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ADS
2016.01

HDMI 2.0 Compliance Test Bench

KEYSIGHT TECHNOLOGIES

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Windows : libdevice.compute_20.bc, libdevice.compute_30.bc, libdevice.compute_35.bc
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Component : CUDA Occupancy Calculation Header Library
All : cuda_occupancy.h

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HDMI 2.0 Compliance Test Bench

NOTE

The HDMI CTB is a Beta version. You can use this CTB to run simulations in ADS. In this release, the Offline waveform support by the Infiniium Offline HDMI 2.0 Compliance App (Version N5399C /N5399D) is not present.

Contents

Installing HDMI 2.0 Compliance Test Bench

Installing HDMI 2.0 Compliance Test Bench

This section provides information about the prerequisites and steps for installing the HDMI 2.0 Compliance Test Bench (CTB).

Prerequisites

Before using the HDMI 2.0 CTB, ensure that ADS 2016.01 is installed.

NOTE The HDMI 2.0 Compliance Test App (Version N5399C/N5399D) does not support any offline waveforms. The present CTB focuses mainly on the ADS Designs to help the user run tests.

Install Instructions

To install HDMI 2.0:

1. Download the *HDMI2p0CTB.deb* package.
2. Select **DesignGuide > Add DesignGuide** from the ADS Main window.
   The Add DesignGuide dialog box is displayed.
3. Click **Add Global DesignGuide**.
4. Browse and select the *HDMI2p0CTB.deb* package.
5. Click **Open**.
   The HDMI 2.0 Compliance Test Bench will be added.
6. Restart ADS.
7. Open a Schematic view and select **DesignGuide**.
   The HDMI 2.0 Compliance Test Bench will be listed under the DesignGuide menu with the name 'HDMI 2.0 Compliance Test Bench'.

Difference between HDMI 1.4 and HDMI 2.0

Difference between HDMI 1.4 and HDMI 2.0

The HDMI (High Definition Multimedia Interface) is an audio/video interface for transferring video and digital audio data from an HDMI compliant source device, to a compatible sink device. It transfers this data using four parallel lanes (3 for Data (RGB) signals; 1 for Clock signal).

The HDMI 2.0 standard increases the bandwidth to 18Gbps from 10.2Gbps (in HDMI 1.4). Therefore, the maximum TMDS per channel throughput increases from 3.4 Gbit/s to 6 Gbit/s, which allows for a maximum total TMDS throughput of 18 Gbit/s. This allows HDMI 2.0 to carry 4K resolution at 60 frames per second (fps).

NOTE The HDMI 2.0 standard is backward compatible with all previous versions (HDMI 1.x).

The following table lists the differences between the two versions of HDMI standards.

	HDMI 1.4	**HDMI 2.0**
Data Rate	10.2 Gbps	18 Gbps
Reference Equalization Parameters		
(Gain Parameter) A	7.34e-8	9.7e-8
(Frequency Parameter) omega_0	2.25 GHz	2.5 GHz
Test Points	TP1	TP1
	TP2	*TP2_EQ(After cable equalization , before Rx)
		TP2
Mask Tests performed at	TP1	TP2_EQ
	TP2	
Eye Height	400 mV(at TP1)	335 mV

