sanwa

BX-505 MULTITESTER

OPERATOR'S MANUAL

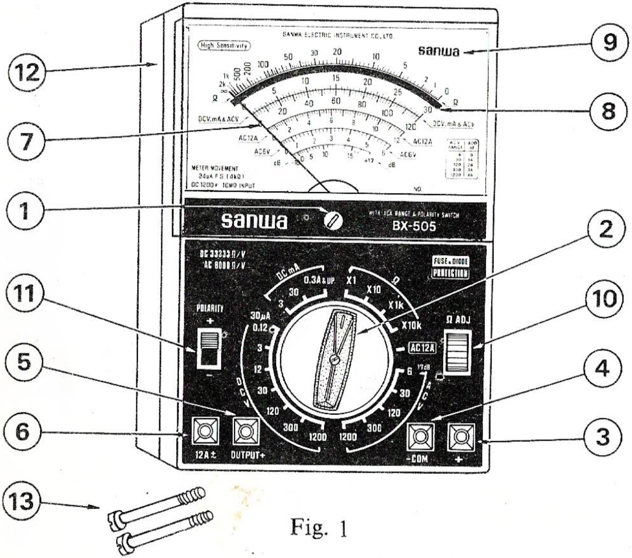


Fig. 1

1	Meter 0 corrector	8	Mirror
2	Range selector switch	9	Indicator cover
3	+ terminal	10	0Ω adjuster
4	−COM terminal	11	Polarity reversal switch
5	OUTPUT(+) terminal	12	Rear case
6	12A exclusive terminal	13	Rear case screws
7	Pointer		

contents

for safety operation

A tester is indeed a convenient instrument commanding many-sided uses of measuring various electrical quantities related to voltage, current, resistance, etc. On one occasion, it is employed to check a high power voltage, and on another a minute current. On the other hand, input impedance which is reckoned as one of the important factors of a tester varies widely from a few ohms up to high megohm level as the measurement range is switched. If, therefore, you should fail to use your utmost care in handling your meter in neglect of paying due attention to the operating and maintenance instructions, not only the meter would be rendered out of use, but you yourself could be exposed to serious physical danger. Especially when testing a power circuit, you need extra attention: no misapplication is allowed. At the same time, a meter laid away unused for over a year, or a one known to be defective even partially can not be used to check a voltage above 100V. Also remember a tester needs periodic inspection at least once a year, when correct voltage reading must be ascertained and withstand voltage test enforced.

introduction

Viewed from the point of circuit design, the BX-505 is a standard multitester to measure voltage, current and resistance. What makes this tester distinguished from ordinary meters is that it is equipped with a high sensitivity indicator of 24uA. It has remarkably improved the resolving power of the instrument to obtain very accurate and efficient measurement imposing all but no current dissipation on the circuit being checked. The polarity switch the instrument is equipped with is now an indispensable gear for aligning various electronic devices where both plus and minus DC elements are present here and there. The series condenser terminal is also a useful outfit for tracing signal in TV service. Regular use of this versatile and high performance test device will completely satisfy you in your electronic service activity.

specifications

Measurement ranges.

DCV (±) 0.12 3 12 30 120 300 (33.3kΩ/V)
1200 (8.3kΩ/V) 30k (w/HV probe)
Allowance – ±2.5% fs

DCA (±) 30u 3m 30m 0.3 12 (30mV drop)
Allowance – ±2.5% fs

ACV 6 30 120 300 1200 (8kΩ/V)
Frequency – 30Hz ~ 20kHz (Within ±1dB)
50Hz ~ 10kHz (Within ±3%)
Allowance – ±3% fs

ACA 12 (300mV drop)
Allowance – ±5% fs

Ω						
	Range	–	×1	×10	×1k	×10k
	Midscale	–	20	200	20k	200k
	Maximum	–	2k	20k	2M	20M
	Minimum	–	0.2	2	200	2k
	Allowance	–	±2.5% of arc			
	Batteries	–	1.5V × 1 & 9V × 1			

dB −10 ~ +17 ~ +63 (0dB – 1mW across 600 – 0.775V)
Allowance – ±4% fs

Dimensions & weight.

170 × 116 × 67mm & abt. 640gr.

Accessories supplied: Test lead pair
Operator's Manual
Batteries
Fuse (1A) w/spare

features

Speedy indication and high-sensitivity meter.

