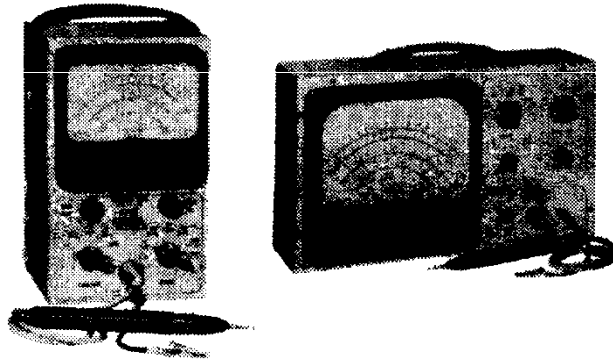




INSTRUCTION MANUAL

Models 232 - 249



ELECTRONIC INSTRUMENT CO., Inc. 84 Withers Street, Brooklyn, N. Y.

This manual is provided FREE OF CHARGE from the "BoatAnchor Manual Archive" as a service to the Boatanchor community.

It was uploaded by someone who wanted to help you repair and maintain your equipment.

If you paid anyone other than BAMA for this manual, you paid someone who is making a profit from the free labor of others without asking their permission.

You may pass on copies of this manual to anyone who needs it. But do it without charge.

Thousands of files are available without charge from BAMA. Visit us at <http://bama.sbc.edu>

general description

Expressly designed for TV servicing, the Model 232 (249) Peak-to-Peak VTVM features a full-wave, high frequency rectifier circuit that responds to and measures the peak-to-peak voltage value of complex and sine waveforms even when DC is present. It also reads the rms voltage of sine waves (on a separate scale), dc voltage values, and resistance values. For consistently high accuracy, there are seven non-skip ranges on all functions to provide a uniform 3 to 1 scale ratio between adjacent ranges.

The input resistance on all dc voltage ranges is 11 megohms, which is high enough to prevent loading error and yet not so high as to impair the stability of the instrument. The dc voltage ranges may be extended to 30,000 volts (with accessory High Voltage Probe HVP-1 or HVP-2) and may also be used for RF voltage measurement up to 250 mc (with accessory RF Probe Model PRF-11). The frequency response of the ac voltage ranges extends from 30 cps to 3 mc. for a source of 100 ohms or less.

Facilities that increase the accuracy, versatility, and ease of operation include zero-center indication for discriminator alignment and bias measurements; zero adjustment unaffected by changing function or range; separate scale for low ac voltage measurement; electronic protection against meter burn out; adjustment of all calibration controls without cabinet removal; and UNI-PROBE, a single unit probe used for all functions.

The Model 232 (4 1/2" meter) and the Model 249 (7 1/2" meter) are identical electrically. Where portability is desired, the Model 232 is preferable because of its extremely compact design. The Model 249 is an ideal bench instrument, having extra long scales to minimize reading errors and permitting permanent placement of the equipment at a practical working distance. Both instruments are ruggedly housed, professional in appearance, and highly dependable and trustworthy measuring devices that will prove extremely valuable in television, fm-am radio servicing, and many industrial applications.

specifications

DC VOLTMETER:

Ranges 0 to 1.5, 5, 15, 150, 500, 1500 volts

Input Resistance 11 MΩ

Accuracy ±3% of full scale or better.

Range extended to 30,000 volts with High Voltage Probe HVP-1 or HVP-2 (1090 MΩ multiplier resistor recommended).

AC VOLTMETER:

RMS values of Sine Waves 0 to 1.5 volts on separate LOW-AC scale
0 to 5, 15, 50, 150, 500, 1500 volts
Peak-to-Peak Values of Sine . . . 0 to 4 volts on separate LOW-AC scale
& Complex Waves 0 to 14, 42, 140, 420, 1400, 4200 volts
Input Resistance & Capacity . . . 1 M Ω , shunted by 60 mmf (approx.)
Accuracy $\pm 5\%$ of full scale or better.
Frequency Response 30 cps to 3 Mc (source Z 100 Ω or less)
RF voltage measurement to 250 Mc (accuracy $\pm 10\%$) with RF Probe PRF-11

OHMMETER: 0 to 1000 Megohms in 7 ranges — RX1, RX10, RX100, RX1000
RX10K, RX100K, RX1Meg (10 ohms center scale on RX1 range)

TUBE COMPLEMENT: 1-6AL5 twin-diode as full-wave peak-to-peak rectifier
1-12AU7 twin-triode in vacuum-tube balanced bridge circuit

POWER SUPPLY: Transformer-operated selenium rectifier; 1.5 volt flashlight cell.

POWER REQUIREMENTS: 105-125 volts AC, 50-60 cps; drain: 5 watts

OVERALL SIZE: Model 232 - 8 1/2"h, 5"w, 5"d; Model 249 - 8 1/2"h, 13"w, 5"d

WEIGHT: Model 232 - 7 pounds; Model 249 - 9 pounds

CASE: Steel cabinet, grey wrinkle finish; satin-aluminum panel, deep-etched and rub-proof

Supplied complete with UNI-PROBE (combined isolating and direct probe, used for all functions and ranges) and ground lead.

operation

PRELIMINARY ADJUSTMENTS

1. Connect the UNI-PROBE to the VOLTS-OHMS terminal, and the Ground Cable to the GND. terminal.

2. Plug the line cord into an outlet supplying 105-125 volts AC, 50-60 cps.

3. Set the FUNCTION selector at "+DC VOLTS" and the UNI-PROBE at "DC". Allow several minutes for the instrument to warm up. If necessary, use the ZERO ADJ. control to set the meter pointer within scale limits during

the warm-up period.

4. Short the UNI-PROBE to the Ground Cable and set the meter pointer at the left-hand zero with the ZERO ADJ. control. If turning the FUNCTION selector to "-DC VOLTS" changes the position of the meter pointer, readjust the mechanical zero of the meter as described under MAINTENANCE.

5. Set the FUNCTION selector at "OHMS", the UNI-PROBE at "AC-OHMS", and the RANGE selector at "RX10". Separate the UNI-PROBE from Ground Cable. The meter pointer should move to approximately full scale.

6. Use the OHMS ADJ. control to position the meter pointer on the last graduation of the scale.

7. Set the FUNCTION selector at "AC VOLTS". If the meter pointer does not read zero volts when the RANGE selector is at "1.5 V", refer to the "AC Voltmeter Balance Adjustment" and "AC Voltmeter Calibration" sections under Maintenance.

Note: Although the meter is protected against burn-out under ordinary overloads, repeated overloads may impair the accuracy of the movement. For this reason, in the following instructions the operator is advised to first make a trial measurement at a range setting higher than the voltage expected.

DC VOLTAGE MEASUREMENT

1. Set the UNI-PROBE at DC and the FUNCTION selector at either "+DC VOLTS" or "-DC VOLTS", depending upon the polarity of the voltage to be measured with respect to ground.

2. Set the RANGE selector at a position considerably higher than the voltage to be measured.

3. Connect the Ground Cable to the ground side of the voltage being measured and touch the UNI-PROBE to the high side.

4. Reset the RANGE selector to the position which gives a reading nearest to full scale and read the dc voltage on the meter.

ZERO CENTER INDICATION

Zero-center indication permits observation of either positive or negative voltage excursions without resetting of the function selector. To prepare the instrument for zero-center indication, simply set the FUNCTION selector at "+DC VOLTS" and turn the ZERO ADJ. control (with no voltage applied) un-

til the meter pointer is set at the center "-0+". The range selector should be set first 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 the scale. The value of a positive voltage (deflection to the right of the center "-0+") is obtained by subtracting half the range selector setting from the dc voltage reading on the scale. The value of a negative voltage (deflection to the left of the center "-0+") is obtained by subtracting the dc voltage reading on the scale from half the range selector setting.

RESISTANCE MEASUREMENT

Remove all power from the equipment under test before making resistance measurements so that no voltages are present.

1. Set the UNI-PROBE at "AC-OHMS" and the FUNCTION selector at "OHMS".

2. Set the RANGE selector at "RX10".

3. Short the UNI-PROBE to the Ground Cable. The meter pointer should be at the left-hand zero. Use the ZERO ADJ. control to reset the pointer at the left-hand "0", if necessary.

4. Separate the UNI-PROBE from the Ground Cable. The meter pointer should be at the last line on the "OHMS" scale. Use the OHMS ADJ. control to reset the pointer at the last line on the "OHMS" scale, if necessary.

5. Connect the clip on the Ground Cable to one terminal of the resistance to be measured and touch the UNI-PROBE to the other terminal.

6. Reset the RANGE selector to give a convenient deflection and multiply the reading on the "OHMS" scale by the factor indicated at the RANGE selector setting.

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 instrument applies up to 1.5 volts to the resistance under measurement.

RESISTANCE MEASUREMENT 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 the value. To measure resistance values above 1000 megohms, an external dc voltage source between 20 and 500 volts can be used to

obtain a measurable pointer deflection. The circuit connections are shown in Fig. 2 and the procedure is as follows.

