# P.110 SERVICE MANUAL

CAMBRIDGE AUDIO
RIVER MILL
ST. IVES
HUNTS.

# P.110 SERVICE MANUAL

## AMENDMENT SHEET 1

### Parts List

| | | | | | |
|---|---|---|---|---|---|
| R55 | should be | 270K | not | 220K |
| R60 | " " | 750R | " | 1K |
| R63 | " " | 120R | " | 82R |
| R70 | " " | 68K | " | 47K |
| R75 | " " | 470K | " | 680K |
| R92 | " " | 10K | " | 27K |
| R96 | " " | 27K | " | 470R |

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

### Circuit Diagram (Master)

R96 should be R86.

R92 should be R96.

R82 adjacent Q27 should be R92.

# P.110 SERVICE MANUAL

## AMENDMENT SHEET 2

5.2.6. Should read "Check that TP20 is at +45V dc and that TP26 is at -45V dc."

5.2.7. Should read "Check that TP2 is at about -20V 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 ................................"

October 1974

# CONTENTS

## 1. INTRODUCTION

The Cambridge Audio P.110 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 | 55W |
| | into 15 ohms | 30W |

**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<br>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, electonic 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 (18dB/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. GENERAL CONT'D

### 2.3 MAINS VOLTAGE CHANGEOVER

- Disconnect unit from mains supply.
- Remove amplifier lid as detailed in 3.2.
- Remove tie 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 P110 can deliver 55 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 Posidriv securing screws from each of the two wooden end plates. The plates will fall off.

- Gripping the top cover by each end, lift it 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 i refitted over the transformer.

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

### 3.3 REMOVAL OF BOTTON HEAT SINK AND ACCESS TO MAIN BOARD

All of the servicing operations and tests on the main board may be don 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.

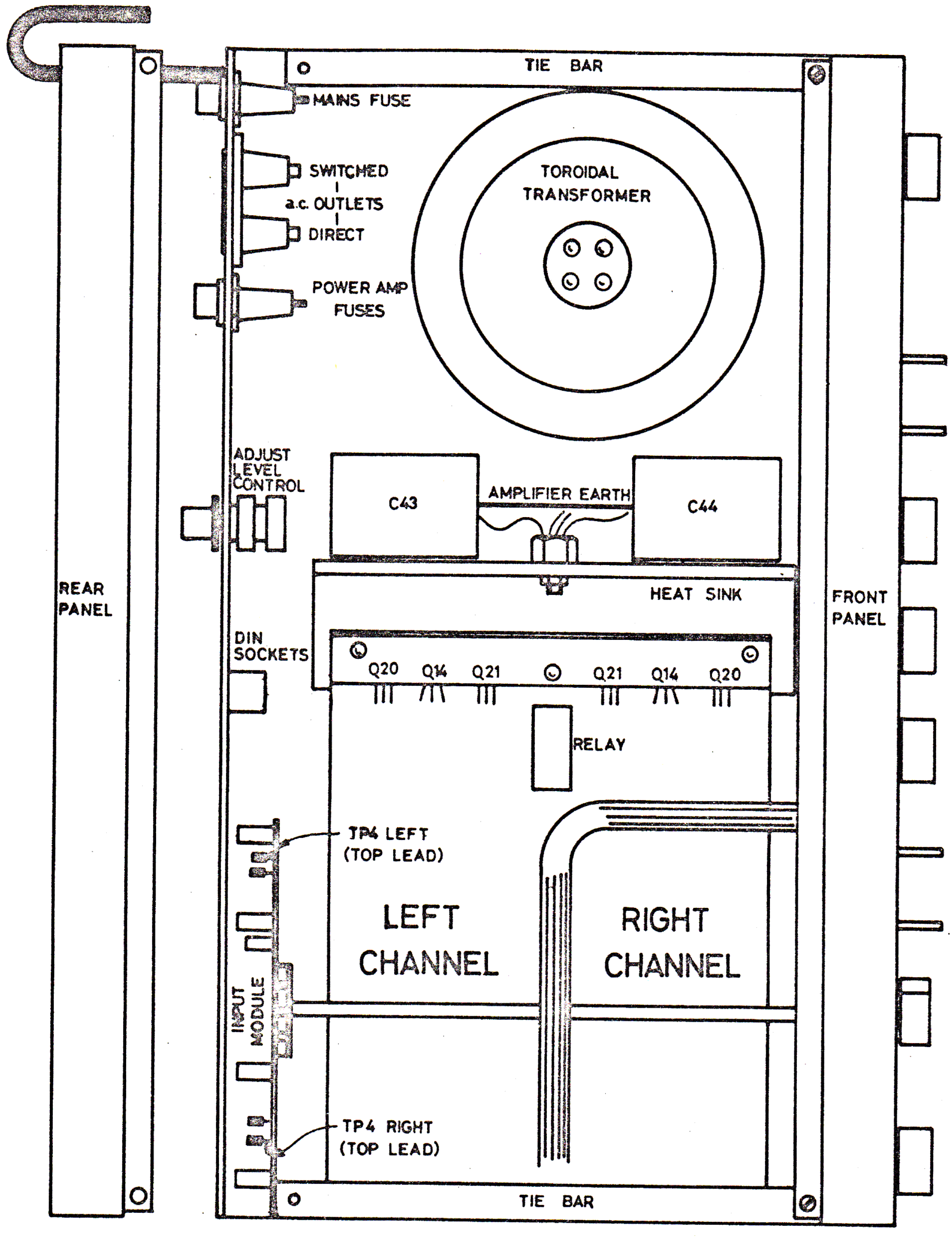
- Remove the two 6 BA screws securing the top of the front panel to the tie bars.

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

- Carefully remove thefront panel of the unit, drawing it over the tog switches.

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

- Replacement is a direct reversal of this procedure.



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

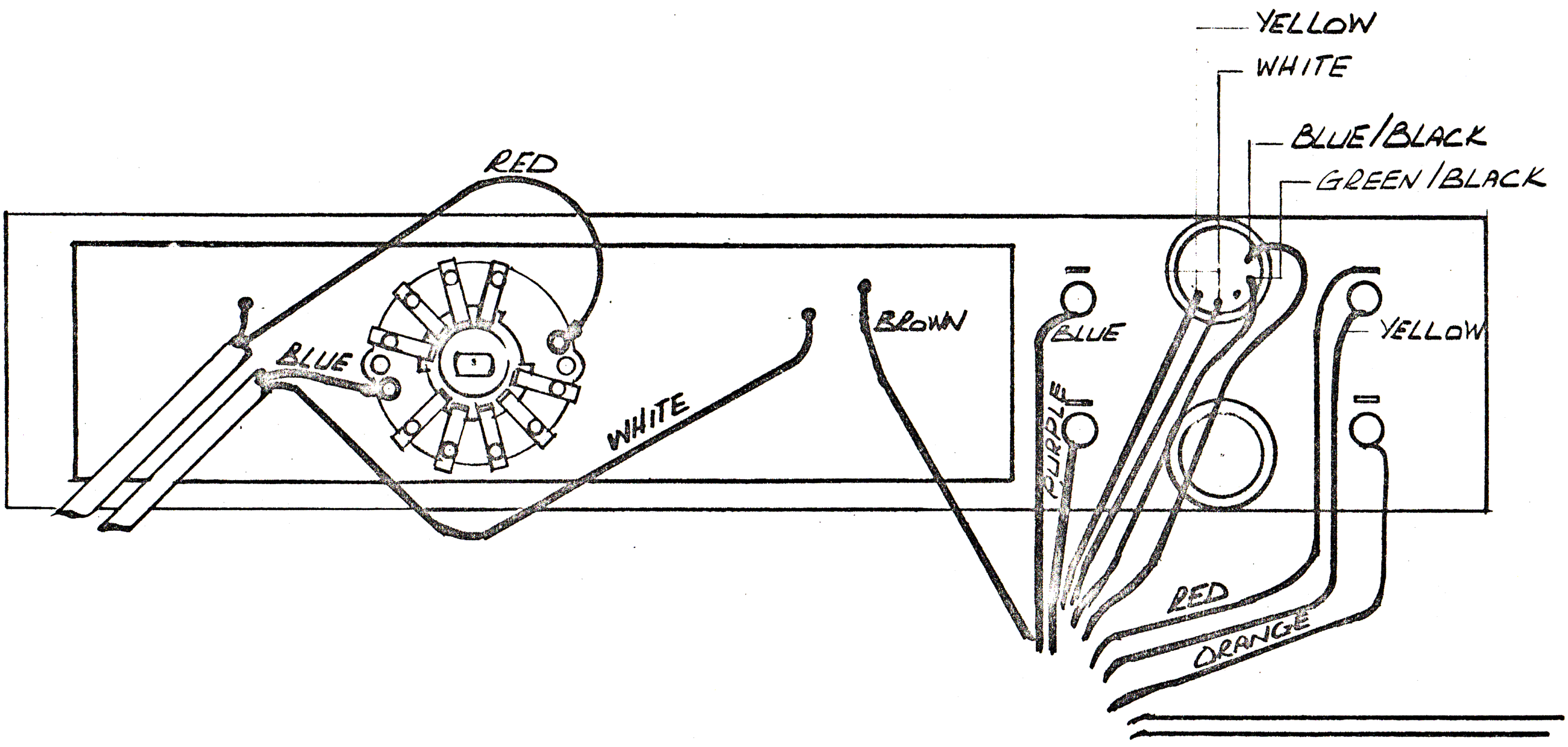



FIG.1.