Increased operation efficiency is provided by the fast-reading indicator, while the input impedance of 33.3 kΩ/V for DC and 8 kΩ/V for AC measurements along with high resolution factor of 0.4uA/scale obtains accuracy reading dissipating negligible current of the circuit under test.

Polarity reversal switch.

So far only high-grade testers had this device provided for FM circuit adjustment, but as operational amplifiers, differential amplifiers, pure complementary OCL circuits, etc. have come widely into use, positive and negative DC voltages are present anywhere. Consequently, negative voltage as well as positive voltage measurement is now an essential factor to diagnose the circuit behavior. It is a common understanding now that any high performance meter should have a polarity switch equipped.

Series condenser terminal (OUTPUT +) for detecting signal.

On a certain circuit, DC and AC elements are present mixed. This terminal has a condenser placed in series with it, which blocks DC component on the circuit and reads AC voltage alone to check AF output level. In TV service, this measurement checks the presence of signal voltage.

Protection by fuse and diode.

Up-to-date testers of the world have adopted this type of protection. It is a very rational method of protection since it eliminates the burnout damage of not only the meter movement, but the circuit resistors as well to afford the instrument uninterrrupted service.

Operation facilities and well-selected measurement ranges.

Switches and terminals neatly and rationally arranged on the panel and their definite representation provide you with operation efficiency and convenience, while the measurement ranges are carefully selected to be appropriate to a standard circuit tester. Especially, the ACA range measuring up to 12A surely adds versatility to the meter being available to monitor the current consumption of various power equipments.

Duplicate scale marking.

The most frequently used DCV · mA & ACV scale is graduated by long and short lines alternated. Just compare the markings below, and see how clearly and definitely you can determine the value indicated.

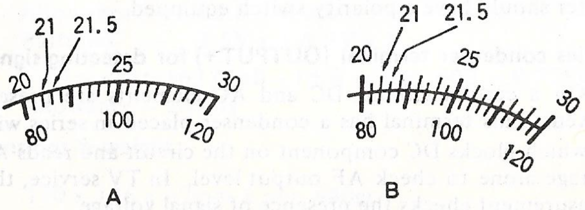


Fig. 2

operating instructions

Indicator zero setting.

Before you take a measurement, check if the pointer is on 0 of the scale left. If you find it off the position, adjust it by slowly turning to the right or left the 0 corrector①. The pointer may shift off 0 by long use or when the meter is transposed.

Range selection.

A measurement range is selected by switching the knob ②. For 12A DC/AC, use the separate jack marked 12A±. For an accurate reading, use the range nearest in value to the quantity being measured; for instance, 1.5V dry cell on the DC 3V range; on the 12V or 30V range, farther will be the reading from the actual value. For resistance measurement, try to read around in the middle of the scale.

Test lead connections.

When connecting the test leads to the meter, insert them well down so as the metal tips of the leads are completely buried in the jacks (Fig. 3-A); they would not come off by the force of 1kg.

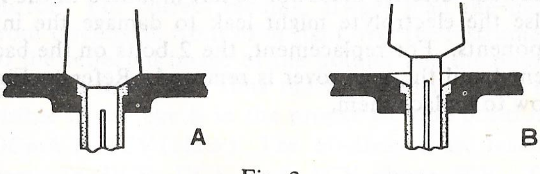


Fig. 3

This connection is unique with SANWA testers provided for safety operation. Any test leads other than those attached will miss the merit. For AF output voltage measurement, the red lead goes to the terminal ⑤, and for 12A DC/AC, to the terminal ⑥.

O-ohm adjustment

This is to adjust the pointer to 0 on the right of the top Ω scale by means of the 0 ADJ knob. The selector switch ② is rotated to the resistance range prescribed. Shorting together the + and −COM jacks, see if the pointer stays exactly on 0 (Fig. 4). The pointer must be adjusted each time the range is moved, but if you cannot adjust it to 0 for the X1 range, the internal 1.5V cell (UM-3) has worn out; if not for the X10 range, 9V (006P) cell has. You must replace them immediately.

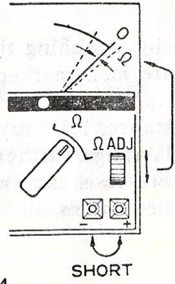


Fig. 4

Replacement of batteries.

