

**MODEL 5000**  
**S E N T R Y**  
**GAS MONITORING SYSTEM**

**Version 6**

**Service and Troubleshooting**



**APPLICABILITY & EFFECTIVITY**

**Effective for all Sentry systems manufactured after September 1, 1995.**

**Instruction Manual Part Number T12001-A1**

**Sierra Monitor Corporation  
1991 Tarob Court, Milpitas, CA 95035  
(408) 262-6611**

## 7. SERVICE

### 7.1 OVERVIEW

#### 7.1.1 GENERAL

This section provides service information for Sentry systems which have software version 6.0 and above. The section is intended for use by a qualified field technician. Sierra Monitor sales and technical staff are available to assist by telephone at (408) 262-6611, during normal west coast working hours.

#### 7.1.2 INSTALLATION INSPECTION

Prior to system start-up or trouble shooting the entire system should be visually inspected. The following are guidelines for that inspection:

##### 7.1.2.1 CONTROLLER INSTALLATION

- Controller installed in conformance to instruction manual recommendations.
- AC power is correctly grounded.
- Hot AC and relay connections have safety covers installed.
- RS232C cable connection to printer correctly seated and retaining screws tight.

##### 7.1.2.2 CABLING INSTALLATION

- All splices are soldered or via terminal block.
- Cabling is away from sources of electrical noise where possible.
- Terminals P, S, G (or 1,2,3) on channel connector match terminals P, S, G on module. Trace color codes to confirm correct wiring.

##### 7.1.2.3 SENSOR MODULE INSTALLATION

- Module installation in conformance with instruction manual recommendations.
- Modules accessible for calibration.
- Terminations to electronics card clean and correct.

##### 7.1.2.4 MOISTURE TRAPS AND RAINSHIELDS

- Conduit seals and drains installed to avoid moisture build up in electronics enclosure. Water accumulation in sensor module enclosures is a major cause of damage and system failures - take precautions to seal

electrical conduits and provide moisture traps and drains to avoid water damage

- Rainshields installed where applicable.

##### 7.1.2.5 STANDARD VOLTAGES

- AC Voltage on AC terminal on connector panel of controller should be 120 VAC (or 220 VAC option) +10%, -15%, 50-60 Hz.
- DC Voltage on DC terminal on connector panel (if used) should be (12 VDC Nominal), 10 to 29 VDC.
- Channel Voltage (power to ground) should be approximately 20 VDC on open channel and approx. 18 VDC on used channel.
- Signal Oscillation on an "in use" channel (signal to ground) can usually be read with a voltmeter at approx. 0 - 6 VDC.

#### 7.1.3 DATA COLLECTION

Sentry can provide a large amount of data which will be helpful during problem solving. If the system has a printer use the **TIME KEY** to select **HISTORY REPORT** and press **ENTER**. When the report is complete **SYSTEM REPORT** will display on the controller, press **ENTER** to print. Diagnostic reporting capability is discussed in Section 7.3.5.

If a printer is not in use, key information can be read and manually recorded by selection of the **HISTORY (TIME KEY)**, **CHECK MODULE** and **CHECK SYSTEM (MODE KEY)** menu choices

#### 7.1.4 INSPECTION AND TROUBLESHOOTING GUIDE

The inspection and troubleshooting guide can be used to step through the system start-up and to determine the corrective action if a fault occurs.

Instructions:

1. Take the action described in the "Operator Action" column.
2. If the "CORRECT" result occurs, proceed to the next Operator Action.
3. If the "Incorrect" result occurs find the probable cause and corrective action in the "Reason/Correction" column.

