Reference Manual
MAN-0115, Rev. A
April 2016

Net Safety ™ SafeGuard Controller

User Manual

EMERSON.
Process Management

Important Instructions

Rosemount designs, manufactures, and tests products to function within specific conditions. Because these products are sophisticated technical instruments, it is important that the owner and operation personnel must strictly adhere both to theinformation printed on the product nameplate and to all instructions provided in this manual prior to installation, operation, and maintenance.

⚠ WARNING

Installing, operating, or maintaining the product improperly could lead to serious injury or death from explosion or exposure to dangerous substances. Comply with all information on the product, in this manual, and in any local and national codes that apply to the product. Do not allow untrained personnel to work with this product. Use Net Safety parts and work procedures specified in this manual.

⚠ WARNING

This manual should be read carefully by all individuals who hve or will have responsibility for using, maintaining, or servicing this product.

The Detector is not field repairable due to the meticulous alignment and calibration of the sensors and the respective circuits. Do not attempt to modify or repair the internal circuits or change their settings, as this will impair the system's performance and void the Rosemount warranty.

Warranty

1. **Limited Warranty**. Subject to the limitations contained in Section 10 (Limitation of Remedy and Liability) herein, Seller warrants that (a) the licensed firmware embodied in the Goods will execute the programming instructions provided by Seller; (b) that the Goods manufactured by Seller will be free from defects in materials or workmanship under normal use and care; and (c) Services will be performed by trained personnel using proper equipment and instrumentation for the particular Service provided. The foregoing warranties will apply until the expiration of the applicable warranty period. Sensors and detectors are warranted against defective parts and workmanship for 24 months from the date of purchase and other electronic assemblies for 36 months from the date of purchase. Products purchased by Seller from a third party for resale to Buyer (**Resale Products**) shall carry only the warranty extended by the original manufacturer. Buyer agrees that Seller has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products. If Buyer discovers any warranty defects and notifies Seller thereof in writing during the applicable warranty period, Seller shall, at its option, (i) correct any errors that are found by Seller in the firmware or Services; (ii) repair or replace FOB point of manufacture that portion of the Goods found by Seller to be defective; or (iii) refund the purchase price of the defective portion of the Goods/Services. All replacements or repairs necessitated by inadequate maintenance; normal wear and usage; unsuitable power sources or environmental conditions; accident; misuse; improper installation; modification; repair; use of unauthorized replacement parts; storage or handling; or any other cause not the fault of Seller, are not covered by this limited warranty and shall be replaced or repaired at Buyer's sole expense and Seller shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by Seller. All costs of dismantling, reinstallation, freight and the time and expenses of Seller's personnel and representatives for site travel and diagnosis under this limited warranty clause shall be borne by Buyer unless accepted in writing by Seller. Goods repaired and parts replaced by Seller during the warranty period shall be in warranty for the remainder of the original warranty period or 90 days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller. The limited warranty herein ceases to be effective if Buyer fails to operate and use the Goods sold hereunder in a safe and reasonable manner and in accordance with any written instructions from the manufacturers. THE WARRANTIES AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE. THERE ARE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE OR ANY OTHER MATTER WITH RESPECT TO ANY OF THE GOODS OR SERVICES.

2. **Limitation of Remedy and Liability**. SELLER SHALL NOT BE LIABLE FOR DAMAGES CAUSED BY DELAY IN PERFORMANCE. THE REMEDIES OF BUYER SET FORTH IN THE AGREEMENT ARE EXCLUSIVE. IN NO EVENT, REGARDLESS OF THE FORM OF THE CLAIM OR CAUSE OF ACTION (WHETHER BASED IN CONTRACT, INFRINGEMENT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE), SHALL SELLER'S LIABILITY TO BUYER AND/OR BUYER'S CUSTOMERS EXCEED THE PRICE TO BUYER OF THE SPECIFIC GOODS MANUFACTURED OR SERVICES PROVIDED BY SELLER GIVING RISE TO THE CLAIM OR CAUSE OF ACTION. BUYER AGREES THAT IN NO EVENT SHALL SELLER'S LIABILITY TO BUYER AND/OR BUYER'S CUSTOMERS EXTEND TO INCLUDE INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES. THE TERM "CONSEQUENTIAL DAMAGES" SHALL INCLUDE, BUT NOT BE LIMITED TO, LOSS OF ANTICIPATED PROFITS, REVENUE OR USE AND COSTS INCURRED INCLUDING WITHOUT LIMITATION FOR CAPITAL, FUEL AND POWER, AND CLAIMS OF BUYER'S CUSTOMERS.

Contents

Section 1: Introduction

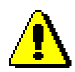
WARNING: Read & understand contents of this manual prior to operation. Failure to do so could result in serious injury or death.

1.1 Important safety issues

The following symbols are used in this manual to alert the user 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.

WARNINGS: 

- **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 6.2).
- Only the combustible monitor portions of this instrument have been assessed by CSA for C22.2 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.
- **WARNING- EXPLOSION HAZARD-** DO NOT DISCONNECT EQUIPMENT 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

- A Certified AC power (mains) disconnect or circuit breaker should be mounted near the SafeGuard Controller and installed following applicable local and national codes. If a switch is used instead of a circuit breaker, a properly rate CERTIFIED fuse or current limiter is required to 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 only with a damp cloth without solvents.
- Equipment not used as prescribed within this manual may impair overall safety.

1.2 General description

The Net Safety Monitoring Inc. SafeGuard 16 channel Controller is designed to display and control alarm event switching for up to sixteen detectors (Flame detectors or transmitters with gas sensor) data points. It may also be set as an eight channel SafeGuard Controller for applications needing fewer inputs. Alarm features such as *ON* and *OFF* delays, *Alarm Acknowledge*, and a dedicated horn relay make the SafeGuard Controller well suited for many multi-point monitoring applications. Data may be input to the SafeGuard Controller by optional analog inputs or the standard Modbus® RTU *master* RS-485 port. A Modbus RTU *slave* RS-485 port is also standard for sending data to PC's, PLC's, DCS's, or even other SafeGuard Controllers. Options such as analog I/O and discrete relays for each alarm are easily added to the addressable I^2C bus. Option boards have 8 channels and therefore require 2 boards for 16 channel applications.

Note: LEL Gas sensors are connected to the SafeGuard Controller via Net Safety Transmitters. They are NOT connected directly to the SafeGuard Controller at this time. Perform calibrations of the transmitter/sensor head. Calibrations may however be performed at the SafeGuard if the transmitter/sensor configuration is in a location not easily accessible. See Cal Mode.

A 240 x 128 pixel graphic LCD readout displays monitored data as bar graphs, trends and engineering units. System configuration is through user friendly menus and all configuration data is retained in non-volatile memory during power interruptions. The SafeGuard Controller's front panel is shown below in Figure 1.0 displaying the 8 channel bar graph screen. Additional data screens are shown in Figure 2.0.

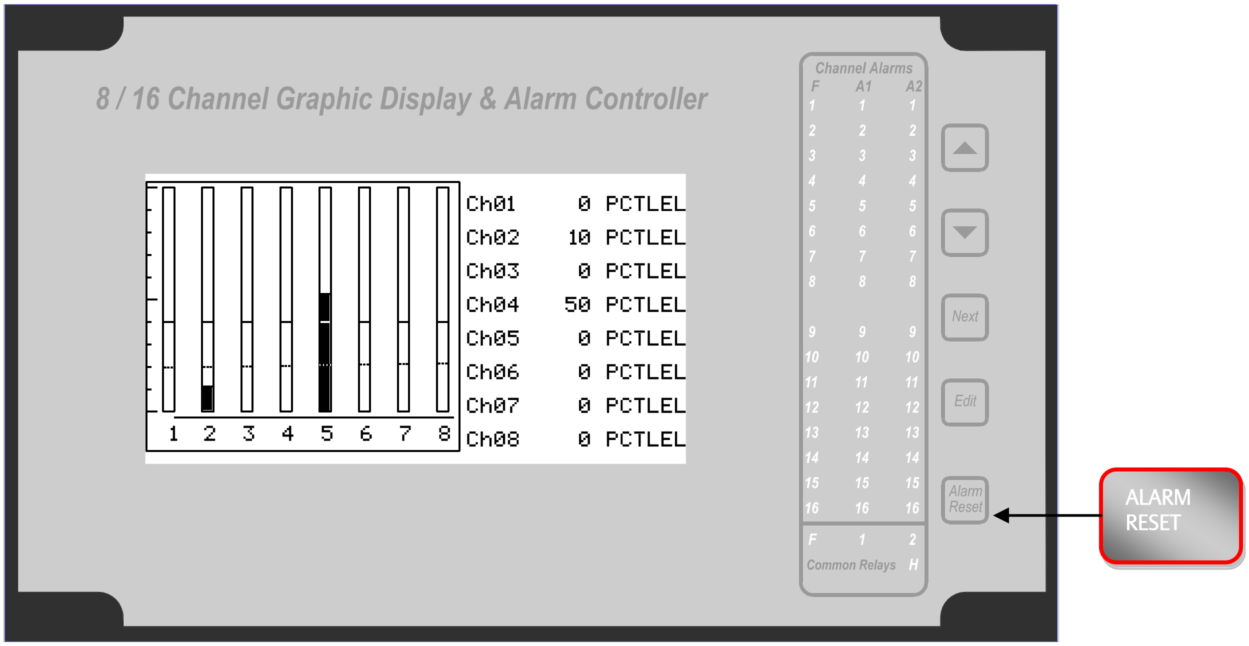


Figure 1.0

1.3 Data display screens

The SafeGuard Controller offers 3 distinct graphic displays for depicting the monitored data. These are Bar Graphs, 24 Hour Trend and Combination. Each is shown in Figure 2.0.

1.3.1 Trend screen

The SafeGuard Controller's Trend screen shown in Figure 2.0 displays a 24 hour trend of input data for the channel selected. Horizontal tic marks are each hour and vertical tic marks are each 10% of full scale. Dashed lines indicate alarm levels. The graphic LCD is 240 pixels wide so each pixel represents 1/10 hour, or 6 minutes worth of data. The trend is 100 pixels high so each represents 1% of full scale in amplitude. Since each data point must be collected for 6 minutes before it may be displayed, it is likely input values will fluctuate during this interval. Therefore, MAX, MIN and AVERAGE values are stored in RAM memory for each 6 minute subinterval. To accurately portray the trend, a vertical line is drawn between MIN & MAX values for each 6 minute subinterval. The AVERAGE value pixel is then left blank, leaving a gap in the vertical line. This is demonstrated in the *noisy* area of the 24 hour trend in Figure 2.0. If the MAX & MIN values are within 2% of each other there is no need for the vertical line and only the AVERAGE value pixel is darkened as in the *quiet* areas.

The top portion of each trend screen indicates channel #, real time reading in engrg. units, measurement name, range, and MIN, MAX & AVERAGE values for the preceding 24 hour period. The SI field on the top right indicates number of seconds remaining in the current 6 minute subinterval.

1.3.2 Bar Graphs screen

The SafeGuard Controller's Bar Graphs screen shown in Figure 2.0 allows all active channels to be viewed simultaneously. Both engineering units values and bar graph values are indicated in real time. Lines across the bars indicate the alarm trip points making it easy to identify channels at or near alarm. A feature in the Systems menu tree allows new alarms to always force the LCD to the bar graphs screen. This is useful for applications requiring channels with alarms to be displayed.

1.3.3 Combination screen

The SafeGuard Controller's Combination screen shown in Figure 2.0 offers a view of a single channel but displays the data as a 30 minute trend, bar graph and large engineering units. It is also useful for testing inputs for stability since MAX, MIN & AVERAGE values refresh each time this screen is selected. For example, to test stability over a one hour period for an input, begin timing as soon as the channel is selected. One hour later record the MAX, MIN & AVERAGE values. The difference between MAX & MIN indicates peak to peak excursions over the one hour period and AVERAGE is the average for the hour. Longer or shorter tests may also be run. The numeric value shown below the bar-graph indicates number of minutes samples have been taken. After 999 minutes the AVERAGE buffer overflows and the error message *UPDATE* appears in the AVERAGE field. Exiting this screen resets the buffer and clears the error message.

1.4 Specifications

1.4.1 DC power supply requirements

Standard SafeGuard Controller power requirements are 10-30VDC @ 3 watts applied to terminals 9 & 11 of TB2 on the standard I/O PCB (see section 3.0). Optional features increase power consumption as described below:

- Discrete Relay PCB option; add 2 watts per PCB (assumes all 8 relays are energized).
- Analog Input PCB option; add 1/2 watt.
- 4-20mA Output PCB option; add 1 watt.
- TB2 terminals 10 & 12 of the standard I/O PCB provide a maximum of 500mA fused output power for powering of auxiliary external devices such as relays, lamps or transmitters. Power consumed from these terminals should be considered when calculating system power consumption.

When wiring transmitters (detectors) to the SafeGuard Controller refer to 3.1.1 Optional Analog Input PCB # SG10-0158 and Figure 3.3.

1.4.2 150 watt AC– 24 Vdc power supply

*110-120 VAC @3.2A max

*220-240VAC @ 1.6A max

* A slide switch on the front of the power supply selects AC input range.

The SG10-0172 150 watt power supply (Figure 3.6) is for powering the SafeGuard Controller and up to 16 detectors. A minimum of 5 watts per channel is available for powering of external transmitters.

1.4.3 Relays

Common relays are standard and menus provide voting logic for ALARM 1, ALARM 2, FAULT and HORN. Discrete relays are optional. Relays are Form C dry contacts and 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. Relay wiring should be kept separate from low level signal wiring.

1.4.4 Ambient temperature range

-25 to +50 degrees C

1.4.5 Humidity range

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

1.4.6 Altitude

Recommended up to 2000 meters

1.4.7 Housings

- *General purpose panel mount weighing 7 lbs and including hardware for 19" rack mounting (Figure 6.1).
- *NEMA 4X wall mount in fiberglass enclosure weighing 17 lbs (Figure 6.2).

1.4.8 Non-intrusive magnetic keypad

The SafeGuard Controller's operator interface includes five front panel *touch* keys. A magnetic keypad option offers these five keys with adjacent magnetic keys. This option is included as a standard feature. It is useful in applications where it may be inconvenient to open the enclosure's door to access the *touch* keypad.

