



STEREO LOUDSPEAKER SWITCHER

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Have you ever wanted to switch between two pairs of loudspeakers to confirm that your favourite pair is simply the best? If so then read on. This ultra-useful project includes an anti-thump circuit and also finds an application in the recording or home studio.

A LOUDSPEAKER SWITCHER is extremely simple in concept yet it finds a wide range of applications for the audiophile and in the recording studio. The most obvious application would be to use it as an A/B loudspeaker switcher. Subjective listening tests on the sound quality of two stereo speaker systems can be made while the switcher is used to quickly switch between the two pairs under test.

In a recording studio environment it is often required to use at least two pairs of monitor speakers whilst doing a recording or during a mixdown. A high quality pair is used to monitor the sound quality of the recording, the other pair is used to give the engineer an idea of the way it would sound in a typical hi-fi set-up in the home. The loudspeaker switcher would also be an economical approach to switching be-

tween the two pairs using a common amplifier. Do I hear whoops of delight from those who have been denied music because the amplifier in the lounge has walked into the studio in the spare room?

Another feature of the ETI-1412 is its anti-thump circuit. At switch-on in an audio set-up the first sign of life is normally heard as a thump from the speakers. In a system where many audio processors are interconnected, eg, in a studio, where powering up via a single mains switch is common practice, the thump can be quite a problem. In extreme cases it can actually damage the speakers. Some amplifiers produce loud thumps on their own at switch-on. The anti-thump circuit is incorporated to reduce these problems.

Description

A toggle switch is used to select loudspeaker A or B and two LEDs indicate which pair is selected. The switch and LEDs are housed in a hand-held remote control box connected via cable to the main unit.

In the early stages of designing the anti-thump circuit, it was decided to avoid having any form of circuitry connected across the loudspeakers as it would inevitably detract from the speaker units under test.

Furthermore deriving a trigger signal for the anti-thump circuit and power source from the amplifier was also avoided as it would mean dismantling and groping deep into the depths of your prized amplifier.

A simple solution used in the switcher is to have the anti-thump detector circuit across the power amplifier output only for the switch-on period. The trigger signal is actually derived from the audio output of the left power amplifier. When power is applied to the switcher, the relay contacts

are configured so that the speakers are disconnected from the amplifier. At this point the anti-thump circuit is connected

across the amplifier output and waits for a signal. When a change of dc level or an audio signal exceeds the threshold level of

