Headphone Adaptor for Power Amplifiers

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Introduction

This simple project is nothing more than a handful of resistors and a double pole, double throw switch, but will reduce the output of almost any amplifier to a nominal level of 5V RMS, and maintains the recommended 120Ω source impedance. This is designed to suit most headphones currently made, as they are generally designed to operate from that impedance.

Naturally, this is not always suitable (some manufacturers have chosen not to adopt the standard for one reason or another), but will suit most headphones very well.

The level of 5V RMS was chosen to ensure that the power amplifier will not clip when driving the headphones, but is much too high for normal listening. As always, you may make changes to suit your preferences, but be aware that nearly all headphones are capable of sound levels that will cause permanent hearing damage, so always be mindful of this.

Warning: This unit is not designed to be used with bridged amplifiers! If there is a warning on your amp that states that the -ve speaker terminals must not be grounded, then you must not connect this adaptor, or the amplifier will be damaged. If in doubt, find out first from the manufacturer or distributor - assumptions can be very costly!

Description

The project could not be simpler - it basically consists of a switch to disable the main speakers, and the attenuator to set the correct level and impedance. Figure 1 shows the circuit diagram of a single channel, and this is duplicated for the second channel.

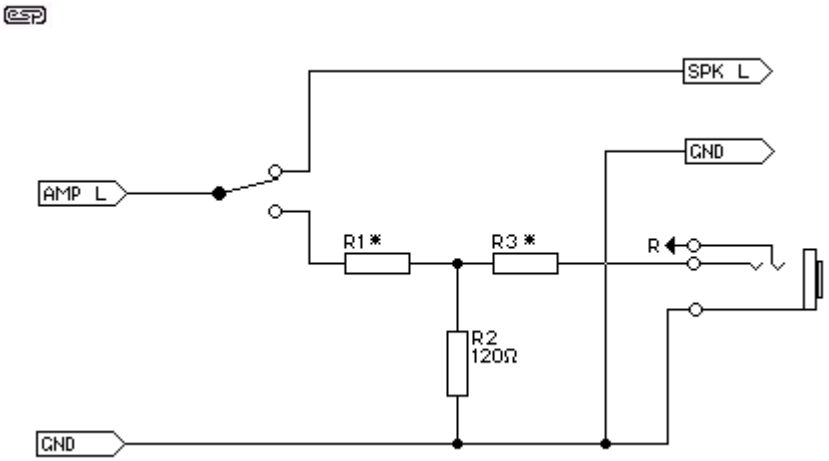

Figure 1 - Schematic for One Channel

The only hard part in all of this is choosing the resistor values that will give you as close as possible to the correct voltage and impedance for all typical amplifier powers. Table 1 saves you the tedium of working this out, and all attenuators use standard value resistors. The nominal voltage and actual output impedance are also shown, and as you can see, the variation is very small.

Power - 8Ω	R1	R3	Z_{out}	V_{out}	R1 Power
20 W	180Ω	47Ω	119Ω	5.2	0.33 - 0.5W
30 W	270Ω	47Ω	122Ω	4.9	0.47 - 0.5W
40 W	330Ω	33Ω	121Ω	4.8	0.54 - 1W
65 W	470Ω	22Ω	118Ω	4.7	0.74 - 1W
100 W	560Ω	22Ω	121Ω	4.9	0.95 - 1W
150 W	680Ω	18Ω	120Ω	5.7	1.37 - 2W
250 W	1kΩ	12Ω	119Ω	5.1	1.79 - 2W

Table 1 - Resistor Values for Different Power Amplifiers

The table shows the nominal amp power (8 ohms), and the values for R1 and R3 (marked with a * in the schematic). The actual voltage available to the headphones is also shown (V_{out}) as is the maximum power for R1 and the recommended power rating for that resistor. R2 is fixed at 120Ω for all power levels. Should you need more (or less signal) for your headphones, you may simply use the values for the next lower (or higher) amplifier power. For example, if your amp is 60W and you want less level for the headphones, use the values for a 100W amp.

Construction

To construct the circuit, you will need a double pole, double throw switch to disconnect the speakers, assuming that this is not already available. Do not be tempted to use a rotary switch, unless it is rated for the maximum amplifier output current - most are not. A heavy duty toggle or rocker switch is recommended, with a minimum current rating of 10A.

As shown, when the speakers are disconnected, the headphone adaptor is connected and vice versa. This prevents power being fed to headphones for no good reason, and also prevents "extraneous" sound when you are listening to the speakers. The entire adaptor may be installed in a separate box, with a speaker switch, headphone socket(s) and speaker in and out connectors.

This approach is assumed in the schematic, and will generally be the easiest way to provide headphone capabilities for an amplifier that does not have this ability. If more than one set of headphones is required, you must use a separate attenuator for each output - do not simply parallel headphones.

The "tip" of a stereo phone plug is the Left channel, the ring is the Right channel and the sleeve is Earth (Ground). If your amplifier has a balance control, you can check that the jack(s) are correctly wired by using the balance control to mute one channel.

Testing

Before connecting the unit to your amplifier, make sure that there are no wiring faults that present a short to the amplifier terminals. This can be tested with a multimeter, and you should also verify that the switch connects and disconnects the headphone attenuators and speakers in the correct manner.

The real test is to connect your amplifier and headphones, and verify that the level is correct, and that everything works as it should. This must not be done until you have checked your wiring thoroughly, and verified that there are no shorts - especially across the speaker leads!

Note: In use, make sure that the amplifier volume is set *low* to start with. Headphones vary considerably in impedance and sensitivity, and it is virtually impossible to determine the correct setting in advance.

It is very important that you always maintain a safe listening level - as stated above, headphones can produce extremely high SPL (Sound Pressure Level) - more than sufficient to cause permanent irreparable hearing damage!