<b>INSPECTION GUIDE</b>		
<b>OPERATOR ACTION</b>	<b>RESULT CORRECT, Incorrect</b>	<i>Reason/Correction</i>
<b>TURN SYSTEM ON</b>	POWER LIGHT FLASHING Power light solid Power light off	<i>Turn off &amp; restart Check fuse &amp; line voltage Check power supply 5v fuse</i>
<b>RESET/RESET/ENTER</b>	POWER LIGHT SOLID Power light flashing & Top Display = "----" Top display = E1 Top display = E2 Top display blank  BOTTOM DISPLAY = "SYSTEM WARM-UP" "PLEASE WAIT MM:SS" Random Blank CLOCK COUNTS DOWN TO ZERO No count down ALARM LED'S BLANK Random LED's ON or flashing CALIB LIGHT OFF Calib light on	<i>System is re-setting, check for channel cable short  EPROM error (fatal) RAM error (fatal) Check +15 &amp; -12V on power supply Check display ribbon cable, cold start Check line: must be &gt;90 VAC, Check EPROM  Check ribbon cable to display Check -12v on power supply  Check lithium battery for 2.5V, Check U15  Reset alarms, If not fixed cold start.  Reset system</i>
<b>MODE/ENTER</b>	CALIB LIGHT ON Calib light off	<i>Procedure error: retry</i>
<b>RESET</b>	UPPER DISPLAY CYCLES ALL MODULE NUMBERS Lower display = "No modules installed  Not all installed module #'s displayed  Lower display shows "Module numbers must be 1-2" or "1-4"  TROUBLE LIGHT OFF Trouble light on	<i>Check module channel wiring Check connector panel seating to controller Check +20V between channel pins 1 and 3 Check +15 &amp; -12V supply Check for oscillation on channel pin 2 Correct above items, replace analog multiplexor Check respective cabling including cross-wiring, opens, shorts, leakage Check cable length &amp; size versus instruction manual Check # of modules on cable run (Max. 4) Check modules for correct digital address Test modules by swapping working for non-working Test modules on short cables at controller to eliminate cable doubts. Modules will only be recognized when controller is in Change/Calib mode  Controller has 2 or 4 channel software, but module numbers have been set &gt;2 or &gt;4  Read lower display for error message and check upper display for module # (See specific error message instructions in this manual)</i>
<b>RESET/RESET/ENTER</b>	TOP DISPLAY CYCLES ALL MODULES WITH "00" CONCENTRATION Some/all modules indicate "no factors" Some/all modules indicate "uncalibrated" Lower display reads: "Replace Battery" Lower display reads: "Calib Switch On" Lower display reads: "Diagnostic Scan" Lower display reads: "Fast Error Check" Lower display reads: "Module Off" Lower display reads: "Module Warm-up"	<i>Input factors via Change Module and calibrate Calibrate Check/Replace lithium battery Magnetic switch in sensor head is on Exit Scan with code "0009" Exit Scan with code "0009" Turn module "on" in "Change Module" mode Wait for clock to zero</i>

