Signal Detecting Auto Power-On Unit

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Introduction

How many times have you wished that there was a simple way to turn on that sub-woofer or some other piece of audio equipment, simply by sending it a signal? This ability is fairly common in commercial subs and some other gear, but there seems to be a complete absence of circuits on the net, and they seem completely unavailable as an add-on device.

The circuit presented here will operate with a signal of 10mV, which will be adequate for all but the quietest listening. Even then, 10mV represents a typical power of about 12mW into a typical amp and 8 Ohm speaker. It is possible to make it more sensitive - I tested it to 1mV, but at this level even tiny amounts of mains hum or other noise will trigger the circuit.

Using cheap and readily available parts, the unit will switch the most powerful amplifier, as long as you select the correct relay. By using a small relay to operate a larger one, you could switch anything you wanted to, so there are few limits.

WARNING: This circuit requires experience with mains wiring. Do not attempt construction unless experienced and capable. Death or serious injury may result from incorrect wiring.

Description

The switch detector unit is shown in Figure 1, and uses a dual opamp (LM1458 or equivalent), and a handful of other parts. The relay switching device is a MOSFET, selected because of the almost infinite input resistance. The MTP3055 shown was used because it has a threshold voltage of about 3V and is fairly cheap, but any device with a similar gate threshold voltage will work just as well.

The circuit uses a 1/2 voltage line (R8, R10 and C3, nominally +6V) to bias the opamp inputs and provide a comparator reference voltage. Since the same supply is used for both, regulation is not required as any variation will be applied both to opamp input and comparator, so the two will track properly over a wide voltage range.

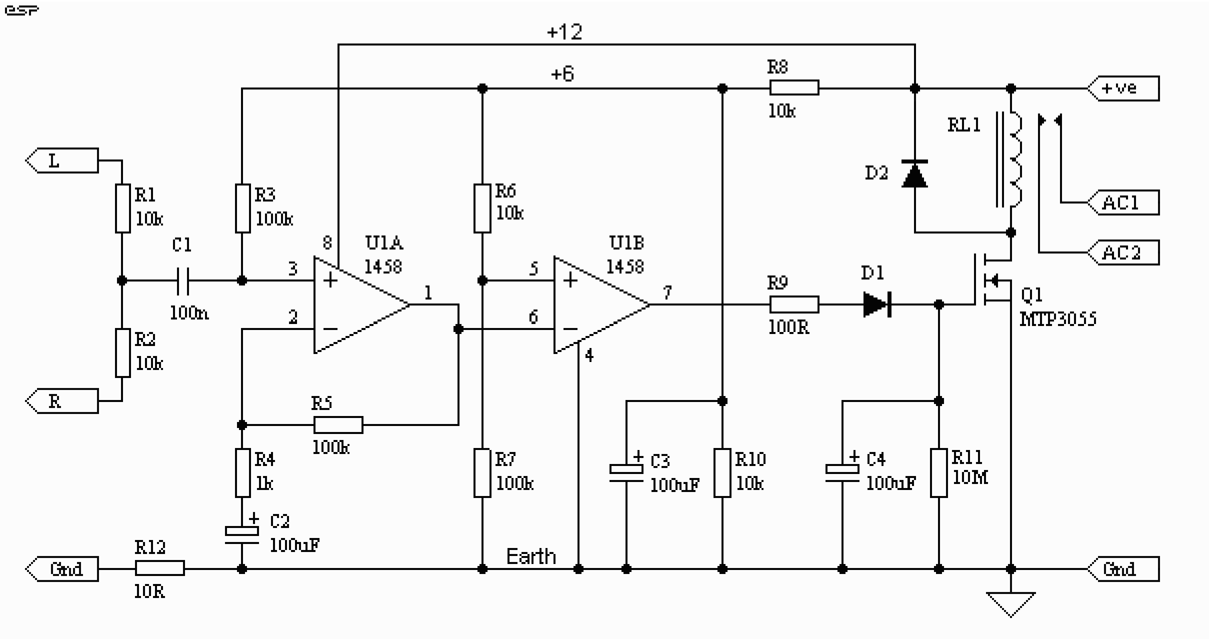

Figure 1 - Audio Detector And Switching Circuit

A signal feed is taken from both Left and Right channels via R1 and R2 (leave out one input resistor for a mono source such as a sub-woofer). This is amplified by 100 by U1A, and the output is supplied to the comparator U1B. When the amplified signal exceeds the comparator threshold of about 0.5V, the output of U1B goes high momentarily, and starts charging C4. After a few cycles, Q1 turns on and energises the relay.

