Chapter 6: Power System Blockset (PSB)

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6.1-Introduction

Power System Blockset (PSB) is a Simulink toolbox that allows dynamic simulation of electric power systems. It models elements like generators, transformers, ...etc.The blockset uses the MATLAB/Simulink environment to represent common components and devices found in electrical power networks [10].

6.2 - Presentation of the Power System Blockset

6.2.1- Block library

Elements in the PSB block library are classified in various groups according to their nature: Electrical Sources, Elements, Power Electronics, Machines, Connectors, and Measurements.

Simulation results can be visualized with Simulink scopes connected to outputs of measurement blocks available in the PSB library. These measurement blocks acts as an interface between the electrical blocks and the Simulink blocks. The voltage and current measurement blocks can be used at selected points in the circuit to convert electrical signals into Simulink signals. Nonlinear elements requiring control, such as power electronic devices, have a Simulink input that allows control from a Simulink system.

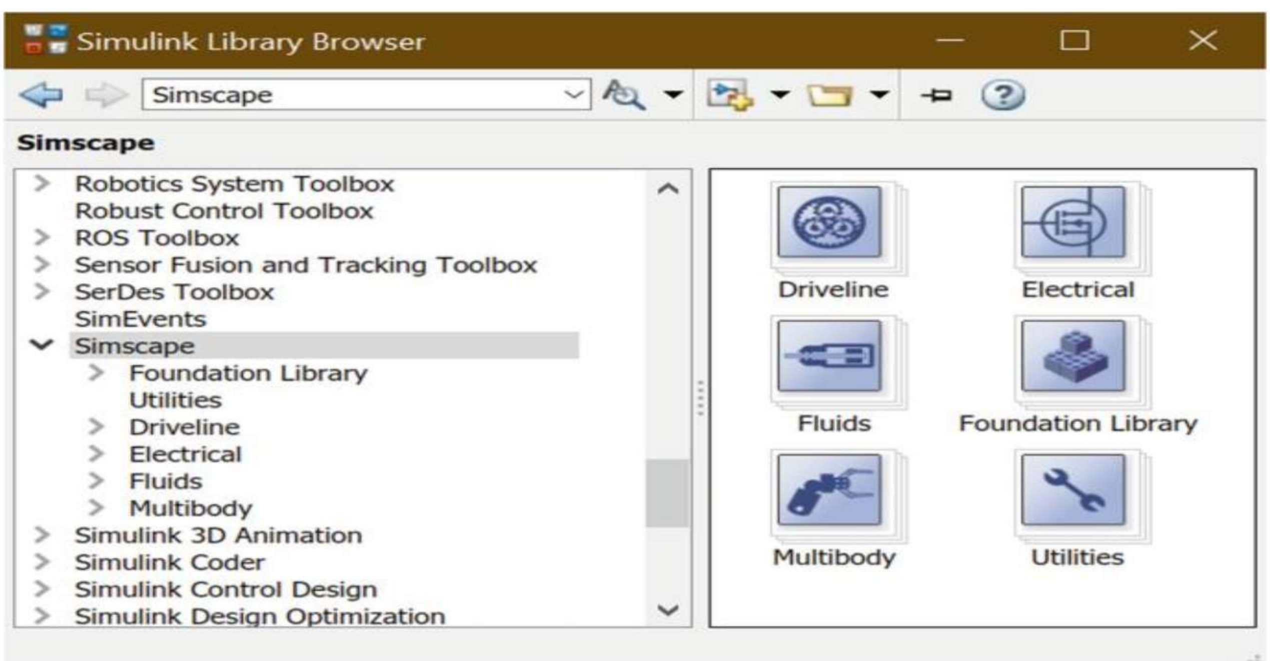


Figure 6.1 The Power System Blockset Library

6.2.2 - Study of a simulation example

6.3- Example

This example illustrates a Single-phase half-wave diode rectification (not controlled). This circuit will be used to illustrate simulate an AC/DC converter with different load and configuration.

The circuit built with the PSB schematic diagram is shown on Figure 6.1. The input is simulated with a AC Voltage source. The rectifier is a semiconductor device that converts AC voltage into DC voltage using a single diode. Thus, the analysis of the voltage and current evolutions at the output of the converter and semiconductors with resistive and inductive load, respectively are done. In addition, the study of inductive loads with Freewheeling Diode.

