Basic Power Supply Design

For the purpose of this design, I am assuming that the user is going to use one of the Gecko drivers (G201 or G210).

In order to size the components, I will use values that I have used in the past. First is the voltage and current for the stepper motors. I used Superior Electric stepper motors model number KLM091f13. The voltage is 1.26 volts DC. The current is 6.6 amps.

At this point, I can calculate the desired power supply voltage. You want to make the power supply voltage at a minimum to be about 20 times the DC voltage rating on the stepper motors (1.26 VDC * 20 = 25.2 VDC) . The maximum voltage should be no more than 25 times the voltage (31.5 VDC). Note the minimum DC voltage for the Gecko drive is 24 VDC.

Once you have established the desired DC voltage, you can calculate the transformer secondary voltage. For my design, I used a transformer from Plitron Manufacturing Inc. In Toronto Canada. Plitro transformers are all custom made and can come in a wide variety of voltages.

To calculate the desired transformer voltage divide the desired power supply voltage by 1.4. Example (28 VDC / 1.4 = 20 VAC).

The last step is to calculate the desired transformer current and Volt amp (VA) rating. Three stepper motors rated at 6.6 amps would equal a total of 19.8 amps. In actuality, the value should never exceed about 67% of the total or in this case about 13.26 amps. Transformer are usually rated in Volt/amp values (20 * 13.26 = 265.32 VA). If you look up the transformer that I used from Plitron (part number 077015201 you would see that it was rated at 300 volt amps and 22 volts AC.

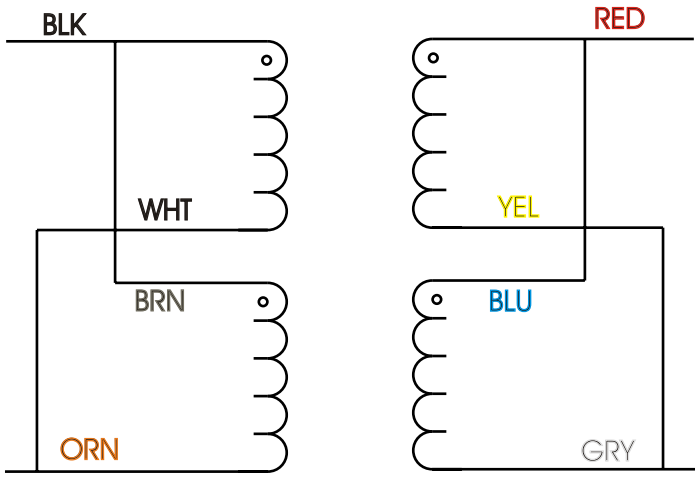
The next calculation would be for the size of the filter capacitor. Use the equation of (C= (80,000 * I) / V)). C is the value in microfarads, I is the current and V is the voltage.

Example : C= (80,000 * 13.27) / 30)). 35,376 uf. My capacitors were rated at 21,500 uf.. In this case, I used two capacitors in parallel.

The next device to select would be the bridge rectifier. I selected a surplus bridge rectifier at 25 amps at 50 volts.

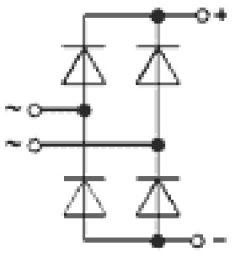
Your next step is to find out how you transformer is wired. The wiring diagram below shows the primary and secondary windings of the transformer that I used. Both the primary and secondary have two sets of windings. The primary could be wired for either 115 volts at 230 volts. The diagram shows the transformer primary windings wired in parallel for 115 volts AC.

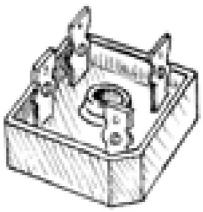
The secondary has two sets of windings. Wire them in parallel to double the current.



