MODEL SH-88TR
ALL-PURPOSE MULTITESTER
(With Current Control-Type Zero Center Function)

SPECIAL FEATURES

● **Broadened Ranges with Additional Functions:**
With the adoption of a 22-channel switch and the inclusion of additional functions, this tester provides a broad and powerful 35 ranges in all.

1. **Can be Used as ±DCV Zero Center Meter (NULL)**
2. **Usable as Capacitor Capacity Checker**
3. **Judges Continuity with Light and Indicates it with LED**
4. **Equipped with OUTPUT Terminals (Series Capacitor Terminals)**
5. **Safety-Emphasis Measuring Terminals and Test Leads are Adopted**
6. **Double Protection Device**

● **Additional Measuring Functions with Use of Optional Accessories**

1. **As Transistor Checker:**
If transistor hFE connector (HFE-6T) is attached, the unit can be used as a transistor checker that can measure hFE from 0 to 1000.

2. **As DC High Voltage Meter:**
With the attachment of high-voltage probe (HV-10), the tester can be measure TV and other direct-current high voltages from 0 to 25 kV.

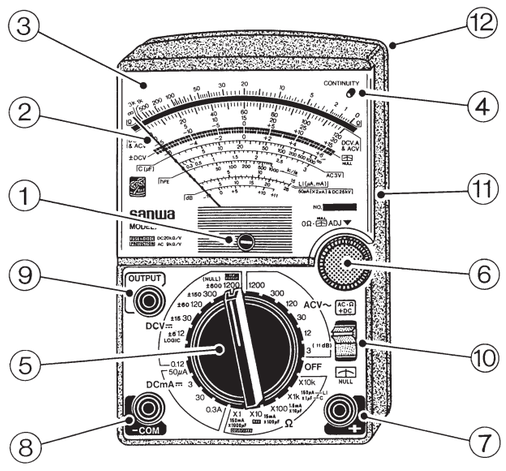
READ FIRST: SAFETY INFORMATION

⚠ WARNING

To ensure that the meter is used safely, follow all safety and operating instruction.

1. Never use meter on the electric circuit that exceed 6 kVA.
2. Pay special attention when measuring the voltage of AC 33 Vrms (46.7 V peak) or DC 70 V or more to avoid injury.
3. Never apply an input signals exceeding the maximum rating input value.
4. Never use meter for measuring the line connected with equipment (i.e. motors) that generates induced or surge voltage since it may exceed the maximum allowable voltage.
5. Never use meter if the meter or test leads are damaged or broken.
6. Never use uncased meter.
7. Be sure to use a fuse of the specified rating or type. Never use a substitute of the fuse or never make a short circuit of the fuse.
8. Always keep your fingers behind the finger guards on the probe when making measurements.
9. Never apply voltage to the current terminal. If voltage is applied to the terminal, the meter occurs short-circuit.
10. Be sure to disconnect the test pins from the circuit when changing the function or range.
11. Before starting measurement, make sure that the function and range are properly set in accordance with the measurement.
12. Never use meter with wet hands or in a damp environment.
13. Never use test leads other than the specified test leads.
14. Never open tester case except when replacing batteries or fuses. Do not attempt any alteration of original specifications.
15. To ensure safety and maintain accuracy, calibrate and check the tester at least once a year.
16. Indoor use.

APPEARANCE AND PARTS NAMES



① Indicator zero adjuster
② Indicator needle
③ Indicator scale dial
④ Continuity indicating LED, (CONTINUITY)
⑤ Range selector switch
⑥ Combination zero ohm adjuster (0 Ω ADJ) and center zero needle adjuster
⑦ + Measuring terminal
⑧ −COM measuring terminal (common for negative)
⑨ Series capacitor terminal (OUTPUT) 0.047 μF/400 V
⑩ Polarity Changeover switch (Center zero changeover switch)
⑪ Panel
⑫ Rear case

