N1095BSCA DCA Optical Compliance Test Application

KEYSIGHT

METHODS OF IMPLEMENTATION

Notices

Software Version

Version 1.6.2.0

Edition

March 2023

Available in electronic format only

Keysight Technologies
1900 Garden of the Gods Road
Colorado Springs, CO 80907 USA

Warranty

THE MATERIAL CONTAINED IN THIS DOCUMENT IS PROVIDED "AS IS," AND IS SUBJECT TO BEING CHANGED, WITHOUT NOTICE, IN FUTURE EDITIONS. FURTHER, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, KEYSIGHT DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED WITH REGARD TO THIS MANUAL AND ANY INFORMATION CONTAINED HEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. KEYSIGHT SHALL NOT BE LIABLE FOR ERRORS OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, USE, OR PERFORMANCE OF THIS DOCUMENT OR ANY INFORMATION CONTAINED HEREIN. SHOULD KEYSIGHT AND THE USER HAVE A SEPARATE WRITTEN AGREEMENT WITH WARRANTY TERMS COVERING THE MATERIAL IN THIS DOCUMENT THAT CONFLICT WITH THESE TERMS, THE WARRANTY TERMS IN THE SEPARATE AGREEMENT WILL CONTROL.

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

U.S. Government Rights

The Software is "commercial computer software," as defined by Federal Acquisition Regulation ("FAR") 2.101. Pursuant to FAR 12.212 and 27.405-3 and Department of Defense FAR Supplement ("DFARS") 227.7202, the U.S. government acquires commercial computer software under the same terms by which the software is customarily provided to the public. Accordingly, Keysight provides the Software to U.S. government customers under its standard commercial license, which is embodied in its End User License Agreement (EULA), a copy of which can be found at http://www.keysight.com/find/sweula. The license set forth in the EULA represents the exclusive authority by which the U.S. government may use, modify, distribute, or disclose the Software. The EULA and the license set forth therein, does not require or permit, among other things, that Keysight: (1) Furnish technical information related to commercial computer software or commercial computer software documentation that is not customarily provided to the public; or (2) Relinquish to, or otherwise provide, the government rights in excess of these rights customarily provided to the public to use, modify, reproduce, release, perform, display, or disclose commercial computer software or commercial computer software documentation. No additional government requirements beyond those set forth in the EULA shall apply, except to the extent that those terms, rights, or licenses are explicitly required from all providers of commercial computer software pursuant to the FAR and the DFARS and are set forth specifically in writing elsewhere in the EULA. Keysight shall be under no obligation to update, revise or otherwise modify the Software. With respect to any technical data as defined by FAR 2.101, pursuant to FAR 12.211 and 27.404.2 and DFARS 227.7102, the U.S. government acquires no greater than Limited Rights as defined in FAR 27.401 or DFAR 227.7103-5 (c), as applicable in any technical data.

Safety Notices

CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

In This Book

This manual describes the tests that are performed by the DCA Optical Compliance Test Application in more detail.

- Chapter 1, “Overview” provides an overview of the compliance test application and the test groups in the DCA Optical compliance test application.
- Chapter 2, “Getting Started” provides the necessary information for getting started with the N1095BSCA DCA Optical Compliance Application, including installing the application and licenses, making the required hardware connections, starting the application, and making a measurement.
- Chapter 3, “200GBASE Tests” provides the Methods of Implementation (MOIs) for the 200GBASE tests using a supported Keysight DCA oscilloscope and the DCA Optical Compliance Test Application.
- Chapter 4, “400GBASE Tests” provides the Methods of Implementation (MOIs) for the 400GBASE tests using a supported Keysight DCA oscilloscope and the DCA Optical Compliance Test Application.
- Chapter 5, “50GBASE Tests” provides the Methods of Implementation (MOIs) for the 50GBASE tests using a supported Keysight DCA oscilloscope and the DCA Optical Compliance Test Application.
- Chapter 6, “100GBASE Tests” provides the Methods of Implementation (MOIs) for the 100GBASE tests using a supported Keysight DCA oscilloscope and the DCA Optical Compliance Test Application.
- Chapter 7, “IEEE P802.3cu Tests” provides the Methods of Implementation (MOIs) for the supported IEEE P802.3cu (100GBASE-FR1, 100GBASE-LR1, 400GBASE-FR4, and 400GBASE-LR4-6) tests using a supported Keysight DCA oscilloscope and the DCA Optical Compliance Test Application.

See Also

- The DCA Optical Compliance Test Application’s Online Help, which describes:
  - Starting the DCA Optical Compliance Test Application.
  - Creating or opening a test project.
  - Setting up the DCA Optical test environment.
  - Selecting tests.
  - Configuring selected tests.
  - Defining compliance limits.
  - Connecting the oscilloscope to the DUT.
  - Running tests.
  - Automating the application.
  - Viewing test results.
  - Viewing/exporting/printing the HTML test report.
  - Understanding the Report.
  - Exporting measurement results to web repository.
  - Saving test projects.
  - Controlling the application via a remote PC.

