TECHNICAL MANUAL

GEIGER COUNTER
MODEL E-500B

EBERLINE
Instrument Corporation
SANTA FE NEW MEXICO

LIST OF EFFECTIVE PAGES

Insert latest revised pages; dispose of superseded pages.

NOTE: On a revised page, the portion of the text affected by the latest change is indicated by a vertical line in the outer margin of the page.

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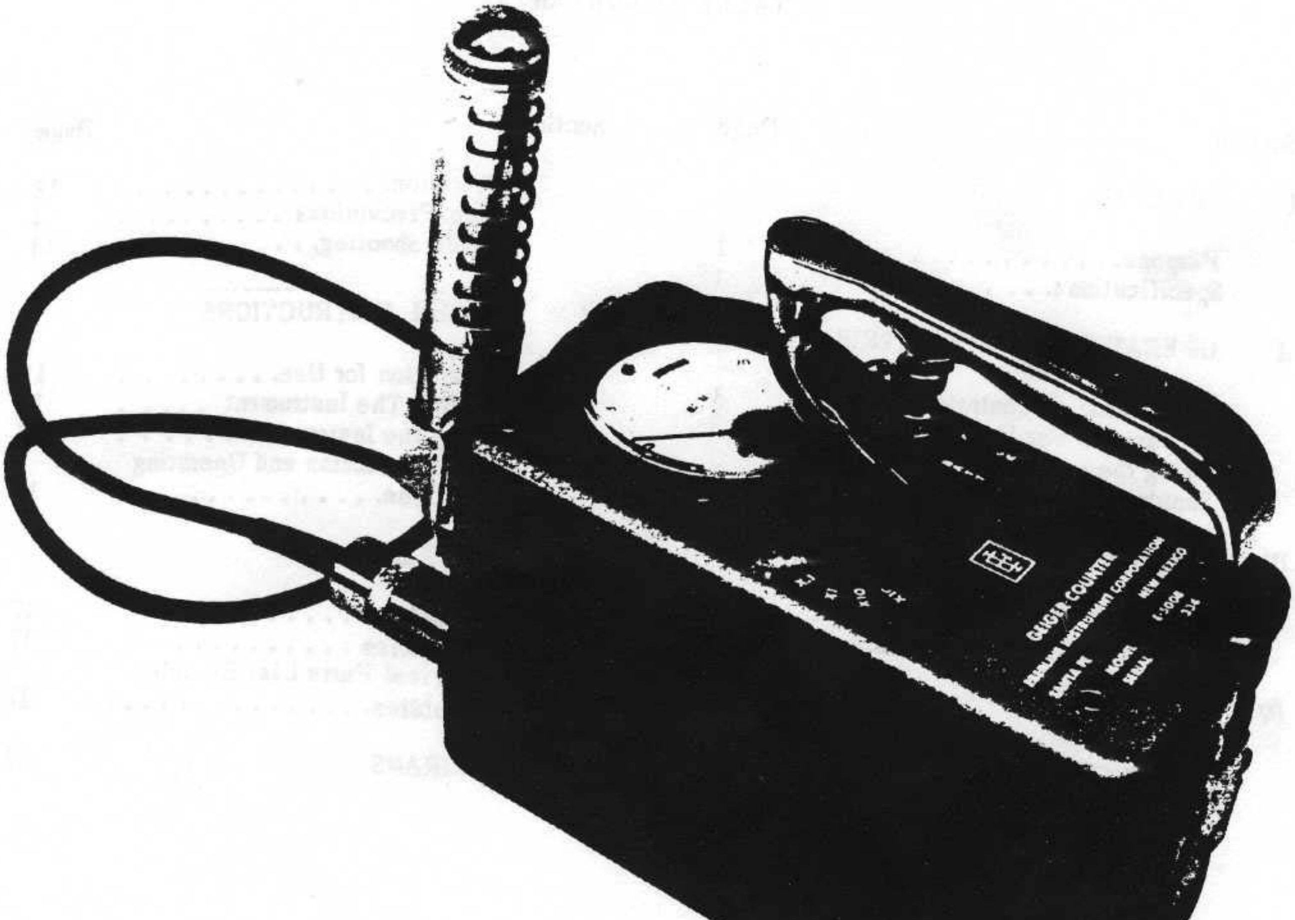


Figure 1-1. Geiger Counter, Model E-500B

SECTION I
GENERAL

A. PURPOSE.

The E-500B Geiger Counter is a lightweight, portable instrument designed to detect and measure beta and/or gamma radiation. Its wide range of response, weather resistant construction and ruggedness renders it suitable for laboratory or field survey work.

An HP-177B Detector Assembly is a hand held or instrument mounted detector. It is used for beta and/or gamma measurements up to 200 mr/hr.

An internal detector is used for gamma measurement only, up to 2 r/hr.

An indicating meter with 5 switch-selected ranges provides field intensity readout. A green area marked on the scale provides battery condition indication.

Aural outlet connection is provided. A headset or speaker assembly may be used.

In addition to the range switch, meter reset and battery check switches are provided to extend the operating convenience of the instrument.

For special purposes a thru end-window GM Detector Assembly (Model HP-180 or HP-180A) or a Scintillation Detector Assembly (Model SPA-1) may be substituted for the standard Model HP-177B Detector Assembly.

B. SPECIFICATIONS. 1.

DETECTORS.

a. Internal: GM tube. Detector

b. External: Eberline: HP-177B Detector

Assembly.

The assembly consists of a GM tube, with rotating beta shield and connector assembly with attached RG-59/U coaxial cable. The cable is 3 feet long with special weatherproof connectors.

2. INDICATORS.

a. Meter.

(1). Movement, 20 microampere, ruggedized, suspension type with less than 5000 ohms impedance.

(2). Scale, 0-20 milliroentgen per hour.

(3). Green Area, indicates battery condition.

(4). Linearity.

± 8%	0-.2,0-2.0,0-20
± 15%	0-200
± 10%	0-2000

b. Aural.

(1). Headset, single phone BA-201, optional.

(2). Speaker: Eberline SK-1 Speaker Assembly, optional.

3. TEMPERATURE CHARACTERISTICS. The maximum operating temperature range is from -40°F to +130°F. For details, see Section V, Special Instructions.

4. POWER REQUIREMENTS. Typical 6 to 8 volts depending on type of battery used. Typical current drain is less than 40 milliamperes, but depends on battery voltage. Five zinc-carbon "D" cells are furnished. For other types of batteries which can be used, see Section V, Special Instructions.

5. CONTROLS.

a. External. The following controls are located on the front panel except one which is in the carrying handle.

(1). Power and scale switch (scale switch function includes detector selection).

(2). BATT CHECK Switch.

(3). RESET Switch (located in forward end of carrying handle).

b. Internal. The calibration controls, one for each range, are on the chassis inside the case. They are labeled:

(1)	X0.01	(4)	X10
(2)	X0.l	(5)	X100
(3)	X1.0		

6. SENSITIVITY. The basic instrument input sensitivity is less than 3 millivolts for a negative pulse with a rise time faster than 1 microsecond.

7. SATURATION. The level of instrument saturation exceeds 1000 R/HR on all ranges.

8. CHECK SOURCE.

A Cesium 137, EIC Model CS-7/t Beta-Gamma check source is supplied with each instrument.

9. MECHANICAL CHARACTERISTICS.

a. Size.

(1). Height: 7 3/8 inches including handle.

(2). Width: 3 7/8 inches.

(3). Length: 9 5/8 inches with detector holder installed.

b. Weight: Approximately 7 lbs depending on type of batteries used.

c. Environmental: The complete assembly including detector assembly is weather resistant.

d. Modules: The following sub-assemblies are plug-in type. The first three are solid state, etched circuit board assemblies.

(1). High voltage power supply, P-57.

(2). Amp-Trigger Assembly, P-8A.

(3). Meter Accessory Assembly, P-16A.

