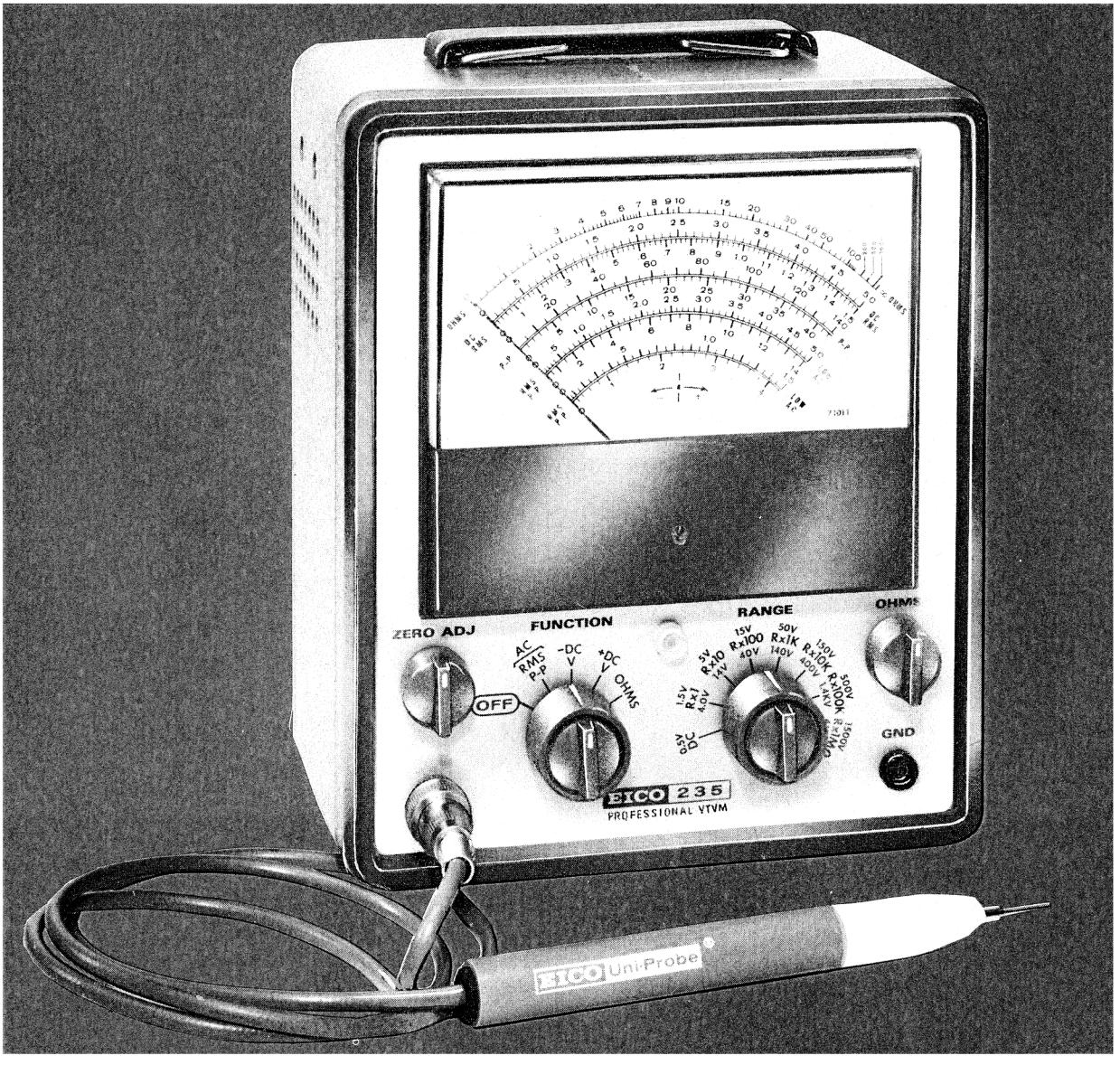
EICO 235 PROFESSIONAL VTVM

USER MANUAL



EICO Electronic Instrument Co., Inc. 283 Malta Street, Brooklyn, N.Y. 11207 (212) 949-1100

EICO SERVICE BULLETIN

ESB No. 157
March 15, 1968

TO: All EICO Service Agencies
FROM: Henry Berlin
SUBJECT: Voltage and resistance chart for Model 235 VTVM

Subject chart, enclosed herewith, was not included in the manual. It is provided for your information. Please insert this bulletin into your manual.

V1 6AL5	VOLTAGE	RESISTANCE
Pin # 1	.8V	infinite
2	.8V	infinite
3	-	.7Ω
4	-	0
5	-	0
6	-	infinite
7	1.4V	30M
Cathode of CR1	106V	-
C. T. of R23	10V	-
Junction of R27-R28	2V	-

V2 12AU7	VOLTAGE	RESISTANCE
Pin #1	70V	70K
2	-	6.7M
3	2.6V	40K
4	-	.7Ω
5	-	68K
6	70V	70K
7	-	7M
8	2.6V	40K
9	-	0

All voltage measurements made with an EICO 249 VTVM. Function switch on "AC", and chassis as common. All resistance measurements made with respect to negative side of C6 (16 mf capacitor) with an EICO 249 VTVM.

