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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DUAL TRACE AMPLIFIER UNIT TYPE V4

INSTRUCTION MANUAL

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INTRODUCTION

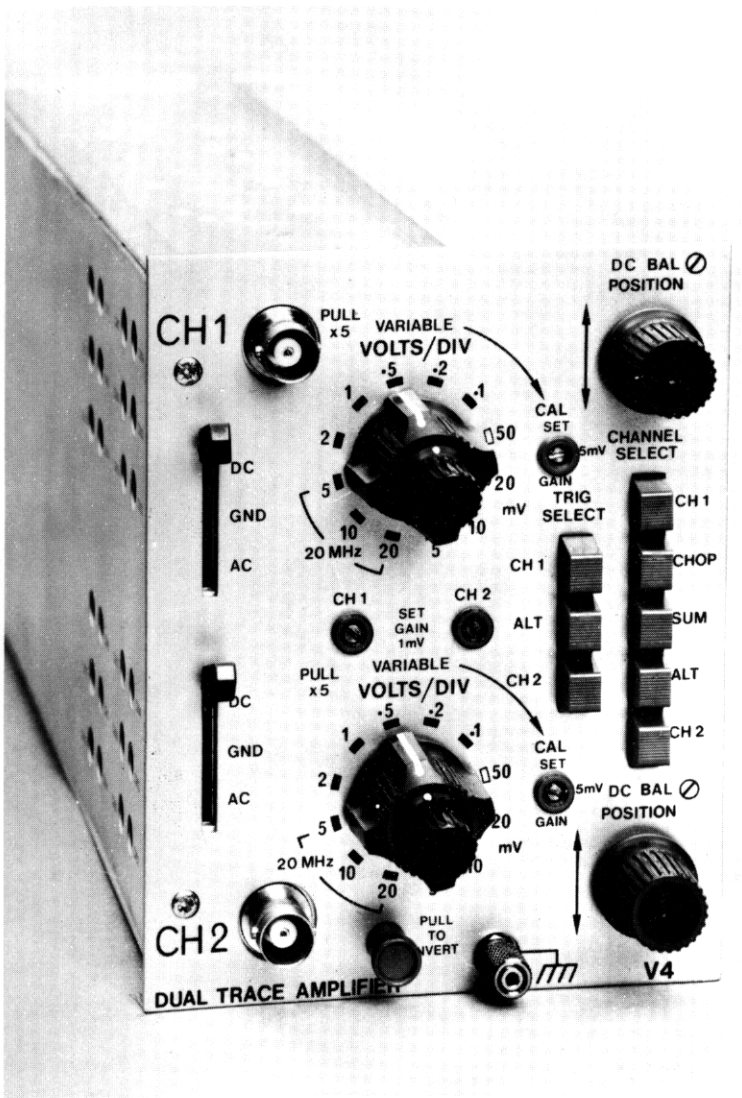
The V4, a 50 MHz dual-trace plug-in, provides the main frame with dual trace vertical facility, which displays either channel separately, adds channels algebraically, alternates or chops between channels.

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

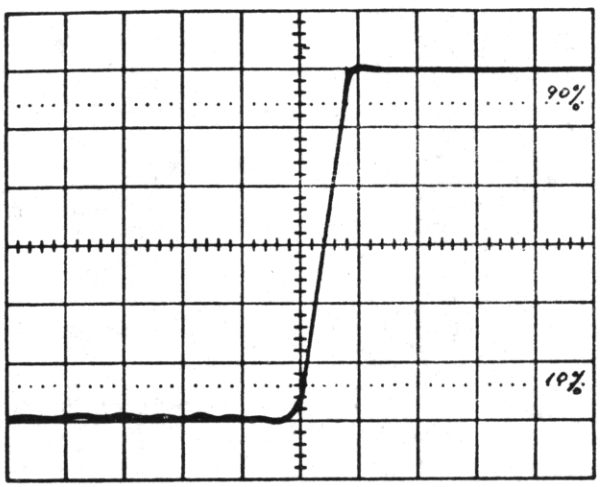


PLATE 4.1

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

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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	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

