TELEQUIPMENT

VERTICAL PLUG-IN

TYPE V1

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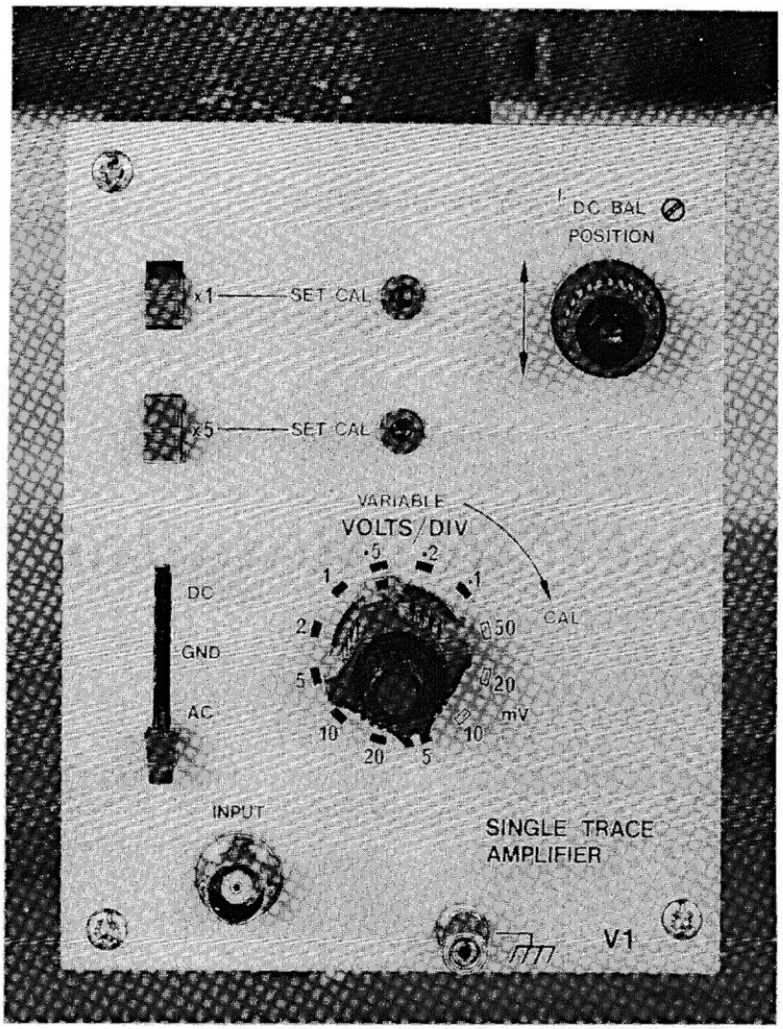
INTRODUCTION

The V1 is a plug-in single trace vertical amplifier.

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.



NOTICE TO OWNER

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

Manual
Probes
Plug Assemblies

CONTENTS

CHAPTER 1
SPECIFICATIONS

OPERATING MODE	Single channel x1 or x5	
Sensitivity		
x1	5 mV – 20 V/DIV ± 3%	
x5	1 mV – 4 V/DIV ± 3%	
Risetime x1	23 ns in D63 or DM63	
3 dB bandwidth	D63 or DM63	D83
5 mV – 2 V/DIV	15 MHz	35 MHz
5 V – 20 V/DIV	15 MHz	20 MHz
1 mV – 4 V/DIV	12 MHz	15 MHz
Variable range	> 2.5 : 1	
Position range	> ± 8 divisions	
Input impedance	1 MΩ, 29 pF in parallel	
Max. input voltage	400 V DC + AC peak	
Power consumption	1.55 VA	
Weight	1.0 kg approx.	

CHAPTER 2
OPERATING INSTRUCTIONS

2.1 FUNCTION OF CONTROLS AND CONNECTORS

	D83	D63
2.1.1 CRT	"MF" Manual	
2.1.2 SWEEP	"S" Manual	"MF" Manual
2.1.3 TRIGGER	"S" Manual	

2.1.4 VERTICAL

DC-GND-AC	selects the input signal coupling. In the DC position, the signal from the INPUT 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 signal is open-circuited; this position enables the 0 V DC level of a trace to be ascertained.
VOLTS/DIV	provides twelve steps of attenuation of input signal. Calibrated sensitivities are only valid when VARIABLE is fully clockwise.
x1	provides the attenuation as selected by the VOLTS/DIV.
x5	when selected, magnifies the display 5 times in the vertical axis.
SET CAL	presets, adjusted to correct accuracy of the VOLTS/DIV for the respective gains. NOTE: VARIABLE should be fully clockwise.
VARIABLE	enables all deflection sensitivities between that selected by the VOLTS/DIV switch and the next below to be covered.
POSITION	moves the trace in the vertical axis.
DC BAL	preset, adjusted to eliminate trave movement when the x1 and x5 push buttons are alternately pressed.

