Electric Circuit Analysis using Simulink

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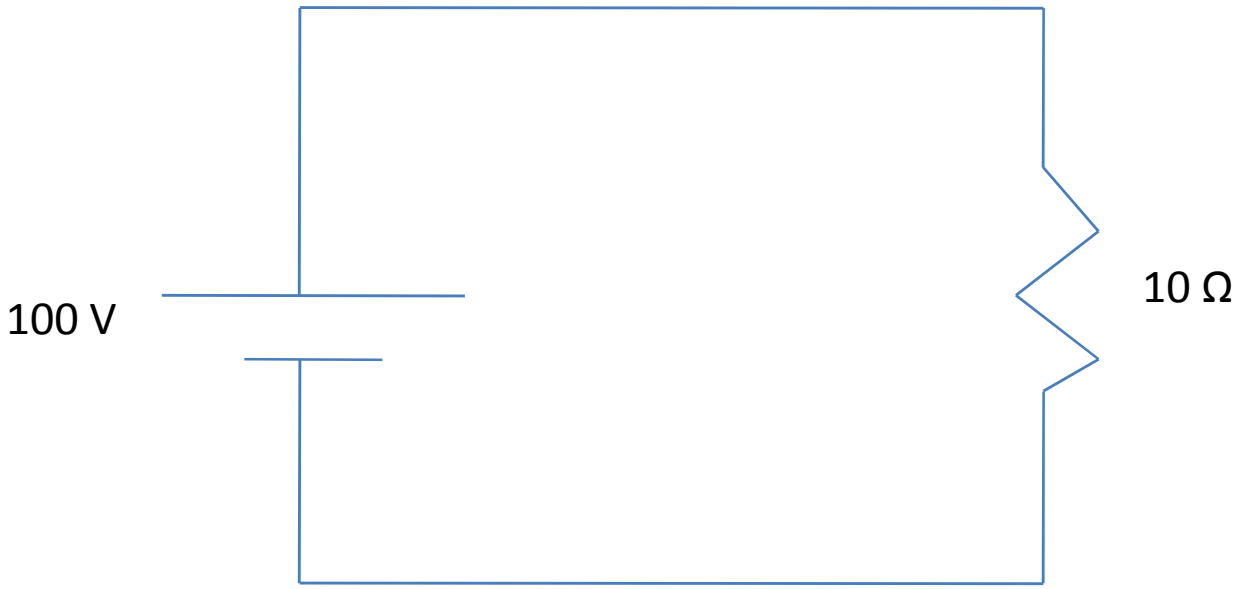
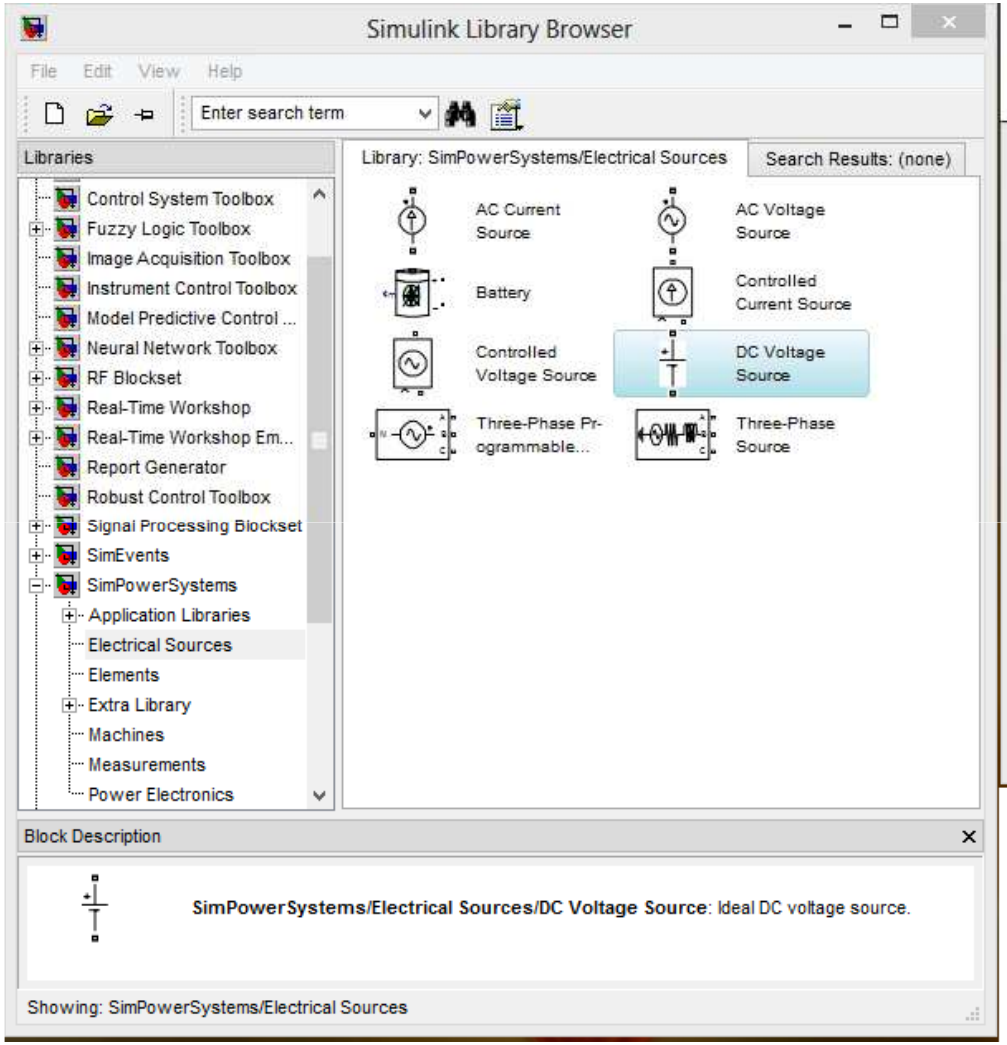
To start with

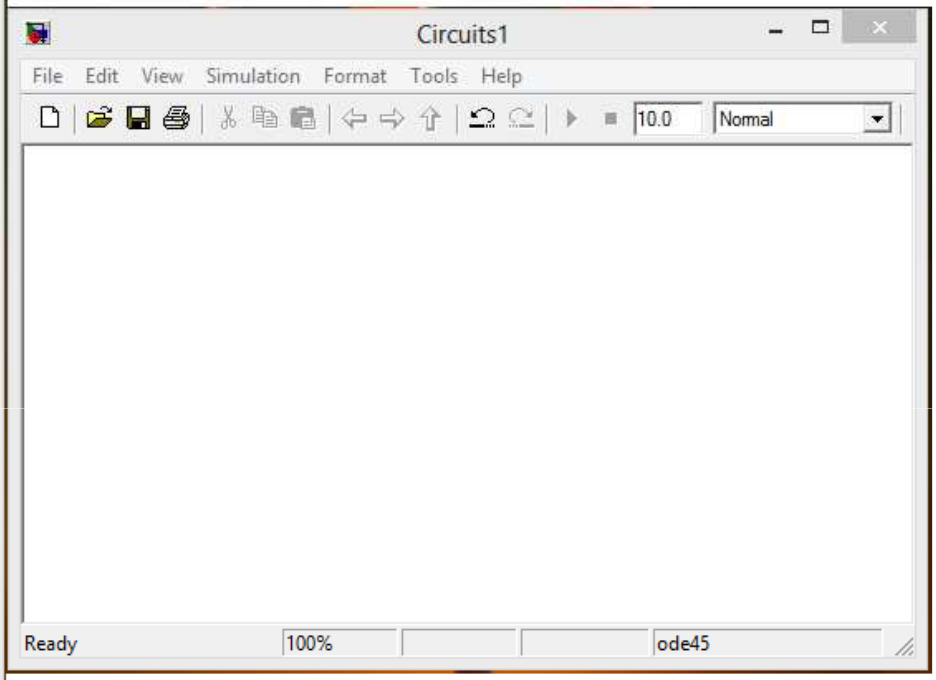
Simulate the simple DC circuit shown below in Simulink and calculate the voltage, current & power in it.

