HIOKI

INSTRUCTION MANUAL

3007

MULTITESTER

HIOKI E.E. CORPORATION

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3007E3-75B-005T Printed in Jaqan

⚠ Safety Note

This multimeter cannot be used with any power line of greater than 250V. Such power lines may involve spikes of several times the rated voltage. For such power lines, use a multimeter with an overcurrent protector for preventing short-circuit accidents.
Hioki's 3008 multimeter is recommended.

Note; power lines include lines supplying power to motors and industrial equipment in factories and office buildings, but do not include domestic in-house lines, which are protected with circuit breakers or the like.

⚠ WARNING

This instrument is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. , this manual must be read carefully and completely before making any measurement. Failure to follow directions can result in a serious or fatal accident.

CONTENTS

OUTLINE

The 3007 tester is a manifestation of our thinking in terms of providing testers that are easy to use in compact, and to equip this model for top performance in electronics work the ranges provided include hFE., LI and LV ranges, etc, and its functional range is further widened by adding optional accessories, including the clamp-on probe, temperature probe and others.

In producing this tester, the HIOKI Company has applied know-how acquired over many years in the tester manufacturing field along with new technology in carrying on the tester revolution represented in its new 3000 series.

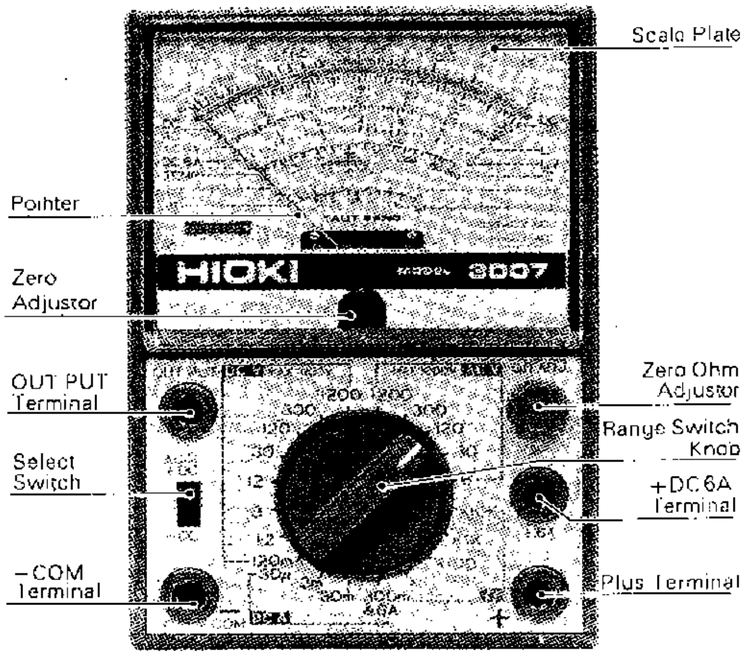
In both AC and DC work a ±3% accuracy is guaranteed, particular attention has been paid to the safety problem and in this connection no metal has been left exposed on the front of the tester, the possibility of damage greatly reduced with effective meter and circuit protection. Until now, breakability had been almost a synonym for meters but all that has changed with the development of HIOKI's core magnet TAUT BAND meter, bringing a new concept in meters so that original precision, safety and durability are maintained over a long and useful tester life.

1. FEATURES

- At 33.3 kΩ on DC.V thery is plenty of input resistance for electronic circuit work.
- The ±3% accuracy on both AC and DC is a whole 1% better than JIS requirements.
- Convenient LI, LV scale for semiconductor testing.
- By having the HIOKI developed and proven core magnet TAUT BAND meter, friction is minimized, shock resistnace improved and the effect of external magnetic fields is no longer a problem, so that this can be described as a high performance meter with outstanding scale characteristics.
- It is provided with a 120mV DC range and stable readings are obtained by combination with the temperature compensating circuit.
- There is an OUTPUT terminal and DC ± polarity selector switch.
- A glass covered fuse provides circuit protection and there is also a meter overload protection circuit.
- You may care to order one or more of the wide range of quality accessories to better adapt the tester to your purpose. For example.
  (1) Amperage readings up to 300A AC can be obtained without interrupting the line but simply by clamping the 9004 Clamp-on Probe over it.
  (2) The 9012 High Voltage Probe gives readings up to 30kV DC.

