computer/terminal.

```
wait
Storing Data
```

Selecting CANCEL will result in the following data being transmitted to the screen of the computer/terminal

```
Linearization cancelled
old lin data retained
```



Typing and entering "C" on the key-board of the terminal/computer used as the calibration will cancel the linearization process and retain old linearization data in the EEPROM memory

**Note:** It is not recommended that a calibration point be placed within 1% of either the zero or span values for the sensor being calibrated. If a calibration point is placed within the  $\pm 1\%$  band around zero or span extrapolated pressure measurements beyond the range limits of the instrument could subject to very large inaccuracies. Regardless of the placement of calibration points, it is not recommended that indicator sensors be used outside the calibration range for the given sensor.

\*\*\*\*\***IMPORTANT NOTE**\*\*\*\*\*

**After saving the new linearization data the calibration procedure must be exited by typing and entering "X" from the main calibration menu. Failure to do this will result in discarding the newly generated linearization data and retaining the old data**

**Step 9** After entering your selection to step 8

the indicator will respond by transmitting the main calibration menu to the screen of the terminal/computer being used for the calibration interface.

The main calibration menu will appear as follows.

**Remote Calibration Menu**

Z zero  
F full scale  
L linearity  
X exit

To exit the calibration mode type and enter "X" from the keyboard of computer/terminal being used as the calibration interface.

After typing and entering the "X" the indicator will transmit the following information to the screen of the computer/terminal

Save calibration data?  
yes  
no

Type and enter "Y" on the keyboard of the computer/terminal to save data. When "Y" is entered the text

"Storing data"  
REMOTE Calibration SAVED

will appear on both the display of the indicator as well as the screen for the computer/terminal. Typing "N" will result in the text

"REMOTE Calibration ABORTED"

being displayed on the screen of the computer/terminal

After entry of either "Y" or "N" the will resume normal pressure measurement activities

**SECTION 20.0 INSTALLING A SECOND PRESSURE OR CHANGING SENSOR ASSEMBLY**

This section details the procedure for adding a second pressure sensor assembly in an instrument that previously had a single sensor or changing an installed sensor assembly. indicator pressure sensor assemblies can be added or changed as required to the instrument to better meet the requirements of any specific measurement exercise to be performed. The calibration data for each pressure sensor assembly resides in EEPROM (Electrically Erasable Programmable Read Only Memory) located within the pressure sensor assembly. As such, pressure sensor assemblies can be installed in any instrument, originally sold for the required accuracy, and provide the rated accuracy of the pressure sensor assembly.

To install a second pressure sensor assembly or change an installed sensor assembly follow the procedures detailed in Section 20.1

**20.1 Procedure for Installing or Changing a Pressure Sensor Assembly**

**Important Notes:**

- 1) The instrument should be turned off and unplugged prior to initiating any of the procedures detailed in this section.
- 2) The procedures detailed in this section should only be performed by individuals experienced with working on precision electrical test equipment.
- 3) The individual performing the pressure sensor assembly change/installation must be properly grounded prior to initiating this process. Failure to do so could result in instrument damage due to electrostatic discharge.

**Step 1** Power down the indicator and unplug from the ac adaptor.

**Step 2** Place the indicator top down on a workbench and remove the four (4) feet by removing the phillips head screw in the bottom center of each foot.

**Step 3** Carefully, holding the upper and lower case halves together, pick up the indicator. With the instrument right side up separate the two case halves.

**Step 4** If a sensor is to be installed in a sensor location that currently is empty proceed to step 7.

To remove a pressure sensor assembly first disconnect the ribbon cable between the main board and pressure sensor assembly where the cable connects to the pressure sensor assembly.

**Step 5** Looking at the rear panel, remove and retain the three (3) phillips head screws that hold the sensor in position. When removing the last screw, hold the pressure sensor assembly to assure that it does not fall from the instrument.

**Step 6** After the last screw has been removed, carefully lift the pressure sensor assembly from the instrument housing by lifting out and up the end with the ribbon cable connection.

**Step 7** If a pressure sensor assembly is being installed in the second sensor location for the first time remove the pressure connection cover by removing the three (3) phillips head screws that hold it in place. After the screws have been removed, set aside the cover plate and retain for future use. Install sensor through the rear panel with the label side up.

**Step 8** Align the sensor so that the three (3) phillips head screws that hold the sensor to the rear plate of the indicator can be easily started. Tighten all three (3) to hold sensor firmly in position.

**Step 9** For first time installations, connect the small ten (10) pin connection on the ribbon cable provided to the corresponding connector on the main board nearest the sensor installation location. For all installations, connect the larger 10 pin connector to the connector on the printed circuit board on the back of the pressure sensor assembly. Check both electrical connections by applying pressure to each connector to assure that it is firmly seated.

**Step 10** If the sensor has been installed for the first time or a sensor of a different range has been installed lift the front board set (switch and display board set) up and out of the retaining groove in the front bezel of the instrument housing. The ribbon cable between this board set and the main board can remain connected.

