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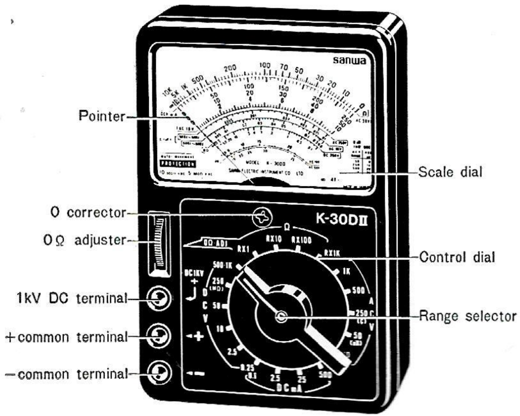
sanwa

K-30DII
MULTITESTER

OPERATOR'S MANUAL

FRONT PANEL ARRANGEMENT



FOR SAFETY OPERATION

The tester is a most widely used test instrument measuring various electric quantities as voltage, current, resistance, etc. Naturally, the object of measurement spreads extensively from minute current to high voltage. On the other, the input impedance of a tester changes widely from several ohms up to high megohm level as measurement ranges are cut over.

Therefore, careless handling of a tester in neglect of safety rules will not only destroy the meter, but in the worst case the operator himself might be involved in danger. Know that voltage measurement above 250 volts is only applicable to high-impedance and low-energy circuits like those of television receivers. It is absolutey prohibitive to attempt to measure a low-impedance, high-energy circuit to avoid disastrous accident. Even for a voltage below 250 volts of a low-impedance circuit, it is advisable to use the fuse-sealed test lead TLF-70A available extra in place of the positive test lead to evade possible danger.

Utmost care should be used not to commit any measurement mistake. A tester laid away unused for over a year or a one casually known to be defective in any way must not be used. Remember a tester needs inspection and calibration periodically at least once in 6-12 months, when withstand voltage test could not be omitted.

CONTENTS

1. FEATURES

1.1 Versatility performance. The handy yet high-performance instrument of 10kΩ/V for DC measurement covers DC voltage from 0.25V up to 1kV in 7 ranges. Joint use of an HV probe extends it to 25kV.

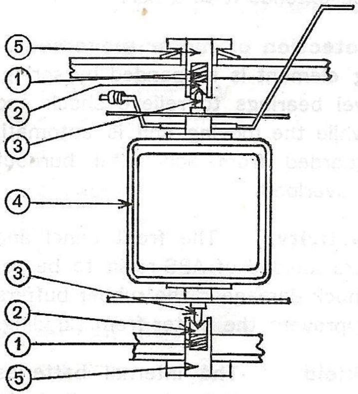
1.2 Double protection of meter movement. The moving element is suspended by spring-backed jewel bearings to relieve shock and vibration, while the moving coil is automatically safeguarded from accidental burnout inadvertent overload.

1.3 Shock resistivity. The front panel and rear case are molded of ABS-resin to be resistive to shock damage. The rubber buffers on the rear prevent the meter from skidding.

1.4 Battery shield. The internal batteries are partitioned by a shield plate to eliminate reading error the type of battery armor may cause.

2. SHOCKPROOF METER MOVEMENT

The jewel bearings supporting the moving element are spring-loaded (Fig. 1). They serve to absorb shock to the pivots if the instrument is accidentally dropped off the bench.



1. Springs
2. Bearings
3. Pivots
4. Moving coil
5. Bearing screws

Fig. 1

3. SPECIFICATIONS

3.1 Measurement ranges.

DCV	0.25	2.5	10	50	250	500
	1k (10kΩ/V) 25k (w/HV probe)					
DCmA	0.1	2.5	25	500 (250mV drop)		
ACV	10	50	250	500	1k (5kΩ/V)	
Ω	Range	R×1	R×10	R×100	R×1k	
	Midscale	96	960	9.6k	96k	
	Maximum	10k	100k	1M	10M	
	Minimum	2	20	200	2k	
dB	−20∼+62					
MΩ	1∼200	Use external power.				
uF	0.0001∼0.6	Use external power.				

