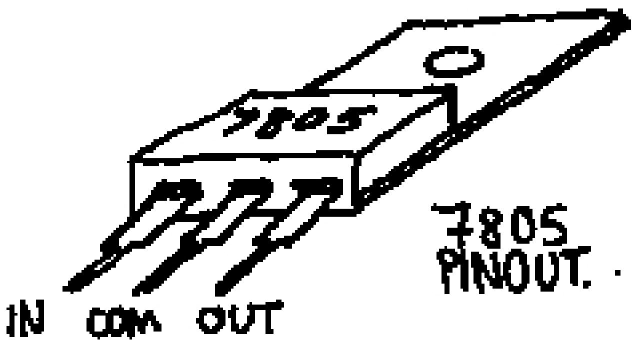
LETHAL VOLTAGES ARE PRESENT - GREAT CARE REQUIRED!!

Everyone needs a power supply. This simple one shows the general principles. The first step is to select a transformer suited to your need. The primary should be for the correct mains voltage in your country (120V in the US, 240V in most of the rest of the world). The secondary voltage should be chosen bearing in mind what the rectified voltage will be, and whether or not you need to regulate it. The rectified direct current (DC) voltage is 1.414 times (square-root-of-2 times) the alternating current (AC) voltage, minus the voltage drop across 2 silicon diodes (2 x approx 0.7V). Therefore in theory if your secondary is 12V AC, once you have rectified it you will have about 15.5V. In practice this will vary considerably with load and under no-load conditions is likely to be somewhat higher.



Another important consideration is the current rating of the secondary, which must be sufficient for your application otherwise the transformer will overheat or burn out.

Do you need a regulated voltage output? If you don't include a regulator then the voltage output will vary depending on the load. For digital logic circuits (e.g. 74LSxx series) you commonly need +5V and the chips will only tolerate a range of 4.5V to 5.5V, so it is good to use a regulator. Or, you might need a variable regulated voltage. Regulator chips are available which with various output voltages, or variable output voltages. Again you need to consider the current consumption and use an appropriately rated device. Common resistive regulators e.g. 7805 dissipate the unwanted voltage resistively as heat. You must bolt them to a large enough heat sink to conduct the heat away from the device to prevent it from overheating.

The alternative to resistive regulators are switch mode regulators. They regulate the voltage by switching the current on and off very rapidly and averaging the output with a large inductor and capacitor. In this way they achieve a much higher efficiency since they do not dissipate the unwanted power as heat. The disadvantages are higher cost, more complexity, and electrical noise generated by the rapid switching process. The latter can be a problem if you are powering radio receivers or other sensitive equipment. I used a switch mode regulator in my Viscometer project . The power supply for that device also uses a toroidal transformer in place of the more usual style of transformer. Toroidal transformers are more expensive but less bulky, and I think their magnetic field is also better contained (possible important in some applications).

The circuit diagram of my power supply is shown with the photos below. This power supply has a +15V unregulated output and a +5V regulated output. The transformer is rated at 4A. I used three 7805 1-amp voltage regulators in parallel. I am now unsure whether or not it is Ok to parallel voltage regulators in this way, if anyone knows the answer to this question, tell me. I haven't tried to take 3A at +5V so do not know whether or not it would cope. A better way would probably be to use a higher rated 7805 rather than three in parallel.

The transformer for this project comes from an old car battery charger. These are an ideal source of suitable transformers since old battery chargers are often available cheaply, and they usually contain other useful components such as a rectifier and smoothing capacitors. Mine even had a 0-5A ammeter, though the more modern chargers usually just have a few coloured LED's to indicate charge rate. I suspect that even if you were to buy a brand new car battery charger and dismantle it, the cost would be less than buying an equivalently rated transformer. Plus, you have the added benefit of the other components.

The rectifier could use separate diodes but I used a packaged bridge rectifier. As usual, this has to have a high enough current rating for your requirements. If you use the transformer from a car battery charger, you're likely to also find a suitable rectifier or diodes inside as well.

My power supply is built in an alumnium box, with the three power sockets (0V, +5V, +15V), On/Off switch, fuse and neon indicator lamp mounted on the front panel. Notice from the circuit diagram that the fuse is in the secondary circuit of the transformer not the primary. My reason for this was to prevent damage to the transformer in the event of a short circuit. I also reasoned that the mains side of the transformer is already somewhat protected by the fuse in the mains plug (UK mains plugs have an integral fuse).

Each of the voltage regulators has its own heatsink. There are actually 4 heatsinks mounted in the box. This is because I originally used a +12V 1A regulator (7812), so the power supply was regulated +12V and regulated +5V. However on drawing too much current on one occasion the 7812 exploded and I didn't replace it. In use, the +15V unregulated output now depends on the load, and can be as high as +19V with small loads.

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