MEASURING RANGES AND PERFORMANCES

Kind of Measurement	Measuring Ranges	Accuracy	Remarks
DC voltage (DCV)	0–0.12 V–3 V–12 V-30 V–120 V–300 V–1200 V –(25 kV) To measure 25 kV, optional HV prove must be used.	±2.5 % of max. graduation (below 1200 V)	Internal resistance : 20 kΩ/V
DC voltage (±DCV)	±0–6 V–15 V–60 V–150 V–600 V	±5 %of max. graduation	Zero center meter type Internal resistance : 40 kΩ/V
DC current (DCmA)	0–50 μA–3 mA–30 mA–0.3 A (50 μA is common with DC 0.12 V range)	±2.5 % of max. graduation	Terminal voltage drop : 300 mV
AC voltage (ACV)	0–3 V–12 V–30 V–120 V–300 V–1200 V 30 Hz–100 kHz ±1 dB } Below 30 V 40 Hz– 30 kHz ±3 % }	±3 % of max. graduation, ±5%for 3Vonly	Internal resistance 9 kΩ/V
Capacity(C)	Range Indication Min. value Max. value x1000 μF 1000 μF 1 F x100 μF 100 μF 0.1 F x10 μF 10 μF 0.01 F x1 μF 1 μF 1000 μF	approximate value	Indicates max. deflection by charging current C
Low-Frequency(dB)	–10 dB ~ +11 dB (AC 3 V range) ~ +63 dB 0 dB=0.775 V(1 mW), 600 Ω-impedance circuit	Same as ACV	Same as ACV
Resistance (Ω) with Continuity Indication	Range Indication x1 x10 x100 x1 k x10 k Max. value 3 kΩ 30 kΩ 300 kΩ 3 MΩ 30 MΩ Central value 20 Ω 200 Ω 2 kΩ 20 kΩ 200 kΩ Min. value 0.2 Ω 2 Ω 20 Ω 200 Ω 2 kΩ Continuity indication LED: In x1 range (Lights below 10)	±3 % of scale length	Inside battery : R6 (1.5 V) x 2 6F22 (9 V) x 1
Leakage Current (I CEO) LI	0– 150 μA . . . . . x1 kΩ range 0– 1.5 mA . . . . . x100 Ω range 0– 15 mA . . . . . x10 Ω range 0–150 mA . . . . . x1 Ω range	±5 % of scale length	The current that flows between +and –COM terminals during measurement
DC Currant Amplification Factor (hFE)	Transistor hFE: 0 ~ 1000 (in x 10 range)	±3 % of scale length	Optional hFE connector must be used

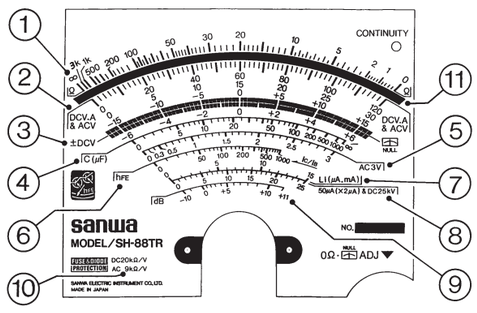
- **Accuracy Assurance Temperature / Humidity Range:** 23±2 ℃ 75 %RH max, No condensation
- **Operating Temperature / Humidity Range:** 0~43 ℃ 80 %RH max, No condensation
- **Dimensions and Mass:** 150 mm x 100 mm x 36 mm, about 280 g
- **Accessories:** One spare fuse Ø 5 x 20 (0.5 A / 250 V) contained inside the tester, one pair of test leads, and an instruction manual
- **Optional accessories:** hFE connector (HFE-6T), high-voltage probe (HV-10), and carrying case

● **Cautions in Using This Tester**

1. **Check Zero Position of Indicator:**
When the indicator needle is not above the zero line on the extreme left of the scale, align it to zero line by turning the zero adjuster in the panel center.
2. **Check Position of Changeover Switch:**
Use the polarity changeover switch of this unit only for ±DCV (center zero meter) measurement. All other measurements are made with this switch turned to Ω, AC,+DC. If the switch is left turned to the center zero (NULL) side, the indicator needle keeps pointing to the meter center, making other measurements impossible.
3. **Select Correct Measuring Range:**
By using the range selector switch, select the right range that suits the object to be measured. When measuring anything whose approximate value level is unknown, begin with the largest range and then switch gradually to the most appropriate range (the range nearest to the value of the object measured). Particularly when high-power commercail AC voltages (more than 100 V) are measured, it is important to take enough care in this respect.
4. **Take Good Care for Keeping:**
Do not leave the unit for a long time in places where it is exposed to shocks, vibrations, direct sunray, high temperature and humidity.
5. **Take Care of the Indicator Protective Cover:**
Do not rub the surface of the indicator cover strongly with dry cloth, for instance. This cover is coated with antistatic liquid. If the antistatic effect weakens after many years of use, it is recommended as stop-gap measure to wipe the cover surface with cloth wetted with water solution of a detergent containing antistatic agent.

