

# OS250 10MHz DUAL TRACE OSCILLOSCOPE

## Instruction Manual



ADVANCE  
INSTRUMENTS

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Telegrams Attenuate Ilford

Telex 263785

Division of ADVANCE ELECTRONICS LIMITED

# Specification

## Section 2

### DISPLAY

5 in flat faced c.r.t. giving 10 cm X 8 cm display E.H.T. – 3.6 kV overall.

Phosphor—P31. Long persistence (P7) available as an option.

### VERTICAL DEFLECTION

Two identical input channels. Y1 and Y2

**Bandwidth** (–3dB) DC–10MHz. (2Hz–10MHz on AC)

**Sensitivity** 5mV/cm to 20V/cm in 1-2-5 sequence.

**Accuracy** ±5%.

**Input Impedance** 1 MΩ/approx. 28 pF.

**Input coupling** DC–GND–AC.

**Protection** 400V DC or pk AC.

### DISPLAY MODES

**Single Trace** Y1 or Y2.

**Dual Trace** chopped or alternate modes, automatically selected on timebase switch. Chop rate approx. 250kHz.

**X-Y mode** with Y1 input giving X deflection and Y2 input giving Y deflection.

**Bandwidth** DC to 500kHz <3° phase shift at 20kHz.

### HORIZONTAL DEFLECTION

**Timebase**—1μs/cm to 0.5s/cm in 18 ranges (1-2-5) sequences.

**Accuracy** ±5%.

**X Expansion**—X10 pull switch gives fastest speed of 100 ns/cm. Accuracy ±5%

Variable control gives >2.5:1 reduction in sweep speed.

### TRIGGER

Variable level control with option of bright line in absence of signal.

Trigger level control range

INTERNAL > 8cm

EXTERNAL > 20V

### Source

Internal Y1 + or –

Y2 + or –

External + or –

External trigger input impedance, approx 100kΩ/10pF.

**Coupling** AC, AC fast, TV Frame.

### Sensitivity

Internal	2mm approx. 40Hz–2MHz.	} bright line on or off.
External	1V approx. 40Hz–2MHz.	
Internal	1cm approx. 8Hz–10MHz.	} bright line off.
External	5V approx. 8Hz–10MHz.	
Internal 2cm pk/pk video on TVF		

### ADDITIONAL FACILITIES

**Calibrator** 1 V ± 2% square wave at supply frequency.

**Ramp output** 0-10V.

**Z mod input** AC coupled. 10V gives visible modulation (2 Hz to 10MHz). 70V gives full blanking.

### SUPPLY

95-111V, 103-121V, 111-130V.	} 45-440Hz
190-222V, 206-242V, 222-260V.	
Approx. 25VA.	

### OPERATING TEMPERATURE RANGE

0-50°C (15°C to 35°C for full accuracy, approx 2% degradation at 0°C and 50°C)

### DIMENSIONS

18cm (7") X 29cm (11<sup>3</sup>/<sub>8</sub>") X 42cm (16<sup>1</sup>/<sub>2</sub>")  
Approx. 7 kg (15 lbs.).

### ACCESSORIES

**Connector BNC**—BNC PL43

**Connector BNC**—clips PL44

### OPTIONAL ACCESSORIES

**Probe Kit PN 32824.** A passive probe kit with X1 and X10 attenuations. With X10 attenuation input impedance is 10MΩ/13.5pF.

**Viewing Hood PN A1/32264.**

**Trolley Type TR4** A general purpose oscilloscope trolley.

**Protective Carrying Case PN 3247.**

A strong carrying case which completely encloses the oscilloscope with three thicknesses of padded material covering the front panel.

**Tube Option** The OS250 may be ordered with a long persistence c.r.t. (P7 phosphor).

**Rack Mount Kit PN 33389**

**Adaptor BNC**—binding post PN 26234

The OS250 block diagram is shown in Fig. 1. Inter connection of the printed circuit boards, controls, tube and associated components is shown in Fig. 6. Circuit diagrams are as follows:-

Fig. 3 Y1 and Y2 attenuators, pre-amplifiers, the main Y amplifier, beam switch and drive circuits.

Fig. 4 Timebase, X amplifier and trigger circuits.

Fig. 5 The power supply and tube network.

## 4.1 GENERAL

Referring to the block diagram (Fig.1) signals applied to the Y1 and Y2 input sockets pass into their respective attenuators and amplifiers. The VOLTS/CM switch controls the gain of the amplifier in the necessary 1, 2, 5 sequence to cover the ranges from 5mV/cm to 0.2V/cm. Above this a  $\div 100$  attenuator is introduced before the amplifier.

The fast electronic beam switch selects either the Y1 or the Y2 signal to be amplified further and passed to the Y deflection plates of the c.r.t.

A sample of each signal is taken and passed to the trigger switch, where selection of Y1, Y2 or Ext trig source is made. The selected signal is amplified and passed to the Schmitt trigger, where it is converted into fast negative-going pulses. The hold off circuit acts as a gate which is normally open to allow a trigger pulse to set the timebase bistable. The bootstrap ramp generator then begins to generate its

linear ramp, which after passing through the X amplifier is applied to the cathode ray tube and drives the electron beam linearly across the tube face. A small portion of the signal from the ramp generator is fed back to the hold off circuit, shutting the gate to prevent any further pulses from the Schmitt trigger from reaching the timebase bistable during the ramp period. When the ramp has reached the necessary maximum level, the timebase bistable is reset, and the ramp is quickly returned to its quiescent state. A time constant in the hold off circuit now holds the gate closed to inhibit another ramp from being initiated for a short period, until the ramp timing capacitor is discharged fully. Thus a ramp is generated at a rate set by the TIME/CM switch when the trigger signal reaches a predetermined level. This ramp sweeps the beam across the c.r.t. face, returns and waits for the next trigger point to be reached. The timebase bistable is connected to a blanking amplifier whose function is to turn on the electron beam during the sweep and blank it off during the fly back and subsequent waiting period.

At fast sweep rates for a dual trace display, the TIME/CM switch automatically selects the alternate sweep mode of control for the beam switch. At the end of each sweep the signal from the time-base bistable reverses the state of the beam switch bistable, causing alternate displays of the Y1 and Y2 signal on successive sweeps of the timebase. At slow sweep rates, the chop mode is selected, when the chop

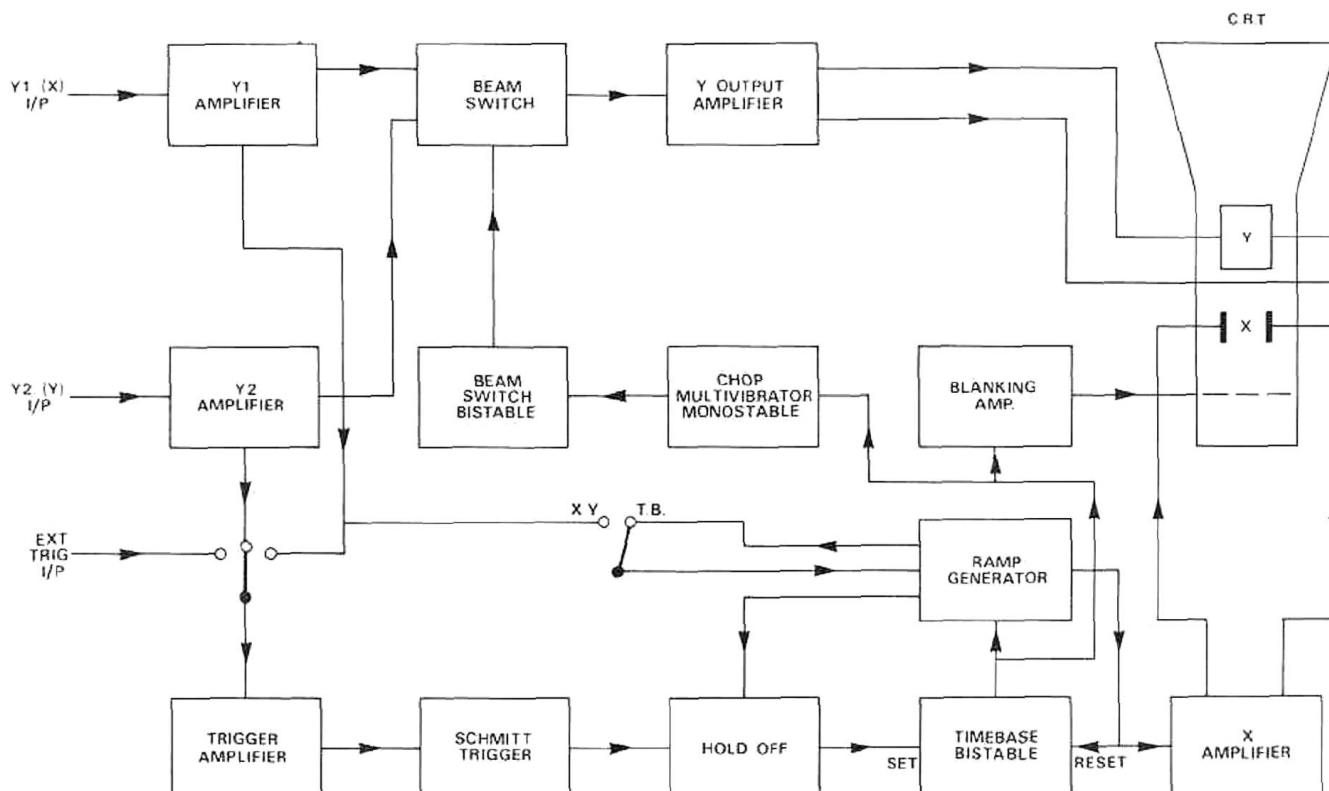


Fig. 1 Block diagram

multivibrator free runs independently, causing the beam to switch between Y1 and Y2 levels during the sweep. A signal from the multivibrator also blanks the trace during each switching transition. With Y1 or Y2 switched to the OFF position the beam switch bistable is locked to switch on the other channel.

