

## DETAILS OF THE PARTS ON THE PARTS LIST

**THE BOX:** You can use any type or size to suit your ability and the size of components that are available to you. Just be careful if you are using a metal box e.g. an Altoids box. You have to take extra care to see that the unconnected components are properly insulated from each other.

**THE PAM8610 AMPLIFIER MODULE:** There are two types of these modules available on Ebay. One is mounted on a black PCB (Shown in my Parts List) and the other is mounted on a red PCB (shown in the picture below). I have both, but I selected the first one for this project because it is more flexible to use. The other one has all the components in fixed positions.

The first question I can expect from anyone who knows even a little electronics is "This is a 20W amplifier (2 x 10W). There should be a lot of heat generated. Why are there no ventilation holes and a huge heat-sink?". The answer is, this is a Class D amplifier. The output stage uses MOSFETs, driven by a pulse width modulated (PWM) audio signal, which switches them from full conduction to cut-off. At no point are they in any intermediate state when current is drawn; therefore (theoretically) no heat is generated. In practice, my amplifier (using 6 Ohm speakers), running at three-quarter volume for half a day only got very slightly hot.

For a nice, practical explanation and no complicated theory on Class D amplifiers please see one of my favourite websites: <http://sound.westhost.com/articles/pwm.htm>

For beginners who don't understand the theory behind Class D amplifiers and for those who don't want to understand it, don't worry your amplifier will work just as well. Just follow the instructions.

I have attached the IC specifications (PDF) for reference. On the right are the specifications for the PAM8610 Amplifier Module.



If you intend to use 4 Ohm speakers in order to get the full 2 x 15W power, you

can make your own heatsink or do a search for "Raspberry Pi heatsink" on Ebay. You get a set of 3 pcs (different sizes) for around USD 0.99 (you don't need the fan). The picture on the left gives you a reference for the required heatsink size.

### PAM8610 2\*15W Dual Channel Stereo Class D Amplifier Board 12V

#### Features

- Working mode: Class D (PWM modulation type)
- Chip type: PAM8610
- Power Range: DC 6V-15V (self-protection)
- Recommended voltage: DC 12V(2A)
- Output Power: 10W x 2(8Ω) 15Wx2(4Ω)
- Frequency Response: 20HZ-15KHZ
- Static Current:20MA (DC12V)
- SNR:90% Recommended
- Speakers:10-100W
- Input impedance: 15K
- Output impedance: 4-8Ω
- Harmonic distortion: <0.1%
- Size:28x22x2.5mm

Here is some general information on speaker system impedances based on my experience:

**8 Ohm Speaker Systems:** These were generally used in the older type home audio systems made up of individual components i.e. amplifier, tuner, disk player etc. They are still in use these days, but are not so common.

**6 Ohm Speaker Systems:** Commonly used in low-cost Mini/Midi and compact home theatre surround sound systems, usually including a built-in DVD or Blu-ray player. The problem with some of these systems is that when they breakdown they are cheaper to replace than to repair. You have to look upon this as a good opportunity for you to "help" your friends/relatives dispose of their old defective systems. You gain for yourself six new reasonably good speakers (one pair front speakers, one pair rear speakers, one sub-woofer and one centre speaker). By the way, this is how I came by my own 6 Ohm set!

**4 Ohm Speaker Systems:** These are usually found in car audio systems, so if you find one of these you will have to build your own cabinet. If you are lucky you may find a set that was used in a home audio system.

**THE 50K + 50K DUAL POTENTIOMETER (Pot):** I have used the sealed version of the Pot. They are slightly more expensive, but they last much longer than other versions. If you are ordering from Ebay look

for "50K + 50K Dual Potentiometer seal". On a quick search I saw two types: a Linear Pot (B50K or 50KB) and a Log Pot (A50K or 50KA). "B" indicates Linear "A" indicates Log.

You can use either type, but if you are going to do more audio projects I would recommend getting the Log type for volume controls. A very simplified explanation for this is that human hearing is non-linear in character. The Log Pot is designed so that it follows this characteristic. This means that when the volume control is set to mid-way, we hear half the volume of the amplifier, at full clockwise, we hear the maximum volume.

If you use a Linear Pot, you will hear about 3/4 of the volume at the midpoint of the volume control and beyond that there is very little change in volume. This is OK for normal use once you accept the theory, but if you still want the Log effect and you only have a Linear Pot, there is an option for modifying it to operate like a Log Pot. According to theory, if you add a resistor of 20% or 25% of the value of the Pot between the centre pin and ground, the Linear Pot behaves like a Log Pot. You will need two resistors (around 10K to 12K each for the dual 50K Pot). More details here: <http://sound.westhost.com/pots.htm> under the section "Changing the Law of a Pot". There is also some good info on Pots for beginners.