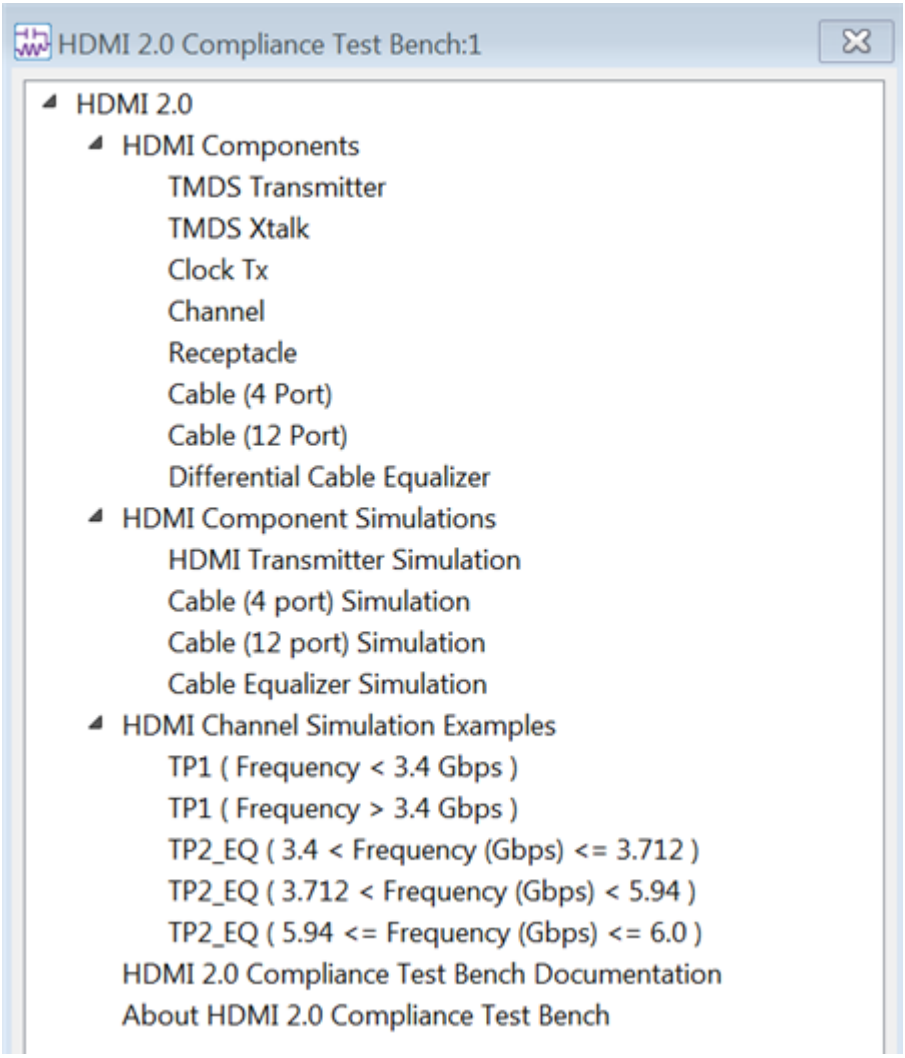
	HDMI 1.4	HDMI 2.0
		(min eye height at TP2_EQ for low frequencies)
	150mV(at TP2)	150 mV (min eye height at TP2_EQ for high frequencies)
Functionalities		
4K resolution at 60Hz	No	Yes
32 Channel Audio	No	Yes
2 Video Streams(Dual View)	No	Yes

HDMI 2.0 Compliance Test Bench Simulation Setups

HDMI 2.0 Compliance Test Bench Simulation Setups

The HDMI 2.0 CTB provides a virtual Test Bench, where you can run tests on the designs before actually implementing in the hardware. It includes component models that can be used to design a HDMI Link from a Transmitter to a Receiver. Additionally, examples of the Full link channel simulation are provided, where you can use the predefined models or create your own models and simulate the link.

The HDMI 2.0 Compliance Test Bench provides the following models and examples:



Models

Following are the list of components included in the HDMI CTB:

- **TMDS Transmitter**: Includes a bit file to implement TMDS encoding and necessary circuitry to implement the Current Mode Logic used in TMDS. (Also included in the CTB are Crosstalk components and Clock Transmitter.)

- **Cable models**: Two cable models have been included. One is a 4 port S-parameter model that emulates a worst case cable model, which can be used in each of the four lanes in a HDMI Channel. The other is a 12 port S-parameter model, in case the user wants to simulate only the Data Channels.
- **Receptacle Model**: Includes a 16 port S-parameter model to be used both at the Source and Sink side to connect the Tx/Rx to the cable.
- **Channel models**: Standard PCB stack ups
- **Differential Equalizer**: Implements mathematical equalization function specified as reference equalizer in the Specification.

