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ADS
2016.01

Ethernet 802.3-2014 Compliance Test Bench

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Component : CUDA FFT Library
Windows : cufft.dll
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Windows : cublas.dll
MacOS : libcublas.dylib
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Windows : cusparse.dll
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Component : NVIDIA Optimizing Compiler Library
Windows : nvvm.dll
MacOs : libnvvm.dylib
Linux : libnvvm.so

Component : NVIDIA Common Device Math Functions Library
Windows : libdevice.compute_20.bc, libdevice.compute_30.bc, libdevice.compute_35.bc
MacOs : libdevice.compute_20.bc, libdevice.compute_30.bc, libdevice.compute_35.bc
Linux : libdevice.compute_20.bc, libdevice.compute_30.bc, libdevice.compute_35.bc

Component : CUDA Occupancy Calculation Header Library
All : cuda_occupancy.h

Read more at: http://docs.nvidia.com/cuda/eula/index.html#ixzz30CrknWfU

Table of Contents

Ethernet 802.3-2014 Compliance Test Bench

Contents

Installing the Ethernet 802.3-2014 Compliance Test Bench

Installing the Ethernet 802.3-2014 Compliance Test Bench

This section provides information on prerequisites and steps to install the Ethernet 802.3-2014 Compliance Test Bench (CTB).

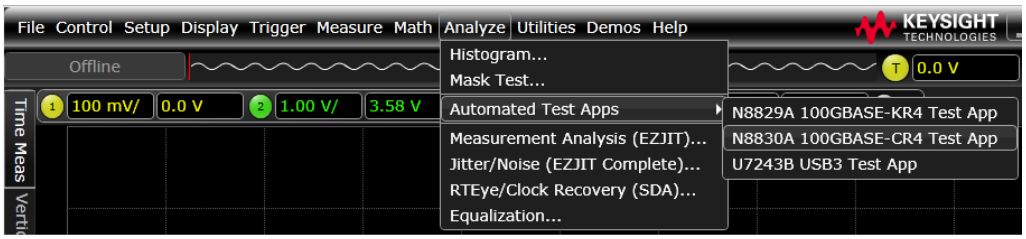
Prerequisites

Before using the Ethernet 802.3-2014 CTB, ensure that the following softwares are installed:

- Infiniium Offline (Version 05.50.0015)
- CR4 Compliance App (Version 2.01(2.1*))
- KR4 Compliance App (Version 2.01(2.1*))
- ADS 2016.01

* This is the version that is shown in the splash screen when the app is opened, and also when using the **Help->About...** menu from the app.

After installing the Ethernet 802.3-2014 CTB, launch the Infiniium Offline software to ensure the Ethernet 802.3-2014 Test App is available under **Analyze > Automated Test Apps**.



Install Instructions

To install the Ethernet 802.3-2014 CTB:

1. Download the *Ethernet802p3.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 *Ethernet802p3.deb* package.
5. Click **Open**.
   The Ethernet 802.3-2014 Compliance Test Bench will be added.

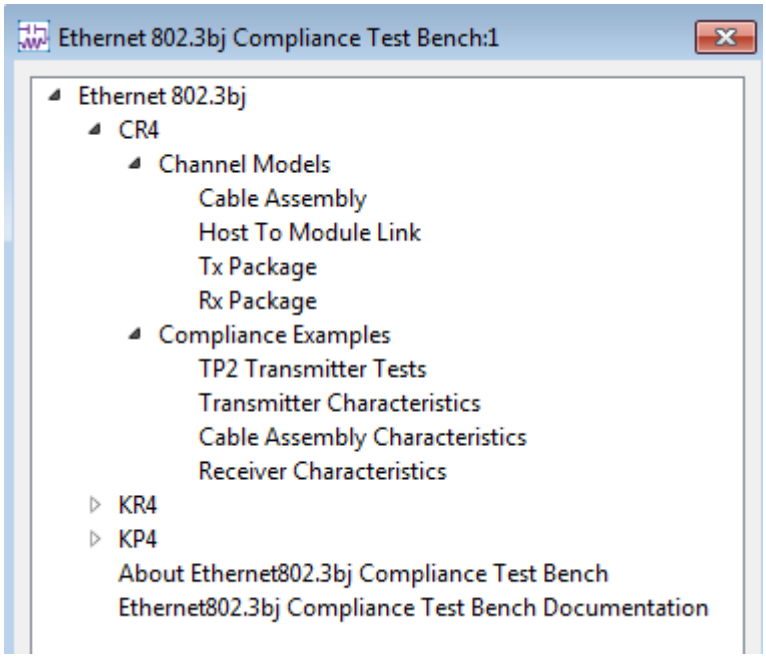
6. Restart ADS.
7. Open a Schematic view and select DesignGuide.
   The Ethernet 802.3-2014 Compliance Test Bench will be listed under the DesignGuide menu with the name 'Ethernet 802.3-2014 Compliance Test Bench'.

Ethernet 802.3-2014 100GBASE-CR4 Compliance Test Bench Simulation Setups

Ethernet 802.3 -2014 100GBASE-CR4 Compliance Test Bench Simulation Setups

100GBASE-CR4 d efines a 4-lane 100 Gbit/s PHY for operation over links consistent with copper twinaxial cables with lengths up to at least 5m. Signalling used is NRZ.

The Ethernet 802.3-2014 Compliance Test Bench provides a variety of tests, which helps to understand the various aspects of the Ethernet 802.3-2014 digital standard (CR4, KR4 and KP4). It provides you the ability to create designs using the included models or your own models. You can refer to the included examples for developing your designs. This Compliance Test Bench provides the following Models and Examples for CR4:



NOTE - The Models used in this design for the host-to-module link, have been downloaded from the IEEE website Public area - http://www.ieee802.org/3/100GCU/public/channel.html

NOTE - Package Models are for educational demonstration only and are not intended for design purposes. Please download the latest up to date models for your application directly from the vendor's website. Models in this example were downloaded from Xilinx Inc. : www.xilinx.com

Models

The following CR4 channel models are available :

- Cable Assembly
- Host To Module Link
- Tx Package
- Rx Package

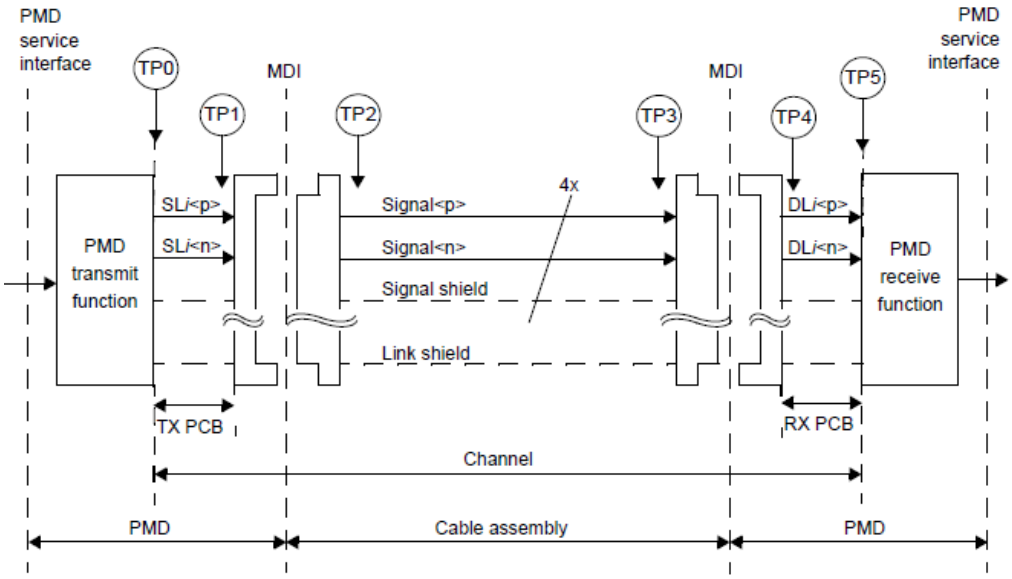
Examples

The following examples are included in the Ethernet 802.3-2014 Compliance Test Bench for CR4:

- TP2 Transmitter Tests
- Transmitter Characteristics
- Cable Assembly Characteristics
- Receiver Characteristics

TP2 Transmitter Tests

The following design displays an Ethernet 802.3-2014 CR4 connection from the Transmitter to the Cable Connector(TP2) where the Transmitter Compliance Testing has to be done:

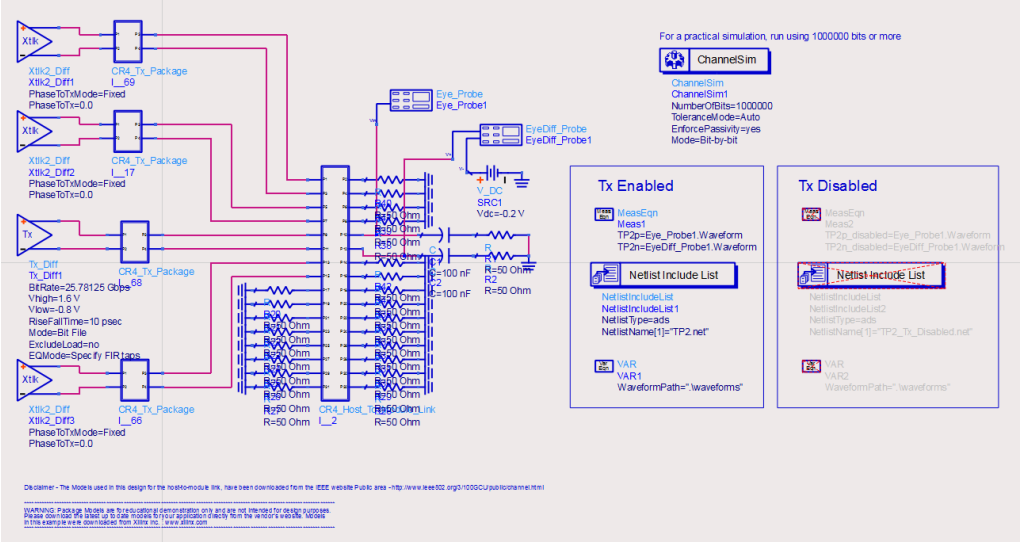


In this design, a 100GBASE-CR4 link in one direction is displayed. The 100GBASE-CR4 channel is defined between the transmitter (TP0) and receiver (TP5) blocks to include the transmitter and receiver differential controlled impedance printed circuit board insertion loss and the cable assembly insertion loss. For 100GBASE-CR4, there are 4 differential paths in each direction for a total of 8 pairs, or 16 connections. The circuit below shows 1 transmitting pair. The other 3 pairs introduce crosstalk on to that transmitting pair.

The Transmitter transmits true PRBS9 data using a file 'prbs9_950.txt', at a rate of 25.78125 Gbps.
The signal from a Differential Transmitter flows through the package and host-to-module link. Eye Probes placed in the circuit capture the waveforms for compliance testing.

NOTE

To run the Compliance Test, which requires the Tranmitter to be disabled, disconnect the Tx_Diff component, short V_DC, deactivate the 'Tx Enabled' block and activate the 'Tx Disabled' block.

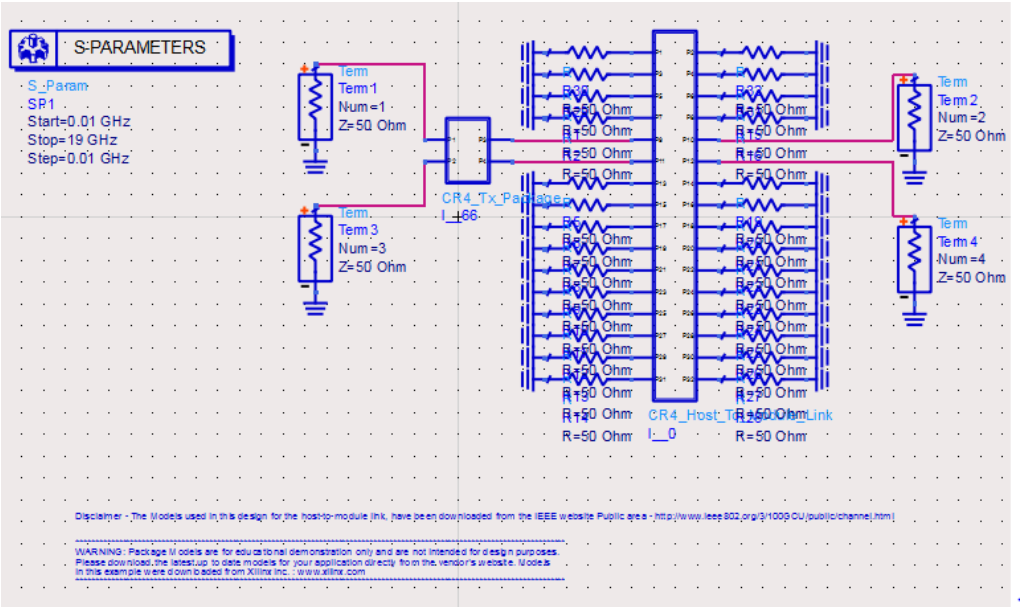


The two lines of the differential pair should carry signals between the same voltage levels but having opposite state. The ADS Tx component creates a differential pair where the two lines carry signals from 0 to X volts and 0 to -X volts, instead of the required 0 to X volts for both lines. To overcome this, a dc voltage of -0.2V is applied to the differential eye probe to move the 'n' signal in the same voltage level as the 'p' signal.

The waveforms generated at TP2 are saved in the data/waveforms directory with the names *TP2p.h5 and TP2n.h5*.