Batteries gradually weaken in the course of time. Exhausted batteries must not be left mounted in the meter, or else the electrolyte might leak to damage the internal components. For replacement, the 2 bolts on the back are loosened and the rear cover is removed. Refer to Fig. 5 as to how to replace them.

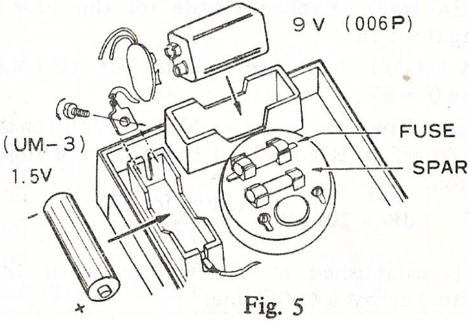


Fig. 5

Polarity reversal.

For ACV, ACA, Ω and DC measurements, the polarity switch is turned to +, and for −DCV and −DCA measurements, to −. The switch interchanges +DC and −DC allowing ready switching of polarities when they need to be reversed.

Scale reading.

1 Ω scale (black). Resistance is directly read on this scale for the X1 range from 0.2Ω at minimum to 2kΩ at maximum.

2 Mirror. For correct reading, always read the meter from directly in front of or right over the instrument, so the reflected image of the pointer and the pointer itself are lined up. Thus the reflected image is not visible if the eye is in the proper viewing position.

3 DCmA & ACV (black). The 60-division arc reads in common DCV, DCA and ACV above 30V. The

scale reads 0 ~ 30 and 0 ~ 120 at full scale.

4 DC 12A (red). Exclusive scale for the 12A range reading 0 ~ 12A.

5 AC 6V (black). Exclusive scale for the AC 6V range reading 0 ~ 6V.

6 dB (red). The scale reads −10dB ~ +17dB for the 6V (AC) range. It is graduated based on the following equation:

$$dB = 20\log^{10} \frac{\text{Reading for 6V}}{0.775V}$$

0dB is established at the voltage when 1mW is dissipated across a 600Ω line.

7 ADD dB table. Addition table when dB is measured on the ranges other than 6V. The value given for the range used is added to the reading on the dB scale.

measurement

Measuring DC voltage (0.12V ~ 1200V).

The polarity switch is set for either + or − depending on the polarity of the voltage being measured.

The range-switch positions, ranges measured, and scale readings are related as follows:

Sw. position	Range measured	Scale to read	Multiplied
0.12 (30μA)	0 ~ 0.12V (120mV)	DCV 0 – 120	0.001 in V 1 in V
3	0 ~ 3V	" 0 – 30	0.1 inV
12	0 ~ 12V	" 0 – 120	0.1 in V
30	0 ~ 30V	" 0 – 30	1 in V
120	0 ~ 120V	" 0 – 120	1 in V
300	0 ~ 300V	" 0 – 30	10 in V
1200	0 ~ 1200V	" 0 – 120	10 in V
(30μA 0.12)	*0 ~ 30kV	" 0 – 30	1 in kV

*For 0 ~ 30kV, use the high voltage probe available extra.

The negative test lead on the meter can remain connected to ground. Thus the polarity of the voltage is readily determined to promote your understanding of the behavior of the circuit checked.

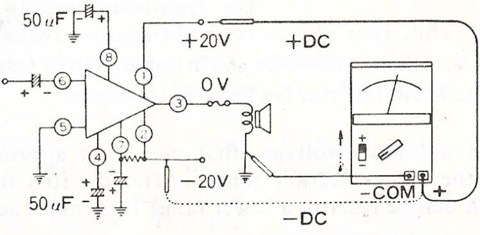


Fig. 6 – OCL circuit.

The OCL circuit of Fig. 6 uses + and – DC as source voltage.

Polarity test determines the type of transistors. With the positive lead connected to the base and the negative lead to the emitter as when base-to-emitter voltage is measured, the position of the polarity switch determines the type of the transistor as to whether it is NPN or PNP.

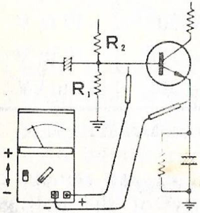


Fig. 7

NPN transistor for the switch position at +.

PNP transistor for the switch position at −.

For the transistor circuit as illustrated, a tester can most efficiently be used for qualitative test of an incircuit transistor and discrimination of its type. The base-to-emitter voltage of a normal Ge transistor usually reads 0.1~1.2V, while that of a normal Si transistor reads higher as 0.5~1V. Simultaneously with qualitative test, this measurement will tell you Ge from Si transistor.

