Advance

COMPONENTS LIMITED

LABORATORY POWER SUPPLY TYPE PP1

INSTRUCTION MANUAL

LABORATORY POWER SUPPLY

TYPE PP1

Instruction Manual

ADVANCE COMPONENTS LIMITED - INSTRUMENT DIVISION

Roebuck Road . Hainault . Ilford . Essex

PART No. 12828

LABORATORY POWER SUPPLY

TYPE PP1

CONTENTS

TABLES

ILLUSTRATIONS

SECTION 1

INTRODUCTION

The robustly constructed laboratory power unit Type PP1 is suitable for use in the development of electronic circuits and in all similar applications where high stability power supplies are required. The instrument operates from a 50 c/s mains supply, and the high degree of stabilization against supply fluctuations is achieved by the use of Volstats (Constant Voltage Transformers) and regulating circuits. It provides two positive d.c. supplies, 0 to 600V stabilized and 100V to 800V essentially unstabilized, two negative d.c. supplies, 0 to -200V and -200V fixed, both of which are stabilized, and two independent 6.3V a.c. supplies.

All the d.c. supplies are developed with reference to a floating 'neutral' line, facilitating the series connexion of two units if required. The two positive d.c. outputs can be switched off without switching off the main circuitry, so that the supplies can be immediately available without the necessity for a warm-up period.

Special features include an electro-magnetic overload trip (positive supplies), provision for artificially injecting up to 6V r.m.s. ripple (to 50 kc/s, with external equipment) on the variable positive supply, and provision for varying the output impedance of the variable positive supply from 0.1Ω to 40Ω. These last two features assist an engineer in evaluating the susceptibility of his circuits to imperfect h.t. supplies.

All the controls are mounted on a recessed front panel and are clearly annotated. An ammeter and a voltmeter, with associated selector switches, enable the outputs to be monitored.

SECTION 2

SPECIFICATION

Power Requirements : The PP1 operates from 50 c/s (only) power supplies between 94V and 138V or 187V and 276V. The power consumption on full load is 560 watts at a power factor of 0.92.

Supplies Provided : The power pack provides four d.c. supplies and two a.c. supplies. The specification for each d.c. supply is given in Table 1.

TABLE 1

OUTPUT SPECIFICATION

SUPPLY No.	1	2	3	4
VOLTAGE	Variable 0 to 600V d.c.	Variable +100 to +800V d.c.	Fixed -200V d.c.	Variable 0 to -200V d.c.
MAXIMUM CURRENT	300mA total		50mA	5mA
STABILIZATION	10% change in supply volts produces output change of less than 0.01% [Factor 1000:1]	Factor of 4:1 (essentially unstabilized)	10% change in supply volts produces output change of less than 0.01% [Factor 1000:1]	
MAXIMUM RIPPLE VOLTAGE (R.M.S)	3mV *	3V	1mV	1mV
MAXIMUM SOURCE IMPEDANCE	0.1Ω (d.c.) ** 0.5Ω (at 50kc/s)	-	0.1Ω (d.c.) 0.3Ω (at 30kc/s)	13kΩ
SHORT CIRCUIT PROTECTION	Electro-magnetic cut-out		100mA fuse	

* Can be varied by front panel control to produce artificial 50 c/s ripple up to 6V r.m.s. maximum. A jack is provided for injecting up to 50 kc/s, 6V r.m.s. maximum, from an external generator working into 5Ω load.

** Can be varied by front panel control from 0.1Ω to 40Ω.

The two a.c. supplies are each 6.3V (r.m.s.) at 4A, stabilized by the Volstat so that a 10% change in supply volts produces an output change of less than 1%.

Output Arrangements :	All outputs are floating with respect to chassis. The positive and negative supplies are connected only through the NEUTRAL terminal, and can be used in series provided that the current drain does not exceed the maximum of the lowest rated supply. All terminals will withstand 1000V potential, and take a standard 4mm plug.
Metering :	Two meters are fitted, a voltmeter and an ammeter. The voltmeter has two scales, 250V for monitoring the negative line and 1000V for monitoring the positive lines, and can be switched to measure all d.c. output voltages. The ammeter has two scales, 0 to 50mA for negative line monitoring and 0 to 500 mA for positive line monitoring.
Dimensions :	19.3/4 in. wide x 15 in. deep x 13 in. high (50.2 cm x 38.1 cm x 33 cm).
Weight :	92 lb (41.7 kg).
Finish :	Light Admiralty grey to B.S.381C, tint No. 697, and Dark Admiralty grey to B.S.381C, tint No. 632.

SECTION 3

CIRCUIT DESCRIPTION

3.1 GENERAL

Reference should be made to the circuit diagram shown in fig. 2.