**Step 11** For installation of replacement sensors only: If the sensor installed is replacing a different range sensor remove the range indication label on the front panel by sliding the label out of the slot on the side of the instrument front panel. Retain range label with removed sensor for future use.

For installation of all other sensors: Locate the range indication label, provided with each pressure sensor assembly and slide the range label into the slot on the side of the display that corresponds to the side of the indicator in which the pressure sensor assembly has been installed.

**Step 12** Lift the front board set up and slide back into the retaining groove in the bezel in the front of the case of the indicator. Be certain board set is firmly seated in the groove.

**Step 13** Replace the top cover of the instrument, carefully aligning the groove in the top cover front bezel with the front board set in the front of the indicator.

**Step 14** Carefully, holding the two case halves together, place the indicator top side down on a workbench.

**Step 15** Re-install the four (4) rubber feet. Do not overtighten the phillips head screws that hold feet in position.

Installation of the pressure sensor assembly is now complete. General use of the indicator can now be resumed.

## Section 21.0 Replacement of Optional Cadmium Batteries

Over time, rechargeable nickel cadmium batteries lose the ability to recharge sufficiently to provide any long term use capability. When this occurs the nickel cadmium power pack must be replaced. The following section details the methodology to be employed to replace the built in rechargeable power pack.

### Important Notes:

- 1) The instrument should be turned off and unplugged prior to initiating any of the procedures detailed in this section.
- 2) The procedures detailed in this section should only be performed by individuals experienced with working on precision electrical test equipment.
- 3) The individual performing the pressure sensor assembly change/installation must be properly grounded prior to initiating this process. Failure to do so could result in instrument damage due to electrostatic discharge.

## 21.1 Procedure for Installing Replacement Nickel Cadmium Batteries

\*\*\*\*\*WARNING\*\*\*\*\*

The optional built-in power pack uses 5 standard AA nickel cadmium rechargeable batteries. Use of any other battery type could cause damage to the indicator as well as injury to the operator of the unit. **ONLY STANDARD AA RECHARGEABLE NICKEL CADMIUM BATTERIES SHOULD BE USED WHEN BATTERY REPLACEMENT IS NECESSARY.**

**Step 1** Power down the indicator and unplug from the ac adaptor.

**Step 2** Place the indicator top down on a workbench and remove the four (4) feet by removing the phillips head screw in the bottom center of each foot.

**Step 3** Carefully, holding the upper and lower case halves together, pick up the indicator. With the instrument right side up separate the two case halves.

**Step 4** Disconnect, at the main board, all ribbon cable connections to the main board.

These include;

- 1- cable(s) between pressure sensor assembly (ies) and the main board
- 2- cable between the main board and the RS232 connection on the rear plate of the indicator (back left)
- 3- cable between the display board and the main board (right front)

4- cable between the switch board and the main board (left front)

**Step 5** Remove the front board set by lifting upward out of the retaining groove. Set aside the front board set.

**Step 6** Remove four phillips head screws that retain main board. One screw in each of the rear corners of the main board. One on the left side of the main, just in from the cut out in the main board. One on the right side of the main board just behind the cut out in the board.

**Step 7** Carefully lift the main board straight up so as not to bend the pin connections between the main board and the power supply board. This will expose the battery holders.

**Step 8** To replace the batteries, lift off each battery retaining clip by placing a small screwdriver in the gap between the battery contact and the end clip. Gently angle the screwdriver handle toward the center of the individual battery holder to disengage clip. Repeat procedure on clip on opposite side of the individual battery holder and for each of the five (5) battery receptacles.

**Step 9** With all the battery retaining clips removed, carefully remove each of the installed batteries.

**Step 10** Install 5 new AA rechargeable batteries. Be certain to follow polarity instructions provided in each of the battery receptacles.

**Step 11** After all 5 batteries have been replaced, re-install the 5 battery retaining clips by aligning the clip over the battery receptacle and pressing down evenly on each end of the clip.

**Step 12** Replace main board, carefully aligning the pin connections on the right side of each board.

Hints to help when changing batteries:

1) The side of the main board with the 2 single rows of pins is positioned to the front of the indicator during main board installation 2) Aligning the screw holes with the main board mounting posts will facilitate the alignment of the pin connection between the main board and the power supply board.

**Step 13** Gently press the board into position and replace the four (4) retaining screws used to hold the main board in position.

**Step 14** Re-connect the three ten pin connectors in the rear of the instrument to the unit's main board as follows:

- 1) Connect cable from the RS232 connector on the rear panel to receptacle on the left rear of the main board.
- 2) Connect cable from the left installed sensor to the receptacle directly in front of it on the main board.
- 3) If the optional second sensor is installed connect the cable from the right installed sensor to the receptacle directly in front of it on the main board.

**Step 15** Slide the front board set (display and switch boards) into the groove in the bezel on the front of the instrument case. Make sure the board set is seated all the way in the groove.

**Step 16** Reconnect the cables between the main board and the front board set as follows: Display cable on the right side of the front board set to the eight (8) pin (single row) connection on the front right side of the main board. Switch ribbon cable (multi-colored) to the fourteen (14) pin connector on the front left side of the main board. Carefully push down on the connectors to be certain they are firmly seated and will provide proper connections.