Three oscilloscopes are used to display waveforms while the simulation is running.

A. Resistive Load

For the shown half-wave rectifier, the source is a sinusoid of 100 Vrms at a frequency of 50 Hz. The load resistor is 10 Ω [11], [12].

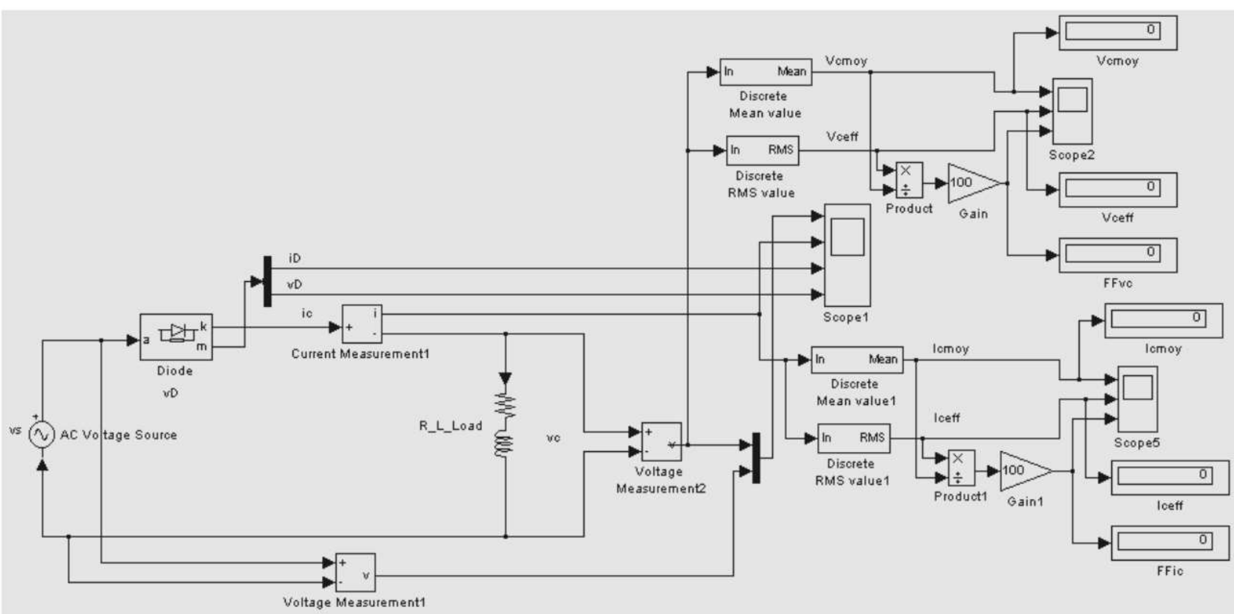


Figure 6.2 Single Phase Half Wave Rectifier (not controlled)

Simulation results obtained for a Single Phase Uncontrolled Half Wave Rectifier with Resistive Load are shown on Figure 6.3.

- For the positive half-cycle of the source in this circuit, the diode is on (forward-biased). Considering the diode to be ideal, the voltage across a forward-biased diode is zero and the current is positive. On the other hand, for the negative half-cycle of the source, the diode is reverse-biased, making the current zero. The voltage across the reverse-biased diode is the source voltage, which has a negative value.

