25W STEREO MOS-FET HI-FI AMPLIFIER

by Dave Goodman

Complete kit ONLY £49.95

- ★ **25W per channel rms with power MOSFET output**
- ★ **Very easy to build — only 7 interconnecting wires**
- ★ **Extremely low total harmonic distortion**
- ★ **Extremely low noise**
- ★ **High efficiency toroidal transformer**
- ★ **Complete kit includes wooden cabinet & chassis**
- ★ **No setting-up required**
- ★ **All components except 5 mount directly on main pcb**

One of the most popular projects we have ever produced is the MOSFET amplifier described in the June 1981 issue of "Electronics and Music Maker". Its popularity is doubtless due to the virtues of the MOSFET transistors — as the article says: they are "virtually bomb-proof — like the best valve amps." For reliability, freedom from thermal runaway and extremely low harmonic distortion there's nothing to touch the MOSFET transistor for audio power output stages.

As well as offering these essential advantages this stereo amplifier has been carefully designed for absolute ease of construction; this in its turn adding to the reliability and repeatable quality for all constructors. All the components, bar five, mount directly on to the main pcb and only seven interconnecting wires are required and they are for the headphone socket and LED.

The inputs and outputs are on pcb mounting DIN sockets and provision has been made on the pcb for connecting a graphic equaliser, though you will need to drill the rear panel to make connection. Otherwise the kit contains everything you need including a punched chassis finished in matt black with legends printed on the front and rear panels. A wooden cabinet is also supplied which has to be glued together with a woodworker's PVA adhesive (e.g. Resin W) and this glue is not supplied in the kit.

No setting-up is required. If the building instructions are carefully followed then the amplifier will work correctly as soon as it is switched on. However, a preset is provided for each input (except auxiliary) which can be adjusted if desired, so that when switching between inputs, the volume control does not have to be altered to keep the output volume constant. In addition, a remote control unit for volume, bass, treble and balance will be published shortly — hopefully in the next issue.

Circuit Description

T1 is a toroidal transformer and was chosen as it has several advantages over conventional types. It is much more efficient as it runs cooler and has lower radiated magnetic fields keeping stray hum to a minimum. its small size

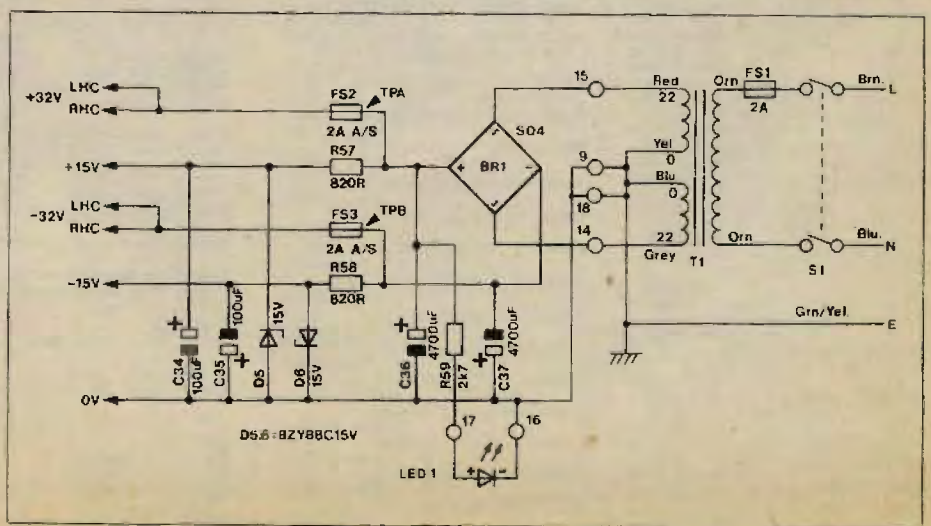


Figure 1. Circuit diagram of power supply.

