

Project 60 Instructions

sinclair

GENERAL INFORMATION

1.1 FOREWORD

This manual covers the following modules:

- STEREO 60** : a stereo preamp and control unit.
- Z30** : a power amplifier suitable for operation up to 35v supply and 20w rms output.
- Z50** : a higher voltage, higher power version of the Z30, using almost the same circuit but with special high voltage transistors. It is capable of operating up to a maximum of 50v supply and 40w rms output.
- PZ5** : a general purpose power supply.

- PZ6** : a high voltage, stabilized version of the PZ5 especially useful where higher impedance speakers are used.

the following modules are covered by separate instructions:

- PZ8** : a high power supply intended for use with Z50s.
- Active filter unit** : rumble and scratch filter for use with the Stereo 60.

7/21/1971

The manual is an attempt to do the impossible – not only to describe to the complete beginner how to assemble a stereo amplifier, but also to describe in full the possibilities and limitations of the project for other applications. In order to do this much of the information given is of a general nature and we hope the manual will be readable, understandable and of interest not only to the complete beginner but also to the skilled engineer.

Part I consists of general information and details of assembling the complete project. Part I is complete in itself except where reference is made to other sections which are relevant. Certain sections of Part II can be added as optional extras to the complete project.

Part II deals with each module in itself and goes into more detail of their possible uses. It is therefore more technical than Part I.

Part III we hope will not be needed but if any fault occurs or if it is necessary for any reason to return modules, or to seek our assistance, it should be referred to.

In the event of service being required please adhere closely to our instructions (section 6.3 – 6.5); failure to comply will result in inevitable delays in service.

1.2 COMPONENT VALUES

Throughout the text and diagrams in this manual we have, to avoid the possibility of misreading, adhered to the internationally preferred method of coding component values, as illustrated below

<i>resistors</i>		<i>capacitors</i>	
6Ω8	= 6.8Ω	5p6	= 5.6pF
6K8	= 6.8 K	5n6	= 5.600 pF = 0.0056μF
6M8	= 6.8 M	560n	= 560.000 pF = 0.56μF
		5μ6	= 5.6μF

Throughout the circuits illustrated resistors can be 1/10w or higher: ¼ or ½w being commonly available. Where higher wattage resistors are needed this is indicated. All resistors can be 10% or 5% tolerance.

Capacitors can all be 12V working or higher unless indicated. Where voltages are indicated this is the minimum allowable and the actual component used may have a working voltage in excess of the indicated value.

1.3 CONNECTIONS AND WIRING

The connections on all the modules are brought out to

edge connections which will mate with standard open-ended 0.2" pitch edge connectors.

However where these connectors are not available soldered connections can be made either direct to the printed circuit board or by means of suitable connecting pins, soldered into the holes provided, to act as terminals (ordinary dress-makers pins, of suitable type, can be used).

TAKE CARE, however, not to overheat the connections and not to place undue mechanical strain on the copper track since this will cause the copper to peel from the board. It is suggested that flexible (stranded) wire be used to make all connections.

Throughout the text and illustrations a square around a number, letter or sign will refer to PZ5/6 connections, a circle to the Stereo 60 and a triangle to the Z 50 thus:



means connections 5 on the Z 50



means connection 5 on the right hand Z 50



means connection + on the PZ5 or 6.



means connection R on the Stereo 60.

1.4 EARTHING

In Figs. 2.3, 2.6.1, 4.11.1 etc it will be noted that many different wires are connected separately and individually to a single earth point. It is of vital importance that this be done, on no account can two connections be made with the same wire unless this is indicated. The physical positioning of the earth point is discussed in section 2.5.4.

The following paragraphs of this section are technical and can be omitted:-

The current in the power supply lead to a class AB amplifier is non-sinusoidal, it flows almost entirely during one half-cycle. Moreover on the Z 50 it reaches a peak value of several amperes.

The input current to the Z 50 itself is in the region of 100,000,000 less than this. It is therefore vital that these two currents do not mix in any length of wire or they will interact causing distortion, instability etc. The policy is therefore, whenever an earth is indicated, to run this to a common earth point so that the wires are arranged like the arms of a spider around the earth point, thus segregating the earth currents and avoiding any interaction between them.

1.5 ACTIVE FILTER UNIT

As well as the modules described in this manual an active rumble and scratch filter unit is available. This unit has two controls and a front panel 90 mm x 40 mm, to match the Stereo 60.

One control gives 12 dB per octave cut at a turn over frequency (3dB point) continually variable between 5KHz and 30KHz (giving -1 dB at 20KHz). The rumble filter gives -12 dB per octave at a continually variable frequency between 100Hz and 25Hz (-1 dB at 35Hz).

The layout diagram in the centre page of this manual leaves space for the A.F.U. if this is required.

PART ONE

2. ASSEMBLING THE COMPLETE STEREO AMPLIFIER

2.1 INTRODUCTION

This section describes the basic requirements necessary to assemble two Z 50s, a Stereo 60 and a PZ5 (or PZ6) into a working amplifier. In order that the description can be as practical as possible it is centered around a practical unit, a drawing of which is given in the centre of this

manual. It must be stressed however that this figure need not be followed exactly although many users will prefer to do this.

Section 3, 4 and 5 may be ignored in the assembly of a stereo amplifier, but in these sections are given additions which can be made to the Stereo amplifier if required.

2.2 CHOICE OF CABINET FOR PROJECT 60

Project 60 is designed to fit as simply as possibly into most plinths currently supplied with various record player decks and even the slimmest of plinths will usually accept the project.

If a separate cabinet is desired it is advisable to choose a metal box in which to mount the units since this will result in better hum, noise and distortion levels. In fig. 2.3 we give our own suggestions for a layout in a metal box of dimensions about 7 $\frac{1}{4}$ " x 13 $\frac{1}{4}$ " x 2 $\frac{3}{4}$ ", but any similar sized box can be used.

If a wooden case is used it is strongly recommended that this be lined by glueing cooking foil, or other metal sheet, over the inside of the woodwork. This is especially important if any part of the wood is within 2" of the switch of the Stereo 60. The metal foil will then become in

effect a metal box lining the cabinet and should be connected to the earth point as described in sections 1.4.

A template for cutting the front panel of the box or cabinet is given in the centre of this manual. Mounting of the Stereo 60 is referred to in section 3.5 and of the Z 50 in section 4.7.

Whatever cabinet is used all metal work must be connected to the earth point once and once only. A wire must be connected from any metal not already earthed to the earth point.

Input and output sockets must be isolated from the chassis and for this reason we recommend continental DIN type plugs and sockets; 3 or 5 pin for the input and two pin speaker sockets for the output. Phono or Jack sockets can be used for the input if mounted on an insulating panel.

DO NOT use output sockets such as jack sockets, which can be short circuited if the plug is withdrawn.

DO NOT use similar sockets for inputs and outputs since plugging your expensive new magnetic cartridge into the amplifier's output can ruin it (the pickup).

2.3 PULL-OUT CENTRE PAGE

2.4 A SUGGESTED LAYOUT – HINTS

Fig. 2.3 shows in detail one of many possible layouts. Take note of the following points:

1. Input sockets are mounted a good distance from the power supply and are as far from the output as possible, without being too far from the Stereo 60.

2. The wiring between the sockets and the Stereo 60 is screened. One end of all the screening is connected to the earth points on the Stereo 60, but only one screen connects to each earth point on the input sockets.

3. Each input wire is a single core screened wire; the use of screened twin wire for each Stereo input is permissible but it could under certain conditions result in cross-talk.

4. Additional matching components are fitted as near the Stereo 60 as possible. Most of them can actually be mounted on the Stereo 60 printed circuit board.

5. The wiring between Stereo 60 and Z 50s is shown on the diagram in a roundabout fashion so that a simple insert (provided with the AFU) can be laid over this section to show the wiring to the AFU. In practise these wires should be run direct from the Z 50s to the Stereo 60 and should be kept shorter than indicated.

12. The Z 50s are shown mounted on a block of aluminium of dimensions shown on the centre page. Instead of this, two L shaped brackets can be used or even two Meccano double brackets No. 11. The aluminium rod is preferred and any machine shop, metal worker or similar place should be able to supply one to order.

2.5 GENERAL CONSIDERATIONS IN MOUNTING AND LAYOUT

2.5.1 Positioning of Stereo 60. This is to be fixed onto the front of the cabinet or plinth by means of the L-brackets fitted to it, but its positioning will be affected by other considerations, such as its position relative to the Z 50s and power supply. It should be mounted so that the input selector switch is at least 3" away from the turntable's motor and is not near to any other transformer or motor.

If any part of the wooden cabinet is within 2" of the selector switch on the Stereo 60 this is best earthed by glueing metal foil (cooking foil is suitable) over the woodwork and connecting this, via a screw, a solder tag and a length of wire, to the main earth point. This will reduce hum pickup.

6. Separate wires are run from each earth to the common earth point.

7. The Z 50s and power supply are mounted as far as possible from the Stereo 60's input end and its wiring.

8. The output capacitors and sockets are as far from the input as possible and separate earth wires are used for each channel.

9. The mains wiring is tightly twisted together and runs around the bend in the edge of the chassis, as near to the metal as possible and as far from the input wiring as possible. If 4 core screened wire is available this can be used for the mains wire, and the screen connected to earth. This will further reduce any hum.

In our layout we have used the braiding (screen) from ordinary T.V. coaxial aerial lead as the screen.

10. Positive leads are mounted in a 'spider' onto the centre (insulated) terminal of a 3 way tagstrip: any insulated stand-off terminal can be used.

11. A capacitor, of 100 μ F, 36v working may be required connected with its negative lead to the earth point and its positive connected to the positive power input as shown. This capacitor is only required if crosstalk or distortion occurs and its value is not critical. See section 2.5.3.

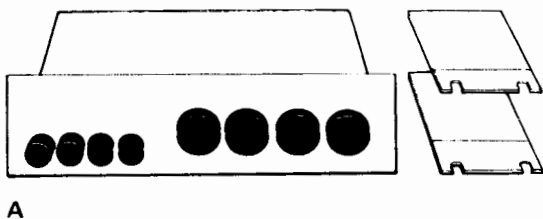
2.5.2. Positioning of Z 50s. The wiring between the Stereo 60 and the Z 50s must be as short as is convenient so that it is advisable to mount the Z 50s near to the right hand side of the Stereo 60. In fig. 2.3 they are mounted behind the Stereo 60 but they could be mounted beside the Stereo 60 in various ways as indicated in Fig. 2.5.2 a to d. It is generally advisable to keep the Z 50s in the shaded area in fig. 2.5.2a.

DO NOT mount the Z 50s anywhere near the left hand end of the Stereo 60, since this will almost certainly cause instability.

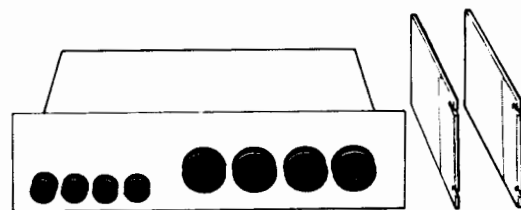
DO NOT mount the Z 50s above or below the input end of the Stereo 60 for the same reason.

These two 'DO NOT's' will not apply if a metal screen is positioned between the Stereo 60 and the Z 50s. This screen must be electrically connected either to the metal chassis if used, or direct to the earth point.

