sanwa

CX-506
MULTITESTER

INSTRUCTION MANUAL

CONTENTS

[1] READ FIRST: SAFETY INFORMATION

⚠WARNING

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

1. Never use meter on the electric circuit that exceed 3k VA.
2. Pay special attention when measuring the voltage of AC30 Vrms (42.4V peak) or DC60V 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. Be sure to disconnect the test pins from the circuit when changing the function or range.
10. Before starting measurement, make sure that the function and range are properly set in accordance with the measurement.
11. Never use meter with wet hands or in a damp environment.
12. Never use test leads other than the specified test leads.
13. Never open tester case except when replacing batteries or fuses. Do not attempt any alteration of original specifications.
14. To ensure safety and maintain accuracy, calibrate and check the meter at least once a year.
15. Indoor use.

High-Sensitivity (DC 50kΩ/V) Multitester
Model CX-506
(with the Function of C-Meter and Transistor Checker)

[2] MAIN FEATURES

1. Widened measuring ranges with the adoption of 26-ch switch

Newly-designed, 26-ch, one-control switch is adopted. The tester is effective and powerful over measurements, for it incorporates 39 ranges in total for general measurements plus extra ones.

2. Incorporates capacitor capacity meter (Transistor oscillator is built-in)

Capacity values in the range of 50 pF ~ 100 μF can be read directly in the two ranges. In addition to the capacitor capacity measurement, the tester is applicable also to testing cords and the oscillator is used as a signal source of signal tracer.

3. As a transitor checker

The h_{FE} (DC current amplification factor I_C/I_B) of PNP and NPN type transistors can be measured in the range of 0 ~ 1000.

4. Continuity checking LED is incorporated in the Ω x 1 range

When resistance is measured in the Ω x 1 range, LED in the meter lights if measured target is in a continuity condition. Thus, continuity can be confirmed visually.

Instantaneous judgement can be made for simple continuity checks.

5. Adoption of high-sensitivity 15.6 μA meter ····· DC 50kΩ/V

There is little measuring loss, for the meter is a high-sensitivity of DC 50 kΩ/V and a high impedance type, so the tester is most suitable for the measurement of transistor and digital circuits.

6. With the polarity reversal switch

Even in the resistance measuring circuit, the polarity reversal switch that controls four circuits is incorporated. As polarities can be reversed not only in the measurment of ±DC but also in the measurement of resistance, the tester is convenient for measuring transistor circuits and polarized resistors (diodes, etc.).

7. With OUTPUT (Series capacitor terminal)

As only AC signal element can be detected in DC • AC mixed circuit, the tester is quite effective in the measurement of TV audio and other electronic circuits.

8. Safety is considered into the structure of the measuring terminals and test lead plugs.

The measuring terminals and test lead plugs are guarded with insulating materials, so no metal part is exposed. Enough consideration is given against the safety of persons performing measurements.

2–1 Expansion of Measuring Functions with the Use of Optional Accessories

As a DC high voltmeter (DCHV)

With the use of DC high voltage probe (HV-50), the tester becomes DC high voltmeter and can measure DC high voltage of TV CRT in the range of 0 ~ 30 kV.

