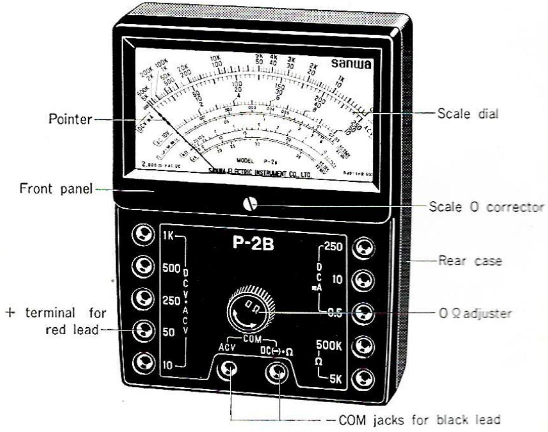
sanwa

P-2B MULTITESTER

OPERATOR'S MANUAL

P-2B MULTITESTER



CONTENTS

1 INTRODUCTION

Pin-jack system is the surest method of selecting a measurement range, because it is in the first place free from mechanical and sometimes electrical trouble incidental to range selection by a rotary switch, and secondly it is least liable of setting a wrong range which might incur serious damage to the instrument. In addition, the iron rear case is not only rugged against impact, but proof against external magnetic effect to avoid reading error.

Small-sized and handy as this instrument is, it is not the kind of cheap testers you may come across on the market, but the clear-cut design of the instrument composed of select materials as other SANWA testers offers you dependable performance rendered by the merits aforementioned, and you are sure to be satisfied with its versatility performance as a pocket tester.

Easy operation makes beginners masters of this fine instrument in minutes.

2 SPECIFICATIONS

2-1 Measurement ranges.

DCV	10 50 250 500 1k (2kΩ/V)		
DCmA	0.5 (854Ω) 10 (66.4Ω) 250 (2.7Ω)		
ACV	10 50 250 500 1k (2kΩ/V)		
Ω	Range ·	0-5k	0-500k
	Minimum ·	1	100
	Midscale ·	50	5k
	Battery ·	1.5V×1	
dB	−20∼+22	+20∼+36	
MΩ	0.1∼50	using external power	
μF	0.0002∼0.03	using external power	
	0.01∼0.6	using external power	

2-2 Allowance.

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

2-3 Dimensions & weight.

120×88×40 mm & 325 gr

3 PRELIMINARIES

3-1 Pointer 0 correction.

Before taking a measurement, 0 corrector ⑥ at the base of the scale dial is adjusted with a small screwdriver to place the pointer exactly on 0 of the scale left. Though it need not be adjusted at each measurement, whenever it is found off 0, it must be. Look at the pointer from right over instead of at an angle.

3-2 Range selection.

Range desired is selected by inserting the shorter pins into jacks. The black lead is connected to either COM/DC(−)•Ω or ACV jack, and the red lead to the jack indicating the range value prescribed. Insert the pin well down, especially for 5k-Ω range.

4 HINTS TO OPERATION

4-1 Preferably the meter is operated in level position taking the reading from right over.

4-2 Be very careful not to give the meter severe shock or vibration. When carrying about, use the case separately available.

4-3 Before the test leads are applied to load, reconfirm their connection. If voltage is measured with the red lead connected to Ω or mA range, the moving coil, resistor, or rectifier will be burnt out rendering the instrument out of use.

4-4 Avoid placing the instrument in the direct sunlight, or leaving it where there is high temperature or moisture.

4-5 Do not use the instrument placed on a motor or transformer: strong magnetic effect will cause erroneous reading or degrade the internal components.

4-6 For high power voltage measurement, it is recommended to use the fused test lead (TLF-70A) available extra for positive connection.

4-7 For maximum safety, do not measure power voltage of high current capacity holding the instrument in the hand. Any misuse might bring danger to the operator especially in case the tester used is casually a faulty one.

5 OPERATION

For the following measurements, the instrument is operated in the order as mentioned referring to the illustrations:

5-1 Measuring DCV.

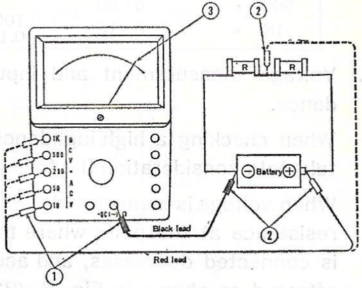


Fig. 1 - DCV measurement.

1) Test leads are connected to the instrument at each jack required.
2) Test leads connected to the tester are applied across the load taking note of the polarity of the circuit being measured, the red lead to plus and the black lead to minus potential.

