

ADC12QJ1600 IBIS & IBIS-AMI Models

User's Guide

Version 00.01.00
December 2021
Copyright © 2021, 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.

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.

© 2021, Texas Instruments Incorporated. All rights reserved.

Table of Contents

1	Introduction	4
1.1	Formatting Conventions.....	4
1.2	Charter of the SerDes IBIS-AMI models	4
1.3	Is / Is Not Table	4
2	About This Release	5
2.1	IBIS Model Files	5
2.2	IBIS-AMI Model Files (ADS workspace).....	5
2.3	IBIS-AMI case definitions.....	7
2.4	IBIS file adc12qj1600aav.ibs.....	8
2.4.1	Device conditions for IBIS corners	8
2.4.2	Component configurations	8
2.4.3	Model selector.....	8
3	IBIS-AMI Model Simulation	9
3.1	IBIS-AMI basic set-up in ADS	9
3.2	IBIS-AMI Model Features	11
3.3	IBIS-AMI example case in ADS	14

1 Introduction

This document describes the organization, structure, and proper usage of the TI ADC12QJ1600 IBIS-AMI/IBIS models (compiled and approved for external customer release), hereafter referred to as the “model” for short. The model is intended for use by the ADC12QJ1600 design team and by ADC12QJ1600 customers for system-level modeling and verification. This document assumes that you are familiar with the relevant IBIS-AMI modeling specifications. In these models the AAV package type is supported.

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 ADC12QJ1600. The models are not intended to be an exact representation of ADC12QJ1600 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

Is	Is Not
Compiled for 64-bit AMI EDA tool that run in Linux & Windows platform. The reference simulator is Keysight – ADS.	
Compliant to IBIS-AMI 6.0	Compliant to a more recent BIRD revisions, if they exist
Model of ADC12QJ1600 I/O functionality, non-idealities and I/O performance	Exact representation of implemented components

2 About This Release

2.1 IBIS Model Files

Table 2: IBIS Model Files

File Name	Type	Description
adc12qj1600aav.ibs	IBIS	Marketing part# ADC12QJ1600AAVQ1 Package-type BGA #pins/pkg drawing 144-pin AAV

2.2 IBIS-AMI Model Files (ADS workspace)

Table 3: IBIS-AMI files, ../data/TI_ADC12QJ1600/

File Name	Type	Description
ADC12xJ_17p16.ibs	IBIS	Top-level IBIS wrapper for Tx AMI model.
ADC12xJ_17p16_typ.ami ADC12xJ_17p16_leakage.ami ADC12xJ_17p16_slow.ami ADC12xJ_17p16_fast.ami ADC12xJ_17p16_tempinv.ami	AMI	Parameters file for Tx model as required by the IBIS-AMI standard (version 6.0)
ADC12xJ_17p16_x64.dll ADC12xJ_17p16_x64.so	DLL, SO	Windows/Linux 64-bit compiled shared library for the Tx model (IBIS-AMI standard version 6.0)

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.

Table 4: IBIS-AMI files, ../data/

File Name	Type	Description
TX_typ.s4p TX_leakage.s4p TX_slow.s4p TX_fast.s4p TX_tempinv.s4p	S4P	driver terminations to capture the output reflection and cross-couple signal
Dxaav.s4p	S4P	Package S4P single lanes for AAV package

Table 5: additional data files

File Name	Type	Description
../data/ ADC12QJ1600_AAV_Dx.s36p	S36P	Package 36port covering interlane coupling for AAV package (8x Dx & RXCLK lanes)
../data/ fr4_100mm.s4p fr4_150mm.s4p fr4_200mm.s4p	S4P	100/150/200mm FR4 line for test and example purposes

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.

2.3 IBIS-AMI case definitions

The IBIS-AMI models are defined for 5 different corner cases. The device conditions are listed below.