2.1.5 CONNECTORS

INPUT	BNC socket connects the signal to be viewed to the vertical amplifier.
⏚	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

2.2.1 SUPPLY Refer to MF Manual

2.2.2 CONTROL SETTING

	D83	D63 or DM63
1. CRT	Refer to MF Manual	MF Manual
2. "S" Plug-in	Refer to 'S' Manual	

3. Set controls as follows:

x1	depressed
POSITION	Central
VOLTS/DIV	5 mV
VARIABLE	fully clockwise
DC-GND-AC	GND

CHAPTER 3
CIRCUIT DESCRIPTION

3.1 VERTICAL AMPLIFIER

The V1 plug-in is a single amplifier which feeds the main amplifier in the main frame.

3.1.1 The input attenuator, reference Figure 1, is 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 DC-GND-AC switch selects 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 amplifier input grounded.

3.1.2 TR601 and TR602 are FETS used as source followers, the gate of TR601 being protected from excessive positive excursions by D601 and D602. A DC balance, applied to the gate of TR602, is adjusted to eliminate trace movement when switching gain between x1 and x5. The output, from TR601 and TR602, is used to drive the phase splitter stage, TR603 and TR604. The emitters of which contain the x1 and x5 gain setting potentiometers R611 and R616 respectively. R619 minimises trace movement when changing the VARIABLE setting. The collectors are connected to a shunt feedback stage formed by TR605 and TR606. The input impedance of this stage is very low and its total input resistance, including the 82 Ω resistors; R623 and R624, is approximately 100 Ω per side. When the VARIABLE is at maximum resistance the attenuation of the signal is small, at minimum, however, the resistance is approximately 32 Ω. The attenuation of the signal is now 3 i.e. 100 Ω – 32 Ω, this covers the gaps in the 1-2-5 sequence in the attenuators. The shift signal inserted at the bases of TR605 and TR606, after the VARIABLE control, ensures that the same amount of shift is obtained regardless of VARIABLE setting. The signal from the shunt feedback stage is fed to the final stage amplifier, TR607 and TR608. The emitters of this stage contain the POSITION BAL potentiometer, which is adjusted to obtain equal excursions of the trace with the normal POSITION control.

Connected between the emitters are the long time constant, R639, C609, and a variable capacitor C611, adjustment of C609 and C611 enable the H.F. response to be set. The collectors of TR607 and TR608 are terminated at the connector to facilitate interfacing with display unit.

CHAPTER 4

MAINTENANCE AND CALIBRATION

4.1 GENERAL

4.1.1 The detailed calibration procedures enable the vertical plug-in V1 to be fully calibrated, assuming that the main frame has been calibrated and meets the specification as laid down in its manual.

4.2 MECHANICAL

4.2.1 ACCESS TO INTERIOR

Depress the plug-in retaining clip on the front of the main frame and withdraw the plug-in. Remove the side cover.

The pre-amplifier controls are mounted on PC board PC160. The attenuator presets are on PC board PC137.

4.3 CALIBRATION

4.3.1 For calibration, the following tools and test equipment are required.

Low-capacitance trimming tool (for preset controls).
Small screwdriver (for preset potentiometers).
Fixture Extender Rigid (067-0689-00).
Squarewave Generator providing outputs of 5 mV to 50 V at 1 kHz accuracy ± 1%.
Squarewave Generator providing 1 MHz risetime <1 ns.
Constant Amplitude Sinewave Generator providing 50 kHz to 40 MHz for measuring bandwidth.
Input Normalizer (067-0539-02); alternative: LC Meter and x10 Probe.

4.3.2 CALIBRATION PROCEDURE

The plug-in requiring calibration should always be installed in the left-hand channel of the main frame – this allows access to the internal preset controls.

1.0 **Check DC BAL.**
1.1 Set DC-GND-AC switch to GND.
1.2 Turn VARIABLE fully clockwise.
1.3 Switch VOLTS/DIV to 5 mV.
1.4 Push x1 button in.
1.5 Set trace to graticule centre line using POSITION.
1.6 Push x5 switch.
1.7 Set trace to graticule centre line using DC BAL.
1.8 Repeat 1.4 through 1.7 until the trace does not move when switching from x1 to x5.

2.0 **Check variable gain balance.**
2.1 Turn VARIABLE fully anticlockwise.
2.2 Note the direction, and if trace is still on the screen, note position of the trace.
2.3 Turn VARIABLE fully clockwise.
2.4 Adjust R619 until trace is in same position as noted in 2.2.
2.5 Set trace to graticule centre line using POSITION.
2.6 Repeat Ops. 2.1 through 2.5 until there is no trace movement with VARIABLE gain.
2.7 Re-check DC BAL as in 1.0.