(4). Battery Pack Assembly, BP-1-1 standard equipment, see Section V, Special Instructions for battery packs and types of batteries suggested.

e. Terminal Board, TB-1. The detector load, pulse coupling, aural coupling, low voltage regulator and decoupling components are located on TB-1 which is fixed to the chassis under the meter.

f. All other components are chassis or control panel mounted.

SECTION II

OPERATION OF THE INSTRUMENT

A. DESCRIPTION OF CONTROLS.

1. FRONT PANEL, SEE FIG.2-1.

a. Scale Switch. This six position control combines the function of turning the instrument ON and selecting the desired scale. The control is marked: OFF, X100, X10, XI, X.I and X.OL

b. RESET: By pressing the RESET button, the meter pointer can be rapidly zeroed after a reading has been taken. This decreases the delay due to slow meter response when changing scales.

c. BATT. CHECK. Battery voltage may be checked by pressing the BATT. CHECK switch and observing the meter. The meter should read within the green portion.

2. INTERNAL CONTROLS. The calibration controls X100, X10, XI, X.I and X.01 are chassis mounted inside the instrument. They adjust the trigger circuit time constant for each scale so that the meter reading corresponds to the trigger input pulse rate.

B. PREPARATION FOR USE.

1. INSPECTION.

See Fig. 1-1. The instrument should be checked by the operator that all parts necessary for proper operation are present, such as, detector(s), detector cable, headset or speaker and check source.

The external physical condition should be checked for broken latches, damaged connectors, loose and/or broken knobs, handle, meter etc.

Connect the detector assembly to the case.

Tighten hand tight ONLY. DO NOT use tools.

C. USING THE INSTRUMENT.

1. STARTING THE INSTRUMENT. Turn scale switch to the X100 position and check battery condition.

2. OPERATION CHECK.

To insure that the E-5M1 is operating properly,

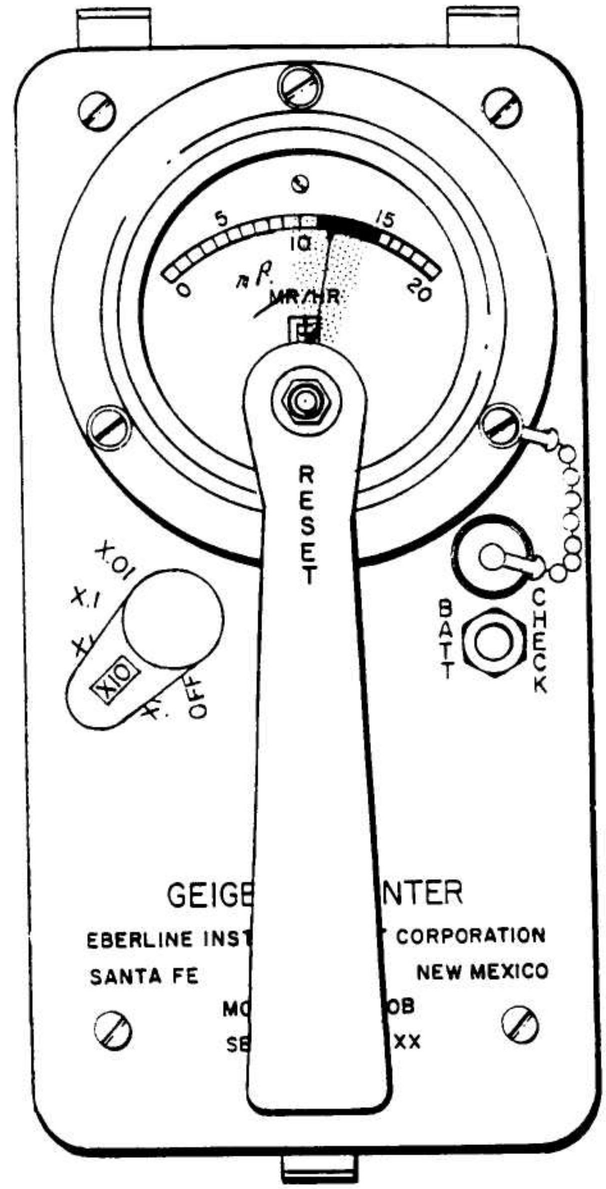


Figure *2-1.* Operating *Controls and* Typical *Meter* Reading

the meter indication should be checked frequently with the check source.

3. INTERPRETATION OF INDICATIONS.

To read the beta-gamma field strength, it is necessary to multiply the meter reading by the number indicated by the scale switch. If the scale switch is set on X10, and the meter reads 12, the beta-gamma field strength would be this 12 multiplied by 10, or 120 mr per hour. See Fig. 2-1.

Radiation is random in nature and when the instrument is in a radiation field, there will be a slow movement of the meter pointer. This movement is due to the randomness of the photon or particle. Observe the meter for a sufficient period of time to determine the average reading.

4. APPLICATION PROCEDURE, a.

Monitoring gamma.

No special distance considerations are necessary. The meter will indicate the strength of the gamma field in which the detector is placed.

To take a reading, turn the detector's beta discriminating shield until it <u>covers</u> the open side of the detector.

Set the scale switch on the X100 position. If the meter does not read up-scale, continue moving the scale switch to the lower multiplier until an up-scale reading is obtained. When the proper scale has been selected, observe the meter action long enough to define the average reading.

Since the internal GM tube (X100 scale or 2 *K/ht* range) is located at the front of the case, the highest sensitivity will result if the gamma source is ahead of the instrument. In this way the gamma field will not be attenuated by the various components (especially the batteries) of the instrument.

b. Monitoring beta-gamma.

Turn the detector beta discriminating shield and expose the open area to a beta source, with the detector near the surface being monitored. Proceed as directed in monitoring for gamma, except begin with scale switch on the X10 position.

5. EXTREME TEMPERATURE ENVIROMENTS

If the instrument has been exposed to very high or low temperatures, meter calibration may be necessary during the temperature transition. If the unit will be operated before it can stabilize within the temperature levels, a check source should be used before and after making each radiation interval reading. The reading should then be corrected to correspond with the calibration of the check source. See para. 6, below.

6. VARIATION IN CALIBRATION.

If the check source does not read within +/- 20% of its value, and the instrument cannot readily be recalibrated, the following procedure should be done to obtain a correct reading.

Divide the stated value of the check source by its actual reading to obtain correction factors, which must then be multiplied, by the unknown sources meter reading.

D. SHUTDOWN FROM OPERATION

1. Check battery condition and turn scale switch to OFF.

2. Thoroughly clean the outside of the instrument by dusting or wiping with known clean cloths.

3. In adverse conditions, such as highly contaminated, dusty and/or muddy areas, wash the instrument, connecting cable and detector using a stream of running water, using a brush if necessary. Be sure the connectors are tight and cover and latches are secured before washing. Then dry with clean cotton cloths of "throw away" material like paper towels or Kleenex.

4. Store in a clean, dry place.

SECTION III

THEORY OF OPERATION

A. SYNOPSIS OF SYSTEM OPERATION.

The detector, when in a radioactive field, will generate negative pulses. The pulses are capacitive coupled to a pulse amplifier. After amplification they are applied to a pulse height discriminator. If they are of sufficient amplitude, they will trigger the monostable multivibrator circuit.

The output of the trigger circuit is direct coupled to the meter integration circuit. The integrating circuit averages the pulse rate of the trigger and presents it as a meter reading. The pulse from the trigger is also applied to a panel connector for aural monitoring.

B. FUNCTIONAL THEORY OF OPERATION.

1. DETECTORS. See Fig. 7-1.

a. GM Detector.

When a beta particle or gamma photon causes a reaction in the GM tube, an ion avalanche is developed. This causes a sharp drop in the anode voltage which appears across detector load resistor R5 and is capacitively coupled to the pulse amplifier through C2-

2. ELECTRONICS.

a. P-8A, Pulse Amplifier, Pulse Height Discriminator and Monostable Multivibrator Assembly. (Amp-Trigger).