Table 6: IBIS-AMI case definitions

case	Silicon model	VDD11 supply	Temperature ambient
typ	nom	1.1V	25degC
leakage	strong	1.15V	125degC
slow	weak	1.05V	125degC
fast	strong	1.15V	-40degC
temp-inv	weak	1.05V	-40degC

2.4 IBIS file adc12qj1600aav.ibs

2.4.1 Device conditions for IBIS corners

Table 7: IBIS corner conditions

Case	Silicon model	VDD18 supply	VDD11 supply	Temperature ambient
Typ	nom	1.9V	1.1V	25degC
Min	weak	1.8V	1.05V	125degC
Max	strong	2.0V	1.15V	-40degC

2.4.2 Component configurations

Two different device component definitions are possible which affect the termination of following differential input pins:

C1, D1	TMSTP+-
F1, G1	CLK+-
J1, K1	SYSREF+-

1. ADC12QJ1600AAVQ1_PECL
In this case each pin is terminated with 50Ohm to ground.
2. ADC12QJ1600AAVQ1_LVDS
In this case a termination of typical 100Ohm between the differential pins is defined.

2.4.3 Model selector

The LVDS output drivers on pins

J9, K9	TRIGOUT+-
--------	-----------

can be operated at different supply levels. The model selector supports two different voltage levels.

1. LVDSP_MODE_0_V1P8, LVDSN_MODE_0_V1P8
The LVDS driver is attached to high VDD18 supply voltage
2. LVDSP_MODE_0_V1P1, LVDSN_MODE_0_V1P1
The LVDS driver is attached to low VDD11 supply voltage

3.1 IBIS-AMI basic set-up in ADS

- Open basic set-up from ADS workspace: ADC12QJ1600_TX – schematic. Make sure EnforcePassivity=no in ChannelSim
- Select IBIS-AMI case combination for Tx_AMI1 and SNP1 instances.
- Select package option and output lane S4P data for SNP2