**THE KNOB:** Use a knob with a wider skirt at the lower end. This helps cover the the nut that holds the Volume Pot to the casing - for a neater finish. Choose the colour to suit your colour scheme.

**THE POWER SWITCH:** Since you need only two connections on the Power On-Off switch, an SPST (Single Pole - Single Throw) switch can be used if available.

**THE STEREO AUDIO JACK SOCKET:** I am using the 3.5mm panel mounted version for easy mounting. The number of contacts on these sockets vary a lot. I will show you how to identify the contacts you need in the following sections.

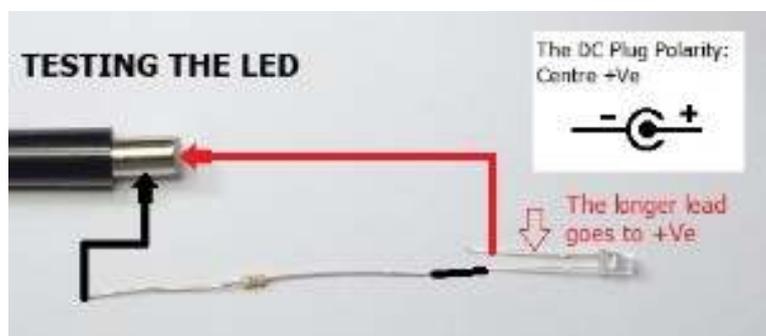
**THE DC JACK SOCKET:** Again, I am using the panel mounting type for easy mounting. I will explain how to identify the terminals in the next section.

**THE 10µF 25V ELECTROLYTIC CAPACITORS:** Try to get the smallest size you can find, so that you have more space to mount them.

**THE SPEAKER TERMINAL BLOCK:** I was not able to get a four terminal block at my local market, so I used two 2-terminal blocks. They are interlocking so when put together they look like one 4-terminal block.

**THE LED AND CURRENT LIMITING RESISTOR:** Please choose the LED colour of your preference. I wanted to have a blue theme, so I chose a blue LED, blue knob top and blue speaker terminals.

When calculating the current limiting resistor value please note that blue and white LEDs have a 3.3V drop across them whereas all other colours have around 1.7V. In my case the calculated resistor value was 470 Ohms  $((12-3.3)/0.02)$ , but on testing, I found that the LED was too bright, so I increased the resistor value till I reached reasonable brightness at 4.7K. This will vary for other colour LEDs. A good start is at the calculated value then increase the resistance progressively till you reach a brightness you like. If you want the light to be slightly diffused, rub the front surface of the LED with emery paper starting with a fine grade (180) and test using the selected resistor and a 12V supply (see the picture) till you are happy with your diffused effect.

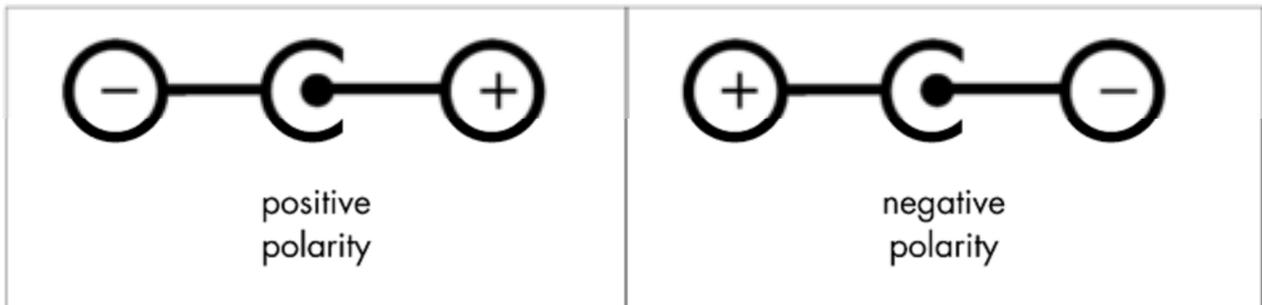


**THE 12V AC ADAPTOR:** The recommended rating for the AC Adaptor is 12V 2A (or 2000mA). You may find one around your home. If you can't find a 12V 2A adaptor, 12V 1.5A (or 1500mA) should do fine for testing and mid-level listening.

Another thing to look out for is plug polarity. The standard black-tip DC plug comes in two variations: Positive polarity and Negative polarity. The polarity is printed on the label on the Adaptor. Look out for one

of the symbols shown in the picture below. The type you use doesn't really matter, but **once you wire your amplifier for one type, you can't use the other**. More about this and how to protect your Amplifier from (fatal) accidental reverse polarity is available in the main text. I have also included here, a picture of the polarity on the actual plug for clarification.

## AC Adaptor Polarity Identifier



## AC ADAPTOR PLUG POLARITY

