



ELECTRONICS
ETI - 1411

Professional studios use
headphone distribution
boxes — you can
make one to suit your
home studio needs.
Greg Simmons tells how.



There comes a time in the career of every ambitious home recordist when the need for more than one pair of headphones arises. Many home studios use domestic hi-fi amplifiers for driving the monitor speakers, which, typically, allows two pairs of headphones (one pair connected to

the mixer headphone output, and another pair connected to the headphone socket of the amplifier). Anyone with an electronics background will be able to wire more headphones into the system using a combination of series and parallel wiring. Unfortunately, this is often messy, time

HEADPHONE DISTRIBUTION BOX

A project for the home recordist

Headphone distribution box

consuming and generally not very satisfactory.

Professional studios use headphone distribution boxes which allow up to, say, six pairs of headphones to be connected to the speaker output of an amplifier. If the headphones used are all the same, each pair will receive the same level. If more than six pairs of headphones are needed, another distribution box can be connected to the amplifier.

Many studios use professional 50 to 100 watt amplifiers to drive the headphones(!). The average pair of headphones requires less than 1 watt for high listening levels, so you may wonder why studios use such high powered amps. The reasons for this are similar to the reasons why 20 to 30 watt reference monitors (Auratones, NS10s, etc.) are connected to high powered amplifiers.

Firstly, the headphone amplifier, like the monitor speaker amplifiers, is usually turned on at the start of the day's work and remains on until the studio is shut down for the night (or early morning!) Obviously, the amplifier must be able to withstand this long workload. A 50 watt amplifier delivering a few watts of power to headphones is not going to be working very hard, and there is less risk of it overheating and malfunctioning. In addition to this, there is little risk of amplifier clipping, since the amplifier is running well within its capabilities. Amplifier clipping is possibly the biggest cause of tweeter and headphone voice coil burn-out. It also makes things sound BAD.

Most home studios don't demand this much from their amplifiers, nor can they afford to buy a 50 or 100 watt amplifier for the headphone system.

The Sonics headphone distribution box allows six pairs of high impedance headphones (40 to 600 ohms) to be driven by a 20 to 40 watt amplifier, such as most domestic hi-fi amplifiers. It can be assembled in a few hours using parts that are readily available from electronic component suppliers including Jaycar, Dick Smith Electronics, David Reid Electronics, Tandy, etc. There is no printed circuit board needed, and the whole thing costs approximately \$35.00.

Circuit details

The circuit diagram is shown in Figure 1. The circuit is designed to drive up to six pairs of stereo headphones with impedances of 40 ohms or more. For best results use headphones of the same or similar impedance, ideally the same models.

The resistors labelled Rh form voltage dividers with the headphones, and protect the amplifier from being damaged. Even if all six headphones go short circuit, the amplifier never has to drive a load lower than 3 ohms per channel.

The resistors labelled RL ensure that with

no headphones plugged in, the amplifier is still connected to a load. Many amplifiers do not appreciate being turned on without a load connected to their outputs – I believe this can sometimes lead to amplifier damage, but I don't intend to prove it.

The circuit diagram shows the stereo

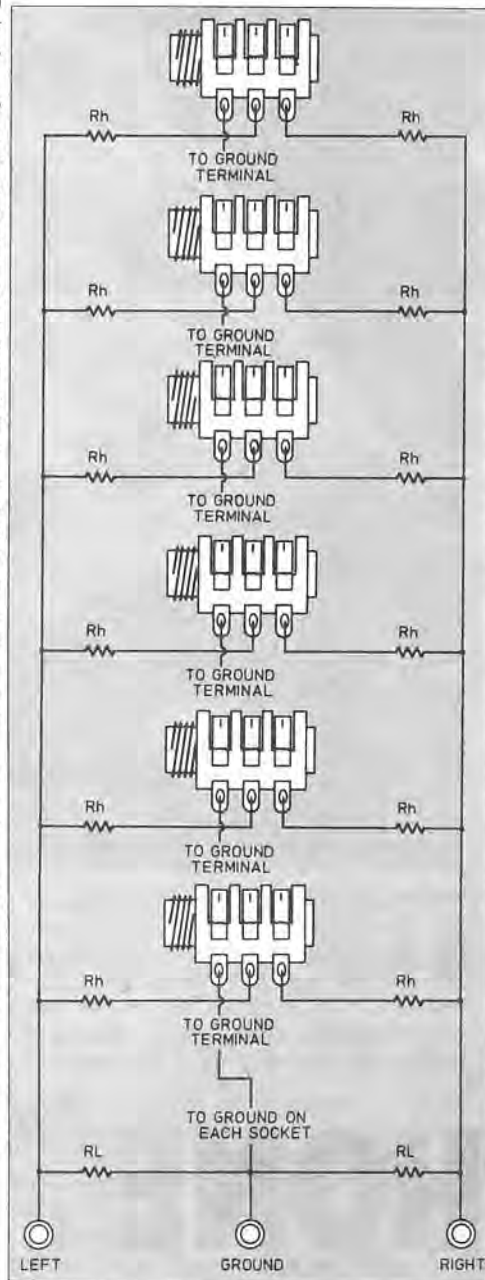


Figure 1: circuit diagram.

sockets as they appear in real life, simplifying the construction and (hopefully) ensuring that everything gets soldered in the right place.

Construction

The unit is housed in a plastic 'zippy' box approximately 11 cm x 20 cm x 6 cm. Since a headphone distribution box spends most of its time on the floor, you may want to build

it into a tougher metal or diecast box. If so, make sure the sockets, terminals and wiring are electrically insulated from the box, or else you may create a short circuit and damage the amplifier.

