

Компьютерные технологии при разработке и проектировании электрооборудования автономных объектов

Вводная лабораторная работа

MATLAB R2012a

File Edit Debug Desktop Window Help

Current Folder: C:\Users\student.ECAO2\Documents\MATLAB

Shortcuts How to Add What's New

Current Folder

- << MATLAB >>
- Name
- .SimulinkProject
- TЭП
- untitled.mdl

Details

Select a file to view details

Command Window

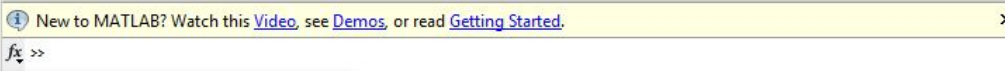
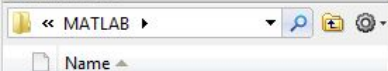
New to MATLAB? Watch this [Video](#), see [Demos](#), or read [Getting Started](#).

Workspace

Name	Value
------	-------

Command History

- 12.02.2019 10:46
- 19.02.2019 14:26
- 26.02.2019 10:40
- 05.03.2019 10:49
- 12.03.2019 10:36
- 19.03.2019 10:46
- 26.03.2019 10:33
- 26.03.2019 14:33
- 09.04.2019 10:31
- 16.04.2019 10:32
- 23.04.2019 10:46
- 23.04.2019 14:41
- 30.04.2019 10:40
- 08.05.2019 17:11
- 14.05.2019 10:47
- 21.05.2019 10:49
- 21.05.2019 15:42
- 28.05.2019 10:33
- 04.06.2019 12:58
- 04.06.2019 14:21
- 04.06.2019 14:30
- 19.06.2019 10:03
- DPT_dataen
- 03.09.2019 14:54



Simulink Library Browser

Edit View Help

Enter search term

Library: Simulink Search Results: (none) Most

- Simulink
 - Commonly Used Blocks
 - Continuous
 - Discontinuities
 - Discrete
 - Logic and Bit Operations
 - Lookup Tables
 - Math Operations
 - Model Verification
 - Model-Wide Utilities
 - Ports & Subsystems
 - Signal Attributes
 - Signal Routing
 - Sinks
 - Sources
 - User-Defined Functions
 - Additional Math & Discrete
- Control System Toolbox
- Simscape

Showing: Simulink

Search Results:

- Commonly Used Blocks
- Continuous
- Discontinuities
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Select a file to view details

```
12.02.2019 13:46 -->
19.02.2019 14:26 -->
26.02.2019 13:40 -->
05.03.2019 13:49 -->
12.03.2019 13:36 -->
19.03.2019 13:46 -->
26.03.2019 13:33 -->
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19.06.2019 13:03 -->
03.09.2019 14:54 -->
```

Simulink Library Browser

Libraries

- Simulink
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Showing: Simulink

Library: Simulink

Search Results: (none)

Most

- Commonly Used Blocks
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Details

Select a file to view details

Simulink Library Browser

File Edit View Help

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- Simulink Coder
- Simulink Extras
- Simulink Verification and Vali...
- Stateflow

Library: Simulink/Sources Search Results

- 1 Constant
- Counter Free-Running
- Counter Limited
- 12.34 Digital Clock
- Enumerated Constant
- untitled.mat From File
- simh From Workspace
- Ground
- In1
- Pulse Generator
- Ramp
- Random Number
- Repeating Sequence
- Repeating Sequence Interpol...
- Repeating Sequence Stair
- Signal Builder
- Generator
- Sine Wave**
- Step
- Uniform Random Number

Showing: Simulink/Sources

untitled *

File Edit View Simulation Format Tools Help

10.0 Normal

Sine Wave

Ready 100% ode45

Simulink Library Browser

File Edit View Help

Enter search term

Libraries

- Simulink
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Library: Simulink/Sinks Search Results

- Display
- Floating Scope
- Scope
- Stop Simulation
- Terminator
- untitled.mat To File
- simout To Workspace
- XY Graph

Showing: Simulink/Sinks

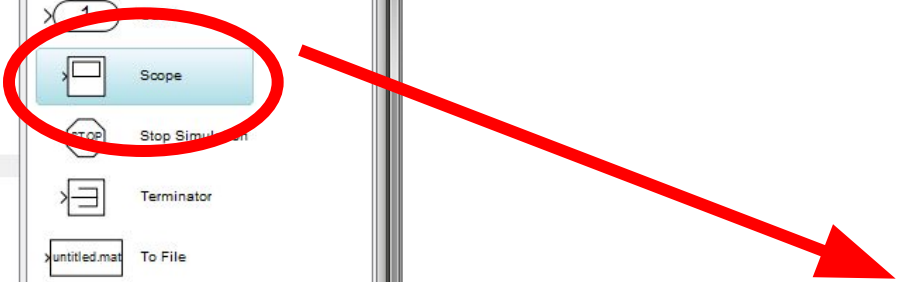
untitled *

File Edit View Simulation Format Tools Help

10.0 Normal

Sine Wave Scope

Ready 100% ode45



Simulink Library Browser

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Ready 100% ode45

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Showing: Simulink/Sinks

untitled *

File Edit View Simulation Format Tools Help

10.0 Normal

Sine Wave Scope

Scope

Time offset: 0

Ready 100% ode45

Simulink Library Browser

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Showing: Simulink/Sinks

untitled *

File Edit View Simulation Format Tools Help

10.0 Normal

Sine Wave Scope

'Scope' parameters

General History Style

Limit data points to last: 5000

Save data to workspace

Variable name: ScopeData

Format: Structure with time

OK Cancel Help Apply

Scope

Time offset: 0

Ready 100% ode45

Simulink Library Browser

File Edit View Help

Enter search term

Libraries

- Simulink
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Library: Simulink/Sinks Search Results

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- Scope
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Showing: Simulink/Sinks

untitled *

File Edit View Simulation Format Tools Help

10.0 Normal

Sine Wave Scope

'Scope' parameters

General History **Style**

Limit data points to last: 5000

Save data to workspace

Variable name: ScopeData

Format: Structure with time

OK Cancel Help Apply

Scope

Time offset: 0

Ready 100% ode45

Simulink Library Browser

File Edit View Help

Enter search term

Libraries

- Simulink
 - Commonly Used Blocks
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- Scope**
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- XY Graph

Showing: Simulink/Sinks

untitled *

File Edit View Simulation Format Tools Help

10.0 Normal

Sine Wave Scope

'Scope' parameters

General History Style

Figure color: Axes colors:

Properties for line: 1

Line: 0.5

Marker: none

OK Cancel Help Apply

Scope

Time offset: 0

Ready 100% ode45

Simulink Library Browser

File Edit View Help

Enter search term

Libraries

- Simulink
 - Commonly Used Blocks
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Library: Simulink/Sinks Search Results

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- Scope**
- Stop Simulation
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- untitled.mat To File
- simout To Workspace
- XY Graph

Showing: Simulink/Sinks

untitled *

File Edit View Simulation Format Tools Help

10.0 Normal

Sine Wave Scope

Scope

Scope parameters

General History Style

Figure color: Axes colors:

Properties for line: 1

Line: 2.0

Marker: none

OK Cancel Help Apply

Time offset: 0

Ready 100% ode45

Simulink Library Browser

File Edit View Help

Enter search term

Libraries

- Simulink
 - Commonly Used Blocks
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 - Signal Attributes
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 - Sources
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Library: Simulink/Sinks Search Results

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Showing: Simulink/Sinks

untitled *

File Edit View Simulation Format Tools Help

10.0 Normal

Source Block Parameters: Sine Wave

Sine Wave

Output a sine wave:

$$O(t) = \text{Amp} * \sin(\text{Freq} * t + \text{Phase}) + \text{Bias}$$

Sine type determines the computational technique used. The parameters in the two types are related through:

Samples per period = $2 * \pi / (\text{Frequency} * \text{Sample time})$

Number of offset samples = $\text{Phase} * \text{Samples per period} / (2 * \pi)$

Use the sample-based sine type if numerical problems due to running for large times (e.g. overflow in absolute time) occur.

Parameters

Sine type: Time based

Time (t): Use simulation time

Amplitude: 1

Bias: 0

Frequency: 100

Phase (rad): 0

Sample time: 0

Interpret vector parameters as 1-D

OK Cancel Help Apply

Ready 100% ode45

Simulink Library Browser

File Edit View Help

Enter search term

Libraries

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- Stateflow

Library: Simulink/Sinks


- Display
- Floating Scope
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- Scope
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- simout To Workspace
- XY Graph

Showing: Simulink/Sinks

untitled *

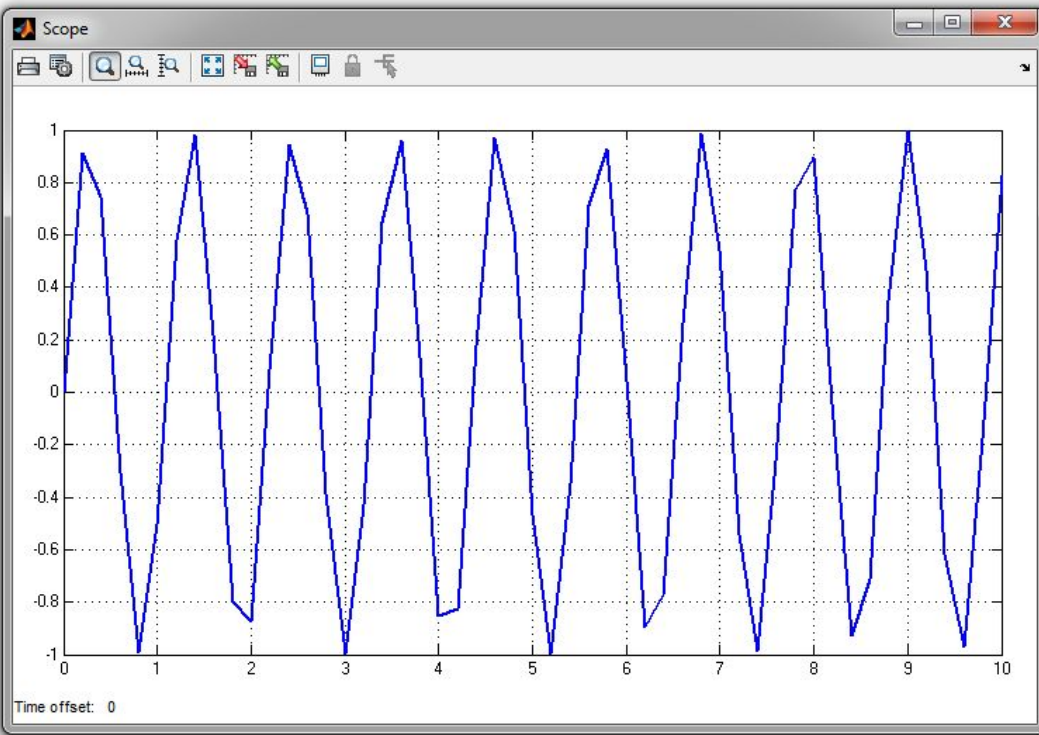
File Edit View **Simulation** Format Tools Help

10.0 Normal



Sine Wave Scope

Scope



Time offset: 0

Ready 100% ode45

Simulink Library Browser

File Edit View Help

Enter search term

Libraries

- Simulink
 - Commonly Used Blocks
 - Continuous
 - Discontinuities
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Library: Simulink/Sinks Search Results

- Display
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- XY Graph

Showing: Simulink/Sinks

untitled *

File Edit View Simulation Format Tools Help

Start Ctrl+T

Configuration Parameters... Ctrl+E

Normal

Accelerator

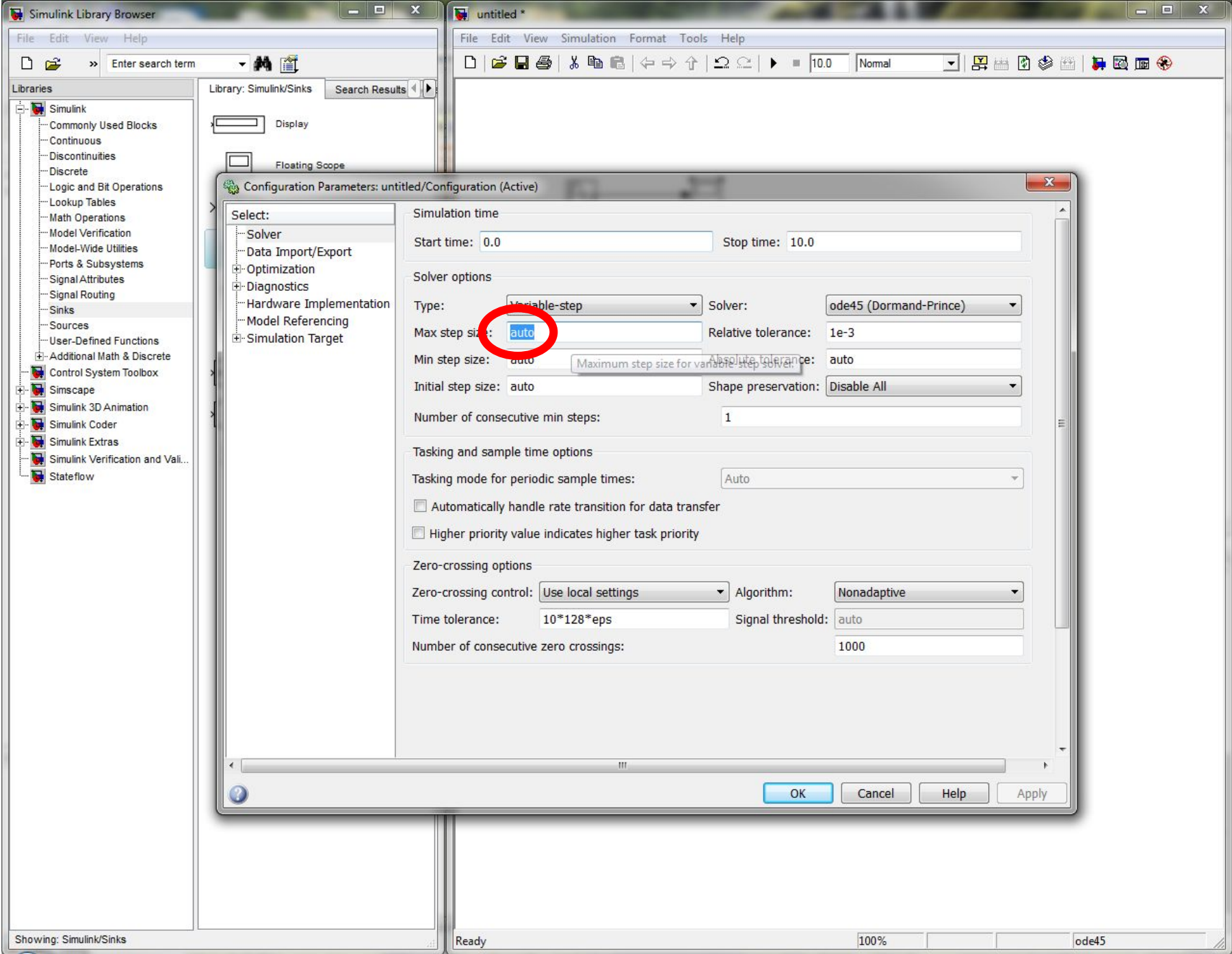
Rapid Accelerator

Sine Wave Scope

Show the active configuration parameters dialog.

