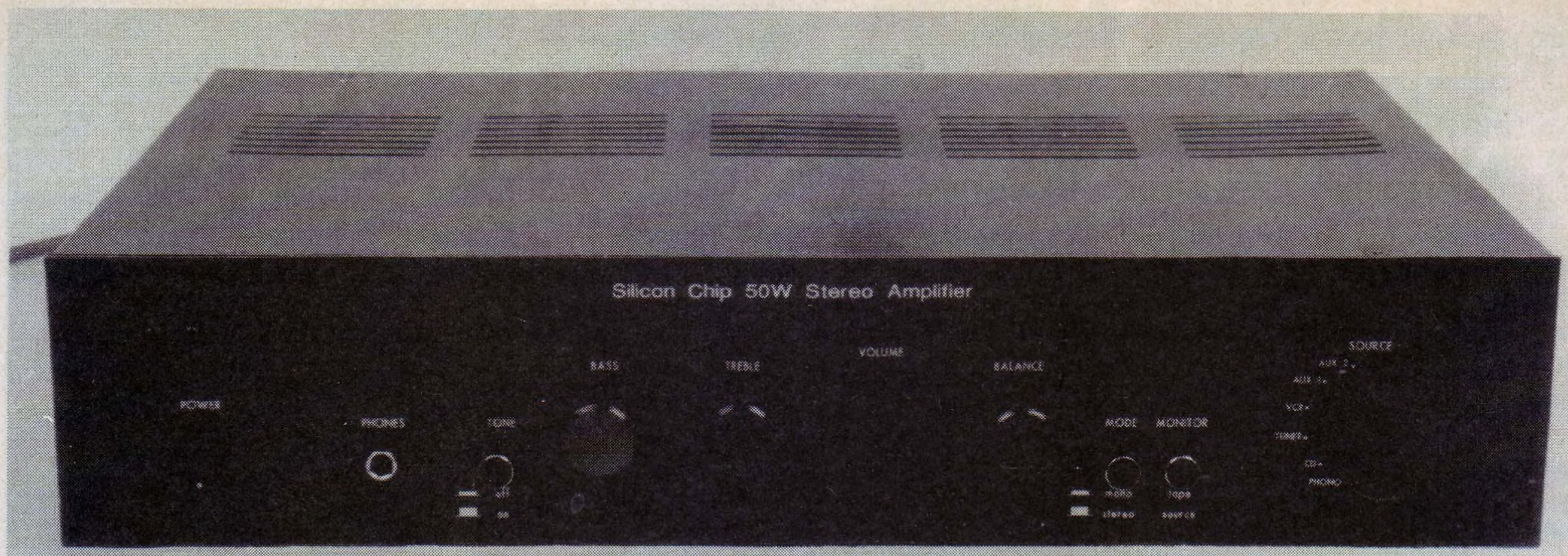


Build a 50W/channel stereo amplifier; Pt.2

Last month, we introduced our new high performance 50W/channel stereo amplifier & described the circuit operation. This month, we conclude with the presentation of the construction details.

By LEO SIMPSON & BOB FLYNN

Most of the construction of the new amplifier is quite straightforward. The work mainly involves mounting components on the five printed circuit board assemblies. These are the power amplifier board, the input selector board, the selector switch board, the tone control board and the optional RIAA preamp board.

The first job is to assemble the input selector board which is shown in Fig.7(a). This board is coded 01103951 and carries the RCA input and output sockets. Before mounting any of the parts, it is a good idea to carefully check the copper pattern on the underside of the board. You should especially check for shorts between the long parallel tracks to the selector switch.

Don't just rely on a visual check here – switch your multimeter to a high Ohms range and use it to confirm that the tracks are isolated from each other. This test will quickly locate faults on any board that has not been correctly etched. You will need to go through a similar checking procedure with each of the other boards when you come to them.

Now install the parts as shown in Fig.7(a). The first job is to install the 25 PC pins. Fourteen of these support the selector switch assembly and these should be installed from the copper side of the PC board; ie, so that the shoulder of each pin sits against its respective copper pad. The remaining pins are located at the left and right channel outputs, the tape inputs and the optional RIAA preamp inputs. If you're not building this latter board, you can forget the pins for the preamp inputs but install a couple of links instead. These links are shown dotted on the diagram.

This board is completed by soldering in the three 3 x 2-way RCA socket panels. One of these, at the end adjacent to the selector switch, is cut down to a 2 x 2-way, so that a total of 16 RCA sockets is provided.

Fig.8(a) shows the selector switch board (code 01103952). Position the switch with the locating spigot towards the top and push the body of the switch all the way down onto the board before soldering the terminals. The pads along the bottom edge of the switch board can now be soldered to the 14 PC pins on the input selector board.

Tone control board

Fig.9(a) shows the parts layout on the tone control PC board (code 01103953). Commence assembly by installing PC pins at the external wiring points, then fit the wire links, resistors, capacitors and semiconductors. Check the orientation of polarised

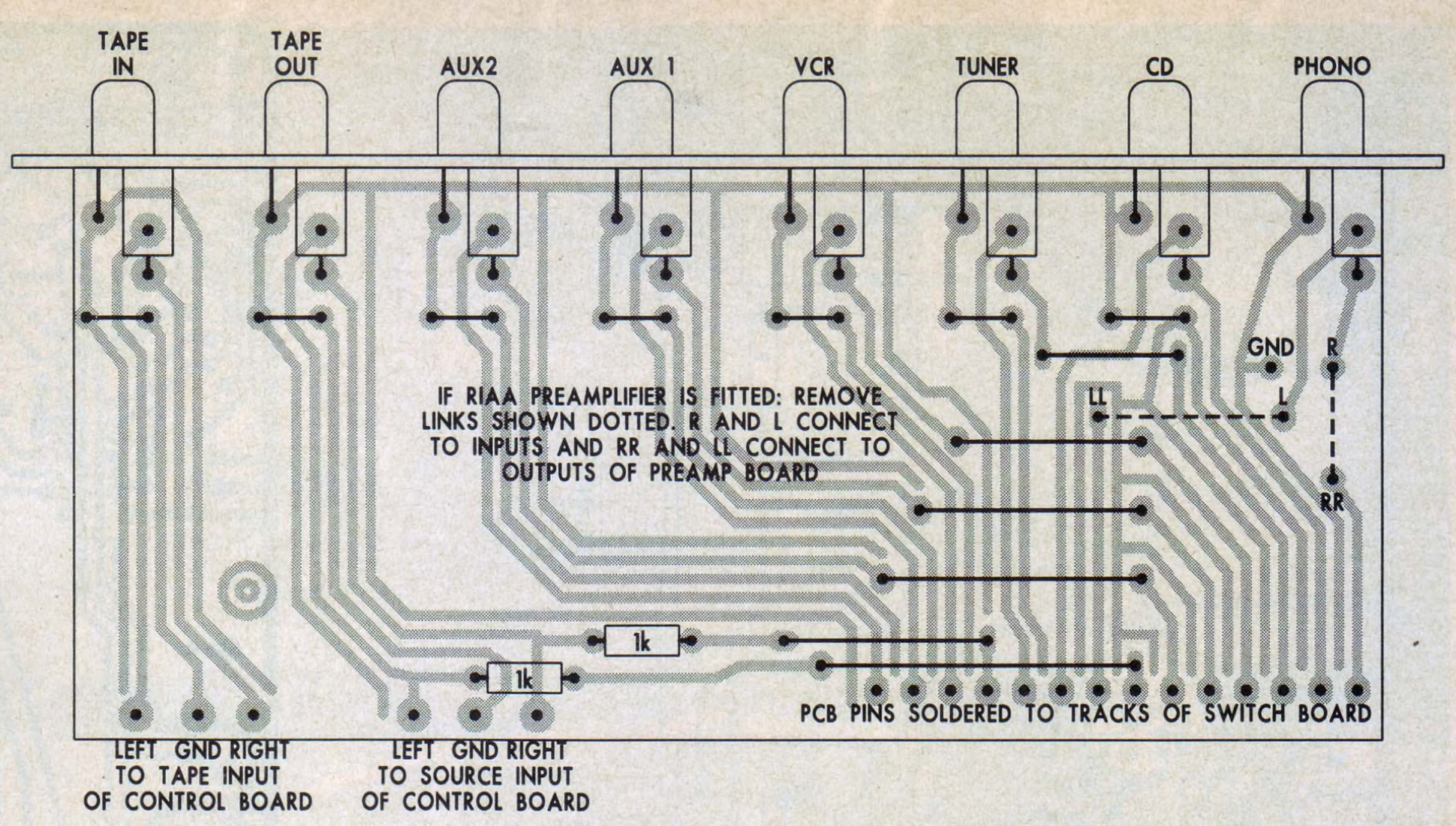


Fig.7(a): the input selector board. Note that if the optional RIAA preamp is not included in the amplifier, the two links shown dotted should be included & the associated PC pins omitted.