Contents

4 400GBASE Tests

5 50GBASE Tests

6 100GBASE Tests

1 Overview

The Keysight N1095BSCA DCA Optical Compliance Test Application enables compliance testing in adherence to the IEEE 802.3-2018, IEEE 802.3cd-2018, IEEE 802.3bs-2018, and IEEE P802.3cu/D3.2 specifications. This chapter provides an overview of the compliance test application and the test groups in the DCA Optical compliance test application.

DCA Optical Compliance Test Application — At A Glance

N1095BSCA is an automated software application that enables you to measure a significant subset of optical transmitter parameters outlined in IEEE 802.3-2018, IEEE 802.3cd-2018, IEEE 802.3bs-2018, and IEEE P802.3cu/D3.2 specifications through a host of logically grouped tests. Use the DCA Optical application with the N1000A-N1030x oscilloscope-optical module combination (Single Mode only) or DCA-M (N109x) oscilloscope either with or without the N1077A/78A clock data recovery (CDR). The N1077A CDR is recommended for single mode and multimode tests using a data rate of 32 GBd, while the N1078A clock recovery is recommended for single mode tests only using a data rate of 64 GBd. More recent models of N1092A/B oscilloscopes support in-built CDR. An external CDR is not required in these cases. The application also enables you to specify an external attenuation factor per lane to take losses into account.

The DCA Optical Compliance Test Application:

- Lets you select individual or multiple tests to run.
- Lets you identify the device being tested and its configuration.
- Shows you how to make oscilloscope connections to the device under test.
- Automatically checks for proper oscilloscope configuration.
- Automatically sets up the oscilloscope for each test.
- Provides detailed information for each test that has been run, and lets you specify the thresholds at which marginal or critical warnings appear.
- Creates a printable HTML report of the tests that have been run.

DCA Compliance Test Application Test Groups

The group of tests specified in this Methods of Implementation document pertains to the IEEE 802.3bs/cd and IEEE P802.3cu/D3.2 specifications. The relevant sections of the specifications define the optical requirements of the signals for the following transmission standards.

Standard	Clause
200GBASE-DR4	IEEE 802.3-2018 - Clause 121
200GBASE-FR4	IEEE 802.3-2018 - Clause 122
200GBASE-LR4	IEEE 802.3-2018 - Clause 122
200GBASE-SR4	IEEE 802.3cd-2018 - Clause 138
400GBASE-FR8	IEEE 802.3-2018 - Clause 122
400GBASE-LR8	IEEE 802.3-2018 - Clause 122
400GBASE-SR16	IEEE 802.3-2018 - Clause 123
400GBASE-DR4	IEEE 802.3-2018 - Clause 124
50GBASE-FR	IEEE 802.3cd-2018 - Clause 139
50GBASE-LR	IEEE 802.3cd-2018 - Clause 139
50GBASE-SR	IEEE 802.3cd-2018 - Clause 138
100GBASE-SR2	IEEE 802.3cd-2018 - Clause 138
100GBASE-DR	IEEE 802.3cd-2018 - Clause 140
100GBASE-FR1	IEEE P802.3cu/D3.2 - Clause 140
100GBASE-LR1	IEEE P802.3cu/D3.2 - Clause 140
400GBASE-FR4	IEEE P802.3cu/D3.2 - Clause 151
400GBASE-LR4-6	IEEE P802.3cu/D3.2 - Clause 151

The test groups in the DCA Optical Compliance Test Application are categorized on the basis of the transmission standard. Hence, the following test groups are available:

- 200GBASE-DR4
- 200GBASE-FR4
- 200GBASE-LR4
- 400GBASE-FR8
- 400GBASE-LR8
- 400GBASE-SR16
- 400GBASE-DR4
- 50GBASE-SR, 100GBASE-SR2, or 200GBASE-SR4
- 50GBASE-FR
- 50GBASE-LR
- 100GBASE-DR
- 100GBASE-FR1
- 100GBASE-LR1
- 400GBASE-FR4

- 400GBASE-LR4-6

NOTE Because of the similarities in implementation of the test logic, 50GBASE-SR, 100GBASE-SR2, and 200GBASE-SR4 constitute one category of tests.

The following table provides the list of available tests for each transmission standard along with other relevant details.

