GENERAL MONITORS

Model 180 Combustible Gas Monitor

Serial No. _____

PLEASE NOTE
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NOTICE

The Model 180 Combustible Gas Monitor is as easy to install, calibrate, and operate as any combustible gas monitoring system. As in all equipment, however, there are certain instructions, contained in this manual, which must be followed if the system is to provide the property and life protection it was purchased for. This manual also contains certain "cautions" and "warnings" which must be observed. Therefore, General Monitors urges that the entire manual be read, and that instructions be followed. in the order presented.

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Model 180

SINGLE CHANNEL COMBUSTIBLE GAS MONITOR

I. INTRODUCTION

A. GENERAL

The General Monitors Model 180 has a field proven record of dependability. By carefully following the instructions in this manual you will be assured of continuous, reliable detection of hazardous accumulations of combustible gases.

The Model 180 is compact and fully solid state. Its printed circuit card construction eliminates many of the problems associated with conventional point-to-point wiring. Plug-in relays permit easy field replacement, if ever required.

Any of General Monitors' low temperature catalytic bead sensor assemblies may be used with the Model 180. Most hydrocarbon gases and vapors and hydrogen may be monitored with the standard sensor. A hydrogen specific sensor is also available.

B. THE CONTROLLER

The controller may be wall or panel mounted. Up to eight channels may also be installed in a 19 inch rack. Mounting hardware for these methods of installation is available from General Monitors, as are weatherproof or explosion proof housings. All external electrical connections are made to terminal screws located on rear-mounted terminal strips.

The controller operates on either 117 VAC, 60 Hz, or 12 VDC, without any adjustments or added accessories. If desired, the 12 VDC input may be used for battery backup, providing continuous protection during commercial power outages.

Analog output terminals provide capability for remote metering or recording. SPDT alarm relay contact terminals are available, either normally open (NO) or normally closed (NC), for HIGH alarm, LOW alarm and MALFUNCTION alarm.

Front-panel indicator lamps show the operational status. These include:

NORMal, green lamp.

MALFunction, blue lamp.

LOW alarm, amber lamp.

HIGH alarm, red lamp.

The horizontally-mounted panel meter reads in percent lower explosive limit (%LEL). SPAN (calibrate) and ZERO controls are accessible through holes in the panel. The high and low gas alarms are normally de-energized. A LATCHING/NON-LATCHING toggle switch permits them to be operated on either manual or automatic reset. The malfunction alarm is non-latching, normally energized. In NON-LATCHING mode, the

INTRODUCTION (con'd)

high and low alarm relays will turn off if the gas concentration drops below their setpoint level. In LATCHING* position, these relays will remain activated until the toggle switch is manually moved to the other position when the gas concentration drops below the alarm setpoint. The alarm setpoints are located internally, on the right-hand circuit board, to discourage unauthorized manipulation. No power ON-OFF switch is provided, for the same reason.

When power is first applied, the NORMAL lamp will not turn on for about 20-25 seconds. This time delay is provided to prevent false alarms during the system warm-up period. If the sensor circuit is open, the malfunciton lamp will turn on immediately when power is applied.

*(A "latching only" version of the Model is available on special order. The toggle switch option of non-latching operation is not available on this version, and the alarms operate latching (manual reset) only).

C. SENSOR OPERATION PRINCIPLE

A combustible gas/air mixture, diffusing through a flame arrestor, oxidizes on a catalytically-treated sensing bead, causing a change in temperature and a resulting electrical resistance in a Wheatstone Bridge circuit. A reference bead, inert to combustible gases, compensates for ambient temperature, humidity, and pressure variations. The difference in resistance of the active and reference beads is proportional to the combustible gas concentration. The circuit signal is amplified in the controller, and displayed on the % LEL meter.

II. INSTALLATION

A. CONTROLLER LOCATION

Installation of the Model 100 Controller should be in a non-hazardous area, in a weather protected environment, unless an appropriate housing has been provided. Mounting should be as free from shock and vibration as possible. The controller may be placed in any of these fixtures:

Single channel wall mount dust enclosure, P/N 18-01-015-3

Single channel panel mount frame, P/N 18-01-016

Single channel wall mount bracket, P/n 18-01-015-1

Eight channel frame for 19" rack or panel mounting, P/N 17-02-000-1

Blank panels (P/N 18-01-019-1) are used to cover unused channel positions in the eight channel frame.

It is recommended that a service loop be used on all wiring connections, to facilitate access to the alarm adjustment pots and the rear mounted terminal strips.

INSTALLATION (cont'd)

B. LINE POWER CONNECTIONS

POWER LINE connections to 117 VAC, 60 Hz, are made to TB-1 terminals 6, 8, and 10 (Line, Neutral, and Ground), using accepted commercial wiring practices. No ON-OFF switch is provided, so DO NOT apply power until all other connections, as discussed in this Section, are made.

C. SENSOR

Two basic types of SENSOR ASSEMBLIES are available. For most installations in which hydrocarbon gases or vapors are the hazard, a Standard Industrial Sensor Assembly is recommended. For hydrogen applications a hydrogen specific sensor and a sealed EYS-type sensor housing is normally used (this sensor is a plug-in type, and approved for NEC Class 1, Div. 1, Groups B, C, and D installations). Although the Standard Industrial Sensor will detect hydrogen it is not specific to hydrogen.

The Standard Industrial Sensor Assembly is comprised of Sensor Housing, P/N 10-007, and one of the following sensors:

P/N 10001-1 Standard Industrial Sensor.
NEC Class group B, C, & D Gases.
All hydrocarbons including methane.

P/N 10001-3 Standard Industrial Sensor.
NEC Class 1, Group B, C, & D solvents.
(Not for methane).

If ordered, the sensor assembly will have an accessory such as sintered stainless steel Dust Cover, P/N 1800822, Disposable Porex Dust Cover, P/N 10071, or Splash Gaurd, P/N 10117, for protection from harsh environments.

The sensor is connected to a numbered terminal strip within the sensor housing, as follows:

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

The sensor assembly must be conduit mounted when installed in a hazardous area. Thread engagement must conform to the requirements of the latest edition of National Electrical Code. The assembly must always remain tight when circuits are alive. The sensor-to-instrument cable need not be shielded unless it runs near high-powered electrical circuits or equipment. When shielded cable is used, it should be grounded only at the controller's AC ground terminal. Care should be taken to ensure that the outer braid does not contact the conduit or junction box.

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INSTALLATION (cont'd)

TB1 Terminal Number	Sensor Cable Color	Sensor Housing Terminal Number
1	Black	1
2	Red	2
3	White	3

The sealed EYS Sensor Assembly, for use with hydrogen, is comprised of the Sensor Housing, Outer Sleeve Guard and Sensor. The sensor is a plug-in type and is Hydrogen Specific. The receptacle within the EYS Housing is connected to the sensor to instrument cable as follows:

Sensor Plug	Receptacle Letter	Wire Color (10' length)
B	B	Black
A	A	Red
C	C	White

The EYS sensor housing must be conduit-mounted, with five full threads engaged. An outer sleeve guard (sintered bronze or stainless steel) is screwed into the housing to protect the sensor and to act as a redundant flame arrestor, providing maximum protection.

