

3 VERTICAL DEFLECTION AMPLIFIER TYPE C

3.1 GENERAL

The Vertical Deflection Amplifier Type C conveniently combines the advantages of an ultra high gain amplifier and a dual-range general purpose amplifier. It has a wide field of application both for general purposes and where high input impedance (1 megohm) and high gain are required. The three ranges provided are as follows:

- DC - 15 Mc/s at 100 mV/cm.
- DC - 0.8 Mc/s at 10 mV/cm.
- 2c/s - 75 Kc/s at 100 uV/cm.

Special care has been taken in the high gain preamplifier to minimize both hum and input noise, and also to ensure that the instrument is stable and free from drift. The amplifier is buffered from both long period and transient fluctuations in mains voltage. It is thoroughly screened against extraneous electrostatic and electromagnetic interference.

The amplifier is self-contained except for its power supplies which are drawn from the main oscilloscope.

3.2 CIRCUIT DESCRIPTION

It will be seen from the circuit diagram (Fig. 3.4) that the amplifier consists of three sections:

- (1) a high gain preamplifier
- (2) an input attenuator network
- (3) a balanced four stage DC-coupled amplifier.

The High Gain Preamplifier

The preamplifier uses one double triode valve (type ECC 82). With S1 in the "AC X100" position, the input signal is taken via a blocking capacitor (C2) to the grid of V1A. This valve is run at low anode current and voltage to minimize noise and drift. The amplified signal from the anode is resistance-capacitance coupled to V1B. This valve, the second amplifier stage, is operated without a bypass capacitor across its cathode load, thus providing negative feedback to improve the signal handling capacity. The variable resistor (RV8) (SET GAIN X100) is used to set the gain of the preamplifier to X100.

The preamplifier output is taken from the anode of V1B, via the DC blocking capacitor (C9) to the "AC X100" position of the input selector switch (S1). This switch has three positions marked "AC X100", "AC X1" and "DC" respectively. In the "AC X100" position the input signal passes through the preamplifier to the main amplifier; in the "AC X1" position the preamplifier is bypassed and the signal is taken via a DC blocking capacitor (C7) to the input attenuator switch; in the "DC" position the input signal is fed directly to this switch.

Preamplifier Power Supplies

The high tension supply to the preamplifier is buffered against mains voltage fluctuations by means of a series stabilizer circuits. This consists of the two halves of a triode pentode valve, type ECF 80 (V2). Any change in HT line voltage at the cathode of V2A is transmitted to the grid of V2B, where it is amplified, inverted in polarity and applied to the grid of V2A. Hence the change is corrected by the high gain of V2B.

The DC heater supply to V1 is produced by rectification of the 12.6 V AC supply by MR 1 and smoothed by the components C28, R64 and C29 so that the high gain stages of the preamplifier operate without hum.

The Input Attenuator (VOLTS/CM SWITCH S2)

The Input Attenuator consists of four frequency-compensated resistance dividers, which are used singly or in series to give nine division ratios. The first section has ratios of 1, 10 and 100; the second ratios of 1, 2 and 5.

The Vertical Deflection Amplifier

The main Vertical Deflection Amplifier uses two pentode valves (type EF184) and three double triodes (type ECC 88).

The input signal is fed from the attenuator network to the grid of V3. The input stage consists of a cathode-coupled pair (V3 and V4). An out of phase signal appears at the anode of V3 and an in phase signal at the anode of V4. These anodes are direct-coupled to the cathode followers V7A and V7B respectively. The inductors (L1 and L2) in the anode circuits of V3 and V4 are peaked for optimum response. RV48, connected between the cathodes of V3 and V4 is the X1 preset gain control.

The potentiometer (RV35) controls the relative DC anode potentials of V3 and V4 and consequently acts as a Vertical Shift (Y SHIFT COARSE) control. When the amplifier is operated at high gain (in the "X10" condition) RV40 acts as a "FINE" Y SHIFT control or vernier.