GENERAL DESCRIPTION

Designed with the stringent requirements of today's electronic technicians, engineers, and experimenters in mind, the Model 235 Professional VTVM is not only excellent for servicing all types of vacuum-tube circuits, but is eminently suited for the extremely exacting low-voltage measurements required in semiconductor circuitry where even a difference of a few millivolts — easily read on the Model 235 — may stand between proper and improper operation of a transistor circuit. In fact, accurate measurements down to 0.01-volt on its 0.5-volt full-scale range are quick and certain on the large easy-to-read 6" meter.

Other innovations are just as good. The "floating ground" used in the Model 235 (signal ground isolated from chassis ground) enables measurements to be made at points far above ground with no interaction from other voltages in the network. Also adding to the Model 235 versatility is the use of the EICO-exclusive Uniprobe — in which one probe with fingertip control — is used for all functions. Further refinements such as the use of all-ceramic switches assure non-arcing at all inputs up to its 4.2kV peak-to-peak range, 1% tolerance precision resistors for maximum accuracy, seven overlapping resistance ranges covering from 0.2Ω to 1000 megohms for precise resistance measurements, zero-center for FM detector alignment, one zero point adjustment for all functions and ranges, and a transformer-powered power supply using silicon rectifiers for line isolation and removal of any hazard, all help to make the Model 235 the fine instrument that it is.

Besides its outstanding electrical specifications, the Model 235 is physically extremely well constructed and features the EICO-exclusive "professional look" that has been welcomed by both servicemen and industry.

SPECIFICATIONS

DC Voltmeter: Range - 0 to 0.5, 1.5, 5, 15, 50, 150, 500, 1500 volts either + or -
Input Resistance: 11 megohms
Accuracy: ±3% of full scale
Range can be extended to 30kV using EICO HVP-1 or HVP-2 High Voltage Probe

AC Voltmeter: Range - RMS; 0 to 1.5, 5, 15, 50, 150, 500, 1500 volts
P-P; 0 to 4, 14, 42, 140, 420, 1400, 4200 volts
Input Impedance: 1.5, 5, 50, 150 volts - 0.83 megs shunted by 70pf
500 volts - 1.3 megohms shunted by 60pf
1500 volts - 1.5 megohms shunted by 60pf
Accuracy: ±3% of full scale (with a sine-wave input signal having less than 1% harmonic distortion)
Frequency Response: ±1db from 30Hz to 3MHz. Can be extended to 250MHz by using EICO RF Probe PRF-11

Ohmmeter: Range - R x 1, R x 10, R x 100, R x 1k, R x 10k, R x 100k, R x 1 megohm

Tube Complement: 1-6AL5, 1-12AU7

Meter: 6-inch, 200uA

Power Supply: Transformer isolated, silicon rectifier, 1.5-volt battery

Power Requirements: 105-125 volts AC, 50-60Hz, 5 watts

Overall Dimensions: Height - 8-3/4 inches; Width - 7-1/4"; Depth - 5"
Weight - 6 lbs.

Signal input ground jack to instrument case impedance: 1 megohm in parallel with .01uF

Supplied complete with Uniprobe (combining isolating and direct probe and useful for all functions and ranges) with associated ground lead.

CALIBRATION

Preliminary Adjustments

1. Remove the 4 screws securing the case to the instrument, and very carefully remove the case.

2. Make sure that both vacuum tubes and the battery are firmly seated in their respective sockets.

3. With the instrument standing normally on the workbench, note that the meter needle rests on the scale zero mark. If not, VERY CAREFULLY, using a fine screwdriver, adjust the meter zero screw (located on the dark, lower portion of the meter frame) until the needle does rest on the zero indication.

4. Connect the Uniprobe to its connector under the ZERO ADJ control and insert the ground lead banana plug into the GND socket. Set the Uniprobe at its AC-OHMS position (pull out the end section and rotate to the required detent), then connect the ground lead alligator clip to the metal tip of the Uniprobe.

5. Plug the line cord into a source of 105-125 VAC, 50-60 Hz power. CAUTION: DO NOT use a power source of any other voltage or frequency or the instrument will be damaged.

6. Place the FUNCTION switch in the AC position. The front-panel indicator lamp will come on. Allow the instrument to warm up for several minutes. During the warmup, the ZERO ADJ control may be adjusted to keep the meter needle on scale.

> NOTE: Calibration of the instrument will drift as the tubes age with use, and before they settle down on their long-term operational plateau. Therefore, a complete new calibration will have to be made after the instrument has had 10 to 15 hours of operational use. Recalibration will also be necessary whenever tubes or battery (or components) are replaced.

