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# General\_SI\_Simulation\_Tutorial\_2

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# Introduction

This tutorial introduces how to perform simulation with SPEED2000 General SI Simulation (Ideal P/G) workflow.

### **Overview**

The SPEED2000 **General SI Simulation (Ideal P/G)** workflow is for general purpose signal integrity simulations without considering the non-ideal power/ground effects. Specifically,

- Level 1 Trace and via couplings not considered, ideal P/G
- Level 2 Trace and via couplings considered, ideal P/G

In General SI Simulation (Ideal/P/G) workflow, you can firstly enable signal nets to be simulated, which are referred as primary nets. In order to better simulate xtalk effects, a new feature - to select which aggressor nets to be included in simulation (optional) - is added to find all the aggressor nets through trace coupling and/or via coupling to primary nets. The primary nets and selected aggressor nets are all included in the subsequent model setup, simulation option setup and simulations. By default, only waveforms at IC components for primary nets are saved.

The main steps for simulation setup are shown in the following block diagram.

1



# **Tutorial Summary**

The sample case used in this tutorial contains one controller and four DRAMs as shown below.



The topology is as the following figure shows.



In this tutorial, only nets **BA0** and **DQ1** are included in analysis as primary nets. Aggressors to these primary nets are automatically shown with user-defined coupling criteria.

The following three original files are used in this tutorial:

- Tutorial\_GSI.spd layout file
- dram\_IO.ibs IBIS file containing DRAM buffer models
- ctrl\_IO.ibs IBIS file containing Ctrl buffer models
- They are all located in: <INSTALL\_DIR>\SpeedXP\Samples\SPEED2000\General SI Simulation\Examples\_PreSetup\

The completed sample and IBIS files (with step by step setup introduced in this tutorial) are also provided and located in:

<INSTALL\_DIR>\SpeedXP\Samples\SPEED2000\General SI Simulation
 \Examples\_PostSetup\Tutorial-2\

General SI Simulation (Ideal P/G) workflow will lead user to:

Setup simulation parameters

- Run simulation
- View simulation results

# Layout Setup

This chapter describes how to load layout file and check stackup.

1. Launch SPEED2000 Generator , and choose the General SI Simulation (Ideal P/G) workflow.



2. Click **Load Layout File** to load tutorial\_GSI.spd. The workflow step **Check Stackup** is enabled.



3. Click Check Stackup to open the Layer manager -> Stack Up window.

Layer Mana	ger -> St	ack Up									×
Stack Up	Pad Sta	dk									
Layer #	Color	Layer Icon	Layer Name	Thickness(	Material	Conductivity(S	Pill-in Dielectric	Permittivity	Loss Tangent	Shape Name	1.4
1			Signal\$_TOP	0.04064		5.959e+007		[1]	[0]	Shape\$TOP	0.
			Medum\$41	0.07747		0		3.9	0.035		
2			Signal\$1.2_GND1	0.01524		5.959e+007		[4.09]	[0.035]	Shape\$L2	0.
			Medum\$43	0.0762		0		4.28	0.035		
3		ETE	Signal\$L3_SIG1	0.01524		5.959e+007		[4.09]	[0.035]	Shape\$L3_50G1	0.
			Medium\$45	0.14351		0		3.9	0.035		
4			Signal\$.4_GND2	0.01524		5.959e+007		[4.09]	[0.035]	Shape\$1.4	0.
			Medium\$47	0.0762		0		4.28	0.035		
5			Signal\$L5_S1G2	0.01524		5.959e+007		[4.09]	[0.035]	Shape\$L5_S0G2	0. =
			Medium\$49	0.142494		0		3.9	0.035		
6			Signal\$L6_GND3	0.03048		5.959e+007		[4.24]	[0.035]	Shape\$L6	0.
			Medium\$51	0.2032		0		4.58	0.035		
7			Signal\$.7_PWR1	0.03048		5.959e+007		[4.32]	[0.035]	Shape\$L7_P	0.
			Medum\$53	0.2413		0		4.06	0.035		
8			Signal\$18_PWR2	0.03048		5.959e+007		[4.32]	[0.035]	Shape\$L8_P	0.
			Medium\$55	0.2032		0		4.58	0.035		
9			Signal\$L11_GND4	0.03048		5.959e+007		[4.24]	[0.035]	Shape\$L11	0.
			Medium\$61	0.142494		0		3.9	0.035		
10			Signal\$L12_SIG3	0.01524		5.959e+007		[4.09]	[0.035]	Shape\$L12	0.
			Medum\$63	0.0762		0		4.28	0.035		
11			Signal\$.13_GND5	0.01524		5.959e+007		[4.09]	[0.035]	Shape\$L13	0.
			Medum\$65	0.144272		0		3.9	0.035		
12			Signal 8, 14 SIG4	0.01524		5.959e+007		[4.09]	0.0351	Shape\$1.14	0. *
-			11								P
Total Thida	ness: 2.0	053e+000 mn	n					6	View Materia	Import	
							Ex	port Auto	Set Layer Special	Void Filter	
							Unit: mm	ок	Cancel	Appl	,