(1). Pulse Amplifier. Fig. 3-1.

The pulse amplifier consists of transistors Q201 and Q202 and associated circuitry.

Amplifiers Q201 and Q202 are common emitter stages. The overall voltage gain with DISCR at maximum is approximately 250.

Q201 bias is obtained through R201 from the collector. The collector load resistor is R202.

RT201 in the emitter circuit of Q201 is a temperature sensitive resistor with a positive temperature coefficient. This helps compensate for changes in transistor gain due to temperature changes.

Diode CR201 is provided to prevent damage to Q201 should the detector high voltage be shorted to ground.

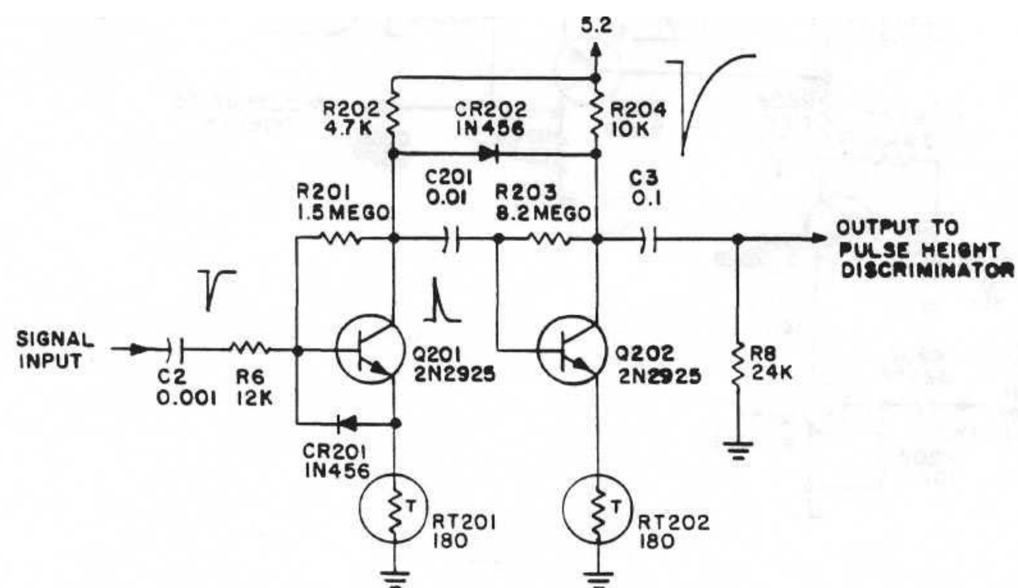


Figure 3-1. *Schematic of Pulse Amplifier*

Diode CR202 is included to limit the height of large input pulses. This prevents saturation of Q202 and increasing resolution time.

As the negative pulse from the detector is applied to the base of Q201, it reduces the current flow through the transistor and collector voltage rises accordingly.

This positive pulse is applied to the base of Q202 through coupling capacitor C201.

Bias for Q202 is obtained through R203 from the collector. The collector load is R204.

RT202 is a temperature sensitive resistor with a positive temperature coefficient. This helps compensate for changes in transistor gain due to temperature changes.

Q202 amplifies and inverts the positive pulse applied to its base. The negative pulse is capacitively coupled to the base of Q203 through the discriminator network.

(2). Pulse Height Discriminator. Fig.3-2.

Transistor Q203 is a common collector stage. The output of Q203 is direct coupled into Q204. Resistor R205 provides the bias for Q203.

Resistor R206 provides a small amount of negative feed-back between Q203 and Q204 for greater stability.

Transistor Q204 is a common base stage which drives R208 and tunnel diode CR203. The output of Q204 approximates a current source to control CR203. When the current through CR203 reaches 1 ma, it flips to its high voltage state. This is sufficient voltage to saturate the germanium transistor Q205.

Normally Q205 is cut off so its collector voltage is zero. When the tunnel diode flips to its high voltage state, Q205 saturates and its collector voltage is approximately 5 volts. This transition is very fast. Q205 remains saturated as long as the current flow through the tunnel diode keeps it in its high voltage state. When the current through CR203 decreases sufficiently, the tunnel flips back and Q205 is cut off. C2D4 slows the fall time of the signal so it will not cause the trigger to cut off also.

(3). Trigger Circuit (Mo no stable Multivibrator). Fig. 3-3.

The multivibrator consists of Q206 and Q2D7 and associated components. The RC timing components are separately mounted from the P-8A assembly.

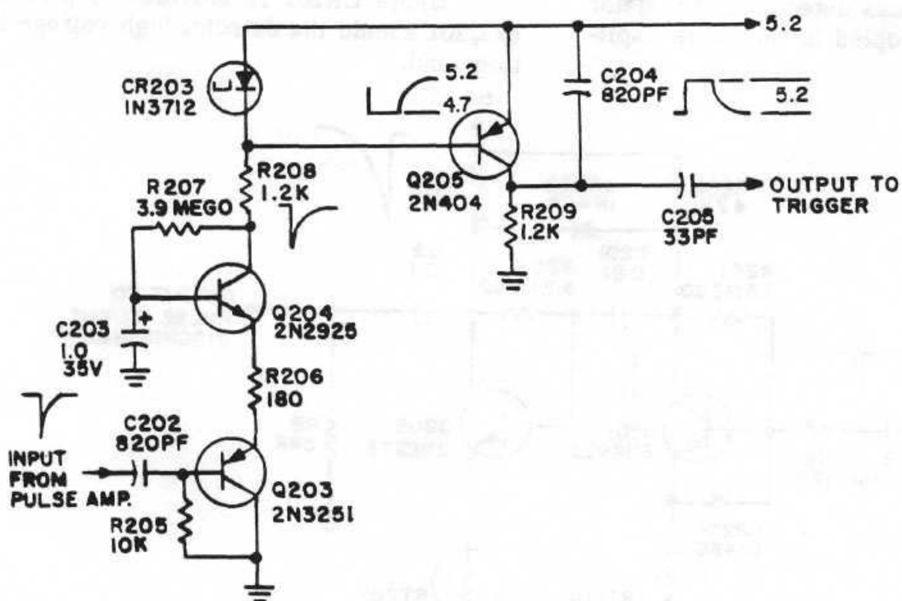
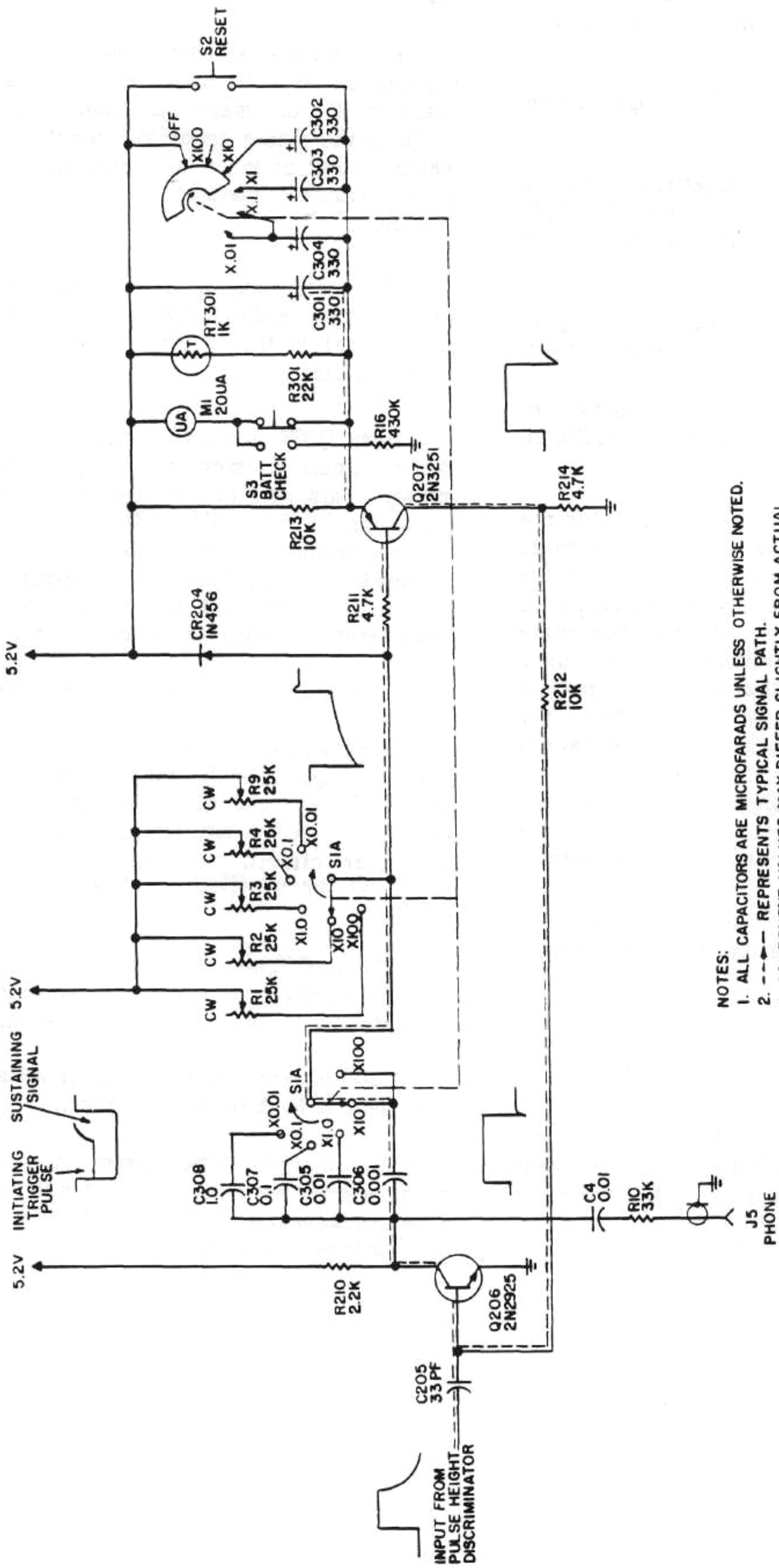


