GENERAL MONITORS

Model 2280A

Four Channel Control Module
Hydrogen Sulfide Gas Applications

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Instruction Manual **08-07**

General Monitors reserves the right to change published specifications and designs without prior notice.

Part No. MAN2280A
Revision D/08-07

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Introduction

Protection for Life

General Monitors' mission is to benefit society by providing solutions through industry leading safety products, services, and systems that save lives and protect capital resources from the dangers of hazardous flames, gases, and vapors.

This manual provides instruction for installing and operating the General Monitors Model 2280A Four Channel Control Module for Hydrogen Sulfide Gas Applications. While the 2280A system is easy to install and operate, this manual should be read in full, and the information contained herein understood, before attempting to place the system in service.

The safety products you have purchased should be handled carefully and installed, calibrated, and maintained in accordance with the respective product instruction manual. Remember these products are for your safety.

Special Warning

Through engineering design, testing, manufacturing techniques, and rigid quality control, General Monitors (GMI) supplies the finest gas detection systems available. The user must recognize his responsibility for maintaining the gas detection system in operational condition.

The Model 2280A Four Channel Hydrogen Sulfide Gas Monitor contains components, which can be damaged by static electricity. Special care must be taken when wiring the system, to ensure that only the connection points are touched.

General Monitors cautions, as with all equipment of this type, that high levels or long exposure to certain atmospheres will "degrade" the sensor and eventually affect sensitivity. Please refer to Section 2.6.3 for specific information. Use in such atmospheres requires calibration checks on a more frequent schedule than normal. General Monitors should be consulted for an application feasibility determination, before installing a system in such atmospheres.

General Monitors' sensors and sensor housings are designed and tested for use in certain classes of hazardous atmospheres. Explosion-proof integrity cannot be maintained, if sensors and sensor housings are operated in other than the "as designed" condition. Terminal access covers of sensor housings must be securely fastened. Sensor housing must be installed in accordance with National Electrical Code acceptable practices, for the class of hazardous atmosphere.

Sensors are designed with sintered metal, or screen covers, that act as flame arrestors. Do not operate sensors without screen or sintered metal parts in place.

General Monitors' gas detection systems are primarily safety devices for the protection of personnel and facilities and must be "always ready". With proper

installation, calibration, and maintenance, the system provides continuous monitoring of hazardous areas. The user must assume all liability for misuse of General Monitors' gas detection systems.

The system's full two-year warranty will be voided if customer personnel, or third parties, damage the system during repair attempts.

Customer Support

For additional product information not contained in this manual, please contact General Monitors Customer Support. For contact information, see Section 6.1.

1.0 Before Installation

1.1 Differences Between Models 2280A and 2280

2280A differences:

- Auto-Calibration
- Front Panel: Polycarbonate with inlay

Refer to Section 2.0, ***Installation***, and Section 3.0, ***Startup and Operation,*** for details.

1.2 General Product Description

The Model 2280A is a four-channel controller with four individual sensor circuits. The controller should be mounted in a weather protected non-hazardous area. Several GMI accessories are available for panel, wall or 19-inch rack installation. For hazardous areas, an explosion proof housing is available for Class I, Division 1 and Division 2, Groups B, C and D.

NOTE: Sensor assemblies may be mounted outdoors in hazardous areas (National Electric Code Class 1, Division 1 and Division 2, Groups B, C, and D).

The Model 2280A Hydrogen Sulfide (H_2S) Monitor has evolved from earlier GMI systems, which have an established reputation for reliable performance. By carefully following the instructions in this manual, you can be assured of the most dependable, continuous protection against hazardous accumulation of hydrogen sulfide gas. Except for periodic calibration checks, there are no routine maintenance requirements. The Model 2280A Controller is a microprocessor-based instrument, which features recent advancements in electronic circuitry and packaging techniques. The system's sensor is a second-generation product, incorporating advancements in sensor technology and performance.

NOTE: The 2280A is different than its predecessor the 2280. The 2280A calibration is automatic where the 2280 must be manually calibrated. Please check the individual manuals for details about wiring, set up, and operation of these two units.

CAUTION: The Model 2280A Controller is easy to install and operate. However, one should fully read and understand this manual before attempting to place the system in service.

Figure 1: Model 2280A

1.3 Controller

The Model 2280A is a four-channel system where the controller continuously monitors the inputs of four sensors. The sensors are monitored independently (i.e. they are not scanned, nor are the signals summed).

Each channel has the following:

- LED indicators for High, Low, Fault, Calibration, and Setup
- Mode Button, accessed by using a small screw driver
- Digital Display in ppm
- High, Low and Fault relays

NOTE: Standard configuration is common relay

NOTE: A service-loop is necessary between the Model 2280A Controller's rear panel terminals and field/power wiring. This service loop permits the controller to be removed or slid forward for servicing. This service loop is a definite advantage when replacing or changing a controller.

1.4 Sensor Assembly

Four sensor assemblies are normally supplied with the system. These assemblies are comprised of the sensor, the sensor housing, and an optional splashguard.

NOTE: This sensor assembly is CSA approved for Class I, Division 1 and Division 2, Groups B, C & D hazardous areas.

2.0 Installation

2.1 Location of the Controller

The Model 2280A controller should be installed in a weather-protected, non-hazardous area. The following hardware is available to assist installation:

Part Description	Part Number
98 mm (4") panel mount frame	10199-1
483 mm (19") rack mount frame	10200-1
98 mm (4") blank panel	10191-2
98 mm (4") wall mount bracket	10202-1
NEMA 7 explosion-proof enclosure	10099
Desk top cabinet (up to four controllers)	914-006

Table 1: Model 2280A Mounting Parts

The following are guidelines for mounting the controller:

- To minimize the possibility of electrical shock, mounting must be as free from shock and vibration as possible, in a grounded enclosure that requires a tool for instrument removal.
- Even though the controller is RFI resistant, do not mount the controller in close proximity to radio transmitters or similar equipment.
- Care should be taken to assure adequate ventilation.
- Do not mount the controller in a manner that restricts the natural convection airflow from normal ambient air.
- The controller operating temperature range is 0°C to 60°C (32°F to 140°F).

2.2 Power Connections

The Model 2280A operates on a nominal line voltage of 117 VAC, 50-60 Hz, 220 VAC operation is optionally available.

Note: To eliminate accidental shutdown, GMI does not provide a power ON-OFF switch. Power must remain disconnected until all other wiring connections are made.

The following are wiring guidelines for the 2280A Controller:

- If AC is to power the system, connect the line power supply to the terminals **L, N**, and **GND** located at the rear of the controller. Use accepted commercial wiring practices.
- Primary DC power may be used instead. Use any 24VDC nominal supply with a minimum rating of 2 amperes.

- Large gauge wire (up to No. 14) should be used to prevent excessive voltage drop.
- Wiring runs should be as short as possible.
- Connect the positive supply to 24VDC (+) and the negative return 24VDC (-) on the terminal block. An internal diode protects the system in the event of inadvertent supply polarity reversal.

2.3 Battery Backup

An emergency battery backup can be used on a system normally operated by AC. The battery rating (ampere-hour capacity) is dictated by the length of time power outages may last. A Model 2280A Controller requires approximately 2 ampere (peak) at 24 VDC. General Monitors recommends that a Lead-Acid type battery be used. This type of battery can be expected to last for several years with minimum maintenance.

The customer furnished battery may be connected as shown in Figure 2. No manual or relay switching is required. In order to keep the 24V lead acid battery (whose voltage is approximately 27VDC when fully charged) continuously charged through the series diode, a regulated 28VDC power supply should be used. The cable lengths should be kept as short as possible. Should AC power to the regulated DC power supply fail, energy to run the system will be obtained from the fully charged lead acid battery. A 24 ampere-hour capacity battery should power one Model 2280A controller with four sensors for at least 12 hours. **DO NOT USE MORE THAN A 24-VOLT BATTERY**.

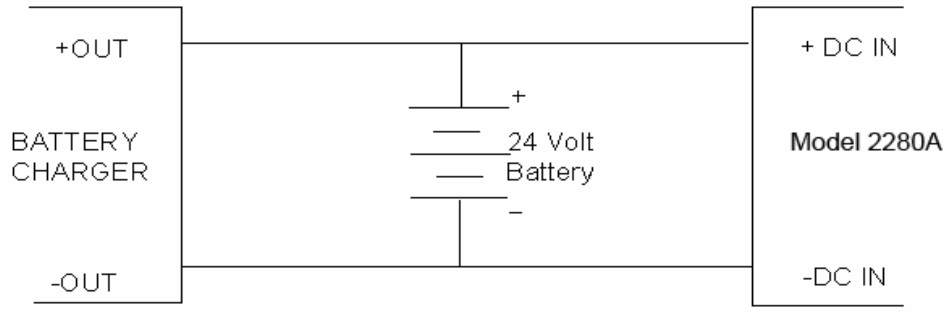

Figure 2: Schematic Battery Backup System

2.4 Analog Output Connection

CAUTION: The Analog Output must either be used or jumpered. If not, the Model 2280A indicates a fault in the normal mode with the display reading "**A0**" and the Fault LED flashing.

