SANWA

OPERATOR'S MANUAL

FOR

U-50D

MULTITESTER

U-50D Multitester

CONTENTS

GENERAL DESCRIPTION

1 Introduction.

The **U-50D** is a pocket-size, high performance circuit tester equipped with a meter movement of 35 micro-amperes in sensitivity.

The high internal resistance of the DC range accurately measures voltage of high impedance circuits.

The acrylic front cover admits full light on the scale dial with a mirror to obtain accurate reading.

The meter movement is doubly protected from damage. The protection circuit electrically safeguards the movement against accidental overcurrent, and, mechanically, the moving element is supported by spring-backed jewel bearings to absorb shock.

Use of the battery sheaths eliminates reading error regardless of the battery armour, magnetic or non-magnetic.

Measurement ranges of DC voltage and current can be extended by the use of accessories available separately.

2 Specifications.

a Measurement Ranges Available.

DC voltage:	0.1V	0.5V	5V	50V	250V 1kV (20kΩ/V)
AC voltage:	2.5V	10V	50V	250V	1000V (8kΩ/V)
DC current:	50μA	0.5mA	5mA	50mA	250mA

Resistance:	Range -	R×1	R×10	R×100	R×1K
	Midscale -	50Ω	500Ω	5kΩ	50kΩ
	Minimum -	1Ω	10Ω	100Ω	1kΩ
	Maximum-	5kΩ	50kΩ	500kΩ	5MΩ

Volume level: −20～+62dB

Capacity: 0.0001～0.2μF
Megohm: 1～500MΩ
} Use external power.

b Internal Batteries. Two 1.5V dry cells. (UM-3, or equivalent)

c Allowance.

DC voltage:	Within ±3% f. s. d.
AC voltage:	Within ±4% f. s. d. (±6% for 2.5V)
DC current:	Within ±3% f. s. d.
Resistance:	Within ±3% of scale length.

d Size & Weight. 131×89×43 mm & 425 gr

GENERAL INSTRUCTIONS

1 Selection of the Range.

Ranges are selected by rotating the selector switch. They are arranged around the knob, resistance ranges on the top, AC voltage ranges on the right, DC voltage ranges on the left, and DC current ranges on the bottom.

2 Test Lead Connections.

For measurements, as a rule, the red lead is inserted in the jack marked + and the black lead in the jack marked —. The jack marked **0.1V • 50μA** (+) is for the red lead connection for measurements on the DC 0.1 volt and 50 microampere ranges.

Before the test leads are connected to the circuit to be measured, confirm the position of the selector switch. If a voltage is checked when the switch is set at a resistance or current range, the meter movement, shunt resistor or rectifier can be permanently damaged.

3 Replacement of Batteries.

Exhausted batteries should be immediately replaced, because the electrolyte might leak and corrode the internal components. For replacement, see OPERATION -5, Note.

4 Reading the Scale.

The meter should be placed level for correct reading. Look at the scale right over where the pointer falls exactly over its image in the mirror.

5 Meter Movement Protection.

The meter movement of the **U-50D** is completely protected against voltages below 1000 volts which might be accidentally impressed on any measurement range, only by having some resistor or the rectifier burnt out. The following table shows the resistors subject to getting burnt when AC 1000 volts is impressed on each range :

Tester ranges	Resistors subject to burn	Part Nos.
R×1	49Ω	R18
R×10	505Ω	R17
R×100	5.56kΩ	R16
R×1K	47.3kΩ	R15
DC 0.1V(50μA)	7Ω	R25
DC 0.5V	8kΩ	R10
DC 5V	90kΩ	R7
DC 0.5mA	841Ω・84.2Ω・5.41kΩ	R11・R12・R19
DC 5mA	84.2Ω	R12
DC 50mA	7.5Ω	R13
DC 250mA	1.87Ω	R14
AC 2.5V	14.6～16.1kΩ	R9
AC 10V	60kΩ	R8
AC 50V	320kΩ	R6

CAUTION. When a resistor is burnt out through misapplication, and if the connection mistake be left as it is, some other resistor as well as the protection circuit, or the meter movement itself would suffer damage.

6 Other Precaurions.

a The selector switch should not be rotated leaving the test leads connected to power: the movement or the internal components could be damaged.

b Avoid allowing the meter to receive severe shock or vibration. Do not leave it where there is high temperature or moisture, or strong magnetic field.

c Do not rub the acrylic surface, or clean it with cleaning material: anti-electrification coating will come off to cause erroneous reading.

OPERATION

1 DC Voltage Measurements.

DC voltage ranges are mostly used for measurements of batteries, B(+) power, plate, screen-grid and cathode voltages of radio/TV receivers and amplifiers. Their circuits generally have minus potential grounded, though pnp transistor circuits, their plus potential.