HOW TO USE THIS TESTER

● **Indicator Scale Dial**



Descriptions of Scales and Other Parts

① Resistance (Ω) scale..... Blue color
② Scale for DC voltage and current (DCV, DCmA) and AC voltage (ACV) above 12 V .....Black color
③ Scale for center zero meter, DC voltage (±DCV) .. Blue color
④ Capacitor (C) scale.....Red color
⑤ Independent scale for AC voltage 3 V (AC 3 V)..... Black color
⑥ Scale for transistor DC current amplification factor (hFE) ..... Blue color
⑦ Scale for Inter-Terminal current (LI) ..... Black color
⑧ Scale for DC high voltage (DC 25 kV) and DC 50 μA current..... Black color
⑨ Decibel (dB) scale..... Red color
⑩ Internal resistances of voltage ranges
⑪ Mirror.....The purpose of this mirror is to help read the indications correctly by aligning the needle seen directly by the eye with the needle reflected in the mirror.

● **Measurement of DC Voltage (DCV)**

1. **Range of Use:**
DCV 0.12 V–3 V–12 V–30 V–120 V–300 V–1200 V
2. **MeasuringTerminals:**
+ and −COM. As a rule, insert the red lead into the + terminal and the black lead into the −COM terminal.
3. **Indicator Scale:**
Use black-colored scale ②. There are two kinds of scales, 0 to 30 and 0 to 120, and the units are V. In 30 V and 120 V ranges read the indications directly, while in other ranges make necessary conversions to obtain true values.
4. Turn the range selector switch to the required DCV range. Normally fix the black negative test rod to negative potential point (ground line) and connect the red positive rod to the test point to be measured. Take good care about polarity when measuring voltage drop between the two ends of resistor, negative oscillator circuit voltage, and transistor circuit voltage.
5. When measuring high voltages used in TV, connect the optional HV probe as shown in Fig. 1.

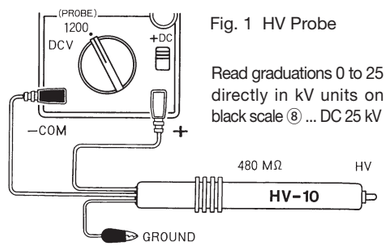


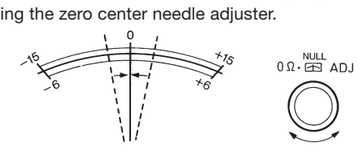
Fig. 1 HV Probe

Read graduations 0 to 25 directly in kV units on black scale ⑧ ... DC 25 kV

● **Measurement of ±DC Voltage (±DCV) Usage as Center Zero Null Meter**

1. **Range of Use:** DCV ±6 V–15 V–60 V–150 V–600 V
2. **Measuring Terminals:**
+ and −COM. The same instructions as those for measuring DCV apply.
3. **Indicator Scale:**
Use blue scale ③... ±DC. There are two kinds of scales, 0 to ±6 V and 0 to ±15 V, and the unit is V.In ±6 V and ±15 V ranges read the indications directly, while in other ranges make necessary conversions to obtain true values.
4. Turn the range selector switch to the necessary range between ± 6 V and ± 600 V.
5. Turn the polarity changeover switch to the position of . As the indicator needle moves toward the center immediately, align it to 0 line on scale ③ using the zero center needle adjuster.

Fig. 2



6. Following the above instructions, use the unit as null meter to measure ±DCV.
7. **After the completion of measurement, do not forget to return the polarity changeover switch to Ω · AC · +DC.**

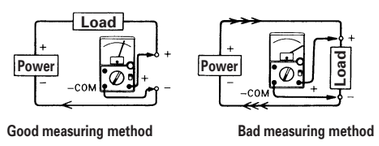
Caution:
As a rule, use the center zero null meter in the designated ±DCV range only.
If the needle fails to reach the center zero line after ZERO ADJ knob is turned, replace the 9 V battery contained inside.