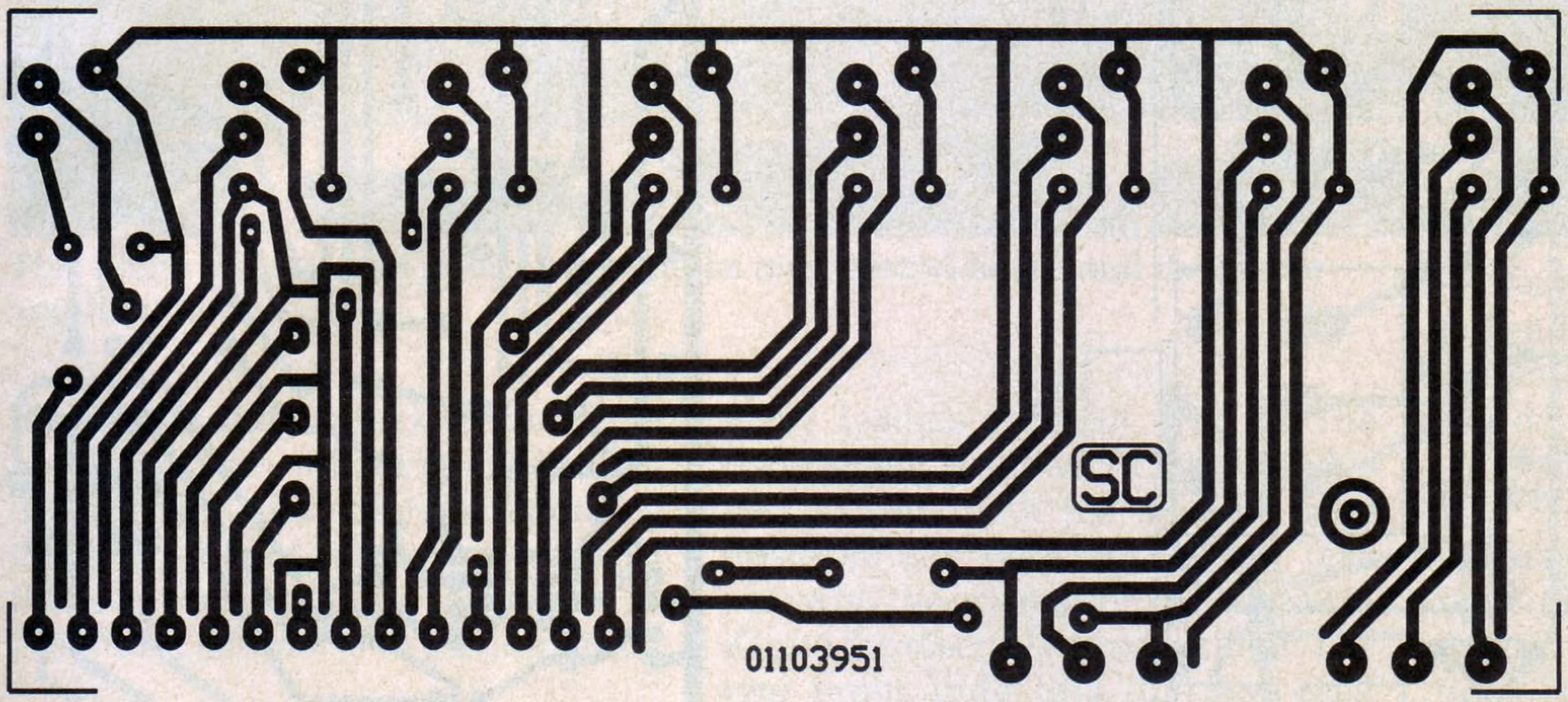


Fig.7(b): this is the full-size etching pattern for the input selector board.

parts carefully when installing them on the board. These include the ICs, diodes, transistors and electrolytic capacitors. The 6.8µF and 22µF capacitors are bipolar types and can be installed either way around.

The headphone socket, pots and pushbutton switches should be left till last. Be sure to push them all the way down onto the board but don't solder all the leads at this stage. Instead, tack solder diagonally opposite pins at either end of each component.

The tone control assembly can now be tested in the chassis to ensure that everything aligns properly. Adjust the alignment of the pots and switches as necessary before soldering the remaining pins.

Balance control

Fig.10 shows the wiring of the switch for the balance control. The resistors are wired around the switch pins together with three short lengths of hook-up wire. These are soldered to the tone control board which can now be mounted in the chassis. It is mounted to the front panel using the pot nuts and lockwashers. The rear of the tone control board is secured using two 12mm tapped spacers and screws.

Don't fit the dress panel to the chassis at this stage. It should be left in its protective wrapping for as long as possible, to protect it from scratches.

When all the pot nuts are secured, use your multimeter to check that all the pot cases are electrically connected together, via the chassis. If not, it might be necessary to remove the board from

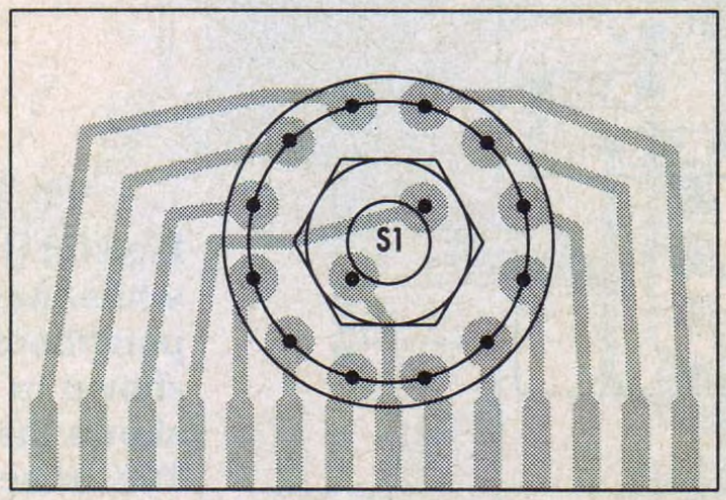


Fig.8(a): the selector switch board. This mates up to the 14 pins on the input selector board & is soldered at right angles to it.

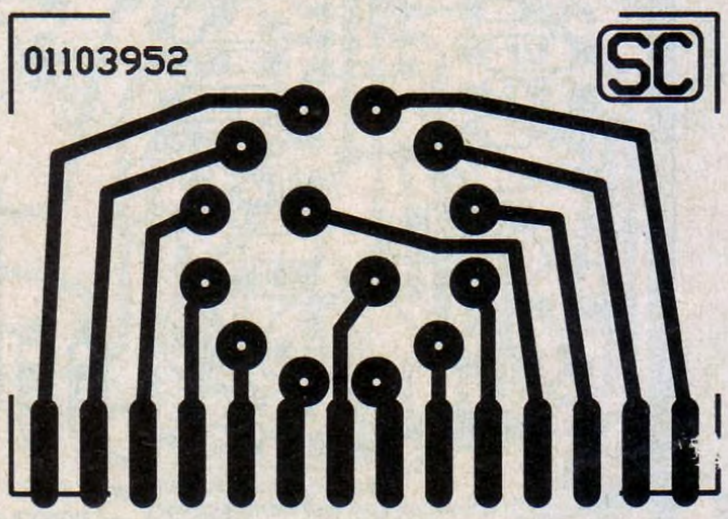
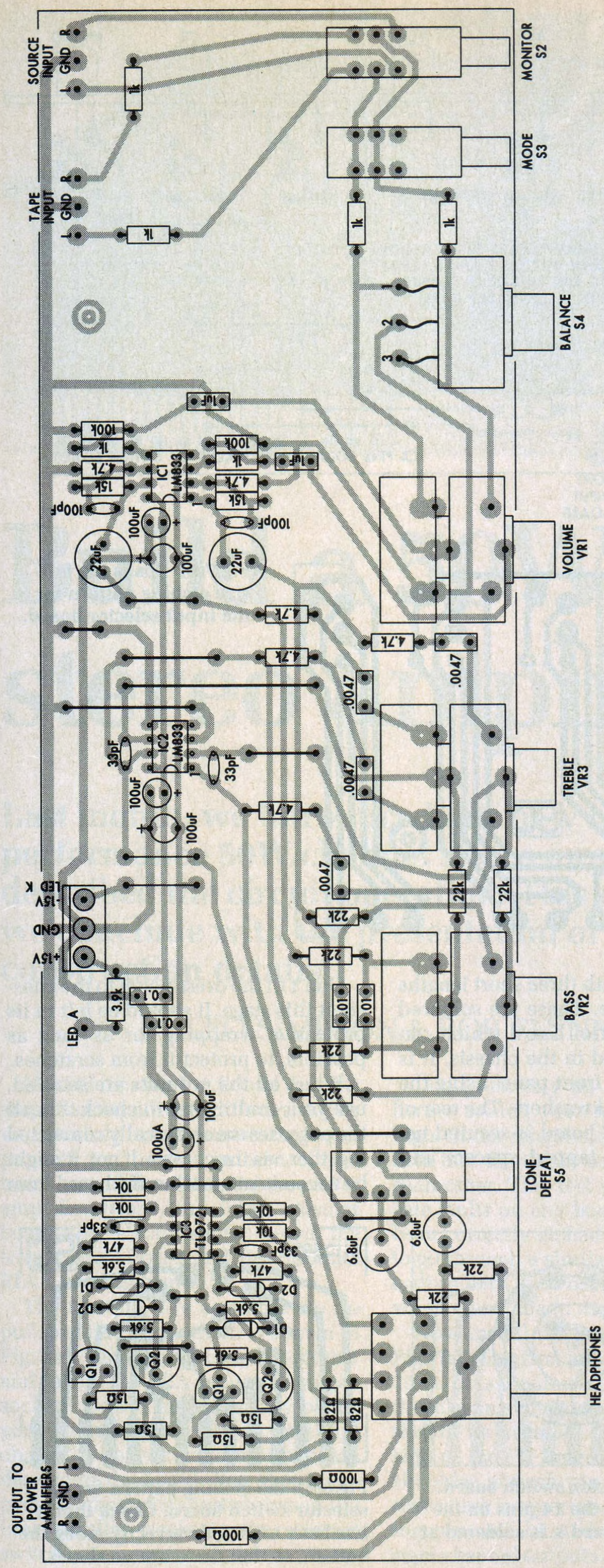