<b>TROUBLE SHOOTING GUIDE</b>		
<b>Symptom</b>	<b>Cause</b>	<b>Fix</b>
<p><b>CONTROLLER</b>  <b>Top Display: wrong characters displaying 8888 or Blank</b>  <b>Bottom Display blank</b></p> <p><b>Diagnostic voltages displayed are more than 10% different from manual</b>  <b>Keyboard: Wrong action based on key press</b>  <b>Alarms intermittent or false</b></p> <p><b>AC fuse blows</b></p> <p><b>Modules not recognized</b></p>	<p>PROM failure; microprocessor failure; other major component failure; AC brown out                      -12 VDC failure on power supply;                      Component failure                      Respective module PCB (digital board) bad</p> <p>Component failure</p> <p>+15 OR -12 VDC failure or out of adjustment                      Wiring error or Power Supply or                      Transformer failure                      Component failure; wiring defect; power to modules may be low</p>	<p><i>Replace components or send to SMC;                      Power up and down for brown-outs                      Replace power supply board or factory repair</i></p> <p><i>Replace module electronics or factory repair</i></p> <p><i>Factory repair</i></p> <p><i>Replace power supply board or factory repair</i></p> <p><i>Check wiring; replace power supply and/or transformer; or factory repair</i></p> <p><i>Check channel wiring for breaks/opens; move to another channel; multiplexors may be bad on main PCB; replace multiplexors; clear RAM</i></p>
<p><b>MODULES</b>  <b>Module not recognized</b></p> <p><b>Module recognized as wrong type</b></p> <p><b>Sensor failure</b></p> <p><b>Multiplexing problem</b></p>	<p>Component failure; wrong address; reversed wiring</p> <p>Component failure; controller RAM initialized incorrectly; wire gauge too small</p> <p>Sensor Module electronics failure                      Signal voltage misadjusted; environmental deterioration</p> <p>DC ground wire not connected at one module;                      Wire AWG is wrong; wire connections faulty</p>	<p><i>Set address correctly; check wiring; check all voltages including sensor; turn on "calibrate or change" light by pressing MODE, ENTER, RESET</i></p> <p><i>factory repair</i></p> <p><i>Check wiring against manual spec; clear RAM for 1 address; clear system RAM</i></p> <p><i>factory repair</i></p> <p><i>Replace module electronics assembly</i></p> <p><i>Adjust per service instructions, replace sensor if necessary</i></p> <p><i>Test individual modules on single channel; check all DC ground connections; verify AWG; solder all splices; replace module</i></p>
<p><b>PRINTER</b>  <b>Not Printing</b></p> <p><b>Printing garbage</b></p>	<p>AC power glitch</p> <p>DIP switches set wrong                      Corrupted printer buffer                      Failed component in Sentry controller                      Ribbon cable damaged                      Paper out light is on</p> <p>Paper misaligned</p>	<p><i>Power down and power up complete system at one time</i></p> <p><i>Set printer for 1200 baud</i></p> <p><i>Clear printer buffer (Diagnostic 0006)</i></p> <p><i>Replace printer drivers</i></p> <p><i>Check/replace printer cable</i></p> <p><i>Replace paper or fix paper to route past paper sensor</i></p> <p><i>Fix alignment</i></p>
<p><b>MODBUS</b>  <b>Not Communicating</b></p>	<p>Incorrect Configuration</p> <p>Hardware Problem</p>	<p><i>Use "Change MODBUS" in Mode menu to turn MODBUS on and set controller address and baud rate to match host. Check for correct interface cable, RS485 configuration and host computer port configuration.</i></p>

## 7.2 CONTROLLER

### 7.2.1 MECHANICAL/FUNCTIONAL DESCRIPTION

The controller consists of four sub assemblies. Figure 7-1.

#### 7.2.1.1 CONNECTOR PANEL

The Back Panel contains all the connectors for providing system power, powering and communicating with the modules, operating alarm devices and communicating with a printer. The panel also contains the AC fuse.

The connector panel contains, internally, an edge card connector which connects the main control card.

To remove the panel from the controller unscrew the four corner screws and gently slide the edge connector apart. This procedure allows the controller to be removed for repair without disconnecting all the wiring from the connector panel.

Except for the AC fuse there are no field repairable components on the connector panel.

#### 7.2.1.2 POWER SUPPLY ASSEMBLY:

The power supply assembly includes the transformer which is installed on the bottom plate of the controller and the power supply board which is "piggy backed" to the main control board. To gain access to the power supply board remove the six screws which hold the perforated side panel on the left side of the controller and slide the panel off toward the connector panel.

The power supply board provides various DC voltages for system operation and is described in Section 7.2.2

To remove the power supply board unplug the large in-line harness connector, remove the four nuts from the corners of the board, and lift the board off the multi-pin connectors which interface the power supply to the main control board.

#### 7.2.1.3 MAIN CONTROL BOARD

The main control board assembly is a printed circuit board which connects to the connector panel and the power supply as described above and to the front panel via a ribbon cable. To access the component side of the board remove the perforated side panel on the right side of the controller.

Field repairs to the main control board involve socketed component replacement only. Board removal is not required for these repairs.

#### 7.2.1.4 FRONT PANEL

The front panel assembly contains the membrane panel, the two displays and the indicator lights (LED's). A ribbon cable connection to the main control card is the only electrical connection to the panel.

Access to the lower display angle adjustment is by removal of the left side panel.