For measurements, go through the following procedure:

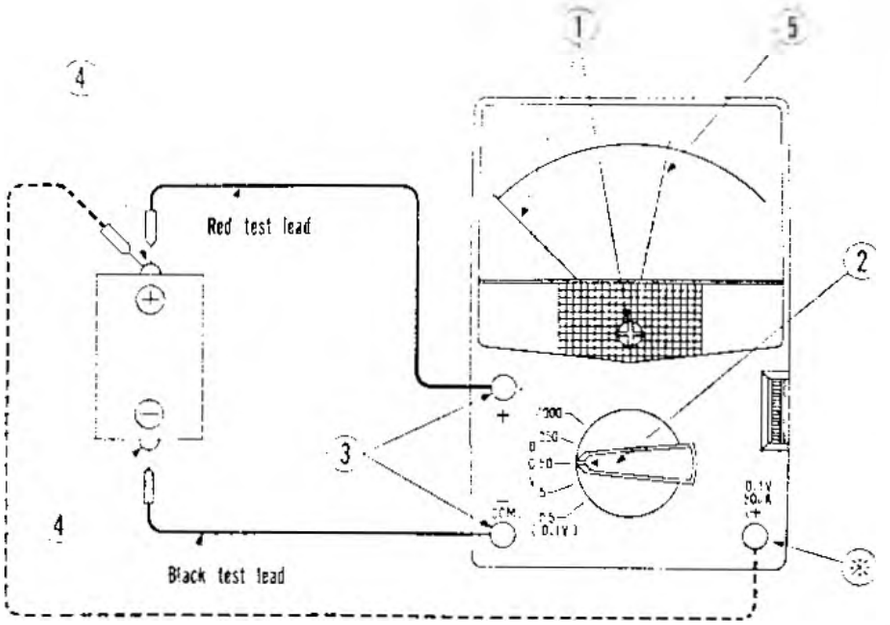


Fig. 1

a Zero Correction. Before making a measurement, confirm the pointer to be exactly on zero of the scale left If it is off the position, adjust it by the

corrector screw at the base of the scale dial. (Fig. 1-1)

b Range Selection. The selector switch can be rotated to any one of the six DCV positions. When in doubt as to the approximate voltage present, always start with the highest range. After the first reading, the switch can be reset to a lower range for a more accurate reading. (Fig. 1-2)

For accurate measurements, use a range which will allow the pointer to fall within the right hand half of the scale.

Measurement of	Proper range to be used
250-1000 volts	1000V
50-250 volts	250V
5-50 volts	50V
0.5-5 volts	5V
0.1-0.5 volts	0.5V
0-0.1 volts	0.1V

c Test Lead Connections. See GENERAL INSTRUCTIONS-2.

The test leads connected to the meter are applied across the voltage to be measured, the red lead to plus and the black lead to minus potential of the load. In most cases, minus side is earthed or connected to the chassis. When measuring, the black lead may be fixed to the chassis, and voltage is checked by applying the red lead to the check point. (Fig. 1-3 & -4)

With pnp transistor circuits, the plus potential of the battery is earthed, and the connections of the test leads are reversed.

Wrong connections deflect the pointer to the left. Just reverse the connections if this occurs.

d Scale Reading. Use the black scale just below the mirror marked **DCV•mA** for all DC voltage measurements. (Fig. 1-5)

Range	Scale to read	Multiplied by
0.1V	0 - 10	0.01
0.5V	0 - 50	0.01
5V	0 - 50	0.1
50V	0 - 50	1
250V	0 - 250	1
1000V	0 - 10	100

2 AC Voltage Measurements.

AC voltage ranges are mostly used for checking the mains, secondary voltages of a power transformer, etc.

Audio frequency voltages of 30-5000Hz can be measured without trouble, but error might occur for higher frequencies. The pointer will vibrate for frequencies lower than 30Hz making it impossible to read. The meter is calibrated for sinusoidal AC(RMS), so error will also occur for non-sinusoidal voltages.

a Zero Correction. See 1-a. (Fig. 2-5)

b Range Selection. The selector switch can be rotated to any one of the five ACV positions. When in doubt as to the approximate voltage present, always start with the highest range. After the first reading, the switch can be reset to a lower range for a more accurate reading. (Fig. 2-2)

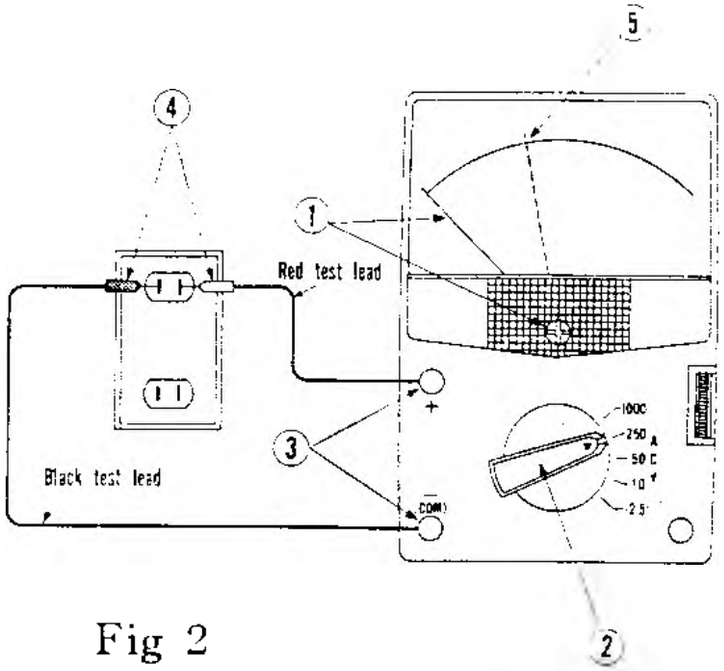


Fig 2

To obtain an accurate reading, use a range which will allow the pointer to fall within the right hand half of the scale.