Figure 3-2. ***Schematic of Pulse Height Discriminator***



NOTES:
1. ALL CAPACITORS ARE MICROFARADS UNLESS OTHERWISE NOTED.
2. - - -▸- - REPRESENTS TYPICAL SIGNAL PATH.
3. COMPONENT VALUES MAY DIFFER SLIGHTLY FROM ACTUAL VALUE IN THE INSTRUMENT.
4. WAVEFORMS INDICATED ARE TYPICAL.
5. CW = CLOCKWISE ROTATION.

Figure 3-3. Schematic of Trigger Circuit Portion, P-8A, P-16A and Chassis

In the stable state, the transistors are normally off. Q206 is held at cut off by R212 and R214. Q2D7 is held off by R211 and the selected calibration control.

When the large pulse from Q205 appears on the base of Q206, it turns on.

When Q206 turns on, a negative pulse is developed across R210 and is coupled to Q207 through one of the RC timing capacitors and resistor R211, Q207 turns on.

When Q207 conducts, a positive pulse is developed across the collector load resistor R214.

A portion of this positive pulse is fed back to Q206 base through resistor R212, holding Q206 in saturation.

The signal at the collector of Q206 holds the timing capacitor in a charging state, which holds Q207 in saturation. The selected capacitor in the RC circuitry has a charging path through its particular calibration control. The setting of the scale switch determines the combination of R and C used in the timing network. As the selected capacitor charges and the base of Q207 approaches the supply voltage potential, Q207 will start out of saturation.

As Q207 starts out of saturation the collector voltage will start to decrease. This will cause Q206 to conduct less and start out of saturation.

As Q206 starts out of saturation, Q207 cuts off and its collector voltage drops to near ground potential.

This drop in collector voltage at Q207 is coupled to the base of Q206 and cuts it off.

As the RC circuit attempts to swing positive, it is clipped by the diode CR204. The time that Q207 conducts is dependent on the capacitor selected by the scale switch and its associated calibration potentiometer adjustment.

b. P-16A, Meter Accessory Assembly. See Fig. 3-3.

The accessory card contains the integration capacitors and temperature compensating shunt resistors for the meter indicator. This card also contains the timing capacitors for the trigger circuit which is part of the P-8A assembly. The meter is panel mounted, separate from the P-16A plug-in module.

The indicating meter and associated circuitry provides the read-out capability. This reading is proportional to the rate of pulses received by the trigger circuit.

When Q207 conducts, current flows through the meter circuit causing a voltage drop across the meter. This voltage charges the meter integration capacitor, (C304, C303, C302 and C301) depending on the setting of the scale switch. When Q207 ceases to conduct, the selected capacitor discharges through the meter and also through the temperature compensating shunt resistance R301 and RT301.

c. P-57, High Voltage Power Supply. Fig.3.4.

The HV power supply is a transistorized etched circuit plug-in module used to supply a regulated 900 VDC to the detector assembly. Q101, T101 and associated components, comprise a blocking oscillator circuit. T101 transformer secondary steps up the oscillator voltage and applies it to C102.

C102, C103, CR101 and CR102 comprise a voltage doubler circuit. The rectified voltage is regulated by V101, a 900 volt corona regulator tube.

C104 further filters the output voltage, which is then applied to the detector through load resistor R5.

The regulator tube current is adjusted for 15 microamperes with no load and 6.0 volts applied. This adjustment is made by selecting R101 and is done at time of assembly.

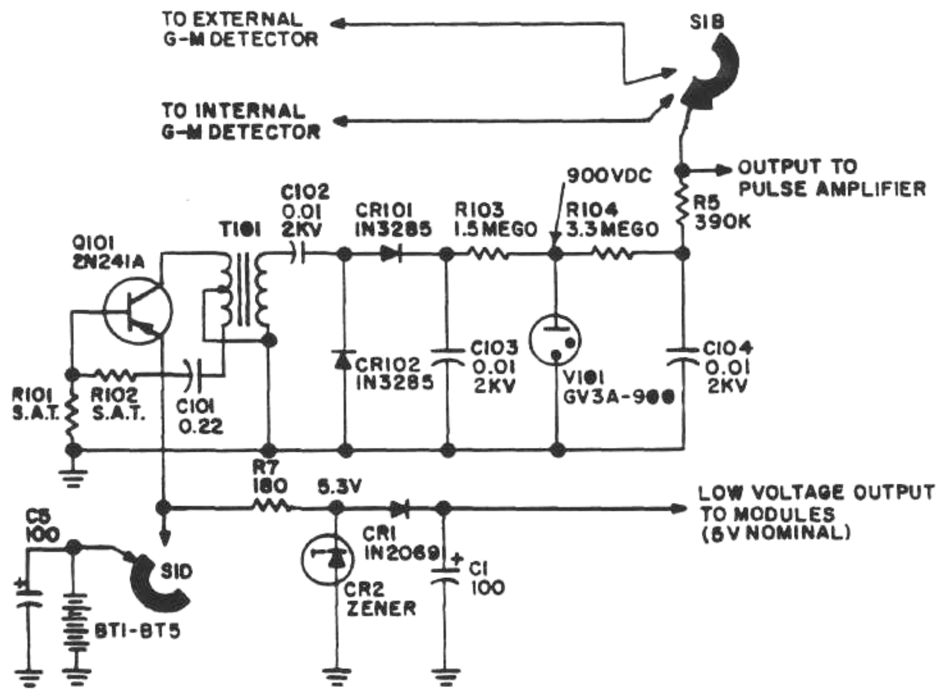


Figure 3-4. Schematic of High and Low Voltage Power Supplies with Detector Circuits