1. Set the FUNCTION selector at "+ DC VOLTS" and the UNI-PROBE at "DC".
2. Measure the voltage at point A and then the voltage at point B.
3. Compute the resistance from the following formula.

$$R_x \text{ (megohms)} = \frac{11 [(\text{Volts at "A"}) - (\text{Volts at "B"})]}{(\text{Volts at "B"})}$$

Example: In measuring a resistance by the method of Fig. 2, the external dc voltage supply is 300 volts. The instrument measures 300 volts at point A and 1.1 volts at B. Then,

$$R_x = \frac{11 (300 - 1.1)}{1.1} = 3000 \text{ megohms (approx.)}$$

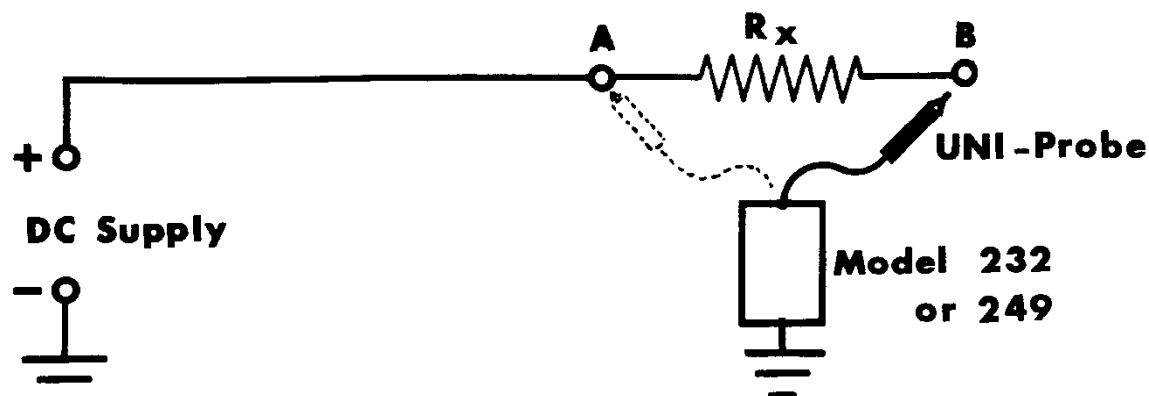


Fig. 2

AC VOLTAGE MEASUREMENTS

1. Set the UNI-PROBE at "AC-OHMS" and the FUNCTION selector at "AC VOLTS".
2. If necessary, use the ZERO ADJ. control to set the meter pointer at the left-hand "0".
3. Set the RANGE selector at a position considerably higher than the voltage to be measured.
4. Connect the Ground Cable to the ground side of the voltage source to be measured and touch the UNI-PROBE to the high side.

5. Reset the RANGE selector to the position which gives a reading nearest to full scale and read the ac voltage.

NOTE: All RMS scales are in black with full-scale values of 1.5, 5, 15, 50, 500, and 1500 volts. All peak-to-peak scales are in red with full-scale values 4, 14, 42, 140, 420, 1400, and 4200 volts. When the instrument is set at the 1.5 volt range, the RMS or P-P scales on the lowest arc (designated as LOW-AC) are read; on higher ranges, the scales on the two center arcs are read. It should be noted that the fixed ratio of 2.83 to 1 between corresponding peak-to-peak and rms scales is derived from the relationship between the peak-to-peak and rms values of a sine wave. Therefore, while peak-to-peak readings are valid regardless of whether the waveform is complex or sine, rms readings are valid only for sine waves. Note also that the time delay between the instant the leads are removed from the source being measured and the instant the meter pointer returns to zero is normal and is the result of circuit constants selected to permit accurate measurement of recurrent pulses with low repetition rates.

applications

This instrument may be used to maintain and service television receivers, fm-am and communication receivers, transmitters, audio equipment, and pulsed electronic and electro-mechanical equipment. Indicative of its versatility are some of the special applications described below.

OSCILLATOR GRID-BIAS MEASUREMENT: The negative dc voltage developed on the oscillator grid is always directly proportional to the strength of oscillation. This voltage can be measured very readily at the oscillator grid while the band switch is turned to the various bands, and in each of its positions the main tuning condenser is rotated from minimum capacity. This will give an indication of the strength of oscillation at all frequencies within the oscillator's range.

AVC-VOLTAGE MEASUREMENTS: The automatic volume control voltage developed by the incoming signal can be measured at a number of places in the receiver. This negative voltage first appears across the diode load resistor. It may also be measured along the avc bus and at the grids of the rf tubes being controlled. The dc voltage measured at the diode load resistor is a very convenient output indication during receiver alignment.

Owing to the high input resistance of this instrument, it is possible to measure bias (avc) voltage on the grid of rf and if amplifier tubes without disrupting the signal.

DC SUPPLY VOLTAGE MEASUREMENTS: Power supply dc voltages can be

measured at the rectifier filaments and in the filter circuits. Plate, screen, and cathode dc voltages can be measured at the corresponding pins of the tube sockets.

BIAS CELL VOLTAGE MEASUREMENTS: This instrument will accurately measure the voltage of a bias cell. Current drawing voltmeters are not capable of making this measurement and in many cases will damage the cell.

DETECTION OF GASSY TUBES: One effect of a gassy tube is to reduce the normal negative grid bias, or even make the grid positive. This instrument is ideal for measuring the voltage directly at the control grid of any tube in order to determine whether or not this effect is present. Excessive gas will cause the tube to cease operating normally, and in an audio amplifier will usually cause the volume control to become noisy. This amount of gas will not always produce a noticeable change in the operation of the radio receiver. Consequently if repeated difficulty is experienced with volume controls becoming noisy in this type of circuit, this instrument should be used to check for incorrect bias.

OUTPUT INDICATION: To measure output in the alignment of am and TV receivers, the instrument is prepared for dc voltage measurement and usually connected to the load resistor of the second detector while the circuit components are adjusted for optimum output. In an fm receiver, the instrument is connected across the limiter load resistor. The zero-center feature is very useful for the alignment of fm discriminators.

DB MEASUREMENTS: In order to avoid crowding of 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. Fig. 1 is a graph for one accepted reference level, namely 0.775 volts across 600 ohms resistive load (1 milliwatt), with which rms ac voltage readings can be converted to db readings. However, the db value read from the chart is correct only when the voltage reading 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 the chart of Fig. 3 for the particular resistive load. If the resistive load is not included in the chart, the correction increment may be calculated from the following formula.

$$\text{Correction Increment} = 10 \log \frac{600}{R} \text{ (where R is the resistive load)}$$

It should be noted that decibel measurements must be made with a sine wave form to avoid waveform error and that the correlation between decibels and ear response is greatest at 1000 cycles.

Load Res.	DB Added
600	0
500	+0.8
300	+3.0
250	+3.8

Load Res.	DB Added
150	+6.0
50	+10.8
15	+16.0
8	+18.8
3.2	+22.7

Fig.3

operating instructions

The central circuit in the operation of this instrument is a vacuum-tube bridge circuit using a 12AU7 twin-triode. When the bridge is balanced, the voltages at the two cathodes will be equal and the meter connected across them will read zero.

DC VOLTMETER OPERATION: When a positive dc voltage is applied, a fraction (depending on the range setting) is taken from the range voltage divider (R12-R18) and applied to the grid of V1a. This causes the current through V1a to increase and consequently, the cathode voltage of V1a to increase. Concurrently the voltage on the arm of R22 tends to increase, which since it tends to make the cathode of V1b more positive, causes a decrease in the plate current and hence in the cathode voltage of V1b. This push-pull action permits a large value of cathode resistance with negligible degeneration and, consequently, greatly increased stability of operation. The meter circuit is connected across the two cathodes and the difference in potential across the meter causes current to flow through the meter from the cathode of V1a to the cathode of V1b.

AC VOLTAGE MEASUREMENTS: The applied voltage is first rectified by the twin-diode V2, which serves as a full-wave peak-to-peak rectifier. The operation of this circuit is as follows: On the positive swing of the ac signal, diode V2a conducts and a negative dc voltage equal to the positive peak value builds up on the plate-connected side of C2. As the ac signal voltage swings negative, diode V2a ceases to conduct (and so prevents any discharge of C2) while diode V2b begins to conduct. The negative dc voltage on C2 is added in series to the signal voltage on the negative swing and is applied to the cathode of V2b. As a result, a negative dc voltage equal to the sum of the positive and negative peaks of the positive and negative peaks of the ac signal voltage is built up on the plate-connected side of C3 through conduction of diode V2b and is maintained because of the relatively long time constants of the circuit. To offset the contact potential within V1, an exactly adjusted positive voltage is taken from the junction of R26 and R27 and applied to the V1 rectifier circuit through isolating resistor R28. The peak-to-peak voltage across C3 is attenuated by R29 before application to the range voltage divider and thereafter the operation is similar to dc voltage measurement.