3.2 Allowance.

Within ±3% fs for DCV & DCmA.
Within ±4% fs for ACV & dB.
Within ±3% of arc for Ω.

3.3 Batteries. 1.5V(UM-3)×2 9V(006P)×1

3.4 Dimensions & weight.

144(H)×96(W)×56(D)mm & 570gr

4. PRELIMINARIES TO OPERATION

4.1 Zero correction. The 0-corrector is turned with a screwdriver, and the pointer is adjusted to 0 of the scale left. It need not be adjusted at each measurement except when it is found off 0.

4.2 Range selection. Ranges are selected by rotating in either direction the range selector knob. Ranges are arranged around the knob, Ω on the top, ACV on the right, DCV on the left, and DCmA on the bottom.

4.3 Test lead connections. As a rule, the red lead is connected to the + and the black lead to the − jack. Insert the pin plugs well down. For 1kv DC, the red lead goes to the exclusive jack marked DC 1kV+.

5. MEASUREMENT

5.1 Measuring DCV.

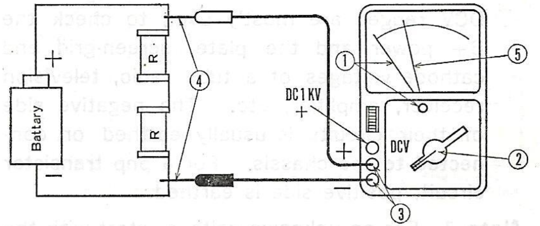


Fig. 2 DCV measurement.

5.1.1 Order of measurement.

① Zero correction.
② Range selection.
③ Test lead connections.
④ Test probes to check point.
⑤ Reading taken.

Note For accuracy reading, use the range which will allow the pointer to read on the right-hand half of the scale.

5.1.2 Voltage is measured across the load. Since direct current is being measured, take note of the polarity. The black lead goes to the negative and the red lead to the positive potential of the load. Wrong connections deflect the pointer in reverse direction across 0.

DCV ranges are mostly used to check the B+ power and the plate, screen-grid and cathode voltages of a tube radio, television receiver, amplifier, etc. The negative side of their circuits is usually earthed or connected to the chassis. For a pnp transistor circuit, positive side is earthed.

Note 1 For an unknown voltage, start with the highest range to know the approximate voltage present. After the first reading, the switch can be reset to a lower range for a more accurate reading.

Note 2 When the range selector needs moved while measuring, switch off the circuit power or disconnect the test leads. If the switch is moved with the pointer left deflected, the meter movement can be damaged.

5.1.3 When measuring a voltage, the combined resistance where the tester is connected decreases subject to the input impedance of the voltage range used. (Fig. 3)

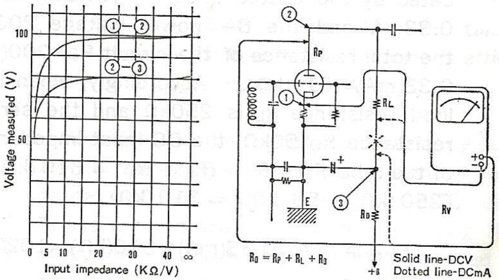


Fig. 3 Voltage measurement & input impedance.

The overall input impedance of a tester is indicated on the instrument. It is 10kΩ per volt DCV for the **K-30DII**, and the input impedance of its 250V range is known to be 10(kΩ/V)×250(V)=2.5(MΩ). In other words, the current the circuit supplies and the tester consumes is: 1(V)/10(kΩ)=100(uA) full scale. Therefore, as Fig. 3 shows, the less the current dissipation, the more accurate is the reading.