Fig.8(b): the etching pattern for the selector switch board. Check that it has been trimmed correctly along the bottom, so that there are no shorts.



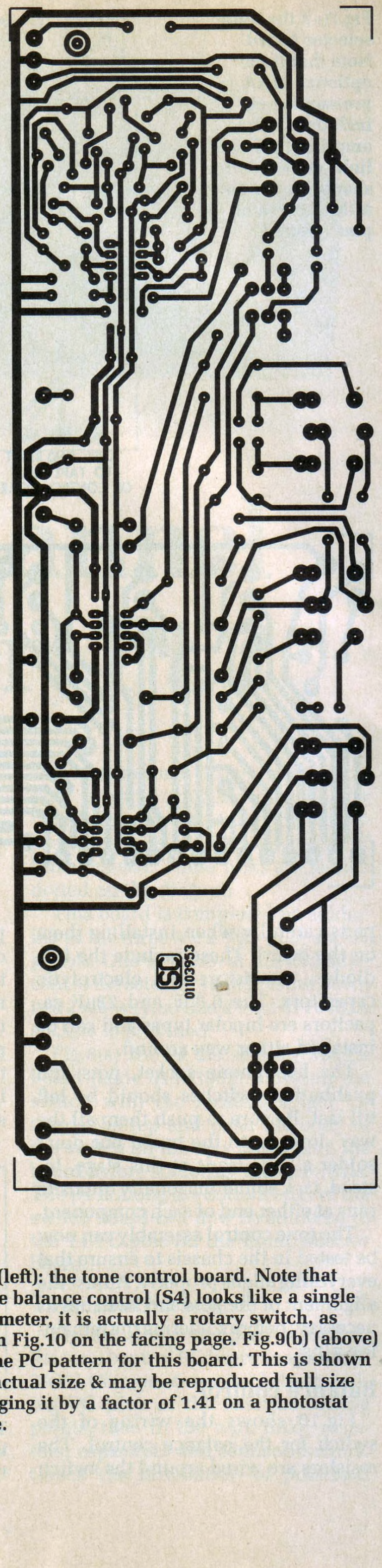
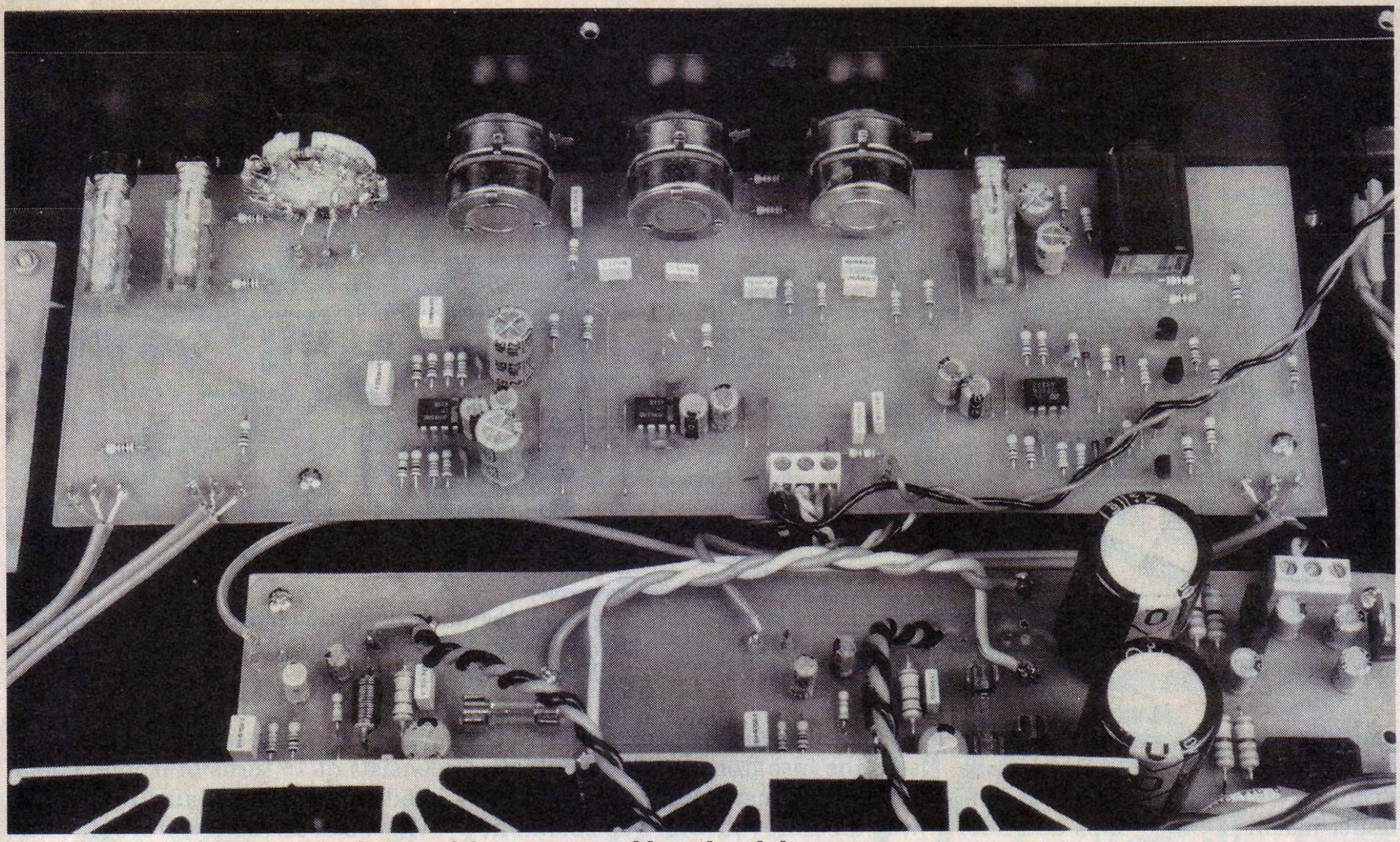


Fig.9(a) (left): the tone control board. Note that while the balance control (S4) looks like a single potentiometer, it is actually a rotary switch, as shown in Fig.10 on the facing page. Fig.9(b) (above) shows the PC pattern for this board. This is shown 70% of actual size & may be reproduced full size by enlarging it by a factor of 1.41 on a photostat machine.



This photo gives a good general view of the tone control board and the power amplifier board.

the chassis and then take a round file to lightly clean off any paint or anodising from around the pot mounting holes. The reason for making sure that the pots are properly earthed is to keep hum and noise to a minimum.