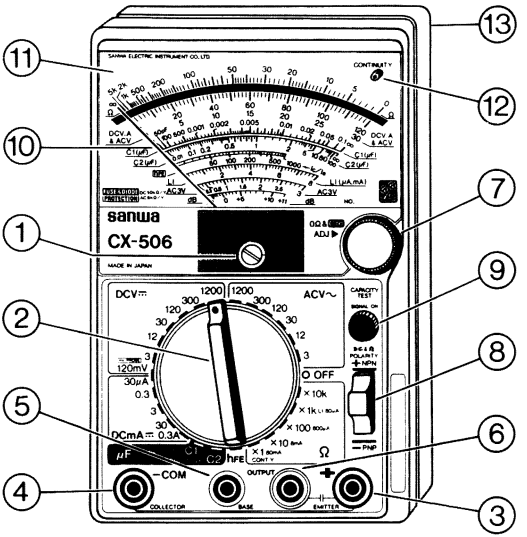
2–2 Measuring Range and Performance

Measuring	Measuring Range and Performance	Accuracy	Remarks
± DCV	± 0–120mV–3V–12V–30V–120V –300V–1200V– (30kV) (with optional probe for 30kV only)	± 2.5% max. scale value	Input impedance 50kΩ/V for 1200V only
± DCA	± 0–30μA–0.3mA–3mA–30mA–0.3A (30μA range is common with DC 120mV range)	± 2.5% max. scale value	Terminal voltage drop 120mV 300mV for 0.3A

Measuring	Measuring Range and Perforamance	Accuracy	Remarks
ACV	0–3V–12V–30V–120V–300V–1200V 30 Hz ~ 100 kHz ± 1 dB 40 Hz ~ 30 kHz ± 3 % } 12V or less	± 3% max. scale value ± 4% 12V or less	Input impedance 8kΩ/V
AF output (dB)	−10 dB ~ +11 dB (AC 3V range) ~ +63 dB 0 dB = 0.775V (1mW) In 600Ω impedance circuit	Same as ACV	Same as ACV
Resistance (Ω) With continuity indicating LED	X1 : 0 ~ 1 Ω ~ 5kΩ center 38 Ω X10 : 0 ~ 10 Ω ~ 50kΩ center 380 Ω X100: 0 ~ 100Ω ~ 500kΩ center 3.8kΩ X1k : 0 ~ 1k ~ 5MΩ center 38kΩ X10k: 0 ~ 10k ~ 50MΩ center 380kΩ Continuity indicating LED: X1 range (Emitting light at 10Ω or less)	± 3% scale length	Internal batteries 1.5V (R6) X2 9 V (6F22) X1
Capacity (C)	C1 range ..... 50pF ~ 0.1μF C2 range ..... 0.01μF ~ 100μF Output impedance C1 .. about 14kΩ C2 .. about 100Ω	± 6% scale length	Oscillator Common with 1.5V X 2 batteries for measurement of Ω
Terminal-to-terminal (LI)	0 – 80μA .... Ω X 1k range 0 – 800μA .... Ω X 100 range 0 – 8mA .... Ω X 10 range 0 – 80mA .... Ω X 1 range	± 5% scale length	Terminal current between + and −COM while measuring
Transistor DC current amp. factor (h_{FE})	Transistor h_{FE} 0 ~ 1000 (Ic/Ib)	± 3% scale length	

- **Size • Weight:** 165 X 106 X 44 mm About 350 g
- **Accessories:** Instruction manual, one pair of test leads (TL-61), fuse 5mm dia × 20mm (250V, 0.5A), spare fuse of the same rating, 2 pcs. of alligator clip lead line (for measuring C and TR). CL-506
- **Optional accessories:**
  DC 30 kV probe (HV-50), and carrying case (C-CA)

[3] LAYOUT AND THE NAME OF EACH PART



① Indicator zero corrector
② Range selector switch knob
③ **Measuring terminal +** (Common with emitter connecting terminal for TR check)
④ **Measuring terminal −COM** (Common with collector connecting terminal for TR check)
⑤ Base connecting terminal for TR check
⑥ OUTPUT terminal (Series capacitor terminal)
⑦ Fullscale adjusting knob (0Ω and C ∞ corrector)
⑧ Polarity reversal switch knob (±DC and Ω)
⑨ Capacitor capacity measuring push-button switch knob
⑩ Indicator pointer
⑪ Indicator scale plate
⑫ Continuity indicating LED (CONTINUITY)
⑬ Rear case

[4] PRECAUTIONS PRIOR TO USAGE

1. Confirmation of the zero position of the indicator pointer

If the indicator pointer is out of the zero line, the leftmost line of the scale plate, turn the indicator zero corrector to have the indicator pointer align with the zero line.

