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

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rev, 4/7/24

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

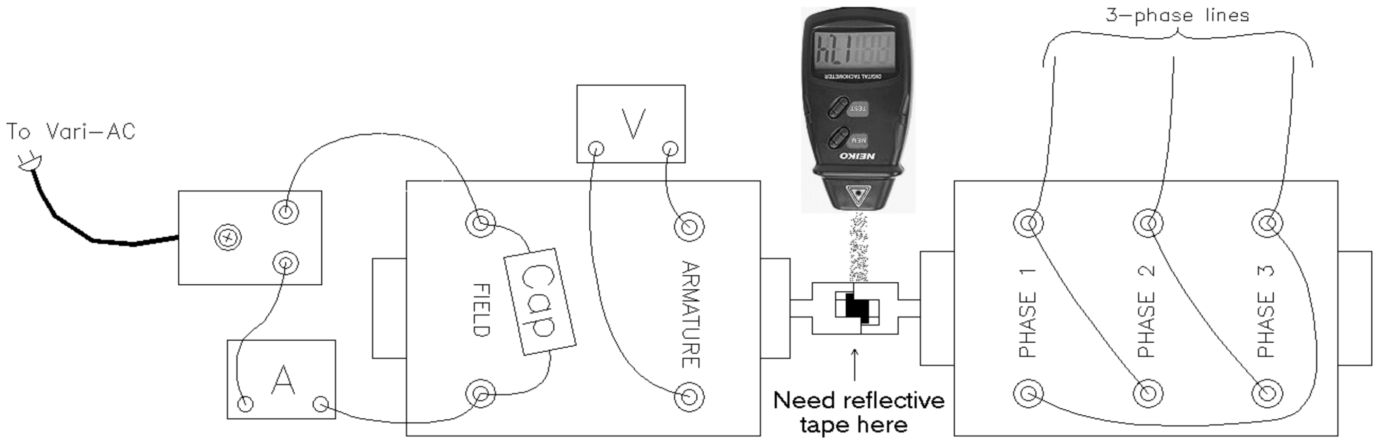
Part to bring or buy:
Electrolytic capacitor, 50 µF or above, **200 V or above**. You can get by without this part, but it's a little more work, so bring one if you have one. Bring your textbook.

Equipment and materials to be checked out from stockroom:
Note: Your TA may have preprinted check-out lists of the following.
- Power wire kit
- 2 Multimeters
- B&K 1601 Power supply or use power supply on the bench
- AC to DC rectifier box
- Vari-AC (Auto-transformer)
- Motor rack
- BOB (bucket of bolts)
- NSH-34 DC motor
- NPP34 3-phase induction motor
- Neiko Optical Tachometer

Magnetization curve
To use the optical tachometer, there will need to be small piece of reflective tape on one of the motor couplers or rubber piece. If you can't find one of these, ask your TA to help you apply one.

Mount the DC motor on the motor rack with the 3-phase induction motor as shown on the next page 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 (**Watch your polarity**). Hook a voltmeter to the armature winding. Turn on the 3-phase power and make sure everything is running smoothly. Read the speed with the optical tachometer. Push "TEST" to read speed, "MEM" to see last reading, minimum &

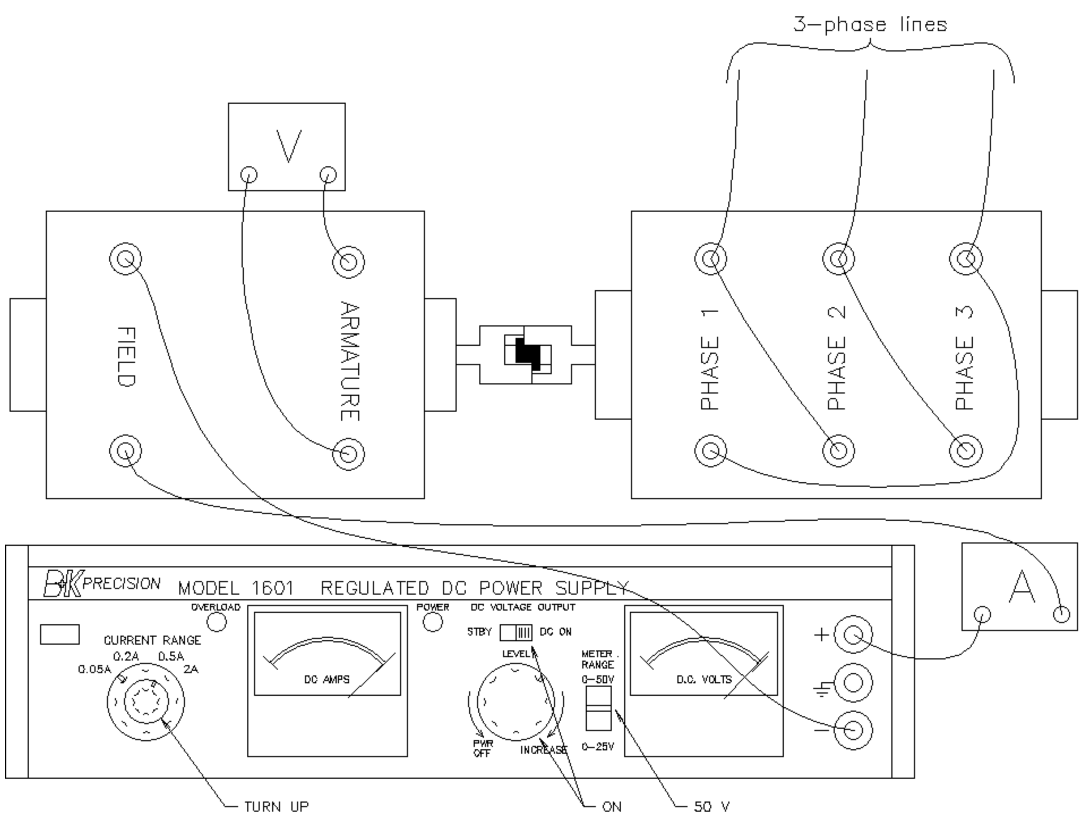


maximum. If the speed seems unreasonable high (above 1800rpm), hold the tachometer further away from the spinning coupling. Now that you have the DC motor spinning at a reasonably constant speed, you can get data to plot a curve like that shown in Figure 8-30 (p.398) of your textbook.

