

TELEQUIPMENT



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DANGER

It is not possible to screen all high voltages, so care should be taken not to touch high voltage tags. Also where possible the instrument should be unplugged AND switched off during servicing. A BLEEDER PATH FOR THE EHT IS NOT PROVIDED, so after switching off and before touching any internal parts, the EHT should be discharged by temporarily shorting the appropriate points to chassis, (for instance the CRT cathode pin and PDA connector where applicable).



FOR SERVICING AND SPARES ENQUIRIES
SEE THE INFORMATION AT START OF SECTION 5

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OSCILLOSCOPE

TYPE D75

INSTRUCTION MANUAL

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INTRODUCTION

The D75 is a dual-trace 50MHz portable oscilloscope designed for operation from an AC mains supply. It consists of two identical Vertical Amplifiers, and a Sweep Unit that provides the Main Time Base and a Delayed Time Base.

This instruction manual is compiled so that the component information and circuit diagrams applicable to the Vertical Amplifier Unit is printed on yellow paper. Similarly, pink paper is used for the Sweep Unit. The design of this instrument is subject to continual development and improvement, therefore minor changes in detail from the information contained herein may be incorporated. These changes which usually affect the Component List and Circuit Diagrams are described on Amendment Lists issued at regular intervals between reprints.

Any Amendment List appertaining to this manual is located in the pocket inside the back cover.

Throughout this manual all references to the front panel controls are in full and capital letters e.g. INTENSITY.

If this instrument is returned for servicing the owner is requested not to send the Probe or Plug Assemblies unless they are suspect. This is to facilitate packing and lessen the risk of damage during transit.

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SECTION 1

SPECIFICATION

1.0 VERTICAL AMPLIFIER

1.1 OPERATING MODE

Channel 1
 Channel 2 (normal or inverted)
 Channels 1 & 2
 Summed
 Alternate
 Chopped (at 350 kHz)

1.2 3 dB BANDWIDTH

5 mV – 2 V/div
 5 V – 20 V/div
 Risetime
 Sensitivity

	X 1	X 5
	50 MHz	15 MHz
	20 MHz	12 MHz
	7 ns	23 ns
	5 mV to 20 V/div	1 mV to 4 V/div

1.3 DEFLECTION FACTORS

Calibrated (12 ranges 1, 2 & 5 sequence)

5 mV – 20 V/div \pm 3% (X 1)
 1 mV – 4 V/div \pm 3% (X 5)

1.4 INPUT IMPEDANCE

1 M Ω , 29 pF in parallel approx.

1.5 CHANNEL – CHANNEL

Breakthrough

> 34 dB up to 50 MHz

2.0 HORIZONTAL AMPLIFIER

2.1 OPERATING MODE

'A' Sweep
 'A' Intensified by 'B'
 'A' and 'B' Mixed
 'B' Delayed by 'A'
 Delayed 'B'
 Variable
 Triggered

Repetitive or Single Shot

2.2 TRIGGER MODE

Level
 Auto

 DC
 AC
 H.F. reject

 Sensitivity
 Internal
 L.F.
 10 MHz
 50 MHz
 External
 L.F.
 10 MHz
 50 MHz

 Polarity
 +
 -

 Source
 Internal
 External

 Line

	'A'	'B'
Level	40 Hz – 50 MHz	free-run between
Auto	Bright line	20 & 50 Hz
DC	D.C. – 50 MHz	
AC	10 Hz – 50 MHz	AC Coupled only,
H.F. reject	10 Hz – 2.0 MHz at min. input levels	3 Hz – 10 MHz
Sensitivity		
Internal		
L.F.	0.2 divisions	0.4 divisions
10 MHz	0.2 divisions	1 division
50 MHz	1 division	
External		
L.F.	300 mV	500 mV
10 MHz	300 mV	1 V
50 MHz	500 mV	
Polarity	from positive signal edge	
+	from negative signal edge	
-		
Source	from vertical amplifier	
Internal	from external source	
External		
Line	from power supply transformer secondary	

2.3 SWEEP

Range
Variable (time)
X 10 Speed
'A' & 'B' Mixed

Accuracy
X 1
X 10
'A' & 'B' Mixed

'A'	'B'
2s - 100 ns/div	1s - 100 ns/div
> 2.5 to 1 10 ns/div max.	
The 'A' sweep as Time/Div, but the mixed portion sweep speed is calculated from speed $\left[\frac{B}{1+B/A} \right]$	
± 3% ± 6%	
The 'A' sweep accuracy is ± 3%. The mixed portion accuracy is ± 3% ± (B/A × 3) %	

2.4 EXT

Sensitivity
X 1
X 10
Bandwidth

400 mV/div ± 15%
40 mV/div ± 20%
> 1 MHz

2.5 DELAY TIME MULTIPLIER

Accuracy
Absolute
Incremental

± 1% of Total Delay + 450 ns max. } excluding
± 1% of Total Delay } sweep accuracy

3.0 CATHODE RAY TUBE (CRT)

Display area
Phosphor Standard
Overall accelerating potential

8 x 10 div (each div 1.0 cm)
P31
15 kV

4.0 FRONT PANEL OUTPUTS

Calibrator, peak to peak
Accuracy
Voltage
Frequency
Current

30 mV, 300 mV or 3 mA at 1 kHz

± 1%
± 20%
± 1%

5.0 Z MOD

Full blanking sensitivity
Input impedance
Frequency response

+ 20 V approx.
10 kΩ and 20 pF approx.
DC - 5 MHz approx.

6.0 GENERAL

6.1 POWER REQUIREMENTS

Voltage

Frequency
Consumption

100 - 125 V in 5 V steps
200 - 250 V in 10 V steps
48 - 400 Hz
85 VA

6.2 SIZE

Height
Width
Depth without front cover
Depth with front cover
Depth with extended handle

136 mm
380 mm
470 mm
480 mm
555 mm

6.3 WEIGHT

11.4 kg (25½ lbs.)

6.4 COOLING

Convection

6.5 TEMPERATURE LIMITS, ambient

Operating
Non-operating

-5 to +40°C approx.
-25 to +70°C approx.

SECTION 2

OPERATING INSTRUCTIONS

2.1 FUNCTION OF CONTROLS AND CONNECTORS

Controls are situated on the front panel except where otherwise specified.

2.2 CRT

INTENSITY	varies the intensity of the display and serves as the power supply ON-OFF switch.
FOCUS ASTIG.	controls the definition of the display. a preset situated on the rear panel, used in conjunction with FOCUS for achieving the best overall definition.
TRACE LOCATE	when pressed brings the trace on to the screen and free-runs A TIMEBASE.
POSITION	varies the position of the trace in the horizontal axis.
FINE	is a fine horizontal position control; when pulled magnifies trace 10 times in the horizontal axis; sweep calibrations must be divided by 10.
TRACE ROTATION	preset situated on the rear panel. Rotates a trace about the horizontal axis of the CRT and used to-align a trace in the horizontal axis.

2.3 HORIZONTAL

2.3.1 SWEEP

A & B TIME/DIV	controls the speed of the respective sweeps. The sweep rates indicated are only valid if VARIABLE is fully clockwise and FINE is not pulled out.
VARIABLE	provides continuously variable sweep speed adjustment between adjacent fixed calibrated speed ranges.
REP SINGLE SHOT	provides continuous repetitive sweeps. a sweep occurs upon application of trigger signal.
RESET	Sets TIMEBASE in 'Wait' condition ready for next trigger signal.
DELAY TIME MULT	varies the point on the 'A' sweep at which the 'B' sweep starts. Used in conjunction with 'A & B Mixed', 'A INT BY B' or 'B DEL BY A'. Note: For minimum delay jitter TRIG mode should be used.
VAR	provides continuously a variable delay for the start of the B sweep set by the D.T.M.
TRIG	starts the B sweep on receipt of the next suitable triggering signal, after the point set by the DELAY TIME MULT.
A ONLY	displays A sweep, B sweep is disabled.
A INT BY B	displays the A sweep with that part of trace covered by B intensified.
MIXED	simultaneously displays both A and B sweeps, but B sweep calibration is affected.
B DEL BY A	displays the delayed B sweep only.

2.3.2 TRIGGER

A TRIG LEVEL	selects that point on the signal waveform at which the A sweep starts.
TRIG MODE AUTO	provides a bright line auto, allowing the A timebase to free run until a signal is applied. LEVEL range is reduced to approximately 1 division.
AC or DC	relate to the coupling of the trigger circuit, and EXT X socket. For very low input frequencies DC should be selected.
AC HF REJ	progressively rejects high-frequency signals, permitting the trigger to respond to low-frequency components of the triggering signal.
POLARITY ±	selects triggering, from the positive or negative-going slope of a waveform.
SOURCE INT and EXT	enable the sweep to be triggered either, internally from the vertical amplifier, or externally.
LINE	provides trigger signal at the power supply frequency.
B TRIG LEVEL	selects that point on the signal waveform at which the B sweep starts. In the AUTO position, the trigger oscillates at a low repetition rate in the absence of a triggering signal. When a suitable signal is applied, the circuit is automatically triggered at the mean level of the input waveform.

2.4 VERTICAL

DC-GND-AC	selects the input signal coupling. In the DC position, the signal from the CH1, CH2 connector is directly coupled to the attenuator. In the AC position a capacitor is inserted in series. In the GND position the input to the attenuator is grounded; this position enables the 0 V D.C. level of a trace to be ascertained.
VOLTS/DIV	provides twelve steps of attenuation of each channel's input signal. Calibrated sensitivities are only valid when VARIABLE is fully clockwise.
SET GAIN 5 mV 1 mV	a preset; adjusts X1 GAIN calibration. a preset; adjusts X5 GAIN calibration. Note: VARIABLE should be fully clockwise.
VARIABLE	enables all deflection sensitivities between that selected by the VOLTS/DIV switch and the next below to be covered. The controls must be fully clockwise for a calibrated sensitivity; when pulled magnifies sensitivity 5 times in the vertical axis.

INVERT	the setting of this button determines whether the CH2 signal is displayed in the same polarity as the input signal or inverted. The inverted setting may be used to display the difference between two signals in the SUM mode.
TRIG SELECT	selects triggering from either channel or the display.
POSITION	moves the respective traces in the vertical axis.
DC BAL	a preset adjustment to eliminate trace movement when the respective PULL X5 control is operated.
CHANNEL SELECT	
CH1	selects Channel 1.
CHOP	the channels are alternately switched on and off at a frequency of about 350 kHz; this mode is suitable for slower sweep speeds.
SUM	the display is the addition of the individual signals: If INVERT is pulled, the resultant display is the difference between two input signals.
ALT	each channel is alternately displayed for the duration of a sweep; the ALT mode is preferable at higher sweep speeds.
CH2	selects Channel 2.

2.5 CONNECTORS

2.5.1 INPUTS

CH1/CH2	BNC sockets connect the signal to be viewed to the respective vertical amplifier.
A EXT TRIG & EXT X	is the right hand BNC connector on the front panel. This enables either external triggering signals to be applied by selecting the adjacent EXT button or in the EXT position of the B'TIME/DIV switch, provides the EXT X input. The connector is DC or AC coupled to both trigger and horizontal amplifier circuits. Input resistance is 100 k Ω .
B EXT TRIG	a separate BNC connector, enables an external trigger signal to be connected to the B Timebase.
Z MOD	an input socket situated on the rear panel DC coupled via Z mod amp. to the CRT grid. A negative-going signal is necessary to intensify the trace while a positive-going signal will blank it.

2.5.2 OUTPUTS



(SAWTOOTH)

provides a positive-going ramp waveform when the A sweep is running. A recurring sawtooth is produced when AUTO is selected. The resistance of an applied load should exceed 47 k Ω to avoid loading the sweep generator.



(GATE OUT)

provides a fast-edged positive-going rectangular pulse lasting for the duration of the sweep.

CAL

output sockets provide a 1 kHz waveform for checking the calibrations of the vertical channels and setting up probes. The two outputs provide 300 mV and 30 mV of a 1 kHz (approx.) squarewave when linked a 3 mA peak to peak current passes.



terminal is connected to the chassis of the instrument.

2.6 PRE-OPERATIONAL CHECKS

2.6.1 SUPPLY

Check the following: 1. Rear voltage-selector plug is indicating the local supply voltage or nearest value.

2. Fuse fitted is a 2 A for 100–125 V operation or 1 A for 200–250 V.

Note: The 3-core supply lead is colour coded as follows:

LINE	NEUTRAL	EARTH (Chassis)
Brown or Black	Blue White	Green/Yellow Green

2.6.2 Set controls as follows:

1. CRT		
INTENSITY		Central
FOCUS		Central
TRACE ROTATION		As set
2. HORIZONTAL		
SWEEP		REP
A ONLY		Depressed
TIME/DIV		5 ms
VARIABLE		Fully clockwise
TRIG MODE		Auto
POLARITY		Depressed
SOURCE		INT
3. VERTICAL		
TRIG SELECT		CH1
CHANNEL SELECT		CH1
POSITION		Central
VOLTS/DIV		5 mV
INVERT		Depressed
VARIABLE		Fully clockwise, pushed in
DC-GND-AC		GND
Input connection		CH1 INPUT

2.7 OPERATION

1. Plug into the supply; turn INTENSITY clockwise – POWER on.
2. Allow a few minutes for warm up then adjust CRT and POSITION controls for a display.
3. Adjust TRACE ROTATION, if necessary to align trace horizontally.
4. Connect the CAL 30 mV to INPUT via co-axial lead.
5. Set DC-GND-AC to DC.
6. Rotate LEVEL anti-clockwise to lock display.
7. Check amplitude of 5 divisions.

SECTION 3

CIRCUIT DESCRIPTION

3.1 GENERAL

3.1.1 This instrument comprises three main assemblies: Mainframe Vertical and Sweep Units. The descriptions are given below. To facilitate references made in this section to the circuit diagrams, a colour code has been adopted to identify the appropriate figure numbers.

3.1.2 The interfaces, reference Figure 1 (White), between the display unit and amplifiers are two 16-way edge connectors. The sockets are mounted on PC147, situated in the display unit and the mating plugs are a part of PC152 and PC133 in the Vertical and Sweep amplifiers respectively. These provide the inter-connections of Vertical (Input), Sweep and Trigger amplifiers, Vertical output and power etc. necessary for the function of the instrument.

3.1.3 The Vertical system comprises two amplifiers, which are switched in various ways to feed a main amplifier in the display unit.

3.1.4 The dual sweep system generates precise timing currents which, when applied to the Sweep amplifier and the bright-up amplifier, enable the CRT to display a highly accurate sweep controlled display. The system comprises a master sweep current generator, known as the 'A' sweep and a subsidiary sweep current generator, the 'B' sweep. Both incorporate an integral bright-up current generator. Individual trigger amplifiers are able to accept internal or external trigger signals. These control the start point of each sweep, also a comprehensive switching system enables a wide variety of display modes to be selected by the user.

3.2 ATTENUATORS

3.2.1 The input attenuators, reference Figure 1 (Yellow) are simple capacity compensated L type sections which are switched singly or in cascade to obtain the correct attenuation. The sections on the two rear wafers of the attenuator are the $\div 1$, $\div 2$ and $\div 4$, on the front two wafers $\div 10$, $\div 100$ and $\div 1000$. The input impedance of the attenuator is maintained at $1\text{ M}\Omega$ and 29 pF on all positions. The attenuators are identical electrically.

The DC-GND-AC switches select either a through connection on DC, a capacitor coupled connection via a $0.1\text{ }\mu\text{F}$ 400 V capacitor on AC or a GND connection with the signal path input open-circuited and the amplifier input grounded.

3.3 VERTICAL AMPLIFIER (Input)

3.3.1 The circuits of channel 1 (CH1) and channel 2 (CH2) are very similar and situated in the Vertical (Input) assembly.

CH1 is described below with reference to Figure 2 (Yellow) except where reference is made to CH2. TR601A and TR601B are FETS used as source followers which drive TR605A and TR605B, a phase-splitting stage. These are a long-tailed pair with the 1 mV and 5 mV SET CAL potentiometers, R696 and R625, in the emitter circuit. DC BAL, R601, is adjusted to eliminate trace movement when the gain is switched; the collectors are connected to a shunt feedback stage, TR609 and TR611 via the variable VOLTS/DIV circuitry. The input impedance of this stage is very low and its total input resistance, including the $91\text{ }\Omega$ resistors, R646 and R647, is approximately $100\text{ }\Omega$ per side. When the variable VOLTS/DIV potentiometer is at maximum resistance, the attenuation of the signal is small. When at minimum, however, the resistance is approximately $51\text{ }\Omega$ per side. The attenuation of the signal is now approx. 3. This covers the gaps in the 1-2-5 sequence in the attenuators. The shift signal is inserted at the bases of TR609 and TR611, after the VARIABLE control. This ensures that the same amount of shift is obtained regardless of VARIABLE setting.

3.3.2 The emitter followers, TR614 and TR615, provide a low output impedance for the trigger pick-off and a low capacity loading for the shunt feedback stage. The CH1 trigger signal is fed to the bases of TR756 and TR757, which are a long-tailed pair; then from their collectors, via a diode matrix to a trigger interface Pins 7 and 10 on SK602. The diode matrix allows the trigger signals to be switched from CH1, CH2 or the displayed signal merely by changing DC levels; $+24\text{ V}$ switches the channel on and -24 V switches the channel off. The display or ALT trigger pick-off circuitry is on the display unit mother board PC147. TR618 and TR619 are series feedback stages with HF peaking between their emitters. The voltage swing at their bases is approximately 22 mV/div/side or 44 mV/div push-pull. Their collectors feed the display unit interface via the channel diode matrix.

3.3.3 When CH1 is selected, the voltage at eyelet 152/24 is taken to $+11\text{ V}$ and at eyelet 152/23 to $+15\text{ V}$. This reverse biases D605, D606, D611 and D613, and switches on D612, D609, D607 and D608. The signal current now passes through D609 and D612. The interface voltage level is approximately $+12.7\text{ V}$; the current sensitivity approximately 0.27 mA/div/side . This gives a voltage swing of 25 mV/div/side as the input impedance of the following stage is $100\text{ }\Omega/\text{side}$ approximately.

3.3.4 When CH2 is selected D612, D609, D607 and D608 are reverse biased and D605, D606, D611 and D613 are switched on. The signal current now flows in D611 and D613. Pin 152/24 is at $+15\text{ V}$ and 152/23 $+11\text{ V}$.

On CHOP, reference Figure 3 (Yellow), these levels are switched at approximately 350 kHz , on ALT at sweep repetition rate. The switching signals are obtained from TR751 and TR753 collectors, eyelets 153/14 and 153/17. The switching levels are $+11\text{ V}$ and $+15\text{ V}$. TR751 controls CH2 and TR755 controls CH1. The collectors and bases are cross-coupled to ensure bi-stable operation. When CH1 is selected: the emitter of TR751 is open-circuited switching it off and TR753 on. The reverse happens when CH2 is selected.

3.3.5 When SUM is selected, both transistors are saturated and R771 is switched into circuit to reduce the current drain from the supply.

3.3.6 On ALT, the circuit operates as a bistable, triggered by negative pulses from the sweep circuit. D751 and D753 are the steering diodes and C750 and C754 the input capacitors. The cross-coupling resistors R756 and R761 are non-symmetrical to ensure that the circuit does not achieve a third stable state with both collectors resting at $+13.5\text{ V}$ due to low common mode gain.

3.3.7 On CHOP, the circuit operates as an emitter-coupled multi-vibrator. R757, C751, C752 and R762 form the timing circuit and C753 provides a blanking pulse output at twice the chop frequency. TR752 is the blanking amplifier and shaper giving a current pulse via D752 and Pin 3 on SK602 to D606, reference Figure 1 (White).

3.3.8 CH2 has an invert facility, a 2-pole change-over switch, S601, which re-routes the signal current when the invert knob is pulled. On CH1, R703 is used to eliminate trace movement, when operating the VARIABLE. On CH2, R704 is used to equalize the currents through the two switch paths, so that no movement occurs on normal/invert operation, R645 provides the balance controls for the VARIABLE movement and R602, the balance control for gain switching movement.

3.3.9 The CH2 trigger signal is fed to the bases of TR758 and TR759, then via a diode matrix, and Pins 7 and 10 on SK602 to the switching diodes D601, D602, D603 and D604, reference Figure 1 (White).

3.4 VERTICAL AMPLIFIER (Final stage)

3.4.1 The signal from input vertical amplifier is carried, via Pins 5 and 13 on SK602 to the delay line drive amplifier. TR603 and TR604, reference Figure 1 (White). To ensure the interface always has the same sensitivity, the gain is set by the series elements R611, R612 and the shunt elements R608, R609. The total gain adjustment is approximately 18%. This enables the input sensitivity to be set to 0.27 mA/div = 5%.

3.4.2 The drive amplifier is a voltage feedback stage giving low input and output impedances i.e. 9 Ω and 11 Ω approx. The resistors, R629 and R628 are used to raise the output impedance of this stage to match the delay line, which is 93 Ω /side. The feedback resistors are split to enable the delay line compensation circuit, C607, R617, C608 and R621 to be inserted, these provide medium frequency peaking. The ALT trigger signal is taken from the low impedance output of this stage and fed through R626 and R627 to the ALT trigger amplifier, TR601 and TR602. Selection of ALT is achieved by a D.C. Control voltage switching the diodes D601, D602, D603 and D604; +24 V at Pin 6 on SK602 selects ALT and -24 V switches it off. The trigger signal is gated with that from Pins 7 and 10 on SK602 and fed to the Trigger amplifier via Pins 11 and 12 on SK601.

3.4.3 The Sum balance control, R614, is in circuit only when SUM is selected on the Vertical amplifier. When this occurs -24 V is applied to Pin 14 on SK602 which switches on D605 and supplies the extra current needed in the SUM mode through R613, R614 and R615. When SUM is not selected the control line is at earth potential.

3.4.4 The delay line is a twin helix type sheathed with braid having a total delay of 140 ns, terminated on PC151 by R701, R703 and L701. The two resistors are in parallel with the input resistance of the next stage and give a terminating resistance of 186 Ω . L701 is a partial compensation for the input capacity of TR701 and TR702, which is adjusted for minimum delay line termination ripple. The following stage is a long tailed pair, TR701 and TR702, with a gain of 2 and peaking between the emitters. R711 and C703 are delay line compensation and C704 high frequency peaking.

The output stage is a cascade comprising TR703, TR704, TR705 and TR706. It has a gain of approximately 15 and runs at a current of 50 mA/side, gain being determined by R724, R725 and R718. The components between the emitters of TR705 and TR706, which drive the Y plates of the CRT, R719, C706, C708 and R721, provide thermal compensation. Zener diodes, D702 and D703, prevent TR703 and TR704 bottoming at extremes of shift and signal.

3.4.5 A portion of the output stage current is used to provide trace rotation. L702 is the trace rotation coil and R727 the preset control on the back panel of the oscilloscope. Geometry control is provided by R634 which is mounted on PC147.

3.5 'A' TRIGGER AMPLIFIER

3.5.1 This amplifier, reference Figure 1 (Pink) can accept balanced trigger signals originating in the vertical amplifier system or single-ended external signals via a panel co-axial socket SK1.

Balanced signals are fed into the trigger amplifier, via a 150 Ω matched transmission line from the edge connexion part of PC135. They connect to the balanced trigger amplifier, TR3 and TR4, via DC blocking capacitors, C3, and C4, the INT/EXT, switch, S1, the POLARITY switch, S2, and terminating resistors, R13 and R31.

3.5.2 TR3 and TR4, form a long-tailed pair amplifier. When S3 is set to H.F. REJ., the amplifier gain commences to fall at frequencies above 2.0 MHz, making the circuit progressively unresponsive to H.F. signals. 'A' LEVEL, R22, alters the currents in TR3 and TR4 permitting the selection of any point on the trigger signal to be set at D.C. level, where the Schmitt amplifier TR6 and TR7 switches over.

In the AUTO position, R22 is shunted by D4, R19, R29. D6 and R21 is connected in series with the wiper. The range of R22 is drastically reduced, thus enabling accurate setting of the trigger point for low amplitude signals. R26 is adjusted to give the correct output D.C. level with the TRIG LEVEL control in mid-position.

3.5.3 Following TR4, is a frequency compensated shunt feedback stage formed by TR5, R32, R33 and C13. R32 and C13 compensate for R23 and C11 in the emitter of TR3 and TR4 and give a flat frequency response but limit the output voltage swing at frequencies above 2 MHz. It is D.C. coupled via parasitic stoppers, R35 and C15 to the Schmitt trigger circuit TR6, TR7.

Normal dividing down action takes place between 2 and 10 MHz depending upon input amplitude. Two outputs are provided:—

- (1) Fast negative spikes via C61 and D61 to the bright line monostable TR61 and TR62.
- (2) Fast positive spikes via C64, L61 and D64 to the A sweep gating bistable TR63 and TR64.

3.5.4 Unbalanced trigger signals, originating from any external source, are applied to the sweep unit via a co-axial socket SK1 at an input impedance of 100 k Ω . The trigger amplifier is responsive to both D.C. and A.C. signals. By operation of S3 the D.C. component of an A.C. signal to the peak value of 250 V may be blocked. TR1 and TR2 form a single-ended shunt feedback pair, the output of which may be directed into the trigger amplifier or the horizontal amplifier in the display unit. This latter connexion is made when the 'B' TIME/DIV switch, reference Figure 3 (Pink), S251, is set to the extreme anti-clockwise position. In all other positions TR1 and TR2 output is connected to the trigger amplifier via S1b, S1a and S2.

R7 enables D.C. adjustment of the external signal level to the same as that of the internal signals. TR2 supply voltage is derived from a twin zener regulator, D3 and D8, fed from the main +24 V line via R12.

3.5.5 In the EXT X position of the 'B' TIME/DIV switch, TR3 and TR4 are disconnected from the -24 V line to prevent trigger signals from internal sources reaching the Schmitt amplifier. D5 permits current, from the +100 V and +24 V lines, to flow to ground.

3.6 'A' SWEEP GENERATOR

3.6.1 This system, reference Figure 2 (Pink), is a conventional Miller Integrator, TR66 and TR67, forming the basic ramp generator. The ramp slope is determined by selection of timing capacitors C275 to C279, C281 and C282, reference Figure 3 (Pink) and timing resistors R276 to R283, with R287 and R289 mounted on the 'A' TIME/DIV switch (S271), R91 provides calibration adjustment.

3.6.2 Trigger pulses from the 'A' Trigger amplifier are differentiated by R41 and L61. D64, being marginally biased in the conducting direction, permits the fast positive-going edges to be applied to TR63 collector and TR64 base via C66. Negative-going edges are rejected by diode action. TR63 and TR64 form a gating bistable. During the WAIT period, when the sweep generator is receptive to trigger signals, TR63 is conducting and TR64 is off. The quiescent state of TR63 and TR64 is set by R73 which adjusts the bias of TR63 with respect to TR64. A positive pulse being applied to TR64 causes it to conduct; the feedback action via the coupled emitter, R76 and C66, switches TR63 off. This collector potential rises to reverse bias D64 and prevents further trigger pulses from entering the bistable and a positive-going gate pulse is made available at the front panel socket SK61 via R80.

3.6.3 TR65 clamps the D.C. level from which the ramp commences. The current flowing from TR65 collector, via D66, D69 and D71 to the timing resistors, is diverted through TR64, which reverse biases D66, D61 and D71 and allows the current through the timing resistors to flow into the timing capacitors.

3.6.4 The TR66 drain voltage then commences to rise linearly carrying TR67 base and emitter with it. A positive feedback to increase the loop gain is provided, via R99 and R96, thus improving ramp linearity by reducing the potential excursion at TR66 gate.

The ramp voltage appearing at the emitter of TR67 is fed to the sweep-out circuit, reference Figure 5 (Pink) via S271 and S192 and also to SK271 on the front panel via R288; and is also applied to the hold-off bistable TR68 and TR69, via D73 and the parallel combination of C75 with R103, R104 and R105. TR69 is normally conducting, drawing part of its collector current through neon lamp V61, mounted on the front panel, causing it to glow during the wait and sweep period.

3.6.5 The ramp terminates when TR68 base potential rises to the same value as TR69 base potential, switching TR68 on, and TR69 off and extinguishing V61. TR69 no longer draws current via R118 and D75, causing D76 to conduct and turn on TR63. The two transistors switch back to the state prior to receiving a trigger pulse. Flyback current then flows from TR65 to the timing capacitors via D66, D69 and D71, causing the ramp voltage to return linearly to the quiescent condition.

3.6.6 As it is undesirable for the sweep to be triggered before flyback is completed, a time delay is achieved by selecting a suitable capacitor mounted on S271, which holds TR69 in the off state, thus preventing TR64 being triggered to the conducting state. Hold-off capacitors C271 to C274 are charged during the sweep period via D73 and discharge during and after the flyback period via R103 to R106. R105 sets the sweep length. At the end of the hold-off period, TR69 conducts, permitting the gating bistable, TR63 and TR64, to be receptive to a trigger signal which initiates another sweep.

3.7 BRIGHT LINE AUTO

3.7.1 TR61 and TR62 form a monostable pair in which TR62 is normally conducting and TR61 is off. When S3a is in the non-auto position, D63 is back biased and exerts no influence on the bias of TR63.

3.7.2 In the AUTO position R68 is open-circuited and the bias resistors, R72 and R73, are shunted by R65, which lowers TR63 base potential, causing the sweep to free-run in the absence of trigger signals, giving visual indication of the trace position.

3.7.3 Upon the application of positive and negative trigger pulses from the 'A' Schmitt amplifier, via C61; D61 being marginally forward biased accepts and passes negative pulses to TR61 base, positive pulses being blocked by diode action. A negative pulse applied to TR61 base, causes TR61 to conduct for a period determined by C63 and R67, before switching back. The mean current drawn by TR61 causes a potential rise across R65, smoothed by capacitor C62 to reverse bias D63 and prevent the gating bistable free-running the 'A' sweep. In this condition the 'A' sweep is triggerable and the trace is locked to the input signal.

D62 prevents TR61 bottoming during its conducting period ensuring an approximate cycling frequency of about 25 Hz.

3.8 UNBLANKING AMPLIFIER

3.8.1 The Unblanking amplifier, reference Figure 3 (White) is a current to voltage convertor or transimpedance amplifier. Current input source for this amplifier is provided by R89, R93 and R92. Prior to the initiation of the sweep D67 is reverse biased by D66, suppressing the CRT beam current. At the commencement of sweep, D66 is reverse biased permitting current from the unblanking amplifier to flow to the -24 V line via D67, R89 and D68. In the 'A' INT BY 'B' position, an additional resistor R217, reference Figure 5 (Pink) is switched in series to reduce slightly the current drawn through D67 and reduce the beam intensity, so that when the 'B' timebase sweeps, the full beam current is restored for the 'B' sweep period via D198, R222, D203 and R218.

3.8.2 Unblanking signals from D67 and D198 via Pin 6 on SK601 are summed at earth potential in the emitter of TR351 reference Figure 3 (White). TR351 drift is compensated for by D351. This composite signal is mixed with the intensity control current at the base of TR352 which, with TR353, forms a low input and output impedance shunt feedback amplifier. R362 and C353 are the gain and frequency response determining components i.e. a 2 mA current change at the base of TR352 produces a 48 V change at the collector of TR353. TR354 and TR355 comprise a complimentary emitter follower stage to provide the large fast transients required.

3.9 'B' SWEEP TRIGGER AMPLIFIER

3.9.1 This amplifier, reference Figure 4 (Pink) can accept balanced trigger signals originating in the vertical amplifier or single-ended A.C. coupled external signals via a panel co-axial socket SK151.

3.9.2 Balanced signals are fed into a high impedance input from a balanced 150 Ω transmission line terminating at the 'A' trigger amplifier. C152 and C154 block the D.C. component and limit the low frequency response to approximately 3.5 Hz. When S152 is in the INT position, balanced signals are applied via POLARITY switch S151 to TR151 and TR152 bases, a frequency compensated long-tailed pair amplifier.

R153, connected between the +24 V line and ground, permits bias adjustment to TR151 thus enabling any point on the input signal to be aligned to the switch-over point of the 'B' Schmitt trigger TR154 and TR155. TR153, R165, R166, R167 and R168 form a shunt feedback stage acting as a buffer amplifier between TR152 and TR154.

3.9.3 In the AUTO position; the LEVEL control, R153, is switched out of circuit and the output from TR155 collector is integrated by R174 and C157 and fed back to the base of TR153 via R165. The circuit then oscillates in the absence of trigger signals at a frequency of approximately 35 Hz. The base waveform of TR154 is triangular in shape and oscillates between the triggering levels of the Schmitt. The mark space ratio is adjusted to unity by R159 and the backlash set to 60 mV by R173.

3.9.4 External trigger signals from front panel socket SK151 are applied via S152 and R151 to the appropriate base of the trigger amplifier. The squarewave response is set up by adjustment of a twisted pair across R151.

3.10 'B' SWEEP GENERATOR

3.10.1 This system is a conventional Miller integrator TR196 and TR197 forming a basic ramp generator, reference Figure 5 (Pink). The ramp slope is determined by selection of timing capacitors C251 to C257 reference Figure 3 (Pink) and timing resistors R251 to R258 mounted on the 'B' TIME/DIV switch S251. R236 provides a calibration adjustment. A close operational similarity exists with the 'A' ramp generator so a full description will not be necessary, except to note that the ramp is terminated by the zener diode D201 and flyback is delayed until the 'A' sweep flyback occurs.

3.10.2 Initiation of the 'B' ramp is dissimilar and totally dependent upon the presence of the 'A' sweep ramp. The 'A' ramp voltage, divided down by R191 and R193, is applied to TR191 base. TR191 and TR192 form a bistable, where TR191 is conducting initially. Conduction switch-over takes place when the divided-down 'A' ramp voltage of TR191 base is equal to the voltage of TR192 base, set by potential divider R199, a precision wirewound potentiometer on the front panel. At the instant of switch-over, TR191 collector current falls rapidly and a negative-going voltage step is applied to TR193 via R206 and C196.

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3.10.3 When S191a is in the VAR position, the D.C. bias on TR193 is such that the negative step applied causes TR193 to switch on and TR194 to switch off. D195 anode potential falls towards the negative line as TR195 current is insufficient to sustain a high enough potential across R212 and R213, and it is caught just below ground potential by D194. D196 and D197 are instantly back biased. TR196 through Miller action commences to generate the 'B' ramp voltage.

3.10.4 With S191a in the TRIG position, the slightly higher bias on TR193 base prevents conduction switch-over upon receipt of the negative step from TR191. TR193 remains off and TR194 conducts with base bias just slightly more negative than TR193.

3.10.5 The 'B' LEVEL control in the AUTO position or adjusted to cause the 'B' Schmitt to operate, permits any input trigger signals of sufficient amplitude to pass fast edges square-wave voltages to D193 via differentiating network C195 and R207. D193 will pass the positive-going differentiated pulses to TR193 collector and TR194 base via C198 and R216. Negative-going spikes are rejected by diode action.

The first positive-going pulse from D193 reaching TR194 base, after the negative step application to TR193 base, causes conduction changeover between TR193 and TR194, initiating the 'B' ramp. Summarising: the 'B' ramp is initiated in the VAR position of S191a by the presence of the 'A' ramp voltage and the setting of DELAY TIME MULTIPLIER, R199. In the TRIG position of S191a are the foregoing conditions plus trigger pulses via D193 from the 'B' Schmitt.

3.10.6 During the period of the 'B' sweep, D198 is forward biased and current from the unblanking amplifier then flows to the -24 V line via R222, Q203, R218 and S192d. A small proportion of this current relative to the current drawn from the same source by the 'A' ramp generator, permits a momentary brightening of the CRT trace. The adjustment of R199 positions the bright portion of the trace to any point on the 'A' trace, the length of the bright portion being dependent upon the 'B' TIME/DIV setting.

Output voltages of both 'A' and 'B' ramp generators are converted to suitable currents by R230 and R233 respectively and fed via Pin 2 on SK601 and R7 to the base of TR3. S192a, S192c and S192d or all three select either 'A', 'B' or MIXED sweeps respectively.

3.11 HORIZONTAL AMPLIFIER

3.11.1 This comprises an input mixing amplifier and an overall multi-stage feedback amplifier, reference Figure 2 (White). The input amplifier TR3 has a gain of 0.5 with low input and output impedances. It mixes the sweep signal with the two position control voltages and provides a composite signal to the main amplifier. R17 is the balance control which sets the voltage at TR3 collector to centralize the position controls. C5 provides H.F. peaking.

3.11.2 The main amplifier is a voltage feedback type which has the advantage of high input and low output impedances. R32 and R31 are the feedback resistors and the gain is determined by these resistors and the resistors between the emitters of TR4 and TR5. For X1 gain these are R26 and R27. On X10 gain R28 and R29 are switched in parallel with R26 and R27. R27 sets X1 gain and R29 sets X10 gain.

3.11.3 The mean X plate potential is set by R23 to approximately 57 V. D4 and D5 limit the excursion on the bases of TR6 and TR7 when X10 gain is used. The output stage TR6, TR7, TR8 and TR9 is capable of delivering large current swings into capacitive loads whilst running at a low quiescent current. In the positive direction the emitter followers TR8 and TR9 supply the current and in the negative direction TR6 and TR7 supply the current through diodes D6 and D7. The output is push-pull, TR4 and TR5 being a phase-splitting stage.

3.12 CALIBRATOR

3.12.1 The calibrator, reference Figure 2 (White) is a simple, saturating multivibrator running at approximately 1 kHz. The timing components are R1, C1, C3 and R6. The transistor TR1 switches between -24 V and earth, TR2 between -24 V and -0.7 V. D2 catches TR2 collector as it aims for +24 V. The accuracy of the calibrator depends on the resistors R5, R9, R13 and the -24 V line. R4 is a $\pm 1.2\%$ control to take up the tolerance of R5. If SK1 and SK2 are shorted together 3 mA passes through the short circuit determined by the -24 V line and $R4 + R5 + R13$.

3.13 TRACE LOCATE

This reduces the maximum swing of vertical and horizontal amplifiers and free-runs the sweep. The vertical amplifier is compressed in the delay line termination stage TR701 and TR702. The sweep is made to free-run by applying a positive voltage to Pin 13 on SK601 via a 300 Ω resistor R602.

3.14 POWER SUPPLY

+105 V, -24 V and -24 V lines, reference Figure 4 (White) are all stabilizing circuits, protected against short circuits, connected to the vertical input and sweep amplifiers via Pins 4, 2, 3 and 9 on SK602 and Pins 14, 4, 3 and 9 on SK601 respectively.

3.14.1 +24 V LINE

D405, D406, D407 and D408 form a full wave bridge circuit. R424, R425 and R426 act as a sampling chain and use the -24 V line as the reference voltage. Any attempted change in output voltage of the +24 V line is padded back to the controlling network of TR408, TR406 and TR405, which reduces the change to a very small value. TR402 and R407 provide current limiting to protect the output from short circuits.

3.14.2 -24 V LINE

This is used as a reference voltage for the other two lines and it is essential that this line is set to its correct voltage. D409, D411, D412 and D413 form a full wave bridge circuit. TR411 and TR407 are a long-tailed pair and together with TR409 and TR413 stabilize the circuit. TR403 and R406 provide current limiting and protect the output from short circuits.

3.14.3 105 V LINE

D401, D402, D403 and D404 provide full wave bridge rectification. This line differs from the -24 V and +24 V lines in that if a short circuit occurs in the output the instrument must be switched off and turned on again before the line can be restored to its normal voltage. TR414, TR412, TR415 and TR416 stabilize the output and TR401 and TR404 provide the short circuit protection in the form of a bistable which is changed over by current flowing through R406.

3.14.4 E.H.T.

The E.H.T., reference Figure 3 (White) is derived from a Class C oscillator operating at approximately 28 kHz. The oscillator transistor TR304 uses transformer, T301, as its load and main frequency determining component. A feedback loop, including a high gain amplifier, TR301, TR302 and TR303, regulates the cathode supply, which is set to the correct potential by adjusting R301, and the grid is set to the correct tube cut-off potential by adjusting R315. Diodes D304 and D303 provide half-wave rectification from T301 for the cathode and grid supplies. A five stage voltage multiplier (quintupler) provides the +12.5 kV PDA. The input to the multiplier is taken from the same tapping on T301 as that used for the cathode supply.

Thermistor TH301 limits the output voltage at switch on and C304 reduces E.H.T. feedback into the unregulated -30 V line. The tube is focused by adjusting R327, which is on the front panel.

SECTION 4

MAINTENANCE AND CALIBRATION

4.1 GENERAL

4.1.1 This instrument comprises three main assemblies: Main Frame, Vertical and Sweep Units. To facilitate references made in this section a colour code has been adopted to identify the appropriate PC boards (see Introduction).

4.1.2 Before it is assumed a fault condition exists, control settings should be verified with reference to the pre-operational checks, para 2.2. Where a component is replaced e.g. transistor, it is advised that the calibration check detailed in para 4.4, be carried out.

4.1.3 The entirely solid-state design of the instrument should render frequent re-adjustment of the internal preset controls unnecessary; however, to ensure full measurement accuracy, it is desirable to make an occasional check of the vertical amplifier sensitivity, reference 4.3.2. The internally generated 30 mV peak to peak calibrator waveform may conveniently be used for these checks.

4.2 MECHANICAL

4.2.1 ACCESS TO INTERIOR

The cabinet covers are removed as follows:—

1. Disconnect the power supply lead.
2. Turn four buttons on each cover to release.
3. Lift to clear channel.
4. The chassis rear plate is secured by four fixing screws, one at each corner.
5. The Vertical and Sweep units are secured by one screw each to the lower front casting. When unscrewed, the units may be withdrawn.

4.2.2 LOCATION OF PRESET CONTROLS

Circuit	PC Board No.	Location w.r.t. CRT	
Calibrator	150	Right	Ref.
E.H.T.	148	Rear Right	Plates
Power Supply	149	Rear Centre	6.1.
Unblanking Amplifier	128	Rear Centre	6.2.
X Amplifier	150	Right	6.3
Y Amplifier	151	Left	white
Interface Connector Board	147	Across	
Attenuator	137	Vertical Unit Left	
Vertical Input	152	Vertical Unit Left	
Trigger Amplifier 'A'	132	Sweep Unit Right	
Trigger Amplifier 'B'	133	Sweep Unit Left	
'A' Sweep Generator	132	Sweep Unit Right	
'B' Sweep Generator	133	Sweep Unit Left	

4.2.3 CRT REMOVAL

1. Remove top, bottom and rear covers.
2. Turn instrument upside down.
3. Release PDA cable securing clips.
4. Cautiously slide cable connexion moulded plug and socket apart to expose connexion.
5. Earth PDA connexion; then disconnect.
6. Remove four neck pins.
7. Remove tube base socket.
8. Remove Intensity, Focus, Fine and Position knobs.
9. Remove two bezel retaining nuts.
10. Allow bezel to fall forward sufficiently to remove filter.
11. Lift-out bezel.
12. Ease CRT forward through front panel aperture.
13. Remove four CRT location mouldings.
14. Remove CRT.

4.2.4 CRT FITTING

Reverse the order detailed in para 4.2.3 above

4.3 CALIBRATION

4.3.1 The following procedure enables a calibration check of the instrument to be accomplished. It is advised that isolated adjustments are not made due to the risk of interaction with settings made in earlier checks. A functional check may be carried out as detailed in para 4.4, checking parameters are met, before proceeding to the next check. Adjustments, if made, should be minimal, except when setting-up procedures are referred to.

The following tools and facilities will be required:—

- Screwdrivers
 - Plain 4 mm blade
 - Non-capacitive.
- Fixture extension, flexible 067-0688-00
 - Screened, BNC adaptors
- Calibration Units
 - Vertical 067-0672-00
 - Horizontal 067-0673-00
- Adaptors
 - BNC 3-way, Male/Female/Male
 - BNC 2 mm
- Fixture extension, rigid 067-0689-00
- Probe X10, with earth lead
- Oscilloscope Monitor
- Pliers, flat nose
- Normalizer, set to 33pF (067-0552-00)
- Probe for voltage measurement

FACILITIES

- Variable voltage supply
- Voltage measurement from -24V to 2.5 kV = 0.5%.

Input Signals		Squarewave		Markers
Sinewave				
1.6 V	50 Hz	5 mV	1 kHz	1%
300 mV	100 Hz	25 mV	1 kHz	1%
1 V	50 kHz	100 mV	1 kHz	1%
2 V	50 kHz	250 mV	1 kHz	1%
4 V	50 kHz	500 mV	1 kHz	1%
300 mV	100 kHz	1 V	1 kHz	1%
500 mV	10 MHz	2.5 V	1 kHz	1%
500 mV	55 MHz	5.0 V	1 kHz	1%
25 mV	20 MHz	10 V	1 kHz	1%
25 mV	50 MHz	25 V	1 kHz	1%
		50 V	1 kHz	1%
		25 mV	50 kHz	
		1ns risetime	100 kHz	
		1ns	25 mV	1 MHz
		1ns	200 mV	1 MHz

Note: Input signal voltages are peak to peak

4.3.2 INITIAL SETTINGS

- 1.1 Ensure that instrument is not connected to a power supply.
- 1.2 Check for correct Voltage Selector setting and fuse as in 2.6.1.
- 1.3 Push INVERT.
- 1.4 Set both DC-GND-AC to GND.
- 1.5 Set both VOLTS/DIV to 5 mV.
- 1.6 Push both VARIABLE and set fully clockwise.
- 1.7 Push TRIG SELECT CH1.
- 1.8 Push CHANNEL SELECT CH1.
- 1.9 Set both POSITION controls to mid position.
- 1.10 Set FINE and POSITION to mid position.
- 1.11 Set DELAY TIME MULT to 5.0.
- 1.12 Push REP. VAR. A ONLY, AUTO.
- 1.13 Push both POLARITY buttons in (+).

