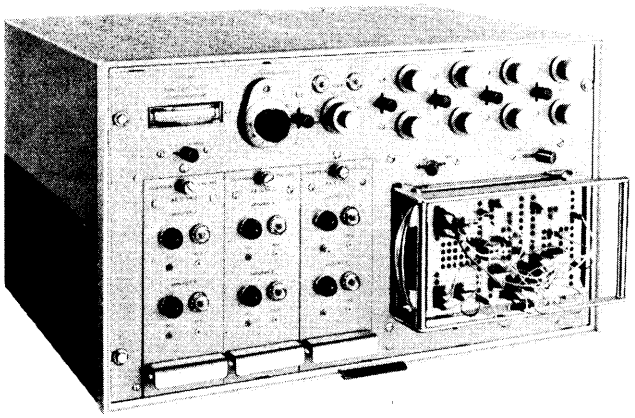
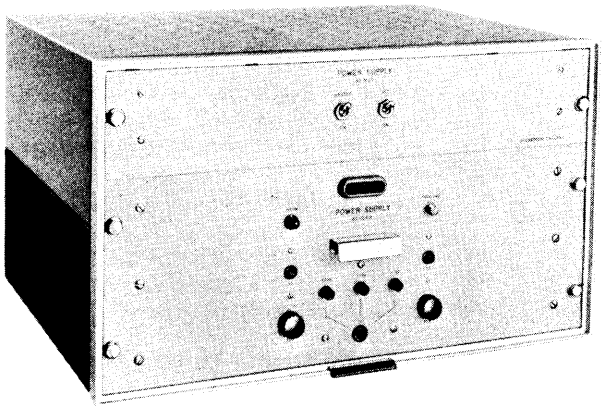


Analogue Tutor II



AS1403 Power Supply Unit

Issue : One

Mod. Ref. : 1351/6

Date : May, 1964

SOLARTRON Instruction Manual

ANALOGUE TUTOR TY1351

SOLARTRON

The Solartron Electronic Group Ltd.
Victoria Road, Farnborough, Hants.
Telephone: Farnborough 3000. Telex: 8545 Solartron Fnbro. Cables: Solartron Farnborough.
A Member of the Schlumberger Group.

I

Printed in England

CONTENTS

ILLUSTRATIONS

APPENDICES

Section 1

INTRODUCTION

1.1 Scope of Manual

The maintenance manual comprises this preliminary volume supplemented by individual handbooks describing standard Solartron units employed in the Analogue Tutor II equipment.

No direct reference is made to the operational use of Tutor, this aspect being covered in a separate booklet.

1.2 General Description

The Tutor is a small six operational amplifier computer designed specifically for use by educational establishments during the teaching of analogue computer techniques.

It is housed in a cabinet suitable for bench mounting and is powered from a second bench mounting cabinet incorporating the AS 1403 Power Supply Unit.

1.3 Specification

Computing Accuracy:	1%	
Component Accuracy:	0.5%	
Reference Supplies:	±100 Volts	
Reference Accuracy:	0.1% or better	
Operating Temperature:	$0^{o}C$ - $45^{o}C$	
Weights:	TY 1351 -	49 lbs (22.25kg)
	AS 1403 -	57 lbs (26kg)
Dimensions	TY 1351 -	19.5 in. x 11 in. x 16.75 in. overall (49.5cm x 28cm x 42.5cm)
	AS 1403 -	19.5 in. x 11 in. x 16 in. overall (49.5cm x 28cm x 40.5cm)

1.4 Equipment Summary

The Tutor incorporates the following items:

(a) Six operational (Three Dual) Amplifiers Type AA 1054.2. Four amplifiers may be used as either Summers or Integrators. The two remaining amplifiers are available for use as Summers only.
Associated with each Summer/Integrator are:

(i) One 1MΩ input resistor
(ii) One 100KΩ input resistor
(iii) One 1MΩ feedback resistor
(iv) One 0.1μF feedback capacitor
(v) One 0.01μF feedback capacitor

Associated with each Summer are:

(i) Two 1MΩ input resistors
(ii) One 100KΩ input resistor
(iii) One 1MΩ feedback resistor

(b) Six free resistors - two 1MΩ and four 100KΩ

(c) Eight 10 - turn 30KΩ helical potentiometers of better than 0.01% resolution, two being earth-free.

(d) A 10 - turn master reference potentiometer with calibrated dial, 0.1% linearity.

(e) A centre zero nulling meter with three sensitivity ranges, ±100V, ±10V and ±1V.

(f) A computer operation switch with the following operational control modes:

(i) Pot Set
(ii) Problem Check
(iii) Compute
(iv) Hold
(v) Repetitive Slow
(vi) Repetitive Fast
(vii) Slave

(g) A patch panel system with a removable problem board.

(h) An external meter jack to facilitate use and demonstration of a Digital Voltmeter for setting-up purposes.

(j) Four free diodes for simulation of simple discontinuities.

(k) Twenty TRUNKS.

(l) Coaxial socket for oscilloscope triggering.

(m) Patch panel power link.

(n) Three patch panel bus bars.

Section 2

CIRCUIT DESCRIPTION

This Section should be read in conjunction with the circuit diagrams of the equipment provided at the rear of the volume.

The Analogue Tutor II circuit may be conveniently considered in two parts, shown in Figures 6 and 7. The first part relates to the patch panel, computing component circuits, potentiometer assembly and reference potentiometer, described in sub-sections 2.1, 2.2 and 2.3. Part two indicates power and reference supplies and the control circuit and is described in sub-sections 2.4, 2.5, 2.6 and 2.7.

2.1 Patch Panel

The patch panel is a 148 way removable unit with sockets identified by colour and, where necessary, by legend. The individual sockets are located by a grid reference system in which horizontal rows are lettered from A to Z and vertical columns are numbered from 1 to 14. The letters I and O are omitted from the alphabetical references to avoid confusion with numerals.

A description and a full colour illustration of the patch panel are given in the applications brochure of the Tutor.

2.2 Potentiometer Assembly

The six earthed coefficient potentiometers RV1-RV6 are connected to the +100V reference supply through the key switches SA - SC and may be set by a backing off procedure. The backing off voltage is supplied from the reference potentiometer RV9 via switch SF1, the meter sensitivity being altered by switch SE1 to enable a null reading to be obtained.

Reference volts and signal ground must be patched in to set up the free potentiometers RV7 and RV8.

Priority switching of the potentiometers is made from left to right, i.e. RV1 and RV2 must be set up while switches SB - SD are centrally positioned, RV3 and RV4 must be set up while switches SC - SD centrally positioned, etc.

The external meter jack SKTG may be connected to a digital voltmeter for monitoring purposes.

2.3 Amplifier Circuitry

The six operational amplifiers are identified in the following manner:

Summer/Integrators	A1	B1	A3	B3
Summers	A2	B2		

2.3.1 Summer/Integrators

The four summer/integrators are identical and consequently only the circuit associated with operational amplifier A1 will be considered in detail.

The circuit comprises input, feedback and initial condition components, together with a 'Sum/Integrate' switch, and computer state relay contacts.

R4 and R5 are the input resistors, shunted by C1 and C2 respectively when switch SG is set to the SUM position. The capacitors compensate for capacity within the amplifier between the output and the summing junctions and are disconnected when switch SG is set to the INT position. R10 and C5 form the feedback pair.

C6 and C7 are the integrator capacitors, a patch cord being used to link E3 and D3 when C6 is used in the repetitive fast mode. D3 and D4 are linked to use C7 in the repetitive slow mode.