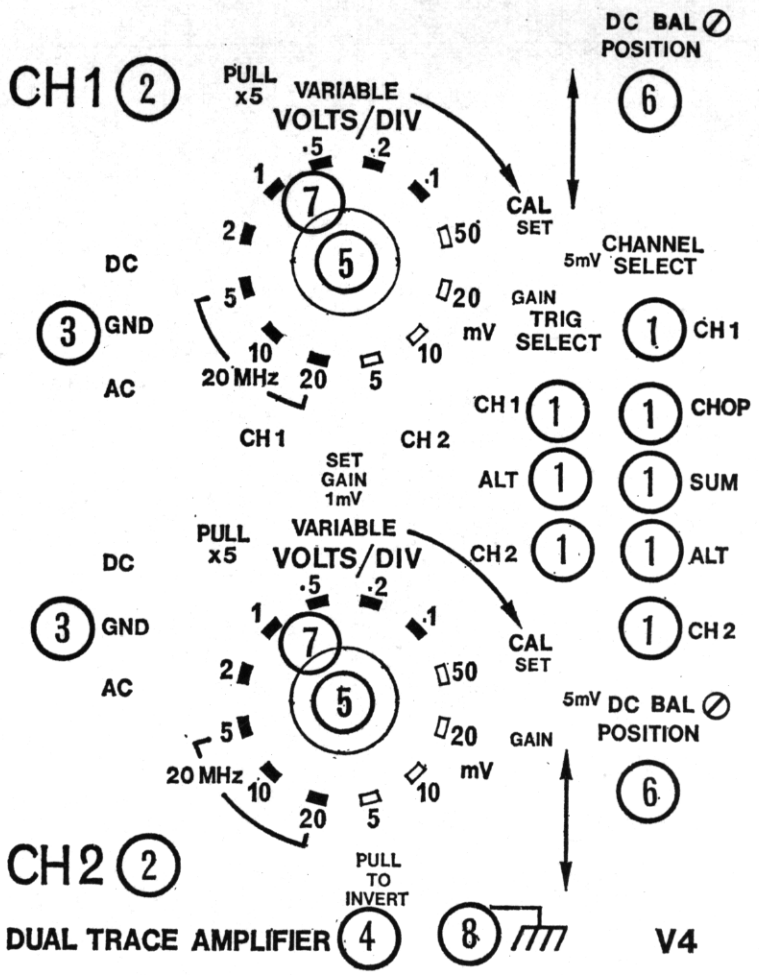
CIR REF	PART NUMBER	VALUE	DESCRIPTION	TYPE	TOL %	RATING
S601	260-1429-00		Slide (2-position)			
S602	311-1471-00		Push-Pull (with R641)			
S603	311-1471-00		Push-Pull (with R642)			
S751	260-1406-00		Push (5 button)			
