



**Agilent Technologies**

# **Circuit Cosimulation Components**

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# Contents

## 1 Circuit Cosimulation Components

Introduction .....	1-1
AMS_Interface .....	1-2
EnvOutSelector .....	1-4
EnvOutShort .....	1-6
RES .....	1-8

## Index



# Chapter 1: Circuit Cosimulation Components

## Introduction

In Advanced Design System, cosimulation between signal processing and circuits provides verification of the impact of real world analog/RF issues on the signal processing algorithm, and vice versa. The signal processing simulator cosimulates with either Circuit Envelope or Transient simulators.

A circuit subnetwork on the signal processing page is simply a component with input and output ports. Every time the circuit subnetwork is fired, the circuit engine generates output based on the input it receives from the signal processing interface. Once the circuit simulator is finished with the simulation of the signal it receives, it passes those results to the signal processing interface.

From the circuit engine, the signal processing *input* interface is viewed as an ideal source. Depending on the number of ports at the input interface to the circuit, there would be as many ideal sources feeding the circuit subnetwork. At the output interface of the circuit, there would be one or more interface nodes. At these nodes the signal processing interface receives a given voltage from the circuit.

In cosimulation with Transient engine, the interface does not require any special component. With Circuit Envelope certain information is needed for proper cosimulation; this is done by connecting an EnvOutSelector (or EnvOutShort) component to each output port of the subcircuit design. These two interface components are identical except EnvOutSelector is an *open* circuit model and EnvOutShort is a *short* circuit model. Using EnvOutShort will load the circuit with the circuit components (if any) directly on signal processing schematic; EnvOutSelector does not load these components. One or more EnvOutSelector (EnvOutShort) components can be connected to each output port of a circuit subnetwork.

## AMS\_Interface



**Description** AMS Export Settings

**Library** Circuit Cosimulation

### Parameters

Name	Description	Default	Type
PortType	port type: electrical, wreal	electrical	enum
TStep	output time step	0.0	real

### Pin Inputs

Pin No.	Description
1	input signal

### Pin Outputs

Pin No.	Description
2	output signal

### Notes/Equations

1. This component is used for interfacing between ADS Ptolemy designs and AMS Designer cosimulation designs.

To access usage examples, from the ADS Main window, choose *File > examples > Tutorial > WLAN\_ExportToAMSD\_prj*.

For AMS Designer cosimulation details, refer to the *ADS Ptolemy in AMSD-ADE* manual in the RFDE documentation.

2. AMS\_Interface components can be used as output ports in sources designs or input ports in sinks designs. The user must connect one end to a Port component and the other end to a DSP component.
3. The PortType parameter specifies the port type of the interface in AMS.

- *electrical* is a discipline of the Verilog-A construct that defines the types of nodes, ports, and branches. It consists of two natures: one for the potential (voltage) and one for the flow (current). The values are determined by analog kernel from beginning to end at each point in time.
- *wreal*, or real net data type, represents a real-valued physical connection between structural entities. A *wreal* net can be used for real-valued nets that are driven by a single driver, such as a continuous assignment. *wreal* nets must be connected to compatible interconnect and other *wreals* or real expressions only; they cannot be connected to any other wires.

## EnvOutSelector



**Description** Envelope Output Selector (Open Circuit Model)  
**Library** Circuit Cosimulation

### Parameters

Name	Description	Default	Type
OutFreq	output frequency options: Bandpass, Lowpass, Allpass	Bandpass <sup>†</sup>	enum
<sup>†</sup> When Bandpass is selected an output frequency value must also be specified.			

### Pin Inputs

Pin No.	Description
1	input signal

### Pin Outputs

Pin No.	Description
2	output signal

### Notes/Equations

4. This component is used for interfacing between circuit subnetwork output and signal processing input under Ptolemy - Circuit Envelope cosimulation. For more general cosimulation information, refer to ["Introduction" on page 1-1](#).

To access usage examples, from the ADS Main window, choose *File > examples > Com\_Sys > Co\_Sim\_prj*.

5. EnvOutSelector is an *open circuit* model; the components at the output of EnvOutSelector will not load the circuit.
6. EnvOutSelector selects the time waveform (associated with a fundamental frequency) from the circuit envelope output.
7. The OutFreq parameter specifies which time domain waveform is selected at the interface and passed to the connecting signal processing component.