● **Measurement of DC Current (DCmA)**

1. **Ranges of Use:** DCmA 50 μA−3 mA−30 mA−0.3 A
2. **Measuring Terminals:**
+ and −COM. As a rule, insert the red lead into the + terminal and the black lead into the − COM terminal.
3. **Indicator Scale:**
Use black scale ② ... DCV, A & ACV. The scale is from 0 to 30 and the units are mA and A. In 30 mA range read the indications directly, while in other ranges make necessary conversions to obtain true values.
For 50 μA only, use black scale ⑧ ... 50 μA (x 2 μA) Read graduations 0 to 25 by doubling them into 0 to 50 μA.

Caution:
When measuring current, be sure to make the connection in series via load. Also avoid absolutely applying any voltage.

Fig. 3



Good measuring method Bad measuring method

● **Measurement of AC Voltage (ACV)**

1. **Ranges of Use:** ACV 3 V–12 V–30 V–120 V–300 V–1200 V
2. **Measuring Terminals:** + and –COM
3. **Indicator Scale:**
Use black scale②... DCV, A & ACV. There are two kinds of ranges, 0 to 30 and 0 to 120, and the unit is V. In 30 V and 120 V ranges read the indications directly, while in other ranges make necessary conversions to obtain true values (but above 12 V). For 3 V only, use black scale ⑤ (AC 3 V) on which the graduations can be read directly.
4. Turn the range selector switch to the requried ACV range.

5. **Cautions in Measuring HighVoltages of more than 200 V:**
(a) Check that the range selector switch is turned correctly to AC 300 V and that the test leads are connected as mentioned in **2**.
(b) Before connecting the tester, turn off the power switch of the power circuit to be measured. After connection, turn on the switch and do the measurement.
(c) Do not touch the wires and tester during measurement. After the completion of measurement, turn off the power switch before disconnecting the tester.

● **Measurement of Low-Frequency Output (dB)**

1. **Ranges of Use:** –10 ~+11~+63 dB, 6 ranges
2. The way of measurement is same as that in ACV.
3. The scale ⑨ is graduated in correspondence with AC 3 V range and only output in 600 Ω impedance circuit can be read directly in dB value. (0 dB= 1 mW = 0.775 V)
4. For 12 V range or higher, obtain true value after adding "ADD dB value" in the following table to indicated value.

ACV range	3 V	12 V	30 V	120 V	300 V	1200 V
ADD dB value	0	12	20	32	40	52
MAX dB value	+11 dB	+23 dB	+31 dB	+43 dB	+51 dB	+63 dB

Example: If+7 dB value is obtained in 12 V range, add 12 of ADD dB value of 12 V range to it. True value is +7 +12 = +19 dB.

● **Measurement of ACV with OUTPUT Terminals (Including Measurement of Low-Frequency Output)**

1. The method of measurement is the same as in the case of ACV. However, connect the + test lead to the OUTPUT terminal with capacitor 0.047 μF/400 V. (OUTPUT and –COM terminals are used.)
2. This measurement can be used when it is necessary to cut DC voltage and measure AC signals only in TV, audio and other circuits where DC and AC are used mixedly and when the existence of various signals in TV circuits have to be determined.

Examples:
- Detection of horizontal signals in horizontal amplification circuits.
- Detection of any input signal in sync. separation and sync. amplification circuits.

● **Resistance (Ω, kΩ, MΩ)**

1. **Ranges of Use:** x1, x10, x100, x1 k, x10 k(0.2 Ω~30 MΩ)
2. **Measuring Terminals:** + and – COM
3. **Indicator Scale:**
Use blue scale ① ... Ω. It has graduations from 0 to 3 k and the unit is Ω. In x1 range read the graduations directly, in x1 kΩ range also read the indications directly but in kΩ units, while in other ranges amplify the readings by the raspective multiples to obtain true values.