For an unknown voltage, first check its approximate value on the highest 1200V range. After the first reading, the switch can be reset to a lower range for a more accurate reading.

The 0.12V range can be used to measure low voltages like the bias voltage of a transistor circuit and the voltage drop of a big current flowing in a conductor as shown in

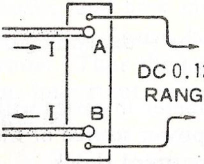


Fig. 8

Fig. 8. In this measurement, correct reading is obtained since the meter dissipates only 0.03mA. Joint use of an amperemeter measures a minute resistance, and, conversely, joint use of a minute resistance as shunt can read big DC current over 12A.

For a circuit voltage corresponding to the source voltage as shown in Fig. 6, the size of the current the meter dissipates has nothing to do with the measured value, but it has a great deal for a minute current circuit loaded with resistance. In this respect, the 30V range of the BX-505 of which the internal resistance is as high as 1MΩ dissipates only 0.03mA at full scale. You can thus check the voltage amplifying circuits, DC amplifiers, oscillating circuits, AGC and AVC voltages, FM circuit and the like efficiently without disturbing the normal condition of the circuit under test.

30kV high voltage probe is available extra for TV service to measure the high voltages of CRT anode, focusing circuit, etc. For high voltage measurements, the range switch is set for DC 30uA, and the probe is connected as shown in Fig. 9. The HV probe must not be used except for measurement of the high voltage of a high impedance circuit with minute current capacity.

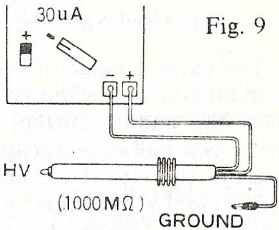


Fig. 9

Measuring DC current (30uA ~ 12A).

The polarity switch is set for either + or – depending on the polarity of the current being measured.

Current is measured connecting the meter in series with the load. Wrong connections cause the power source of the circuit measured to suffer abnormal overcurrent shock.

Switch positions, ranges being measured, and scale readings are related as follows:

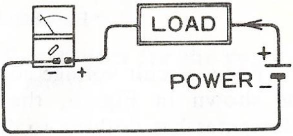


Fig. 10

Sw. position	Range measured	Scale to read	Multiplied
DCV 30uA 0.12	0 ~ 30uA	DCmA 0 – 30	1 in uA
DCmA 3	0 ~ 3mA	" 0 – 30	0.1 in mA
" 30	0 ~ 30mA	" 0 – 30	1 in mA
" 0.3A & UP	0 ~ 0.3A	" 0 – 30	10 in mA 0.01 in A
" "	0 ~ 12A	" 0 – 120	0.1 in A

* Use the separate jack marked 12A± for the red lead connection. For big current measurements, an extra lead is available.

The current range of the instrument covers from 0.5uA at minimum to the power current of 12A. The uA range reads the minute current of semiconductor circuits, and serves as a null detector for a bridge circuit; the mA ranges measure the circuit current of communication equipments and radio/TV receivers; and the 12A range, the charging current [illegible] power transistor circuits. More and more electronic equipments have their circuits composed of IC blocks, and how much is the current each block dissipates is the conclusive factor of diagnosing the behavior of the whole. Thus the current range of a tester has come to play an important role in the alignment of semiconductor circuits.

Measuring AC voltage (6V ~ 1200V).

The Si diode rectifier is highly stable and efficient allowing the DCV scale read in common for ACV measurement except for 6V. Eventually it has made the scale dial look neat and tidy.

The ACV measurement responds to the frequency of 30Hz ~ 20kHz, which is considered sufficient for a circuit tester to cover.

Switch positions, ranges to be measured, and scales to read are related as follows:

Sw. position	Range measured	Scale to read	Multiplied
6	0 ~ 6V	AC 6V	1 in V
30	0 ~ 30V	DCVmA & ACV 0 – 30	1 in V
120	0 ~ 120V	0 – 120	1 in V
300	0 ~ 300V	0 – 30	10 in V
1200	0 ~ 1200V	0 – 120	10 in V

The polarity switch can always take the + position.

