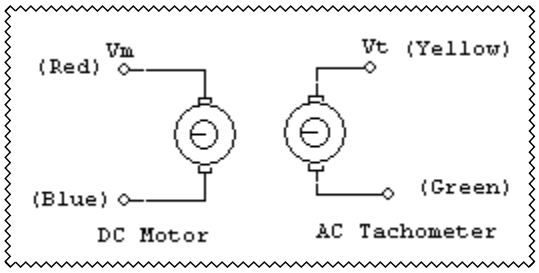
ET-350/L Name:

Lab 2 Study of D.C. Motors and Direct Drive Tachometers



1. Identify the following pairs of leads for your motor unit.

The Power Leads:

The red and blue leads connect to the armature, commutators and brushes, which are of course in series. It is between these two leads that the voltage V_M is applied to make the motor turn.

The Tachometer Leads:

The yellow and green leads connect to the tachometer. The tachometer voltage V_T can be read between these two leads - either by a voltmeter, an oscilloscope or a specialized electronic circuit. This is an A.C. sine wave voltage and either its amplitude or its frequency can be used to measure the rate of rotation (or RPMs) of the motor.

2. The Armature Resistance

Measure the D.C. resistance between the power leads, using a voltmeter set to measure resistance. This is often called "Armature Resistance", even though it includes the resistance of the contacts made by the brushes on the commutators. Make several resistance measurements - each time rotating the motor shaft by hand in between measurements - and record the typical value you get.

If you get an unusually high reading or one that varies a lot while you are making the measurement, it is because one of the brushes is not making a good contact with its commutator. Ignore these readings.

Armature Resistance in Ohms
Armature Current in Amps

2A. Calculate armature current: $I_A = V_M / R_A$

3. Measure the relationship between V_M and I_M for three different power supply voltages as shown:

V_M	I_M (in mA)
6V	
9V	
12V	

4. Measuring the "Locked Rotor" motor current.

Keep the current measuring arrangement you used in part 3 above. Return the power supply voltage to 6V and verify that the value of I_M is close to what you measured before for 6V. Grab the motor shaft and force it to stop for a few seconds and measure I_M while the armature (rotor) is stopped. Do not hold the motor stopped for more than three or four seconds.

Locked Rotor Current

This is the Locked Rotor motor current. It is the same as the initial start-up current for the motor since the rotor is not turning whenever a motor is first started. When a motor is turning it generates "Counter EMF" which limits the current in the armature. Most motors will burn out if the rotor remains locked for too long.

5. Measuring the Tachometer Output

Use an oscilloscope to measure the frequency and amplitude of the output of the tachometer, while the motor is being powered by the three power supply voltages shown.

If you are unfamiliar with the use of the oscilloscope, let the instructor know. The instructor may choose to give individual instruction or an overall class demonstration.

The fundamental use of an oscilloscope involves three important areas:

A. Triggering - to hold a stable picture of the waveform on the oscilloscope screen.

B. Measuring voltage on the vertical scale of a channel of the oscilloscope.

C. Measuring the time of a complete cycle of a waveform on the horizontal scale of the oscilloscope.

V_M	V_T- Amplitude in peak to peak voltage	V_T -Time period for one cycle in msec.	V_T -Frequency in Hertz
6V			
9V			
12V			

Questions:

1. For a D.C. permanent magnet motor, make a simple drawing to show how the power leads, the brushes, the commutators and a winding of the armature are connected together.

2. For a motor, why is the starting current always greater than the current when the motor is running?

3. Say you have a motor which is turning some gears and one of the gears gets jammed and this causes the motor to stop. Why is this situation dangerous for the motor?

4. Which parameters of the tachometer output waveform can be used to give an accurate measurement of the rate of rotation of the motor?

5. An oscilloscope has controls for the vertical voltage scale, horizontal time scale and for triggering of the horizontal sweep. Which is most important for holding a stable picture of the waveform on the screen?

6. Explain how to convert the time period of a repeating waveform into a frequency.

7. Calculate motor speed at 6V given that: $f = {}^{s \times p}/_{60}$

(Hint: solve for s)