Table 1 Transmission standards and supported tests

Transmission Standard	Symbol Rate (Gbd)	PAM4 or NRZ?	Single mode (SM) OR Multi mode (MM)	Wavelength	Supported Tests
200GBASE-DR4	26.5625	PAM4	SM	1310 nm	- Transmitter and dispersion eye closure - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Outer Optical Modulation Amplitude (OMA) - Outer Extinction Ratio - Transmitter and Dispersion Eye Closure - Launch power in OMAouter minus TDECQ - Relative Intensity Noise (RIN21.4 OMA)
200GBASE-FR4	26.5625	PAM4	SM	1310 nm	- Transmitter and dispersion eye closure - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Outer Optical Modulation Amplitude (OMA) - Outer Extinction Ratio - Launch power in OMAouter minus TDECQ - Relative Intensity Noise (RIN17.1 OMA) - Difference in Launch Power for any two lanes
200GBASE-LR4	26.5625	PAM4	SM	1310 nm	- Transmitter and dispersion eye closure - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Outer Optical Modulation Amplitude (OMA) - Outer Extinction Ratio - Launch power in OMAouter minus TDECQ - Relative Intensity Noise (RIN15.6 OMA) - Difference in Launch Power for any two lanes
400GBASE-FR8	26.5625	PAM4	SM	1310 nm	- Transmitter and dispersion eye closure - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Outer Optical Modulation Amplitude (OMA) - Outer Extinction Ratio (OER) - Launch power in OMAouter minus TDECQ - Relative Intensity Noise (RIN17.1 OMA) - Difference in Launch Power for any two lanes

Transmission Standard	Symbol Rate (Gbd)	PAM4 or NRZ?	Single mode (SM) OR Multi mode (MM)	Wavelength	Supported Tests
400GBASE-LR8	26.5625	PAM4	SM	1310 nm	- Transmitter and dispersion eye closure - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Outer Optical Modulation Amplitude (OMA) - Outer Extinction Ratio (OER) - Launch power in OMAouter minus TDECQ - Relative Intensity Noise (RIN15.6 OMA) - Difference in Launch Power for any two lanes
400GBASE-SR16	26.5625	NRZ	MM	850 nm	- Transmitter and dispersion eye closure - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Optical Modulation Amplitude (OMA) - Extinction Ratio (ER) - Launch power in OMAouter minus TDEC
400GBASE-DR4	53.125	PAM4	SM	1310 nm	- Transmitter and dispersion eye closure - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Outer Optical Modulation Amplitude (OMA) - Outer Extinction Ratio - Launch power in OMAouter minus TDECQ
50GBASE-SR 100GBASE-SR2 200GBASE-SR4	26.5625	PAM4	MM	850 nm	- Transmitter and dispersion eye closure - TDECQ minus Ceq - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Outer Optical Modulation Amplitude (OMA) - Outer Extinction Ratio (OER) - Transmitter transition time - Transmitter and Dispersion Eye Closure - Launch power in OMAouter minus TDECQ - Relative Intensity Noise (RIN12 OMA)
50GBASE-FR	26.5625	PAM4	SM	1310 nm	- Transmitter and dispersion eye closure - TDECQ minus Ceq - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Outer Optical Modulation Amplitude (OMA) - Outer Extinction Ratio - Transmitter transition time - Launch power in OMAouter minus TDECQ - Relative Intensity Noise (RIN17.1 OMA)
50GBASE-LR	26.5625	PAM4	SM	1310 nm	- Transmitter and dispersion eye closure - TDECQ minus Ceq - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Outer Optical Modulation Amplitude (OMA) - Outer Extinction Ratio (OER) - Transmitter transition time - Launch power in OMAouter minus TDECQ - Relative Intensity Noise (RIN15.6 OMA)

Transmission Standard	Symbol Rate (Gbd)	PAM4 or NRZ?	Single mode (SM) OR Multi mode (MM)	Wavelength	Supported Tests
100GBASE-DR	53.125	PAM4	SM	1310 nm	- Transmitter and dispersion eye closure - TDECQ minus Ceq - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Outer Optical Modulation Amplitude (OMA) - Outer Extinction Ratio - Transmitter transition time - Launch power in OMAouter minus TDECQ
100GBASE-FR1	53.125	PAM4	SM	1310 nm	- Transmitter and dispersion eye closure - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Outer Extinction Ratio - Transmitter transition time - Transmitter Overshoot - Transmitter Undershoot - Transmitter Power Excursion - Transmitter eye closure - Outer Optical Modulation Amplitude (OMA) - TDECQ minus TECQ