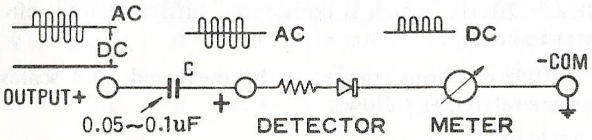
For an unknown voltage, first check its approximate value on the highest 1200V range. After the first reading, you can reset the switch to a lower range for a more accurate reading.

Measuring AF output voltage (OUTPUT+ jack).

To measure AF output voltage, the positive test lead is connected to the OUTPUT+ jack instead of the usual + jack. The negative test lead goes to the –COM jack.

OUTPUT+ jack is otherwise known as a series condenser terminal since a condenser is connected in series to read AC voltage alone with the DC element existing together in the circuit isolated by the blocking condenser. Refer to Fig. 11.

Fig. 11



The 30V or 120V range is used for this measurement to check the presence of signal in the horizontal amplifying circuit of a TV receiver. Likewise, the input signal of the synchronous detaching and synchronous amplifying circuits are also checked on the lower ACV ranges.

Measuring AF output level (dB).

Instead of by wattage, AF output power level is often referred to by decibel (dB) to compare output levels in a simple way, for which the reference value (0dB) is established at the voltage that 1mW develops across 600Ω impedance. It is expressed as:

$$dB = 10\log_{10}\frac{W}{1mW}$$

Thus the output voltage of a 600Ω impedance line is measured and read directly in dB on the dB scale provided.

The overall input impedance (8kΩ/V) of the ACV range is big enough to ignore loss by connecting the meter to a 600Ω line.

For a circuit other than 600Ω impedance, the following conversion table is referred to to obtain actual value:

Impedance (Ω)	ADD dB
2k	-5.2
1k	-2.2
600	0
500	0.8
300	3.0
200	4.8

Impedance (Ω)	ADD dB
150	6.0
75	9.0
50	10.8
16	15.8
8	18.8
4	21.8

Generally, the input and output impedances of an amplifier are not definite, and the dB value measured by a tester is nothing but a voltage read on the corresponding dB scale. However, when input and output levels are to be compared, this is a useful form of notation. Simple addition and subtraction save us from complicated calculation problem.

Besides the 30V range, any ACV range can be used for dB measurement, when the actual value is obtained by adding to the reading on the dB scale the value given in the ADD dB table on the corner of the scale dial.

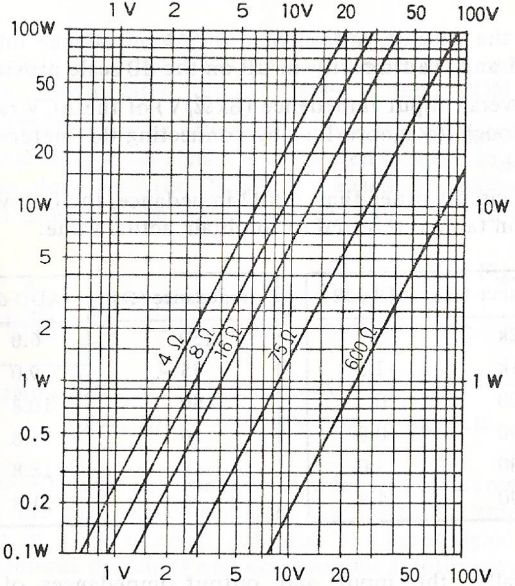


Fig. 12 – Correlative nomograph of output (W), impedance (Ω) and ACV.

Providing the 6V range reads 4V for 8Ω line impedance, 2W is obtained on the graph. It is expressed as:

$$\text{Output (W)} = \frac{(\text{Output ACV})^2}{\text{Load impedance } (\Omega)}$$

Measuring power voltage (300V and up DC/AC).

Be certain to switch off power before you connect the meter to the circuit under test. Confirm if the smoothing condensers in the circuit are discharged.

Make sure of the correct position of the range switch and the connections of the test leads.

Power is switched on.

While you measure and read the scale, never touch the meter and the test leads by the hand not to speak of the circuit under test.

As measurement is over, power is switched off, but do not take off the connections until the pointer is ascertained to have returned to 0.

Despite the above precautions, the high impedance circuits of TV and communication apparatuses (mostly DC) can be measured in a usual manner.

Measuring AC current (12A).

As for DCA measurement, the meter is connected in series with the load.

