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UNITED STATES ATOMIC ENERGY COMMISSION

MANUFACTURING SPECIFICATIONS FOR THE PORTABLE GM TUBE SURVEY METER

by

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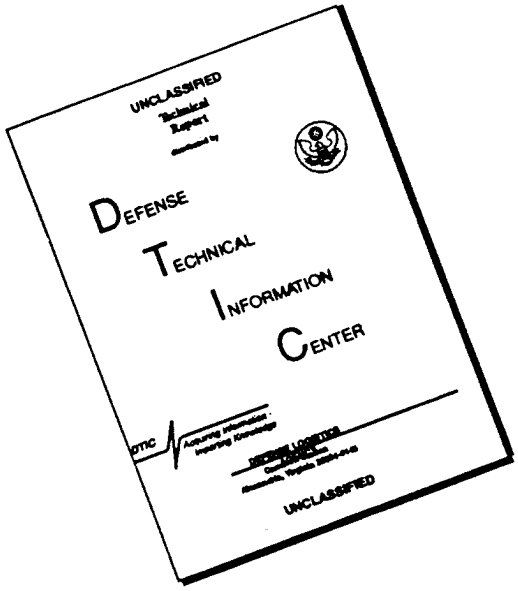

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ERRATUM FOR MDDC-805

It is requested that page 1 of MDDC-805 now in your possession be replaced by the attached revised page 1; also, paragraph 1, page 4, should read "To obtain the correct adjustment for R_{18}, first adjust R_{19} so that its full resistance is in the circuit, then, set the selector switch on position 3 (H.V. set) and vary R_{18} until the meter reads about 46 μa. Next turn the selector switch to position 6 (.001r/8hr) and place a 1 mg radium source about three feet away from the front of the instrument. Vary R_{19} until the meter just starts to indicate pulses. Return the selector switch to position 3 (H.V. set) and adjust R_{18} until the meter reads full scale (50 μa). The proper setting of R_{18} is then determined.

Technical Information Service, Oak Ridge, Tennessee
AEC, Oak Ridge, Tenn., 4-23-51--850-W11632

