TELEQUIPMENT OSCILLOSCOPE D83 MAINFRAME

INTRODUCTION

The D83, with two plug-ins, is an all solid state oscilloscope. An 8 x 10 div. CRT provides a bright and clear display. The features of the horizontal and vertical systems depend on the type of plug-ins used and are given in the appropriate manual.

The manual covers the mainframe, which houses the following:—

Calibrator
E.H.T. generator
Horizontal amplifier
Un-blanking amplifier
Vertical amplifier, output stage

This manual should be read in conjunction with the manuals of the plug-ins used. References are annotated "S" and "V" for the sweep and vertical plug-ins respectively.

The design of this instrument is subject to continuous development and improvement, consequently this instrument may incorporate minor changes in detail from the information contained herein, which would, in the main, affect the Components List and Circuit Diagrams. The reader should pay particular attention to the notes at the beginning of Chapter 5.

NOTICE TO OWNER

To obviate the risk of damage during transit and facilitate packaging, the owner is requested to remove the power supply plug and NOT send the following items unless they are suspect, should this Instrument be returned to TELEQUIPMENT for servicing:—

Manual
Probes
Power Supply Lead
Plug Assemblies

CONTENTS

CHAPTER 1
SPECIFICATION

1.1 CATHODE RAY TUBE (CRT)

Display area	8 x 10 div (each div 1·22 cm)
Phosphor Standard	P31
Overall accelerating potential ...	15 kV

1.2 FRONT PANEL OUTPUTS

Calibrator, peak to peak	30 mV or 300 mV or 3mA } at 1 kHz
Accuracy	
Voltage	±1%
Frequency	±20%
Current	±1%

1.3 Z MOD

Full blanking sensitivity	+20 V approx
Input impedance	10 kΩ and 15 pF approx.
Frequency response	DC—5 MHz approx.

1.4 POWER REQUIREMENTS

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

1.5 SIZE

Height	290 mm
Width	215 mm
Depth	520 mm

1.6 WEIGHT ... ... 9·5 kg

with plug-ins ... ... 14 kg

1.7 COOLING ... ... Convection

1.8 TEMPERATURE LIMITS, ambient

Operating	+5 to +40°C approx.
Non-operating	—25 to +70°C approx.

CHAPTER 2

OPERATING INSTRUCTIONS

2.1 FUNCTION OF CONTROLS AND CONNECTORS

Controls are situated on the front panel except where otherwise specified. For the controls not covered below, reference should be made to Chapter 2 of the manuals for the respective modules.

2.1.1 CRT

GRATICULE	varies the intensity of the graticule illumination and serves as the power supply ON-OFF switch.
INTENSITY	varies the intensity of the display.
ASTIG	a preset used in conjunction with FOCUS for achieving the best overall definition.
TRACE LOCATE	when pressed brings the trace onto the screen and free runs the A timebase.
←→	varies the position of the trace in the horizontal axis.
FINE	is a fine horizontal position control.
X10	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 the trace about the horizontal axis of the CRT and used to align the trace in the horizontal axis.

2.1.2 SWEEP

"S" Manual.

2.1.3 TRIGGER

"S" Manual.

2.1.4 VERTICAL

"V" Manual.

2.1.5 CONNECTORS

Z MOD	input socket situated on the rear panel is 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.
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 1 kHz (approx.) squarewave, when linked a 3 mA peak to peak current passes.
INTERFACE	an edge connector internally situated connects the plug-ins to main-frame.

2.2 PRE-OPERATIONAL CHECKS

2.2.1 POWER SUPPLY

Check the following:

1. Correct plug-ins are plugged in.
2. Rear voltage-selector plug is indicating the local supply voltage or nearest value.
3. 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	Blue	Green/Yellow

Power Cord should be secured by the screws and nuts provided to comply with local legislation.

2.2.2 Set controls as follows:

1. CRT

INTENSITY	Central
FOCUS	Central
TRACE ROTATION	As set
GRATICULE	Fully anti-clockwise

2. Set "S" plug-ins controls.
3. Set "V" plug-ins controls.

2.3 OPERATION

1. Plug into the supply; turn GRATICULE clockwise — POWER ON.
2. Allow a few minutes for warm up then press TRACE LOCATE and adjust 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 is 6 divisions.

CHAPTER 3
CIRCUIT DESCRIPTION

3.1.0 VERTICAL AMPLIFIER

3.1.1 The interface reference Figure 1 with the Vertical plug-in is a 16-way socket mounted on the Mother Board PC124. The signal is carried through pins 5 and 13 to the delay line driver amplifier, TR603 and TR604. To ensure that the main frame 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%.

3.1.2 This amplifier is a voltage feedback stage giving low input and output impedances, i.e., 9 Ω and 11 Ω approx. The impedance of the delay line used is 93 Ω/side, and the padding resistors, R629 and R628, are used to raise the output impedance of the stage to the correct value. The feedback resistors are split to enable the delay line compensation circuits C607, R617, C608 and R621 to be inserted. These provide medium frequency peaking by reducing the feedback at these frequencies. 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 trigger is achieved by a D.C. control voltage from the vertical plug-in switching the diodes D601, D602, D603 and D604; +24 V at pin 6 on SK602 selects ALT trigger and −24 V switches it off. The trigger signal is mixed with that from pins 7 and 10 on SK602 and then fed to the Sweep plug-in via pins 11 and 12 on SK601.

3.1.3 The Sum balance control, R614, is in circuit only when SUM is selected on the Vertical plug-in. When this occurs +24 V is applied to pin 14 of 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; pin 14 is at earth potential.

3.1.4 The delay line is a twin helix type sheathed with braid having a total delay of 140 ns. It is terminated on PC125 by R701, R703 and L701. The two resistors in parallel with the input resistance of the next stage gives a terminating resistance of 186 Ω. L701, adjusted for minimum delay line termination wriggle, is a partial compensation for the input capacity of TR701 and TR702. The following stage is a long-tailed pair, TR701 and TR702, with a gain of 2 and peaking between their emitters. R711 and C703 are delay line compensation and C704 high frequency peaking.

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

3.1.5 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 R708 which is mounted on PC125.

3.2.0 HORIZONTAL AMPLIFIER

3.2.1 This comprises an input mixing amplifier and an overall multistage feedback amplifier. The input amplifier, TR3, reference Figure 2, has a gain of 0·5 and has low input and output impedances. It mixes the sweep with the two position controls and provides a composite signal to the main amplifier. R17, a balance control, sets the voltage at TR3 collector to centralize position controls. C5 adjusts H.F. peaking, which is set by the manufacturer.

3.2.2 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 those between the emitters of TR4 and TR5. For X1 gain these are R26 and R27. On X10 gain R28 and R29 are put in parallel with R26 and R27. R27 sets X1 gain and R29 the X10 gain.

3.2.3 The mean X plate potential is set by R23 to approximately 55 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 capacitance, while 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.

3.3.0 UNBLANKING AMPLIFIER

In this amplifier, reference Figure 3, all unblanking signals are summed, at earth potential, in the emitter of TR351. Vbe 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 48 V at the collector. A complementary emitter follower stage, TR354 and TR355, to provide the large fast transients required.

3.4.0 MOTHER BOARD PC124

All inter-connections between Vertical and Horizontal plug-ins are made on the Mother Board, which are for trigger, alternate pulse, blanking amplifier and power lines.

3.5.0 TRACE LOCATE

This is obtained by reducing the maximum swing of vertical and horizontal amplifiers and free-running the sweep. S2 performs all these functions. The vertical amplifier is compressed in the output stage and the vertical amplifier is compressed in the delay line termination stage TR701 and TR702. The sweep unit is made to free-run by applying a positive voltage to pin 13 of SK601 via a 330 kΩ resistor R602.

3.6.0 CALIBRATOR

The Calibrator, reference Figure 2, 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 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, a ±1·2% control, takes 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.

3.7.0 POWER SUPPLY

+105 V, −24 V and +24 V lines, reference Figure 4, are all stabilizing circuits and protected against short circuits.

3.7.1 +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 a reference voltage. Any attempted change in output voltage of the +24 V line is passed 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.

3.7.2 −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 R405 provide current limiting and protect the output from short circuits.

3.7.2 105 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, TR401 and TR404 provide the short circuit protection in the form of a bistable, which is changed over by current flowing through R406.

3.8.0 E.H.T.

The E.H.T., reference Figure 3, PC129, is derived from a class C oscillator operating at approximately 24 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 set to the current 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 which is taken from T301 on the same tapping as that used for the cathode supply.

Thermistor TH301 limits the O/P at switch on and C304 reduces EHT feedback into the unregulated +30 V line. The tube is focussed by adjusting R327, which is on the front panel.

CHAPTER 4

4.1.0 GENERAL

4.1.1 This manual should be read in conjunction with the manuals for the plug-ins in use.

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 components are replaced, e.g., transistors, it is advised that the calibration checks detailed in para. 4.4.0 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 4.3.3. The internally generated 30 mV peak to peak calibrated waveform may conveniently be used for these checks.

4.2.0 MECHANICAL

4.2.1 ACCESS TO INTERIOR

The cabinet covers are removed as follows:—

1. Disconnect the power supply lead.
2. Turn two buttons at the top of each cover to release.
3. Ease the top of each side outwards.
4. Lift to clear bottom channel. The chassis base plate is secured by six fixing screws, one at each corner and one half-way along each side.

4.2.2 LOCATION OF PRESET CONTROLS

Circuit	PC Board No.	Location
Calibrator	126	R.H. side
E.H.T.	129	R.H. side
Power Supply	127	Rear end
Unblanking Amp.	128	R.H. side
X amplifier	126	R.H. side
Y amplifier output	125	L.H. side

4.2.3 CRT REMOVAL

1. Remove both cabinet sides, reference para. 4.2.1.
2. Earth PDA connector with a screwdriver.
3. Unplug PDA connector.
4. Remove rear cover (two screws).
5. Unplug the 14 pin CRT base connector.
6. Unplug the five neck pin connectors.
7. Remove two screws securing the bezel.
8. Slide CRT through the front panel aperture.
9. Remove rubber location moulding.

4.2.4 CRT FITTING

Reverse the order detailed in para 4.2.3 above.

4.3.0 CALIBRATION

4.3.1 The following procedure enables a calibration check of this unit to be accomplished. It is advised, that isolated adjustments are not made, due to risk of interaction with settings made in earlier checks. A functional check be carried out as detailed in para. 4.4 below. Checking parameters are met, then proceeding to the next check. Adjustments, if made, should be minimal.

The following tools and facilities will be required:

TOOLS

Screwdrivers	Plain 4 mm. blade. Non-capacitive.
Plug-in, Calibration	'V' 067-0672-00. 'S' 067-0673-00.
Leads	Screened c/w BNC Adaptors.
Adaptors	BNC 3-way, Male/Female/Male. BNC/2 mm.
	Probe X10 c/w earth lead.
	Oscilloscope Monitor.

FACILITIES

Variable voltage supply (Variac).

Voltage measurement from −24 V to 2·5 kV ±0·5%.

Input Signals	Markers
Squarewave	1 ms
25 mV 1 kHz 1%	
250 mV 1 kHz 1%	
1 V 1 kHz 1%	
10 V 1 kHz 1%	
10 ns risetime 100 kHz	
25 mV 1 MHz	
250 mV 1 MHz	

4.3.2 INITIAL CONTROL SETTINGS

1. Disconnect the instrument from the supply.
2. Check voltage-selector plug and power cord. Reference Chapter 2.2.
3. Connect power supply lead to Variac.
4. Turn GRATICULE fully anti-clockwise.
5. Push FINE.
6. Set FINE and ←→ to mid-position.
7. Connect Variac to power supply and set to minimum.
8. Switch-on Variac and set to voltage, reference Op. 2.
9. Turn GRATICULE clockwise; adjust illumination.
10. Allow instrument to warm-up; adjust INTENSITY and FOCUS.
11. Observe Neon (speed, alight).
12. Adjust TRACE LOCATION.

Note: Reference should be made to 'S' and 'V' manual for the respective initial control settings.

4.3.3 GAIN CHECK

Reference should be made to the 'S' and 'V' manuals for initial control settings.

1. Set VOLTS/DIV to 5 mV.
2. Set TIME/DIV to 0·5 ms.
3. Connect CAL to 'V' Input.

Note: use screen leads.

4. Adjust LEVEL for locked display.
5. Adjust POSITION.
6. Turn GRATICULE clockwise; adjust illumination.
7. Check amplitude = 6 divs, adjust as detailed in 'V' manual, Chapter 2.

Should a second channel require checking repeat Ops. 1, 3 and 7 using corresponding controls.

4.3.4 PROBES

1. Repeat Op. 1 para. 4.3.3 for X10 probe. Set VOLTS/DIV to 5 mV for X1.
2. Connect BNC to 'V' input.
3. Connect probe tip to 300 mV CAL for X10 probe and 30 mV CAL for X1.
4. Set TIME/DIV to 1 ms.
5. Repeat para. 4.3.3, Op. 4 through 6.
6. Adjust probe for square corner, see probe instruction.

4.4.0 CALIBRATION PROCEDURE

4.4.1 POWER SUPPLY

CAUTION—High voltage lines.

1.0 Check line voltages.

1.1 Remove cabinet covers (reference para. 4.2.1) and perforated cover.

1.2 Connect Meter to location: Col. 1.

1.3 CHECK voltages: Col. 2.

1.4 Adjust to correct voltage: Col. 3.

Location		Voltage	Adjust
PC No.	Pin	V	
127	10	+ 24	R425
127	14	− 24	R428
127	9	+105	R433
129	16	− 2·5 k	R301
126	14	55	R23

2.0 Check grid cut-off.
2.1 Set TIME/DIV to 10 ms.
2.2 Rotate INTENSITY.
2.3 Observe trace black-outs.
2.4 Turn INTENSITY anti-clockwise.
2.5 Adjust R315, PC129 anti-clockwise ensure trace blacks out.
2.6 Fit perforated cover.

4.4.2 HORIZONTAL AMPLIFIER

Note: Adjustments should be minimal. Note C11 and C13 should not be altered, to set-up refer to para. 4.5.1.

1.0 Check X-shift position range.
1.1 Set TIME/DIV to 1 ms.
1.2 Turn FINE and ←→ to opposite range extremities.
1.3 Check trace ends past vertical centre line.
1.4 Adjust R17, PC126 to achieve Op. 1.3.

2.0 Check X calibration: R27, R29. PC126.
2.1a Connect 1 ms Marker Signal to 'V' Input.
b Set VOLTS/DIV to 0·2 V.
c Set DC-GND-AC to DC.
2.2 Set TIME/DIV to 1 ms.
2.3 Align leading marker and L.H. vertical.
2.4 CHECK alignment of subsequent markers; error <0·3 div.
2.5 Adjust R27, PC126, for optimum alignment.
2.6 Set Marker Generator to 0·1 ms.
2.7 Pull FINE and turn ←→ slowly.
2.8 CHECK alignment; error <0·6 div.
2.9 Adjust R29, PC126 for optimum alignment.

4.4.3 UNBLANKING AMPLIFIER

1.0 Check pulse response.
1.1 Set TIME/DIV to 0·1 μs.
1.2 Observe trace intensity for non-uniformity.
1.3 Adjust C353, PC128, for uniformity.

4.4.4 VERTICAL AMPLIFIER (Final Stage).

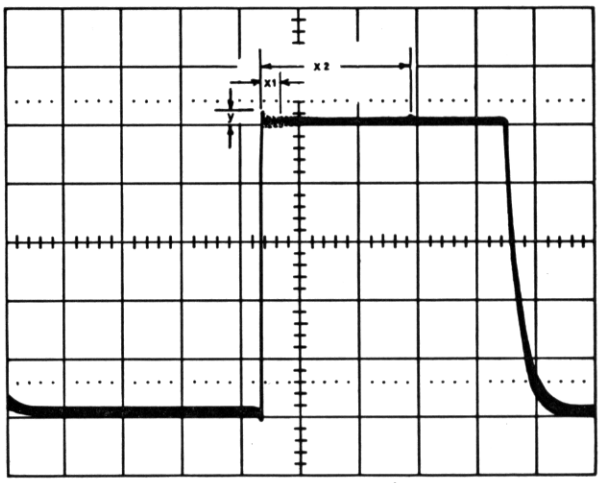
Note: Remove 'V' plug-in extension lead; fit L.H. cover; install plug-in.

1.0 Check pulse response.
Minimal adjustment only.

CAUTION: R609 and R706 should not be altered. To set-up refer to para 4.5.2.

1.1a Connect 25 mV, 1 MHz squarewave to "V" Input.
b Set VOLTS/DIV to 5 mV.
1.2 Set TIME/DIV to 0·1 μs.
1.3 CHECK trace with Plate 4.1.
1.4 If aberrations, from leading edge is:—
'X1' >0·25 div; adjust C608. PC124.
'X1' >0·1 <0·25 div, adjust C711 and R722. PC125.
'X1' <0·1 div, adjust C707. PC125.

2.0 Check delay line ripple.
2.1 CHECK top edge ripple; 'X2' <2·8 div, reference Plate 4.1.
2.2 Set C704, PC125, to mid-range.
2.3 Adjust L701, PC125, to minimize ripple.
2.4 Adjust C704 for perpendicular leading edge and 'Y' <0·1 div, reference Plate 4.1.



Refer to relevant Ops. for 'x1', 'x2' and 'y'

PLATE 4.1

4.4.5 CALIBRATOR

1.1 Check setting.
1.2a Connect 25 mV, 1 kHz squarewave to 'V' Input.
b Select 'V' Input.
c Set DC-GND-AC to DC.
d Set VOLTS/DIV to 5 mV.
e Turn VARIABLE fully clockwise.
1.3a Set TIME/DIV to 1 ms.
b Turn VARIABLE fully clockwise.
1.4 CHECK amplitude = 5 divisions.
1.5 Adjust CAL.
1.6 Connect 30 mV CAL to 'V' Input.
1.7 CHECK amplitude = 6±0·1 divisions.
1.8 Adjust R4, PC126.

2.0 Check frequency.
2.1 Set Monitor Oscilloscope (M.O.).
Volts/Div to 5 mV.
Time/Div to 1 ms.
2.2 Connect M.O. to 30 mV CAL.
2.3 CHECK display for 10 ±2 cycles.

4.4.6 GENERAL

1. Examine instrument for cleanliness.
2. Fit cabinet covers.
3. Repeat para. 4.3.2.

4.5.0 SETTING-UP

1.0 To set-up Horizontal Amplifier.
1.1 Replace 'S' plug-in with 'S' Calibration plug-in.
1.2 Set R17, R23, R27, R29, PC126, to centre of range.
1.3 Set C11, C13, PC126, with stator and rotor leafs disengaged.
1.4 Centralize FINE & ←→.
1.5 Connect 0-10 V squarewave to CAL, Test plug-in.
1.6 Adjust R17 to centralize trace.
1.7 Connect voltmeter to eyelet 14.
1.8 Adjust R23 to obtain 55 V.
1.9 Observe trace is central.
1.10 Adjust R27 to give 10 div trace.
1.11 Connect 0-1 V, 1 kHz squarewave to CAL.
1.12 Pull FINE.

1.13 Adjust R29 to give 10·2 div trace.
1.14 Push FINE.
1.15a Link CAL (calibration plug-in) to 'V' input.
b Set DC-GND-AC to DC.
v Set VOLTS/DIV to 5 V.
1.16 Connect 100 kHz, 10 ns risetime squarewave to link (Op. 1.15a).
1.17 Adjust C11 to give 2 div squarewave display.
1.18 Pull FINE.
1.19 Adjust C13 to give 2 div squarewave display.
1.20 Push FINE.
1.21 Replace 'S' Calibration plug-in with 'S' plug-in.

2.0 To set-up Vertical Amplifier.
2.1 Replace 'V' plug-in with 'V' Calibration plug-in.
2.2 Select BAL.
2.3 Adjust R706, PC125, to centralize line.
2.4 Select CAL.
2.5 Connect 250 mV, 1 kHz squarewave to INPUT.
2.6 Adjust R609, PC124, for 5 div amplitude.
Note: ±0·2 div error acceptable if at range limit.
2.7 Connect 250 mV, 1 MHz squarewave to INPUT.
2.8 Repeat para. 4.4.4, Ops. 1.2 through to 2.4.

CHAPTER 5
COMPONENT 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 farad; ratings at 70°C. are in volts or kilovolts.

Whenever possible, exact replacements for components should be used, although locally available alternatives 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

CIRCUIT REFERENCE BLOCKS

The table below gives the blocks of circuit references, so that the reader can relate the items listed in this chapter and their location in the circuitry and printed circuit boards in Chapter 6.

Circuit Reference		Circuit	Fig.	P.C. Board No.
From	To			
1	300	'X' Output Amplifier	2	126
301	350	Bright-up	3	128
351	400	E.H.T.	3	129
401	450	Power Supply	4	127
601	700	'Y' Amplifier	1	124
701	800	'Y' Amplifier	1	125

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

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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	Description Value F	Type	Tol %	Rating V
C1	285-1015-00	4·7 n	PE	20	160
C2	281-0710-00	10 n	CER		250
C3	285-0800-00	10 n	PE	20	250
C4	281-0734-00	100 n	CER		30
C5	281-0156-00	1·4-6·4 p	PP		500
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	281-0155-00	2-22 p	PP		500
1037 C12	285-0870-00	120 p	PS	2	350
C13	281-0157-00	5·5-65·5 p	PP		500
C14	281-0710-00	10 n	CER		250
C301	285-1014-00	1 μ	PE	20	63
C302	290-0495-00	47 μ	E		40
C303	281-0736-00	1 n	CER		8 k
C304	290-0495-00	47 μ	E		40
C305	285-0799-00	33 n	PE	20	250
C306	281-0681-00	10 n	CER		4 k
C307	285-0837-00	20 n	PE		5 k
C308	285-1015-00	4·7 n	PE	20	160
C309	281-0681-00	10 n	CER		4 k
C310	285-0837-00	20 n	PE		5 k
C311	281-0710-00	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

Cir Ref	Part Number	Description Value F	Type	Tol %	Rating V
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
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	290-0556-00	22 μ	E		25
C415	290-0556-00	22 μ	E		25
C416	290-0625-00	4·7 μ	E		160
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	350
C606	285-0867-00	20 p	PS	1	350
C607	285-0844-00	39 p	PS	2 p	350
C608	281-0155-00	2-22 p	PP		500
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	350
C704	281-0154-00	2-12 p	PP		500
C705	285-0800-00	10 n	PE	20	250
C706	281-0710-00	10 n	CER		250
C707	281-0155-00	2-22 p	PP		500
C708	281-0710-00	10 n	CER		250
C709	285-0843-00	30 p	PS	2	350
C711	281-0155-00	2-22 p	PP		500
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

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Clr 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	152-0468-00	150	Rectifier	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
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
171) D356	152-0062-01		1N914/1N4148	Si		75 V
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
D606	152-0062-01		1N914/1N4148	Si		75 V
D701	152-0546-00	47	Zener	Si	5	1
D702	152-0472-00	5·6	Zener	Si	5	330 mW
D703	152-0472-00	5·6	Zener	Si	5	330 mW
D704	152-0543-00	5·1	Zener	Si	5	330 mW
D705	152-0547-00	22	Zener	Si	5	330 mW

Cir Ref	Part Number	Value	Description	Rating	
FS401	159-0073-00	1 A (200-250 V)	1·25 in. fast		
	159-0069-00	2 A (100-125 V)	1·25 in. fast		
FS402	159-0073-00	1 A	1·25 in. fast		876
FB	276-0597-00	Ferrite bead Mullard FX1115			
L701	114-0323-00		Variable inductor		
L702	108-0700-00		Trace rotation coil 1920 turns		
LP401	150-0074-00	6·5 V	Les	1 W	
LP402	150-0074-00	6·5 V	Les	1 W	
LP403	150-0074-00	6·5 V	Les	1 W	

Cir Ref	Part Number	Value ohms	Description 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	311-0717-00	220	CP	20	250 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	311-1346-00	10 k	CV	20	250 m	
R9	321-0093-42	90·9	MF	0·5	125 m	
R11	317-0393-01	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	5	125 m	
R17	311-0802-00	4·7 k	CP	20	250 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	311-0802-00	4·7 k	CP	20	250 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	311-0851-00	1 k	CP	20	250 m	
R28	321-0843-48	270	MF	1	125 m	
R29	311-0712-00	100	CP	20	250 m	

Cir Ref	Part Number	Value ohms	Description Type	Tol %	Rating W	
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	311-0850-00	15 k	CP	20	250 m	
R302	315-0223-01	22 k	C	5	250 m	
R304	301-0685-02	6·8 M	C	5	500 m	
R305	301-0685-02	6·8 M	C	5	500 m	
R306	317-0102-01	1 k	C	5	125 m	
R307	317-0124-01	120 k	C	5	125 m	
R308	317-0331-01	330	C	5	125 m	
R309	301-0685-02	6·8 M	C	5	500 m	
R310	316-0221-01	220	C	10	250 m	896
R311	317-0102-01	1 k	C	5	125 m	
R312	307-0184-00	15 k	MO	5	1·5	
R313	301-0685-02	6·8 M	C	5	500 m	
R314	317-0184-01	180 k	C	5	125 m	
R315	311-0910-00	2·2 M	CP	20	250 m	

* With S1

Cir Ref	Part Number	Value ohms	Description Type	Tol %	Rating W	
R316	317-0273-01	27 k	C	5	125 m	
R317	301-0106-02	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	301-0825-01	8·2 M	C	5	500 m	
R324	301-0106-02	10 M	C	5	500 m	
R325	301-0106-02	10 M	C	5	500 m	
R326	301-0755-01	7·5 M	C	5	500 m	
R327	311-1347-00	2·5 M	CV	20	250 m	
R328	317-0104-01	100 k	C	5	125 m	
R329	311-1348-00	100 k	CV	20	250 m	
R331	317-0682-01	6·8 k	C	5	125 m	
R332	315-0335-02	3·3 M	C	5	250 m	
R333	315-0335-02	3·3 M	C	5	250 m	
R334	315-0335-02	3·3 M	C	5	250 m	
R351	311-1349-00	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	125 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	
(1171) R368	317-0561-01	560	C	5	125 m	
*R401	311-0709-00	25	WWV	10	1	
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	
794 R406	308-0725-00	2·7	WW	10	1	
R407	308-0727-00	1	WW	10	1	
R408	317-0274-01	270 k	C	5	125 m	
R409	317-0100-01	10	C	5	125 m	
R410	317-0471-01	470	C	5	125 m	

*With S401

Cir Ref	Part Number	Value ohms	Description Type	Tol %	Rating W	
R411	317-0332-01	3·3 k	C	5	125 m	
R412	317-0334-01	330 k	C	5	125 m	794
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	311-1378-00	4·7 k	WWP	10	1	
R426	321-1325-48	24 k	MF	1	125 m	
R427	321-0871-48	6·8 k	MF	1	125 m	
R428	311-1419-00	1·5 k	WWP	10	1	
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	311-1378-00	4·7 k	WWP	10	250 m	
R434	321-0289-48	10 k	MF	1	125 m	
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	311-1377-00	10 k	CP	20	250 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	311-0719-00	470	CP	20	250 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	

Cir Ref	Part Number	Value ohms	Description Type	Tol %	Rating W
R701	321-0095-48	95·3	MF	1	125 m
R702	317-0101-01	100	C	5	125 m
R703	321-0095-48	95·3	MF	1	125 m
R704	317-0332-01	3·3 k	C	5	125 m
R705	315-0821-01	820	C	5	250 m
R706	311-0719-00	470	CP	20	250 m
R707	315-0821-01	820	C	5	250 m
R708	311-0765-00	100 k	CP	20	250 m
R709	317-0333-01	33 k	C	5	125 m
R711	317-0362-01	3·6 k	C	5	125 m
R712	317-0121-01	120	C	5	125 m
R713	317-0121-01	120	C	5	125 m
R714	317-0470-01	47	C	5	125 m
R715	317-0121-01	120	C	5	125 m
R716	307-0372-00	390	MO	5	3·5
R717	307-0372-00	390	MO	5	3·5
R718	317-0680-01	68	C	5	125 m
R719	317-0680-01	68	C	5	125 m
R721	317-0680-01	68	C	5	125 m
R722	311-0719-00	470	CP	20	250 m
R723	315-0103-01	10 k	C	5	250 m
R724	307-0371-00	510	MO	5	5
R725	307-0371-00	510	MO	5	5
R726	307-0369-00	160	MO	5	1·5
R727	311-1344-00	1 k	WWP	20	1·6
R728	307-0369-00	160	MO	5	1·5

Cir Ref	Part Number	Description
S1	311-1345-00	Pull (with R15)
S2	260-1408-00	Push (1-button)
S401	311-0709-00	Rotary with R401)

Cir Ref	Part Number	Description
T301	120-0771-00	E.H.T. oscillator transformer
T401	120-0770-00	Power transformer
TH301	307-0258-00	Thermistor NTC 130 Ω

Cir Ref	Part Number	Description		
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	151-0257-00	BF305 Ates	Si	NPN
TR7	151-0257-00	BF305 Ates	Si	NPN
TR8	151-0257-00	BF305 Ates	Si	NPN
TR9	151-0257-00	BF305 Ates	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

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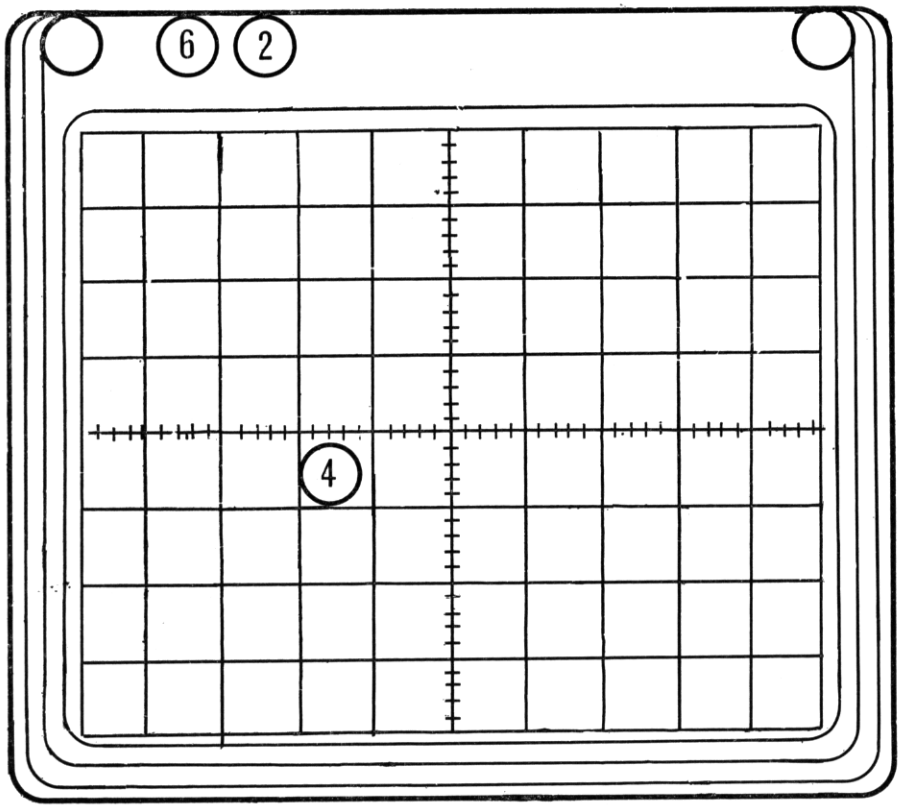
Clr	Ref	Part Number	Description		
980	TR351	151-0257-00	BF305 Ates	Si	NPN
	TR352	151-0326-00	BC107	Si	NPN
	TR353	151-0404-00	T0203	Si	PNP
980	TR354	151-0257-00	BF305 Ates	Si	NPN
	TR355	151-0404-00	T0203	Si	PNP
1089	TR401	151-0257-01	BF305 Ates	Si	NPN
	TR402	151-0404-00	TZ0203	Si	PNP
	TR403	151-0326-00	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
980	TR412	151-0257-00	BF305 Ates	Si	NPN
	TR413	151-0400-00	2N5191	Si	NPN
	TR414	151-0320-00	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	151-0127-02	BSX20/2N2369	Si	NPN
	TR702	151-0127-02	BSX20/2N2369	Si	NPN
	TR703	151-0127-02	BSX20/2N2369	Si	NPN
	TR704	151-0127-02	BSX20/2N2369	Si	NPN
884	TR705	151-0310-01	E1530LL	Si	NPN
	TR706	151-0310-01	E1530LL	Si	NPN
1021	V301	154-0640-05	CRT Tektronix T7400-31-2		



POWER
GRATICULE

7
5

OFF

INTENSITY

10

ASTIG

FOCUS

10

TRACE LOCATE

3

FINE

PULL
x10

8
9

30mV CAL 300mV

11 11

PANEL, FRONT.

