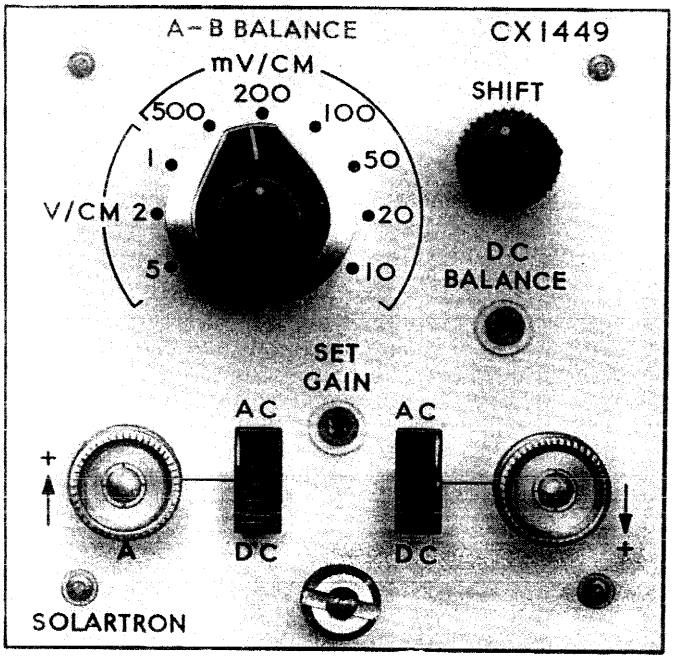
WIDE BAND DIFFERENTIAL Y-AMPLIFIER SUB-UNIT CX 1449 (CD 1400 SERIES)



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SECTION 1

GENERAL

1.1 Introduction

The CX1449 Wide Band Differential 'Y' Amplifier is a plug-in sub-unit used with the CD 1400 Oscilloscope system for examining low-level wide band signals in the presence of large in-Phase signals. It consists of a four-stage wide band balanced amplifier preceeded by an input attenuator. The input stage has an A - B balance control to optimise the common mode rejection.

1.2 Specification

Bandwidth Better than DC - 10Mc/s (-3dB) on all calibrated ranges

Rise Time: <35n sec.

Pulse Response: <2% overshoot

Sensitivity: 10mV/cm to 5V/cm covered by 9 calibrated ranges in 1, 2, 5 steps. A preset gain control, accessible from the front panel has a range of 4:1 giving sensitivities down to 20V/cm. It is used to set up the amplifier gain for correct calibration.

Common mode rejection:
10mV/cm range. 2500:1, d.c. - 50kHz reducing to 100:1 at 10MHz
Other ranges: 2500:1, d.c. - 1kHz
Note: The specified degree of rejection is realised only when both input selectors are set to D.C.

Input: Impedance - approximately 35pF and 1MΩ each side to earth.

Condition - switched choice of d.c. or a.c. (via 0.1 μFd) coupling.

Maximum voltage 400V Peak (on AC input)

Maximum d.c. in-phase signal is 5 volts on the 10mV/cm range, increasing pro-rata to 100 volts on the 200mV/cm range. Above this, 160V d.c. is the maximum that can be tolerated.

Measuring Accuracy: ± 5%.

Shift: Approximately two screen diameters on all ranges.

Overall dimensions and weight:

Height	8.2cms	$3\frac{1}{4}$"
Width	8.2cms	$3\frac{1}{4}$"
Depth	28.3cms	$11\frac{1}{2}$"
Weight	1kg.	2 lbs.

SECTION 2

OPERATION

2.1 Installation

Insert the CX1449 sub-unit into either of the left-hand positions of the CD1400 main frame unit. Engage thread of captive securing screw, and drive sub-unit fully home by turning screw in a clockwise direction.

Cautions:

(1) Do not operate the instrument when it is standing on its back or on either side. Short-term operation in these positions is permissible for servicing purposes.
(2) Always switch-off the instrument before removing any plug-in unit.
(3) Do not operate the instrument for long periods of time with any plug-in unit removed.
(4) Do not restrict the ventilation by placing other equipment or articles on top of the instrument.

2.2 Panel Controls

Input A (SKTA)/Input B (SKTB): Two 83 UHF co-axial sockets for balanced signal input.

Input Condition Selecter (SC. SB) Two single pole on-off switches for choice of DC or AC signal coupling on A and B inputs.

Range Selector (SA): A nine position switch giving calibrated control of the Y amplifier sensitivity between 10mV/cm and 5V/cm in 1, 2, 5 sequence.

Set Gain (RV3): A preset screwdriver-adjusted variable resistor giving control of amplifier gain for calibration purposes.

D. C. Balance (RV2): A preset screwdriver adjusted potentiometer for setting the DC balance of the amplifier.

A-B Balance (RV5): A potentiometer for balancing the gain of the two input amplifier channels to give best common mode rejection.

Shift Control (RV1): A potentiometer controlling the trace position on the vertical axis.

2.3 Operating Instructions

General: The operating instructions which now follow assume that the CX1449 is fitted in a CD1400 main frame with a suitable time-base unit installed and that the controls have been adjusted to provide two satisfactory traces.

D. C. Balancing Procedure: Apply power to the CD 1400 main frame unit, switch on and allow a suitable warming up period. Set the RANGE SELECTOR switch SA to 5V/cm, Input condition (SC, SB) to DC. Set the SHIFT control to mid-traverse then adjust the DC balance control to set the trace to its electrical centre on the CRT graticule (0.5 cms above centre line for Y1, and 0.5 cms below centre line for Y2).

A-B Balancing Procedure:
Feed an identical in-phase signal of 5 volts at 1kHz into the A and B input sockets. Adjust the A - B BALANCE control for minimum trace deflection, which should not exceed 2mm on the 10mV/cm range. This procedure must be carried-out with a suitable signal level on any range before it is used in order to obtain maximum common mode rejection. On the 10mV/cm range only, the A - B Balance control may be adjusted to obtain 2500 : 1 rejection up to 50kHz, and 100 : 1 rejection up to 10MHz.

Calibration: Set the RANGE selector switch SA to 100mV/cm and connect input A to the system 500mV calibrator. Adjust the SET GAIN control for 5cms deflection. The trace calibration is now set up to ±2% accuracy on that range, and other ranges will be within ±5%.