1.4.9 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: Operation

2.1 Basic operation

The SafeGuard Controller offers 3 graphic screens for viewing monitored data and a *Set-Up* menu screen for operator interface to configuration menus. They are shown below in Figure 2.0. The *Bar Graphs* screen allows viewing of all active channels simultaneously. The *Trend* screen displays a 24 hour trend one channel at a time. The *Combination* screen displays a bar graph, large engineering units and a 30 minute trend one channel at a time. Input channels may be displayed in sequence with the **UP/DOWN** keys. The **NEXT** key switches between the 3 graphic data screens. When SafeGuard power is applied, the graphic LCD returns to the screen active when power was last removed.

Setup menus are entered by pressing **EDIT** from any data screen, and scrolling to the desired menu using the **UP/DOWN** keys. Pressing **EDIT** again enters the selected menu's tree of variables. 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. An **AUTHORIZE** menu offers a password feature to prevent tampering with the SafeGuard Controller's parameters.

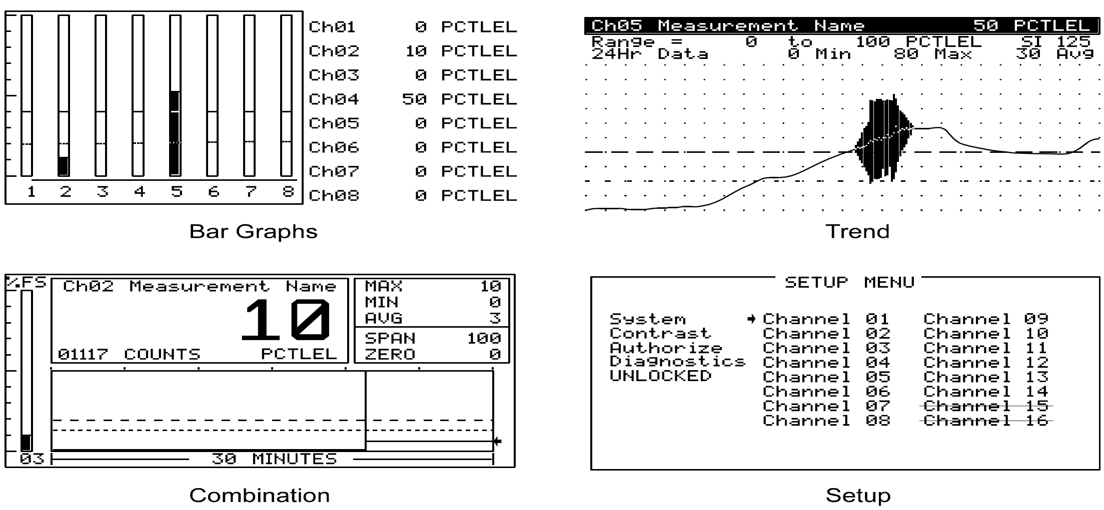


Figure 2.0

2.2 Setup menu configuration

Variables inside *system* and *channel* menu trees allow optimum SafeGuard Controller configuration for a wide range of demanding multi-point monitoring applications. Access to menus is via the *Setup* mode by pressing **EDIT** and activating the *Setup* screen shown in Figure 2.0. Menu trees are provided for each of the 16 channels and another for system variables. Select the desired menu by scrolling with **UP/DOWN** and **EDIT** to enter the menus.

2.2.1 Changing menu variables using the key pad

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 *Measurement Name* and *Eunits* fields may have many ASCII character possibilities. Allowed ASCII characters are as follows: ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz blank space !"#$%&`()*+,-./0123456789:;<=>?@. **EDIT** places a cursor over 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 it into non-volatile memory where it is retained indefinitely. With no cursor present, **NEXT** closes open menus in reverse order and returns the LCD to the most recent data display.

2.3 Channel configuration menus

Figure 2.1 illustrates the menu tree for configuring Channel variables. These items affect only the specific channel selected. System specific variables are in the menu tree shown in section 2.3.

CHANNEL MENUS TREE

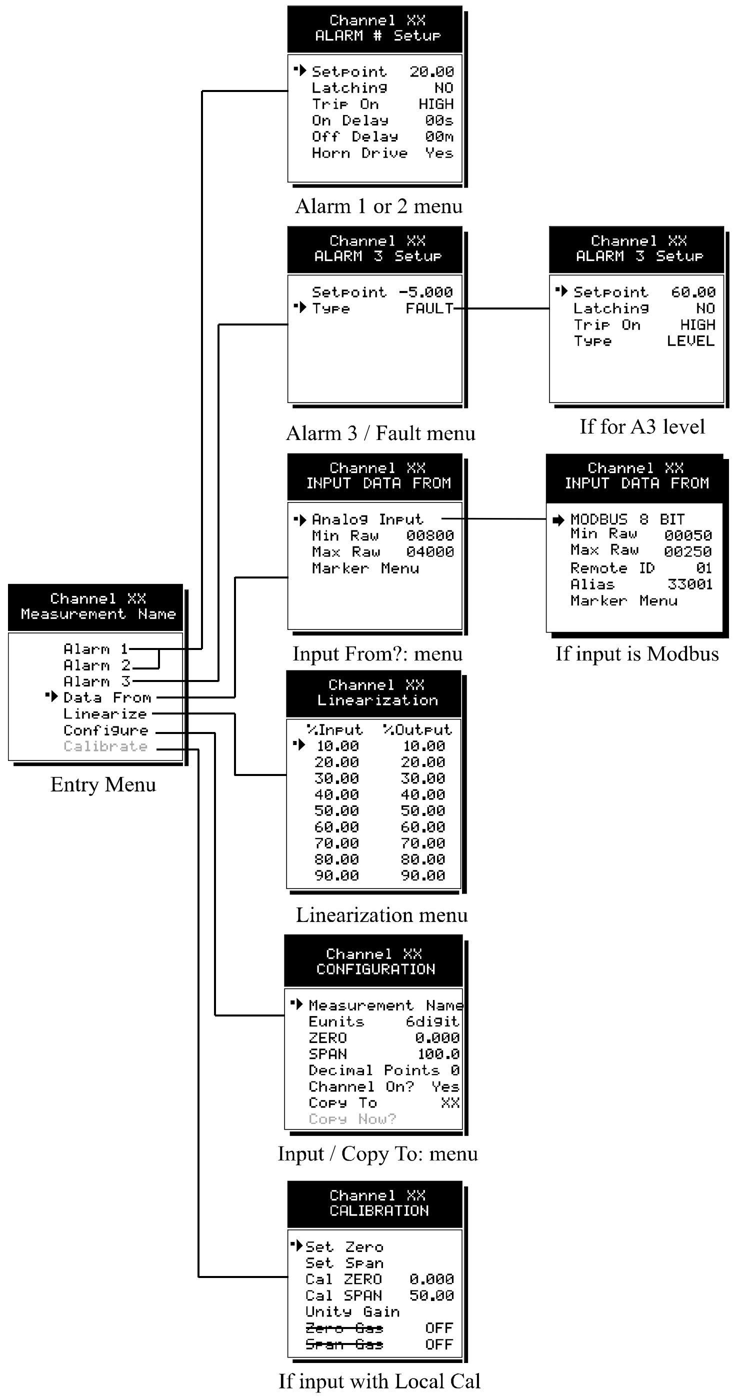


Figure 2.1

2.3.1 Channel setup entry menu

The *entry menu* shown on the left side of Figure 2.1 allows access to all configuration variables for the selected channel. These are **Alarm 1**, **Alarm 2**, **Alarm 3**, **Data From? Linearize**, **Configure** and **Calibrate**.

2.3.2 Alarm 1 / Alarm 2 / Horn Relay Setup menu

Alarms 1 and 2 are identical except A1 may not be *acknowledged* and front panel LED indicators are yellow while A2's are red. Since their configuration menus are the same only one is shown in Figure 2.2 for clarity.

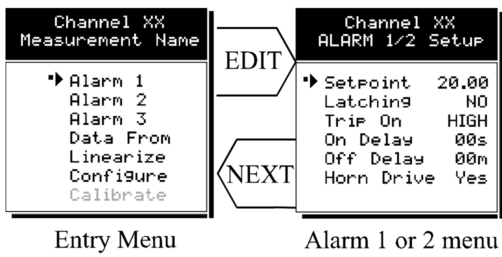


Figure 2.2

The first entry determines the **Setpoint** value where the alarm trips. It is entered in engineering units. For example, if a channel monitors 0-50 ppmH2S and the alarm must trip at 10 ppm, the correct entry is 10.00.

- **Latching** determines either manual or automatic alarm reset operation. **YES** requires a manual **Alarm Reset** (see Figure 1) to unlatch the alarm even though an alarm condition no longer exists. **YES** also causes this alarm group's common relay, front panel LED, and optional discrete relay to latch. **NO** allows all outputs for this alarm to automatically reset as soon as the alarm condition clears.

- **TRIP ON** is set to **HIGH** for increasing alarms or **LOW** for decreasing alarms to determine if the alarm activates upon exceeding or falling below the setpoint.

- The **ON DELAY / OFF DELAY** entries allow **ON** and **OFF** time delays affecting how long the setpoint 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.

Note: For **ON DELAY** the alarm is activated after the 'set time' is reached. For **OFF DELAY** the alarm remains activated for the duration of the 'set time', after the alarm condition has passed.

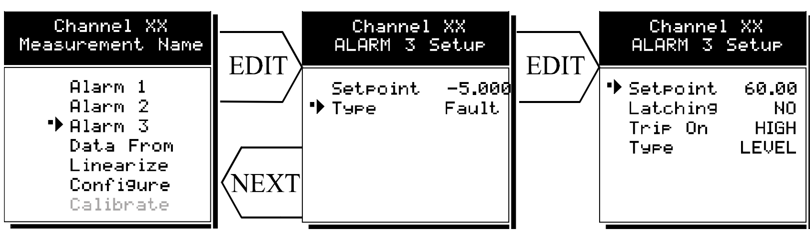
- The **HORN ON** entry allows linking this alarm to the common horn relay. **NO** causes the alarm to have no effect upon the horn relay. Entering **YES** causes this alarm to turn the horn relay on steady, or, to pulse it depending upon horn configuration in the system menu (see section 2.3.3).

Discrete LED indicators on the front panel indicate the status of each alarm and relay. Any *new* alarm event causes the associated LED to flash until **Alarm Reset** occurs causing an *acknowledged* steady on condition. Operators should recognize *new* alarms by a flashing LED. **Alarm Reset** also *acknowledges*, or deactivates, the horn relay until another new alarm occurs.

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

2.3.3 Alarm 3 / Fault Alarm menu

The discrete channel alarms identified as Alarm 3/Fault may be configured either as a 3rd level alarm, or, as a Fault alarm indicating the input is out of range in the negative direction. When used as a level alarm, features such as on / off delays, latching, and trip direction are also available. It is important to understand that though discrete channel alarms (LED's & optional discrete relays) may be set as Alarm 3 level alarms, the common relay for this group is always a Fault alarm. The fault *out of range* threshold for the channel is the most recent Fault trip point entered prior to changing the menu to Alarm 3. The following example describes how to configure both the Fault *out of range* and Alarm 3 *level* trip points for a channel. ***Example:*** If the common Fault relay must trip as the input falls below negative 10% of full scale, and, the discrete alarms trip as the input exceeds a level, then the –10% Fault setpoint must be entered first. Toggle the *TYPE* menu entry to **FAULT** and enter –10.00% into the *setpoint* entry. Next, toggle the menu back to **LEVEL** and enter the desired Alarm 3 level *setpoint*. The -10% Fault value is retained in memory even though it no longer appears on the menu.



Entry Menu   Alarm 3 / Fault menu   If for A3 Level

Figure 2.3

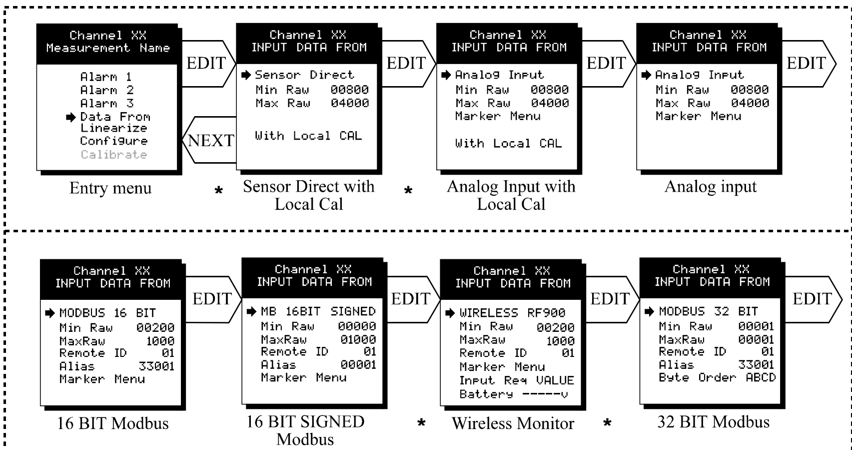
2.3.4 Data from? menu to set input source

Channels may be independently configured to accept input data from the following sources (also see Figure 2.4):

- An analog input PCB attached to the I²C bus.
- A sensor input PCB may be attached to the I²C bus. **This Option Board is however not used at this time.**
- The Modbus RS-485 master port connected to modbus slave devices. **Note**: Each *Modbus* menu selection also requests the RTU # and the Alias register # location of the data to be retrieved from the RTU. Alias register numbers define the location of the variable representing the input value and must be obtained from the manufacturer of the Modbus RTU device.

EDIT toggles the *Data From*: entry between *Analog, Analog with Local Cal and Modbus RTU (signed, unsigned & floating point)*.

Analog Input should be selected when the channel's input comes from a transmitter or monitoring device with a *calibrated* output such as 4-20mA. *Sensor Direct* is identical to *Analog Input with Local Cal* and both activate the SafeGuard Controller's *Cal Mode* features. Problems may arise if calibrations are performed in two places upon the same signal so Cal Mode menus are only visible when *Sensor Direct* or *Analog Input with Local Cal* is selected. These applications would require the SafeGuard Controller to be used as the calibration point; when calibration transmitter and sensor configuration at the SafeGuard Controller, select *Analog Input with Local Cal*. Note that gas sensors are not connected directly to the SafeGuard Controller at this time, hence *Sensor Direct* is not used.