OHMMETER OPERATION: The applied resistance determines the current through the battery and the section of the ohms range network (R5-R11) selected by the range switch. With nothing connected across the input terminals, no current is drawn, and consequently there is no voltage drop across the ohms network. As a result, the entire battery voltage is applied to the grid of V1-a. Potentiometer R30 in the meter circuit is adjusted to produce full-scale deflection (infinity reading) in this condition. A short across the input terminals produces a voltage drop in the ohms range network equal and opposite to the battery voltage and effectively places the grid of V1a at ground potential for a zero reading. Intermediate values of resistance produce voltage drops exceeded by the battery voltage and the difference in voltage is applied to the grid of V1a. This voltage causes an intermediate deflection on the meter which has an ohms scale calibrated to read the applied resistance.

maintenance

Included in this section are instructions for calibration, adjustment, repair, and part replacement.

CALIBRATION

General: Instruments purchased in kit form must be calibrated before use as described below. Factory-wired instruments have been calibrated and tested at the factory. If a change occurs in the accuracy of the instrument after a long period of use, it is probably due to aging of the components. The accuracy of the instrument may readily be restored by repeating this calibration procedure. Recalibration will also be necessary, whenever parts (tubes, etc.) are replaced.

Mechanical Zero: The meter pointer should rest directly over the left-hand zero when the power is shut off. If the meter pointer comes to rest at a deflected position, adjust it to zero by turning the slotted screw directly beneath the meter face.

Warm-up: Insert the leads and plug the line cord into an outlet supplying 105-125 volts AC, 50-60 cps. Turn the unit on and allow a minimum of 2 hours for the warm-up preliminary to calibration. For maximum stability of calibration, a 36 hour warm-up period is desirable. If necessary, use the ZERO ADJ. control to set the meter pointer within scale limits during the warm-up period.

AC Voltmeter Balance Adjustment: Set the FUNCTION selector at "AC VOLTS", the RANGE selector at "1500 V", and the UNI-PROBE at "AC-

OHMS". Short the UNI-PROBE to the Ground Cable and use the ZERO ADJ. control to set the meter pointer exactly at the left-hand zero. Keeping the leads shorted, reset the RANGE selector at "1.5 V" and use the AC Balance potentiometer, R27, to reset the meter pointer at the left-hand zero.

AC Voltmeter Calibration: Set the FUNCTION selector at "AC VOLTS", the RANGE selector at "150 V", and the UNI-PROBE at "AC-OHMS". Connect the UNI-PROBE and the Ground Cable across the 117 volts AC supply. Adjust the AC Calibration potentiometer, R32, until the meter reads 117 rms volts. If the maximum accuracy of which the instrument is capable is desired ($\pm 5\%$ of full scale), apply exactly 150 volts (60 cps) on the "150 V" range (or 50 volts on the "50 V" range) and adjust R32 for exactly full-scale deflection.

DC Voltmeter Calibration: Set the FUNCTION selector at "+ DC VOLTS", the RANGE selector at "5 V", and the UNI-PROBE at "DC". Connect the UNI-PROBE and the Ground Cable across two flashlight cells in series, which will provide a voltage of 3.10 volts when fresh. Adjust the DC Calibration potentiometer, R31, until a 3.10 volt reading is obtained on the meter.

Ohmmeter Calibration: No separate calibration is required.

NOTE: Access to the three calibration controls is obtained by temporary removal of the plug-buttons inserted in the side of the cabinet. Fig. 4 shows the location of each control in Models 232 and 249.

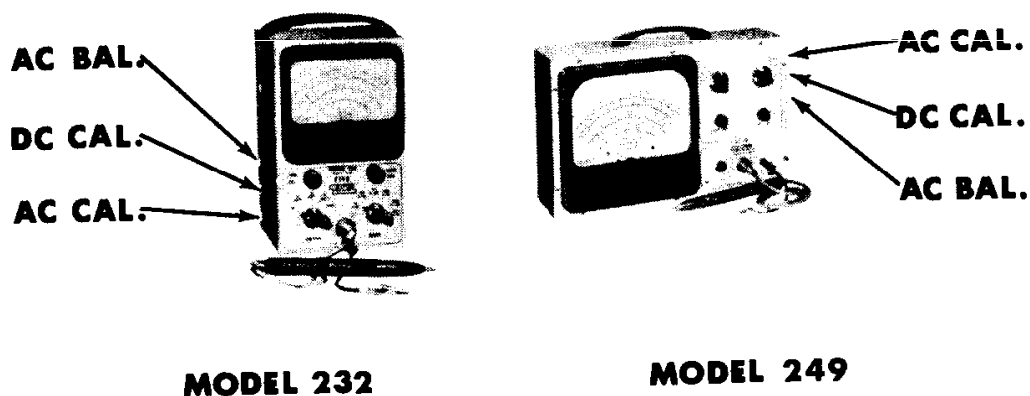


Fig.4

TUBE REPLACEMENT

When a new tube is installed in the instrument, it may be necessary to re-zero when switching from the lowest to the highest dc-voltage ranges unless the tube is aged by operating it in the instrument for 36 hours. The calibration should be checked after this period.

BATTERY REPLACEMENT

Do not permit an exhausted battery to remain inside the instrument case as the chemicals from a deteriorated battery may damage the components. Indications of a weak battery will be found in the trouble-shooting section.

TROUBLE-SHOOTING THE MODEL 232 or 249

As an aid to localizing the cause of faulty operation, the following general trouble-shooting procedure has been prepared. Obviously all possible troubles can not be listed and the technician should use the schematic diagram to trace down unlisted troubles. In general, newly constructed kit instruments should be given a through, step-by-step check of the wiring, following the tables and pictorial diagrams in the construction book, in case the trouble is not listed or cannot be corrected by checking the listed possible causes.

Instrument fails to operate on all functions; tubes do not light

1. Line cord broken or not making contact at outlet.
2. Switch section S1D defective.
3. T1 defective: Check for shorted or open windings.

Tubes light; ZERO ADJ. does not work properly; meter pointer does not move or bangs to right or left.

1. Incorrect operating voltages on bridge tube V1.
 - a. No B plus or B minus voltage present: Check CR1, C5, T1 high voltage winding, R26, R27, and R24 with ohmmeter; check connections between these components also.
 - b. B plus and B minus voltage present: Open or short in V1 circuit.
 - c. V1 defective: See "Tube Replacement".
2. Switch section S1-C defective or wired incorrectly.
3. Defective meter movement.
4. ZERO ADJ. control erratic in operation: Potentiometer R22 is defective; replace with new control. NOTE: First make sure mechanical zero of pointer is correct. See "Mechanical Zero" under Calibration.

Meter pointer sticks

1. Cracked or broken jewel bearing in meter. NOTE: Individual replacement parts for meter movement are not available. Meter should be returned for repairs or replaced with new meter.

Intermittent operation on all functions

1. Loose or bad connections in probe or cables.
2. Wiper contact on S1B or S1C defective.
3. Loose or bad connection in bridge circuit wiring, including meter terminals. With power applied, probe wiring and components with insulated probe.
4. V1 defective. Replace as described under "Tube Replacement."
5. CR1 intermittent.

Instrument fails to operate on OHMS; works normally on ac and dc voltage measurements.

1. Battery exhausted or not making contact.
2. Defective wiper contact on switch section S2C.
3. "OHMS" contact (terminal 7) on S1B defective.
4. Open circuit in resistor network or burned out resistor around switch section S2C. Check continuity of network R5 through R11. NOTE: This network is made up of resistors which are added in series as switch is rotated. Therefore, one faulty resistor may cause improper operation on one or more ranges.
5. Loose or broken "Ohms" contact on switch section S1C (terminal 1)

OHMS ADJ. fails to give infinity setting on "OHMS" scale.

1. Battery exhausted.
2. OHMS ADJ. potentiometer, R30 defective.
3. V1 defective. See "Tube Replacement".

Resistance readings inaccurate on some or all "ohms" ranges.

1. One or more resistors in network around switch section S2C have changed value.
2. Excessive leakage in "ohms" circuit. Check switch wafers on S2C and S1B for dirt or damage. NOTE: High humidity may cause leakage and inaccurate readings on high ohms scales. Bake out inside of instrument with light bulb.
3. Shorted wiring in resistor network around S2C.
4. Faulty or high-resistance connections in "ohms" circuit.

Instrument fails to operate on any ac voltage range; works normally on OHMS and DC VOLTS.

1. V2 defective. See "Tube Replacement."
2. AC volts contact on S1A, S1B, S1C, or S2B defective.
3. Faulty wiper contact on S2D.
4. Open or short in circuitry associated with V2. Check out wiring and components values with ohmmeter.
5. C1, C2, or R29 open; C3 shorted.

Meter pointer moves off zero when ranges are changed.

1. "AC Balance" potentiometer R27 out of adjustment. Readjust as describe under "AC Voltmeter Balance Adjustment." If adjustment cannot be made, then
2. R28 or R27 is defective. Check value with ohmmeter.

AC voltage readings inaccurate on some or all ac ranges; performance on ohms and dc voltage ranges is normal.

1. Defective contacts or wipers, or excessive leakage in S2B. Check for loose or dirty contacts.
2. V2 defective. Install new 6AL5. See "Tube Replacement."
3. C2 or C3 leaky.
4. R29 changed in value. Check with ohmmeter.

