GENERAL MONITORS

MODEL 580

Dual Channel
Combustible Gas Monitor

INSTRUCTION MANUAL 11/88

Part No. MAN580
Revision 11/88

GENERAL MONITORS

CONTENTS

GENERAL MONITORS

MODEL 580

DUAL CHANNEL COMBUSTIBLE GAS MONITOR

I. INTRODUCTION

A. NOTICE

All information contained in this instruction manual may be used only to install and operate the Model 580 System provided by GENERAL MONITORS, INC. (GMI). The sale of the instrument does not license the user to reproduce GMI drawings, or to utilize any information in this manual without prior written permission.

The Model 580 System is easy to install and operate. However, this manual should be read in full, and the information contained herein understood, before attempting to place the system in service.

B. GENERAL

The Model 580 Dual Channel System is a CSA approved system designed to continuously monitor for potentially explosive concentrations of most combustible gases or vapors at two sensor locations. Normally only a periodic calibration check is needed to assure dependable performance. The system operates in the range 0-100% LEL (Lower Explosive Limit) of a particular gas or vapor. There are relatively few combustible gases which should not be monitored; however, as a precaution GMI should always be consulted to verify the feasibility of monitoring any gas or vapor other than those specified at the time of purchase.

The Model 580 consists of a controller plus two sensor assemblies. The controller is fully solid state. It must be mounted in a weather protected, nonhazardous area. Several GMI mounting accessories are available for panel, wall, or 19 inch rack installation.

Any GMI low temperature catalytic bead combustible gas sensor assembly may be used with the system. Sensor assemblies may be mounted outdoors in hazardous areas (National Electrical Code Class I, Div. 1, Groups B, C, and D). They must be connected to the controller in accordance with the instructions in this manual.

C. SENSOR OPERATING PRINCIPLE

A high efficiency source supplies constant direct current to a Wheatstone Bridge circuit. One leg of the bridge is formed by two bead elements in series, contained within the sensor. These beads are heated by the direct current. The other leg, located on the printed circuit board in the controller, is a resistive divider. With the sensor exposed to clean air, any initial bridge imbalance is

C. SENSOR OPERATING PRINCIPLE (cont.)

trimmed out with a zero pot. When a combustible gas/air mixture diffuses into the sensor, it oxidizes on one of the beads (the "active" bead, which has been catalytically treated). The second (reference) bead, inert to combustible gases, compensates for ambient temperature, humidity, and pressure variations. The oxidation at the active bead causes a temperature increase which produces an electrical resistance change and unbalances the Wheatstone Bridge. The difference in resistance between the two beads is proportional to the concentration of the combustible gas. The signal from the bridge imbalance is amplified at the controller, and is displayed in % LEL on the meter.

II. SYSTEM COMPONENTS

A. SENSOR ASSEMBLIES

Two SENSOR ASSEMBLIES (See Figure 2) are normally supplied with the system. They are comprised of the sensor, P/N 10001-1, plus the sensor housing, P/N 10252. This sensor assembly is CSA approved for Class I, Division 1, Groups B, C, and D hazardous areas. On some occasions a different P/N sensor and/or sensor housing will have been supplied (see Section IX). The appropriate P/N sensor will have been provided if GMI was made aware of the gas or vapor which will be monitored. Most combustible gases may be monitored, including most hydrocarbons, hydrogen, and carbon monoxide.

> **CAUTION**
>
> Sensors have a different sensitivity to each gas. GMI should be consulted if a sensor is expected to detect more than one gas, to recommend the best calibration gas.

A variety of sensor covers may be purchased. They provide extra protection from wind, weather, and dust. See Section X for information to aid in selecting the best sensor cover for various conditions.

In the event the system is to have only one active channel, P/N 10102 dummy sensor should be substituted for one of the sensors. Otherwise the MALF (malfunction) LED indicator for the unused channel will remain lit.

B. THE CONTROLLER

The Model 580 is a dual channel system in which the controller continuously monitors the inputs from the two sensors. The sensors are monitored independently (i.e., they are not scanned, nor are the signals summed). Each channel has its own constant current sensor drive. The controller automatically displays the signal from the higher reading channel on the meter. The meter is linearly scaled from 0-100% LEL.

A green CHANNEL IDENTIFICATION LED is provided for each channel. They are located on the front panel. The Channel I.D. LED of the higher reading channel is illuminated when the controller is in automatic mode. A manual override pushbutton switch, positioned between the two Channel I.D. LED's, allows the operator to check the reading on the second channel at any time.

Both channels share three alarm circuits: MALF (malfunction), LOW (low gas), and HIGH (high gas). The channels also share a malfunction LED indicator (amber), a low alarm LED indicator (amber), and a high alarm LED indicator (red).

B. THE CONTROLLER (cont.)

The alarm set points for the two gas alarm circuits (high and low) are fully adjustable from 0 to 100% LEL. Normally it is recommended that the low alarm be set fairly low (for example, 25% LEL) and that the high alarm be set no higher than 60% LEL. This may vary from one application to another. The alarm set point adjustments are located on the right hand side of the controller (when facing it). Access to the adjustments is gained by sliding the controller slightly forward from its mounting. GMI recommends that a wiring service loop be utilized for connections to the rear panel, to facilitate access to these adjustments.

One alarm relay is provided for each of the three alarm circuits. These relays are common to both channels. Whenever the sensor signal (meter reading) of either channel exceeds the low or the high alarm set point, the alarm relay is activated. The malfunction relay is activated upon certain problem conditions such as low power, power outage, sensor connections being loose at the controller or sensor housing, or severed cable. The low and high alarm relays are DPDT rated 3 amps at 117 VAC, resistive. The malfunction relay is SPDT, 3 amps at 117 VAC, resistive.

CAUTION

Do not utilize an inductive load without reading Section III. F.

The standard Model 580 provides latching operation (requiring manual reset) of the high alarm circuit, and non-latching operation (automatic reset) of the low alarm and malfunction circuits. On special order the Model 580 can be provided with any combination of latching or non-latching low and high alarms. The malfunction alarm is always non-latching. The standard gas alarm relays are normally de-energized (with power applied) but they can be supplied normally energized on special order. The malfunction relay is always normally energized.

The reset button for cancelling latched alarm circuits is located at the bottom of the front panel. The circuits will only reset if the gas concentration has fallen below the set point level.

A green "READY" LED is also provided on the front panel. When illuminated, this indicates that system operation is normal.

On the left hand side of the front panel is a recessed toggle switch having two positions. The "OP" (operating) position is for normal use. In "CAL" position, used for calibration and for setting alarm set points, alarm circuits are bypassed to prevent activation of external equipment, and the "MALF" LED flashes to indicate "out of normal operating condition".

ZERO and SPAN calibration potentiometers for each channel are located behind the front panel. They are accessible from the front panel by using a small screwdriver.

III. INSTALLATION INSTRUCTIONS

A. LOCATION OF THE CONTROLLER

The Model 580 Controller must be installed in a weather protected, non-hazardous area. The following mounting hardware is available to facilitate installation:

49mm (2") panel mount frame	P/N 10201-1
98mm (4") panel mount frame (2 controllers)	P/N 10199-1
483mm (19") rack frame (8 controllers)	P/N 10200-1
Blank panel (one for each unused position in 19" frame)	P/N 10187-1
49mm (2") wall mount bracket	P/N 10195-1
98mm (4") wall mount bracket (2 controllers)	P/N 10202-1

Mounting should be as free from shock and vibration as possible. Caution should be taken not to mount the controller in close proximity to radio transmitters or similar equipment, even though the controller is RFI resistant. Care should be taken to assure adequate ventilation. Do not mount the controller in a manner which will restrict the natural convection air flow from normal ambient air. The controller operating temperature range, including self-heating is -18°C to +66°C (0°F to 150°F).

B. REAR TERMINAL INTERCONNECTIONS

As an aid in wiring and in servicing, the Model 580 controller is supplied with removable plugs for the rear terminations. The plugs are held securely in the header assemblies by a locking ramp (See Figure 1). To complete the interconnection wiring, the external connections should be made to the screw terminations of the plugs. If it is more convenient, the plugs may be removed from the controller by depressing the locking ramp, pulling them straight out and making the external connections to them. The plugs should then be replaced making sure they are seated fully and the locking ramp is locked into its proper position.

> **NOTE**
>
> It is important that a wiring service loop be utilized to ensure access to the alarm set point adjustments and to unplug the controllers from the interconnecting wiring when unnecessary.

C. POWER CONNECTIONS

The system operates on nominal line power of 117 VAC, 50/60Hz or 24 VDC. Power must remain disconnected until all other wiring connections are made. (NOTE: To eliminate accidental system shutdown, GMI does not provide a power on-off switch.)

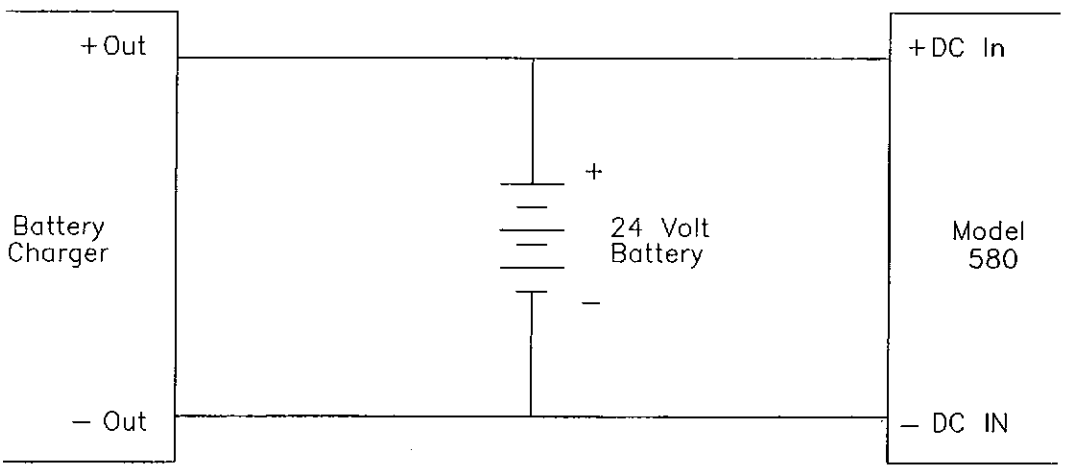
If AC is to power the system, connect the line power supply to the TB-1 terminals LINE, NEUTRAL, and GROUND (L, N, and ⏚) located on the rear of the controller. Refer to Figure 1. Use accepted commercial wiring practices.

