A DEMO Manual for Virtual laboratory of DC Electrical Machines

(POUYA Software)

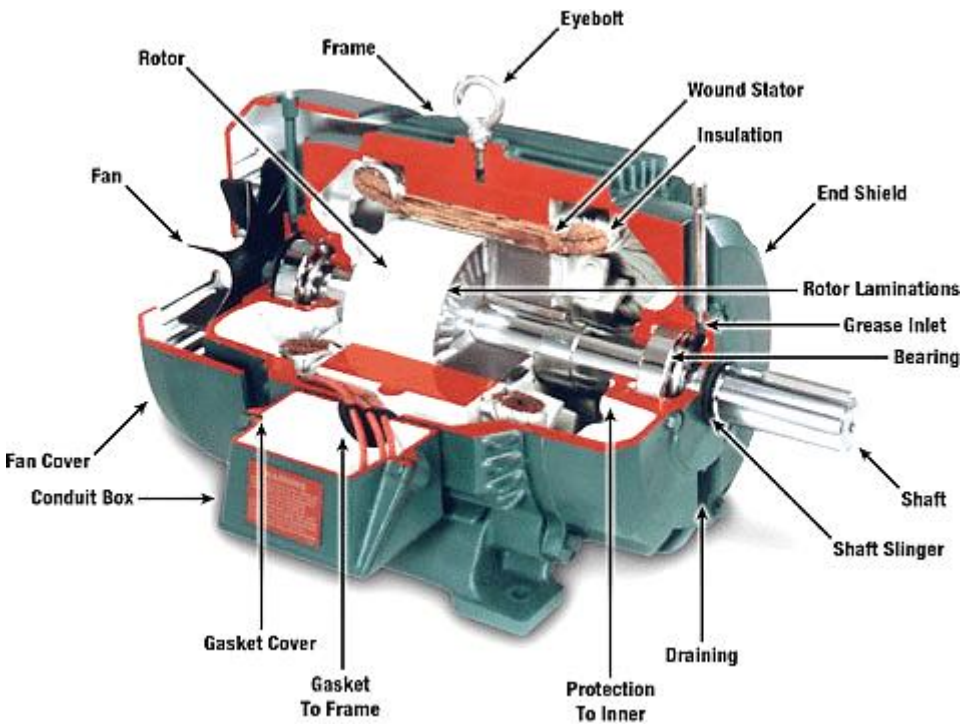


Table of Contents

1. No-load and Full-load characteristic of separately excited DC

Generator Preparation and initial report: 4

Experiment description 4

No-Load Test 4

Load Test: 7

Discussion and conclusion 8

Simulate all types of loads including DC machines in a glance 9

2. No-Load and Load curve of Series DC Generator 11

Preparation and initial report 11

Experiment description 12

No-Load Test 12

Load Test: 13

Discussion and conclusion 14

3. No-Load and Load curve of DC Compound Generator 15

Preparation and initial report 15

Experiment description 16

No-Load Test 16

Load Testing 17

Discussion and conclusion 19

4. Series DC Motor 20

Preparation and initial report: 20

Testing Procedure 21

No-Load Test 21

Discussion and conclusion 22

5. DC shunt motor 23

Preparation and initial report 23

Testing Procedure: 24

Load Testing 24

No-Load Testing 25

Discussion and Conclusion 25

6. Separate excitement motor 26

Preparation and initial report 26

Testing Procedure 27

Load Testing 27

No-Load Testing 28

Discussion and Conclusion: 28

7. Compound DC Motor 29

Preparation and initial report 29

Testing Procedure 29

Load Testing 29

Load Testing for a flat compound motor: 30

Load Testing for Over-Compound generator: 30

Load Testing for Under-Compound Motor 30

Load Testing for Differential-Compound motor: 31

Discussion and conclusion 31

1. No-load and Full-load characteristic of separately excited DC generator

Preparation and initial report:

In Separately excited dc generator, excitation winding is excited through a separate DC voltage source. In these generators, the excitation current is independent from terminal current and therefore voltage control is a much easier process. The circuit for separately excited dc generator is as shown in Figure 1.1.

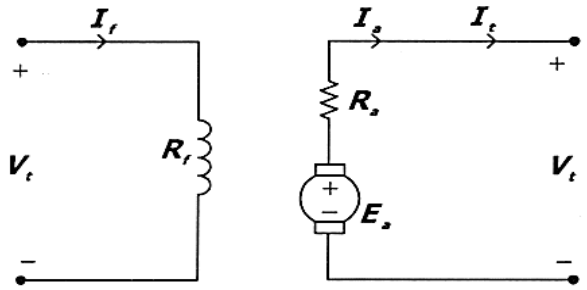


Figure 1.1: The circuit for separately excited dc generator

In order to obtain the No-Load characteristic curves of generators, the best way is to employ separately excited DC Generators. The reason is obvious and can be explained by the students themselves.

