# OPERATING INSTRUCTIONS

# LABORATORY OSCILLOSCOPE

# TYPE D33/D33R



MAINFRAME AND TIMEBASE.
NO Y-AMPLIFIERS.

by TELEQUIPMENT

# GENERAL DESCRIPTION

## CATHODE RAY TUBE

This is a $3\frac{1}{2}$" flat faced tube with helical post deflection acceleration. It has two identical gun and vertical deflection assemblies. The top gun is usable over the top 5 cm of the 6 cm graticule, the lower gun over the lower 5 cm.

Separate brightness and focus controls are provided for the two traces with a common astigmatism control. The P1 phosphor is normally supplied but a long persistence (P7) tube is available if specified. A green or amber filter is provided to improve the contrast under conditions of high ambient illumination. Internal preset controls are provided for horizontal alignment of the two traces and equalisation of the deflection sensitivities of the two guns.

## VERTICAL DEFLECTION AMPLIFIER TYPE 'A'

The amplifier whichis plugged into the upper position will drive the vertical deflector plates of the upper gun, and the amplifier in the lower position drives the deflector plates of the lower gun.

The type 'A' amplifier is a four stage, balanced, DC coupled circuit which uses both inter-stage and output cathode followers, the amplifier is compensated for optimum pulse response without overshoot. The sensitivity is 100 mV per cm DC to 6 Mc/s (-3dB) with the Y amplifier gain switch in the normal position and 10 mV per cm DC to .5 Mc/s (-3dB) with the Y amplifier gain switch in the X 10 position.

The nine-position input attenuator is frequency compensated and gives sensitivities of 100mV (10mv), 500mV (50mv), 1V(100mV), 2V (200mV), 5V (500mV), 10V (1V), 20V (2V), 50V (5V). The bracketed figures apply with the amplifier gain switch in the X 10 position.

The preset gain controls adjacent to the X10 and X 1 selector buttons are used to standardise the sensitivities of the amplifier against an internally generated 1V peak to peak squarewave.

The input impedance is 1 megohm, shunted by about 30 pf.

## VOLTAGE CALIBRATOR

A 1 volt p.p. squarewave, stabilised against line voltage variations is available at a connector on the amplifier front panel.

## TIME BASE UNIT

The time base unit which is detachable for service has three main sections, the sweep generator, horizontal amplifier and the trig selector circuit.

The terminals on the front panel give access to the sweep output, X amplifier input and external trig.

## SWEEP CIRCUIT

The sweep generator is a Miller run-down circuit giving excellent linearity. Eighteen pre-set sweep speeds are provided, from 1 usec. per cm. down to .5 sec. per cm. in 1, 2, 5, 10 etc. multiples. A variable control with a range of approximately 3:1, allows adjustment of sweep speed between ranges.

## HORIZONTAL AMPLIFIER

The X-GAIN control expands the trace to over 10 diameters and sufficient shift is provided to enable any part of the expanded trace to be positioned centrally on the screen.

## TRIGGERING

Two modes of triggering are provided:

1. AUTO. On this setting the sweep free runs at a slow speed in the absence of an input signal, but will be triggered automatically as soon as an input signal is applied. This mode of operation can be used for 90% of all normal laboratory uses.

2. TRIGGER LEVEL SELECTION. With the AUTO switch OFF the Trigger Level Control allows the sweep to be triggered at any point on the input waveform.

## T. V. SYNC SEPARATOR

The built-in TV sync separator triggers the sweep from the Line or Frame pulses of a composite Television waveform.

## Z MOD

A socket is provided on the rear panel of the instrument.

## TRACE UNBLANKING

D.C. coupling of the unblanking waveform gives uniform trace brightness at all sweep speeds and operates in such a way that the time base flyback is completely eliminated.

## PROBE TEST POINT

A test point is provided on the front panel giving a suitable step voltage for adjustment of the high impedance probes.

## COOLING

The D.33 is cooled by convection. Air enters the bottom of the case and is drawn up past the tubes and other hot components and is passed out through the slots at the top.

Do not obstruct the air flow in any way.

Do not put anything on top of the instrument. Make sure that there is an air space underneath.

## FIRST TIME OPERATION

Unless you are familiar with this type of sweep generator follow these simple instructions carefully and then run through the procedure a few times to feel thoroughly at home with the instrument before putting it into use.

Set the front panel controls as follows :

| | |
|---|---|
| INPUT SWITCH | D.C. |
| VOLTS/CM | .5 |
| FOCUS Upper | Mid position |
| ASTIG | Mid position |
| Y SHIFT | Mid position |
| BRILLIANCE Upper | Fully anti-clockwise |
| X GAIN | Fully anti-clockwise |
| X SHIFT | Mid position |
| STABILITY | Fully clockwise |
| TRIGGER LEVEL | Anti-clockwise to position just before switch operates. |
| TIME/CM | 20 ms |
| VARIABLE | Fully clockwise |
| TRIG SELECTOR | Normal $Y_1$ tve |

Switch on and allow a few minutes for the instrument to warm up. Now advance the brilliance control until a trace appears and position the trace in the centre of the screen by means of the X and Y SHIFT controls. Adjust the ASTIG and FOCUS controls for a clean sharp trace.

Repeat for the other trace.

Now back off the STABILITY control until the sweep just fails to free run. This is the normal position of the STABILITY control and once it is set it should not require any readjustment except at the very highest sweep speeds. The instrument is now ready for use.

You will find that if the TRIGGER LEVEL control is turned fully anti-clockwise to operate the AUTO switch, the trace will re-appear. In this condition the instrument is ready to accept almost

any input waveform and trigger automatically from it, the only adjustments required are the selection of the appropriate sweep speed and Y Sensitivity (VOLTS/CM). However, in order to use the D33 to best advantage the functions of the controls should be understood fully and the following procedure will demonstrate their use.

Return the TRIG LEVEL control to the position just before the Switch operates. There should now be no traces visible on the screen (there may be a bright spot at the left-hand side of the screen depending on the precise setting of the BRILLIANCE controls).

Now join a short connector between the CAL. post and the INPUT sockets and rotate the TRIG. LEVEL control clockwise until the traces appear. (If the sweep does not trigger it is because the STABILITY control has been backed off too far). The Scope is now displaying the calibration voltage waveform which should be a square wave of 2 cm. amplitude with one cycle occurring every cm. You will find that this is a very convenient waveform for demonstrating the functions of the controls.

## FOCUS AND ASTIG

You will find that by adjusting the FOCUS controls either the horizontal or vertical edges of the squarewave can be brought into focus, but only if the ASTIG. control is in the correct position will it be possible to focus the whole of the waveform simultaneously. Once the ASTIG. control is set it should require no further adjustment and a clean fine trace will be obtained over the whole of the screen.

## SWEEP CONTROLS

### TIME/CM

The calibration waveform is at supply line frequency so that when operating at 50 c/s, 1 cycle occupies 20 milliseconds. With the TIME/CM switch set to 20 milliseconds per cm. the SET SPEED control can be adjusted so that one cycle of the calibration waveform occupies precisely 1 cm. This standardises the whole of the time calibration of the instrument, all other ranges being direct multiples of this. Speed calibrations only apply when the VARIABLE control is in its fully clockwise position.

For most purposes, however, when time calibration is not required, the TIME/CM and VARIABLE controls are merely used to obtain a picture of convenient size.

In the case of instruments intended for use on 60 cycle supplies :

Press switch to calibrate on 10 milliseconds VARIABLE fully clockwise.

TRIG LEVEL

Set the TIME/CM switch to 5 ms./cm. giving 1 cycle of the squarewave 4 cm. long. Now rotate the TRIG. LEVEL control and it will be found that the starting point of the trace can be moved up and down the sloping edge of the squarewave. If the control is turned too far clockwise the trigger point goes over the top of the squarewave and the sweep stops. Similarly, rotation too far anti-clockwise sets the point too low and the sweep again stops. It should now be appreciated that this control does not govern the amplitude of the trigger signal but sets the precise point or level at which the sweep triggers. Thus by adjusting this control the sweep can be made to trigger at any point on the input waveform. (Positive or negative edges can be selected on the TRIG. SELECTOR SWITCH). This facility is extremely useful when dealing with complex waveforms when a normal type of sweep generator will either not trigger at all or will double trigger and produce a multiple pattern. It is also useful as an amplitude discriminator enabling the sweep to ignore small amplitude signals and only trigger when the input voltage reaches a pre-determined value. You will find that adjusting the sweep speed does not alter the trigger point, the trace simply expands from the given starting point. This will enable you to examine a section of the waveform in detail by setting the TRIG. LEVEL control to trigger just before the portion to be examined and expanding this portion as required by the sweep speed controls.

AUTO

On this setting no control over the trigger level is available. The sweep automatically adjusts itself to trigger at approximately the mean level of the input waveform. You can use this setting for practically all applications involving repetitive waveforms of a fairly simple nature and the sweep generator will trigger automatically on signals between about 50 c/s and 1 Mc/s, provided the amplitude exceeds about 2 mm.

In the AUTO position with no input signal the trace will become progressively less bright as the sweep speed is increased. This is normal since in the absence of a trigger signal the sweep free runs at about 50 c/s whatever the setting of the speed control. As soon as an input signal is applied the sweep will immediately synchronise to it and the trace will revert to its full brightness.

TRIG. SELECTOR

The D.33 has three selector switches, one selecting the signal source and, of the other two, one selects positive or negative polarity and the third normal operation, T.V. line or T.V. frame. In order to clarify the operation of the selector switches their functions are listed below:-

| | |
|---|---|
| Normal | Both out |
| T.V. frame | Top in |
| T.V. line | Lower in |
| | |
| + ve | Top in |
| - ve | Lower in |
| | |
| External | Both out |
| Y 1 | Top in |
| Y 2 | Lower in |

X-GAIN AND X-SHIFT

With the X-GAIN control in the minimum (anti-clockwise) position, the trace will be approximately 7 cm. long and the X-SHIFT control should be used to centre this trace about the 6 cm.

ruled graticule. Increasing the X-GAIN control expands the trace about the centre of the screen up to a maximum of just over 10 screen diameters giving an effective trace length of 60 cm. and the X-SHIFT control is then used to position the required portion of this trace on the screen.