### 7.2.2 ELECTRICAL DESCRIPTION

#### 7.2.2.1 POWER SUPPLY DESCRIPTION

The controller power supply is configured to accept 120 VAC and/or 12 VDC. See specifications Section 8.1 for specific requirements.

The controller can also accept +10 to +29 VDC. If both AC and DC supplies are connected and the AC drops below 90 VAC the system will operate on DC until that supply drops below 10.5 VDC. At that time the controller will reset.

The power supply provides a regulated +24 to +26 volts for the channel regulators, +5 volts for the main control card and front panel board, and +15 & -12 volts for the main control card. A 1 Amp (120 VAC) or .5 Amp (220 VAC) slo-blow fuse protects the AC input power. Check the fuse on the connector panel if the power light is off. - Figure 3-9

The power supply is protected by an over-voltage transient protector (MOV), an EMI/RFI line filter and Zener transient protectors.

The following are symptoms of power supply failure. Figure 7-3.

1. No +24 volts: no modules recognized by the system.

Action: check the fuse on the connector panel, check that the 9 pin in-line connector is fully seated. If the +24 volts is still absent, replace the power supply board. (The failed board can be factory repaired.)

2. No +5 volts: no lights or displays on the front panel.

Action: check fuse F1 on power supply board.

3. No +15 volts: no modules recognized by the system & no bottom display.

Action: replace power supply board.

4. No -12 volts: no lower display and/or no modules recognized, no printing and no alarm functions.

Action: replace power supply board.

5. No +12 volts with battery back-up: no lights on front panel.

Action: check fuse F2 on power supply board. If power supply jumpers have been cut, cold start requires 110 VAC.

### 7.2.2.2 POWER SUPPLY ADJUSTMENTS

The +24 volts can be measured at TP1 or TP2 (Test Point 1 or 2) with respect to ground (GT1). Figure 7-3. If there is no +24 volts and replace fuse F1

The +5 volts can be measured at TP4. If there is no +5 volts check and replace fuse F3.

The +15 volts can be measured at TP5.

The -12 volts can be measured at TP7

### 7.2.2.3 LITHIUM BATTERY

The lithium battery which is located on the main control board, Figure 7-2, looks like a large coin and is mounted in a round battery holder with a metal retaining clip. Typical battery voltage should be 3.0 volts and can be measured by connecting the negative lead of the meter to Ground Test 1 (GT1) on the main control board, and the positive lead to the shoulder of the battery holder arm. The voltage should be greater than +2.2 volts or the battery should be replaced. To remove the battery (use Panasonic BR2325 or equal) use a nonmetallic probe to carefully lift the metal clip and push the battery to one side.

It is advisable to increase the tension on both the positive and negative contacts before installing the new battery. To do this slide an insulator between the contacts and use a small screwdriver to lift the lower contact up and push the upper contact down. Install the new battery with the positive terminal ("+") facing up. The insulator is important to avoid shorting the two terminals as this will erase the data accumulated in RAM.

Battery replacement is necessary when the **REPLACE BATTERY** message appears on the lower display during normal operation. The controller memory of factors, calibration and history will be retained for a period of several minutes during battery replacement.

### 7.2.2.4 EPROM'S

There is one EPROM located on the main control board. Figure 7-2. The EPROM can be identified by the white label on the window. The EPROM stores all the software for Sentry. The EPROM needs replacement when the user wishes to upgrade to additional options or when a factory upgrade is issued for the system. The following precautions must be exercised when replacing the EPROM:

- EPROM's are sensitive to static discharge and extreme care must be used in their handling. The technician should be grounded before picking up or installing EPROM's.

- Always remove power to the controller before removing or installing EPROM's.
- Before installing check each EPROM for bent pins.
- Insure that pin orientation is correct, pin 1 toward center of controller.
- After installation clear RAM using diagnostic code 0099. (See Section 8.3.5)
- If there is a problem with the EPROM, the display will read an "E-01" error. This is usually a result of an improperly installed EPROM.