Experiment description

No-Load Test

In DC generator tests, in order to rotate the shaft and produce electricity, a mechanical exciter is needed which in industrial complex, it may be a Diesel Motor. In this virtual Laboratory, A compound DC Motor has been used for providing the shaft power.

Run POUYA; retrieve the circuit of a separately excited generator according to the explanations described at: http://www.tomcad.com/labs/POUYAlabs.pdf document. Briefly, after running POUYA Software and clicking on "Labs" icon from the main menu of POUYA this will bring you a list of labs. Choose "DC Machine Lab 1" that will bring the DC machine lab networks list. From the list provided under "Network Name" select and retrieve "DC Lab 1.1". The Single Line Diagram (SLD) together with the steady state result is shown in figure 1.2. In order to get familiar with POUYA software results please review the video file that is presented in the Lab.

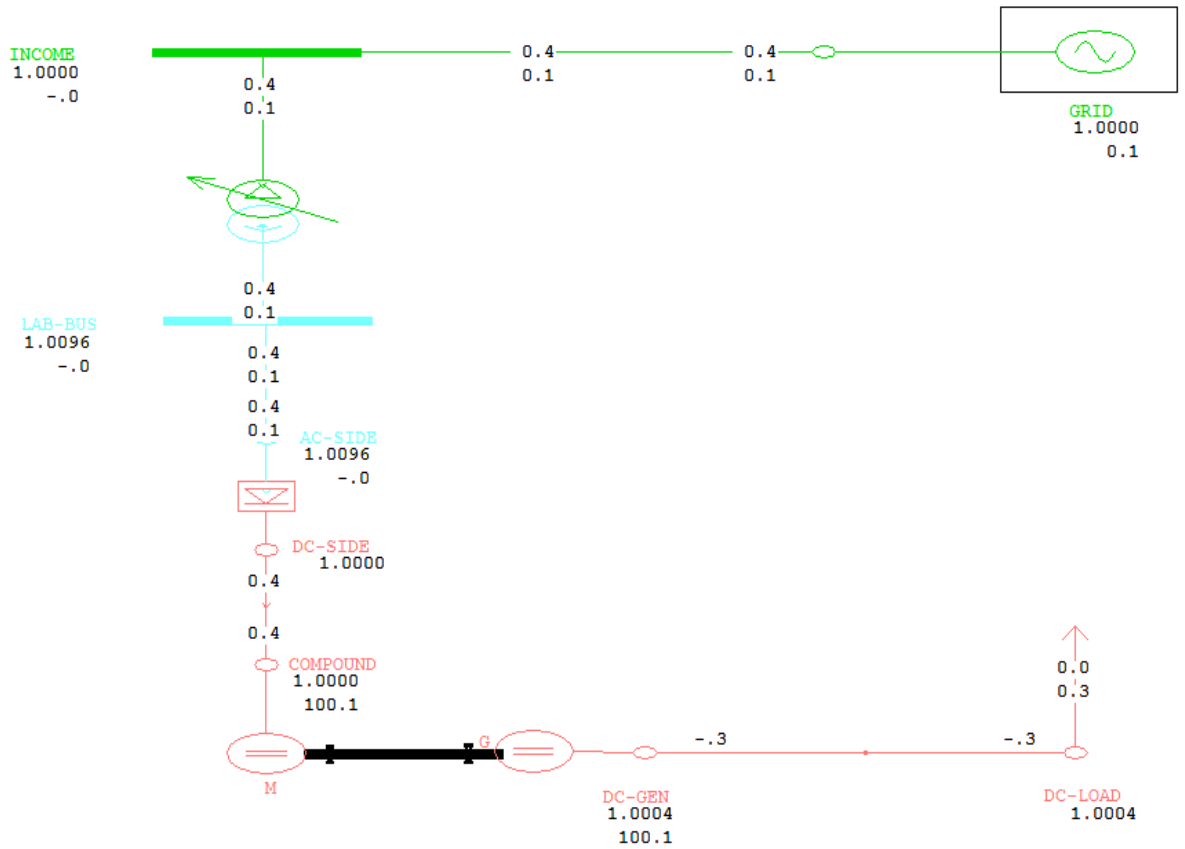


Figure 2.1 No-Load Test of separately excited DC generator

Note that during the Test, the speed (the value 100.1 as shown on SLD) must be remained constant. To do so, you need to click on the specified section on the compound Motor as shown in figure 1.3. Clicking on this section will change

the Motor excitation; keep the speed 100.1% on nominal value during the test (100% corresponds to 1500 rpm).