Transmitter Characteristics

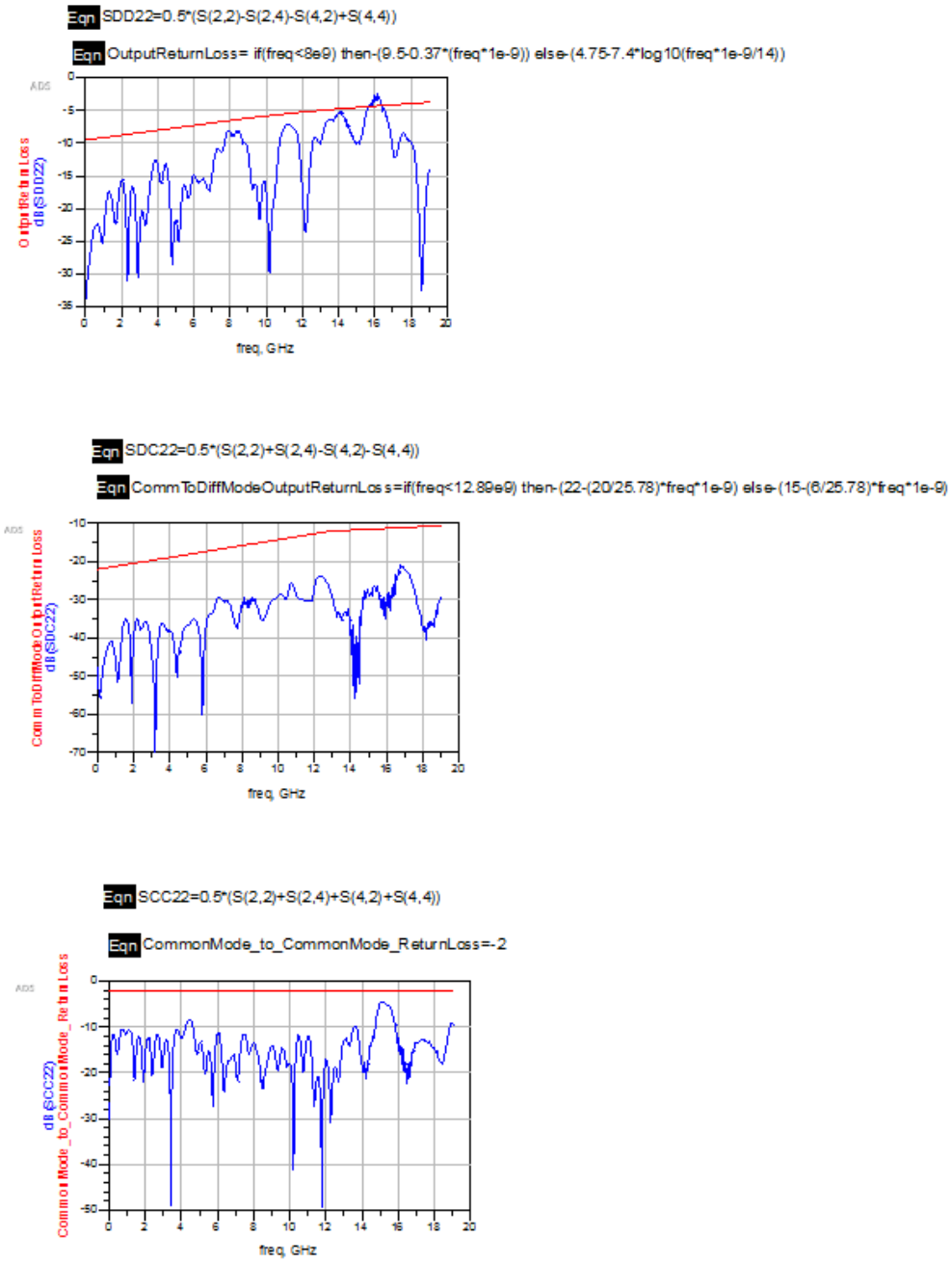
The following design shows the S-Parameter simulation required for the CR4 Transmitter Compliance. The results have been compared with the corresponding Masks.



The following parameters are plotted in the results, along with their masks:

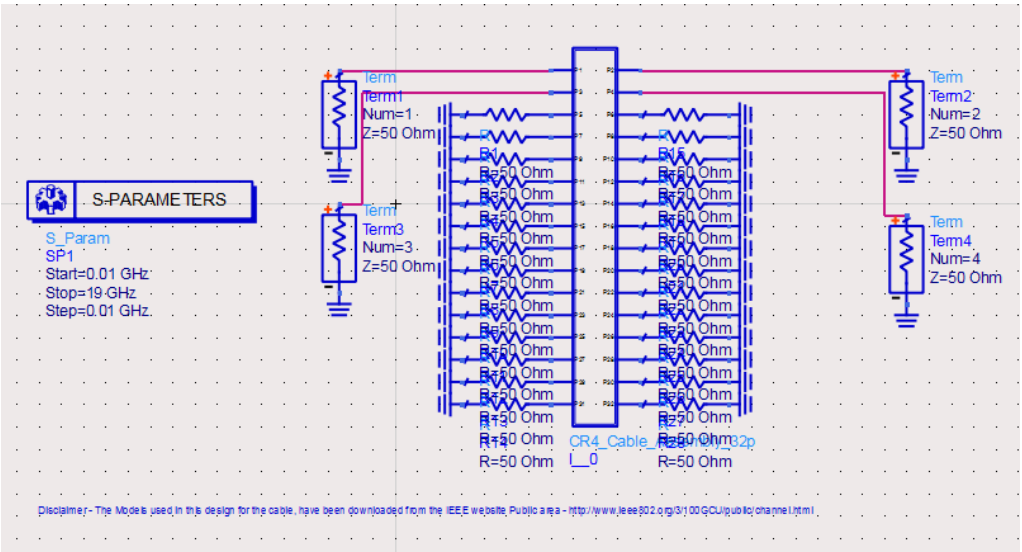
- Differential Output Return Loss
- Common-mode to differential mode output return loss

- Common-mode to common-mode output return loss



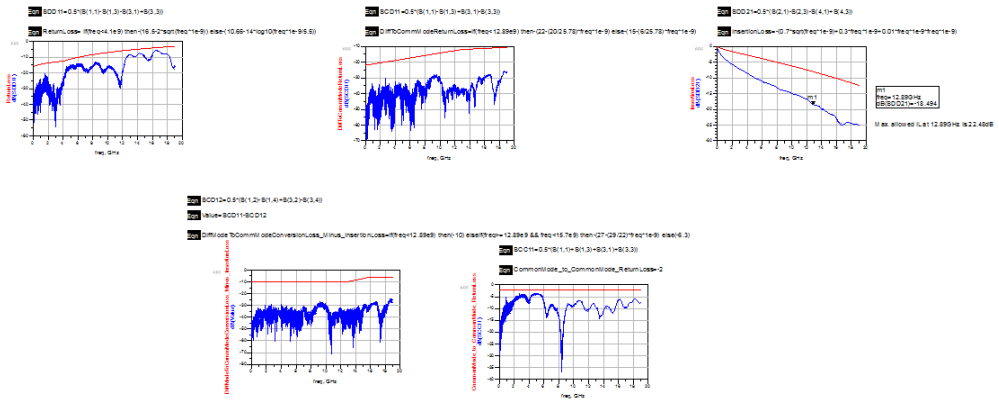
Cable Assembly Characteristics

The following design shows the S-Parameter simulation of a CR4 Cable Assembly. The results have been compared with the corresponding Cable Assembly Masks:



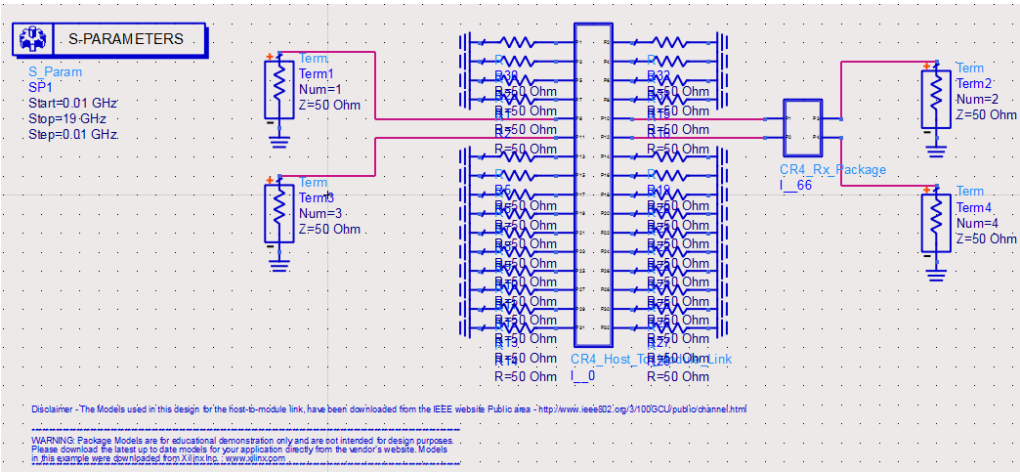
The following parameters are plotted in the results, along with their masks:

- Maximum insertion loss at 12.8906 GHz
- Minimum insertion loss at 12.8906 GHz
- Minimum return loss at 12.8906 GHz
- Differential to common-mode return loss
- Differential to common-mode conversion loss
- Common-mode to common-mode return loss



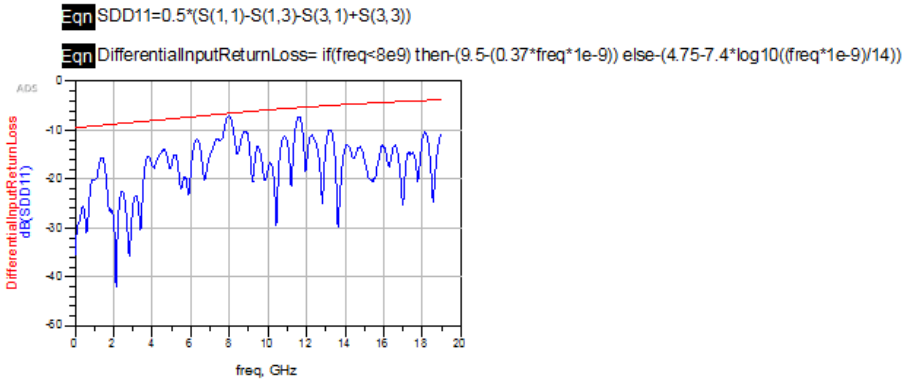
Receiver Characteristics

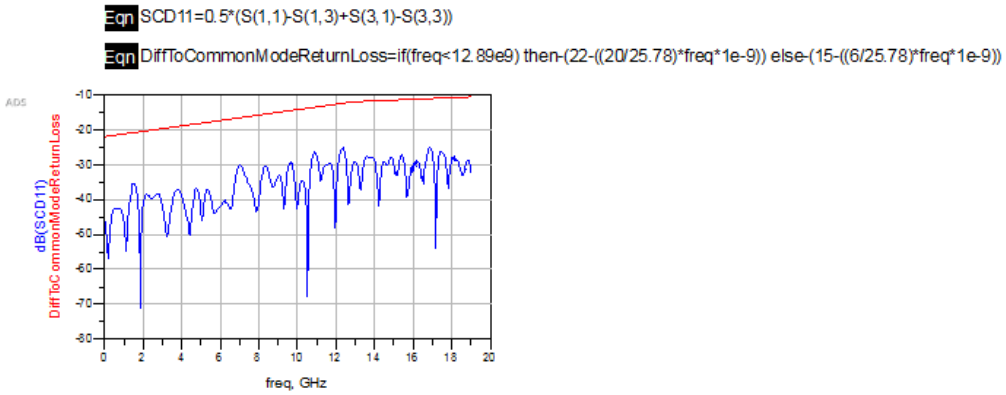
The following design shows the S-Parameter simulation required for the CR4 Receiver Compliance. The results have been compared with the corresponding Masks.



The following parameters are plotted in the results, along with their masks:

- Differential input return loss
- Differential to common-mode input return loss





References

- IEEE Std 802.3bj™-2014 - IEEE Standard for Ethernet, Amendment 2: Physical Layer Specifications and Management Parameters for 100 Gb/s Operation Over Backplanes and Copper Cables

Running 100GBASE-CR4 Compliance Tests on Infiniium Offline

Running 100GBASE-CR4 Compliance Tests on Infiniium Offline

Using the Keysight Infiniium Offline software you can run the compliance test on these waveforms. In the Ethernet 802.3-2014 100GBASE-CR4 Compliance Test Bench Simulation Setups section, the Channel Simulation example generated signal waveforms in .h5 format.

NOTE For the test that requires the transmitter to be disabled, use the waveforms generated after making the necessary changes as described in the design.

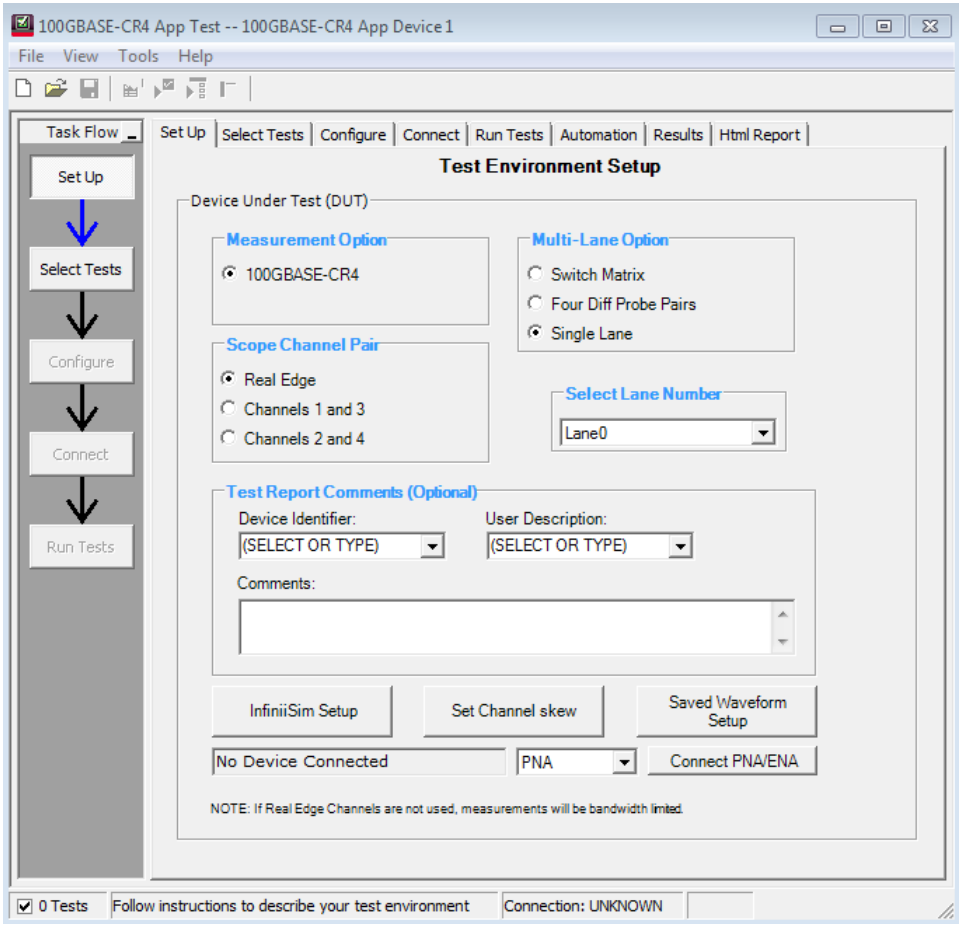
The waveforms *TP2p.h5 and TP2n.h5* are used in this tutorial.