The EYS sensing assemblies are numbered as follows:

P/N	Descriptions
HOUSINGS	
13-04-000	EYS sensor housing, with sintered bronze outer sleeve.
17-04-000	EYS sensor housing, with sintered stainless steel outer sleeve.
(NOTE: Both housings are furnished as sealed units, complete with 10 ft. of sensor cable.)	
HYDROGEN SENSOR	
17-11-000-1	Bronze sinter, hydrogen specific.

CABLE RUNS for the sensor assemblies should not exceed the following distances:

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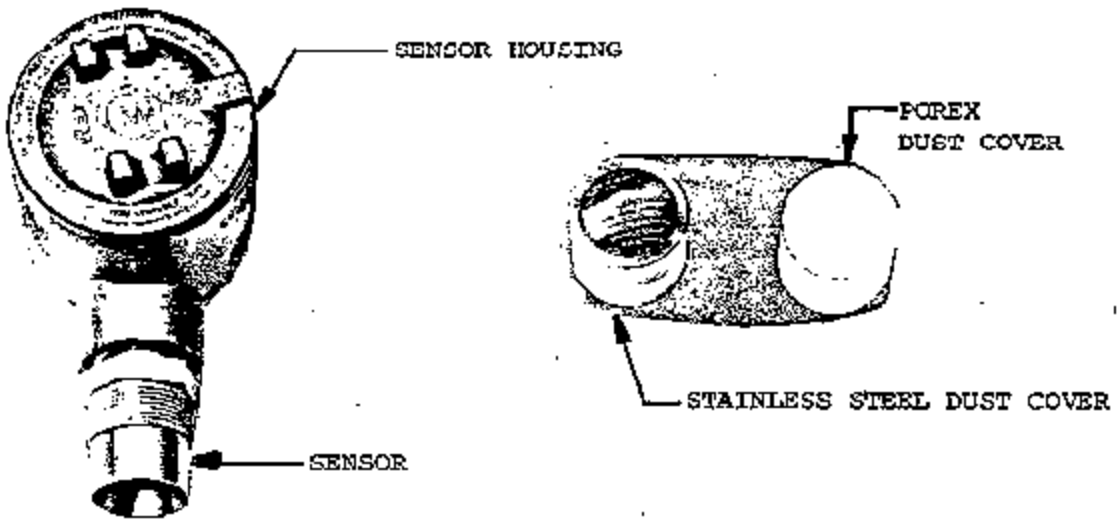
INSTALLATION (cont'd)

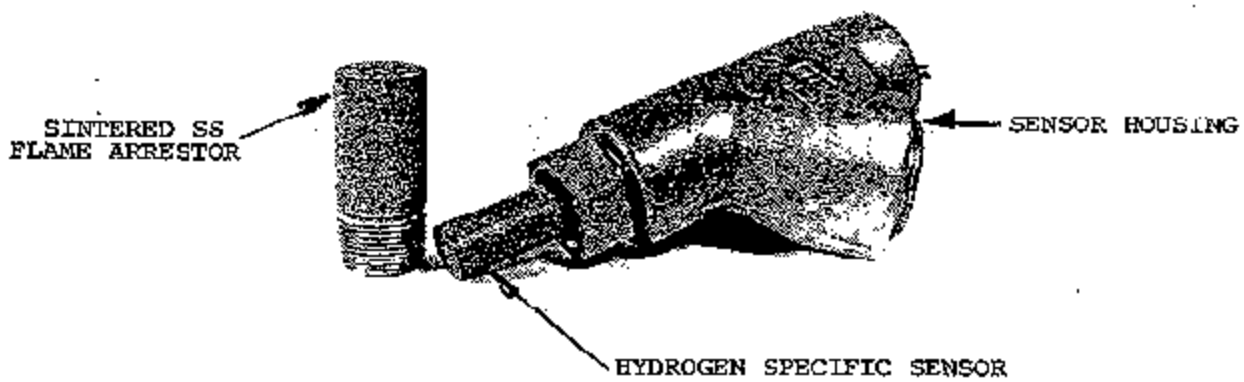
Conductor Gauge	Max. Cable Run (Sensor to Controller)	
AWG#	HYDROCARBON SENSOR	HYDROGEN SENSOR
20	400 ft.	800 ft.
18	800 ft.	1600 ft.
16	1200 ft.	2400 ft.
14	1800 ft.	3600 ft.
12	2800 ft.	5600 ft.

Regardless of wire size, the resistance of the cable (one way) should be less than 5 ohms/conductor for hydrocarbon sensors, and less than 10 ohms/conductor for hydrogen sensors. Splices should be avoided if possible. If required, they must be of high quality, preferably soldered. Sensors should always be mounted pointing downward.

STANDARD INDUSTRIAL SENSOR ASSEMBLY



EYS SENSOR ASSEMBLY



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INSTALLATION (cont'd)

D. ALARM CONNECTIONS

CUSTOMER ALARM CONTACTS are brought to terminal strip TB2 at the rear of the controller as follows:

ALARM CIRCUIT	RELAY CONTACTS			
	NO	COM	NC	
MALFUNCTION	3	4	2	(TB2 terminal #)
HIGH	6	7	5	" "
LOW	9	10	8	" "

The SPDT contacts are rated 2A, 28 VDC, or 2A, 117 VAC resistive. They may be used to operate auxiliary alarms or to shut down or start up equipment. The malfunction relay is normally energized in operation, and can be used to indicate a power outage or sensor circuit discontinuity. The gas alarm relays are normally de-energized.

E. OUTPUT SIGNAL CONNECTION

The ANALOG OUTPUT is on TB1, terminals 4(+) and 5(-). The analog voltage is proportional to % LEL, and varies from 0 to +1 volt looking into a minimum load of 10,000 ohms. Note that neither output terminal is grounded, and that a differential input recorder (or DVM) must be used if the controller is connected to a battery.

F. BATTERY OPERATION

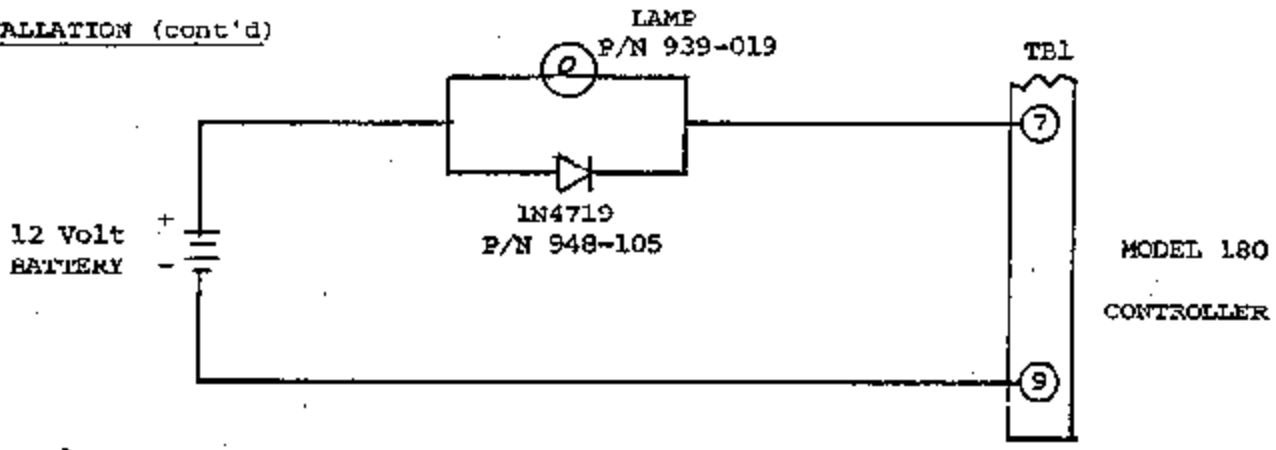
BATTERY POWER for the MODEL 180 system can be provided by a 12 volt automotive type battery. Connections are made to TB1, terminals 7(+) and 9(-). The battery input is not internally fused except for a circuit breaker common to both power inputs, and an external one ampere line fuse should be provided. Insure cables are adequate to minimize voltage drop.