The cathodes of V7A and V7B are directly connected to the grids of the output amplifier valves, V5A and V6B. The cathodes of these valves are connected, via RV49 (SET GAIN X10). The switch S3 (Y GAIN - X1/X10) short circuits RV49 in the X1 position. The inductors (L3 and L4) in the anode circuits of V5A and V6A provide compensation at high frequency on the "X1" range (DC - 15 Mc/s).

In the "X10" condition the cathode bias resistors of V5A and V6B (R53 and R54) are not returned to earth, but to the preset "ASTIG BAL" variable resistor (RV60). This control is used to correct the DC level of the cathodes of V5A and V6A when the valves are operating at high gain. Incorrect adjustment affects the potential of the Y plates of the CRT, causing astigmatism of the spot.

The vertical deflection outputs to the CRT "Y" plates are fed from the cathode followers V5B and V6B. The series inductors (L5 and L6) give compensation at high frequencies. The signal from the cathode of V5B is also taken to the Y1, Y2 positions of the Trigger-Selector switch (S101, Fig. 2.1). The neon diodes (N2 and N3) between the grids and cathodes of V5B and V6B protect these valves from the voltages which appear at their grids immediately upon switching on, before the cathodes reach full emitting temperature.

With the Y GAIN switch in the "X1" position the maximum sensitivity is 100 mV/cm., unless the high gain preamplifier is in circuit. The gain can be adjusted by the SET GAIN X1 control (RV48).

When the Y GAIN switch (S3) is in the "X10" position, higher value load resistors are switched into the anode circuits of the input and output amplifier valves (V3 and V4, V5A and V6A). The maximum sensitivity of the amplifier is then 10 mV/cm. and the gain can be adjusted, for calibration purposes, by the SET GAIN X10 control (RV49).

High Tension Supply to Input Stages

The anode and screen voltages for V3A and V4A are taken from a common resistor (R59) in the cathode circuits of V5B and V6B. The cathode current of the input stages therefore flows through the two output cathode followers. This reduces the total current consumption of the amplifier, and provides a measure of stabilization, so that the overall gain is proportional to the supply voltage.

A negative supply is obtained by rectifying the 12.6 heater winding. This voltage is smoothed by C29, R67, and C31. The negative voltage shows the cathode resistors R68, R69 of V3, V4 to be large, so ensuring a constant current through the valves.

3.3 OPERATION

The amplifier has two modes of operation: it may be used as an ultra high gain amplifier having a sensitivity of 100 μ V/cm. and an input impedance of 1 megohm, or as a general purpose dual-range instrument. A full description of operating procedures for its use as a general purpose amplifier will be found in the handbook for the oscilloscope with which the amplifier is to be used.

Use of the Ultra High Gain Facility

To check that the amplifier is functioning correctly and that it is calibrated, a signal generator is required capable of providing a square wave output of 0.2 V peak to peak at 1 Kc/s which may be accurately attenuated by 40 dB. The procedure is as follows:

- (1) Check that the amplifier is properly situated in the oscilloscope and that the oscilloscope is correctly adjusted for use. (Correct mains voltage, etc.). Connect an earth to avoid hum pickup via the case of the instrument.
- (2) Switch on and allow a few minutes for the instrument to reach operating temperature.
- (3) Adjust to obtain a clearly defined trace according to the instructions in the main handbook.
- (4) Set the switch S1 to "AC X1". Connect the signal generator output to the INPUT HIGH socket and link the INPUT LOW terminal to earth. The trace amplitude of the 0.2 V peak to peak signal should be adjusted, using the SET GAIN X1 preset control (RV48), to give exactly 2 cm. vertical deflection.
- (5) Reduce the signal generator output to 0.02 V peak to peak, switch S3 to X10, and adjust the SET GAIN X10 (RV49) to give exactly 2 cm. of vertical deflection.
- (6) Reduce the signal generator output to 0.002 V peak to peak, set the switch S1 to AC X100 and S3 to X10, and adjust RV8 for 2 cm. of vertical deflection.

The gain settings of the amplifier have now been correctly adjusted.

