University of Utah
Electrical & Computer Engineering Department
ECE 3600 Lab 5
DC Motor

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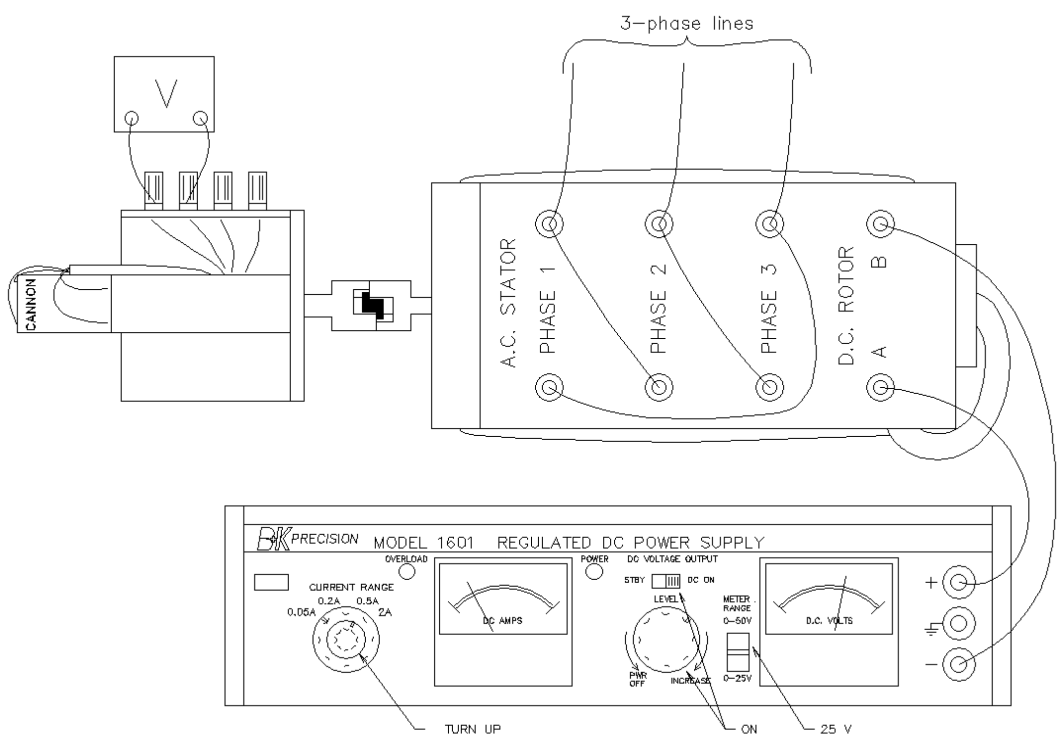
Objectives
1. Spin the motor at a constant speed, observe the effects of varying the field current, and plot the magnetization curve of this motor for 1800 rpm.
2. Determine Kφ for two field currents.
3. Run the DC motor with a constant field current plot the speed vs. armature voltage.
4. Observe the effect of losing the field current.
5. Find the armature resistance and expected armature currents and plot with actual.

Part to bring or buy:
Electrolytic capacitor, 50 µF or above, **200 V or above**. You can get by without this part, but it's a little more work, so bring one if you have one.

Equipment and materials to be checked out from stockroom:
See the last page of this lab and cut out the check-out list. Check out those items.

Calibrate Tachometer
Mount the 3-phase synchronous motor and the small servo motor with tachometer on the motor rack as shown below. Give the motors plenty of slack at the coupling. You may need to use shims to make the two line up well. Also, if the servo motor shaft is bent (many are), you may have to try another one. Hook up a voltmeter to the green and yellow connections of the tachometer.