The range switch is set for AC 12A (red), and the polarity switch for + as for ACV measurement. The test leads are connected to the 12A± and −COM jacks.

For quick measurement, the test leads supplied can be used, but for a measurement taking time, use the power cord available extra.

Maximum current allowed is 12A, so the current consumption of power equipments can be measured up to

1.2kW for 100V power line. The ACA range is also available for monitoring power appliances at the time of their shipment, inspecting the ON-OFF gap of a tempera-true switch, and for trouble shooting of power equipment in general.

Measuring resistance (Ω, kΩ, MΩ).

The polarity switch can be set for +.

Resistance is measured in 4 ranges, X1 ~ X10k. For the X1 range, the top Ω scale is read directly. For the other ranges, actual values are obtained by multiplying the readings by the multiple of each range used.

Switch positions, ranges to be measured, and the current consumption for each range are related as follows:

Sw. position	Range being measured			Max. current consumption	Max. termi-nal voltage
	Min.	Max.	Mid.		
X1	0.2	2k	20	75mA	1.5V
X10	2	20k	200	7.5mA	"
X1k	200	2M	20k	750uA	"
X10k	2k	20M	200k	53uA	10.5V

While measuring the resistance of a very thin wire coil or a bulk-type semiconductor, you will find their impedance changes on account of the current flowing in them or the voltage applied. You may recognize some abnormality to occur having the test sample self-heated. Pay attention to the relation among the elements as mentioned in the above table.

Terminal polarity can be ignored for the measurement of ordinary resistance such as DC resistance of a transformer, continuity check, etc.: polarity has nothing to do with resistance measurement.

The resistance of some semiconductors like a junction transistor or diode is markedly polarized. So is it with electrolytic capacitors. When you test them, be it well noted that the terminal polarity of the meter is reversed on the panel, the + terminal being in minus and the –COM terminal in plus potencial.

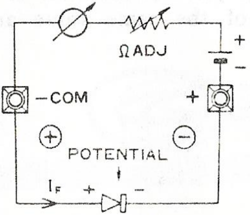


Fig 13

How the protection fuse functions.

Any physical shock will do serious damage to the meter. On the other, it is more frequently rendered out of use by burnout through misapplication. Some resistor or shunt can be instantly burnt by AC voltage over 100V inadvertently applied.

Safeguarding the indicator against such damage, a silicon diode is placed across the moving coil to bypass the overcurrent misapplied. The meter has a fuse (1A) fitted to prevent the resistance or current range, mostly X1 and 0.3A ranges, from getting burnt out. Thus not only the instrument itself is practically proof against burnout damage but you can also be protected from possible danger by sparking that misuse may accompany.

If the fuse is blown, the meter ceases to perform, when the rear case is removed as when the batteries are replaced, and the fuse blown is exchanged for the spare stocked. To provide against emergency, keep a new fuse on the fuse holder.

Overvoltage misapplied to a resistance or current range other than the X1 and 0.3A ranges may sometimes cause the circuit resistor to burn in place of the fuse. It can then be replaced with a one of the same value and same allowance (±1%).

maintenance

Indicator cover.

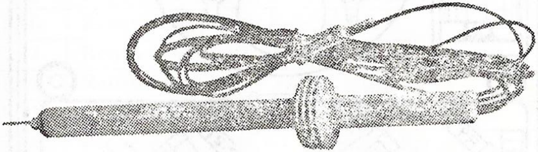
The cover is metacryllic. It is softer than glass, and, what is more, it is treated with anti-electrification coating. Do not wipe it hard with a dry cloth not to scratch it or have the coating come off. Coating effect, however, may diminish by long use, when, as a makeshift, anti-electrification solvent can be diluted and spread over the surface with a soft cloth.

Storage.