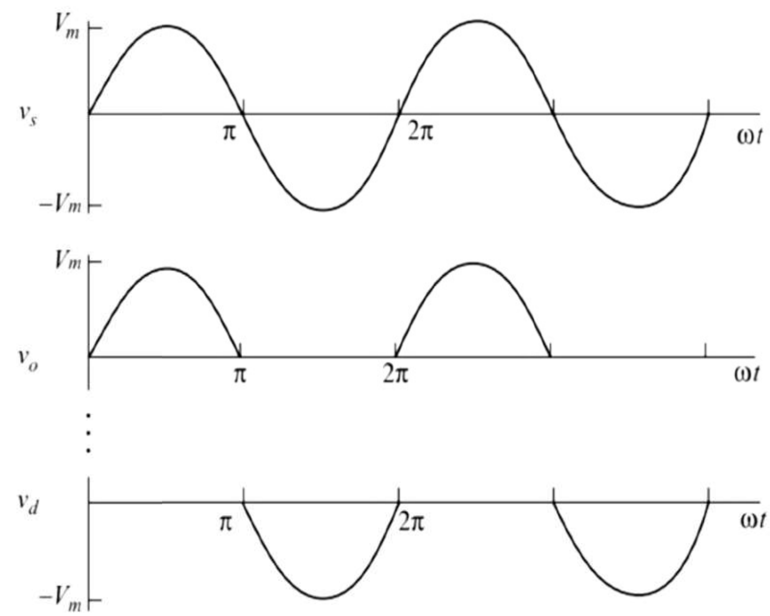


Figure 6.3 *Diagrams of the evolution of the supply voltages, rectified voltage and reverse voltage applied across the diode*

B. Inductive Load

In this case, the half-wave rectifier is the same circuit of Figure 6.2, with slight change in the load (R=10 Ω and L=0.1 H). The simulation results of this case are illustrates in Figure 6.4.

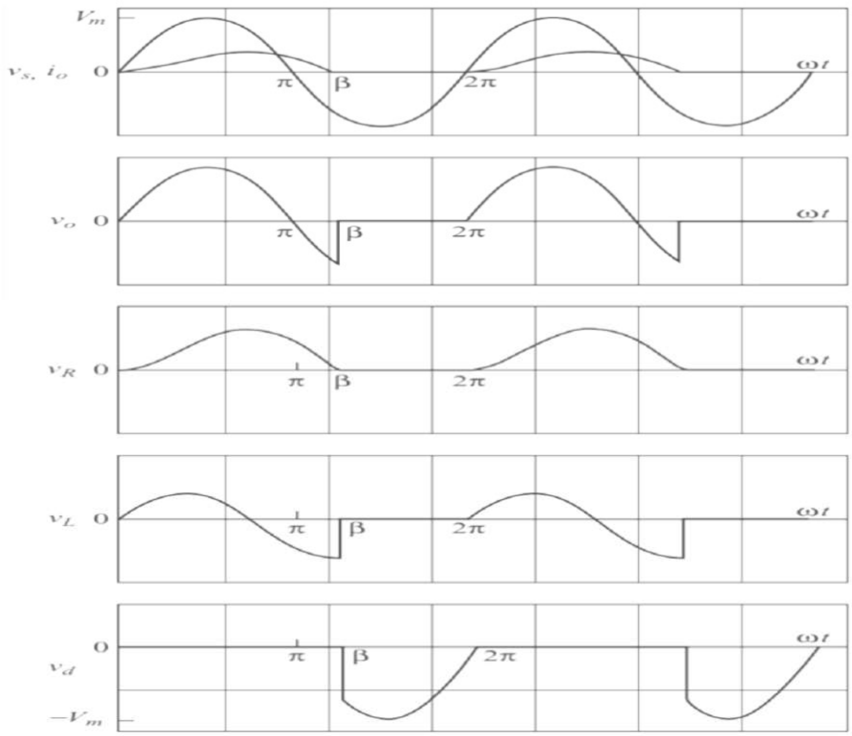


Figure 6.4 *Results of the evolution of the supply voltages, rectified current and voltage, resistance and inductance voltage, and reverse voltage applied across the diode*

C. Inductive Load with Freewheeling Diode

In this case, a freewheeling diode $\boldsymbol{D_2}$, can be connected across an RL load as shown in Figure 6.5.

