Application Note
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Quick Start Guide
Example Agilent ADS Project for DS80PCIxxx, DS100KRxxx, DS125BRxxx, DS100MBxxx, and DS125MBxxx Family

Version 4
April 2024

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1 Document Revision History

Revision	Comment	Date
1	Initial creation of Quick Start Guide for example ADS project.	23-Feb-2012
2	Updated for ADS 2013.06. Quick guide was made generic to cover most linear repeater devices.	11-Mar-2012
3	Update for ADS 2014.01.	24-Sep-2014
4	Updated for public release.	19-April-2024

2 Overview

This document is a Quick Start Guide for a custom Agilent ADS project using the a linear Buffer Repeater in a generic channel topology. Table 1 below lists pertinent information related to the delivered project.

Table 1: Quick Start Guide related information

Item	Value/Comment
IBIS-AMI Simulator	*Agilent ADS*
IBIS-AMI Simulator version	*2014.01*. TI strongly recommends updating to version 2014.01 or later to enable certain features such as single-schematic retimer/redriver simulations.
TI device models included	*Linear Buffer Repeater devices including DS80PCIxxx, DS100KRxxx, DS125BRxxx, DS100MBxxx, DS125MBxxx*
Other device models included	*None*. When interfacing to the linear repeater, only generic TX/RX models were used. Customer will need to replace these with other vendors' models if desired.
Project names	*Agilent_ADS_2014.01.7ads*: ADS project using the Repeater.
Supported platforms	• 32-bit Windows • 64-bit Windows • 64-bit Linux

The topology implemented in the example project matches Figure 1 below. There are two main parts to this topology:

1. Link between a generic TX (pattern generator) and the Repeater.
2. Link between the Repeater and a generic RX (scope).

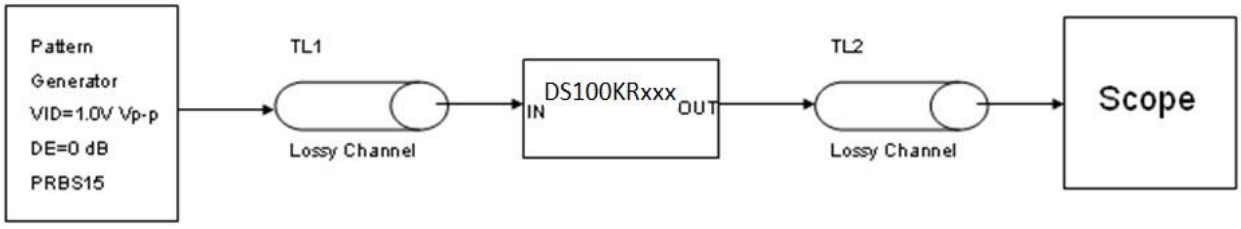

Figure 1: Link topology for the example project

3 Project Quick Start Guide

The example project included in this distribution contains one schematic:

- ***ASIC_TX_Repeater_ASIC_RX***: Link between a Generic ASIC TX model, the Repeater, and a generic ASIC RX model. Contains:

    a. A generic TX model *which should be replaced by the ASIC vendor's TX model*

    b. A generic FR4 trace model *which should be replaced by actual channel*

    c. The Repeater RX model (can be replaced by other linear repeater models depending on your application)

