# SENSIDYNE®

## Industrial Health & Safety Instrumentation

**INSTRUCTION MANUAL**

**MODEL 9000 TWO CHANNEL CONTROLLER**

**Document No. 360-0050-01 Revision E**



⚡ **Warning: Read & understand contents of this manual prior to operation. Failure to do so could result in serious injury or death.**

# WARNINGS

## READ AND UNDERSTAND ALL WARNINGS BEFORE USE

Read and understand **ALL** warnings before using this product. Failure to read, understand, and comply with **ALL** warnings could result in property damage, severe personal injury, or death.

Read and understand **ALL** applicable Federal, State, and Local environmental health and safety laws and regulations, including OSHA. Ensure complete compliance with **ALL** applicable laws and regulations before and during use of this product.

**UNDER NO CIRCUMSTANCES** should this product be used except by qualified, trained, technically competent personnel and not until the warnings, *Operation and Service Manual*, labels, and other literature accompanying this product have been read and understood.

This product should **NOT** be used in any way other than specified in this manual.

**DO NOT** remove, cover, or alter any label or tag on this product, its accessories, or related products.

**DO NOT** operate this product should it malfunction or require repair. Operation of a malfunctioning product, or a product requiring repair may result in serious personal injury or death.

**DO NOT** attempt to repair or modify the instrument, except as specified in the *Operation and Service Manual*. Contact the Sensidyne Service Department to arrange for a Returned Material Authorization (RMA).

**ONLY** use genuine Sensidyne replacement parts when performing any maintenance procedures provided in this manual. *Failure to do so may seriously impair instrument performance.* Repair or alteration of the product beyond the scope of these maintenance instructions, or by anyone other than a certified Sensidyne serviceperson, could cause the product to fail to perform as designed and persons who rely on this product for their safety could sustain severe personal injury or death.

Operation of the alarm relays above their contact ratings may result in false alarms or relay failure.

### Disclaimer

Sensidyne, LP assumes no responsibility whatsoever, to any party whosoever, for any property damage, personal injury, or death received by or resulting from, in whole, or in part, the improper use, installation, or storage of this product by the user, person, firm, entity, corporation or party not adhering to the instructions and warnings or not adhering to all federal, state, and local environmental and occupational health and safety laws and regulations.

The seller shall not be liable for direct, indirect, consequential, incidental or other damages resulting from the sale and use of any goods and seller's liability hereunder shall be limited to repair or replacement of any goods found defective. This warranty is in lieu of all other warranties, expressed or implied, including but not limited to the implied warranties of merchantability and fitness for use or for a particular purpose which are expressly disclaimed.

# SECTION 1

## *IMPORTANT SAFETY ISSUES*

The following terms and symbols are used in this manual to alert the operator of important instrument operating issues:

This symbol is intended to alert the user to the presence of important operating and maintenance (servicing) instructions.

This symbol is intended to alert the user to the presence of dangerous voltage within the instrument enclosure that may be sufficient magnitude to constitute a risk of electric shock.

This symbol signifies the system's ground terminal

DC refers to direct current voltages.
VAC refers to alternating voltages.

**WARNINGS:**
- **WARNING- EXPLOSION HAZARD**- DO NOT OPEN ENCLOSURE OR DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
- **Shock Hazard** - Disconnect or turn off power before servicing this instrument.
- NEMA 4X wall mount models should be fitted with a locking mechanism after installation to prevent access to high voltages by unauthorized personnel (see Figure 4.0).
- Only the combustible monitor portions of this instrument have been assessed by CSA for 122.2 No. 152 performance requirements.
- This equipment is suitable for use in Class I, Division 2, Groups A,B,C and D or non-hazardous locations only.
- **WARNING- EXPLOSION HAZARD**- SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.
- **WARNING- EXPLOSION HAZARD**- DO NOT REPLACE FUSE UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
- Use a properly rated CERTIFIED AC power (mains) cable installed as per local or national codes.
- For DC powered units, DC power must be from a SELV rated source.
- A breaker is required and should be mounted near the controller and installed following applicable local and national codes.  If a switch is used instead of a

circuit breaker, a properly rated CERTIFIED fuse or current limiter is required to be installed as per local or national codes.  Markings for positions of the switch or breaker should state (I) for on and (O) for off.
- Clean using only a damp cloth with no solvents.
- Equipment not used as prescribed within this manual may impair overall safety.

## 1.0     GENERAL DESCRIPTION

The Sensidyne, LP MODEL 9000/DUAL Two channel Controller is designed to display, and control alarm event switching for two sensor points.  Sensor signals may be input as 4-20mA from transmitters, or, several signal conditioning options (see section 3.1) are available to accept sensors directly.  The MODEL 9000 is equipped with three alarms per channel with features such as *ON / OFF* delays, latching relays and alarm *Acknowledge*.  A dedicated horn driver circuit for a local audible annunciator is also standard.  Two standard 5-amp alarm relays are configurable via the "alarm voting" menu to make relays trip based upon various alarm combinations.  Real-Time Clock and Calendar are also standard. Options such as 4-20mA outputs, discrete relays for each alarm and audible annunciators are easily added.  RS-485 (Modbus RTU) or Ethernet (Modbus TCP) ports are also available for sending data to PC's, PLC's, DCS's, or other controllers.

A 128 x 64 pixel graphic LCD readout displays monitored data as bar graphs, 30-minute trends and engineering units.  System configuration is via user friendly menus and all configuration data is retained in non-volatile memory during power interruptions.  The MODEL 9000 front panel is shown below in Figure 1.0 displaying the bar graph data screen.  The five button symbols below the display are magnetically activated using the supplied magnetic wand without opening the enclosure.  Opening the enclosure door provides access to the "touch" keypad as shown in Figure 1.1.
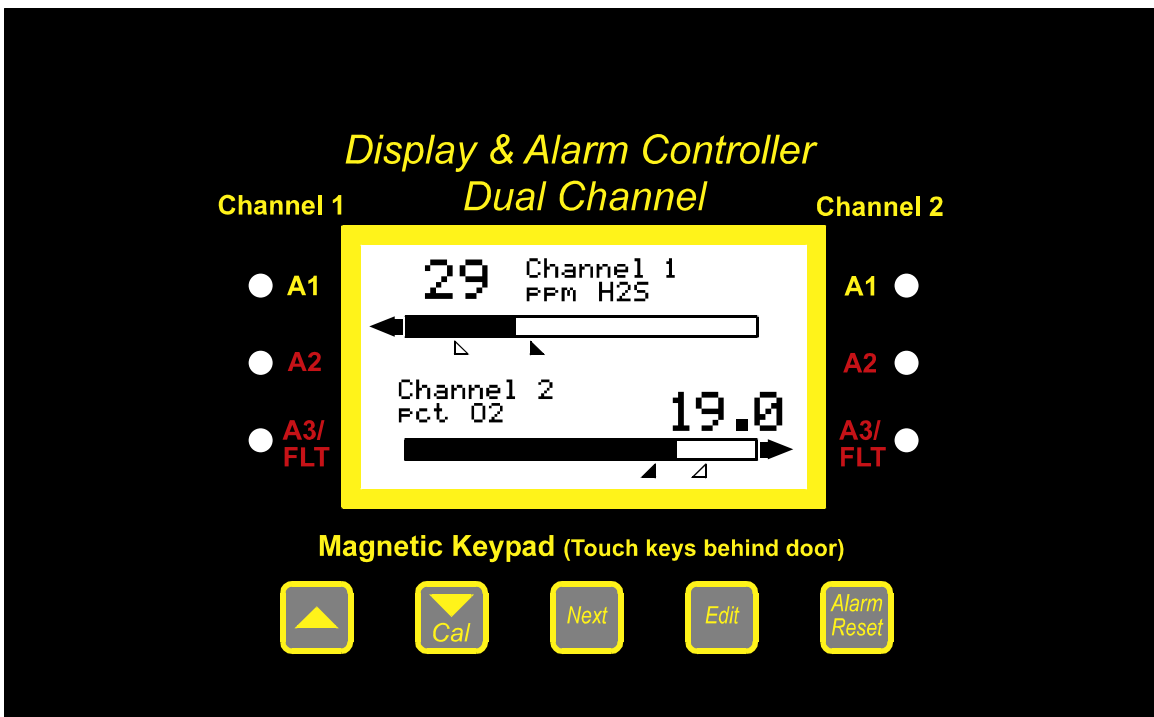


Figure1.0
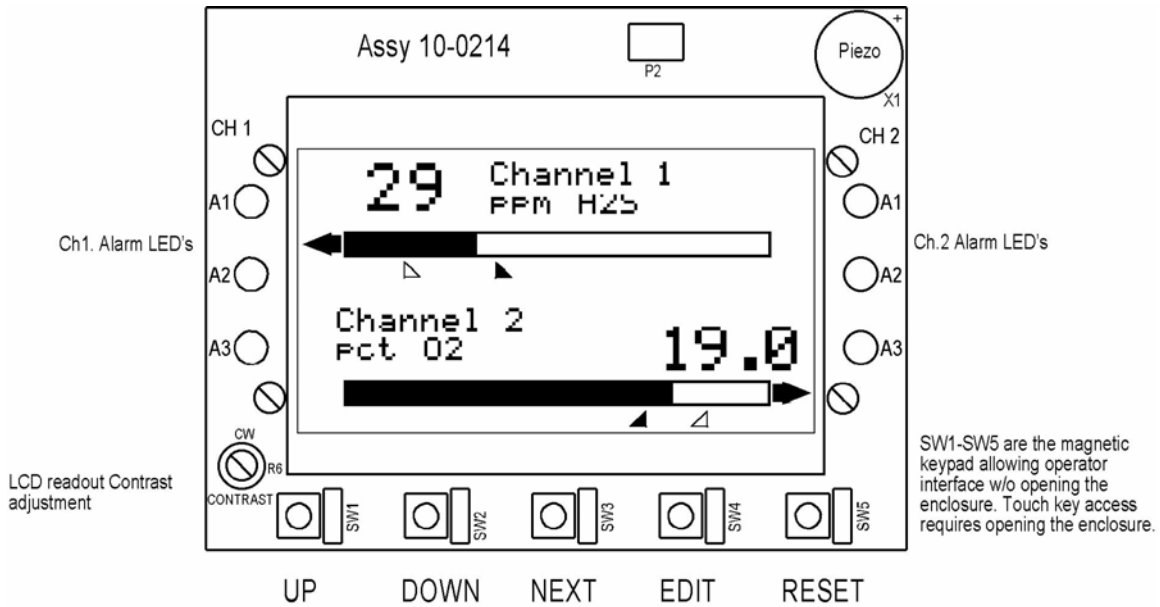
Figure1.1

## 1.1    DATA DISPLAY SCREENS

The MODEL 9000 Controller offers three modes for displaying monitored data.  Each are shown below in Figure 1.2.



Main Data Screen

Trend Screen

Blind Mode Screen
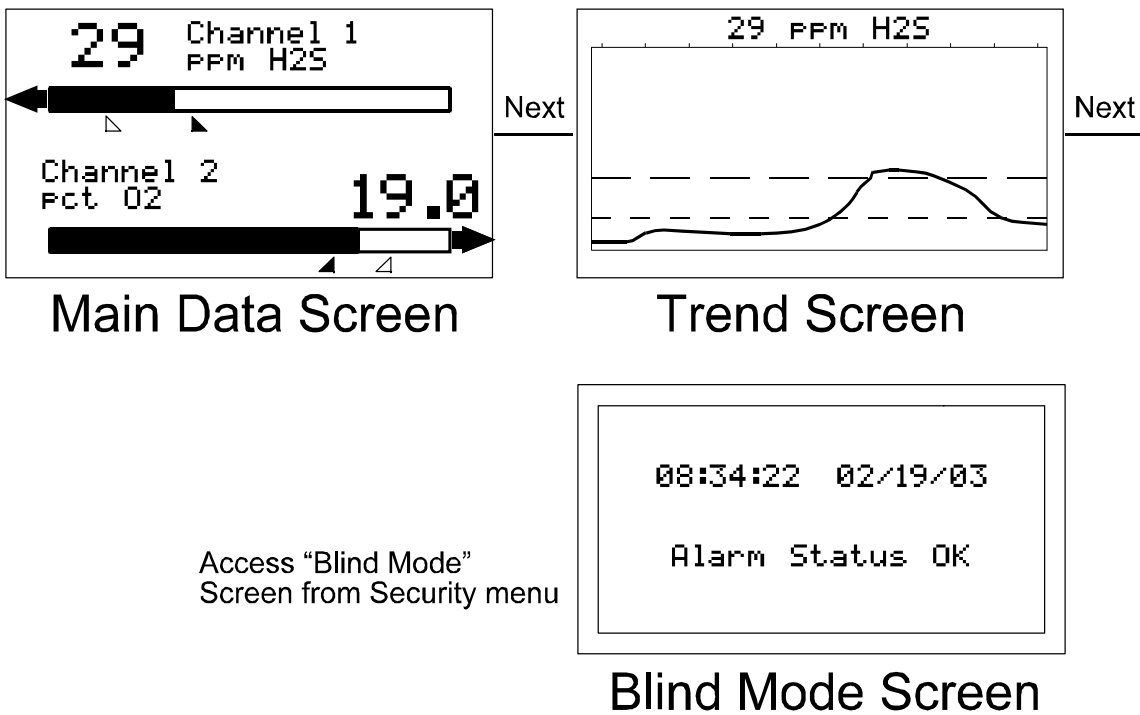
Figure 1.2

### 1.1.1   MAIN DATA SCREEN

The MODEL 9000 Main Data screen shown at left in Figure 1.2 allows each channel to be viewed simultaneously.  Engineering unit values and bar graph values are both displayed in real time.  Arrows **below** the bars indicate alarm trip point values, making it easy to identify channels at or near alarm.  The direction the horizontal 45 degree arrow side points indicates either a HIGH or LOW trip as illustrated in Figure 1.1 where Ch 1 points right indicating high level trips and Ch 2 points left indicating low level trips.  Left and Right hand arrows located at the **ends** of each bar graph point towards Channel Alarm LED's on the front panel associated with this reading.  The 10-digit ASCII fields for identifying engineering units and Channel ID for each channel are also shown on the Main Data screen.

### 1.1.2   TREND SCREEN

In addition to the Main Data screen described above, the MODEL 9000 also provides 30-minute trend screens for each channel as shown in Figure 1.2.  Data screens are selected by the NEXT key.

### 1.1.3   BLIND MODE SCREEN

The MODEL 9000 Blind Mode screen shown at right in Figure 1.2 does not allow viewing of channel engineering unit values.  It only indicates the system's alarm status and time / date.  Some applications require only alarm status be displayed and prefer monitored values not be shown.  A SECURITY menu (see section 2.40) allows locking all configuration parameters and having only the Blind Mode screen available for viewing.

### 1.2     SPECIFICATIONS:

### 1.2.1   POWER SUPPLY REQUIREMENTS

MODEL 9000 primary power may be either 10-30 VDC or 100-240VAC.  AC power requirements are 100-240 VAC 50/60 Hz @ .80 amp max (including inrush) and 40 watts max steady state, applied to TB5 on the motherboard.  If AC power is not available the primary power may be 10-30 VDC applied to TB1 on the motherboard.  A back-up DC power source may also be connected to TB1 for automatic switchover if the AC power source fails.  See Figures 3.0 & 3.1 for wiring information.

The basic MODEL 9000 consumes only 1.5 watts of 10-30 VDC power.  Optional features such as relays and analog outputs increase power consumption as described below:

- 299-0002-01, **Analog Input PCB** option; add wattage for each monitor connected to this board's 24 VDC terminals.
- 299-0003-01, **Discrete Relay PCB** option; add 1.5 watt.
- 299-0004-01, **4-20mA Output PCB** option; add .5 watt.
- 10-0219, **Bridge Sensor Input PCB** option; add wattage of each sensor attached.

With an AC primary power source connected to TB1 on the motherboard, TB3 terminals 1 & 2 on the motherboard provide a maximum of 12 watts output power for powering of auxiliary external devices such as relays, lights and monitors (see Figure 3.0). Power consumed from TB3 must be included when calculating system power consumption. **IMPORTANT!** <u>TB3 only provides 24VDC power when AC is primary power</u>.