- 4. Check the stackup and edit as desired (no changes in this example).
- 5. Click **OK** to quit the window.

# **Simulation Setup**

This chapter introduces how to set up simulation parameters for general SI simulation.

Click Enable General SI Simulation Mode to enable General SI simulation mode.



When enabled, a check mark  $\checkmark$  appears ahead the workflow step. And all other related steps are enabled.

## **Enabling Simulation Nets**

To perform general SI simulation with SPEED2000, you'll need to select simulation nets first and define the differential pair property.

- 1. Click **Select/Enable Signal Nets** in the **Workflow** pane. The **Net Manager** appears in the right side of the window.
- 2. Click to enable power net VTT and signal nets **BA0** and **DQ1**.

Net Ma	anager
Net:	
	how Coupled Line
	iow coupled time
Net Lis	t (Sort all) 🛛 🛆
	BA0
	📿 🗾 BA1
	📿 🖊 BA2
	📿 🗾 CAS_B
	📿 🗾 CKE
⊕ □	
	🖉 🗹 CS_B
	DM0
	🖉 🖊 DM1
	🖉 🗾 DM2
	🖉 🗹 DM3
	∠DQ1
닏	🖉 🗾 DQ2
닏	DQ3
브	
Gene	ral
🗹 Kee	ep shape enabled when t
Hid	e Disabled
Gra	y Disabled
Coup	led Lines
Dis	able Coupled Line Simulat
Couple	d Lines Report
laver	Selection Net Manage
Layer	Selection Net Manage

#### lcon

The diff-pair and polarity are guessed out automatically.

- If the diff-pair is not guessed out, choose both positive and negative nets, right-click and choose Classify as diff pair to define it manually.
- If the polarity is not guessed out, right-click the positive net and choose Switch Polarity to define it manually.

### **Showing Aggressor Nets**

This step is to identify potential aggressors for BA0 and DQ1 based on trace coupling and via

coupling. You can manually choose the desired aggressor signal nets to be included in simulation.

- 1. Click Show/Select Aggressor Nets in the Workflow pane. The Search/Select Aggressor Nets Wizard opens.
- 2. Input the following values to each field:
  - Coupling(%): 2
  - Rise time(ps): 50
  - Search Distance: 1 (mm)

ch/Select	: Aggressor Net	s Wizard			_ [
Trac	ce Coupling Parar	neters			
C	oupling(%):	2			
Ri	ise time(ps):	50			
Via	Coupling Parame	ers			
S	erach Distance:	1	mm		
			< <u>B</u> ack	Next >	Cancel

3. Click Next.

SPDGEN starts to enable nets and analyze aggressor nets. The time it takes depends on the size and settings of the specific case. When the process is completed, the **Search/Select Aggresssor Nets Wizard** displays all aggressors nets.

	Aggressors			
8		Enabled Victims	Max Trace Coupling(%;mm)	Min Via Separation(mm)
	DMO	DQ1	-	0.8
	DQ3	DQ1	-	0.8
	DQ7	DQ1	-	0.8
	DQS0_P	DQ1	-	0.8
	A1	BA0	2.08803;298.427	-
	A3	BA0	-	0.8
	BA1	BA0	-	0.8
	BA2	BA0	2.09276;1271.2	0.8
	CS_B	BA0	-	0.8
			111	

4. Click to enable all nets in this sample and click Finish .

The **Search/Select Aggressor Nets Wizard** exists and the corresponding nets are enabled in **Net Manager**.



### **Assigning DC Voltage**

If power or ground nets are enabled as simulation nets, the DC voltage should be assigned before simulation.