R6 and R11 are the initial condition components.

Relay RLA is energised when the 'state' switch SL is set to position PS, pot.set. The input resistors R4 and R5 are disconnected from the amplifier and taken to signal ground.

When the 'state' switch is set to position H (hold) relay RLC is energised, so holding the computer.

The problem check condition, PC on the state switch, is achieved by energising relay RLD, as described in Section 2.7.

2.3.2 Summers

The two summers are identical and only the circuit associated with operational amplifier A2 will be considered.

The circuit comprises input and feedback components, together with pot.set. relay contacts.

R14, R15 and R16 are the input resistors, shunted by C11, C12 and C13 respectively. The components are connected to signal ground when relay RLA is operated in the computer pot.set state.

C17 and R26 form the feedback pair and a link must be inserted between Q1 and Q2 to complete the feedback circuit.

The summing junction is connected to N3 on the patch panel, so allowing provision for extra inputs.

2.4 Negative Reference Supply

The +300 volt and -200 volt supplies are obtained from the AS 1403 Power Supply Unit. The -100 volt reference supply is derived from the -200 volt supply V1A cathode is held referenced by a stabiliser valve V2. The grid of V1A is fed from a shunt connected to the -100 volt output line, i.e. the anode of V3. Any variation in the voltage on this line is amplified by V1A and applied through R40 to the grid of V1B. V3 and V1B form a white amplifier, V3 grid being DC coupled to V1B anode. DC potential is dropped down the chain of neon lamps ILP3 - ILP6. Output current is supplied through V3 and stability ensured by C41.

2.5 Positive Reference Supply

The +100 volt supply is taken from the cathode of V5 and referenced from the -100 volt line via R47, RV11 and R48. Any variation in the positive voltage is fed into the grid of V4A which is DC coupled to V4B. The cathode follower then drives V5 through C35 to correct the change. Additional gain is obtained from the small loop R52 driving VT1.

2.6 Auxiliary Power Supplies

Power for the heaters of valves V1, V3, V4, V5 and V6 is supplied from the secondary windings of transformer T1.

Power for the operational amplifiers is obtained directly from the AS 1403 Power Supply Unit.

Patch board holes M14 and N14 must be linked together to enable relay RLE to operate and connect -200V and +300V to the Tutor.

2.7 The control state of the Tutor is selected by switch SL. The states are listed below:

Position	State
PS	Pot Set
PC	Problem Check
C	Compute
H	Hold
RS	Repetitive Slow
H	Hold
RF	Repetitive Fast
S	Slave

Relays RLA and RLB are the pot.set relays and are energised from the -200 volt supply.

The problem check state is one state of the multivibrator formed by V6A, V6B and their associated components. It is achieved by holding on V6B via R67 to the +300 volt line and by holding off V6A via R59 to the -200 volt line, so energising relay RLD.

The compute state is the opposite condition to the problem check state and is achieved by holding off V6B via R66 to the -200 volt line and holding on V6A via R60 to the +300 volt line.

Relay RLC is energised in the hold state. The computer may also be held by patching -100 volts into Q14 on the patch panel.

The repetitive slow state is achieved by operating the multivibrator V6A, V6B in one of its two free running conditions, the values of C37 and R67 determining the switching speed of the circuit.

The repetitive fast state is attained when the multivibrator is operated in its second free running condition, C37 and R70 values determining the switching speed of the circuit.

In both repetitive states RV12 enables variations of time to be adjusted.

Indicator lamp, ILP1 is illuminated during the compute and hold states.

Indicator lamp ILP2 is illuminated during the pot.set and problem check states. The lamps cycle in the repetitive fast and slow states.

MR12 prevents C38 going negative and causing incorrect operation of the timer in the slave mode.

2.8 AS 1403 Power Supply

The AS 1403 power supply unit provides main HT and LT, supplies for the TY 1351 and computer amplifiers AA 1054.2. This unit is fully described in Appendix B at the rear of the manual.

Section 3

MAINTENANCE INFORMATION

3.1 Initial Checking Procedure

1. Turn on the Heater switch on the AS 1403 Power Supply Unit front panel. This action connects heater voltages to valves in the AS 1104.2 Power Supply, in the Tutor and in the AA 1054.2 Operational Amplifiers. It also energises the Control relays. Check that the valve heaters glow and that the choppers vibrate.
2. Insert patch cords to link M14 to N14, Q1 to Q2 and Q10 to Q11. Turn on the H.T. switch on the AS 1403 Power Supply. Check that relay RLE operates. It should de-energise on removal of the patch panel.
3. Check that all overload lamps on the front panels of the Operational Amplifiers and on the front panel of the AS 1104.2 Power Supply Unit cease to glow.
4. Check that approximately +100 volts and -100 volts appear on the patch panel at G6, P8, Y6 and G9, P6, Y9 respectively.
5. Using the indicator lamps, check the timer states including the fast/slow controls.
6. Check the reference potentiometer with the voltmeter line connected to signal ground.
7. Check all coefficient potentiometers.

3.2 Test Procedure

The procedure given in this section is basically the production test to which all units are subjected prior to despatch. It is provided to enable the user of the equipment to check its performance and to make any required adjustments.

An Avometer, a Solartron LM 1010 Digital Voltmeter, a Solartron CD 1014.3 Oscilloscope, a resistive load and a stop watch or other timing device are required.

The operational amplifiers and front panel of the Tutor may be extracted from the cabinet when the four chromium plated screws located near the corners of the front panel are released.

1. Adjust the -100 volts reference supply by means of RV10. The ripple should be considerably less than 5mV.
2. Repeat test 1 on the +100 volts reference supply line adjusting RV11 if necessary. The ripple should again be considerably less than 5mV.
3. Load the +100 volts line with 1K derived from the rheostat. The ripple should not exceed 10mV. The volts drop should not exceed 50mV with 100mA flowing through the circuit.

BI

4. Repeat 3 for similar results on the -100 volts rail.
5. Zero test points 1 of the amplifiers. The voltages at these points should not exceed 750mV peak-to-peak.
6. Monitor the amplifier output points on the patch panel. Noise should not exceed 5mV peak-to-peak.
7. Check the reference potentiometer. A zero reading on the dial of the potentiometer should correspond to a zero reading on the null meter. Check the linearity roughly at three or four points.
8a. Check the amplifier input resistors and the free resistors. With 100 volts applied to a 1MΩ component an amplifier output should read 100 volts. With 10 volts applied to a 100KΩ component, an amplifier output should read 100 volts.
8b. Check the initial condition resistors on the summer/integrators. The amplifier switches should be set to integrate. The amplifier outputs should be greater than 100 volts.
9. With +100 volts patched into a 100KΩ initial condition potentiometer, leakage should be better than 5×10^{-9}, e.g. with a 1MΩ feedback resistor the voltage at the amplifier output terminal should not exceed 5mV. Set the appropriate Sum/Integrate switch to Sum for this test.

10. Check the timing of the integrators:

    a) 0.1μF 0.1 volts in 100 volts in 100 seconds.
    b) 0.01μF 0.01 volts in 100 volts in 100 seconds.

    0.1 volts and 0.01 volts can be obtained by using Summers at 0.1 gain.
11. Check leakage times with 100 volts on the outputs. They should not exceed 1 volt in 100 seconds.
12. Check the free diodes.
13. Check the hold state with -100 volts applied to Q14 on the patch panel.
14. Check the timer to obtain approximately 1.5 seconds and 150 milliseconds in RS and RF respectively.
15. Check the voltmeter jack socket.
16. Check master slave on timer by coupling two units together.
17. Check the trigger socket.
18. Check TRUNKS.