MECHANICAL

Part Number	Description	Location
381-0334-00	Bar, Handle	
136-0304-00	Base	
136-0183-01	Base Transistor, T05	PCB
136-0343-00	Base Transistor, T018	PCB
361-0254-00	Bead, Ceramic	PC127
276-0597-00	Bead, Ferrite	PC125
200-1218-01	Bezel	
200-1218-02	Bezel, Marked	2
366-1403-00	Button, Push	3
358-0460-00	Bush, Panel	Handle
377-0386-00	Bush, Thread, 4 BA	
390-0277-00	Cabinet, Side	
334-1305-00	Card, Instruction	Accessory
343-0196-00	Clamp, Cable (Brass)	Delay line
343-0198-00	Clamp, Cable Tie Down	Delay line
344-0247-00	Clip, Fuse	PC127
200-0904-00	Connector, Cap PDA	EHT
131-1282-01	Connector, Edge 16 Way Socket	PC124
131-0649-00	Connector, Male BNC	Accessory
131-0650-01	Connector, BNC	Z Mod.
131-0644-00	Connector, PDA Button	EHT

ASSEMBLIES

	Assembly	Part Number	Includes Circuit References
1183	Bright-up PC128	670-2182-01	C351 to C355, D351 to D356, R353 to R359, R361 to R368, TR351 to TR355
	EHT PC129	670-2183-00	C301 to C309, D301, D302, L301, R301, R309, R311 to R319, R321 to R326, R332 to R334, TR301 to TR304
	Graticule Light	352-0160-00	L402, L403
	Mother Board PC124	670-2178-00	C601 to C609, C611, D601 to D605, R601 to R609, R611 to R619, R621 to R629, SKT601, SKT602, TR601 to TR604
	Power Board PC127	670-2181-00	C401 to C409, C411 to C416, D401 to D409, D411 to D417, FS402, R402 to R419, R421 to R429, R431 to R434, TR401 to TR409, TR411 to TR416
	Quintupler	650-0021-00	Sealed unit.
	'Y' Output PC125	670-2179-00	C701 to C709, C711, C712, D701 to D704, R701 to R709, R711 to R719 R721 to R723, R726 to R728, TR701 to TR704
	'X' Output PC126	670-2180-00	C1 to C9, C11 to C14, D1 to D7, R1 to R7, R11, R12, R14, R16 to R19, R21 to R29, R31 to R35, TR1 to TR9

	Part Number	Description	Location
1173	131-1557-00	Contact, Earth	
	131-1259-00	Contact, Earth	
	200-1005-00	Cover	
	378-0719-01	Filter	4
	252-0606-00	Foam Rubber, $\frac{1}{4}$" x $\frac{1}{4}$"	CRT
	348-0169-00	Foot, Front (Grey)	
	348-0168-00	Foot, Rear (Grey)	
	348-0160-00	Grommet, $\frac{3}{8}$" id.	EHT
	348-0161-00	Grommet, $\frac{1}{8}$" id.	EHT & CRT
	367-0168-00	Handle	
	136-0311-00	Holder, Bulb	5
	352-0152-00	Holder, Fuse	PC127
	352-0160-00	Holder, Lamp	6
1049	342-0156-00	Insulator, Stand Off	
	003-0674-00	Key, Allen 1·5 mm A/F	7 - 10
888	131-1364-00	Key, Polarizing	Interface
	366-1239-01	Knob, Neutral Grey	7
	366-1254-00	Knob, Grey	8
	366-1255-00	Knob, Red	9
	366-1266-00	Knob, Grey	10
	105-0348-00	Latch, Grey	
	195-0105-00	Lead Set, CRT Deflection (X Plate)	
	195-0106-00	Lead Set, CRT Deflection (Y Plate)	
	210-0291-00	Lug, Pillar	EHT
	004-1142-00	Packaging	Accessory
	386-2407-00	Plate, Spring	
	131-0865-00	Pin, Terminal	CRT X
	134-0135-00	Plug, Mains	
	134-0097-00	Plug, 8 Way	
	213-0248-00	Screw, Socket, 3 x 3 mm	7 - 10
	166-0464-00	Sleeve	Graticule
	131-1325-00	Socket, 8 Way	
	131-1268-00	Socket, 2 mm.	11
	136-0448-00	Socket and Lead, U.K.	
	136-0448-01	Socket and Lead, U.S.A.	
	344-0246-00	Spirel Fix (Push-On)	
	385-0215-00	Spacer, 6 BA x 5·0 mm	PC125
	385-0209-00	Spacer, $\frac{3}{8}$" x 11 mm	
	361-0413-00	Spacer, $\frac{3}{8}$" x 25 mm	
	361-0198-00	Spacer, 6 BA x $\frac{3}{8}$"	EHT
	385-0206-00	Spacer, 6 BA 8 BA x ·5$\frac{3}{8}$	
	361-0202-00	Spacer, 6 BA x 1·0"	
	361-0283-00	Spacer, Mounting	
	361-0197-00	Spacer, 4 BA Clear x $\frac{1}{2}$"	
	214-1080-00	Spring, 1" lg.	Graticule
	252-0607-00	Strip, PVC Edging	CRT Shield
	355-0167-01	Stud, 6 BA x 52 mm	EHT
1030	124-0289-00	Tag strip, 4-way	
	210-0275-00	Tag, Solder, $\frac{3}{8}$"	
	253-0108-00	Tape, PVC Adhesive, 1" wide	CRT
	210-1075-00	Washer, Foot Packing	
	210-1086-00	Washer, Locking	Astig

CHAPTER 6

CIRCUIT DIAGRAMS

To minimize the risk of misinterpretation of component values on circuit diagrams, the decimal point has been replaced by the multiplier or sub-multiplier of the basic unit. For instance. 2·2 megohms is shown as 2M2 and 1·8 picofarads is shown as 1p8.

To aid the reader further, in addition to the block Circuit Reference Table in Chapter 5.1, to locate a component in the circuit diagrams, a table is provided at the top of each circuit diagram, in which the circuit reference will appear, where practicable, directly above the component being sought.

PRINTED CIRCUIT

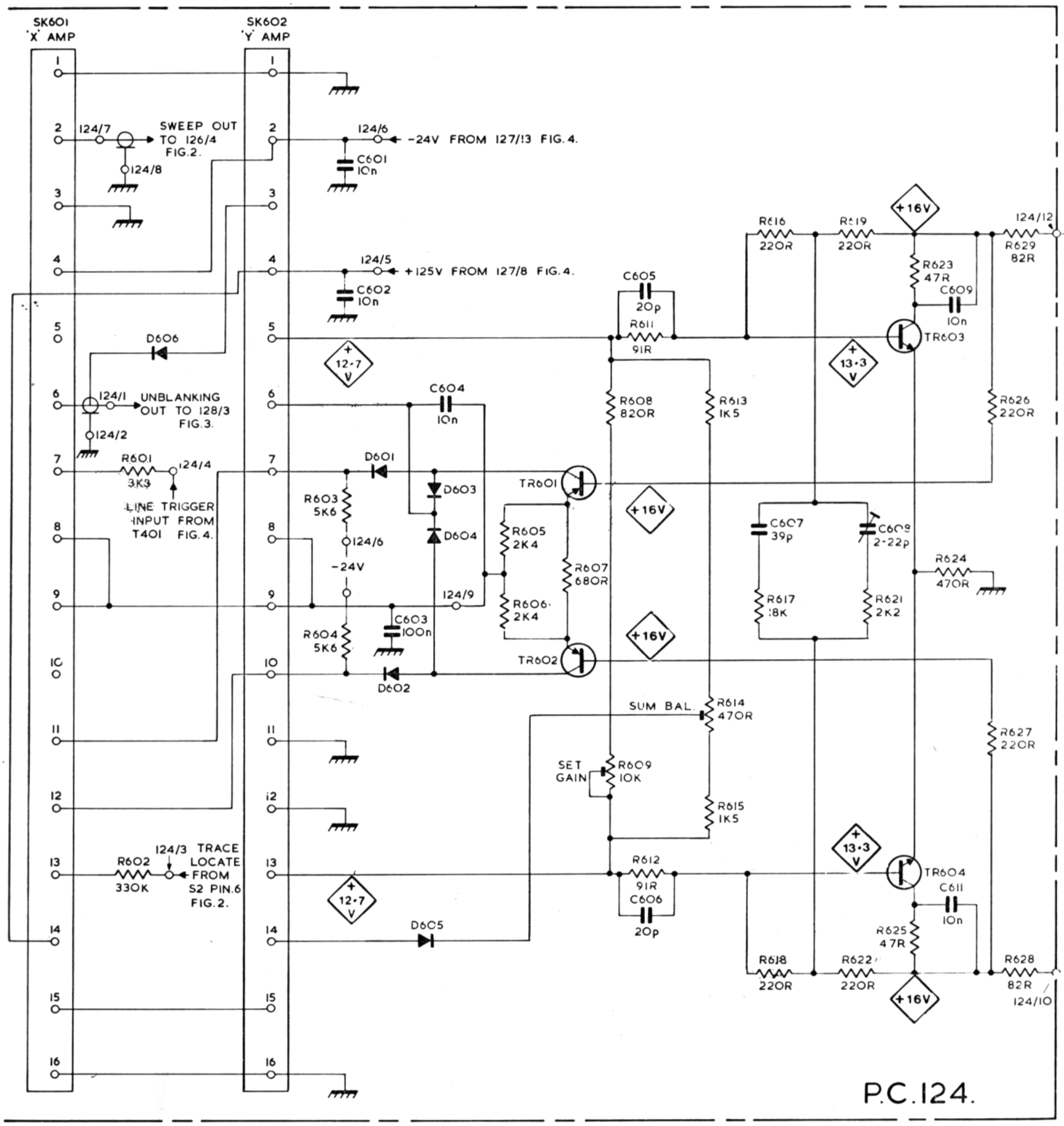
Blue shows the rear track as seen through the board. Yellow the component side track.

Component locations are given on the page preceding the Figure 5.

WAVEFORMS

Waveforms, illustrated in Plate 6/1, may be monitored at point with the corresponding number.

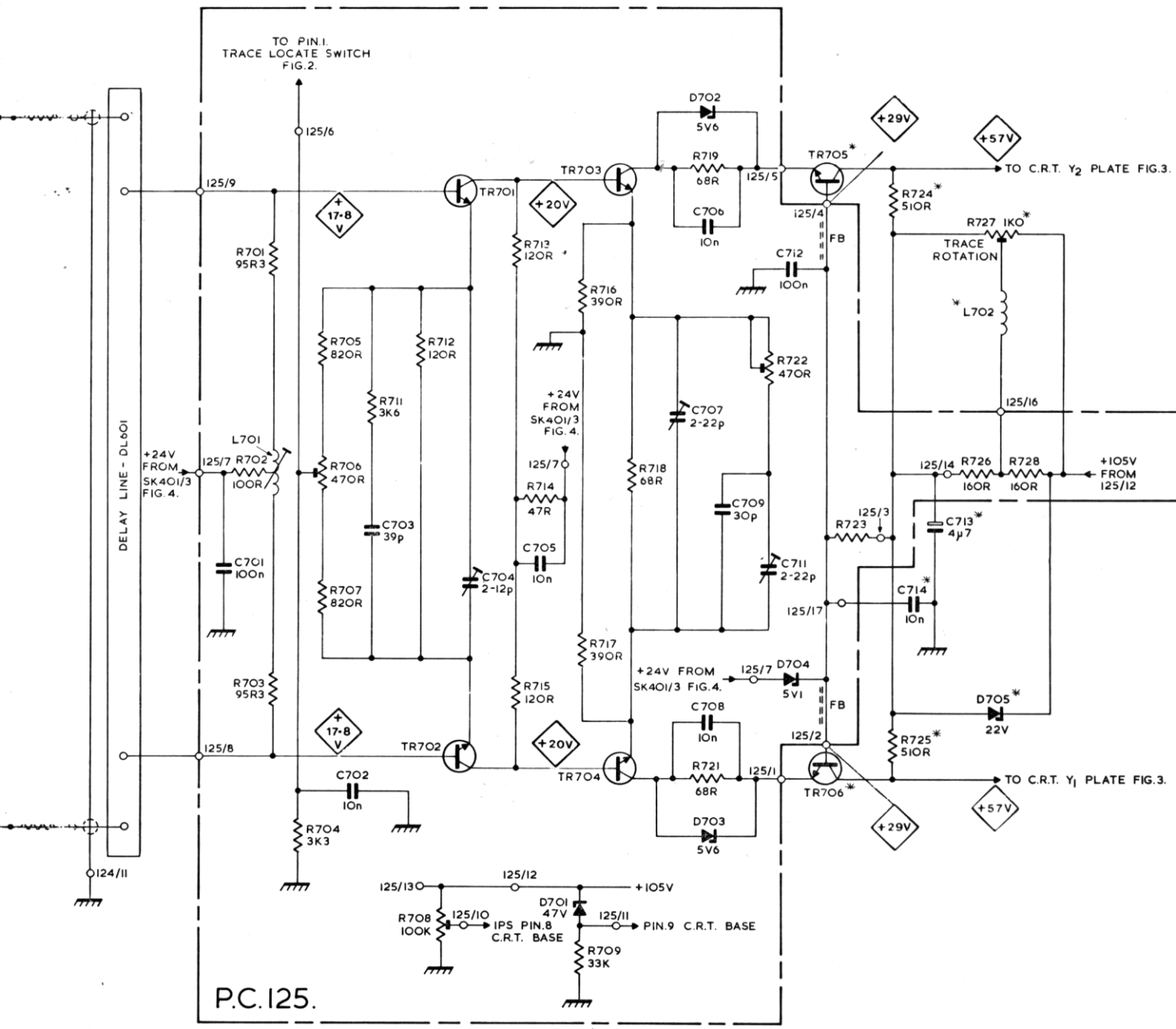
RESISTORS		601 602		603	604	605 606	607	608 611 612 609	613 614 615	616 617 618	619 621 622	623 624 625	626 627	629 628
CAPACITORS				601 602	604			605 606		607	608		609 611	
MISC.	SK601	D606	SK602	D601 D602	D603 D604	D605	TR601 TR602					TR603 TR604		



NOTES.

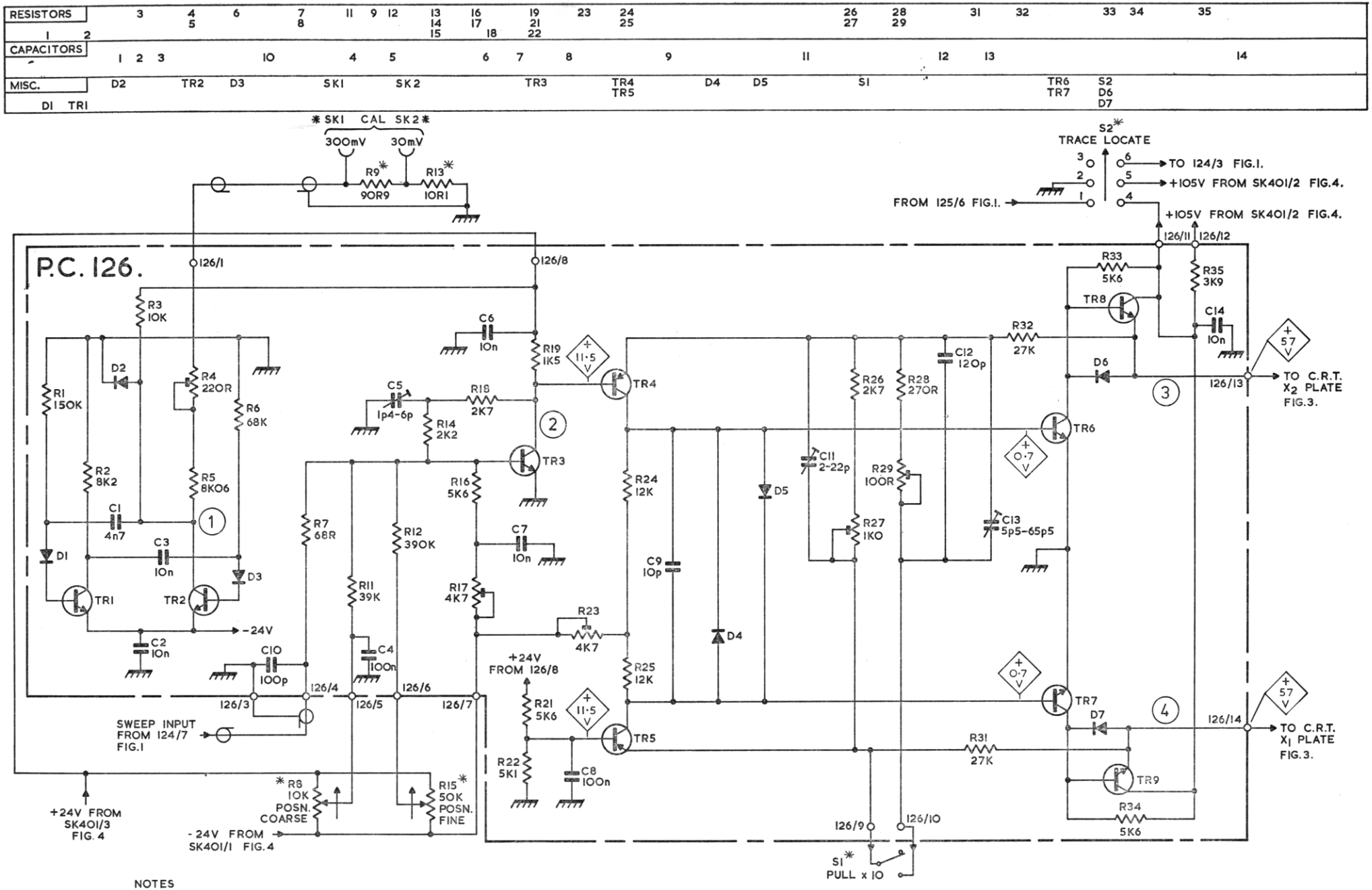
1. * DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD.
2. 124/2 DENOTES P.C. BOARD/EYELET OR TERMINAL No.

	701 704 711 708 713 709 718 719 722 723 724 702 705 712 714 721 725 726 703 706 715 716 727 707 717 728
	701 702 704 705 706 711 713 703 707 709 714 708
DL601	L701 TR701 TR703 D702 TR704 L702 TR702 TR704 TR706 D701 D704 D705



MAIN 'Y' AMPLIFIER — D83

FIG. 1.



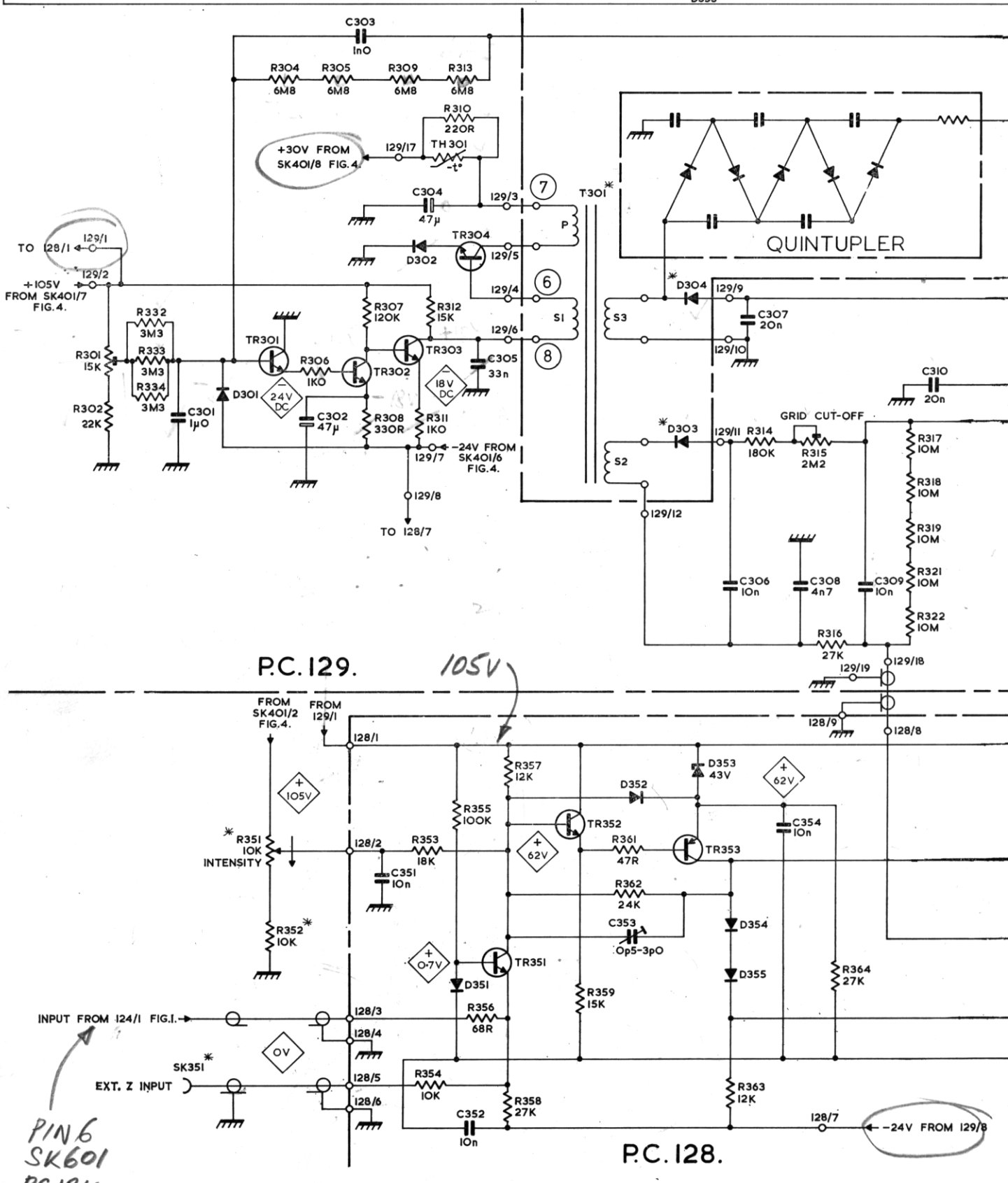
NOTES

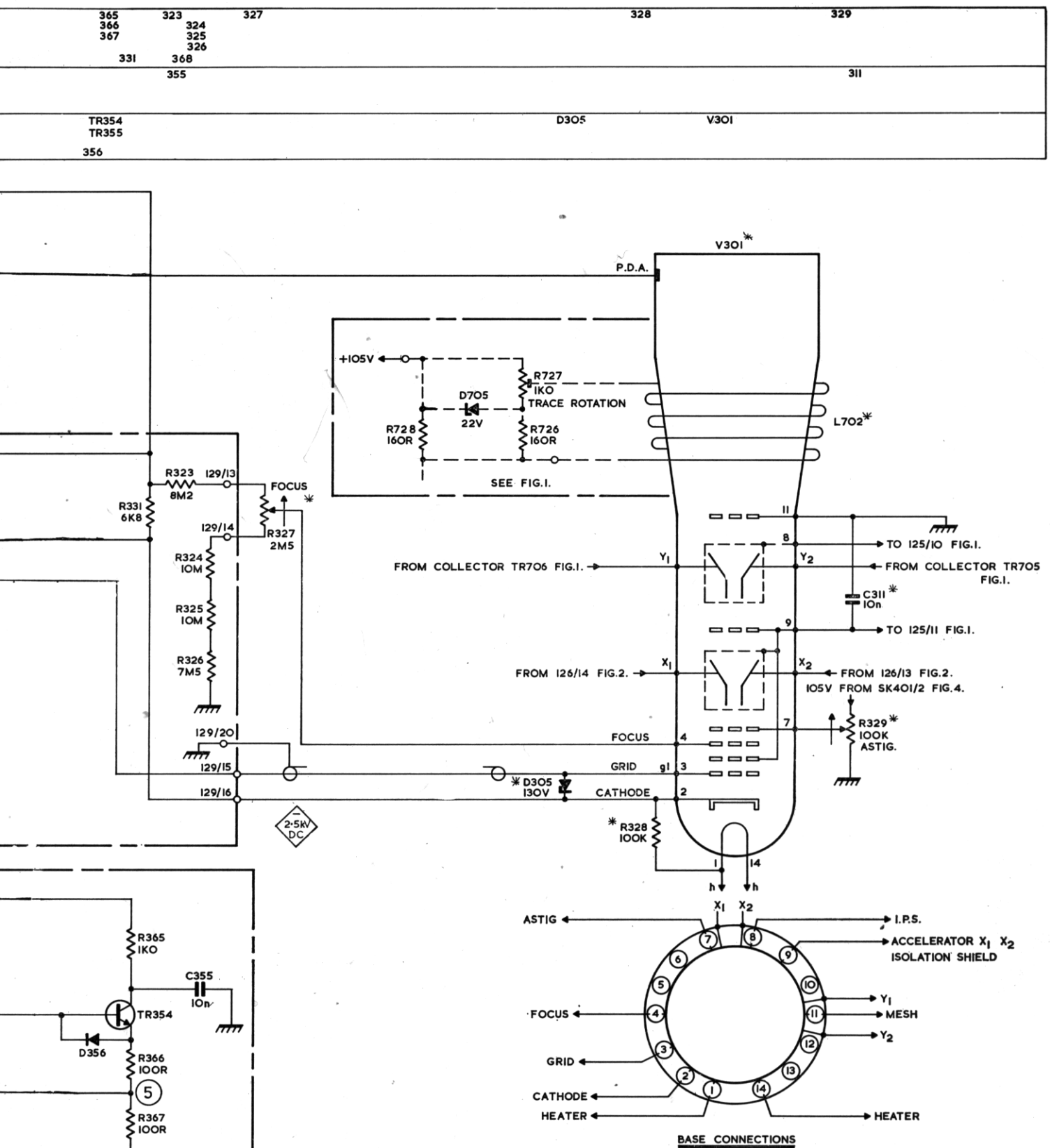
1 * DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD

2 126/2 DENOTES P.C BOARD/ EYELET OR TERMINAL No

'X' AMPLIFIER & CALIBRATOR – D83 FIG. 2.

RESISTORS	301 302 332 333 334 304 351 352 305 306 307 308 309 311 312 313 353 354 355 356 310 357 358 359 361 362 363 314 315 316 364 317 318 319 321 322
CAPACITORS	301 302 303 351 304 352 305 353 306 307 308 354 309
MISC.	SK351 D301 TR301 TR302 TR303 D302 D351 TR304 TH301 TR351 T301 TR352 D303 D304 D352 TR353 D353 D354 D355



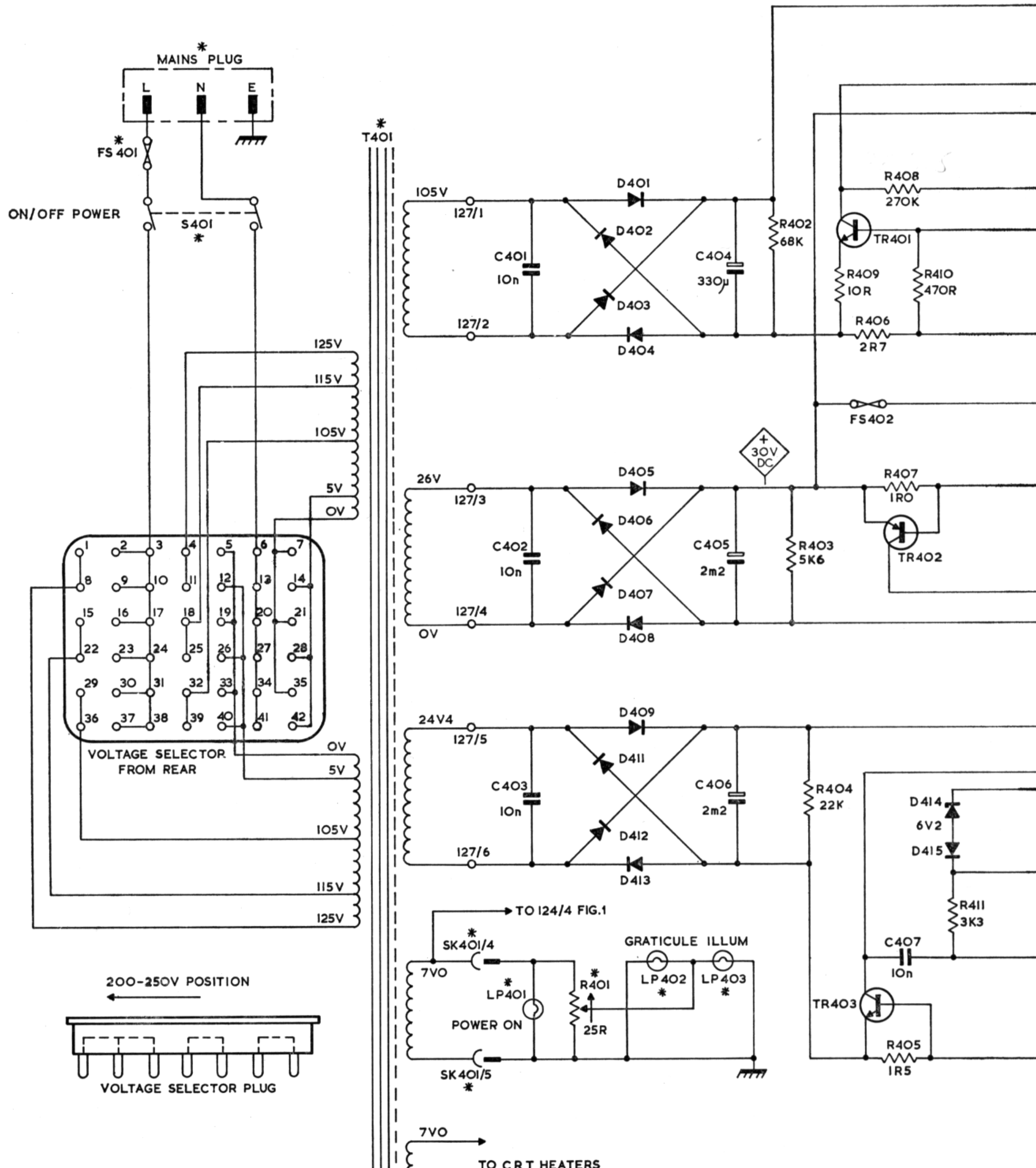


NOTES.
1. * DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD.
2. 128/4 DENOTES P.C. BOARD/EYELET OR TERMINAL No.

QUINTUPLER, E.H.T.-P.C.129, BRIGHT-UP-P.C.128, & C.R.T. — D83

FIG. 3.