S752	260-1407-00		Push (3-button)			
* S901	260-1412-00		Lever (3 position)			
* S902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

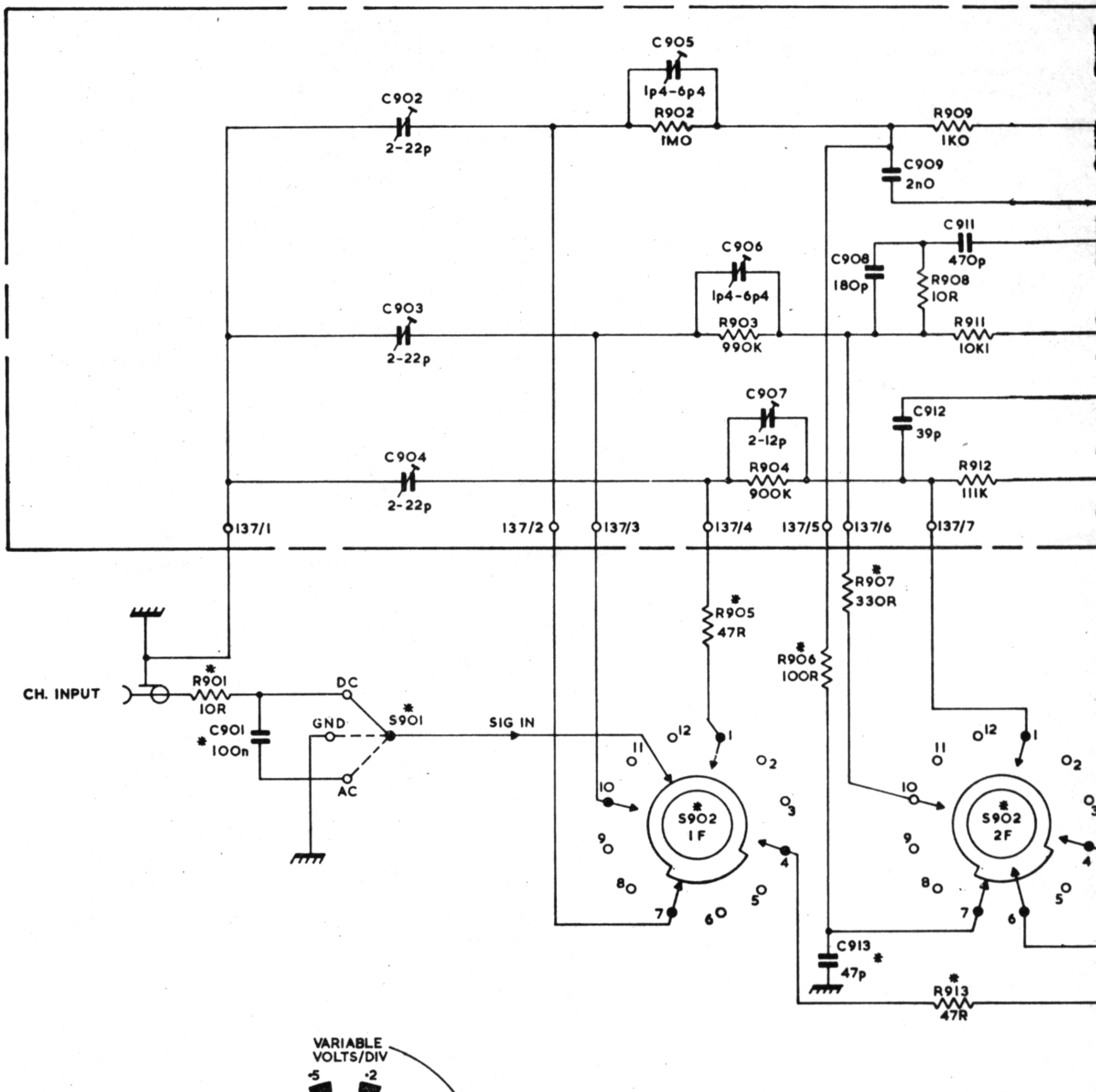
Blue shows the rear track as seen through the board. Yellow the component side track.