It should be noted that the time calibration only holds good at the minimum setting of the X-GAIN control. If you want to measure time intervals at any other setting the speed must be standardised at this setting by means of the internal calibration waveform. For instance, if the X-GAIN control is increased so that 1 cycle of the calibration waveform occupies 5 cm. then the gain is exactly five times on all ranges, and provided the X-GAIN control is not touched all sweep speeds will be multiplied by a factor of 5. Obviously you can have any multiplication factor between 1 and 10.

VOLTS PER CM.

This is a nine-position switch which inserts a series of frequency compensated resistance dividers between the input socket and the Vertical Amplifier. Normally this is used merely to obtain a picture of convenient height, but if the gain of the Amplifier is standardised, direct readings of input voltage can be made. For this purpose the gain should be set by means of the SET Y-GAIN pre-set controls on the front panel so that the 1 volt squarewave calibration occupies exactly 2 cm. on the .5v/cm. scale with the Y-GAIN control in the normal position. With the gain in X 10 position the 1 volt squarewave will occupy 2 cms. on the 5 v/cm. scale. The squarewave amplitude should be measured between the horizontal flat portions. All other ranges then direct readings in volts per cm.

X1. X10 GAIN SWITCH

This switch changes the value of plate loads in the Y amplifier, the sensitivity being multiplied by 10 when the X10 position is selected, the attenuator reading in volts/cm should be divided by 10, and in the X1 position will be read directly.

## D.C./A.C. SWITCH

On the A.C. position this switch inserts a blocking capacitor in series with the input of the Vertical Amplifier removing the D.C. component of the signal. This is the condition in which the D33 will normally be used unless it is specifically required to include the D.C. component or to use the instrument on very low frequency signals. The time constant of the input circuit on the A.C. position is such that the response is 3dB down at 2 cycles, which, while adequate for all normal purposes, may limit the application in some instances. For instance you will notice that on the 50 cycle squarewave a pronounced tilt occurs on the A.C. position. If a longer time constant is required, a higher capacity external blocking capacitor must be used with the input switch set to D.C.

## Z MOD.

This socket which is located on the rear panel of the instrument is connected via a blocking capacitor to the cathode of the C.R.T. Thus, a negative pulse will brighten the trace. The time constant of this circuit is .01 mf. and 10,000 ohms.

## SIMPLIFIED METHOD

In the above instructions the functions of controls have been explained in some detail so that the engineer using the D33 may fully appreciate its capacities and the method of function. There will, however, be a large number of users who will not require all the facilities provided and to whom simplicity of operation is of major importance. The following simplified instructions will suffice for most applications, in fact for any application where the older type of Oscilloscope could be used the following method will provide much better results much more quickly and simply.

Set input switch to A.C.

Switch on and allow a few minutes to warm up.

Turn STABILITY control fully clockwise and adjust BRILLIANCE and FOCUS controls for a sharp trace.

Back off STABILITY control until the TIME BASE stops. The STABILITY control once set should not require any further adjustment.

The instrument is now set for use.

For most applications switch to AUTO, connect input signal and adjust VOLTS/CM. switch to give a convenient size trace. Use TIME/CM and VARIABLE as coarse and fine frequency controls to suit the input signal.

For TV waveform use L or F positions of TRIG. SELECTOR. If the sweep fails to lock, the STABILITY control has been turned up too far.

For some input waveforms and sometimes for T.V. waveforms it may be necessary to adjust the TRIG. LEVEL control rather than to use the AUTO position.

# MAINTENANCE ADJUSTMENTS

The simplicity of the circuitary of the D33 makes it an extremely reliable instrument and for the most part servicing will be limited to the replacement of defective tubes. When replacing tubes in the vertical Amplifiers you may find that you will have to select pairs of tubes of approximately the same characteristics in order to get the vertical SHIFT to operate symmetrically about the centre of the screen. Apart from this, replacements of tubes in the Vertical Amplifier will have very little effect on its performance and no readjustment should be necessary. In the sweep generator and Horizontal Amplifier the tubes are not particularly critical and you will find that you can replace these without having to alter the internal adjustments. If for any reason the internal pre-set controls do require adjustment the following detailed instructions will allow you to do this quickly and accurately.

## ADJUSTMENT PROCEDURE

### INPUT ATTENUATOR

In order to adjust the input attenuator compensation you will need a squarewave generator with a frequency of approximately 2KCs and whose output can be varied between .2 volts and 100 volts. The rise time of the squarewave need not be particularly fast but it must have a good flat top and bottom. Connect the squarewave generator to the input socket and adjust the output to approximately .2 volt. Set the input attenuator to .1 volt per cm. and adjust the sweep controls so that you are displaying 3 cycles of the squarewave. Now carry out the following procedure step by step adjusting each trimmer to give a square corner to the squarewave. On each setting of the input attenuator you should adjust the output of the squarewave generator to give a trace of approximately 2 - 3 cm. amplitude.

| Set Input Attenuator to: | Adjust |
|---|---|
| .2 volts per cm. | C12 |
| .5 " " " | C13 |
| 1 " " " | C4 |
| 2 " " " | C8 |
| 5 " " " | C9 |
| 10 " " " | C5 |

If you have carried out these adjustments correctly the 20 volts per cm. and the 50 volts per cm. ranges are automatically correct. In order to adjust the capacitors C2 and C3 it is necessary to use the high impedance probe as these two capacitors only affect compensation when this probe is in use. Remove the squarewave generator from the input socket and plug in the high impedance probe, connect the output of the squarewave generator to the probe tip and set the input attenuator to .1 volt per cm., set the output of the squarewave generator to give approximately 2 cm. amplitude and adjust the probe trimmer (this is accessible through the hole in the probe body) to give a flat top to the squarewave. Now switch the input attenuator to the 1 volt per cm. range, re-adjust the output of the squarewave generator and adjust C2, set the input attenuator to the 10 volts per cm. range and adjust C3. All other ranges will automatically be correct.

## VERTICAL AMPLIFIER

Adjustment of the high frequency compensation of the vertical Amplifier should only be carried out if you have at your disposal a squarewave generator which is capable of producing an accurate squarewave at a frequency of about 250 KCs with a rise time less than 40 milli-seconds and which is known to be absolutely free from ring or overshoot. The compensation circuits in the vertical Amplifier are extremely stable and unless such a generator is available you would be wise not to attempt any readjustment.

Set the input attenuator switch to .1 volt per cm. and adjust the output of the squarewave generator to give a trace of approximately 2-3 cm. amplitude (the output frequency on the generator should be between 200 and 300 KCs). The variables L1. L5. L6 and C17 are to some extent interdependent and it may be necessary

to adjust any or all of these to obtain the desired result which is a flat topped squarewave with a fast rise time, square corners and no overshoot. L5 and L6 affect the extreme corners of the square wave and should be adjusted so that they are approximately equal inductances. C17 has a longer time constant and should be set to give a flat top to the squarewave.

The only other adjustments on the vertical amplifier are the set GAIN controls, X1. X10. These should be standardised against the internal lv. squarewave.

## TRIGGER CIRCUIT

* R123, LATER VERSIONS.

The only adjustment necessary in the TRIGGER circuit is an occasional setting of the TRIGGER sensitivity control R119.* This should be set so that the TRIGGER circuit will operate when the trace amplitude on the screen exceeds 2 mm. If any attempt is made to increase the sensitivity beyond this point erratic operation will almost inevitably result. This adjustment can conveniently be made using the internal calibration signal. Join a connector between the CAL. output and the input and adjust the sweep controls so that you are displaying about 5 cycles of the calibration waveform. Now set the input attenuator to the 5 volts per cm. range (giving a trace 2 mm. high) and adjust the TRIGGER sensitivity control so that at a critical setting of the TRIG. LEVEL control the sweep will just trigger, now reduce the trace amplitude to 1 mm. and make sure that the sweep will not trigger on this signal.

## SWEEP GENERATOR AND HORIZONTAL AMPLIFIER

To make a complete readjustment of the Sweep Generator and Horizontal Amplifier carry out the following procedure :

Set the TIME/CM switch to 100 usecs. and the MULTIPLIER Switch to 10, advance the STABILITY control until the Sweep just free runs. With the X-SHIFT control in its mid position and the X-GAIN control in the minimum position, adjust R145 until the trace length is approximately 7 cm. and adjust R160 to centre this trace about the 6 cm. marks on the graticule. Adjust R170 preset potentiometer adjacent to V106 to stop the retrace blanking

generator. Now advance the BRILLIANCE control until you can see the spot at the beginning of the trace and you will find that by adjusting C107 you will be able to make a small "tail" appear to one side of the spot or the other. The correct setting for C107 is the point at which this "tail" just disappears into the spot. Re-set R170 to the point where the time base initial spot is suppressed. (See note on Retrace Blanking.) Alternatively, C107 can be adjusted by displaying a signal of approximately 100 KCs and setting C107 for optimum linearity at the beginning of the trace, but the first method is more simple and is quite satisfactory. Now set the TIME/CM switch to 20 millisecond. Now display the calibration voltage waveform and set the "set speed" control so that 1 cycle of the calibration waveform occupies exactly 1 cm. (still with the X-GAIN control to its minimum position). Now set the TIME/CM switch to one usec. Inject an accurate 1 megacycle signal into the input and adjust the volts per cm. switch to give a trace approximately 2 cm. amplitude. Now adjust C113 so that each cycle of this 1 megacycle signal occupies 1 cm.

## VOLTAGE CALIBRATOR

R198 in the voltage calibrator circuit is provided so that the output can be set to precisely 1 volt. This adjustment can only be made by comparing the output with a known accurate 1 volt peak to peak signal. R198 will normally require no adjustment, provided that if the gas diode N103 is replaced, one of a similar type is used (N101 and N102 have a negligible effect on the amplitude of the output waveform).

## RETRACE BLANKING

Adjustment of R170 will show that there are three separate modes of operation for the Retrace blanking generator. These are: 1. The trace is uncontrollably bright and the retrace is apparent. 2. The retrace is blanked. 3. The full trace is blanked. The correct position of the potentiometer within the centre section is such that increasing the brightness does not affect the trace length.

