P.50 SERVICE MANUAL

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CONTENTS

This manual is intended to cover three different models of the P.50 amplifier. These are:

(i) The mark I P.50 (two PCB construction)

(ii) The mark II P.50 (single PCB)

(iii) The mark II P.50 (single PCB with improved protection circuitry)

To avoid unnecessary duplication of the same subject matter the manual has been written for the improved Mark II amplifier. Supplementary sections then follow which detail the other versions.

It should be noticed that where particular transistors are no longer available for the Mark I P.50 substitutions can be chosen by reference to the Mark II circuit diagram.

1. INTRODUCTION

The Cambridge Audio P50 amplifier has been designed and engineered to give the highest possible quality of sound reproduction. It can be operated in conjunction with record players, tape recorders, one or more radio tuners, loudspeakers and headphones. It has generous tone controls and filters and a comprehensive monitoring system for use when tape recording.

The Amplifier has been built with high quality components to give wide safety margins in normal operation. It is fully protected against overloading by a relay which disconnects the loudspeakers in the event of a serious fault. The relay can be heard to click within the unit shortly after switching on and whenever the Input Selector switch is operated.

This handbook has been written to enable you to perform a logical test sequence by reading straight through it. In some places, however, it will be necessary to refer forward or backward in the book and references are made using section and paragraph numbers.

You are recommended to read the handbook through before performing any tests on the amplifier in order to familiarise yourself with the use of the book and with the operation of the amplifier.

2. GENERAL

2.1 SPECIFICATION

Power Output @ 1 kHz per channel

	into 8 ohms	25W
	into 15 ohms	15W

Frequency Response	± 0.5 dB	25Hz - 25kHz

Total Harmonic Distortion

@ 1 kHz, @ all powers to rated o/p ⩽ 0.1 %

Intermodulation Distortion

f_1 = 60 Hz; f_2 = 7 kHz; amplitude ratio 4 : 1 ⩽ 0.1 %

Signal to Noise Ratio

PU 1, PU 2	60 dB (unweighted)
Radio, Aux	70 dB (unweighted)

Sensitivities

PU 1	3 mV
Input Impedance 47 K , RIAA equalised	
PU 2	100 mV
Input Impedance 100 k , RIAA equalised	
Radio	250 mV
Input Impedance 220 k , flat	
Aux	100 mV
Input Impedance 100 k , flat	
Tape	400 mV
Input Impedance 30k , flat	
Tape Output max Signal Level Minimum Load Impedance 1 k	250 mV

Crosstalk

Better than 50 dB @ 1 kHz

2. GENERAL CONT'D

2.1 SPECIFICATION CONT'D

Damping Factor

Into 8 ohms	>100
Into 15 ohms	>185

Stability

Stable into open circuit or complex impedance

Power protected against overloaded output

(Short Term, electronic switch)

(Long Term, fuse & relay)

Input Overload Capability

Better than 50 dB, relative to input sensitivity at rated distortion.

Balance Control

+2, -18 dB swing on each channel.

Bass Control

± 12 dB @ 100 Hz.

Treble Control

± 12 dB @ 10 kHz.

Hi Filter

Insertion loss @ 10 kHz.	Grad	2.5 dB (6 dB/Octave)
	Steep	5 dB (18 dB/Octave)

Lo Filter

Insertion loss @ 25 Hz	12 dB (6 dB/Octave)

Stereo/Mono Control

Virtual earch mixing in Mono Mode

Headphone Jack Socket

¼" Stereo jack accepting any moving coil type 8 ohms. Electrostatic types should be connected to the speaker sockets.

Dimensions

16½", 9⅜", 2" (40.5, 24.1, 5.1 cm.).

2. GENERAL CONT'D

2.1 SPECIFICATION CONT'D

Weight

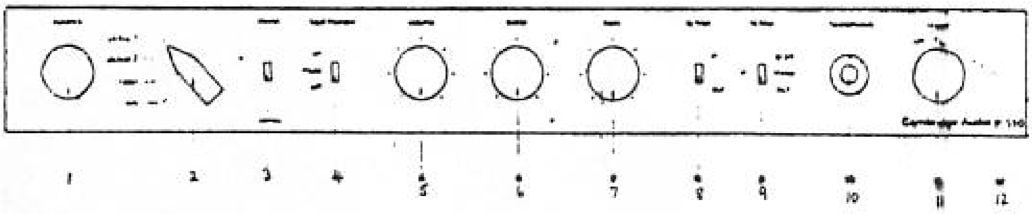
12 lbs. (5.44 kGm)

Supply

Mains power supply, preset within unit to accept 110/120V or 220/240V.

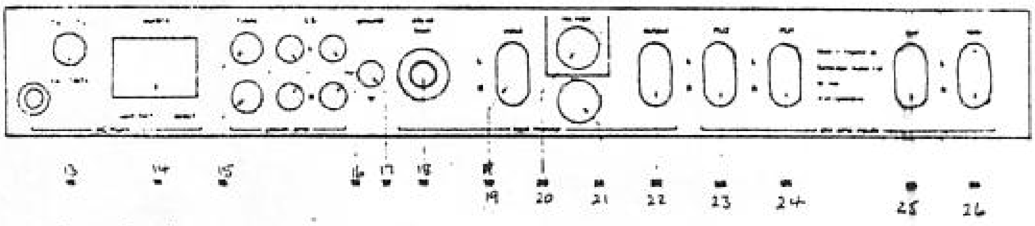
Two mains outlets provided; one switched one direct.

2.2 FRONT AND REAR PANEL FUNCTIONS



Front Panel

1. Balance Control
2. Input Selector
3. Stereo/Mono Switch
4. Tape Monitor Switch
5. Volume Control
6. Treble Control
7. Bass Control
8. Lo Filter Switch
9. Hi Filter Switch
10. Headphones Socket
11. Power Control
12. Power Indicator Lamp



Rear Panel

13. Mains Fuse
14. A.C. Outlet Sockets
15. Power Amp Fuses
16. LS Sockets
17. Ground Socket
18. Tape Monitor Adjust Level Control
19. Tape Monitor Input Sockets
20. Decoder DIN Socket
21. Tape Monitor DIN Socket
22. Tape Monitor Output Sockets
23. PU2 Input Sockets
24. PU1 Input Sockets
25. AUX Input Sockets
26. RADIO Input Sockets

2.3 MAINS VOLTAGE CHANGEOVER

- Disconnect unit from mains supply.
- Remove amplifier lid as detailed in 3.2.
- Remove the bar at right hand end of amplifier (2 x 6BA screws).
- Remove four 4 BA transformer securing nuts and lift transformer from unit.
- Cut off the rubber sleeves on the transformer output wires.
- Unsolder the wires connecting the transformer to:
  - (a) the mains fuse
  - (b) the switched mains output socket
- Rewire according to the following table:

VOLTS	110	120	220	240
TO FUSE	Br & Y	Br & Y	Br	Br
TO SOCKET	R & G	O & Bl	G	Bl
SHORT TOGETHER	-	-	R & Y	O & Y
OPEN CIRCUIT	O	R	O	R
OPEN CIRCUIT	Bl	G	Bl	G

Br	=	Brown	Y	=	Yellow
R	=	Red	G	=	Green
O	=	Orange	Bl	=	Blue

- Insulate all loose ends of wire with PVC tape or rubber sleeves of the correct size, and bind lengths of wire together.
- Remove old voltage marking and mark new voltage on the transformer.
- Replace transformer in unit and secure loosely with the four securing nuts.
- Adjust the transormer for minimum hum pick-up as follows:
  - (a) Set INPUT SELECTOR to PU 1 with no input.
  - (b) Set BASS and TREBLE controls to central positions.
  - (c) Insert a pair of headphones into HEADPHONE socket.
  - (d) Set LO and HI FILTERS to OUT.
  - (e) Set VOLUME to maximum.
  - (f) Rotate transormer for minimum audible hum pickup in both the MONO and STEREO modes, a compromise position may be necessary
  - (g) Drop on the lid without securing. It is advisable to do this with the mains disconnected to avoid the risk of an accidental short from mains to chassis.

2. GENERAL CONT'D.

2.3 MAINS VOLTAGE CHANGEOVER CONT'D.

(h) Check that the hum level does not increase audibly, if it does, readjust the position of the transformer and try again.

(i) Tighten the transformer securing nuts.

- Replace the tie bar, and reassemble lid.
- Mark the new mains voltage setting on the lead and base plate, removing the old markings.

2.4 USE OF AMPLIFIER

To obtain a flat audio output from the amplifier, it may be used with a record player pick-up on either of the PU inputs and with any other input of adequate drive capability on either the RADIO or AUX sockets. The sensitivities quoted in the specification are those which produce full power output into 8 ohms with the volume control at maximum.

If larger input voltages are fed to the amplifier, reducing the volume control will reduce the sensitivity with no increase in distortion and without overloading the preamplifier stages. The useful range of the volume control is, however, decreased so that, as a rough guide, inputs greater than ten times those in the specification should not be used.

If the amplifier is overloaded with signal it will not be damaged even if used continuously in this condition. Damage will occur, however, if the inputs are connected to the mains.

The P50 can deliver 25 Watts of power from each loudspeaker socket and care should be taken to ensure that loudspeakers connected to it can handle the power output of the amplifier. The use of series resistors to reduce the power dissipated in the loudspeakers is a solution but this causes the damping factor of the amplifier to be reduced and loudspeaker distortion to rise considerably. As a general rule, the volume control setting should be reduced if even slight amounts of harsh or buzzing distortion are heard.

The TAPE MONITOR INPUT sockets and the AUX sockets may be paralleled together with an external screened wire link without producing instability. This enables the user to go from tape monitor mode to a tape input on AUX without having to change the arrangements of plugs on the back of the amplifier.

3. DISMANTLING

3.1 DISCONNECT THE AMPLIFIER FROM THE MAINS SUPPLY

3.2 REMOVAL OF TOP COVERS

- Remove the four BA no. 2 Posidrive securing screws from each of the two wooden end plates. The plates will fall off.

- Gripping the top cover by each end, lift if off the unit.

- Replacement is a direct reversal of this procedure, but ensure that if there is a mumetal sheet on the underside of the top cover, it is refitted over the transformer.

- In order to fit the cover and end pieces of the amplifier squarely, it may be necessary to tap the ends of the top cover into position with a wooden mallet before final tightening of the screws.

3.3 REMOVAL OF BOTTOM HEAT SINK AND ACCESS TO MAIN BOARD

All of the servicing operations and tests on the main board may be done without removing it from the amplifier case. To gain access:

- Remove the four 4 BA screws holding the rubber feet to the unit, and the five 4 BA screws midway along the heat sink.

- The heat sink will now lift off.

- Replacement is a direct reversal of this procedure, ensuring that silicone grease or thermo-paste is spread between the heat sink and the chassis.

3.4 REMOVAL OF FRONT AND REAR PANELS

(a) Front Panel

- Remove the knobs from the controls. There is one screw per knob, a 6 BA allan key is necessary for this operation.

- Remove the two 6 BA screws securing the top of the front panel to the tie bars.

- Remove the three 4 BA screws securing the bottom of the front panel to the chassis.

- Carefully remove the front panel of the unit, drawing it over the toggle switches.

- Take care not to lose the black discs which are on the lever of the toggle switches, behind the front panel.

- Replacement is a direct reversal of this procedure.

3. DISMANTLING CONT'D

3.4 REMOVAL OF FRONT AND REAR PANELS CONT'D

(b) Rear Panel

- Remove the two 6 BA screws securing the top of the rear panel to the tie bars.

- Remove the three 4 BA screws securing the bottom of the rear panel to the chassis.

- Carefully remove the rear panel from the unit, drawing it along the mains cable.

- Replacement is a direct reversal of this procedure.

3.5 ACCESS TO AND REMOVAL OF THE INPUT MODULE

Most of the servicing of the input module may be done without removing it from the unit. To gain access remove the rear panel as detailed in 3.4 (b).

If is is necessary to remove the input module, procede as follows:-

- Remove the front panel as explained in 3.4 (a).

- Loosen the nut securing the input selector switch.

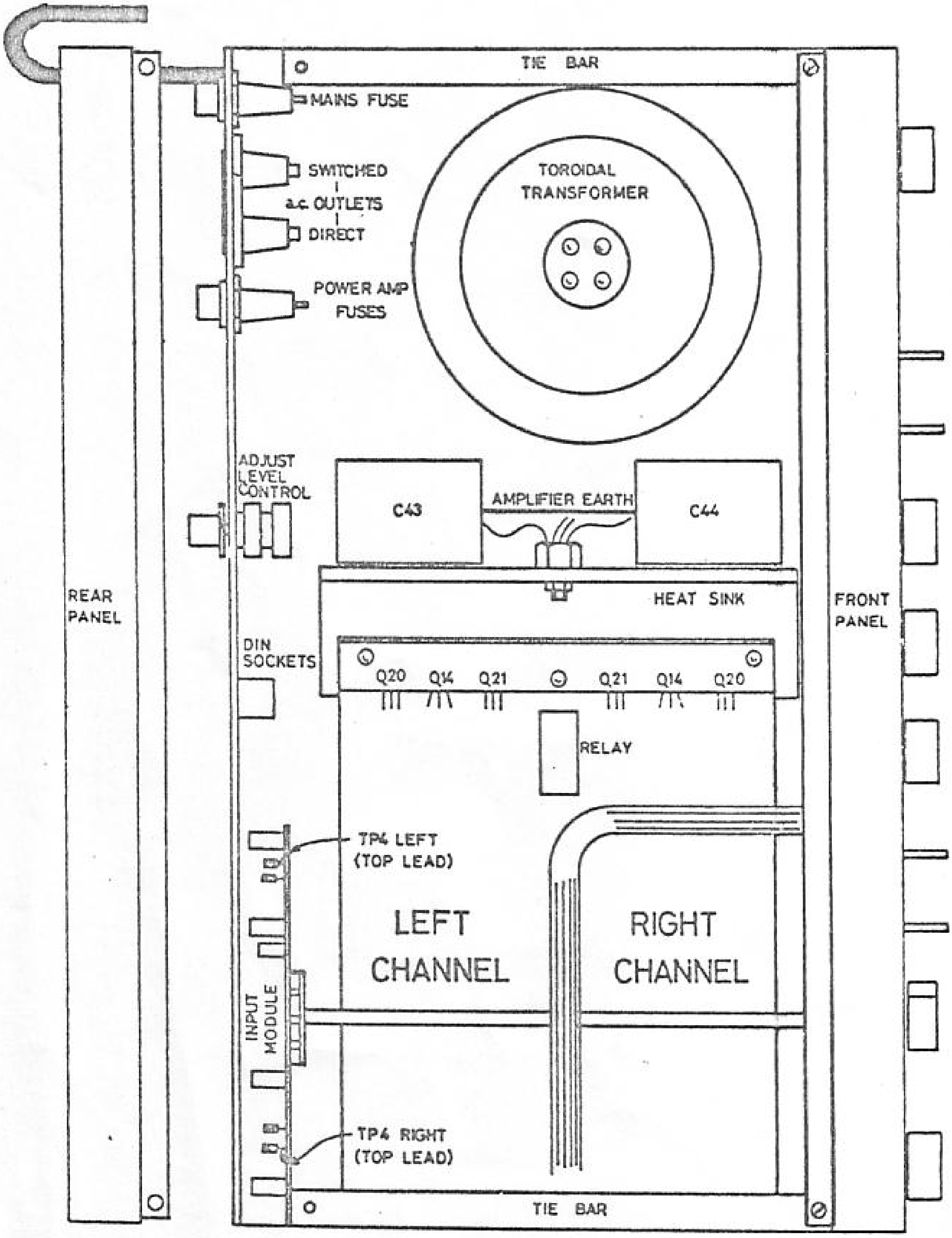
- Lift the input selector switch up the slot in the front of the chassis, and ease forward so that its shaft disengages from the input module switch wafer.

- Remove the eight 6 BA screws holding the input module to the back of the chassis.

- Carefully ease the input module out of the unit.

- Unsolder the leads to the input module checking their colours and connections against fig. 1. There are 14 leads.

- Replacement is a direct reversal of this procedure but ensure that the input selector switch wafer is correctly positioned before inserting the shaft. It will be necessary to adjust the positions of the wafers of the selector switch. To do this, rotate the front switch assembly before tightening the securing nut until the gap in the rear switch assembly is central on one of the sets of wiper contacts.


TIE BAR
MAINS FUSE
SWITCHED
a.c. OUTLETS
DIRECT
POWER AMP
FUSES
TOROIDAL
TRANSFORMER
ADJUST
LEVEL
CONTROL
C43
AMPLIFIER EARTH
C44
REAR
PANEL
HEAT SINK
FRONT
PANEL
DIN
SOCKETS
Q20
Q14
Q21
Q21
Q14
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LEFT
CHANNEL
RIGHT
CHANNEL
INPUT
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TP4 RIGHT
(TOP LEAD)
TIE BAR

