



Analog communication lab

second stage –lab 11

AM Modulation demodulation

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2021-2022

Simulink/ Commonly Used Blocks










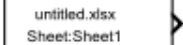















- Simulink
 - Commonly Used Blocks
 - Continuous
 - Dashboard
 - Discontinuities
 - Discrete
 - Logic and Bit Operations
 - Lookup Tables
 - Math Operations
 - Model Verification
 - Model-Wide Utilities
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 - Instrument Control Toolbox
 - Model Predictive Control Toolbox
 - > Neural Network Toolbox
 - OPC Toolbox
 - > Phased Array System Toolbox
 - Report Generator
 - Robotics System Toolbox
 - Robust Control Toolbox

The image shows a grid of Simulink blocks. A context menu is open over the Constant block, listing the following actions:

- Add block to model untitled (Ctrl+I)
- Help for the Constant block
- Go to parent (Esc)
- Block parameters
- Sort in library model order

Simulink/Sources

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 - Image Acquisition Toolbox
 - Instrument Control Toolbox

 Band-Limited White Noise	 Chirp Signal	 Clock	 Constant	 Counter Free-Running	 Counter Limited	 Digital Clock	 Enumerated Constant
 From File	 From Spreadsheet	 From Workspace	 Ground	 In1	 Pulse Generator	 Ramp	 Random Number
 Repeating Sequence	 Repeating Sequence Interpolated	 Repeating Sequence Stair	 Signal Builder	 Signal Generator	 Sine Wave	 Random Number	 Random Number
 Waveform Generator							

- Add block to model untitled **Ctrl+I**
- Help for the Sine Wave block
- Go to parent **Esc**
- Block parameters
- Sort in library model order

Enter search term

k/Sources

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- Coder
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- Instrument Control Toolbox
- Machine Learning Predictive Control Toolbox
- Mathematical Network Toolbox
- System Toolbox
- Simulink Array System Toolbox
- Test Case Generator
- Toolbox
- Control System Toolbox
- Control System Toolbox
- F

Band-Limited White Noise

Chirp Signal

Clock

From File

From Spreadsheet

Repeating Sequence

Repeating Sequence Interpolated

Waveform Generator

untitled * - Simulink

File Edit View Disp

untitled

untitled

Constant

1

Explore

Cut	Ctrl+X
Copy	Ctrl+C
Paste	Ctrl+V
Comment Through	Ctrl+Shift+Y
Comment Out	Ctrl+Shift+X
Delete	Del

Find Referenced Variables

Create Subsystem from Selection Ctrl+G

Format

Rotate & Flip

Arrange

Mask

Library Link

Signals & Ports

Requirements Traceability

Coverage

Model Advisor

Fixed-Point Tool...

C/C++ Code

HDL Code

PLC Code

Polyspace

Block Parameters (Sin)

Properties...

12:34

Digital Clock

10.0

untitled * - Simulink

File Edit View Display Diagram Simulation Analysis Code Tools Help

10.0

untitled

untitled

1
Constant

Sine Wave

Sine Wave 1

Ready 100% VariableStep

The image shows the Simulink software interface. At the top, there is a title bar with the text "untitled * - Simulink" and standard window controls. Below the title bar is a menu bar with options: File, Edit, View, Display, Diagram, Simulation, Analysis, Code, Tools, and Help. Underneath the menu bar is a toolbar containing various icons for file operations (like Save, Open, Print), navigation (Back, Forward, Home), simulation control (Run, Stop, Pause), and a numeric input field set to "10.0". The main workspace is titled "untitled" and contains three blocks: a "Constant" block with the value "1", a "Sine Wave" block, and a "Sine Wave 1" block. A vertical toolbar on the left side of the workspace contains icons for zooming, panning, and other navigation functions. At the bottom of the window, a status bar displays "Ready", "100%", and "VariableStep".

Simulink Library Browser

Enter search term

Simulink/ Commonly Used Blocks

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The image shows a grid of Simulink blocks. The 'Sum' block is highlighted in blue, and a context menu is open over it. The context menu contains the following items:

- Add block to model untitled Ctrl+I
- Help for the Sum block
- Go to parent Esc
- Block parameters
- Sort in library model order



Simulink/ Commonly Used Blocks




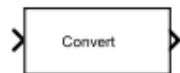




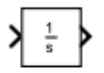







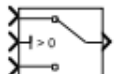


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Bus Creator	Bus Selector	Constant	Convert Data Type Conversion	Delay	Demux	Discrete-Time Integrator	Gain	Ground
In1	Integrator	Logical Operator	Mux	Out1	Product	Scope		
Subsystem	Sum	Switch	Terminator	Vector Concatenate				

- Add block to model untitled **Ctrl+I**
- Help for the Product block
- Go to parent **Esc**
- Block parameters
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Simulink/Commonly Used Blocks