- 1.14 Push both INT.
- 1.15 Set A and B VARIABLE TIME/DIV to CAL.
- 1.16 Set A and B TIME/DIV to 0.1ms.
- 1.17 Connect instrument to a variable AC power supply.
- 1.18 Switch on variable power supply and increase voltage gradually to the instrument voltage setting.
- 1.19 Turn INTENSITY clockwise for POWER ON (Lamp should glow) and visible trace.
- 1.20 Adjust FOCUS and ASTIG.
- 1.21 Adjust TRACE ROTATION to align trace with graticule.

4.4 CALIBRATION PROCEDURE

4.4.1 POWER SUPPLY

CAUTION HIGH VOLTAGE.

- 1.1 Remove main covers.
- 1.2 Set voltages as shown in table.

LOCATION SKT 603 PC147 (white)		VOLTAGE PRESETS PC149 (white)
Pin No.	Voltage	Adjust
7	- 24	R428
3	- 24	R425
5	+ 105	R433

4.4.2 SET CATHODE VOLTAGE -2.5kV.

NOTE:— A Voltmeter of input impedance greater than 25M Ω should be used.

- 1.1 Connect meter to Pin 2 (mauve wire) of CRT base.
- 1.2 Adjust preset R301 to PC148 (white) for a meter reading of -2.5kV.

4.4.3 SET GRID CUT-OFF.

- 1.1 Set TIME/DIV to 10ms.
- 1.2 Turn INTENSITY anticlockwise.
- 1.3 Adjust R315 PC148 (white) until trace just blanks out.

4.4.4 MAIN FRAME ADJUSTMENTS

Raster distortion

- 1.1 Apply 100kHz sinewave to CH1 input.
- 1.2 Adjust controls for 10 x 8 div raster.
- 1.3 Adjust R634 PC 147 for minimum raster distortion.
- 1.4 Disconnect signal and switch off instrument.

Horizontal balance

- 2.1 Remove Dual Sweep Unit.
- 2.2 Insert HORIZONTAL CALIBRATION UNIT (067-0673-00) and switch on instrument.
- 2.3 Apply 5V D.C. to input.
- 2.4 Set horizontal POSITION and FINE to mid position.
- 2.5 Adjust R17 PC150 (white) to centralize spot.

Horizontal plate potentials

- 3.1 Connect a voltmeter between Pin 14 PC150 and GND.
- 3.2 Adjust R23 PC150 for 57V D.C.
- 3.3 Remove 5V input.

Horizontal sensitivity

- 4.1 Apply 10V, 1kHz squarewave to HORIZONTAL input.
- 4.2 Adjust R27 PC150 for 10.0 div display.
- 4.3 Apply 1V, 1kHz squarewave to HORIZONTAL input.
- 4.4 Pull FINE for X10 magnification.
- 4.5 Adjust R29 PC150 for 10.2 div display.
- 4.6 Disconnect signal and switch off instrument.
- 4.7 Remove HORIZONTAL CALIBRATION UNIT.
- 4.8 Insert Sweep Unit and switch on instrument.

Horizontal linearity

- 5.1 Apply 20MHz to CH1 input.
- 5.2 Set TIME/DIV to 0.1 μ s.
- 5.3 Set controls for a 3 division locked trace.

- 5.4 Adjust C11 PC150 for best linearity on the first few cycles.
- 5.5 Pull LINE for X10 magnification.
- 5.6 Adjust C13 and C5 PC150 for best linearity on the first few cycles.
- 5.7 Push FINE.
- 5.8 Disconnect signal.

Calibrator setting

- 6.1 Select CH1.
- 6.2 Apply 25mV, 1kHz squarewave to CH1.
- 6.3 Set DC-GND-AC to DC.
- 6.4 Set VOLTS/DIV to 5mV.
- 6.5 Push VARIABLE in and set to CAL.
- 6.6 Set TIME/DIV to 1ms.
- 6.7 Adjust SET 5mV GAIN for 5 div display.
- 6.8 Disconnect 25mV input.
- 6.9 Connect 30mV CAL to CH1.
- 6.10 Adjust R4 PC150 (white) for a 6 div display to ± 0.1 divisions.
- 6.11 Disconnect 30mV input.

Horizontal position balance

- 7.1 Set TIME/DIV to 1ms.
- 7.2 Adjust R17 PC150 to centralize trace so that POSITION and FINE move each end of trace past screen centre equally.

Unblinking amplifier pulse response

- 8.1 Set TIME/DIV to 0.1 μ s.
- 8.2 Set INTENSITY for just visible trace.
- 8.3 Adjust C353 PC128 (white) for uniformity of intensity at start of trace.

Vertical balance

- 9.1 Remove VERTICAL Unit.
- 9.2 Insert VERTICAL CALIBRATION UNIT (067-0672-00).
- 9.3 Select BAL.
- 9.4 Set TIME/DIV to 1ms.
- 9.5 Adjust R706 PC151 (white) to align trace with vertical centre.

Vertical sensitivity

- 10.1 Select CAL.
- 10.2 Apply 250mV 1kHz squarewave to vertical input.
- 10.3 Adjust R609 PC147 (white) for 5 div display ± 0.2 div.
- 10.4 Disconnect signal.

Vertical pulse response

- 11.1 Set TIME/DIV to 0.1 μ s.
- 11.2 Pull FINE for X10 magnification.
- 11.3 Apply 1MHz squarewave with 1ns risetime to vertical input, to give 5 div display.
- 11.4 Adjust C608 PC147 to give flat top.
- 11.5 Adjust C711 and R722 PC151 for optimum response.
- 11.6 Adjust C707 PC151 for optimum response.
- 11.7 Set C704 PC151 to mid position.
- 11.8 Adjust L701 PC151 for minimum delay-line glitch.
- 11.9 Adjust C704 PC151 for optimum response.
- 11.10 Disconnect signal and switch off instrument.
- 11.11 Remove VERTICAL CALIBRATION UNIT.
- 11.12 Insert Vertical Unit.

SWEEP UNIT ADJUSTMENTS

4.4.5 'A' TRIGGER

NOTE: 'A' controls are used unless otherwise stated.

- 1.1 Withdraw Sweep Unit and connect to Mainframe Unit via flexible extension (067-0688-00).
- 1.2 Remove unit covers.
- 1.3 Switch on instrument.

Set sensitivity

- 2.1 Push A ONLY, AC and INT.
- 2.2 Depress POLARITY.
- 2.3 Set TIME/DIV to 10 μ s.
- 2.4 Set VOLTS/DIV to 0.5V.
- 2.5 Select CH1 trig and channel.
- 2.6 Apply 300mV, 50kHz sinewave to CH1.

- 2.7 Set DC-GND-AC to AC.
- 2.8 Obtain trace.
- 2.9 Connect monitor oscilloscope (M.O.) via screened X10 Probe to junction of R32/C15 PC132 (pink) GRID REF 6-E3).
- 2.10 Set M.O. TIME/DIV to 5 μ s.
- 2.11 Set M.O. VOLTS/DIV to 10mV input AC coupled and auto trigger.
- 2.12 Adjust R36 PC132 for triggering levels 80mV (0.8div) apart. Similar to Plate 4.1.
- 2.13 Check that triggering levels are within \pm 10mV with change in POLARITY.
- 2.14 Check that trace starts on correct polarities.
- 2.15 Disconnect M.O. probe.
- 2.16 Disconnect signal.

Set level range

- 3.1 Push A ONLY, AUTO and INT.
- 3.2 Depress POLARITY.
- 3.3 Apply 1V 50kHz sinewave to CH1.
- 3.4 Set TIME/DIV to 10 μ s.
- 3.5 Set VOLTS/DIV to 1V.
- 3.6 Set DC-GND-AC to AC.
- 3.7 Adjust R26 PC132 (pink) so that trace does not free-run at LEVEL extremities.
- 3.8 Disconnect signal.

Set external trigger

- 4.1 Apply 2V 50kHz sinewave to EXT and CH1.
- 4.2 Release and depress POLARITY.
- 4.3 Adjust LEVEL for trace triggering point to coincide.
- 4.4 Set trace start at centre of screen.
- 4.5 Push EXT.
- 4.6 Adjust R7 PC132 (pink) to align trigger point with screen centre.
- 4.7 Reduce signal to 300mV.
- 4.8 Observe stable trace on DC, AC, AC HF REJ with LEVEL control adjustment.
- 4.9 Disconnect signal.

Set Ext X

- 5.1 Push A ONLY, DC and INT.
- 5.2 Turn 'B' TIME/DIV fully anticlockwise.
- 5.3 Apply 100kHz sinewave to CH1 and EXT X linked together.
- 5.4 Set VOLTS/DIV to 1V.
- 5.5 Increase signal voltage until trace crosses extreme verticals.
- 5.6 Check that vertical difference between extremities is 4 divs \pm 0.8 div.
- 5.7 Adjust twisted pair on PC132 to minimize elliptical effect.
- 5.8 Set DC-GND-AC to GND.
- 5.9 Adjust signal voltage to give 5 div trace.
- 5.10 Increase signal frequency to reduce trace to 3.5 divisions.
- 5.11 Check frequency > 1.4MHz.
- 5.12 Disconnect signal.

Check H.F. triggering

- 6.1 Push A ONLY, AUTO, INT.
- 6.2 Turn 'B' TIME/DIV to 5 μ s.
- 6.3 Set DC-GND-AC to AC.
- 6.4 Set TIME/DIV to 0.1 μ s.
- 6.5 Apply 50MHz to CH1.
- 6.6 Set amplitude to 0.5 div
- 6.7 Check for locked trace on AUTO, DC, AC with LEVEL control adjustment.
- 6.8 Apply 500mV 50 MHz sinewave to EXT X and CH1.
- 6.9 Push EXT.
- 6.10 Check for locked trace on AUTO, DC, AC with LEVEL control adjustment.
- 6.11 Disconnect signal.

Check H.F. rejection

- 7.1 Push A ONLY, AC, INT.
- 7.2 Depress POLARITY.
- 7.3 Apply 20MHz to CH1.
- 7.4 Set VOLTS/DIV to give 8 div trace.
- 7.5 Set TIME/DIV to 0.2 μ s.
- 7.6 Adjust LEVEL to lock trace.
- 7.7 Push H.F. REJ.
- 7.8 Adjust LEVEL.

- 7.9 Observe trace unlockable.
- 7.10 Disconnect signal.

Check line trigger

- 8.1 Push A ONLY, AC LINE.
- 8.2 Depress POLARITY.
- 8.3 Set TIME/DIV to 5ms.
- 8.4 Apply AC line supply to CH1 via 10 : 1 Probe.
- 8.5 Set VOLTS/DIV to give 8 div trace.
- 8.6 Adjust LEVEL for locked trace.
- 8.7 Release and depress POLARITY.
- 8.8 Observe trace locks at all points of the waveform.
- 8.9 Disconnect signal.

4.4.6 'A' SWEEP

NOTE:— 'A' controls are used unless otherwise stated.

Set timing

- 1.1 Push A ONLY, AUTO and INT.
- 1.2 Depress POLARITY.
- 1.3 Turn VARIABLE fully clockwise.
- 1.4 Apply 1ms marker signal to CH1.
- 1.5 Set TIME/DIV to 1ms.
- 1.6 Set VOLTS/DIV to give approximately 2 div display.
- 1.7 Adjust LEVEL for locked trace.
- 1.8 Adjust R91 PC132 (pink) for one marker per division.
- 1.9 Disconnect signal.

Set H.F. timing

- 2.1 Apply 0.1 μ s marker signal.
- 2.2 Set TIME/DIV to 0.1 μ s.
- 2.3 Set VOLTS/DIV to give approximately 3 div display.
- 2.4 Adjust LEVEL for locked trace.
- 2.5 Adjust C281 on TIME/DIV switch (access hole in PC132, GRID REF 6-F2).
- 2.6 Adjust for one marker per div.
- 2.7 Check TIME/DIV ranges overlap using VARIABLE.
- 2.8 Check range calibration.
- 2.9 Disconnect signal.

Check stability

- 3.1 Push A ONLY, AUTO and INT.
- 3.2 Depress POLARITY.
- 3.3 Set TIME/DIV to 10 μ s.
- 3.4 Set VOLTS/DIV to 1V.
- 3.5 Apply 2V 50kHz to CH1.
- 3.6 Adjust LEVEL to lock trace.
- 3.7 Rotate R73 PC132 (pink) clockwise until trace free-runs.
- 3.8 Note slot position on R73.
- 3.9 Rotate R73 anticlockwise until trace disappears.
- 3.10 Note slot position.
- 3.11 Set R73 to centre of two noted positions.
- 3.12 Disconnect signal.

Set trace length

- 4.1 Push A ONLY, AUTO and INT.
- 4.2 Set DC-GND-AC to GND.
- 4.3 Set TIME/DIV to 0.1ms.
- 4.4 Adjust R105 PC132 (pink) for 10.4 divisions.

Check sawtooth and pedestal voltage

- 5.1 Apply 1ms marker signal to CH1.
- 5.2 Set VOLTS/DIV to give approximately 2 div display.
- 5.3 Connect M.O. probe to Pin 33 PC132 (GRID REF 6-H2) See plate 4.2.
CHECK: Y 1 = 15 \pm 0.2V as Plate 4.2
Y 2 = 2 \pm 0.5V as Plate 4.2
- 5.4 Disconnect signal.
- 5.5 Do not disconnect probe.

Set hold-off time

- 6.1 Set as table. See plate 4.3

Sweep Unit 'A' TIME/DIV	M.O. TIME/DIV.	M.O. X axis DIVISIONS
10ms	2ms	2 to 4
0.1ms	50 μ s	1.2 to 2.4
10 μ s	5 μ s	1.2 to 2.4
0.5 μ s	1 μ s	1 to 2

- 6.2 Adjust R108 PC132 for optimum hold-off time as in plate 4.3.
- 6.3 Reset trace length.
- 6.4 Disconnect probe.

Check single shot

- 7.1 Apply 100ms marker signal to CH1.
- 7.2 Push REP, A ONLY, AC and INT.
- 7.3 Obtain trace by rotating LEVEL.
- 7.4 Set VOLTS/DIV to display approximately 2 div.
- 7.5 Set TIME/DIV to 0.2 sec.
- 7.6 Set DC-GND-AC to AC.
- 7.7 Push SINGLE sweep.
- 7.8 Observe neon goes off at end of sweep.
- 7.9 Set DC-GND-AC to GND.
- 7.10 Push RESET.
- 7.11 Observe neon glows with no sweep.
- 7.12 Set DC-GND-AC to AC.
- 7.13 Observe neon glows for period of sweep.
- 7.14 Push REP.
- 7.15 Disconnect signal.

4.4.7 'B' TRIGGER

Replace right hand cover of unit and turn over to give access to PC133.

NOTE: - 'B' controls are used unless otherwise stated.

Set internal triggering

- 1.1 Set DELAY TIME MULT (DTM) to 5.0.
- 1.2 Depress VAR/TRIG.
- 1.3 Push A INT BY B, 'A' AUTO and both INT's.
- 1.4 Depress POLARITY.
- 1.5 Rotate LEVEL fully anticlockwise.
- 1.6 Set TIME/DIV 'A' 10 μ s, 'B' 5 μ s.
- 1.7 Apply 1V 50 kHz sinewave to CH1.
- 1.8 Set VOLTS/DIV to 2V.
- 1.9 Set DC-GND-AC to AC.
- 1.10 Adjust 'A' LEVEL for locked trace.
- 1.11 Connect monitor oscilloscope (M.O.) via 10 : 1 probe to junction of R166/R168 PC133 (GRID REF 6-F6) (pink).
- 1.12 Set M.O. TIME/DIV to 5 μ s.
- 1.13 Set M.O. VOLTS/DIV to 5 mV.
- 1.14 Adjust R159 PC133 to obtain M.O. trace.
NOTE: if R159 is at the end of its range change over TR151 and TR152 PC133 (GRID REF 6-G5).
- 1.15 Adjust R173 PC133 for triggering levels. 60mV (1.2 div) apart similar to Plate 4.1.
- 1.16 Connect M.O. probe to junction of C195/R174 PC133 (GRID REF 6-F4).
- 1.17 Set M.O. VOLTS/DIV to 50mV.
- 1.18 Check M.O. trace is 1.25 \pm 0.25V.
- 1.19 Reduce CH1 to give 0.2 div of trace.
- 1.20 Release and depress POLARITY.
- 1.21 Adjust R159 PC133 for optimum mark/space ratio.
- 1.22 Disconnect signal.

4.4.8 'B' SWEEP

NOTE: 'B' controls are used unless otherwise stated.

Set timing

- 1.1 Turn VARIABLE fully clockwise.
- 1.2 Set TIME/DIV 'A' 2ms, 'B' 1ms.
- 1.3 Apply 1ms marker signal to CH1.
- 1.4 Set DELAY TIME MULT (DTM) to 1.00.
- 1.5 Set VOLTS/DIV to approximately 2 div display.
- 1.6 Push B DEL BY A.
- 1.7 Adjust R236 PC133 for one marker per div.
- 1.8 Check TIME/DIV ranges overlap using VARIABLE.

Set H.F. timing

- 2.1 Apply 0.1 μ s marker signal to CH1.
- 2.2 Set TIME/DIV 'A' 0.2 μ s, 'B' 0.1 μ s.
- 2.3 Adjust 'A' LEVEL for locked trace.
- 2.4 Adjust C255 (right hand side of 'B' TIME/DIV switch) for one marker per div.
- 2.5 Disconnect signal.

Check sawtooth and pedestal voltage

- 3.1 Apply 1ms marker signal to CH1.
- 3.2 Set TIME/DIV 'A' 2ms, 'B' 1ms.
- 3.3 Set VOLTS/DIV to give approximately 2 divisions display (GRID REF 6-G4).
- 3.4 Connect M.O. probe to pin 16 PC133 (GRID REF 6-G4) see Plate 4.2
Check Y1 = 15.5 \pm 0.5V as Plate 4.2
Y2 = 2.0 \pm 0.5V as Plate 4.2
- 3.5 Disconnect M.O. probe.

Check range calibration

- 4.1 Set TIME/DIV's 'A' 0.2 μ s, 'B' 0.1 μ s.
- 4.2 Apply 0.1 μ s marker signal to CH1.
- 4.3 Turn both TIME/DIV switches together anticlockwise one setting at a time.
- 4.4 Set marker signal to correspond with 'B' TIME/DIV for each setting.
- 4.5 Adjust R236 PC133 (pink) to equalize errors for each setting.
- 4.6 Disconnect signal.

Set stability

- 5.1 Push A INT BY B and INT.
- 5.2 Release VAR/TRIG.
- 5.3 Depress POLARITY.
- 5.4 Set DELAY TIME MULT (DTM) to 5.0.
- 5.5 Connect 10MHz sinewave to CH1.
- 5.6 Set VOLTS/DIV to give 1 div of display.
- 5.7 Set TIME/DIV's 'A' 1 μ s, 'B' 0.1 μ s.
- 5.8 Adjust 'A' LEVEL for locked trace.
- 5.9 Turn 'B' LEVEL fully clockwise.
- 5.10 Set M.O. VOLTS/DIV 50mV.
- 5.11 Set M.O. TIME/DIV 2 μ s.
- 5.12 Connect M.O. probe to junction of R192/R196 PC133 (GRID REF 6-E4) (pink).
- 5.13 Observe M.O. trace reference Plate 4.4, 'C'
- 5.14 Adjust R204 PC133 (pink) so that small positive step travels towards and is just absorbed into large positive going step. Plate 4.4, 'A'
NOTE: further rotation of R204 is detrimental.
- 5.15 Turn LEVEL to AUTO small step should re-emerge, track forward to the negative going edge. Plate 4.4, 'B'
- 5.16 Disconnect probe.
- 5.17 Set VOLTS/DIV to give 0.5 div display.
- 5.18 Observe bright-up.
- 5.19 Push B DEL BY A.
- 5.20 Observe locked 'B' sweep by adjustment of LEVEL control.

Check level control

- 6.1 Set DTM to 5.
- 6.2 Push A INT BY B.
- 6.3 Depress POLARITY.
- 6.4 Turn LEVEL fully anticlockwise.
- 6.5 Set TIME/DIV's 'A' 10 μ s, 'B' 5 μ s.
- 6.6 Apply 50kHz sinewave to CH1.
- 6.7 Set VOLTS/DIV to give 2 div display.
- 6.8 Adjust INTENSITY for bright-up.
- 6.9 Rotate LEVEL.
- 6.10 Observe bright-up moves along slope.
- 6.11 Set bright-up start approximately halfway up slope.
- 6.12 Rotate DTM.
- 6.13 Observe bright-up jumps to same position on successive cycles.
- 6.14 Release and depress POLARITY.
- 6.15 Observe bright-up polarity change.
- 6.16 Re-check LEVEL control at 0.2 div of display.
- 6.17 Re-set stability if unsatisfactory.

Set external triggering

- 7.1 Apply 300mV 50kHz sinewave to 'B' EXT TRIG and CH1 together.
- 7.2 Push 'B' EXT.
- 7.3 Rotate LEVEL.
- 7.4 Observe bright-up.
- 7.5 Push B DEL BY A.
- 7.6 Observe locked 'B' sweep by adjustment of LEVEL control.
- 7.7 Disconnect signal.
- 7.8 Apply 1MHz squarewave via 50 Ω termination to 'B' EXT TRIG.

- 7.9 Set 'B' LEVEL to centre of range.
- 7.10 Remove TR155 PC133 (pink) (GRID REF 6-F5).
- 7.11 Connect M.O. probe to junction R166/R168 PC133 (GRID REF 6-F5).
- 7.12 Set M.O. TIME/DIV 0.2 μ s.
- 7.13 Set M.O. VOLTS/DIV 20mV.
- 7.14 Adjust EXT TRIG input voltage for 4 divisions M.O. display.
- 7.15 Adjust twisted pair PC133 for optimum squarewave.
- 7.16 Replace TR155.
- 7.17 Remove probe and signal.

Check H.F. triggering

- 8.1 Push A INT BY B.
- 8.2 Set DTM to 5.0.
- 8.3 Set TIME/DIV's 'A' 0.5 μ s 'B' 0.1 μ s.
- 8.4 Set VOLTS/DIV to 0.2.
- 8.5 Apply 0.5V 10MHz sinewave to 'B' EXT TRIG and CH1.
- 8.6 Release VAR/TRIG.
- 8.7 Adjust 'B' LEVEL.
- 8.8 Observe bright-up.
- 8.9 Push B DEL BY A.
- 8.10 Observe locked 'B' sweep with adjustment of LEVEL control.
- 8.11 Disconnect signal.

Check A & B mixed

- 9.1 Push A INT BY B and INT.
- 9.2 Depress POLARITY.
- 9.3 Turn LEVEL fully anticlockwise.
- 9.4 Apply 50kHz sinewave to CH1.
- 9.5 Set TIME/DIV's 'A' 0.5ms 'B' 20 μ s.
- 9.6 Set VOLTS/DIV for 2 div display.
- 9.7 Note position of bright-up.
- 9.8 Push MIXED.
- 9.9 Observe start of the expanded portion coincides with the start of the bright-up portion.
- 9.10 Release 'B' POLARITY.
- 9.11 Observe start of expanded portion changes slope.
- 9.12 Observe both portions of trace are of similar intensity.
- 9.13 Rotate DTM through range. Note start of expanded portion at constant point on slope.
- 9.14 Depress VAR/TRIG.
- 9.15 Rotate DTM.
- 9.16 Observe mixed sweep. Note start of expanded portion follows sinewave curve.
- 9.17 Disconnect signal.

4.4.9 CALIBRATE DELAY TIME MULTIPLIER (DTM)

- 1.1 Push A INT BY B, 'A' AUTO, and both INT's.
 - 1.2 Depress POLARITY.
 - 1.3 Set TIME/DIV's 'A' 1ms, 'B' 1 μ s.
 - 1.4 Set DC-GND-AC to GND.
 - 1.5 Adjust INTENSITY for maximum contrast.
 - 1.6 Adjust FINE to align 'A' trace start with 1st vertical.
 - 1.7 Set DTM to 1.0.
 - 1.8 Adjust R202 PC133 (pink) to align spot on 2nd vertical.
 - 1.9 Set DTM to 9.0.
 - 1.10 Adjust R198 PC133 to align spot on 10th vertical.
 - 1.11 Repeat last four operations until both alignments are correct.
 - 1.12 Check for error $\leq \pm 1\%$ on each major division.
 - 1.13 Centralize bright-up spot.
 - 1.14 Set TIME/DIV's 'A' 1 μ s, 'B' 0.2 μ s.
 - 1.15 Adjust FINE to align 'A' trace start on 1st vertical.
 - 1.16 Check bright-up $< 0.45\mu$ s from centre vertical.
- NOTE: Turn unit on to left hand side and remove cover to give access to PC132.

Check delay jitter

- 2.1 Push A INT BY B, 'A' AUTO and both INT's.
- 2.2 Depress VAR/TRIG.
- 2.3 Set TIME/DIV's 'A' 1ms, 'B' 1 μ s.
- 2.4 Apply 1ms marker signal to CH1.
- 2.5 Set DC-GND-AC to DC.
- 2.6 Set VOLTS/DIV to give 4 div display.
- 2.7 Set 'A' POLARITY to match marker signal.
- 2.8 Set bright-up on 9th marker.
- 2.9 Push B DEL BY A.
- 2.10 Adjust R90 PC132 (pink) to centralize marker.

- 2.11 Adjust 'A' LEVEL to minimize jitter.
NOTE: lighthouse may be required.
- 2.12 Check jitter < 1 division reference Plate 4.5.
- 2.13 Switch off instrument.
- 2.14 Remove signal and extension lead.
- 2.15 Replace unit covers.
- 2.16 Insert Sweep Unit into Mainframe.
- 2.17 Switch on instrument.

4.4.10 VERTICAL UNIT ADJUSTMENTS

Set CH1 X5 balance

- 1.1 Push A ONLY, A AUTO
- 1.2 Set 'A' TIME/DIV to 1ms.
- 1.3 Adjust POSITION to centralize trace.
- 1.4 Pull VARIABLE for X5 magnification.
- 1.5 Adjust D.C. BAL to re-centralize trace.
- 1.6 Push VARIABLE.
- 1.7 Re-centralize trace with POSITION control.
- 1.8 Repeat last four operations until no movement occurs.

Set CH2 X5 balance

- 2.1 Set as in CH1 using corresponding CH2 controls.
- 2.2 Switch off instrument. Remove Vertical Unit.
- 2.3 Remove unit left-hand cover.
- 2.4 Connect unit to Mainframe via extension lead.
- 2.5 Lay unit on right-hand side giving access to PC152.
- 2.6 Switch on instrument.

Set CH1 Variable gain balance

- 3.1 Push CH1 TRIG and CHANNEL SELECT.
- 3.2 Rotate VARIABLE anticlockwise.
- 3.3 Adjust POSITION to centralize trace.
- 3.4 Turn VARIABLE fully clockwise.
- 3.5 Adjust R703 PC152 (yellow) to re-centralize trace.
- 3.6 Repeat last four operations until no movement occurs.

Set invert balance

- 4.1 Adjust POSITION to centralize CH2 trace.
- 4.2 Pull INVERT and note new position of trace.
- 4.3 Adjust R704 PC152 (yellow) to centralize trace between two positions.
- 4.4 Push INVERT.
- 4.5 Repeat operations until no movement occurs.

Set CH2 Variable gain balance

- 5.1 Set as in CH1 using corresponding CH2 controls and R645 PC152 (yellow).
- 5.2 RE-CHECK CH2 X5 BALANCE.
- 5.3 RE-CHECK CH2 INVERT BALANCE.

Set CH1 Gain

- 6.1 Set TIME/DIV to 0.1ms.
- 6.2 Set VOLTS/DIV to 5mV.
- 6.3 Select CH1.
- 6.4 Set DC-GND-AC to DC.
- 6.5 Apply 25mV 1kHz squarewave to CH1.
- 6.6 Rotate SET GAIN 5mV.
- 6.7 Check amplitude ranges from < 4.5 to > 5.5 divisions.
- 6.8 Set amplitude to 5 divisions.
- 6.9 Turn VARIABLE fully anticlockwise.
- 6.10 Check amplitude < 2.0 divisions.
- 6.11 Turn VARIABLE fully clockwise and pull.
- 6.12 Reduce input to 5mV.
- 6.13 Rotate SET GAIN 1mV.
- 6.14 Check amplitude ranges from < 4.5 to > 5.5 divisions.
- 6.15 Set amplitude to 5 divisions.
- 6.16 Disconnect signal.

Set CH2 gain

- 7.1 Set as in CH1 using corresponding CH2 controls.

Set CH1 trigger

- 8.1 Place unit on its left-hand side.
- 8.2 Remove cover to expose PC153.
- 8.3 Select CH1.
- 8.4 Set TIME/DIV to 5 μ s.
- 8.5 Set VOLTS/DIV to 5mV.
- 8.6 Set DC-GND-AC to DC.
- 8.7 Apply 25mV 50kHz sinewave to CH1.
- 8.8 Push ALT (TRIG).

- 3.9 Push DC on Sweep Unit.
- 3.10 Adjust LEVEL to start trace on vertical centre line.
- 3.11 Push CH1 (TRIG).
- 3.12 Adjust R797 PC153 (yellow) to correct trigger point movement.
- 3.13 Disconnect signal.

Set CH2 trigger

- 9.1 Set as in CH1 using corresponding CH2 controls.
- 9.2 Adjust R798 PC153 (yellow) to correct trigger point movement.

CH1 attenuator compensation

- 10.1 Switch off instrument.
- 10.2 Remove extension lead and fit right-hand cover.
- 10.3 Connect unit to Mainframe via extension board (670-2864-00).
- 10.4 Switch on instrument.
- 10.5 Push A ONLY, AUTO.
- 10.6 Set TIME/DIV to 0.1 μ s.
- 10.7 Set DC-GND-AC to DC.
- 10.8 Select CH1.
- 10.9 Set VOLTS/DIV ranges as in table.
- 10.10 Set for flat response.
- 10.11 Apply 25mV 1kHz via input normalizer 33pF to CH1.

CH1 & CH2 VOLTS/DIV SETTING	INPUT VOLTAGE	ADJUST TRIMMER PC 137
5 mV	50 mV	C916
Remove input normalizer	-	-
10 mV	50 mV	C917
20 mV	100 mV	C918
50 mV	250 mV	C907
0.1 V	0.5 V	C915
0.2 V	1 V	C914
0.5 V	2.5 V	C906
5 V	25 V	C905
Apply input via X10 probe		Adjust probe trimmer
50 mV	0.5 V	C904
0.5 V	5 V	C903
5 V	50 V	C902

CH2 attenuator compensation

- 11.1 Set and adjust as in CH1 using corresponding CH2 controls.
- 11.2 Disconnect signal.
- 11.3 Switch off instrument.
- 11.4 Remove extension board and refit unit to instrument.
- 11.5 Switch on instrument.

Set CH1 pulse response

- 12.1 Select CH1 TRIG AND CHANNEL SELECT.
- 12.2 Set VOLTS/DIV to 5mV.
- 12.3 Set TIME DIV to 0.1 μ s and push FINE.
- 12.4 Set DC-GND-AC to AC.

- 12.5 Apply 25mV 1MHz <1ns risetime squarewave to CH1.
- 12.6 Adjust C616 and R628 PC152 (yellow) for trace overshoot <0.1 divisions.
- 12.7 Pull FINE for X10 magnification.
- 12.8 Adjust C614 PC152 (yellow) for 10% - 90% risetime <0.7 = 0.1 div.
- 12.9 Disconnect signal.

Set CH2 pulse response

- 13.1 Set as in CH1 using corresponding CH2 controls.
- 13.2 Adjust C617 and R629 PC152 (yellow) for trace overshoot.
- 13.3 Adjust C615 PC152 for risetime.

Check CH1 X1 bandwidth

- 14.1 Select CH1 TRIG AND CHANNEL SELECT.
- 14.2 Set TIME/DIV to 1ms.
- 14.3 Apply 50kHz sinewave to CH1.
- 14.4 Adjust generator to give 6 div display.
- 14.5 Switch generator to 50MHz.
- 14.6 Check amplitude >4.2 div of display.

Check CH1 X5 bandwidth

- 15.1 Pull VARIABLE for X5 magnification.
- 15.2 Apply 50kHz sinewave to CH1.
- 15.3 Adjust generator to give 6 div display.
- 15.4 Switch generator to 15MHz.
- 15.5 Check amplitude <4.2 div of display.
- 15.6 Disconnect signal.

Check CH2 X1 bandwidth

- 16.1 Check as for CH1 using corresponding CH2 controls.

Check CH2 X5 bandwidth

- 17.1 Check as for CH1 using corresponding CH2 controls.
- 17.2 Replace left-hand cover of unit.
- 17.3 Re-check CH1 and CH2 X5 BALANCE.

Sum balance

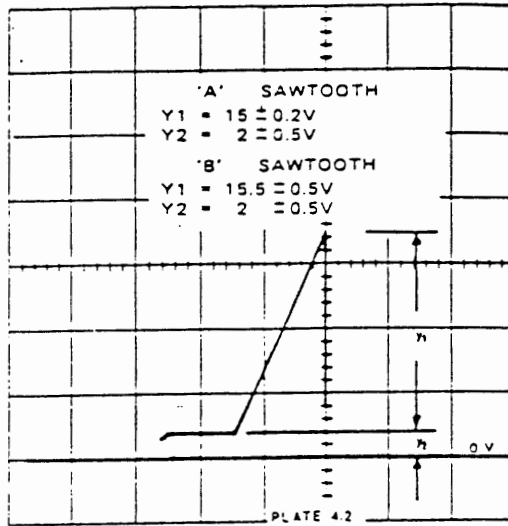
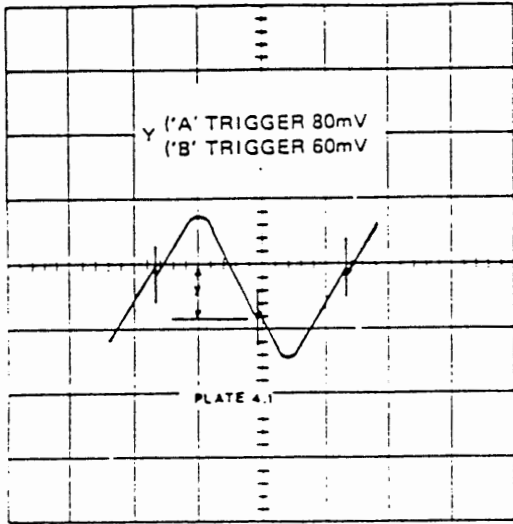
- 18.1 Select ALT CHANNEL SELECT.
- 18.2 Set both DC-GND-AC to GND.
- 18.3 Set TIME/DIV to 1ms.
- 18.4 Centre both traces with POSITION controls.
- 18.5 Push SUM.
- 18.6 Adjust R614 PC147 (white) to centre trace.

Switch off instrument, secure units in Mainframe and replace main covers.

Switch on instrument to ensure that covers do not cause short circuit faults.

Switch off instrument and variable power supply.

Disconnect instrument from variable power supply.



'A' HOLD - OFF TIME

Unit	M.O. Time/Div	M.O. X Axis Divisions
10 ms	2 ms	2 to 4
0.1 ms	50 μs	1.2 to 2.4
10 μs	5 μs	1.2 to 2.4
0.5 μs	1 μs	1 to 2

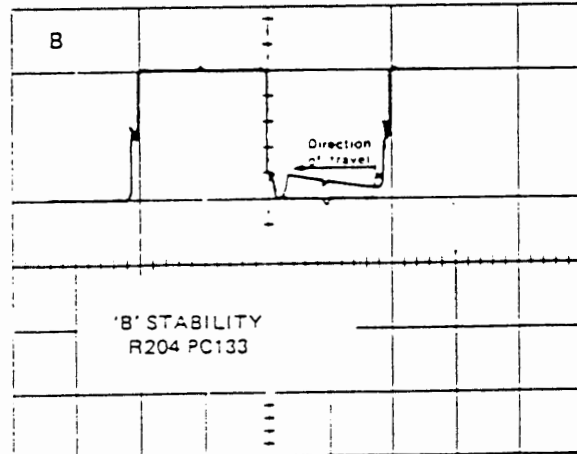
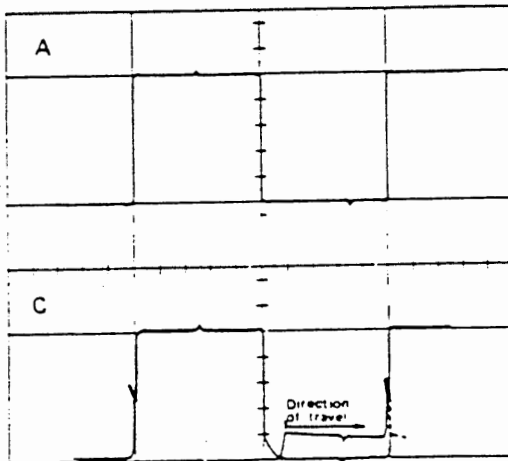
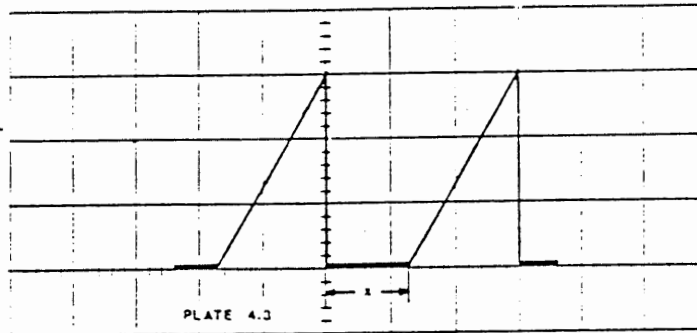
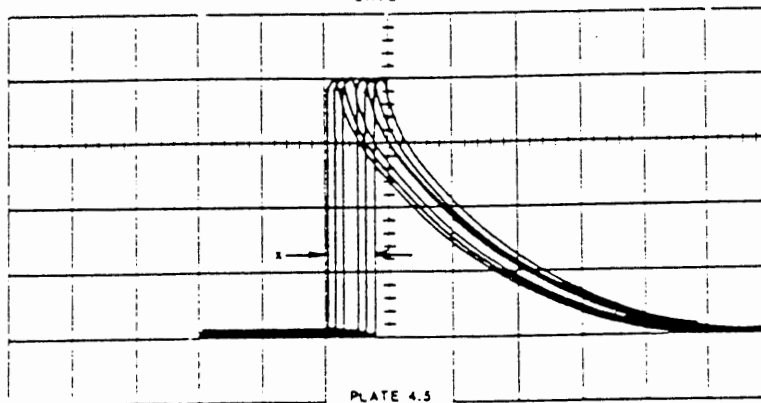


PLATE 4.4



DELAY JITTER

SECTION 5

COMPONENTS LIST

Values of resistors are stated in ohms or multiples of ohms; ratings at 70°C are in watts or sub-multiples of watts. Values of capacitors are stated in sub-multiples of farads; ratings at 70°C are in volts or kilovolts.

Whenever possible, exact replacements for components should be used, although locally available alternative may be satisfactory for standard components.

Any order for replacement parts should include:

1. Instrument type
2. Instrument serial number
3. Component circuit reference
4. Component part number
5. Component value

ABBREVIATIONS

BM	Button mica	CMP	Cermet preset	PS	Polystyrene
C	Carbon	E	Electrolytic	Se	Selenium
CP	Carbon preset	Ge	Germanium	Si	Silicon
CV	Carbon variable	MF	Metal Film	SM	Silver mica
CER	Ceramic	MO	Metal oxide	WW	Wire-wound
CT	Ceramic trimmer	PE	Polyester	WWP	Wire-wound preset
CM	Cermet thick film	PP	Polypropylene	WWV	Wire-wound variable

TEKTRONIX U.K. LIMITED

36 - 38 Coldharbour Lane, Harpenden, Hertfordshire, England.

Telephone: Harpenden 63141 Telex: 25559

All requests for repairs or replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service.