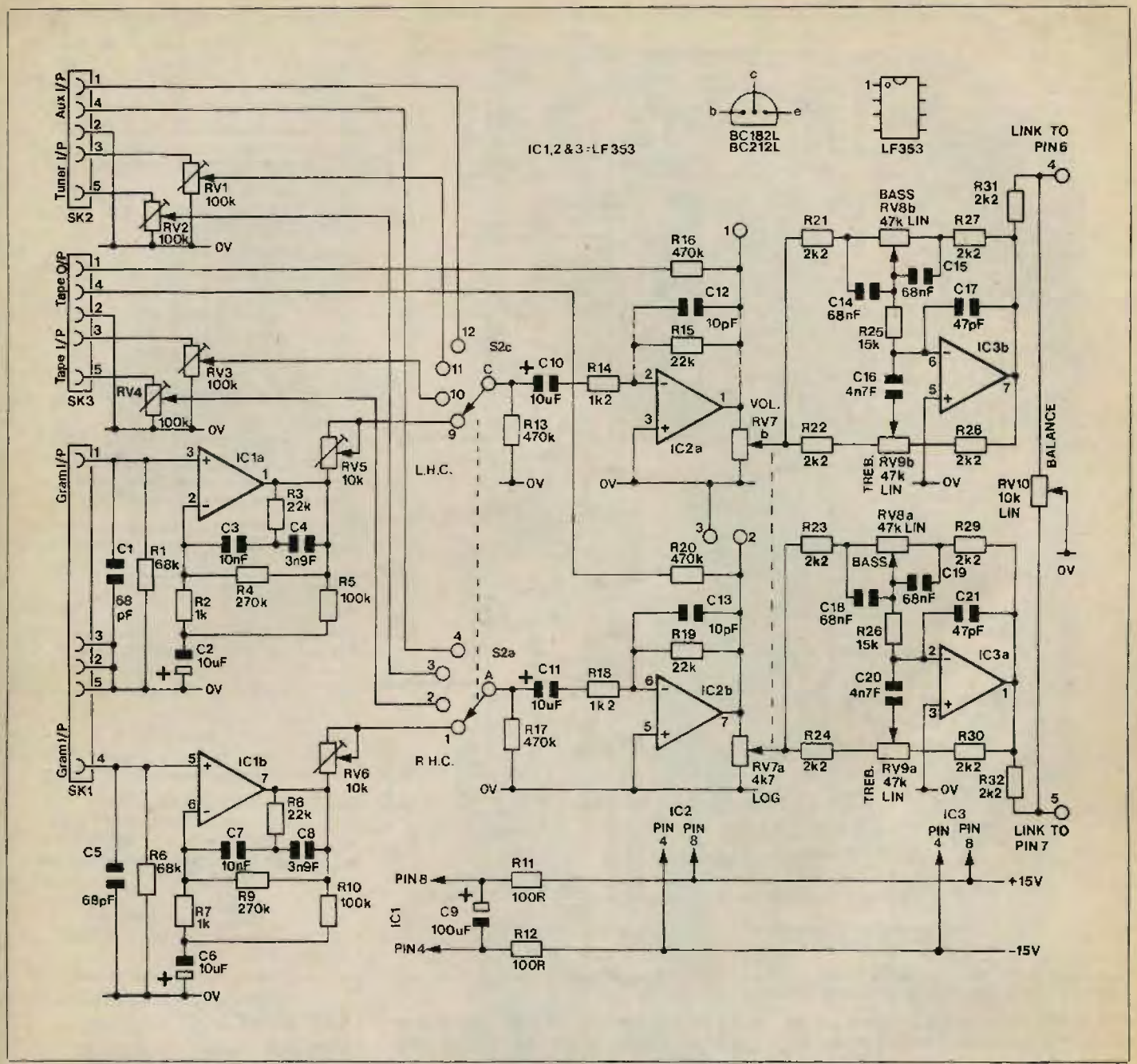


Figure 2. Circuit diagram of pre-amp and tone controls.

Specification of prototype

Input sensitivities for max. output (with preset adjusted for max. sensitivity).
Magnetic pick-up input: 2mV at 47kΩ
Tape input: 50mV at 100kΩ
Tuner input: 50mV at 100kΩ
Auxiliary input: 50mV at 470kΩ
Magnetic pick-up input overload threshold: 40mV
Tape output at rated input: 100mV into 100kΩ
Power output: >26W per channel rms into 8Ω or 4Ω continuous at 1kHz both channels driven.
Total harmonic distortion: Better than 0.075% at 1kHz at >25W output.
Frequency response: 20Hz to 40kHz ±1dB (from magnetic pick-up input ±1dB from RIAA)
Signal to noise: Better than 60dB on magnetic pick-up input
Better than 80dB on all other inputs
Channel separation: Better than 40dB
Bass control: ±14dB boost and cut at 100Hz
Treble control: ±8dB boost and cut at 10kHz
Balance control: -50dB to +1.5dB

also allows the cabinet to be low-profile and it has no open terminals making it intrinsically safer.

The transformer secondary is full-wave rectified by BR1 and smoothed by C36 and C37. The output via fuses FS2 and FS3 deliver ±32V to the MOSFET output stages only, whilst Zener diodes D5 and D6 and resistors R57 and R58 produce ±15V to drive the remainder of the circuitry in the amplifier. IC2 and IC3 are supplied directly from these rails, but IC1 has further decoupling provided by R11, R12 and C9.

IC1a and b is a dual bi-fet op-amp whose non-inverting inputs are suitably matched for use with magnetic cartridges. A degree of protection from stray rf is also provided. The feedback circuitry about each input produces a response to within ±1dB of the recommended RIAA curve. This is achieved by using frequency selective feedback to boost the lower and cut the upper frequencies. Presets RV5 and RV6 control the gain of the pick-up input and allow fine adjustment of channel balance or reduction of volume of high output magnetic cartridges.

RV1 and RV2 perform the same function for the tuner input and RV3 and RV4 for the tape input. If not required simply turn them to the end that gives maximum volume. The auxiliary input level is not presettable, but is selected along with the other inputs by S2. IC2 is a mixer stage supplying the tape output and has an almost perfectly flat response over the audio spectrum.

The volume control, RV7, supplies the selected input signal to IC3 which looks after the tone compensation. RV8 gives boost or cut of the bass frequencies while RV9 controls the gain of