RESISTORS FIXED

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Manufacturer	and Type
R1	100K	0.5	1/4	1604 00074	Plessey	ATMF
R2	1M	0.5	1/4	1604 00025	Plessey	ATMF
R3	10K	10	1/4	1723 41000	Erie	16 Carbon
R4	1M	0.5	1/4	1604 00025	Plessey	ATMF
R5	100K	0.5	1/4	1604 00074	Plessey	ATMF
R6	100K	0.5	1/4	1604 00074	Plessey	ATMF
R7	1M	0.5	1/4	1604 00025	Plessey	ATMF
R8	100K	0.5	1/4	1604 00074	Plessey	ATMF
R9	100K	0.5	1/4	1604 00074	Plessey	ATMF
R10	1M	0.5	1/4	1604 00025	Plessey	ATMF
R11	110K	0.5	1/4	1604 00075	Plessey	ATMF
R12	1M	0.5	1/4	1604 00025	Plessey	ATMF
R13	110K	0.5	1/4	1604 00075	Plessey	ATMF
R14	1M	0.5	1/4	1604 00025	Plessey	ATMF
R15	1M	0.5	1/4	1604 00025	Plessey	ATMF
R16	100K	0.5	1/4	1604 00074	Plessey	ATMF
R17	1M	0.5	1/4	1604 00025	Plessey	ATMF
R18	1M	0.5	1/4	1604 00025	Plessey	ATMF
R19	100K	0.5	1/4	1604 00074	Plessey	ATMF
R20	100K	0.5	1/4	1604 00074	Plessey	ATMF
R21	100K	0.5	1/4	1604 00074	Plessey	ATMF
R22	100K	0.5	1/4	1604 00074	Plessey	ATMF
R23	1M	0.5	1/4	1604 00025	Plessey	ATMF
R24	1M	0.5	1/4	1604 00025	Plessey	ATMF
R25	100K	0.5	1/4	1604 00074	Plessey	ATMF
R26	1M	0.5	1/4	1604 00025	Plessey	ATMF
R27	1M	0.5	1/4	1604 00025	Plessey	ATMF
R28	1M	0.5	1/4	1604 00025	Plessey	ATMF
R29	100K	0.5	1/4	1604 00074	Plessey	ATMF
R30	100K	0.5	1/4	1604 00074	Plessey	ATMF
R31	1M	0.5	1/4	1604 00025	Plessey	ATMF
R32	100K	0.5	1/4	1604 00074	Plessey	ATMF
R33	100K	0.5	1/4	1604 00074	Plessey	ATMF
R34	1M	0.5	1/4	1604 00025	Plessey	ATMF
R35	110K	0.5	1/4	1604 00075	Plessey	ATMF
R36	1M	0.5	1/4	1604 00025	Plessey	ATMF
R37	110K	0.5	1/4	1604 00075	Plessey	ATMF
R38	22K	5	6	1737 42200	Painton	306A WW
R39	330K	1	1/4	1704 53300	Painton	92 HS
R40	2.2M	1	1/4	1704 62200	Painton	92 HS
R41	15	1	1/2	1707 41500	Painton	93 HS
R42	2.2M	1	1/4	1704 62200	Painton	92 HS
R43	47K	5	12	1743 44700	Painton	302A WW
R44	3.3K	10	1/4	1723 33300	Dubilier	BTT Carbon
R45	68K	10	1/4	1723 46800	Dubilier	BTT Carbon

RESISTORS FIXED - continued

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Manufacturer	and Type
R46	1M	10	$\frac{1}{4}$	1723 61000	Dubilier	BTT Carbon
R47	100K	1	$\frac{1}{4}$	1704 51000	Painton	92 HS
R48	110K	1	$\frac{1}{4}$	1704 51100	Painton	92 HS
R49	100K	10	$\frac{1}{2}$	1725 51000	Dubilier	BTA Carbon
R50	10K	10	$\frac{1}{4}$	1723 41000	Dubilier	BTT Carbon
R51	22K	10	$\frac{1}{2}$	1725 42200	Dubilier	BTA Carbon
R52	10K	10	$\frac{1}{4}$	1723 41000	Dubilier	BTT Carbon
R53	100K	10	$\frac{1}{4}$	1723 51000	Dubilier	BTT Carbon
R54	1K	5	12	1743 31000	Painton	302A WW
R55	68K	10	$\frac{1}{4}$	1723 46800	Dubilier	BTTCarbon
R56	12K	10	$\frac{1}{4}$	1723 41200	Dubilier	BTT Carbon
R57	47K	10	$\frac{1}{4}$	1723 44700	Dubilier	BTT Carbon
R58	47K	10	$\frac{1}{4}$	1723 44700	Dubilier	BTT Carbon
R59	1M	10	$\frac{1}{4}$	1723 61000	Dubilier	BTT Carbon
R60	150K	1	1	1713 51500	Painton	92 HS
R61	1M	10	$\frac{1}{4}$	1723 61000	Dubilier	BTT Carbon
R62	10K	5	2.6	1737 41000	Painton	306A WW
R63	1M	10	$\frac{1}{4}$	1723 61000	Dubilier	BTT Carbon
R64	10K	5	2.6	1734 41000	Painton	MV1A WW
R65	1M	10	$\frac{1}{4}$	1723 61000	Dubilier	BTT Carbon
R66	1M	10	$\frac{1}{4}$	1723 61000	Dubilier	BTT Carbon
R67	3.3M	10	$\frac{1}{2}$	1725 63300	Dubilier	BTA Carbon
R68	1M	10	$\frac{1}{4}$	1723 61000	Dubilier	BTT Carbon
R69	1M	10	$\frac{1}{4}$	1723 61000	Dubilier	BTT Carbon
R70	510K	5	0.7	1965 55100	Electrosil	N25 O.F.
R71	10K	5	2.6	1734 41000	Painton	MV1A WW
R72	100	10	$\frac{1}{4}$	1723 21000	Dubilier	BTT Carbon

RESISTORS VARIABLE

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Manufacturer	and Type
RV1	30K	5	2	1101 50190	Reliance	HEL-07-10
RV2	30K	5	2	1101 50190	Reliance	HEL-07-10
RV3	30K	5	2	1101 50190	Reliance	HEL-07-10
RV4	30K	5	2	1101 50190	Reliance	HEL-07-10
RV5	30K	5	2	1101 50190	Reliance	HEL-07-10
RV6	30K	5	2	1101 50190	Reliance	HEL-07-10
RV7	30K	5	2	1101 50190	Reliance	HEL-07-10
RV8	30K	5	2	1101 50190	Reliance	HEL-07-10
RV9	50K	5	4	1101 50200	Colvern	CLR23/00/13
RV10	10K	10	$\frac{1}{2}$	1100 26100	Colvern	CLR1206/9S
RV11	10K	10	$\frac{1}{2}$	1100 26100	Colvern	CLR1206/9S
RV12*	25K	10	3		AB Metals	58