### 7.2.2.5 CHANNEL VOLTAGE

There are eight regulated power supplies on the main control board. The regulators supply power to the module channels. The voltages which can be measured between the power and ground connectors of any channel should be between +20.5 and +19.0 volts with no sensor modules connected to any channel. If the channel voltage is greater than +21 volts that channel should not be used.

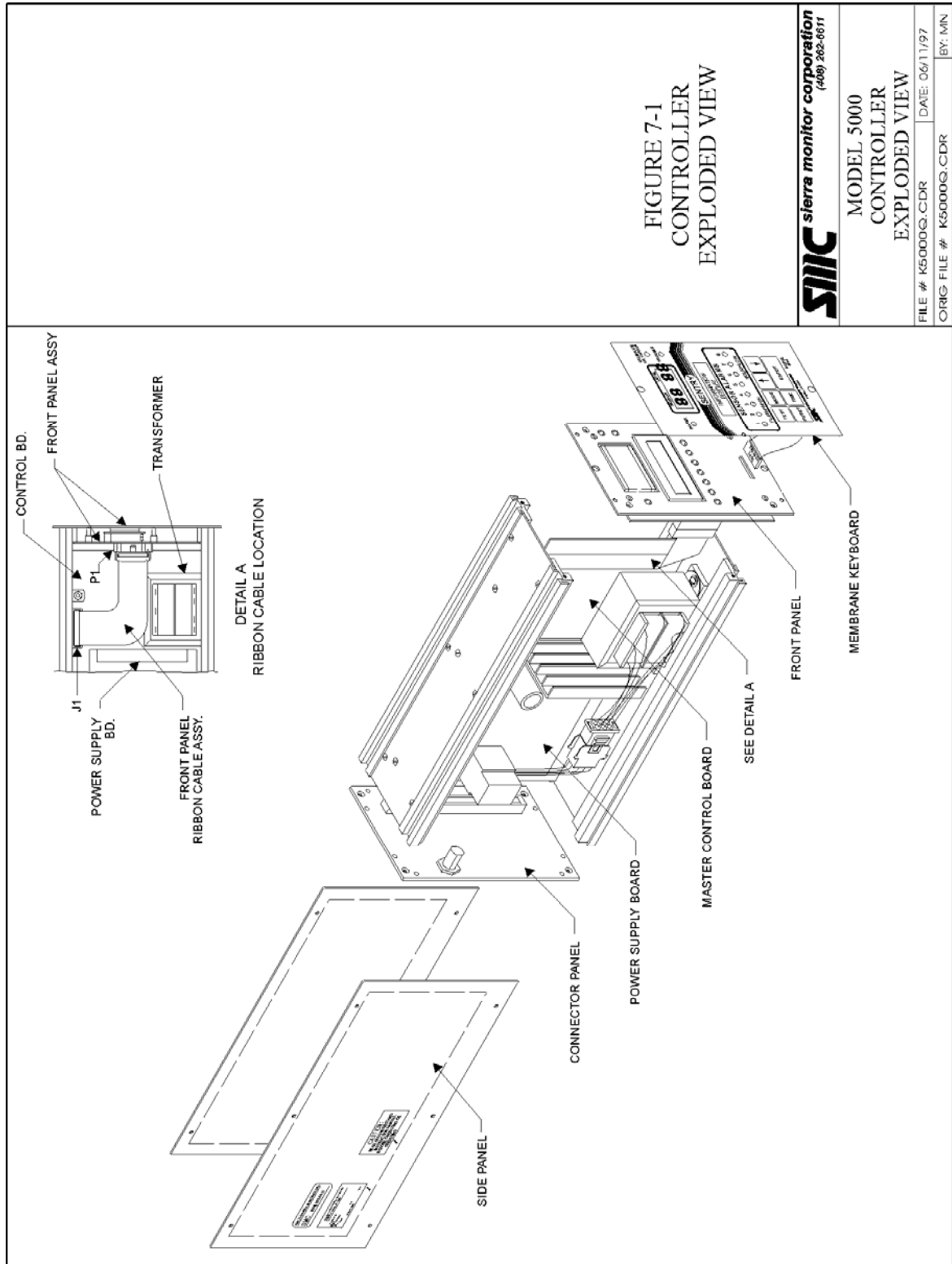
### 7.2.2.6 ALPHANUMERIC DISPLAY ANGLE ADJUSTMENT

The alphanumeric display is the lower display on the front panel. The viewing angle can be altered via the display angle adjustment potentiometer located on the side of the display panel. To access the adjustment slide the left panel back and use a small screwdriver on the only visible potentiometer on the front panel assembly.