(3) DC Amplification measurement (h_{FE} lead)
(4) Temperature measurement (9021 temperature probe)

2. NAMES OF PARTS



3. SPECIFICATIONS

- Reading Ranges

DC Voltage (DC V)	: 120mV, 1.2V, 3V, 12V, 30V, 120V, 300V and 1200V (MAX. 1000V)
AC Voltage (AC V)	: 6V, 30V, 120V, 300V and 1200V (MAX. 1000V)
DC Current (DC A)	: 30μA, 3mA, 30mA, 300mA and 6A
Resistance (Ω)	: 0~3kΩ (center 25Ω) x1, x100, x1k and x10k
Decibels	: −10dB~+17dB and +15dB~+31dB (on 600 ohm line)

- Specifications and Accuracy

DC Voltage

Input Resistance : 33.3kΩ/V (1200V:10kΩ/V)

Accuracy : Not over ±3% of full scale value

AC Voltage

Input Resistance : 10kΩ/V

Accuracy : Not over ±3% of full scale value

DC Current

Voltage Drop : 120mV

Accuracy : Not over ±3% of full scale value

Resistance

Batteries Used : SUM-3 type (1.5V), 006p

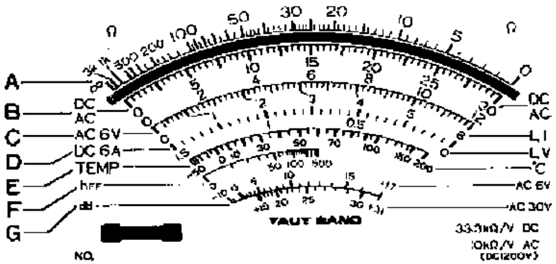
Accuracy : Not over ±3% of scale length

Decibels

Accuracy : Not over ±4% of scale length

- **Protective Circuits** : Circuit protection by means of glass tube fuse
  Varister protection against meter overload
- **Accessory Circuits** : OUTPUT terminal, DC ± polarity selector switch, temperature compensating circuit, +DC 6A terminal
- **Accessories** : One set of test leads, one glass tube fuse (0.5A, 250V)
- **Dimensions and Weight**
  : 133H×93W×49Dmm
  approx. 330g.

4. HOW TO READ THE SCALE



Range to measure		Scale to use	Multiplying figure	Unit
DC V	120mV	B (12)	×10	mV
	1.2V	B (12)	×0.1	V
	3V	B (30)	×0.1	V
	12V	B (12)	×1	V
	30V	B (30)	×1	V
	120V	B (12)	×10	V
	300V	B (30)	×10	V
	1200V	B (12)	×100	V
DC A	30μA	B (30)	×1	μA
	3mA	B (30)	×0.1	mA
	30mA	B (30)	×1	mA
	300mA	B (30)	×10	mA
	6A	C (6)	×1	A
AC V	6V	C (6)	×1	V
	30V	B (30)	×1	V
	120V	B (12)	×10	V
	300V	B (30)	×10	V
	1200V	B (12)	×100	V
Ω	R×1	A	×1	Ω
	R×100	A	×100	Ω
	R×1k	A	×1	kΩ
	R×10k	A	×10	kΩ
TEMP	R×100	E	×1	℃
L I	R×1	D (6)	×10	mA
	R×100	D (6)	×100	μA
	R×1k	D (6	×10	μA
L V	R×1		×1	V
	R×100	〃	×1	V
	R×1k	〃	×1	V
h_{FE}	R×100	F(0～500)	×1	
dB	AC6V	G(−10～+17)	×1	dB
	AC30V	G(+15～+31)	×1	dB
	AC120VUP	G(+15～+31)		dB

5. GENERAL CAUTIONS CONCERNING USE

- **Check the meter zero position.**

  After the tester has been in use for a long time, or because of the position in which it is held when in use, there will be a tendency for zero to be no longer indicated exactly and this is corrected by means of the zero position adjuster on the middle of the meter. No matter how much care is taken in reading the meter, if zero is not indicated exactly the meter reading will be incorrect the degree of error being equivalent to the distance that the pointer is away from zero when not actually in process of taking a reading.

- **Make sure that the appropriate range has been selected for the reading to be taken.**

  The most common cause of damage to testers is using them in, for example, attempting to take a power voltage reading when the resistance or current reading range has been selected, and so on, the user being unaware at the time that the wrong range is in use because he has not taken care to check the range selected before use.

- **Remove the test leads from the circuit being tested before turning the range selector.**
- **If the tester fails to function altogether, look at the glass covered fuse and if it is blown the function will fail to function on any range.**

If the resistance meter of the tester (R x 1k, x 100, etc.) is selected and the test lead tips shorted but the meter pointer fails to move at all, replace the fuse and try once more.

- **Do not use the tester to test electrical equipment where the voltage involved is over 200V.**

  Although this meter is fitted with a fuse capable of withstanding 250V, 100A, if inadvertently used where the commercial power of the equipment is, for example 400V or 600V, the resultant overload will be more than the use can withstand and there is always the danger of shock. For this reason it is advisable to avoid using the tester on electrical equipment in factories. The range must always be confirmed and the tester used carefully.

- **Avoid using the tester on the high frequency part of electrical equipment having high output and high frequency voltage.**

  Voltage resistance is down to only a fraction of normal where high frequency is involved and therefore there is always the danger of electric shock.

- **Do not keep the tester is a hot or humid place or where sunlight strikes it.**

  Even the case of the tester has been known to become distorted when left in a closed motor vehicle on a hot day.