Simulations

- Transmitter Simulation
- Cable Simulations
- Differential Equalizer Simulation
- Transmitter Test Simulations

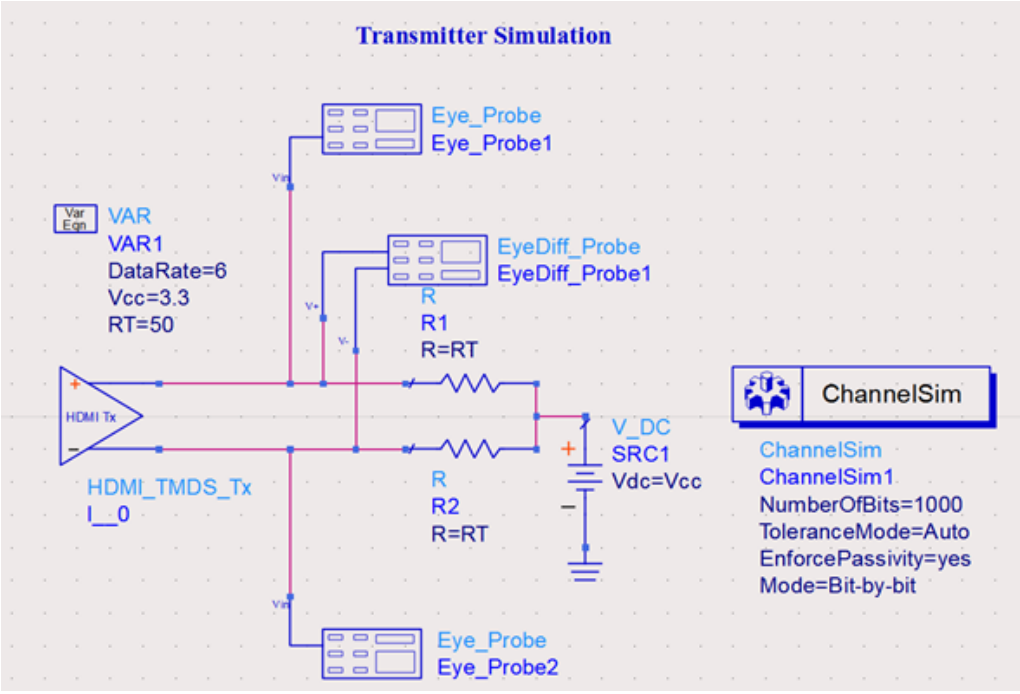
Transmitter Simulation

The HDMI Standard uses TMDS (Transition Minimized Differential Signaling) to transmit Data. TMDS uses CML to implement the signaling.

Accordingly, the Tx component has been made and the Bit pattern is generated from a Bit file(encoded).

The same has been simulated and the waveform being transmitted can be observed in this design.

Transmission Data Rate can be changed by simply altering the value of the variable DataRate.



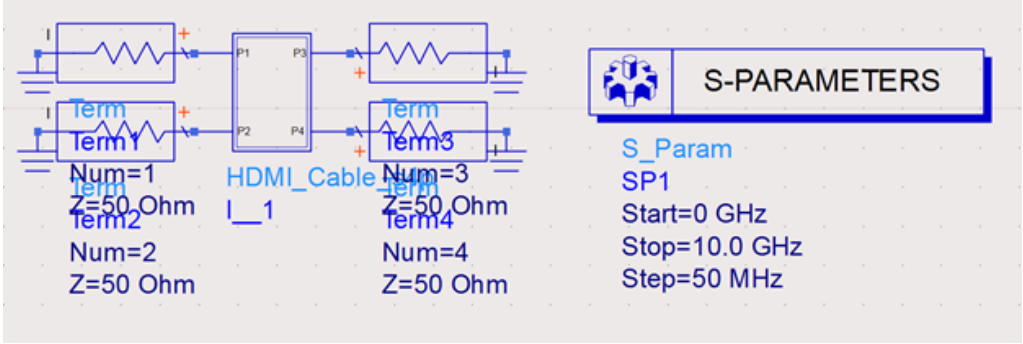
Cable Simulations

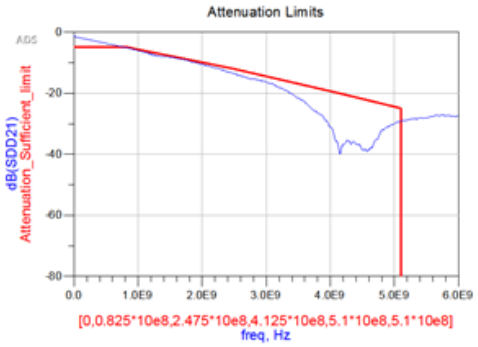
Simulation for 4 Port Cable Model:

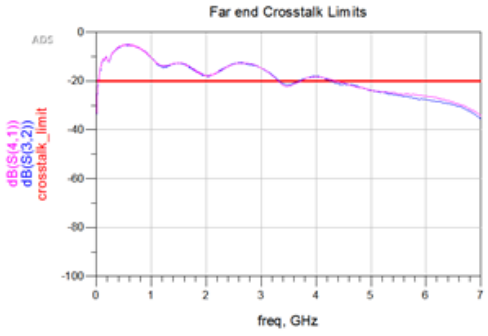
The cable used in the Design can be simulated and checked to see if they pass the cable Attenuation and Crosstalk Limits. The masks for the same have been provided.

In the present design, the cable model used has been taken keeping in mind worse case scenarios and hence they appear to partially pass the tests.

The reason for using them is that, if a design passes the tests(mask tests at TP2_EQ) using this cable model, then that design would pretty much work for any cable model used.



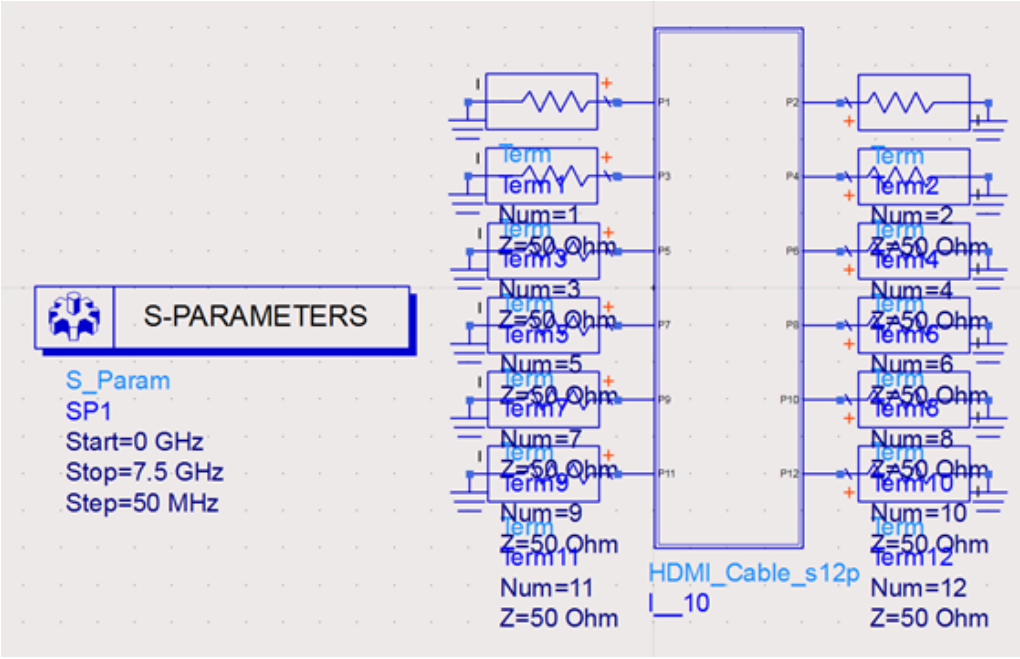


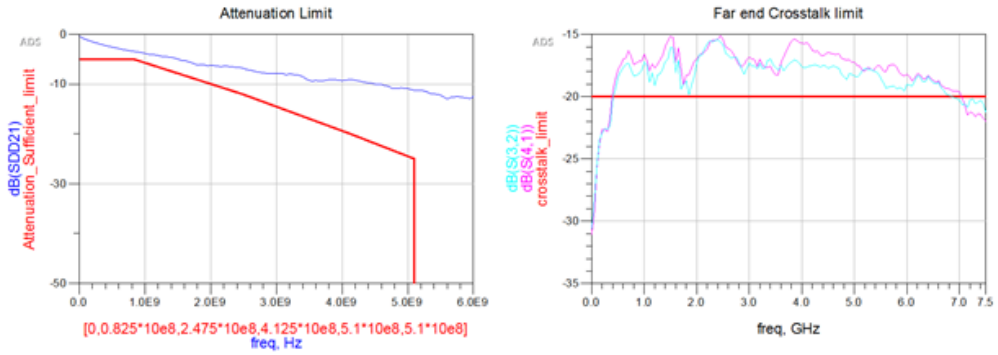


Simulation for 12 Port Cable Model:

This Model can be used when the user wants to simulate only the Data Channels; i.e. the color channels.

User can check if it passes the Attenuation and Far End Cross-talk limits and masks have been included in the DDS Window for the same.

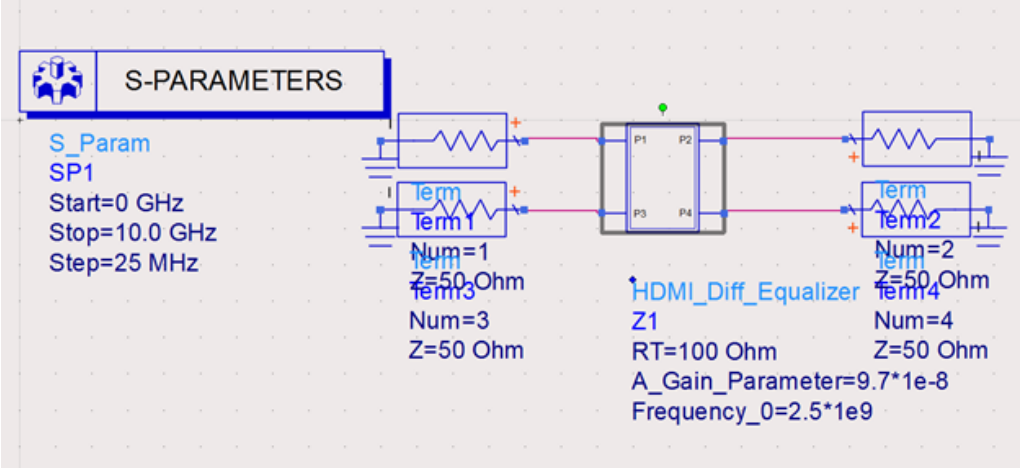


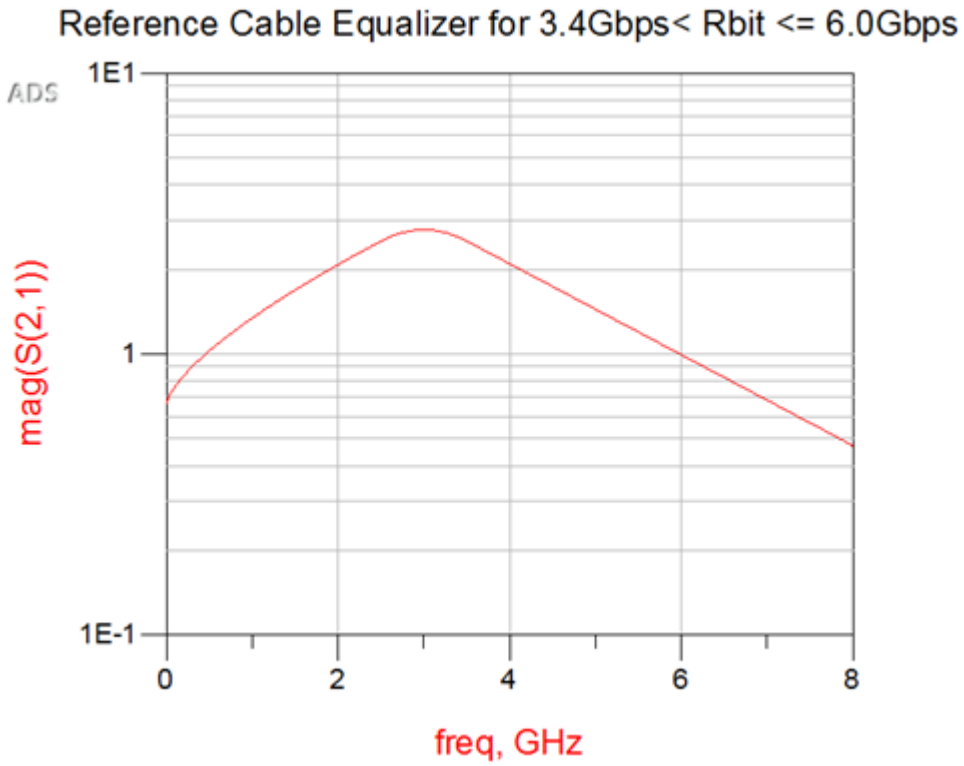


Equalizer Simulation

Reference Equalizer Simulation

In order to take care of the distortion introduced in the signal by the cable, an equalizer is needed at the Receiver side after the Receptacle. HDMI Specification provides a mathematical model of a Reference Cable Equalizer which has been implemented in the Compliance Test bench and is provided as a separate component.





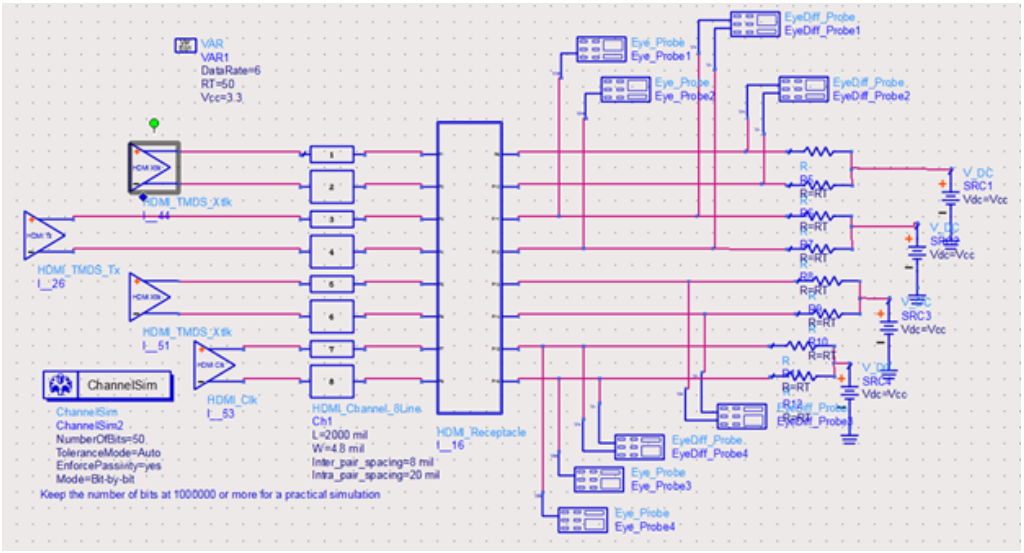
Transmitter Test Simulations

TP1 Simulation:

This design shows the Source side of the Link. TP1 is the Test Point just beyond the receptacle of the Source. For HDMI 2.0, no mask test has been specified; while in HDMI 1.4 a mask has been specified at TP1. Hence two designs have been made, keeping in mind the backward compatibility of the HDMI 2.0 with HDMI 1.4.

(Later when the Offline app is available, user can take the waveform from the Designs and test the same in the App for Compliance.)

In the following design, you can change the DataRate by changing the value of the variable DataRate. It displays the source side which includes Tx+Channel+Receptacle :



TP2_EQ Simulation:

The following Design shows a Full Link Simulation of HDMI from a HDMI Source to the HDMI Sink.

HDMI Source is made up of: Transmitter + Channel + Receptacle

HDMI Sink is made up of: Receptacle + Channel + Equalizer + Receiver

Connecting the two is the HDMI Cable.

The HDMI 2.0 specification mentions the test point TP2_EQ after the Equalization in the sink side. In the design below, Eye Probes are used to observe the Waveforms at Test Point TP2_EQ.

The mask tests at different frequencies are different. Hence, three different designs have been made keeping that in mind. User can simply change the **DataRate** and make the designs work at any frequency within these ranges .

In the clock channel, since the clock frequency is quite low, equalization is not required.