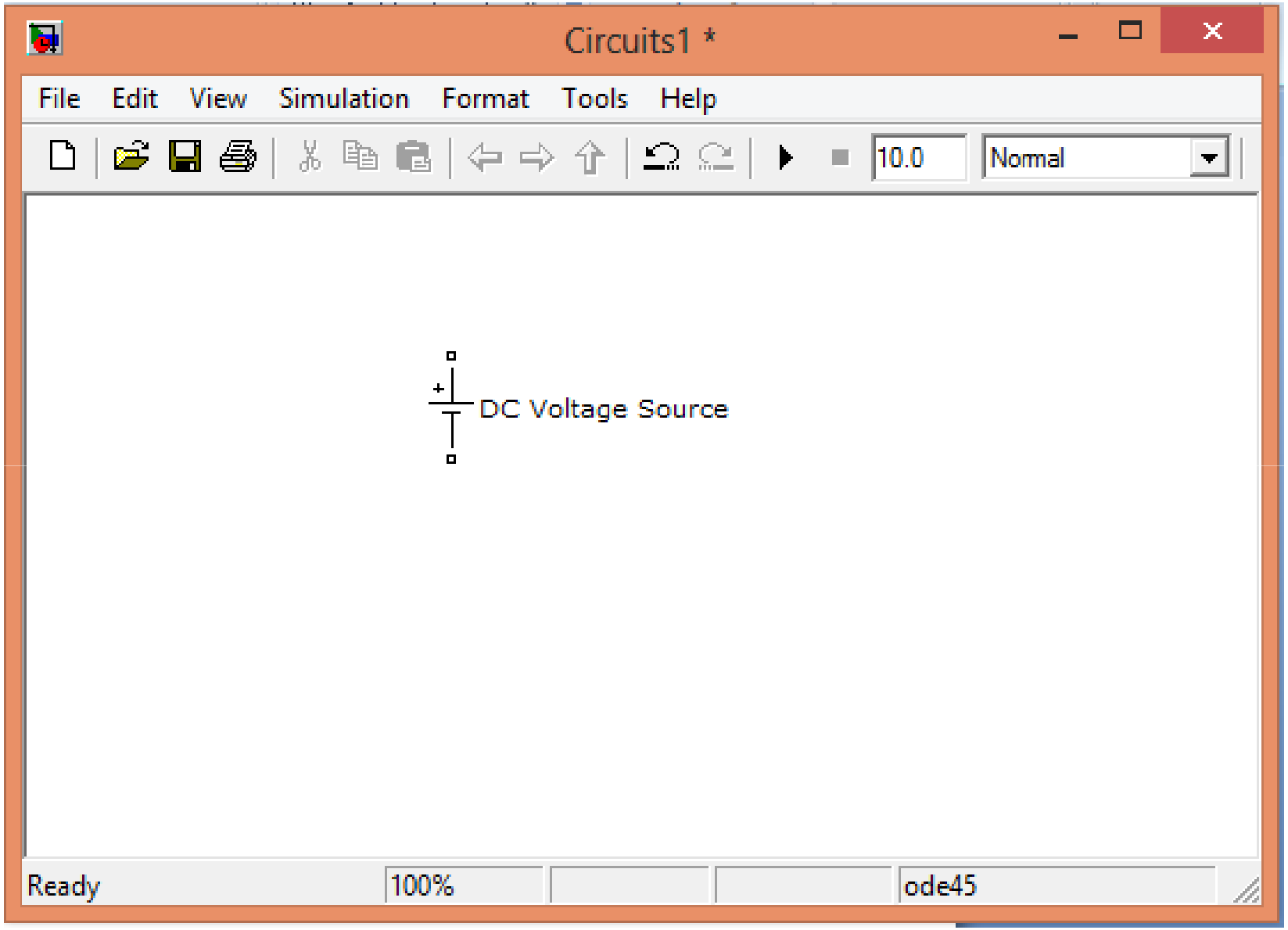


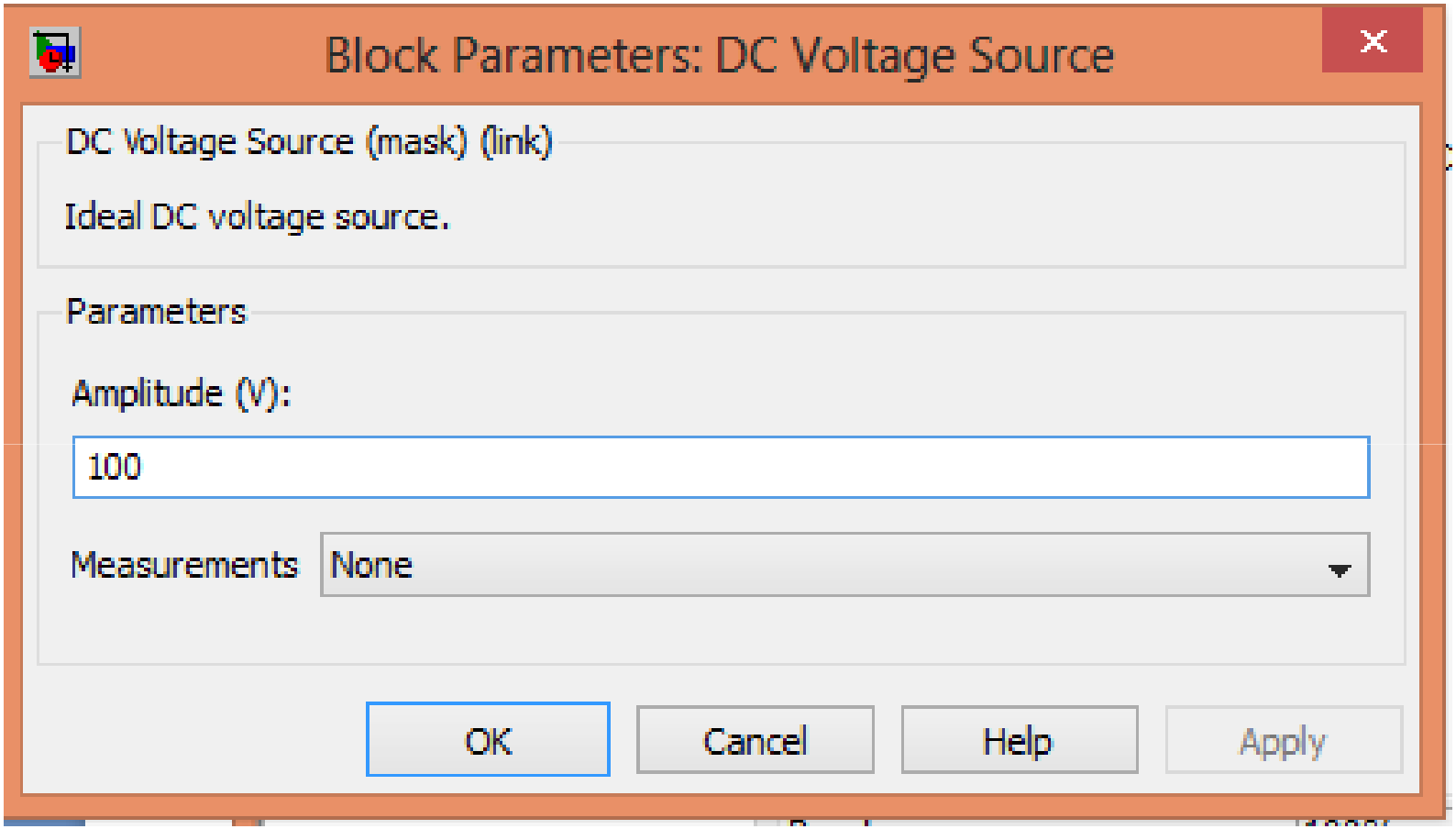
Steps

1) Find the required components- (i) DC Voltage Source and (ii) Resistance.
2) Go to Simulink Library.
3) Choose SimPowerSystems in Simulink library.
4) Choose Electrical Sources in SimPowerSystems.
5) Choose DC Voltage Source and bring it to the Simulink Workspace.
6) Change the voltage to 100 V if required.


Simulink Library Browser
File Edit View Help
Enter search term
Libraries
Control System Toolbox
Fuzzy Logic Toolbox
Image Acquisition Toolbox
Instrument Control Toolbox
Model Predictive Control ...
Neural Network Toolbox
RF Blockset
Real-Time Workshop
Real-Time Workshop Em...
Report Generator
Robust Control Toolbox
Signal Processing Blockset
SimEvents
SimPowerSystems
Application Libraries
Electrical Sources
Elements
Extra Library
Machines
Measurements
Power Electronics
Library: SimPowerSystems/Electrical Sources
Search Results: (none)
AC Current Source
AC Voltage Source
Battery
Controlled Current Source
Controlled Voltage Source
DC Voltage Source
Three-Phase Pr-ogrammable...
Three-Phase Source
Block Description
SimPowerSystems/Electrical Sources/DC Voltage Source: Ideal DC voltage source.
Showing: SimPowerSystems/Electrical Sources

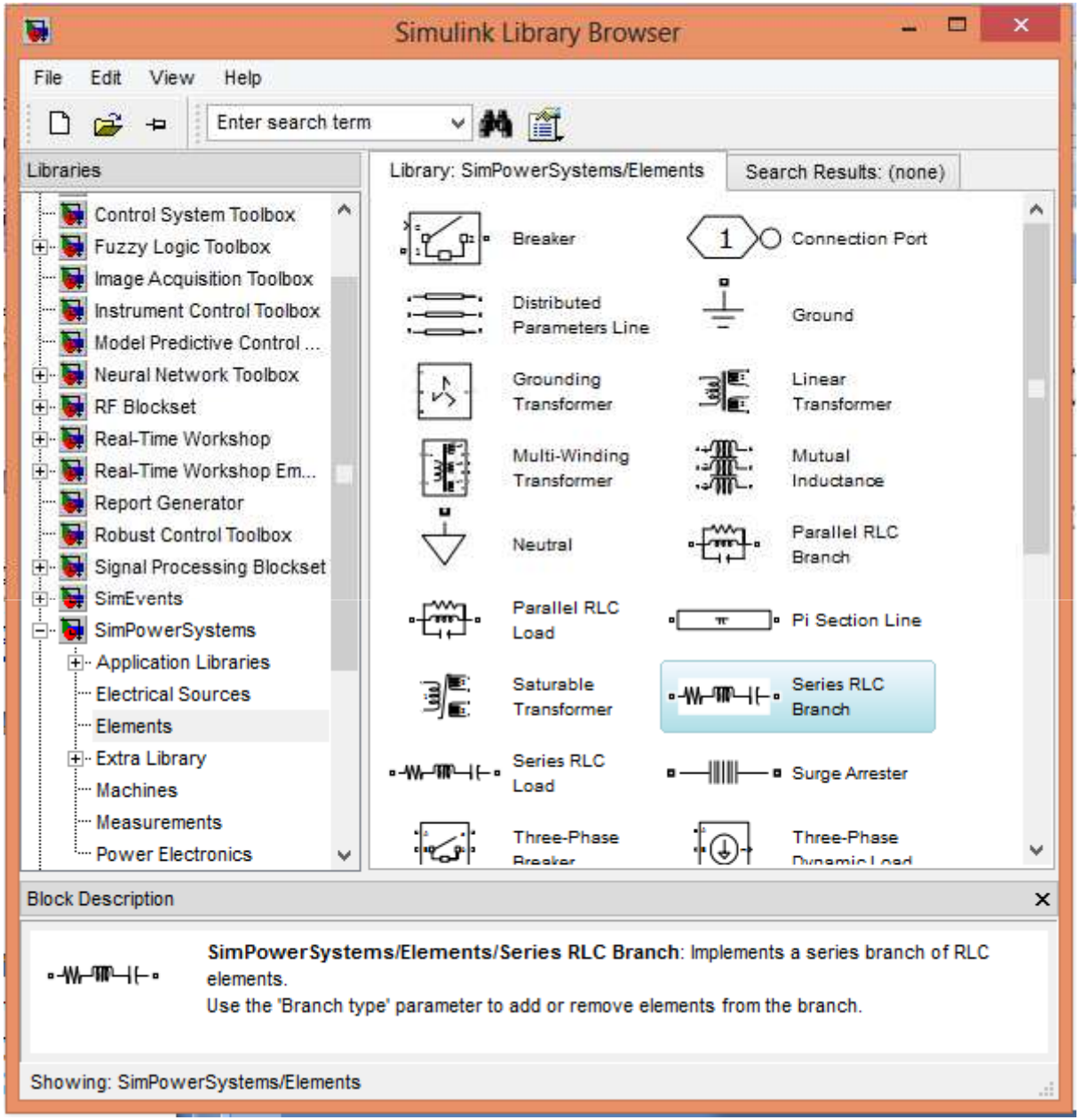

Circuits1
File Edit View Simulation Format Tools Help
10.0
Normal
Ready
100%
ode45

