

T1200

AND

T1202

SERVICE MANUAL

Polar

POLAR INSTRUMENTS LIMITED

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DESCRIPTION

The T1200 will plot on its C.R.T. display a graph of voltage against current of a component under test.

In the LO and HI ranges, a stimulus voltage is applied to a component under test via a pair of hand held probes. The resultant display will be the voltage/current relationship seen by the probes across that component.

By observation of the impedance signature, the operator can detect component faults, errors etc.

To facilitate checking, two outputs (A and B) are provided whereby a known good board can be compared with a faulty board. The unit automatically switches alternately between the two outputs (A and B) and thus the two signatures are alternately displayed.

In addition there are four transistor testing ranges where the unit will display the output characteristics of a device when plugged into one of the front panel sockets.

To allow matching etc., the switching feature is also present between the two sockets when both A and B are depressed.

A fuller description is given in the Operators Manual.

SPECIFICATIONS

- LO— open circuit voltage 12.5V peak
short circuit current 125mA peak
- HI— open circuit voltage 60V peak
short circuit current 1.5mA peak
- NPN/PNP— I_B , 7 steps of $100\mu A$
Display sensitivity I_C 8 divs at 10mA/div
 V_{CE} 10 divs at 2V/div
- NFET/PFET— V_{GS} , 7 steps of 0.5V
Display sensitivity I_D 8 divs at 2mA/div
 V_{DS} 10 divs at 2V/div
- MAG— will increase X and Y sensitivities by x 3 (approx).
- Accessories— unit supplied with all probes, interconnecting leads, operators handbook etc, housed in pouch on top of unit.

CHANGE OF MAINS RANGE

There are two primary ranges of operation for the unit:

- (i) 100 – 125 V.
- (ii) 200 – 250 V.

In addition, each of the above ranges is split into two to optimise CRT voltages etc. On early units, these are selected by internal Jumper links – the pcb is fully marked. On later units there is a HI - LO switch on the rear panel which allows adjustment to be made without disassembly of the unit.

- LO 100 – 112V or 200 – 225V.
- HI 112 – 125V or 225 – 250V.

To change the selected range:-

1. Remove power from the instrument.
2. Unscrew the four screws through the feet and remove the bottom of the case. Lift off the grey side rails and handle assembly.
3. Observe the links connected in the top corner of the board adjacent to the transformer TXM110.
4. Remove the links and refit them so that they achieve the desired range.
5. Reassemble the instrument and change the rear panel fuse if necessary (see rear panel).

CALIBRATION

Caution!

Dangerous voltages are exposed when the case is open and power is applied. All adjustments should be made with insulated tools and should be performed by qualified personnel only.

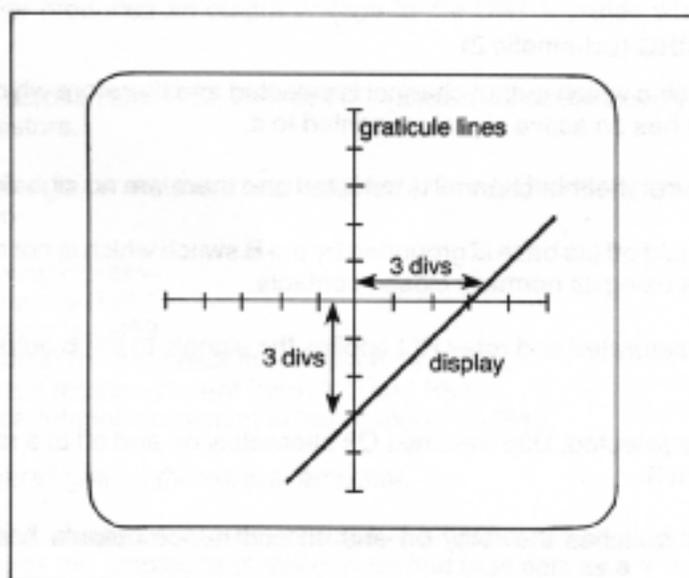
Equipment required:-

- (a) Test oscilloscope calibrated accurately in $0.5V/div$, $5V/div$.
- (b) 100Ω resistor (0.5% or better).
- (c) a zener diode 9V to 15V in value.