ETI — 1412 — HOW IT WORKS

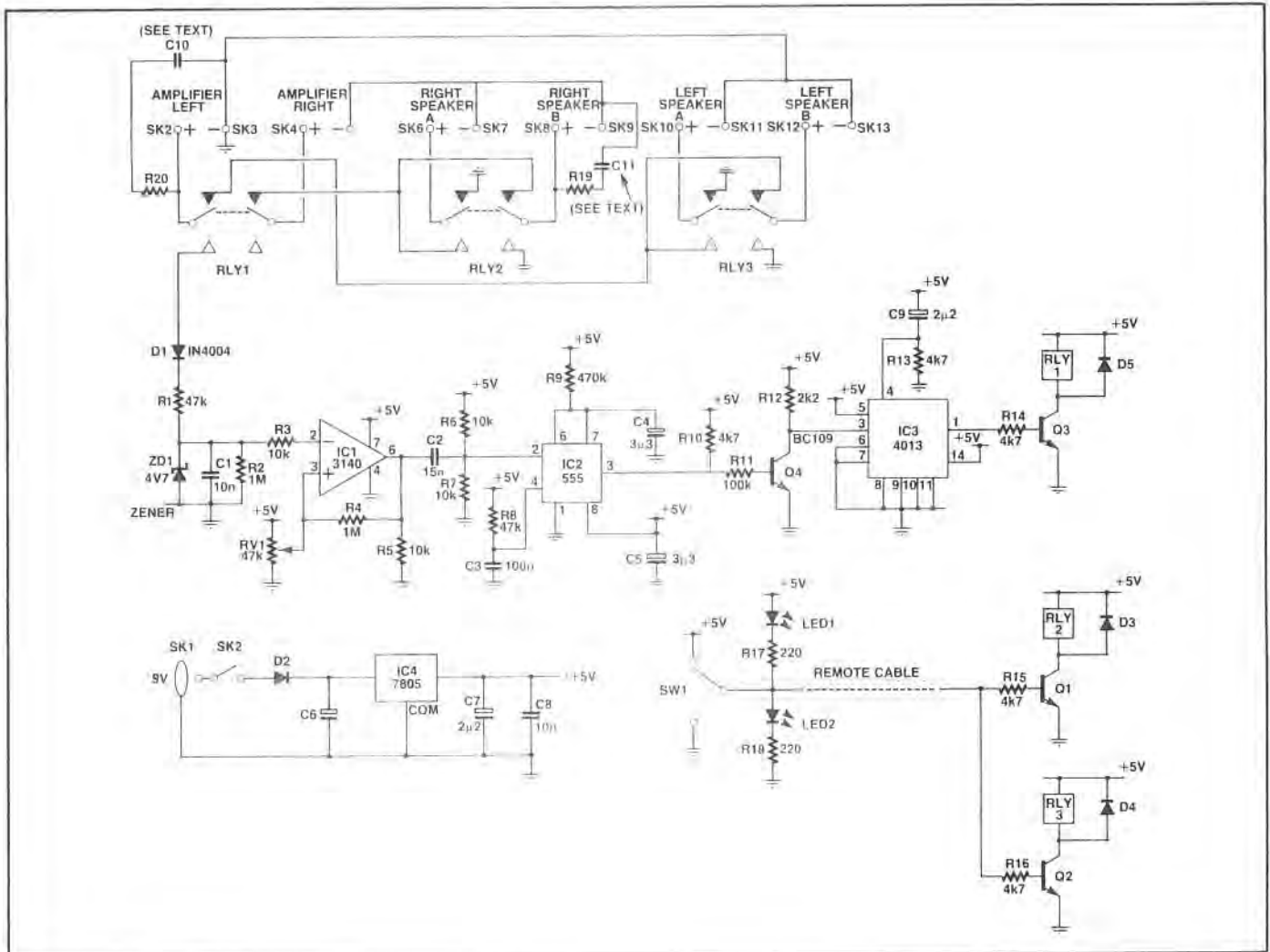
Relays RLY2 and RLY3 actuate the speaker switching from pair A to pair B and vice versa. The relays are configured to ground the speaker pair that is not selected to minimize crosstalk, eg, if pair A is selected then pair B is grounded. Q1 and Q2 are the transistor coil drivers of RLY2 and RLY3 respectively. The switching voltage is derived from SW1 in the remote control.

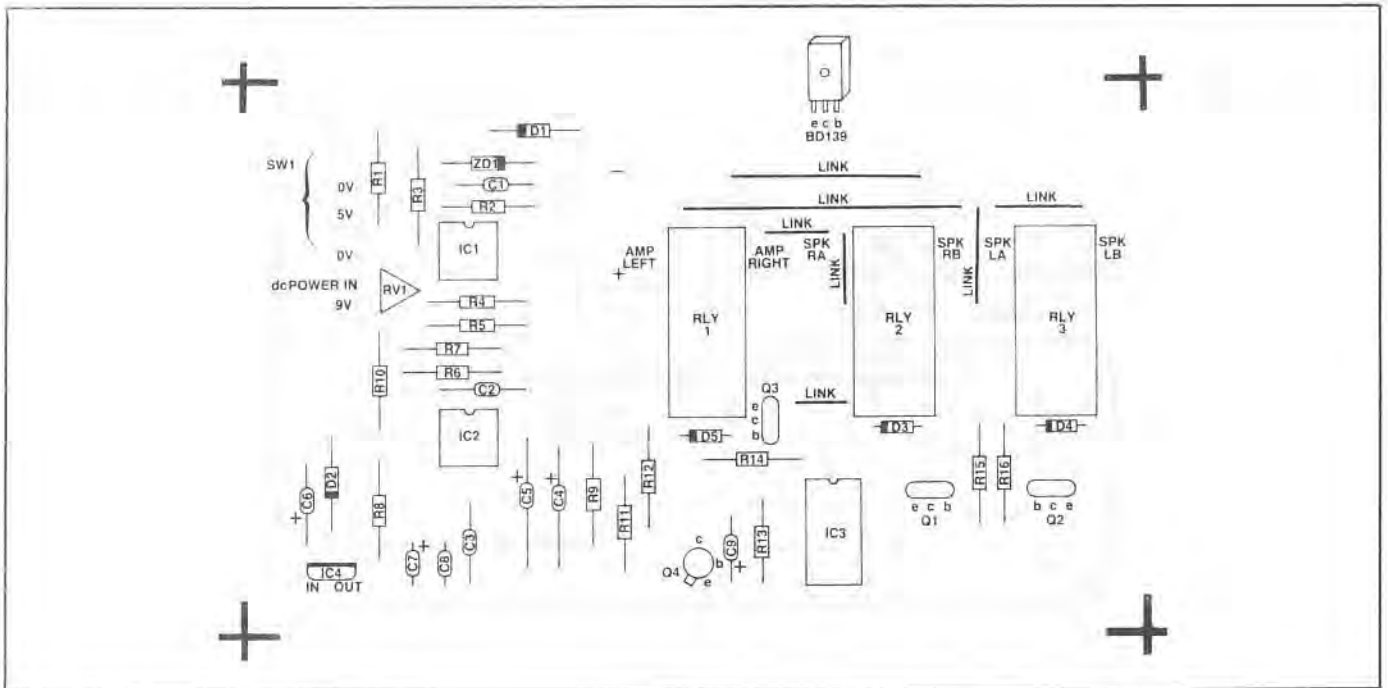
D1 is a half-wave rectifier and with C1 derives a dc signal from the output of the left amplifier to trigger the anti-thump. ZD1 clamps the voltage to 4.7 V for large voltage excursions. The rectified voltage is fed to IC1 which is configured as a Schmitt trigger.