## HIGH IMPEDANCE PROBE

The adjustment of the probe compensation is best carried out with a squarewave generator with an output frequency of approximately 1 KC. The compensation trimmer is accessible through the hole in the body of the probe and you should adjust this to give a square corner to the squarewave. If a squarewave generator is not readily available the probe can be compensated using an internal signal from the sweep generator in the following manner :

Set the sweep speed to 1 millisecond per cm. and set the input attenuator to the 20 volts per cm. position. Set the AC/DC switch to AC. Now apply the tip of the probe to the test point and adjust the probe compensating trimmer to give a level start to the trace.

## TUBE DATA

For the benefit of users not familiar with this type of double gun cathode ray tube with helical post deflection acceleration, we reprint the following extracts from the tube manufacturer's specification :

### BASE CONNECTIONS

Base : B 12F

| | | | |
|---|---|---|---|
| 1. | g'' | 7. | $a_1'$ |
| 2. | k'' | 8. | $a_2'$ |
| 3. | h'' | 9. | h' |
| 4. | h'' | 10. | h' |
| 5. | $a_2''$ | 11. | k' |
| 6. | $a_1''$ | 12. | g' |

Pins 6 and 7 internally connected

Side pin connections as viewed from base and reading clockwise from base-pin 3 :

$x_1''$ $x_2''$ $y_2''$ $y_1''$ $a_3''$ s $a_3'$ $y_2'$ $y_.'$ $x_2'$ $x_1'$

Side contact ($a_4$) : CT8

The undeflected spots will lie within two circles of 3 mm. radius whose centres lie on the Y axis 12 mm. from the centre of the tube face.

Minimum useful scan measured about a centre $\pm$ 3 mm. from the centre of the tube face: X: 6 cms. Y: 4.8 cms.

Each individual gun will scan a square of at least 6 x 6 cm.

Angle between deflection axes of each gun: $90 \pm 1^{o}$.

The corresponding deflection axes are co-linear within $1^{o}$.

Deflection linearity. The deflection factor for a deflection of less than 75% of the useful scan area will not differ from that for a deflection of 25% by more than 2%.

Pattern distortion. The edges of test rasters scanned by both guns and superimposed will lie between two concentric rectangles of 61.5 x 51.2 mm. and 58.5 x 48.8 mm.

The individual horizontal x-traces will not depart from a mean straight line by more than $\pm$ 0.25 mm.

## TUBE CHANGING INSTRUCTIONS

It will be appreciated that there are inherent differences between any two tubes of the same type due to small variations in both X plate alignment and sensitivities. The following simple instructions will enable the instrument to be re-aligned to give the same "X" performance on each trace.

Remove the sides, front bezel and graticule of the D.33.

Remove the tube base and side connectors from the tube.

Unscrew the two 2BA screws on either side of the support clamp at rear of the tube and remove clamp.

By gently pushing the front of the tube and supporting the tube in the other hand, it will now be possible to lift the tube out. Remove the outer mu metal shield, inner gun shield and rubber bands from the tube and replace on the new tube in identical manner. Replace the tube etc. in reverse to the above instructions; replace the clamp and screws, but do not tighten the screws. Switch the instrument on, and obtain two traces on the screen of the tube. It will now be found necessary to rotate the whole tube assembly until the traces are exactly horizontal, this can be

checked against the graticule. Having done this, the screws on the support clamp may be tightened.

Set the time base speed to approximately 1 millisec. per centimetre, the traces approximately 1 mm apart in the centre of the tube and on examination it will almost certainly be noticed that the trace lengths are either not of the same length or not in the same position on the X axis, or a combination of both.

The relative positions and trace lengths are adjusted by the pre-set potentiometers R150 and R156 in the anode circuits of the X Amplifier output tubes. The potentiometers are adjusted simultaneously, the trace lengths being altered by turning both controls in the same direction, the position of each trace is altered by rotating the controls in opposite directions.

Next set the time base speed at 1 millisec. per centimetre and adjust R145 (1 M.ohm) for a trace length of 7 cms. Finally adjust trimmer C107 (6-30pf) so that the spot at the beginning of the trace is not elongated, i.e. has no "tail" on it - see note on Sweep Generator and Horizontal Amplifier. Replace the sides, graticule and appropriate filter and instrument is ready for use.

# TRIGGER CIRCUIT

| Part No. | C.C.T. Ref. | Value | Description | Type | Tol. | Rating |
|---|---|---|---|---|---|---|
| 38L | R101 | 1.2 M | RESISTOR - Type 'S' | C | 10% | ¼w |
| 38L | R102 | 1.2 M | " " | " | " | " |
| 8L | R103 | 100 | " " | " | " | " |
| 11L | R104 | 470 | " " | " | " | " |
| 50L | R105 | 4.7K | " " | " | " | " |
| 50L | R106 | 4.7K | " " | " | " | " |
| 23L | R107 | 6.8K | " " | " | " | " |
| 38L | R108 | 1.2M | " " | " | " | " |
| 38L | R109 | 1.2M | " " | " | " | " |
| 26L | R110 | 22K | " " | " | " | " |
| 30L | R111 | 68K | " " | " | " | " |
| 47C | RV112 | 100K | POTENTIOMETER 'Trig.Level' | | | |
| 29L | R113 | 56K | RESISTOR - Type 'S' | C | 10% | ¼w |
| 29L | R114 | 56K | " " | " | " | " |
| 8L | R115 | 100 | " " | " | " | " |
| 57M | R116 | 22K | RESISTOR - Type 'Y' | C | 10% | 1w |
| 20L | R117 | 3.3K | RESISTOR - Type 'S' | C | 10% | ¼w |
| 29L | R118 | 56K | " " | " | " | " |
| 36L | R119 | 560K | " " | " | " | " |
| 57M | R120 | 22K | RESISTOR - Type 'Y' | C | 10% | 1w |
| 19L | R121 | 2.7K | RESISTOR - Type 'S' | C | 10% | ¼w |
| | R122 | | | | | |
| 93C | RV123 | 100K | POTENTIOMETER PRESET 'Trig.Sens.' | | | |
| 16K | C101 | 0.1uf | CAPACITOR Wima Tropyfol | POL | 10% | 400v |
| 16K | C102 | 0.1uf | " " " | POL | " | 400v |
| 53K | C103 | 100pf | " | CER | " | 350v |
| 16K | C104 | 0.1uf | " Wima Tropyfol | POL | " | 400v |
| | C105 | | | | | |
| 25K | C106 | 0.01uf | " | M.P. | " | 500v |
| 16K | C107 | 0.1uf | " Wima Tropyfol | POL | " | 400v |
| 41K | C108 | 30pf | " | CER | " | 350v |
| 31K | C109 | 500pf | " | M.P. | " | 350v |
| 53K | C110 | 100pf | " | CER | " | 350v |

## TRIGGER CIRCUIT (continued)

| Part No. | C.C.T. Ref. | Value | Description | Type | Tol. | Rating |
|---|---|---|---|---|---|---|
| 10T | V101 | | ECF80 VALVE | | | |
| 19T | V102 | | ECF804 VALVE | | | |
| 35D | S101 | | 2 BUTTON SWITCH - AB TYPE 500 | | | |
| 35D | S102 | | 2 BUTTON SWITCH - AB TYPE 500 | | | |
| 35D | S103 | | 2 BUTTON SWITCH - AB TYPE 500 | | | |

## TIME BASE & HORIZONTAL AMPLIFIER

| Part No. | C.C.T. Ref. | Value | Description | Type | Tol. | Rating |
|---|---|---|---|---|---|---|
| 32L | R123 | 220K | RESISTOR - Type 'S' | C | 10% | ¼w |
| 61C | R124 | 50K | POTENTIOMETER 'VARIABLE' | | | |
| 26L | R125 | 22K | RESISTOR - Type 'S' | C | " | " |
| 24C | R126 | 100K | POTENTIOMETER PRESET 'SET SPEED' | | | |
| 29L | R127 | 56K | RESISTOR - Type 'S' | " | " | " |
| 36L | R128 | 560K | " " | " | " | " |
| 8L | R129 | 100 | " " | " | " | " |
| 8L | R130 | 100 | " " | " | " | " |
| 50L | R131 | 4.7K | RESISTOR - Type 'Y' | C | 10% | 1w |
| 8L | R132 | 100 | RESISTOR - Type 'S' | C | 10% | ¼w |
| 50M | R133 | 39K | RESISTOR - Type 'O' | C | 10% | 2w |
| 42L | R134 | 4.7M | RESISTOR - Type 'S' | C | 10% | ¼w |
| 35L | R135 | 39K | " " | " | " | " |
| 39L | R136 | 1.5M | " " | " | " | " |
| 38L | R137 | 1.2M | " " | " | " | " |
| 31L | R138 | 100K | " " | " | " | " |
| 47C | R139 | 1M | POT. STABILITY | | | |
| 51M | R140 | 100K | RESISTOR - Type 'O' | C | 10% | 2w |
| | R141 | | | | | |
| 31L | R142 | 100K | RESISTOR - Type 'S' | C | 10% | ¼w |
| 21L | R143 | 4.7K | " " | " | " | " |
| 36L | R144 | 560K | " " | " | " | " |
| 35C | R145 | 1M | POTENTIOMETER PRESET. TRACE LENGTH | | | |
| | R146 | | | | | |
| 32L | R147 | 220K | RESISTOR - Type 'S' | C | 10% | ¼w |
| 42C | R148 | 100K | POTENTIOMETER 'X' SHIFT | | | |
| 60M | R149 | 56K | RESISTOR - Type 'Y' | C | 10% | 1w |
| 31C | R150 | 5K | POTENTIOMETER PRESET | | | |
| 60M | R151 | 56K | RESISTOR - Type 'Y' | C | 10% | 1w |
| 21L | R152 | 4.7K | RESISTOR - Type 'S' | C | 10% | ¼w |
| 18L | R153 | 2.2K | " " | " | " | " |
| 43C | R154 | 9K | POTENTIOMETER 'X' GAIN | | | |
| 60M | R155 | 56K | RESISTOR - Type 'Y' | C | 10% | 1w |