To obtain Ep across ① and ② accurately unaffected by the Ω/V of the tester, the current is measured by the connection indicated by the dotted lines. Providing Ip is 0.33mA and the B+ power voltage 200V, the total resistance of the circuit $R_0 = 200(V)/0.33(mA) \doteqdot 610(k\Omega)$. Accordingly, when the load resistance R_L is 250kΩ and the series resistance R_D 50kΩ, the DC input impedance of the tube $R_P = R_0 - (R_L + R_D) = 610(k\Omega) - [250(k\Omega) + 50(k\Omega)] = 310(k\Omega)$.

$$\therefore \quad E_P = I_P \times R_P = 0.33(mA) \times 310(k\Omega) = 102(V)$$

There is practically no error. When the same circuit is measured on the 250V range of the tester, the combined resistance (R_{10}) of the input impedances of R_V and R_P is:

$$\frac{R_P \times R_V}{R_P + R_V} = \frac{310(k\Omega) \times 2500(k\Omega)}{310(k\Omega) + 2500(k\Omega)} \doteqdot 276(k\Omega)$$

on account of the connection of the tester to the circuit.

On the other, I_P' on R_P is: $I_P' = 200(V) / [50(k\Omega) + 250(k\Omega) + 276(k\Omega)] \doteqdot 0.347(mA)$.

The voltage the tester reads is: $200(V) - 0.347(mA)[250(k\Omega) + 50(k\Omega)] \doteqdot 96(V)$.

The graph also reads 96 (V), while the actual value being 103 (V), the error the tester reads is: 103 (V) − 96 (V) = 7 (V). This fact taken into account, the **K-30DII** will serve as efficiently as a high-sensitivity instrument.

5.1.4 Negative voltage. Negative voltage exists at the test point of a television tuner, horizontal and vertical oscillating grid, AGC, etc. These circuits are checked by reversing the connections of the test leads, the red lead to the − and the black lead to the + potential. Negative voltage also occurs when there is a signal voltage at the grid-leak bias circuit of the horizontal output tube and the synchronous detaching tube.

5.2 Measuring DCmA.

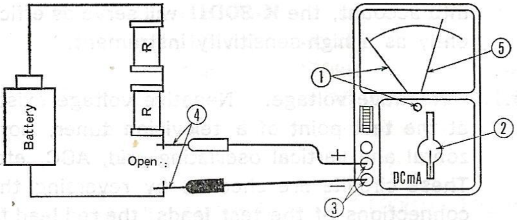


Fig. 4 DCmA measurement.

5.2.1 Order of measurement.

① Zero correction.
② Range selection.
③ Test lead connections.
④ Test probes to check point.
⑤ Reading taken.

5.2.2 Current is measured connecting the tester in series with the load taking note of the polarity of the circuit being checked. Major measurements are the collector current of a transistor, the plate current of a tube, the total current consumption of radio/TV receivers, etc.

Note 1 The measurement of unknown current should be started with the highest 500mA range. After the first reading, the switch can be reset to a lower range for a more accurate reading.

Note 2 Do not move the range selector switch leaving the circuit loaded. Switch off power, or disconnect the test leads.

Note 3 For current measurement, the input impedance of the range used is connected in series resulting in so much decrease of current. It is conspicuous for a low impedance circuit.

5.3 Measuring ACV (including dB).

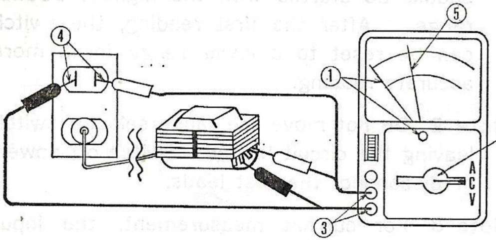


Fig. 5 ACV measurement.

5.3.1 Order of measurement.

① Zero correction.
② Range selection.
③ Test lead connections.
④ Test probes to check point.
⑤ Reading taken.

Note For 50V and up, use the scale in common with DCV measurement. For 10V alone, the exclusive scale is used.

5.3.2 The test probes are applied across the voltage. Since alternating current is being measured, polarity can be ignored. ACV ranges are mostly used to measure the secondary voltages of a power transformer, the power distribution line voltage, etc. Usually the secondary voltages of a power transformer for radio use are when unloaded about 10% higher than their rated values.

Note 1 Measurement of an unknown voltage should be started with the highest 1kV range. After the first reading, the switch can be reset to a lower range for a more accurate reading.

Note 2 Do not move the range selector switch leaving the circuit loaded. Switch off power, or disconnect the test leads.