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 Bus Creator	 Bus Selector	 Constant	 Data Type Conversion	 Delay	 Demux	 Discrete-Time Integrator
 In1	 Integrator	 Logical Operator	 Mux	 Out1	 Product	 Relational Operator
 Subsystem	 Sum	 Switch	 Terminator	 Vector Concatenate		

Context menu for Gain block:

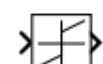
- Add block to model untitled **Ctrl+I**
- Help for the Gain block
- Go to parent **Esc**
- Block parameters
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Simulink/Discontinuities

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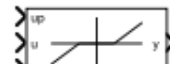
Backlash



Coulomb & Viscous Friction



Dead Zone



Dead Zone Dynamic



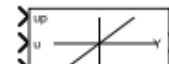
Hit Crossing



Quantizer



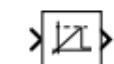
Rate Limiter



Rate Limiter Dynamic



Relay



Wrap To Zero

- Add block to model untitled Ctrl+I
- Help for the Saturation block
- Go to parent Esc
- Block parameters
- Sort in library model order

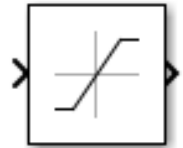
Saturation

Limit range of signal

Library

Discontinuities

Description

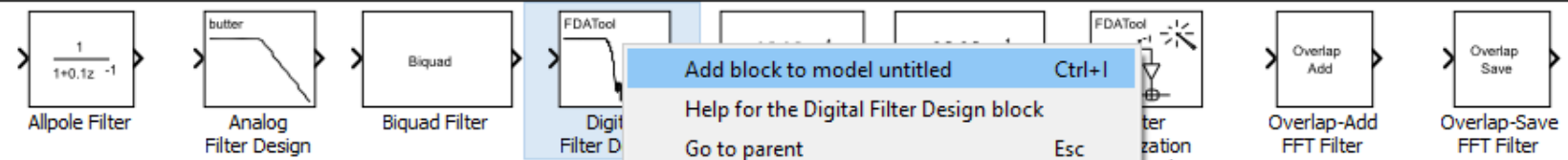


The Saturation block imposes upper and lower limits on an input signal.

When the input is...	Where...	The block output is the...
Within the range specified by the Lower limit and Upper limit parameters	$\text{Lower limit} \leq \text{Input value} \leq \text{Upper limit}$	Input value
Less than the Lower limit parameter	$\text{Input value} < \text{Lower limit}$	Lower limit
Greater than the Upper limit parameter	$\text{Input value} > \text{Upper limit}$	Upper limit

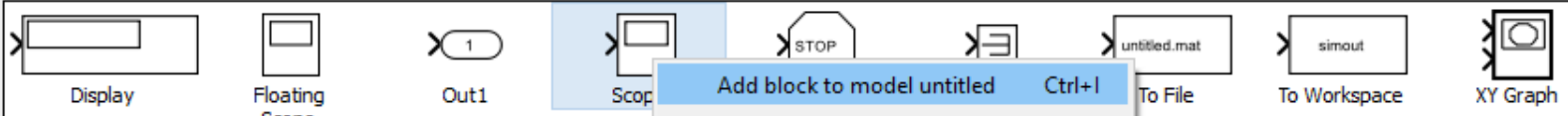
DSP System Toolbox/Filtering/Filter Implementations

- Comm Filters
- Comm Sinks
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- Equalizers
- > Error Detection and Correction
- > Interleaving
- MIMO
- > Modulation
- RF Impairments
- RF Impairments Correction
- Sequence Operations
- Source Coding
- > Synchronization
- Utility Blocks
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- Control System Toolbox
- ▼ DSP System Toolbox
 - > Estimation
 - ▼ Filtering
 - Adaptive Filters
 - Filter Designs
 - Filter Implementations
 - Multirate Filters
 - > Math Functions
 - Quantizers



- Add block to model untitled **Ctrl+I**
- Help for the Digital Filter Design block
- Go to parent **Esc**
- Block parameters
- Sort in library model order

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 - Comm Sinks



- Add block to model untitled Ctrl+I
- Help for the Scope block
- Go to parent Esc
- Block parameters
- Sort in library model order