Measurement of	Proper range to be used
250-1000 volts	1000V
50-250 volts	250V
10-50 volts	50V
2.5-10 volts	10V
0-2.5 volts	2.5V

c Test Lead Connections. See GENERAL INSTRUCTIONS-2.

The test leads connected to the meter are applied across the voltage to be checked. Since alternating current is being measured, the readings are correct to which side of the voltage the test leads are connected. (Fig. 2-3 & -4)

d Scale Reading. Use the red scale third from the top marked **AC 10V UP** for all AC voltage measurements except for the 2.5 volt range, for which the black scale below marked **AC 2.5V** is used. (Fig. 2-5)

Range	Scale to read	Multiplied by
2.5V	0 - 2.5	1
10V	0 - 10	1
50V	0 - 50	1
250V	0 - 250	1
1000V	0 - 10	100

3 Internal Resistance of a Voltage Range.

Voltage is measured applying the test leads in parallel with the power. Current energy (current consumption of a voltmeter) can cause the pointer to give erroneous reading.

Current consumption is inversely proportional to the internal resistance of the meter: the bigger the resistance, the less the current consumption.

As a rule, the internal resistance of a voltmeter is expressed by resistance per volt using the symbol of Ω/V. Therefore, the internal resistance of a certain voltage range is known by the voltage value multiplied by the Ω/V of the meter. For instance, the overall internal resistance of the **U-50D** being 20,000 ohms per volt for

DC, the internal resistance of the 250 volt range is $250 \times 20{,}000 = 5{,}000{,}000\,(\Omega) = 5{,}000\,(\mathrm{k}\Omega)$, or 5 megohms.

When the plate or screen-grid voltage of a triode or pentode of high impedance load and high amplification factor along with small circuit current is checked by a meter of small internal resistance, considerable current flows from the meter into the series load resistance of the tube. As a consequence, there is greater voltage drop, and the meter reads lower than the true value: the connection of the meter upsets the circuit to be checked.

Error can be minimized by the use of a meter of high internal resistance, but unless it is infinite, some error is inevitable even if a vacuum tube voltmeter be used for checking such a circuit.

The internal resistance of a meter little affects the checking of the DC voltage of B(+) power, or plate and screen-grid of a power tube, because their impedances are smaller than the meter impedance. It is the control grid voltage that is disturbed by voltage measurement.

4 DC Current Measurements.

a Zero Correction. See 1-a. (Fig. 3-1)

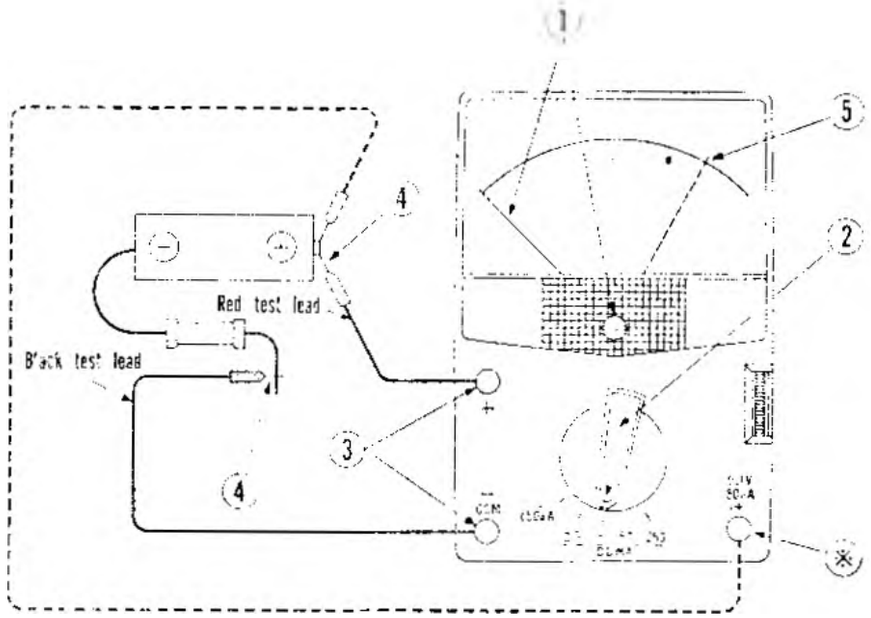


Fig. 3

b Range Selection. The selector switch can be rotated to any one of the five current ranges prescribed. When in doubt as to the approximate current present, always start with the highest range. The switch can be reset to a lower range for a more accurate reading. (Fig. 3-2)

To obtain an accurate reading, use a range which will allow the pointer to fall within the right hand half of the scale.