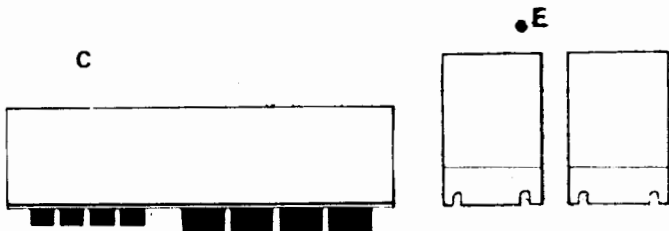
2.5.3. Positioning of power supply. This can be mounted anywhere convenient, but if the leads from it are longer than 3–4 inches h.f. instability can arise in the Z 50s. The normal symptoms of this are either distortion on both channels, cross talk, or hum (on both channels) but either



A

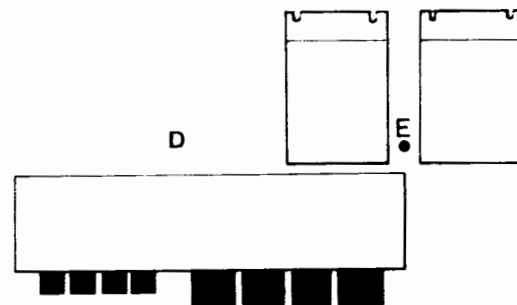


B



C

E



D

E

Fig 2.5.2

channel on its own will normally sound correct. If any of these or similar symptoms occur an electrolytic capacitor of about $100\mu\text{F}$, 36v working (any value higher than $20\mu\text{F}$ will normally suffice) should be connected between the earth point and $\Delta 8$ on one or other Z 30/Z50.

However the power supply must not be mounted near the input (left-hand) end of the Stereo 60, nor must any wires run near to the mains transformer. This is especially important with input wiring to the Stereo 60.

As a general rule no wire must approach the transformer nearer than 3", although 6" is preferable.

If this is unavoidable hum may be present when the volume and bass controls are at maximum and the input is shorted. If such hum is present the power supply can be rotated or moved to reduce it.

2.5.4. The earth point. In order to realise the full performance of which Project 60 is capable particular attention must be paid to the earth point, which should be a 6 way solder tag (or 6 tags arranged in a 'spider') or similar terminal. In our layout we have used the earth tag of one of the tag strips used to mount the output capacitors. The earth point should be situated as near as possible to, but equidistant from, Stereo 60 and Z 50s.

Note the position shown for this in fig. 2.3 and fig. 2.5.2. If a metal chassis is used, this earth point should be physically mounted on, and electrically connected to, the chassis.

2.5.5. Mounting. Hints on mounting of Stereo 60 are given in section 3.5 and for the Z 50 in section 4.7. A template for mounting Stereo 60 is given in the centre of this manual.

2.6 WIRING

2.6.1 Wiring between Stereo 60, Z50s and PZ5/6

The wiring is shown in fig. 2.6.1. Note the use of screened cables between Z 50s (screen to terminal $\Delta 2$ and core to terminal $\Delta 5$ on each) and the Stereo 60 (both screens to \textcircled{E} one core to \textcircled{B} and the other core to \textcircled{L}).

Wires are also connected to the earth point from $\Delta 1$, $\Delta 1R$, $\Delta 3L$, $\Delta 3R$, and \textcircled{E} (which already has the screens of the connections from the Z 50s connected to it). Do not miss any of these wires, especially not the connection from \textcircled{E} to earth point. The earth point will also be connected (by its mounting) to the metal chassis. Make quite certain that there are no other connections whatsoever, with the exception of the power supply chassis, direct to

the chassis: a good way of doing this is to remove the screw which holds the earth point to the chassis so that this connection is not made. An ohmmeter connected between chassis and earth terminal will now, if wiring is correct, indicate an open circuit.

If a metal chassis is not used a separate wire should be connected from the earth point to any screening used: any metal parts of the construction which are not already connected must also be connected to the earth point. Make certain however that only one wire connects to each piece since a duplicated connection will cause an earth loop which can easily cause hum and other troubles.

Special attention must be paid to the negative connection to the power supply: PZ6 and later PZ5s have their negative output already connected to their chassis. When mounted on a metal chassis the negative power supply connection will be made through the chassis: do not then run a separate connection. If a power supply with a floating earth is used, or if a wooden chassis is used, this connection will not be made automatically and a separate wire should be connected.

ON NO ACCOUNT MUST ANY OTHER CONNECTION BE MADE VIA THE CHASSIS.

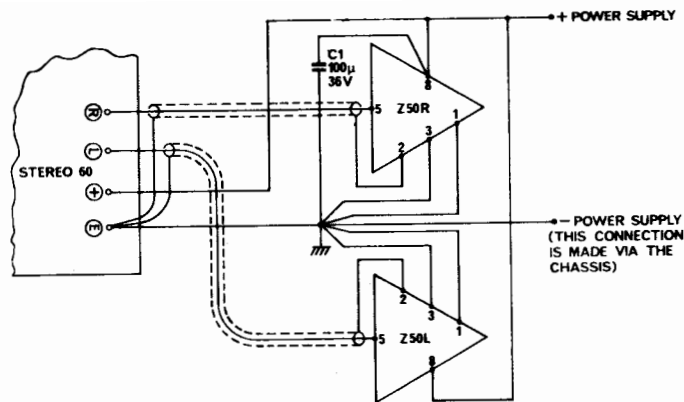


Fig.2.6.1

2.6.2. *Output wiring.* Connect terminal $\triangle 9R$ to the positive of a 1000μ 25v capacitor and the negative of this capacitor to the live terminal on the RH output socket.

Connect $\triangle 9L$ similarly to another identical capacitor and thence to the LH output socket.

These capacitors can conveniently be mounted between two tag strips as shown in fig. 2.3. A value of 1000μ F, 25v is sufficient for most purposes but other values are permissible: see section 4.12.1.

The earthy connections on the output sockets should be separately connected direct to the earth point.

2.6.3. *Input Wiring to Stereo 60.* Nine input terminations are provided on the Stereo 60:

$\textcircled{1L}$ PU Left	$\textcircled{2L}$ Radio Left	$\textcircled{3L}$ Aux Left
$\textcircled{1R}$ PU Right	$\textcircled{2R}$ Radio Right	$\textcircled{3R}$ Aux Right
$\textcircled{1E}$ Earth	$\textcircled{2E}$ Earth	$\textcircled{3E}$ Earth

It should be noted that, although the inputs correspond to the push buttons (i.e. the p.u. push-button selects p.u. input) the order is not the same.

The pu input will directly accept any magnetic pickup.

The radio and auxiliary inputs will directly accept all magnetic microphones, radio tuners etc. with outputs between 3 and 25mV. Other inputs will require matching

networks A and B (as shown in fig. 2.3.) which are described in detail in section 3.8.

Each stereo input thus has three connections: right signal, left signal and earth. Two separate screened leads (or a 'figure 8' stereo screened lead) should be used to convey the signal from the pickup or other input to the Stereo 60. Connect the core of the right hand lead to \textcircled{R} , the core of the left hand lead to \textcircled{L} and both screens to \textcircled{E} of the input chosen.

2.6.4. *Connections to pickup.*

The other ends of the pickup screened lead should be connected in accordance with the deck manufacturer's instructions. Most common turntables (BSR, Garrard etc.) are supplied with a 5-way tag strip, with colour coded wires internally to the cartridge.

Connect the live/core of the right hand lead from the Stereo 60 to the tag which already has a red wire connected. Connect the screen of the right channel to the tag with the green wire.

Connect the core of the left channel to the white and the screen of the left to the blue.

It is best to run a separate single (stranded) flexible wire from the centre tag to the earth point on the amplifier

chassis, making certain that there is no connection from either the green or blue tag to the centre tag, also make sure that all the turntable's metalwork is connected to the centre tag.

The turntable must not be separately connected to the mains earth.

If a plug and socket are required to connect the pickup a 5 pin DIN type is most suitable, since a separate pin can be used for each wire. We have used this in fig. 2.3.

2.6.5. Mains Wiring. A 2 pole on/off switch is provided on the Stereo 60, its connections numbered as in fig. 3.3.

Connect the live mains lead to a 0.5A fuse (a panel mounting fuse holder, such as Radiospares miniature panel fuse holder, is recommended).

Connect the other fuse terminal to contact 1 on the mains switch and the neutral mains wire to contact 3 on the switch. Connect contact 2 on the switch to contact **L** on the PZ5 and contact 4 to contact **N** on the PZ5.

These mains wires should be tightly twisted together and run along the corner of the chassis to give the lowest hum level, as in fig. 2.3.

The mains earth wire should connect direct to the

main earth point.

Contacts 5 and 6 should not be used, see section 3.10.

2.7 BATTERY OPERATION

Two Z50s with a Stereo 60 can be run from batteries but in order to get good power large batteries are required such as two or three HP1 12v batteries in series. Smaller batteries can be used with correspondingly reduced life. Layer type batteries are not generally recommended although three PP9s can be used.

It is important however that a capacitor of not less than 1,000 μ F be connected as described in section 2.5.3. With smaller batteries such as PP9s this capacitor should be increased to 5000 μ F or even higher.

It is not permissible to reduce the value of R16 in the Stereo 60 to operate this and the Z 50s from the same battery as this will result in instability. If R16 is reduced a separate battery must be used for the Stereo 60 (see section 3.6).

PART TWO

3. STEREO 60

3.1 TECHNICAL DESCRIPTION

The input signal is selected by S2 and S3 from one of three inputs and fed to the base of TR1. TR1 and TR2 are direct coupled with d.c. feedback from Tr2's emitter to TR1's base to provide stability. A.c. feedback is applied at the same time and also, via S4 and associated components, from the collector of TR2 to TR1's emitter in order to give accurately defined gain and frequency response,

The combined effect of both feedbacks also controls the input impedance.

The signal is taken from TR2's collector to a Baxandall type control arranged around TR3. Output is taken from TR3's collector via the volume and balance controls.

3.4 TYPICAL PERFORMANCE SPECIFICATION

Input sensitivity on all inputs at 1KHz :3mV

Input impedance on all inputs at 1KHz :50K

Power requirements 15 – 35V at 3 – 10 mA

or 9 – 15V at 3 – 10 mA

Equalization (PU input) correct to RIAA curve

+ 1dB, 20Hz to 25KHz

Frequency response, rad and aux \pm 1dB 20Hz to 25KHz

Overload factor 20 dB at 1KHz on all inputs.

Distortion 0.03%

Signal to noise ratio – 70 dB

Treble control \pm 15 dB at 10KHz

Bass control \pm 15 dB at 100Hz

Output (for 3mV input) 250 mV

Output load impedance: not less than 25K

Dimensions: P.C.B. 200mm x 65mm Front panel 207mm x 40mm.