Commonly Used blocks

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Display

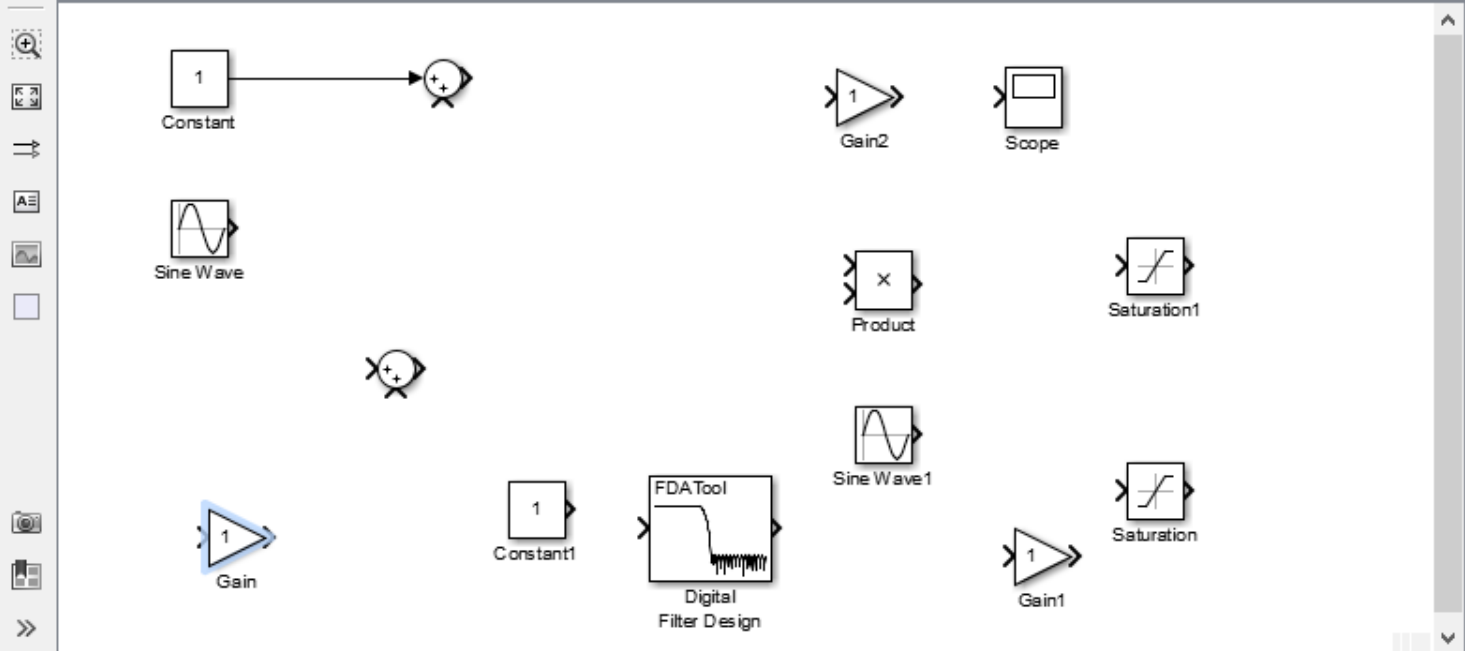
Floating Scope

untitled * - Simulink

File Edit View Display Diagram Simulation Analysis Code Tools Help

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untitled



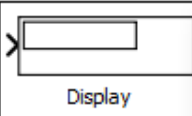
Ready

100%

VariableStepAuto



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Scope

File Tools View Simulation Help

Open at Start of Simulation

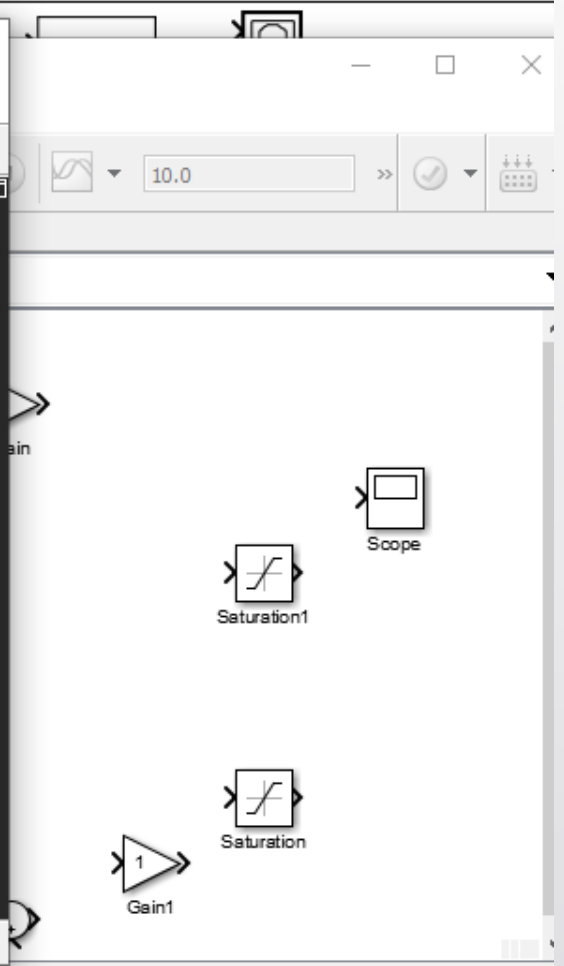
Number of Input Ports 1

Print ... Ctrl+P 2

Print to Figure 3

Close Ctrl+W More...