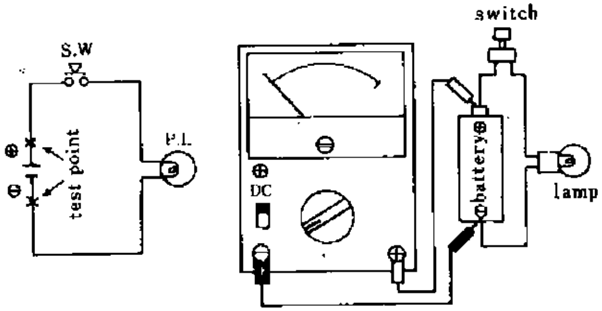
6. HOW TO TAKE READINGS

6-1 Measuring DC Voltage (DC V)

- Plug the black test lead into the ⊖ COM terminal and the red lead into the ⊕ terminal.
- Turn the selector switch to [+ DC·Ω / AC]
- From among the various test ranges (120mV ~ 1200V), select that most suitable for the test to be done by means of the range selector knob and if the user has no idea at all how great the voltage is, start with the 1200V range.
- Contact the ⊖ side of the object being tested with the tip of the black lead and the ⊕, side with the red lead (parallel connection with the tester).
- If the reading obtained is quite small on the range used then select a lower range, and vice versa.

  Note: The closer the reading is to the maximum on the range, the smaller will be any error in that reading and this should be kept in mind when selecting the range for use.
- If the meter pointer deflects in the wrong direction it will be necessary to reverse the positions in which the test leads are connected or to turn the selector switch to −DC and take another reading. Incidentally, because this switch makes it possible to reverse polarity without reversing the lead connection, it proves very convenient in such work as the adjustment of FM sets, etc.

*See section 6 on meter reading.



(1) Measuring DC voltage

6-2 Measuring DC Current (DCmA)

(1) Current below 300mADC

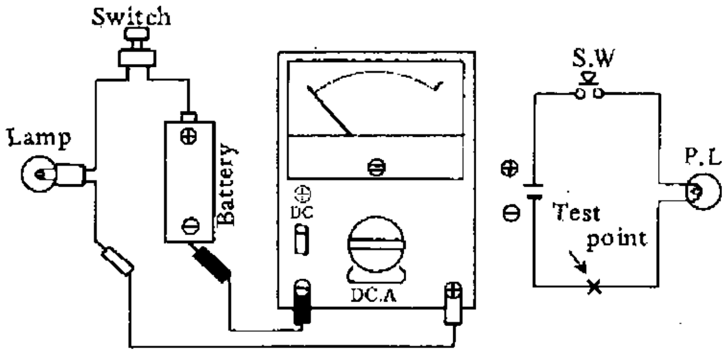
- Plug the black test lead into the ⊖COM terminal and the red lead into the ⊕ terminal.
- Turn the selector switch to [+ DC·Ω / AC]
- From among the various test ranges (30μA ~ 300mA), select that most suitable for the test to be done and, if it is difficult to tell how great the figure may be, start with the 300mA range.
- Disconnect the circuit to be tested (i.e. turn the power off) and make a series connection with the tester by contacting the ⊕ side with the red test lead and the ⊖ side with the black.
- If the reading obtained is quite small on the range used then select a lower range and if it is too great to be shown on the range, select a higher range.

  Note: Make sure that power is disconnected before changing the range because if it remains on for a moment the tester circuit is the meter only, meter overload may occur and result in damage to the instrument.
- On completing the test, remove the test leads before switching on the power again.

  *See section 6 on meter reading.

(2) Current up to 6ADC

Insert the black test lead into the ⊖COM terminal and the red one into the +6A terminal. Set the range switch knob to DC 300mA & 6A range. Measurement and reading are to be done in the same way as for DC mA.



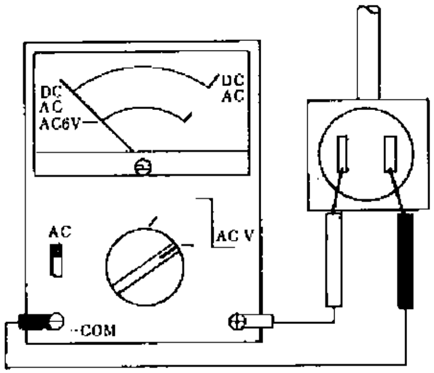
Measuring DC Current

6-3 Measuring AC Voltage (AC V)

- Plug the black test lead into the ⊖COM terminal and the red lead into the ⊕ terminal.
- Turn the selector switch to [+ DC·Ω / AC]

- From among the various test ranges (6V ~ 1200V) select that most suitable for the test to be done and if it is difficult to tell how great the figure may be, start with the 1200V range.
- Connect the object to be tested to the tester in parallel.

  Note: Unlike DC, in the case of AC the meter pointer will not deflect in the wrong direction, but the red lead of the tester must be connected to the AC high potential side and the black lead to the low potential side (chassis or ⊖COM line) and this connecting method followed as standard practice.
- If the reading obtained on the range selected is quite small, select a lower range and if it is too great to be shown on the range, select a higher range.
- See section 6 on meter reading.