Probe Adjustment:
(1) Connect probe leads to both input sockets ('A' and '-B') on the CX1449 sub-unit.
(2) Set the RANGE selector (SA) to '2V/cm' and the INPUT CONDITION selector (SC and SB) to AC.
(3) On the X sub-unit set the TIME/CM control to '500 sec' and set the time base to FREE-RUNNING.
(4) Insert probe tips in turn, into PROBE TEST socket mounted in lower left-hand corner of the X sub-unit (CX1443) front panel.
(5) Adjust pre-set variable capacitor in probe for optimum square-wave response of the trace displayed.
(6) Insert both probe tips together into the PROBE TEST socket and adjust the A - B balance control for optimum in-phase rejection.

2.4 Operational Notes

The Wide band differential amplifier is intended for examining signal waveforms superimposed on large common mode (in-phase) signals.
A typical example of this application would be the examination of the signal existing between the two sides of a differential amplifier, or across a transistor.
The A - B balance control is provided to compensate for differences in transmission through the two sides of the input attenuator and input amplifier. It is essential of maximum common mode rejection is required, that this control be reset at a suitable signal level, on each range.
If attenuator probes are required to examine the signal these are set up as previously described. The A - B balance control should be reset including both probes in the transmission path.

Caution: The calibration of any CX1449 sub-unit is valid only so long as the module is operated in the same position in the identical CD1400 main frame unit in which the calibration was performed. If the CX1449 sub-unit is transferred to another CD1400 frame unit, or inter-changed between the upper and lower positions in the original CD1400 frame unit, the sub-unit must be recalibrated following the directions given in sub-paragraphs 'A - B Balancing Procedure,' and 'Calibration', preceeding.

SECTION 3

TECHNICAL DESCRIPTION

3.1 Physical Description

Mechanical:
The CX1449 sub-unit is constructed on a rigidly braced frame-work and provided with locating slots to ensure accurate alignment of the connecting plug with the mating socket mounted on the CD1400 main frame unit. The control panel is faced with Melamine laminate material, and the sub-unit captive securing screw is drilled to accept a 4mm banana plug for the purpose of earth connection.

Electrical:
The power and signal connections to the sub-unit are applied via an 18-way plug PLA. The pin assignments for this connector are listed in Table 1, and a

sketch showing the position of the pins on the plug is given in the circuit diagram

TABLE 1
Pin Assignments CX1499 Connector PLA

PLA Pin No.	Function
1	No connection
2	No connection
3	-50V rail, decoupled
x 4	+360V rail, direct off reservoir capacitor
5	-56V rail, direct off reservoir capacitor
6	+320V rail, decoupled
7	Chassis, zero volts
x 8	+7.5V rail
x 9	-7.5V rail
10	-16V d.c. heater supply
x 11	6.3V, 3.5A, a.c. heater supply
x 12	
13	6.3V, 2.5A, a.c. heater supply floating at 200 volts above earth.
14	
15	Trigger signal to X sub-unit
16	
17	Balanced drive to c.r.t. Y plates
18	

NOTE: The supplies appearing at pins marked with an asterisk (x) are not used on the CX1449 sub-unit.

3.2 Circuit Description

General:

The CX1449 circuit employs a balanced nine-stage attenuator followed by four balanced stages of amplification. Of these, the first and last use valves, while the second and third use transistors. This method gives the most efficient use of the available supply potentials.

Input Attenuator

The input attenuator is built in two identical halves, one for input A and one for input B. The attenuator switches are mounted on a common spindle with one front panel control. Each attenuator is itself in two sections, one giving decade switching and the other controlling the 1, 2, 5 sequence. Very thorough screening is employed between sections of the attenuator to minimise stray coupling which would otherwise distort pulse wave shapes. For the purpose of this description, only the Input A attenuator will be described. The input B attenuator is electrically identical. Signal is applied at the input A socket and, on a.c. coupled operation, routed to the attenuator through C1. On d.c. coupled working, SC is closed to by-pass C1. R1, R2, R3, R4 and R5 damp out any 'ringing' which might occur in connecting leads under the influence of fast positive and negative-going edges. Capacitor compensated resistive attenuators are used in all sections.

The first section of the attenuator gives decade attenuation of unity, one tenth, or one-hundredth. On the 1, 2, and 5V/cm ranges, the basic attenuation is 100:1 effected by R8 and R9 with capacitive compensation provided by C5 and C7. C6 is provided to set the input capacity on this range to be identical with that on the 10mV/cm range. On the 100, 200, and 500mV/cm ranges, the basic attenuation is 10:1 effected by R6 and R7 with capacitive compensation provided by C2 and C4. C3 sets the input capacity on this range to be identical with that on the 10mV/cm range. On the 10, 20, and 50mV ranges, there is no attenuation.

The second section of the attenuator divides by 1, 2, and 5, to give the intermediate steps in each decade. On the 5V, 500mV and 50mV ranges, attenuation is effected by R12 and R13 with C11 providing capacitive compensation. C12 sets the input capacitance on these ranges to be identical with that on the 10mV range. On the 2V, 200mV and 20mV ranges, attenuation is effected by R10 and R11, with C8 and C10 providing capacitive compensation. C9 sets the input capacitance on these ranges to be identical with that on the 10mV range. On the 1V, 100mV and 10mV ranges, there is no attenuation from this section. The two attenuator sections operate in cascade to provide the nine required levels of attenuation.

The input amplifier consists of a cathode-coupled differential amplifier with cathode follower input. The two halves of a double triode V1 (ECC88) are used as cathode followers operating between a potential of approximately 100V and -50V. Signals from the input attenuator are fed through the resistors R96 and R97 to the grids of V1. The resistors, which are by-passed for AC by C48 and C49, limit the grid current from V1 on excessive positive signals.

The outputs from the cathodes of V1 are fed to the grids of V2 (ECC88) through the buffer impedances R34 and R41. These resistors, which are by-passed for AC by C26 and C27, provide the resistance across which the shift and d.c. balance voltages are developed. The cathode resistors of V2 and R37 and R38, while RV3 connected between the two cathodes provides gain control for the purpose of calibration. The transistor VT1 operates at constant current, thereby controlling the current drawn by V2. This acts like a very high cathode resistor to improve greatly the Common Mode rejection of the amplifier.

Second and Third Amplifiers:
The anodes of V2 are connected directly to the bases of VT2 and VT4 and are effectively virtual earths, due to the effects of negative feedback through R50 and R53. VT2 and VT5 form an emitter-coupled differential amplifier with negative feedback from collector to base. The output taken from the collectors, feeds the bases of VT3 and VT4, a second emitter-coupled differential amplifier. The emitters of this stage are coupled through the time constant R87, C30, RV6 which may be adjusted for optimum pulse response.