## TIME BASE & HORIZONTAL AMPLIFIER (continued)

| Part No. | C.C.T. Ref. | Value | Description | Type | Tol. | Rating |
|---|---|---|---|---|---|---|
| 31C | R156 | 5K | POTENTIOMETER PRESET | | | |
| 60M | R157 | 56K | RESISTOR - Type 'Y' | C | 10% | 1w |
| 21L | R158 | 4.7K | RESISTOR - Type 'S' | C | 10% | $\frac{1}{4}$w |
| 12L | R159 | 560 | " " | " | " | " |
| 35C | R160 | 1M | POTENTIOMETER PRESET. 'X' SHIFT | | | |
| 38L | R161 | 1.2M | RESISTOR - Type 'S' | C | 10% | $\frac{1}{4}$w |
| 16J | C107 | 6-30pf | TRIMMER | CER | | 250v |
| 28K | C108 | 0.01uf | CAPACITOR - Wima Tropyfol | POL | 10% | 400v |
| 18K | C109 | 100pf | CAPACITOR | SM | 10% | 350v |
| 10J | C110 | 0.22uf | CAPACITOR - Wima Tropyfol | POL | 10% | 400v |
| 26K | C111 | 0.1uf | CAPACITOR - Wima Tropyfol | POL | 10% | 400v |
| 10T | V103 | | ECF80 VALVE | | | |
| 10T | V104 | | ECF80 VALVE | | | |
| 10T | V105 | | ECF80 VALVE | | | |
| 34E | MR101 | | OA 81 DIODE | | | |

# TIME/CM SWITCH

| Part No. | C.C.T. Ref. | Value | Description | Type | Tol. | Rating |
|---|---|---|---|---|---|---|
| 16M | R162 | 350K | RESISTOR | H.S.C. | 1% | $\frac{1}{4}$w |
| | R163 | 820K | " | " | " | " |
| 15M | R164 | 400K | " | " | " | " |
| 9M | R165 | 1.2M | " | " | " | " |
| 8M | R166 | 2M | " | " | " | " |
| 6M | R167 | 4M | " | " | " | " |
| 4M | R168 | 12M | RESISTOR 2x6 MEG | " | " | " |
| 42K | C112 | 39pf | CAPACITOR | CER | 10% | 350v |
| 16J | C113 | 6-30pf | TRIMMER | CER | | 250v |
| 9K | C114 | 180pf | CAPACITOR | SM | 2% | 350v |
| 53K | C115 | 100pf | " | CER | 10% | 350v |
| 36K | C116 | 0.002uf | " | POLYSTYRENE | 2% | 350v |
| 18K | C117 | 0.001uf | " | MP | 10% | 500v |
| 37K | C118 | 0.02uf | " | POLYSTYRENE | 2% | 350v |
| 25K | C119 | 0.01uf | " | MP | 10% | 500v |
| 27K | C120 | 2x0.17f | " | POL | 5% | 400v |
| 26K | C121 | 0.1uf | " | POL | 10% | 400v |

## C.R.T. & RE-TRACE BLANKING

| Part No. | C.C.T. Ref. | Value | Description | Type | Tol. | Rating |
|---|---|---|---|---|---|---|
| 62L | R169 | 4.7K | RESISTOR - Type 'O' | C | 10% | 2w |
| | R170 | 10K | POTENTIOMETER PRESET | | | |
| 39L | R171 | 3Meg | RESISTOR - 2x1.5Meg Type 'S' | C | 10% | $\frac{1}{4}$w |
| 8L | R172 | 100 | RESISTOR - Type 'S' | " | " | " |
| 52L | R173 | 6.8K | RESISTOR - Type 'Y' | C | 10% | $\frac{1}{2}$w |
| 49L | R174 | 3.9K | " " | " | " | " |
| 50L | R175 | 4.7K | " " | " | " | " |
| 8L | R176 | 100 | RESISTOR - Type 'S' | C | 10% | $\frac{1}{4}$w |
| 32L | R177 | 220K | " " | " | " | " |
| 22X | R178 | 68K | RESISTOR - Type 'Y' | C | 10% | $\frac{1}{2}$w |
| 34M | R179 | 1M | POTENTIOMETER PRESET. I.P.S. | | | |
| 38L | R180 | 1.2M | RESISTOR - Type 'S' | C | 10% | $\frac{1}{4}$w |
| 48C | ( R181 | 1M | POTENTIOMETER FOCUS | | | |
| | ( R183 | | " BRILLIANCE | | | |
| 36L | R182 | 560K | RESISTOR - Type 'S' | C | 10% | $\frac{1}{4}$w |
| 24L | R184 | 10K | " " | " | " | " |
| 48C | ( R185 | 1M | POTENTIOMETER FOCUS | | | |
| | ( R187 | 200K | " BRILLIANCE | | | |
| 36L | R186 | 560K | RESISTOR - Type 'S' | C | 10% | $\frac{1}{4}$w |
| 38L | R188 | 1.2M | " " | C | 10% | $\frac{1}{4}$w |
| | R189 | 1M | POTENTIOMETER ASTIG | | | |
| 29L | R190 | 56K | RESISTOR - Type 'S' | C | 10% | $\frac{1}{4}$w |
| 31L | R191 | 100K | " " | C | 10% | $\frac{1}{4}$w |
| 59L | R192 | 100K | RESISTOR - Type 'Y' | C | 10% | $\frac{1}{2}$w |
| 25L | R193 | 15K | RESISTOR - Type 'S' | C | 10% | $\frac{1}{4}$w |

## C.R.T. & RE-TRACE BLANKING (continued)

| Part No. | C.C.T. Ref. | Value | Description | Type | Tol. | Rating |
|---|---|---|---|---|---|---|
| 57J | C122 | 32uf | CAPACITOR | ELEC | | 275v |
| | C123 | 32uf | " | ELEC | | 275v |
| 41K | C124 | 30pf | " | CER | | 350v |
| 16K | C125 | 0.1uf | CAPACITOR - Wima Tropyfol | POL | 10% | 400v |
| 35J | C126 | 0.01uf | CAPACITOR | CER | 10% | 1.5kv |
| 16K | C127 | 0.1uf | CAPACITOR - Wima Tropyfol | POL | 10% | 400v |
| 16K | C128 | 0.1uf | CAPACITOR - Wima Tropyfol | POL | 10% | 400v |
| 18 O | MR102 | | 50 AS SILICON RECTIFIER | | | |
| 18T | V106 | | ECC 88 VALVE | | | |
| 56Y | CRT | | CATHODE RAY TUBE 924F. | | | |

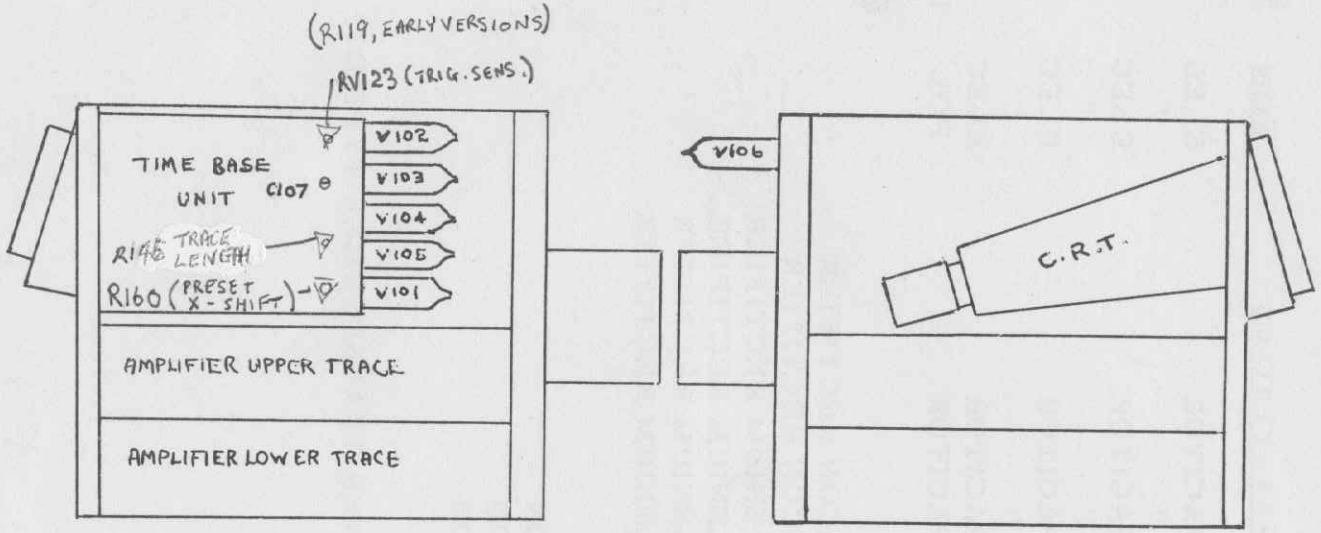
# POWER SUPPLY

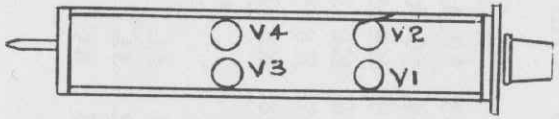
| Part No. | C.C.T. Ref. | Value | Description | Type | Tol. | Rating |
|---|---|---|---|---|---|---|
| 28L | R191 | 33K | RESISTOR - Type 'S' | C | 10% | ¼w |
| 36L | R192 | 560K | " " | " | " | " |
| 36L | R193 | 560K | " " | " | " | " |
| 57L | R194 | 39K | RESISTOR - Type 'Y' | C | 10% | ½w |
| 8M | R195 | 2M | RESISTOR | H.S.C. | 1% | ¼w |
| 57L | R196 | 39K | RESISTOR - Type 'Y' | C | 10% | ½w |
| 19M | R197 | 18K | RESISTOR | H.S.C. | 1% | ¼w |
| | RV198 | 5K | POTENTIOMETER PRESET | | | |
| 30M | R199 | 500 | RESISTOR | W/W | 5% | |
| 30M | R200 | 500 | " | " | " | |
| 34M | R201 | 5K | " | " | " | |
| 30M | R202 | 500 | " | " | " | |
| 34M | R203 | 5K | " | " | " | |
| 33M | R204 | 4.7K | " | " | " | 5w |
| 40M | R205 | 12K | " | " | " | " |
| 44M | R206 | 15K | " | " | " | " |
| 78M | R207 | 680K | RESISTOR - Type 'S' | C | 10% | ¼w |
| 31L | R208 | 100K | " " | C | 10% | ¼w |
| | | | | | | |
| 16K | C129 | .1uf | CAPACITOR - Wima Tropyfol | POL | 10% | 400v |
| 16K | C130 | .1uf | CAPACITOR - Wima Tropyfol | POL | 10% | 400v |
| 39J | C131 | .05uf | CAPACITOR | P | | 2kv |
| 60J | C132 | 100uf | CAPACITOR | ELEC | | 275v |
| 60J | C133 | 100uf | " | " | | 275v |
| 49X | C134 / C136 / C137 | .25uf | CAPACITOR | P | | 1500v |
| 13K | C135 | .05uf | CAPACITOR | | | 2.6kv |
| 20K | C138 | .005uf | CAPACITOR - Wima | POL | | 125v |
| 59J | C139 / C141 | 32uf | CAPACITOR | ELEC | | 450v |
| | | 32uf | " | " | | " |

