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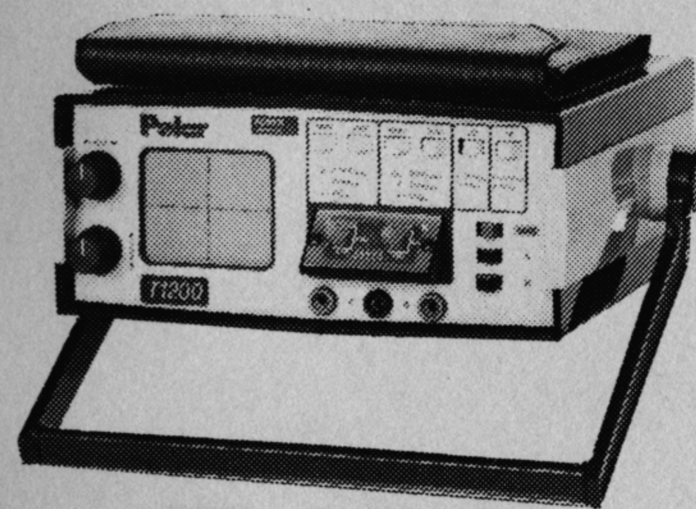
User Manual

T1200



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CAUTION!

There are no user serviceable parts in the T1200. Dangerous voltages and components that require special handling are present inside the unit.
Repairs and/or servicing should be performed by qualified personnel only.

CONNECTING AND SETTING UP THE UNIT

1. Connect the power lead to a suitable voltage supply (see the rear panel for voltage setting). Note that the green/yellow wire must be connected to GROUND.

2. Using the power switch on the rear panel switch on the T1200 – check that the front panel glows red in the POWER box.

3. The cathode ray tube (CRT) controls are on the rear panel and after about 1 minute warm up on the CRT heater, these may be adjusted to give an optimum brightness and focus of the display as below.

4. Push buttons A and LO in and check that all other buttons are out. Remove the clip probes from the pouch and plug the red probe into the red A socket and the black probe into the black socket.

   Connect any diode across the probes and check for the normal diode display on the CRT (see Figure 2).

   Using the three rear panel CRT controls adjust for an optimum display where the trace is in focus both vertically and horizontally.

   Once set correctly, these three controls should rarely need readjusting.

GENERAL TROUBLESHOOTING USING THE HI & LO RANGES

Remove the pair of red and black needle probes from the pouch and plug the red one into the front panel socket labelled A (i.e. on the left hand side) and the black one into the lower black socket.

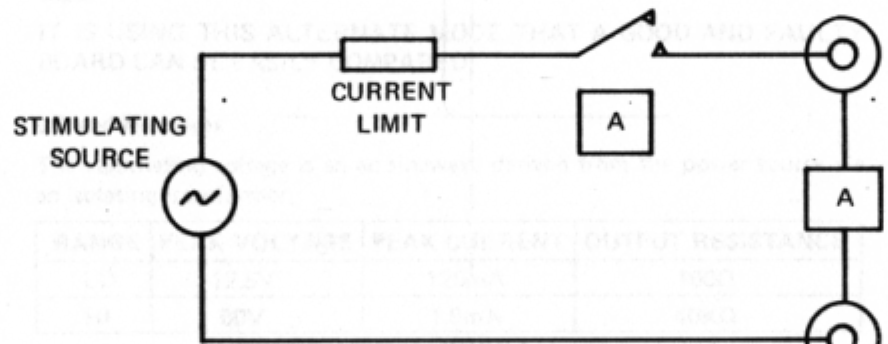
Troubleshooting is accomplished by putting the probes across two points on a faulty pcb and observing the resultant display on the CRT.

The T1200 plots a graph of the current versus voltage that the two probes "see" when connected to the faulty pcb. It is this graph or signature that will allow you to identify the faulty components or areas where a known good board differs from a faulty board.

Button A

The A and B buttons connect a stimulating voltage to the probes. If both buttons are OUT then the probes are inactive (off) and no display will be made on the CRT.

Push in button A and the LO button.



A horizontal line should appear on the CRT. The front panel states that the horizontal calibration is 2 volts per division and vertical sensitivity is 20 mA per division.

The horizontal line shows that there is NO current flowing (the probes are open circuit).

If the probe tips are now shorted, the line becomes vertical. This is because a maximum (limited) current is flowing throught the probes, and because the probes are shorted with no resistance, there is no voltage drop.