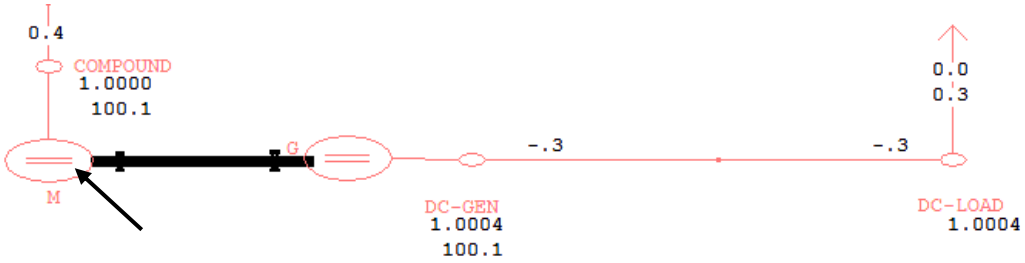


Figure 1.3 Adjusting the excitation of Compound Motor

Now, by clicking on the specified part in Figure 1.4, reduce the exciting current gradually from 1 to 0 and another time, increase it from 1 to 1.8. Watch out the menu bar as shown below to find out the control actions results (review 11 pages quick manual by selecting help to get familiar with menu bar concept in POUYA).

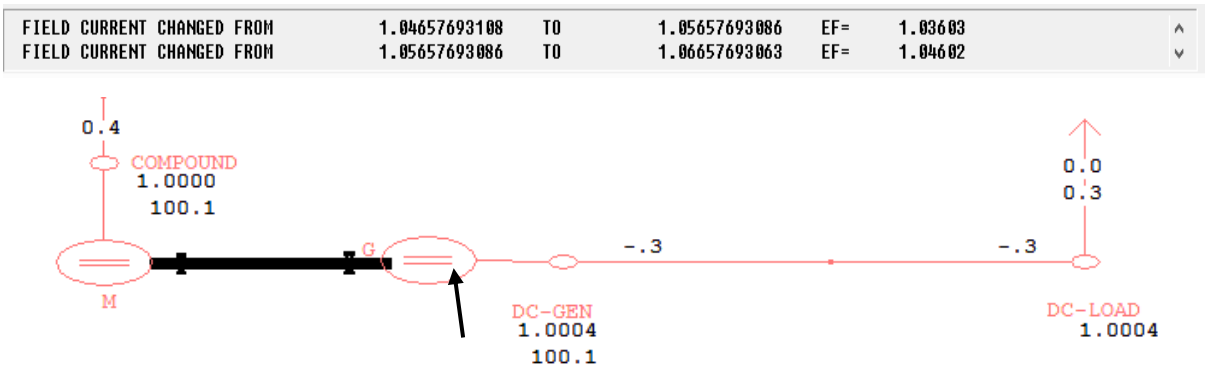


Figure 1.4 Increasing and Decreasing the Motor Excitation

Write down the results of each step of changes to the table below. You need to extract them from menu bar located at the top of network.

Keep doing until Saturation ($E_a = 220 * E_F$).

I_f																
E_a																

Load Test:

After running POUYA Software click on "Labs" icon from the main menu of POUYA this will bring you a list of labs. Choose "DC Machine Lab 1" that will bring the DC machine lab networks list. From the list provided under "Network Name" select and retrieve "DC Lab 1.2". The Single Line Diagram (SLD) together with the steady state result is shown in figure 1.2. In order to get familiar with POUYA software results please review the video file that is presented in the Lab.

Put the speed of two Motors in their nominal value (1500 rpm). By clicking on specified part in Figure 1.5, change the load until the current become 13A or so (note that for reading currents, press key "6" when you are in real time simulation).