The power supply input is applied to the primaries of the Volstats (Constant Voltage Transformers) CVT1 and CVT2 via the on/off switch S2, fuses FS1 and FS2, contacts A1 of the safety cut-out device and the supply voltage tapping panel. The tapping panel provides a coarse adjustment to suit the local supply; by use of 'Volstats' fine adjustment is unnecessary.

The +100V to +800V d.c. unstabilized supply and the 0 to +600V d.c. stabilized supply are developed from the secondary outputs of CVT1, while the 0 to -200V d.c., the -200V d.c. (fixed) and the two 6.3V a.c. stabilized supplies are developed from the secondary outputs of CVT2.

All of the d.c. supplies are derived with respect to a neutral line, which is not earthed or connected to the chassis. This facilitates the series connexion of units, if required, and the connexion to earth, for reference, of any of the output potentials provided.

3.2 +100V to +800V D.C. UNSTABILIZED OUTPUT

This variable output supply is derived from a tapped secondary on CVT1. The tap for the required output range is selected by section C of the COARSE control S1, and its output is routed to the hard-valve bridge circuit, V12, V13, V14 and V15. Smoothing is effected by electrolytic capacitors C12, C13, C14, C16 and C17, each of which has a parallel connected bleed resistor, R29, R30, R32, R34, R35 and R36.

The supply is referenced to the neutral line (terminal T4) via the safety cut-out device A/1 and the ammeter shunt R38. The smoothed output, adjustable in level by means of RV4 (on the same spindle as the FINE control RV6), is routed to the anodes of the series-regulator valves for the 0 to 600V d.c. stabilized output, and via the POSITIVE H.T. SWITCH S5 to terminal T2, providing the +100V to +800V d.c. output.

3.3 0 to 600V D.C. STABILIZED OUTPUT

This supply is derived from a series-regulator which is anode-fed from the 100V to 800V unstabilized supply, and which is controlled by a shunt amplifier supplied by the smoothed output of a further secondary winding on CVT1. By providing the shunt amplifier with an independent h.t. supply, the positive stabilized line can be operated with full performance down to zero output volts.

The output from 225V secondary of CVT1 is rectified by bridge MR1 (contact cooled selenium rectifiers) to provide the screen supply for the series regulator valves (six pentodes in parallel), and, after smoothing by C1 to C3, R1 and R2, to provide the h.t. supply for the shunt amplifier V10 and V11. Rectifier MR2 provides, via a 150V neon stabilizer, the reference line for the shunt amplifier h.t. supply.

The input to the shunt amplifier valve V11b is derived from a potentiometer chain connected between the 'neutral' line and an 85V line, stabilized by V8. The potentiometer chain includes R31, R33 and R37, selected by section A of the COARSE control S1, the FINE control RV6, R19 and the range-adjustment pre-set control, RV2. The required level of a.c. ripple is also applied to the grid of V11b, either from RV5 (50 c/s RIPPLE AMPLITUDE) connected across a primary of CVT2, or from an external source via the jack JK.

The grid of V11a is connected to the positive stabilized output line. V11 operates as a differential amplifier, amplifying any differences between the output line potential and the relative potential produced by the control settings. The anode output of V11b is d.c. coupled to a further high gain differential amplifier V10. Positive current feedback is applied to the amplifier via RV1, which enables the output impedance of the 0 to 600V supply to be set virtually to zero. The output of V10b is employed to bias and hence control the series-regulator valves V1 to V6. A change in the bias to these valves alters their combined impedance, so that the change in voltage drop across them opposes and effectively cancels the initiating change in the stabilized output.

Potentiometer RV3, connected in the output line, enables the source impedance to be adjusted to any value between 0.1Ω and 40Ω. The supply can be switched off at the output terminal by the POSITIVE H.T. SWITCH S5.

3.4 POSITIVE SUPPLIES SAFETY CUT-OUT

The safety cut-out device A/1 is connected between the negative connexion of bridge V12 to V15 and the neutral line, and is adjustable to operate approximately 15% above 300mA. Should the current drawn from the positive d.c. supply circuits (either singly or together) exceed this value, contacts A1 open to break the energizing supply for the primaries of CVT1 and CVT2. Re-setting the cut-out is performed manually, after the cause of excessive current has been removed.

3.5 -200V D.C. FIXED AND VARIABLE SUPPLIES

The high voltage secondary output of CVT2 is rectified by the contact-cooled selenium bridge rectifier MR3. The rectifier output is applied direct to the anode of the negative series-regulator V16, and after smoothing, to the screen of V16 and to the anode of the shunt-amplifier valve V17a. The shunt-amplifier, formed by double-triodes V17 and V19, operates in a similar manner to the positive line shunt-amplifier, the reference-source being provided by V18. The -200V level is set by means of RV9, in the potentiometer chain providing the bias for V19b. The amplifier is compensated for load current changes by voltage and current feedback. Voltage feedback is adjustable by RV8 (anode load of V17b) and current feedback is adjustable by RV7. RV7 enables the output impedance of the negative stabilized lines to be adjusted to zero. The output of the shunt-amplifier, developed across R42, is employed to bias the series regulator valve V16.