DO NOT CONNECT 117 VAC and 12 VDC PRIMARY POWER AT THE SAME TIME WITHOUT READING THE FOLLOWING SECTION ON BATTERY BACKUP. FAILURE TO COMPLY MAY DAMAGE THE INSTRUMENT AND VOID THE WARRANTY.

G. BATTERY BACKUP

BATTERY BACKUP may be provided easily and inexpensively for the Model 180. No manual or relay switch is required. The battery is simply "floated" across the power supply in the controller, which has sufficient excess capacity to trickle-charge (up to 0.25A) the battery. A blocking diode, and a current-limiting lamp, must be used externally to the controller as shown in the schematic as follows:

INSTALLATION (cont'd)



If more than one Model 180 Controller is to be backed up by a single battery, consult your sales representative or the factory. A single controller will operate from a fully charged 60 ampere-hour battery for isolated 24 hour periods.

NOTE: "Battery Backup" will provide power to the controller and sensor circuits. Alarm circuits are not powered by the above circuit.

H. APPLYING POWER

Having followed the foregoing installation instructions, and double-checking all connections, you are now ready to apply power to the system. When first connected, none of the indicator lamps should light. If the blue MALF lamp comes on immediately, there is a fault in the sensing assembly circuit. If there is no such fault, within 20-25 seconds the green NORM lamp should come on. If the amber low alarm lamp or the red high alarm lamp should light, either there is a gas condition at the sensor, or the alarm setpoints are improperly set, or the zero potentiometer is advanced. To correct the situation, follow the calibration procedure outlined in the following section.

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III. CALIBRATION

A. GENERAL

Your Model 180 has been factory calibrated if General Monitors was aware of the gas you will be monitoring. However, a startup calibration is a must. Calibration of the system may be easily and quickly accomplished. Frequency of subsequent calibration checks depends upon local conditions (e.g., potential of mud accumulation on sensors, etc.) but normally is recommended at least every 3 months.

B. CALIBRATION PROCEDURE

The system is calibrated as follows:

1. Assure that the sensor assembly is in "clean" air.
2. Adjust the ZERO potentiometer so that the %LEL meter reads ZERO, using the instrument screwdriver provided. Note that, for a particular sensor, changing the ZERO pot setting has absolutely no effect on the sensitivity, or SPAN. It simply shifts the zero setting of the meter.
3. Expose the sensor to calibration gas using the Portable Purge Calibrator (for Methane, Hydrogen, etc.) P/N 14-00-150 or the Portable Calibration Chamber P/N 14-00-200 (for solvents).
4. Adjust the SPAN pot to bring the %LEL meter deflection to the same value as the calibration gas.
5. Remove the calibration gas, allowing the sensor to return to clean air. The %LEL meter should return to a "zero" reading. Re-zero if necessary, and again expose the sensor to calibration gas. Fine adjustment of the SPAN pot may be necessary. Remove the calibration gas, and the %LEL meter should return to zero. Re-check the zero. The calibration procedure is completed.

IV. ALARM SETPOINT ADJUSTMENTS

The ALARM SETPOINTS are electronic, and are set by adjusting the HIGH and LOW alarm potentiometers located on the right-hand circuit card. First, advance the ZERO potentiometer until the %LEL meter reaches the point you wish to use as the low alarm setpoint--usually about 35%. Then adjust the LOW alarm potentiometer until the green NORM lamp goes out and the amber LOW alarm lamp turns on. Further advance the ZERO potentiometer until the high setpoint value is reached on the %LEL meter--usually about 65%. Then adjust the HIGH alarm potentiometer until the amber low alarm lamp turns off and the red high alarm lamp comes on. Back off the zero potentiometer until the meter again reads zero.

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V. OTHER ADJUSTMENTS

BIAS AND SENSOR CURRENT potentiometers seldom require adjusting in the field. Should they require adjusting, proceed as follows:

BIAS POTENTIOMETER SETTING. First turn the SPAN potentiometer (25 turns) fully counter-clockwise, until it clicks. Then adjust the BIAS potentiometer until the %LEL meter reads zero. Reset the SPAN pot to about 6 turns clockwise, and recalibrate the system.

SENSOR CURRENT SETTING. Connect a 20,000 ohm/volt voltmeter across resistor R4, and adjust the CUR ADJ potentiometer to read 0.6 volts for hydrogen sensors or 1.25 volts for hydrocarbon sensors. Or, connect a milliampmeter in series with either the black or white sensor wires and adjust the CUR ADJ potentiometer to 150mA for hydrogen sensors or 300mA for hydrocarbon sensors.

In either case, recalibrate the system after making the adjustment.

VI. 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 in this section do not eliminate the problem. If equipment or qualified personnel required for various tests are not available it is recommended that the defective unit be returned to General Monitors for repair. A complete written discription of the problem should be included.

Be sure to 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 (not including simple replacement of recommended spare parts) performed by persons other than General Monitors authorized personnel may void the warranty. Please read the warranty statement carefully.

PROBLEM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
1. The controller does not "time out" within 25-30 seconds after application of power or after the unit comes out of the malfunction mode. The green NORMal light, HIGH, LOW and MALF lamps are not lit.	1. NORMal bulb is burned out.	1. Check the bulb by removing it and inserting a spare or one of the alarm bulbs. Replace if defective.
	2. Malfunction relay K1* is not fully energized or is defective.	2. a) Check with a spare or check for continuity with an ohmmeter. If the relay is functioning correctly the ohmmeter should go to zero ohms when the relay is actuated. b) Sensor "current" is set too low. Refer to Page 9 in the manual, and check the controller for proper sensor "current".
	3. MALFunction bulb is burned out. (If it is lit proceed to the Problem #2 section below).	3. Check per #1 above and replace if defective.
	4. Power to the system is low.	4. Check the input A.C. or battery power. Change or replace the power source.

*See Schematic Drawing 18-01-003

PROBLEM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
		5. c) Short terminals 1 and 2 at the controller. If the meter goes hard upscale, the open is in the sensor cable. Inspect the cable and correct the condition. d) Short the white and black leads at the sensor. If the MALF light goes out, the sensor is defective. Replace the sensor. If the light stays on, the open is in the sensor cable. Inspect the cable and correct the open condition.
3. LOW and/or HIGH alarm lamps do not turn "on" when LEL Meter reads above alarm set point.	1. Lamp(s) burned out.	1. Replace lamp(s). Check lamp sockets for +12 VDC by using terminal #9 on TB1 (rear of controller) as common (-) point.
	2. Sensor red lead is open or broken.	2. Check sensor cable for continuity in red conductor.
	3. Span potentiometer is turned to full CCW position.	3. Normal setting of SPAN pot is minimum of 4 turns CW from CCW end.
	4. Alarm circuits are not operating properly.	4. Refer to 180 schematic on Page of the manual. Contact General Monitors and/or return the controller for repair if the problem cannot be resolved with available test equipment and personnel.