Transmission Standard	Symbol Rate (Gbd)	PAM4 or NRZ?	Single mode (SM) OR Multi mode (MM)	Wavelength	Supported Tests
100GBASE-LR1	53.125	PAM4	SM	1310 nm	- Transmitter and dispersion eye closure - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Outer Extinction Ratio - Transmitter transition time - Transmitter Overshoot - Transmitter Undershoot - Transmitter Power Excursion - Transmitter eye closure - Outer Optical Modulation Amplitude (OMA) - TDECQ minus TECQ
400GBASE-FR4	53.125	PAM4	SM	1310 nm	- Transmitter and dispersion eye closure - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Outer Extinction Ratio - Transmitter transition time - Transmitter Overshoot - Transmitter Undershoot - Transmitter Power Excursion - Outer Optical Modulation Amplitude (OMA) - Transmitter Eye Closure - Difference in Launch Power for any two lanes - Total Average Launch Power - TDECQ minus TECQ
400GBASE-LR4-6	53.125	PAM4	SM	1310 nm	- Transmitter and dispersion eye closure - Average (Optical) Launch Power (TX OFF) - Signaling Rate - Average (Optical) Launch Power - Outer Extinction Ratio - Transmitter transition time - Transmitter Overshoot - Transmitter Undershoot - Transmitter Power Excursion - Outer Optical Modulation Amplitude (OMA) - Transmitter Eye Closure - Difference in Launch Power for any two lanes - Total Average Launch Power - TDECQ minus TECQ

NOTE

Depending on the N1092x (DCA-M Oscilloscope) or N1000A-N1030x hardware configuration options installed, you will be able to run the tests corresponding to either the entire set of optical transmission standards or just a subset of the standards in the N1095BSCA application.

Thus, if you have installed N1092x-30A option, the N1095BSCA application will support both single mode (SM) and multimode (MM) standards. However, if you have installed N1092x-40A option, only SM standards will be enabled.

Furthermore, if you have installed N1092x-30A option, the RIN tests are available only if you switch to the Debug mode under the Configure tab. Also, the result is reported as “Information only” in this case.

If you have installed N1030x, only SM standards will be enabled. Furthermore, the RIN tests are available only if you switch to the Debug mode under the Configure tab. Also, the result is reported as “Information only” in this case.

NOTE

The following tests can be performed using a single waveform acquisition if they are selected as a group with the conditions that the SSPRQ pattern is used and *Suppress All Connection Prompts option* is selected on the Connect tab:

* Signaling Rate

* Average (Optical) Launch Power

* Outer Optical Modulation Amplitude (for IEEE 802.3 bs Or cd standard only)

* Outer Extinction Ratio

* Transmitter Eye Closure

* Transmitter Transition time (for IEEE 802.3 cd Or cu spec only)

* Transmitter Overshoot (IEEE 802.3 cu only)

* Transmitter Undershoot (IEEE 802.3 cu only)

* Transmitter Power Excursion (IEEE 802.3 cu only)

NOTE

TDECQ is the only measurement that is performed with the fiber. The short patch chord is used for all other measurements.

2 Getting Started

This chapter provides the necessary information for getting started with the N1095BSCA DCA Optical Compliance Application, including installing the application and licenses, making the required hardware connections, starting the application, and making a measurement.

Getting Started

Perform the following steps to get started with the N1095BSCA DCA Optical Compliance Test Application.

1 Review the system requirements. Refer to "Required Equipment and Software" on page 21.

2 Install the N1095BSCA DCA Optical Compliance Test Application. Refer to "Installing the Software" on page 22.

3 Install the required licenses. Refer to "Installing the License Key" on page 23.

4 Connect the hardware. Refer to "Making Hardware Connections for Compliance Testing" on page 26.

5 Establish a connection between FlexDCA, oscilloscope, and the clock data recovery. Refer to "Connecting N1010A FlexDCA to N109X or N1000A-N1030x Oscilloscope and N107X" on page 29

6 Start the N1095BSCA DCA Optical Compliance Test Application. Refer to "Starting the DCA Optical Compliance Test Application" on page 30.

7 Make a measurement using N1095BSCA DCA Optical Compliance Test Application. Refer to "Making a Measurement" on page 32.

Required Equipment and Software

In order to run the DCA Optical Compliance Test Application, you need the following equipment and software:

- Either the N1000A-N1030x oscilloscope-optical module combination (for Single Mode tests only) or
  DCA-M Oscilloscope: Supported options include N1092A, N1092B, N1092C, N1092D, and N1092E (for both Single Mode and Multi Mode).
- Optional: Optical/Electric Clock Recovery: Supported options include N1077A and N1078A. For information regarding the compatibility between oscilloscope and clock recovery, refer to Table 2.
- The minimum version of FlexDCA oscilloscope software (see the N1095BSCA DCA Optical Compliance Test Application release notes).
- N1095BSCA DCA Optical Compliance Test Application software.

For the list of required licenses to run this application, refer to the Data Sheet for this application.

NOTE

Depending on the N1092x (DCA-M Oscilloscope) or N1000A-N1030x hardware configuration options installed, you will be able to run the tests corresponding to either the entire set of optical transmission standards or just a subset of the standards in the N1095BSCA application.