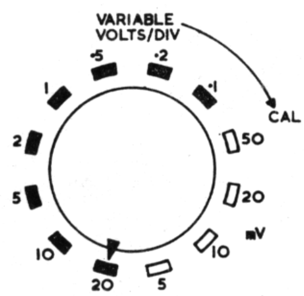
Location of components are listed on the page preceding the PCBs.

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

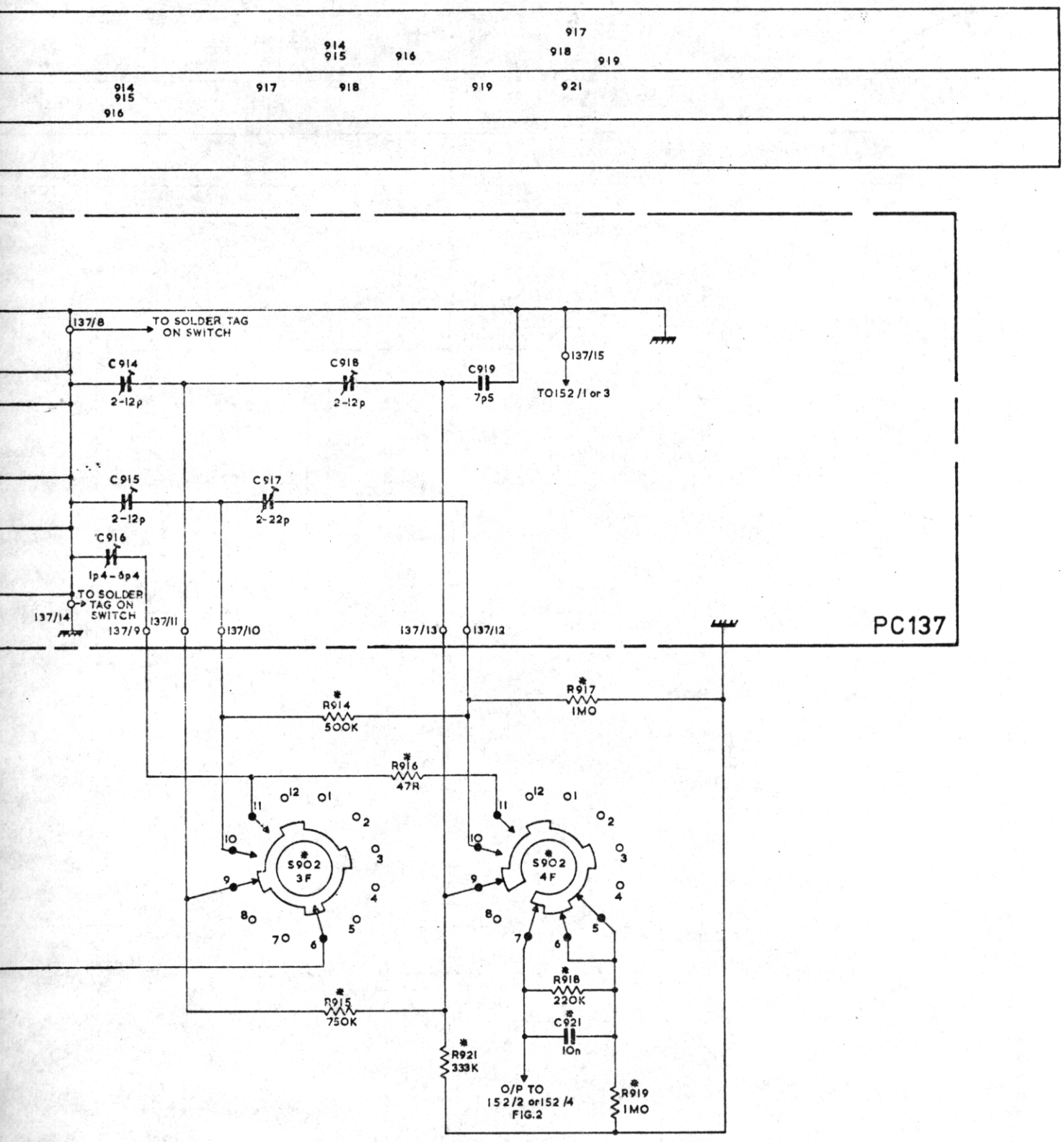




FRONT PANEL MARKING

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

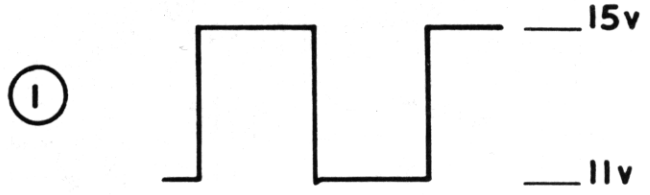
VOLTS / DIV SWITCH

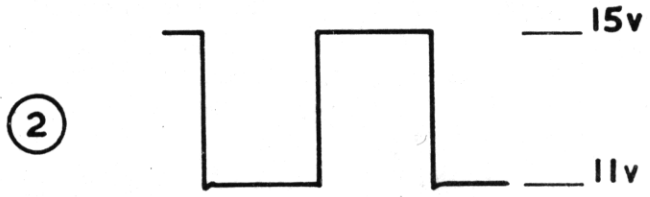
FIG. 1

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





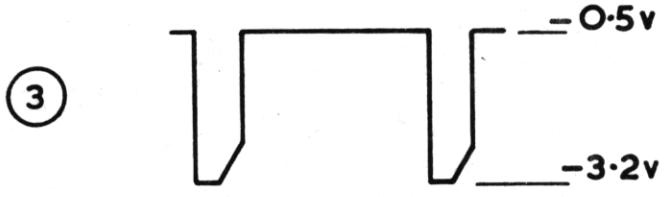
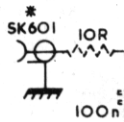