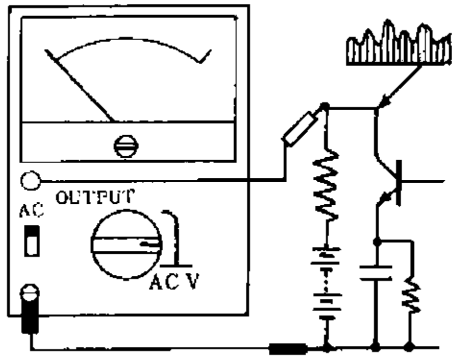


Measuring AC voltage

6-4 Using the OUTPUT terminal to take readings

A DC blocking condenser is directly connected to this terminal so that it is used to select and measure AC voltage only when testing circuits (e.g. collector voltage of power transistors and so on) in which there are both AC and DC.

- Plug the red test lead into the OUTPUT terminal and the proceed as in the case of AC V readings.
- In this case, because of the frequency characteristics of the 0.1μF DC blocking condenser, the lower the range on which readings are taken and the lower the frequency involved in the test, the greater the amount of error there will be. (At 80Hz there will be about a 5% error when taking OUTPUT readings on the 6V AC range.)



OUTPUT terminal test

6-5 Measuring Decibels (dB)

Since the output of amplifiers, etc., is expressed in decibels (dB), this tester is equipped with a dB scale. The test procedure is similar to that for ordinary AC voltage and to AC voltage tests when the OUTPUT terminal is used, in fact the only difference is that the result is read off the dB scale. Readings for the various ranges are obtained as follows:

On the 6V AC range, take the scale readings as they are
(−10~+17dB)

On the 30V AC range, take the scale readings as they are
(+15~+31dB)

On the 12V AC range, and 12 to the scale reading (+15~+31dB)

On the 300V AC range, and 20 to the scale reading (+15~+31dB)

On the 1200V AC range, and 32 to the scale reading (+15~+31dB) dB is a unit of measure often used to express the characteristics of signal transmitting circuits of amplifiers and filters, etc. The logarithm of the ratio of input to output being found and expressed as the number of decibles.

There are many reasons why dB is a very convenient unit of measure and among them the fact that the expression approaches the human senses and also when amplifier circuits are connected in a

number of stages the characteristics of the whole can be expressed as the total for all the stages, and so on.

Since it is very important, in the case of electric circuits, to know how the power is transmitted and how much is taken as output, the number of decibels is fixed by taking 1mW of electric power as the reference value. Input and output terminal impedance of amplifiers, etc., is 600Ω (In radio equipment, etc., it is 75Ω or 50Ω) and under these conditions the equations used in finding dB from output power and output voltage are:

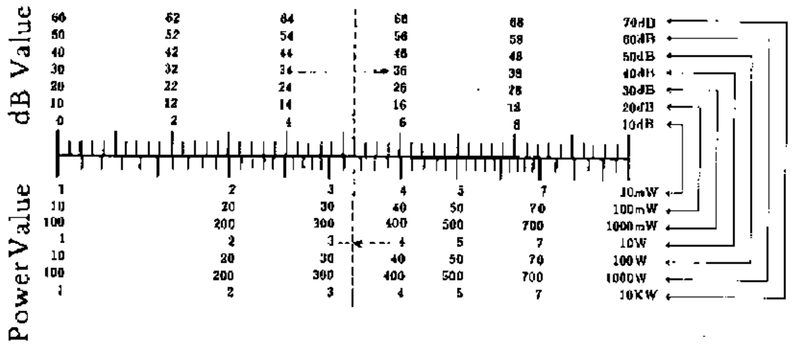
Output power (P): $dB = 10 \log P(mW)$

Output voltage (E): $dB = 20 \log \frac{E(V)}{0.775(V)}$

Because here the number of decibels at 600Ω impedance is being measured, even if this tester is used in an attempt to find the number of decibels when the impedance figure is other than 600Ω, a power figure cannot be obtained (but it does function as a level meter with 0.775V as the reference) so that it is then necessary to correct the decibel reading obtained by adding the appropriate figure in the table in order to bring it to the dB value for the impedance figure found.

Load Resistance (Ω)	3	4	8	16	50	75	150	300
Amount Added (dB)	20.3	21.8	18.8	15.7	10.8	9.03	6.02	3.01
Load Resistance (Ω)	1 k	2.5 k	5 k	7 k	10 k	12 k	30 k	50 k
Amount Added (dB)	−2.22	−6.20	−9.21	−10.7	−12.2	−13.0	−17.0	−19.2

It is possible to change the dB values so found into power (W) by using the kind f scale shown in the sketch below. For example, 35.2 dB,



becomes 3.3W

[Exercise]

The outputof a speaker having 4Ω impedance was shown as 13.4dB on the tester. It is now necessary to fiind dB and W at 4Ω.

The chart shows 21.8dB as the correcting value in the case of 4Ω, so that the dB value when impedance is M would be the meter reading (13.4) plus 21.8 which is 35.22dB. The scale is then used to convert this to watts and the answer is 3.3W.