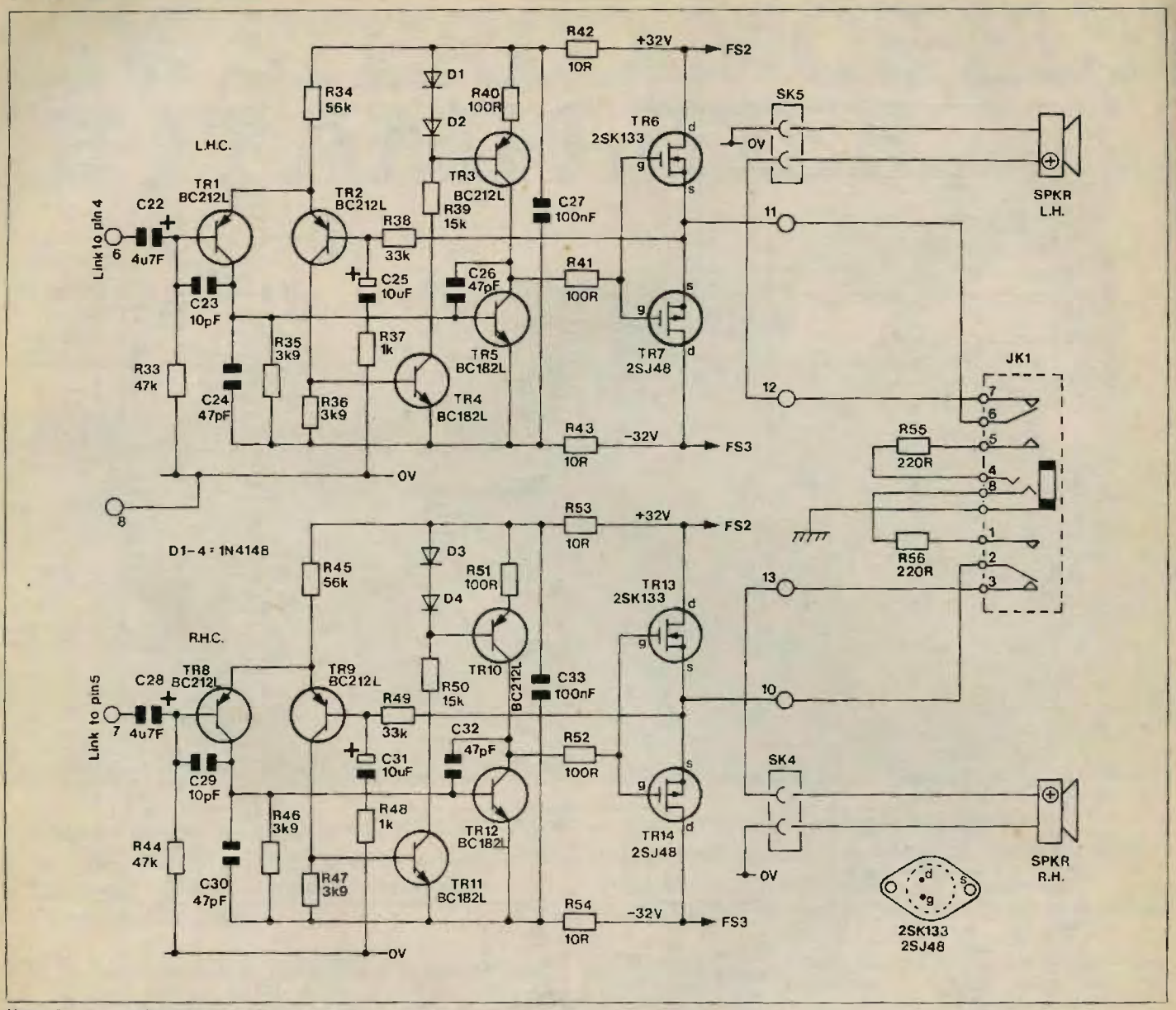


Figure 3. Circuit diagram of MOSFET power amp.

the treble frequencies. In their centre positions, this stage too has an almost perfectly flat response over the audio range. The balance control, RV10, simply shunts the audio signal to ground of the channel it is turned from.

Pins 4 and 5 are strapped to pins 6 and 7, but these straps can be removed if you wish to insert a graphic equaliser.

TR1 and 2 form a differential amplifier whose output is fed to TR5, a voltage amplifier/driver stage. TR3 is a constant current and impedance source which is controlled by TR4. The output of TR5 drives the power MOSFET's TR6 and TR7.

Power MOSFET's have a very low 'on' resistance and an extremely high 'off' resistance and display the characteristic channelling effect when driving into near short-circuits, since the forward resistance increases as the temperature of the device rises, unlike a bipolar transistor, where the opposite effect causes the destruction of the device. The effect allows circuit design to be simple and this in turn improves the distortion and noise figures.

Even further simplicity of design is achieved because the gates of MOSFET's having such a high impedance allows them to be connected and biased together without suffering from cross-over distortion. A small bias voltage is applied from a constant current set to around 20mA, though this is not critical and hence no setting-up is required.

The overall gain of the power amplifier is 33 as set by the ratio of R38 to R37. The power amp has a virtually perfectly flat response over the entire audio range with excellent stability and very fast switching or slew rate which gives an extremely wide power bandwidth, yet the damping factor is still very good.

The output of the power amp is fed to DIN sockets SK4 and SK5 which supply the external speakers, while JK1 disconnects this output and connects it via R55 and R56 to a stereo headphone when a plug is inserted.

The additional pins 1, 2 and 3 have been included so that a remote control unit for volume, bass, treble and balance may be added. Details of this easy-to-construct addition will be published shortly — hopefully in the next edition if space is available.

Construction

Main pcb

With reference to Figure 4 insert the 28 Veropins from the track side, then push them firmly home with the tip of a hot soldering iron and solder to the pcb. Fit the thirteen links using 24 swg tinned copper wire as shown in Figure 4. This Figure also shows how to fit and solder the two straps required between pins 4 and 6 and between pins 5 and 7 and again this should be done with the tinned copper wire and soldered.

Resistors R1 to R54 and R57 to R59 can now be fitted to the pcb. Bend the leads before insertion and push them down on to the pcb. If you cannot read the colour code directly, use the chart in the resistor section of our catalogue or the colour wheel (XL05F). Note that R3, 4, 8 and 9 must be 1% tolerance types and these are either marked 1% or they have a brown ring where the gold ring is found on 5% types.

Next insert the 1N4148 diodes, D1 to D4 and the two Zener diodes D5 and D6. These six diodes have a black band and must be placed on the pcb so that this band is at the same end as the white band printed on the pcb.

RV1 to RV6 are preset potentiometers. Carefully check the values stamped on the wiper: RV1 to RV4 are 100k and RV5 and RV6 are 10k. Fit these to the pcb. By now quite a jungle of leads will be forming beneath the pcb, so solder these in position and cut off all remaining ends close to the joint. It is advisable to check for shorts between tracks and soldered joints after each use of the soldering iron. Excess flux can be removed using cellulose paint thinner and a stiff paint brush, but use the thinners conservatively or a sticky deposit will be formed.

Next fit the ceramic plate capacitors. Their leads do not require bending and should fit straight in. Fit the tantalum bead capacitors C10, 11, 22 and 28 taking care that the '+' sign on the body of the capacitor lines up with the '+' sign printed on the pcb. The little box-shaped capacitors are the polycarbonates and should be fitted next, followed by the polystyrene capacitors whose leads should be pre-formed before fitting to the pcb.

This should also be done to the axial electrolytics C9, 34 and 35 which should be fitted next taking care that the '+' sign printed on the pcb is at the same end as the indentation that runs around the body of the capacitor. The vertically mounted electrolytics C2, 6, 25 and 31 are inserted straight into the pcb and again must be positioned so that the '+' signs are aligned.

Now solder all the components in position, trim the leads, clean and check the pcb as before then mount the three integrated circuits. The small dot