2. Be sure to plug the test leads firmly.

Attached test leads are designed for safety first. Be sure to plug the test leads into the terminals completely and firmly.

3. Make sure the measuring range well and select an appropriate range.

Prior to measurement, select the range selector switch position that is suitable for measured target. If measured value is unknown, set the range selector switch knob to the highest range and gradually lower the measuring range until it is suitable for measured target value. Such consideration is required for safety.
Enough care must be taken especially when such high power as AC commercial power source voltage (AC 100V or higher) is measured. Refer to page 44.

4. Make sure the internal fuse.

The tester fails to operate if the internal fuse is blown due to erroneous operation. Refer to page 49 for the rating and replacement of the fuse.

5. Be careful while the tester is put away.

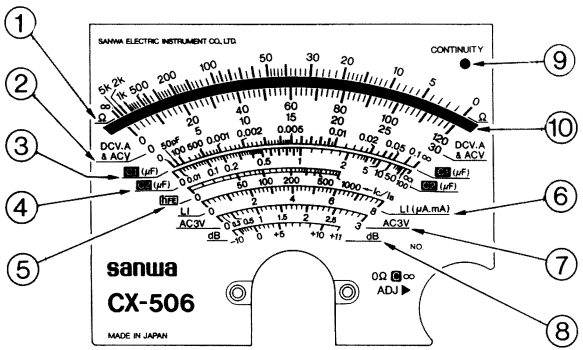
Do not leave the tester for a long time in a place where much shock or vibration is given, in the direct rays of the sun, or in a high temperature or humidity.

6. About the indicator protection cover

Do not wipe the indicator cover with a dry cloth. The cover is coated with antistatic solvent. When the antistatic effect is weakened after a long use, wipe the cover surface with soap water containing antistatic solvent as a stopgap measure.

[5] HOW TO USE THE TESTER

5–1 Indicator Scale Plate (Meter Scale)



Explanations about each scale

① Resistance (Ω) scale . . . . . Blue
② DCV, DCA (DCV, A) and
ACV (AC12V or higher) scale . . . . . Black
③ Capacitor scale exclusive for C1 range . . . . . Red
④ Capacitor scale exclusive for C2 range . . . . . Red
⑤ Transistor DC current amplification factor
(h_{FE}) scale . . . . . Blue
⑥ Ω range t. to t. current (LI) scale . . . . . Black
⑦ AC 3V exclusive (AC 3V) scale . . . . . Black
⑧ Decibel (dB) scale . . . . . Red
⑨ Continuity indicating LED
⑩ Mirror . . . . . Aimed at obtaining indicated value with little error by putting together the line of vision, the pointer, and the pointer that is reflected to the mirror.

5–2 Measuring DCV (±DCV)

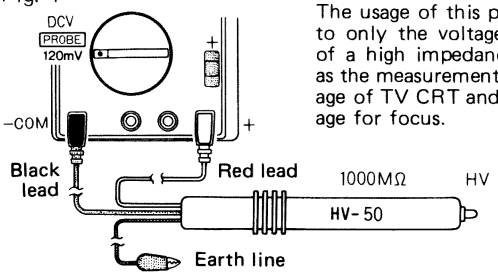
1. **Using purposes:** Measuring the voltage of various batteries and electric appliances, the bias voltage of IC and TR circuits, and other DC voltages.
2. **Measuring ranges:** DCV 120 mV ~ 3V ~ 12V ~ 30V ~ 120V ~ 300V ~ 1200V
3. **Measuring terminals:** + and −COM are used. Generally the red test lead is connected to + terminal and the black test lead to −COM terminal.
4. **Indicator scale:** Use the scale ② . How to read out the scale in each range and how to multiply indicated value are shown in the following table.