**Step 17** Replace the top cover of the instrument, carefully aligning the groove in the top cover front bezel with the front board set in the front of the indicator.

**Step 18** Carefully, holding the two case halves together, place the indicator top side down on a workbench.

**Step 19** Re-install the four (4) rubber feet. Do not over-tighten the phillips head screws that hold feet in position

Installation of the replacement batteries is now complete. General use of the indicator can now be resumed.

## SECTION A-1.0 INTRODUCTION

The remote RS232 interface is designed to provide the user with:

- 1) The necessary tools to query the indicator for information regarding the various user programmable set up configurations
- 2) The ability to modify the instrument set up via a remote terminal or computer.

Commands issued to the indicator must be from the library of commands contained within this appendix. If the indicator receives an unrecognized command it will respond with an error message.

**Important Note:** When the indicator is in the remote mode local (keypad activity) is locked out. The indicator must be removed from the remote operating mode to restore access to front panel functionality.

## SECTION A-2.0 NOTATION CONVENTIONS

This appendix uses the following conventions:

<b>Convention</b>	<b>Meaning</b>
<b>UPPER CASE</b>	Bold, uppercase letters indicate a command name
<i>left</i>	italicized letters indicate command parameters
[right]	items in [ ] indicate optional command parameter
USER I/O	Gothic letters indicate literal user I/O

## SECTION A-3.0 NUMERIC FORMAT

Numeric arguments may contain the following characters; +, -, . (decimal point) and 0 through 9. All numeric inputs will be truncated to an integer value. For example, a numeric input of 2.7 will be truncated to 2. There is no requirement in the indicator communication protocol for the use of numeric values that are not whole numbers.

## SECTION A-4.0 COMMAND REFERENCE

Each allowable entry is listed alphabetically. The information contained herein will provide details on the action performed as the result of each allowable command as well the proper syntax to use. A remarks section, providing details on optional information and typical usage and is included, as required, for each command. The expected return values (response of the indicator to the specific command) are included in examples provided for each command.

## SECTION A-5.0 COMMAND LIBRARY SUMMARY

Where input fields for two numeric values are provided for independent setting can be accommodated for both installed pressure sensor assemblies in indicators with optional second sensor.

Command	Expected Result																												
?	Indicator transmits numeric pressure value for active installed pressure sensor assemblies																												
BATCK?	Indicator transmits battery level in volts (numeric only)																												
DAMP?	Indicator transmits numeric value from 0-3 representing level of damping invoked																												
DAMP_0	Sets level of damping off																												
DAMP_1	Sets level of damping to low																												
DAMP_2	Sets level of damping to medium																												
DAMP_3	Sets level of damping to high																												
EUNIT?	Indicator transmits numeric value for engineering unit in use for active sensor(s) where:																												
	<table border="1"> <thead> <tr> <th>Response</th> <th>Represents</th> </tr> </thead> <tbody> <tr> <td>-1</td> <td>leave as is</td> </tr> <tr> <td>1</td> <td>psi</td> </tr> <tr> <td>2</td> <td>"Hg</td> </tr> <tr> <td>3</td> <td>"WC</td> </tr> <tr> <td>4</td> <td>ftSW</td> </tr> <tr> <td>5</td> <td>bar</td> </tr> <tr> <td>6</td> <td>mbar</td> </tr> <tr> <td>7</td> <td>kPa</td> </tr> <tr> <td>8</td> <td>MPa</td> </tr> <tr> <td>9</td> <td>mmHg</td> </tr> <tr> <td>10</td> <td>cmWC</td> </tr> <tr> <td>11</td> <td>mmWC</td> </tr> <tr> <td>12</td> <td>kgcm<sup>2</sup></td> </tr> </tbody> </table>	Response	Represents	-1	leave as is	1	psi	2	"Hg	3	"WC	4	ftSW	5	bar	6	mbar	7	kPa	8	MPa	9	mmHg	10	cmWC	11	mmWC	12	kgcm <sup>2</sup>
Response	Represents																												
-1	leave as is																												
1	psi																												
2	"Hg																												
3	"WC																												
4	ftSW																												
5	bar																												
6	mbar																												
7	kPa																												
8	MPa																												
9	mmHg																												
10	cmWC																												
11	mmWC																												
12	kgcm <sup>2</sup>																												
EUNIT X [,X]	Command to change engineering unit(s) numeral in [ ] would be for optional second (right) sensor.																												
HOLD?	returns 0 or 1 where: 0 = hold off 1 = hold active																												
HOLD_0	Disable hold function																												
HOLD_1	Activates hold function																												
KEYLOCK?	Requests status of keypad lockout function returns 0 or 1 where:																												
	<table border="1"> <thead> <tr> <th>Response</th> <th>Represents</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Keypad is disabled</td> </tr> <tr> <td>1</td> <td>Keypad is enabled</td> </tr> </tbody> </table>	Response	Represents	0	Keypad is disabled	1	Keypad is enabled																						
Response	Represents																												
0	Keypad is disabled																												
1	Keypad is enabled																												
KEYLOCK_0	Enables keypad																												
KEYLOCK_1	Disables keypad.																												
LASTERR?	Provides information on last error.																												
MIN/MAX?	Indicator transmits minimum & maximum value of any active sensor(s)																												
MIN/MAX [ ] [, ]	Indicator transmits minimum & maximum value of any active sensor(s) use: 0 or -1 to review and not reset values use: 1 to review and reset values																												
PORT?	Indicator transmits numeric value of 0-4 representing current configuration.																												
POR_0	Set indicator for left port active only																												
PORT_1	Set indicator for right port active only																												
PORT_2	Set indicator for left & right ports active																												
PORT_3	Set indicator for left - right (differential)																												
PORT_4	Set indicator for right - left (differential)																												
TARE?	Indicator transmits numeric value representative of current tare status.																												
TARE X [,X]	where: numeric value -1 = leave as is numeric value 0 = deactivate tare numeric value 1 = activated tare																												
ZERO X [,X]	where: numeric value -1 = leave as is numeric value 1 = establish new zero value																												