The Output Amplifier:
Output from the collectors of VT3 and VT4 feeds the bases of the emitter followers VT6 and VT7 which drive the input grids of the output amplifier V3 and V4. These two double triodes are connected as a differential stacked amplifier, the most efficient configuration for driving current into the plate capacities of the cathode-ray tube. Negative feedback is taken from the output points back to the bases of the emitter followers VT6 and VT7 to improve gain stability and to set the mean plate potential to 225V. Each feedback path is provided with two time constants which are adjusted for optimum pulse response.

Heater Supplies:
The Heaters for V3 and V4 are supplied from a 6.3V a.c. heater supply floating at 200V above earth. The Heaters for V1 and V2 are smoothed and stabilised by VT9 and VT10 from the -16V heater supply. VT10 is the series control element while VT9 is the control amplifier. It draws its collector current from the -56 volts rail through R86.

SECTION 4

MAINTENANCE

4.1 General Information

Removal of CX 1449 Sub-Unit:
(1) Turn captive securing screw in a counter-clockwise direction until screw thread is completely disengaged.

(2) Withdraw sub-unit from main frame by a direct pull on the captive screw.

Improved Access for Servicing Purposes:
The CX1449 sub-unit may be operated outside the CD1400 Main Frame Unit to give improved access for maintenance. For this purpose, the sub-unit and main frame are coupled via an 18-way cable-form connected pin-for-pin between an 18-way free plug at one end, and an 18-way free socket at the other. (McMurdo types XP18 and XS18). A ready-made cableform is available as an optional extra.

Removal of Board mounted Components:
Defective wire-ended, board-mounted components should not be unsoldered from the printed-circuit. Instead, the defective component must be detached from the board by severing the connecting wires at those points where they enter the body of the component. The replacement component is then soldered to the residual wire stubs, and the original soldered joint to the printed-circuit is thus left intact. This method of replacement cannot be applied to tag-mounting capacitors, which must be unsoldered from the printed-circuit to enable the fixing tag to be straightened-out prior to capacitor removal.

4.2 Setting-up and Test Procedure

General: The following procedure is basically the production test to which all CX1449 Sub-Units are subjected prior to despatch. It is given to enable the user to confirm the performance of the sub-unit and to make any adjustments that may be necessary.

Test Equipment Required:
The following items of test equipment will be required if the procedure is to be carried-out in its entirety. The type numbers of suitable Solartron instruments are given in brackets.

(1) Square wave (1kHz) generator 0-100V amplitude

(2) 2:1 Pad (see sub-para 'Input Attenuator', Section 4.)

(3) Avometer Model 8.

(4) Fast Rise Generator Cossor 1030.

(5) 10:1 Pad to suit (Attenuator Probe)

(6) Signal Generator (DO905)

(7) Monitor Oscilloscope (CD1400)

Preparatory

(1) Insert the CX1449 Sub-Unit under test into Y1 left-hand compartment of a tested CD1400 Main Frame Unit, fitted with an operationally sound time-base/X amplifier sub-unit. A serviceable Y amplifier must be inserted in the vacant left-hand compartment of the CD1400.

(2) Set the listed controls in accordance with the directions given:-

RV4 anti-clockwise
RV3 fully clockwise
All others mid way
Attenuator at 10mV/cm
AC/DC switches at DC

(3) Adjust RV4 so that voltage emitter to ground of VT10 is -12.6V (T.P.)

(4) Check rails PLA, Pin 3, -47V (T.P.)
Pin 6, +320V
Top of C51 approximately +100V
Top of C33 approximately 20V with respect to top of C51.
All with respect to earth, except where stated.

Centralise trace with DC Balance Control, with shift set mid-way.

(5) Inject 20mV of 1Kc/s square wave into "A" socket. Check that more than 2cm of deflection appears.

(6) Vary "Set Gain" control RV3. Check that at least 4:1 variation of gain occurs. (i.e., 2cm of picture can be reduced to less than 0.5cm). Return to 2cm.

(7) Check the operation of the AC/DC switch.

(8) Inject signal into "B" socket, check operation of AC/DC switch.

(9) Check operation of SHIFT and DC BALANCE CONTROLS.

(10) Inject Fast Rise Generator via 10:1 pad. Set 5 cms of picture.

(11) Observe cathodes of V4A, V3A. (Output leads - junction of R72, R90 and R77, R91) (TP) with a dual trace monitor oscilloscope using probes. Adjust C38 and C35 for a flat top on one and flat bottom on other, on pulse response. Remove monitor oscilloscope.

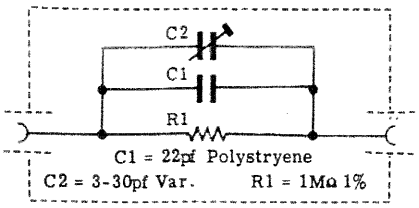
(12) Adjustment of C36, C37 and RV6, will now give optimum pulse response, coupled with fastest edge. RV6 affects the 'corner', and C36, C37 the edge. This is observed on C.R.T. screen.

(13) Remove 'fast rise' from 'A', and inject into 'B'. Check that pulse response is the same, but inverted. Check that variation of SHIFT does not alter pulse response.

(14) Check bandwidth. Inject a signal from the DO 905. Set 5 cms of 50kHz sinewave using 10:1 pad. Increase frequency until picture decreases to 3.5 cms. Check that this is at least 10MHz.

(15) Set up attenuator, using 10kHz square wave. Inject into 'A' the signals listed in the following table and adjust the relevant capacitor for best square wave response.

(16) Make simple 2:1 attenuator pad as shown. Inject signal of 50mV through this pad to input on 10mV range, adjust capacitor on pad for best square wave. Using same pad, inject 500mV and 5V on the 100mV and 1V ranges respectively. Adjust C3 and C6 for best square wave.



(17) Transfer input to 'B' attenuator. Repeat as above except using trimmers in the following order: C21, C24, C15, C18, C22, C25, C16, C19.