If instrument is inaccurate on 500 and 1500 volt ranges only, check contacts 10 and 11 on S2D and also R2, R3, and R4. If inaccurate on 1.5 volt range only, replace V2. See "Tube Replacement."

Instrument fails to operate on any range of "+VOLTS" or "-VOLTS"; works normally on ohms and ac volts.

1. UNI-PROBE resistor is open. Try applying low dc-voltage with UNI-PROBE set at "AC-OHMS". If reading is obtained (about 10% high), replace UNI-PROBE resistor.
2. DC voltage contacts on switch sections S2A, S1B, or S1C are defective. Check for loose or broken contacts.

Voltage readings inaccurate on "+VOLTS". "-VOLTS", ac voltage and resistance readings are correct.

1. R31 out of adjustment. Reset as described under "DC Voltmeter Calibration."
2. UNI-PROBE switch is shorted, resulting in readings about 10% high on all +DC and -DC voltage ranges. Use ohmmeter to check for short between input and output of probe at "DC" position as well as "AC-OHMS" position.
3. Resistances in network around S2A has changed value. Check with ohmmeter and replace defective resistors.

EICO Repair Service

If your instrument fails to function properly and the cause of the trouble can not be found with the trouble shooting information provided, you may return it to the EICO repair department where it will be repaired at a charge of \$5.00 plus the cost of parts. If your instrument has been built from the kit form, refer to the complete statement of the EICO servicing policy in your construction book. (Note: Please include UNI-PROBE when returning instrument for repair.)

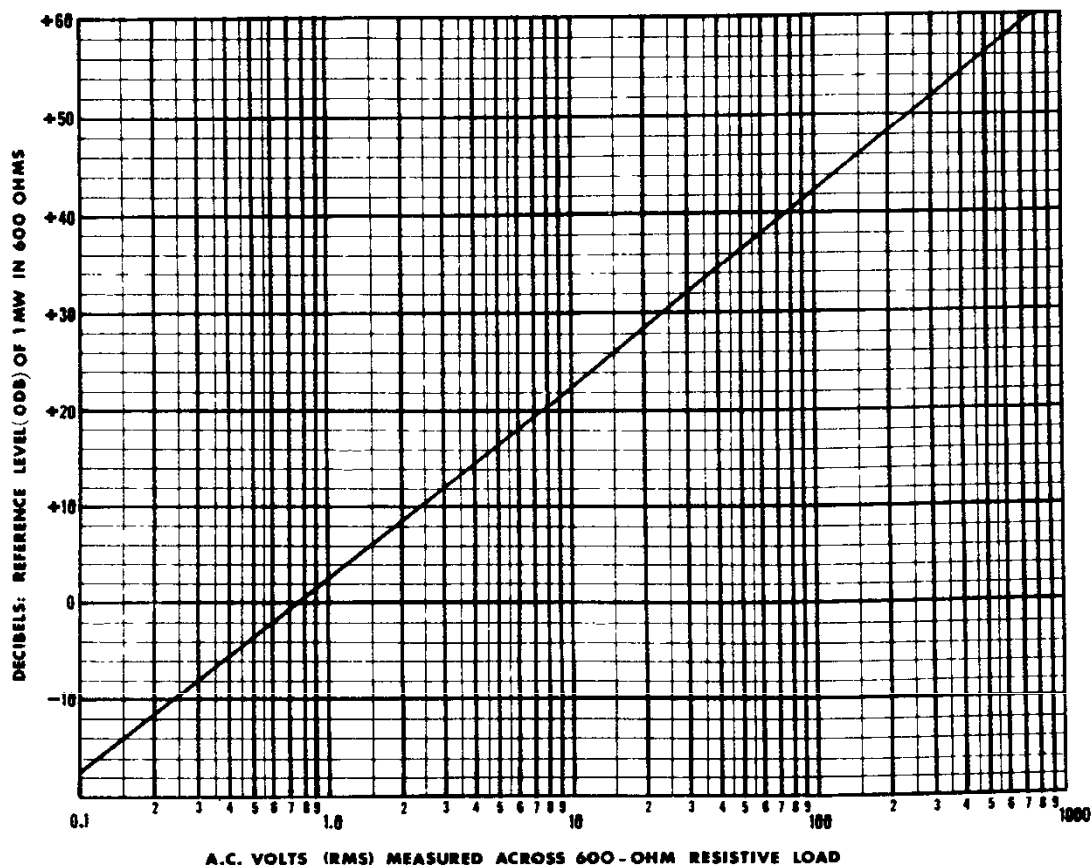


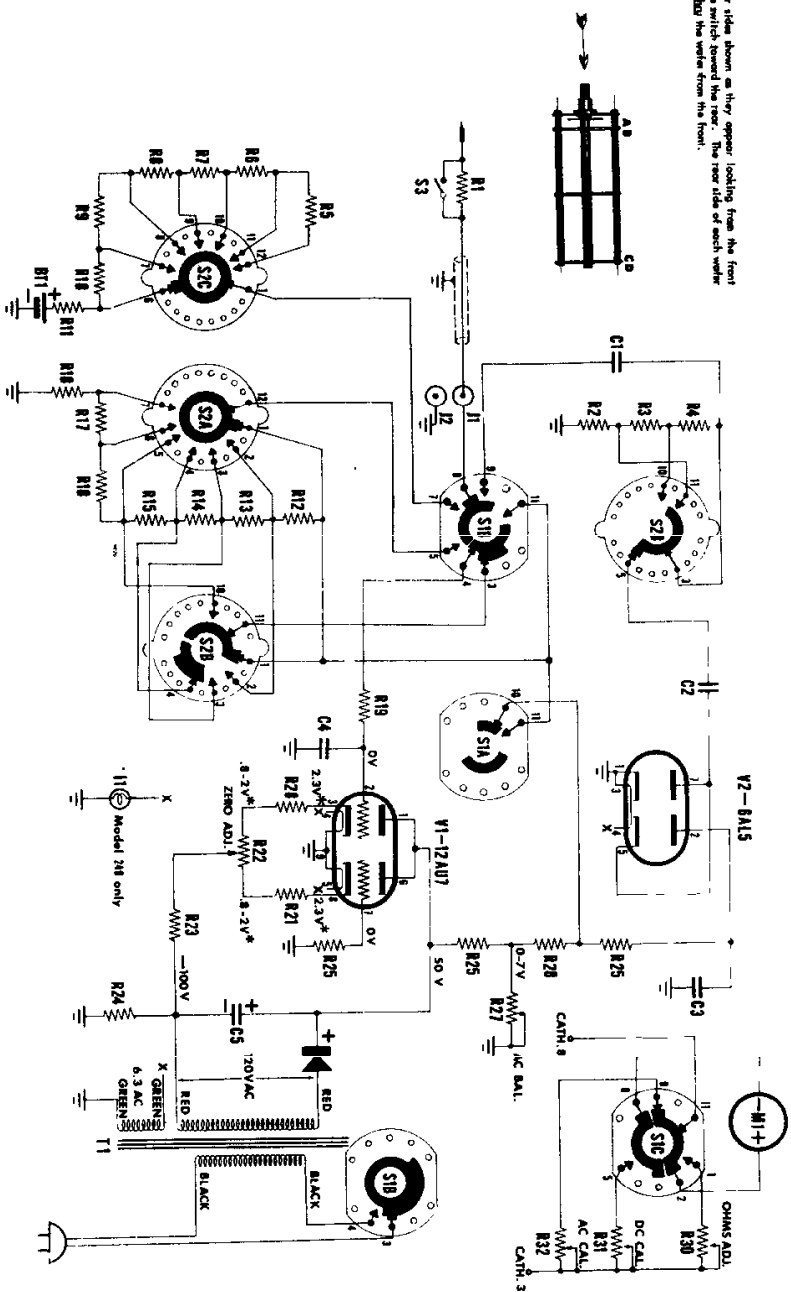
Fig. 1

REPLACEMENT PARTS LIST

STK.NO.	SYM.	DESCRIPTION	STK.NO.	SYM.	DESCRIPTION
10033	R19	Res., 3.3 MΩ, 1/2W, 20%	11049	R16	" 70 KΩ, 1/2W, 1%
10034	R25	" 4.7 MΩ, 1/2W, 20%	11050	R17	" 20 KΩ, 1/2W, 1%
10404	R28	" 82 MΩ, 1/2W, 10%	11051	R18	" 10 KΩ, 1/2W, 1%
10406	R20,21	" 680 Ω, 1/2W, 10%	11052	R3	" 325 KΩ, 1/2W, 1%
10407	R1	" 1 MΩ, 1/2W, 10%	11700	R4	" 900 KΩ, 1W, 1%
10503	R26	" 33K, 1/2W, 5%	11701	R12	" 7 MΩ, 1W, 1%
10520	R24	" 68K, 1/2W, 5%	16000	R22,30	" pot., 2 KΩ, linear
10521	R23	" 47K, 1/2W, 5%	18014	R31,32	" pot., 2 KΩ, linear
10524	R29	" 18 MΩ, 1/2W, 5%	18015	R27	" pot., 10KΩ, linear
11025	R2	" 150KΩ, 1/2W, 1%	20003	C1	cap., .1 mf - 1000 V
11026	R15	" 200 K, 1/2W, 1%	20007	C4	cap., .003 mf - 400 V
11037	R9	" 900 Ω, 1/2W, 1%	20012	C2, C3	cap., .025 mf - 400 V
11038	R8	" 9 KΩ, 1/2W, 1%	23010	C5	cap., elec. 10mf, 150V
11039	R7	" 90 KΩ, 1/2W, 1%	56000	BT1	battery, 1 1/2 V
11043	R11	" 9.7 Ω, 1/2W, 1%	60024	S2	switch, range
11044	R10	" 90 Ω, 1/2W, 1%	60025	S1	switch, function
11045	R6	" 900 KΩ, 1/2W, 1%	72004	M1	meter, 400 ua
11046	R5	" 9 MΩ, 1/2W, 1%	90013	V1	tube, 12AU7
11047	R13	" 2 MΩ, 1/2W, 1%	90017	V2	tube, 6AL5
11048	R14	" 700 KΩ, 1/2W, 1%	92000	I1*	bulb, #47
			93003	CR1	rect., 35 uo