24 VDC terminals on the 10-0221 Analog input option (see Figure 3.3) may also be used to power external transmitters and these loads must be calculated into the overall power budget. These terminals receive power from both the integral AC / DC power supply and the external TB1 supply as shown in Figure 3.0.

Some applications may require 24VDC power in excess of that available from the MODEL 9000's integral AC power supply and thereby require an external AC/DC supply. NEC Class 2 FIFTY WATT external supplies are available for Division 1 (part # 10-0314) and Division 2 (part # 10-0315) potentially hazardous area installations and both also include a NEMA 4X weather rating. See complete specifications at: http://www.rcsystemsco.com/rc/prod_view.asp?pid=25.

### 1.2.2 RELAYS

Two mechanical (dry contact) Common Form C relays are standard and may be mapped to various alarm events as described in section 2.3.1. MODEL 9000's may also be equipped with optional solid-state common Form A relays (see order guide for details) in applications requiring non-arcing switching. Solid-state relays are recommended for switching of highly inductive loads.

A six mechanical (dry contact) Discrete Relay option board (see section 3.1.6) provides dedicated Form C relays for ALARM 1, ALARM 2 and FAULT for both channels.

⚠️ All mechanical (dry contact) relays are rated at 5 Amp for 28 VDC and 250 ~VAC **RESISTIVE** loads. IMPORTANT: Appropriate diode (DC loads) or MOV (AC loads) snubber devices must be installed with inductive loads to prevent RFI noise spikes.

Optional solid state relays are rated at 2 Amp 12-280 ~VAC (600Vpk).

Relay wiring should be kept separate from low level signal wiring.

### 1.2.3 AMBIENT TEMPERATURE RANGE

-25 to 60 degrees C

### 1.2.4 HUMIDITY RANGE

0 TO 90% R. H. Non-Condensing.

### 1.2.5 ALTITUDE

Recommended up to 2000 meters

### 1.2.6 HOUSINGS / INSTALLATION CATEGORIES

- *NEMA 4X wall mount. DIV 2 Groups A,B,C,D; Category II and pollution degree 3; NEMA 4X; IP66

- *NEMA 7 wall mount for DIV 1 & 2 Groups B,C,D; includes 'O' Ring in door to satisfy NEMA 4 rating.

*Includes standard non-intrusive magnetic keypad.

### 1.2.7    APPROVALS

CSA C22.2 No 1010.1 and ISA S82.02; CSA C22.2 No 152 for combustibles; UL 1604 / C22.2 No 213 (Div 2 Groups A,B,C,D); EN55011 & EN61000 (CE Mark).  CSA File # = 219995 and may be seen at:  CSA-International.org.

# SECTION 2

### 2.0    BASIC OPERATION

The MODEL 9000's graphic LCD displays monitored data and with the 5-button keypad also serves as the system's operator interface.  All MODEL 9000 configuration variables are entered with this operator interface using SETUP menus accessed by pressing **EDIT** from either data screen.  This *Setup* mode may be exited manually by pressing **NEXT,** or automatically when no keys are pressed for 5 minutes.  Alarm relays and front panel alarm LED indicators remain active during the *Setup* mode.  Alarm LED's flash upon new alarms and become steady after *Acknowledged* by pressing the **ALARM RESET** key.  A **SECURITY** menu offers a password feature to prevent tampering with MODEL 9000 parameters.

Several signal conditioning input options are available to allow the MODEL 9000 accept sensor and other analog signals directly (see section 3.1).  A "sign-on" screen appears briefly after power is applied that indicates what type input / output options the unit is configured with.

### 2.1    SETUP MENU CONFIGURATION

Variables inside the **CHANNEL** (see section 2.2) and **SYSTEM** (see section 2.3) menu trees allow MODEL 9000 configuration for a wide range of monitoring applications.  Select the desired menu by scrolling with **UP/DOWN** and then **EDIT** to enter each menu.  Figure 2.0 illustrates the menus tree for configuring *Channel* variables on its right side and *System* specific variables on the left side.  *Channel* variables affect only the specific channel selected while *System* variables are related to features not specific to either channel.

**Blind Mode Screen**

```
08:34:22  02/19/03

Alarm Status OK
```

"Blind Mode" may be locked from
the SECURITY menu for app's
where live readings should not
be displayed.

**Ch. Trend Screen**

```
29 ppm H2S
```

**Main Data Screen**

```
   Channel 1
29 ppm H2S


   Channel 2
   Pct 02      19.0
```

Press Next to
toggle Data
Screens

Press Edit

**System SECURITY**

```
►Contact Name
 Blind Mode    NO
 Pass Code

        Unlocked
```

**Clock/Delays**

```
►Startup Delay  60s
 Cal Delay      60s
 Time       08:34:22
 Date       02/19/03
```

**Diagnostics**

```
►Ouput Zero
 Output Span
 Input Min/Max
 Common Relays
 Discrete Relays
```

**Horn/Piezo**

```
►Piezo On      YES
 Horn ACK      NO
```

**Relay 2**

```
►Set Relay Logic
 Fail Safe    STEADY
 Horn
 Acknowledge   NO
```

**Relay 2**

```
        OR  AND  OVR
 Ch2 A1
 Ch2 A2
 Ch2 A3
 Ch1 A1
 Ch1 A2
 Ch1 A3
```

**Relay 1**

```
►Set Relay Logic
 Fail Safe      NO
 Horn     PULSE
```

**Relay 1**

```
        OR  AND  OVR
 Ch2 A1
 Ch2 A2
 Ch2 A3
 Ch1 A1
 Ch1 A2
 Ch1 A3
```

**SETUP**

```
►Channel 1
 Channel 2
 System
 Security
```

Select Item, press Edit

**System SETUP**

```
►Relay 1
 Relay 2
 Horn/Piezo
 Conn Port
 Clock/Delays
 Diagnostics
```

Select Item, press Edit

Select Item, press Edit

Select Item, press Edit

"System" Setup Menus

Press Next to reverse direction

< "Channel" Setup Menus

**Channel 1 SETUP**

```
►Alarm 1
 Alarm 2
 Alarm 3
 Configure
 CAL Setup
```

Select Item, press Edit

**Channel 1 CONFIG**

```
►Name    User Info
 EUNIT   10 digits
 Zero          0
 Span        100
 Decimal Pts.
 Channel Active YES
```

**Ch. 1 CAL SETUP**

```
►Zero Gas      0.0
 Span Gas     50.0
 Set UNITY Gain
 CAL Offset 0.000
 CAL Gain   1.000
```

Select Item, press Edit

**Alarm 1 Setup**

```
►Set Point      20
 ON Delay       0s
 OFF Delay      0m
 Low Trip       NO
 Latching       NO
```

Note:
Alarm 2 & 3 menus not
shown since identical to
Alarm 1.

# ST-90 Two Channel Controller Menu Tree

**Figure 2.0**

## 2.2　　CHANGING MENU VARIABLES USING THE KEYPAD

Upon entering a menu, a pointer controlled by the **UP/DOWN** keys indicates the selected variable.  Some are simple *YES/NO* or *ON/OFF* entries toggled by pressing the **EDIT** key.  Others, such as *Channel ID* and *Eunits* fields may have many ASCII character possibilities.  Allowed ASCII characters are as follows: ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz blank space !"#$%&`()*+,-./0123456789:;<=>?@.  Notice the often used *blank* character is located after lower case **z** and before the exclamation point **!.  EDIT** places a cursor under the item and **UP/DOWN** scrolls through each allowed entry.  The **NEXT** key moves the cursor to the next position within a field.  When the field is complete, **EDIT** clears the cursor and loads the field into non-volatile memory where it is retained indefinitely.  Without a cursor present, the **NEXT** key closes open menus in reverse order and returns the LCD to the data display.

### 2.2.1　　MODEL 9000 SETUP CONFIGURATION MENUS

The SETUP menu shown in the middle of Figure 2.0 and in Figure 2.1 below is reached by pressing **EDIT** with any data display present.  This is the entry-level screen to ALL *Channel*, *System* and *Security* menus.  It also shows the revision of firmware operating in the MODEL 9000.  Use the **UP/DOWN** keys to move the pointer to the desired menu and press the **EDIT** key.
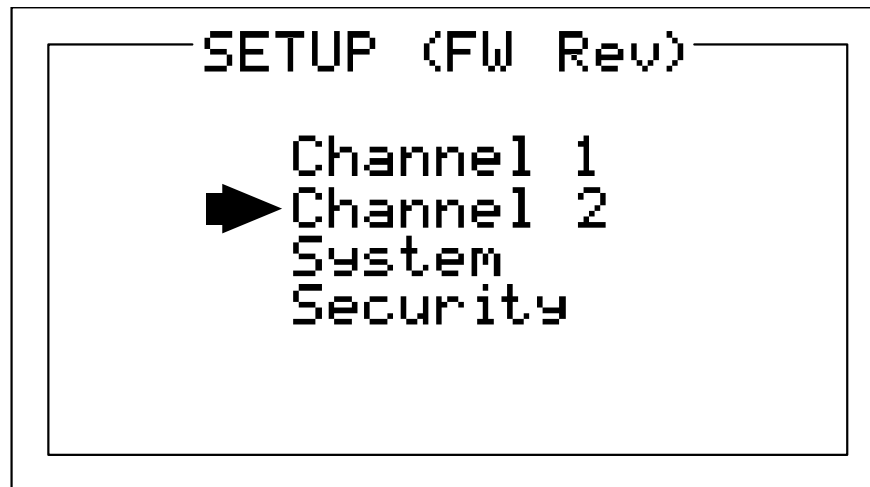


Figure 2.1

### 2.2.2　　CHANNEL SETUP ENTRY MENU

The CHANNEL menu shown below in Figure 2.2 allows configuration of all variables for the selected channel.  These are **Alarm 1**, **Alarm 2**, **Alarm 3**, **Configure** and **Calibrate**.
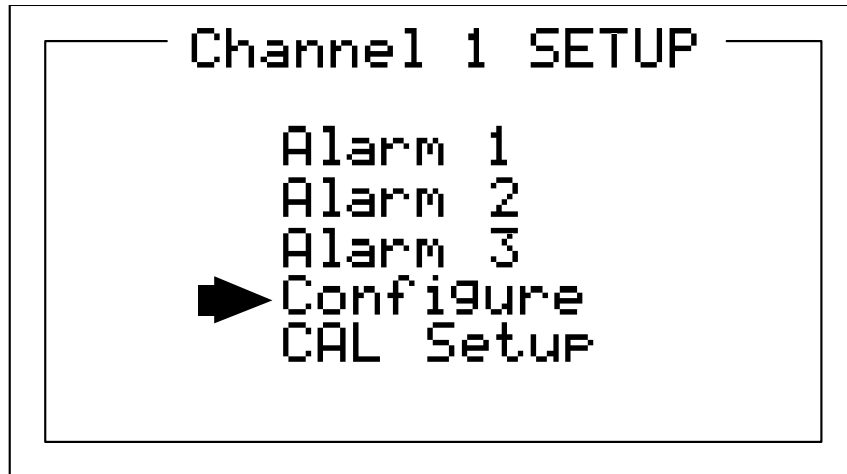
Figure 2.2

### 2.2.3    ALARM 1 / ALARM 2 / ALARM 3 SET-UP MENUs

Alarms 1, 2 and 3 have identical menus.  The only difference between each is A1 front panel LED indicators are yellow while A2's and A3's are red.  Typical applications often have A1 set at a WARN level, A2 at a HIGH level and A3 at a negative FAULT level.  However, it is important to understand there is no functional difference between A1, A2 and A3.  Since their configuration menus are identical, only one is shown in Figure 2.3.
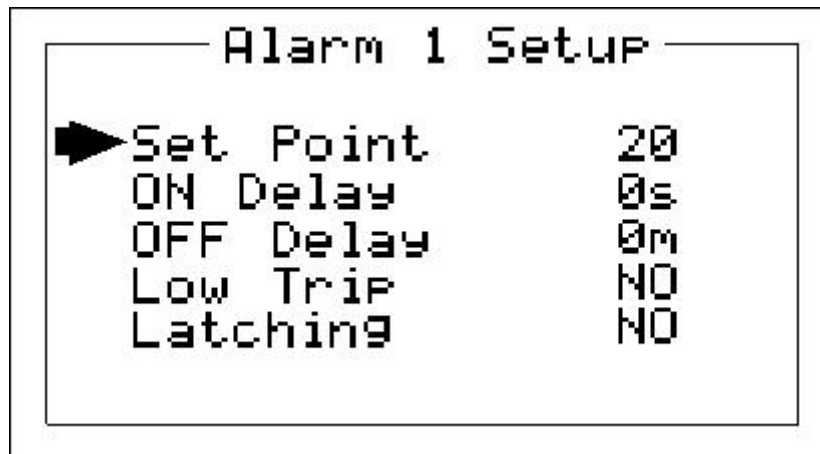


Figure 2.3

- **Set Point** is entered in engineering units and determines the value where the alarm trips.  For example, if a channel monitors 0-50 ppmH2S and the desired alarm level is 10 ppm, the correct entry is 10.00.  A one percent dead band prevents alarm chatter.  This means after tripping an alarm the input must move at least 1% of full scale back through the setpoint for the alarm to auto reset.
- The **ON Delay / OFF Delay** entries allow **ON** and **OFF** time delays affecting how long the trip-point must be surpassed before an alarm event transition occurs.  **ON** delays are limited to 10 seconds while **OFF** delays may be as long as 120 minutes.  Delays are useful in many applications to prevent nuisance alarms and unwanted cycling into and out of alarm conditions.

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- **Low Trip** is set for **NO** for increasing alarms or **YES** for decreasing alarms to determine if the alarm activates upon exceeding or falling below the set-point.
- **Latching** determines either manual or automatic alarm reset operation. **YES** requires a manual **Alarm Reset** to unlatch the alarm even though an alarm condition no longer exists. **YES** also causes this alarm's common relay, front panel LED, and optional discrete relay to latch. **NO** allows all outputs for this alarm to automatically reset after the alarm condition clears.

Discrete LED indicators on the front panel indicate the status of each alarm. Any *new* alarm event causes the associated LED to flash until an **Alarm Reset** occurs causing an *acknowledged* steady on condition. Operators should recognize *new* alarms by a <u>flashing</u> LED. **Alarm Reset** also *acknowledges*, or deactivates, audible devices driven by the AUDIBLE ALARM option connector J2 (see Figure 3.1)

## 2.2.4    CONFIGURE MENU TO DEFINE CHANNEL

The channel setup menu after the alarm menus is **CONFIGURE.** It allows setting *Name* and *EUNIT* ASCII fields, defining the measurement range, and how many decimal points of resolution the reading will have.

```
┌──────── Channel 1 CONFIG ────────┐
│ ►Name           Enter  ID        │
│  EUNIT          10 digit         │
│  Zero                       0    │
│  Span                     100    │
│  Decimal  Pts.              0    │
│  Channel  Active          YES    │
│                                  │
└──────────────────────────────────┘
```
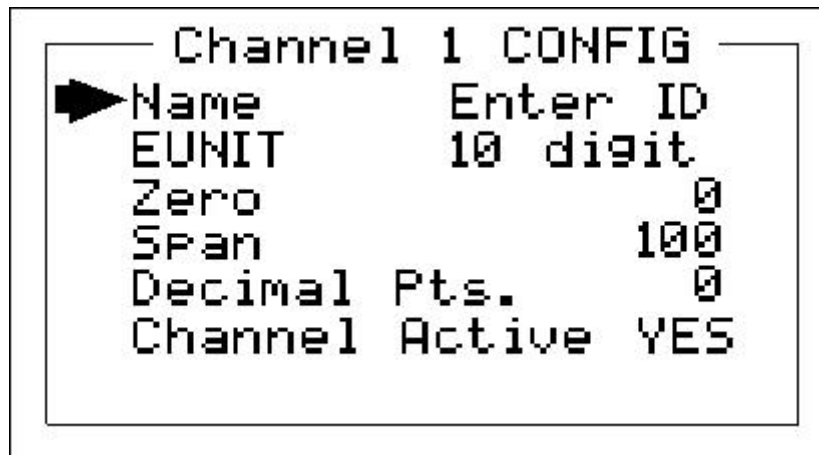
Figure 2.4

### 2.2.4a   NAME / EUNITS ASCII DATA FIELDS

The first two items in this menu are for entering the 10 character channel *Name* and *engineering unit* ASCII fields. *Name* should describe the channel's data in user terminology such as tag # or other description. *Eunits* should define the units of measure for what this channel is to display. Several standard *Eunits* fields are available by pressing **EDIT** but if these are inappropriate, a CUSTOM field allows editing of each character. Section 2.2 describes how to modify these fields using the keypad.