The -200V fixed supply is fed directly to the output terminal T6, the variable negative supply being fed to terminal T5 via the adjustment control RV10. Both supplies are protected by the 100mA fuse FS3, connected in the cathode output of the series-regulator, which is referenced to the neutral line.

3.6 6.3V 4A SUPPLIES

The two 6.3V 4A a.c. supplies are derived from secondary windings on CVT2. The supplies are stabilized by a factor of 15:1 against input supply fluctuations, and can withstand short period overloads, by the characteristics of the Volstat CVT2. The supplies are connected, via low resistance wiring, to terminals T7, T8 and T9, T10. Terminals T8 and T9 can, if required, be connected to provide a 12.6V 4A a.c. supply.

The 'supply-on' indicator lamp, ILP, is connected across one of these two supplies.

SECTION 4

OPERATING INSTRUCTIONS

4.1 PREPARATION FOR USE

Ensure that the tapping panel, readily accessible at the rear of the unit, is set to within 15% of the local power supply, and that the fuses FS1, FS2 are of the correct rating. Alternative fuses are provided; 5A fuses for use when the instrument is operated from a 187V to 276V, 50 c/s (only) supply, and 10A fuses for operation from a 94V to 138V, 50 c/s (only) supply. The fuses not in use are carried in clips adjacent to the tapping panel.

Ensure that the power supply ventilation grills are clear.

Since high potentials may be present on the terminals when the power supply is operating, it is desirable to connect the loads <u>prior</u> to switching on. Also, before switching on, the hum injection and source resistance controls should be set to their minimum positions (counter clockwise), and the 'cut-out' button should be pushed home.

4.2 TERMINALS

The terminals are clearly annotated with the potentials they carry. All the supplies are floating with respect to chassis and earth. The d.c. supplies are referenced to the neutral line, facilitating series connexion or earthing at any potential, if required. The current taken from the positive stabilized supplies, either singly or combined, should not exceed 300mA, the current taken from the fixed negative supply should not exceed 50mA, and the current taken from the variable negative supply should not exceed 5mA.

The two low tension a.c. supplies can be connected in series to provide 12V a.c. at 4A, by linking the right hand terminal (T8) of the 'top' supply with the left hand terminal (T9) of the lower supply.

4.3 CONTROLS

The function and method of use of each control on the front panel is as follows:

COARSE (S1) : A five position switch (1 off position) for setting the output range of the 0 to 600V d.c. stabilized supply to 0 to 150V, 150V to 300V, 300V to 450V or 450V to 600V. The switch is also used in conjunction with the FINE control and the panel voltmeter, to set the level of the +100V to +800V unstabilized supply to the required value.

FINE (RV6) :	A potentiometer switch which enables the positive stabilized line to be adjusted to any level within the range of the COARSE control setting, and which facilitates the adjustment of the +100V to +800V output. The total excursion of the FINE control ensures overlap on all ranges.
SOURCE RESISTANCE (RV3) :	A potentiometer for adjusting the d.c. impedance (source resistance) of the positive stabilized line from 0.1Ω to 40Ω.
50 C/S RIPPLE AMPLITUDE (RV5) :	A potentiometer for adjusting the superimposed hum level from 3mV to 6V r.m.s. on the positive stabilized output provided that the output exceeds 20V and 20mA.
ALTERNATIVE RIPPLE INJECTION (JK) :	A jack enabling ripple up to 6V r.m.s. maximum and up to a frequency of 50 kc/s to be superimposed on the positive stabilized output from an external source. The signal input impedance is 5Ω; when an external source is connected, the internal hum injection circuit is isolated.
NEGATIVE SUPPLY 0 to -200V (RV10) : (5mA max)	A potentiometer for setting the stabilized variable negative d.c. supply to any value between 0 and -200V.
POSITIVE H.T. SWITCH (S5) :	A two pole switch for breaking both the stabilized and unstabilized positive supplies directly, enabling the supplies to be switched on again without the necessity of waiting for a warm-up period.
VOLTMETER SELECTOR (S4) AND AMMETER SELECTOR (S3) :	Two switches which enable the panel voltmeter and ammeter to be used for monitoring the various output lines. The f.s.d. of the meters for each range is indicated against the switch position. When two units are connected in series, the output voltage is indicated by taking the sum of the respective meter readings. The voltmeter is used to indicate the level of the +100V to +800V d.c. unstabilized supply which is adjusted, with the load connected, by the COARSE and FINE controls.

4.4 OVERLOAD

The safety cut-out device operates when the current drawn from the positive supply circuits exceeds 300mA. To re-set after a trip has occured, switch-off the power supply input and depress the OVERLOAD RESET button on the front panel.