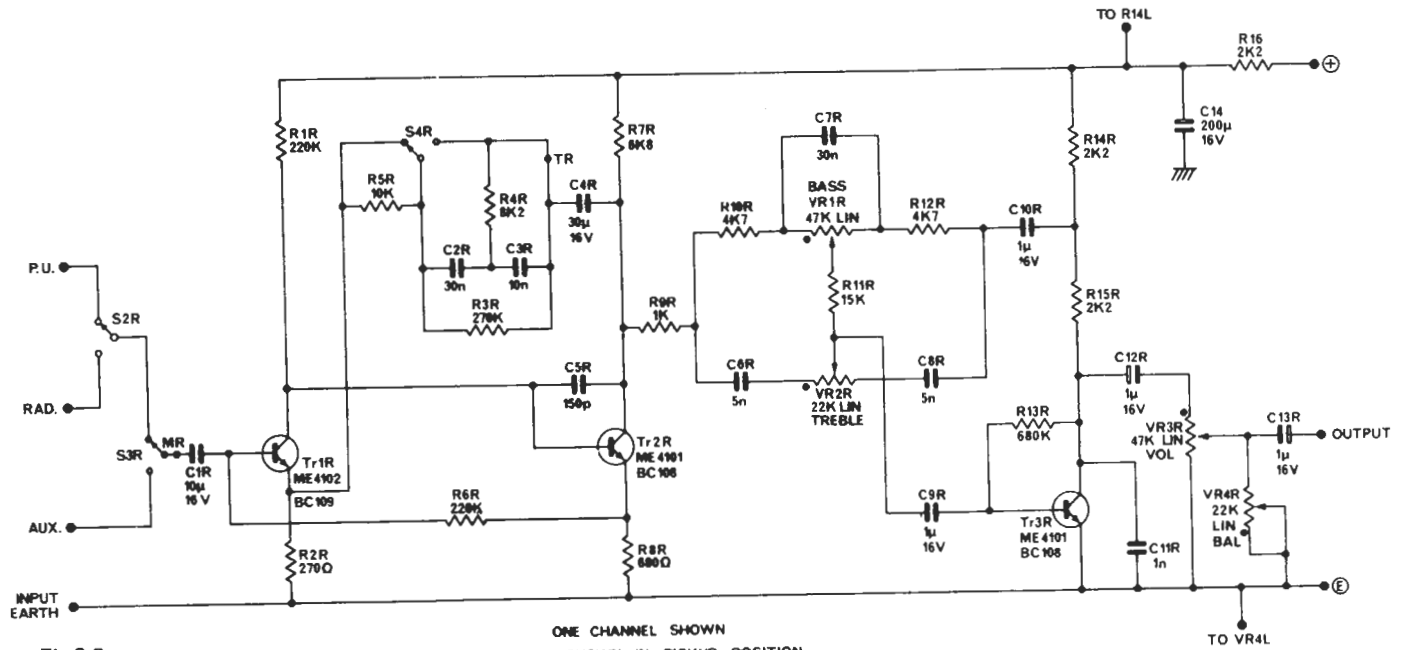


Fig.3.2

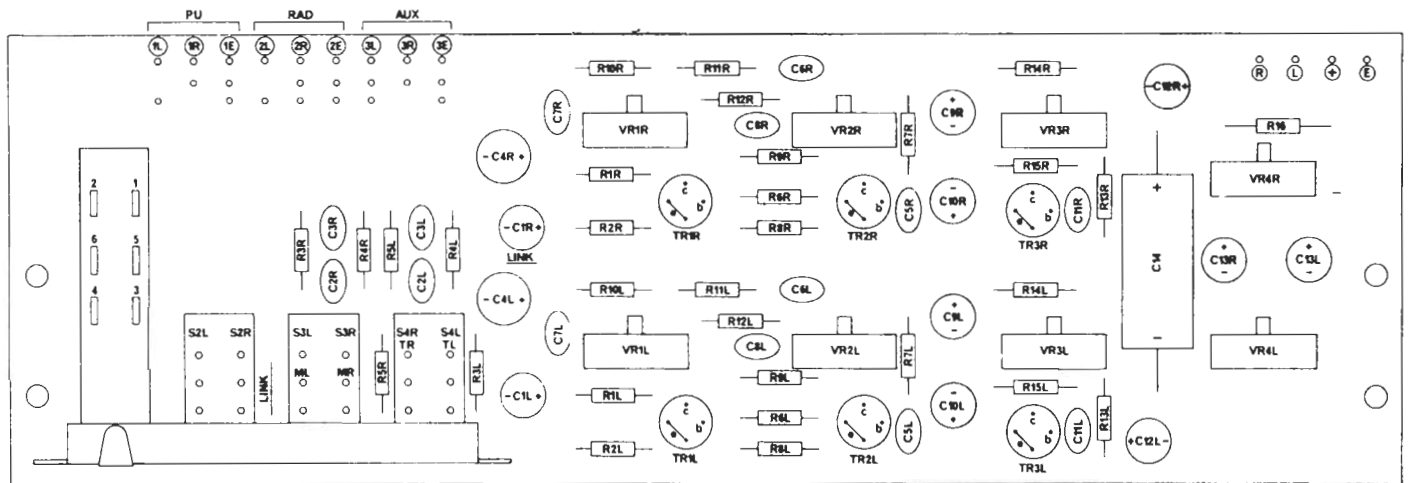


Fig.3.3

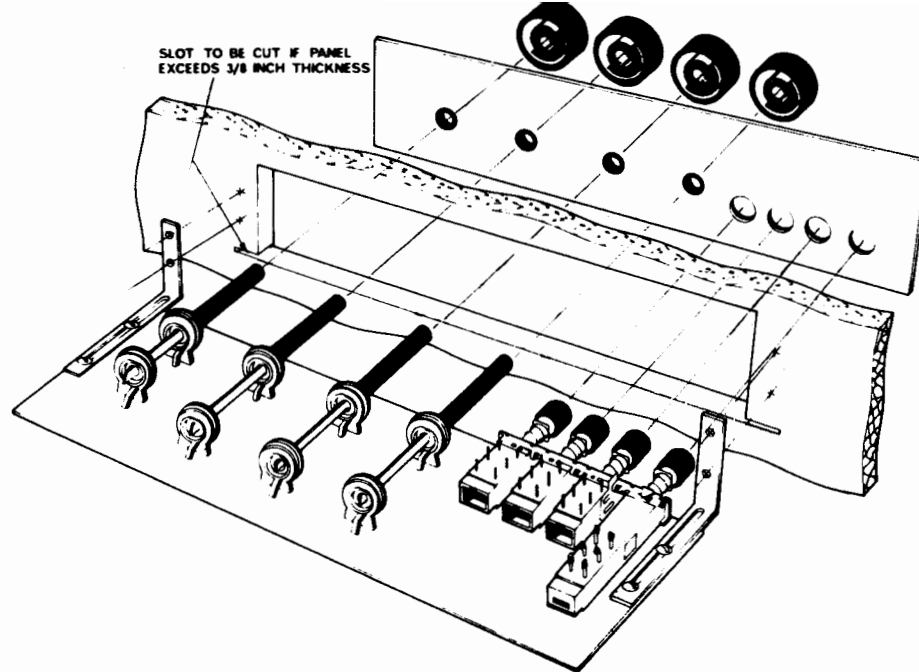


Fig.3.5.1

3.5 MOUNTING STEREO 60

Dismantling — grip the control shaft firmly with one hand and pull the control knob off the shaft with the other. In this way all four knobs are removed, taking great care that the metal shaft does not move within the potentiometer bushes.

The front panel can now be removed and the plastic bushes can also be removed if required. These will normally be used between the knob and the panel to give about 1 mm spacing.

IMPORTANT NOTE: In dismantling and reassembly great care should be taken at all times not to put any force on the control potentiometers, nor to move the control spindle in the controls.

The Stereo 60 is supplied with two mounting brackets so that it can be mounted on the front panel of the cabinet or plinth, this is illustrated in fig. 3.5.1.

First a rectangular hole $7\frac{1}{4}'' \times 1''$ is cut out in the front panel, as shown in fig. 3.5.1.

With panel thickness up to $\frac{3}{8}''$ the screws holding the bracket to the PCB should be loosened and the PCB pushed up tight to the wood panel. The control panel should then be mounted on the front of the case and the control

knobs pushed home. The PCB of the Stereo 60 can now be withdrawn from the wood panel so that the knobs are flush against the bushes. The Stereo 60 fixing screws should now be tightened.

If a panel thickness greater than $\frac{3}{8}''$ is used the slots should be cut as shown on the template so that the PCB itself fits into the slots in the wood panel. The brackets can accommodate in this way a thickness of up to $\frac{3}{4}''$.

To mount the front panel peel off the protective paper back to expose the self-adhesive face and press the panel into position.

The mounting bracket should not be fitted on the coppered side of the board but should be mounted only on the component side as shown in fig. 3.5.1.

3.6 POWER REQUIREMENTS

Voltage maximum	35 @ 10 mA
minimum	15 @ 3.5 mA

voltages higher than 35 can be used if R16 is increased.

The Stereo 60 can also be run off its own separate battery (9 or 12V) if R16 is short circuited.

Power is fed between ⊕ and ⊖ shown in fig. 3.3.

3.7 OUTPUT

The Stereo 60 has a voltage gain of approximately 80 so that the output voltage will be 80 times the input voltage, i.e. for 3mV input the Stereo 60 will give approximately 250 mV output.

Output impedance is about 25K and the input impedance of the main amplifier fed from the Stereo 60 should be higher than this.

Outputs are taken between (L) and (E) and between (R) and (E) shown in fig. 3.3.

3.8 INPUTS

3.81. General For most inputs other than magnetic microphones and pickups, which can feed direct to the Stereo 60, some input matching network is necessary and this is to be duplicated, one network for the left-hand input and the duplicate for the right-hand input.

The input components are arranged normally in a potential divider, shown in fig. 3.8.a, usually consisting of two resistors but occasionally capacitors will be used. Network B can normally be mounted on the Stereo 60 in the holes provided near the inputs, network A will

be included in series with the live signal lead. The components can be clearly seen in our layout, fig. 2.3.

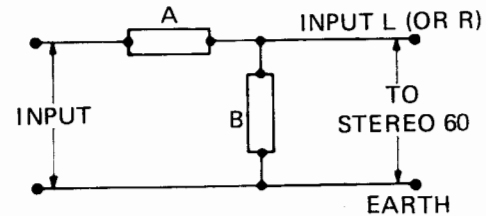


Fig 3.8.1

If preferred a single preset potentiometer of 47K or 100K could be used to replace networks A and B — one end of the control will be the input, the other end earth and the wiper will go to the Stereo 60's input. The control can then be set at the position giving best results.

3.8.2. Flat inputs This applies to all input signals derived from radio tuners, taperecorders, other preamplifiers etc. giving a 'flat' frequency response which does not require

equalization. For these inputs networks A and B will be resistors, typical values are shown in the following table.

input sensitivity	A	B
3mV	0	open-circuit
10mV	68K	22K
30mV	100K	10K
100mV	100K	3K3
300mV	100K	1K0
1V	100K	330Ω

These all give an input impedance of 100K, approximately. To give an impedance of 200K the values should be doubled etc.

It is of no consequence that the impedance be matched to the tuner, provided the input impedance to the Stereo 60 is greater than the tuner's output impedance. The sensitivity of the Stereo 60 will normally be chosen to be greater than the tuner's output. Thus, with a tuner giving 500 mV at 1K a suitable matching network would be that for 300 mV 100K.