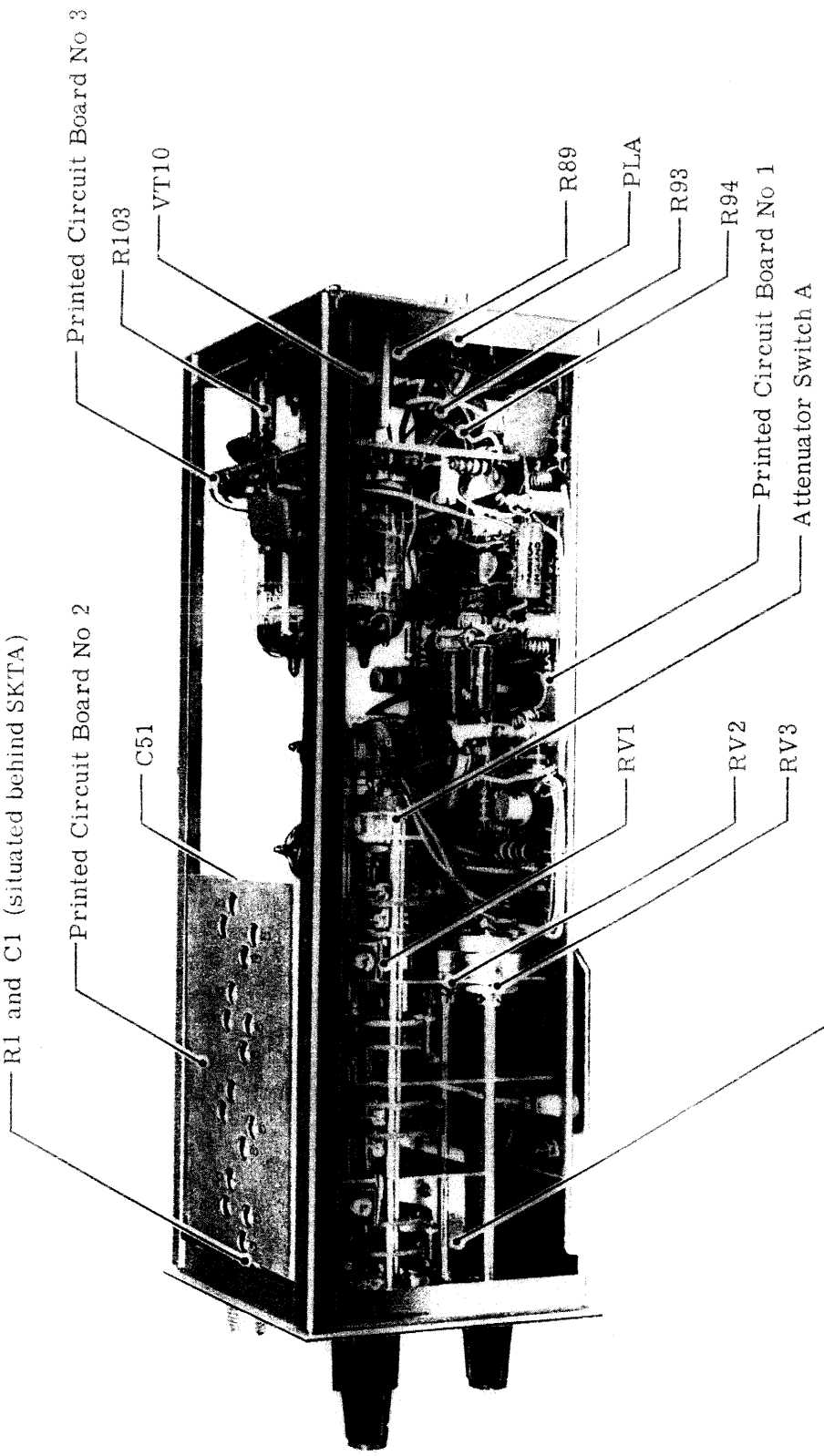
(18) With input sockets open, check that hum level is less than 2mm.

(19) Check in-phase rejection. Set attenuator to 5V/cm and inject a 1kHz sine wave of 400V p-p amplitude into both A and B inputs via a Tee piece and balanced lengths of co-axial feeder. Adjust A - B Balance Control RV5 for a minimum trace amplitude of less than 2mm (Slight adjustment of DC Balance Control RV2 may be necessary to achieve this). Repeat the above procedure on 2V/cm and 1V/cm ranges. Check remaining ranges as listed (slight re-adjustment of the appropriate trimmers, as listed in para. 15, may be required to meet the specification)

Range	Input Voltage P-P	Max Trace Amplitude
500mV/cm	250V	2mm
200mV/cm	100V	2mm
100mV/cm	50V	2mm
50mV/cm	25V	2mm
20mV/cm	10V	2mm
10mV/cm	5V	2mm

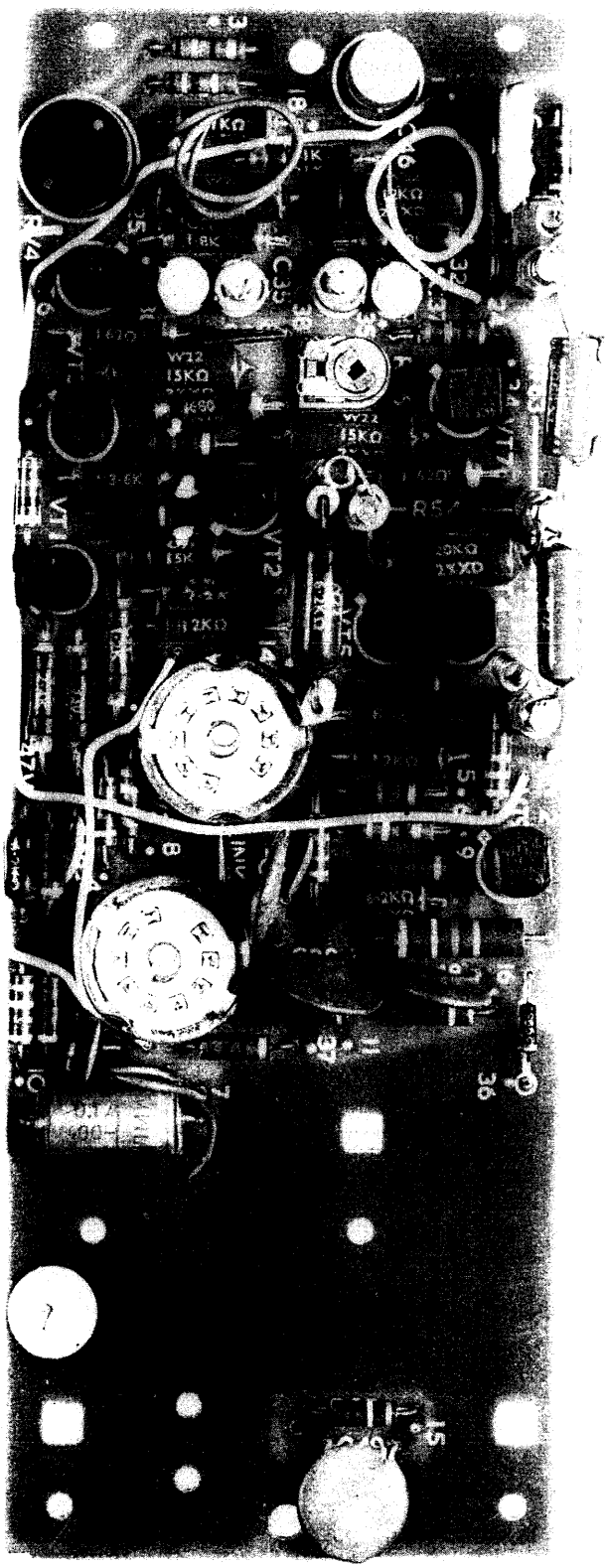
On 10mV range only, repeat at 50kHz with 5V p-p input and check amplitude is not greater than 2mm. With an input of 5V p-p at 10MHz check that amplitude is not greater than 5cm.