3.0 **Check VARIABLE range and SET CAL (x1 and x5).**
3.1 Set TIME/DIV to 1 ms.
3.2 Connect 25 mV, 1 kHz squarewave to INPUT.
3.3 Set DC-GND-AC to DC.
3.4 Set amplitude to 5 divisions using x1 SET CAL.
3.5 Rotate VARIABLE fully anticlockwise.
3.6 Check amplitude <2 divisions.
3.7 Turn VARIABLE fully clockwise.
3.8 Reduce the squarewave input to 5 mV.
3.9 Push x5 switch.
3.10 Set amplitude to exactly 5 divisions using x5 SET CAL.
3.11 Push x1 switch.

4.0 **Set position balance (R636).**
4.1 Set DC-GND-AC to AC.
4.2 Connect 50 mV 1 kHz squarewave to INPUT.
4.3 Adjust R636 such that at extreme anticlockwise and clockwise ends of the POSITION control, the amount of trace movement is similar.
4.4 Turn VARIABLE anticlockwise to give 8 divisions of deflection.
4.5 Check that at the extreme ends of the POSITION control, the top and bottom of the signal clear the centre line of graticule.

4.3.3 VERTICAL RESPONSE

Remove V1 plug-in and re-connect it to 'MF' using fixture extender 067-0689-00 thus allowing access to the attenuator presets.

1.0 **Check attenuation.**
1.1 Connect 50 mV 1 kHz squarewave via *input normalizer (29 pF) to INPUT.
1.2 Set DC-GND-AC to DC.
1.3 Set VARIABLE to CAL.
1.4 Set VOLTS/DIV as in Col. 1.
1.5 Set squarewave generator as in Col. 2.
1.6 Check 5 div trace for over or undershoot.

COL 1 VOLTS/DIV	COL 2 1 kHz squarewave	COL 3 Adjust	
5 mV	50 mV	C916	PC137
Remove input normalizer			
10 mV	50 mV	C917	PC137
20 mV	100 mV	C918	PC137
50 mV	250 mV	C907	PC137
0.1 V	500 mV	C915	PC137
0.2 V	1 V	C914	PC137
0.5 V	2.5 V	C906	PC137
5 V	25 V	C905	PC137
Fit input normalizer			
50 mV	500 mV	C904	PC137
0.5 V	5 V	C903	PC137
5 V	50 V	C902	PC137

*If input normalizer is not available, follow the alternative procedure given below:

For 5 mV/DIV setting:
Check the input capacity using LC meter; adjust C916 to obtain 29 pF.
Display 250 mV 1 kHz squarewave via x10 probe and adjust probe trimmer for square corners.

For 50 mV, 0.5 V and 5 V/DIV settings:
Using compensated probe, display 5 divisions of 1 kHz squarewave.
Adjust C904, C903 and C902 on 50 mV, 0.5 V and 5 V settings respectively for over or undershoot.

Note: Remove fixture extender 067-0689-00 and install the plug-in in the "MF"

2.0 **Check vertical pulse response.**
2.1 Connect 20 mV 1 MHz < 1 ns risetime squarewave to INPUT.
2.2 Set VOLTS/DIV to 5 mV.
2.3 Set TIME/DIV to 0.2 μs.
2.4 Check pulse aberration is <2%.
2.5 Adjust C609 PC160 for optimum response.
2.6 Adjust C611 PC160 for optimum response.
2.7 Repeat Ops. 2.5 and 2.6 for overall optimum response.

Note: The V1 plug-in may be set up in either a 'D63' or a 'D83' MF. However, owing to the difference between the D83 and D63 MF bandwidths, the effect of C611 in the D63 is very small. But, in the D83, C611 may be set such that overshoot does not exceed 2%.

3.0 **Check x1 bandwidth in D63 MF.**
3.1 Connect 50 kHz sinewave to INPUT.
3.2 Adjust signal generator to give 5 div trace.
3.3 Set TIME/DIV to 1 ms.
3.4 Switch signal generator to 15 MHz.
3.5 Check amplitude >3.5 divisions.

4.0 **Check x5 bandwidth in D63 MF.**
4.1 Push x5 switch.
4.2 Connect 50 kHz sinewave to INPUT.
4.3 Adjust signal generator to give 5 div trace.
4.4 Switch signal generator to 12 MHz.
4.5 Check amplitude >3.5 divisions.

5.0 **Check x1 bandwidth in D83 MF.**
5.1 Connect 50 kHz sinewave to INPUT.
5.2 Adjust signal generator to give 6 div trace.
5.3 Set TIME/DIV to 1 ms.
5.4 Switch signal generator to 40 MHz.
5.5 Check amplitude >4.2 divisions.

6.0 **Check x5 bandwidth in D83 MF.**
6.1 Connect 50 kHz sinewave to INPUT.
6.2 Adjust signal generator to give 6 div trace.
6.3 Set TIME/DIV to 1 ms.
6.4 Switch signal generator to 15 MHz.
6.5 Check amplitude >4.2 divisions.