1. Remove the base of the enclosure, apply power and allow the unit to warm up for 15 minutes.
2. Adjust the rear panel CRT controls for optimum intensity, focus and astigmatism. A simple way to do this is:-
 - (a) Select LO and A.
 - (b) Connect any diode across the A red and black 4mm sockets on the front panel.
 - (c) Observe a diode display on the CRT.
 - (d) Adjust the \updownarrow and \leftrightarrow to centre the display.
 - (e) Adjust the CRT controls for optimum sharpness of display for both the vertical and horizontal lines. Remove the diode.
3. Select LO and A. Adjust R29 for an exactly horizontal trace.

4. Connect the red and black clips to the A red and black 4mm sockets. Connect the clips together (ie short them).
Adjust R103 for an exactly vertical trace.
N.B. R103 is only fitted on later models.
5. Select PFET and A. Set test scope to $0.5V/div$, d.c. coupled, $10ms/div$ and connect the ground clip to the solder tag on the CRT fixing point to the front panel.
Connect the probe tip to the base of transistor socket A on the front pod.
Observe a staircase wave form consisting of 7 steps going from 0V to +3.5V.
Adjust R31 for an overall amplitude of exactly 3.5V. Remove the probe.
6. Select NPN and A. Connect a 9V to 15V zener diode into transistor socket A between the collector and emitter. Diode anode to emitter, diode cathode to collector.
Observe the typical zener breakdown characteristic on the T1200 display.
7. Set the test scope to $5V/div$, $20ms/div$ and connect the probe tip to the zener diode cathode.
Observe a truncated full wave rectified sinewave on the test scope. Measure its peak to peak value (between 9V to 15V depending on the zener value).
Calculate how many divisions of horizontal deflection this should cause on the T1200, ie

$$\text{No. of divisions} = \frac{\text{Peak to peak voltage}}{2}$$
8. Adjust R27 for the correct number of divisions of deflection calculated in 5 above.
Remove the zener diode.
9. Select LO and A. Connect an accurate 100 ohm resistor between the A red 4mm socket and black socket.
Observe a line on the T1200 display with a slope of about 45° .
10. Using R30, adjust the slope so that it is exactly 45° .
This may be done by using the T1200 \updownarrow and \leftrightarrow controls and adjusting R30 so that the display crosses the graticule lines at an equal number of divisions horizontally and vertically from the centre line as shown in the figure below.
Remove the resistor and scope probe.



CIRCUIT DESCRIPTION

BASE STEP GENERATOR (schematic 1)

The function of this circuit is to generate a staircase waveform of correct polarity to be applied to transistor plugged into the two front panel sockets.

U1 is a counter which is clocked with pulses at line frequency via U4c which is connected as a comparator.

The four 20k Ω and two 10k Ω resistors on the output of U1 form a digital to analogue converter producing a positive going staircase voltage on pins 3 and 5 of U4.

The base level of the staircase is -8V and each step is 0.5V (approx).

U4a and Q9 convert the staircase voltage into a current staircase of 100 μ A per step. This is used for testing PNP transistors.

U4b and Q10 invert the voltage staircase and apply it to U3a and Q7 which converts it into a current staircase suitable for testing NPN transistors.

Overall amplitude of the staircase outputs is set by the tracking +8V and -8V supplies shown on schematic 6.

The switching shown on schematic 2 converts the current staircase back to a voltage staircase for testing field effect transistors (using R87 and R88).

The base outputs to the front panel sockets are:-

- NPN - + 100 μ A per step.
- PNP - -100 μ A per step.
- NFET - -0.5V per step.
- PFET - +0.5V per step.

RELAY AND SWITCHING (schematic 2)

Buttons A and B determine which output channel is selected and therefore which red 4mm socket or which transistor socket has an active signal presented to it.

When both buttons are out, neither channel is selected and there are no signals on the outputs.

With A selected, Q8 is held off (its base is grounded by the B switch which is not selected). RLI applies signals to the A outputs using its normally closed contacts.