## APPENDIX A – INDICATOR SERIAL PORT FUNCTIONS VERSION 1.0

The following procedure can be employed for verification of serial port functionality on indicators and to gain an understanding of the command library for integration into other software.

### I. Equipment Requirements.

- A. Indicator with one or two sensors
- B. DB 9 Pin serial connector cable wired for straight through operation
- C. HVC, fittings and plumbing to generate pressure
- D. PC with Windows, Terminal application and open com port

### II. Test setup

- A. Connect cable to Indicator serial port and PC com port.
- B. Power up Indicator by pressing and holding “Hold” then pressing power button. This will display the Firmware Revision currently installed in the unit. Record the number in the block labeled “Firmware Revision” above
- C. Configure the serial port on the indicator as follows:
  1. Press “Shift”
  2. Press “Output” repeatedly until the menu option “remote” is flashing
  3. Press “Enter”.
  4. Press “Output” repeatedly until “9600” is flashing
  5. Press “Enter”
  6. Press “Output” repeatedly until CRLF (carriage return & line) is flashing
  7. Press “Enter”. The indicator’s serial port is now configured for 9600 baud communication with CRLF appended to data packet.
- E. Configure the com port in the PC Terminal application.
  1. Click on the Settings menu option and pull down to select Communications
  2. Click on 9600 Baud, 8 Data Bits, 1 Stop Bit, Parity None, Flow Control None, select the appropriate Com Port, and click OK. The Terminal application is now configured to communicate with the Indicator in the Remote Mode.
- F. Verify Communication between and PC
  1. Type a question mark character and press enter. The Indicator should respond with a display of pressure readings from both sensors similar to the following: ?  
0.004469,-0.000227

2. If there is no response, check cable connections, cable type (modem vs.thru), Com Port, and repeat steps D and E above.
3. If communication is established proceed to step III. If not there is a problem with the chip/firmware - consult engineering

### III Verification Procedure - Baud Rate

- A. Verify communication at all selectable baud rates.
- B. Configure the serial port on the indicator as follows:
  1. Press “Shift”
  2. Press “Output” repeatedly until the menu option “remote” is flashing
  3. Press “Enter”.
  4. Press “Output” repeatedly until “4800” is flashing
  5. Press “Enter”
  6. Press “Output” repeatedly until CRLF (carriage return & line) is flashing
  7. Press “Enter”. The indicator’s serial port is now configured for 4800 baud communication with CRLF appended to data packet.
- C. Configure the com port in the PC Terminal application.
  1. Click on the Settings menu option and pull down to select Communications
  2. Click on 4800 Baud, 8 Data Bits, 1 Stop Bit, Parity None, Flow Control None ,select the appropriate Com Port, and click OK. The Terminal application is now configured to communicate with the Indicator in the Remote Mode.
- D. Verify Communication at configured Baud Rate
  1. Type a question mark character and press enter. The Indicator should respond with a display of pressure readings from both sensors similar to the following: ?  
0.004469,-0.000227
  2. If there is no response, check cable connections, cable type (modem vs. thru), Com Port, and repeat steps B and C above.
  3. If communication is established repeat steps B through D, changing the baud rates to 2400, 600, 300 for each repetition. When complete set the baud rates back to 9600. If a problem is encountered note it in the notes column and consult engineering.