Diode Display

Connect any small diode (eg IN914, IN4148, IN4000 series etc.) across the probes. Red probe to diode anode, black to diode cathode (usually marked with a line).

A graph of the diode current voltage should now appear as in figure 2.

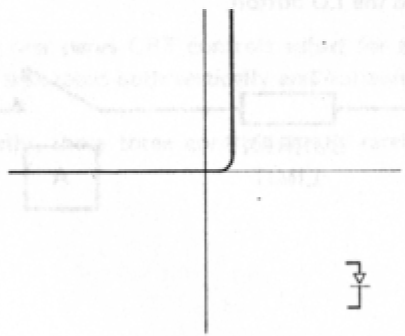


FIGURE 2

The RHS of the display shows the diode conducting current in forward bias with 0.7 to 0.8v across it. – the LHS is a horizontal line since the diode is in reverse bias and therefore conducting no current.

A and B buttons

Remove the red and black leads with the clips from the pouch and plug the red one into the B red socket. Remove the black needle probe 4mm plug from the panel, plug in the black "through plug", on the clip lead and then replace the needle probe plug into the back of the "through plug", so that both black leads are plugged into the black front panel socket.

Press button A so that it comes out (not selected) and press button B so that it becomes selected.

The stimulating voltage is now across the B terminals.

Short the red and black clips together and observe a vertical line – connect a diode across them and observe the diode display.

Short the needle probes and note that there is no effect on the display because they are disconnected via button A.

Clip a diode across the red and black clips – now depress button A (leaving button B in).

The CRT will alternately display A then B i.e. the needle probes and then the clips.

IT IS USING THIS ALTERNATE MODE THAT A GOOD AND FAULTY BOARD CAN BE EASILY COMPARED.

LO and HI ranges

The stimulating voltage is an ac sinewave derived from the power source via an isolating transformer.

RANGE	PEAK VOLTAGE	PEAK CURRENT	OUTPUT RESISTANCE
LO	12.5V	125mA	100Ω
HI	60V	1.5mA	40KΩ

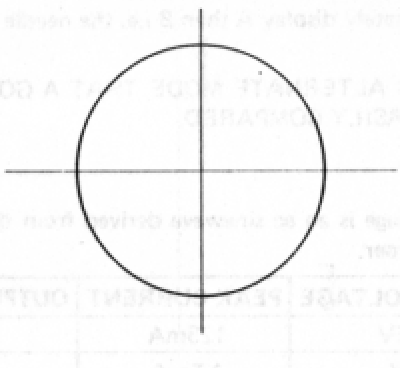
Selection of the LO or HI ranges automatically alters the sensitivity (as stated on the front panel) so that the display occupies the full screen area.

TESTS MUST BE PERFORMED ON UNPOWERED BOARDS.

Troubleshooting Notes and Hints

1. Troubleshooting must only be performed on UNPOWERED boards.

2. Since the test voltage is ac, capacitors and inductors will produce loops on the display as in Figure 3.



CAPACITOR
HI RANGE

FIGURE 3

3. To avoid confusing results, it is recommended that the faulty pcb or unit under test is entirely disconnected from a power source, thus removing any ground connection.

   This also reinforces the removal of power from the board under test.

4. The current available from the probes is limited and it is quite safe to short them. Some discrimination is needed when using the ranges e.g. to test boards containing CMOS devices.

   CMOS input protection diodes are typically only rated at 10mA max. – thus it is safer to troubleshoot boards with these devices on the HI range only.

   The LO range is ideal for testing analogue, TTL and discrete devices. The HI range is also useful on these devices as it will safely show leakages and breakdowns that are not present when testing on the LO range.

5. When a board or card is known to be faulty, the easiest way to commence troubleshooting is to try and obtain a known good board for comparison.