- 1. Click Assign/Show DC Voltages in the Workflow pane. The Assign/Show DC Voltages window opens.
- 2. Input **0.75V** for **VTT** net like the following figure shows.

Net Name	Volt(V)	
Zm	0.75	

3. Click **OK** .

### **Assigning Component Models**

This section introduces how to assign models to all components.

#### Assigning IBIS Model to IC Component U0

1. Click Assign/Show Component Models in the Workflow pane.

The Set up Component Models window opens.

Set Up	o Component	Models		
	Comp Name	Comp Turpe	Dark Name	
	Comp Name	to		
	114	IC	Dram	
	U1	IC	Dram	
	U2	IC	Dram	=
	U3	IC	Dram	
×.	R326	R	R_0402_40_2	
	R333	R	R_0402_40_2	
- Š	R334	R	R_0402_40_2	
	K337	-		
		19.11		
Note	e: Comp Type is	editable.		
As		odele		-
19	7 Assign 1013 m	oueis		
	Copy IBIS N	fodel to		
			OK Cancel	Apply

2. Select to highlight component **U0** and click the **Edit Model** button. The **Assign IBIS models** window opens.

Assign IBIS models					×
Layout Comp Name:	UO		IBIS Model File: IBIS Component:	: [xe3\SpeedXP\Samples\SPEED2000\General SI Simulation\Example_PreSetup\ctrl_IO.ibs]  tt: [DDR3_j	
LayoutPinName / NetName (Sort By A Net)	IBISModelPinName / SignalName	Model Name			
M5 / A1 L4 / A3 L7 / BA0 L6 / BA1 M6 / BA2					
P6 / CS_B B1 / DM0 C3 / DQ1 D1 / DQ3 D3 / DQ7					
D2 / DQS0_N C2 / DQS0_P Package Model :	None O Pin RLC O	Package Model:			
	0			Clear All Recover OK Cancel	

- 3. Browse to load the IBIS file ctrl\_IO.ibs. The IBIS file is loaded.
- 4. Use Shift and Ctrl keys to select multiple nets  $A1 CS_B$ .
- 5. Click the icon is in the field of **Model Name** column and select **cmd\_ctrl** from the pop-up window.

LayoutPinName / NetName (Sort By A Net)	IBISModelPinName / SignalName	Model Name		
M5 / A1				
L4 / A3		Pin Name	Signal Name	Model Name
L7 / BA0		Not Connected	-	
L6 / BA1		Not connected		data
M6 / BA2				
P6 / CS_B				end etcl
B1 / DM0				data_odt100
C3 / DQ1				data_odtoff
D1 / DQ3				CND
D3 / DQ7				DOWER
D2 / DQS0_N				FOWER
C2 / DQS0_P				
Package Model : 💿 N	one O Pin RLC O			
		ОК	Cancel	Model Selector name is italic and underlined.

6. Click **OK** .

The selected nets are assigned with the model  $cmd\_ctrl$ . Repeat the above steps to assign nets  $DM0 - DQS0\_P$  with the model data . All nets are assigned with IBIS models.

LayoutPinName / NetName (Sort By A Net)	IBISModelPinName / SignalName	Model Name
M5 / A1	M5 / A1	cmd_ctrl
L4 / A3	L4/A3	cmd_ctrl
L7 / BAO	L7 / BA0	cmd_ctrl
L6 / BA1	L6 / BA1	cmd_ctrl
M6 / BA2	M6 / BA2	cmd_ctrl
P6 / CS_B	P6 / CS_B	cmd_ctrl
B1 / DM0	B1/DM0	<u>data</u>
C3 / DQ1	C3/DQ1	<u>data</u>
D1 / DQ3	D1/DQ3	<u>data</u>
D3 / DQ7	D3 / DQ7	<u>data</u>
D2 / DQS0_N	D2 / DQS0_N	<u>data</u>
C2 / DQS0_P	C2/DQS0_P	<u>data</u>

7. Check the newly generated models and click  $\ensuremath{\text{OK}}$  .

The **Update IBIS File** dialog box opens to confirm the changes.

Update IBIS File	X
IBIS file has been changed.	
To save changes to a new file, dick COPY.	
Copy Cancel	

8. Click Copy.

A dialog box opens to confirm the location where the IBIS file is copied to.



9. Click **OK** to create a new IBIS model.

The **Assign IBIS models** window quits and a pin matched component IBIS model for controller **U0** is generated, located in the sub-folder named **IBIS** under the project folder.