Measuring range	Switch position	Scale to be read out	Muliplying factor
0 ~ 120mV	DCV 120mV	DCV.A & ACV 0 ~ 120	X1 Read directly in mV unit
0 ~ 3V	〃 3	〃 0 ~ 30	X0.1 Read in V unit
0 ~ 12V	〃 12	〃 0 ~ 120	X0.1 Read in V unit
0 ~ 30V	〃 30	〃 0 ~ 30	X1 Read directly in V unit
0 ~ 120V	〃 120	〃 0 ~ 120	X1 Read directly in V unit
0 ~ 300V	〃 300	〃 0 ~ 30	X10 Read in V unit
0 ~ 1200V	〃 1200	〃 0 ~ 120	X10 Read in V unit
0 ~ 30kV	DCV 120mV PROBE	〃 0 ~ 30	X1 Read directly in kV unit

5. Perform measurement with the range selector switch knob set to a necessary range within DCV range. Generally measurement is performed with the black test lead fixed to the negative electric potential point (earth line) and the red test lead connected to each test point. However, take care of the polarities when measuring voltage drop in the both ends of resistor, negative voltage of oscillation circuit, and transistor circuit.

At the time of general measurements, the polarity reversal switch knob is left set to the + side as a rule, but it is convenient to set it to the – side when measuring the negative voltage circuit mentioned above.

6. Connect the optional HV probe to the tester when measuring other high voltages for TV, etc. as shown in Fig. 1



The usage of this probe is limited to only the voltage measurement of a high impedance circuit such as the measurement of anode voltage of TV CRT and of a high voltage for focus.

5–3 Measuring DC Current (DCμA, mA, A)

1. **Using purposes:** Measuring the consumption current of electrical appliances that work on DC, the operation current of TR • IC circuits, or the bias current.
2. **Measuring ranges:** DCmA 30μA ~ 0.3mA ~ 3mA ~ 30mA ~ 0.3A
3. **Measuring terminals:** + and –COM are used.
4. **Indicator scale:** Use the scale ② . How to read out the scale in each range and how to obtain true values after multiplying indicated values are shown in the following table.

Measuring range	Switch position	Scale to be read out	Multiplying factor
0 ~ 30μA	DCmA 30μA	DCV.A & ACV 0 ~ 30	X1 Read directly in μA unit
0 ~ 0.3mA	" 0.3	" 0 ~ 30	X0.01 Read in mA unit
0 ~ 3mA	" 3	" 0 ~ 30	X0.1 Read in mA unit
0 ~ 30mA	" 30	" 0 ~ 30	X1 Read directly in mA unit
0 ~ 0.3A	" 0.3A	" 0 ~ 30	X0.01 Read in A unit X10 Read in mA unit

5. The 30μA range is common with the DC 120mV range in the range selector switch knob position. For other ranges, set the range selector switch knob to a necessary range in DCmA ranges and perform measurement while considering the polarities.

6. The polarity reversal switch is usually set to the – side. When the pointer is swung to the – side (reverse swinging), it is set to the – side.

Cautions: Be sure to connect measured power source in series with load when current is measured. Take care not to apply any voltage to the tester.

5–4 Measuring ACV

1. **Using purposes:** Measuring the voltage of electric lines wired in houses and factories (commercial line voltage), AC power source circuit of electric appliances that use commercial line voltage, each tap voltage of power source transformers, and the voltage of signal from 30 Hz to 100 Hz.
2. **Measuring ranges:** ACV 3V ~ 12V ~ 30V ~ 120V ~ 300V ~ 1200V
3. **Measuring terminals:** + and -COM are used. The color distinction of test leads is not specially designated.

4. **The position of the polarity reversal switch knob:** The switch knob is set to + side.
5. **Indicator scale:** Use the scale ② for 12V or higher and the exclusive scale ⑦ for 3V only.

How to read out the scale in each range and how to obtain true value after multiplying indicated value are shown in the following table.

