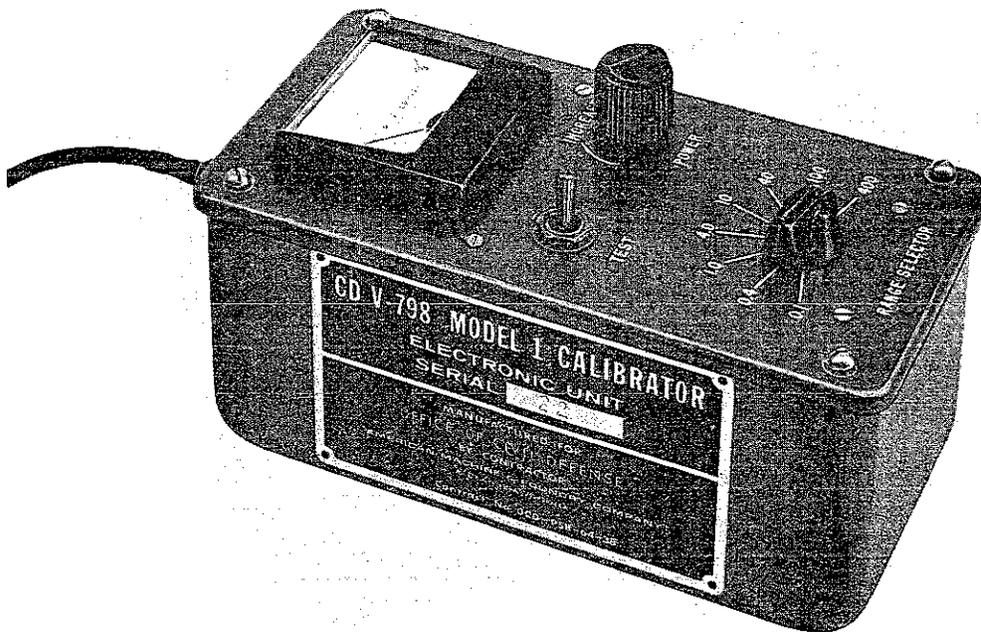


Instruction and Maintenance Manual

RADIOLOGICAL SURVEY METER CALIBRATOR

OCD Item No. CD V-798, Model 1

ELECTRONIC UNIT



AMERICAN MACHINE & FOUNDRY COMPANY
ALEXANDRIA DIVISION

1025 NORTH ROYAL STREET, ALEXANDRIA, VIRGINIA 22314 • 703 548-7221

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I. WARNINGS - High Impedance Circuitry

The output circuit of this instrument has very high resistance. Any accumulation of dirt or grease on the output connector or the cable connectors will contribute to leakage currents and cause inaccurate readings on the radiological survey meter being tested. The instrument and cables should be stored in a clean, protected location.

II. GENERAL DESCRIPTION

A. Introduction

The CD V-798 Model I Calibrator Electronic Unit, is a portable electronic calibrator for radiological survey meters, Type CD V-715 Model 1A, by Landers, Frary and Clark and Victoreen Inst. Co. and Type CD V-717 Model 1, by Victoreen Inst. Co. It is contained in a metal box approximately 3-1/4" x 4-1/4" x 8-1/4". The output and ground connectors are on one end and all controls and a meter are located on the top panel. The instrument is shown in Figure 1.

B. Cables

Three cables are supplied. Each cable has a connector which mates with the calibrator on one end and a special connector which mates with the survey meter on the other end.

C. Circuit

All the electronic components are attached to the panel of the instrument as shown in Figure 2 making it possible to remove the case with no disassembly of parts. The circuit generates a small current through the output connector. This small current is used to simulate the ionization chamber current in the survey meter.

D. Battery

The calibrator is powered by two 6 volt cells (NEDA 2). Battery life will be greater than 500 hours.