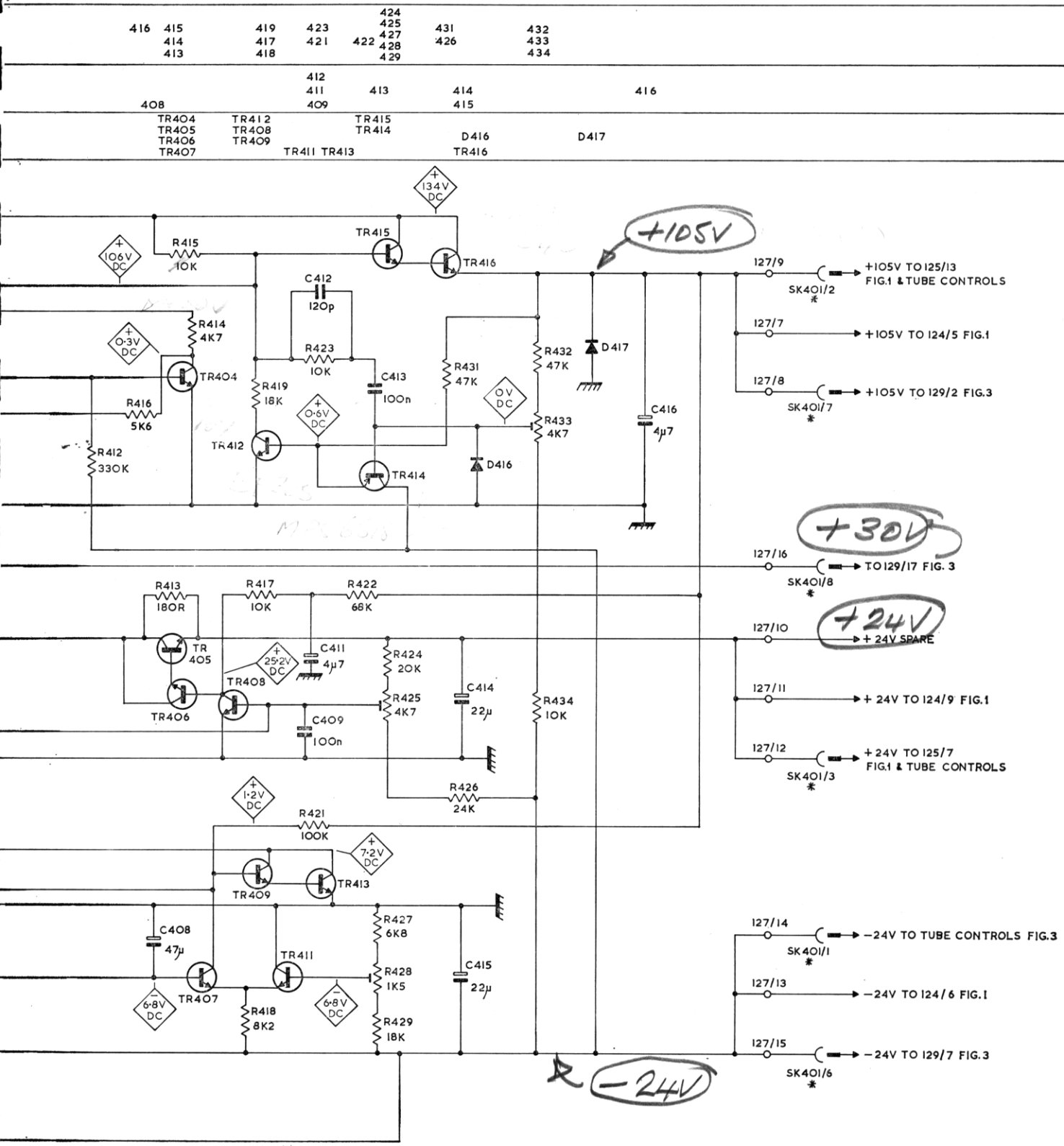
RESISTORS				401		402 403 404	409 408 406 407 410 405	412 411
CAPACITORS				401 402 403		404 405 406	407	
MISC.	FS401	S401	T401		D401 D405 D409 D402 D406 D411 D403 D407 D412 LP402 D404 D408 D413 LP403		TR401 FS402 TR402 TR403	D414 D415



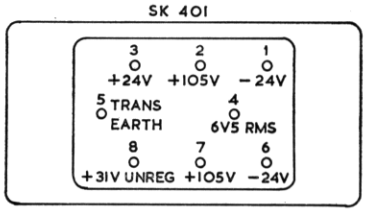
NOTES.

1. * DENOTES COMPONENTS NOT MOUNTED ON PC BOARD
2. 127/2 DENOTES PC BOARD / EYELET OR TERMINAL No

POWER SUPPLY PC127

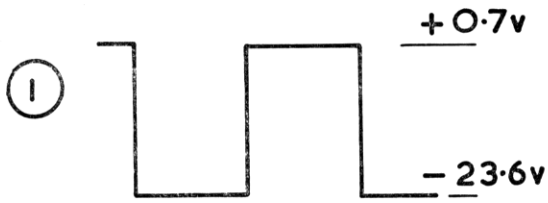


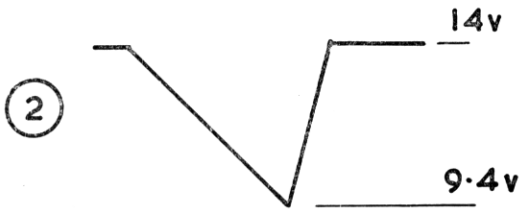
SK 401

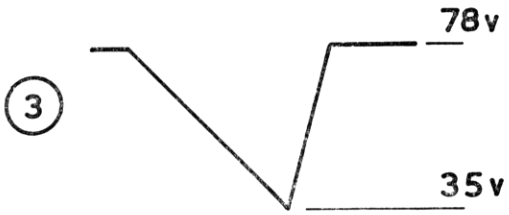


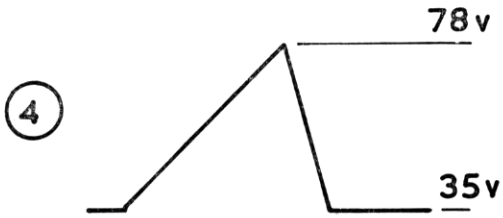
SOCKET CABLEFORM CONNECTION

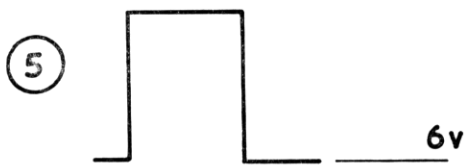
D83 FIG. 4.

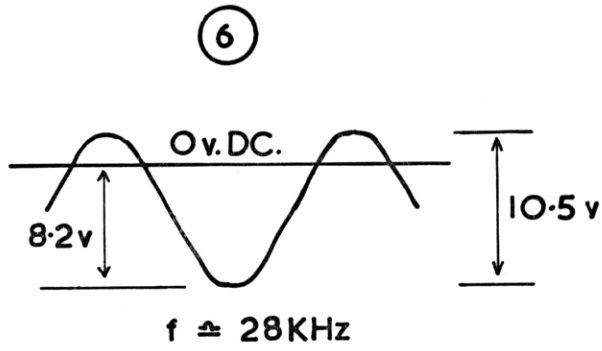

1
+0·7v
−23·6v

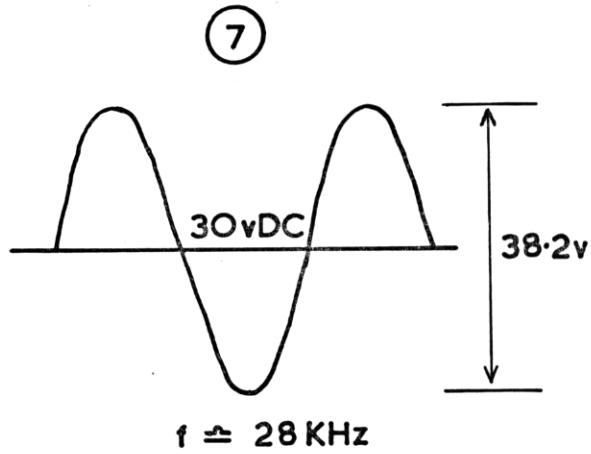

2
14v
9·4v


3
78v
35v


4
78v
35v


5
6v


6
0v.DC.
8·2v
10·5v
f ≙ 28KHz


7
30vDC
38·2v
f ≙ 28KHz

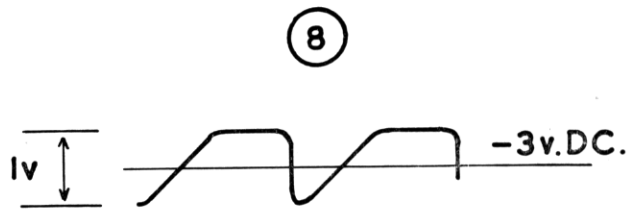

8
1v
−3v.DC.

PLATE 6/1

LOCATION OF COMPONENTS ON PRINTED CIRCUITS

Cir Ref	Grid Location
C1	5—E2
C2	5—E1
C3	5—E1
C4	5—F3
C5	5—G3
C6	5—E3
C7	5—F3
C8	5—E2
C9	5—G2
C10	5—G3
C11	5—G2
C12	5—G2
C13	5—F1
C14	5—G1
C301	6—C3
C302	6—D4
C303	6—C4
C304	6—D5
C305	6—D5
C306	6—B5
C307	6—A3
C308	
C309	6—B5
C310	6—B4
C311	
C351	6—C2
C352	6—C2
C353	6—B1
C354	6—B1
C355	6—B1
C401	6—G2
C402	6—G3
C403	6—G4
C404	6—H2
C405	6—H3
C406	6—H4
C407	6—H5
C408	6—G6
C409	6—E5
C411	6—E6
C412	6—E2
C413	6—F1
C414	6—F6
C415	6—G6
C416	6—E1
C601	
C602	5—B4
C603	
C604	
C605	5—C5
C606	5—C4
C607	5—D5
C608	5—C5
C609	5—C5
C611	5—C4
C701	5—F6
C702	5—E4
C703	5—F5
C704	5—F5
C705	5—F6
C706	5—G6
C707	5—G5
C708	5—G5
C709	5—G5
C711	5—G5
C712	5—G6
C713	
C714	
D1	5—E1
D2	5—E2
D3	5—E2
D4	5—G2
D5	5—G2
D6	5—G1
D7	5—G1
D301	6—D4
D302	6—D6
D303	
D304	
D305	
D351	6—C1
D352	6—C1
D353	6—B1
D354	6—B2
D355	6—B2
D401	6—G2
D402	6—G2
D403	6—G2
D404	6—G3
D405	6—G3
D406	6—G3
D407	6—G3
D408	6—G3
D409	6—G4
D411	6—G4
D412	6—G4
D413	6—G4
D415	6—H6
D414	6—G6
D416	6—F1
D417	6—E1
D601	6—C4
D602	6—C3
D603	6—C3
D604	6—C3
D605	6—B5
D606	6—D2
D701	6—E5
D702	6—G6
D703	6—G4
D704	6—G6
D705	
FS401	
FS402	6—F5
FB	5—G5
L301	
L701	5—E5
L702	
LP401	
LP402	
LP403	
R1	5—E1
R2	5—E1
R3	5—E2
R4	5—E3
R5	5—E2
R6	5—E2
R7	5—G3
R8	Coarse
R9	
R11	5—F3
R12	5xF3
R13	
R14	5—G3
R15	Fine
R16	5—G3
R17	5—F3
R18	5—G3
R19	5—F3
R21	5—F3
R22	5—F2
R23	5—F3
R24	5—G3
R25	5—F2
R26	5—G2
R27	5—F2
R28	5—G2
R29	5—F2
R31	5—F2
R32	5—G1
R33	5—G1
R34	5—F1
R35	5—F1
R301	6—C4
R302	6—C4
R304	6—C3
R305	6—C3
R306	6—C4
R307	6—C4
R308	6—C4
R309	6—C3
R311	6—C5
R312	6—C5
R313	6—B3
R314	6—C5
R315	6—C5
R316	6—A5
R317	6—B6
R318	6—B6
R319	6—B6
R321	6—A6
R322	6—A5
R323	6—B3
R324	6—B4
R325	6—B4
R326	6—A4
R327	
R328	
R329	
R331	6—B4
R332	6—C4
R333	6—C4
R334	6—C4
R351	
R352	
R353	6—C1
R354	6—C1
R355	6—C1
R356	6—C1
R357	6—C1
R358	6—C2
R359	6—C2
R361	6—C2
R362	6—C2
R363	6—B2
R364	6—B1
R365	6—B1
R366	6—B1
R367	6—B1
R401	S401
R402	6—G2
R403	6—G3
R404	6—G4
R405	6—H5
R406	6—H1
R407	6—E4
R408	6—F1
R409	6—H1
R410	6—G1
R411	6—G5
R412	6—G2
R413	6—E4
R414	6—G1
R415	6—F1
R416	6—G1
R417	6—E5
R418	6—G5
R419	6—F1
R421	6—E5
R422	6—E5
R423	6—F1
R424	6—F5
R425	6—F5
R426	6—F5
R427	6—F6
R428	6—F5
R429	6—G5
R431	6—E1
R432	6—F2
R433	6—G2
R434	6—F2
R601	5—C2
R602	5—D2
R603	5—C3
R604	5—C2
R605	5—C4
R606	5—C3
R607	5—C3
R608	5—C5
R609	5—B5
R611	5—C5
R612	5—C4
R613	5—C5
R614	5—B5
R615	5—B5
R616	5—C5
R617	5—D4
R618	5—C4
R619	5—D5
R621	5—C4
R622	5—D4
R623	5—C5
R624	5—D5
R625	5—C4
R626	5—D4
R627	5—D4
R628	5—D4
R629	5—D5
R701	5—E5
R702	5—E6
R703	5—E5
R704	5—F4
R705	5—F5
R706	5—E5
R707	5—F5
R708	5—E4
R709	5—E5
R711	5—F5
R712	5—F5
R713	5—F5
R714	5—F6
R715	5—F5
R716	5—F5
R717	5—G5
R718	5—G5
R719	5—G6
R721	5—G5
R722	5—G5
R723	5—G5
R724	
R725	
R726	5—E6
R727	
R728	5—E6
S1	X10
S2	Trace Locate
S401	On/off
T301	
T401	
TR1	5—E1
TR2	5—E2
TR3	5—G3
TR4	5—G2
TR5	5—F2
TR6	5—G2
TR7	5—F2
TR8	5—G1
TR9	5—F1
TR301	6—C4
TR302	6—C4
TR303	6—C5
TR304	6—C6
TR351	6—C1
TR352	6—C1
TR353	6—B1
TR354	6—B1
TR355	6—B2
TR401	6—G1
TR402	6—E4
TR403	6—H5
TR404	6—G1
TR405	6—D4
TR406	6—D4
TR407	6—H5
TR408	6—E5
TR409	6—E6
TR411	6—G5
TR412	6—E1
TR413	6—D6
TR414	6—F1
TR415	6—E1
TR416	6—D1
TR601	5—D4
TR602	5—C3
TR603	5—C3
TR604	5—C4
TR701	5—F6
TR702	5—F4
TR703	5—F6
TR704	5—G5
TR705	
TR706	
V301	

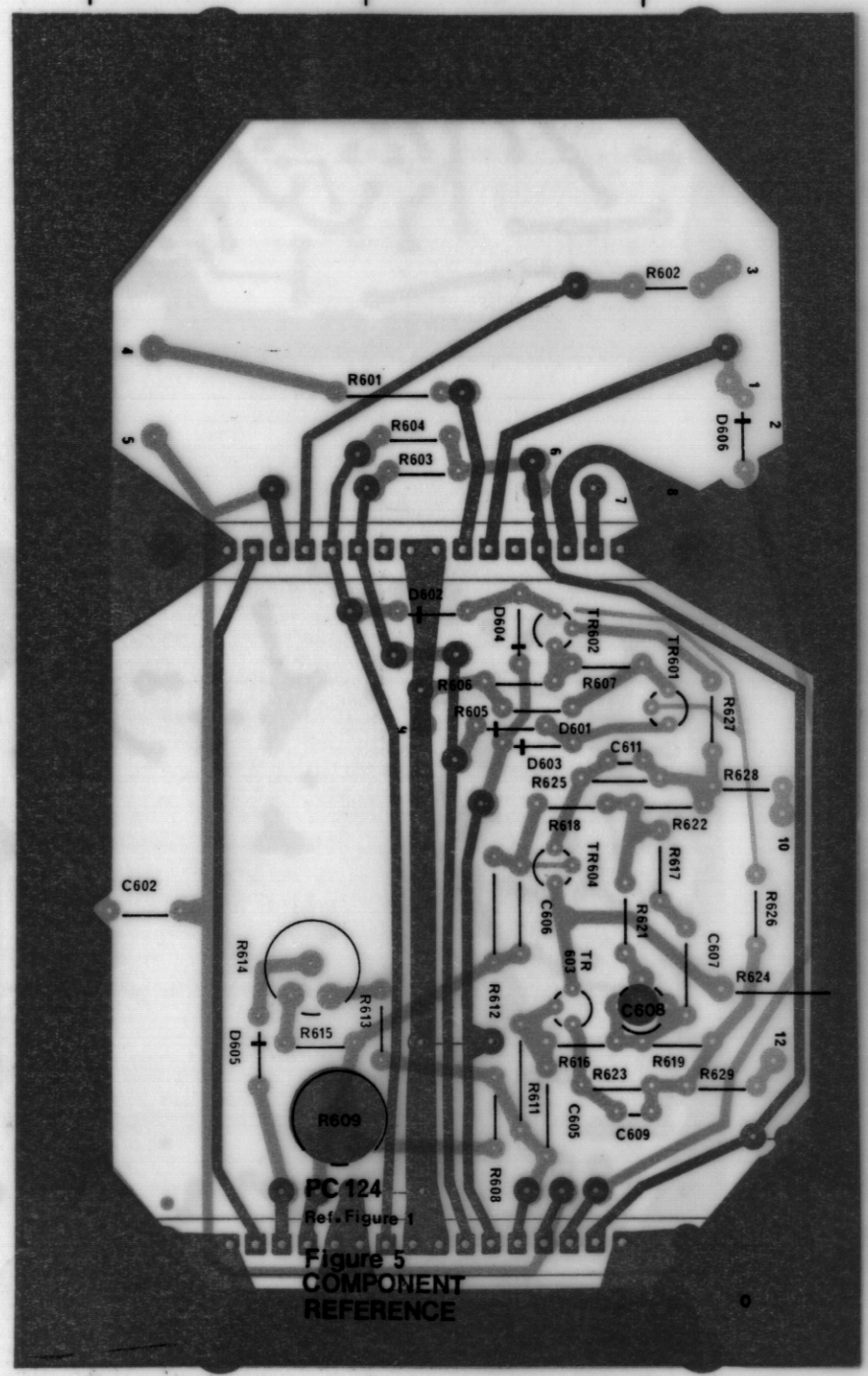
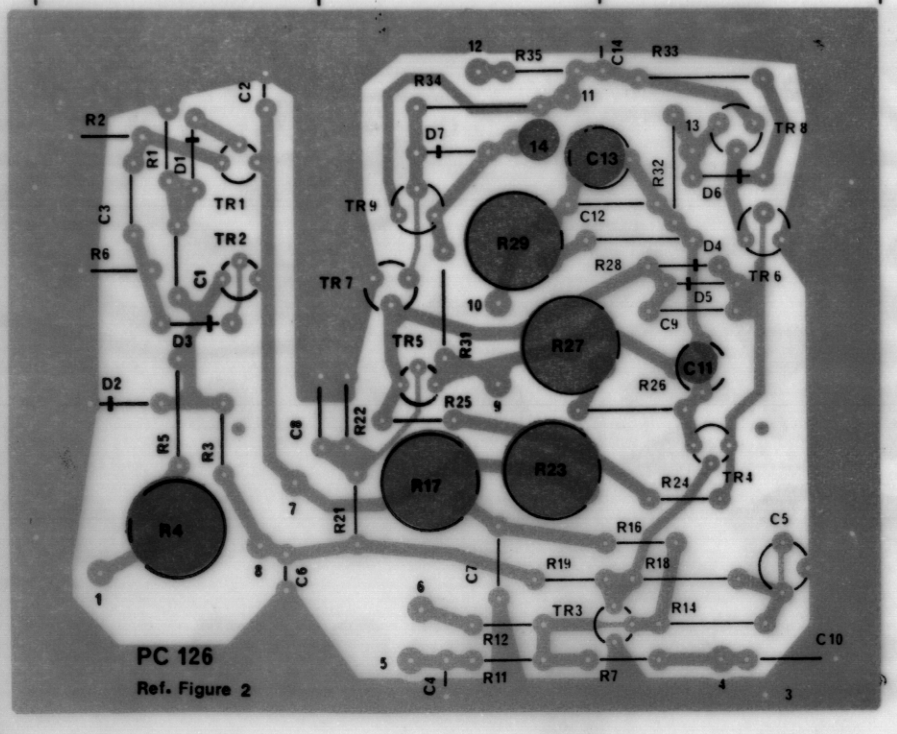
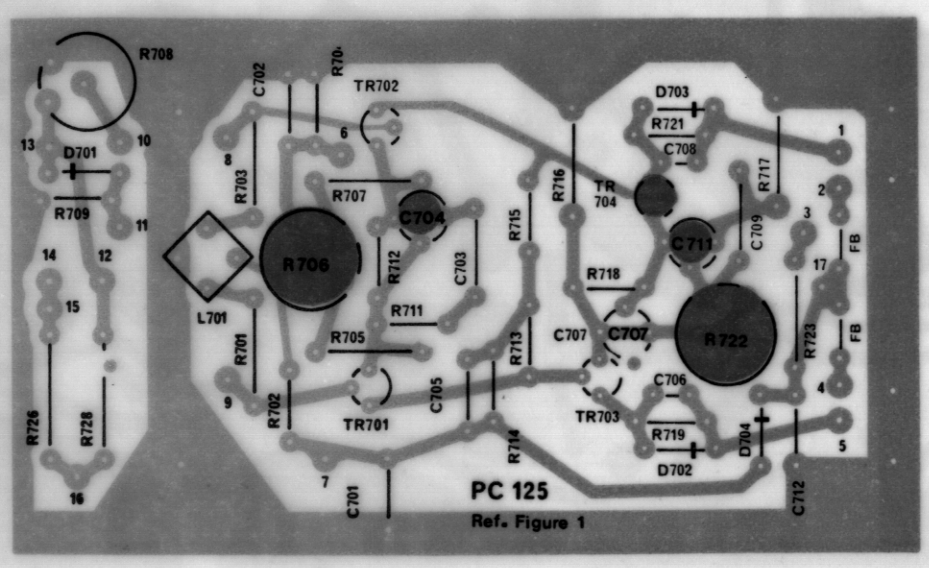


Figure 5
COMPONENT
REFERENCE





PC 127
PC 128
PC129
Figure 6
COMPONENT
REFERENCE

D83 Issue 5

Amendment List 1

The following changes have been introduced. Where possible the instrument serial numbers, from which the changes apply, are given. The corrected information is as follows:-

Manual page 5/6. *R71 number changes to 317-0111-01 and value to 110Ω (Effective from number 523176).

Manual Page	Cir. Ref.	Part Number		Effective Serial No.
5/6	TR6	151-0525-00	SPS5286 Si NPN)	
	TR7	151-0525-00	SPS5286 Si NPN)	
	TR8	151-0525-00	SPS5286 Si NPN)	
	TR9	151-0525-00	SPS5286 Si NPN)	523176
5/7	TR351	151-0525-00	SPS5286 Si NPN)	
	TR354	151-0525-00	SPS5286 Si NPN)	
	TR412	151-0525-00	SPS5286 Si NPN)	
5/8		200-0544-00	Connector, Cap PDA EHT)	523050
		131-0026-00	Connector, PDA Button EHT)	

* See also figure 1.

TELEQUIPMENT ®

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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313 Chase Road
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London N14 6JJ
ENGLAND.

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Telex: 262004
Cables:
TELEQUIPT LONDON N14

TEKTRONIX INC.,
P.O. Box 500
Beaverton,
Oregon (97005)
U.S.A.

Telephone
(503) 644-0161
Telex: 36 0485
Cables:
TEKTRONIX

DUAL SWEEP UNIT
TYPE S2A

INSTRUCTION MANUAL

070-1426-01

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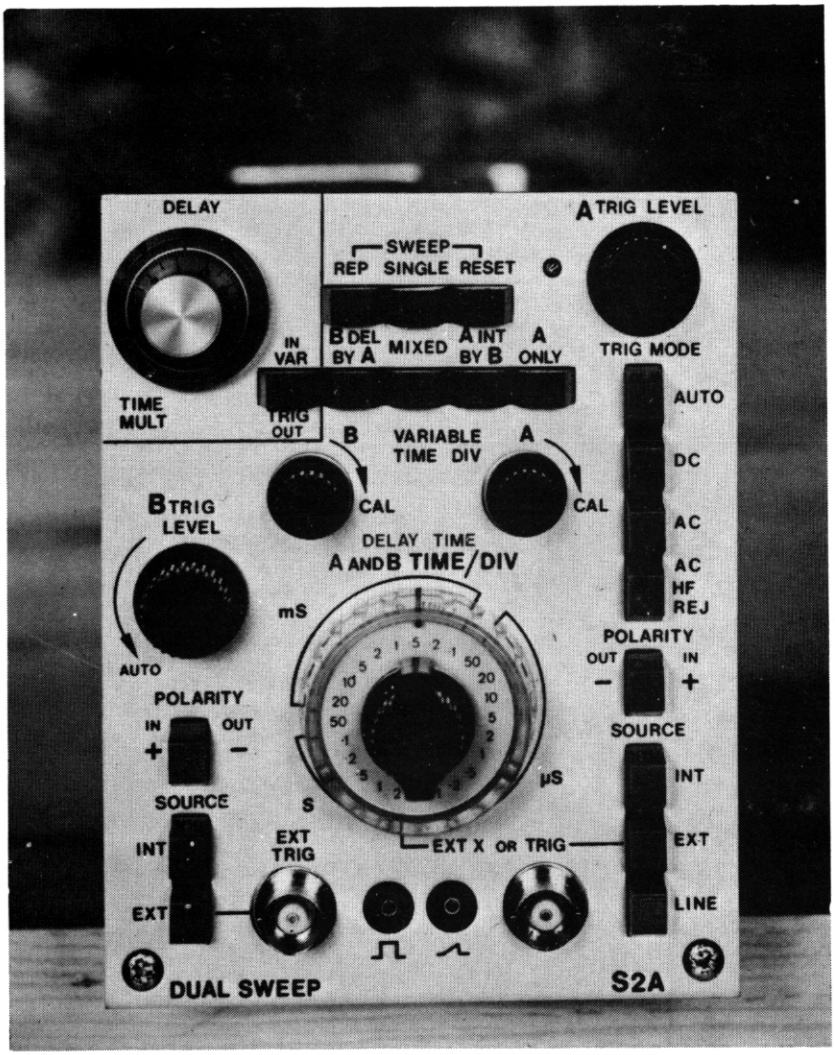
INTRODUCTION

The S2A, a dual sweep plug-in, provides the main frame with a delayed sweep facility to permit close examination of any part of a complex waveform and allows for an accurate time measurement of the input signals.

This manual should be read in conjunction with the plug-in manuals of the units used. References are annotated "MF" and "V" for the main frame and vertical plug-in respectively.

The design of this instrument is subject to continuous development and improvement, consequently this instrument may incorporate minor changes in detail from the information contained herein. This would, in the main, affect the Components List and Circuit Diagrams. The reader should pay particular attention to the notes at the beginning of Chapter 5.



NOTICE TO OWNER

To obviate the risk of damage during transit and facilitate packaging; do NOT send the following items unless they are suspect, should this Instrument be returned to TELEQUIPMENT for servicing.

Manual
Probes
Plug Assemblies

CONTENTS

CHAPTER 1
SPECIFICATION

1.1 OPERATING MODE

A Sweep — Repetitive or Single shot dependent on 'A'

A Intensified by B
B delayed by A
A and B Mixed
Delayed B
  Variable
  Triggered

1.2 TRIGGER

	A	B
Mode		
Auto	Bright line	10 Hz — 10 MHz freerun between 20 & 50 Hz
Level	40 Hz — 50 MHz	
DC	D.C. — 50 MHz	
AC	10 Hz — 50 MHz	
HF reject	10 kHz — 2·0 MHz (−3 dB)	
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
Internal ... ... — from vertical amplifier
External ... ... — from external source
Line ... ... — from power supply Transformer secondary

1.3 SWEEP

Range	2 s — 100 ns/div	1 s — 100 ns/div
Variable (time)	>2·5 to 1	
X10 Speed	10 ns/div max.	
'A' & 'B' Mixed	The 'A' sweep as Time/Div, but the mixed portion sweep speed is calculated from speed $\left(\frac{B}{1 + B/A}\right)$	
Accuracy		
X1	±3%	
X10	±6%	
'A' & 'B' Mixed	The 'A' sweep accuracy is ± 3%. The mixed portion accuracy is ± 3% ± (B/A x 3) %	

1.4 EXT X

Sensitivity	
X1	400 mV/div ±15%
X10	40 mV/div ±20%
Bandwidth	>1 MHz

1.5 DELAY TIME MULTIPLIER

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

CHAPTER 2

OPERATING INSTRUCTIONS

2.1 FUNCTION OF CONTROLS AND CONNECTORS

These are situated on the front panel except where otherwise specified. For those controls not covered below, reference should be made to Chapter 2 of the manuals for the main frame and "V" plug-in.

2.1.1 **CRT** "MF" Manual.

2.1.2 **SWEEP**

A & B TIME/DIV — controls the speed of the respective sweeps. The sweep rates indicated are only valid if VARIABLE is at CAL and X10 is not selected.
If X10 is selected and VARIABLE at CAL, the calibrations should be divided by 10 factor to ascertain the sweep speed.

A & B VARIABLE TIME/DIV — enables speeds between that indicated by the respective TIME/DIVs and the next lower speed to be selected.

REP — pressed, selects repetitive triggering.

SINGLE SHOT — assists in viewing or photographing a non-recurrent signal. If a recurrent signal is applied to the oscilloscope in the SINGLE-SHOT mode, the sweep will run once each time RESET is pressed. When a recurring signal is applied, the timebase should be locked by using LEVEL.

DELAY TIME MULT — varies the point on the 'A' sweep at which the 'B' sweep starts.

DELAY — used in conjunction with 'A INT BY B' or 'B DEL BY A.'

NOTE: For minimum delay jitter, TRIG mode should be used.

VARIABLE — starts the 'B' sweep at the point set by the DELAY TIME MULT, for closer investigation of any part of the waveform displayed.

TRIG — starts the 'B' sweep, on receipt of a suitable triggering signal, after the point set by the DELAY TIME MULT; which, when rotated, causes the bright-up to jump to the same position on the adjacent cycle. Also permits closer investigation of the waveform edge selected by POLARITY.

A ONLY — displays 'A' sweep, 'B' sweep is disabled.

A INT BY B — displays the trace with that part of 'A' sweep covered by 'B' intensified.

B DEL BY A — magnifies the intensified trace permitting closer investigation.

MIXED — pressed displays 'A' & 'B' mixed, the 'B' sweep calibration is affected. See para. 1.3.

2.1.3 **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, permits the 'A' timebase to free run until signal is applied. LEVEL range is reduced to approximately 1 division.

AC or DC — relate to the coupling of the trigger circuit. For very low input frequency DC should be selected.

AC HF REJ. — rejects high-frequency signals, permitting the trigger to respond only 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 amplifiers, or externally via panel BNC socket.

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.

POLARITY }
SOURCE } see above.

2.1.4 **VERTICAL** "V" Manual.

2.1.5 **CONNECTORS**

INPUT

A EXT TRIG & EXT X is the right hand BNC connector of the pair on the front panel. This enables either external triggering signals to be applied by selection adjacent EXT source 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 kΩ.
For amplification of the horizontal display refer to "MF" Manual.

B EXT TRIG is the left hand BNC connector of the pair on the front panel. This enables an external trigger signal to be AC connected to the 'B' Timebase.

OUTPUTS

SAWTOOTH provides a positive-going ramp waveform when the 'A' sweep is running. A recurring sawtooth is produced when AUTO is selected.

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

2.2 PRE-OPERATIONAL CHECKS

Note: Reference should be made to the 'MF' and 'V' manuals for control setting and operation.

2.2.1 **POWER SUPPLY.** See 'MF' Manual.

2.2.2 **CONTROL SETTINGS**

1. CRT. See 'MF' Manual.
2. Set controls as follows:

SWEEP	REP
A ONLY	Depressed
TIME/DIV	5 ms
VARIABLE	Fully clockwise
TRIG MODE	Auto
POLARITY	Depressed
SOURCE	INT

2.3 OPERATION. See 'MF' Manual.

CHAPTER 3
CIRCUIT DESCRIPTION

3.1.0 GENERAL

3.1.1 The S2 dual sweep unit generates precision timing currents which, when applied to the sweep amplifier, reference Figure 2 and the bright-up amplifier, reference Figure 3, enable the CRT to display a highly accurate sweep of controlled intensity.