Close All Scope Windows



nulink/Sinks

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Scope

File Tools View Simulation Help

Configuration Properties: Scope

Main Time Display Logging

Open at simulation start

Display the full path

Number of input ports: 4 Layout

Sample time: -1

Input processing: Elements as channels (sample based)

Maximize axes: Off

Axes scaling: Manual [Configure...](#)

OK Cancel Apply

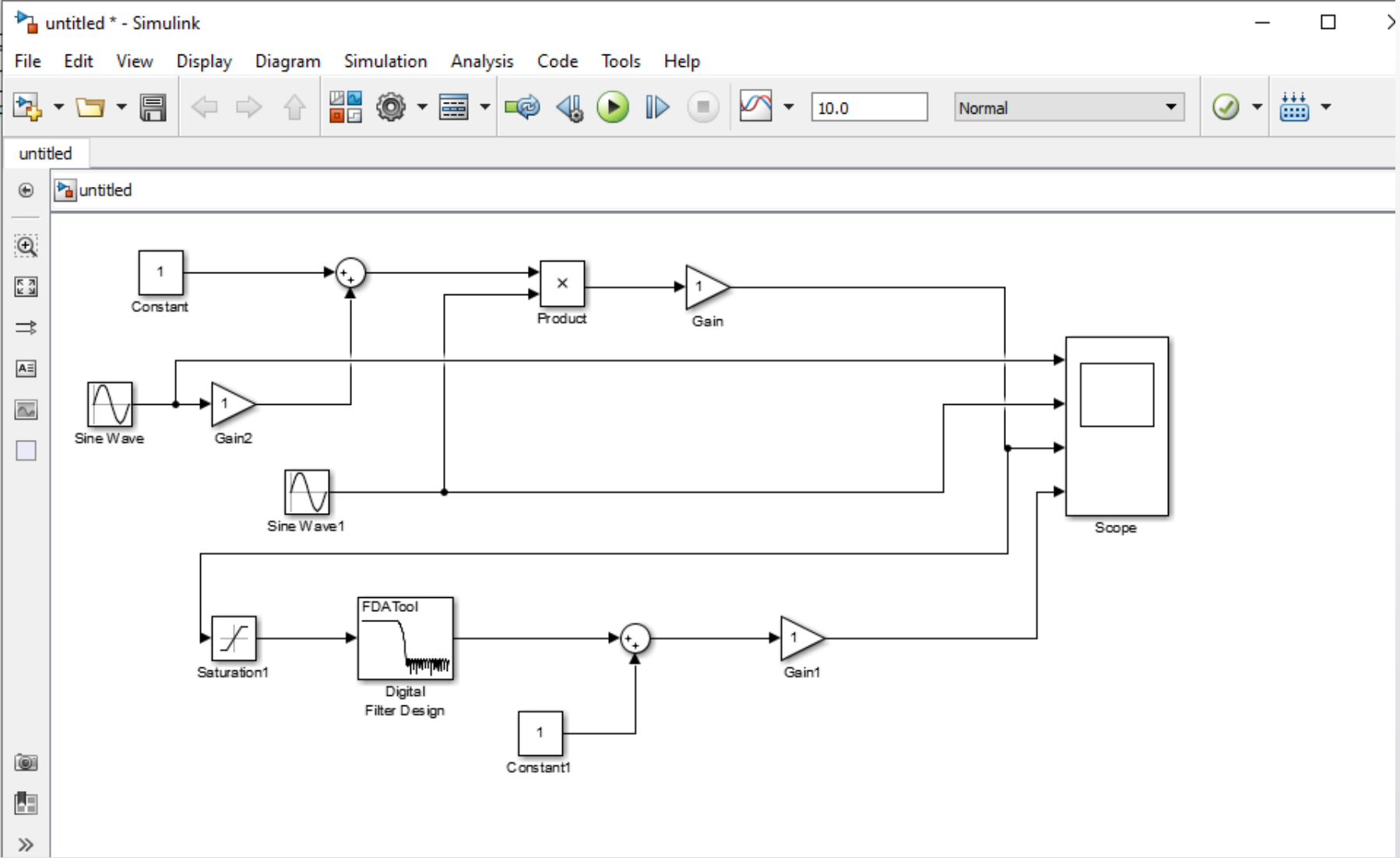
Ready

Ready 100%

VariableStepA

mulink/Sinks

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untitled * - Simulink

File Edit View Display

untitled

untitled

Constant

Sine Wave

Gain

Saturate

Scope

Block Parameters: Sine Wave

number of onset samples = $\text{Phase} + \text{Samples per period} / (2 \cdot \pi)$

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 (rad/sec): $2500 \cdot \pi$