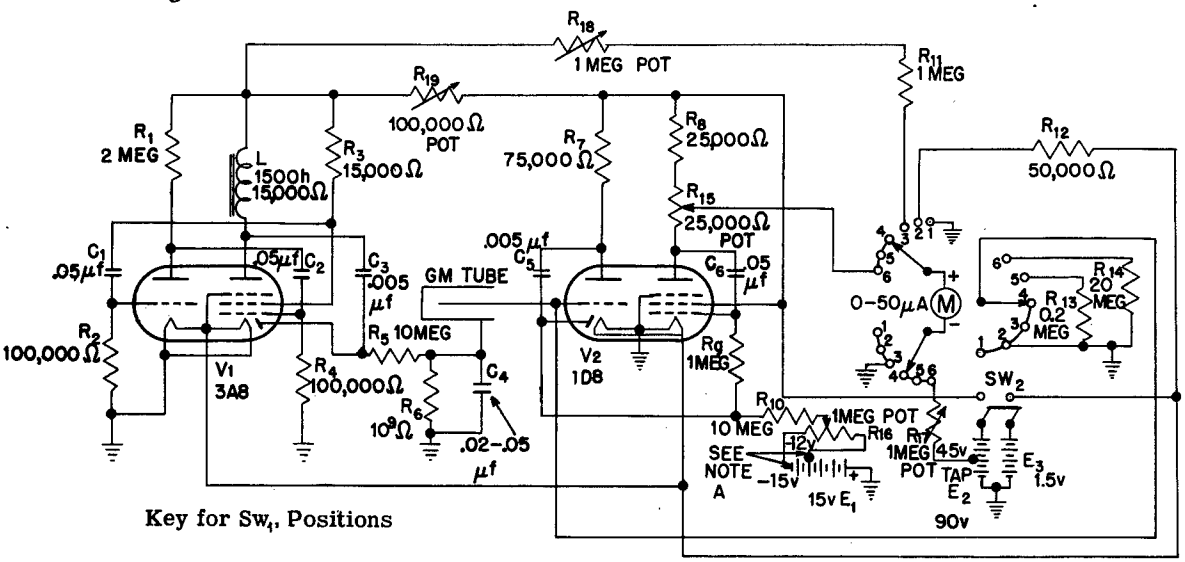
MANUFACTURING SPECIFICATIONS FOR THE PORTABLE GM TUBE SURVEY METER

By John Dorsey

SUMMARY

The following report gives an explanation of the electrical operation of the Portable GM Tube Survey Meter. Also included is a schematic diagram (Figure 1), photograph (Figure 2), diagram showing location and position of labels (Figure 3) and parts list. The development of the Portable GM Tube Survey Meter is due largely to the work of W. H. Hinch.

In order to facilitate understanding of the circuit operation, reference should be made to the schematic diagram.



Key for Sw_1, Positions

1. Short
2. Fil check
3. HV set
4. Zero set
5. .02v/8hr
6. .001v/8hr

Note A: Rig across either -15 to -12 or -12 to -7 v.

R_{15} - Zero set adjustment
R_{16} - Bias adjustment
R_{17} - Sensitivity adjustment
R_{18} - Voltmeter adjustment
R_{19} - High voltage adjustment

Figure 1. Schematic diagram of portable GM tube survey meter.

ELECTRICAL DESCRIPTION

The circuit consists of two tubes: both are diode, triode, pentode types. The 3A8-GT is used as a multi-vibrator to supply the negative high voltage for the Geiger counter. The negative high voltage is obtained as follows. Assuming that the triode section starts conducting before the pentode section (it makes no difference which side starts first), then the plate of the triode becomes less positive. This action makes the grid of the pentode move negative, raising both the screen and plate voltages. The positive change in screen voltage further increases the potential on the grid of the triode. The process is repeated until the bias on the grid of the pentode reaches its cut-off value. At this point