In the X-Y mode, the signal from the Y1 amplifier, normally used for trigger, is passed via the ramp generator, which acts as a voltage follower, to drive the X plates while the beam switch selects Y2 to drive the Y plates. The beam blanking signal is not used.

## 4.2 THE Y AMPLIFIERS

The attenuator and pre-amplifier in the Y1 channel are identical to those in the Y2 channel. Accordingly, only the Y1 channel is described.

The input signal is applied to the front panel socket SKA and then to the 3 position slide switch S20, via R26. The switch selects AC or DC input coupling by including or by-passing C21 in the signal path. In the middle position of the switch, the input socket is disconnected, and the input of the attenuator is connected to ground through R27. The attenuator feeds into an impedance of  $1M\Omega$  (R29). The  $\div 100$  attenuation is determined by the potential divider action of R20 in series with the parallel combination of R29 and R201. High frequency compensation of the attenuator is achieved by the a.c. potential divider C202 and C203; C202 is set for the correct ratio. C201 is adjusted to maintain constant input capacitance between divided and undivided ranges. This attenuator is used on the six higher voltage ranges i.e. 0.5V/cm – 20V/cm, dividing them down to 5–200mV/cm. Further selection of input sensitivity is carried out by gain switching within the amplifier, and is described later. Diodes D201 and D202 in conjunction with R28 protect the input up to 400 volts peak.

The input stage consists of TR201 and TR202, a matched pair of field effect transistors. The current in TR202 is self biased such that the potential drop across R205 equals the gate/source potential. This same current flows in TR201, which operates as a source follower on the input signal. As R207 equals R205 the base potential of TR203 always equals the input voltage on the gate of TR201. The signal is passed via emitter follower TR203 to the gain switching stage.

The grounded emitter transistor TR204 forms a shunt feedback amplifier with gain determined by the ratio of the feedback resistor R211 to the input resistor R40 in parallel with the resistor selected by the range switch as shown in Table 1. R202 (BALANCE) sets the base of TR203 to null the potential across R40 etc.

The signal from the collector of TR204 is passed via R214 to the base of TR205 which in conjunction with TR206 forms a long tail pair amplifier, the gain of which

Table 1.

Switch Setting	Attenuation	Resistor Used	Amplifier Gain
5mV	$\div 1$	R40+R45	5
10mV	$\div 1$	R40+R44	2.5
20mV	$\div 1$	R40+R43	1.25
50mV	$\div 1$	R40+R42	0.5
100mV	$\div 1$	R40+R41	0.25
200mV	$\div 1$	R40 only	0.125
500mV	$\div 100$	R40+R45	5
1V	$\div 100$	R40+R44	2.5
2V	$\div 100$	R40+R43	1.25
5V	$\div 100$	R40+R42	0.5
10V	$\div 100$	R40+R41	0.25
20V	$\div 100$	R40+ only	0.125

is set by R217 and R223. The collector current of TR205 feeds into the trigger section of the timebase and 'X' amplifier circuit (fig.4). Potentiometer R52 provides a variable current via R219 into the collector circuit of TR206, to produce 'Y' shift. The bases of TR206 (Y1) and TR216 (Y2) are driven from the collector circuit of TR217 which being connected in a similar manner to TR204 and TR214 provides the correct bias and compensation for supply and temperature variations.

The beam switch, consists of diodes D203, D204, D206 and D207, with their associated drive circuitry and is described in detail in section 4.3. It selects the collector current of TR206 or of TR216 to pass through D205 and R223. The voltage developed across R223 consists of a fixed d.c. component, a variable d.c. component (Y shift) and the signal and is applied to the base of TR207, a common emitter amplifier. The emitter circuit includes potentiometer R222, to set the gain of the stage and hence the overall gain of the amplifier. The signal from the collector of TR207 is passed to the base of TR208, which with TR209, TR210 and TR211 forms the output cascode stage. TR208 and TR209, is a long-tail pair, which converts the input signal voltage to differential output current; its gain is determined by emitter resistors R234 and R236, with high frequency gain set by networks R232/C211/C212, R233/C213 and R236/C236. The collector currents of TR208 and TR209 flow into the emitters of the grounded base transistors TR210 and TR211 to develop the differential output voltage across the load resistors R230/R240 to drive the c.r.t. deflection plates. Inductors L201 and L202 are included to improve the high frequency response.



### 4.3 THE BEAM SWITCH

The cathode of D203 is supplied with a 6 volt positive-going square wave from the bistable TR218/TR219. When the waveform is "high", D203 is biased off and the collector current of TR206 passes through D204 into the output amplifier. During the low state of the waveform D203 conducts, passing this current to ground through TR219. As diodes D203 and D207 are fed with complimentary waveforms, when the current from TR206 passes to the output amplifier, that from TR216 is shunted to ground and vice-versa.

Bistable TR218/TR219 is switched with pulses from TR220/TR221, the chop multivibrator.

This emitter coupled circuit free runs at approx. 500kHz on TIME/CM settings from 0.5s to 1ms,<sup>†</sup> causing the bistable to operate the beam switch at 250kHz. In addition to driving the bistable, an output from the collector of TR221 is fed to the cathode of the c.r.t. to blank the trace during the beam switching transitions. The mark/space ratio of the multivibrator is approx. 1:4, causing the trace to be blanked for one fifth of each switching period.

At faster TIME/CM settings of 0.5ms<sup>††</sup> to 1μs, the lower end of R292 is taken to -20V by a contact on the timebase switch biasing off TR221, and preventing oscillation. The circuit now acts as a monostable, triggered via C220 at the end of each sweep by pulses from the timebase bistable, each output pulse reversing the beam switch bistable and rapidly blanking the trace.

For single trace operation, the Y shift control on the channel not required is rotated fully anti-clockwise to operate the OFF switch. In this position, the switch S27 or S28 is closed, connecting the cathode of its associated diode to the negative line. This biases off the relevant transistor in the bistable. Thus when Y1 is turned off, S27 closes, biasing off TR218; TR219 turns on and sinks the current from Y1 channel to ground through D203. A reversal occurs when Y2 is turned off. In the X-Y mode, both shift controls are set to the on position; a contact on the TIME/CM switch in parallel with S27 is used to bias TR218 off, allowing Y2 signals only to reach the Y output stage.

### \* 4.4 THE TRIGGER CIRCUITS (Fig. 4)

The collector currents from TR205 and TR215 in the Y amplifier pass to the timebase printed circuit board into R108 and R109 respectively. In series with R108 is R110 shunted by C101, a collector load network used when X-Y mode is selected. External trigger signals appear across R107, and these, together with those across R108 and R109 pass to the trigger selector switch. The selected trigger signal is amplified by TR107 and passed to the coupling switch. Here, high pass, direct

and low pass networks provide the required ACF-AC-TV filtering. Trigger level and slope selection operations are performed by long-tail pair amplifier TR101/TR102. The signal is applied to either input as determined by the slope selector switch, the other input being grounded via C121. The Trigger Level control, R10, provides a variable d.c. bias at both inputs, which the amplifier sums with the signal. The output at the collector of TR102, consisting of an alternating signal voltage superimposed on a d.c. level, passes to the Schmitt Trigger TR103/TR104, where fast negative edges are generated as the input signal crosses the circuit threshold.

### 4.5 THE TIMEBASE BISTABLE AND RAMP GENERATOR

The ramp generator comprises TR111, TR112 and TR113 as cascaded emitter follower stages, with bootstrap feedback action provided from the cathode of Zener diode D104. This feedback maintains constant voltage across the VARIABLE TIME control R11, R148, R147 and the timing resistor selected by the TIME/CM switch. This constant voltage drop, independent of actual voltage level produces a constant current to linearly charge the timing capacitor, also selected by the TIME/CM switch. The VARIABLE TIME control provides fine adjustment of the timing current, and hence sweep time, by varying the feedback voltage applied to the timing resistor.

In the quiescent condition of the timebase bistable, TR108 is on, TR109 is off and clamp transistor TR110, which shunts the timing capacitor, is saturated. A negative-going pulse from the Schmitt Trigger is coupled via C111 and D102 to turn off TR108. TR109 turns on, thus turning off TR110. The clamp is removed, allowing the timing capacitor to charge, producing the linear ramp. As the emitter of TR113 rises, a feedback voltage, via D105, R143 and R133 biases off D102 to prevent any further pulses reaching the bistable. Connected to the junction of R133/R143 is the HOLD OFF capacitor which now charges positive. When the ramp reaches its final amplitude, a rise of approximately 10V, feedback from the junction of R151/R149 is applied to the base of TR108, turning it on. The bistable reverts to its initial state allowing TR110 to turn on, rapidly discharging the timing capacitor and returning the ramp to its quiescent level. The hold off capacitor, which was charged to a positive voltage during the ramp, now slowly discharges through R143 and R153, until it is caught by D105. Only then is D102 biased for the next trigger pulse to initiate the next sweep.

An output is taken from the ramp generator via R155 to SKE, the RAMP OUT socket, on the front panel.

<sup>†</sup> 2ms. on OS250TV.

<sup>††</sup> 1ms. on OS250TV.

\* See OS250TV Supplement.