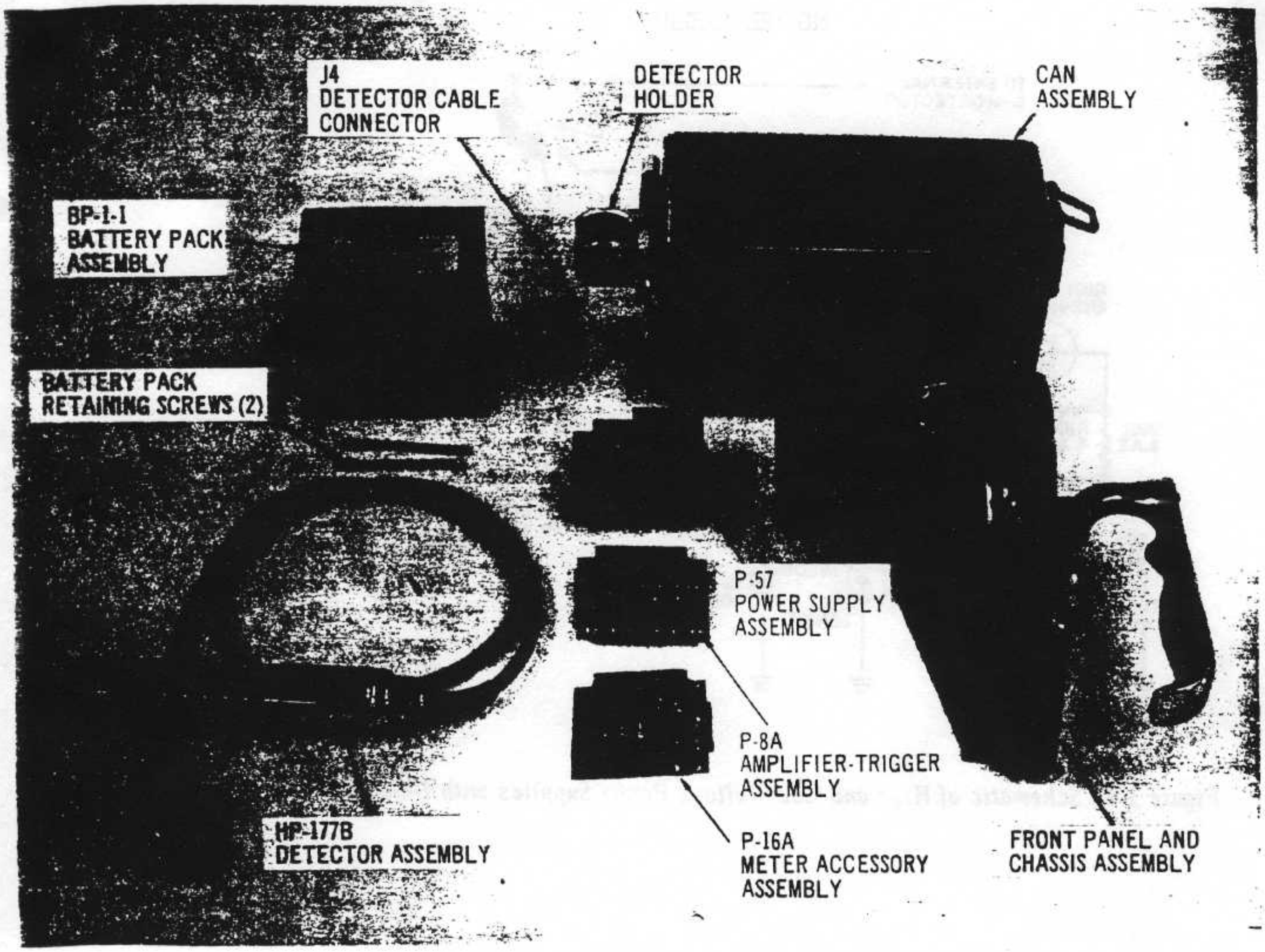


Figure 4-1. Composite Assemblies of the Model E-500B Geiger Counter

SECTION IV
MAINTENANCE

A. DISASSEMBLY AND REASSEMBLY.

1. DISASSEMBLY,

a. E-500B See Fig. 4-1.

Basically the complete instrument consists of three sub-sections.

They are:

(1), Detector assembly.

(2). Electronic chassis, control panel and plug-in modules.

(3). Can Assembly.

The electronic chassis and control panel may be removed from the can by releasing the spring loaded latches and lifting the electronics section out of the case.

WARNING

The high voltage in this instrument is dangerous. Avoid contact with high voltage points.

b. Printed Circuit (PC) Assemblies.

To remove the modular PC boards, remove the retaining screw then work the board from side to side, maintaining a constant pull until the board is free.

CAUTION

DO NOT work the board loose with a front to back movement.

WARNING

Short high voltage to ground before removing P-57 Assembly. See Fig. 7-1.

c. Battery Pack Assemblies.

(1). BP-1, Standard Equipment.

The BP-1 batteries may be removed and/or replaced by removing the two binder head screws in the phenolic cover. This cover will be spring loaded if the assembly contains batteries. Hold cover securely in place until both screws are removed. Remove cover and batteries.

The BP-1 assembly retaining screws are recess mounted through the phenolic cover.

(2). BP-2.

The BP-2 assembly must be removed in order to service the batteries.

The assembly may be removed by disengaging the retaining screws.

On the BP-2, the retaining screws are fillister head captive type located on the side of the assembly.

Remove the two flathead screws in the black cover for access to the LR-5 or Mallory mercury batteries.

2. REASSEMBLY.

When installing the PC assemblies, be sure they are positioned correctly before they are pushed into the socket. Replace retaining screw.

When replacing the batteries or Battery Pack Assembly use the reverse of the disassembly procedure outlined above.

CAUTION

When reassembling either Battery Pack to the chassis, be sure the battery connectors line up before forcing it into place and securing it with the retaining screws.

When replacing the electronics in the can, align the HV Contactor in the can with the one on the chassis. Gently slide the chassis into can. Be sure the can edge fits properly in the seal groove on the panel. Secure latches.

Connect the detector assembly to the case, hand tight ONLY, do not use tools.

B. PREVENTIVE MAINTENANCE.

The E-500B has been designed as a weather resistant instrument. However, the instrument and accessories should be kept as clean and dry as possible.

1. CLEANING THE ASSEMBLY.

The instrument should be removed from its case periodically and checked for moisture condensation and dirt. See para. A, Disassembly.

If moisture is evident inside the instrument, permit to "air" dry before reassembly. Inspect O-ring seal around instrument edge for damage.

To remove dust and dirt, use a camel hair brush to loosen dirt and a vacuum cleaner to remove the dirt. Do not use a blower since this may cause dirt to lodge in places where critical voltages exist and provide leakage paths which may cause erratic readings and/or failure of the instrument.

Remove the detector assembly from the instrument. Inspect all connectors for dirt, metal filings and moisture. Clean the connectors with a camel hair brush and alcohol. DO NOT use any other type of solvent. Other types of solvent may cause deterioration of the insulation and/or the surfaces adjacent to the connector.

2. DECONTAMINATION.

Refer to Section II, D, Shutdown from Operation for decontamination procedures.

3. BATTERIES.

Always replace the batteries whenever their check reading is below the green area on the meter.

Never leave the batteries in the instrument if it is to be in an inactive status for any length of time.

When the wet cell pack (BP-2-1) is used, recharge at monthly intervals or sooner if the meter reading on BATT CHECK drops below green area or an unsteady reading is observed when the check is made.

C. CALIBRATION.

1. REQUIREMENTS.

A calibrated gamma source range is required.