CIR REF	PART NUMBER	VALUE F	DESCRIPTION		
			TYPE	TOL %	RATING V
C1	285-1015-00	4.7 n	PE	20	160
C2	290-0627-00	22 μ	E		40
C3	285-0800-00	10 μ	PE	20	250
C4	281-0734-00	100 n	CER		30
C5	281-0192-00	2-6 p	CT		250
C6	281-0710-00	10 n	CER		250
C7	285-0800-00	10 n	PE	20	250
C8	285-0915-00	100 n	PE	20	100
C9	285-0866-00	10 p	PS	1 p	350
C10	285-0854-00	100 p	PS	2 p	350
C11	281-0135-00	4-20 p	CT		250
C12	285-0870-00	120 p	PS	2	350
C13	281-0191-00	10-60 p	CT		250
C14	290-0664-00	4.7 m	E		160

C201	285-1014-00	1 μ	PE	20	63
C202	290-0495-00	47 μ	E		40
C303	281-0736-00	1 n	CER		30
C304	290-0495-00	47 μ	E		40
C305	285-0799-00	33 n	PE	20	250
C306	281-0681-00	10 n	CER		30
C307	285-0837-00	20 n	PE		50
C308	285-1015-00	4.7 n	PE	20	160
C309	281-0681-00	10 n	CER		40
C310	285-0837-00	20 n	PE		50
C311	281-0677-00	10 n	CER		20
C312	282-0710-00	10 n	CER		250

C351	285-0800-00	10 n	PE	20	250
C352	281-0710-00	10 n	CER		250
C353	281-0183-00	0.5-3 p	CT		250
C354	285-0800-00	10 n	PE	20	250
C355	285-0800-00	10 n	PE	20	250

C401	285-0793-00	10 n	PE	20	630
C402	285-0793-00	10 n	PE	20	630
C403	285-0793-00	10 n	PE	20	630
C404	290-0547-00	330 μ	E		160
C405	290-0624-00	2.2 m	E		40
C406	290-0624-00	2.2 m	E		40
C407	281-0710-00	10 n	CER		250
C408	290-0494-00	47 μ	E		25
C409	285-0915-00	100 n	PE	20	100
C410	285-0854-00	100 p	PS	2 p	350
C411	290-0635-00	4.7 μ	E		63
C412	285-0870-00	120 p	PS	2	350
C413	285-0796-00	100 n	PE	20	250
C414	290-0627-00	22 μ	E		25
C415	290-0627-00	22 μ	E		25
C416	290-0625-00	4.7 μ	E		160

CIR REF	PART NUMBER	VALUE F	DESCRIPTION		
			TYPE	TOL %	RATING V
C601	281-0710-00	10 n	CER		250
C602	285-0800-00	10 n	PE	20	250
C603	285-0915-00	100 n	PE	20	100
C604	285-0800-00	10 n	PE	20	250
C605	285-0867-00	20 p	PS	1 p	350
C606	285-0867-00	20 p	PS	1 p	350
C607	285-0776-00	27 p	PS	1 p	350
C608	281-0135-00	4-20 p	CT		250
C609	281-0710-00	10 n	CER		250
C611	281-0710-00	10 n	CER		250

C701	285-0915-00	100 n	PE	20	100
C702	285-0800-00	10 n	PE	20	250
C703	285-0844-00	39 p	PS	2 p	350
C704	281-0135-00	4-20 p	CT		250
C705	285-0800-00	10 n	PE	20	250
C706	281-0710-00	10 n	CER		250
C707	281-0135-00	4-20 p	CT		250
C708	281-0710-00	10 n	CER		250
C709	285-0844-00	39 p	PS	2 p	350
C711	281-0135-00	4-20 p	CT		250
C712	285-0915-00	100 n	PE	20	100
C713	290-0625-00	4.7 μ	E		160
C714	281-0710-00	10 n	CER		250
C715	285-0866-00	10 p	PS	1 p	350

CIR REF	PART NUMBER	VALUE V	DESCRIPTION	TYPE	TOL %	RATING
D1	152-0062-01		1N914/1N4148	Si		75 V
D2	152-0062-01		1N914/1N4148	Si		75 V
D3	152-0062-01		1N914/1N4148	Si		75 V
D4	152-0062-01		1N914/1N4148	Si		75 V
D5	152-0062-01		1N914/1N4148	Si		75 V
D6	152-0062-01		1N914/1N4148	Si		75 V
D7	152-0062-01		1N914/1N4148	Si		75 V
D301	152-0062-01		1N914/1N4148	Si		75 V
D302	152-0554-00	50	8AY 74	Si		200 mA
D303	152-0515-00	6 k	Rectifier	Si		10 mA
D304	152-0515-00	6 k	Rectifier	Si		10 mA
D305	152-0388-00	130	Zener	Si	5	330 mW
D306	152-0510-00	150	Zener	Si	5	1 W
D350	152-0062-01		1N914/1N4148	Si		75V
D351	152-0062-01		1N914/1N4148	Si		75 V
D352	152-0062-01		1N914/1N4148	Si		75 V
D353	152-0544-00	43	Zener	Si	5	700 mW
D354	152-0062-01		1N914/1N4148	Si		75 V
D355	152-0062-01		1N914/1N4148	Si		75 V
D356	152-0062-01		1N914/1N4148	Si		75 V
D357	152-0062-01		1N914/1N4148	Si		75V
D358	152-0494-00	75	Zener	Si	5	1 W
D401	152-0341-00	450	Rectifier	Si		500 mA
D402	152-0341-00	450	Rectifier	Si		500 mA
D403	152-0341-00	450	Rectifier	Si		500 mA
D404	152-0341-00	450	Rectifier	Si		500 mA
D405	152-0341-00	450	Rectifier	Si		500 mA
D406	152-0341-00	450	Rectifier	Si		500 mA
D407	152-0341-00	450	Rectifier	Si		500 mA
D408	152-0341-00	450	Rectifier	Si		500 mA
D409	152-0341-00	450	Rectifier	Si		500 mA
D411	152-0341-00	450	Rectifier	Si		500 mA
D412	152-0341-00	450	Rectifier	Si		500 mA
D413	152-0341-00	450	Rectifier	Si		500 mA
D414	152-0348-00	6.2	Zener	Si		330 mW
D415	152-0062-01		1N914/1N4148	Si		75 V
D416	152-0062-01		1N914/1N4148	Si		75 V
D417	152-0468-00	150	Rectifier	Si		200 mA
D601	152-0062-01		1N914/1N4148	Si		75 V
D602	152-0062-01		1N914/1N4148	Si		75 V
D603	152-0062-01		1N914/1N4148	Si		75 V
D604	152-0062-01		1N914/1N4148	Si		75 V
D605	152-0062-01		1N914/1N4148	Si		75 V

CIR REF	PART NUMBER	VALUE	DESCRIPTION	TYPE	TOL %	RATING
D606	152-0062-01		1N914;1N4148	Si		75 V
D607	152-0546-00	47	Zener	Si	5	770 mW
D702	152-0472-00	5.6	Zener	Si	5	300 mW
D703	152-0472-00	5.6	Zener	Si	5	300 mW
D704	152-0543-00	5.1	Zener	Si	5	300 mW
D705	152-0547-00	22	Zener	Si	5	300 mW
FS401	159-0081-00 159-0119-00	1A (200-250V) 2A (100-125V)	1.25 in. delay 1.25 in. delay			
FS402	159-0073-00	1A	1.25 in. fast			
FB	276-0597-00		Ferrite bead Mullard FX1115			
L1	108-0482-00	160 uH	Fixed inductor			
L701	114-0323-00		Variable inductor			
L702	108-0700-00		Trace rotation coil 1920 turns			
LP401	150-0074-00	6.5V	Les			

CIR REF	PART NUMBER	VALUE ohms	DESCRIPTION			EFF. Ser.No.
			TYPE	TOL %	RATING W	
R1	317-0154-01	150 k	C	5	125 m	
R2	317-0822-01	8.2 K	C	5	125 m	
R3	317-0103-01	10 k	C	5	125 m	
R4	311-1445-00	220	CP	20	75 m	
R5	321-0280-48	8.06 k	MF	1	125 m	
R6	317-0683-01	68 k	C	5	125 m	
R7	317-0680-01	68	C	5	125 m	
R8	311-1468-00	10 k	CV	20	250 m	
R9	321-0093-42	90.9	MF	0.5	125 m	
R11	317-0392-01	39 k	C	5	125 m	
R12	317-0394-01	390 k	C	5	125 m	
R13	325-0123-00	10.1	MF	0.5	125 m	
R14	321-0844-48	2.2 k	MF	1	125 m	
R15	311-1345-00	50 k	CV	20	250 m	
R16	317-0562-01	5.6 k	C	6	125 m	
R17	311-1449-00	4.7 k	CP	20	75 m	
R18	321-0845-48	2.7 k	MF	1	125 m	
R19	317-0152-01	1.5 k	C	5	125 m	
R21	317-0562-01	5.6 k	C	5	125 m	
R22	317-0512-01	5.1 k	C	5	125 m	
R23	311-1445-00	4.7 k	CP	20	75 m	
R24	317-0123-01	12 k	C	5	125 m	
R25	317-0123-01	12 k	C	5	125 m	
R26	321-0845-48	2.7 k	MF	1	125 m	
R27	311-1448-00	1 k	CP	20	75 m	
R28	321-0843-48	270	MF	1	125 m	
R29	311-1445-00	100	CP	20	75 m	
R30	317-0101-01	100	C	5	125 m	
R31	321-0850-48	27 k	MF	1	125 m	
R32	321-0850-48	27 k	MF	1	125 m	
R33	307-0143-00	5.6 k	MO	5	1.5	
R34	307-0143-00	5.6 k	MO	5	1.5	
R35	317-0392-01	3.9 k	C	5	125 m	
R301	311-1456-00	15 k	CP	20	75 m	
R302	315-0223-01	22 k	C	5	250 m	
R304	307-0532-00	6.8 M	CM	5	500 m	
R305	307-0532-00	6.8 M	CM	5	500 m	
R306	317-0102-01	1 k	C	5	125 m	
R307	317-0124-01	120 k	C	5	125 m	
R308	317-0337-01	330	C	5	125 m	
R309	307-0532-00	6.8 M	CM	5	500 m	
R310	316-0221-01	220	C	10	250 m	
R311	317-0102-01	1 k	C	5	125 m	
R312	307-0184-00	15 k	MO	5	1.5	
R313	307-0532-00	6.8 M	CM	5	500 m	
R314	317-0184-01	180 k	C	5	125 m	
R315	311-1451-00	2.2 M	CP	20	75 m	
R316	317-0273-01	27 k	C	5	125 m	
R317	301-0105-02	10 M	C	5	500 m	
R318	301-0106-02	10 M	C	5	500 m	
R319	301-0106-02	10 M	C	5	500 m	
R321	301-0106-02	10 M	C	5	500 m	
R322	301-0106-02	10 M	C	5	500 m	
R323	301-0395-01	3.9 M	C	5	500 m	
R324	301-0475-02	4.7 M	C	5	500 m	
R325	301-0475-02	4.7 M	C	5	500 m	
R326	301-0565-01	5.6 M	C	5	500 m	
R327	311-1347-01	2.5 M	CV	20	250 m	

CIR REF	PART NUMBER	VALUE ohms	DESCRIPTION			EFF. Ser.No.
			TYPE	TOL %	RATING W	
R328	316-0106-01	10 M	C	10	250 m	
R329	311-0767-00	100 k	CP	20	11	
R330	317-0102-01	1 k	C	5	125 m	
R331	301-0682-01	6.8 k	C	5	500 m	574101
R333	321-0481-48	1 M	MF	1	125 m	
R351	311-1469-00	10 k	CV	20	250 m	
R352	315-0103-01	10 k	C	5	250 m	
R353	317-0183-01	18 k	C	5	125 m	
R354	317-0103-01	10 k	C	5	125 m	
R355	317-0104-01	100 k	C	5	125 m	
R356	317-0680-01	68	C	5	125 m	
R357	317-0123-01	12 k	C	5	125 m	
R358	317-0273-01	27 k	C	5	125 m	
R359	315-0153-01	15 k	C	5	250 m	
R361	317-0470-01	47	C	5	125 m	
R362	321-1325-48	24 k	MF	1	125 m	
R363	317-0123-01	12 k	C	5	125 m	
R364	317-0273-01	27 k	C	5	125 m	
R365	317-0102-01	1 k	C	5	125 m	
R366	317-0101-01	100	C	5	125 m	
R367	317-0101-01	100	C	5	125 m	
R368	317-0561-01	560	C	5	125 m	
R400	315-0200-01	20	CF	5	250 m	574801
R402	317-0683-01	68 k	C	5	125 m	
R403	317-0562-01	5.6 k	C	5	125 m	
R404	317-0223-01	22 k	C	5	125 m	
R405	308-0726-00	1.5	WW	10	1	
R406	308-0725-00	2.7	WW	10	1	
R407	308-0727-00	1	WW	10	1	
R408	317-0474-01	470 k	C	5	125 m	
R409	317-0100-01	10	C	5	125 m	
R410	317-0471-01	470 k	C	5	125 m	
R411	317-0332-01	3.3 k	C	5	125 m	
R412	317-0334-01	330 k	C	5	125 m	
R413	307-0370-00	180	MO	5	6	
R414	315-0472-02	4.7 k	C	5	250 m	
R415	307-0144-00	10 k	MO	5	1.5	
R416	317-0562-01	5.6 k	C	5	125 m	
R417	317-0103-01	10 k	C	5	125 m	
R418	317-0822-01	8.2 k	C	5	125 m	
R419	316-0183-01	18 k	C	10	250 m	
R421	317-0104-01	100 k	C	5	125 m	
R422	317-0683-01	68 k	C	5	125 m	
R423	317-0103-01	10 k	C	5	125 m	
R424	321-0318-48	20 k	MF	1	125 m	
R425	311-1453-00	4.7 k	CMP	20	500 m	
R426	321-1325-48	24 k	MF	1	125 m	
R427	321-0871-48	6.8 k	MF	1	125 m	
R428	311-1454-00	1.5 k	CMP	20	500 m	
R429	321-1313-48	18 k	MF	1	125 m	
R431	316-0473-01	47 k	C	10	250 m	
R432	321-1353-48	47 k	MF	1	125 m	
R433	311-1453-00	4.7 k	CMP	20	500 m	
R434	321-0289-48	10 k	MF	1	125 m	

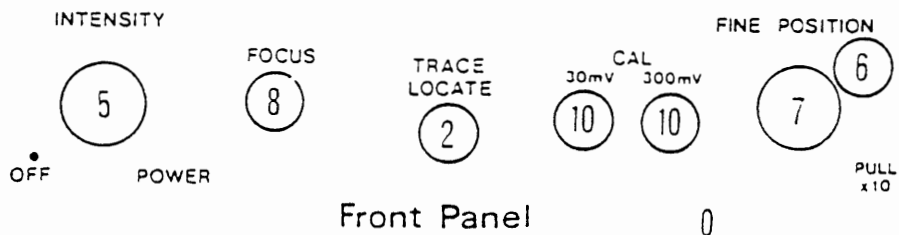
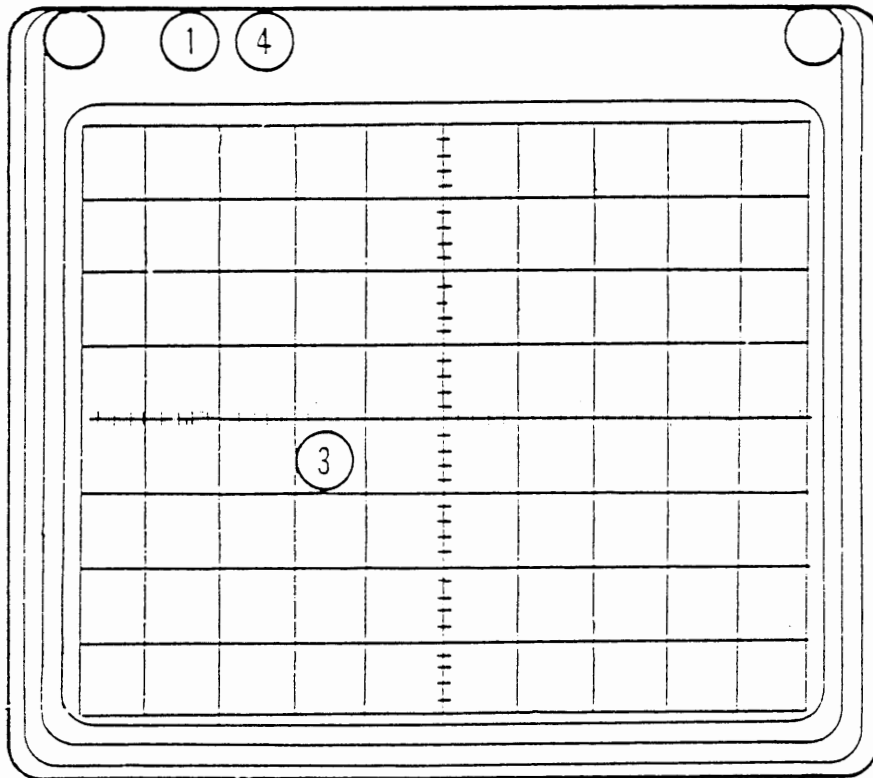
CIR REF	PART NUMBER	VALUE F	DESCRIPTION		RATING W	VALUE F	DES TYP
			TYPE	TOL %			
R601	316-0332-01	3.3 k	C	10	250 m		
R602	317-0334-01	330 k	C	5	125 m		
R603	317-0562-01	5.6 k	C	5	125 m		
R604	317-0562-01	5.6 k	C	5	125 m		
R605	317-0242-01	2.4 k	C	5	125 m		
R606	317-0242-01	2.4 k	C	5	125 m		
R607	317-0681-01	680	C	5	125 m		
R608	317-0821-01	820	C	5	125 m		
R609	311-1455-00	10 k	CP	20	50 m		
R611	321-0968-48	91	MF	1	125 m		
R612	321-0968-48	91	MF	1	125 m		
R613	317-0152-01	1.5 k	C	5	125 m		
R614	311-1456-00	470	CP	20	50 m		
R615	317-0152-01	1.5 k	C	5	125 m		
R616	317-0221-01	220	C	5	125 m		
R617	317-0183-01	18 k	C	5	125 m		
R618	317-0221-01	220	C	5	125 m		
R619	317-0221-01	220	C	5	125 m		
R621	317-0222-01	2.2 k	C	5	125 m		
R622	317-0221-01	220	C	5	125 m		
R623	317-0470-01	47	C	5	125 m		
R624	307-0173-00	470	MO	5	1.5		
R625	317-0470-01	47	C	5	125 m		
R626	317-0221-01	220	C	5	125 m		
R627	317-0221-01	220	C	5	125 m		
R628	317-0820-01	82	C	5	125 m		
R629	317-0820-01	82	C	5	125 m		
R631	307-0369-00	160	MO	5	1.5		
R633	307-0369-00	160				MC	
R634	311-1457-00	100 k				CP	
R635	317-0333-01	33 k				C	
R701	321-0095-48	95.3				M	
R702	317-0101-01	100				C	
R703	321-0095-48	95.3				M	
R704	317-0332-01	3.3 k				C	
R705	315-0821-01	820				C	
R706	311-1447-00	470				C	
R707	315-0821-01	820				C	
R711	317-0362-01	3.6 k					
R712	317-0111-01	110					
R713	317-0121-01	120					
R714	317-0470-01	47					
R715	317-0121-01	120					
R716	307-0372-00	390					
R717	307-0372-00	390					
R718	317-0680-01	68					
R719	317-0680-01	68					
R721	317-0680-01	68					
R722	311-1446-00	220					
R723	315-0103-01	10 k					
R724	307-0371-00	510					
R725	307-0371-00	510					
R727	311-0727-00	1 k					

CIR REF	PART NUMBER	VALUE	DESCRIPTION	TYPE
S1	311-1345-00		Pull (with R15)	
S2	260-1408-00		Push 1-button	
S401	311-1469-00		Rotary (with R351)	
T301	120-0771-00		E.H.T. oscillator transformer	
T401	120-0813-00		Power transformer	
TH301	307-0258-00		130Ω Thermistor Mullard VA 1040	

CIR REF	PART NUMBER	DESCRIPTION		TYPE
TR1	151-0326-00	BC107	Si	NPN
TR2	151-0326-00	BC107	Si	NPN
TR3	151-0317-00	BC109C	Si	NPN
TR4	151-0320-01	MPS6518 Motorola	Si	PNP
TR5	151-0320-01	MPS6518 Motorola	Si	PNP
TR6	151-0525-00	FRB749/SPS5286	Si	NPN
TR7	151-0525-00	FRB749/SPS5286	Si	NPN
TR8	151-0525-00	FRB749/SPS5286	Si	NPN
TR9	151-0525-00	FRB749/SPS5286	Si	NPN
TR301	151-0326-00	BC107	Si	NPN
TR302	151-0317-00	BC109C	Si	NPN
TR303	151-0317-00	BC109C	Si	NPN
TR304	151-0400-00	2N5191	Si	NPN
TR351	151-0525-00	FRB749/SPS5286	Si	NPN
TR352	151-0326-00	BC107	Si	NPN
TR353	151-0404-00	TO203	Si	PNP
TR354	151-0525-00	FRB749/SPS5286	Si	NPN
TR355	151-0404-00	TO203	Si	PNP
TR401	151-0257-01	BF305	Si	NPN
TR402	151-0404-00	TO203	Si	PNP
TR403	151-0326-00	BC107	Si	NPN
TR404	151-0326-00	BC107	Si	NPN
TR405	151-0400-00	2N5191	Si	NPN
TR406	151-0318-00	BFY51	Si	NPN
TR407	151-0317-00	BC109C	Si	NPN
TR408	151-0326-00	BC107	Si	NPN
TR409	151-0318-00	BFY51	Si	NPN
TR411	151-0317-00	BC109C	Si	NPN
TR412	151-0525-00	FRB749/SPS5286	Si	NPN
TR413	151-0400-00	2N5191	Si	NPN
TR414	151-0320-00	BFX48/MPS6518	Si	PNP
TR415	151-0311-00	MJE340	Si	NPN
TR416	151-0311-00	MJE340	Si	NPN
TR601	151-0320-01	MPS6518 Motorola	Si	PNP
TR602	151-0320-01	MPS6518 Motorola	Si	PNP
TR603	151-0127-02	BSX20/2N2369	Si	NPN
TR604	151-0127-02	BSX20/2N2369	Si	NPN
TR701	151-0127-03	BSX20	Si	NPN
TR702	151-0127-03	BSX20	Si	NPN
TR703	151-0127-03	BSX20	Si	NPN
TR704	151-0127-03	BSX20	Si	NPN
TR705	151-0310-01	E1530 LL	Si	NPN
TR706	151-0310-01	E1530 LL	Si	NPN
V301	154-0731-00	CRT Tektronix 4651		

ASSEMBLIES

ASSEMBLY	PART NUMBER	INCLUDES CIRCUIT REFERENCES
(1716) Bright-up PC128	670-2182-02	C351 to C355, D350 to D358, R353 to R359, R351 to R368, TR351 to TR355 (1
EHT PC148	670-2393-00	C301 to C309, D301, D302, L301, R302, R304 to R319, R321 to R324, R326, R331, R333, TH301, TR301 to TR304
Mother Board PC147	670-2392-00	C601 to C609, C611, D601 to D607, R601 to R609, R611 to R619, R621 to R629, SKT601 to SKT603, TR601 to TR604
(1619) Power Board PC149	670-2394-00	C401 to C410, C411 to C416, D401 to D409, D411 to D417, FS401, FS402, R402, R405 to R419, R421 to R429, R431 to R434, TR401 to TR409, TR411 to TR416
Quintupler	650-0021-00	Sealed unit
'Y' Output PC151	670-2396-00	C701 to C709, C711 to C715, D702 to D703, R701 to R709, R711 to R719, R721 to R725, TR701 to TR704
(1717) 'X' Output PC150	670-2395-02	C1 to C14, D1 to D7, L1, R1 to R7, R11, R12, R14, R16 to R19, R21 to R25, TR1 to TR9. (1



MECHANICAL LIST

PART NUMBER	DESCRIPTION	LOCATION
136-0183-00	Base Transistor, 3 pin TO5	
136-0343-00	Base Transistor, 3 pin TO18	
361-0254-00	Bead Ceramic	
276-0597-00	Bead Ferrite	
200-1471-00	Bezel	1
366-1403-00	Button, Push	2
437-0149-00	Cabinet, Cover	
437-0148-00	Cabinet, Rear	
334-1305-00	Card, Instruction	Accessory
131-0472-01	Connector, Female	CRT X & Y
131-0649-00	Connector, Male BNC	Accessory
131-0650-01	Connect BNC	Z MOD
016-0564-01	Cover protection, front	Accessory
378-0812-00	Filter	
252-0606-00	Foam Rubber 1/4" X 1/4"	
348-0344-00	Foot	
348-0167-00	Foot (Grey)	
348-0160-00	Grommet 3/8" id.	E.H.T.
348-0161-00	Grommet 1/8" id.	C.R.T.
367-0174-01	Handle	
136-0311-00	Holder Bulb	4
352-0153-00	Holder, Fuse	
342-0156-00	Insulator, Stand off	
033-0674-00	Key Allen 1.5 mm A/F	Accessory
131-1364-00	Key Polarizing	PC147
366-1239-01	Knob Grey/Red	5
366-1254-00	Knob Grey	6
366-1255-00	Knob Red	7
366-1266-00	Knob Grey	8
105-0348-00	Latch, Grey	
161-0085-00	Lead Power, U.S.A.	
161-0085-01	Lead Power, U.K.	
195-0108-00	Lead Set, CRT Deflection (X Plate)	
195-0109-00	Lead Set, CRT Deflection (Y Plate)	
210-0291-00	Lug, Pillar	E.H.T.
004-0866-00	Packaging	Accessory
134-0135-00	Plug, Mains	
213-0248-00	Screw Socket 3 X 3 mm	5-8
131-1325-01	Socket 8 Way Edge Con.	PC147
131-1268-00	Socket 2 mm	10
131-1282-01	Socket 16 way Edge con.	PC147
385-0215-00	Spacer (6BA X 5.0 mm)	PC147
361-0567-00	Spacer (3/8")	CRT Controls
361-0283-00	Spacer, Mounting	149, 148, 128
361-0197-00	Spacer (48A Clear X 1/2")	Delay Line
361-0206-00	Spacer (48A clear x 5/16" x 1/8")	
214-1855-01	Spring Filter Retaining	Between C302 & C304
334-2968-00	Warning, marker ident.	Cabinet Rear.

CIR REF	PART NUMBER	VALUE F	DESCRIPTION			EFF. Ser.No.	CIR REF	PART NUMBER	VALUE F	TYPE	TOL %	RATING V	EFF. Ser.No.
			TYPE	TOL %	RATING V								
C601	285-0915-00	100 n	PE	20	100		C756	281-0710-00	10 n	CER		250	
C602	285-0915-00	100 n	PE	20	100		C757	290-0623-00	4.7 μ	E		25	
C603	281-0710-00	10 n	CER		250		C758	285-0759-00	2.2 n	PS	5	125	
C604	285-1014-00	1 μ	PE	20	63								
C605	285-0858-00	1 n	PS	1	350	569001							
C606	285-0858-00	1 n	PS	1	350	569001							
C607	281-0858-00	1 n	PS	1	350	569001	C762	281-0731-00	5.6 p	CER	0.5 p	750	
C608	285-0858-00	1 n	PS	1	350	569001	C763	281-0731-00	5.6 p	CER	0.5 p	750	
C609	281-0710-00	10 n	CER		250								
C610	285-1064-00	680 p	PS	5	160	569751							
C611	281-0710-00	10 n	CER		250								
C612	281-0710-00	10 n	CER		250								
C613	281-0710-00	10 n	CER		250								
C614	281-0155-00	2-22 p	PP		500								
C615	281-0155-00	2-22 p	PP		500								
C616	281-0155-00	2-22 p	PP		500								
C617	281-0155-00	2-22 p	PP		500								
C618	281-0710-00	10 n	CER		250								
C619	285-1014-00	1 μ	PE	20	63		*C901	285-0772-00	100 n	PE	10	400	
C620	285-1064-00	680 p	PS	5	160	569781	*C902	281-0155-00	2-22 p	PP		500	
C621	285-1014-00	1 μ	PE	20	63		*C903	281-0155-00	2-22 p	PP		500	
C622	285-1014-00	1 μ	PE	20	63		*C904	281-0155-00	2-22 p	PP		500	
C623	285-1014-00	1 μ	PE	20	63		*C905	281-0156-00	1.4-6.4 p	PP		500	
							*C906	281-0156-00	1.4-6.4 p	PP		500	
							*C907	281-0154-00	2-12 p	PP		500	
							*C908	285-0872-00	180 p	PS	2	350	
							*C909	283-0607-00	2 n	BM	10	500	
							*C911	283-0719-00	470 p	BM	10	500	
							*C912	285-0844-00	39 p	PS	2 p	350	
							*C913	285-0869-00	47 p	PS	2 p	350	
							*C914	281-0154-00	2-12 p	PP		500	
							*C915	281-0154-00	2-12 p	PP		500	
							*C916	281-0156-00	1.4-6.4 p	PP		500	
							*C917	281-0155-00	2-22 p	PP		500	
							*C918	281-0154-00	2-12 p	PP		500	
							*C919	283-0662-00	7.5 p	SM	0.5 p	350	
C750	285-0854-00	100 p	PS	2 p	350		*C921	285-1017-00	10 n	PE	20	500	
C751	285-0800-00	10 n	PE	20	250								
C752	285-0800-00	10 n	PE	20	250								
C753	285-0810-00	820 p	PS	5	125								
C754	285-0854-00	100 p	PS	2	350								
C755	285-0800-00	10 n	PE	20	250								

* Two per unit

CIR REF	PART NUMBER	VALUE	DESCRIPTION	TYPE	TOL %	RATING
D601	152-0565-00		EXP5072A	Si		
D602	152-0565-00		EXP5072A	Si		
D503	152-0543-00	5.1 V	Zener	Si	5	330 mW
D604	152-0545-00	10 V	Zener	Si	5	330 mW
D605	152-0554-00		BAY 74	Si		50 V
D 07	152-0554-00		BAY 74	Si		50 V
D607	152-0554-00		BAY 74	Si		50 V
D608	152-0554-00		BAY 74	Si		50 V
D609	152-0062-01		1N914/1N4148	Si		75 V
D611	152-0062-01		1N914/1N4148	Si		75 V
D612	152-0062-01		1N914/1N4148	Si		75 V
D613	152-0062-01		1N914/1N4148	Si		75 V
D751	152-0062-01		1N914/1N4148	Si		75 V
D752	152-0062-01		1N914/1N4148	Si		75 V
D753	152-0062-01		1N914/1N4148	Si		75 V
D754	152-0062-01		1N914/1N4148	Si		75 V

CIR REF	PART NUMBER	VALUE ohms	DESCRIPTION		
			TYPE	TOL %	RATING W
R751	317-0103-01	10 k	C	5	125 m
R752	317-0393-01	39 k	C	5	125 m
R753	317-0470-01	47	C	5	125 m
R754	317-0473-01	47 k	C	5	125 m
R755	315-0621-02	620	C	5	250 m
R756	317-0472-01	4.7 k	C	5	125 m
R757	317-0821-01	820	C	5	125 m
R758	315-0471-01	470	C	5	250 m
R759	317-0470-01	47	C	5	125 m
R761	317-0392-01	3.9 k	C	5	125 m
R762	317-0821-01	820	C	5	125 m
R763	317-0470-01	47	C	5	125 m
R764	317-0103-01	10 k	C	5	125 m
R765	317-0103-01	10 k	C	5	125 m
R766	317-0123-01	12 k	C	5	125 m
R767	317-0562-01	5.6 k	C	5	125 m
R768	315-0621-02	620	C	5	250 m
R769	307-0394-00	3.9	C	5	125 m
R771	315-0122-02	1.2 k	C	5	250 m
R772	317-0473-01	47 k	C	5	125 m
R773	317-0103-01	10 k	C	5	125 m
R774	317-0823-01	82 k	C	5	125 m
R786	317-0151-01	150	C	5	125 m
R787	317-0151-01	150	C	5	125 m
R788	317-0151-01	150	C	5	125 m

CIR REF	PART NUMBER	VALUE ohms	DESCRIPTION		
			TYPE	TOL %	RATING W
R789	317-0151-01	150	C	5	125 m
R791	317-0121-01	120	C	5	125 m
R792	317-0121-01	120	C	5	125 m
R793	317-0332-01	3.3 k	C	5	125 m
R794	317-0332-01	3.3 k	C	5	125 m
R795	317-0332-01	3.3 k	C	5	125 m
R796	317-0332-01	3.3 k	C	5	125 m
R797	311-0851-00	1 k	CP	20	250 m
R798	311-0851-00	1 k	CP	20	250 m
R799	317-0181-01	180	C	5	125 m
* R901	317-0100-01	10	C	5	125 m
* R902	321-0481-42	1 M	MF	0.5	125 m
* R903	325-0124-00	990 k	MF	0.5	125 m
* R904	325-0125-00	900 k	MF	0.5	125 m
* R905	317-0470-01	47	C	5	125 m
* R906	317-0101-01	100	C	5	125 m
* R907	317-0331-01	330	C	5	125 m
* R908	317-0100-01	10	C	5	125 m (1075)
* R909	321-0193-42	1 k	MF	0.5	125 m
* R911	321-1289-42	10.1 k	MF	0.5	125 m
* R912	321-1389-42	111 k	MF	0.5	125 m
* R913	317-0470-01	47	C	5	125 m
* R914	321-0970-42	500 k	MF	0.5	125 m
* R915	325-0126-00	750 k	MF	0.5	125 m
* R916	317-0470-01	47	C	5	125 m
* R917	321-0481-42	1 M	MF	0.5	125 m
* R918	316-0224-01	220 k	C	10	250 m
* R919	321-0481-48	1 M	MF	1	125 m
* R921	321-0628-42	333 k	MF	0.5	125 m

* Two per unit

CIR REF	PART NUMBER	VALUE	DESCRIPTION	TYPE	TOL %	RATING
S601	260-1429-00		Slide (2-position)			
S602	311-1471-00		Push-Pull (with R641)			
S603	311-1471-00		Push-Pull (with R642)			
S751	260-1406-00		Push (5-button)			
S752	260-1407-00		Push (3-button)			
S901	260-1412-00		Lever (3-position)			
S902	260-1409-00		Rotary (12-position)			
TH601	307-0403-00	4.7 Ω	Thermistor		20	
TH602	307-0403-00	4.7 Ω	Thermistor		20	

* Two per unit

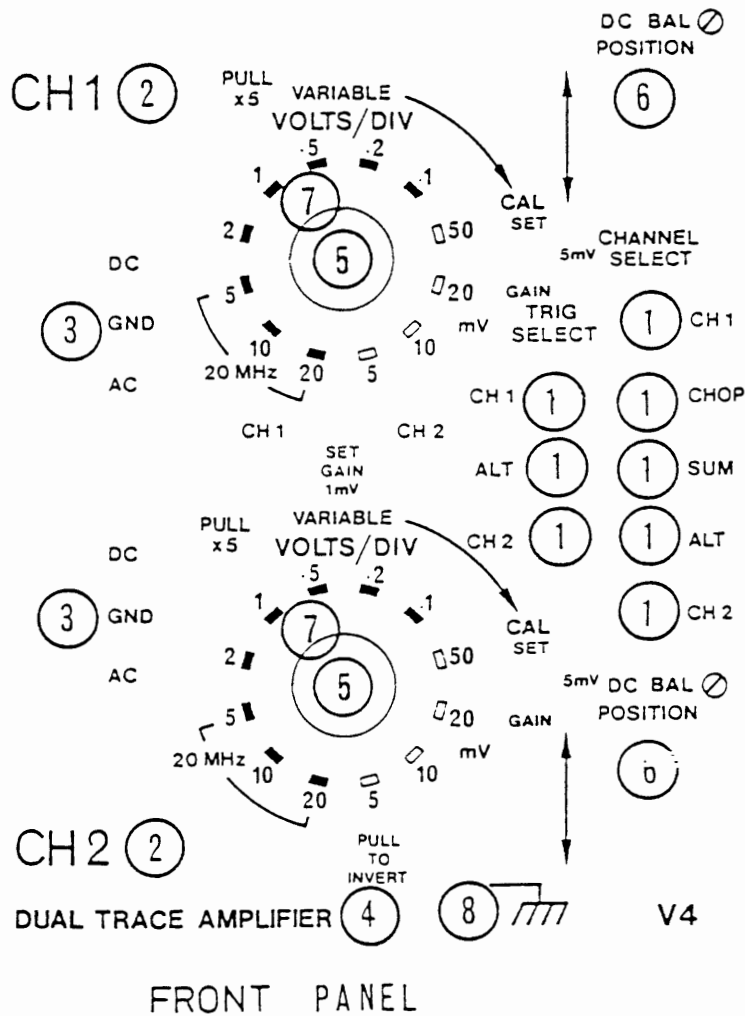
CIR REF	PART NUMBER	DESCRIPTION		TYPE
TR601A) B)	151-1036-00	Dual fet	Si	N-channel
TR603A) B)	151-1036-00	Dual fet	Si	N-channel
TR605A) B)	151-0422-00	Dual MD2369B Motorola	Si	NPN
TR607A) B)	151-0422-00	Dual MD2369B Motorola	Si	NPN
TR609	151-0127-02	BSX20/2N2369	Si	NPN
TR611	151-0127-02	BSX20/2N2369	Si	NPN
TR612	151-0127-02	BSX20/2N2369	Si	NPN
TR613	151-0127-02	BSX20/2N2369	Si	NPN
TR614	151-0421-00	ZTX320/MPS918	Si	NPN
TR615	151-0421-00	ZTX320/MPS918	Si	NPN
TR616	151-0421-00	ZTX320/MPS918	Si	NPN
TR617	151-0421-00	ZTX320/MPS918	Si	NPN
TR618	151-0127-02	BSX20/2N2369	Si	NPN
TR619	151-0127-02	BSX20/2N2369	Si	NPN
TR621	151-0127-02	BSX20/2N2369	Si	NPN
TR622	151-0127-02	BSX20/2N2369	Si	NPN
TR751	151-0127-02	BSX20/2N2369	Si	NPN
TR752	151-0326-00	BC107	Si	NPN
TR753	151-0127-02	BSX20/2N2369	Si	NPN
TR756	151-0320-01	MPS6518 Motorola	Si	PNP
TR757	151-0320-01	MPS6518 Motorola	Si	PNP
TR758	151-0320-01	MPS6518 Motorola	Si	PNP
TR759	151-0320-01	MPS6518 Motorola	Si	PNP

ASSEMBLIES

ASSEMBLY	PART NUMBER	INCLUDES CIRCUIT REFERENCES
Amplifier PC152	670-2557-00	C601 to C610, C611 to C618, C620, D601 to S609, D611 to D613, R603 to R609, R611 to R619, R621 to R624, R627 to R629, R631 to R635, R643 to R649, R651 to R654, R657 to R659, R661 to R669, R671 to R679, R681 to R689, R691, R694 to R699, R701 to R706, S601, TR601 to TR609, TR611 to TR619, TR621, TR622.
Attenuator CH1	011-0114-01	C901, C913, C921, PC137, R901, R905 to R907, R913 to R919, R921, S902.
Attenuator CH2	011-0114-00	C901, C913, C921, PC137, R901, R905 to R907, R913 to R919, S902.
PC137	670-2191-00	C902 to C909, C911, C912, C914 to C919, R902 to R908, R909, R911, R912.
Trigger PC153	670-2658-00	C750 to C759, C761 to C763, D751 to D759, D761, D762, R751, R752, R754 to R758, R761 to R765, R767 to R769, R771 to R779, R781 to R789, R791 to R798, S751, TR751 to TR753, TR756 to TR759

MECHANICAL

PART NUMBER	DESCRIPTION	LOCATION
136-0235-00	Base Transistor 6 pin	PCB
136-0343-00	Base Transistor, T018	PCB
366-1403-00	Button, Push	1
131-0649-00	Connector, Male BNC	Accessory
131-0650-01	Connector, Bulkhead Socket	2
210-0735-00	Eyelet, L613	PCB
210-0739-00	Eyelet, L737	PCB
342-0177-00	Insulator, Feed thru	PC130
003-0674-00	Key, Allen 1.5 A/F	4 - 7
366-0214-02	Knob, Lever	3
366-1404-00	Knob, Push-Pull	4
366-1266-01	Knob, Black/Red	5
366-1254-00	Knob, Grey	6
366-1387-00	Knob, Grey	7 </td
220-0647-00	Nut	8
220-0527-00	Nut, Chrome	4 - 7
004-1143-00	Packaging	Accessory
129-0374-00	Post, Terminal	8
213-0248-00	Screw, Socket 3 x 3 mm lg.	4 - 7
162-0058-00	Sleeving, PTFE .035"	
361-0223-00	Spacer, 6 BA	PCB
385-0206-00	Spacer, 6 BA/B BA x .05"	1
105-0347-00	Stop	Rear of Mod.
210-0275-00	Tag, Solder, 3/8"	



CIR REF	PART NUMBER	VALUE	DESCRIPTION	TYPE	TOL %	RATING	Eff. Ser.No.
D1	152-0062-01		1N914/1N4148	Si		75 V	
D2	152-0062-01		1N914/1N4148	Si		75 V	
D3	152-0472-00	5.6 V	Zener	Si	5	330 mW	
D4	152-0062-01		1N914/1N4148	Si		75 V	
D5	152-0062-01		1N914/1N4148	Si		75 V	
D6	152-0062-01		1N914+1N4148	Si		75 V	
D7	152-0543-00	5.1 V	Zener	Si	5	330 mW	
D8	152-0472-00	5.6 V	Zener	Si	5	330 mW	
D9	152-0339-00		1N4001	Si		50 V	
D10	152-0472-00	5.6 V	Zener	Si	5	400 mW	538736
D61	152-0062-01		1N914/1N4148	Si		75 V	
D62	152-0062-01		1N914/1N4148	Si		75 V	
D63	152-0062-01		1N914/1N4148	Si		75 V	
D64	152-0554-00		BAY 74	Si		50 V	536976
D65	152-0062-01		1N914/1N4148	Si		75 V	
D56	152-0062-01		1N914/1N4148	Si		75 V	
D67	152-0062-01		1N914/1N4148	Si		75 V	
D68	152-0062-01		1N914/1N4148	Si		75 V	
D69	152-0541-00		BAY 82	Si		10 V	
D71	152-0483-00		25 pA leakage current at -6 V and 25°C	Si			
D72	152-0062-01		1N914/1N4148	Si		75 V	
D73	152-0062-01		1N914/1N4148	Si		75 V	
D74	152-0062-01		1N914/1N4148	Si		75 V	
D75	152-0062-01		1N914/1N4148	Si		75 V	
D76	152-0062-01		1N914/1N4148	Si		75 V	
D193	152-0062-01		1N914/1N4148	Si		75 V	
D194	152-0062-01		1N914/1N4148	Si		75 V	
D195	152-0062-01		1N914/1N4148	Si		75 V	
C196	152-0541-00		BAY 32	Si		10 V	
D197	152-0483-00		25 pA leakage current at -6 V and 25°C	Si			
D198	152-0062-01		1N914/1N4148	Si		75 V	
D199	152-0062-01		1N914/1N4148	Si		75 V	
D201	152-0466-00	15V	Zener	Si	5	330 mW	
D202	152-0062-01		1N914/1N4148	Si		75 V	
D203	152-0062-01		1N914/1N4148	Si		75 V	
F8251	276-0597-00		Ferrite Bead Mullard Fx1115				536461
F8271	276-0597-00		Ferrite Bead Mullard FX1115				
L1	108-0720-00	7.7 μH	Fixed inductor				
L2	108-0483-00	16 μH	Fixed inductor				
L61	108-0481-00	1.3 μH	Fixed inductor				

CIR REF	PART NUMBER	VALUE ohms	DESCRIPTION			RATING W	EFF Ser.No.
			TYPE	TOL %			
R1	317-0184-01	180 k	C	5	125 m	538736	
R2	317-0153-01	15 k	C	5	125 m	538736	
R3	317-0183-01	18 k	C	5	125 m		
R4	317-0104-01	100 k	C	5	125 m	538736	
R5	315-0433-02	43 k	C	5	250 m		
R6	317-0432-01	4.3 k	C	5	125 m		
R7	311-0995-00	680	CP	20	250 m		
R8	317-0151-01	150	C	5	125 m	538736	
R9	317-0562-01	5.6 k	C	5	125 m		
R10	317-0102-01	1 k	C	5	125 m		
R11	317-0151-01	150	C	5	125 m		
R12	317-0331-01	330	C	5	125 m	538736	
R13	317-0750-01	75	C	5	125 m		
R14	317-0153-01	15 k	C	5	125 m		
R15	317-0123-01	12 k	C	5	125 m		
R16	317-0100-01	10	C	5	125 m		
R17	317-0392-01	3.9 k	C	5	125 m		
R18	317-0822-01	8.2 k	C	5	125 m		
R19	317-0752-01	7.5 k	C	5	125 m		
R21	317-0562-01	5.6 k	C	5	125 m		
R22	311-1575-00	7.5 k	CV	10	1		
R23	317-0101-01	100	C	5	125 m		
R24	317-0822-01	8.2 k	C	5	125 m		
R25	317-0104-01	100 k	C	5	125 m		
R26	311-0802-00	4.7 k	CP	20	250 m		
R27	317-0123-01	12 k	C	5	125 m		
R28	317-0100-01	10	C	5	125 m		
R29	317-0222-01	2.2 k	C	5	125 m		
R31	317-0750-01	75	C	5	125 m		
R32	317-0511-01	510	C	5	125 m		
R33	317-0122-01	1.2 k	C	5	125 m		
R34	317-0153-01	15 k	C	5	125 m		
R35	317-0100-01	10	C	5	125 m		
R36	311-1388-00	47	CP	20	250 m		
R37	317-0331-01	330	C	5	125 m	538726	
R38	317-0220-01	22	C	5	125 m		
R39	317-0182-01	1.8 k	C	5	125 m		
R41	317-0101-01	100	C	5	125 m		
R42	317-0100-01	10	C	5	125 m		
R43	317-0103-01	10 k	C	5	125 m		
R6	317-153-01	15 k	C	5	125 m		
R63	317-0105-01	1 M	C	5	125 m		
R64	317-0682-01	6.8 k	C	5	125 m		
R65	317-063-01	56 k	C	5	125 m	537318	
R66	317-0203-01	20 k	C	5	125 m		
R67	317-0473-01	47 k	C	5	125 m		
R68	317-0101-01	100	C	5	125 m		
R69	317-0392-01	3.9 k	C	5	125 m		
R71	317-0622-01	6.2 k	C	5	125 m		
R72	317-0153-01	15 k	C	5	125 m		
R73	311-0735-00	10 k	CP	20	250 m		
R74	317-0682-01	6.8 k	C	5	125 m		
R75	317-0331-01	330	C	5	125 m		
R76	317-0332-01	3.3 k	C	5	125 m		
R77	317-0472-01	4.7 k	C	5	125 m		
R78	321-0291-48	10.5 k	MF	1	125 m		
R80	317-0471-01	470	C	5	125 m		

CIR REF	PART NUMBER	VALUE ohms	DESCRIPTION			RATING W	EFF Ser.No.
			TYPE	TOL %			
R81	317-0183-01	18 k	C	5	125 m		
R82	317-0392-01	3.9 k	C	5	125 m		
R83	317-0473-01	47 k	C	5	125 m		
R84	317-0472-01	4.7 k	C	5	125 m		
R85	321-0373-48	75 k	MF	1	125 m		
R86	317-0823-01	82 k	C	5	125 m		
R87	321-0293-48	11 k	MF	1	125 m		
R88	317-0562-01	5.6 k	C	5	125 m		
R89	321-0291-48	10.5 k	MF	1	125 m		
R90	311-0913-00	1.5 k	CP	20	250 m		
R91	311-0798-00	2.2 k	CP	20	250 m		
R92	317-0124-01	120 k	C	5	125 m		
R93	317-0104-01	100 k	C	5	125 m		
R94	317-0221-01	220	C	5	125 m		
R95	317-0201-01	200	C	5	125 m		
R96	317-0221-01	220	C	5	125 m		
R97	317-0562-01	5.6 k	C	5	125 m		
R98	317-0154-01	150 k	C	5	125 m		
R99	317-0203-01	20 k	C	5	125 m		
R100	317-0471-01	470	C	5	125 m	538976	
R101	316-0475-01	4.7 M	C	10	250 m		
R102	317-0225-01	2.2 M	C	5	125 m		
R103	317-0433-01	43 k	C	5	125 m		
R104	317-0473-01	47 k	C	5	125 m		
R105	311-0750-00	22 k	CP	20	250 m		
R106	317-0393-01	39 k	C	5	125 m		
R107	317-0122-01	1.2 k	C	5	125 m		
R108	311-0851-00	1 k	CP	20	250 m		
R109	317-0222-01	2.2 k	C	5	125 m		
R111	317-0243-01	24 k	C	5	125 m		
R112	317-0512-01	5.1 k	C	5	125 m		
R113	317-0105-01	1 M	C	5	125 m		
R114	317-0433-01	43 k	C	5	125 m		
R115	317-0513-01	51 k	C	5	125 m		
R116	317-0104-01	100 k	C	5	125 m		
R117	317-0753-01	75 k	C	5	125 m		
R118	317-0302-01	3 k	C	5	125 m		
R151	317-0104-01	100 k	C	5	125 m		
R152	317-0682-01	6.8 k	C	5	125 m		
R153	311-1353-00	47 k	CV	20	250 m		
R154	317-0184-01	180 k	C	5	125 m		
R155	317-0163-01	16 k	C	5	125 m		
R156	321-1308-48	16 k	MF	1	125 m		
R157	317-0133-01	13 k	C	5	125 m		
R158	317-0241-01	240	C	5	125 m		
R159	311-0798-00	2.2 k	CP	20	250 m		
R161	315-0513-02	51 k	C	5	125 m		
R162	317-0133-01	13 k	C	5	125 m		
R163	321-1308-48	16 k	MF	1	125 m		
R164	317-0163-01	16 k	C	5	125 m		
R165	317-0822-01	8.2 k	C	5	125 m		
R166	317-0362-01	3.6 k	C	5	125 m		
R167	317-0514-01	510 k	C	5	125 m		
R168	317-0123-01	12 k	C	5	125 m		
R169	317-0101-01	100	C	5	125 m		
R171	317-0392-01	3.9 k	C	5	125 m		
R172	317-0222-01	2.2 k	C	5	125 m		