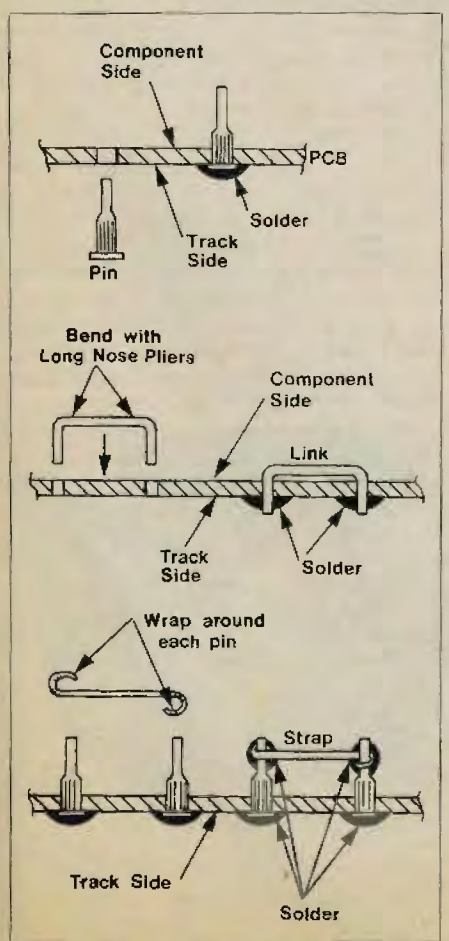
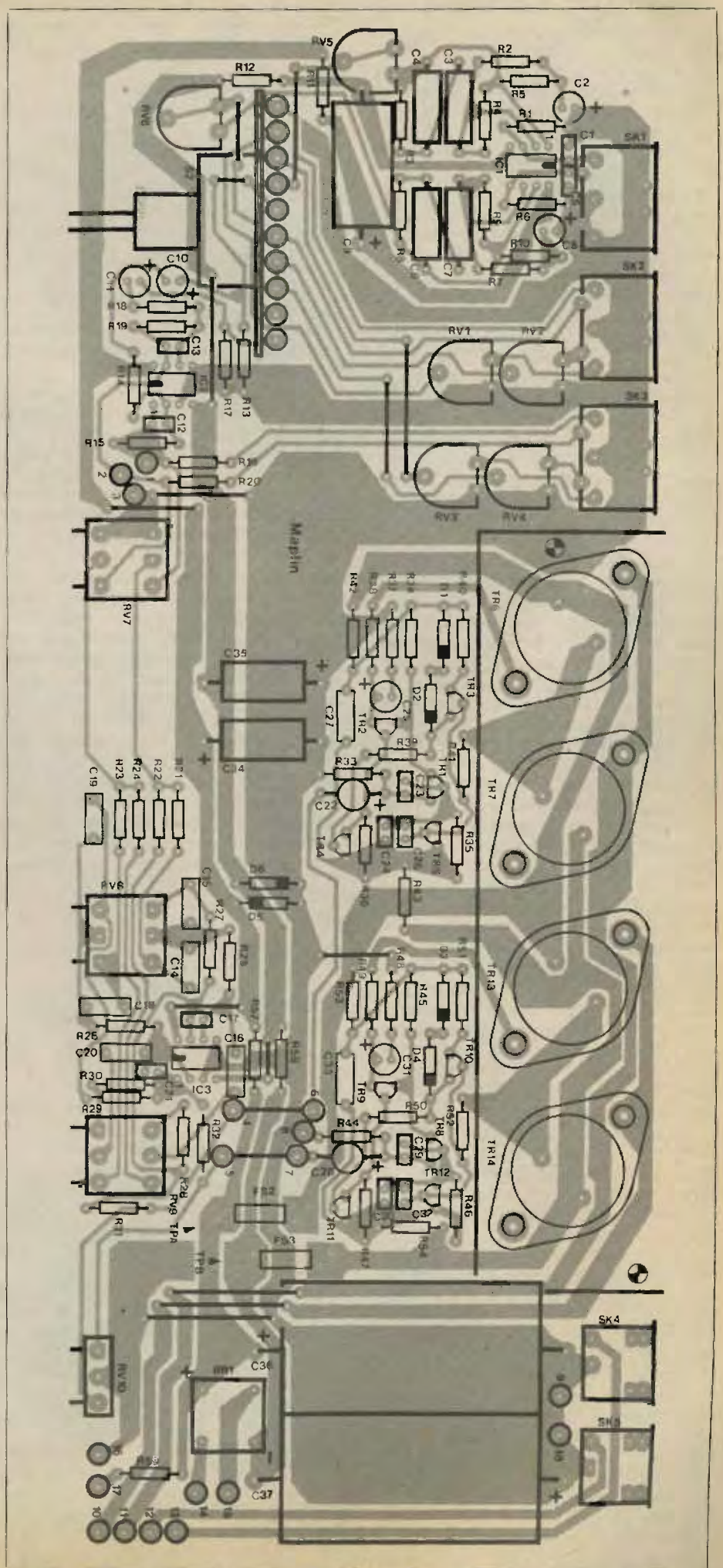


Figure 4. Insertion of pins and links in pcb.



Component overlay of main pcb shown less than full size.

on the top of the IC body indicates pin 1 and should be positioned so that it is at the same end as the 'D' shape formed on the pcb legend. Take care to ensure that all eight leads fit through the pcb on each IC.

Next, fit the bridge rectifier BR1. One edge of the plastic package has a '+' sign painted on it and as before this must be positioned to align with the '+' sign on the pcb. Push the plastic body right down onto the pcb.

Transistors TR1 to TR3 and TR8 to TR10 are type BC212L and their 'D' shaped package must line up with the pcb legend. The same applies to TR4, 5, 11 and 12 which are type BC182L. Push all these transistors down to about 0.5 to 1cm (¼in) from the pcb otherwise they can be easily bent or broken. Fit the two polyester capacitors C27 and C33. These are usually colour coded and from the top the colours are brown, black, yellow, black or white, red or yellow. Now solder all these components as before.

Place the FET mounting bracket over the pcb on the component side and bolt in position with two nuts, washers and 6BA ¼in bolts inserted from the track side. Ensure that the top of the bracket is perfectly smooth and clean. Carefully adjust the position of the bracket so that 16 holes (4 per FET) in the pcb are exactly centralised under the holes in the bracket, and then tighten the bolts. This operation is very important as misalignment will result in a short circuit between the FET and the bracket (0V). One bolt passes through a large area of track and to ensure that there is a good connection between this track (0V) and the bracket, solder the bolt head to the track.

Smear a thin layer of Thermpath over both sides of a mica insulator and place it on one of the power FET's then repeat with the other three. Place each FET with its insulator over the mounting bracket noting that the two leads on the 2SK133's are towards the rear of the pcb (the bracket itself is on the rear edge) and on the 2SJ48's they mount towards the front.

With reference to Figure 5 insert two 6BA ½in bolts from the track side up through each MOSFET and tighten up with 6BA washers and nuts. Solder the FET leads to the pcb and then solder all eight bolt heads to the pcb.

The four small fuseholder clips may now be fitted. The easiest way to do this is to clip a fuse between each pair and then place and solder the whole assembly to the pcb. Remove the fuses when this is completed.