*Model 249 only

All switch wafers shown as they appear looking from the front (left end) of the switch toward the rear. The rear side of each wafer is seen looking B20 the wafers from the front.



Buttons on all switch wafers shown in extreme counter-clockwise position.

Sym.	Description	Sym.	Description	Sym.	Description
B1	battery, 1 1/2V	R4	res., 900K Ω , 1W, 1%	R25	res., 4.7M Ω , 1/2W
C1	cap., .1mF - 1000V	R5	res., 9M Ω , 1/2W, 1%	R26	res., 33K Ω , 1/2W
C2, C3	cap., .025mF - 400V	R6	res., 900K Ω , 1/2W, 1%	R27	pot., 10K Ω , linear
C4	cap., .003mF - 400V	R7	res., 900K Ω , 1/2W, 1%	R28	res., 82M Ω , 1/2W
C5	cap., elec., 10mF - 150V	R8	res., 9K Ω , 1/2W, 1%	R29	res., 18M Ω , 1/2W
CR1	rect., 35 ma	R9	res., 900 Ω , 1/2W, 1%	R30	DC CAL
CR2	rect., 47	R10	res., 900 Ω , 1/2W, 1%	R31	AC CAL
M1	meter, 400 μ A	R11	res., 9.7 Ω , 1/2W, 1%	R32	AC CAL
R1	res., 1M Ω , 1/2W, 1%	R12	res., 7M Ω , 1W, 1%	R33	OHMS ADJ.
R2	res., 150K Ω , 1/2W, 1%	R13	res., 2M Ω , 1/2W, 1%	R34	OHMS ADJ.
R3	res., 325K Ω , 1/2W, 1%	R14	res., 700K Ω , 1/2W, 1%	R35	OHMS ADJ.
R4	res., 900K Ω , 1W, 1%	R15	res., 200K Ω , 1/2W, 1%	R36	OHMS ADJ.
R5	res., 9M Ω , 1/2W, 1%	R16	res., 70K Ω , 1/2W, 1%	R37	OHMS ADJ.
R6	res., 900K Ω , 1/2W, 1%	R17	res., 20K Ω , 1/2W, 1%	R38	OHMS ADJ.
R7	res., 900K Ω , 1/2W, 1%	R18	res., 10K Ω , 1/2W, 1%	R39	OHMS ADJ.
R8	res., 9K Ω , 1/2W, 1%	R19	res., 3.3K Ω , 1/2W, 1%	R40	OHMS ADJ.
R9	res., 900 Ω , 1/2W, 1%	R20	res., 680 Ω , 1/2W, 1%	R41	OHMS ADJ.
R10	res., 900 Ω , 1/2W, 1%	R21	res., 2K Ω , linear	R42	OHMS ADJ.
R11	res., 9.7 Ω , 1/2W, 1%	R22	res., 2K Ω , linear	R43	OHMS ADJ.
R12	res., 7M Ω , 1W, 1%	R23	res., 47K Ω , 1/2W, 1%	R44	OHMS ADJ.
R13	res., 2M Ω , 1/2W, 1%	R24	res., 68K Ω , 1/2W, 1%	R45	OHMS ADJ.

* Model 249 only

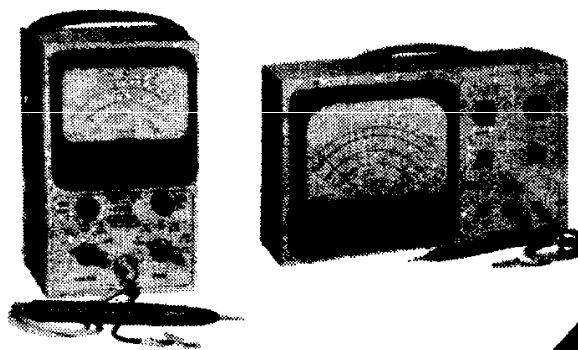
MODEL 232 PEAK TO PEAK VTVM

ELECTRONIC INSTRUMENT CO., INC.
84 Wilshire St., Brooklyn 11, N. Y.



SERVICE BULLETIN

Models 232 - 249



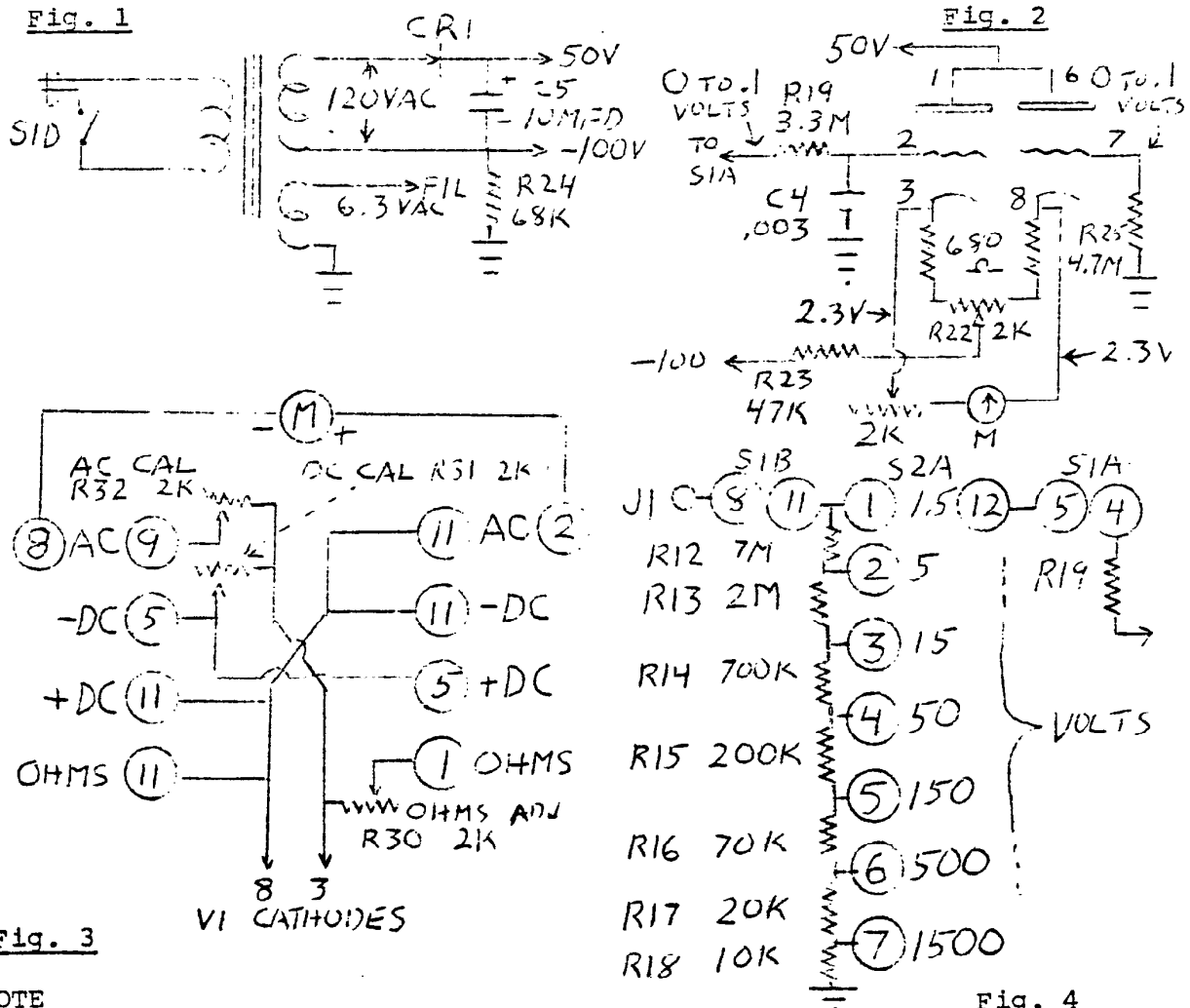
TSD FOR EICO MODELS 232 & 249

Before you start trouble shooting, check wiring carefully. In most cases, trouble will result from wrong or reversed wiring, cold or unsoldered connections, wrong parts used or transposed with others. If you have followed the instructions given with your kit, used a good soldering iron, a good grade rosin core solder, and used a heat sink on precision resistors, you should have no fear of high resistance solder joints or shorts and over-heated parts.