TROUBLE-SHOOTING (cont'd)

PROBLEM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
2. Controller is in malfunction mode1. The blue MALF lamp is lit. This indicates that either the white or black lead to the sensor is open. NOTE: On units with the "B-Mod" an open red lead will also be indicated by the MALF lamp being on.	1. Terminal(s) loose on sensor cable.	1. Tighten all terminal.
	2. Black lead is open.	2. Check to see if the %LEL Meter is driven hard downscale. Check the voltage across R4. It should be zero volts. Check the voltage across terminals 1 and 3 on TB1 on the controller. It should read approximately 12 volts. Proceed to paragraph 5 below.
	3. White lead is open.	3. Check to see if the %LEL Meter is driven hard upscale. Check to see if the voltage across R4 is zero volts. Check to see if the voltage across terminals 1 and 3 on TB1 on the controller is approximately 12 volts. Proceed to paragraph 5 below.
	4. Red lead is open. (MALF lamp is not lit.)	4. Check whether there is no meter deflection with a combustible gas present, or with a zero or span adjustment. Check to see whether the voltage across terminals 1 and 3 on TB1 on the controller is approximately 4.5 - 6 volts, and across terminals 1 and 2 approximately one half that across terminals 1 and 3. Proceed to paragraph 5 below.
		5. Disconnect any external alarm wiring. Determine where the break in the sensor circuit has occured as follows: a) Short the white to black leads at terminals 1 and 3 on TB1 on the controller. If the MALF lamp goes off, the controller is operating correctly. If the lamp remains on the problem is in the controller. General Monitors should be contacted and/or the unit should be returned for repair. b) If the lamp went off in a) above, the open is in the sensor cable. Inspect the cable and correct the condition.

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VII. CIRCUIT DESCRIPTION

The component reference designations referred to in this Section are in accordance with the General Monitors schematic drawing Number 18-01-003.

Transformer T1 steps the 117 VAC line voltage down to approximately 24 VAC. This voltage is rectified by diodes CR1 and CR2 to provide the 12 VDC, filtered by capacitor C1. The transformer is protected by fuse F1. Alternative primary power input is by 12 VDC battery applied directly to the rectifier output.

Lamp RT1, Zener diodes VR1 and VR2, and resistor R1 provide regulated output voltages of about 11 VDC and 5 VDC for circuit operation. Lamp RT1 is used as a current regulator to offset line voltage fluctuations.

Transistors Q1, Q2, Q3 and Q4, and their associated resistor network supply constant current to the sensor circuit through MALFunction relay coil K1. Diode CR3 is used for ambient temperature compensation. Sensor circuit constant current is adjusted by the CURrent ADJust potentiometer, R2. Normally-energized MALFunction relay K1 switches to alarm position in the event of a fault in the sensor current circuit OR a power interruption. In a Malfunction Alarm condition, the blue MALF lamp DS1 is on and the SPDT MALFunction relay contacts are switched (de-energized).

The sensor circuit is a Wheatstone bridge configuration comprised of resistors R12 and R13 located in the controller, and two sensor beads which are the "active" and "reference" beads. The "active" bead contains a catalyst material which causes combustible gas mixtures to oxidize on its surface at a relatively low (600-700°F) temperature. The active bead is exposed to the same ambient atmosphere as is the "reference" (no catalyst) bead. The only difference in resistance is the heating effects of the combustible gas mixture on the active bead. The constant current supplied by the controller eliminates the effects of sensor cable resistance changes and ambient temperature changes. The bridge is balanced by adjusting ZERO potentiometer R10, which is a 25-turn pot with no positive stops.

Any difference in resistance between the sensor beads causes current to flow through and a voltage to develop across SPAN potentiometer R17. A portion of this voltage across R17 is tapped off and applied to one input of differential amplifier A1. When calibrated for methane, the SPAN pot setting is normally somewhere near 6 turns clockwise from the full counter-clockwise position.

BIAS potentiometer R20 feeds a portion of a regulated DC supply voltage into the other input to A1. This "offset" Bias voltage permits a true "no gas @ sensor" setting of A1 and %LEL meter. Output signal from the amplifier is measured the %LEL meter M1, through series resistor R21. The analog signal, which ranges from 0 to 1 VDC, is also fed to the two alarm circuit inputs.

The dual alarm amplifier A2 is powered through a time delay circuit made up of an RC network R22 and C4, a unijunction transistor Q5, blocking diode CR4 and SCR1. This circuit holds amplifier A2 "off" until about 25 seconds after relay K1 is energized. The time delay circuit also holds the LOW and HIGH alarm circuits "off" during the system warmup period to eliminate false alarms.

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CIRCUIT DESCRIPTION (cont'd)

Output of the alarm amplifiers switches transistors 1Q6 and 2Q6 on at signal levels determined by settings of LO-ADJ and HI-ADJ potentiometers 1R29 and 2R29. When these switching transistors are on, they allow current to flow through the alarm relay coils K2 and K3, energizing the relays. Note that current to the LOW alarm NORM lamps flows through normally closed relay contacts 8 and 9 or HIGH alarm relay K3. When either alarm relay is switched, the green NORM lamp is extinguished, and the amber LOW alarm or red HIGH alarm lamp comes on.

A toggle switch, S1, permits operating the alarm relays in either LATCHING or NON-LATCHING modes. In the LATCHING position, diodes 1CR5 or 2CR5 become forward-biased. They will continue to conduct, holding 1Q6 or 2Q6 on until switch S1 is moved to the NON-LATCHING position. Thus the alarm circuits will be held in alarm status until manually switched off. 1CR6 and 2CR6 are blocking diodes, while 1CR7 and 2CR8 are used for transient suppression across the relay coils.

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VIII. SPECIAL WARNING

Through engineering design, testing, manufacturing techniques and rigid quality control, General Monitors delivers 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 "calibration" on a regular schedule. "Calibration" should be conducted at least every ninety (90) days. This is the only method of insuring proper system operation and response.

   "Calibration" is defined as the procedure of applying a known concentration of gas to the system sensor while observing the monitor. The visual display will indicate the gas concentration and activate alarm indicators/ circuits 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. "Poison atmospheres" include: halides (compounds containing fluorine, chlorine, iodine or bromine), sulphur, silicone and lead. Use in this type of atomsphere requires "calibration" on a more frequent schedule.

3. General Monitors' sensors and sensor housings are designed and tested for use in certain classes of hazardous atmosphere. Explosion-proof integrity cannot be maintained if sensors and sensor housings are used in other than the "as-designed" condition. Terminal access covers of sensor housings must be secured in place. Sensor housings must be installed in accordance with National Electrical Code acceptable practice 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. Some General Monitors' controllers have a "test" switch. The user is cautioned that this "test" switch checks out electronics only and gives no indication of a sensor condition chemically.