Measuring range	Switch position	Scale to be read out	Multiplying factor
0 ~ 3	ACV 3	AC3V 0 ~ 3	X1 Read V directly
0 ~ 12	〃 12	DCV.A & ACV 0 ~ 120	X0.1 Read V
0 ~ 30	〃 30	〃 0 ~ 30	X1 Read V directly
0 ~ 120	〃 120	〃 0 ~ 120	X1 Read V directly
0 ~ 300	〃 300	〃 0 ~ 30	X10 Read V
0 ~ 1200	〃 1200	〃 0 ~ 120	X10 Read V

6. Measurement should be performed with the range selector switch knob set to a necessary range of ACV range. **Absolutely do not measure ACV with the switch knob left set to DCmA range or Ω range.**

7. **Precautions when high voltages of 200V or higher are measured.**

① Make sure if the range selector switch is correctly set to high voltage ranges of AC 300V or higher.
② Connect the tester to the measured circuit after turning off its power source switch.
③ Turn on the power source switch and read measured value. At this time, never touch the tester, the connecting cord, and the measured circuit.
④ After finishing measurement, detach the tester from the measured circuit after turning off the power source switch.

5–5 Measuring AF Output (dB)

The ratio of output to input in the amplifier or transmission circuit is shown in logarithm. This is because the human ears are sensitively logarithmically proportioned and decibel (dB) is used as a unit.
When the load impedance of circuit is fixed, power can be compared by simply showing the ratio of voltage (current) in dB unit. According to the dB scale of the tester, 0 dB means when 1mW power is consumed in 600Ω impedance circuit. The scale is graduated on the basis of 0 dB = 0.775V.
As a result, output in 600Ω impedance circuit can be read directly in dB value. However, when impedance in measured circuit varies, measured dB value is nothing but a simple ACV value corresponding with it. (Indicator scale: dB scale is used.)

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

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

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

5–6 ACV Measurement with OUTPUT Terminal (Measurement of low frequency output)

Series capacitor is connected to OUTPUT terminal. Use this teminal for TV or audio circuits where DC and AC elements are mixed, and DC element will be cut and only AC signal element alone can be measured.
The way of measurement is same as that in ACV except that the positive side test lead is connected to OUTPUT terminal. Therefore, OUTPUT and −COM terminals are used in this case.

5–7 Measuring Resistance (Ω)

1. **Using purposes:** Measuring the resistance value of resistors, continuity and short-circuit (0Ω) of circuits, open-wire (∞ Ω), and semi-conductors.
2. **Measuring ranges:** Ω X1 ~ X10 ~ X100 ~ X1k ~ X10k (1Ω ~ 50MΩ)
3. **Measuring terminals:** + and –COM are used.
4. **Indicator scale:** Use the scale ①. Read out figures between 0 and 5k in Ω unit.

The figures on the scale are values in X1, so they can be read directly in X1 range. In other ranges, calculate true resistance values by multiplying the figures according to the multiplification factors shown in each range.
(Refer to the article Resistance (Ω) in Measuring Range and Performance, page 35.)

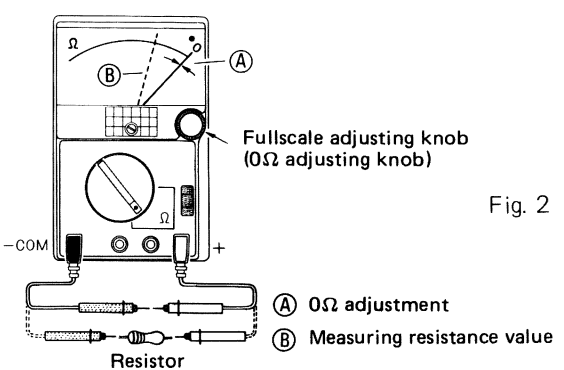


Fig. 2

5. **0Ω adjustment (0Ω ADJ):** 0Ω adjustment, in other words fullscale adjustment, must be done prior to using the tester. Short + and –COM terminals in such a condition

as is shown in Fig. 2 Ⓐ, turn the 0Ω adjusting knob (0Ω ADJ), and align the indicator pointer with the 0Ω line, the rightmost Ω scale. Do measurement after finishing this adjustment. If this adjustment is down whenever ranges are switched, more correct indicated values can be obtained.