    d. A generic RX model *which should be replaced by the ASIC vendor's RX model*

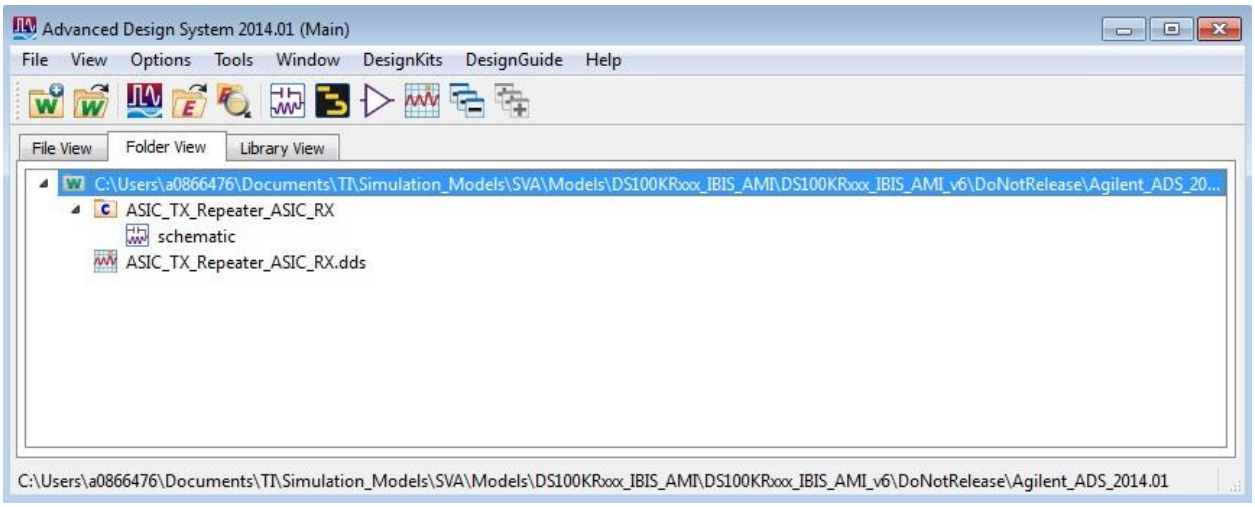

Figure 2: ADS main window showing the available schematic

The recommended procedure for simulating the enclosed example project is as follows:

1. Open the project. From the main ADS control window, select "File > Unarchive Workspace or Project", then browse to the project file provided with this release: Agilent_ADS_2014.01.7zads. ADS will ask you to name the project and specify where you want it to be placed.

2. Open the ASIC_TX_Repeater_ASIC_RX schematic.

3. Replace the generic TX IBIS-AMI model with the desired ASIC vendor TX model. This can be done by double-clicking on the TX_AMI model. Browse to and select the desired IBIS model to replace the generic TX model that is currently instantiated in the schematic. Note that this generic TX model does not contain

any de-emphasis or amplitude control and is solely for the purpose of completing the simulation setup.

4. Replace the generic TX package model with the package model supplied by the ASIC TX vendor. Do this by double-clicking on the TX package s-parameter block and selecting the new s-parameter file. Note that the example ASIC TX package used in this schematic has a port ordering such that port 1 goes to port 3 and port 2 goes to port 4. If the package model supplied by the ASIC TX vendor has a different port ordering, then the schematic hook-up will need to be edited to make sure the signal propagates through the package and into the channel correctly.

5. Replace the generic FR4 trace model with your system's channel.

6. Replace the generic RX package model with the package model supplied by the ASIC RX vendor. Note that the example ASIC RX package used in this schematic has a port ordering such that port 1 goes to port 3 and port 2 goes to port 4. If the package model supplied by the ASIC RX vendor has a different port ordering, then the schematic hook-up will need to be edited to make sure the signal propagates through the package and into the channel correctly.

7. Replace the generic RX IBIS-AMI model with the desired ASIC vendor RX model. Note that the generic RX model included in this project does not have any equalization, so it is effectively a scope.