CAPACITORS

Cct. Ref.	Value µF	Tol. %	Rating Volts	Solartron Part No.	Manufacturer and Type
C1	100pF	2.5	500	2104 21000	GEC 21001 Po
C2	0.001	2.5	500	2104 31000	GEC 31001 Po
C3	100pF	2.5	500	2104 21000	GEC 21001 Po
C4	0.001	2.5	500	2104 31000	GEC 31001 Po
C5	91pF	2.5	500	2104 19100	Suflex HS Po
C6	0.01	1	500	2103 41000	Suflex HS Po
C7	0.1	1	500	2103 51000	Suflex HS Po
C8	91pF	2.5	500	2104 19100	Suflex HS Po
C9	0.01	1	500	2103 41000	Suflex HS Po
C10	0.1	1	500	2103 51000	Suflex HS Po
C11	100pF	2.5	500	2104 21000	GEC 21001 Po
C12	100pF	2.5	500	2104 21000	GEC 21001 Po
C13	0.001	2.5	500	2104 31000	GEC 31001 Po
C14	100pF	2.5	500	2104 21000	GEC 21001 Po
C15	100pF	2.5	500	2104 21000	GEC 21001 Po
C16	0.001	2.5	500	2104 31000	GEC 31001 Po
C17	91pF	2.5	500	2104 19100	Suflex HS Po
C18	91pF	2.5	500	2104 19100	Suflex HS Po
C19	100pF	2.5	500	2104 21000	GEC 21001 Po
C20	0.001	2.5	500	2104 31000	GEC 31001 Po
C21	100pF	2.5	500	2104 21000	GEC 21001 Po
C22	.001	2.5	500	2104 31000	GEC 31001 Po
C23	91pF	2.5	500	2104 19100	Suflex HS Po
C24	0.01	1	500	2103 41000	Suflex HS Po
C25	0.1	1	500	2103 31000	Suflex HS Po
C26	91pF	2.5	500	2104 19100	Suflex HS Po
C27	0.01	1	500	2104 10000	Suflex HS Po
C28	0.1	1	500	2103 51000	Suflex HS Po
C29	0.047	10	400	2208 44700	Wima Tropyfol M
C30	0.047	10	400	2208 44700	Wima Tropyfol M
C31	0.1	10	125	2203 51000	Wima Tropyfol M
C32	0.1	10	400	2208 51000	Wima Tropyfol M
C33	0.1	10	125	2203 51000	Wima Tropyfol M
C34	Not fitted				
C35	2	-20 +50	150	2616 62000	Hunts MEW92T
C36	0.1	10	125	2203 51000	Wima Tropyfol M
C37	1	20	600	2083 50017	Hunts WF49
C38	1	20	600	2083 50017	Hunts WF49
C39	0.022	10	400	2208 42200	Wima Tropyfol M
C40	0.22	10	400	2208 52200	Wima Tropyfol M
C41	16	-20 +50	150	2616 71600	Hunts MEF112T

* Supplied with Switch SL

VALVES

Cct. Ref.	Description	Solartron Part No.	Manufacturer and Type	
V1	Triode Pentode	3000 35010	Brimar	6U8
V2	Reference Tube	3000 11020	Mullard	85A2
V3	Pentode	3000 05240	Mullard	EL86
V4	Triode Pentode	3000 35010	Brimar	6U8
V5	Pentode	3000 05240	Mullard	EL86
V6	Double Diode	3000 33020	Brimar	12AT7

SEMICONDUCTORS

VT1	Transistor	3005 50530	Mullard	ACY17
MR1	Diode	3005 21040	Mullard	OA202
MR2	Diode	3005 21040	Mullard	OA202
MR3	Diode	3005 21040	Mullard	OA202
MR4	Diode	3005 21040	Mullard	OA202
MR5	Diode	3005 21040	Mullard	OA202
MR6	Diode	3005 20910	Mullard	OA10
MR7	Diode	3005 20910	Mullard	OA10
MR8	Diode	3005 20910	Mullard	OA10
MR9	Diode	3005 20910	Mullard	OA10
MR10	Diode	3005 21080	Ferranti	ZS74
MR11	Diode	3005 21080	Ferranti	ZS74
MR12	Diode	3005 21080	Ferranti	ZS74

MISCELLANEOUS

T1	Transformer		Solartron	3010 10110
M1	Meter	3400 22010	Taylor	Model 220
SA	Switch Lever	3750 00270	AB Metals	L02
SB	Switch Lever	3750 00270	AB Metals	L02
SC	Switch Lever	3750 00270	AB Metals	L02
SD	Switch Lever	3750 00270	AB Metals	L02
SE	Switch Lever	3750 00280	AB Metals	L04
SF	Switch Lever	3750 00270	AB Metals	L02
SG	Switch Lever	3750 00270	AB Metals	L02
SH	Switch Lever	3750 00270	AB Metals	L02
SJ	Switch Lever	3750 00270	AB Metals	L02
SK	Switch Lever	3750 00270	AB Metals	L02
SL *	Switch Wafer Trolex	3743 00050	AB Metals	
SM	Switch Toggle DPDT	3760 00080	Painton	501085
FS1	Fuse Link	3601 01320	Belling & Lee	L562/2
SKTA	Socket Fixed 24 Way	3525 24010	McMurdo	RS24
SKTB	Socket Fixed 24 Way	3525 24010	McMurdo	RS24
SKTC	Socket Fixed 24 Way	3525 24010	McMurdo	RS24
SKTD	Socket Fixed 15 Way	3525 15010	Electromethods	BA-15-S
SKTE	Socket Fixed 15 Way	3525 15010	Electromethods	BA-15-S
SKTF	Socket Coaxial	3521 01160	Belling & Lee	L603A
SKTG	Socket Jack	3525 01210	Rendar Inst.	J400A
PLA	Plug Fixed 15 Way	3523 15010	Electromethods	BA-15p
RLA	Relay	3006 50180	Varley VP4	CAA120
RLB	Relay	3006 50180	Varley VP4	CAA120

* Supplied with Resistor Variable RV12

Cct. Ref.	Description	Solartron Part No.	Manufacturer and Type
RLC	Relay	3006 50180	Varley VP4 CAA120
RLD	Relay	3006 50180	Varley VP4 CAA120
RLE	Relay P.O. 3000	3006 50340	Keyswitch
PB1	Patchboard		Woden
ILP1	Neon Indicator Lamp(Clear)	3007 20120	Arcolectric SL81
ILP2	Neon Indicator Lamp (Clear)	3007 20120	Arcolectric SL81
ILP3	Neon Indicator	3007 20110	Arcolectric T49
ILP4	Neon Indicator	3007 20110	Arcolectric T49
ILP5	Neon Indicator	3007 20110	Arcolectric T49
ILP6	Neon Indicator	3007 20110	Arcolectric T49