#### IV. Test Procedure - Verify Remote Command Library

The following library commands must be typed in terminal and the results verified. This is done by simply typing the commands exactly as shown, followed by pressing the enter key, and comparing the display results to those listed under each command. Where spaces required in the command string, they are indicated by underscore marks (don't type underscore hit space bar)

##### A. Battery Check Function

1. BATCK?
2. Response: 6.71 (or similar value)

##### B. Set/Get Dampening Value

1. DAMP\_2
  - a. Response: OK
2. DAMP?
  - a. Response: 2

##### C. Set/Get Engineering Unit Values

1. Type: EUNIT\_1,\_2
  - a. Response: OK
2. Type: EUNIT?
  - a. Response: 1,2
3. Type : EUNIT\_0,\_0
  - a. Response: OK

##### D. Verify engineering unit conversion factors

1. Apply slight pressure to the right sensor and lock HVC system
2. Type: EUNIT\_0
  - a. Response: OK
3. Observe and record the value displayed for the right sensor on the 's display. This value will be used to verify engineering unit conversion factors.
4. Type: EUNIT\_1
  - a. Response: OK
  - b. The right sensor data is now displayed in Inches of Water
  - c. Refer to drawing 822B122 "Conversion Factors for Units of Pressure"
  - d. Using the PSI value recorded in step E-3, and the conversion value from the drawing calculate the inches of water value and compare to the displayed value.
  - e. Assuming they are equivalent, proceed, if not consult engineering
5. Repeat steps E-3 through E-4-e, substituting the following values in the "type EUNIT\_1 command and compare the results to the calculated values.
  - a. Substitution Values:

- 2 (inches HG - psi x 2.03602)
- 3 (inches water @ 20C: psi x 27.703)
- 4 (ftSW - psi x 2.2457)
- 5 (Bar - psi x .0689476)
- 6 (mBar - psi x 68.9476)
- 7 (Kpa - psi x 6.89476)
- 8 (MPa - psi x 68.9476x10-4)
- 9 (mmHg - psi x 51.7149)
- 10 (cmWC@ 20C - psi x 70.433)
- 11 (mmWC - psi x 684.82)
- 12 (Kg/cm2 - psi x .07030696)

##### E. Set/Check Hold Value

1. Type: HOLD\_1
  - a. Response: OK (display indicates H)
2. Type: HOLD?
  - a. Response: 1
3. Type: HOLD\_0
  - a. Response: OK (display H disappears)

##### F. Set/Check Keylock Value

1. Type: KEYLOCK\_1
  - a. Response: OK
2. Type: KEYLOCK?
  - a. Response: 1 (keyboard is locked)
3. Type: KEYLOCK0
  - a. Response: OK (keyboard is unlocked)

##### G. Check Last error code

1. Type: ABC
  - a. Response: Err01
2. Type: LASTERR?
  - a. Response: Err01
3. Type: LASTERR?
  - a. Response: None

##### I. Reset/Get MinMax Values

1. Type: MINMAX?
  - a. Response:  
-0.012719,1.075889,  
-0.002789,0.018580  
(or similar value)
2. Type MINMAX?\_0,\_0
  - a. Response:  
-0.012719,1.075889,  
-0.002789,0.018580  
(should be the same value as response from step 1)

##### J. Get/Reset Port Configuration

1. Type: PORT?
  - a. Response: 2
2. Type: PORT\_0
  - a. Response: OK (display left port only)
3. Type: PORT?
  - a. Response: 0
4. Type: PORT\_1
  - a. Response: OK (display right port only)

5. Type: PORT?
  - a. Response: 1
6. Type: PORT\_2
  - a. Response: OK (display both ports)
7. Type: PORT?
  - a. Response: 2
8. Type: PORT\_3
  - a. Response: OK (display left-right port)
9. Type: PORT?
  - a. Response: 3
10. Type: PORT\_4
  - a. Response: OK (display right-left port only)
11. Type: PORT?
  - a. Response: 4
12. Type: PORT\_5
  - a. Response: OK (display left+right port)
13. Type: PORT\_2

#### K. Get/Set Tare Value

1. Type: TARE?
  - a. Response: 0,0
2. Type: TARE\_1,\_1
  - a. Response: OK (display shows two T's)
3. Type: TARE?
  - a. Response: 1,1
4. Type: TARE\_0,\_0
  - a. Response: OK (display T's gone)
5. Type: TARE?
  - a. Response: 0,0

#### L. ZERO Ports

1. Type ZERO\_1,\_1
  - a. Response: OK
1. Type ZERO\_0,\_1
  - a. Response: OK
1. Type ZERO\_1,\_0
  - a. Response: OK

#### V. Verify Print Function

##### A. Configure the serial port on the indicator as follows:

1. Press "Shift"
2. Press "Output" repeatedly until the menu option "print" is flashing
3. Press "Enter".
4. Press "Output" repeatedly until "9600" is flashing
5. Press "Enter"
6. Press "Output" repeatedly until CRLF (carriage return & line) is flashing
7. Press "Enter". The indicator's serial port is now configured for 9600 baud communication with CRLF appended to data packet.
8. Press "Output" repeatedly until "All" is flashing
9. Press "Enter"
10. Press "Output" repeatedly until "Man" is flashing