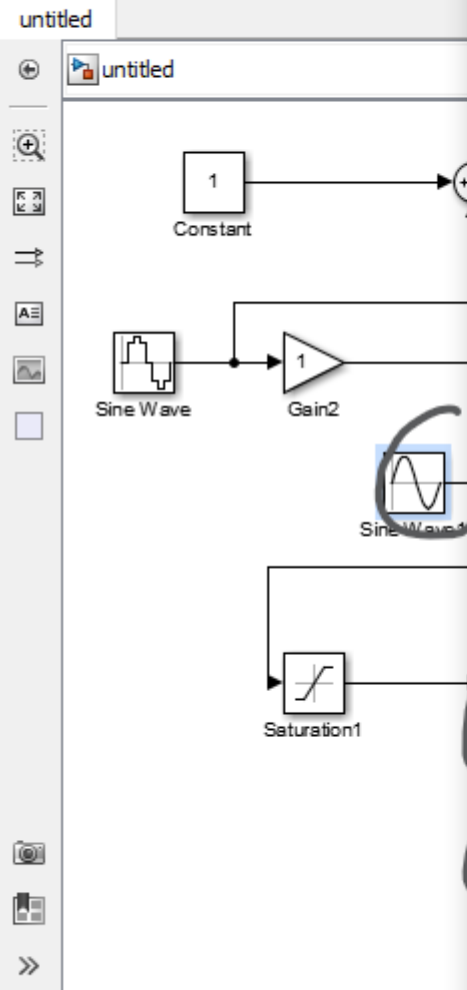
Phase (rad): 0

Sample time: $1e-6$

Interpret vector parameters as 1-D

OK Cancel Help Apply

Ready 100% VariableSte



Block Parameters: Sine Wave1

number of onset samples = phase / 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 (rad/sec): 1

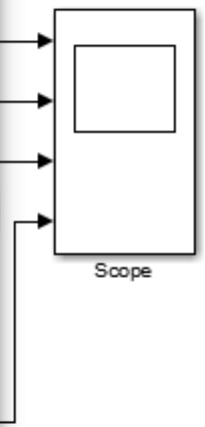
Phase (rad): $2 \cdot 10^{-4} \cdot \pi$

Sample time: $1e-6$

Interpret vector parameters as 1-D

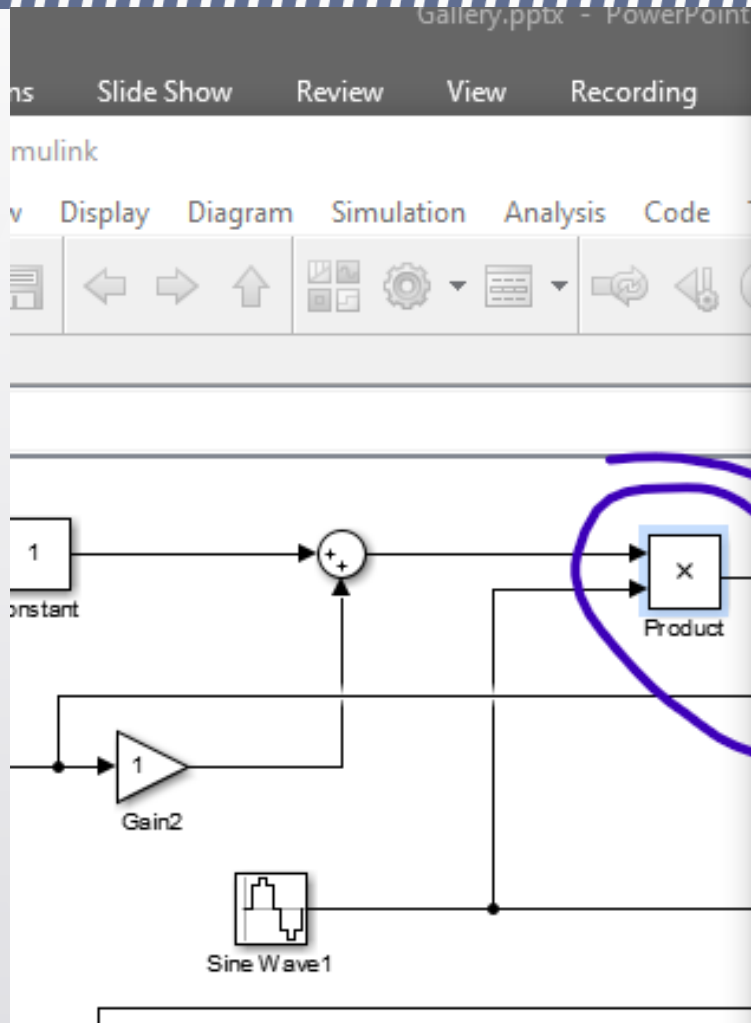
OK Cancel Help Apply

carrier settings





The image shows a Simulink workspace with a 'Block Parameters: Constant' dialog box open. The dialog box has a title bar 'Block Parameters: Constant' and a close button. It contains the following text: '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.', and two tabs: 'Main' and 'Signal Attributes'. The 'Main' tab is active and shows: 'Constant value:' with a text field containing '1', a checked checkbox for 'Interpret vector parameters as 1-D', and 'Sample time:' with a text field containing 'inf'. At the bottom of the dialog are buttons for '?', 'OK', 'Cancel', 'Help', and 'Apply'. The 'OK' button is circled in blue. In the background, a Simulink block diagram is visible. It includes a 'Sine Wave' block, a 'Constant' block (value 1, circled in blue), a 'Saturation1' block, an 'FDA Tool' block (Digital Filter Design), a summing junction (+), a 'Constant1' block (value 1, circled in blue), and a 'Gain1' block (value 1, circled in blue). The outputs of the summing junction and the 'Gain1' block are connected to a 'Scope' block. The 'Constant' block in the diagram is also circled in blue.