All sockets and terminals in the prototype were mounted on the bottom of the box, as this is much more rigid than the lid. Start by marking out and drilling all the holes. The template provided in this article will make the job easier, and also serves as a front panel. Just photocopy it, cut it out and fix it to the box with a thin smear of glue (I used a 'UHU' glue stick). Make sure the entire template is glued down, not just the edges, or else the holes will not be accurate. Drill small pilot holes first, and don't push the drill too hard or else it will damage the edges of the holes when it comes through the other side, and may also tear the template (you did use a photocopy, didn't you?) After the holes are drilled, clean up the edges and put a layer of clear self-adhesive contact onto the front panel. This will protect the template and provide a durable finish. Use a scalpel or blade to cut the appropriate holes in the contact for the sockets and terminals to go through.

The prototype uses stereo 6.35 mm sockets, available from Jaycar. They are made from black or coloured plastic, with three metal strips across them that serve as contacts. These particular sockets make it easy to see what contact connects to which part of the headphone plug. Being plastic, they can also be used in metal boxes with no insulation problems.

Figure 2 shows the bottom of one of these connectors. Underneath, you will find six terminals, a row of three on each side. Make sure you use the row that connects to the long strips across the top of the connectors. (The terminals that connect to the short strips are used for switching only, and do not connect to anything when the plug is in the socket.) If you use a different type of stereo 6.35 mm socket, you may have to use a multimeter to find out which terminals connect to the left, right and ground connections of the plug. Sometimes you can work this out by carefully studying the construction of the socket.

The next step is to solder the components onto the connectors. The easiest way to do this is to mount the stereo sockets upside down, so that the sockets are on the outside of the box. You can now solder all the components in place with relative ease (don't make any connections to the three 'speaker' terminals yet). Solder the components to the contacts on the stereo sockets exactly as shown in the circuit diagram.

Once everything is soldered in place, unscrew the 6.35 mm sockets and carefully mount the completed circuit inside the box.

The prototype uses three 4 mm 'banana'

terminals for the connections from the amplifier, each one a different colour – white for left, black for ground and red for right. Put the three terminals in place and make the final three connections to them. (You may want to use a 3-pin XLR connector, or a stereo 6.35mm socket instead.) Double-check your workmanship, screw the lid on, and you're ready to test it.

Testing

Connect the headphone distribution box to a 20 to 40 watt amplifier with a length of 3-core power lead, or two lengths of 2-core speaker wire (avoid using shielded signal cable). Make sure the amplifier is turned off while doing this.

Most amplifiers have four terminals for speaker connections. Two of these will be for ground, or negative, usually marked with a '-' symbol. To connect the distribution box, you must link the two ground terminals together on the back of the amplifier, as shown in Figure 3. These terminals are often linked together inside the amplifier. There are four terminals because each speaker has its own speaker lead, and each lead must have a ground connection.

With headphones, there is only one lead from the amplifier, and since the ground is common to both channels, only three connections are used. (Some amplifiers have

totally separate power supplies for each channel, and linking the grounds may degrade performance a little. Fortunately, these amplifiers are generally high powered and unlikely to find themselves being used for headphone amplifiers in home studios. If you're uncertain, consult the owner's manual or a service centre.)

With the connections made, turn the amplifier volume down to minimum and switch it on. Plug some headphones into the box, apply a stereo signal to the amplifier, and slowly bring up the volume until you get a decent monitoring level with no signs of distortion and a good stereo balance. If not, you may have to check the wiring. If anything starts to smoke you have certainly made a wrong connection somewhere! You have my sympathy.

If you cannot get enough level, and all the wiring and soldering proves to be correct, you are probably using very low impedance headphones, less than 40 ohms. Although the distribution box is not designed for this, using a higher powered amplifier might solve the problem. Be careful when you first try it out, though...

In use

For best performance use headphones of similar impedance. The circuit is designed so

PARTS LIST — ETI-1411

12 x 18 ohm, 5 watt resistors (Rh)
2 x 100 ohm, 5 watt resistors (RL)
6 x stereo 6.35mm sockets (see text)
3 x 4mm 'banana' sockets (see text)
1 x 'Zippy' box – 11cm x 20cm x 6cm
1 x 20cm length white hookup wire
1 x 20cm length black hookup wire
1 x 20cm length red hookup wire
1 x 3m length 3-core power lead

that plugging in an additional set of headphones should not noticeably affect the level of those already connected. Using different impedance headphones may result in different levels, and it will be necessary to find a compromise amplifier volume setting. Try giving the louder headphones to the drummer and bass player – that should keep everyone happy.

Most home studio mixers provide a mono foldback/headphone signal. If so, be sure to connect the appropriate mixer output to both left and right inputs of the amplifier, otherwise you will only have signal in one side of the headphones. Alternatively, if the amplifier has a mono switch, use this instead. Hopefully, all has gone well and you are now the proud owner of a sonics headphone distribution box. Happy headphone monitoring!

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USE THESE THREE CONTACTS ONLY!

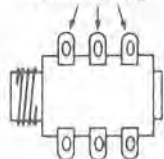


Figure 2: view of stereo socket from underneath.

SPEAKER TERMINALS ON REAR OF AMPLIFIER

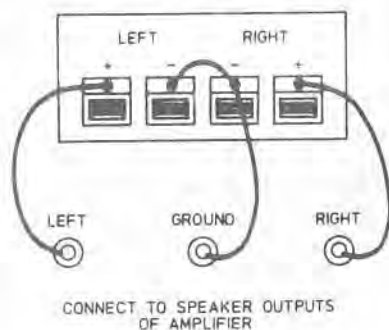


Figure 3: connections from stereo amplifier to headphone box. (Note the link between the negative terminals of the amplifier).

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