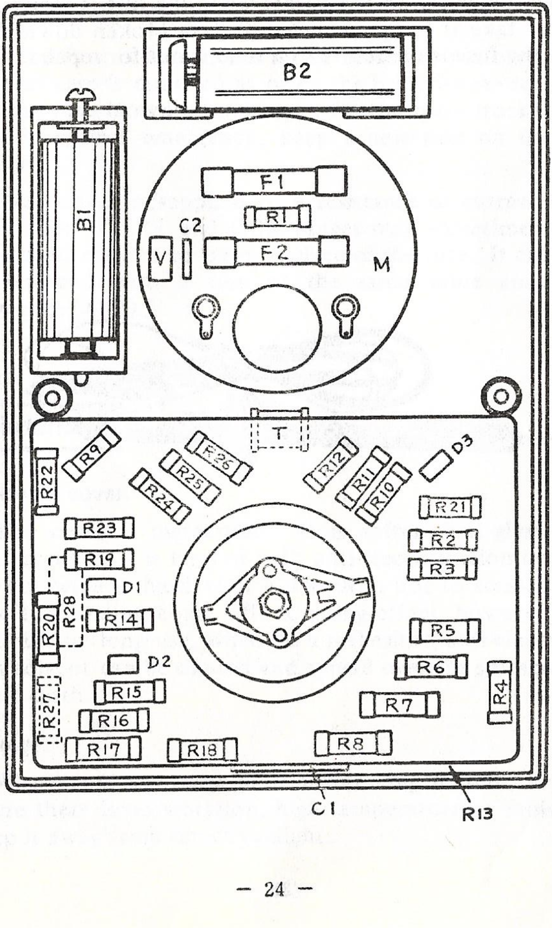
When you lay away your meter long unused, store it where there is no vibration, high temperature or moisture. Keep it away from direct sunlight.

Fuse.

The meter ceases to operate when the fuse is blown, but do not take it for your meter to have broken down. Just see if the fuse is ok before you send it out for repair.



ARRANGEMENT OF PARTS (rear view)



LIST OF PARTS

Part #	Description	RS
B5R01	Resistor (2kΩ), millivolt calibration	R1
B5R02	Resistor (800Ω), series	R2
B5R03	Resistor (6kΩ), series	R3
B5R04	Resistor (90kΩ), 3V DC multiplier	R4
B5R05	Resistor (300kΩ), 12V DC multiplier	R5
B5R06	Resistor (600kΩ), 30V DC multiplier	R6
B5R07	Resistor (3MΩ), 120V DC multiplier	R7
B5R08	Resistor (6MΩ), 300V DC multiplier	R8
B5R09	Resistor (3.33kΩ), 1200V DC shunt	R9
B5R10	Resistor (91Ω), 3mA DC shunt	R10
B5R11	Resistor (9Ω), 30mA DC shunt	R11
B5R12	Resistor (0.97Ω), 0.3A DC shunt	R12
B5R13	Resistor (0.025Ω), 12A DC/AC shunt	R13
B5R14	Resistor (35.5kΩ), 6V AC multiplier	R14
B5R15	Resistor (192kΩ), 30V AC multiplier	R15
B5R16	Resistor (720kΩ), 120V AC multiplier	R16
B5R17	Resistor (1.44MΩ), 300V AC multiplier	R17
B5R18	Resistor (7.2MΩ), 1200V AC multiplier	R18
B5R19	Resistor (14.7kΩ), ACV sensitivity calibration	R19
B5R20	Resistor (17.3kΩ), shunt	R20
B5R21	Resistor (5~10kΩ), ACA calibration	R21
B5R22	Resistor (190kΩ), ΩX10k series	R22
B5R23	Resistor (18.4kΩ), Ω series	R23
B5R24	Resistor (66.7kΩ), ΩX1k shunt	R24
B5R25	Resistor (201Ω), ΩX10 shunt	R25
B5R26	Resistor (19.5Ω), ΩX1 shunt	R26

Part #	Description	RS
B5R27	Resistor (12kΩ), shunt	R27
B5R28	Potentiometer (20kΩ), 0Ω adjuster	R28
RF06	Silicon diode	D1
RF06	Silicon diode	D2
RF05	Germanium diode	D3
C049	Capacitor	C1
C050	Capacitor	C2
V001	Varister	V
B001	Dry cell (1.5V)	B1
B005	Dry cell (9V)	B2
TR03	Transformer	T
	Indicator (24uA)	M
MB01	Indicator case	
MC01	Indicator cover	
P015	Front panel (BX-505)	
X015	Rear case (BX-505)	
	Control dial plate (BX-505)	
T002	Terminal jack (4ϕ), 4 required	
L001	Test lead (4ϕ), pair	
SW14	Range selector switch	
K014	Range selector switch knob	
PSW2	Polarity switch	
F001	Fuse (1A) w/holder	F1
	Fuse (1A), spare	F2

RS - Reference symbol

79. 5 S

sanwa
SANWA ELECTRIC
INSTRUMENT CO., LTD.
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