The two analog output terminals, AO (+) and AO (-), are located at the rear of the unit. The maximum series resistance permitted is 600-ohms. For a 250-ohm resistor in series the voltage produced across the resistor by the 4-20mA signals is 1 to 5 VDC. A differential input amplifier must sense this voltage, as the analog output current cannot be diverted to any external reference potential.

2.5 Remote Reset Connection

Remote reset (of the alarm relays) is made to the rear panel of the Model 2280A and should be connected between the **RESET** and **24VDC(-)** terminals. A remote reset button must be a "**normally open / momentary closed"** type.

NOTE: If the system is to be powered from a primary DC power supply or if battery backup is provided, the **24VDC (-)** terminal has two wires when remote reset is used. The diameter of the two wires cannot be larger than an AWG 14 wire.

2.6 Choosing Sensor Locations

There are no hard and fast rules governing the selection of sensor locations. The customer must evaluate conditions at their own facility to make this determination. However, the following general suggestions should be considered with regard to particular conditions at the site where a Model 2280A is being installed.

2.6.1 Likely Sources of Gas Emission

In general, at least one sensor should be located in close proximity to each point where Hydrogen Sulfide (H_2S) gas is most likely to escape into the air. Consideration should also be given to placing sensors at locations where the H_2S may be carried by local air currents, ventilation equipment, etc.

2.6.2 Environmental Factors

Avoid installing sensors where they will be unnecessarily exposed to wind, rain, dust, water, shock or vibration. For the temperature range limitations of sensors covered, see Section 7.4.2.

2.6.3 Film Degradation

Sensors may be adversely affected by prolonged exposure to certain materials. Loss of sensitivity or corrosion may be gradual if such materials are present in low concentrations, or it may be rapid at high concentrations. The more important materials adversely affecting sensors are:

- Halides: compounds containing Fluorine, Chlorine, Bromine and Iodine
- Silicones (often contained in greases and aerosols). Silicones do not chemically attack the sensor. They instead, coat it and therefore reduce or stop its response to H_2S.
- Acid Vapors
- Caustic liquids or vapors

The presence of such materials in an area does not preclude the use of a sensor. The feasibility of using a sensor in such areas must be determined by an analysis of the specific factors in each application. Consult General Monitors before attempting any such installation.

Sensors used in these areas usually require more frequent calibration checks than normal and typically have a shorter life. In many such applications the normal two-year warranty does not apply.

CAUTION: General Monitors discourages the painting of sensor assemblies. If the sensor head is painted-over, gas will not be able to diffuse into the sensor and many paints contain lead, which can poison a sensor.

2.7 Sensor Installation

The standard sensor assembly consists of a sensor housing (GMI P/N 10252-1) and sensor (P/N 50445-1, -5, or -9), (Figure 3).

NOTE: When installing the sensors, be sure to leave enough clearance from the ground and walls to be able to fit the calibration bottles supplied with the system onto the sensor head.

The dash (**-**) numbers correspond to full-scale ranges of 0-100 ppm, 0-50 ppm or 0-20 ppm, respectively. The sensor assembly is recognized safe for United States National Electric Code Class I, Division 1 and Division 2, Groups B, C, and D hazardous areas, and is approved by the Canadian Standards Association (CSA).

NOTE: Each H_2S Sensor is shipped with a red plastic cap fitted over the sensing head. Inside the cap is a desiccant. **DO NOT** remove this cap until power has already been applied to the system. Save the cap and re-cap the sensor when powering down the system or if the system power is off for an extended period of time. The desiccant packs may be saved and reused providing that they have been stored in a dry area.

CAUTION: Sensors should ALWAYS be mounted pointing downward to prevent the collection of moisture or contaminants.

To connect the cable to the sensor:

1. Remove the P/N 10252-1 housing lid to reveal the terminal strip. The sensor is connected in the housing according to color designations as follows:

Sensor Housing Terminal Number	Sensor Wire Color
1	White
2	Black
3	Red
4	Green

Table 2: Sensor Wire Colors

2. Install the sensor assembly with conduit in hazardous areas. A good design would include conduit seals to prevent water build-up.

3. Connect the cable so that the terminal color at the sensor housing matches the terminal color at the controller. General Monitors' sensor leads are color coded, and should be connected to the rear Terminal Connector as shown in the following table:

Terminal Connector	Sensor Cable Color
W1	White
B2	Black
R3	Red
G4	Green

Table 3: Sensor Cable Colors

The maximum cable length, using four conductor cable, should be such that the total loop resistance of any signal path (for example the black leads) does not exceed 20-Ohms at 25º Celsius. The following table may be used as a guide to determine cable length versus wire size:

AWG	Feet	Meters
14	3,375	1,030
16	2,250	685
18	1,350	410
20	900	275

Table 4: Cable Length

In the event the system is to have less than four active channels, the sensor should be substituted with a sensor simulator for each unused channel. Otherwise, the unused channel will be in Fault condition (sensor failure).

NOTE: If sensors were matched with a specific channel at the factory, each one will be tagged accordingly. Check and match each sensor to the proper channel before installing it.

Two accessories are available which can be supplied with the system, if ordered:

- Splash Guard, P/N 10395-1
- Test Gas Applicator, P/N 10460-2

Both of these products are designed to provide extra protection in problem environments.

NOTE: Shielded cable should be grounded only at the controller, using the ground terminal provided. Care should be taken to insure that the outer braid does not contact the conduit or junction box.

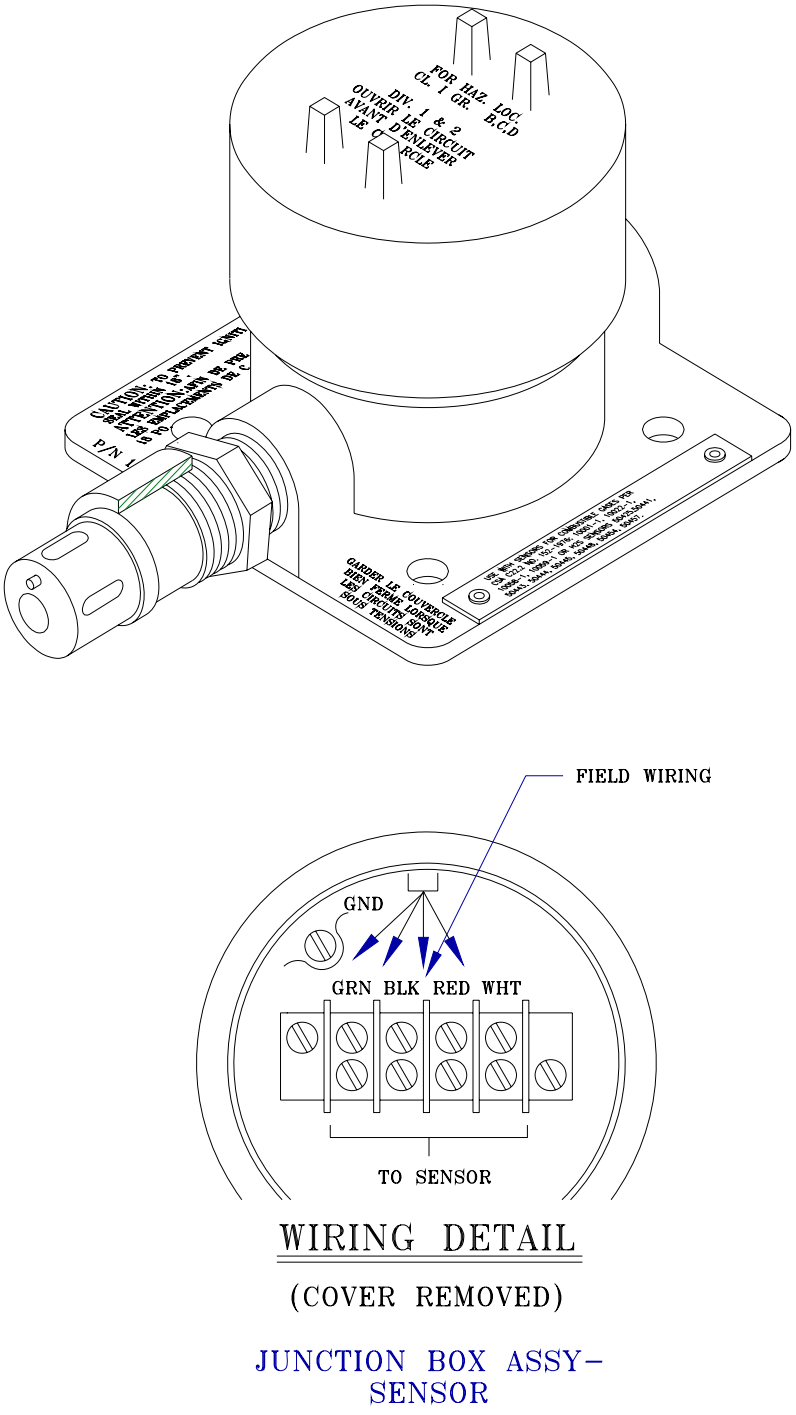

Figure 3: Junction Box Assembly Sensor

2.8 Alarm Wiring Connections

The Model 2280A can be configured to have individual alarm and fault relays for each channel, or have a common set of relays (that is, any alarm of fault occurring on any of the four channels will cause a relay on the channel one card to activate). The alarm relays may be operated as normally de-energized or normally energized, and latching or non-latching.