ELECTRICAL BALANCE

To determine the condition of both triode portions of the 12AU7A tube, proceed as follows:

1. Set the FUNCTION switch at +DC V.

2. Rotate the ZERO ADJ control clockwise until the meter indicates about 60% of full scale.

3. Reset the meter pointer back to zero, using the ZERO ADJ control.

4. Place the FUNCTION switch at -DC V.

5. Rotate the ZERO ADJ control counterclockwise until the meter indicates about 60% of full scale.

6. Reset the meter pointer back to zero using the ZERO ADJ control.

If the ZERO ADJ control does not set the meter pointer to about 60% in both of the above FUNCTION switch positions, the 12AU7A tube has an unbalance between the two triodes, and a new tube should be inserted.

AC BALANCE

1. Set the Uniprobe at AC-OHMS, and short the ground lead to the Uniprobe metal tip.

2. Set the FUNCTION switch at AC.

3. Set the RANGE switch at 1500V. The meter should indicate zero. If not, adjust the ZERO ADJ control until it does.

4. Place the RANGE switch in the 1.5V position. The meter should still indicate zero. If not, adjust R23 (see Figure 1) until it does.

5. Repeat steps 3, 4, and 5 until the meter indicates zero at both the 1.5 and 1500 volt settings of the RANGE switch.

AC VOLTMETER CALIBRATION

To perform this calibration, some known AC voltage level must be used — this may be either the 117 VAC power line, a power supply delivering some known level of AC voltage, or a metered audio generator such as the EICO Model 378.

1. Set the FUNCTION switch to the required range.

2. Connect the Uniprobe (in the AC-OHMS setting) tip to one side of the AC source, and the ground lead to the other side of the AC source.

3. With the source operational, note that the Model 235 indicates the correct voltage. If not, adjust R39 (see Figure 1) until it does.

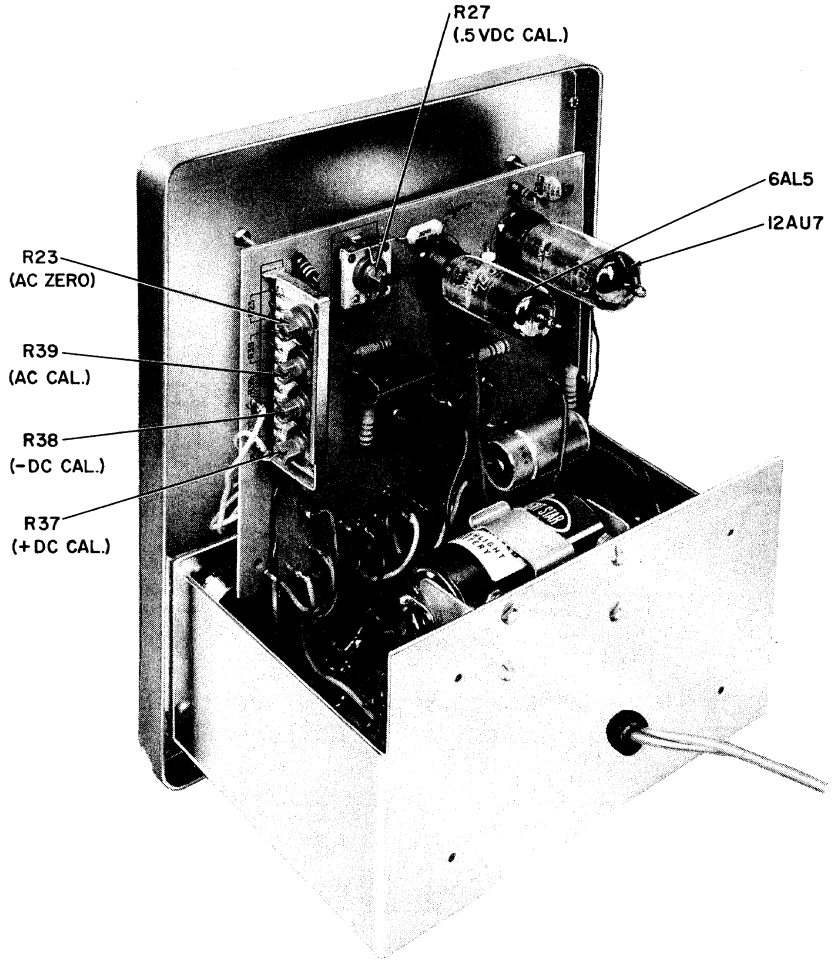


FIGURE 1

4. For maximum accuracy, select a test voltage source that will be approximately full scale.

DC VOLTMETER CALIBRATION

To perform this calibration, a pair of series-connected fresh dry cells (1.55 volts each) must be used.