***** **Direct Gas Sensor inputs are not used at this time ***

The Modbus Master RS-485 port supports most integer types, resolutions and formats. "MODBUS 16 BIT" menu indicates 16 bit is maximum but also supports 8, 10, 12 bit formats by editing Min/Max Raw menus to contain the correct counts range.

***** **The Wireless Option and features are not used at this time ***

Figure 2.4

2.3.5 Min / Max Raw counts entries

The Min Raw and Max Raw counts entries included in Input Data From: menus define the range of input counts that provide *Measurement Range* read-out values described in section 2.2.6b. This menu entry is determined by the A/D converter resolution of the channel's input. For example, if the input is a 10 bit Modbus® device with zero at 200 counts and 100% at 1000 counts, then this menu's MIN should be set at 200 and MAX at 1000. If communicating with the SafeGuard Controller's optional 12 bit Analog Input PCB the MIN should be 800 and the MAX 4000.

If the input device's resolution is unknown, the live counts variable on the bottom of the screen displays actual raw A/D counts currently being read by this channel. This reading may be used to test the input device for what A/D counts are provided for zero and 100% if these values are unknown. Forcing the input device to read zero should provide the A/D counts value needed to make this channel's display also read zero. Likewise, forcing the input device to read 100% should provide the A/D counts value needed to make the SafeGuard channel's display also read 100%.

If Modbus 32 BIT is selected, a Byte Order entry appears at the bottom of the menu. This determines WORD and BYTE alignment of data at the remote Modbus transmitter when sending its 4 byte IEEE Floating Point values. With the pointer on this entry, the EDIT key toggles between the 4 possible modes. Min / Max Raw values are not used in this mode.

Note: Each *Data From*: item has a matching default Min/Max counts value of 20% to 100% with ± 5% over/under range applied. If the default value is incorrect for the input device it should be edited.

2.3.6 Marker menus

Some transmitters or monitoring devices providing SafeGuard Controller inputs also indicate special modes of operation, such as *Calibration, Maintenance or Fault,* by transmitting a special <4mA or negative "Marker" value. The SafeGuard Controller offers channel Marker menus for detecting and indicating such events (see Figure 2.5). While active, the SafeGuard Controller displays a 6-digit ASCII message to indicate the special event and if equipped with SG10-0167 4-20mA output option, the SafeGuard Controller also transmits the same <4mA value.

- **Marker Enabled** turns the marker feature ON and OFF
- The negative Marker value is entered into the **Marker %** field as a negative percent of full scale. For example, -15.62% of full scale detects a marker value of 1.5mA (1.5mA is -15.62% of full scale when 4-20mA is the range).
- It should be noted that for **Net Safety Flame Detectors the current output for a visual integrity fault is 2.0 mA this corresponds to a Marker % of -12.5%. For Net Safety Gas Sensor Fault Condition, the current output is 2.5 mA which would correspond to a Marker % of approximately -9.4 %.**
- The **Mark As** menu allows user entry of the 6-digit ASCII message to be displayed when the marker is detected.

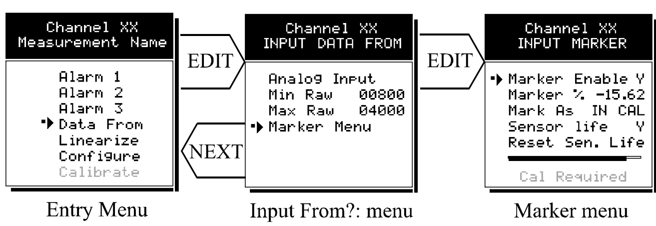


Figure 2.5

2.3.7 Sensor Life detection (- this feature is not used at this time)

Sensor Life should only be activated when the Marker event is *Calibration* and when a sensor life value is transmitted after each calibration. For **Sensor Life** to record properly the monitor must perform as follows: After the *Calibration* Marker interval, 4.0mA transmits for 10 seconds to indicate its *calibration mode* is complete. The monitor then transmits between 4.0mA and 5.0mA for five seconds depending on remaining sensor life where 4.0mA = 0% and 5.0mA = 100% remaining sensor life. The SafeGuard Controller reads this value and records it as the channel's **Sensor Life**. **Sensor Life** is stored in the SafeGuard Controller's modbus database and displayed as a bar-graph in the Sensor Info screen (see section 2.3.6). It is a useful tool for planning sensor replacement schedules.

2.3.8 Linearization menu

The linearization menu allows each channel to have its own linearization curve stored in the SafeGuard Controller's non-volatile memory. Input versus output points must be entered in *percent of full scale* values. This means if the range is 0-200 ppm H2S then 100 ppm is 50% of full scale. Zero input will provide a zero output and 100% input a 100% output. Nine intermediate points may be entered to define the curve.

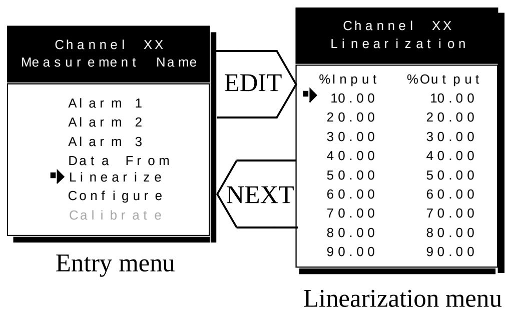


Figure 2.6

2.3.9 Configure menu

From the entry level setup menu in Figure 2.7 the CONFIGURE menu may be entered for setting variables defining how the SafeGuard Controller presents monitored data to the various graphic displays.

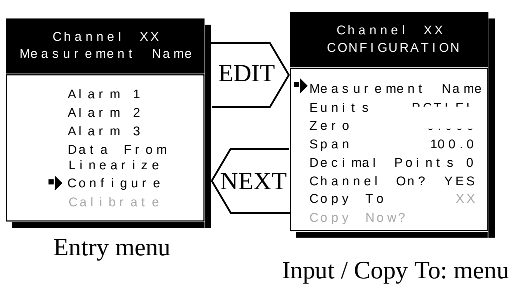


Figure 2.7

2.3.10 Eunits / Measurement Name ASCII data fields

The first two items in this menu are for entering the 6 character *engineering unit* and 16 character *Measurement Name* ASCII fields. Eunits should define the units of measure for what this channel is to display. *Measurement Name* should describe the source of this data in the user's terminology. Section 2.1.1 of this manual describes how to use the front keypad to modify these fields.

2.3.11 Input measurement range

The **ZERO / SPAN** entries allow configuration of the measurement range displayed by the channel. Measurement Range works along with *A/D Counts* menus, described in section 2.2.4a, to define 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 H2S, then the **Zero** value should equal 0.000 and the **Span** value equal 10.00. The six ASCII engineering units previously entered are automatically displayed at the top of each menu as a reminder. Four digits must appear in this entry so trailing 0's may appear here that are not displayed on other data screens.

2.3.12 Decimal point resolution

Resolution of displayed channel values is configured in this menu by setting the number digits trailing the decimal point. Values are limited to a maximum of four digits, and a polarity sign. An auto-ranging feature displays the highest resolution allowed by this menu's decimal point entry. For example, if three decimal points are entered, and the range is 0 to 100ppm, the reading will be **0.000** at 0ppm and **100.0** at 100ppm. However, this may be undesirable due to the high resolution at zero unless the detector'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. In the above example, this would cause 0ppm to display **0** and 100ppm to display **100**.

2.3.13 Turning off unused channels

The **Channel On?** entry determines if this channel is to be utilized. Turning it off will cause the SafeGuard Controller to never process inputs applied to this channel and no alarms will be tripped or data displayed. Inactive channels have a line drawn through them on the Setup screen as indicated by channels 15 & 16 in Figure 2.0. If less than 9 channels are to be activated, the SafeGuard Controller may be set for 8 channel mode, deactivating channels 9-16. This is done in the System Setup menu described in section 2.3. The SafeGuard Controller will only allow 15 channels to be turned off. At least one channel must remain on.

2.3.14 Copy Data to?

This menu simplifies the Setup procedure by allowing similar channels to be copied from one to another. For example, if all channels are identical except for the *Measurement Name* entry, channel 1 could be configured and copied to channels 2 – 16. Only *Measurement Name* then must be configured on channels 2 – 16. Use **EDIT** to increment channel numbers and **UP/DN** to point to **Copy Now?** Press **EDIT** once more to copy.

2.3.15 Cal mode

This SafeGuard Controller feature is only accessible when ***Sensor Direct*** or ***Analog Input with Local Cal.*** is selected. The ***Analog Input with Local Cal.*** option may be used if the transmitter and sensor connected to the controller are located in an area not easily accessible. A calibration tube should be fitted to the sensor and run to an easy access location where a gas canister is fitted and calibration performed using the calibration menu. It should be noted that the current output from the SafeGuard Analog Output Board will be 1.5 mA when the device is in calibration mode.

The CALIBRATION MENU allows entering the correct **Cal ZERO** & **Cal SPAN** set-point values needed to calibrate the sensor. These are entered in the same engineering units as input range. **Set Zero** & **Set Span** controls in this menu allow pushbutton calibration by moving the pointer to each and pressing the **EDIT** key. A live reading of the channel's value allows calibration checks to see if an adjustment is needed. Unintentional calibrations are reset by the **Unity Gain** menu item. **Unity Gain** resets zero offset to 0 and span gain to 1. It 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 it is new, and again at later dates when degradation may have occurred.

To check zero calibration, apply the ZERO calibration value to the sensor and observe the live reading. If the zero reading differs from the zero setpoint, a calibration is needed. To calibrate zero, move the pointer to **Set Zero** and press **EDIT**. A warning message explains that pressing **EDIT** again will change the zero calibration and any other key will exit. The procedure for span calibration is identical. For example, if an LEL combustible sensor is to be spanned with 50% LEL span gas, the span set-point must be 50%. If 45% LEL is to be used later, the span set-point must be changed to 45% to match the span calibration gas. If the reading is only 40% LEL with the 50% gas applied a span calibration is needed. Move the pointer to the **Set Span** entry and press **EDIT** twice. **Unity Gain** may be used at anytime to cancel incorrect calibrations and start again. See Figure 2.8.

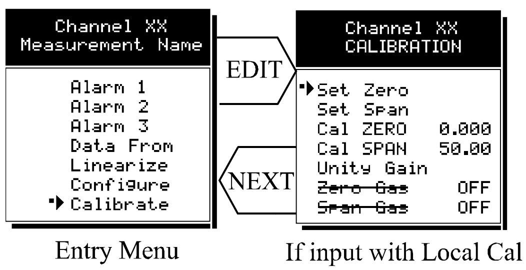


Figure 2.8

2.4 System configuration menus

Some items needing configuration are not specific to a channel but affect the entire SafeGuard Controller system. These are located in the system entry menu shown on the left side of Figure 2.9. System menus are accessed by pointing to the desired item and pressing **EDIT**.

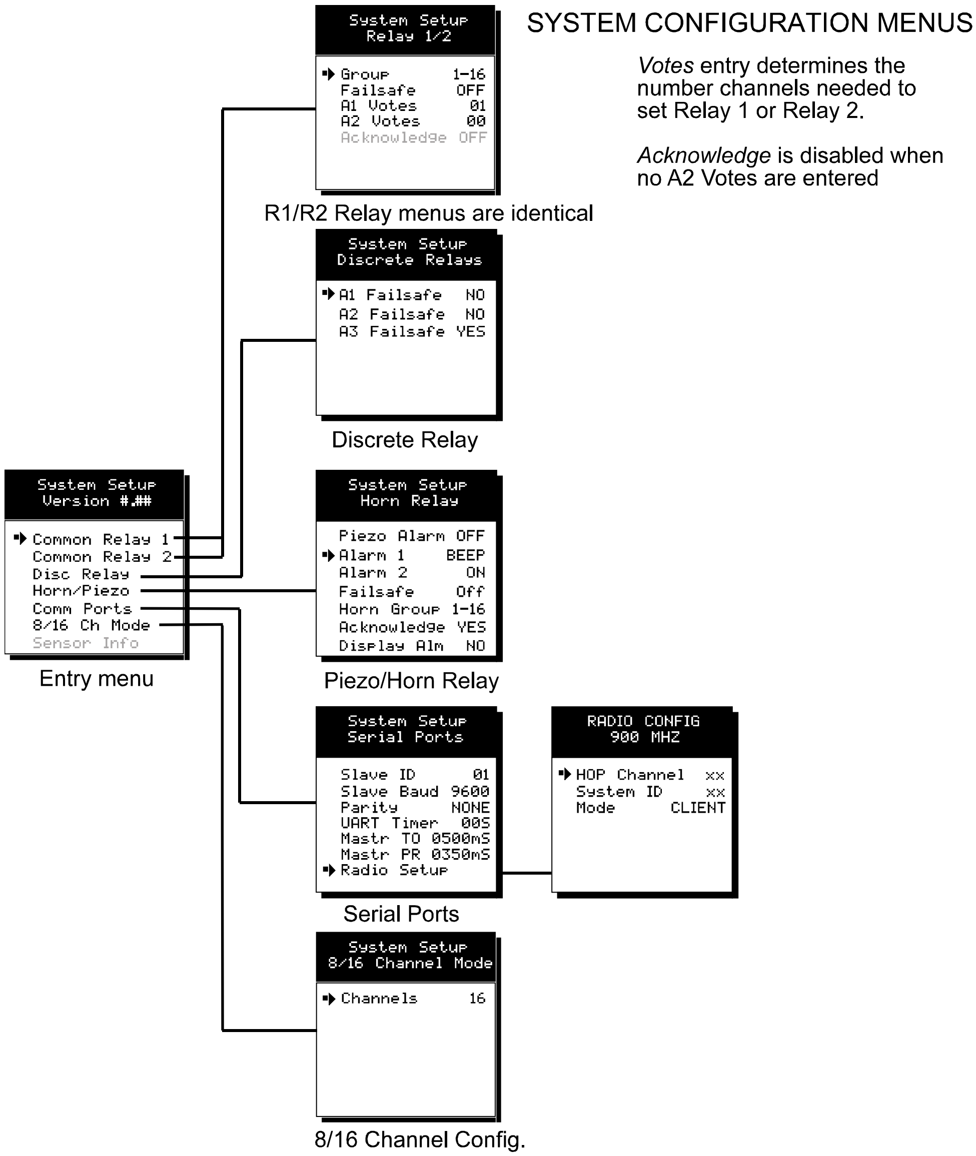
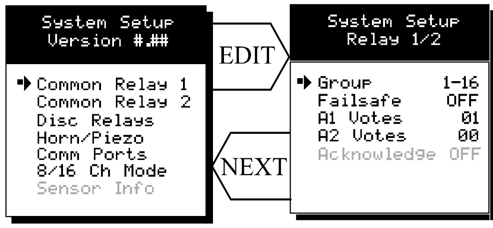


Figure 2.9

2.4.1 Common Alarm Relays 1 and 2

⚠ **READ THIS SECTION CAREFULLY AND TEST ALL SETTINGS BY SIMULATING INPUT CONDITIONS THAT SHOULD ACTIVATE THESE ALARM RELAYS!**

Common Relay 1 & **Common Relay 2** menus are identical and therefore discussed only once. It is very important to fully understand these menus since they determine the functions of each common relay.