3) Meter reading is noted on the black scale second from the top marked DCV•mA scale.

Range used	Scale to read	Multiplier
10 DCV	0 - 10	1
50 〃	0 - 50	1
250 〃	0 - 250	1
500 〃	0 - 50	10
1K 〃	0 - 10	100 in V 0.1 in kV

NOTE. Voltage measurement and input impedance.

When checking a high inpedance circuit, take into consideration the following fact!

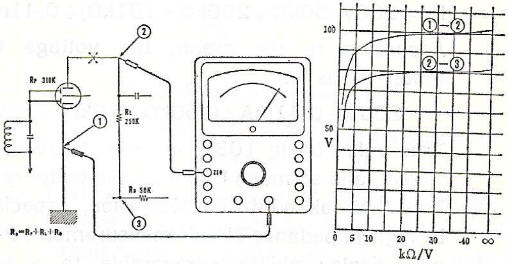
When voltage is measured, the compound resistance at the point where the tester is connected decreases, and accuracy is affected as shown in Fig. 6 - (B). As a rule, a tester has its overall input impedance mentioned on the instrument by Ω/V, it being 2k ohms per - volt for P - 2B. Accordingly. the input impedance of its 250V range is:

$$2kV \times 250V = 500k\Omega$$

In other words, the current supplied by the circuit being measured and dissipated by the tester at full scale is:

$$1V/2k\Omega = 500\mu A$$

It signifies that the bigger the input impedance of a tester is, and the less the current it dissipates, the more accurate is the reading as shown in Fig. - 2 (B). To check Ep across 1 - 2 unaffected by input impedance is to measure Ip at point × of Fig. 2 - (A).



(A) (B)

Fig. 2 - DCV measurement & Ω/V.

Providing $Ip = 0.33mA$ and $B(+) = 200V$, the total circuit resistance (Ro) is: $200V/0.33mA \doteqdot 610k\Omega$. Therefore, the input impedance of the tube $(Rp) = Ro - (R_L + R_D) = 610k\Omega - (250k\Omega + 50k\Omega) = 310k\Omega$. Therefore.

$$Ep = Ip \times Rp = 0.33mA \times 310k\Omega = 102V$$

and there is practically no error.

Now a measurement is made on 250V range. and the compound resistance (R_{O1}) of the input impedances Rv and Rp on account of the tester connected is:

$$R_{O1}=\frac{Rp \times Rv}{Rp+Rv}=\frac{310k\Omega \times 500k\Omega}{310k\Omega+500k\Omega} \doteqdot 191k\Omega$$

Current Ip' flowing through R_L is:

$$Ip'=200V/(50k\Omega+250k\Omega+191k\Omega) \doteqdot 0.41mA$$

According to the graph, the voltage the tester reads is:

$$200V-0.41mA \times (250k\Omega+50k\Omega)=77V$$

True value being 103V, error is: 103V−77V =26V, and so much less does the tester read. This fact taken into consideration, especially in high impedance circuit measurement, P-2B can display ability comparable to a high sensitivity instrument.

5-2 Measuring DCmA.

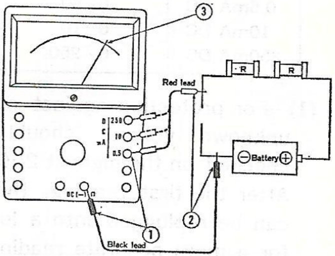


Fig. 3 - DCmA measurement.

1) Test leads are connected to the instrument at each jack required.

2) Test leads connected to the tester are applied in series with load, for which the circuit being checked is opened. Take note of the polarity of the circuit, the red lead going to the plus potential, and the black lead to the minus potential. Wrong connections deflect the pointer to reverse direction across zero.

3) Reading is noted on the scale as follows:

Tester range	Scale line to read	Multiplier
0.5mA DC	0 - 50	0.01
10mA DC	0 - 10	1
250mA DC	0 - 250	1

NOTE. (1) For protection against overcurrent, unknown voltage should first be checked on the highest 250mA range. After the first reading, the test lead can be replugged into a lower range for a more accurate reading.

(2) Each DCmA range has its own input impedance as mentioned in SPECIFICATIONS. For measurement of a low impedance circuit, the input impedance of the range used can not be ignored, because the decreased current causes erroneous reading.

5-3 Measuring ACV.

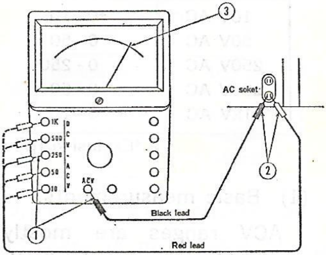


Fig. 4 - ACV measurement.