Measurement of	Proper range to be used
50 - 250mA	250(mA)
5 - 50mA	50(mA)
0.5 - 5mA	5(mA)
0.05 - 0.5mA	0.5(mA)
0 -0.05mA	50(μA)

c Test Lead Connections. See GENERAL INSTRUCTIONS-2.

Before taking a measurement, the circuit to be checked is opened, and the meter is connected in series with the load by way of the test leads, the red lead to plus and the black lead to minus potential. (Fig. 4-3 & -4)

d Scale Reading. Use the black scale just below the mirror marked **DCV·mA** for all DC current measurements. It is used in common with DC voltage measurements.

Range	Scale to read	Multiplied by
50μA	0 - 50	1
0.5mA	0 - 50	0.01
5mA	0 - 50	0.1
50mA	0 - 50	1
250mA	0 - 250	1

Note. For measurement of a low resistance circuit, the internal resistance of the current range used is connected in series with it resulting in current decrease to cause erroneous reading.

5 Resistance Measurements.

a Zero Correction. See 1-a (Fig. 4-1)

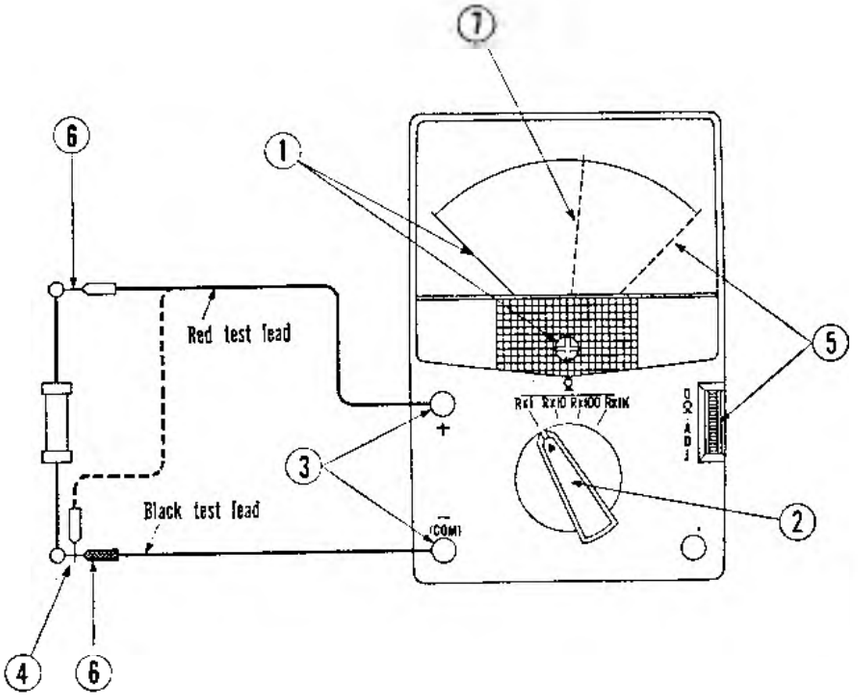


Fig. 4

b Range Selection. The selector switch can be rotated to any one of the four Ω positions. (Fig. 4-2) For an accurate measurement, use a range which will allow the pointer to fall near the middle of the ohm scale. Refer to the following table:

Measurement of	Proper range to be used
0 - 150Ω	R×1
150Ω - 1.5kΩ	R×10
1.5kΩ - 15kΩ	R×100
15kΩ - 5mgΩ	R×1K

c Test Lead Connections. See GENERAL INSTRUCTIONS-2. (Fig. 4-3)

d Zero Ohm Adjustment. The test leads connected to the meter are shorted together. As the pointer deflects towards right, it is adjusted to be exactly over zero by turning the zero ohm adjuster (0Ω ADJ). Fig. 4-4 & -5. Do not force it beyond its stop position.

Zero ohm adjustment is to avoid error caused by the wearing out of the internal batteries or change of their load current. The pointer must be adjusted every time the range is moved over, and from time to time when resistances are checked.

If zero adjustment is impossible when the adjuster is turned full downwards, or if the pointer moves to zero but soon moves back on the R×1 position, the

internal batteries are exhausted, and they must be immediately replaced. For replacement, see Note below.

After the pointer is properly adjusted, the test leads are opened and are applied across the resistance to be measured. (Fig. 4-6)

e Scale Reading. Use the top black scale marked Ω for all resistance measurements. (Fig. 4-7)

For the R×1 range, read the figures directly.

For the R×10, R×100 and R×1K ranges, read the figures multiplied by 10, 100 and 1000, respectively.

Note. (1) Replacement of the batteries. Put the meter face down on a soft cloth, and loosen the bolt on the back to remove the case. To take out the batteries, the fixing bolts on the minus sides are loosened.

After the batteries are replaced, do not tighten the bolts too much, or the holder will be cracked or the batteries punctured. Be careful not to allow dust to get into the meter while the batteries are replaced.

(2) Use of the battery sheaths. If iron-armoured cells are used in this model, magnetic field effect will cause big error of reading. Without the sheaths, the meter will read error on plus side. Always use them when the batteries are replaced.