Votes entry determines the number channels needed to set Relay 1 or Relay 2.

Acknowledge is disabled when no A2 Votes are entered

Entry menu R1/R2 Relay menus are identical

Figure 2.10

- The **Group** menu entry offers additional flexibility by controlling which channels trip this menu's common alarm relay. The 3 choices are **1-16**, **1-8** or **9-16**. Some applications have different types of detectors, or, detectors in different areas connected to the same SafeGuard Controller. In these cases, it may be undesirable for a detector on channel 9 to trip the same relay as a detector on channel 2. The **Group** menus may restrict this. For example, channels 1-8 might be set to trip common relay 1 while channels 9-16 trip common relay 2. Another possibility is channels 1-8 be set to trip common relay 1 while channels 9-16 trip relays on an optional discrete relay PCB configured for Alarm 1 (see section 3.1.2).

- **Failsafe** controls relay activation for this common relay. **Failsafe ON** causes the relay to de-energize during alarm conditions and energize when there is no alarm. Thereby, a power failure forces the relay contact to the alarm position. Note the common Fault relay is always failsafe and may be monitored separately to indicate loss of power conditions in many applications.

- **A1 and A2 Votes** allows creation of logical AND function equations that control common relay 1 & common relay 2. Default settings for common relay 1 are **A1 Votes = 01** and **A2 Votes = 00** which causes relay 1 to trip if any channel has an A1 level alarm active. Default settings for common relay 2 are **A1 Votes = 00** and **A2 Votes = 01** which causes relay 2 to trip if any channel has an A2 level alarm active. Example: If either default setting is modified such that **A1 Votes = 02** and **A2 Votes = 01,** then any two channels must have an A1 level alarm active and any one channel must have an A2 level alarm active to trip that relay. REMEMBER! One of the A1's and the A2 could be on the same channel. These level alarms must come from a channel included in the **Group** entry described above.

- Turning **Acknowledge ON** (not available on Alarm 1) allows the common relay to be deactivated during alarm conditions by an **Alarm Reset**. This is useful if an audible device is being driven by the relay.

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

2.4.2 SG10-0195 Discrete relay *Failsafe* mode

SG10-0195 Discrete relay options may also be configured to function in a *Failsafe* mode using the System Setup menu shown in Figure 2.11. Entering YES causes these discrete relays to have energized coils when no alarm condition exists for the associated channel and de-energized coils when the alarm occurs. *Failsafe* is useful for indicating failed relay coils and loss of power conditions. **Important: SG10-0195 zoning jumpers (see Figure 3.4) should not be used when Discrete Relays menus are set for failsafe.** Zoning jumpers cause ANY relay in the zone to energize ALL other relays in the same zone. Zoning of failsafe relays may be accomplished with wiring at the relay contact terminals.

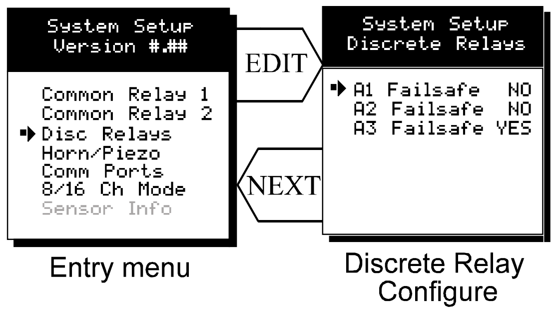


Figure 2.11

2.4.3 Common horn relay and local piezo

The SafeGuard Controller is equipped with a low decibel audible piezo which chirps when keys are pressed and may be configured to audibly indicate alarm conditions. The common horn relay is similar to the common A1 & A2 common relays.

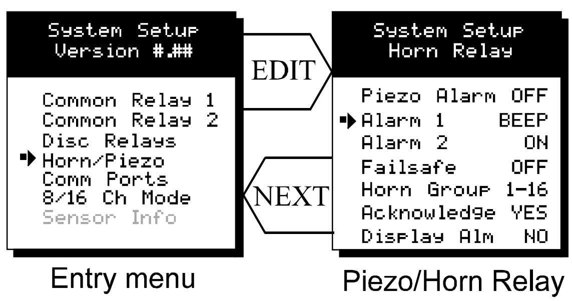


Figure 2.12

- Turning **Piezo Alarm ON** causes the audible piezo to duplicate the action of the horn relay. This feature may be used to provide a low decibel indication of the status of the system's horn.
- **Alarm 1 & Alarm 2** menus control how the alarm level from each channel will affect the common horn relay. Choices are **OFF**, **ON** or **BEEP** (one Hz. Pulsating). As an example, A2 conditions might pulse the horn (**BEEP**) and A1 conditions cause a steady horn (**ON**). Any other combination of these 3 choices is possible for A1 and A2 levels affecting the horn relay. This feature is very useful since it allows the horn relay to serve as another level A1, level A2, or both; for channels 1-16, 1-8 or 9-16. Individual channel alarms may also be configured to not affect the Horn relay on a channel by channel basis (see section 2.2.2).
- **Failsafe** & **Horn Group** menu entries are identical to the descriptions for menus **Common Relay 1** & **Common Relay 2** in section 2.3.1.

- Turning **Acknowledge OFF** allows the common Horn relay to drive devices other than horns or sirens such as a light or a fan.
- **Display Alm YES** forces the LCD to display the Bar Graphs screen upon any new alarm. This feature is offered to satisfy applications requiring channels in alarm to be displayed automatically (all channels are displayed on the Bar Graphs screen).

2.4.4 Comm Port menus

The system Comm Port menu allows setting RTU **Slave ID** address, **Slave Baud** rate, **Parity** and **UART Timer** for the comm2 *slave* Modbus serial port (comm1 *master* port ID settings are per channel as described in section 2.2.4). This slave port may be used to transfer the SafeGuard Controller data to a host device such as a PC, PLC, DCS or even another SafeGuard Controller. The slave port is addressable, allowing many SafeGuard Controllers to be connected to a single RS-485 cable. The **UART Timer** setting is disabled with 00 seconds entered. Entering a value causes the comm2 *slave* Modbus serial port to reinitialize if no modbus query is processed within this time period. This ensures against serial port lockup. Section 5 of this manual provides important information describing how to interface to the SafeGuard Controller's Modbus slave port.

The **Mastr TO** (master time out) and **Mastr PR** (master poll rate) menu items affect the SafeGuard Controller's *master* Modbus port. *Time out* sets length of time in milliseconds before a communications error. Three consecutive timeout errors must occur before a communication error is indicated. This item is useful for optimizing throughput to the SafeGuard Controller from other slave RTU's. *Poll Rate* sets frequency of data requests to the RTU's in milliseconds. This is useful when an RTU is limited in how fast it may respond to consecutive data requests.

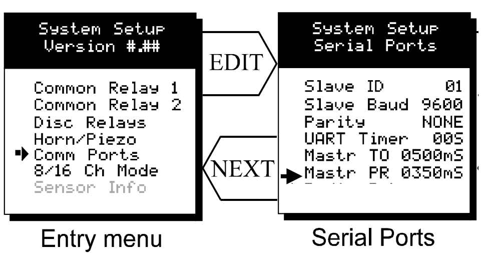


Figure 2.13

2.4.5 Eight / sixteen channel modes

The system menu allows setting the SafeGuard Controller to accept either 8, or, 16 channels. If 8 channels are selected by this menu they are channels 1-8 and 9-16 are disabled. One way the SafeGuard Controller cost is kept low is Input / Output option PCB's are arranged into groups of 8 channels. Therefore, users with less than 9 channels require only 1 PCB and do not pay for I/O hardware for 16 channels. If more than 8 channels are needed a second I/O option PCB may be required.

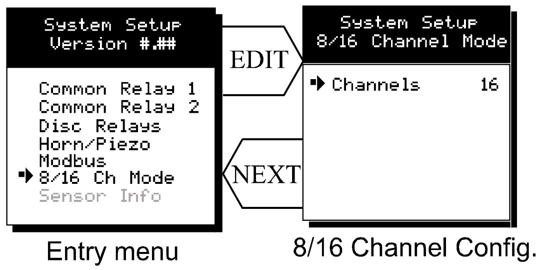


Figure 2.14

2.4.6 Sensor Information (this feature is not used at this time)

Sensor Info is available when at least one channel has **Sensor Life** activated in the **Marker** menu (see section 2.2.4b). The **Sensor Info** screen displays each channel's sensor status as illustrated in Figure 2.15. Channels with **Sensor Life** disabled indicate **Option Disabled** above the corresponding empty bar-graph. If **Sensor Life** is enabled, the channel will have its Measurement Name above the bar, or, an empty bar with a **Cal Required** label. **Cal Required** indicates no Calibration Marker value has been received by the SafeGuard Controller.

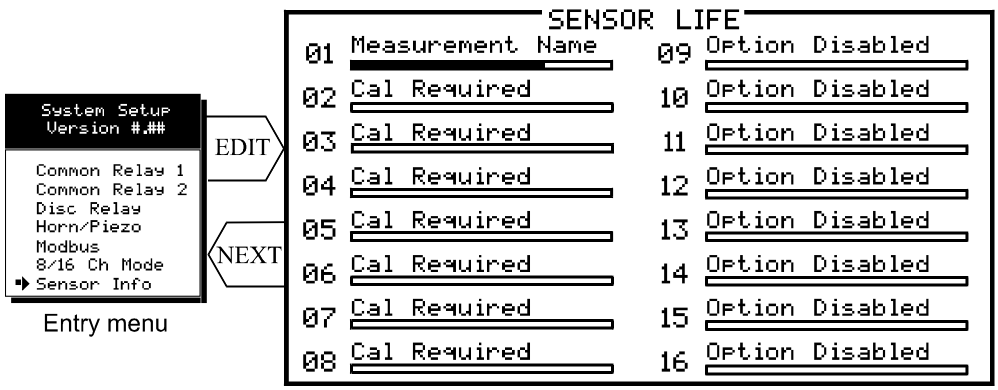


Figure 2.15

2.5 Authorization mode

A password entered in the **AUTHORIZATION** menu allows locking 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 10 digit field. To lock or unlock the system the correct 4 digit authorization number must be entered into the **Enter Code** field. Point to the **Unlock System** menu entry and press **EDIT** to complete the unlock procedure.

It is very important to record the 4 digit code. However, if lost it may be displayed briefly at power up using the following procedure:

Remove power from the SafeGuard Controller. Reapply power and as the alarm LED's begin scrolling down, hold the following keys simultaneously "UP", "DOWN",

"NEXT", & "EDIT". Watch closely. The 4-digit authorization code appears briefly at bottom left of the screen.
IMPORTANT! DO NOT hold the keys before applying power since this causes a cold boot and returns all settings back to factory defaults.

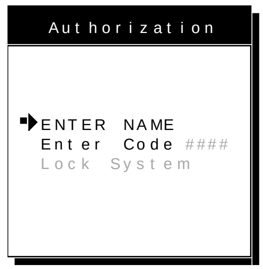


Figure 2.16

2.6 LCD contrast adjustment

The Setup menu item identified as **CONTRAST** allows users to adjust the LCD contrast to a level suitable to the ambient lighting. Selecting **CONTRAST** and pressing **EDIT** causes the **UP/DOWN** keys to increase and decrease LCD contrast.

Section 3: Inputs and Outputs

3.1 Main I/O interface PCB

The most basic SafeGuard Controller requires only the I/O PCB shown in Figure 3.1 for interfacing to field wiring. The SafeGuard Controller's primary power supply is applied to terminals 9 & 11 of TB2. This may be from 10 – 30 VDC.

WARNING: HIGH VOLTAGES SUCH AS 115 VAC APPLIED TO THESE TERMINALS MAY CAUSE SEVERE DAMAGE!

DC output terminals 10 & 12 on TB2 provide up to 500mA of output power for powering remote devices such as lamps, transmitters etc.

This PCB includes both ***master*** *(COMM 1)* and ***slave*** *(COMM 2)* RS-485 Modbus ports, 5 amp form C relays for each common alarm event (A1, A2, FAULT/A3 & HORN), and power supply I/O terminals. JP1 allows the RS-485 ports to be configured for 2 or 4 wire operation. A 26 pin ribbon cable connects the I/O PCB to the SafeGuard Controller's CPU and Display nest assembly. Two I^2C bus connectors allow addition of optional functions such as analog I/O and discrete alarm relays for each channel.

Horizontal jumpers installed in JP1 connect the RS-485 port's RX & TX lines, simplifying 2 wire daisy chains by providing additional terminals for incoming and outgoing cables. For example, installing the 2 COM 1 jumpers connects screw terminals 1 & 5 and terminals 3 & 7. Socketed RS-485 terminating resistors R6 (COMM 1) and R12 (COMM 2) are located on the MAIN I/O board. These resistors should be removed if communication wire lengths are very short (less than 25 feet), or, if the port is not at the end of the communication line.