100%

ode45



File Edit View Help

Enter search term

Libraries

- Simulink
 - Commonly Used Blocks
 - Continuous
 - Discontinuities
 - Discrete
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 - Stateflow

Library: Simulink/Sinks Search Results

Display

Showing: Simulink/Sinks

File Edit View Simulation Format Tools Help

10.0 Normal

Configuration Parameters: untitled/Configuration (Active)

Select:

- Solver
- Data Import/Export
- Optimization
- Diagnostics
- Hardware Implementation
- Model Referencing
- Simulation Target

Simulation time

Start time: 0.0 Stop time: 10.0

Solver options

Type: Variable-step Solver: ode45 (Dormand-Prince)

Max step size: 1/10000 Relative tolerance: 1e-3

Min step size: auto Absolute tolerance: auto

Initial step size: auto Shape preservation: Disable All

Number of consecutive min steps: 1

Tasking and sample time options

Tasking mode for periodic sample times: Auto

Automatically handle rate transition for data transfer

Higher priority value indicates higher task priority

Zero-crossing options

Zero-crossing control: Use local settings Algorithm: Nonadaptive

Time tolerance: 10*128*eps Signal threshold: auto

Number of consecutive zero crossings: 1000

OK Cancel Help Apply

Ready 100% ode45

Simulink Library Browser

File Edit View Help

Enter search term

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Library: Simulink/Sinks Search Results

- Display
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- untitled.mat To File
- simout To Workspace
- XY Graph

Showing: Simulink/Sinks

untitled *

File Edit View Simulation Format Tools Help

10.0 Normal

Sine Wave Scope

Scope

Time offset: 0

Ready 100% ode45

Simulink Library Browser

File Edit View Help

Enter search term

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Showing: Simulink/Sinks

untitled *

File Edit View Simulation Format Tools Help

10.0 Normal

Sine Wave Scope

Scope

Time offset: 0

Ready 100% ode45

Simulink Library Browser

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Showing: Simulink/Sinks

untitled *

File Edit View Simulation Format Tools Help

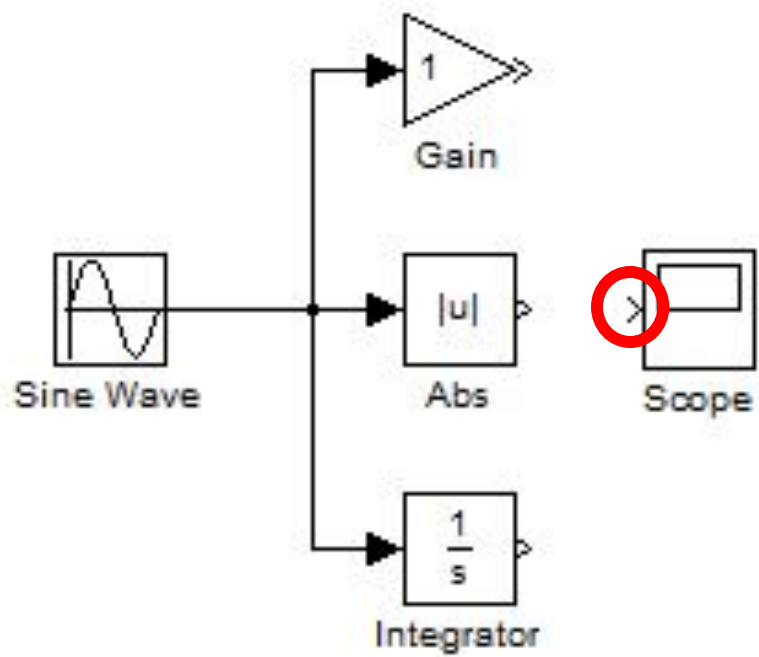
0.5 Normal

Sine Wave Scope

Scope

Time offset: 0

Ready 100% ode45



Simulink Library Browser

File Edit View Help

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Libraries

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Library: Simulink/Continuous Search R

- $\frac{du}{dt}$ Derivative
- $\frac{1}{s}$ Integrator
- $\int \frac{1}{s}$ Integrator Limited
- $\frac{1}{s^2}$ Integrator, Second-Order
- $\int \frac{1}{s^2} dx$ Integrator, Second-Order Limit...
- PID(s) PID Controller
- Ref PID(s) PID Controller (2DOF)
- $\begin{matrix} x' = Ax + Bu \\ y = Cx + Du \end{matrix}$ State-Space
- $\frac{1}{s+1}$ Transfer Fcn
- $\frac{1}{s}$ Transport Delay
- $\frac{1}{s}$ Variable Time Delay
- $\frac{1}{s}$ Variable Transport Delay
- $\frac{(s-1)}{(s+1)}$ Zero-Pole

Showing: Simulink/Continuous

untitled *

File Edit View Simulation Format Tools Help

0.5 Normal

Scope

'Scope' parameters

General History Style

Number of axes: 3

Time range: auto

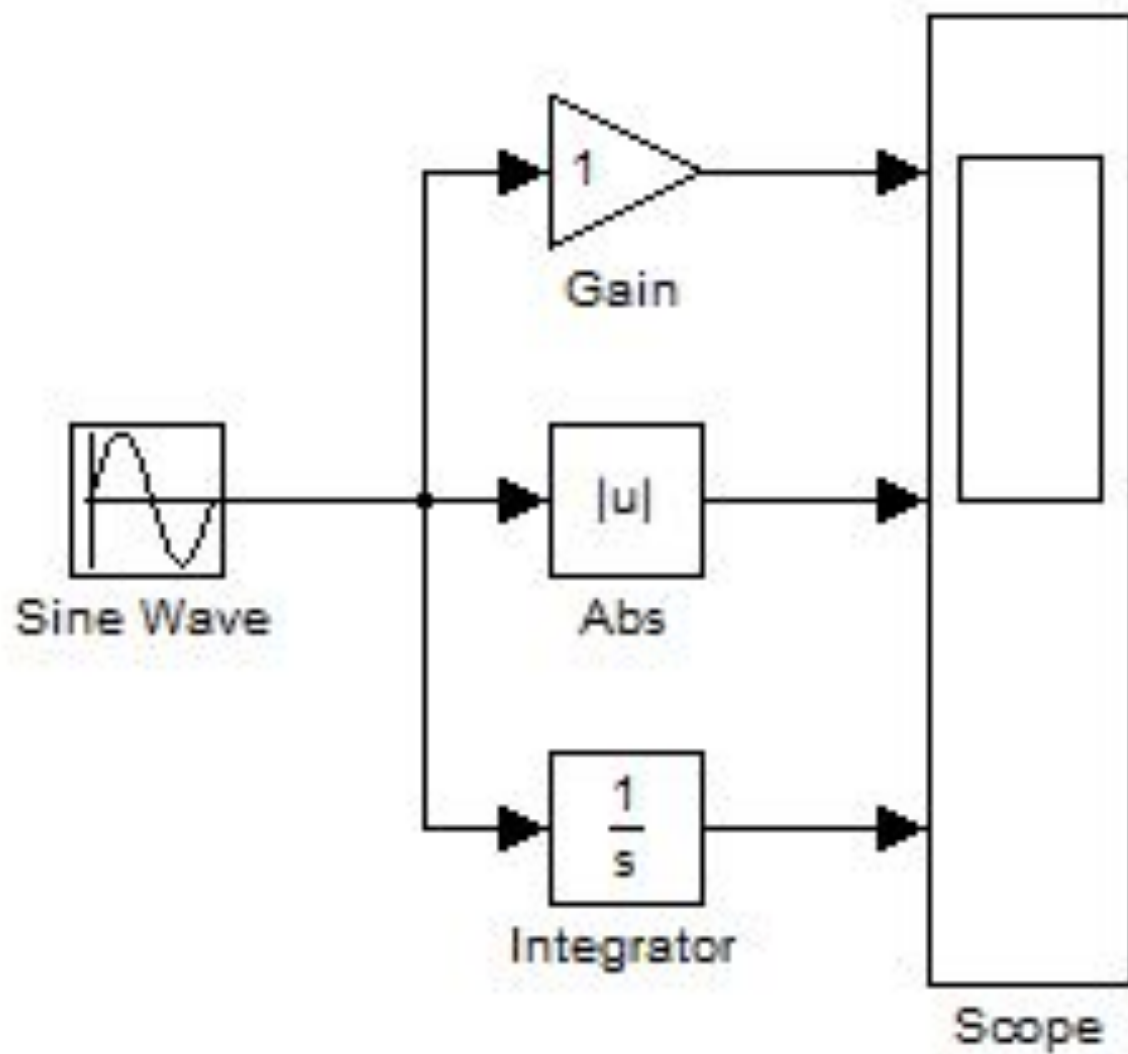
Tick labels: bottom axis only

Sampling

Decimation: 1

OK Cancel Help Apply

Ready 100% ode45



Simulink Library Browser

File Edit View Help

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- $\frac{1}{s^2} \int dx$ Integrator, Second-Order Limit...
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- $\begin{matrix} x' = Ax + Bu \\ y = Cx + Du \end{matrix}$ State-Space
- $\frac{1}{s+1}$ Transfer Fcn
- $\frac{D}{T}$ Transport Delay
- $\frac{D}{T} \int dx$ Variable Time Delay
- $\frac{D}{T} \int dx$ Variable Transport Delay
- $\frac{(s-1)}{s(s+1)}$ Zero-Pole

Showing: Simulink/Continuous

untitled *

File Edit View Simulation Format Tools Help

0.5 Normal

Sine Wave

Gain

Abs

Integrator

Scope

Function Block Parameters: Gain

Gain

Element-wise gain ($y = K.*u$) or matrix gain ($y = K*u$ or $y = u*K$).

Main Signal Attributes Parameter Attributes

Gain:

3

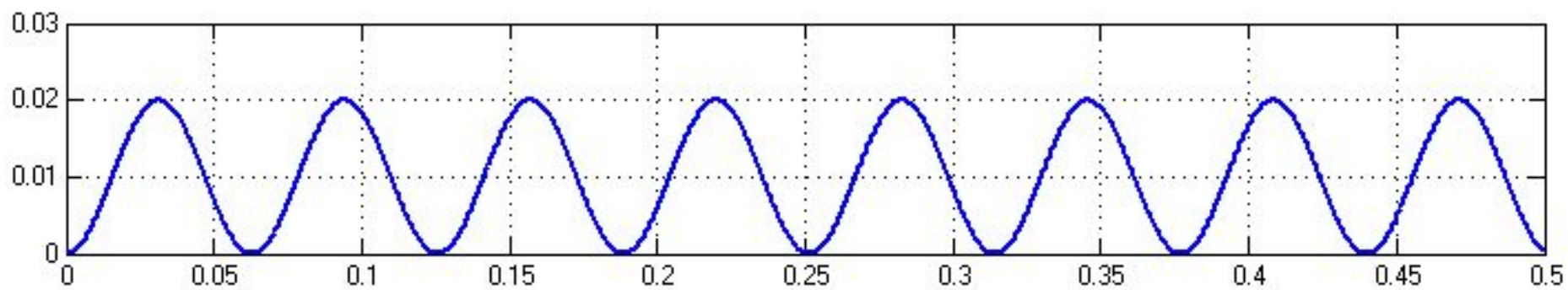
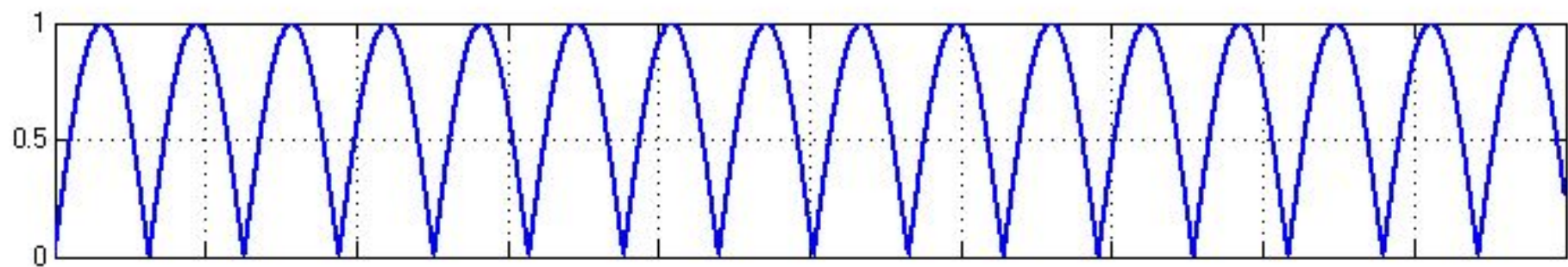
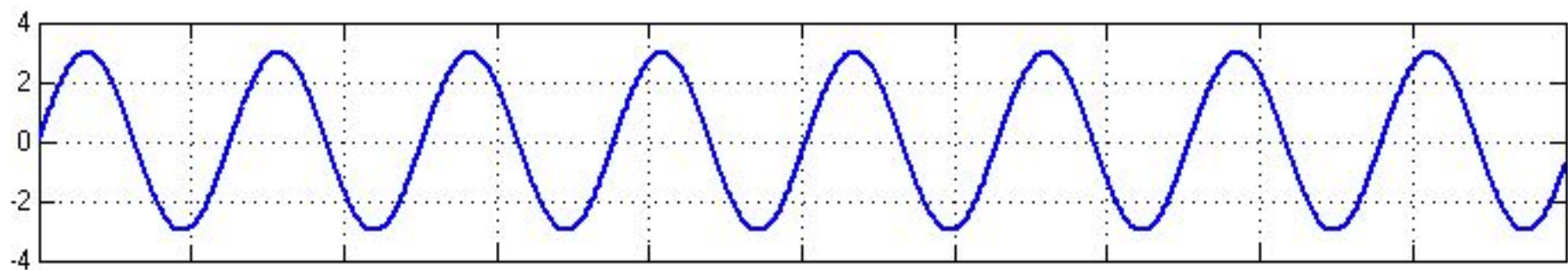
Multiplication: Element-wise($K.*u$)

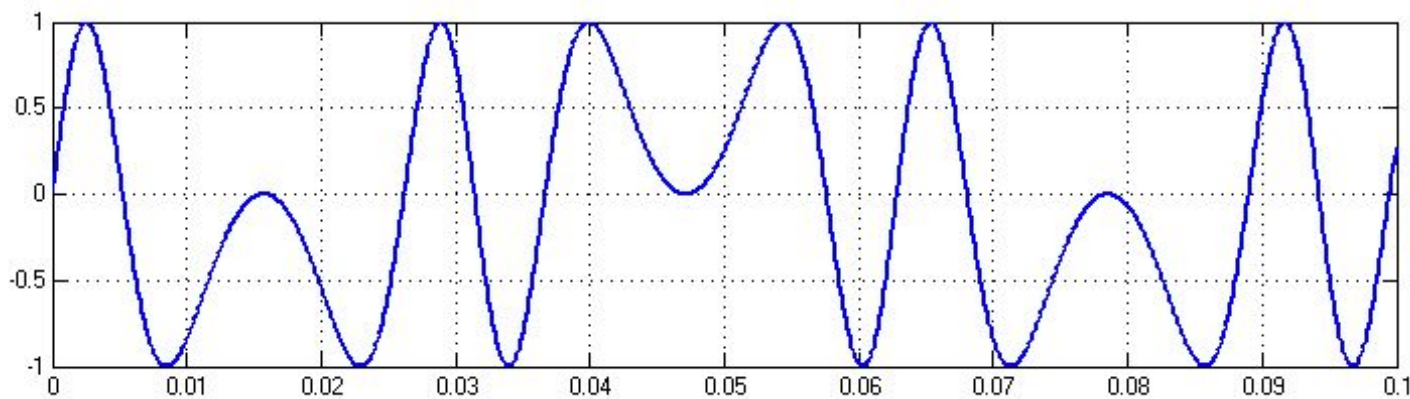
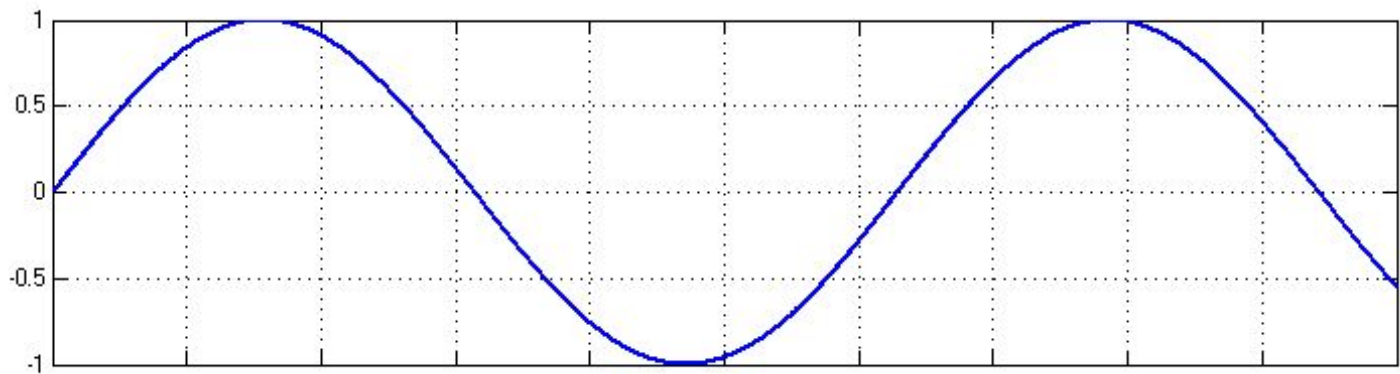
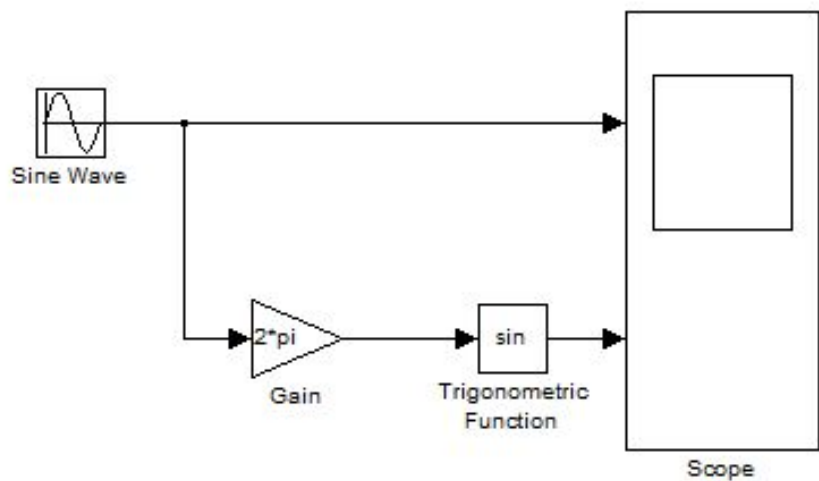
Sample time (-1 for inherited):

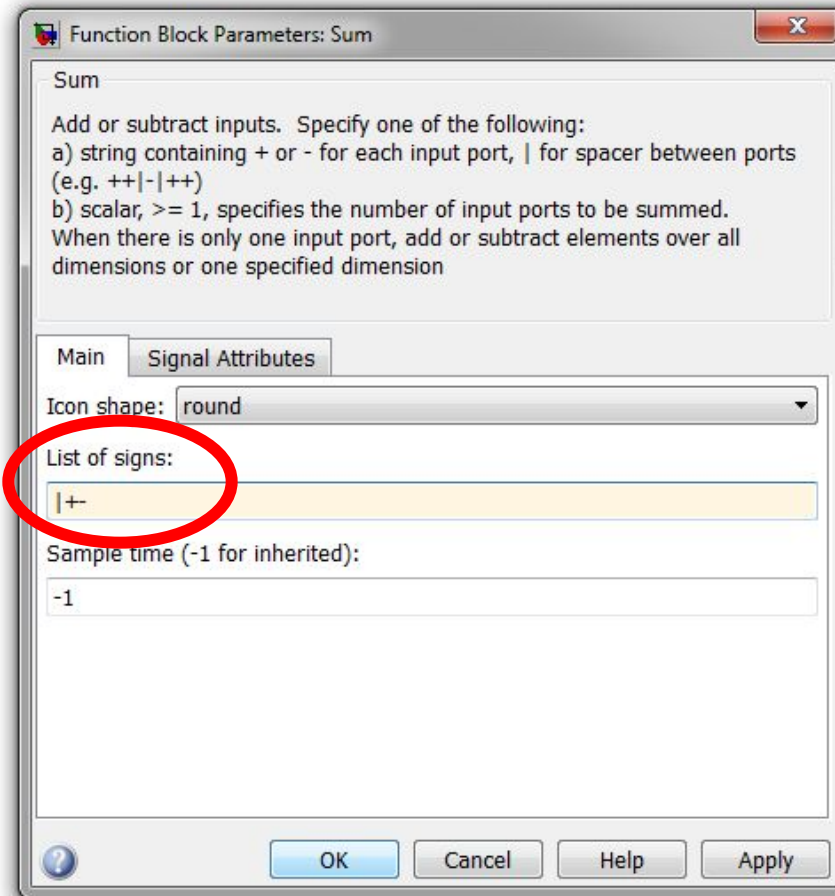
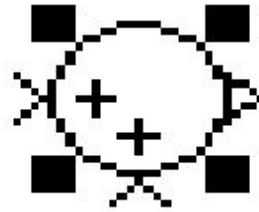
-1

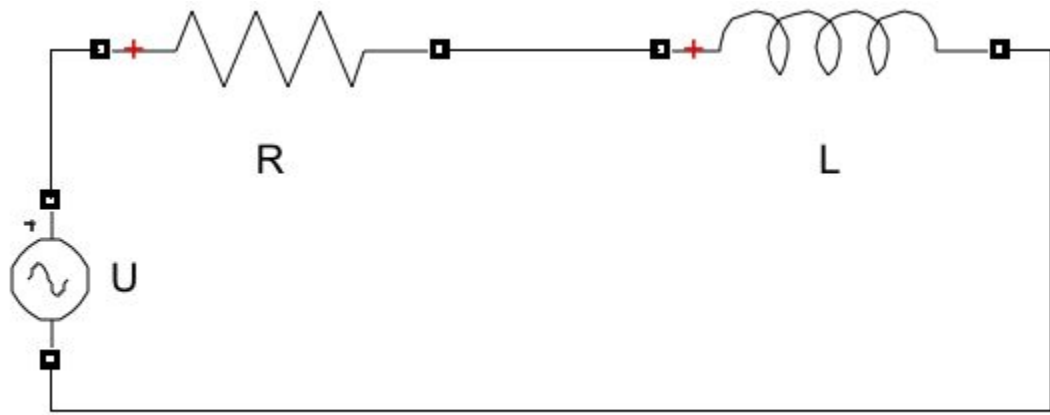
OK Cancel Help Apply

Ready 100% ode45









$$u(t) = e(t) + i(t) \cdot R$$

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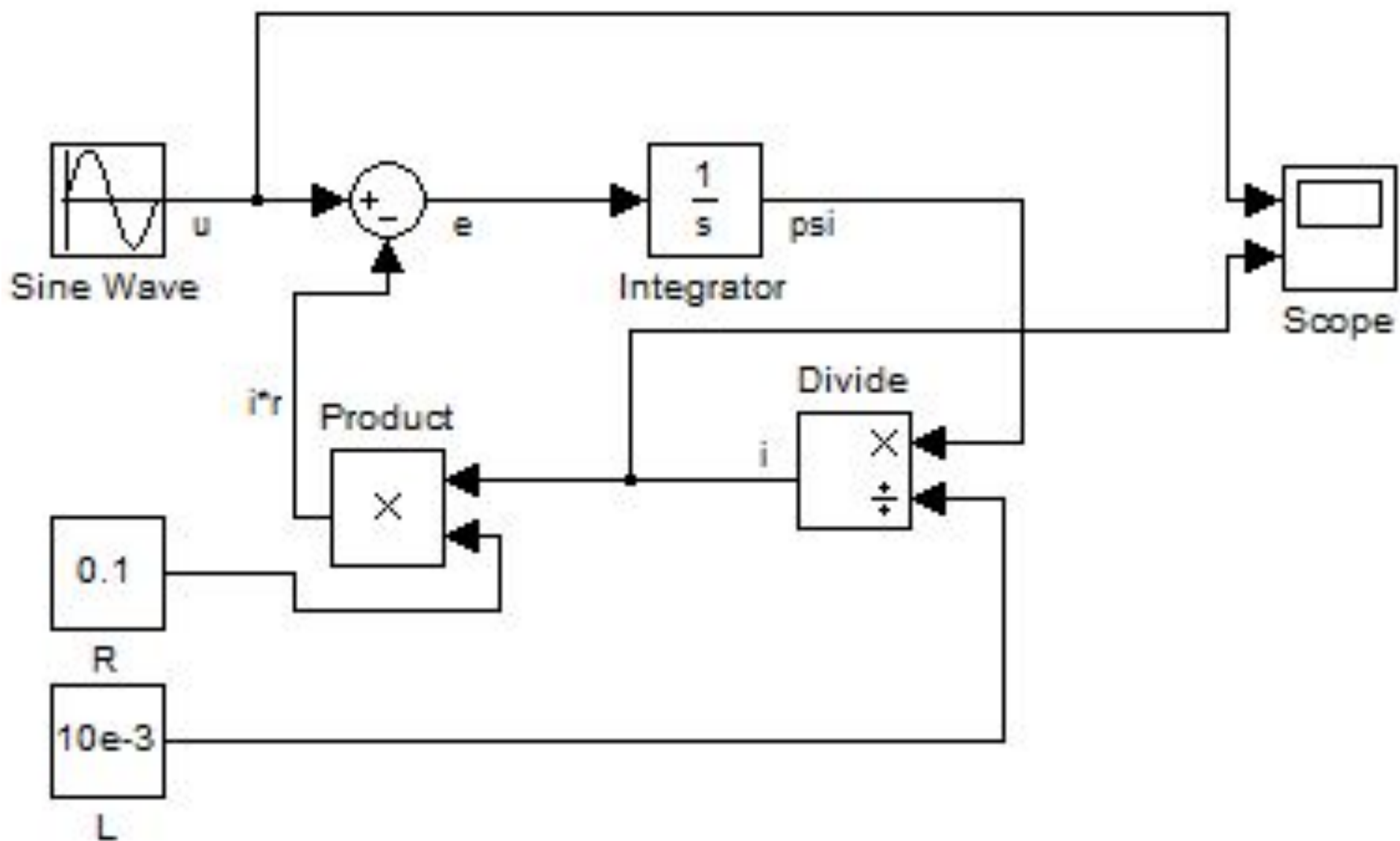
$$u(t) = e(t) + i(t) \cdot R$$