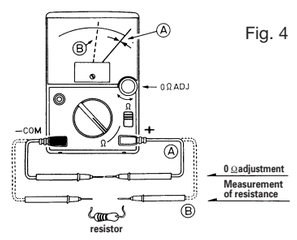


Fig. 4

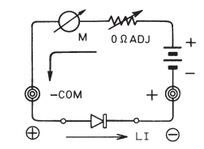
4. **Zero Ohm Adjustment (0 Ω ADJ):**
Before using the unit, short-circuit the + and – COM terminals as shown in Fig. 4 Ⓐ and align the indicator needle to 0 Ω line using the zero ohm adjuster. (This operation is also called ''Full scale adjustment.'') This adjustment should be completed before beginning measurement.
If this adjustment is made each time the range has been changed, correct measurements can be explected.
5. When measuring resistance in circuits, be sure to turn off the power switch in advance. Particularly, take care not to apply any voltage to x1 and x10 ranges.

6. **Continuity Check with LED:**
When measurement is made in x1 range, if the measured resistance value is less than around 10 Ω, continuity indication LED to the top right of the dial lights up. (The brightness varies depending on the resistance value.) This LED indication is very convenient for simple continuity and broken wire tests as it responds faster than the needle and it shows the result visually and quietly without the buzzer noise.

NOTE

● **Polarity of Tester Terminals when Resistance is Measured**

Fig. 5



As shown in Fig. 5, when measurement is made in ohm range, the normally +terminal becomes the negative terminal and the normally − terminal the positive terminal.
This is because the negative pole of the inside battery is connected to the positive terminal of the tester.
Keeping this relation in mind helps when measuring polar resistances such as those of transistors and diodes (junction semiconductor) and when testing the leakage of electrolytic capacitors.

● **About Inter-Terminal Current LI**

LI scale is graduated to measure the value of the current that flows between the + and –COM terminals during resistance measurement. (See Fig. 5) In some objects measured, the resistance varies depending on the current that flows across them and the voltage that is applied to them. Also abnormal condition can occur because of self heating. Therefore, the user must understand this relation well for each Ω range before doing the measurement.

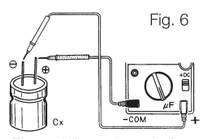
Switch position	Max. current consumption	Max. terminal inter-terminal voltage
×1	150 mA	3 V
×10	15 mA	3 V
×100	1.5 mA	3 V
×1 k	150 μA	3 V
×10 k	(60 μA)	12 V

The brackets mean the graduations need conversion.

● **Measurement of Capacitor Capacity (C)**

1. **Ranges of Use:** x1000 μF, x100 μF, x10 μF, x1 μF
2. **Measuring Terminals:** + and – COM
3. **Indicator Scale:**
Use red-colored scale ④ ... C (μF). The scale is from 0 to 1000 to ∞ and the unit is μF. In x1 μF range only read the indication directly, while in x10 μF range multiply the reading by 10, in x100 μF range multiply the reading by 100 and in x1000 μF range multiply it by 1000 to obtain true values.
4. Make full scale adjustment for each range as the measurement of capacitors also uses the resistance measuring range. (See the section for the measurement of resistance.)
In other words, short-circuit the + and – COM terminals before measuring, and align the needle to ∞ position on the extreme right of the scale by 0 Ω ADJ.

Fig. 6



5. Connect the capacitor Cx to be measured to the + and – COM terminals. At this time, take care of the polarity of Cx. Make sure that – COM terminal of the unit is connected to the positive terminals of Cx, as shown in Fig. 6. When there is fear that Cx may be charged, short-circuit both ends of Cx and discharge it before doing the measurement.
6. By the charging current flowing to Cx, the needle swings in the full- scale direction. But at a certain point, it begins to return toward zero. The value of Cx is this highest point indicated by the needle. (When the value of Cx is large, the swing of the needle is large and when the value is small, the swing is also small.)

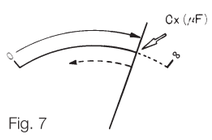
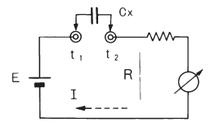


Fig. 7

7. If a capacitor measured once has to be measured again, discharge it before making the connection.

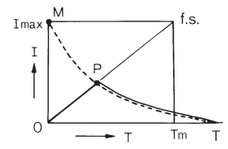
⚠ **Electric double layer capacitor can not be measured.**

MECHANISM OF CAPACITY MEASUREMENT BY THIS TESTER

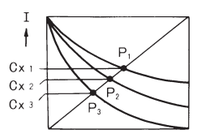


$I = Imax\ e^{-\frac{1}{CxR}T}$
$Imax = \frac{E}{R}$
E=Inside battery voltage (V DC)
R=Inside resistance of the device
Cx=Capacitor (μF)

1. When Cx is connected between measuring terminals T_1 and T_2. Imax, equivalent to E/R, flows at first as charging current I. (Imax is the same as the current that flows when T_1 and T_2 are shortened.) At this time the meter indication rises as Imax gives rotating power to the needle. (See the locus 0-p in the figure) But T minutes later, charging current I begins to drop because of Cx in a relation that is expressed by $I = max\ e^{-\frac{1}{CxR}T}$ Locus for the charging current is M-P. Tm is the time (in sec.) needed for reaching full scale.