Block Parameters: Product

Product

Multiply or divide inputs. Choose element-wise or matrix product and specify one of the following:

- a) * or / for each input port. For example, $**/*$ performs the operation 'u1*u2/u3*u4'.
- b) scalar specifies the number of input ports to be multiplied.

If there is only one input port and the Multiplication parameter is set to Element-wise(*), a single * or / collapses the input signal using the specified operation. However, if the Multiplication parameter is set to Matrix(*), a single * causes the block to output the matrix unchanged, and a single / causes the block to output the matrix inverse.

Main | **Signal Attributes**

Number of inputs:

Multiplication: **Element-wise(*)**

ted



untitled

Block Parameters: Gain2

Gain

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

Main Signal Attributes Parameter Attributes

Gain: 0.3

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

OK Cancel Help Apply

Digital Filter Design

Constant1

Constant

Sine Wave

Gain2

Saturation1



untitled * - Simulink

File Edit View Display Diagram Simulation Analysis Code Tools Help

untitled

untitled

Block Parameters: Gain

Gain

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

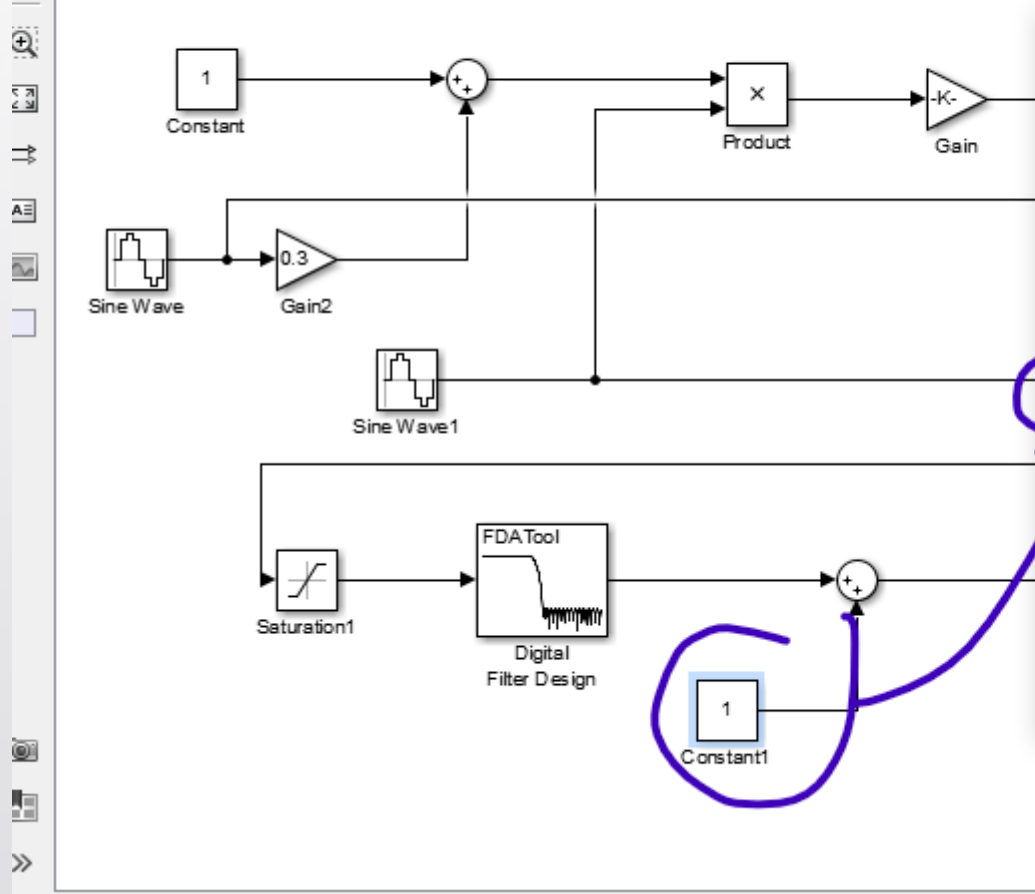
Main Signal Attributes Parameter Attributes

Gain: $2*\sqrt{2}$

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

OK Cancel Help Apply

The image shows a Simulink workspace with a block diagram and an open 'Block Parameters: Gain' dialog box. The dialog box is focused on the 'Gain' parameter, which is set to $2*\sqrt{2}$. The 'Multiplication' dropdown is set to 'Element-wise($K.*u$)'. The block diagram in the background includes a 'Gain' block (circled in purple) with a value of 1, a 'Product' block, a 'Gain2' block with a value of 0.3, a 'Gain1' block with a value of 1, and several other blocks like 'Constant', 'Sine Wave', 'Saturation', and 'FDA Tool'.