With B selected, Q8 is saturated and relay RLI applies the signals to the B outputs using its normally open contacts.

When both A and B are selected, U3d switches Q8 alternately on and off at a rate determined by the squarewave from U4 pin 3.

This action alternately switches the relay on and off and hence outputs A and B are alternately activated.

OUTPUT SIGNALS TO PROBES AND COLLECTORS (schematic 2)

Transformer T2 provides the drive signals to the various front panel sockets at supply frequency.

R67, R68, R25 and R26 provide short circuit current limiting.

In the LO and HI modes, an alternating sinewave is applied across the selected 4mm sockets.

Bridge rectifier DB3 provides a full wave rectified output for use in the four transistor testing modes. The polarity appearing across the collector emitter terminals is set by the relevant transistor push switch.

HORIZONTAL AMPLIFIER (schematic 3)

The horizontal amplifier monitors the voltage appearing across the device and amplifies this to cause a horizontal (x) deflection on the CRT.

Schematic 2 shows R70 to R73 which attenuate the device voltage and apply this to unity gain amplifier U2a where the output is at 460 mV/div approx.

U2d is a summing amplifier which adds position current to the signal from R83. R27 controls the overall gain of the horizontal amplifier. A dc offset is applied to this stage in NPN/NFET and PNP/PFET via D24 and D25 to cause a position shift in the four transistor testing modes.

Q2 and Q3 form a paraphase amplifier driving the X plates with a push pull signal. Q4 acts as a constant current source.

R11 is used to increase the output stage gain in MAG.

R50 and R51 apply a signal to the vertical amplifier which is proportional to the horizontal signal. Since the two signals are in antiphase and R29 adjusts the amplitude of the R51 signal, R29 acts as an X trace rotation control.

VERTICAL AMPLIFIER (schematic 4)

The vertical amplifier produces an output voltage to the CRT Y plates which is proportional to the device current.

A voltage appears across R69, R99, R74 or R77 (shown on schematic 2) which are connected as current sensing resistors.

This voltage is applied to current summing amplifier U2c which directly drives the output paraphase amplifier Q5 and Q6.

U2c sums the following inputs:–

- (1) Signal via R49.
- (2) Position via R53.
- (3) Offset in the transistor modes via R54 or R55.
- (4) X trace rotation current from R50 and R51.
- (5) Trace rotation correction in the HI mode via R48.

R30 controls the overall gain of the vertical amplifier.

R100 and R102 feed a current into the horizontal amplifier which is proportional to the vertical deflection. R103 varies the amplitude of this current and thus acts as a Y trace rotation control.

CRT CIRCUIT (schematic 6)

The high voltage supply is provided by a sextupler operating from the power transformer T2.

ALL COMPONENTS IN THIS AREA ARE AT A HIGH VOLTAGE AND CAUTION MUST BE TAKEN IN THIS PART OF THE PCB!

Note that it may take up to one minute for the high voltages to leak away after power is removed from the instrument.

The high voltage is stabilised by a zener diode string D10 - D22.

D22 provides the negative voltage for the grid via intensity control R3.