### 2.2.4b   INPUT MEASUREMENT RANGE

The **ZERO / SPAN** menu entries allow configuration of the measurement range displayed by this channel. Measurement Range defines the range of the input signal's engineering units. For example, if a channel's input is 4-20mA from a transmitter monitoring 0 to 10ppm chlorine, then the **Zero** value should equal 0.000 and the **Span**

value equal 10.00. Four digits must be entered so trailing 0's may appear here that are not displayed on other data screens.

### 2.2.4c  DECIMAL POINT RESOLUTION

Resolution of the displayed channel value is configured in this menu by setting the number digits trailing the decimal point. Displayed readings are limited to a maximum of four digits with a polarity sign. Auto-ranging displays the highest resolution allowed by this menu's decimal point entry. For example, a range of 0 to 100ppm and two decimal points reads **0.00** at 0ppm and **100.0** at 100ppm. This may be undesirable due to the high resolution at zero unless the sensor's output is extremely stable. If decimal points are limited to one, the 0ppm reading becomes **0.0** and the 100ppm reading remains **100.0**. Resolution may be limited further by setting decimal points to 0 where in the above example, 0ppm reads **0** and 100ppm reads **100**.

### 2.2.4d  TURNING OFF UNUSED CHANNELS

The **Channel Active?** menu entry asks if this channel is to be utilized. **OFF** causes the controller to never process inputs applied to this channel and no alarms are tripped or data displayed. Inactive channels have a line drawn through them on the Setup screen to indicate it is turned off.

### 2.2.5  CAL SETUP MENU

The MODEL 9000 CAL MODE feature supports pushbutton calibration of zero and span values. This feature should be utilized only when there are no other zero/span controls within the monitoring system since it is inappropriate to calibrate a signal at more than one point. Therefore, if calibration will be performed at another transmitter or monitoring device, the MODEL 9000 CAL MODE feature should not be used.

The **CAL SETUP** menu allows entering the correct **Zero Gas** & **Span Gas** set-point values needed to calibrate the sensor. These are entered in the same engineering units as input range.

```
┌───  Ch. 1 CAL SETUP  ───┐
│                          │
│  ➤ Zero Gas      0.0     │
│    Span Gas     50.0     │
│    Set UNITY Gain        │
│    CAL Offset 0.000      │
│    CAL Gain    1.000     │
│                          │
└──────────────────────────┘
```
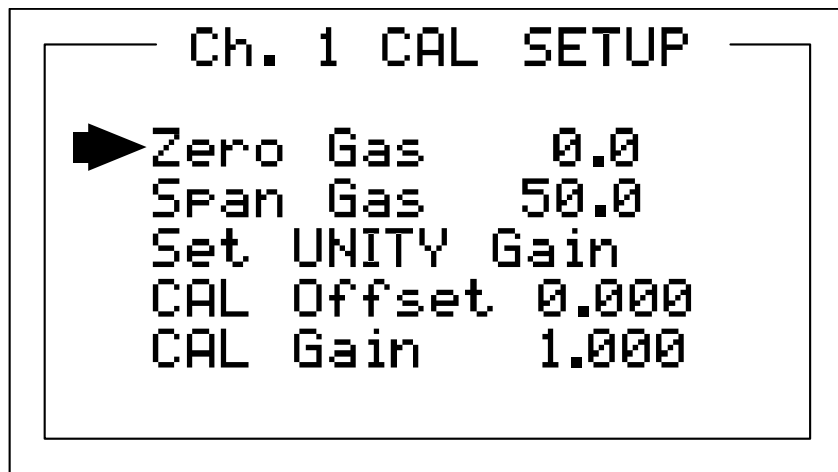
Figure 2.5

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### 2.2.6    CALIBRATE INPUT MENU

Calibration is the most important function for insuring correct operation of MODEL 9000's equipped with sensor inputs.  The CAL MODE (flow chart shown in Figure 2.6) is designed to make calibration quick, easy and error free.  A successful ZERO and SPAN calibration requires only five keystrokes.  Optional 4-20mA outputs (if equipped) transmit 1.5mA during CAL MODE and 4mA during the subsequent CAL PURGE delay to prevent external alarms during calibration.  Local MODEL 9000 alarm relays are inhibited during CAL MODE.  Unintentional calibrations may be reset by the **Set UNITY** menu item.  **Set UNITY** resets **Cal OFFSET** to 0 & **Cal GAIN** to 1 which is useful for returning the calibration to a known starting place.  Sensor aging may be monitored by recording zero and span readings at **Unity Gain** when the sensor is new, and again later when degradation may have occurred.  CAL MODE automatically exits if no keystroke is detected after 5 minutes.

Follow these MODEL 9000 sensor calibration guidelines:

- Calibration accuracy is only as good as the calibration standard accuracy. Sensidyne recommends calibration standards with NIST (National Institute of Standards and Technology) traceable accuracy to increase the validity of the calibration.
- Do not use a gas cylinder beyond its expiration date.
- Calibrate a new sensor before use.
- Allow the sensor to stabilize before starting calibration (approximately 5 minutes).
- Calibrate on a regular schedule. (Sensidyne recommends once every 3 months, depending on use and sensor exposure to poisons and contaminants.)
- Calibrate only in a clean atmosphere free of background gas.

Use the following step-by-step procedure to perform ZERO and SPAN calibrations.

1. To enter the CAL MODE from any data display, press the dual purpose DOWN / CAL key and within 5 seconds press the EDIT key.

2. Using the Cal-Cup and following the instructions on the screen, apply a clean ZERO gas or be sure there is no background target gas in the monitored area. After the reading is stable, (approximately 1 minute) press the EDIT key to perform a ZERO calibration.

3. If the ZERO calibration is successful, CAL MODE automatically proceeds to the SPAN check.

4. Apply the **<u>correct</u>** SPAN gas at .5 liters/min.  After the reading is stable, (approximately 1 minute) press the EDIT key to perform a SPAN calibration. **WARNING:**  The SPAN gas used must match the value specified since this is what the MODEL 9000 will indicate after a successful SPAN calibration.  The *Span Gas* value may be edited if it becomes necessary to apply a different gas concentration (see *Span Gas* in section 2.2.5).

5. If the SPAN calibration is successful, the display flashes "REMOVE CAL GAS" and starts the CAL PURGE delay.

6.  CAL MODE will be complete after the end of the CAL PURGE delay.

The flow chart in Figure 2-6 illustrates the above procedure.  **UP**, **CAL**, **NEXT** & **EDIT** labels indicate keystrokes (**CAL/DOWN** is a dual purpose key).  The CAL MODE information screen (top of the chart) is available for advanced users to see Offset / Gain calibration constants and live analog to digital converter (A/D) counts.  Span Gas calibration values may also be edited from this screen.   Holding the **UP** key, for 5 seconds during CAL MODE, displays this screen.

**Unity Gain** may be used at anytime to cancel incorrect calibrations and start again.
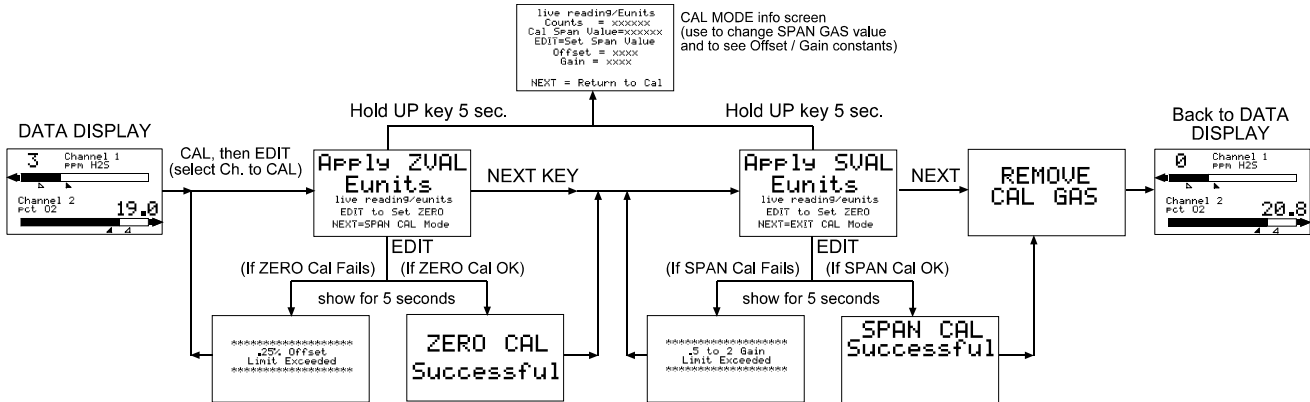


Figure 2.6

## 2.3     SYSTEM CONFIGURATION MENUS

Several items needing configuration are not specific to either channel but affect the entire MODEL 9000 system.  These are located in the *system* tree entry menu shown on the left side of Figure 2.0.  System menus are accessed by pointing to the desired item and pressing **EDIT**.  The **Diagnostics** menu group (section 2.3.5) is useful for testing relay and analog I/O without stimulating the input.



Figure 2.7

13
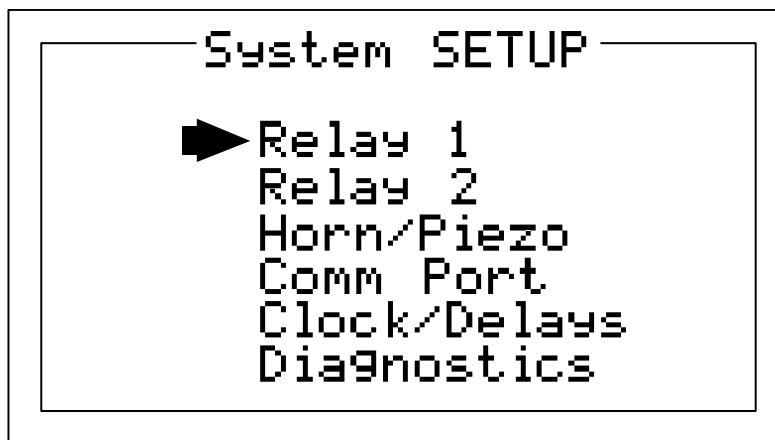
### 2.3.1   RELAY 1 / RELAY 2 MENUS

The **Relay 1** & **Relay 2** menus are identical except **Relay 2** has an *acknowledge* feature useful if it controls an audible device.  All other **Relay 1** & **Relay 2** features are identical and therefore are discussed only once.

```
┌──────── Relay 2 ────────┐
│                         │
│  ▶ Set Relay Logic      │
│    Fail Safe      NO     │
│    Horn        STEADY    │
│    Acknowledge    NO     │
│                         │
└─────────────────────────┘
```
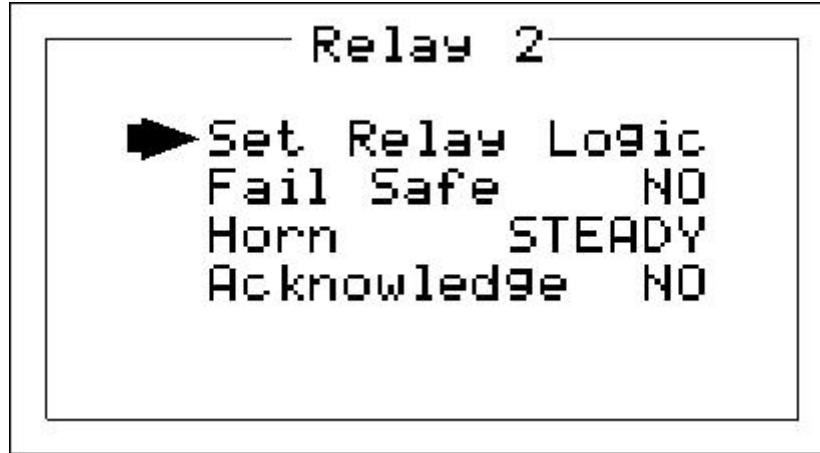
Figure 2.8

- The **Set Relay Logic** menu shown below in Figure 2.9 offers additional "voting" flexibility by controlling the channel alarm combinations that will trip this common alarm relay.  **"OVR"** on the menu's right side stands for *override* and means ANY of the selected alarms will activate the relay.  The **"OR"** / **"AND"** columns work together based upon the following logic equation:

   **[AND column selections] *ANDED WITH* [OR column selections] = relay activation.**

   For example, if Ch1A1 & Ch2A1 are selected in the AND column and Ch1A2 & Ch2A2 are selected in the OR column, the logic equation is [Ch1A1 *AND* Ch2A1] *ANDED WITH* [Ch1A2 *OR* Ch2A2].  This requires both A1's along with either A2 to activate the relay.

```
┌─────────────────────────────────┐
│  Relay 1     OR   AND   OVR      │
│                                  │
│  Ch2  A1      □    ☒    □        │
│  Ch2  A2  ▶   ☒    □    □        │
│  Ch2  A3      □    □    □        │
│  Ch1  A1      □    ☒    □        │
│  Ch1  A2      ☒    □    □        │
│  Ch1  A3      □    □    □        │
└─────────────────────────────────┘
```

Figure 2.9

- **Failsafe** controls relay activation for the common relays. **Failsafe ON** causes these relays to de-energize during alarm conditions and energize when there is no alarm. With **Failsafe** active, a power failure forces the relay contact to the alarm position.
- **Horn** controls how activating this relay will affect the horn driver circuit connected to J2 on the motherboard. Choices are **NO**, **STEADY** or **PULSE**. Warning level alarms might be set to pulse the horn with high alarms set for steady. Personnel then know which alarm level is present by hearing the pulsing or steady horn.
- Turning **Acknowledge ON** (not allowed on Relay 1) allows Relay 2 to be deactivated during alarm conditions by an **Alarm Reset**. This is useful if another audible device is being driven by the relay. The acknowledge feature is not available for Relay 1 since it is often used for driving a warning light and Relay 2 for driving a 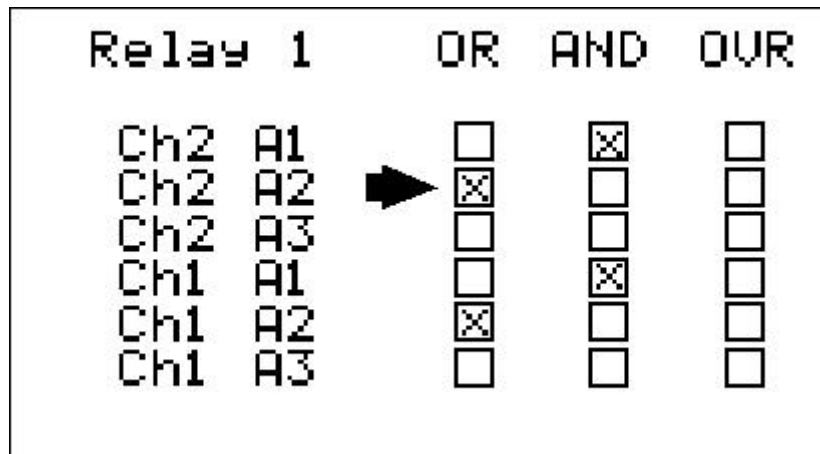horn. It could be dangerous if an operator acknowledged the horn AND the light since no indication of the high alarm condition remains.

### 2.3.2   HORN / PIEZO MENU

- The MODEL 9000 display PCB is equipped with a small audible piezo that chirps when keys are pressed providing an audible feedback to the operator. It also may be set to audibly indicate alarm conditions by entering YES into the **Piezo On** menu item in Figure 2.10. This piezo will then mimic the **Horn** settings menus described in section 2.3.1.

