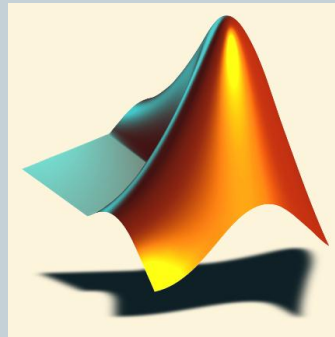


Lecture Series – 12

# SimPowerSystems

1



*Shameer Koya*

# SimPowerSystems Introduction

2

- Simulink library blocks dedicated to modeling, simulation and analysis of
  - electrical circuits,
  - electrical machines and drives,
  - static converters and
  - power energy systems
- SimPowerSystems library can be used with standard Simulink block diagrams to construct various connecting elements of a dynamic system, and their effects on the entire power system.

# SimPowerSystems Library Uses

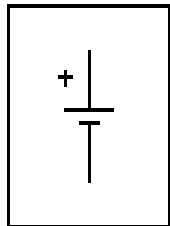
3

- Models and simulate electrical and electronic circuits using standard symbols such as resistor, coil, capacitor or diode, thyristor, transistor etc.
- Provides blocks that shape different types of electrical machines (MCC induction machine, synchronous machine), static converters (rectifiers in bridge inverters);
- Provides blocks for modeling a full power energy system (transport, distribution);
- Allows different methods of analysis of a system (electrical circuit) and calculated power transfer
- Displays voltage and current and other parameters in steady state

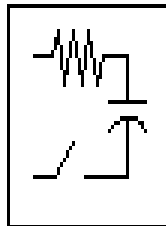
# SimPowerSystems library

4

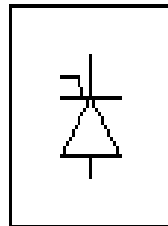
- contains nine libraries of electrical and electronic components (powerlib):



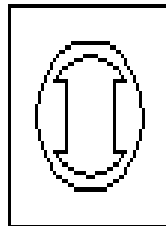
Electrical  
Sources



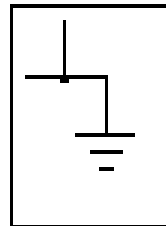
Elements



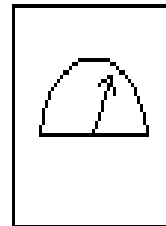
Power  
Electronics



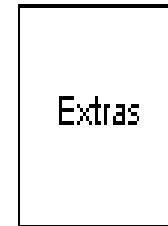
Machines



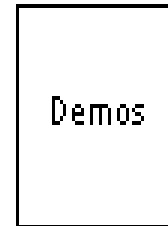
Connectors



Measurements



Extras



Demos

SimPowerSystems

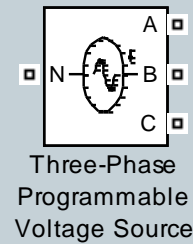
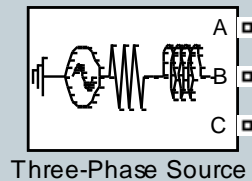
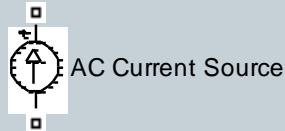
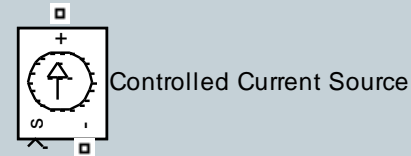
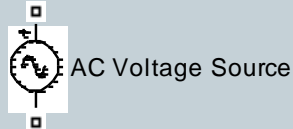
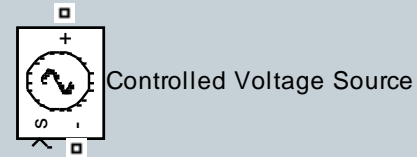
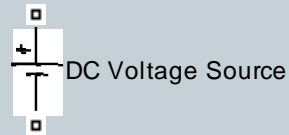
Copyright 1997-2002 TransEnergie Technologies, under sublicense  
from Hydro-Quebec, and The MathWorks, Inc.

