

# Application Report

## AM64x SerDes IBIS AMI README



### ABSTRACT

This application report is intended to serve as a guide to the AMI models and associated simulation methodologies. [Section 1](#) provides an insight into the simulation methodology required to validate system-level signal integrity for high-speed serial links on AM64x. [Section 2](#) provides details about the AMI models and the various parameters involved in the modeling.

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### Trademarks

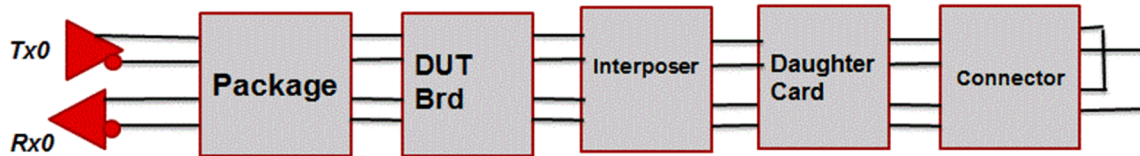
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## 1 Simulations

### 1.1 SerDes

#### 1.1.1 Introduction

The general methodology for evaluating signal integrity for high-speed SERDES interfaces is illustrated in [Figure 1-1](#). This involves running a channel simulation for the serial link. The methodology uses IBIS-Algorithmic Modeling Interface (AMI) models for the Tx/Rx blocks. The basic setup and settings documented here can be used to validate all SerDes links and also across a variety of EDA Signal Integrity simulators. This channel simulation should be performed as a signoff check for all high-speed Serial Link interfaces.



**Figure 1-1. Signal Integrity Analysis Setup - Channel Simulation**

#### 1.1.2 Simulator Settings and Model Usage

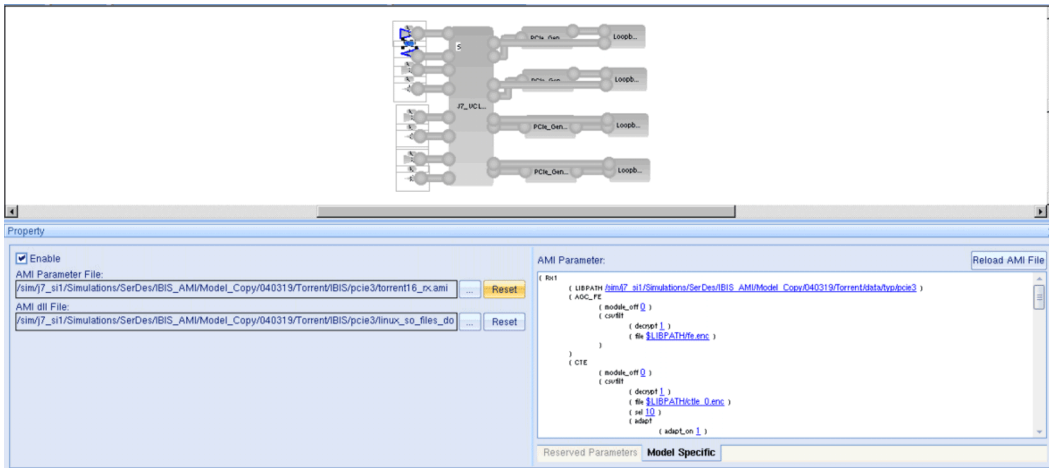
The following things need to be kept in mind while performing channel simulation:

- Odd mode crosstalk is used to define aggressor and victim switching in opposite directions. This is required if multiple lanes are simulated.
- An important note to keep in mind is that the jitter and noise of Tx/Rx blocks should not be double counted. As the IBIS-AMI models already have the various jitter sources incorporated, the option to include additional jitter in these blocks must be turned off in the EDA simulation engine of choice.

#### 1.1.3 Simulation Parameters

The serial link simulations involve a parametric sweep:

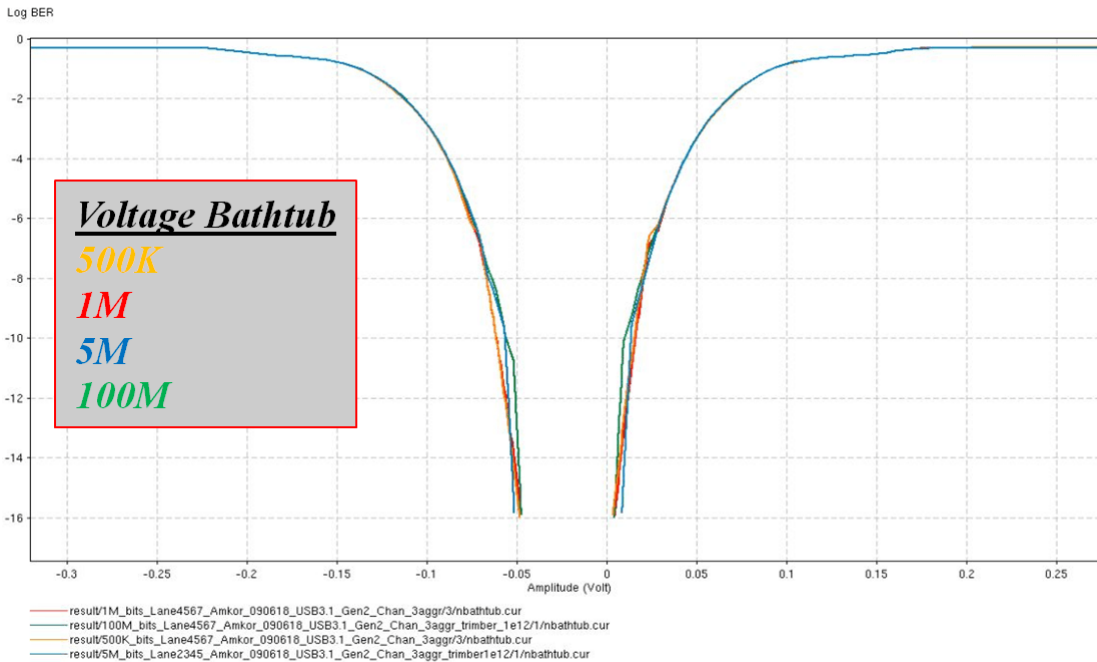
- **Corners:** The IBIS-AMI models for Tx/Rx are characterized as Fast/Typ/Slow corners. The different Deterministic and Random Jitter budgets are built in to the models using these corners.
- **Transmitter Presets:** These are specific to each standard and control the coefficients in the transmitter Decision Feedback Equalizer (DFE). These presets also model the level of de-emphasis in the transmit amplifier which are required to equalize the overall system-level response across different frequencies and counteract the impact of ISI (Inter-symbol interference). It is recommended using a parametric sweep and simulate for all different transmitter presets for a given Serial Link protocol. This is due to the fact that the best eye observed can be highly dependent on the system impulse response and therefore different presets could yield the best results on different systems.
- **Data Patterns:** It is recommended to use PRBS23 or PRBS31 patterns to validate the system, in order to excite larger levels of ISI.
- **LIBPATH Definition:** Ensure that the “LIBPATH” variable in the Rx IBIS-AMI model is set correctly, to point to the local data directory, which points to the Rx CTLE files as shown in [Figure 1-2](#). The name of this variable might change from simulator to simulator. However, the directory always needs to point to the local copy.



**Figure 1-2. LIBPATH Definition**

### 1.1.4 Simulation Methodology

For interfaces where the eye mask is specified in terms of a BER target it is recommended to run the initial channel simulations for around 100K bits and observe the extrapolated bathtub curves for the corresponding target BER, as reported by the simulator. Another simulation for around 500K and 1M bits can be rerun and the bathtub curves can be overlaid to observe the impact of running for larger bit sequences. An example of voltage bathtub curves overlaid is shown in Figure 1-3). Similar overlay can be made for the jitter bathtub curves.



**Figure 1-3. Bathtub Curve Overlay**

Typically, all the ISI should be accounted for within the first 100K bits of the simulation and beyond this point, all bathtub curves should converge if the Random Jitter (Rj) in the models is sufficiently small. It is recommended to confirm this convergence up front by running at least one set of system-level channel simulations each for 100K, 500K and 1M bit sequences. If the voltage and jitter bathtub curves from each of these simulations are almost identical, the remainder of the simulations can be run at 100K bits to optimize run times.

For interfaces where the eye mask is not specified for any particular BER target, a 100K bit simulation should suffice.

