

OPERATING INSTRUCTIONS

for

TRANSISTOR TESTER

TYPE TM12

GUARANTEE

We undertake to repair, or replace free of charge, any components that fail within 12 months of the date of purchase of an instrument provided that the instrument is not, in our opinion, modified or misused.

Instruments returned by post should be well packed to avoid damage.

We recommend the use of two strong cartons, one to fit closely around the instrument and the other large enough to float the small carton in at least 2" thickness of wood wool.

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TRANSISTOR TESTER TYPE TM12

This instrument measures the characteristics of bipolar transistors, diodes and zener diodes. Leakage currents down to 0.5nA are measured at voltages from 2V to 150V. Current gains of transistors are checked at collector currents from 1 μ A to 100mA. Breakdown voltages up to 100V are measured at currents of 10 μ A, 100 μ A and 1mA. The collector to emitter saturation voltage of a transistor is measured at collector currents of 1mA, 10mA, 30mA and 100mA for I_C/I_B ratios of 10, 20 and 30.

A 9V battery powers the instrument that contains a transistor D.C. to D.C. converter to produce 150V. Stabilisation circuits ensure that measurements are independent of the state of the battery which is indicated by a neon panel lamp.

TRANSISTOR RANGES (PNP OR NPN)

- I_{CBO} & I_{EBO} : 10nA, 100nA, 1 μ A, 10 μ A and 100 μ A f.s.d. acc. $\pm 2\%$ f.s.d. $\pm 1\%$ at voltages of 2V, 5V, 10V, 20V, 30V, 40V, 50V, 60V, 80V, 100V, 120V and 150V acc. $\pm 3\%$ ± 100 mV up to 10 μ A with fall at 100 μ A $< 5\% + 250$ mV. Short circuit current limit 1mA.
- BV_{CBO} : 10V or 100V f.s.d. acc. $\pm 2\%$ f.s.d. $\pm 1\%$ at currents of 10 μ A, 100 μ A and 1mA $\pm 20\%$. Open circuit voltage limit 150V.
- I_B : 10nA, 100nA, 1 μ A 10mA f.s.d. acc. $\pm 2\%$ f.s.d. $\pm 1\%$ at fixed I_E of 1 μ A, 10 μ A, 100 μ A, 1mA, 10mA, 30mA and 100mA acc. $\pm 1\%$. $V_{CE} = 2$ V approx.
- h_{FE} : 3 inverse scales of 2000 to 100, 400 to 30 and 100 to 10 convert I_B into h_{FE} readings. Acc. is $\pm (2 + 200 \div \% \text{ of f.s.d. })\%$ i.e. $\pm 4\%$ at f.s.d.
- V_{BE} : 1V f.s.d. acc. ± 20 mV measured at conditions on h_{FE} test.
- $V_{CE(sat)}$: 1V f.s.d. acc. ± 20 mV at collector currents of 1mA, 10mA, 30mA and 100mA with I_C/I_B selected at 10, 20 or 30 acc. $\pm 20\%$.

DIODE & ZENER DIODE RANGES

- I_{DR} : As I_{EBO} transistor ranges.
- V_Z : Breakdown ranges as BV_{CBO} for transistors.
- V_{DF} : 1V f.s.d. acc. ± 20 mV at I_{DF} of 1 μ A, 10 μ A, 100 μ A, 1mA, 10mA, 30mA and 100mA acc. $\pm 1\%$.

POWER SUPPLY

One type PP9 battery, or A.C. mains when a LEVELL Power Unit is fitted.

SIZE & WEIGHT

7" x 10.1/4" x 5 1/2" (i.e. 18cm x 26cm x 14cm). 8lbs (i.e. 3.6kg)

OPERATING INSTRUCTIONS FOR LEVELL TRANSISTOR TESTER TYPE TM12

1. Connection of Power Supply

Remove the back panel from the case and connect a 9V battery, Ever Ready type PP9 or equivalent, by means of the snap fastener connector provided.

A LEVELL Power Supply Unit type PU1 may be fitted in place of the batteries when operation is required from an A.C. mains supply. The earth connection on the Power Unit must be joined to the case of the instrument.

Replace the back panel taking care to ensure that the screws are tight so that there is a good electrical connection between the back panel and the instrument case.

The state of the power supply is indicated by the neon panel lamp which glows when the instrument is switched on. It is normal for there to be some reduction in the intensity of this lamp when the consumption from the power supply is high such as on the 100mA range. Failure of the battery is indicated when the lamp starts to flicker or fails to glow at all.