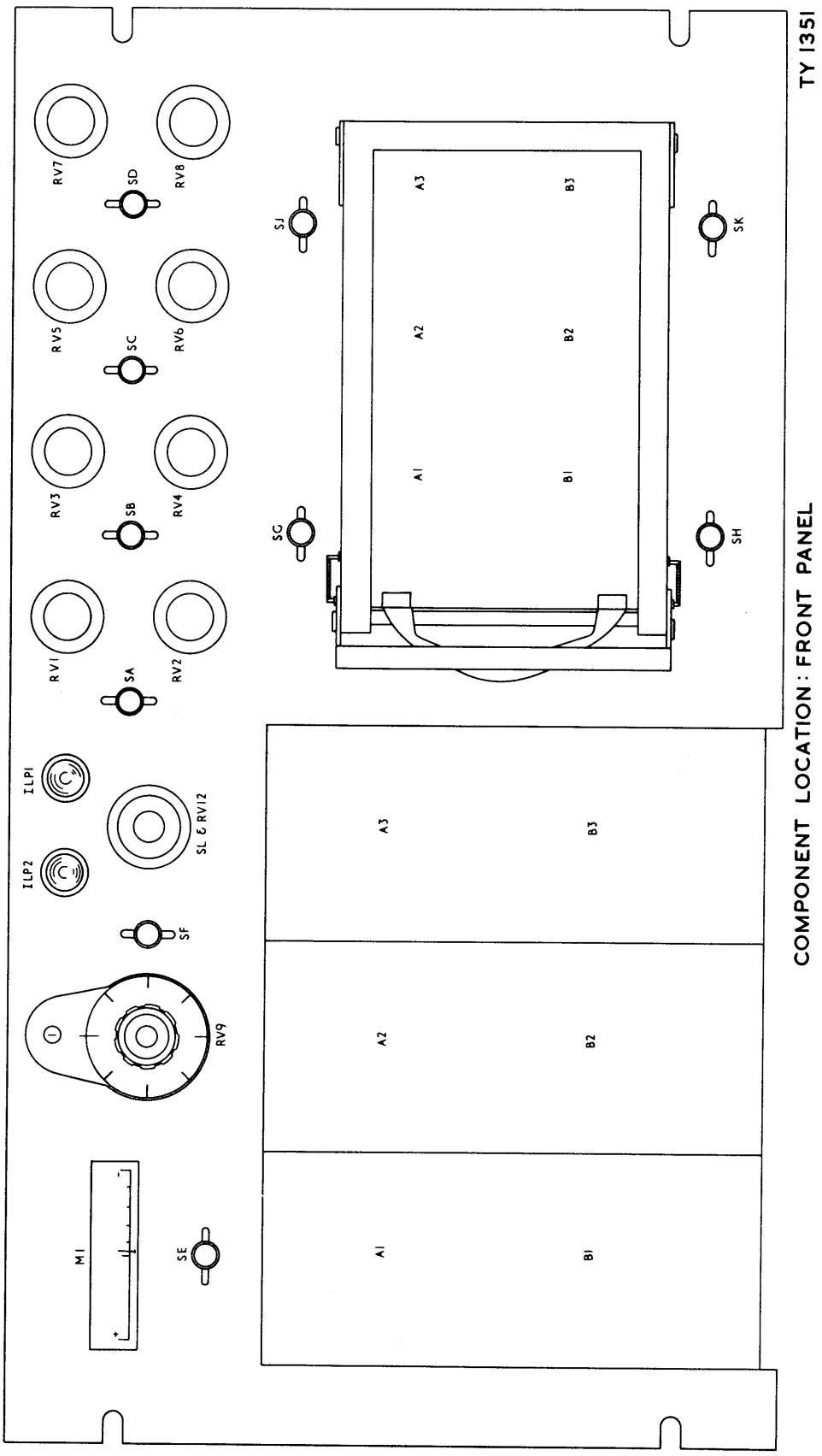


Fig. 1 - Component Location : Front Panel

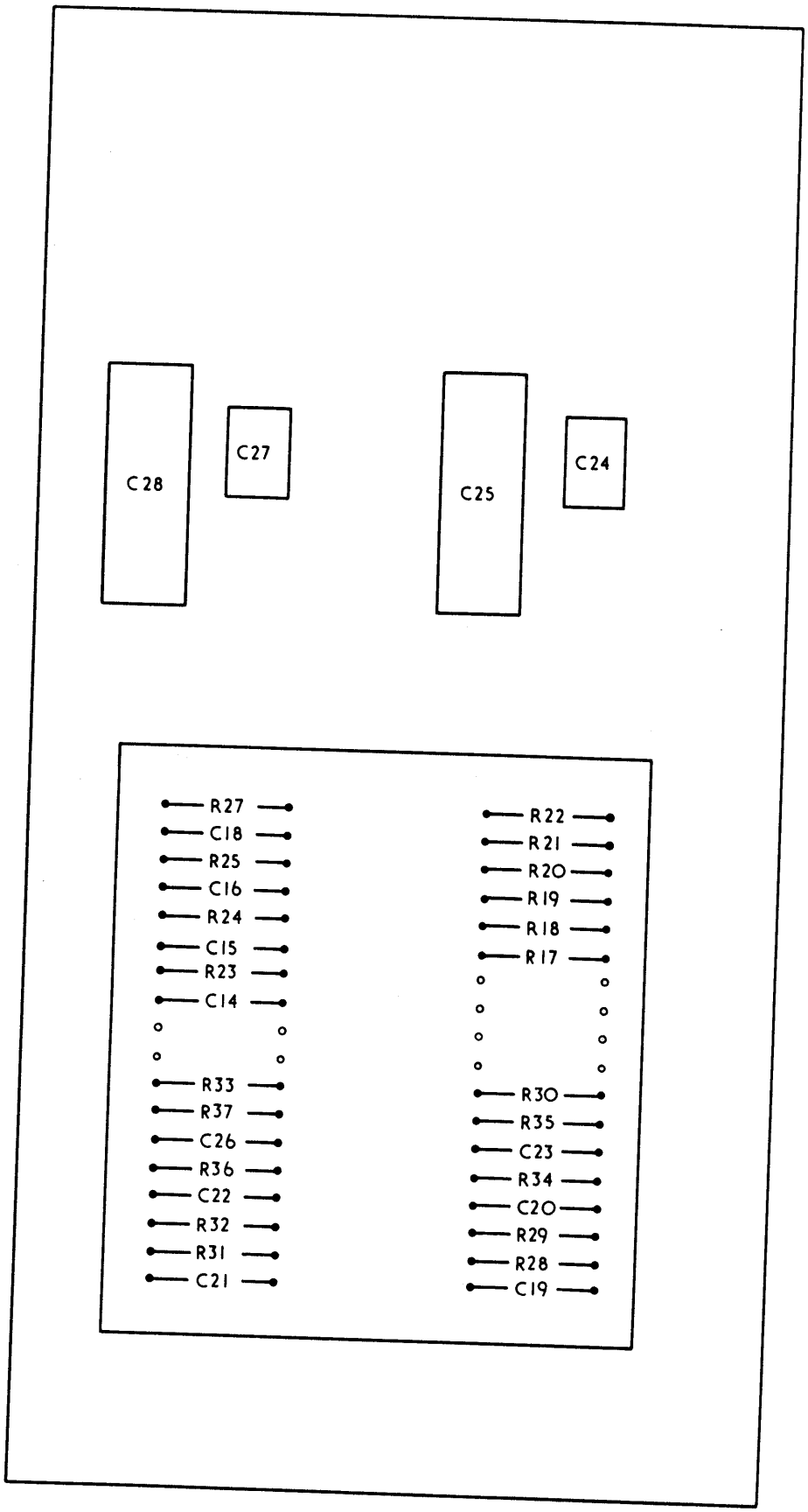


Fig. 2 - Component Location : Right-hand Side Panel

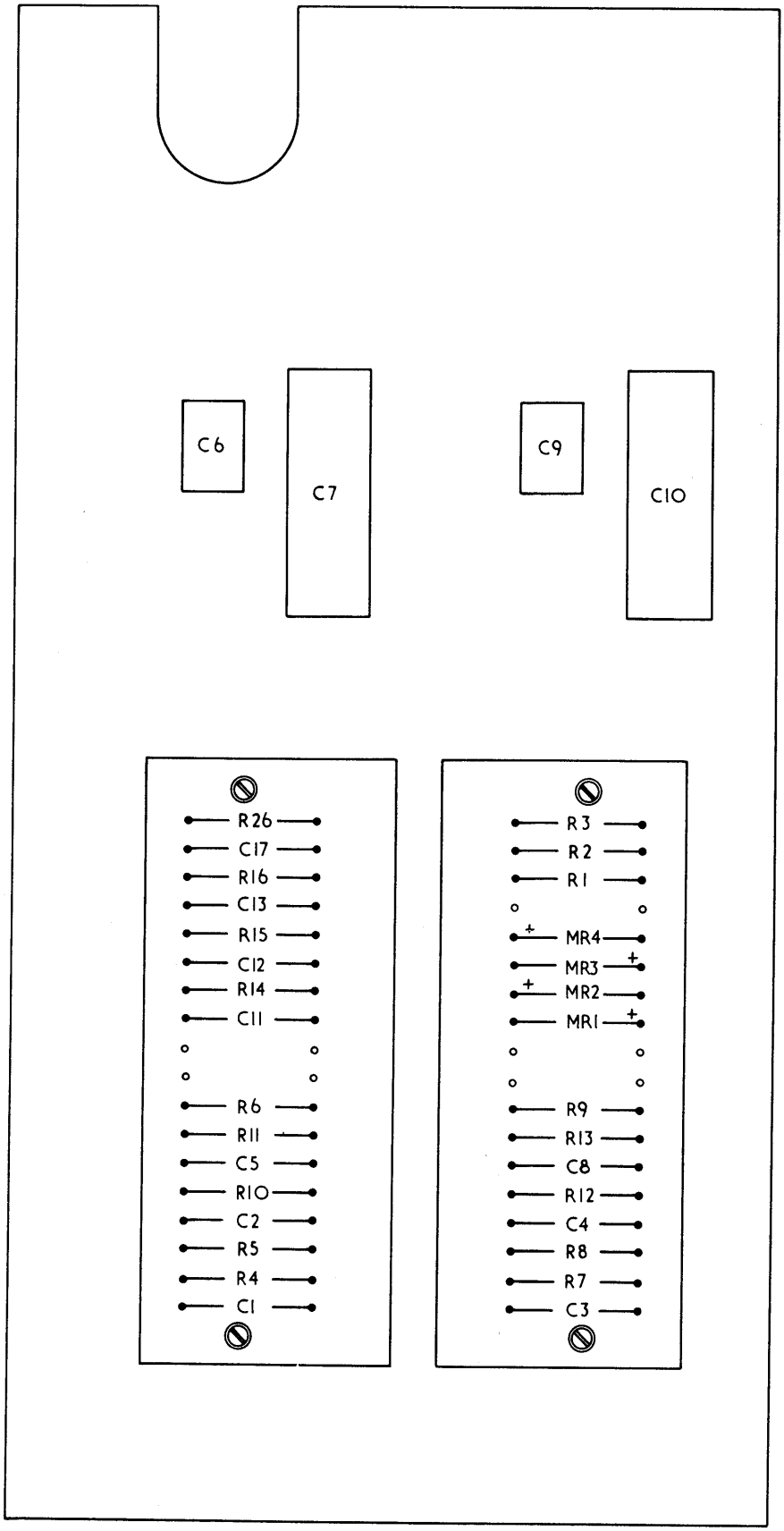