## 4.6 BRIGHT LINE CIRCUIT

When sufficient trigger signal is available, the square wave from the collector of TR104 passes through R127/C104, where restoration by D101 produces a negative going signal with respect to the negative rail. This negative signal on the base of TR105 is integrated by R124/C107 to produce a d.c. bias sufficient to hold off TR106. In this condition the circuit has no effect on timebase operation. However, when the triggering signal falls below the required level, the Schmitt trigger ceases to operate, removing the signal from D101. The voltage on the emitter of TR105 rises to approximately one volt above the negative line, turning on TR106. R177 is now effectively connected between the negative rail and the cathode of D102. It rapidly discharges the hold off capacitor below the normal quiescent level to a point where D102 conducts, turning TR108 off and initiating a sweep. At the end of the ramp, the charge on the hold off capacitor is again removed by R177/R143 and another ramp begins. These consecutive sweeps produce the bright line display. When the "PULL BRIGHT LINE OFF" control is operated, switch S10 closes, effectively shorting the base and emitter of TR106, holding it off; in this condition a ramp is only generated after the arrival of a trigger pulse.

## 4.7 THE X OUTPUT AMPLIFIER

The ramp or X-Y signal at the emitter of TR113 passes through R156 to the base of TR114, which with TR117 forms a long tail pair. Gain switching is carried out in the emitter circuit by selection of one of two resistance paths, with gains set by R169(X1) and R16 R162(X10). In timebase mode, the PULL X10 switch S11 can be operated in order to expand the trace length ten times. In the X-Y mode contacts on the TIME/CM switch, in parallel with S11, close to select this higher gain setting automatically. An X SHIFT voltage is produced at the base of TR117 by R12. The signals on the collectors of TR111 and TR117 are applied to the differential output amplifier, TR115 and TR116. Signals from the collectors of these two transistors drive the horizontal deflection plates of the c.r.t.

## 4.8 X-Y Mode

In this mode, signals are applied to both Y1 and Y2 input sockets; Y2 is routed through the beam switch to the Y deflection plates in the normal manner. Y1 is routed through the ramp generator, now acting as a high impedance unity gain buffer, and into the X output stage.

Signals entering Y1 channel pass through the attenuator and gain switching stage, as described previously. Current from TR105 passes to the X board, while that in TR206 is shunted to ground through D203. The current from TR205 develops a voltage across the series connection of

R110, R108. This voltage is level-shifted by R144/R146 to the base of TR111. In the X-Y mode, both timing resistors and capacitors are switched out of circuit, consequently TR111, TR112 and TR113 merely act as emitter followers which provide buffering between the level-shift resistors and the X output amplifier.

When this mode is selected, a contact on the TIME/CM S14(a) switch connects the cathodes of D106 and D107 to the negative line. The current drawn through D106 and R138 turns off TR108 and consequently TR110, and removes blanking. (See section 4.11)

Current through D107 controls the state of the beam switch bistable. (See section 4.3)

## 4.9 POWER SUPPLIES (Fig. 5)

All power supplies are derived from transformer T1. The primary winding can be connected to accept six supply voltage ranges, as shown in fig. 2, on the inside of the top cover.

The transformer secondary has four windings developing the following r.m.s. voltages; 6.3V, 44V (centre tapped), 140V and 1000V.

The 6.3V winding supplies the c.r.t. heater.

The 44V a.c. is rectified by MR32 and smoothed by C33/C34 to form the unstabilised +26V and -26V d.c. lines. These voltages are fed to series regulators to provide the stabilised +20V and -20V lines. As both regulators operate in an identical manner, only one will be described.

The base of series pass transistor, TR32, is fed from the output of the high gain error amplifier formed by TR305/TR306. This amplifier compares the zener reference voltage from D316 with the voltage at the junction of R310/311, a potential divider connected between the emitter of TR32 and ground. As this emitter supplies the +20V line, any fluctuations in the line voltage appear at the base of TR306 where they are amplified and inverted. This signal is then fed to the base of TR32 to correct the error, thus maintaining a constant output voltage. Resistor R309, in series with the collector of TR32, drops a voltage which is proportional to the output current. Under normal conditions, this voltage drop is less than that across R307, biasing off D310. As the output current rises above the safe maximum, D310 turns on, taking the current in R307 away from the emitter of TR305. This causes a drop in voltage at the collector of TR306 and hence on the base and emitter of TR32, limiting the current to a safe value.

The voltage from the 140V winding is rectified by MR31 and smoothed by C31 to form the unstabilised 170V line.

## Circuit Description

## Section 4

The 1000V winding energises both the  $-1.2\text{kV}$  and  $+2.4\text{kV}$  supplies. Half wave rectification of the negative half cycle by D301 produces the negative line, while voltage doubling by D302/D303 produces the positive. Stabilisation of both lines against supply variation is achieved as follows. One end of the 1000V winding feeds the diodes mentioned above. The other end passes to ground through bridge rectifier MR301. The alternating current in the winding passes through the rectifier as direct current via R338 and TR301, developing a smooth direct voltage across C315. This voltage, controlled by the conduction of TR301, forms a threshold above which the alternating voltage applied to the bridge must rise before current can flow. As this threshold must be reached on both positive and negative excursions of the supply waveform, the overall effect is to take the middle out of the sine wave, thus reducing its voltage. This controlled voltage is rectified to produce the E.H.T. supplies. R322 feeds a negative current into the base of TR302, proportion to the peak value of the regulated waveform. This current is balanced by a reference current from the + line fed via R319 and SET E.H.T. potentiometer R320. The voltage at the summing point of the two currents appears at the emitter of TR302 and controls the current flow through D304, which in turn controls the conduction of TR301. As it is this conduction which controls the alternating voltage from which the feedback is derived, a closed loop circuit is formed. Variations in the magnitude of voltage across the 1000V winding either increases or decreases the voltage on the  $-1.2\text{kV}$  line. Feedback from this line is compared with a reference and the conduction of TR301 is varied accordingly to bring the line back to its correct voltage. As the  $+2.4\text{kV}$  line is derived from the same stabilised source as the  $-1.2\text{kV}$ , it also remains constant.

### 4.10 CALIBRATOR (Fig. 5)

The  $1\text{V} \pm 2\%$  square wave at the CAL 1V socket, SKD, is produced by TR307, on the power supply board. Current for the base of this transistor is supplied via R305 and D311. The anode of D312, is connected to the junction of these two components, its cathode being taken to one of the 22V windings. On positive excursions of the winding, D312 is biased off, and the current through R305, D311 saturates TR307. During negative excursions, D312 conducts, and the current in R305 passes through the transformer winding. In this condition

D311 and TR307 are turned off. The result is a square wave on the collector of TR307, at line frequency, with amplitude set by adjustment of R304.

### 4.11 BLANKING

The signal which blanks the c.r.t. when a sweep is not occurring is produced by TR308. The base of this transistor is fed via R135/C118 from the collector of TR108 in the timebase bistable. When TR108 is on, no current flows in R135, thus TR308 is off and its collector is at approximately 70V, as determined by R335, R336 and R337. This voltage is fed to the beam blanking plates of the c.r.t., pin 5, and blanks the trace. As TR108 turns off to initiate a sweep, the current in R135 turns TR308 on; its collector voltage falls to about 3V, where it is held by the action of the forward biased diode, D313. Under this condition c.r.t. blanking is removed. Blanking is not effected in the X-Y mode as TR108 in the timebase bistable is permanently off.

When dual trace operation is selected, a pulse is coupled via C314 from the collector of TR221 into the cathode of the c.r.t. in order to blank the trace during the switching transition.

### Z Modulation

Signals applied to SKF on the rear panel pass via C313 to the grid of the c.r.t. where they produce trace intensity modulation.

### 4.12 TUBE NETWORK

The cathode of the c.r.t. draws current from the  $-1.2\text{kV}$  line through the BRILLIANCE control, R33. Clockwise rotation of this control decreases the grid potential, and hence varies the tube conduction from cut off to maximum. Electrons emitted from the cathode are focussed into a narrow beam by potentials on the focus and astigmatism electrodes. These potentials are approximately  $-850\text{V}$  and  $+80\text{V}$ , controlled by R34 and R332 respectively.

When a positive potential is applied to the blanking plates, the electron beam is deflected to one side of the tube, thus preventing the electrons striking the tube face. The geometry control R333 varies the potential on an electrostatic shield placed between the X and Y deflector plates to minimise interaction. After deflection by the X and Y plates, the electron beam is accelerated by the PDA potential of  $+2.4\text{kV}$ , to strike the phosphor coated tube face at high velocity, and produce a display.