6-6 Measuring Resistance (Ω)

- Plug the black test lead into the ⊖COM terminal and the red test lead into thhe ⊕ terminal.
- Turn the selector switch to + DC·Ω AC
- From among the various test ranges (R × 1 ~ × 10k) select that most suitable for the test to be done and, if it is difficult to tell how great the figure may be, start with the × 10k range.
- Short the metal tips of the test leads and make sure that the meter pointer deflects to the right.
- Next the zero adjustment is carried out. Turn the knob of the adjust until the pointer points exactly at 0.

  NOTE: If the pointer fails to move to zero when adjusted with the knob, this shows that the batteries are exhausted. Open the back of the case with a coin or similar object and reeplace the batteries, making sure to put themm in correctly and not reverse polarity. (It will be found easier to put the negative end in first)
- After 0Ω adjustment, contact the object being tested with the tips of the test leads. It must be kept in mind that error in the reading will easily occur if both hands are touchhing the test lead tips. As quite often happens when care is not taken in testing, the electrical resistance of the human body is connected in parallel to the object tested and the reading will be affected.

- If the pointer points to 10 or below this shows that the range selected is too high and a lower once must then be used. In the case of over 100, since the range setting will be too low, a high range is selected. In the case of some ranges 0 will require checking and adjusting first.

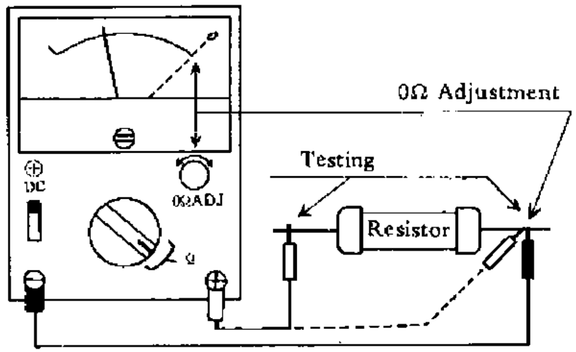
NOTE: In the case of the ohmmeter, since readings are taken near the center of the scale and there is less chance of error there, take care to select a range where the reading will be about the center of the range. However, depending on the testing conditions involved, readings may vary for semi-conductors and for this reason a range must be chosen that suits the test conditions. (See the section on LI and LV scales)

The final figure is obtained by multiplying the reading by the multiplying factor for the range but for further details see section.

NOTE: When taking resistance readings on the circuit of a set, turn off the power supply to it and also wait for condensers, etc., to be completely discharged. If tests are carried out while there is voltage present, not only will the readings so obtained be unreliable but damage to the tester may result.

NOTE: As to the polarity of the ohmmeter when thought of as a power source, the ⊖ terminal (black test lead) takes on ⊕ polarity and this must be kept in mind when testing diodes, etc.

NOTE: When testing resistors that have been incorporated into semiconductor circuits (Especially transistor and diode base circuits) because of the batteries in the resistance meter the semi-conductors will be in a state of continuity and sometimes an accurate reading cannot be obtained. In that case they should be removed for testing.



Measuring Resistance

6-7 How to Use the LI and LV Scales

When measuring semiconductor resistance, because of variations in the test conditions, i.e. the amount of current flowing through at the time and the voltage applied, by getting a clear grasp of the nature of these conditions more accurate conclusions can be formed, making it possible to check the characteristics of semiconductors, etc.

This tester is equipped with an LV (Load Voltage) scale to show thyvoltage in objects when testing their resistance and an LI (Load Current) scale to show the current.

- Test procedure is the same as that for resistance testing and if necessary the resistance can be read off the resistance scale.
- At this time the voltage applied can be read off the LV scale (a 0~1.5 scale, the reverse of normal) and the unit is V.
- The current is read off the LI scale (uniformly divided from 0 to 6) but unlike the LV value current will vary according to the resistance range in use andfor this reason in order to obtain the true value it is necessary to multiply the reading shown by the factor required to make the maximum value on the scale equal to the reference figure on the scale next to it.

  In the case of the R × 1 range. . . . . × 10mA
  In the case of the R × 100 range. . . . . . × 100μA
  In the case of the R × 1k range. . . . . . . × 10μA

  The LI and LV scales are graduated to allow for values when 1.5V batgery power is used in the tester, so that the actual readings will vary according to the state of the batteries.

(1) Transistor I_{CEO}

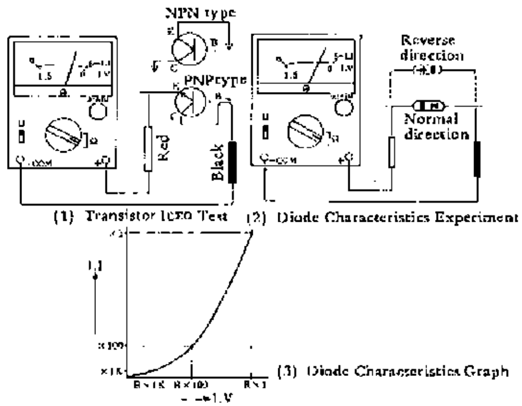
- Connect the collector (C) and emitter (E) of the transistor.