SpeedXP  Samples  SPEED2000  General SI S	imulation + IBIS	-
orary      Share with      Burn New folder		
Name	Date modified	Туре
U0_ctrl_JO.ibs	12/3/2013 1:56 PM	IBS File

A green check mark appears ahead **U0** in the **Set up Component Models** window.

Comp Name	Comp Type	Part Name	
UO	10	Controller	
U4	1C	Dram	
U1	IC IC	Dram	
U2	IC IC	Dram	
U3	1C	Dram	
R325	R	R_0402_40_2	
R326	R	R_0402_40_2	
R327	R	R_0402_40_2	
R328	R	R_0402_40_2	
sign models	models	Assign simple termination models     O Assign SPICE models	O Value 0
IS models			
1805 File:	1815'LJ0_ctrl	JO.bs Edit Model	Component: DDR3_j

#### Assigning IBIS Model to IC Component U1

- 1. Select to highlight component **U1** and click the **Edit Model** button. The **Assign IBIS models** window opens.
- 2. Browse to load the IBIS file dram\_IO.ibs. The IBIS file is loaded.
- 3. Repeat the steps described in the above section to assign nets **A1 CS\_B** with the model **INPUT**.
- 4. Assign nets DMO DQ7 with the model DQ.
- 5. Assign net  $DQS0_N$  and  $DQS0_P$  with the model DQS.

All nets are assigned with the IBIS models.

LayoutPinName / NetName (Sort By Net)	IBISModelPinName / SignalName	Model Name
L7 / A1	L7/A1	<u>INPUT</u>
K2 / A3	K2 / A3	<u>INPUT</u>
J2 / BAO	J2 / BA0	<u>INPUT</u>
K8 / BA1	K8 / BA1	<u>INPUT</u>
J3 / BA2	J3 / BA2	<u>INPUT</u>
H2 / CS_B	H2/CS_B	<u>INPUT</u>
B7 / DM0	B7 / DM0	DQ
C7 / DQ1	C7/DQ1	DQ
C8 / DQ3	C8 / DQ3	DQ
E7 / DQ7	E7 / DQ7	DQ
D3 / DQS0_N	D3 / DQS0_N	<u>DQS</u>
C3 / DQS0_P	C3/DQS0_P	DQS

6. Check the newly generated models and click  $\mathbf{OK}$  .

The Update IBIS File dialog box opens to confirm changes.



7. Click Copy .

A dialog box opens to confirm the location where the IBIS file is copied to.



8. Click **OK** to create a new IBIS model.

The **Assign IBIS models** window quits and a pin matched component IBIS model for controller **U1** is generated, located in the sub-folder named **IBIS** under the project folder.

SpeedXP + Samples + SPEED2000 +	Seneral SI Simulation 🕨 IBIS 🔹 😽 Se
rary 🔻 Share with 👻 Burn	New folder
Name	Date modified Type
U0_ctrl_J0.ibs	12/3/2013 1:56 PM IBS File 12/3/2013 2:16 PM IBS File

A green check mark appears ahead **U1** in the **Set up Component Models** window.

	Comp Name	Comp Type	Part Name		<u>^</u>
~	00	IC .	Controller		
	U4	IC	Dram		-
~	U1	IC .	Dram		
	U2	IC	Dram		
	U3	IC	Dram		
~	R325	R	R_0402_40_2		
~	R326	R	R_0402_40_2		
~	R327	R	R_0402_40_2		
~	R328	R	R_0402_40_2		
11					
-As	sign models Assign IBIS mo	dels	O Assign simple termination models	O Assign SPICE models	O Value 0
-18	IS models				
	IBIS File:	1BIS\U1_dram	LJO.bs Edit Model		Component: dram16x4
	Copy IBIS M	odel to			

#### Copying IBIS Model to U2, U3 and U4 from U1

- 1. Click the **Copy IBIS Model to** button. The **IBIS Copy** window opens.
- 2. Select to check the components U4 , U2 and U3 (uncheck U0 ).

	U0 U4 U2	
	U4 U2	
	U2	
	U3	2

- 3. Click OK .
  - All nets for component U2, U3 and U4 are assigned with IBIS models..