NOTE Ensure that the waveforms are generated with number of bits simulated in the Channel Simulation Controller equal to or more than 1000000.

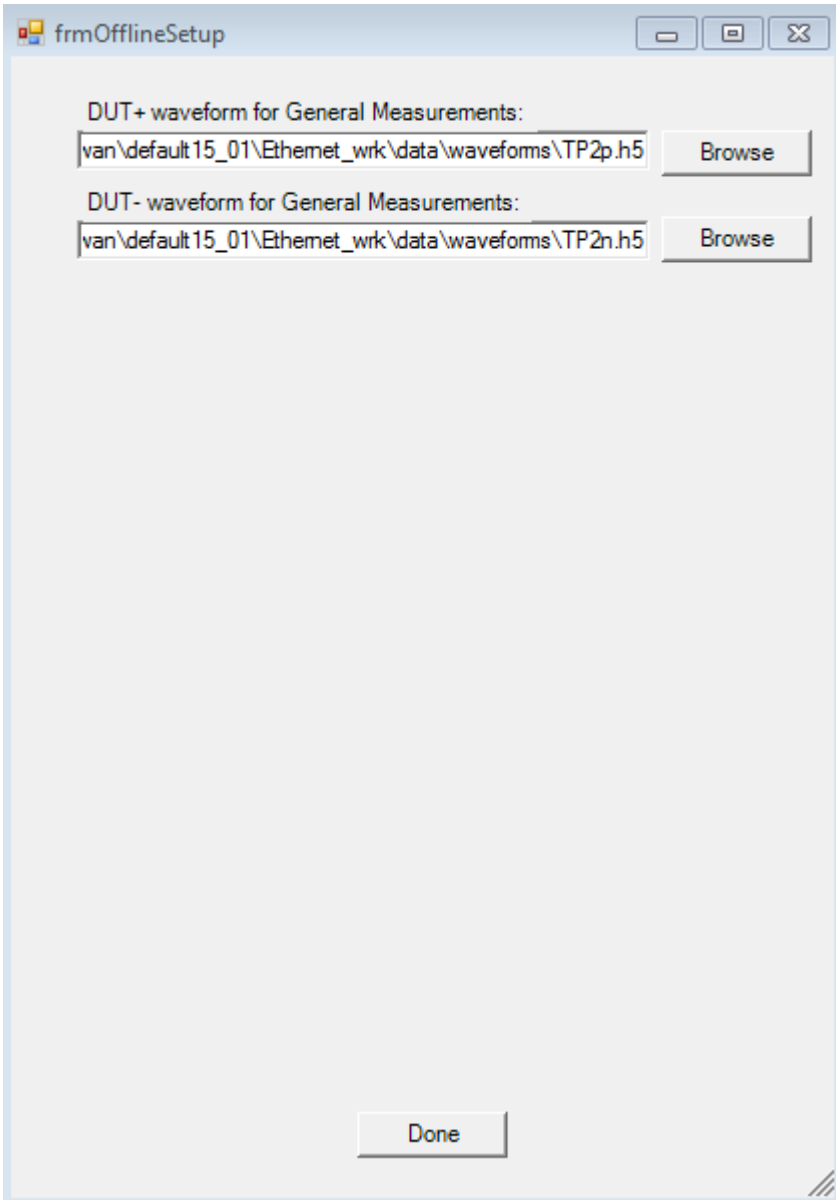
To run the Compliance tests:

1. Click **Analyze > Automated Test Apps > N8830A 100GBASE-CR4 Test App** from the Infiniium Offline software to open the CR4 application.

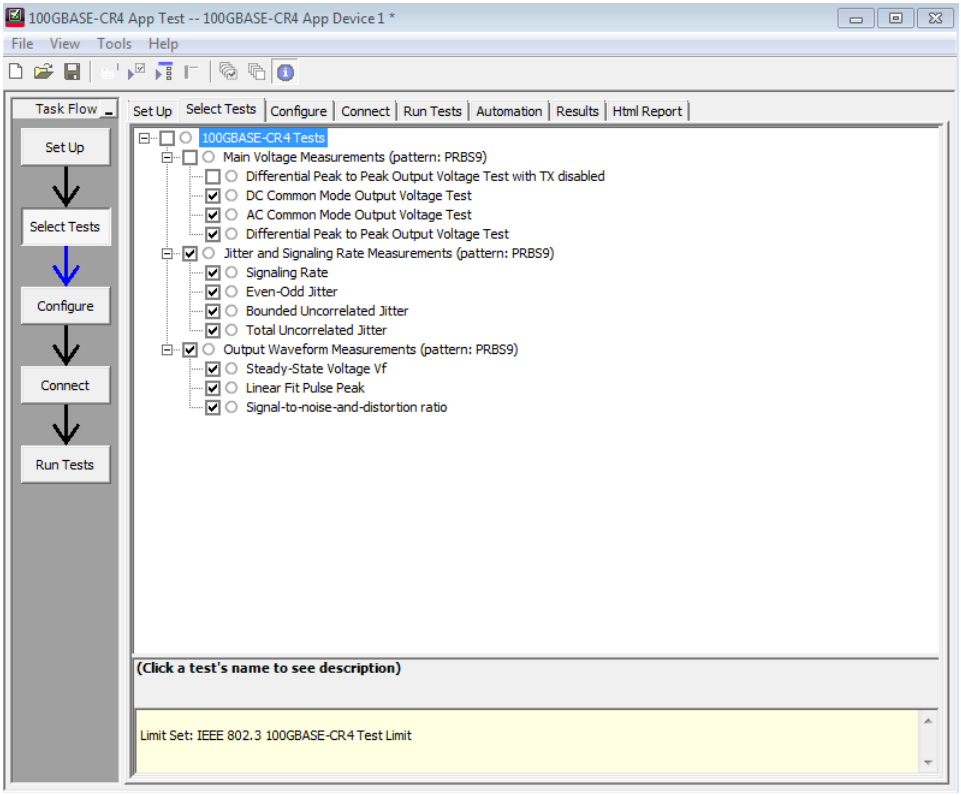
2. In the **Setup** tab, click **Saved Waveform Setup**.



3. Click **Browse** and select the *TP2p.h5* and *TP2n.h5* waveform files for the DUT+ and DUT- fields respectively. Click **Done**.



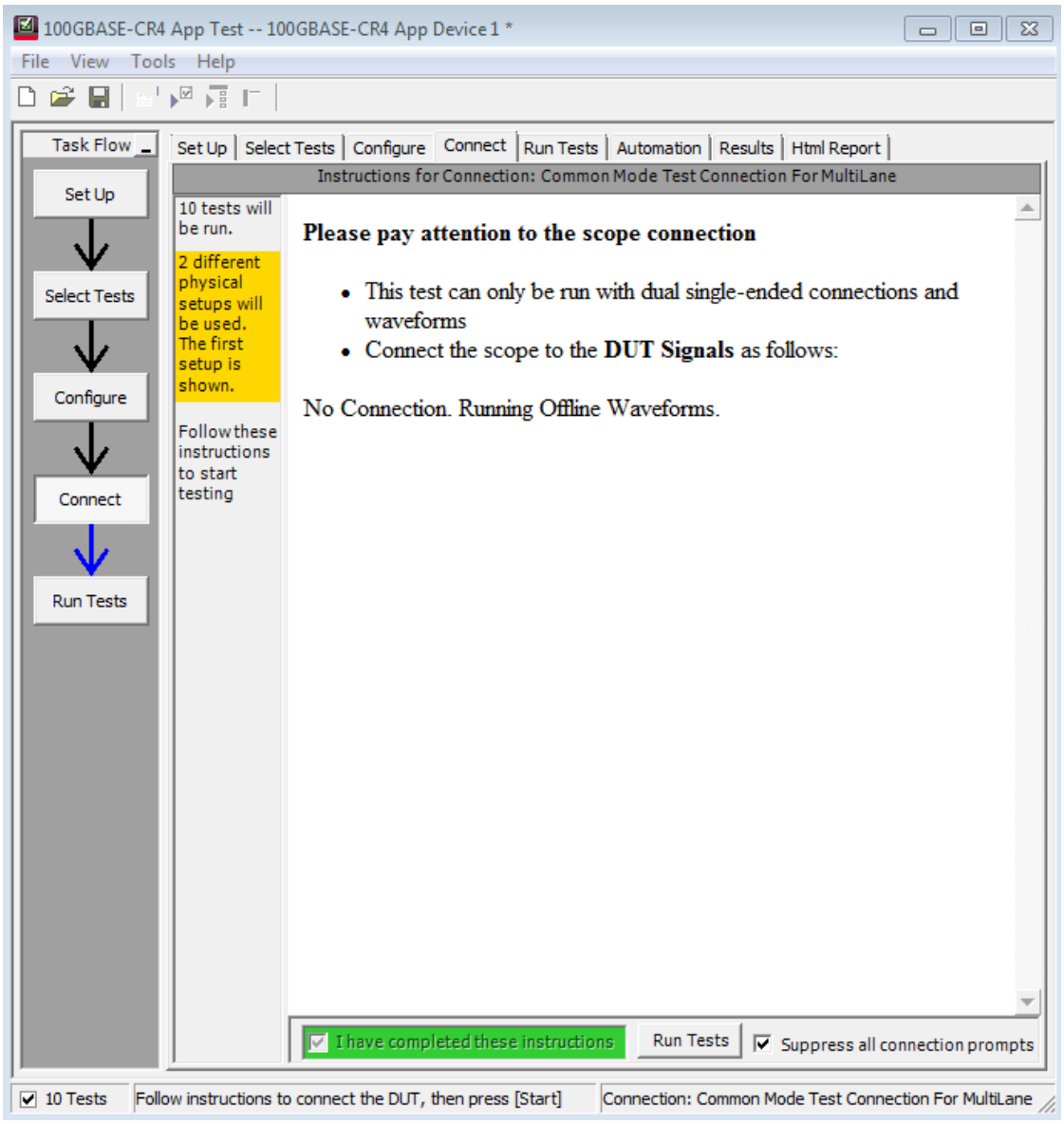
4. Click the **Select Tests** tab and select the tests, as shown in the following figure:



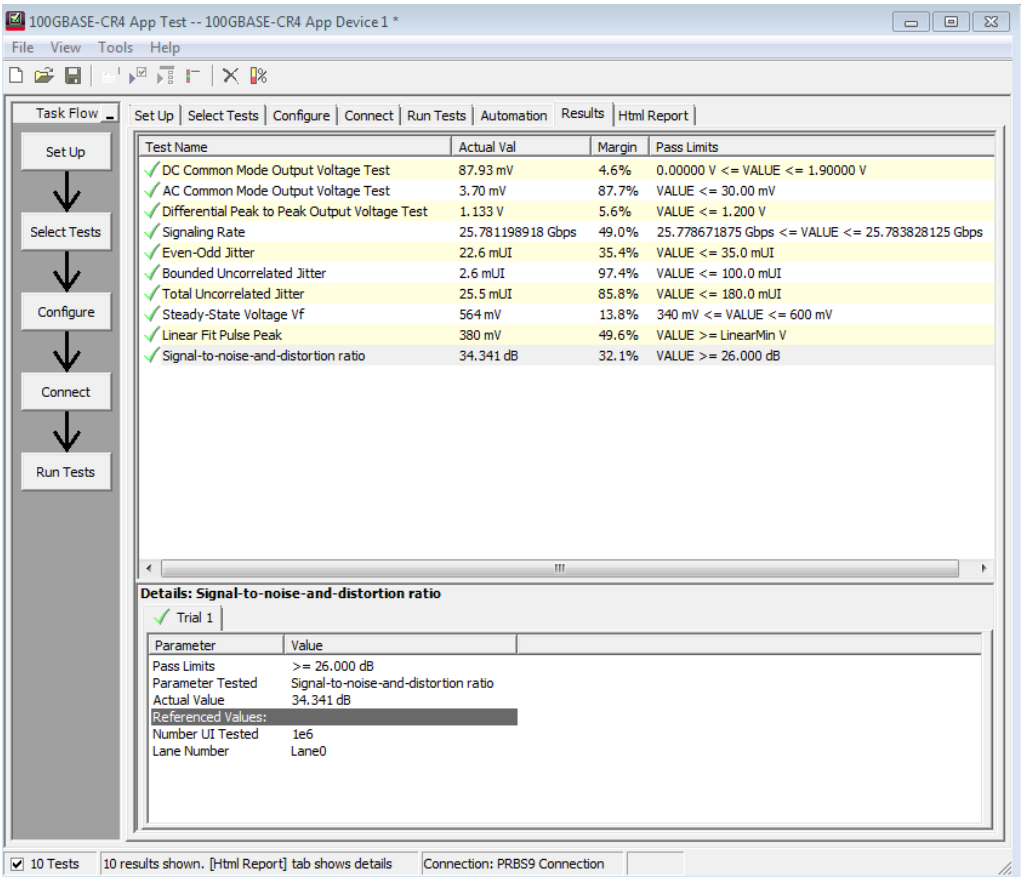
5. Click the **Connect** tab and select the following:

    a. Check **I have completed the instructions.**

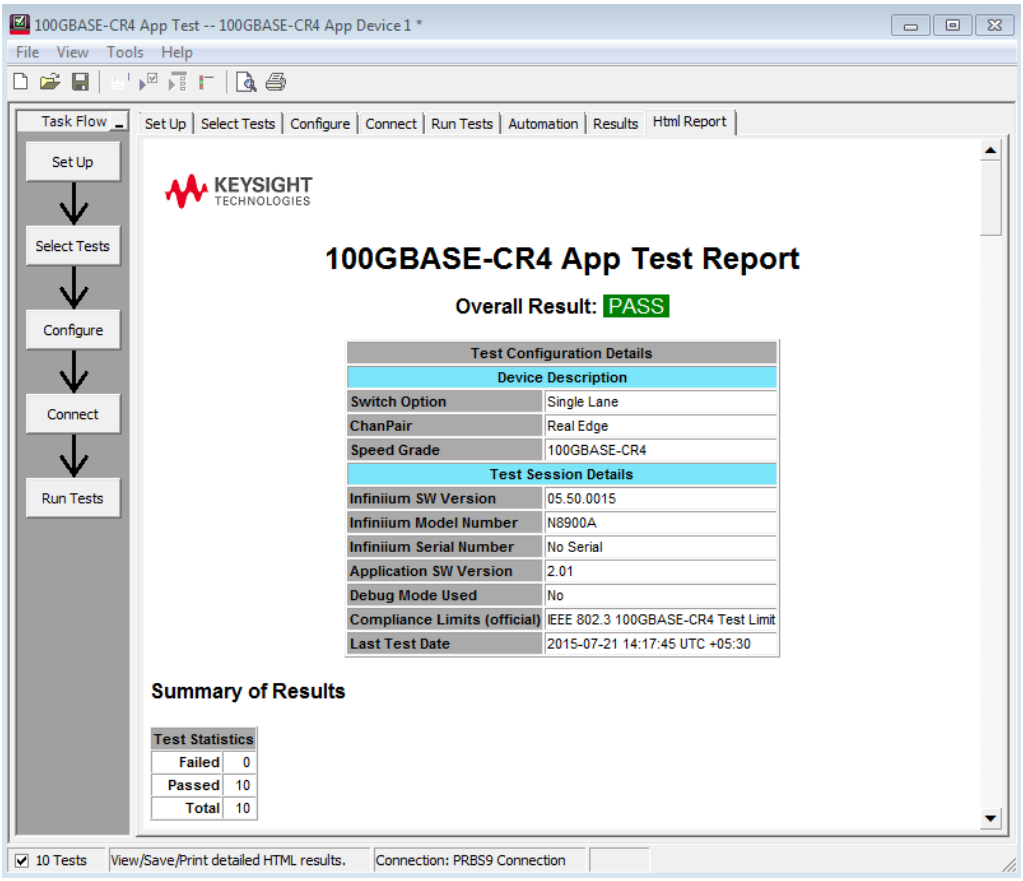
    b. Click **Run Tests**.