6. General Monitors' gas detection systems are primarily SAFETY devices for the protection of personnel and facilities, and must be "always ready". With proper calibration, maintenance and installation, the system will provide continuous monitoring of hazardous areas. The user assumes all liability for misuse of General Monitors' gas detection systems by its employees or other persons.

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IX. LIMITED WARRANTY

G.M.I. warrants all of its products to be free from defects in workmanship or material under normal use and service within two (2) years after date of shipment. G.M.I. 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 G.M.I. 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 G.M.I. 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. G.M.I.'s responsibility under the above warranty shall be limited to the repair or replacement at G.M.I.'s option free of charge to the purchaser of any component which fails during the two (2) year period provided that the purchaser has promptly reported such failure to G.M.I. in writing and G.M.I., 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, G.M.I. 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 G.M.I. FOR DAMAGES INCLUDING BUT NOT LIMITED TO CONSEQUENTIAL DAMAGES ARISING OUT OF/OR IN CONNECTION WITH, THE USE OR PERFORMANCE OF THE PRODUCT.

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X. RECOMMENDED SPARE PARTS LIST

QUANTITY	PART NUMBER	DESCRIPTION	SYMBOL
1	945-002	Relay AZ-420-21-4HZ	K1
1	945-001	Relay AZ-420-1011-4H	K2 or K3
1	951-030	Switch C&K 7201A	S1
1	*951-051	Switch C&K 7208-AEX37	S1
2	951-002	Fuse 3AG 3/8AMP	F1
5	939-009	Lamp #382	DS1, 2, 3, 4
1	As Req.	Sensor	

*For "latching alarm only" version

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XI. SPECIFICATIONS

CONTROLLER

Dimensions:	2.10"W x 4.12"H x 9.60"D (53mm x 105mm x 244mm)
Weight:	3 lbs. (1.36 kg.)
Mounting Options:	Rack, Panel or Wall
Temperature Range:	Model 180: -40°F to +150°F (-40°C to 66°C)
	Model 180A: 32°F to 150°F (0°C to +70°C)
Power:	105-130VAC, 12-15VDC, 50-60 Hz
	8 watts (Model 180) 9 watts (Model 180A)
Readout Range:	Model 180 meter: 0 to 100% Lower Explosive Limit (LEL) Model 180A digital display: 0 to 99% LEL
Repeatability:	±2% full scale
Alarm Circuits:	Three: High, Low and Malfunction
Controls:	Current Adjust, Bias Adjust, Low and High Alarm Setpoints, Zero Adjust, Span Adjust, Alarm Mode Select (Reset)-- latching or non-latching
Indicators:	% LEL Meter (180) or Digital Display (180A), Low Alarm Lamp (Amber), High Alarm Lamp (Red) Malfunction Lamp (Blue), Normal Lamp (Green)
Electrical Classification:	General Purpose for mounting in non-hazardous area
Output:	Individual, isolated latching or non-latching relay contacts for Low and High Alarms. Malfunction relay is normally energized, non- latching. Customer contact are SPDT, rated at 2A, 26VAC; or 2A, 117VAC resistive. A floating analog signal of 0-1 volt for recording purposes.
Warranty:	Two years

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SPECIFICATIONS (cont'd)

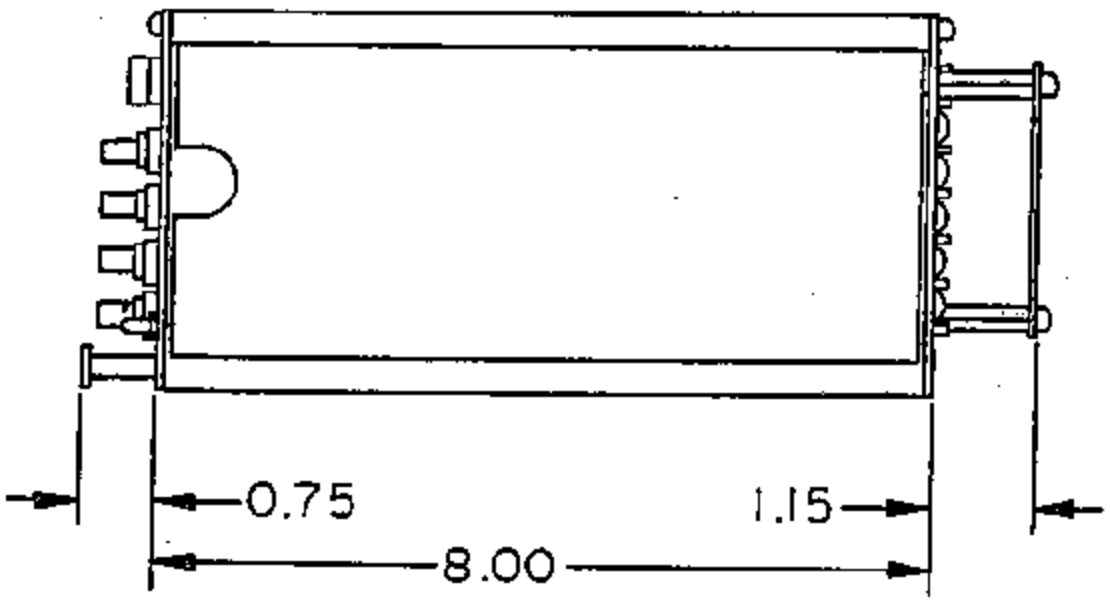
SENSOR

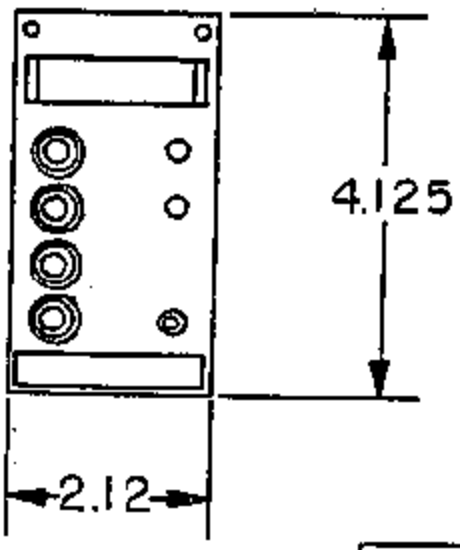
Type:	Diffusion, low temperature catalytic bead
Temperature Range:	-65°F to +200°F (-55°C to +93°C)
Catalyst Surface Temperature:	750°F (399°C)
Response Time:	Typically 6-second time constant when exposed to 50% LEL of Methane gas.
Drift:	Less than 5% per year
Life:	Up to 3 years, normal service
Electrical Classification:	NEC Class 1, Division 1, Group B, C and D; VDE 0171 (EX) SD 3N G5; CSA, Class 1, Division 1, Group B, C and D
Warranty:	Two years
Cable Length:	3-wire, normally unshielded. Maximum cable length allowable between controller and sensor assembly with one way resistance of 5 ohms (10 ohms loop) for hydrocarbon sensors:

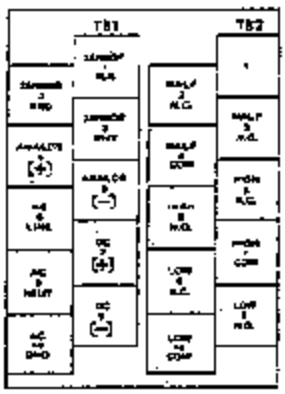
Wire Size (AWG)	Length (Feet)	Length (Meters)
20	400	122
18	800	244
16	1200	366
14	1800	549
12	2800	854

NOTE: Subject to change without notice due to possible technical changes in the system.