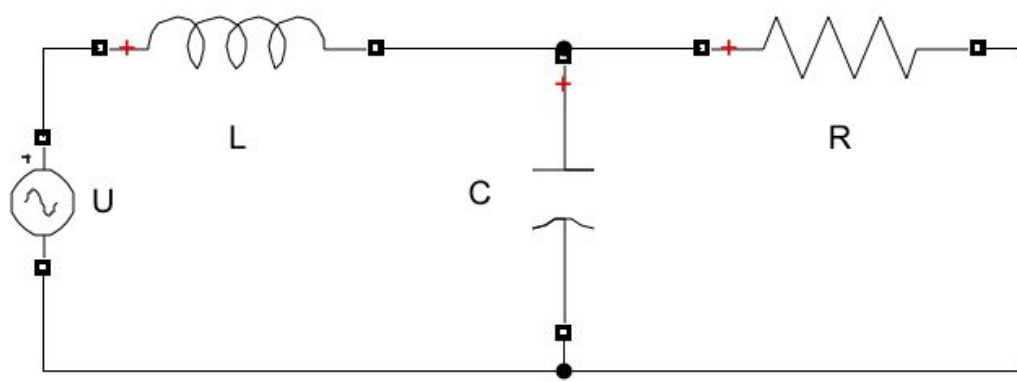
$$u(t) = e(t) + i(t) \cdot R$$

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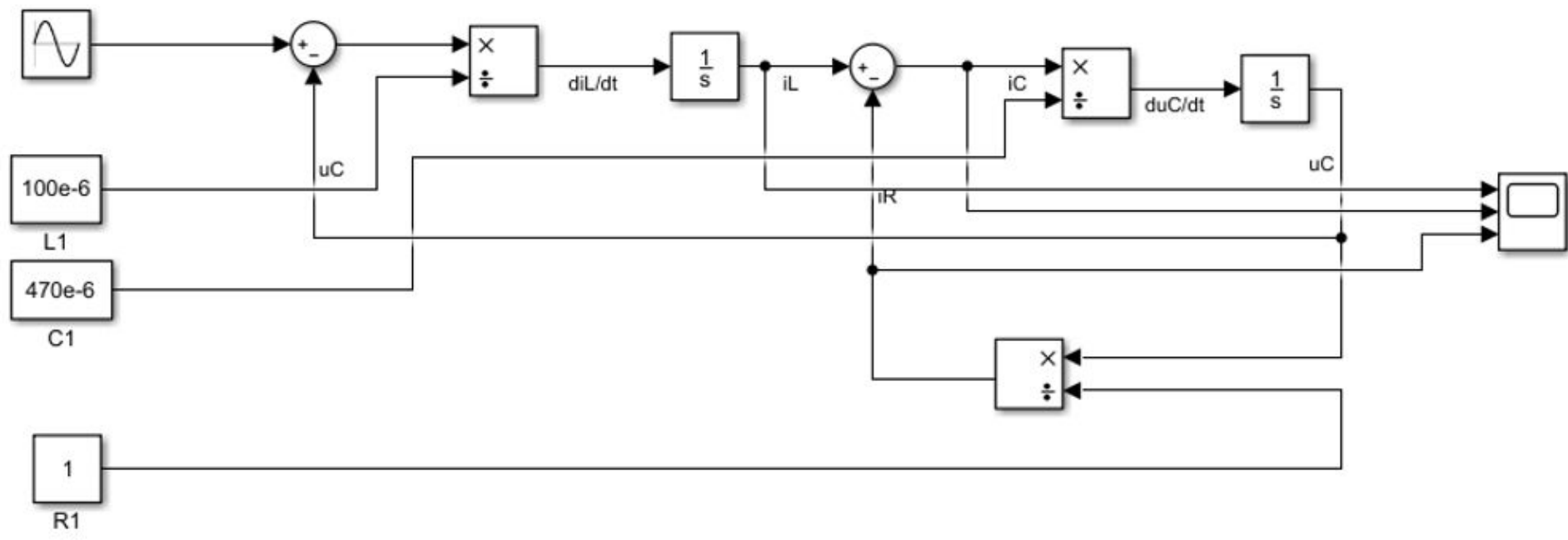
$$u(t) = e(t) + i(t) \cdot R$$

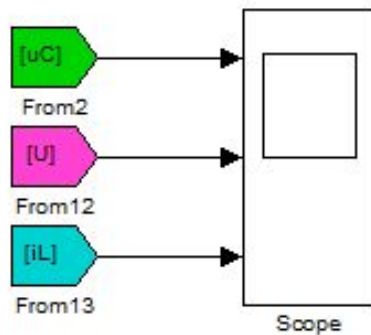
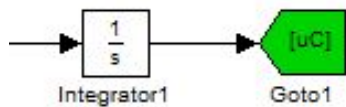
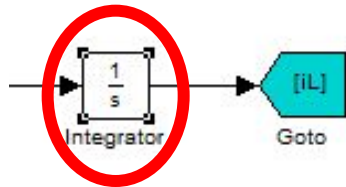
$$u(t) = e(t) + i(t) \cdot R$$

$$u(t) = e(t) + i(t) \cdot R$$

$$u(t) = e(t) + i(t) \cdot R$$

$$u(t) = e(t) + i(t) \cdot R$$





Function Block Parameters: Integrator

Integrator
Continuous-time integration of the input signal.

Parameters

External reset: none

Initial condition source: internal

Initial condition:
0

Limit output

Upper saturation limit:
inf

Lower saturation limit:
0

Show saturation port

Show state port

Absolute tolerance:
auto

Ignore limit and reset when linearizing

Enable zero-crossing detection

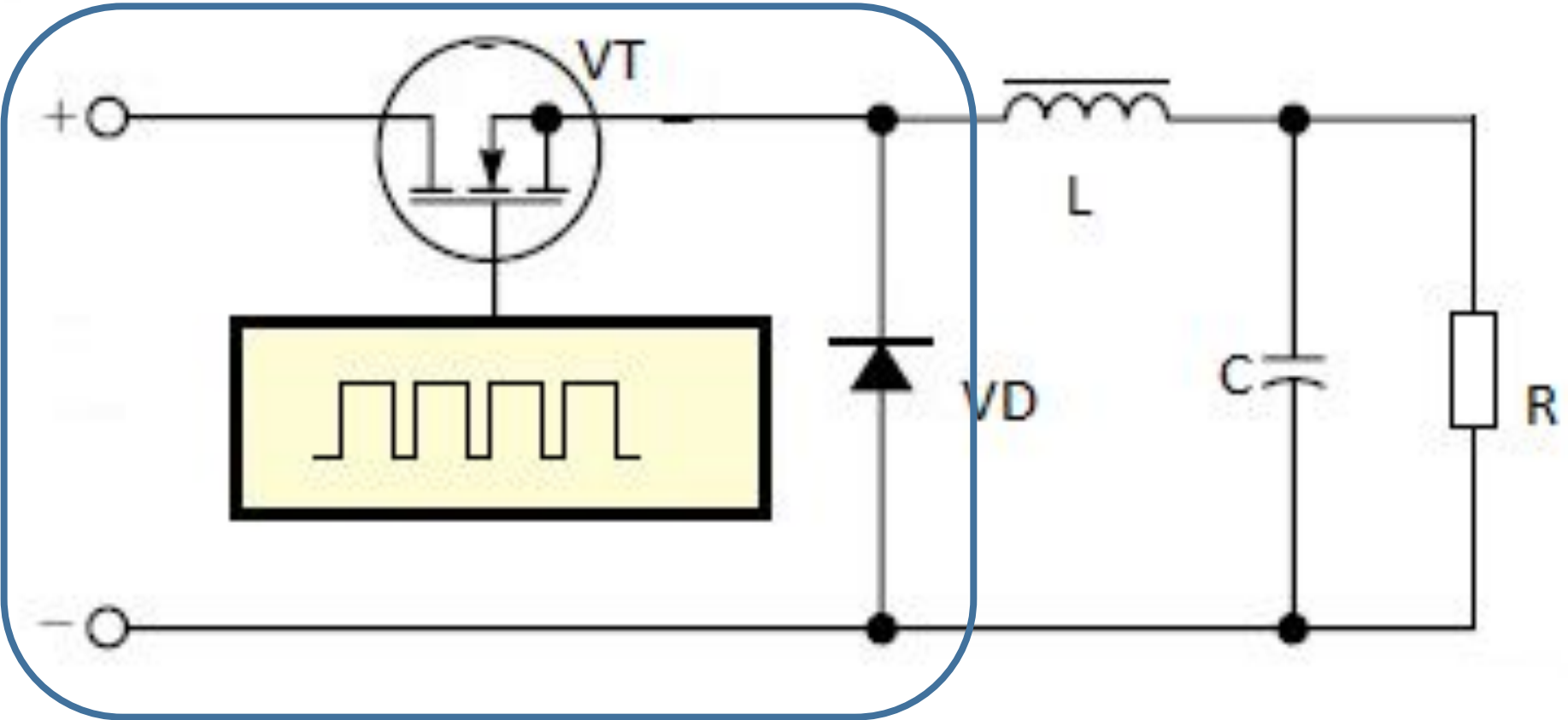
State Name: (e.g., 'position')
"

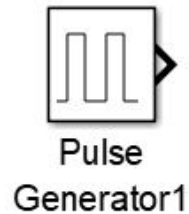
Buttons: ? OK Cancel Help Apply

Компьютерные технологии при разработке и проектировании электрооборудования автономных объектов

Лабораторная работа 1

Модель понижающего регулятора
напряжения в среде Simulink





Source Block Parameters: Pulse Generator1

Pulse Generator

Output pulses:

```
if (t >= PhaseDelay) && Pulse is on
  Y(t) = Amplitude
else
  Y(t) = 0
end
```

Pulse type determines the computational technique used.

Time-based is recommended for use with a variable step solver, while Sample-based is recommended for use with a fixed step solver or within a discrete portion of a model using a variable step solver.