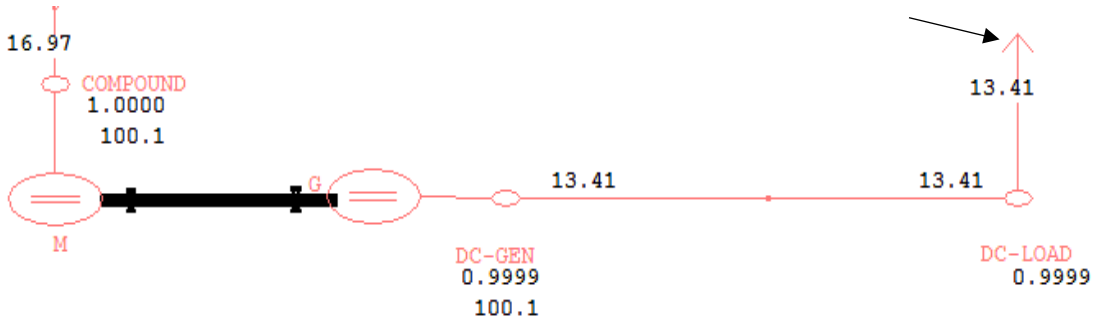


Figure 1.5 Changing method of the Load

Click on the specified part as shown in Figure 1.5 and described in POUYA quick manual, and gradually decrease the load into 1 (Amp.). For different load currents, see the voltage output and write it down on Table below:

Ia													
Vt													

Click on LAB blue bottom to bring the answer sheet and answer the questions. To answer these questions you need to follow up the below discussion and conclusions.

Discussion and conclusion

1. Draw the No-Load characteristic of the machine.

2. Draw external characteristic of the machine.

3. Draw the reaction characteristics of the machine. Explain the method to draw this characteristic and discuss about it.

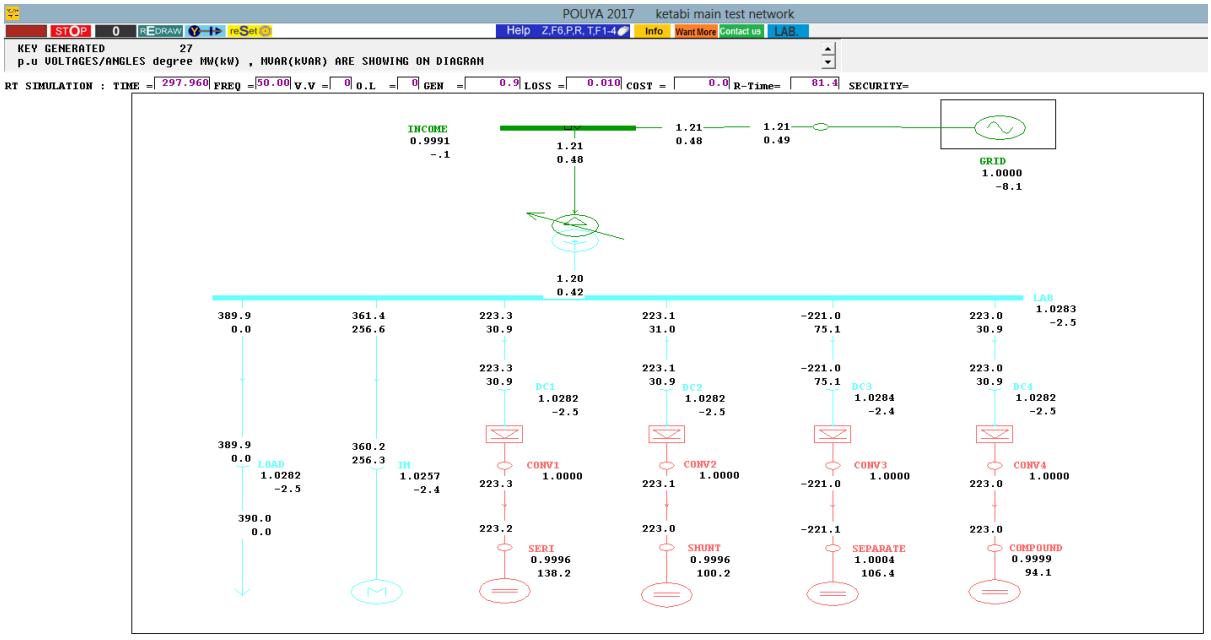
4. Regarding the shape of No-Load characteristic, what is your idea about the best place for operating point of the machine: Linear area, the knee area, or the saturation area? Why?

5. If in the No-Load Test, we cannot keep the speed constant, how we may manipulate the results to obtain the No-Load characteristic for a constant speed?

6. What are the applications of separately excited generator?

Test No. 1 DC separately excited generator

The comparison between the performance of DC generators and the static and induction loads can be made by simulating the below lab single line diagram. In here the name SERI represents series excited DC motor, SHUNT stands for shunt DC motor, SEPARATE and COMPOUND represent the associated DC machines. Please note that the SEPARATE machine is actually a generator that feeds power to the network as the minus sign in the diagram clearly indicates the generation property.



Simulate all types of loads including DC machines in a glance

Please send an email to smk@tomcad.com for full exercise and the files.

Continued……