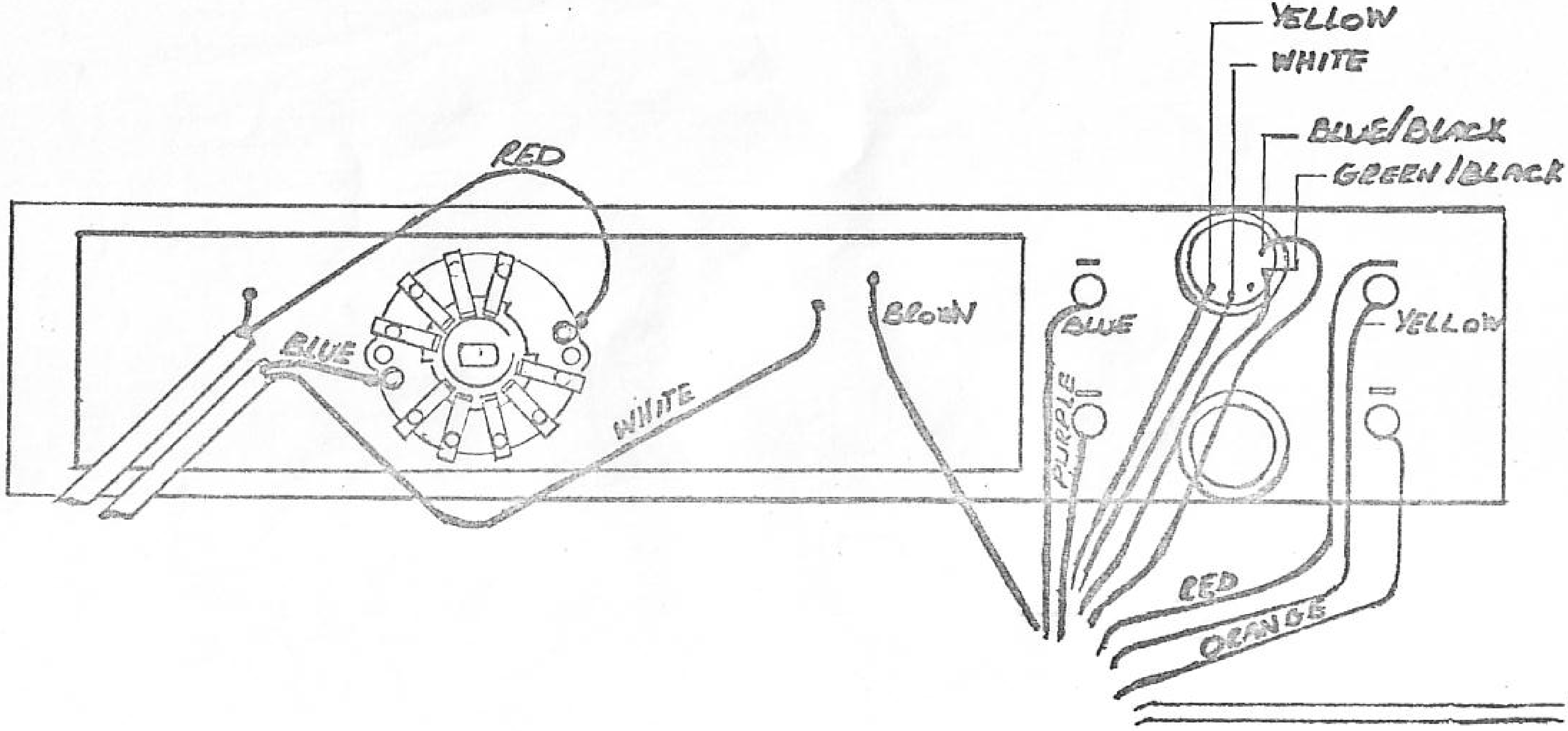


FIG 1

INPUT MODULE

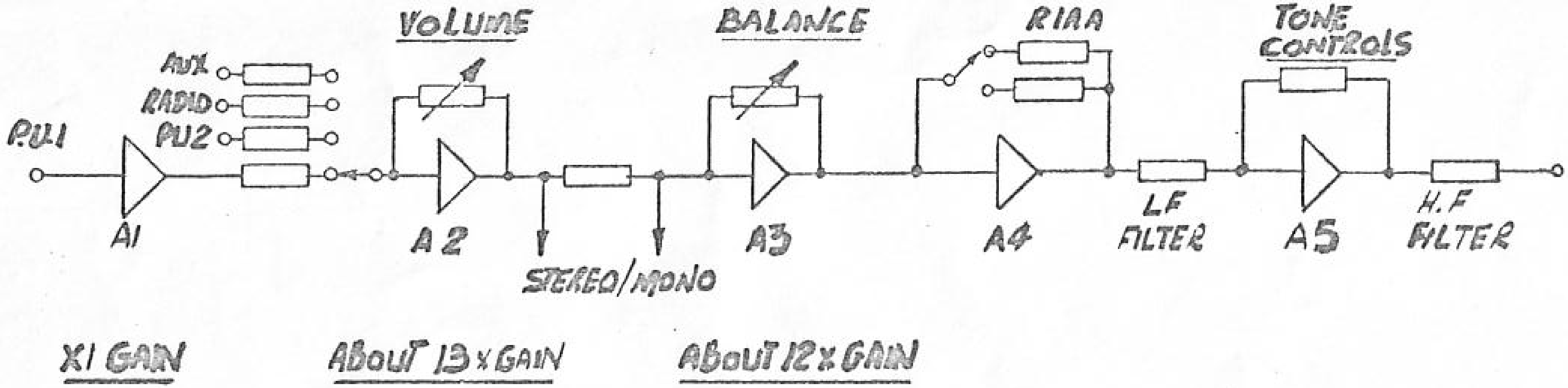


FIG.3

PRE AMPLIFIER BLOCK DIAGRAM

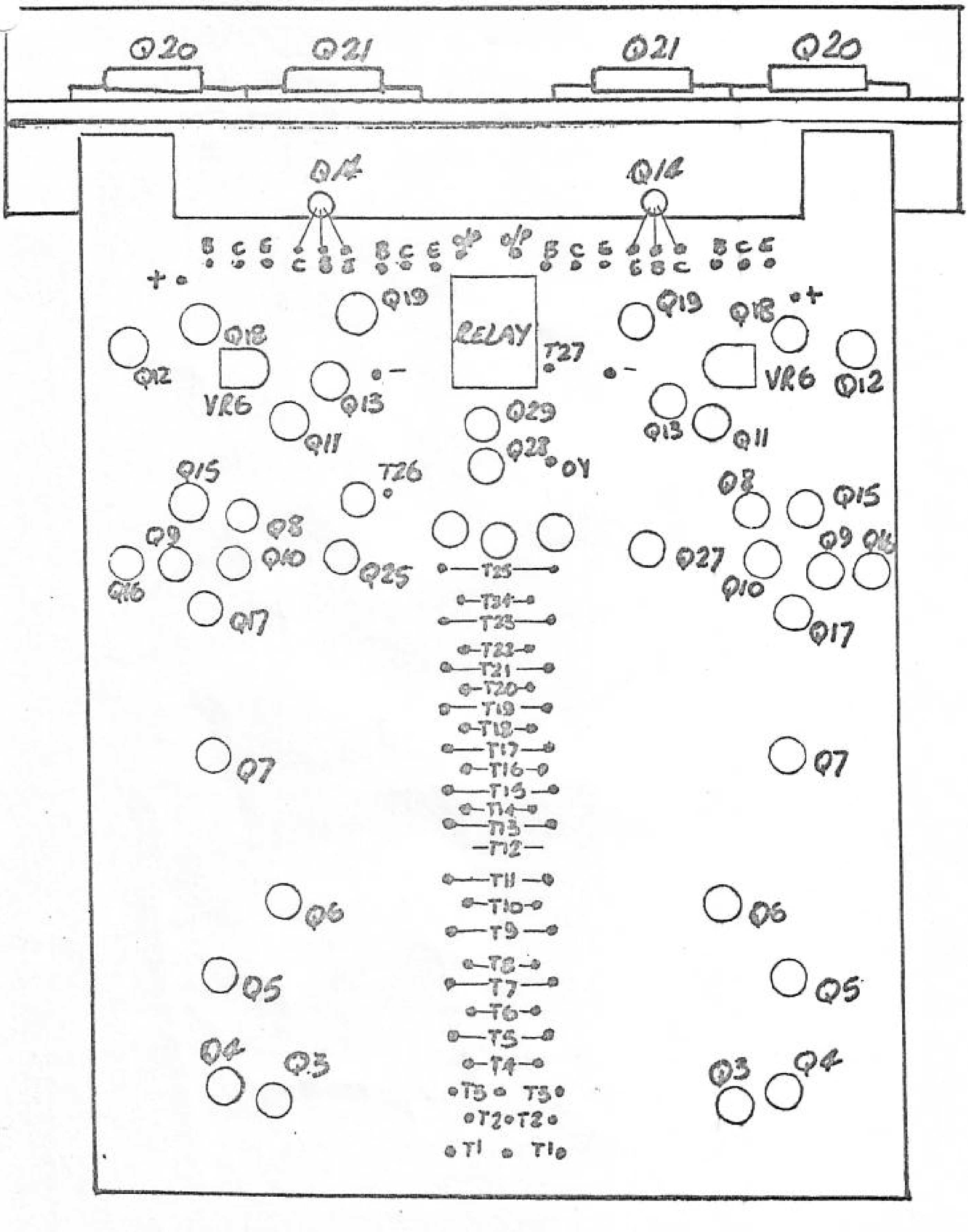


FIG. 4

P.50 PCB LAYOUT

3. DISMANTLING CONT'D

3.6 REMOVAL OF TRANSFORMER

- Remove the mains connections to the transformer as detailed in 2.3.
- Unsolder the secondary windings from
  (i) the earch busbar between the capacitors
  (ii) the bridge rectifier.
- Remove the 4 BA securing nuts (4 off) and their washers.
- Remove the top disc from the transformer.
- Ease the transformer upwards from its polystyrene securing piece.
- Replacement is the reversal of this procedure.

  Check the table in 2.3 to ensure that the correct winding is used for the local supply voltage.

  Before tightening the securing nuts, switch the amplifier on and repeat the procedure of 2.3 for adjusting the transformer for minimum hum.

3.7 REMOVAL OF POWER DEVICES

Four TO3 Metal Devices are fitted to an aluminium extrusion in the centre of the chassis.

- Unsolder the base and Emitter leads from the transistors.
- Remove the securing screws, the collector lead (solder tag) will be released by doing this.
- Remove the transistors from the heat sink.
- Replacement is a direct reversal of this procedure, but refer to the figure 2 and ensure that the insulating bushes are mounted correctly and that there is silicone grease or thermo-paste between the transistor and its mica washer and between the mica washer and the extrusion.
- Check that the metal can of each transistor is insulated from the chassis
- Resolder the leads to the transistor.
- P.50 amplifier has 4 Plastic power transistors fitted to an aluminium extrusion in the centre of the chassis.

4. AMPLIFIER DESCRIPTION

4.1 SYSTEM DESCRIPTION

- The P.50 consists of six amplifying stages per channel, plus associated switching, protection and power supply circuitry. Refer to Block Diagram, Fig. 3.

4.1.1 - SW1a selects one of the four inputs from the input phono sockets. PU1 is buffered by A1 which provides a 47 k Ohm resistive loading to a magnetic cartridge and a low source impedance to A2. PU2, RAD and AUX are taken directly to A2, their input impedances being defined by R1, R2 and R3 respectively.

4.1.2 - A2 is a virtual earth amplifier with VR1 providing shunt feedback. As the gain of this stage is proportional to the value of the resistor between its output and its input, when the wiper of VR1 is at the left hand end of its travel the amplifier has very low gain. This allows the P.110 to have very high 'headroom', and it will tolerate inputs in excess of 50dB greater than those specified without overload.

4.1.3 - The network consisting of the resistor track to the right of the wiper of VR1, plus R22 and R24 forms the input resistor to A3. This circuit modifies the law of VR1 to conform reasonably closely to that of the human ear. By this means a logarithmic track for VR1 has been avoided, and advantage is taken of the inherent accuracy of a linear potentiometer giving very good channel matching.

4.1.4 - A3 also provides the balance control. Any imbalance in the room acoustics may be compensated by varying VR2 which provides shunt feedback, but works in opposite senses on each channel. A3 acts as a virtual earth mixing amplifier when the P.50 is used in the MONO mode.

4.1.5 - Amplifier A4 provides RIAA equalisation when the input selector switch is in either of the PU positions, and also the low source impedance necessary to drive the tone controls. These are implemented with conventional Baxandall type circuits round A5.

4.1.6 - The LO FILTER SWITCH introduces a smaller coupling capacitor between A4 and A5. Thus decreasing the low frequency response. When the LO FILTER is out this capacitor is shorted by SW3.

4.1.7 - The HI FILTER consists of a twin-tee network in series with the signal after A5. This becomes high impedance at approximately 30 KHz, and effectively blocks the signal at that frequency and reduces is appreciably above 10 KHz. In the GRAD position the Q factor of the network is reduced since R50 is switched in parallel with it and in the HI FILTER OUT position, it is shorted altogether, allowing free passage to the signal. SW4 selects these modes of operation. The output of A5 goes direct to the TAPE OUTPUT socket, so the HI FILTER is bypassed by this socket as the return path from the TAPE INPUT is after the filter.

4.1.8 - The Tape Input Socket receives a return signal from a tape machine, and VR5 is provided to control its level so that a large range of signal amplitudes may be handled. The switch SW5 (The Tape Monitor Switch) then selects either this return signal, or the signal from the output of the Hi Filter to the input of A6 (the power amplifier).

4. AMPLIFIER DESCRIPTION CONT'D

4.1 SYSTEM DESCRIPTION

4.1.9. - The Power Amplifier increases the power of the signal to a level at which it can drive a loudspeaker. This amplifier is protected by an electronic switch which turns it off if the power taken from it is greater than it can safely handle (for instance if a loudspeaker has a low impedance at a particular frequency). This switch would normally only operate for a very short time, however if the overload condition is sustained a timing circuit turns the whole power amplifier off and disconnects the loudspeaker sockets with relay RL1. The circuit can only be reset by switching the mains switch off and on again.

4.1.10. - The loudspeakers are also switched off by the relay driver circuit for the first few seconds that the amplifier is switched on, and whenever the input selector switch is operated. This protects the loudspeakers from large voltage surges which might damage them, and also prevents the listener from hearing the loud thumps sometimes associated with these operations.

4.1.11. - Finally, the unit is supplied with power from the secondary of the toroidal transformer through a rectifier bridge. The supply to the power amplifier is smoothed but unregulated at plus and minus 40 volts dc, and from the negative side a circuit provides regulated dc at 20 Volts to power the preamplifier. The supplies are fully fused.

4.2 CIRCUIT DESCRIPTIONS

4.2.1. - INPUT MODULE CIRCUIT (A1)

The two transistors, Q1 & Q2, form a Darlington Pair emitter follower. The base voltage of Q1 is derived from the potential divider R4, R6 through resistors R5 and R7 (N.B. R7 improves R.F.I. supression). The emitter of Q2 is at a voltage 1.4 volts (two diode drops) below the base of Q1. Q1 and Q2 of the left channel are mounted between the PU sockets, and of the right channel between the AUX and RADIO sockets. In both cases Q2 is the transistor furthest from the SELECTOR switch wafer.

Resistor R11 holds one plate of capacitor C3 at a dc potential of 0V. Were it not there the leakage of the capacitor would result in a dc voltage at this point and thus cause clicks whenever the SELECTOR is operated. It will be seen that such resistors are fitted wherever switching between stages takes place. Figure 5.

4.2.2. VOLUME CONTROL CIRCUIT (A2)

Two transistors Q2 and Q3 are arranged as a Common Emitter stage coupled to an Emitter Follower stage. Combined ac and dc negative feedback is taken from the emitter of Q4 to the base of Q3 via R18 and R16. The values are chosen to give a large amount of feedback to give good dc stability. However, only a moderate amount of ac feedback is required and so capacitor C7 is fitted to decouple ac signals to ground and thus establish in part ration of R16 to R18 the ac open loop gain of the stage (fig. 6).

The output of the PU stage and the other inputs are fed to the SELECTOR switch (and then to Q3) via resistors R10, R1, R2 and R3 whose values determine the input sensitivities. Note that the SELECTOR switch has a guard band wafer which shorts any input not selected to prevent signal breakthrough.

4.2.2. VOLUME CONTROL CIRCUIT (A2) CONT'D

The significant feature of this stage is the volume control arrangement which uses a 50K Ohm linear potentiometer to obtain the required non-linear law. If figure 7 is referred to it will be seen that the non-linear law can be controlled by means of a fixed resistor R. This can be seen readily by imagining at first, that R is a short circuit. The gain of A2 is then controlled linearly by the 47K Ohm pot. If R is now removed altogether, the gain of A2 is still controlled by the linear pot, but the gain of A3 is also being varied since the portion of the gain control pot outside the feedback loop of A2 is now in series with A3, the Balance Control amplifier. Thus, as the gain control is moved away from its zero position, the gains of stages A2 and A3 then increases with an approx. square law, until near maximum when the maximum gain in A3 is limited by the 3K3 fixed input resistor. This square law is, in practice, too sharp for use as a volume control and so we achieve something between the two extremes described by making R a fixed resistor of 22K Ohms. This gives a gain, in the volume control centre position, about 20 dB down from the maximum.

It can be seen the maximum gain of this stage is the ratio of the feedback resistor to the input resistor.

e.g. for PU $\quad \text{Gain} = \frac{VR1}{R10} = \frac{47K}{2K7}$ approximately 17 times.

4.2.3. BALANCE CIRCUIT (A3)

The balance amplifier is a simple common emitter stage with the dc conditions set by R28. AC feedback is taken from collector to base by R26 and R27. R26 is shunted by a 1M Ohm pot; this being one half of the BALANCE CONTROL.

The gain of this stage with the BALANCE control fully off is about:

$$\frac{1 + (38K = 3K3)}{3K3} = 12.5 \text{ times.}$$

and with the control fully on:

$$\frac{1 + 3K3}{3K3} = 1.3 \text{ times.}$$

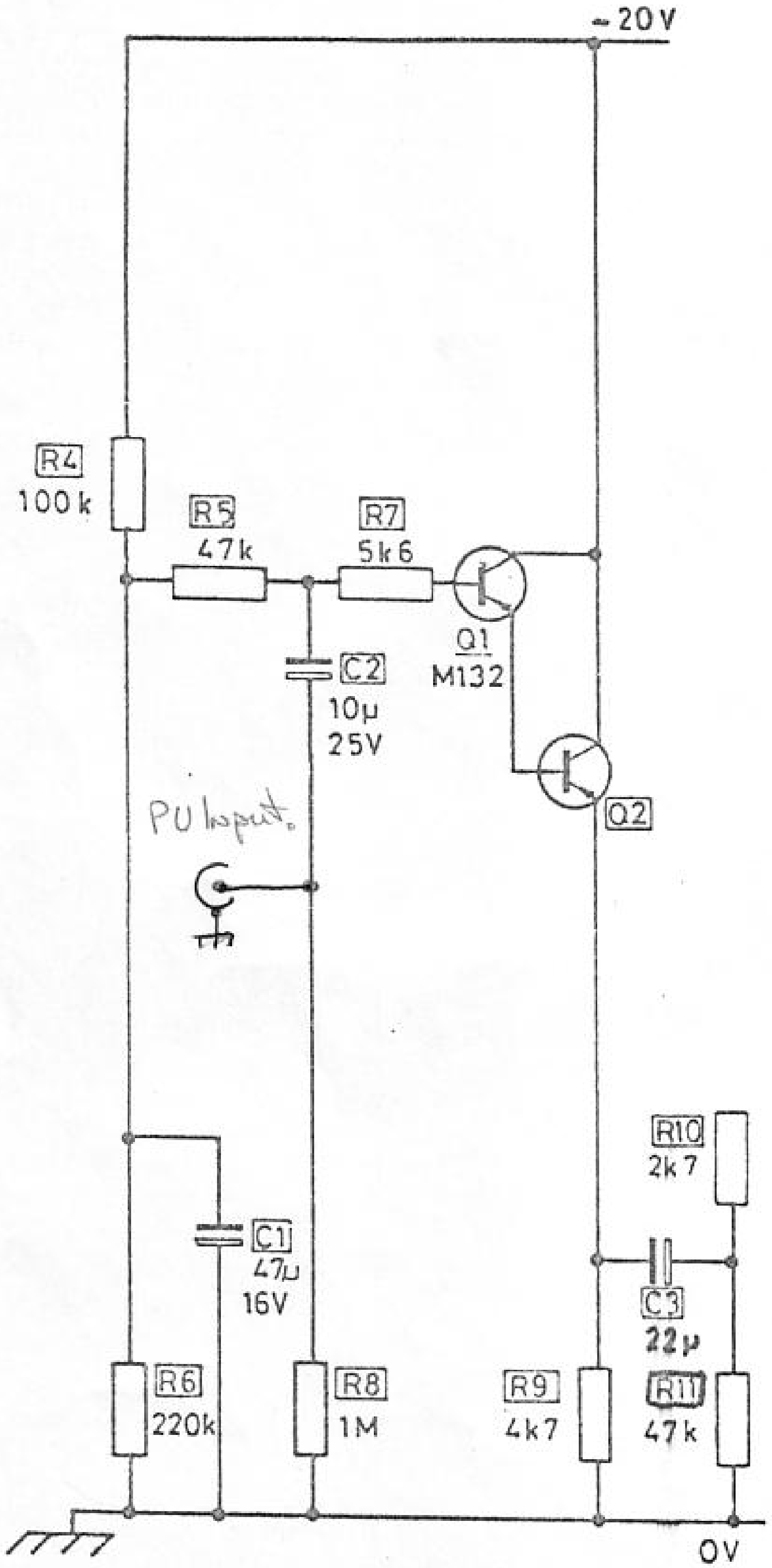
The Stereo/Mono switch cross-connects the two channels via 3K3 summing resistors thus giving equal gain to both signals. (Figure 8).

4.2.4. EQUALISATION CIRCUIT (A4)

This stage is a similar common emitter stage having two possible feedback network selected by an additional wafer of the input selector switch. In the pickup positions a time constant network equal to the RIAA characteristic gives the stage Bass boost and Treble cut.