Fit the three 5-pin DIN sockets, SK1 to SK3, ensuring that all seven pins (2 are securing pins) go through the pcb and none are left bent underneath. Sockets SK4 and SK5 should be fitted in the same way. The last two axial electrolytic capacitors C36 and C37 can now be fitted. They mount with polarities in opposite directions so take care to ensure that the indentation around the body is at the same end as

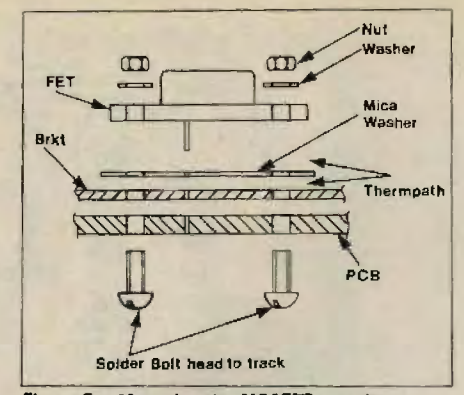


Figure 5. Mounting the MOSFET transistors.

the '+' sign on the pcb. Solder these last seven items to the pcb.

The four-way rotary switch S2 has to be prepared before it can be mounted. Firstly, straighten all fifteen tags on the back of the switch then cut off the tags marked B, 5, 6, 7 and 8 close to the plastic moulding. Secondly, cut off the loops on the ends of the remaining ten tags leaving as much straight pin as possible. Refer to Figure 6. The switch can now be fitted to the small pcb ensuring that all ten pins have come through and solder them in position.

On the main pcb there are ten Veropins situated near the front left side of the board. Lightly tin these pins with a soldering iron (i.e. cover each pin with a *thin* layer of solder). With reference to Figure 7, place S2 facing towards the front of the main pcb and offer the switch pcb up to the ten pins so that they align with the ten tracks on that pcb. Hold the board as upright as you can and solder one pin. Resolder if the

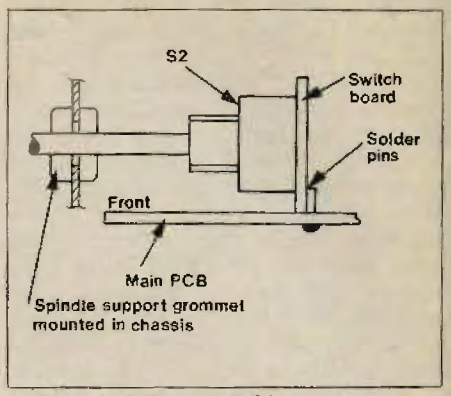


Figure 7. Mounting switch S2.

board is not perfectly upright, then when satisfied, solder the remaining nine pins.

Finally, mount the four rotary potentiometers on the pcb checking the resistance values against the RV numbers to ensure correct placement, before soldering. The pcb is now complete and should be cleaned up. Re-check all components for correct values and correct orientation of polarised components. Check for dry joints and short circuits and carefully re-solder any suspect joints.

If you possess a multimeter, check for short circuits between the pins and case of the MOSFET transistors and the mounting bracket. Switch to ohms and with one lead on the bracket check each lead and case in turn. If there are any short circuits then you will have to strip down the mounting bracket to find out why, but careful construction should have prevented this.

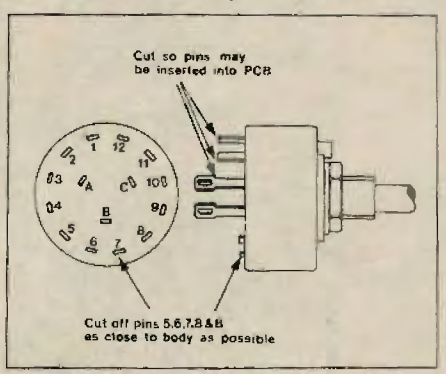


Figure 6. Preparing switch S2.

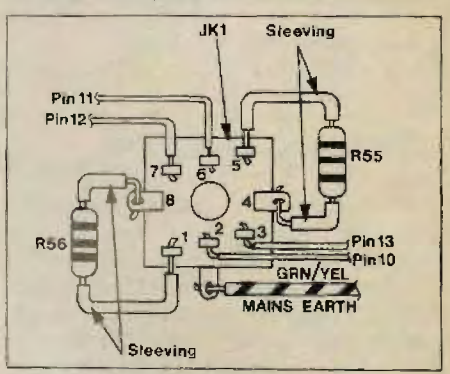
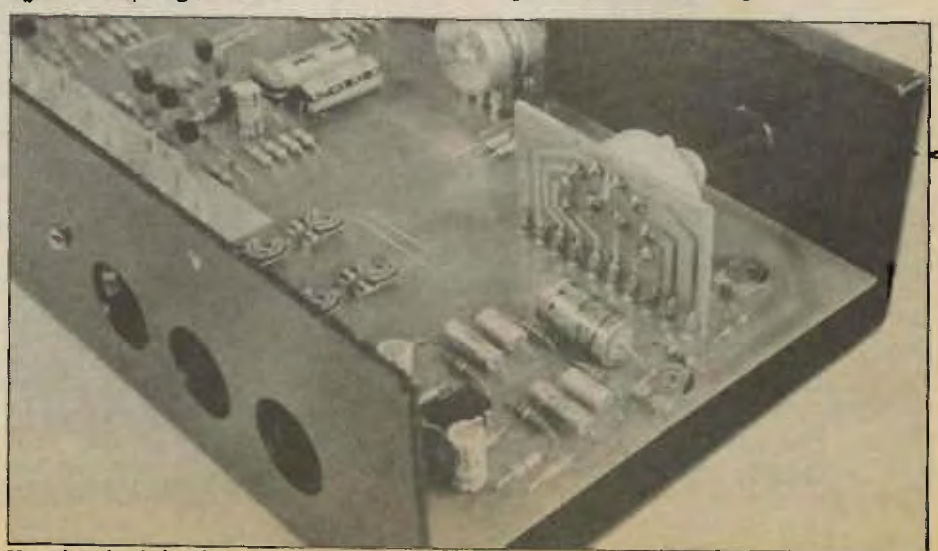


Figure 8. Jack socket wiring.



Mounting of switch pcb.

Assembly

Cut the four potentiometer spindles so that they are about 13mm (½in) long. Remove the nuts and washers from RV8 and RV9 but leave them on RV7 and RV10 and tighten up these two. Fit a grommet into the selector switch hole in the front panel, then slide the pcb into the chassis by guiding the control spindles in first, then lowering into position.