-DC Ranges (above .5 volts)

1. Place the Uniprobe in the DC position.

2. Place the FUNCTION switch in the -DC V position.

3. Place the RANGE switch in the 5V position.

4. Connect the Uniprobe tip to the battery - (negative) terminal, and the ground lead to the battery + (positive) terminal. The meter should indicate 3.10 volts. If not, adjust R38 (see Figure 1) until it does.

5. This one adjustment should suffice for all ranges. However, if desired, an accurate metered, adjustable power supply, such as the EICO Model 1030 can be used to check all ranges.

+DC Ranges (above .5 volts)

1. Perform the same steps as for the -DC Ranges except place the FUNCTION switch in the +DC V position, and reverse the connections to the Uniprobe. In this case, use R37 (see Figure 1) for +DC V adjustment.

0.5 Scale Calibration

This calibration is performed after an accurate calibration has been made of the Model 235 5V DC range.

1. Connect a 1000-ohm potentiometer across the 3.1 volt dry cell battery (or any reasonably low voltage DC source) as shown in Figure 2. Set the wiper arm so that exactly .5 volt exists between the negative side of the battery and the wiper arm of the potentiometer.

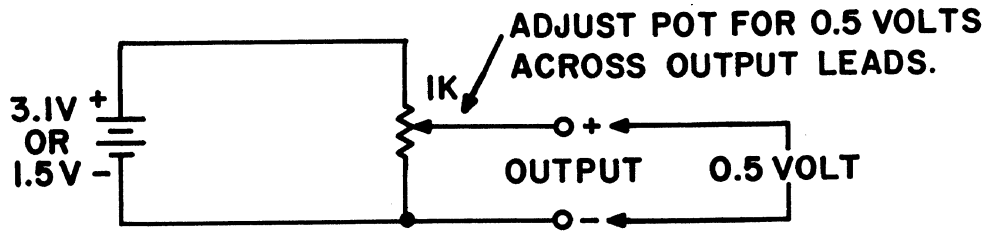


FIGURE 2

2. Place the FUNCTION switch in the +DC V position, and the RANGE switch in the 0.5 V DC position. Adjust ZERO ADJ for a zero indication with Uniprobe shorted to the ground lead.

3. Connect the ground lead to the battery negative terminal lead and the Uniprobe tip (in the DC setting) to the wiper arm of the potentiometer.

4. The meter should indicate .5 volt. If not, adjust R27 (see Figure 2) until it does.

OHMMETER CALIBRATION

No separate calibration is required. If desired, known accurate resistors may be checked on the pertinent ohmmeter ranges to check the calibration.

To determine the extent (if any) of leakage in the ohmmeter circuit, check as follows:

1. Place the FUNCTION switch at OHMS.

2. Place the RANGE switch in the Rx1 position. The meter needle should deflect to the right.

3. Adjust the OHMS control for full-scale deflection.

4. Place the RANGE switch in the Rx1MΩ position. Without touching the OHMS control, note that the meter needle indicates above 1000 on the resistance scale.

5. If the meter needle is below 1000, it indicates that there is excessive leakage in the ohmmeter circuit, and it should be thoroughly checked out.

RESISTANCE MEASUREMENTS ABOVE 1000 MEGOHMS

The upper limit of direct resistance measurement with this instrument is 1000 megohms. The leakage resistance of small paper and mica capacitors usually exceeds this value. To measure resistance above 1000 megohms, an external DC source between 20 and 500 volts can be used to obtain a measurable meter pointer deflection. The circuit connections are shown in Figure 3 and the procedure is as follows:

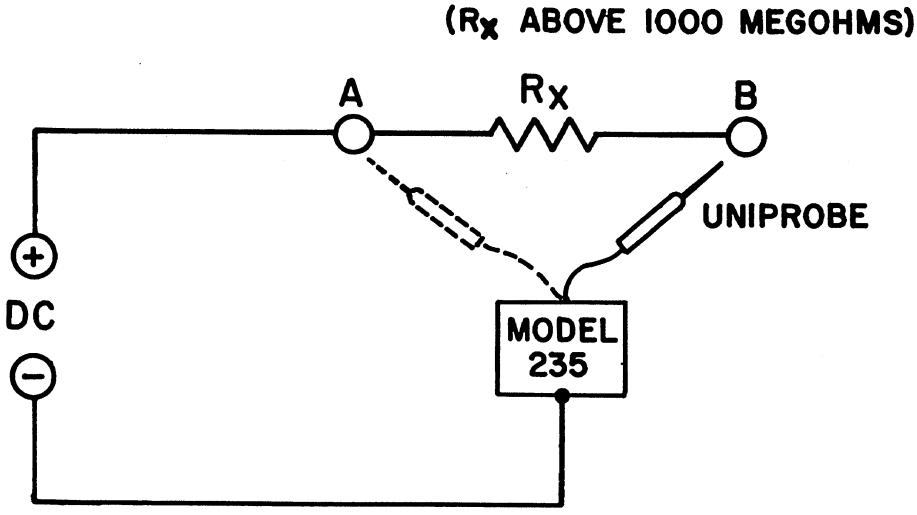


FIGURE 3

1. Set the FUNCTION switch to +DC V and the Uniprobe to DC. Place the RANGE switch at a range that encompasses the voltage of the power supply used.