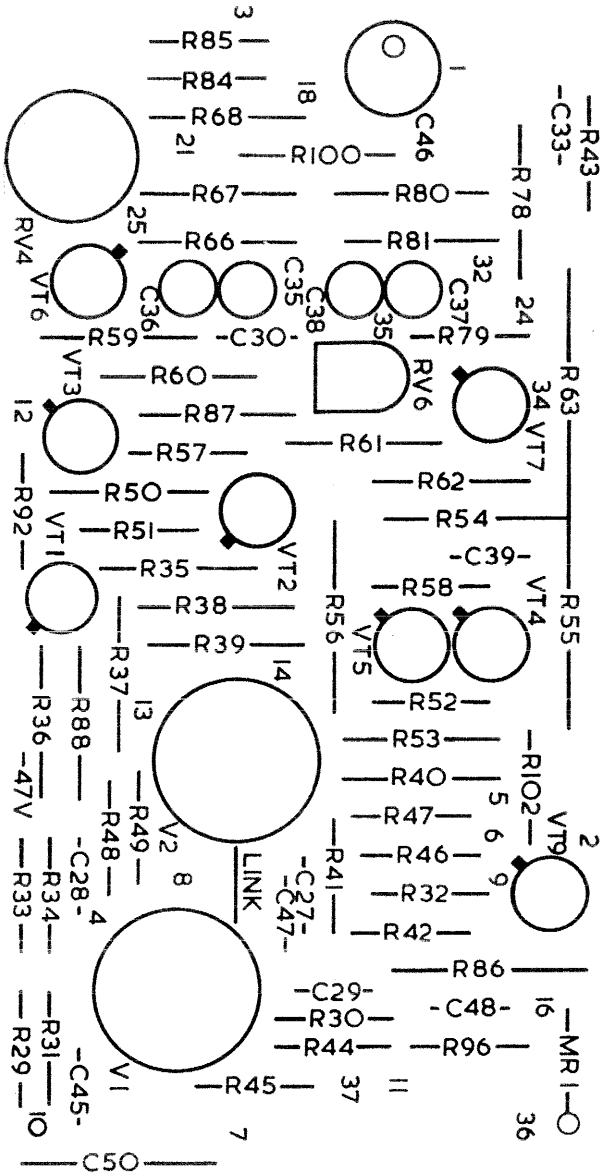
COMPONENT LAYOUT DIAGRAMS
for
Main Frame Assembly



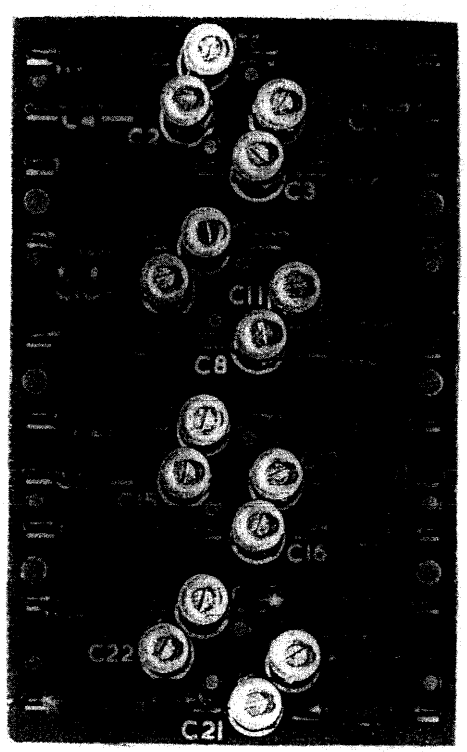
NOTE. For front panel component layout see circuit diagram.

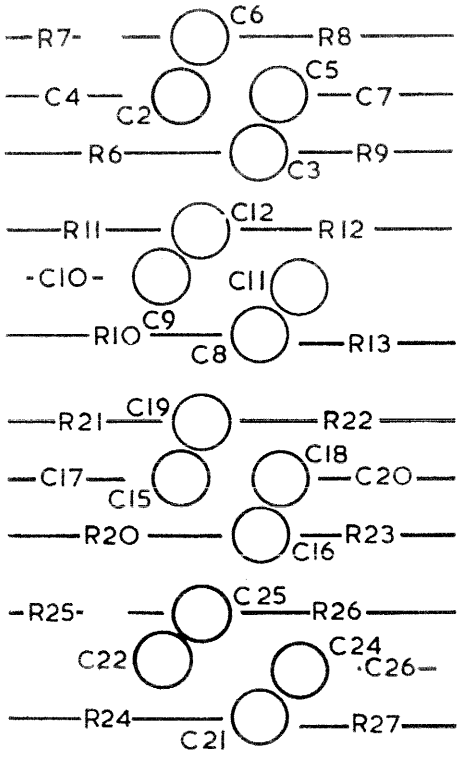
COMPONENT LAYOUT DIAGRAM
for
Printed Circuit Board No 1