- The **Horn ACK** menu item determines if the Horn Driver output may be acknowledged by an Alarm Reset. **YES** causes an Alarm Reset to silence the horn even though an alarm condition remains active.

```
┌─────── Horn/Piezo ───────┐
│                          │
│  ▶Piezo On        YES    │
│   Horn ACK        NO     │
│                          │
└──────────────────────────┘
```
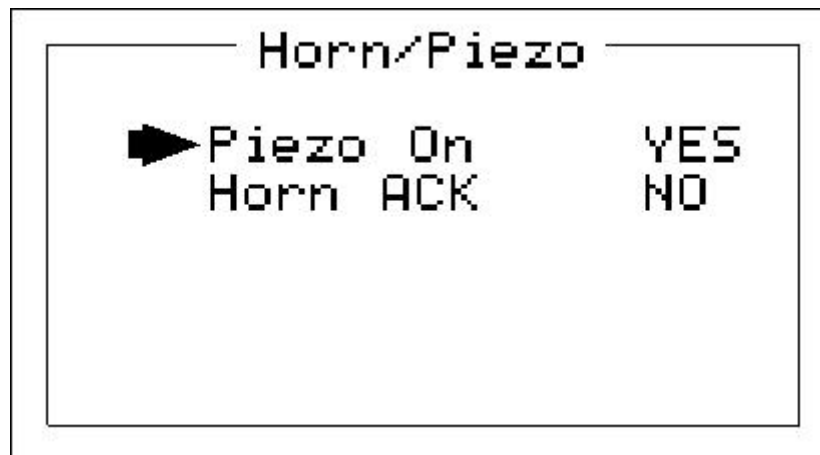
Figure 2.10

### 2.3.3   COMM PORT MENU

The system **Comm Port** menu allows setting RTU address for the optional *slave* Modbus serial port. This slave port may be used to transfer MODEL 9000 data to a host device such as a PC, PLC, DCS or even another Controllers. The slave port is

addressable, allowing many MODEL 9000 controllers to be connected to a single RS-485 cable.



Figure 2.11

### 2.3.4    CLOCK / DELAYS MENU

- The MODEL 9000 monitors signals from sensors that may require varying times to stabilize after power is applied.  The **Warm Up Delay** menu item allows setting how long alarm relays remain disabled after power is applied.

- **Cal Delay** determines how long alarm relays are inhibited after completing a calibration.

- The MODEL 9000 is equipped with a 24-hour clock and calendar.  **Time** and **Date** menu items are for setting the correct time and date.  Time of day must be entered in 24 hour mode.  For example, 6:00:00 PM = is indicated as18:00:00.
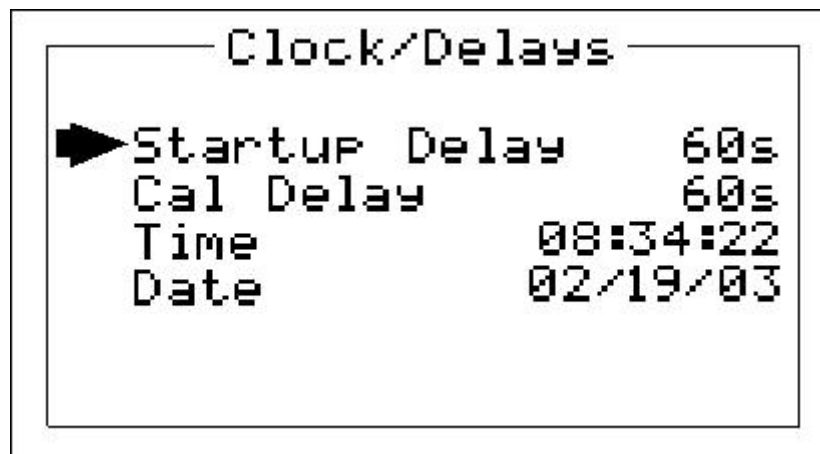


Figure 2.12

### 2.3.5    DIAGNOSTICS MENU

**WARNING:  Alarm processing is halted with the Diagnostics mode active.**

The **Diagnostics** menu in Figure 2.13 is useful for testing standard and optional Input / Output devices such as relays and 4-20mA outputs.  Diagnostic menu items are described below:

```
┌──────────────────────────────────┐
│  ┌─── Diagnostics ───┐            │
│  │                               │
│     ▶ Output Zero                 │
│       Output Span                 │
│       Input Min/Max               │
│       Common Relays               │
│       Discrete Relays             │
│                                   │
└──────────────────────────────────┘
```
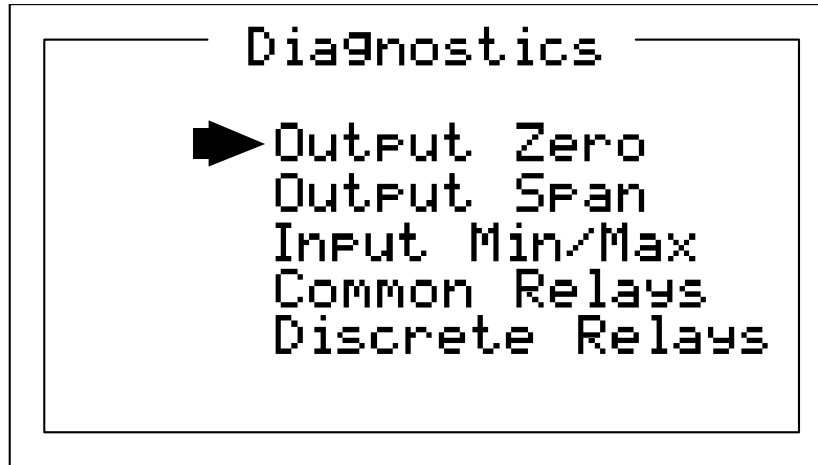
Figure 2.13

**Output Zero / Output Span** DAC value (digital to analog converter) menu items are set at the factory to calibrate optional 299-0004-01 4-20mA Output boards.  If field adjustment is required, monitor the 4-20mA output and set the **Output Zero** DAC value for 4mA on each channel then set the **Output Span** DAC value for 20mA on each channel.  These menu items may also be used to drive 4-20mA into receiver devices without stimulating sensor inputs.

**Input Min / Max** ADC (analog to digital converter) menu items are set at the factory with default values for each channel of either 200 to 1000 counts, or, 400 to 2000 counts. Direct sensor input options 10-0216, 10-0219 and 10-0220 (see Section 3) default to the 10-bit settings of 200 to 1000 counts.  4-20mA input option 299-0002-01 default to the 11-bit settings 400 to 2000 counts.  These settings may be utilized to affect what input values provide ZERO and SPAN readouts.  For example, if an application required 8mA input to a 299-0002-01 4-20mA input option to read ZERO at 800 counts, an **Input Min** setting of 800 would accomplish this.

```
┌──────── INPUT MIN/MAX ────────┐
│                               │
│  ➤ Input Raw Min    0200      │
│    Input Raw Max    1000      │
│                               │
│                               │
└───────────────────────────────┘
```
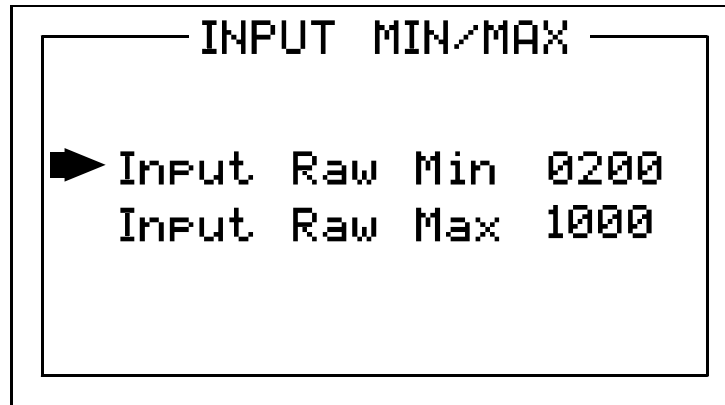
Figure 2.14

**Common Relays** menu item allows manual activation of the common relays and optional local audible piezo.

**Discrete Relays** menu item allows manual activation of the optional 299-0003-01 Discrete Relay boards.

## 2.4    SYSTEM SECURITY MENU

A 4-digit **Pass Code** entered and confirmed in this menu item locks all menus. *Viewing* menus is not denied but attempts to *edit* variables flashes the ***Locked*** message on the LCD.

Authorized individuals locking the system should first enter a name, phone #, or other contact information into the 12 character field on the top line of the Security screen. To lock or unlock the system the correct 4 digit authorization number must be entered into the **Pass Code** field. It is very important to remember the 4 digit code since the factory must be consulted if it is lost.

```
┌──────── System SECURITY ────────┐
│                                 │
│ ➤Contact Name                   │
│  Blind Mode     NO              │
│  Pass Code                      │
│                                 │
│           Unlocked              │
│                                 │
└─────────────────────────────────┘
```
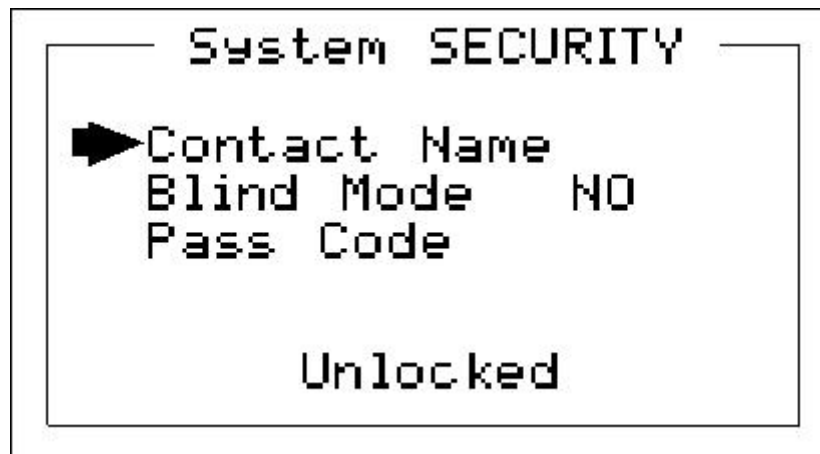
Figure 2.15

# SECTION 3

## *3.0    MOTHERBOARD INTERFACE PCB # 10-0215*

The MODEL 9000 Motherboard shown below in Figure 3.1 is the interface between the Display / CPU assembly and all other system I/O devices.  The Display / CPU assembly attaches to the motherboard with 4-standoffs and connects via ribbon cable to S1. Several input options, described in the following sections, are available that may be installed into the *Sensor Input Option* P1 connector located on the lower left side of the motherboard.  The middle position P2 connector is for the 299-0004-01 4-20mA Output option and the right position P3 connector is for the 299-0003-01 Discrete Relay option. Other option devices such as Modbus RTU RS-485, Ethernet and a data logger may also be installed to connectors located on the Motherboard.

The Motherboard PCB contains a 24 VDC universal input (100-240 VAC) switching power supply with up to 350mA available at TB3 Auxiliary Power Output terminals.  If AC power is unavailable, or if a DC battery back-up supply is needed, TB1 provides terminals for DC power input.  Blocking diodes isolate internal and external DC supplies as shown in Figure 3.0.  See section 1.2.1 for additional power source information.
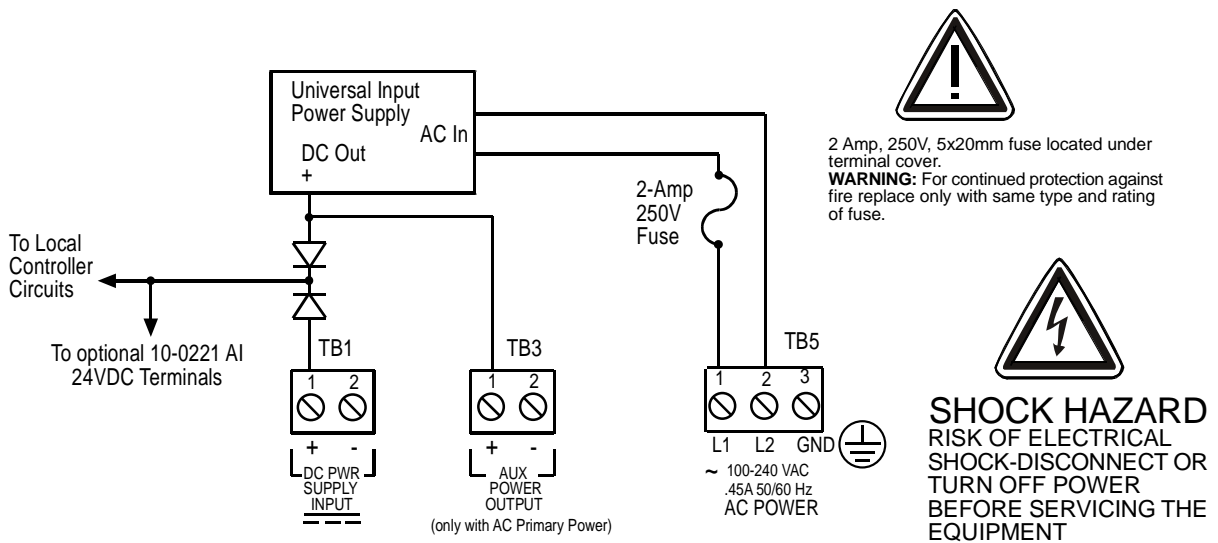


Figure 3.0

TB2 offers field terminals for a remote alarm reset switch.  The motherboard also includes alarm relays 1 & 2 (K1 & K2) and their indicating LED's.  TB4 provides field wiring terminals for these relays.  TB5 is for connection to the 100-240 VAC power source.  J2 is a 2-pin connector for powering the optional part # 1000-1892 audible annunciator.

S2

RS-R85 / ETHERNET OPTION

ACL

ACN

Universal Switching Power Supply
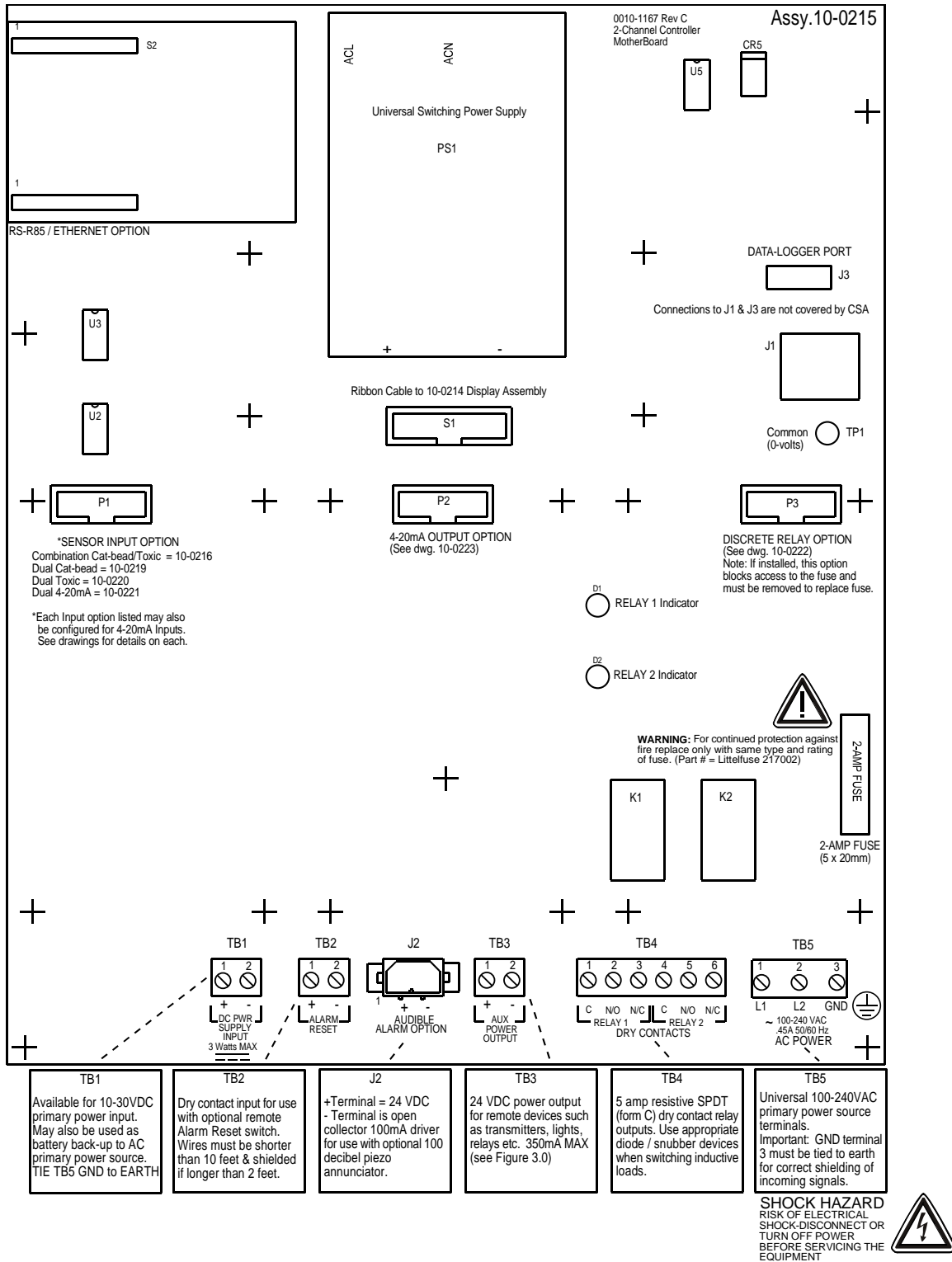
PS1

0010-1167 Rev C
2-Channel Controller
MotherBoard

Assy.10-0215

CR5

U5

+

DATA-LOGGER PORT

J3

Connections to J1 & J3 are not covered by CSA

J1

U3

Common
(0-volts)   TP1

U2

Ribbon Cable to 10-0214 Display Assembly

S1

P1

P2

P3

*SENSOR INPUT OPTION
Combination Cat-bead/Toxic = 10-0216
Dual Cat-bead = 10-0219
Dual Toxic = 10-0220
Dual 4-20mA = 10-0221

*Each Input option listed may also
be configured for 4-20mA Inputs.
See drawings for details on each.