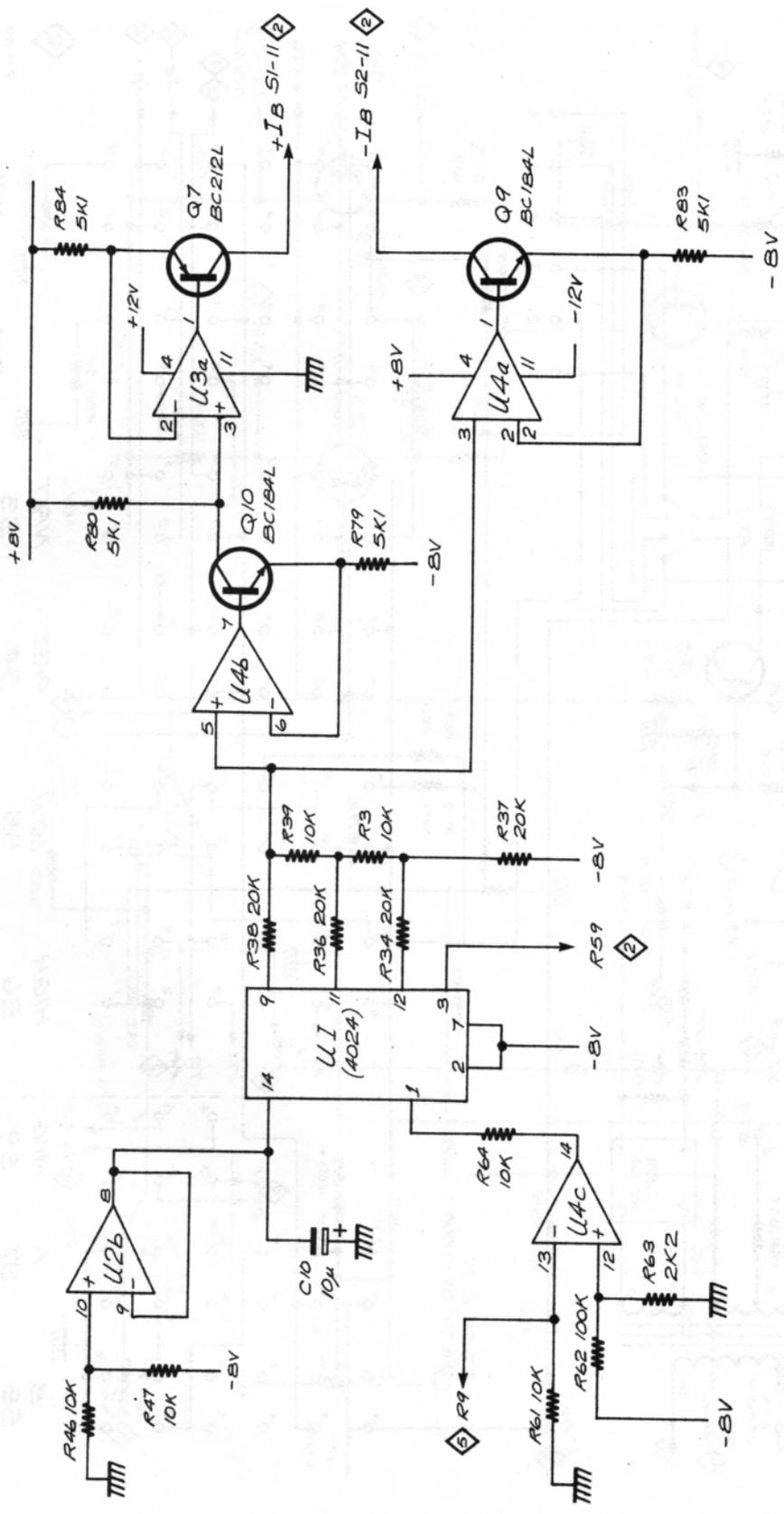
POWER SUPPLIES (schematics 5 and 6)

The unregulated +12 and -12 supplies are derived from conventional bridge rectifier circuits with smoothing.

The 200V supply for the output horizontal and vertical amplifier is half wave rectified and smoothed by D2 and C3.

The regulated +8 and -8 supplies are referenced to D26 and are derived by U3b operating as a d.c. amplifier.