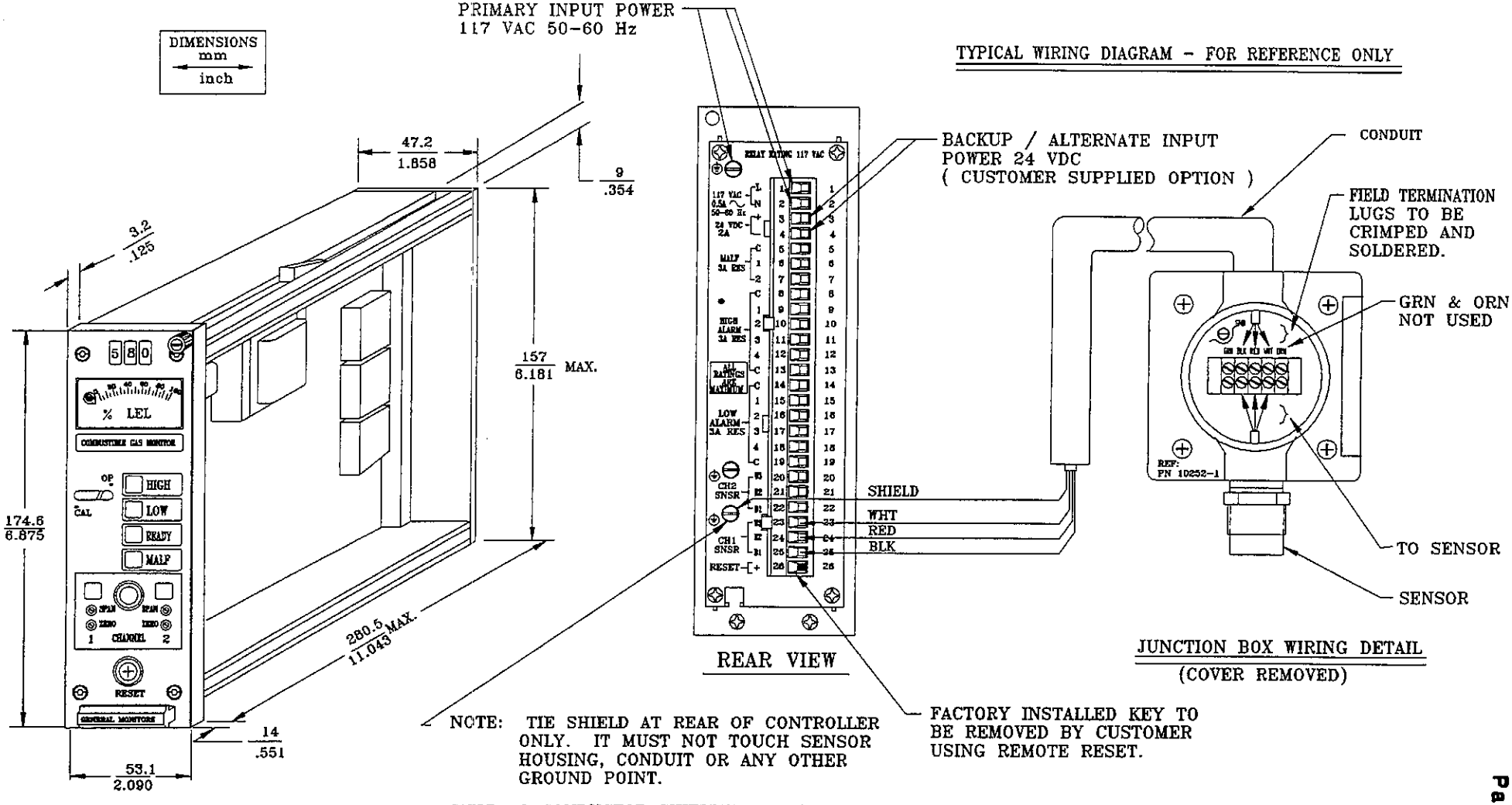
Primary DC power may be utilized instead. Use any 24V nominal direct current supply. No. 14 wire should be used to prevent excessive voltage drop, and the run should be as short as possible. Connect the positive supply to 24 VDC (+) and the negative supply to 24 VDC (-) on the terminal block. An internal diode protects the system in the event of inadvertent supply reversal.

D. BATTERY BACKUP

An emergency battery backup may be employed on a system normally powered by AC. A customer furnished battery may be connected as shown. No manual or relay switching is required. Note that there is no provision for battery charging. A customer furnished battery charger should be used to keep the battery charged to the battery manufacturer's recommended level. The cable length (battery to controller) should be as short as possible. Should an AC power failure occur, the 24 Volt battery supplies current through the diode to the controller circuitry. DO NOT USE MORE THAN A 24 VOLT BATTERY.

The battery rating (ampere-hour capacity) is dictated by the length of time you expect power outages to last. A Model 580 requires approximately 1 ampere (peak) at 24 VDC. General Monitors recommends that a Lead-Acid type battery be used. This type battery can be expected to last for several years with minimum maintenance.





NOTE: TIE SHIELD AT REAR OF CONTROLLER ONLY. IT MUST NOT TOUCH SENSOR HOUSING, CONDUIT OR ANY OTHER GROUND POINT.

CABLE: 3 CONDUCTOR SHIELDED CABLE. DO NOT SPLICE CABLE UNLESS NECESSARY. SPLICES INCLUDING SHIELD MUST BE TIGHT AND SOLDERED (ALL ACTIVE CHANNELS).

FIG. 1

OUTLINE DRAWING AND REAR TERMINAL CONNECTIONS

(REF 20701 H)

E. CHOOSING SENSOR LOCATIONS

Several variables are involved in selecting locations to install sensors to assure the detection of combustible gases. There are no hard and fast rules defining the optimum location. However, the following general suggestions should be considered in regard to particular conditions at the site where a Model 580 is being installed.

(1) Vapor Density

Whether the gas/vapor to be monitored is lighter or heavier than air will affect sensor placement. For lighter-than-air gases, sensors should generally be placed close to the roof or ceiling in indoor installations. For gases much heavier than air, sensors should generally be located near the floor or ground when there is no air currents in the area. Gases with a density equal to air, or slightly greater than air, will tend to rise, particularly when air currents are present.

(2) Air Currents

If there are winds, fans, or other sources of air movement, combustible gases might tend to rise or to accumulate in certain sections of a facility. Local air currents should be studied to aid in selection of sensor locations.

(3) Likely Sources of Gas Emission

In general, at least one sensor should be located in close proximity to each point where a leak of a combustible gas is likely to occur. This is particularly important when a liquid having a low volatility is to be monitored.

(4) Environmental Factors

Avoid installing sensors where they will be unnecessarily exposed to wind, dust, water, shock, or vibration. Observe the temperature range limitations of sensors, covered in the Specification section of this manual.

(5) Catalytic "Poisons"

Sensors will be adversely affected by prolonged exposure to certain materials. Loss of sensitivity (i.e. reduced response to combustible gases), 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 chlorine, fluorine, bromine, or iodine).
- Sulfur compounds such as SO_2, H_2S, CS_2.
- Heavy metals such as tetraethyl lead.
- Silicones (often contained in greases and aerosols). Silicones do not chemically attack the sensor. They instead coat the beads and therefore reduce or stop the oxidation of the combustible gas at the catalytically active bead.
- Acid vapors.
- Caustic liquids or vapors.

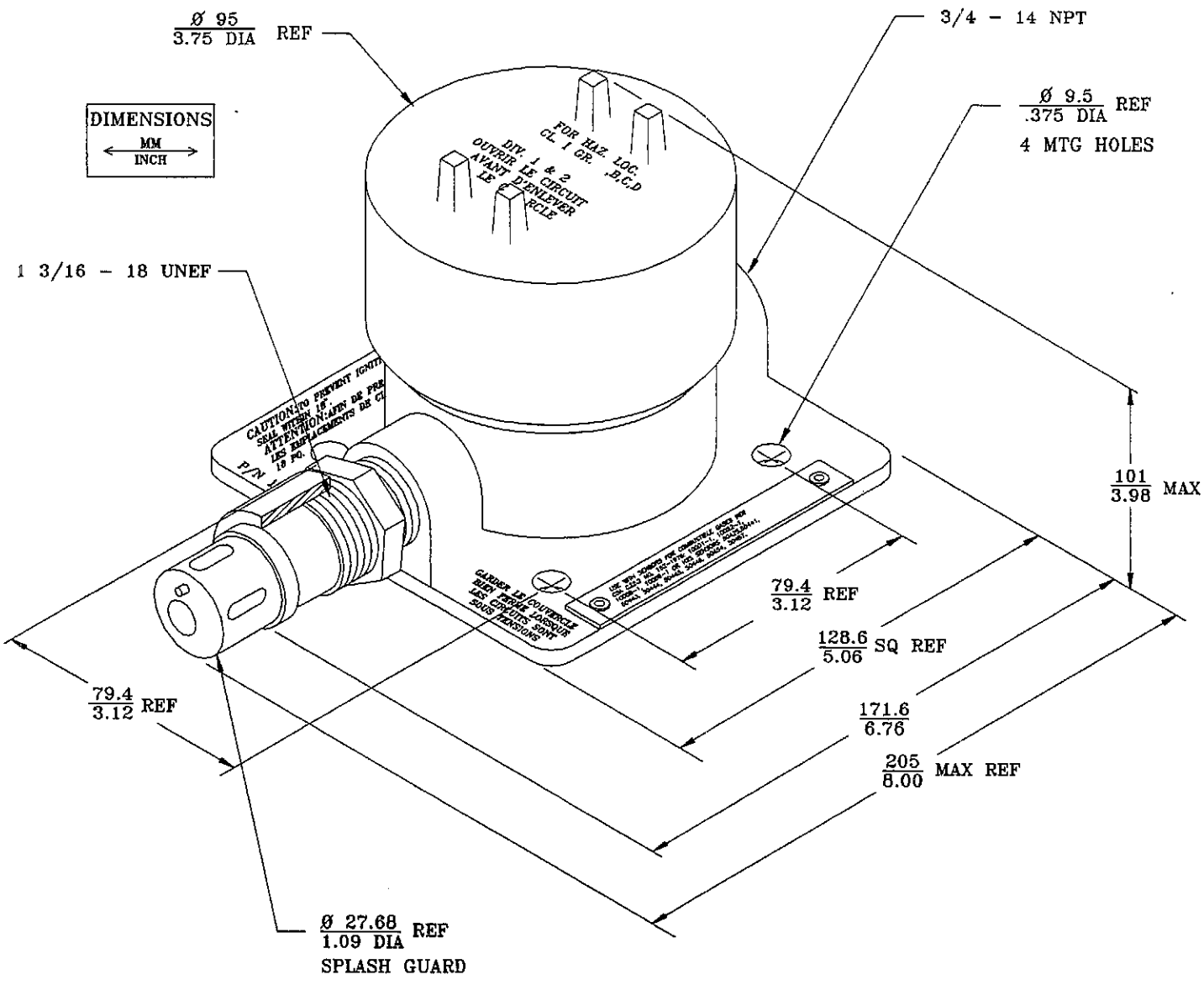
The presence of such materials in an area does not necessarily preclude the use of a catalytic bead sensor. The feasibility of using a sensor in such areas must be determined by an analysis of the specific factors in each application. However, sensors used in such areas usually require calibration checks on a more frequent basis than normal, and typically have a shorter life than normal. In many such applications the normal two year warranty would not apply.

CAUTION

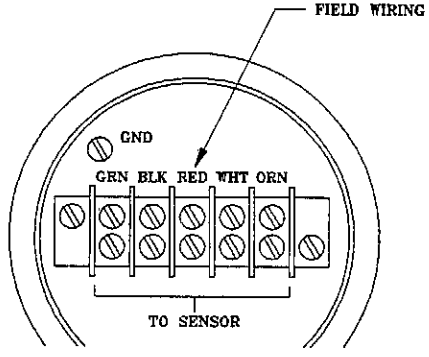
GMI discourages the painting of sensor assemblies for two reasons. First, if the sensor head is painted over, gas will not be able to diffuse into the sensor. Secondly, many paints contain lead compounds which can poison a sensor.

F. SENSOR INSTALLATION

Various types (P/N's) of sensors can be provided with the Model 580. However, the installation method is identical in all cases. See Section IX for further information.



SENSOR GUARDS	
PART NUMBER	DESCRIPTION
1800822	DUST GUARD
10395	SPLASH GUARD
10110	DUST GUARD WITH DISPOSABLE SCREEN



WIRING DETAIL

(COVER REMOVED)

JUNCTION BOX ASSY-
SENSOR

3. JUNCTION BOX ASSY (WITHOUT SENSOR) PN 10252.
2. SENSOR INSTALLATION - LUBRICATE THREADS AND DO NOT USE WRENCH, HAND TIGHTEN ONLY.
1. BEFORE INSTALLING LID, LUBRICATE THREAD STACK.