11. Press "Enter". The serial port is now configured to respond to activity on the "Print" key.

##### B. Press "Print" Key

1. Response: ,2 -0.0001 kPa +0.000 PSI (or similar data)

#### VI. Check Data Packet Contents

##### A. Configure the serial port on the indicator as follows:

1. Press "Shift"
2. Press "Output" repeatedly until the menu option "print" is flashing
3. Press "Enter".
4. Press "Output" repeatedly until "9600" is flashing
5. Press "Enter"
6. Press "Output" repeatedly until CRLF (carriage return & line) is flashing
7. Press "Enter". The indicator's serial port is now configured for 9600 baud communication with CRLF appended to data packet.
8. Press "Output" repeatedly until "Press+EU" is flashing
9. Press "Enter"
10. Press "Output" repeatedly until "Man" is flashing
11. Press "Enter". The serial port is now configured to respond to activity on the "Print" key with only pressure and engineering unit data

##### B. Press "Print" Key

1. Response: -0.0001 kPa +0.000 PSI (or similar value)

##### C. Configure the serial port on the indicator as follows:

1. Press "Shift"
2. Press "Output" repeatedly until the menu option "print" is flashing
3. Press "Enter".
4. Press "Output" repeatedly until "9600" is flashing
5. Press "Enter"
6. Press "Output" repeatedly until CRLF (carriage return & line) is flashing
7. Press "Enter". The indicator's serial port is now configured for 9600 baud communication with CRLF appended to data packet.
8. Press "Output" repeatedly until "Pressure" is flashing
9. Press "Enter"
10. Press "Output" repeatedly until "Man" is flashing

11. Press “Enter”. The serial port is now configured to respond to activity on the “Print” key with only pressure data.

D. Press “Print” Key

1. Response: -0.0002 -0.000 (or similar data)

## VII. Verify Output Options

### A. Pace Mode

1. Configure the serial port on the indicator as follows:
  1. Press “Shift”
  2. Press “Output” repeatedly until the menu option “Print” is flashing
  3. Press “Enter”.
  4. Press “Output” repeatedly until “9600” is flashing
  5. Press “Enter”
  6. Press “Output” repeatedly until CRLF (carriage return & line) is flashing
  7. Press “Enter”. The indicator’s serial port is now configured for 9600 baud communication with CRLF appended to data packet.
  8. Press “Output” repeatedly until “All” is flashing
  9. Press “Enter”
  10. Press “Output” repeatedly until “Pace” is flashing
  11. Press “Enter”. The serial port is now configured to respond to activity on the “Print” key.
2. Press the “Enter” key on the computer keyboard
  1. Response: ,2 -0.0002 kPa -0.001 PSI (or similar data)

### A. 1s Mode

1. Configure the serial port on the indicator as follows:
  1. Press “Shift”
  2. Press “Output” repeatedly until the menu option “Print” is flashing
  3. Press “Enter”.
  4. Press “Output” repeatedly until “9600” is flashing
  5. Press “Enter”
  6. Press “Output” repeatedly until CRLF (carriage return & line) is flashing
  7. Press “Enter”. The indicator’s serial port is now configured for 9600 baud communication with CRLF appended to data packet.

8. Press “Output” repeatedly until “All” is flashing

9. Press “Enter”

10. Press “Output” repeatedly until “1s” is flashing

11. Press “Enter”. The serial port is now configured to respond to activity on the “Print” key.

2. Press the “Enter” key on the computer keyboard

1. Response: ,2 -0.0002 kPa -0.001 PSI  
,2 -0.0002 kPa -0.001 PSI  
,2 -0.0002 kPa -0.001 PSI  
(or similar data)

### B. 15s Mode

1. Configure the serial port on the indicator as follows:

1. Press “Shift”

2. Press “Output” repeatedly until the menu option “Print” is flashing

3. Press “Enter”.

4. Press “Output” repeatedly until “9600” is flashing

5. Press “Enter”

6. Press “Output” repeatedly until CRLF (carriage return & line) is flashing

7. Press “Enter”. The indicator’s serial port is now configured for 9600 baud communication with CRLF appended to data packet.

8. Press “Output” repeatedly until “All” is flashing

9. Press “Enter”

10. Press “Output” repeatedly until “15s” is flashing

11. Press “Enter”. The serial port is now configured to respond to activity on the “Print” key.

2. Press the “Enter” key on the computer keyboard

1. Response: ,2 -0.0002 kPa -0.001 PS (or similar data)

- C. Repeat steps B1 through B2.1 substituting “1m”, “15m”, “1h”, “Cont” and observe the results on the screen

## APPENDIX B - END OF MESSAGE CHARACTERS

Character	Decimal	Hexadecimal
CRLF	13 10	0D 0A
CR	13	0D
EOT	4	04
,	44	2C
ETX	3	03
HTAB	9	09
;	59	3B
NULL	0	00

## APPENDIX C – PRODUCT SPECIFICATIONS

### PHYSICAL SPECIFICATIONS

#### Dimensions

7.72 in. (L) x 6 in. (W) x 2.95 in. (H)

#### Panel Cutout

5.4 in. x 2.68 in.

#### Weight

Depending on configuration

Max. <4 lbs. w/2 sensors and battery pack

#### Case Material

High impact ABS

#### Sensor Capacity

2 bays for sensors or RTD assembly

#### Display

2 line LCD, 0.038 in. height per line. Can display simultaneous readings from both bays.