Preamplifier, AC X100 Position

To avoid overloading the preamplifier in the AC X100 position, the switch S3 should always be set to X10.

Maximum input to the preamplifier should be limited to 0.5 V peak to peak to avoid any distortion of the output waveform.

Input High and Low Terminals

Owing to the very high gain of the amplifier (100 $\mu\text{V}/\text{cm}$), hum caused by earth currents is a great problem, particularly when the oscilloscope is being used as a double beam display.

To avoid multiple earths, the amplifier has all the earth connections in the high gain parts of the circuit brought to a common point on the front panel, marked INPUT LOW. This is not connected to earth.

When only one amplifier is being used, the INPUT LOW terminal should be connected to the EARTH terminal. However, when two amplifiers are being used, at high gain, and are connected to a common signal source, the INPUT LOW sockets of each amplifier should be connected together and taken to any convenient earth. In this way, hum loops around the oscilloscope will be avoided.

To avoid hum loops between the source and the oscilloscope, the earth link may be broken at the oscilloscope and only one earth connection made at the source, or alternatively the source may be earthed at the oscilloscope.

AMPLIFIER TYPE C

AMPLIFIER TYPE C (continued)

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
10M	R 1	1M	HSC	1%	1/2w
21X	R 2	68K	HSC	1%	1/2w
S15210	R 3	1.5K	C	10%	1/2w
S10310	R 4	10K	C	10%	1/2w
912510	R 5	1.2M	C	10%	1/2w
S68310	R 6	68K	C	10%	1/2w
S22210	R 7	2.2K	C	10%	1/2w
31C	RV 8	5K	Potentiometer 'Preset Set Gain X100'		
S10310	R 9	10K	C	10%	1/2w
S22210	R10	2.2K	C	10%	1/2w
S27310	R11	27K	C	10%	1/2w
S22310	R12	22K	C	10%	1/2w
S10110	R13	100	C	10%	1/2w
12M	R14	900K	HSC	1%	1/2w
18M	R15	111K	HSC	1%	1/2w
11M	R16	990K	HSC	1%	1/2w
20M	R17	10.1K	HSC	1%	1/2w
S22410	R18	220K	C	10%	1/2w
S68310	R19	68K	C	10%	1/2w
S33310	R20	33K	C	10%	1/2w
14M	R21	500K	HSC	1%	1/2w
13M	R22	800K	HSC	1%	1/2w
17M	R23	250K	HSC	1%	1/2w
10M	R24	1M	HSC	1%	1/2w
10M	R25	1M	HSC	1%	1/2w
S10410	R26	100K	C	10%	1/2w
S10110	R27	100	C	10%	1/2w
S15310	R28	15K	C	10%	1/2w
S10110	R30	100	C	10%	1/2w
S15310	R31	15K	C	10%	1/2w
S10205	R32	1K	C	5%	1/2w
S10205	R33	1K	C	5%	1/2w
Y15310	R34	15K	C	10%	1/2w
60C	RV35	25K	Potentiometer 'Y Shift Coarse		
24C	RV40	100K	Potentiometer 'Y Shift Fine		