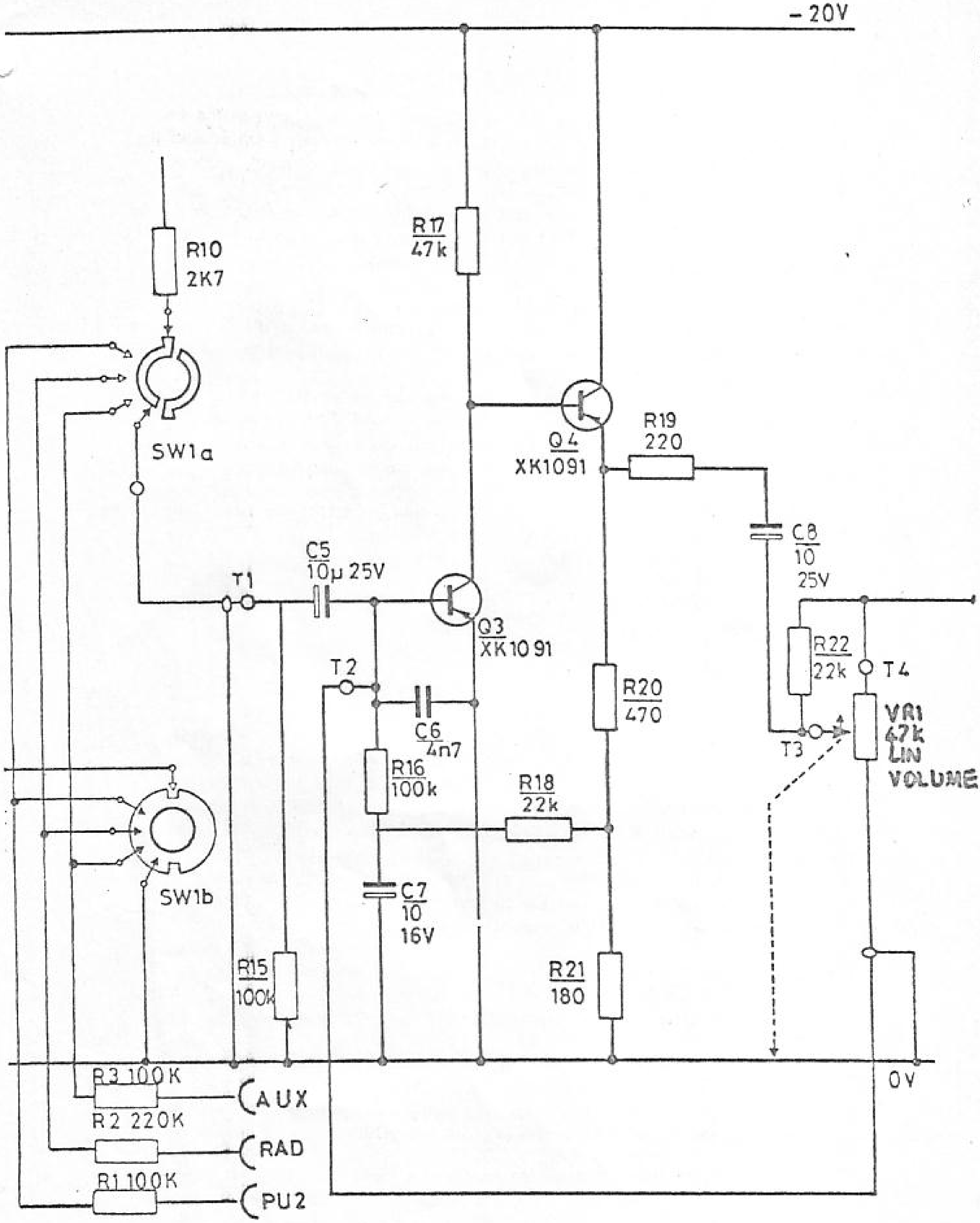
For the other inputs the switch selects a 10K Ohm (R32) resistor which sets the stage gain at about unity.

The collector to base capacitor C16 is ensure hf stability by rolling off the hf response of the stage (Figure 9).



-20V
R4
100k
R5
47k
R7
5k6
Q1
M132
C2
10μ
25V
Q2
PU Input.
R10
2k7
C1
47μ
16V
C3
22μ
R6
220k
R8
1M
R9
4k7
R11
47k
0V

FIG.5



-20V
R10
2K7
R17
47k
SW1a
Q4
XK1091
R19
220
C8
10
25V
T1
C5
10µ 25V
Q3
XK10 91
T2
C6
4n7
R16
100k
R20
470
R22
22k
T4
T3
VR1
47k
LIN
VOLUME
R18
22k
SW1b
C7
10
16V
R15
100k
R21
180
0V
R3 100K
AUX
R2 220K
RAD
R1 100K
PU2

FIG.6

4. AMPLIFIER DESCRIPTION CONT'D

4.2.5. TONE CONTROL CIRCUIT (A5)

The tone control stage uses the same common emitter circuit as the two preceeding stages. The tone controls from the ac feedback loop around the stage. The component values are arranged so that at mid-band frequencies (1KHz) the stage gain is unity. The bass roll-off frequency is determined by C20 and C19. The treble roll-off frequency is determined by C21. Resistors R42 and R41 isolate the two tone controls to prevent interaction.

Before the tone controls is a LF filter. This is a simple CR (C17, R37) network in the signal path and provides a 6 dB/Octave roll-off (6 dB down at about 60Hz). In the normal mode it is shorted across by the switch.

Directly after the tone control amp. is the H.F. filter. Rather than the usual moderate high-frequency roll-off it is a notch filter having a centre frequency of about 27 KHz. This means the circuit will start to pass signal again at much higher frequencies but these are well outside the audio-band.

In the H.F. Gradual position a resistor is shunted across the Twin T to reduce its "Q" and hence the filters sharpness. (Figure 10).

4.2.7. POWER AMP PROTECTION CIRCUITS

These circuits consist of two sensing circuits (Q.16, Q17) and a latching circuit (Q15 and Q16).

Reference to figure 12 shows the Q17 sense circuit. This circuit is arranged to monitor the current through Q21 and the voltage across it. The circuit thus senses the power dissipation of Q21.

This form of sensing is called VI and overcomes the main limitation of current only sensing. This is that with a reactive load the current and voltage in the load can be out of phase and thus the dissipation of the output transistor higher.

Taking the circuit of Q17 it can be seen that when the voltage across R82 rises above 2.5 volts (collector current of about 17 Amps) then Q17 turns on and its collector goes negative.

This negative potential also turns on Q16. As the voltage drop across Q21 increases R75 provides a current which reduces the voltage necessary across R82 to turn on Q17. Hence not only is the current to the load limited but also the power dissipated Q21. (Similarly Q20 and Q16).

When Q16 turns on its collector goes positive and turns Q15 off. C34 provides regenerative feedback to complete the monoitable circuit. Thus Q15 is held off for a period determined by C34 and R69. When Q15 is turned on it removes the deive voltage from both of the current sources Q9 and Q12 by shorting their bases to the supply rail thereby turning the whole power amplifier off.

4.2.7. POWER AMP PROTECTION CIRCUITS CONT'D

Each time the monostable toggles it allows C33 to charge up while Q15 is off. If this happens repeatedly there is no time for it to discharge through R69 and Q15 during its ON periods and after a short time the voltage across C33 is enough to keep Q15 permanently off by turning Q16 on through R71. Thus the action of the flip-flop has become bistable.

Q15 and Q16 may now only be reset by turning off the power supply; when C33 is allowed to discharge through R71 and R73 (the drive through R70 from the negative supply being removed).

There is an output from the collector of Q15 through R68 to the relay driver circuit. (Figure 13).

4.2.8. RELAY DRIVE CIRCUIT

This circuit is arranged such that the relay is normally energised and hence the loudspeakers connected to the power amp. output lines. (Fig. 14).

Q25 and Q26 monitor the d.c. offset of the power amplifier output lines, and, with diodes D11, D12 and D13, bias the base of Q28 off if this offset voltage is greater than ± 0.6 volts.

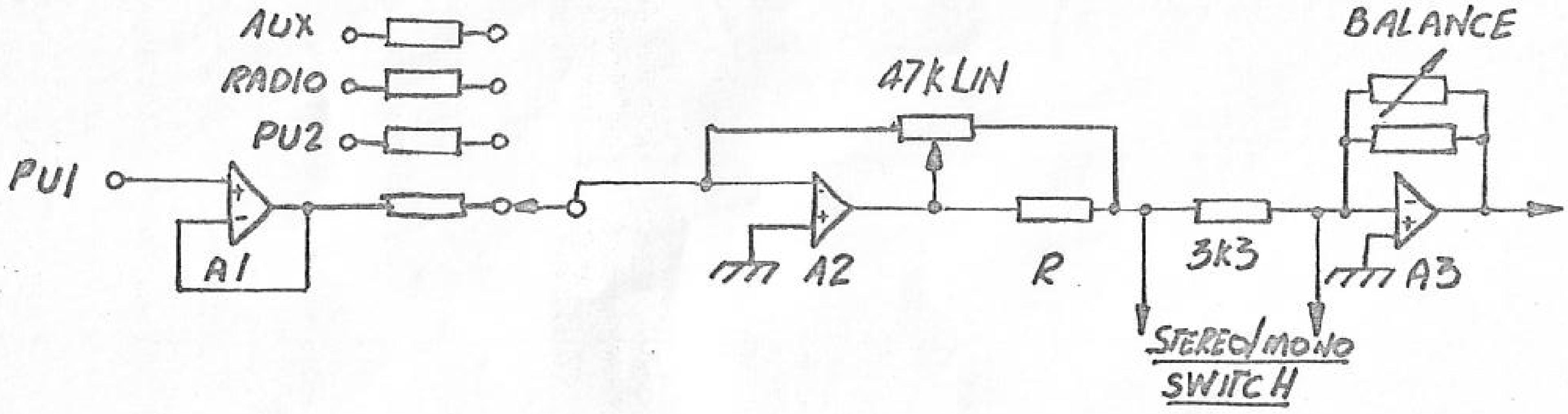
During normal operation Q28 is biased on by the current down R100 and R68. The collector of Q28 deives the base of Q29 which deives the relay coil. This the relay is normally powered. If Q15 switches off (power amp. protection circuit) in its bistable mode the drive to the base of Q28 is removed (with a delay as C40 discharges) and the relay is de-energised and disconnects the loudspeakers.

There is a fleeting contact (operates between switch positions, but open circuit otherwise) wafer on the SELECTOR switch (SWID) which discharges C40 through R91 each time the switch is turned, thereby disconnecting the loudspeakers for a few seconds as the dc conditions of the input settle, so as to avoid unwanted transients through the loudspeakers.

4.2.9. PREAMPLIFIER POWER SUPPLY CIRCUIT

This circuit consists of Q27 which acts as an emitter follower whose base voltage is defined by the potential divider R93 and R94 from the unregulated negative rail.

The base is decoupled by C41 to reduce ripple. C42 acts as the reservoir capacitor for the 20V rail, which powers all the pre-amplifier circuits. (Figure 15).



AUX
RADIO
PU2
PU1
A1
47k LIN
A2
R
3k3
STEREO/MONO
SWITCH
BALANCE
A3

FIG. 7

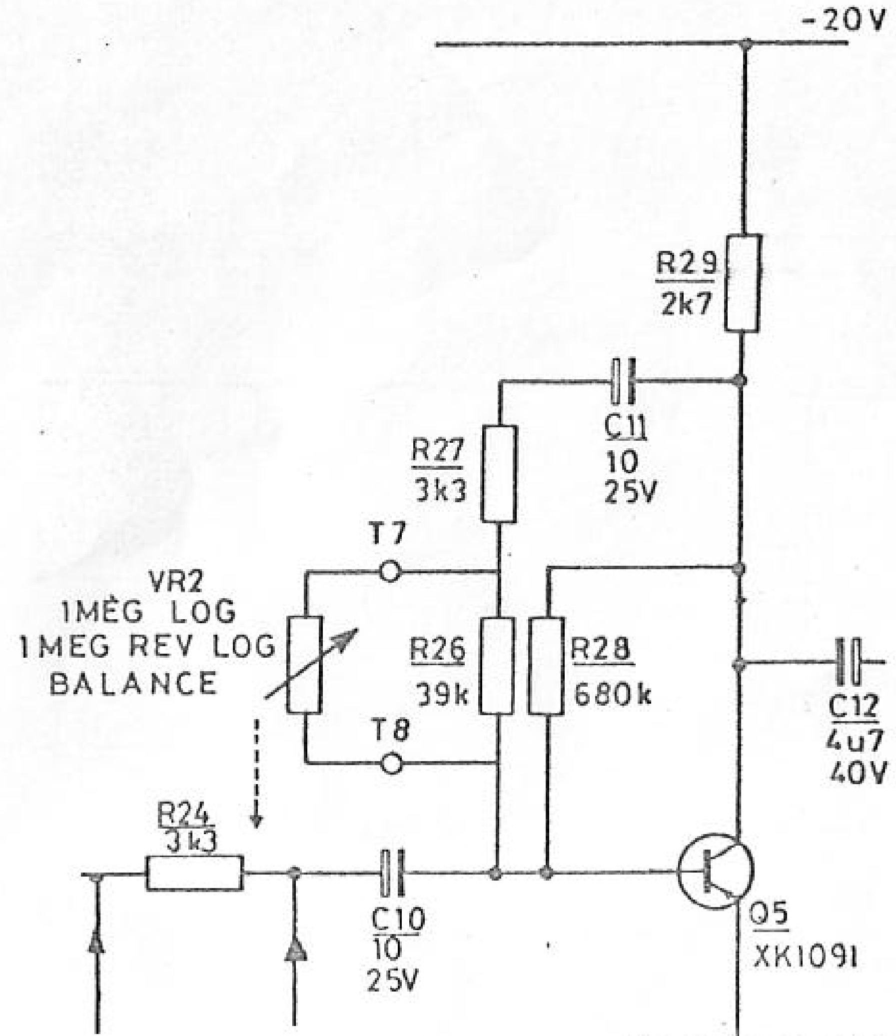
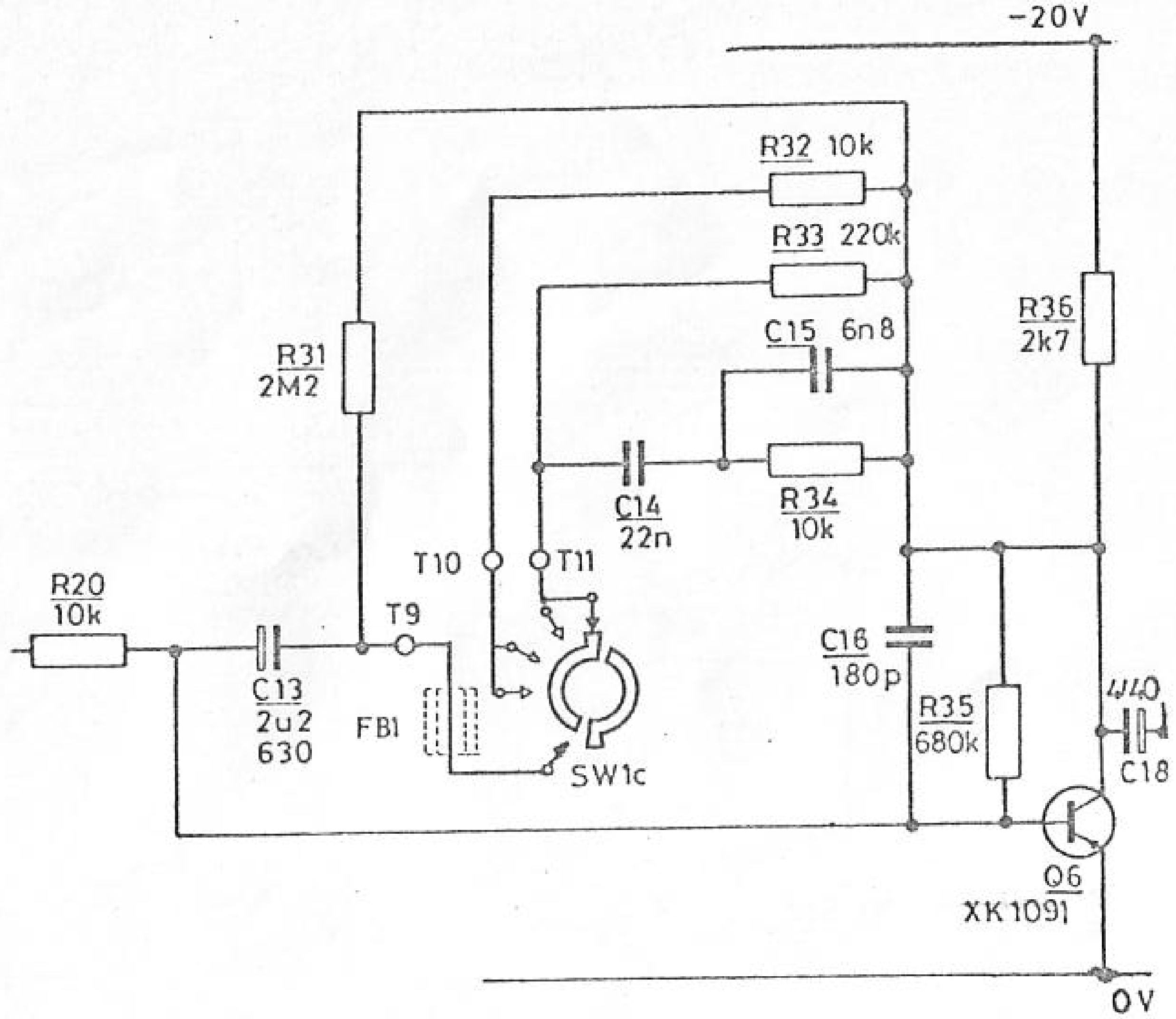
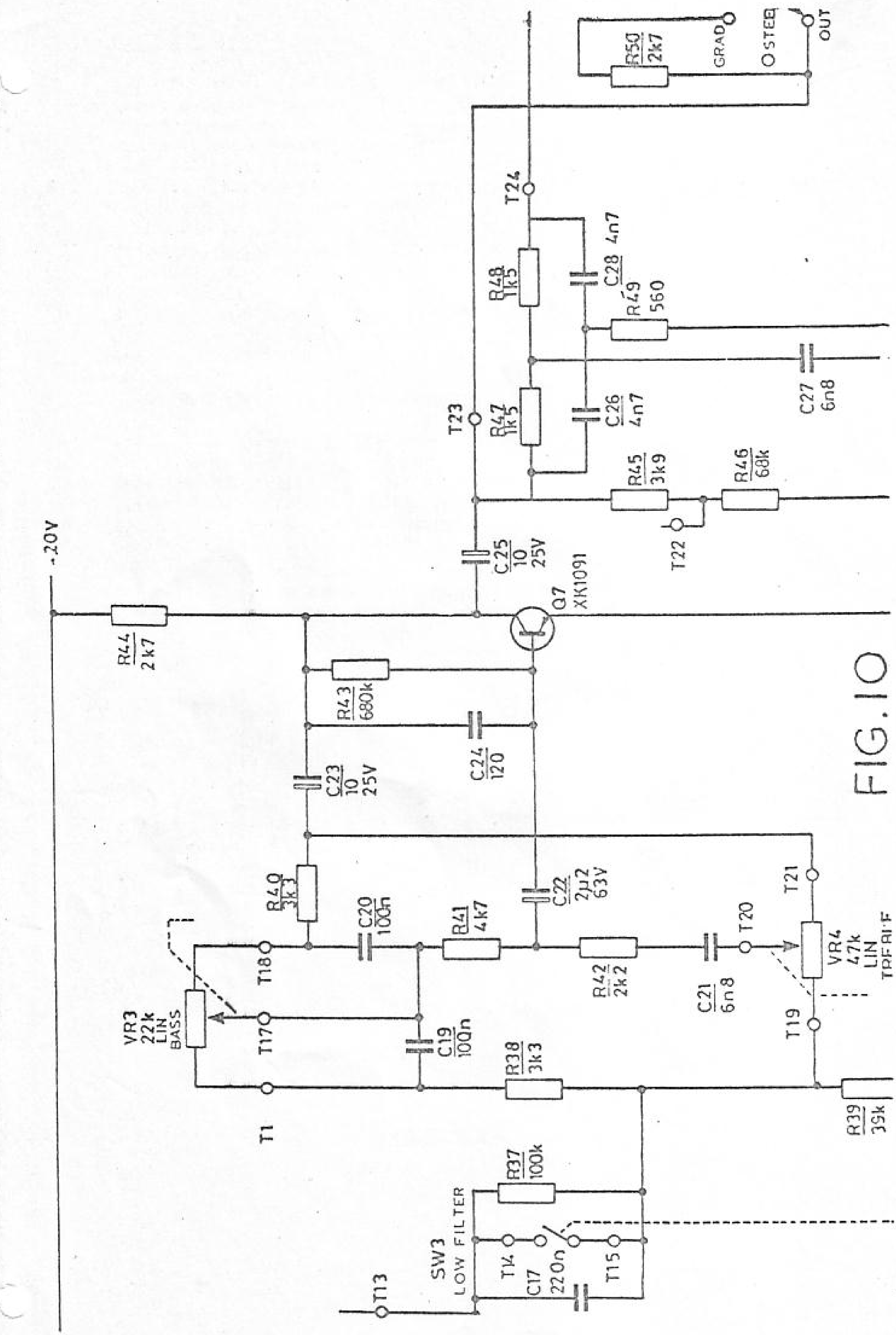

-20V
R29
2k7
C11
10
25V
R27
3k3
T7
VR2
1MEG LOG
1MEG REV LOG
BALANCE
R26
39k
R28
680k
C12
4u7
40V
T8
R24
3k3
C10
10
25V
Q5
XK1091
0V