(REF 10266D)

FIG.2

JUNCTION BOX ASSY-
SENSOR

F. SENSOR INSTALLATION (cont'd)

The SENSOR ASSEMBLY (Figure 2) is used most often. It consists of P/N 10001-1 sensor plus GMI P/N 10252 sensor housing. This assembly is CSA approved for NEC Class I, Division 1, Groups B, C, and D hazardous areas.

Although sensors are interchangeable between channels, it is recommended that each sensor be used with the channel it was matched with at the factory. The controller is tagged with this information.

Each sensor assembly is connected to the controller using 3-conductor stranded cable, and must be installed with conduit in hazardous areas. Total loop resistance excluding the sensor must not exceed 40 ohms. A separate cable is required for each sensor.

GMI recommends the use of shielded cable as a general rule, though in some cases it is not an absolute necessity. Due to the low levels of sensor signal voltages, shielded cable will be required in some installations to guard against extraneous electrical noise. The shield must be enclosed in a suitable insulating outer jacket, and must be grounded only at the rear panel sensor shield ground terminal (see Figure 1). Care must be taken to assure that the shield does not come into contact with the sensor housing or metal conduit.

Avoid running sensor cables close to high power cables, radio transmission lines, or cables subject to pulses of high current.

Sensor cable connections must be crimped and SOLDERED for stable operation. Use only continuous, unjointed cable runs if possible. Improperly spliced cable can result in corrosion, resistance changes and drift.

To connect the cable at the sensor, remove the P/N 10252 housing lid to reveal the terminal strip. The sensor is connected in the housing according to the color designations shown in Figure 2. (The green and orange positions are not used).

Sensor cables are connected at the controller to the terminal blocks located along the bottom of the rear of the controller. The channel numbers (1 and 2) are identified to the left of the terminals. Connections are identified, including ground (for shielded cable). Connect the cable so that the terminal color at the sensor housing matches the terminal color at the controller as follows (see Figure 1):

Wire Color	Terminal Number	
	CH 1 SNSR	CH 2 SNSR
Black	B1	B1
Red	R2	R2
White	W3	W3
Shield	⏚	⏚

F. SENSOR INSTALLATION (cont'd)

Cable runs should not exceed the following distances (maximum loop resistance of 40 ohms).

AWG	FEET	METERS
20	1900	580
18	3000	910
16	4800	1460
14	7600	2320

IMPORTANT: Sensors should always be mounted pointing downward so that water will not accumulate on the sensor head. Mounting should be as free from shock and vibration as possible, and should be convenient for calibration checks in place. The sensor housing must never be opened when power is on, otherwise the explosion-proof integrity of the sensor assembly is violated. The threads on the housing lid must be fully engaged.

IMPORTANT

WHEN IT BECOMES NECESSARY TO REPLACE A SENSOR IN AN OPERATING SYSTEM, SEE NOTE ON PAGE 24.

G. ALARM WIRING CONNECTIONS

The low and high alarm contacts for customer use are DPDT, and are rated 3 amps at 117 VAC, resistive. The malfunction alarm contact is SPDT, 3 amps at 117 VAC, resistive. These contacts are brought out to terminals on the rear of the controller as follows (see Figure 1):

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

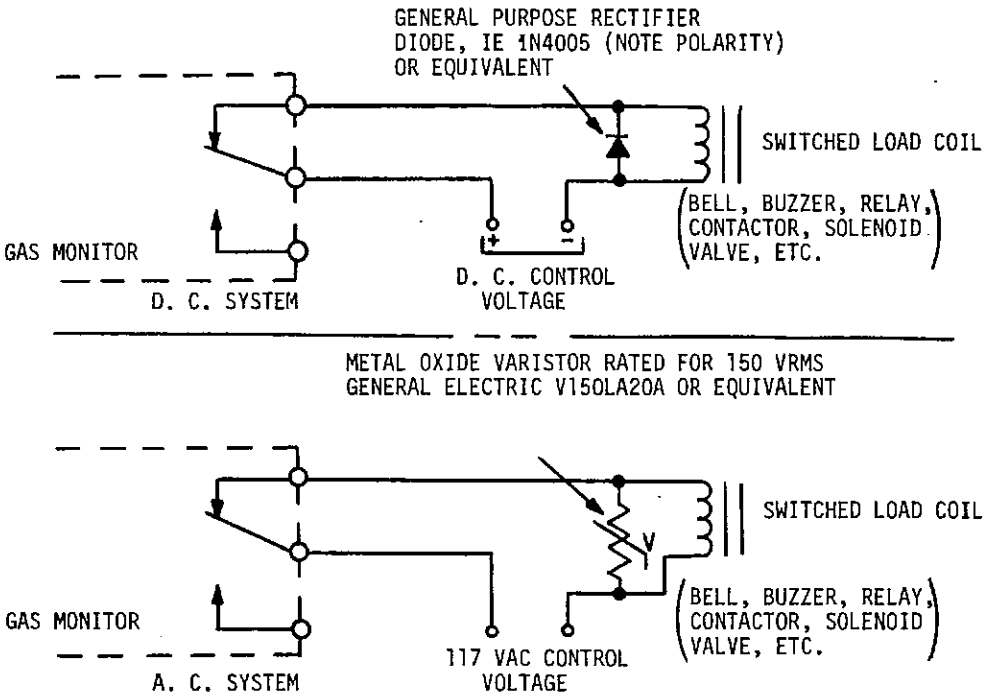
The above chart shows the high and low alarm contacts in the standard de-energized state (with power applied). These two alarm relays are normally de-energized unless specially ordered for normally energized operation. The malfunction relay is always supplied normally energized.

If normally energized, the terminations are:

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

*****CAUTION*****

Inductive loads (bells, buzzers, relays, contactors, solenoid valves, etc.) connected to the high alarm, low alarm, and malfunction 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.



H. REMOTE RESET CONNECTION

Remote Reset (of alarm circuits) connections are made to rear panel Terminal Board connection RESET and the 24VDC (-) terminal. If a remote reset switch is used, it must be a "normally open, momentary action" type.

NOTE

If the system is to be powered from a primary DC power supply or if battery backup is provided, the 24VDC (-) terminal will have two wires when remote reset is used. The diameter of the two wires cannot be larger than a No. 14 wire.

IV. START-UP AND OPERATION

A. INITIAL APPLICATION OF POWER

Before applying power for the first time double-check all wiring components.

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.

When power is first applied, one of the CHANNEL I.D. LED's will illuminate. This indicates that power is on. The % LEL meter may rise during the initial time delay period while the system is stabilizing. During the time delay period the % LEL meter will settle back to zero unless a gas condition exists (zero adjustment may be necessary with initial power application due to variations in wiring). If the amber MALFUNCTION LED lights, there is a defect in the sensing assembly on the channel not showing an illuminated CHANNEL I.D. LED. Check the Trouble-shooting Section of this manual for corrective action. ** NOTE:** A defect in one sensor circuit will not affect the operation of the other channel.

B. CHECKING FACTORY ADJUSTMENTS (15V SUPPLY, CURRENT, AND BIAS ADJUSTMENTS)

Refer to Figures 3 and 5 in back of this manual.

The following adjustments are factory set, and normally do not require adjustment in the field. We do not recommend that they be checked or adjusted unless the system is not operating properly. If they are adjusted, the 15V Supply must be adjusted first. These adjustments must always be followed by re-calibration. A 20,000 ohm/volt meter will be adequate for the measurements. All measurements and adjustments described are made on the right hand side of the controller (when facing it). Slide the controller forward until the appropriate components are exposed.

1. 15V Supply

   Measure the voltage from the bottom of R134 to ground (the - lead of C22 or C23 respectively are the most accessible points). If adjustment is needed, turn R146 until the voltmeter reads 15 ±.025 volts.

B. CHECKING FACTORY ADJUSTMENTS 15V SUPPLY, CURRENT, AND BIAS ADJUSTMENTS (cont'd)

2. Current Adjustment

These adjustments control the constant current to the sensors. For Channel No. 1 connect the voltmeter across R99. If necessary, adjust R108 to 450 ± 1.5 mv. For Channel No. 2, connect the voltmeter across R40 and adjust R43.

3. Bias Adjustment

Both channels have a bias adjustment, which must be adjusted separately. IMPORTANT: Be sure that the channel being adjusted has its Channel I.D. LED on.

For Channel 1, turn the span pot R83 (20 turn pot) fully counterclockwise until it clicks. Adjust the bias pot (R67) until the meter reads zero. For Channel 2, adjust the span pot (R23) and the bias pot (R6) in the same manner. After adjusting the bias on each channel, turn the associated span pot 7 turns clockwise and leave in the position.

Alternately, for Channel 1 the bias may be checked by measuring the voltage between the top of R73 and the bottom of R88, and adjusting the bias pot (R67), if necessary, until 0±5 mv is read on the voltmeter. For Channel 2 measure the voltage from the top of R8 to the bottom of R28 and (if necessary) adjust R9 to 0±5mv.

4. The "meter adjust" pot (R34) should NOT be adjusted unless there is reason to believe someone has tampered with it. To check the "meter adjust", perform the ALTERNATE "bias adjust" check described above and observe the controller's % LEL meter. If it is not at zero, adjust R34 until the % LEL meter reads zero.

NOTE: In summary, do not perform any of the adjustments described above unless the system is not performing normally. Re-calibrate the system once any of the adjustments are performed.

C. ALARM SET POINT ADJUSTMENTS

Alarm set points are electronic, and are set by adjustment of the HIGH and LOW ALARM pots located on the right-hand side of the circuit board. These pots are R91 (HIGH) and R90 (LOW). Each alarm circuit is common to both channels. To change the setpoints, advance the ZERO pot (a front panel adjustment) of either channel until the % LEL meter reads the concentration you wish to use as the LOW setpoint - usually not to exceed about 35% LEL. Then adjust the LOW alarm pot until the amber LOW alarm LED begins to flash. Further advance the ZERO pot until the HIGH setpoint value is reached on the % LEL meter - usually not to exceed about 60% LEL. Then adjust the HIGH alarm pot until the red HIGH alarm LED begins to flash. Turn the ZERO pot counterclockwise until the meter again reads zero.

C. ALARM SET-POINT ADJUSTMENTS (cont'd)

These alarm circuits may be of the latching or non-latching (manual or automatic) reset type, depending upon how the instrument was initially ordered. A reset switch is provided in the lower half of the instrument panel to reset the alarm circuits as required.

Check both set points by moving the meter upscale once again with the ZERO pot and observing the meter reading where the LED's illuminate. When the set points have been checked, re-set the meter to zero with the ZERO pot.

NOTE: Up to 5% hysteresis is normal around alarm set points. This is required to prevent relay chatter. If the relays are latching, the RESET will have to be depressed to deactivate alarm circuits.

D. CALIBRATION

Considering the potential hazard of an explosive level of a combustible gas, General Monitors strongly recommends the period between calibrations should never exceed 90 days.

It is very important that the owner/operator of this equipment determine the correct calibration schedule for their particular environment. Frequently because of environmental contaminants and conditions the frequency of calibration may be substantially shorter than 90 days. This calibration frequency must be determined empirically by following a regular calibration routine and procedure.

A sample calibration schedule and checklist have been provided in the appendix of the manual. Please refer to it in establishing the required calibration program.

Calibration to the specified gas is initially done at the factory. GMI strongly recommends, however, that the Model 580 system be recalibrated upon start-up in order to familiarize the operator with the procedure and verify correct operation of the system. The calibration procedure is as follows:

1. If the gas alarm relays are not to be activated during calibration (since they might be connected to external devices), move the recessed front panel toggle switch to the "CAL" position. The MALF light will flash and the relays will be held in standby. The meter and gas alarm LED's will function normally.