Should it be found that the circuit is too sensitive, increase the value of R6 - this makes the comparator less sensitive, so more signal will be needed. Likewise, to increase sensitivity reduce the value of R6 - use a 20k trimpot for a useful sensitivity range.

Note that the above circuit is intended for signal levels, *NOT* speaker level. If the signal to be switched is speaker level, it must first be attenuated so that even at full power, no more than about 2 Volts is applied to the circuit inputs. High signal levels may destroy the input circuit of the opamp. See Figure 4 for a modified version of the input stage for speaker level signals.

After the audio signal is removed, it will take some time for C4 to discharge through R11, and after about 20 minutes Q1 will switch off again, and disconnect power from the amplifier. The time can be varied by changing either C4 or R11 - increase either to make the time longer, or vice versa. Note that even small amounts of leakage on a circuit board will reduce the time delay, so the junction of the gate of Q1, anode of D1 C4 and R11 can be "skyhooked", or suspended in air.

The diodes can be 1N4148 or 1N4004 types, whichever is the easiest to find (or is already at hand). They are not critical, so other types may be just as suitable (I shall leave this to the reader).

When I tested the circuit, I tried a 100nF cap to the gate (instead of 100uF), and no discharge resistor. I got tired of waiting for the relay to release, so it is possible to get very long (but unpredictable) times even with small capacitance values.

If this unit is to be used to power existing equipment and will be in its own casing, use the input circuit shown in Figure 2 to allow the signal to pass through the switching unit. There are no electronics in the signal path, so the signal will not be impaired in any way. The 10k input resistors may introduce some crosstalk if the drive amp has high output impedance, but this is unlikely to cause a problem with the majority of preamps. If you have a valve preamp with an output impedance of more than 1k Ohm, you might want to use only one input and leave the other disconnected.

An alternative is to increase the value of the resistors (R1 and R2), but bear in mind that this will reduce the system's sensitivity. It might be necessary to increase the gain of U1A (reduce R4) to compensate, as well as install a 20k trimpot in place of R6 (Figure 1) to allow you to set the sensitivity.

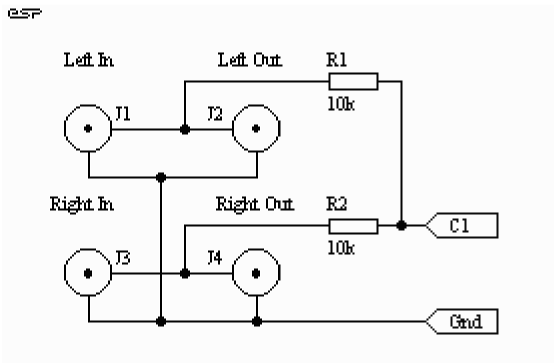

Figure 2 - Pass Through Input Circuit

Note: The point marked "C1" on this circuit connects to C1 in Figure 1. R1 and R2 in this diagram are the same as in Figure 1 and not an addition.

Power Supply And Mains Switching

The power supply for this circuit must be on permanently (predictably), so I suggest that a quality transformer be used to prevent the possibility of fire or other failure. This point cannot be overlooked, as a cheap tranny will not have the build quality of a good one and may pose a genuine hazard. A transformer with an integral thermal fuse provides added peace of mind.

Having said this, the supply is very simple. It does not need to be regulated, and the detector will work quite happily from 9 to 15 Volts. A plug-pack ("wall-wart") supply is quite suitable, and most of these are well protected against internal failure. Since it expected that a 12V relay (coil voltage) will be the most commonly available, I suggest a supply of 12V. The relay must have contacts rated at the full mains voltage (240 or 110 VAC, as appropriate), and with sufficient current rating to suit the amplifier being powered. Typically a 5 or 10A relay will be more than sufficient, but bear in mind that some large power amps draw a massive current when switched on, so make sure that the relay is capable of high surge current (most are, but if you are not sure, ask your parts dealer for advice).

The bridge rectifier shown can be made using 1N4004 type diodes, as the current is low and standard diodes will be quite satisfactory. A 1A bridge rectifier will be more than sufficient to power the circuit.