An Auxiliary Relays *piggyback* PCB may be added to the I/O PCB via ribbon cable J4. These add another form C contact set to the common A1, A2 and HORN alarms. Auxiliary Relay contacts are available at the TB1 (AUX) terminals shown in Figure 3.1.

TB1 AUX. RELAYS (OPTION # 10-0144)

1 A1 - NO	2 N/A
3 A1 - COM	4 N/A
5 A1 - NC	6 N/A
7 A2 - NO	8 HORN - NO
9 A2 - COM	10 HORN - COM
11 A2 - NC	12 HORN - NC

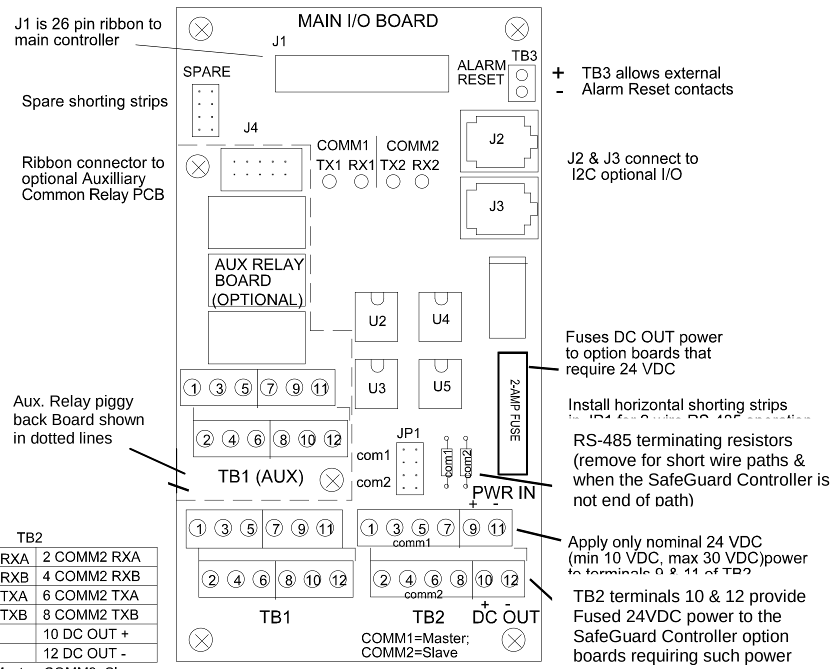
TB1

1 A1 - NO	2 A3 - NO
3 A1 - COM	4 A3 - COM
5 A1 - NC	6 A3 - NC
7 A2 - NO	8 HORN - NO
9 A2 - COM	10 HORN - COM
11 A2 - NC	12 HORN - NC

TB2

1 COMM1 RXA	2 COMM2 RXA
3 COMM1 RXB	4 COMM2 RXB
5 COMM1 TXA	6 COMM2 TXA
7 COMM1 TXB	8 COMM2 TXB
9 DC IN +	10 DC OUT +
11 DC IN -	12 DC OUT -

COMM1=Master; COMM2=Slave



Main I/O PCB WITH COMMON RELAYS

Figure 3.1

3.1.1 Modbus Communication between SafeGuard and Digital Millennium II Series Transmitters.

Examples:

M2X-AD/ARD menu settings (See MAN-0076):

Refer to MAN-0076 prior to attempting setup. Power up the unit and enter the transmitter Modbus menu option, ('Modbus Setup').

Select address 001 or the desired address for each unit.

Choose Baud Rate of **09600 bps**.

Select ‘NO’ under parity. Note that the unit will retain its settings if power is removed.

M2B-D DIP Switch settings (See MAN-0082):

1. Refer to MAN-0082 prior to setup. Select the desired address for the device. Example: DIP Switch 1 positions 1, 2, 3, 4 “ON”. This corresponds to a Modbus Address of 1. Refer to MAN-0082.
2. Set DIP Switch 2 position 1 “OFF” and position 2 “ON”. This corresponds to a Baud Rate of **9600 bps**.
3. Set DIP Switch 2 positions 3 and 4 in “OFF”. This allows 8 data bits, no parity bit, 2 stop bits (also compatible to 1 stop bit)

Connection between the Digital Millennium II Transmitter series and SafeGuard:

1. Prior to connection, ensure that the SafeGuard and the transmitter are not powered up.
2. Check to make sure the Millennium II Sensor is properly connected to the Millennium II Transmitter.
3. Connect the transmitter power terminals to the "DC Out" TB2 terminals (terminals 10 and 12) on the SafeGuard. Take note of the SafeGuard's positive and negative terminals at DC Out.
4. Connect the transmitter Modbus terminal "A" to the SafeGuard Master Comm 1 terminal 1 or Master Comm 1 terminal 5 on SafeGuard.
5. Connect the transmitter Modbus terminal "B” to the SafeGuard Master Comm 1 terminal 3 or Master Comm 1 terminal 7 on SafeGuard. Note that the SafeGuard's Master Comm1 terminals are the top terminals 1, 3, 5, 7. See Figure 3.1.
6. Jumper the transmitter’s ‘COM’ (-VDC) terminal and the Communication 'COM' terminal (tie them together).
7. Power up the SafeGuard.

SafeGuard settings:

Note: Leave Jumpers at JP1 in place for two wire RS-485 operation. See Figure 3.1.

1. Choose a Channel and select **'Data From',** then choose the following settings:
    - Modbus 16 Bit
    - Min raw: 00000

- Max raw: 00100
- Remote ID: 01
- Alias: 40001

2. Under "**System**", select "**Comm Ports**" and choose the settings as follows:

- Slave ID: 01
- Slave Baud rate: 9600
- Parity: None
- UART Timer: 155 s
- Mastr TO 0200 ms
- Mastr PR 0200 ms
- ECHO ACK OFF

Proper communication between the two devices will be confirmed by the TX1 and RX1 LEDs.

Note: When configuring other Net Safety products refer to specific user manual.

3.2 Input/output optional PCBs

Telephone style RJ11 connections are used to add optional 8 channel analog and digital I/O. A screen appears briefly after power up indicating what options are connected and for which channels. This information is also available from the *Diagnostics Mode* described in Section 4.

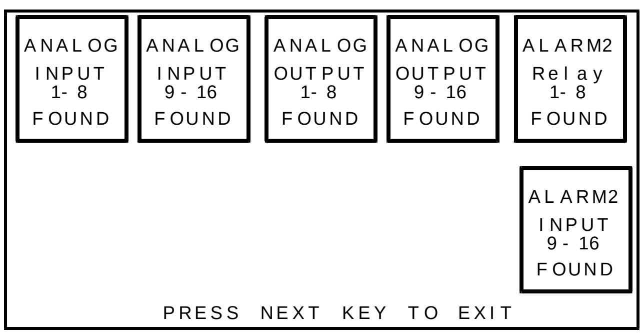


Figure 3.2

3.2.1 Optional analog input PCB # SG10-0158

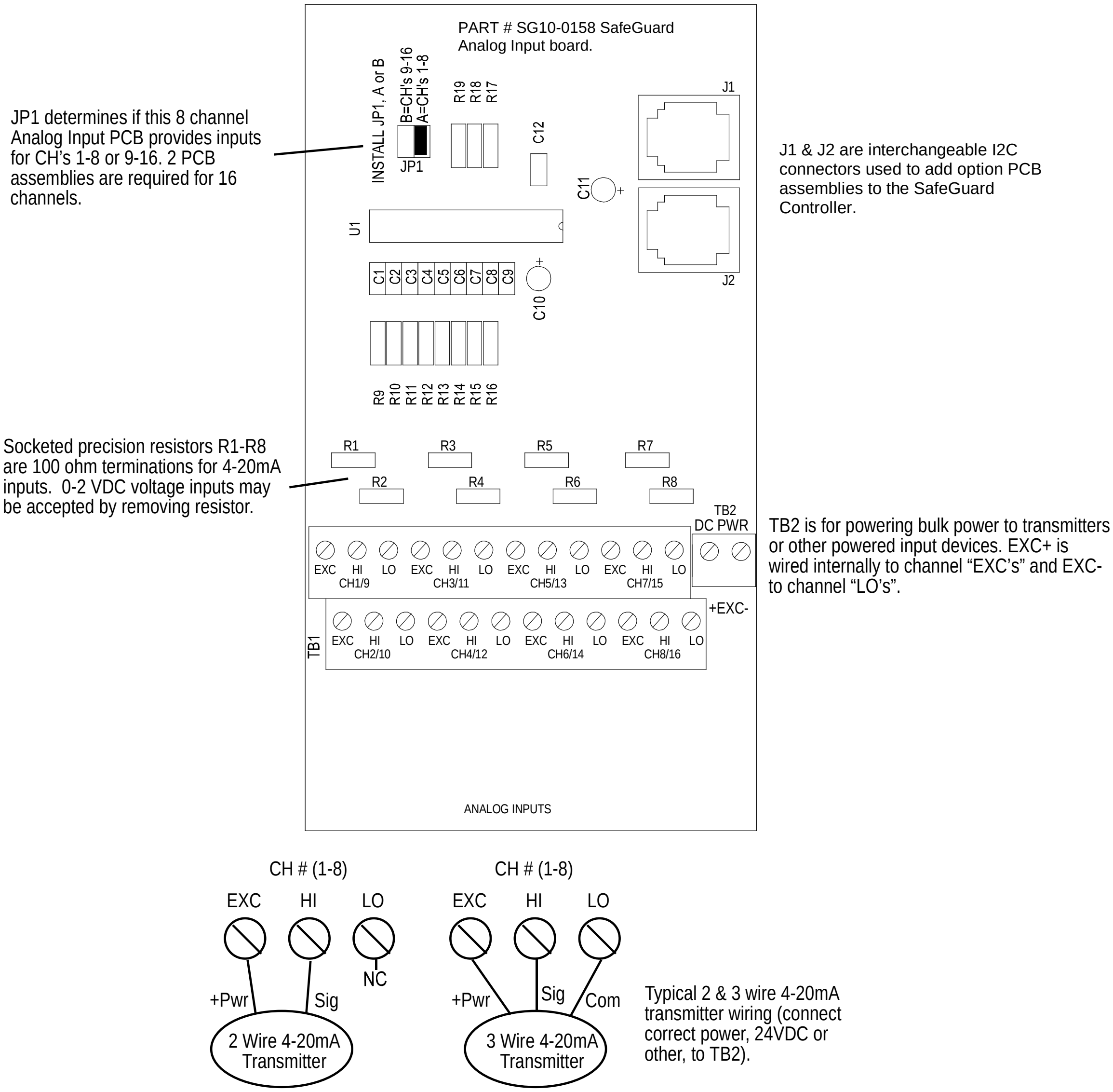
Many transmitters (detectors) have analog output signals and the 12 bit *Analog Input PCB*, shown in Figure 3.3, is available to accept these. TB1, with 24 positions, offers 3 terminals per channel for distributing power and receiving analog inputs. These are **EXC** and **HI** / **LO** inputs. TB2, with only two positions, is for connecting the power supply for powering external transmitters. Precision 100 ohm resistors (R1 – R8) between each channel's **IN LO** and **IN HI** terminals are socketed termination resistors for 4-20mA inputs. These may be removed if voltage inputs are to be applied.

EXC and **IN LO** terminals are bussed together internally. **EXC** terminals are tied directly to TB2-1 (+) and **IN LO** terminals are tied to TB2-2 (-). Bussing allows transmitter power to be brought into the system at a single point (TB2) and distributed back out at each channel's **EXC** / **IN LO** terminals to simplify field wiring. Figure 3.3 includes typical wiring to 2 & 3 wire 4-20mA transmitters.

JP1 determines if the 8 analog inputs are applied to channels 1-8 or channels 9-16. Connecting more than 8 analog inputs requires 2 PCB's with one's JP1 set for channels 1-8 and the other set for channels 9-16.

For a 3 wire transmitter (detector), the power (+) wire from the transmitter is connected to the **EXC** terminal on the SafeGuard Analog Input Board, the power (-) wire is connected to **LO** terminal on the SafeGuard Analog Input Board and the 4-20mA signal wire is connected to **HI** terminal on the SafeGuard Analog Input Board .