Note 3 There is no trouble of checking the voltage of 30Hz ~ 5kHz. But above 5kHz, error occurs, and below 30Hz, the pointer vibrates unable to take the reading.

Note 4 To measure the ACV of a circuit where DC element is present mixed, a capacitor of about 0.1uF is placed in series with the circuit to block DC component. Voltage reads lower than the actual value because the reactance element of the capacitor connected in series acts as multiplier. For 1kHz frequency, error can be disregarded above 50V range, but the 10V range reads an error of about −0.3%. It must be noted for lower frequencies.

Note 5 The AC scale of a tester is calibrated in terms of RMS value assuming sinusoidal input, and the value measured is approximate for a nonsinusoidal voltage. Therefore, for a square wave, sawtooth wave, or pulse-wave circuit, the value read of a normal set may be of use.

5.3.3 Reading dB. The dB scale of a tester is graduated based on the ACV scale establishing 0dB at 0.7745V, so dB is measured just in the same way as ACV. For a dB too big to be checked on the 50V range, higher ranges are used, when the values given in the "ADD dB" table on the corner of the scale dial are added to the reading on the scale.

5.3.4 Same as for DCV measurement, some error occurs when the tester is connected to a high impedance circuit as a transformer for communication use. Error can be ignored for a 600Ω impedance circuit, but the input impedance of the tester must be taken into account because the circuit impedance grows

higher.

5.3.5 Example of audio circuit measurement of a radio receiver.

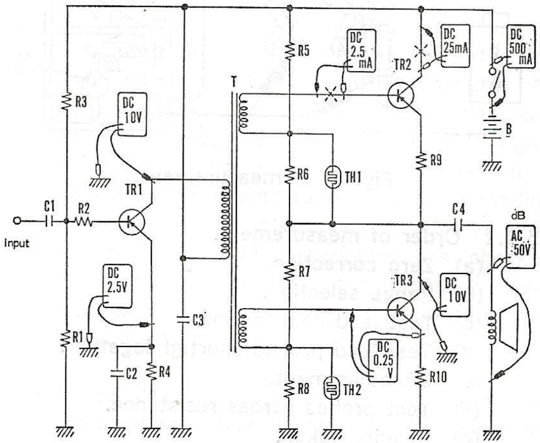


Fig. 6 Checking audio circuit.

TR1 · Audio amplifying transistor
TH1, TH2 · Thermistors
TR2, TR3 · Output transistors
T · Input transformer
X · Opened for current measurement

5.4 Measuring Ω.

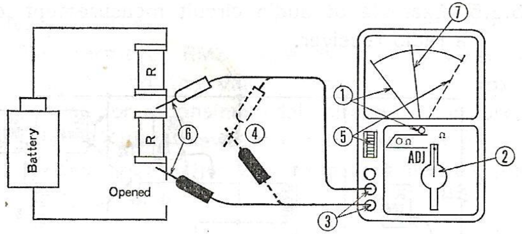


Fig. 7 Ω measurement.

5.4.1 Order of measurement.

(a) Zero correction.
(b) Range selection.
(c) Test lead connections.
(d) Test lead probes shorted together.
(e) 0Ω adjustment.
(f) Test probes across resistance.
(g) Reading taken.

5.4.2 Selecting the range. For a more accurate reading, choose a range which will allow the pointer to read near the middle of the scale. Refer to the following table:

Resistance	Proper range
0-300Ω	R×1
300Ω-3kΩ	R×10
3kΩ-30kΩ	R×100
30kΩ-10MΩ	R×1k

5.4.3 0Ω adjustment. At the 4th order of measurement, as the test leads are shorted together, the pointer moves towards right. As it rests, the 0ΩADJ is adjusted to place the pointer exactly on 0Ω of the scale right. This adjustment must be repeated each time the range is moved to avoid error of reading due to change of current load, and from time to time when resistors are checked consecutively because the batteries wear gradually. Do not force the adjuster knob beyond its stop position.

5.4.4 Besides mesuring resistance, the ohmmeter is used to determine the quality of semiconductors, check the continuity of coils, wiring and short circuit, the leakage of capacitors, etc.