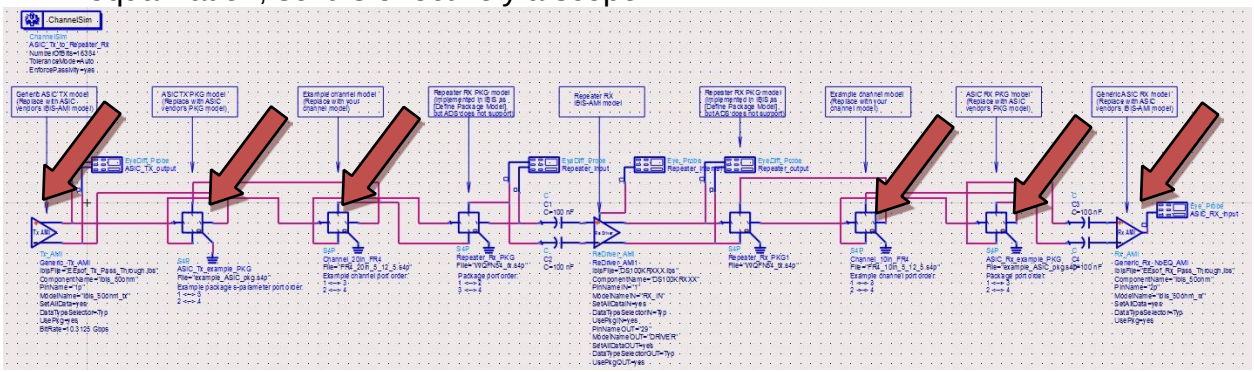

Figure 3: ASIC TX to Repeater schematic (user should replace the items with arrows pointing to them)

8. Simulate the ASIC_TX_Repeater_ASIC_RX schematic by clicking on the  button. As the schematic is simulating ADS will display the simulation progress. Before simulating you can adjust the Repeater's settings by double-clicking on the Repeater model and going to the AMI parameters tab. The range of possible settings for this model is described in the model user's guide.

9. Once the simulation completes, the plot window will appear. To plot the resulting post-equalized eye, click on the  button and click again in the blank area to drop down a plot axis.

10. When the plot is inserted, the “Plot Traces & Attributes” window will open up. Select one of the “Density” plots and then click on “>>Add>>”. Click “OK” to plot the eye. The example project contains a data display page called ASIC_TX_DS100_Krxxx_ASIC_RX.dds that plots the eye along the signal path similar to the figures below.

4 Example result plots

Using the example project discussed in the previous section, some example results are given for different use conditions.

- For applications involing link training (i.e. 10GBASE-KR, 40GBASE-KR4/CR4, PCIe-Gen3, SAS-3), the Limit parameter should be set to 0 to put the device in a linear mode of operation.

- When in linear mode, the output differential voltage (VOD) of the repeater is a function of the input differential voltage. The VOD setting should be set to 7 to maximize linearity.

- Figure 4, Figure 5, and Figure 6 demonstrate that the output VOD does not change much with VOD setting. They are all very similar to each other, and the VOD=7 case is the most linear.

- Figure 7 demonstrates that in linear mode, when the input amplitude changes, the output amplitude follows that change. Figure 4 shows that the output amplitude is about 1000mVppd for a 1000mVppd input. Figure 7 shows that the output amplitude is about 800mVppd for an 800mVppd input.

- Figure 8 and Figure 9 demonstrate that in limiting mode (Limit=1), the output amplitude is a function of the VOD setting. Limiting mode can be used when link training is not required.