2. Affected by the charging current I continuing to drop, the meter indication which has been rising from 0 to P turns downward at point P, heading in the direction of original point 0. (The thick line represents the locus of meter response.) If Cx = 0 Ω, the indication keeps dropping and reaches full scale Tm seconds later.
3. The position of point P is proportional to the size of Cx. Therefore, if points C that vary with Cx are marked in capacity values on the scale, Cx can be measured from the position where the meter turns downward.



● **Replacement of Battery**

1. When it becomes impossible to make zero ohm adjustment in x1 Ω range, the 1.5 V (R6) batteries contained inside have been exhausted. In this case, replace the batteries with two new ones.
2. When it becomes impossible to make zero ohm adjustment in x10 kΩ range only, replace the 9 V (6F22) battery with new one.
3. When replacing battery, loosen the 4 Ø x12 screw on the rear case, remove the case, and insert the new batteries correctly with the right polarity as shown in Fig. 8.

● **Replacement of Fuse**

1. Should a voltage higher than AC 100 V be applied to the tester by accident while the range is left turned to some current ranges, particularly 0.3 A range, or ohm x1 and x10 ranges, the inside fuse burns out.
2. When the fuse has burned out, the unit does not function. So replace it with the spare fuse (Ø 5x20 mm, 0.5 A/250 V) which is positioned as shown in Fig. 8.

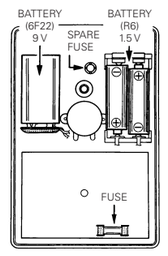
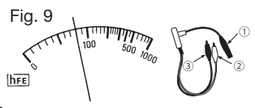


Fig. 8

MEASUREMENT OF TRANSISTORS (USE AS TRANSISTOR CHECKER)

With the attachment of the hFE connector (HFE-6T), this unit can measure the DC current amplification factor hFE (IC / IB) of transistors in the 0 to 1000 range.

Fig. 9



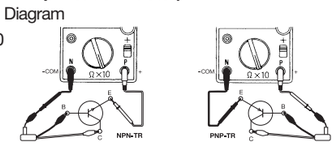
① Probe jack
② Transistor collector terminal connecting clip
③ Transistor base terminal connecting clip

● **Preparations before Measurement**
To measure transistors, this unit uses the resistance measuring range. Therefore, make full scale adjustment (0 Ω adjustment) of the indicator needle before doing the measurement. Just as before measuring resistance, turn the range to x10 Ω, short circuit the + and –COM terminals and align the needle to 0 Ω line with 0 Ω ADJ.

● **Measurement of hFE (DC Current Amplification Factor)**

1. Connection Diagram

Fig. 10



2. Then depending on the polarity of the transistor to be tested, insert the probe jack into the black lead if it is NPN transistor and into the red lead if it is PNP transistor.
3. There are two lead lines each with an alligator clip at the end. Connect the black clip to the base terminal of the transistor and the red clip to the collector terminal.
4. Then connect the test lead (the red lead if the transistor is NPN and the black lead if PNP) to the emitter terminal of the transistor to be tested. With this connection, the tester needle responds, indicating the IC/IB (hFE) value on the blue hFE scale ⑥.

● **Testing of LED-Light Emitting Diode (Application of Ohm Range)**

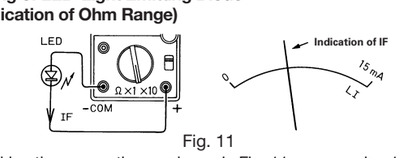


Fig. 11

After making the connection as shown in Fig. 11, measure in x1 Ω or x10 Ω ranges. When the LED is energized, it lights. The value of the current at this time, or IF, is indicated simultaneously on the LI scale of the unit.