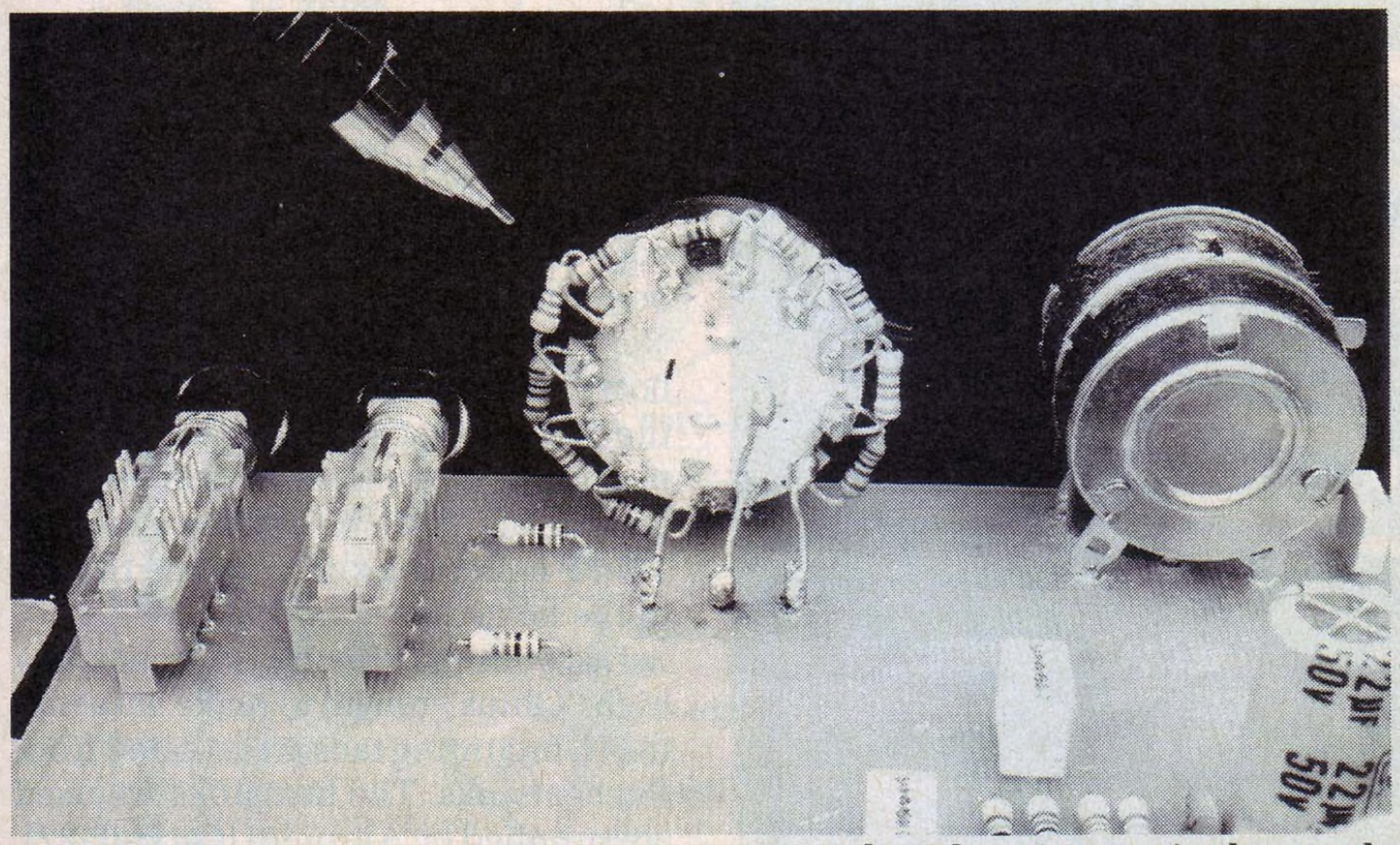
RIAA preamp board

As noted previously, this preamp board is optional and we assume that many readers will not need it. The parts layout is shown in Fig.11(a). It's best to start with the smaller parts (resistors and wire links) first. Take care with the orientation of the LM833 IC and the electrolytic capacitors. The two input inductors (L1) are each made by winding four turns of 0.4mm enamelled copper wire on a ferrite bead (Philips type 4330 030 3218).

Don't forget to strip the enamel off the ends of the lead wires before the inductors are soldered into the PC board.

Power amplifier board

This board is identical to that presented in the February 1995 issue but we are repeating the assembly instructions here for the sake of completeness. The component layout is shown in Fig.13(a). To begin, first install the PC pins and links, followed by the



The balance control is an 11-position rotary switch with resistors wired around its terminals. This arrangement gives much better separation between channels than a potentiometer.

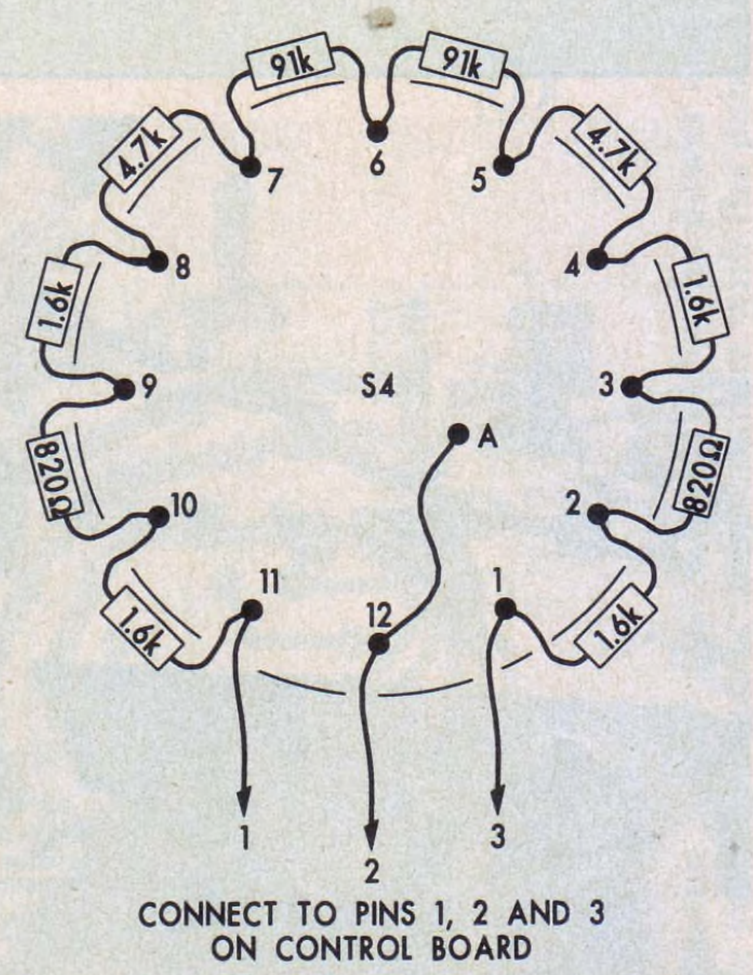


Fig.10: here's how the rotary switch is wired with the resistors to provide the balance control.

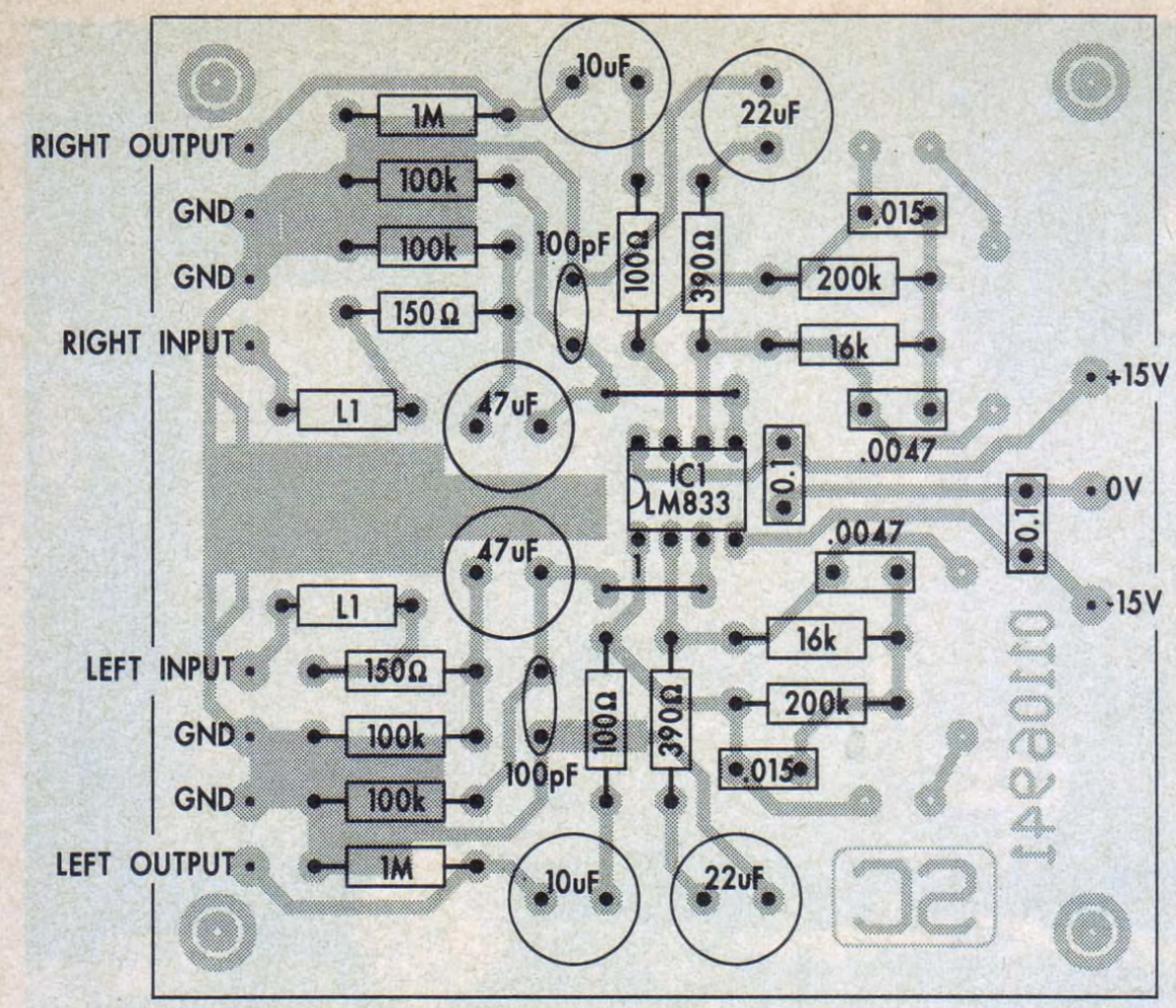


Fig.11(a): the optional RIAA preamplifier board. The large electrolytic capacitors are bipolar types & can be installed either way around.