The Low and High alarm contacts for customer use are DPDT (double pole, double throw), and are rated 4 amps at 115 VAC, resistive. The Fault alarm contact is SPDT (single pole, double throw), 4 amps at 115 VAC, resistive. These contacts are brought out to terminals on the rear of the controller as follows:

ALARM RELAY	CONTACT CONDITION		
	OPEN	COM	CLOSED
Fault	2	C	1
Low Alarm	2,3	C	1,4
High Alarm	2,3	C	1,4

Table 5: De-Energized Alarm Relay Contacts

The above chart shows the High and Low alarm contacts in the standard de-energized state (with power applied). These two alarm relays are normally de-energized unless specially ordered for normally energized operation. **The Fault relay is always supplied normally energized.**

If normally energized, the terminations are:

ALARM RELAY	CONTACT CONDITION		
	OPEN	COM	CLOSED
Fault	2	C	1
Low Alarm	1,4	C	2,3
High Alarm	1,4	C	2,3

Table 6: Energized Alarm Relay Terminations

CAUTION: Inductive loads, such as bells, buzzers, relays, contactors, solenoid valves, etc., connected to the high alarm, low alarm and fault alarm relays must be clamped down as shown in the diagrams below. Unclamped inductive loads can generate voltage spikes in excess of 1000 Volts. Spikes of this magnitude will cause false alarms and possible damage.

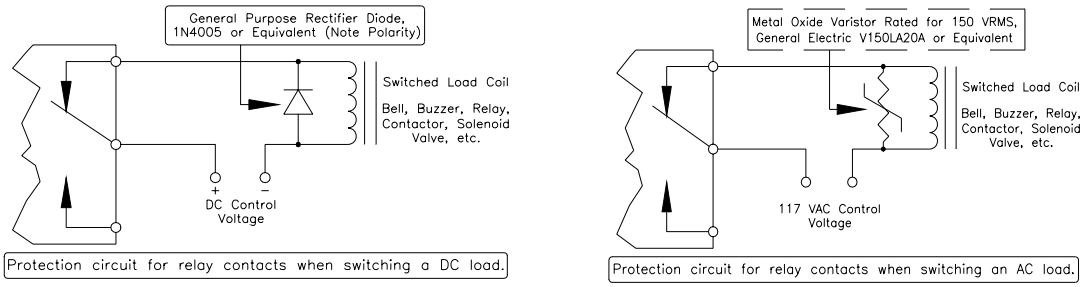

Figure 4: Protection Circuit for Relay Contacts

2.9 Multiple Controller Operation

Up to sixteen points of gas detection utilizing one set of alarm relays may be configured by interconnecting the "=", "H", and "M" terminals of TB2 at the rear of four Model 2280A controllers. Each Specific terminal, such as the "H" terminal, is connected from controller to controller using 20AWG wire (or larger). The controllers must be installed adjacent to each other, and the interconnecting wires kept as short as possible. By using two or three Model 2280A controllers, respectively, the same method may be used to interconnect eight or twelve sensors (Figure 10).