## POWER SUPPLY (continued)

| Part No. | C.C.T. Ref. | Value | Description | Type | Tol. | Rating |
|---|---|---|---|---|---|---|
| 59J | C140 | 32uf | CAPACITOR | ELEC | | 450v |
| | C142 | 32uf | " | " | | " |
| 59J | C143 | 32uf | CAPACITOR | ELEC | | 450v |
| | C144 | 32uf | " | " | | " |
| 56J | C145 | 32uf | CAPACITOR | ELEC | | 350v |
| | C146 | 32uf | " | " | | " |
| 51J | C147 | 8uf | CAPACITOR | ELEC | | 450v |
| 16K | C148 | .1uf | CAPACITOR | POL | 10% | 400v |
| 18 O | MR103 | 50 AS | SILICON RECTIFIER | | | |
| 18 O | MR104 | 50 AS | SILICON RECTIFIER | | | |
| 6 O | MR105 | K8/50 | SELENIUM RECTIFIER | | | |
| 6 O | MR106 | K8/50 | SELENIUM RECTIFIER | | | |
| 6 O | MR107 | K8/50 | SELENIUM RECTIFIER | | | |
| 59F | MR108 | K8/20 | SELENIUM RECTIFIER | | | |
| 36Y | N101 | 3L | NEON | | | 60v |
| 36Y | N102 | 3L | NEON | | | 60v |
| 20Y | N103 | XC1.5 | NEON | | | 60v |
| 52S | T101 | | POWER TRANSFORMER TYPE D33 | | | |

# VALVE LAYOUT



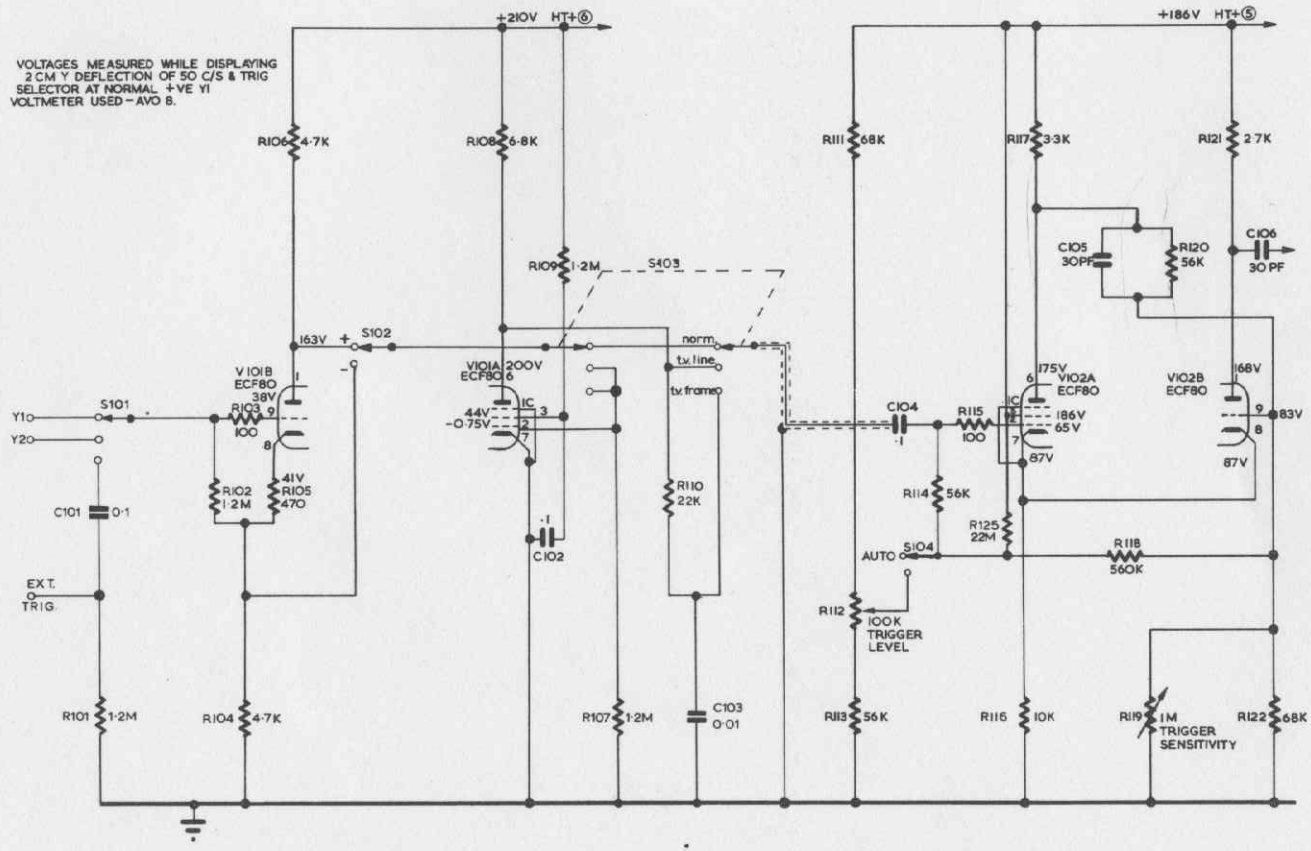




TYPE "A" GENERAL PURPOSE AMPLIFIER.

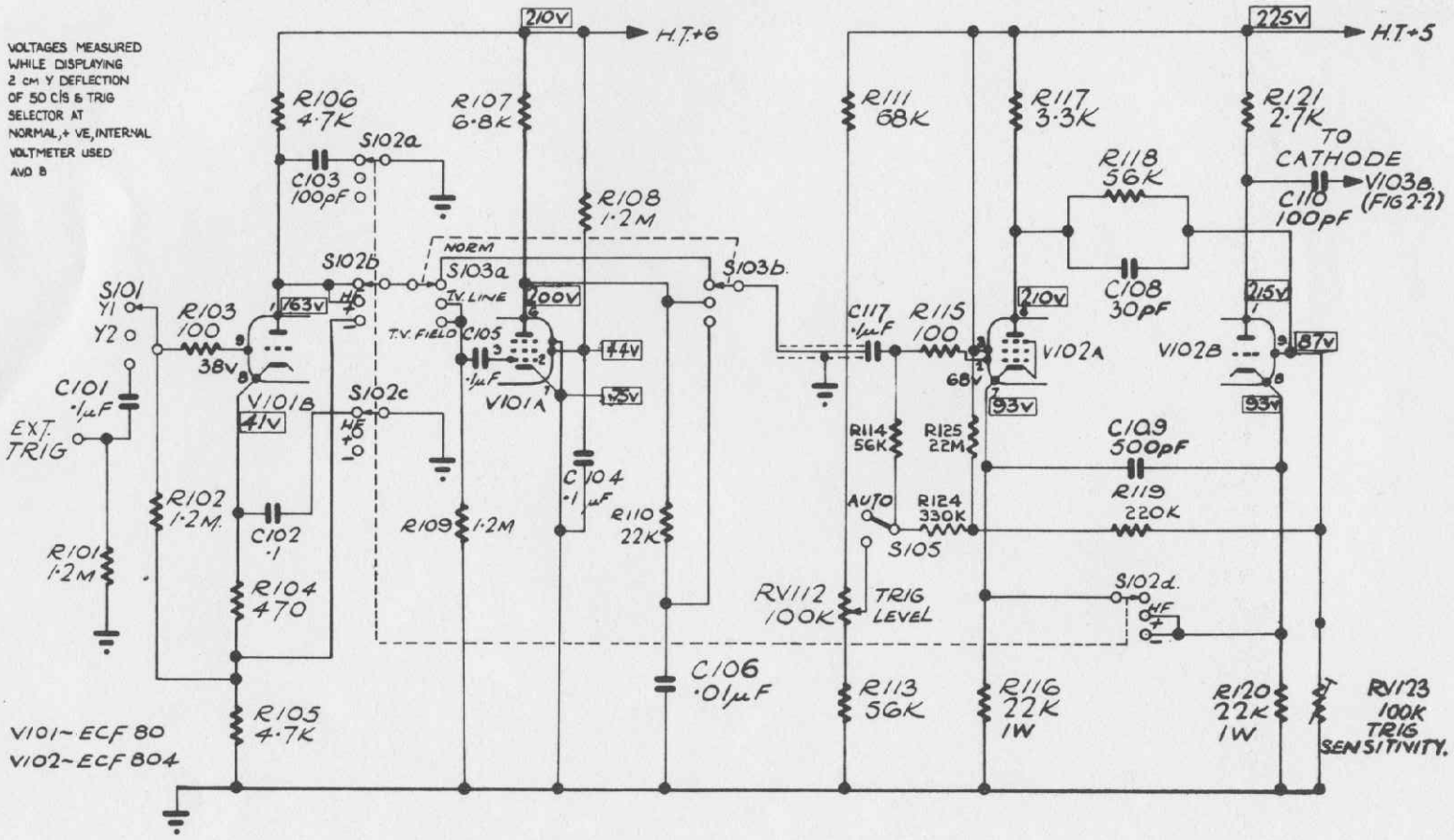
EARLY (NO H.F.)