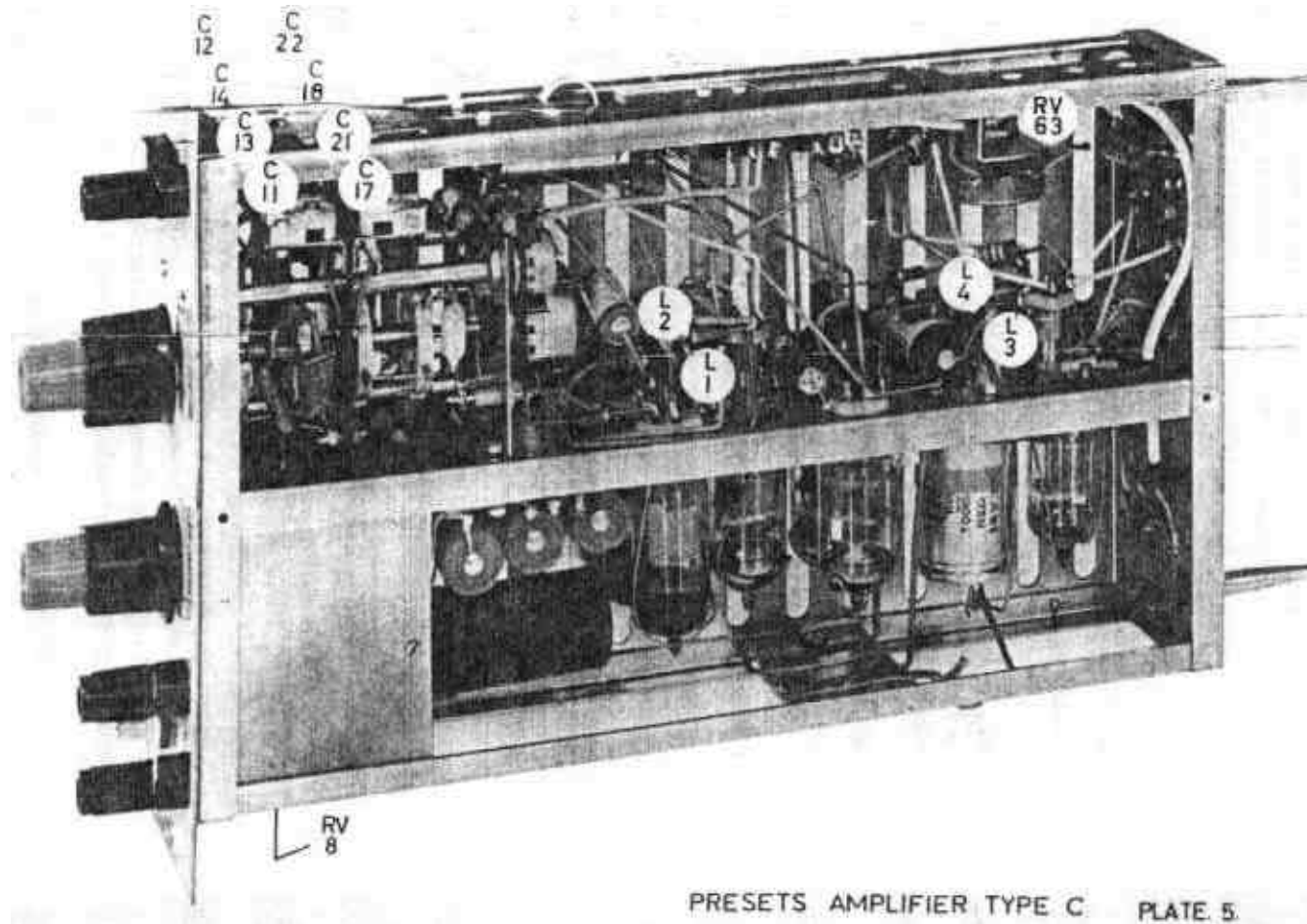
Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
Y15310	R36	15K	C	10%	1/2w
S10110	R37	100	C	10%	1/2w
S10110	R38	100	C	10%	1/2w
S56310	R39	56K	C	10%	1/2w
S56310	R41	56K	C	10%	1/2w
S10110	R42	100	C	10%	1/2w
S10110	R43	100	C	10%	1/2w
31X	R44	7.5K	WW	5%	3w
Y68210	R45	6.8K	C	10%	1/2w
Y68210	R46	6.8K	C	10%	1/2w
31X	R47	7.5K	WW	5%	3w
23C	RV48	1K	Potentiometer 'Set Gain X1'		
23C	RV49	1K	Potentiometer 'Set Gain X10'		
Y27210	R50	2.7K	C	10%	1/2w
Y27210	R51	2.7K	C	10%	1/2w
S10110	R52	100	C	10%	1/2w
37M	R53	10K	WW	5%	3w
37M	R54	10K	WW	5%	3w
S10010	R55	10	C	10%	1/2w
S10110	R56	100	C	10%	1/2w
S10110	R57	100	C	10%	1/2w
31X	R58	7.5K	WW	5%	3w
30X	R59	3.3K	WW	5%	5w
59C	RV60	10K	Potentiometer 'Astig Balance'		
S22210	R61	2.2K	C	10%	1/2w
31X	R62	7.5K	WW	5%	3w
S10110	R63	100	C	10%	1/2w
Y15010	R64	15	C	10%	1/2w
S10110	R65	100	C	10%	1/2w
S18010	R66	18	C	10%	1/2w
S56110	R67	560	C	10%	1/2w
S15210	R68	1.5K	C	10%	1/2w
S15210	R69	1.5K	C	10%	1/2w
S10310	R70	10K	C	10%	1/2w
S10310	R71	10K	C	10%	1/2w
S18010	R72	18	C	10%	1/2w