ABBREVIATIONS USED FOR COMPONENT DESCRIPTIONS

RESISTORS

CC	Carbon Composition	$\frac{1}{2}$ W	10%	unless otherwise stated
CF	Carbon Film	$\frac{1}{8}$ W	5%	unless otherwise stated
MO	Metal Oxide	$\frac{1}{2}$ W	2%	unless otherwise stated
MF	Metal Film	$\frac{1}{4}$ W	1%	unless otherwise stated
WW	Wire Wound	6W	5%	unless otherwise stated
CP	Control Potentiometer		20%	unless otherwise stated
PCP	Preset Potentiometer Type MPD, PC		20%	unless otherwise stated

CAPACITORS

CE(1)	Ceramic		+ 80% - 25%	
CE(2)	Ceramic	500V	$\pm$ 10%	unless otherwise stated
SM	Silver Mica			
PF	Plastic Film		$\pm$ 10%	unless otherwise stated
PS	Polystyrene			
PE	Polyester		$\pm$ 10%	unless otherwise stated
PC	Polycarbonate			
E	Electrolytic (aluminium)		+ 50% - 10%	
T	Tantalum		+ 50% - 10%	

# Component List and Illustrations

## Section 6

### Y AMPLIFIER

Ref	Value	Description	Tol %±	Part No.	Ref	Value	Description	Tol %±	Part No.
<b>RESISTORS</b>									
R 201	10k	MF	1	26338	R253	18k	CF		21811
R202	22k	CP		A4/32894	R254	470	CF		21797
R203	18k	CF		21811	R255	470	CF		21797
R204	470	CF		21797	R256	39k	CF		28728
R205	470	CF		21797	R257	470	CF		21797
R206	39k	CF		28728	R258	470	CF		21797
R207	470	CF		21797	R259	6k8	CF		21807
R208	470	CF		21797	R260	2k2	CF		21802
R209	6k8	CF		21807	R261	2k	MO		26731
R210	2k2	CF		21802	R262	18	CF		28709
R211	2k	MO		26731	R263	6k8	MO		28796
R212	18	CF		28709	R264	220	CF		21796
R213	6k8	MO		28796	R265	3k3	CF		21803
R214	220	CF		21796	R266	3k3	CF		21803
R215	3k3	CF		21803	R267	180	MO		26744
R216	3k3	CF		21803	R268	180k	CF		21822
R217	180	MO		26744	R269	12k	CF		21810
R218	180k	CF		21822	R270	10	CF		21793
R219	12k	CF		21810	R271	6k8	MO		28796
R220	10	CF		21793	R272	47	CF		28714
R221	47	CF		28714	R273	2k	MO		26731
R222	100	PCP		28520	R274	2k2	CF		21802
R223	330	CF		28721	R275	10	CF		21793
R224	12k	CF		21810	R276	22k	CF		21812
R225	56	CF		28715	R277	1k8	CF		28725
R226	3k3	CF	5	½W	18556	R278	2k7	CF	28726
R227	1k2	CF		21800	R279	1k8	CF		28725
R228	680	CF		28723	R280	15k	CF		28727
R229	10	CF		21793	R281	22k	CF		21812
R230	3k	MO	5	6W	33212	R282	22k	CF	21812
R231	47	CF		28714	R283	15k	CF		28727
R232	47	CF		28714	R284	22k	CF		21812
R233	22k	CF		21812	R285	1k	CF		21799
R234	120	CF		28718	R286	3.9k	CF		21804
R235	820	MO	5	4W	33212	R287	27k	CF	21813
R236	15k	CF		28727	R288	1k8	CF		28725
R237	180	CF		21795	R289	4k7	CF		21805
R238	47	CF		28714	R290	6k8	CF		21807
R239	10	CF		21793	R291	10k	CF		21809
R240	3k	MO	5	6W	33212	R292	27k	CF	21813
R241	1k2	CF		21800	R293	33k	CF		21814
R242	2k7	CF		28726	<b>CAPACITORS</b>				
R243	10	CF		21793	C201	6pF	Trimmer		25750
R244	560	CF		21798	C202	6pF	Trimmer		25750
R245	2k2	CF		21802	C203				
R246	2k2	CF		21802	C204	.01µF	CE(2)	25	250V 22395
R247	2k2	CF		21802	C205	.01µF	CE(2)	25	250V 22395
R248	2k2	CF		21802	C206	39pF	CE(2)		22371
R249	47	CF		28714	C207	.01µF	CE(2)	25	250V 22395
R250	10	CF		21793	C208	39pF	CE(2)		22371
R251	10k	MF	1	26338	C209	10/40pF	Trimmer		29483
R252	22k	CP		A4/32894	C210	1000pF	CE(2)		22387



## Component List and Illustrations

## Section 6

### Y AMPLIFIER (Cont.)

<i>Ref</i>	<i>Value</i>	<i>Description</i>	<i>Tol %±</i>		<i>Part No.</i>	<i>Ref</i>	<i>Value</i>	<i>Description</i>	<i>Tol %±</i>	<i>Part No.</i>
C211	10/40pF	Trimmer			29483	TR207		2N3904		24146
C212	220pF	PS	10	125V	11587	TR208		2N2369		23307
C213	270pF	CE(2)			22380	TR209		2N2369		23307
C214	68pF	CE(2)			22374	TR210		BF380		32902
C215	.1μF	CE(1)		30V	19647	TR211		BF380		32902
C216						TR212 }		AE23		A32957
C217	560pF	CE(2)			22384	TR213 }		Matched Pair		
C218	68pF	CE(2)			22374	TR214		2N3904		24146
C219	.01μF	CE(2)	25	250V	22395	TR215		2N3640		31781
C220	47pF	CE(2)			22372	TR216		2N3640		31781
C221	6pF	Trimmer			25750	TR217		2N3904		24146
C222	6pF	Trimmer			25750	TR218		2N2369		23307
C224	.01μF	CE(2)	25	250V	22395	TR219		2N2369		23307
C225	.01μF	CE(2)	25	250V	22395	TR220		BC212		29327
C226	47pF	CE(2)			22372	TR221		BC212		29327
C227	.01μF	CE(2)	25	250V	22395	TR222		2N3906		21533
C228	27pF	CE(2)			22369					
C229	27pF	CE(2)			22369					
C230	.01μF	CE(2)	25	250V	22395	D201		IN3595		29330
C231	15pF	CE(2)			22366	D202		IN3595		29330
C232	15pF	CE(2)			22366	D203		IN4148		23802
C233						D204		IN4148		23802
C234	.01μF	CE(2)	25	250V	22395	D205		IN4148		23802
C235	.01μF	CE(2)	25	250V	22395	D206		IN4148		23802
C236	47pF	CE(2)			22372	D207		IN4148		23802
C237	39pF	CE(2)			22371	D208		IN4148		23802
C238	100pF	CE(2)			22376	D209		IN4148		23802
C239	.01μF	CE(2)	25	250V	22395	D210		IN4148		23802
C240	.01μF	CE(2)	25	250V	22395	D211		IN4148		23802
C241	.1μF	CE(1)		30V	19647	D212		IN4148		23802
C242	.1μF	CE(1)		30V	19647	D213		IN4148		23802
C243	.1μF	CE(1)		30V	19647	D214		IN4148		23802
C244	330pf	CE(2)			22381	D215		IN3595		29330
C245	0.1μF	CE(1)		30V	19647	D216		IN3595		29330
C246	68pF	CE(2)			22374					
						MISCELLANEOUS				
TRANSISTORS						L201	33μH			33204
TR201 } TR202 {	AE23 Matched Pair				A32957	L202	33μH			33204
TR203	2N3906				21533	L203	Bead Ferrite FX1115			4442
TR204	2N3904				24146					
TR205	2N3640				31781	L204	Bead Ferrite FX1115			4442
TR206	2N3640				31781					