# TRIGGER SELECTOR & TRIGGER CIRCUIT

## TYPE D33 & D33R

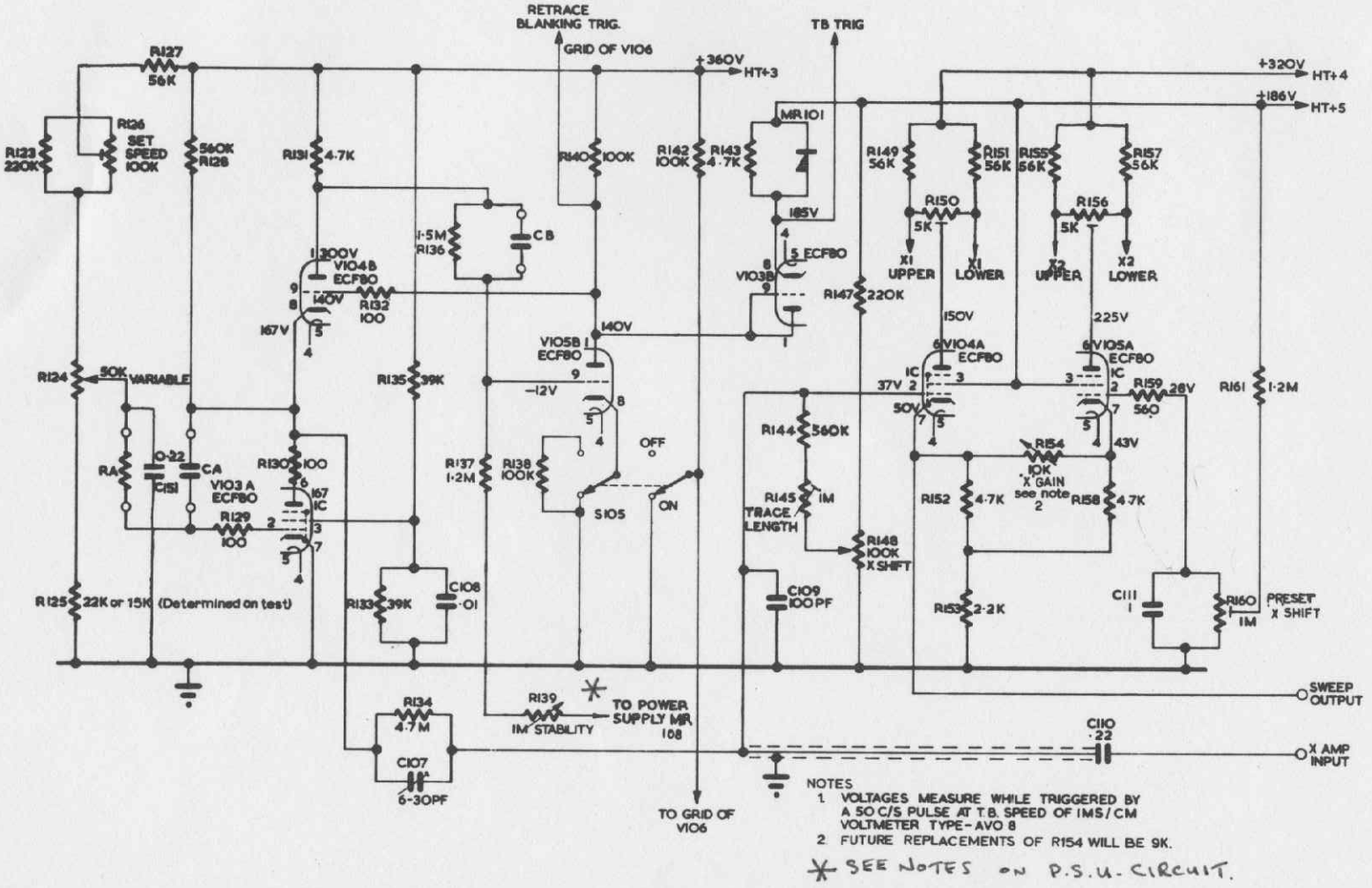


# TRIGGER CIRCUIT (WITH HF) TYPE D33 & D33R



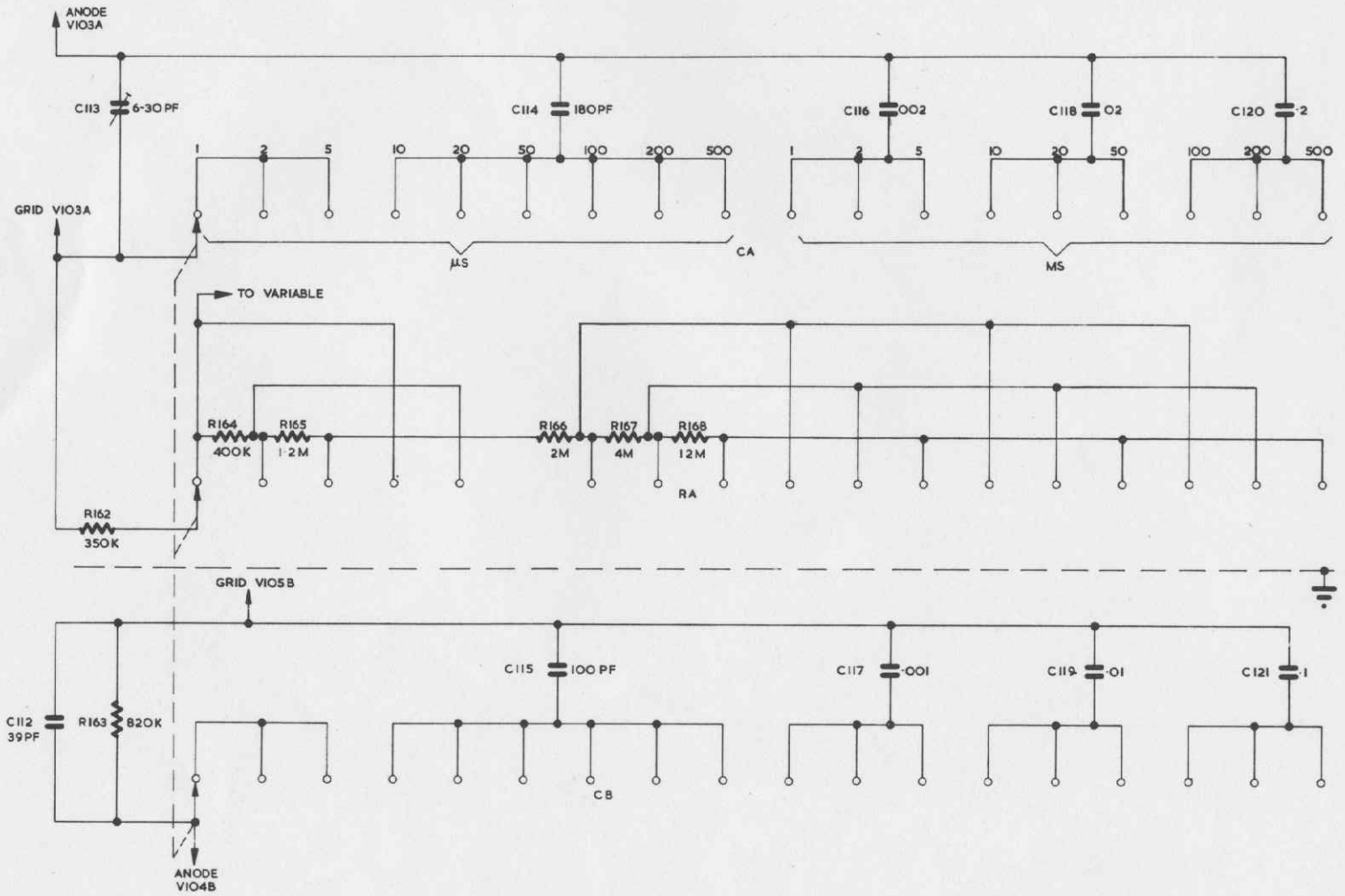
# TIME BASE & HORIZONTAL AMPLIFIER.