#### Options

*Backlit Display*

*Built-in NiCad Rechargeable Battery Pack*

*Handle*

*Panel Mounting Brackets*

### OPERATING SPECIFICATIONS

#### Operating Temperature Range

32° to 120°F

#### Storage Temperature

-4° to 158°F

#### Update Rate

130 ms (nominal) with one sensor installed

#### Resolution

±0.002% of span, 60,000 counts (max)

#### Power Requirements

Standard: ac adapter provided for 110Vac/60 Hz

Available: ac adapter provided for 220Vac/50 Hz

ac adapter provided for 100Vac/60 Hz

Optional: Built-in rechargeable NiCad Battery Pack\*

\* (Life: 25 hours nominal without backlit LCD, 5 hours nominal with backlit LCD. Activating RS232 results in approximately 30% reduction in battery life.)

#### Certification

N.I.S.T. Traceable certification document provided for base display unit and sensor modules

### PRESSURE SENSOR SPECIFICATIONS

#### LOW PRESSURE SENSORS

##### Pressure Types

Gauge, differential and compound

#### Available Ranges

(See Chart)

#### Available Accuracies

±0.06 (0/2-0/200 in. H<sub>2</sub>O), ±0.07 (0/0.25-0/1 in. H<sub>2</sub>O) or 0.1% of Span

#### Compensated Temperature Range

20°F to 120°F

#### Temperature Effect

±0.004% of Span per °F over compensated range (from reference temperature range of 70° ±3°)

#### Repeatability

±0.01% of span (range 0/1 in. H<sub>2</sub>O or higher)

±0.02% of span (ranges below 0/1 in. H<sub>2</sub>O)

#### Sensitivity

±0.002% of span (typical)

#### Media Compatibility

Clean, dry, non-conductive, non-corrosive gas

#### Under/Overpressure Capability

-15 to 50 psi

#### Maximum Static (line) Pressure

100 psi

#### Process Connection

Standard: 1/8 NPT female

Optional: G 1/8 British standard

### MEDIUM-HIGH PRESSURE SENSORS

#### Pressure Types

Gauge, absolute, compound and vacuum

#### Available Ranges

(See Chart)

#### Available Accuracies

±0.025, 0.05 or 0.1 % of Span (±0.025 & 0.05% not available on 0/10,000 psi range)

#### Compensated Temperature Range

20°F to 120°F

#### Temperature Effect

Standard: ±0.004% of Span per °F over the compensated range (from reference temperature range of 70° ±3°)

Optional: No additional error due to temperature over the compensated range

#### Repeatability

±0.01% of span

#### Sensitivity

±0.002% of span (typical)

#### Media Compatibility

0/5-0/10,000 psi ranges: Any medium compatible with 316 SS isolation.

Optional: Cleaned for Oxygen Service



**Overpressure Capability**  
 200% for ranges up to 1000 psi  
 150% for ranges over 1000 psi

**Process Connection**  
 Standard: 1/8 NPT female  
 Optional: 1/8 NPT female with flush port  
 (ranges 10 psi and over)  
 G 1/8 British standard  
 G 1/8 British standard with flush port  
 (ranges 10 psi and over)  
 Welded VCR fitting with standard  
 finish

**RTD INTERFACE ASSEMBLY**

RT1: Accommodates Pt100, Ni120, Cu120 and other common 2, 3 or 4 wire probes with resistance outputs of 400 ohms or less.  
 RT2: Accommodates Pt1000 and other common 2, 3 or 4 wire probes with resistance outputs of 4000 ohms or less.

**Input Receptacle**  
 Accepts TA4F type RTD connector

**RTD Probes Available**  
 Pt-100 probes, 6" or 12" length, with or without handle. DIN Class A accuracy. Includes mating TA4F connector. Consult factory for details and availability.



Rear view of Indicator with 2 pressure sensors installed

STANDARD RANGES		
Med.-High ranges – psi (gauge and absolute pressure)	Low ranges in. H <sub>2</sub> O (gauge/differential pressure)	Other Engineering Units**
5		
10	0.25*	psi
15	0.5*	in. H <sub>2</sub> O
30	1.0*	in. Hg
50	2.0*	ftSW
60	3.0*	bar
100	5.0*	mbar
150	10*	kPa
200	15*	MPa
250	25*	mmHg
300	50*	cmH <sub>2</sub> O
500	100*	mmH <sub>2</sub> O
600	150*	kg/cm <sup>2</sup>
1000	200*	User Selectable
1500		
2000		
2500		
3000		
5000		
6000		
7500		
10,000		
<b>vacuum</b>		
5		
10		
15		
<b>compound</b>		
±5		
±10	±0.125*	
±15	±0.25*	
-15/+30	±0.5*	
-15/+60	±1.0*	
	±1.5*	
	±2.5*	
	±5.0*	
	±7.5*	
	±12.5*	
	±25*	
	±50*	
	±75*	
	±100*	

\*\*Note: Engineering units identified above are accessible through the unit select feature. However, readout will default to the primary unit of measure on start-up. Sensor modules scaled in primary units other than in. H<sub>2</sub>O (low pressure) or psi (high pressure) are also available. Consult factory.