Parameters

Pulse type: Time based

Time (t): Use simulation time

Amplitude:
50

Period (secs):
5e-4

Pulse Width (% of period):
50

Phase delay (secs):
0

Interpret vector parameters as 1-D

OK Cancel Help Apply

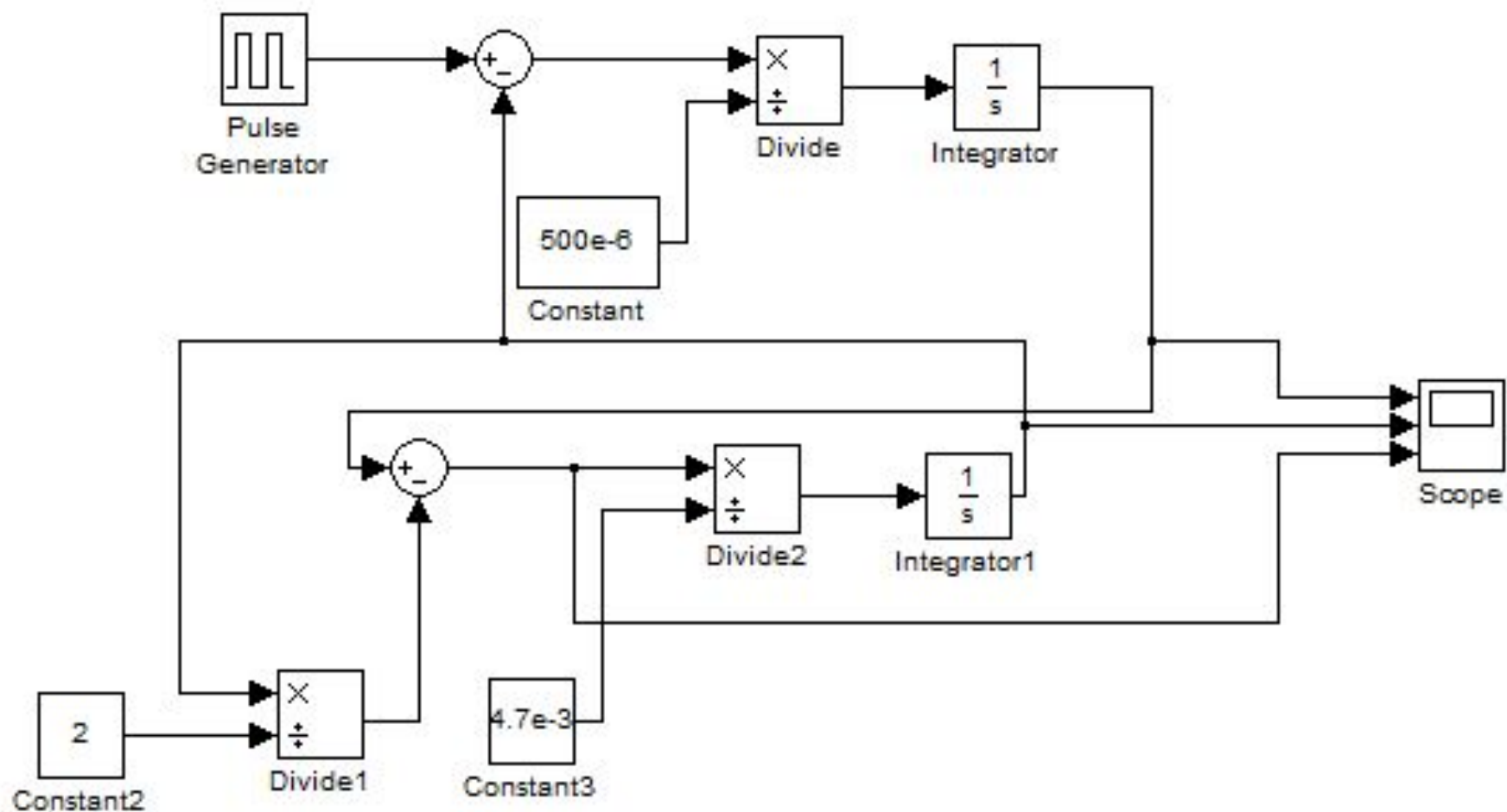
№ вар.	1	2	3	4	5	6			
U_{in} , В	30	40	50	30	40	50			
f , Гц	350	300	250	250	300	350			
R_H , Ом	3.3	3.9	4.7	5.6	6.8	8.2			
№ вар.	7	8	9	10	11	12	13	14	15
U_{in} , В	60	70	80	60	70	80	90	100	110
f , Гц	350	300	250	250	300	350	350	300	250
R_H , Ом	3.3	3.9	4.7	5.6	6.8	8.2	5.6	6.8	8.2

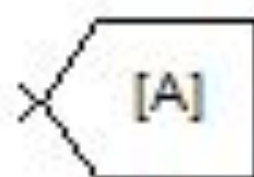
U_{in} – входное напряжение регулятора; f – частота переключения ключа;
 R – сопротивление нагрузки

$$L \geq \frac{R_H}{2f} (1 - D_{min}).$$

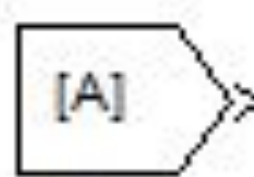
D_{min} – минимальное значение
коэффициента заполнения равно 0,1

$$2\pi \cdot f \cdot C_{out} R_H \gg 1.$$

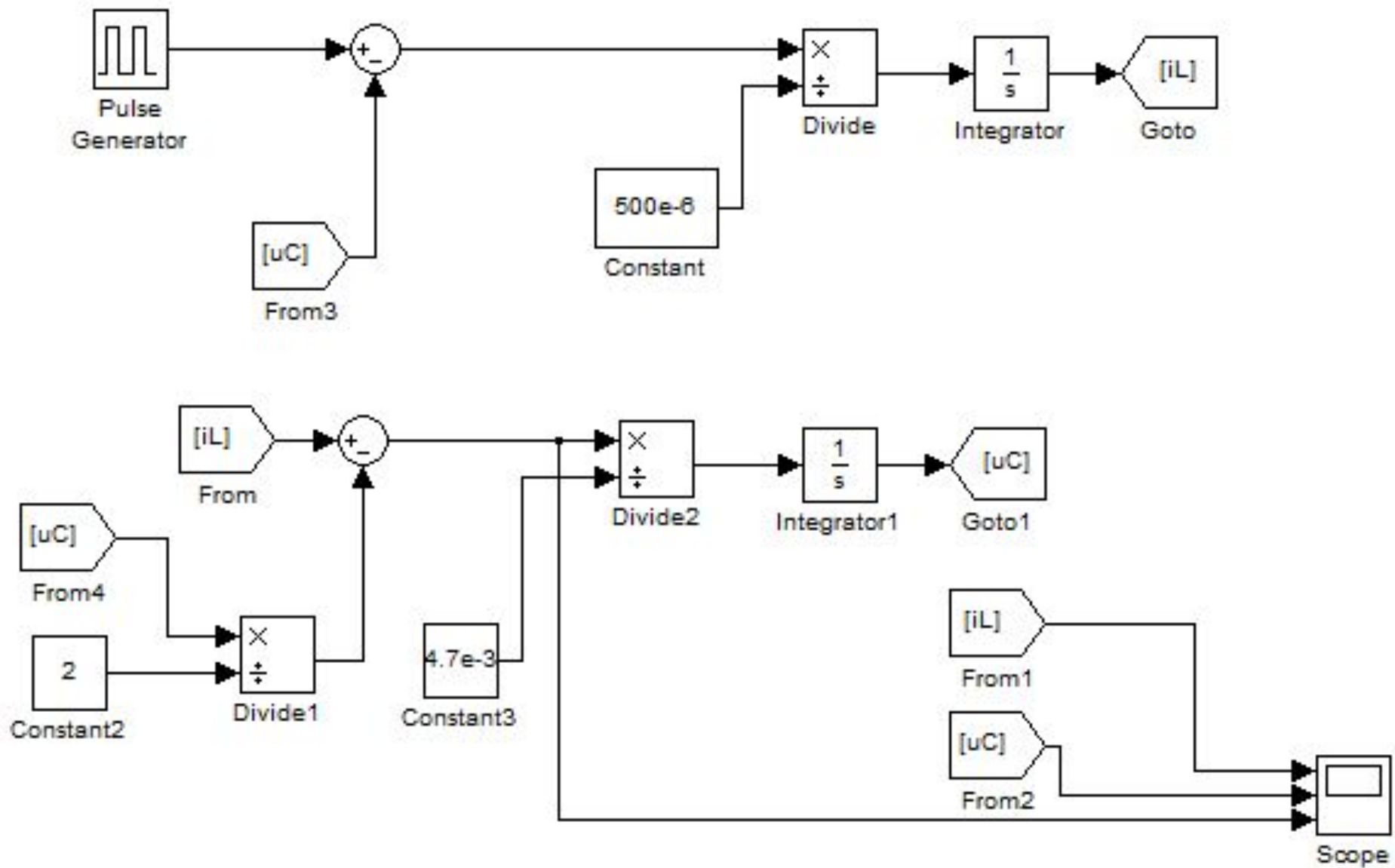


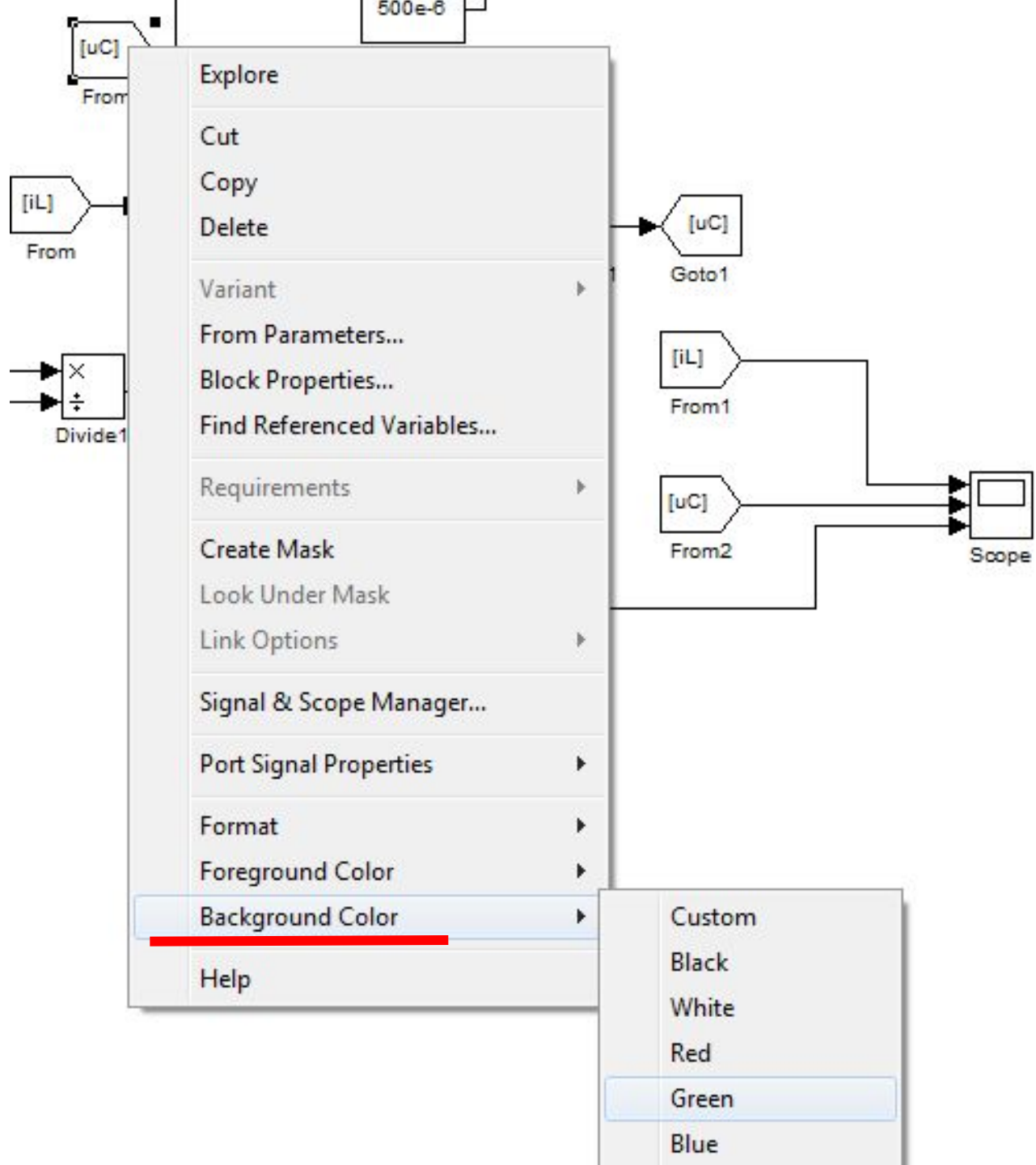


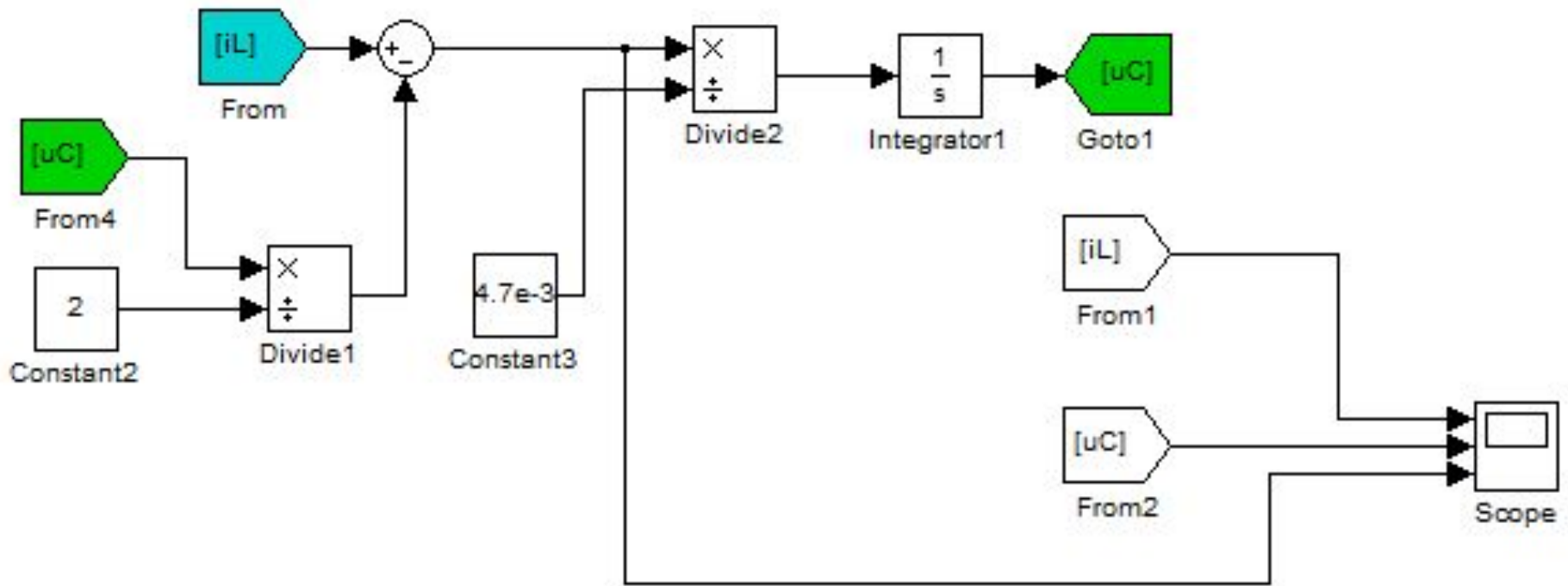
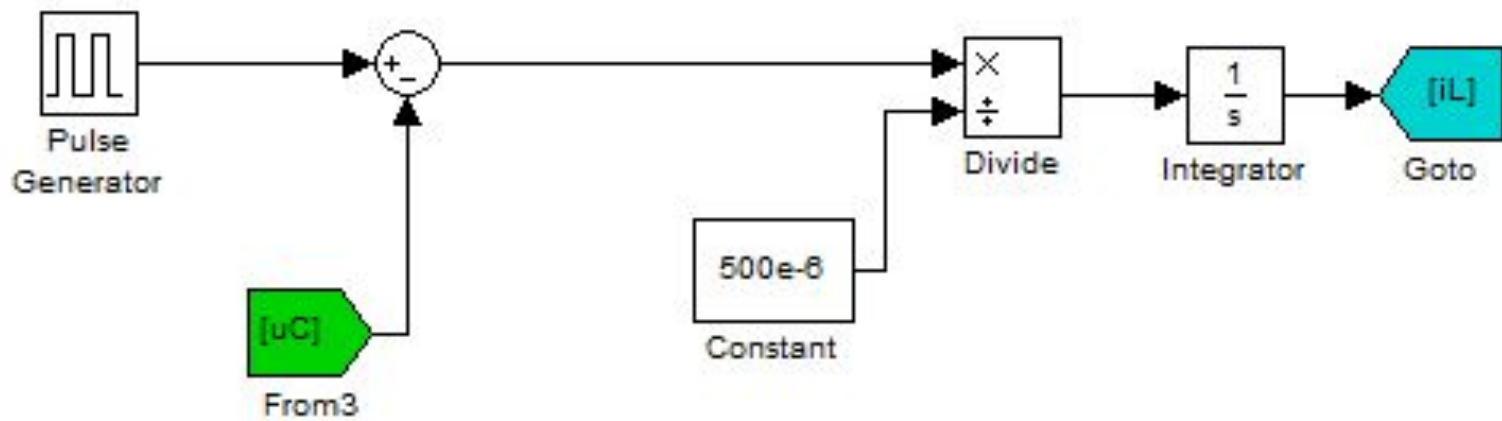
Goto

