Identifying and Using Stepper Motors

This brief article is indented to help you to identify the various type of stepper motors and how to connect them to the various interface device that can be found in many school Technology labs.

Motor Types

Stepper motors are used in applications where precise positioning control is required. These motors are not designed to rotate continuously but rotate a number of steps determined by the software control program. Stepper motors are categorized by a number of parameters including turning and holding torque, operating voltage and current, resolution that is the angle turned in one step and basic type. A stepper motor consists of two fixed electromagnetic coils surrounding a permanent magnet connected directly to the rotating shaft. Generally there are two types of Stepper motors. **Unipolar** motors, which usually have five or six wires and **bipolar** motors which have 4 wires. Unipolar motors can be used as bipolar but not the reverse.

Stepper motors can be purchased but good surplus motors can be found in older hard disk drives, floppy and tape drives, and dot matrix and inkjet printers. If surplus motors are not marked, you will need to determine their parameters.

Identifying Motor Parameters

You need to identify the various wires before connecting to the control circuit. This can easily be done with an ohmmeter (preferably a digital multimeter).

6 Wire Motors: Set the Ohmmeter to the lowest resistance scale.

- Attach one of the wires to the meter and, in turn, check each of the remaining five wires. Two of these wires will give a reading while the other three will not.

- Mark the wires that gave a reading and mark the first wire you started with. This group will be coil 1.

- The remaining three wires will be coil 2.

- Take the three wires of coil 1 and measure the resistance between pairs. If you label the wires 1, 2 and 3 you can set up a table to document your measurements. For example:

Combination	Resistance (Ω)
1 - 2	40
1 - 3	80
2 - 3	40

Note that two of the combinations gave lower readings. What wire was common to the pairs that had lower resistances? In this example it is wire 2. This wire is called a center tap, a wire connected to the middle of the coil. Wire 1 and 3 are the ends of the coil 1nd therefore give a higher resistance. The following illustrations show how the wires connect to the coil.

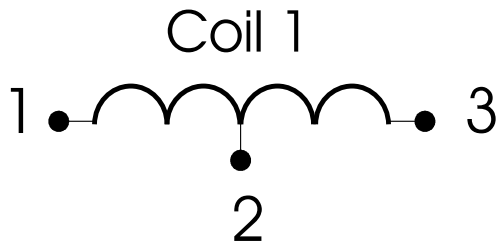


Figure 1

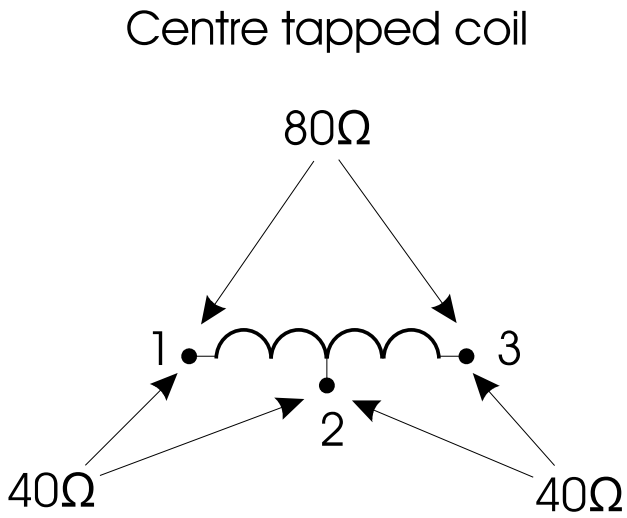


Figure 2

– Make the same measurements for coil 2. When you have identified the Centre tap, mark it in some way (tape?). Also make sure the other wires for coil 2 are marked.