INPUT MODULE

## 3.4 REMOVAL OF FRONT AND REAR PANELS CONT'D

### (b) Rear Panel

- Remove the two 6 BA screws securing thetop 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 it 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 theinput 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 agains 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 unitl the gap in the rear switch assembly is central on one of the sets of wiper contacts.

## 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 upward 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 tl 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 chassi

- Resolder the leads to the transistor.

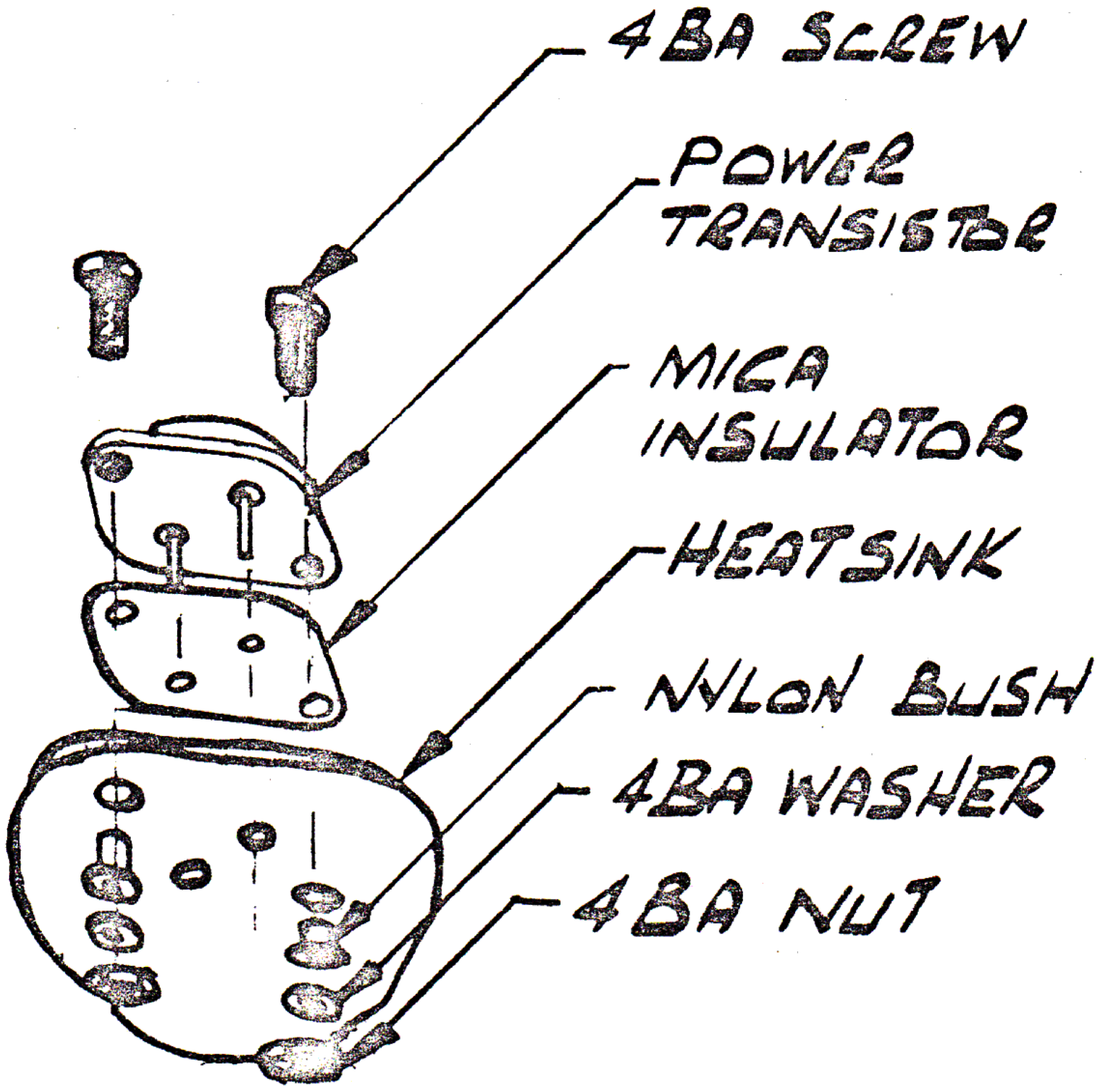

4BA SCREW
POWER TRANSISTOR
MICA INSULATOR
HEATSINK
NYLON BUSH
4BA WASHER
4BA NUT

FIG.2

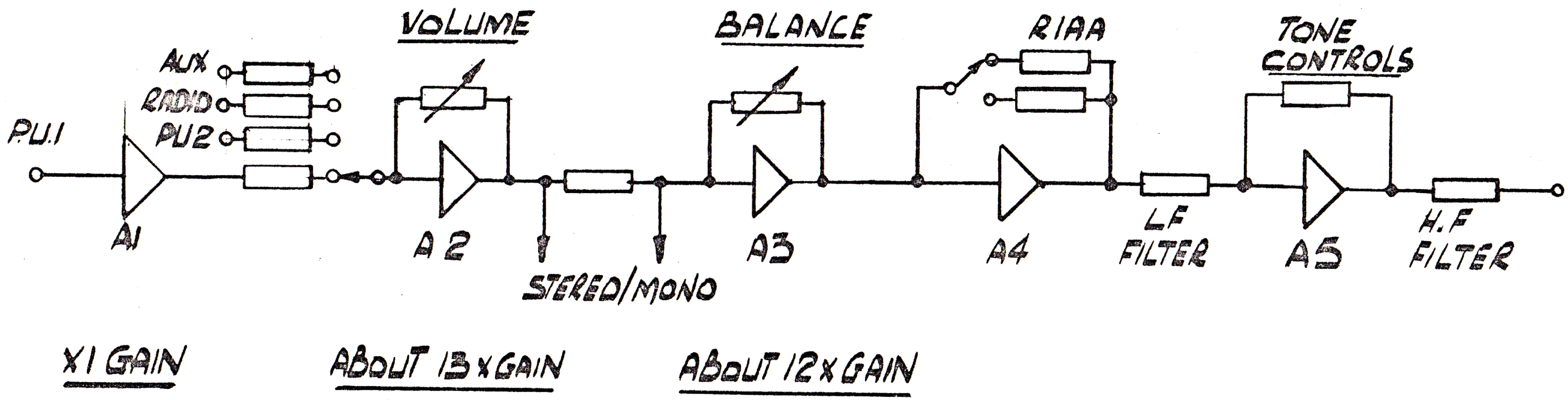



FIG. 3

PRE AMPLIFIER BLOCK DIAGRAM

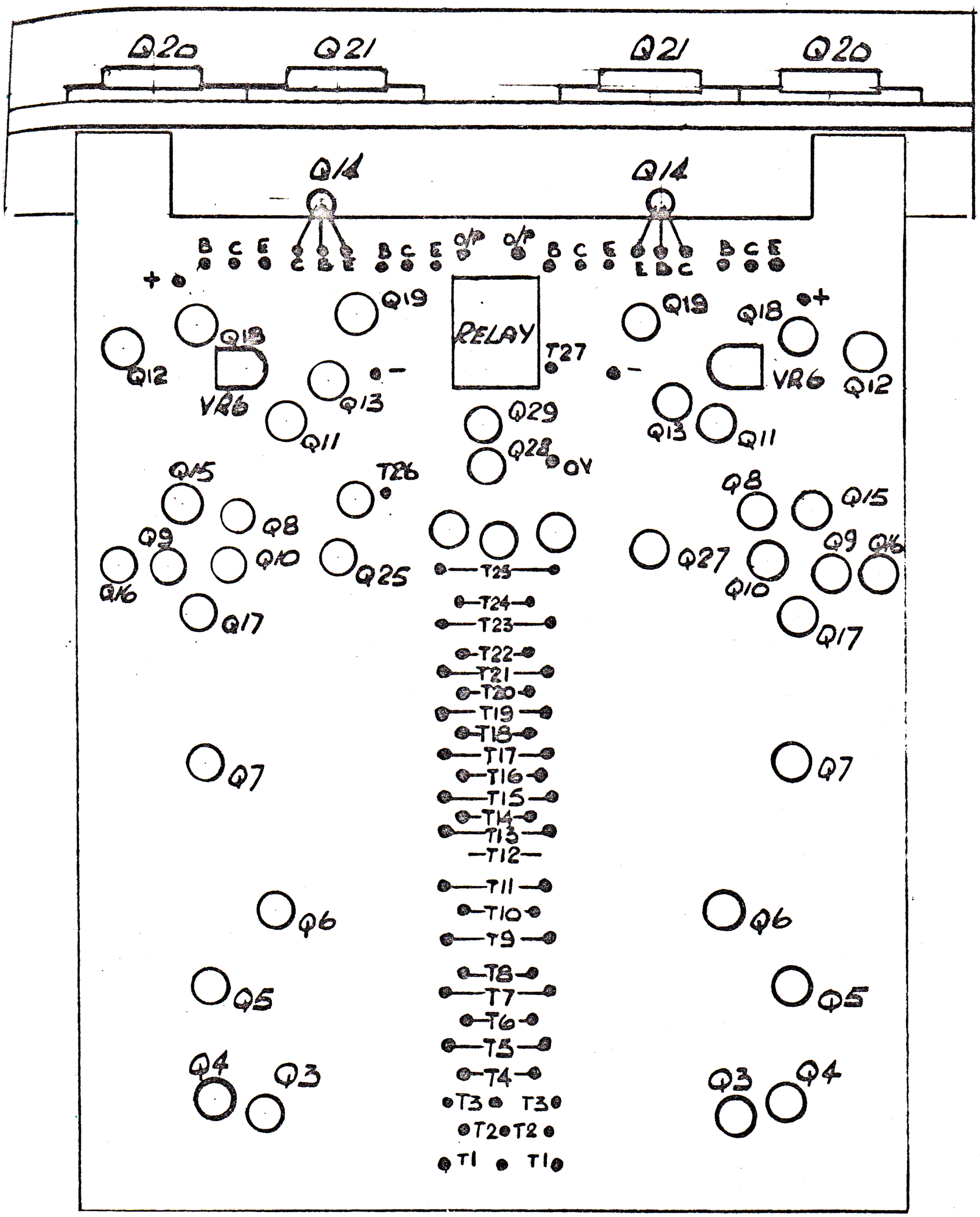



FIG. 4

P110 PCB LAYOUT

4. AMPLIFIER DESCRIPTION

4.1 SYSTEM DESCRIPTION

