

# **TUSB564 IBIS-AMI Models**

## ***User's Guide***

Version 00.01.00

{ TC } May 2018

Copyright © 2018, Texas Instruments Incorporated. All rights reserved.

The information and/or drawings set forth in this document and all rights in and to inventions disclosed herein and patents which might be granted thereon disclosing or employing the materials, methods, techniques, or apparatus described herein are the exclusive property of Texas Instruments. No disclosure of information or drawings shall be made to any other person or organization without the prior consent of Texas Instruments.

**Texas Instruments Proprietary Information**

## **Disclaimer**

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI is a trademark of Texas Instruments Incorporated.

© 2018, Texas Instruments Incorporated. All rights reserved.

## Table of Contents

<b>1</b>	<b>Introduction .....</b>	<b>4</b>
1.1	Formatting Conventions.....	4
1.2	Charter of the SerDes IBIS-AMI models .....	4
1.3	Is / Is Not Table .....	4
<b>2</b>	<b>About This Release .....</b>	<b>6</b>
2.1	IBIS-AMI Model Files .....	6
2.2	EQ AMI model specific parameters.....	6
<b>3</b>	<b>Model Simulation.....</b>	<b>8</b>
<b>4</b>	<b>ADS Simulation Setup Guide.....</b>	<b>9</b>
4.1	Introduction.....	9
4.2	Creating a new workspace.....	9
4.3	Schematic Creation .....	9
4.4	Importing IBIS and AMI files .....	10
4.5	Importing S-Parameter models .....	10
4.6	Simulation Settings.....	10
4.7	Simulation Results.....	10

# 1 Introduction

This document describes the organization, structure, and proper usage of the TI TUSB564 IBIS-AMI models (compiled and approved for external customer release), hereafter referred to as the “model” for short. The model is intended for use by the TUSB564 design team and by TUSB564 customers for system-level modeling and verification. This document assumes that you are familiar with the relevant IBIS-AMI modeling specifications.

## 1.1 Formatting Conventions

The help readability, various formatting conventions are used throughout this document:

- Hyperlinks to material within and outside this document are marked in [blue](#).
- Courier font is used for `file names, code, variables, structures, parameters, and terminal commands`.

## 1.2 Charter of the SerDes IBIS-AMI models

The models are designed in accordance with the [IBIS-AMI standard](#) and attempt to model the significant characteristics of most components in the TUSB564. The models are not intended to be an exact representation of TUSB564 components implemented. Rather, the models seek to provide as high a degree of accuracy as is feasible outside of Spice-based models and simulations.

## 1.3 Is / Is Not Table

The following table describes the features and purposes of the models, as well as the limitations of the models.

**Table 1: Model Is / Is Not Table**

<b>Is</b>	<b>Is Not</b>
Compiled for 64 bit AMI EDA tool that run in Windows platform	Compiled for any other platform (i.e. 32-Linux)
Compliant to IBIS-AMI 5.0	Compliant to a more recent BIRD revisions, if they exist
<i>Model of TUSB564 functionality, non-idealities, and performance</i>	<i>Exact representation of implemented components</i>

The TI IBIS-AMI models contain information on products that is based on high-level specifications. These may not accurately represent the product design in all cases. Please verify the accuracy of the models with TI before using the results.

## 2 About This Release

### 2.1 IBIS-AMI Model Files

Table 2 shows the key IBIS-AMI model files delivered with the model release as part of the compressed archive.

**Table 2: IBIS-AMI files included with the model release**

File Name	Type	Description
TUSB564_AMI_users_guide.pdf	PDF	TI TUSB564 AMI model user's guide.
TUSB564_v1.ibs	IBIS	Top-level IBIS wrapper for the Tx and Rx AMI model.
tx_v1.ami	AMI	Parameters file for the Tx model as required by the IBIS-AMI standard. This is a text file which is common for all OS/execution platforms.
tx_v1_x64.dll	DLL	Windows 64-bit compiled shared library for the Tx model. This shared library includes the AMI_Init, AMI_GetWave, and AMI_Close functions defined in the IBIS-AMI standard.
TUSB564_rx1.ami	AMI	Parameters file for the Rx model as required by the IBIS-AMI standard. This is a text file which is common for all OS/execution platforms.
TUSB564_rx1_x64.dll	DLL	Windows 64-bit compiled shared library for the Rx model. This shared library includes the AMI_Init, AMI_GetWave, and AMI_Close functions defined in the IBIS-AMI standard.
TUSB564_TXTERM.s4p	s4p	Driver termination to capture the output reflection and cross-couple signal between differential pair.
TUSB564_RXTERM.s4p	s4p	Input termination for input differential pair.
TUSB564_ADS_release.7zads		Archieved ADS.7zads that contains a simple testbench in ADS.