XII. DRAWINGS

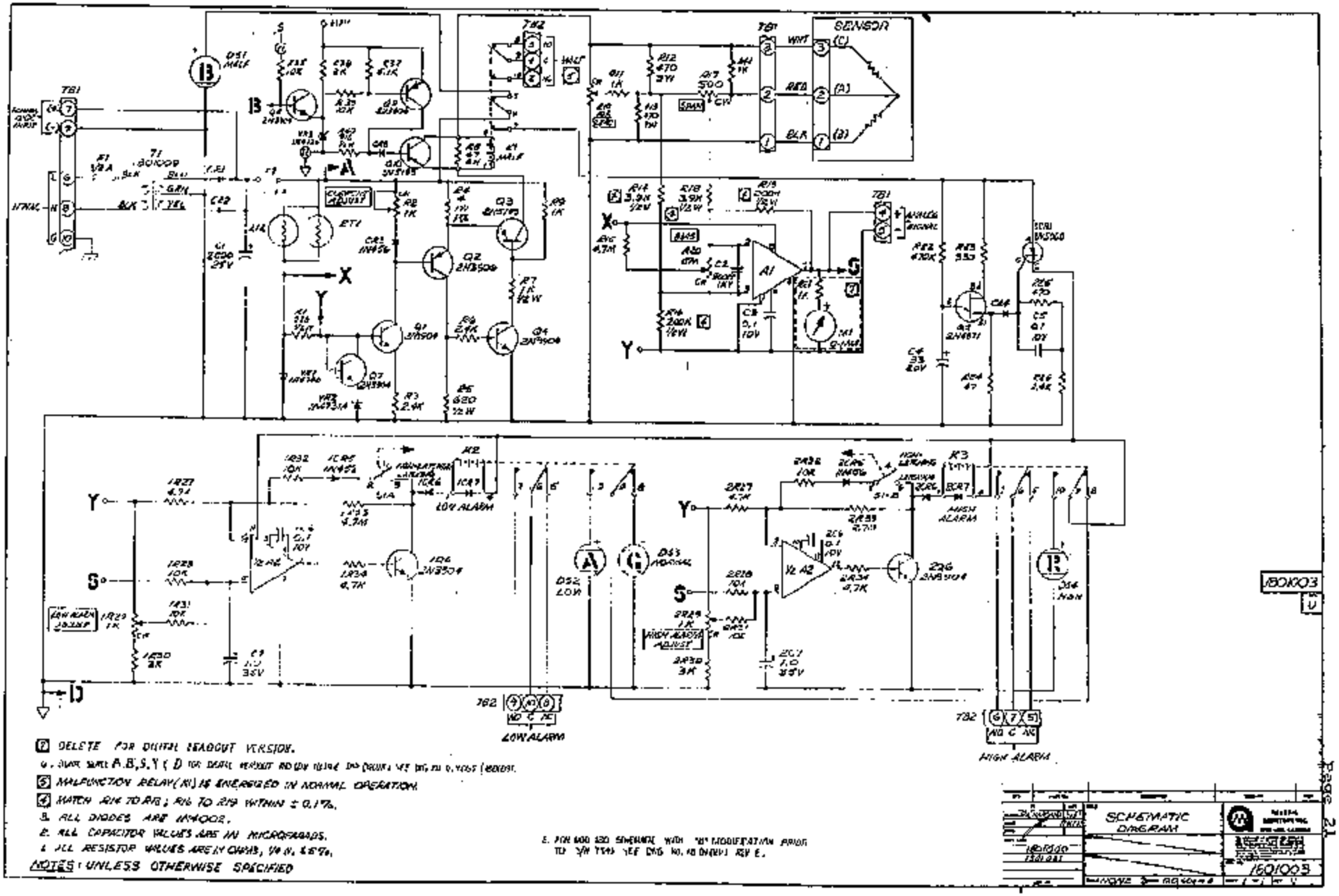






INTERNAL
CONNECTION DIAGRAM

OUTLINE, MODEL 180 / FIG. 1



? DELETE FOR DIGITAL READOUT VERSION.

6. SWITCH SECTIONS A,B,S,Y (D) FOR DIGITAL VERSION ARE ON SEPARATE SWITCH DRAWING. SEE DWG. NO. 160104, REV. D.

5 MALFUNCTION RELAY (K1) IS ENERGIZED IN NORMAL OPERATION.

4 MATCH R16 TO R15; R16 TO R19 WITHIN ± 0.1%.

3. ALL DIODES ARE IN4002.

2. ALL CAPACITOR VALUES ARE IN MICROFARADS.

1. ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, ± 5%.