3.8.3. Magnetic pickups Since magnetic pickups are generally of superior performance to ceramic and crystal pickups

they are to be preferred, especially since all magnetic pickups will feed the Stereo 60 satisfactorily. It can occur that if a high output magnetic pickup is used, the Stereo 60 volume control will be set at a very low level for normal listening. If this is undesirable the Stereo 60's gain can be reduced by increasing R2R and R2L (see fig. 3.2 and 3.3). Increasing these from 270Ω to 560Ω will approximately halve the gain on all inputs.

3.8.4. Other pickups A crystal or ceramic pickup, when fed into a high impedance, gives a flat frequency response. However, when fed into a low impedance (lower than 1M or so) the bass is reduced and treble increased. By correct loading it is possible to give a very similar output to that from a magnetic pickup.

These are three basic methods of feeding to the Stereo 60

a) Via a 1M or 2M2 resistor (A in fig. 3.8.1) to a flat input, when resistor B is chosen to suit the cartridge's output as follows:

Cartridge output	30mV	100	300	1V
recommended resistor 'B'	open circuit	33K	10K	3K3

This method is recommended for the cheaper, high output, crystal cartridges when A of 2M2 and B of 4K7

should give good results.


The treble can be increased by fitting a small capacitor (50-200pF) across the 2M2 resistor.

b) Loading with a capacitor. In this case the cartridge is fed direct to a flat input and the capacitor fitted in place of network B (fig. 3.8.1.)

This method is recommended for use with the lower output ceramic cartridges, when the capacitor can be about 50n to 100n: the larger it is the better the bass response.

The treble can be increased by fitting a small resistor (100Ω – 500Ω) in series with the capacitor.

c) By loading the cartridge to give RIAA response. The cartridge's manufacturer will often be able to recommend a particular loading network, but the table below gives some specific networks.

MAKE	CARTRIDGE	A	B
BSR	C 1	47K	∞
DECCA	DERAM	0	

3.10 MONO USE

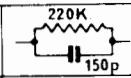
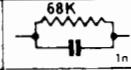
Mono/Stereo Switching is not strictly necessary since, with a stereo record player, stereo records come through in stereo and mono records will come through in mono. With a stereo tuner switching is normally accomplished by the decoder.

If a mono input is to be fed into the Stereo 60 used with only one Z50 all connections to the left hand channel of the Stereo 60 and to the left hand Z50 can be omitted entirely.

If a mono signal is to be fed to both channels input Ⓐ and input Ⓑ should be connected together and the input fed via the appropriate matching network to the combined input, as in section 3.8

Mono switching can be accomplished by shorting together points MR and ML on the aux. switch, shown in fig. 3.3. If these points are shorted any signal fed into either Ⓐ or Ⓑ input will be amplified by both channels.

If the mains 'on' switch is not required this can be used. Connect contact 5 to MR and contact 6 to ML. DO NOT DO THIS if the switch is used for mains. Otherwise a separate single-pole toggle (or other type)

GOLDRING	CS 90		22 K
SONOTONE	9TAHC		8K2

This method is recommended if the cartridge manufacturer gives a specific matching circuit.

3.9 MAINS SWITCH

The mains switch fitted to the Stereo 60 makes two connections when in and makes a third when out, the first being broken.

Contacts are made between terminals 1 and 2 and between 3 and 4 when the switch is in and between 5 and 6 when out.

The switch is rated at 2A 250V and can be used to switch the power to the mains power supply as well as to the turntable and other equipment up to 500 VA.

Mains wires to the switch should be twisted together tightly and kept away from any input wiring. More details of this are given in figure 2.3 and section 2.4.

Contacts 5 and 6 are not normally used for switching the mains.

on/off switch can be used.

An alternative, comprehensive, switching circuit is given in section 4.15.6.

3.11 TAPE RECORDER

A signal of approximately 120 mV, unaffected by tone and volume controls can be taken from points TR (or TL) on the pickup switch (see fig. 3.3) and earth to feed to a tape recorder. This signal is not suitable for feeding direct to a tapehead.

For driving a tapehead direct a special amplifier with its own oscillator would be required and this has to be closely matched to the tapehead in use.

The Stereo 60 could be modified for playback from a tapehead by fitting a capacitor of 6n8 in series with R5R and with R5L, to give CCIR equalization for 7.5 i.p.s. For other tapespeeds, CCIR, the resistors R5 can be changed as follows:

3.75	i.p.s.	new standard 13K	old standard 18K
1.875	i.p.s.	new standard 18K	old standard 27K

a.c. (signal) input. This is compared with the voltage on the base of TR2 and any difference is amplified and fed to TR3 which amplifies it further. TR6 and 7 are emitter followers to drive the output transistors TR8 and 9 and the voltage on the output, terminal 9, will follow the voltage on TR3's collector.

This output voltage, on terminal 9, is fed back via a potential divider and its phase is such as to cancel out any difference signal that originally caused it. The output d.c. voltage will therefore stabilize itself at the value determined by R1 and R2 in the Z50 or at the value determined by the combined effects of R1, R2 and R8, R6+R7 in the Z30. The a.c. output signal will be in ratio to the input of $\frac{R8+R7}{R7}$ so that

the voltage gain is exactly 40.

TR4 and 5 are arranged as a constant current collector load to TR3 and it is this that enables such low distortion performance to be obtained, as well as accurately defining the current in TR3 and hence TR6 and 7.

Currents and voltages are shown for the Z50 (or bracketed for the Z30) from a voltage of 35. The voltages shown will vary at other values of supply.

4. Z30 AND Z50

4.1 TECHNICAL DESCRIPTION

TR1 and TR2 are a long-tailed pair by means of which the input conditions (on the base of TR1) are compared with the output conditions.

The input consists of two parts: a d.c. level, proportional to the supply voltage, obtained from R1 and R2 and the

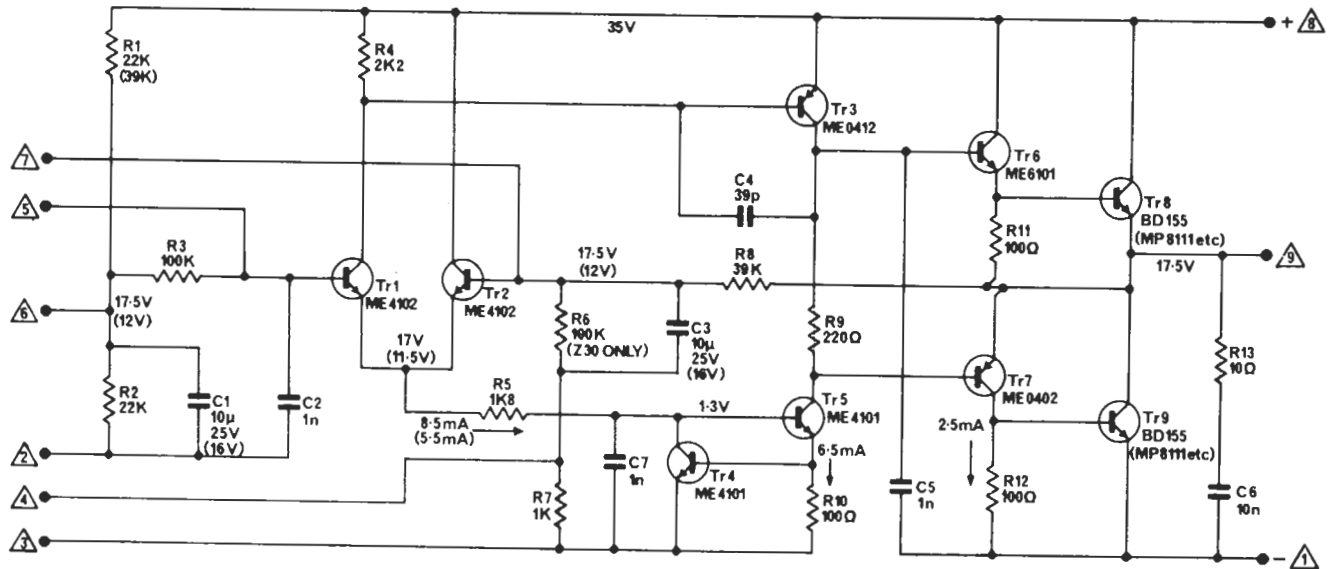


Fig 4.2

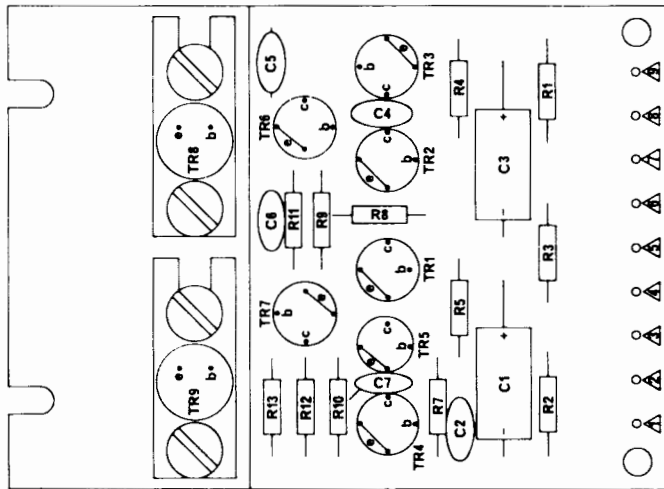


Fig 4.3.1 layout of early Z30

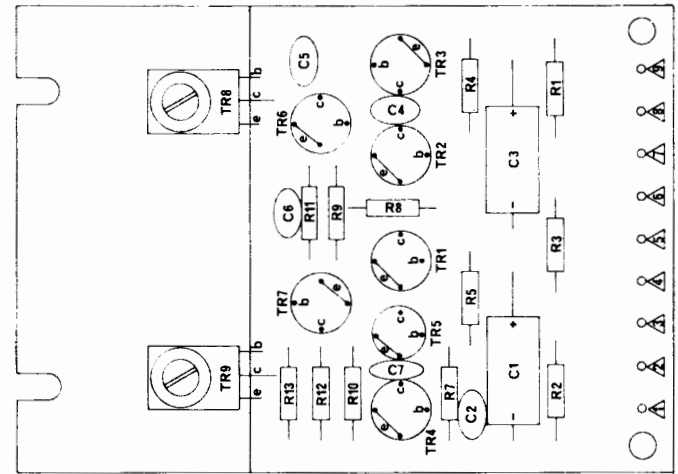


Fig 4.3.2 layout of Z50

IMPORTANT NOTE Z30s are now fitted with similar transistors to those indicated for the Z50 (above), but the transistors in these Z30s will not be safe in operation above the rated 35v. In particular these Z30s will have R1 39Ω, and R6 will be present.

4.4 TYPICAL PERFORMANCE SPECIFICATIONS

Dimensions: 55mm x 75mm

Input impedance: 100K// 1n

Output Impedance: 0.1Ω

Voltage gain: 40

Signal/noise ratio: 70dB below full output at 30v.

Frequency response: 20Hz to 300KHz±3dB.

Distortion: 0.02% at all levels at 1KHz into 8Ω or 15Ω

Load Impedance: not less than 3Ω

Maximum supply voltage: Z30 : 36v

Z50 : 50v

Sensitivity for: 10w 3Ω : 125mV

10w 8Ω : 200mV

10w 15Ω : 300mV

Power output: see fig. 4.6.