The two negative supplies are protected by a 100mA fuse located on the front panel.

SECTION 5

MAINTENANCE

5.1 GENERAL

The PP1 is of robust construction and utilizes conservatively rated components throughout. It can, therefore, be operated for long periods without the necessity for maintenance.

To obtain access to the internal components, place the instrument face downwards on a flat surface, remove the power supply cover plate which is secured by four screws, remove the five case-retaining screws, and lift the case clear of the unit.

WARNING: Care should be taken when handling the unit if it is switched on whilst the case is removed, since it contains many high voltage parts.

5.2 FAULT FINDING

As an aid to fault finding, the circuit diagram is marked with typical voltages, measured with a high resistance multimeter (e.g. AVOmeter Model 8). The conditions under which these voltages were recorded are:

(a) No load

(b) FINE control at its minimum position

(c) COARSE control set to the 150V to 300V range

The series-regulator and shunt-amplifier (positive supply circuit) voltages are with respect to terminal T1, i.e. the 0 to 600V d.c. stabilized output line, the remainder of the voltages being with respect to terminal T4, i.e. the neutral line.

A.C. voltages are measured across the appropriate windings of the transformers; erroneous readings (about 7% high) are indicated by a rectifier type instrument when measuring a Constant Voltage Transformer voltage. Typical voltages are indicated on the circuit diagram (fig. 2).

5.3 VOLTAGE ADJUSTMENT

1. 0 to 600V d.c. stabilized output.

   If the reference valve V8 (85A2) is replaced, the positive-line range pre-set control, RV2, may have to be re-adjusted. This is accomplished as follows:

   (a) Set the COARSE control to the 450V to 600V range.

(b) Set the FINE control to its minimum position.

(c) Set the VOLTAGE SELECTOR to the STAB. 0 TO 600V position.

(d) Adjust RV2 (see fig. 1) until the front panel voltmeter reads 450V.

2. -200V d.c. fixed stabilized output.

If the reference valve V18 (85A2) is replaced, the fixed negative line may need to be re-set to -200V, as follows:

(a) Set the VOLTMETER SELECTOR to the -200V position.

(b) Adjust RV9 (see fig. 1) to give a reading of -200V on the panel voltmeter.

5.4 FEEDBACK ADJUSTMENT

Pre-set controls RV1, RV7 and RV8 are used to adjust the feedback conditions in the two shunt amplifiers. RV1 adjusts the positive current feedback in the positive supply amplifier, and is set to give a minimum value of output impedance. RV7 adjusts the positive current feedback in the negative supply amplifier, and RV8 adjusts the voltage feedback; RV7 and RV8 are adjusted in conjunction with each other to provide a minimum d.c. and a.c. output impedance without causing instability in the amplifier.

The re-adjustment of the controls RV1, RV7 and RV8 is generally unnecessary with normal component replacement. Should it be considered that re-adjustment is necessary, it would be advisable to return the power pack to Advance Components Ltd., since specialized equipment is required.

SECTION 6

SCHEDULE OF COMPONENTS

RESISTORS

Ref.			Description	Pt.No.
R1	1K	10%	Erie, Type 8	6911
R2	1K	10%	Erie, Type 8	6911
R3	100	10%	Erie, Type 9	1273
R4	100	10%	Erie, Type 9	1273
R5	100	10%	Erie, Type 9	1273
R6	100	10%	Erie, Type 9	1273
R7	100	10%	Erie, Type 9	1273
R8	100	10%	Erie, Type 9	1273
R9	1K	10%	Erie, Type 9	1175
R10	1K	10%	Erie, Type 9	1175
R11	1K	10%	Erie, Type 9	1175
R12	1K	10%	Erie, Type 9	1175
R13	1K	10%	Erie, Type 9	1175
R14	1K	10%	Erie, Type 9	1175
R15	1.2K	10%	Erie, Type 8	12936
R16	9.1K	10%	Erie, Type 8	12935
R17	100K	10%	Erie, Type 9	1270
R18	100K	10%	Erie, Type 9	1270
R19	10K	5%	RRC, Type 55 CD2 H.S.	11503
R20	470K	10%	Erie, Type 9	1816
R21	4.7K	3W	Wire Wound	138
R22	330K	10%	Erie, Type 9	4408
R23	47K	10%	Erie, Type 8	10869
R24	330K	10%	Erie, Type 9	4408
R25	33K	10%	Erie, Type 8	1274
R26	1.5K	10%	Erie, Type 8	11097
R27	50	5%	RRC, Type LG134	12764
R28	100K	10%	Erie, Type 10	12763
R29	220K	10%	Erie, Type 10	12766
R30	100K	10%	Erie, Type 10	12763
R31	91K	HS	1% RRC, Type IQ4	12765
R32	100K	10%	Erie, Type 10	12763
R33	91K	HS	1% RRC, Type IQ4 Insul.	12765
R34	100K	10%	Erie, Type 10	12763
R35	220K	10%	Erie, Type 10	12766
R36	100K	10%	Erie, Type 10	12763
R37	91K	HS	1% RRC, Type IQ4 Insul.	12765
R38	E.T.I	Shunt	to Suit Meter	
R39	680	10%	Erie, Type 9	7497