	Comp Name	Comp Type	Part Name		
-	10	to comp tipe	Controller		n
5		10	Dram		=
5		10	Dram		
Б	01	10	Dram		
Ľ	02	10	Dram		
Ľ٠,	03	IC	Dram		
1	R325	R	R_0402_40_2		
14	R326	R	R_0402_40_2		
1	R327	R	R_0402_40_2		
1	R328	R	R_0402_40_2		+
R.				11	
	sion models				
			0	O service strategy and the	Ovata D
19	Assign 1815 m	ooeis	<ul> <li>Assign simple termination models</li> </ul>	Assign SPICE models	Vale vale
-15	IS models				
				_	
	IBIS File:	IBIS/U1_dra	m_IO.ibs Edit Mode		Component: dram16x4
-					
	Copy IBIS M	todel to			

A green check mark appears ahead components **U4**, **U2** and **U3** in the **Set up Component Models** window. If the assigned IBIS models are not as desired, you can choose the corresponding component and click **Edit Model** button to change the IBIS model.

• The value of passive component is generated automatically by default.

Set	Up	Component I	Models			□ ×
Γ		Comp Name	Comp Type	Part Name		
	~	U1	IC	Dram_U1		
	~	U2	IC	Dram_U2		
	~	U3	IC	Dram		
	~	R326	R	R_0402_40_2		
	~	R333	R	R_0402_40_2		=
	~	R334	R	R_0402_40_2		
	~	R337	R	R_0402_40_2		
1	~	R343	R	R_0402_40_2		
	~	R347	R	R_0402_40_2		
	• [					•
N	ote	: Comp Type is	editable.			
Г	As	sign models				
	С	) Assign IBIS mo	odels	O Assign simple termination models	O Assign SPICE models	Value     40.2     ohm

The value is editable (no change in this example).

4. Click OK to exit the Set up Component Models window.

### **SI Simulation Options Setup**

This section introduces how to set up SI simulation options.

Click Set up SI Simulation Options in the Workflow pane.

The **GeneralSI simulation setup -> GeneralSI Options** pane appears at the bottom of the window.

GeneralSI simulation setup -> GeneralSI Options											×	
GeneralSI Options Set up Probes												
	ſ	Simulation Configuration	Corner		Models and Data Patterns Data Rate: 1	Gbps Clo	ock Period: T = [	2 ns # of Bits: 10	) Tmax:	2.67819	ns 🔻	
		Level-1: Single Line, Ideal P/G	OFast		ComPinName/NetName	I/O Selection	Transmitter IO Model	Receiver IO Model	Stimulus Pattern	Stimulus Offset(ns)	UI(ns)	
		O Level-2: Coupled Lines, Ideal P/G			□ [IC] U0							
					B1/DM0	Un-assigned	data_odtoff	data_odtoff	1010101010	0	1T	Ξ
			◯ Slow		C2/DQS0_P	Un-assigned	data_odtoff	data_odtoff	1010101010	0	1T	
		Ideal P/G Option Simulation			C3/DQ1	Un-assigned	data_odtoff	data_odtoff	1010101010	0	1T	
		Time Step(ps): 20			D1/DQ3	Un-assigned	data_odtoff	data_odtoff	1010101010	0	1T	
		Time Step(ps).			D3/DQ7	Un-assigned	data_odtoff	data_odtoff	1010101010	0	1T	
		Coupling (%): 2			L4/A3	Un-assigned	cmd_ctrl	cmd_ctrl	1010101010	0	1T	
					L6/BA1	Un-assigned	cmd_ctrl	cmd_ctrl	1010101010	0	1T	
		Rise Time(ps): 50			L7/BA0	Un-assigned	cmd_ctrl	cmd_ctrl	1010101010	0	1T	
					Export Options	Imp	ort Options				C	_

The pane contains two tabs: GeneralSI Options and Set up Probes .

#### **General SI Options**

- 1. Choose Level-2: Coupled Lines, Ideal P/G, and set the following parameters:
  - Time Step(ps): 20
  - Coupling (%): 2
  - Rise Time(ps): 50
  - Corner: Typ

Simulation Configuration	n				
P/G and Coupling O	Corner	٦			
O Level-1: Single Li	ine, Ideal P/G	⊙тур			
• Level-2: Coupled	• Level-2: Coupled Lines, Ideal P/G				
	Cever-2, Coupled Lines, Ideal Pyo				
Ideal P/G Option Si	mulation				
Time Step(ps):	20				
Coupling (%):	2				
Rise Time(ps):	50				

- 2. Input the following models and data parameters:
  - Data Rate : 1.333Gbps
  - # of Bits : 10
  - Tmax: 15ns
     Models and Data patterns
     Data Rate: 1.333 Gbps Clock Period: T = 1.500375 ns # of Bits: 10 Tmax: 15 ns
- 3. Click the column title **CompPinName/Netname** to reorder the nets alphabetically.