### 2.2 EQ AMI model specific parameters

TUSB564 model consists of receiver and transmitter models. EDA tool is responsible for cascading the receiver to the transmitter to form a redriver to perform signal integrity analysis.

The following tables corresponding to Equalization parameter settings.

**Table 3. Model Specific Parameters for Receiver**

The TI IBIS-AMI models contain information on products that is based on high-level specifications. These may not accurately represent the product design in all cases. Please verify the accuracy of the models with TI before using the results.

Parameter	Description and Setting
eq	0 to 15. Control the receiver equalization amount. Please see Table 3.1 for detail. Please note due to the nature of linear redriver, equalization setting will impact the driver characteristic as well.
Path	0 to 2. Data path Direction 0: RX1 to SSRX. 1: SSTX to TX1. 2: TX2 to DP0.

**Table 3.1 eq setting**

eq	Path 0: RX1 to SSRX (dB at 2.5GHz)	Path 1: SSTX to TX1 (dB at 2.5GHz)	Path 2: TX2 to DP0 (dB at 4.05 GHz)
0	-0.9	-2.4	-0.3
1	0.2	-1.3	1.6
2	1.2	-0.4	3.0
3	2.2	0.7	4.4
4	3.1	1.5	5.4
5	4.0	2.5	6.5
6	4.8	3.2	7.3
7	5.6	4.0	8.1
8	6.3	4.8	8.9
9	7.0	5.5	9.5
10	7.5	6.0	10.0
11	8.1	6.6	10.6
12	8.5	7.1	11.0
13	9.1	7.6	11.4
14	9.5	8.0	11.8
15	9.9	8.5	12.1

### 3 Model Simulation

Figure 1. Schematic of a system that consists of ideal transmitter, TUSB564 redriver, and ideal receiver.

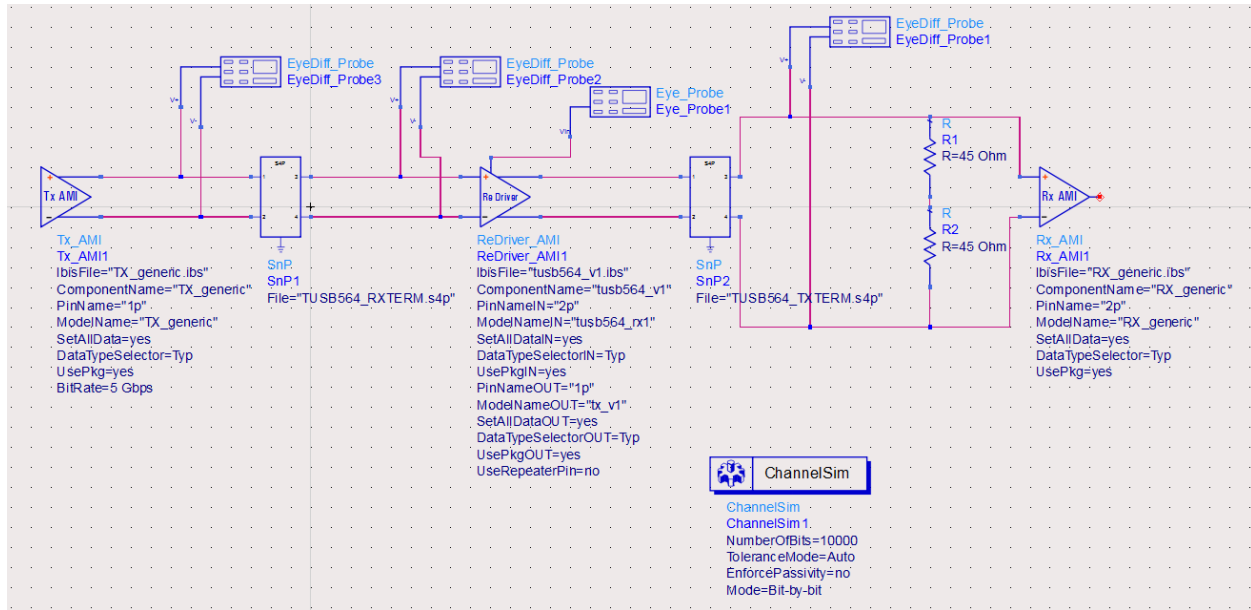
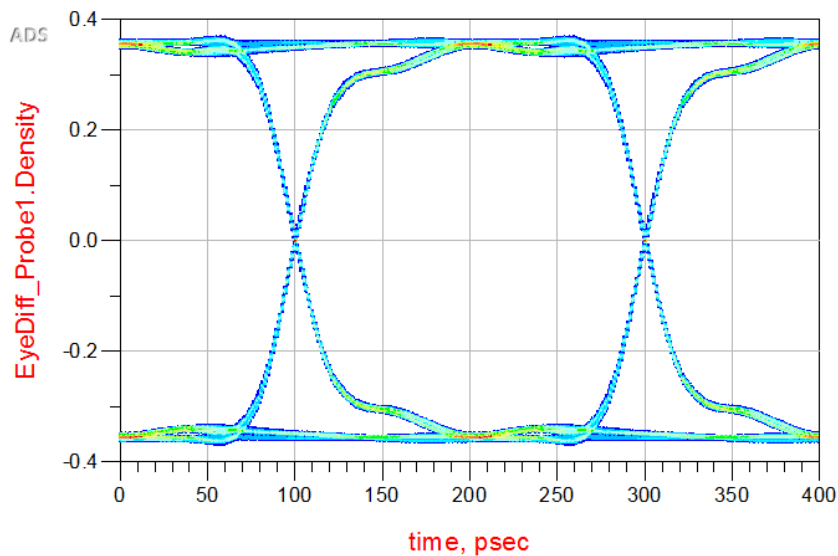


