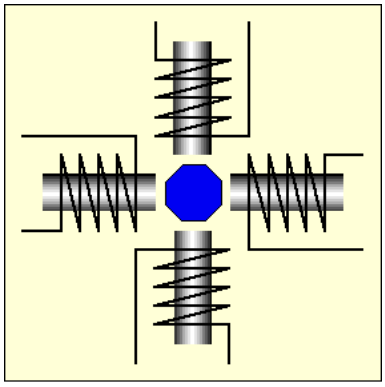
Diesel Electric Alternator System

This article deals with the Electrical Generation side of a Diesel Electric locomotive. In this worked example you will see how the modular control system works. In full size practice as in automotive practice the rotor field windings are maintained by a DC flux, however in scale practice a magnet replaces the rotor field windings. An Alternator generates AC flux by spinning the magnets on the armature to the fixed stator coils. This can be replicated by using a modern stepper motor in **reverse**.

The picture below shows a stepper motor that has a 10mm shaft and weighs 1.57Kg. Its normal input is 7.5 Volts and 6 Amperes.

The normal stepper motor has four poles and "normally" eight wires, other versions may have five, or six -but still have four poles.

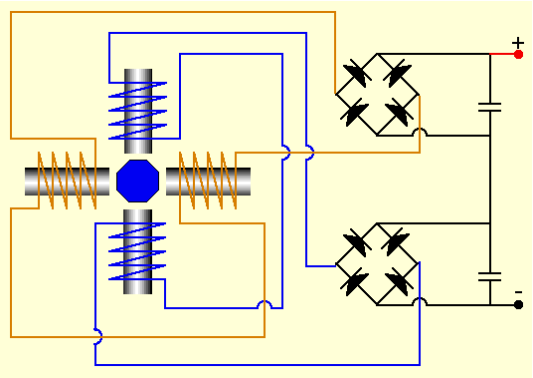


The first step of the process is to identify the "pairs" of coils, the data sheet for the stepper motor should say -(but!)... The standard method of doing this is to clamp a battery pistol drill to the shaft and turn the motor. Using an AVO meter select two wires from a coil and twist them with another -note the voltage. You will find some combinations generate 0 Volts, in which case you have one of the pairs of wires connected the wrong way around. Eventually you will have four cables out from your motor giving 7.5 Volts AC across two matched pairs.

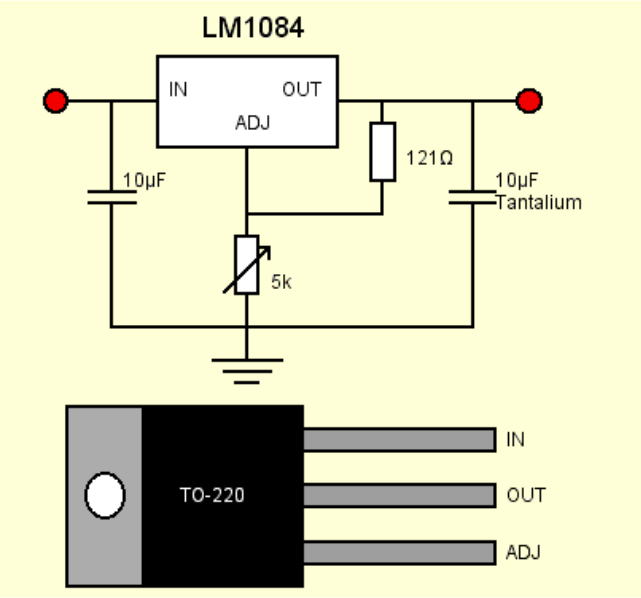
These are then taken to a pair of bridge rectifiers. These consist of four "Schottky" barrier diodes arranged in the conventional manner. These are chosen because they have a low forward loss and they are capable of rectifying high frequency AC fluxes. They should be at least 3A rated and better.

Each pair of windings is rectified individually and then summed using a 20 Volt 1,000µF capacitor between each bridge output line. Thus the negative of the top bridge is connected to the positive side of the bottom bridge and the net capacitance between the summed lines is 20 Volts @ 1,000µF.

Remember to ensure that the capacitors are the correct way around....



The DC flux is now fed to a std "3 leg" voltage regulator. The drawing below shows a conventional variable voltage regulator setup. This can normally take 5A but by stacking the Voltage Regulators multiples of 5A are easily achievable.



The smoothed DC at the correct voltage is now taken to a simple Pulse Width Modulator, The drawing shows a common "pin out" for the power HexFET -but they can vary -check with your supplier. The circuit is driven from NAND gate -this feeds the GATE terminal of the HexFET. The SOURCE connection goes to the chassis earth or negative. The DRAIN connection goes to the motor. The mark/space ratio is controlled by the 100kΩ potentiometer. This setup can modulate 5A and again the system can be stacked and all the HexFETs fed from the one NAND and potentiometer.