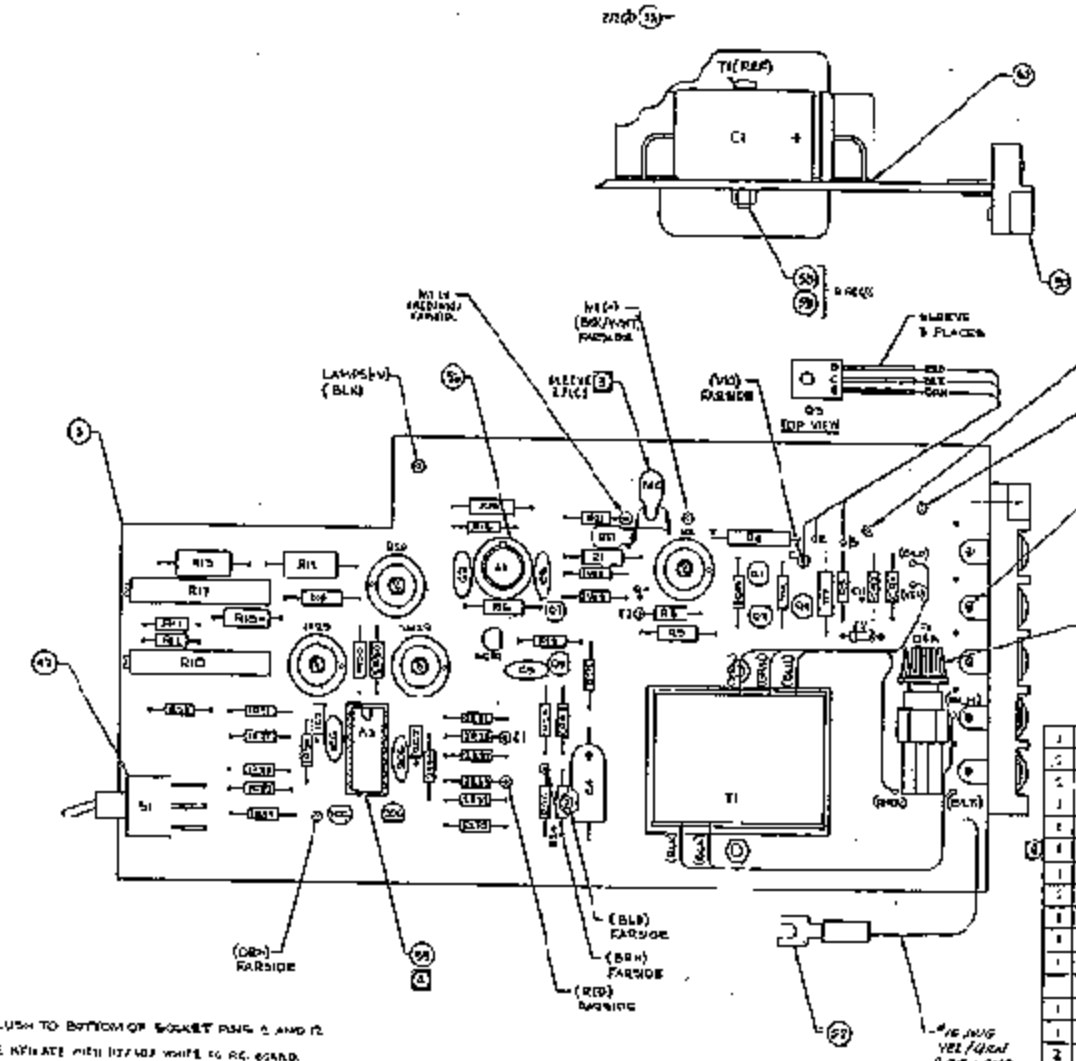
NOTES: UNLESS OTHERWISE SPECIFIED

E. FOR 600 SERIES WITH "B" MODIFICATION PRIOR TO S/N 1745 SEE DWG. NO. 160104 REV. E.

160103

U

Page 21



A CUT FLUSH TO BOTTOM OF SOCKET PINS 5 AND 12.

B SOLDER APPROX. FIFTY (50) WIRES TO PC. BOARD.

1. SCHEMATIC DIAGRAM 18 01 003
2. PARTS ARRAY 18 01 000
NOTES: UNLESS OTHERWISE SPECIFIED

4	947-083	RES. 61.9K 1/4W 1%	R50, 1337 R54, 1338		40
1	947-070	RES. 43K 1/4W 1%	R29		39
1	947-068	RES. 47K 1/4W 1%	R24		38
1	947-066	RES. 33K 1/4W 1%	R23		37
1	947-096	RES. 499K 1/4W 1%	R12		36
1	947-507	POT. (BIAS)	R10 1338		35
1	947-333	RES. FILM 1/2W 5%	R15, 18		34
2	947-070	RES. 43K 1/4W 1%	R25, 1335		33
1	947-081	POT. (BIAS)	R7 1335		32
1	947-930	RES. FILM 2.5W 5%	R16, 18		31
2	947-413	RES. 4.75K 1/4W 1%	R35, 8		30
1	947-938	POT. (SENS.)	R6 1335		29
4	947-096	RES. 499K 1/4W 1%	R2, 1, 21, 11		28
1	947-124	RES. 162K 1/4W 1%	R9		27
1	947-160	RES. 620K 1/4W 1%	R8		26
1	947-401	RES. 4.64K 1/4W 1%	R34		25
5	948-062	DIODE 1N4933	CR3, 5, 24		24
3	947-301	POT. FILM 1/2W 10%	R33, 1338, 1339		23
1	947-116	RES. 820 +/-5% 1/4W	R1		22
					21
1	948-216	TRANSISTOR 2N3906	Q5		20
1	948-218	TRANSISTOR 2N3823	Q3		19
1	948-201	TRANSISTOR 2N3904	Q4		18
5	948-206	TRANSISTOR 2N3906	Q1, 2, 6, 7, 8		17
					16
1	951-306	FUSE 0.4A	F1		15
5	948-104	DIODE 1N4936	CR2, 4, 6, 23, 25		14
4	948-102	DIODE 1N4002	CR1, 2, 4		13
1	951-111	FUSE, 2 1/2"	F2		12

18 01 010 V

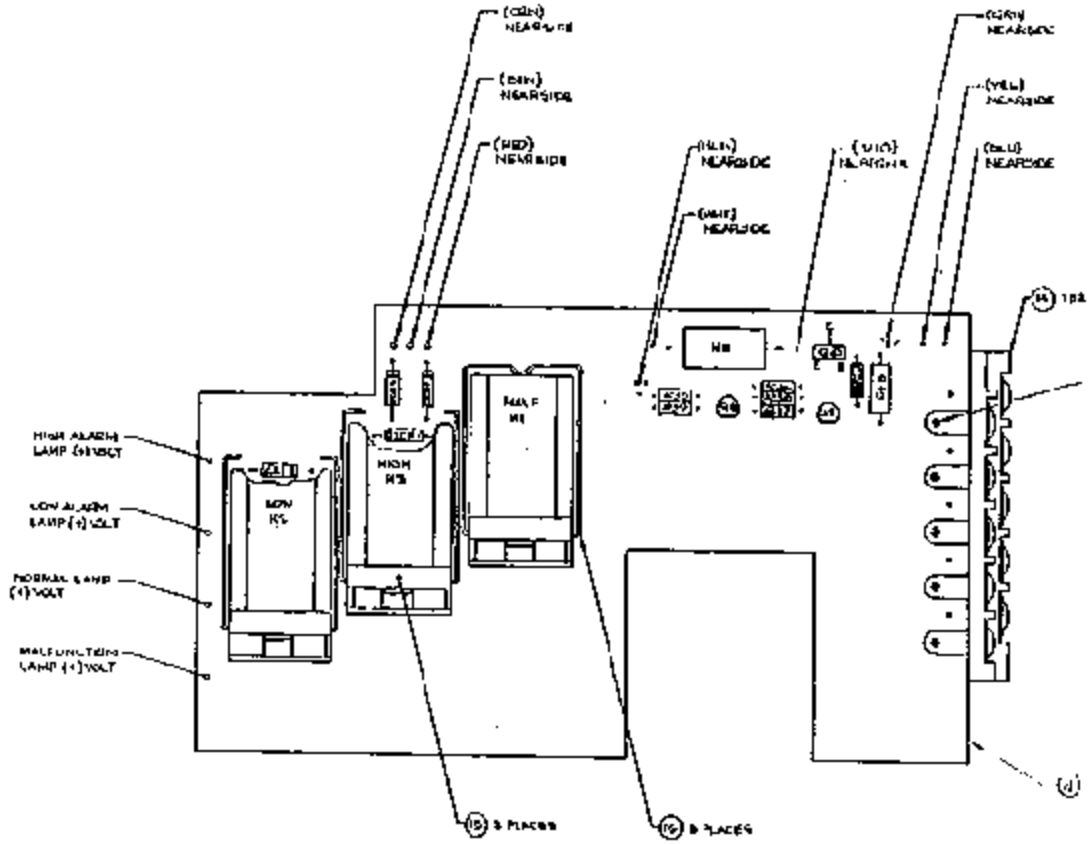
2	915-102	CAP. CER. 10 PF, 500 VDC	C32, 33		11
2	915-104	CAP. CER. .01 UF, 50 VDC	C28, 29		10
4	915-001	CAP. CER. .01 UF, 50 VDC	C4, 5, 26, 27		9
1	915-122	CAP. CER. .022 UF, 50 VDC	C3		8
1	915-008	CAP. CER. 300 PF, 1000 V	C2		7
1	739-502	AMPLIFIER, I.C.	A2		6
1	739-300	AMPLIFIER, I.C.	A3		5
1	18 01 003	TRANSFORMER	T1		4
1	18 01 011	P.C. BOARD			3
					2
-1	-1	SWITCH			1
QTY	PART NO.	DESCRIPTION	REMARKS		ITEM NO.