AMPLIFIER TYPE C (continued)

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
33K	C 1	0.1	POL	20%	125v
16K	C 2	0.1	POL	20%	400v
50X	C 3	8	ELEC		275v
38J	C 4	500	ELEC		6v
33K	C 5	0.1	POL	20%	125v
50X	C 6	8	ELEC		275v
16K	C 7	0.1	POL	20%	400v
50X	C 8	8	ELEC		275v
16K	C 9	0.1	POL	20%	125v
16K	C10	0.1	POL	20%	400v
16J	C11	6-30pf	CER TRIMMER		350v
16J	C12	6-30pf	CER "		350v
16J	C13	6-30pf	CER "		350v
16J	C14	6-30pf	CER "		350v
59K	C15	100pf	SM	20%	350v
61K	C16	0.001	SM	20%	350v
16J	C17	6-30pf	CER TRIMMER		350v
16J	C18	6-30pf	CER "		350v
63X	C19	15pf	SM		350v
64X	C20	20pf	SM		350v
16J	C21	6-30pf	CER TRIMMER		350v
16J	C22	6-30pf	CER "		350v
65X	C23	30pf	SM		350v
63X	C24	15pf	SM		350v
67J	C25	0.01	POL	20%	400v
16K	C26	0.1	POL	20%	400v
18J	C27	8	ELEC		150v
47X	(C28	1000	ELEC		18v
	(C29	1000	ELEC		18v
56X	C30	8	ELEC (Reversible)		25v
33X	C31	250	ELEC		18v
33X	C32	250	ELEC		18v
20K	C33	4700pf	P.E.	20%	125v

AMPLIFIER TYPE C (continued)

Part No.	C.C.T. Ref.	Value	Description	Tolerance	Rating @ 70°C
20Y	N1		Neon XC15 Hivac		
36Y	N2		Neon 3L		
36Y	N3		Neon 3L		
18O	MR1		Diode 50 A5		
Brown	L1	3.9/7.5μH	Variable Compensating Coils		
Brown	L2	3.9/7.5μH	" " "		
Orange	L3	7/16μH	" " "		
Orange	L4	7/16μH	" " "		
	L5	1.15μH	Compensating Coil	10%	
	L6	1.15μH	" " "	10%	
38P	S1		Switch AC/DC/X100		
36P	S2		Switch VOLTS/CM		
28D	S3		Switch X1-X10 'Y GAIN'		
7T	V1		Valve Mullard ECC82		
10T	V2		Valve Mullard ECF80		
26T	V3		Valve Mullard EF184		
26T	V4		Valve Mullard EF184		
18T	V5		Valve Mullard ECC88		
18T	V6		Valve Mullard ECC88		
18T	V7		Valve Mullard ECC88		



