MEE210 ELECTRICAL MACHINES – Experiment #8

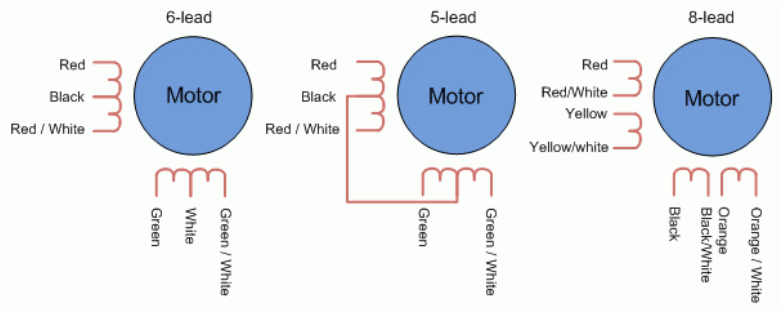
LABORATORY CONTENT: Stepper motor

EQUIPMENT REQUIRED: (students should bring electronic components)

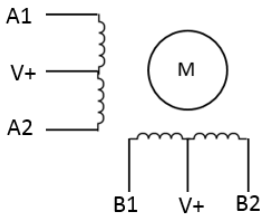
Qty	Description
1	Voltage supply (will be ready at lab.)
1	**Computer (Arduino IDE program should be installed)**
1	5-lead unipolar stepper motor
1	Arduino card (with operation voltage 5 V like Arduino Uno, Mega, etc.)
1	Multimeter
1	Breadboard
4	*2N2222 transistor (these components may fail during the application, advised to bring extra for backup)
4	*1N4001 diode
4	150 Ω resistor
-	Wiring equipment (jumper cables, crocodiles, etc.)

**** You may use equivalent components as well, just look up the datasheet for the component specifications***

INTRODUCTION:

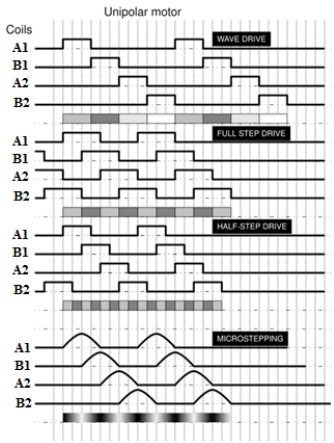


Stepper motors are preferred for their cheap prices for the applications where a precise positioning is required. The most common stepper motor types are unipolar and bipolar stepper motors. Although unipolar stepper motors have different cabling variations (you can search for other variations on the internet), a 5-lead unipolar stepper motor cabling is figured on the right side. The cable colors may not be identically equal for each motor in practice (ex. even if your motor has 5 leads, the colors may not be the same as in the figure), so for a unipolar stepper motor, only the COMMON cable can be determined by measuring the resistances between terminals. For a bipolar motor, the resistance measurement method is the easiest and the best way for more accurate determination. This cable sequence is important due to driving methodology which is applied in this exercise. The driving method can be categorized depending on the resolution of the motion and the torque provided to the rotor (names are shown on the top of the time charts). *A1* and *A2* represents the first coil, *B1* and *B2* represents the second coil.



PRELIMINARY QUESTIONS: !!! (no preliminary report is required, but the steps should be followed before the session)

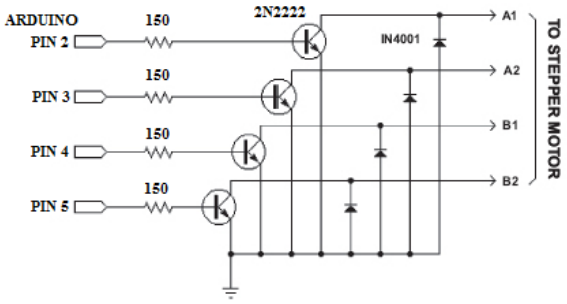
You can execute the experiment at home that all the required components are enough for this. (It is possible that you may not observe a proper motion even if your cabling is correct if you are using "5V pin" of Arduino as V_{cc} pin of the circuit, the problem is that the provided current may not be enough, in laboratory application there is no problem with an external power supply)



1) Determine the *COMMON* cable by measuring resistances between terminals.
2) Download Arduino code given below.
3) Set up the circuit given on the right-side figure where ***COMMON*** terminals of the motor are connected **to V_{cc}** (power supply for the motor).
4) Determine the cables by tryouts where a smooth rotation is obtained.
5) Try out the driving modes by changing the code. Change "*mytime*" variable to observe the limits of the motor.
6) Modify Arduino code given in a way that the motor can rotate in both directions as demanded. The modification will be made just for just one mode function (add an input to the function as it will indicate the rotation direction).

EXERCISE STEPS:

1) Show the motion with the Arduino code given in lecture website.



POSTLIMINARY QUESTIONS:

1) Search about hybrid stepper motors.

2) Compare stepper motors with servo motors (control method, motor types, power, torque, speed, cost prices, ergonomics, etc.)

3) Briefly describe Darlington pair transistor and compare it with single BJT transistor configuration.