Bolt the mounting bracket to the back of the chassis using three 6BA ¼in bolts and nuts, two washers and a solder tag with the bolts inserted from the outside. The tag washer fits on the bolt nearest to the two 2-pin speaker sockets. The two remaining pot mounting washers and nuts fit onto RV7 and RV10 and tighten up on to the chassis. Make sure that all five DIN sockets line up with the holes in the chassis and readjust to suit.

With reference to Figure 8 slide a piece of sleeving over each wire on R55 and R56 then solder them between tags 4 and 5 and tags 1 and 8 of the jack socket. Cut four pieces of wire each 125mm long, and strip and tin a short length at each end of each piece. Solder these four wires to tags 2, 3, 6 and 7 on the jack socket. Fix the jack socket to the front panel then connect the four wires to the pcb as follows:

JK1 tag	to	pcb pin
2		10
3		13
6		11
7		12

Keep all wiring as short as possible and neatly laid out. Thin wire or cable ties could be used to hold groups of wires together, but there is so little wiring in this project that it is not really necessary and no problems should be encountered. Figure 9 shows the complete wiring arrangements.

Cut two pieces of wire each 150mm long and strip and tin a short length at each end of each piece. Connect one wire to each lead on LED1. A tiny '+' and '-' sign is stamped into the plastic beside each lead, but for those who cannot see them the thicker lead is the negative and the thinner lead is the positive. See Figure 10. Fit the LED in the chassis next to the headphone socket and connect the two wires to the pcb as follows:

LED1	to	pcb pin
+ (thin)		17
- (thick)		16

Now mount the toroidal transformer T1 as shown in Figure 11. Insert the bolt (supplied with the transformer) from under the chassis base through the hole in the indent. Place one of the two rubber washers over the bolt, then the transformer with the wires uppermost. Put the remaining rubber washer on top followed by the clamping plate. Tighten in position with the nut and washer supplied with the transformer.

Carefully scrape the enamel coating off a short length of the end of each of the transformer's six wires. This can be

Interwiring in chassis.

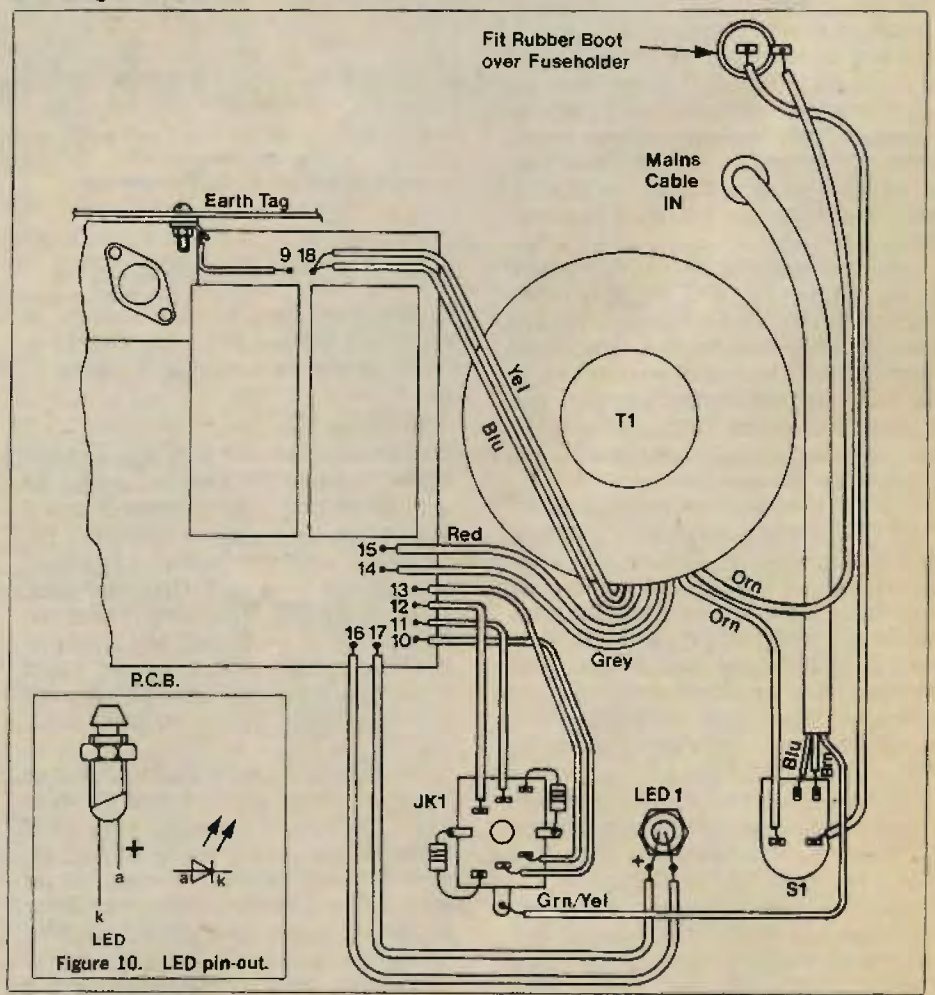
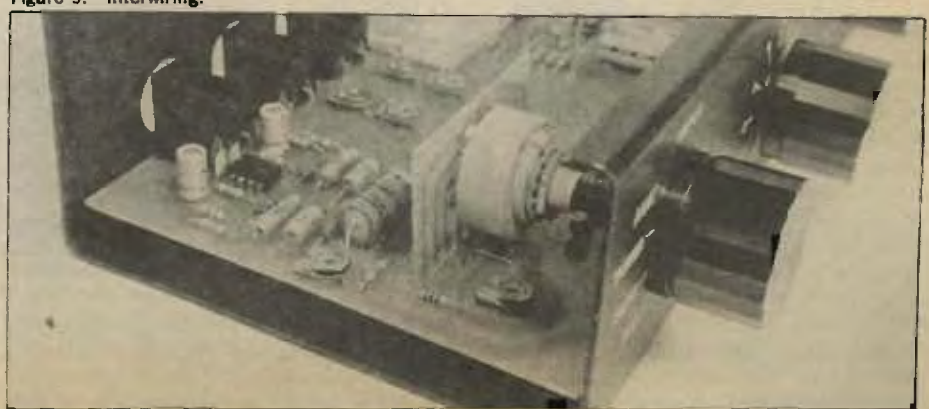
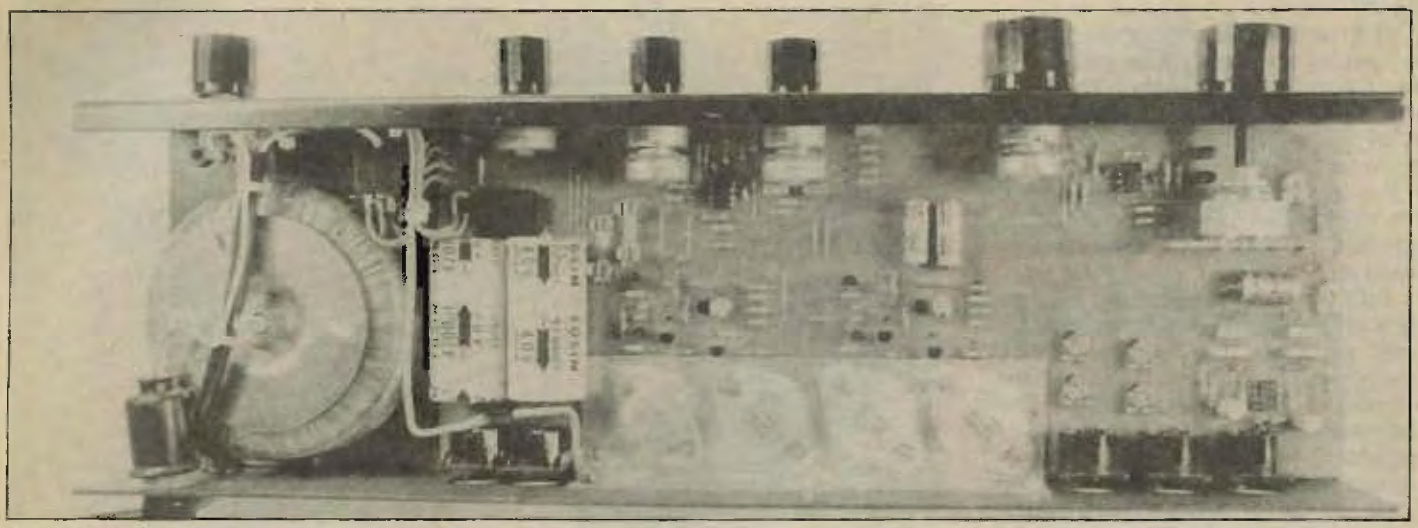