4-20mA OUTPUT OPTION
(See dwg. 10-0223)

DISCRETE RELAY OPTION
(See dwg. 10-0222)
Note: If installed, this option
blocks access to the fuse and
must be removed to replace fuse.

D1   RELAY 1 Indicator

D2   RELAY 2 Indicator

WARNING: For continued protection against
fire replace only with same type and rating
of fuse. (Part # = Littelfuse 217002)

K1

K2

2-AMP FUSE

2-AMP FUSE
(5 x 20mm)

TB1
1  2
+  -
DC PWR
SUPPLY
INPUT
3 Watts MAX

TB2
1  2
+  -
ALARM
RESET

J2
+  -
AUDIBLE
ALARM OPTION

TB3
1  2
+  -
AUX
POWER
OUTPUT

TB4
1  2  3   4  5  6
C  N/O  N/C   C  N/O  N/C
RELAY 1    RELAY 2
DRY CONTACTS

TB5
1  2  3
L1  L2  GND
~ 100-240 VAC
.45A 50/60 Hz
AC POWER

| TB1 | TB2 | J2 | TB3 | TB4 | TB5 |
|---|---|---|---|---|---|
| Available for 10-30VDC primary power input. May also be used as battery back-up to AC primary power source. TIE TB5 GND to EARTH | Dry contact input for use with optional remote Alarm Reset switch. Wires must be shorter than 10 feet & shielded if longer than 2 feet. | +Terminal = 24 VDC - Terminal is open collector 100mA driver for use with optional 100 decibel piezo annunciator. | 24 VDC power output for remote devices such as transmitters, lights, relays etc. 350mA MAX (see Figure 3.0) | 5 amp resistive SPDT (form C) dry contact relay outputs. Use appropriate diode / snubber devices when switching inductive loads. | Universal 100-240VAC primary power source terminals. Important: GND terminal 3 must be tied to earth for correct shielding of incoming signals. |

SHOCK HAZARD
RISK OF ELECTRICAL
SHOCK-DISCONNECT OR
TURN OFF POWER
BEFORE SERVICING THE
EQUIPMENT

Figure 3.1

## 3.1    INPUT / OUTPUT OPTIONAL PCB's

P1, P2 and P3 connectors on the motherboard offer unique positions for I/O options described in this section.  A screen appears briefly after power-up indicating what I/O options are connected.  Input options installed into the P1 position may be either 10-bit or 12-bit and the **Input Min / Max** menu shown in Figure 2.14 must be set accordingly. The 299-0002-01 option's default setting is 400 – 2000 counts and the 10-0216, 10-0219 and 10-0220 each have a default setting of 200 – 1000 counts.

P2 is reserved only for the 299-0004-01 4-20mA Output option and P3 is reserved only for the 299-0003-01 Discrete Relay option.  Connector locations, relative to each option's mounting screws, prevent incorrect installation.

### 3.1.1    OPTIONAL ANALOG INPUT PCB # 299-0002-01

**Important!** 299-0002-01 PCB's may only be installed into motherboard position P1.

12-bit Analog input PCB option # 299-0002-01, shown in Figure 3.2 allows interfacing MODEL 9000's to field transmitters having 4-20mA or voltage outputs.  Remove socketed 100 ohm R1 or R2 terminators for 0-4 VDC max voltage inputs.  The 299-0002-01 utilizes a 12-bit A/D converter such that 4mA provides 400 counts and 20mA 2000 counts.  Min/Max raw counts menus default to 400/2000 but may be adjusted between 0/4095 as described in the **Input Min / Max** discussion in section 2.3.5.  TB1 provides Channel 1 & Channel 2 + / - terminals for receiving analog inputs.  TB1 also provides 2-terminals connected to the MODEL 9000 internal 24 VDC power supply for powering external transmitters.  Figure 3.3 shows correct wiring for both 2-wire and 3-wire transmitters.
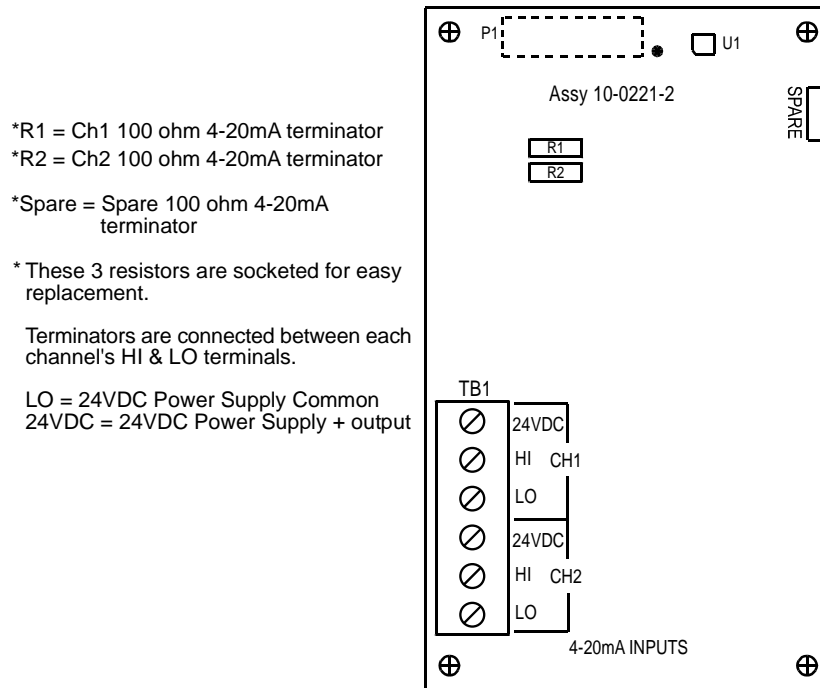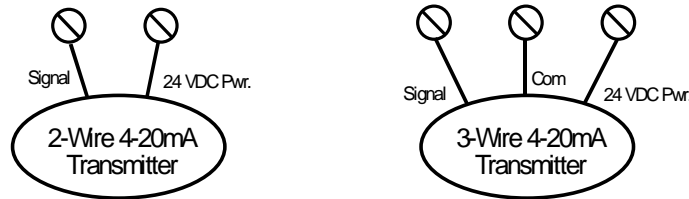


Figure 3.2

Figure 3.3

### 3.1.2    OPTIONAL BRIDGE / EC SENSOR INPUT BOARD #10-0216

**Important!** 10-0216 PCB's may only be installed into motherboard position P1.

The 10-bit 10-0216 Sensor input option shown in Figure 3.4 allows a bridge sensor into channel one and an electrochemical sensor into channel two.  This combination is useful for monitoring volatile and toxic (or oxygen) gases at the same location.  The bridge sensor channel includes bridge amplifier, balance potentiometer, and adjustable switching regulator for setting the correct sensor excitation voltage.  A 3-position coarse gain jumper allows setting the gain of the bridge amplifier.  Bridge sensors not mounted to the MODEL 9000 enclosure at the factory will require the *Initial Setup* calibration procedure described in section 3.1.4.  After performing the one time only *Initial Setup* all subsequent calibrations are by the MODEL 9000's electronic Cal Mode menus (see section 2.2.5).  Sensors mounted locally to the MODEL 9000 normally do not require *Initial Setup* since it is performed at the factory.

The electrochemical channel has a preamplifier, bridge amplifier, sensor coefficient jumpers and a 2-position coarse gain jumper for setting the gain of the bridge amplifier.  Socketed resistor R11 controls the gain of the preamplifier and is installed at the factory (consult factory if sensor gas type is to be changed after shipment).  Fault supervision circuitry forces the MODEL 9000 into a FAULT condition upon sensor failure or removal.

The 10-0216 may also be configured to accept 4-20mA inputs for mixing a direct sensor input and a current loop into the same board.  Placing either channel's 2 position SENSOR/4-20mA jumper (JP4 or JP5) into the 4-20mA position, and installing the associated precision 100 ohm socketed resistor, allows 4-20mA signals to be applied to the mA+ / mA- terminals (see *Optional 4-20mA notes* in Figure 3.4).  100 ohm resistors are taped to the inside of the MODEL 9000 enclosure.  Bridge amplifiers are bypassed in this configuration.  Figure 3.4 shows jumper options with channel 1 configured for a 4-20mA input and channel 2 for a sensor input.
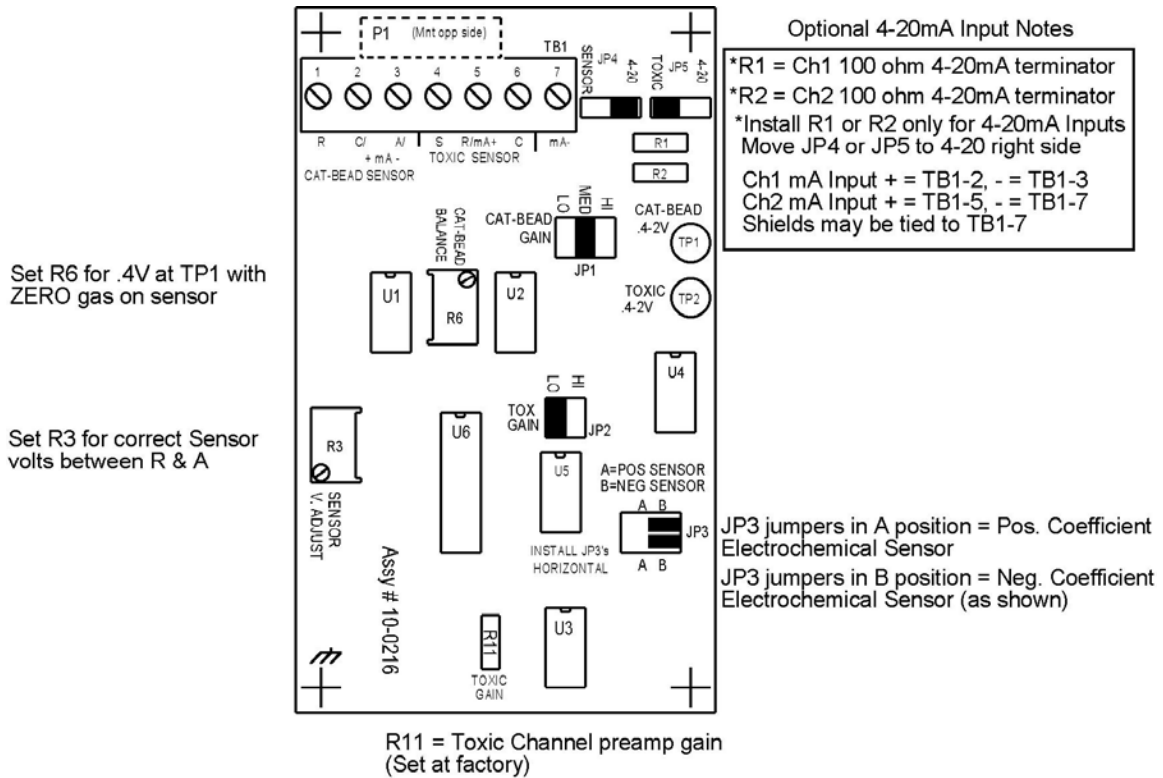
Figure 3.4

### 3.1.3 OPTIONAL BRIDGE SENSOR INPUT BOARD #10-0219

**Important!** 10-0219 PCB's may only be installed into motherboard position P1.

The 10-bit 10-0219 Two Channel *Bridge Sensor Input* option shown in Figure 3.5 allows these popular gas detectors to be connected directly to the MODEL 9000 without additional signal conditioning or transmitters. Each channel is equipped with a bridge amplifier, balance potentiometer, and an adjustable switching regulator for setting the correct sensor excitation voltage. A 3 position coarse gain jumper allows setting the gain of the bridge amplifier. Fault supervision circuitry forces the MODEL 9000 into a FAULT condition upon sensor failure or removal.

This option may also be configured to accept 4-20mA inputs for mixing a sensor and a current loop into the same board. Placing either channel's 2 position SENSOR/4-20mA jumper (JP3 or JP4) into the 4-20mA position, and installing the associated precision 100 ohm socketed resistor, allows 4-20mA signals to be applied to the mA+ / mA- terminals (see *Optional 4-20mA notes* in Figure 3.5). 100 ohm resistors are taped to the inside of the MODEL 9000 enclosure.

Bridge sensors not mounted to the MODEL 9000 enclosure at the factory will require the *Initial Setup* calibration procedure described in section 3.1.4. After performing the one time only *Initial Setup* all subsequent calibrations are by the MODEL 9000's electronic Cal Mode menus (see section 2.2.5). Sensors mounted locally to the MODEL 9000 normally do not require *Initial Setup* since it is performed at the factory.

### 3.1.4    BRIDGE SENSOR INITIAL SETUP

Bridge sensors vary widely in power requirements and sensitivity.  It is therefore important to configure each channel to match the sensor with which it will operate. **Sensors attached to the MODEL 9000 enclosure at the factory have already had** *Initial Setup.*

1. Prior to connecting remote sensors, apply power to the system.  Measure the voltage between each channel's A and R terminals and set the *Voltage Adjust* potentiometers for the correct sensor excitation voltage (remove MODEL 9000 terminal cover).  This may range from 1.5 volts to 7.5 volts depending upon sensor specifications.  **Sensors may be damaged by accidental over voltage conditions.  It is recommended the** *Voltage Adjust* **potentiometer screws be covered by a dollop of RTV or similar material after completion of this procedure.**

2. Remove system power and connect sensor wires to the A-C-R terminals.  Reapply system power and confirm correct voltage across each sensor's A & R terminals. Note if sensor wires are long, it will be necessary to measure the excitation voltage at the sensor end to compensate for I * R voltage losses in the wiring.

3. With the minus voltmeter lead on TB2-2 (common), connect the plus lead to the channel's red test point.  With zero air on that sensor, adjust it's *Balance* potentiometer for .4 volts at the test point.