NPN Type:	Collector	→ black (⊖ terminal)
	Emitter	→ red (⊕ terminal)
PNP Type:	Emitter	→ black (⊖ terminal)
	Collector	→ red (⊕ terminal)

- Use the Rx1k resistance range and find the L value. If the meter pointer deflects very far, since it does not mean that the LV reading will be low, lower resistance range should be selected until some LV value (over 1V) is obtained. Now read the test voltage from the LV scale and the I_{CEO} from the LI scale.

(2) Diode Characteristics

- Adjust and connect the diode to the test polarity In the case of the normal direction, the cathode mark should be connected to the red lead (+) and when direction is reversed, the cathode mark should be connected to the black lead (−).
- Turn the resistance selector to the various ranges in order from Rx1k and record the LI and LV values for each range.
- Plot the readings so obtained on a graph to show the diode characteristics.



(1) Transistor I_{CEO} Test (2) Diode Characteristics Experiment

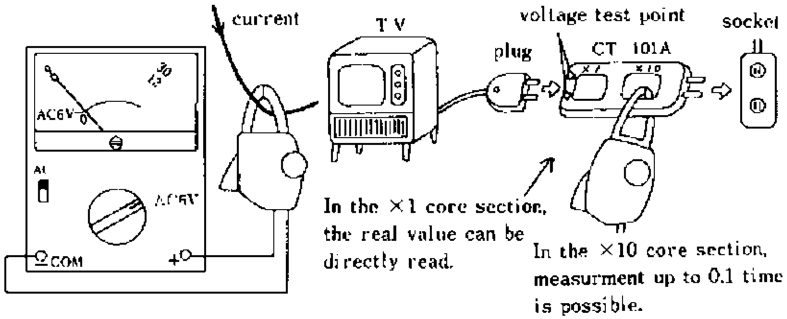
(3) Diode Characteristics Graph

7. OPTIONAL ACCESSORIES

(1) 9004 Clamp-on Probe

Readings up to 300A can be obtained and, unlike ordinary ammeters, it is not necessary to disconnect the line being tested but simply clamp this probe over it. When used together with the CT-101A Line Splitter amperage readings can be simply obtained in the case of most ordinary types of electrical appliances.

- Test Range: 0~6A, 12A, 30A, 120A, and 300A AC
- Tolerance: Not over ±6% of rated value (When used in combination with the 3007 Multitester)
- How to Use: Use the 6V AC range on the Multitester when employing this probe.



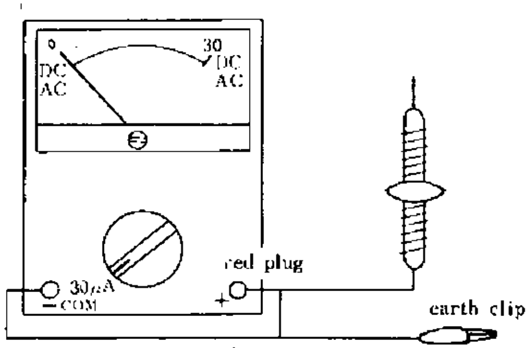
The 9004 Clamp-on Probe which is simply clamped over the line for tests

Used with the CT-101A it is handy in amperage tests on electrical appliances

(2) 9012 High Voltage Probe

This is a 30kVDC high voltage probe designed for great dielectric strength and outstanding insulating properties to make safety certain and to facilitate the testing of high voltage DC equipment such as TV Braun tubes, etc.

- Test Voltage: 0~30kV DC (Internal resistance: 1000MΩ)
- Accuracy: Not over ±5% of rated value (when used with the 3007 Multitester)
- How used: With tester on 30μA DC range.



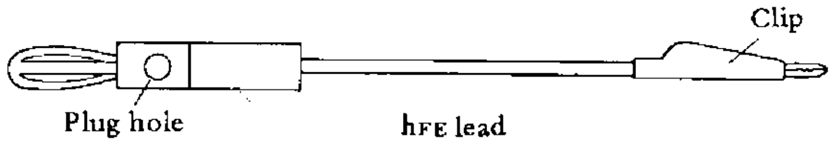
(3) Measuring the Transistor DC Amplification Factor (h_{FE})

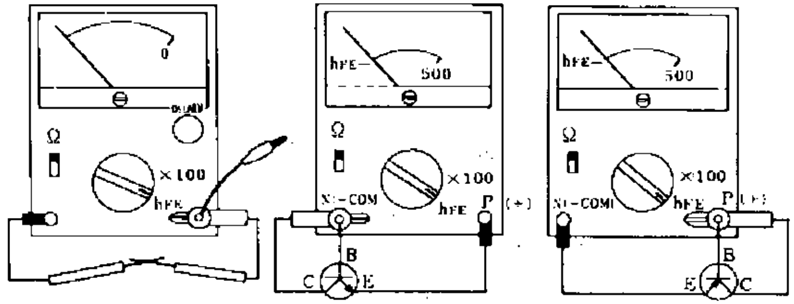
- Adapting the accessory hFE test lead to the type of transistor to be tested, plug it into either the ⊖ or the ⊕ terminal and then into the grip of this lead plug the red lead of the normal test lead set.