Thus, if you have installed N1092x-30A option, the N1095BSCA application will support both single mode (SM) and multimode (MM) standards. However, if you have installed N1092x-40A option, only SM standards will be enabled.

Furthermore, if you have installed N1092x-30A option, the RIN tests are available only if you switch to the Debug mode under the Configure tab. Also, the result is reported as “Information only” in this case.

If you have installed N1030x, only SM standards will be enabled. Furthermore, the RIN tests are available only if you switch to the Debug mode under the Configure tab. Also, the result is reported as “Information only” in this case.

Installing the Software

1. Make sure you have the minimum version of FlexDCA software (see the N1095BSCA test application release notes) by choosing **Help > About FlexDCA**... from the main menu.
2. To obtain the DCA Optical Compliance Test Application, go to Keysight web site: http://www.keysight.com/find/N1095BSCA.
3. Navigate to the DCA Optical Compliance Test Application software download.
4. Follow the instructions to download and install the application software.

Installing the License Key

For the most current license requirements, it is recommended to refer to the Data Sheet for this application.

To procure a license, you require the Host ID information that is displayed in the Keysight License Manager application installed on the same machine where you wish to install the license.

Using Keysight License Manager 5

To view and copy the Host ID from Keysight License Manager 5:

1 Launch Keysight License Manager on your machine, where you wish to run the Test Application and its features.

2 Copy the Host ID that appears on the top pane of the application. Note that x indicates numeric values.

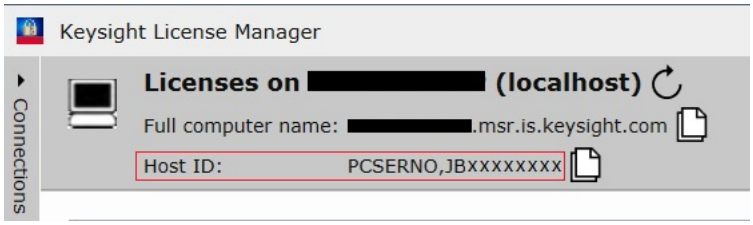

Figure 1 Viewing the Host ID information in Keysight License Manager 5

To install one of the procured licenses using Keysight License Manager 5 application,

1 Save the license files on the machine, where you wish to run the Test Application and its features.

2 Launch Keysight License Manager.

3 From the configuration menu, use one of the options to install each license file.

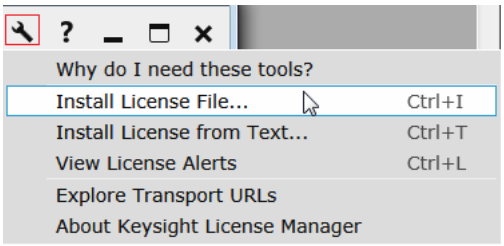

Figure 2 Configuration menu options to install licenses on Keysight License Manager 5

For more information regarding installation of procured licenses on Keysight License Manager 5, refer to Keysight License Manager 5 Supporting Documentation.

Using Keysight License Manager 6

To view and copy the Host ID from Keysight License Manager 6:

1 Launch Keysight License Manager 6 on your machine, where you wish to run the Test Application and its features.

2 Copy the Host ID, which is the first set of alphanumeric value (as highlighted in Figure 3) that appears in the Environment tab of the application. Note that x indicates numeric values.