2. Locate the ZERO and SPAN potentiometer screwdriver access openings for each channel on the lower portion of the front panel adjacent to the channel identification LED's.

3. Select one channel to calibrate. Assure that the sensing assembly for that channel is in "clean" air.

4. Adjust the appropriate (20 turn) ZERO pot for that channel until the % LEL meter reads zero, using a small thin-blade screwdriver. Make sure that you are adjusting the proper channel zero setting by observing the channel I.D. LED.

D. CALIBRATION (cont'd)

5. Expose the sensor for the channel being calibrated to calibration gas, using the GMI Portable Purge Calibrator (for methane, hydrogen, etc.), P/N 1400150, or Calibration Chamber, P/N 1400200 (for solvents).

6. Adjust the channel's SPAN pot to bring the % LEL meter to the concentration matching the calibration gas being used. (NOTE: Gas cylinders are normally labeled either in % LEL or % by volume of the gas. Refer to NFPA Standards No. 325M or other authority for conversions if required. For methane, 50% LEL = 2.5% gas by volume; for hydrogen, 50% LEL = 2.0% gas by volume.

7. Remove the calibration gas, allowing the sensor to return to clean air. Allow sufficient time for the meter reading to stabilize. It should stabilize at or near 0% LEL. If a minor adjustment is required to reach zero, the calibration is acceptable. Adjust the meter to zero with the ZERO potentiometer. If a significant adjustment is necessary to return to zero, repeat the entire calibration procedure. If the same result is observed, perform the checks described in Section IV.B. (NOTE: The bias is the most likely problem.)

8. Repeat the previous steps (1-7) for the other channel.

E. CHECK POINTS FOR CALIBRATION AND OPERATION

(1) Frequency of Calibration

As a rule of thumb GMI recommends that the calibration be checked on each sensor at least every 90 days. If a sensor is installed where it may be subjected to splashing water, mud or dirt accumulation, or adverse gases as described in Section III D.(5), more frequent calibration is recommended. The exact frequency can vary with the severity of conditions and must be established in the field.

(2) Observations During Calibration

(a) A negative movement of the % LEL meter when the sensor is exposed to calibration gas indicates that the white and black leads of the sensor cable are reversed.

E. CHECK POINTS FOR CALIBRATION AND OPERATION (cont'd)

(b) The SPAN potentiometer is a 20-turn pot. The number of clockwise turns required to obtain the correct meter reading during calibration varies from one gas to another. For a particular gas at a specific concentration, a steady increase over a short period of time in the number of turns required to obtain the correct meter reading indicates that the sensor is losing sensitivity and/or has been contaminated. Operators should periodically check how many turns remain in the span pot. GMI highly recommends replacing the sensor while a few turns still remain, since it is probably approaching the end of its useful life.

See Section V for additional important information.

(3) Background of Combustible Gases

In some applications there will be an occasional or continuous presence of "background" combustible gases. Generally this will be a very small % LEL. Usually it is advisable to zero out the background gas concentration during calibration. To do so, isolate the sensor from the surrounding air using a plastic bag (or by placing your hand tightly over the sensor). Observe the reading on the % LEL meter. A gradual drop in reading indicates the presence of a background of combustible gases. With the bag in place, set the meter to read 0% LEL using the zero potentiometer. Remove the bag and proceed with normal calibration.

(4) CAUTION - Extended Exposure to Combustible Gases

Extended exposure of a sensor to a high concentration of combustible gases can introduce stress in the sensing element which may seriously affect performance. Re-calibration should therefore be performed after an alarm due to a high concentration of gas, and the sensor should be replaced if necessary. A meter reading of 100% LEL, or high offscale, may mean an explosive concentration of gas is present.

NOTE: The foregoing warning is applicable to all catalytic bead sensors, regardless of manufacturer.

V. SYSTEM PROBLEMS AND TROUBLE-SHOOTING

A. GENERAL

It is highly recommended that a spare sensor be on hand at all times. While GMI sensors are the most reliable, longest life catalytic bead sensors available, sensor failure tends to be the largest potential cause of real downtime. A full complement of other GMI recommended spare parts should also be on hand. GMI's warranty will be voided if damage results from repair efforts involving replacement of PC boards or their components, or other system components other than routine replacement of recommended spare parts. It is recommended that defective controllers be returned to the factory for repair even if the warranty has expired.

B. MAINTENANCE

Once installed, the Model 580 system requires little or no routine maintenance other than periodic calibration checks. GMI recommends that a calibration schedule be established and adhered to. GMI also recommends that a log book be kept showing calibration dates and dates of sensor replacement.

The removal of particulate matter from accessory sensor covers may be facilitated by the use of an appropriate halogen-free solvent. Water or ethanol are examples of suitable solvents. The sensor cover should be thoroughly dried with compressed air if necessary, before refitting to the sensor body. A calibration check should be made after the cleaned cover has been re-installed because the cleaning process may increase response due to removal of dirt, etc.

IMPORTANT

SEE NOTE ON PAGE 24 FOR SENSOR REPLACEMENT

C. TROUBLE-SHOOTING 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.

V. MODEL 580 TROUBLE-SHOOTING

INTRODUCTION:

This section is intended to be a guide in correcting problems which 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.

Be sure to place instrument in CAL mode or disconnect external alarm wiring before making any check which might send the unit into alarm, if an alarm condition will create problems.

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.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Neither channel indicator LED lights after application of power (AC or DC).	1. No input power. 2. .5 amp AC fuse (F1) is defective. 3. 2 amp DC fuse (F2) is defective.	1. Insure proper power supply to controller. 2. Replace F1. 3. Replace F2.
2. The controller does not "time out" within 45 seconds after application of power. MALF LED is flashing.	1. Low input power. 2. OP-CAL switch is in "CAL" Mode.	1. Insure proper power supply to controller. 2. Place switch in OP position.
3. Controller is in malfunction mode (MALF LED is flashing).	1. Low ZERO adjust. 2. Terminal(s) loose on sensor cable at sensor housing or controller. 3. Controller current drive section not operating properly. 4. Cable is open. 5. Sensor is defective. 6. Low input power.	1. Re-zero. 2. Tighten all terminals. 3. Return to factory for repair. 4. Replace cable. 5. Replace sensor. 6. Check input power.
4. LOW and/or HIGH alarm LED's do not turn "on" when LEL Meter reads above alarm set point.	1. Alarm circuits are not operating. 2. LED defective.	1. Contact General Monitors and/or return the controller for repair if the problem cannot be resolved with available test equipment and personnel. 2. Replace LED.

VI. SPECIAL WARNING

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

(1) GENERAL MONITORS recommends a calibration check on a regular schedule. The calibration check should be conducted at least every ninety (90) days. This is the only method of insuring proper system operation and response to combustible gases. More frequent calibration checks are encouraged to spot 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 are at variance (see CALIBRATION section of this manual).

(2) GENERAL MONITORS cautions, as with all equipment of this type, that high levels or long exposure to certain atmospheres will "poison" the sensor catalyst and eventually affect sensitivity. See Section III D. (5) for specific information. Use in such atmospheres requires calibration checks on a more frequent schedule than normal. General Monitors should be consulted for application feasibility determination before installing a system in such atmospheres.

(3) 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 on. Sensor housing must be installed in accordance with National Electrical Code acceptable practices for the class of hazardous atmosphere.

(4) Sensors are designed with sintered metal or screen covers which act as flame arrestors. Do not operate sensors without screen or sintered metal parts in place.

(5) 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 will provide continuous monitoring of hazardous areas. The user must assume all liability for misuse of GENERAL MONITORS' gas detection systems.

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

GENERAL MONITORS

VII. WARRANTY

GMI warrants all of its products to be free from defects in workmanship or material under normal use and service within two (2) years (Gas Detection) and (1) year (Flame Detection) from date of shipment. GMI will repair or replace without charge any equipment found to be defective during the warranty period. Final determination of the nature and responsibility for defective or damaged equipment will be made by GMI personnel. Gas detection elements which have been poisoned by contaminants are not included in this warranty. In all cases this warranty is limited to the cost of the equipment. All warranties hereunder are contingent upon proper use in the application for which the product was intended and do not cover products which have been modified or repaired without GMI 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. GMI's responsibility under the above warranty shall be limited to the repair or replacement at GMI's option at no cost to the purchaser for parts or labor, of any component which fails during the warranty period provided that the purchaser has promptly reported such failure to GMI in writing and GMI, upon inspection, found such component to be defective. The purchaser must obtain shipping instructions for the return of any item under this warranty provision and compliance with such instruction shall be a condition of this warranty.

EXCEPT FOR THE EXPRESS WARRANTY STATED ABOVE, GMI DISCLAIMS ALL WARRANTIES WITH REGARD TO THE PRODUCTS SOLD HEREUNDER 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 GMI FOR DAMAGES INCLUDING, BUT NOT LIMITED TO CONSEQUENTIAL DAMAGES ARISING OUT OF/OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THE PRODUCT.

GENERAL MONITORS

Appendix. GENERAL SPECIFICATIONS

CONTROLLER

Dimensions:	Approx. 53mm x 175mm x 294mm (2.1"W x 6.9"H x 11.5"D)
Weight:	Approx. 1.8kg (3.8 lb.)
Mounting Configurations:	Rack, panel, wall, weatherproof enclosure
Temperature Range:	-18°C to +66°C (0°F to 150°F)
Power:	105-130 VAC/50-60 Hz 205-255 VAC/50-60 Hz 22-30 VDC. 7 watts nominal (117VAC)
Meter Readout:	Range 0-100% Lower Explosive Limit (% LEL)
Repeatability:	±2% full scale
Linearity:	±5% full scale
Alarm Circuits:	Independent HIGH, LOW, and MALFunction circuits common to both channels. HIGH and LOW DPDT 3 Amp relays @ 117 VAC, resistive. MALFunction relay SPDT, 3 Amps @ 117 VAC, resistive. MALFunction relay is normally energized, non-latching. HIGH (latching) and LOW (non-latching) alarm relays are normally de-energized. All above specifications are standard. Options are available.
Status Indicators:	Flashing amber for LOW alarm; flashing red for HIGH alarm; green for READY (power on-after time delay ends); flashing amber for MALFunction; green Channel I.D. LED for each channel.
Output Signal:	None
Electrical Classification:	General purpose (non-hazardous, indoors)
Warranty:	Two years

SENSOR

Type:	Diffusion, low temperature catalytic bead Standard Industrial Types: Combustible Gas; Solvent Special; High Temperature Combustible Gas; High Temperature Solvent Special.
Temperature Range:	-55°C to +93°C (-65°F to +200°F) standard; high temperature special to 200°C (400°F).
Response Time:	Typically 6 second time constant when exposed to 50% LEL of Methane gas.
Zero Drift:	Less than 5% per year
Typical Life:	3 years in normal service
Electrical Classification:	NEC Class I, Division 1, Groups B, C, and D
Warranty:	Two years
Cable:	3 wire maximum cable length allowable between controller and sensor assembly with one way resistance of 20 ohms (total 40 ohms loop):

AWG	METERS	FEET
20	580	1900
18	910	3000
16	1460	4800
14	2320	7600

GENERAL MONITORS

A. SENSORS

The following is a list of GMI sensors available for use with the Model 580 System:

P/N	
10001-1	Standard Industrial Combustible Gas Sensor. Used for most hydrocarbons and hydrogen. Temperature range -55°C to 93°C (-65°F to +200°F).
10001-1R	Same as P/N 10001-1 except greatly improved resistance to poisons such as HMDS (Hexamethyldisiloxane) and H_2S.
10014-1	High Temperature Standard Industrial Combustible Gas Sensor. Same as P/N 10001-1 except it may be used at temperatures up to 200°C (400°F).
10058-1	Same as P/N 10001-1 except sensor body is stainless steel.
10058-1R	Same as P/N 10058-1 except greatly improved resistance to poisons such as HMDS (Hexamethyldisiloxane) and H_2S.
10022-1	Similar to P/N 10001-1 except PTB approved.
10059-1	Same as P/N 10022-1 except body is constructed of stainless steel.
10015-1	High temperature equivalent of P/N 10022-1. It may be used in temperatures up to 200°C (400°F).