## TYPE D33 & D33R.

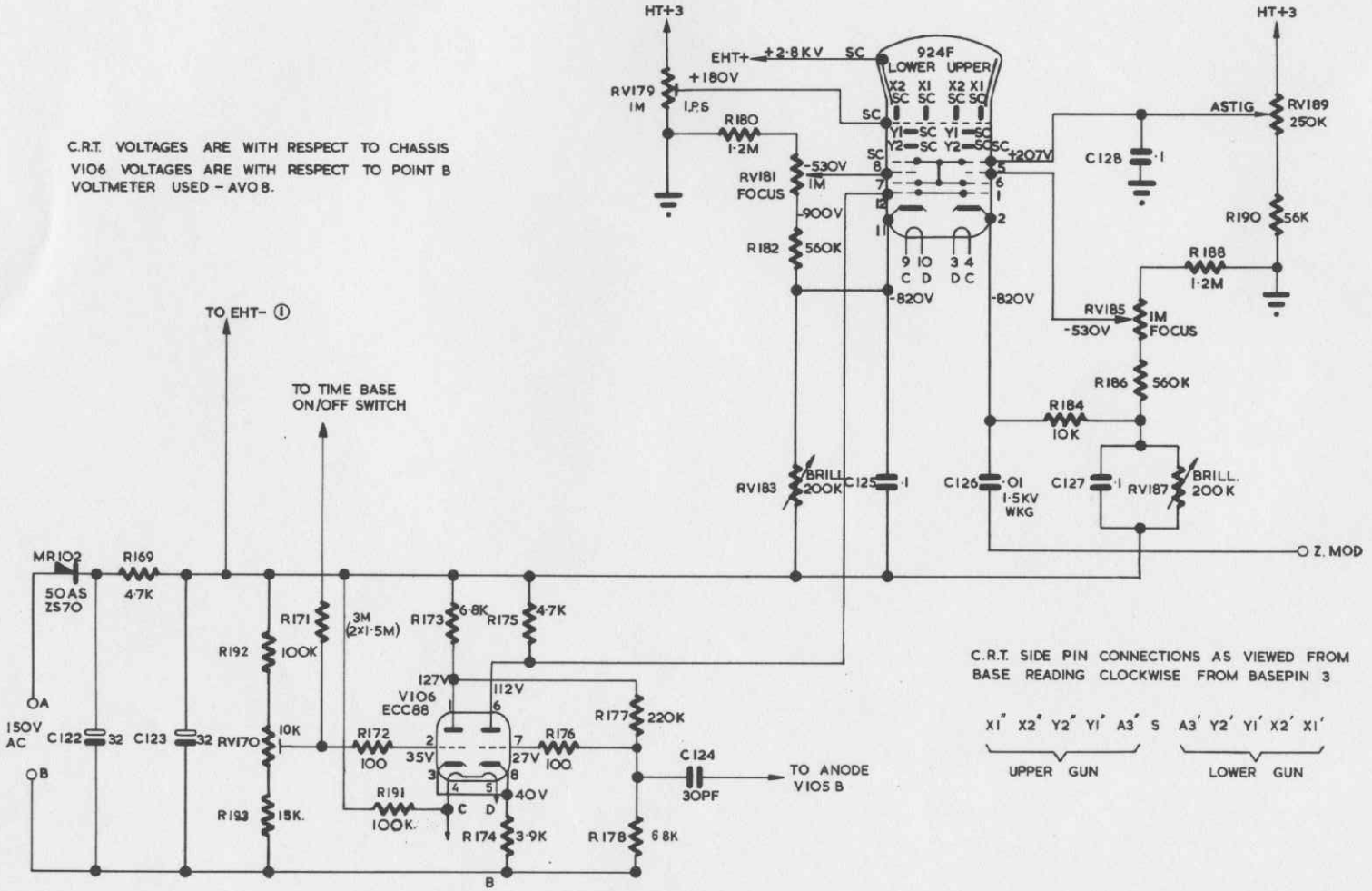


# TIME/CM SWITCH

# TYPE D33 & D33R

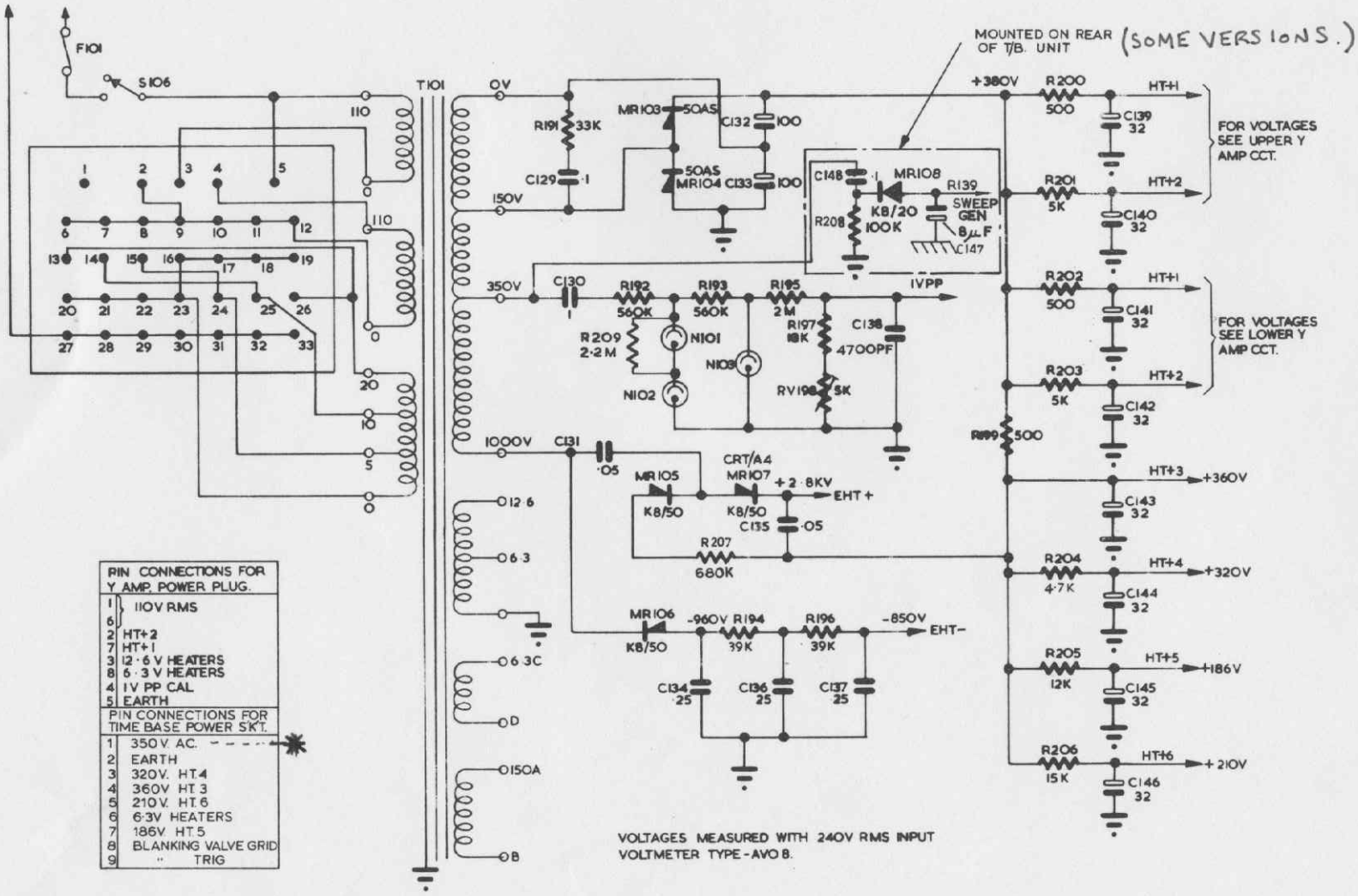


# C.R.T. & RE-TRACE BLANKING TYPE D33 & D33 R



# POWER SUPPLY.

# TYPE D33 & D33R




| PIN CONNECTIONS FOR Y AMP. POWER PLUG. | |
|---|---|
| 1, 6 | 110V RMS |
| 2 | HT+2 |
| 7 | HT+1 |
| 3 | 12·6 V HEATERS |
| 8 | 6·3 V HEATERS |
| 4 | 1V PP CAL |
| 5 | EARTH |

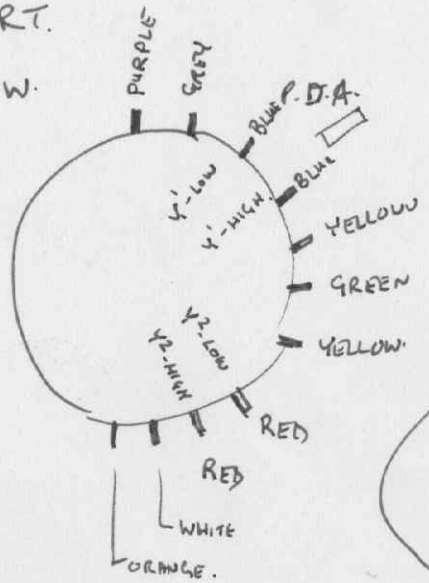
| PIN CONNECTIONS FOR TIME BASE POWER SKT. | |
|---|---|
| 1 | 350V. A.C. - - - - - * |
| 2 | EARTH |
| 3 | 320V. HT.4 |
| 4 | 360V HT.3 |
| 5 | 210V. HT.6 |
| 6 | 6·3V HEATERS |
| 7 | 186V. HT.5 |
| 8 | BLANKING VALVE GRID |
| 9 | " TRIG |

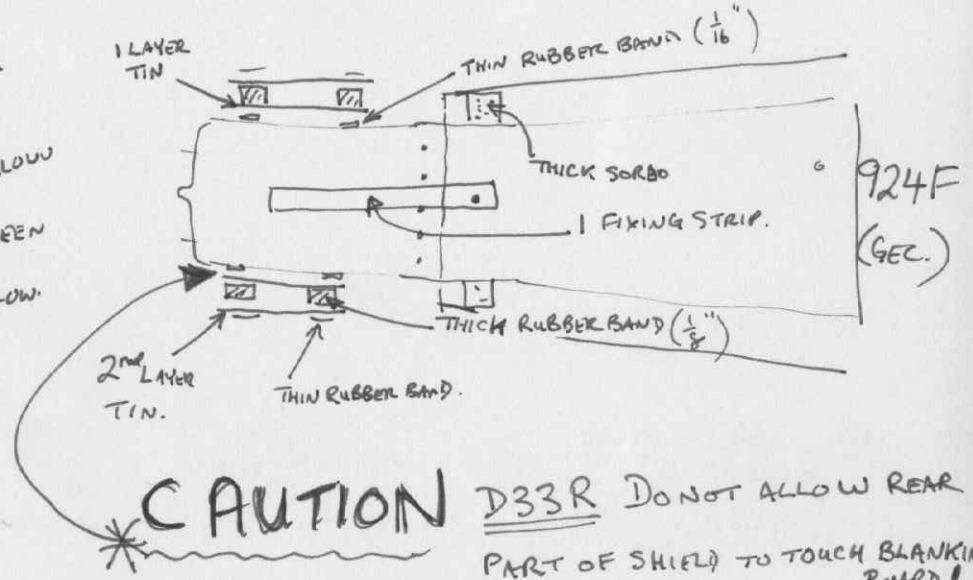
VOLTAGES MEASURED WITH 240V RMS INPUT
VOLTMETER TYPE - AVO 8.

* SOME VERSIONS, WHERE T/B DOES NOT INCLUDE MR108 etc, PIN 1 OF T/B POWER SOCKET CARRIES E.H.T. ⊖ ive.