The non-inverting input of IC1 has its threshold voltage varied by RV1. When the threshold level is exceeded the output of IC1 is driven low and triggers the 555 timer. When triggered, the timer will drive its out-

put (pin 3) to a high for the timing period of about 2 seconds in this case. The on period cannot be re-triggered until it times itself out and is determined by R9 and C4 (see text). On powering up C3 and R8 ensure that the 555 is reset. IC3 is a D-type flipflop and latches its output to a high when the timing period of the 555 expires. This in turn will drive Q2 on and switch over the relay contacts of RLY1. Once the flipflop is latched, the only means of resetting it would be to turn off the dc supply. On powering up the flipflop is reset by C9 and R13.

The dc supply is derived from a 9 V power pack and IC4 provides a 5 V regulated voltage rail. The switcher draws a maximum of around 210 mA and occurs when RLY1, RLY2 and RLY3 are driven on. D2 protects the circuit from power supply reversal.





ETI-1412 — PARTS LIST

Resistors all 1/4 W, 5%, unless noted	D3, 4, 5..... 1N4148
R1, 8..... 47k	Q1, Q2, Q3..... BD139
R2, 4..... 1M	Q4..... BC109 or equiv
R3, 5, 6, 7..... 10k	IC1..... 3140 FET input op-amp
R9..... 470k	IC2..... 555 timer
R10, 13, 14, 15, 16..... 4k7	IC3..... 4013B dual D flipflop
R11..... 100k	IC4..... 7805 5 V regulator
R12..... 2k2	Miscellaneous
R17, 18..... 220	RLY1, 2, 3..... pcb mounting DPDT 6 V, 5 A 72 ohm coil resistance (Fujitsu 621D006)
R19, 20..... 8R2 5 W (see text)	SW1..... miniature SPDT toggle
RV1..... 47k vertical preset	SW2..... miniature on-off toggle
Capacitors	SK1..... dc power socket (2.1 mm)
C1..... 10n greencap	SK2-SK13..... banana sockets or sockets of your choice:
C2..... 15n greencap	8-pin DIL IC socket, 2-off;
C3..... 100n greencap	14-pin DIL IC socket, 1-off
C4, 5..... 3µ3 electrolytic 25 V	ETI-1412 pcb; metal cabinet (185 x 70 x 160 mm); Zippy box (28 x 54 x 83 mm); 9 V plugpack 300 mA; loudspeaker cable; 6 m twin shielded cable; regulator clip-on; heatsink.
C6..... 220µ electrolytic 25 V	
C7, 9..... 2µ2 electrolytic 25 V	
C8..... 10n ceramic 25 V	
C10, 11..... 220n greencap	
Semiconductors	
LED1, 2..... 5 mm LED	
D1, 2..... 1N4004	
ZD1..... 4V7 Zener 1 W	

Price estimate: \$80
(excluding plugpack)

a Schmitt trigger things start to happen. A 555 timer will be triggered for around 2 seconds and when the delay period expires, the relay contacts will close and connect the amplifier output to the speakers. This should allow sufficient time for the various power supplies to complete charging their smoothing capacitors.