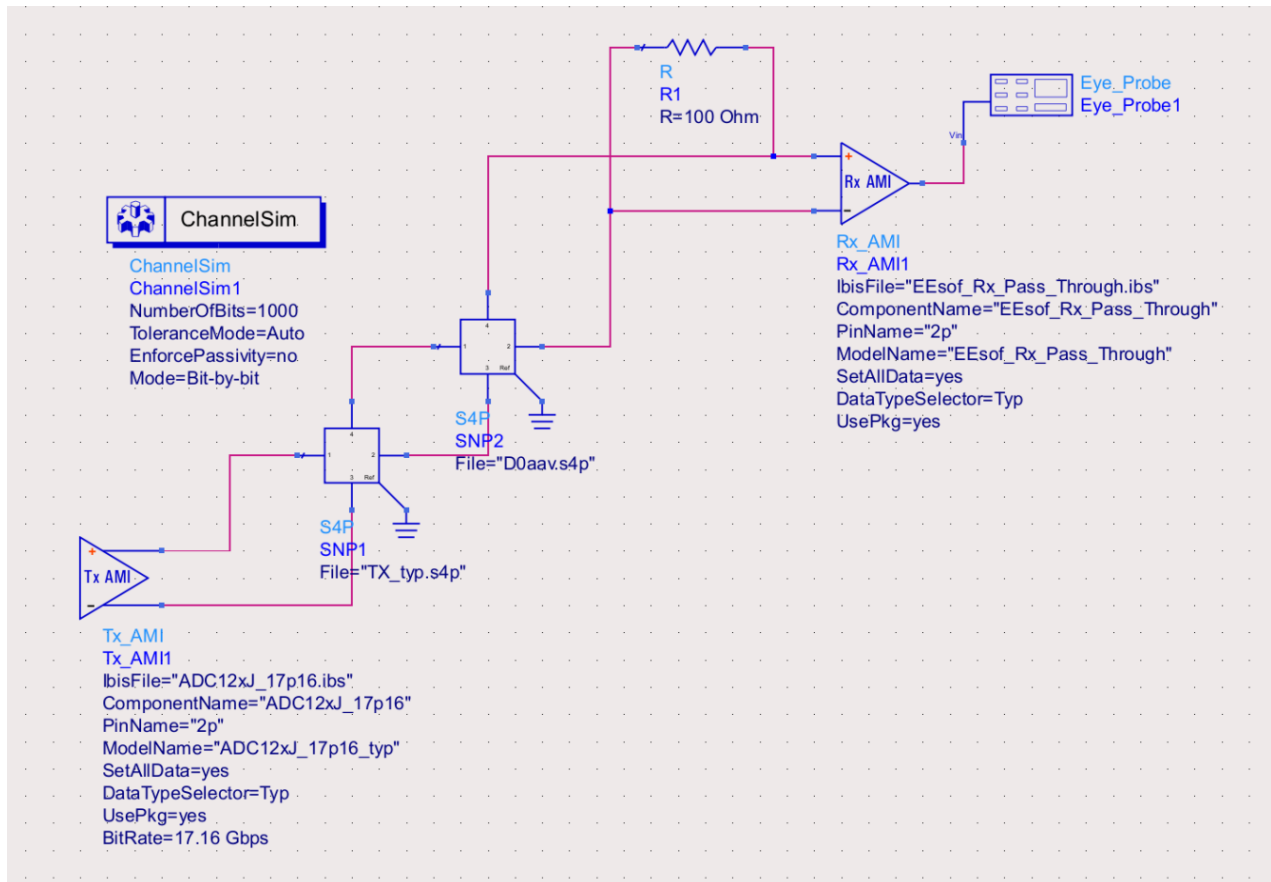


Figure 1. Basic IBIS-ADI schematic set-up in ADS

Expected result at Eye_Probe in this example

- typical case, 17.16Gbps
- lane D0 in AAV package
- preemphasis value = 0
- ideal 100Ohm termination