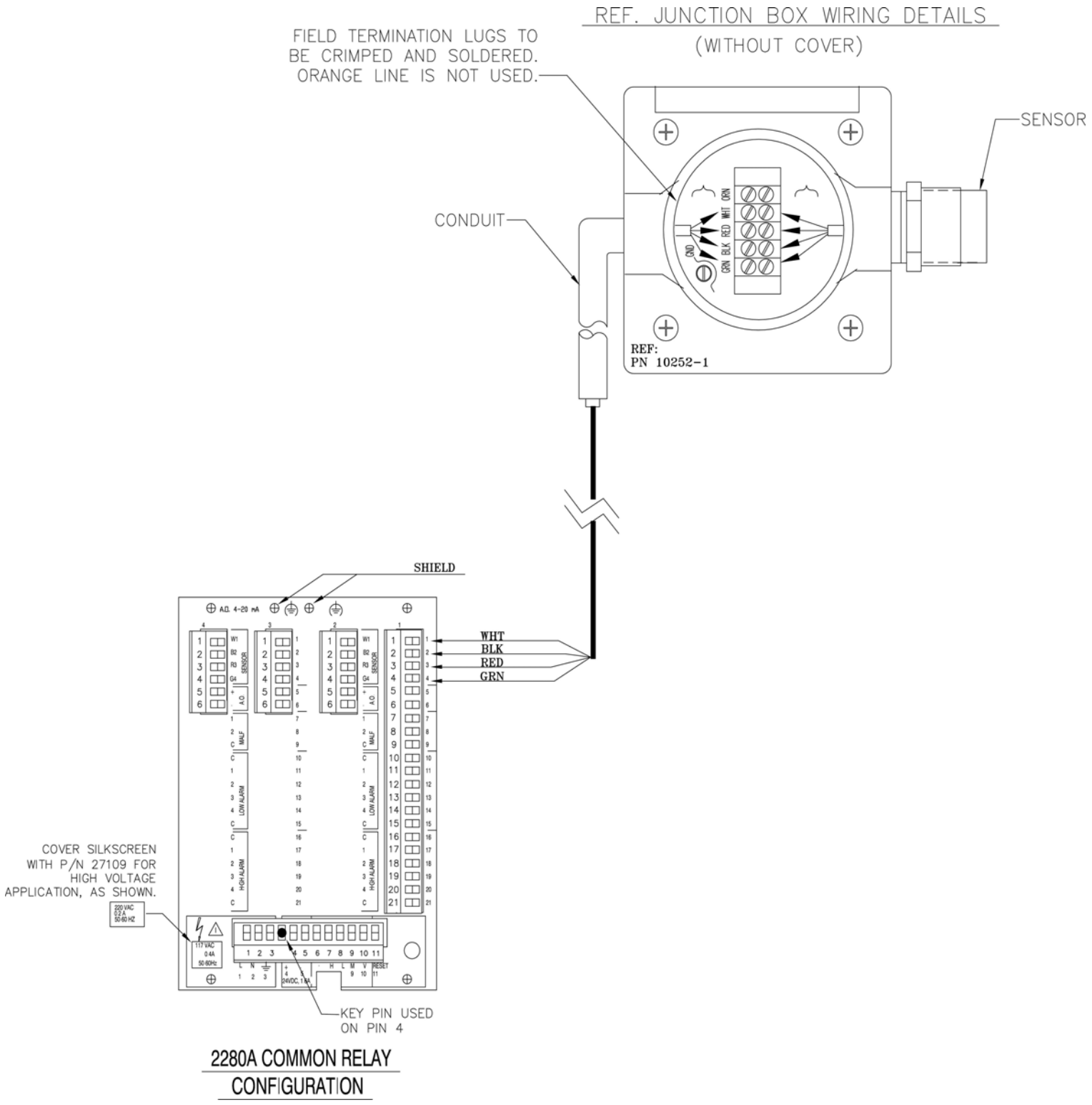

Figure 5: Common Relay & Rear Terminal Connections

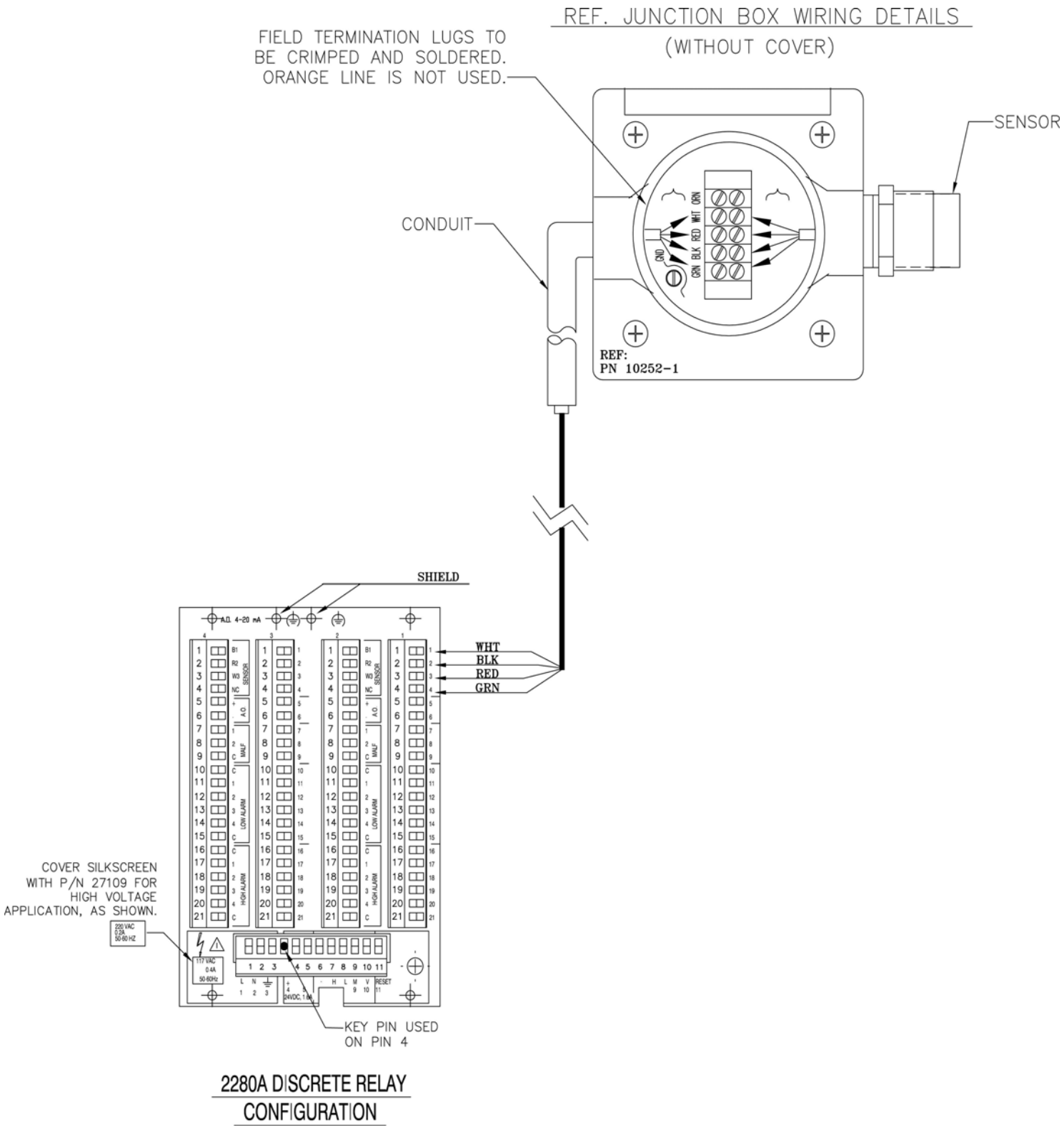

Figure 6: Discrete Relay & Rear Terminal Connections

3.0 Start Up and Operation

3.1 Types of User Interfaces

User interfaces are provided so that the operator may interpret and direct the Model 2280A in the performance of its various functions. User interfaces consist of a digital display, status indicators, a mode button, and a reset button.

- The digital display provides the user with the gas concentration at the sensor site, fault diagnostic codes, calibration prompts, and setup parameters.
- The status indicators provide the user with an indication of the current mode of operation: **HIGH** (High alarm), **LOW** (Low alarm), **FAULT**, **CAL** (Calibration or Calibration Check modes) and **SETUP** (Setup and Setup Check modes).
- **Mode** button provides the user access to the Calibration, Calibration Check, Setup, and Setup Check modes. The **Mode** button is accessed using a small screwdriver in the front of the unit.
- The **Reset** button allows the user to reset latched alarms.

Figure 7: Front Panel Display

3.2 Initial Application of Power

Before applying power for the first time, double-check all the wiring components. Insure that the sensor is correctly installed.

The system has a time delay feature. The High and Low alarm circuits are disabled for approximately 45 seconds after power is applied. This feature prevents false alarms while the sensor circuits are stabilizing.

At the initial application of power, the unit will enter a 45-second start-up mode. During this time, the display will read "**SU**". The unit will then enter operational mode and the current gas concentration of the sensor will display. If a channel fault occurs, the **FAULT LED** will flash, the fault relay will become active and the unit will display the appropriate error code. This fault indication is independent of the abovementioned time delay feature.

NOTE: A defect in one sensor circuit does not affect the operation of other channels.

3.3 Resetting Latched Alarms

The user may select a "latching" or "non-latching" alarm output for High and/or Low alarms. If an alarm output activates and the condition that caused that activation is no longer present, a non-latching alarm output resets automatically. A latched alarm output needs to be reset manually

Resetting latched alarm outputs is done with the **Reset** button located on the Channel 1 board. Pressing the **Reset** button resets any latched conditions that are no longer valid.

EXAMPLE: The sensor detects a gas concentration in excess of an alarm set point. The associated alarm outputs activate. After a few moments, the gas concentration drops below the alarm set point. If the alarm outputs are latched, the operator can press the **Reset** button and the latched alarm outputs returns to the normal (safe) state.

3.4 Analog Output

The Analog Output is a 0 to 21.7mA current signal with 4 to 20mA being proportional to 0 to 100% of full scale.

Analog Output Values	
Signal Range	4-22mA
Fault	<1.0mA
Start-up	4mA
Calibration	1.5mA
Detection Range	4-20mA
Over-Range	20 - 21.7mA

When a channel is in the Calibration, Calibration Check, Setup, or Setup Check modes, a 1.5mA signal is generated by this output. During Calibration mode the digital display

shows prompts associated with the calibration procedure. During Calibration Check Mode, the digital display shows the gas concentration as a flashing digit, or pair of digits.

When a channel enters into a fault condition a 0mA signal is generated by this output. During a fault, the display shows a fault code.

If the sensor attached to the channel is seeing gas in excess of 100% of full-scale, the output generates a signal between 20 and 21.7mA (not proportional).

3.5 Calibration Preparation Instructions

Before a full calibration or calibration check is begun, ensure the sensor assembly is seeing "clean air". If the atmosphere at the sensor contains a low background of H_2S observe the following procedure:

1. Obtain a GMI field calibrator plastic bottle (P/N 50000). Assure that it contains no H_2S by flushing it with clean air. Place your hand or a cover over the bottle's open end and take it to the sensor.
2. Place the bottle over the sensor.
3. Wait a few minutes for the sensor to become permeated with clean air.
4. Remove the sensor from the bottle.

After each use of the field calibrator bottle, clear the bottle of residual H_2S gas by flushing it with clean air.

3.5.1 Gas Application Options

3.5.1.1 Breaker Bottles and Ampoules

General Monitors offers ampoules with breaker bottles as a method of reliably introducing calibration gas to the Model 2280A. The ampoule is placed inside the breaker bottle into the breaker slot, and the breaker bottle is placed over the sensor. The ampoule should contain 50% full-scale of H_2S of the sensor range. For example, 100 ppm full-scale is a 50 ppm ampoule. Check the date code on the ampoule to make sure the expiration date has not passed. Follow the calibration procedure below in Sections 3.6 and 3.7.

To apply gas using Breaker Bottles and Ampoules:

1. Remove cap and flush breaker bottle with fresh air.
2. Insert one ampoule into the ampoule holder. Replace the cap.
3. Place cap over the sensor and rotate bottle for a tight fit.
4. Turn knob clockwise until ampoule breaks.
5. Allow the sensor to see the gas for 1 to 2 minutes.

3.5.1.2 Portable Purge Calibrator

An alternate method for introducing calibration or test gas to the Model 2280A is available. The H_2S Portable Purge Calibrator is a compact, practical, accurate and safe

system for field calibration of H_2S sensors. The bottle is filled with a hydrogen sulfide (H_2S) in air mixture and is available in 7 concentrations. The temperature limitation for operation and storage is 0°F to +130°F (-18°C to +54°C). Make sure the Model 2280A has had power applied for at least 24 hours to ensure that the metal oxide film of the sensor has stabilized. Make sure the sensor is seeing clean air.

Figure 8: Portable Purge Calibrator

To Use the Portable Purge Calibrator

1. Place the calibration cup over the sensor.
2. Apply the gas by opening the ON/OFF valve on the cylinder.
3. Allow the sensor to see the gas for1 to 2 minutes.

NOTE: Do not store the cylinder with the regulator fully engaged in the cylinder valve.