4. Apply 50% span gas to the sensor and allow the test point voltage to stabilize. Two volts = 100% input to the A – D Converter and .4 volts = 0%.  Therefore, 1.2 volts = 50%.  Place the 3 position *Coarse Gain* jumper into the position which reads between 1.1 volts and 1.4 volts on the test point with 50% gas on the sensor. Gain settings for each jumper position are as follows:  no jumper = 1, **LO** = 7, **MED** = 12, **HI** = 24.  Multiple jumpers have an additive affect upon gain, so for example the **LO** and **MED** jumpers together provide a gain of 19.

Initial setup is now complete and normally only requires repeating if a sensor is replaced. Final calibration of this channel may now be performed using the MODEL 9000's electronic Cal Mode feature described in section 2.2.5.

Optional 4-20mA Input Notes

*R1 = Ch1 100 ohm 4-20mA terminator
*R2 = Ch2 100 ohm 4-20mA terminator
*Install R1 or R2 only for 4-20mA Inputs
Move JP3 or JP4 to 4-20 right side

Ch1 mA Input + = TB1-2, - = TB1-3
Ch2 mA Input + = TB1-5, - = TB1-6
Shields may be tied to TB1-7

Set R6 / R14 for .4V at TP1 / TP2 with ZERO gas on sensors

Set R3 / R11 for correct Sensor volts between R & A terminals for channels 1 & 2.
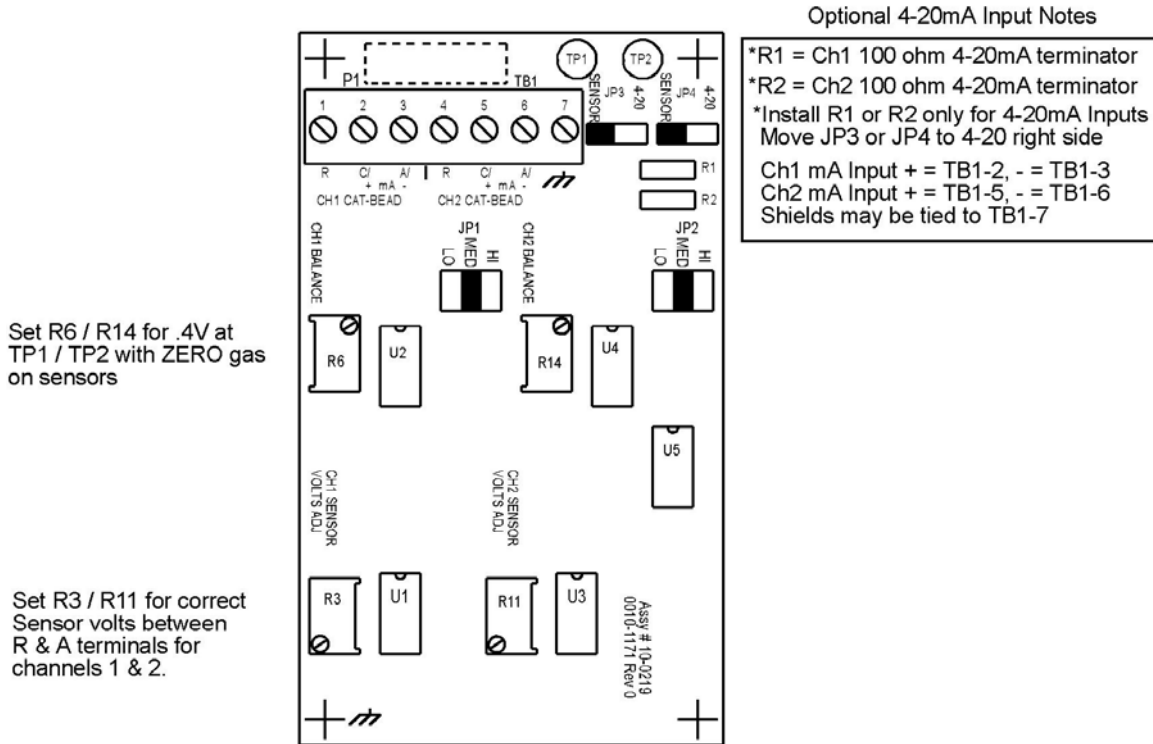
Figure 3.5

### 3.1.5   OPTIONAL ELECTROCHEMICAL SENSOR INPUT BOARD #10-0220

**Important!** 10-0220 PCB's may only be installed into motherboard position P1.

The 10-bit 10-0220 Two Channel *Electrochemical Sensor Input* option shown in Figure 3.6 allows these popular gas sensors to be connected directly to the MODEL 9000 without additional signal conditioning or transmitters.  Each channel is equipped with a preamplifier, bridge amplifier, sensor coefficient jumpers and a 2 position coarse gain jumper for setting the gain of the bridge amplifier.  Socketed resistors R4 and R16 control the gain of the preamplifier and are installed at the factory (consult factory if sensor gas type is to be changed after shipment).  Fault supervision circuitry forces the MODEL 9000 into a FAULT condition upon sensor failure or removal.

This option may also be configured to accept 4-20mA inputs for mixing an electrochemical sensor and a current loop into the same board.  Placing any channel's 2 position TOXIC/4-20mA jumper into 4-20mA position and installing the associated precision 100 ohm socketed resistor allows 4-20mA signals to be applied to it's mA + / mA - terminals.  Bridge amplifiers are bypassed in this configuration.
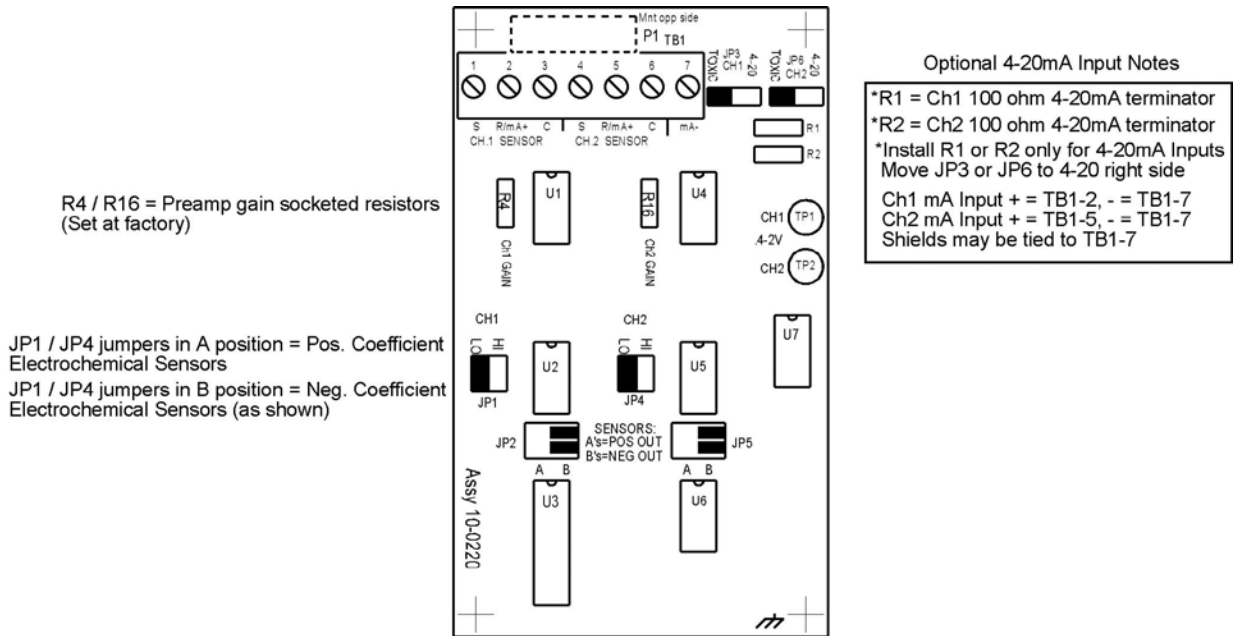
Figure 3.6

### 3.1.6   OPTIONAL DISCRETE RELAY PCB's #'s 299-0003-01

**Important!** 299-0003-01 PCB's may only be installed into motherboard position P3.

The optional *Discrete Relay PCB*, shown in Figure 3.7, adds six 5 amp form C relays. Each relay is associated to one of A1, A2 or A3 for channel 1 or 2.  Many MODEL 9000 applications utilize the standard equipped Relay 1 / Relay 2 (see section 2.3.1) and do not require optional discrete relays for each of the 6 alarms events (2 A1's, 2 A2's & 2 A3's).

All mechanical (dry contact) relays are rated at 5 Amp for 28 VDC and 250 ~VAC **RESISTIVE** loads.  IMPORTANT:  Appropriate diode (DC loads) or MOV (AC loads) snubber devices must be installed with inductive loads to prevent RFI noise spikes.

AC or DC power supplies to relays on the 299-0003-01 Discrete Relay PCB option must be the same for each relay.  Example:  24VDC should not be the power switched by one relay and 115VAC by others.
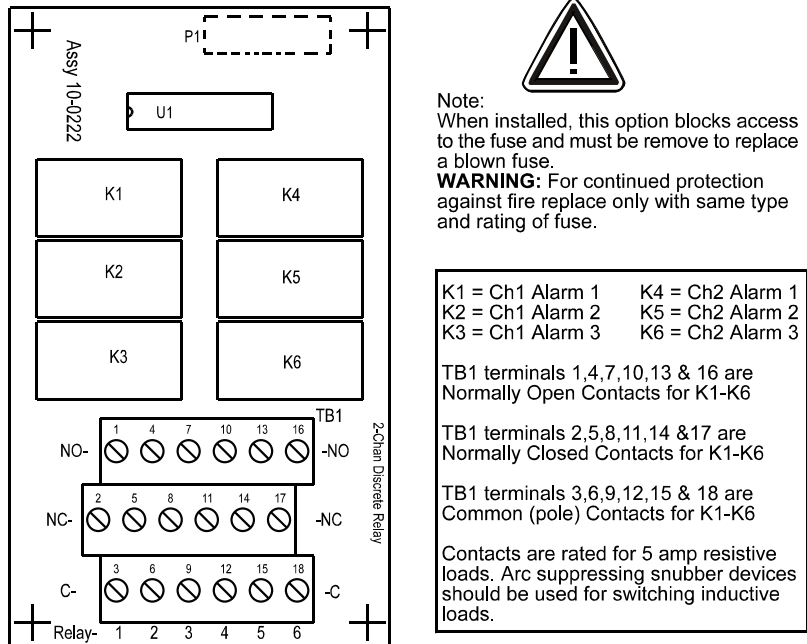
Note:
When installed, this option blocks access to the fuse and must be remove to replace a blown fuse.
**WARNING:** For continued protection against fire replace only with same type and rating of fuse.

K1 = Ch1 Alarm 1    K4 = Ch2 Alarm 1
K2 = Ch1 Alarm 2    K5 = Ch2 Alarm 2
K3 = Ch1 Alarm 3    K6 = Ch2 Alarm 3

TB1 terminals 1,4,7,10,13 & 16 are Normally Open Contacts for K1-K6

TB1 terminals 2,5,8,11,14 &17 are Normally Closed Contacts for K1-K6

TB1 terminals 3,6,9,12,15 & 18 are Common (pole) Contacts for K1-K6

Contacts are rated for 5 amp resistive loads. Arc suppressing snubber devices should be used for switching inductive loads.

Figure 3.7

## 3.1.7    OPTIONAL 4-20mA ANALOG OUTPUT BOARD #299-0004-01

**Important!** 299-0004-01 PCB's may only be installed into motherboard position P2.

An optional 10-bit 4-20mA analog output board, shown in Figure 3.8, may be added. Each channel's output will transmit 4mA for 0% readings and 20mA for 100% readings. If the MODEL 9000 primary power is 100 – 240 VAC or at least 24 VDC, 4-20mA outputs are capable of driving 20mA through a 750 ohm load.  Outputs are self powered and DC power should not be provided by the receiving device.  Precision calibration of the 4-20mA output DAC (digital to analog converter) is accomplished via the **Diagnostics** menu as described in section 2.3.5.

Optional 4-20mA Output Notes

4-20mA Outputs are sourcing and
24 VDC power must not be supplied
by the receiver device.

Loop drive capability is 750 ohms
with nominal 85-240 VAC power or
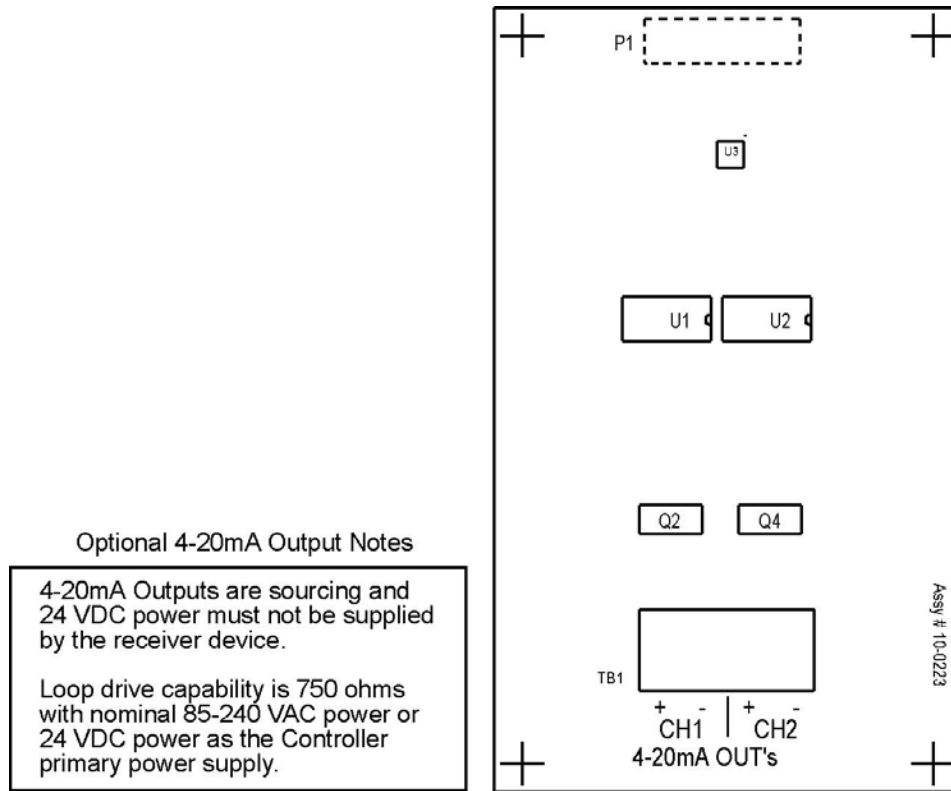24 VDC power as the Controller
primary power supply.

Figure 3.8

### 3.2    MODBUS RS-232 / RS-485 INTERFACE OPTION 299-0016-01

The 299-0016-01 Modbus option PCB add both RS-232 and RS-485 Modbus RTU slave
ports.  Figure 3.9 shows this optional PCB which mounts to connectors on the upper right
corner of the MODEL 9000 motherboard.  TB1 provides two pairs of T/Rx terminals and
a floating terminal for shield continuation.  This makes it easy to multi-drop MODEL
9000's onto an RS-485 cable without doubling wires into the same screw terminals.  RS-
232 interface may be made by connecting to DB9 connector S1.  Section 3.2.1 lists all
modbus registers and their function codes.