PLATE 6/1



DC BAL

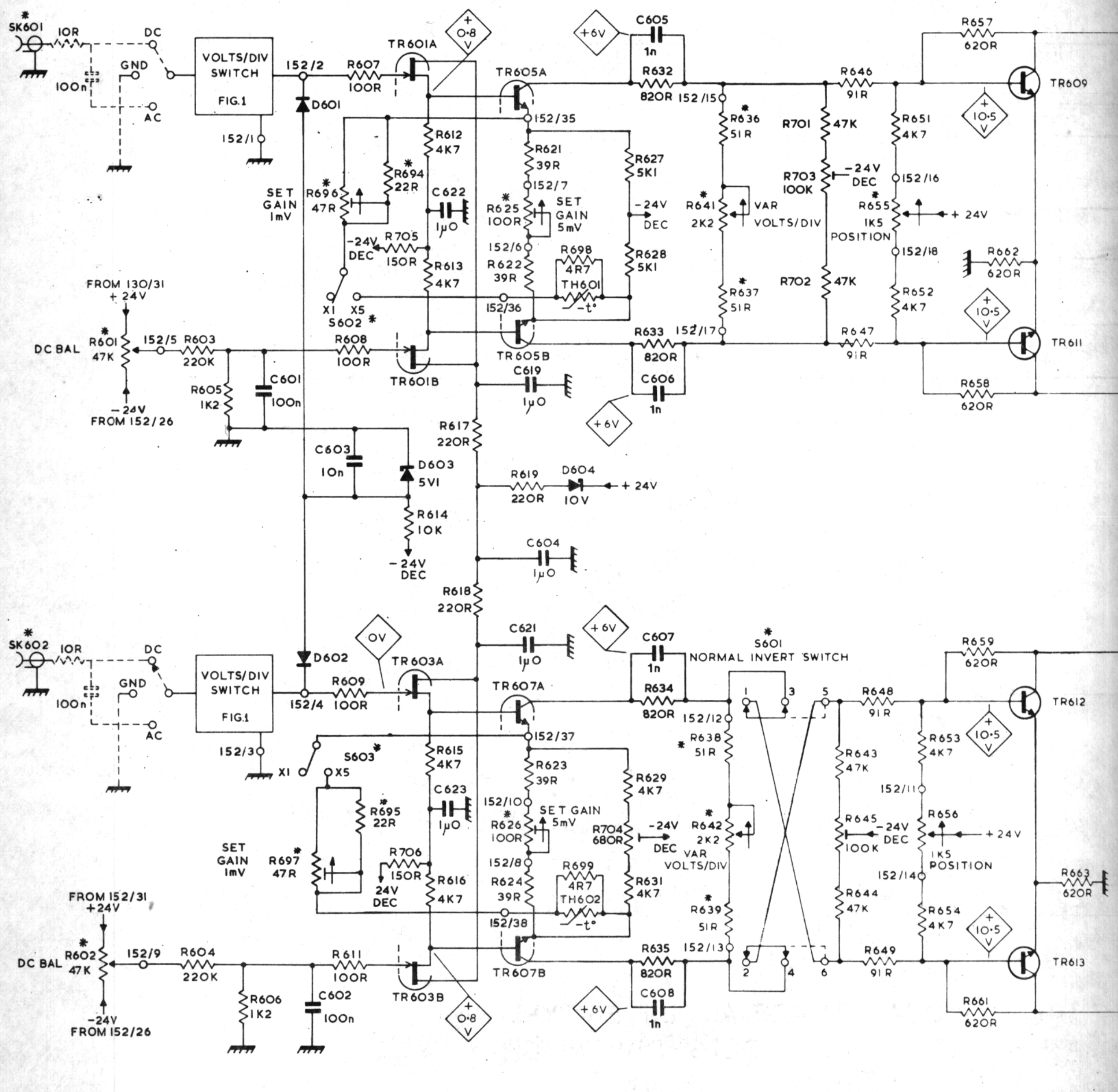
FR

DC BAL R60
47K

FR

NOTES
1. * DENOTE
2. 152/2 DI

RESISTORS	601 602 603 604 605 606 696 697 607 608 609 611 694 705 695 706 614 612 613 615 616 617 618 619 621 625 622 623 626 624 698 699 704 629 631 627 628 632 633 634 635 636 641 637 638 642 639 701 702 703 643 645 644 646 647 648 649 651 655 652 653 656 654 657 658 659 661 662 663
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