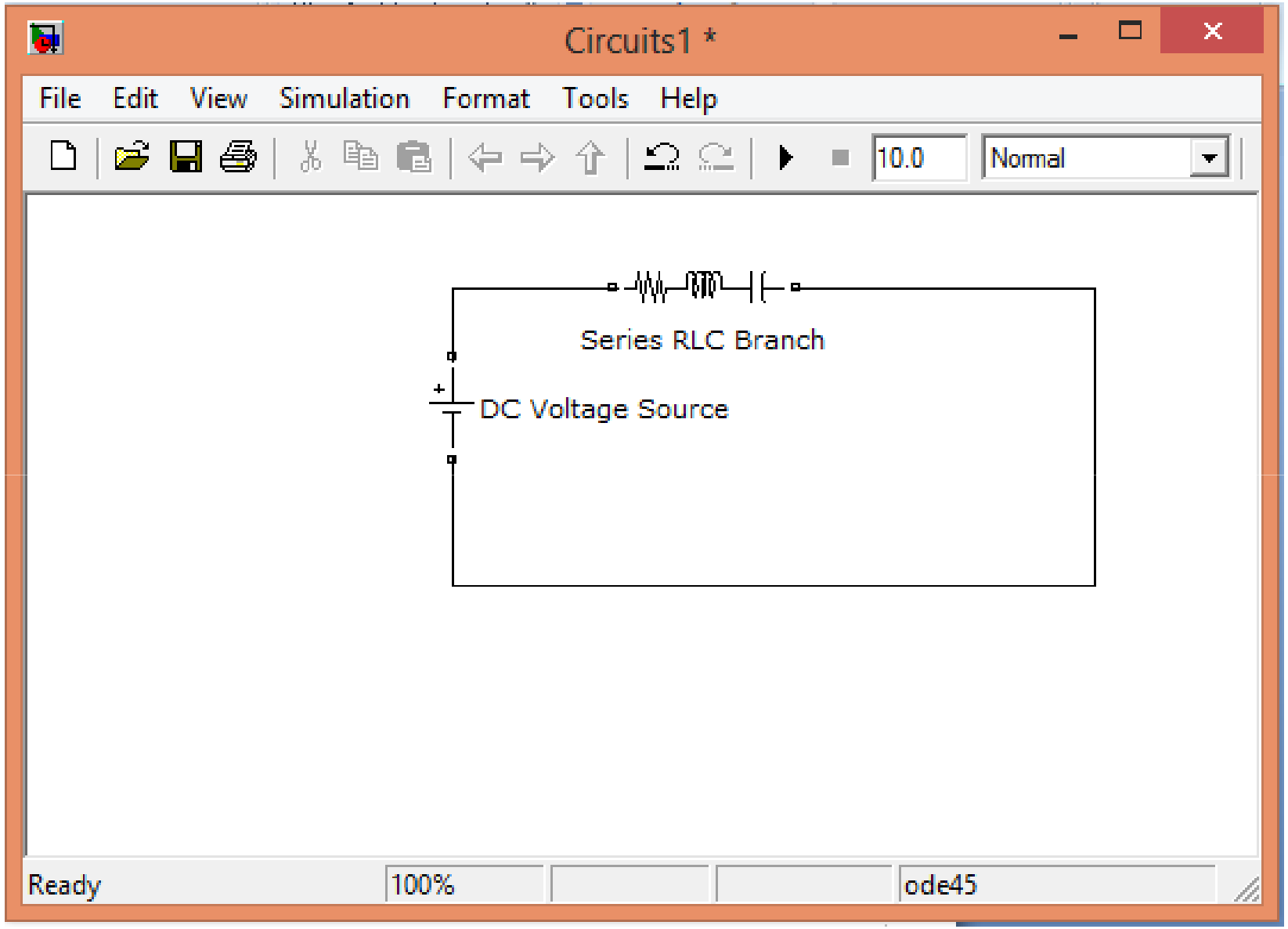

Circuits1 *
File Edit View Simulation Format Tools Help
10.0
Normal
DC Voltage Source
Ready
100%
ode45

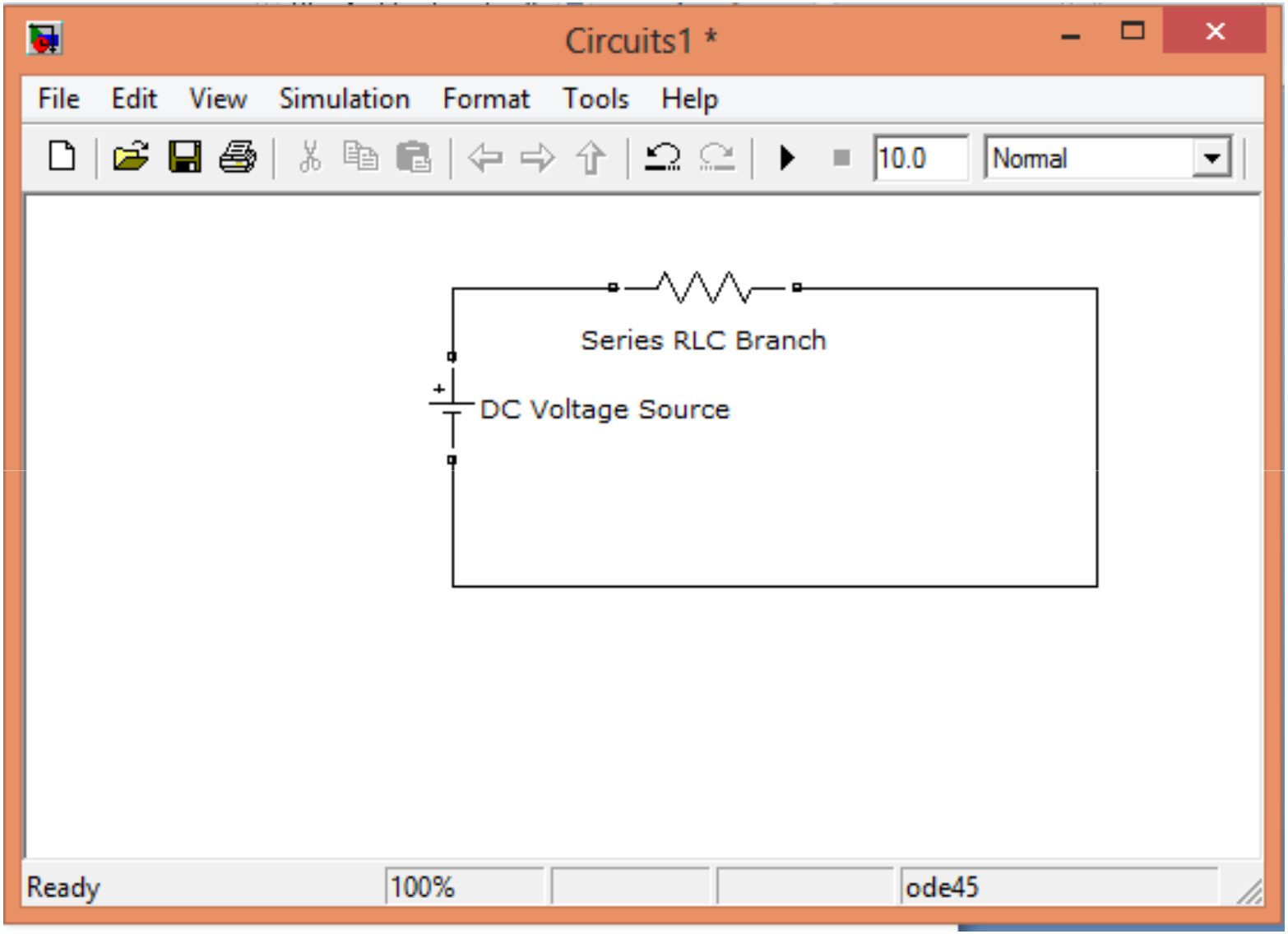

Block Parameters: DC Voltage Source
DC Voltage Source (mask) (link)
Ideal DC voltage source.
Parameters
Amplitude (V):
100
Measurements
None
OK
Cancel
Help
Apply

Steps

7) Choose Elements in SimPowerSystems.
8) Choose Series RLC branch from Elements.
9) Double click on the RLC branch and change the block parameter to R.
10) Give it a value of 10 ohms.