*With S153

CIR REF	PART NUMBER	VALUE ohms	DESCRIPTION			EFF. Ser.No.
			TYPE	TOL %	RATING W	
R173	311-1388-00	47	CP	20	250 m	
R174	317-0822-01	8.2 k	C	5	125 m	
R175	317-0121-01	120	C	5	125 m	
R176	317-0392-01	3.9 k	C	5	125 m	
R177	317-0153-01	15 k	C	5	125 m	
R191	321-1353-48	47 k	MF	1	125 m	
R192	317-0392-01	3.9 k	C	5	125 m	
R193	321-1353-48	47 k	MF	1	125 m	
R194	317-0224-01	220 k	C	5	125 m	
R195	317-0182-01	1.8 k	C	5	125 m	
R196	317-0273-01	27 k	C	5	125 m	
R197	321-0276-48	7.32 k	MF	1	125 m	
R198	311-1420-00	3.3 k	WWP	10	1	
R199	311-1387-00	5 k	WWV	5	750 m	
R200	317-0221-01	220	C	5	125 m	
R201	321-0178-48	698	MF	1	125 m	
R202	311-1381-00	680	WWP	10	1	
R203	317-0392-01	3.9 k	C	5	125 m	
R204	311-0735-00	10 k	CP	20	250 m	
R205	317-0223-01	22 k	C	5	125 m	
R206	317-0272-01	2.7 k	C	5	125 m	
R207	317-0102-01	1 k	C	5	125 m	
R208	317-0271-01	270	C	5	125 m	
R209	321-1296-48	12 k	MF	1	125 m	
R211	317-0472-01	4.7 k	C	5	125 m	
R212	321-0287-48	9 k 53	MF	1	125 m	536461
R213	321-0298-48	12.4 k	MF	1	125 m	
R214	321-0402-48	150 k	MF	1	125 m	
R215	317-0104-01	100 k	C	5	125 m	
R216	317-0912-01	9.1 k	C	5	125 m	
R217	317-0681-01	680	C	5	125 m	
R218	317-0393-01	39 k	C	5	125 m	
R219	317-0473-01	47 k	C	5	125 m	
R221	317-0472-01	4.7 k	C	5	125 m	
R222	321-0294-48	11.3 k	MF	1	125 m	
R223	317-0123-01	12 k	C	5	125 m	
R224	317-0101-01	100	C	5	125 m	
R225	317-0101-01	100	C	5	125 m	
R226	317-0471-01	470	C	5	125 m	538976
R227	317-0154-01	150 k	C	5	125 m	
R228	317-0221-01	220	C	5	125 m	
R229	317-0203-01	20 k	C	5	125 m	
R230	321-0306-48	15 k	MF	1	125 m	
R231	315-0102-02	1 k	C	5	250 m	
R232	317-0133-01	13 k	C	5	125 m	
R233	321-0306-48	15 k	MF	1	125 m	
R234	317-0332-01	3.3 k	C	5	125 m	
R235	317-0362-01	3.6 k	C	5	125 m	
R236	311-0719-00	470	CP	20	250 m	
R237	317-0103-01	10 k	C	5	125 m	
R238	317-0204-01	200 k	C	5	125 m	
R239	317-0204-01	200 k	C	5	125 m	
R251	324-0616-40	7.5 M	MF	1	1	
R252	324-0544-40	4.53 M	MF	1	1	
R253	322-0498-40	1.5 M	MF	1	250 m	
R254	321-0469-48	750 k	MF	1	125 m	
R255	321-0448-48	453 k	MF	1	125 m	

CIR REF	PART NUMBER	VALUE ohms	DESCRIPTION			EFF. Ser.No.
			TYPE	TOL %	RATING W	
R256	321-0402-48	150 k	MF	1	125 m	
R257	321-0402-48	150 k	MF	1	125 m	
R258	321-0402-48	150 k	MF	1	125 m	
R259	317-0103-01	10 k	C	5	125 m	
R261	311-1356-00	22 k	CV	20	250 m	
R271	317-0302-01	3 k	C	5	125 m	
R272	317-0332-01	3.3 k	C	5	125 m	
R273	317-0562-01	5.6 k	C	5	125 m	
R274	317-0183-01	18 k	C	5	125 m	
R275	321-0355-48	48.7 k	MF	1	125 m	
R276	324-0594-40	15 M	MF	1	1	
R277	324-0616-40	7.5 M	MF	1	1	
R278	324-0544-40	4.53 M	MF	1	1	
R279	322-0498-40	1.5 M	MF	1	250 m	
R281	321-0469-48	750 k	MF	1	125 m	
R282	321-0448-48	453 k	MF	1	125 m	
R283	321-0402-48	150 k	MF	1	125 m	
R284	321-0402-48	150 k	MF	1	125 m	
R285	311-1355-00	100 k	CV	20	250 m	
R286	317-0223-01	22 k	C	5	125 m	
R287	321-0402-48	150 k	MF	1	125 m	
R288	317-0103-01	10 k	C	5	125 m	
R289	317-0154-01	150 k	C	5	125 m	
S1	260-1403-00					Push (3-button)
S2	260-1401-00					Push (1-button)
S3	260-1402-00					Push (4-button)
S61)						
S62)	260-1405-00					Push (3-button)
S151	260-1401-00					Push (1-button)
S152	260-1400-00					Push (2-button)
S153	311-1353-00					Rotary (with R153)
S191)						
S192)	260-1499-00					Push (5-button)
S251	260-1411-00					Rotary (23-position)
S271	260-1410-00					Rotary (23-position)
TH1	307-0270-00	330Ω				Thermistor 20% 500 mW

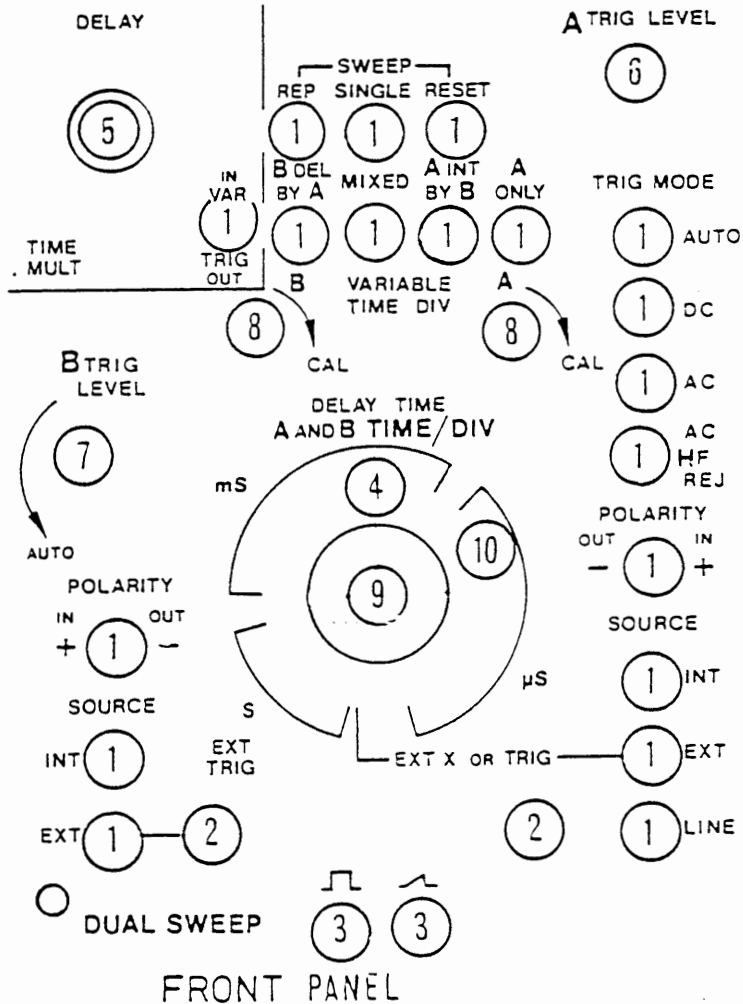
CIR REF	PART NUMBER	DESCRIPTION		TYPE	Eff. Ser. No.
TR1	151-0127-03	BSX20	Si	NPN	536485
TR2	151-0320-00	MPS6518/BFX48	Si	PNP	
TR3	151-0242-00	2N3904	Si	NPN	
TR4	151-0242-00	2N3904	Si	NPN	
TR5	151-0320-00	MPS6518/BFX48	Si	PNP	
TR6	151-0127-02	BSX20/2N2369	Si	NPN	
TR7	151-0127-02	BSX20/2N2369	Si	NPN	
TR61	151-0320-00	MPS6518/BFX48	Si	PNP	N-channel
TR62	151-0320-00	MPS6518/BFX48	Si	PNP	
TR63	151-0242-00	2N3904	Si	NPN	
TR64	151-0242-00	2N3904	Si	NPN	
TR65	151-0320-00	MPS6518/BFX48	Si	PNP	
TR66	151-1062-00	FET Teleequipment spec.	Si	N-channel	
TR67	151-0242-00	2N3904	Si	NPN	
TR68	151-0317-00	BC109C	Si	NPN	
TR69	151-0242-00	2N3904	Si	NPN	
TR151	151-0242-00	2N3904	Si	NPN	NPN
TR152	151-0247-00	2N3904	Si	NPN	
TR153	151-0320-00	MPS6518/BFX48	Si	PNP	
TR154	151-0127-02	BSX20/2N2369	Si	NPN	
TR155	151-0127-02	BSX20/2N2369	Si	NPN	
TR191	151-0320-00	MPS6518/BFX48	Si	PNP	N-channel
TR192	151-0320-00	MPS6518/BFX48	Si	PNP	
TR193	151-0320-00	MPS6518/BFX48	Si	PNP	
TR194	151-0320-00	MPS6518/BFX48	Si	PNP	
TR195	151-0320-00	MPS6518/BFX48	Si	PNP	
TR196	151-1062-00	FET Teleequipment spec.	Si	N-channel	
TR197	151-0242-00	2N3904	Si	NPN	
V61	150-0105-00	Neon capless 34L			

ASSEMBLIES

ASSEMBLY	PART NUMBER	INCLUDES CIRCUIT REFERENCES	Eff. Ser.No.
'A' Sweep & Trigger PC132	670-2186-03	C1 to C4, C6 to C9, C11 to C15, C61 to C68, C71 to C79, C81, D1, D2, D4 to D7, D10, D61 to D69, D71 to D74, D76, L1, L61, R1 to R6, R8 to R11, R13 to R19, R21, R23 to R29, R31 to R39, R41 to R43, R62 to R69, R71 to R79, R81 to R89, R92 to R109, R111 to R118, S1 to S3, TR1 to TR7, TR61 to TR69.	538976
'A' TIME/DIV switch	262-0958-00	C271 to C279, C281, C282, R287, R289	
'B' Sweep & Trigger PC133	670-2187-02	C5, C151 to C159, C192 to C199, C201, C202, C204, D3, D193 to D195, D197 to D199, D201 to D203, R12, R151, R152, R154 to R159, R161 to R169, R171, R172, R174, R176, R177, R191 to R197, R201 to R209, R211 to R216, R219, R221 to R226, R231 to R237, S151, S152, TR151 to TR155, TR191 to TR197.	538976
'B' TIME/DIV switch	262-0959-00	C251 to C257, R251 to R258	
Reset Lamp PC140	670-2354-00	V61	
Timing Resistor PC136	670-2190-00	R271 to R279, R281 to R283	

MECHANICAL

PART NUMBER	DESCRIPTION	LOCATION
136-0343-00	Base Transistor, T018	PCB
136-0344-00	Base Transistor, 4 pin	PCB
366-1403-00	Button, Push	1
343-0191-00	Clamp, Cable	
131-0650-01	Connector, Bulkhead Socket BNC	2
131-1268-00	Connector, Single Pole 2mm	3
131-0649-00	Connector, Male BNC	Accessory
331-0316-00	Dial, Time/Div	4
331-0317-00	Dial, Turns Counting	5
210-0735-00	Eyelet, L.613	PCB
210-0739-00	Eyelet, L.737	PCB
003-0674-00	Key, Allen 1.5 mm A/F	6-10
003-0704-00	Key, Nut Locking	5
003-0745-00	Key, Soecial Allen	5
366-1238-00	Knob, Grey/Black	6
366-1239-02	Knob, Grey/Red	7
366-1266-00	Knob, Grey/Black	8
366-1289-00	Knob, Grey/Red	9
366-1386-00	Knob, Assy Transparent	10
220-0527-00	Nut, Chrome	6-10
213-0249-00	Screw, Socket, 3 x 3 mm	6-10
385-0206-00	Spacer, 6 BA/3 BA x .5"	1
361-0478-00	Spacer, Soecial	4
105-0347-00	Stop	Rear of Mod
343-0198-00	Strap, Cable Insuloid	
210-0275-00	Tag, Solder, 3/8"	
210-1177-00	Wasner	6



SECTION 6 CIRCUIT DIAGRAMS

To facilitate cross referencing, a colour code has been adopted.

To minimize the risk of misinterpretation of component values on the circuit diagrams, the decimal point has multiplier or sub-multiplier of the basic unit. For instance, 2.2 megohms is shown as 2M2 and 1.8 picofarads is shown as

To aid the reader further to locate a component in the circuit diagrams, a table is provided at the top of each circuit reference will appear, where practicable, directly above the component being sought.

PRINTED CIRCUIT

Blue shows the rear track as seen through the board. Yellow the component side track.

WAVEFORMS

Waveforms, illustrated in the sections may be monitored at the point with the corresponding number in the respo

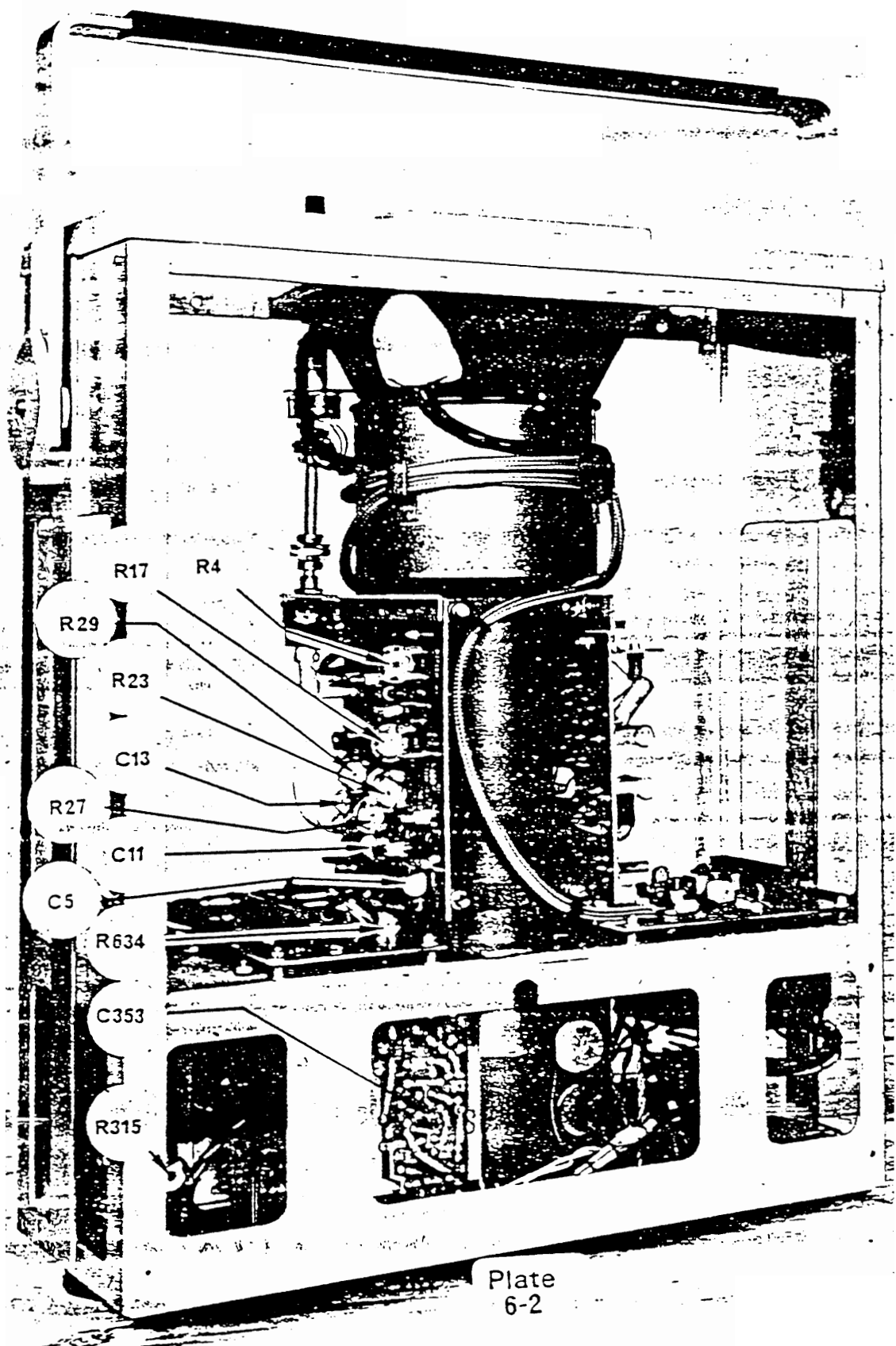
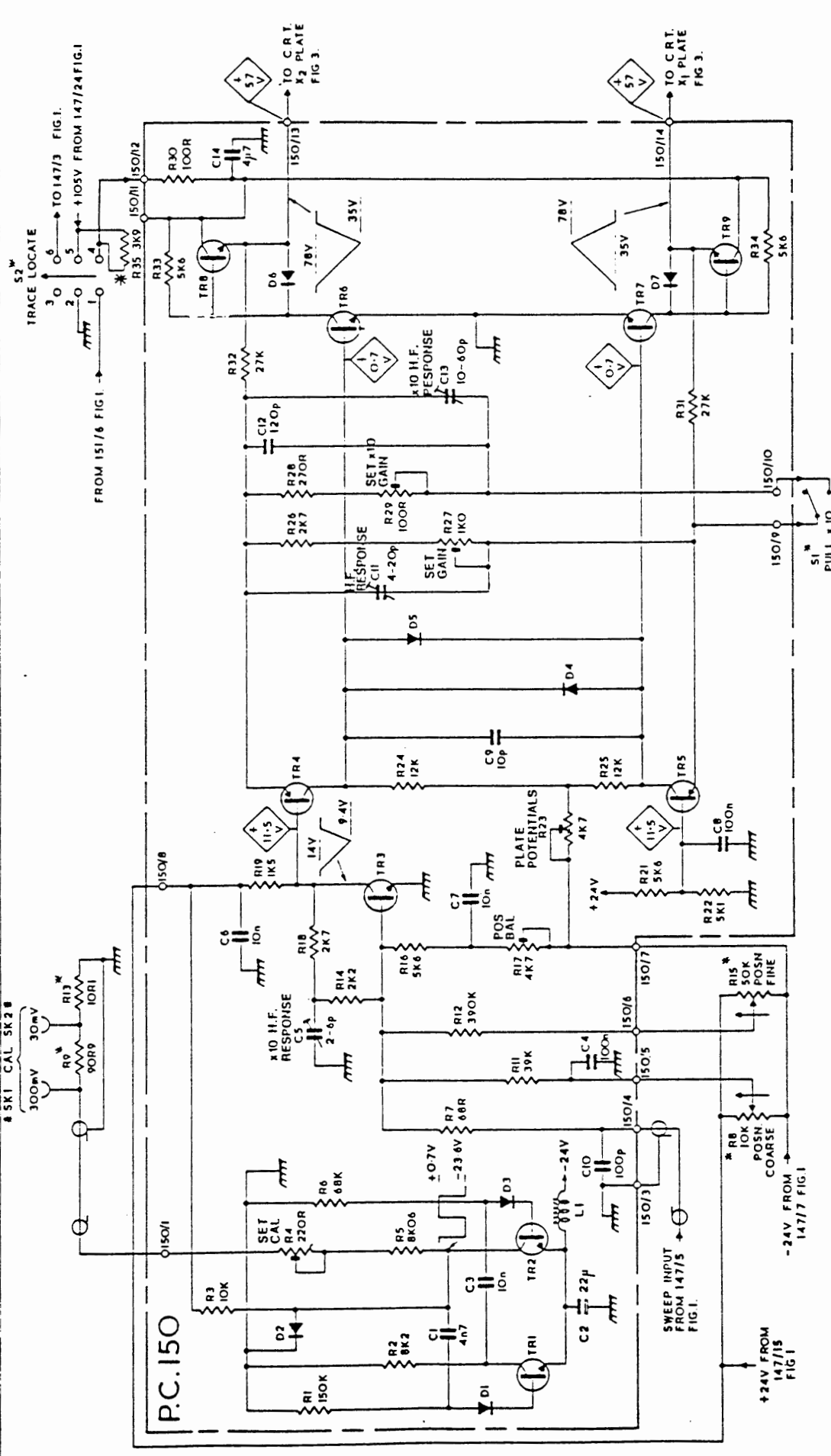


Plate
6-2

RESISTORS	3	4	6	7	10	11	12	13	14	15	16	17	18	22	23	24	25	26	27	28	30	31	32	33	34	35
CAPACITORS	1	2																								
MISC.	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26
DI	TR1	TR2	TR3	TR4	TR5	TR6	TR7	TR8	TR9	TR10	TR11	TR12	TR13	TR14	TR15	TR16	TR17	TR18	TR19	TR20	TR21	TR22	TR23	TR24	TR25	TR26
	LI	SK1	SK2	SK3	SK4	SK5	SK6	SK7	SK8	SK9	SK10	SK11	SK12	SK13	SK14	SK15	SK16	SK17	SK18	SK19	SK20	SK21	SK22	SK23	SK24	SK25



X AMPLIFIER & CALIBRATOR - D75

FIG. 2. 3-77

NOTES

1. * DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD.

2. 150/2 DENOTES P.C. BOARD/EYELET OR TERMINAL N°.

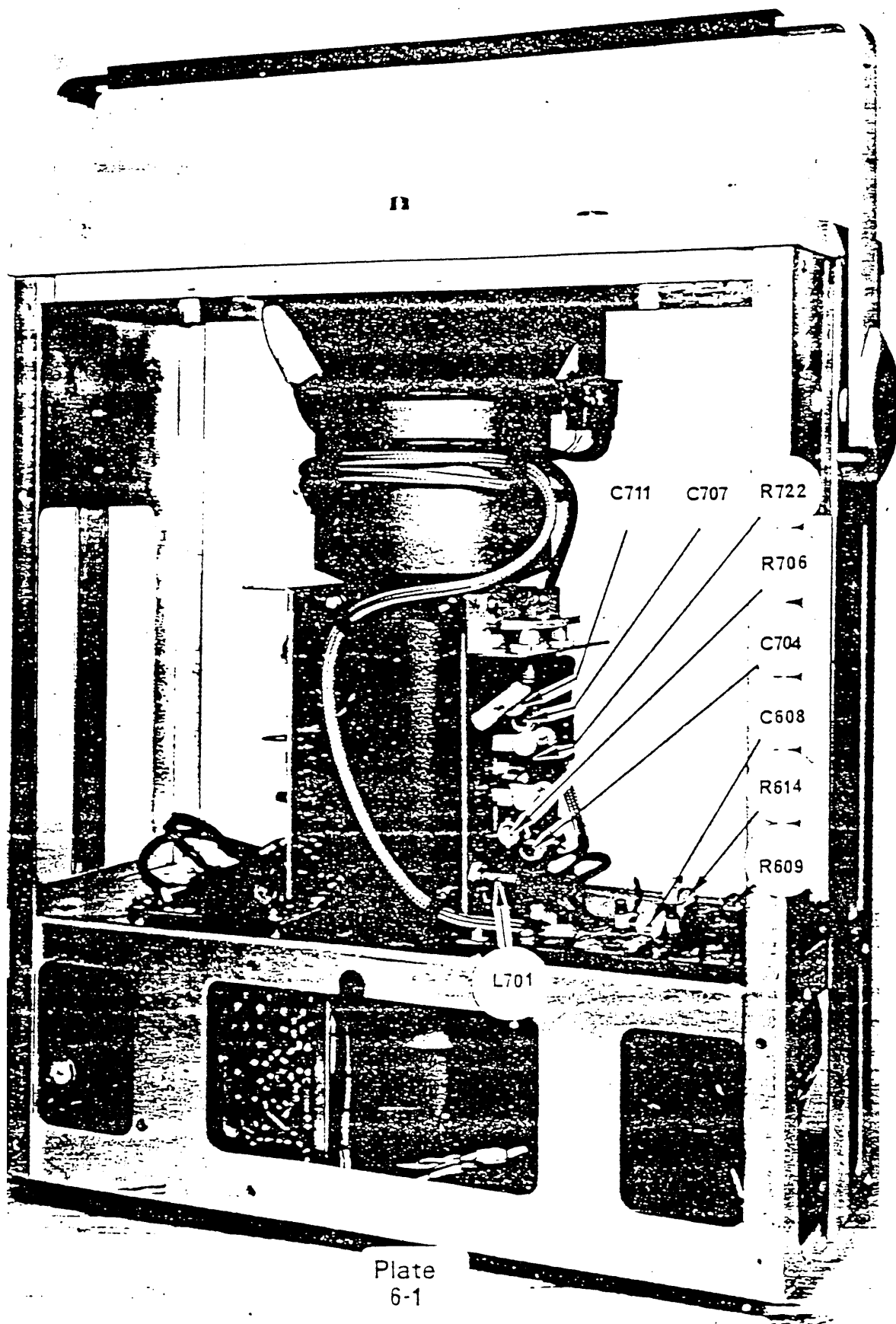
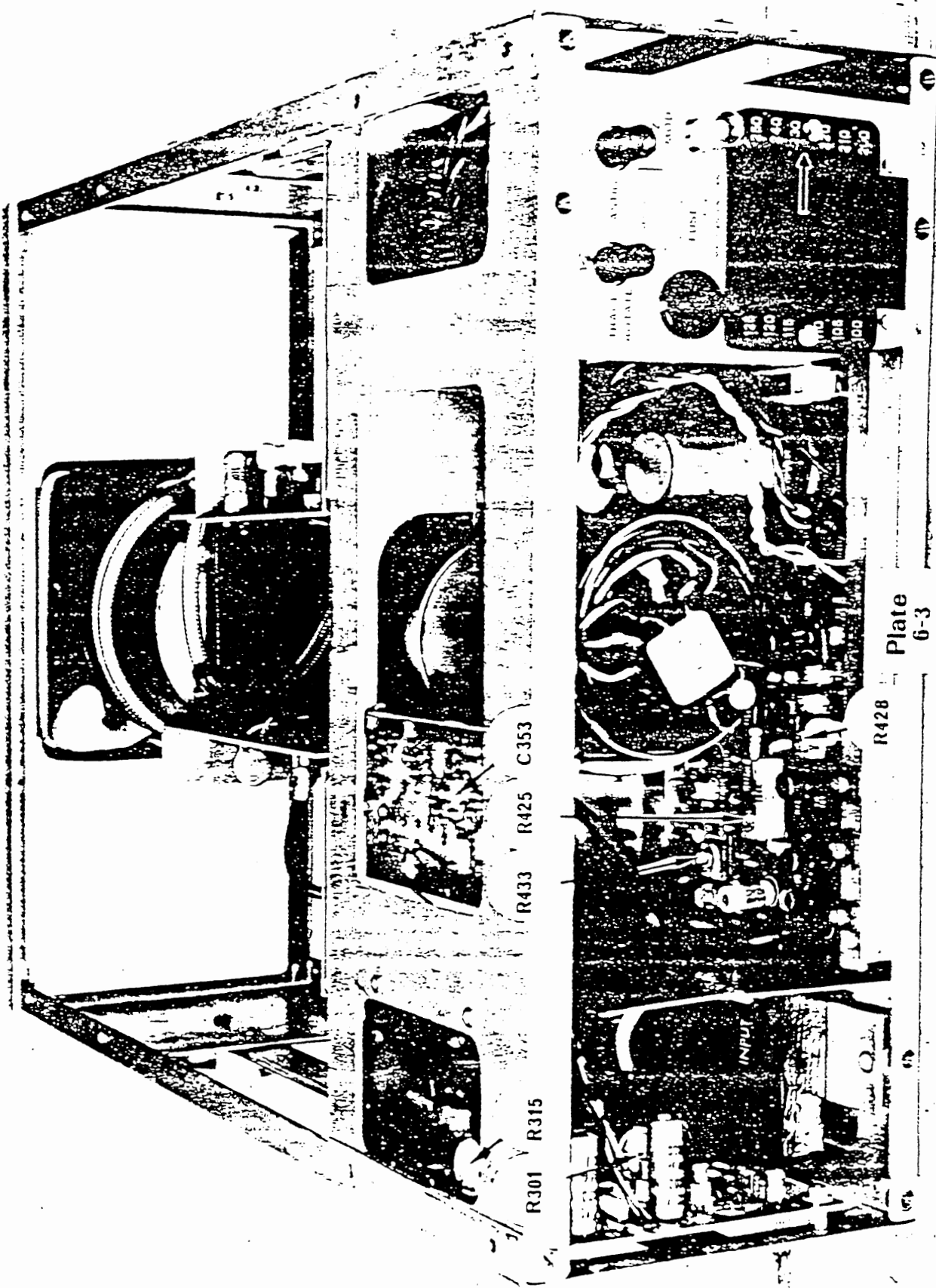


Plate
6-1

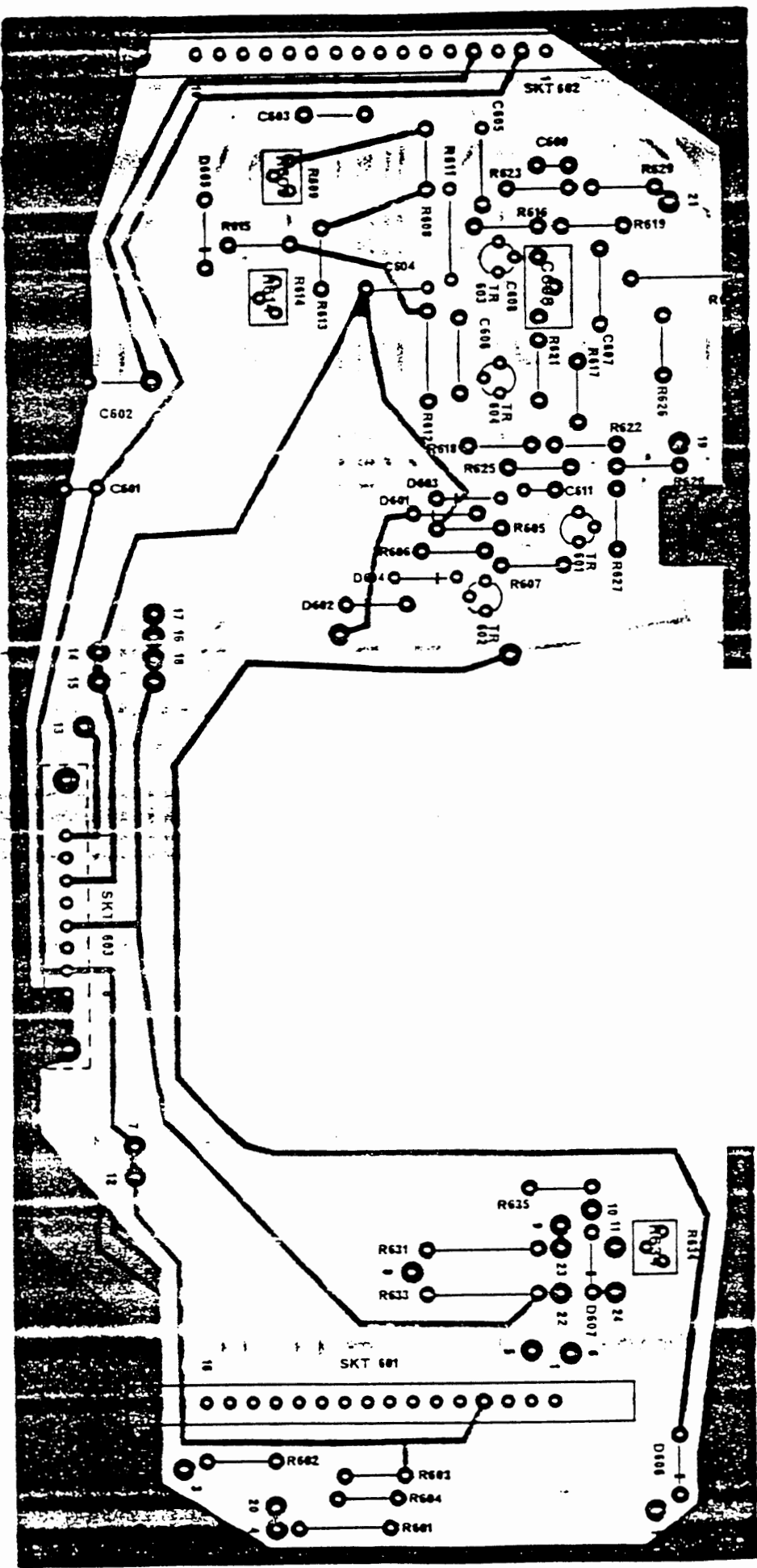


R301 R315

R433 R425 C353

R428 Plate 6-3

A B C D E F G H



PC 147

COMPONENT REFERENCE FIG 5

8

5

4

3

2

1

1

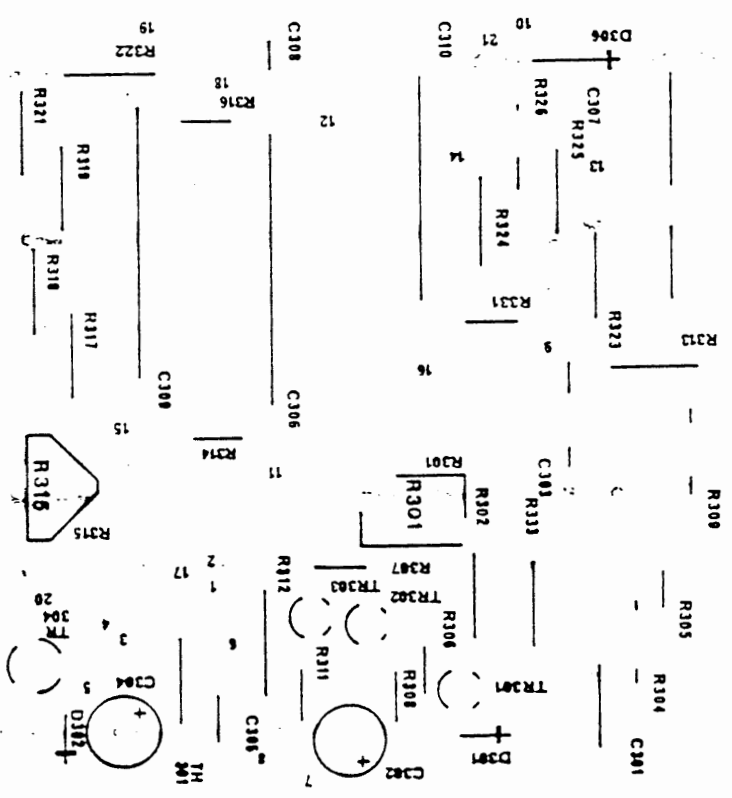
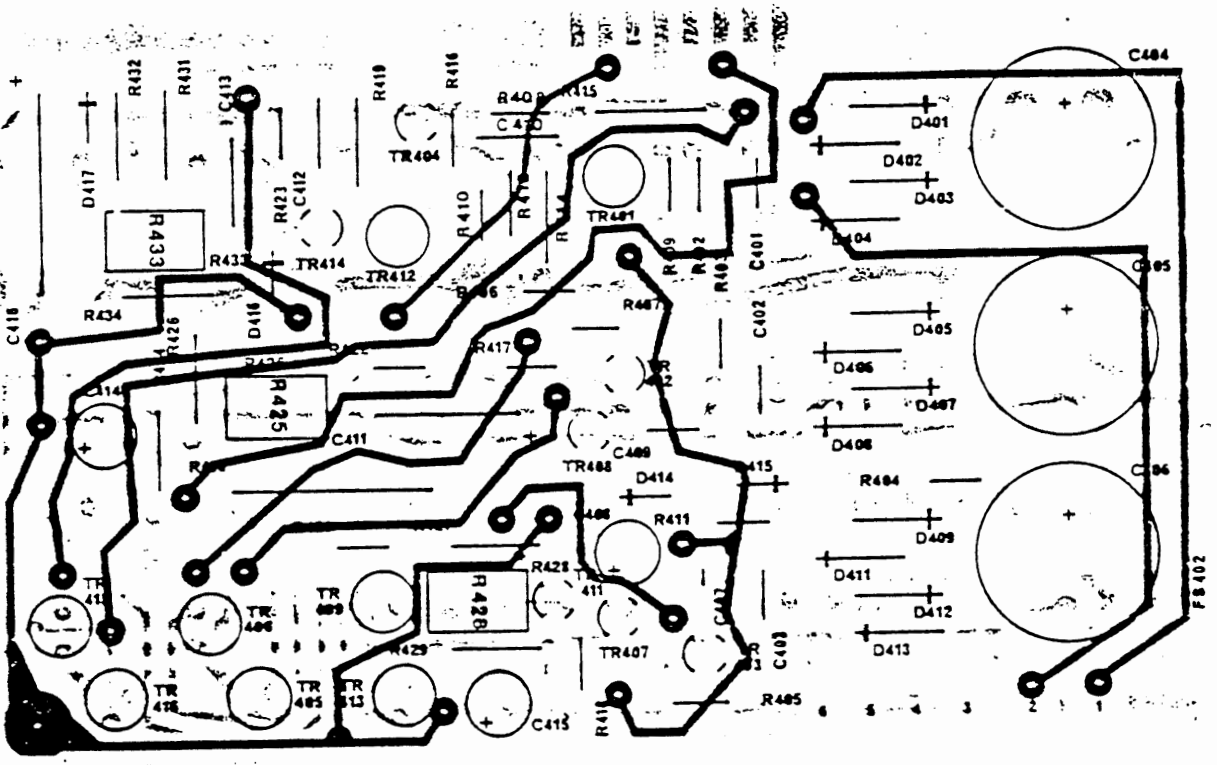
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3

4

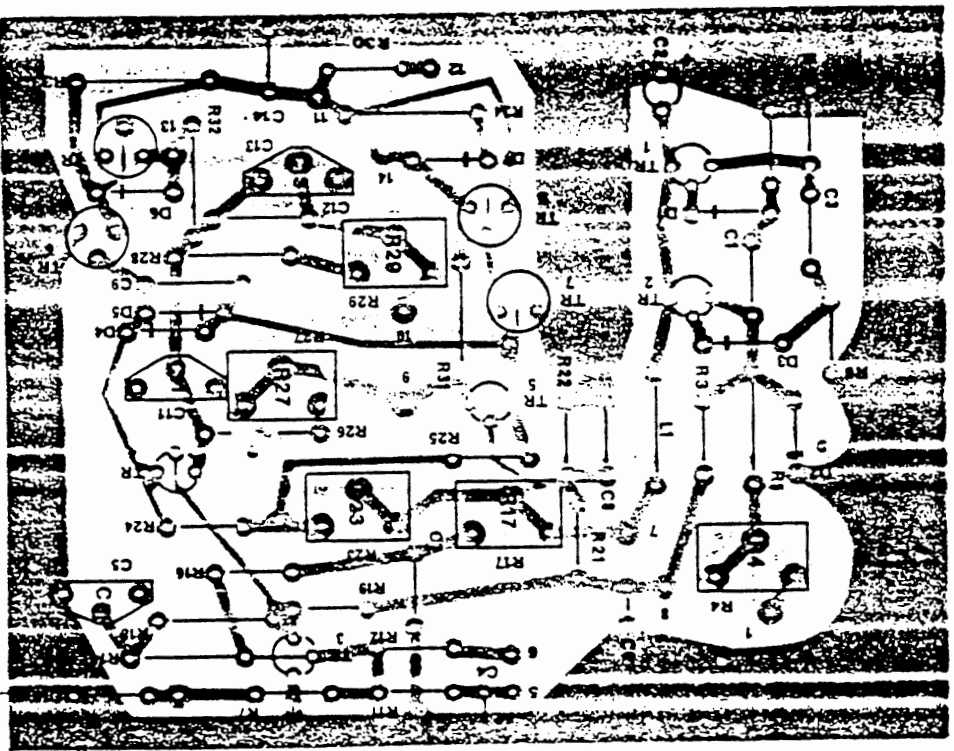
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A | B | C | D | E | F | G | H

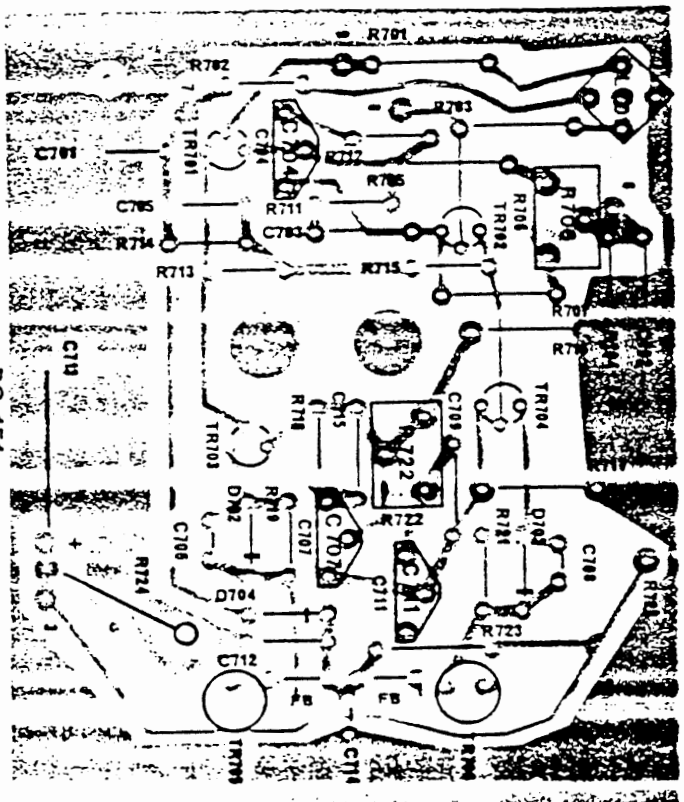


COMPONENT REFERENCE FIG. 6

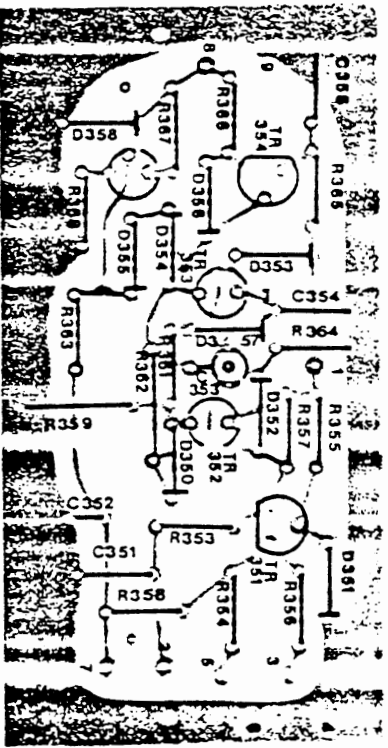
A B C D E F G H



PC 150



PC 151



PC 128

COMPONENT REFERENCE FIG. 7

9

5

4

3

2

1

9

5

4

3

2

1

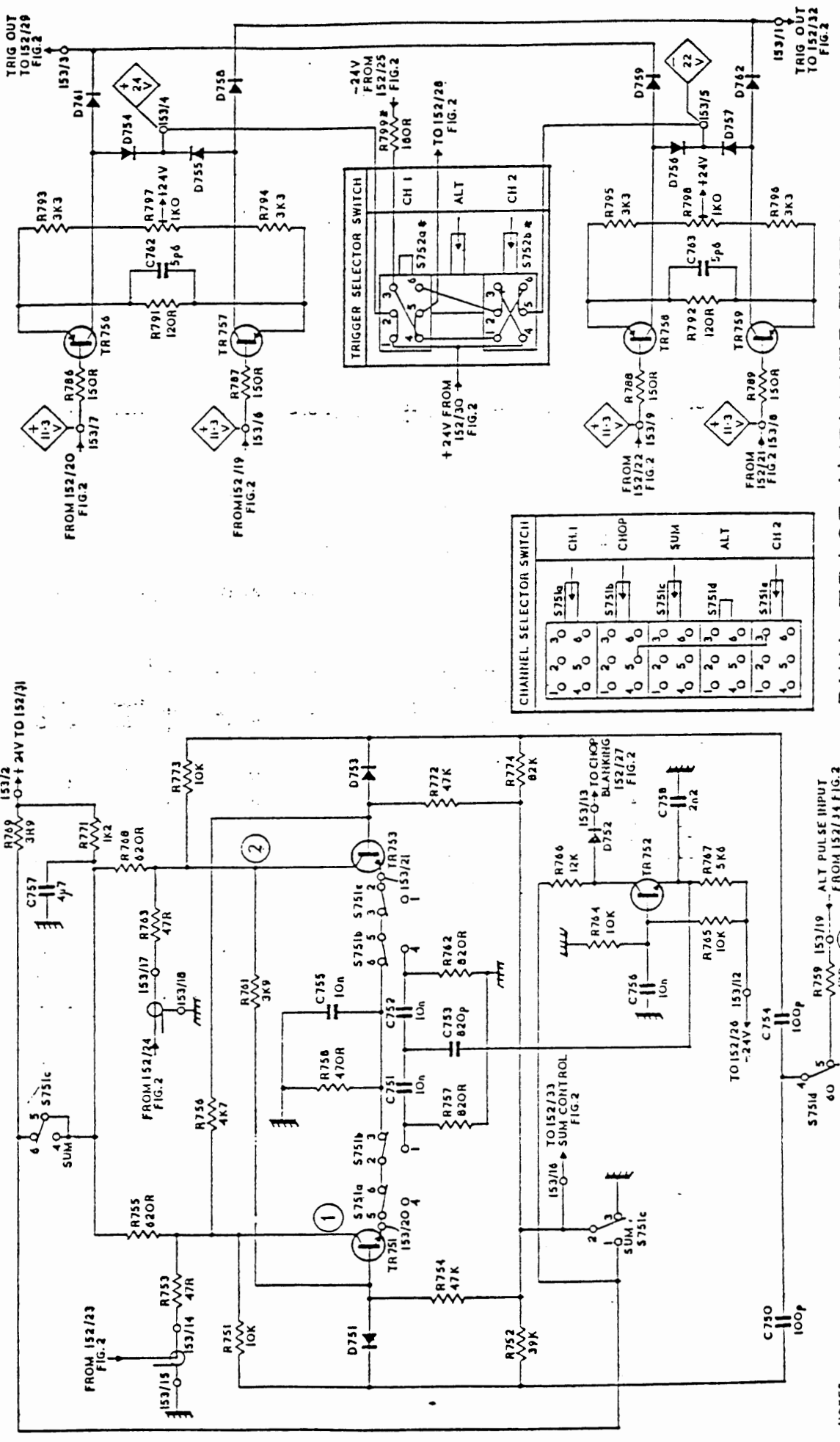
Switch Position	ATTENUATION SELECTED BY WAFER				Selected Resistor To Earth	Resistor Between Eyelets and 2F	Selected Resistor Between 3F and 4F	Selected Resistor Between 4F and Earth
	1	2	3	4				
20 V	Eyelet No.: 137/2	Eyelet No.: 137/5	Eyelet No.: 137/11	Eyelet No.: 137/13	R902 R909	R906	R915	R921 R919
10 V	137/2	137/5	137/10	137/12	R902 R909	R906	R914	R917 R919
5 V	137/2	137/5	137/9	—	R902 R909	R906	R916	R919
2 V	137/3	137/6	137/11	137/13	R903 R908 R911	R907	R915	R921 R919
1 V	137/3	137/6	137/10	137/12	R903 R908 R911	R907	R914	R917 R919
0.5 V	137/3	137/6	137/9	—	R903 R908 R911	R907	R916	R919
0.2 V	137/4	137/7	137/11	137/13	R905 R904 R912	—	R915	R921 R919
0.1 V	137/4	137/7	137/10	137/12	R905 R904 R912	—	R914	R917 R919
50 mV	137/4	137/7	137/9	—	R905 R904 R912	—	R916	R919
20 mV	—	—	137/11	137/13	—	Resistor Between 1F & 2F R913	R915	R921 R919
10 mV	—	—	137/10	137/12	—	R913	R914	R917 R919
5 mV	—	—	137/9	—	—	R913	R916	R919