powergui

# Electrical Sources

5

- Different electrical sources – DC/ AC



# Electrical Elements

6

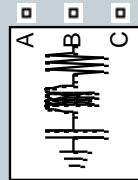
## Elements



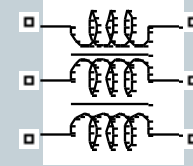
Series RLC Branch



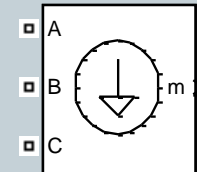
Series RLC Load



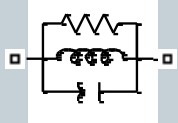
Three-Phase Series RLC Load



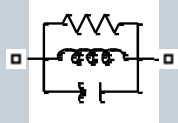
Mutual Inductance



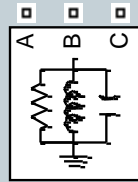
Three-Phase Dynamic Load



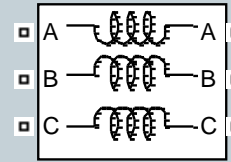
Parallel RLC Branch



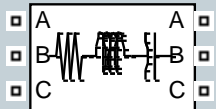
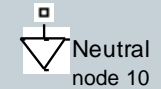
Parallel RLC Load



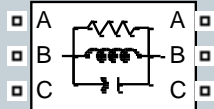
Three-Phase Parallel RLC Load



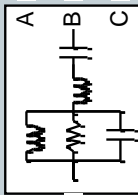
Three-Phase Mutual Inductance Z1-Z0



Three-Phase Series RLC Branch



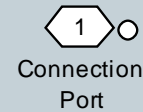
Three-Phase Parallel RLC Branch



Three-Phase Harmonic Filter



Surge Arrester

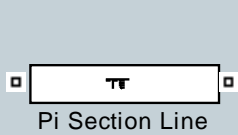


Connection Port

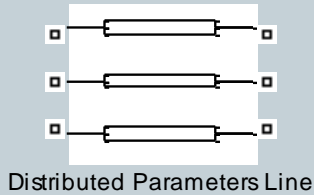
# Elements .....

7

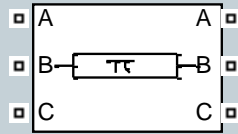
## Lines



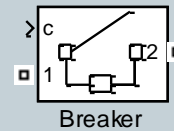
Pi Section Line



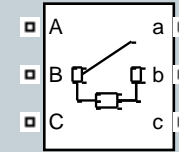
Distributed Parameters Line



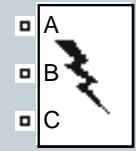
Three-Phase  
PI Section Line



Breaker

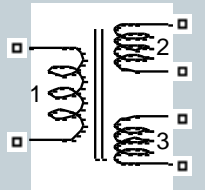


Three-Phase Breaker

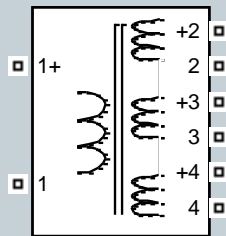


Three-Phase Fault

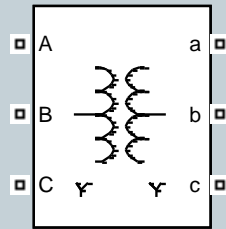
## Transformers



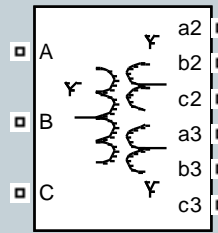
Linear Transformer



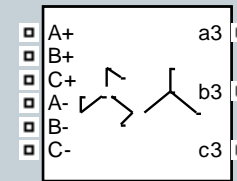
Multi-Winding  
Transformer



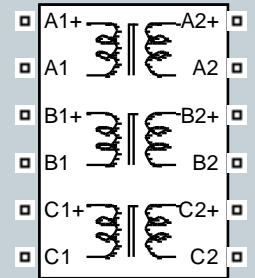
Three-Phase  
Transformer  
(Two Windings)



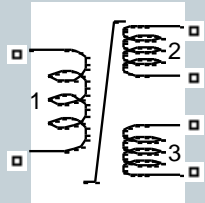
Three-Phase  
Transformer  
(Three Windings)