3.6 Calibration Check Mode

This procedure is used to periodically check the response of an installed system to a known concentration of H_2S gas that is at least 50% of the full-scale reading.

To perform a calibration check, use the following procedure:

NOTE: The Calibration Check mode cannot be entered if the channel is in alarm.

1. Enter the Calibration Check mode by pressing and holding the **Mode** button until the **CAL** LED begins to flash (about ten seconds). The channel displays the calibration level. When the **CAL** LED begins to flash, release the **Mode** button. The channel is now in the Calibration Check mode.
2. When the **Mode** button is released, the display indicates a flashing pair of bars (**--**) for about ten seconds.
3. When the display indicates flashing digits, for example “0”, apply the test gas to the sensor. The display begins to go up scale as the sensor sees the gas. If no gas is applied, the channel returns to the normal operating mode after 12 minutes.
4. The reading stabilizes after 1 to 2 minutes of exposure to the test gas. This response time may increase due to the presence of the Dust Guard, Splash Guard or other sensor accessories.
5. If the sensor does see the gas, the read-out on the display flashes for as long as the unit remains in the Calibration Check mode. The operator should compare the reading with the gas concentration applied and determine if it is necessary to calibrate the sensor.
6. Remove the gas and expose the sensor to clean air. If the gas is not removed within 12 minutes, the channel reverts to a fault condition.
7. Press the **Mode** button. Calibration level is displayed for a short time, and the channel exits out of Calibration Check mode.

NOTE: Low and High alarms are disabled during Calibration Check mode.

3.7 Calibration Mode

This procedure is used for initial installation of the system. It is also used to re-calibrate the system if the controller or sensor is replaced, or if the calibration check is not within expected limits.

NOTE: For better results power up the sensor at least an hour before calibration. Make sure the calibration gas is the same concentration as the user specified calibration level. It is recommended to recalibrate after 24 hours.

To calibrate the Model 2280A:

1. Make sure the sensor is seeing clean air.

2. Enter Calibration mode by following the procedure for entering Calibration Check mode in 3.6. Continue to press and hold the **Mode** button until the **CAL** LED becomes steady, approximately fifteen seconds. When the **CAL** LED is steady, release the **Mode** button. The display shows flashing bars (**--**) for approximately 30 to 90 seconds. When the display changes from (**--**) to **AC,** clean air calibration is complete. The channel is now being calibrated at clean air.
3. When the channel displays **AC**, apply gas to the sensor. Watch the display change from **AC** to **CP** as the sensor detects gas. If the display does not change from **AC** to **CP** after 12 minutes, the channel returns to normal operation.
4. After 2 to 5 minutes, the calibration routine is complete and the display changes from **CP** to **CC**. If the display indicates **F2** (failure to calibrate), remove the gas, wait 5 minutes then recalibrate.
5. Remove the gas and watch the display return to normal operation.

NOTE: Low and High alarms are disabled during Calibration mode.

3.7.1 Aborting Calibration

Calibration can be aborted before the calibration gas has been applied.

To abort Calibration:

1. Wait until **AC** displays. Calibration cannot be aborted when "**- -**" is flashing.
2. Press the **Mode** button and hold it for approximately 5 seconds. Release the button, after the calibration level displays.
3. The channel returns to normal operation.

3.8 Setup and Setup Check modes

The Setup Check mode allows the operator to view the selected options for the module without allowing any changes to be made. Once this mode has been entered, the module automatically displays each of the selected options for a short period of time and then it returns to normal operation. The Setup mode allows the operator to change the operating parameters by making choices for selected options.

The Setup Check & Setup modes display identical information with the following exceptions:

- The Setup Check mode allows the user to view the operating parameters of the channel, whereas the setup mode allows the user to change these parameters.
- Entering the optional password is only available in the Setup mode.

NOTE: The Setup and Setup Check modes cannot be entered if the channel is in alarm or fault.

During the Setup mode, the operator is allowed to select options. The selection procedure is the same for most of the options. Pressing the **Mode** button toggles the available choices. When the display has indicated a choice for five consecutive seconds,

without the operator pressing the **Mode** button, the setup routine accepts that selection and moves on to the next option available.

NOTE: Before entering the Setup mode to make changes, the user should fill out the Setup Mode Selection Table (Section 3.9). This aids the user during the selection process in the Setup mode.

The Password, the High & Low alarm set points, and the Calibration Level options offer the operator more than two choices. While these options are being selected, pressing the **Mode** button repeatedly, sequences the display to the next available choice for that option.

To enter the Setup Check mode:

1. Press and hold the **Mode** button until the **SETUP** LED begins flashing (about twenty seconds).
2. When the **SETUP** LED is flashing, release the **Mode** button to enter the Setup Check mode

To enter the Setup mode:

1. Press and hold the **Mode** button until the **SETUP** LED begins flashing (about twenty seconds).
2. Continuing to press and hold the **Mode** button until the **SETUP** LED stops flashing (about five seconds more).
3. When the **SETUP** LED stops flashing and stays on, release the **Mode** button and the unit enters the Setup mode.

3.8.1 Entering the Password

This option applies to the Setup mode only:

- If the Password option is enabled, the right digit of the display is blank and a “0” appears in the left digit on the display. Press the **Mode** button until the first number of your password displays, and then wait about five seconds.
- The left digit of the display blanks out and a “0” appears in the right digit on the display. Press the **Mode** button until your correct password number displays, then wait about five seconds. If the password is correct the unit proceeds to the Password Enabled/Disabled option. If the password is incorrect the user cannot proceed and the unit returns to the normal operating mode. Once in the operating mode the user may re-enter the setup mode. The factory default password is **00**.

3.8.2 High Alarm Options

Next, the **HIGH** LED is flashing while the energized/de-energized option displays. This option is available for discrete relays configuration only. The display indicates the current selection, (**En or dE**). Press the **Mode** button to toggle the selection. **De-Energized (dE)** is the factory default for this selection.

The **HIGH** LED on the front panel flashes while the latching/non-latching option displays. The display indicates the current selection, (**nL or LA**). Press the **Mode** button to toggle the selection. **Latching (LA)** is the factory default for this selection.

The last High alarm option to appear on the display is the alarm set point (trip level). If this level is reached or exceeded, the High alarm outputs activate. The display indicates the current High alarm set point. Press the **Mode** button repeatedly, until the desired High alarm set point appears on the display. **60% of full-scale value** is the factory default for this selection. In case of common alarms, this option is available at the master board only.

High Alarm (All Values in ppm)		
Measure Range	Set Point Range	Increment
0-100	5-95	5
0-50	2-48	2
0-20	1-19	1

Table 7: High Alarm Set Points

NOTE: The High set point cannot be set lower than the current Low set point. To accomplish this, you need to go through setup twice. The Low set point should be set lower than the desired High set point, then re-enter the Setup mode and set the High set point.

3.8.3 Low Alarm Options

Next, the **Low** LED flashes while the energized/de-energized option displays. This option is available only for discrete alarms configuration. The display indicates the current selection, (**En or dE**). Press the **Mode** button to toggle the selection. **De-Energized (dE)** is the factory default for this selection.

The **Low** LED on the front panel flashes while the latching/non-latching option is displayed. The display will indicate the current selection, (**nL or LA**). Press the **Mode** button to toggle the selection. **Non-Latching (nL)** is the factory default for this selection.

The last Low alarm option to appear on the display is the alarm set point (trip level). If this level is reached or exceeded, the Low alarm outputs activate. The display indicates the current Low alarm set point. Press the **Mode** button repeatedly, until the desired Low alarm set point appears on the display. The Low set point cannot be set higher than the High set point. **30% of full-scale value** is the factory default for this selection. In case of common alarms, this option is available at the master board only.

3.8.4 Password Enabled/Disabled Option

After the Calibration Level option has been selected, the Password Enabled/Disabled option displays. The display indicates the current selection, (**PE or Pd**). Press the **Mode** button to toggle the selection. **Password Disabled (Pd)** is the factory default for this selection.

If password disabled is selected, the unit returns to normal operation. If this setting is changed from password disabled to password enabled, the user enters a new password. The unit displays the left digit of the existing password (flashing on the display). The right digit is blank until the left digit has been selected. Press the **Mode** button repeatedly until the desired value displays. Once the left digit is correct, wait for five seconds and the right digit of the display begins flashing and the left digit is blank. Press the **Mode** button repeatedly, until the desired value displays.

3.8.5 LED Test

Press and hold the Reset button for 5seconds. All LED and display segments will flash for as long as the Reset button is pressed. When the button is released the LEDs will return to their normal state reflecting the current status condition of each channel.

3.9 Setup Mode Selection Table

This section helps the operator make selections during the Setup mode. It is recommended that the operator fill-in the selections in the proper blanks and then use this page as a reference while programming the Model 2280A. The table shown below indicates the order of options in the Setup mode. To the right of the option is a description of the choices that are available for that option.