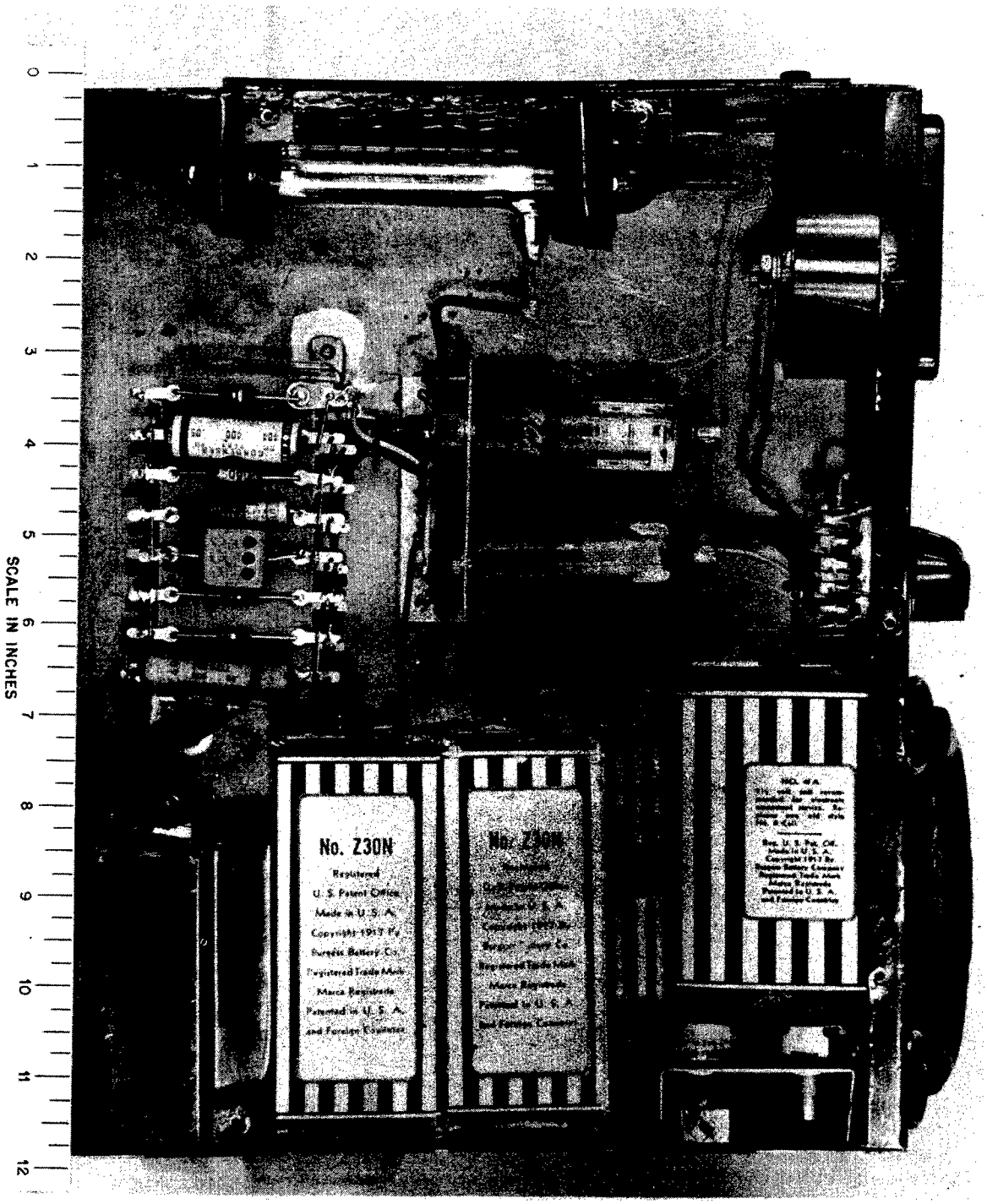


Figure 2. Inside view of portable GM tube survey meter.

there are no changes in voltage taking place, therefore, the charge on the grid of the triode starts to leak off through the resistance R_2. As soon as this occurs the triode plate voltage increases and the process is the reverse of that previously described. All of these actions, of course, take place in a fraction of a second. Due to the rapid change in plate current of the pentode, the 1500 henry reactor acts as a high impedance to the current flow. As a result, a charge is placed on the condenser, C_3, alternating in sign. During the positive cycle electrons are drawn to the diode and held there. During the negative cycle the diode acts as a rectifier and no electrons are collected or lost. With every positive pulse on the diode the charge becomes increasingly negative until an equilibrium condition is reached, that is, until the leakage current is equal to the charging current. Inasmuch as the charge that is collected is negative in sign, the high voltage supply will necessarily be negative with respect to ground potential.

"The second tube, 1D8-GT, is the tube that integrates the pulses from the counter. The integration takes place in the following manner. When a negative pulse from the counter tube is placed on the grid of the triode, the plate voltage rises momentarily. This positive pulse is transmitted to the diode plate through the condenser C_5. Electrons are drawn to the diode and a negative charge is thus collected on the diode and in turn on the grid of the pentode. This increase in negative bias on the grid causes the plate voltage to rise and is shown as a positive reading on the microammeter M. The more numerous the pulses, the greater the reading. By using a grid leak resistor of 20 megohms, the effective voltage heights of the pulses are increased. If less sensitivity is desired, a smaller leak resistor may be used so that the effective pulse height is decreased. Another method of decreasing sensitivity is by changing the normal bias on the grid of the pentode." *

ADJUSTMENT FOR PROPER OPERATION

With the selector switch on position 2 (Fil. check) the meter reading should be 25 μa or greater. If it is not, renew both batteries E_2 and E_3 since their voltages are too low for proper operation. Before renewing these batteries, however, their voltages should be checked to make certain their replacement is necessary.