- The P.110 consists of si x 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 thefour inputs from the input phono sockets. PU1 is buffered by A1 which provides a 47 kOhm 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 50 dB 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.110 is used in the MONO mode.

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

4.1.6. - The LO FILTER SWITCH intorduces 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 it 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 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 main 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 byt 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)

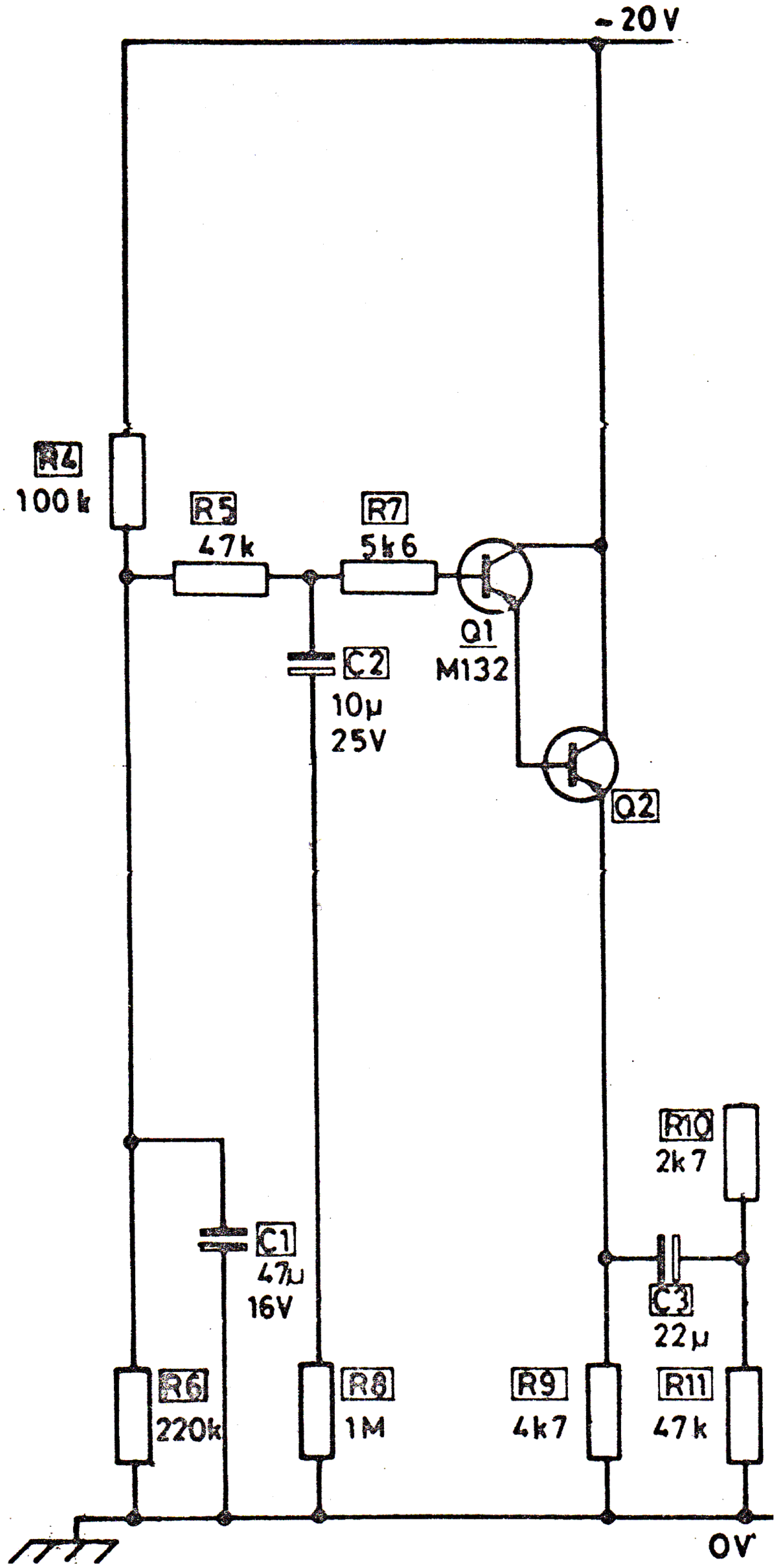
The two transistors, Q1 & Q2, form a Darlington Pair emitter follower. The base voltage of Q1 is derived from the potential divider R4, R6 through resistors R5 and R7 (N.B. R7 improves R.F.I.supression). The emitter of Q2 is at a voltage 1.4 volts (two diode drops) below the base of Q1. Q1 and Q2 of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