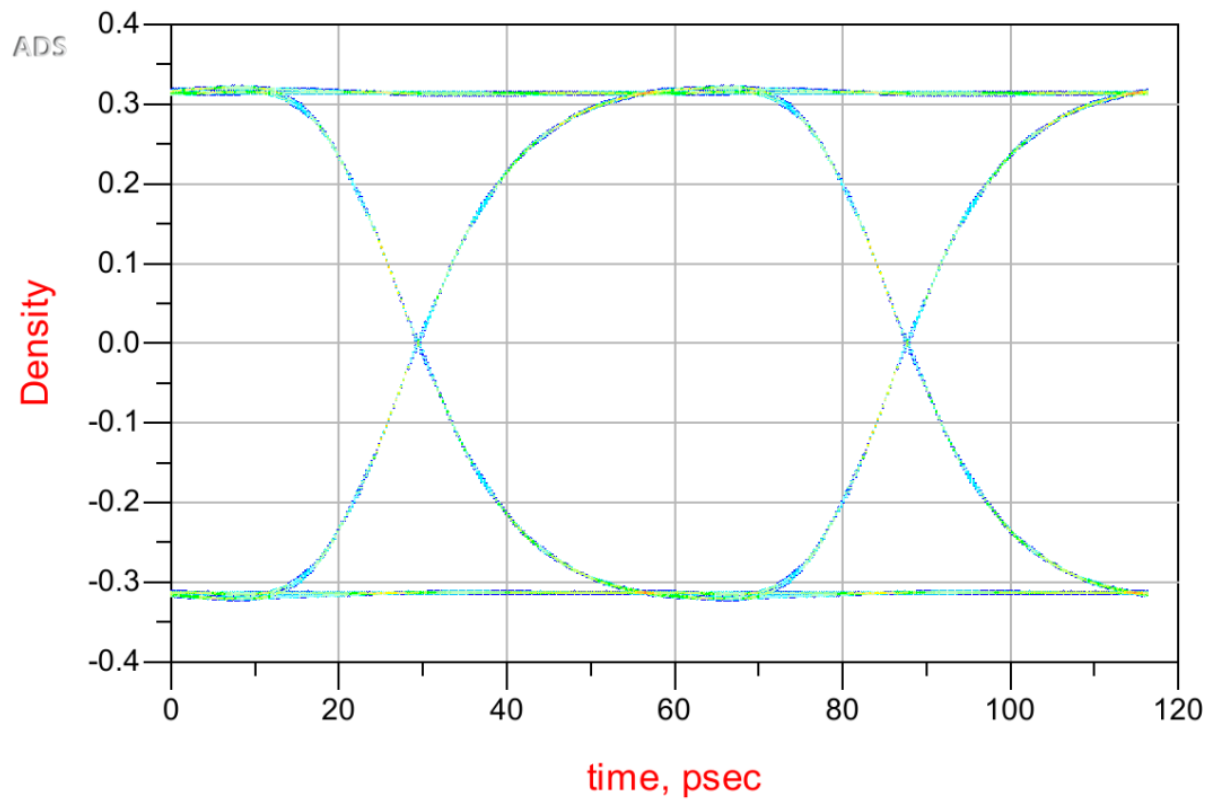


Figure 2. Eyeprobe output in ADS

3.2 IBIS-AMI Model Features

IBIS-AMI simulation case can be selected under “Pin”. There are 5 cases defined (see Table 6). Make sure S4P data for SNP1 instance matches the selected simulation case.

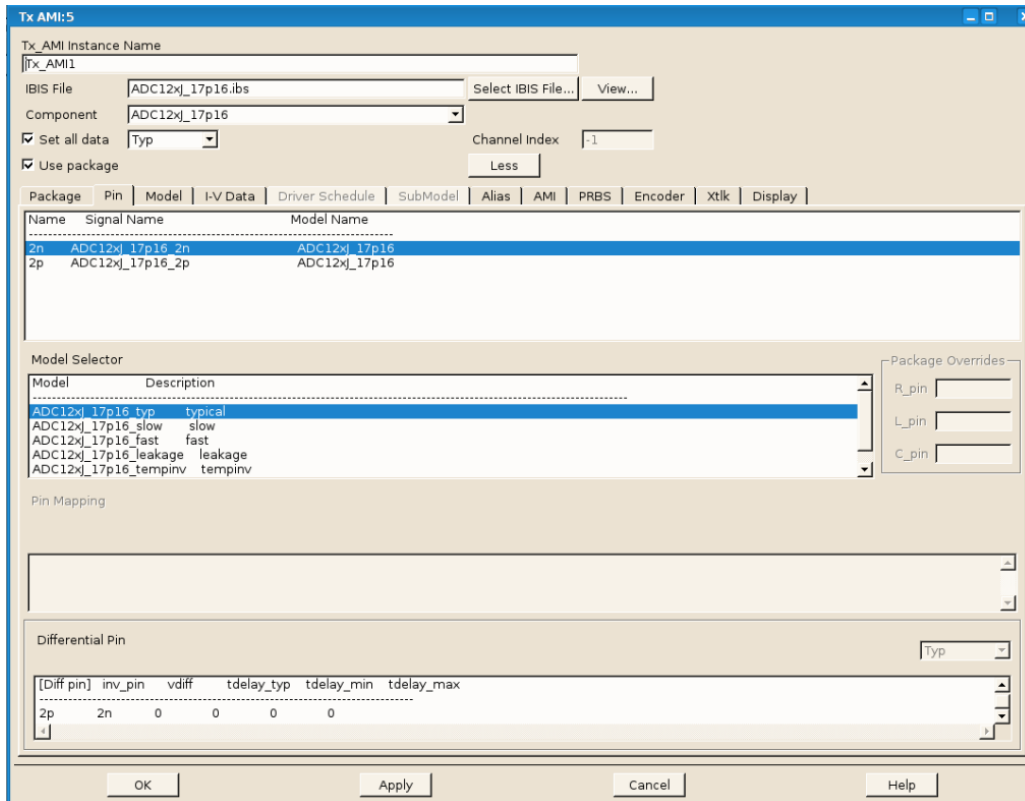


Figure 3. selection of simulation case

There are two possibilities to set the preemphasis value

“AMI” selector – Autoinit

Autoinit = 1 = Yes (default)