FIG.8



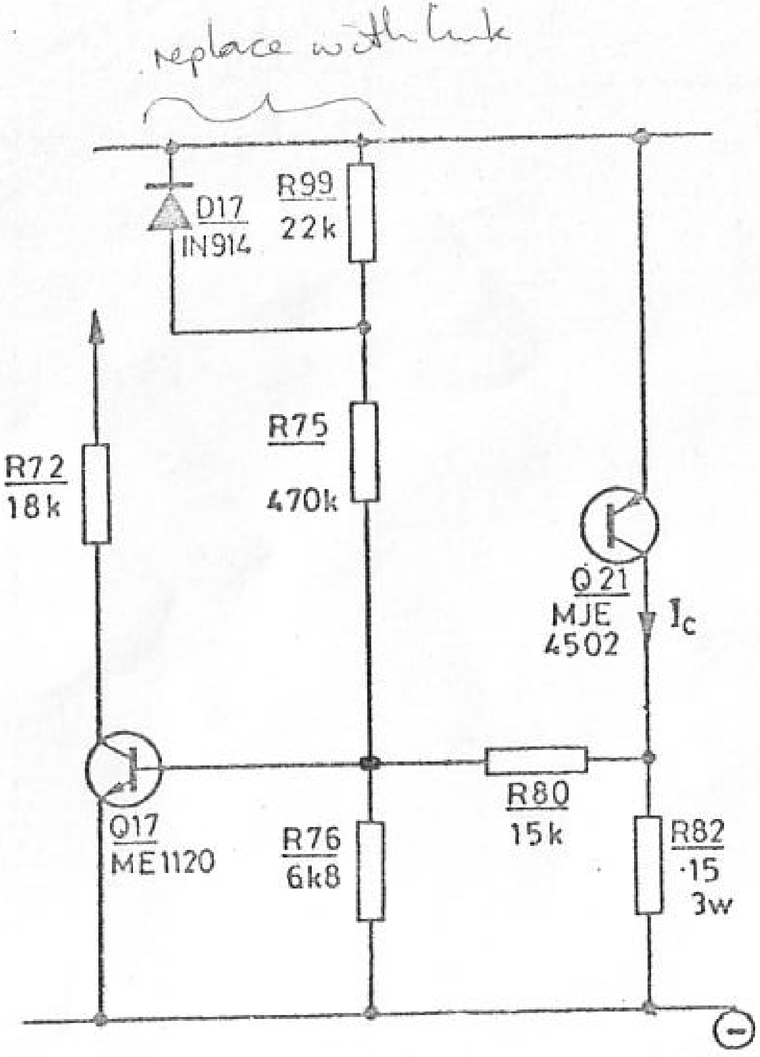
-20V
R32 10k
R33 220k
C15 6n8
R36
2k7
R31
2M2
C14
22n
R34
10k
T10
T11
R20
10k
T9
C13
2u2
630
FB1
SW1c
C16
180p
R35
680k
440
C18
Q6
XK1091
0V

FIG9



-20V
R44 2k7
R43 680k
C24 120
C23 10 25V
R40 3k3
C20 100n
R41 4k7
C22 2μ2 63V
R42 2k2
C21 6n8
T20
T21
VR4 47k LIN TREBLE
T19
R39 39k
VR3 22k LIN BASS
T18
T17
T1
C19 100n
R38 3k3
R37 100k
SW3 LOW FILTER
T14
T15
C17 220n
T13
Q7 XK1091
C25 10 25V
T22
R45 3k9
R46 68k
T23
R47 1k5
C26 4n7
C27 6n8
R48 1k5
C28 4n7
R49 560
T24
R50 2k7
GRAD
STEEP
OUT

FIG. 10



replace with link
D17
IN914
R99
22k
R72
18k
R75
470k
Q21
MJE
4502
Ic
Q17
ME1120
R76
6k8
R80
15k
R82
·15
3w

FIG12

4.2 POWER AMPLIFIER

The input stage consists of transistors Q8 and Q10 arranged in a long-tailed pair configuration (differential amp.). This arrangement has the advantages of excellent temperature stability of the output dc level, as any change in the base emitter voltage of the transistor Q8 due to temperature change is offset by a similar change in the base emitter voltage of transistor Q10. This circuit seeks to establish a condition of balance between the two halves and as the base of Q8 is connected by R56 and R57 to the earth line; this is achieved when the dc potential on the base of Q10 is also at zero volts. Since this point is connected to the output line then the dc potential of this line will automatically be adjusted to zero (earth potential). Transistor Q9 is arranged as a constant current feed to the long tail pair and thus can just be considered as a high impedance.

The ac gain of the power amplifier is set by the ratio of 1 + R62 and R60 and is set at 53 times. The low frequency roll off is mainly determined by C34 and this gives a -3dB frequency of 20Hz.

The long tail pair feed transistors Q11 which is an emitter follower intended to reduce the loading on Q10 and provide a low impedance drive to the voltage amplifier stage Q11. Q14 is employed as an amplified diode to provide the correct biasing for the output transistor pairs. This transistor is mounted on the heat sink and so is in thermal contact with the output devices.

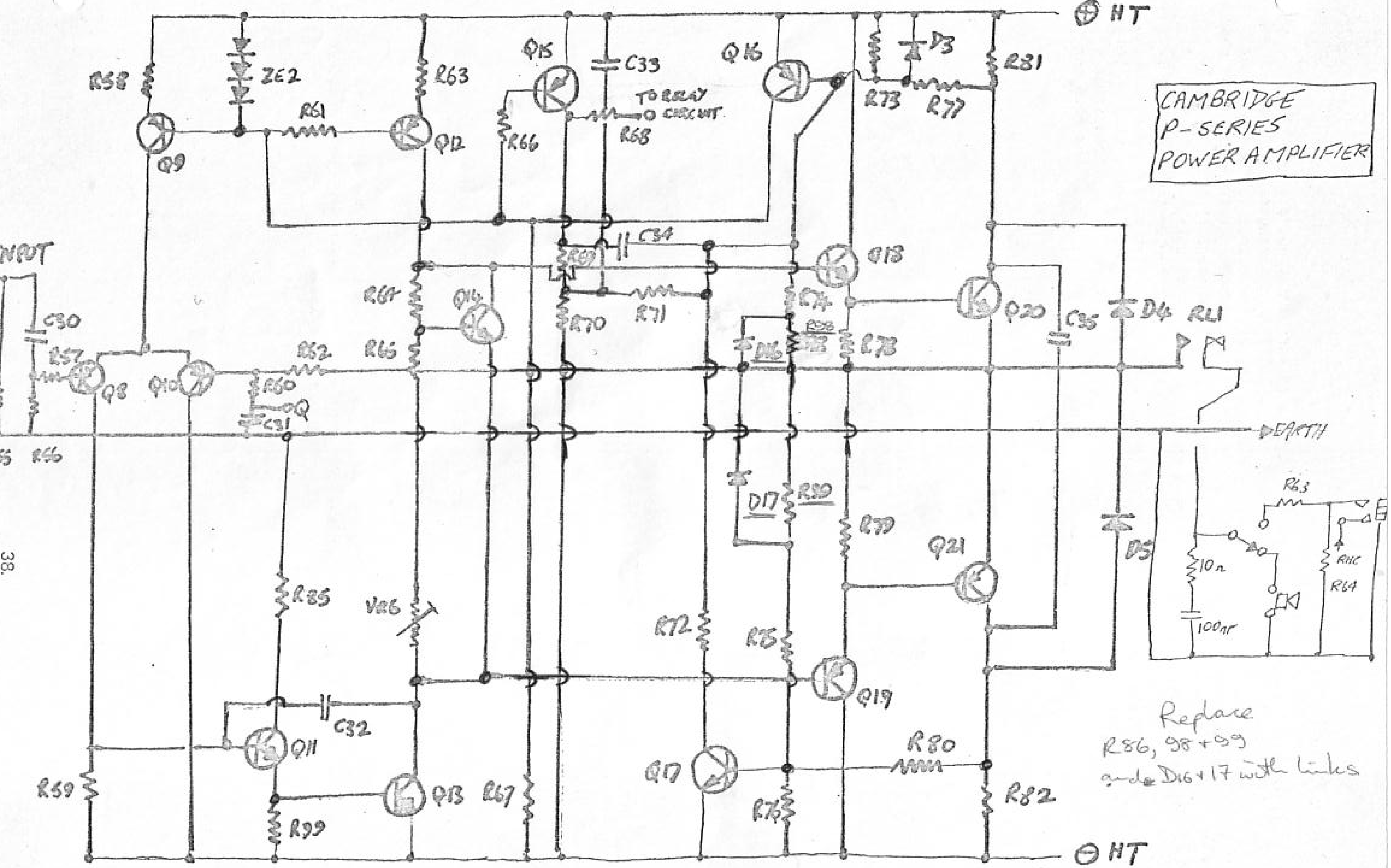
Transistor Q12 is arranged as a constant current sink. This transistor has a constant voltage across its base by the potential divider formed by diode chain ZE2 and resistor R67. The voltage across ZE2 turns on Q12 and ensures that the voltage across its emitter resistor (R63) and thus the current sunk by transistor Q12 remains constant with changes in temperature, as any change in the base emitter voltage of Q12 is compensated for by a similar change in the diode voltage.

This arrangement reduces the current owing on the voltage amplifier Q13. Also an improvement in cross-over distortion (particularly at high frequencies) is obtained. This is because the transistor current sink maintains its high output impedance throughout the complete range of output swing, which ensures a fast turn on of the ongoing half of the output stage at the crossover point. This contrasts with the more common boot strapped resistor arrangement whose input impedance tends to fall at the cross-over point because the voltage on the collector of the transistor Q11 changes more than the output voltage - thus the resistor cannot act as a constant current sink at the crossover point.

The output transistor pairs are arranged as Darlington pairs; the pair having a current gain the product of the two individual gains.

Resistor R53 and capacitor C35 across the loudspeaker output for a Zobel network provided to tailor the HF gain and phase relationships ensuring that the amplifier will be stable into reactive loads.

CAMBRIDGE P-SERIES POWER AMPLIFIER



Replace R86, 98 + 99 and D16 + 17 with links

5.1 GENERAL NOTES ON TESTING

5.1.1. The Cambridge Audio P.50 may be tested throughout using an AVO Model 8, Mk. III Meter or a similar instrument, however an oscilliscope makes some of the tests easier. For a.c. tests a one microfarad non-polarised capacitor should be used in series with the meter. A sine wave oscillator is also necessary, and this should have a calibrated output. Bear in mind that the output of an oscillator may be calibrated for 600 ohm loading, and if such an oscillator is loaded with only the high impedance of any of the signal inputs of the amplifier, its meter will indicate approximately half of the actual voltage delivered.

5.1.2. To convert r.m.s. voltages to peak-peak voltages in order to read them on an oscilloscope, multiply by 2.8, so 1.6 volts r.m.s. = 4.5 volts p-p approximately.

5.1.3. If it is suspected that a transistor is faulty, it may be tested in circuit using an AVO on the R.100 range, otherwise it should be removed from the circuit for test. There are six tests to make on a transistor, these are tabulated below with a rough indication of the meter reading for each test. In all six the meter is used on a resistance measuring range. It should be remembered that most meters deliver a positive voltage from their negative terminal when testing resistance.

AVO Mk. VIII ÷ 100	
Emitter-Base forward bias:	Mid range approx.
Collector-Base forward bias:	Mid range approx.
Emitter-Base reverse bias:	Very high.
Collector-Base reverse bias:	Very high.
Emitter-Collector:	Very high.
Collector-Emitter:	Very high.

5.1.4. Do not remove or replace components with the power switched on, this can cause more problems than were originally there.

5.1.5. In the text the term 'diode-drop' is used, this is the voltage drop across a forward biased silicon diode or transistor emitter-base junction. This is normally 0.5 to 0.7 volts and is measured in circuit with the power switched on. It may be measured as a quick check to see if a transistor is operating correctly. If the emitter-base drop is greater than 0.7 volts the transistor is certainly faulty, if lesss than 0.5 volts it may be faulty, or there is another fault in the circuit that is removing the base drive current. It should be noted that D1 is a triple diode, and so there will be a drop of approximately 2.1 Volts across it.

5.1.6. A logical test sequence follows. It is recommended that section 4 of this manual be read before testing, in order that an understanding of the working of the amplifier is gained.
Test Points are shown on the circuit diagram.
All voltages are measured with respect to the amplifier chassis unless indicated.
Loudspeakers or loads should not be connected for these tests.

5. TESTING CONT'D

5.2 D.C. TESTS

DO NOT switch on the power yet.

5.2.1. Remove the amplifier covers (see 3.2 and 3.3).

5.2.2. Check that the fuse in the mains plug is intact (if fitted).

5.2.3. Remove the three fuses from the back of the amplifier and check for continuity. A filament of fuse wire should be visible inside the glass case, and should be intact. Replace the mains fuse in the amplifier, fitting a new one of the same rating if necessary.

5.2.4. Plug the amplifier into the mains and switch on. The indicator above the mains on/off switch should light up.

5.2.5. Switch off, replace the power amplifier fuses, and switch on again.

5.2.6. Check that TP1 is at +30 V d.c., and TP2 is at -30 V d.c. If these are not approximately correct check the fuses again, if either is blown there is probably a fault in one or both of the power amplifiers and their protection circuits; it is likely that the power transistors are faulty, see 6.1.

5.2.7. Check that TP3 is at -18 V d.c.

5.2.8. Check the other d.c. voltages against those on the main circuit diagram.
A discrepancy will indicate a fault in the associated components.

5.3. A.C. TESTS

5.3.1. Apply 100 mV at 1 kHz to the AUX input, with the BALANCE, TREBLE and BASS controls central, both the FILTER switches OUT, the VOLUME control at maximum, and the AUX selected on the input selector switch. Make the following a.c. measurements.

TP4	50 mV rms	140 mV p-p
TP5	500 mV rms	1.4V p-p
TP6	500 mV rms	
TP7	500 mV rms	
TP8	21 volts rms	

5.3.2. Apply 3 mV rms to the PU 1 input with PU 1 selected and the other controls set as above. Check that TP8 gives the same reading.

5.3.3. Apply 100 mV rms to the PU2 input with PU2 selected and the other controls set as above. Check that TP 8 gives the same reading.

5.3.4. Apply 250 mV rms to the RAD input with RAD selected and the other controls set as above. Check that TP9 gives the same reading.

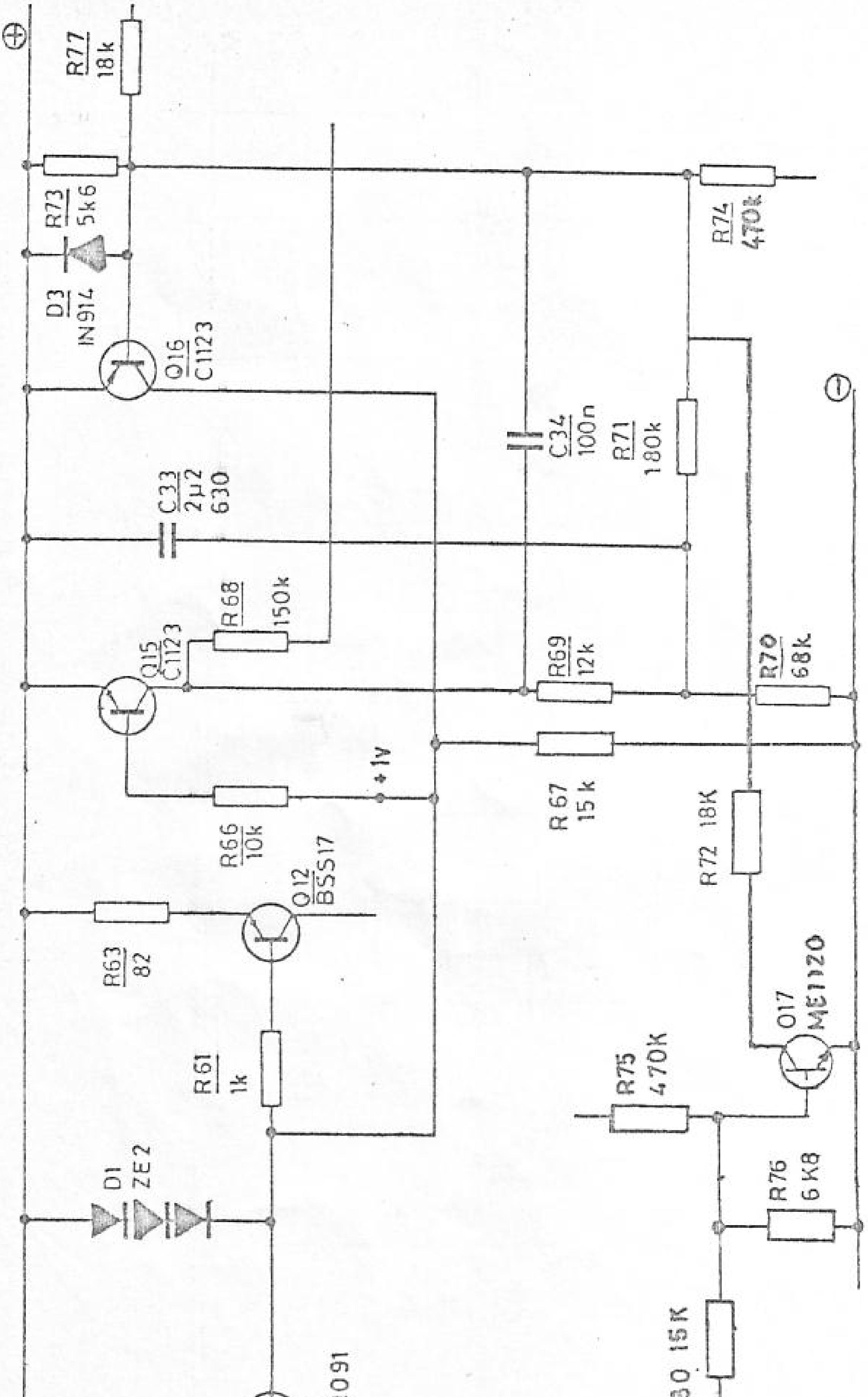

R77
18k
R73
5k6
D3
IN914
Q16
C1123
C33
2μ2
630
C34
100n
R71
180k
R74
470k
R68
150k
Q15
C1123
R69
12k
R70
68k
R67
15k
+1V
R66
10k
Q12
BSS17
R63
82
R61
1k
D1
ZE2
Q9
XK1091
R72 18K
Q17
ME1120
R75
470K
R76
6K8
R80 15K

FIG 13

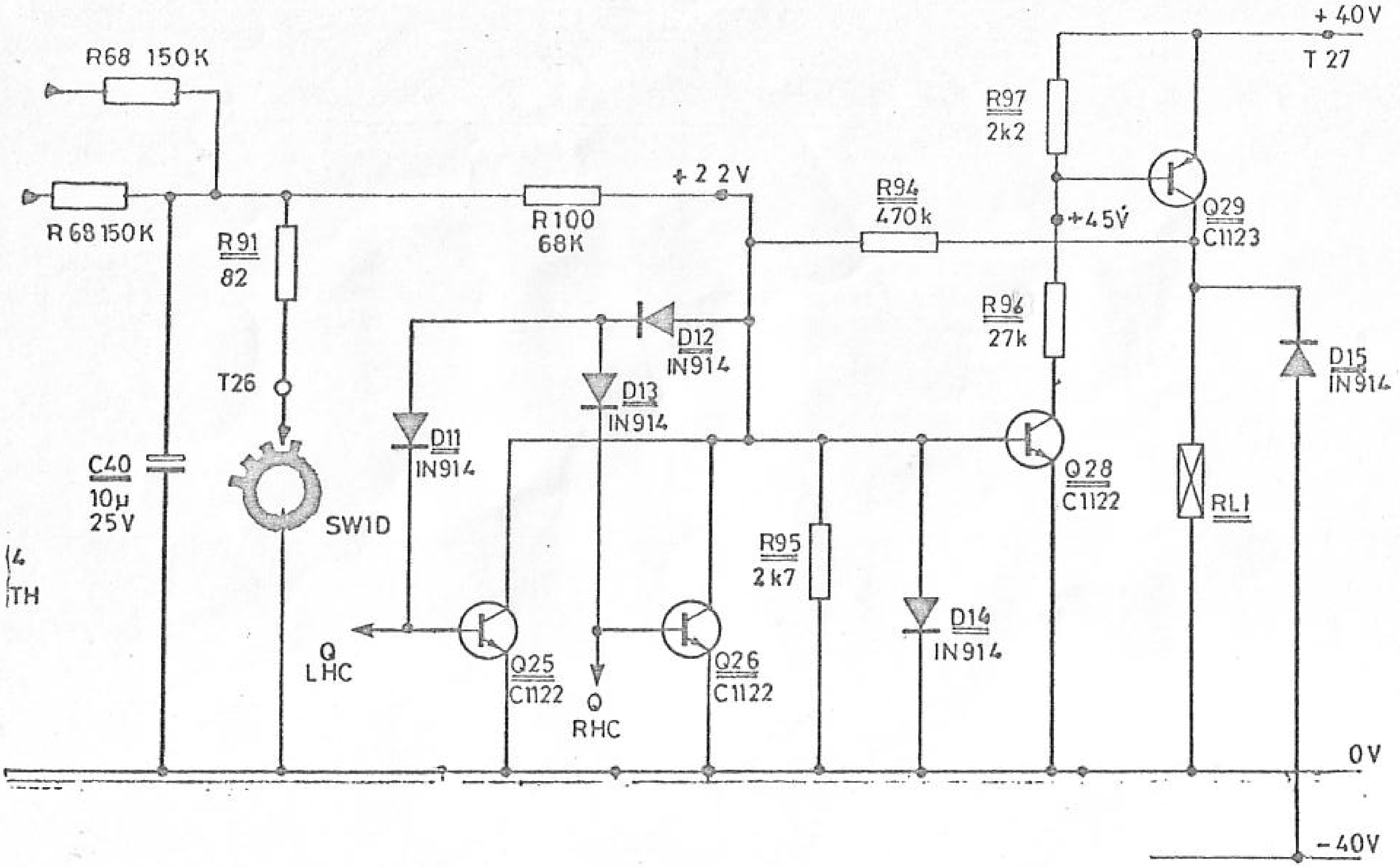

R68 150K
R 68 150K
R91
82
R100
68K
+22V
R94
470k
R97
2k2
+45V
Q29
C1123
+40V
T 27
R96
27k
D12
IN914
D13
IN914
D11
IN914
T26
C40
10μ
25V
SW1D
Q
LHC
Q25
C1122
Q
RHC
Q26
C1122
R95
2k7
D14
IN914
Q28
C1122
RL1
D15
IN914
0V
-40V
14
TH

FIG. 14.