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


FIG 5

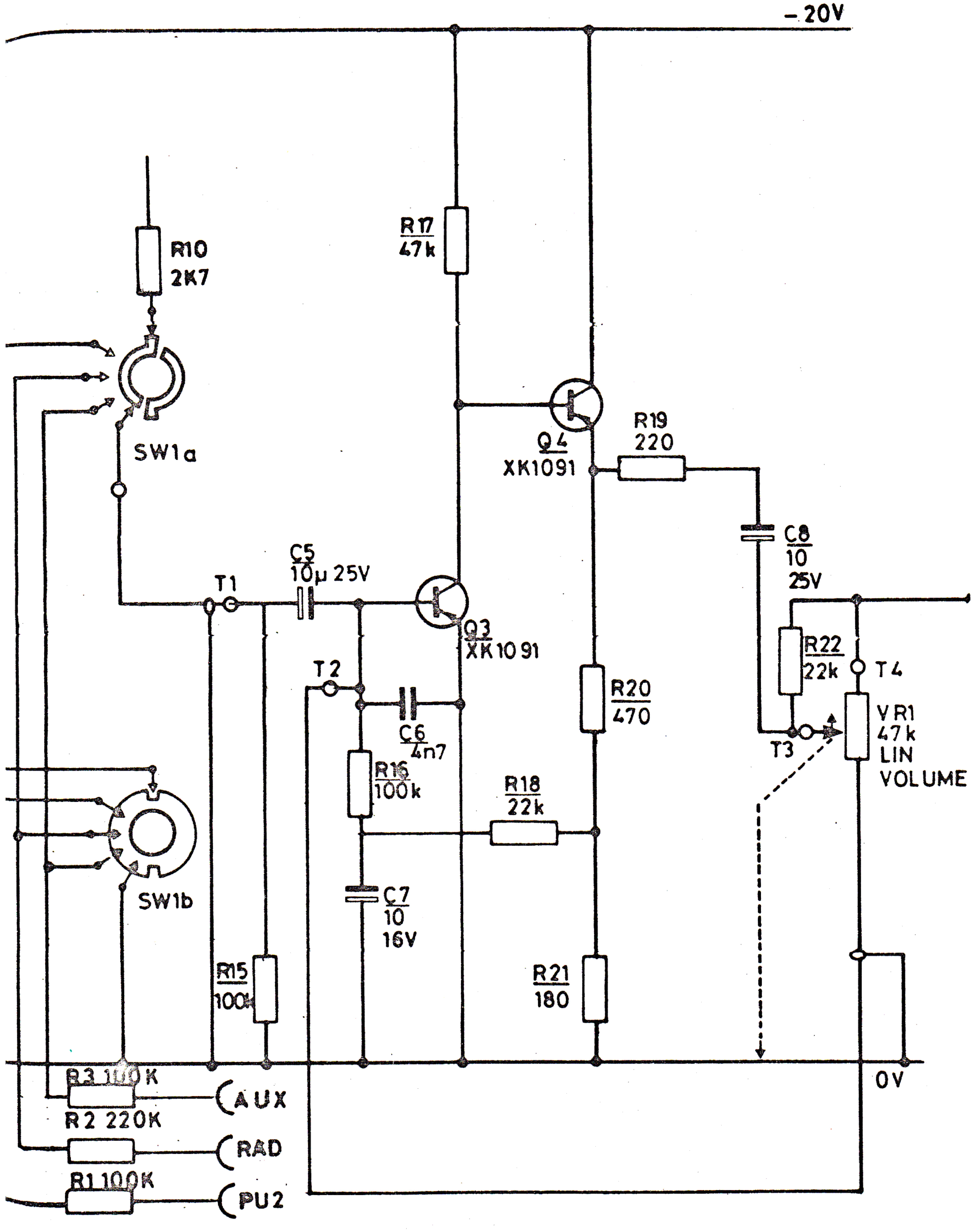

-20V
R10
2K7
R17
47k
SW1a
Q4
XK1091
R19
220
C8
10
25V
C5
10µ 25V
T1
Q3
XK10 91
T2
C6
4n7
R16
100k
R18
22k
R20
470
R22
22k
T4
VR1
47k
LIN
VOLUME
T3
SW1b
C7
10
16V
R15
100k
R21
180
0V
R3 100K
AUX
R2 220K
RAD
R1 100K
PU2

FIG.6

## 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 controlledby 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 exteemes 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 $\text{Gain} = \frac{VR1}{R10} = \frac{47K}{2K7}$ 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 networks 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).

## 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 form 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 ( 5 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. Using just resistors (R75, R76 and R80) the circuit would have a linear response but the addition of R99 and decode D17 (the diode can be considered a non-linear resistor) 'bends' the response to suit the published maximum dissipation curve of the output transistor. 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 acorss R82 rises above 2.5 volts (collector current of about 17Amps) 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 disspiated 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 Q 9 and Q12 by shorting their bases to thesupply rail thereby turning the whole power amplifier off.