6. Once the tests are completed, you can view the test results under the **Results** tab.



You can also view the HTML report under the **HTML Report** tab.



NOTE

If you open the **Select Tests** tab before loading your waveforms, you will see tests which are not listed in the screenshot in Step 4 above. These tests are in the application but not supported currently. They will be supported in a future release of this Compliance Test Bench and 100GBASE-CR4 application.

References

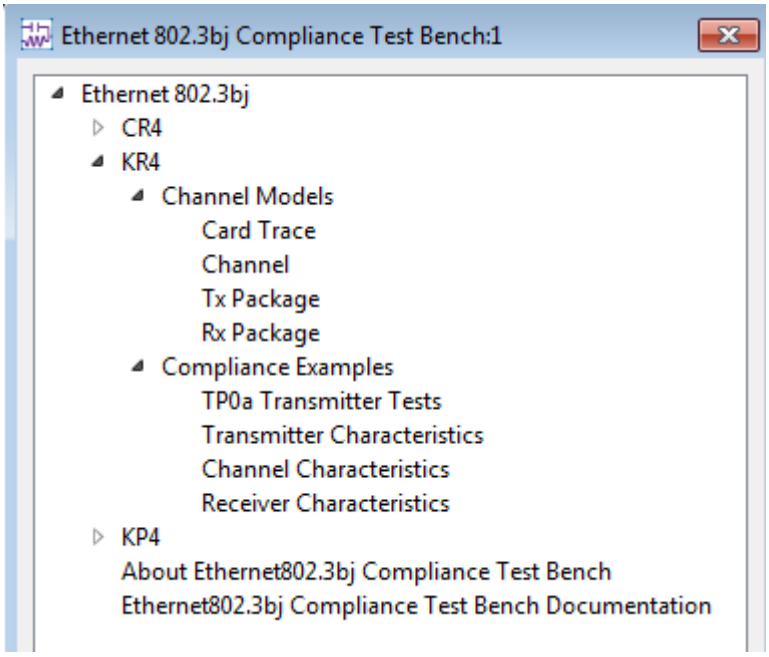
- IEEE Std 802.3bj™-2014 - IEEE Standard for Ethernet, Amendment 2: Physical Layer Specifications and Management Parameters for 100 Gb/s Operation Over Backplanes and Copper Cables

Ethernet 802.3-2014 100GBASE-KR4 Compliance Test Bench Simulation Setups

Ethernet 802.3 -2014 100GBASE-KR4 Compliance Test Bench Simulation Setups

100GBASE-KR4 d efines a 4-lane 100 Gbit/s backplane PHY for operation over links consistent with copper traces on “improved FR-4” with lengths up to at least 1m . Signalling used is NRZ.

The Ethernet 802.3-2014 Compliance Test Bench provides a variety of tests, which helps to understand the various aspects of the Ethernet 802.3-2014 digital standard (CR4, KR4 and KP4). It provides you the ability to create designs using the included models or your own models. You can refer to the included examples when developing the designs. This Compliance Test Bench provides the following Models and Examples for KR4:



NOTE - The Models used in this design for the host-to-module link, have been downloaded from the IEEE website Public area - http://www.ieee802.org/3/100GCU/public/channel.html

NOTE - Package Models are for educational demonstration only and are not intended for design purposes. Please download the latest up to date models for your application directly from the vendor’s website. Models in this example were downloaded from Xilinx Inc. : www.xilinx.com

Models

The following KR4 channel models are supported:

- Card Trace

- Channel
- Tx Package
- Rx Package

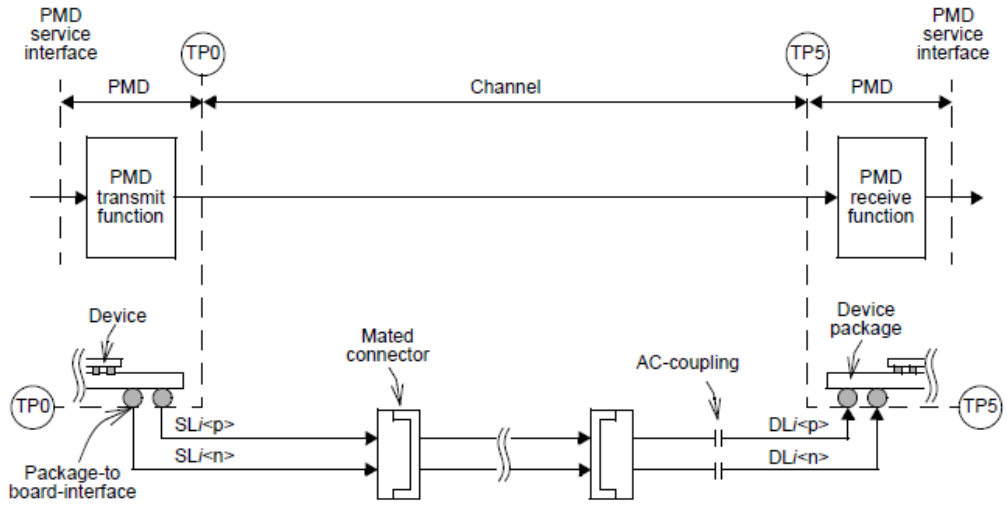
Examples

The following examples are included in the Ethernet 802.3-2014 Compliance Test Bench for KR4:

- TP0a Transmitter Tests
- Transmitter Characteristics
- Channel Characteristics
- Receiver Characteristics

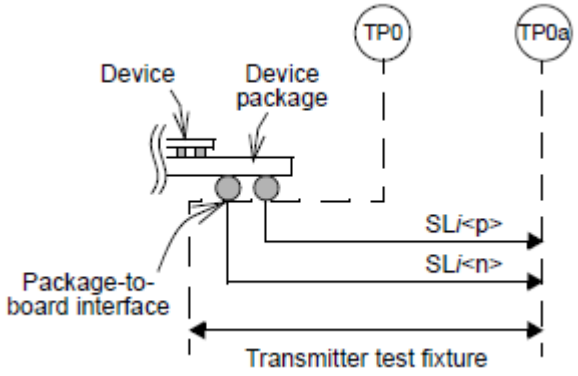
TP0a Transmitter Tests

The following design displays an Ethernet 802.3-2014 KR4 connection from the Transmitter to the Card Traces(TP0a) where the Transmitter Compliance testing is done.



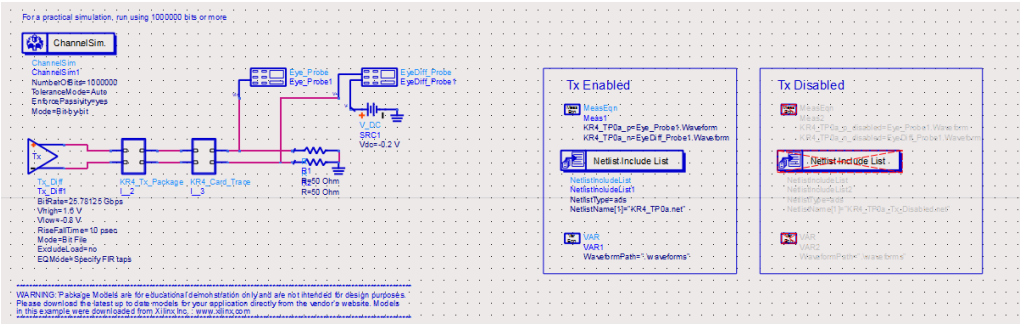
One direction for one lane of a 100GBASE-KR4 link is shown in Figure above. The 100GBASE-KR4 channel is defined between the transmitter (TP0) and receiver (TP5) blocks.

For 100GBASE-KR4, there are 4 differential lanes in each direction for a total of 8 pairs, or 16 connections. The circuit below shows 1 transmitting lane. The other 3 lanes are not shown as the crosstalk effects are negligible.
The Transmitter transmits true PRBS9 data using a file 'prbs9_950.txt', at a rate of 25.78125 Gbps.
The signal from a Differential Transmitter flows through the package and card traces. Eye Probes placed in the circuit at TP0a capture the waveforms for compliance testing.



NOTE

To run the Compliance Test which requires the Tranmitter to be disabled, disconnect the Tx_Diff component, short V_DC, deactivate the 'Tx Enabled' block and activate the 'Tx Disabled' block.

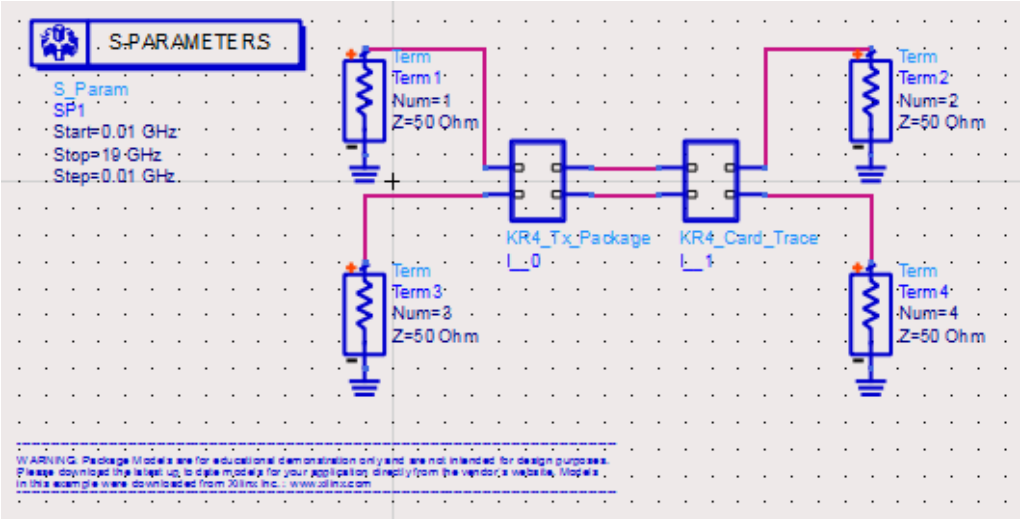


The two lines of the differential pair should carry signals between the same voltage levels but having opposite state. The ADS Tx component creates a differential pair where the two lines carry signals from 0 to X volts and 0 to -X volts, instead of the required 0 to X volts for both lines.
To overcome this, a dc voltage of -0.2V is applied to the differential eye probe to move the 'n' signal in the same voltage level as the 'p' signal.

The waveforms generated at TP0a are saved in the data/waveforms directory with the names *KR4_TP0a_p.h5* and *KR4_TP0a_n.h5*.

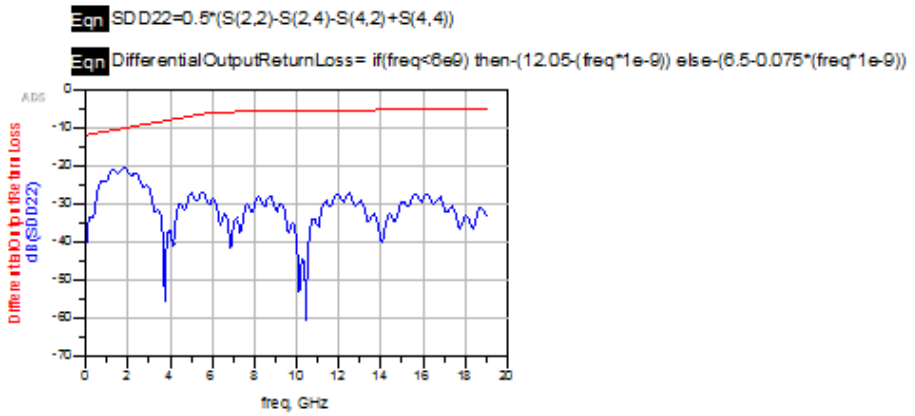
Transmitter Characteristics

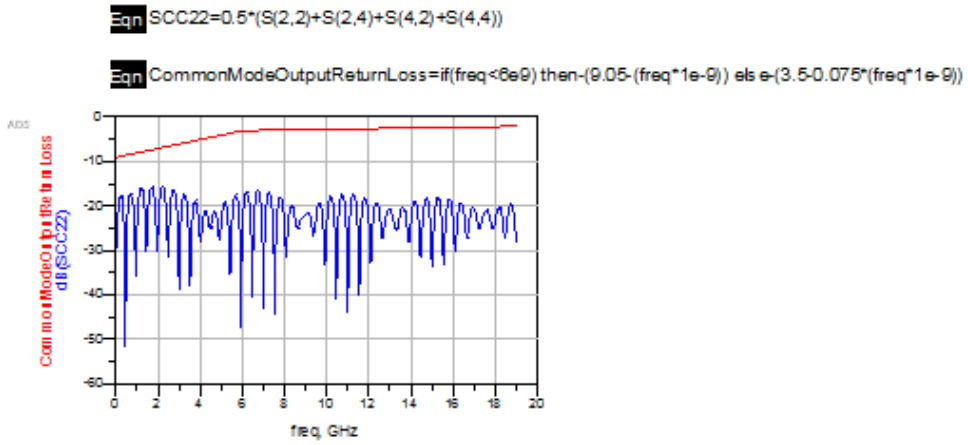
The following design shows the S-Parameter simulation required for the KR4 Transmitter Compliance. The results have been compared with the corresponding Masks.