RESISTORS	R24 R56 R21 R57	R27 R22	R20 R54 R28 R201 R20 R23 R55 R24 R261 R25	R203 R208 R204 R266 R248 R206 R258 R200 R205 R255 R208 R252 R254 R252 R245 R255 R256	R208 R207 R257 R247 R204 R264 R248 R206 R200 R205 R255 R208 R252 R254 R252 R245 R255 R256	R40-45 R46-51	R212 R213 R214 R210 R262 R220 R260 R52 R261 R263 C239 C240	R214 R219 R214 R269 R269	R215 R217 R216 R265 R216 R208 R221 R274 R264 R277 R279 R271	R224 R228 R227 R227 R276 R283 R225 R281 R222 C243 C228 C214	R230 R237 R235 R235 R240 R231 R234 R235 R237 R278 R249 R214 R275 R282 R280 R284 R285 C237 C208 C216 C230 C209 C231 C232 C235 C229 C246	R241 R242 R286 R260 R291 R287 R290 R292 C214 C211 C245 C218 C219 C244																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
CAPACITORS	C40 C41	C25 C21 C27 C23	C201 C221	C202 C222	C23 C26 C24 C28	C242 C244	C204 C224	C205 C225	C206 C226	C207 C227	C208 C228	C209 C229	C210 C230	C211 C231	C212 C232	C213 C233	C214 C234	C215 C235	C216 C236	C217 C237	C218 C238	C219 C239	C220 C240	C221 C241	C222 C242	C223 C243	C224 C244	C225 C245	C226 C246	C227 C247	C228 C248	C229 C249	C230 C250	C231 C251	C232 C252	C233 C253	C234 C254	C235 C255	C236 C256	C237 C257	C238 C258	C239 C259	C240 C260	C241 C261	C242 C262	C243 C263	C244 C264	C245 C265	C246 C266	C247 C267	C248 C268	C249 C269	C250 C270	C251 C271	C252 C272	C253 C273	C254 C274	C255 C275	C256 C276	C257 C277	C258 C278	C259 C279	C260 C280	C261 C281	C262 C282	C263 C283	C264 C284	C265 C285	C266 C286	C267 C287	C268 C288	C269 C289	C270 C290	C271 C291	C272 C292	C273 C293	C274 C294	C275 C295	C276 C296	C277 C297	C278 C298	C279 C299	C280 C300	C281 C301	C282 C302	C283 C303	C284 C304	C285 C305	C286 C306	C287 C307	C288 C308	C289 C309	C290 C310	C291 C311	C292 C312	C293 C313	C294 C314	C295 C315	C296 C316	C297 C317	C298 C318	C299 C319	C300 C320	C301 C321	C302 C322	C303 C323	C304 C324	C305 C325	C306 C326	C307 C327	C308 C328	C309 C329	C310 C330	C311 C331	C312 C332	C313 C333	C314 C334	C315 C335	C316 C336	C317 C337	C318 C338	C319 C339	C320 C340	C321 C341	C322 C342	C323 C343	C324 C344	C325 C345	C326 C346	C327 C347	C328 C348	C329 C349	C330 C350	C331 C351	C332 C352	C333 C353	C334 C354	C335 C355	C336 C356	C337 C357	C338 C358	C339 C359	C340 C360	C341 C361	C342 C362	C343 C363	C344 C364	C345 C365	C346 C366	C347 C367	C348 C368	C349 C369	C350 C370	C351 C371	C352 C372	C353 C373	C354 C374	C355 C375	C356 C376	C357 C377	C358 C378	C359 C379	C360 C380	C361 C381	C362 C382	C363 C383	C364 C384	C365 C385	C366 C386	C367 C387	C368 C388	C369 C389	C370 C390	C371 C391	C372 C392	C373 C393	C374 C394	C375 C395	C376 C396	C377 C397	C378 C398	C379 C399	C380 C400	C381 C401	C382 C402	C383 C403	C384 C404	C385 C405	C386 C406	C387 C407	C388 C408	C389 C409	C390 C410	C391 C411	C392 C412	C393 C413	C394 C414	C395 C415	C396 C416	C397 C417	C398 C418	C399 C419	C400 C420	C401 C421	C402 C422	C403 C423	C404 C424	C405 C425	C406 C426	C407 C427	C408 C428	C409 C429	C410 C430	C411 C431	C412 C432	C413 C433	C414 C434	C415 C435	C416 C436	C417 C437	C418 C438	C419 C439	C420 C440	C421 C441	C422 C442	C423 C443	C424 C444	C425 C445	C426 C446	C427 C447	C428 C448	C429 C449	C430 C450	C431 C451	C432 C452	C433 C453	C434 C454	C435 C455	C436 C456	C437 C457	C438 C458	C439 C459	C440 C460	C441 C461	C442 C462	C443 C463	C444 C464	C445 C465	C446 C466	C447 C467	C448 C468	C449 C469	C450 C470	C451 C471	C452 C472	C453 C473	C454 C474	C455 C475	C456 C476	C457 C477	C458 C478	C459 C479	C460 C480	C461 C481	C462 C482	C463 C483	C464 C484	C465 C485	C466 C486	C467 C487	C468 C488	C469 C489	C470 C490	C471 C491	C472 C492	C473 C493	C474 C494	C475 C495	C476 C496	C477 C497	C478 C498	C479 C499	C480 C500	C481 C501	C482 C502	C483 C503	C484 C504	C485 C505	C486 C506	C487 C507	C488 C508	C489 C509	C490 C510	C491 C511	C492 C512	C493 C513	C494 C514	C495 C515	C496 C516	C497 C517	C498 C518	C499 C519	C500 C520	C501 C521	C502 C522	C503 C523	C504 C524	C505 C525	C506 C526	C507 C527	C508 C528	C509 C529	C510 C530	C511 C531	C512 C532	C513 C533	C514 C534	C515 C535	C516 C536	C517 C537	C518 C538	C519 C539	C520 C540	C521 C541	C522 C542	C523 C543	C524 C544	C525 C545	C526 C546	C527 C547	C528 C548	C529 C549	C530 C550	C531 C551	C532 C552	C533 C553	C534 C554	C535 C555	C536 C556	C537 C557	C538 C558	C539 C559	C540 C560	C541 C561	C542 C562	C543 C563	C544 C564	C545 C565	C546 C566	C547 C567	C548 C568	C549 C569	C550 C570	C551 C571	C552 C572	C553 C573	C554 C574	C555 C575	C556 C576	C557 C577	C558 C578	C559 C579	C560 C580	C561 C581	C562 C582	C563 C583	C564 C584	C565 C585	C566 C586	C567 C587	C568 C588	C569 C589	C570 C590	C571 C591	C572 C592	C573 C593	C574 C594	C575 C595	C576 C596	C577 C597	C578 C598	C579 C599	C580 C600	C581 C601	C582 C602	C583 C603	C584 C604	C585 C605	C586 C606	C587 C607	C588 C608	C589 C609	C590 C610	C591 C611	C592 C612	C593 C613	C594 C614	C595 C615	C596 C616	C597 C617	C598 C618	C599 C619	C600 C620	C601 C621	C602 C622	C603 C623	C604 C624	C605 C625	C606 C626	C607 C627	C608 C628	C609 C629	C610 C630	C611 C631	C612 C632	C613 C633	C614 C634	C615 C635	C616 C636	C617 C637	C618 C638	C619 C639	C620 C640	C621 C641	C622 C642	C623 C643	C624 C644	C625 C645	C626 C646	C627 C647	C628 C648	C629 C649	C630 C650	C631 C651	C632 C652	C633 C653	C634 C654	C635 C655	C636 C656	C637 C657	C638 C658	C639 C659	C640 C660	C641 C661	C642 C662	C643 C663	C644 C664	C645 C665	C646 C666	C647 C667	C648 C668	C649 C669	C650 C670	C651 C671	C652 C672	C653 C673	C654 C674	C655 C675	C656 C676	C657 C677	C658 C678	C659 C679	C660 C680	C661 C681	C662 C682	C663 C683	C664 C684	C665 C685	C666 C686	C667 C687	C668 C688	C669 C689	C670 C690	C671 C691	C672 C692	C673 C693	C674 C694	C675 C695	C676 C696	C677 C697	C678 C698	C679 C699	C680 C700	C681 C701	C682 C702	C683 C703	C684 C704	C685 C705	C686 C706	C687 C707	C688 C708	C689 C709	C690 C710	C691 C711	C692 C712	C693 C713	C694 C714	C695 C715	C696 C716	C697 C717	C698 C718	C699 C719	C700 C720	C701 C721	C702 C722	C703 C723	C704 C724	C705 C725	C706 C726	C707 C727	C708 C728	C709 C729	C710 C730	C711 C731	C712 C732	C713 C733	C714 C734	C715 C735	C716 C736	C717 C737	C718 C738	C719 C739	C720 C740	C721 C741	C722 C742	C723 C743	C724 C744	C725 C745	C726 C746	C727 C747	C728 C748	C729 C749	C730 C750	C731 C751	C732 C752	C733 C753	C734 C754	C735 C755	C736 C756	C737 C757	C738 C758	C739 C759	C740 C760	C741 C761	C742 C762	C743 C763	C744 C764	C745 C765	C746 C766	C747 C767	C748 C768	C749 C769	C750 C770	C751 C771	C752 C772	C753 C773	C754 C774	C755 C775	C756 C776	C757 C777	C758 C778	C759 C779	C760 C780	C761 C781	C762 C782	C763 C783	C764 C784	C765 C785	C766 C786	C767 C787	C768 C788	C769 C789	C770 C790	C771 C791	C772 C792	C773 C793	C774 C794	C775 C795	C776 C796	C777 C797	C778 C798	C779 C799	C780 C800	C781 C801	C782 C802	C783 C803	C784 C804	C785 C805	C786 C806	C787 C807	C788 C808	C789 C809	C790 C810	C791 C811	C792 C812	C793 C813	C794 C814	C795 C815	C796 C816	C797 C817	C798 C818	C799 C819	C800 C820	C801 C821	C802 C822	C803 C823	C804 C824	C805 C825	C806 C826	C807 C827	C808 C828	C809 C829	C810 C830	C811 C831	C812 C832	C813 C833	C814 C834	C815 C835	C816 C836	C817 C837	C818 C838	C819 C839	C820 C840	C821 C841	C822 C842	C823 C843	C824 C844	C825 C845	C826 C846	C827 C847	C828 C848	C829 C849	C830 C850	C831 C851	C832 C852	C833 C853	C834 C854	C835 C855	C836 C856	C837 C857	C838 C858	C839 C859	C840 C860	C841 C861	C842 C862	C843 C863	C844 C864	C845 C865	C846 C866	C847 C867	C848 C868	C849 C869	C850 C870	C851 C871	C852 C872	C853 C873	C854 C874	C855 C875	C856 C876	C857 C877	C858 C878	C859 C879	C860 C880	C861 C881	C862 C882	C863 C883	C864 C884	C865 C885	C866 C886	C867 C887	C868 C888	C869 C889	C870 C890	C871 C891	C872 C892	C873 C893	C874 C894	C875 C895	C876 C896	C877 C897	C878 C898	C879 C899	C880 C900	C881 C901	C882 C902	C883 C903	C884 C904	C885 C905	C886 C906	C887 C907	C888 C908	C889 C909	C890 C910	C891 C911	C892 C912	C893 C913	C894 C914	C895 C915	C896 C916	C897 C917	C898 C918	C899 C919	C900 C920	C901 C921	C902 C922	C903 C923	C904 C924	C905 C925	C906 C926	C907 C927	C908 C928	C909 C929	C910 C930	C911 C931	C912 C932	C913 C933	C914 C934	C915 C935	C916 C936	C917 C937	C918 C938	C919 C939	C920 C940	C921 C941	C922 C942	C923 C943	C924 C944	C925 C945	C926 C946	C927 C947	C928 C948	C929 C949	C930 C950	C931 C951	C932 C952	C933 C953	C934 C954	C935 C955	C936 C956	C937 C957	C938 C958	C939 C959	C940 C960	C941 C961	C942 C962	C943 C963	C944 C964	C945 C965	C946 C966	C947 C967	C948 C968	C949 C969	C950 C970	C951 C971	C952 C972	C953 C973	C954 C974	C955 C975	C956 C976	C957 C977	C958 C978	C959 C979	C960 C980	C961 C981	C962 C982	C963 C983	C964 C984	C965 C985	C966 C986	C967 C987	C968 C988	C969 C989	C970 C990	C971 C991	C972 C992	C973 C993	C974 C994	C975 C995	C976 C996	C977 C997	C978 C998	C979 C999	C980 C1000	C981 C1001	C982 C1002	C983 C1003	C984 C1004	C985 C1005	C986 C1006	C987 C1007	C988 C1008	C989 C1009	C990 C1010	C991 C1011	C992 C1012	C993 C1013	C994 C1014	C995 C1015	C996 C1016	C997 C1017	C998 C1018	C999 C1019	C1000 C1020	C1001 C1021	C1002 C1022	C1003 C1023	C1004 C1024	C1005 C1025	C1006 C1026	C1007 C1027	C1008 C1028	C1009 C1029	C1010 C1030	C1011 C1031	C1012 C1032	C1013 C1033	C1014 C1034	C1015 C1035	C1016 C1036	C1017 C1037	C1018 C1038	C1019 C1039	C1020 C1040	C1021 C1041	C1022 C1042	C1023 C1043	C1024 C1044	C1025 C1045	C1026 C1046