1) Test leads are connected to the instrument at the jack required, the black lead going to COM-ACV.

2) Test leads connected to the tester are applied across load as for DCV measurement. Polarity can be ignored and readings are correct no matter to which side of the load the test leads are applied.

3) Reading is noted on the scale as follows:

Tester range	Scale line to use	Multiplier
10V AC	*0 - 10	1
50V AC	0 - 50	1
250V AC	0 - 250	1
500V AC	0 - 50	10
1kV AC	0 - 10	0.1

*Exclusive red scale.

NOTE. (1) Basic measurements.

ACV ranges are mostly used for checking power distribution line voltage, secondary voltages of a power transformer, etc. The secondary voltages of a power transformer are usually about 10% higher than their rated values.

(2) AF output level measurement.

The dB scale of the instrument is graduated based on ACV scale establishing 0dB at 0.775V, and dB is measured just in the same way as ACV measurement taking the reading on the dB scale provided. When DC element is present mixed in the circuit, use a capacitor to block it.

For a big dB unreadable on 50V range,

a higher range can be used, when the following figures are added to the reading on 50V range:

Range used	Add dB
250V	+14dB
500V	+20dB
1kV	+26dB

(3) Influence by frequency and waveform.

There is no trouble of measuring a voltage of which the frequency is 30Hz ~5kHz, but above 5kHz error occurs, and below 30Hz the pointer vibrates and it is impossible to take the reading. Furthermore, the instrument is calibrated for sinusoidal rms reading. and error will also occur for non-sinusoidal AC voltage.

(4) Ω/V of AC range and its effect.

Same as for DCV measurement, connection of the instrument to a high impedance circuit reads differently from when it does before the tester is connected.

(5) Sample measurements.

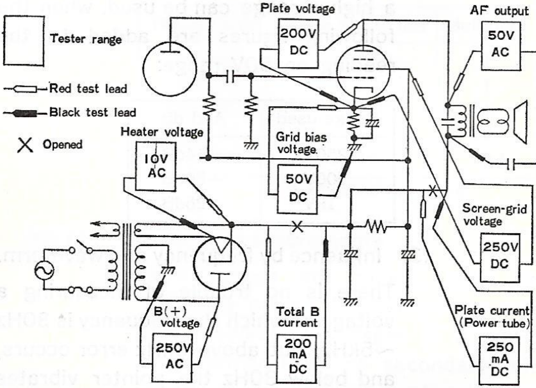


Fig. 5 - Audio circuit of a receiver.

5-4 Measuring Ω.

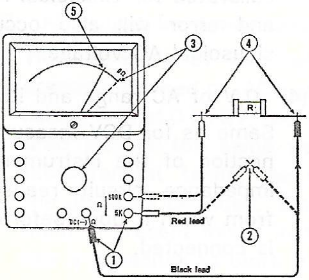


Fig. 6 - Ω measurement.

1) Test leads are connected to the instrument.

2) The probes of the test leads connected to the tester are shorted together.

3) As the pointer moves towards right, 0ΩADJ in the center is adjusted to place it exactly on 0 of the Ω scale.

4) The probes shorted are opened and applied across the resistance being measured.

5) Reading is noted on the scale. Use the upper figures for 500kΩ and the lower figures for 5kΩ.

NOTE. (1) In connecting the test leads to the jacks prescribed, insert them well down. Especially for 5kΩ, loose connection fails to activate the internal switch causing erroneous reading.

(2) 0Ω adjustment avoids reading error on account of the internal battery worn out causing change of measuring current. The pointer must be adjusted every time the range is moved, or resistors are checked continuously. Do not force the adjuster beyond its stop position.

(3) Polarity of the tester for resistance

measurement is, as shown in the schematic diagram, reversed. It must be remembered when testing the polarity of semiconductors and insulation of electrolytic capacitors.

If 0Ω adjustment is impossible by turning the adjuster full clockwise, or the pointer moves back from 0Ω for 5kΩ range, the internal battery has worn out needing replacement. For replacement, remove the rear case by loosening the bolt on the back. Loosen the bolt "S" (See 7-2) to take out the battery.

CAUTION. (1) Do not check resistance in a live circuit. Where a capacitor is connected, be sure to discharge the load even after power is switched off.

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

5-5 Measuring C.

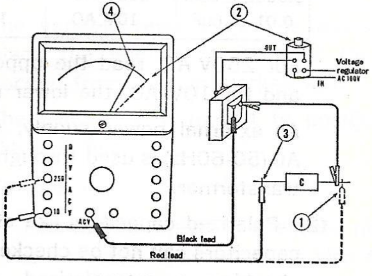


Fig. 7 - C measurement.