The anti-thump circuit is now set and can only be reset by turning off the power supply. In normal use this function is quite

adequate and resetting is only required when the audio system is switched off.

Construction

Building the switcher should not present any problems as most of the components, except for the remote control, are mounted on the pcb. Start by checking the board for bridged or broken tracks. Once you are satisfied that the board is acceptable, drill all the necessary holes, includ-

ing those for mounting.

Next insert and solder the links, resistors and capacitors, taking care to get the correct orientation of the electrolytics. The IC sockets come next. Make sure that they are pressed down properly on the board when soldering. Do not insert the ICs themselves until later on. Next proceed by mounting and soldering in the relays, RV1 and finally the diodes, transistors and regulators. Ensure that the polarity of the diodes is correct and that the transistors and the regulator are oriented the correct way. Refer to the component overlay.

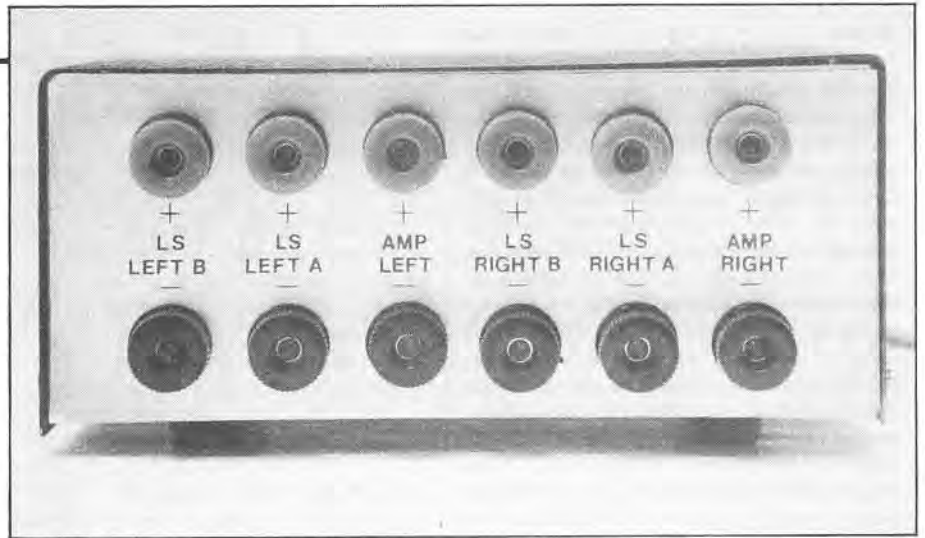
Tin the copper tracks of the relay connections to the amplifier and speaker as they will be carrying high currents under load.

Before the wiring to the pcb can be completed, the switch and sockets need to be mounted on the front and back panel of the box. I have opted to use banana sockets for the speaker and amplifier connections, however other socket types may be used. Starting with the back panel, drill the holes for the banana sockets or sockets of your choice. Then proceed with the holes for the on-off switch, dc power switch and remote cable on the front panel. Once that is done mount the sockets and switches into position. A clamping rubber grommet should be used to fasten the remote cable where it leaves the box.