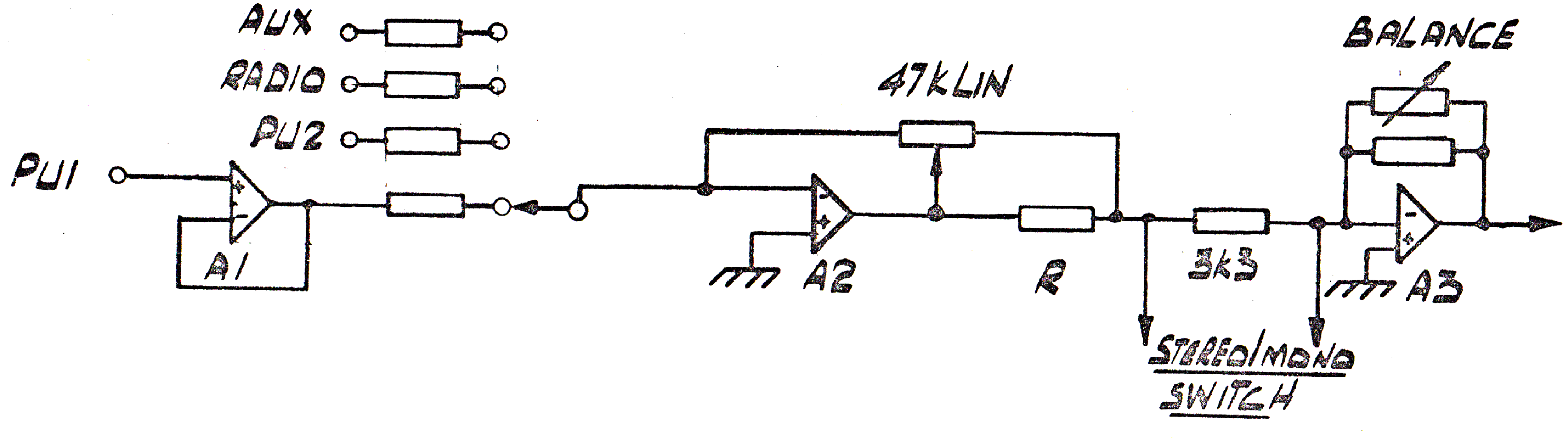

AUX
RADIO
PU2
PU1
A1
47k LIN
A2
R
3k3
STEREO/MONO
SWITCH
BALANCE
A3

FIG. 7

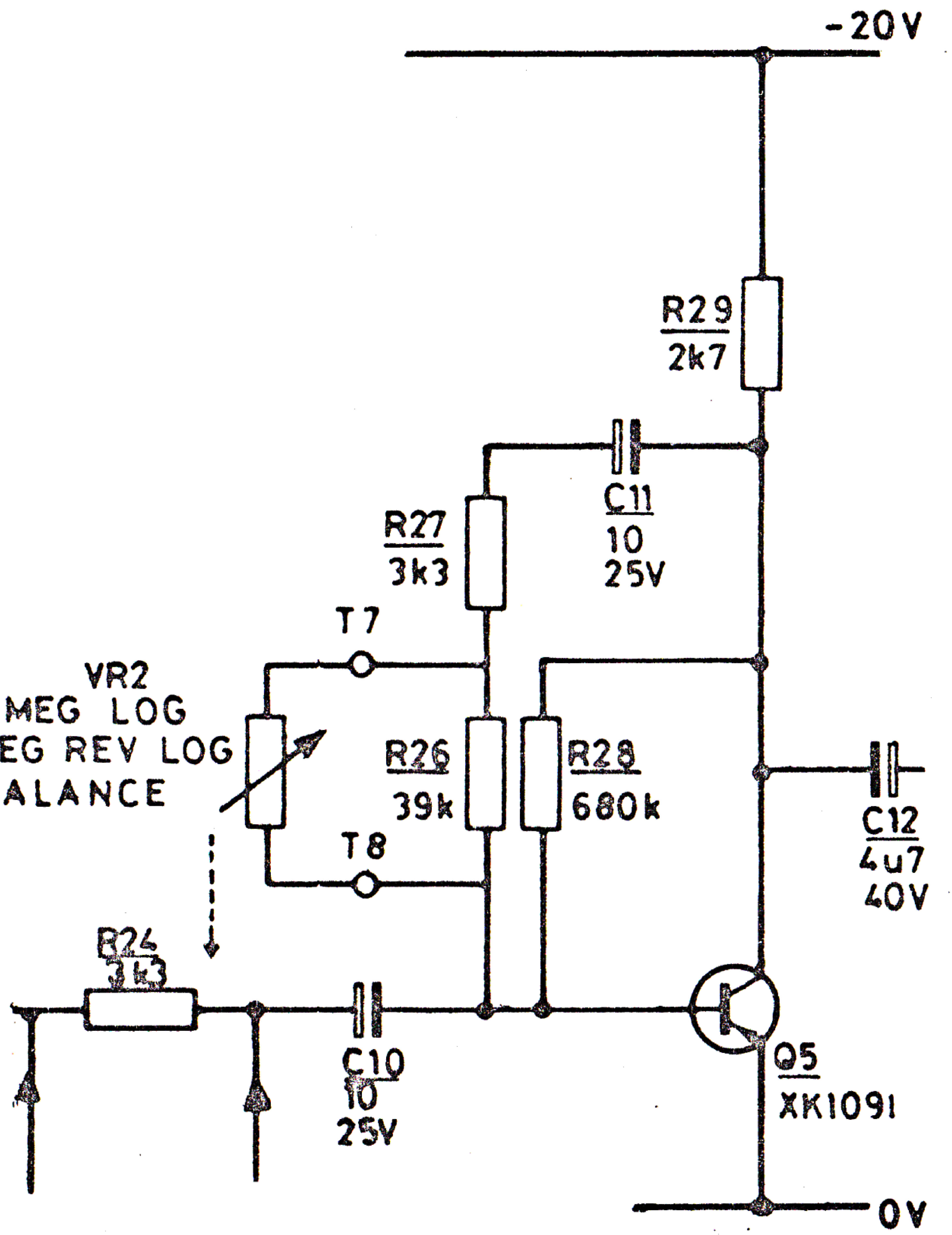

-20V
R29
2k7
C11
10
25V
R27
3k3
T7
VR2
1MEG LOG
1MEG REV LOG
BALANCE
R26
39k
R28
680k
C12
4u7
40V
T8
R24
3k3
C10
10
25V
Q5
XK1091
0V

FIG.8

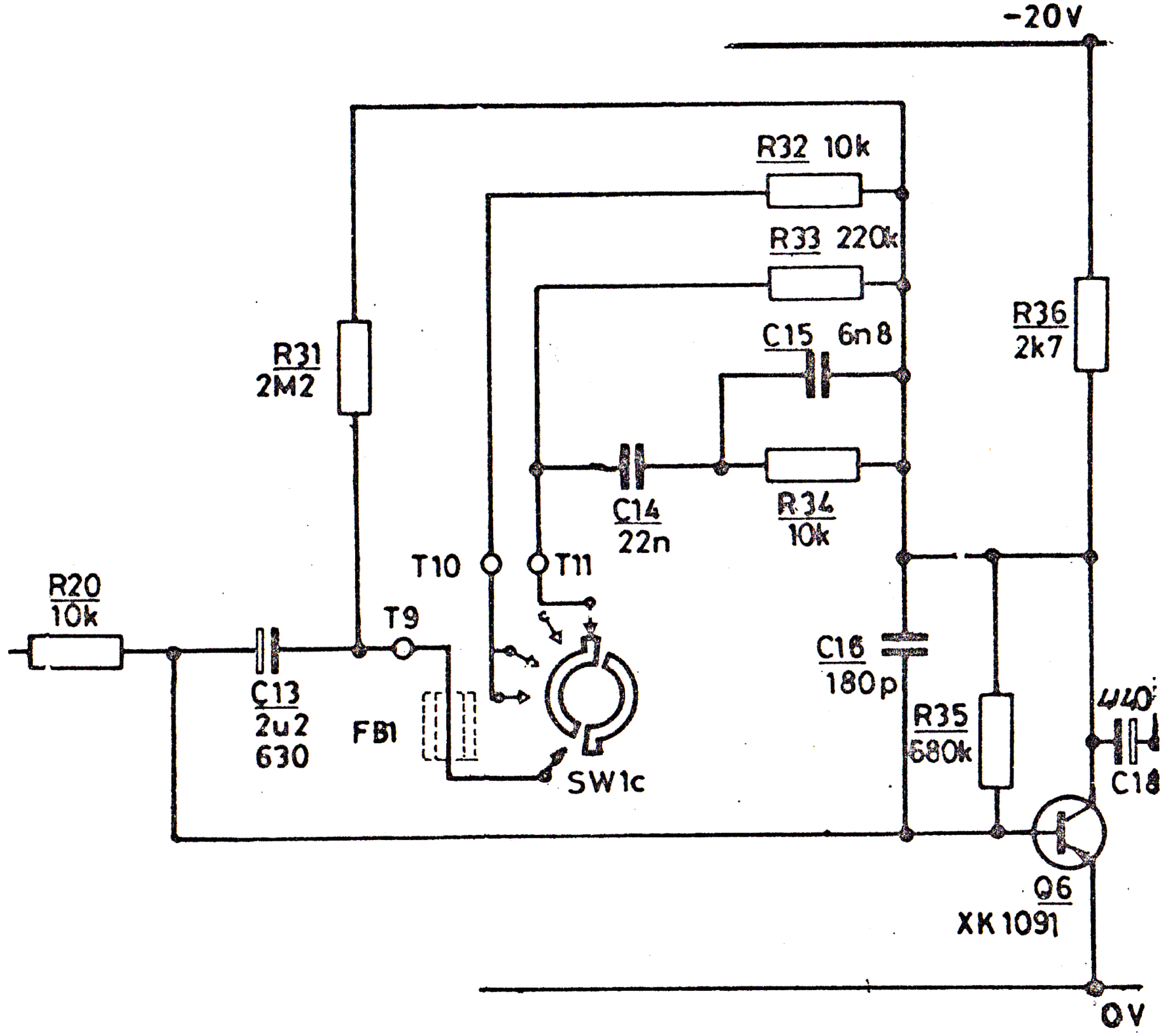
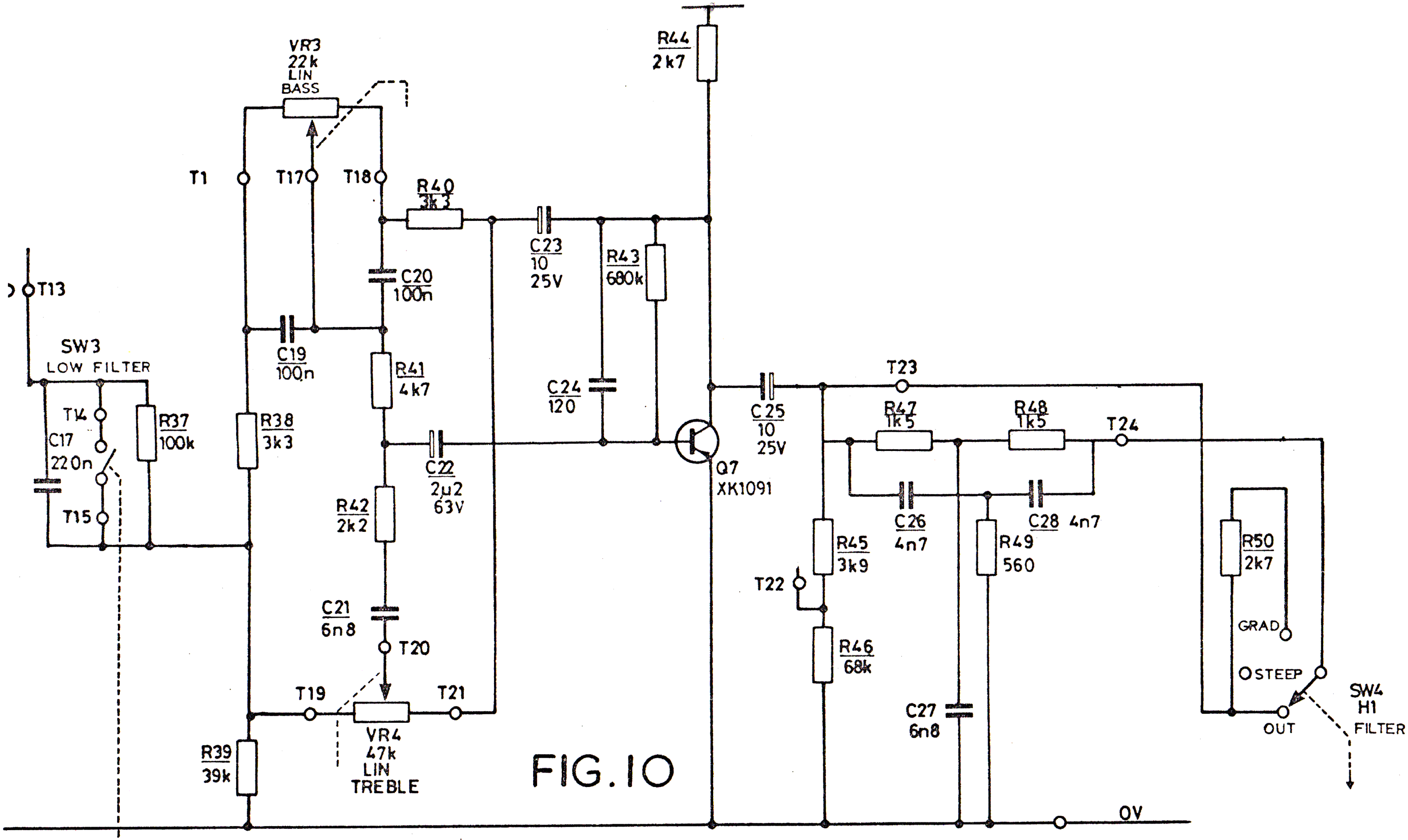