4.5 FACTORS AFFECTING THE OUTPUT

4.5.1. Power Supply and Loudspeaker impedance effects.

The Z50 acts substantially as a voltage amplifier so that the voltage at the loudspeaker will depend only on the voltage applied to the input, subject to the limitation that the peak to peak output voltage can never be

greater than the supply voltage and in practise is below this by about 3-5V.

The loudspeaker behaves approximately as a resistor so that the power can be calculated:

Assuming a sinewave of maximum amplitude V , where V is 3-5V less than the power supply voltage, the rms

output will be $\frac{V}{2\sqrt{2}}$ volts. The output power will be $\frac{V}{2\sqrt{2}R_L}$ watts, where R_L is the load impedance, in ohms.

Therefore maximum power will be given into a low impedance from the higher supply voltages. A typical correlation between available power and power supply voltage is shown in Fig. 4.6.

4.5.2. Gain

The open circuit voltage gain of the amplifier is defined by R7 such that the gain, $A = \frac{R8 + R7}{R7} = 40$

Thus a signal of x volts at the input will produce $40x$ volts at the output, provided the peak to peak voltage at the output does not exceed the maximum voltage swing V (see 4.5.1.)

4.5.3. Non-Technical Summary

The Z50 and any other amplifier) can only increase its signal input (from the pickup etc.), by a certain factor called its gain. If the output is insufficient more input is required, or the amplifier's gain has to be increased.

The output cannot exceed a maximum (even ignoring safety considerations). If too much input causes loud passages to sound broken up and scratchy the output is limited and in this case the power supply voltage may be too low or the loudspeaker inefficient or of too high an impedance

The impedance of the loudspeaker, will affect the 'loudness' of the amplifier but an efficient 16Ω working at 1W can sound louder than an inefficient 3Ω working at 10W.

4.6 SUPPLY VOLTAGE AND LOAD IMPEDANCE LIMITATIONS

4.6.1. Voltage

The absolute maximum voltages are: for the Z.50, 50v; for the Z 30, 35v. If these voltages are exceeded damage to the amplifier may well result.

The amplifiers will perform down to 8v although they will give little power at this voltage.

40v with 3Ω load, 45v with 4Ω load with the Z.50 or 30v with the Z 30.

The amplifiers are not recommended for continuous tone testing at these powers and any sinewave tests should be of short duration only to avoid overheating.

Very low impedances of less than 4Ω are not recommended unless the power supply voltage is reduced proportionally, e.g. with 2Ω load, not more than 17v (25 under very high power conditions).

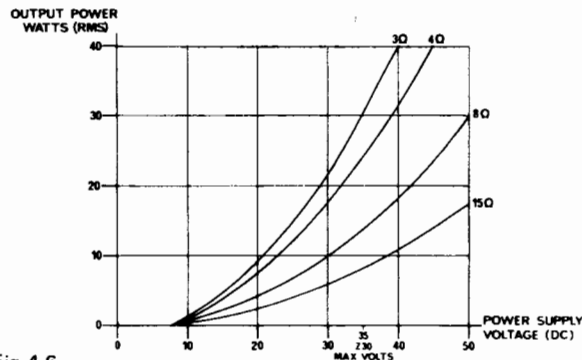


Fig 4.6

4.6.2. Load impedance

High impedances. The Z30/Z50 is quite safe on high impedance loads and will not be damaged by an open-circuit load. Since the power will be greatly reduced into high impedance loads no heatsinking will generally be required.

8Ω – 15Ω loads are recommended for normal use. Heat sinking will be necessary unless the Z 30/Z 50 is operated from the lower supply voltages, but no special precautions provided that the loudspeaker can handle the power that is available, shown in fig. 4.6.

4Ω to 8Ω loads will demand highest power from the amplifiers and unless very high power operation is required it is best, for general purpose use, to operate the amplifier at a reduced supply voltage, not more than 25v with the Z 30 or 35v with the Z 50.

If higher power use is required the following steps must be taken:

- 1) A large heatsink must be used (see section 4.7).
- 2) Precautions must be taken to protect the loudspeaker and amplifier at switch on – it is best to do this by switching on with the loudspeakers disconnected (see section 4.17).
- 3) The following maximum voltages should not be exceeded:

4.7 HEATSINK AND MOUNTING REQUIREMENTS

The maximum power available from the Z50/Z30 will depend upon the power supply voltage and the load impedance. If the available power is greater than about 5 watts heatsinking is desirable. If the Z50s/Z30s are mounted inside a metal cabinet this can of course be the heatsink. The Z50/Z30s can be mounted by means of a metal bar or L-bracket, either parallel to the chassis or perpendicular to it as illustrated in fig. 4.7.1. This bracket will put the Z50's heatsink in thermal contact with the whole of the metal chassis which will then act as a heatsink.

If the amplifier is not mounted in a metal chassis a separate piece of aluminium or copper sheet can be used, this should be of 16, 14 or 12 s.w.g., thicker sizes being preferable. 10sq" will suffice up to about 10w, 25sq" up to 30w, and 100 sq" up to 40w. These sizes should be adequate for continuous use at the stated powers and if the amplifier is used for normal domestic listening purposes the heatsink can be reduced in size or even omitted, except at very high powers, say above 30w. The same heatsink can be used for both Z 50s, but its size should be increased in proportion. The heatsink should be connected directly or indirectly, into the amplifier's earthing system.

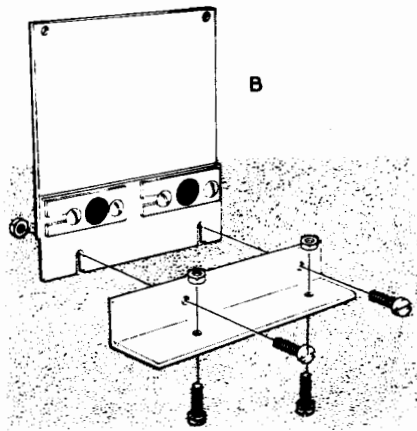


Fig. 4.7.1 a & b

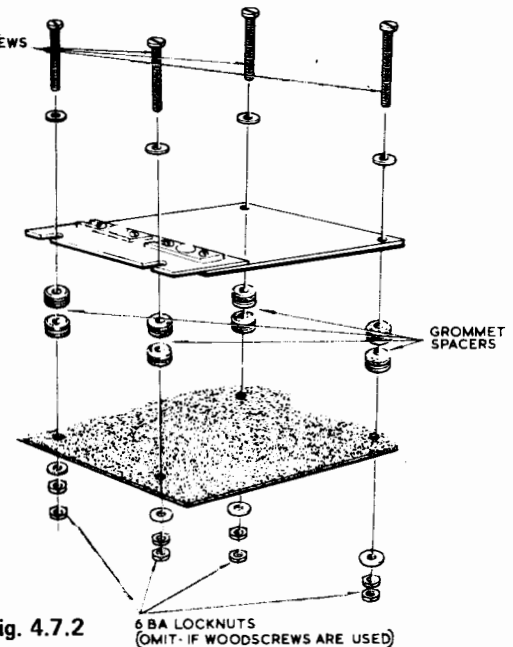
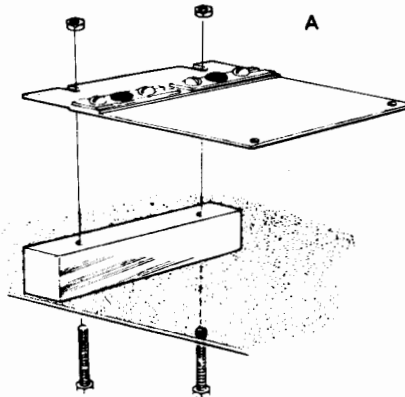


Fig. 4.7.2

The Z50's output transistors, being silicon, will work with a case temperature of 100°C so that the Z50 may be safe even if the heatsink will boil water. This however is clearly undesirable because of the danger of burning oneself on the transistors! It is best therefore if the transistors do become too hot to touch to increase the size of the heatsink.

The end bearing the connections need not be fixed down and can be left freely floating if desired.

At low powers, when heatsinking is not used, the Z50 can be mounted by means of screws and/or nuts using ordinary rubber grommets as spacers, as shown in fig. 4.7.2.

4.8 CURRENT CONSUMPTION

The table shows approximate current consumption, based on sine wave (continuous) levels at various voltages.

	4 Ω	8 Ω	15 Ω
50V	not safe	1A (30w)	600mA (18w)
40V	1.5A (33w)	800mA (19w)	450mA (11w)
30V	1.1A (20w)	600mA (10w)	300mA (5w)
20V	700mA (7w)	400mA (3.5w)	150mA (1.5w)
10V	300mA (1.5w)	200mA (.75w)	75mA (0.5w)

The above figures are as a guide only and are generally within about 20%. Subject to the power and voltage limitations (section 4.6) they apply to Z 50 and to Z 30.

For normal music listening the current drawn will be far less, say about $\frac{1}{2}$ to $\frac{3}{4}$ for loud pop music and about $\frac{1}{2}$ to $\frac{1}{4}$ for classical music and low level listening.

4.9 BATTERY OPERATION

Because of the low current consumption batteries are a very suitable power supply; 12V, 18V or 24V are suitable combinations.

Remember however that for a power of 5W from the amplifier the battery may have to give up to 10W, so don't expect too much from a small battery. The battery should be able to supply the current indicated in section 4.8.

For battery operation the capacitor mentioned in 2.5.3 *must* be included but its value should be increased. $1000\mu\text{F}$ is to be considered the minimum value but larger values ($5,000\mu\text{F}$ or $10,000\mu\text{F}$) are advisable especially with smaller sizes of battery. This capacitor must be rated at a working voltage equal to or greater than that of the chosen battery. The capacitor is shown as C3 in fig. 4.11.1.

4.10 CONNECTIONS

Nine connections numbered 1-9 are provided. These are located as shown in fig. 4.2 and fig. 4.3.

- 1 Power supply earth (-ve)
- 2 Input earth
- 3 Driver stage earth
- 4 Feedback point
- 5 Input
- 6 Alternative input earth
- 7 Differential input (feedback point)
- 8 Positive power supply
- 9 Output.

4.11 EARTHING

In order to realise the low distortion of which the Z50 is capable it is of paramount importance to observe the following points. Failure to do this may result in instability and will certainly increase the distortion.

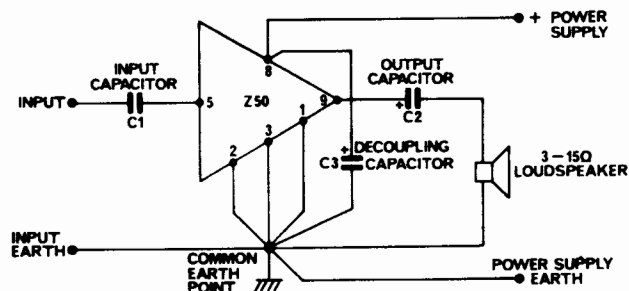


Fig 4.11.1

A point must be chosen roughly in the middle of the amplifier and its associated circuitry. This earth point must be connected to the chassis or metal-work used and it is

vital that no other connection is made to the chassis. To this point must be run separate wires from: terminals 1, 2 and 3 of each Z50 in the system, each loudspeaker earth, any volume controls, preamplifier etc. in use and the power supply. If the power supply lead is longer than a few inches the capacitor mentioned in section 2.5.3 must be included, see also section 4.9. This earthing arrangement is shown in fig. 4.11.1

4.12 OUTPUT

4.12.1 Output Capacitor No output capacitor is supplied since this is a bulky component and including it in the Z50 would substantially increase its size and reduce the mounting flexibility of the Z50. In addition the output can be selected for the loudspeaker chosen and there are certain applications in which a capacitor is not required. This capacitor is included in the circuits illustrated when applicable.