(3) As the schematic diagram shows, the polarities of the measuring terminals are reversed for resistance ranges, the plus terminal being in minus and the minus terminal in plus potential. It must be remembered when semiconductor circuits are checked.

CAUTION. (1) Do not check resistance while power is on. Be sure the electric charge of condensers is discharged.

(2) While checking, keep off the fingers from the metal parts of the test leads: part of the current runs to the ground through the body causing erroneous reading.

(3) Do not leave the range switch set to

a resistance range when the meter is not in us. The test leads might be accidentally shorted allowing the internal battereries to become consumed.

6 Volume Level Measurements.

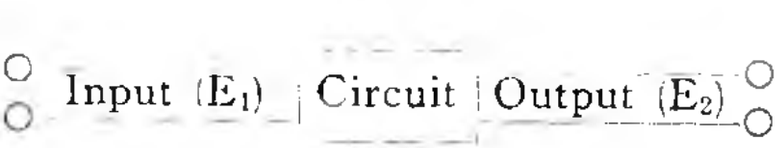
Audio output of a tube radio and amplifier where both DC and AC currents are present is checked on AC voltage ranges by placing a non-polarized condenser of 0.1-2 microfarads in series with a meter terminal to block DC component. This is called AF (audio frequency) output measurement, for which any AC voltage range can be used reading the scale for AC voltage measurements.

On the other hand, what matters to amplifiers and transmission circuits is their input-output power ratio, which is gain (amplification) or loss (attenuation) of the circuit. Comparative reading by voltage, current or power would annoy one with the odd figures to be obtained by calculation, while the response of the human ear is analogous to logarithmic variation, voltage, current and power ratios are usually expressed as follows:

$$\text{Voltage} - 20 \log_{10} \frac{E_2}{E_1}$$

$$\text{Current} - 20 \log_{10} \frac{I_2}{I_1}$$

$$\text{Power} - 10 \log_{10} \frac{P_2}{P_1}$$



They are decibels. But they only express input and output by ratio independently from each other, and can not be taken as comparison values. For comparison, there must be a reference value.

As a rule, 0dB is set at a voltage when 0.001 watt is dissipated across a 600-ohm line, while voltage (E) is related to decibel as follows :

$$P = \frac{E^2}{Z_0} \qquad E = \sqrt{P \times Z_0} = \sqrt{0.001 \cdot 600} = 0.7745$$

(Z_0 : Line impedance)

Therefore, zero reference level is established at approximately 0.775 volt.

Though a meter does not read power level directly, if the line impedance is uniform, it can be known by the voltage because voltage and power are proportionately related. If the line impedance is converted to a 600-ohm reference level, the dB scale of the meter directly reads decibel.

For instance, for a 600-ohm line of a uniform impedance on both input and output sides, gain or loss can be readily known by the output dB minus input dB. If the impedance is other than 600 ohms on one side or on both sides, each decibel measured only serves to compare their voltage level.

In this case, the different impedances can be unified to 600-ohm level by reading the matching graph given on page 26. The power level can be compared by the decibel values thus obtained.

The AC voltage ranges of the **U-50D** measure decibel by reading the dB scales provided in pair on the bottom of the scale dial.

a Range Selection. Any AC voltage range may be used for decibel measurement.

b Test Lead Connections. See GENERAL INSTRUCTIONS-2.

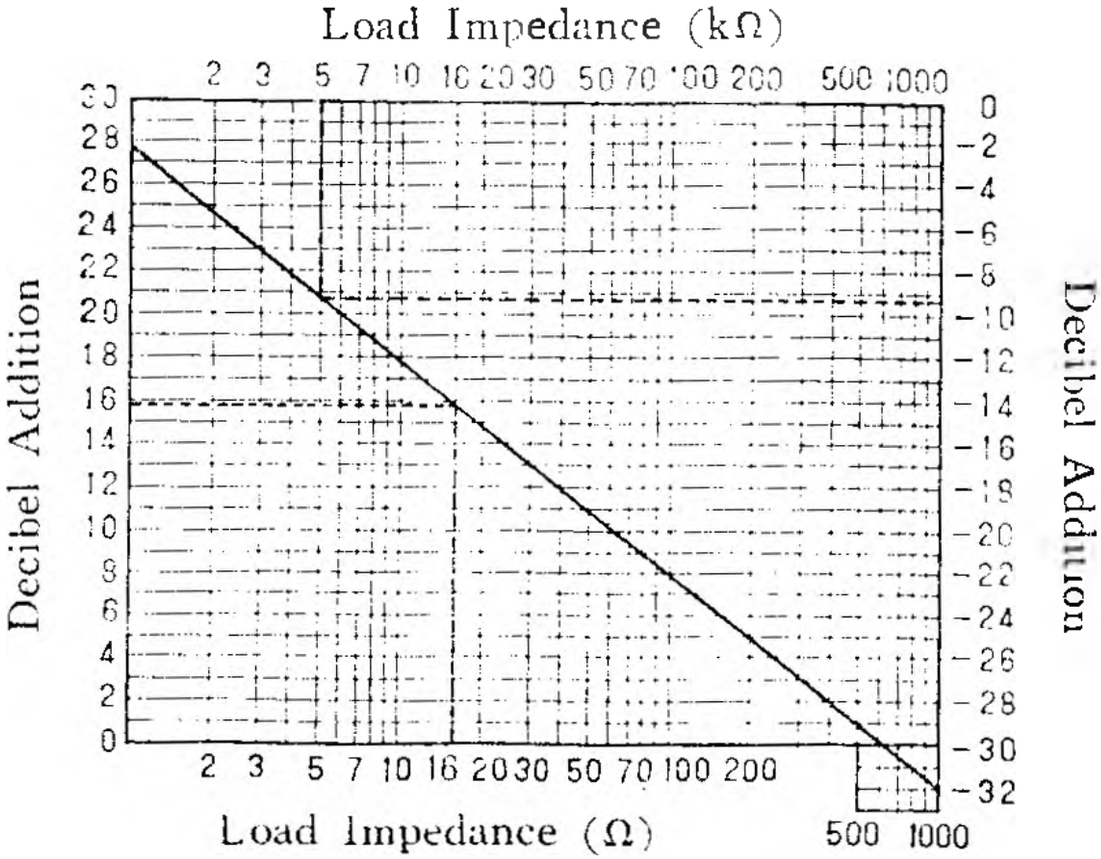
Before taking a decibel measurement, a condenser of 0.1-2 microfarads is connected in series with either + or − jack. Do not use an electrolytic capacitor.