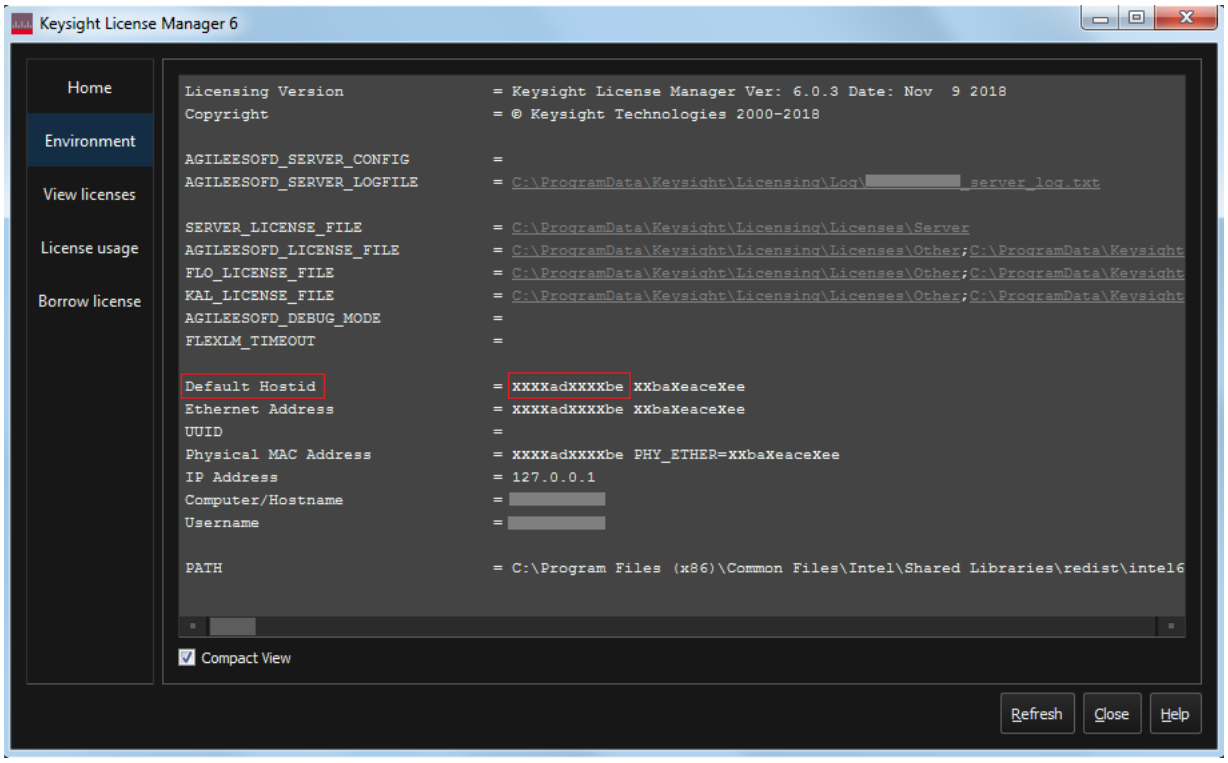

Figure 3 Viewing the Host ID information in Keysight License Manager 6

To install one of the procured licenses using Keysight License Manager 6 application,

1 Save the license files on the machine, where you wish to run the Test Application and its features.

2 Launch Keysight License Manager 6.

3 From the Home tab, use one of the options to install each license file.

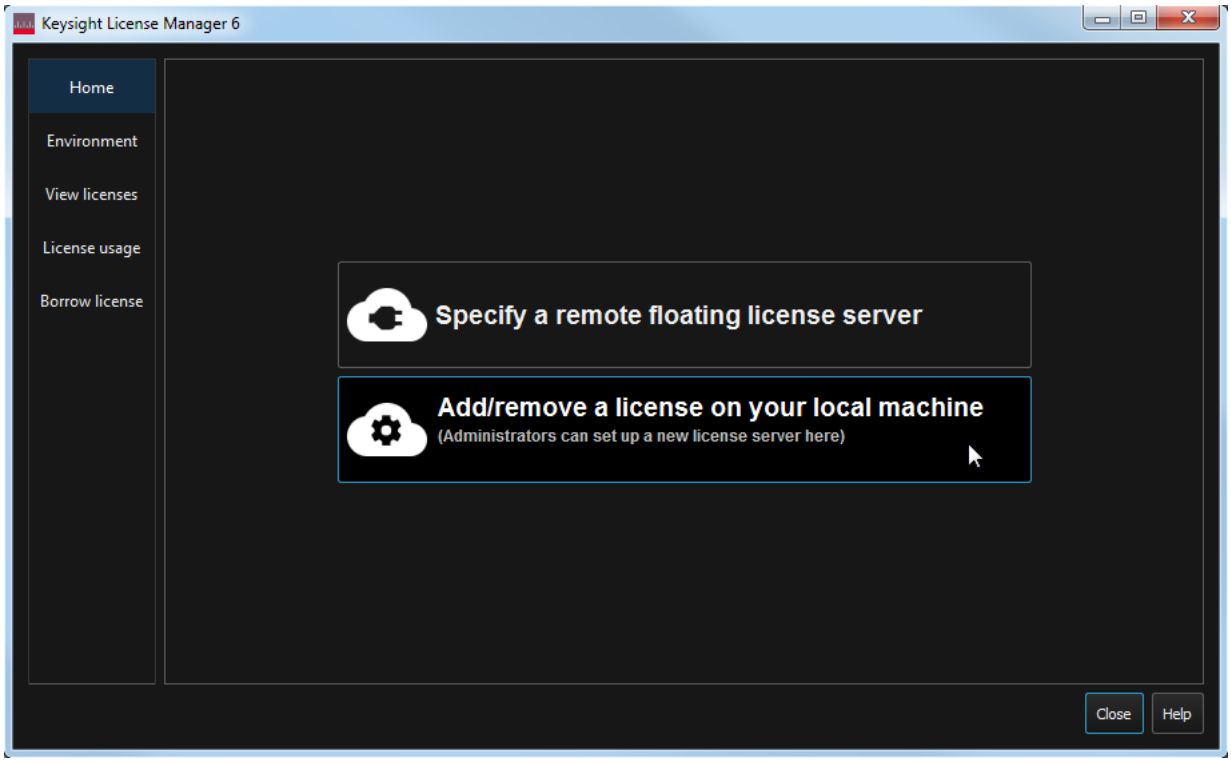

Figure 4 Home menu options to install licenses on Keysight License Manager 6

For more information regarding installation of procured licenses on Keysight License Manager 6, refer to Keysight License Manager 6 Supporting Documentation.