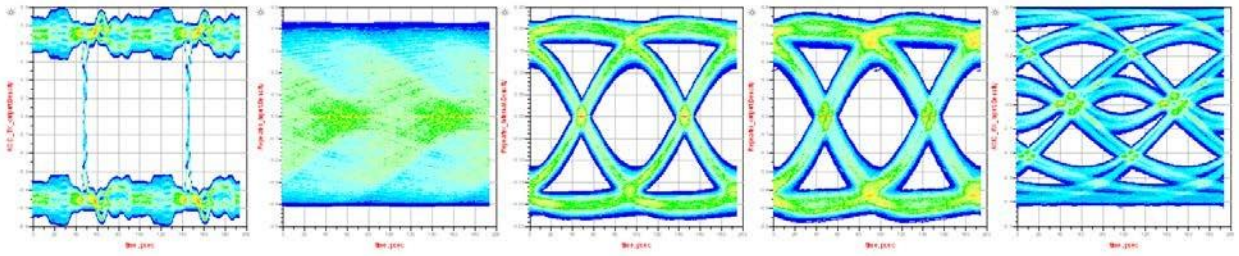

Figure 4: ASIC TX amplitude=~1000mVppd, Limit=0, EQ_Level=5, VOD=7, DE_Level=0

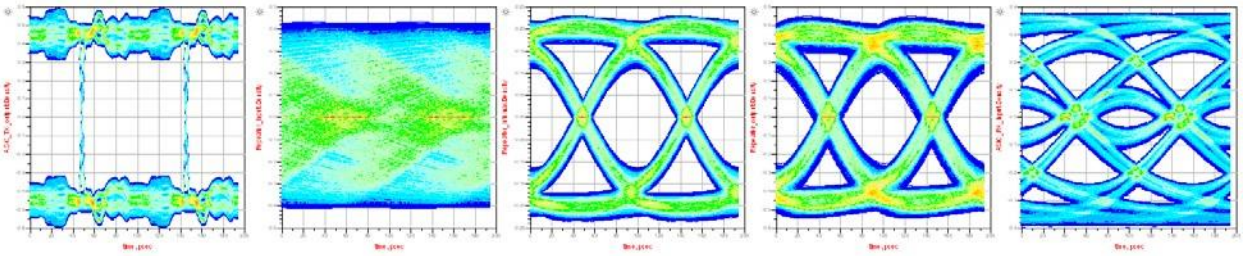

Figure 5: ASIC TX amplitude=~1000mVppd, Limit=0, EQ_Level=5, VOD=6, DE_Level=0

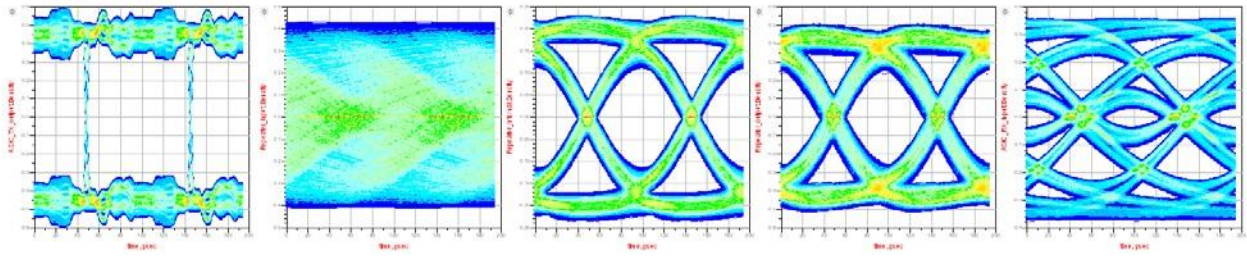

Figure 6: ASIC TX amplitude=~1000mVppd, Limit=0, EQ_Level=5, VOD=5, DE_Level=0

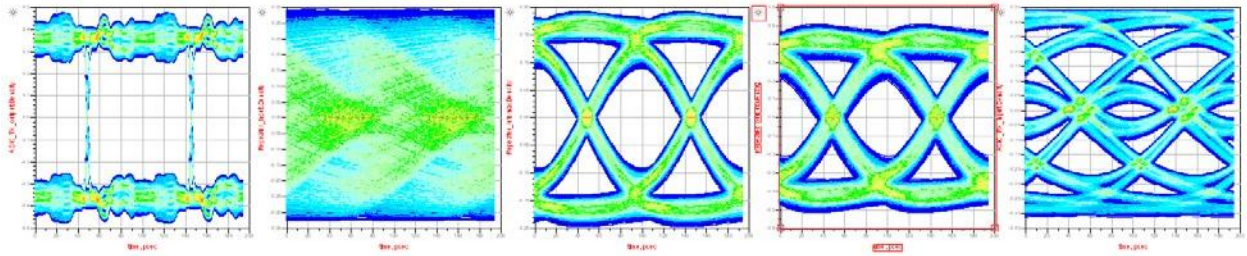

Figure 7: ASIC TX amplitude=~800mVppd, Limit=0, EQ_Level=5, VOD=7, DE_Level=0

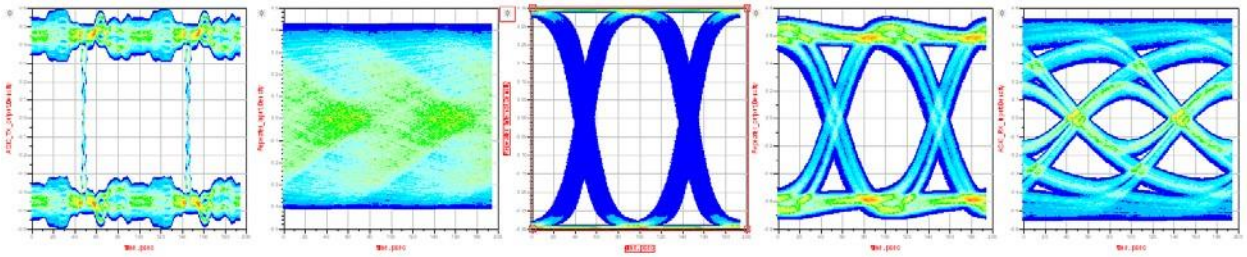

Figure 8: ASIC TX amplitude=~1000mVppd, Limit=1, EQ_Level=5, VOD=7, DE_Level=0

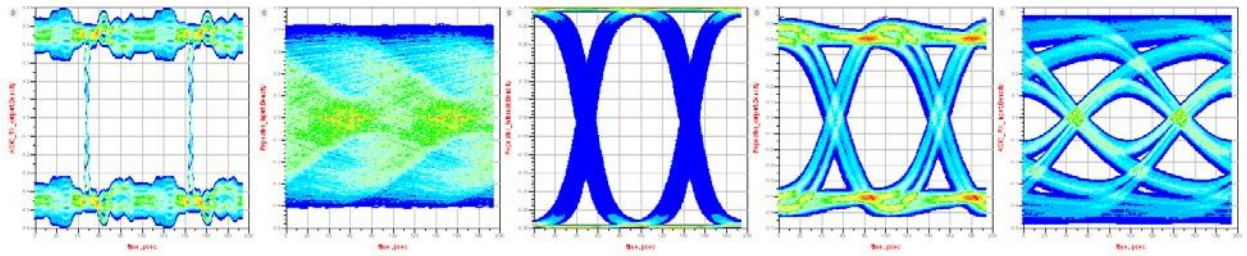

Figure 9: ASIC TX amplitude=~1000mVppd, Limit=1, EQ_Level=5, VOD=5, DE_Level=0

5 Suggestions and Tips

Simulations involving a configurable transmitter model and a configurable receiver model (especially if they originate from different IC vendors) often involve running multiple iterations in an attempt to identify the best settings. Here are some general tips for optimizing your simulations:

- ASIC TX to Repeater direction ○ The following model-specific parameters will affect the eye shape: ASIC TX output amplitude, ASIC TX de-emphasis setting, repeater EQ_Level, and repeater limit mode setting (Limit).
    - Generally speaking, an amplitude setting of 0.8V to 1.2V on the ASIC TX should be adequate for most channels.