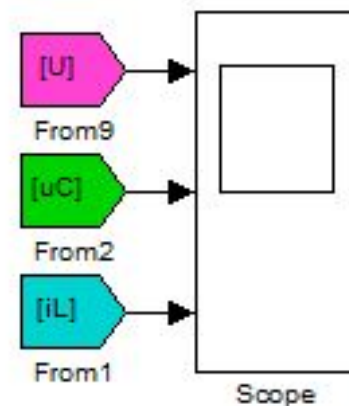
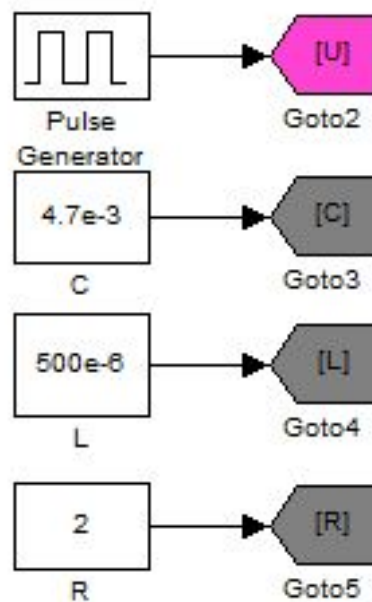
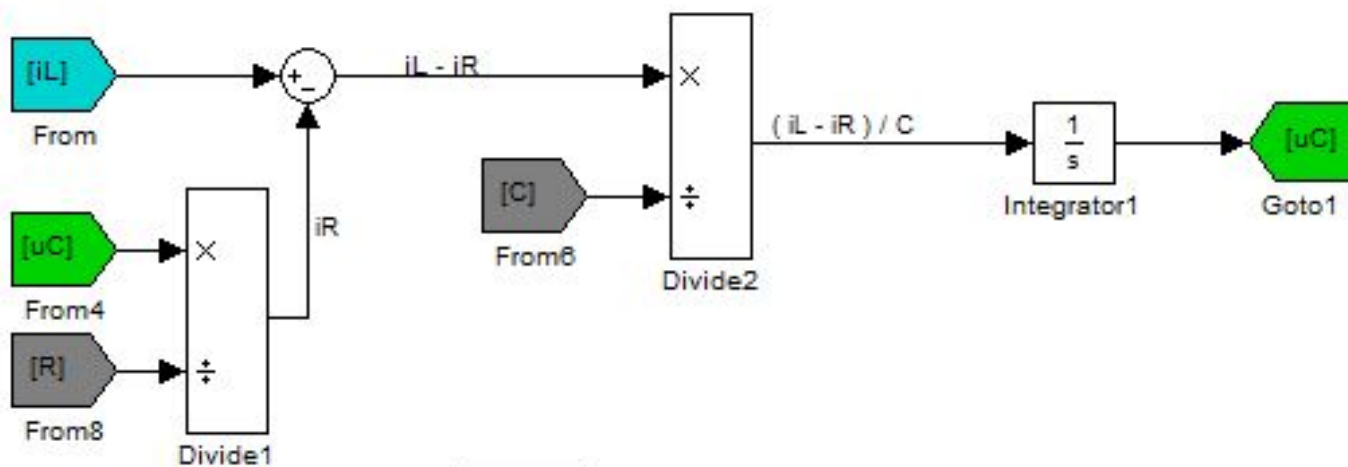
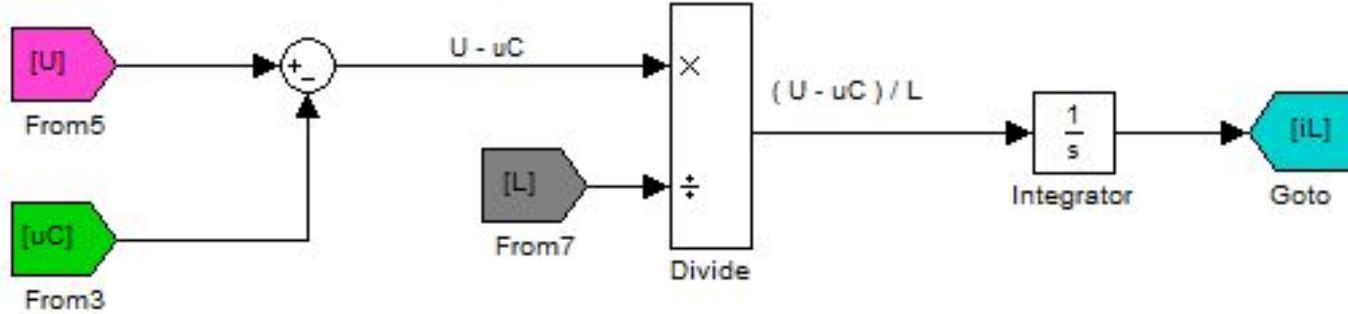


From









Source Block Parameters: L

Constant

Output the constant specified by the 'Constant value' parameter. If 'Constant value' is a vector and 'Interpret vector parameters as 1-D' is on, treat the constant value as a 1-D array. Otherwise, output a matrix with the same dimensions as the constant value.

Main Signal Attributes

Constant value:

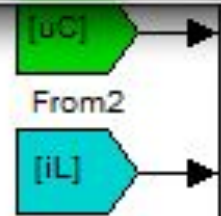
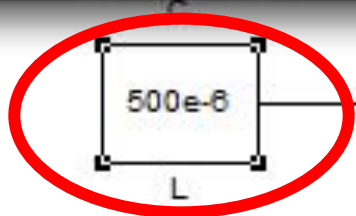
L

Interpret vector parameters as 1-D

Sampling mode: Sample based

Sample time: inf

OK Cancel Help Apply



Workspace

Select data to...

Name	Value
tout	<1000x1 double>

Sort By

Refresh F5

New Ctrl+N

The image shows a software interface with a 'Variable Editor - L' window. The window title bar includes standard window controls and a status bar that reads 'Stack: Base' and 'No valid plots for: L'. Below the title bar is a toolbar with various icons. The main area of the window is a grid with columns numbered 1 to 9 and rows numbered 1 to 21. The cell at row 1, column 1 contains the value '0'. A red circle highlights the top portion of the window, encompassing the toolbar and the top part of the grid.

	1	2	3	4	5	6	7	8	9
1	0								
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									

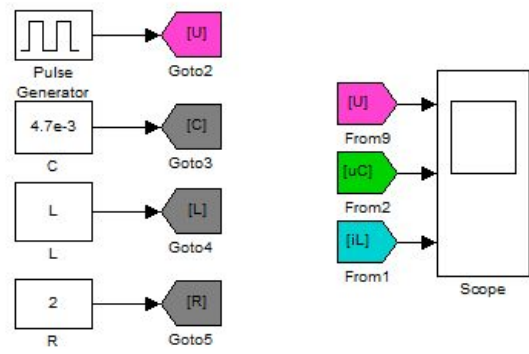
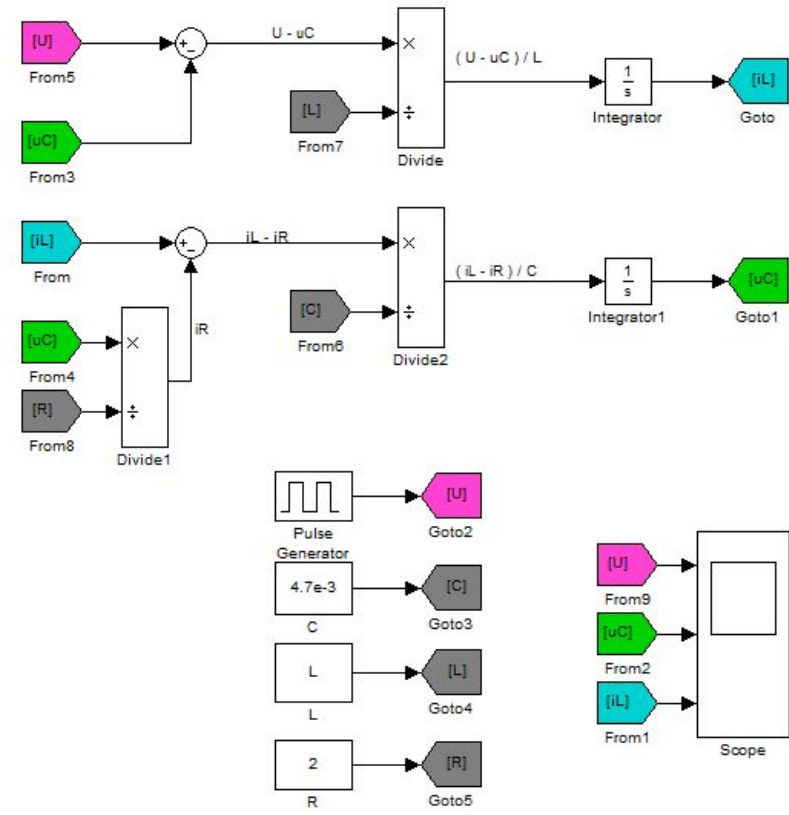
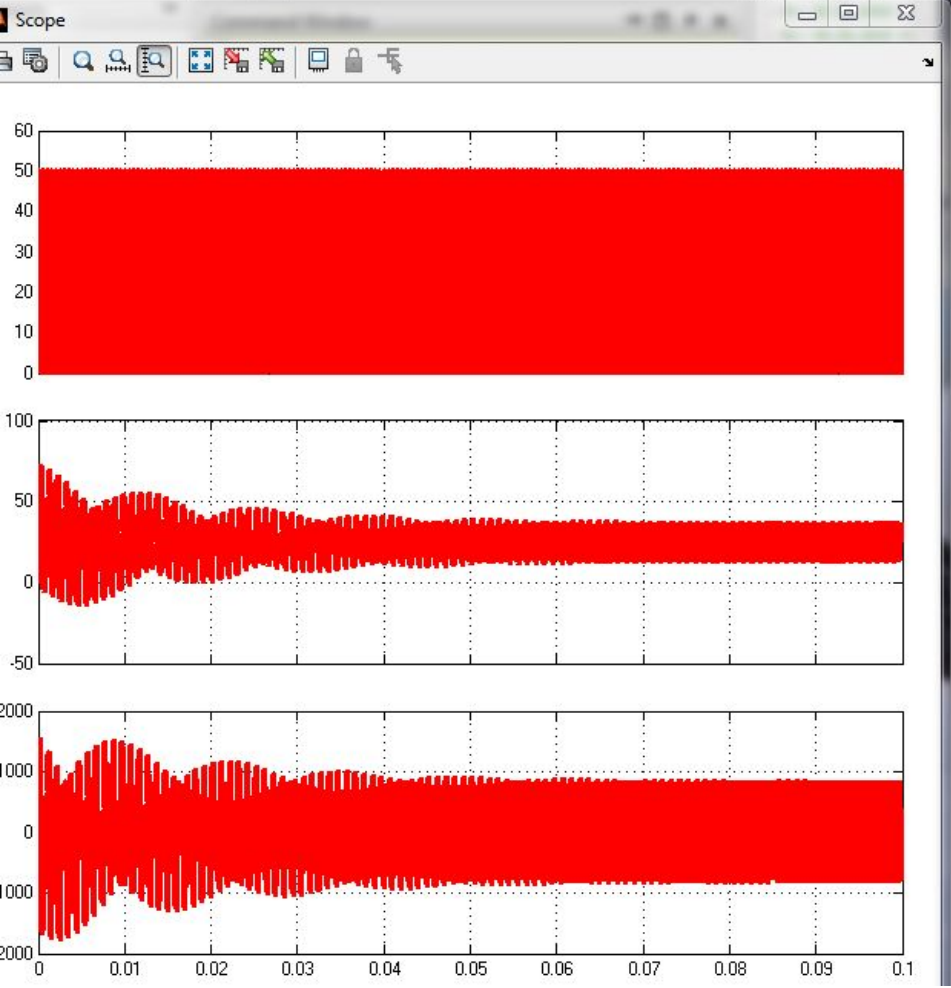
Workspace