# Component List and Illustrations

## Section 6

### TIMEBASE AND X AMPLIFIER

Ref	Value	Description	Tol %±	Part No.	Ref	Value	Description	Tol %±	Part No.
<b>RESISTORS</b>									
R101	22k	CF		21812	R155	18k	CF		21811
R102	22k	CF		21812	R156	100	CF		21794
R103	1k2	CF		21800	R157	56k	CF	5	1W 19058
R104	47	CF		28714	R158	220	CF		21796
R105	10	CF		21793	R159	2k2	CF		21802
R106	100k	CF	5	1W 19061	R160	10k	MO	5	4W 29481
R107	560	CF		21798	R161	100	CF		21794
R108	220	CF		21796	R162	100	PCP		28520
R109	220	CF		21796	R163	2k	MO		26731
R110	620	MO		22485	R164	1k8	CF		28725
R111	10	CF		21793	R165				
R112	390	CF		28722	R166	1k5	CF		21801
R113	1k2	CF		21800	R167	100	CF		21794
R114	3k3	CF	5	½W 18556	R168	10k	MO	5	4W 29481
R115	1k2	CF		21800	R169	1k	PCP		26870
R116	1k2	CF		21800	R170	2k	MO		26731
R117	10	CF		21793	R171	56k	CF	5	1W 19058
R118	47	CF		28714	R172	1k8	CF		28725
R119	100k	CF		21819	R173	100	CF		21794
R120	6k8	CF		21807	R174	1k8	CF		28725
R121	270	CF		28720	R175	1k8	CF		28725
R122	1k5	CF		21801	R176	10	CF		21793
R123	3k3	CF		21803	R177	10k	CF		21809
R124	1M	CF		31840	R178	27	CF		28711
R125	100	CF		21794	R179	270k	CF		32356
R126	4k7	CF		21805	R180				
R127	10k	CF		21809					
R128	2k2	CF		21802					
R129	120	CF		28718					
R130	1k	CF		21799					
R131	1k	CF		21799	<b>CAPACITORS</b>				
R132	2k7	CF		28726	C101	100pF	CE(2)		22376
R133	1k	CF		21799	C102	.01μF	CE(2)	25	250V 22395
R134	12k	CF		21810	C103	10μF	E		25V 32180
R135	18k	CF		21811	C104	.01μF	CE(2)	25	250V 22395
R136	3k9	CF		21804	C105	.01μF	CE(2)	25	250V 22395
R137	3k9	CF		21804	C106	33pF	CE(2)		22370
R138	10k	CF		21809	C107	.47μF	CE(1)		3V 35352
R139	47k	CF		21815	C108	33pF	CE(2)		22370
R140	47k	CF		21815	C109	270pF	CE(2)		22380
R141	100k	CF		21819	C110	.1μF	CE(1)		30V 19647
R142	10k	CF		21809	C111	27pF	CE(2)		22369
R143	1k	CF		21799	C112	22μF	E		25V 32181
R144	1k5	CF		21801	C113	.47μF	CE(1)		3V 35352
R145	100k	CF		21819	C114				
R146	15k	CF		28727	C117	27pF	CE(2)		22369
R147	2M2	CC		1180	C118	27pF	CE(2)		22369
R148	68k	CF		21816	C119	4700pF	CE(2)	25	500V 22393
R149	2k7	CF		28726	C120	.01μF	CE(2)	25	250V 22395
R150	100	CF		21794	C121	100pF	CE(2)		22376
R151	1k2	CF		21800	C122	27pF	CE(2)		22369
R152	56k	CF	5	1W 19058	C123	22pF	CE(2)		22368
R153	27k	CF		21813	C128	180pF	PS	5	125V 33343
R154	3k9	CF		21804	C129	10pF	CE(2)		22364

# Component List and Illustrations

# Section 6

## TIMEBASE AND X AMPLIFIER (Cont.)

<i>Ref</i>	<i>Value</i>	<i>Description</i>	<i>Tol %±</i>	<i>Part No.</i>	<i>Ref</i>	<i>Value</i>	<i>Description</i>	<i>Tol %±</i>	<i>Part No.</i>
<b>TRANSISTORS</b>									
TR101		2N2369		23307	TR116		BF258		31490
TR102		2N2369		23307	TR117		BC212		29327
TR103		2N2369		23307					
TR104		2N2369		23307					
TR105		BC212		29327	<b>DIODES</b>				
TR106		BC182B		33205	D101		IN3595		29330
TR107		BC182B		33205	D102		IN4148		23802
TR108		2N2369		23307	D103		IN4148		23802
TR109		2N2369		23307	D104	8V2	ZENER	5	3798
TR110		2N2369		23307	D105		IN4148		23802
TR111		BC212		29327	D106		IN4148		23802
TR112		BC212		29327	D107		IN4148		23802
TR113		BC182B		33205	D108		IN4148		23802
TR114		BC212		29327	D109		IN4148		23802
TR115		BF258		31490	D110		IN4148		23802



# Component List and Illustrations

## Section 6

### POWER SUPPLY

Ref	Value	Description	Tol %±	Part No.	Ref	Value	Description	Tol %±	Part No.
<b>RESISTORS</b>									
R301	5k6	CF		21806	C305	.01μF	CE(2)	25	1.5kV 23603
R302	1k	CF		21799	C306	5000pF	CE(1)		3kV 1514
R303	8k2	CF		21808	C307	5000pF	CE(1)		3kV 1514
R304	10k	PCP		28525	C308	5000pF	CE(1)		3kV 1514
R305	100k	CF		21819	C309	4μF	E		450V 23599
R306	47k	CF		21815	C310	4μF	E		450V 23599
R307	82	CF		28717	C311	4μF	E		450V 23599
R308	1k	CF		21799	C312	4μF	E		450V 23599
R309	5R6	CF	5	½W 33210	C313	.02μF	CE(1)		1.5kV 25223
R310	2k2	CF		21802	C314	470pF	CE(2)	20	1.5kV 33207
R311	1k3	CF		33338	C315	4μF	E		450V 23599
R312	15k	CF		28727	C316	4.7μF	E		63V 32195
R313									
R314	5R6	CF	5	½W 33210	C317	.01μF	CE(2)	25	250V 22395
R315	82	CF		28717	C318/9	.01μF	CE(2)	25	250V 22395
R316	2k2	CF		21802	<b>TRANSISTORS</b>				
R317	1k3	CF		33338	TR301		MPS U10		32924
R318	47k	CF		21815	TR302		BC 182B		33205
R319	43k	MO		28813	TR303		BC 182B		33205
R320	10k	PCP		28525	TR304		BC212		29327
R321	1M5	CC		7016	TR305		BC212		29327
R322	3M3	CF	5	2W 29482	TR306		BC182B		33205
R323	2M2	CC		1180	TR307		2N 2369		23307
R324	47k	CC		2933	TR308		2N 5831		33209
R325					MR301		WO4		29367
R326	100k	CF		21819	<b>DIODES</b>				
R327	47k	CF		21815	D 301		MR995A		32903
R328	4M7	CC		597	D302		MR995A		32903
R329	270k	CF		32356	D303		MR995A		32903
R330					D304		IN 4007		52337
R331	1M5	CC		7016	D305		IN 4148		23802
R332	220k	PCP		29363	D306		IN 4148		23802
R333	470k	PCP		28529	D307		IN 4148		23802
R334	100k	CF		21815	D308		IN 4148		23802
R335	27k	CF	5	2W 33211	D309		IN 4148		23802
R336	15k	CF	5	½W 18564	D310		IN 4148		23802
R337	22k	CF	5	½W 18566	D311		IN 4148		23802
R338	4k7	CC		3427	D312		IN 4148		23802
R339	2M2	CC		1180	D313		IN 4148		23802
R340					D314		IN 4148		23802
R341	2M2	CC		1180	D315	6V8	ZENER	5	4666
R342	2M2	CC		1180	D316	6V8	ZENER	5	4666
<b>CAPACITORS</b>									
C301	4μF	E		450V 23599	D317		IN 4148		23802
C302	4μF	E		450V 23599					
C303	4μF	E		450V 23599					
C304	4μF	E		450V 23599					

RESISTORS	R300 R318	R307 R315	R309 R314	R310 R317 R316	R304 R303	R305 R337	R301 R341 R342 R339	R302 R342 R336	R335 R338	R323 R312	R332 R321	R333 R334	R320 R319 R322 R334	R324 R328	R331 R326	R329 R326 R327
CAPACITORS				C317 C318	C305	C306 C307	C315 C308		C316				C301-304 C309-312			C314
MISC	D308 D309 D306 D305	TR305 D316 D315 TR304	TR306 D310 TR303 D307		TR307 D303	D311 D302	D312 MR301		TR308 D313		D304 D301	TR302				D314 D317