c Scale Reading. Use the scales in pair on the bottom of the scale dial marked **dB.** The upper scale

is for measurement on the AC 2.5 volt range, and the lower scale on the AC 10 volt range.

For the 50, 250 and 1000 volt ranges, 14(dB), 28(dB) and 40(dB) is added respectively to the reading of each range.

d Impedance Matching by a Graph. Decibel (output power) is obtained from output voltage measured by reading the graph given below.



Example 1. Providing the meter reads 9dB for the AC 2.5 volt range for a speaker impedance of 16 ohms, the Load Impedance (Ω) 16 is followed up, and then to the left at the intersecting point with the oblique line to obtain 15.7 on the Decibel Additon axis.

$$9 + 15.7 = 24.7$$

24.7 is the decibel value to be taken for comparison.

Example 2. Providing the primary of an output transformer of 5k-ohm impedance is checked on AC 50 volt range and the meter reads 20.2dB on the scale for AC 10 volt reading, it is 20.2 + 14 = 34.2 dB for the 50 volt reading. Now 5 of the Load Impedance kΩ is followed down, and then to the left at the intersecting point with the oblique line to obtain 9.2 on the Decibel Addition axis.

$$34.2 - 9.2 = 25$$

25 is the decibel value to be taken for

comparison.

Loss from connecting the meter to a 600-ohm line is negligible, but when a high impedance circuit is checked, the internal resistance of the meter must be fully taken into consideration.

7 Capacity and High Resistance Measurements.

a Zero Correction. See 1-a.

b Range Selection. Use a suitable range referring to the following table:

Measurement of	Range measured	External power	Meter range
Capacity	0.001~0.2μF	AC 10 volts	AC 10V
Capacity	0.0001~0.006μF	AC 250 volts	AC 250V
High resistance	1~500MΩ	DC 250 volts	DC 250V

c Connections. For the connections of the meter, external power and the unit to be checked, see the illustrations of next page.

For capacity.

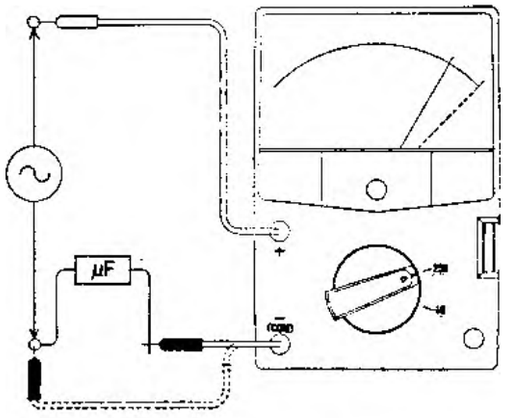


Fig. 6

For high resistance.