3.1.2 The unit consists of a master sweep current generator, known as the 'A' sweep and a subsidiary sweep current generator, the 'B' sweep, both incorporating an integral bright-up current generator. Individual trigger amplifiers are able to accept internal or external trigger signals, which control the start point of each sweep together with a comprehensive switching system to enable a wide variety of display modes to be selected by the user. The complete unit is constructed in modular form, all power supplies and signal outputs being transferred via a single 16 way edge connector extending to the rear of the plug-in.

3.2.0 'A' SWEEP TRIGGER AMPLIFIER

3.2.1 This amplifier 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 plug-in edge connexion part of PC133 then to the balanced trigger amplifier, TR3 and TR4, via D.C. blocking capacitors, C3 and C4, the INT/EXT, switch, S1, the POLARITY switch, S2, and terminating resistors, R13 and R31.

3.2.2 TR3 and TR4, form a long-tailed pair amplifier. When S3d 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 and 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.

3.2.3 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.

3.2.4 Unbalanced trigger signals, originating from any external source, are applied to the sweep unit via co-axial socket SK1 at an input impedance of 100 kΩ. 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 main frame. The latter is connected when the 'B' TIME/DIV Switch 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 DC adjustment of the level of external signals to the same as that of internal signals. TR1 and TR2 supply voltage is derived from a twin zener regulator, D3 and D8, fed from the main +24 V line via R12.

3.2.5 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.

3.3.0 'A' SWEEP GENERATOR

3.3.1 This system is a conventional Miller Integrator, TR66 and TR67, forming a basic ramp generator, reference Figure 2. Ramp slope is determined by selection of timing capacitors C275 to C279, C281 and C282 reference Figure 3 and timing resistors R276 to R283, R287 and R289 mounted on the 'A' TIME/DIV switch, S271; R191 provides calibration facilities.

3.3.2 Trigger pulses from the 'A' Trigger amplifier are passed through a differentiating network R41 and L61. D64, being marginally biassed 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 spike being applied to TR64 causes it to conduct; the feedback action via the coupled emitter, R76 and C66, switches TR63 off. It's 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 via socket SK61.

3.3.3 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, D6[illegible] and D71 and allows the current through the timing resistors to flow into the timing capacitors.

3.3.4 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, via S271, S192 and SK271 on the front panel, 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.

3.3.5 The ramp terminates when TR68 base potential rises to the same value as TR69 base potential, switching TR68 on, 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 rapidly to the quiescent condition.

3.3.6 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 reference Table, which holds 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 states, permitting the gating bistable, TR63 and TR64, to be receptive to a trigger signal which initiates another sweep.

3.4.0 BRIGHT-LINE AUTO

3.4.1 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 biassed and exerts no influence on the base bias of TR63.

3.4.2 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 run free, in the absence of trigger signals, giving visual indication of the trace position.

3.4.3 Upon the application of positive and negative trigger pulses from the 'A' Schmitt amplifier, via C61; D61 being marginally forward biassed 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.

3.5.0 UNBLANKING AMPLIFIER

3.5.1 The unblanking pulse amplifier 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 biassed by D66; suppressing CRT beam current. At the commencement of sweep, D66 is reverse biassed 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, 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, R218 and R198.

3.6.0 'B' SWEEP TRIGGER AMPLIFIER

3.6.1 This amplifier can accept balanced trigger signals originating in the vertical amplifier system or single-ended A.C. coupled external signals via a panel co-axial socket SK151.

3.6.2 Balanced signals are fed into a high impedance input from a balanced 150 Ω transmission line terminating at the 'A' trigger amplifier. C151 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.

3.6.3 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 wave form 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.

3.6.4 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 wire pair across R151.

3.7.0 'B' SWEEP GENERATOR

3.7.1 This system is a conventional Miller integrator TR196 and TR197 forming a basic ramp generator, reference Figure 5. The ramp slope is determined by selection of timing capacitors C251 to C257 reference Figure 3 and timing resistors R251 to R258 mounted on the 'B' TIME/DIV. switch S251. R236 provides a calibration facility. 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.

3.7.2 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 at 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.

3.7.3 When S191a is in the VAR position, the D.C. bias on TR193 is such that the negative step applied causes to switch on TR193 and TR194 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 is caught just below ground potential by D194, D196 and R197 and are instantly back biassed, TR196 through Miller action commences to generate the 'B' ramp voltage.

3.7.4 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.

3.7.5 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 edged 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.

3.7.6 During the period of the 'B' sweep, D198 is forward biassed and current from the unblanking amplifier then flows to the −24 V line via R222, D203, R218 and S192d. The 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 currents by R230 and R233 respectively, suitable for application to the 'X' amplifier. S192a, S192c and 192d or all three select either 'A', 'B' or MIXED.

CHAPTER 4

MAINTENANCE AND CALIBRATION

4.1.0 GENERAL

4.1.1 This manual should be read in conjunction with the manuals for the main frame and plug-in in use.

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 components are replaced, e.g., transistors, it is advised that the calibration checks detailed in para. 4.4.0 be carried out.

4.2.0 MECHANICAL

4.2.1 **ACCESS TO INTERIOR**

Withdraw plug-in and remove covers.

4.2.2. **LOCATION OF PRESET CONTROLS**

'A' Sweep and Trigger (PC132) are situated on the right. 'B' Sweep and Trigger (PC133) on the left.

4.3.0 CALIBRATION

4.3.1 The following procedure enables a calibration check of the plug-in to be accomplished. It is advised, that isolated adjustments are not made, due to risk of interaction with settings made in earlier checks. A functional check may be carried out as detailed in para. 4.4 below. Checking parameters are met, then proceeding to the next check. Adjustments, if made, should be minimal.

The following tools and facilities will be required:

TOOLS

Screwdrivers	Plain 4 mm. blade. Non-capacitive.
Fixture	Extension, Flexible, 067-0688-00. Rigid, 067-0689-00.
Adaptors	Screened c/w BNC Adaptors, BNC 3-way, Male/Female/Male.

Probe X10 c/w earth lead.
Oscilloscope Monitor.
Pliers flat nose.
Terminator 50 Ω

FACILITIES

Variable voltage supply (Variac).

Input Signals Sinewave		Squarewave 25 mV 1 MHz	Markers 100 ms
300 mV	50 kHz		1-2-5 sequence.
1 V	50 kHz		from 0·1 μs
2 V	50 kHz		through 2 S.
	50 kHz		
	100 kHz		
	10 MHz		
0·5 mV	10 MHz		
	55 MHz		
25 mV	20 MHz		
	A.C. Line		

4.3.2 **INITIAL SETTING**

(a) Set DELAY TIME MULT to 5·0.
(b) Push REP, VAR, A ONLY, AUTO and both INTs.
(c) Depress both POLARITYs.
(d) Turn both VARIABLEs (Time) fully clockwise.
(e) Turn 'B' LEVEL fully anti-clockwise.
(f) Set both TIME/DIVs to 0·5 μs.

Note: Reference should be made to "MF" and "V" manuals for the respective initial control settings.

4.4.0 CALIBRATION PROCEDURE

4.4.1 **'A' TRIGGER**

Note 1: 'A' controls are used, unless otherwise specified.

Note: 2: Withdraw plug-in and connect to Main Frame with extension lead 195-0112-00. Remove plug-in covers.

1.0 Check Sensitivity.

1.1 Push REP, VAR, A ONLY, AC and INT.
1.2 Depress POLARITY.
1.3 Set TIME/DIV to 1 ms.
1.4a Connect 300 mV, 50 kHz sinewave to "V" input.
b Set VOLTS/DIV to give 2 div amplitude.
c Set DC-GND-AC to AC.
1.5 Connect Monitor Oscilloscope (M.O.) via screened X10 probe, to R35 (Grid 6-E3).
1.6 Set M.O., reference Plate 4.1.
1.7 Observe M.O. trace similar to Plate 4.1.
1.8 Adjust LEVEL to obtain M.O. trace.
1.9 CHECK "Y"=80 mV (0·4 div).
1.10 Adjust R36, PC132 to correct "Y" (Plate 4.1).
1.11 Release POLARITY.
1.12 CHECK.
1. Change of "Y" $<\pm 10$ mV (Plate 4.1).
2. Trace commences on negative slope.

2.0 Check Level range.

2.1 Push REP, VAR, A ONLY, AUTO and INT.
2.2 Depress POLARITY.
2.3a Connect 1 V, 50 kHz sinewave to "V" input.
b Set VOLT/DIV to 1 V.
c Set DC-GND-AC to DC.
2.4 Set TIME/DIV to 10 μs.
2.5 Rotate LEVEL to range extremities.
2.6 Observe trace may freerun at extremities only.
2.7 Adjust R26, PC132, to correct.

3.0 Check external trigger.

3.1 Repeat Ops. 2.1 and 2.2.
3.2 Connect 2 V, 50 kHz to EXT X and "V" input.
3.3 Release and depress POLARITY.
3.4 Observe start of trace coincide.
3.5 Adjust LEVEL for trace trigger point to coincide.
3.6 Push EXT.
3.7 CHECK trigger point coincides with Op. 3.4.
3.8 Adjust R7, PC132, to align trigger point, Ref. Op 3.4.
3.9 Reduce Signal Generator voltage.
3.10 Observe trace stable at 300 mV.
3.11 Push DC, AC then AC H/F REJ.
3.12 Observe trace stable at each TRIG MODE (Op. 3.12).
3.13 Push INT.
3.14 Reduce trace to 0·2 div.
3.15 Repeat Op. 3.11 and 3.12.

4.0 Check EXT. X.

4.1 Push REP, VAR, A ONLY, DC and INT.
4.2 Depress POLARITY.
4.3 Turn 'B' TIME/DIV fully anti-clockwise.
4.4 Link EXT. X to 'V' input.
4.5a Set VOLTS/DIV to 1 V.
b Connect 100 kHz sinewave to link (Op. 4.4).

4.6 Increase signal voltage till trace cross extreme verticals.
4.7 CHECK
1. Vertical difference between trace extremities $=4\pm0{\cdot}8$ Div.
2. Trace for ellipticity.
4.8 Adjust Twisted Pair, PC132, to minimize ellipticity.
4.9 Set DC-GND-AC to GND.
4.10 Adjust Signal voltage to give 5 div trace.
4.11 Increase Signal frequency to reduce trace to 3·5 divisions.
4.12 CHECK frequency $\geqq$1·4 MHz.
4.13 Push AUTO and INT.
4.14 Turn 'B' TIME/DIV clockwise.
4.15 Set DC-GND-AC to DC.
4.16 Set TIME/DIV to 0·1 μs.
4.17 Connect 55 MHz sinewave to 'V' input.
4.18 Adust LEVEL for locked trace.
4.19 CHECK amplitude $\leqq$0·5 divisions.
4.20 Repeat Ops. 3.11 and 3.12.
4.21 Connect 55 MHz sinewave to EXT.
4.22 Turn 'B' TIME/DIV to fully anti-clockwise.
4.23 Increase signal voltage for a trace.
4.24 CHECK voltage $<$500 mV.
4.25 Repeat Ops. 3.11 and 3.12.

5.0 Check H.F. rejection
5.1 Repeat Ops. 1.1 and 1.2.
5.2a Connect 20 MHz sinewave to 'V' input.
b Set VOLTS/DIV to give 8 div trace.
5.3 Set TIME/DIV to 0·2 μs.
5.4 Adjust LEVEL to lock trace.
5.5 Push HF/REJ.
5.6 Adjust LEVEL.
5.7 Observe (i) trace unlockable.
(ii) a single sweep at mid-range approx.

6.0 Check Line Trigger.
6.1 Repeat Ops. 2.1, 2.2 and push LINE.
6.2a Connect AC line sinewave to 'V' input.
b Set VOLTS/DIV to give 8 div trace.
6.3 Adjust LEVEL for locked trace.
6.4 Release and depress POLARITY.
6.5 Adjust LEVEL.
6.6 Observe trace locks in each POLARITY (Op. 6.4).

4.4.2 'A' SWEEP

Note: 'A' controls are used, unless otherwise specified.

1.0 Check timing.
1.1 Repeat para. 4.4.5, Ops. 2.1 and 2.2.
1.2 Turn VARIABLE fully clockwise.
1.3 Set TIME/DIV to 1 ms.
1.4a Connect 1 ms Marker Signal to 'V' input.
b Set VOLTS/DIV to give 2 div trace.
1.5 CHECK Marker/Graticule alignment.
1.6 Adjust R91, PC132 to correct alignment.

2.0 Check Pedestal voltage.
2.1 Repeat para. 4.4.5, Ops. 2.1 and 2.2.
2.2a Connect 1 ms marker signal to 'V' input.
b Set VOLTS/DIV to give 2 div trace.
2.3 Turn VARIABLE fully clockwise.
2.4 Set Monitor Oscilloscope (M.O.), reference Plate 4.2.
2.5 Connect M.O. probe to pin 33 (Grid 6-H2).
2.6 Check Y1 $=15\pm0{\cdot}2$ V.
Y2 $=2\pm0{\cdot}5$ V.

3.0 Check stability.
3.1 Repeat para. 4.4.5, Ops. 1.1 and 1.2.
3.2a Connect 2 V, 50 kHz to 'V' input.
b Set VOLTS/DIV to 1 V.
3.3 Set TIME/DIV to 10 μs.
3.4 Adjust LEVEL.
3.5 Observe trace locks.
3.6 Turn R73, PC132, clockwise until trace freeruns
3.7 Note slot position.
3.8 Turn R73 anti-clockwise until trace disappears.
3.9 Note slot position.
3.10 Set R73 to centre of Ops. 3.7 and 3.9.

4.0 Check length.
4.1 Repeat para. 4.4.5, Ops. 1.1 and 1.2.
4.2 Set DC-GND-AC to GND.
4.3 Set TIME/DIV to 0·1 ms.
4.4 CHECK trace length $=10{\cdot}4$ div.
4.5 Adjust R105, PC132, to correct length.

5.0 Check H.F. timing.
5.1 Repeat para. 4.4.5, Ops. 1.1 and 1.2.
5.2a Connect 10 MHz sinewave to 'V' input.
b Set VOLTS/DIV to give 3 div. trace.
5 3 Set TIME/DIV to 0·1 μs.
5.4 CHECK peak/graticule alignment.
5.5 Adjust C281; T/D switch (adjacent to R36, Grid 6-F2) to correct alignment.
5.6 Connect Marker Signals to 'V' input to correspond with TIME/DIV.
5.7 Repeat Ops. 5.4 and 5.6 at each TIME/DIV position.
5.8 Adjust R91, PC132, to equalize maximum errors.

6.0 Check Single Shot.
6.1 Repeat para. 4.4.5, Ops. 1.1 and 1.2.
6.2a Connect 100 ms Marker Signal to 'V' input.
b Set VOLTS/DIV to give 0·5 div trace.
c Set DC-GND-AC to AC.
d Push AC.
6.3 Set TIME/DIV to 0·2 s.
6.4 Push SINGLE.
6.5 Observe neon extinguishes at end of sweep.
6.6 Set DC-GND-AC to GND.
6.7 Push RESET.
6.8 Observe Neon alight, no sweep.
6.9 Set DC-GND-AC to AC.
6.10 Observe Neon alight for period of sweep.

7.0 Check Hold-off time.
7.1 Set DC-GND-AC to GND.
7.2 Push AUTO and REP.
7.3 Connect M.O. probe to pin 33 (Grid 6-H2).
7.4 Set TIME/DIV to 10 ms, 0·1 ms, 10 μs, and 0·5 μs.
7.5 Set M.O. TIME/DIV, reference Plate 4.3.
7.6 Check 'X' = 2 to 4; 1·2 to 2·4; 1·2 to 2·4; 1 to 2 div respective, reference Plate 4.3.
7.7 Adjust R108, PC132, for optimum hold-off time.

4.4.3 'B' TRIGGER

Note: 'B' controls are used, except where otherwise specified.

1.0 Check internal setting.
1.1 Set DELAY TIME MULT (DTM) to 5.
1.2 Push REP, VAR, A INT BY B, AUTO and both INTs.
1.3 Depress POLARITY.
1.4 Turn LEVEL fully anti-clockwise.
1.5 Set TIME/DIVs 'A' 10 μs, 'B' 5 μs.
1.6a Connect 1 V, 50 kHz sinewave to 'V' input.
b Set VOLTS/DIV to 1 V.
c Set DC-GND-AC to AC.
1.7 Adjust 'A' LEVEL for locked trace.
1.8 Set M.O., reference Plate 4.1.
1.9 Connect M.O. probe to junction R166/R168 (Grid 6-F5).
1.10 Observe M.O. trace is similar to Plate 4.1.
1.11 Adjust R159, PC133, to obtain M.O. trace.

Note: If R159 at end of range, change over TR151 and TR152 (Grid 6-E2).

1.12 CHECK 'Y'=60 mV (0·3 div).
1.13 Adjust R173, PC133, to correct 'Y'.
1.14 Connect M.O. probe to C195 (Grid 6-F4).
1.15 CHECK M.O. trace=1·25±0·25 V.
1.16 Reduce 'V' input to give 0·2 div trace.
1.17 Connect M.O. probe to C195 (Grid 6-F4).
1.18 CHECK M.O. trace for equal mark/space ratio.
1.19 Adjust R159 to correct mark/space ratio.
1.20 Release POLARITY.
1.21 Repeat Op. 1.18.
1.22 Push EXT.
1.23 Set M.O. TIME/DIV to 10 ms.
1.24 CHECK M.O. squarewave trace=35±15 cycles.
1.25 Set M.O. TIME/DIV to 10 μs.
1.26 Push INT.
1.27 Adjust LEVEL.
1.28 Repeat Op. 1.18.
1.29 Disconnect M.O.

4.4.4 'B' SWEEP

Note: 'B' controls are used unless otherwise specified.

1.0 Check Timing.
1.1 Repeat para. 4.4.1, Ops. 1.1 through 1.4.
1.2 Turn both VARIABLEs (speed) fully clockwise.
1.3 Set TIME/DIV 'A' 2 ms, 'B' 1 ms.
1.4a Connect 1 ms Marker Signal to 'V' input
b Set VOLTS/DIV to 2 div trace.
1.5 Set DTM to 0·5.
1.6 Push B DEL BY A.
1.7 CHECK marker/graticule alignment.
1.8 Adjust R236 to correct alignment.

2.0 Check Pedestal voltage.
2.1 Repeat para. 4.4.7, Ops. 1.1 through 1.4.
2.2a Connect 1 ms Marker Signal to 'V' input.
b Set VOLTS/DIV to give 3 div trace.
2.3 Turn VARIABLE fully clockwise.
2.4 Set M.O., reference Plate 4.2.
2.5 Connect M.O. probe to pin 16 (Grid 6-G4).
2.6 Check Y1=15·5±0·5 V.
Y2= 2·0±0·5 V.

3.0 Check H.F. timing.
3.1 Repeat para. 4.4.7, Ops. 1.1 through 1.4.
3.2a Connect 10 MHz sinewave to 'V' input.
b Set VOLTS/DIV to give 2 div trace.
3.3 Set TIME/DIVs; 'A' 0·2 μs, 'B' 0·1 μs.
3.4 Adjust DELAY TIME MULT (DTM) for first peak/graticule alignment.
3.5 CHECK peak-graticule alignment.
3.6 Adjust C255, T/D switch for optimum alignment.

4.0 Check range calibration.
4.1 Repeat para. 4.4.7, Ops. 1.1 through 1.4.
4.2 Repeat Ops. 3.2 and 3.3 above.
4.3 Turn both TIME/DIVs together anti-clockwise; 1 segment.
4.4 Set Marker Generator to correspond with 'B' TIME/DIV.
4.5 CHECK alignment.
4.6 Repeat Ops. 4.3 through 4.5.
4.7 Adjust R236, PC133, to equalize errors.

5.0 Check stability.
5.1 Repeat para. 4.4.7, Ops. 1.1 and 1.3.
5.2 Push REP, TRIG, B DEL BY A and INT.
5.3a Connect 10 MHz sinewave to 'V' input.
b Set VOLTS/DIV to give 0·5 div trace.
5.4 Set TIME/DIVs 'A' 1 μs, 'B' 0·1 μs.
5.5 Observe trace steady.
5.6 Push A INT BY B.
5.7 Turn LEVEL fully clockwise.
5.8 Set VOLTS/DIV to give 1 div trace.
5.9 Set Monitor Oscilloscope (M.O.).
Volts/Div 50 mV.
Time/Div 2 μs.
5.10 Connect M.O. probe to junction R192/R196 (Grid 6-E4).
5.11 Observe M.O. trace, reference Plate 4.4a.
5.12 Rotate LEVEL.
5.13 Observe step travels towards trailing edge, reference Plate 4.4b.
5.14 Adjust R204, PC133, reference Plate 4.4c.
a Turn clockwise for step to emerge.
b Turn anti-clockwise to just merge step with leading edge.

CAUTION. Over-adjustment is detrimental.

5.15 Disconnect M.O.
5.16 Adjust LEVEL to lock trace.
5.17 Set to AUTO.
5.18 Observe bright-up steady.
5.19 Set VOLTS/DIV to give 0·5 div trace.
5.20 Observe bright-up.
5.21 Push B DEL BY A.
5.22 Observe bright-up.

Note: Some jitter is permissible.

6.0 Check LEVEL control.
6.1 Set DTM to 5·00.
6.2 Push REP, TRIG, A INT BY B and INT.
6.3 Repeat para. 4.4.7, Ops. 1.3 and 1.4.
6.4a Connect 50 kHz sinewave to 'V' input.
b Set VOLTS/DIV to give 2 div trace.
6.5 Set TIME/DIVs; 'A' 10 μs, 'B' 5 μs.
6.6 Adjust INTENSITY for bright-up.
6.7 Rotate LEVEL.
6.8 Observe bright-up moves along slope.
6.9 Note position of bright-up.
6.10 Rotate DTM.
6.11 Observe bright-up skips to Op. 6.9 position on successive cycles.
6.12 Release and depress POLARITY.
6.13 Observe response, trace start coincide.
6.14 Set VOLTS/DIV to give 0·2 div trace.
6.15 Repeat Ops. 5.20 through 5.22 above.

7.0 Check EXT setting.
7.1a Link EXT to 'V' input.
b Set VOLTS/DIV to give 2 divs trace.
7.2 Connect 300 mV, 50 kHz sinewave to Link.
7.3 Push 'B' EXT.
7.4 Repeat Ops. 5.20 through 5.22 above.
7.5 Connect 1 MHz squarewave via terminator to EXT.
7.6 Set 'B' LEVEL to centre of range.
7.7 Remove TR155 (Grid 6-F5).
7.8 Connect M.O. probe to junction R166/R168 (Grid 6-F5).
7.9 Observe M.O. squarewave trace.
7.10 Adjust Twisted Pair, PC133, for optimum squarewave.
7.11 Fit TR155.
7.12 Remove Terminator.
7.13 Repeat Op. 7.1a.
7.14 Connect 0·5 V, 10 MHz to link.
7.15 Repeat Ops. 6.14, then 5.20 through 5.22 above.

8.0 Check Mixed.
8.1 Repeat Ops. 6.1 through 6.3 above.
8.2a Connect 50 kHz sinewave to 'V' input.
b Set VOLTS/DIV to give 2 div trace.
8.3 Set TIME/DIV; 'A' 0·5 ms, 'B' 20 μs.
8.4 Adjust INTENSITY for optimum contrast.
8.5 Turn 'B' LEVEL fully anti-clockwise.

8.6 Note position of bright-up.
8.7 Push MIXED.
8.8 Observe bright-up position as Op. 8.6.
8.9 Release 'B' POLARITY, then 'A' POLARITY.
8.10 Observe bright-up position as Op. 8.6.
8.11 Turn 'B' LEVEL clockwise.
8.12 Observe bright-up responds to Op. 8.11.
8.13 Rotate DTM through range.
8.14 CHECK DTM setting/bright-up position error <1% on horizontal scale.
8.15 Push VAR.
8.16 Rotate DTM.
8.17 Observe bright-up respond to Op. 8.16 and intensity uniform.

4.4.5 DELAY TIME MULTIPLIER

1.0 Check calibration.
1.1 Repeat para. 4.4.1, Ops. 1.1 through 1.3.
1.2 Set TIME/DIVs; 'A' 1 ms, 'B' 1 μs.
1.3 Set DC-GND-AC to GND.
1.4 Adjust INTENSITY for maximum contrast.
1.5 Adjust FINE to align 'A' trace start/1st vertical.
1.6 Set DTM to 1·0 div.
1.7 Turn DTM clockwise.
1.8 CHECK major Div/Vertical bright-up alignment error $<\pm 1\%$ (1·0 Div).
1.9 Check Op. 1.4 alignment.
1.10 Centralize bright-up.
1.11 Set TIME/DIVs; 'A' 1 μs, 'B' 0·2 μs.
1.12 CHECK bright-up <0·45 div from centre vertical.
1.13 Set DTM to 1·0 div.
1.14 Adjust R202, PC133, to correct alignment.
1.15 Set DTM to 9·0 div.
1.16 Adjust R198, PC133, to correct alignment.
1.17 Repeat Ops. 1.13 through 1.16.
1.18 Fit plug-in covers, remove EXT lead, install plug-in into Main Frame.
1.19 Turn 'B' TIME/DIV fully anti-clockwise.
1.20 Pull FINE and centralize spot.
1.21 CHECK bright-up <0·2 div.

2.0 Check Delay Jitter.
2.1 Repeat Op. 1.18 above.
2.2 Repeat para. 4.4.1, Ops. 1.1 and 1.2.
2.3 Check polarity of Marker Signal Generator output.
2.4a Connect 0·1 ms Marker Signal to 'V' input.
b Set VOLTS/DIV to give 4 div.
c Set DC-GND-AC to DC.
2.5 Set 'A' POLARITY to match Op. 2.3.
2.6 Set TIME/DIVs; 'A' 1 ms, 'B' 1 μs.
2.7 Observe extreme right marker/bright-up alignment.
2.8 Adjust DTM to correct alignment.
2.9 Push B DEL BY A.
2.10 Adjust R90 to centralize trace.
2.11 Adjust 'B' LEVEL to minimize jitter.

Note: Lighthood may be needed.

2.12 CHECK jitter 'Y' <1 division, reference PLATE 4.5.

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 C274	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	—	—	—	—

'A' TIME/DIV S271

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

'B' TIME/DIV S251

TABLE — SWITCH CONNEXIONS

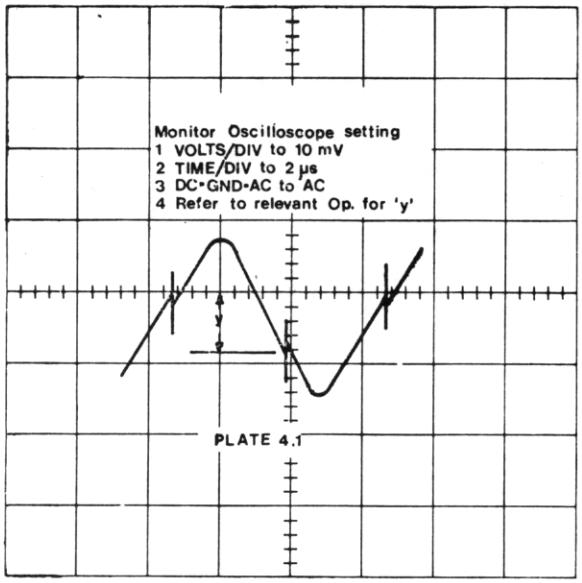


PLATE 4.1

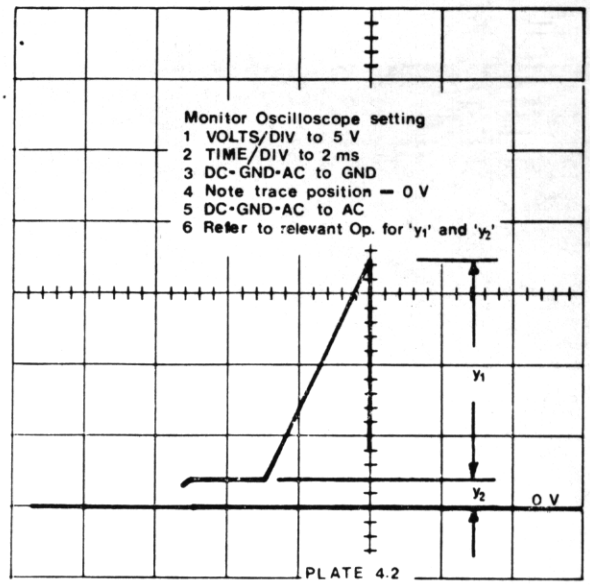


PLATE 4.2

Monitor Oscilloscope

for Checking	set TIME/DIV
10 ms/div	2 ms
0.1 ms/div	50 µs
10 µs/div	5 µs
0.5 µs/div	1 µs

Refer to relevant Op. for 'x'

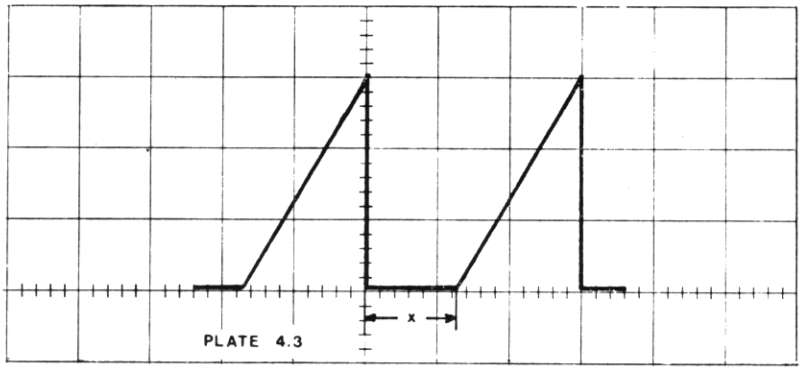


PLATE 4.3

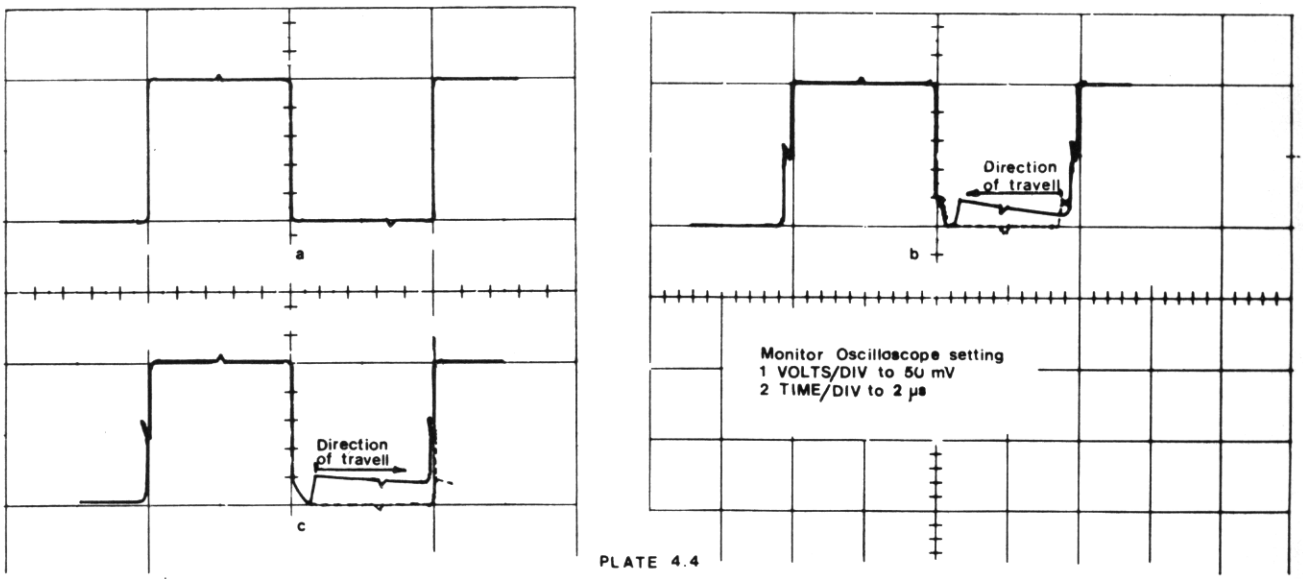


PLATE 4.4

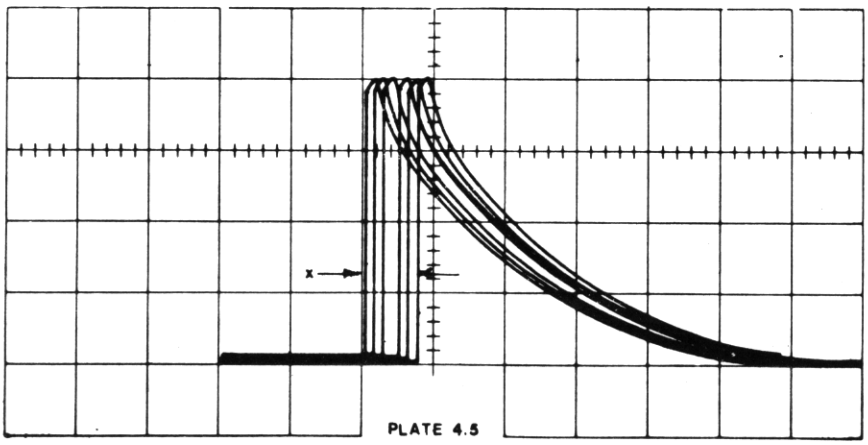


PLATE 4.5

CHAPTER 5
COMPONENT 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

CIRCUIT REFERENCE BLOCKS

The table below gives the blocks of circuit references, so that the reader can relate the items listed in this chapter and their location in the circuitry and printed circuit boards in Chapter 6.