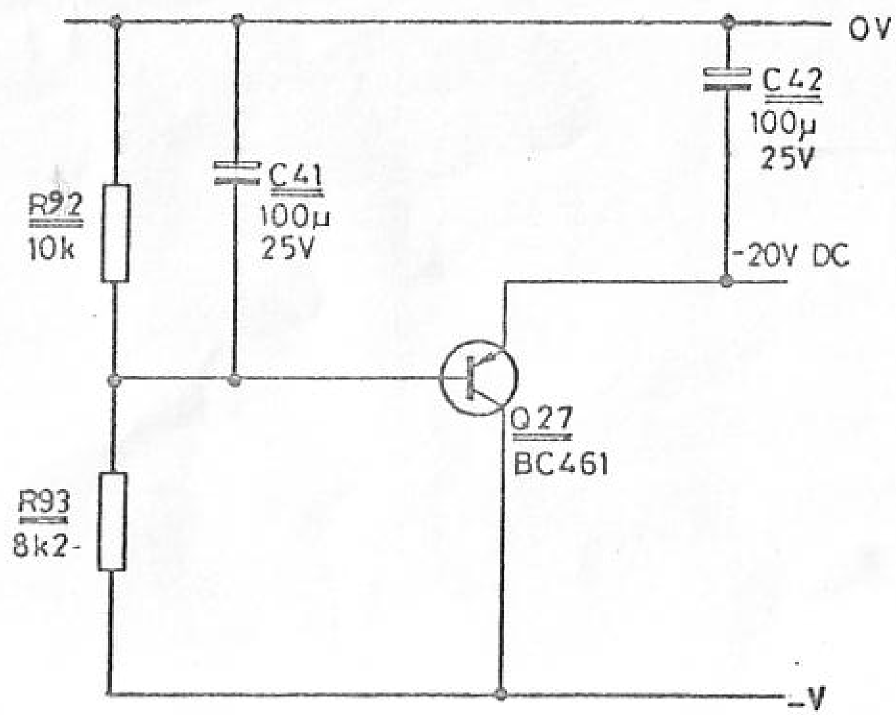


FIG.15

6.1. POWER AMPLIFIER

The power amplifier is best checked by measuring the d.c. voltages at various points in the circuit against those published.

Note that the voltages on the circuit diagram are typical and a 10% tolerance is usually acceptable.

for ten seconds and back on again. If the tests above are still showing that the protection circuit has tripped, it is likely that the power transistors are faulty. Whilst checking, also check Q18 and Q19 and replace as necessary.

Note that if the protection circuit on either side has tripped, the relay should be unpowered. This can be checked by seeing which contacts of the relay are touching, if nearer the transformer it is unpowered.

7. COMPONENT LIST (ELECTRICAL)

When ordering spare parts, it is helpful if the part to be replaced is returned with the order. This will enable a part to be matched exactly, or the best substitute to be provided.

The parts used in the P.50 amplifier are subject to change from time to time because of Cambridge Audio's policy of continuous improvement.

When ordering parts always quote part numbers.

6.1 - Check TP14 reads 1.8 - 2.2V dc across diode D1.
Check that the voltage across D3 is about 0.55V. dc.
Check that the voltage across C33 is about 11Vdc.
If it is much more than 11V, the power amplifier protection circuit has tripped.
Turn the amplifier off

COMPONENT LIST (ELECTRICAL) CONT'D

Circuit Ref.	Value.	Part Code.	Quantity.
R1	100k	0338 or 0233	2
R2	220k	0342 or 0237	2
R3	100k	0338 or 0233	2
R4	100k	0338 or 0233	2
R5	47k	0337 or 0229	2
R6	220k	0342 or 0237	2
R7	5k6	0326 or 0218	2
R8	1MO	0350 or 0244	2
R9	4k7	0325 or 0217	2
R10	2k7	0322 or 0214	2
R11	47k	0337 or 0229	2
R15	100k	0338 or 0233	2
R16	100k	0338 or 0233	2
R17	47k	0337 or 0229	2
R18	22k	0333 or 0225	2
R19	220R	0310 or 0201	2
R20	470R	0313 or 0204	2
R21	180R	0309 or 0200	2
R22	22k	0333 or 0225	2
R23	22k	0333 or 0225	2
R24	3k3	0323 or 0215	2
R25	3k3	0323 or 0215	2
R26	39k	0336 or 0228	2
R27	3k3	0323 or 0215	2
R28	680k	0348 or 0242	2
R29	2k7	0322 or 0214	2
R30	10k	0329 or 0221	2
R31	2M2	0352 or 0245	2
R32	10k	0329 or 0221	2
R33	220k	0342 or 0237	2
R34	10k	0329 or 0221	2
R35	680k	0348 or 0242	2
R36	2k7	0322 or 0214	2
R37	100k	0338 or 0233	2
R38	3k3	0323 or 0215	2
R39	39k	0336 or 0228	2
R40	3k3	0323 or 0215	2

Circuit Ref.	Value.	Part Code.	Quantity.
R41	4k7	0325 or 0217	2
R42	2k2	0321 or 0212	2
R43	680k	0348 or 0242	2
R44	2k7	0322 or 0214	2
R45	8k2	0324 or 0216	2
R46	22k	0339 or 0231	2
R47	1k5	0319 or 0210	2
R48	1k5	0319 or 0210	2
R49	560R	0314 or 0205	2
R50	2k7	0322 or 0214	2
R55	220k	0342 or 0237	2
R56	39k	0336 or 0228	2
R57	1k0	0317 or 0208	2
R58	2k2	0321 or 0212	2
R59	3k3	0323 or 0215	2
R60	1k0	0317 or 0208	2
R61	1k0	0317 or 0208	2
R62	39k	0336 or 0228	2
R63	82R	0306 or 0197	2
R64	1k2	0318 or 0209	2
R65	470R	0313 or 0204	2
R66	10k	0329 or 0221	2
R67	15k	0331 or 0223	2
R68	120k	0340 or 0235	2
R69	12k	0330 or 0222	2
R70	47k	0337 or 0229	2
R71	180k	0341 or 0236	2
R72	18k	0332 or 0224	2
R73	5k6	0326 or 0218	2
R74	68k	0346 or 0240	2
R75	680k	0348 or 0242	2
R76	8k2	0327 or 0219	2
R77	18k	0332 or 0224	2
R78	470 R	0313 or 0204	2
R79	470R	0313 or 0204	2
R80	15k	0331 or 0223	2
R81	0.15R	0680	2
R82	0.15R	0680	2

Circuit Ref.	Value.	Part Code.	Quantity.
R83	120R, ½W	0101	2
R84	68R, ½W	0094	2
R85	10k	0329 or 0221	2
R87	10R, ½W	-	2
R91	82R	0306 or 0197	1
R92	27k	0334 or 0226	1
R93	5k6	0328 or 0219	1
R94	470k	0346 or 0240	1
R95	4k7	0322 or 0213	1
R96	27k	0313 or 0204	1
R97	2k2	0321 or 0212	1
R100	150k	0339 or 0231	1
C1	47u/16V	1108	2
C2	10u/25V	1082	2
C3	22u/16V	1094	2
C5	10u/25V	1082	2
C6	4n7	0920	2
C7	10u/16V	1081	2
C8	10u/25V	1082	2
C9	10u/25V	1082	2
C10	10u/25V	1082	2
C11	10u/25V	1082	2
C12	4u7/35V	1058	2
C13	2u2/64V	1047 or 1076	2
C14	22n	0960	2
C15	6n8	0933 or 0883	2
C16	180p	0846	2
C17	220n	1004	2
C18	4u7/35V	1058	2
C19	100n	0992	2
C20	100n	0992	2
C21	6n8	0933 or 0883	2
C22	2u2/64V	1047 or 1076	2
C23	10u/25V	1082	2
C24	120p	0839	2
C25	10u/25V	1082	2
C26	4n7	0920	2
C27	6n8	0933 or 0883	2
C28	4n7	0920	2
C30	3u3/16V	1050	2
C31	47u/6V3 or 10V	1107	2
C32	33p	0820	2
C33	2u2/50V		2
C34	100n	0992	2

Circuit Ref.	Value.	Part Code.	Quantity.
C35	470p		2
C36	100n		2
C40	10u/25V	1082	1
C41	100u/25V	1123	1
C42	100u/25V	1123	1
C43	6800u/50V		1
C44	6800u/50V		1
C45	100n 250V AC		1
Q1	M132		2
Q2	M132		2
Q3	XK1091	1633	2
Q4	XK1091	1633	2
Q5	XK1091	1633	2
Q6	XK1091	1633	2
Q7	XK1091	1633	2
Q8	XK1091	1633	2
Q9	XK1091	1633	2
Q10	XK1091	1633	2
Q11	C1122	1609	2
Q12	BSS17		2
Q13	BSS15		2
Q14	MPSA06	1601	2
Q15	C1123	1610	2
Q16	C1123	1610	2
Q17	ME1120		2
Q18	BSS15 / BC441 NPN BC142		2
Q19	BSS17 / BC461 PNP BC143		2
Q20	MJE802		2
Q21	MJE4502		2
Q25	C1122	1609	1
Q26	C1122	1609	1
Q27	BC461	1641 or 1630	1
Q28	C1122	1609	1
Q29	C1123	1610	1

Circuit Ref.	Value.	Part Code.	Quantity.
D1	ZE2	1216	2
D3	IN914	1267	2
D4	IN4002	1253	2
D5	IN4002	1253	2
D11	IN914	1267	1
D15	IN914	1267	1
D16	IN914	1267	1
D17	IN914	1267	1
D18	IN914	1267	1
BR1	KBN502	–	1

Substitutions

M132	–	Low noise BCY71
XK1091	–	BCY71
BSS17	–	BC461 (selected high voltage)
BSS15	–	BC441 (selected high voltage)

SUPPLEMENT FOR EARLIER VERSIONS

OF P.50 MARK II

P.50 AMPLIFIER MARK II (Earlier Versions)

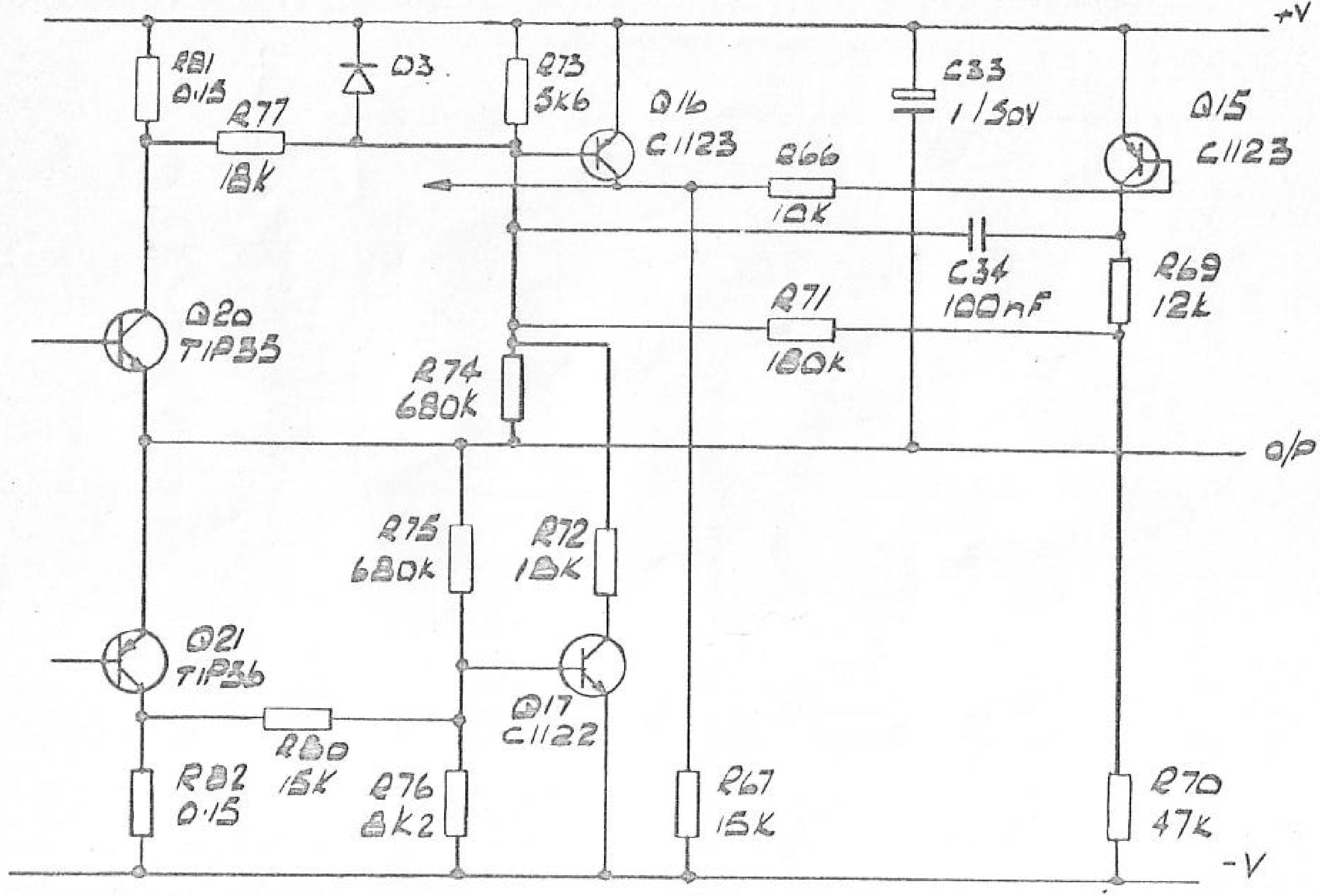
This amplifier differs from lat er versions only in the design of the relay protection circuit. The earlier version is built on a printed circuit board type CAL P.50/02 - 03 and the later version on board type CAL P50/05.

RELAY DRIVE CIRCUIT

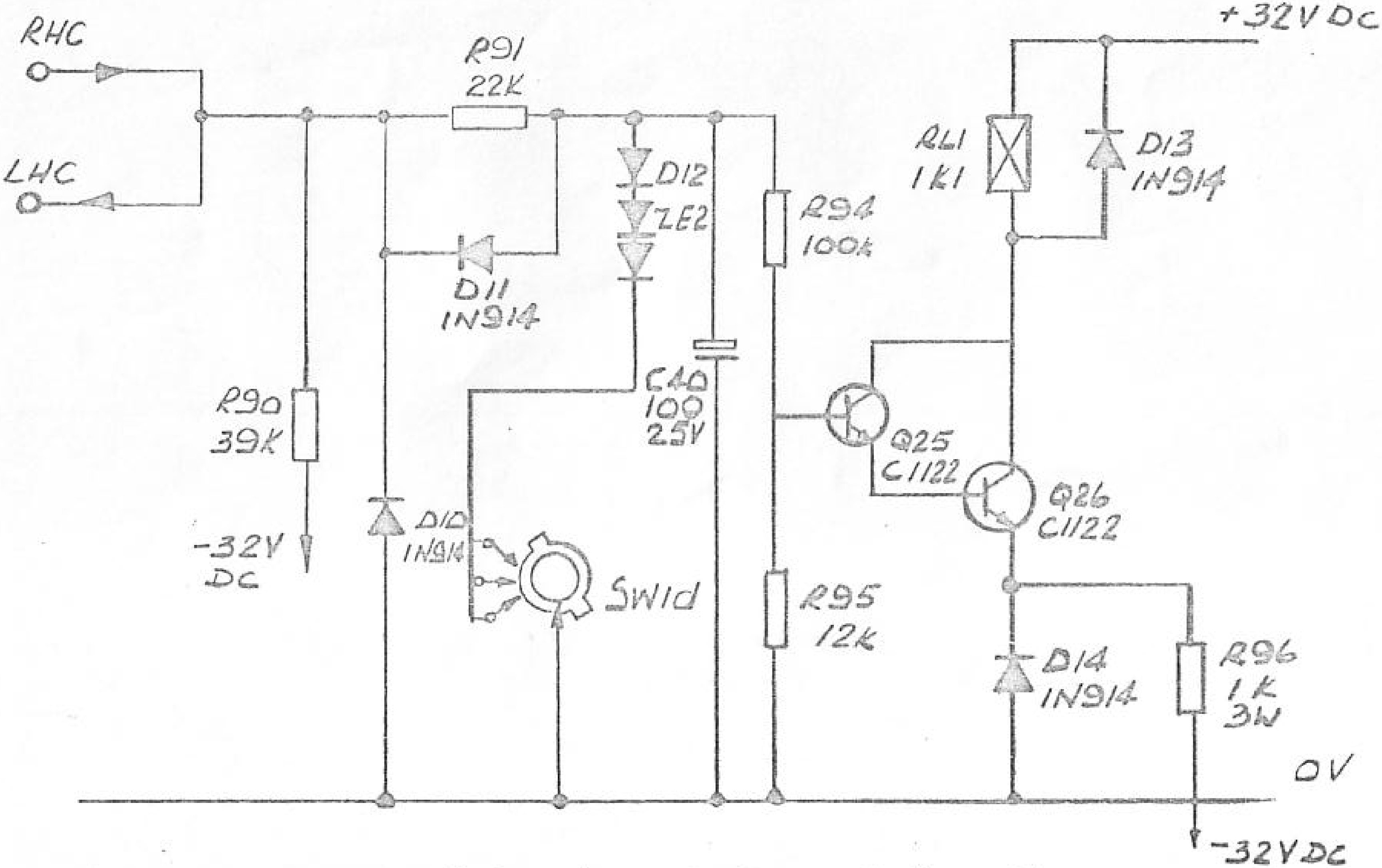
This circuit consists of Q25 and Q26 with associated components. Q25 and Q26 form a Darlington Pair whose emitter voltage is one diode drop below ground potential - D14 defines this with R96 providing the drive current from the negative rail. When the amplifier is in operation the base drive to Q25 is provided from each side of the power amplifier via the two R.68's, R91 and R94, so the relay is powered and the loudspeaker sockets are connected to the power amplifier output. If either of the power protection circuits trip, a pulse is sent down the base bias resistor chain, but C40 maintains its charge and the relay will not open. However, if the power protection circuit goes into its bistable mode, C40 has time to discharge and the relay is turned off, disconnecting the loudspeakers.