\* Non-isolated, for clean dry gas only

**APPENDIX D – REMOTE COMMUNICATIONS PROTOCOL ERRATA SHEET**

This errata sheet describes changes were made to the firmware that affect the operation of the Remote Protocol. These changes were made at Firmware Version 2.04 and apply to Version 2.04 and later. Reference to Version 2.03 apply to Version 2.03 and earlier.

**Character Echo.**

**Version 2.03.** All characters received by the unit, when in Remote protocol, will be echoed back to the host. After the End Of Message (EOM) sequence is received and echoed, the unit will transmit an additional EOM sequence before transmitting the reply message followed by the final EOM sequence.

**Version 2.04.** An additional menu is added if Remote Protocol is selected. The user can select between 'Terminal

Mode' or 'Computer Mode'. In Terminal Mode, the character echo function will operate just as it did in Version 2.03. In Computer Mode, character echo will not occur, the query command will not be echoed and an additional EOM sequence will not be transmitted.

End of Message Character(s).

The End Of Message (EOM) character sequence is configured from the menus when Remote protocol is selected.

Version 2.03.

If the unit is configured for the CRLF EOM character sequence, the unit will (incorrectly) recognize a single CR (0Ah) character as the end of message. If the host transmits a two character sequence CRLF (0Dh 0Ah) at the end of a message, the next message will fail (Err 01). The

unit will (correctly) transmit the two character CRLF(0Dh 0Ah) EOM sequence on transmissions to the host.

If the unit is configured for any single character EOM sequence, , the unit will (correctly) recognize the single character as the end of message. The unit will (incorrectly) transmit a two character EOM sequence consisting of the EOM character followed by a NULL, on transmissions to the host.

If the comma is selected as the EOM character, the unit will not recognize it as an EOM character since the comma is recognized (first) as a delimiter character.

The EOM sequences and the resultant receive and transmit characters are as followed.

Menu Selection	Receive Transmit	
	Hex	Hex
CRLF	0D	0D 0A
CR	0D	0D 00
EOT	04	04 00
,	2C	2C 00
ETX	03	03 00
HTAB	09	09 00
;	3B	3B 00
NULL	00	00 00

The following examples illustrate these characteristics.

(A) This example shows the interface sequence with the host running HyperTerminal. Note that the characters are echoed as they are received because of the relatively low data rate.

The host will transmit: EUNIT 1,2[CR]  
 The unit will reply:  
 EUNIT 1,2[CR][CR][LF]OK[CR][LF]

Serial Line Analyzer Display:  
 EOM=CRLF, MSG=EUNIT 1,2 Data is shown in Hex.

```
Host 45 55 4E 49 54 20 31 2C 32 0D
Unit 45 55 4E 49 54 20 31 2C 32 0D 0D 0A
```

## Host

```
Unit 4F 4B 0D 0A
```

(B) This example shows the format for single character EOM sequences (CR).

The host will transmit: HOLD?[CR]  
 The unit will reply:  
 HOLD?[CR][CR][NULL]0[CR][NULL]

Serial Line Analyzer Display  
 EOM=CR, MSG=HOLD? Data is shown in Hex.

```
Host 48 4F 4C 44 3F 0D
Unit 48 4F 4C 44 3F 0D 0D 00 30 0D 00
```

## Version 2.04.

The unit will correctly recognize and process, one and two character EOM character sequences. The comma EOM character is replaced with the colon.

The EOM sequences and the resultant receive and transmit characters are as followed.

```
Host 48 4F 4C 44 3F 0D
Unit 30 0D
```

## Remote Calibration

Remote calibration is initiated by holding the PRINT key down while powering up the unit. When remote calibration is activated, the communications protocol is forced to Remote-Terminal Mode, regardless of any mode that was previously selected from the front panel menus.

The terminal (or computer) that is attached to the unit should be set up as follows:

```
Baud Rate: 300/600/2400/4800/9600
Data Bits: 8
Stop Bits: 1
Parity: None
Flow control: None
Comm Port: per port being used.
```

The indicator should be set up as follows:

```
Baud Rate: 300/600/2400/4800/9600 (must match terminal rate)
End of Msg: CRLF
Note: Any EOM character sequence may be used as long as it matches the terminal setup.
```

References in the manual to Left Port and Right Port sensor assemblies, are as viewed from the front of the unit.

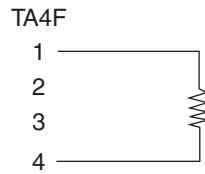
# APPENDIX E

## RTD PROBE CONNECTOR

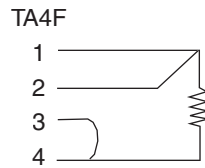
### SWITCHCRAFT TINI QG (TA4F)

PIN	FUNCTION
1	2W+
2	4W+
3	4W-
4	2W-

#### 2 WIRE RTD



#### 3 WIRE RTD



#### 4 WIRE RTD





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SP 250 Rev. 3.2 3/04 (I&M002-10110)