Figure 10. LED pin-out.

Figure 9. Interwiring.



Switch pcb front view.



Internal view of completed amplifier.

done with a sharp knife or a piece of fine emery cloth or wet and dry. Twist together the blue and yellow wires and connect both to pin 18 on the pcb. Connect a short length of wire between pin 9 and the earth tag as shown in Figure 9. Form the red and grey wires around to the bridge rectifier and solder on to pins 14 and 15 on the pcb. It makes no difference which wire goes to which pin.

Fix the chassis fuseholder to the rear panel above T1 and fit a rubber grommet in the hole beneath it. Fix the rotary mains switch S1 to the front panel taking care that the small spigot fits into the matching hole. Cut the spindle to the same length as the other spindles. Also trim the spindle on S2 to this length.

Connect one of the orange wires from T1 (it doesn't matter which one) to the side tag on the fuseholder FS1, after sliding the rubber boot over the wire first. Cut a piece of wire about 150mm (6in) long, strip and tin each end then pass it through the rubber boot and connect it to the rear tag on FS1. Solder both wires, then push the rubber boot forward so that it completely covers the body of the fuseholder.

Connect the other end of this wire to one of the top two terminals on switch S1. Then connect the other orange wire from T1 to the other top terminal on S1. Strip 80mm (3in) of the outer covering of the piece of mains lead and strip and tin a short length of each of the three internal wires. Put the mains lead through the grommet in the rear panel and terminate the blue wire to the tag on S1 immediately below the orange wire from T1 and terminate the brown wire to the tag on S1 immediately below the piece of wire from FS1.

The mains earth (green and yellow wire) should be connected to the earthing tag on the top of JK1. Ensure that all the connections you have made are properly soldered. Check carefully for dry joints and short circuits. Insert the 2A antisurge fuse into FS1 and ensure that the other two fuses are NOT inserted into their clips on the main pcb. Fit the control knobs on to the spindles as shown in the photographs.

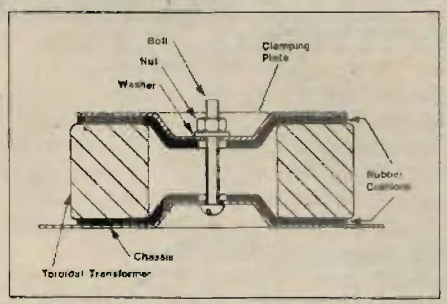


Figure 11. Mounting the toroidal transformer.

Finally check that the last section of wiring is identical to all the diagrams. The amplifier is now ready for testing.

Testing

Fit the 13A mains plug to the mains cable. The rear of S1 could be covered with insulating tape if desired and it would then be quite safe to work in the amplifier with the mains connected without risk of a shock. On no account, however, should children or untrained persons be allowed near the amplifier in this condition. Little fingers could easily unpeel your carefully applied insulating tape with potentially lethal results.

Do not connect any loudspeakers or inputs at this stage and fuses FS2 and 3 must not be fitted. Set all the front panel controls fully anticlockwise. Adjust presets RV5 and RV6 to half-way and set RV1, 2, 3 and 4 fully clockwise. Give the project a final visual inspection then connect the mains plug to the mains and switch the amplifier on by turning S1 clockwise.

LED1 should light up. If it does not switch off, remove the mains and check fuse FS1. If it is still intact, try reversing the wires on pins 16 and 17 on the pcb. Switch on again. If all is well switch a multimeter to 50V DC or 100V DC or thereabouts, connect the negative lead to the metal chassis or the tag on the top of JK1 and the positive lead to pin TPA on the pcb. The meter should read around +32V (±5V). Now put the meter's positive lead to the chassis and connect the negative lead to pin TPB on the pcb. Again the meter should read the same voltage as before i.e. -32V (±5V).

Switch off. If all is well the other two 2A fuses can now be fitted into the fuse clips on the pcb. If desired and you have sufficient knowledge, two further checks can be made. The +15V rails can be checked on D5 and D6 and you should obtain a reading of above 100mV DC between the cases of the four power MOSFET's and the chassis.