### 7.2.2.7 RELAY REPLACEMENT

The three socketed DPDT 3 Amp dry contact relays are on the main control board Figure 7-2. The relay function can be tested using the **TEST ALARMS** function of the controller which causes each relay to throw during the time the respective display is indicated on the front panel.

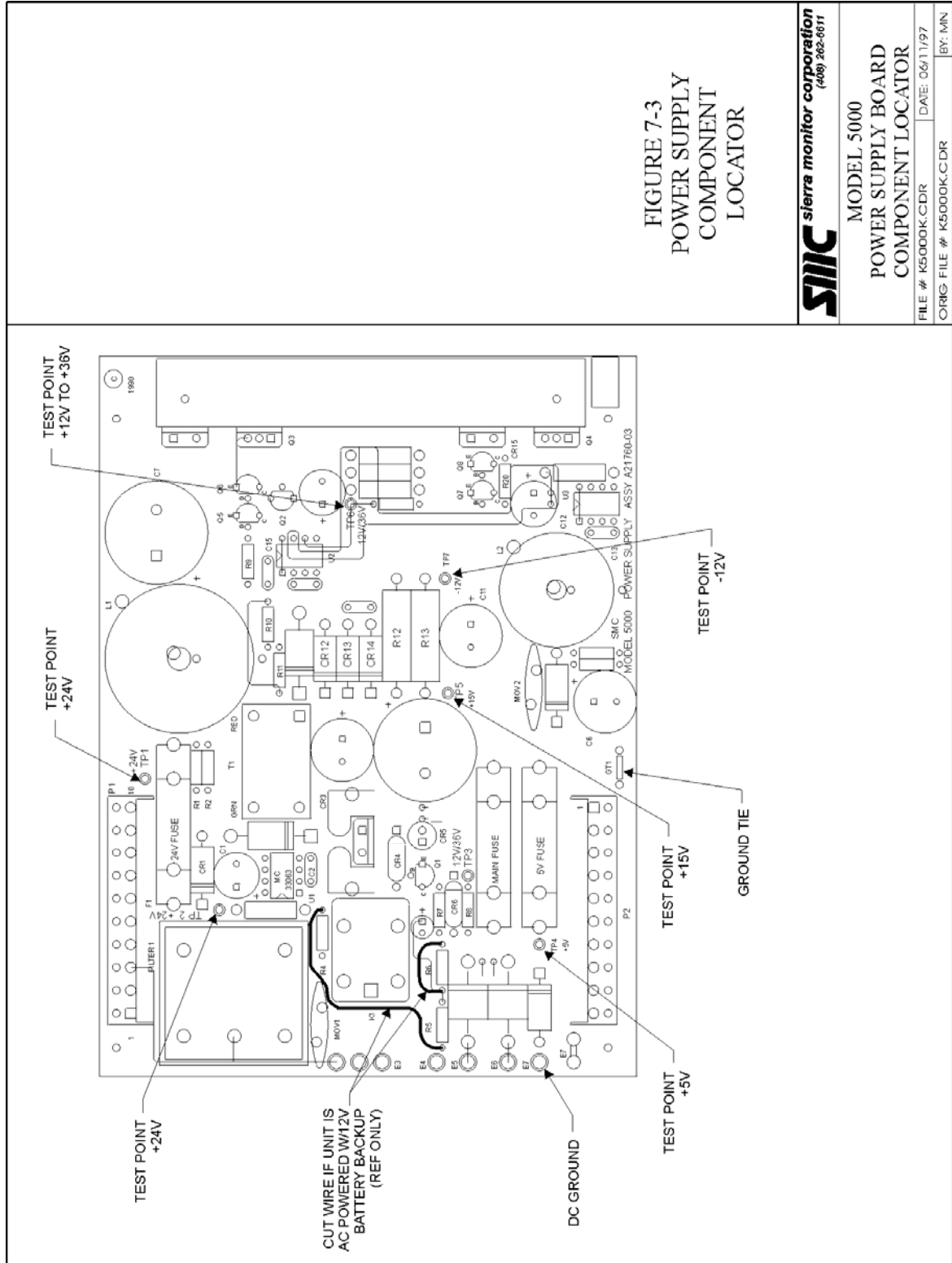
It is important that replacement relays be installed in the same orientation; pin 1 of the relay must line up with pin 1 of the socket.