1) Test leads are connected as shown in the illustration above, the red lead first going as shown by the dotted line.

2) The pointer is adjusted to read full scale by means of a voltage regulator.

3) Test leads are moved to the positions of the true line.

4) Reading is noted on the scale marked C(uF).

NOTE. (1) Refer to the following table for the range to be used and the external voltage to be regulated for full scale:

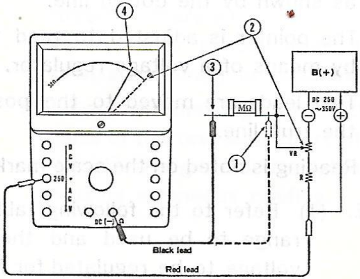
Capacitor	Range to use	External power
0.0002-0.03uF	250V AC	250V AC
0.01—0.6uF	10V AC	10V AC

For 250V AC, read the upper figures and for 10V AC, the lower flgures.

As external power supply, sinusoidal AC (50-60Hz) is used through a power transformer.

(2) Polarized capacitors like electrolytic capacitors can not be checked. When checking a nonpolarized capacitor, take note of its withstand voltage.

5.6 Measuring MΩ.



VR : 50kΩ (above ½W) R : 100kΩ (above ½W)

Fig. 8 - MΩ measurement.

1) Test leads are connected as shown in the illustration above, but the black lead first goes as shown by the dotted line.

2) The variable resistor (VR) is adjusted to place the pointer at 0MΩ of the scale second from bottom marked MΩ.

3) The black lead is moved to position 3 of the true line.

4) Reading is noted on the scale.

NOTE. This measurement is available not only to measure resistance but also to test the insulation of the windings of a transformer and insulation resistance of capacitors.

6 MORE INFORMATION ABOUT DB

The input and output powers of a coupled circuit are usually compared by input/output ratio, which is gain or loss of the circuit. Power and voltage ratios of the circuit can be measured by reading the dB scale of a tester.

6-1 Circuit impedance for power dB measurement.

In the above circuit, the elements given are related as follows:

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

Because the dB scale of a tester is graduated based on voltage, it is possible to compare power when Z1=Z2, and Z1 and Z2 are eliminated in the above formula. Thus:

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

When $Z1 \neq Z2$,

$$10\log_{10}\frac{P_1}{P_2} = 10\log_{10}\frac{E_1^2/Z_1}{E_2^2/Z_2} \neq 20\log_{10}\frac{E_1}{E_2}$$

In this case, correct dB is obtained by compensating the value measured or by matching the impedance making use of the following graph:

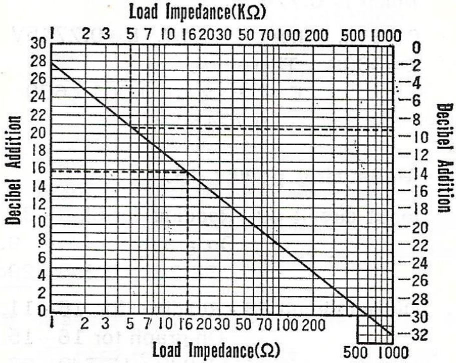


Fig. 9 · dB addition graph.

6-2 Referance value for power dB.

As power dB reference of a tester for expressing and comparing output, OdB is established at ImW when it is dissipated across 600 line.

6-3 Reference value for voltage dB.

To express or compare amplitude by voltage, reference dB is established at a voltage when lmW is dissipated across 600 line, which is 0.7745V.

$P=E^2/Z$, where $P=1mW$, $E=0.7745V$ and $Z=600\Omega$. Therefore,

$$E=\sqrt{P\times Z}=\sqrt{0.001\times 600}$$
$$=0.7745(V)$$

6-4 Measuring power dB.

Input circuit dB - Reading for 5k……38.2dB
On graph for 5k…−9.2dB
38.2dB−9.2dB=29dB

Output circuit dB - Reading for 16…11.8dB
On graph for 16…15.7dB
11.8dB+15.7dB=27.5dB

It is also obtained by calculation as follows:

$$10\log_{10}P_2/P_1=10\log_{10}\frac{E_2{}^2/Z_2}{E_1{}^2/Z_1}$$
$$=10\log_{10}\frac{3^2/16}{0.7745^2/600}$$
$$=10\log_{10}\frac{0.562}{0.001}$$
$$=10\log_{10}100+10\log_{10}5.62$$
$$=10\times 2+10\times 0.7497\doteqdot 27.5\text{dB}$$

The value read on the dB scale is for 16Ω against 600Ω, and

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

$$= 10\log_{10}\frac{3^2/600}{0.7745^2/600}$$

$$= 10\log_{10}\frac{0.015}{0.001}$$

$$= 10\log_{10}10 + 10\log_{10}1.5$$

$$= 10\times1 + 10\times0.176 \doteqdot 11.8\text{dB}$$

Thus, the value added according to graph corresponds to the difference: 27.5dB−11.8 dB=15.7dB. Therefore, 29dB−7.25dB= 1.5dB is the loss the output transformer incurs.