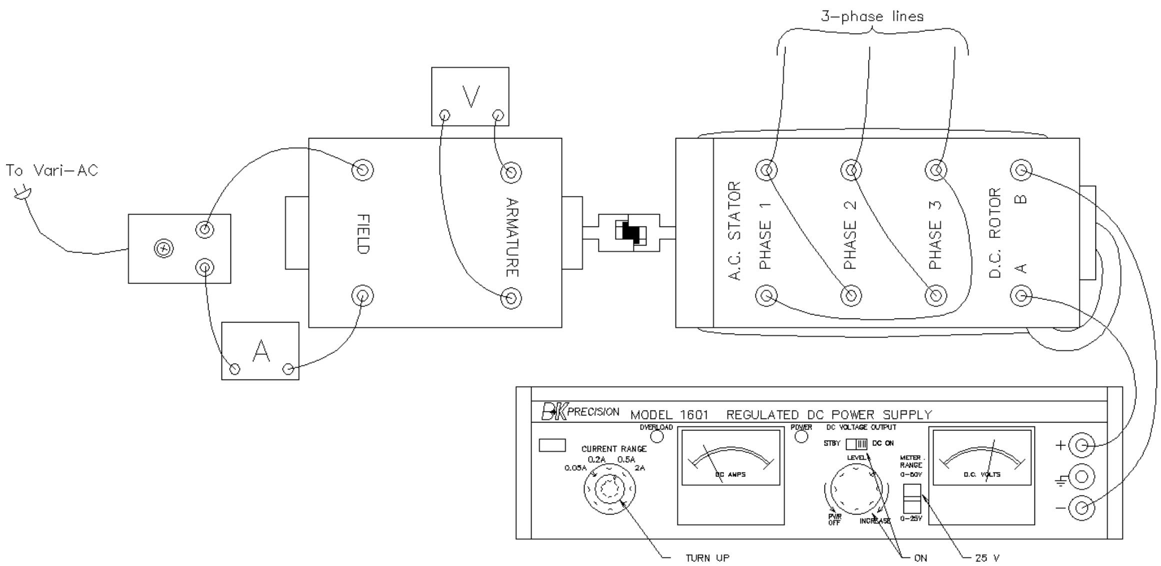


Turn off the 3-phase line breaker and hook up the 3-phase synchronous motor to the 3-phase lines (black, red, & blue) in Δ. Pay no attention to the connector colors of the motor. Hook the B&K power supply to the D.C. ROTOR (A B) connections. Set the B&K to about 15 V. Turn on the 3-phase power and make sure everything is running smoothly. Now you have the tachometer spinning at a known speed of 1800 rpm. Record the tachometer voltage. Turn off the 3-phase power.

Remove the small servo motor with tachometer and set it aside, you'll use it later.

Magnetization curve

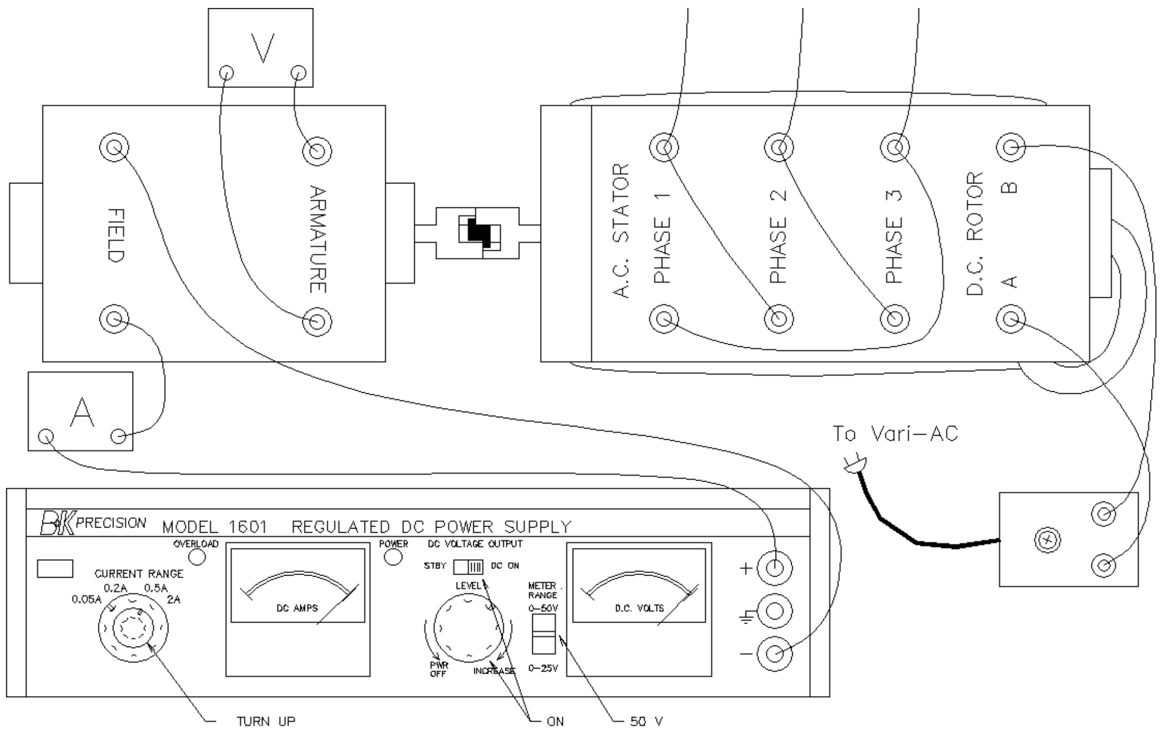
Mount the DC motor on the motor rack with the 3-phase synchronous motor as shown below. Give the motors plenty of slack at the coupling. You may need to use a shim under the DC motor to make the two line up well.



Plug the AC to DC rectifier box into the Vari-AC (Auto-transformer) and hook the DC side to the field winding though an ammeter. If you brought or bought an electrolytic capacitor, add it across the field winding. Hook a voltmeter to the armature winding. Turn on the 3-phase power and make sure everything is running smoothly. Now you have the DC motor spinning at a constant 1800 rpm and you can get data to plot a curve like that shown in Figure 8-30 (p.398) of your textbook.