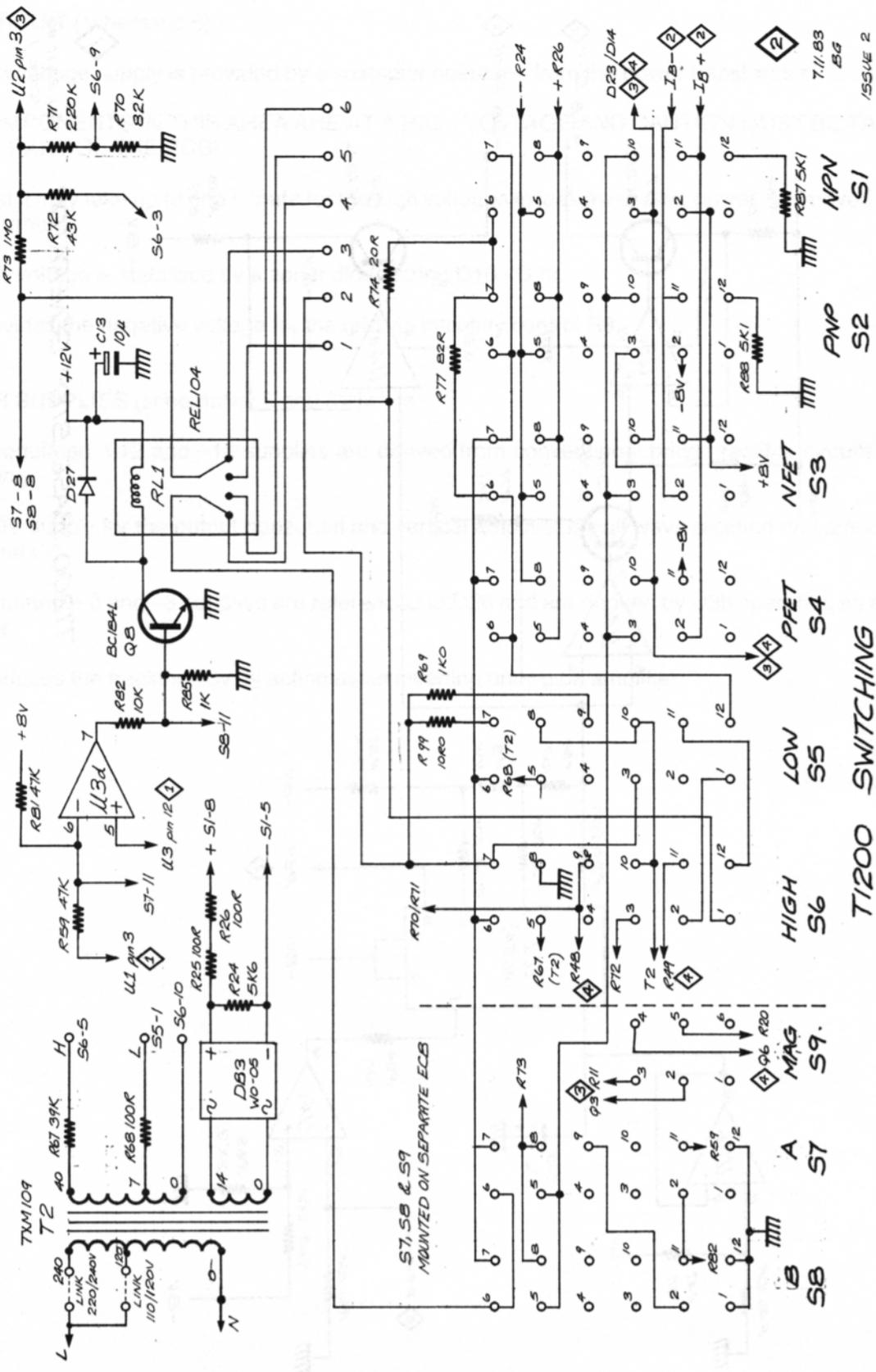
U4d produces the tracking -8v by acting as an inverting unity gain amplifier.