P/N 10001-1, 10058-1, 10022-1, and 10059-1 sensors are CSA C22.2 No. 152-1976 certified.

P/N 10252 sensor housing is normally used in the Western Hemisphere. Special PTB approved housings are normally used in Europe.

NOTE: SENSOR REPLACEMENT

When it becomes necessary to replace a sensor in an operating system, the following precautions must be taken.

1) If possible, the area should be declassified and power removed from the Model 580 controller.

2) If power cannot be removed from the controller, a temporary jumper should be placed between the terminals of the black and white leads in the sensor housing until the new sensor leads are securely tightened. Then remove the jumper before replacing the sensor housing cover.

If this procedure is not followed there is a strong possibility that the new sensor will be burned out during its installation.

B. ACCESSORIES

1. CALIBRATION EQUIPMENT

Calibration accessories may be purchased from GMI. Contact the factory or your local representative for technical or ordering information.

The P/N 1400200 Portable Calibration Chamber is used to calibrate sensors for any specific combustible vapor which has a flash point below ambient temperature. The customer must provide his own sample of the liquid to use with the chamber. GMI provides a microliter syringe for exact measurement of volumes to be used. Instructions for use are provided with the chamber.

GMI P/N 1400150 portable purge calibrators are available for several common gases, including hydrogen, methane, ethane, propane and butane. The portable purge calibrator is a ready-for-use assembly including a lecture bottle containing approximately 50% LEL of the gas ordered, plus regulator and an adaptor which fits over the sensor. Replacement cylinders are also available.

2. SENSOR COVERS

The information below is of a general nature. GMI or your local representative should be contacted for specific recommendations.

NOTE: If sensor covers are used they should remain in place during calibration. If they are going to be cleaned, the sensor should be recalibrated after the sensor cover is re-installed. Although several of the available covers do not effect sensitivity or response time themselves, accumulations of dust, dirt, water, etc., may do so.

(a) Dust Guard Assembly (P/N 10110)

The dust guard assembly is a simple, threaded stainless steel (type 303) cylinder with a disposable wire screen at one end. It is easily unscrewed for cleaning and/or replacement of the screen. The screen material is stainless steel (type 316) with a nominal 40 micron mesh. This accessory is specially designed to prevent dust and particulate matter from reaching the sensor flame arrestor. Such debris can plug the screen and limit the amount of gas reaching the active surface of the sensor. When the dust guard is installed, this problem is minimized and sensor response is virtually unchanged. The dust guard is also available in a kit (P/N 10044) with twelve replaceable screens. It can be used as an effective windscreen, and is recommended for corrosive, windy or high temperature environments. A typical application would be in the area surrounding a drying oven.

2. SENSOR COVERS (Cont'd.)

(b) Porex Dust Cover (P/N 10071)

This cover is a disposable porous plastic dust guard which eliminates the problem of fine particles plugging the sensor flame arrestor. The material used is high density polyethylene with a 250 micron mesh. It consists of a cylindrical barrel with one end closed, which screws in place on the sensor body. Due to the small pore size which restricts the gas diffusion path, porex dust covers may depress sensor response by as much as 40% and increase response time by a few seconds. Because of this, the sensor must never be calibrated with the porex dust cover off. The porex dust cover is inexpensive and therefore may be considered a disposable item, although it may be cleaned and re-used several times. It is recommended for extremely dusty or windy environments, but should not be used for applications in which it will be exposed to temperatures in excess of 80°C (180°F).

(c) Sintered Stainless Steel Dust Guard (P/N 1800822)

The construction of this accessory is similar to P/N 10110 above, but it has a 3mm (1/8") thick sintered stainless steel disc at one end. The body material is stainless steel. It has an internal thread for installation on the sensor body. This dust guard provides protection from fine particulates and windy environments. It should be used only in dry locations because of the tendency of the sintered disc to absorb water, which would then act as a gas diffusion barrier until the disc dried out again. This dust guard reduces sensor response, so it must never be removed for calibration.

(d) Splash Guard (P/N 10117)

The Splash Guard is a rugged ABS plastic cylinder which screws into place over the sensor body. It contains a series of internal baffles which are designed to deflect water away from the sensor flame arrestor. A stainless steel mesh may be inserted into the open end of the Splash Guard. The Splash Guard is recommended for areas where heavy rain or frequent equipment hosedowns occur.

(e) Sensor Flow Chamber (P/N 10066)

The General Monitors' Sensor Flow Chamber is constructed of aluminum (optional stainless steel construction available). The chamber has an internal thread into which a sensor may be screwed, and two threaded ports which accept 1/4 inch tube fittings. The chamber is designed for insertion into a sampling system.

GENERAL MONITORS

3. SAMPLE CALIBRATION SCHEDULE AND CHECKLIST

Sensor Serial Number _____ Location _____

a) Installation and Preliminary Calibration (Record date after preliminary calibration in done) Date: _____

b) 24 hour calibraton (Record date after 24 hour calibration is done) Date: _____

c) 7 day calibration check (Record date and reading of calibration check. Repeat after 7 days if reading deviates more than +/- 10%, otherwise go to step 4.)

Date/Reading		Date/Reading		Date/Reading	
____	____	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____

d) 14 day calibration check (Record date and reading of calibration check. Repeat after 14 days if reading deviates more than +/- 10%, otherwise go to step 5.)

____	____	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____

e) 1 month calibration check (Record date and reading of calibration check. Repeat after 1 month if reading deviates more than +/- 10%, otherwise go to step 6.)

____	____	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____

f) 2 months calibration check (Record date and reading of calibration check. Repeat after 2 months if reading deviates more than +/- 10%, otherwise go to step 7.)

____	____	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____

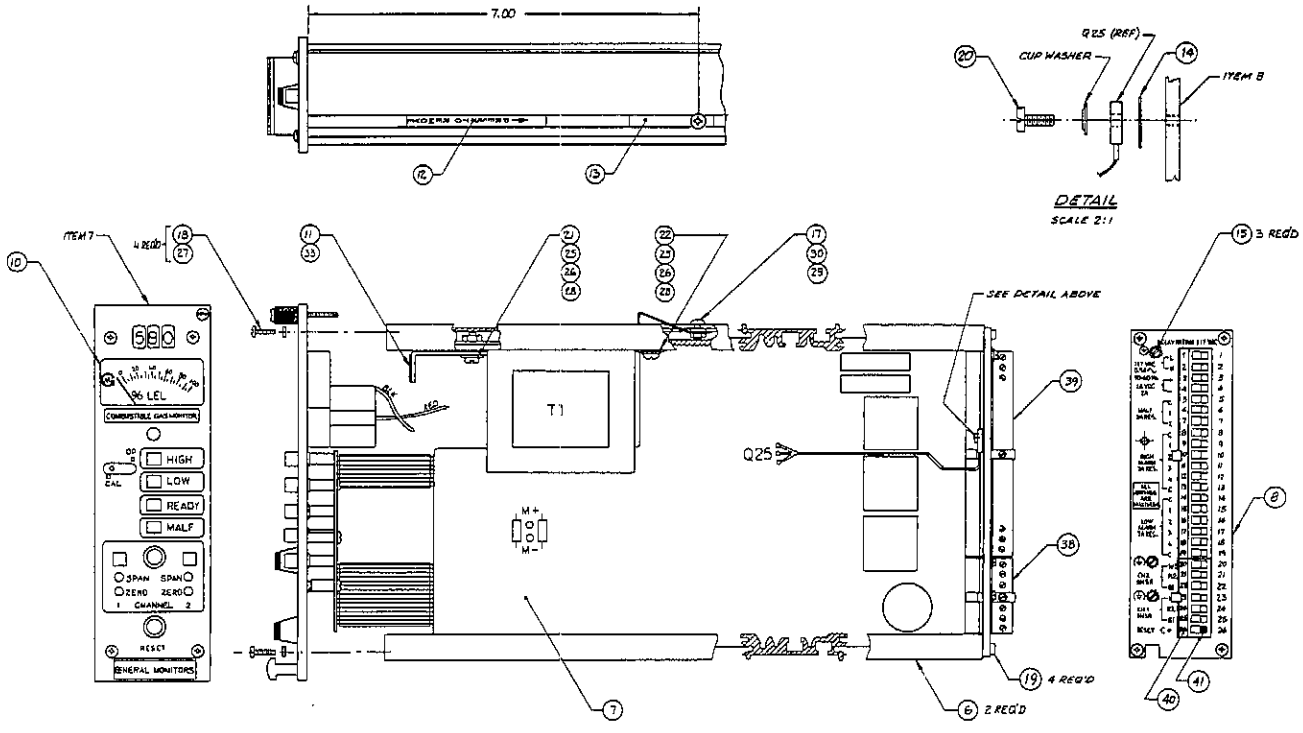
g) 90 day calibration check

D. RECOMMENDED SPARE PARTS

One Model 580

For up to Two Years Operation

ITEM	DESCRIPTION	PART NUMBER	QTY.
1	LENS - Amber	939-048	1
2	LENS - Red	939-049	1
3	LENS - Green	939-047	1
4	FUSE, .5 amp, 110 VAC	951-200	2
5	FUSE, 2 amps, 110 VAC	951-015	2
6	Sensor	Per original order	1



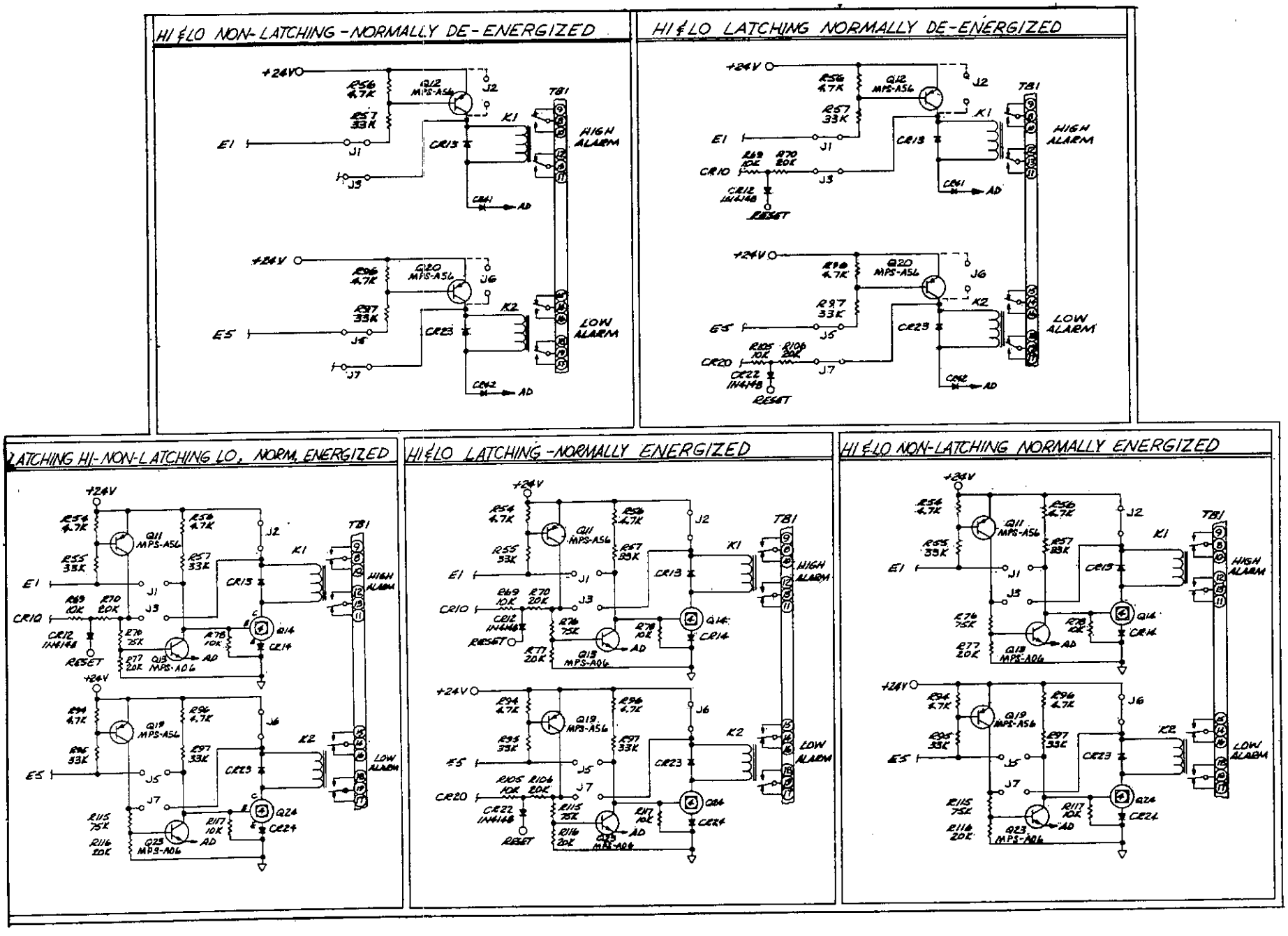
			43
			42
1		TIE WRAP, .10 WIDE (MODIFIED)	41
1	10381-1	MARKER STRIP, 1-26 (MODIFIED)	40
1	921-366	TERM BLOCK, PLUG 19-POS	39
1	921-364	TERM BLOCK, PLUG 7-POS	38
QTY	PART NO.	DESCRIPTION	ITEM