Note 1 When measuring, keep off the fingers from the metal parts of the test leads: part of the current runs to the ground through the body to cause erroneous reading.

Note 2 Do not check the resistance of a circuit while it is alive. Even after the power is switched off, the circuit capacitor can remain charged. Be certain to discharge the load before the tester is connected to the circuit.

5.4.5 Replacement of the batteries. If 0Ω adjustment is impossible by turning the 0ΩADJ full up, or the pointer soon moves back for the R×1 range, the internal batteries have worn out needing replacement. To replace them, the rear cover is removed loosening the rear bolt. Putting the tester on a soft cloth face down, the fixing bolts are loosened and the batteries are taken out. When putting fresh batteries into the battery case, take note of the polarity. Do not tighten the bolts too much not to have the battery case cracked.

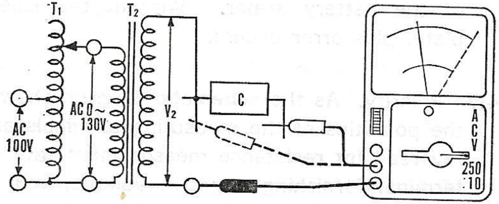
5.4.6 Shield plate. When ferrous armor batteries are used in the tester, its magnetic field is affected to cause error of 3%~8%. The shield plate eliminates this error regardless

of the battery armor. Without the shield plate, plus error occurs.

5.4.7 Polarity. As the schematic diagram shows, the polarities of the measuring terminals are reversed for resistance measurement, the + terminal furnishing negative voltage, and − terminal, positive voltage. It must be remembered when semiconductors are checked.

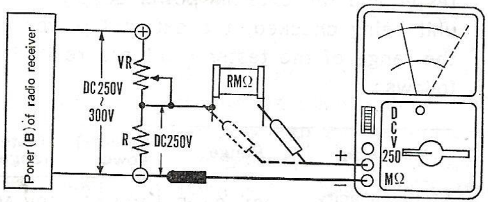
5.5 Measuring uF and MΩ. As shown in Figs. 8 and 9, the capacitor or the resistor being measured is connected in series with the tester and the external power supply. The unit being checked, the external power and the range of the tester used are related as follows:

Measuring	Range	External power	Tester range
Static capacity (uF)	0,001~0,6uF	10V AC	10V AC
〃 〃 〃	0,0001~0,01uF	250V AC	250V AC
Resistance(MΩ)	0,1~200MΩ	250 DC	250V DC



T1 : Voltage regulator
T2 : Transformer

Fig. 8 Measuring capacity.



VR : Variable resistor 50kΩ (1/2W or more)
R : 100kΩ (2/3W or more)

Fig. 9 Measuring high resistance.

5.6 LI and LV (battery check).

5.6.1 When checking a semiconductor on a resistance range, the tester reads the voltage it is loaded with as a voltmeter and the current simultaneously as an amperemeter. The characteristics of a diode can thus be checked. When the resistance of a thermistor or a thin wire coil is checked, they may be heated by the current applied to cause reading error, so it is necessary to know in advance their current load LI.

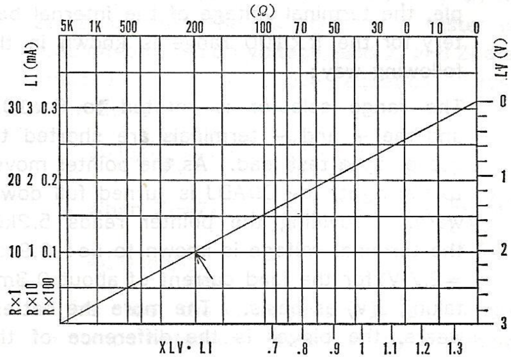


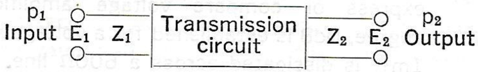
Fig. 10 LI and LV graph.

For example, when a resistance reads 19kΩ on the ×100 range of the tester, LI and LV are known on the graph (p. 23) to be 2V and 0.1mA, respectively.