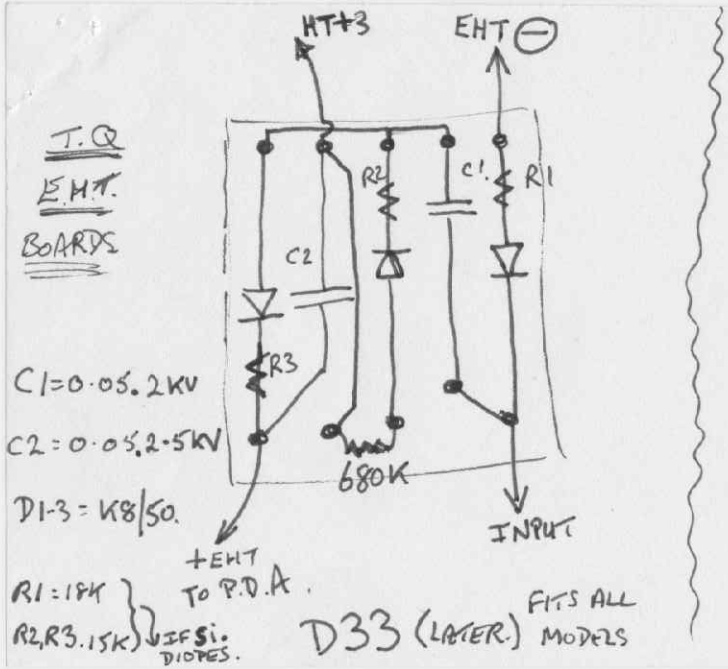
# D33 CRT.

REAR VIEW.




CAUTION D33R DO NOT ALLOW REAR PART OF SHIELD TO TOUCH BLANKIN BOARD!




T.Q. E.H.T. BOARDS

C1=0·05.2KV

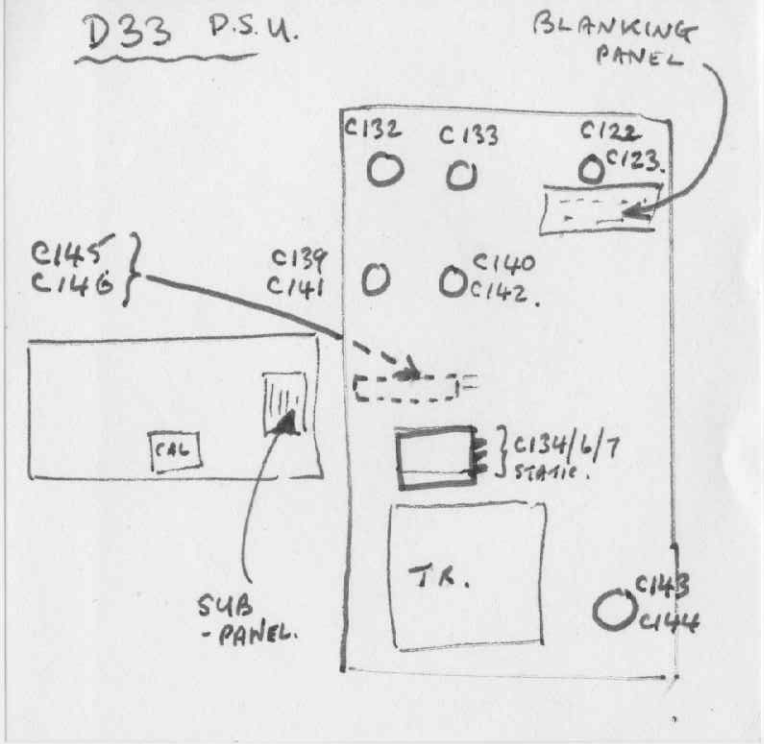
C2=0·05.2·5KV

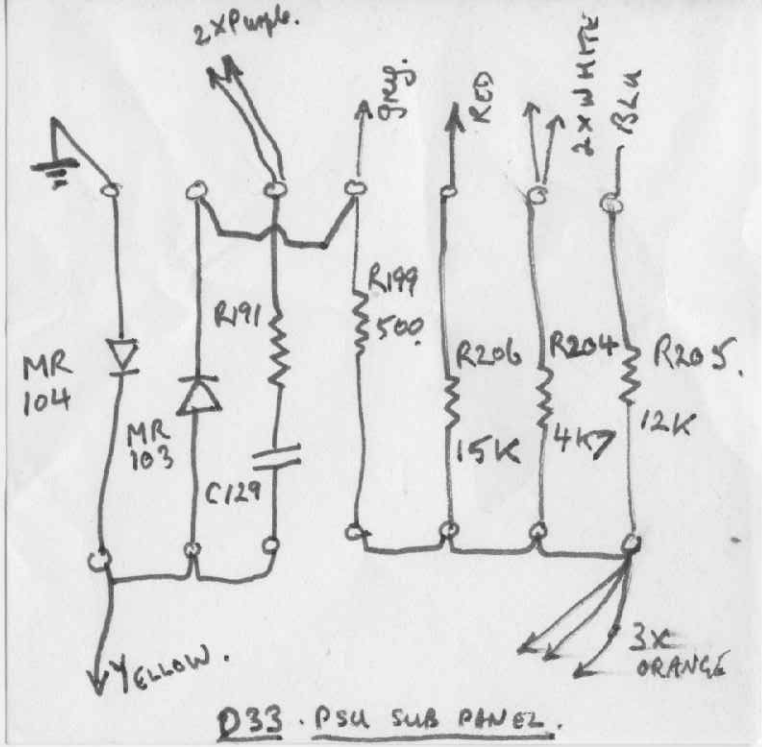
D1-3=K8/50.

R1=18K } IF Si. DIODES.

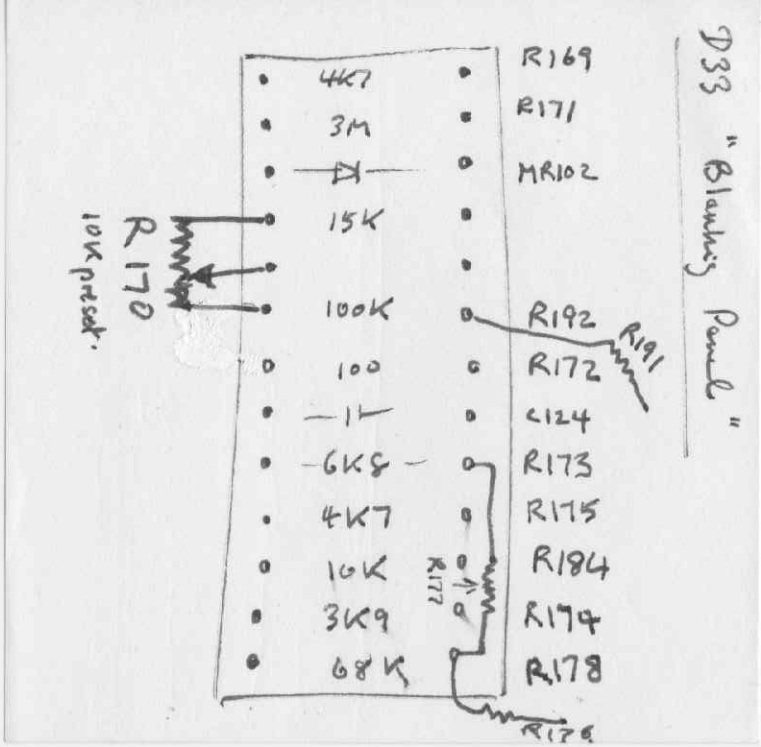
R2,R3.15K }

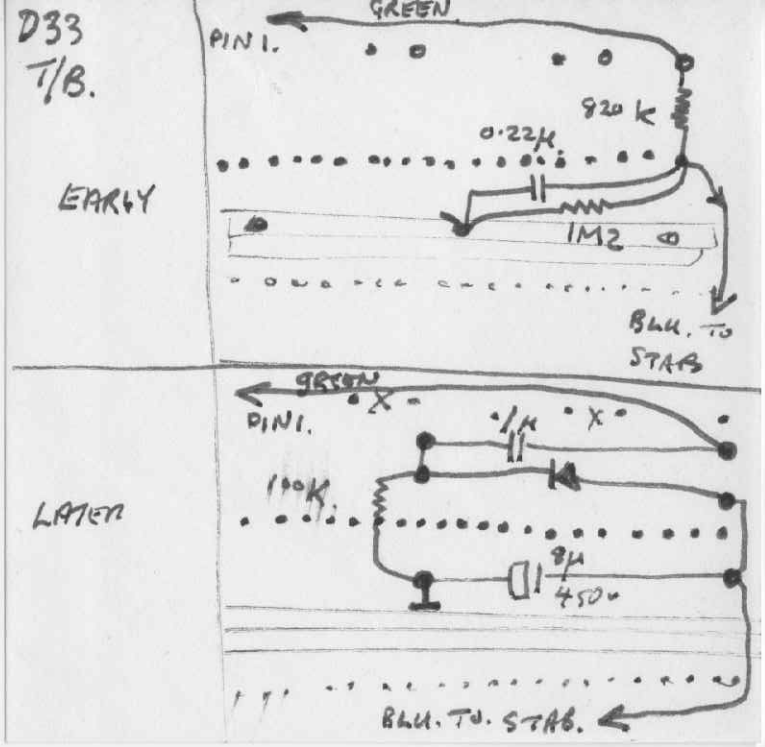
D33 (LATER.) FITS ALL MODELS




D33 . PSU SUB PANEL.


D33 "Blanking Panel"
4K7
3M
MR102
15K
100K
100
1K
6K8
4K7
10K
3K9
68K
R169
R171
R170
10K preset.
R192
R191
R172
C124
R173
R175
R184
R177
R174
R178
R176


D33
T/B.
EARLY
GREEN
PIN 1.
820 K
0.22μ
1M2
BLU. TO
STAB
LATER
GREEN
PIN 1.
1μ
100K
8μ
450v
BLU. TO. STAB.

# TELEQUIPMENT LIMITED

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