OPTION	DESCRIPTION	ENTER SELECTION
Password	Enter the Password, if the Password is enabled	_____
High Alarm Options	Set the Energized (En) / De-Energized (dE) Option Set the Latching (LA) / Non-Latching (nL) Option Set the High alarm set point	_____ _____ _____
Low Alarm Options	Set the Energized (En) / De-Energized (dE) Option Set the Latching (LA) / Non-Latching (nL) Option Set the Low alarm set point	_____ _____ _____
Password Options	Set the Password to be Disabled (Pd) or Enabled (PE) If the Password option to be changed from Disabled to Enabled: Set the password digits	_____ _____ Left_____ Right_____

Table 8: Setup Display Options

3.10 Check Points for Calibration and Operation

3.10.1 Frequency of Calibration

GMI recommends that the calibration be checked on each sensor at least every ninety (90) days. If a sensor is installed where it may be subjected to splashing water, mud or dirt accumulation, or adverse gases, more frequent calibration is recommended. The exact frequency can vary with the severity of conditions and must be established in the field.

3.10.2 Replacing a Sensor

When a sensor is replaced, the new sensor **must** be calibrated. To avoid false alarms, GMI recommends disabling all the alarm circuits until the sensor is calibrated. For better results, the sensor should be powered up at least 24 hours before calibration.

4.0 Maintenance

4.1 General Maintenance

Once installed, the Model 2280A Controller requires little or no routine maintenance, other than periodic calibration checks. General Monitors recommends that a calibration schedule be established and adhered to. GMI also recommends that a logbook be kept, showing calibration dates and dates of sensor replacement.

Considering the toxicity of hydrogen sulfide, General Monitors' strongly recommends the period between calibrations should never exceed 90 days.

It is important that the owner/operator of this equipment determine the correct calibration schedule for their particular environment. Environmental conditions and contaminants can cause the frequency of calibration to be substantially shorter than 90 days. This is the only method of ensuring proper system operation and response to hydrogen sulfide. More frequent calibration checks are encouraged to detect problems, such as mud collecting on the sensor heads; accidental painting over of sensors, etc. A calibration check is defined as the procedure of applying a known concentration of gas to the system sensors, while observing the controller. The visual display will indicate the gas concentration, and alarm indicators/circuits will activate in direct relationship to gas concentration. Calibration adjustments must be made if results vary (Section 3.7).

4.2 Periodic System Verification

The following system verifications should be performed annually. Verify wiring, terminal connections and stability of mounting for all integral safety equipment including, but not limited to:

- Power supplies
- Control modules
- Field detection devices
- Signaling / output devices
- Accessories connected to field and signaling devices

Proper system operation should be verified by performing a full, functional test of all component devices of the safety system, ensuring that the proper levels of alarming occur.

Fault/Malfunction circuit operation should be verified.

Calibration intervals should be independently established through a documented procedure, including a calibration log maintained by plant personnel or third party testing services.

5.0 Troubleshooting

5.1 General

It is highly recommended that a spare sensor be on hand at all times. Sensor failure tends to be one of the potential causes of real downtime. A full complement of other GMI recommended spare parts should also be on hand. (Please refer to Section 7.4.3).

In the event the system is to have less than four active channels, the sensor should be substituted with a sensor simulator for each unused channel. Otherwise, the unused channel will be in fault condition (sensor failure). It is recommended that defective controllers be returned to the factory for repair, even if the warranty has expired.

5.2 Troubleshooting Table

The information presented in the following table is designed to correct the more common problems, which appear during system startup and operation. Should the various actions suggested in the table fail to restore normal operation, we recommend that the factory be consulted and, if necessary, that the system be returned to the factory for repair.

This section is intended to be a guide in correcting problems that may arise in the field. This section is not all-inclusive, and General Monitors should be contacted for assistance, if the corrective actions listed do not eliminate the problem. If equipment or qualified personnel required for various tests is not available, it is recommended that the defective unit be returned to General Monitors for repair. A complete written description of the problem should be included.

NOTE: If the equipment is under warranty, any repairs performed by persons other than General Monitors' authorized personnel may void the warranty. Please read the warranty statement carefully.

5.3 Fault Codes

In addition to the Fault LED on the front panel, the Model 2280A provides a fault code on the digital display whenever a fault condition occurs. The Fault Codes that can appear on the digital display are:

FAULT CODE	DESCRIPTION	SOLUTION
AO	Open Analog Output Signal	Check connections on rear terminal pins 5 & 6 and the analog output circuitry. If the problem is fixed, but "AO" is still displayed, restart the 2280A unit.
HI	High Supply Voltage	Make sure the supply voltage level is within specification limits.
LO	Low Supply Voltage	Make sure the supply voltage level is within specification limits.
SE	Sensor Failure	Sensor heater connections are open, shorted, defective, or wired incorrectly. Make sure the sensor wires are connected properly (in the field and at the rear of the unit) and recalibrate if necessary. If this fault continues to occur, replace the sensor.
F2	Failed to Complete Calibration	If this fault occurs, remove the gas and expose the sensor to clean air for at least five minutes. Then attempt another calibration. If the second attempt fails, replace the sensor. If this fault continues to occur after the sensor has been replaced, consult the factory or your GMI Representative.
F3	Software Checksum Error	This fault occurs during initial power-up of the unit. If this fault occurs, remove and reapply power to the unit. If the fault continues to occur, consult the factory or your GMI Representative.
F5	Reset Button Malfunction	If the fault occurs, consult the factory or your GMI Representative.
F6	Mode Select Button Malfunction	If the fault occurs, consult the factory or your GMI Representative.
F7	EEPROM Verification Error for Calibration Storage	If the fault occurs, consult the factory or your GMI Representative.
F8	EEPROM Verification Error for Setup Storage	If the fault occurs, consult the factory or your GMI Representative.
F9	Calibration Check Period Exceeded	If the calibration checks gas is left on the sensor for more than 12 minutes, this fault occurs. Remove the gas and expose the sensor to clean air.

Table 9:Troubleshooting Table

6.0 Customer Support

6.1 General Monitors' Offices

Area	Phone/Fax/Email
UNITED STATES	
	Toll-Free: +1-800-446-4872
Corporate Office 26776 Simpatica Circle Lake Forest, CA 92630	Phone: +1-949-581-4464 Fax: +1-949-581-1151 Email: sales@generalmonitors.com
9776 Whithorn Drive Houston, TX 77095	Phone: +1-281-855-6000 Fax: +1-281-855-3290 Email: gmhou@generalmonitors.com
UNITED KINGDOM	
Heather Close Lyme Green Business Park Macclesfield, Cheshire United Kingdom, SK11 0LR	Phone: +44-1625-619583 Fax: +44-1625-619098 Email: info@generalmonitors.co.uk
IRELAND	
Ballybrit Business Park Galway, Republic of Ireland	Phone: +353-91-751175 Fax: +353-91-751317 Email: service@gmil.ie
SINGAPORE	
No. 2 Kallang Pudding Rd. #09-16 Mactech Building Singapore 349307	Phone: +65-6-748-3488 Fax: +65-6-748-1911 Email: genmon@singnet.com.sg
MIDDLE EAST	
LOB12, #G20 P.O. Box 61209 Jebel Ali, Dubai United Arab Emirates	Phone: +971-4-8815751 Fax: +971-4-8817927 Email: gmme@emirates.net.ae

6.2 Other Sources of Help

General Monitors provides extensive documentation, white papers and product literature for its complete selection of safety products. A selection of these documents are available online at the General Monitors website at **http://www.generalmonitors.com.**

7.0 Appendix

7.1 Warranty

General Monitors warrants the Model 2280A to be free from defects in workmanship or material under normal use and service within two years from the date of shipment.

General Monitors will repair or replace without charge any such equipment found to be defective during the warranty period. Full determination of the nature of, and responsibility for, defective or damaged equipment will be made by General Monitors' personnel.

Defective or damaged equipment must be shipped to General Monitors' plant or representative from which the original shipment was made. In all cases this warranty is limited to the cost of the equipment supplied by General Monitors. The customer will assume all liability for the misuse of this equipment by its employees or other personnel.

All warranties are contingent upon proper use in the application for which the product was intended and does not cover products which have been modified or repaired without General Monitors' approval, or which have been subjected to neglect, accident, improper installation or application, or on which the original identification marks have been removed or altered.

Except for the express warranty stated above, General Monitors disclaims all warranties with regard to the products sold, including all implied warranties of merchantability and fitness and the express warranties stated herein are in lieu of all obligations or liabilities on the part of General Monitors for damages including, but not limited to, consequential damages arising out of, or in connection with, the performance of the product.