The following parameters are plotted in the results, along with their masks:

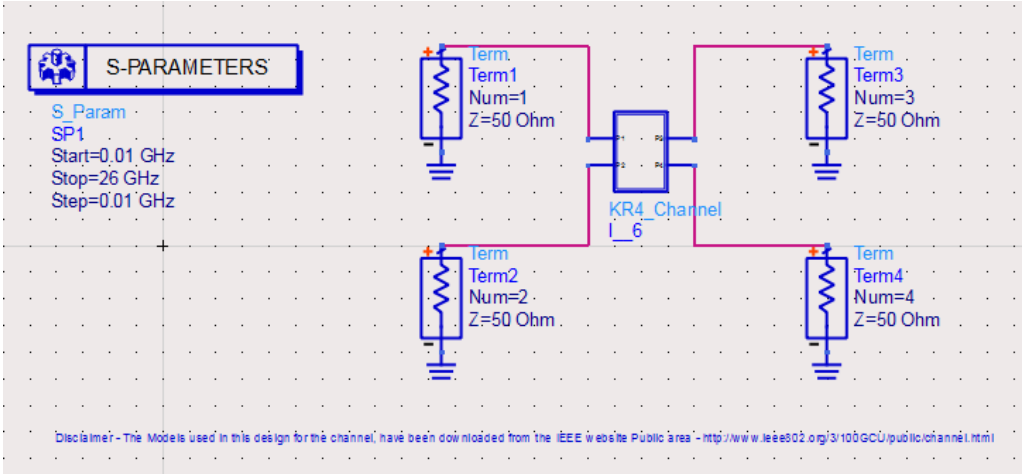
- Differential Output Return Loss
- Common-mode output return loss





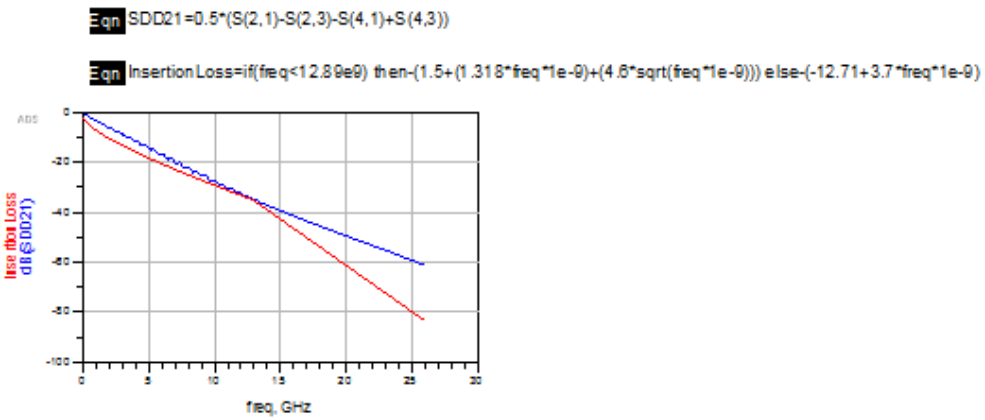
Channel Characteristics

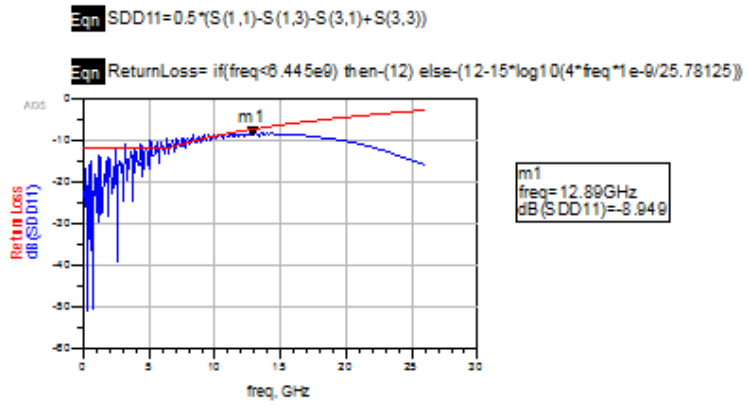
The following design shows the S-Parameter simulation of a KR4 Channel. The results have been compared with the corresponding Channel Masks.



The following parameters that are plotted in the results, along with their masks:

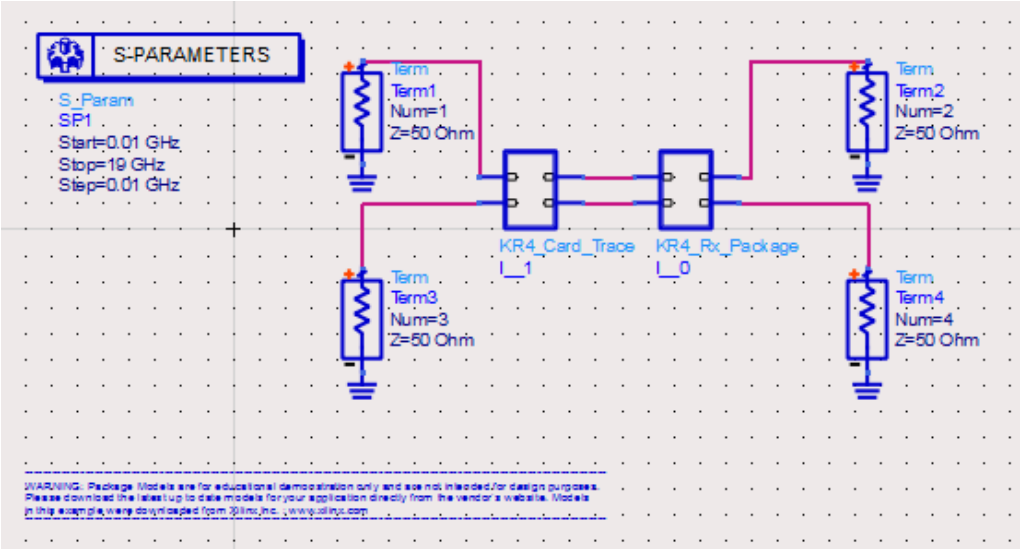
- Insertion Loss
- Return Loss





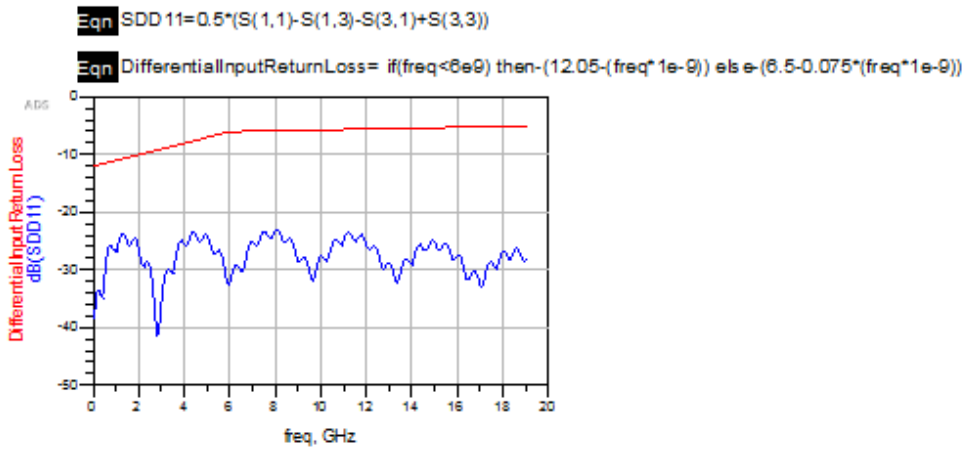
Receiver Characteristics

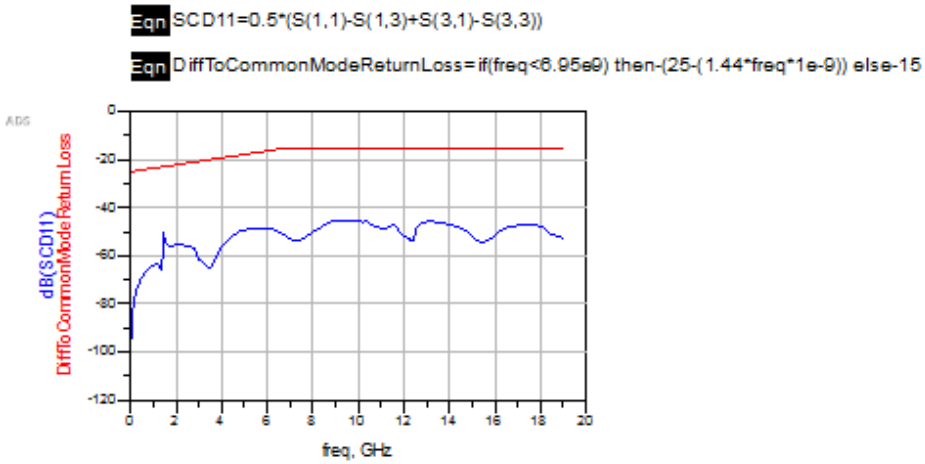
The following design shows the S-Parameter simulation required for the KR4 Receiver Compliance. The results have been compared with the corresponding Masks.



The following parameters that are plotted in the results, along with their masks:

- Differential input return loss
- Differential to common-mode input return loss





References

- IEEE Std 802.3bj™-2014 - IEEE Standard for Ethernet, Amendment 2: Physical Layer Specifications and Management Parameters for 100 Gb/s Operation Over Backplanes and Copper Cables

Running 100GBASE-KR4 Compliance Tests on Infiniium Offline

Running 100GBASE-KR4 Compliance Tests on Infiniium Offline

In the Ethernet 802.3-2014 100GBASE-KR4 Compliance Test Bench Simulation Setups section, the Channel Simulation example generates signal waveforms in .h5 format. Using the Keysight Infiniium Offline software you can run the compliance test on these waveforms.

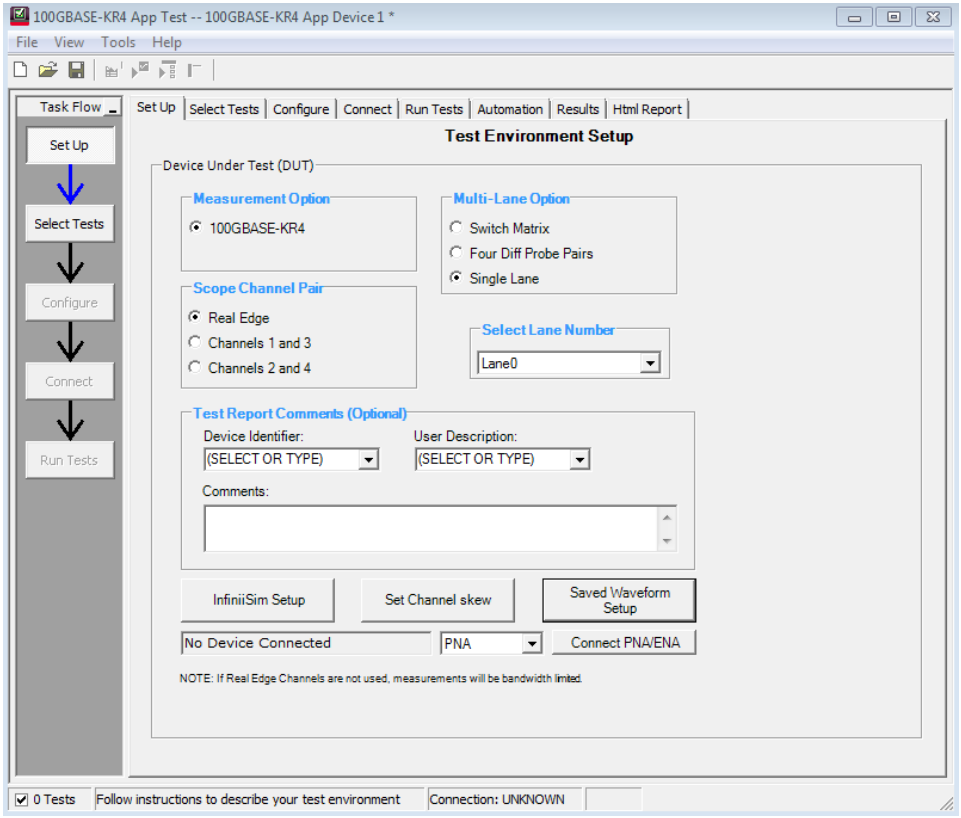
The waveforms *KR4_TP0a_p.h5 and KR4_TP0a_n.h5* are used in this tutorial. For the test that requires the transmitter to be disabled, use the waveforms generated after making the necessary changes as described in the design.

NOTE Ensure that the waveforms are generated with number of bits simulated in the Channel Simulation Controller equal to or more than 1000000

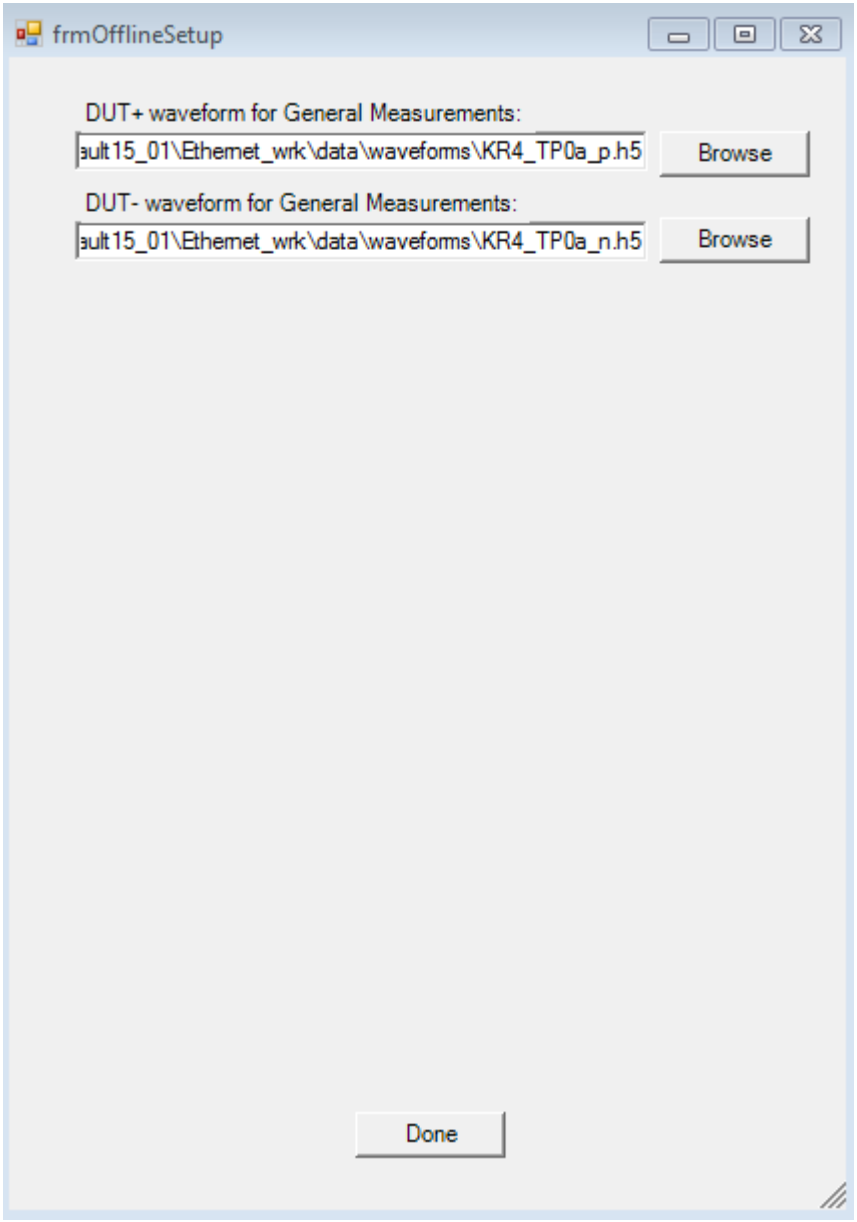
To run the Compliance tests:

1. Click **Analyze > Automated Test Apps > N8829A 100GBASE-KR4 Test App** from the Infiniium Offline software to open the KR4 application.

