

ECE 5671/6671 – LAB 2

DC GENERATOR AND PARALLEL OPERATION

1. Introduction

The first objective of this lab is to measure the droop line of a DC generator using a variable resistive load. An additional generator and motor set will then be connected in parallel with the first generator in a load-sharing configuration, and the droop line will again be observed and compared with the previous result. The second motor/generator set will come from teaming up with another group in the lab.

The procedures discussed for the remainder of this lab require correct execution of the instructions presented. Upon careful reading and comprehension of directions, proceed with the experiments. This experiment will not require the use of Simulink or dSPACE. All measurements will be taken with multimeters. Note that the DCG is used as the prime mover and the DCM is used as the generator.

2. Experiment

Equipment needed:

- 1 DC generator (DCG), frame mounted, with coupler
- 1 DC Motor (DCM)
- Three-phase resistor box
- (2) digital multi-meters

2.1 Droop Line of a Single Motor and Generator

Using the equation $V = K\omega + RI$ for both the generator and motor, derive an equation for the droop line, $V(I)$. Hint: Use $V_m = K\omega + RI_m$ and $V_G = K\omega + RI_G$. Because the torque is equal on the motor and generator, the current I_m can be set equal the current I_G .

>>Hardware Setup

Apply a voltage around 20V to the DC motor and measure the output voltage from the generator. Connect the generator to the resistor using two arbitrary lines of the three phases (**WARNING!** Start at the highest line-to-line resistance on the three-phase resistor box), use one multi-meter to measure the current through the load and one to measure the voltage across the resistor.

Vary the load resistance on the box from high to low, and measure the current and voltage at each resistance value. Plot the droop line $V(I)$ of the generator, and calculate the generator's resistance using the equation obtained above.

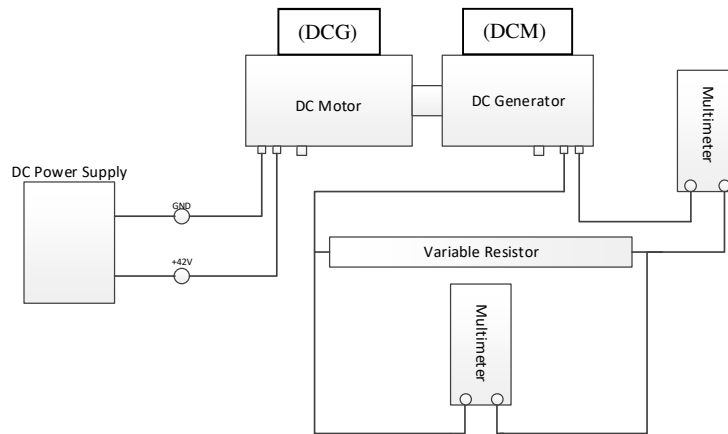


Figure 1. Layout for droop line experiment

2.2 Droop Line of Parallel Load Sharing

Disconnect the variable resistive load from the generator. Team up with another group to use a second DC motor and generator set up and experiment with parallel operation of generators. Connect the second motor to a DC power supply and apply 20V. Measure the output voltage of the second generator and adjust the voltage to the motors so the output voltages of the two generators match. Once the output voltages match (record this number for the droop line plot), connect both generators to the load box. Using multi-meters, measure the current from each generator and the voltage across the load resistance.

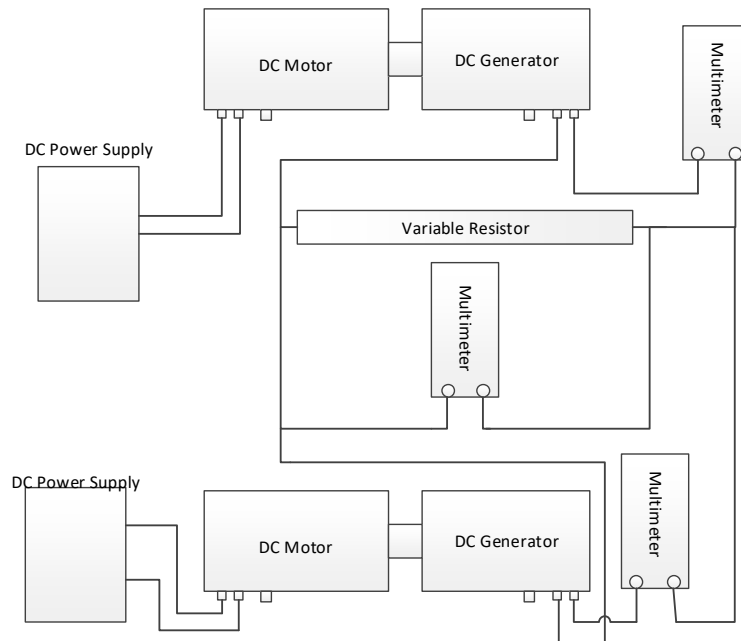


Figure 2. Layout for droop line of 50:50 load sharing experiment

Vary the load resistance and note the voltage and current at each resistance value. Plot the droop line of both motors to show the current produced by generator 1 and generator 2, as well as the total current going through the resistor ($I_1 + I_2$). Then, using your knowledge of

parallel operation, calculate what the slope of the parallel droop line is and compare to the value expected from the previously calculated resistance values of the individual generators. Be sure to include the data point where the current is zero. How far is the plot from the expected 50:50 load sharing? Comment on anything unexpected and possible reasons for the outcome.

3. Report Requirements:

Use the following as a guideline when preparing the lab report:

- Introduction with objectives
- Include the equipment number of all of the major components used
- Droop line equation and calculations
- Droop line plot of single generator
- Calculated resistance value from droop line slope
- Parallel droop line plots
- Calculated resistance value from parallel droop line slope
- Comments on expected droop line vs. measured droop line
- Provide a conclusion summarizing the concepts and procedures covered in this lab. Also, describe what worked well and did not work well in this lab, and make suggestions for possible improvements.