### 1.1.5 Reviewing Simulation Results

The results generated by the channel simulations outlined in the preceding sections are compared against an eye mask spec. This eye mask is summarized in [Table 1-1](#). This is used as a pass/fail check for the system

**Table 1-1. Eye Mask Specifications for Different Standards**

Protocol	Eye Height (mV)	Eye Width (pS)	Notes
DP/eDP	NA	NA	TP3_EQ eye mask (eDP_v1.4b_E1 spec, Section 4.6.1, Figure 4.4) BER Target 1E-09
PCIe	50	25	Post-equalization eye mask. BER Target 1E-12
USB3	50	25	
QSGMII	50	25	
SGMII	50	25	

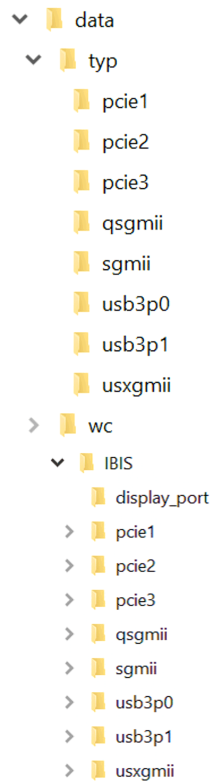
## 2 Models

### 2.1 IBIS-AMI Model Kit

The IBIS – AMI Model Kit provides the IBIS/AMI models corresponding to 16nm PHY from the Cadence IP team. The kit models the transmitter for various FFE combinations and receiver for peak amp, VGA, attenuator, DFE and CDR. It also models the back channel, provided the simulation tool supports it.

### 2.2 The Kit Structure

[Figure 2-1](#) is a snapshot of the structure of the model kit.



**Figure 2-1. Structure of the Models Kit**

**Table 2-1. Folder Contents**

Folder	Contents
data	Contains folders containing data files associated with peak amplifier, variable gain amplifier (VGA), attenuator in specific folders of the Torrent16FFCreceiver.
IBIS	IBIS AMI model corresponding to 16nm PHY from Cadence Design Systems.

## 2.3 Contents of the Kit

The IBIS-AMI models provided in the kit represent the Torrent16FFC TSMC 16 nm PHY from Cadence Design Systems.

**Table 2-2. AMI Model Kit Content**

File Name	Description
torrent16_display_port.ibs	The IBIS file containing circuit models for full strength Torrent16FFC transmitter and receiver, without equalization.
torrent16_gen1.ibs	The IBIS file containing circuit models for full strength Torrent16FFC transmitter and receiver, without equalization.
torrent16_gen2.ibs	The IBIS file containing circuit models for full strength Torrent16FFC transmitter and receiver, without equalization.
torrent16_gen3.ibs	The IBIS file containing circuit models for full strength Torrent16FFC transmitter and receiver, without equalization.
torrent16_sgmiib.ibs	The IBIS file containing circuit models for full strength Torrent16FFC transmitter and receiver, without equalization.
torrent16_qsgmiib.ibs	The IBIS file containing circuit models for full strength Torrent16FFC transmitter and receiver, without equalization.
torrent16_usb3p0.ibs	The IBIS file containing circuit models for full strength Torrent16FFC transmitter and receiver, without equalization.
torrent16_usb3p1.ibs	The IBIS file containing circuit models for full strength Torrent16FFC transmitter and receiver, without equalization.
torrent16_usxgmiib.ibs	The IBIS file containing circuit models for full strength Torrent16FFC transmitter and receiver, without equalization.
torrent16_tx_display_port.ami	The AMI parameter file for transmitter equalization for display port
torrent16_tx_gen1.ami	The AMI parameter file for transmitter equalization for Gen1
torrent16_tx_gen2.ami	The AMI parameter file for transmitter equalization for Gen2
torrent16_tx_gen3.ami	The AMI parameter file for transmitter equalization for Gen3
torrent16_tx_sgmiib.ami	The AMI parameter file for transmitter equalization for sgmiib
torrent16_tx_qsgmiib.ami	The AMI parameter file for transmitter equalization for qsgmiib
torrent16_tx_usb3p0.ami	The AMI parameter file for transmitter equalization for usb 3.0
torrent16_tx_usb3p1.ami	The AMI parameter file for transmitter equalization for usb 3.1
torrent16_tx_usxgmiib.ami	The AMI parameter file for transmitter equalization for usxgmiib
torrent16_rx.ami	The AMI parameter file for receiver equalization for all speeds.
torrent16_tx_win64.dll	The algorithmic model for transmitter equalization, compiled for 64-bit Windows platform
torrent16_rx_win64.dll	The algorithmic model for receiver equalization, compiled for 64-bit Windows platform.
torrent16ffc_rx_linux.so	The algorithmic model for receiver equalization, compiled for a linux platform
torrent16ffc_tx_linux.so	The algorithmic model for transmitter equalization, compiled for linux platform

As per the IBIS-AMI specification, the algorithmic model and channel simulator executable must be compiled for the same hardware platform to work. For more information, see the IBIS specification at <http://www.eda.org/ibis/ver5.1/>.

This IBIS-AMI Model Kit has been tested with the Allegro Sigrity SystemSI product from Cadence Design Systems, Inc.