2. PROCEDURE. See Fig. 4-2.

a. The E-500B was completely calibrated on a Cesium 137 source range before leaving the factory. Recalibration is recommended when the check source reading changes by approximately 20%.

b. When the E-500B requires recalibration, the following procedure is recommended.

Turn scale switch to the OFF position.

Remove the instrument from the case.

WARNING

The high voltage in this instrument is dangerous. Avoid contact with high voltage points.

CAUTION

The gamma field can be injurious to personnel. Apply normal gamma range precautions.

Using a shielded clip lead, connect high voltage and ground contacts in the case to those on the chassis. See Fig. 4-3. Place the instrument and case, with the external detector (HP-177B) connected and beta shield closed, on the gamma range at a position that will yield approximately 3/4 scale reading.

Turn the instrument ON and set scale switch to the appropriate scale. Allow sufficient time for the instrument to stabilize, then adjust the appropriate calibration potentiometer so the meter indicates the correct value for that position.

c. Repeat the above procedure for each of the other four scales. On the X100 scale the instrument should be replaced in the case.

Point the front of the case toward the source at the range position that provides approximately 1.5 R/hr. It will be necessary to remove the instrument from the case to adjust the X100 calib. pot.

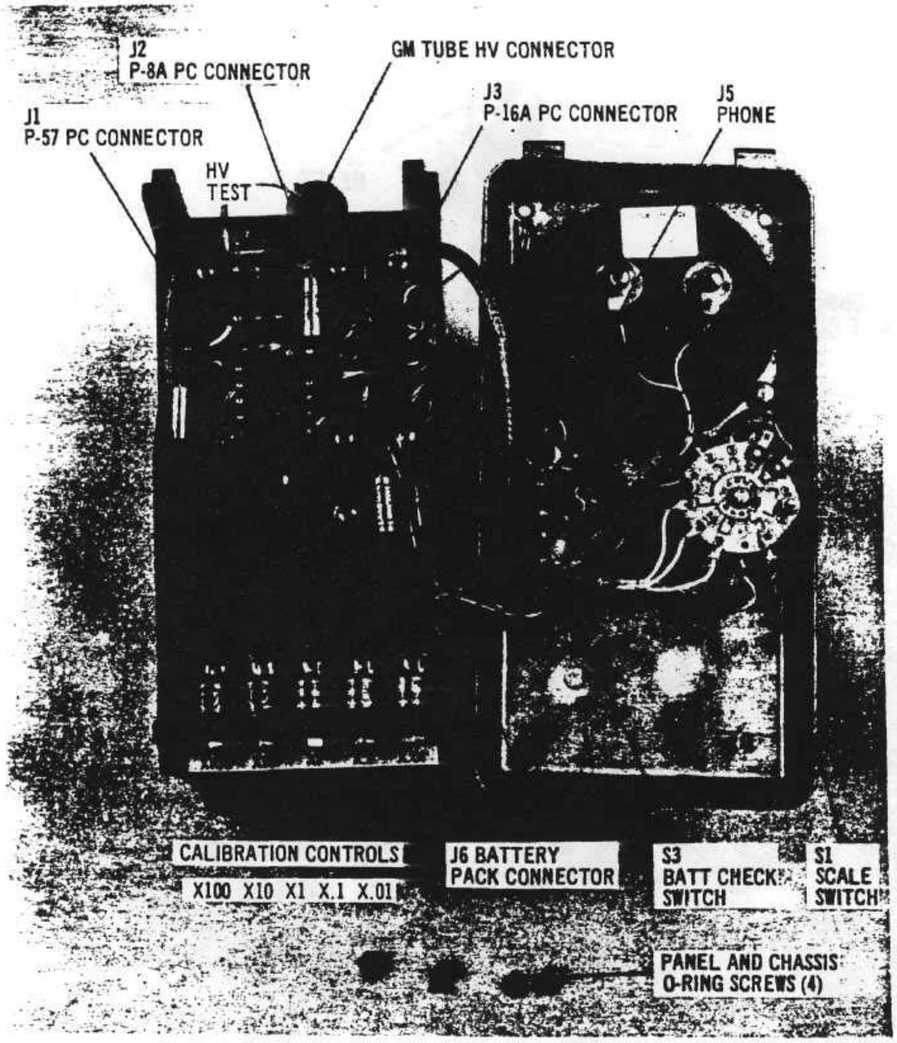


Figure 4-2. Front Panel and Chassis Layout

D. REPAIR PRECAUTIONS.

See disassembly and reassembly.

1. BATTERIES. Remove batteries or battery pack before starting any continuity checks or replacement of components on the chassis assembly.

2. METER SAFETY. The indicating meter in this instrument is very sensitive. Should it be necessary to check continuity in the instrument, place a jumper across the meter terminals.

3. SOLDERING.

a. Always use heat sinks on diodes and transistors.

b. Use a low wattage soldering iron on PC assemblies.

c. Do not overheat the PC boards.

4. CHASSIS AND PANEL REPAIR.

Should it be necessary to repair or replace any of the components on the chassis or panel, remove the four O-ring screws at the comers of the control panel. The panel will then unfold approximately 90° away from the chassis, providing easy access to components and terminals. Do not lose the O-ring screws since they provide part of the weather-resistant feature of the instrument.

F. TROUBLE SHOOTING.

A possible source of trouble in the instrument is dirty or corroded contacts. This trouble may be located at any of the plug-in module sockets or cable connectors. The best procedure for localizing the trouble is suggested below.