Fig. 3 - Component Location : Left-hand Side Panel

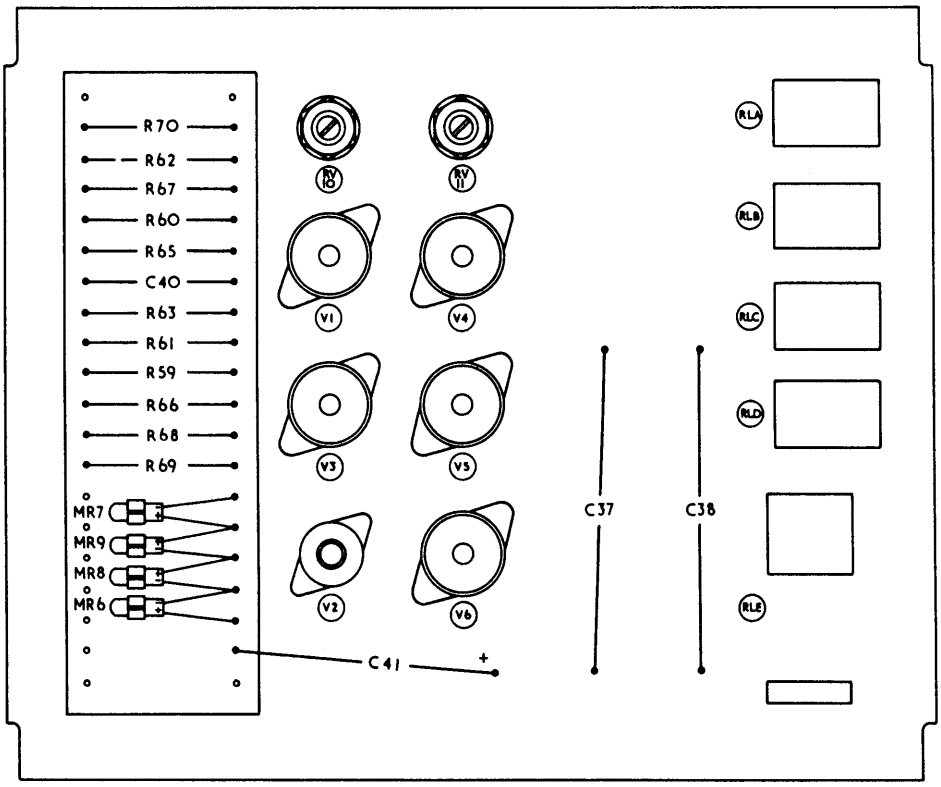


Fig. 4 - Component Location : Valve Chassis (Top View)

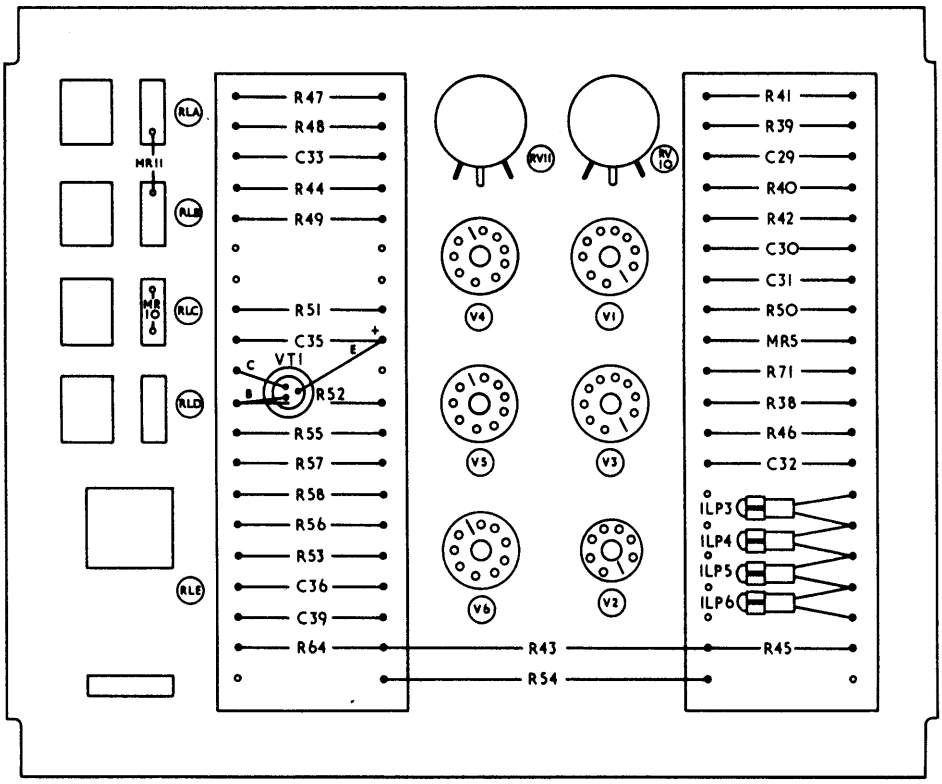


Fig. 5 - Component Location : Valve Chassis (Underside View)