TABLE -- VOLTS/DIV SWITCH CONNEXIONS

RESISTORS		751 752 753 754 755		761 763 768 769 773		786 788 791 793 796	
CAPACITORS		756 758		764 766 771 772 774		794 797 798 800	
MISC.		751 752 753 754 755		758 759 760 761 762		799	

RESISTORS		762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800					
CAPACITORS		751 752 753 754 755		758 759 760 761 762		799	
MISC.		751 752 753 754 755		758 759 760 761 762		799	

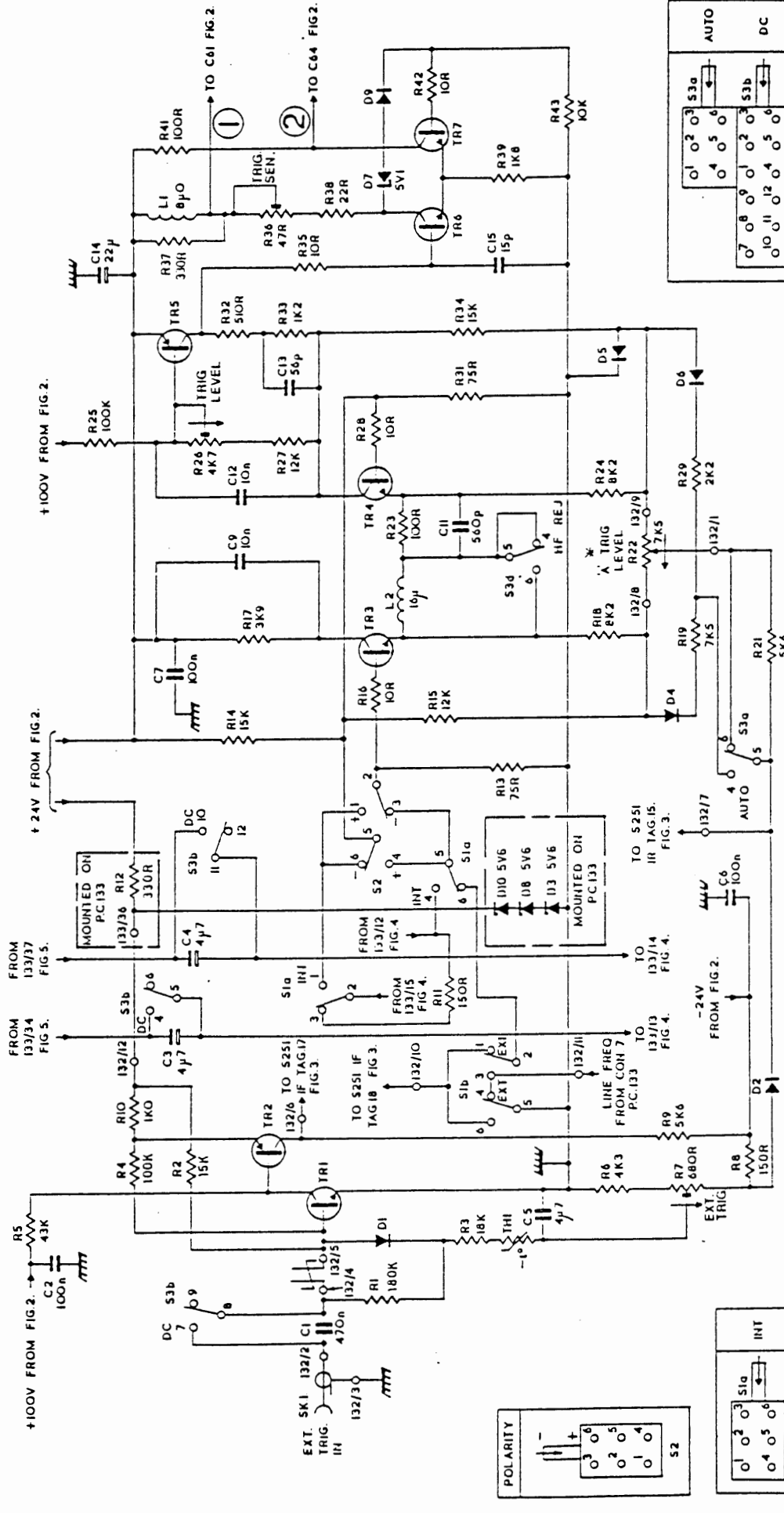
RESISTORS		751 752 753 754 755		761 763 768 769 773		786 788 791 793 796	
CAPACITORS		756 758		764 766 771 772 774		794 797 798 800	
MISC.		751 752 753 754 755		758 759 760 761 762		799	



DUAL TRACE AMPLIFIER TYPE V4
FIG 3
PC 153

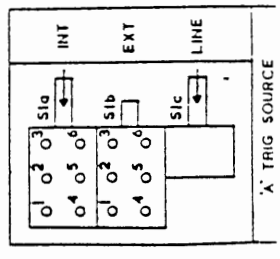
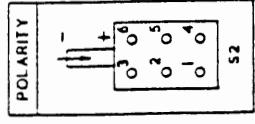
NOTES.
1 153/3 DENOTES PC BOARD/EYELET OR TERMINAL No.
2 * DENOTES COMPONENTS NOT MOUNTED ON PC BOARD

RESISTORS	1	3	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44		
CAPACITORS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
MISC.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44



DUAL SWEEP TYPE S2A
A TRIGGER AMPLIFIER
P.C.132 FIG.1

NOTES:
1. * DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD.
2. 132/10 DENOTES P.C. BOARD/EYELET OR TERMINAL No.

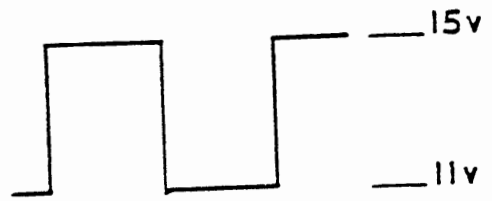


* A TRIG SOURCE

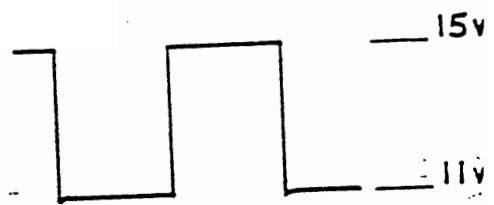
POSITION	Timing Capacitors selected by wafer	Timing resistors selected by wafer
1 S	C254, C251, C255, C252	R251 - R257
.5 S	C254, C251, C255, C252	R252 - R257
.2 S	C254, C251, C255, C252, C256	R253 - R257
.1 S	C254, C251, C255, C252, C256, C253	R254 - R257
50 mS	C254, C251, C255, C252, C256, C253	R255 - R256
20 mS	C254, C251, C255, C252, C256, C253	R256 - R257
10 mS	C254, C251, C255, C252, C256, C253	R257
5 mS	C257, C251, C255, C252, C256, C253	R252 - R257
2 mS	C257, C251, C255, C252, C256, C253	R253 - R257
1 mS	C257, C251, C255, C252, C256, C253	R254 - R257
.5 mS	C257, C251, C255, C252, C256, C253	R255 - R257
.2 mS	C257, C251, C255, C252, C256, C253	R256 - R257
.1 mS	C257, C251, C255, C252, C256, C253	R257
50 μ S	C251, C255, C252, C256, C253	R255 - R257
20 μ S	C251, C255, C252, C256, C253	R256 - R257
10 μ S	C255, C252, C256, C253	R257
5 μ S	C255, C252, C256, C253	R255 - R257
2 μ S	C255, C252, C256, C253	R256 - R257
1 μ S	C256, C253	R257
.5 μ S	C256, C253	R257 - R258
.2 μ S	C253	R257 - R258
.1 μ S	—	R257 - R258

'B' TIME/DIV. SWITCH CONNEXIONS

①



②



③

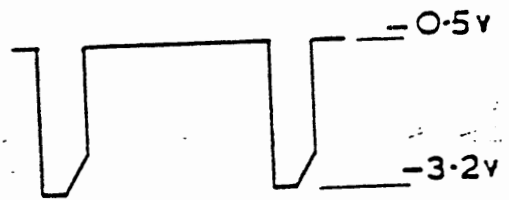
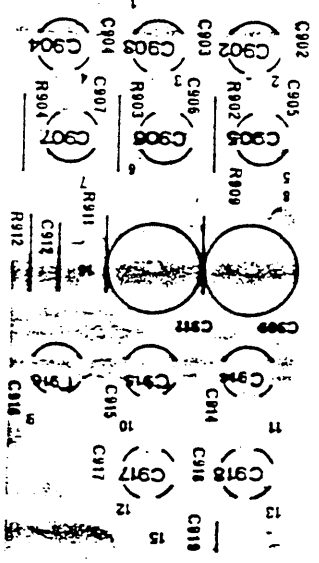
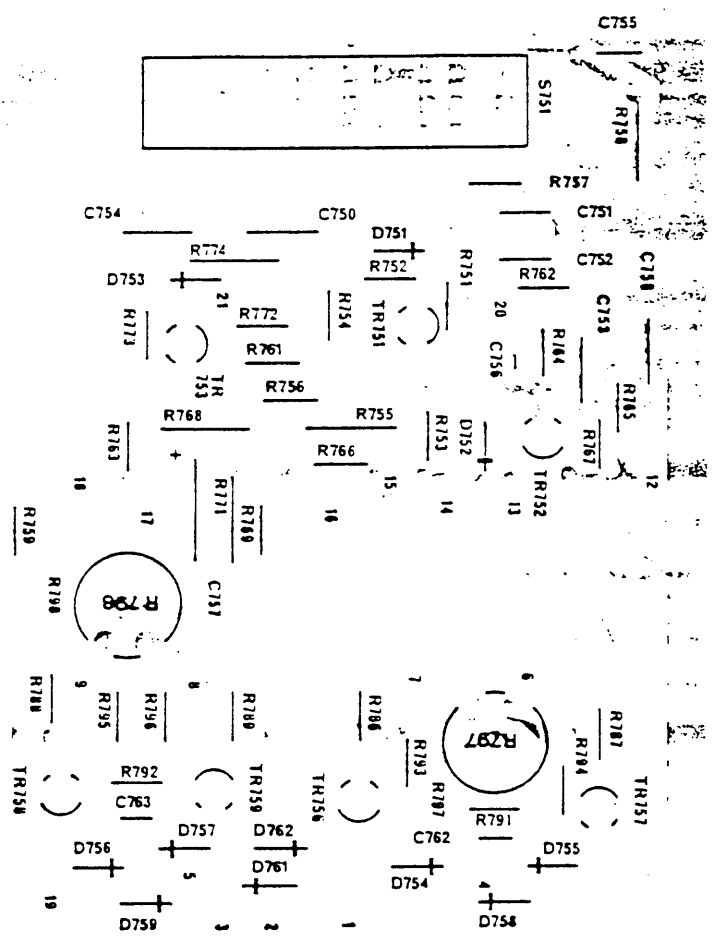
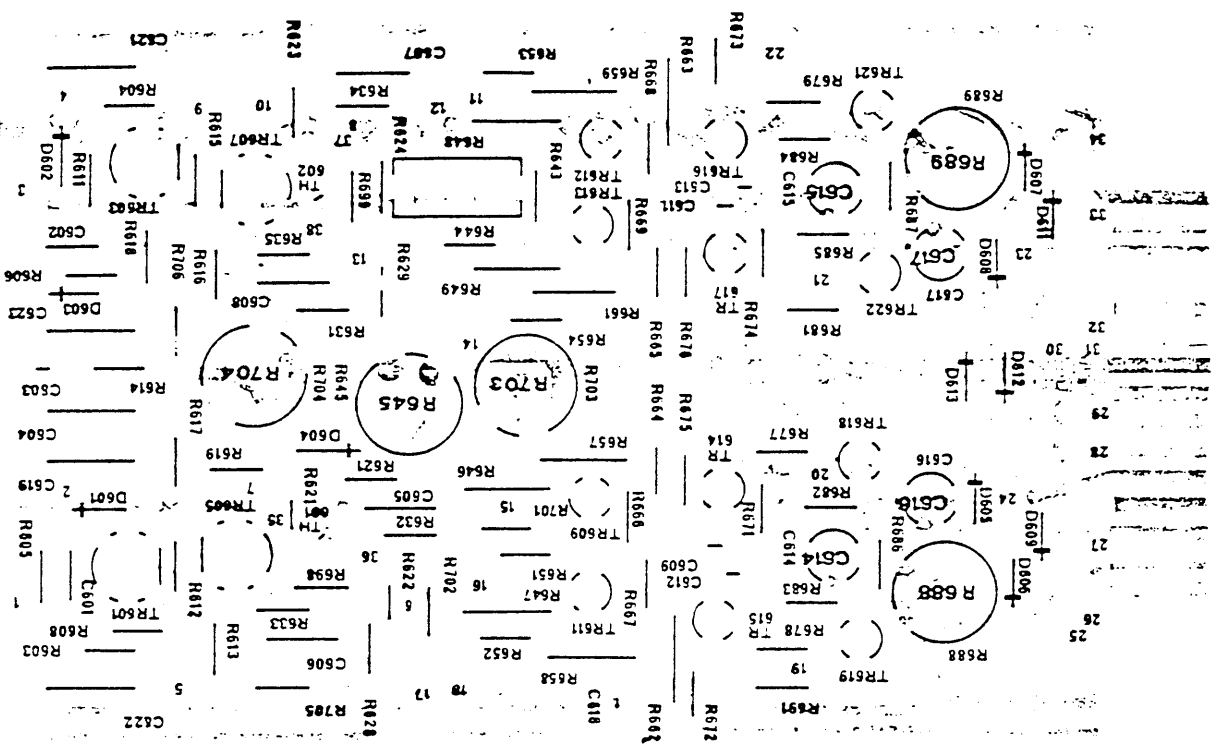
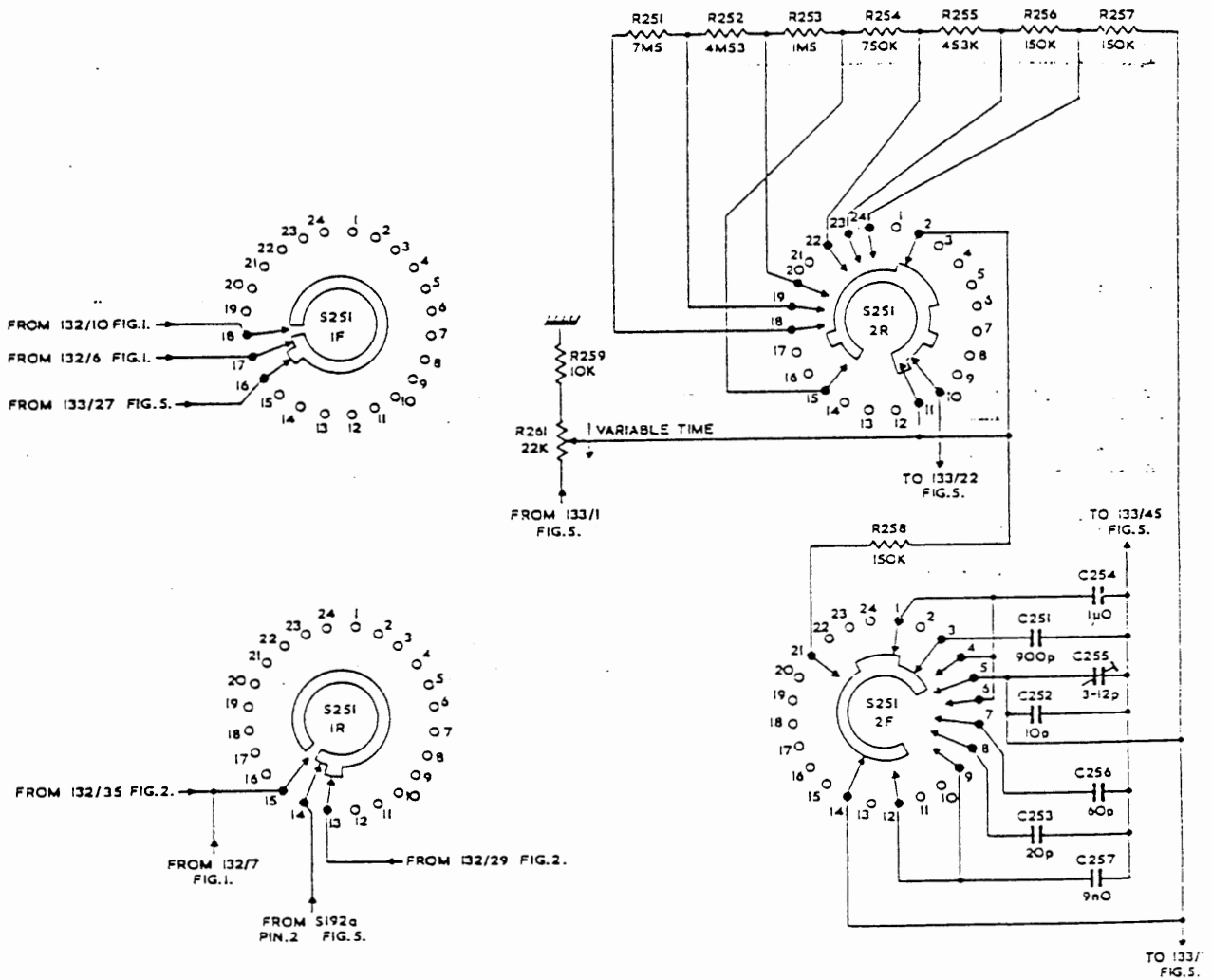


PLATE 6/1

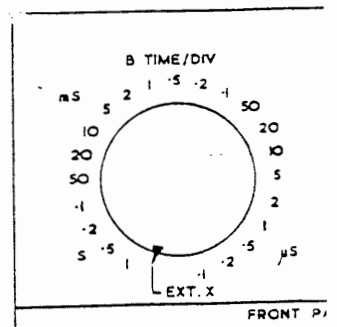
A B C D E F G H



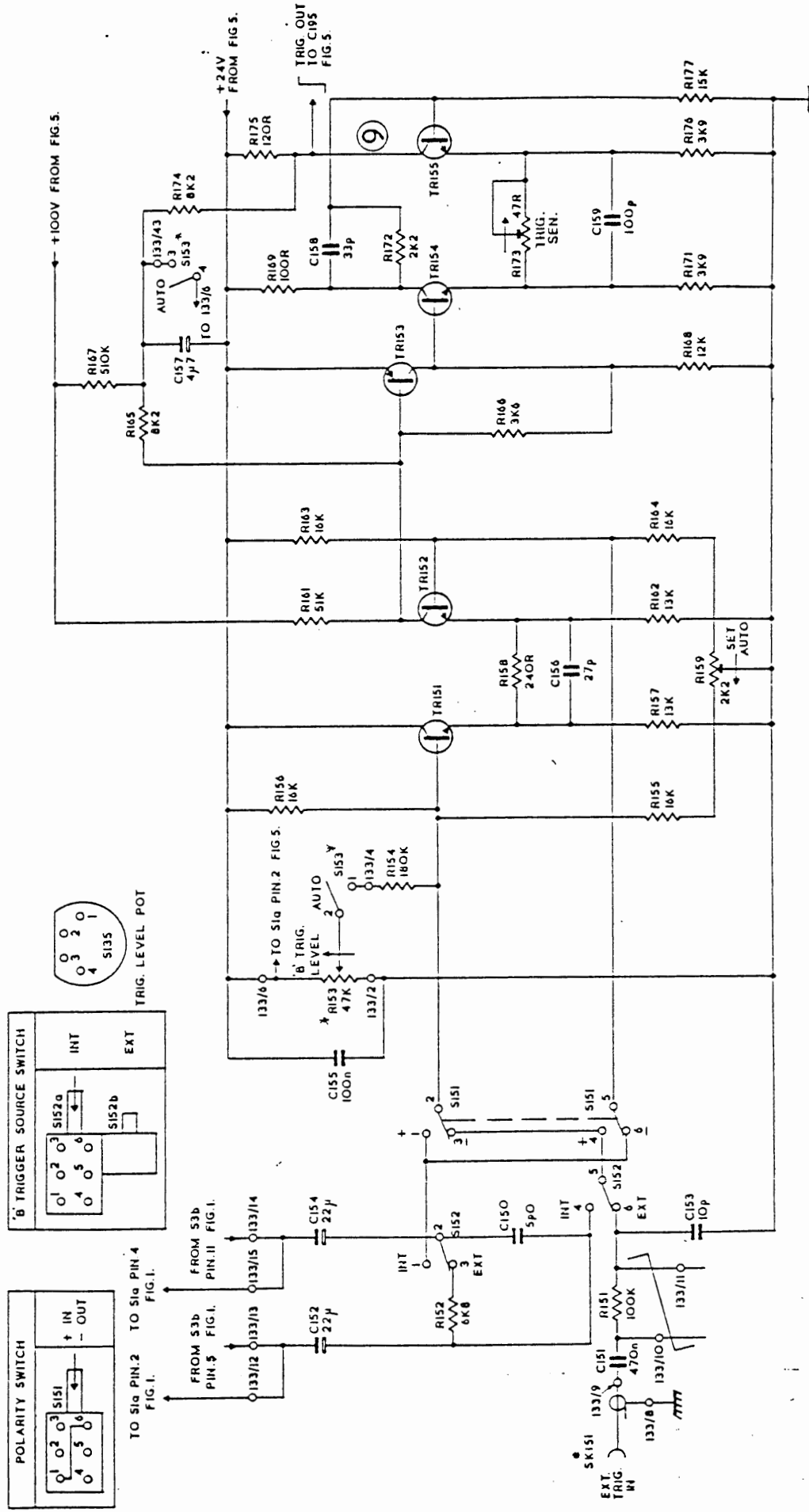
RESISTORS	259 261	251	252	253	254 258	255	256	257
CAPACITORS							251 252 253	254 255 256 257
MISC.		S251						



B TIME/DIV. SWITCH S2A
FIG. 3.



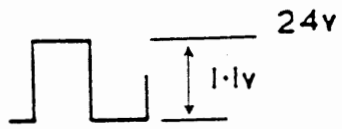
RESISTORS	151	152	153	154	155	156	157	158	159	160	161	163	164	165	166	167	169	170	171	172	173	174	175	176	177
CAPACITORS	151	152	153	154	155	156	157	158	159	160	161	163	164	165	166	167	169	170	171	172	173	174	175	176	177
MISC.	SK151																								



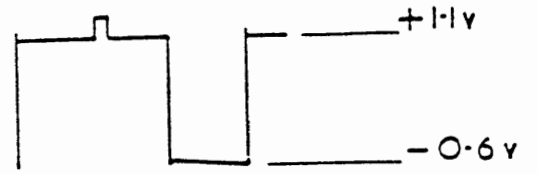
NOTES.
 1. * DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD.
 2. 133/10 DENOTES P.C. BOARD/EYELET OR TERMINAL No.

DUAL TRACE TYPE S2A 'B' TRIGGER AMPLIFIER PC.133

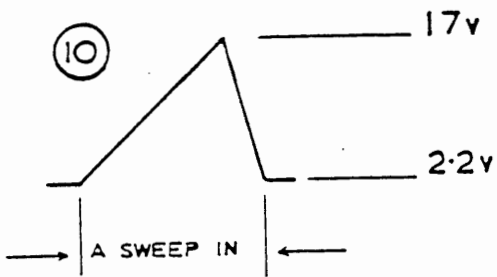
9



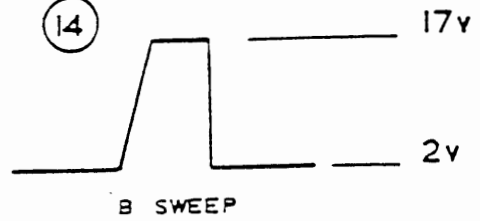
13



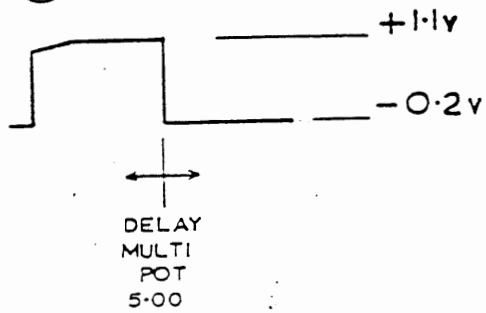
10



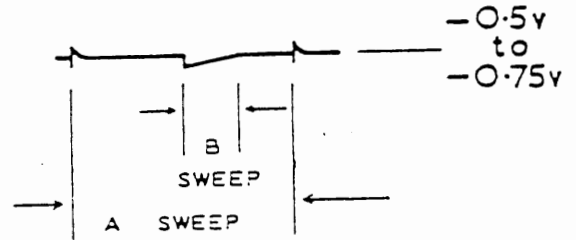
14



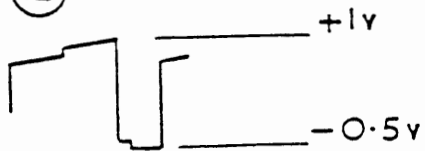
11

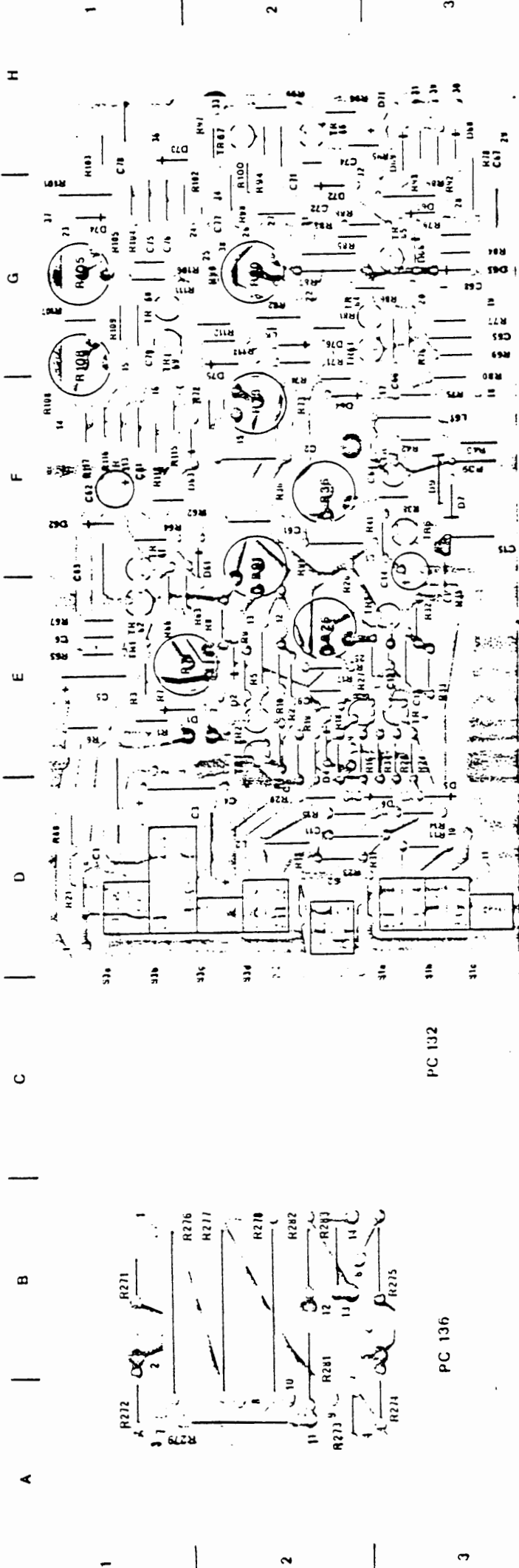


15

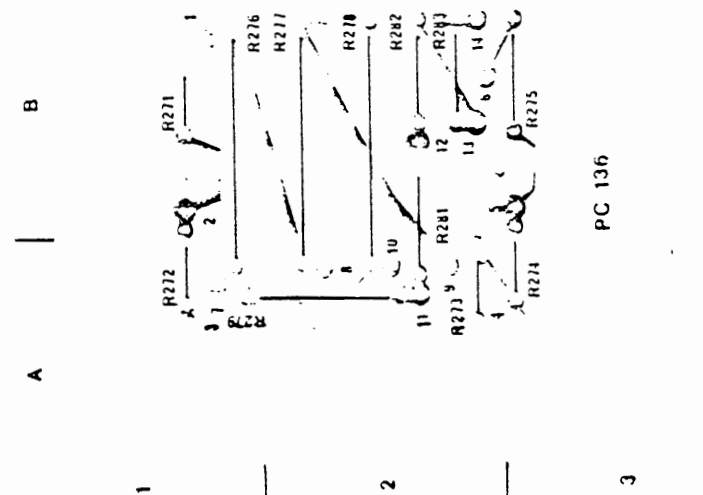


12

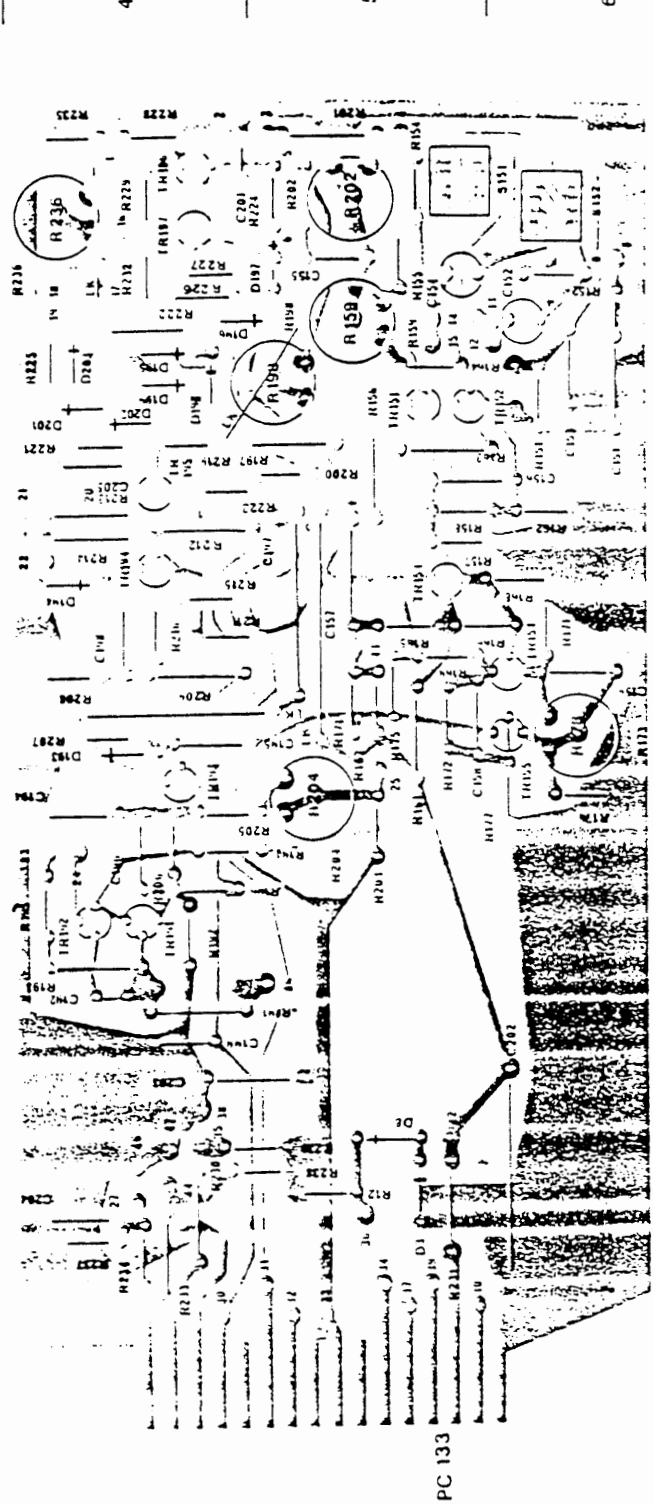




PC 132

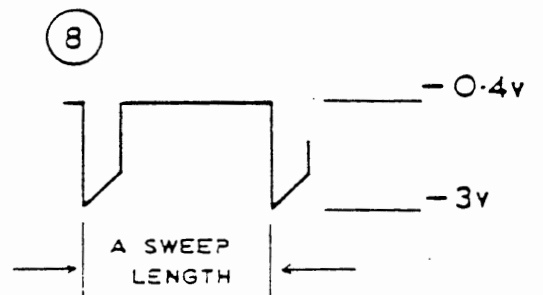
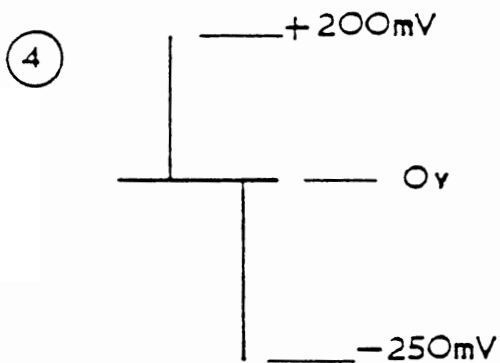
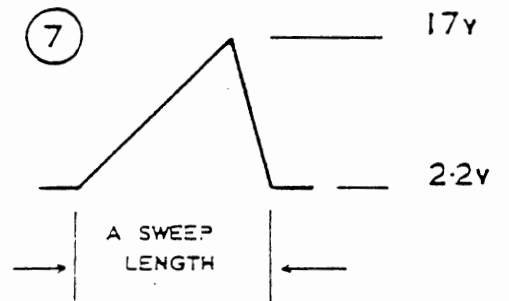
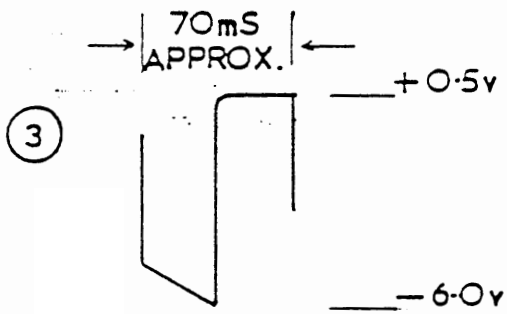
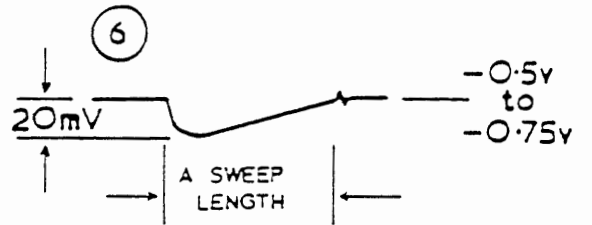
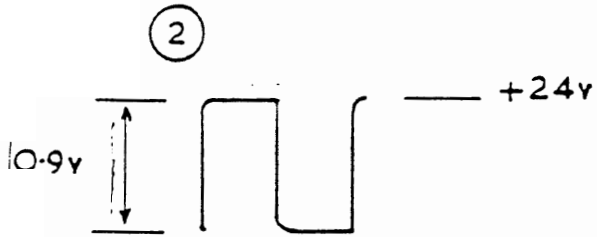
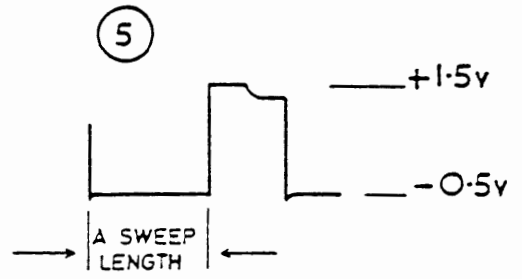
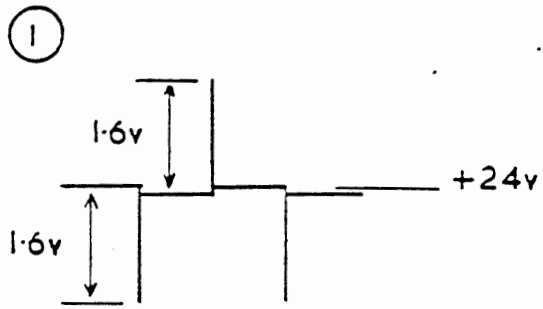


PC 136

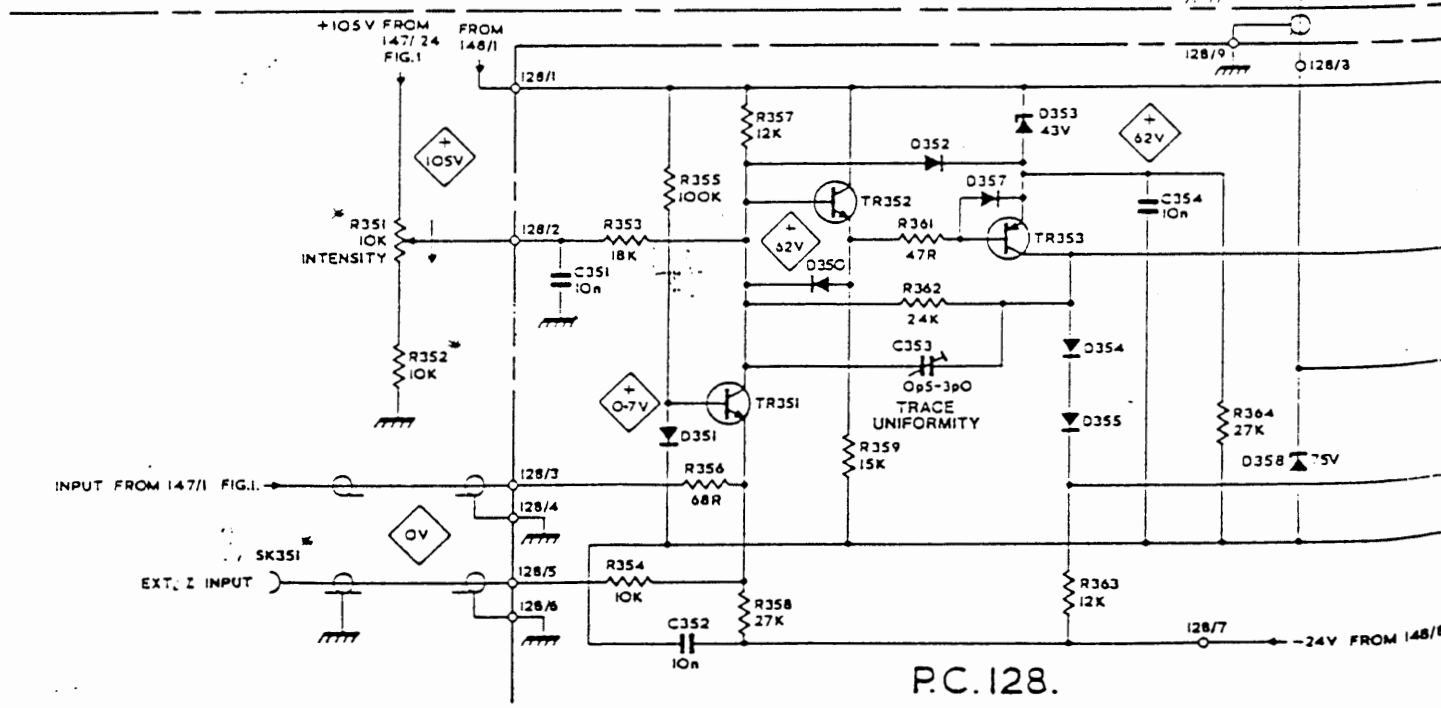
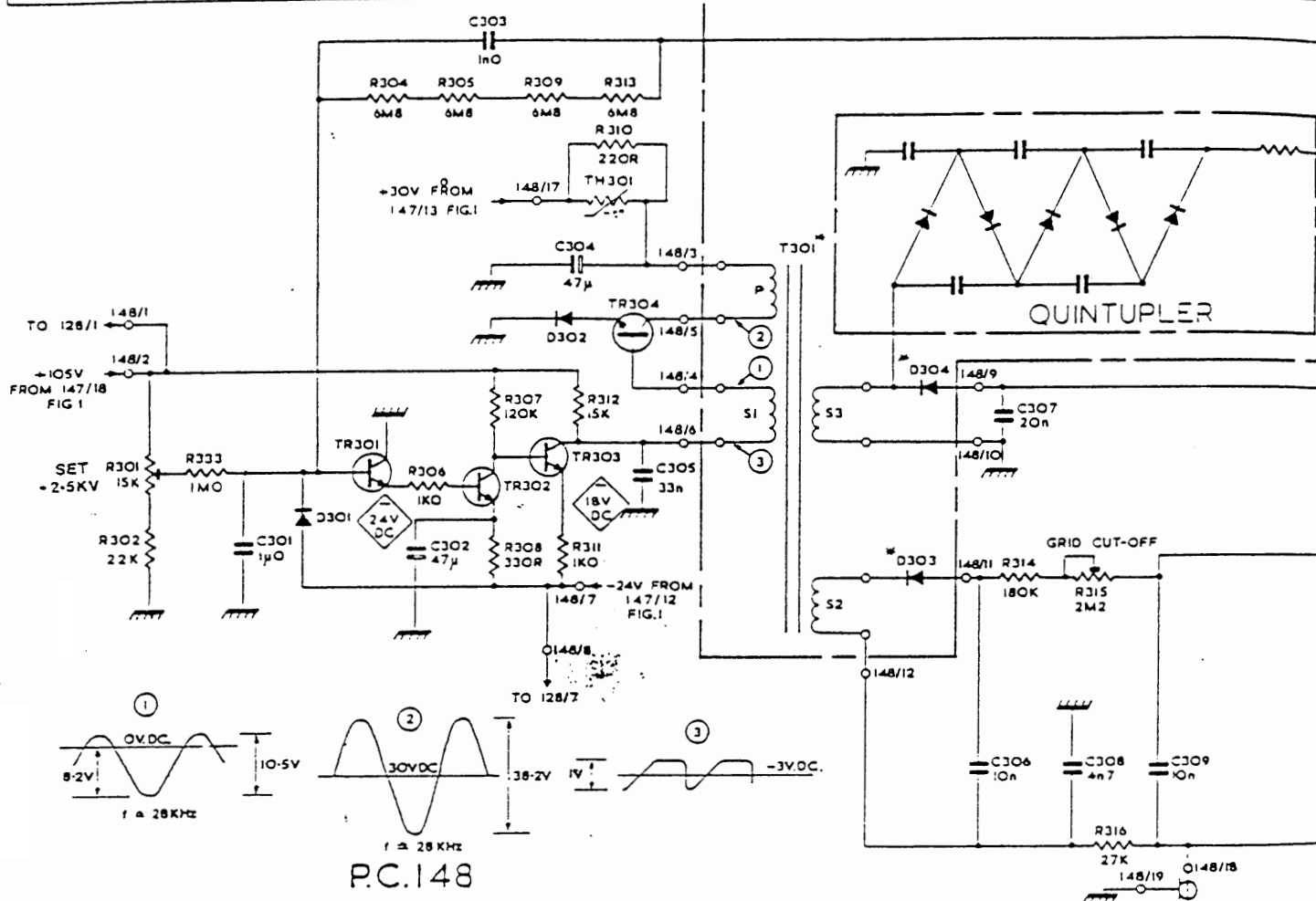