Similarly, when the amplifier is just switched on the relay is not powered until C40 has charged through R68 and R91, so there is a slight delay during which no signal reaches the loudspeakers. This protects the loud-speakersfrom the switch on thump that may be generated.

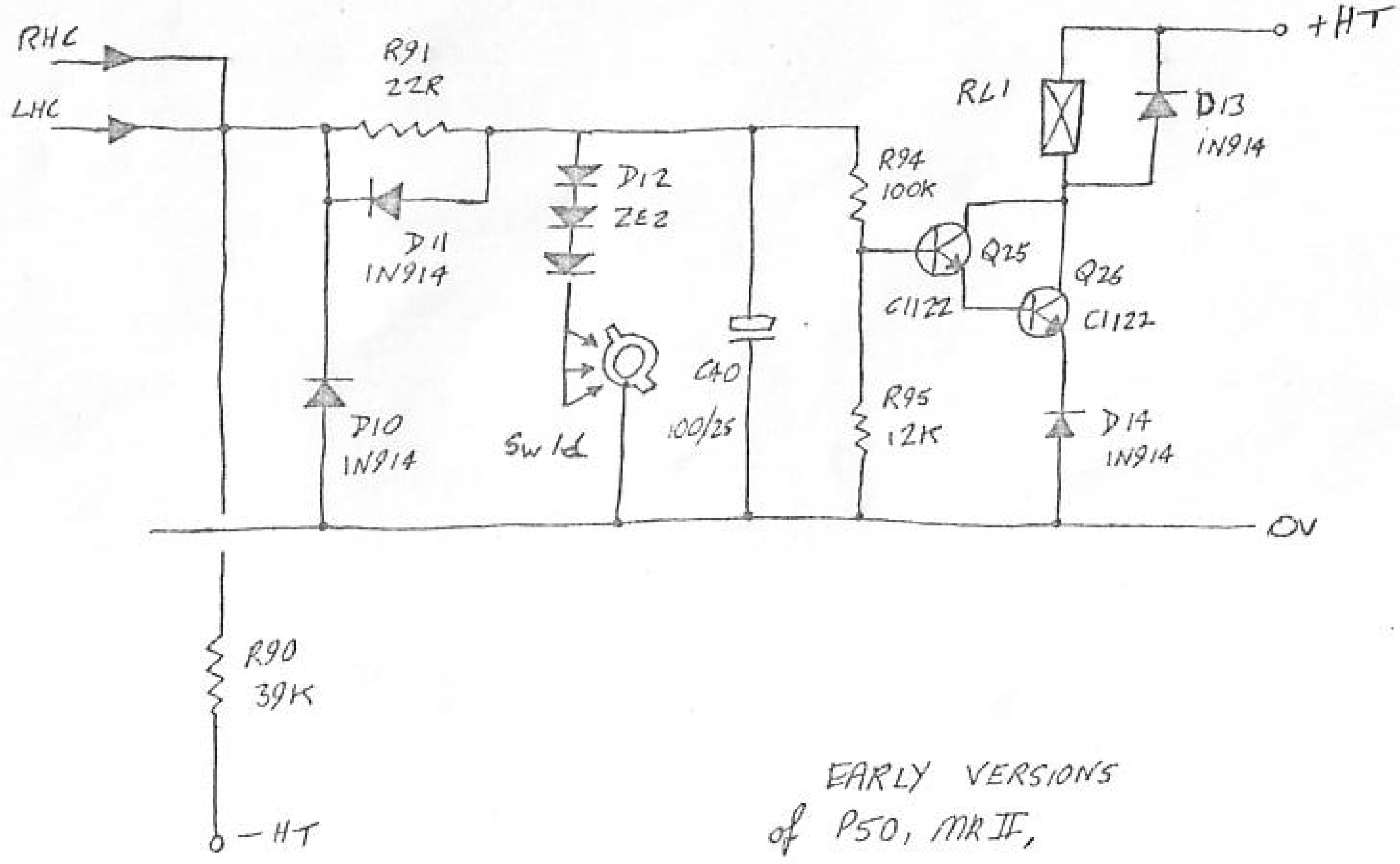
There is also a fleeting contact (operates between switch positions, but open circuit otherwise) wafer on SW1 which discharges C40 through D12 each time the position of the input selector is changed, thereby disconnecting the loud-speakers for a few seconds as the d.c. conditions at the input settle, in order to avoid unwanted transients through the loudspeakers.


+V
R81
0.15
R77
18K
D3
R73
5K6
Q16
C1123
R66
10K
C33
1/50V
Q15
C1123
C34
100nF
R69
12K
R71
180K
Q20
TIP35
R74
680K
o/p
R75
680K
R72
18K
Q21
TIP36
Q17
C1122
R80
15K
R82
0.15
R76
8K2
R67
15K
R70
47K
-V

P50 MkII



RELAY DRIVE CIRCUIT



EARLY VERSIONS
of P50, MK II,

RELAY DRIVE CIRCUIT.

COMPONENTS

R90	39K
R91	22K
R94	100K
R95	18K
R96	1K 3W
C40	100mFD 25V
D10	IN914
D11	IN914
D12	ZER
D13	IN914
D14	IN914
Q25	C1122
Q26	C1122
RL1	1100 Ohm COIL. CA no. 1155

SUPPLEMENT FOR P.50 MARK I

PRE - AMP DESCRIPTION

The pre-amp section is basically the same as in the Mark II version. The only difference, electronically, is the derivation of the supply rails. A feed is taken from the power-amp supply rail (about 60 volts negative) and dropped by R.20 (C9 decoupling) to around 23 volts negative to feed Q4. A feed is taken from this point via R21 (C12 decoupling) to give 15 volts negative for Q5. Another feed is taken from the 23 rail via R14 (C4 decoupling) to give a 16 volt negative rail for Q1, Q2 and Q3. The biasing to the base of Q1, Q2 is further decoupled twice R4, C2 and R5, C1.

The supply to Q6 and Q7 is taken from the power-amp centre rail (about 30 volts negative) by R70 (C30 decoupling).

It is, therefore, possible for a pre-amp fault to be mistaken for a power-amp fault. If in doubt disconnect the pre-amp supply lines. Low frequency instability in the pre-amp will usually be found to be caused by a faulty decoupling capacitor.

The pre-amp is built onto two PCB's. The two PU.1 input stages (Q1, Q2) are on a PCB module directly mounted onto the input sockets. The remainder of the circuitry is on the lower of the Plug in PCB's.

POWER AMPLIFIER DESCRIPTION

The power-amp input signal is connected to a high open loop gain voltage amplifier, Q8, having an overall feedback loop in series with its emitter. This loop increases the input inpadance. The dc line for this stage is derived from a decoupled feed from the power-amp centre rail via R70 and C30.

The voltage amplifier Q10 has a constant current source Q9 as a collector feed via a multiple diode chain (D4 - D6). These diodes with preset VR7 set the output bias conditions and thus the quiscent current. The current source Q9 derives its base current through a delay network R59, C40 which is designed to eliminate any switch on plop. The emitter current for Q9 is derived from Q16 which normally operates in a saturated condition, with its collector less than 0.5 volts from the negative rail. Q15 and Q16 are part of the protection circuit described later.

From the collectors of Q9 and Q10 the signal passes to the load via compound common-emitter pairs Q11, Q13 and Q12, Q4. D.C. operating point stability is maintained by a shunt feedback network R60 and VR6. VR6 is adjusted so that the amplifier clips symmetrically at maximum output (approximately half supply voltage).

PROTECTION CIRCUIT

The Q15 and Q16 form a flip-flop whose action is bislable. The input comes from R62 which montiors the current through the power transistors. The voltage dropped across VR8 (a wire link between Q13 collector and the adjacent tag strip) rises until it is high enough to turn on Q15. When Q15 turns on its collector goes negative and this potential, through R64, turns Q16 off. When Q16 turns off the negative potential on the collector of Q9 (via R61) is removed and thus signal drive to the output stage.

As the voltage drop across Q13 increases R66 provides a turn-on current which reduces the voltage necessary across R81 to cause the bistable to trigger. Hence not only is the current to the load limited, but also the power disspiated in the power device.

The trip point is adjusted by varying the length of the wire link (VR8); longer for more sensitive and shorter for less sensitive trip.

Q15 and Q16 can only be reset by switching off the supply for ten or fifteen seconds.

NOTES

1. Creeping quiescent current may be due to partial breakdown of Q9, Q10, Q11, Q12, Q13 and Q14. The offending devices may be discovered by a process of systematic replacement.

2. Shorts between the negative supply and earth can be caused by the collector of Q13 touching the chassis. Check the insulating bush and the mica washer.

3. High distortion levels may be caused by:

(a) collector of Q14 shorting to earch directly (e.g. chassis), check bush and mica washer.

(b) excessively high quiescent current.

(c) feedback loop fault causing either low gain or instability.

PARTS LIST

R1	100K	R41	4K7
R2	220K	R42	3K3
R3	100K	R43	680K
R4	47K	R44	2K7
R5	47K	R45	22K
R6	47K	R46	8K2
R7	220K	R47	4K7
R8	1M	R48	1K
R9	4k7	R49	4K7
R10	47K	R50	10K
R11	100K	R51	1M
R12	100K	R52	10K
R13	47K	R53	680K
R14	2K7	R54	2K7
R15	22K	R55	47
R16	180	R56	1K8
R17	470	R57	15K
R18	220	R58	10K
R19	2K2	R59	10K (47K later models)
R20	2K9	R60	100K
R21	1K5	R61	470
R22	22K	R62	5K6
R23	22K	R63	22K
R24	3K3	R64	39K
R25	3K3	R65	39K
R26	33K	R66	390K
R27	3K3	R67	3K9
R28	680K	R68	3K9
R29	2K7	R69	18K
R30	10K	R70	1K
R31	2M	R71	10
R32	10K	R72	1K2
R33	220K	R73	120
R34	10K	R74	68
R35	680K	R75	150K
R36	2K7	R76	2K7
R37	100K	R77	1K
R38	3K3	R78	1K
R39	39K		
R40	2K2		

Parts List cont'd

VR1	50K LIN DUAL
VR2	1M LOG + ANTI-LOG
VR3	25K LIN DUAL
VR4	50K LIN DUAL
VR5	50K LIN DUAL
VR6	470K LIN PRESET
VR7	250 OHM LIN PRESET
VR8	ADJUSTABLE WIRE LINK

C1	47/16
C2	47/16
C3	10/25
C4	100/25
C5	22/16
C6	10/25
C7	4700pF
C8	10/15
C8	100/25
C10	10/25
C11	10/25
C12	100/25
C13	10/25
C14	180pF
C15	5/25
C16	10/25
C17	2/25
C18	22,000pF
C19	6,800pF
C20	180pF
C21	0.22mFD
C22	2/15
C23	0.1 mFD
C24	0.1 mFD
C25	6,800pF
C26	2/15
C27	180pF
C28	10/15
C29	10/15
C30	400/25
C31	1,500 pF
C32	1,500pF
C33	1,500pF
C34	120pF
C35	0.1mFD
C36	180pF
C37	100/15
C38	47/63
C39	59pF
C40	100/15
C41	2,500mFD 40V
C42	0.1 mFD
C43	2,500mFD 64V
C44	0,1mFD 250Vac

FS1	2.5 amp
FS2	1.6 amp
FS3	1.6 amp

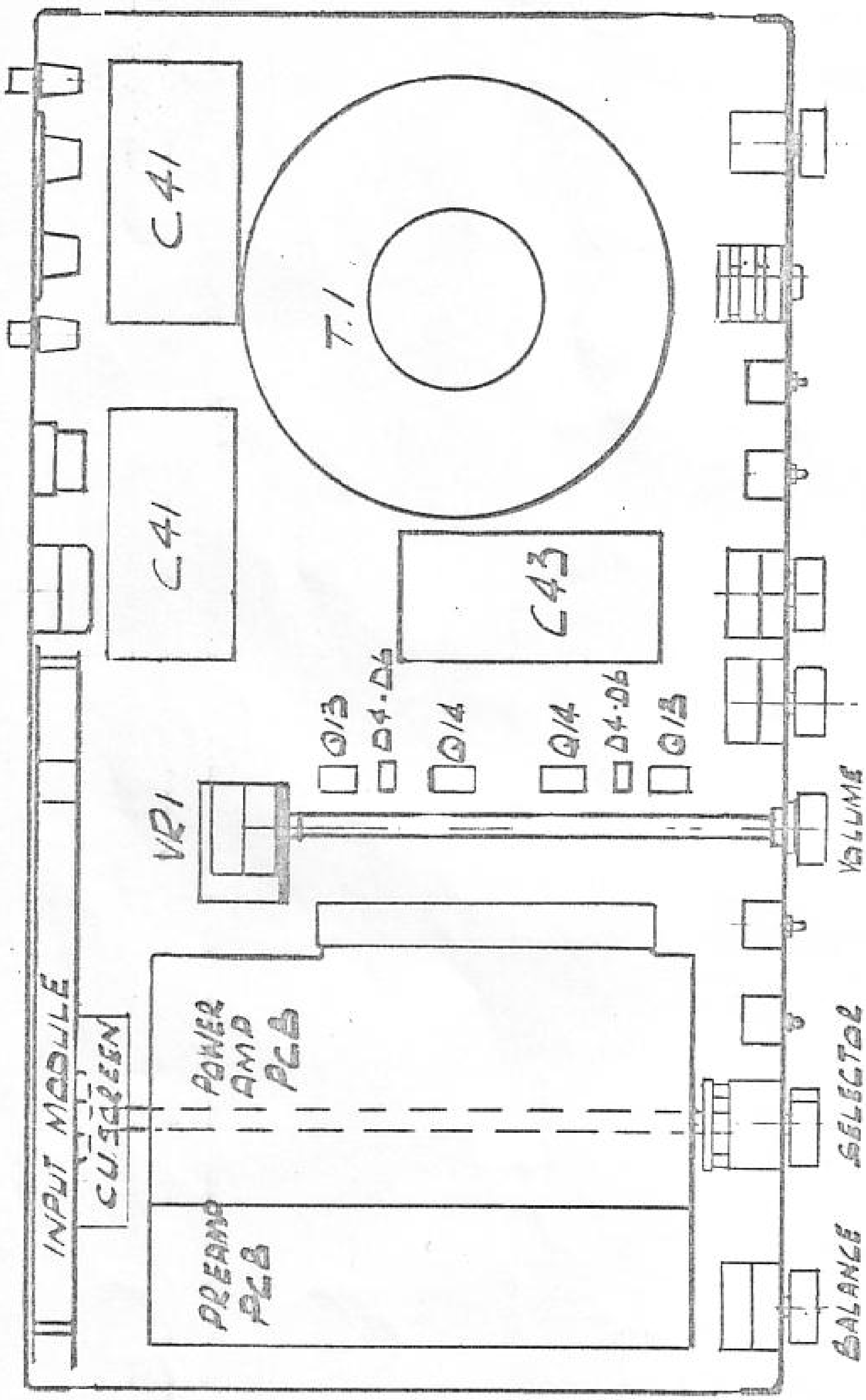
Q1	BC230B or C1132
Q2	BC230B or C1132
Q3	BC263
Q4	BC263
Q5	BC263
Q6	BC263
Q7	BC263
Q8	BC263
Q9	MPSA06
Q10	MPSA56
Q11	BC461
Q12	BC441
Q13	TIP36B
Q14	TIP35B
Q15	ME4101
Q16	ME4101

Substitutes

BC263 = YK1091 = BCY71

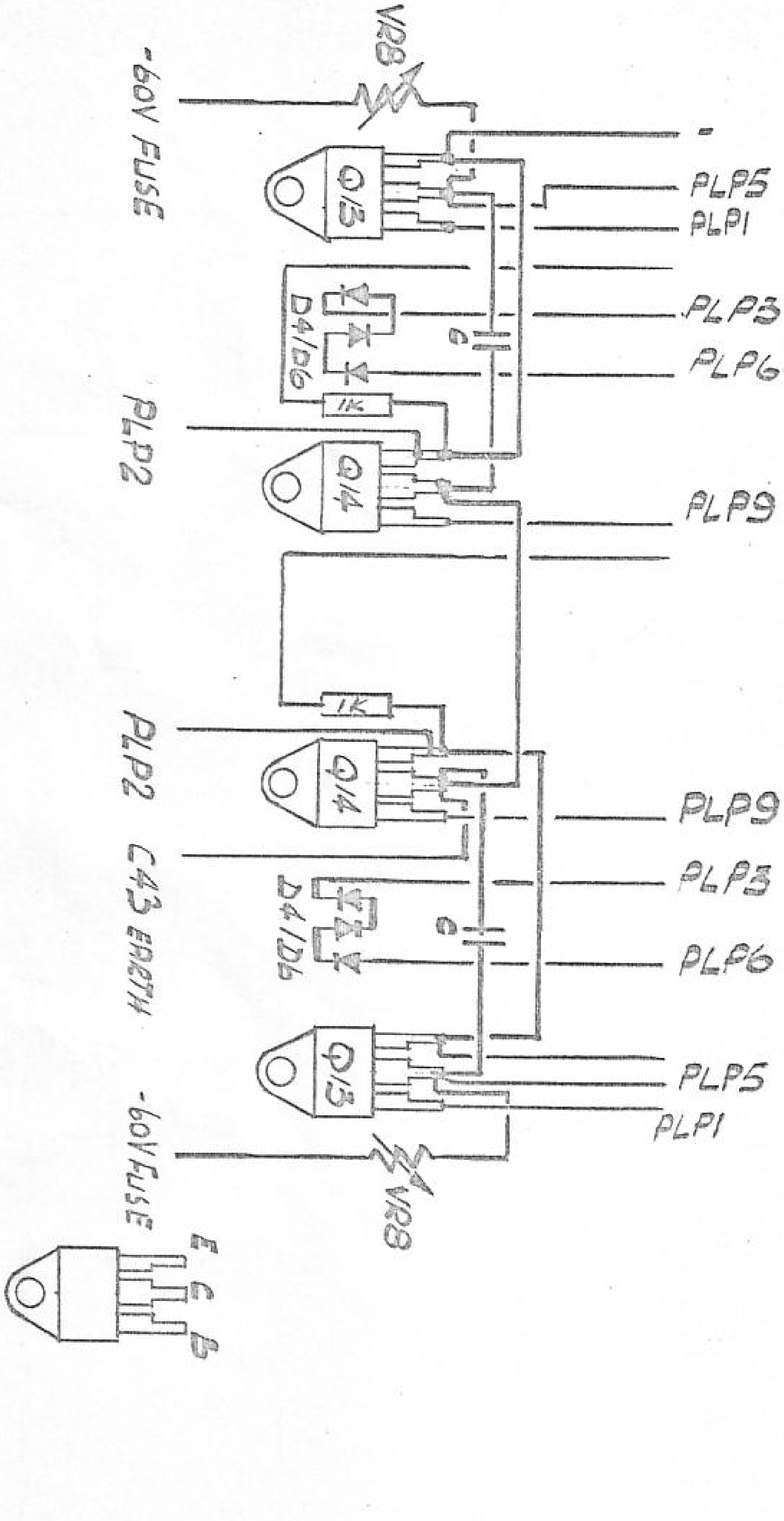
Q1 and Q2 are matched for gain matched low noise BCY71's may be used.