Circuit Reference		Circuit	Fig.	P.C. Board No.
From	To			
1	60	'A' Trigger Amplifier	1	132
61	150	Generator	2	132
151	190	'B' Trigger Amplifier	4	133
191	250	Generator	5	133
251	300	Time/Div Switch	3	136

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
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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	Description Value F	Type	Tol %	Rating V
C1	285-0946-00	470 n	PE	20	250
C2	285-0796-00	100 n	PE	20	250
C3	290-0623-00	4·7 μ	E		40
C4	290-0623-00	4·7 μ	E		40
C5	290-0623-00	4·7 μ	E		40
C6	285-0915-00	100 n	PE	20	100
C7	285-0915-00	100 n	PE	20	100
C9	281-0710-00	10 n	CER		250
C11	285-0847-00	560 p	PS	5	125
C12	281-0710-00	10 n	CER		250
C13	285-0920-00	56 p	PS	2 p	350
C14	290-0627-00	22 μ	E		40
C15	285-0842-00	15 p	PS	1 p	350
C61	285-0871-00	150 p	PS	5	350
C62	290-0627-00	22μ	E		40
C63	285-0779-00	470 n	PE	20	100
C64	281-0710-00	10 n	CER		250
C65	285-0940-00	12 p	PS	1 p	350
C66	285-0845-00	68 p	PS	2 p	350
(1452)					
C68	281-0710-00	10 n	CER		250
C71	285-0776-00	27 p	PS	1 p	350
C72	285-0836-00	47 n	PE	20	250
C74	281-0711-00	3·9 p	CER	0·25 p	750
C75	285-0940-00	12 p	PS	1 p	350
C76	285-0866-00	10 p	PS	1 p	350
C77	281-0710-00	10 n	CER		250
C78	285-0867-00	20 p	PS	1 p	350
C79	285-0869-00	47 p	PS	2 p	350
C81	285-0873-00	200 p	PS	5	350
C150	281-0712-00	5 p	CER	0·25 p	750
C151	285-0946-00	470 n	PE	20	250
C152	290-0627-00	22 μ	E		40
C153	285-0866-00	10 p	PS	1 p	350
C154	290-0627-00	22 μ	E		40
C155	285-0915-00	100 n	PE	20	100
C156	285-0776-00	27 p	PS	1 p	350
C157	290-0623-00	4·7 μ	E		40
C158	285-0786-00	33 p	PS	2 p	350
C159	285-0854-00	100 p	PS	2 p	350

Cir Ref	Part Number	Description Value F	Type	Tol %	Rating V
C192	281-0745-00	4·7 p	CER	0·5 p	500
C194	285-0867-00	20 p	PS	1 p	350
C195	285-0838-00	75 p	PS	2 p	350
C196	285-0873-00	200 p	PS	5	350
C197	290-0648-00	150 μ	E		25
C198	285-0870-00	120 p	PS	2	350
C199	285-0915-00	100 n	PE	20	100
C201	281-0711-00	3·9 p	CER	0·25 p	750
C202	290-0634-00	22 μ	E		160
C203	285-1014-00	1 μ	PE	20	63
C204	285-0838-00	75 p	PS	2 p	350
C205	285-0867-00	20 p	PS	1 p	350
C206	281-0710-00	10 n	CER		250
C251	283-0721-00	900 p	SM	1	350
C252	283-0723-00	10 p	SM	0·5 p	350
C253	281-0738-00	20 p	CER	0·25 p	750
C254	285-0943-00	1 μ	PC	1	63
C255	281-0732-00	3-12 p	CT		250
C256	283-0722-00	60 p	SM	1 p	350
C257	285-1023-00	9 n	PC	1	400
C271	285-0792-00	4·7 n	PE	20	125
C272	285-0874-00	470 p	PS	5	125
C273	285-0786-00	33 p	PS	2 p	350
C274	285-0791-00	470 n	PE	10	125
C275	285-1023-00	9 n	PC	1	400
C276	281-0738-00	20 p	CER	0·25 p	750
C277	283-0721-00	900 p	SM	1	350
C278	285-0943-00	1 μ	PC	1	63
C279	283-0722-00	60 p	SM	1	350
C281	281-0732-00	3-12 p	CT		250
C282	283-0723-00	10 p	SM	0·5 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	152-0472-00	5·6	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
(1626) D7	152-0543-00	5.1	Zener	Si	5	330 mW
D8	152-0472-00	5·6	Zener	Si	5	330 mW
(1626) D9	152-0339-00		1N4001	Si		50 V
D10	152-0472-00	5.6 V	Zener	Si		400 mW
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		BAY74	Si		50 V
D65	152-0062-01		1N914/1N4148	Si		75 V
D66	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
D196	152-0541-00		BAY 82	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	15	Zener	Si	5	330 mW
D202	152-0062-01		1N914/1N4148	Si		75 V
D203	152-0062-01		1N914/1N4148	Si		75 V
(1538) FB251	267-0597-00		Ferrite Bead Mullard FX1115			
(1449) FB271	267-0597-00		Ferrite Bead Mullard FX1115			

Cir Ref	Part Number	Value	Description
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 Type	Tol %	Rating W
	R1	317-0184-01	180 k	C	5	125 m
	R2	317-0153-01	15 k	C	5	125 m
	R3	317-0183-01	18 k	C	5	125 m
	R4	317-0104-01	100 k	C	5	125 m
	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
	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
1773	R12	317-0331-01	330	C	5	125 m
	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
1009	R22	311-1575-00	7·5 k	CV	10	1 w
	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
	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
1626	R43	317-0103-01	10 k	C	5	125 m
	R62	317-0153-01	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	317-0563-01	56 k	C	5	125 m
	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

Cir Ref	Part Number	Value ohms	Description Type	Tol %	Rating W
	R78	321-0291-48	10·5 k	MF	1	125 m
						1452
	R80	317-0471-01	470	C	5	125 m
	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	104
	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
	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
	R100	317-0471-01	470	C	5	125 m (1786)
	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	250 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

*With S153

Cir Ref	Part Number	Value ohms	Description Type	Tol %	Rating W
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
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
1538 R212	321-0287-48	9.53 k	MF	1	125 m
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
1786 R226	317-0471-01	470	C	5	125
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

Cir Ref	Part Number	Value ohms	Description Type	Tol %	Rating W
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
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	317-0154-01	150 k	C	5	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	321-0402-48	150 k	MF	1	125 m

Cir Ref	Part Number	Description
S1	260-1403-00	Push (3-button)
S2	260-1401-00	Push (1-button)
S3	260-1402-00	Push (4-button)

Cir Ref	Part Number	Description
S61 S62	260-1405-00	Push (3-button)

Cir Ref	Part Number	Description
S151	260-1401-00	Push (1-button)
S152	260-1400-00	Push (2-button)
S153	311-1353-00	Rotary (with R153)

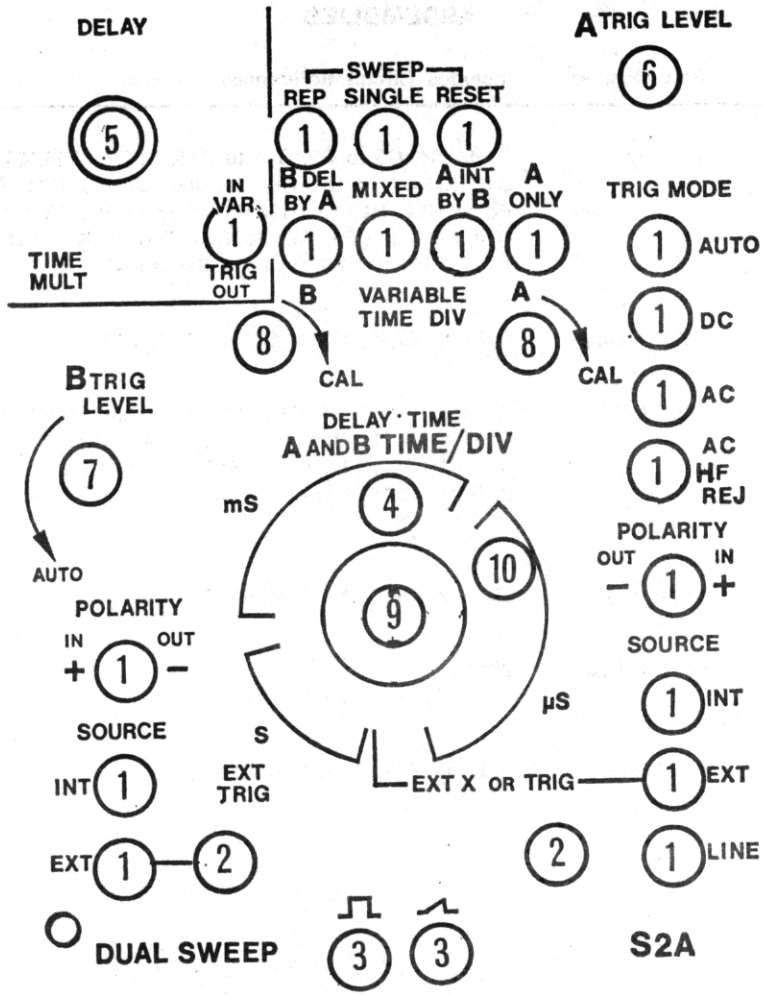
Cir Ref	Part Number	Description
S191, S192	260-1499-00	Push (5-button)
S251	260-1410-01	Rotary (23-position)
S271	260-1410-01	Rotary (23-position)

Cir Ref	Part Number	Value	Description	Tol.	Rating
TH1	307-0270-00	330 Ω	Thermistor	20%	500 mW

	Cir Ref	Part Number	Description		
1541	TR1	151-0127-03	BSX20	Si	NPN
	TR2	151-0320-00	MPS6518/BFX48	Si	PNP
1626	TR3	151-0242-00	2N3904	Si	NPN
1626	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
	TR62	151-0320-00	MPS6518/BFX48	Si	PNP
1611	TR63	151-0242-00	2N3904	Si	NPN
1611	TR64	151-0242-00	2N3904	Si	NPN
	TR65	151-0320-00	MPS6518/BFX48	Si	PNP
	TR66	151-1062-00	FET Telequipment 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
1330	TR151	151-0242-00	2N3904	Si	NPN
1330	TR152	151-0242-00	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
	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 Telequipment 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
'A' Sweep & Trigger 1710 PC132	670-2186-02	C1 to C4, C6 to C9, C11 to C15, C61 to C68, C71, C72, C74 to C79, C81, D1, D2, D4 to D7, D61 to D69, D71 to D74, D76, L1, L61, R1 to R6, R8 to R11, R13 to R19, R21, R23 to R29, R31 to R36, R38, R39, R41 to R43, R62 to R69, R71 to R79, R81 to R89, R92 to R99, R100 to R109, R111 to R118, S1 to S3, TR1 to TR7, TR61 to TR69
'A' TIME/DIV switch	262-0958-02	C271 to C279, C281, C282, R287, R289
'B' Sweep & Trigger PC133	670-2187-00	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 TR198
'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



FRONT PANEL

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 2 mm	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
	003-0703-00	Key, Nut Locking	5
(1330)	003-0748-00	Key, Special Allen	5
1095	366-1238-00	Knob, Grey/Black	6
	366-1239-00	Knob, Grey/Black	7
	366-1266-00	Knob, Grey/Black	8
	366-1289-00	Knob, Grey/Red	9
	366-1386-00	Knob, Transparent	10
	220-0527-00	Nut, Chrome	6 - 10
	004-1143-00	Packaging	Accessory
	373-0249-00	Screw, Socket, 3 x 3 mm	6 - 10
	385-0206-00	Spacer, 6 BA/8 BA x ·5"	1
	361-0478-00	Spacer, Special	4
	105-0347-00	Stop	Rear of Mod.
	343-0198-00	Strap, Cable Insuloid	
	210-0275-00	Tag, Solder, ⅜"	
1009	210-1177-00	Washer	6

CHAPTER 6

CIRCUIT DIAGRAMS

To minimize the risk of misinterpretation of component values on circuit diagrams, the decimal point has been replaced by the multiplier or sub-multiplier of the basic unit. For instance, 2·2 megohms is shown as 2M2 and 1·8 picofarads is shown as 1p8.

To aid the reader further, in addition to the block Circuit Reference Table in Chapter 5.1, to locate a component in the circuit diagrams, a table is provided at the top of each circuit diagram, in which the circuit reference will appear, where practicable, directly above the component being sought.

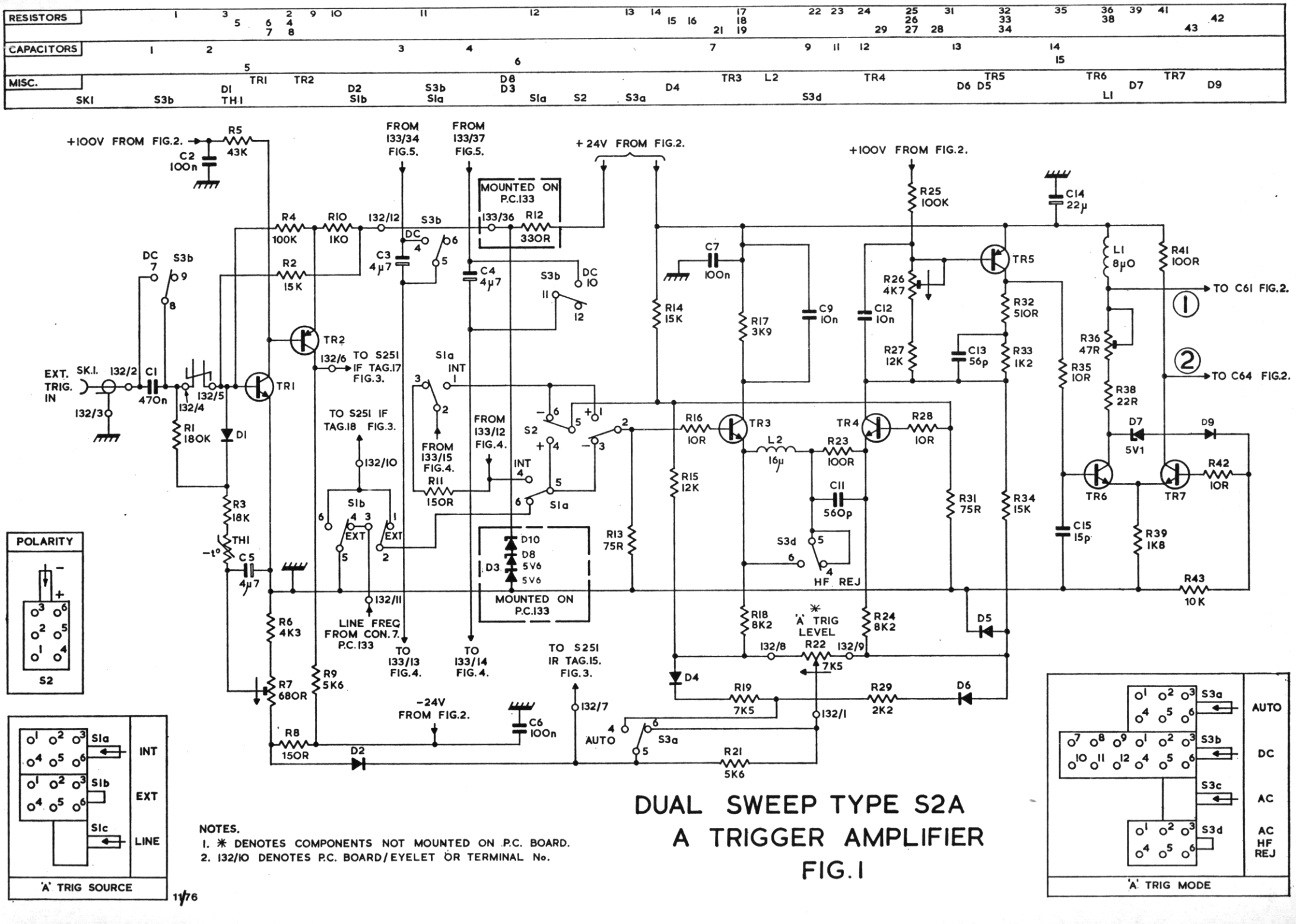
PRINTED CIRCUIT

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

Location of components are listed on the page preceding the PCBs.

WAVEFORMS

Waveforms, illustrated in Plates 6/1 and 6/2, may be monitored at point with the corresponding number.



DUAL SWEEP TYPE S2A A TRIGGER AMPLIFIER FIG.1

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

1/76

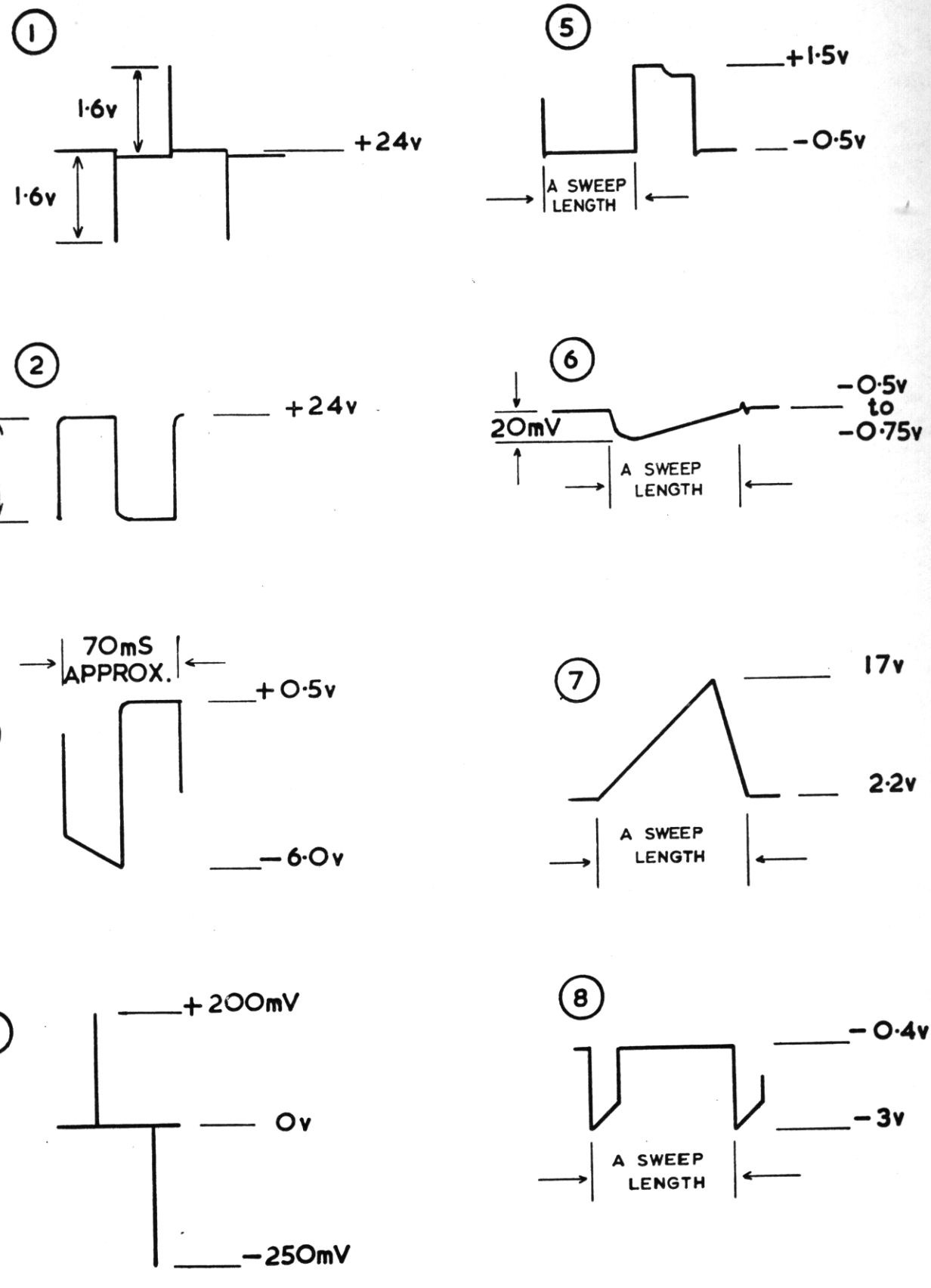
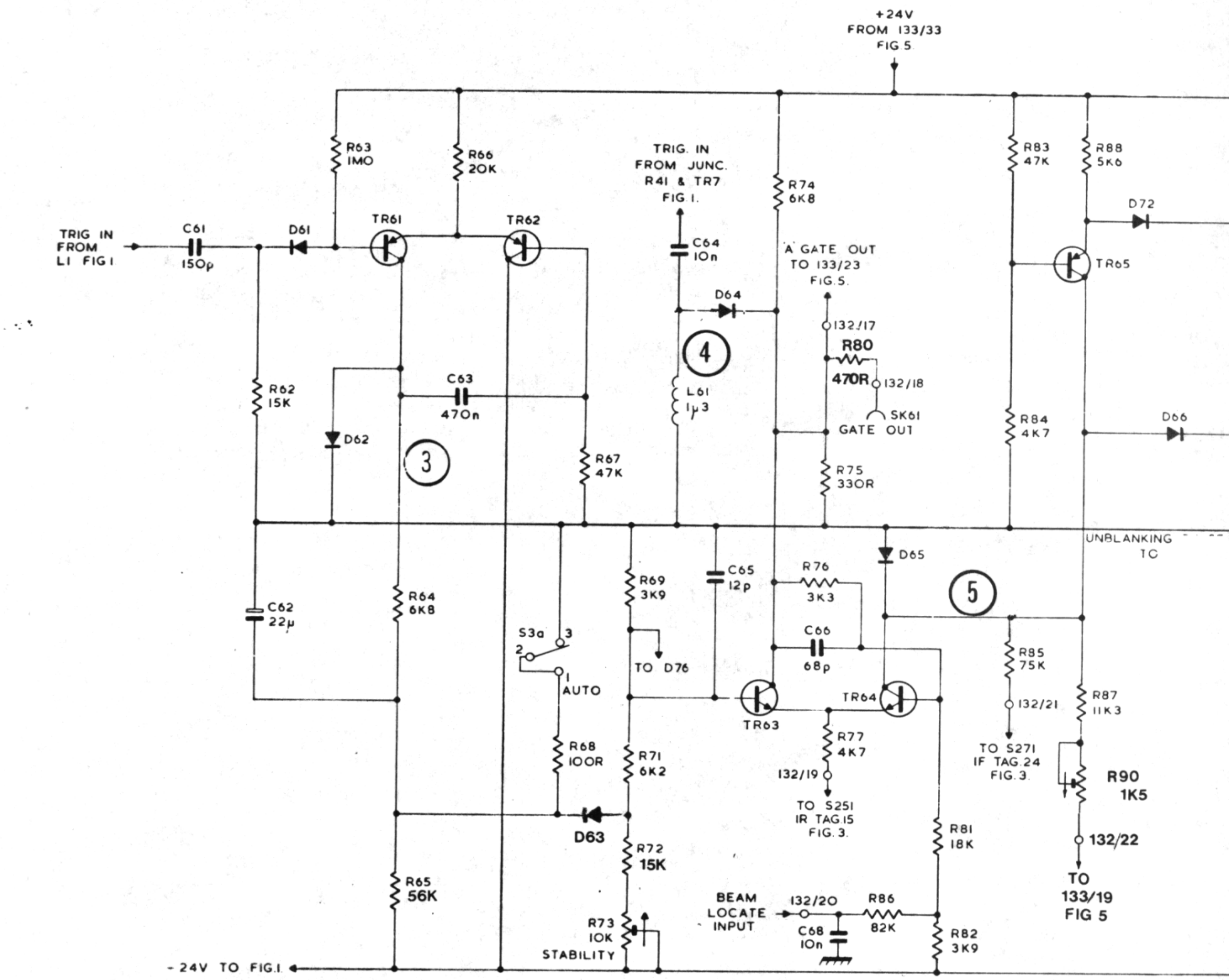
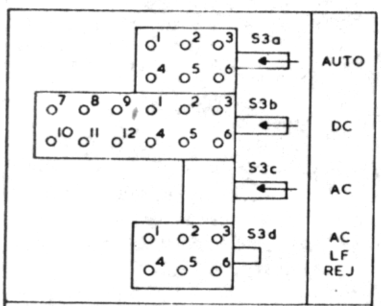

1
1·6v
1·6v
+24v
2
+24v
0·9v
3
70mS
APPROX.
+0·5v
−6·0v
4
+200mV
0v
−250mV
5
+1·5v
−0·5v
A SWEEP
LENGTH
6
20mV
−0·5v
to
−0·75v
A SWEEP
LENGTH
7
17v
2·2v
A SWEEP
LENGTH
8
−0·4v
−3v
A SWEEP
LENGTH

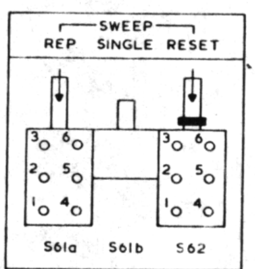
PLATE 6/1

RESISTORS	62 63 64 65 66 67 68 69 71 72 73 74 75 76 77 80 86 81 82 83 84 85 89 87 90
CAPACITORS	61 62 63 64 65 66 68
MISC.	D61 D62 TR61 TR62 S3a D63 L61 D64 TR63 TR64 D65 SK61 TR65 D72