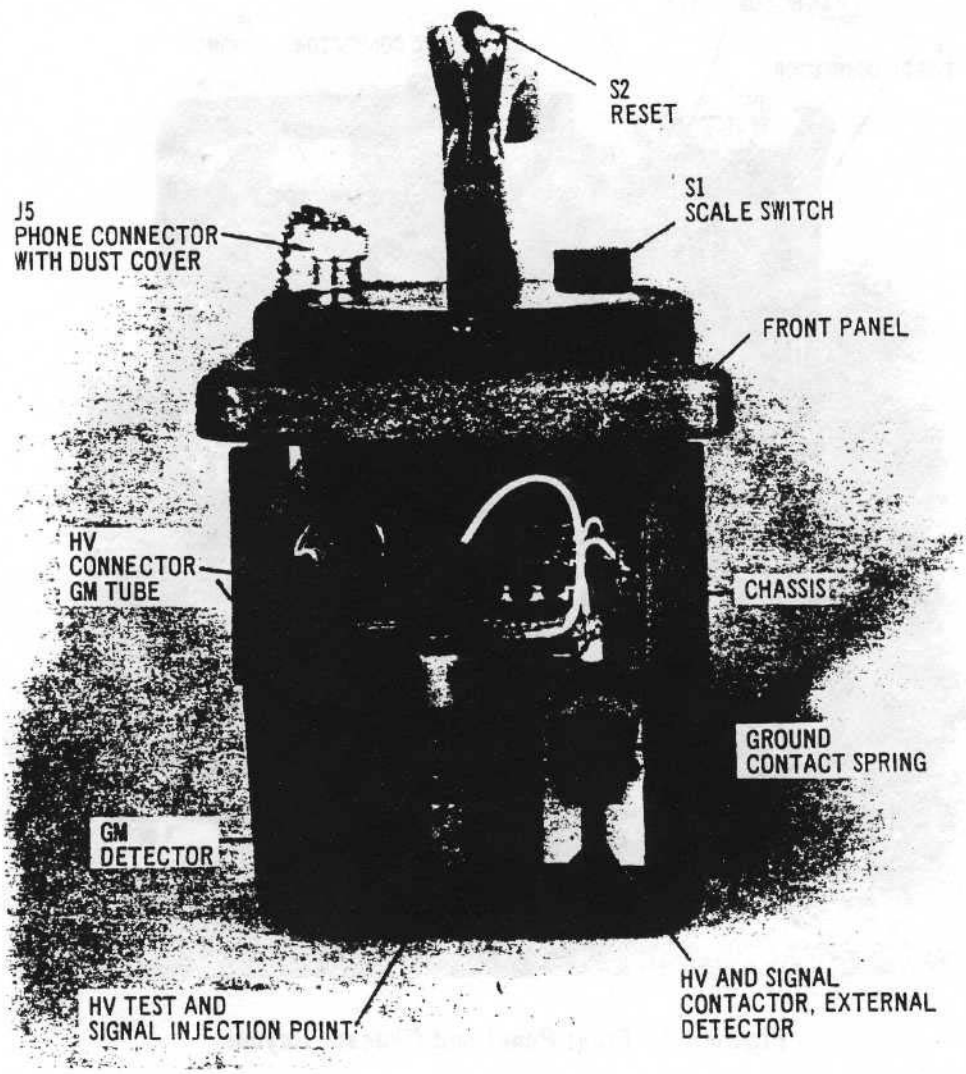


Figure 4-3. Front End View of Chassis

1. Clean detector cable connectors (primarily be sure the inner conductor contact and insulator is clean).

2. Clean each of the plug-in module contactors on each assembly (Use a soft pencil eraser, do not use any abrasive).

3. Bend plug-in socket contacts together (Use a soldering aid or similar tool).

4. While each sub-assembly is out of the instrument inspect each for broken and/or burnt components, broken leads and solder joints and broken conductor paths on the etched board.

Should this fail to correct the fault, it is suggested that the following checks be made.

1. Check supply voltage from battery pack. (5.8 or more volts). Also at contactor "A" of the P-8A Assembly (5.2± .2 volts).

2. Check HV output to detector (900 VDC ±20). Replace P-57 assembly if no voltage is present.

3. Replace P-8A Amplifier-Trigger Assembly.

4. Replace P-16A Meter Accessory Assembly.

5. Check continuity of sub-assembly wiring and components. See paragraph D-2 above.

SECTION V

SPECIAL INSTRUCTIONS

A. PREPARATION FOR USE.

1. INITIAL RECEIPT.

When the instrument is initially received it should be unpacked and the instrument and accessories checked for completeness and condition.

2. SHIPPING DAMAGE CHECK.

Remove the electronics assembly from its case and inspect for any shipping damage, such as. loose or broken wires, loose terminals, sockets and damaged meter.

3. BATTERY INSTALLATION. See Para D below for types of batteries.

Install batteries if they have been shipped separately. Be sure to align batteries according to polarity. When replacing the battery box cover align the stationery key pin with hole in cover provided.

4. REASSEMBLE.

a. Replace instrument in its case and fasten spring latches. See Section IV, A.

b. Install detector assembly.

5. OPERATIONAL CHECK.

a. Turn scale selector switch to X100 scale.

b. Press BATT CHECK switch and check battery condition.

c. Set scale selector switch to scale that matches check source reading.

d. Place check source next to external detector, with beta shield closed.

e. The meter should indicate in the vicinity of half scale on the XI range. The exact reading should be recorded for future reference.

f. Turn scale selector switch to OFF.

g. The instrument is now ready for use.

B. SHIPPING THE INSTRUMENT.

1. Thoroughly clean the instrument and accessories and if possible, check for any contamination.

2. Set scale selector switch to OFF.

3. Remove headset or speaker assembly.

4. Remove batteries.

5. Remove detector and cable.

6. Place the instrument in a plastic bag. In very humid areas, place a dessicant compound in the bag also. Evacuate as much air as possible and seal the bag.

7. Treat the accessories in the same manner as the instrument using one or more plastic bags.

8. Pack in a shipping carton large enough to accommodate the instrument and accessories with several layers of flex-hair or equivalent for shock and vibration protection. Separate the assorted plastic bag to prevent damage from rubbing together.

C. STORING THE INSTRUMENT.

1. SHORT TERM STORAGE.

a. Clean the instrument and accessories thoroughly and if possible, check for any contamination.

b. Remove batteries if the instrument is to be inactive for 30 days or longer.

c. Store in a clean dry place.

2. LONG TERM STORAGE.

It is recommended that the instrument and accessories be treated in the same manner as is recommended for shipping in paragraph B above, omitting the packing and shipping container.

D. BATTERY SELECTION AND OPERATING CONDITIONS.

The instrument upper operating temperature limit is governed by component limits. The lower temperature limit varies with the type of battery used. Any of the battery pack assemblies will give satisfactory results in extreme low temperatures (-40°F) for one to four hours of continuous operation. However, when operating for longer periods under adverse conditions the following criteria are suggested:

1. BP-1 (-X) Battery Pack Assembly with D size cells:

a. Carbon-Zinc (-1) or RM-42 Mercury (-2) +15°F

b. Alkaline (-3) or Ni-Cad (-4) -20°F

2. BP-2 (-X) Battery Pack Assembly with special batteries.

a. Yardney LR-5(-l) -40°F

b. Mallory Mercury (-2) +15°F

SECTION VI
PARTS LIST

A. ASSEMBLIES.

The following assemblies make up the standard Eberline Geiger Counter, Model E-500B. These assemblies are available from Eberline Instrument Corporation. Complete customer service for repair and/or reconditioning of these assemblies is available.

10372-00	E-500B (Basic)
P-57	Power Supply Module Assembly
P-8A	Amplifier Trigger Module Assembly
P-16A	Meter Accessory Assembly
BP-1-1	Battery Pack Module Assembly (Standard Equipment) (contains 5 ea. size "D" ZnC Dry Cells) See Section V, D.
CJ-2	Connector, can mounted (J4 Detector Cable Connector)
HP-177B	Beta-Gamma GM Detector Assembly with 3 feet coax cable and CJ-1 connector
CS-7	Cesium 137 Check Source
10125-B99	Carrying Strap, 62"
BA-201	Headset, Single phone (Standard Equipment)

B. ACCESSORIES.

The following accessories and/or assemblies may be used with the E-500B to expand the versatility of the instrument. These items may be substituted, in lieu of certain items in the standard "make up" of the instrument for special purpose application. Refer to Eberline Instrument catalog for details concerning the utilization of these items. Should further question arise, please contact the Sales Department of Eberline Instrument Corporation or a Regional Office.

SK-1	Speaker Assembly
BP-2-1	Yardney Wet Cell Battery Pack Assembly See Section V, D.
BP-2-2	Mallory Mercury Battery Pack Assembly