D1 - D3 IN914
D4 - D6 IN914
BRI KB502

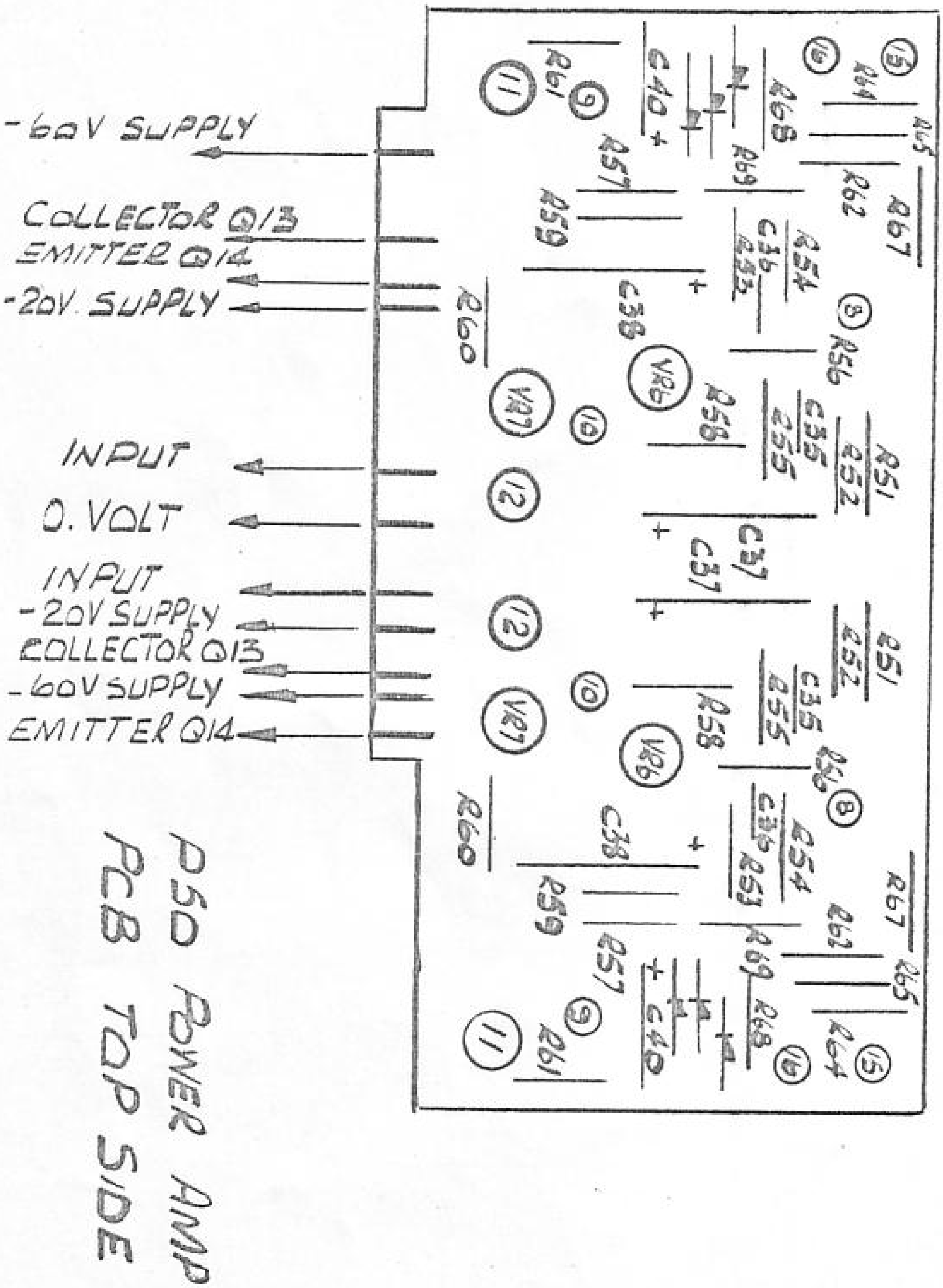


P50 MkI

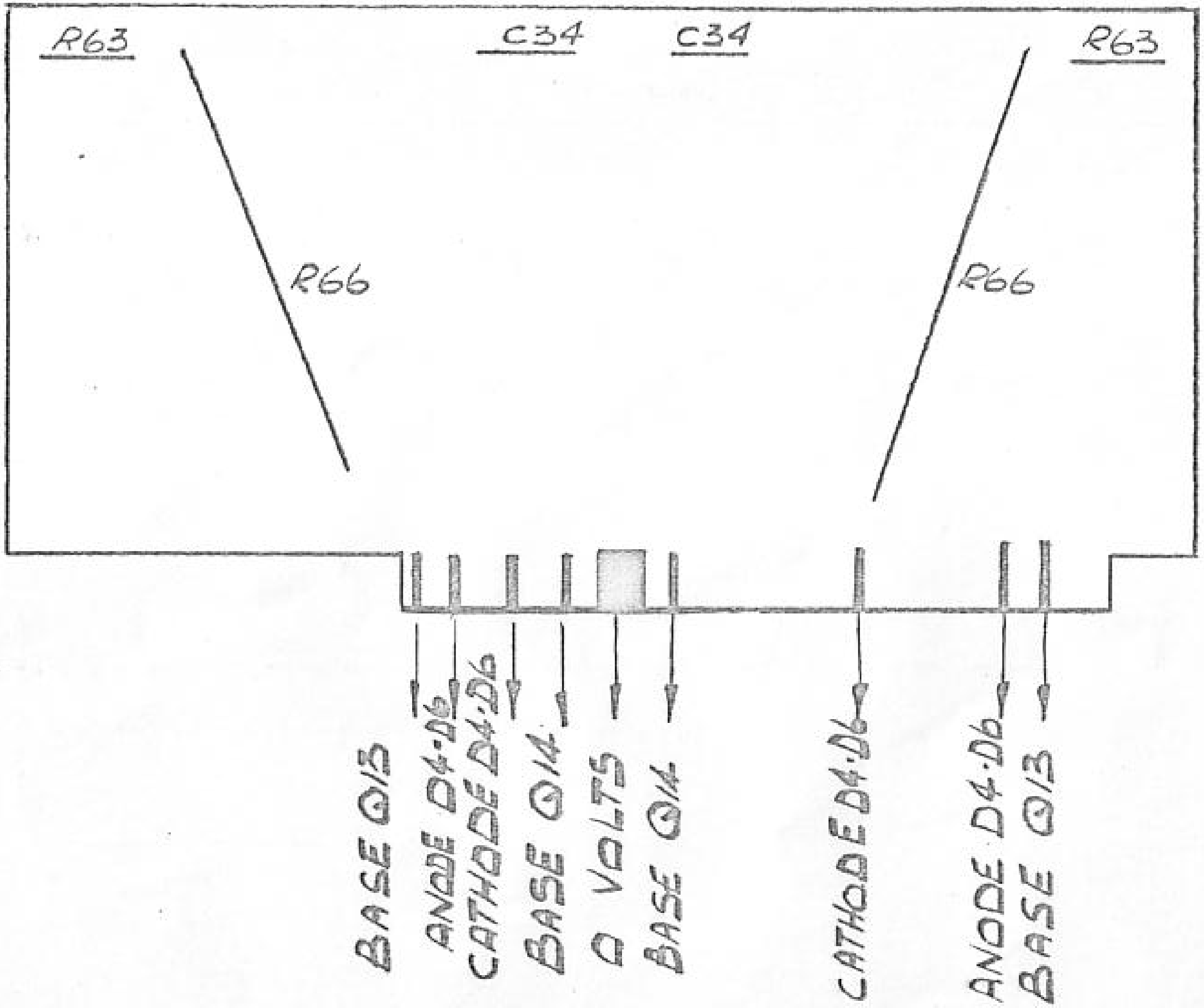
INTERNAL LAYOUT



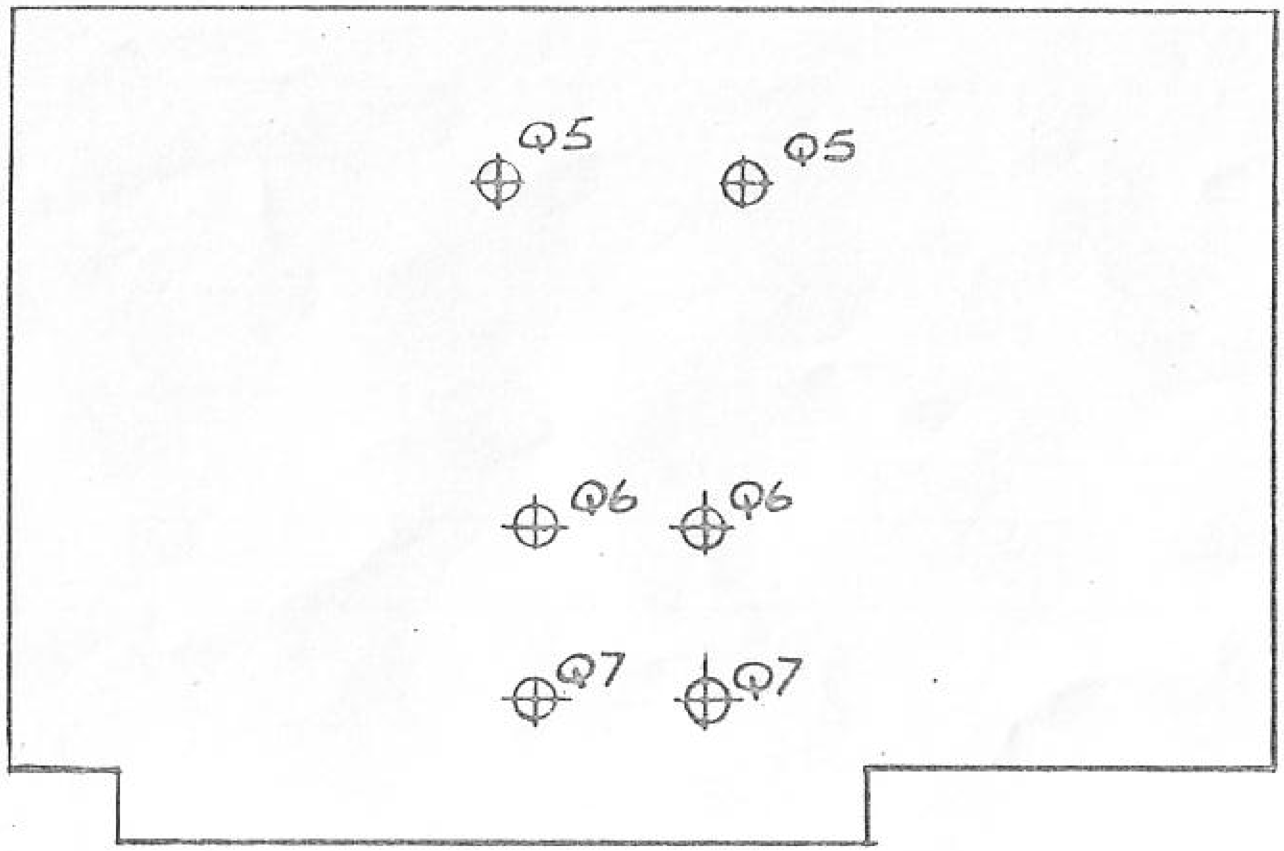
PLASTIC TRANSISTOR CONNECTIONS



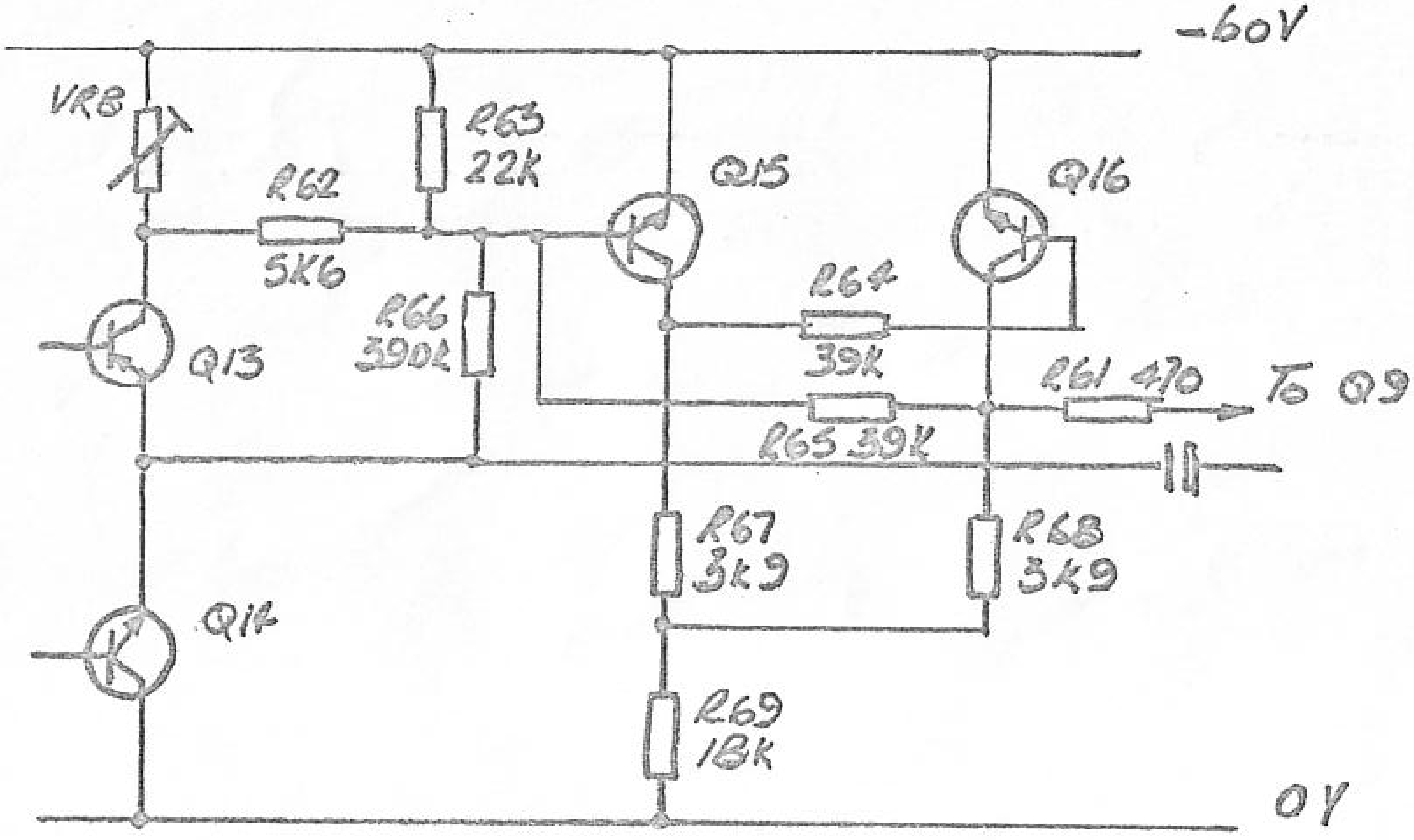
P50 POWER AMP
PCB TOP SIDE



P50 POWER AMP P.C.B UNDERSIDE



P50 MKI PRE-AMP P.C.B


-60V
VRB
R63
22K
R62
5K6
Q15
Q16
R66
390K
Q13
R64
39K
R61 470
To Q9
R65 39K
R67
3k9
R68
3k9
Q14
R69
18K
0V

P50 MKI

VOLTS RMS	POWER INTO 8 OHMS WATTS
14.0	24.5
14.1	24.85
14.2	25.2
14.3	25.56
14.4	25.9
14.5	26.25
14.6	26.65
14.7	27.1
14.8	27.5
14.9	27.75
15.0	28.2
15.1	28.5
15.2	29.0
15.3	29.5
15.4	29.75
15.5	30.05
15.6	30.42
15.7	30.8
15.8	31.2
15.9	31.6
16.0	32.0
16.1	32.4
16.2	32.8
16.3	33.2
16.4	33.6
16.5	34.0
16.6	34.4
16.7	34.9

TRANSFORMERS

1. 240V/120V

240V operation:	L	Brown
	N	Yellow
	Link Red to Orange	
120V operation:	L	Brown & Orange
	N	Red & Yellow

2. 220V/110V

220V operation:	L	Brown
	N	Yellow
	Link Red to Orange	
110V operation:	L	Brown & Orange
	N	Red & Yellow

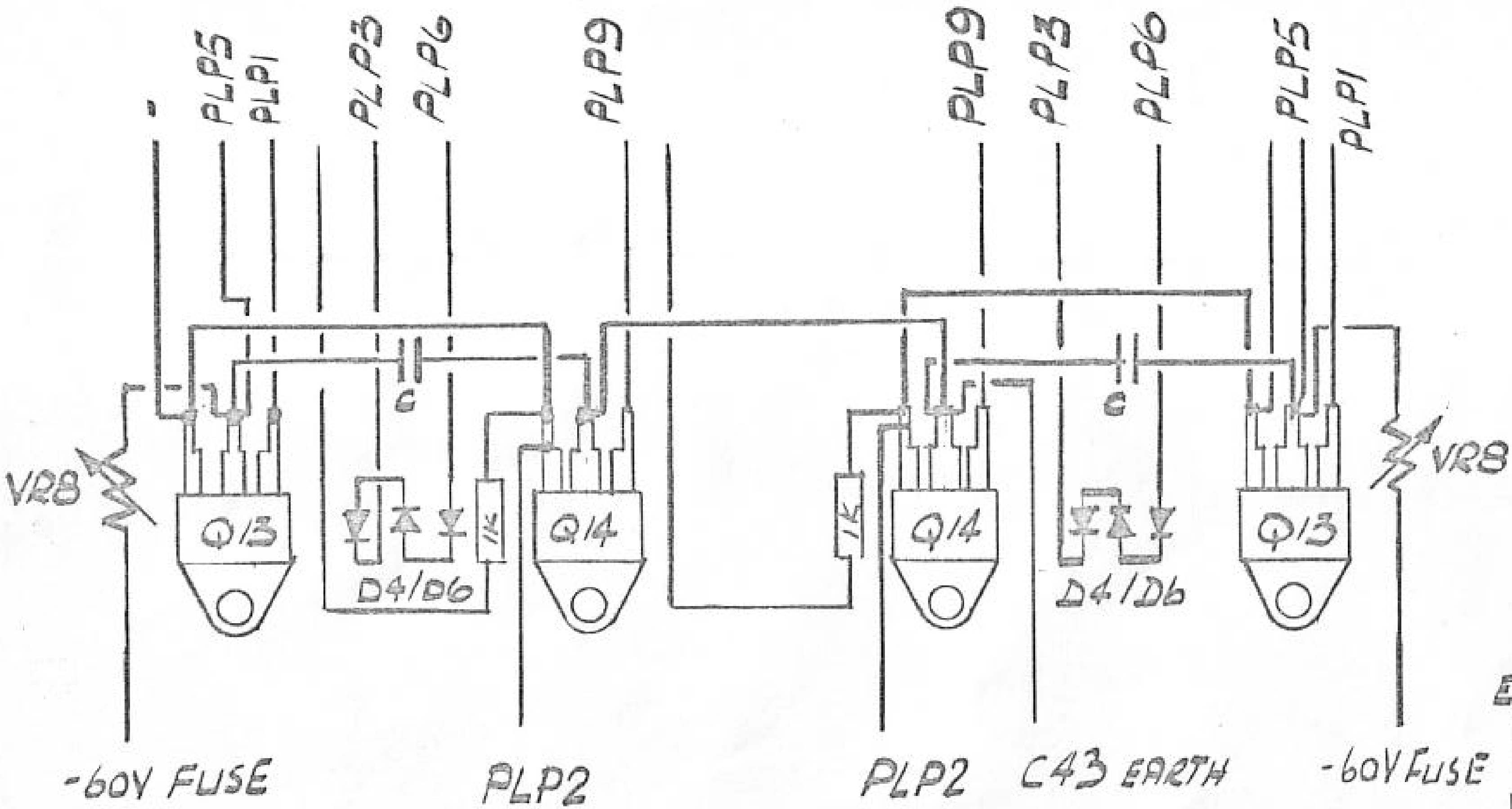
3. 240V/120V/220V/110V

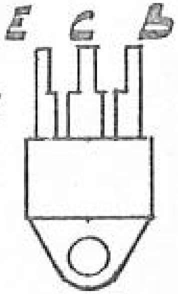
240V operation:	L	Brown
	N	Blue
	Link Orange and Yellow	
220V operation:	L	Brown
	N	Green
	Link Red and Yellow	
120V operation:	L	Brown and Yellow
	N	Orange and Blue
110V operation:	L	Brown and Yellow
	N	Red and Green

4. 220V Only

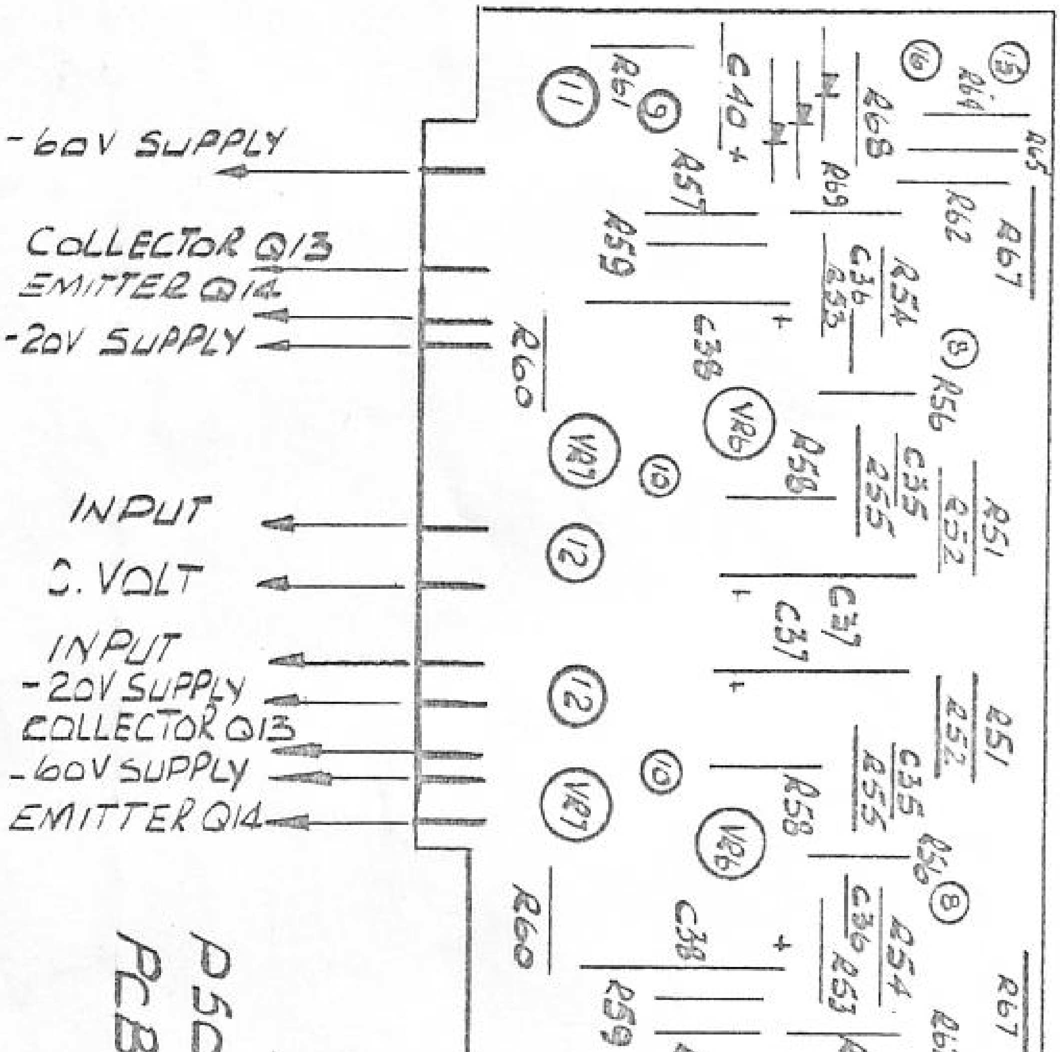
	L	Brown
	N	Red

When fitted a black wire is to the screen.