-> auto adapt to optimum preemphasis value

Autoinit = 0 = No

-> manual selection of preemphasis value

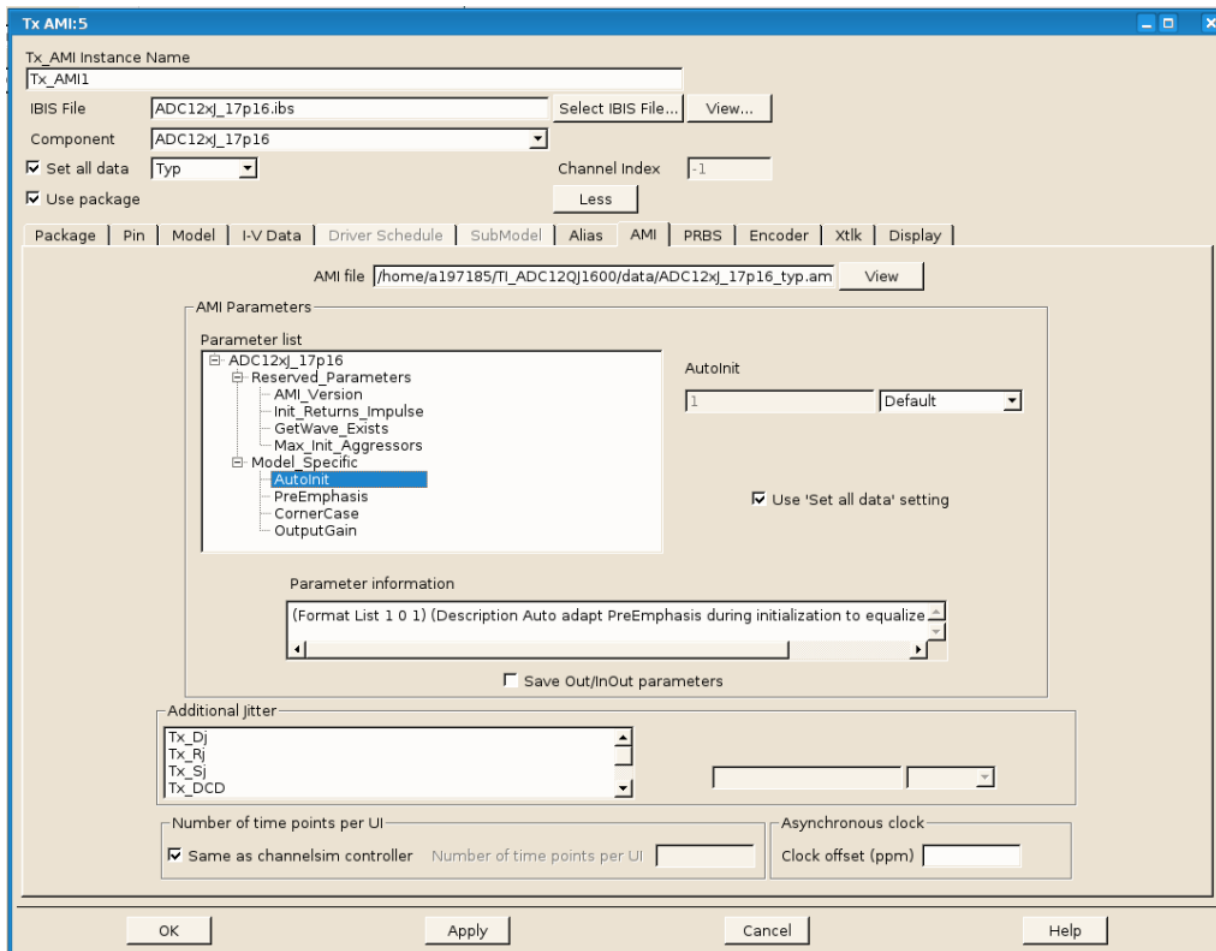


Figure 4. Automatic Preemphasis selection

For manual preemphasis selection use

“AMI” selector – PreEmphasis

Manual selection of preemphasis value if Autoinit = 0.