Bridge Rectifiers

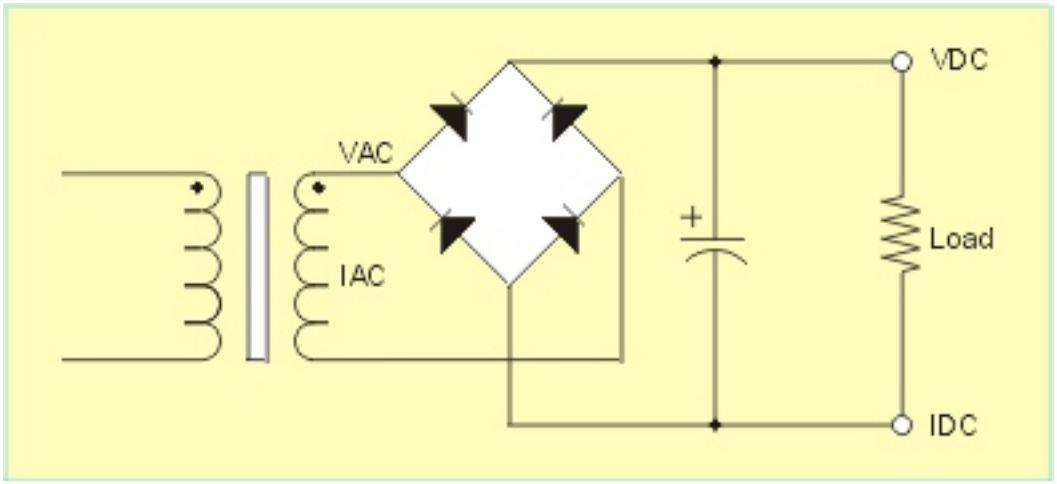
What is a bridge rectifier? A bridge rectifier is a device that converts AC from a transformer into pulses of DC voltage. The DC voltage is then stored in a capacitor. The drawing on the left shows four diodes in a bridge configuration. The middle drawing shows a bridge rectifier with one corner cut off. This cut-off corner indicated that the terminal nearest to the corner is the positive or + terminal. The second picture shows another configuration for a bridge rectifier. In this case the bridge rectifier will be marked with a + symbol to indicate the positive terminal. The opposite (diagonal) terminal would then be the Negative (-) terminal. The other two terminals are for the output from the transformer secondary windings.