5.6.2 A battery has internal resistance of its own. For a dry cell, it increases as it wears, and the terminal voltage necessarily changes by the quantity of current to be loaded. The same graph gives the terminal voltage of the internal battery (UM-3) through the current load, the current that the resistance dissipates while it is measured. For example, the terminal voltage of the internal battery for the R×100 range is known in the following way:

The range selector is rotated to R×100, and the + and − terminals are shorted together by a test lead. As the pointer moves to the right, the 0ΩADJ is turned full downward. Providing the pointer reads 5.2kΩ, the terminal voltage is known to be: 0.9×3 =2.7(V) for the load current of about 0.3mA taking 3(V) as basis. The more the battery wears, the bigger is the difference of the terminal voltages measured on the LI-0.3mA and LI-3mA ranges.

5.7 Measuring dB. Decibel (dB) is a unit used to compare input and output powers to express gain or loss of a coupled circuit. It is an input/output ratio. The dB scale provided reads both power and voltage ratios.



The input and output powers of a transmission circuit above are related as follows:

$$10 \log_{10} P_2/P_1 = 10 \log_{10} \frac{E_2^2/Z_2}{E_1^2/Z_1}$$

where power can be compared only when $Z_1 = Z_2$ because the dB scale of a tester is graduated based on voltage, and Z_1 and Z_2 are omitted from the above equation. Thus, when $Z_1 = Z_2$,

$$10 \log_{10} \frac{P_2}{P_1} = 10 \log_{10} \frac{E_2^2}{E_1^2} = 20 \log_{10} \frac{E_2}{E_1}$$

When $Z_1 \neq Z_2$, $10 \log_{10} \frac{P_2}{P_1} = 10 \log_{10} \frac{E_2^2/Z_2}{E_1^2/Z_1}$

$$\neq 20 \log_{10} \frac{E_2}{E_1}$$

In this case, the value obtained must either be compensated or coordinated by matching the impedance.

5.7.1 Power dB reference. For a tester, 0dB is established for the output where 1mW is dissipated across 600Ω impedance.

5.7.2 Voltage dB reference. For the dB to express or compare voltage amplification degree, 0dB is established for a voltage where 1mW is dissipated across a 600Ω line. It is 0.7745V.

5.7.3 Power dB measurement.

Input circuit dB —

For 5kΩ input impedance	38.2dB
5kΩ dB on the graph	−9.2dB
	29dB

Output circuit dB —

For 16Ω output impedance	11.8dB
16Ω dB on the graph	15.7dB
	27.5dB

The output transformer loss is therefore

29dB−27.5dB=1.5dB

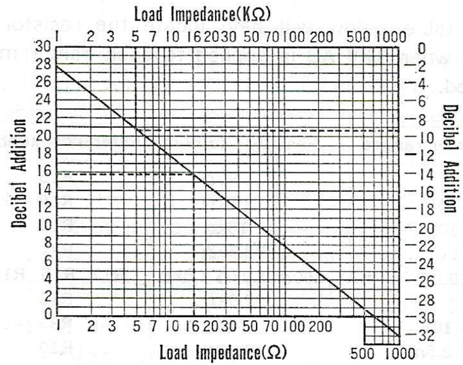
5.7.4 Votage dB measurement.

Input circuit dB	38.2dB
Output circuit dB	11.8dB

Therefore, the attenuation of the output transformer is :

38.2dB−11.8dB=26.4dB

The load of an output power tube is mostly measured by power dB checking the primary and secondary of the output transformer, while the gain of an amplifier circuit is usually measured by checking voltage dB.



6. METER MOVEMENT PROTECTION

The meter movement of the **K-30DII** is perfectly protected from high voltage below 1kV applied to any measurement range. Some resistor or the rectifier may be burnt out but it is no more necessary to send the instrument damaged for repair, but it can restore normal performance by replacing the part burnt out.

The table below will help locate the resistor to burn when 1kV AC is applied to each range mentioned.