2. Zero Adjustments

There are two adjustments which should be checked before measurements are made with the instrument. The first is the mechanical zero adjustment on the meter which is set by a screwdriver when the POLARITY switch is in the OFF position. The second is the current zero adjustment which is set when the METER RANGE switch is in the SET ZERO position and the POLARITY switch is set to either the PNP or NPN position as appropriate to the component to be tested later. The current zero adjustment is independent of the setting of the two FIXED CONDITIONS switches and independent of components across the test connections. The instrument should be left switched on at least 1 minute before setting the current zero.

3. To Measure I_{CBO} and I_{EBO} of a Transistor.

- (a) Turn the POLARITY switch to OFF and connect the transistor to the terminals or test sockets provided.

- (b) Set the lower FIXED CONDITIONS switch to V_{CBO} or V_{EBO} and select the required test voltage on the upper switch.
- (c) Turn the POLARITY switch to PNP or NPN to suit the transistor that is to be tested.
- (d) Turn the METER RANGE switch to the most suitable of the five current ranges of 10nA to $100\mu\text{A}$ and read the indicated value of I_{CBO} or I_{EBO} .

4. To Measure BV_{CBO} of a Transistor

- (a) Proceed as up to 3(a).
- (b) Turn the lower FIXED CONDITIONS switch to the required test current of $10\mu\text{A}$, $100\mu\text{A}$ or 1mA on the positions marked " I_C for BV_{CBO} & V_Z ".
- (c) Turn the METER RANGE switch to 100V on the position marked " BV_{CBO} & V_Z ".
- (d) Turn the POLARITY switch to PNP or NPN and read BV_{CBO} on the top scale of the meter. Turn the METER RANGE switch to 10V when the indicated value is less than 10V .

5. To Measure h_{FE} of a Transistor

- (a) Proceed as up to 3(a).
- (b) Turn the lower FIXED CONDITIONS switch to the required test current I_E between $1\mu\text{A}$ and 100mA .
- (c) Turn the POLARITY switch to PNP or NPN and then rotate the METER RANGE switch to the I_B range between 10nA and 10mA that gives the best indication of the base current on the top scale of the meter.
- (d) Observe the value of the chosen I_B range and evaluate $I_E/(I_B \text{ range})$. Decide which of the three h_{FE} scales has this value on its most clockwise marking and then read off h_{FE} of the transistor using this scale.

6. To Measure V_{BE} of a Transistor.

- (a) Proceed as up to 5 (c) but set the METER RANGE switch to " V_{BE} " and read the value on the top scale of the meter.

7. To Measure $V_{CE(sat)}$ of a Transistor.

- (a) Proceed as up to 3 (a).
- (b) Turn the lower FIXED CONDITIONS switch to the required test current $I_{C(sat)}$ between 1mA and 100mA.
- (c) Turn the upper FIXED CONDITIONS switch to the required test ratio I_C/I_B of 10, 20 or 30.
- (d) Turn the METER RANGE switch to $V_{CE(sat)}$.
- (e) Turn the POLARITY switch to PNP or NPN and read $V_{CE(sat)}$ on the top scale of the meter.

8. To Measure the Forward Characteristic of a Diode.

- (a) Turn the POLARITY switch to OFF and connect the diode across the "e" and "b" terminals.
- (b) Set the lower FIXED CONDITIONS switch to the required forward test current I_{DF} between $1\mu A$ and 100mA.
- (c) Turn the METER RANGE switch to V_{DF} .
- (d) Turn the POLARITY switch to the D, Z & NPN position and read the forward voltage drop on the top scale of the meter.

9. To Measure the Reverse Leakage Current of a Diode.

- (a) Proceed as up to 8 (a).
- (b) Set the lower FIXED CONDITIONS switch to V_{DR} ^{V_{eL_0}} and select the required test voltage on the upper switch.
- (c) Turn the POLARITY switch to D, Z & NPN position.

- (d) Turn the METER RANGE switch to the most suitable of the five current ranges of 10nA to 100 μ A and read the indicated value of I_{DR} .

10. To Measure the Breakdown Voltage of a Diode or Zener Diode.

- (a) Turn the POLARITY switch to OFF and connect the diode or zener diode across the "b" and "c" terminals.
- (b) Proceed as 4(b) to 4(d) but set the POLARITY switch to the position marked D, Z & NPN.