RESISTORS

Ref.	Description			Pt.No.
R40	100	10%	Erie, Type 9	1273
R41	1K	10%	Erie, Type 9	1175
R42	330K	10%	Erie, Type 9	4408
R43	15K	10%	Erie, Type 9	1177
R44	100K	RRC	2H53 2%	255
R45	100K	HS	2% RRC, Type 2H53	255
R46	250K	1%	Welwyn C25	12932
R47	680K	10%	Erie, Type 9	5024
R48	560K	10%	Erie, Type 9	4409
R49	100K	10%	Erie, Type 9	1270
R50				
R51	250K	1%	Welwyn C25	12932
R52	1M	10%	Erie, Type 9	1171
R53	100K	10%	Erie, Type 9	1270
R54	1.5M	10%	Erie, Type 9	7016
R55	82K	RRC	2HS3 2%	256
R56	100K	HS	2% RRC, Type 2H53	255
R57	250K	1%	Welwyn C25	12932
R58	250K	1%	Welwyn C25	12932
R59	4.7	10%	RRC, LG.138	441

CAPACITORS

Ref.	Description	Pt.No.
C1)		
C2)	32 + 32 + 16 350V Plessey CE626	12757
C3)		
C4	.1 20% Plesseal	11860
C5	.1 20% Plesseal	11860
C6	32 Elect. 350V Plessey CE513	12755
C7	32 Elect. 350V Plessey CE513	12755
C8	32 Elect. 350V Plessey CE513	12755
C9	.1 1000V Hunts WF 311	12930
C10	16 Elect. 500V Plessey CE5001	12754
C11	4 850V Duconal. Sel.	12759
C12	100 + 200 Elect. Plessey CE682/9	12758
C13	32 Elect. 500V Hunts L32/1	12756
C14	100 + 200 Elect. Plessey CE682/9	12758
C15	16 Elect. 500V Plessey CE5001	12754
C16	32 Elect. 500V Hunts L32/1	12756
C17	100 + 200 Elect. Plessey CE682/9	12758
C18	100 Elect. 6V Plessey CE1207	11484
C19	20 275V TCC Visconal. Sel.	7515
C20)	32 + 32 + 16 Plessey CE626	12757
C21)	16 Sect. not used	11860

CAPACITORS

Ref.	Description	Pt.No.
C22	.1 20% Plesseal	
C23	.01 Hunts W99	8587
C24	.01 Hunts W99	8587
C25	.1 20% Plesseal	11860
C26	32 Elect. 350V Plessey CE513	12755
C27	220pF 5% Lemco 2010	11673

MISCELLANEOUS

Ref.	Description		Pt.No.
RV1	10	Preset Egen 196	12933
RV2	50K	Colvern CLR 3001/75	12771
RV3	40	Colvern CLR 5008/13	12774
RV4	500	Berco L50 Type 760 Spindle	12772
RV5	1K	Colvern CLR 4027/13	12775
RV6	100K	5% CLR4001	A12773
RV7	10	Preset Egen 196	12933
RV8	20K	Preset Egen 174	12934
RV9	100K	Colvern CLR 4001/75	12770
RV10	50K	Colvern CLR 5008/13	12776
V1-V6	EL84		12785
V7-V9	150C4		154
V8	85A2		12788
V10-V11	ECC81		7106
V12-V15	EY84		12786
V16	EL81		12787
V17	ECC81		7106
V18	85A2		12788
V19	ECC81		7106
N1-N2	Hivac	Type 3L	12781
MR1	B250/C125	S & H	12783
MR2	B250/C75	S & H	12784
MR3	B250/C125	S & H	12783
FS1)	5A B/Lee L1055		12807
FS2)	or 10A B/Lee L1055		12991
FS3	100mA L1055		3725
CVT1	Constant Voltage Transformer		MT357
CVT2	Constant Voltage Transformer		MT358

MISCELLANEOUS

Ref.	Description	Pt.No.
S1	Crater LRC/6/ACL.1	12779
S2	On/Off Arrow	12778
S3	Ammeter Selt. Switch	12777
S4	Voltmeter Selt.	12780
S5	On/Off Arrow 102/P	442
M1	E.T. Type 703	A12810
M2	E.T. Type 703	A12811
MTP	McMurdo 279001	A12792
PL1	Bulgin 3 Pin	4729
RLA	Mag. Dev. 339/3.5/B2/AC350	12806
JK	Jack Igranic Type P66	410
ILP	12V 2.2W G.E.C. 987	12931