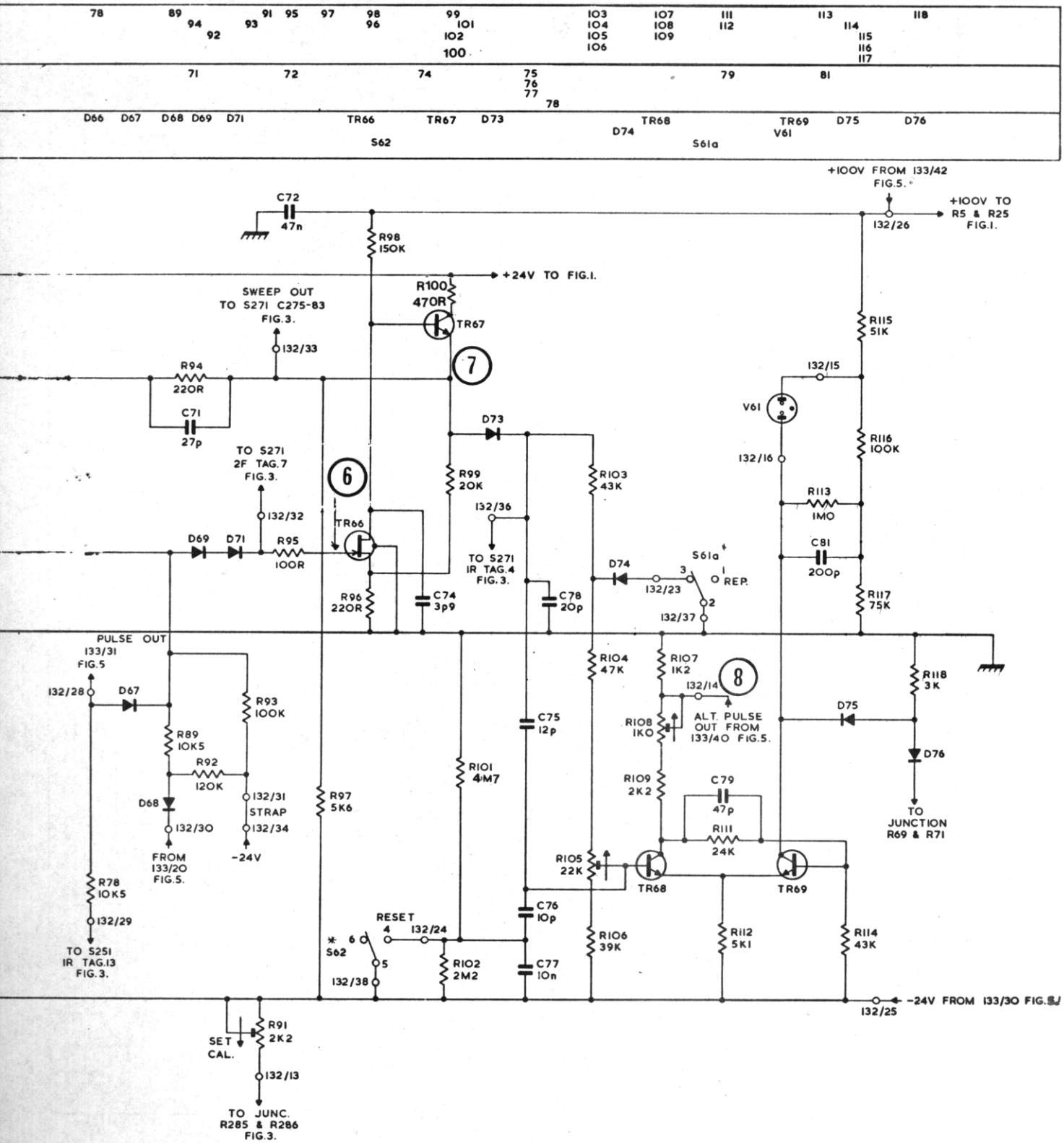


A TRIG MODE



SINGLE SWEEP

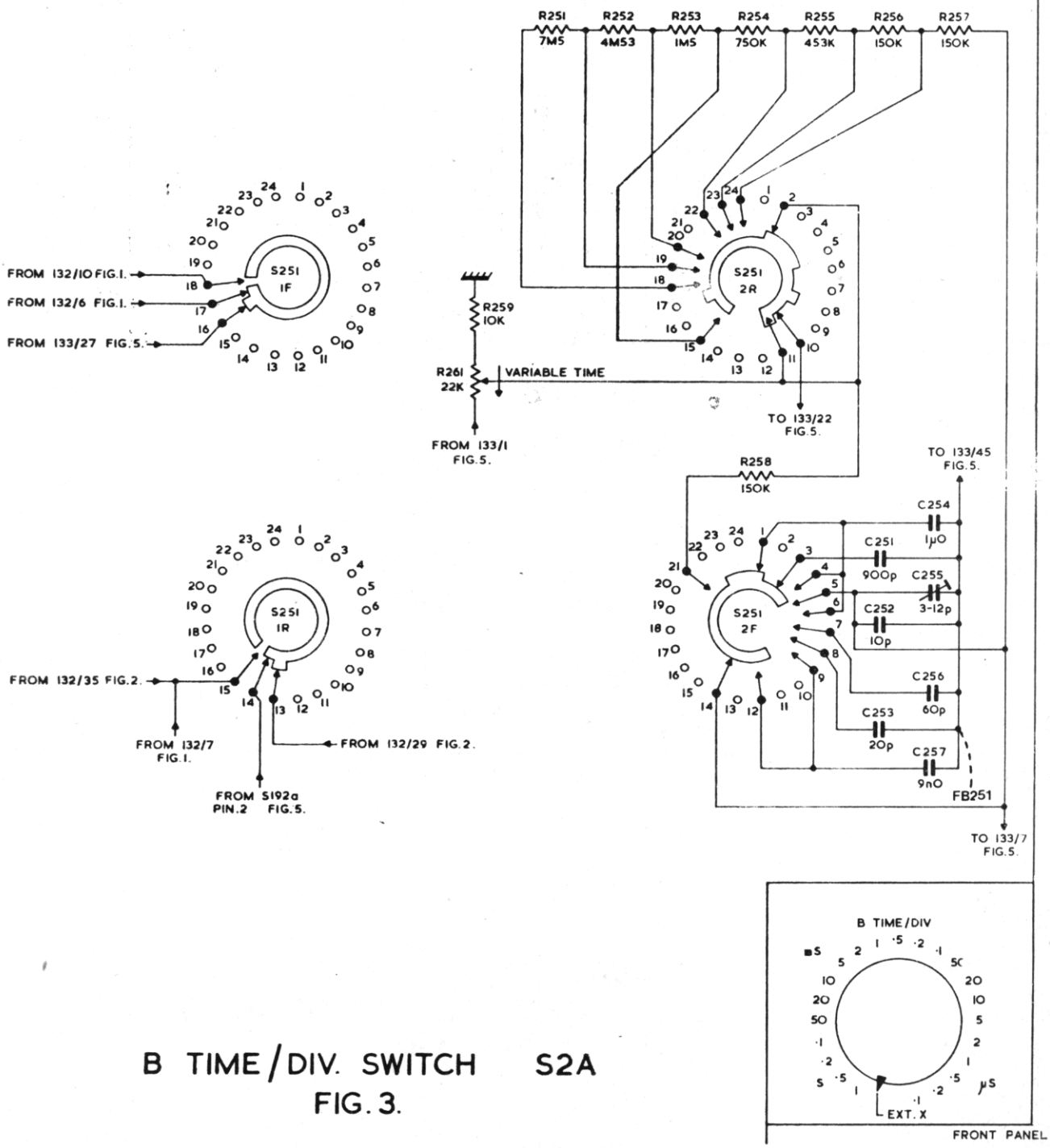
NOTES.
1. + DENOTES COMPONENTS NOT MOUNTED
2. 132/20 DENOTES P.C. BOARD/EYELET



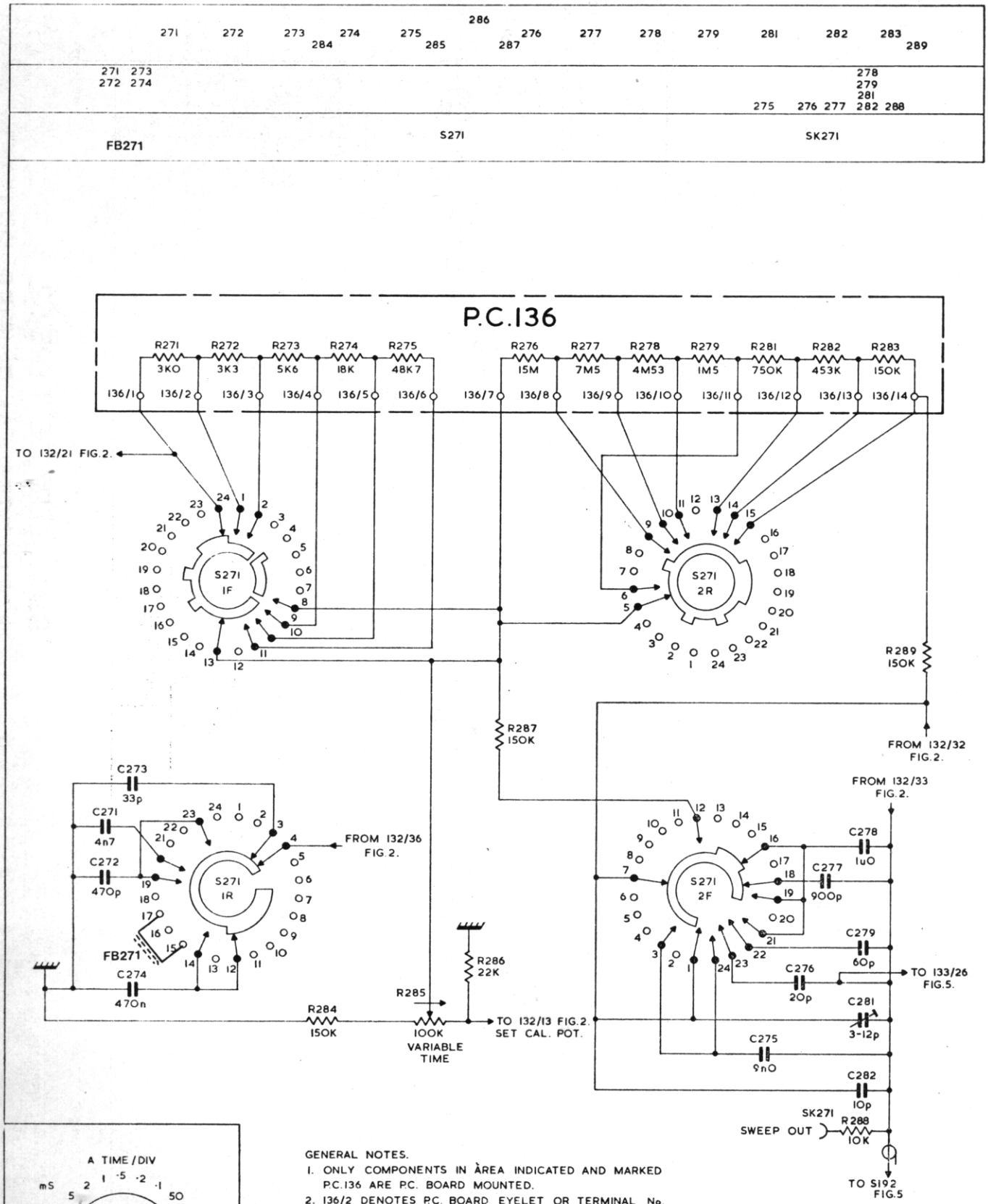
ON P.C. BOARD.
OR TERMINAL No.

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

RESISTORS		259 261	251	252	253	254 258	255	256	257
CAPACITORS								251 252 253	254 255 256 257
MISC.		S251							FB251



B TIME/DIV. SWITCH S2A
FIG. 3.



GENERAL NOTES.

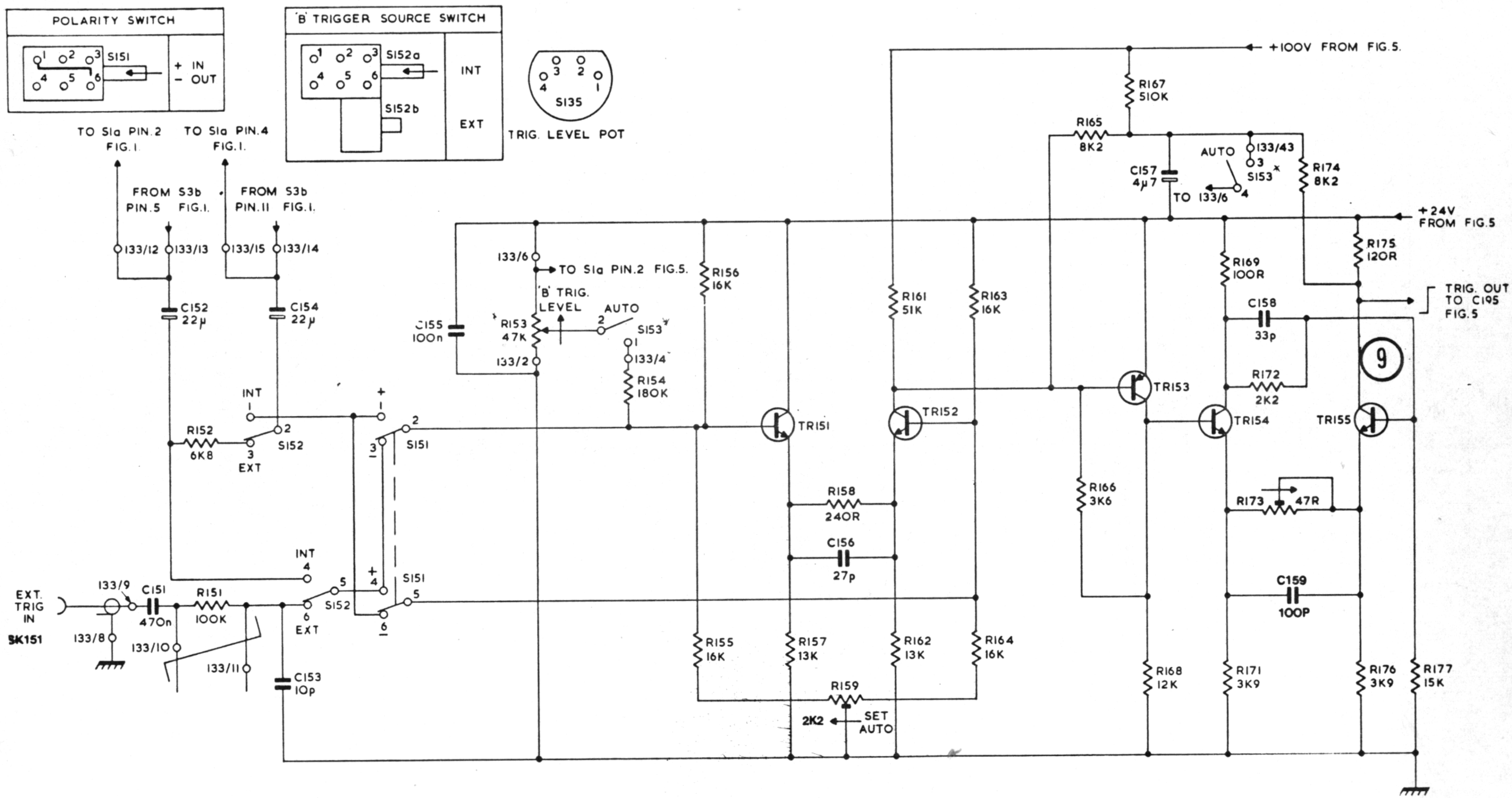
1. ONLY COMPONENTS IN AREA INDICATED AND MARKED P.C.136 ARE P.C. BOARD MOUNTED.
2. 136/2 DENOTES P.C. BOARD EYELET OR TERMINAL No.
3. SWITCH SHOWN IN FULLY ANTICLOCKWISE POSITION.

A TIME/DIV. SWITCH S2A
FIG. 3.

RESISTORS	151	152	153	154	155	156	157	158 159	161 162	163 164	165 166	167 168	169 171	172 173	174	175 176	177

CAPACITORS	151	152	153	154	155	156	157	158	159

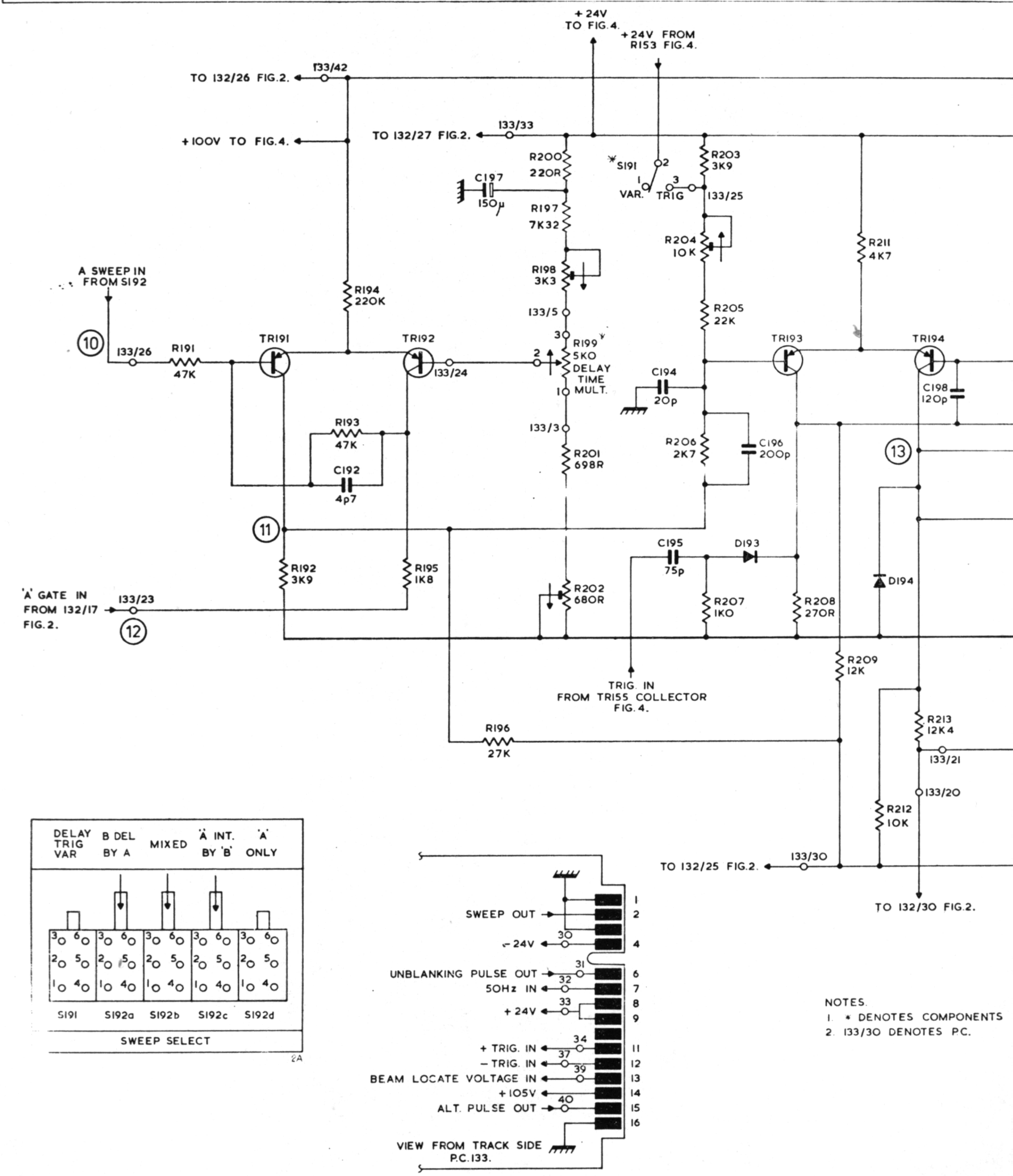
MISC.	S152	S151	S153	TR151	TR152	TR153	TR154	S153	TR155



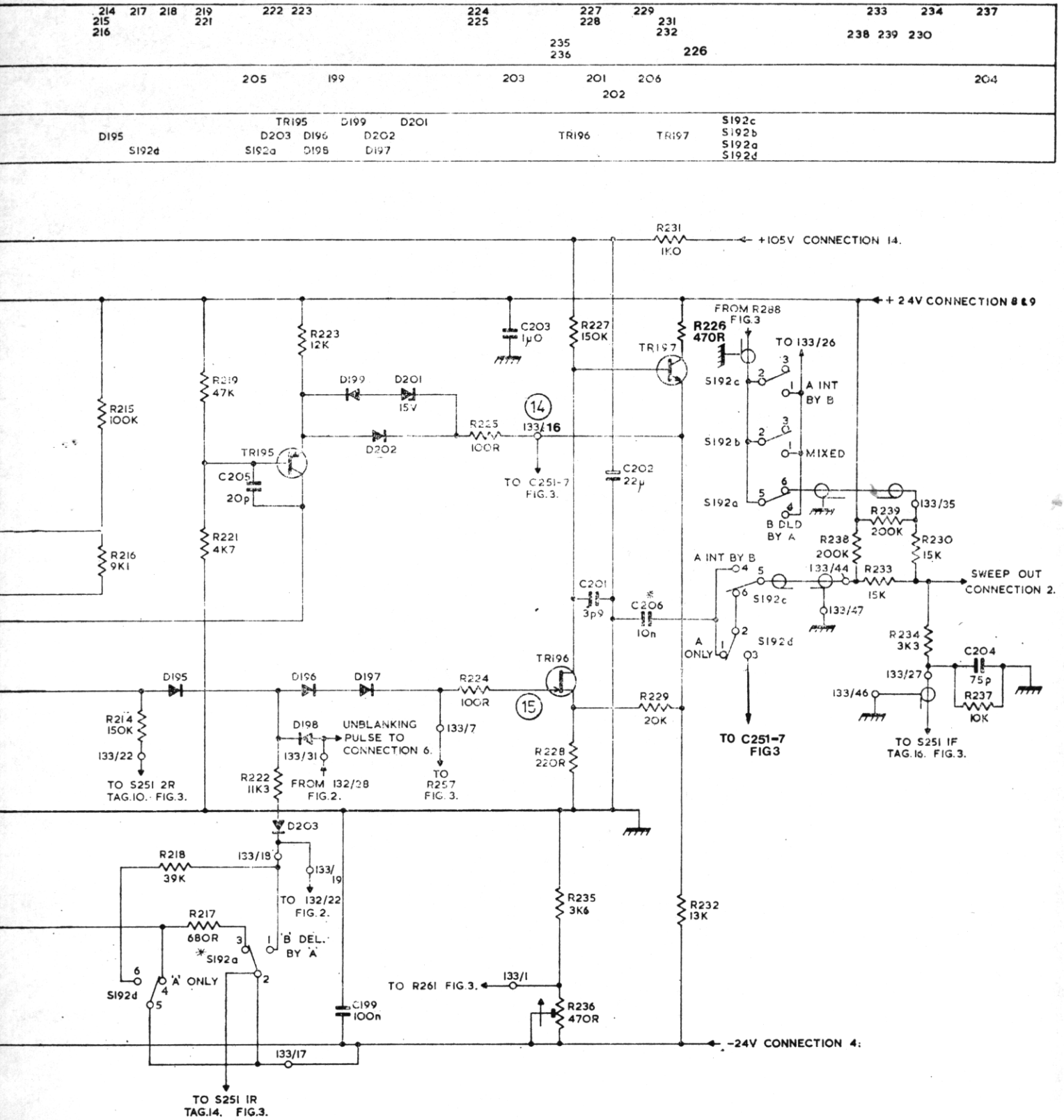
NOTES.
1. * DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD.
2. 133/10 DENOTES P.C. BOARD/EYELET OR TERMINAL No.

DUAL TRACE TYPE S2
'B' TRIGGER AMPLIFIER P.C.133
FIG. 4.

RESISTORS	191	192	193 194	195	196	200	197 198 199 201 202	203 204 205 206 207	208	209	211 212	213		
CAPACITORS			192		197			194 195	196			198		
MISC.		TR191		TR192				S191	D193	TR193	D194	TR194		



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



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

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

5R
11/76

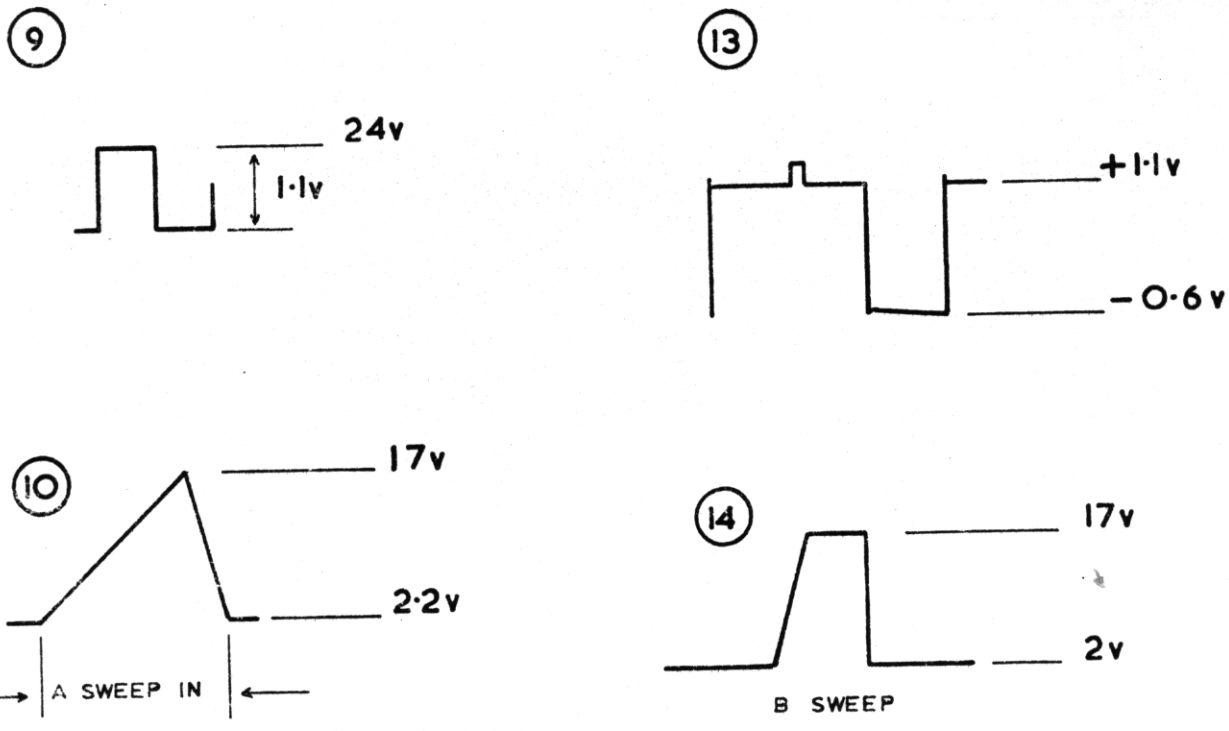

9
24v
1·1v
13
+1·1v
−0·6v
10
17v
2·2v
A SWEEP IN
14
17v
2v
B SWEEP
11
+1·1v
−0·2v
DELAY
MULTI
POT
5·00
15
−0·5v
to
−0·75v
B
SWEEP
A SWEEP
12
+1v
−0·5v

PLATE 6/2

LOCATION OF COMPONENTS ON PRINTED CIRCUIT BOARDS

Cir Ref	Grid Location
C1	6—D1
C2	6—F2
C3	6—D2
C4	6—D2
C6	6—E1
C7	6—E2
C8	6—D2
C9	6—E2
C11	6—D2
C12	6—E3
C13	6—E3
C14	6—E3
C15	6—F3
C61	6—F2
C62	6—F1
C63	6—E1
C64	6—F3
C65	6—G3
C66	6—G3
C67	6—G3
C68	6—G3
C71	6—G2
C72	6—G2
C74	6—H2
C75	6—G1
C76	6—G1
C77	6—G2
C78	6—H1
C79	6—G1
C81	6—F1
C151	6—G6
C152	6—G6
C153	6—G6
C154	6—G5
C155	6—G5
C156	6—G5
C157	6—F5
C158	6—F5
C159	6—F6

Cir Ref	Grid Location	
C192	6—E4	
C194	6—E4	
C195	6—F4	
C196	6—E4	
C197		
C198	6—F4	
C199	6—D4	
C201	6—H4	
C202	6—D5	
C203	6—D4	
C204	6—D4	
C251		'B' T/D Switch
C252		
C253		
C254		
C255		
C256		
C257		
C271		'A' T/D Switch
C272		
C273		
C274		
C275		
C276		
C277		
C278		
C279		
C281		
C282		
D1	6—E1	
D2	6—E2	
D3	6—D5	
D4	6—E2	
D5	6—D3	
D6	6—D3	
D7	6—F3	
D8	6—D5	

Cir Ref	Grid Location
D61	6—F2
D62	6—F1
D63	6—F2
D64	6—F2
D65	6—G3
D66	6—G3
D67	6—G3
D68	6—H3
D69	6—H3
D71	6—H3
D72	6—G2
D73	6—H1
D74	6—G1
D75	6—G2
D76	6—G2
D193	6—F4
D194	6—F4
D195	6—G4
D196	6—G4
D197	6—G5
D198	6—G4
D199	6—G4
D201	6—G4
D202	6—G4
D203	6—G4
L1	
L61	6—F3
R3	6—E1
R1	6—E1
R2	6—E2
R4	6—E2
R5	6—E2
R6	6—E1

Cir Ref	Grid Location
R7	6—E1
R8	6—E2
R9	6—E2
R10	6—E2
R11	6—D3
R12	6—D5
R13	6—D2
R14	6—D3
R15	6—D2
R16	6—E2
R17	6—E2
R18	6—E2
R19	6—E2
R21	6—D1
R22	
R23	6—D2
R24	6—E3
R25	6—E2
R26	6—E2
R27	6—E3
R28	6—E3
R29	6—D2
R31	6—D2
R32	6—E3
R33	6—E3
R34	6—E3
R35	6—E3
R36	6—F2
R38	6—F3
R39	6—F3
R41	6—F3
R42	6—F3
R43	6—F3
R62	6—F1
R63	6—E2
R64	6—F1
R65	6—E1
R66	6—E1
R67	6—E1
R68	6—D1
R69	6—G3
R71	6—G2

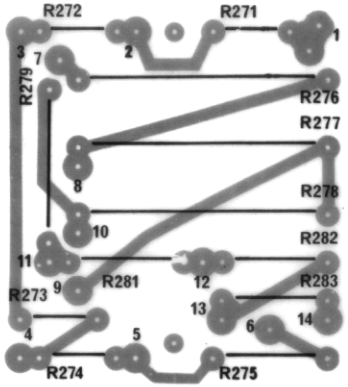
Cir Ref	Grid Location
R72	6—F2
R73	6—F2
R74	6—F2
R75	6—F3
R76	6—G3
R77	6—G3
R78	6—G3
R79	6—G3
R81	6—G2
R82	6—G2
R83	6—G2
R84	6—G3
R85	6—G2
R86	6—G3
R87	6—G2
R88	6—G2
R89	6—G3
R91	6—E2
R92	6—H3
R93	6—H3
R94	6—H2
R95	6—H3
R96	6—H2
R97	6—H2
R98	6—G2
R99	6—H2
R101	6—G1
R102	6—G2
R103	6—H1
R104	6—G1
R105	6—G1
R106	6—G1
R107	6—G1
R108	6—F1
R109	6—G1
R111	6—G1
R112	6—G2
R113	6—F1
R114	6—G2
R115	6—F1
R116	6—F1
R117	6—F1
R118	6—F1

Cir Ref	Grid Location
R151	6—G6
R152	6—G6
R153	S153
R154	6—H5
R155	6—G5
R156	6—G5
R157	6—F5
R158	6—F5
R159	6—G5
R161	6—F5
R162	6—F6
R163	6—G5
R164	6—G5
R165	6—F5
R166	6—F5
R167	6—F5
R168	6—F5
R169	6—F5
R171	6—F6
R172	6—F5
R173	6—E6
R174	6—F5
R175	6—F5
R176	6—E6
R177	6—E6
R191	6—E4
R192	6—E4
R193	6—E4
R194	6—E4
R195	6—E4
R196	6—E4
R197	6—G4
R198	6—G4
R199	
R200	
R201	6—H5
R202	6—H5
R203	6—E5
R204	6—E5
R205	6—E4
R206	6—E4
R207	6—F4
R208	6—F4
R209	6—F4

Cir Ref	Grid Location	
R211	6—F4	
R212	6—F4	
R213	6—F4	
R214	6—F4	
R215	6—F4	
R216	6—F4	
R217		
R218		
R219	6—G4	
R221	6—G4	
R222	6—G4	
R223	6—F4	
R224	6—H5	
R225	6—G4	
R227	6—G4	
R228	6—H4	
R229	6—H4	
R231	6—D5	
R232	6—G4	
R233	6—D4	
R234	6—D4	
R235	6—H4	
R236	6—G4	
R237	6—D4	
R251		'B' T/D Switch
R252		
R253		
R254		
R255		
R256		
R257		
R258		
R259		
R261		
R271	6—A1	
R272	6—A1	
R273	6—A2	
R274	6—A2	
R275	6—B2	
R276	6—A1	

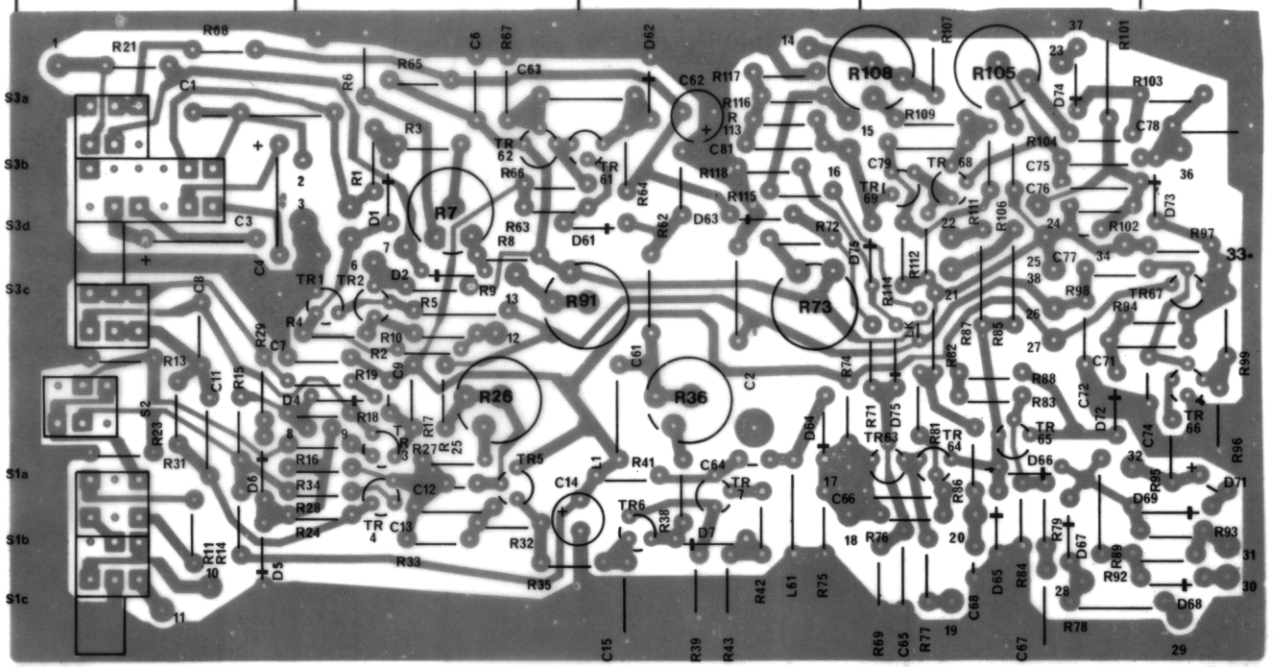
Cir Ref	Grid Location	
R277	6—A2	
R278	6—A2	
R279	6—A1	
R281	6—A1	
R282	6—B2	
R283	6—B2	
R284		
R285		
R286		
R278		
R289		
S1		'A' Source
S2		'A' Polarity
S3		Trig Mode
S61		Rep
S62		Reset
S151		'B' Source
S152		'B' Polarity
S153		'B' Auto
S191		Delay
S192		Sweep Select
S251		'B' Time/Div
S271		'A' Time/Div
TR1	6—E2	
TR2	6—E2	
TR3	6—E2	
TR4	6—E3	

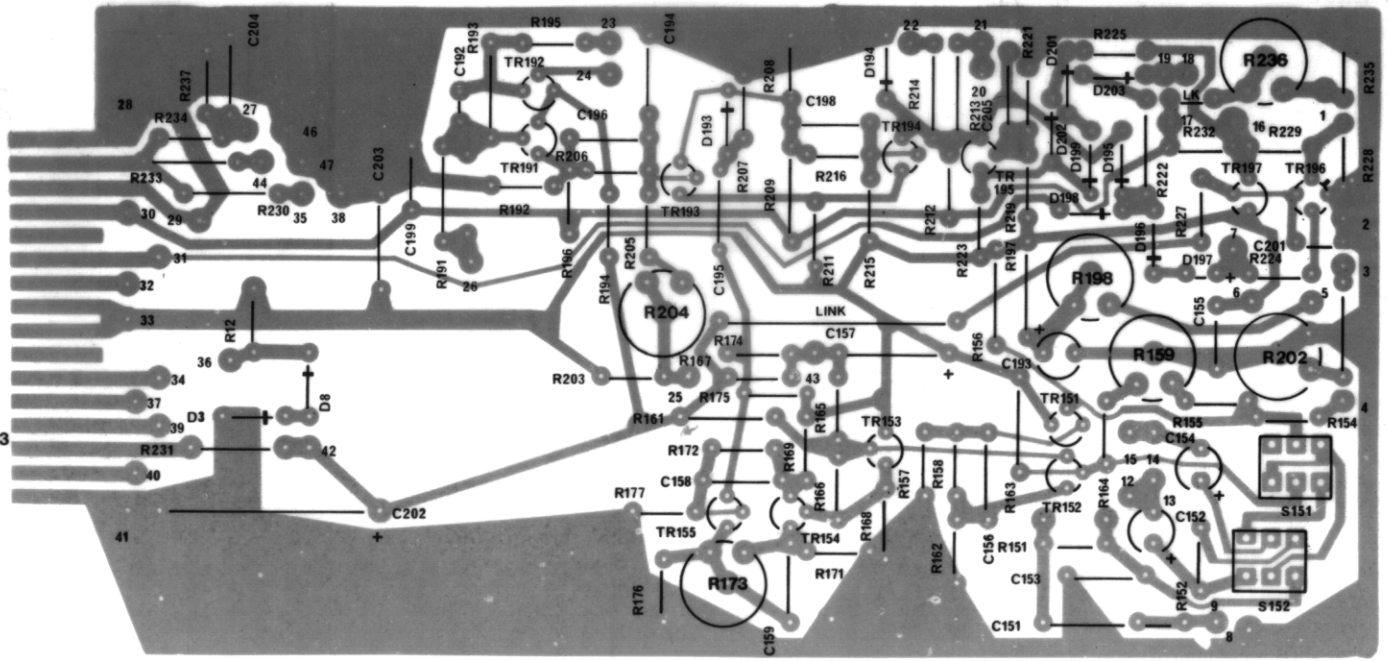
Cir Ref	Grid Location
TR5	6—E3
TR6	6—F3
TR7	6—F3
TR61	6—E1
TR62	6—E1
TR63	6—G3
TR64	6—G3
TR65	6—G2
TR66	6—H2
TR67	6—H2
TR68	6—G1
TR69	6—G1
TR151	6—G5
TR152	6—G5
TR153	6—F5
TR154	6—F5
TR155	6—F5
TR191	6—E4
TR192	6—E4
TR193	6—E4
TR194	6—F4
TR195	6—G4
TR196	6—G4
TR197	6—H4



PC136

PC132





PC133

Figure 6
COMPONENT REFERENCE

TELEQUIPMENT ®

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.