The treble, bass and balance controls can now be set centrally. Speakers may now be connected and inputs as required. The input connections are as follows:—

SK1 Magnetic pick-up input (5-pin DIN 180°)
Pin 1 Left channel input
Pin 4 Right channel input
Pins 2, 3, 5 Common (0V)
SK2 Tuner/Aux input (5-pin DIN 180°)
Pin 1 Auxiliary left channel input
Pin 4 Auxiliary right channel input
Pin 3 Tuner left channel input
Pin 5 Tuner right channel input
Pin 2 Common (0V)
SK3 Tape input/output (5-pin DIN 180°)
Pin 1 Tape left channel output
Pin 4 Tape right channel output
Pin 3 Tape left channel input
Pin 5 Tape right channel input
Pin 2 Common (0V)

If when any particular input is selected there is an obtrusive hum, try disconnecting the earth from the plug at one end of the interconnecting lead. Check out the remaining functions of the amplifier and adjust the six presets RV1 to 6 to suit your equipment if desired.

Carefully fold the wooden cabinet glueing the corners together with a PVA adhesive such as Evostik's "Resin W". Slide the chassis into the wooden sleeve when the glue is properly set, so that the four holes in the bottom line up with the four holes in the base of the chassis. Then bolt on the four rubber feet using the four 4BA ¼in bolts supplied in the kit. If you have bought the parts separately, you will need to cut the excess length off the 4BA 1in bolts. The amplifier is now complete and its reliable, superb quality should give many years of listening pleasure.

Continued on page 55.

25W STEREO MOSFET AMP Continued from page 44

PARTS LIST

Resistors — all ¼W 5% carbon unless specified			
R1,6	68k	2 off	(M68K)
R2,7,37,48	1k	4 off	(M1K)
R3,8	22k (1%)	2 off	(T22K)
R4,9	270k (1%)	2 off	(T270K)
R5,10	100k	2 off	(M100K)
R11,12,40,41, 51,52	100R	6 off	(M100R)
R13,16,17,20	470k	4 off	(M470K)
R14,18	1k2	2 off	(M1K2)
R15,19	22k	2 off	(M22K)
R21-24,27-32	2k2	10 off	(M2K2)
R25,26,39,50	15k	4 off	(M15K)
R33,44	47k	2 off	(M47K)
R34,45	56k	2 off	(M56K)
R35,36,46,47	3k9	4 off	(M3K9)
R38,49	33k	2 off	(M33K)
R42,43,53,54	10R	4 off	(M10R)
R55,56	220R (¼W)	2 off	(S220R)
R57,58	820R	2 off	(M820R)
R59	2k7		(M2K7)
RV1-4	100k horizontal sub-min preset	4 off	(WR61R)
RV5,6	10k horizontal sub-min preset	2 off	(WR58N)
RV7	4k7 log dual pot		(FX08J)
RV8,9	47k lin dual pot	2 off	(FW87U)
RV10	10k lin pot		(FW02C)
Capacitors			
C1,5	68pF ceramic	2 off	(WX54J)
C2,6,25,31	10uF 35V PC electrolytic	4 off	(FF04E)
C3,7	10nF 1% polystyrene	2 off	(BX86T)
C4,8	3n9 1% polystyrene	2 off	(BX63T)
C9	100uF 40V axial electrolytic		(FB50E)
C10,11	10uF 16V tantalum	2 off	(WW68Y)
C12,13,23,29	10pF ceramic	4 off	(WX44X)
C14,15,18,19	68nF polycarbonate	4 off	(WW39N)
C16,20	4n7 polycarbonate	2 off	(WW26D)
C17,21,24,26 30,32	47pF ceramic	6 off	(WX52G)
C22,28	4uF 16V tantalum	2 off	(WW64U)
C27,33	100nF polyester	2 off	(BX76H)
C34,35	100uF 25V axial electrolytic	2 off	(FB49D)
C36,37	4700uF 40V axial electrolytic	2 off	(RK26D)
Semiconductors			
D1-4	1N4148	4 off	(QL80B)
D5,6	BZY88C15V	2 off	(QH18U)
LED1	Chrome LED small		(YY59P)
BR1	Bridge S04		(QL10L)
TR1,2,3,8,9,10	BC212L	6 off	(QB60Q)
TR4,5,11,12	BC182L	4 off	(QB55K)
TR6,13	2SK133	2 off	(QQ36P)
TR7,14	2SJ48	2 off	(QQ34M)
IC1,2,3	LF353	3 off	(WQ31J)
Miscellaneous			
S1	Rotary mains switch		(FH57M)
S2	Rotary 3-pole 4-way switch		(FH44X)
SK1,2,3	PC DIN socket 5-pin 'A'	3 off	(YX91Y)
SK4,5	PC DIN socket 2-pin	2 off	(YX90X)
JK1	DPDT jack socket		(BW80B)
T1	Toroidal transformer 22V 80VA		(YK18U)
FS1,2,3	2A antisurge fuse	3 off	(WR20W)
	Safuseholder 20mm		(RX96E)
	Rubber boot		(HL51F)
	Fuse clips	4 off	(WH49D)
	Mica insulator TO3	4 off	(WR24B)
	Small thermpath		(HQ00A)
	Stereo amp heatsink		(RK25C)
	Stereo amp pcb		(GA71N)
	Stereo amp switch pcb		(GA78K)
	Stereo amp chassis		(XG15R)
	Stereo amp woodwork		(XG16S)
	Cabinet feet	1pk	(FW19V)
	Grommet small	2 off	(FW59P)
	Knob K44	3 off	(HB39N)
	Knob K45		(HB40T)
	Knob K46	2 off	(HB41U)
	Veropin 2141	28 off	(FL21X)
	Bolt 4BA 1in	4 off	(BF04E)
	Bolt 6BA ½in	5 off	(BF05F)
	Bolt 6BA ¾in	8 off	(BF06G)
	Nut 6BA	13 off	(BF18U)
	Washer 6BA	12 off	(BF26D)
	Tag 6BA		(BF29G)
	13A mains plug		(RW67X)
	Min mains cable	2m	(XR01B)
	Hook-up wire yellow	1m	(BL10L)
	Tinned copper wire 24 swg	1m	(BL15R)
	Systoflex 2mm black	10cm	(BH05G)

A complete kit of all the parts listed above is available
Order As LW71N (25W Stereo MOSFET Amp Kit) Price £49.95