COMPONENT LAYOUT DIAGRAM
for
Printed Circuit Board No 2





COMPONENT LAYOUT DIAGRAM
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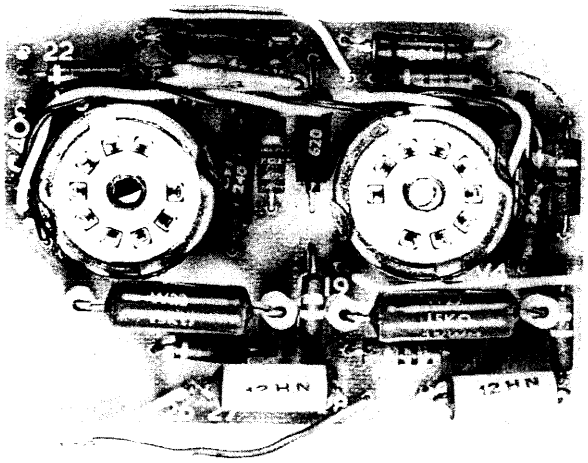
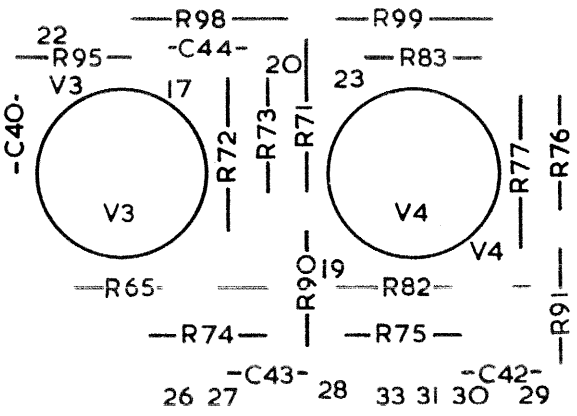
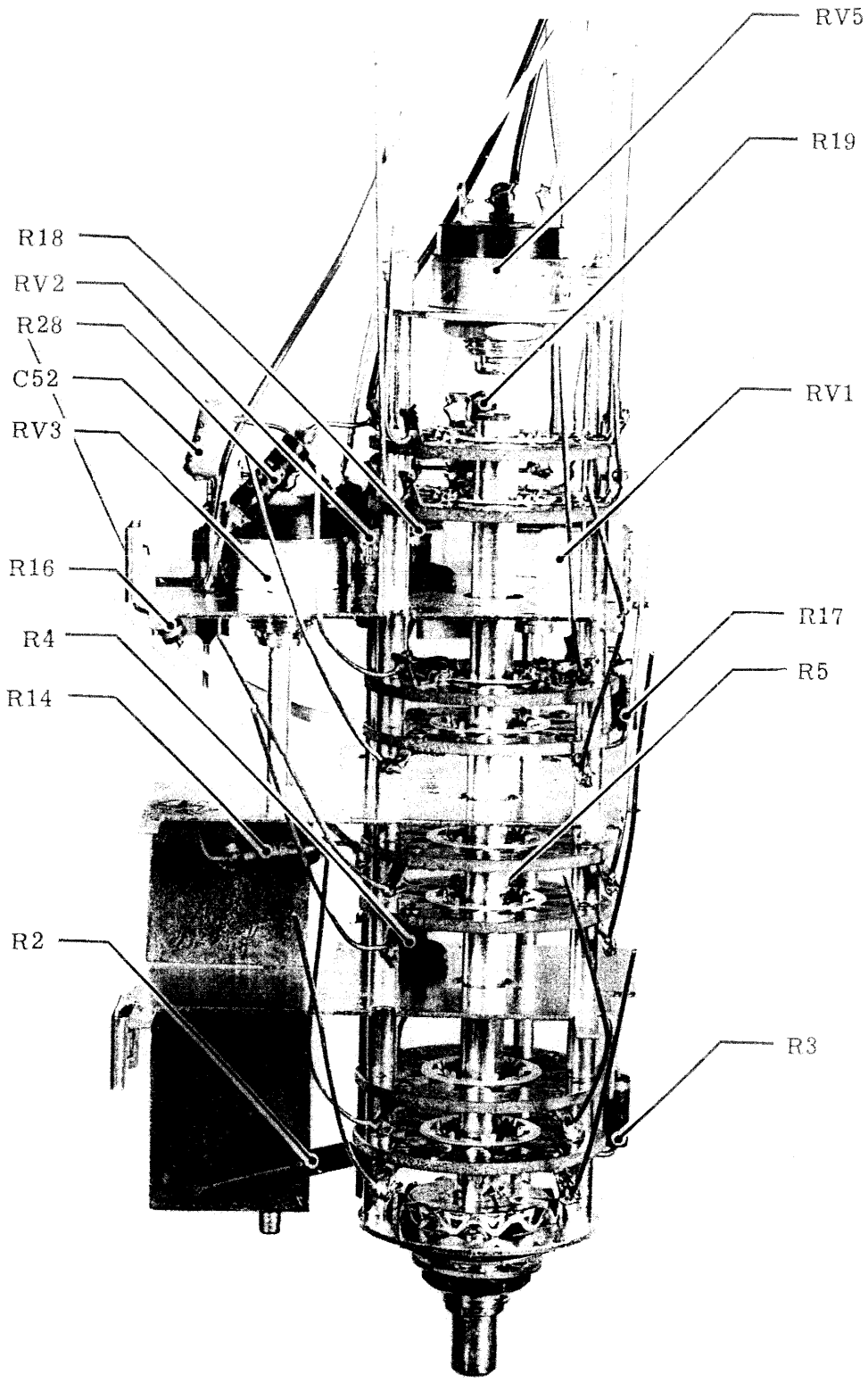




COMPONENT LAYOUT DIAGRAM
for
Attenuator Switch A



COMPONENT PARTS LIST
Abbreviations

Circuit References

R	Fixed Resistor (Ω)
RV	Resistor Variable (Ω)
C	Capacitor (μF)
VT	Transistor
MR	Diode
V	Valve
S	Switch
PL	Plug
SKT	Socket

Component

W	Resistor Composition, Insulated Tolerance < 5%
X	Resistor Composition, Insulated Tolerance> 5%
Y	Resistor Wire Wound, Vetreous
Z	Resistor Oxide Film, Insulated Tolerance> 5%
Ce	Ceramic
Ce Var	Ceramic Variable
El	Electrolytic
M. Po	Metalised Polyester
Pe	Polystyrene

COMPONENT PARTS LIST
for
Main Frame Assembly

Cct. Ref.		General Description			Solartron Part No.
R1	X	10	¼W	10%	172311000
R15	X	10	¼W	10%	172311000
R89	X	270	½W	10%	172522700
R93	X	10	¼W	10%	172311000
R94	X	10	¼W	10%	172311000
R103	Y	6800	6W	5%	173736800
RV1	X	1M	¼W	20%	110012970
RV2	X	1M	¼W	20%	110012970
RV3	X	2500	¼W	20%	110012980
C1	M. Po	0.1	400V	2%	220651000
C14	M. Po	0.1	400V	2%	220651000
C51	El.	12	200V	-20% +50%	208600010
VT10	T13027		Philco		300552630
SB	Slider D. P. C. O. Diamond H. Controls Ltd. Oaktype 278				375000340
SC	Slider D. P. C. O. Diamond H. Controls Ltd. Oaktype 278				375000340
PLA	Fixed 18 Way. McMurdo XP18				352318030
SKTA	Fixed 1 Way. Greenpar GE 40010.				352101170
SKTB	Fixed 1 Way. Greenpar GE 40010.				352101170