E. Meter and Controls

The Electronic Unit uses a meter and three controls. One control is a switch which selects the range; another control is used to set the

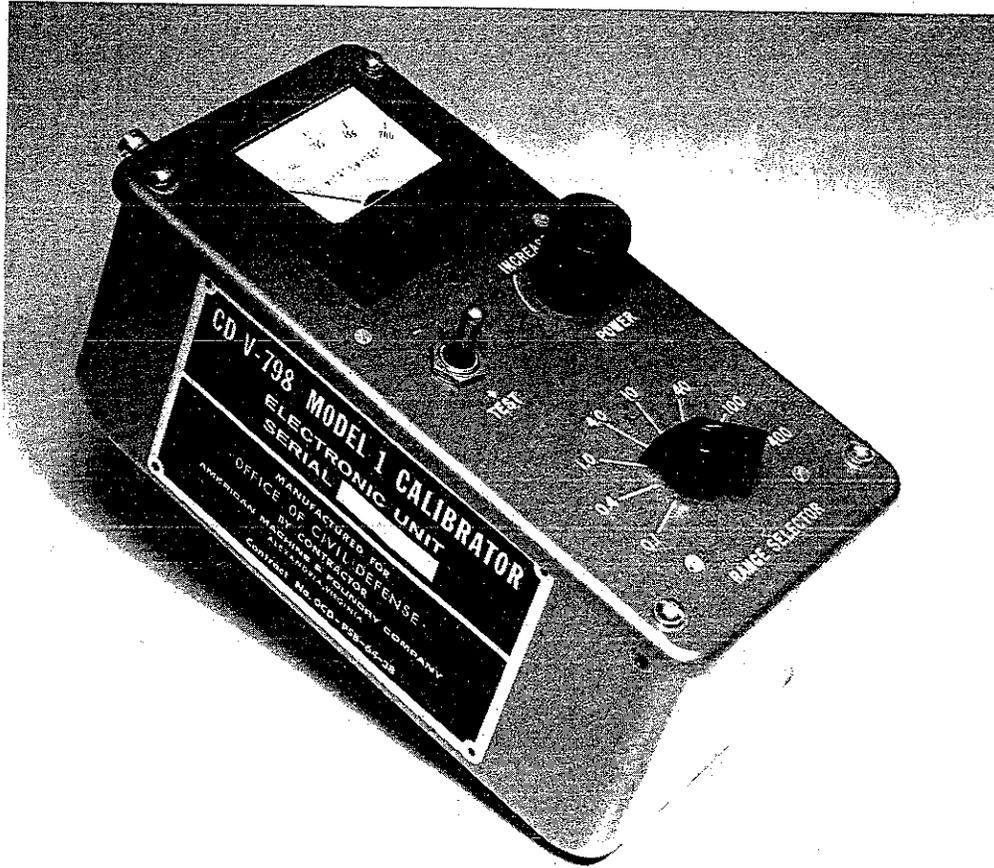


Figure 1. Operating Controls, and Case

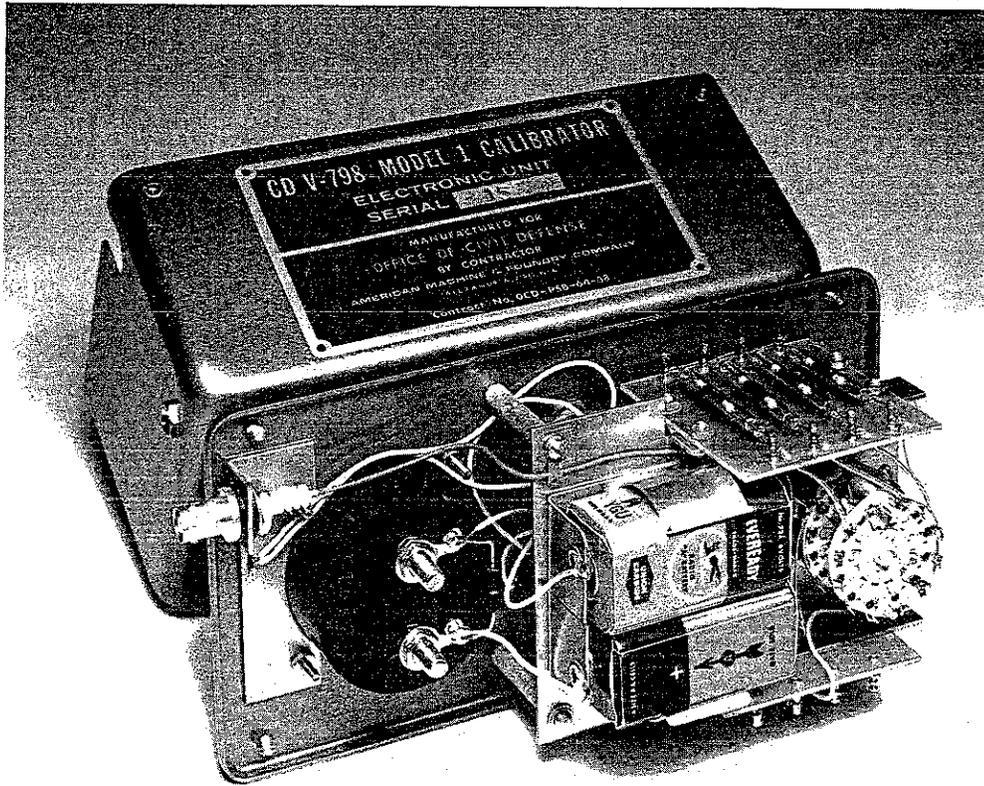


Figure 2. Inside View of Components

output current; and a third control switches the instrument on. This switch is momentary in two directions. Reversing the direction of the switch reverses the polarity of the output current.

III. THEORY OF OPERATION

A. Circuit

The basic circuit is shown in Figure 3. A known current is passed through resistors R_4 and R_5 to provide a known voltage across these resistors with a ratio of four to one. One or the other of these voltages is applied to the survey meter through a large series resistor R_6 . The large series resistor is used to make the calibrator a current source. Adjustable resistor, R_2 is used to adjust the current through R_4 and R_5 to the correct value. The voltage drop across both R_4 and R_5 will produce a current through R_6 and the input resistance of the survey meter which will give an indication of "four" on the survey meter scale and the lower voltage across only R_5 will give an indication of "one" on the survey meter. The selection of high or low voltage and series resistor R_6 is accomplished when the range switch on the calibrator is set.

B. Test Switch

The test switch is a momentary type toggle switch with an off position in the center. Holding this switch in the "+" position will produce a current in the positive polarity on the center conductor of the output cable. Holding the switch in the "-" position makes the center conductor negative. These two output polarities are necessary to permit the calibrator to be used on survey meters requiring either positive or negative voltage on the electrometer tube.

C. Case Ground

The case ground places the container of the calibrator at the same potential as the case of the survey meter. This ground reduces the movement of the survey meter indicator when the operator's hands are moved near the instruments.

IV. INSTALLATION

A. Inspection

The instrument is shipped with batteries removed and packed separately. Inspect the instrument for damage in shipment. If damage