NOTE

1. COMPONENTS NOT ENCLOSED WITHIN THE DOTTED AREA ARE CALLED FOR ON INTERCONNECTION DIAGRAM SK.2349.

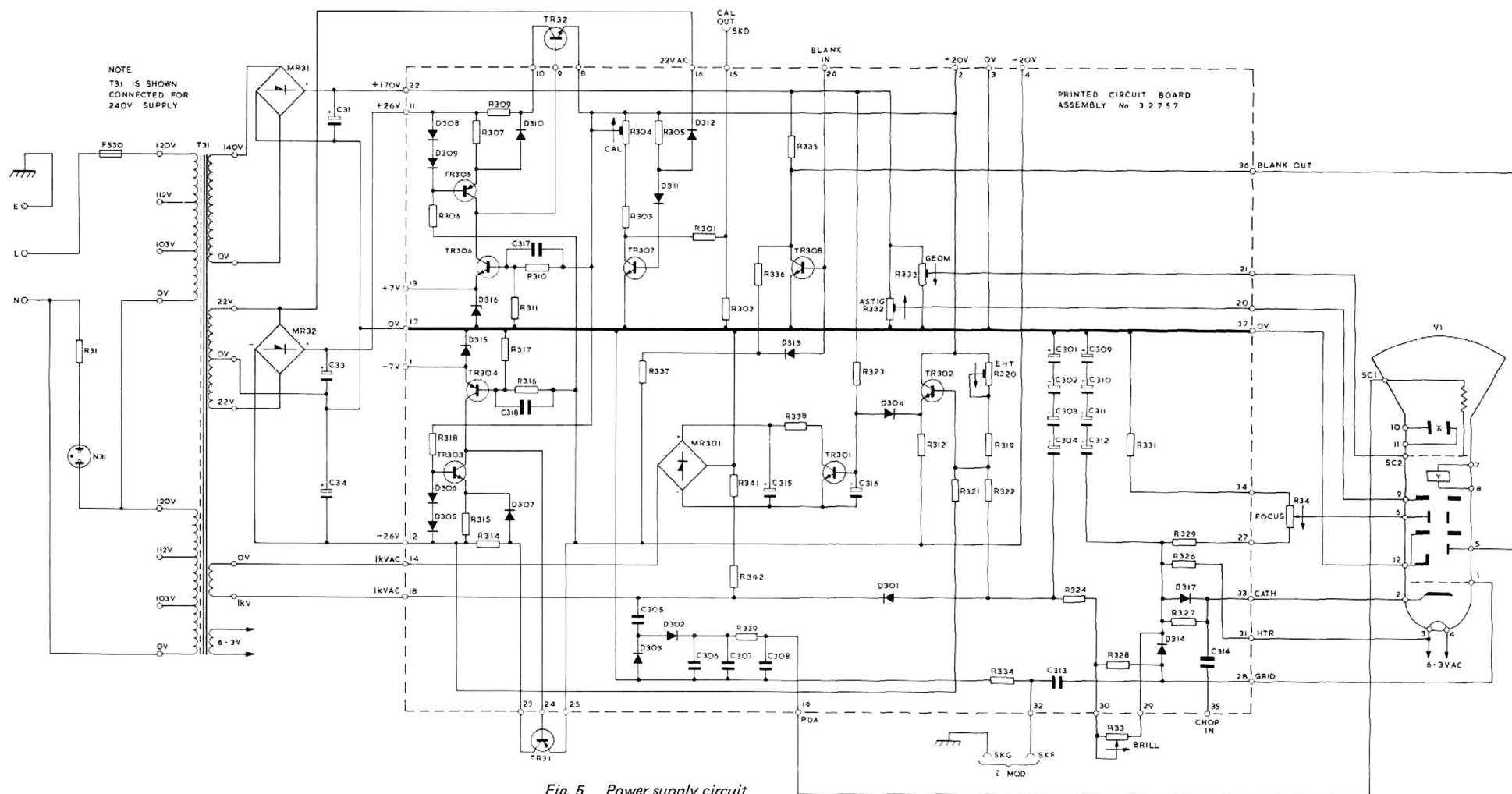


Fig. 5 Power supply circuit



# Component List and Illustrations

## Section 6

### INTERCONNECTION

Ref	Value	Description	Tol %±	Part No.	Ref	Value	Description	Tol %±	Part No.
<b>RESISTORS</b>									
R10	100k	CP With S10		A4/32897	C26	470pF	PS	10	125V 11492
R11	10k	CP With S11		A4/32898	C27	8.2pF	CE(2)	1pF	500V 22363
R12	2k2	CP		A4/32896	C28	470pF	PS	10	125V 11492
R13	100k	MF	1	29476	C31	100μF	E		275V 32906
R14	100k	MF	1	29476	C33	1000μF	E		40V 32907
R15	301k	MF	1	29477	C34	1000μF	E		40V 32907
R16	499k	MF	1	26342	C35	1000pF	CE(2)		22387
R17	1M	MF	1	26346	C40	5.6kpF	CE(2)		22394
R18	3M01	MF	1	29478	C41	5.6kpF	CE(2)		22394
R20	990k	MF	1	26345	<b>TRANSISTORS</b>				
R21	22	CF		28710	TR31		BD166		32901
R22	22	CF		28710	TR32		BD165		32900
R23	990k	MF	1	26345	MR31		WO4		29367
R24	470k	CC		4906	MR32		WO4		29367
R25	1M	MF	1	26346	<b>SOCKETS</b>				
R26	22	CF		28710	SKA		50ΩBNC		1222
R27	22	CF		28710	SKB		50ΩBNC		1222
R28	470k	CC		4906	SKD		4mm Black		30097
R29	1M	MF	1	26346	SKE		4mm Black		30097
R31	68k	CF		21816	SKF		4mm Black		29492
R33	220k	CP With S30		A4/32899	SKG		4mm Black		29492
R34	1M	CP		A4/32893	SKH		4mm Black		29492
R40	16k	MF	1	29361	<b>SWITCHES</b>				
R41	15k8	MF	1	33291	S10		Part of R10		
R42	5k23	MF	1	33290	S11		Part of R11		
R43	1k72	MF	1	33289	S12				25869
R44	787	MF	1	33288	S13				32636
R45	360	MF	1	33287	S14				32634
R46	16k	MF	1	29361	S20				25869
R47	15k8	MF	1	33291	S21				32635
R48	5k23	MF	1	33290	S24				
R49	1k72	MF	1	33289	S25				25869
R50	787	MF	1	33288	S26				32635
R51	360	MF	1	33287	S27		Part of R52		
R52	22k	CP With S27		A4/32895	S28		Part of R53		
R53	22k	CP With S28		A4/32895	S30		Part of R33		
R54	22	CF		28710	S31				25869
R55	22	CF		28710	<b>MISCELLANEOUS</b>				
R56/57	330k	CC		4408	V1		CRT D13-610 GH		32904
<b>CAPACITORS</b>							OR		
C10	6/25pF	Trimmer		23593			CRT D13-610 GM		32905
C11	68pF	SM	5	4513	FS30		Long Persistence		
C12	.01μF	PS	1	24886			FUSE 220V Supply	250mA	33684
C13	1μF	PC	2	33206			OR		
C14	.047μF	CE(1)		30V 2793			FUSE 110V Supply	500mA	33685
C15	4.7μF	E		63V 32195	T31		Transformer		A1/32637
C16	1000pF	CE(2)		22387	N31		Indicator Neon Type Q		26586
C21	.1μF	PE		400V 29495	L10		Ferrite Bead FX1242		26986
C22	.01μF	CE(1)		500V 24902	L11		Ferrite Bead FX1242		26986
C23	.1μF	PE		400V 29495					
C24	0.1μF	CE(1)		500V 24902					
C25	8.2pF	CE(2)	1pF	500V 22363					