Meter ranges	Resistors to burn	Reference number
R×1	95Ω	R18
R×10	1kΩ	R16
R×100	16kΩ	R12
R×1k	93.5kΩ	R7
DC0.25V(0.1mA)	360Ω 1.2kΩ 1.5kΩ	R17 R15 R13
DC 2.5V	22.9kΩ	R10
DC 10V	75kΩ	R8
DC 2.5mA	94.2Ω	R19
DC 25mA	9.54Ω	R20
DC 500mA	0.5Ω	R21
AC 10V	47kΩ	R9

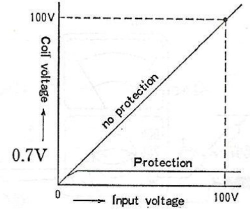


Fig. 11 Effect of protection circuit.

Fig. 11 shows that the protection device subdues 100V input voltage applied to the moving coil down to about 0.3V. Thus the movement is automatically protected from damage.

Note 1 The misconnection causing burnout must be immediately removed, or else some other resistor, the protection circuit, or the meter movement itself would suffer damage.

Note 2 In the table (p. 28), R13 and R15 are semifixed resistors. When they are burnt and replaced, the DCV and ACV ranges must be adjusted in the following way:

(1) DCV range.

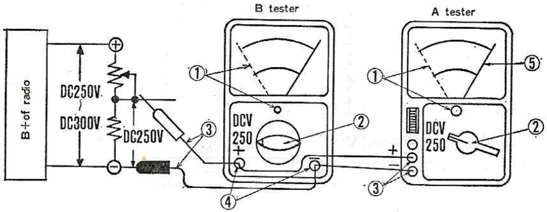


Fig. 12 Adjusting DCV range.

① Scale zero is corrected.
② Range selector is placed at 250(V) DC.
③ Test leads are connected.
④ The tester to be adjusted (A) is connected to the reference tester (B) in parallel.
⑤ R1 is adjusted for the pointer to read 250V DC.

(2) ACV range.

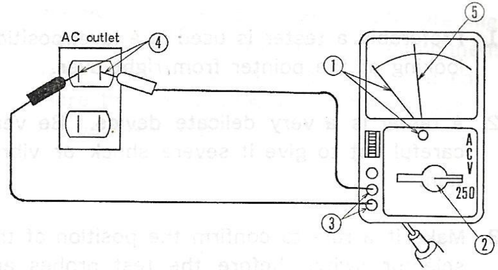


Fig. 13 Adjusting ACV range.

① Scale zero is corrected.
② Range selector is placed at 250(V) AC.
③ Test leads are connected.
④ The test probes are connected to the AC power source.
⑤ R15 is adjusted for the pointer to read the power source voltage.

7. MAINTENANCE

7.1 Preferably a tester is used in a level position looking at the pointer from right over.

7.2 A tester is a very delicate device. Be very careful not to give it severe shock or vibration.

7.3 Make it a rule to confirm the position of the selector switch before the test probes are applied to load. If a voltage is measured placing the switch on an ohm or milliampere range, it will burn the internal component rendering the instrument inoperative: it is very liable for a serious accident to occur.

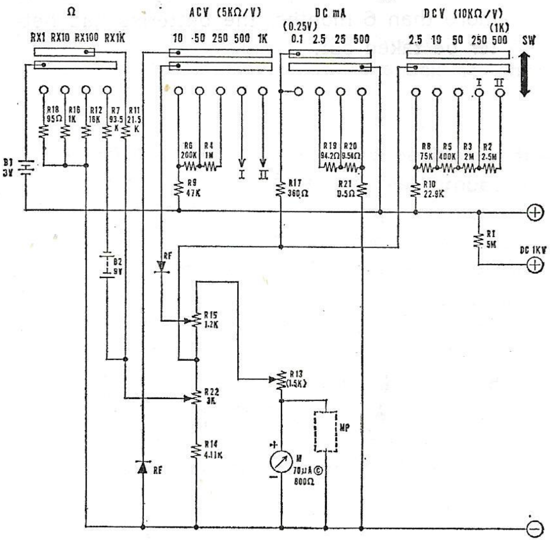
7.4 Do not use the tester exposed in the direct sunlight, or where there is high temperature or humidity. The performance of the meter movement will fall or the rectifier be deteriorated.