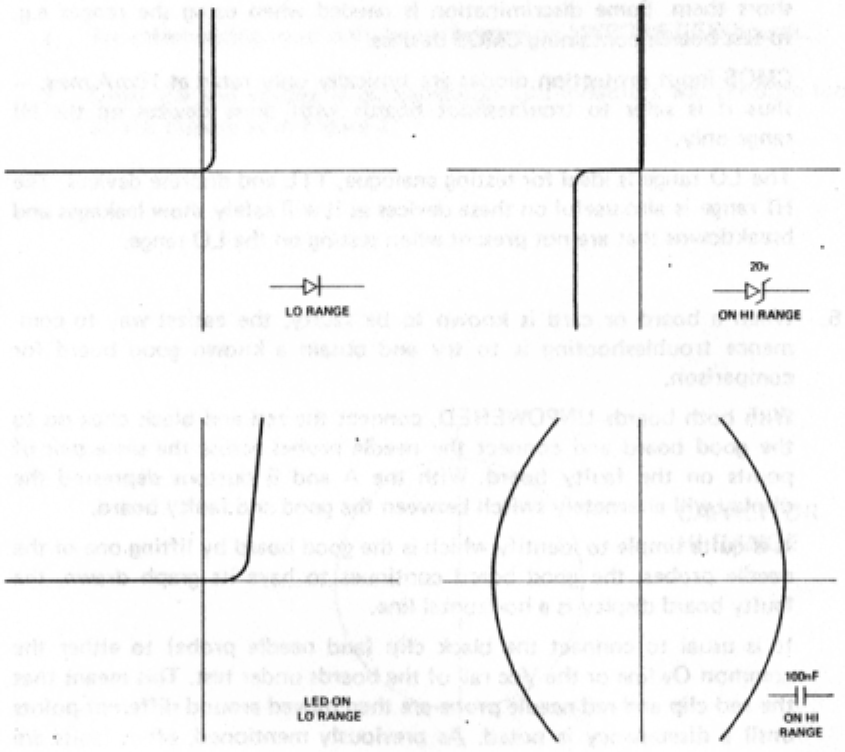
   With both boards UNPOWERED, connect the red and black clips on to the good board and connect the needle probes across the same pair of points on the faulty board. With the A and B buttons depressed the display will alternately switch between the good and faulty board.

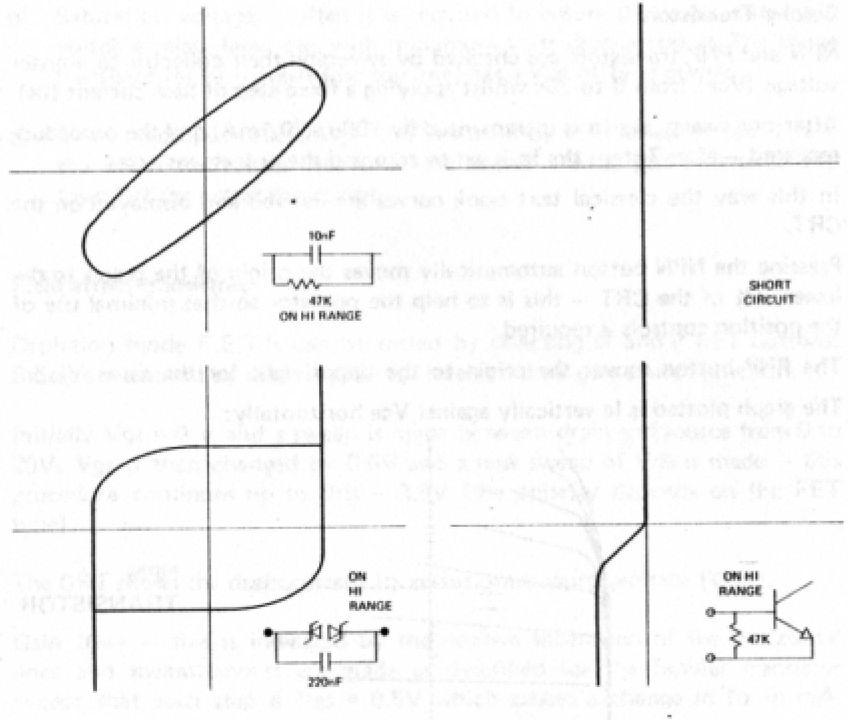
   It is quite simple to identify which is the good board by lifting one of the needle probes, the good board continues to have its graph drawn, the faulty board display is a horizontal line.

   It is usual to connect the black clip (and needle probe) to either the common Ov line or the Vcc rail of the boards under test. This means that the red clip and red needle probe are then moved around different points until a discrepancy is noted. As previously mentioned, often faults are only discernable on one range – hence it is useful to switch between the HI and LO ranges if there is no problem with CMOS devices.

6. **The recognition of faulty signatures and the choice of ranges when troubleshooting will come with experience of using the T1200. It will not locate timing faults etc. but it will locate a wide variety of faults down to device level as the operator gains experience in using it.**

7. **Some typical displays:—**





TESTING AND CHECKING TRANSISTORS

The two sockets on the front panel allow a transistor to be plugged in and have its characteristic output curves plotted on the CRT.