6. Be sure to turn off the power source switch of measured circuit when the resistance in the circuit is measured. **Take enough care not to apply any voltage to X1 or X10 range during measurement.**

7. **Continuity check with an LED:** When measured resistance value is less than about 10Ω in X1 range, the LED for CONTINUITY indication right above on the indicator lights. (Luminous intensity varies according to measured resistance values.)
For continuity or open-wire test, the LED responds more quickly than the indicator pointer, more quietly than the buzzer, and is easier-to-catch visually.

5–8 Terminal-to-Terminal Current (LI)

Terminal-to-terminal current is the current that runs between −COM and + terminals while measured object is being measured in Ω range. As there may be some cases in which the impedance of measured objects, especially semi-conductors, varies according to current value that is run or something abnormal occurs due to the self-heating of measured object, please understand the relations well in each Ω range and do measurements.

The maximum values are printed alongside each Ω range. Use the indicator scale ⑥. Value varies according to each range. Read out value after conversion of multiplication factors and units. (X1 range ~ X1k range)

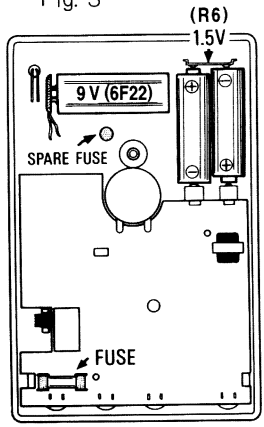
In X10k range alone, the maximum value is about 32μA. Read out value after making the scale value four times as large as it.

5–9 Light Emitting Diode (LED) Test

Measurement is done in Ω X1 or Ω X10 range. If continuity of LED is normal, tested LED lights. The current value then can be obtained on the LI scale.

BATTERY REPLACEMNT

Fig. 3



The internal batteries, 1.5V (R6), have worn out if 0Ω adjustment in X1Ω range or fullscale adjustment (C ∞ ADJ) in capacitor C2 range is impossible. Replace them with two fresh ones.

If 0Ω adjustment in X10kΩ range alone is impossible, replace the internal 9V (6F22) battery with a new one.

When batteries are replaced, remove the screw 4mm dia. X12mm of the rear case, detach the case, and insert fresh batteries as shown in Fig. 3, taking note of the polarities.

FUSE REPLACEMENT

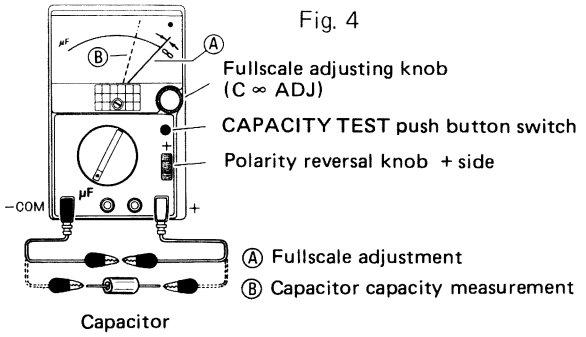
The tester does not work at all if the internal fuse is blown by erroneous operation. In this case, replace it with the spare fuse (5mm dia. X 20mm 250V, 0.5A). Its location is shown in Fig. 3.

5–10 Measuring Capacity (C)

1. **Using purposes:** Measuring capacitor capacity, testing cords, and other applications.
2. **Measuring ranges:** μF C1 · · · · · 50pF ~ 0.1μF
   C2 · · · · 0.01μF ~ 100μF
3. **Measuring terminals:** + and −COM are used.
   Use the test leads or alligator clipped lead wire according to measured objects.
4. **Indicator scale:** Scale ③ . . . . . C1 range
   Scale ④ . . . . . C2 range

They are exclusive scales, so read scale values that correspond with the ranges directly.