T1200 BASE STEP GENERATOR

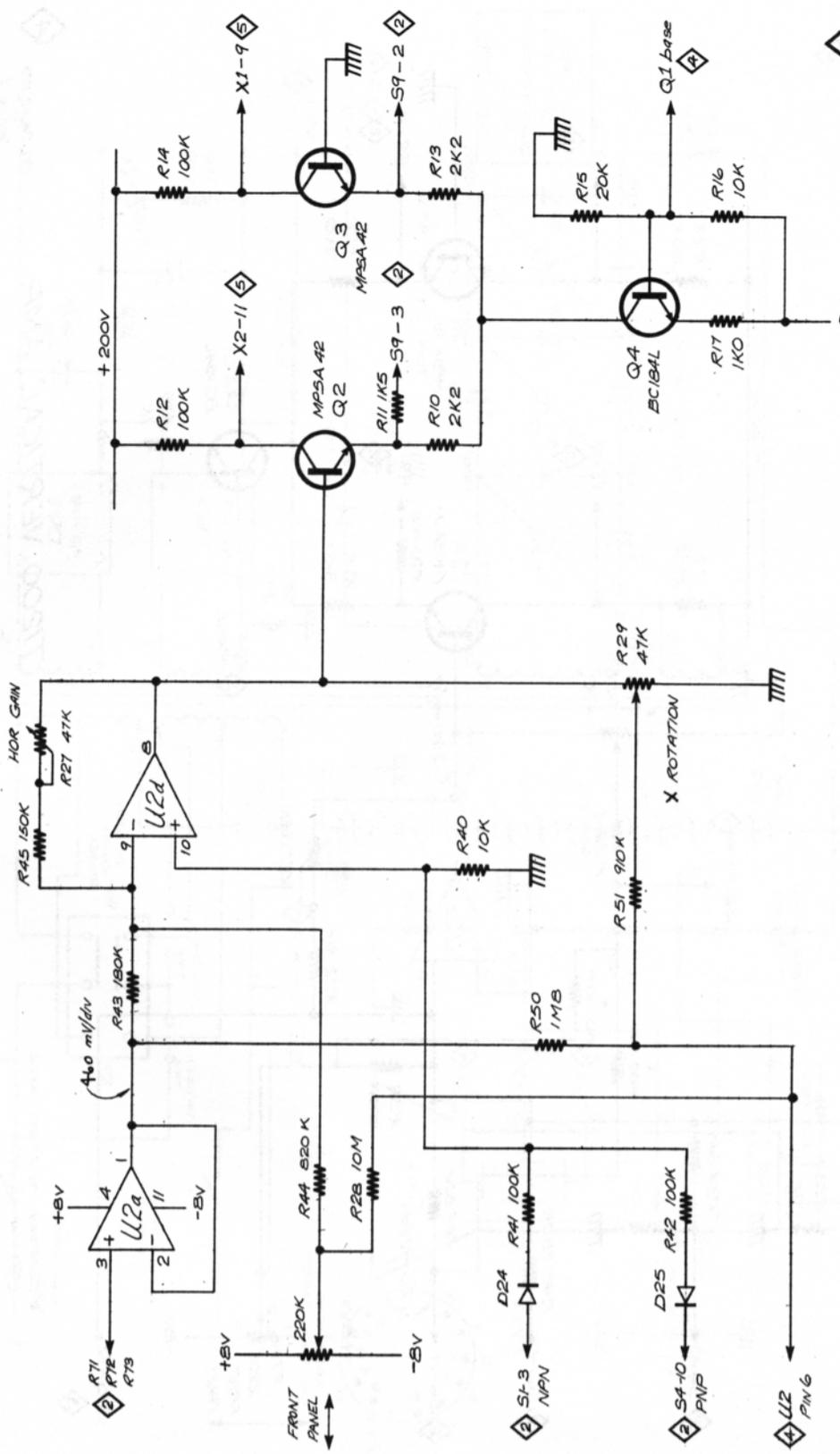
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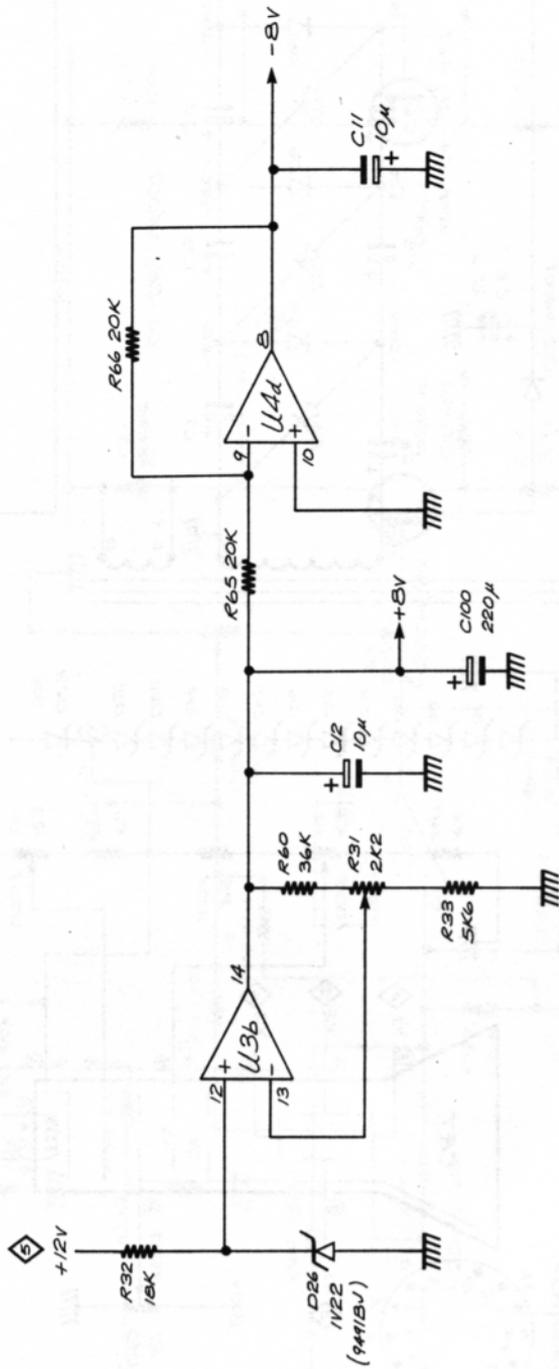
T1200 SWITCHING