TEKTRONIX U.K. LTD
313 Chase Road
Southgate,
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01-882 6100
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Beaverton,
Oregon (97005)
U.S.A.

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(503) 644-0161
Telex: 36 0485
Cables:
TEKTRONIX

DUAL TRACE AMPLIFIER UNIT TYPE V4

INSTRUCTION MANUAL

Issue 6 (569001
June 1977

070-1495-00

Printed in England by D & H NEWMAN LTD, 29 Harcourt Street, London W1. 01-262 6356

INTRODUCTION

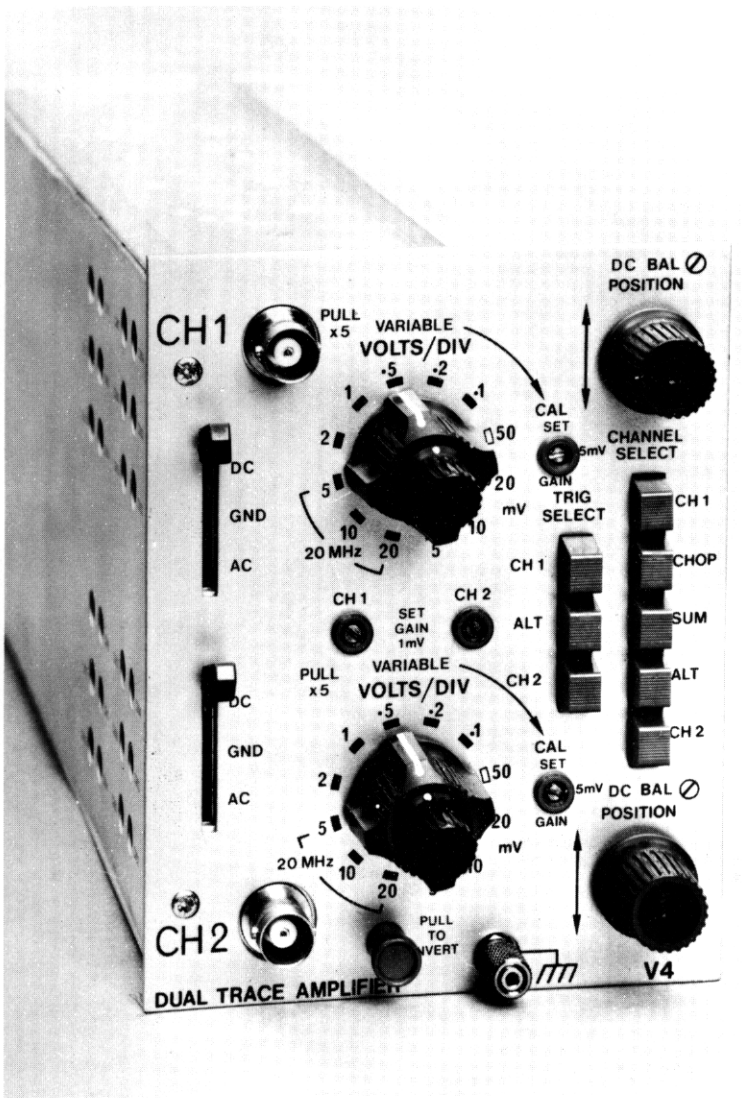
The V4, a 50 MHz dual-trace plug-in, provides the main frame with dual trace vertical facility, which displays either channel separately, adds channels algebraically, alternates or chops between channels.

This manual should be read in conjunction with the manuals of the associated units; e.g. Mainframe and Sweep units.

The high frequency performance of this plug-in is optimized in conjunction with main frame, thus interchanging plug-ins may necessitate minor readjustment, see Section 4. If no readjustment is made the overshoot may be up to 4%.

The design of this instrument is subject to continuous development and improvement, consequently minor changes from the information contained herein may be incorporated.

These changes which usually affect the Components Lists and Circuit Diagrams are described on Amendment Lists issued at regular intervals between manual reprints. Any Amendment List appertaining to this Manual is located in the pocket provided inside the back cover of this manual.



NOTICE TO OWNER

To lessen the risk of damage during transit and to facilitate packaging, the owner is requested NOT to send the following items unless they are suspect, if this instrument is returned for servicing.

Probe Plug Assemblies

CONTENTS

SECTION 1

SPECIFICATION

1.1 OPERATING MODE

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

	X1	X5
3 dB bandwidth		
5 mV – 2 V/div	50 MHz	15 MHz
5 V – 20 V/div	20 MHz	12 MHz
Risetime	7 ns	23 ns
Sensitivity	5 mV to 20 V/div	1 mV to 4 V/div

Deflection factors

Calibrated (12 ranges 1.2.5 sequence) — 5 mV – 20 V/div ± 3%
1 mV – 4 V/div ± 3%

Input impedance — 1 MΩ, 33 pF in parallel
Voltage — 400 V D.C. + A.C. peak max.

Trigger Sources
Channel 1 only
Channel 2 only
Alternative (from display signal)

Channel – Channel

Breakthrough — > 34 dB up to 50 MHz

SECTION 2

OPERATING INSTRUCTIONS

2.1 FUNCTION OF CONTROLS AND CONNECTORS

These are situated on the front panel except where otherwise specified. For those controls not covered below, reference should be made to Section 2, in the manuals for the Main Frame and Sweep Unit plug-in.

2.1.1 CRT — Mainframe Manual.

2.1.2 SWEEP — Sweep Unit Manual

2.1.3 TRIGGER — Sweep Unit Manual

2.1.4 VERTICAL

DC-GND-AC — selects the input signal coupling.
In the DC position, the signal from the CH1/CH2 connector is coupled directly to the attenuator.
In the AC position a capacitor is inserted in series.
In the GND position the input to the attenuator is grounded, and the input socket is isolated; 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 — a preset; adjusts X1 gain calibration.
1 mV — a preset; adjusts X5 gain calibration.
NOTE: VARIABLE should be fully clockwise.

VARIABLE — enables all deflection sensitivites between that selected by the VOLTS/DIV switch and the next below to be covered. When pulled magnifies the display 5 times in the vertical axis. The control must be fully clockwise for a calibrated display.

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 is used to display the difference between two signals of the same phase in the SUM mode.

TRIG SELECT — selects triggering from either channel or display.

POSITION — moves the respective trace in the vertical axis.

DC BAL — preset, adjusted to eliminate trace movement when the respective VARIABLE are pulled.

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 lower sweep speeds.
When X5 gain is used HF/REJ should be selected on sweep plug-in.

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.

2.1.5 CONNECTORS

INPUTS — BNC sockets connect the signal to be viewed to the respective vertical amplifier.

OUTPUTS — terminal connected to the chassis of the instrument.

INTERFACE — edge connector situated at the rear; connects with mother-board in the main frame.

2.2 PRE-OPERATIONAL CHECKS

NOTE: Reference should be made to the Mainframe and Sweep Unit manuals for control settings and operation.

2.2.1 POWER SUPPLY — See Mainframe manual

2.2.2 CONTROL SETTINGS

1. CRT — See Mainframe manual
2. Sweep Unit plug-in. See Sweep Unit manual
3. Set controls as follows:

TRIG SELECT	CH1
CHANNEL SELECT	CH1
POSITION	Central
VOLTS/DIV	5 mV
INVERT	depressed
VARIABLE	fully clockwise
DC-GND-AC	GND
INPUT CONNECTION	CH1

2.3 OPERATION — See Mainframe Manual.

SECTION 3

CIRCUIT DESCRIPTION

3.1 VERTICAL AMPLIFIER

The V4 plug-in consists of 2 amplifiers, which are switched in various ways to feed a single main amplifier in the main frame.

3.1.1 The input attenuators, reference Figure 1, are simply 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 − 1, −2 and −4; on the front two wafers are the −10, −100 and −1000. The input impedance of the attenuator is maintained at 1 MΩ 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 μF 400 V capacitor on AC or a GND connection with the signal path input open circuited and the amplifer input grounded.

3.1.2 The circuits of channel 1 (CH1) and channel 2 (CH2) are very similar. CH1 is described below with reference to Figure 2, except where reference is made to CH2. TR601A and TR601B are a matched pair of 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 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 Ω resistors R646 and R647, is approximately 100 Ω 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 Ω/side. The attenuation of the signal is now approximately 3. This covers the gaps in the 1-2-5 sequence in the attenuators. The shift or position 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.

3.1.3 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 the main frame trigger interface. The diode matrix allows the trigger signals to be switched from CH1, CH2 or the displayed signal merely by changing DC levels, + 24V switches the channel on and − 24V off. The display or ALT trigger pick-off circuitry is on the main frame mother board.
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 main frame interface via the channel select diode matrix.

3.1.4 When CH1 is selected, reference Figure 3, the voltage at eyelet 152/24 is taken to + 11 V and at eyelet 152/23 to + 15 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 V and the interface current sensitivity is approximately 0.27 mA/div/side. This gives a voltage swing of 25 mV/div/side as the input impedance of the main frame is 100 Ω/side approximately.

3.1.5 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 + 15V and pin 152/23 + 11 V.
On CHOP these levels are switched at approximately 350 kHz and on ALT sweep repetition rate. The switching signals are obtained from TR751 and TR753 collectors on PC153, eyelets 153/14 and 153/17. The switching levels are + 11 V and + 15 V. TR751 controls CH2 and TR753 CH1. The collectors and bases are cross-coupled to ensure bistable operation. When CH1 is selected the emitter of TR751 is open-circuited, thus switching it off and TR753 on. The reverse happens when CH2 is selected.

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

3.1.7 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 V due to low common mode gain.

3.1.8 On CHOP, the circuit operates as an emitter-coupled multivibrator. 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 to the main frame interface.

3.1.9 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, the R703 is used to eliminate trace movement, when operating the VARIABLE. On CH2 the 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 control for the VARIABLE movement and R602 the balance control for gain switch movement. The CH2 trigger signal is fed to the bases of TR758 and TR759 then through the diode matrix to the main frame interface.

SECTION 4

MAINTENANCE AND RE-CALIBRATION

4.1 GENERAL

4.1.1 This manual should be read in conjunction with the manuals for the main frame and plug-in in use.

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 components are replaced, e.g., transistors, it is advised that the calibration checks detailed in para 4.4 be carried out.

4.2 MECHANICAL

4.2.1 ACCESS TO INTERIOR
Withdraw plug-in and remove covers.

4.2.2 LOCATION OF PRESET CONTROLS
Attenuator (PC137) and Vertical amplifier (PC152) are situated on the left. Trigger amplifier (PC153) on the right.

4.3 CALIBRATION

4.3.1 The following procedure enables a calibration check of the unit to be accomplished. It is advised, that isolated adjustments are not made, due to risk of interaction with settings made in earlier checks. A functional check may be carried out as detailed in para 4.4 below, checking parameters are met, then 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.

TOOLS

Screwdrivers	Plain 4mm. blade Non-capacitive.
Fixture	Extension, flexible, 067-0688-00 rigid, 067-0689-00.
Adaptors	Screened c/w BNC Adaptors, BNC 3-way, Male/Female/Male, BNC/2 mm.

Normalizer or capacitance measuring facility 33 pF.
Probe for voltage measurement (067-0552-00).

NOTE: Input signal voltages are peak to peak.

FACILITIES

Input Signals		
Sinewave		Squarewave
20 mV	50 kHz	
		25 mV 1 kHz 1%
	50 kHz	50 mV 1 kHz 1%
		100 mV 1 kHz 1%
		250 mV 1 kHz 1%
		500 mV 1 kHz 1%
		1 V 1 kHz 1%
		2.5 V 1 kHz 1%
	15 MHz	5.0 V 1 kHz 1%
		25 V 1 kHz 1%
		50 V 1 kHz 1%
		25 mV 1 MHz H 10 ns risetime

4.3.2 INITIAL SETTING
1.1 Push INVERT
1.2 Set both DC-GND-Ac to GND.
1.3 Set both VOLTS/DIV to 5 mV.
1.4 Set both VARIABLEs fully clockwise.
1.5 Push CH1 (Trig & Channel Select).
1.6 Set both POSITION controls to mid position.
NOTE: Reference should be made to Mainframe and Sweep Unit manuals for the respective initial control settings.

4.4 CALIBRATION PROCEDURE

4.4.1 VERTICAL AMPLIFIER BALANCE

Set CH1 X5 balance
1.1 Push A ONLY, A AUTO.
1.2 Set 'A' TIME/DIV to 1 ms.
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 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 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.
5.2 RE-CHECK CH2 X5 BALANCE.
5.3 RE-CHECK CH2 INVERT BALANCE.

Set CH1 Gain
6.1 Set TIME/DIV to 0.1 ms.
6.2 Set VOLTS/DIV to 5mV.
6.3 Select CH1.
6.4 Set DC-GND-AC to DC.
6.5 Apply 25mV 1 kHz 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 5μs.
8.5 Set VOLTS/DIV to 5mV.
8.6 Set DC-GND-AC to DC.
8.7 Apply 25mV 50 kHz sinewave to CH1.

8.8 Push ALT (Trig).
8.9 Push DC on Sweep Unit.
8.10 Adjust LEVEL to start trace on vertical centre line.
8.11 Push CH1 (TRIG).
8.12 Adjust R797 PC153 to correct trigger point movement.
8.13 Disconnect signal.

Set CH2 trigger

9.1 Set as in CH1 using corresponding CH2 controls.
9.2 Adjust R798 PC153 to correct trigger 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 0.1μs.
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 PC137
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 0.1μs 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 R688 PC152 for trace overshoot $<$0.1 divisions.
12.7 Pull FINE for X10 magnification.
12.8 Adjust C614 PC152 for 10% – 90% risetime $<$0.7 $\pm$0.1 div (Plate 4.1).
12.9 Disconnect signal.

Set CH2 pulse response

13.1 Set as in CH1 using corresponding CH2 controls.
13.2 Adjust C617 and R689 PC152 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 Sum Balance pot on Mainframe 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.

Refers to para. 4.4.4 of 4.0

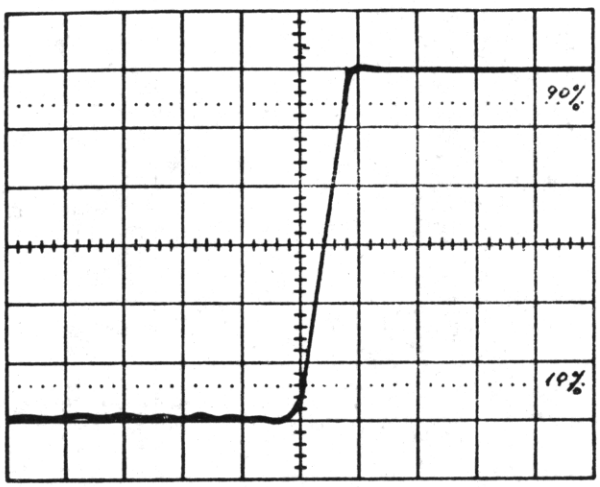


PLATE 4.1

SECTION 5

COMPONENT 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

CIRCUIT REFERENCE BLOCKS

The table below gives the blocks of circuit references, so that the reader can relate the items listed in this section and their location in the circuitry and printed circuit boards in Section 6.

Circuit Reference		Circuit	Fig.	P.C. Board No.
From	To			
601 751	700) 800)	Dual Trace Amplifier	(2 (3	152 153
901	950	Volts/Div Switch	1	137

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 - 36 Coldharbour Lane, Harpenden, Hertfordshire, England

Telephone: Harpenden 65141 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	Eff. Ser.No.
C601	285-0915-00	100 n	PE	20	100	
C602	285-0915-00	100 n	PE	20	100	
C603	281-0710-00	10 n	CER		250	
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
C608	285-0858-00	1 n	PS	1	350	569001
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	
C620	285-1064-00	680 p	PS	5	160	569751
C621	285-1014-00	1 μ	PE	20	63	
C622	285-1014-00	1 μ	PE	20	63	
C623	285-1014-00	1 μ	PE	20	63	
C750	285-0854-00	100 p	PS	2 p	350	
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	
C756	281-0710-00	10 n	CER		250	
C757	290-0623-00	4.7 μ	E		25	
C758	285-0759-00	2.2 n	PS	5	125	
C762	281-0731 00	5.6 p	CER	0.5 p	750	
C763	281-0731 00	5.6 p	CER	0.5 p	750	
*C901	285-0772-00	100 n	PE	10	400	
*C902	281-0155-00	2-22 p	PP		500	
*C903	281-0155-00	2-22 p	PP		500	
*C904	281-0155-00	2-22 p	PP		500	
*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	
*C921	285-1017-00	10 n	PE	20	500	
C922	285-0866-00	10 p	PS	1	350	670601
C923	185-0866-00	10 p	PS	1	350	670601

*Two per unit.

CIR REF	PART NUMBER	VALUE	DESCRIPTION	TYPE	TOL %	RATING
D601	152-0565-00		EXP5072A	Si		
D602	152-0565-00		EXP5072A	Si		
D603	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
D606	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	DESCRIPTION	TYPE	TOL %	RATING
D755	152-0062-01		1N914/1N4148	Si		75 V
D756	152-0062-01		1N914/1N4148	Si		75 V
D757	152-0062-01		1N914/1N4148	Si		75 V
D758	152-0062-01		1N914/1N4148	Si		75 V
D759	152-0062-01		1N914/1N4148	Si		75 V
D761	152-0062-01		1N914/1N4148	Si		75 V
D762	152-0062-01		1N914/1N4148	Si		75 V

CIR REF	PART NUMBER	VALUE ohms	DESCRIPTION TYPE	TOL %	RATING W
* R601	311-1352-00	47 k	CV	20	250 m
† R602	311-1352-00	47 k	CV	20	250 m
R603	317-0224-01	220 k	C	5	125 m
R604	317-0224-01	220 k	C	5	125 m
R605	317-0122-01	1.2 k	C	5	125 m
R606	317-0122-01	1.2 k	C	5	125 m
R607	317-0101-01	100	C	5	125 m
R608	317-0101-01	100	C	5	125 m
R609	317-0101-01	100	C	5	125 m
R611	317-0101-01	100	C	5	125 m
R612	317-0472-01	4.7 k	C	5	125 m
R613	317-0472-01	4.7 k	C	5	125 m
R614	317-0103-01	10 k	C	5	125 m
R615	317-0472-01	4.7 k	C	5	125 m
R616	317-0472-01	4.7 k	C	5	125 m
R617	317-0221-01	220	C	5	125 m
R618	317-0221-01	220	C	5	125 m
R619	317-0221-01	220	C	5	125 m
R621	317-0390-01	39	C	5	125 m
R622	317-0390-01	39	C	5	125 m
R623	317-0390-01	39	C	5	125 m
R624	317-0390-01	39	C	5	125 m
R625	311-1350-00	100	CP	20	250 m
R626	311-1350-00	100	CP	20	250 m
R627	317-0512-01	5.1 k	C	5	125 m
R628	317-0512-01	5.1 k	C	5	125 m
R629	317-0472-01	4.7 k	C	5	125 m
R631	317-0472-01	4.7 k	C	5	125 m
R632	317-0821-01	820	C	5	125 m
R633	317-0821-01	820	C	5	125 m
R634	317-0821-01	820	C	5	125 m
R635	317-0821-01	820	C	5	125 m
R636	317-0510-01	51	C	5	125 m
R637	317-0510-01	51	C	5	125 m
R638	317-0510-01	51	C	5	125 m
R639	317-0510-01	51	C	5	125 m
** R641	311-1471-00	2.2 k	CV	20	250 m
*** R642	311-1471-00	2.2 k	CV	20	250 m
R643	317-0473-01	47 k	C	5	125 m
R644	317-0473-01	47 k	C	5	125 m
R645	311-0765-00	100 k	CP	20	250 m
R646	321-0968-48	91	MF	1	125 m
R647	321-0968-48	91	MF	1	125 m
R648	321-0968-48	91	MF	1	125 m
R649	321-0968-48	91	MF	1	125 m
R651	317-0472-01	4.7 k	C	5	125 m
R652	317-0472-01	4.7 k	C	5	125 m
R653	317-0472-01	4.7 k	C	5	125 m

CIR REF	PART NUMBER	VALUE ohms	DESCRIPTION TYPE	TOL %	RATING W
R654	317-0472-01	4.7 k	C	5	125 m
* R655	311-1352-00	1.5 k	CV	20	250 m
† R656	311-1352-00	1.5 k	CV	20	250 m
R657	321-0862-48	620	MF	1	125 m
R658	321-0862-48	620	MF	1	125 m
R659	321-0862-48	620	MF	1	125 m
R661	321-0862-48	620	MF	1	125 m
R662	315-0621-02	620	C	5	250 m
R663	315-0621-02	620	C	5	250 m
R664	317-0361-01	360	C	5	125 m
R665	317-0361-01	360	C	5	125 m
R666	317-0471-01	470	C	5	125 m
R667	317-0471-01	470	C	5	125 m
R668	317-0471-01	470	C	5	125 m
R669	317-0471-01	470	C	5	125 m
R671	317-0272-01	2.7 k	C	5	125 m
R672	317-0272-01	2.7 k	C	5	125 m
R673	317-0272-01	2.7 k	C	5	125 m
R674	317-0272-01	2.7 k	C	5	125 m
R675	317-0100-01	10	C	5	125 m
R676	317-0100-01	10	C	5	125 m
R677	317-0220-01	22	C	5	125 m
R678	317-0220-01	22	C	5	125 m
R679	317-0220-01	22	C	5	125 m
R681	317-0220-01	22	C	5	125 m
R682	317-0162-01	1.6 k	C	5	125 m
R683	317-0162-01	1.6 k	C	5	125 m
R684	317-0162-01	1.6 k	C	5	125 m
R685	317-0162-01	1.6 k	C	5	125 m
R686	317-0151-01	150	C	5	125 m
R687	317-0151-01	150	C	5	125 m
R688	311-0717-00	220	CP	20	250 m
R689	311-0717-00	220	CP	20	250 m
R691	307-0394-00	3.9	C	5	125 m
R694	317-0220-01	22	C	5	125 m
R695	317-0220-01	22	C	5	125 m
R696	311-1481-00	47	CP	20	250 m
R697	311-1481-00	47	CP	20	250 m
R698	317-0047-01	4.7	C	5	125 m
R699	317-0481-00	4.7	C	5	125 m (1400)
R701	317-0473-01	47 k	C	5	125 m
R702	317-0473-01	47 k	C	5	125 m
R703	311-0765-00	100 k	CP	20	250 m
R704	311-0995-00	680	CP	20	250 m
R705	317-0151-01	150	C	5	125 m
R706	317-0151-01	150	C	5	125 m

* † Dual pot ** with S602 *** with S603

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
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

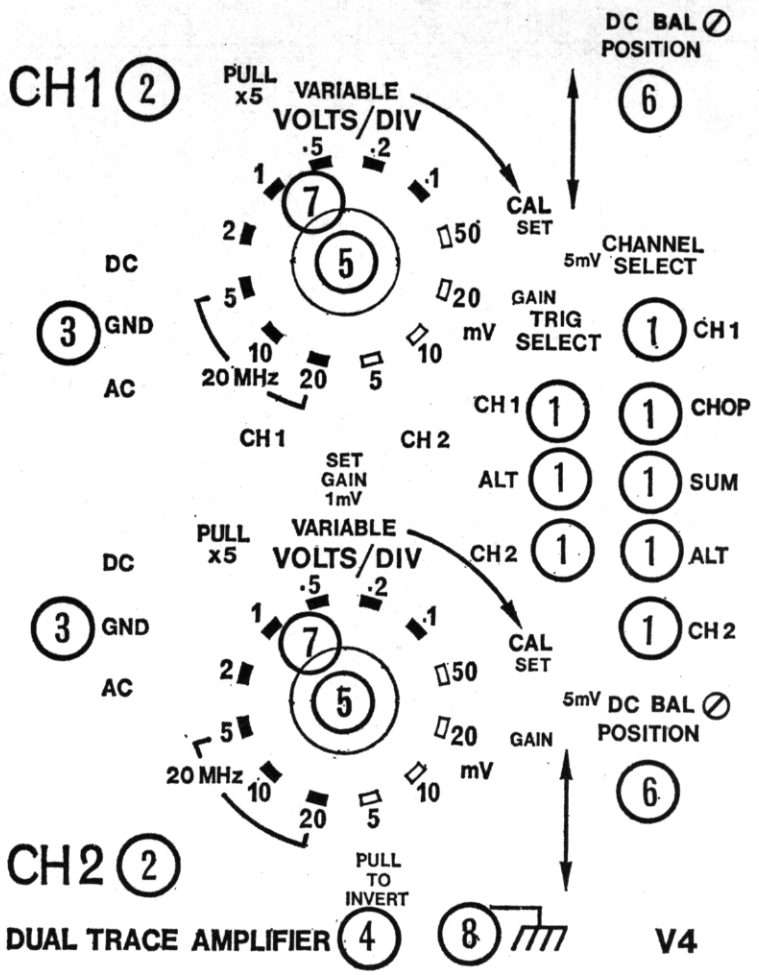
CIR REF	PART NUMBER	VALUE	DESCRIPTION	TYPE	TOL %	RATING
S601	260-1429-00		Slide (2-position)			
S602	311-1471-00		Push-Pull (with R641)			
S603	311-1471-00		Push-Pull (with R642)			
S751	260-1406-00		Push (5 button)			
S752	260-1407-00		Push (3-button)			
* S901	260-1412-00		Lever (3 position)			
* S902	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	151-0242-00	2N3904	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



FRONT PANEL

MECHANICAL

Part Number	Description	Location
136-0344-00	Base Transistor, 4 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
131-0651-01	Connector, Panel Jack	3
210-0735-00	Eyelet, L.613	PCB
210-0739-00	Eyelet, L.737	PCB
342-0177-00	Insulator, Feed Thru.	PC130
003-0674-00	Key, Allen 1·5 A/F	4 - 7
366-1404-00	Knob, Push-Pull	4
366-1266-01	Knob, Red/Red	5
366-1254-00	Knob, Grey	6
366-1387-00	Knob, Grey	7
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/8 BA x ·05"	1
105-0347-00	Stop	Rear of Mod.
210-0275-00	Tag, Solder, $\frac{3}{8}$"	

SECTION 6

To minimize the risk of misinterpretation of component values on circuit diagrams, the decimal point has been replaced by the multiplier or sub-multiplier of the basic unit. For instance, 2.2 megohms is shown as 2M2 and 1.8 picofarads is shown as 1p8.

To aid the reader further, in addition to the block Circuit Reference Table in Section 5.1, to locate a component in the circuit diagrams, a table is provided at the top of each circuit diagram, in which the circuit reference will appear, where practicable, directly above the component being sought.

PRINTED CIRCUIT

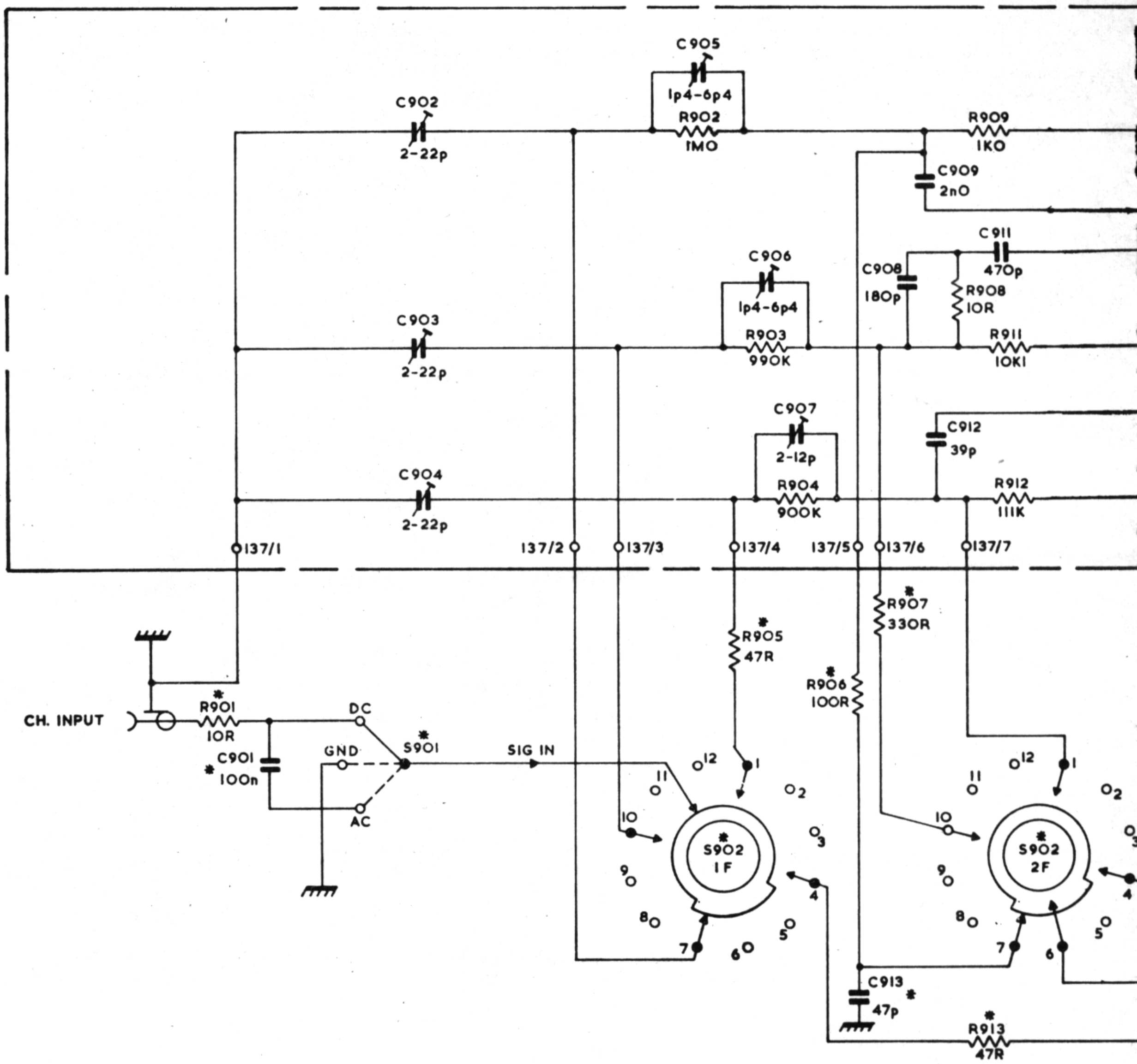
Blue shows the rear track as seen through the board. Yellow the component side track.