2. Measure and record the voltage at point A, and then the voltage at point B.

3. Compute the value of the unknown resistance from the following formula:

$$RX\ (\text{megohms}) = \frac{11[(\text{volts at point A}) - (\text{volts at point B})]}{(\text{volts at point B})}$$

EXAMPLE: Assume that the power supply used is 300 volts, and the Model 235 measures 300 volts at point A and 1.1 volts at point B. Then,

$$RX = \frac{11\ (300 - 1.1)}{1.1} = 3000 \text{ megohms (approximate)}$$

TUBE REPLACEMENT

When a new tube is installed in the instrument, it will be necessary to recalibrate the various ranges after a 2 hour warm-up, then recalibrate again after several hours of operation when the tube finally arrives at its long-term operational plateau.

BATTERY REPLACEMENT

Do not permit an exhausted battery to remain in the instrument case as the chemicals released from an exhausted battery may corrode the battery connectors and surrounding components. When installing a new battery, observe the polarity markers on the battery support frame.

CLEANING THE CASE AND METER

A lightly soaped moist cloth can be used to clean both the case and the meter face. DO NOT use detergents as the plastic meter surface may be damaged.

OPERATION

Connect the Uniprobe to its connector and the ground lead banana plug to the GND connector.

Plug the line cord into a 105-125V, 50-60 HZ power source.

Place the FUNCTION switch in any position other than OFF (the front-panel indicator lamp comes on), and allow the instrument to warm up for several minutes.

NOTE

Always keep in mind that the Model 235 signal ground IS NOT chassis ground. It is this floating ground feature that makes the Model 235 much more versatile than other VTVM's.

DC VOLTAGE MEASUREMENTS

1. Rotate the end section of the Uniprobe until the detent locks in the DC position. Note that the Uniprobe end can be rotated either way.

2. Place the FUNCTION switch in the -DC V or + DC V position, depending on the polarity of the voltage to be measured. The indicated + or - is the voltage that will be present at the tip of the Uniprobe. The ground lead will go to the other side.

3. Place the RANGE switch in a voltage range GREATER than that expected to be measured. (If in doubt, always start at the 1500 V range and progress downward.)

4. Short the ground lead to the Uniprobe tip and adjust the ZERO ADJ control until the meter indicates zero.

5. Connect the ground lead and the Uniprobe to the circuit being measured.

AC VOLTAGE MEASUREMENTS

1. Rotate the end section of the Uniprobe until the detent locks in the AC-OHMS position. Note that the Uniprobe end can be rotated either way.

2. Place the FUNCTION switch in the AC position.

3. Place the RANGE switch in a voltage range GREATER than that expected to be measured. (If in doubt, always start at the 1500 V RMS range and progress downward.)

4. Short the ground lead to the Uniprobe tip and adjust the ZERO ADJ control until the meter indicates zero.

5. Connect the ground lead and the Uniprobe tip to the circuit being measured.

NOTE: The AC scale arrangement of the Model 235 shows both RMS (black scale) and companion peak-to-peak (red scale) of the voltage being measured. No conversion is necessary as both scales are direct reading. Peak-to-peak indications are valid regardless of whether the waveform is complex or sine wave, the rms indication apply only to sine waves.

OHMMETER MEASUREMENTS

1. Rotate the end section of the Uniprobe until the detent locks in the AC-OHM position. Note that the Uniprobe end can be rotated either way.

2. Place the FUNCTION switch in the OHMS position.

3. Place the RANGE switch in the Rx10 position.

4. Short the ground lead to the Uniprobe tip and adjust the ZERO ADJ control until the meter needle rests on the left-hand zero mark of the ohmmeter scale.

5. Remove the ground lead from the Uniprobe tip and adjust the OHMS control until the meter needle rests exactly on the extreme right-hand marker of the ohmmeter scale.

6. Repeat steps 4 and 5 as these two controls have a certain amount of interaction.

7. Remove all power from the equipment under test to avoid damage to the Model 235.

8. Connect the ground lead and the Uniprobe tip across the resistance to be measured. Set the RANGE switch for a convenient deflection. Multiply the indication on the ohms scale by the factor indicated on the RANGE switch.

CAUTION

Meter movements, thermocouples, and other low-current, low-resistance devices may be damaged unless a range above RX10 is used. At the RX1 and RX10 positions, the Model 235 applies up to 1.5 volts to the resistance under measurement.