INFO	20703	OPTION TABULATION	37
INFO	20702	SCHEMATIC DIAGRAM - CONTROL ELECTRONICS	36
INFO	20701	OUTLINE DRAWING & REAR TERMINAL CONNECTIONS	35
INFO	10342	INSTRUCTION DRAWING, METER REPLACEMENT	34
AR	832-013	TAPE, FOAM, ⅛ THICK	33
			32
			31
1		WASHER, LOCK INT. TOOTH NO. 6 STL-CAD	30
1		NUT, HEX NO. 6 STL - CAD	29
2	DIN 934	NUT, HEX M4 STL - CAD	28
4	DIN 125	WASHER, FLAT M3 FIBER, BLK	27
2	DIN 6797	WASHER, LOCK M4 INT TOOTH STL - CAD	26
2	DIN 125	WASHER, FLAT M4 STL-CAD	25
			24
			23
1	DIN 7985	SCREW, MACH M4x8 P-SST-PHIL	22
1	DIN 7985	SCREW, MACH M4x10 P-SST-PHIL	21
1		SCREW, MACH #4-40x¼ PAN-NY-SLOT	20
4		SCREW, SELF TAP 4x½ P-STL-PHIL-ZN	19
4		SCREW, SELF TAP 4x½ P-STL-PHIL, BLK OXIDE	18
1		SCREW, MACH 6-32x¼ P-SST-PHIL	17
1	DIN 7985	SCREW, MACH - M3 x 12 PAN-SST-PHIL	16
3	928-315	SCREW, GUILLOTINE #6-32x⅜	15
1	931-001	INSULATOR, SIL-PAD	14
1	10165-1	SAFETY LATCH, RACK MOUNTING, CONTR. INSTR.	13
1	10166-1	LABEL, SAFETY LATCH, RACK MOUNTING	12
1	10182	BRACKET, METER	11
1	10310-1	METER, PANEL - 100% LEL	10
			9
(1) 1	20723-1	PANEL, REAR - SILKSCREENED	8
1	20713	INTERFACE ASSY	7
2	10179	PLATE, MOUNTING - 49	6
			5
(1) 1	20716	TRANSFORMER, POWER - 115 VAC T1	4
			3
			2
—	-1	FINAL ASSY, COMBUSTIBLE GAS MONITOR-DUAL CHAN.	1
QTY	PART NO.	DESCRIPTION	ITEM

FINAL ASSEMBLY
COMBUSTIBLE GAS MONITOR
DUAL CHANNEL MODEL 580

FIG. 3

(REF 20700)



SCHEMATIC DIAGRAM,
CONTROL ELECTRONICS & POWER SUPPLY

FIG. 4 SHT 2

(REF 20702 L)

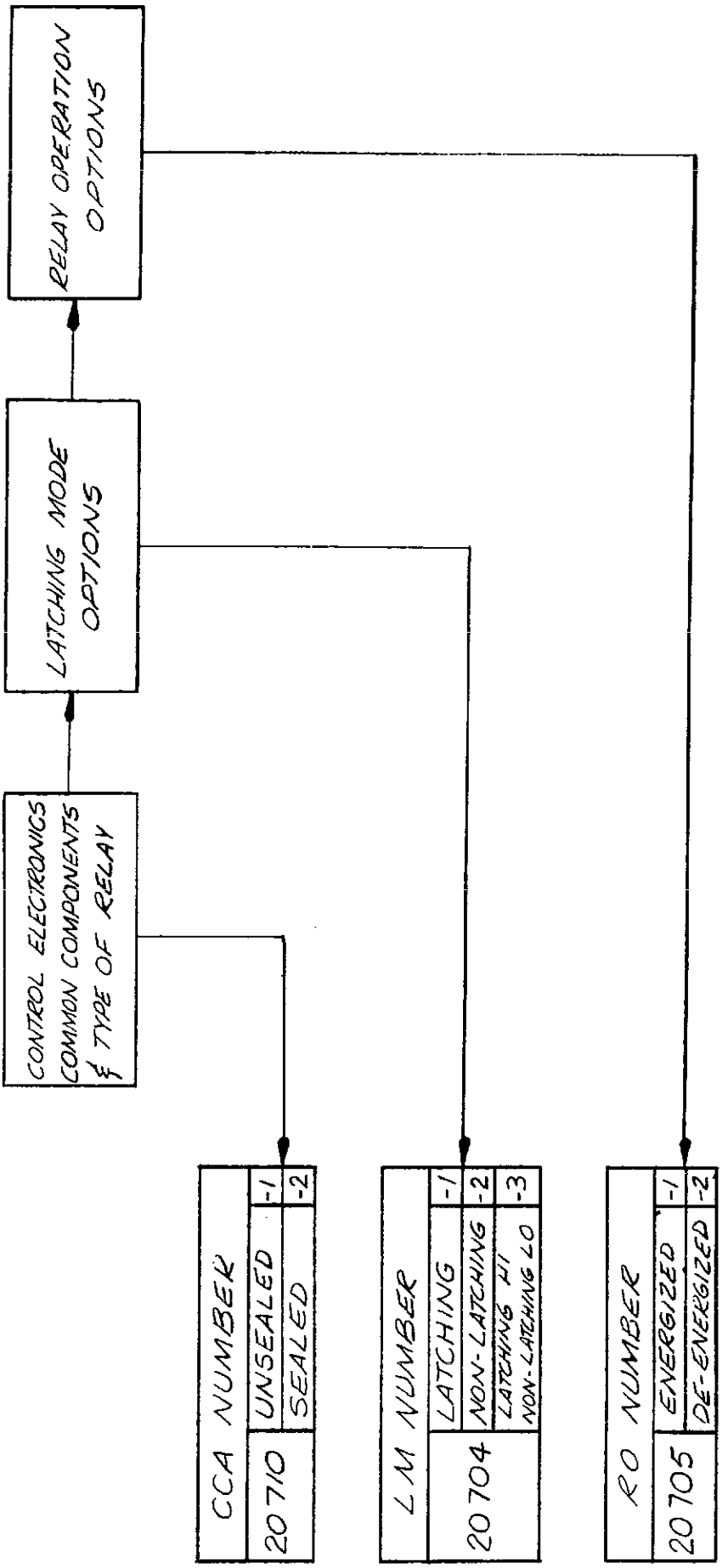
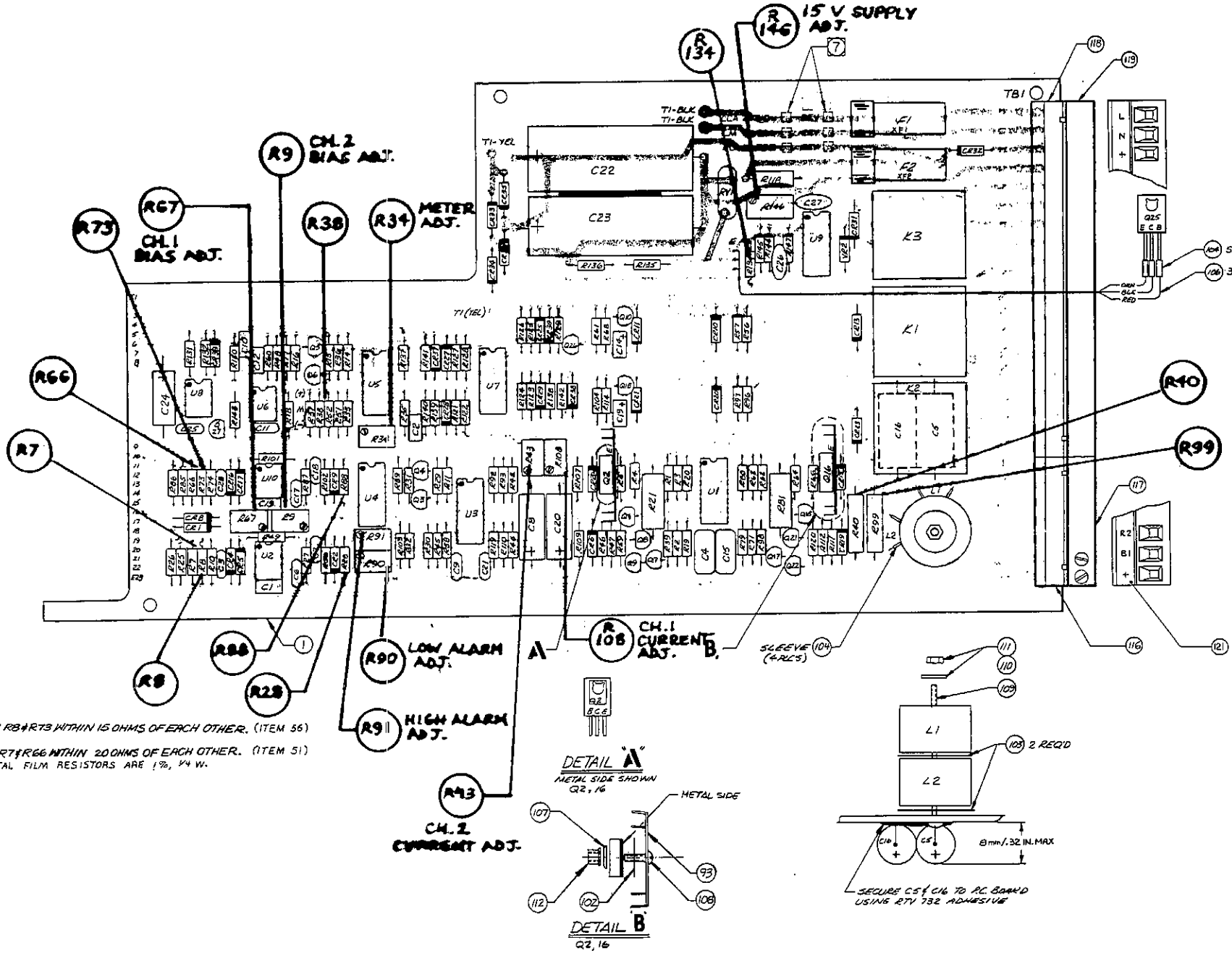