7.2 Sensor Operating Principle

GMI's sensor is a solid-state, continuous, diffusion type element. The sensor uses the ability of Hydrogen Sulfide to strongly and significantly adsorb onto certain materials as the basis for measurement. Specifically, H_2S adsorbs onto many different metals (as well as many other materials, including numerous hydrocarbons, sulfur dioxide, and other sulfur compounds). GMI has developed a proprietary metal oxide semi-conductor, which is extremely selective in permitting H_2S to adsorb onto it. That is, very few other compounds found in practical applications will affect this metal oxide. The semiconductor material is therefore specific to H_2S.

The semiconductor is located in the system circuit, acting as a resistor. When air, which contains H_2S, diffuses into the sensor through the outer flame arrestor, the adsorption of the H_2S onto the semiconductor causes its electrical resistance to decrease. The sensor is temperature controlled to prevent adsorption rate variations from ambient temperature changes. The decrease in resistance is extremely repeatable over a range of 0-20, 0-50 or 0-100 ppm H_2S. Therefore, the change produces a signal approximately proportional to the logarithm of the H_2S concentration. This signal is processed, linearized, and displayed as a digital number on the front of the controller. The controller's analog

current output signal tracks the digital reading as well. The adsorption process is reversible so that when the air containing no H_2S diffuses into the sensor, the H_2S gas desorbs. The semiconductor then resumes its original “clean air” resistance value.

7.3 General Specifications - Controller

7.3.1 Mechanical Specifications

Dimensions:	4.0”W x 6.9”H x 11.5”D (102mm x 175mm x 292mm)
Weight:	6.2 lbs. (2.86 kg)
Mounting:	Rack, panel, wall

7.3.2 Environmental Specifications

Temperature Range:	32°F to 140°F (0°C to 60°C)
Storage Temperature:	-4°F to +149°F (-20°C to 65°C)
Operating Humidity:	15% to 95% Non-Condensing

7.3.3 Electrical Specifications

Power:	105-130 VAC/50-60 Hz 205-255 VAC/50-60 Hz 22-30VDC. 9-Watts nominal per channel (117 VAC)
Alarm Circuits:	4 Amp relays @ 117 VAC, resistive
Output Signal:	0-21.7 mA, 300-Ohm maximum load Accuracy: ± 5%, 1.5-20mA

7.3.4 System Specifications

Digital Readout:	0-20, 0-50 or 0-99 ppm
Accuracy:	± 2 or ±10% of applied gas, whichever is greater
Electrical Classification:	General purpose (non-hazardous, indoors)
Warranty:	Two years
Approvals:	CSA

7.4 General Specifications - Sensor

7.4.1 System Specifications

Type:	Continuous diffusion, adsorption type
Response Time:	T_{50} < 1 minute with full-scale gas applied (screen) T_{50} < 2 minutes with full-scale gas applied (sintered)
Repeatability:	±10% of reading or 2 ppm, whichever is greater
Specificity:	Hydrogen Sulfide specific
Electrical Classification:	Class I, Division 1 and 2, Groups B, C and D
Warranty:	Two years

7.4.2 Environmental Specifications

Temperature Range:	-40° to +167° F (-40° to 75° C)

7.4.3 Recommended Spare Parts List

Qty	Description	Part Number
2	Fuse, .8 amp, 250 VAC	951-012
2	Fuse, 3.15 amp, 250 VAC	951-213
1	Sensor	Per Original Order

Table 10: Spare Parts List

7.5 Sample Calibration Schedule and Checklist

Sensor Serial Number _____ Location _____

1. Installation and Preliminary calibration. Record date after preliminary calibration is done.	Date: _____					
2. 24-hour calibration. Record date after 24-hour calibration is done.	Date: _____					
3. 7-day calibration check. Record date and reading of calibration check. Repeat after 7 days if reading deviates more than ±20% or 2 ppm, whichever is greater. Otherwise go to step 4.	Date/Reading		Date/Reading		Date/Reading	
	____	____	____	____	____	____
	____	____	____	____	____	____
	____	____	____	____	____	____
	____	____	____	____	____	____
4. 14-day calibration check. Record date and reading of calibration check. Repeat after 14 days if reading deviates more than ±20% or 2 ppm, whichever is greater. Otherwise go to step 5.	Date/Reading		Date/Reading		Date/Reading	
	____	____	____	____	____	____
	____	____	____	____	____	____
	____	____	____	____	____	____
	____	____	____	____	____	____
5. 30-day calibration check. Record date and reading of calibration check. Repeat after 30-days if reading deviates more than ±20% or 2 ppm, whichever is greater. Otherwise go to step 6.	Date/Reading		Date/Reading		Date/Reading	
	____	____	____	____	____	____
	____	____	____	____	____	____
	____	____	____	____	____	____
	____	____	____	____	____	____
6. 60-day months calibration check. Record date and reading of calibration check. Repeat after 60 days if reading deviates more than ±20% or 2 ppm, whichever is greater.	Date/Reading		Date/Reading		Date/Reading	
	____	____	____	____	____	____
	____	____	____	____	____	____
	____	____	____	____	____	____
	____	____	____	____	____	____
7. 90-day calibration check.	Date/Reading		Date/Reading		Date/Reading	
	____	____	____	____	____	____
	____	____	____	____	____	____
	____	____	____	____	____	____
	____	____	____	____	____	____

Table 11: Calibration Schedule

7.6 Product Configuration Table

MODEL 2280A

FOUR CHANNEL H2S CONTROLLER

A	B	C	D	E	F
1	**1**	**1**	**01**	**1**	**4**

A. CONTROLLER

2280A	Model 2280A Controller 6.2 lbs.
1 (Std) -P1	110 VAC/24VDC
2 -P2	220 VAC/24 VDC

B. RELAY ALARM

1	(STD)	RA1	COMMON RELAY/COMMON ALARMS
4		RA1	DISCRETE RELAYS/DISCRETE ALARMS

C. RELAY – STATE - NC

1	(STD)	RS 1NC	LATCH ALARM, NON-LATCH WARN, DE-ENERGIZED
2		RS 2NC	LATCH ALARM, NON-LATCH WARN, ENERGIZED
3		RS 3NC	LATCH ALARM, LATCH WARN, DE-ENERGIZED
4		RS 4NC	LATCH ALARM, LATCH WARN, ENERGIZED
5		RS 5NC	NON-LATCH ALARM, NON-LATCH WARN, DE-ENERGIZED
6		RS 6NC	NON-LATCH ALARM, NON-LATCH WARN, ENERGIZED
7		RS 7NC	NON-LATCH ALARM, LATCH WARN, DE-ENERGIZED
8		RS 8NC	NON-LATCH ALARM, LATCH WARN, ENERGIZED

C. H2S – SENSOR

00		NONE	No Sensor	0.5 Lbs.
01	(STD)	50445-1	Sensor Al 0 to 100 PPM H2S	0.5 Lbs.
02		50445-5	Sensor Al 0 to 50 PPM H2S	0.5 Lbs.
03		50445-9	Sensor Al 0 to 20 PPM H2S	0.5 Lbs.
04		50448-1	Sensor SS 0 to 100 PPM H2S	0.5 Lbs.
05		50448-5	Sensor SS 0 to 50 PPM H2S	0.5 Lbs.
06		50448-9	Sensor SS 0 to 20 PPM H2S	0.5 Lbs.
07		50454-1	Sensor PTB AL 0 to 100 PPM H2S	0.5 Lbs.
08		50454-5	Sensor PTB AL 0 to 50 PPM H2S	0.5 Lbs.
09		50454-9	Sensor PTB AL 0 to 20 PPM H2S	0.5 Lbs.
11		51457-1	Sensor SS Atex H2S 0-100 (Replaces 50457-1)	0.0 Lbs.
12		51457-1L	Sensor SS Atex H2S 0-100 (W/Lugs)	0.5 Lbs.
13		51457-5	Sensor SS Atex H2S 0-50 (Replaces 50457-5)	0.5 Lbs
14		51457-5L	Sensor SS Atex H2S 0-50 (W/Lugs)	0.5 Lbs.
15		51457-9	Sensor SS Atex H2S 0-20 (Replaces 50457-9)	0.5 Lbs.
16.		51457-9L	Sensor SS Atex H2S 0-20 (W/Lugs)	0.5 Lbs.