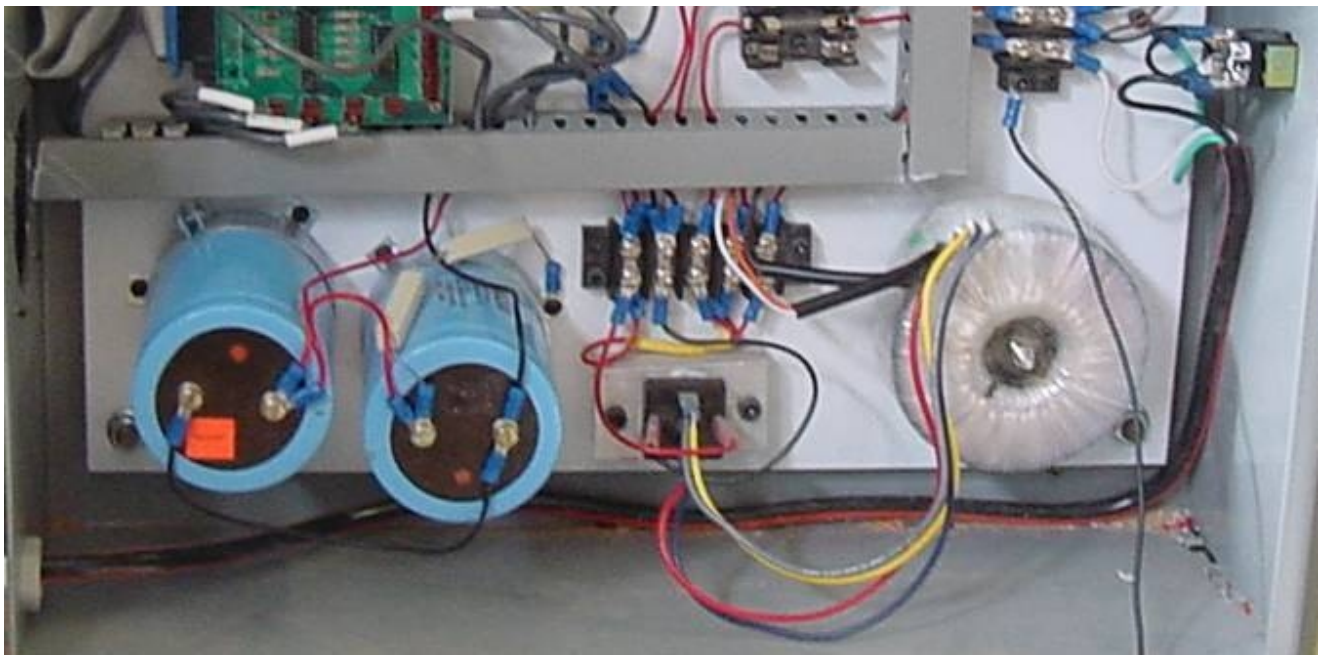
Capacitor

The next item that makes up a power supply is the storage capacitor. It is necessary to have a capacitor to store the voltage and filter out the pulses coming from the bridge rectifier. Below is a picture of a filter capacitor. Note that it has a working voltage and a surge voltage specified. Once you know the voltage for your power supply, then you can select the proper size (working voltage) capacitor. Note: this one has a capacity of 21,500micro farads (uf). For my power supply, I used two in parallel.



The picture above shows the proper connection from the secondary of the transformer to the bridge rectifier and the connection from the bridge rectifier to the filter capacitor.

The picture below shows the power supply section of the control box. Several additional items are required to complete the power supply. One is an on/off switch which should be rated to handle the current in the primary of the transformer. The current in the primary in this case should be under 5 amps. At the bottom left is a strain relief where the AC power cord is brought through the side of the control box. The other item is a couple of terminal strips.



Wiring the Power Supply

First start by laying out the components. Drill and tap holes to mount the components. The transformer used a 3/8” bolt. I placed the bridge rectifier on a piece of aluminum to act a a heat sink.

Wiring, start with the AC cord. I used a 14 amp 3 wire extension cord from my local Home Depot. Cut the receptacle end off. Then strip the insulation off by about 8”. Put a terminal lug on the end of the green wire (not shown below)and bolt it to a ground point on the back panel. Put terminal lugs on the end of the white. Attach the white to a terminal strip. Attach the end of the black wire to the on/off switch. From the other side of the on/off switch, run a wire to another terminal on the terminal switch. Locate the black and brown wire on the primary side of the transformer and install a terminal lug connecting both of them to one lug. Route the white an orange wire and attach the lug to the terminal strip opposite the white wire coming from the AC cord. Now find the black and brown wire and connect them together with a luge. Attach the black and brown wire to the same terminal as the wire that came from the on/off switch.

Now wire the secondary wires from the transformer to the bridge rectifier. You should have two pairs (red and blue and yellow and grey). Find the + terminal on the bridge rectifier. The two terminals adjacent to the + terminal are for the AC from the secondary from the transformer. From the + terminal on the bridge rectifier, run a wire to the + terminal of the first capacitor. Run another wire from the negative terminal on the bridge rectifier to the second terminal (-) on the first capacitor. Now run two more wires from the first capacitor to the second capacitor (+ to + and - to -).

The following wires are not shown. From the negative side of one of the capacitors, run a wire to a common ground terminal location. You will only want one ground point. All ground wires should be attached to this point. You will also want to run a wire from the + terminal on one of the capacitors to a terminal strip. Later you will run a wire from the terminal to the fuse block.

One item that is not shown is a circuit breaker. You can break the black wire that goes to the on/off switch and add a circuit breaker. The other item that is not shown is the emergency off switch. In the next file, I will add an EPO switch and a contractor.