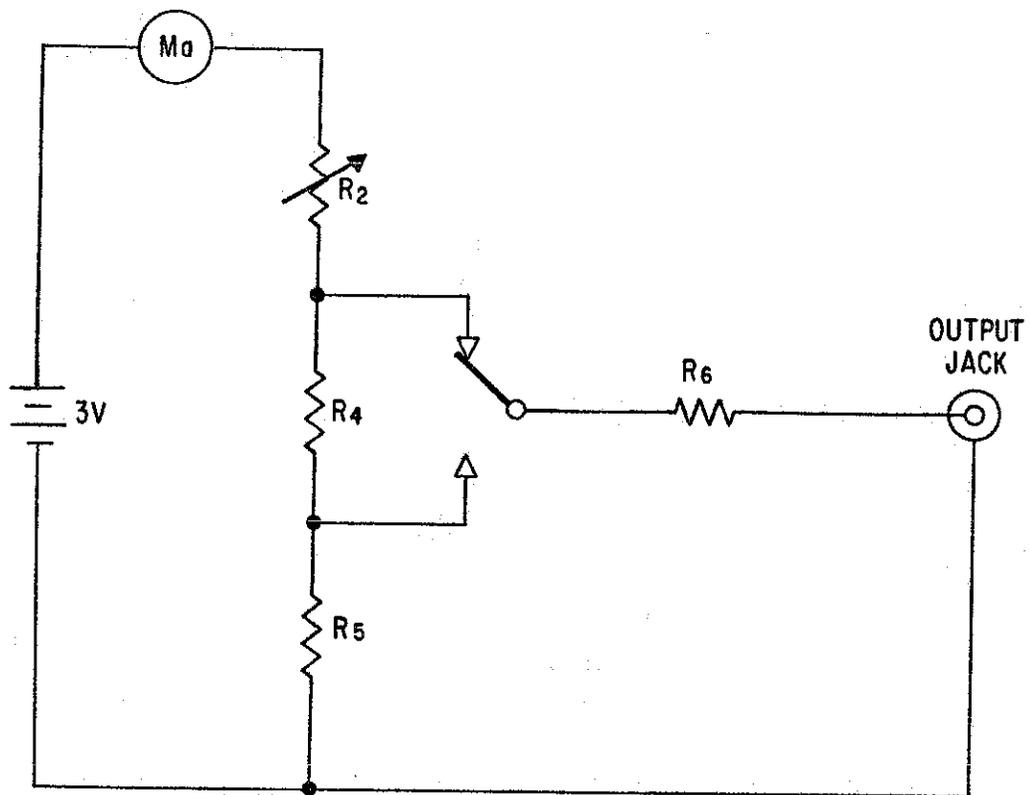


Figure 3. Basic Circuit

is apparent the batteries should not be installed and the instrument should not be used. Inspect the batteries for possible leakage before installation. Do not install a leaking battery.

B. Battery Installation

Open the instrument by unscrewing the four round-head screws on the panel. These screws are retained by the panel and need not be removed from the panel. Insert two batteries in the battery box observing the polarity indicated on the bottom of the battery box. Close the instrument and tighten the four screws to hold the panel to the box.

V. OPERATING INSTRUCTIONS

A. Radiation Unit Check

Calibration of the x 0.1 range should be checked first in the CDV-798, Model 1, Radiation Unit. Operate the Radiation Unit in accordance with the instruction manual for that instrument and perform the following:

1. Adjust the shelf height to the position specified in the manual to produce a reading of 400 mr/hr. on the Radiological Survey Meter. (Use 350 mr/hr for CDV-717 Model 1 by Victoreen Instrument Co.)
2. Note actual meter reading at the 400 mr/hr (or 350 mr/hr) shelf position.
3. Remove instrument from Radiation Unit.
4. Connect Electronic Calibrator as described in paragraph V, B below.

B. Connecting Electronic Calibrator

1. CD V-715, Model 1 by Victoreen Instrument Co.
 - a. Remove case bottom.
 - b. Remove four screws holding ion chamber to case.

- c. Carefully remove ion chamber by lifting away from case. Take care not to lose the spring around the ion chamber electrical connector.
 - d. Plug a ground lead into the banana ground jack on the calibrator and attach the alligator clip to the survey meter case casting at an unpainted point.
 - e. Attach cable RS 2023 to the BNC connector on the calibrator. Place the probe on the other end of the cable through the hole in the printed circuit which was exposed when the ion chamber was removed. Attach the bracket on the probe under the nearby screw.
2. CD V-715, Model 1A by Landers, Frary and Clark
- a. Remove case bottom.
 - b. Remove the two ion chamber mounting screws nearest the battery holder. Note the positions of the insulating washer and metal washers on these screws.
 - c. Loosen the other two ion chamber screws just enough to permit the edge of the ion chamber to swing about one half inch away from the printed circuit board.