Turn down, plug in, and turn on the Vari-AC. Take readings of the armature voltage as you vary the field current from 0 to 130 mA (or as close as you can get). Specifically include readings at 50 and 100 mA. Make a plot of E_A vs. I_F now or leave room in your notebook to add it later. Note the polarity of the armature voltage.

If you don't have a filter capacitor on the field winding: The DC motor field and the ammeter may not be "averaging" the field current quite the same way, so you'll need to repeat one reading with a true DC field current. Turn down the Vari-AC and turn off the 3-phase power. Swap the DC power sources as shown in the next figure. Set the Vari-AC to about 15 V and adjust the B&K to provide 50 mA (or as close as you can get). Turn on the 3-phase power and record the armature voltage. Turn off the 3-phase power.



Calculate Kφ at I_F = 50 mA at 100 mA.

DC Motor Speed and Model

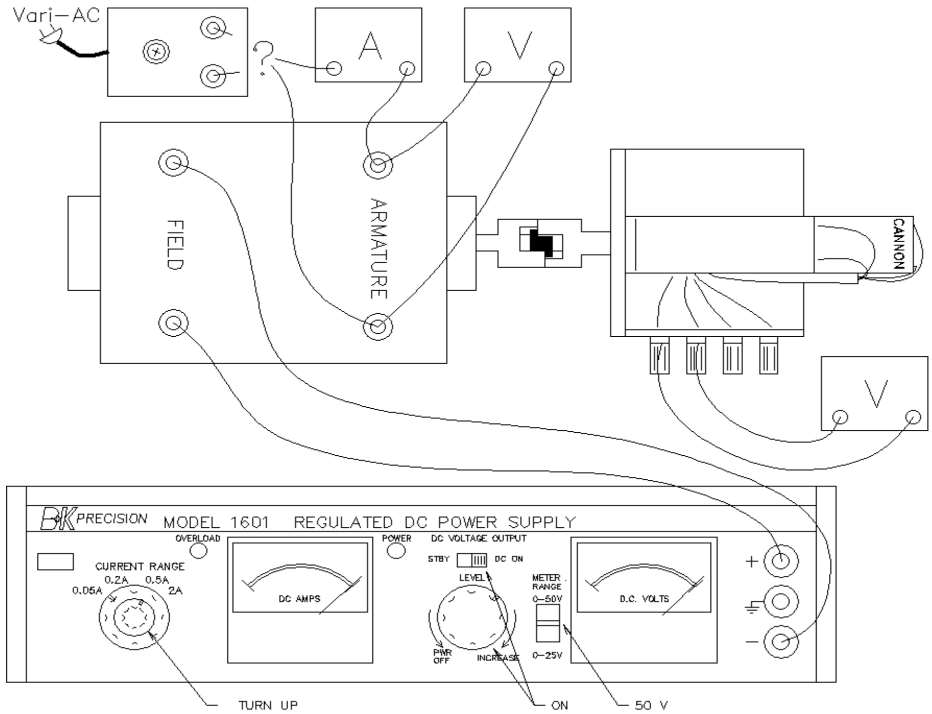
If you haven't already done so, set up the DC field as shown in the drawing above and adjust the B&K to provide 50 mA (or as close as you can get).

Proceed to the next page.

Cut - Out

Area

Move the ammeter so that it can measure the armature current and set up the DC motor as shown at right. Match the polarity of the armature voltage that you measured before. **The wires may have to be crossed at the ? in the drawing!**. Replace the 3-phase synchronous motor with the small servo motor with tachometer and hook up a voltmeter to the green and yellow connections of the tachometer.



At an armature voltage of 50 V or less, briefly disconnect the field winding and observe what happens to the motor speed. Comment in your notebook. Say why someone should keep a hand on the Vari-AC's power switch from now on and why the field supply should always be turned off before the armature supply.

NAME	
DATE	
CLASS	ECE 3600 SECTION 001
QUANTITY	DESCRIPTION
1	Power wire kit
2	Multimeters
1	B&K 1601 Power supply
1	AC to DC rectifier box
1	Vari-AC (Auto-transformer)
1	Motor rack
1	BOB (bucket of bolts)
1	NSH-34 DC motor
1	NNP34 3-phase synchronous motor
1	Small servo motor with Cannon tachometer

Take readings of the tachometer voltage and the armature current as you vary the armature voltage from 0 to 100 V. Turn down the armature voltage.

Convert your tachometer voltages to rpm values, assuming a linear relationship between the two. Make a plot of speed vs. Voltage now or leave room in your notebook to add it later.

Use the Kφ you found earlier and armature voltages to find R_A at several speeds. Average the values to find your best estimate of R_A. Draw the motor model.

Calculate the expected armature currents for the measured speeds. Plot calculated and actual armature currents vs. speed.

Check off, Conclude and Clean Up

Check off and conclude as always. Be sure to compare what you found in the lab to what you expect to see from theory.