For a 2 wire transmitter (detector), the power (+) wire is connected to the **EXC** terminal on the SafeGuard Analog Input Board, and the 4-20mA signal wire is connected to **HI** terminal on the SafeGuard Analog Input Board. See Figure 3.3



8 channel Analog Input Board Part # SG10-0158

Figure 3.3

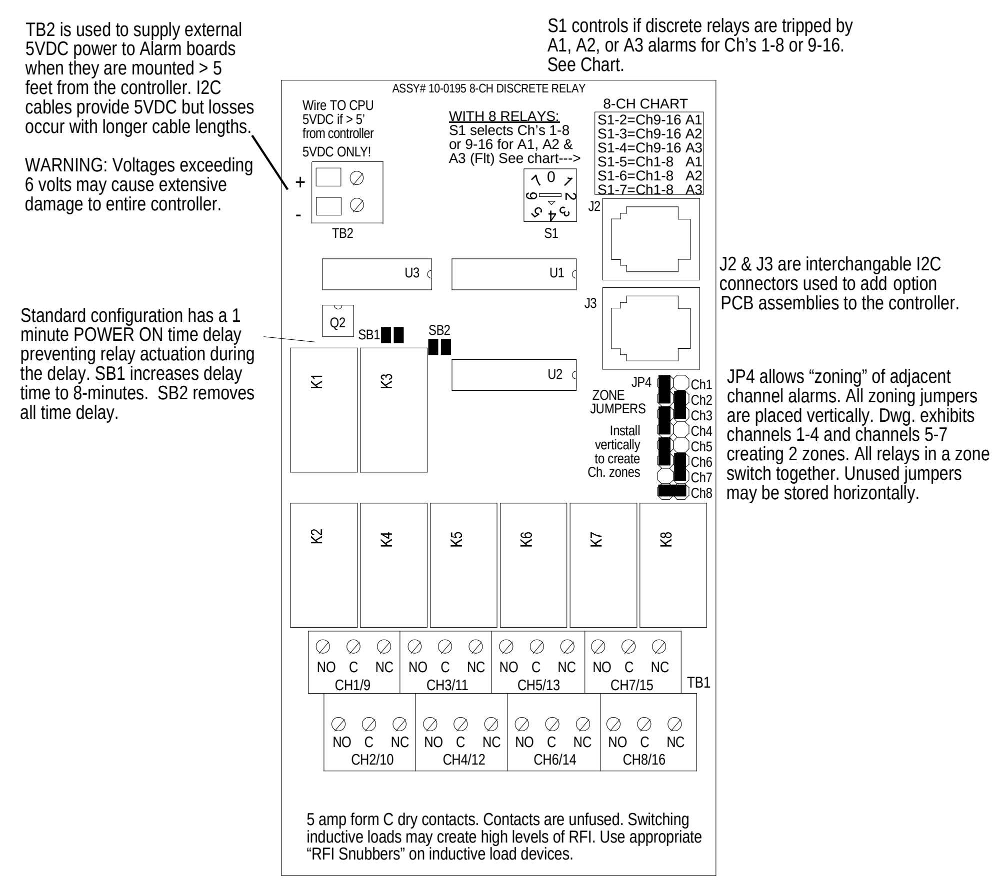
3.2.2 Optional discrete relay PCB # SG10-0195

An optional *Discrete Relay PCB*, shown in Figure 3.4, adds eight 5 amp (resistive) form C relays per sixteen channel alarm group (2 PCB's required when utilizing more than 8 channels). Each PCB may be configured via rotary switch S1 to function for ALARM 1, ALARM 2 or ALARM 3/FAULT for channels 1-8 or 9-16. A one (1)-minute time delay after power, is provided to inhibit relay actuation until the system has had time to stabilize. Alarm groups, or zones, may be created by connecting adjacent channels together using JP4 as shown. This creates a wire *OR* function with selected channels, causing *any* alarm included within the zone to actuate *ALL* zone relays. *Failsafe* operation of SG10-0195 discrete relays may be programmed in the *system* menu as described in section 2.3.2. Many SafeGuard

Controller applications utilize the common alarm relays (see section 3.0) and do not require discrete relays for each of the 48 alarm events (16 A1's, 16 A2's & 16 A3's). If discrete relays are needed for all 48 alarms, then six PCB's are required.

5 VDC power to the discrete relay option PCB's is normally supplied from the SafeGuard Controller via the slender I^2C cables connected to J2 and J3. However, I^2C cables are limited in ability to carry this power further than a few feet without a significant voltage drop. Some SafeGuard Controller applications with relays for all 48 alarms may require up to 6 boards. TB2 allows a heavier 5VDC power cable to be connected from terminals on the back of the SafeGuard Controller front panel assembly, bypassing the I^2C cable. A 20AWG pair connected to only one of the several TB2's is sufficient when these boards are in close proximity to each other.

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



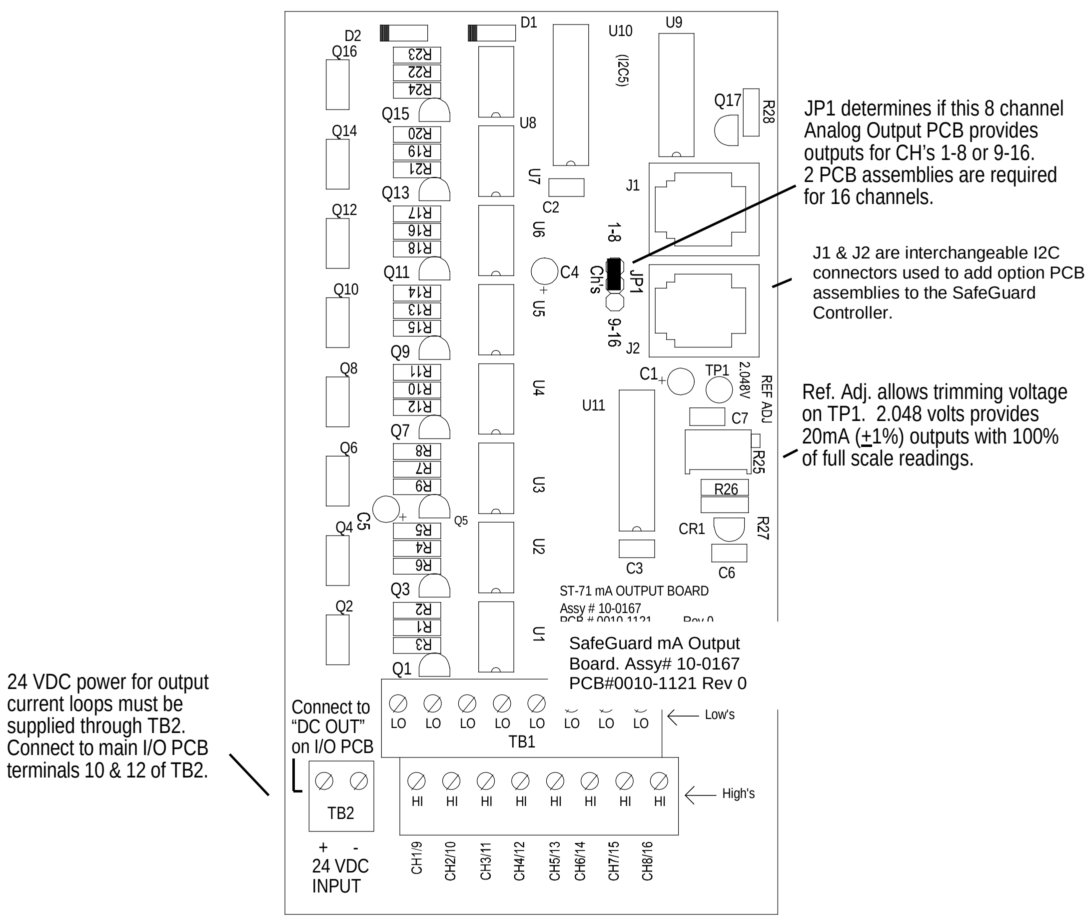
8 Channel Discrete Relay Option #10-0195

Figure 3.4

3.2.3 Optional 4-20mA analog output board # SG10-0167

An optional 10 bit 4-20mA analog output board, shown in Figure 3.5, may be connected to the I^2C bus. Each channel's output will transmit 4mA for 0% readings and 20mA for 100% readings. Loop drive capability depends upon the level of the SafeGuard Controller's primary DC power supply. With at least 20 volts DC primary power they 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. Note: This PCB requires nominal 24VDC power be connected to TB2 terminals 1 & 2 as shown in Figure 3.5. Suitable power is available from the SafeGuard Controller's Main I/O board's TB2 terminal 10 & 12 (see Figure 3.1). The current loop (Milliamp output) is completed between High and Low Terminals. Note that the Low Terminal is the negative end (common) of the loop.

Since the PCB has 8 channels, two PCBs are required for 16 channel applications. JP1 configures the outputs for channels groups 1-8 or 9-16. Also see 2.2.4b Marker Menu to configure the SafeGuard Controller for current output for a fault condition of a detector or transmitter and gas sensor configuration.

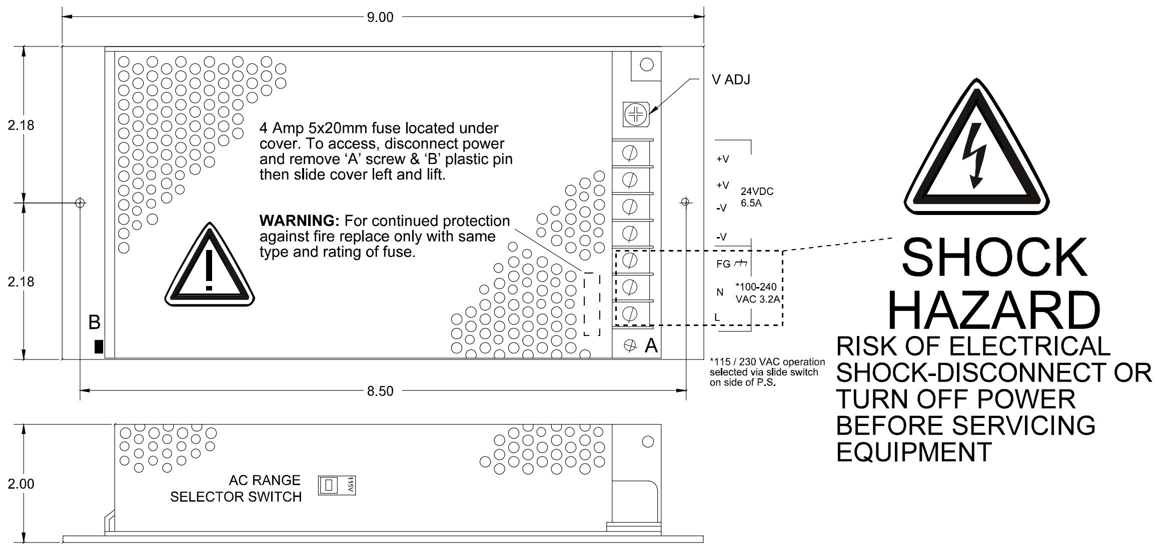


Channel 4-20 mA Output Board Part # SG10-0167

Figure 3.5

3.2.4 Optional 24VDC 150 watt power supply

The SafeGuard Controller may be powered from 10-30VDC. However, many applications require 24VDC power for the monitors or transmitters providing inputs to the SafeGuard Controller. A 150 watt AC / DC power supply may be included for these applications (115VAC or 230 VAC selected via slide switch). When ordered from the factory, it is pre-wired to provide 24VDC primary power for the SafeGuard Controller as well as any transmitters or monitors that may be connected by the end user.

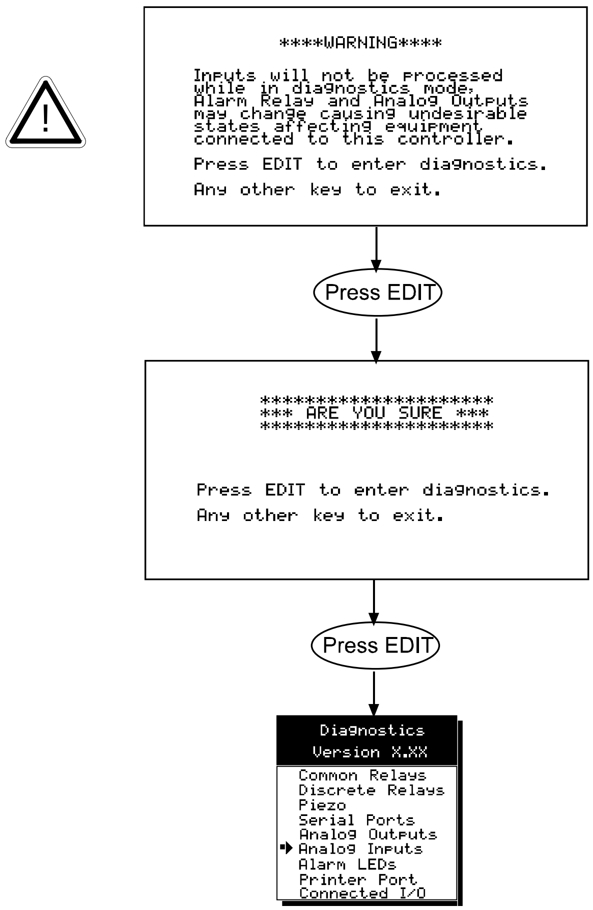


150 Watt 24 VDC Power Supply Option # SG10-0172

Figure 3.6

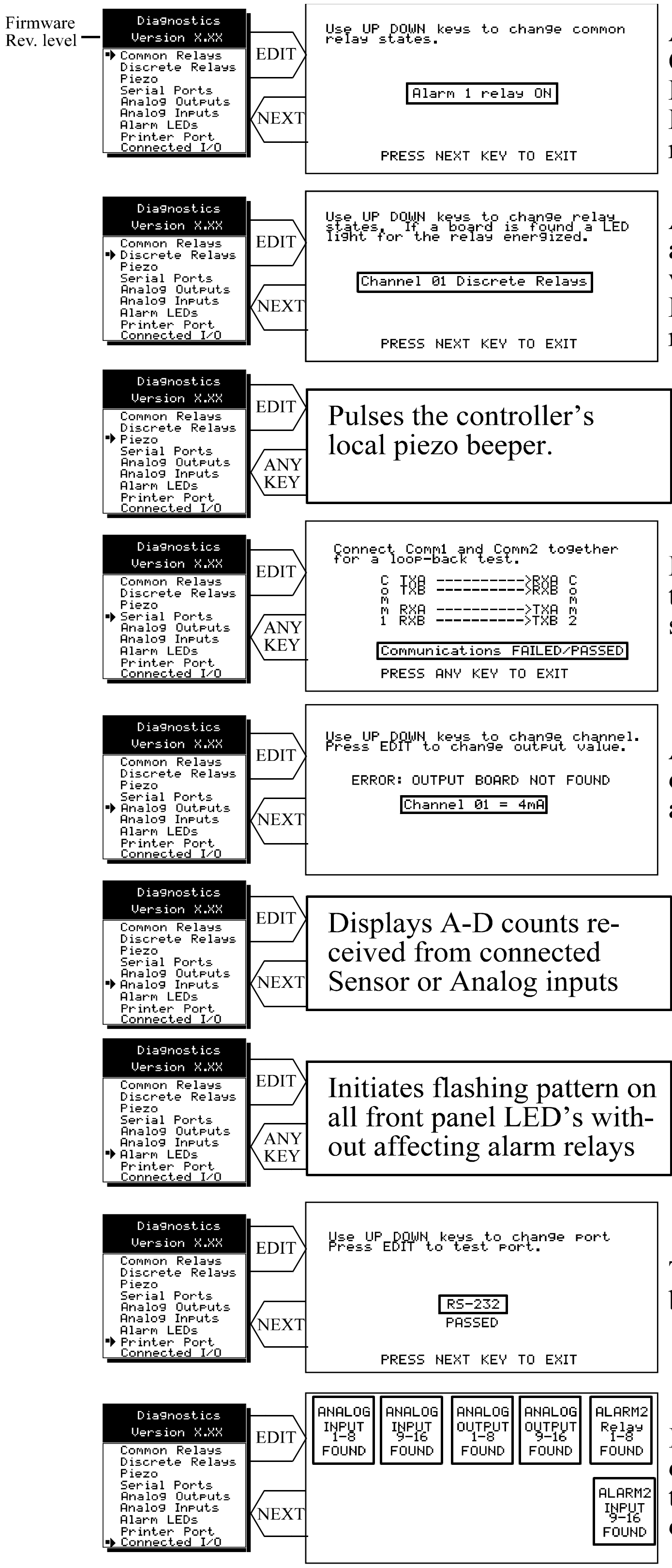
Section 4: System diagnostics

A *System Diagnostic Mode* shown in Figures 4.1 and 4.2 may be entered during normal operation from the Setup menu. The entry menu indicates firmware revision and offers useful routines for testing front panel LED's, relays, serial ports and analog I/O. It is exited manually by pressing **NEXT** and automatically if no keys are pressed for 5 minutes. It is very important to understand that **CHANNEL INPUT DATA IS NOT PROCESSED DURING THE DIAGNOSTICS MODE**. It is possible to miss important input values while utilizing this mode and appropriate safeguards should be in place. However, the Diagnostics Mode can prove invaluable when testing I/O since relays and analog outputs may be stimulated without driving inputs to precise levels.