1	18 01 004	PANEL			60
2	4-40	LOCKNUT	STD CAD PLATE		59
2	4-40X5/8	SCREW	CRES PHIL HD		58
1	931-007	BUSHING, SNAP			57
1	931-002	SEPARATOR			56
1	931-111	SOCKET, IC	14 PIN		55
1	18-007	HOLDER, FUSE P.C. MT.	FOR 1/4" FUSE		54
2		WIRE, #22 AWG			53
1	948-005	DIODE, ZENER	VOLT. 1N4731A		52
1	948-039	DIODE, ZENER	VOLT. 1N4740A		51
1	10 020	TERMINAL BLOCK	TB1		50
					49
1	940-211	DECR. THICK FILM	DATA		48
1	18-307	SWITCH	SPDT		47
2	931-011	LAMP	NE-2		46
					45
					44
1	947-071	RES. 22K 1/4W 1%	R31		43
2	947-043	RES. 5K 1/4W 1%	R22, R30		42
6	947-036	RES. 4K 1/4W 1%	R13, 14, 17, 20, 32, 1336		41

GENERAL MONITORS, INC.

MODEL 180 V

PC. BOARD, CIRCUIT, ASSEMBLY 18 01 010



SYM	DESCRIPTION	DATE	APPROVAL
A	1. RELEASED FOR PRODUCTION	6-30-71	
B	1. CLOCKED DIODES	9-15-71	
C	1. ICR6 WAS V6R, 2CR4 WAS 1CR5 2. REMOVED PRODUCTION REQUIREMENT, HEAT SOLDER PASTE AND REMOVE PINS 2 & 5 AS SHOWN	11-22-71	
D	1. ITEM 19 P/N WAS: 6MT-008	9-3-71	
E	1. ICR5 WAS 1CR7, 1CR7 WAS 1CR6, 2CR2 WAS 2CR7, 2CR7 WAS 2CR2	9-15-71	
F	1. PART NO. CHANGED TO PR. NO.	5-22-73	
G	ADDED: CR10, CR11, R34, R35, R36, Q13, VR6, 209 WAS 499, PART NUMBER 04, CHANGED 1 TERM. QTY WAS 3	11-XX-80	

4 R89 WAS 549 OHMS

QTY	PART NO.	DESCRIPTION	REMARKS
4	947-001	RESISTOR, FILM, 1/8 W, 1%, 12K	R89
9	947-201	RESISTOR, FILM, 1/8 W, 1%	R8
1	947-049	RESISTOR, FILM, 1/8 W, 1%	R83
1	947-069	RESISTOR, FILM, 1/8 W, 1%	R37
8	947-104	RESISTOR, FILM, 1/8 W, 1%	10K R35,R36,R85
6	948-015	RETAINER, RELAY	
5	971-005	SOCKET, RELAY	
1	10 060	TERMINAL BLOCK	TB4
1	946-204	TRANSISTOR 2N4904	Q8
1	18 01 012		
1	948-207	TRANSISTOR 2N3906	Q9
1	948-219	TRANSISTOR 2N5812	Q10
2	945-001	RELAY	K1,4
1	945-002	RELAY	K1
6	418-102	DIODE IN4001	CR1, 2CR3, CR7, 2CR7, CR8
1			
1	18 01 013	P.C. BOARD	
—		ASSY	

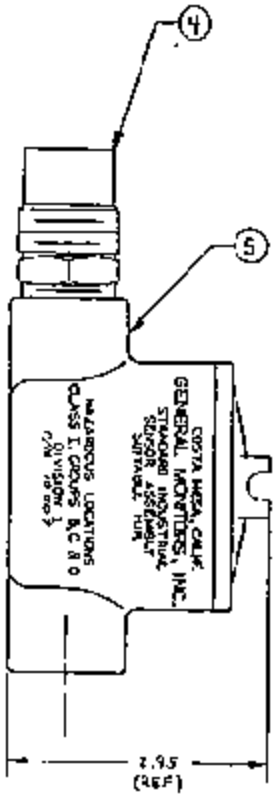
RELAY SOCKET MODIFICATION VIEW
SCALE 2:1

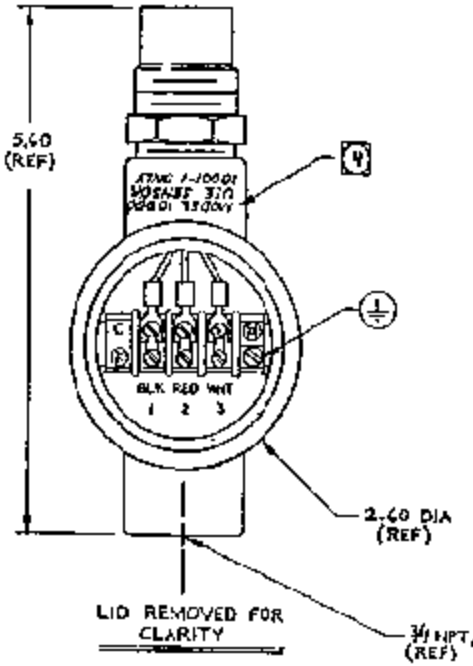
3 WIRING VIEW TO BE USED IN CONJUNCTION WITH WIRING VIEW ON DWG 18 01 00 (MATCH WIRE COLORS)
2. SCHEMATIC DIAGRAM 18 01 003
1 HEAT ASSY 18 01 008
UNLESS OTHERWISE SPECIFIED

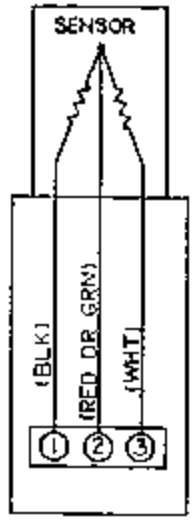
GENERAL MONITORS, INC.
MODEL 180
P.C. BOARD, ASSY
18 01 012

EFFECTIVE: MAY 1974

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
C	1. REVISED AND REDRAWN, UTILIZING GMI CUSTOM JUNCTION BOX.	5/29/79	
D	ADDED ITEMS 6, 7, AND NOTE [5]	9 DEC 79	
E	ADDED: NOTE [4]	6 MAY 80	
F	DELETED: ITEM 6, 10073, TAG, #7 960-300 LEAD SEAL & NOTE [3] INSTALLATION OF FRENCH TAG FOR USE IN CANADA	15 AUG 80	







SCHEMATIC

10 000 F

				7
				6
1	10 007	JUNCTION-BOX	[1]	5
1	10 001	SENSOR	[2]	4
				3
				2
–	-1	ASSY		1
QTY	PART NO.	DESCRIPTION	REMARKS	ITEM NO.

[4] ELECTRO-CHEMICALLY ETCH AS NECESSARY.

[2] SENSOR INSTALLATION-LUBRICATE THREADS AND DO NOT USE WRENCH, HAND TIGHTEN ONLY.

[1] BEFORE INSTALLING LID, LUBRICATE THREAD STACK.

NOTES: UNLESS OTHERWISE SPECIFIED

GENERAL MONITORS, INC.

F

SENSING ELEMENT ASSY 10 000