CAUTION

If the ion chamber is pulled too far away from the printed circuit board, the ion chamber electrical connection will be pulled off and it will be necessary to disassemble the instrument in order to replace the connection.

- d. Plug a ground lead into the banana ground jack on the calibrator and attach the alligator clip to the survey meter ground. (Case casting or lug on zero pot case)
- e. Attach cable RS 2021 to the BNC connector on the calibrator. Connect the blue ground wire under the printed circuit mounting screw nearest the negative end of the battery. Position the lug on the blue wire carefully so that it does not contact any nearby conductors on the printed circuit. Place the probe between the ion chamber and the printed

circuit and attach the hook on the probe to the rod conductor on the ion chamber. Tightening one of the loosened ion chamber mounting screws will help hold the probe in position.

- f. Attach the ground wire with two alligator clips between the ion chamber outside metal shell and ground. (Clip on the ion chamber flange and on the case casting or on other alligator clip on lug of zero pot case).
3. CD V-717, Model 1 by Victoreen Instrument Co.
 - a. Open case at the joint nearest the top of the instrument.
 - b. Plug a ground lead into the banana ground jack on the calibrator and attach the alligator clip to the flat grounding spring at the side of the printed circuit in the survey meter.
 - c. Attach cable RS 2022 to the BNC connector on the calibrator. Place the probe in the ion chamber connection hole in the printed circuit and attach the mounting bracket to the nearby screw.

C. Calibration of Survey Meter

1. CD V-715 Model 1 by Victoreen Instrument Co. and CD V-715 Model 1A by Landers, Frary and Clark.
 - a. Perform step V, A and connect to calibrator as described under V, B.
 - b. Allow survey meter to warm-up at least 5 minutes.
 - c. Set calibrator range switch to "0.4" position.
 - d. Set survey meter range switch to "X0.1" position.
 - e. Zero survey meter on actual range, not on "zero" position.
 - f. Hold calibrator "Test" switch in "+" position for Victoreen Instrument Co. instruments and in "-" position for Landers, Frary and Clark instruments.

- g. Turn "Power" control on calibrator until meter on survey meter reads the same as that obtained in V, A step 2.

Note

This calibrates the current in the calibrator and care should be taken not to turn the "Power" control during the remaining calibration steps.

- h. Adjust "X. 1 Cal" control if necessary to make survey meter read 0. 4.
- i. Set calibrator range switch to "0. 1" position.
- j. Survey meter should now read 0. 1. If not, adjust "X. 1 Cal" until survey meter reads within tolerance at both 0. 1 and 0. 4 readings
- k. Switch the survey meter to the "X1" range and the calibrator range to "4. 0".
- l. Zero the survey meter on actual range, not on "zero" position.
- m. Operate the "Test" switch on the calibrator.
- n. Adjust "X1 Cal" control on the survey meter if necessary to make the meter read 4. 0.
- o. Set the calibrator range switch to the "1. 0" position.
- p. The survey meter should now read 1. 0. If not, adjust "X1 Cal" until meter reads within tolerance at both 1. 0 and 4. 0 readings.
- q. Repeat steps k through p for the next two higher ranges of the survey meter, using the next higher ranges of the calibrator, being careful to zero the survey meter each time its range is changed.

2. CD V-717 Model 1 By Victoreen Instrument Co.

- a. Perform step V, A using 350 mr/hr shelf position and connect calibrator as described under V, B.
- b. Allow survey meter to warm-up at least 5 minutes.
- c. Since calibrator cannot be set to 0.35 r/hr it will be necessary to calculate the error obtained at the 0.35 r/hr reading in terms of a 0.40 r/hr reading. Do this as follows:

$$\text{Corrected Reading "X"} = \text{Actual Reading} \times 1.14$$

- d. Set calibrator range switch to "0.4" position.
- e. Set survey meter range switch to "X0.1" position.
- f. Zero survey meter on actual range, not on "zero" position.
- g. Hold calibrator "Test" switch in the "+" position.
- h. Turn "Power" control on calibrator until meter on survey meter reads the same as the corrected reading "X" obtained in step 3.