## 2.4 IBIS Analog Models

The IBIS analog models provided in the kit in the file “torrent16\_gen<1/2/3>.ibs” include:

- Transmitter (Tx) IO model “torrent16\_driver”
- Receiver (Rx) IO model “torrent16\_receiver”

## 2.5 Algorithmic Models

Descriptions of the transmitter (Tx) and receiver (Rx) algorithmic models are given in the following sections.

### 2.5.1 Transmitter (Tx) Model

The Tx model has a 3-tap Feed Forward Equalizer (FFE)

- Fixed tap settings are available as specified in the PCIe3.0 specification
- Backchannel support is available
  - 1st tap is based on pre-cursor ISI delay error by 1UI
  - 2nd tap ensures that sum of all taps is equal to 1
  - 3rd tap is set by back channel. The tap increment/decrement is with resolution of 32, steps from 0 to 1.
  - self\_adapt\_ffe – This enables self adaptation of the FFE, and writes the optimized coefficients in the file self\_adapt\_ffe\_coeff.txt. This parameter is to be used to mimic backchannel functionality.

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#### Note

Formal backchannel capability is not currently supported in the IBIS specification.

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#### 2.5.1.1 TX AMI Parameters for Gen 1

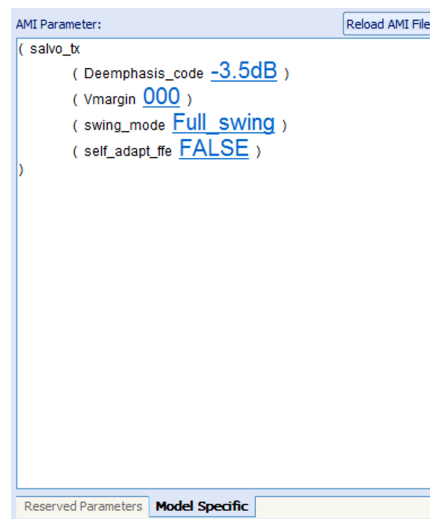
The Torrent16FFC TX AMI parameters are listed in [Figure 2-2](#). In Cadence SystemSI, clicking on a parameter value opens the AMI Parameter Editor where you can change the value.

De-emphasis code available for Gen 1 are 0dB, -3.5dB.

#### 2.5.1.2 TX AMI Parameters for Gen 2

The Torrent16FFC TX AMI parameters are listed in [Figure 2-2](#). In Cadence SystemSI, clicking on a parameter value opens the AMI Parameter Editor where you can change the value.

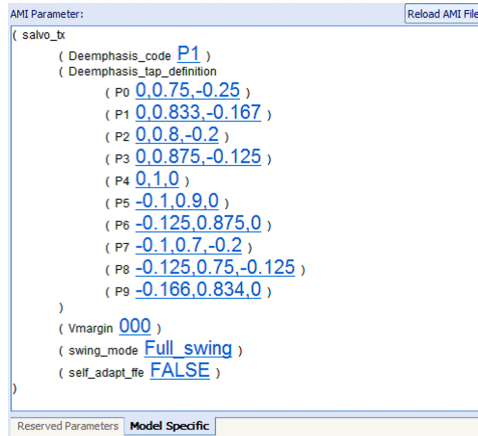
De-emphasis code available for Gen 2 are 0dB, -3.5dB, -6dB.



**Figure 2-2. TX Algorithmic Model Parameters for Gen1 & Gen2**

### 2.5.1.3 TX AMI Parameters for Gen 3

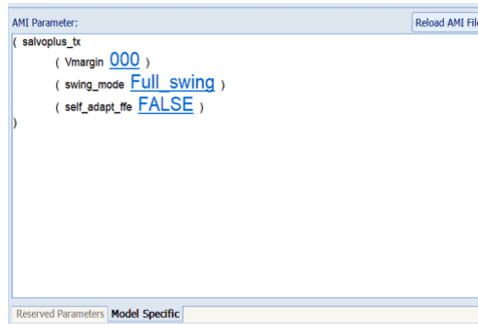
The Torrent16FFC TX AMI parameters are listed in [Figure 2-3](#). In Cadence SystemSI, clicking on a parameter value opens the AMI Parameter Editor where you can change the value.



**Figure 2-3. Tx Algorithmic Model Parameters**

### 2.5.1.4 TX AMI Parameters for Sgmii

The Torrent16FFC TX AMI parameters are listed in [Figure 2-4](#). In Cadence SystemSI, clicking on a parameter value opens the AMI Parameter Editor where you can change the value.