Choose value between 0 (no preemphasis) and 15 (decimal, max. preemphasis)

Please note the order of preemphasis strength for given TX buffer

(0, 8, 1, 9, 2, 10, 3, 11, 4, 12, 5, 13, 6, 14, 7, 15).

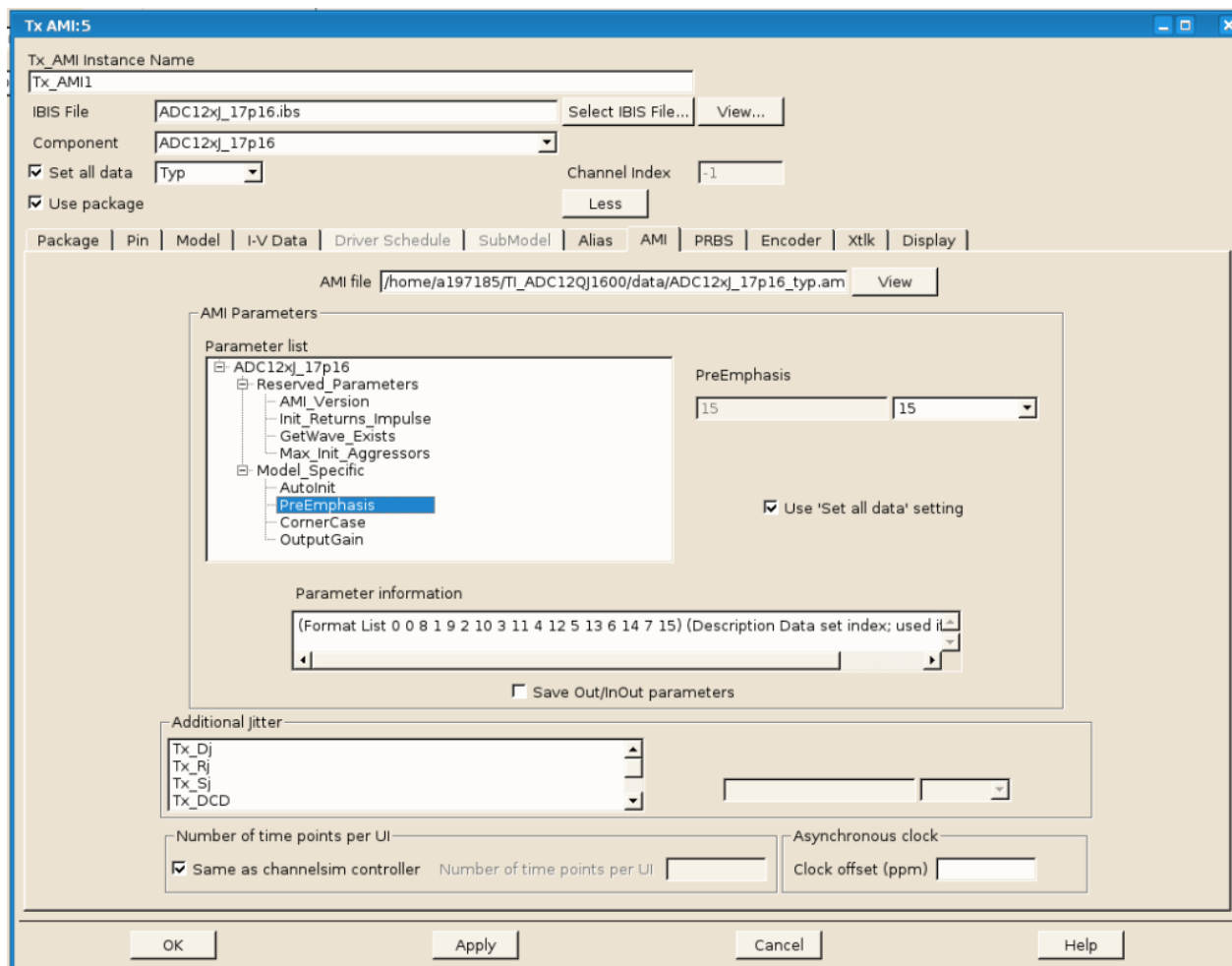


Figure 5. Manual Preemphasis selection

3.3 IBIS-AMI example case in ADS

The following application example in ADS can be found under ADC12QJ1600_TX_example – schematic. A 100mm FR4 line is used as a channel. The “Autoinit” feature is active and chooses preemphasis = 11 (decimal) as the optimum setting.