6.5 **Measuring voltage dB.** (Refer to 6-4.)

dB read for input circuit·········38.2dB
dB read for output circuit ······11.8dB

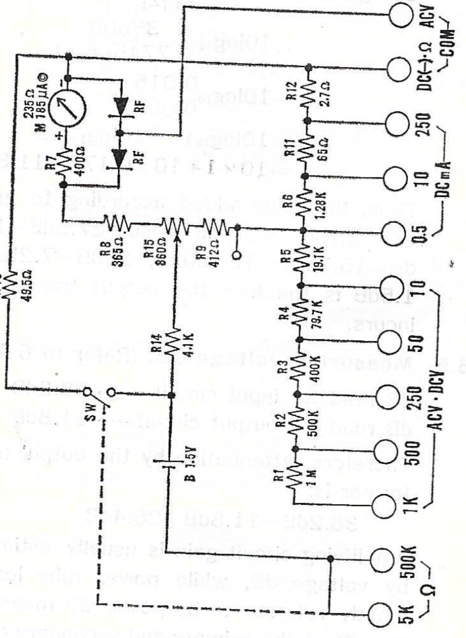
Therefore, attenuation by the output transformer is:

38.2dB−11.8dB=26.4dB

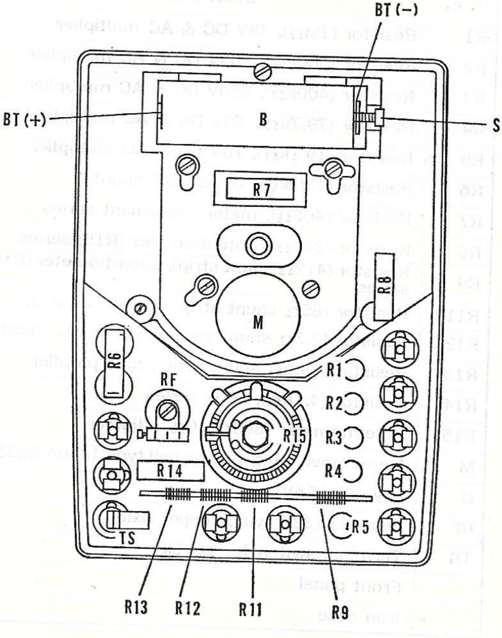
Amplifying circuit gain is usually estimated by voltage dB, while power tube load is mostly referred to by power dB measuring the dB of the primary and secondary of the output transformer.

7 SUPPLEMENTARY DATA

7-1 Schematic diagram.



7-2 Arrangement of parts (rear view).



7-3 List of main parts.

R. S.	Description
R1	Resistor (1MΩ), 1kV DC & AC multiplier
R2	Resistor (500kΩ), 500V DC & AC multiplier
R3	Resistor (400kΩ), 250V DC & AC multiplier
R4	Resistor (79.7kΩ), 50V DC & AC multiplier
R5	Resistor (19.1kΩ), 10V DC & AC multiplier
R6	Resistor (1.28kΩ), 0.5mA DC shunt
R7	Resistor (400Ω), meter movement series
R8	Resistor (365Ω), potentiometer (R15) series
R9	Resistor (412Ω shunt strip), potentiometer (R15) series
R11	Resistor (65Ω shunt strip), 10mA DC shunt
R12	Resistor (2.7Ω shunt strip), 250mA DC shunt
R13	Resistor (49.5Ω shunt strip), 5kΩ parallel
R14	Resistor (4.1kΩ), 500k series
R15	Potentiometer (860Ω), 0Ω adjuster
M	Meter movement(moving coil type,185uA C235Ω)
B	Dry cell (1.5V)
RF	Rectifier (32B type, copper oxide)
TS	Terminal switch for Ω・5k
	Front panel
	Iron case

R. S. Reference symbol

ACCESSORIES AVAILABLE EXTRA.

Carrying case.	
Clip adapter. (TL-12)	Connected to the probe point, the alligator clip on the other end fixes it to the ground.
Fused test lead. (TLF-70 A)	With a 0.5A fuse in, used as positive test lead for safety measurement. Supplied with a spare fuse contained.

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