FIG.5

OPTION TABULATION, CONTROL ELECTRONICS

(REF 20 703 A)



(REF 20 710K)

FIG. 6
SHT 1

CCA, CONTROL ELECTRONICS COMMON COMPONENTS

QTY-2	QTY-1	PART NO	DESCRIPTION		ITEM
					121
1	1	921-415	MARKER STRIP, TERMINAL, 26 POS, 580		120
1	1	921-366	TERMINAL BLOCK, PLUG 19 POS.	TB1	119
1	1	921-367	TERMINAL BLOCK, HEADER 19 POS.	XTB1	118
1	1	921-364	TERMINAL BLOCK, PLUG 7 POS	TB1	117
1	1	921-365	TERMINAL BLOCK, HEADER 7 POS	XTB1	116
					115
					114
A/R	A/R		WIRE, BUS - 22 AWG		113
2	2	DIN 985	NUT, LOCK, M3 ST NY INSERT		112
1	1		NUT, HEX M3 x 0.5/"L-32 NYLON		111
1	1		WASHER, FLAT M3/25 3/16 4 NYLON		110
1	1		SCREW, MACH, M3 x 0.5 x 35mm/M 6-32 x 1.37 Min-SLT-NY		109
2	2	DIN 7985	SCREW, MACH M3X 10 PHIL-PAN HD-SST		108
2	2		WASHER, CUP		107
3	3		WIRE, PVC INS. 22 AWG (102 mm/4.0 IN. LONG)		106
					105
A/R	A/R		TEFLON SLEEVING		104
2	2	931-040	INSULATOR PAD		103

QTY-2	QTY-1	PART NO.	DESCRIPTION	REMARKS	ITEM
2	2	931-001	INSULATOR SIL PAD		102
					101
1	1	948-237	TRANSISTOR 2N5191	Q25	100
6	6	948-226	UZT4306	Q7,10,17,18,26,27	99
6	6	948-243	MPS-A06	Q3,4,8,9,21,22	98
2	2	948-238	2N5194	Q2,16	97
4	4	948-240	TRANSISTOR MPS-A56	Q1,5,6,15	96
					95
					94
2	2	948-405	HEATSINK		93
					92
					91
					90
1	1	947-333	RESISTOR 39.2K 1%	R89	89
1	1	947-362	8.06K, 1%	R103	88
1	1	947-366	3.01K, 1%	R147	87
1	1	947-365	3.32K, 1%	R145	86
1	1	947-337	7.87K, 1%	R141	85
1	1	947-315	2.21K, 1%	R139	84
1	1	947-344	121Ω, 1%	R138	83
1	1	947-357	9.09K, 1%	R136	82
1	1	947-343	15.8K, 1%	R135	81
1	1	947-007	3Ω, 1/4W, ±5%	R134	80
1	1	947-071	2.7M, 1/4W, ±5%	R131	79
1	1	947-116	220Ω, 1/2W, ±5%	R118	78
					77
2	2	947-042	33K, 1/4W, ±5%	R57, 97	76
6	6	947-070	4.7M, 1/4W, ±5%	R62,93,112,124,126,128	75
3	3	947-026	1.5K, 1/4W, ±5%	R50, 102, 144	74
2	2	947-054	18K, 1/4W, ±5%	R46, 111	73
2	2	947-363	576Ω, 1%	R44, 109	72
2	2	947-428	1.5Ω, 1W, 1%	R40, 99	71
1	1	947-604	909Ω, 1%	R38	70
1	1	947-314	49.9Ω, 1%	R37	69
1	1	947-376	14K, 1%	R35	68
1	1	947-043	47K, 1/4W, ±5%	R32	67
3	3	947-049	120K, 1/4W, ±5%	R31, 130, 137	66
7	7	947-032	4.7K, 1/4W, ±5%	R30,42,58,59,96,111,120	65
12	12	947-036	10K, 1/4W, ±5%	R29,36,45-50,114,119 R121,123,125,127,129,142	64
2	2	947-006	33Ω, 1/4W, ±5%	R27, 87	63
4	4	947-304	3.92K, 1%	R25, 26, 85, 86	62
2	2	947-213	1K, 2.5W, 3%	R21, 81	61
3	3	947-047	39K, 1/4W, ±5%	R19, 79, 143	60
1	1	947-367	402Ω, 1%	R18	59
1	1	947-368	22.1Ω, 1%	R17	58
1	1	947-031	3.9K, 1/4W, ±5%	R16	57
(11) 1	1	947-195	5.11K, 1% MATCHED PAIR R8 & R13		56
1	1	947-082	10M, 1/4W, ±5%	R11	55
4	4	947-306	200K, 1%	R10, 49, 74, 101	54
1	1	947-374	5.11K, 1%	R140	53
9	9	947-301	10K, 1%	R7,15,22,33,113 R48,88,107,116	52
(10) 1	1	947-196	10K, 1% MATCHED PAIR R7 & R66		51
2	2	947-017	270Ω, 1/4W, ±5%	R6, 65	50
3	3	947-024	1K, 1/4W, ±5%	R4, 64, 132	49
8	8	947-038	10K, 1/4W, ±5%	R3,35,37,41 R63,80,94,104	48
4	4	947-316	100K, 1%	R2, 48, 60, 71	47
4	4	947-325	RESISTOR, 20K, 1%	R1, 39, 61, 98	46

QTY-2	QTY-1	PART NO.	DESCRIPTION	REMARKS	ITEM
3	-	945-030	RELAY (SEALED) 3A	K1, 2, 3	45
-	3	945-027	RELAY (UNSEALED) 3A	K1, 2, 3	44
1	1	947-552	POT. 1K	R146	43
2	2	947-537	POT. 10K	R90, 91	42
2	2	947-526	POT. 200Ω	R83, 108	41
1	1	947-548	POT. 2K	R34	40
2	2	947-543	POT. 100K	R9, 67	39
					38
1	1	931-338	I.C., VOLT. REG. LM723J	U9	37
2	2	931-306	I.C., TIMER NE555	U6, 8	36
1	1	931-416	I.C., QUAD SWITCH MCM01GCP	U4	35
3	3	931-316	I.C., OP AMP LM324N	U3, 5, 7	34
2	2	931-355	I.C., OP AMP LM725CN	U2, 10	33
1	1	931-354	I.C., VOLT COMP. LM339N	U1	32
					31
2	2	20 505	INDUCTOR, 3.8 mH	L1, 2	30
					29
2	2	921-607	HOLDER, FUSE	XF1, XF2	28
1	1	951-015	FUSE, MINIATURE - 2A	F2	27
1	1	951-200	FUSE, MINIATURE-0.5A	F1	26
					25
1	1	948-028	DIODE, ZENER IN4753A	VR2	24
1	1	931-360	VARISTOR, V47ZA7	RV1	23
11	11	948-123	DIODE, IN4004	CR11,18,21,23,31 CR32,35,36,35,36,38	22
5	5	948-125	DIODE, IN3595	CR4,5,16,17,39	21
2	2	948-124	DIODE, IN4934	CR3, 15	20
14	14	948-104	DIODE, IN4148	CR1,2,6,8,9,10,19 CR20,25,27,28,33,37	19
2	2	915-035	CAPACITOR, .0047 UF, 50V	C9, 21	18
2	2	915-130	CAPACITOR, 1.2 UF, 10V	C14, C19	17
1	1	915-013	CAPACITOR, 500 PF, 1KV	C27	16
2	2	915-159	CAPACITOR, 1000 UF, 50V	C22, 23	15
1	1	915-102	CAPACITOR, 1 UF, 35V	C12	14
3	3	915-017	CAPACITOR, .01 UF, 50V	C11, 25, 26	13
3	3	915-157	15 UF, 35V	C8, 20, 24	12
2	2	915-032	.022 UF, 50V	C7, 18	11
2	2	915-012	.001 UF, 1KV	C6, 17	10
2	2	915-164	.68 UF, 60V	C5, 16	9
2	2	915-051	3300 PF, 400V	C4, 15	8
2	2	915-030	330 PF, 100V	C3, 28	7
4	4	915-033	CAPACITOR, 0.1 UF, 50V	C1, 2, 10, 13,	6
					5
					4
					3
					2
1	1	20 711	CCA, CONTROL ELECTRONICS		1
QTY-2	QTY-1	PART NO.	DESCRIPTION	REMARKS	ITEM

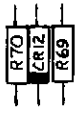
(REF 20 710 G)

FIG.6 SHT 2

CCA, CONTROL ELECTRONICS COMMON COMPONENTS

-1 LATCHING

-2 NON-LATCHING



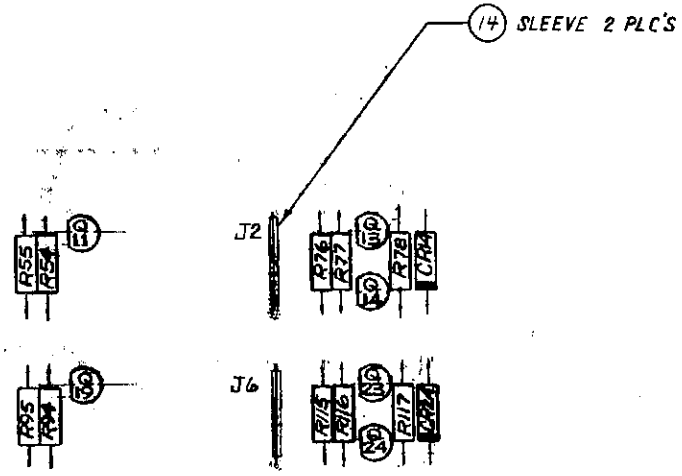
-3 LATCHING HI/NON-LATCHING LOW

						10
						9
						8
						7
1	—	2	947-066	RESISTOR, 20K, ¼W, 5%	R70, 106	6
1	—	2	947-036	RESISTOR, 10K, ¼W, 5%	R69, 105	5
						4
1	—	2	948-104	DIODE, IN4148	CR12, 22	3
						2
						1
QTY-3	QTY-2	QTY-1	PART NO.	DESCRIPTION		ITEM

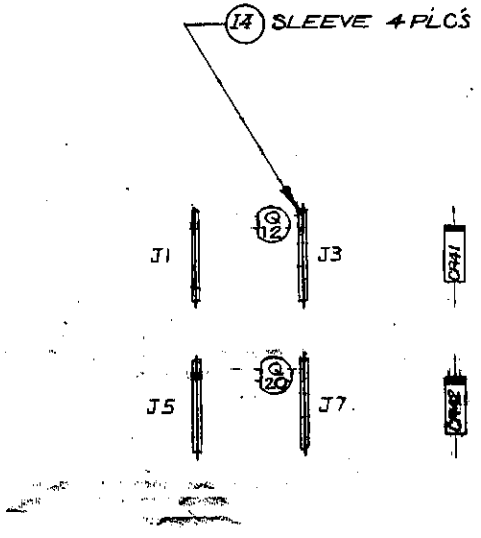
(REF 20 704A)

