

Iowa State University
Electrical and Computer Engineering
E E 452. Electric Machines and Power Electronic Drives

Laboratory #1
Introduction to Simulink and ASMG Modeling Software

Summary

Basic concepts of computer simulation of power electronics circuits using MATLAB/Simulink and the Automated State Model Generator (ASMG) are introduced.

Learning objectives

- Simulate power electronics circuits using software tools.
- Understand what ASMG is and how it is used.
- Use MATLAB/Simulink and ASMG to simulate simple rectifier circuits.

Background material (should be read before coming to the lab)

- Simulink Getting Started Guide
- Trzynadlowski chapter 1.1–1.2, pp. 1–7
- Trzynadlowski chapter 1.6, pp. 31–43

Exercises and Questions

Instructions: every student should deliver his/her own report at the end of the lab session, even though the experiments are conducted in groups. You may want to answer the questions as you go along the exercises. Time yourselves according to the recommendations below.

1. Introduction to the lab and student pre-assessment. [30 minutes]

Discussion of expectations and desired outcomes will be held, along with a written pre-assessment of student knowledge.

2. Getting Started with Simulink [45 minutes]

Create and run the simple Simulink model shown in Figure 1 and described in Part 3 of the *Simulink Getting Started Guide* (just follow the steps of the guide).

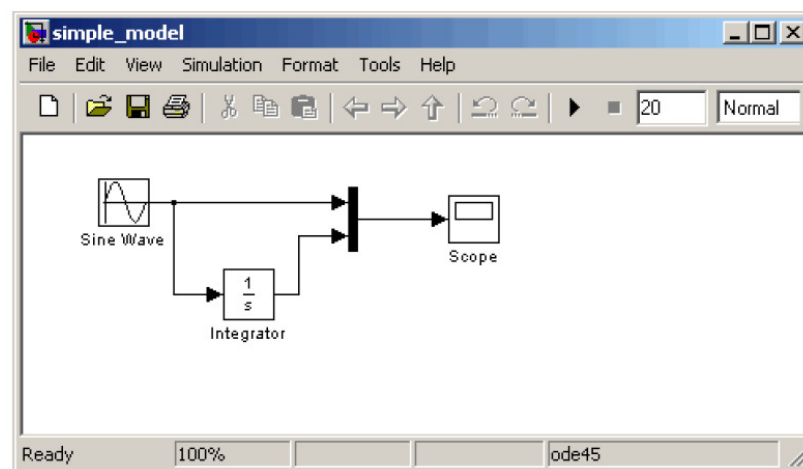


Figure 1. A simple model to understand the basics of MATLAB/Simulink.

DELIVERABLE 1: What is the amplitude and frequency of the sine wave source (what are the default values)?

DELIVERABLE 2: The Simulink tutorial asks you to set the maximum step size to 0.2 sec. Report what happens to the simulation if you set this value to 2 seconds, and then again if set to 0.002 sec. Why is simulation step size important?

3. Introduction to ASMG circuit modeling Library [45 minutes]

Create an ASMG simulation of the single-pulse diode rectifier with a freewheeling diode shown in Figure 2. The voltage source is sinusoidal, and has rms value 120 V and frequency 60 Hz; the load is a series-connected RL load, and its parameters are $R = 1\ \Omega$ and $L = 1\text{ mH}$. Adjust the various simulation parameters so that the simulation runs satisfactorily, with a simulation time of 0.1 s.

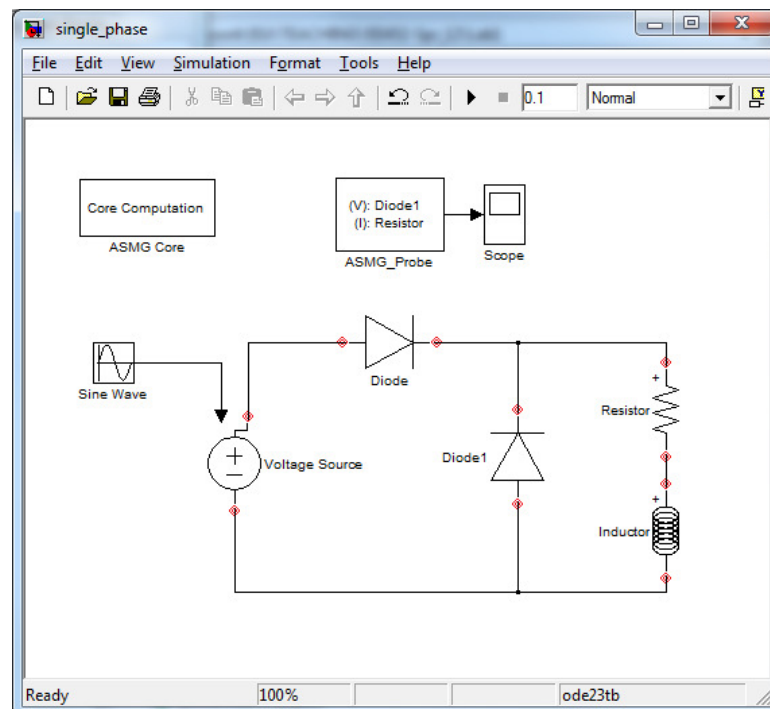


Figure 2. Simulink diagram of the single-pulse diode rectifier with freewheeling diode.

DELIVERABLE 3: Sketch by hand the variation of the output voltage and current, as observed in the simulation. Make sure that your plots are as accurate as possible by annotating them appropriately.

DELIVERABLE 4: Rerun the simulation using a ten times larger inductance, and discuss what happens.

DELIVERABLE 5: Explain how this circuit would have to be modeled in Simulink if ASMG (or a program with similar capabilities) were not available.

4. Two-pulse Diode Rectifier [45 minutes]

Create an ASMG simulation of the two-pulse diode rectifier shown in Figure 3 (modify the previous simulation). Use the same circuit parameters as earlier, with $R = 1 \Omega$ and $L = 1 \text{ mH}$.

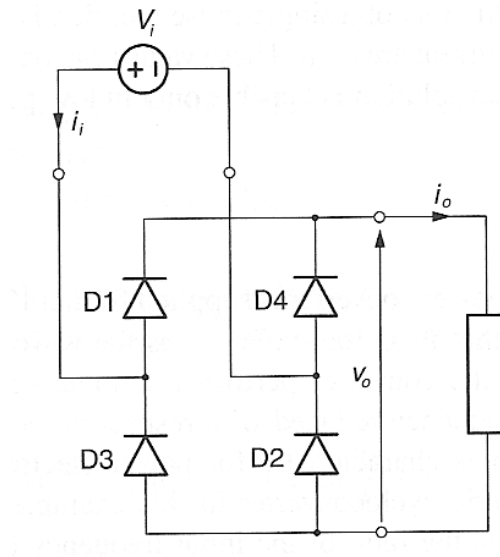


Figure 3. Simulink diagram of the two-pulse diode rectifier (from *Trzynadlowski*).

DELIVERABLE 6: Sketch by hand the variation of the output voltage and current, as observed in the simulation. Make sure that your plots are as accurate as possible by annotating them appropriately.

DELIVERABLE 7: Add an inductor $L_s = 1 \text{ mH}$ in series with the voltage source, and repeat the simulation. Do your best to explain what is happening in this case.

5. Conclusion [15 minutes]

Write about one or two things you learned in this lab that you think are important or interesting, and why.