FORM: MKT-A-H.CDR. REV B

Figure 7-1  
Controller Exploded View





**Figure 7-3  
Power Supply Component Locator**

**7.3 COMMUNICATIONS**

**7.3.1 DESCRIPTION OF COMMUNICATIONS**

The Sentry controller scans each channel in turn taking less than one second to scan all channels. At each channel:

1. A "reset" signal is sent out to clear all module communications.
2. An address (which is a module number) is sent out and the controller waits for a response. The response is a digital frequency which is proportional to the first of eight parameters which are interrogated by the controller.
3. Because the controller received an answer and knows that the particular module is on that channel it continues to interrogate that module to retrieve the remaining seven parameters before moving to the next module number.

The eight (total) signals are:

- Value of Ground.
- Value of sensor signal (relates to gas concentration).
- Heater voltage (Type 1 Module) or Bridge Voltage (Type 2 Module).
- Heater current (Type 1 Module) or Bridge Current (Type 2 Module).
- Sensor type (Type 1 through 4 Modules).
- Calibration switch condition on/off.
- Module voltage (tests line drop from controller to module).
- Reference voltage (used together with ground to ratiometrically compensate for any temperature drift in module components)

The controller interprets the information received during the polling and takes actions as necessary. (Any deviation from normal is rapidly validated to avoid errors due to electrical noise.) The information, combined with continual system diagnostics allows the controller to accurately determine abnormal conditions. Table 7-1 provides a categorized listing of Sentry messages.

SYSTEM ERRORS	MODULE ERRORS	WARNING/STATUS MESSAGES
E-01 (ROM Check Failed)	DISCONNECTED	NO MODULE
E-02 (RAM Check Failed)	CHECK POWER ADJ	MODULE OFF
TIMER FAILURE	MODULE VOLTAGE LOW	WARM-UP WAIT - 00:00
CLOCK FAILURE	SENSOR FAILURE	FACTOR MISSING
	DUPLICATE MODULE	UNCALIBRATED
	CHK BRIDGE VOLTAGE	REPLACE SENSOR
	TYPE ERROR	CALIBRATION OVERDUE
		REPLACE BATTERY
		CALIBRATION SWITCH ON
		DIAGNOSTIC SCAN
		FAST ERROR CHECK
		LOW SENSITIVITY
		NOT CALIBRATED
		CALIBRATION ABORTED

**Table 7-1  
Sentry Error and Diagnostic Messages**

**7.3.2 WARNING AND ERROR MESSAGES**

**7.3.2.1 SYSTEM ERRORS**

If Sentry cannot operate the basic computer functions one of the System Errors listed in Table 7-1 will display.

These failures indicate internal controller problems which are most likely to require board level repairs by the factory.

**7.3.2.2 TROUBLE CONDITIONS**

The following "Trouble Conditions" require operator corrective action.

<b>DISCONNECTED:</b>	The controller is not able to communicate with the module
<b>CHECK POWER ADJ</b>	A hydrogen sulfide sensor heater is not functioning. Current drops to zero or voltage increases to maximum.
<b>MODULE VOLT LOW</b>	The module voltage is too low (<11.5V). This indicates there is an excessive drop in the line from the controller to the module.
<b>SENSOR FAILURE</b>	Sensor signal voltage is out of limits.
<b>DUPLICATE MODULE</b>	A response to one address number has been received on two channels.
<b>CHK BRIDGE VOLTAGE</b>	The bridge voltage on a combustible sensor is out of limits.
<b>TYPE ERROR</b>	The module which responded is a different type than previous response.