CompPinName/NetNa NetName)		I/O Selection	Transmitter IO Model	Receiver IO Model	Stimulus Pattern	Stimulus Offset(ns)	UI(ns)
	[IC] U0						
	M5/A1	Un-assigned	cmd_ctrl	cmd_ctrl	1010101010	0	1T
	L4/A3	Un-assigned	cmd_ctrl	cmd_ctrl	1010101010	0	1T
	L7/BA0	Un-assigned	cmd_ctrl	cmd_ctrl	1010101010	0	1T
	L6/BA1	Un-assigned	cmd_ctrl	cmd_ctrl	1010101010	0	1T
	M6/BA2	Un-assigned	cmd_ctrl	cmd_ctrl	1010101010	0	1T
	P6/CS_B	Un-assigned	cmd_ctrl	cmd_ctrl	1010101010	0	1T
	B1/DM0	Un-assigned	data_odtoff	data_odtoff	1010101010	0	1T
	C3/DQ1	Un-assigned	data_odtoff	data_odtoff	1010101010	0	1T

#### **U0** Parameters Setup

- 1. Choose to highlight all nets  $A1 DQS0_0$  under U0.
- 2. Click the icon 토 in the field of **I/O Selection** column and select **Output** from the drop-down list.

Com NetN	pPinName/NetNamer lame)	I/O Selection	Transmitter IO Model	Receiver IO Model	Stimulus Pattern	Stimulus Offset(ns)	UI(ns)
Ξ	[IC] U0						
	M5/A1	Un-assigned 🛛 🔻	cmd_ctrl	cmd_ctrl	1010101010	0	1T
	L4/A3	Un-assigned	cmd_ctrl	cmd_ctrl	1010101010	0	1T
	L7/BA0	Input	cmd_ctrl	cmd_ctrl	1010101010	0	1T
	L6/BA1	Output	cmd_ctrl	cmd_ctrl	1010101010	0	1T
	M6/BA2	Un-assigned	cmd_ctrl	cmd_ctrl	1010101010	0	1T
	P6/CS_B	Un-assigned	cmd_ctrl	cmd_ctrl	1010101010	0	1T
	B1/DM0	Un-assigned	data_odtoff	data_odtoff	1010101010	0	1T
	C3/DQ1	Un-assigned	data_odtoff	data_odtoff	1010101010	0	1T
	D1/DQ3	Un-assigned	data_odtoff	data_odtoff	1010101010	0	1T
	D3/DQ7	Un-assigned	data_odtoff	data_odtoff	1010101010	0	1T
⊕	C2/DQS0_P	Un-assigned	data_odtoff	data_odtoff	1010101010	0	1T
L	D2/DQS0_N	Un-assigned	data_odtoff	data_odtoff	0101010101	0	1T

3. Select to highlight nets  $DMO - DQSO_P$ .

#### 4. Click the icon 토 in the field of **UI** column and input **0.5T** in the field.

CompPinName/NetName NetName)	I/O Selection	Transmitter IO Model	Receiver IO Model	Stimulus Pattern	Stimulus Offset(ns)	UI(ns)
L7/BA0	Output	cmd_ctrl		1010101010	0	1T
L6/BA1	Output	cmd_ctrl		1010101010	0	1T
M6/BA2	Output	cmd_ctrl		1010101010	0	1T
P6/CS_B	Output	cmd_ctrl		1010101010	0	1T
B1/DM0	Output	data_odtoff		1010101010	0	0.5T
C3/DQ1	Output	data_odtoff		1010101010	0	1T
D1/DQ3	Output	data_odtoff		1010101010	0	1T
D3/DQ7	Output	data_odtoff		1010101010	0	1T
C2/DQS0_P	Output	data_odtoff		1010101010	0	1T
D2/DQS0_N	Output	data_odtoff		0101010101	0	1T

#### **U1** Parameters Setup

- 1. Select to highlight nets **DM0 DQS0\_P** under **U1**.
- 2. Click the icon 토 in the field of **I/O Selection** column and select **Input** from the drop-down list.