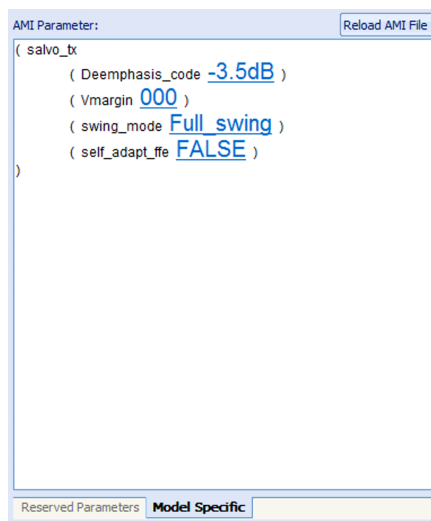


**Figure 2-4. Tx Algorithmic Model Parameters for SGMII**

### 2.5.1.5 TX AMI Parameters for Qsgmii

The Torrent16FFC TX AMI parameters are listed in [Figure 2-5](#). In Cadence SystemSI, clicking on a parameter value opens the AMI Parameter Editor where you can change the value.

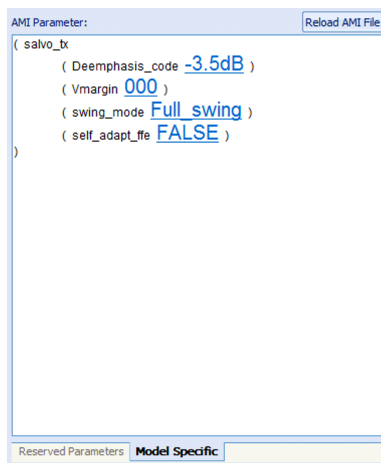
De-emphasis code available for Gen 2 are 0dB, -3.5dB, -6dB.



**Figure 2-5. Tx Algorithmic Model Parameters for Qsgmii**

### 2.5.1.6 TX AMI Parameters for USB3.0

The Torrent16FFC TX AMI parameters are listed in [Figure 2-6](#). In Cadence SystemSI, clicking on a parameter value opens the AMI Parameter Editor where you can change the value. This mode allows you to set custom pre/main/post cursor.



**Figure 2-6. Tx Algorithmic Model Parameters for USB3.0**

### 2.5.1.7 TX AMI Parameters for USB3.1

The Torrent16FFC TX AMI parameters are listed in [Figure 2-6](#). In Cadence SystemSI, clicking on a parameter value opens the AMI Parameter Editor where you can change the value.



### 2.5.1.8 TX AMI Parameters for USXGMII

The Torrent16FFC TX AMI parameters are listed in [Figure 2-7](#). In Cadence SystemSI, clicking on a parameter value opens the AMI Parameter Editor where you can change the value.

```
AMI Parameter: Reload AMI File
( salvopus_tx
  ( Deemphasis_code Drive\_01 )
  ( Deemphasis_tap_definition
    ( Drive_00 "-0.1.0.9.0" )
    ( Drive_01 "-0.1.0.775,-0.125" )
    ( Drive_11 "0,1,0" )
    ( Drive_10 "0,0.875,-0.125" )
  )
  ( Vmargin 000 )
  ( swing_mode Full\_swing )
  ( self_adapt_ffe FALSE )
)
```

**Figure 2-7. Tx Algorithmic Model Parameters for USB3.1/USXGMII**

### 2.5.1.9 TX AMI Parameters for Display Port

The Torrent16FFC TX AMI parameters are listed in [Figure 2-8](#). In Cadence SystemSI, clicking on a parameter value opens the AMI Parameter Editor where you can change the value. The preset values can be chosen at “Default\_preset\_Value”.

```
[ TX_PRIMARY_licensed
  ( FFE
    ( module_off 0 )
    ( preset_taps
      ( def
        ( s0p0 "0, 0.672, 0" )
        ( s0p1 "0, 0.672, 0.156" )
        ( s0p2 "0, 0.672, 0.25" )
        ( s0p3 "0, 0.672, 0.328" )
        ( s1p0 "0, 0.758, 0" )
        ( s1p1 "0, 0.758, 0.141" )
        ( s1p2 "0, 0.758, 0.242" )
        ( s2p0 "0, 0.852, 0" )
        ( s2p1 "0, 0.852, 0.148" )
        ( s3p0 "0, 1, 0" )
      )
      ( Default_Preset_Value s3p0 )
    )
  )
)
```

**Figure 2-8. Tx Algorithmic Model Parameters**

[Table 2-3](#) provides a description of the Torrent16FFC TX AMI parameters:

**Table 2-3. TX AMI Parameters for Display Port**

Parameter	Description
Deemphasis_code	You can set the TX De-emphasis tap coefficients. The drive strength in decibels is set according to the De- emphasis code that is selected. For example, code P1 equates to drive strength of -3.5db. The default value is P1.
Deemphasis_tap_definition<tap values>	For more information, see <a href="#">Table 2-4</a> .
Vmargin	For more information, see <a href="#">Table 2-5</a> .
Swing_mode	It can have following modes : <ul style="list-style-type: none"> <li>• Fullswing</li> <li>• Reducedswing</li> </ul>
self_adapt_ffe<TRUE FALSE>	A value of TRUE results in the best CTLE curve being selected during simulation to find the most optimized FFE taps at Tx for the current channel. The default value of this parameter is 'TRUE'.
Pre_cursor_tap, main_tap, post_cursor_tap	C <sub>-1</sub> , C <sub>0</sub> & C <sub>+1</sub> can be specified. C <sub>0,max</sub> (FS) value is 46. C <sub>0,max</sub> = 46, C <sub>0,min</sub> = 26 C <sub>-1,max</sub> = 0, C <sub>-1,min</sub> = -9 C <sub>+1,max</sub> = 0, C <sub>+1,min</sub> = -17 Default values are: C <sub>0</sub> = 31, C <sub>-1</sub> = -3, C <sub>+1</sub> = -12

### 2.5.1.10 Transmitter Specifications

Transmitter IO allows de-emphasis options as per PCIe3.0 guidelines.

**Table 2-4. Transmitter Specifications**

Preset Number (see Note (1))	Preshoot (dB)	De-Emphasis (dB)	C <sub>-1</sub>	C <sub>+1</sub>	Va/Vd	Vb/Vd	Vc/Vd
P4	0.0	0.0	0.000	0.000	1.000	1.000	1.000
P1	0.0	-3.5 ±1 dB	0.000	-0.167	1.000	0.668	0.668
P0	0.0	-6.0 ± 1.5 dB	0.000	-0.250	1.000	0.500	0.500
P9	3.5 ± 1 dB	0.0	-0.166	0.000	0.688	0.688	1.000
P8	3.5 ± 1 dB	-3.5 ±1 dB	-0.125	-0.125	0.750	0.500	0.750
P7	3.5 ± 1 dB	-6.0 ± 1.5 dB	-0.100	-0.200	0.800	0.400	0.600
P5	1.9 ± 1 dB	0.0	-0.100	0.000	0.800	0.800	1.000
P6	2.5 ± 1 dB	0.0	-0.125	0.000	0.750	0.750	1.000
P3	0.0	-2.5 ± 1 dB	0.000	-0.125	1.000	0.750	0.750
P2	0.0	-4.4 ± 1.5 dB	0.000	-0.200	1.000	0.600	0.600
P10	0.0	See note (2)	0.000	See note (2)	1.000	See note (2)	See note (2)

- (1) Reduced swing signaling must implement presets #4, #1, #9, #5, #6 and #3. Full swing signaling must implement all of the above presets.
- (2) P10 boost limits are not fixed, since its de-emphasis level is a function of the LF level that the Tx advertises during training. This approach permits both full and reduced swing transmitters to use P10 for testing to their respective boost limits.

**Table 2-5. Vmargin for Different Swing Modes**

	Full-Swing Mode	Reduced Swing Mode
000	No margining (FS)	61% FS
001	87% of FS	53% of FS
010	76% of FS	44% of FS
011	63% of FS	39% of FS
100	50% of FS	31% of FS
101	37% of FS	22% of FS
110	26% of FS	14% of FS

### 2.5.1.11 TX\_Jitter Injection Parameters

The TX AMI model contains several jitter-related parameters that were introduced with *IBIS BIRD 123*, and will be incorporated into a future version of the IBIS specification. Most commercial EDA tools that support AMI simulation have already incorporated support for *IBIS BIRD 123*. If the EDA tool you are using does not yet support the BIRD 123 parameters, do the following:

1. Open the AMI file for editing.
2. Delete these parameters.
3. Set their equivalent functionality directly in the EDA tool. Allegro Sigrity SystemSI supports this functionality.

Allegro Sigrity SystemSI supports this functionality.

The Tx AMI file contains the following jitter parameters:

```
(Tx_Rj (Usage Info) (List 0.0031 0.0054 0.001064) (Type UI)
  (Description "Tx Random Jitter in UI. It is RMS UI. Values are for BEST TYP WORST corner
  respectively"))
(Tx_Dj (Usage Info) (List 0.00068 0.01288 0.03168) (Type UI)
  (Description "Tx Bounded Jitter in UI. It is half of pk-to-pk UI. Values are for BEST TYP WORST
  corner, respectively")) (Tx_DCD (Usage Info) (List 0.0005 0.00064 0.00112) (Type UI)
  (Description "TX Duty Cycle Distortion in UI. Values are for BEST TYP WORST corner
  respectively"))
```

**Note**

Above jitter numbers are for PCIe Gen3.