Zigzag  
Phase-Shifting Transformer



Three-Phase Transformer  
12 Terminals



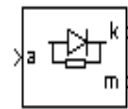
Saturable Transformer

# Power Electronics

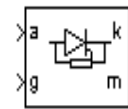
8

- SimPowerSystems library provides a set of blocks dedicated to the modeling of electronic devices (diodes, thyristors and transistors) and static converters (rectifiers and inverters single phase or three phase bridge) called Power Electronics

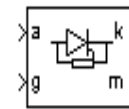
## Devices



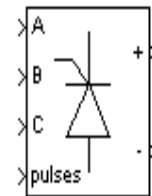
Diode



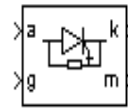
Thyristor



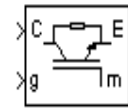
Detailed Thyristor



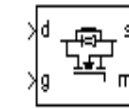
Universal Bridge



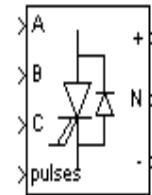
Gto



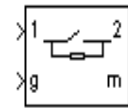
IGBT



Mosfet



Three-Level Bridge



Ideal Switch

## Extras

Discrete Control blocks

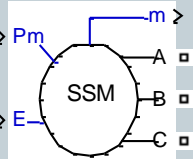
Control blocks



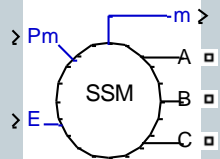
# Machines

9

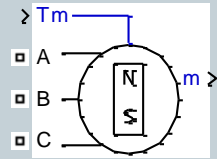
## Synchronous Machines



Simplified Synchronous Machine pu Units

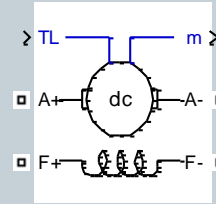


Simplified Synchronous Machine SI Units

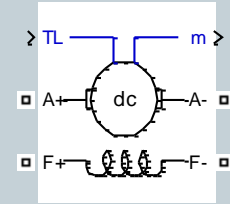


Permanent Magnet Synchronous Machine

## DC Machines

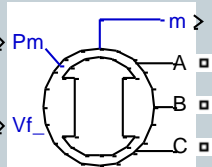


DC Machine

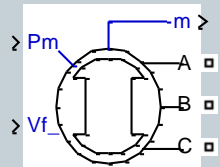


Discrete DC Machine

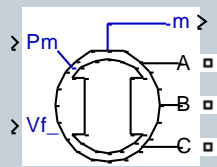
## Prime Movers and Regulators



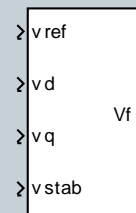
Synchronous Machine pu Fundamental