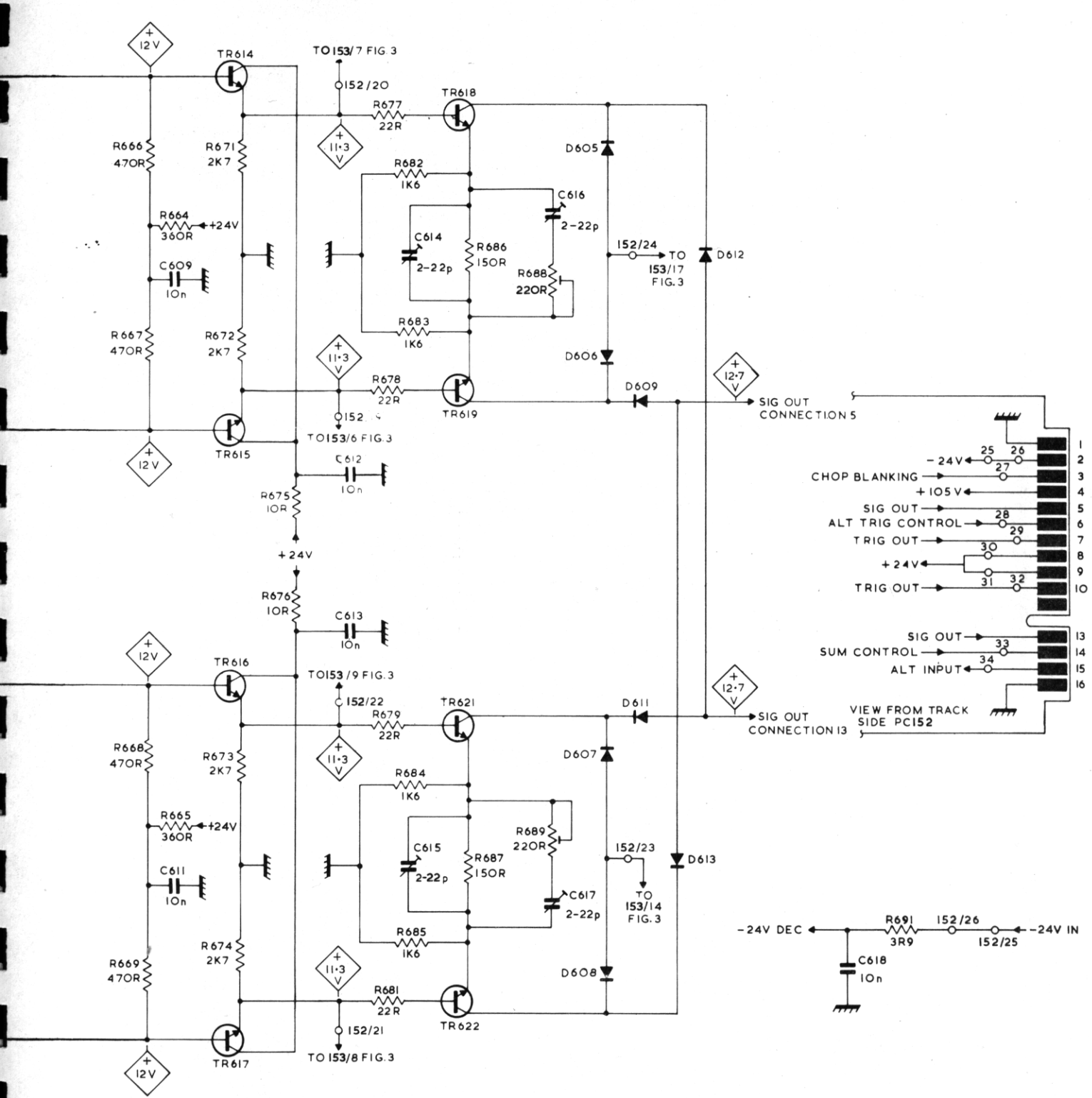
NOTES
1. * DENOTES COMPONENTS NOT MOUNTED ON PC BOARD
2. 152/2 DENOTES PC BOARD/EYELET OR TERMINAL No