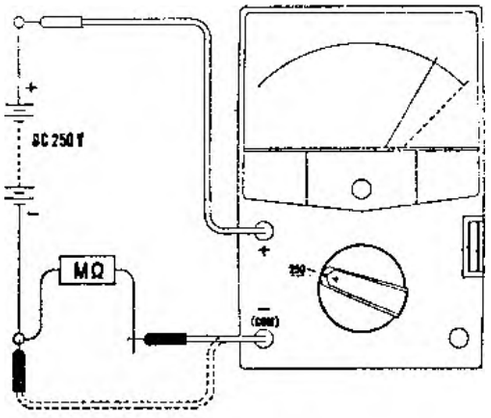


Fig. 7

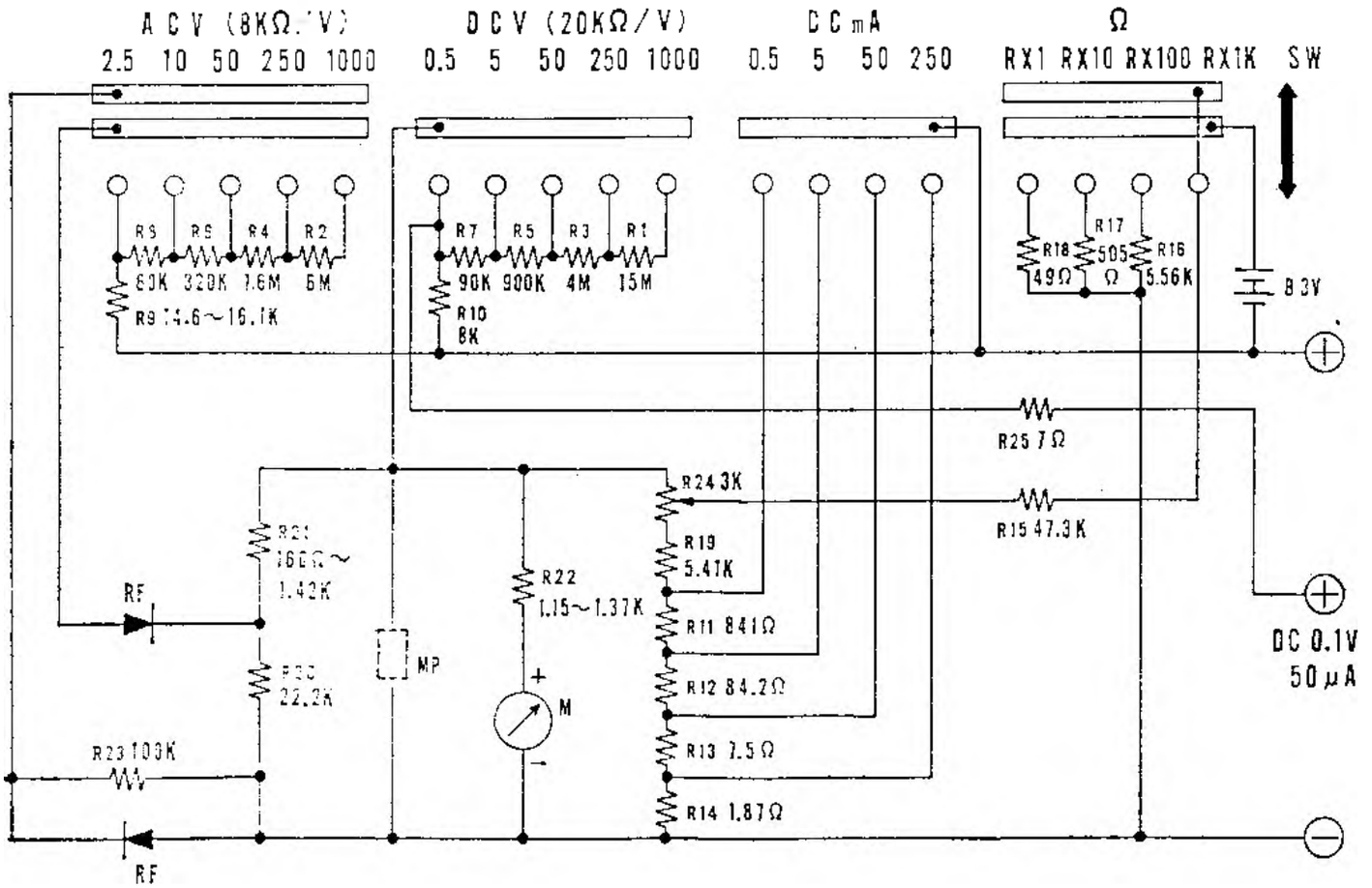
The selector switch is rotated to a specified voltage range, and, connecting the test leads to the external power as shown by the dotted line, the pointer is calibrated to full scale by means of a voltage regulator (for AC) or potentiometer (for DC). The test leads are then applied across the unit to be checked, and the reading of the meter is noted.

d Scale Reading. For capacity, use the pair of scales marked **C** (**μF**) either for AC 10 or 250 volt range. For high resistance, read the red scale marked **MΩ** directly setting the selector switch to the DC 250 volt range.