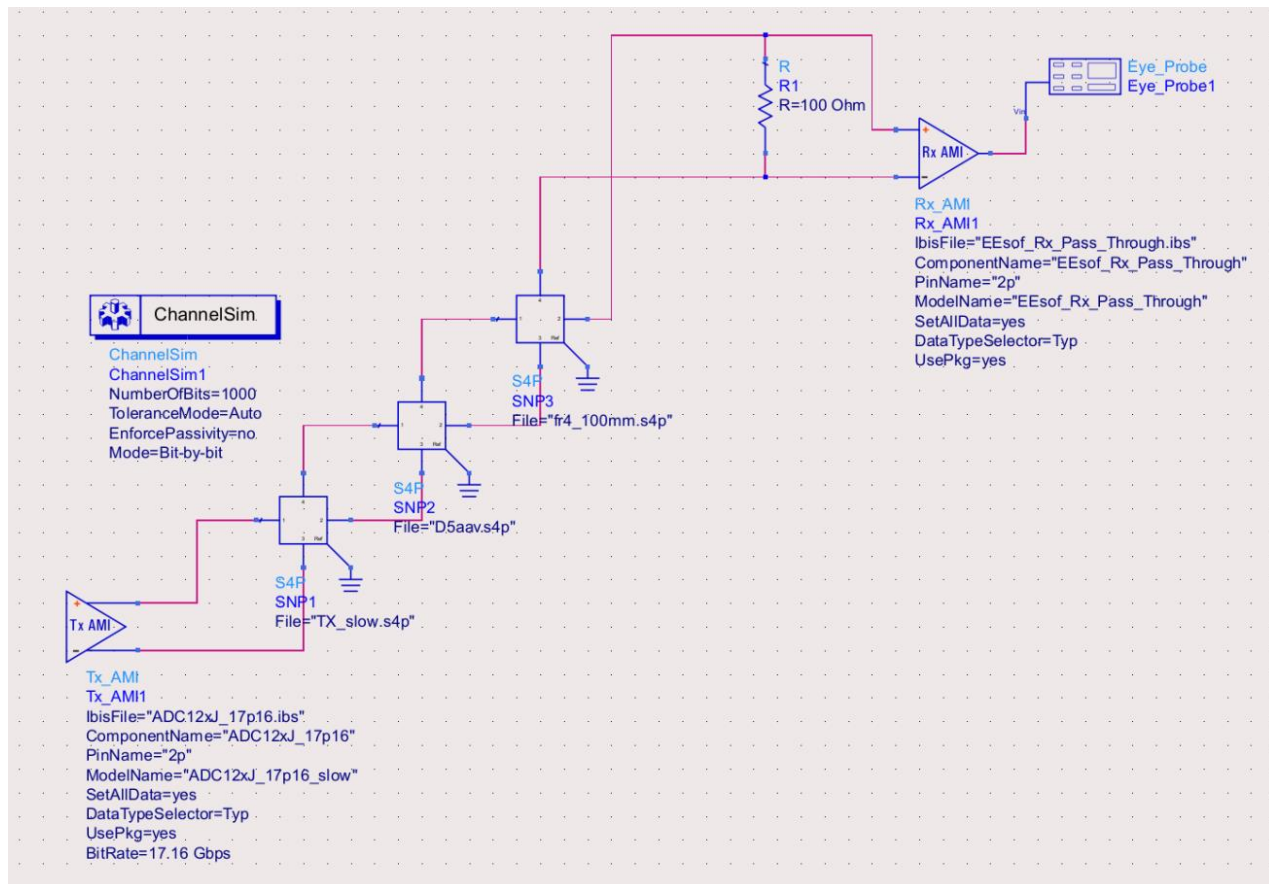


Figure 6. ADS channel example with 100mm FR4 line

- IBIS-AMI slow case, 17.16Gbps
- Lane D5
- 100mm FR4 channel attached