Diagnostics menu

Figure 4.1



Allows manual actuation of Common Alm1,Alm2, FAIL and HORN relays. Front panel LED ON-confirms relay actuation.

Allows manual actuation of any connected discrete relays without stimulating the inputs. Front panel LED ON, confirms relay actuation.

Provides simple means of testing the controller's serial ports.

Allows forcing 4mA, 12,mA, or 20mA to any connected analog output channels.

Tests printer ports by sending a brief test message to the printer.

*** Note: The Printer Option is not used at this time.***

Indicates all connected I/O options. If not indicated, the option is not connected or a problem exists.

Figure 4.2

Section 5: Modbus

5.1 Modbus RS-485 ports

The SafeGuard Controller is equipped with *Master* (COMM 1), and *Slave* (COMM 2), modbus RTU ports. Port configurations are described in sections 2.2 and 2.3 of this manual. Section 5.0 defines register locations of data available via the SafeGuard Controller's slave port.

5.2 Modbus slave register locations

The following tables describe the SafeGuard Controller's modbus slave database. Any portion of this data may be read by a modbus master device such as a PC, PLC or DCS. Since the modbus port is RS-485, many SafeGuard Controllers may be multi-dropped onto the same cable.

Memory Integer ASCII:
Notes: ASCII may be read 2 characters at a time or in strings using a multiple register read.

Sixteen character channel tag name

Type	Channel	First	Last	Read FC	Write FC	Notes
Channel Tag	1	40401	40408	3	n/a	2 characters per register
Channel Tag	2	40409	40416	3	n/a	2 characters per register
Channel Tag	3	40417	40424	3	n/a	2 characters per register
Channel Tag	4	40425	40432	3	n/a	2 characters per register
Channel Tag	5	40433	40440	3	n/a	2 characters per register
Channel Tag	6	40441	40448	3	n/a	2 characters per register
Channel Tag	7	40449	40456	3	n/a	2 characters per register
Channel Tag	8	40457	40464	3	n/a	2 characters per register
Channel Tag	9	40465	40472	3	n/a	2 characters per register
Channel Tag	10	40473	40480	3	n/a	2 characters per register
Channel Tag	11	40481	40488	3	n/a	2 characters per register
Channel Tag	12	40489	40496	3	n/a	2 characters per register
Channel Tag	13	40497	40504	3	n/a	2 characters per register
Channel Tag	14	40505	40512	3	n/a	2 characters per register
Channel Tag	15	40513	40520	3	n/a	2 characters per register
Channel Tag	16	40521	40528	3	n/a	2 characters per register

Six character Eunits Tag

Type	Channel	First	Last	Read FC	Write FC	Notes
EUNITS	1	40529	40531	3	n/a	2 characters per register; 3 registers per channel
EUNITS	2	40532	40534	3	n/a	2 characters per register; 3 registers per channel
EUNITS	3	40535	40537	3	n/a	2 characters per register; 3 registers per channel
EUNITS	4	40538	40540	3	n/a	2 characters per register; 3 registers per channel
EUNITS	5	40541	40543	3	n/a	2 characters per register; 3 registers per channel
EUNITS	6	40544	40546	3	n/a	2 characters per register; 3 registers per channel
EUNITS	7	40547	40549	3	n/a	2 characters per register; 3 registers per channel
EUNITS	8	40550	40552	3	n/a	2 characters per register; 3 registers per channel
EUNITS	9	40553	40555	3	n/a	2 characters per register; 3 registers per channel
EUNITS	10	40556	40558	3	n/a	2 characters per register; 3 registers per channel
EUNITS	11	40559	40561	3	n/a	2 characters per register; 3 registers per channel
EUNITS	12	40562	40564	3	n/a	2 characters per register; 3 registers per channel
EUNITS	13	40565	40567	3	n/a	2 characters per register; 3 registers per channel
EUNITS	14	40568	40570	3	n/a	2 characters per register; 3 registers per channel
EUNITS	15	40571	40573	3	n/a	2 characters per register; 3 registers per channel
EUNITS	16	40574	40576	3	n/a	2 characters per register; 3 registers per channel

Six character Value ASCII string

Type	Channel	First	Last	Read FC	Write FC	Notes
ASCII Value	1	40577	40579	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	2	40580	40582	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	3	40583	40585	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	4	40586	40588	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	5	40589	40591	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	6	40592	40594	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	7	40595	40597	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	8	40598	40600	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	9	40601	40603	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	10	40604	40606	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	11	40607	40609	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	12	40610	40612	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	13	40613	40615	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	14	40616	40618	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	15	40619	40621	3	n/a	2 characters per register; 3 registers per channel
ASCII Value	16	40622	40624	3	n/a	2 characters per register; 3 registers per channel

Memory Floating Point:

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

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

Type	Channel	First	Last	Read FC	Write FC	Notes
Channel Value	1-16	33001-16	n/a	4	n/a	15bit 2s complement w/+- 5% over/under range

Analog Output:

Notes: 12 bit integer for Channel Reading value = 800 counts = zero value, 4000 counts = 100% value.

Type	Channel	First	Last	Read FC	Write FC	Notes
Channel Reading	1-16	31001	31016	4	n/a	12bit integer

Channel Status words contain configuration and status bits for a channel. They are as follows:

Type	Channel	First	Last	Read FC	Write FC	Notes
Channel Status	1-16	31017	31032	4	n/a	16bit integer (see bit by bit definition below)

Alarm 1 Trip	bit0	1 = Low	0 = High
Alarm 1 Horn Drive	bit1	1 = On	0 = Off
Alarm 3 Type	bit2	1 = Level	0 = Fault
Alarm 2 Horn Drive	bit3	1 = On	0 = Off
Linearize	bit4	1 = On	0 = Off
Alarm 3 Trip	bit5	1 = Low	0 = High
Input *Marker*	bit6	1 = Input *Marker* Detected	0 = Normal Mode
Channel Disable	bit7	1 = Disabled	0 = Enabled
Controller Channel *In Cal*	bit8	1 = Local Cal Mode	0 = Normal Mode
Modbus Data Type	bit9	1 = 4 byte float	0 = 2 byte integer
reserved	bit10	*reserved*	*reserved*
reserved	bit11	*reserved*	*reserved*
Alarm 1 Latch	bit12	1 = Latching	0 = Non latching
Alarm 2 Latch	bit13	1 = Latching	0 = Non latching
Alarm 3 Latch	bit14	1 = Latching	0 = Non latching
Alarm 2 Trip	bit15	1 = Low	0 = High

Alarm status words are bits packed into 16 bit integer where lsb = channel 1 alarm status and msb = channel 16 alarm status.

Alarm status (bit = 1 indicates alarm is active)

Type	Channel	First	Last	Read FC	Write FC	Notes
Alarm 1 Status	1-16	31033	n/a	4	n/a	packed 16bit integer
Alarm 2 Status	1-16	31034	n/a	4	n/a	packed 16bit integer
Alarm 3 Status	1-16	31035	n/a	4	n/a	packed 16bit integer
*Relay Status	n/a	31036	n/a	4	n/a	packed 16bit integer

*Note: Common Relay status bits (register 31036) are as follows.

Relay 1= bit0.

Relay 2= bit1

Fault Relay = bit2

Horn Relay = bit3

Type	Channel	First	Last	Read FC	Write FC	Notes
Cal Status	1-16	31037	n/a	4	n/a	packed 16bit integer
Trend Interval Timer	1-16	31038	n/a	4	n/a	16bit integer (Time in Seconds)
Fault Status	1-16	31039	n/a	4	n/a	packed 16bit integer

Alarm LED flashing status (bit = 1 indicates LED is flashing; "Acknowledge" clears all to 0)

Type	Channel	First	Last	Read FC	Write FC	Notes
Alarm 1 Status	1-16	31049	n/a	4	n/a	packed 16bit integer
Alarm 2 Status	1-16	31050	n/a	4	n/a	packed 16bit integer
Alarm 3 Status	1-16	31051	n/a	4	n/a	packed 16bit integer
Common LED Status	1-16	31052	n/a	4	n/a	packed 16bit integer

LCD Display Screen Displayed Integer

Type	Channel	First	Last	Read FC	Write FC	Notes
LCD Screen	n/a	31053	n/a	4	n/a	8bit integer

Sensor Life (not used at this time)

Type	Channel	First	Last	Read FC	Write FC	Notes
Sensor Life	1	31065	n/a	4	n/a	Signed 16bit integer
Sensor Life	2	31066	n/a	4	n/a	Signed 16bit integer
Sensor Life	3	31067	n/a	4	n/a	Signed 16bit integer
Sensor Life	4	31068	n/a	4	n/a	Signed 16bit integer

Sensor Life	5	31069	n/a	4	n/a	Signed 16bit integer
Sensor Life	6	31070	n/a	4	n/a	Signed 16bit integer
Sensor Life	7	31071	n/a	4	n/a	Signed 16bit integer
Sensor Life	8	31072	n/a	4	n/a	Signed 16bit integer
Sensor Life	9	31073	n/a	4	n/a	Signed 16bit integer
Sensor Life	10	31074	n/a	4	n/a	Signed 16bit integer
Sensor Life	11	31075	n/a	4	n/a	Signed 16bit integer
Sensor Life	12	31076	n/a	4	n/a	Signed 16bit integer
Sensor Life	13	31077	n/a	4	n/a	Signed 16bit integer
Sensor Life	14	31078	n/a	4	n/a	Signed 16bit integer
Sensor Life	15	31079	n/a	4	n/a	Signed 16bit integer
Sensor Life	16	31080	n/a	4	n/a	Signed 16bit integer

*Note: -2 = Disabled, -1 = CAL Required, 0-100 = Sensor Life

Coils

Notes: Set this coil to issue an alarm “Acknowledge” via modbus.

Type	Channel	First	Last	Read FC	Write FC	Notes
Alarm Reset	n/a	2001	n/a	n/a	5	write 0xff to high byte to set

Memory Discretes

Notes: May be read as single discrete or packed with multiple register read.

Type	Channel	First	Last	Read FC	Write FC	Notes
Chnl Alarm 1	1-16	12001-16	n/a	2	n/a	discrete, may be packed
Chnl Alarm 2	1-16	12017-32	n/a	2	n/a	discrete, may be packed
Chnl Alarm 3	1-16	12033-48	n/a	2	n/a	discrete, may be packed

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.

Type	Channel	First	Last	Read FC	Write FC	Notes
Zero Real	1-16	41001-16	n/a	3	n/a	zero real w/o decimal point
Zero DP	1-16	41017-32	n/a	3	n/a	zero real divisor

Span Real	1-16	41033-48	n/a	3	n/a	span real w/o decimal point
Span DP	1-16	41049-64	n/a	3	n/a	span real divisor
Alarm 1 Real	1-16	41065-80	n/a	3	n/a	alarm 1 real w/o decimal point
Alarm 1 DP	1-16	41081-96	n/a	3	n/a	alarm 1 real divisor
Alarm 2 Real	1-16	41097-112	n/a	3	n/a	alarm 2 real w/o decimal point
Alarm 2 DP	1-16	41113-28	n/a	3	n/a	alarm 2 real divisor
Alarm 3 Real	1-16	41129-44	n/a	3	n/a	alarm 3 real w/o decimal point
Alarm 3 DP	1-16	41145-60	n/a	3	n/a	alarm 3 real divisor
Fault Real	1-16	41161-76	n/a	3	n/a	alarm 3 real w/o decimal point
Fault DP	1-16	41177-92	n/a	3	n/a	alarm 3 real divisor

24 Hour Trend Database

The 24 hour MAX, MIN and AVERAGE trend data may be retrieved over the Modbus serial interface. Each channel consists of 240 MAX, MIN and AVERAGE values, or, one value for every 1/10 hour (6 minutes). Since there are 16 channels this database equals 3,840 registers in addresses 33017-36857. Due to the large size, MAX, MIN or AVERAGE values may only be retrieved one at a time. To improve bandwidth the master may retrieve the database in blocks of 120 registers at a time (one half of a channel's data). The C1 only updates these 3,840 registers upon receiving an update command from the Modbus master.

Type	Channel	First	Last	Read FC	Write FC	Notes
Update MIN	n/a	2065	n/a	n/a	5	Moves 24 hour MIN data trend to trend data base
Update AVG.	n/a	2066	n/a	n/a	5	Moves 24 hour MIN data trend to trend data base
Update MAX	n/a	2067	n/a	n/a	5	Moves 24 hour AVG data trend to trend data base

This update requires several seconds. Therefore, a data ready register is available to notify the master upon completion.