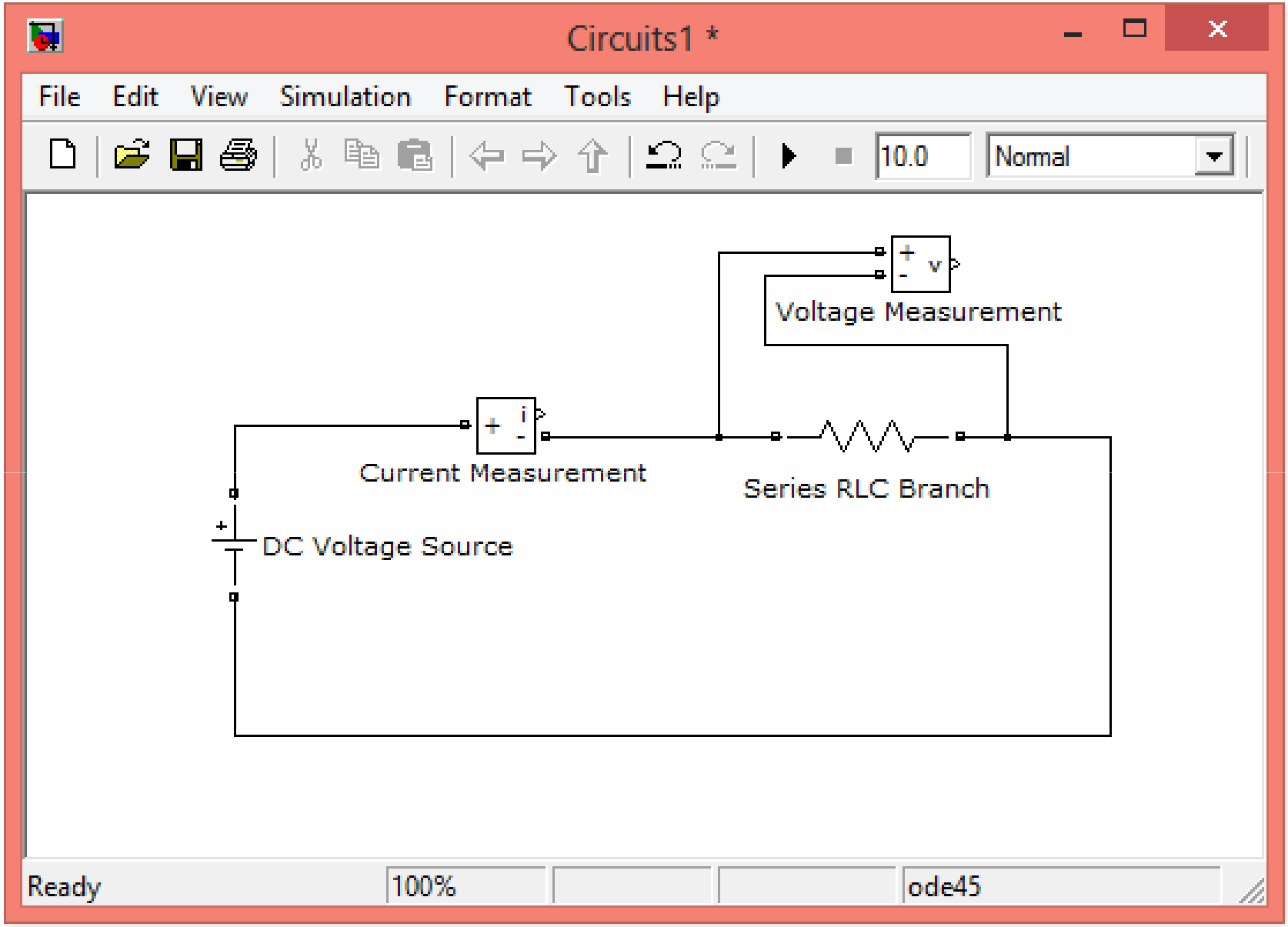

Simulink Library Browser
File
Edit
View
Help
Enter search term
Libraries
Control System Toolbox
Fuzzy Logic Toolbox
Image Acquisition Toolbox
Instrument Control Toolbox
Model Predictive Control ...
Neural Network Toolbox
RF Blockset
Real-Time Workshop
Real-Time Workshop Em...
Report Generator
Robust Control Toolbox
Signal Processing Blockset
SimEvents
SimPowerSystems
Application Libraries
Electrical Sources
Elements
Extra Library
Machines
Measurements
Power Electronics
Library: SimPowerSystems/Elements
Search Results: (none)
Breaker
Connection Port
Distributed Parameters Line
Ground
Grounding Transformer
Linear Transformer
Multi-Winding Transformer
Mutual Inductance
Neutral
Parallel RLC Branch
Parallel RLC Load
Pi Section Line
Saturable Transformer
Series RLC Branch
Series RLC Load
Surge Arrester
Three-Phase Breaker
Three-Phase Dynamic Load
Block Description
SimPowerSystems/Elements/Series RLC Branch: Implements a series branch of RLC elements.
Use the 'Branch type' parameter to add or remove elements from the branch.
Showing: SimPowerSystems/Elements


Circuits1 *
File
Edit
View
Simulation
Format
Tools
Help
10.0
Normal
Series RLC Branch
DC Voltage Source
Ready
100%
ode45


Circuits1 *
File Edit View Simulation Format Tools Help
10.0
Normal
Series RLC Branch
DC Voltage Source
Ready
100%
ode45

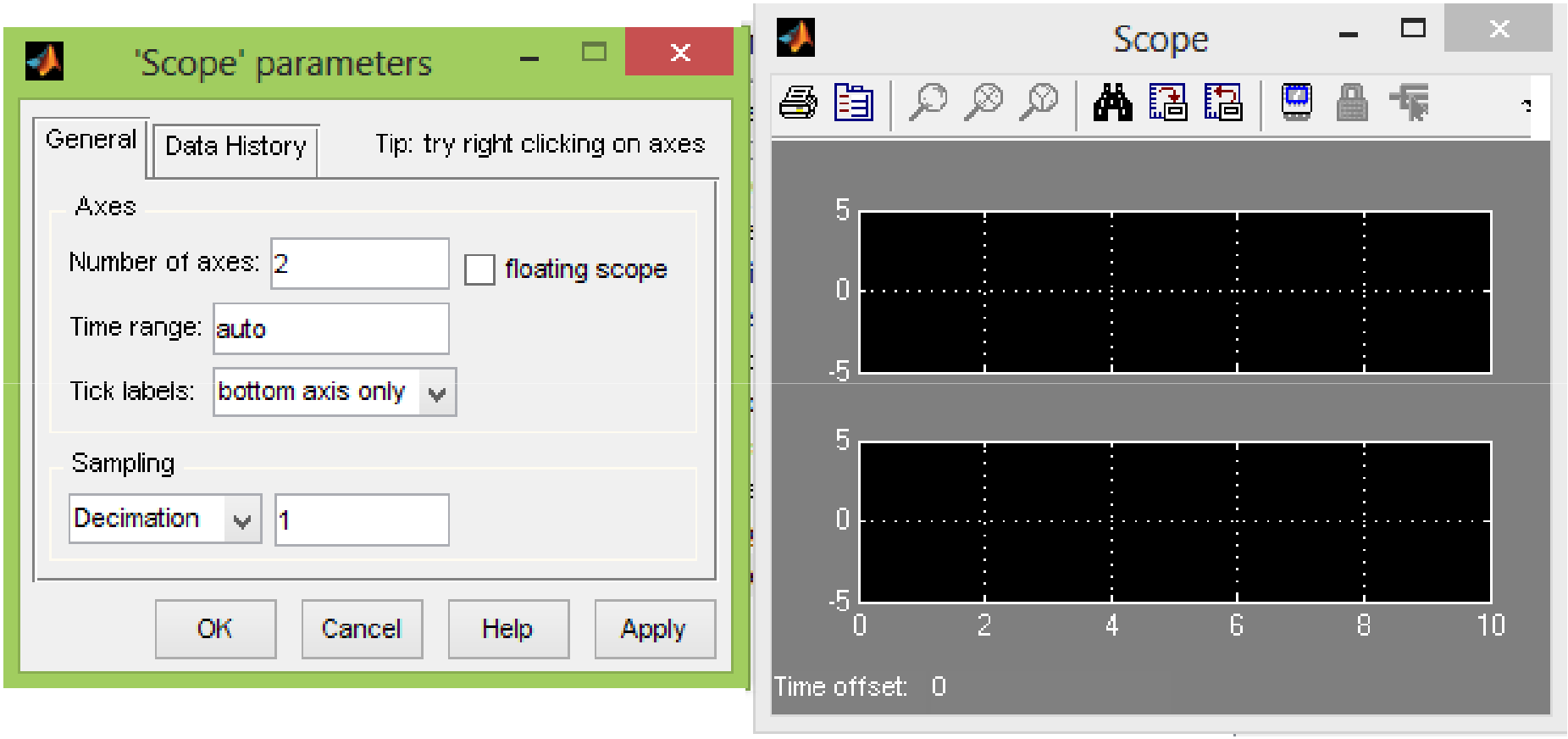
Measure the current and voltage

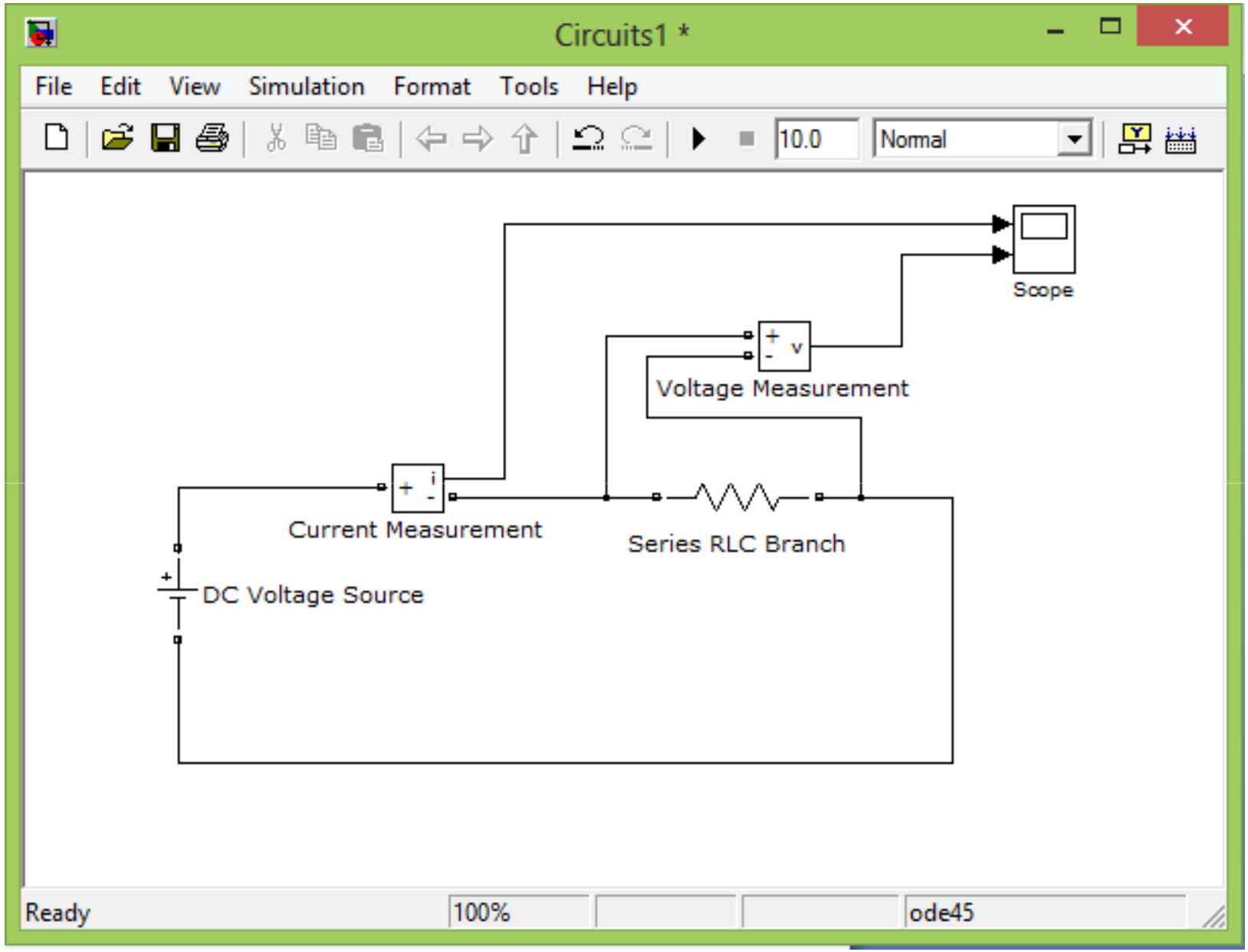
1) Simulink library browser → SimPowerSystems → Measurements → Current Measurement block.
2) Connect it in series in the circuit.
3) Simulink library browser → SimPowerSystems → Measurements → Voltage Measurement block.
4) Connect it in parallel to the resistance in the circuit.