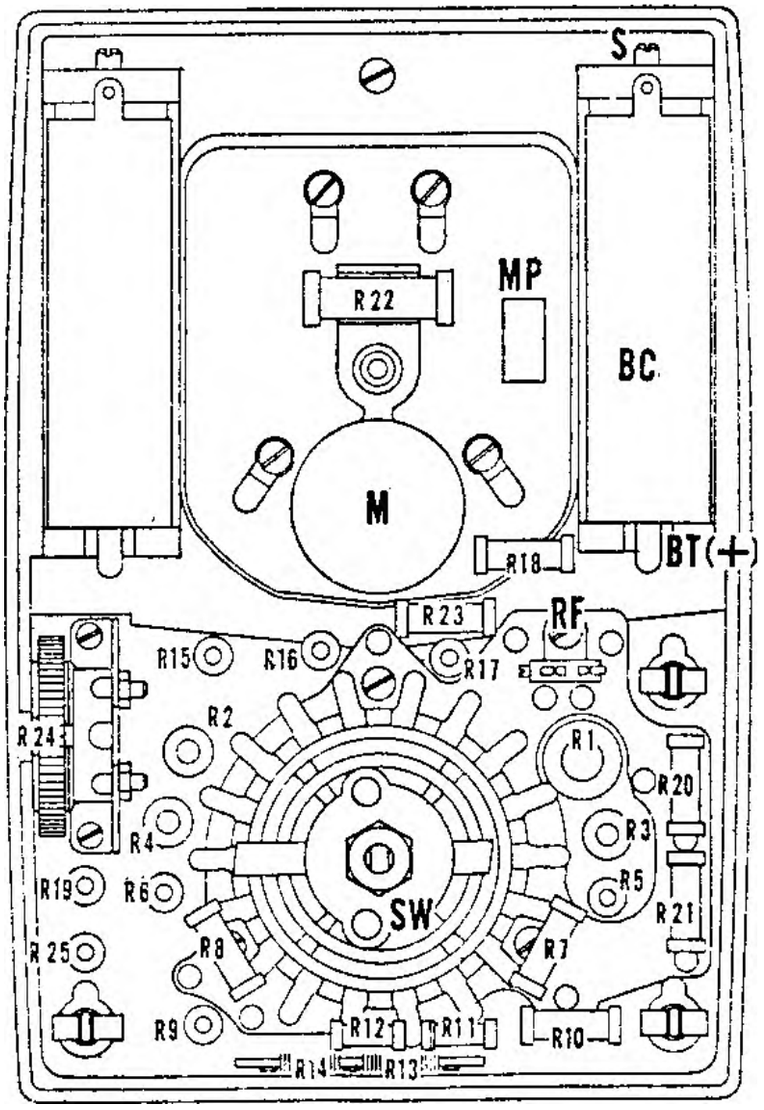
Note. The static capacity of electrolytic condensers can not be checked.

SUPPLEMENTARY DATA

1. Schematic Diagram



Arrangement of Parts (Rear View)



3. List of Main Parts

R.S.	Name	Descriptiou
R1	Resistor	15M ohm (film, ¾W), DC 1000V multiplier
R2	Resistor	6M ohm (film, ½W), AC 1000V multiplier
R3	Resistor	4M ohm (film, ½W), DC 250V multiplier
R4	Resistor	1.6M ohm (film, ½W), AC 250V multiplier
R5	Resistor	900k ohm (film, ¼W), DC 50V multiplier
R6	Resistor	320k ohm (film, ¼W), AC 50V multiplier
R7	Resistor	90k ohm (film, ¼W), DC 5V multiplier
R8	Resistor	60k ohm (film, ¼W), AC 10V multiplier
R9	Resistor	14.6~16.1k ohm (film, ¼W), AC 2.5V multiplier
R10	Resistor	8k ohm (film, ¼W), DC 0.5V multiplier
R11	Resistor	841 ohm (film, ⅛W), DC 0.5mA shunt
R12	Resistor	84.2 ohm (film, ⅛W), DC 5mA shunt
R13	Resistor	7.5 ohm (wirewound), DC 50mA shunt
R14	Resistor	1.87 ohm (wirewound), DC 250mA shunt
R15	Resistor	47.3k ohm (film, ¼W), R×1K series
R16	Resistor	5.56k ohm (film, ¼W), R×100 parallel
R17	Resistor	505 ohm (film, ¼W), R×10 parallel
R18	Resistor	49 ohm (film, ¼W), R×1 parallel
R19	Resistor	5.41k ohm (film, ¼W), variable resistor, series
R20	Resistor	22.2k ohm (film, ¼W), AC voltage auxilliary
R21	Resistor	160Ω~1.42k ohm (film, ¼W), meter movement series
R22	Resistor	1.15~1.37k ohm (film, ½W), AC voltage calibration
R23	Resistor	100k ohm (film, ¼W), rectifier parallel
R24	Potentiometer	3k ohm, zero ohm adjuster
R25	Resistor	7 ohm (wirewound), meter protection
M	Meter movement, moving coil type, 35 microampere-1.6k ohm	
SW	Rotary switch 18-position range selector	
MP		Meter movement overload protection
RF	Rectifier	Copper-oxide (Type 20A)
B	Battery	1.5V (UM-3 or equivalent), 2 required
BC	Battery sheath, 2 required	
BT	Battery terminal (+), 2 required	

Accessories Available for U-50D

1. Shunt Adapter. (SA-25A) — For exclusive use of the **U-50D** to extend the DC current range to 1, 5 and 25 amperes.

2. High Voltage Probe. (8W) — 25kV rating for 20k Ω/V to measure high DC voltage.

3. Carrying Case. — Type PL-8.

4. Clip Adapter. (TL-12) — Extension lead with an aligator clip.

5,000-3-69

SANWA

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J-02-021