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.

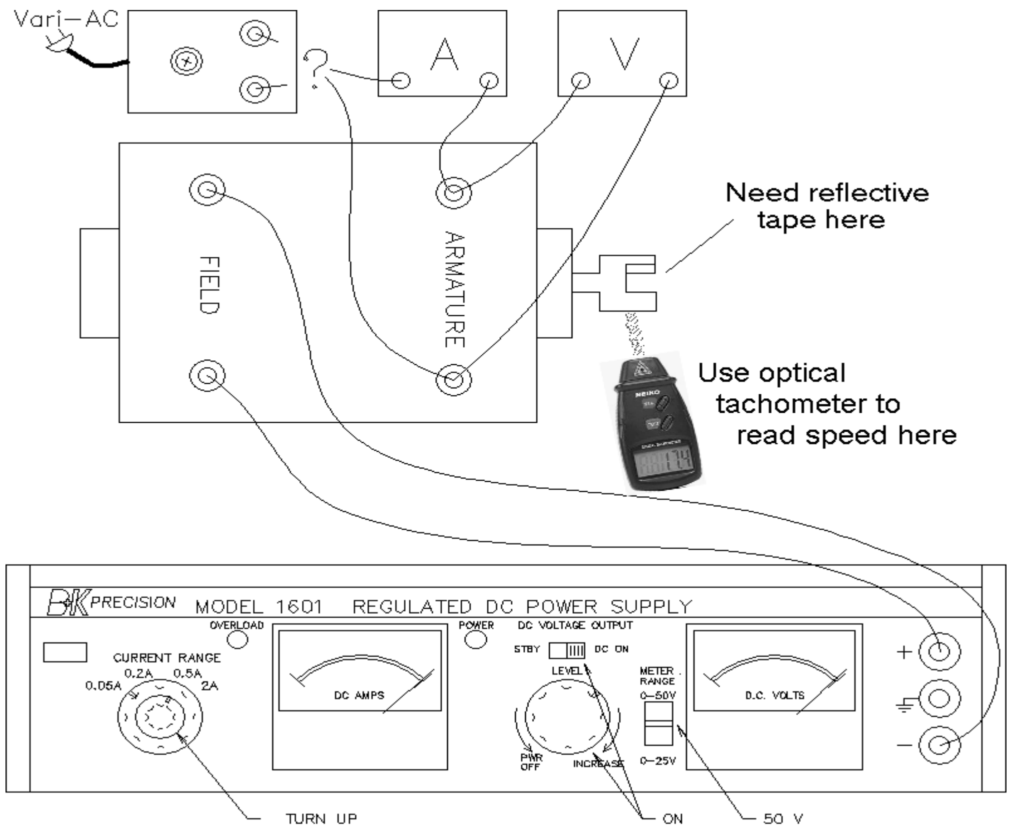
Calculate Kφ at I_F = 50 mA at 100 mA.

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. Change the DC field power source as shown in the next figure 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. Recalculate Kφ at I_F = 50 mA.



DC Motor Speed and Model

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



Move the ammeter so that it can measure the armature current and set up the DC motor as shown. Match the polarity of the armature voltage to the polarity you measured before. **The wires may have to be crossed at the ? in the drawing!**.

At an armature voltage of 50 V or less, briefly disconnect the field winding and observe what happens to the motor speed. (Note: If the motor doesn't speed up significantly, repeat with a higher armature voltage. Comment in your notebook. Say why someone should keep a hand on the Vari-AC's power switch from now on and why the armature supply should always be turned off before field the supply.

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

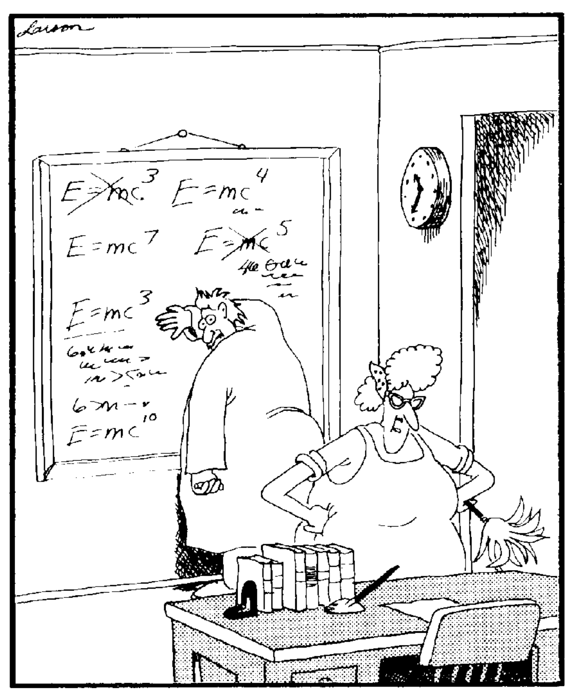
Make a plot of speed vs. armature voltage now or leave room in your notebook to add it later.

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.



"*Now* that desk looks better. Everything's squared away, yessir, squaaaaaared away."