Circuits1 *
File
Edit
View
Simulation
Format
Tools
Help
10.0
Normal
Voltage Measurement
Current Measurement
Series RLC Branch
DC Voltage Source
Ready
100%
ode45

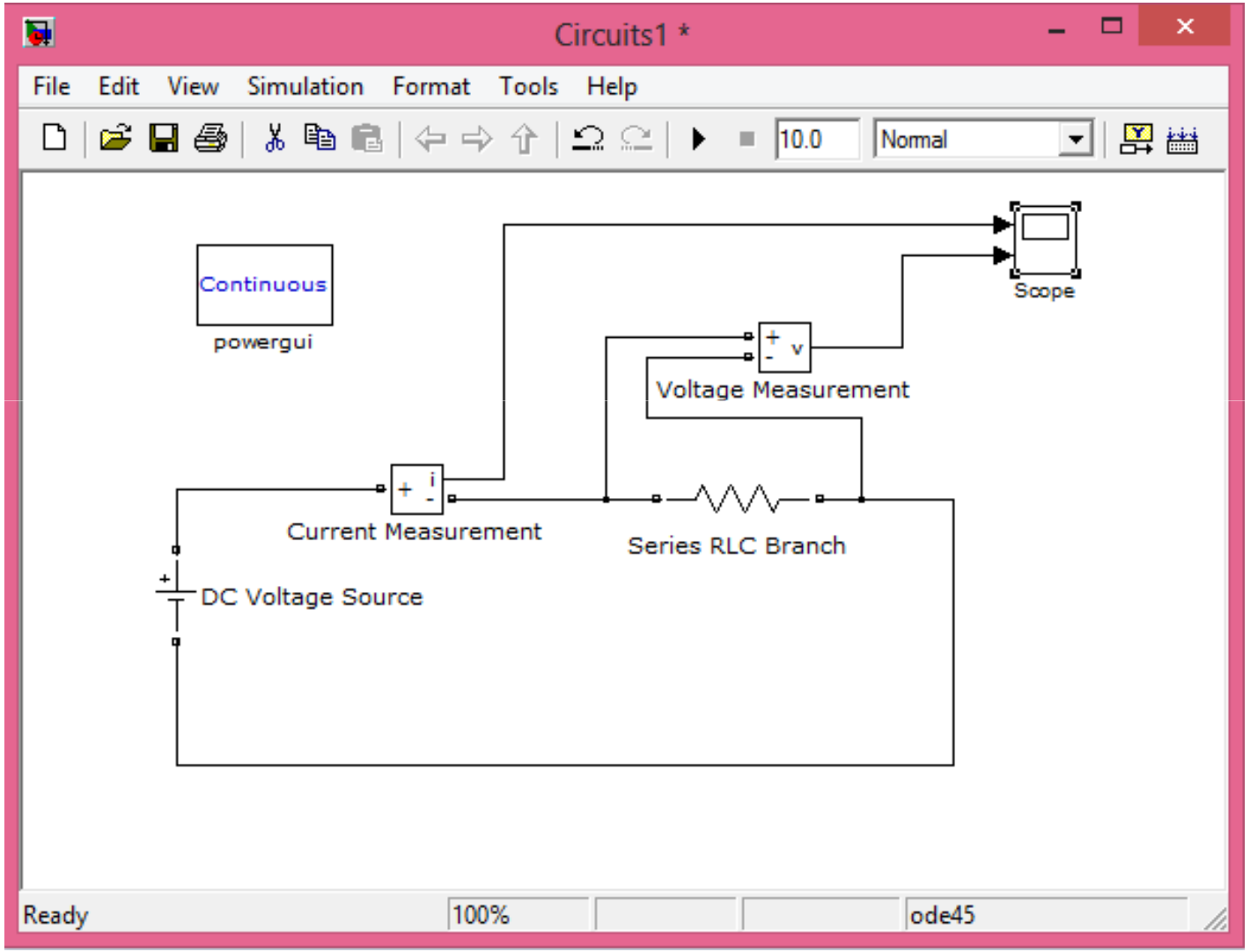
Viewing the results

1) Simulink → Commonly used blocks → Scope
2) Scope → Parameters → No. of axes → 2
3) Connect the inputs to Current & Voltage measurement block outputs


'Scope' parameters
General
Data History
Tip: try right clicking on axes
Axes
Number of axes: 2
floating scope
Time range: auto
Tick labels: bottom axis only
Sampling
Decimation
1
OK
Cancel
Help
Apply
Scope
5
0
-5
5
0
-5
0
2
4
6
8
10
Time offset: 0


Circuits1 *
File
Edit
View
Simulation
Format
Tools
Help
10.0
Normal
Scope
Voltage Measurement
Current Measurement
Series RLC Branch
DC Voltage Source
Ready
100%
ode45