Block Parameters: Constant1

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.

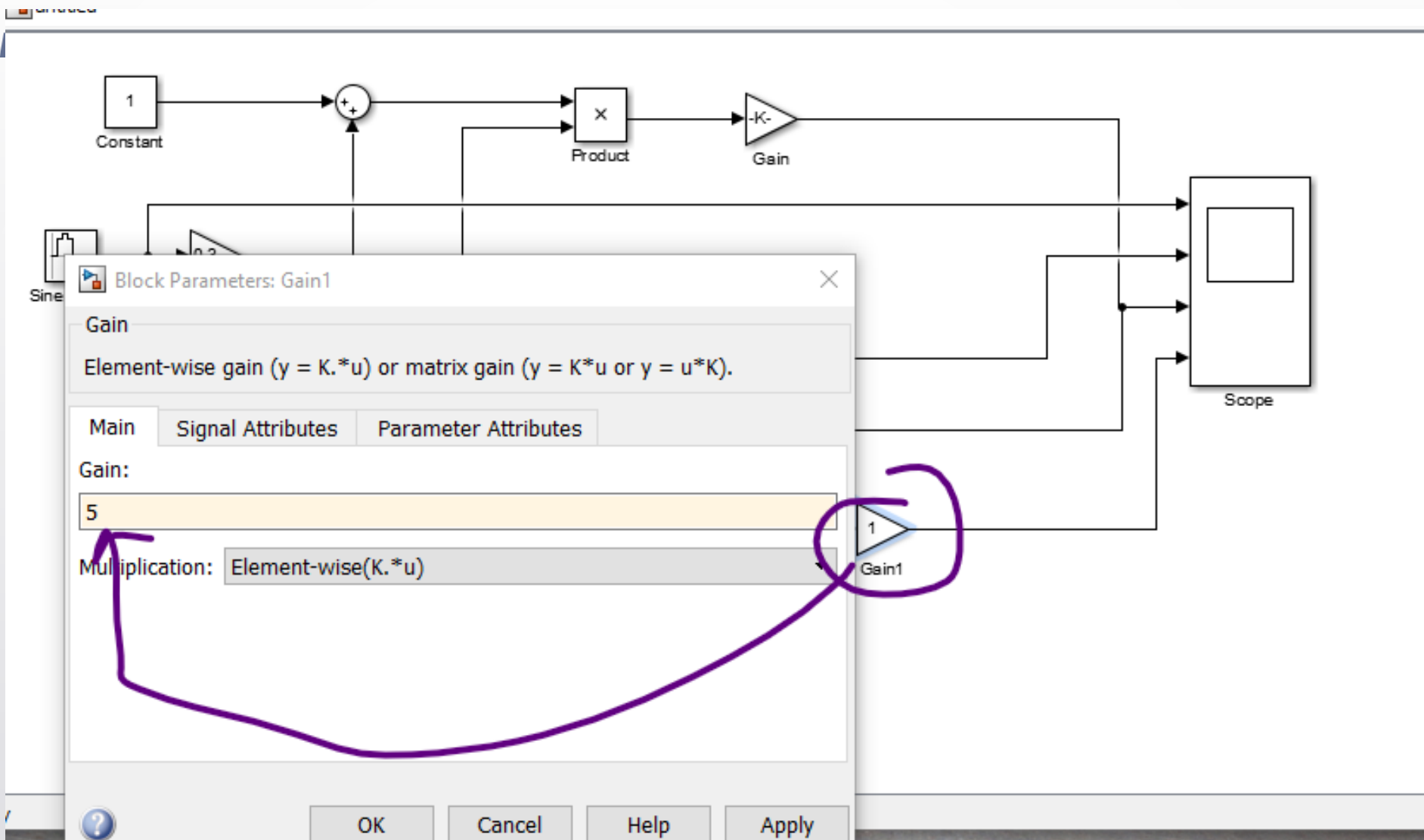
Main Signal Attributes

Constant value:
-.0866

Interpret vector parameters as 1-D

Sample time:
inf

OK Cancel Help Apply





The image shows a Simulink model window titled "untitled" with a block diagram and an open "Block Parameters: Saturation1" dialog box.

Block Diagram:

- A **Constant** block with value 1 is connected to a **Sum** junction (+).
- A **Sine Wave** block is connected to a **Gain2** block with value 0.3.
- The output of **Gain2** is connected to the **Sum** junction (+).
- The output of the **Sum** junction is connected to a **Product** block (x).
- The output of the **Product** block is connected to a **Gain** block (-K-).
- The output of the **Gain** block is connected to a **Scope** block.
- The output of the **Sum** junction is also connected to the **Scope** block.
- The output of the **Sine Wave** block is connected to the **Scope** block.
- A **Saturation1** block is also present in the diagram, with a blue circle and arrow pointing to it from the dialog box.