-20V
R31
2M2
R32 10k
R33 220k
C15 6n8
R36
2k7
C14
22n
R34
10k
T10
T11
R20
10k
T9
C16
180p
C13
2u2
630
FB1
SW1c
R35
680k
440
C18
Q6
XK1091
0V

FIG 9



R44
2k7
VR3
22k
LIN
BASS
T1
T17
T18
R40
3k3
C23
10
25V
R43
680k
T13
C20
100n
SW3
LOW FILTER
C19
100n
R41
4k7
C24
120
T23
T14
R37
100k
C17
220n
T15
R38
3k3
C22
2μ2
63V
Q7
XK1091
C25
10
25V
R47
1k5
R48
1k5
T24
C26
4n7
C28 4n7
R42
2k2
R45
3k9
R49
560
R50
2k7
T22
C21
6n8
T20
R46
68k
GRAD
STEEP
T19
T21
SW4
H1
FILTER
OUT
C27
6n8
R39
39k
VR4
47k
LIN
TREBLE
0V


FIG. 10

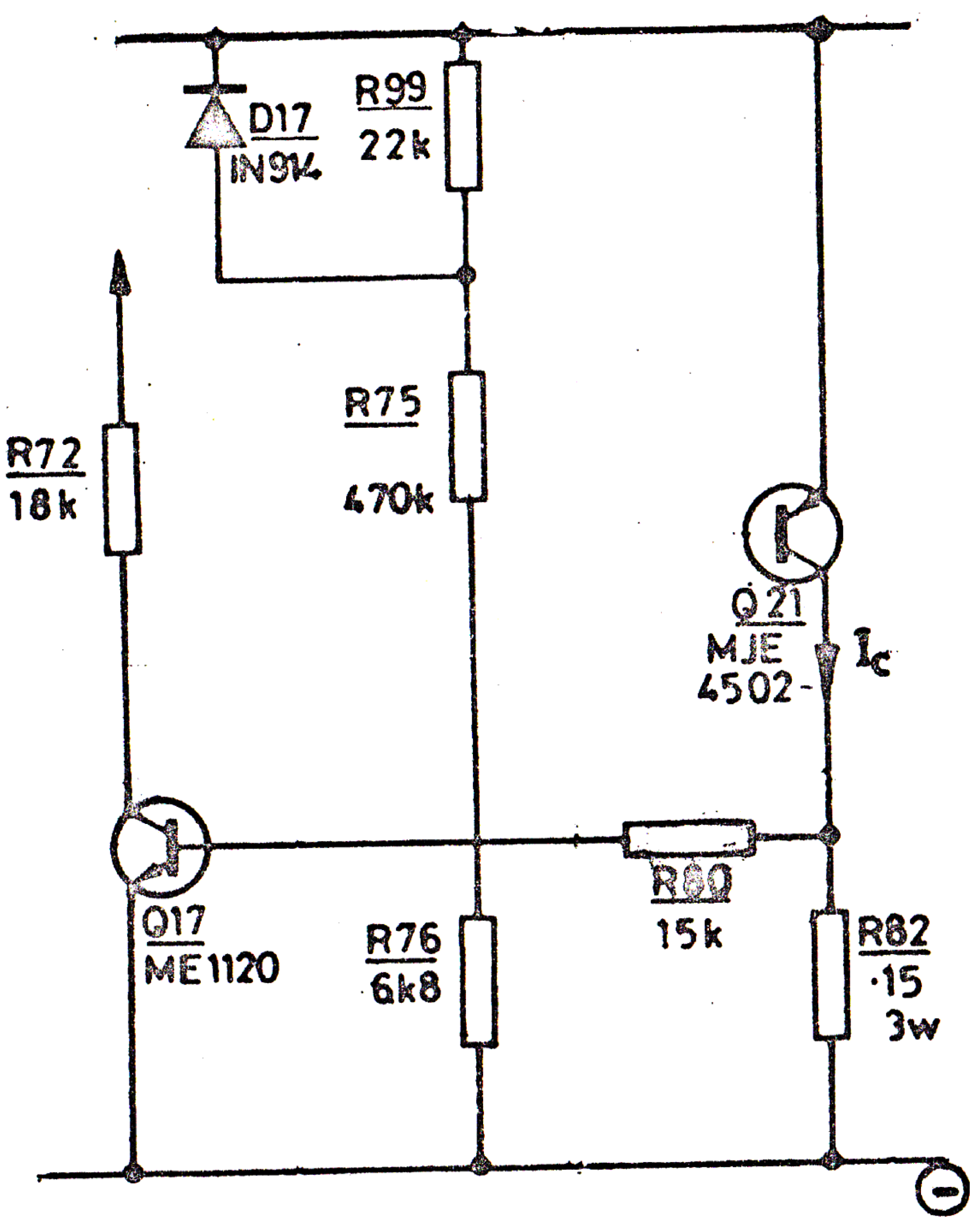

D17
IN914
R99
22k
R72
18k
R75
470k
Q21
MJE
4502
Ic
Q17
ME1120
R76
6k8
R80
15k
R82
·15
3w

FIG12

## 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 curcuit 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 Q 28 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 dirve 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 seitch 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 reservior capacitor for the 20V rail, which powers all the pre-amplifier circuits. (Figure 15).

## 5. TESTING

### 5.1 GENERAL NOTES ON TESTING

5.1.1. The Cambridge Audio P.110 may be tested throughout using an AVO Model 8, Mk. III Meter or a similar instrument, however an oscilloscope 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 calabrated 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.

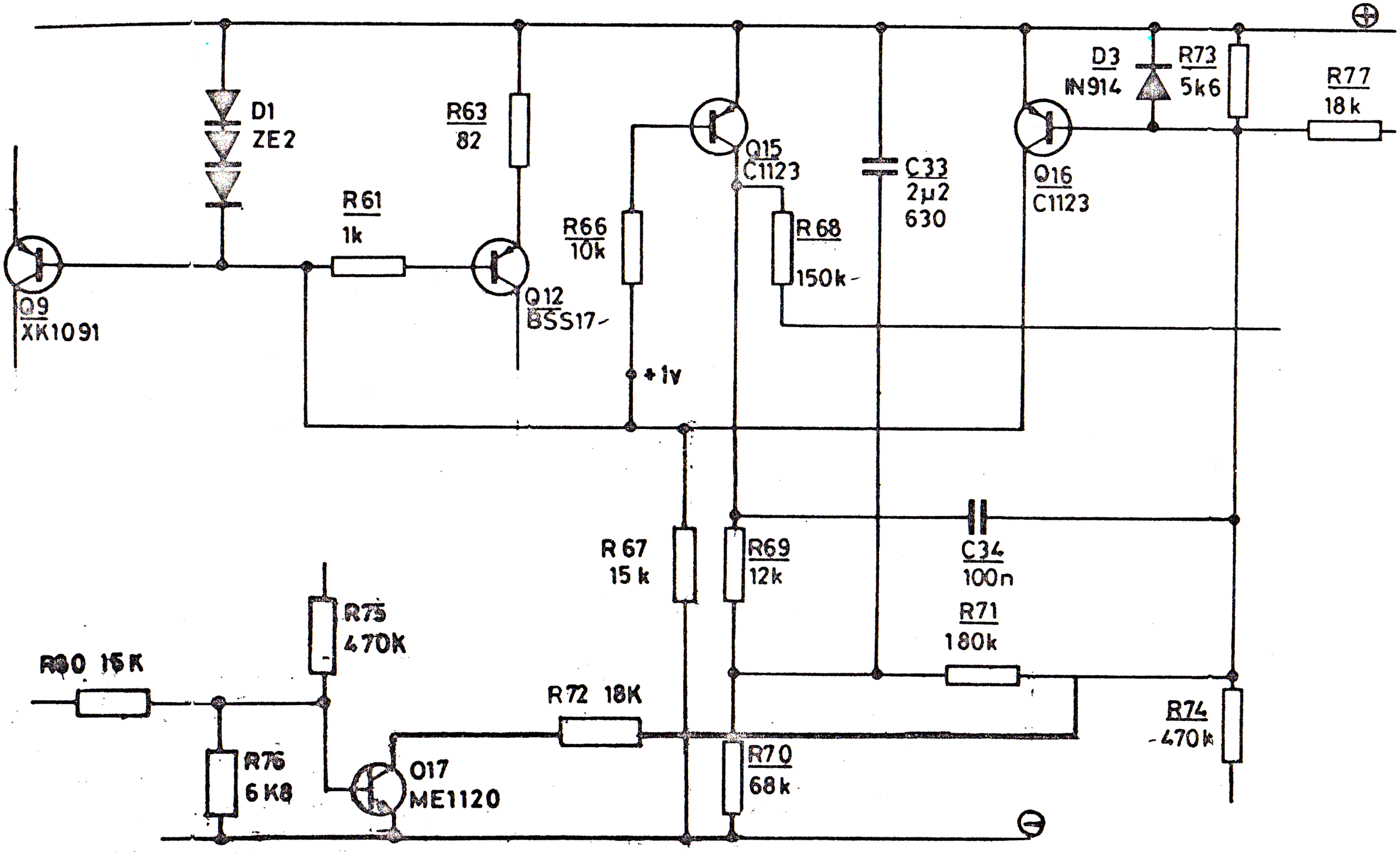
5.1.3 If it is suspected that a transistor is faulty, it may be tested in circuit using an AVO on the R.100 range, otherwise it should be removed from the circuit for test. There are six tests to make on a transistor, these are tabulated below with a rough indication of the meter reading for each test. 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 less 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 the manual be read before testing, in order than 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.