2. Click **Saved Waveform Setup** in the **Set Up** tab.

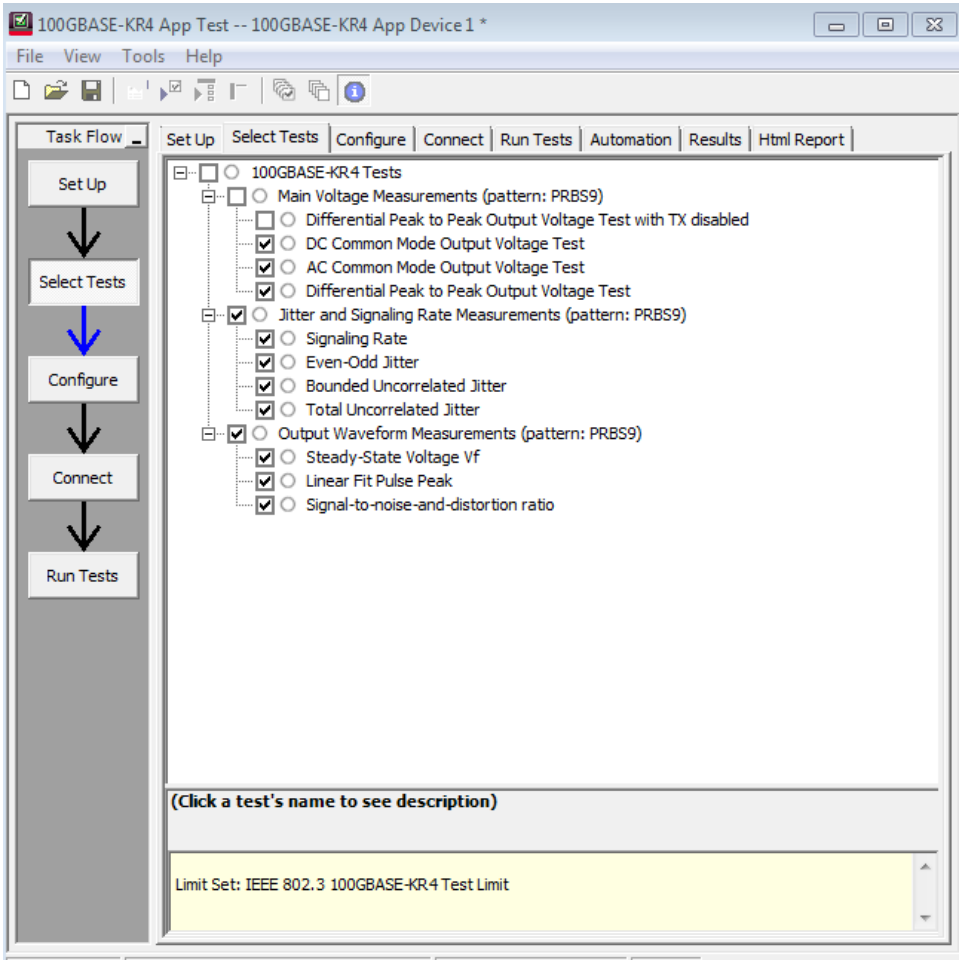


3. Click **Browse** and select the *KR4_TP0a_p.h5 and KR4_TP0a_n.h5* waveform files for the DUT+ and DUT- fields respectively.



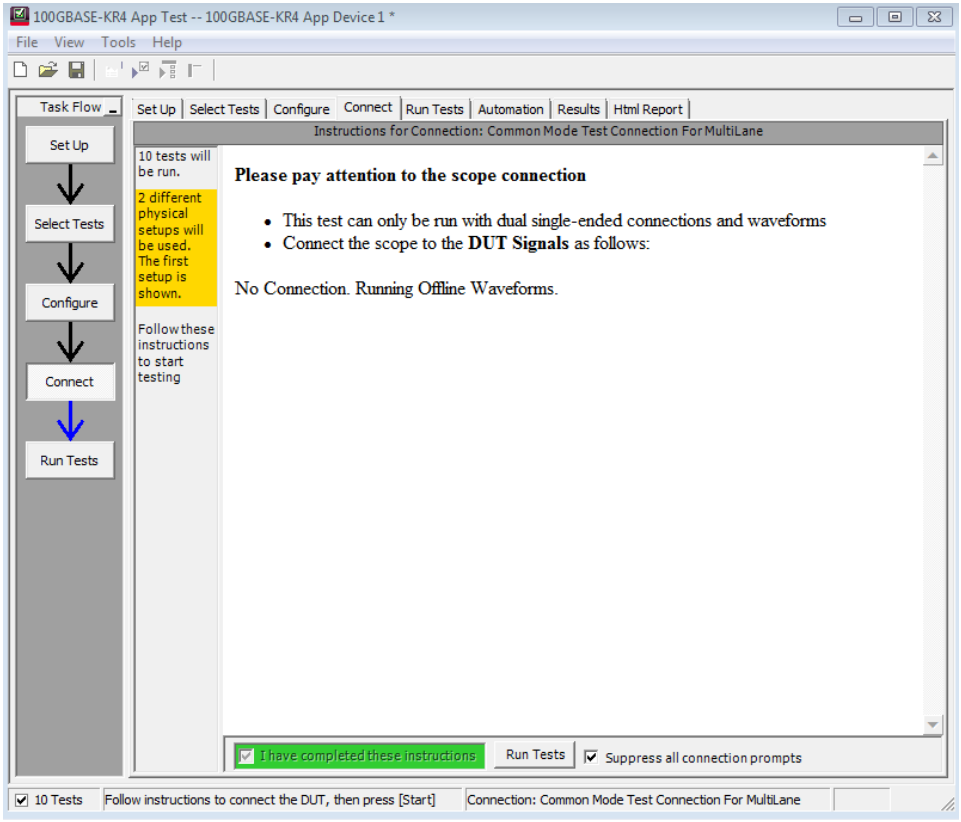
4. Click **Done**.
5. Click the **Select Tests** tab.

6. Select the tests, as shown in the following figure:



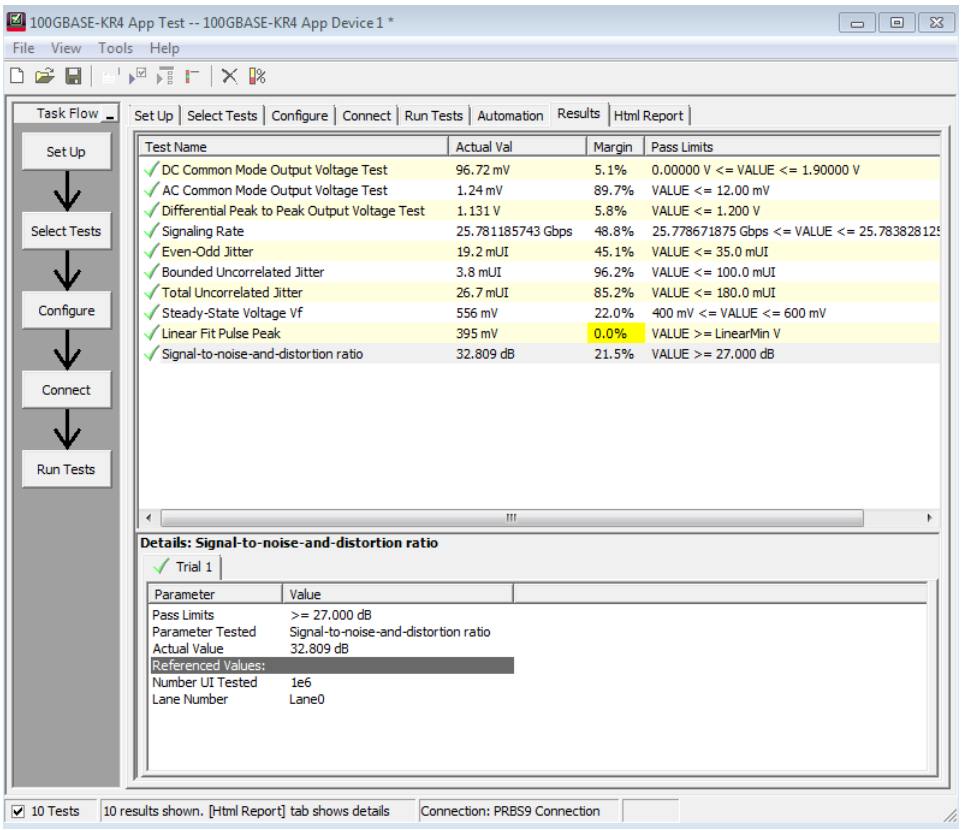
7. Click the **Connect** tab.

8. Select **I have completed the instructions**.

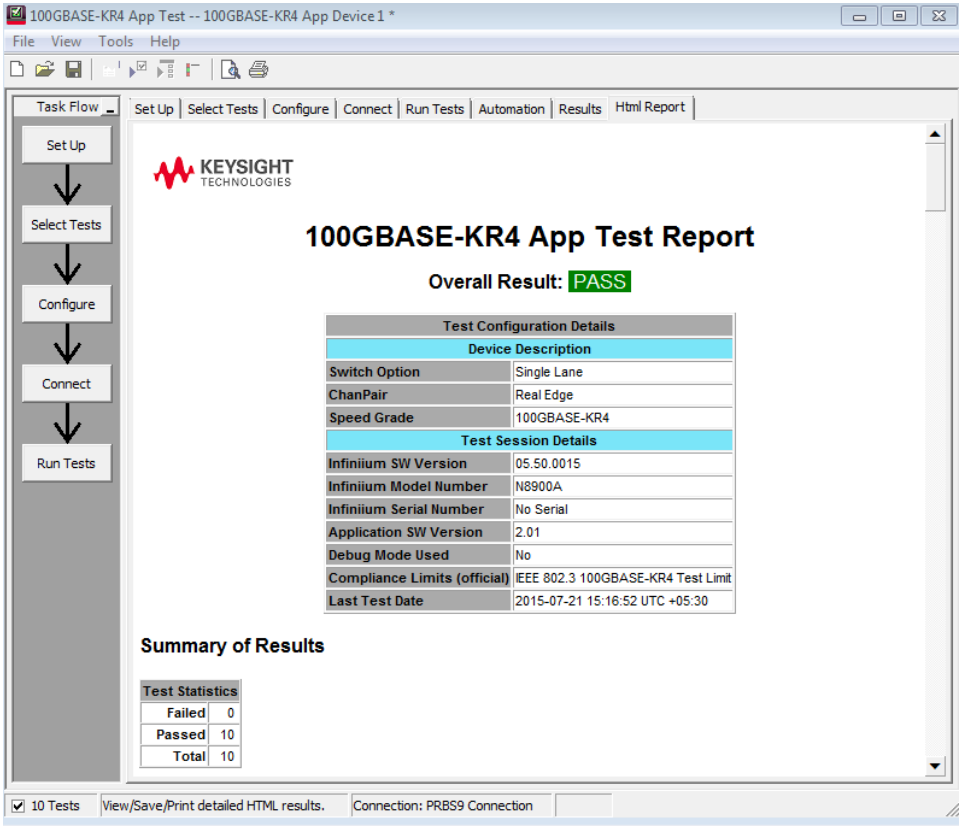


9. Click **Run Tests**.

10. Click the **Results** tab. The test results are displayed, as shown in the following figure:



You can also view the HTML report under the **HTML Report** tab.



NOTE

If you open the **Select Tests** tab before loading your waveforms, you will see tests that are not listed in the screenshot in Step 4 above. These tests are in the application but not supported currently. They will be supported in a future release of this Compliance Test Bench and 100GBASE-KR4 application.

References

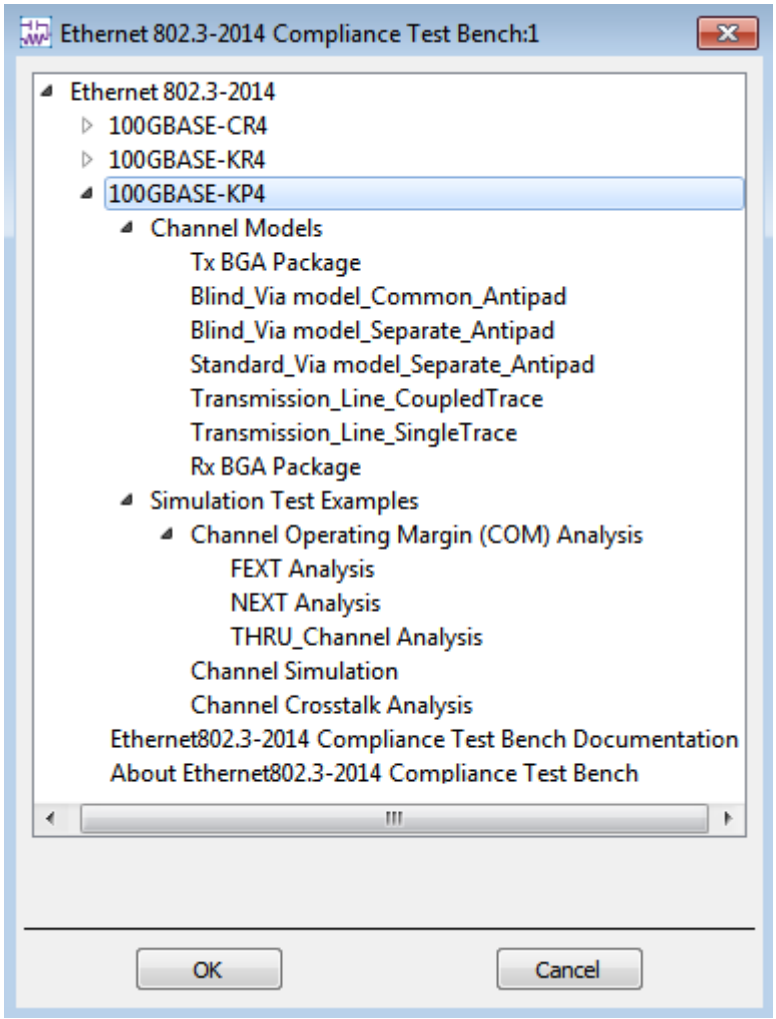
- IEEE Std 802.3bj™-2014 - IEEE Standard for Ethernet, Amendment 2: Physical Layer Specifications and Management Parameters for 100 Gb/s Operation Over Backplanes and Copper Cables

Ethernet 802.3-2014 100GBASE-KP4 Compliance Test Bench Simulation Setups

Ethernet 802.3-2014 100GBASE-KP4 Compliance Test Bench Simulation Setups

100GBASE -KP4 d efines a 4-lane 100 Gbit/s backplane PHY for operation over links consistent with copper traces on “improved FR-4” with lengths up to at least 1m . Signalling used is PAM4.