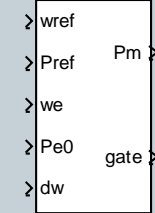
Synchronous Machine Standard



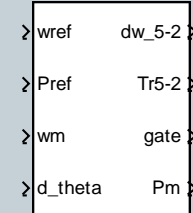
Synchronous Machine SI Fundamental



Excitation System

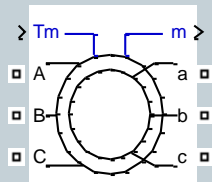


Hydraulic Turbine and Governor

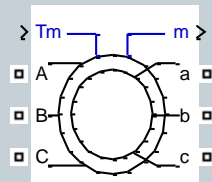


Steam Turbine and Governor

## Asynchronous Machines

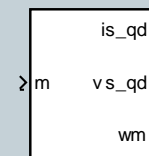


Asynchronous Machine pu Units



Asynchronous Machine SI Units

## Machine Measurements



Machines Measurement Demux



Generic Power System Stabilizer

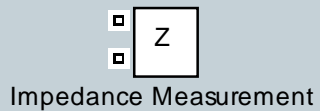
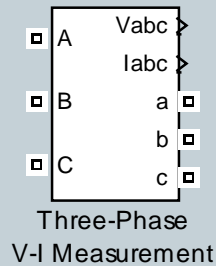
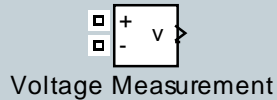
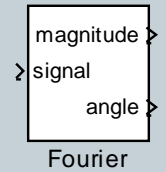
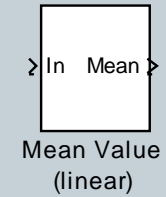
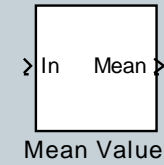
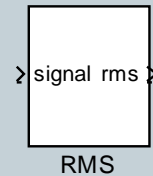
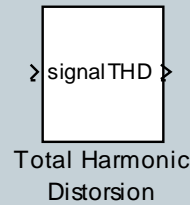
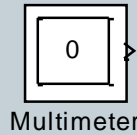
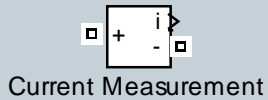


Multi-Band Power System Stabilizer

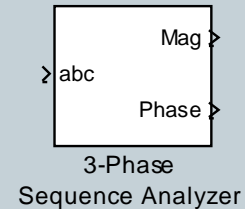
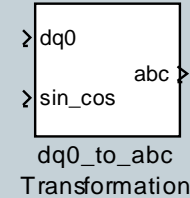
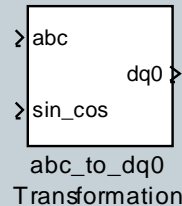
# Measurements

10

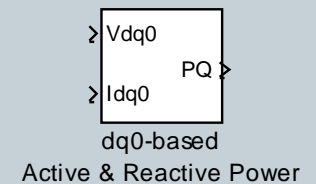
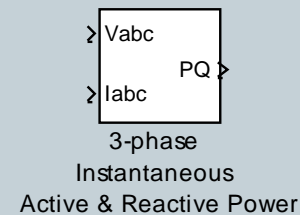
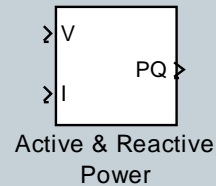
## Single-Phase Measurements



## Three-Phase Measurements



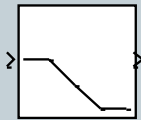
## Power Measurements



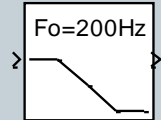
# Discrete Control and Control blocks

- dedicated control blocks composed of both static converters and various configurations of filters and discrete controllers:

## Filters

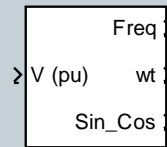


1st-Order Filter

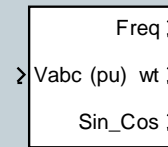


2nd-Order Filter

## Phase-Locked Loop (PLL) Systems

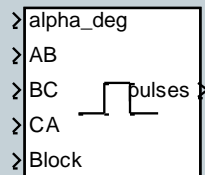


1-phase PLL

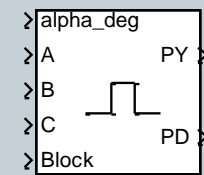


3-phase PLL

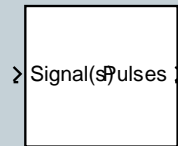
## Pulse Generators



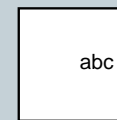
Synchronized 6-Pulse Generator



Synchronized 12-Pulse Generator

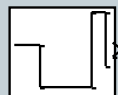


PWM Generator

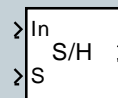


3-phase Programmable Source

## Miscellaneous



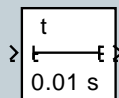
Timer



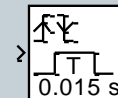
Sample & Hold



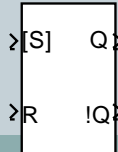
Edge Detector



On/Off Delay



Monostable

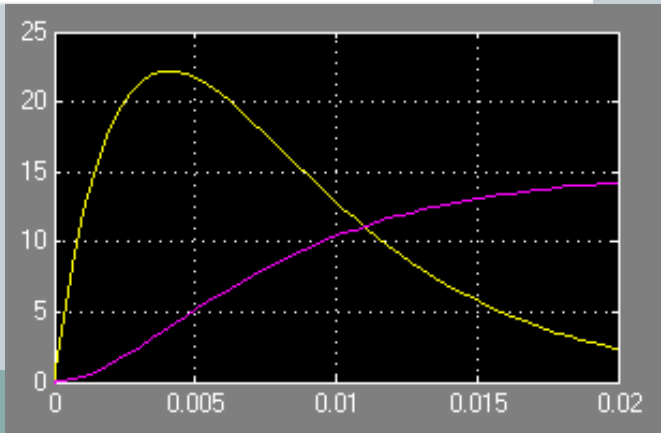
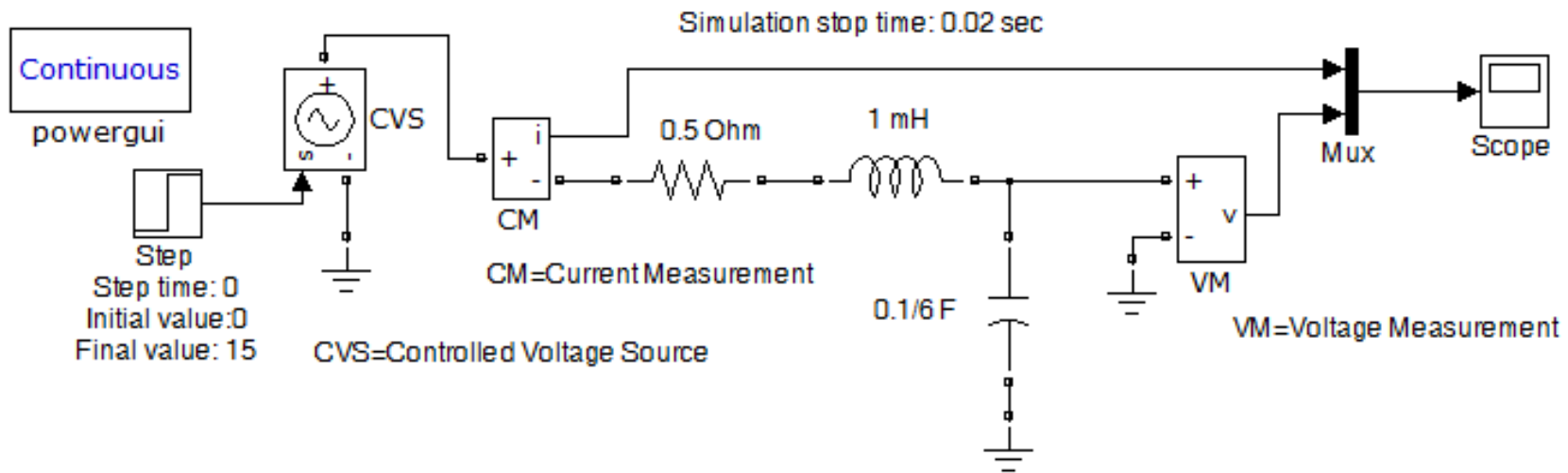