7.5 Avoid using the tester in a strong magnetic field or on an iron plate; the sensitivity of the meter movement will be upset to read error.

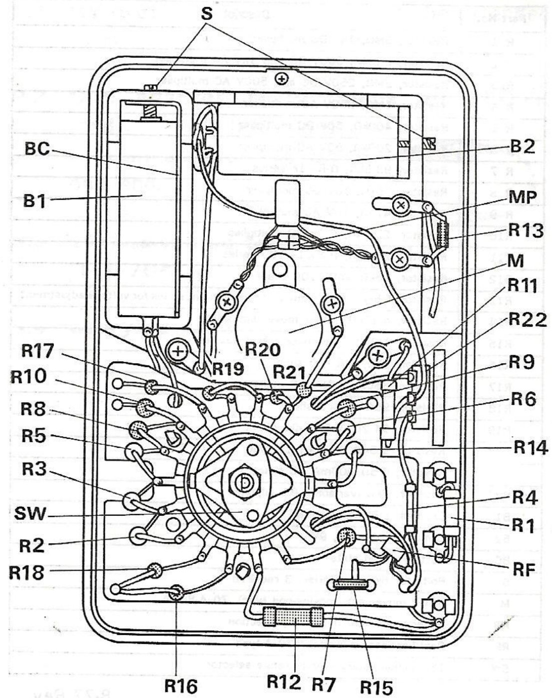
7.6 The internal batteries worn out must be immediately replaced, or else the electrolyte might leak to corrode the internal components. When the tester is laid away unused for more than 6 months, the batteries had better be taken out.

8. SUPPLEMENTARY DATA

8.1 Schematic diagram



8.2 Arrangement of parts



8.3 List of main parts

Part No.	Description
R 1	Resistor, 5MΩ, 1kV DC multiplier
R 2	Resistor, 2.5MΩ, 500V DC and 1kV AC multiplier
R 3	Resistor, 2MΩ, 250V DC and 500V AC multiplier
R 4	Resistor, 1MΩ, 250V AC multiplier
R 5	Resistor, 400kΩ, 50V DC multiplier
R 6	Resistor, 200kΩ, 50V AC multiplier
R 7	Resistor, 93.5kΩ, Ω-R×1k series
R 8	Resistor, 75kΩ, 10V DC multiplier
R 9	Resistor, 47kΩ, 10V AC multiplier
R10	Resistor, 22.9kΩ, 2.5V DC multiplier
R11	Resistor, 21.5kΩ, Ω-R×1~100 series
R12	Resistor, 16kΩ, Ω-R×100 shunt
R13	Resistor, 1.5kΩ (semi-fixed), meter movement series for voltage adjustment
R14	Resistor, 4.11kΩ, meter movement shunt
R15	Resistor, 1.2kΩ, (semi-fixed), ACV auxiliary
R16	Resistor, 1kΩ, Ω-R×10 shunt
R17	Resistor, 360Ω, 0.25V DC multiplier
R18	Resistor, 95Ω Ω-R×1 shunt
R19	Resistor, 94.2Ω, 2.5mA DC shunt
R20	Resistor, 9.54Ω, 25mA DC shunt
R21	Resistor, 0.5Ω 500mA DC shunt
R22	Resistor, 3kΩ (variable), 0Ω adjuster
B1	Dry cell, 1.5V, 2 required
B2	Laminated dry cell, 9V
BC	Battery shield plate
S	Bolts for fixing batteries, 3 required
M	Meter movement (moving-coil type), 70μA-820Ω
MP	Meter movement overload protection
RF	Rectifier (copper oxide), #20 A-type
SW	18-position rotary switch, range selector

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9. ACCESSORIES AVAILABLE EXTRA

9.1 HV probe. The DCV range can be extended to measure 25kV at maximum.

9.2 Clip adapter TL-12 (black) or TL-12R (red). A short cord with an alligator clip on one end.

9.3 1A-fuse-sealed test lead (TLF-70A).

9.4 Carrying case