**2.5.2 Receiver (Rx) Model**

RX has VGA, Continuous-Time Linear Equalizer (CTLE), Attenuator, 3-tap DFE and CDR:

**Table 2-6. Receiver Blocks**

Rx Blocks	Description
CTLE block	The CTLE block models various peak amp settings that auto-adapt for best eye <ul style="list-style-type: none"> <li>• 22 codes</li> </ul>
VGA	Voltage gain amplifier settings. <ul style="list-style-type: none"> <li>• 23 codes</li> </ul>
Attenuator	Set the attenuation settings at the RX for the CTLE & VGA blocks. <ul style="list-style-type: none"> <li>• This is done by changing the file name for the CTLE and VGA blocks.</li> </ul>
CDR	<ul style="list-style-type: none"> <li>• Decision for early/late response is made after 4UI</li> <li>• Phase Interpolator step-size of <math>2\pi/32</math></li> </ul>
Sum-amplifier	There is a sum-amp after the VGA block
Decision Feedback Equalizer (DFE)	DFE is 3 tap: <ul style="list-style-type: none"> <li>• Sign-Sign LMS adaptation (blind): LMS is signed-signed LMS that optimizes the taps of blind-DFE</li> <li>• Clocked (sampled) by CDR</li> </ul>

**2.5.2.1 RX AMI Parameters**

The Torrent16FFC RX AMI parameters are listed in [Figure 2-9](#). These are for all supported speeds. Parameter descriptions are provided in [Table 2-7](#).

Set the path of the data folder where companion files of Rx are kept at the 'LIBPATH' section of .ami file.

```
(Model_Specific
(LIBPATH
(Usage In )
(Type String )
(Value "C:\Users\deepv\Documents\AMI_model_encryption\TI\torrent16ffc\testbench\data\typ\pcie2")
(Description "Global Parameter to specify the path for CTE/AGC files." )
```

**Figure 2-9. Receiver Algorithmic Model Parameters**

```

AMI Parameter:
( Rx1
  ( LIBPATH C:\Users\deepv\Documents\AMI_model_encryption\TI\Torrent16
    ( AGC_FE
      ( module_off 0 )
      ( csvfilt
        ( decrypt 1 )
        ( file $LIBPATH\fe.enc )
      )
    )
    ( CTE
      ( module_off 0 )
      ( csvfilt
        ( decrypt 1 )
        ( file $LIBPATH\ctle_0.enc )
        ( sel 10 )
        ( adapt
          ( adapt_on 1 )
        )
      )
      ( exprout
        ( tancip 0.6 )
      )
    )
  )
  ( AGC
    ( module_off 0 )
    ( csvfilt
      ( decrypt 1 )
      ( file $LIBPATH\vgc_0.enc )
      ( sel 10 )
    )
    ( adapt
      ( adapt_on 1 )
    )
    ( exprout
      ( tancip 0.6 )
    )
  )
  ( att
    ( module_off 0 )
    ( file $LIBPATH\attfix.txt )
    ( sel 0 )
    ( col AGC )
    ( adapt_att_sel_file attsel.txt )
    ( adapt
      ( adapt_on 1 )
      ( adapt_agc_code AGC )
      ( adapt_lo_code 2 )
      ( adapt_hi_code 10 )
      ( adapt_lo_size_fact 5 )
      ( adapt_hi_size_fact 5 )
      ( adapt_reverse_indec 0 )
    )
    ( Description "Attenuator Model - please do not modify variables." )
  )
  ( AGC_SA
    ( module_off 0 )
    ( csvfilt
      ( decrypt 1 )
      ( file $LIBPATH\sa.enc )
    )
    ( exprout
      ( tancip 0.6 )
    )
  )
  ( DFE
    ( module_off 0 )
    ( dfe_off 0 )
  )
)

```

Table 2-7 provides a description of the Torrent16FFC Rx AMI parameters.

### Note

If a parameter is not covered below, do NOT adjust the values. Leave the default value!