PART No. 12828

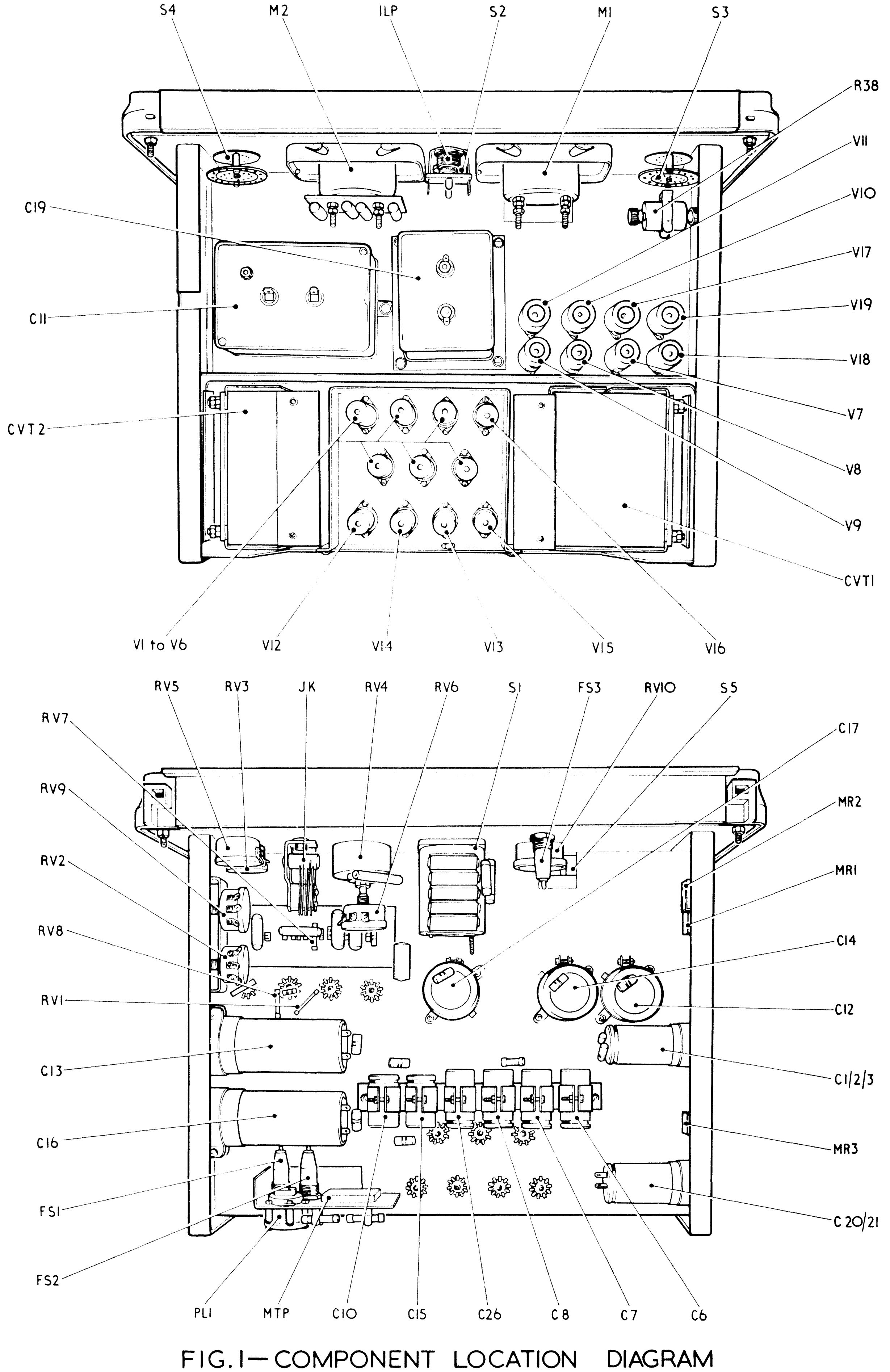