CompPinName/NetName		I/O Selection	Transmitter IO Model	Receiver IO Model	Stimulus Pattern	Stimulus Offset(ns)	UI(ns)
L	D2/DQS0_N	Output	data_odtoff		0101010101	0	0.5T
	[IC] U1						
	L7/A1	Input		INPUT_1333			
	K2/A3	Input		INPUT_1333			
	J2/BA0	Input		INPUT_1333			
	K8/BA1	Input		INPUT_1333			
	J3/BA2	Input		INPUT_1333			
	H2/CS_B	Input		INPUT_1333			
	B7/DM0	Un-assigned 🛛 🔻	DQ_34_1333	DQ_34_1333	1010101010	0	1T
	C7/DQ1	Un-assigned	DQ_34_1333	DQ_34_1333	1010101010	0	1T
	C8/DQ3	Input	DQ_34_1333	DQ_34_1333	1010101010	0	1T
	E7/DQ7	Output	DQ_34_1333	DQ_34_1333	1010101010	0	1T
⊕	C3/DQS0_P	Un-assigned	DQS_34_1333	DQS_34_1333	1010101010	0	1T
L	D3/DQS0_N	Un-assigned	DQS_34_1333	DQS_34_1333	0101010101	0	1T

- 3. Assign the nets **DM0 DQ7** with the **Receiver IO Model DQ\_34\_ODT60\_1333** from the drop-down list.
- 4. Assign the nets **DQS0\_P** and **DQS0\_N** with **Receiver IO Model DQS\_34\_ODT60\_1333** from the drop-down list.

CompPinName/NetName		I/O Selection	Transmitter IO Model	Receiver IO Model	Stimulus Pattern	Stimulus Offset(ns)	UI(ns)
L	D2/DQS0_N	Output	data_odtoff		0101010101	0	0.5T
Ξ	[IC] U1						
	L7/A1	Input		INPUT_1333			
	K2/A3	Input		INPUT_1333			
	J2/BA0	Input		INPUT_1333			
	K8/BA1	Input		INPUT_1333			
	J3/BA2	Input		INPUT_1333			
	H2/CS_B	Input		INPUT_1333			
	B7/DM0	Input		DQ_34_ODT60_1333			
	C7/DQ1	Input		DQ_34_ODT60_1333			
	C8/DQ3	Input		DQ_34_ODT60_1333			
	E7/DQ7	Input		DQ_34_ODT60_1333			
⊕	C3/DQS0_P	Input		DQS_34_0DT60_1333			
L	D3/DQS0_N	Input		DQS_34_0DT60_1333			

5. Click **OK** to save all settings.

#### **Probes Setup**

 Click Set up Probes in the Workflow pane. The GeneralSI simulation setup -> Setup Probes pane appears at the bottom of the window.

GeneralSI simulation setup -> Set up Probes					
GeneralSI Options	Set up Probes				
RefDes		PinName/NetName			
🗏 🗹 [IC] U0					
		B1/DM0			
⊕ □		C2/DQS0_P			
		D2/DQS0_N			
		D1/DQ3			
		C3/DQ1			
		D3/DQ7			
		L4/A3			
		L6/BA1			
		L7/BA0			
		M5/A1			
		M6/BA2			
		P6/CS_B			
🗏 🗹 [IC] U4					
		H2/CS_B			
		J2/BA0			
		J3/BA2			
		K2/A3			
		K8/BA1			
		L7/A1			
🗏 🗹 [IC] U1					
		B7/DM0			
⊕□		C3/DQS0_P			
-		D3/DQS0_N			

You can also open the pane by clicking the **Setup Probes** tab in the above section.

In this example, **BA0** and **DQ1** are primary nets. You can add the other probes of aggressor nets as desired.

- 2. Go back to the **GeneralSI simulation setup -> GeneralSI Options** pane.
- 3. Check all models and click **OK** to quit the pane.

## **Saving File**

When all settings are complete, you can:

1. Click Save File in the Workflow pane to save the .spd files.

A message window opens for you to confirm the selections.



2. Click  $\mathbf{OK}$  with the default settings.

# **Simulation and Results**

Click **Start Simulation** in the **Workflow** pane to perform simulation.

When the simulation is completed, the result waveforms are shown below.



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