The A and B buttons control the transistor sockets in the same way as they control the probes i.e. depression of button A activates socket A, depression of button B activates socket B — both buttons in causes an automatic alternate selection of socket A then socket B. This latter feature is ideal for matching or comparison of two devices.

Bipolar Transistors

NPN and PNP transistors are checked by sweeping their collector to emitter voltage (Vce) from 0 to 20v whilst applying a fixed step of base current (I_B).

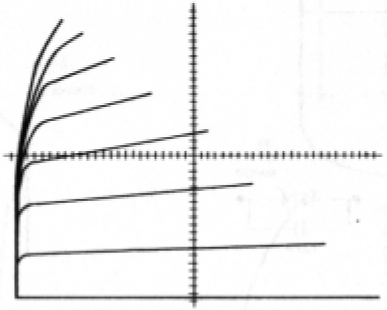
After one sweep, the I_B is incremented by 100µA (0.1mA) and the procedure repeated – after 7 steps the I_B is set to zero and the process restarts.

In this way the classical text book curves are derived and displayed on the CRT.

Pressing the NPN button automatically moves the origin of the graph to the lower left of the CRT – this is to help the operator so that minimal use of the position controls is required.

The PNP button moves the origin to the upper right for the same reason.

The graph plotted is Ic vertically against Vce horizontally:



NPN
TRANSISTOR

a) Current gain (β or H_{fe}) is indicated by the separation of each horizontal line. Each base step I_B is 100µA, the greater the separation of the lines the higher the transistor gain.

In the above figure the separation of steps 1 and 2 along Vx is approximately 1.5 divisions which is 1.5 x 10mA = 15mA

$$\text{Hence } \beta = \frac{15mA}{0.1mA} = 150$$

Note that the gain can vary over different parts of the characteristic.

b) Saturation voltage – often it is required to ensure that a transistor will switch a relay, lamp etc, with minumum volts drop across it. The above transistor for I_B = 70µA (the top line) has a Vce of 1v at 60mA.

c) Slope or output resistance – this is shown by the flatness of each line – the more horizontal each line, the higher the output resistance and (usually) the better the device.

Field effect transistors

Depletion mode F.E.T.'s can be tested by selecting N and P FET buttons. F.E.T.'s are tested by applying voltage levels to their gate source junction.

Initially Vgs = 0 V and a sweep is made between drain and source from 0 to 20V. Vgs is then changed by 0.5V and a new sweep of Vds is made – this procedure continues up to Vds = 3.5V (the polarity depends on the FET type).

The CRT shows the drain current I_D versus drain source voltage (V_{DS}).

Gain (g_m) – this is indicated by the relative separation of the horizontal lines and measurements are made as described for the bipolar transistor except that each step is Vgs = 0.5V which causes a change in I_D in mA.

$$\text{Hence gm} = \frac{\text{Current change}}{\text{Voltage step}}$$

and has the units of siemens (formerly mhos).

Matching

Devices may be easily matched by selecting A and B buttons and plugging two devices in the sockets and comparing the alternate displays. Devices are changed until the best match is obtained.

Lead Configuration

The test board sockets are marked with the lead configuration c,b,e and d,g,s. Unfortunately many devices have the base at one end of their package!

Depending on how often this occurs, often twisting the leads will allow the device to be plugged in and tested.

If it is envisaged that many different devices of various lead configurations will be tested, then use may be made of the five holes on a 0.1 inch pitch brought out at the bottom of the test board.

If a standard 0.1 inch 5 way pin assembly is soldered into these holes, all the A and B transistor test signals are available to be taken to an expansion box and wired to suit your own device lead configuration. The advantage of putting pins into the test pcb is that the personalised test box can be disconnected when it is not required.

Oscillation

When testing certain transistors, the curves may be seen to break up and cause a fuzzy display for some steps. If a hand is placed on or near the device leads, this may disappear and the normal curves appear.

The cause is likely to be oscillation. Ferrite beads are present on the cables under the test board to minimise this effect but certain devices may require further beads. This is especially likely if an expansion box is used as described in the paragraph above.

INCREASED SENSITIVITY

If it is desired to examine part of a waveform in greater detail, e.g. the breakdown of a zener diode, this can be accomplished quite easily.

Depression of the MAG button increases both the X and Y sensitivities. It is recommended that the MAG button is left out during normal operation.