STEP 1

Compare the voltages in your unit with any shown on the schematics and locate the cause of any found to differ by 20%. See figures 1 and 2.

SIMPLIFIED SCHEMATIC BREAKDOWN



NOTE

Numbers in the circles refer to contacts. Numbers between the circles indicate continuity when switch is in position identified. Numbers above the circles refer to switch wafers.

Fig 1. - Power Supply

Fig.2. - Basic Bridge Circuit

Fig 3.- SIC Function Switching

Fig 4.-- DC Switching Circuit.

STEP 2

The next step will trace the trouble either to the basic bridge circuit or the grid circuit of the 12AU7. Place the function switch into +DC volts and ground the junction of R19 and S1A-4 with a screwdriver or the common lead of your instrument. This will balance the bridge and will enable you to adjust the pointer with the zero adjust pot. If there is no adjustment, we know the trouble is in the cathode circuit. If the pointer does return to zero, we then know the trouble is in the grid circuit. See figure 2.

STEP 3

Improper or dissimilar voltages in the cathode circuit are usually indicative of a defective 12AU7, improper or open resistors, defective zero adjust pot, or leakage to ground on the socket, switch S1C or in the pot (R22). 2.3V \pm 20% is usually measured between cathodes and ground which will vary when the zero adjust pot is varied. Zero adjustment should be possible in all functions. If the meter does not move continuity through S1C, or through the calibration pots, is suspected. See figure 3. Grounding one cathode or the other through a 4.7K ohm resistor should cause the meter to move up scale showing the meter movement is good.

STEP 4

Operation of the grid circuit can be checked by connecting a 3.3 meg, 1/2 watt resistor from the positive terminal of B11 to Xv1-2. The meter should move up scale and indicate about .8 to 1.3 on the 1.5 volt DC scale: the actual value will depend on the position of the DC calibration pot. Operation of the DC calibration pot R31 may be checked at this time if capacitor C4 is not shorted or leaky.

STEP 5

With the range switch in the 1500V position removal of the short installed in Step 2 should not greatly change the meter reading, but higher readings will normally be obtained when the range switch is turned towards the 1.5 volt position. If there is a change, ground terminals S1A-4, S1A-5, S2A-12 and S2A-1 (in that order) with the common lead, will pinpoint the wafer containing the poor connection or contact. See figure 4.

STEP 6

With the range switch in the 1.5 volts position, the application of 1.5 volts through a 3.3 meg resistor to J1 should give you a reading on the meter. If not, move the resistor to S1B-8, S1B-11 and to S2A-1, and note where the first reading is obtained. An indication will pinpoint the area where continuity is lacking.

STEP 7

Any problems remaining will be limited to bad resistors, poorly soldered connections, or no continuity through the switches in the circuit preceeding R19. Figures 5 & 6 ... will be helpful when trouble shooting problems existing in OHMS and AC FUNCTIONS. It is advisable to use another ohmmeter when checking for continuity or values of resistors.

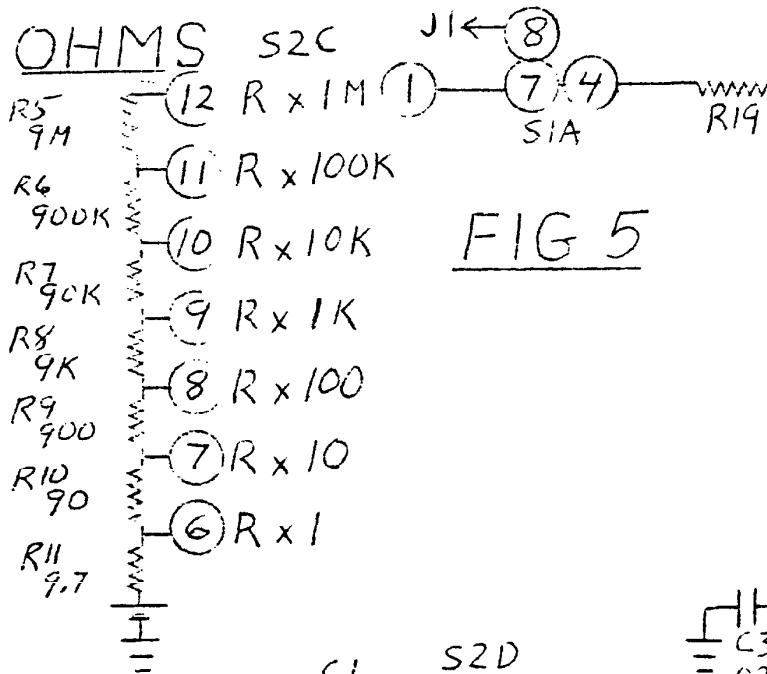
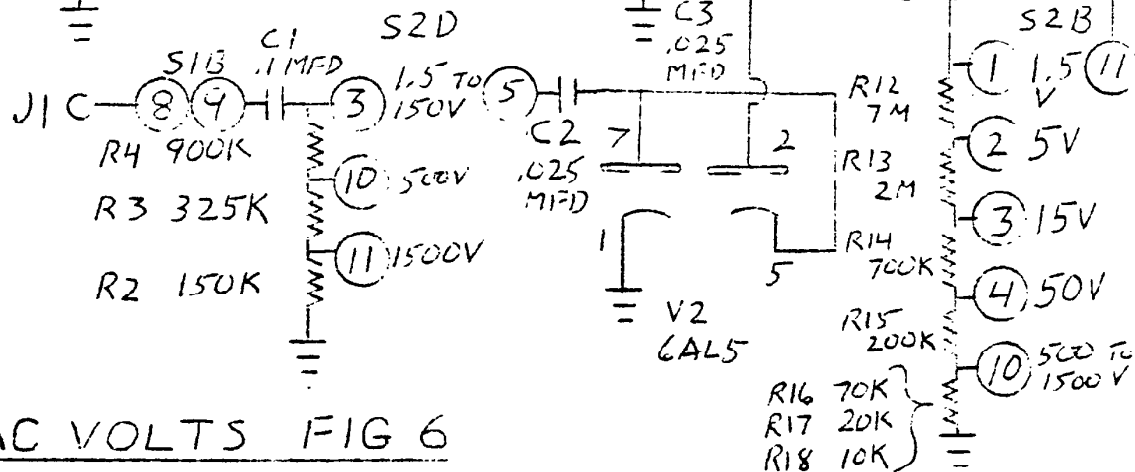


FIG 5



NOTE

Numbers in index refer to contacts. Numbers between the circles indicate continuity when switch is in position identified. Numbers above the circles refer to switch wafers.

INTERCONNECTION CHARTS

Function Switch S1 #60067

	OFF	AC-VOLTS	-DCV	+DCV	OHMS
A	3-4	3-4, 10-11	4-5	4-5	4-7-8
B	-----	8-9	8-11	8-11	-----
C	2-11-9	2-11, 8-9	2-11, 5-8	2-5, 8-11	1-2, 8-11
D	-----	3-4	3-4	3-4	3-4

Function Switch S2 #60024

	1.5 R X 1	5 R X 10	15 R X 100	50 R X 1K	150 R X 10K	500 R X 100K	1500 R X 1M
A	1-12	2-12	3-12	4-12	5-12	6-12	7-12
B	1-11	2-11	3-11	4-11	10-11	10-11	10-11
C	1-6	1-7	1-8	1-9	1-10	1-11	1-12
D	3-5	3-5	3-5	3-5	3-5	5-10	5-11

Below you will find a list of possible troubles and their remedies:

SYMPTOMS PROBABLE CAUSE SUGGESTED PROCEDURE

POWER SUPPLY

1. Trans. operates hot	(a) In normal operation, tran will get warm	(a) None
2. Trans. leaking wax	(a) Short in power supply. (b) Leaky filter condenser.	(a) Remove rectifier CR1, check trans. voltage and CR1. Replace trans. or CR1. (b) Replace condenser.