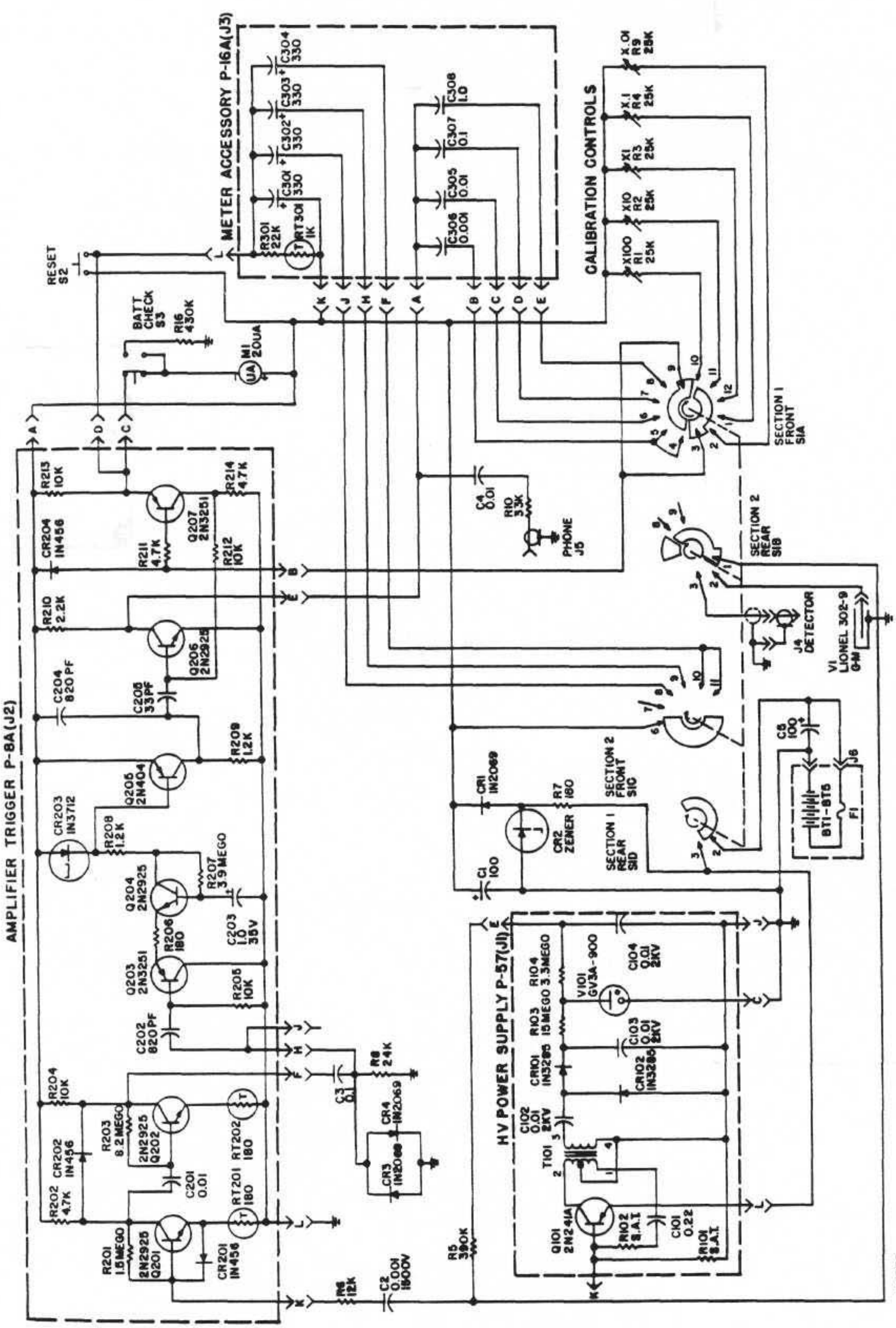
C. ELECTRICAL PARTS LIST BY SUB-ASSEMBLIES.

REF DESIG	NAME	DESCRIPTION	VENDOR
1. Chassis, Cover and Can Assembly, E-500B.			
Cl, C5	Capacitor	100MFD,10V, tantalum	SCM107GP010A4 Texas Instruments
J1-J3	Socket	P.C.	K10S, Winchester
J4	Connector	CJ-2(can mounted)	10337-00, EIC
J5	Connector	Phone, UG657/U	
J6	Connector	Battery (chassis mounted)	
Ml	Meter	20 ua less than 5000 ohm impedance, Meter Face 10060-01	EIC

REF DESIG	NAME	DESCRIPTION	VENDOR
R1-R4,R9	Potentiometer	25K Log taper	GA2MD28S253RC Allen Bradley
RI0	Resistor	33K,l/2W,10%	
R16	Resistor	430K,l/2W,5%	
SI	Switch	Power & Scale, Rotary Push-	10125-67,EIC
S2	Switch	Button, RESET Push-	39-12, Grayhill
S3	Switch	Button,BATT CHECK	1PB5, Minn-Honey well
VI	Tube	GM	302-900V,Lionel
2. TB1, Terminal Board (Part of Chassis Assembly with the following components)			
C2	Capacitor	0.001MFD,1500V,ceramic max. size 7/16" Dia.	808-001 Z5V0120M Erie
C3	Capacitor	0.1MFD,200V	P123 ZG,Aerovox
C4	Capacitor	0.01MFD,200V	P12 3 ZG, Aero vox
CR1CR3.CR4	Diode	IN 2069	
CR2	Diode	Zener, 5.3V + 0.2 at 5ma	DZ50517A, Dickson
R5	Resistor	390K, l/2W,10%	
R6	Resistor	12K,l/2W,10%	
R7	Resistor	180 ohm, 1/2 W, 5%	
R8	Resistor	24K,1/2W, 5%	
	Terminal Bd	Complete Assembly	10125-92 EIC
3. Battery Pack Assembly (BP-1) See Para. A and B above.			
BT1-BT5	Batteries	Size "D"	See Accessories
4. P-16A Meter Accessory Assembly.			
C301-C304	Capacitor	330MFD, 6V, tantalum + 20%	
C305	Capacitor	0.01MFD,200V	P123ZG Aerovox
C306	Capacitor	0.001MFD,200V	P123ZG, Aero vox
C307	Capacitor	0.1MFD,2D0V	P12 3ZG, Aerovox
C308	Capacitor	1.0MFD,2D0V	P12 3ZG, Aerovox
R301	Resistor	22K,1/2W,5%	
RT301	Thermistor	lK,Grade 1	#D203,Carboloy, Div.G.E.

REF DESIG	NAME	DESCRIPTION	VENDOR
5. P-8A Amplifier-Trigger.			
C201	Capacitor	0.01MFD,100WVDC,±20% moulded	MC80V103AM Aerovox
C202,C20.4	Capacitor	820PFD,100WVDC,±2D% moulded	MC80V821M Aerovox
C203	Capacitor	1.0MFD,35WVDC,tantalum	K1J35Kemet
C205	Capacitor	33PF,100WVDC, ±20% moulded	MC80V330AM Aerovox
CR201,CR202 CR204	Diode	Silicon, 1N456	
CR203	Diode	Tunnel, 1N3712	
Q201,Q202 Q204,Q206	Transistor	Silicon,NPN,2N2925	
Q203,Q207	Transistor	Silicon,PNP,2N3251	
Q205	Transistor	Germanium,PNP,2N404	
R201	Resistor	1.5MEGO,±10%,l/4W,carbon	
R202,R211 R214	Resistor	4.7K,±10%,l/4W,carbon	
R203	Resistor	8.2MEGO,±10%,l/4W,carbon	
R204,R205,R213, R212	Resistor	10K,±10%,l/4W,carbon	
R206	Resistor	180 ohm, ± 10%, 1/4W, carbon	
R207	Resistor	3.9MEGO,±10%, l/4W,carbon	
R208,R209	Resistor	1.2K,±10%,l/4W,carbon	
R210	Resistor	2.2K,±10%,l/4W,carbon	
RT201,RT202	Sensistor	180 ohm at 25°C	TM1/8 Texas Instruments
6. Power Supply P-57.			
C101	Capacitor	.22MFD, 200V, paper	P123ZG Aerovox
C102-C104	Capacitor	.01MFD,2KV, 13/16" Dia.maximum	BL Buffer Sprague
CR101,CR102	Diode	IN 3285,Selected special	EIC
Q101	Transistor	2N241A	
R101	Resistor, Selected	l/2W,5%,Selected 180K Nominal,carbon	
R102	Resistor, Selected	l/2W,5%,Selected 2.2K nominal,carbon	
R103	Resistor	15MEGO,l/2W,10%,carbon	
R104	Resistor	3.3MEGO,l/2W,107c,carbon	
T101	Transformer	Special	10031-175 EIC
V1O1	Tube	900V Corona Regulator	GV3A-900,Victoreen

SECTION VII
DIAGRAMS



NOTES
1. UNLESS OTHERWISE NOTED, CAPACITOR VALUES ARE IN MICROFARADS, RESISTOR VALUES ARE IN OHMS.
2. S.A.T. = SELECTED AT TEST BY MANUFACTURER.
3. F1 FUSE IN BP-2 ONLY.
4. COMPONENT VALUES MAY DIFFER SLIGHTLY FROM ACTUAL VALUE IN THE INSTRUMENT.

Figure 7-1. General Schematic of Model E-500B