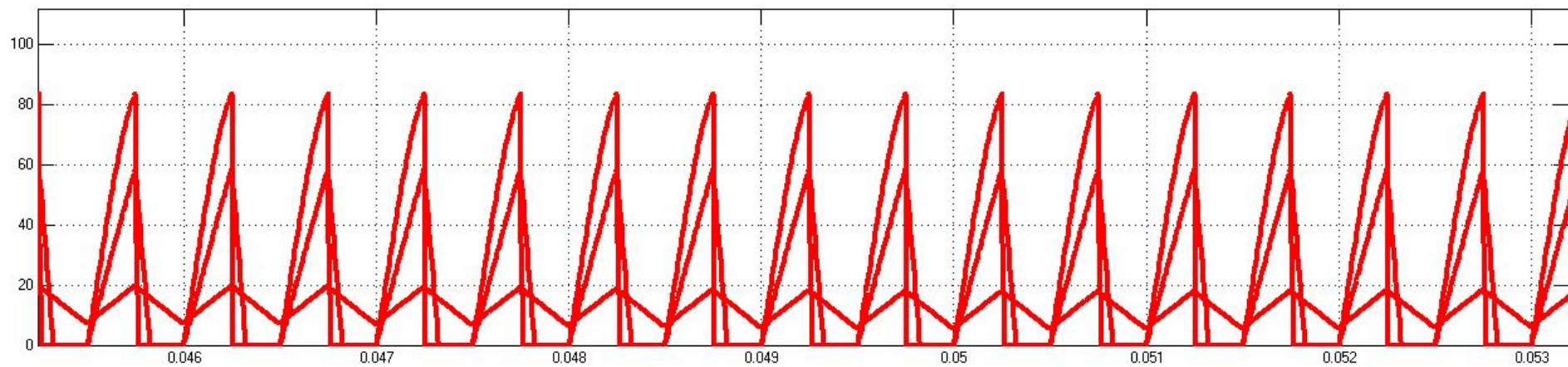
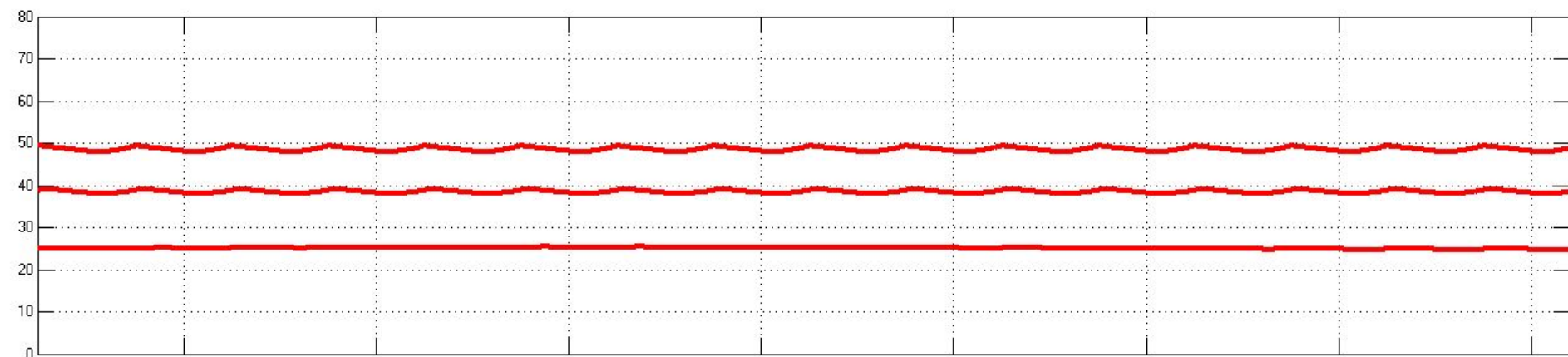
Name	Value
L	0
tout	<1000x1 doub

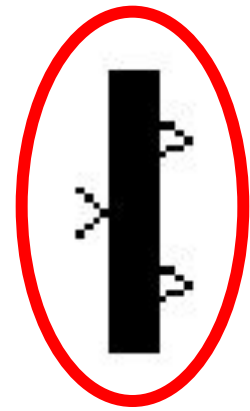
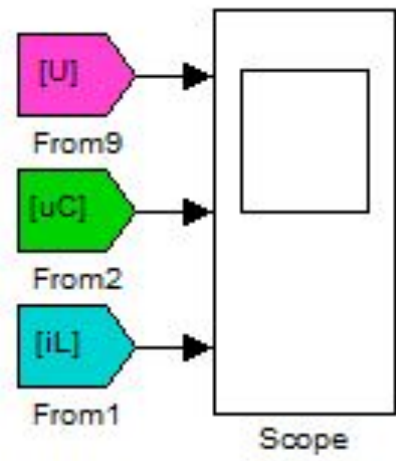
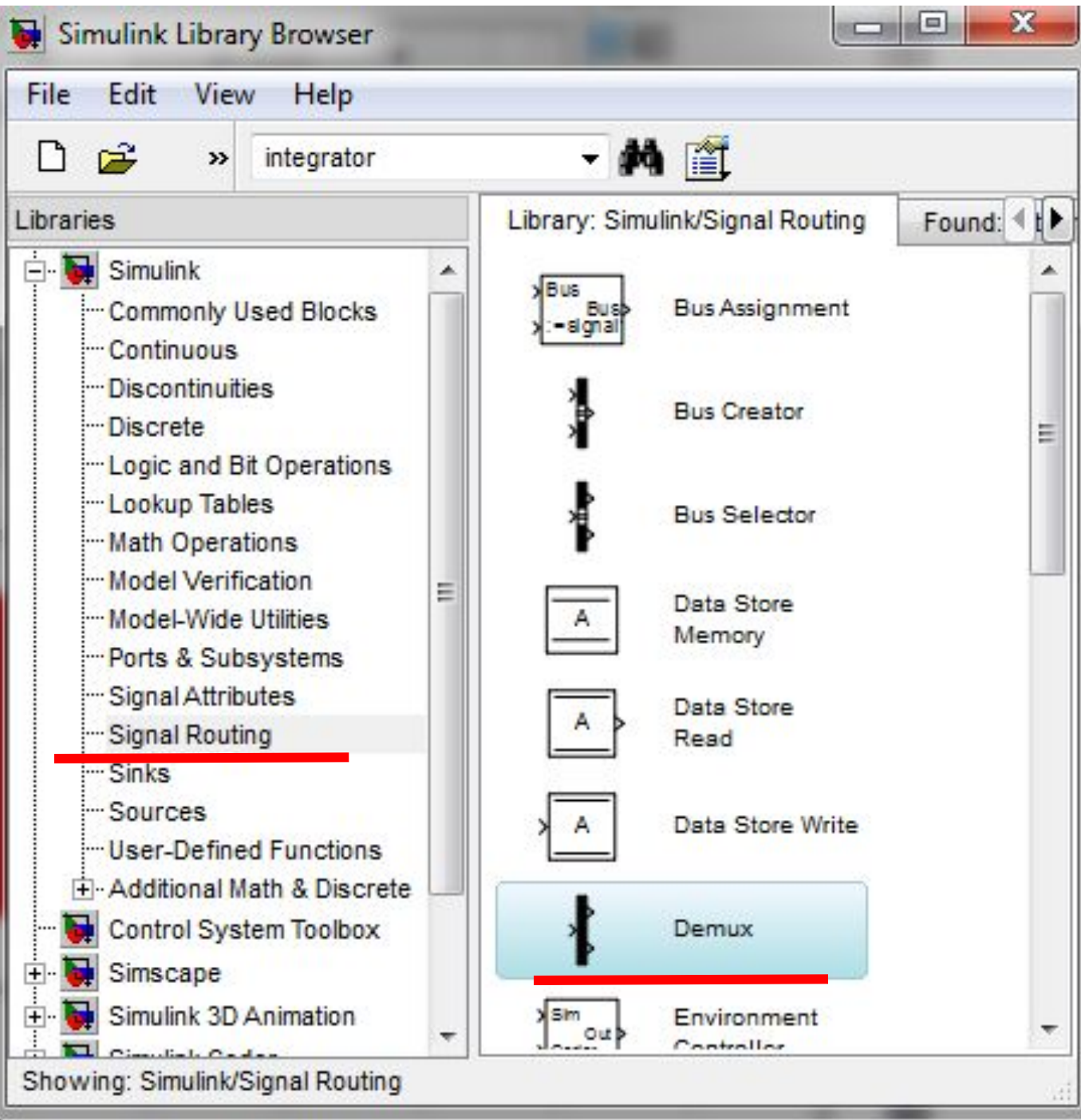
Command History

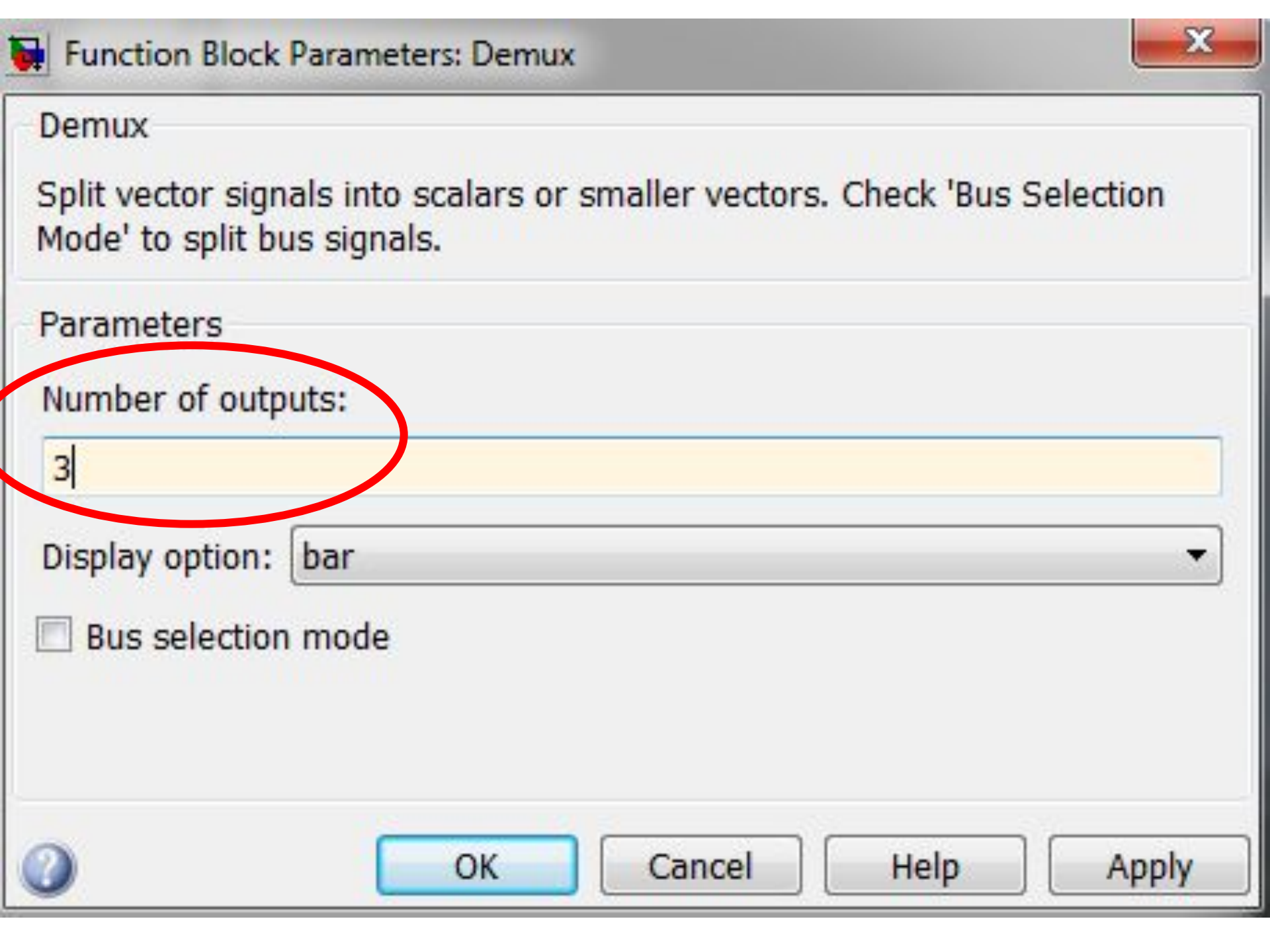
- 12.03.2019 13:36
- 19.03.2019 13:46
- 26.03.2019 13:33

	1	2	3	4
1	5.0000e-06	5.0000e-05	5.0000e-04	
2				
3				
4				









Function Block Parameters: Demux



Demux

Split vector signals into scalars or smaller vectors. Check 'Bus Selection Mode' to split bus signals.