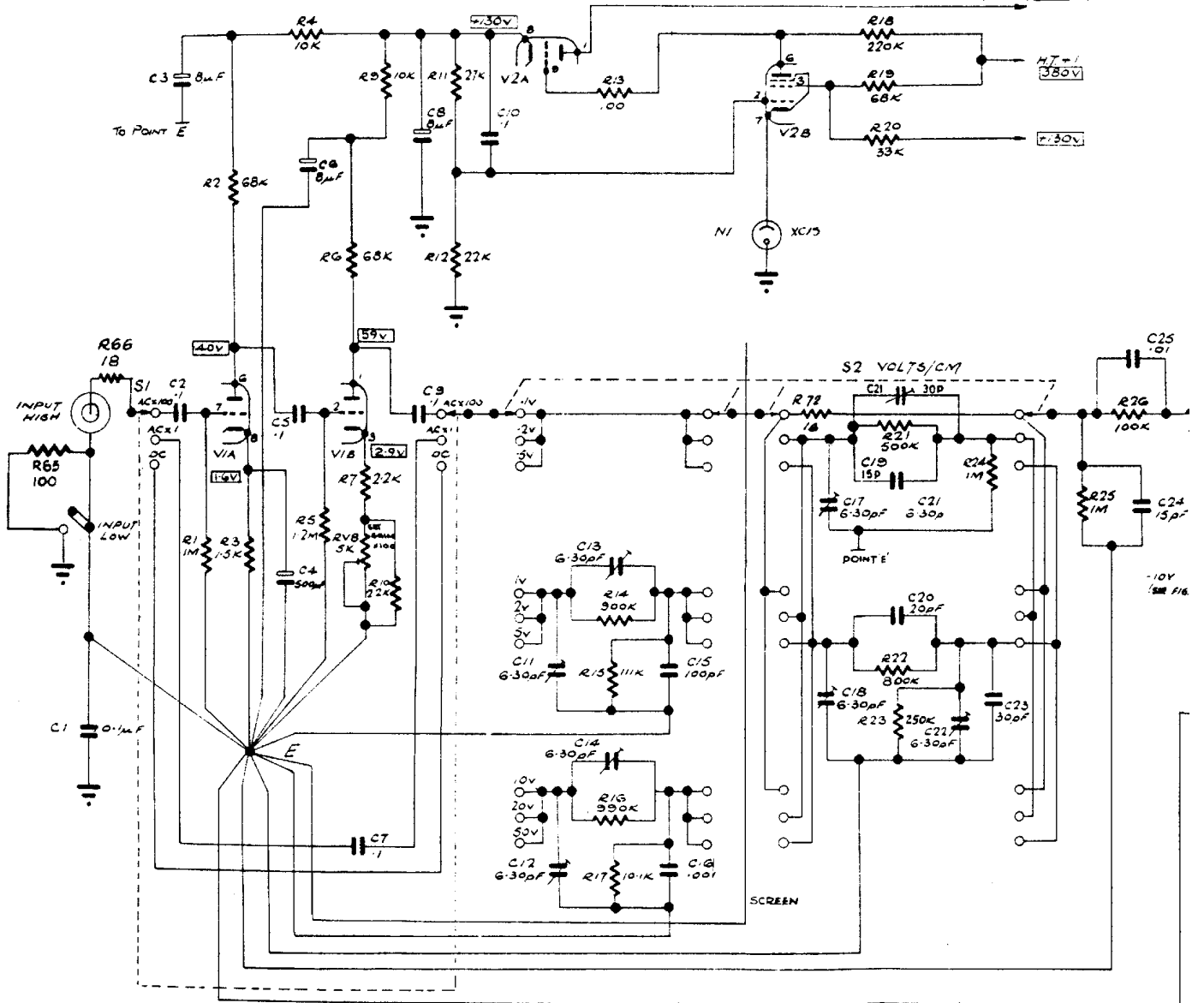
PRESETS AMPLIFIER TYPE C PLATE 5.

TYPE C AMPLIFIER

CONNECTIONS TO REAR POWER SOCKET

- PIN NO
- 2 HT +2
 - 3 126V A.C.
 - 4 1V P.P.
 - 5 E
 - 6
 - 7 HT +1
 - 8 6.3V A.C.