    - The ASIC TX de-emphasis and repeater EQ_Level settings may need to be co-optimized. In general, fixing the ASIC TX de-emphasis to a small negative value (i.e. -2dB to -4dB) or a value of zero will be adequate for the repeater's robust equalizer.
    - Minimizing the jitter at the output of the repeater will improve the far-end eye.
    - For applications which involve link training (i.e. 10GBASE-KR, PCIe Gen3, SAS-3), the repeater must operate in a non-limiting mode so that the farend Tx FIR coefficients can pass through the Repeater during link training. Set Limit=0 for such applications. If link training is not used in the application, Limit=1 can be used to potentially yield a better eye opening.
- Repeater to ASIC RX direction ○ It is not unusual that an ASIC RX model will not support time domain processing (i.e. Init_Returns_Impulse=True and GetWave_Exists=False). It is always preferred that an ASIC model support time domain processing for accuracy reasons; but in such a case, when the ASIC RX model does not support time domain processing, the LTI_mode=1 setting in the repeater TX (default) will allow the ASIC RX model to optimize its equalization in the presence of the repeater's TX de-emphasis.
    - The following model-specific parameters will affect the eye shape: VOD_Level and DE_Level.
    - For applications that involve link training, where the Limit=0 setting is used in the receiver model, it is recommended to use VOD=7 to optimize linearity. The actual peak-to-peak output voltage will depend on the input voltage in this mode.