Bistable

# Making of RLC Circuits

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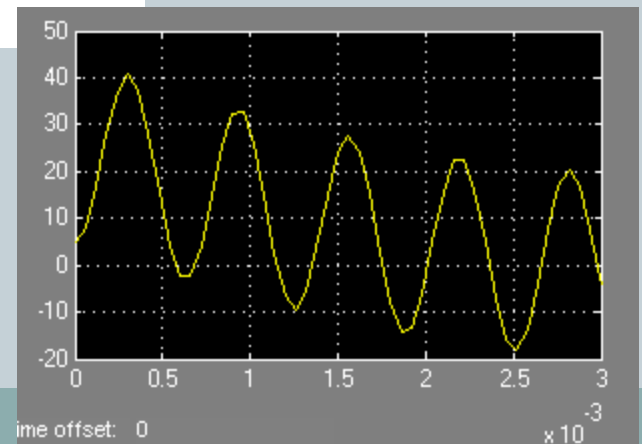
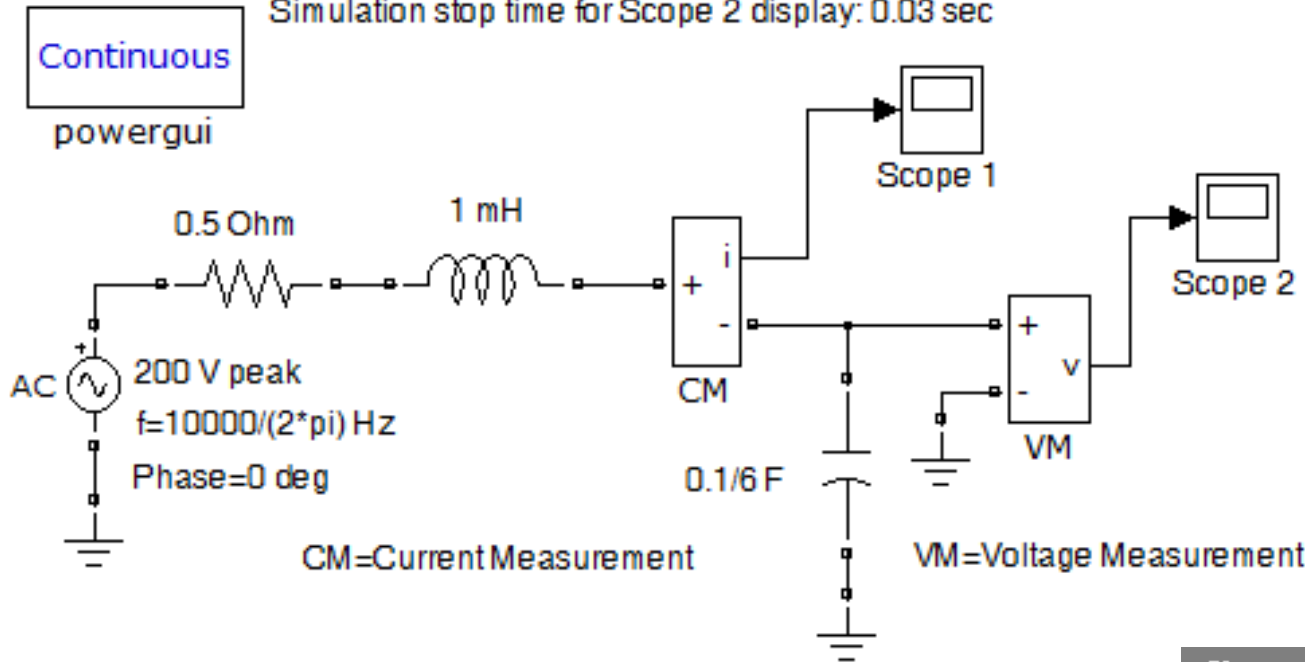
- [RLC Video](#)