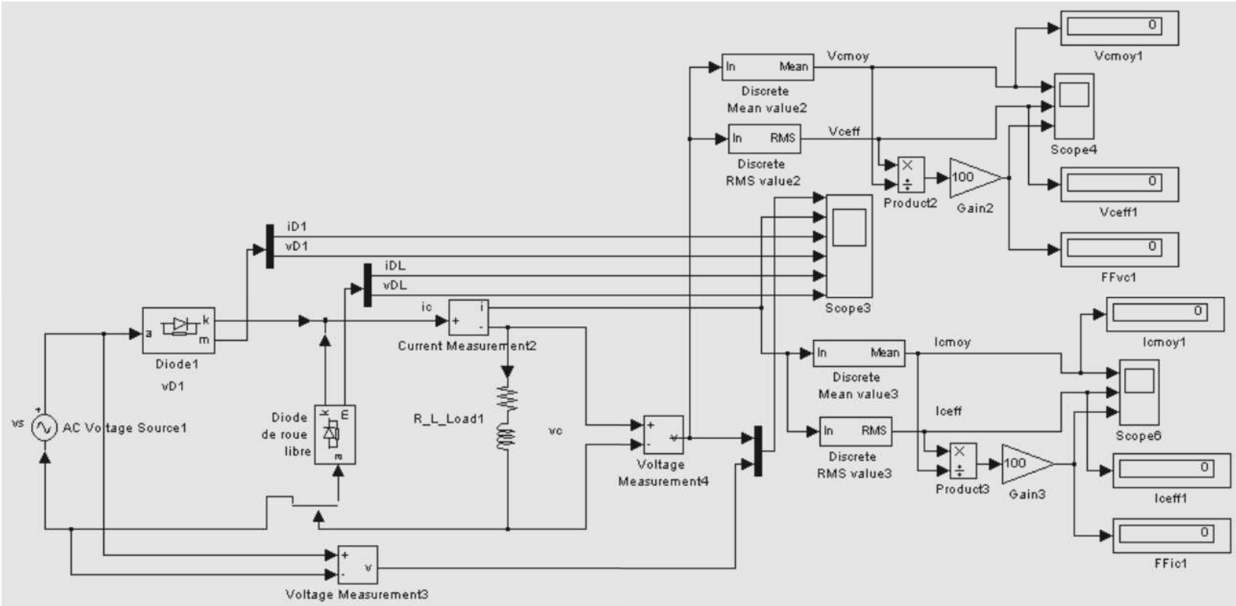


Figure 6.5 Single-phase half-wave diode rectification (RL load) with freewheeling diode

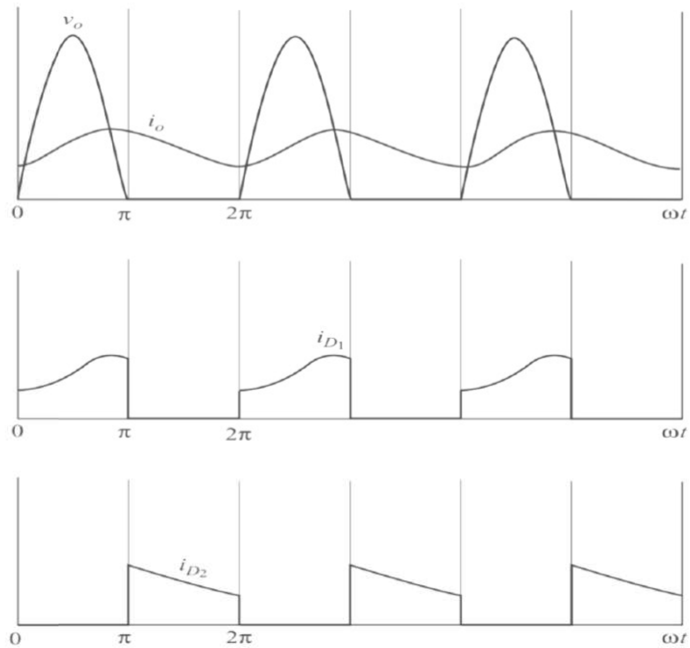
➢ Both diodes cannot be forward-biased at the same time. Diode D_1 will be **ON** when the source is positive, and diode D_2 will be **ON** when the source is negative.

- For a positive source voltage (D_1 is on. D_2 is off):

➢ The voltage across the RL load is the same as the source.

- For a negative source voltage (D_1 is off. D_2 is on):

➢ The voltage across the RL load is zero.



Simulation results of steady state load, source, and diode currents are shown in the Figure 6.6

***Figure 6.6** The evolution of rectified current and voltage, current across D_1 and D_2*

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