D. H2S METER SCALE:

1	(STD)	H2S1	99 PPM SCALE
2		H2S2	50 PPM SCALE
3		H2S3	20 PPM SCALE

E. ACTIVE CHANNELS:

0		Controller Only		
1		One Active Channel		6.2 Lbs.
		1X	Cal Kit Refill 4 Ea #20/#50/#1	0.7 Lbs.
		3X	H2S sensor simulator w/o SW	0.5 Lbs.
		1X	Sensor Housing	3.0 Lbs.
		1X	Calibration Bottle	1.0 Lbs.
		Two Active Channels		9.4 Lbs.
		2X	Cal Kit Refill 4 Ea #20/#50/#1	0.7 Lbs.
		2X	H2S sensor simulator w/o SW	0.5 Lbs.
		2X	Sensor Housing	3.0 Lbs.
		2X	Calibration Bottle	1.0 Lbs.
		Three Active Channels		12.6 Lbs.
		3X	Cal Kit Refill 4 Ea #20/#50/#1	0.7 Lbs.
		1X	H2S sensor simulator w/o SW	0.5 Lbs.
		3X	Sensor Housing	3.0 Lbs.
		1X	Calibration Bottle	1.0 Lbs.
4	(STD)	Four Active Channels		15.8 Lbs.
		4X	Cal Kit Refill 4 Ea #20/#50/#1	0.7 Lbs.
		4X	Sensor Housing	3.0 Lbs
		1X	Calibration Bottle	1.0 Lbs.

7.6.1 Panel Assembly, Panel Mount – 98, Ref: 10199C

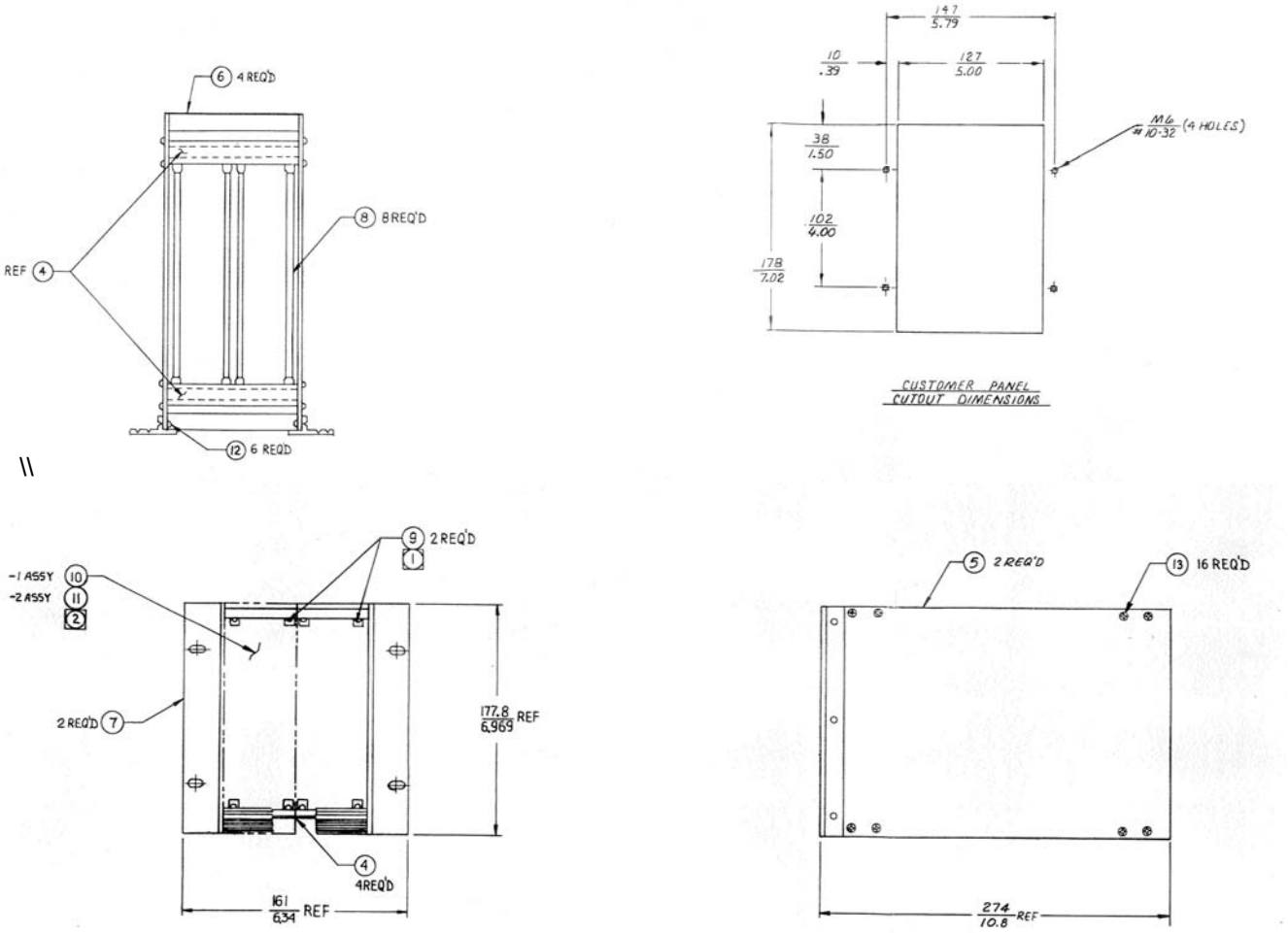

Figure 9: Panel Assembly, Panel Mount – 98, Ref: 10199C

7.6.2 Interconnection Drawing Zone Control Model 2280A Controller

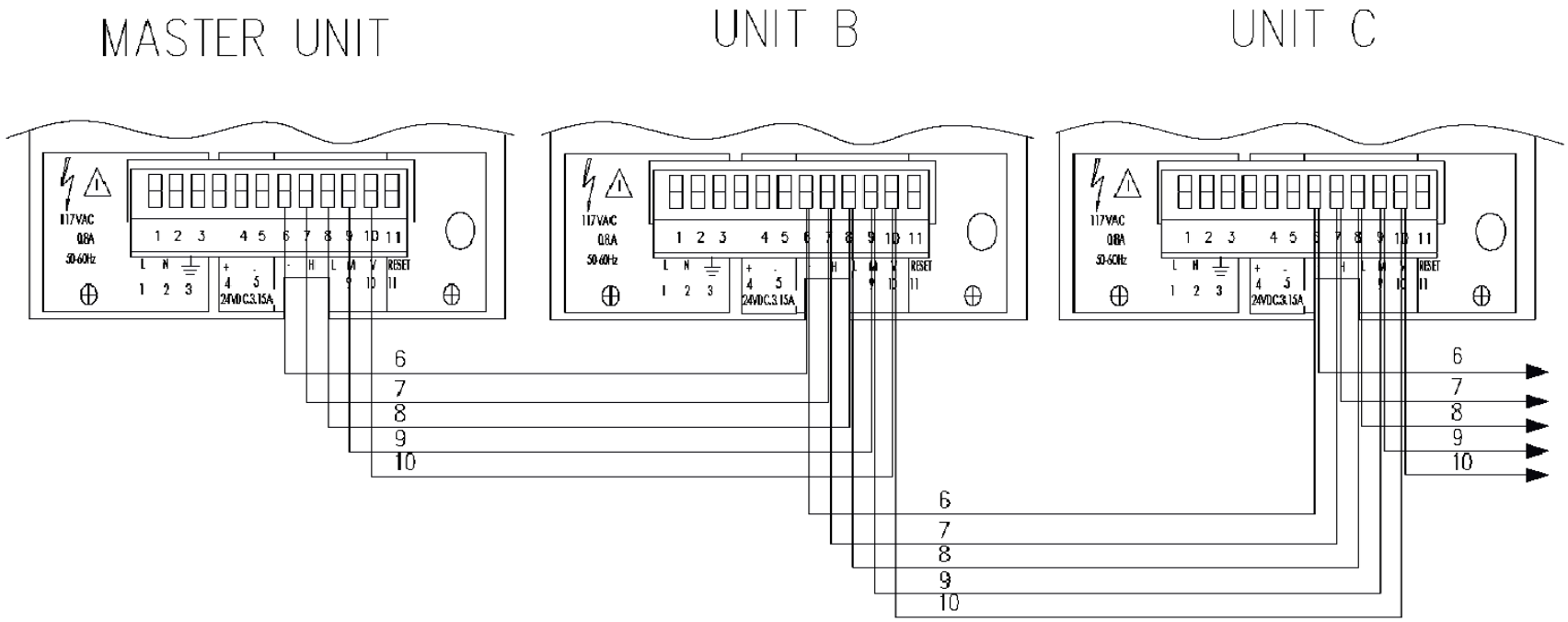

Figure 10: Interconnection Drawing Zone Control Model 2280A Controller

ADDENDUM
Product Disposal Considerations

This product may contain hazardous and/or toxic substances.

EU Member states shall dispose according to WEEE regulations. For further General Monitors' product WEEE disposal information please visit:
www.generalmonitors.com/customer_support/faq_general.html

All other countries or states: please dispose of in accordance with existing federal, state and local environmental control regulations.

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