For 2SA000 or 2SB000
Types (PNP Types). . . . . . The N (−) terminal
For 2SC000 or 2SD000
Types (NPN Types) . . . . . The P (+) terminal

- Plug the black test lead into the other terminal. An alligator clip fitted to the other end of each of these test leads will prove usuful when testing. Use is recommended.
- Turn the selector too + DC·Ω·AC
- Turn the range selector to h_{FE} (the × 100 range on the ohmmeter).
- Short the red and blmck leads and, as in the case of resistance testing, carry out 0Ω adjustment.
  1. Contact the collector (C) with the red test lead
  2. Contact the emitter (E) with the black test lead and
  3. Contact the base (B) with the h_{FE} test lead.
- Take the readings from the h_{FE} scale.

NOTE: Since this is a simplified test method employing the ohmmeter, it should not be used in connection with commerical transactions.





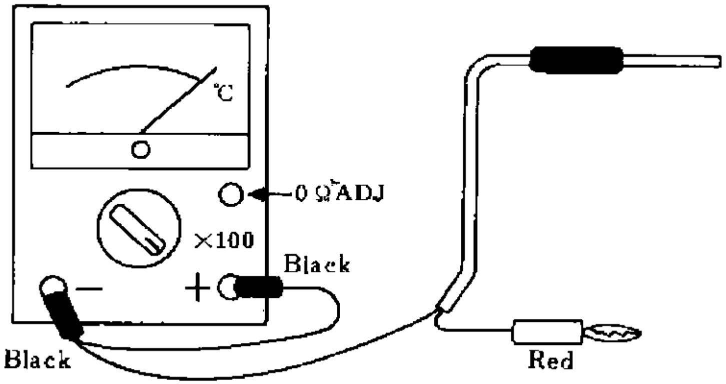
(1) 0 Adjustment (2) Testing NPN Type (3)Testing PNP Type

(4) 9021 Temperature Probe

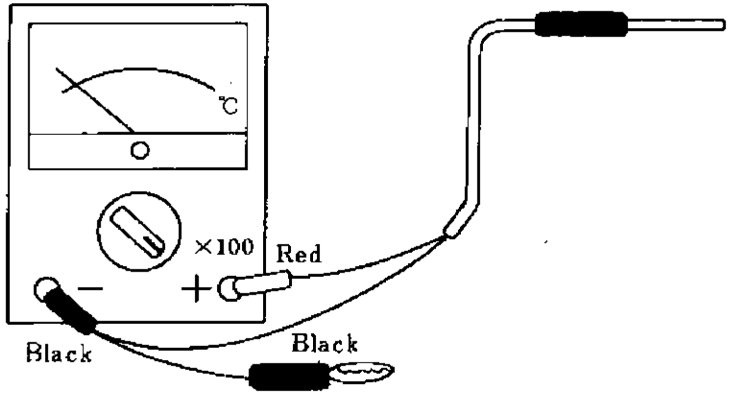
−50°C~200°C can be obtained

Temperature Range:	−50°C~200°C
Accuracy:	±3% of rated value (When used in combination with the 3007)
How to use:	With the tester on the ×100 ohmmeter. Reading to TEMP scale.

Method of operate (Measuring Temperature)



(1) 0Ω Adjustment (set the ×100Ω range)