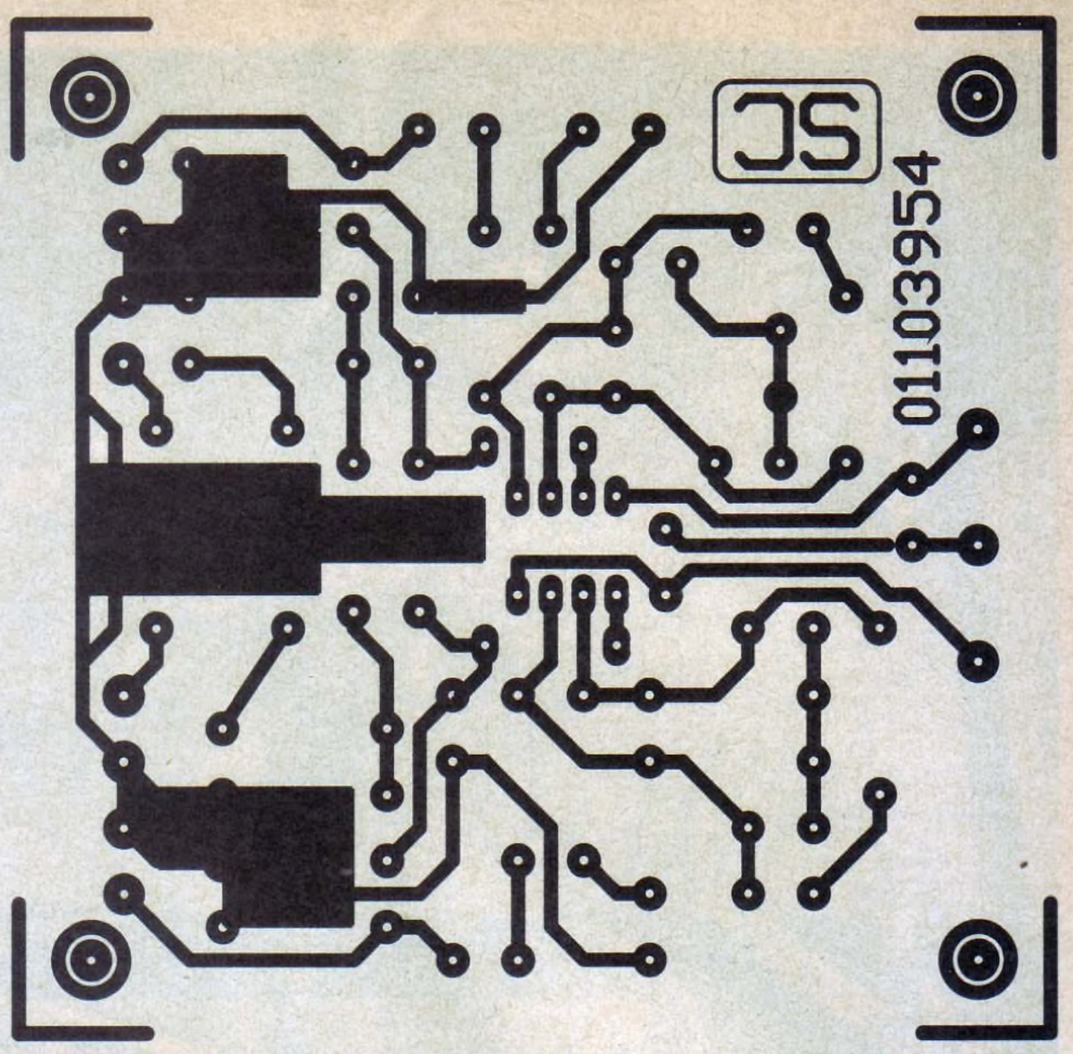


Fig.11(b): the full-size etching pattern for the optional RIAA preamplifier board. In most cases, this board will not be needed.

resistors and capacitors. Make sure that you install the electrolytic capacitors with correct polarity. This done, install the fuse clips and note that there is a trick to this task. The clips have little lugs at one end which stop the fuse from moving longitudinally. If you install the clips the wrong way around, you won't be able to fit the fuses.

L1, the loudspeaker filter inductor, consists of 15 turns of 0.5mm enamelled copper wire wound onto a 10Ω 1W resistor and soldered at both ends. To wind it, first scrape the enamel off the start of the copper wire and solder it to one end of the resistor. Now neatly wind 15 turns onto the resistor body, then scrape the enamel off the end of the wire and solder it to the other end of the resistor. Finally, install and solder the assembly into the PC board.

The positive and negative power supply connections to the right channel should be made with heavy duty hook-up wire (32 x 0.2mm or better) which should be twisted as shown on Fig.13(a). The 0V connections should be made via the same sort of hook-up wire but underneath the board.

Finally, you can install the power ICs. Make sure that the tabs of the devices line up precisely with the back edge of the PC board so that they can be properly secured to the heatsinks. Next, fit 15mm metal standoffs to the board and line up the heatsinks against the ICs so that the positions of the mounting screws can be marked. After drilling these holes, use standard TO-3P mounting kits to secure the ICs to the heatsinks – see Fig.12.

Use your multimeter (switched to a high "Ohms" range) to make sure that the IC mounting tabs are isolated from the heatsinks. The heatsinks we used are supplied by Altronics (Cat H-0522). To mount them into the chassis, you could use small L-shaped brackets or,