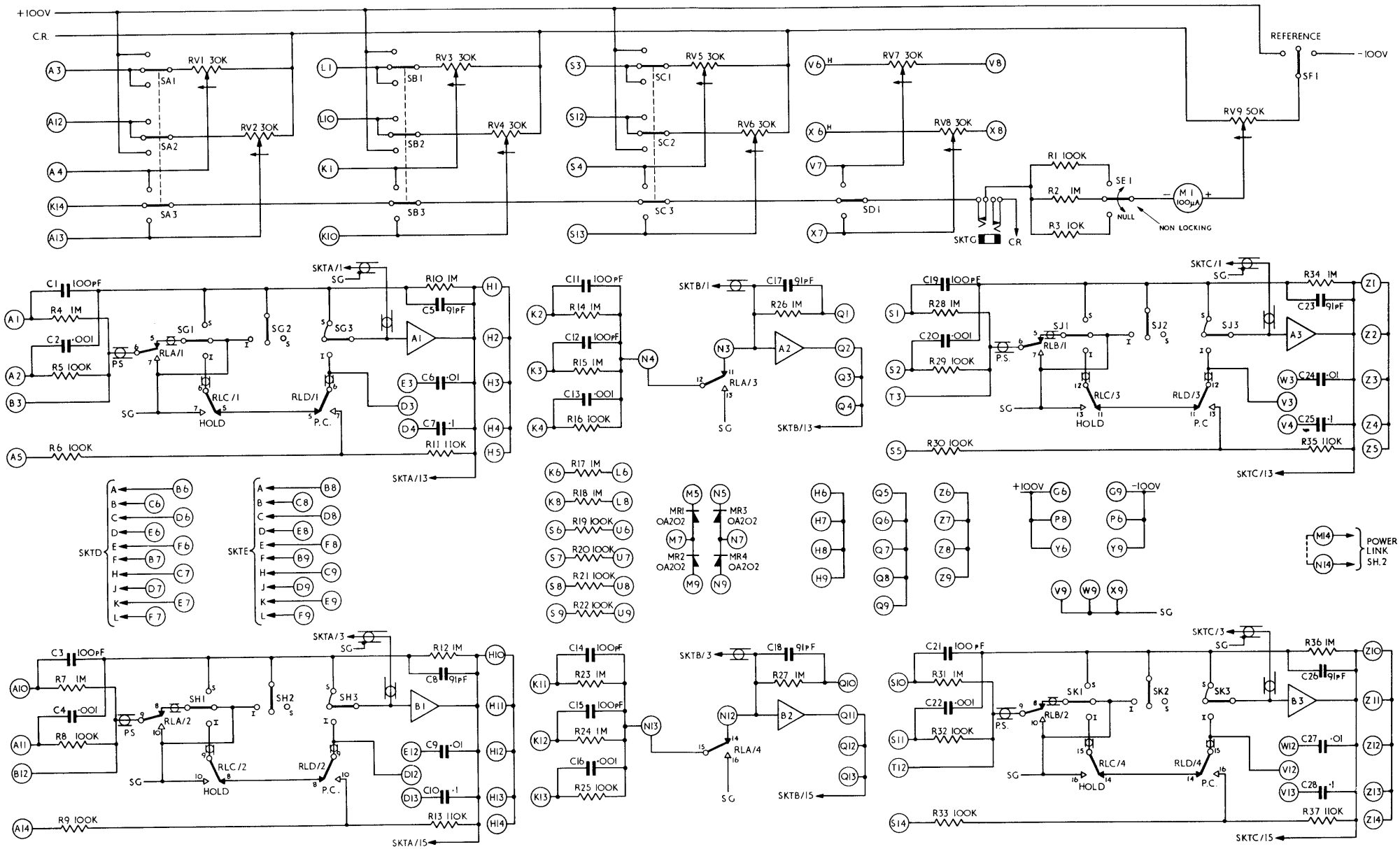


Fig. 6 - Circuit Diagram (Sheet 1) : Analogue Tutor II

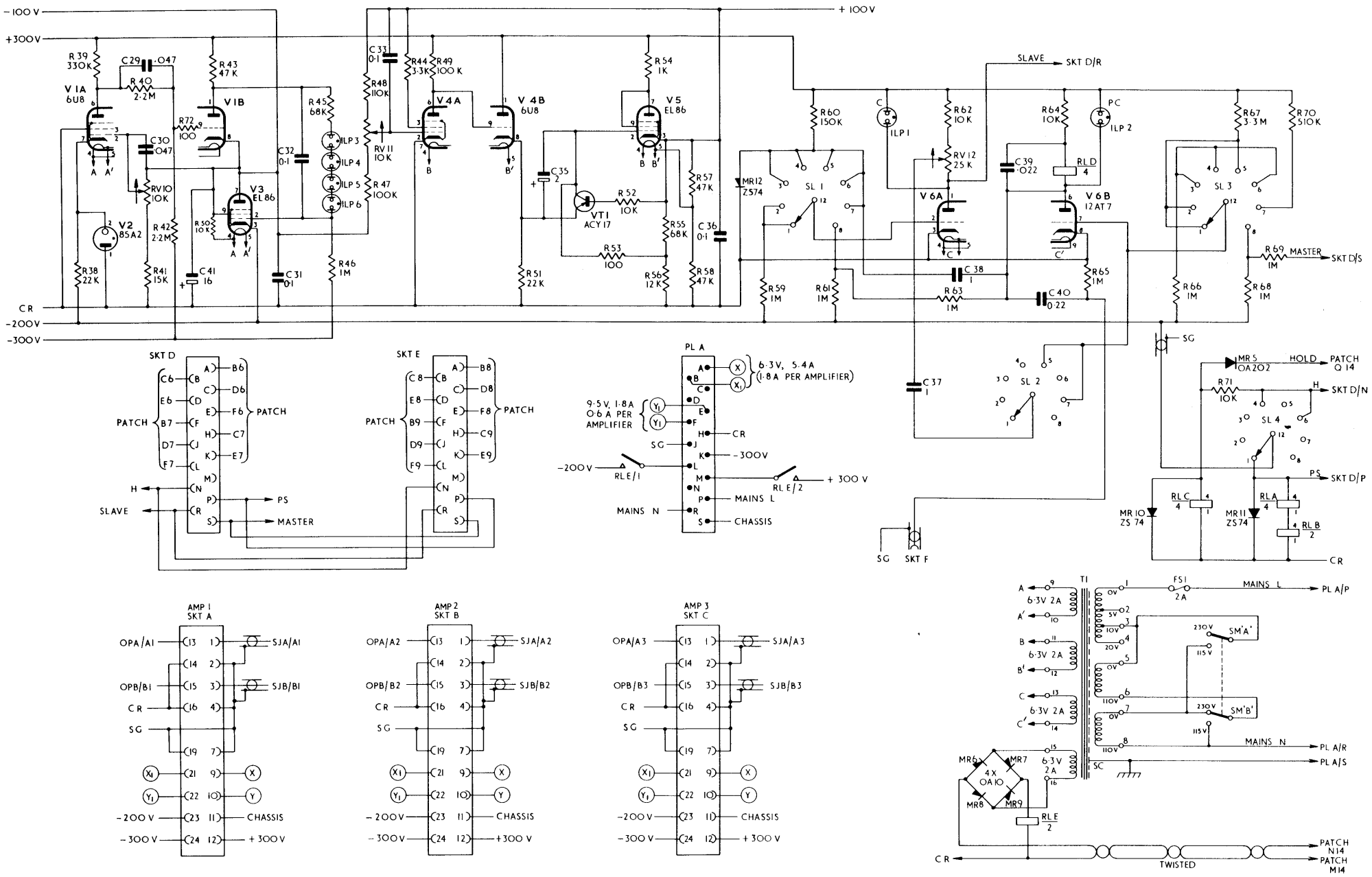


Fig. 7 - Circuit Diagram (Sheet 2) : Analogue Tutor II

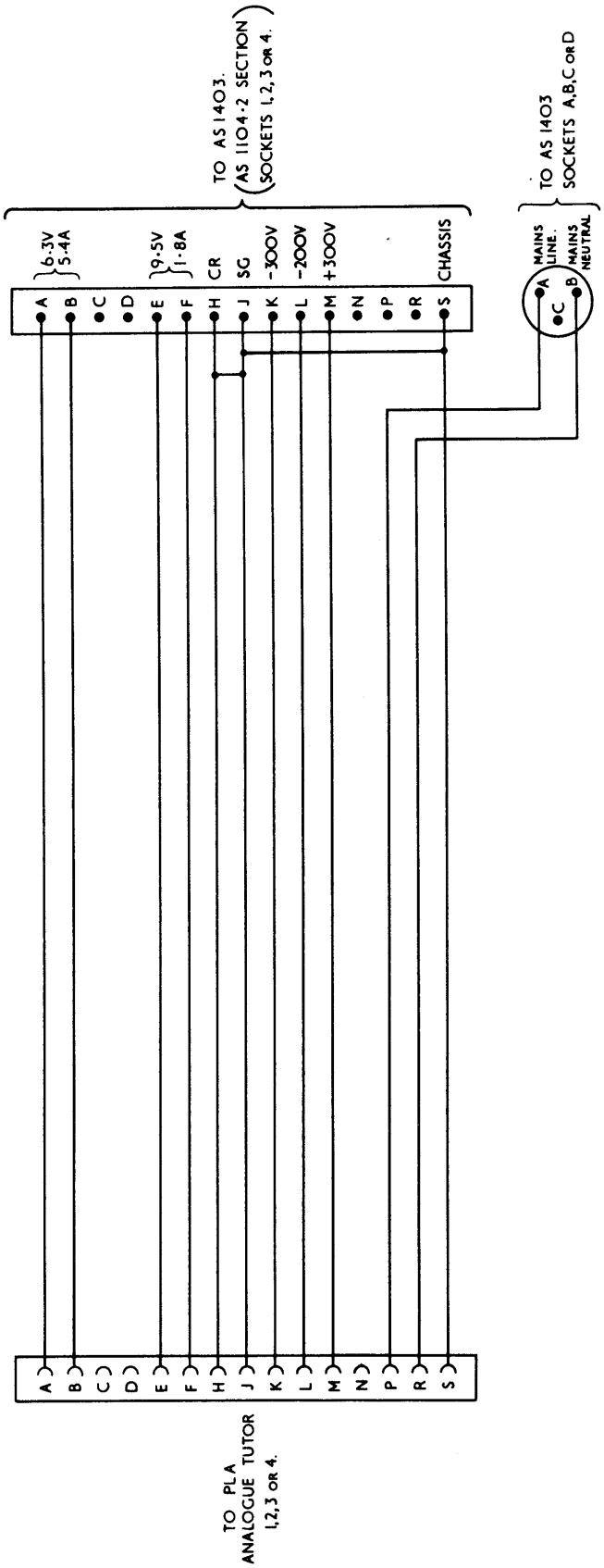


