Audio Amplifier Power Supplies

The low power amplifier modules are mostly aimed at car audio applications by the manufacturers, and are therefore designed to work well from a 12V D.C. power source. Obviously a car battery is a good low impedance, low noise, high current supply, although some care needs to be taken to avoid other noise sources in an automotive environment. The main areas for the introduction of noise are via the supply and earth leads, and ignition radiation. Resistive spark plug leads and/or resistive spark plugs are usually sufficient to reduce ignition noise, and proper supply leads will minimise noise currents. Car audio noise filters are readily available, but it is often better to provide suitably large supply cables directly from the battery to the amplifier and music source. Pay careful attention to grounding, do not assume a wire placed under a nearby bolthead will be sufficient. Make sure the amplifier and source earths are well connected, especially when the amplifier is located some distance from the source.

These general points still apply when using a mains supply, however there are a number of other considerations you need to consider. A transformer and rectifier combination has a very large ripple voltage. The peak value must be below the absolute maximum voltage stated for the module. Remember that a transformer output will be higher than it's rated AC voltage when it is supplying much less than it's rated current. Also the rectified peak value will be approximately 1.4 times the specified AC voltage. To reduce the ripple voltage, a suitably large value of capacitance must be added to the rectifier output. The no load peak voltage will still be the same, however the capacitor will maintain the voltage at the point where the transformer output dips to zero. If the capacitor was sufficiently large, the voltage would dip very little, even when fully loaded. This can be difficult or costly to achieve, so some compromise may have to be made. One solution is to regulate the supply using an IC or discrete regulator. The drawback is the extra expense of the regulator, and a larger supply is required to counter the power lost in the regulator as extra heat. For these reasons a regulator is not often used for high power amplifiers, however you may consider this option for lower power requirements, especially if mains hum is a problem.

The current requirements for each kit are somewhat flexible. The continuous power available from the supply must be greater than the continuous power required from the amplifier, plus all the power lost throughout the circuit, mostly as heat. In general you can not expect much more than 50 – 60% conversion efficiency for an audio amplifier, so a continuous power output of 3 watts for example from a 12V source would require about ½ Amp D.C. supply, or 1A for stereo. Possibly more depending on actual load. However the peak currents will be higher still, and need to be allowed for. The initial charging current for large values of capacitance can be a major problem. Care is required to make sure the rectifier can handle the short term peak current, as well as the transformer and any fuses. However the average current is usually less of a problem due to the inherent nature of music. The average power necessary to drive a speaker will be in the order of 1/10th the peak value, if clipping is to be avoided. And clipping ***Should*** be avoided at all costs. Not only will the distortion sound bad, but the compression caused can lead to tweeter damage if sustained. Remember that most tweeters can handle only a few watts of real continuous power. Fortunately they are not usually required to handle any more. For these reasons one must be very careful when testing using continuous waveforms rather than music.

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A suitable low cost power supply for 12V modules can be made from a car battery charger. These are often available more cheaply than a similar sized transformer alone. The common 4A types could power a pair of modules like our kit 143. It is important to check however that full wave rectification is used, or hum will surely be evident. It will also be necessary to add a large enough value of capacitance, as this is unnecessary for battery charging purposes, and thus not usually included. The peak no load voltage will certainly be much greater than 12V, however this should not be a problem as long as it is below the maximum voltage given for the kit you are building. This is usually 18V or more for most modules designed for car audio applications. Check the data sheets first and measure your power supply with a voltmeter if possible, to be sure. Remember that a car battery will actually reach 13.8V during charging, such as when driving. For this reason power output is usually quoted at 13.8V rather than 12V for car audio.

High power amplifiers are usually designed to work from a positive and negative supply. One big advantage of this is that the output will be zero volts DC with respect to ground, and thus no large DC coupling capacitors are required. Few extra components are required to provide both supplies, however a mains transformer with a centre tapped output is required. These are very common, but make sure you know what the output voltage really is when purchasing. A transformer may be specified as 50V centre tapped, or 25V-0-25V, for example. The output current may be given for both series and parallel connection of the output windings. If you are using both windings as separate positive and negative supplies, then the lower current figure applies, i.e. series connection.