Use of too small a capacitor will result in loss of bass: the bass response will be -3dB at a frequency, F, where

$$F = \frac{10^6}{2\pi R_L C}$$

where F is the frequency in Hz, R_L is the load impedance

in ohms and C is the output capacitor in microfarads. 500 μ F with 15 Ω load, 1,000 μ F with 8 Ω or 2000 μ F with 3 Ω will give a frequency limit of about 20Hz. The capacitor is to be connected in series with the live loudspeaker lead as shown in fig. 4.11.1 and should be rated to work at a voltage greater than half the power supply voltage, thus from 35V supply this capacitor must have a voltage rating of at least 18. For safety it is best to choose a value above this, i.e. 25V working.

UNDER NO CIRCUMSTANCES must the Z50 be run into a normal load without this output capacitor.

4.12.2 Output to Headphones The Z50 can be used to drive headphones of any impedance between 10K and 3 Ω . The circuit is shown in fig. 4.12.2.

SW1 is a headphone/loudspeaker switch shown in the loudspeaker position.

R is a resistor of typically 270 Ω (it may vary between 10 Ω and 1K depending upon the headphones) which is chosen to give a comfortable earphone volume level at the control setting normally used for loudspeaker listening. It should be rated at 1W.

If separate volume control of the headphones is

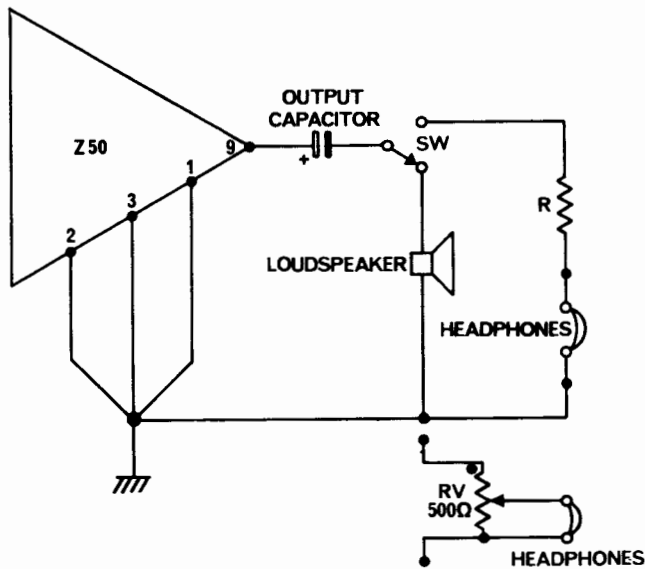


Fig 4.12.2

used, this is shown in fig. 4.11.1 and will be included in the circuits given where appropriate. Failure to use this capacitor when necessary will prevent the Z50 functioning at all. This capacitor is not necessary when used with the Stereo 60, nor is it required when the input is fed between 5 and 6 as in fig. 4.15.4.

The value of C will again affect the bass response, which will be -3dB where

$$F = \frac{10}{2\pi C}$$

F is the frequency of Hz

C is the value of the input capacitor in μF

By a diligent choice of this capacitor and the output capacitor in 4.12.1 bass roll-off can be provided of -6 dB per octave, giving a simple rumble filter.

4.14 INCREASING THE GAIN

The voltage gain of the Z50 is controlled by R8 and R7 (see section 4.5.2). For input devices (pick-up etc), giving too low an output the gain can be increased by fitting a resistor between $\triangle 3$ and $\triangle 4$. This resistor

required the circuit inset can be used in place of the headphones. RV is an ordinary wirewound type.

If the loudspeaker listening is not required SW can be dispensed with and the output capacitor can be decreased to $100\mu\text{F}$.

4.12.3 Output via transformer The Z50 can be used via a matching transformer to drive inefficient 15Ω loudspeakers, or they can be used with a 100V line or other matching transformer. However since the primary d.c. resistance of some transformers is low there can be danger to the output transistors from switch-on pulses. The protection circuit of 4.17 should therefore be used and the output capacitor should not be greater than $1000\mu\text{F}$.

4.12.4 Electrostatic loudspeakers No special precaution need be taken with capacitive loads since the Z50 is stable with such loading. However the precautions required for transformer output should be taken: See section 4.17.

4.13 INPUT

The input between $\triangle 5$ and $\triangle 2$ has a dc voltage present and therefore an isolating capacitor must be

will not normally be less than 100Ω although even more gain can be obtained by reducing further. The lower the resistor the greater the gain.

Unfortunately greater gain can only be obtained by increasing the distortion, but a large increase is possible before this becomes even audible.

4.15 CONTROL CIRCUITS

Throughout these circuits a dot indicates the contact at the clockwise end of the track as shown in Fig. 4.15.

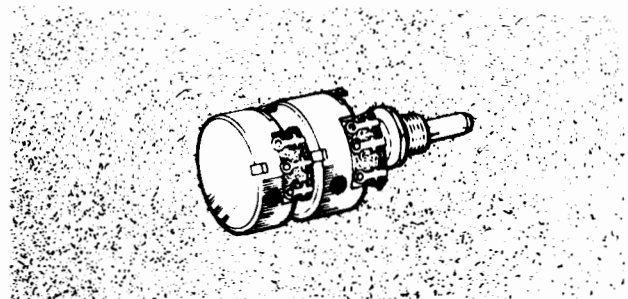


Fig 4.15

4.15.1 Simple Volume Control A volume control can be added as shown in fig. 4.15.1. 100K is a suitable value for most purposes but other values such as 47K, 22K, 10K or 5K can be used. It should be a logarithmic type but a semi-log or linear type can also be used.

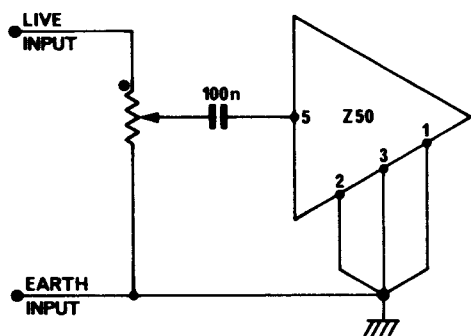


Fig 4.15.1

4.15.2 Simple Stereo Volume and Balance Control This combines two volume controls of fig. 4.15.1 with a balance control and the values can be the same as those in fig. 4.15.1. The volume control should be a dual log type

and the balance a linear type of the same value as the volume control.

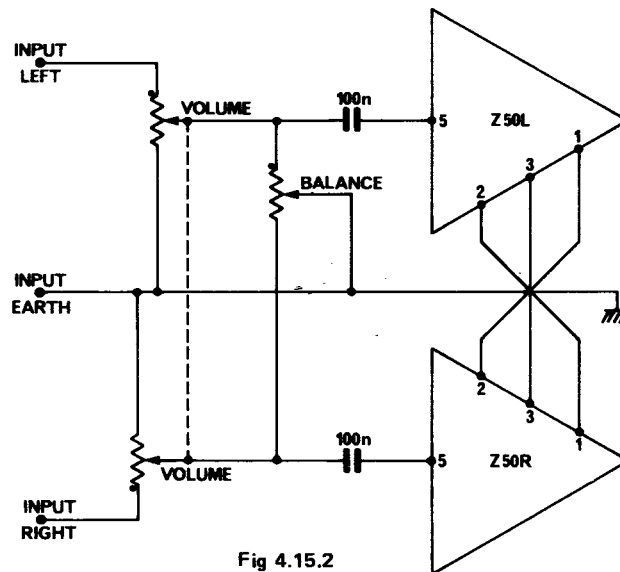


Fig 4.15.2

4.15.3 Alternative Stereo Volume and Balance This circuit can be preferable to 4.15.2 but requires a ganged log/antilog potentiometer of the same value as the volume control.

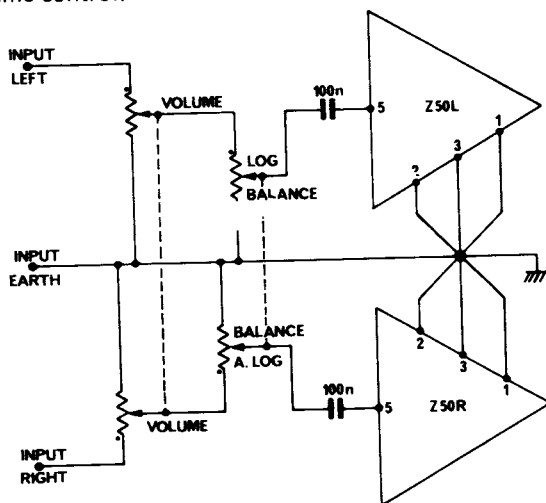


Fig 4.15.3

4.15.4 Alternative Volume Control This circuit is suitable for use with crystal pickups, but guitar pickups and other 'floating' inputs can be used if C1 and R1 are omitted.

R1 should be 330K for most pickups. Increasing R1 will give less gain but will result in an increase in bass response.

C1 should be about 300pF: higher if more treble is needed, lower if less.

R2 is to increase the gain, see 4.14.

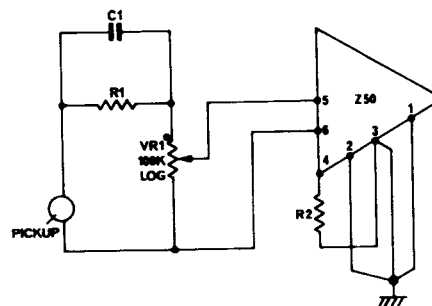


Fig 4.15.4

4.15.5 Comprehensive Tone Control This circuit gives approximately $\pm 15\text{dB}$ at 100Hz and 10KHz. Input is between points A and earth and should be fed from a suitable preamp or other source of not more than 10K impedance.

Output is from points B and earth should be fed to the volume control circuit of fig. 4.15.1, 4.15.2 or 4.15.3, using a value of 100K for the volume control.

The tone controls will reduce the gain of the amplifier considerably since they cause a voltage loss of about 12 –

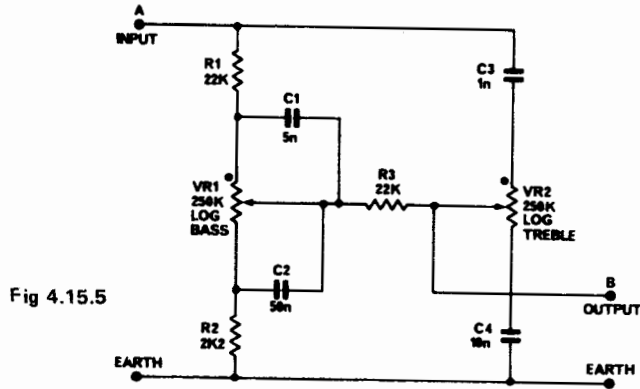


Fig 4.15.5

the input sensitivity is about 3 volts. Some tuners and tape-recorders will feed it satisfactorily since a small increase in gain can be made to the Z 30 as detailed in section 4.14.

The circuit will not work from a pickup direct, a suitable preamp circuit is given in 4.15.6.