S7, S8 & S9
MOUNTED ON SEPARATE PCB



T1200 HORIZONTAL AMP

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T1200 +8V & -8V SUPPLIES

T1202 DESCRIPTION

The T1202 is designed to be used with the Polar T1200 (or T1000) Faults Locator. It acts as a switch by routing a particular I.C. pin (selected by the front panel switch) to the T1200 or to its front panel 20 Volt digital voltmeter. It is used on UNPOWERED boards with the T1200, and powered boards with the D.V.M.

CHANGE OF MAINS RANGE

There are two ranges of operation for the unit:

- (i) 100 – 125V
- (ii) 200 – 250V

These ranges are selected by internal links on the p.c.b.

To change the selected range:-

1. REMOVE POWER FROM THE INSTRUMENT.
2. Unscrew the four screws through the feet and remove them. Lift off the top of the case and then the handle assembly.
3. Remove the screws securing the pcb to the lower case.
4. Observe the link positions marked adjacent to the power transformer and change as required. (Two for 120V, one for 240V).
5. Reassemble the instrument and change the rear panel fuse as per the rating shown on the panel.

T1202 CALIBRATION

Caution!

Dangerous voltages are exposed when the case is open and power is applied. The adjustment should be made with an insulated tool by qualified personnel only.

1. Remove the top of the enclosure and apply power.
2. Set the T1202 rotary switch to "SOCKETS" and select "A" and "D.V.M" using the toggle switches.
3. Apply an accurate (0.2% or better) 10 volt voltage source to the red A socket and black common socket.
4. Adjust the multiturn pot on the back of the D.V.M. module for a reading of 10.00. This is the only adjustment.
5. Reassemble the instrument.

T1202 CIRCUIT DESCRIPTION

CIRCUIT DESCRIPTION

The circuit acts as a switch and directs a selected input to either the internal D.V.M. or to a T1200 (or T1000).