When any of these conditions are identified the controller:

- activates the trouble relay and trouble light
- displays an "E --" beside the corresponding module number (i.e.: "1E --")
- describes the error condition on the lower display, and
- logs the error in history memory for later recall via the keyboard or printer.

***NOTE***  
*Trouble conditions logged into memory are erased by the Reset System command. All other erasable History is cleared by the Reset History command.*

All other modules on the channel and modules on other channels remain in full operation and continue to be scanned by the controller. If the problem is corrected, the trouble light and relay will turn off and the module will be brought back on line after a warm-up period.

**7.3.2.3 WARNING AND STATUS**

The warning and status messages are displayed when valid and do not log to history.

**7.3.3 WARM-UP TIMERS**

Three "timers" are used by Sentry to delay bringing the system or parts of the system on-line during a stabilization period. These timers can be cleared via the diagnostic code "0000" described in Appendix C.

- **SYSTEM WARM-UP:** After any loss of power (AC & DC) Sentry will count down a five minute system warm-up. During this period the modules will be under power but will not be displayed, nor will their output be used to determine a gas concentration.
- **MODULE WARM-UP:** Any module which has been disconnected, or has just been "recognized" by the controller will be held in a module warm-up delay for a period of five minutes before being displayed as "on line".
- **CALIBRATION DELAY:** Immediately after calibration each module is held in a calibration delay which is similar to the module warm-up. Although the controller display indicates **CALIBRATION COMPLETE/PLEASE WAIT** if the system is reset, each applicable module will be indicated as **MODULE WARM-UP**.

**7.3.4 ACCESS CODES**

Sentry software allows users to establish user codes which restrict access by unauthorized users to critical parameters or functions. (See Section 8.3).

**7.3.5 DIAGNOSTIC CODES**

Diagnostic codes allow the technician to use the system software to collect diagnostic data for use in system check-out. Diagnostic code assignment is described in Section 8.3.5.

**7.3.6 DIAGNOSTIC REPORT**

A Diagnostic report can be printed using diagnostic codes 0008 or 0010. Figure 7-4 is a typical report..

<b>ID:A 11/20 15:16</b>			
<b>S1= +0.376</b>	<b>BV= +2.021</b>	<b>BI= 0.323</b>	<b>SP= 0653</b>
	<b>ST= +0.284</b>	<b>MV= +19.0</b>	<b>CS= +0.000</b>
<b>S2= +1.20</b>	<b>HV= +0.920</b>	<b>HI= +0.975</b>	<b>SP= 400</b>
	<b>ST= +0.009</b>	<b>MV= +19.4</b>	<b>CS= +0.000</b>
<b>Figure 7-4</b> Typical Diagnostic Report			

Table 7-2 is a description of the information contained in a typical diagnostic report

<b>Report</b>		<b>Description</b>
ID:A		Controller Identification
11/20 15:16		Time report was generated
S1	+0.376	Data that follows is for Module 1 Sensor Signal is +0.376 VDC
BV	+2.021	Bridge Voltage 2.021 VDC
BI	+0.322	Bridge Current 323 mA
SP	0653	Sensor Power 653 mW
ST	+0.284	Sensor Type (Where: .2 -.3 VDC: Combustible)
MV	+19.0	Module Voltage = 19 VDC
CS	+0.000	Calibration Switch Off 0.000, On = 2.5 VDC
S2	+1.20	Data that follows is for Module Sensor Signal is + 1.20 VDC
HV	+0.920	Heater Voltage Signal
HI	+0.975	Heater Current Signal
SP	400	Sensor Power 400 mW
ST	+0.009	Module Type (Where: .11-.1 VDC: H2S)
<b>Table 7-2</b> <b>Diagnostic Report Description</b>		