Fig. 8 - Inter-connecting Cable : Analogue Tutor II to Analogue Tutor II

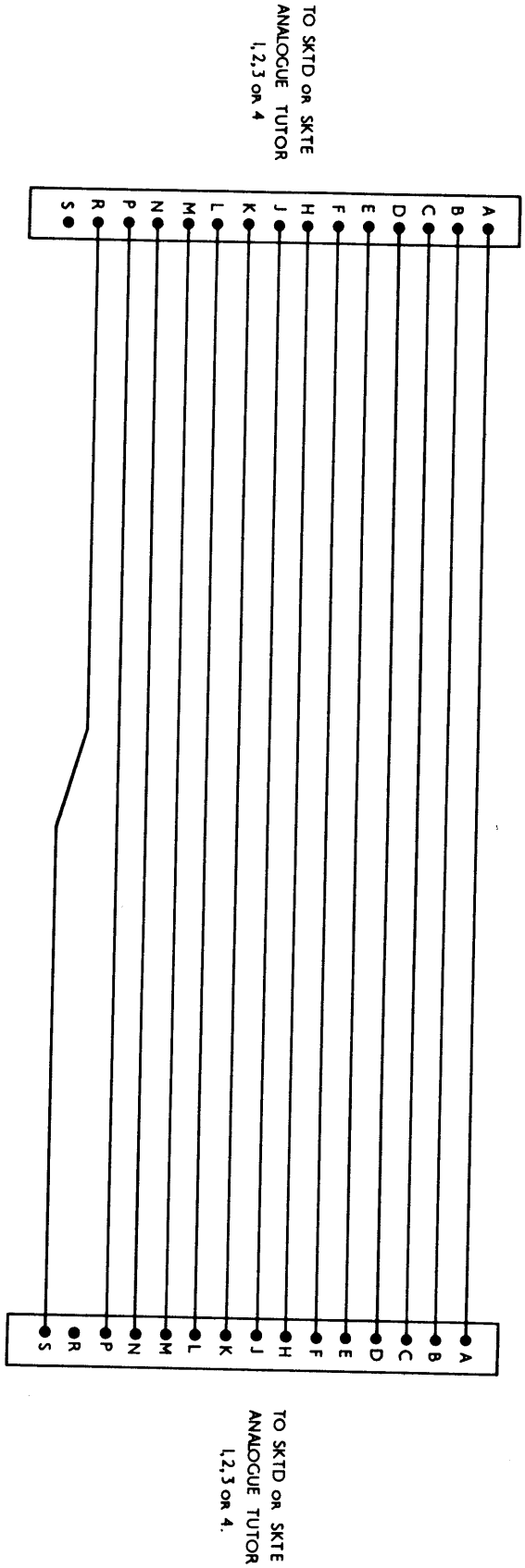


Fig. 9 - Inter-connecting Cable : Analogue Tutor II to AS1403 Power Supply Unit

APPENDIX A

Technical Manual : Dual Operational Amplifier
Type AA1054.2 and Amplifier
Mounting Unit Type TX1055.2