CHAPTER 5
COMPONENTS LIST

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

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

Any order for replacement parts should include:

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

ABBREVIATIONS

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

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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 Volts	Eff. Ser.No.
C601	285-0915-00	100 n	PE	20	100	
C602	281-0710-00	10 n	CER		250	
C603	281-0710-00	10 n	CER		250	
C604	285-1014-00	1 μ	PE	20	63	
C605	281-0710-00	10 n	CER		250	
C606	281-0710-00	10 n	CER		250	
C607	281-0710-00	10 n	CER		250	
C608	281-0710-00	10 n	CER		250	
C609	281-0156-00	1.4-6.4 p	PP		500	
C611	281-0154-00	2-12 p	PP		500	
C612	281-0710-00	10 n	CER		250	
C613	281-0710-00	10 n	CER		250	
C614	285-1014-00	1 μ	PE	20	63	
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	

CIR REF	PART NUMBER	VALUE F	DESCRIPTION TYPE	TOL %	RATING Volts	Eff. Ser.No.
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		
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	

CIR REF	PART NUMBER	VALUE	DESCRIPTION	TYPE	TOL %	RATING	Eff. Ser.No.
D601	152-0565-00		EXP5072	Si			
D602	152-0543-00	5.1 V	Zener	Si	5	330 mW	
D603	152-0354-00	12 V	Zener	Si	5	330 mW	

CIR REF	PART NUMBER	VALUE Ohms	DESCRIPTION TYPE	TOL %	RATING W	Eff. Ser.No.
R601	311-1352-00	47 k	CV	20	250 m	
R602	317-0224-01	220 k	C	5	125 m	
R603	317-0102-01	1 k	C	5	125 m	
R604	317-0101-01	100	C	5	125 m	
R605	317-0101-01	100	C	5	125 m	
R606	315-0123-02	12 k	C	5	250 m	
R607	315-0123-02	12 k	C	5	250 m	
R608	317-0101-01	100	C	5	125 m	
R609	317-0201-01	200	C	5	125 m	
R610	317-0103-01	10 k	C	5	125 m	
R611	311-1350-00	100	CV	20	250 m	
R612	317-0820-01	82	C	5	125 m	
R613	317-0391-01	390	C	5	125 m	
R614	317-0391-01	390	C	5	125 m	
R615	317-0390-01	39	C	5	125 m	
R616	311-1350-00	100	CV	20	250 m	
R617	315-0432-02	4.3 k	C	5	250 m	
R618	315-0432-02	4.3 k	C	5	250 m	
R619	311-0995-00	680	CP	20	250 m	
R621	317-0101-01	100	C	5	125 m	
R622	311-1351-00	2.2 k	CV	20	250 m	
R623	317-0820-01	82	C	5	125 m	
R624	317-0820-01	82	C	5	125 m	
R625	317-0103-01	10 k	C	5	125 m	
R626	311-1352-00	1.5 k	CV	20	250 m	
R627	317-0103-01	10 k	C	5	125 m	
R628	321-0222-48	2 k	MF	1	125 m	
R629	321-0222-48	2 k	MF	1	125 m	
R631	317-0271-01	270	C	5	125 m	
R632	317-0271-01	270	C	5	125 m	
R633	317-0511-01	510	C	5	125 m	

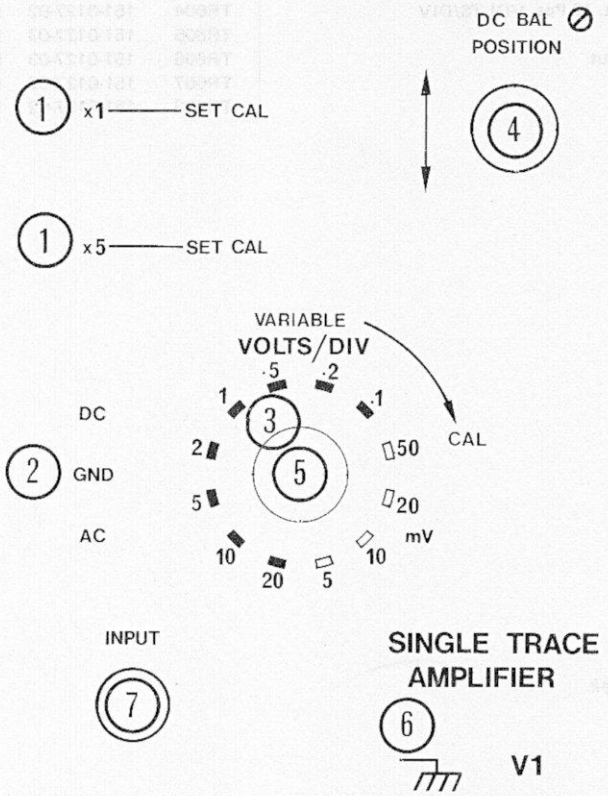
CIR REF	PART NUMBER	VALUE Ohms	DESCRIPTION TYPE	TOL %	RATING W	Eff. Ser.No.
R634	317-0152-01	1.5 k	C	5	125 m	
R635	317-0152-01	1.5 k	C	5	125 m	
R636	311-0798-00	2.2 k	CP	20	250 m	
R637	315-0432-02	4.3 k	C	5	250 m	
R638	315-0432-02	4.3 k	C	5	250 m	
R639	311-0798-00	2.2 k	CP	20	250 m	
R641	317-0221-01	220	C	5	125 m	
R642	317-0101-01	100	C	5	125 m	
R643	317-0101-01	100	C	5	125 m	
R644	317-0100-01	10	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	307-0382-00	7.5	C	5	125 m	
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	