Note

This calibrates the current in the calibrator and care should be taken not to turn the "Power" control during the remaining calibration steps.

- i. Adjust "X.1 Cal" control if necessary to make the survey meter read 0.4.
- j. Set calibrator range switch to "0.1" position.
- k. Survey meter should now read 0.1. If not, adjust "X.1 Cal" until survey meter reads within tolerance at both 0.1 and 0.4 readings.
- l. Switch the survey meter to the "X1" range and the calibrator range to "4.0"

- m. Zero the survey meter on the actual range, not on "zero" position.
- n. Operate the "Test" switch on the calibrator to the "+" position.
- o. Adjust "X1 Cal" control on the survey meter if necessary to make the meter read 4.0.
- p. Set the calibrator range switch to the "1.0" position.
- q. The survey meter should now read 1.0. If not, adjust "X1 Cal" until meter reads within tolerance at both 1.0 and 4.0 readings.
- r. Repeat steps l through q for the next two higher ranges of the survey meter using the next higher ranges of the calibrator being careful to zero the survey meter each time its range is changed.

VI. OPERATOR'S MAINTENANCE

A. Battery Replacement

Battery replacement is indicated whenever the instrument can no longer be adjusted to give the correct indication on a survey meter. To replace the batteries, open the case and install new batteries as described in Paragraph IV, B, Battery Installation.

B. Cleaning

WARNING

DO NOT USE CLEANING SOLVENTS OR
ABRASIVE CLEANERS ON THE PLASTIC
METER CASE.

Clean the meter and instrument case with a damp cloth and soap. Remove traces of soap with a clean damp cloth.

Battery leakage should be removed from the case bottom by filling with warm water and allowing to stand. The battery spillage will be loosened in a short while and can be rinsed out.

VII. PREVENTIVE MAINTENANCE

It is recommended that the preventive maintenance procedures be carried out once a month when the instrument is in use, and about once every six months when the instrument is in storage.

Preventive maintenance should be carried out as follows:

- A. Remove the batteries, clean battery contacts and battery terminals if necessary and remove any corrosion present.
- B. Replace the batteries.
- C. Press "Test" switch in either direction and turn "Power" knob maximum clockwise. If meter reads less than 120 microamperes, replace the batteries.

The batteries should be removed from the instrument and stored separately if the instrument is to be stored more than a few weeks.

VIII. CORRECTIVE MAINTENANCE

A. Dissassembly for Corrective Maintenance

1. Loosen the four round-head screws on the front panel. These screws are self-retaining on the panel and need not be removed from the panel.
2. Remove the box from the panel. All circuit components are attached to the panel allowing the box to be completely removed from the panel.

B. Trouble Shooting

The meter, switches, potentiometer, and low-value resistors are standard parts familiar to electronic technicians and are readily checked by conventional means. The high-megohm resistors require special instruments to read the high resistance values. The insulating portions of the output jack, wafer switch, high megohm resistors, and their mounting board must be clean and should not be handled. If surface leakage on any of these items is suspected, they should be cleaned with reagent grade anhydrous methyl alcohol using a camel hair brush or "Q" tips.

The meter circuit may be checked by moving the "Test" switch to either the "+" or the "-" position. The meter should read approximately 90 microamperes with the "Power" adjustment maximum counter-clockwise and approximately 200 microamperes when the "Power" adjustment is fully clockwise. If this circuit is operating correctly, the trouble may be a defective high megohm resistor, wafer switch, or cable.