Follow correct IEEE RS-232 and RS-485 installation guidelines when using the
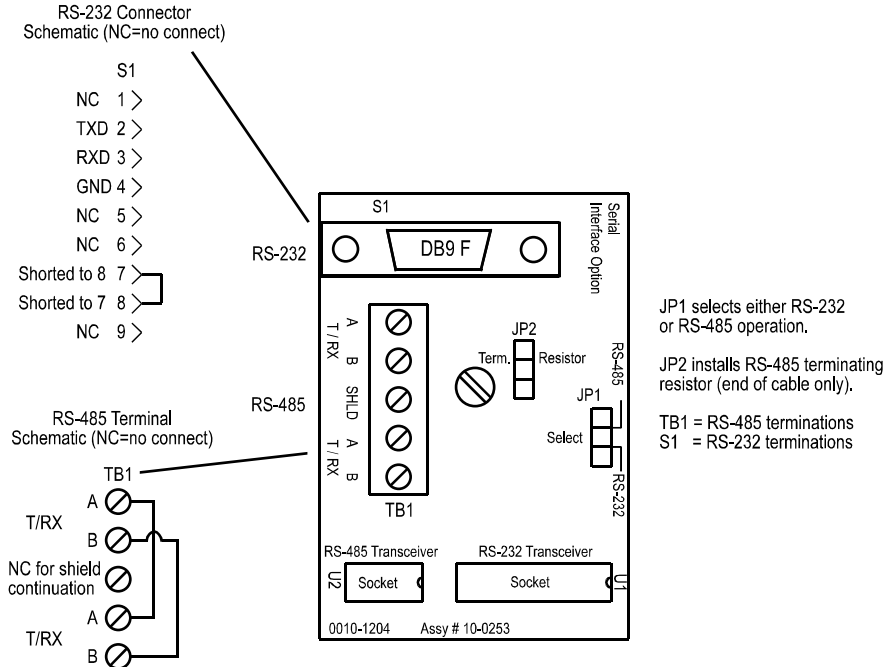299-0016-01 option.

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Figure 3.9

## 3.2.1   MODBUS REGISTER AND FUNCTION CODE SUMMARY

The following table identifies MODEL 9000 Modbus register locations and function codes.

| VARIABLE | ALIAS | READ FUNCTION CODE | WRITE FUNCTION CODE |
|---|---|---|---|

**Read/Write Coils:**

| | | | | |
|---|---|---|---|---|
| Alarm Ack/Reset | | 2001 | 1 | 5 |

  *Note: After writing a TRUE to this register, the MODEL 9000 will reset it to FALSE.*

**Read Only Discrete:**

| | | | | |
|---|---|---|---|---|
| Chan 1 | Alarm 1 | 12001 | 2 | NA |
| Chan 1 | Alarm 2 | 12002 | 2 | NA |
| Chan 1 | Alarm 3/Flt | 12003 | 2 | NA |
| Chan 2 | Alarm 1 | 12004 | 2 | NA |
| Chan 2 | Alarm 2 | 12005 | 2 | NA |
| Chan 2 | Alarm 3   /Flt | 12006 | 2 | NA |
| Relay 1 | | 12007 | 2 | NA |
| Relay 2 | | 12008 | 2 | NA |

**Read Only Registers:**

| | | | |
|---|---|---|---|
| Product ID | 30001 | 4 | NA |

Returns the numeric value 90 for product ID.

| | | | |
|---|---|---|---|
| Firmware value | 30002 | 4 | NA |

Return a numeric value for firmware value as (Version X 100).

| | | | |
|---|---|---|---|
| D2A Chan 1 | 31001 | 4 | NA |
| D2A Chan 2 | 31002 | 4 | NA |

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10 bit value representing the D2A value of 0 to 1023 after all cal features are applied.

| | | | |
|---|---|---|---|
| A2D Raw Chan 1 | 31003 | 4 | NA |
| A2D Raw Chan 2 | 31004 | 4 | NA |

10 bit value representing the A2D value of 0 to 1023 for -25 to 103 %FS (197=0% & 1003=100%).

| | | | |
|---|---|---|---|
| Chan 1 Status | 31005 | 4 | NA |
| Chan 2 Status | 31006 | 4 | NA |

16 bit status word bit assignment for each channel.

| | |
|---|---|
| ALARM1_BELOW_BIT | BIT0 |
| ALARM2_BELOW_BIT | BIT1 |
| ALARM3_BELOW_BIT | BIT2 |
| ALARM1_LATCH_BIT | BIT3 |
| ALARM2_LATCH_BIT | BIT4 |
| ALARM3_LATCH_BIT | BIT5 |
| ALARM3_ACTIVE_BIT | BIT6 |
| CHANNEL_DISABLED_BIT | BIT7 |
| CHANNEL_CAL_BIT | BIT8 |

| | | | |
|---|---|---|---|
| System Status Word | 31007 | 4 | NA |

16 bit status word bit assignment for system status.

| | |
|---|---|
| PIEZO_DRIVE | BIT6 |
| HORN_ACK | BIT7 |
| K1_HORN_DRIVE | BIT8 |
| K2_HORN_DRIVE | BIT9 |
| K1_HORN_PULSE | BIT10 |
| K2_HORN_PULSE | BIT11 |
| K1_FAILSAFE | BIT12 |
| K2_FAILSAFE | BIT13 |
| K2_ACK | BIT14 |
| LOCK | BIT15 |

| | | | |
|---|---|---|---|
| Alarm Status Word | 31008 | 4 | NA |

16 bit status word bit assignment for system status.

| | |
|---|---|
| CHAN_1ALM_1 | BIT0 |
| CHAN_1ALM_2 | BIT1 |
| CHAN_1ALM_3 | BIT2 |
| CHAN_2ALM_1 | BIT3 |
| CHAN_2ALM_2 | BIT4 |
| CHAN_2ALM_3 | BIT5 |
| RELAY_1 | BIT6 |
| RELAY_2 | BIT7 |
| PIEZO | BIT7 |

| | | | |
|---|---|---|---|
| SENSOR_LIFE Chan1 | 31009 | 4 | NA |
| SENSOR_LIFE Chan2 | 31010 | 4 | NA |

Returns –1 for "Cal Required" status or 0 to 100 for Sensor Life.

| | | | |
|---|---|---|---|
| LED Blink Status | 31011 | 4 | NA |

Bit set to 1 = LED Blinking, bit set to 0 = LED Not blinking.

| | |
|---|---|
| CHAN1_ALM1 | BIT0 |
| CHAN1_ALM2 | BIT1 |
| CHAN1_ALM3 | BIT2 |
| CHAN2_ALM1 | BIT3 |
| CHAN2_ALM2 | BIT4 |
| CHAN2_ALM3 | BIT5 |

| | | | |
|---|---|---|---|
| Disc Relay Status | 31012 | 4 | NA |

16 bit status word bit assignment for system status.

| | |
|---|---|
| CHAN_1ALM_1 | BIT0 |
| CHAN_1ALM_2 | BIT1 |
| CHAN_1ALM_3 | BIT2 |
| CHAN_2ALM_1 | BIT3 |

|                |      |      |
|----------------|------|------|
| CHAN_2ALM_2    | BIT4 |      |
| CHAN_2ALM_3    | BIT5 |      |
| RELAY_1        | BIT6 |      |
| RELAY_2        | BIT7 |      |
| PIEZO          | BIT7 |      |

## Memory Floating Point:

*Notes: Returned as 15 bit 2s complement with +- 5% over/underrange applied.. Therefore this must be considered when scaling values to be displayed at the Workstation. The following equation may be used to determine a value for display.*

$$Display\ Value = \frac{MODBUS\ Value\ [\ (Span\ Value\ -Zero\ Value)\ 1.1]}{32767} + \{Zero\ Value\ - [(Span\ Value\ -\ Zero\ Value)\ .05]\}$$

| FP Value Chan 1 | 33001 | 4 | NA |
|-----------------|-------|---|----|
| FP Value Chan 2 | 33002 | 4 | NA |

## Memory Reals:

*Notes: Real value represents float value without the decimal point such as 123.4 is returned as 1234. Decimal devisor is returned as 1, 10, 100, or 1000 for decimal position of 1, 2, 3, or 4, where 123.4 would return the value 10.*

| Chan 1 Zero Real      | 41001 | 3 | NA |
|-----------------------|-------|---|----|
| Chan 1 Zero Devisor   | 41002 | 3 | NA |
| Chan 1 Span Real      | 41003 | 3 | NA |
| Chan 1 Span Devisor   | 41004 | 3 | NA |
| Chan 1 Alarm 1 Real   | 41005 | 3 | NA |
| Chan 1 Alarm 1 Devisor| 41006 | 3 | NA |
| Chan 1 Alarm 2 Real   | 41007 | 3 | NA |
| Chan 1 Alarm 2 Devisor| 41008 | 3 | NA |
| Chan 1 Alarm 3 Real   | 41009 | 3 | NA |
| Chan 1 Alarm 3 Devisor| 41010 | 3 | NA |
| Chan 2 Zero Real      | 41011 | 3 | NA |
| Chan 2 Zero Devisor   | 41012 | 3 | NA |
| Chan 2 Span Real      | 41013 | 3 | NA |
| Chan 2 Span Devisor   | 41014 | 3 | NA |
| Chan 2 Alarm 1 Real   | 41015 | 3 | NA |
| Chan 2 Alarm 1 Devisor| 41016 | 3 | NA |
| Chan 2 Alarm 2 Real   | 41017 | 3 | NA |
| Chan 2 Alarm 2 Devisor| 41018 | 3 | NA |
| Chan 2 Alarm 3 Real   | 41019 | 3 | NA |
| Chan 2 Alarm 3 Devisor| 41020 | 3 | NA |

## Binary Cal Data:

| Chan 1 A2D MIN | 41021 | 3 | NA |
|----------------|-------|---|----|
| Chan 1 A2D MAX | 41022 | 3 | NA |
| Chan 1 D2A MIN | 41023 | 3 | NA |
| Chan 1 D2A MAX | 41024 | 3 | NA |
| Chan 2 A2D MIN | 41025 | 3 | NA |
| Chan 2 A2D MAX | 41026 | 3 | NA |
| Chan 2 D2A MIN | 41027 | 3 | NA |
| Chan 2 D2A MAX | 41028 | 3 | NA |

Min and Max calibration points for the A/D and D/A converters.

**Memory ASCII Strings:**

| | | | |
|---|---|---|---|
| User Info Chan 1 | 40401-40405 | 3 | NA |
| User Info Chan 2 | 40406-40410 | 3 | NA |

10 ASCII characters (2 per register) assigned to the unit identifier read as bytes.

| | | | |
|---|---|---|---|
| EUNITS Chan 1 | 40411-40415 | 3 | NA |
| EUNITS Chan 2 | 40416-40420 | 3 | NA |

10 ASCII characters (2 per register) assigned to the engineering units read as bytes.

| | | | |
|---|---|---|---|
| Chan 1 ASCII Reading | 40421-40423 | 3 | NA |
| Chan 2 ASCII Reading | 40424-40426 | 3 | NA |

6 ASCII characters (2 per register) reflecting the display readout..

**Firmware Version:**

| | | | |
|---|---|---|---|
| Version | 40427-40428 | 3 | NA |

3          ASCII characters (2 per register) reflecting the firmware version.

## 3.3     OPTIONAL EXTERNAL 24VDC 50 WATT POWER SUPPLIES

Some applications may require 24VDC power in excess of the 12 watts supplied by the MODEL 9000.  NEC Class 2 FIFTY WATT external supplies are available for Division 1 (part # 10-0314) and Division 2 (part # 10-0315) potentially hazardous area installations and both also include a NEMA 4X weather rating.  See complete specifications at: http://www.rcsystemsco.com/rc/prod_view.asp?pid=25.

# SECTION 4

## 4.0     MODEL 9000N4 NEMA 4X WALL MOUNT ENCLOSURE

The MODEL 9000/DUAL/N4 wall mount NEMA 4X enclosure is shown in Figure 4.0. Non-metallic enclosures are not grounded by metal conduit.  For internal ground points to be grounded to earth, the TB5 – GND terminal must have a proper earth ground connection (see Figure 3.1).

CAUTION: NONMETALLIC ENCLOSURE DOES NOT PROVIDE GROUNDING BETWEEN CONDUIT CONNECTIONS.  USE GROUNDING TYPE BUSHINGS AND JUMPER WIRES.  ALL FIELD WIRING MUST HAVE INSULATION SUITABLE FOR AT LEAST 250V.
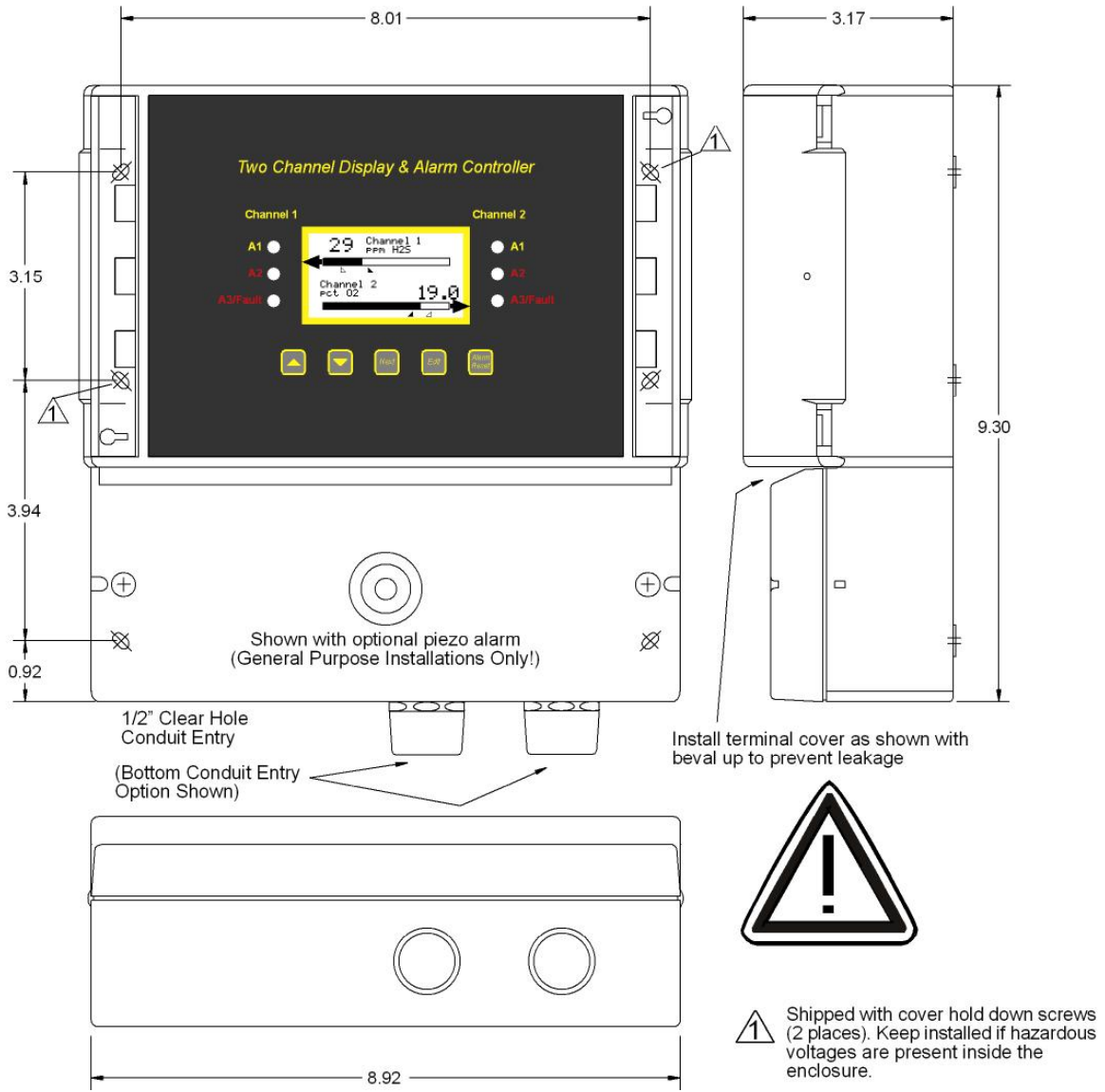
Figure 4.0