COMPONENT PARTS LIST
for
Printed Circuit Board No.1

Cct. Ref.		General Description			Solartron Part No.
R29	X	3300	¼W	10%	172333300
R30	X	3300	¼W	10%	172333300
R31	X	100	¼W	10%	172321000
R32	X	10	¼W	10%	172311000
R33	Y	6200	2½W	2%	160200056
R34	X	6800	¼W	10%	172336800
R35	W	15K	¼W	1%	170441500
R36	W	2400	¼W	1%	170432400
R37	W	1200	¼W	1%	170431200
R38	W	1200	¼W	1%	170431200
R39	W	2000	¼W	1%	170432000
R40	W	2000	¼W	1%	170432000
R41	X	6800	¼W	10%	172336800
R42	Y	6200	2½W	2%	160200056
R43	X	22	¼W	10%	172312200
R44	X	100	¼W	10%	172321000
R45	X	10	¼W	10%	172311000
R46	X	3.9M	¼W	10%	172363900
R47	X	1.8M	¼W	10%	172361800
R48	X	1.8M	¼W	10%	172361800
R49	X	3.9M	¼W	10%	172363900
R50	W	3600	¼W	1%	170433600
R51	X	10	¼W	10%	172311000
R52	X	10	¼W	10%	172311000
R53	W	3600	¼W	1%	170433600
R54	Y	20K	6W	2%	160200059
R55	Y	20K	6W	2%	160200059
R56	Y	6200	6W	2%	160200058
R57	X	22	¼W	10%	172312200
R58	X	22	¼W	10%	172312200
R59	W	62	¼W	1%	170416200
R60	Y	15K	6W	2%	160200057
R61	Y	15K	6W	2%	160200057
R62	W	62	¼W	1%	170416200
R63	Y	8200	3W	1%	173638200
R66	W	1800	¼W	1%	170431800

R67	Y	12K	6W	2%	160200060
R68	W	1000	¼W	1%	170431000
R78	W	1000	¼W	1%	170431000
R79	X	22	¼W	10%	172312200
R80	Y	12K	6W	2%	160200060
R81	W	1800	¼W	1%	170431800
R84	X	180	¼W	10%	172321800
R85	X	180	¼W	10%	172321800
R86	X	3900	½W	10%	172533900
R87	W	680	¼W	1%	170426800
R88	W	330	¼W	1%	170423300
R92	X	22	¼W	10%	172312200
R96	X	100K	¼W	10%	172351000
R97	X	100K	¼W	10%	172351000
R100	W	5100	¼W	1%	170435100
R102	X	270K	¼W	10%	172352700
RV4		150	¼W	20%	110012050
RV6		100	⅛W	20%	110006280
C27	Ce.	0.01	30V	-20%	
				+80%	208450007
C28	Ce.	0.01	30V	-20%	
				+80%	208450007
C29	Ce.	0.01	500V	-20%	
				+80%	241041000
C30	Ce.	390pF	200V	5%	208450072
C33	Ce.	0.1	200V	-20%	
				+80%	208450017
C35	Ce. Var.	7/35pF	160V		290020270
C36	Ce. Var.	3.5/ 13pF	160V		290020250
C37	Ce. Var.	3.5/ 13pF	160V		290020250
C38	Ce. Var.	7/35pF	160V	-20%	
				+80%	290020270
C39	Ce.	0.01	500V	-20%	
				+80%	241041000
C45	Ce.	0.01	30V	-20%	
				+80%	208450007
C46	El.	25	25V	-20%	
				+100%	208600141
C47	Ce.	0.01	500V	-20%	
				+80%	241041000
C48	Ce.	0.01	500V	-20%	
				+80%	241041000
C49	Ce.	0.01	500V	-20%	
				+80%	241041000
C50	M. Po.	0.1	400V	10%	220851000
MR1	OAZ243		Mullard		300520170
V1	ECC88				300033120
V2	ECC88				300033120

VT1	2N3053	R. C. A.	300551800
VT2	A1672/2	SGS Fairchild	300551910
VT3	A1672/2	SGS Fairchild	300551910
VT4	A1672/2	SGS Fairchild	300551910
VT5	A1672/2	SGS Fairchild	300551910
VT6	BFY17	STaC	300551280
VT7	BFY17	STaC	300551280
VT9	2S302	Texas Inst.	300550630

COMPONENT PARTS LIST
for
Printed Circuit Board No.2

Cct. Ref.	General Description			Solartron Part No.
R6	W 900K	½W	1%	170759000
R7	W 111K	¼W	1%	170451110
R8	W 990K	½W	1%	170759900
R9	W 10.1K	¼W	1%	170441010
R10	W 500K	½W	1%	170755000
R11	W 1M	¼W	1%	170461000
R12	W 800K	½W	1%	170758000
R13	W 250K	¼W	1%	170452500
R20	W 900K	½W	1%	170759000
R21	W 111K	¼W	1%	170451110
R22	W 990K	½W	1%	170759900
R23	W 10.1K	¼W	1%	170441010
R24	W 500K	½W	1%	170755000
R25	W 1M	¼W	1%	170461000
R26	W 800K	½W	1%	170758000
R27	W 250K	¼W	1%	170452500
C2	Ce. Var. 3.5/ 13pF	160V		290020250
C3	Ce. Var. 3.5/ 13pF	160V		290020250
C4	Pe. 47pF	125V	2.5%	210114700
C5	Ce. Var. 3.5/ 13pF	160V		290020250
C6	Ce. Var. 3.5/ 13pF	160V		290020250
C7	Pe. 680pF	125V	2.5%	210126800
C8	Ce. Var. 3.5/ 13pF	160V		290020250
C9	Ce. Var. 2.5/ 6pF	160V		290020300
C10	Ce. 6.8pF	750V	±¼pF	240006801
C11	Ce. Var. 3.5/ 13pF	160V		290020250
C12	Ce. Var. 3.5/ 13pF	160V		290020250
C13	Ce. Var. 10pF	500V	10%	210511000