The schematic diagram, shown in Figure 4, and the following table of troubles and corrective actions are presented as an aid to trouble shooting:

TROUBLE-SHOOTING CHART

TROUBLE & CAUSE	CORRECTIVE ACTION
<u>No Reading on Calibrator Meter</u>	
Batteries bad	Replace batteries
Corroded battery contacts	Clean contacts
Meter damaged	Replace meter
Bad "Power" Adjustment	Replace potentiometer
"Test" Switch Defective	Replace switch
Open Resistor R_3 , R_4 or R_5	Replace resistor
<u>Calibrator Meter Reads Low</u>	
Batteries Low	Replace batteries
<u>Good Survey Meter Reads Low on x1.0 and/or x0.1 Scale</u>	
Dirty Cable Connectors	Clean cable connectors
Dirty High Megohm Resistors and/or Mounting Board	Clean Resistors and Mounting Board
Dirty Wafer Switch	Clean wafer switch
<u>Survey Meter Reads Off Scale When Case Ground is Attached (all scales)</u>	
Defective insulating washer between case and inner chassis or between case and coaxial connector	Replace defective insulating washer (see note)

Note: Fiber insulating washers must be impregnated with clear varnish and dried before using.

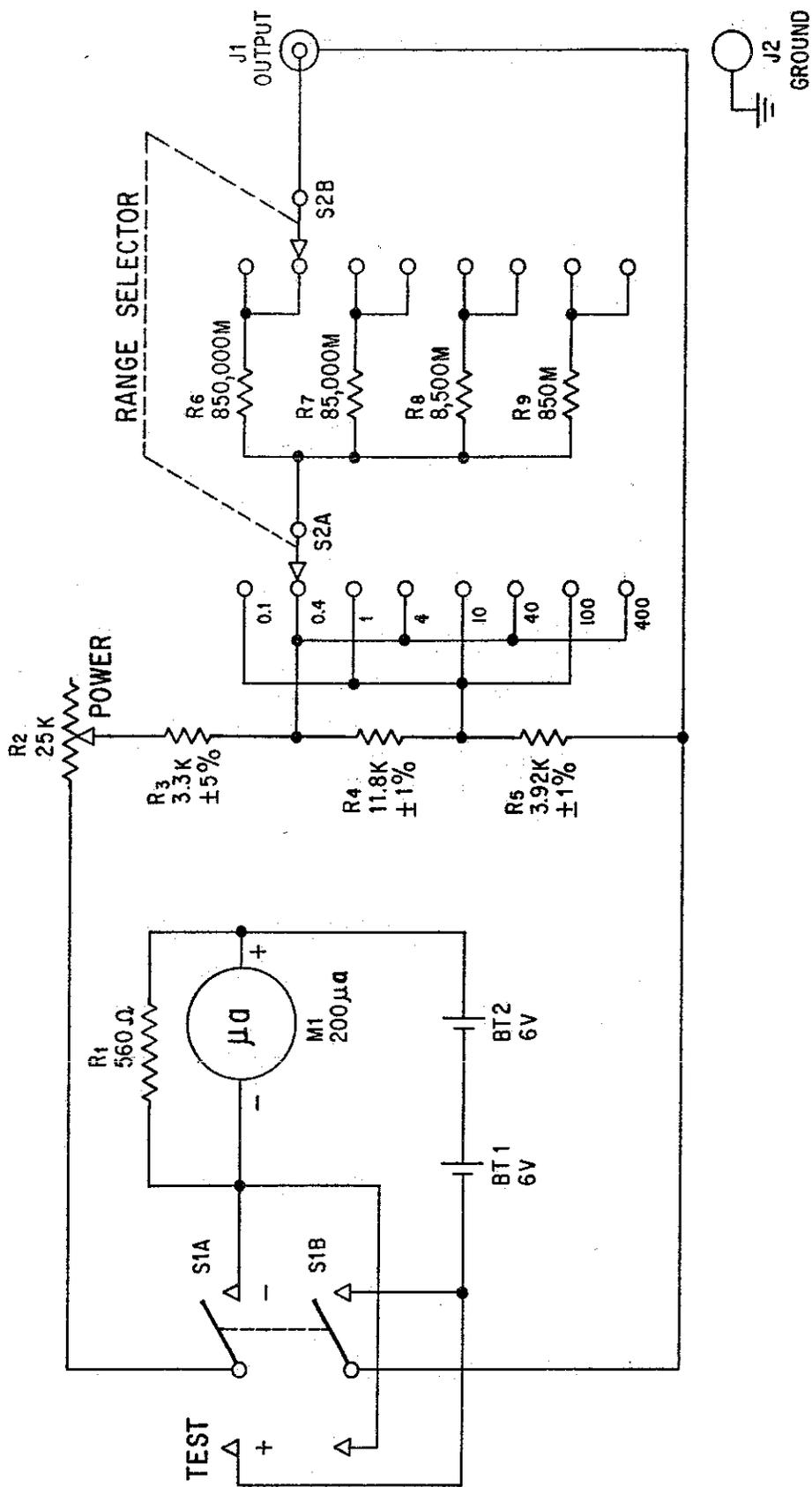


Figure 4. Schematic Diagram

IX. REPLACEMENT PARTS LIST

A. Electrical Components

<u>Circuit Symbol</u>	<u>Description</u>	<u>Function</u>	<u>Manufacturer</u>	<u>Mfr. Part No.</u>	<u>Quantity Per Equipment</u>
BT1	Battery, 6v	Power source	Union Carbide	724	2
BT2	Same as BT1	Power source	-----	---	--
J1	Connector	Output Connection	Dage	3651-1	1
J2	Jack, Banana	Ground Connection	H. H. Smith	101	1