Bring powergui block to the workspace



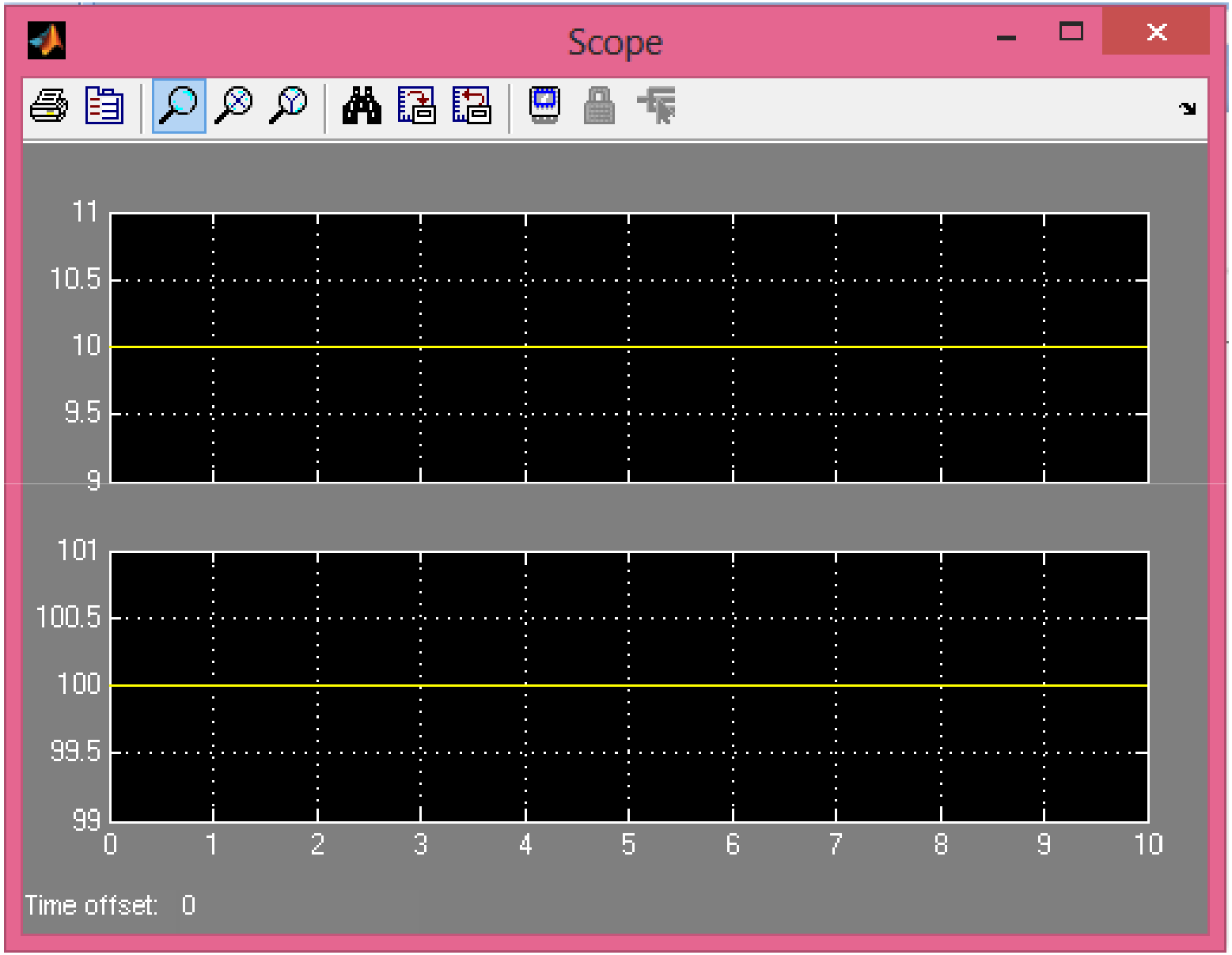
Steps for observing the output

Run the simulink model

Double click on the Scope

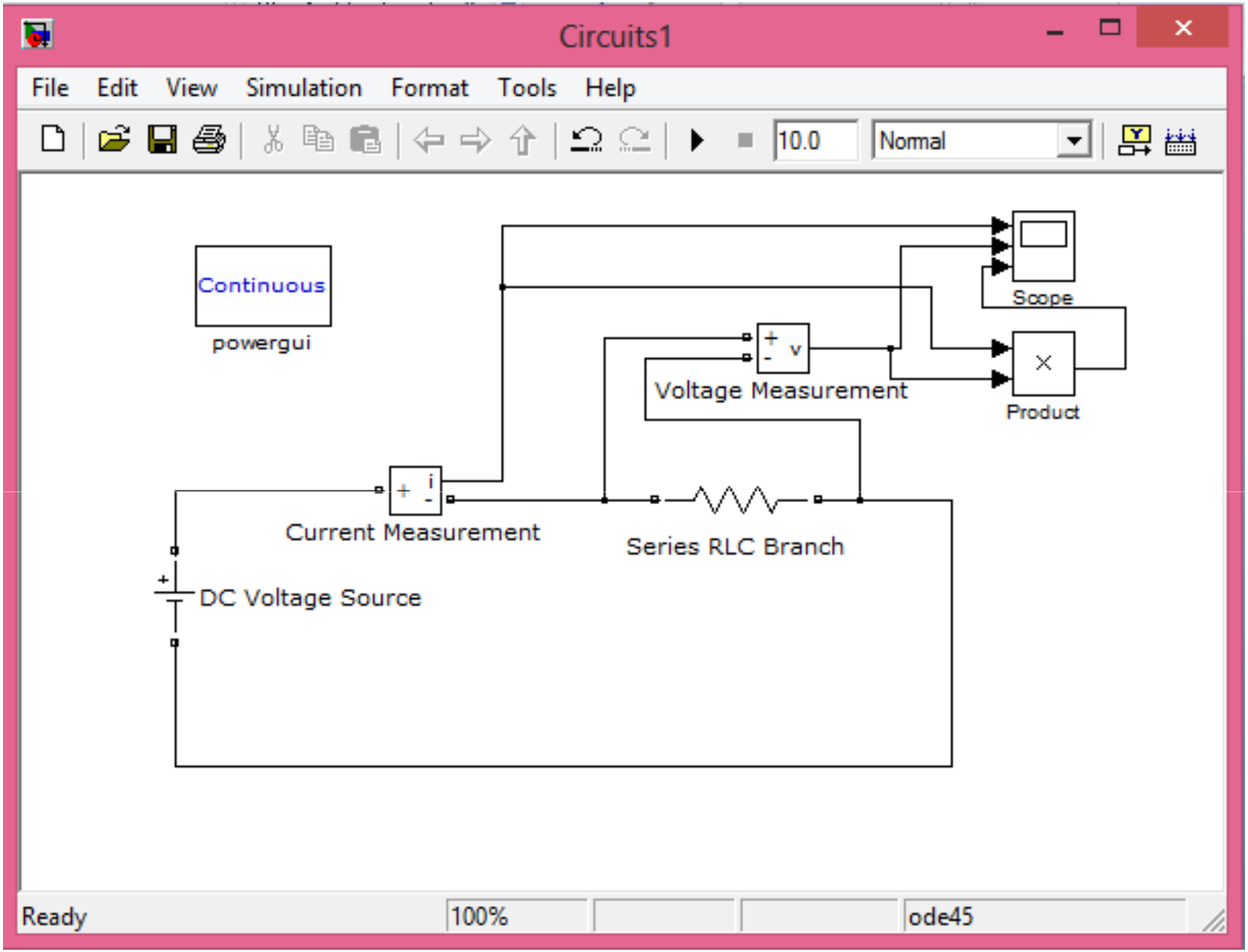
Observe the graphs

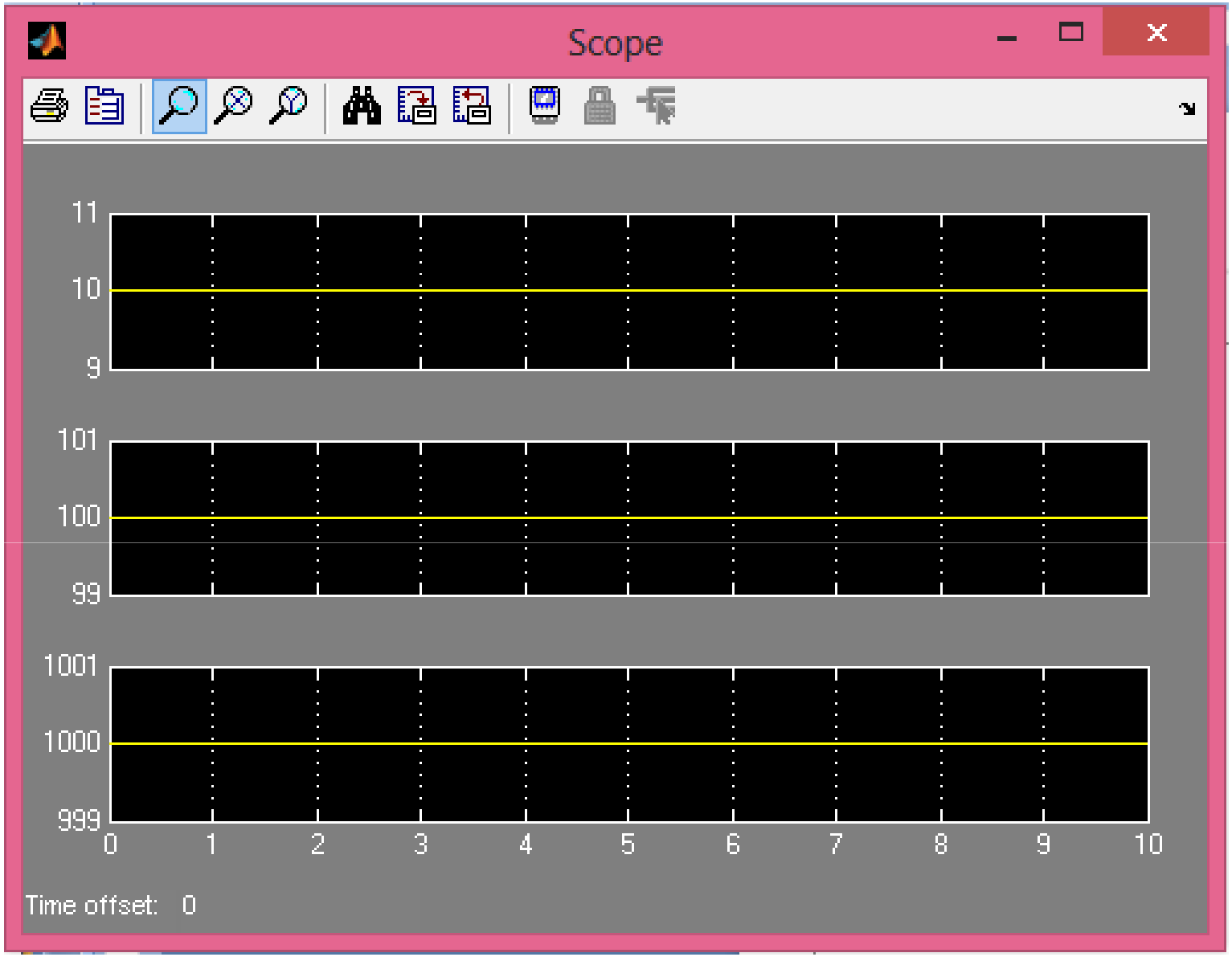
Use Autoscale option if required


Scope
11
10.5
10
9.5
9
101
100.5
100
99.5
99
0
1
2
3
4
5
6
7
8
9
10
Time offset: 0

Measure the Power

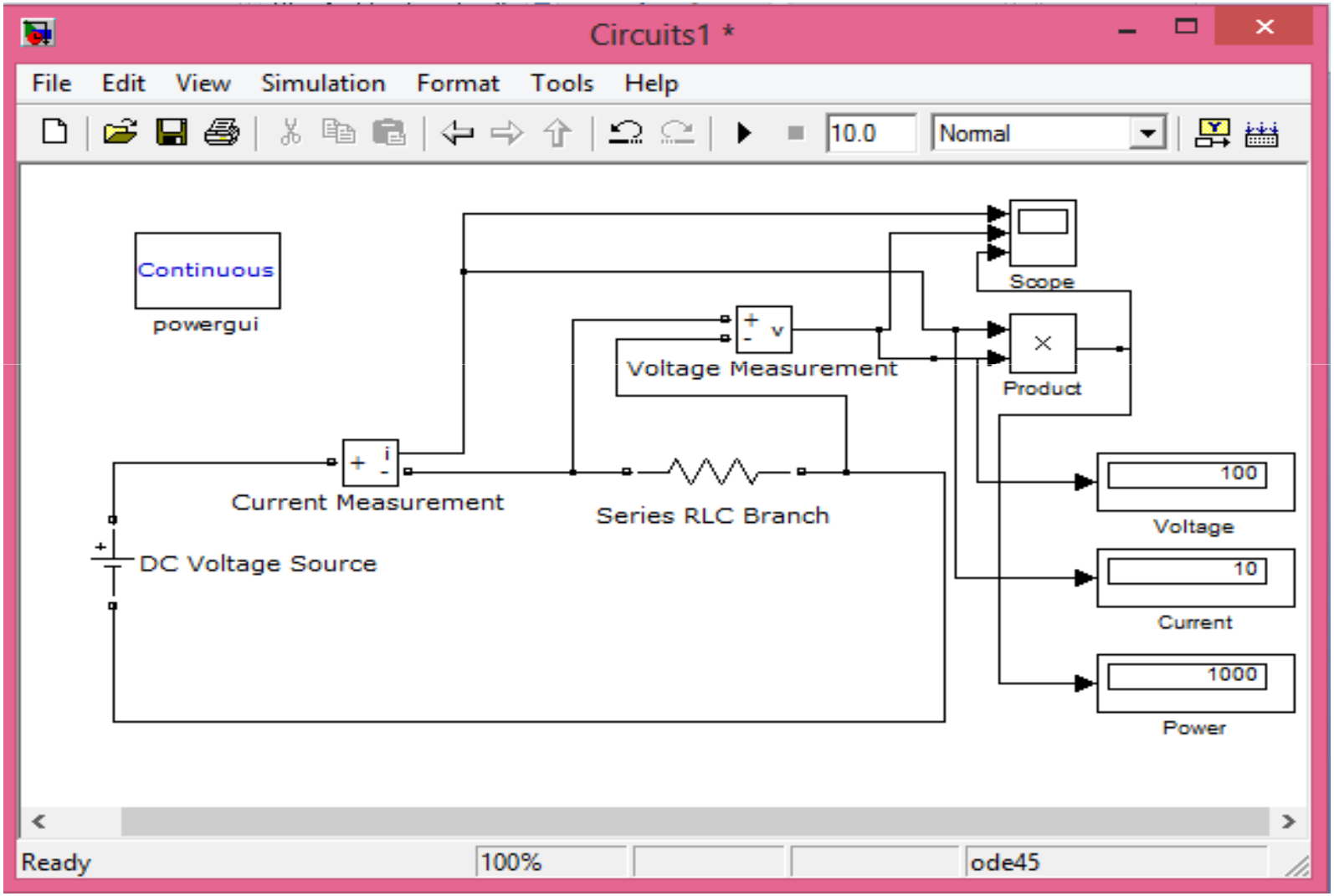
1) P=VI
2) Simulink → Math Operations → Product
3) Connect the inputs to Current & Voltage measurement block outputs


Circuits1
File
Edit
View
Simulation
Format
Tools
Help
10.0
Normal
Continuous
powergui
Scope
Voltage Measurement
Product
Current Measurement
Series RLC Branch
DC Voltage Source
Ready
100%
ode45