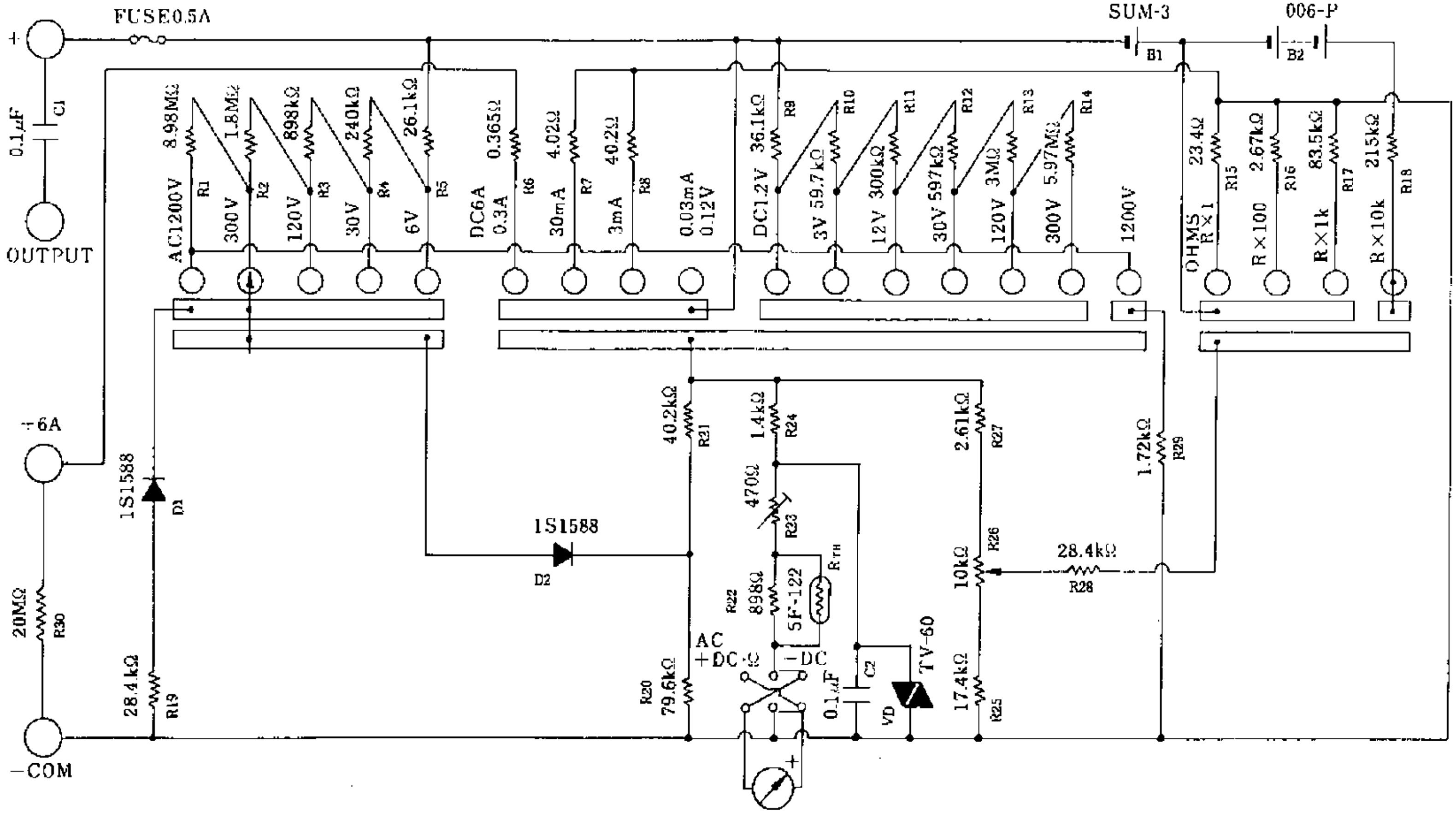


(2) Measurment (Temperature)

MEMO

Mark	Items		
R1	Metal glaze resistor	RK½P	8.98MΩF
R2	Metal film resistor	SN14K2E	1.8MΩF
R3	Metal film resistor	SN14K2E	898kΩF
R4	Metal film resistor	SN14K2E	240kΩF
R5	Metal film resistor	SN14K2E	26.1kΩF
R6	Wire resistor	¼L	0.365ΩF
R7	Metal film resistor	SN14K2H	4.02ΩF
R8	Metal film resistor	SN14K2E	40.2ΩF
R9	Metal film resistor	SN14K2E	36.1kΩF
R10	Metal film resistor	SN14K2E	59.7kΩF
R11	Metal film resistor	SN14K2E	300kΩF
R12	Metal film resistor	SN14K2E	597kΩF
R13	Metal film resistor	SN14K2H	3MΩF
R14	Metal glaze resistor	RK½P	5.97MΩF
R15	Metal film resistor	SN14K2H	23.4ΩF
R16	Metal film resistor	SN14K2E	2.67kΩF
R17	Metal film resistor	SN14K2E	83.5kΩF
R18	Metal film resistor	SN14K2E	215kΩF
R19	Metal film resistor	SN14K2E	28.4kΩF
R20	Metal film resistor	SN14K2E	79.6kΩF
R21	Metal film resistor	SN14K2E	40.2kΩF
R22	Metal film resistor	SN14K2E	898ΩF
R23	Trimmer	SR-19R	470Ω-B ±20%
R24	Metal film resistor	SN14K2E	1.4kΩF
R25	Metal film resistor	SN14K2E	17.4kΩF
R26	Variable control	SR-19D	10KΩ-B ±20%
R27	Metal film resistor	SN14K2E	2.61kΩF
R28	Metal film resistor	SN14K2E	28.4kΩF
R29	Metal film resistor	SN14K2E	1.72kΩF
R30	Shunt resistor		20mΩ
C1	Oil condenser	0.1μF	600WV
C2	Film condenser	0.1μF	50WV
D1,2	Silicon diode	1S1588	
VD	Varistor	TV-60	
RTH	Thermistor	5F-122	
B1	Battery	SUM-3	1.5V
B2	Battery	006-P	9V
F	Glass fuse	0.5A	250V

3007 CIRCUIT DIAGRAM



The value of circuit element is subject to change without notice.