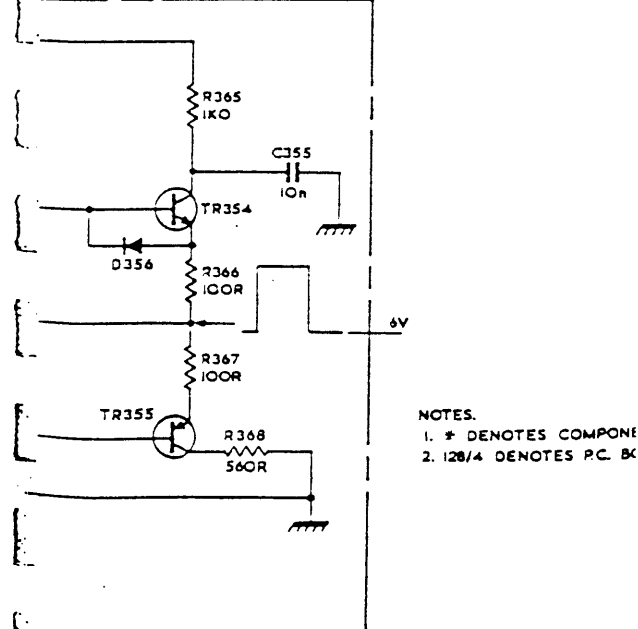
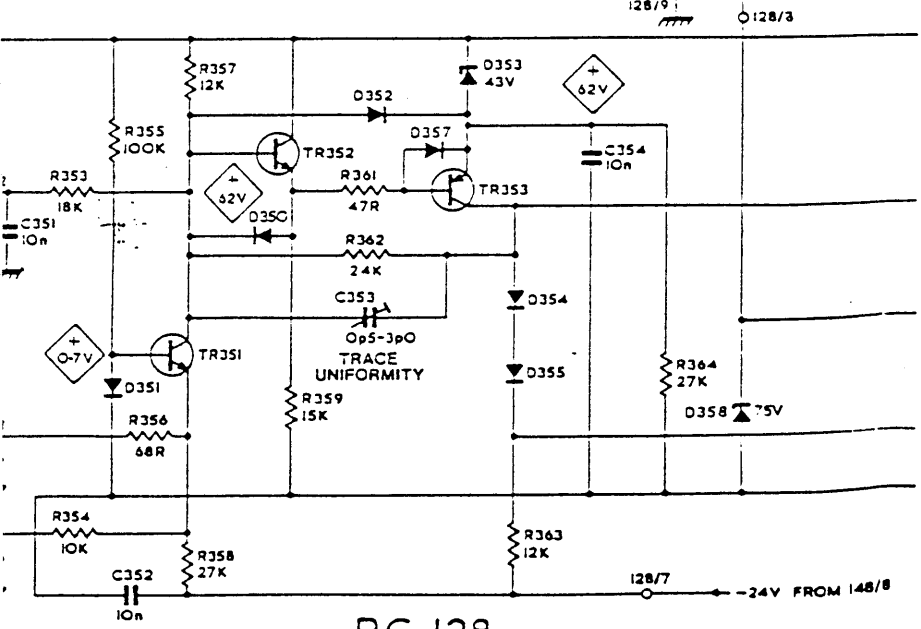
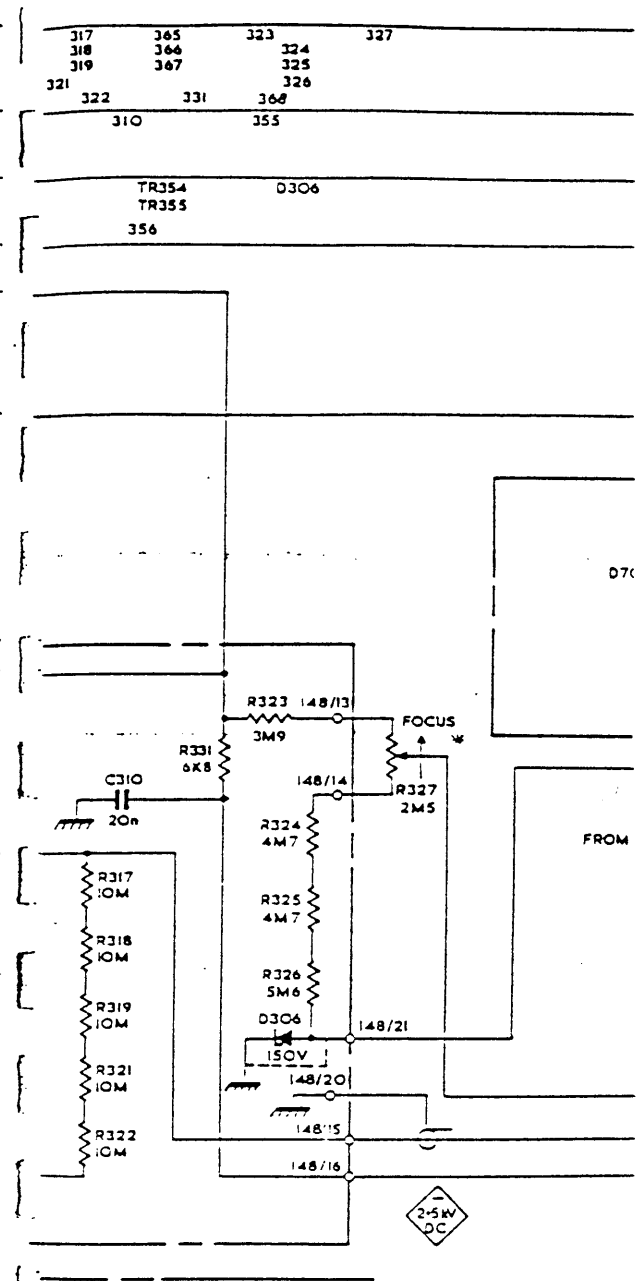
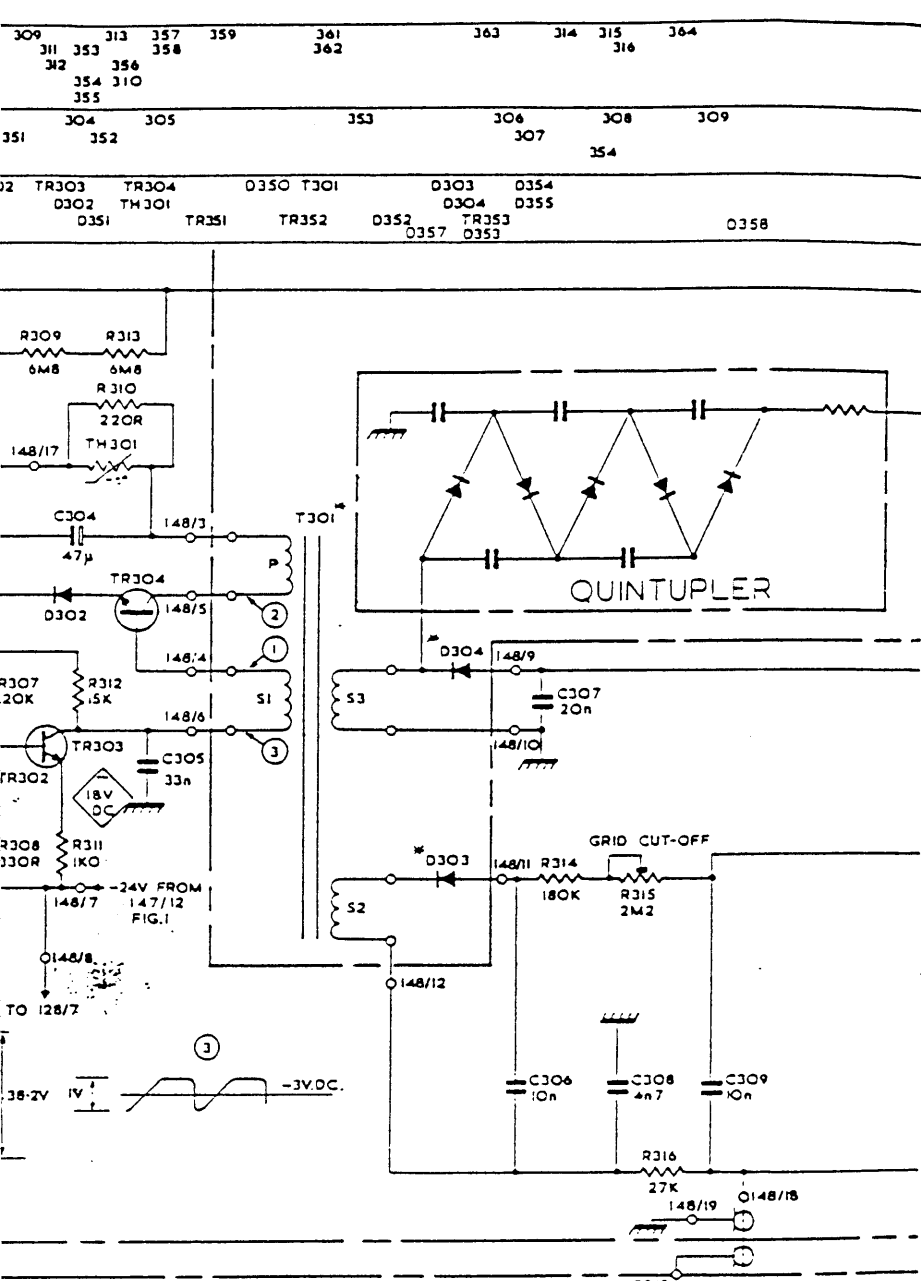
PC 133

Figure 6
COMPONENT
REFERENCE



RESISTORS	301 302	304 351	305 306	307 308	309 311 312	353 354 356 355	313 357 358	359	361 362	363	314	315 316	364
CAPACITORS	301	302	303	351	304 352	305	353	306 307	308 309				
MISC.	SK351	D301	TR301	TR302	TR303 D302 D351	TR304 TH301	D350 TR351 TR352	T301	D303 D304 D355	D354 D353			D358

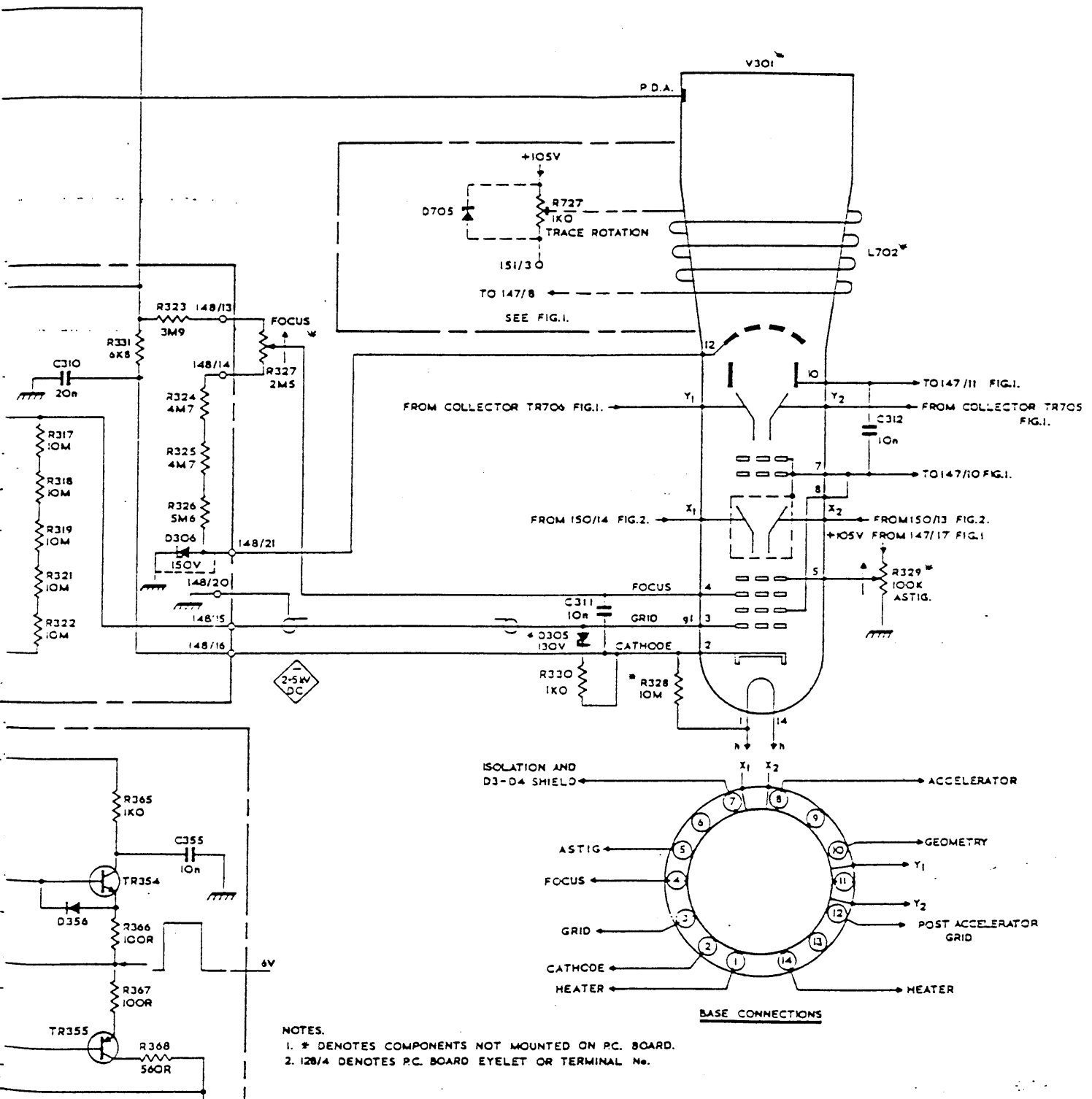




NOTES.
 1. * DENOTES COMPONE
 2. 128/4 DENOTES P.C. BK

P.C. 128.

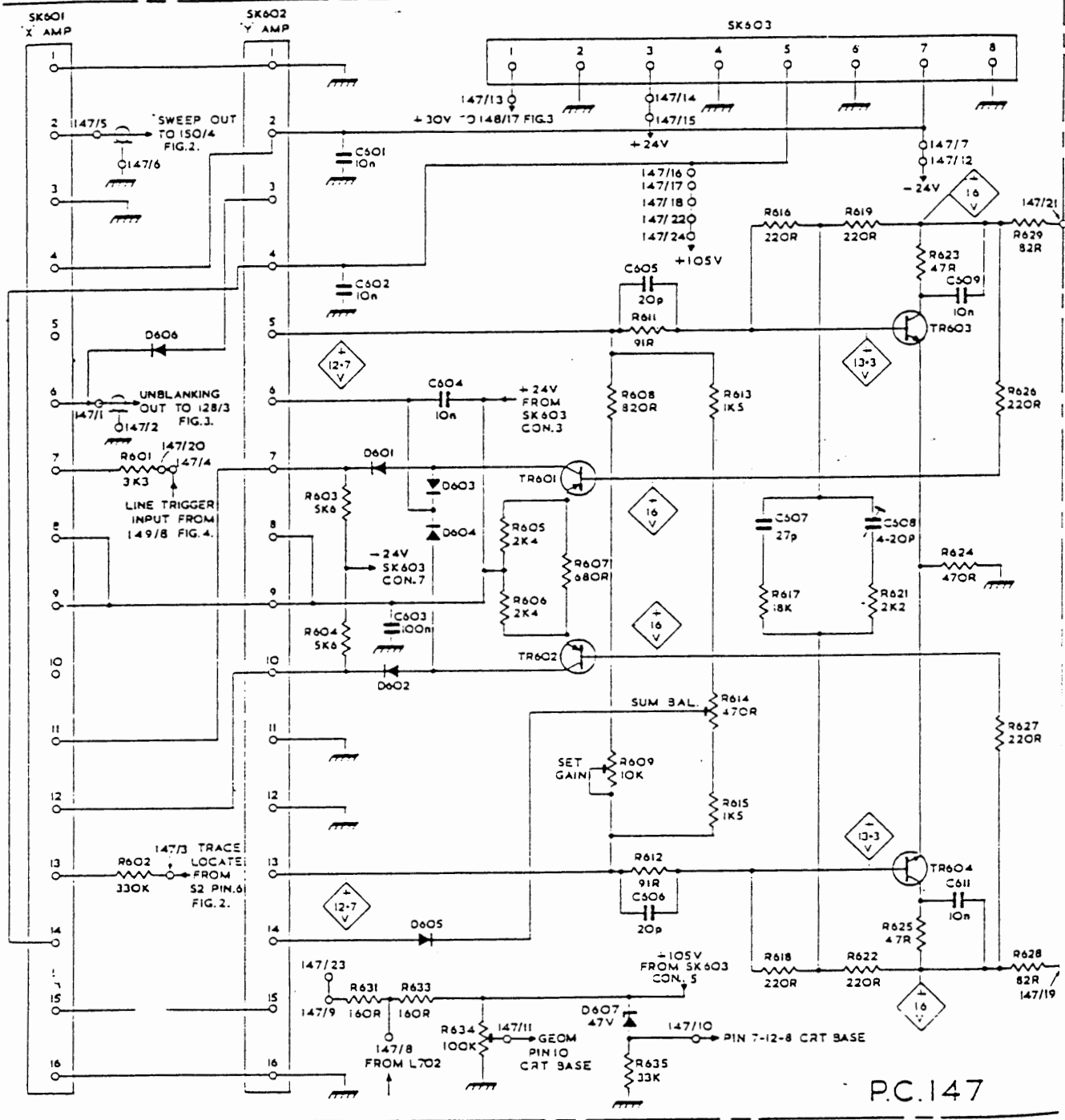
317	365	323	327	330	328	329
318	366	324				
319	367	325				
321		326				
322	331	368				
310	355			311		312
TR354	D306			D305		V301
TR355						
356						



NOTES.
 1. * DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD.
 2. 128/4 DENOTES P.C. BOARD EYELET OR TERMINAL No.

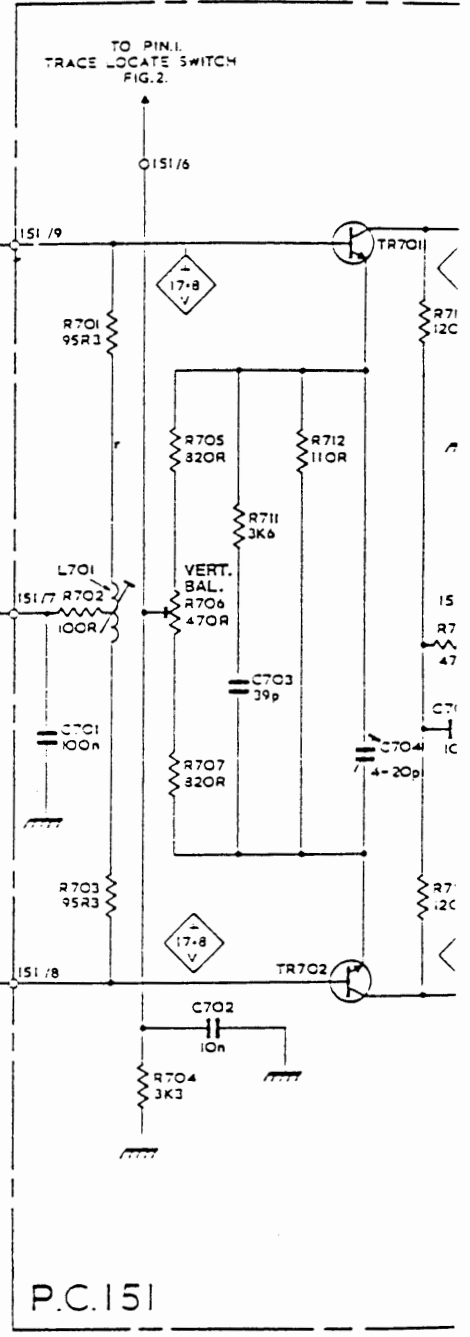
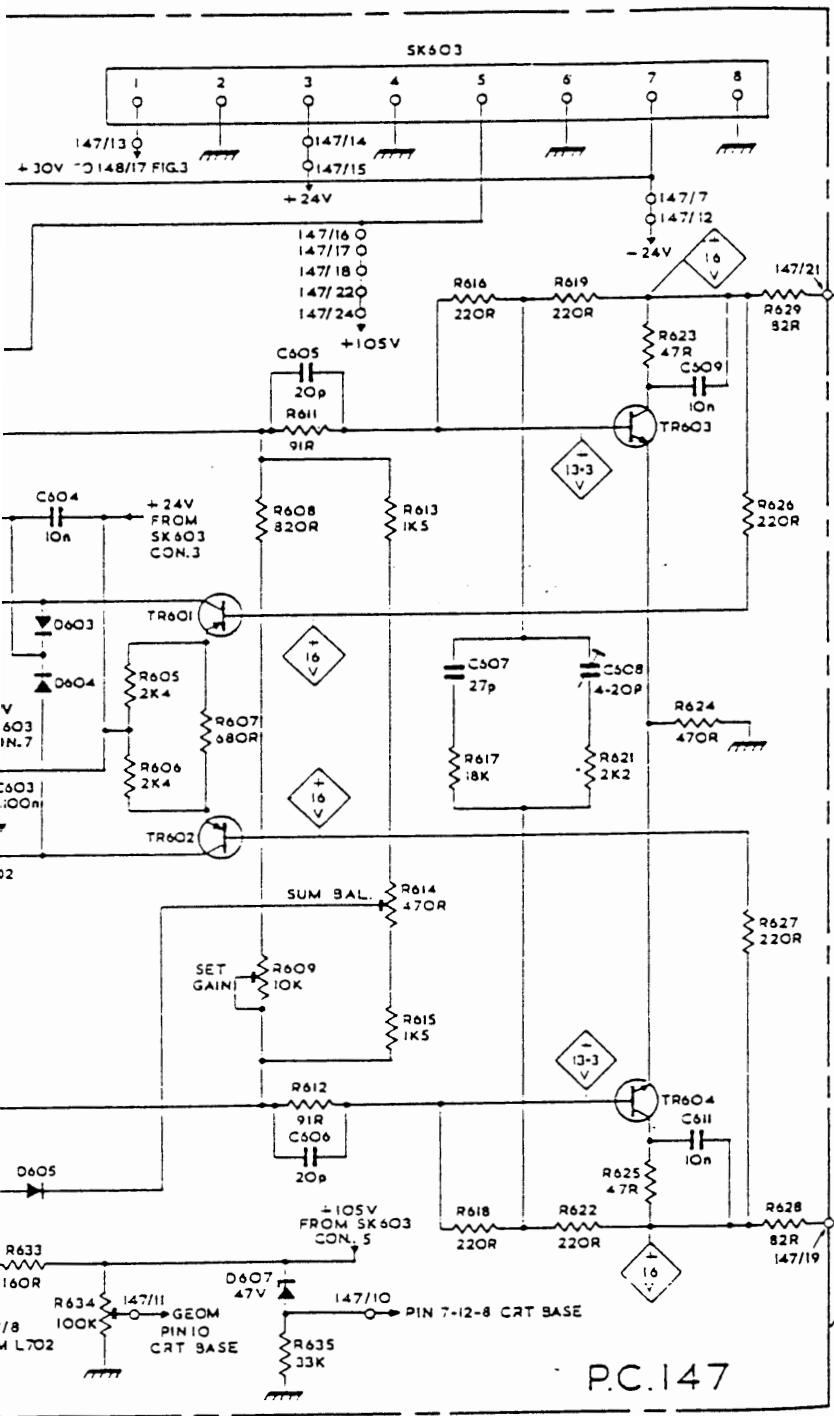
QUINTUPLER, E.H.T.-P.C.148,
 BRIGHT-UP-P.C.128, & C.R.T. - D75
 FIG. 3.

RESISTORS	601 602	603	604	605 606	607	608 609	611 612	613 614 615	616 617 618	619 621 622	623 624 625	626 627	629 628
CAPACITORS		631 602	603	604		635	605 606		607	608		609 611	
MISC.			D601 D602	D603 D604 D605		TR601 TR602						TR603 TR604	
	SK601		D606	SK602			D607		SK603				



NOTES.
 1 * DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD.
 2. 124/2 DENOTES 'C. BOARD/EYELET OR TERMINAL No.

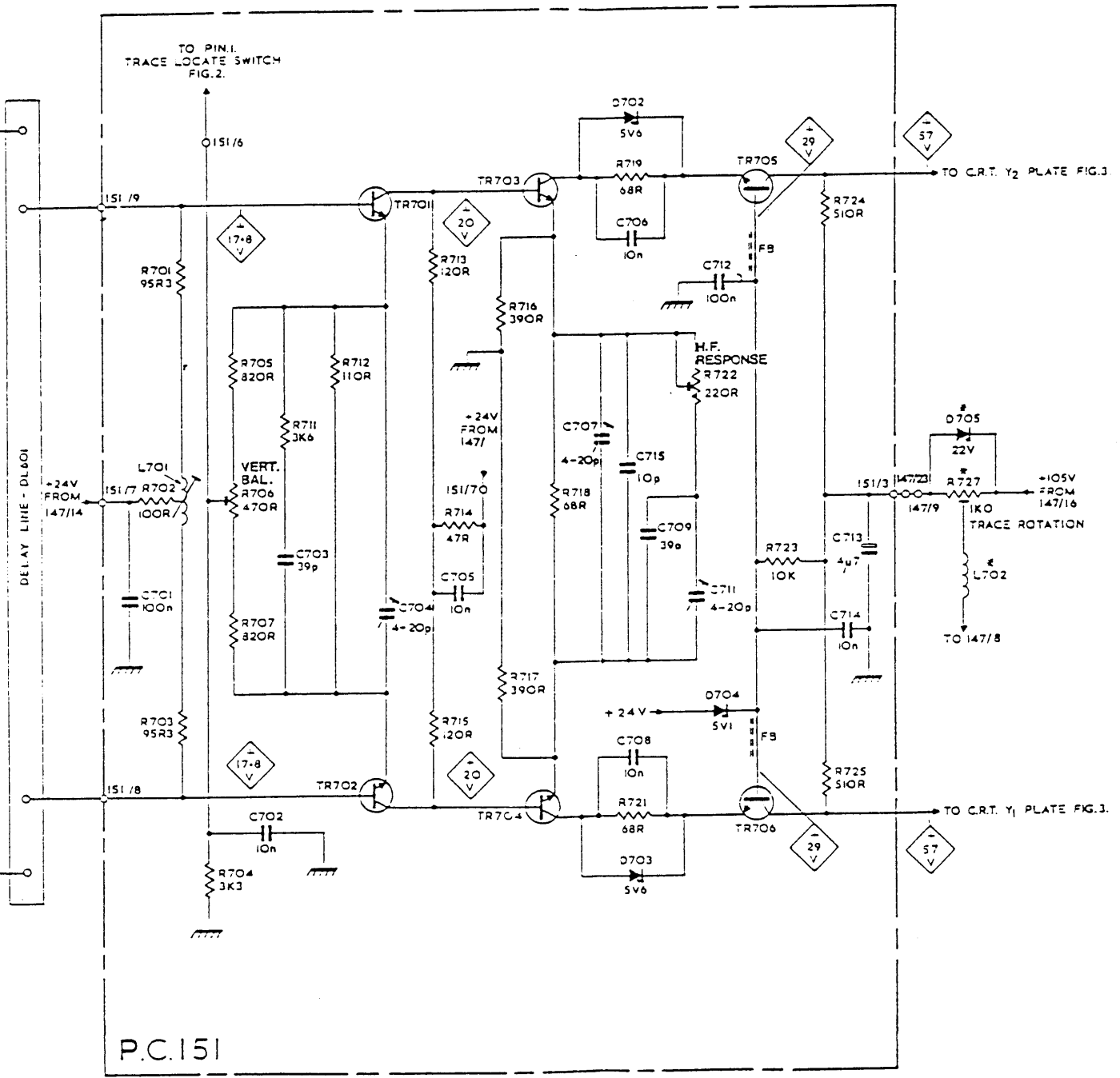
04	605	608	611	613	616	619	623	626	629	701	704	711	712	713
	606	607	612	614	617	621	624	627	628	702	705	712		715
			609	615	618	622	625			703	706	707		
633	634	635								701		702	703	704
	604	605	606	607	608	609	611							70
D603	TR601	TR602		SK 603		TR603	TR604			DL601	L701			TR701
D604														TR702
D605	D607													



UNTED ON P.C. BOARD.
OR TERMINAL No.

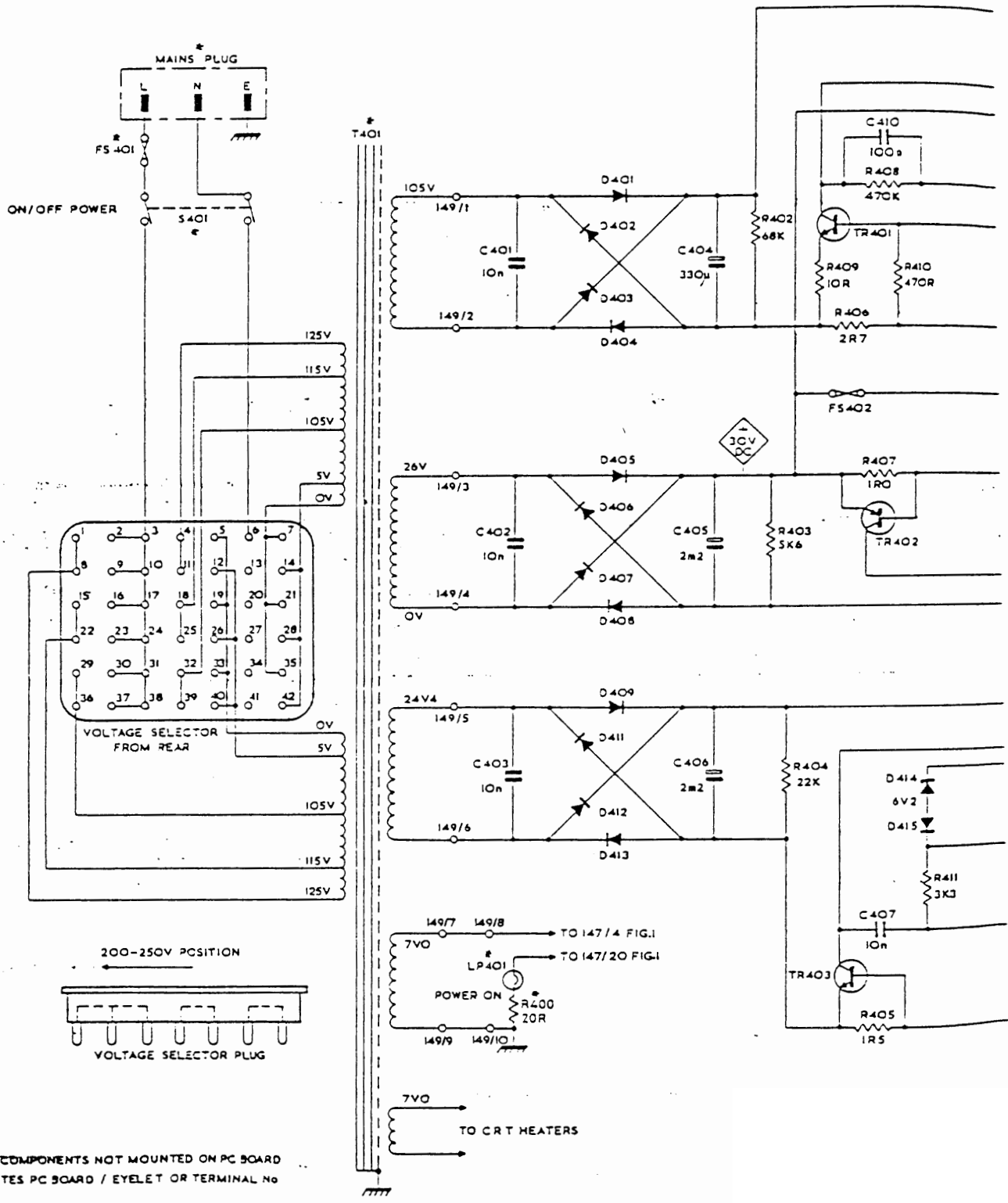
MAIN 'Y' AMPLI

	701 702 703	704 705 706 707	711	712	713 714 715	709 716 717	718	719 721	722	723	724 725	727
	701	702 703	704	705				706 707 708 709	711 712		713 714	
DL601	L701		TR701 TR702		TR703 TR704			0702 0703		TR705 TR706		L702 0705



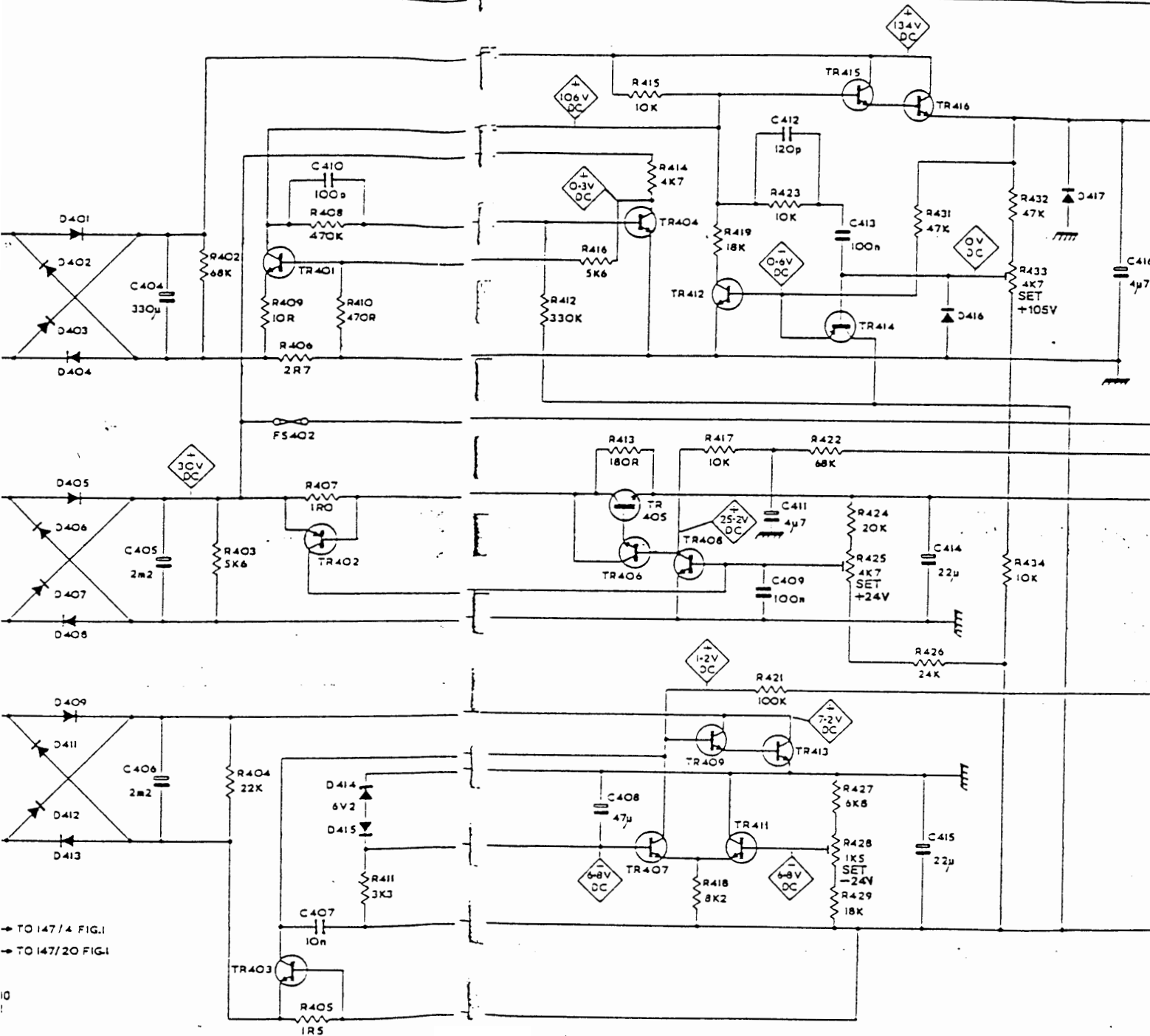
MAIN 'Y' AMPLIFIER D75 FIG.1

RESISTORS								402	408
								403	409
								404	407
									410
									405
									411
CAPACITORS								401	404
								402	405
								403	406
									410
									407
MISC.									
	FS 401	S 401		T 401		D 401	D 405	D 409	TR 401
						D 402	D 406	D 411	FS 402
						D 403	D 407	D 412	TR 402
						LP 401	D 404	D 413	TR 403
									D 414
									D 415



NOTES
 1. * DENOTES COMPONENTS NOT MOUNTED ON PC BOARD
 2. 149/2 DENOTES PC BOARD / EYELET OR TERMINAL No

402	408	412	416	415	419	423	424	425	431	432
403	409	414	417	418	417	421	422	428	426	433
404	407	413	413	418	418	429	429	429	429	434
404	410									
405	410									
406	407									
D401	D405	D409	TR401	TR404	TR412	TR415	TR415	TR414	D416	D417
D402	D406	D411	FS402	TR405	TR408	TR414	TR414			
D403	D407	D412	TR402	TR406	TR409					
D404	D408	D413	TR403	TR407		TR411	TR413			



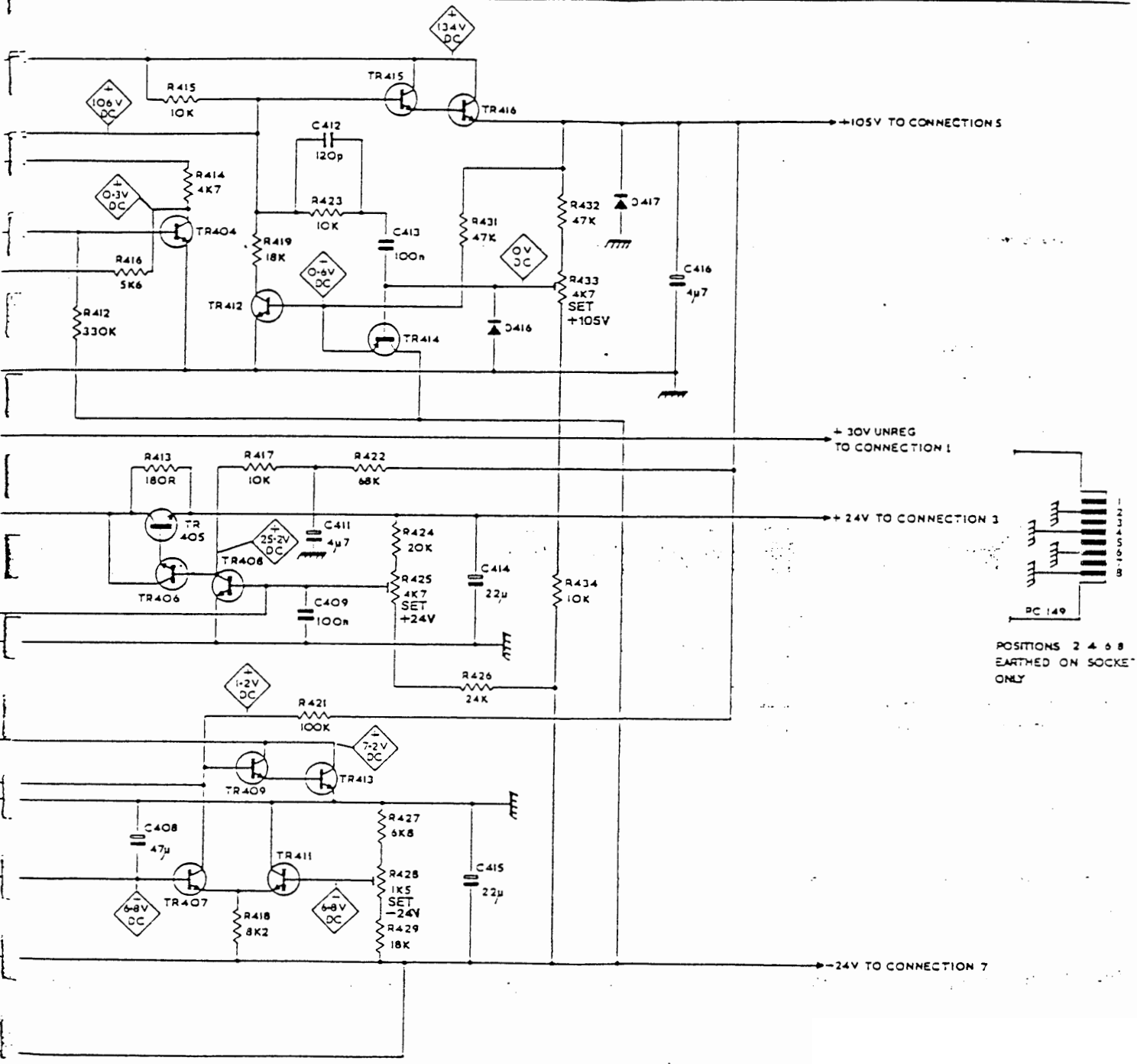
→ TO 147/4 FIG.1
 → TO 147/20 FIG.1

TERS

412	416	415	419	423	424	431	432
	414		417	421	425	426	433
	413		418	422	427		434
				428	429		

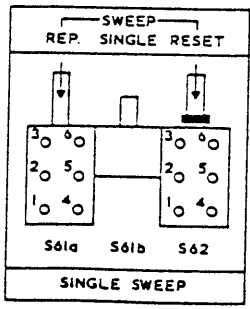
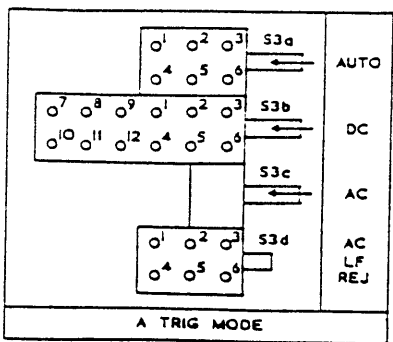
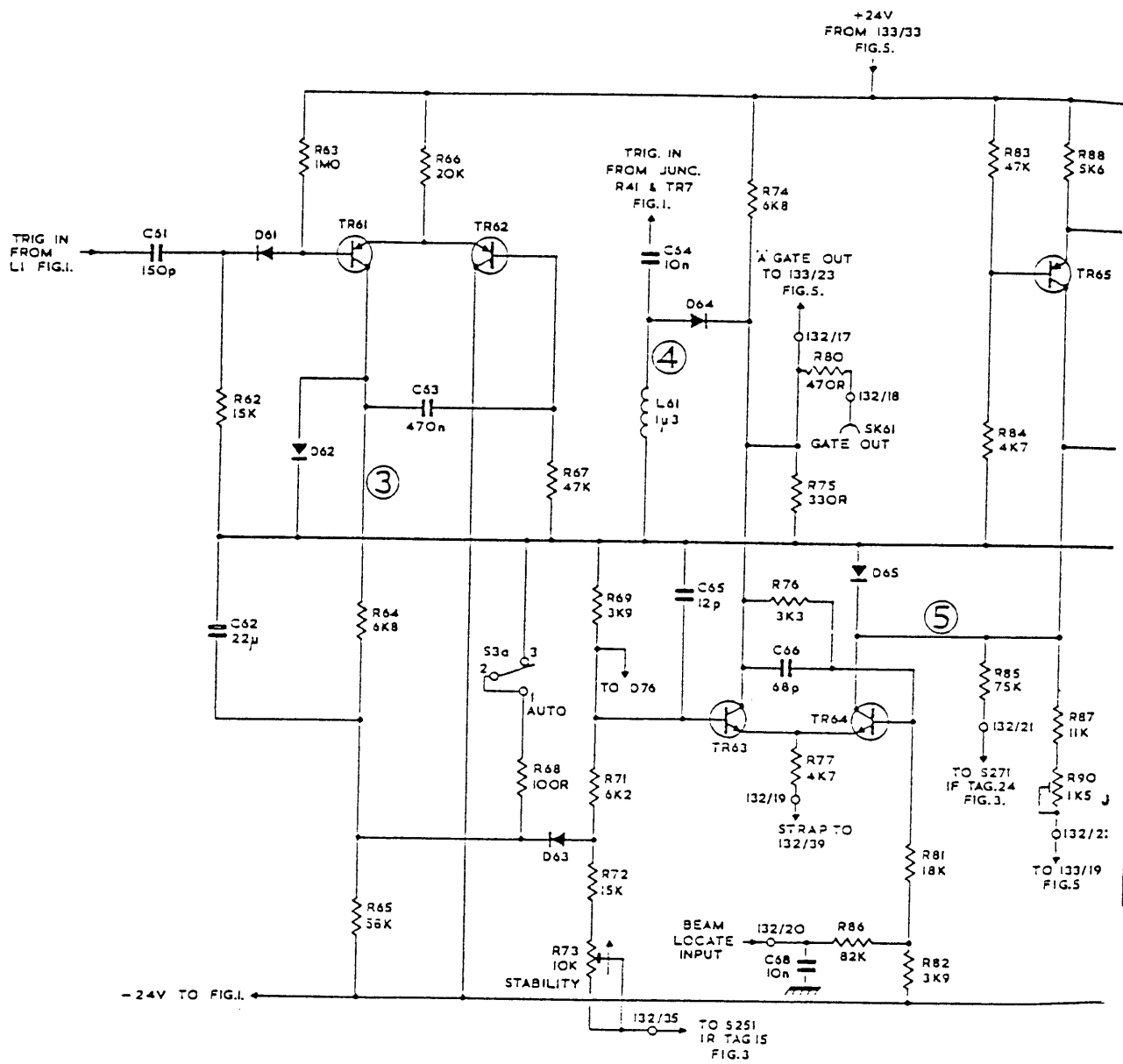
408	412	413	414	416
	411		415	
	409			