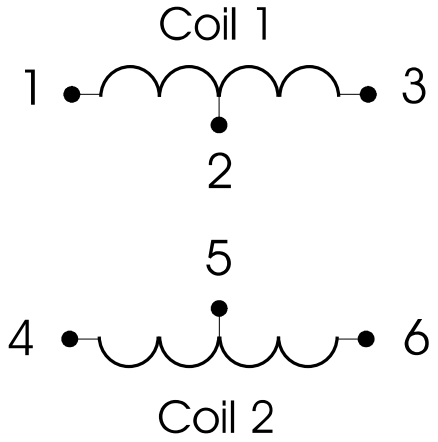
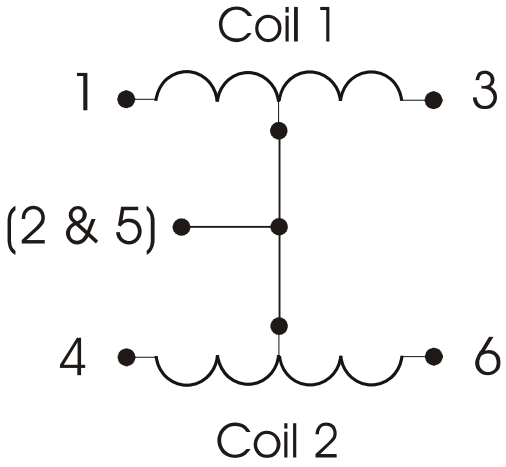


Figure 3

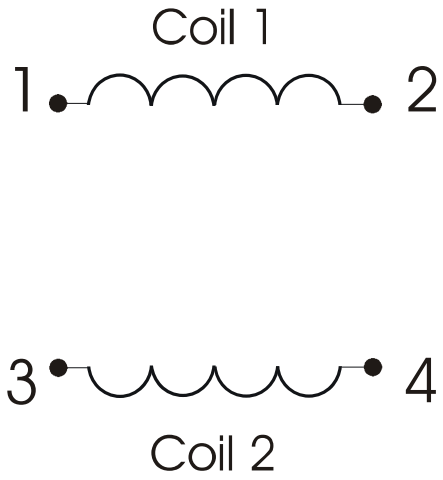
5 Wire Motors

These are also unipolor motors but have both centre tap wires connected together inside the motor. Both centre taps are then brought to the outside via a single wire. Because it is common to both coils, this wire can easily be identified using an ohmmeter as it will give a reading in combination with each of the other four wires. Coil 1 and coil 2 are identified and marked in the same way as for the 6 wire motors.



4 Wire Motors

Motors with 4 wires are called bipolar motors. These motors also have 2 coils but they are not centre tapped as in the unipolar motor. To determine which wires are connected to the two coils use an ohmmeter and proceed as in the 6 wire motor. In this case a wire will only give a reading with one other wire, which is of course, the other end of the coil. Mark these two wires coil A. The other two wires are marked as coil B.



Motor Voltage and Current

Each stepper motor is rated as working at a certain voltage ie, 3, 5 or 12 volts and drawing some current usually measured in milliamperes (1000 millamperes = 1 ampere). You can determine the current draw for a surplus motor by knowing the coil resistance and using Ohm's law. The control circuits that the steppers connect to have limits on the amount of current they can supply without destroying themselves. Therefore, it is important that you use a stepper motor that has a coil resistance that draws a current equal to or less than the maximum. A simple calculation using ohm's law can verify if a motor can be used.

Example: You need to use a 12 volt power supply to run the motor. The control circular can pass 300 milliamperes safely. In the following calculation, the current has to be converted to amperes (0.3 a)

Voltage = Current x Resistance

Resistance = Voltage / Current

R = 12v / 0.3a = 40Ω

In a unipolar motor, the coil resistance should be 80Ω or more (since the coil is centre tapped it is

actually 2 coils, each having half the resistance) so as to not damage the driver IC. In practice, a lot of the stepper motors from older 5.25" floppy drives have 72Ω coils and these work fine although the chip will get fairly warm. For a bipolar motor, the coils would have to be 40Ω or more as there is no centre tap.