# RLC AC Response

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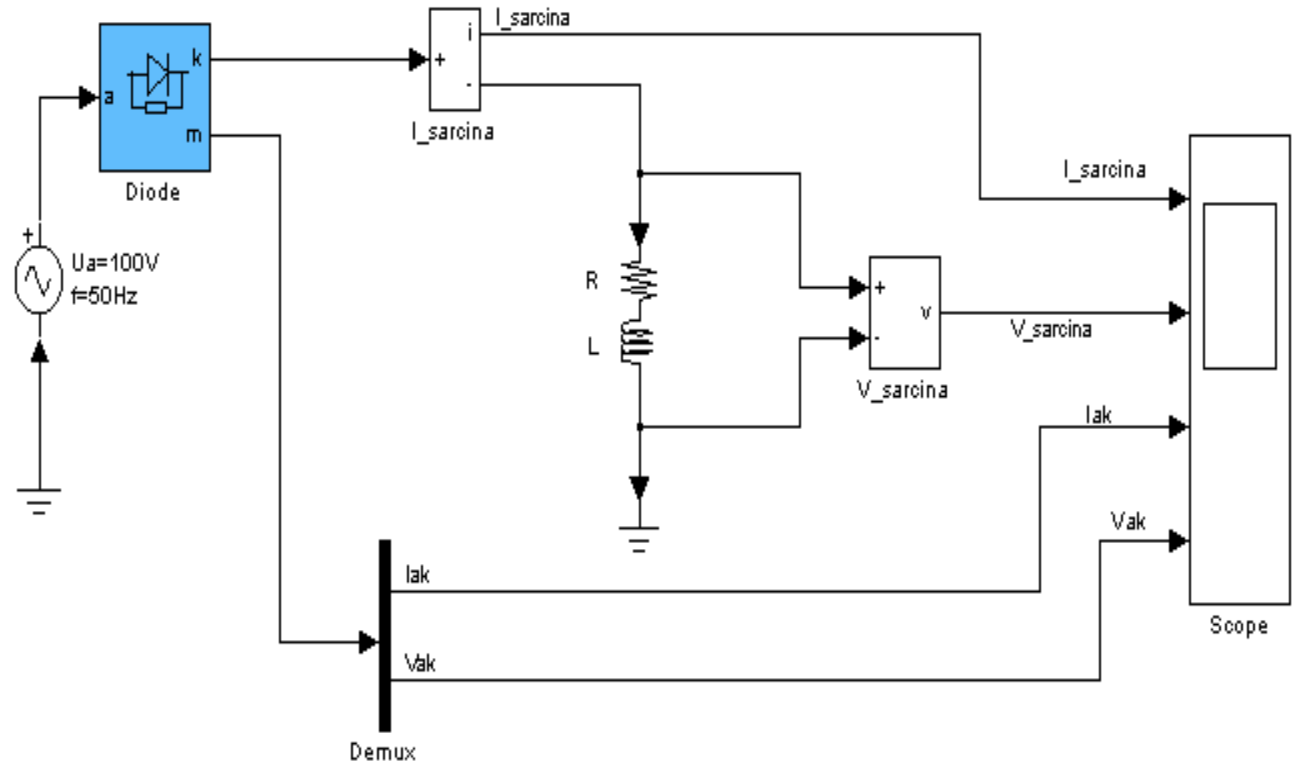
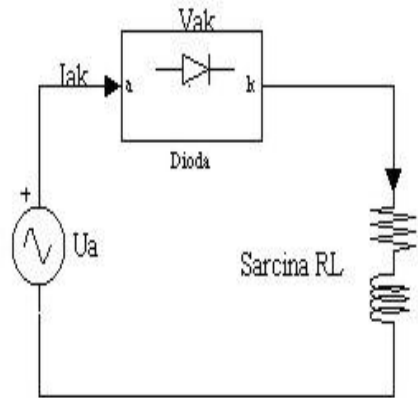
Simulation stop time for Scope 2 display: 0.03 sec