YAMP SUPPLY 245V HT +2



AR POWER

H7-2

- V1 - ECC82
- V2 - ECF80
- V3 - EF184
- V4 - EF184
- V5 - ECC88
- V6 - ECC88
- V7 - ECC88

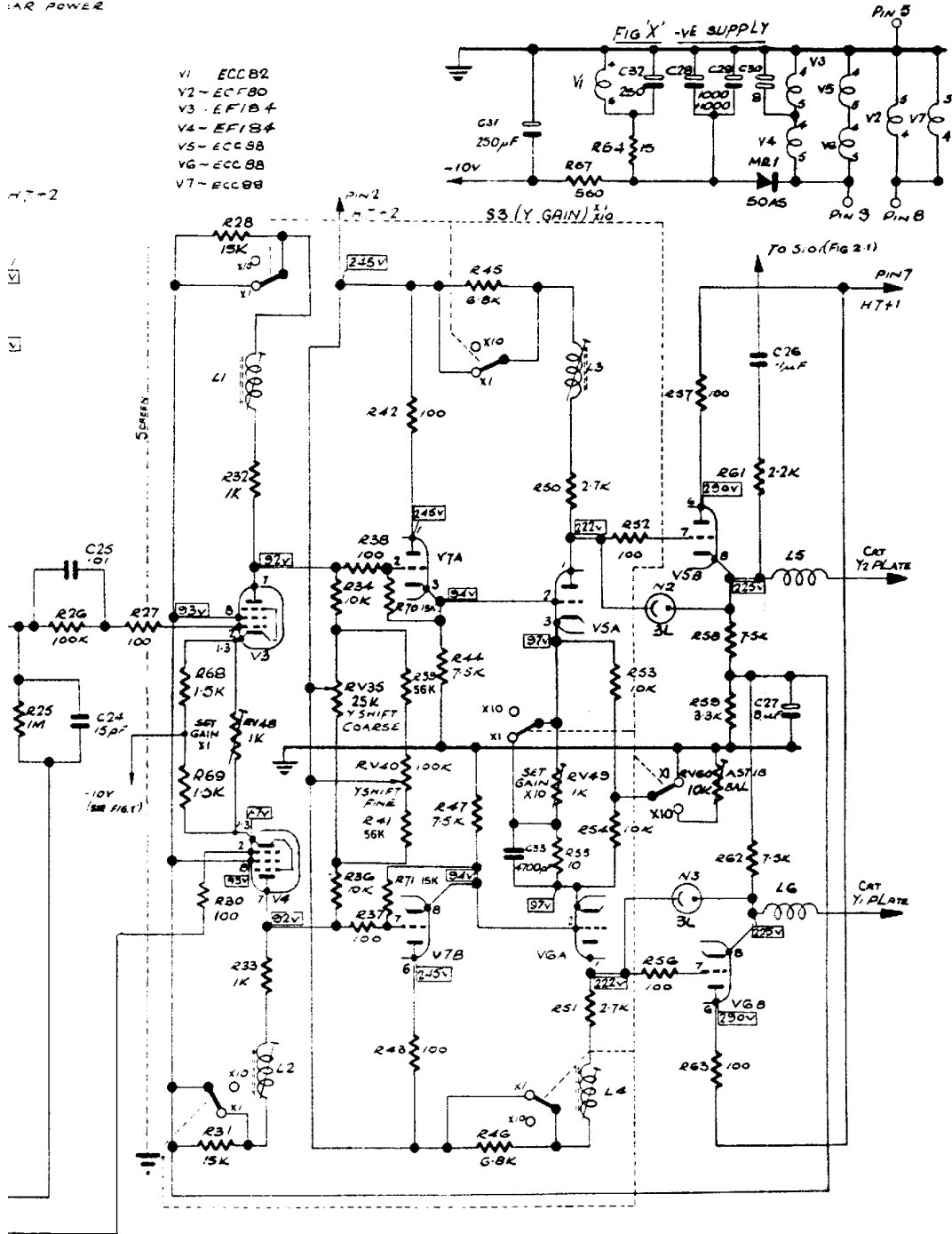


FIG. 34