Figure 2. Simulation Result of re-driver



The TI IBIS-AMI models contain information on products that is based on high-level specifications. These may not accurately represent the product design in all cases. Please verify the accuracy of the models with TI before using the results.



## 4 ADS Simulation Setup Guide

### 4.1 Introduction

This section provides an overview of running TI IBIS-AMI models using Agilent's Advance Design System Software. For instructions on how to install the software, please refer to Agilent's [Website](#).

### 4.2 Creating a new workspace

1. To create a new workspace in ADS, goto File -> New -> Workspace
2. Follow the new workspace wizard to create a new workspace
3. Enter the Project Name as 'XXXXX\_wrk'
4. Instantiate a new schematic from the created workspace
5. Name the cell as 'cell\_1' selecting the library as 'XXXXX\_lib'
6. You can follow the wizard or manually place parts to create your required test bench

### 4.3 Schematic Creation

1. To insert any part in ADS schematic, goto Insert -> Component -> Component Library
2. Use search box to search for your required components and drag them to schematic
3. Search for Tx\_AMI, Rx\_AMI to insert Transmitter and Receiver IBIS-AMI Models
4. Insert S data blocks to link S4P files for Analog Impairments and differential channels. Connect ground to the reference node.
5. Use ChannelSim component to create the required simulation environment
6. Insert eye probe to view the eye diagram, waveform and other measurements post simulation.
7. Create the schematic as shown in Figure 1 above

#### 4.4 Importing IBIS and AMI files

1. To import the ibis files in ADS, double Tx\_AMI or Rx\_AMI components on the schematic, and browse for the respective IBIS files
2. User can view details of IBIS model from various information tabs after selecting the IBIS files for transmitter and receiver
3. ADS automatically links the \*.ami and \*.dll files associated with the \*.ibs files

#### 4.5 Importing S-Parameter models

1. To import the S-parameter files, double click S4P block and browse for the required .s4p files to instantiate into the schematic.
2. Repeat this method for all S4P blocks to import various .s4p files
3. Rearrange the wiring between Tx\_AMI, S4P blocks and Rx\_AMI components to match the required port order w.r.t .sp4 file

#### 4.6 Simulation Settings

1. To access the simulation settings double click ChannelSim block.
2. User can change various simulation setting and parameters according to his need
3. Use help option to get detail understanding of various parameters
4. To run the simulation, goto simulate -> Simulate
5. Refer to simulation status popup for various simulation warnings and errors during simulation

#### 4.7 Simulation Results

1. Before running simulation, check for appropriate properties in eye probe for correct results
2. Set the data rate in parameters tab to the simulation bit rate as set in Tx\_AMI's PRBS tab
3. In measurements tab, include all the required measurement options required to be recorded
4. In the popup after simulation, insert rectangular plot from palette panel and link density measurement to view the eye diagram. Refer Figure 2.

---

The TI IBIS-AMI models contain information on products that is based on high-level specifications. These may not accurately represent the product design in all cases. Please verify the accuracy of the models with TI before using the results.

5. Use list from palette panel and link various other measurements in view in textual format