C15	Ce. Var.	3.5/13pF	160V		290020250
C16	Ce. Var.	3.5/13pF	160V		290020250
C17	Pe.	47pF	125V	2.5%	210114700
C18	Ce. Var.	3.5/13pF	160V		290020250
C19	Ce. Var.	3.5/13pF	160V		290020250
C20	Pe.	680pF	125V	2.5%	210126800
C21	Ce. Var.	3.5/13pF	160V		290020250
C22	Ce. Var.	2.5/6pF	160V		290020300
C24	Ce. Var.	3.5/13pF	160V		290020250
C25	Ce. Var.	2.5/6pF	160V		290020300
C26	Ce.	15pF	750V	10%	240111501

COMPONENT PARTS LIST
for
Printed Circuit Board No.3

Cct. Ref.		General Description			Solartron Part No.
R65	Z	15K	6W	2%	160200057
R71	W	620	¼W	1%	170426200
R72	W	240	¼W	1%	170422400
R73	X	22	¼W	10%	172312200
R74	X	10	¼W	10%	172311000
R75	X	10	¼W	10%	172311000
R76	X	22	¼W	10%	172312200
R77	W	240	¼W	1%	170422400
R82	Y	15K	6W	2%	160200057
R83	X	10	¼W	10%	172311000
R90	X	220K	¼W	10%	172352200
R91	X	220K	¼W	10%	172352200
R95	X	10	¼W	10%	172311000
R98	W	100	¼W	1%	170421000
R99	W	100	¼W	1%	170421000

C40	Ce.	0.01	500V	-20% +80%	241041000
C42	Ce.	12pF	750V	10%	240311200
C43	Ce.	12pF	750V	10%	240311200
C44	Ce.	0.1	200V	-20% +80%	208450017

V3	ECC88	300033120
V4	ECC88	300033120

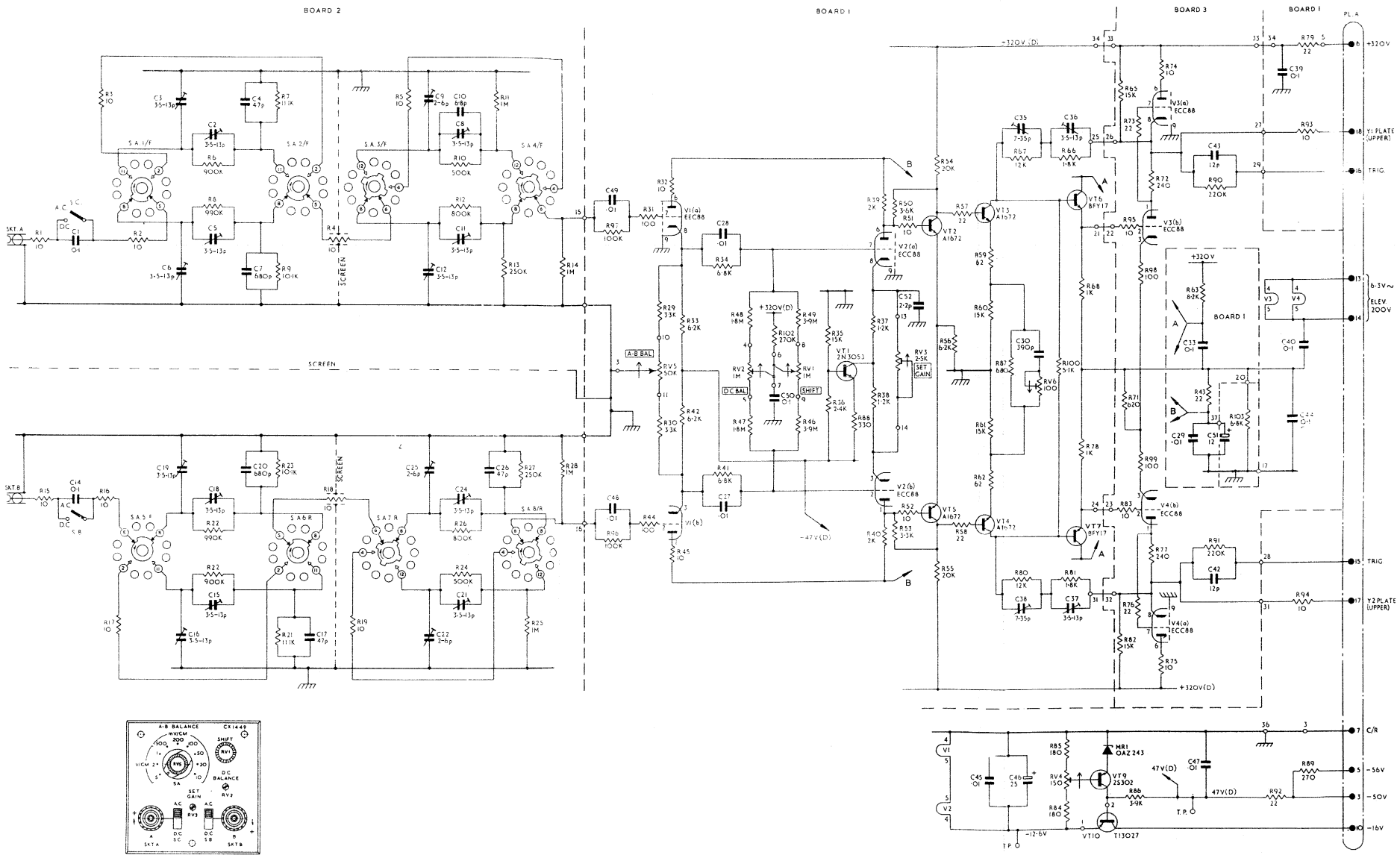
COMPONENT PARTS LIST
for
Attenuator Switch (SA)

Cct. Ref.		General Description			Solartron Part No.
R2	X	10	¼W	10%	172311000
R3	X	10	¼W	10%	172311000
R4	X	10	¼W	10%	172311000
R5	X	10	¼W	10%	172311000
R16	X	10	¼W	10%	172311000
R17	X	10	¼W	10%	172311000
R18	X	10	¼W	10%	172311000
R19	X	10	¼W	10%	172311000
R14	W	1M	¼W	1%	170461000
R28	W	1M	¼W	1%	170461000
RV5	X	50K	¼W	20%	110012880

C52	Ce.	2.2pF	750V	±.5pF	240202201

COMPONENT PARTS LIST
for
Accessories

Cct. Ref.	General Description	Solartron Part No.
PL	1 Way Greenpar GE40001	351001040



Circuit Diagram: Wide-Band Differential Amplifier CX1449