5. **Measuring general capacitors:**



① Fullscale adjustment (C ∞ ADJ)

Fullscale adjustment must be done prior to using the tester. Make preparation in such condition as is shown Fig. 4 Ⓐ and depress CAPACITY TEST push button switch.

The indicator pointer then moves toward the right side. Turn the fullscale adjusting knob while keeping depressing the push button switch and align the indicator pointer with ∞ position of C1 or C2 scale.
This operation must be done in both C1 and C2. When the battery has worn out, this adjustment in C2 range becomes impossible. In this case, refer to the article "BATTERY REPLACEMENT".
(The difference between the fullscale position of C1 range and that of C2 range is about 10 to 15% of the scale length. This is, however, not abnormal.)

② **Measurement**

When the fullscale adjustment is finished, connect measured capacitor as shown in Fig. 4 Ⓑ, depress CAPACITY TEST push button switch, and read out measured value on the exclusive scale that corresponds with C1 or C2 range.

6. Application of C measurement

- **Testing cords**

Continuity or open-wire check of parallel cords as shown in Fig. 5 can be done by measuring capacitance between the core wires (conductors) as a comparison test. The longer the cords are, the easier the detection of open-wire on the way becomes. As the capacity value lost by leakage between the wires is proportioned to the length of the wires, it is useful in measuring or adjusting the length by measured C value.

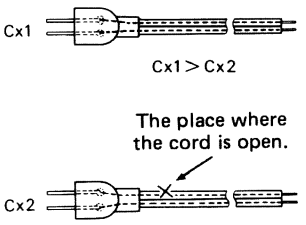


Fig. 5

5–11 Measuring Transistors

1. **Connection of measuring lead wires:**

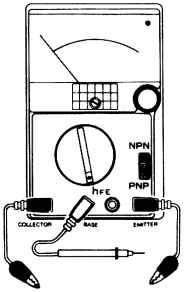


Fig. 6

Connection is made as in Fig. 6. Set the range selector switch knob to h_{FE} position. Then, set the polarity reversal switch knob to either NPN or PNP side according to the transistor (hereinafter simply called TR) to be measured.

2. **Fullscale adjustment (0Ω ADJ):**

The fullscale adjustment must be done prior to measurement. Do the same operation as is done in 0Ω adjustment of resistance measurement. Short the lead wires from + (E) and –COM (C) terminals and turn 0Ω ADJ knob to have the indicator pointer align with the fullscale position.

3. **Measuring I_{CEO} (leakage current):**

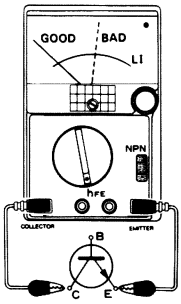


Fig. 7

As in Fig. 7 (the connection of NPN transistor) connect TR emitter and TR collector to each measuring terminal. In this condition, base open collector current, namely I_{CEO} is measured. Except large type TR for power, the I_{CEO} of normal silicon TR is in almost a zero condition and the indicator pointer doesn't respond at all. On the contrary, if the internal short-circuit or the increase of leakage current exists in measured TR, a large value is indicated (the indication of LI value is large) and such measured TR is considered abnormal. The full-scale of LI value is 8mA.

4. **Measuring DC current amplification factor (h_{FE}):**

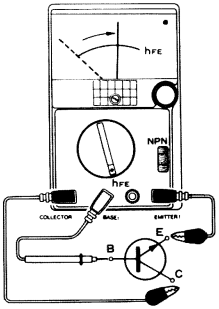


Fig. 8

Connect TR as in Fig. 8. If measured TR is normal the indicator pointer swings to the right side and indicates a certain value. Read it out on the scale ⑤, h_{FE} 0 ~ 1000. This is h_{FE} (I_C/I_B) value.

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④ 02.02 Ⓜ