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


FIG 13

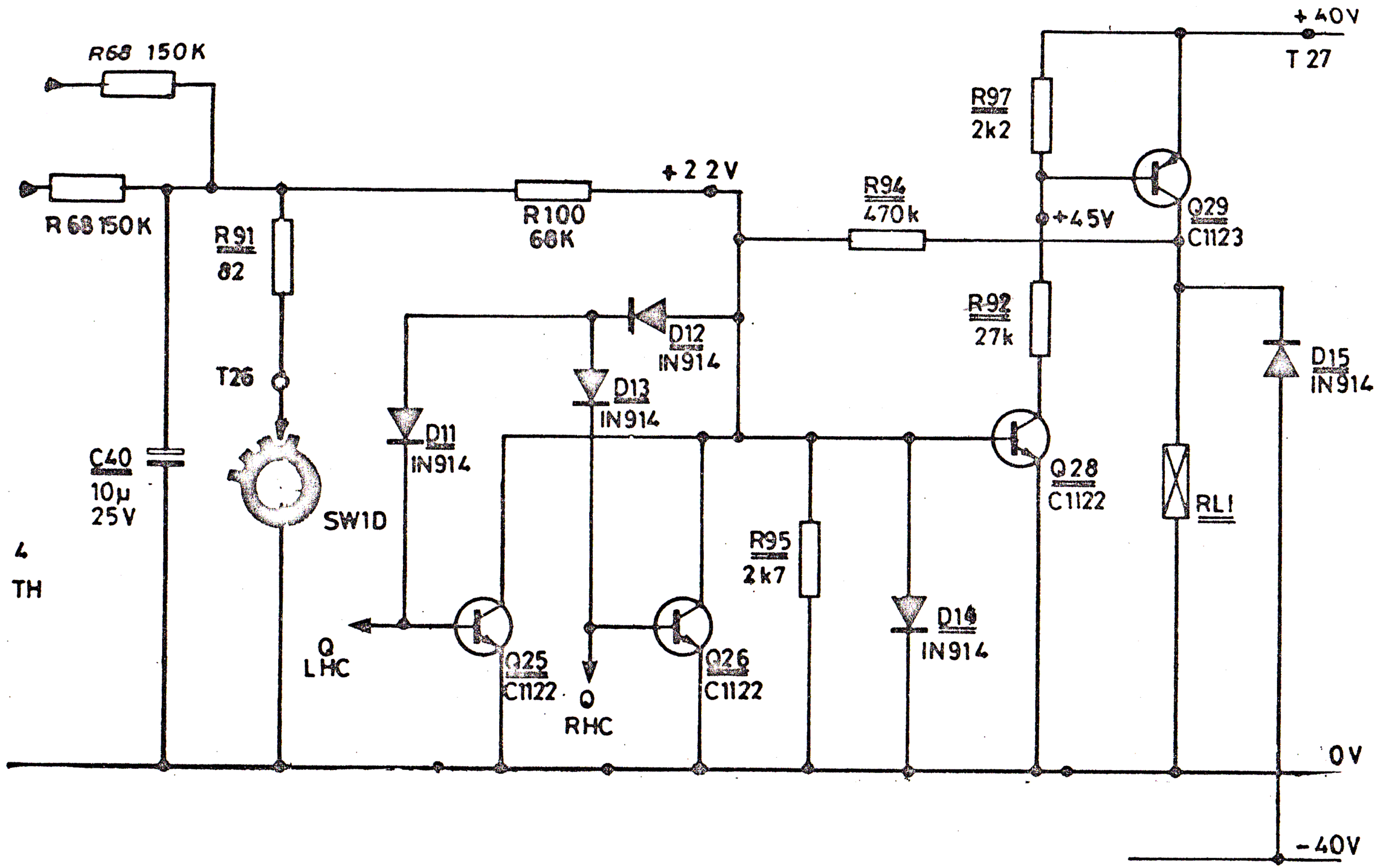



FIG 14

RELAY PROTECTION CIRCUIT

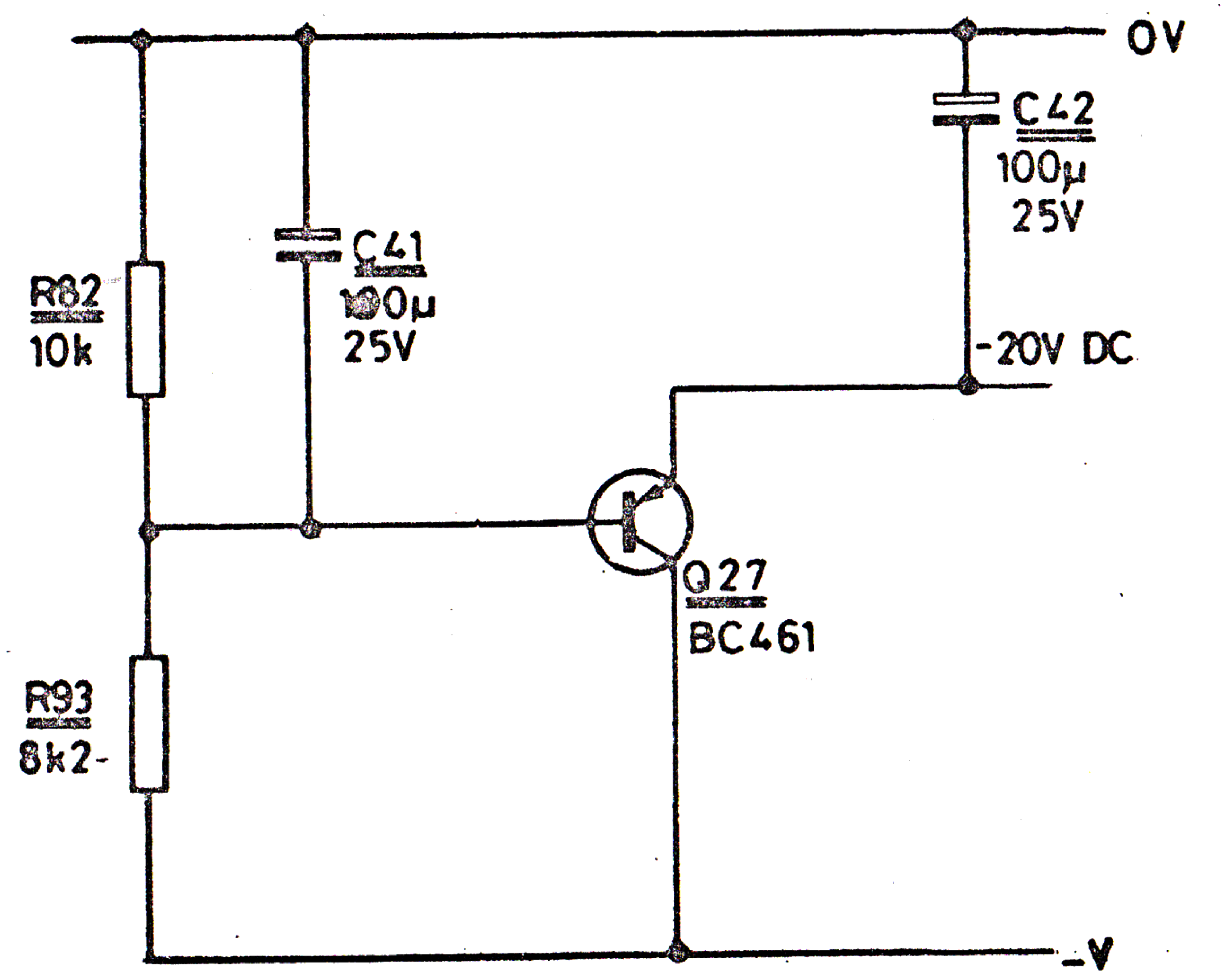



FIG.15

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 +45 V d.c., and TP2 is at +45 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 -20 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 | 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.