DC BRIDGE CIRCUIT

- | | | |
|---|--|---|
| 1. Meter does not move. | (a) No voltage on plate of 12AU7. | (a) Check power supply (See diagram) |
| | (b) Short in function switch. | (b) Remove meter leads, check resistance from leads to ground to locate trouble. Trace wiring through function switch using figure 3. |
| | (c) Short on meter movement | (c) Remove any shorting wire on meter used for shipping purposes |
| 2. Meter jump when you touch probe on 5V, 10V and high ohms ranges. | (a) Normal reaction due to electrostatic pickup; will read correctly if calibrated properly. | (a) Some of the pickup might be reduced by inserting a .01 mfd. from one side of the line to the ground. |
| 3. Pointer swings off scale on all ranges. | (a) Open bridge circuit | (a) Use procedure in paragraph three. |
| | (b) Defective 12AU7 | (b) Change 12AU7. |
| 4. Pointer swings off scale on all voltage ranges except ohms. | (a) Poor ground on AC, DC divider network (See figure 4 & 6). | (a) Solder and secure ground two lugs on RANGE switch. |
| | (b) One of the res. in divider network open or not making proper contact. | (b) Check divider using ohmmeter. See fig. 4 & 6 |
| 5. Pointer swings off scale on only one range. | (a) No continuity through S2 range switch. | (a) Use ohmmeter to check continuity through inoperative position and adjust or clean the errant contact. |
| 6. Plus and minus DC, no readings | (a) Short in Uniprobe | (a) See that shield is not touching inner conductor. |
| | (b) Resistor open | (b) Replace resistor. |

<u>SYMPTOMS</u>	<u>PROBABLE CAUSE</u>	<u>SUGGESTED PROCEDURE</u>
6.	(c) Shorted jack	(c) Replace jack or look for solder inside of jack.
	(d) Defective DC calibration pot.	(d) Replace pot.
7. Meter moves immediately after unit is turned on	(a) Leakage to ground in pots.	(a) Replace or clean inside of pots R22, R30, R31 or R32.
	(b) Short or leakage on S1C function switch.	(b) Replace switch, clean with alcohol or spray. Examine for shorts caused by wire or solder.
8. Shift on 5V and 10V ranges.	(a) This should only happen on DC. AC has a balancing pot.	(a) Normal shift; DC very slight. Try changing 12AU7.
9. Meter seems sluggish; needle moves across scale slowly	(a) C4 condenser bad or leaky.	(a) Replace same.
	(b) Condenser marked incorrectly.	(b) Replace same.
	(c) Meter movement sticks. OK when topped with finger.	(c) Replace same.
10. With leads shorted touch the probe tips. Needle jumps.	(a) Ground jack on panel not grounded	(a) Fibre washer left on banana jack. Remove fibre washer and make sure it is grounded to panel
11. Needle jumps when you touch cabinet or panel.	(a) A.C. leakage in transformer.	(a) Put .01 condenser from side one to ground.
12. DC voltage reads high; can not be calibrated.	(a) Resistor in DC probe left out or wrong value	(a) Insert resistor (1meg) in probe. (b) Replace transformer. (c) Reverse A.C. plug.
	(b) Plate voltage on 12AU7 too high.	(b) Check power supply and resistance in the cathode circuit of 12AU7.
		(c) Try other 12AU7's.

<u>SYMPTOMS</u>	<u>PROBABLE CAUSE</u>	<u>SUGGESTED PROCEDURE</u>
13. DC reads low	(a) Break down in probe (b) Break down on function switch	(a) Check insulation in panel mounted connector. (b) Remove leads from function switch. See paragraph on leakage.
14. Not enough swing, unable to obtain zero center.	(a) Plate voltage on 12AU7 too low. (b) Insufficient gain in 12AU7.	(a) Check power supply. (See section on power supply troubles) (b) Try replacing 12AU7

OHMMETER SECTION

1. Not enough swing on ohms scale	(a) Battery bad. (b) Voltage on plate of 12AU7 too high. (c) Voltage on plates of 12AU7 too low. (d) 12AU7 has low gain. (e) Zero adj. pot changes value	(a) Replace battery. (b) Check power supply and also zero adj. pot. (c) Check power supply (replace filter condenser paralleling it will not show leakage). (d) Replace tube. (e) Check value and replace if necessary.
2. Ohms does not read but has enough swing	(a) Uniprobe open (b) No continuity through S1A. (c) Banana jack not grounded properly. (d) Test leads open	(a) Adjust contacts in Uniprobe. (b) Adjust or clean contacts. See figure 5. (c) Check and remove shoulder washer if necessary. (d) Check and repair.
3. Pointer swings off scale to the right and ohms adjust has little or no affect at all.	(a) Battery left out or wired in incorrectly. (b) Battery wires broken.	(a) Install battery or rewire correctly. (b) Replace battery wires

<u>SYMPTOMS</u>	<u>PROBABLE CAUSE</u>	<u>SUGGESTED PROCEDURE</u>
3.	(c) If this occurs only on one range, the resistors for that range or switch is making poor contact.	(c) Replace defective resistors, clean switch wafer with carbon tetrachloride, resolder to lug. See figure 5.
4. Pointer swing to the left when range switch is rotated to the high ohms ranges	(a) Gassy tubes	(a) Replace 12AU7
5. Pointer swings to the right of scale only on RX1 meg range.	(a) Due to insufficiently aged 12AU7. (b) Pickup	(a) Allow 12AU7 to age longer. If it still does not help replace tube. (b) Add a .01 condenser from one side of the line to ground. Reverse the plug.
6. With leads shorted all ohms ranges zero except RX1 range.	(a) High resistance connection in unit.	(a) Resolder female coaxial connector and banana plug. Resolder all connection in ohmmeter section or unit. Adj. uni-probe contacts. 1/10 or 2/10 residual reading is normal.
7. Readings on all ranges either high or low.	(a) Internal resistance of battery has changed although voltage readings of battery is correct. (b) 12AU7 not up to par.	(a) Replace battery. (b) Try other brand new tubes. Select one for best accuracy $\pm 10\%$ is acceptable.
8. No movement in ohms	(a) Cup washer or battery clip grounded	(a) Install fiber shoulder washers. Check for shorts See fig. 2 in Construction manual.

<u>SYMPTOMS</u>	<u>PROBABLE CAUSE</u>	<u>SUGGESTED PROCEDURE</u>
<u>AC Section</u>		
1. No voltage when AC is applied.	(a) Blocking condenser in AC network open, missing or wired improperly.	(a) Replace condenser or rewire to proper contact. (c1 or C2).
	(b) Leaky bypass condenser on 6AL5.	(b) Replace condenser C3.
	(c) 6AL5 tube defective.	(c) Replace 6AL5 tube.
	(d) TB3 grounded by solder	(d) Remove excess solder. Do not mistake TB3 for ground lug on XV2. See fig. 3 in instruction manual.
2 AC will not calibrate, reads too high or too low.	(a) 6AL5 tube defective.	(a) Replace tube.
	(b) Bypass cond. on the 6AL5 leaky.	(b) Check and replace cond. C3 if necessary.
	(c) AC compensating resistors changed value.	(c) Check and replace if necessary with correct value.
	(d) Leakage in switches.	(d) See section on leakage.
3. AC will not zero balance.	(a) Tubes not balanced properly.	(a) First replace 6AL5. If this does not help, then replace 12AU7.
	(b) Res. in balancing network wrong value. (R26, R28, R27)	(b) Check values of balancing resistors.
	(c) Balancing resistors left out.	(c) Insert resistors R26 and R28.
	(d) 12AU7 tube not grounded properly.	(d) Resolder all connections.

<u>SYMPTOMS</u>	<u>PROBABLE CAUSE</u>	<u>SUGGESTED PROCEDURE</u>
4. AC non-linear does not read same voltage on any two ranges. EX: 100V input should read 100 volts on 100V, 500V and 1000 volt range.	(a) Unbalanced tube. (b) Break down of connector. (c) Leakage in function switch.	(a) Replace 6AL5 tube Also try replacing 12AU7 tube. (b) Replace panel mounted connector. (c) See section devoted to leakage.

LEAKAGE

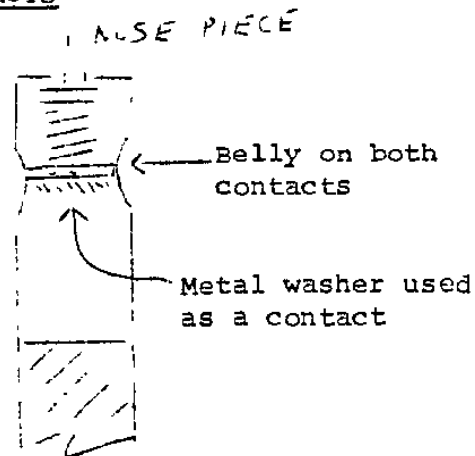
One of the most common troubles in sensitive equipment is leakage and it is one of the most difficult troubles to locate. In order to determine whether or not leakage is present in your unit, the following procedures may be used:

1. Apply a known voltage (somewhere around 100V) to the input (probe) of the VTVM. Set range switch to desired range, check reading, then move the range switch to the next range (without changing the input voltage). The reading should be the same. In other words, if 100 volts is being used as a standard, the VTVM should read 100V on the 100V range and when switched to 500 or 1000V ranges, it should also read 100 volts.

2. Leakage can occur on wafer B of S1 (See figure 4 & 6) or wafers A of S1, B of S2 or D of S2, (see figure 6). In order to locate the exact point at which the leakage is taking place, you must remove the leads from the function switch and make direct contact, thus eliminating the switch from the circuit.

UNIPROBE CONTACTS

In cases where meter readings are erratic or not constant the contacts in the Uniprobe are suspect. These contacts should be bent so that a belly is formed in the vicinity of the metal washer on the nose piece.