TR404	TR412	TR415	D416	D417
TR405	TR408	TR414		
TR406	TR409			
TR407	TR411 TR413	TR416		

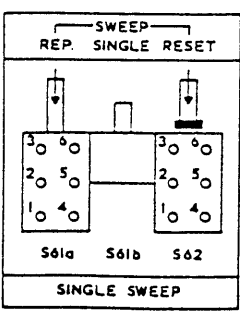
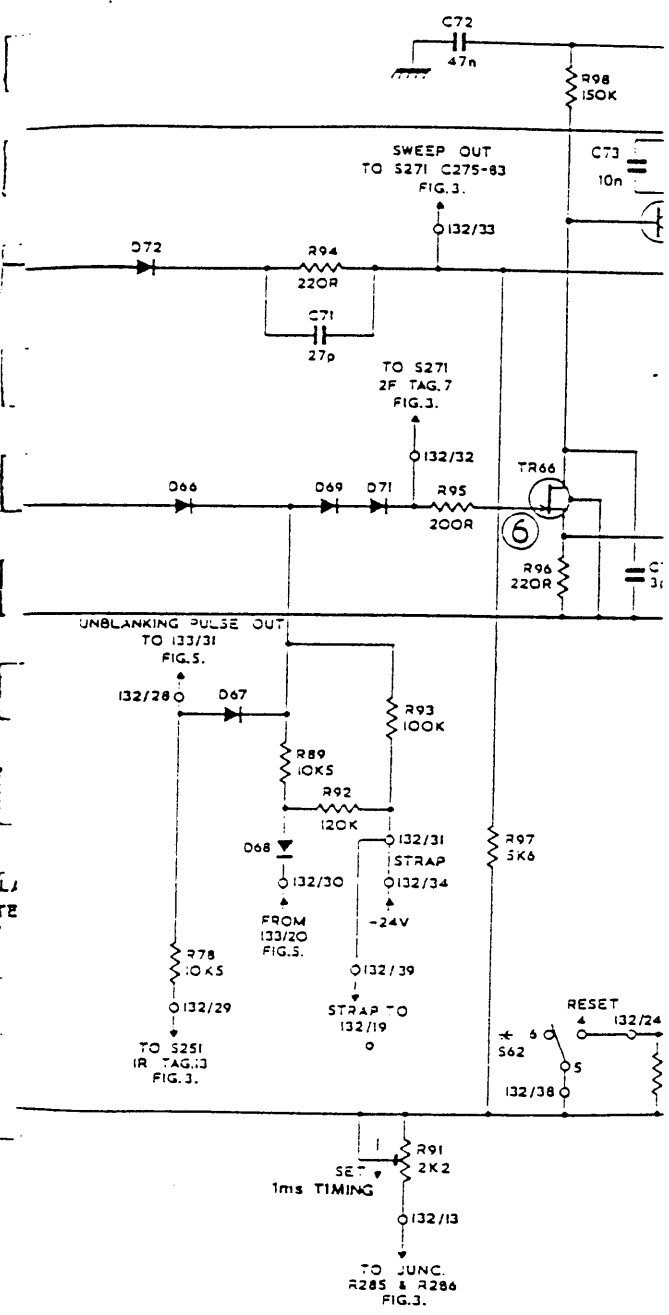
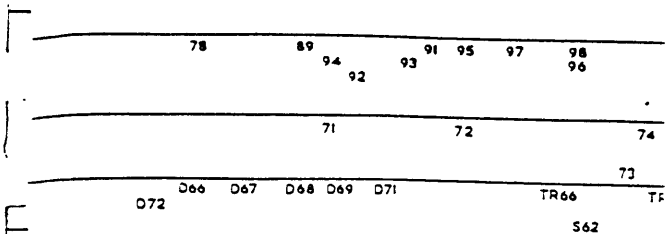
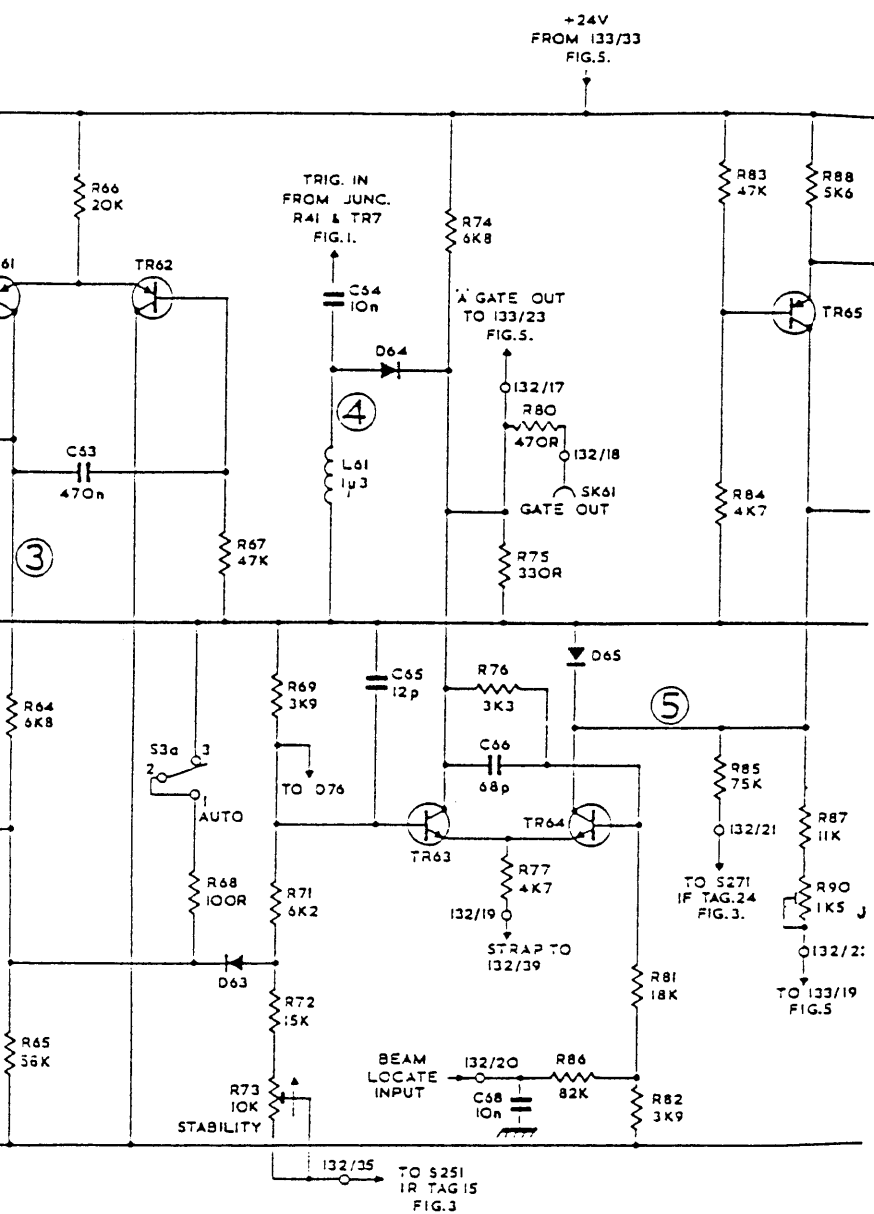
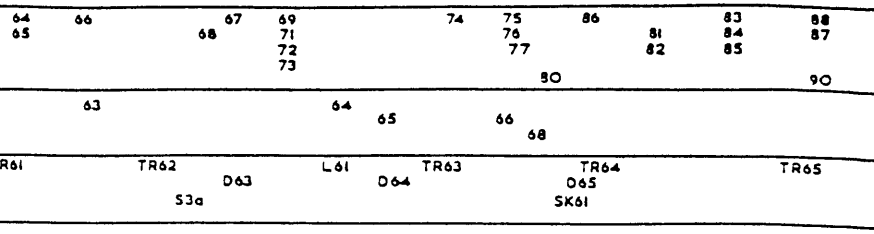


POWER SUPPLY PCI49 D75 FIG. 4

RESISTORS	62	63	64 65	66	67	68	69 71 72 73	74	75 76 77	86	81 82	83 84 85	88 87
CAPACITORS	61	62		63			64	65	66	68			90
MISC.		D61	TR61		TR62	D63	L61	D64	TR63		TR64 D65 SK61		TR65



NOTES.
 1. * DENOTES COMPONENTS
 2. I32/20 DENOTES PC. BOARD



NOTES.

1. * DENOTES COMPONENTS

2. 132/20 DENOTES P.C. BOARD

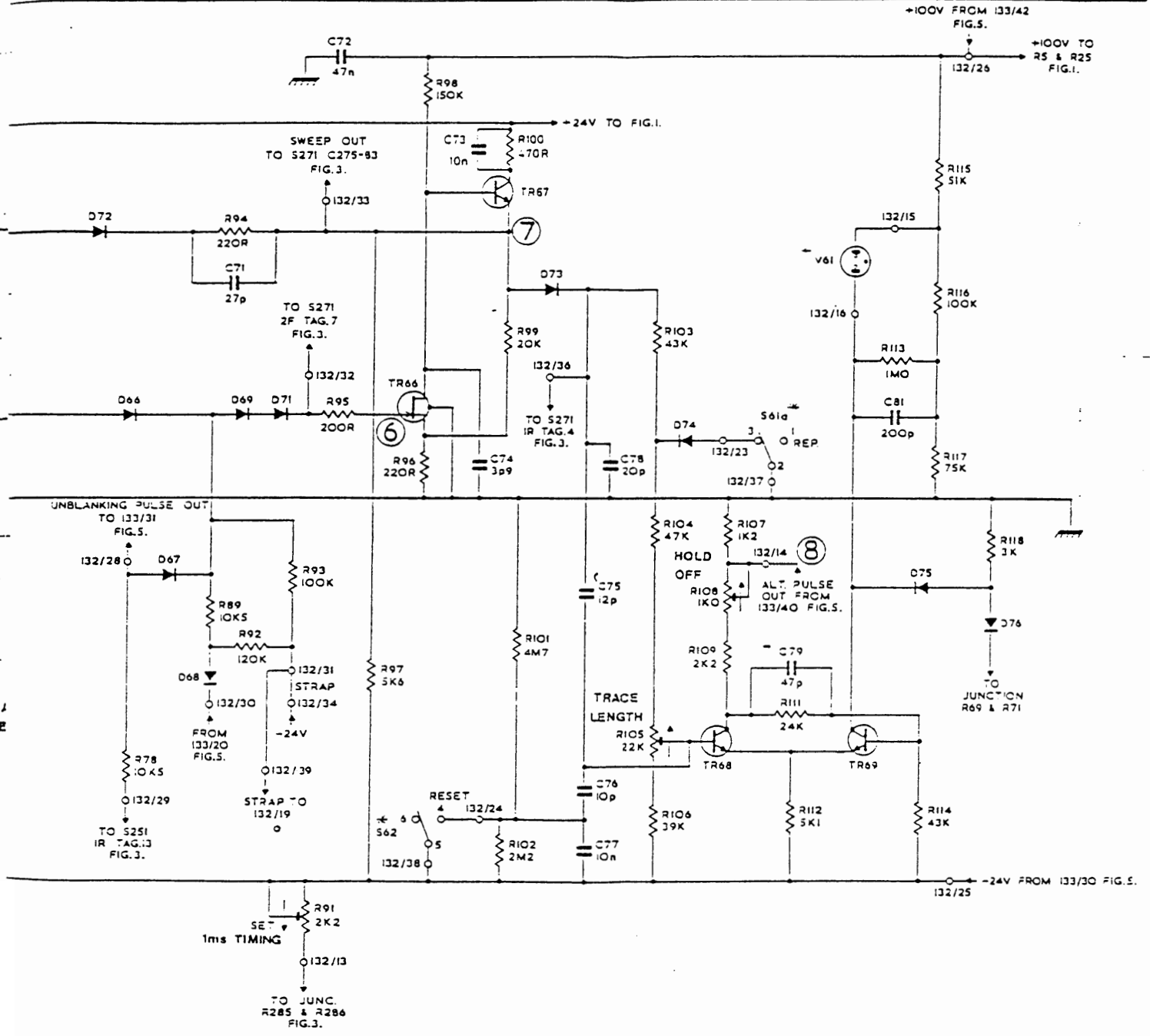
NOT MOUNTED ON P.C. BOARD.

EYELET OR TERMINAL No.

DUAL

A S1

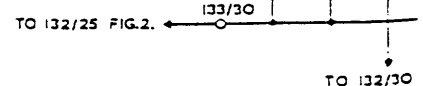
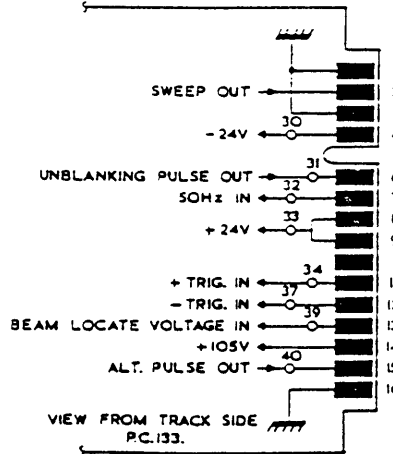
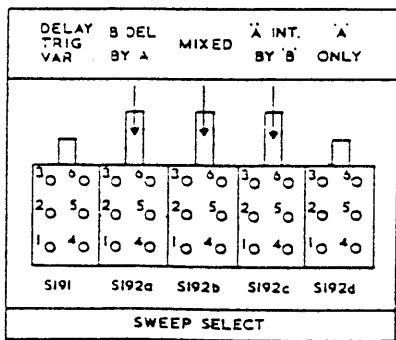
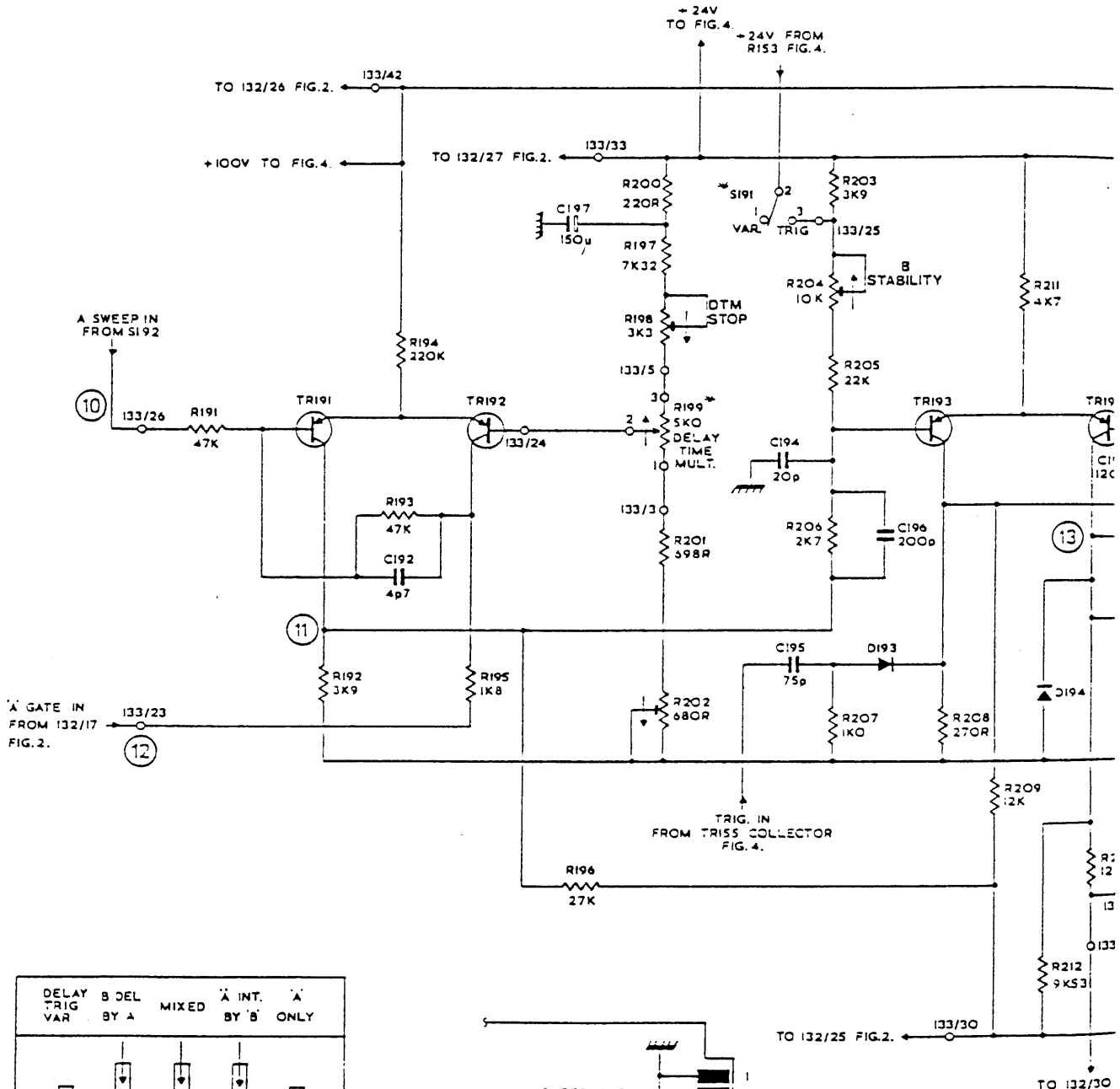
78	89	94	92	93	91	95	97	98	96	99	101	102	100	103	104	105	106	107	108	109	111	112	113	114	115	116	117	118
	71				72					74				75	76	77	78				79		81					
D72	D66	D67	D68	D69	D71			TR66		TR67		D73						TR68			TR69		D75				D76	
								S62						D74				S61a			V61							



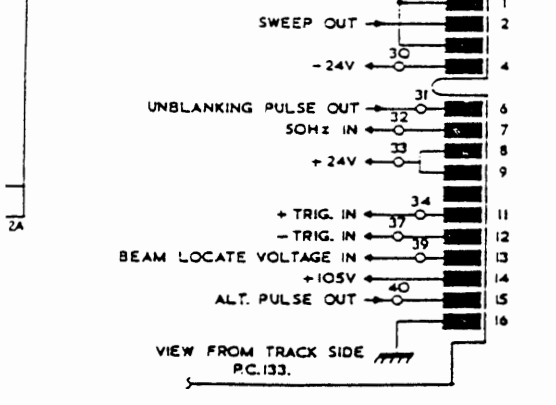
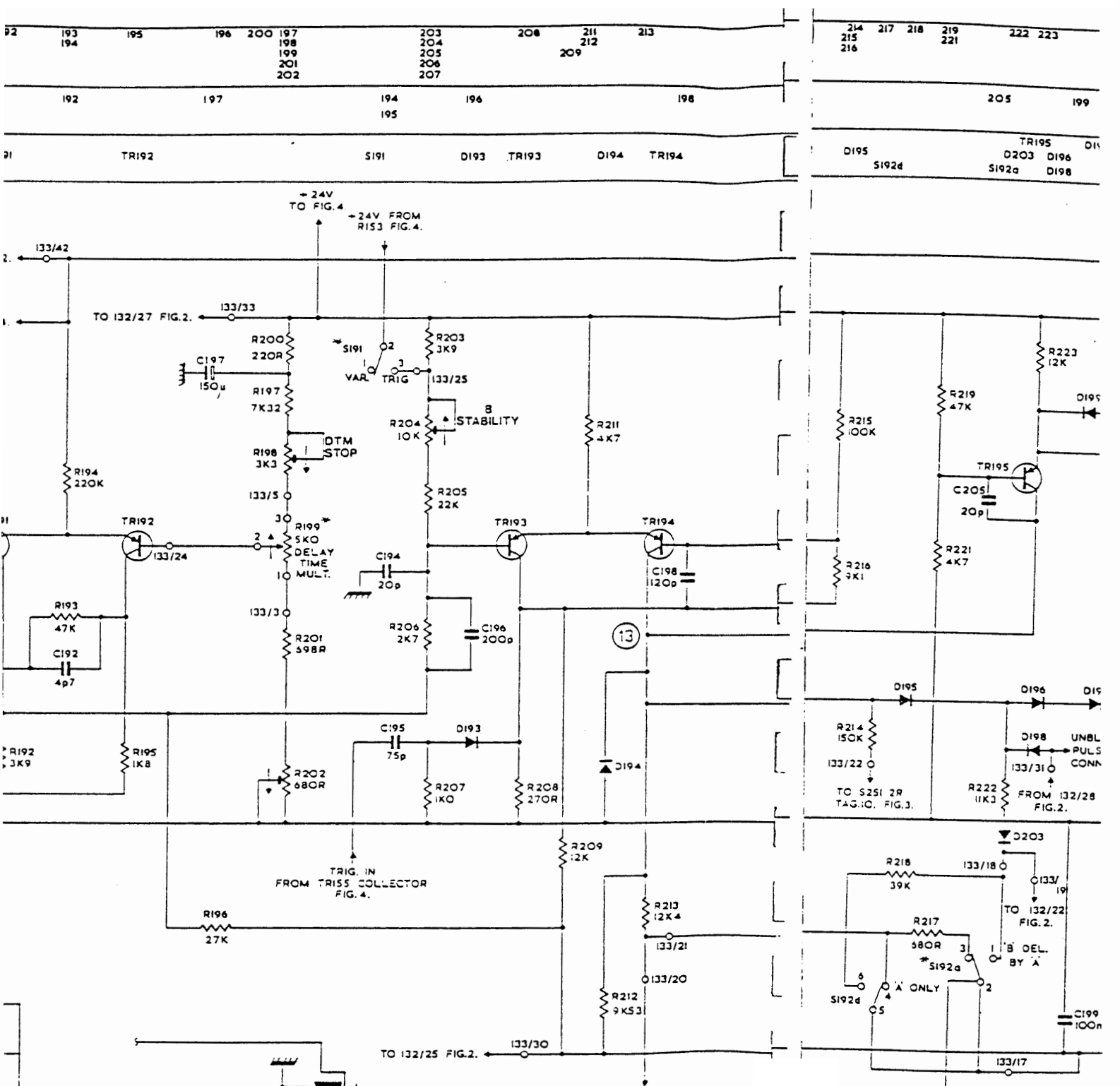
NOT MOUNTED ON P.C. BOARD.
EYELET OR TERMINAL No.

DUAL SWEEP TYPE S2A
A SWEEP GENERATOR P.C.132
FIG. 2.

RESISTORS	191	192	193 194	195	196	200	197 198 199 201 202	203 204 205 206 207	208	211 212 209	213
CAPACITORS		192			197			194 195	196		
MISC.		TRI91		TRI92				SI91	DI93	TRI93	DI94



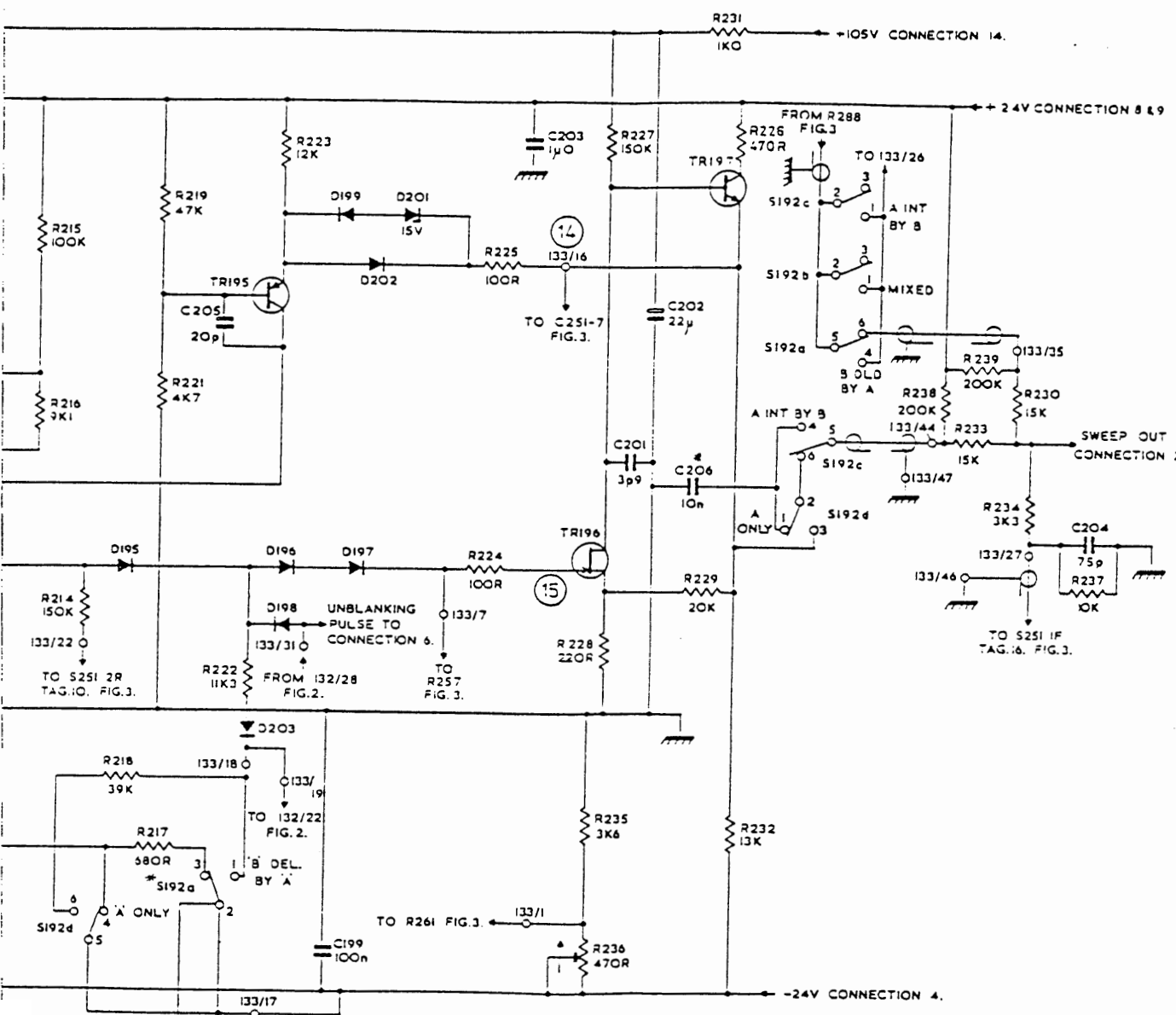
NOTES.
1. # DENOTES COL
2. 133/30 DENOTES



NOTES.
1. * DENOTES COMPONENTS
2. 133/30 DENOTES P.C. BOARD/

NOT MOUNTED ON P.C. BOARD.
EYELET OR TERMINAL No.

214	217	218	219	222	223	224	227	229	233	234	237
215			221			225	228	231	238	239	230
216								232			
							235				
							236				
								R226			



NOT MOUNTED ON P.C. BOARD.
 EYELET OR TERMINAL No.

DUAL SWEEP TYPE S2A
 'B' SWEEP GENERATOR P.C.133
 FIG. 5.

LOCATION OF

Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location
C601	4- C6			D603	4- B5	R607	
C602	4- B5			D604	4- C4	R608	4- C5
C603	4- B6			D605	4- C2	R609	
C604	4- C5			D606	4- C2		
C605	4- C4			D607	4- B2	R611	4- B5
C606	4- C5			D608	4- B2	R612	4- C5
C607	4- A4			D609	4- C2	R613	4- C5
C608	4- B5	C901				R614	4- B5
C609	4- C3	C902	4- E5	D611	4- B2	R615	4- B5
		C903	4- E5	D612	4- B2	R616	4- B5
C611	4- B3	C904	4- E5	D613	4- B2	R617	4- C5
C612	4- C3	C905	4- E5			R618	4- B5
C613	4- B3	C906	4- E5			R619	4- C5
C614	4- C2	C907	4- E5				
C615	4- B2	C908				R621	4- C4
C616	4- C2	C909	4- F5	D751	4- E2	R622	4- C5
C617	4- B2			D752	4- F2	R623	4- A5
C618	4- D3	C911	4- F5	D753	4- E3	R624	4- B4
C619	4- C5	C912	4- F5	D754	4- G2	R625	
		C913		D755	4- G2	R626	
C621	4- A5	C914	4- F5	D756	4- G3	R627	4-
C622	4- D5	C915	4- F5	D757	4- G3	R628	4- C4
C623	4- B5	C916	4- F5	D758	4- H2	R629	4- B4
		C917	4- G5	D759	4- H3		
		C918	4- G5			R631	4- B4
		C919	4- G5	D761	4- G3	R632	4- C4
				D762	4- G3	R633	4- C5
C750	4- E3	C921				R634	4- A4
C751	4- E2					R635	4- B5
C752	4- E2					R636	
C753	4- E2					R637	
C754	4- E3					R638	
C755	4- D1					R639	
C756	4- F2						
C757	4- F3						
C758	4- E1						
				R601		R641	
				R602		R642	
				R603	4- C5	R643	4- B4
				R604	4- A5	R644	4- B4
C762	4- G2	D601	4- C5	R605	4- C6	R645	4- B4
C763	4- G3	D602	4- B6	R606	4- B5	R646	4- C4

LOCATION OF COMPONENTS ON PRINTED CIRCUITS

Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Gr Lc
4-C6			D603	4-B5	R607		R647	4-C4	R687	4-B2	R765	4-
4-B5			D604	4-C4	R608	4-C5	R648	4-B4	R688	4-C2	R766	4-
4-B6			D605	4-C2	R609		R649	4-B4	R689	4-B2	R767	4-
4-C5			D606	4-C2							R768	4-
4-C4			D607	4-B2	R611	4-B5	R651	4-C4	R691	4-D3	R769	4-
4-C5			D608	4-B2	R612	4-C5	R652	4-C4				
4-A4			D609	4-C2	R613	4-C5	R653	4-A4			R771	4-
4-B5	C901				R614	4-B5	R654	4-B4	R694	4-	R772	4-
4-C3	C902	4-E5	D611	4-B2	R615	4-B5			R695	4-	R773	4-
	C903	4-E5	D612	4-B2	R616	4-B5			R696	4-	R774	4-
4-B3	C904	4-E5	D613	4-B2	R617	4-C5	R657	4-C3	R697	4-		
4-C3	C905	4-E5			R618	4-B5	R658	4-C3	R698	4-C4		
4-B3	C906	4-E5			R619	4-C5	R659	4-A3	R699	4-B4		
4-C2	C907	4-E5										
4-B2	C908				R621	4-C4	R661	4-B3	R701	4-C4		
4-C2	C909	4-F5	D751	4-E2	R622	4-C5	R662	4-C3	R702	4-C4		
4-B2			D752	4-F2	RS23	4-A5	R663	4-A3	R703	4-B4		
4-D3	C911	4-F5	D753	4-E3	R624	4-B4	R664	4-C3	R704	4-B5		
4-C5	C912	4-F5	D754	4-G2	R625		R665	4-B3	R705	4-D5	R786	4-
	C913		D755	4-G2	R626		R666	4-C3	R706	4-B5	R787	4-
4-A5	C914	4-F5	D756	4-G3	R627	4-	R667	4-C3			R788	4-
4-D5	C915	4-F5	D757	4-G3	R628	4-C4	R668	4-B3			R789	4-
4-B5	C916	4-F5	D758	4-H2	R629	4-B4	R669	4-B3				
	C917	4-G5	D759	4-H3							R791	4-
	C918	4-G5			R631	4-B4	R671	4-C3			R792	4-
	C919	4-G5	D761	4-G3	R632	4-C4	R672	4-D3			R793	4-
4-E3			D762	4-G3	R633	4-C5	R673	4-A3	R751	4-E2	R794	4-
4-E2	C921				R634	4-A4	R674	4-B3	R752	4-E2	R795	4-
4-E2					R635	4-B5	R675	4-C3	R753	4-F2	R796	4-
4-E2					R636		R676	4-B3	R754	4-E3	R797	4-
4-E3					R637		R677	4-C3	R755	4-F2	R798	4-
4-D1					R638		R678	4-C3	R756	4-F3	R799	
4-F2					R639		R679	4-A3	R757	4-E2		
4-F3									R758	4-E1		
4-E1					R601		R681	4-B2	R759	4-F4		
			R602		R641		R682	4-C2				
			R603	4-C5	R642		R683	4-C2	R761	4-F3		
			R604	4-A5	R643	4-B4	R684	4-B3	R762	4-E2		
4-G2	D601	4-C5	R605	4-C6	R644	4-B4	R685	4-B2	R763	4-F3		
4-G3	D602	4-B6	R606	4-B5	R645	4-B4	R686	4-C2	R764	4-E2		
					R646	4-C4						

COMPONENTS ON PRINTED CIRCUITS

Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location
R647	4-C4	R687	4-B2	R765	4-F1	R901		TR611	4-C3
R648	4-B4	R688	4-C2	R766	4-F2	R902	4-E5	TR612	4-B3
R649	4-B4	R689	4-B2	R767	4-F1	R903	4-E5	TR613	4-B3
				R768	4-F3	R904	4-E6	TR614	4-C3
R651	4-C4	R691	4-D3	R769	4-F3	R905		TR615	4-C3
R652	4-C4					R906		TR616	4-B3
R653	4-A4			R771	4-F3	R907		TR617	4-B3
R654	4-B4	R694	4-	R772	4-E3	R908		TR618	4-C2
		R695	4-	R773	4-E3	R909	4-F5	TR619	4-C2
		R696	4-	R774	4-E3				
R657	4-C3	R697	4-			R911	4-F5	TR621	4-B2
R658	4-C3	R698	4-C4			R912	4-F6	TR622	4-B2
R659	4-A3	R699	4-B4			R913			
						R914			
R661	4-B3	R701	4-C4			R915			
R662	4-C3	R702	4-C4			R916			
R663	4-A3	R703	4-B4			R917			
R664	4-C3	R704	4-B5			R918			
R665	4-B3	R705	4-D5	R786	4-G2	R919		TR751	4-E2
R666	4-C3	R706	4-B5	R787	4-G1			TR752	4-F2
R667	4-C3			R788	4-G4	R921		TR753	4-E3
R668	4-B3			R789	4-G3				
R669	4-B3								
				R791	4-G2			TR756	4-G2
R671	4-C3			R792	4-G3			TR757	4-G1
R672	4-D3			R793	4-G2	TH601	4-C5	TR758	4-G4
R673	4-A3	R751	4-E2	R794	4-G2	TH602	4-B5	TR759	4-G3
R674	4-B3	R752	4-E2	R795	4-G3				
R675	4-C3	R753	4-F2	R796	4-G3				
R676	4-B3	R754	4-E3	R797	4-G2				
R677	4-C3	R755	4-F2	R798	4-F3	TR601	4-C5		
R678	4-C3	R756	4-F3	R799					
R679	4-A3	R757	4-E2			TR603	4-B5		
		R758	4-E1						
R681	4-B2	R759	4-F4			TR605	4-C5		
R682	4-C2								
R683	4-C2	R761	4-F3			TR607	4-B5		
R684	4-B3	R762	4-E2						
R685	4-B2	R763	4-F3			TR609	4-C3		
R686	4-C2	R764	4-E2						

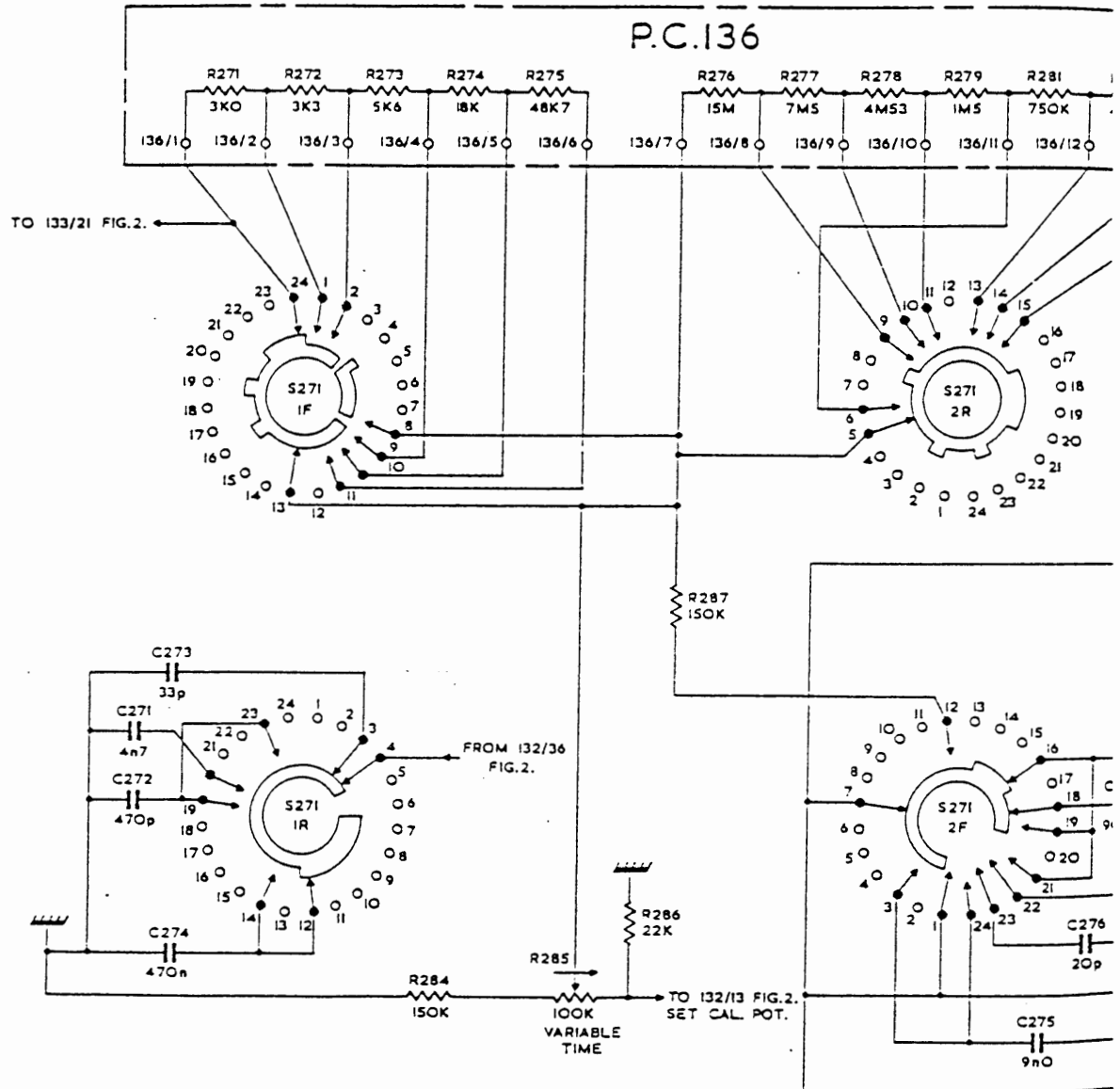
271 272 273 274 275 280 276 277 278 279 281
 284 285 287

271 273
 272 274

275 276

S271

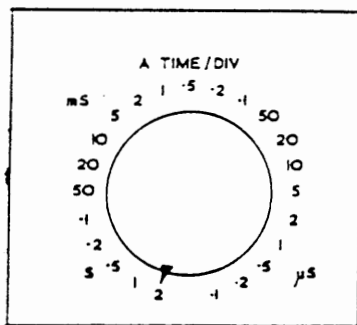
5



SK2
 SWEEP OUT

GENERAL NOTES.

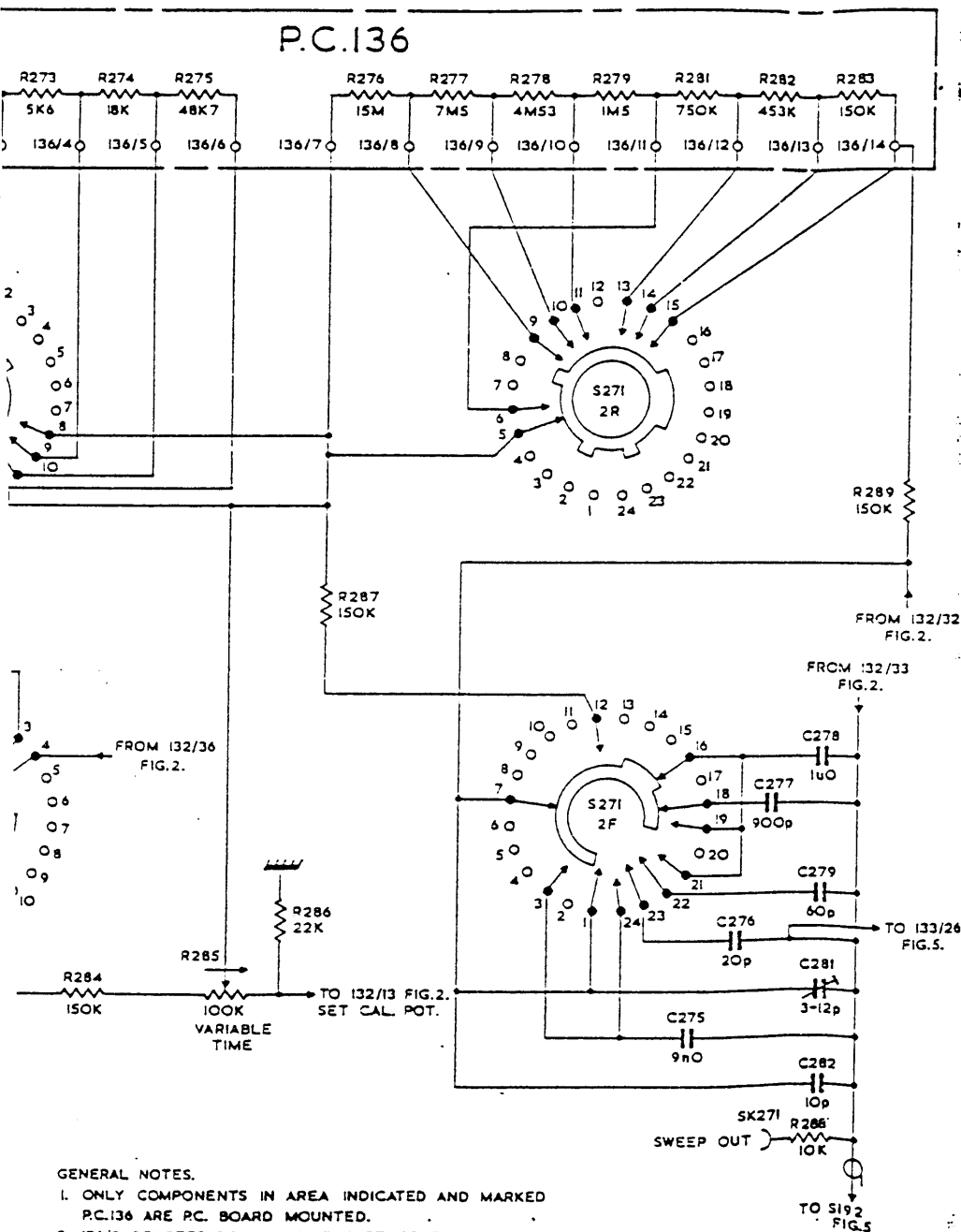
1. ONLY COMPONENTS IN AREA INDICATED AND MARKED P.C.136 ARE P.C. BOARD MOUNTED.
2. 136/2 DENOTES P.C. BOARD EYELET OR TERMINAL No.
3. SWITCH SHOWN IN FULLY ANTICLOCKWISE POSITION.



MARKING.

A TIME/DIV. SWITCH S2A
 FIG.3.

273	274	275	286	276	277	278	279	281	282	283
284	285	287							278	283
									279	
									281	
									282	288
S271					SK271					

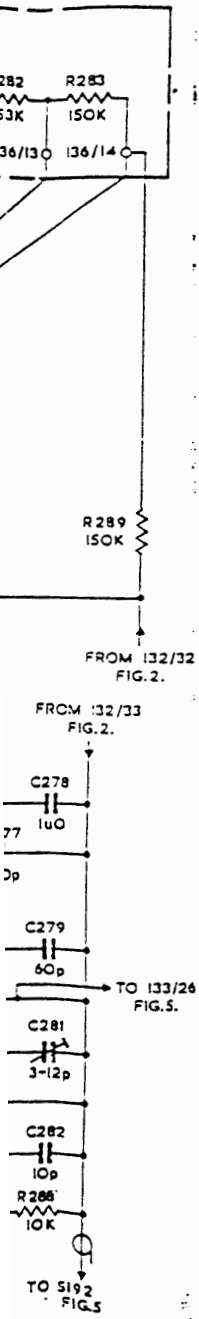
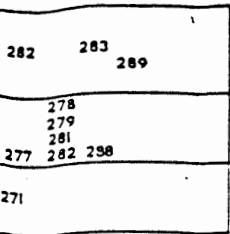


GENERAL NOTES.
 1. ONLY COMPONENTS IN AREA INDICATED AND MARKED P.C.136 ARE P.C. BOARD MOUNTED.
 2. 136/2 DENOTES P.C. BOARD EYELET OR TERMINAL No.
 3. SWITCH SHOWN IN FULLY ANTICLOCKWISE POSITION.