11. To Measure the Leakage Current of a Condenser.

- (a) Turn the POLARITY switch to OFF and connect the condenser across the "b" and "e" terminals with the black "e" terminal connected to the negative end when the condenser is of the electrolytic type.
- (b) Set the lower FIXED CONDITIONS switch to V_{DR} and select the required test voltage on the upper switch. V_{e6e}
- (c) Turn the POLARITY switch to PNP.
- (d) Turn the METER RANGE to the most suitable of the five current ranges of 10nA to 100 μ A and read the indicated value of the leakage current after allowing sufficient time for the leakage to settle to a steady value.

12. To Adjust the Preset Controls.

The layout of the preset controls is given on the diagram at the end of the text.

The preset controls are provided to permit optimum adjustment of the performance of the instrument. These controls are set prior to despatch of the instrument from the factory when operating from a supply of $8.2V \pm 10\%$ at a temperature of 20 $^{\circ}$ C to 25 $^{\circ}$ C. Readjustment of these controls will not normally be required for many months unless the instrument has had a component failure.

Adjustment should be made only in the following order.

- (a) "150V" control. Connect a standard voltmeter across the "c" and "b" terminals with the instrument set as for measurement of I_{CBO} on the $100\mu\text{A}$ range at V_{CBO} set to 150V. The voltmeter must measure 150V to within $\pm 1\%$ with a current consumption of less than $10\mu\text{A}$. Adjust the preset control to obtain exactly 150V output.
- (b) "Z" control. Remove the voltmeter used in the preceding test and observe the panel meter on the instrument. Adjust the preset control until the meter reads zero.
- (c) "1V" control. Connect a standard voltmeter across the "e" and "b" terminals to read 1V within $\pm 0.3\%$. Select the conditions as for measurement of the forward voltage drop of a diode. Select a suitable fixed current and shunt the voltmeter with adjustable resistance until the voltmeter reads between 0.8V and 1V. Adjust the preset control until the panel meter on the instrument agrees with the standard.
- (d) "10nA" control. Connect a standard current meter in series with a resistance box across the "e" and "b" terminals. The current meter must measure 10nA to within $\pm 0.3\%$. Select the conditions as for measurement of the reverse leakage current of a diode on the 10nA range and adjust the value of V_{DR} and the resistance box until the current reads between 8nA and 10nA on the standard meter. Adjust the preset control until the panel meter agrees with the standard.
- (e) "100nA" control. Repeat as for the preceding test but on the 100nA range with a current reading between 80nA and 100nA.
- (f) " I_E " control. Connect a standard multirange current meter across the "e" and "b" terminals and measure the error on each of the seven fixed currents from $1\mu\text{A}$ to 100mA. Adjust the preset control until the errors do not exceed $\pm 1\%$ on any of the fixed currents.
- (g) V_Z control. Connect a standard voltmeter in parallel with a resistance box across the "b" and "c" terminals. Select the conditions for measurement of a zener diode voltage on the 10V range and adjust the resistance box and test current until the standard voltmeter reads between 8V and 10V. Observe the error

6. To Measure V_{BE} of a Transistor.

- (a) Proceed as up to 5 (c) but set the METER RANGE switch to " V_{BE} " and read the value on the top scale of the meter.

7. To Measure $V_{CE(sat)}$ of a Transistor.

- (a) Proceed as up to 3 (a).
- (b) Turn the lower FIXED CONDITIONS switch to the required test current $I_{C(sat)}$ between 1mA and 100mA.
- (c) Turn the upper FIXED CONDITIONS switch to the required test ratio I_C/I_B of 10, 20 or 30.
- (d) Turn the METER RANGE switch to $V_{CE(sat)}$.
- (e) Turn the POLARITY switch to PNP or NPN and read $V_{CE(sat)}$ on the top scale of the meter.

8. To Measure the Forward Characteristic of a Diode.

- (a) Turn the POLARITY switch to OFF and connect the diode across the "e" and "b" terminals.
- (b) Set the lower FIXED CONDITIONS switch to the required forward test current I_{DF} between 1 μ A and 100mA.
- (c) Turn the METER RANGE switch to V_{DF} .
- (d) Turn the POLARITY switch to the D, Z & NPN position and read the forward voltage drop on the top scale of the meter.

9. To Measure the Reverse Leakage Current of a Diode.

- (a) Proceed as up to 8 (a).
- (b) Set the lower FIXED CONDITIONS switch to V_{DR} and select the required test voltage on the upper switch.
- (c) Turn the POLARITY switch to D, Z & NPN position.