Making Hardware Connections for Compliance Testing

The required hardware and interconnections depend on whether a CDR is used or not. The N1077A CDR is recommended for single mode and multimode tests using a data rate of 32 GBd, while the N1078A clock recovery is recommended for single mode tests only using a data rate of 64 GBd. More recent models of N1092A/B oscilloscopes support in-built CDR. An external CDR is not required in these cases. The following table shows the compatibility information for the supported DCA-M oscilloscopes and clock data recovery.

Table 2 Supported DCA Oscilloscope and N107xA CDR configurations

DCA Model	In-built CDR	N1077A CDR	N1078A CDR	Without CDR
N1092A	▪			
N1092A		▪		
N1092A			▪	
N1092A				▪
N1092B	▪			
N1092B		▪		
N1092B			▪	
N1092B				▪
N1092C		▪		
N1092C			▪	
N1092C				▪
N1092D		▪		
N1092D			▪	
N1092D				▪
N1092E		▪		
N1092E			▪	
N1092E				▪
N1000A-N1030x		▪	▪	▪

Connection Diagram for DCA-M when an external CDR is used

Make the connections between the instruments as shown below when an external CDR is used.

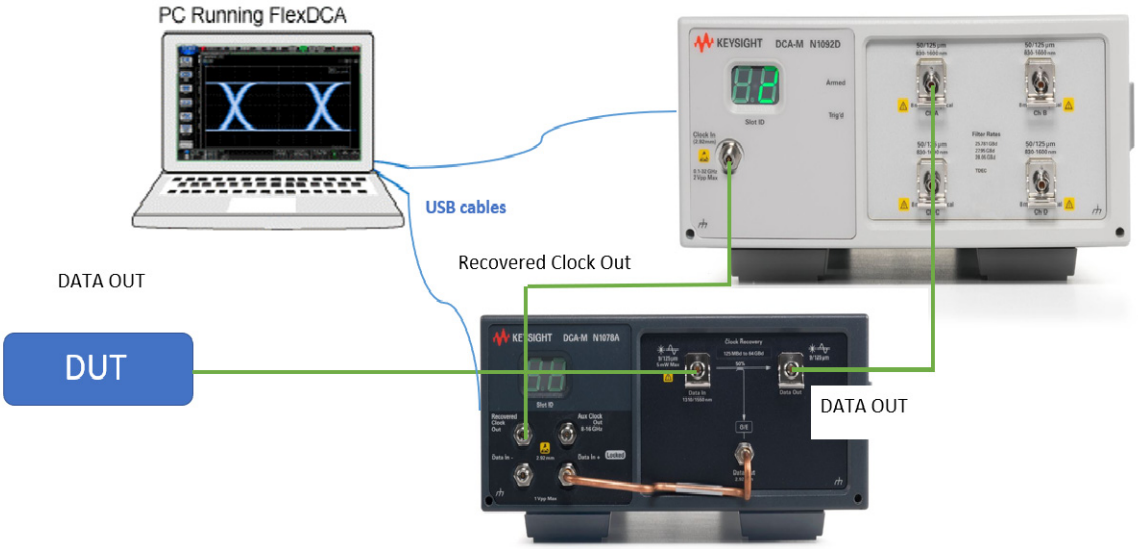

Figure 5 Connection diagram when an external CDR is used

Connection Diagram for DCA-M when an external CDR is not used

Make the connections between the instruments as shown below when an external CDR is not used.