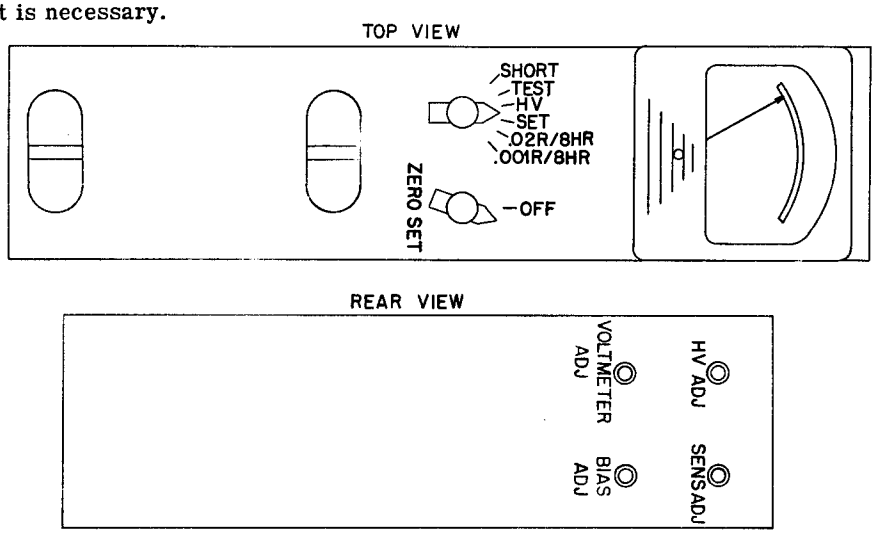


Figure 3. Diagram showing location and position of labels for portable GM tube survey meter.

* From report CP 1161 by William H. Hinch.

To obtain the correct adjustment for R_{18}, set the selector switch on position 3 (H.V. set) and vary R_{18} until the meter reads about 46 μa. Next turn the selector switch to position 6 (.001r/8hr) and place a 1 mg radium source about three feet away from the front of the instrument. Vary R_{19} until the meter just starts to indicate pulses. Return the selector switch to position 3 (H.V. set) and adjust R_{18} until the meter reads full scale (50 μa). The proper setting of R_{18} is then determined.

With the setting of R_{18} thus determined the H.V. Adjustment, R_{19}, is always adjusted until the meter reads full scale when the selector switch is set on position 3.

To set R_{16}, the Bias Adjustment, put the selector switch on position 4 and turn the zero set adjustment, R_{15}, clockwise about two-thirds of its total movement. R_{16} can be connected across either -15 v to -12v, or -12v to $-7\frac{1}{2}$ v, whichever gives the proper setting just described (See also Note A on schematic diagram — Figure 1).

The Zero Set Adjustment is made by varying R_{15} when the selector switch is on position 4 until the meter reads zero.

Positions 5 and 6 are the two operating positions.

ACCEPTANCE SPECIFICATIONS

1. The electrical circuit must follow exactly that of the schematic diagram (Figure 1).

2. The physical layout must be approximately as shown in the photograph (Figure 2).

3. The labeling for the selector switch, zero set adjustment, bias adjustment, sensitivity adjustment, voltmeter adjustment, and high voltage adjustment is to be as indicated on the included drawing which shows the location and position of the labels (Figure 3).

4. The furnished operating instructions should be printed on the side of the case.*

PERFORMANCE SPECIFICATION

The meter must read full scale on the .02r/8hr operating position (selector switch position 5) when a 1 mg radium source is placed directly in front of the Portable GM Tube Survey Meter along a line normal to the axis of the GM tube at its center. The distance from the center of the GM tube and the center of the lead case of the source should be 41 cm.

A written record is to be made indicating a satisfactory and successful fulfillment of the foregoing Performance Specification and a copy presented to authorized Metallurgical Laboratory personnel.

*OPERATING INSTRUCTIONS

1. Turn left knob from SHORT to TEST.
2. Turn right knob clockwise. Meter should read 25 μa. or greater.
3. Turn left knob to H.V. Meter should read 50 μa.
4. Turn left knob to SET. Allow meter to stop drifting.
5. Turn right knob until meter reads zero.
6. Turn left knob to desired sensitivity scale.
7. Recheck zero set every 10 minutes.
8. To turn off: (a) Turn right knob to OFF, (b) Turn left knob to SHORT.