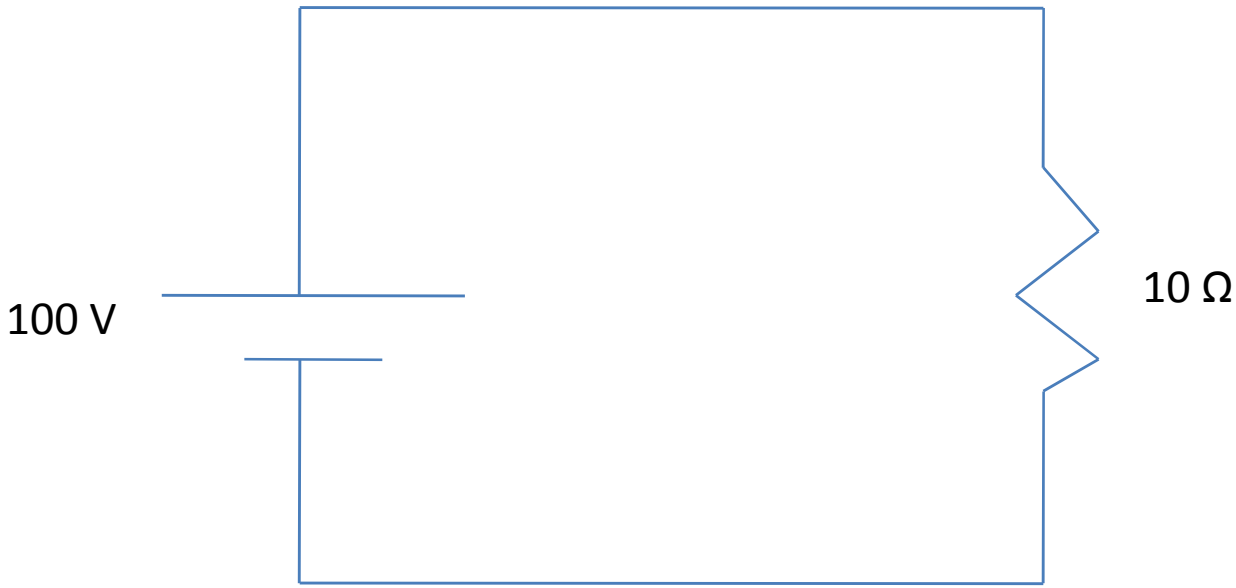


Voltage, Current and Power Outputs

Use Display block to observe the values of V, I and P



Simulation of the same circuit using another method in Simulink



Corresponding equations of the circuit

$$V = IR$$

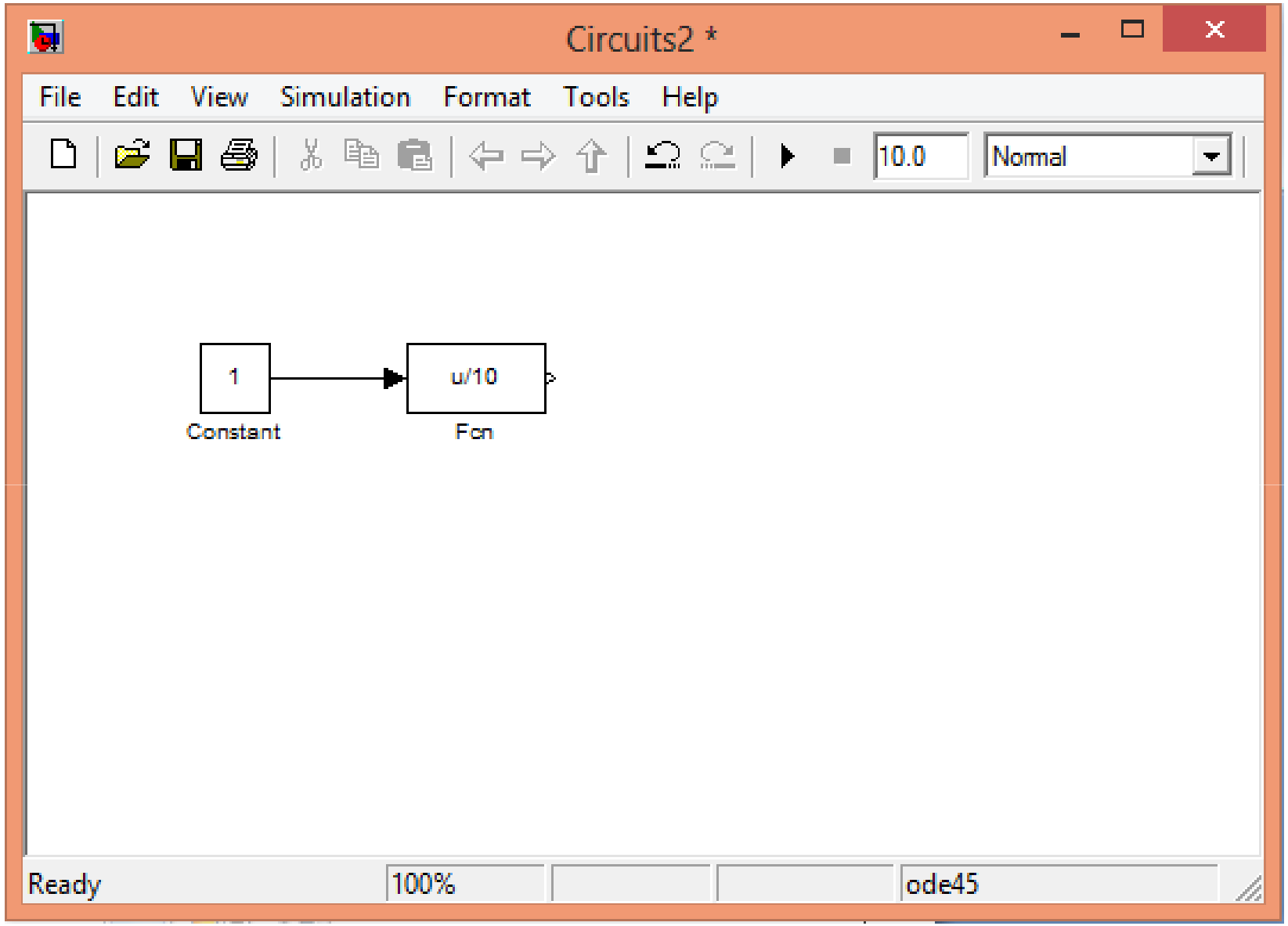
$$I = \frac{V}{R}$$

$$P = \frac{V^2}{R} = I^2 R$$

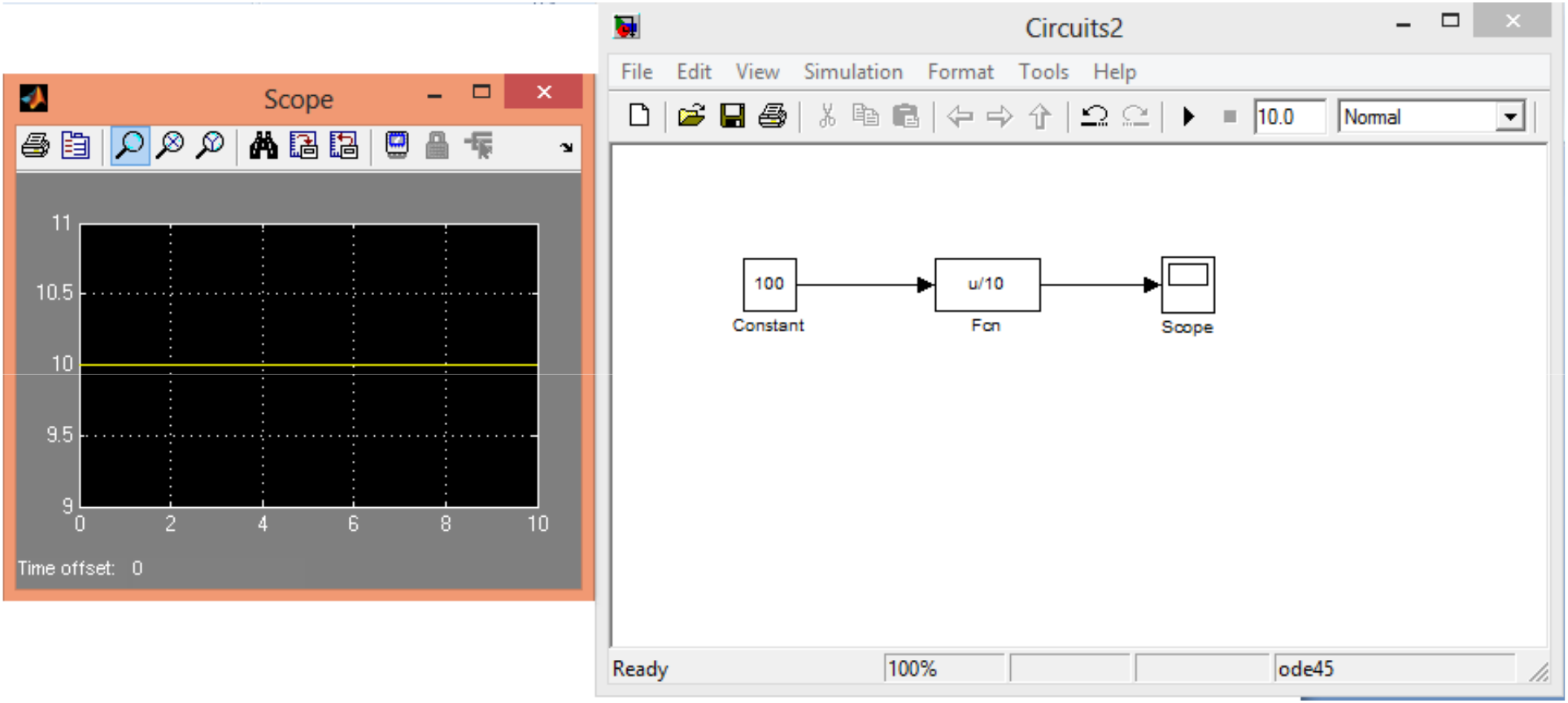
Steps

Simulink → Commonly used blocks → Constant → Change the value of the block to 100 by double clicking (Corresponding to 100 V of the source)

Bring Fcn block from Simulink library → Double click → Change the function to u/10 (Corresponding to V/R, as R= 10 Ω)


Circuits2 *
File
Edit
View
Simulation
Format
Tools
Help
10.0
Normal
1
Constant
u/10
Fcn
Ready
100%
ode45

Scope connected to the output of the Fcn block will show the current


Scope
11
10.5
10
9.5
9
0
2
4
6
8
10
Time offset: 0
Circuits2
File Edit View Simulation Format Tools Help
10.0
Normal
100
Constant
u/10
Fcn
Scope
Ready
100%
ode45