4.15.6 Preamp for Crystal/Ceramic Pickups Current consumption of this circuit is approximately

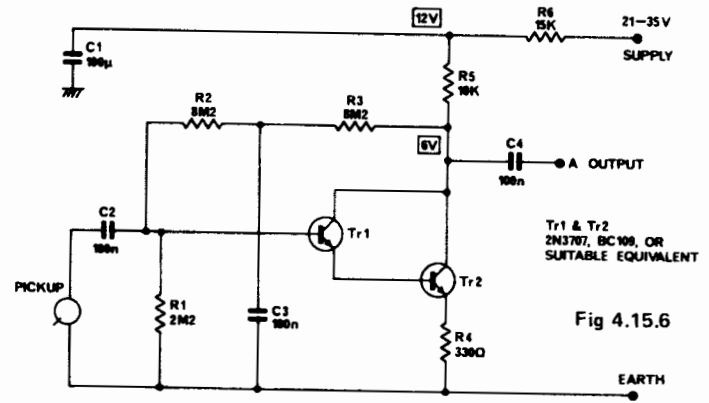


Fig 4.15.6

600µA from 21V supply. If the supply voltage is reduced below 21V, R6 should be reduced to keep a voltage of not less than 12 on C1.

R3 can be adjusted if necessary to keep the voltage on point 'A' at about 6V (half C1 voltage).

Input impedance is about 1M5 to 2M and the voltage gain is about 25, giving an input sensitivity when used with 4.15.5 of about 50mV suitable for most ceramic pickups. With the higher output cartridges R4 can be increased to 1K or 2K2 to reduce the gain.

4.15.7 Mono/stereo switch

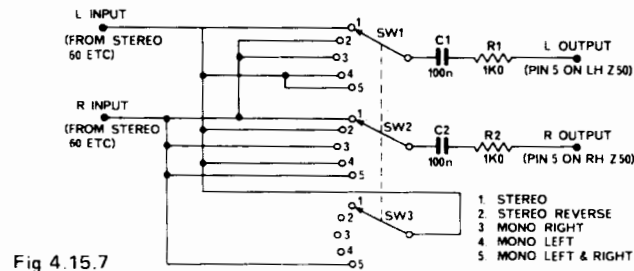


Fig 4.15.7

Fig. 4.15.7 shows a comprehensive mono/stereo control which can be inserted between the volume control or other input circuit used and terminal 5.

All wires to this should be screened and kept as short as possible.

The balance control will only operate as such when the switch is in the normal or reverse stereo mode.

4.16 APPLICATION NOTES

4.16.1 High Power Low Distortion Audio Oscillator

The output is fed back, via an attenuator consisting of a 6v bulb in series with RV3 and the Wien Bridge consisting of R1, RV1, C1, R2, RV2 and C2 to the input.

In operation the lamp will glow giving a visible indication of operation. If the output increases for any reason the bulb's resistance will increase, reducing the signal fed back and hence stabilizing the output.

With a 6v 0.3a bulb R3 can be 1Ω5 but a variable resistor can be used if it is required to vary the output. R3 should not be reduced to too low a value or instability will result. Reducing R3 will cause the bulb to grow dim and if an output below 6v is required a lower voltage bulb

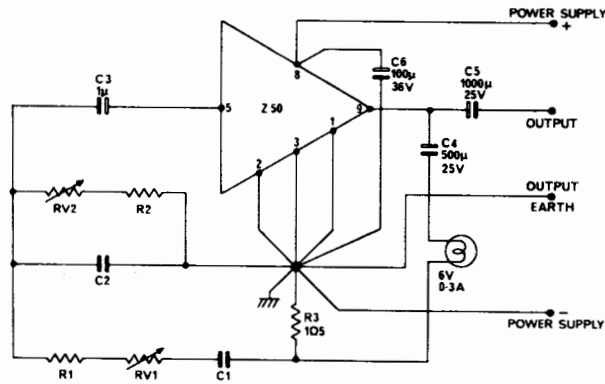


Fig 4.16.1a

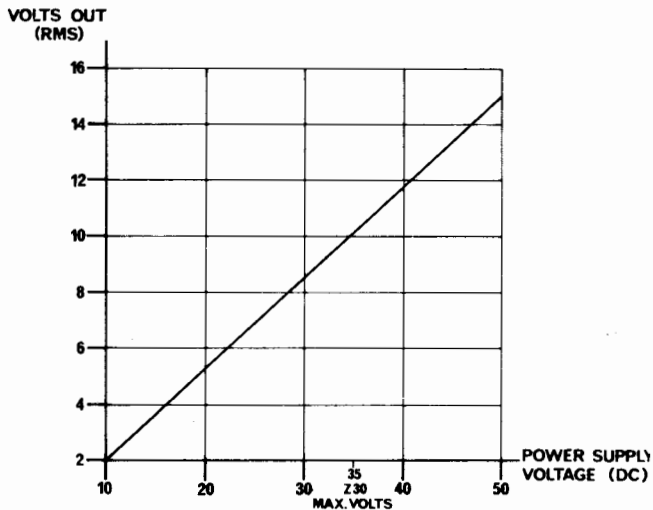


Fig 4.16.1b

should be used, when the value of R3 can be increased.

The frequency is determined by the Wien Bridge network and will be approximately 1KHz when $RV1 + R1 = RV2 + R2 = 10K$ and $C1 = C2 = 15nF$.

The circuit will give 15w sinewave, from 35v supply, at 0.15% distortion into 8Ω load, and 1w into 15Ω at 0.05% distortion, when using the Z30 and up to 30W with the Z50.

Fig 4.16.1b gives the approximate r.m.s. sinewave voltage obtainable into an 8Ω , 15Ω or greater load at various power voltages.

The circuit will oscillate at up to 200KHz, although the distortion rises considerably at high frequencies.

The circuit can be used for testing loudspeakers, as a general purpose signal generator. It could also be used, via a suitable transformer, to drive a tape erase head or to supply up to 30W power at any audio frequency, to drive a small motor etc.

It can also be used to make interesting noises (electronic music) by fitting a light dependant resistor (ORP12) between $\triangle 3$ and $\triangle 4$: flashing a light on the resistor will modulate the oscillation. Other effects can be obtained by feeding another signal, via 100K and 100n, into pin 6, when beat frequencies etc can result.

4.16.2 Full Bridge Circuit 60w rms Amplifier For

some purposes where very high power is required or when a large power has to be delivered to a high impedance load the circuit of fig. 4.16.2 can be used. This will deliver approximately twice the power, into 15Ω , that can be delivered into 7.5Ω by the normal circuit, i.e. 60w rms continuous at 50v or 12w at 24v. It can be used with 7.5Ω load at a maximum of 35v and up to 60w rms output, or about 20w rms from 24v. It is not recommended for operation into 3Ω

Amplifier 1 is used in the normal mode and a signal is fed from its output to the out-of-phase input $\triangle 7$ on the second amplifier whose in-phase input $\triangle 5$ is earthed. This causes amplifier 2 to give an equal voltage out of phase with amplifier 1. The loudspeaker is now connected direct between the outputs. No isolating capacitor is required since the d.c. levels at terminals $\triangle 8$ are identical for both amplifiers. The outputs of the amplifiers are effectively in series, thus doubling the voltage swing available and giving four times the power into the equivalent load.

RV1 and R2 are included so that, should there be a small d.c. voltage difference between terminals 9 this can be removed. To adjust connect a voltmeter in place

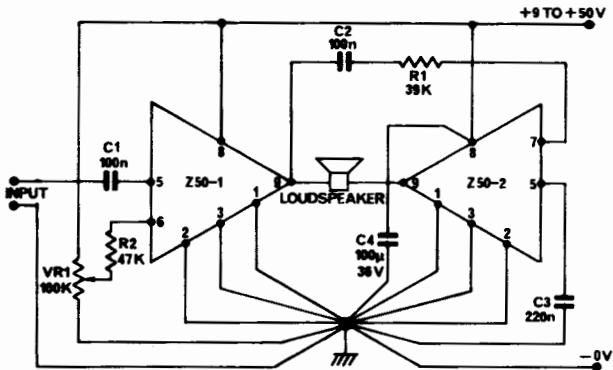


Fig 4.16.2

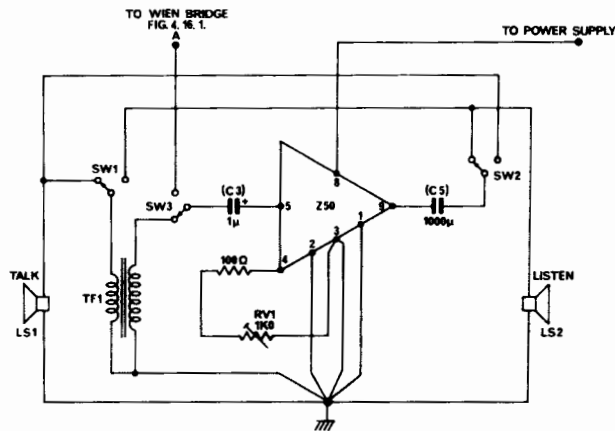


Fig 4.16.3

of the loudspeaker and adjust RV1 so that no voltage difference is measurable. The voltmeter can now be removed and the loudspeaker connected.

Failure to adjust RV1 could result in a small d.c. imbalance causing a net current flow through the load and this can lead to overheating and runaway of one or other driver transistors. R1 must be mounted directly on terminal 7 of the second Z 50 to keep this lead as short as possible.

If the gain of the circuit needs to be increased section 4.14 need be applied only to Z 50 - 1.

It is not necessary to fit the switch-on-surge suppression circuit (4.17) to this amplifier since no surge at switch-on can occur.

4.16.3 Intercom

The Z 50 can be used as a very effective intercom, using two suitable loudspeakers. The circuit is shown in fig. 4.16.3.

SW1 and SW2 are ganged and are shown with LS1 as the microphone and LS2 as the loudspeaker. If required SW1 and SW2 could be relay contacts so that a third wire could be run to the remote loudspeaker so that this could

operate the talk/listen switch (the third wire would be used in conjunction with the remote earth return wire).

LS1 and LS2 can be any suitable 3, 8 or 15Ω loudspeakers.

TF1 is best as a microphone transformer with 3, 8 or 15Ω to 100K matching, but an ordinary output transformer, of the sort that is used with valve radios, is quite suitable. The low impedance secondary that was will become the primary and the old primary will feed to the Z.50. Do not position this transformer near the Z 50's power supply since it will pick up hum from even over a foot away.

RV1 is a gain control, to increase the Z 50's gain. It can be omitted in many cases.

SW3 is a call switch, which can be omitted if not required. It is used in conjunction with the circuit of 4.16.1 which is fitted around the Z 50 and switched into use when required. Point A will connect the junction of R1, C2 and RV2 in 4.16.1a.

4.17 SWITCH ON SURGE

At switch on a large voltage is immediately developed across the loudspeaker, which can be at the least annoying and may be damaging if a 3Ω loudspeaker is used.

a) Fig. 4.17.1 illustrates additional components that can be added to each Z 50 to reduce this surge, although it is not possible to completely remove it by this method.

The diode can be any small signal silicon diode with low junction capacitance. A rectifier diode is not satisfactory. The following types can be used: 0A200, 0A202, BA100, BA148, Y630, ISJ50, ISJ150 etc.