- With “Autoinit” = 1 optimum preemphasis setting calculated to “PreEmphasis” = 11 (decimal)
- ideal termination 100Ohm

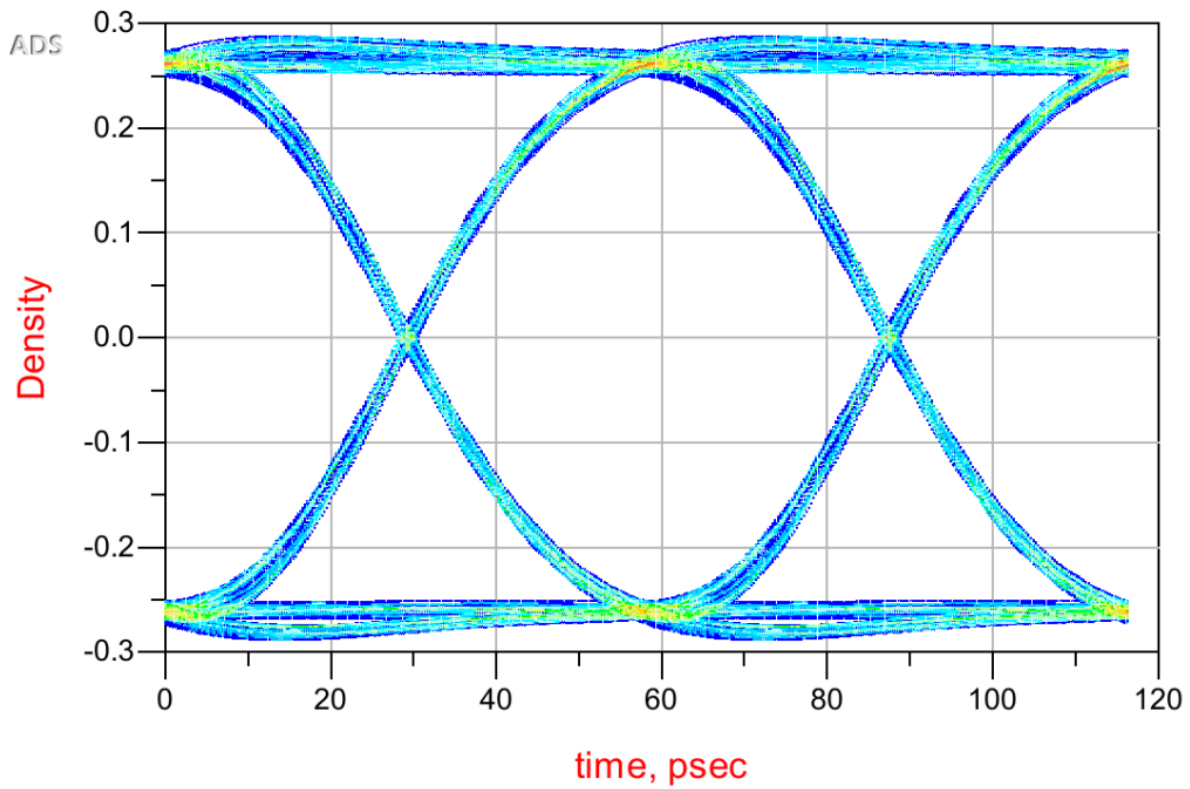


Figure 7. ADS simulation output