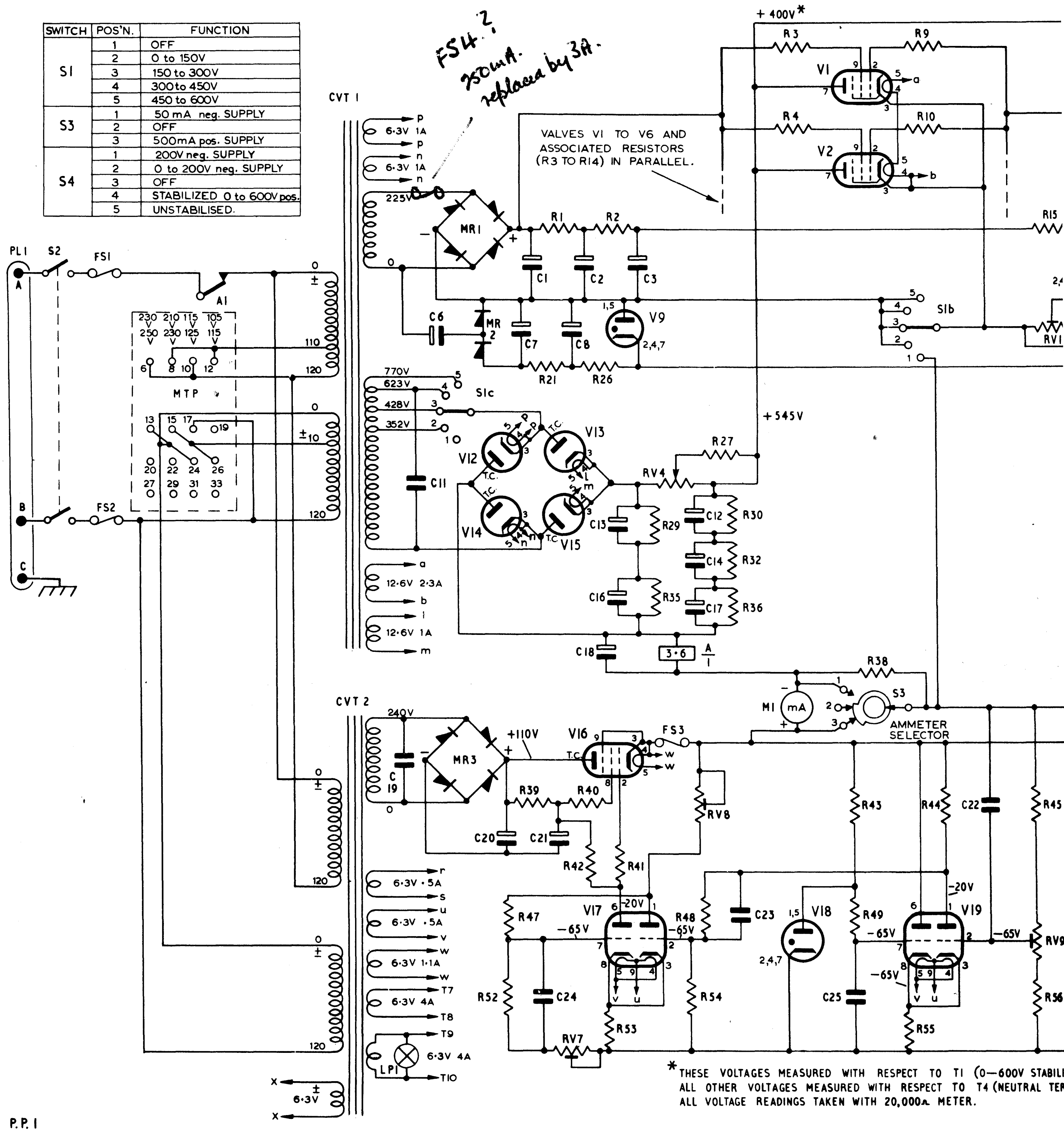