CIR REF	PART NUMBER	DESCRIPTION	Eff. Ser.No.
S601	260-1564-00	Push button x1-x5	
S901	260-1412-00	Slide DC-GND-AC	
S902	260-1409-00	Rot. 12 Pos. VOLTS/DIV	
SK901	131-0650-01	Input	

CIR REF	PART NUMBER	DESCRIPTION		TYPE	Eff. Ser.No.
TR601 } TR602 }	151-1069-00	FET WD212 matched pair }	Si	N-channel	
TR603	151-0127-02	BSX20	Si	NPN	
TR604	151-0127-02	BSX20	Si	NPN	
TR605	151-0127-03	BSX20 Mullard	Si	NPN	
TR606	151-0127-03	BSX20 Mullard	Si	NPN	
TR607	151-0127-02	BSX20	Si	NPN	
TR608	151-0127-02	BSX20	Si	NPN	

ASSEMBLIES

ASSEMBLY	PART NUMBER	INCLUDES CIRCUIT REFERENCES
Attenuator	011-0114-00	C901, C913, C921, PC137, R901, R905 to R907, R913 to R919, R921, S902
PC137	670-2191-00	C902 to C909, C911, C914 to C919, R902 to R904, R908, R909, R911, R912
PC160	670-3038-00	C601 to C609, C611 to C614, D601 to D603, R602 to R610, R612 to R615, R617 to R619, R621, R623 to R625, R627 to R629, R631 to R635, R637 to R639, R641 to R644, S601, TR601 to TR608



FRONT PANEL, V1.

MECHANICAL

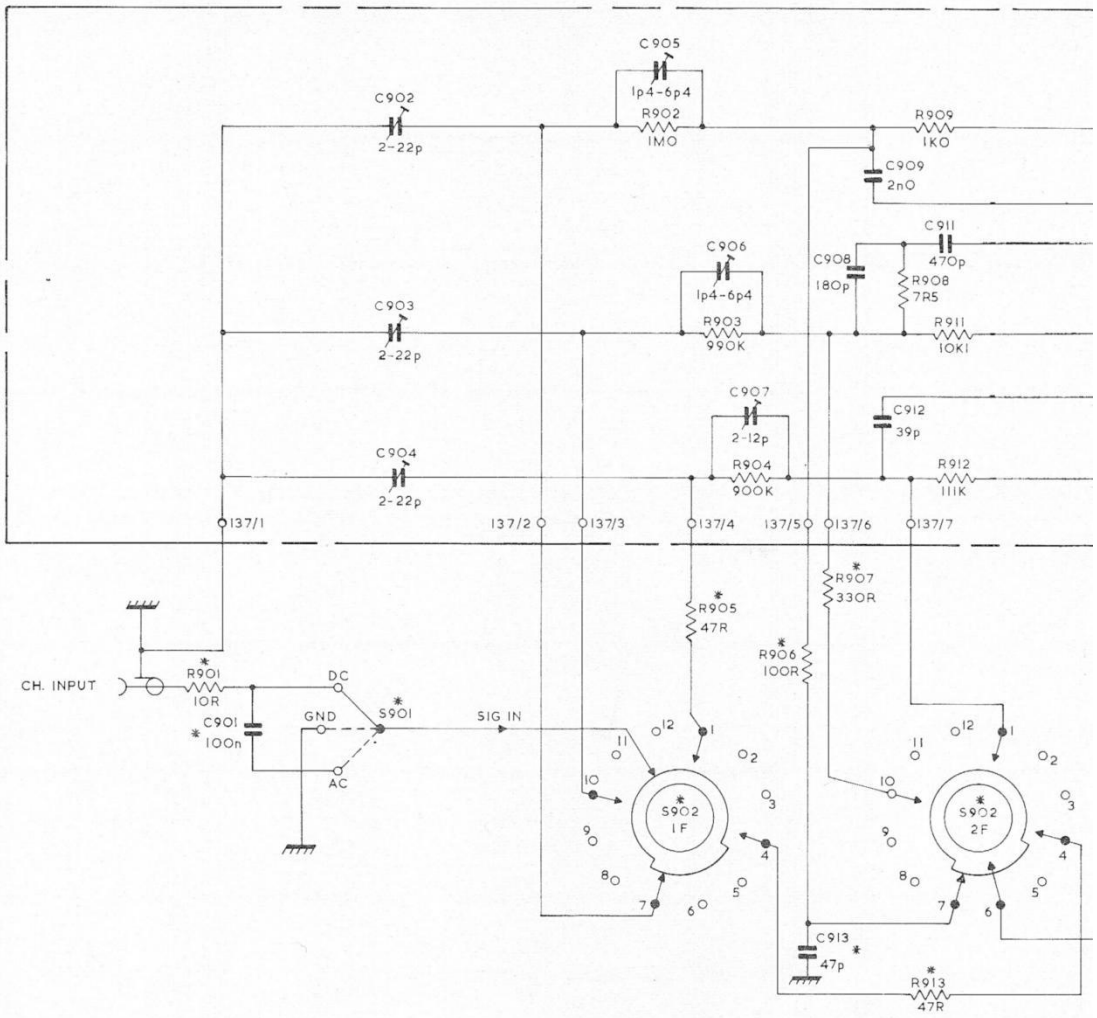
DESCRIPTION	PART NUMBER	LOCATION
Bush, panel	358-0460-00	
Button push	366-1403-00	1
Connector BNC	131-0649-00	Accessory
Holder transistor	136-0343-00	PCB
Insulator stand-off	342-0083-00	PCB
Key Allen 1.5 mm A/F	003-0674-00	Accessory
Knob, lever	366-0215-02	2
Knob grey/black	366-1387-00	3
Knob grey	366-1254-00	4
Knob red	366-1266-01	5
Nut, terminal	220-0647-00	6
Nut, chrome	220-0527-00	3 & 4
Packaging	004-1143-00	Accessory
Spacer 6BA x 14 mm	361-0576-00	PCB
Stop	105-0347-00	Rear of Plug-in
Screw socket hd 3 x 3 mm	213-0248-00	3, 4 & 5
Socket, BNC	131-0650-01	7
Tag solder 3/8" i/d	210-0275-00	PCB
Terminal post	129-0374-00	6