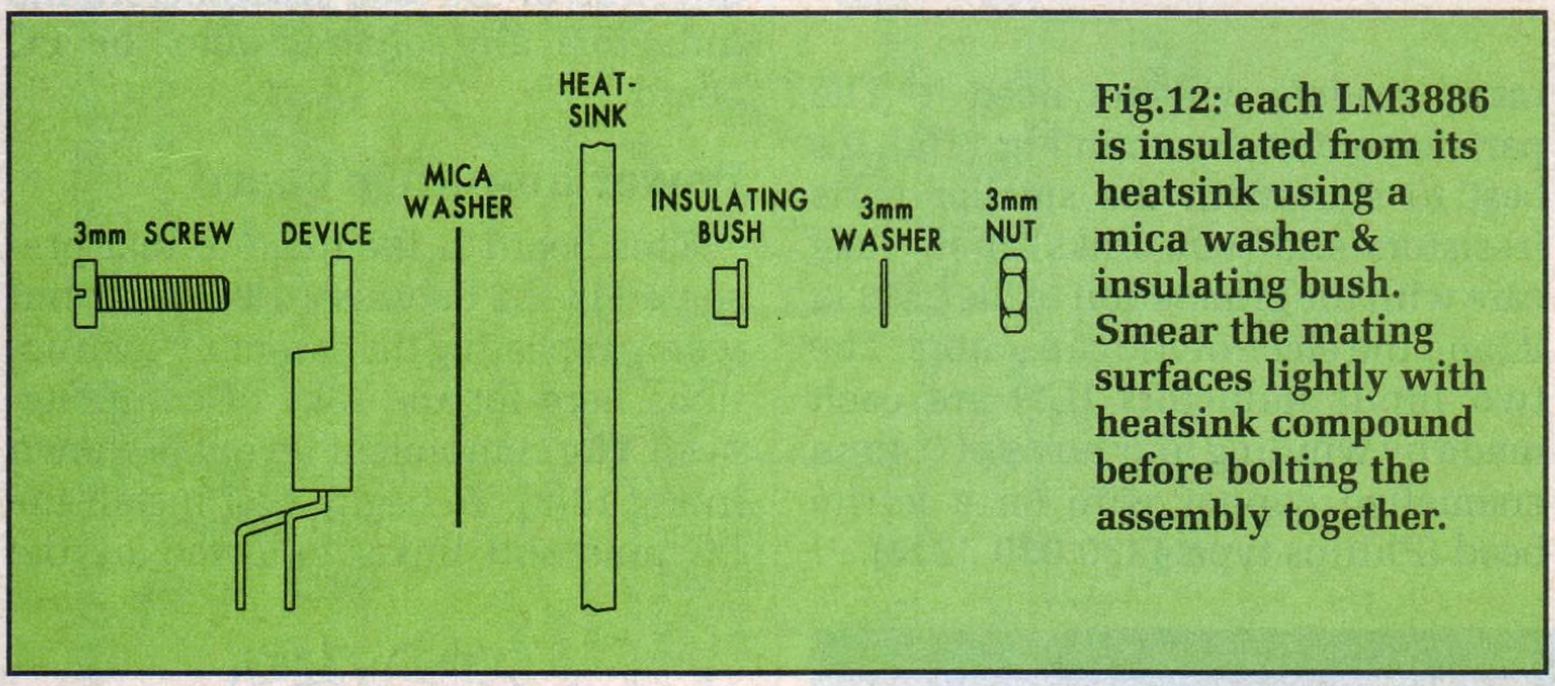
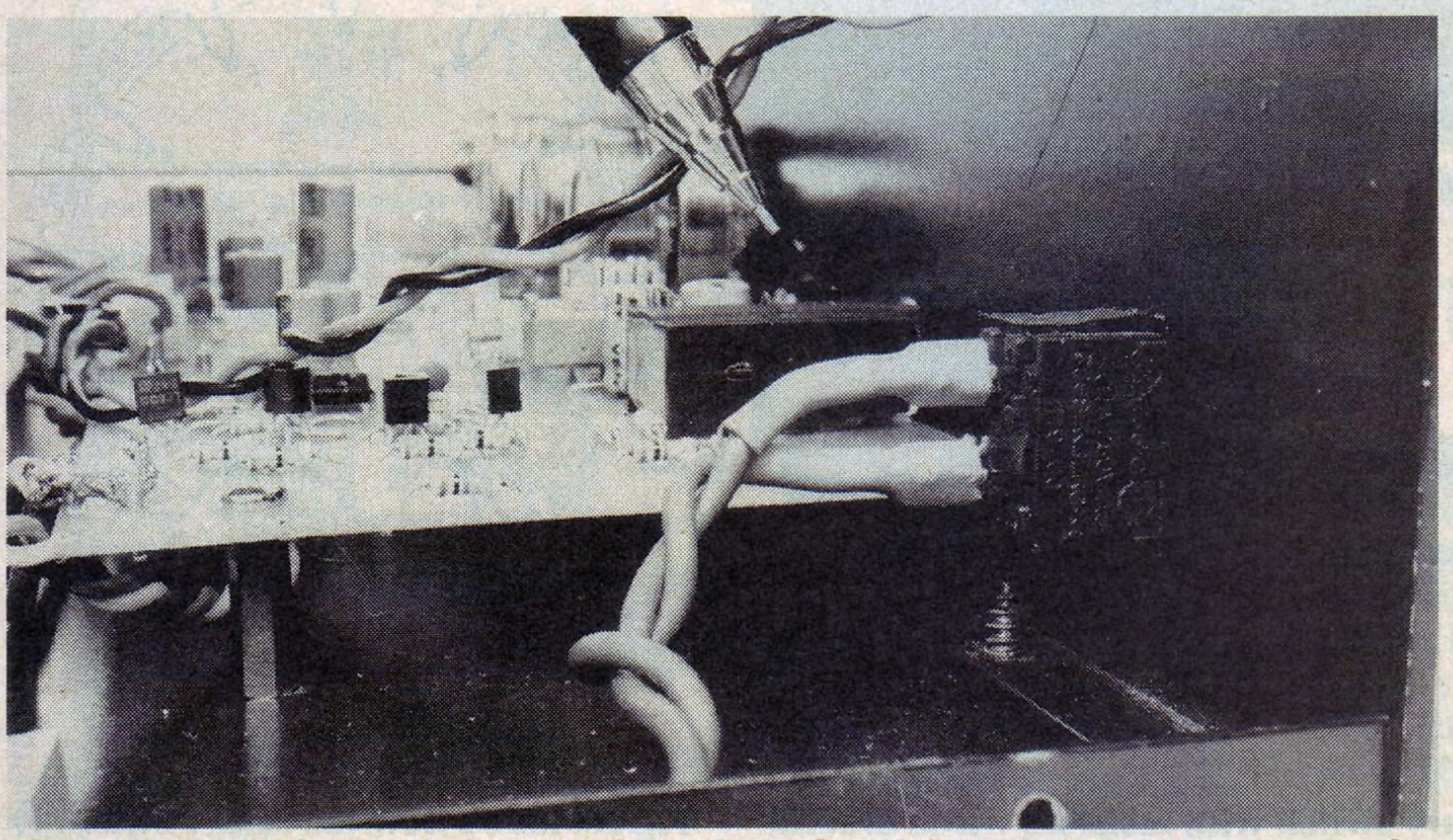


Fig.12: each LM3886 is insulated from its heatsink using a mica washer & insulating bush. Smear the mating surfaces lightly with heatsink compound before bolting the assembly together.



The mains switch should have its lugs sleeved with heatshrink tubing to avoid the possibility of electric shock.

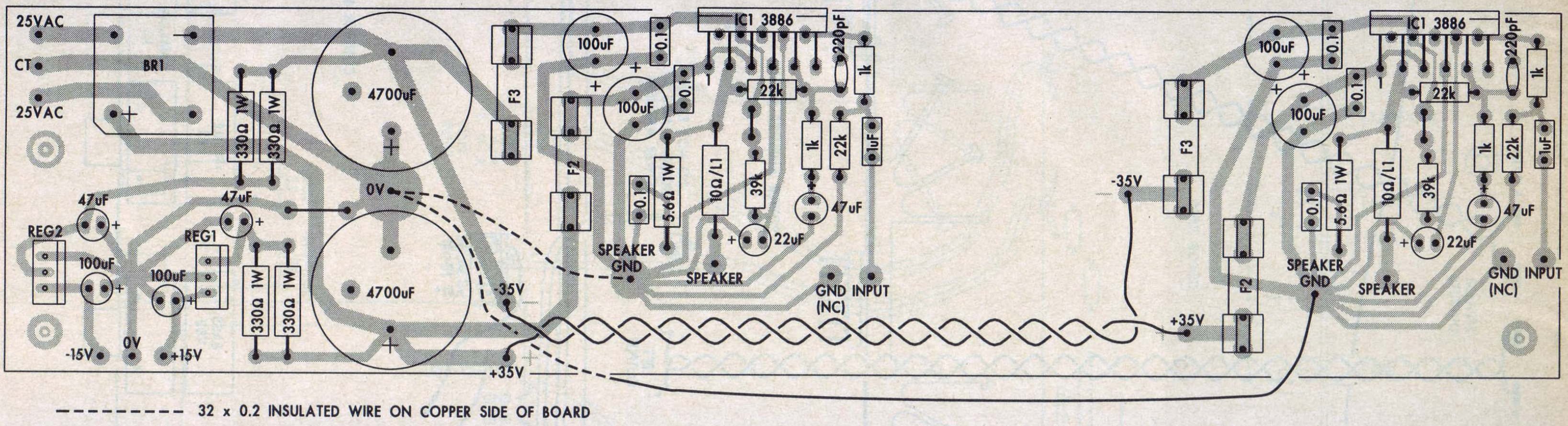


Fig.13(a): this is the parts layout on the power amplifier board. Use PC stakes to terminate external connections & note the twisted supply connections for the righthand channel. The leads shown dotted are underneath the board. The two LM3886 audio amplifier ICs must be insulated from the heatsinks, as shown in Fig.12.