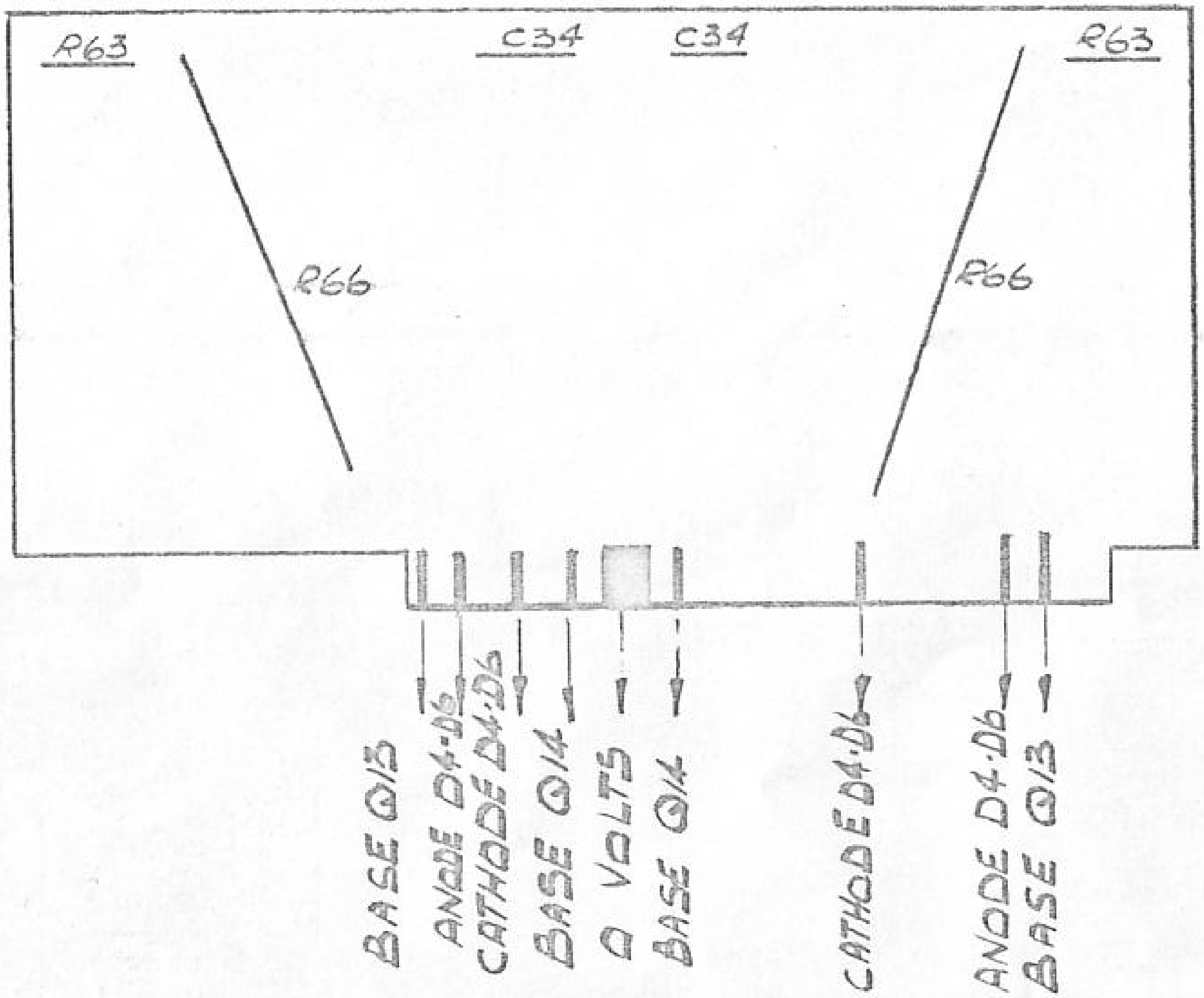




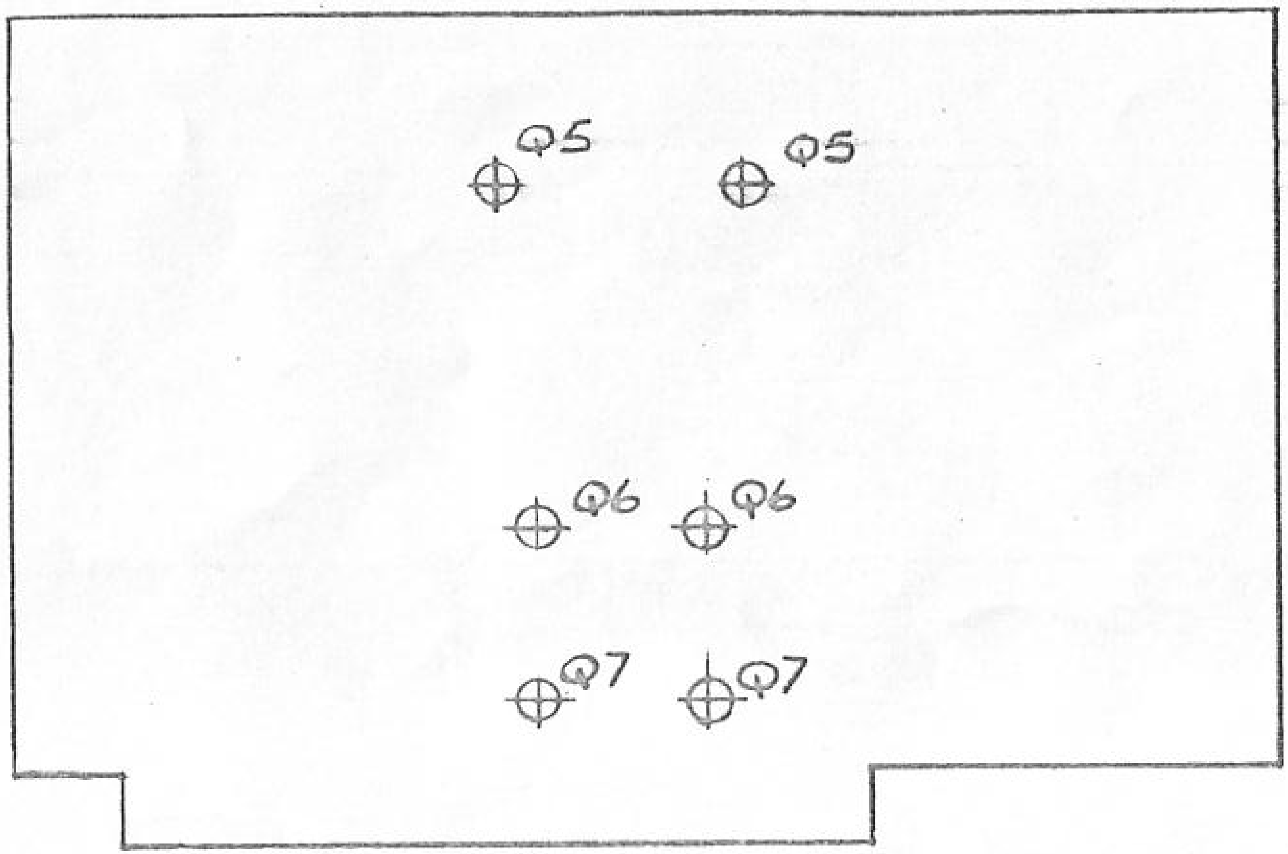
PLASTIC TRANSISTOR CONNECTIONS



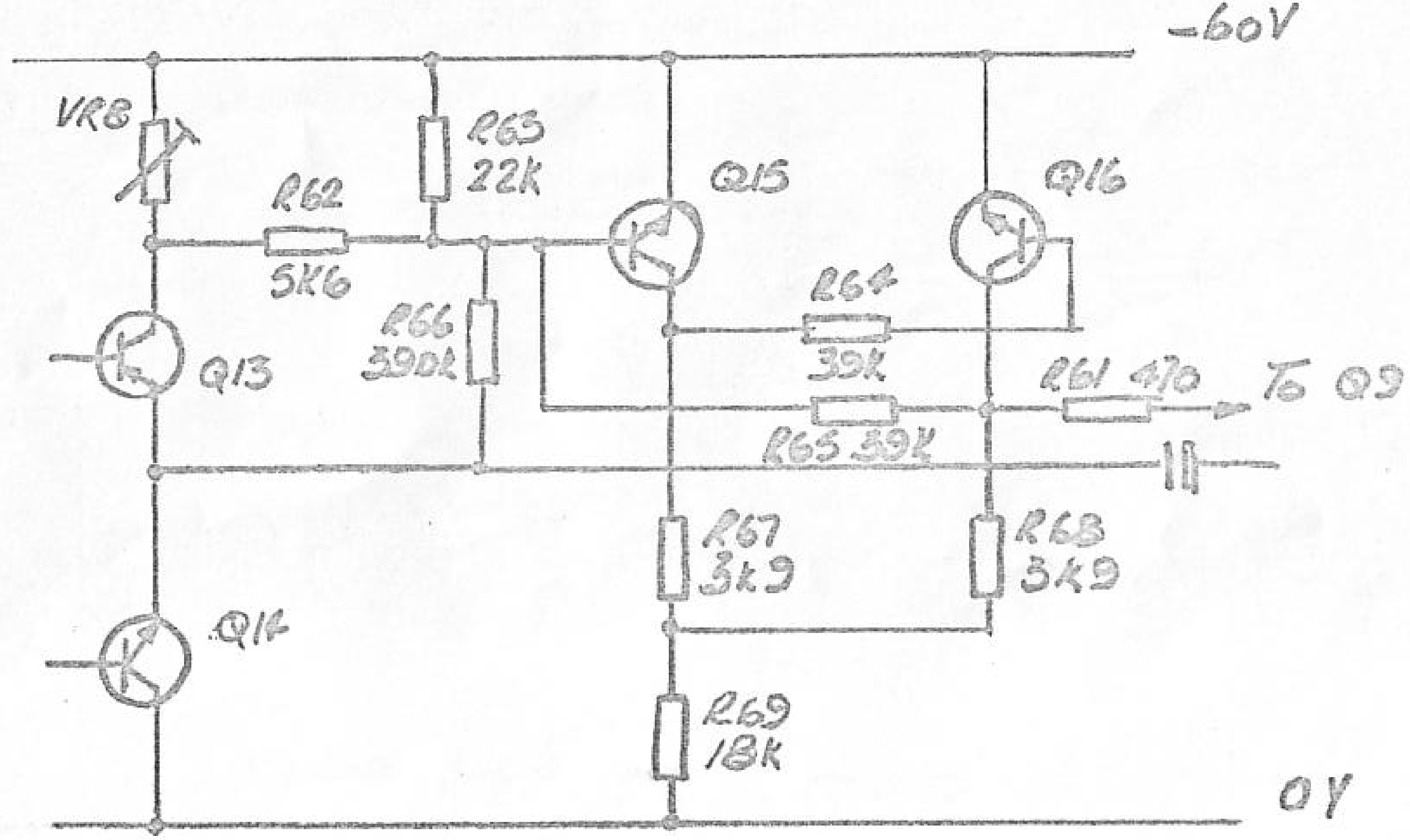
P50 POWER AMP
PCB TOP SIDE



P5D POWER AMP P.C.B UNDERSIDE



P50 MKI PRE-AMP P.C.B


-60V
VR8
R63
22k
R62
5K6
Q15
Q16
R66
390k
Q13
R64
39k
R61 470
To Q9
R65 39k
R67
3k9
R68
3k9
Q14
R69
18k
0V

P50 MKI

VOLTS RMS	POWER INTO 8 OHMS WATTS
14.0	24.5
14.1	24.85
14.2	25.2
14.3	25.56
14.4	25.9
14.5	26.25
14.6	26.65
14.7	27.1
14.8	27.5
14.9	27.75
15.0	28.2
15.1	28.5
15.2	29.0
15.3	29.5
15.4	29.75
15.5	30.05
15.6	30.42
15.7	30.8
15.8	31.2
15.9	31.6
16.0	32.0
16.1	32.4
16.2	32.8
16.3	33.2
16.4	33.6
16.5	34.0
16.6	34.4
16.7	34.9

TRANSFORMERS

1. 240V/120V

240V operation:	L	Brown
	N	Yellow
	Link Red to Orange	
120V operation:	L	Brown & Orange
	N	Red & Yellow

2. 220V/110V

220V operation:	L	Brown
	N	Yellow
	Link Red to Orange	
110V operation:	L	Brown & Orange
	N	Red & Yellow

3. 240V/120V/220V/110V

240V operation:	L	Brown
	N	Blue
	Link Orange and Yellow	
220V operation:	L	Brown
	N	Green
	Link Red and Yellow	
120V operation:	L	Brown and Yellow
	N	Orange and Blue
110V operation:	L	Brown and Yellow
	N	Red and Green

4. 220V Only

	L	Brown
	N	Red

When fitted a black wire is to the screen.

P.50 SERVICE MANUAL

AMENDMENT SHEET 1

Parts List

R45	should	read	8K2	not	3K9
R46	"	"	22K	"	68K
R68	"	"	120K	"	150K
R74	"	"	68K	"	470K
R76	"	"	8K2	"	6K8
R93	"	"	5K6	"	8K2
R95	"	"	4K7	"	2K7
R96	"	"	27K	"	470R
R100	"	"	150K	"	68K

R86, 98 and 99 not used.

Part numbers are being revised and should not be quoted until a revised list is issued.

Circuit Diagram (Master)

R86, R98 & 99, D16 & 17 all replaced by link (s/c). ✓ R86 ??

R92 should be R96. ✓

R82 adjacent Q27 should be R92: ✓

Or

AMENDMENT SHEET 2

3.7 The P.50 Amplifier has four Plastic Power Transistors fitted to an aluminium extrusion in the centre of the chassis.

4.2.7. Delete sentence starting "Using just resistors (R75, R76 and R80) the ...."

5.2.6. Should read "Check that TP20 is at +30V dc and TP26 is at -30V dc".

5.2.7. Should read "Check that TP2 is at -18 V dc"

6.1. Should read "Check TP14 reads 1.8 to 2.2V dc across diode D1. Check that voltage across D3 is about 0.55V dc. Check that the voltage across C33 is about 11V dc. If it is much more than 11V then the power protection circuit has tripped. Turn the amplifier off for............".

Fig. 5. PU input should be shown applied to the junction of C2 and R8.

AMENDMENT SHEET NO. 3

P.50 Mk. II AMPLIFIER

P.110 AMPLIFIER

4.2 POWER AMPLIFIER DESCRIPTION

The input stage consists of transistors Q8 and Q10 arranged in a long-tailed pair configuration (differential amp.). This arrangement has the advantages of excellent temperature stability of the output dc level, as any change in the base emitter voltage of transistor Q8 due to temperature change is offset by a similar change in the base emitter voltage of transistor Q10. This circuit seeks to establish a condition of balance between the two halves, and as the base of Q8 is connected by R56 and R57 to the earth line; this is achieved when the dc potential on the base of Q10 is also at zero volts. Since this point is connected to the output line then the dc potential of this line will automatically be adjusted to zero (earth potential). Transistor Q9 is arranged as a constant current feed to the long tail pair and thus can just be considered as a high impedance.

The ac gain of the power amplifier is set by the ratio of 1 + R62 and R60 and is set at 40 times. The low frequency roll off is mainly determined by C31 and this gives a -3dB frequency of 20Hz.

The long tail pair feed transistors Q11 which is an emitter follower intended to reduce the loading on Q10 and provide a low impedance drive to the voltage amplifier stage Q13. Q14 is employed as an amplified diode to provide the correct biasing for the output transistor pairs. This transistor is mounted on the heat sink and so is in thermal contact with the output devices.

Transistor Q12 is arranged as a constant current sink. This transistor has a constant voltage across its base by the potential divider formed by diode chain ZE2 and resistor R67. The voltage across ZE2 turns on Q12 and ensures that the voltage across its emitter resistor (R63) and thus the current sunk by transistor Q12, remains constant with changes in temperature, as any change in the base emitter voltage of Q12 is compensated for by a similar change in the diode voltage.

This arrangement reduces the current swing on the voltage amplifier Q13. Also an improvement in cross over distortion (particularly at high frequencies) is obtained. This is because the transistor current sink maintains its high output impedance throughout the complete range of output swing, which ensures a fast turn on of the ongoing half of the output stage at the crossover point. This contrasts with the more common boot-strapped resistor arrangement whose input impedance tends to fall at the crossover point because the voltage on the collector of the transistor Q11 changes more than the output voltage - thus the resistor cannot act as a constant current sink at the crossover point.

The output transistor pairs are arranged as Darlington pairs, the pair having a current gain the product of the two individual gains.

Resistor R87 and Capacitor C36 across the loudspeaker output form a Zobel network provided to tailor the HF gain and phase relationships ensuring that the amplifier will be stable into reactive loads.

SETTING QUIESCENT CURRENT

The two presets (VR6), one for each power amplifier, should be turned to minimum. Fuse link FS1 should now be removed and an AVO meter connected across the fuseholder terminals. The meter should be set to the 100mA dc range. The amplifier should be switched on and the mains supply voltage increased on a Variac and a standing current (around 20 to 40mA) will be read. The supply should be interupted if the standing current is significantly higher (several humdred mA) as a fault obviously exists in such an amplifier. One preset should be turned until the current increases by about 7mA. The other preset may now be turned until the current increases by a further 7mA. Both presets hould now be fixed with a spot of varnish.

An alternative technique is to measure the T.H.D. and observe the distortion residual (at 1KHz) on an oscilloscope. The presets should be adjusted (one channel at a time) until the crossover spikes are absent from the trace.