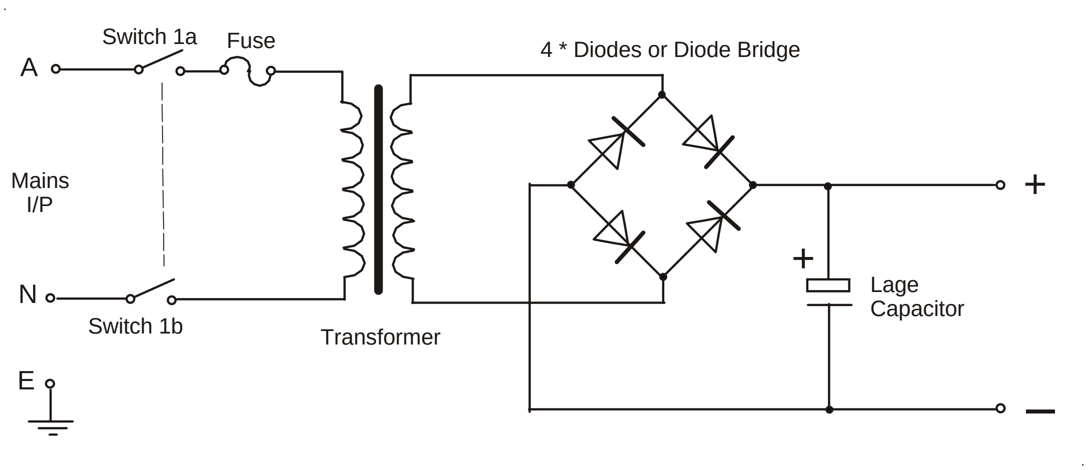
Transformers are often specified as the “VA” rating, this is the output volts multiplied by the output current. If the above transformer was rated as 100VA, then it’s output would be 50V at 2A for the series connection. This will also give us two 25V supplies, at 2A each. The A.C. output then needs to be rectified and filtered to provide us with the necessary D.C. supply “rails” our amplifier requires to operate. Because the capacitors charge to the peak voltage of the rectified sine wave, this is approximately 1.4 times the specified AC “RMS” value. Thus our 25V A.C. supplies, are now approximately 35V D.C. supplies. This will be under no load conditions, and drop a little under full load current as we have previously mentioned.

When dealing with mains transformers, we also need to be careful of safety requirements. This will usually mean providing a suitable earth to any metal case, providing a suitable fuse and switch to the transformer primary windings, and making sure all wires and connections are properly insulated. When choosing a fuse, make sure it is large enough to allow for surge currents when the amplifier is first switched on, however it should be small enough to provide some overload protection in the event of circuit failure.

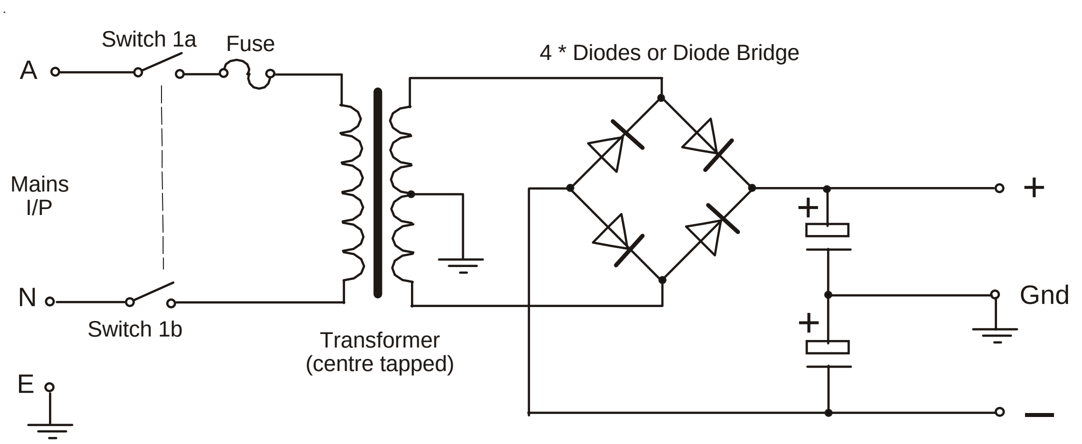
Make sure all diodes can handle both the peak voltages and peak currents expected, not just the normal values.
Similarly the capacitors must have a rating higher than the peak no load D.C. voltage expected. A suitable safety margin is prudent in both cases.

The circuits shown below should give you a good idea of what is required, and how to connect the components for both a single supply, and a “split rail” dual supply.

Standard circuit for a mains derived single rail power supply



Standard circuit for a mains derived split rail power supply



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