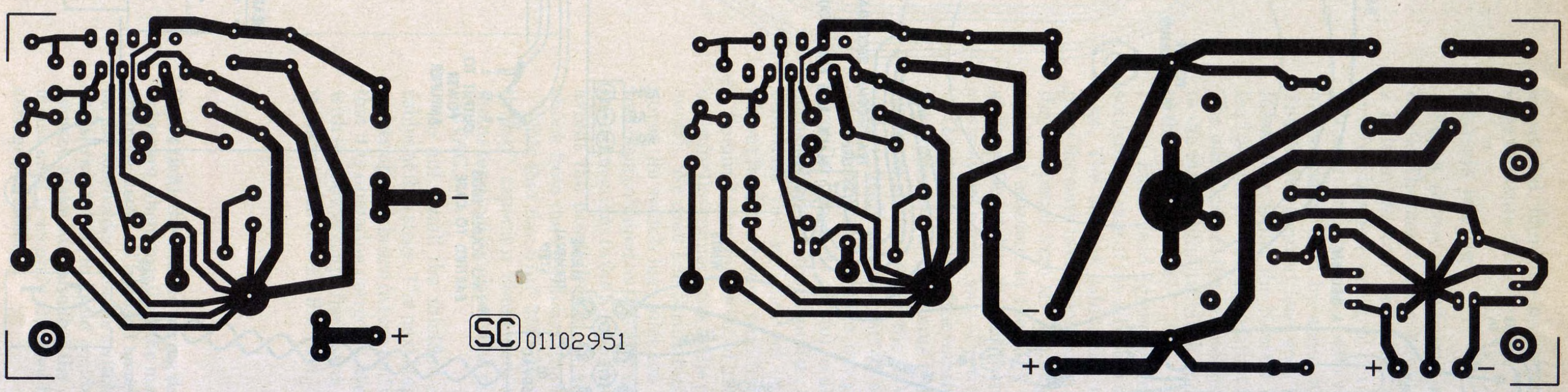


Fig.13(b): this is the full-size artwork for the power amplifier PC board. Check all PC boards carefully for possible etching defects (compare them with the published patterns) before installing any of the parts.

F1
1A

CORD
GRIP
GROMMET

A (BROWN)

EARTH

N (BLUE)

ACTIVE

WHITE

WHITE

*

MAINS
TERMINAL
STRIP

.01
250VAC

* TWO SOLDER LUGS
EARTHED TO CASE

POWER
S7

LED1

K

A

EARTH

POWER
TRANSFORMER

TRANSFORMER SECONDARIES
GREY
BLACK, BLUE AND GROUND CONNECTION
RED

-15V
0V
+15V

R G L
OUTPUT TO
POWER
AMPLIFIER

LEFT + - - + RIGHT

SPEAKER
OUTPUTS

GND
(0V)

-35V

+35V

- LEFT +
OUTPUT

POWER AMPLIFIER BOARD

-35V

G
(NC)

L

DO NOT EARTH
SIGNAL BRAIDS AT
POWER AMPLIFIER

+35V

A
LED1
K

+15V
0V
-15V

CONTROL BOARD

TONE DEFEAT
S5

HEADPHONES

BASS
VR2

TREBLE
VR3

VOLUME
VR1

as we did, blind-tap holes into the edge to secure them directly.

Chassis wiring

Fig.14 shows the chassis wiring details. The mains cord enters through a hole in the rear panel and is securely clamped using a cord-grip grommet. Strip back the outer sheath of the mains cord by about 80mm. The Active (brown) lead goes to the fuseholder while the Neutral (blue) lead goes to the mains terminal block. The other side of the fuseholder goes to the mains terminal block and then to the mains switch.

The Earth lead (green/yellow) is soldered to one of the adjacent solder lugs. The second solder lug terminates the earth lead which is run along the rear panel from the binding post terminal adjacent to the RCA input sockets. Don't alter the earth wiring – you may get a hum loop if you do.

The primary leads of the transformer are connected to the mains terminal block, as shown, while the 25V secondary leads are connected to the screw terminal block on the power amplifier board. Be careful to use the correct phasing of the secondary leads, otherwise you will not get any DC output from the bridge rectifier.

Be sure to use mains-rated 250VAC cable for the connections to the power switch. We used heatshrink tubing to cover the switch lugs after the wires had been soldered on. We also sleeved the connections to the fuseholder. This avoids the possibility of an electric shock from the switch terminals.

Note that the .01µF 250VAC "anti-thump" capacitor connected at the mains terminal block must be rated at 250VAC.

Do not install the shielded signal cables at this stage. The next step is to power up each board in turn and check that it is operating correctly. We start with the power amplifier board, since it the most involved. But first, check

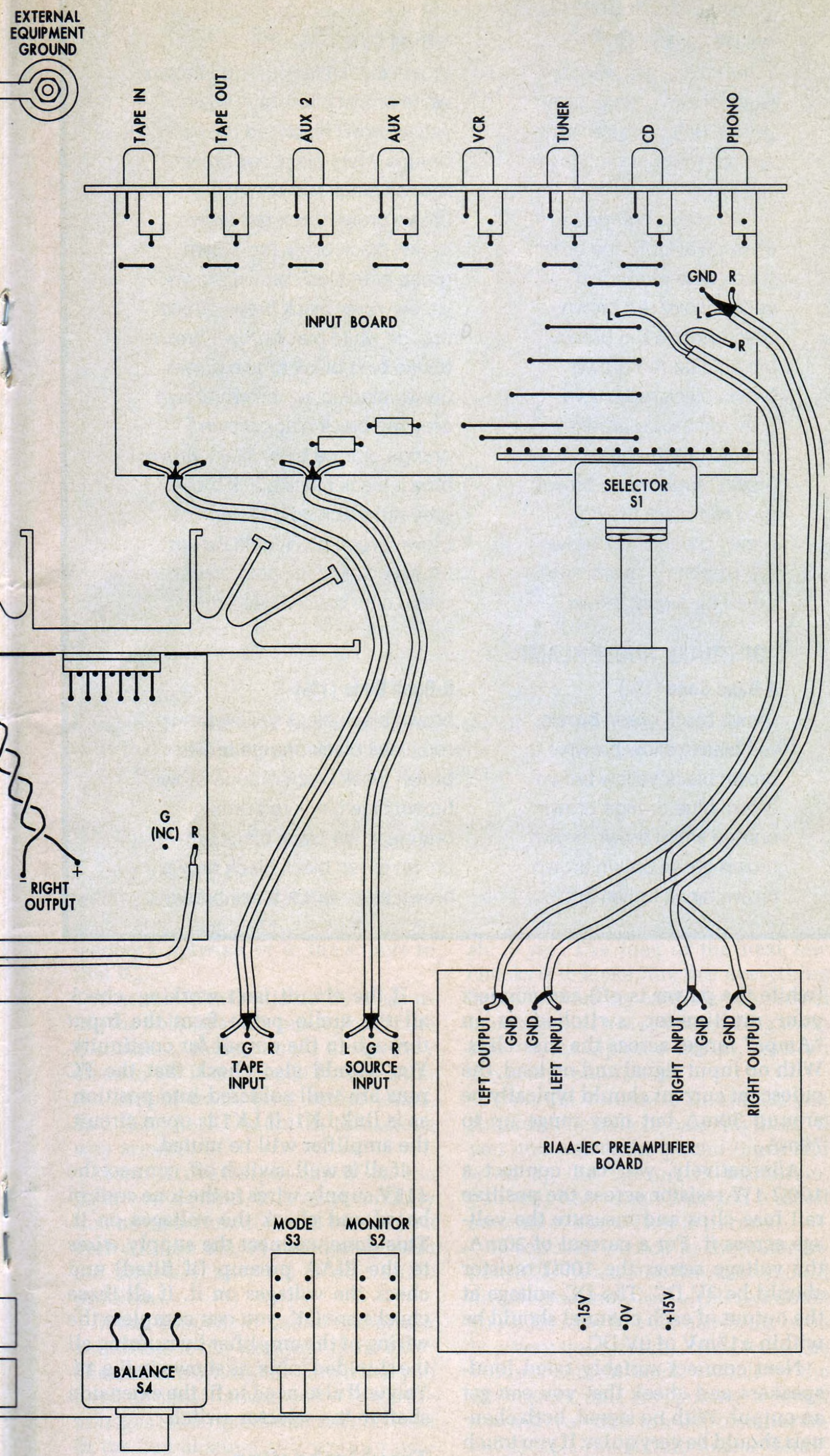


Fig.14 (left): the chassis wiring details. Take care when installing the mains wiring & sleeve all exposed terminals on the fuseholder & mains switch with heatshrink tubing to avoid accidental contact. Make sure also that the mains cord is securely clamped by the cord grip grommet.

RESISTOR COLOUR CODES

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	2	100kΩ	brown black yellow brown	brown black black orange brown
❑	2	91kΩ	white brown orange brown	white brown black red brown
❑	2	47kΩ	yellow violet orange brown	yellow violet black red brown
❑	2	39kΩ	orange white orange brown	orange white black red brown
❑	12	22kΩ	red red orange brown	red red black red brown
❑	2	15kΩ	brown green orange brown	brown green black red brown
❑	4	10kΩ	brown black orange brown	brown black black red brown
❑	4	5.6kΩ	green blue red brown	green blue black brown brown
❑	8	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	1	3.9kΩ	orange white red brown	orange white black brown brown
❑	4	1.6kΩ	brown blue red brown	brown blue black brown brown
❑	12	1kΩ	brown black red brown	brown black black brown brown
❑	2	820Ω	grey red brown brown	grey red black black brown
❑	4	330Ω	orange orange brown brown	orange orange black black brown
❑	2	100Ω	brown black brown brown	brown black black black brown
❑	2	82Ω	grey red black brown	grey red black gold brown
❑	4	15Ω	brown green black brown	brown green black gold brown
❑	2	10Ω	brown black black brown	brown black black gold brown
❑	2	5.6Ω	green blue gold brown	green blue black silver brown

OPTIONAL RIAA PREAMP

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	2	1MΩ	brown black green brown	brown black black yellow brown
❑	2	200kΩ	red black yellow brown	red black black orange brown
❑	4	100kΩ	brown black yellow brown	brown black black orange brown
❑	2	16kΩ	brown blue orange brown	brown blue black red brown
❑	2	390Ω	orange white brown brown	orange white black black brown
❑	2	150Ω	brown green brown brown	brown green black black brown
❑	2	100Ω	brown black brown brown	brown black black black brown

all your work carefully against the associated wiring diagrams of Fig.13(a) and Fig.14.