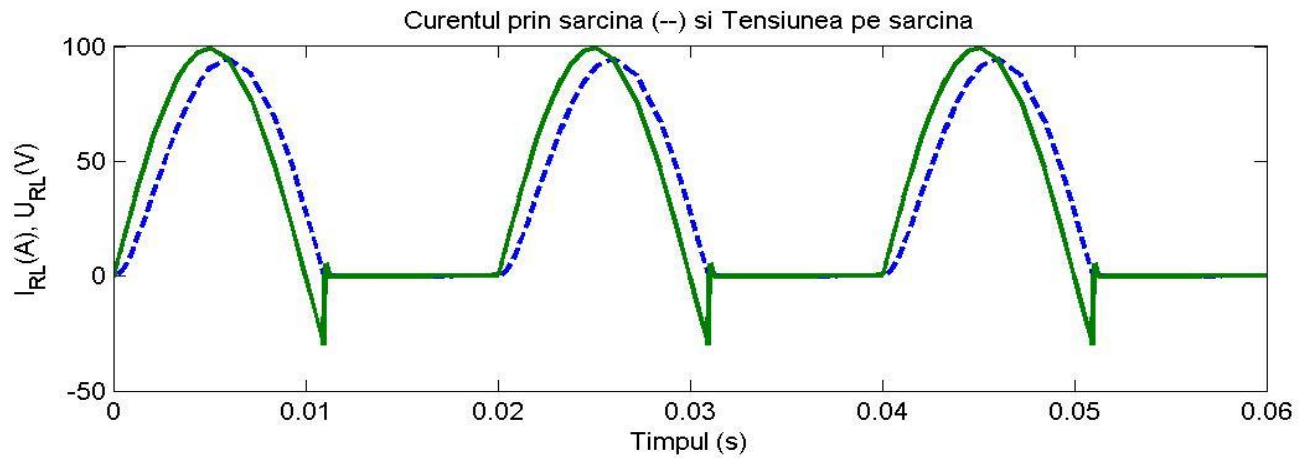
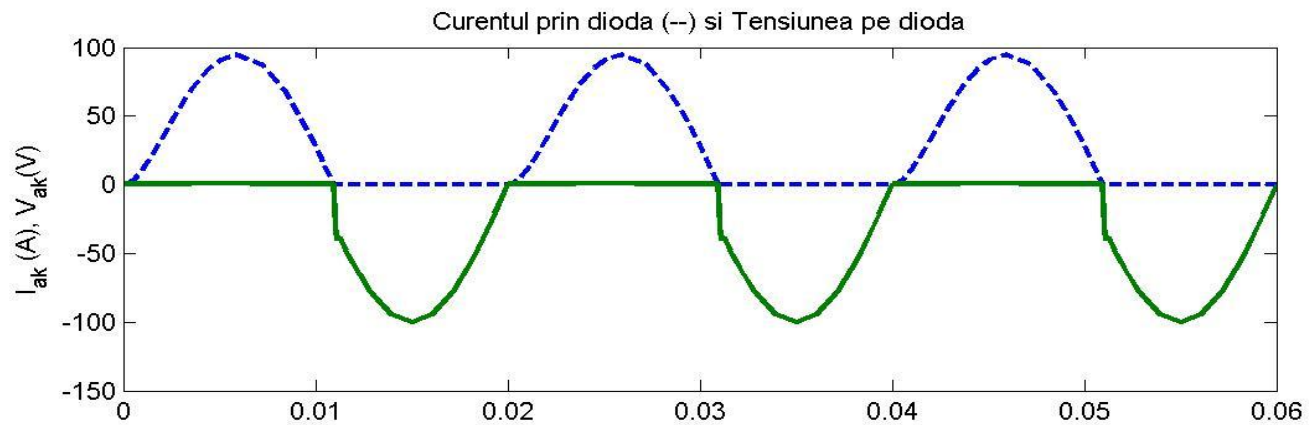
# Diode rectifier – Half wave

14

- Rectifier Voltage

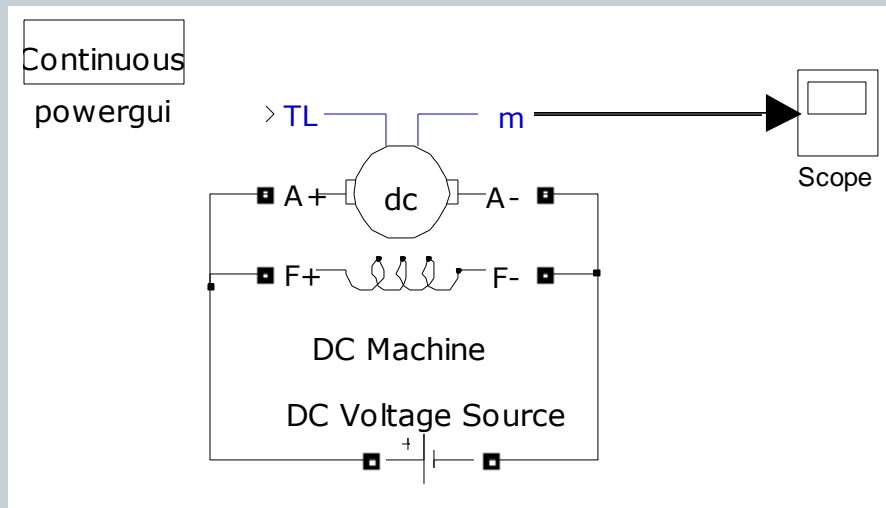


Redresor monoalternanta



# DC Motor model

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# Thank You

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That's all

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Wish you 'All the best'