Type	Channel	First	Last	Read FC	Write FC	Notes
MIN Ready	n/a	12065	n/a	2	n/a	0 = data ready; 1 = update in progress
AVG. Ready	n/a	12066	n/a	2	n/a	0 = data ready; 1 = update in progress
MAX Ready	n/a	12067	n/a	2	n/a	0 = data ready; 1 = update in progress

Trend database registers

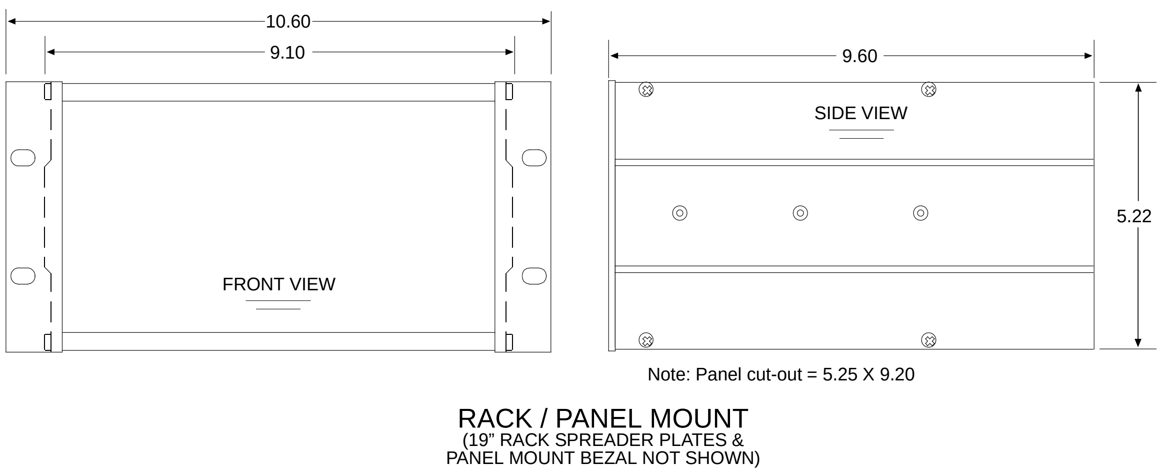
Type	Channel	First	Last	Read FC	Write FC	Notes
24 hr Trend	1-16	33017	36857	5	n/a	Transfers 24 hour trend for MAX, MIN or AVG.

Section 6: Dimensions

6.1 SafeGuard PM panel / rack mount enclosure

The SafeGuard Panel Mount shown in Figure 6.1 is a half width 19" rack enclosure. It is supplied with hardware that allows mounting in either a full width 19" rack style cabinet or it may be panel mounted in a rectangular cutout. Only two 8 channel I/O option PCB's such as analog input or discrete relays may be mounted directly to the back of the enclosure. Refer to section 3 for information on each option PCB.

Additional 8 channel I/O option PCB's must be located external from the assembly on another mounting plate. A 3 foot length of I^2C cable is also supplied for this purpose. Weight is approximately 7 pounds. Properly ground the enclosure and follow national and local electrical codes.



Rack Panel Mount Part # SG10-0208

Figure 6.1

6.2 SafeGuard n4 NEMA 4X wall mount fiberglass enclosure

The SafeGuard N4 shown in Figure 6.2 is a fiberglass NEMA 4X wall mount enclosure. Seven, 8 channel I/O option PCB's, such as analog input or discrete relays, may be mounted inside this enclosure. Refer to section 3 for information on each option PCB.

The enclosure may be mounted outdoors with a weather deflector shield. It weighs approximately 17 pounds. Figure 6.3 provides important warning information concerning correct grounding procedures for non-metallic enclosures. Conduit entries are not provided so installers may place entries as needed. Bottom or lower side areas are recommended. Care must be taken to avoid drilling into circuit boards mounted inside the enclosure. Properly ground the enclosure and follow national and local electrical codes.

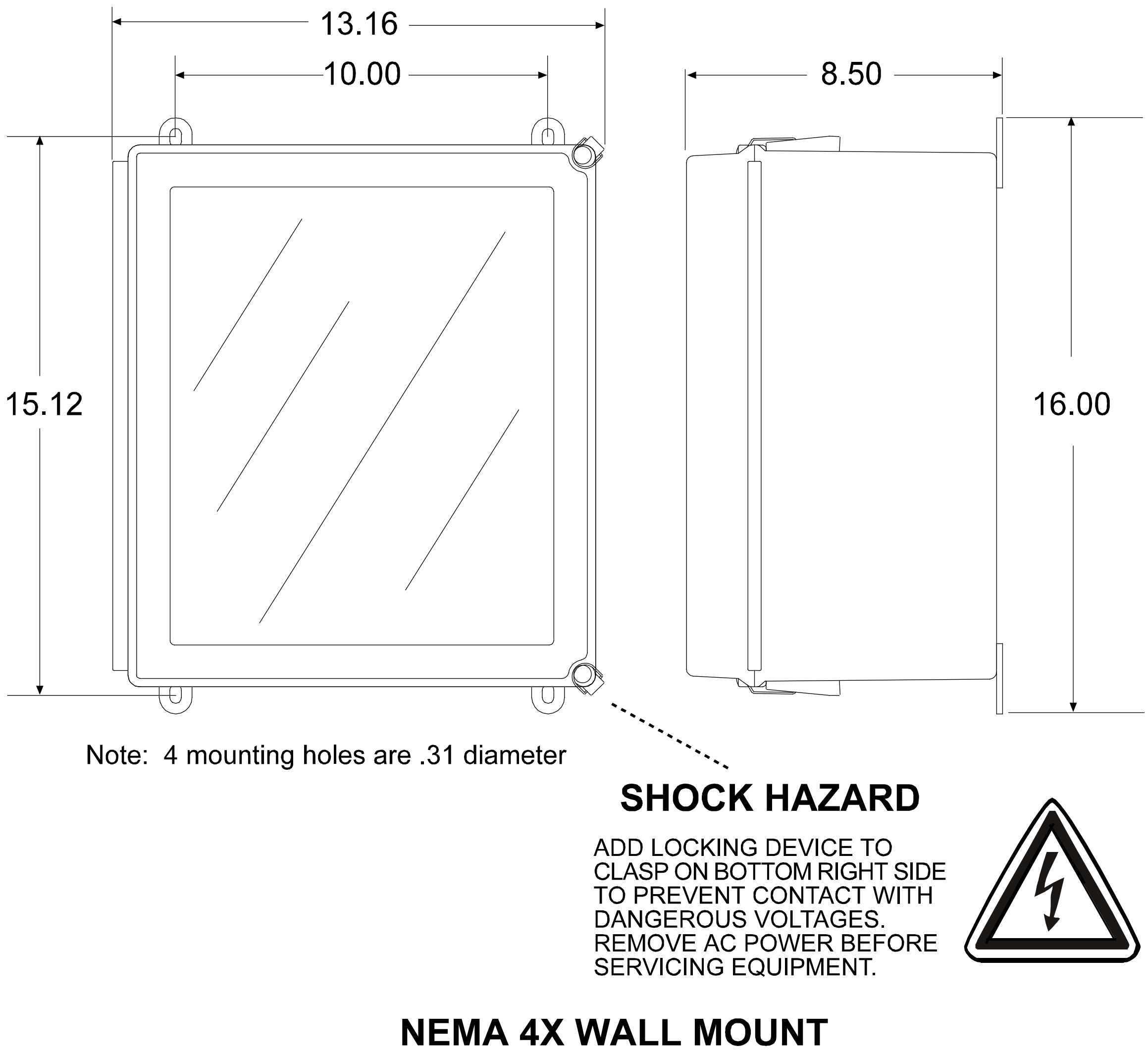


Figure 6.2

⚠WARNING

To avoid electric shock, grounding must be installed by the customer as part of the installation. Non-metallic enclosures do not provide grounding between conduit connections.

GROUNDING OF EQUIPMENT AND CONDUIT

Ground in accordance with the requirements of the National Electrical Code.
Conduit hubs for metallic conduit must have a grounding bushing attached to the hub on the inside of the enclosure. Grounding bushings have provisions for connection of a grounding wire.
Non-metallic conduit and hubs require the use of a grounding wire in the conduit. Grounding bushings are not required.
System grounding is provided by connection wires from all conduit entries to the subpanel or to other suitable point which provides continuity. Any device having a metal portion or portions extending out of the enclosure must also be properly grounded.

TYPICAL GROUNDING ILLUSTRATIONS

METALLIC CONDUIT **NON-METALLIC CONDUIT**

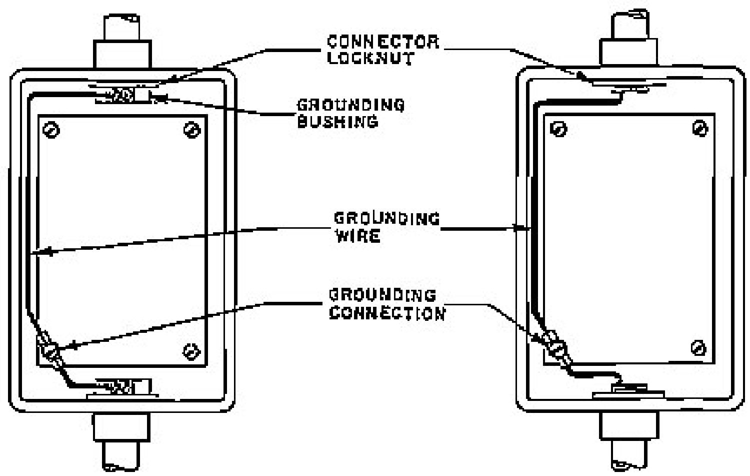


Figure 6.3

6.3 SafeGuard main I/O & option PCB footprint dimensions

SafeGuard Controllers have virtually unlimited possibilities for configuration of options such as analog I/O, discrete relays, printer interface and others. All SafeGuard enclosure styles require the Main I/O PCB (Figure 3.1) but also support the mounting of additional option PCB's as described below:

- SafeGuard PM Panel / Rack Mount supports 2 option positions as standard and 4 more with the SG10-0180 expansion plate (since in panel / rack mount installations SG10-0180's must be mounted in user space behind panels or inside racks, multiple SG10-0180's may be incorporated to support the required option positions).
- SafeGuard N4 Wall Mount supports 3 option positions as standard and 4 more with the 10-0180 expansion plate.

Figure 6.4 provides Main I/O and option PCB dimensions.

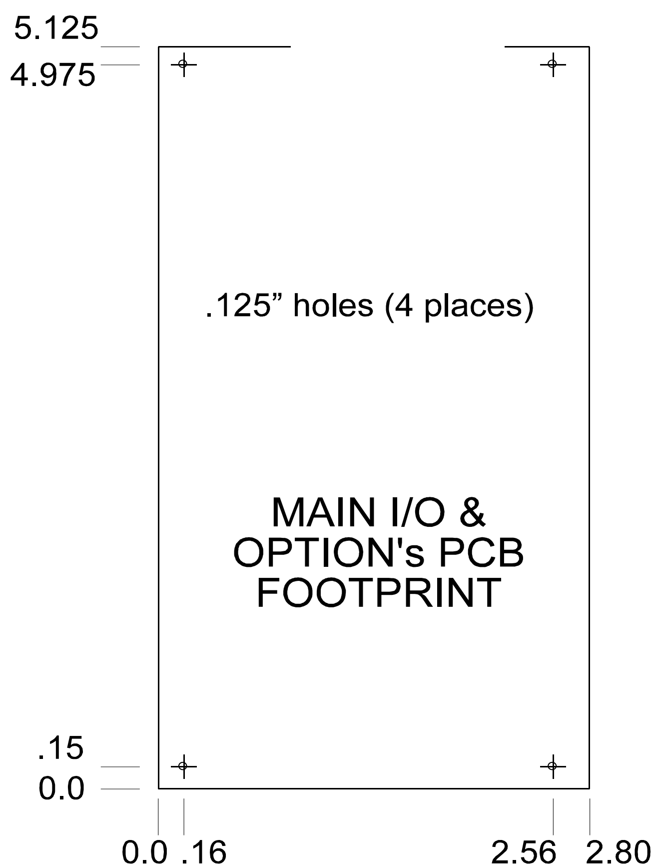


Figure 6.4

Section 7: How to return equipment

A Material Return Authorization number is required in order to return equipment. Please contact Rosemount at +1 (866) 347-3427, before returning equipment or consult our Service Department to possibly avoid returning equipment.

If you are required to return equipment, include the following information:

1. A Material Return Authorization number (provided over the phone to you by Net Safety).

2. A detailed description of the problem. The more specific you are regarding the problem, the quicker our Service Department can determine and correct the problem.

3. A company name, contact name and telephone number.

4. A purchase order, from your company, authorizing repairs or request for quote.

5. Ship all equipment, prepaid to:
   Rosemount
   6021 Innovation Blvd.
   Shakopee, MN 55379

6. Mark all packages: **RETURN for REPAIR**.

Ensure a duplicate copy of the packing slip is enclosed inside the box indicating item 1 – 4 along with the courier and account number for returning the goods.

Pack items to protect them from damage and use anti-static bags or aluminum-backed cardboard as protection from electro-static discharge.

ALL equipment must be shipped prepaid. Collect shipments will not be accepted.

Section 8: Appendix

Appendix A: Electrostatic sensitive device (ESD)

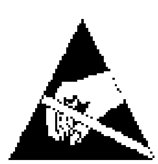
Definition: Electrostatic discharge (ESD) is the transfer, between bodies, of an electrostatic charge caused by direct contact or induced by an electrostatic field.

The most common cause of ESD is physical contact. Touching an object can cause a discharge of electrostatic energy—**ESD**! If the charge is sufficient and occurs near electronic components, it can damage or destroy those components. In some cases, damage is instantaneous and an immediate malfunction occurs. However, symptoms are not always immediate—performance may be marginal or seemingly normal for an indefinite period of time, followed by a sudden failure.

To eliminate potential ESD damage, review the following guidelines:

- Handle boards by metal shields—taking care not to touch electronic components.
- Wear grounded wrist or foot straps, ESD shoes or heel grounders to dissipate unwanted static energy.
- Prior to handling boards, dispel any charge in your body or equipment.
- Ensure all components are transported and stored in static safe packaging
- When returning boards, carefully package in the original carton and static protective wrapping
- Ensure **ALL** personnel are educated and trained in ESD Control Procedures

In general, exercise accepted and proven precautions normally observed when handling electrostatic sensitive devices. A warning label is placed on the packaging, identifying product using electrostatic sensitive semiconductor devices.



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