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

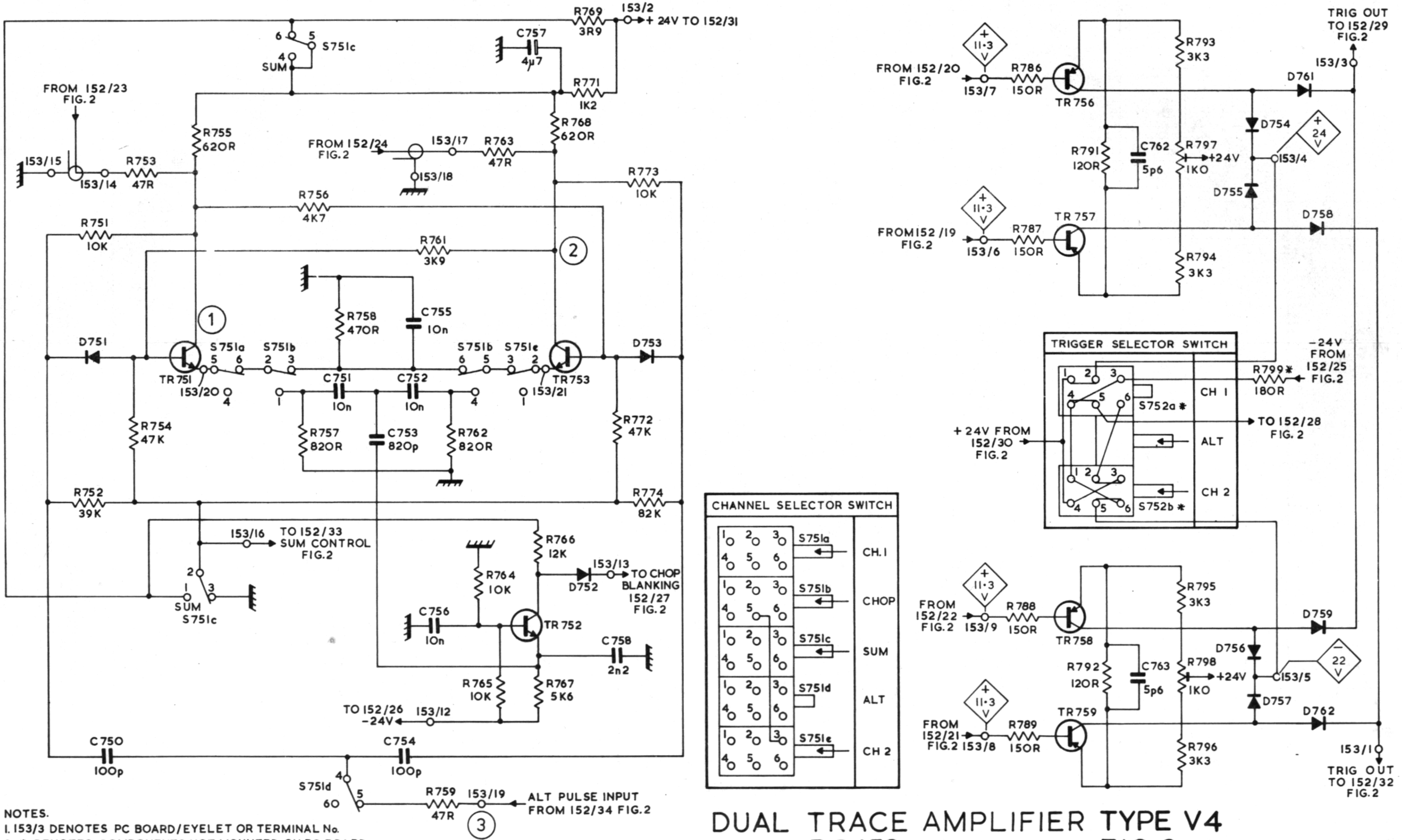
TR614 TR615 TR616 TR617 TR618 TR619 TR621 TR622 D605 D606 D607 D608 D609 D611 D612 D613