**Table 2-7. Description of the Torrent16FFC Rx AMI Parameters**

Parameter	Description
AGC_FE	<ul style="list-style-type: none"> <li>Select the sub directory for the speed.               <ul style="list-style-type: none"> <li>usb3p1 (8-10Gb/s)</li> <li>usb3p0 (5Gb/s)</li> <li>pcie3 (5-8Gb/s)</li> <li>pcie2 (2.5-5Gb/s)</li> <li>pcie1 (1.25-2.5Gb/s)</li> <li>SGMI (&gt;1.25Gb/s)</li> </ul> </li> <li><b>This MUST be set as the absolute path to this directory.</b></li> <li><b>This file MUST be the "fe.enc" file.</b></li> </ul>
CTE file name	<ul style="list-style-type: none"> <li>Select the sub directory for the speed.               <ul style="list-style-type: none"> <li>usb3p1 (8-10Gb/s)</li> <li>usb3p0 (5Gb/s)</li> <li>pcie3 (5-8Gb/s)</li> <li>pcie2 (2.5-5Gb/s)</li> <li>pcie1 (1.25-2.5Gb/s)</li> <li>SGMII (&gt;1.25Gb/s)</li> </ul> </li> <li><b>This MUST be set as the absolute path to this directory.</b></li> <li><b>This file MUST be the ctle_0.enc file.</b></li> </ul>
CTE options	<ul style="list-style-type: none"> <li><i>module_off</i>: Turn entire module on or off.</li> </ul>

**Table 2-7. Description of the Torrent16FFC Rx AMI Parameters (continued)**

Parameter	Description
AGC file name	<ul style="list-style-type: none"> <li>Select the sub directory for the speed.                             <ul style="list-style-type: none"> <li>usb3p1 (8-10Gb/s)</li> <li>usb3p0 (5Gb/s)</li> <li>pcie3 (5-8Gb/s)</li> <li>pcie2 (2.5-5Gb/s)</li> <li>pcie1 (1.25-2.5Gb/s)</li> <li>SGMI (&gt;1.25Gb/s)</li> </ul> </li> <li><b>This MUST be set as the absolute path to this directory.</b></li> </ul>
	<ul style="list-style-type: none"> <li><b>This file MUST be the vga_0.encfile.</b></li> </ul>
AGC options	Variable Gain Amplifier <ul style="list-style-type: none"> <li><i>module_off</i>: set the value to 0 to enable the VGA and to 1 to disable it.</li> <li><i>sel</i>: VGA curves can range from 0 to 15.</li> </ul>
Attenuator	Attenuation is adjusted by changing the number at the end of the CTLE and/or the VGA file name. Use the following decode for increasing the attenuation. Always increase the attenuation sequentially. <ul style="list-style-type: none"> <li><b>Please do not touch variables</b></li> </ul>
AGC_SA	<ul style="list-style-type: none"> <li>Select the sub directory for the speed.                             <ul style="list-style-type: none"> <li>usb3p1 (8-10Gb/s)</li> <li>usb3p0 (5Gb/s)</li> <li>pcie3 (5-8Gb/s)</li> <li>pcie2 (2.5-5Gb/s)</li> <li>pcie1 (1.25-2.5Gb/s)</li> <li>SGMII (&gt;1.25Gb/s)</li> </ul> </li> <li><b>This MUST be set as the absolute path to this directory.</b></li> <li><b>This file MUST be the "sa.enc"file.</b></li> </ul>

### 2.5.2.2 Rx Jitter Injection Parameters

Similar to TX, the Rx AMI file also contains the following jitter parameters associated with the Torrent16FFC receiver per BIRD 123:

```
Rx_Rj (Usage Info) (List 0.004 0.008 0.016) (Type UI)
(Description "Rx Random Jitter in UI. It is RMS UI. Values are for BEST TYP WORST corner
respectively"))

(Rx_Dj (Usage Info) (List 0.0125 0.025 0.05) (Type UI)
(Description "Rx Bounded Jitter in UI. It is half of pk-to-pk UI.Values are for BEST TYP WORST
corner, respectively"))

(Rx_Noise (Usage Info) (Value 0.0) (Type Float)
(Description "Rx amplitude noise at sampling latch
in Volts."))
```

#### Note

Above jitter numbers are for reference.

**Table 2-8. Valid Simulation Condition**

	Min Jitter	Typ Jitter	Max Jitter
WC corner	valid	valid	not valid
TYP corner	valid	valid	valid

### 2.6 Valid Simulation Condition

	Min Jitter	Typ Jitter	Max Jitter	
WC corner	Valid	Valid	Valid	Not valid
TYP corner	Valid	Valid	Valid	Valid

## 2.7 Eye Mask Requirement

Minimum eye-mask requirement at sampler for target BER (for example, 1E-12): **50mvp2p x 25ps.**

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