FIG.7

CCA, LATCHING MODES - COMMON COMPONENTS



-1 ENERGIZED



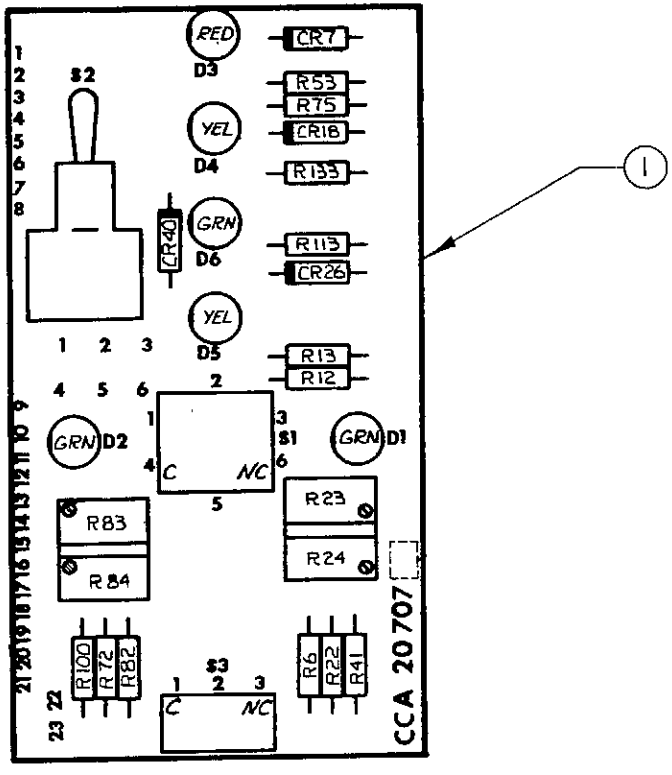
-2 DE-ENERGIZED

A/R	A/R	932-002	COATING, CONFORMAL		15
A/R	A/R		WIRE, JUMPER #22 AWG		14
2	—	948-226	TRANSISTOR, U2TA506	Q14,24	13
2	—	948-243	TRANSISTOR, MPS-A06	Q13,23	12
2	2	948-240	TRANSISTOR, MPS-A56	Q11,19,12,20	11
					10
2	—	947-036	RESISTOR, 10K, 1/4 W, ±5%	R78,117	9
2	—	947-066	RESISTOR, 20K, 1/4 W, ±5%	R77,116	8
2	—	947-068	RESISTOR, 75K, 1/4 W, ±5%	R76,115	7
2	—	947-032	RESISTOR, 4.7K, 1/4 W, ±5%	R54,94	6
2	—	947-042	RESISTOR, 33K, 1/4 W, ±5%	R55,95	5
					4
2	2	948-123	DIODE, IN4004	CR14,24,41,42	3
					2
					1
QTY-1	QTY-2	PART NO.	DESCRIPTION		ITEM

(REF 20 705 C)

FIG.8

CCA, RELAY OPERATIONS COMMON COMPONENTS

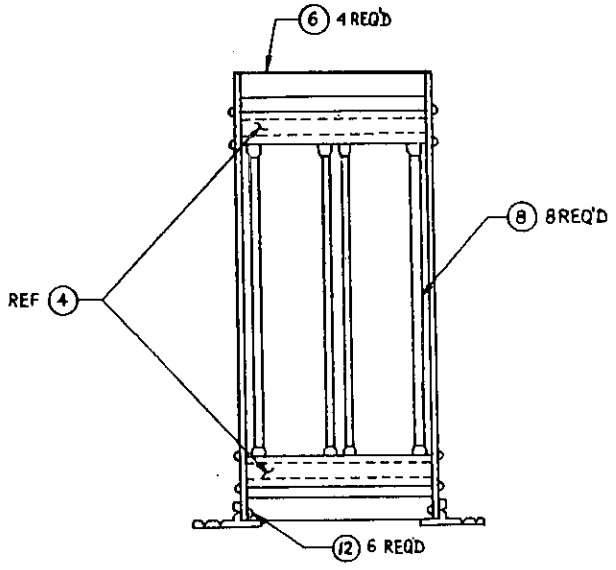


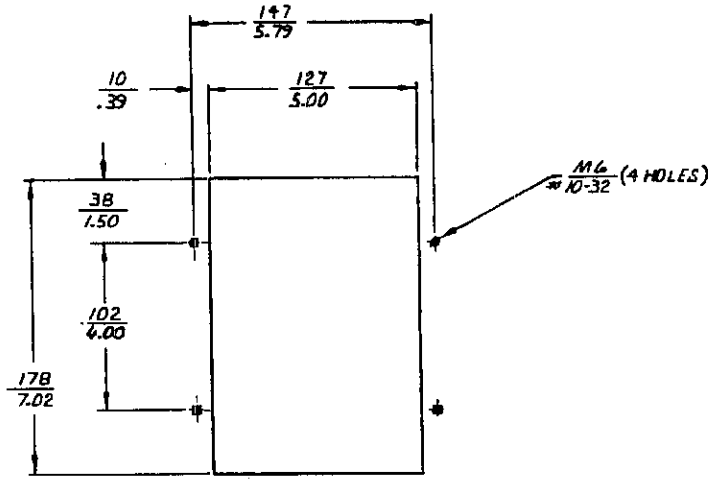
(5)	A/R	932-002	COATING, CONFORMAL	23
				22
				21
	1	951-417	SWITCH, PUSHBUTTON	S3 20
	1	951-311	SWITCH, TOGGLE (DPDT)	S2 19
	1	951-403	SWITCH, PUSHBUTTON	S1 18
				17
	4	947-021	RESISTOR, 560Ω, 1/4 W, ±5%	R53,75,113,133 16
	2	947-449	RESISTOR, 549Ω, 1%	R41,100 15
	2	947-304	RESISTOR, 3.92K, 1%	R22,82 14
	2	947-072	RESISTOR, 620Ω, 1/4 W, ±5%	R12,13 13
	2	947-429	RESISTOR, 470Ω, 1W, 1%	R6,72 12
				11
	2	947-526	POT, 200Ω	R24,84 10
	2	947-529	POT, 500Ω	R23,83 9
				8
	2	948-329	LED, EXTENDED-AMBER	D4,5 7
	1	948-327	LED, EXTENDED-RED	D3 6
	3	948-328	LED, EXTENDED-GREEN	D1,2,6 5
				4
	4	948-123	DIODE, IN4004	CR 7,18,26,40 3
				2
	1	20 708	CCD, DISPLAY BOARD	1
	QTY.	PART NO.	DESCRIPTION	ITEM

(REF 20 707 B)

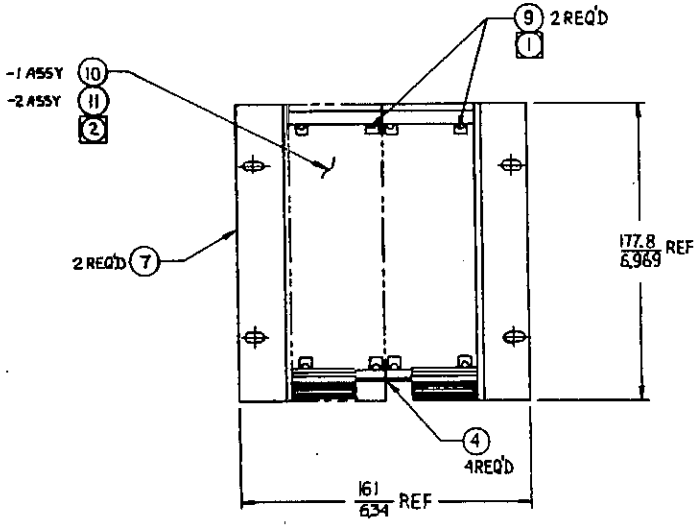
FIG. 9

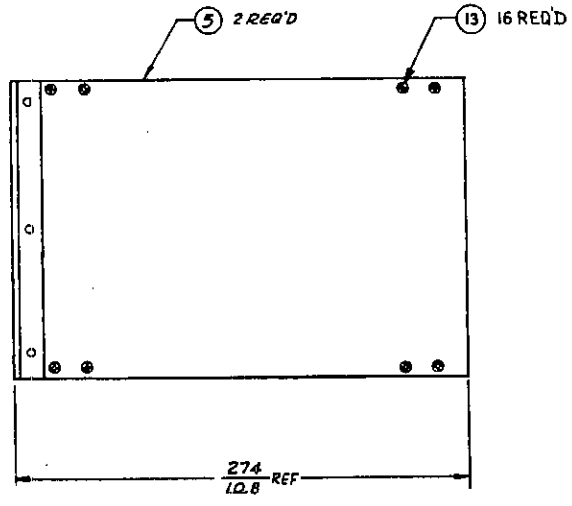
CCA, DISPLAY BOARD





CUSTOMER PANEL
CUTOUT DIMENSIONS

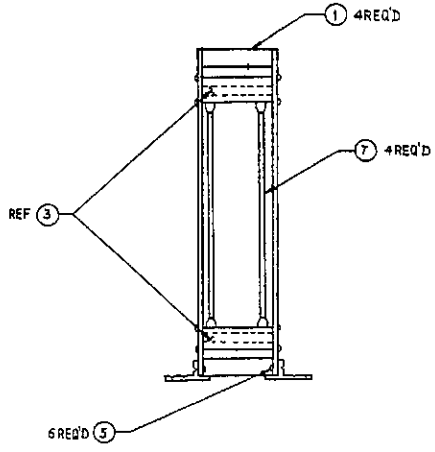


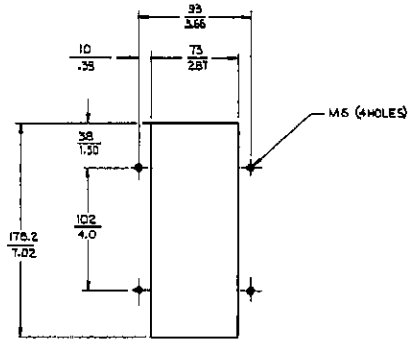


(REF 10199C)

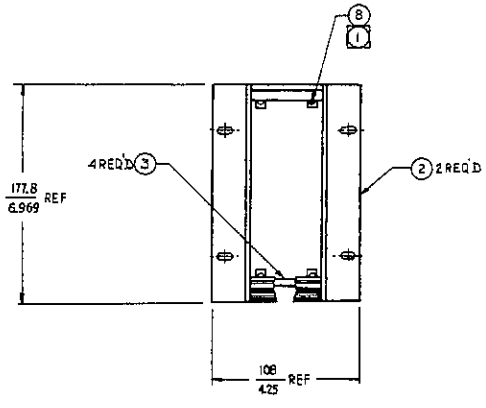
FIG. 10

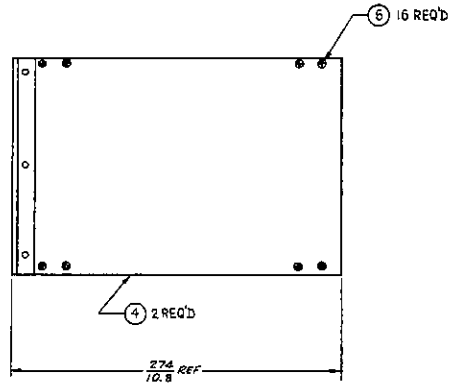
RACK ASSEMBLY, PANEL MOUNT - 98





CUSTOMER PANEL
CUTOUT DIMENSIONS





	1	[1]	NUT, SQUARE M4x0.7 STL-CAD-PLT	8
	4	921-209	GUIDE, SNAP-IN	7
	16		SCR, THD. FORMING, M3x0.5x12 P-PH-ST-ZI	6
	6	DIN 7985	SCR, MACH - M3x0.5x6, P-PHIL-SST	5
	2	10197-2	SIDE PANEL, *PANEL MOUNTING*	4
	4	10185-1	STRIP, LOCATING	3
	2	10196	MOUNTING BRACKET, FRONT VERTICAL	2
	4	10198-1	HORIZONTAL MEMBER	1
QTY-2	QTY-1	PART NO.	DESCRIPTION	ITEM

(REF 10201B)

FIG. 11

RACK ASSEMBLY, PANEL MOUNT-49