POSITION	R285 Loading Resistors Selected by Wafer 1F
2 s	-
1 s	-
0.5 s	-
0.2 s	R271
0.1 s	R271, R272
50 ms	R271, R272, R273
20 ms	R271, R272, R273, R274
10 ms	R271, R272, R273, R274, R275
5 ms	-
2 ms	R271
1 ms	R271, R272
.5 ms	R271, R272, R273
.2 ms	R271, R272, R273, R274
.1 ms	R271, R272, R273, R274, R275
50 μ s	R271, R272, R273
20 μ s	R271, R272, R273, R274
10 μ s	R271, R272, R273, R274, R275
5 μ s	R271, R272, R273
2 μ s	R271, R272, R273, R274
1 μ s	R271, R272, R273, R274, R275
.5 μ s	-
.2 μ s	-
.1 μ s	-

TABLE 'A'

A TIME/DIV. SWITCH S2A
 FIG. 3.



POSITION	R285 Loading Resistors Selected by Wafer 1F	Timing Resistors Selected by Wafer 2R	Hold Off Capacitor Selected by Wafer 1R	Timing Capacitors Selected by Wafer 2F
2 s	-	R276, R277, R278, R279, R281, R282, R283	C273, C274	C277, C278
1 s	-	R277, R278, R279, R281, R282, R283	C273, C274	C277, C278
0.5 s	-	R278, R279, R281, R282, R283	C273	C277, C278
0.2 s	R271	R279, R281, R282, R283	C273, C274	C277, C278, C279
0.1 s	R271, R272	R281, R282, R283	C273, C274	C276, C277, C278, C279
50 ms	R271, R272, R273	R282, R283	C273, C274	C276, C277, C278, C279
20 ms	R271, R272, R273, R274	R283	C273, C274	C276, C277, C278, C279
10 ms	R271, R272, R273, R274, R275	-	C272, C273, C274	C276, C277, C278, C279
5 ms	-	R278, R279, R281, R282, R283	C271, C272, C273	C275, C276, C277, C279
2 ms	R271	R279, R281, R282, R283	C271, C272, C273	C275, C276, C277, C279
1 ms	R271, R272	R281, R282, R283	C271, C272, C273	C275, C276, C277, C279
.5 ms	R271, R272, R273	R282, R283	C271, C272, C273	C275, C276, C277, C279
.2 ms	R271, R272, R273, R274	R283	C271, C272, C273	C275, C276, C277, C279
.1 ms	R271, R272, R273, R274, R275	-	C271, C272, C273	C275, C276, C277, C279
50 μs	R271, R272, R273	R282, R283	C272, C273	C276, C277, C279
20 μs	R271, R272, R273, R274	R283	C272, C273	C276, C277, C279
10 μs	R271, R272, R273, R274, R275	-	C272, C273	C276, C277, C279
5 μs	R271, R272, R273	R282, R283	C273	C276, C279
.2 μs	R271, R272, R273, R274	R283	C273	C276, C279
1 μs	R271, R272, R273, R274, R275	-	C273	C276, C279
.5 μs	-	-	C273	C276, C279
.2 μs	-	-	-	C276
.1 μs	-	-	-	-

TABLE 'A' TIME/DIV SWITCH CONNEXIONS

LOCATIC

Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref
C1	6-D1					R7
C2	6-F2					R8
C3	6-D2					R9
C4	6-D2	C192	6-E4	D61	6-F2	R10
				D62	6-F1	R11
C6	6-E1	C194	6-E4	D63	6-F2	R12
C7	6-E2	C195	6-F4	D64	6-F2	R13
C8	6-D2	C196	6-E4	D65	6-G3	R14
C9	6-E2	C197		D66	6-G3	R15
		C198	6-F4	D67	6-G3	R16
C11	6-D2	C199	6-D4	D68	6-H3	R17
C12	6-E3			D69	6-H3	R18
C13	6-E3	C201	6-H4			R19
C14	6-E3	C202	6-D5	D71	6-H3	
C15	6-F3	C203	6-D4	D72	6-G2	R21
		C204	6-D4	D73	6-H1	R22
				D74	6-G1	R23
C61	6-F2			D75	6-G2	R24
C62	6-F1	C251		D76	6-G2	R25
C63	6-E1	C252				R26
C64	6-F3	C253	'B'			R27
C65	6-G3	C254	T/D			R28
C66	6-G3	C255	Switch	D193	6-F4	R29
C67	6-G3	C256		D194	6-F4	
C68	6-G3	C257		D195	6-G4	R31
				D196	6-G4	R32
				D197	6-G5	R33
C71	6-G2	C271		D198	6-G4	R34
C72	6-G2	C272		D199	6-G4	R35
		C273				R36
C74	6-H2	C274		D201	6-G4	
C75	6-G1	C275	'A'	D202	6-G4	R38
C76	6-G1	C276	T/D	D203	6-G4	R39
C77	6-G2	C277	Switch			
C78	6-H1	C278				R41
C79	6-G1	C279				R42
				L1		R43
C31	6-F1	C281				
		C282				
				L61	6-F3	R62
C151	6-G6	D1	6-E1			R63
C152	6-G6	D2	6-E2			R64
C153	6-G6	D3	6-D5			R65
C154	6-G6	D4	6-E2	R1	6-E1	R66
C155	6-G5	D5	6-D3	R2	6-E2	R67
C156	6-G5	D6	6-D3	R3	6-E1	R68
C157	6-F5	D7	6-F3	R4	6-E2	R69
C158	6-F5	D8	6-D5	R5	6-E2	
C159	6-F8	D9	6-F3	R6	6-E1	R71

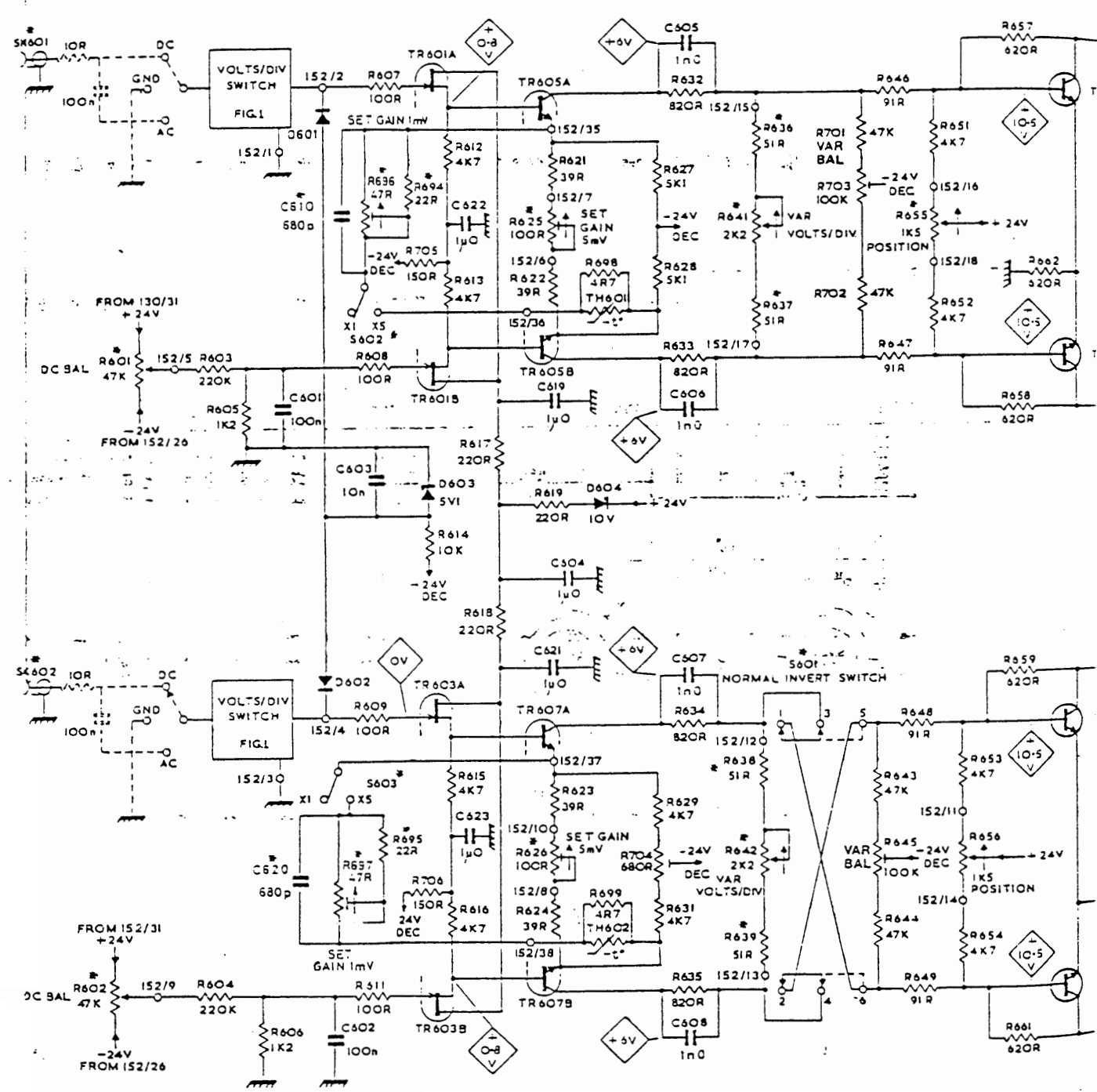
LOCATION OF COMPONENTS ON PRINTED CIRCUIT BOARD

Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location
C1	6-D1					R7	6-E1	R72	6-F2	R151	6-G6
C2	6-F2					R8	6-E2	R73	6-F2	R152	6-G6
C3	6-D2					R9	6-E2	R74	6-F2	R153	S153
C4	6-D2	C192	6-E4	D61	6-F2	R10	6-E2	R75	6-F3	R154	6-H5
				D62	6-F1	R11	6-D3	R76	6-G3	R155	6-G5
C6	6-E1	C194	6-E4	D63	6-F2	R12	6-D5	R77	6-G3	R156	6-G5
C7	6-E2	C195	6-F4	D64	6-F2	R13	6-D2	R78	6-G3	R157	6-F5
C8	6-D2	C196	6-E4	D65	6-G3	R14	6-D3	R79	6-G3	R158	6-F5
C9	6-E2	C197		D66	6-G3	R15	6-D2			R159	6-G5
		C198	6-F4	D67	6-G3	R16	6-E2	R81	6-G2		
C11	6-D2	C199	6-D4	D68	6-H3	R17	6-E2	R82	6-G2	R161	6-F5
C12	6-E3			D69	6-H3	R18	6-E2	R83	6-G2	R162	6-F6
C13	6-E3	C201	6-H4			R19	6-E2	R84	6-G3	R163	6-G5
C14	6-E3	C202	6-D5	D71	6-H3			R85	6-G2	R164	6-G5
C15	6-F3	C203	6-D4	D72	6-G2	R21	6-D1	R86	6-G3	R165	6-F5
		C204	6-D4	D73	6-H1	R22		R87	6-G2	R166	6-F5
				D74	6-G1	R23	6-D2	R88	6-G2	R167	6-F5
C61	6-F2			D75	6-G2	R24	6-E3	R89	6-G3	R168	6-F5
C62	6-F1	C251		D76	6-G2	R25	6-E2			R169	6-F5
C63	6-E1	C252				R26	6-E2	R91	6-E2		
C64	6-F3	C253	'B'			R27	6-E3	R92	6-H3	R171	6-F6
C65	6-G3	C254	T/D			R28	6-E3	R93	6-H3	R172	6-F5
C66	6-G3	C255	Switch	D193	6-F4	R29	6-D2	R94	6-H2	R173	6-E6
C67	6-G3	C256		D194	6-F4			R95	6-H3	R174	6-F6
C68	6-G3	C257		D195	6-G4	R31	6-D2	R96	6-H2	R175	6-F5
				D196	6-G4	R32	6-E3	R97	6-H2	R176	6-E6
				D197	6-G5	R33	6-E3	R98	6-G2	R177	6-E6
C71	6-G2	C271		D198	6-G4	R34	6-E3	R99	6-H2		
C72	6-G2	C272		D199	6-G4	R35	6-E3				
		C273				R36	6-F2	R101	6-G1		
C74	6-H2	C274		D201	6-G4			R102	6-G2	R191	6-E4
C75	6-G1	C275	'A'	D202	6-G4	R38	6-F3	R103	6-H1	R192	6-E4
C76	6-G1	C276	T/D	D203	6-G4	R39	6-F3	R104	6-G1	R193	6-E4
C77	6-G2	C277	Switch					R105	6-G1	R194	6-E4
C78	6-H1	C278				R41	6-F3	R106	6-G1	R195	6-E4
C79	6-G1	C279				R42	6-F3	R107	6-G1	R196	6-E4
				L1		R43	6-F3	R108	6-F1	R197	6-G4
C31	6-F1	C281						R109	6-G1	R198	6-G4
		C282								R199	
				L61	6-F3			R111	6-G1	R200	
C151	6-G6	D1	6-E1			R62	6-F1	R112	6-G2	R201	6-H5
C152	6-G6	D2	6-E2			R63	6-E2	R113	6-F1	R202	6-H5
C153	6-G6	D3	6-D5			R64	6-F1	R114	6-G2	R203	6-E5
C154	6-G6	D4	6-E2	R1	6-E1	R65	6-E1	R115	6-F1	R204	6-E5
C155	6-G5	D5	6-D3	R2	6-E2	R66	6-E1	R116	6-F1	R205	6-E4
C156	6-G5	D6	6-D3	R3	6-E1	R67	6-E1	R117	6-F1	R206	6-E4
C157	6-F5	D7	6-F3	R4	6-E2	R68	6-D1	R118	6-F1	R207	6-F4
C158	6-F5	D8	6-D5	R5	6-E2	R69	6-G3			R208	6-F4
C159	6-F8	D9	6-F3	R6	6-E1	R71	6-G2			R209	6-F4

INDEX OF COMPONENTS ON PRINTED CIRCUIT BOARDS

Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location
6-E1	R72	6-F2	R151	6-G6	R211	6-F4	R277	6-A2	TR5	6-E3
6-E2	R73	6-F2	R152	6-G6	R212	6-F4	R278	6-A2	TR6	6-F3
6-E2	R74	6-F2	R153	S153	R213	6-F4	R279	6-A1	TR7	6-F3
6-E2	R75	6-F3	R154	6-H5	R214	6-F4				
6-D3	R76	6-G3	R155	6-G5	R215	6-F4	R281	6-A1		
6-D5	R77	6-G3	R156	6-G5	R216	6-F4	R282	6-B2		
6-D2	R78	6-G3	R157	6-F5	R217		R283	6-B2	TR61	6-E1
6-D3	R79	6-G3	R158	6-F5	R218		R284		TR62	6-E1
6-D2			R159	6-G5	R219	6-G4	R285		TR63	6-G3
6-E2	R81	6-G2					R286		TR64	6-G3
6-E2	R82	6-G2	R161	6-F5	R221	6-G4	R287		TR65	6-G2
6-E2	R83	6-G2	R162	6-F6	R222	6-G4			TR66	6-H2
6-E2	R84	6-G3	R163	6-G5	R223	6-F4	R289		TR67	6-H2
	R85	6-G2	R164	6-G5	R224	6-H5			TR68	6-G1
6-D1	R86	6-G3	R165	6-F5	R225	6-G4			TR69	6-G1
	R87	6-G2	R166	6-F5						
6-D2	R88	6-G2	R167	6-F5	R227	6-G4	S1	'A' Source		
6-E3	R89	6-G3	R168	6-F5	R228	6-H4	S2	'A' Polarity		
6-E2			R169	6-F5	R229	6-H4	S3	Trig Mode	TR151	6-G5
6-E2	R91	6-E2							TR152	6-G5
6-E3	R92	6-H3	R171	6-F6	R231	6-D5			TR153	6-F5
6-E3	R93	6-H3	R172	6-F5	R232	6-G4			TR154	6-F5
6-D2	R94	6-H2	R173	6-E6	R233	6-D4	S61	Rep	TR155	6-F5
	R95	6-H3	R174	6-F6	R234	6-D4	S62	Reset		
6-D2	R96	6-H2	R175	6-F5	R235	6-H4				
6-E3	R97	6-H2	R176	6-E6	R236	6-G4				
6-E3	R98	6-G2	R177	6-E6	R237	6-D4			TR191	6-E4
6-E3	R99	6-H2							TR192	6-E4
6-E3							S151	'B' Source	TR193	6-E4
6-F2	R101	6-G1					S152	'B' Polarity	TR194	6-F4
	R102	6-G2	R191	6-E4	R251		S153	'B' Auto	TR195	6-G4
6-F3	R103	6-H1	R192	6-E4	R252				TR196	6-G4
6-F3	R104	6-G1	R193	6-E4	R253	'B'			TR197	6-H4
	R105	6-G1	R194	6-E4	R254	T/D	S191	Delay		
6-F3	R106	6-G1	R195	6-E4	R255	Switch	S192	Sweep Select		
6-F3	R107	6-G1	R196	6-E4	R256					
6-F3	R108	6-F1	R197	6-G4	R257					
	R109	6-G1	R198	6-G4	R258					
			R199		R259		S251	'B' Time/Div		
	R111	6-G1	R200							
6-F1	R112	6-G2	R201	6-H5	R261					
6-E2	R113	6-F1	R202	6-H5						
6-F1	R114	6-G2	R203	6-E5			S271	'A' Time/Div		
6-E1	R115	6-F1	R204	6-E5						
6-E1	R116	6-F1	R205	6-E4	R271	6-A1				
6-E1	R117	6-F1	R206	6-E4	R272	6-A1				
6-D1	R118	6-F1	R207	6-F4	R273	6-A2	TR1	6-E2		
6-G3			R208	6-F4	R274	6-A2	TR2	6-E2		
			R209	6-F4	R275	6-B2	TR3	6-E2		
6-G2					R276	6-A1	TR4	6-E3		

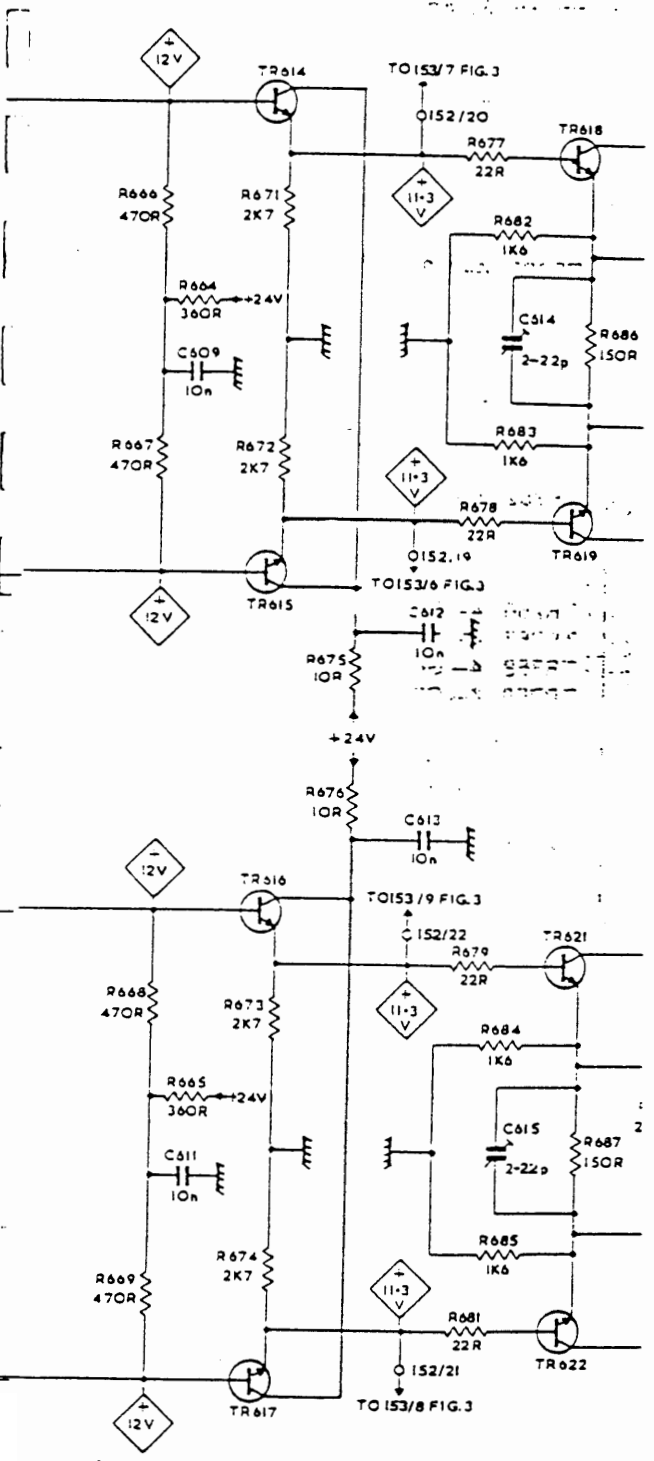
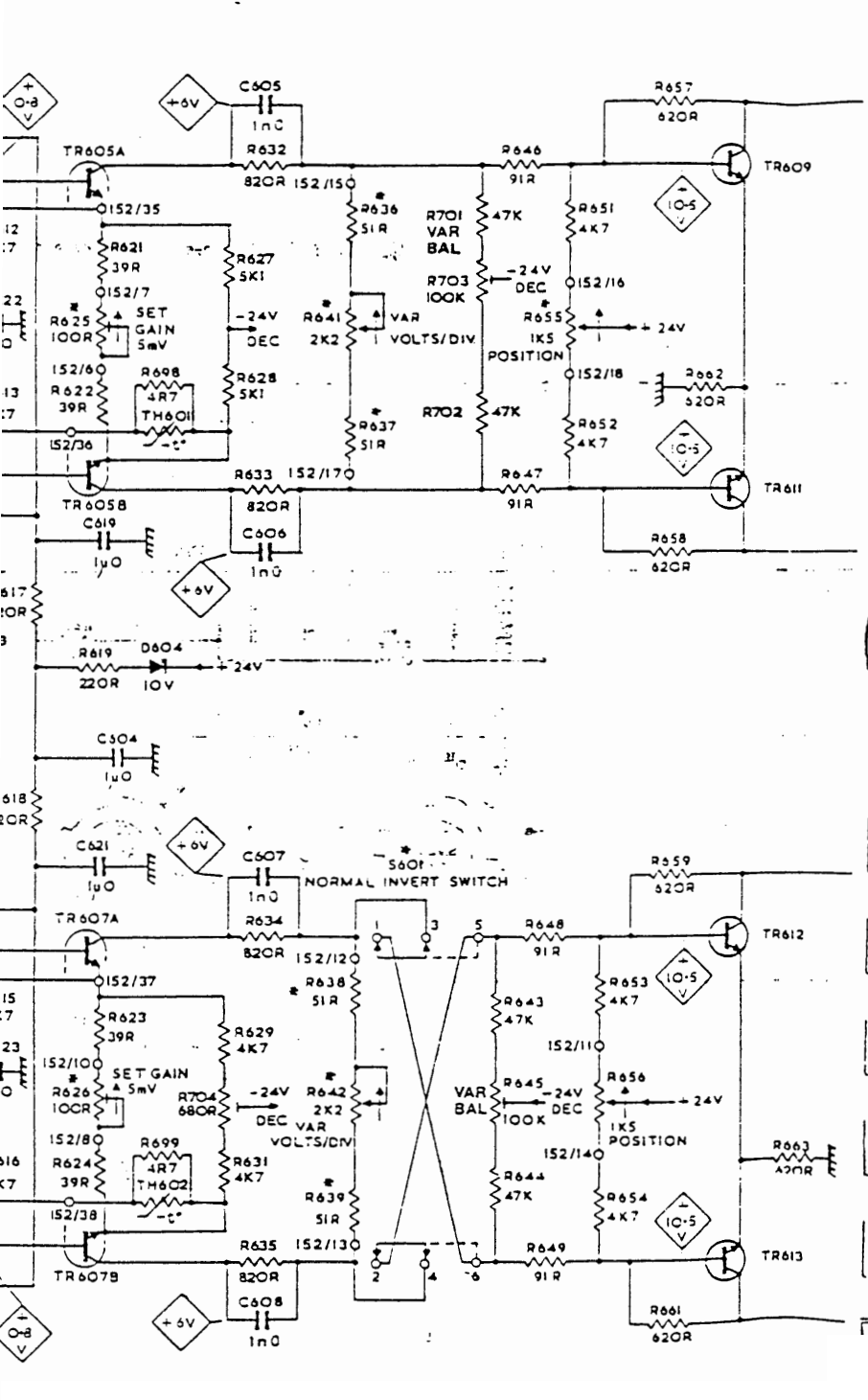
RESISTORS	601	605	696	607 694 612 617 621 698 627 636 701 702 651 657
			608 705 613 618 625 699 628 641 703 646 655 658	
	602 603 606	697	611 706 615 626 704 633 638 643 647 652 653 659	
			614 616 620 629 634 642 645 648 654 656 661	
			624 631 635 639 644 649 654 662	
CAPACITORS	601	603	622	619 605 606 607 608
	610 620	602	623	604 621
MISC.	D601 S602	D602 S603	D603	TR601A TR605A TH601 D604
SK601 SK602				TR601B TR605B TH602 S601
				TR603A TR607A TR603B TR607B



NOTES
 1. * DENOTES COMPONENTS NOT MOUNTED ON PC BOARD
 2. 152/2 DENOTES PC BOARD/EYELET OR TERMINAL No.

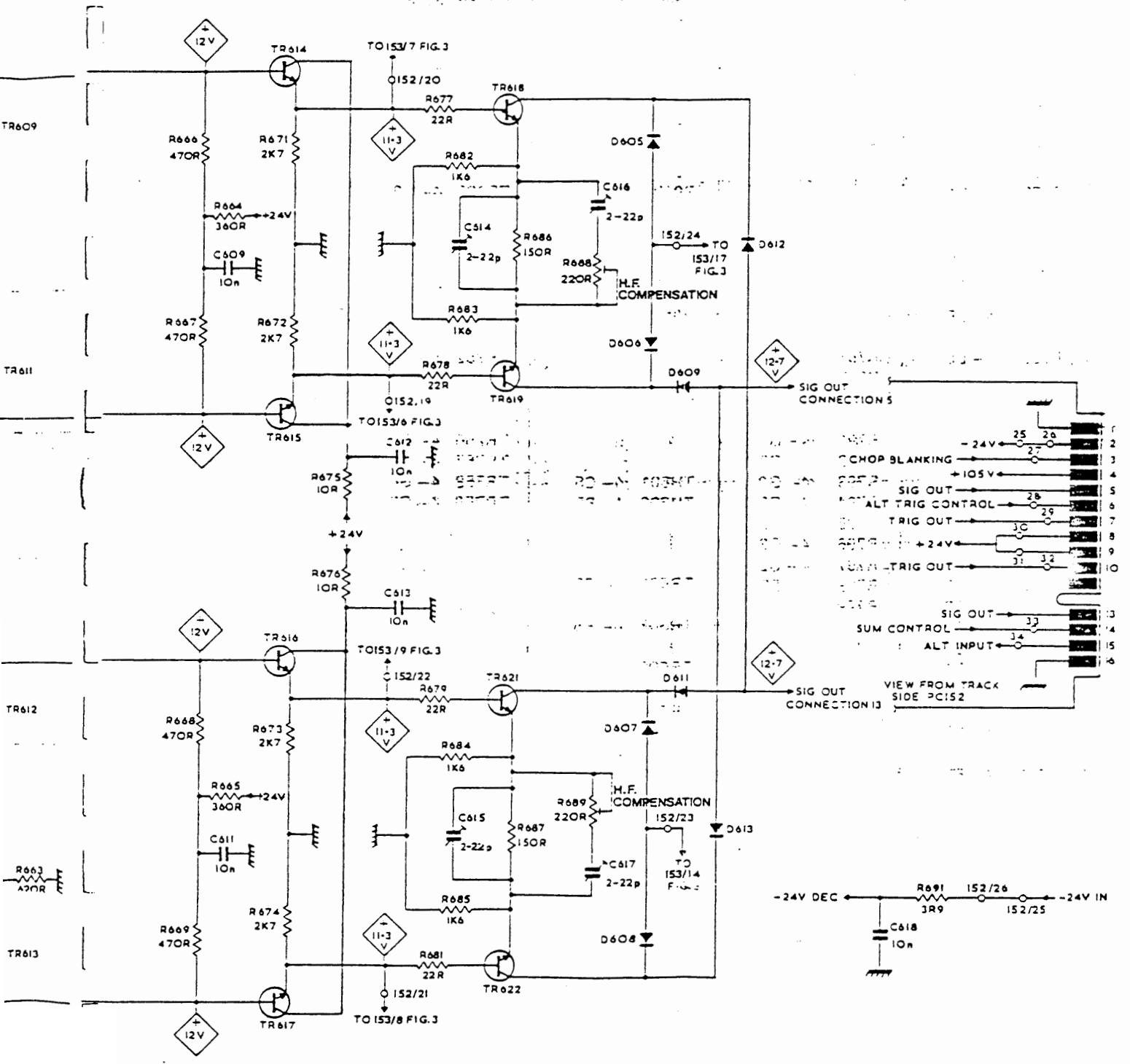
12	617	621	698	627	636	701	702	651	657
13	618	625	699	628	641	703	646	653	658
15	619	622	704	632	637	643	647	652	659
16	626	623	629	633	638	645	648	654	661
	624	624	631	634	642	644	649	654	662
				635	639				663
2	619	605							
	604	606							
3	621	607							
		608							
O1A	TR605A	TH601							TR609
O1B	TR605B	D604							TR611
O3A	TR607A	TH602			5601				TR612
O3B	TR607B								TR613

666	671	675	677	682
667	672	676	678	683
668	673		679	684
669	664		681	685
	665			
609		612	614	
611		613	615	
	TR614			TR618
	TR615			TR619
	TR616			TR621
	TR617			TR622



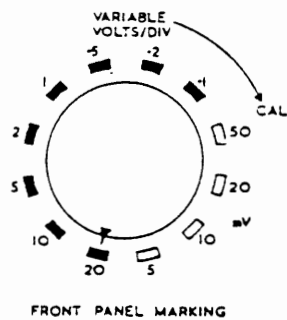
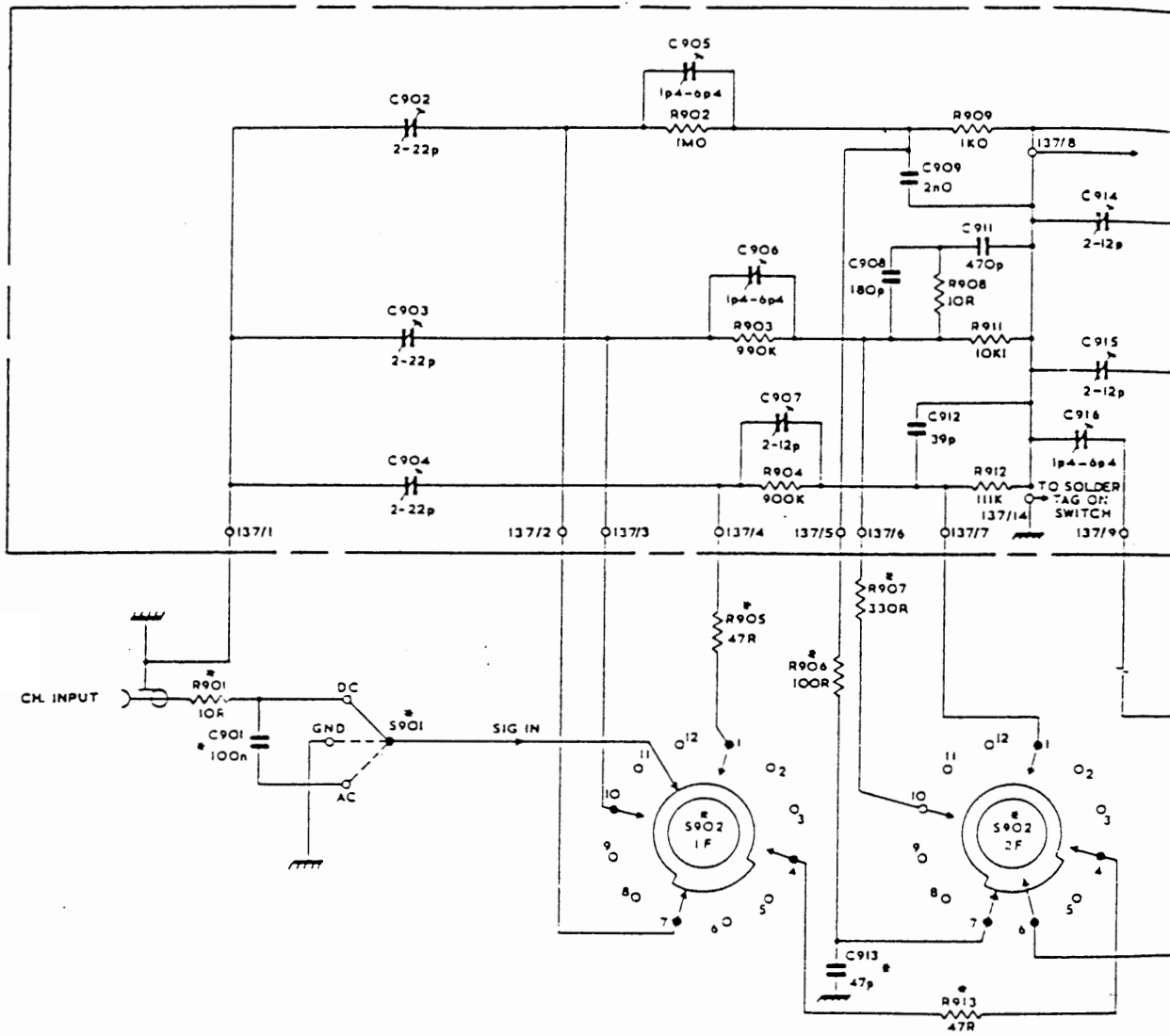
DUAL TRACE A
PCI5

666	671	677	682		
667	672	678	683	686	688
668	673	679	684	687	689
669	674	681	685		
664					
665					
609	612	614	616	618	
611	613	615	617		
TR609	TR614	TR618	D605		
TR611	TR615	TR619	D606		
TR612	TR616	TR621	D607	D609	D612
TR613	TR617	TR622	D608	D611	D613

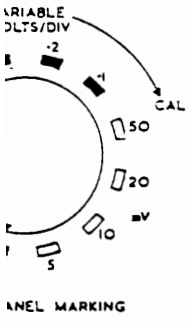
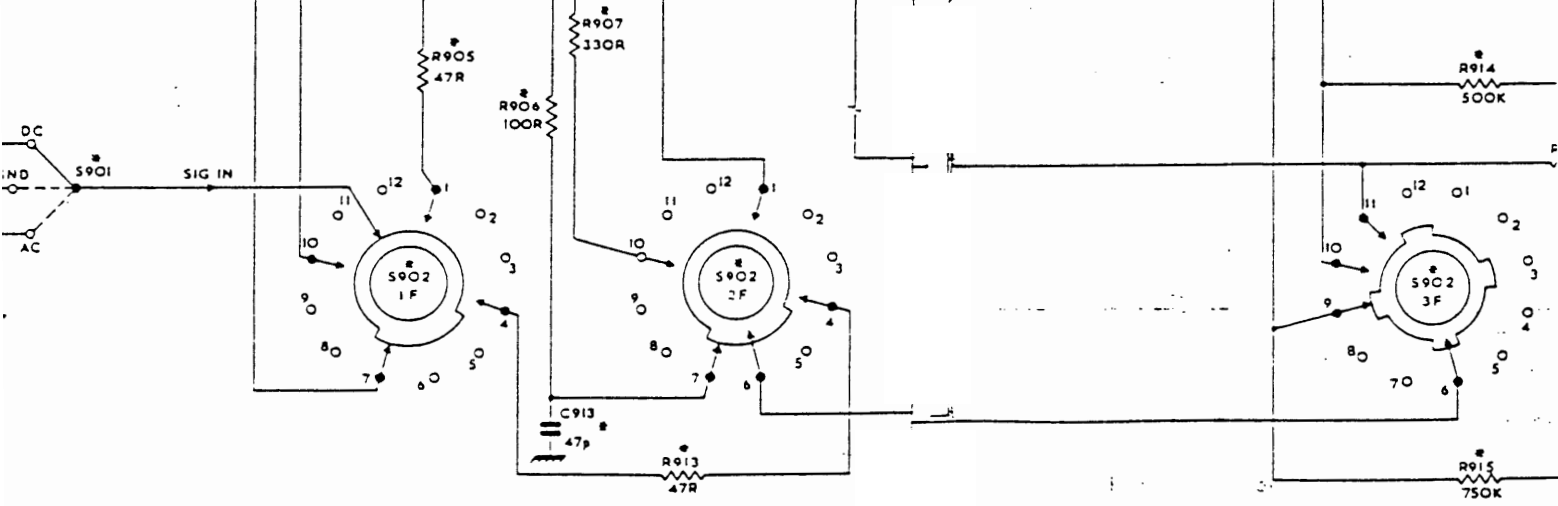
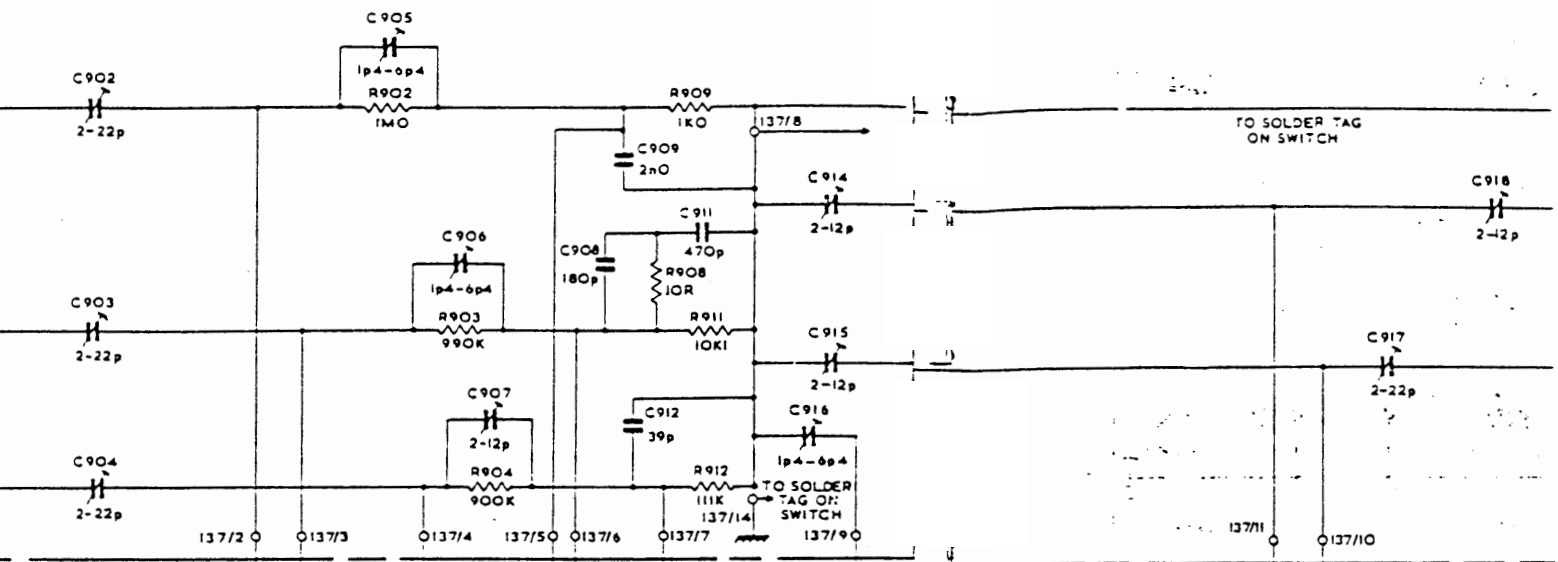
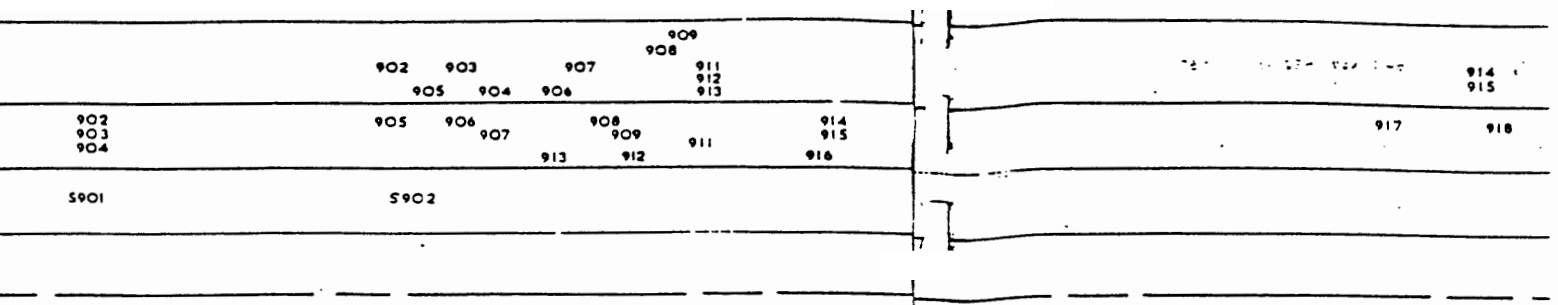


DUAL TRACE AMPLIFIER TYPE V4
PC152 FIG.2

RESISTORS	901	902	903	907	908	909	911	912	913		
		905	906	907	908	909	911	912	913		
CAPACITORS	901	902	903	904	906	907	908	909	911	914	915
		904								916	
MISC.		S901		S902							

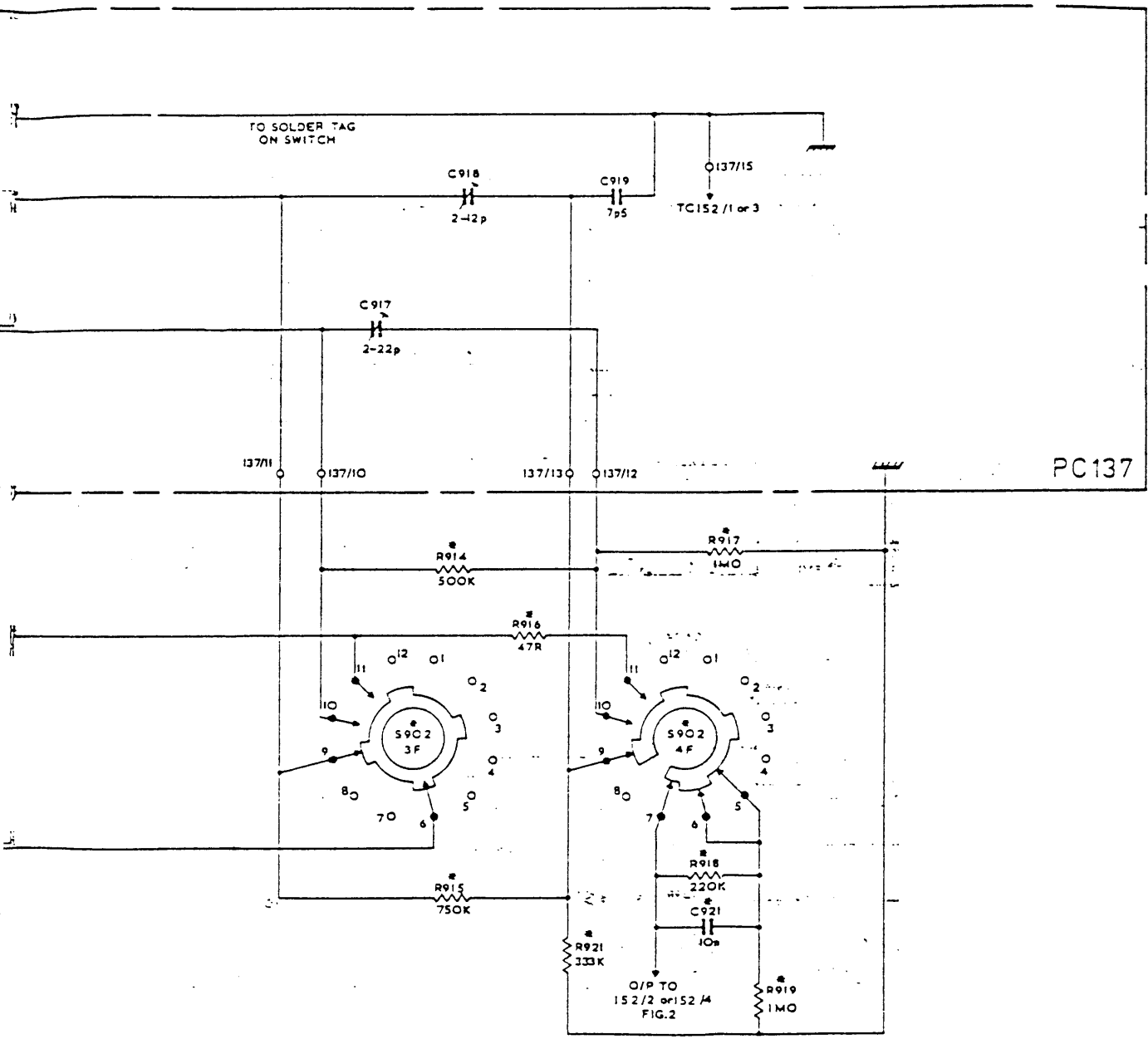


- NOTES.
1. 137/10 DENOTES PC BOARD/EYELET OR TERMINAL No.
 2. # DENOTES COMPONENTS NOT MOUNTED ON PC BOARD
 3. SWITCH IS SHOWN IN FULLY ANTICLOCKWISE POSITION



DUAL TRACE / VOL

914	915	916	917	918	919	920	921	922



DUAL TRACE AMPLIFIER TYPE V4
VOLTS/DIV SWITCH
FIG.1