M1	Meter, 0-200 μ a	Current Indicator	Simpson	1227C	1
R1	Resistor, fixed 560 ohm \pm 5%, 1/2W	Meter shunt	----	RC20GF561J	1
R2	Resistor, variable 25,000 ohm \pm 10%, 2W	Current Adjustment	Ohmite	CU2531	1
R3	Resistor, fixed 3,300 ohm \pm 5%, 1/2W	Current Limiter	----	RC20GF332J	1
R4	Resistor, fixed 11,800 ohm \pm 1%	Voltage Divider	----	RN60B1182F	1
R5	Resistor, fixed 3920 ohm \pm 1%	Voltage Divider	----	RN60B3921F	1
R6	Resistor, fixed 850,000 megohm \pm 1%	Output Series Resistor	Victoreen	RX-1	1
R7	Resistor, fixed 85,000 megohm \pm 1%	Output Series Resistor	Victoreen	RX-1	1
R8	Resistor, fixed 8,500 megohm \pm 1%	Output Series Resistor	Victoreen	RX-1	1
R9	Resistor, fixed 850 Megohm \pm 1%	Output Series Resistor	Victoreen	RX-1	1
S1	Switch, DP DT; 3 Position Momentary and Off Switch	Polarity Reversing	Cutler-Hammer	8869K2	1
S2	Switch, rotary 2 poles-8 position	Range Selector	Centralab	PA-2004	1

B. Mechanical Parts

<u>Description</u>	<u>Function</u>	<u>Manufacturer</u>	<u>Mfr. Part No.</u>	<u>Quantity per Equipment</u>
Panel	Top of Instrument	AMF	RS2002	1
Knob	Power Adjust	Raytheon	90-2-2G	1
Knob	Range Selector	Harry Davies	2300	1
Component Board	Supports Resistors	AMF	RS2008	2
Container	Covers Components	AMF	RS2009	1
Chassis - Component	Supports Components	AMF	RS2004	1
Cable	Connects to CD V-715 Model 1A L, F & C	AMF	RS2021	1
Cable	Connects to CD V-717 Model 1 Victoreen	AMF	RS2022	1
Cable	Connects to CD V-715 Model 1 Victoreen	AMF	RS2023	1
Ground Lead	Grounds Case	H. H. Smith	1866-36-102	1
Ground Lead	Grounds Ion Chamber	H. H. Smith	1596-12-103	1