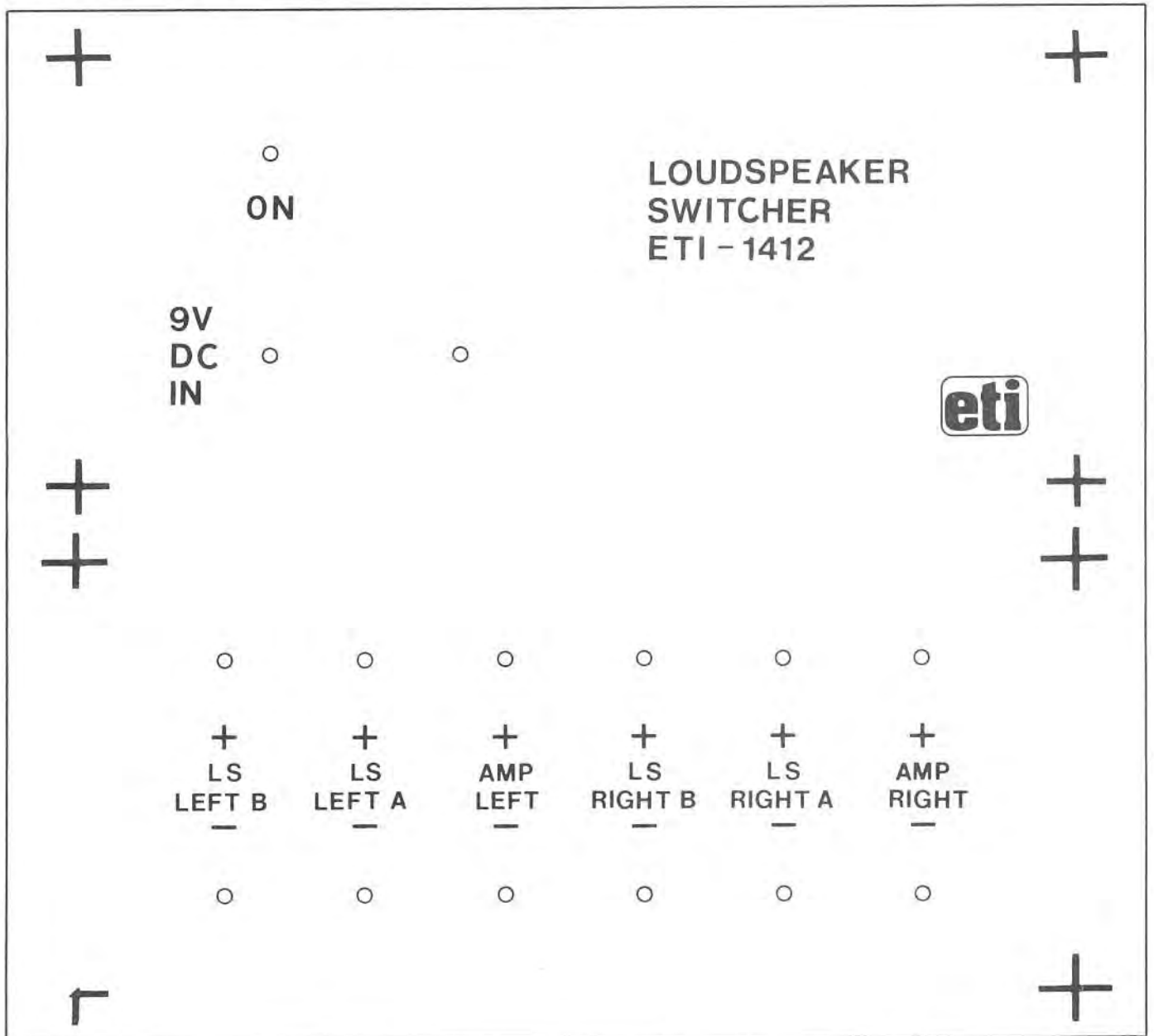
Use tinned copper wire (22 swg) to connect the negative terminal of the left amplifier to the negative end of the left A

and B loudspeaker at the sockets on the back panel. (Refer to the wiring diagram.) Similarly do the same for the right amplifier and right A and B speakers. It is important to ensure that the negative terminal of the left and right channels is not connected as unwanted hum-loops can develop. Also make sure that the correct polarities are observed. Use suitable loudspeaker cable for the speaker and amplifier to socket connections. Note that only the negative terminal of the left amplifier is connected to 0 V on the pcb. The on-off switch and plugpack dc socket can now be wired in.

The construction of the remote control can now be started. Drill the holes for the



Sockets on the rear panel.



Project 1412

selector switch and the two LEDs on the top plate of the box. Drill another hole on the side for the remote cable. Use a grommet or tie knot in the cable to fasten it down. I chose to use a twin screened cable with the outer braiding connected to 0 V; 6 m should be adequate for most applications. The writing can now be completed according to the wiring diagram.