Power amplifier testing

Before checking the power amplifier board, connect a 1kΩ 0.5W resistor between the +15V and 0V rails at the 3-way terminal block (adjacent to the 3-terminal regulators). This 1kΩ resistor will draw a 15mA current from the +15V supply rail and thus ensure that the input voltage to the 7815 regulator does not exceed the ratings (ie, 35V).

Now apply power and check the supply rails. They will normally be around ±37V, depending on the value of the AC mains voltage. Now check the quiescent current in each channel. This can be done in one of two ways. The first is to remove one fuse (while the power is off) and connect your multimeter, switched to an "Amps" range, across the fuse clips. With no input signal and no load, the quiescent current should typically be around 30mA but may range up to 70mA.

Alternatively, you can connect a 100Ω 1W resistor across the positive rail fuse clips and measure the voltage across it. For a current of 30mA, the voltage across the 100Ω resistor should be 3V DC. The DC voltage at the output of each channel should be within ±15mV of 0V DC.

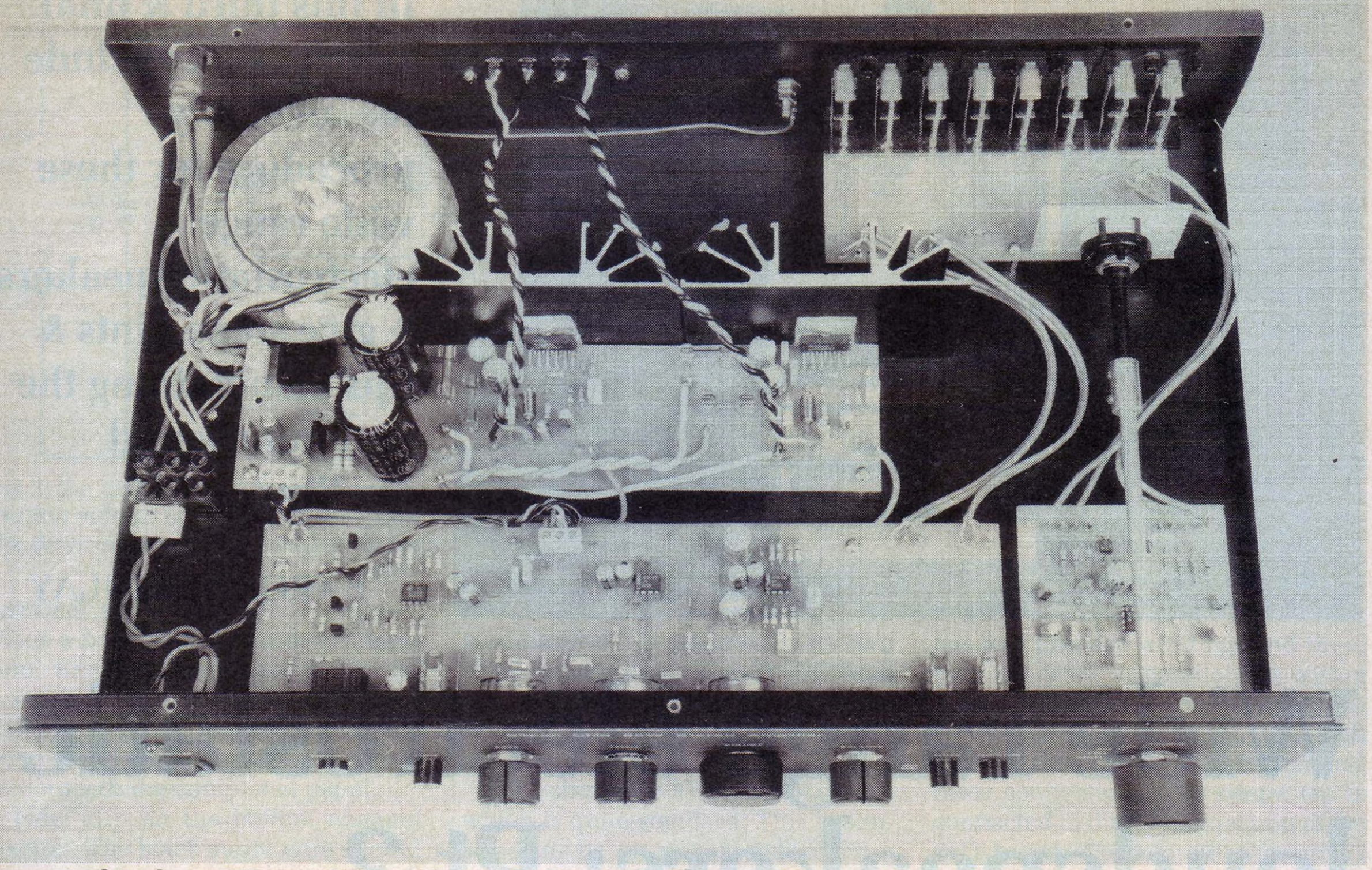
Next connect suitably rated loudspeakers and check that you can get an output. With no signal, both channels should be very quiet. If you touch the input PC pins on the PC board you should get an audible "blurt" from the relevant loudspeaker.

If the circuit isn't working, check all the audio paths from the input through to the output for continuity. You should also check that the PC pins are well soldered into position, as is link LK1. If LK1 is open circuit, the amplifier will be muted.

If all is well, switch off, connect the ±15V supply wires to the tone control board and check the voltages on it. This done, connect the supply wires to the RIAA preamp (if fitted) and check the voltages on it. If all these checks are OK, you can complete the wiring of the amplifier by running all the shielded cable, as shown in Fig.14. You will also need to fit the extension shaft to the selector switch.

Troubleshooting

If the above measurements are not OK, the most likely causes are broken



Compare this photo of the amplifier with the chassis wiring diagram of Fig.14. Note that the RIAA preamp in the righthand front corner is optional & if left out, it leaves an extra pair of high level inputs.

tracks or solder bridges between IC pins. For example, if you have the correct supply voltages on an IC but its output is close to +15V or -15V, it is most likely that there is a break in the feedback network or to the inputs to that IC.

You can follow this up by measuring the voltage at the input pins of the ICs. Again, these should all be very close to 0V. If not, check for breaks in the copper track, poor solder joints, and that the IC is not in the wrong way around.

Note: if you've put the IC in the right way around, it is most unlikely that any malfunction will be due to a faulty IC. So don't immediately rush out and buy new ICs if you strike problems.

What happens if one of the power amplifiers is not working? If the other channel is working correctly, then you have an ideal crosscheck. Check the voltages in the good channel and then in the bad channel and you can usually get a fair idea of what the problem is. It is unlikely that you will get the same fault in both channels, unless you have made the same assembly mistake in both!

Listening tests

No, we're not going to listen to music – yet. The idea of the next few checks is to make sure that everything is really working as it should. You'll need a pair of headphones. Plug them into the headphone socket, turn on the power and listen.

With the Volume at minimum you shouldn't be able to hear anything. If you now select the phono input and wind up the Volume to maximum, you will hear some hiss and a small amount of hum. That is normal.

If you now switch to the other inputs (CD, Tuner, etc), the noise should drop to extremely low levels (we doubt you'll be able to hear anything, even in a very quiet room). Now wind the Volume control back, switch to the CD inputs and try poking a small screwdriver into the left channel input socket. You should hear a "blurt" in the left channel. Now try the test for the right channel.

If you repeat this test for extreme settings of the tone controls (eg, full bass boost, full bass cut, etc) you can confirm that they are working as well. Similarly, you can check the operation of the Mono/Stereo switch and the Balance control.

If all is well, the front panel can now be mounted but be careful – one scratch and you'll ruin the appearance of the whole project. Fit the lid to the case and the job is finished. **SC**

CAPACITOR CODES

Value	IEC	EIA
1µF	1u0	105
.01µF	10n	103
.0047µF	4n7	472
220pF	220p	221
100pF	100p	101
33pF	33p	33

OPTIONAL RIAA PREAMP

Value	IEC	EIA
1µF	1u0	105
.015µF	15n	153
.0047µF	4n7	472
100pF	100p	101