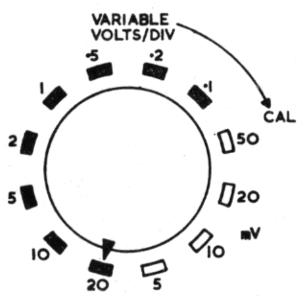
Location of components are listed on the page preceding the PCBs.

WAVEFORMS

Waveforms, illustrated in Plate 6/1, may be monitored at point with the corresponding number.

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

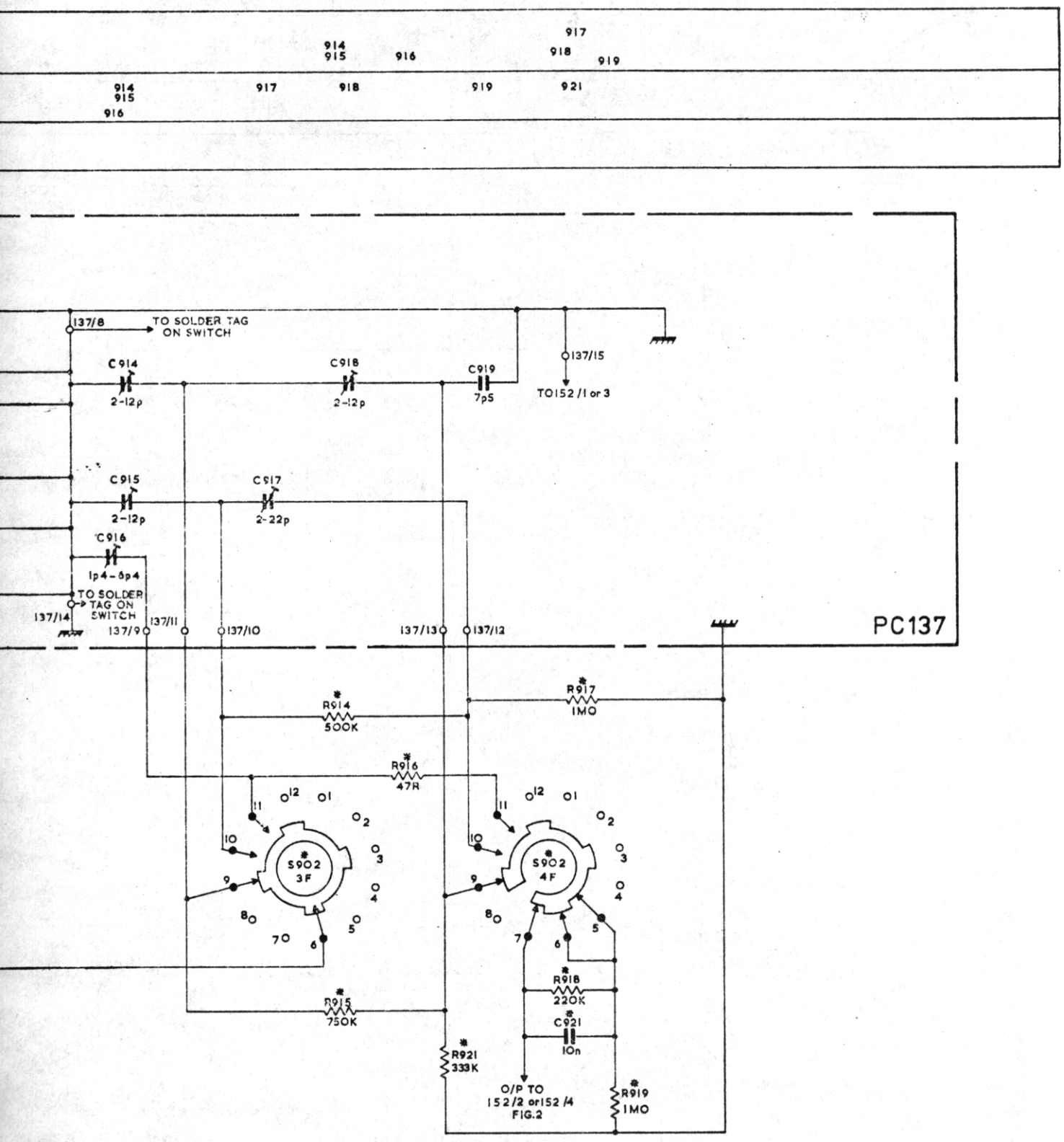




FRONT PANEL MARKING

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 AMPLIFIER TYPE V4

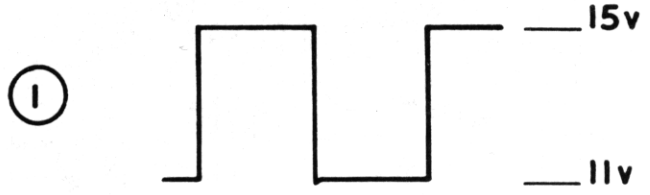
VOLTS / DIV SWITCH

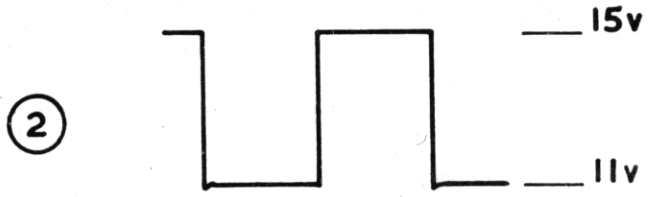
FIG. 1

ATTENUATION SELECTED BY WAFER					Selected Resistor To Earth 1F	Resistor Between Eyelets and 2F	Selected Resistor Between 3F and 4F	Selected Resistor Between 4F and Earth
Switch Position	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
CAPACITORS
MISC.
SK601 SK602





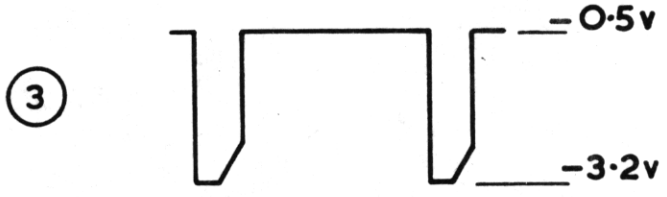
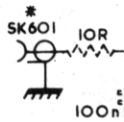


PLATE 6/1



DC BAL

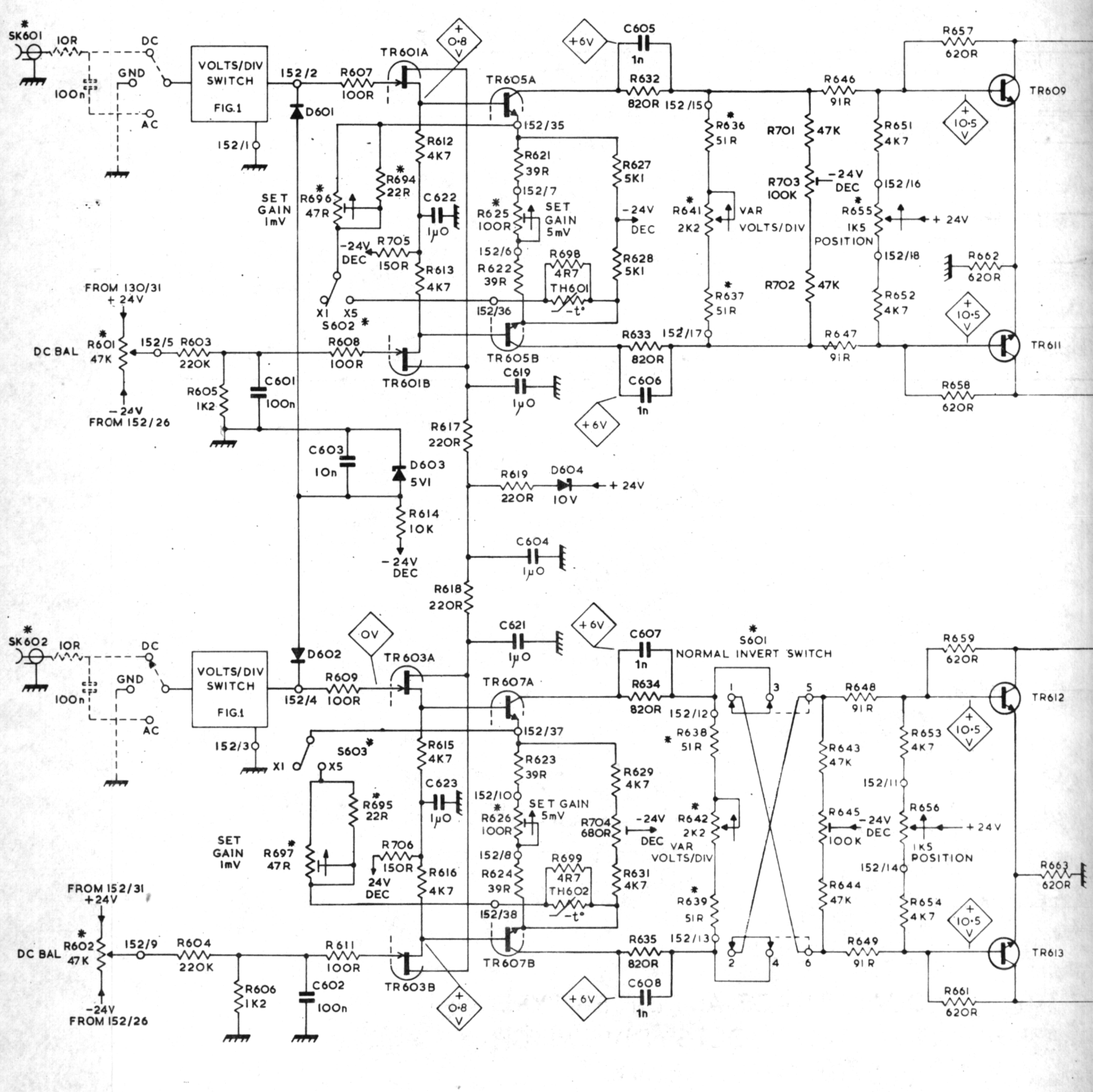
FR

DC BAL R60
47K

FR

NOTES
1. * DENOTE
2. 152/2 DI

RESISTORS	601 602	605 603 604 606		696 697	607 608 609 611	694 612 705 613 695 706 615 614 616	617 618 619	621 625 622 623 626 624	698 699 704 629 631	627 628 632 633 634 635	636 641 637 638 642 639	701 702 703 646 643 647 645 648 644 649	651 655 652 653 656 654	657 658 659 661	662	663
CAPACITORS			601	603 602		622 623		619 604 621		605 606 607 608						
MISC. SK601 SK602				D601 D602 S602 S603	D603	TR601A TR6C1B TR603A TR603B		TR605A TR605B TR607A TR607B	TH601 D604 TH602			S601				TR609 TR611 TR612 TR613



NOTES

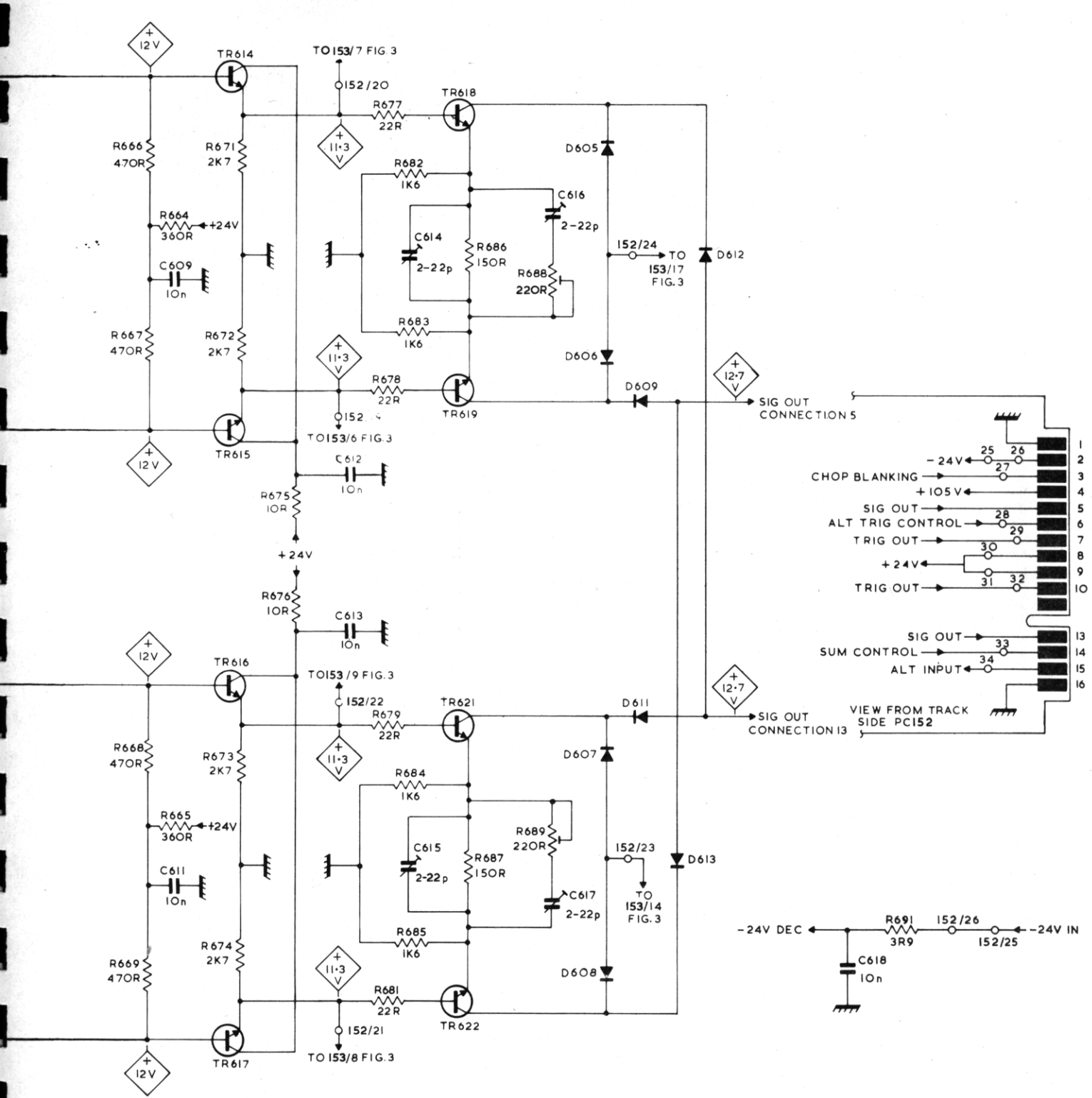
1. * DENOTES COMPONENTS NOT MOUNTED ON PC BOARD
2. 152/2 DENOTES PC BOARD/EYELET OR TERMINAL No

11/76

666 667 668 669 664 665 671 672 673 674 675 676 677 678 679 681 682 683 684 685 686 687 688 689 691

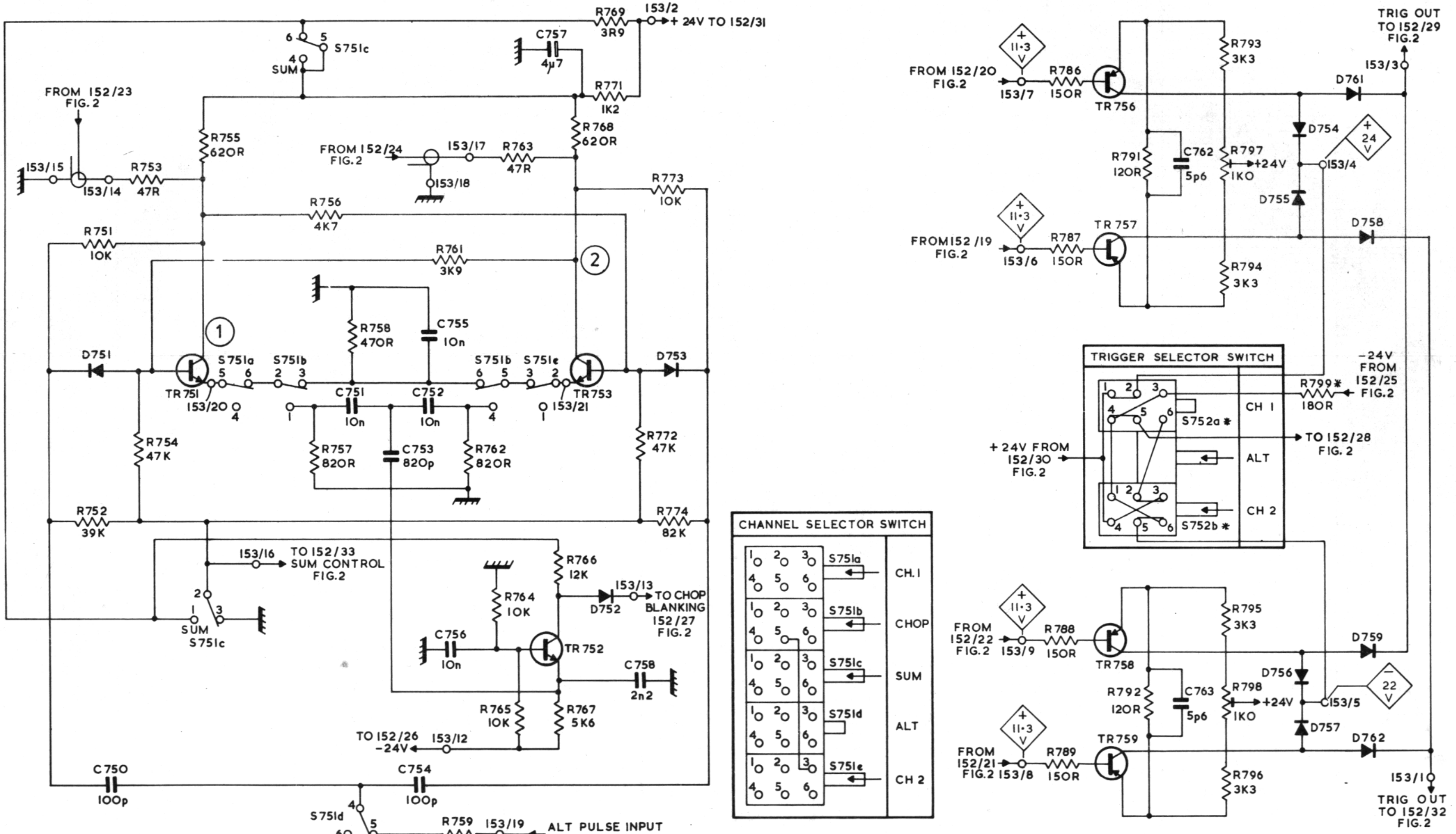
609 611 612 613 614 615 616 617 618

TR614 TR615 TR616 TR617 TR618 TR619 TR621 TR622 D605 D606 D607 D608 D609 D611 D612 D613



DUAL TRACE AMPLIFIER TYPE V4
PC152 FIG. 2

RESISTORS	751 752	753 754	755	756 757 758	761 762 759	763 764 765	768 766 767	769 771 772 774	773	786 788 787 789	791 792	793 796 794 797 795 798	799
CAPACITORS	750			751 753 754	755 752 756		757	758			762 763		
MISC.	D751	TR751 S751a S751c	S751b	S751c S751d	S751b	S751e TR752	TR753 D752	D753		TR756 TR758 TR757 TR759		S752a S752b	D754 D756 D758 D761 D755 D757 D759 D762

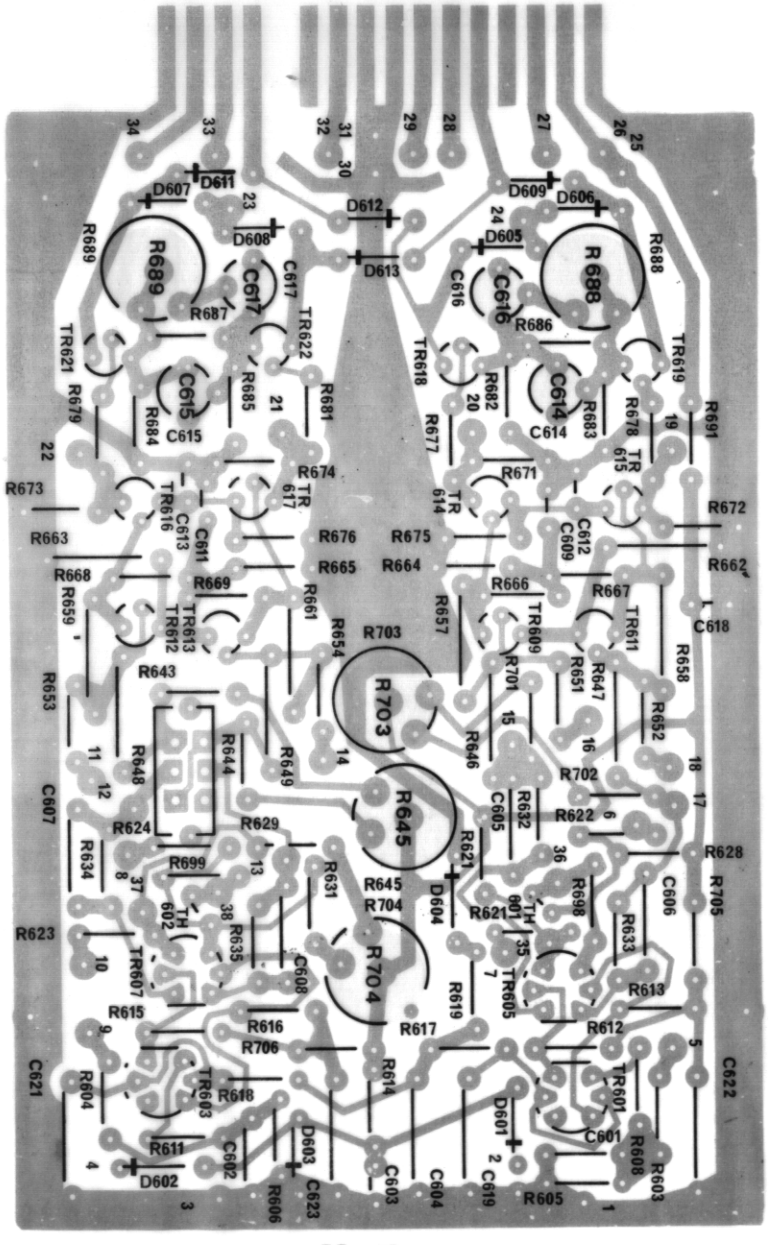


NOTES.
1. 153/3 DENOTES PC BOARD/EYELET OR TERMINAL No.
2. * DENOTES COMPONENTS NOT MOUNTED ON PC BOARD

DUAL TRACE AMPLIFIER TYPE V4
PC 153 FIG. 3

LOCATION OF COMPONENTS ON PRINTED CIRCUITS

Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location	Cir Ref	Grid Location
C601	4– C6			D603	4– B5	R607		R647	4– C4	R687	4– B2	R765	4– F1	R901		TR611	4– C3
C602	4– B5			D604	4– C4	R608	4– C5	R648	4– B4	R688	4– C2	R766	4– F2	R902	4– E5	TR612	4– B3
C603	4– B6			D605	4– C2	R609		R649	4– B4	R689	4– B2	R767	4– F1	R903	4– E5	TR613	4– B3
C604	4– C5			D606	4– C2							R768	4– F3	R904	4– E6	TR614	4– C3
C605	4– C4			D607	4– B2	R611	4– B5	R651	4– C4	R691	4– D3	R769	4– F3	R905		TR615	4– C3
C606	4– C5			D608	4– B2	R612	4– C5	R652	4– C4					R906		TR616	4– B3
C607	4– A4			D609	4– C2	R613	4– C5	R653	4– A4			R771	4– F3	R907		TR617	4– B3
C608	4– B5	C901				R614	4– B5	R654	4– B4	R694	4–	R772	4– E3	R908		TR618	4– C2
C609	4– C3	C902	4– E5	D611	4– B2	R615	4– B5			R695	4–	R773	4– E3	R909	4– F5	TR619	4– C2
		C903	4– E5	D612	4– B2	R616	4– B5			R696	4–	R774	4– E3				
C611	4– B3	C904	4– E5	D613	4– B2	R617	4– C5	R657	4– C3	R697	4–			R911	4– F5	TR621	4– B2
C612	4– C3	C905	4– E5			R618	4– B5	R658	4– C3	R698	4– C4			R912	4– F6	TR622	4– B2
C613	4– B3	C906	4– E5			R619	4– C5	R659	4– A3	R699	4– B4			R913			
C614	4– C2	C907	4– E5											R914			
C615	4– B2	C908				R621	4– C4	R661	4– B3	R701	4– C4			R915			
C616	4– C2	C909	4– F5	D751	4– E2	R622	4– C5	R662	4– C3	R702	4– C4			R916			
C617	4– B2			D752	4– F2	R623	4– A5	R663	4– A3	R703	4– B4			R917			
C618	4– D3	C911	4– F5	D753	4– E3	R624	4– B4	R664	4– C3	R704	4– B5			R918			
C619	4– C5	C912	4– F5	D754	4– G2	R625		R665	4– B3	R705	4– D5	R786	4– G2	R919		TR751	4– E2
		C913		D755	4– G2	R626		R666	4– C3	R706	4– B5	R787	4– G1			TR752	4– F2
C621	4– A5	C914	4– F5	D756	4– G3	R627	4–	R667	4– C3			R788	4– G4	R921		TR753	4– E3
C622	4– D5	C915	4– F5	D757	4– G3	R628	4– C4	R668	4– B3			R789	4– G3				
C623	4– B5	C916	4– F5	D758	4– H2	R629	4– B4	R669	4– B3								
		C917	4– G5	D759	4– H3							R791	4– G2			TR756	4– G2
		C918	4– G5			R631	4– B4	R671	4– C3			R792	4– G3			TR757	4– G1
		C919	4– G5	D761	4– G3	R632	4– C4	R672	4– D3			R793	4– G2	TH601	4– C5	TR758	4– G4
C750	4– E3			D762	4– G3	R633	4– C5	R673	4– A3	R751	4– E2	R794	4– G2	TH602	4– B5	TR759	4– G3
C751	4– E2	C921				R634	4– A4	R674	4– B3	R752	4– E2	R795	4– G3				
C752	4– E2					R635	4– B5	R675	4– C3	R753	4– F2	R796	4– G3				
C753	4– E2					R636		R676	4– B3	R754	4– E3	R797	4– G2				
C754	4– E3					R637		R677	4– C3	R755	4– F2	R798	4– F3	TR601	4– C5		
C755	4– D1					R638		R678	4– C3	R756	4– F3	R799					
C756	4– F2					R639		R679	4– A3	R757	4– E2			TR603	4– B5		
C757	4– F3									R758	4– E1						
C758	4– E1			R601		R641		R681	4– B2	R759	4– F4			TR605	4– C5		
				R602		R642		R682	4– C2								
				R603	4– C5	R643	4– B4	R683	4– C2	R761	4– F3			TR607	4– B5		
				R604	4– A5	R644	4– B4	R684	4– B3	R762	4– E2						
C762	4– G2	D601	4– C5	R605	4– C6	R645	4– B4	R685	4– B2	R763	4– F3			TR609	4– C3		
C763	4– G3	D602	4– B6	R606	4– B5	R646	4– C4	R686	4– C2	R764	4– E2						



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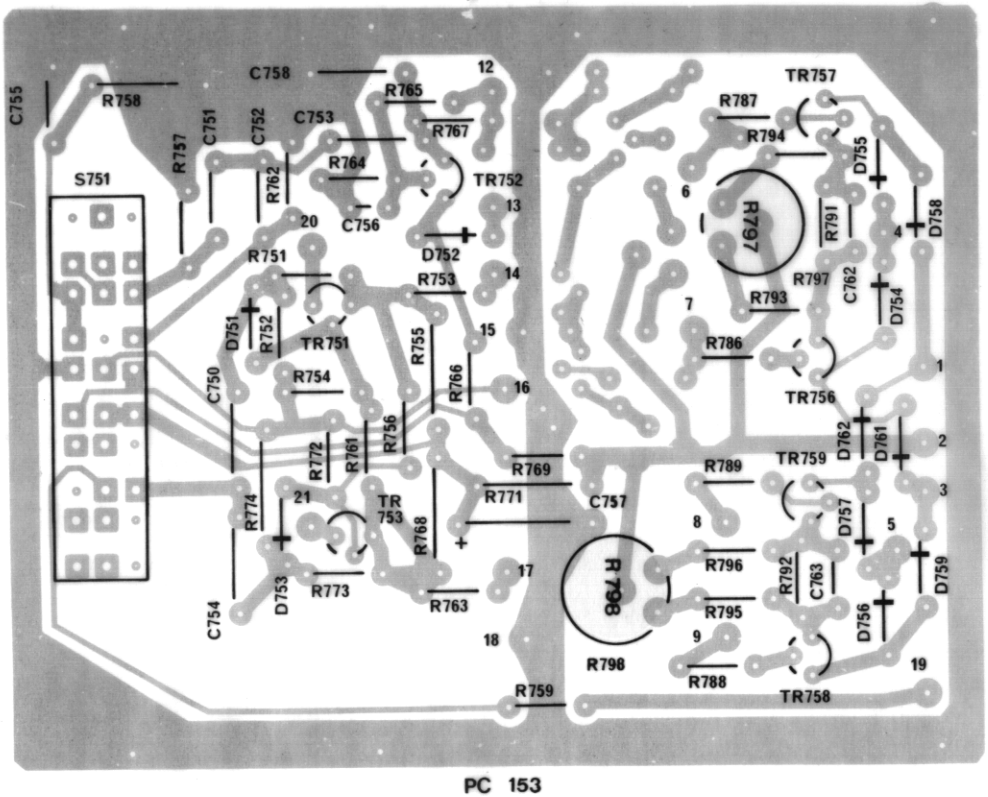

PC 153

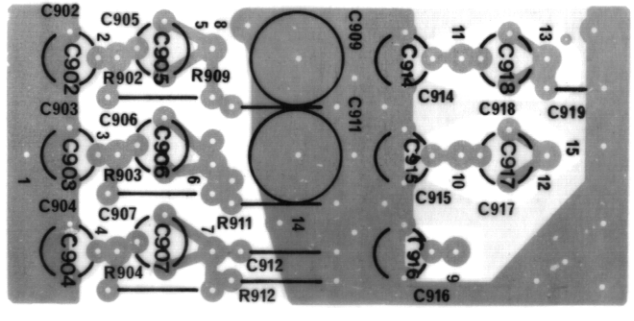

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FIGURE 4 COMPONENT REFERENCE