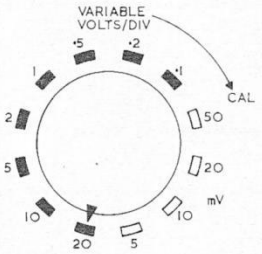
CHAPTER 6

CIRCUIT DIAGRAMS AND PC BOARDS

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.

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

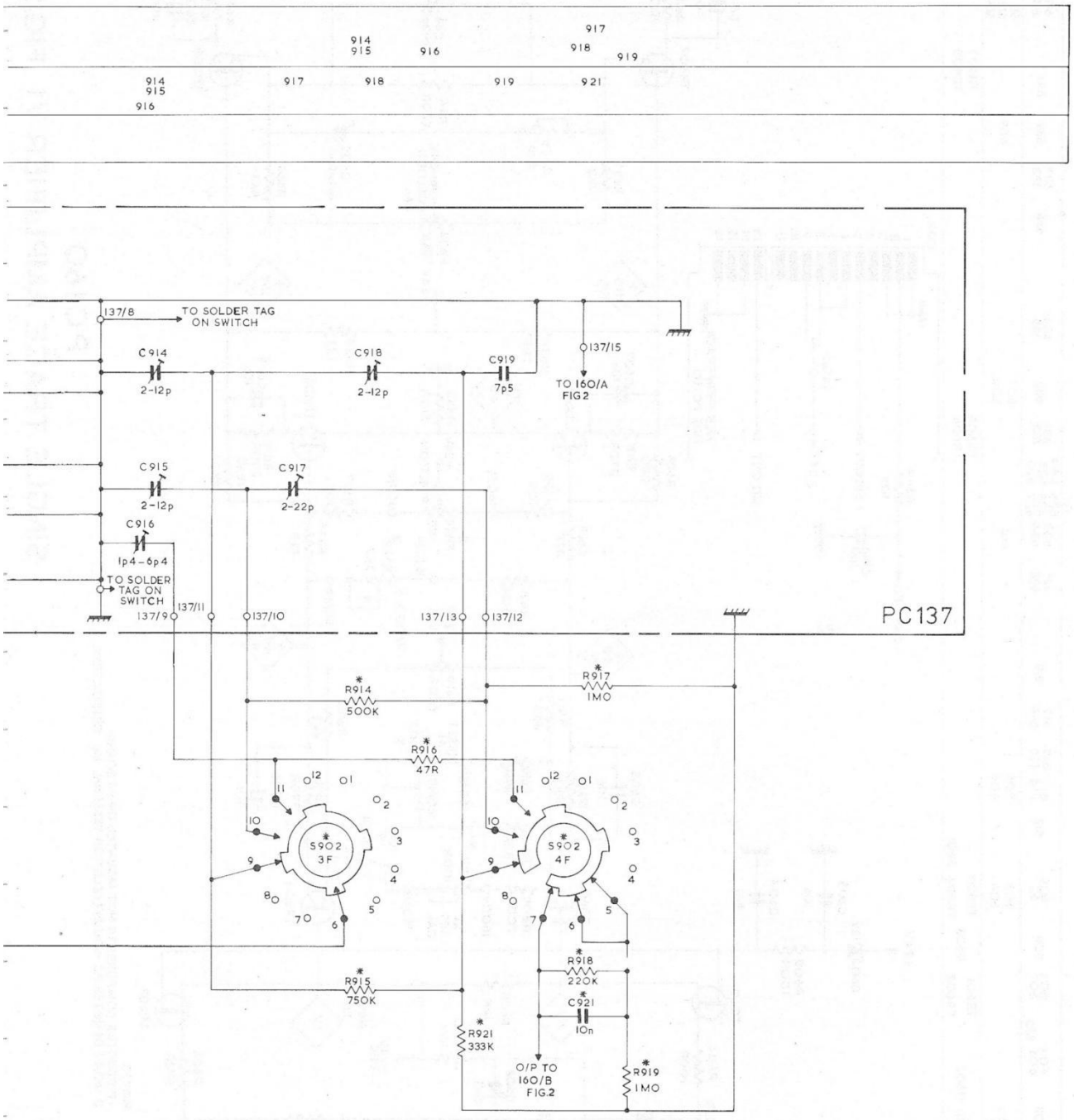




FRONT PANEL MARKING

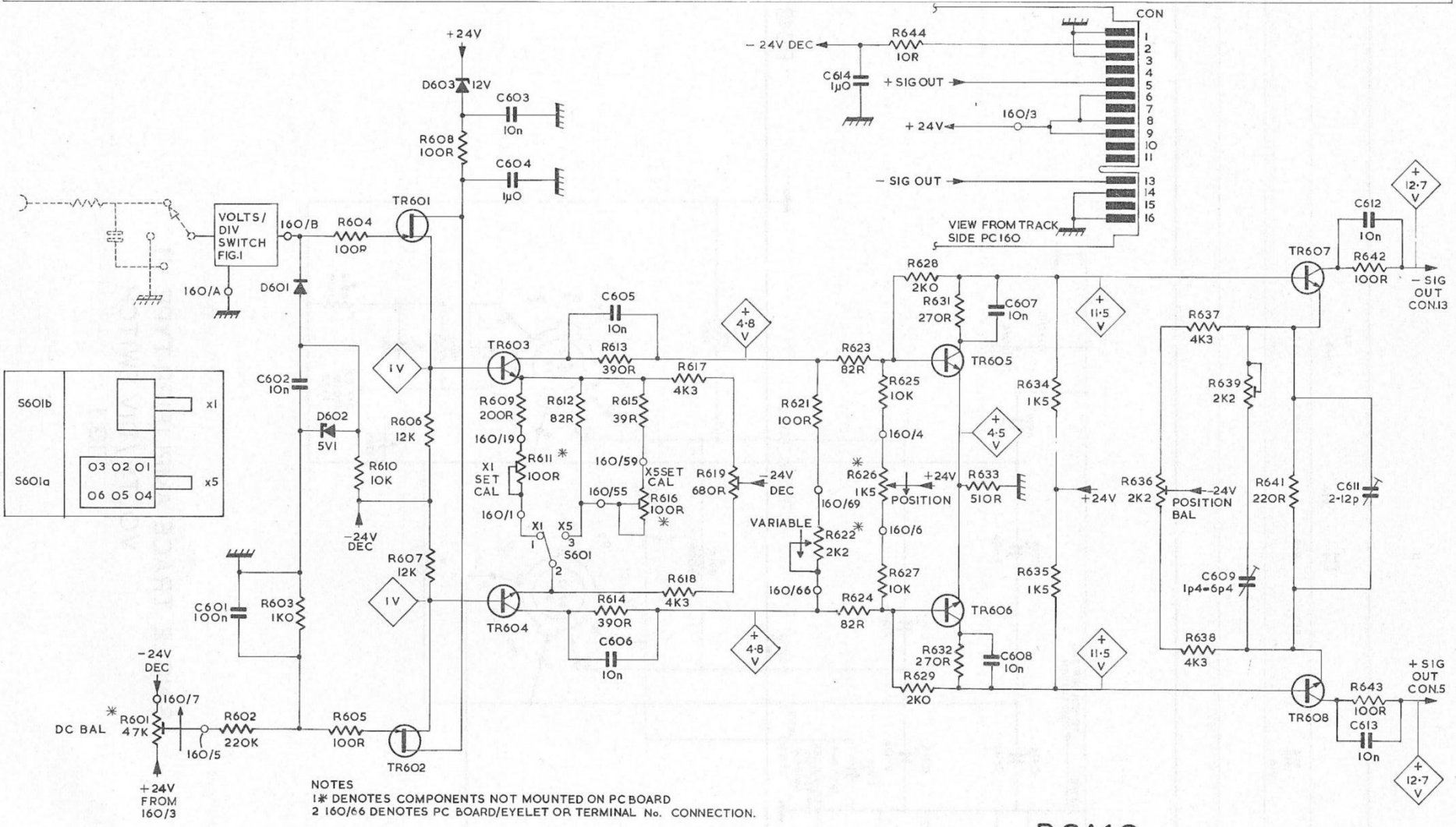
NOTES.