The next exercise is to go back to the pcb and check it very carefully for dry joints and solder splashes, all of which are quite common even for the experienced constructor. It is important to check for short circuits in the vicinity of the amplifier and speaker connections as a simple solder splash can be an expensive one. Once you are convinced that all is well, insert the ICs into their sockets making sure of their correct orientation. Take the usual precautions with handling the CMOS devices.

Testing

Connect the 9 V plugpack and switch on the dc power switch. If the measured voltage rail is not within 800 mV of 5 V, disconnect the plugpack and re-check the circuit in the vicinity of the supply rail. If all is well, one LED on the remote will light and toggling the selector switch will toggle RLY2 and RLY3. The relay switching can be heard as the contacts change over.

Next, measure the dc voltage at pin 3 of IC1 and adjust RV1 for a reading of 600 mV on the multimeter. This is the maximum sensitivity for triggering the anti-thump circuitry. Connect the amplifier and speakers to the unit and once that is done, power up the amplifier with the volume control turned right down. Gradually increase the volume control, with a sound source connected to the amplifier, of course. When the signal level exceeds the threshold level, IC1 will trigger and start the delay time thereafter connecting the speakers. The sensitivity can be decreased by adjusting RV1 for a higher threshold voltage. If you want the time delay changed then it is a simple matter of changing the value of R9 or C4. The time delay is given by the equation: $t_d = 1.1 \cdot R \cdot C$.

Once the circuit is triggered it is time to use the switcher for switching. Toggling the switch on the remote should switch-over your speakers from pair A to pair B or vice versa. If not, then check your wiring to the back panel of the unit and then the amplifier and speaker connections.

The 5V regulator (IC4) will get warm as the circuit will draw around 210 mA when all the relays are driven on. A small heat-sink clip mounted on the regulator will help dissipate some of the heat.

A B

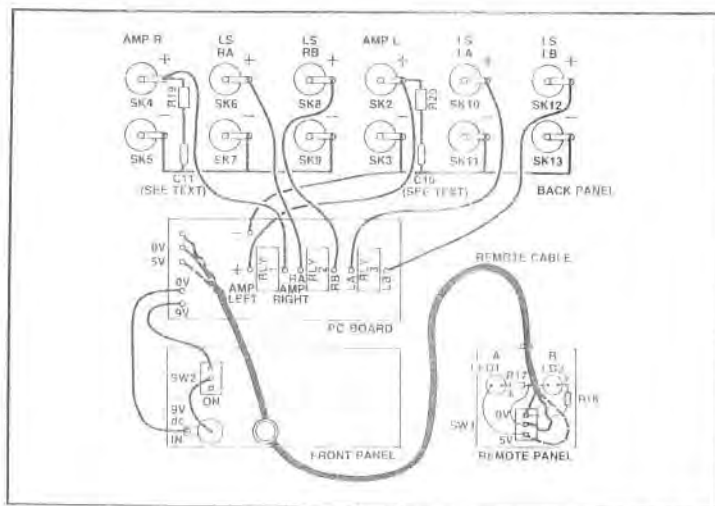
ETI-1412

In use

The switcher will cope with a maximum power rating of 100 W into 8 ohms per channel with the stated relays. We recommend you do not switch near or at full power due to the problems of switching highly inductive loads. It's far better to be safe than sorry. Furthermore the life ex-

pectancy of the relays tends to decrease when switching high currents.

Some switching noise will be apparent due to the switching of inductive loads and open-circuiting the amplifier outputs for the change-over period. For these reasons it is imperative to use an amplifier that remains stable under these conditions. Certain valve amplifiers, for example, will protest quite strongly by exterminating themselves under no load conditions. Also, avoid using ac coupled output amplifiers, remember them? The switching noise heralds itself as a click and is dependent on signal level, amplifier, cross-over and speaker type. As an option, connecting in R19, C11 and R20, C10 across the right and left amplifier respectively should help reduce the switching noise a little by introducing a load at high frequencies. These components can be mounted at the sockets on the back panel (see the wiring diagram). My colleagues and I felt quite strongly about having minimal additional circuitry in the audio path and at average listening levels the transient noise is negligible. ●



Wiring diagram.

The pc board inside the box.