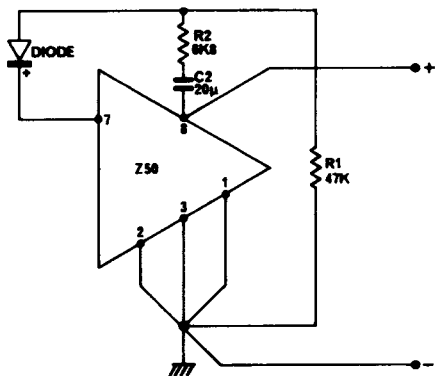


Fig 4.17

WARNING. If the Z 30 shows any tendency towards instability, which may not be audible, fitting fig. 4.17 will result in total instability with very audible results. Use of the wrong diode will also aggravate this. The diode should be mounted on terminal 7 with its positive lead as short as possible.

b) An alternative is to use two on-switches, one to switch on the mains and a second which is used to connect the loudspeakers into circuit after a few seconds. A 2 pole switch is required, one pole to be used for each speaker, and a 100Ω 1W resistor should be connected from the output capacitor's negative lead to earth on each channel, to provide a charging path for the output capacitor.

Output protection. It is difficult to effectively protect the Z 30s output since modern output transistors are so quick acting that complicated electronic circuitry is needed for protection.

It is however permissible to insert a resistor in series with the output capacitor. Whilst this will cut the power down for most uses full power will not be needed so the resistor will have very little audible effect. However a resistor inserted here will protect the amplifier should the loudspeakers be inadvertently short-circuited.

A resistor of 3 – 5Ω is generally suitable.

5. POWER SUPPLIES

5.1 TECHNICAL DESCRIPTION

The PZ5 uses a transformer with two primary windings and two secondary windings. The primaries are connected in parallel for 100-125V or in series for 200-250V. The secondaries, giving a maximum 20V, are full wave rectified to give a maximum no load 30V across the smoothing capacitor. The circuit is shown in fig.5.2.1.

In the PZ6 the same transformer is used with the secondaries in series, bridge rectified to give a no load 60V across the smoothing capacitor. This is then stabilized to 35V at the output.

Since the voltage across the base-emitter junction of a silicon transistor is essentially constant under normal bias conditions, this voltage in TR4 is used as the reference and the output voltage stabilizes itself so that the ratio of the output to the voltage across R4 is in proportion to the ratio of R6 to R5. The output voltage can therefore be varied by adjusting R6. The circuit is shown in fig. 5.2.2.

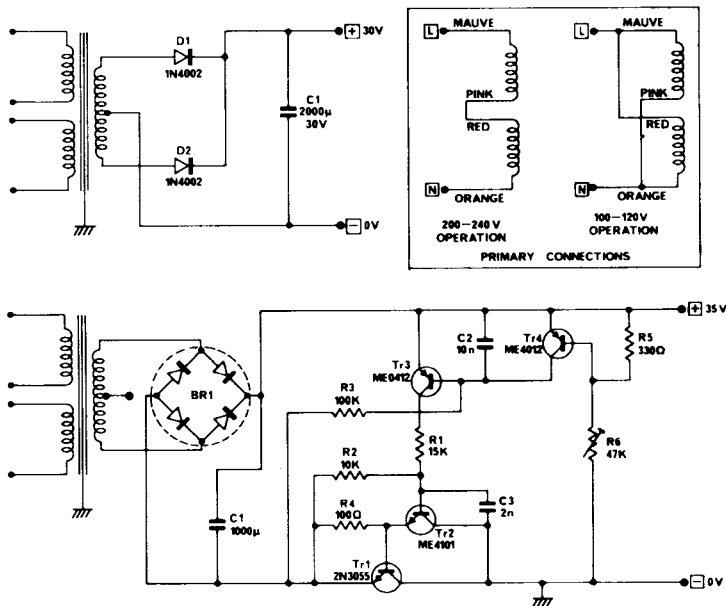


Fig 5.2.1 and Fig 5.2.2

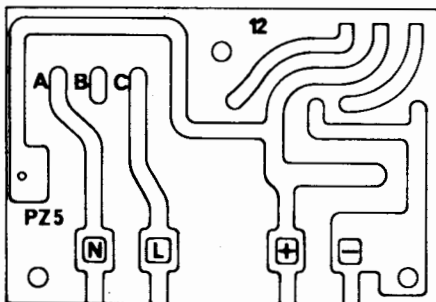


Fig 5.3.1

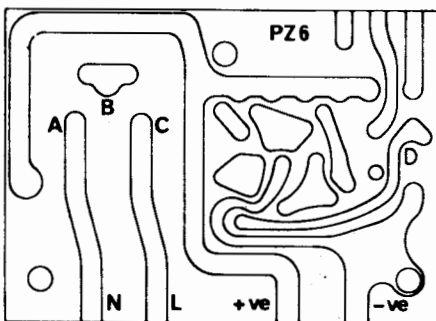


Fig 5.3.2



5.4. SPECIFICATIONS

A.c. Mains input	100-125v or 200-250v	50/60Hz
Size	100mm x 72 mm x 48 mm.	
Weight (inc. packing)	1 Kg.	

	PZ5	PZ6
Output voltage, no load	30V max	35v
Output voltage at 1A	25v typically	35v
Maximum current	1.5A	1.5A

5.5. CONNECTIONS

PZ5 connecting points are as shown in Fig. 5.3.1
 PZ6 connecting points are as shown in Fig. 5.3.2

5.5.1 *Mains connections* are to be made, via a fuse (500mA or 250mA slow-blow) and a switch, to contacts  and  as shown in Fig. 5.5.1.

The use of a fuse is vital and we will accept no responsibility for any damage arising from the omission of this fuse.

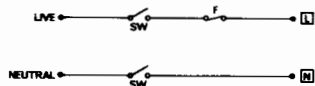








Fig 5.5.1

5.5.2 *Output* of the power supplies is between + and (chassis) . On the earlier PZ5  was isolated from the chassis and a separate  terminal used for the chassis connection.

5.5.3 *Earthing* If the power supply is mounted on the same metal chassis as the rest of Project 60 the connection between the earth point and  will be made through the chassis and no separate wired connection is to be made.

However if the power supply is an early PZ5 or is insulated from the chassis a separate earth connection must join the earth point to .

Mains earth should connect normally to the main earth point, but when the power supply is used to drive other equipment mains earth can connect to  direct.

5.5.4 *100-125v Working* To change from 220 to 110v the red and pink wires from the transformer (at present connected to land B in Figs. 1 and 2) should be unsoldered. Now connect the red wire to the same land as is connected the mauve wire, and connect the pink wire to the same land as is connected the orange wire.

For 110v operation the fuse rating (mentioned under mains connections) should be doubled.

To change from 110 to 220v the above procedure must be reversed.

PART THREE

If the fault arises however the following procedure can be used to locate the fault:-

6.1.1 *One channel only exhibiting fault*

- (a) Test loudspeakers: exchange left speaker and right speaker: if the fault stays on the same loudspeaker this is faulty.
- (b) Check pickup and input circuitry: short out MR to ML, putting Project 60 into mono. If both channels amplify properly the fault is in the pickup, tuner, input socket, components etc.
- (c) Check Z 50s: short (L) to (R). If the fault remains on the same channel this Z 50 is at fault. If both channels go dead there is probably a short circuit in the wiring, or possibly the Z 50 is at fault, but if both channels come to life the fault is in the Stereo 60.

6. SERVICE INFORMATION

6.1 FAULT FINDING

If the instructions in this manual have been adhered to the equipment should give long service without requiring attention but, should it be necessary, information is given elsewhere which should enable many faults to be located, and spare parts are available should the user wish to effect the repair himself.

6.1.2. *Both channels at fault:* This is not so likely if the units have been correctly assembled, but incorrect assembly is likely to damage PZ6 or Z 50s. PZ5 and Stereo 60 are not so easily damaged. Failure of a system which has been working is most likely to be due to a fault in power supply or wiring.

6.2 FAULTS

Whilst none of the following faults are common they can occur.

6.2.1 *Stereo 60 Mains switch:* the push-push interlock mechanism is controlled by a spigot and a leaf spring which is retained by the coil spring on the switch shaft. Coil and leaf springs are visible in fig. 3.5.1. If the springs are disturbed the spigot can drop out and the switch will not lock in. Spare parts are available.

ON NO ACCOUNT use switch cleaner to remove faults inside the mains switch since this will dissolve the mechanism.

Channel matching: The matching between channels is controlled by the volume controls. It is possible to alter the matching by gripping the shaft between the two volume control potentiometers with two pairs of pliers and slightly twisting the shaft. This is best done at the volume level where mismatching is most noticeable.

6.2.2 *Z 30/Z.50* Overloading the project will normally place a strain on the power transistors which are therefore more liable to damage than the rest of the circuit. It is quite

permissible to remove both power transistors from circuit to test the amplifier, but of course the amplifier will not work into a load of less than 100Ω with the power transistor missing.

R11/R12 overheating: This can only occur if the e.b. junction of the relevant power transistor is open circuit. If the resistor overheats there is no point in replacing it unless the power transistor is also replaced.

6.2.3 *Power Supplies* There is little to fail on the PZ5 and mechanical damage is most likely.

The PZ6 will however be damaged by overloading the output, normally the driver transistor, TR2, will fail either short-circuit or open-circuit.

6.3 CONDITIONS OF GUARANTEE

All modules of Project 60 are covered by 24 months guarantee under which we will rectify at no charge any fault due to defective components or manufacture, subject to the following conditions.

- (1) That the item concerned be returned to us separated from all external circuitry, properly packed so as to avoid

damage in transit to us. The equipment must be returned direct to us, not through a third party.

(2) That the item has been used in accordance with our instructions, has been subjected to no form of mis-use and has in no way been subject to unauthorised mechanical or electrical modifications: in particular the metal work etc. must not have been drilled or cut.

(3) That no damage has been done by inexpert attempts to repair fault(s).

(4) That the equipment be returned with a letter stating: Date of purchase. Name and address of supplier. The nature of the suspected fault.

(5) Instruction for return (section 6.5) must be adhered to.

If any of the above conditions of guarantee are not met the guarantee will be null and void.

6.4 SERVICE OUTSIDE GUARANTEE

For service not covered by the guarantee we make a standard charge for service as follows:

Z30	15/—	PZ5	20/—
Z50	15/—	PZ6	20/—
Stereo 60	20/—		

This fee must be included with the parcel sent for repair.

It covers components, labour and inland carriage so we are not prepared to invoice for repair. On invoiced jobs 5/— extra will be charged to cover the clerical work involved.

6.5 GENERAL CONDITIONS OF SERVICE

All modules returned to us for any reason will normally be replaced by a reconditioned module in similar condition.

We cannot (except at our discretion) replace modules, which have in any way been used, by new unused modules.

We cannot undertake to answer letters enclosed with repair work: all letters requiring answer and orders for equipment must be sent separately.

Do not return equipment without a covering letter: we will accept no responsibility for loss of equipment which does not include a letter.

Under no circumstances can we accept customer's own installations for repair except by prior written agreement.

The fault may be a simple one, or one which we can readily recognise so it may be worth contacting us for information before returning the equipment for repair.

It is not necessary to remove any connecting pins that have been fitted to the modules.

The equipment must be properly packed so as to avoid damage in transit to us.

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