ZERO CENTER OPERATION

Zero center indications allows observation of either positive or negative voltage excursions without resetting the FUNCTION switch. To prepare the instrument for such operation, place the FUNCTION switch in the +DC V position and adjust the ZERO ADJ control (with the ground lead connected to the Uniprobe tip) until the meter needle rests on the -0+ mark (the center indication on the meter scale). The RANGE switch must be set to a position at least twice the voltage to be measured and then to the lowest position which permits the meter pointer to remain on scale (voltage applied). The value of positive voltage indicated (deflection to the right of the zero center in the + region) is obtained by subtracting half the RANGE selector value from the DC voltage reading on the appropriate scale. The value of a negative voltage (deflection to the left of the zero center in the - region) is obtained by subtracting the DC voltage reading on the appropriate scale from half the RANGE setting.

CAUTION

Althouth the Model 235 is protected against meter burn-out under normal conditions, repeated overloads may impair the accuracy of the meter movement (slamming the needle against the stops). For this reason, always make sure that when measuring voltages, both AC and DC, on any range, that you always start with a RANGE setting that is greater than that expected to be measured. Always pay attention to polarities when measuring DC.

DB MEASUREMENTS

To avoid crowding of the frequently used scales, there is no DB scale on the meter. Another reason for the absence of this scale is that there are many different reference levels in use, and each reference level results in a different scale. Figure 4 is a graph for one accepted reference level, namely 0.775 volts across 600 ohms resistive load (1 milliwatt), with which RMS AC voltages can be converted into DB readings.

However, the DB value read on Figure 4 is correct only when the voltage indication has been taken across a 600-ohm resistive load. If the reading has not been taken across a 600-ohm load, the DB value read from the chart must be corrected by adding algebraically to it, the correction increment specified in Table 1 for the particular resistive load. If the resistive load is not included in the table, the correction increment may be calculated as follows:

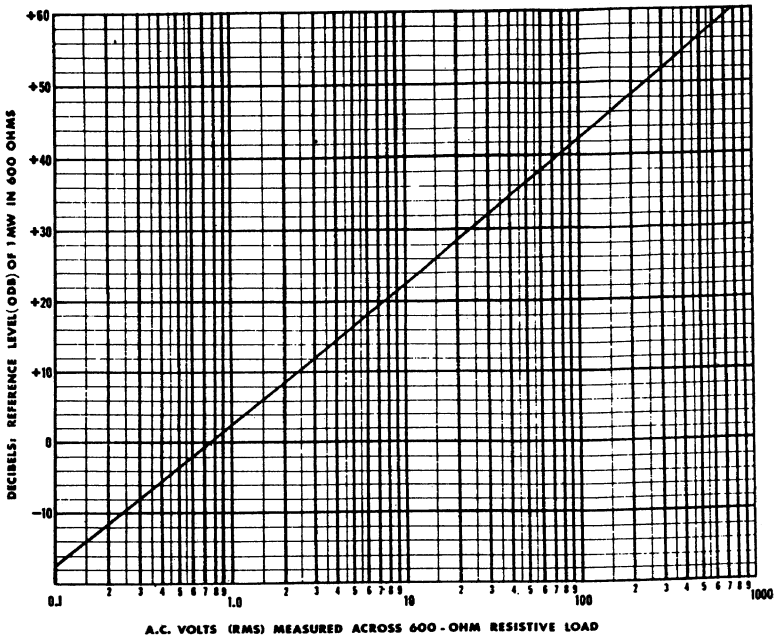


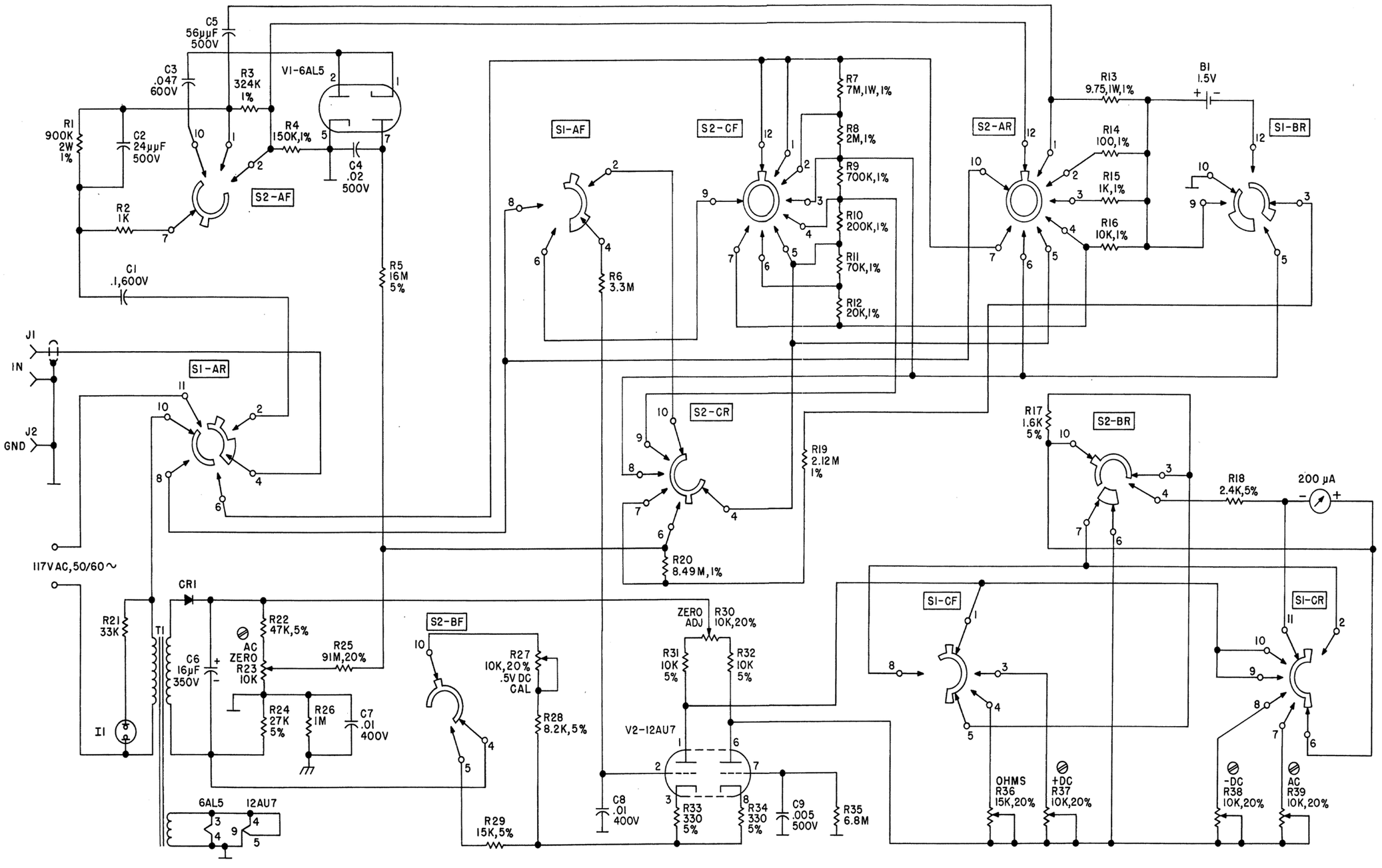
FIGURE 4

correction increment = 10 log (600/R), where R is the resistive load used.

It should be noted the DB measurements must be made with a sine wave to avoid waveform error.

Table 1. Correction Increment for Various Loads

LOAD RES.	DB ADDED	LEAD RES.	DB ADDED
600	0	150	+6.0
500	+0.8	50	+10.8
300	+3.0	15	+16.0
250	+3.8	8	+18.8
		3.2	+22.7



15 50 5 150 1.5 500 .5 S2 1500

RANGE SWITCH

-DC AC +DC OFF S1 Ω

FUNCTION SWITCH

NOTES:

1. ALL RESISTORS 10% UNLESS OTHERWISE NOTED
2. ALL CAPACITORS IN UFD, UNLESS OTHERWISE NOTED
3. ⊘ DENOTES SCREWDRIVER ADJUSTMENT
4. ALL POINTS MARKED ⊥ ARE CONNECTED TO GND TERMINAL
5. ⫽ CHASSIS GROUND
6. ROTARY SWITCHES SHOWN IN FULLY CCW POSITIONS. WAFERS ARE VIEWED AND LETTERED (A, B, AND C) FROM KNOB END. F = FRONT, R = REAR.

EICO 235 PROFESSIONAL VTVM

PARTS LIST

CAPACITORS

PRICE EACH	SYM. #	STOCK#	DESCRIPTION
.48	C1	20098	.1mfd, 600V, 20%
.32	C2	22026	24pf, 500V, 2%
.29	C3	20026	0.047 mfd, 600V, 10%
.23	C4	20086	.02mfd, 400V, 20%
.12	C5	22546	56pf, 500V, 10%
1.12	C6	23003	16mfd, 350V
.22	C7, 8	20087	.01mfd, 400V, 10%
.12	C9	22526	.005mfd, 500V