The Ethernet 802.3-2014 Compliance Test Bench provides a variety of tests, which helps to understand the various aspects of the Ethernet 802.3-2014 digital standard (CR4, KR4 and KP4). It provides you the ability to create designs using the included models or your own models. You can refer to the included examples when developing the designs. This Compliance Test Bench provides the following Models and Examples for KR4:



NOTE -

1. Package Models are for educational demonstration only and are not intended for design purposes. Please download the latest up to date models for your application directly from the vendor's website. Models in this example were downloaded from Xilinx Inc. : www.xilinx.com
2. This design guide includes features which are supported after ADS 2016.01 version.

Models

The following KP4 channel models are supported:

- Tx Package
- Rx Package
- Connector
- Via models
- Transmission Line Models

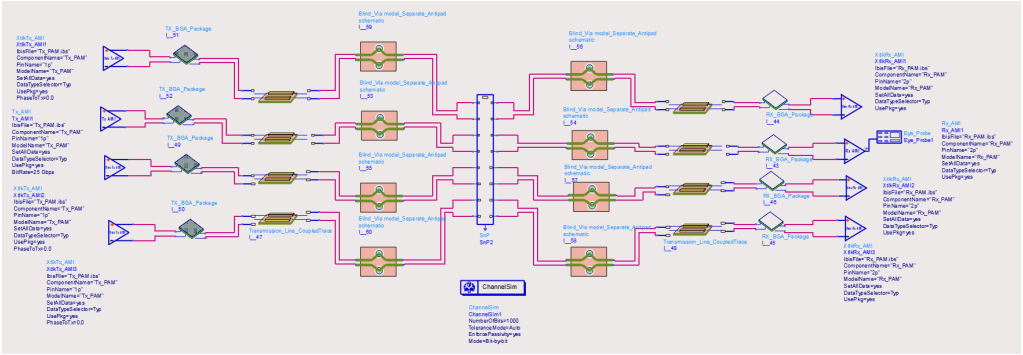
Examples

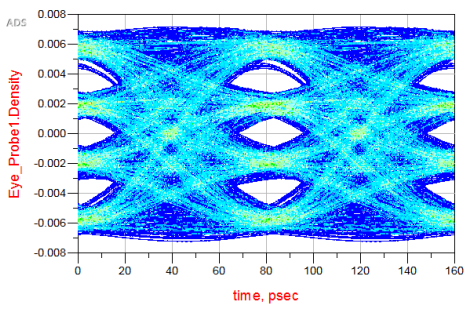
The following examples are included in the Ethernet 802.3-2014 Compliance Test Bench for KR4:

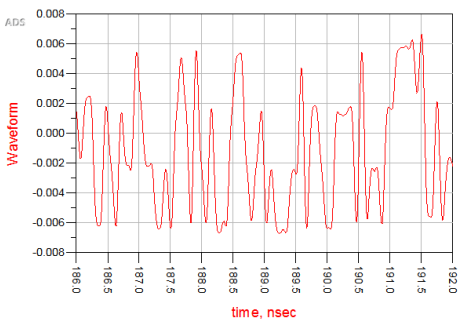
- Channel Crosstalk Analysis
- Channel Operating Margin (COM) Analysis
- Channel Simulation

C hannel Crosstalk Analysis

Enable or Disable Crosstalk components, "Xtalk TX AMI & Xtalk RX AMI", to see the interference of noise on Eye Diagram.







C hannel Operating Margin (COM) Analysis

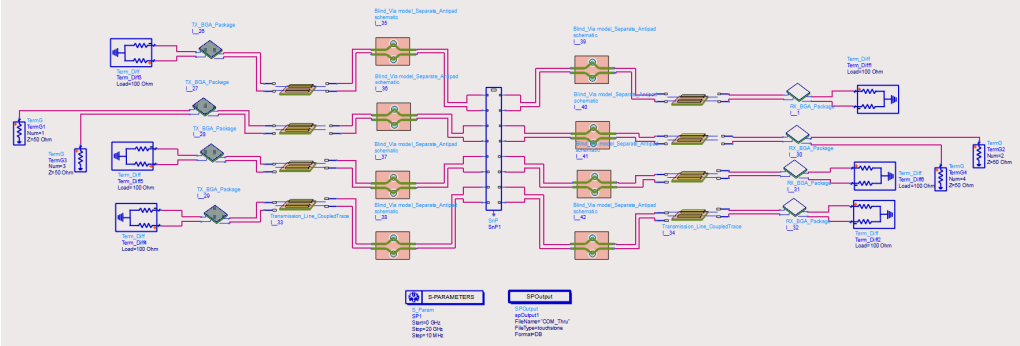
The following design shows the S-Parameter generating model required to run Channel Operating Margin (COM) Analysis for the KP4. In order to perform COM analysis, the user need to generate THRU channel, FEXT and NEXT models fro the channel. Goto respective designs to generate the required models.

THRU Channel Analysis:

This design extracts the following files in data folder of workspace.

1. config_com_ieee8023_93a=100GBASE-KP4.xls
2. config_com_ieee8023_93a_doc.pdf
3. com_ieee8023_93a.m

Run this design to generate "COM_Thru" 4 port S-parameter model at data folder of workspace.

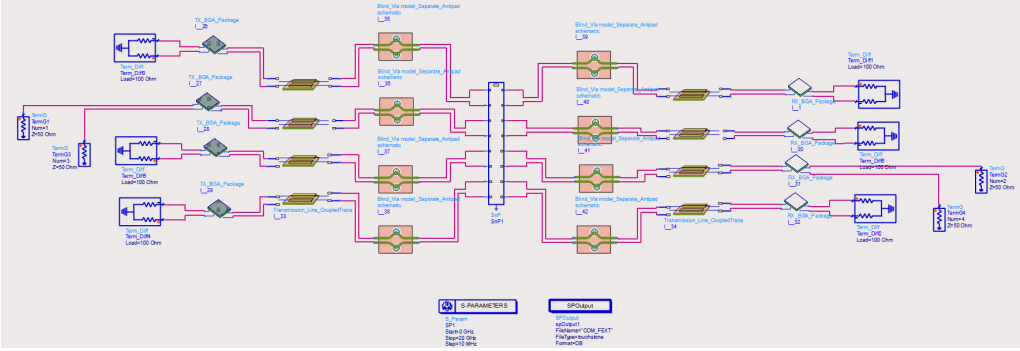


FEXT Analysis:

This design extracts the following files in data folder of workspace.

1. config_com_ieee8023_93a=100GBASE-KP4.xls
2. config_com_ieee8023_93a_doc.pdf
3. com_ieee8023_93a.m

Run this design to generate "COM_FEXT" 4 port S-parameter model at data folder of workspace.



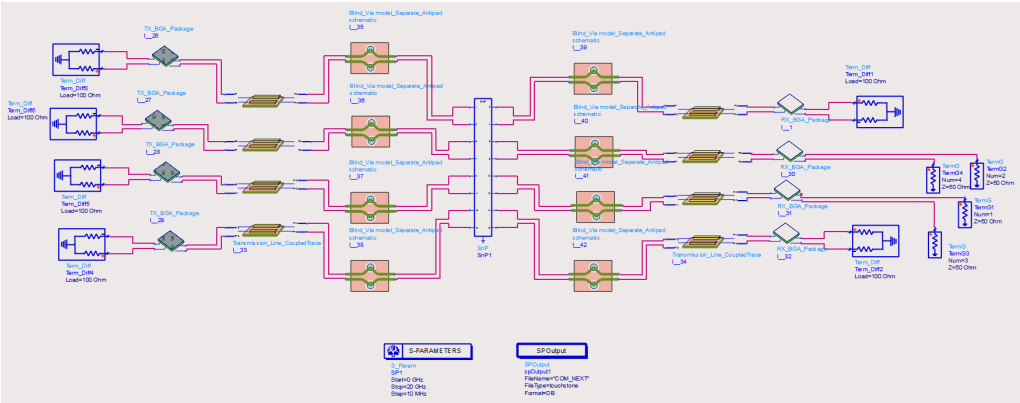
NEXT Analysis:

This design extracts the following files in data folder of workspace.

1. config_com_ieee8023_93a=100GBASE-KP4.xls

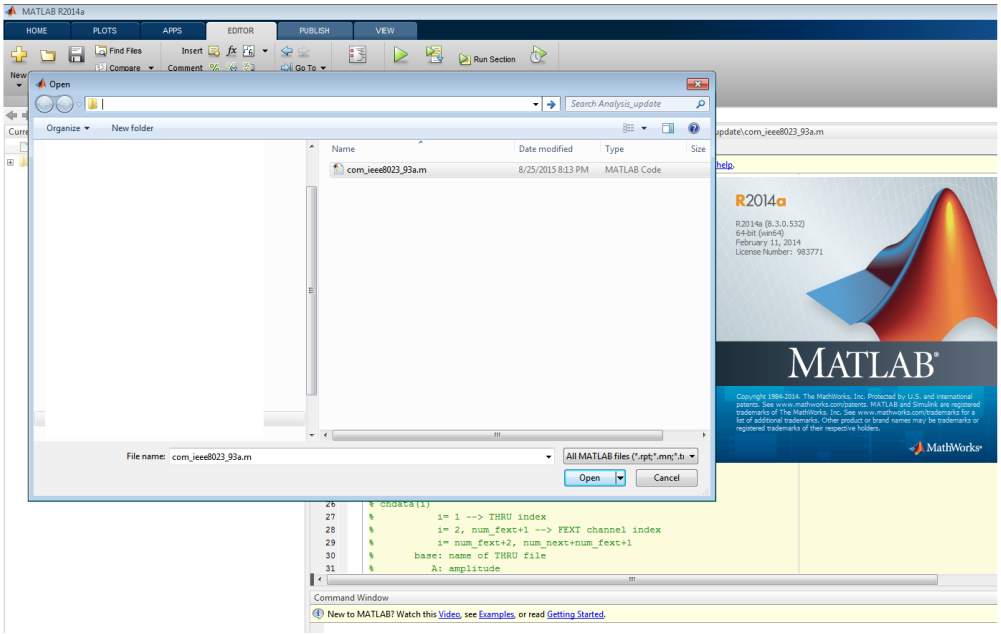
2. config_com_ieee8023_93a_doc.pdf
3. com_ieee8023_93a.m

Run this design to generate "COM_NEXT" 4 port S-parameter model at data folder of workspace.



Matlab for Channel Operating Margin (COM) Analysis:

- Open the Matlab software and load the code "com_ieee8023_93a.m"



- Now edit the contents in "config_com_ieee8023_93a=100GBASE-KP4.xls" file and save them as per the design requirement.