DUAL TRACE AMPLIFIER TYPE V4
PC152 FIG. 2

-24V IN

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

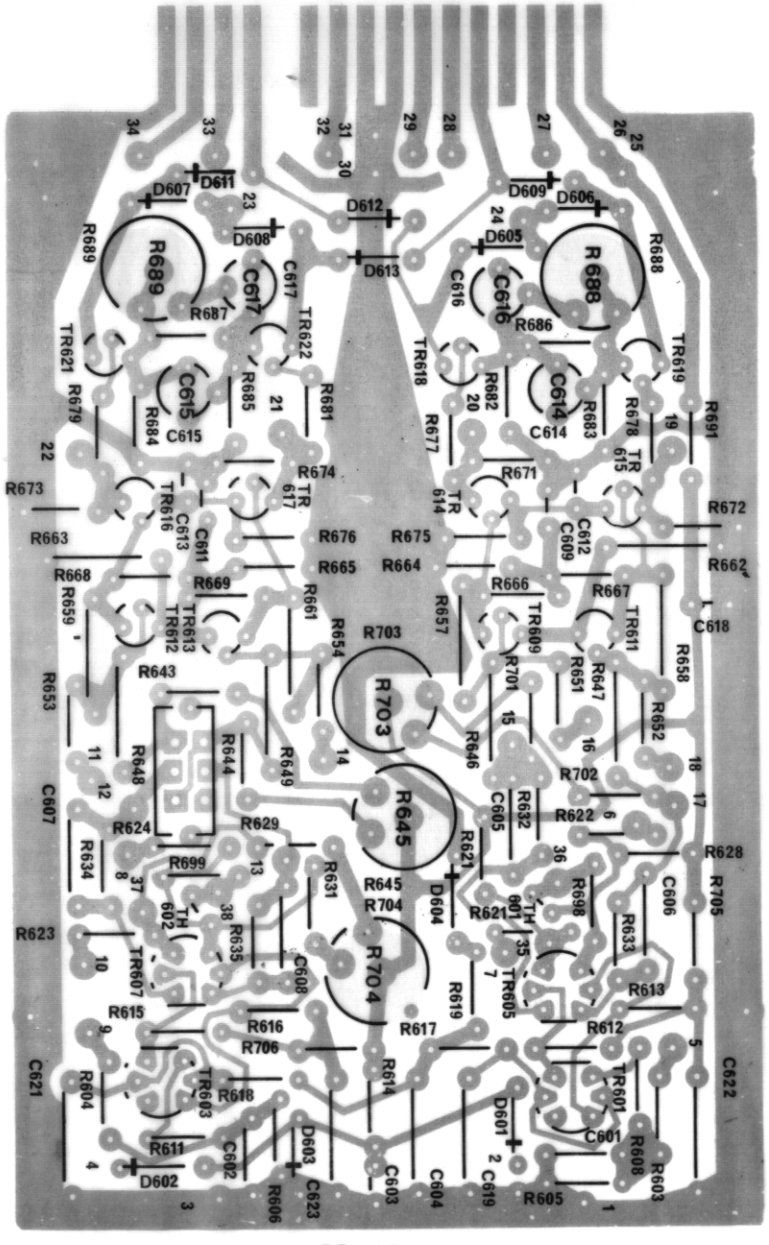


NOTES.
1. 153/3 DENOTES PC BOARD/EYELET OR TERMINAL No.
2. ✱ DENOTES COMPONENTS NOT MOUNTED ON PC BOARD

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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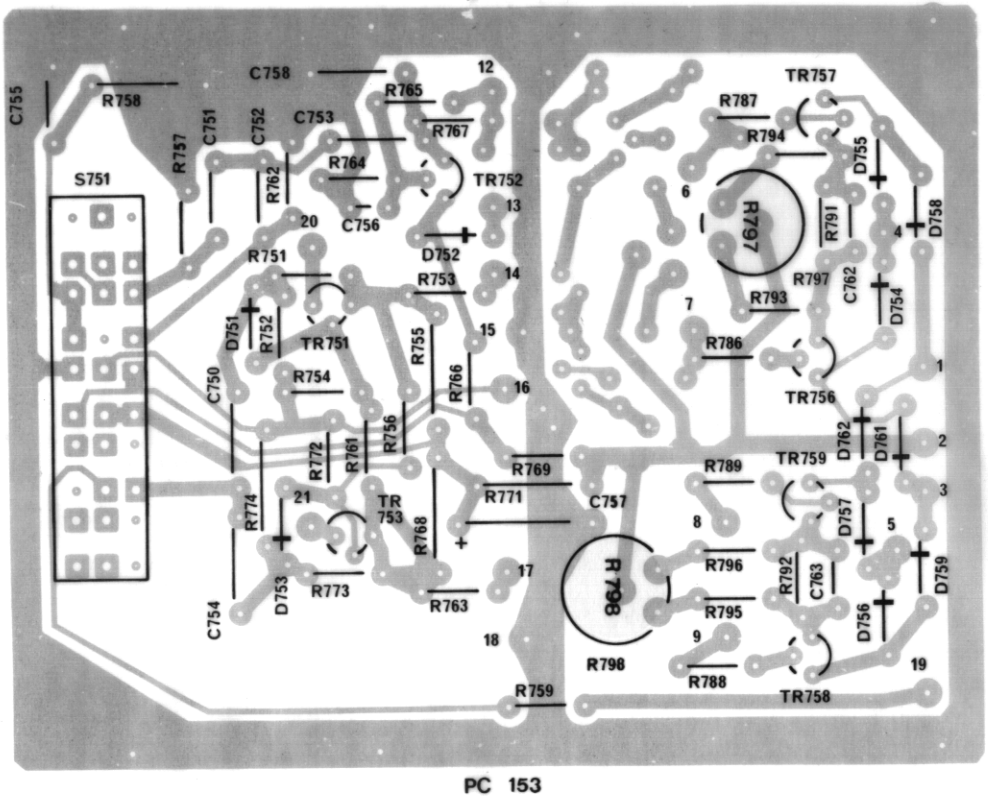

PC 153

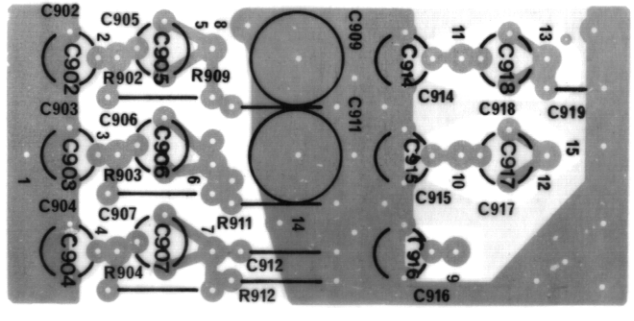

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FIGURE 4 COMPONENT REFERENCE