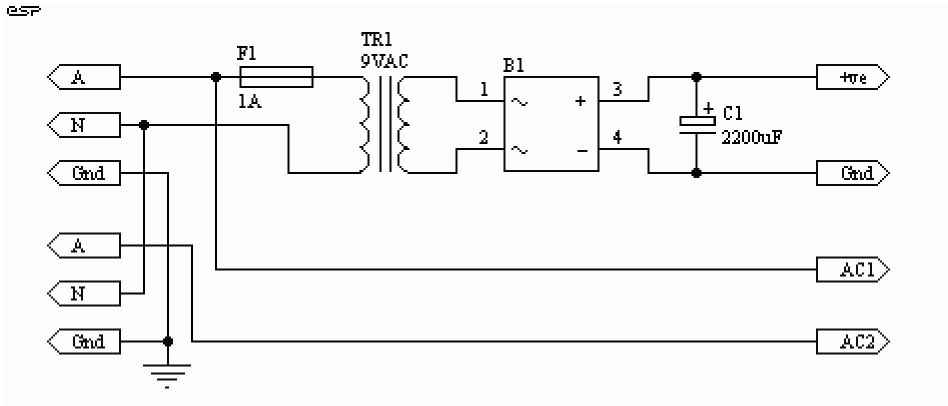

Figure 3 - Power Supply And Mains Switching

All mains wiring must be done using approved mains cable (i.e. do not use hook-up wire), and any exposed terminals must be securely shrouded using heatshrink tubing or similar. Do not use insulation tape, as this has a tendency to come undone and leaves sticky stuff all over everything. Use an approved mains outlet if the unit is to be used as a peripheral device to existing equipment. In this case, see Figure 2 for pass through connector wiring.

Make sure that mains wiring is properly separated from input wiring and other low voltage wiring. The relay must be mounted securely, and well away from the signal input wiring. The terminal marked "A" is the active or hot mains lead, and as seen goes to the transformer (via the fuse) and to the normally open switching contacts on the relay. The neutral lead is connected to the transformer, and to the outlet (lower three connections on the left of the diagram). The earth (ground) must be connected to prevent electric shock, and is connected to the chassis (assuming a metal case). If a plastic case is used, the earth should be connected to the case of the transformer.

The secondary circuitry (after the transformer) does not need to be connected to earth, however it is far safer to do so. The 10 Ohm resistor (R12 in Figure 1) is designed to prevent any earth loop hum, so connecting the secondary circuitry to mains earth will not cause a problem with hum or other noise.

Speaker Signal Powering

If the unit is to be operated by detecting speaker level signals, some changes are needed to the front-end circuitry. The level must be reduced, and protection is needed for the opamp input, otherwise the high signal level would damage the opamp. Figure 4 shows the needed changes.

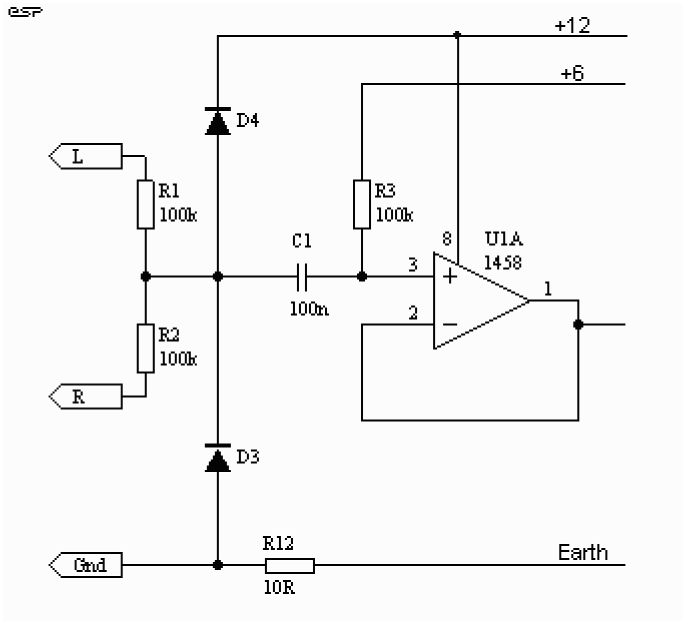

Figure 4 - Input Circuit For Speaker Input

The diodes will prevent high level signals from causing damage, and the signal is attenuated and current limited by using 100k input resistors. The opamp is run with no gain, and could be dispensed with, but to keep the circuit as flexible as possible I decided to leave it in. Diodes are 1N4148 or 1N4004.

The supply connections are as shown, and the opamp output goes directly to pin 6 as before.