NOTES ON 232 AND 249

There appears to be some confusion between the range and function switches. The switch illustrated in both Figure #4 and #5 is marked #60024 on the detent plate. This is the range switch.

The function switch is marked #60067 and should not have any of the precision resistors wired on to it. It is not illustrated separately but may be found in Figure #7, marked S1.

Page 4, Figure 3, 2nd Column - 6th instruction:
"Connect the 4.7 megohm resistor....."Change lug "C" (C) to lug "D" (C)".

On Figure 3 TB3-1 looks like a ground lug on XV2. Care should be taken not to ground the terminal strip.

Page 8, Figure 7. Meter terminal No.1 is the positive (+) terminal; terminal No. 2 is the negative (-) terminal.

Page 12, Step 3. Insert battery with positive terminal into the cup washer.

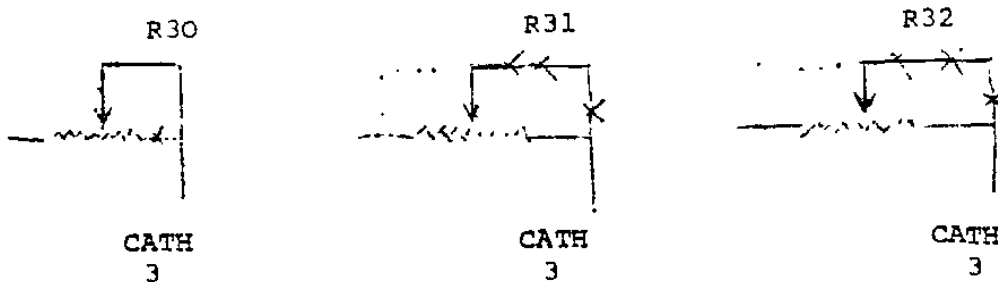
Page 12, Step 5. (Third line): Change 50,000 ohms to 40,000 ohms.

Page 9, Fig. 8. E13 should be shown pointing downward.

Page 14, Operating Instructions. Schematic diagram is incorrect. Use corrected schematic diagram in the Construction Manual.

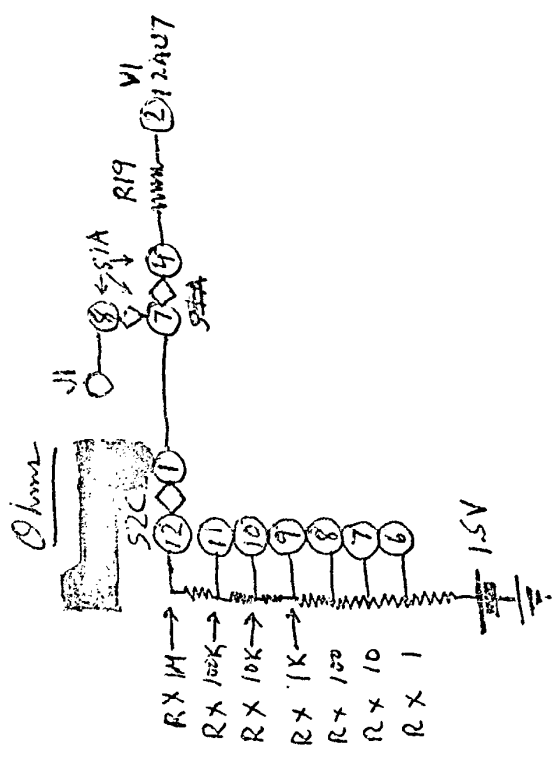
An apparent discrepancy exists in the wiring of R30, R31 and R32 when figures 3 and 7 are compared with the schematic. However the 232 will work wired either way.

The schematic may be corrected as follows: Wires marked with an X are to be eliminated - wires indicated by dots are to be added.

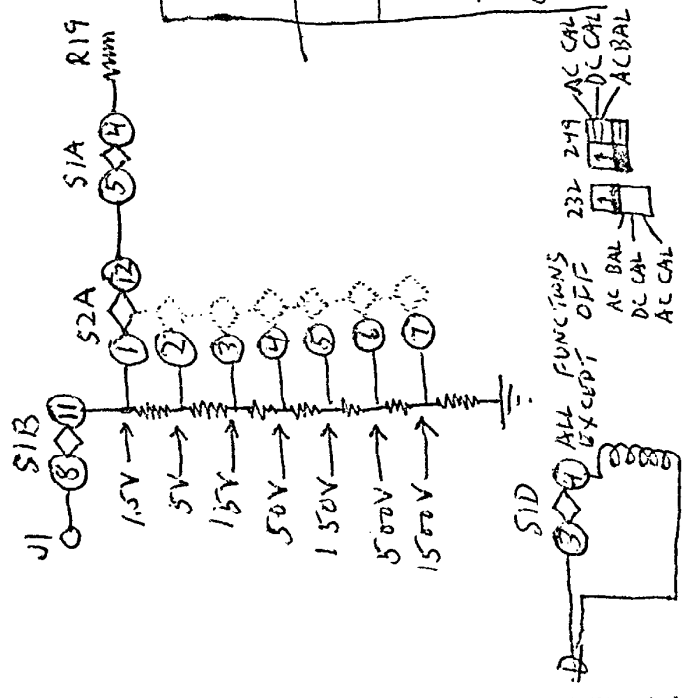


From a cold start, the meter should not move when the unit is turned on until the 12AU7 reaches operating temperature. Leakage paths to ground in R22, R30, R31, R32 or S1C causing such operation can be cleared (removed) by using a contact cleaner spray. Application directions will be found on the container.

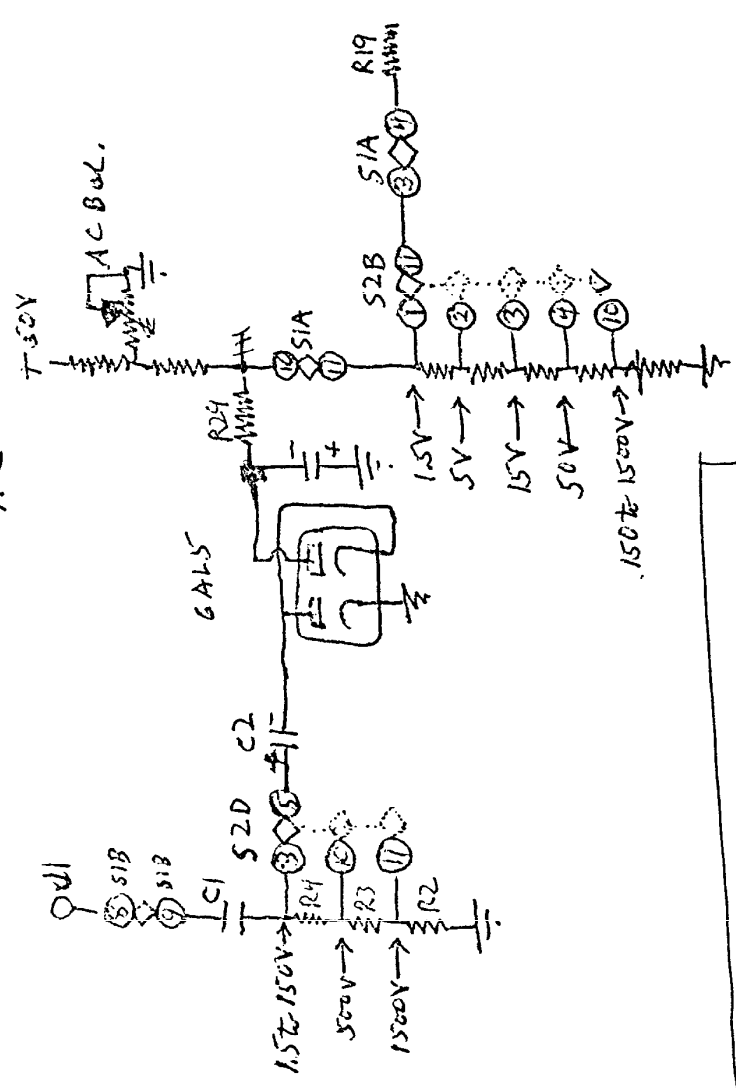
232 - 249



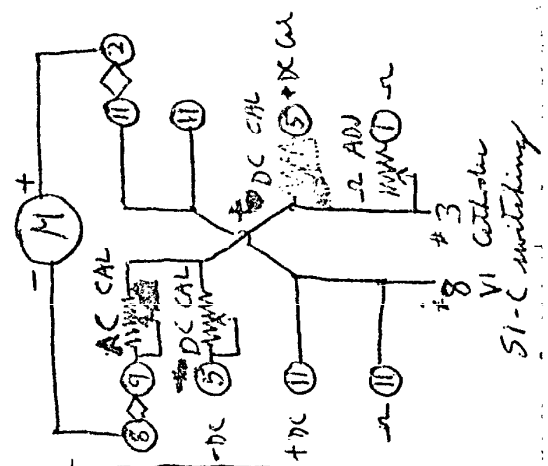
± DC



AC



AC	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
-DC	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
+DC	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
ohm	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100



51-C switching