- For the Bandpass option the user must specify an output frequency value. If the frequency specified does not exist in the list of fundamentals, the interface code will search and snap to the nearest fundamental. A frequency within 0.01% of a fundamental will be snapped to that fundamental frequency; if the frequency specified is not within 0.01% of the fundamental, a default value of 100 MHz will be used and a warning message issued.
- The Lowpass option will output the time-varying dc waveform to signal processing, setting the carrier frequency at the interface to zero.
- The Allpass option will output the composite time-varying signal; the carrier frequency is set to zero.

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**Note** You cannot change between the Bandpass, Lowpass, and Allpass options on the Schematic window; the option must be selected in the component parameter dialog box. When Lowpass or Allpass is selected, changing the option in the Schematic window will reset the value of OutFreq to Allpass or Lowpass, respectively. When Bandpass is selected, OutFreq can be edited to any value. However, if arrow keys are used to set the value of OutFreq to Lowpass or All (or if the Lowpass or All value is typed in), the simulation will error out.

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8. Circuit ports are input/output (bidirectional) ports. When a signal processing component has output connected to both a circuit port and another signal processing component input, an EnvOutSelector or EnvOutShort component is needed at the circuit port to the input of the second signal processing component.

## EnvOutShort



**Description** Envelope Output Selector (Short Circuit Model)

**Library** Circuit Cosimulation

### Parameters

Name	Description	Default	Type
OutFreq	output frequency options: Bandpass, Lowpass, Allpass	Bandpass <sup>†</sup>	enum
<sup>†</sup> When Bandpass is selected an output frequency value must also be specified.			

### Pin Inputs

Pin No.	Description
1	input signal

### Pin Outputs

Pin No.	Description
2	output signal

### Notes/Equations

1. This component is used for interfacing between circuit subnetwork output and signal processing input under Ptolemy - Circuit Envelope cosimulation. For more general cosimulation information, refer to [“Introduction” on page 1-1](#).

To access usage examples, from the ADS Main window, choose *File > examples > Com\_Sys > Co\_Sim\_prj*.

2. EnvOutShort is a *short circuit* model; the components at the output of EnvOutShort will load the circuit.
3. EnvOutShort selects the time waveform (associated with a fundamental frequency) from the circuit envelope output.

4. The OutFreq parameter specifies which time domain waveform is selected at the interface and passed to the connecting signal processing component.
  - For the Bandpass option the user must specify an output frequency value. If the frequency specified does not exist in the list of fundamentals, the interface code will search and snap to nearest fundamental. A frequency within 0.01% of a fundamental will be snapped to that fundamental frequency; if the frequency specified is not within 0.01% of the fundamental, a default value of 100 MHz will be used and a warning message issued.
  - The Lowpass option will output the time-varying dc waveform to signal processing, setting the carrier frequency at the interface to zero.
  - The Allpass option will output the composite time-varying signal. Here again the carrier frequency is set to zero.

---

**Note** You cannot change between the Bandpass, Lowpass, and Allpass options on the Schematic window; the option must be selected in the component parameter dialog box. When Lowpass or Allpass is selected, changing the option in the Schematic window will reset the value of OutFreq to Allpass or Lowpass, respectively. When Bandpass is selected, OutFreq can be edited to any value. However, if arrow keys are used to set the value of OutFreq to Lowpass or All (or if the Lowpass or All value is typed in), the simulation will error out.

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5. Circuit ports are input/output (bidirectional) ports. When a signal processing component has output connected to both a circuit port and another signal processing component input, an EnvOutSelector or EnvOutShort component is needed at the circuit port to the input of the second signal processing component.

## RES



**Description** Resistor

**Library** Circuit Cosimulation

### Parameters

Name	Description	Default	Unit	Type	Range
R	resistance	50 Ohm	ohms	real	[0, +∞)
Temp	temperature of resistor, in degrees C	DefaultRTemp	temperature	real	[-273.15, +∞)

### Notes/Equations

1. RES is a resistor circuit component. Signal flow through this resistor includes thermal (Johnson) noise when Temp is greater than absolute zero ( $-273.15\text{ }^{\circ}\text{C}$ ).
2. This component operates only with timed baseband or RF (complex envelope) signals.

# Index

## A

AMS\_Interface, 1-2

## E

EnvOutSelector, 1-4

EnvOutShort, 1-6

## R

RES, 1-8