Block Parameters: Saturation1 Dialog:

- Saturation**: Limit input signal to the upper and lower saturation values.
- Main** / **Signal Attributes** tabs.
- Upper limit:** 10
- Lower limit:** 0
- Treat as gain when linearizing**
- Enable zero-crossing detection**
- Buttons: **OK**, **Cancel**, **Help**, **Apply**

At the bottom right of the window, the text "VariableStepA" is visible.

Block Parameters: Digital Filter Design

File Edit Analysis Targets View Window Help

Current Filter Information

Structure: Direct-Form FIR
Order: 32
Stable: Yes
Source: Designed

Magnitude Response (dB)

Store Filter ...
Filter Manager ...

Response Type

- Lowpass
- Highpass
- Bandpass
- Bandstop
- Differentiator

Filter Order

- Specify order: 32
- Minimum order

Options

- Scale Passband
- Window: Chebyshev
- Sidelobe Atten: 100

Frequency Specifications

- Units: Normalized (0 to 1)
- Fs: 48000
- wc: .05

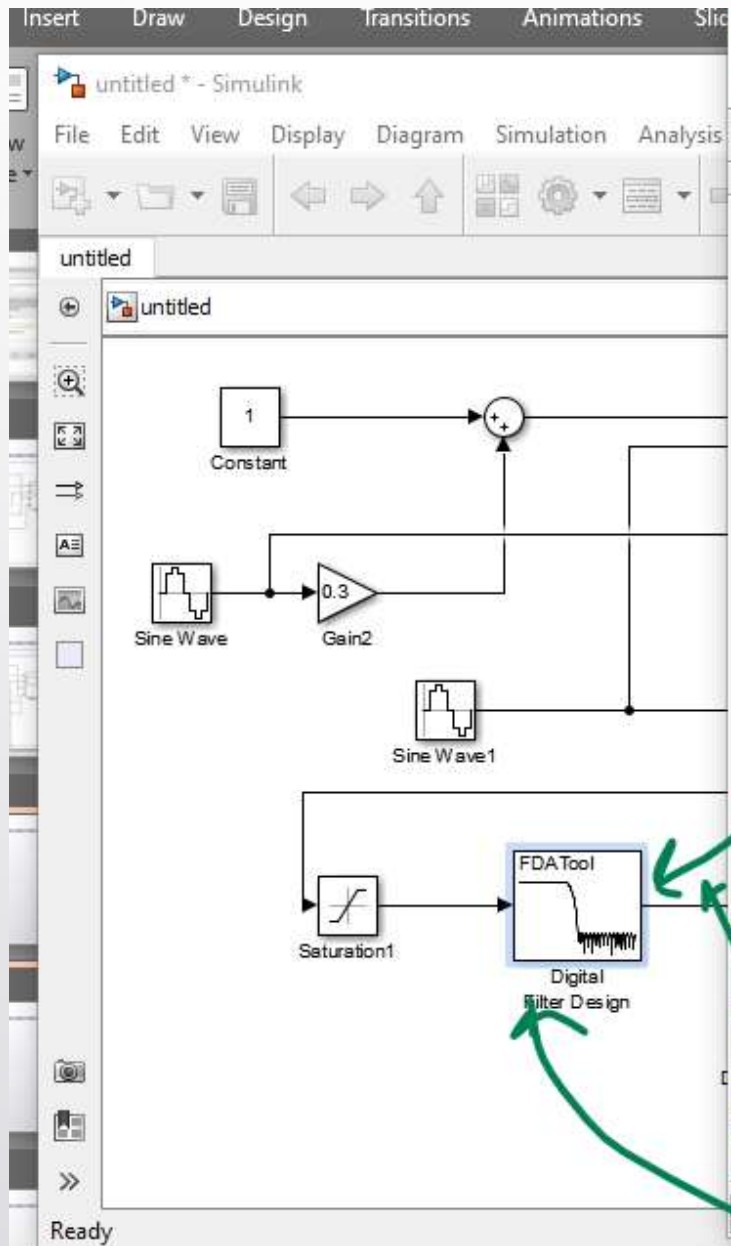
Magnitude Specifications

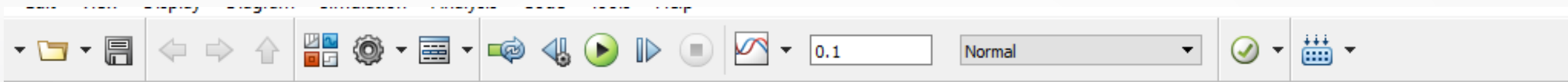
The attenuation at cutoff frequencies is fixed at 6 dB (half the passband gain)

Designing Filter ... Done

Input processing: Columns as channels (frame based)

Design Filter





itled

untitled