FIG. 1—COMPONENT LOCATION DIAGRAM

R	47 52 21 39 1 42 RV7 26 40 53 2 41 RV4 29 35 30 32 27 36 54 RV8 48 3 5 7 4 6 8 38 43 49 9 12 55 10 13 11 14 44 45 RV9 56 15 RV1
C	19 11 6 20 7 24 1 21 8 13 2 16 3 18 12 14 17 23 25 22
MISC.	S2 FS1 FS2 A1 CVT 1 CVT 2 LP1 S1c MR 1 MR 2 MR 3 V12 V14 V13 V15 V9 V16 V17 A/I FS3 M1 V18 V1,2,3,4,5,6 S3 S1b V19

SWITCH	POS'N.	FUNCTION
S1	1	OFF
	2	0 to 150V
	3	150 to 300V
	4	300 to 450V
	5	450 to 600V
S3	1	50 mA neg. SUPPLY
	2	OFF
	3	500mA pos. SUPPLY
S4	1	200V neg. SUPPLY
	2	0 to 200V neg. SUPPLY
	3	OFF
	4	STABILIZED 0 to 600V pos.
	5	UNSTABILISED.

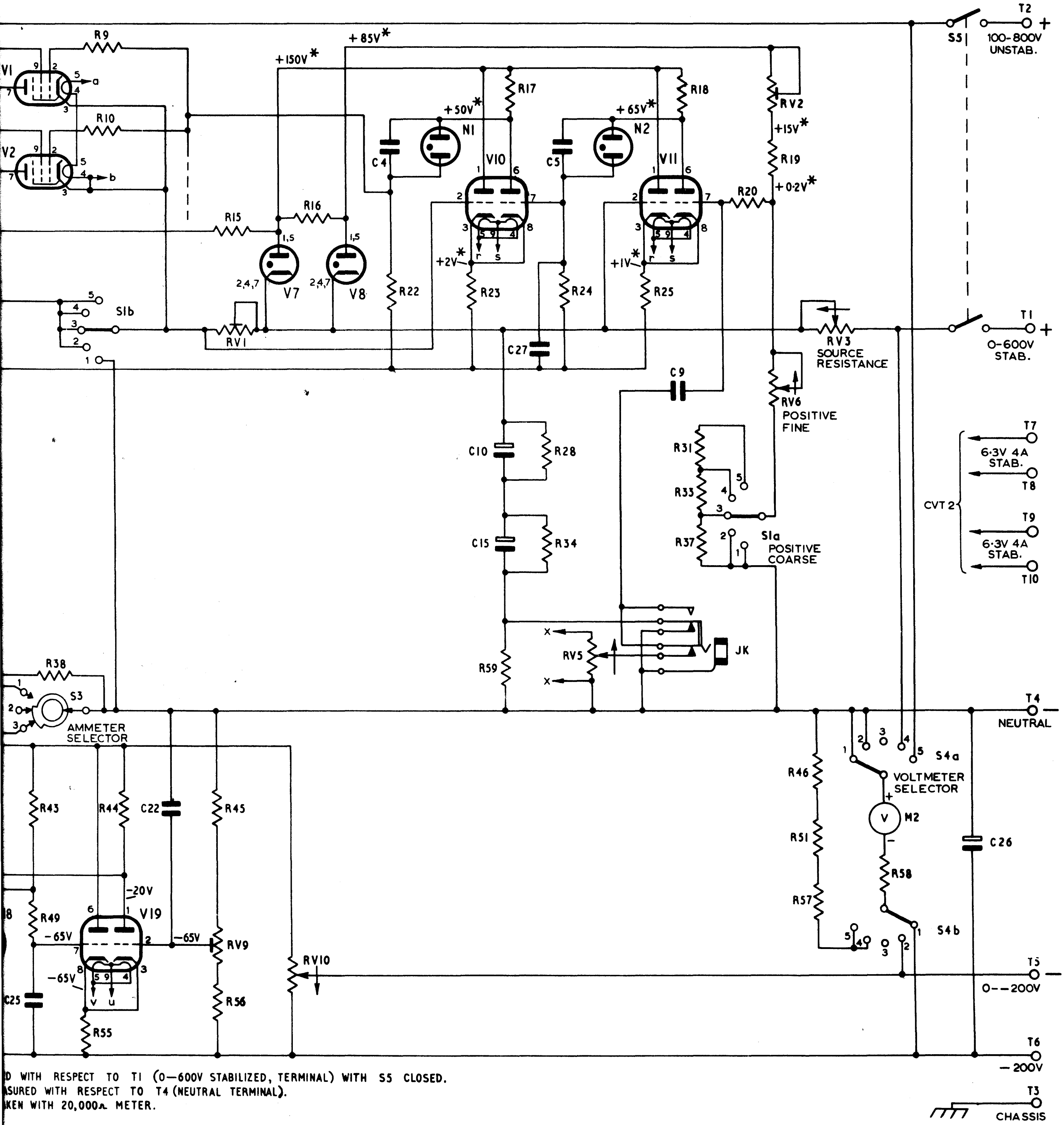


* THESE VOLTAGES MEASURED WITH RESPECT TO T1 (0—600V STABILI
ALL OTHER VOLTAGES MEASURED WITH RESPECT TO T4 (NEUTRAL TER
ALL VOLTAGE READINGS TAKEN WITH 20,000Ω METER.

P.P. 1

FIG. 2 - CIRCUIT DIAG

R	38 9 10 11 45 15 16 28 18 31 RV2 46 / 43 12 13 14 RV9 RVI RV10 22 23 17 34 24 33 20 19 51 RV3 58 / 49 55 44 56 59 RV5 25 37 RV6 57
C	5 / 22 4 10 27 9 / 25 15 26
MISC.	,2,3,4,5,6 N1 N2 S5 / S1b V7 V8 V10 V11 S1a M2 / S3 V19 JK S4



D WITH RESPECT TO T1 (0—600V STABILIZED, TERMINAL) WITH S5 CLOSED.
SURED WITH RESPECT TO T4 (NEUTRAL TERMINAL).
KEN WITH 20,000Ω METER.

THE RIGHT IS RESERVED TO ADJUST THE VALUES OR AMEND THE CIRCUIT WITHOUT NOTICE. CSK 1349 ISSUE 5

FIG. 2 - CIRCUIT DIAGRAM