### 4.1     MODEL 9000XP NEMA 7 EXPLOSION-PROOF WALL MOUNT ENCLOSURE

The MODEL 9000DUAL/XP shown in Figure 4.1 is an aluminum NEMA 7 wall mount enclosure designed for mounting into potentially hazardous.
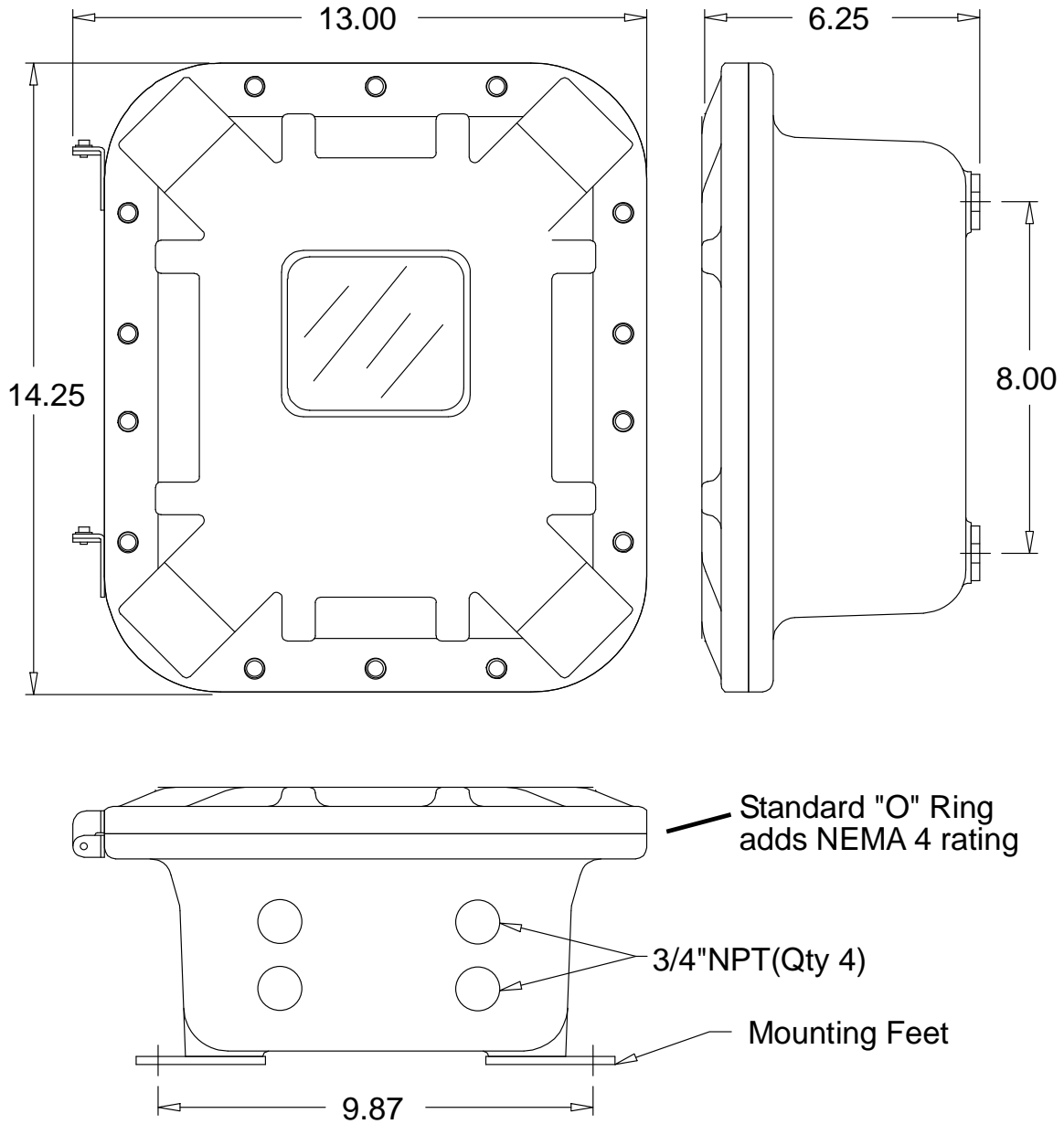


Figure 4.1

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## 4.2     MODEL 9000PY NEMA 4X POLYCARBONATE WALL MOUNT ENCLOSURE

The MODEL 9000/DUAL/PY wall mount NEMA 4X enclosure is shown in Figure 4.2. Non-metallic enclosures are not grounded by metal conduit.  For internal ground points to be grounded to earth, the TB5 – GND terminal must have a proper earth ground connection (see Figure 3.1).

⚠  CAUTION: NONMETALLIC ENCLOSURE DOES NOT PROVIDE GROUNDING BETWEEN CONDUIT CONNECTIONS.  USE GROUNDING TYPE BUSHINGS AND JUMPER WIRES.  ALL FIELD WIRING MUST HAVE INSULATION SUITABLE FOR AT LEAST 250V.
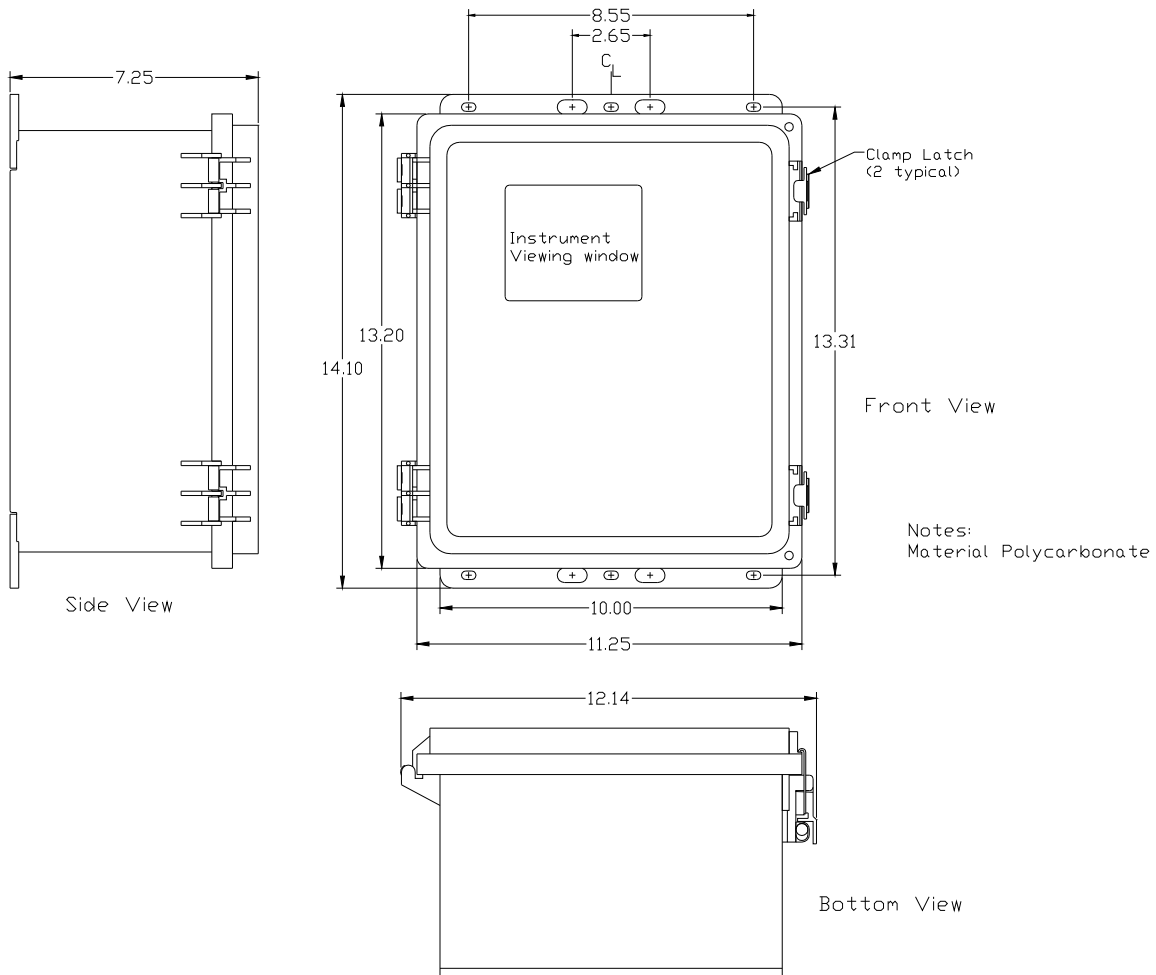


Figure 4.2

## 4.3 MODEL 9000PCS NEMA 4 PAINTED STEEL WALL MOUNT ENCLOSURE

The MODEL 9000DUAL/PCS shown in Figure 4.3 is a Painted Carbon Steel NEMA 4 wall mount enclosure designed for non-corrosive installations.
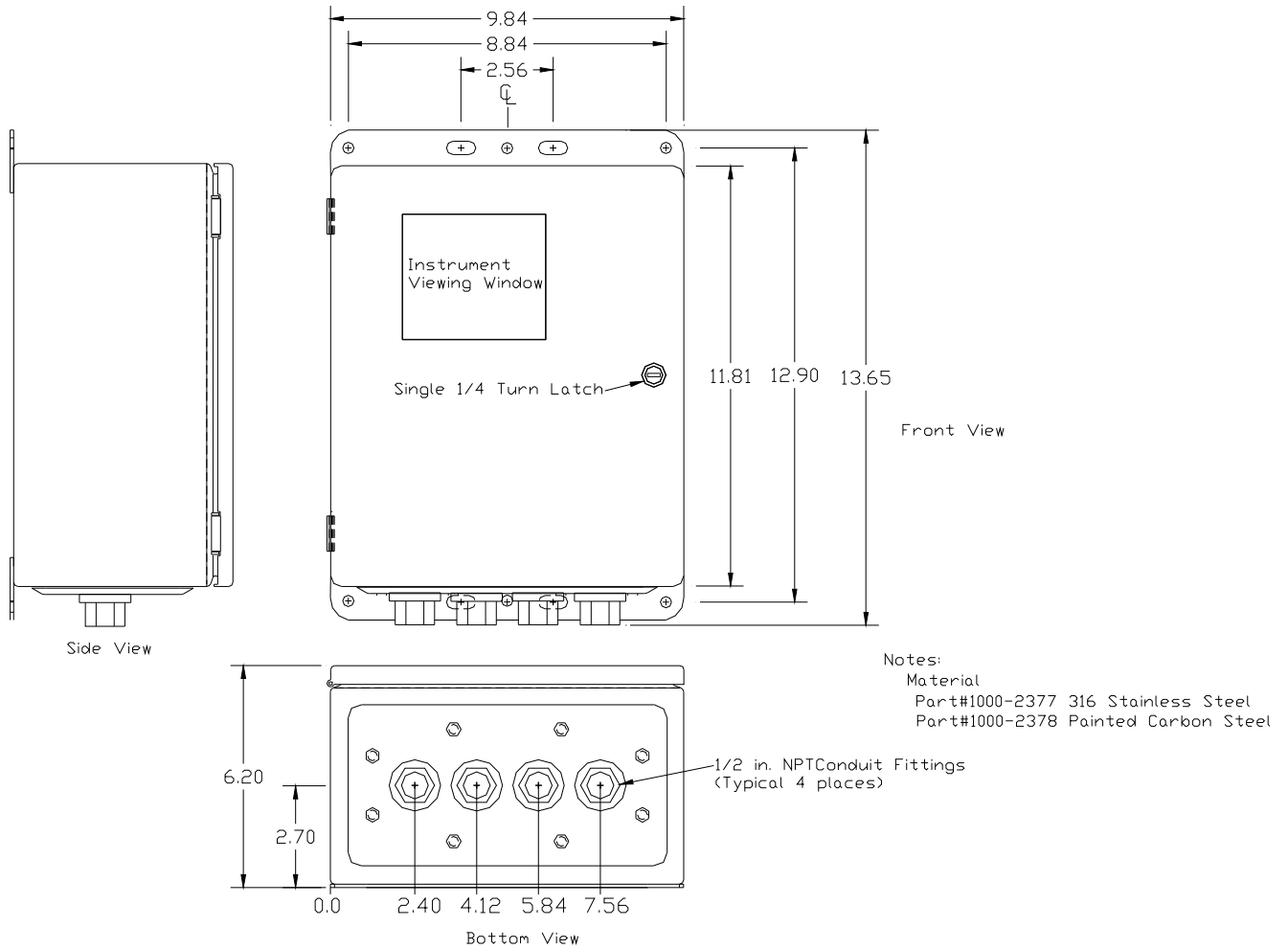


Figure 4.3

## 4.4      MODEL 9000SS NEMA 4X STAINLESS STEEL WALL MOUNT ENCLOSURE

The MODEL 9000DUAL/SS shown in Figure 4.4 is a 316 Stainless Steel NEMA 4X wall mount enclosure designed for corrosive installations.
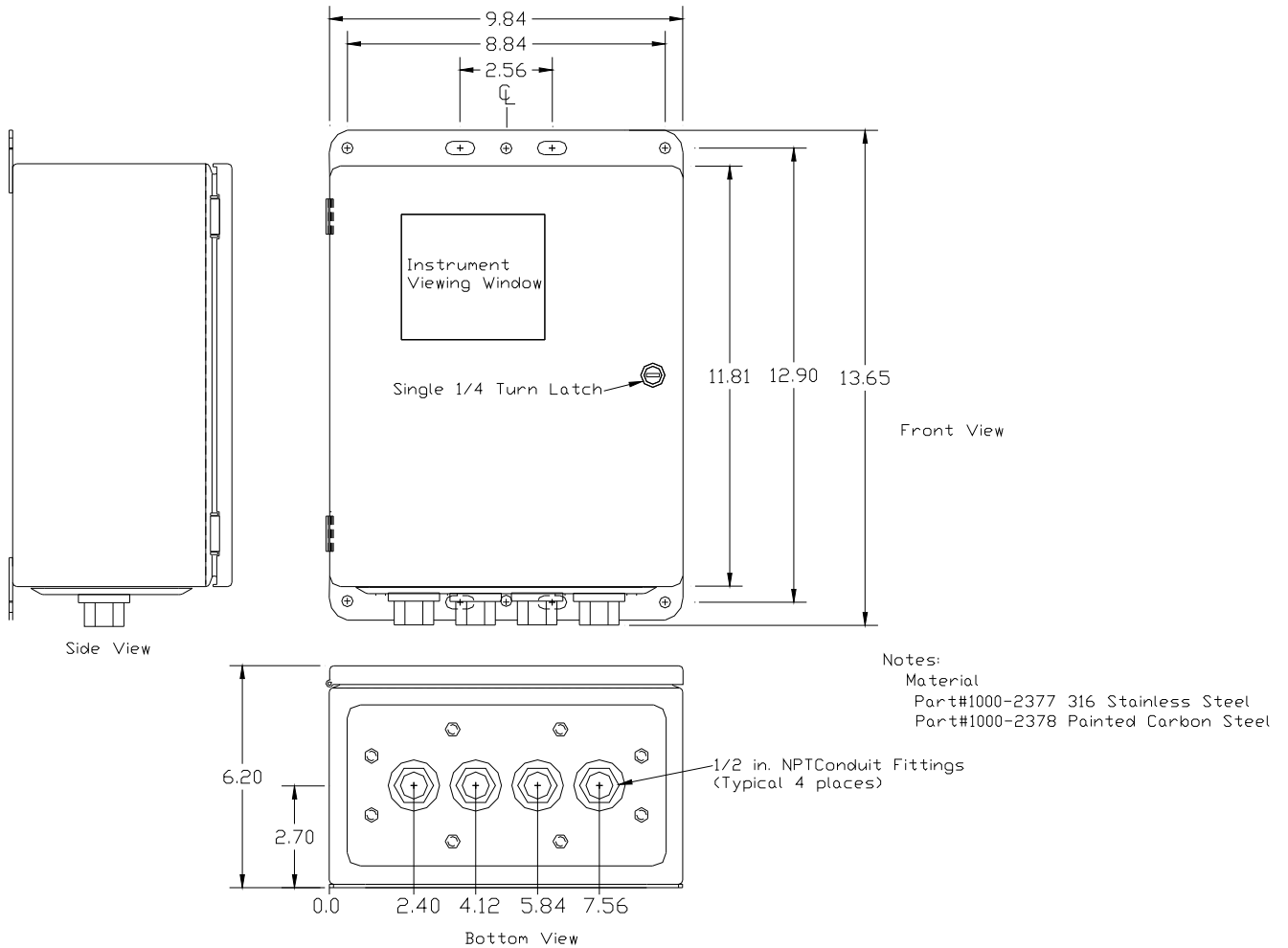
Figure 4.4