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



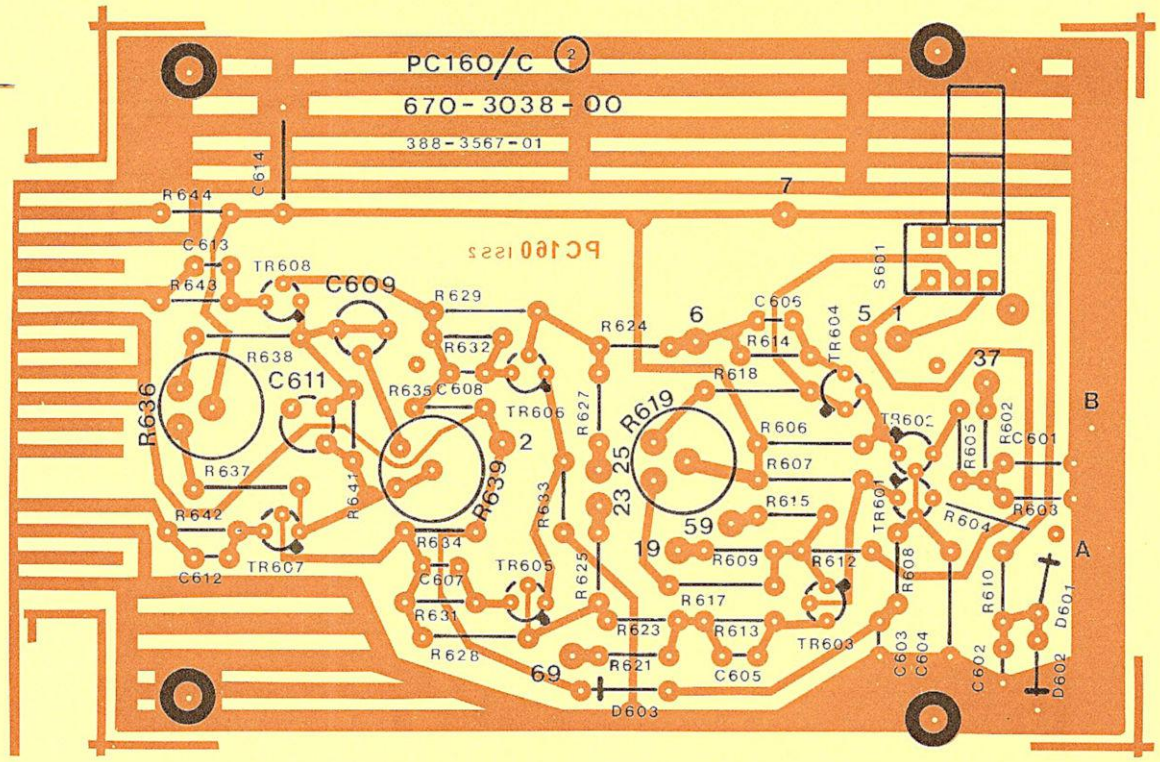
SINGLE TRACE AMPLIFIER TYPE V1
VOLTS / DIV SWITCH
FIG. 1

RESISTORS	601 602 603 604 605 610 606 607 608 609 611 612 613 614 615 616 617 618 619 621 622 623 624 625 626 627 644 628 629 631 632 633 634 635 636 637 638 639 641 642 643
CAPACITORS	601 602 603 604 605 606 614 607 608 609 611 612 613
MISC	D601 D602 TR601 TR602 D603 TR603 TR604 S601 TR605 TR606 TR607 TR608

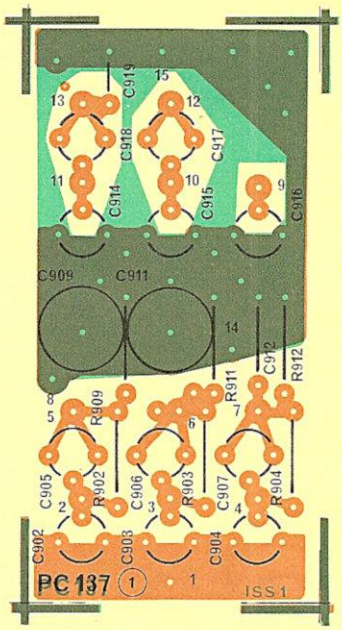


NOTES
1* DENOTES COMPONENTS NOT MOUNTED ON PC BOARD
2 160/66 DENOTES PC BOARD/EYELET OR TERMINAL No. CONNECTION.

PC160
SINGLE TRACE AMPLIFIER V1 FIG.2



P.C.160



P.C.137

PRINTED CIRCUIT BOARDS

FIG.3.