RESISTORS

.75	R1	11907	900K, 2W, 1%
.08	R2	10432	1K, 1/2W, 10%
.42	R3	12004	324K, 1/2W, 1%
.41	R4	11025	150K, 1/2W, 1%
.40	R5	11593	16M, 1/2W, 5%
.09	R6	10457	3.3M, 1/2W, 10%
.87	R7	11701	7M, 1W, 1%
.41	R8	11047	2M, 1/2W, 1%
.41	R9	11048	700K, 1/2W, 1%
.41	R10	11026	200K, 1/2W, 1%
.41	R11	11049	70K, 1/2W, 1%
.41	R12	11050	20K, 1/2W, 1%
1.12	R13	11722	9.75Ω, 1W, 1%
.39	R14	11005	100Ω, 1/2W, 1%
.41	R15	11080	1K, 1/2W, 1%
.41	R16	11051	10K, 1/2W, 1%
.14	R17	11542	1.6K, 1/2W, 5%
.14	R18	11512	2.4K, 1/2W, 5%
.39	R19	12005	2.12M, 1/2W, 1%
2.04	R20	12006	8.49M, 1/2W, 1%
.08	R21	10426	33K, 1/2W, 10%
.23	R22	10521	47K, 1/2W, 5%
.14	R24	11552	27K, 1/2W, 5%
.30	R25	10553	91M, 1/2W, 5%
.08	R26	10407	1M, 1/2W, 10%
.29	R28	11580	8.2K, 1/2W, 5%
.14	R29	11556	15K, 1/2W, 5%
.14	R31, 32	11500	10K, 1/2W, 5%
.24	R33, 34	10501	330Ω, 1/2W, 5%
.30	R35	10519	6.8M, 1/2W, 5%

POTENTIOMETERS

2.44	R23, 37, 38, 39	16500	4 x 10K, linear, 30%
.72	R27	16501	10K, linear, 30%
.95	R30	18107	10K, linear, 20%
1.19	R36	16022	15K, linear, 20%

METER

19.22	M1	71011	meter, 200mA, 6"

SWITCHES

12.00	S1	60178	rotary, 5 position
18.00	S2	60179	rotary, 8 position

TRANSFORMER

3.28	T1	30012	power transformer

TUBES, DIODES, SOCKETS & PILOT LAMPS

.82	CR1	93023	rectifier, silicon
.54	I1	97715	pilot light assembly
1.75	V1	90017	tube, 6AL5
2.35	V2	90033	tube, 12AU7
.21	XV2	97089	tube socket, 9 pin
.17	XV1	97090	tube socket, 7 pin

HARDWARE

.01	40000	nut, hex, #6-32 x 1/4	(4)
.02	40001	nut, hex, 3/8-32 x 1/2	(4)
.01	40007	nut, hex, #4-40 x 1/4	(4)
.03	40046	nut, Tinnerman, twin #6-32	(2)
.02	40061	nut, hex, 5/16-32	(1)
.05	41024	screw, set, #8-32 x 1/4	(1)
.02	41034	screw, #6 x 3/8, P.K. Ph. R. H.	(4)
.07	41061	screw, set, #8-32 x 3/16	(1)
.01	41086	screw, #6-32 x 5/16, B.H.	(3)
.01	41088	screw, #6-32 x 3/8, F.H.	(4)
.01	41091	screw, #4-40 x 1/4, F.H.	(4)
.01	41140	screw, #6-32 x 1/4, R.H. Ph.	(10)
.02	42000	washer, lock, 3/8	(4)
.01	42001	washer, flat, 3/8	(4)
.01	42002	washer, lock, #6	(3)
.01	42020	washer, fibre, spec.	(1)
.01	42021	washer, fibre, spec.	(1)
.02	42511	ret. ring, plastic pilot light	(1)

MISC. HARDWARE

.10	44002	spacer, fibre, spec.	(1)
.08	44003	spacer, fibre, spec.	(1)
.05	46016	foot	(4)
.12	47002	spring, compression	(1)

JACKS, PLUGS & KNOBS

PRICE EACH	STOCK#	DESCRIPTION	
.48	50002	jack, connector, male	(1)
.39	50044	jack, banana, black	(1)
.72	51000	plug, connector, female	(1)
.62	51005	plug, banana, small	(1)
.02	51300	terminal pin, P.C. Bd.	(26)
.20	51500	clip, alligator	(1)
.60	53036	knob, 1-1/16 dia.	(2)
.49	53037	knob, 3/4 dia.	(2)
.10	54018	terminal strip, 4 Post w/gnd.	(1)

MISCELLANEOUS

1.56	56523	battery holder	(1)
.77	57004	line cord	(1)
.03/ft.	58400	cable, kinkless, black	(4 ft.)
.08/ft.	58403	cable, coax, grey	(4 ft.)
1.50	66176	operating manual	(1)
1.50	66409	assembly manual	(1)
2.20	80192	front panel	(1)
2.75	81489	chassis	(1)
.10	82101	line cord clamp	(1)
3.00	82532	P.C. board	(1)
4.02	86013	frame	(1)
1.50	86548	assembly, handle & links consists of:	
	87006	handle	(1)
	89648	link	(2)
2.00	86552	nosepiece assembly consists of:	
	89521	metal tip	(1)
	89658	nosepiece w/red indicator	(1)
7.25	88143	cabinet	(1)
n/c	89410	label, power	(1)
.02	89517	rotor contact	(1)
.15	89518	long contact	(1)
.15	89519	long contact	(1)
.93	89520	fibre contact holder	(1)
.08	89649	handle mounting bracket	(2)
2.40	89659	probe body, screened	(1)

To order replacement parts, specify description and part number. Remittance must be made with order. Prices and specifications subject to change without notice.