## 6. FAULT FINDING

### 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 shown on the circuit diagram are typical and a 10% tolerance is usually acceptable.-

| | | | | |
|---|---|---|---|---|
| Check: | TP9 | - | 1.8V | measured from TP1 |
| | TP10 | - | 0.4V | measured from TP1 |

If TP9 is at - 0.4V measured from TP1 and TP10 is more than -10V from TP1, then the power protection circuit has tripped. Turn the amplifier off 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 P110 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.

7. 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 | 1M0 | 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 |

7. COMPONENT LIST (ELECTRICAL) CONT'D

| 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 | 3k9 | 0324 or 0216 | 2 |
| R46 | 68k | 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 | 150k | 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 | 470k | 0346 or 0240 | 2 |
| R75 | 680k | 0348 or 0242 | 2 |
| R76 | 6k8 | 0327 or 0219 | 2 |
| R77 | 18k | 0332 or 0224 | 2 |
| R78 | 470R | 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 |

7. COMPONENT LIST (ELECTRICAL) CONT'D

| Circuit Ref. | Value | Part Code | Quantity |
|---|---|---|---|
| R83 | 120R, ½W | 0101 | 2 |
| R84 | 68R, ½W | 0094 | 2 |
| R85 | 10k | 0329 or 0221 | 2 |
| R86 | 470R | 0313 or 0204 | 2 |
| R87 | 10R, ½W | - | 2 |
| R91 | 82R | 0306 or 0197 | 1 |
| R92 | 27k | 0334 or 0226 | 1 |
| R93 | 8k2 | 0328 or 0219 | 1 |
| R94 | 470k | 0346 or 0240 | 1 |
| R95 | 2k7 | 0322 or 0213 | 1 |
| R96 | 470R | 0313 or 0204 | 1 |
| R97 | 2k2 | 0321 or 0212 | 1 |
| R98 | 22k | 0333 or 0225 | 1 |
| R99 | 22k | 0333 or 0225 | 1 |
| R100 | 68k | 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 | 1107 | 2 |
| C32 | 33p | 0820 | 2 |
| C33 | 2u2/50V | | 2 |
| C34 | 100n | 0992 | 2 |

7. COMPONENT LIST (ELECTRICAL) CONT'D

| 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 | | 2 |
| Q19 | BSS17 | | 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 |

## 7. COMPONENT LIST (ELECTRICAL) CONT'D

| 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 |
| D12 | IN914 | 1267 | 1 |
| D13 | 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) |

## RELAY DRIVER CIRCUIT FAULT FINDING

If the relay is permanently unpowered check the following dc voltages:

| | | |
|---|---|---|
| TP1 | 0V ± | 0.1V |
| TP2 | + | 15 to 16V |
| TP3 | 0.3 to o.5V | |
| TP4 | + 31V | |

If TP1 is more than ± 0.5V then the fault is probably not in the relay driver circuit, but in the power amplifier or its protection circuit.

If TP2 is less than +10V, the power protection circuit has probably tripped.

If the relay is unpowered even though the voltages as TP1 and TP2 are correct, or if the relay is permanently powered and does not change state temporarily as the selector switch is operated, test Q28 and Q29 for faults.

| VOLTS RMS | POWER INTO 8 OHMS (WATTS) |
|---|---|
| 18.0 | 40.06 |
| 18.1 | 41.10 |
| 18.2 | 41.50 |
| 18.3 | 42.10 |
| 18.4 | 42.35 |
| 18.5 | 42.70 |
| 18.6 | 43.30 |
| 18.7 | 43.70 |
| 18.8 | 44.20 |
| 18.9 | 44.60 |
| 19.0 | 45.20 |
| 19.1 | 45.60 |
| 19.2 | 46.10 |
| 19.3 | 46.70 |
| 19.4 | 47.05 |
| 19.5 | 47.60 |
| 19.6 | 48.00 |
| 19.7 | 48.60 |
| 19.8 | 49.00 |
| 19.9 | 49.54 |
| 20.0 | 50.00 |
| 20.1 | 50.05 |
| 20.2 | 51.00 |
| 20.3 | 51.60 |
| 20.4 | 52.00 |
| 20.5 | 52.60 |
| 20.6 | 53.00 |
| 20.7 | 53.60 |
| 20.8 | 54.00 |
| 20.9 | 54.60 |
| 21.0 | 55.20 |
| 21.1 | 55.70 |
| 21.2 | 56.10 |
| 21.3 | 56.70 |
| 21.4 | 57.30 |
| 21.5 | 57.90 |

# TRANSFORMERS

## 1. 240V/120V

| | | |
|---|---|---|
| 240V operation: | L | Brown |
| | N | Yellow |
| | Link | Red to Orange |
| 120V operation: | L | Brbwn & Orange |
| | N | Red and 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 |
| 220V Only | L | Brown |
| | N | Red |

[illegible] a black wire is to the screen.

AMENDMENT SHEET NO. 3

P.50 Mk. II AMPLIFIER

P.110 AMPLIFIER

## 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 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 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.


VOLUME
BALANCE
LO FILTER
BASS
-20v
HI FILTER
GRAD
DECODER
TREBLE
0v
PU1
PU2
RAD
AUX
SW1a
SW1b
SW1c
STEREO MONO
QUIESCENT CURRENT SET TO 7MA
TAPE OUT
TAPE IN
TAPE MONITOR
VR5
TO P.A.
LHC
FS1
SET IQ 7mA
SW1d
RHC
-20v dc
BR1
RL1
FS2
FS3
NEON
OUTLET
TEST POINT.
E
N
L
CAMBRIDGE AUDIO P50(P70), P110 (P140).
FOR DIFFERENCES SEE PARTS LIST. DRAFT ISSUE

## P50 TEST VOLTAGES

These voltages are measured on an AVO meter model 8 and are to be considered typical, and so should be used as a guide when fault-finding.

| | | | |
|---|---|---|---|
| TP1 | 12V | TP12 | 0.6V |
| TP2 | 18V | TP13 | 28V (or 2V across R58) |
| TP3 | 11.5V | TP14 | 2.2V across D1 |
| TP4 | 3V | TP15 | +1V |
| TP5 | 2.6V | TP16 | -1V |
| TP6 | 0.6V | TP17 | +12V |
| TP7 | 8V | TP20 | +30V |
| TP8 | 0.6V | TP21 | 0V±50mV |
| TP9 | 8V | TP22 | 0.6V |
| TP10 | 0.6V | TP23 | +30V |
| TP11 | 7.2V | TP24 | +30V |
| | | TP26 | -30V |

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# P110 TEST VOLTAGES

These voltages are measured on an AVO meter model 8 and are to be considered typical, and so should be used as a guide when fault-finding.

| | |
|---|---|
| TP1 | 17V |
| TP2 | 20V |
| TP3 | 16.5V |
| TP4 | 3V |
| TP5 | 2.8V |
| TP6 | 0.6V |
| TP7 | 9.5V |
| TP8 | 0.6V |
| TP9 | 7.5V |
| TP10 | 0.6V |
| TP11 | 10V |
| TP12 | +0.6V |
| TP13 | 38V (or 2V across R58) |
| TP14 | 2.2V across D1 |
| TP15 | +1V |
| TP16 | -1V |
| TP17 | +12.5V |
| TP20 | +40V |
| TP21 | 0V±50mV |
| TP22 | 0.5V |
| TP23 | +40V |
| TP24 | +39V |
| TP26 | -40V |

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13.9.74