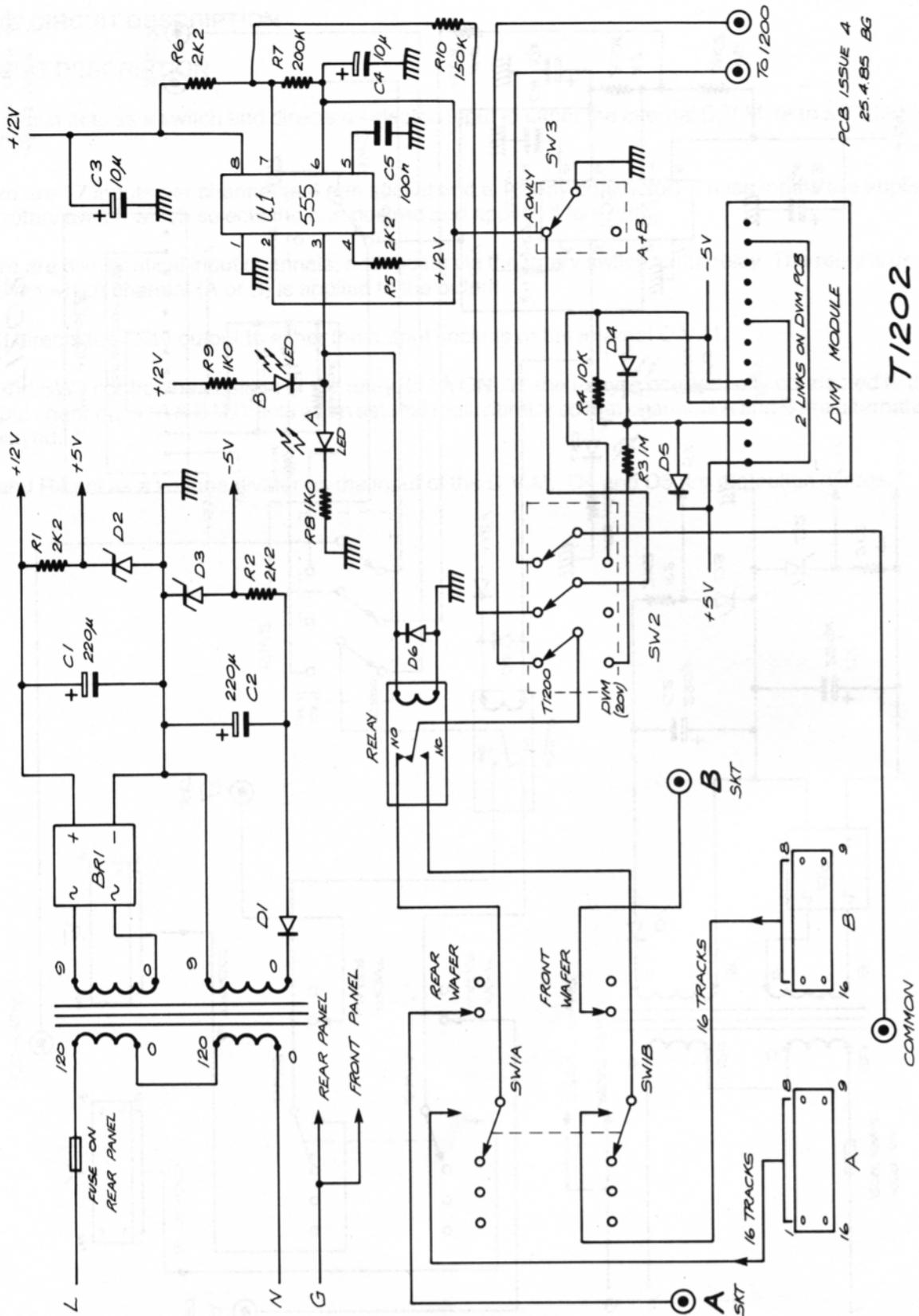
There are 17 inputs per channel (a 4 mm socket and a 16 way connector). These inputs are applied to a rotary switch which selects the one desired and applies it to a relay.

There are two identical input channels, both going via the rotary switch to the relay. The relay is used to select which channel (A or B) is applied to the output.

SW2 directs the relay output to either the output sockets or the internal D.V.M.

U1 and SW3 control the position of the relay. In "A ONLY" the relay is permanently connected to the A input channel. In "A & B" U1 acts as an astable multivibrator so that channels A and B are alternately displayed.

R3 and R4 act as a voltage divider on the input of the D.V.M., D4 and D5 are protection diodes.



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