Parameters

Number of outputs:

3

Display option: bar

Bus selection mode

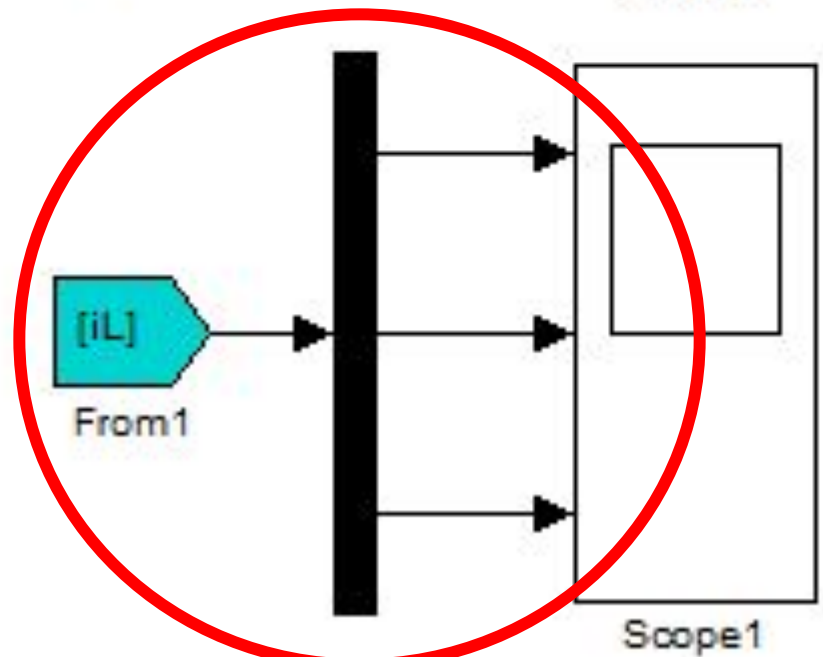
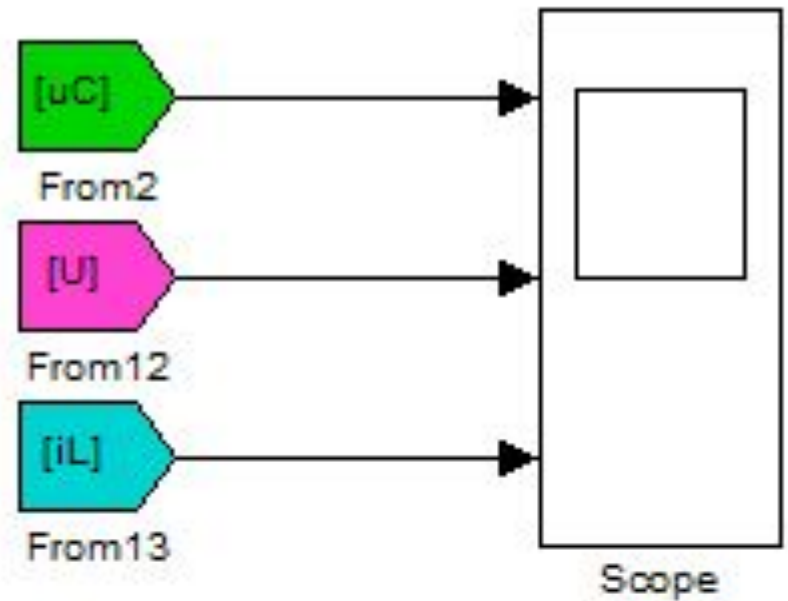
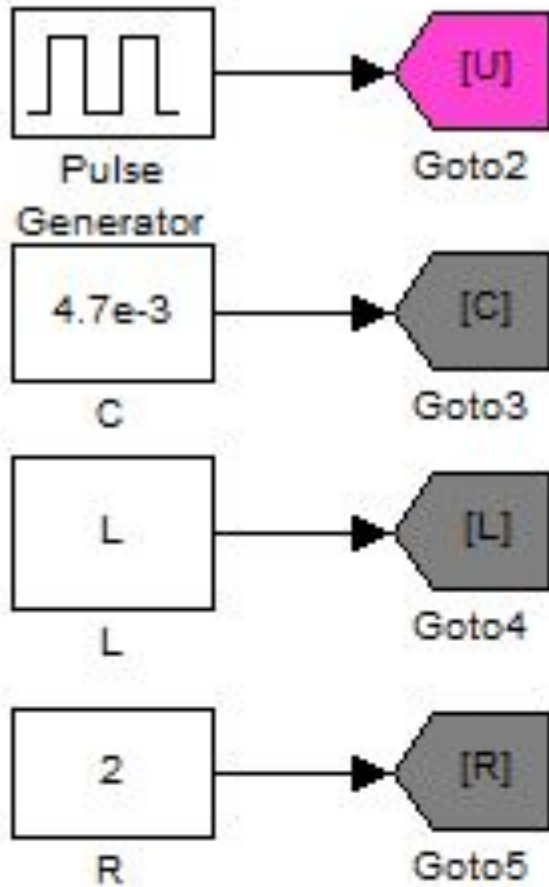


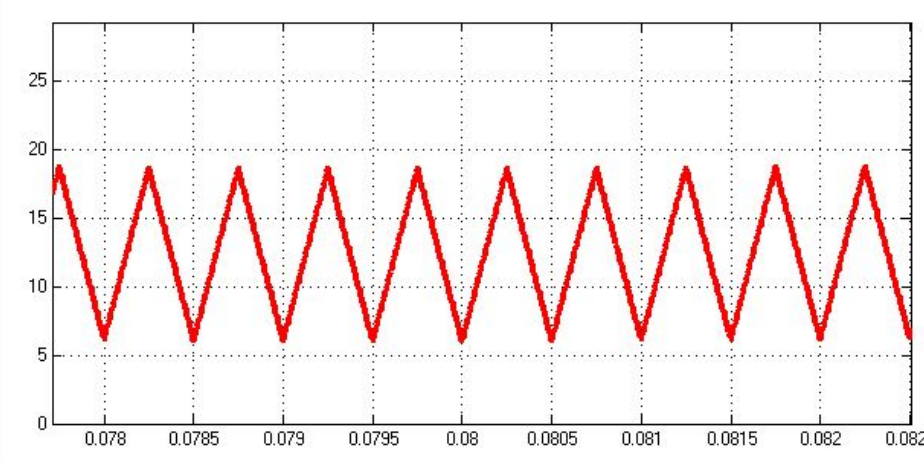
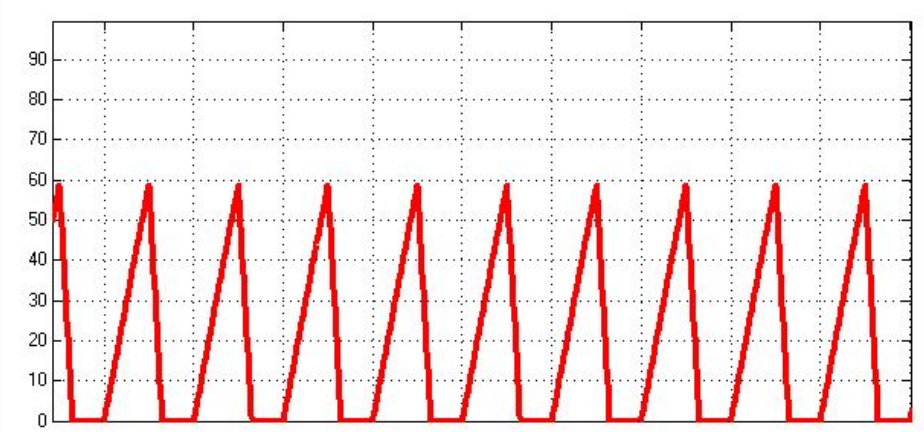
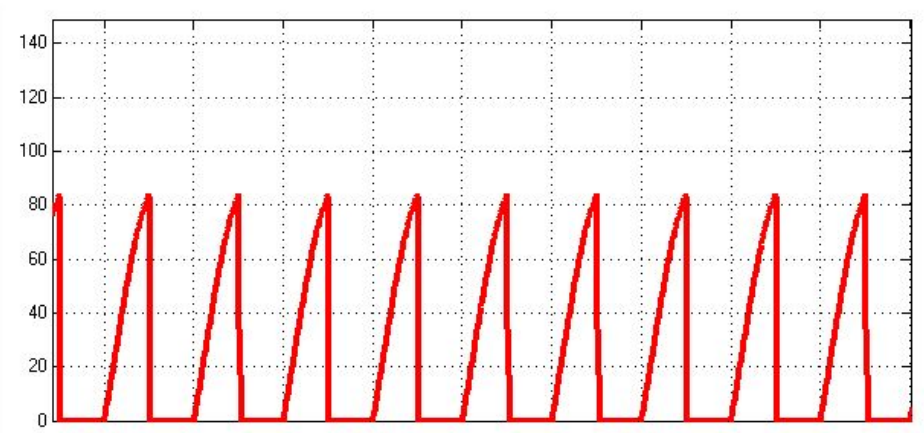
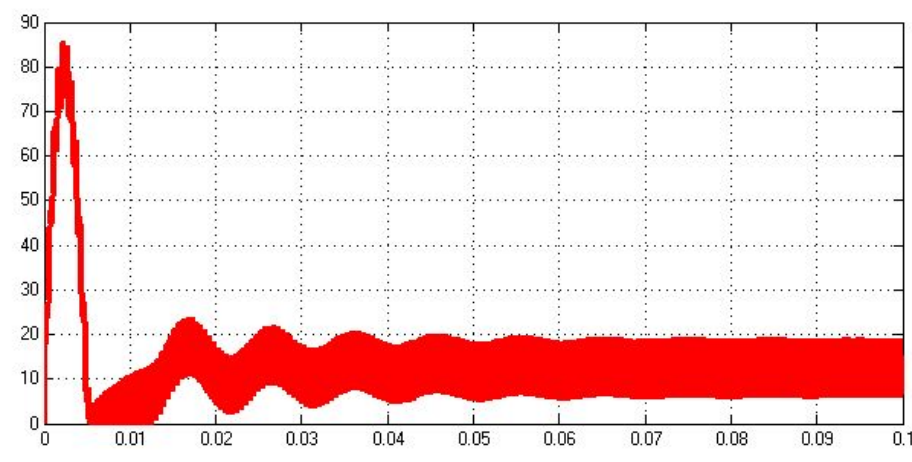
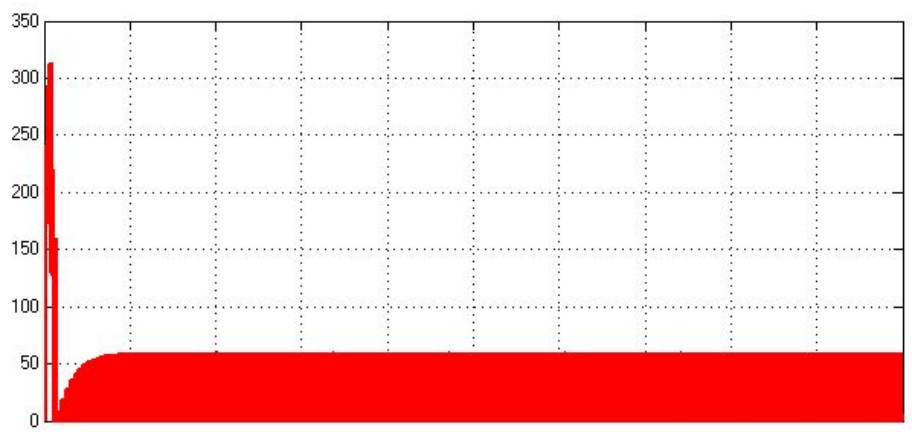
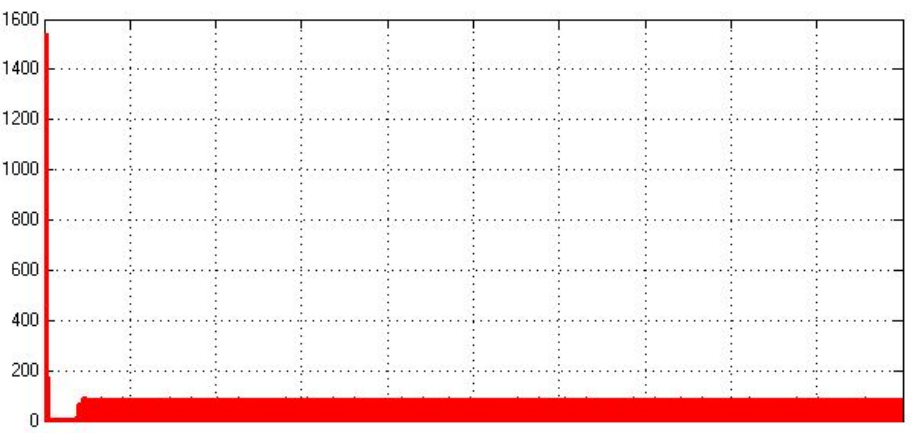
OK

Cancel

Help

Apply





Задание на защиту ЛР1

1. Сформировать мат. модель понижающего регулятора напряжения с данными ранее параметрами для каждой бригады
2. Каждый из 2х человек в бригаде должен сделать индивидуальное задание, а именно:
 - Параметрически изменяя индуктивность в пределах 10 ... 190 % (минимум 5 значений) получить осциллограммы тока дросселя и напряжения на нагрузке
 - Параметрически изменяя емкость в пределах 10 ... 190 % (минимум 5 значений) получить осциллограммы тока дросселя и напряжения на нагрузке

Полученные осциллограммы, а так же принцип работы модели каждый должен уметь пояснить!