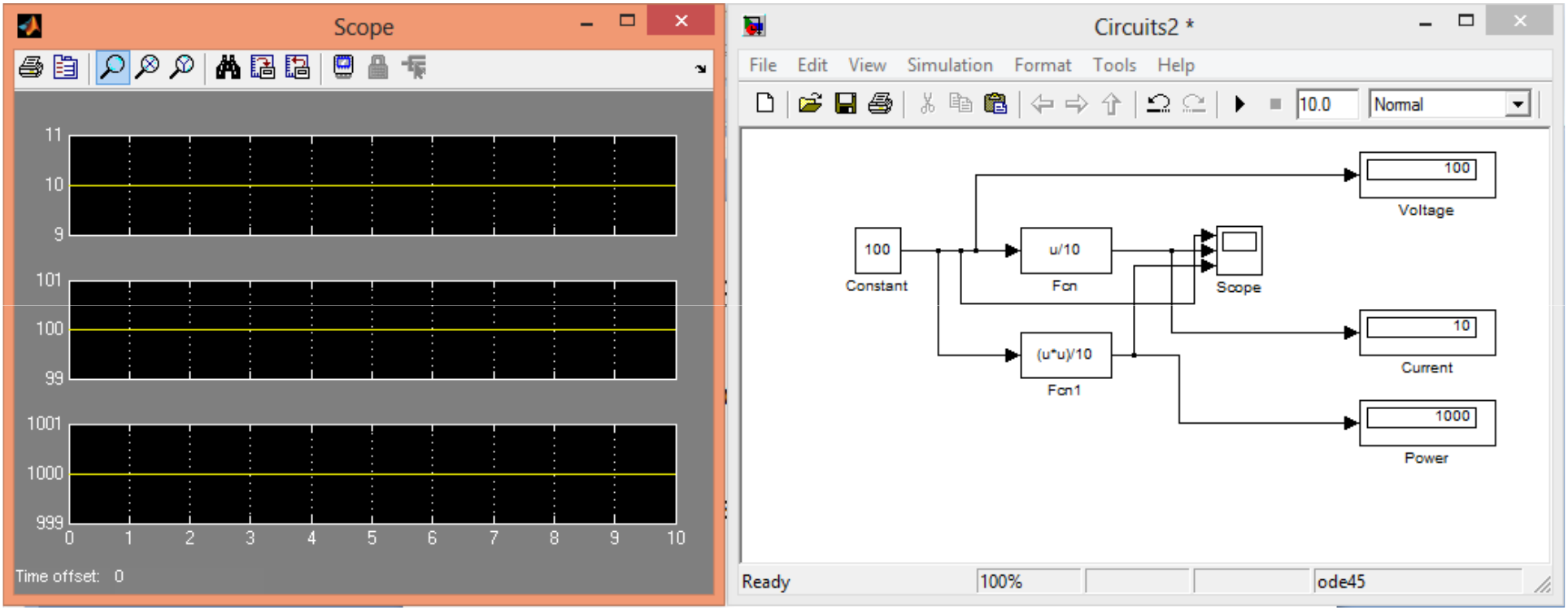
For measurement of Power

Use another Fcn block.

Change its expression to (u*u/10), corresponding to V^2/R).

Connect its input to Constant voltage block output.

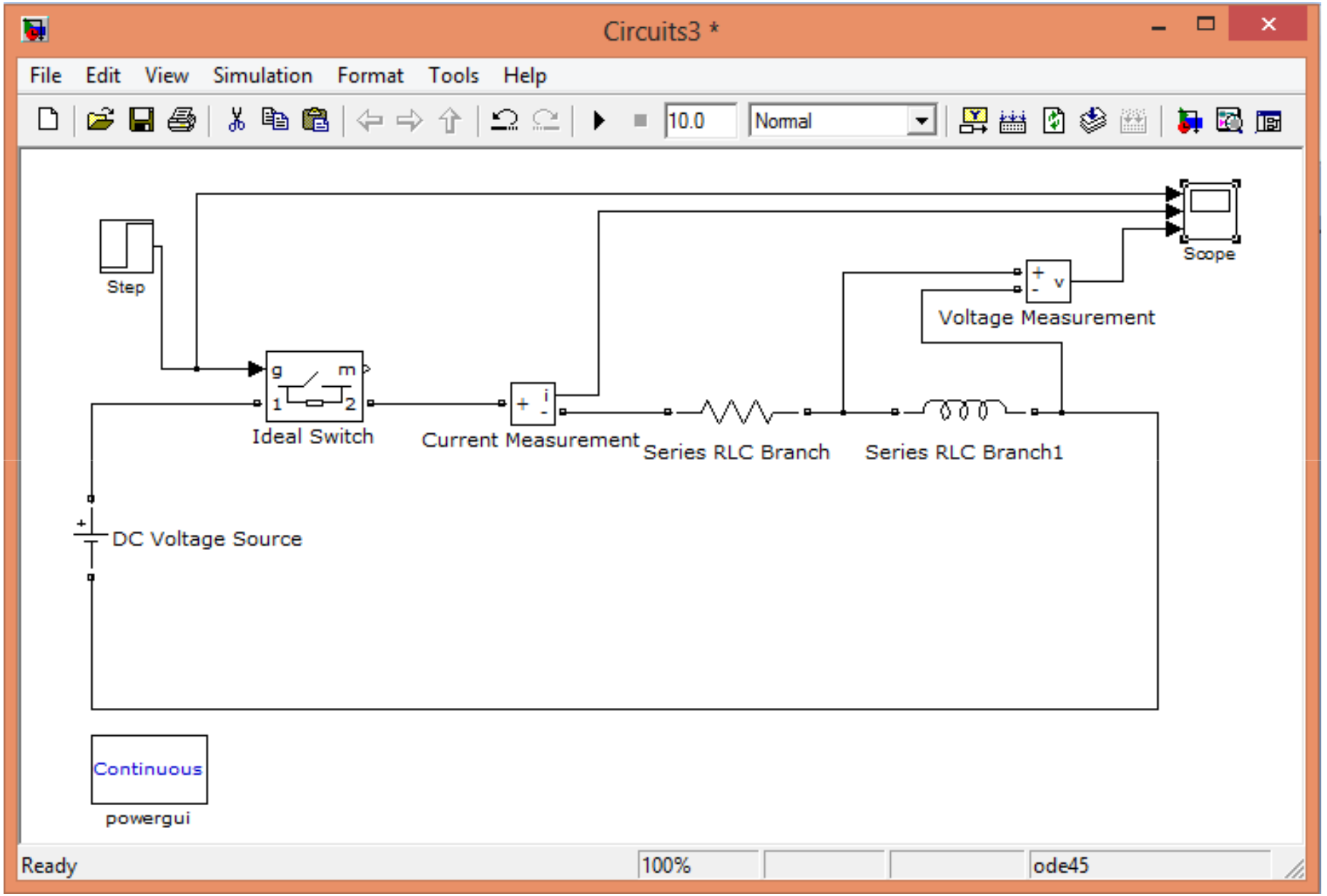
Connect its output to a display.

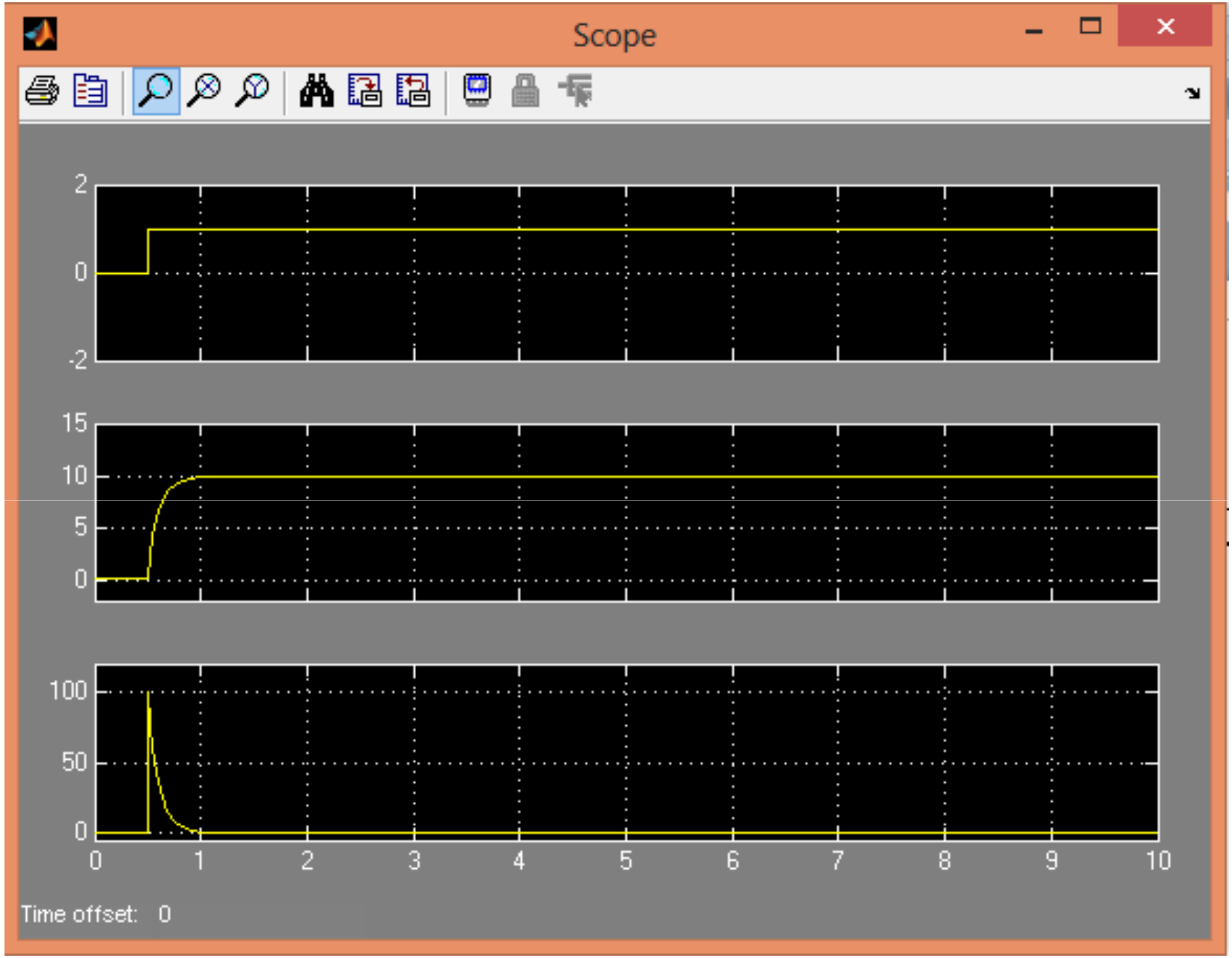

Scope
11
10
9
101
100
99
1001
1000
999
0 1 2 3 4 5 6 7 8 9 10
Time offset: 0
Circuits2 *
File Edit View Simulation Format Tools Help
10.0
Normal
100
Voltage
100
Constant
u/10
Fcn
Scope
10
Current
(u*u)/10
Fcn1
1000
Power
Ready
100%
ode45

Simulation of R-L Series Circuit

Hands-on:

Please follow the steps as shown on the screen.


Circuits3 *
File Edit View Simulation Format Tools Help
10.0
Normal
Step
Scope
Voltage Measurement
g
m
1
2
Ideal Switch
Current Measurement
Series RLC Branch
Series RLC Branch1
DC Voltage Source
Continuous
powergui
Ready
100%
ode45


Scope
2
0
-2
15
10
5
0
100
50
0
0
1
2
3
4
5
6
7
8
9
10
Time offset: 0

Questions please ?????

End of Day-2 Session-2

Thank You