SPECIFICATIONS FOR PORTABLE GM TUBE SURVEY METER

ITEM	QUANTITY	DESCRIPTION	MANUFACTURER
1	1	3 by 10 by 12-inch metal chassis	Special
2	1	V_1 —3A8 type tube	R.C.A. (To be supplied)
3	1	V_2 —1D8 type tube	R.C.A.
4	2	E_1 —7.5 volt battery	Burgess No. W5BP or equiv.
5	2	E_2 —45 volt battery	Burgess No. Z3ON or equiv.
6	1	E_3 —1.5 volt battery	Burgess No. 4FA or equiv.
7	1	L —1500h, @ 3ma, volts.	Thordarson No. T17C40 (15 to be supplied)
8	1	R_1 —2 meg. resistor 1/2 watt	I.R.C. No. BT 1/2 or equiv.
9	2	R_2, R_4 —100,000 ohm resistor 1/2 watt	I.R.C. No. BT 1/2 or equiv.
10	1	R_3 —15,000 ohm resistor 1/2 watt	I.R.C. No. BT 1/2 or equiv.
11	2	R_5, R_{10} —10 meg. resistors 1/2 watt	I.R.C. No. BT 1/2 or equiv.
12	1	R_6 —10^9 ohm resistor	Victoreen (to be supplied)
13	1	R_7 —75,000 ohm resistor	I.R.C. No. BT 1/2 or equiv.
14	1	R_8 —25,000 ohm resistor	I.R.C. No. BT 1/2 or equiv.
15	1	R_9 —1 meg. resistor	I.R.C. No. BT 1/2 or equiv.
16	1	R_{11} —1 megohm resistor	I.R.C. No. BT 1/2 or equiv.
17	1	R_{12} —50,000 ohm resistor	I.R.C. No. BT 1/2 or equiv.
18	1	R_{13} —200,000 ohm resistor	I.R.C. No. BT 1/2 or equiv.
19	1	R_{14} —20 meg. resistor	I.R.C. No. BT 1/2 or equiv.
20	1	R_{15} —25,000 ohm potentiometer	I.R.C. No. D11-120 or equiv.
21	3	R_{16}, R_{17}, R_{18} —1 meg. potentiometer	I.R.C. No. D11-137 or equiv.
22	1	R_{19} —100,000 ohm potentiometer	I.R.C. No. D11-128 or equiv.
23	3	C_1, C_2, C_6 —.05 mfd 400 D.C.W.V. paper tubular	Aerovox type 484 or equiv.
24	1	C_3 —.005 mfd. H.V. 1000V. test mica 600 D.C.W.V.	Aerovox size 1450 or equiv.
25	1	C_4 —.02 mfd to .05 mfd H.V. 600v test mica 600 D.C.W.V.	Cornell-Dubilier type 9 or equiv.
26	1	C_5 —.005 mfd 600 v test mica	Aerovox type 1467 or equiv.
27	1	Sw_1 —3 circuit 6 contacts per circuit single gang switch	Mallory No. 3236J or equiv.
28	1	Sw_2 —DPST attachable switch to go on R_{15}	I.R.C. No. 22 or equiv.

SPECIFICATIONS FOR PORTABLE GM TUBE SURVEY METER

ITEM	QUANTITY	DESCRIPTION	MANUFACTURER
29	1	M—0-50 microammeter	Triplet code TAIBE or equiv.
30	1	Square case for microammeter Model No. 327A	Triplet code TEPAT or equiv.
31	2	Fahnstock clips for GM tube terminals	
32	2	Midget knobs for controls, black pointer type to fit 1/4-inch shaft	General Cement No. 1118 or equiv.
33	1	GM tube, glass, thinwalled	To be supplied.

Sponge rubber mounting for GM tube.

Four potentiometers submounted for screwdriver adjustment. Adjustment screw holes to be closed with cinch plugs. All four adjustments to be mounted on back side of case at the top.

All potentiometers to be connected so that meter reading will increase when they are turned clockwise.

A potential of 1.23 to 1.25v. across meter and 50,000 ohm resistor in series must give a meter reading of 25, therefore, it will probably be necessary to select the proper resistor to fulfill this condition.

END OF DOCUMENT