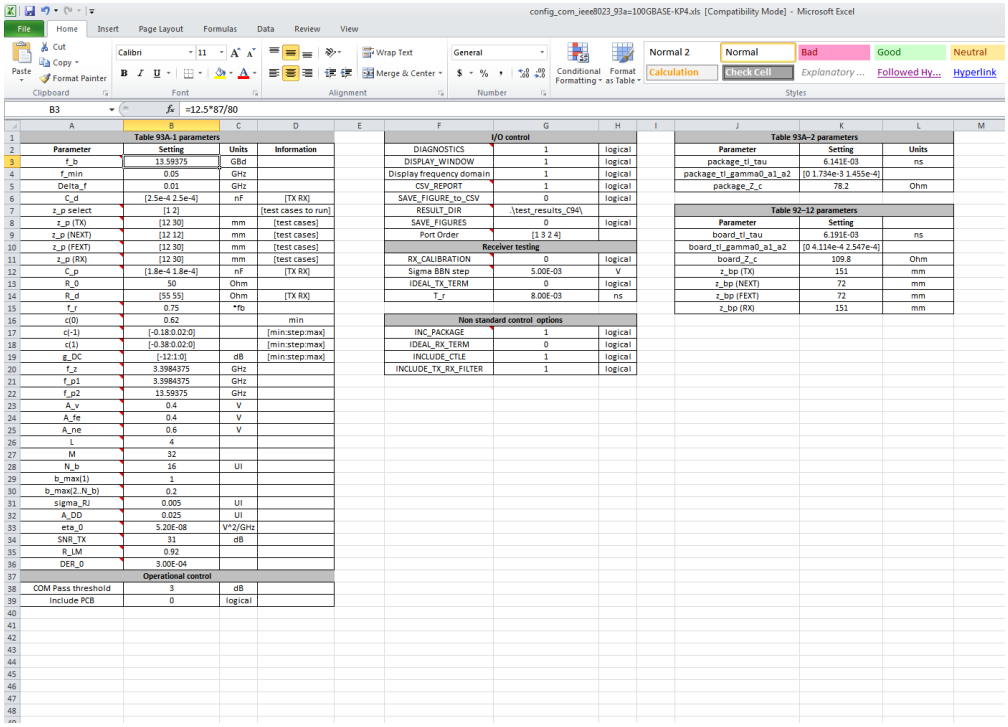


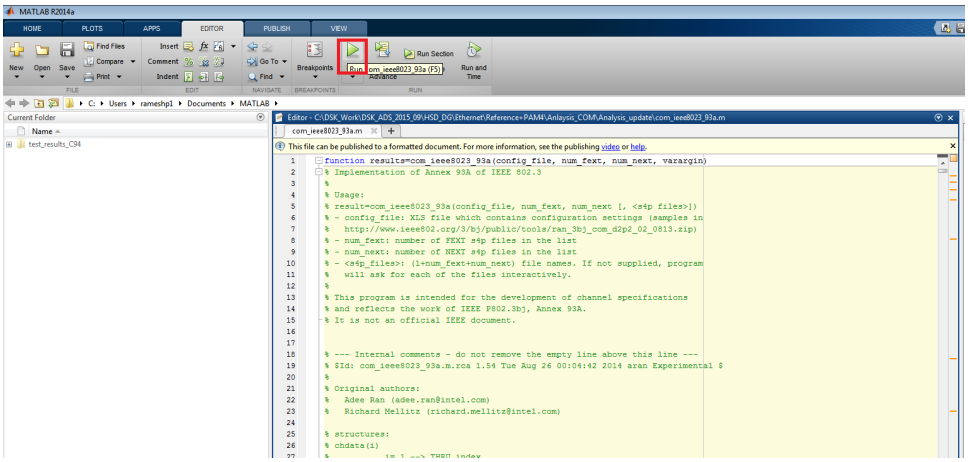
Table 93A-1 parameters			
Parameter	Setting	Units	Information
f_b	13.59375	GBd	
f_min	0.05	GHz	
Delta_f	0.01	GHz	
C_d	[2.5e-4 2.5e-4]	nF	[TX RX]
z_p select	[1 2]		[test cases to run]
z_p (TX)	[12 30]	mm	[test cases]
z_p (NEXT)	[12 12]	mm	[test cases]
z_p (FEXT)	[12 30]	mm	[test cases]
z_p (RX)	[12 30]	mm	[test cases]
C_p	[1.8e-4 1.8e-4]	nF	[TX RX]
R_0	50	Ohm	
R_d	[55 55]	Ohm	[TX RX]
f_r	0.75	*fb	
c(0)	0.62		min
c(-1)	[-0.18:0.02:0]		[min:step:max]
c(1)	[-0.38:0.02:0]		[min:step:max]
g_DC	[-12:1:0]	dB	[min:step:max]
f_z	3.3984375	GHz	
f_p1	3.3984375	GHz	
f_p2	13.59375	GHz	
A_v	0.4	V	
A_fe	0.4	V	
A_ne	0.6	V	
L	4		
M	32		
N_b	16	UI	
b_max(1)	1		
b_max(2..N_b)	0.2		
sigma_RJ	0.005	UI	
A_DD	0.025	UI	
eta_0	5.20E-08	V^2/GHz	
SNR_TX	31	dB	
R_LM	0.92		
DER_0	3.00E-04		
Operational control			
COM Pass threshold	3	dB	
Include PCB	0	logical	

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
Display frequency domain	1	logical
CSV_REPORT	1	logical
SAVE_FIGURE_to_CSV	0	logical
RESULT_DIR	.\test_results_C94\	
SAVE_FIGURES	0	logical
Port Order	[1 3 2 4]	
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V
IDEAL_TX_TERM	0	logical
T_r	8.00E-03	ns
Non standard control options		
INC_PACKAGE	1	logical
IDEAL_RX_TERM	0	logical
INCLUDE_CTLE	1	logical
INCLUDE_TX_RX_FILTER	1	logical

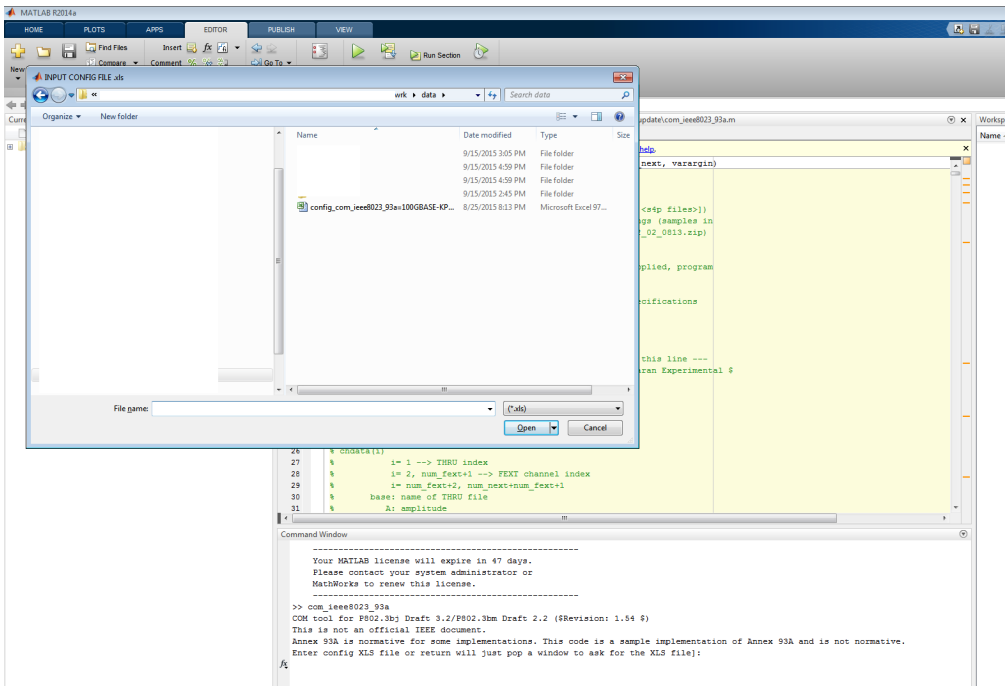
Table 93A-2 parameters		
Parameter	Setting	Units
package_tl_tau	6.141E-03	ns
package_tl_gamma0_a1_a2	[0 1.734e-3 1.455e-4]	
package_Z_c	78.2	Ohm

Table 92-12 parameters		
Parameter	Setting	
board_tl_tau	6.191E-03	ns
board_tl_gamma0_a1_a2	[0 4.114e-4 2.547e-4]	
board_Z_c	109.8	Ohm
z_bp (TX)	151	mm
z_bp (NEXT)	72	mm
z_bp (FEXT)	72	mm
z_bp (RX)	151	mm

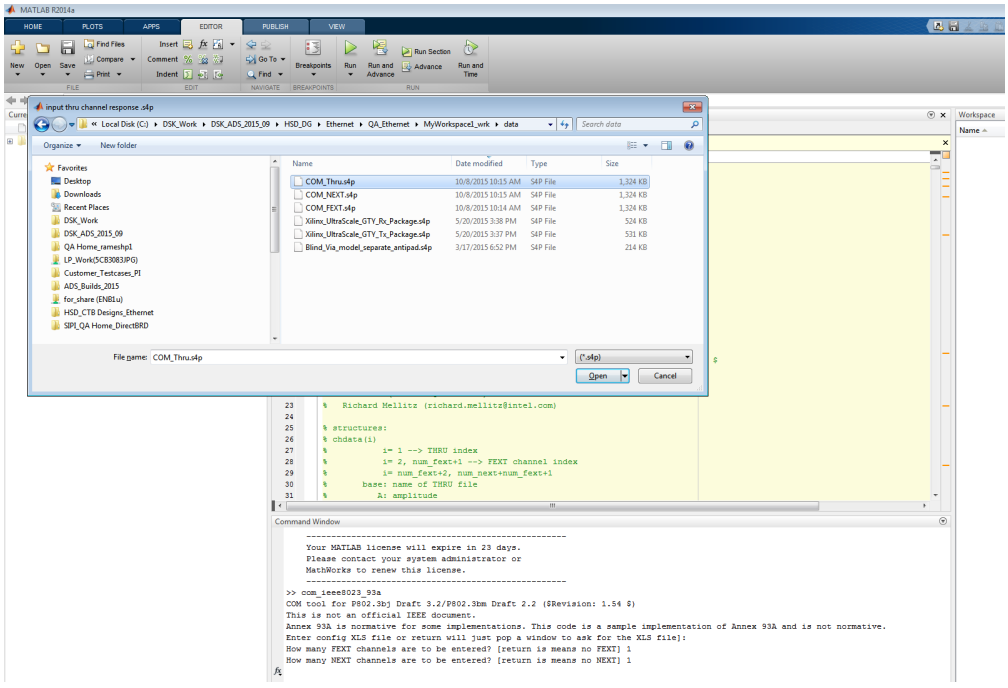
- Click Run in the Matlab software to Start simulation



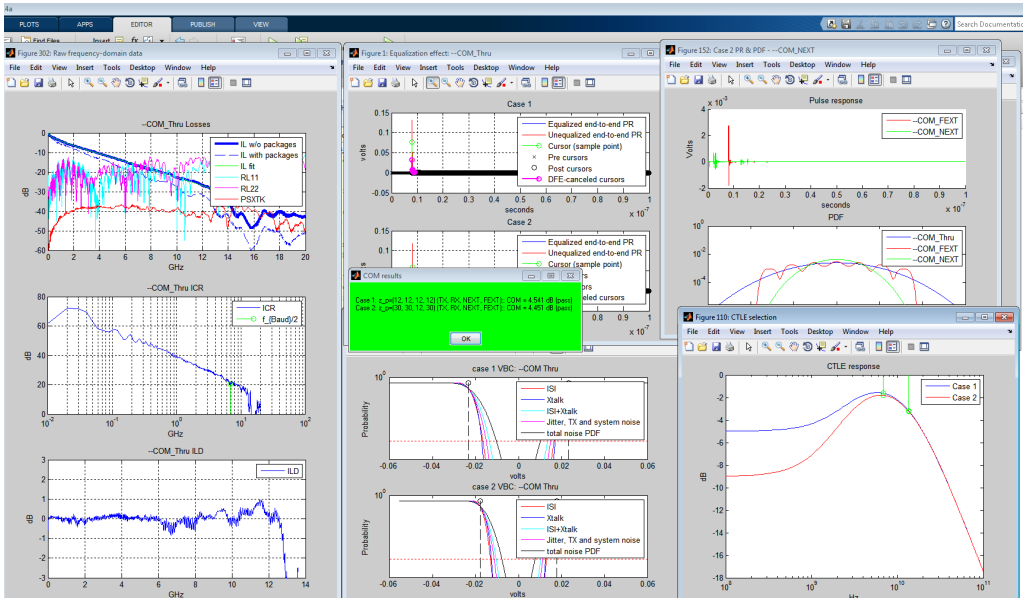
- Click Enter to load the configuration file " "config_com_ieee8023_93a=100GBASE-KP4.xls"



- Enter the number of channel of created for FEXT and NEXT analysis. In this case, we have created for 1 channel for FEXT and 1 channel for NEXT channel.Click enter to load the touchstone models from data folder of workspace. This file will be generated from ADS channel simulation: COM_Thru.s4p , COM_FEXT.s4p and COM_NEXT.s4p one by one a Matlab prompts.

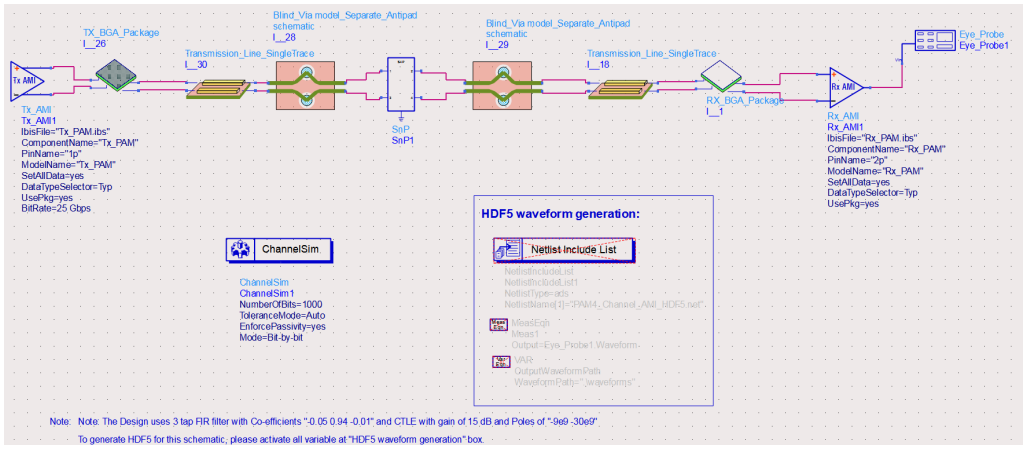


- After loading the required files, the software initiates simulation and displays the following results for KP4 - COM analysis.

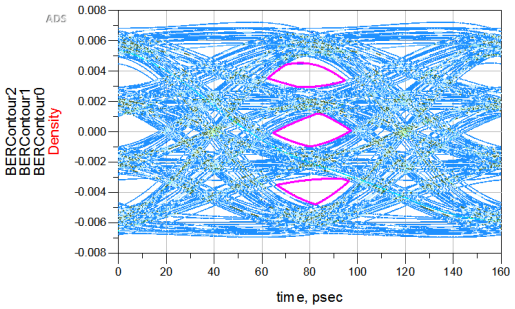


Channel Simulation

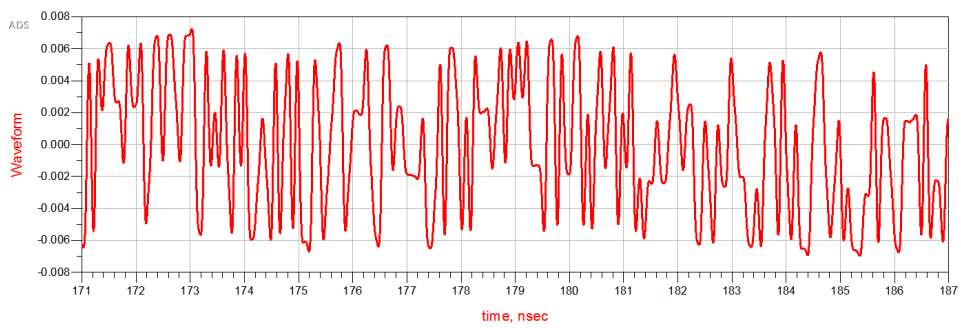
The following design shows the end to end simulation of KP4 channel and generates eye diagram.



The following parameters that are plotted in the results:



measurement	Summary
WidthAtBER0	3.005E-11
WidthAtBER1	3.274E-11
WidthAtBER2	3.245E-11
HeightAtBER0	0.002
HeightAtBER1	0.002
HeightAtBER2	0.002
CrossingLevel0	-0.003
CrossingLevel1	-5.000E-6
CrossingLevel2	0.003



References

- IEEE Std 802.3bj™-2014 - IEEE Standard for Ethernet, Amendment 2: Physical Layer Specifications and Management Parameters for 100 Gb/s Operation Over Backplanes and Copper Cables