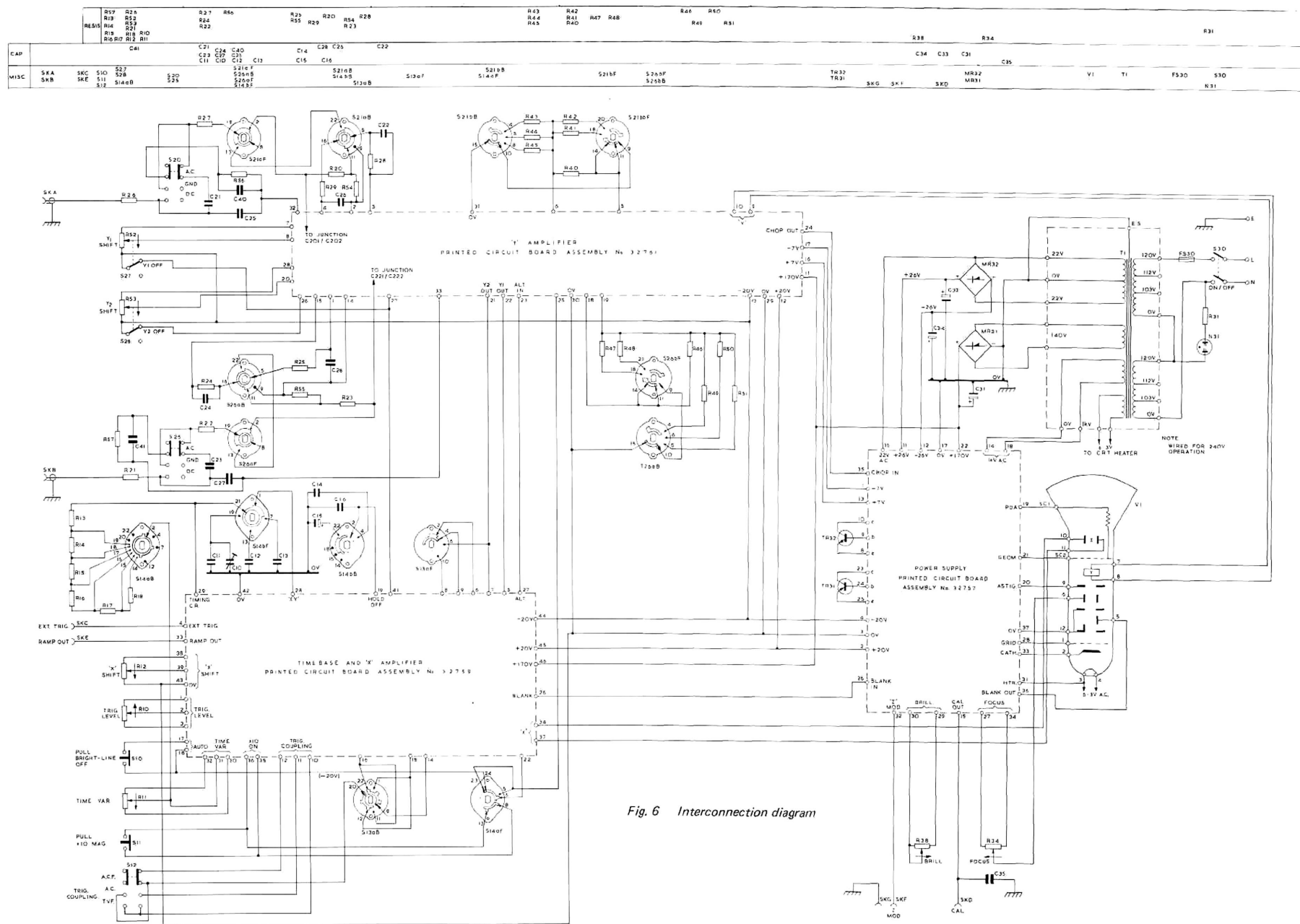


Fig. 6 Interconnection diagram

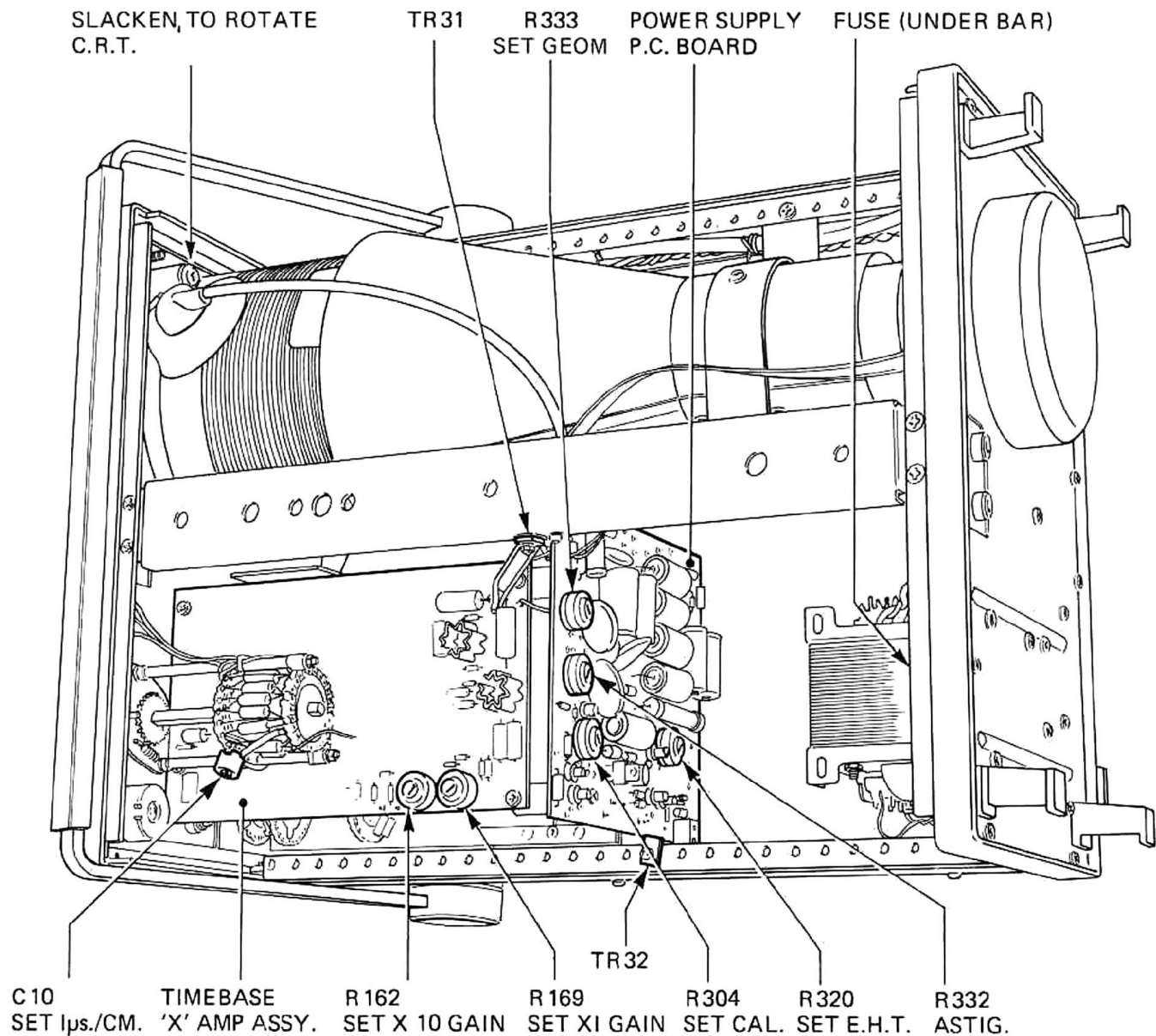


Fig. 7 Top view

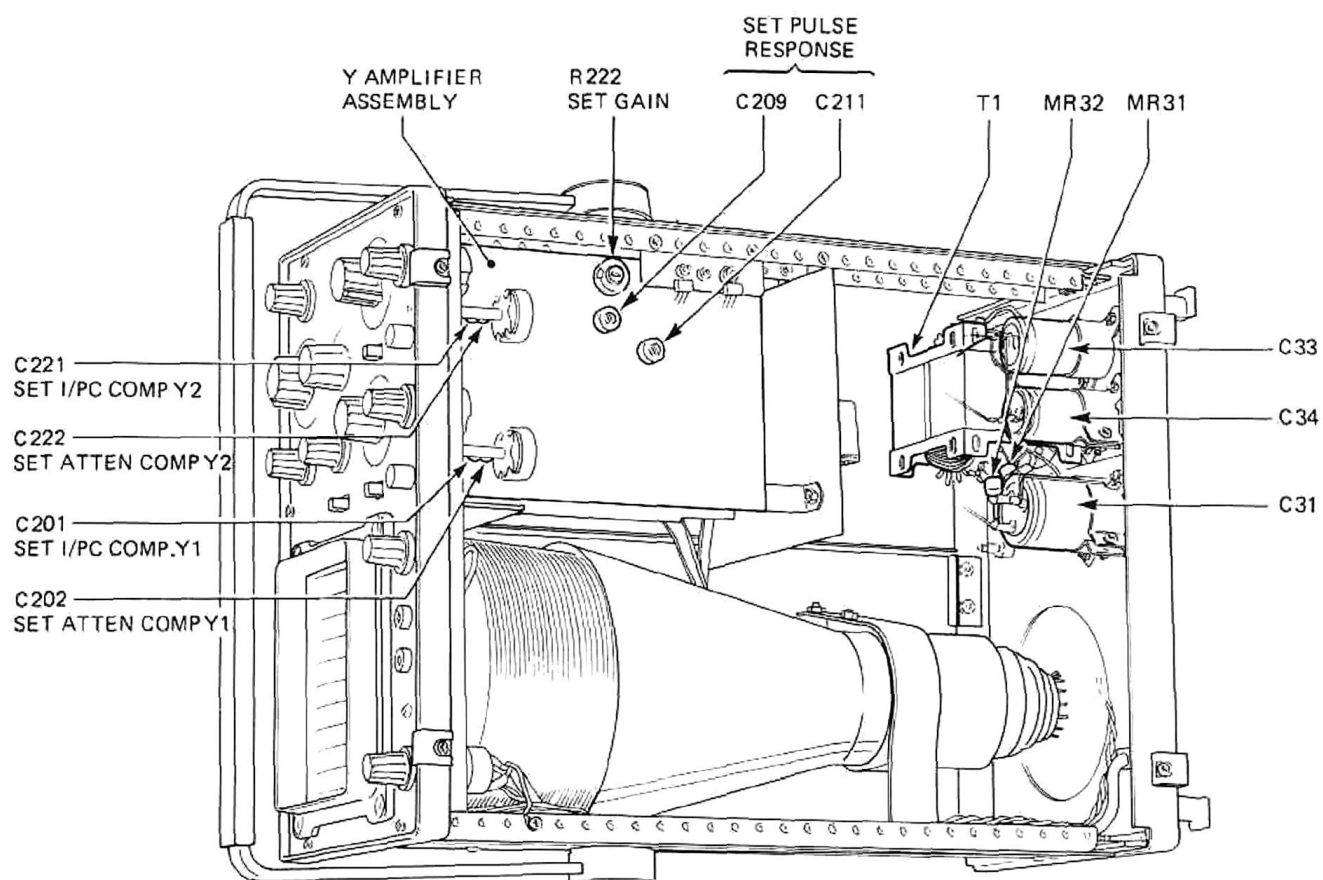


Fig. 8 Bottom view