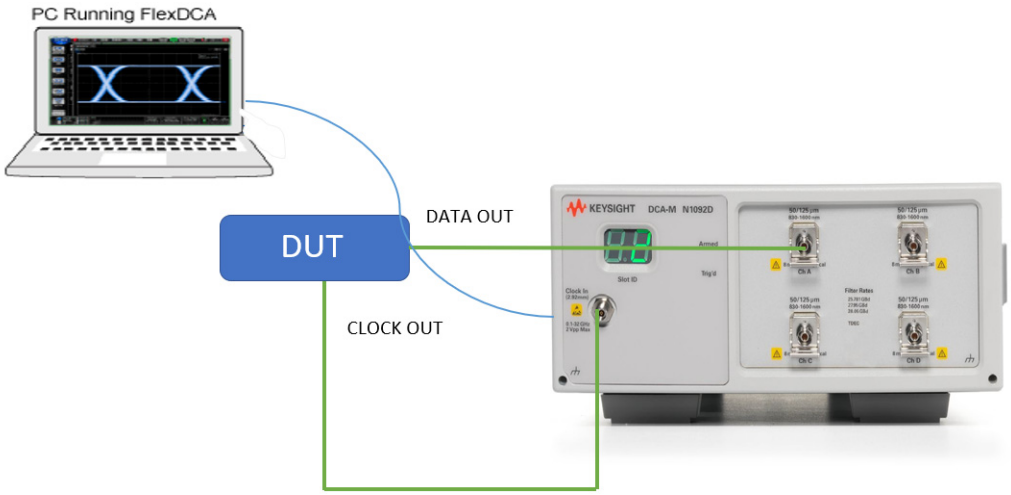

Figure 6 Connection diagram when an external CDR is not used

Connection Diagram for N1000A-N1030x when an external CDR is used

Make the connections between the instruments as shown below when an external CDR is used.

Figure 7 Connection diagram when an external CDR is used

Connection Diagram for N1000A-N1030x when an external CDR is not used

Make the connections between the oscilloscope and the DUT as shown below when an external CDR is not used.

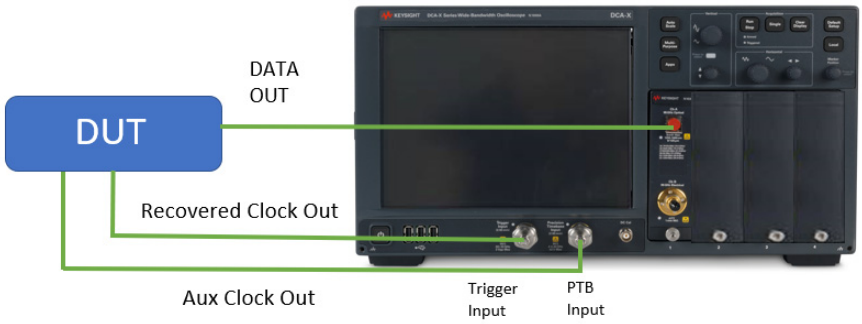

Figure 8 Connection diagram when an external CDR is not used

Connecting N1010A FlexDCA to N109X or N1000A-N1030x Oscilloscope and N107X

Perform the following steps to connect your N109X oscilloscope or N1000A-N1030x oscilloscope-optical module combination with N107X clock data recovery using FlexDCA:

1 Launch FlexDCA.

2 When FlexDCA starts, the **Extended Module Configuration** window is displayed automatically. If the **Extended Module Configuration** window does not appear, from the FlexDCA interface's main menu, click **Setup > Configure Extended Modules...**.

3 Configure Slot 7 to be the N109X or N1000A-N1030x oscilloscope-optical module combination module.

4 Configure Slot 8 to be the N107X module.

5 Remove any other N109X/N107X that is configured for Slot 5 and Slot 6.

6 Click **Close** to exit the **Extended Module Configuration** window.

7 Once the connection is established, you may proceed to launch the DCA Optical Compliance Test Application on your PC.

Starting the DCA Optical Compliance Test Application

NOTE Before running the DCA Optical automated tests, you must calibrate the oscilloscope. After the oscilloscope has been calibrated, you are ready to start the DCA Optical Compliance Test Application and perform the measurements.

1 From the FlexDCA's main menu, choose **Apps > Automated Test Apps > N1095BSCA DCA Optical Test App.**

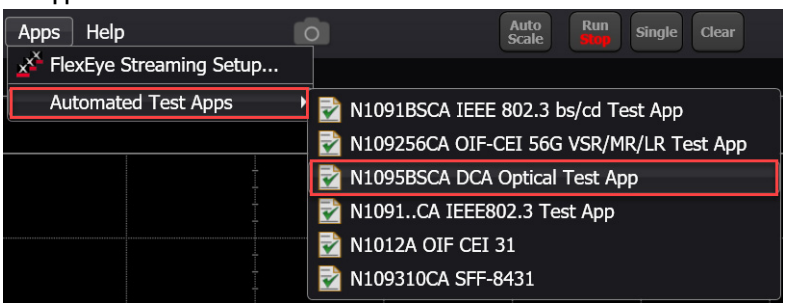

Figure 9 Starting the DCA Optical Compliance Test Application

Alternatively, launch the N1095BSCA DCA Optical Test App from the Start menu of the Windows operating system. Choose **Start > Keysight FlexDCA Applications > Launch DCA Optical Test App**. The DCA Optical Compliance Test Application is displayed.

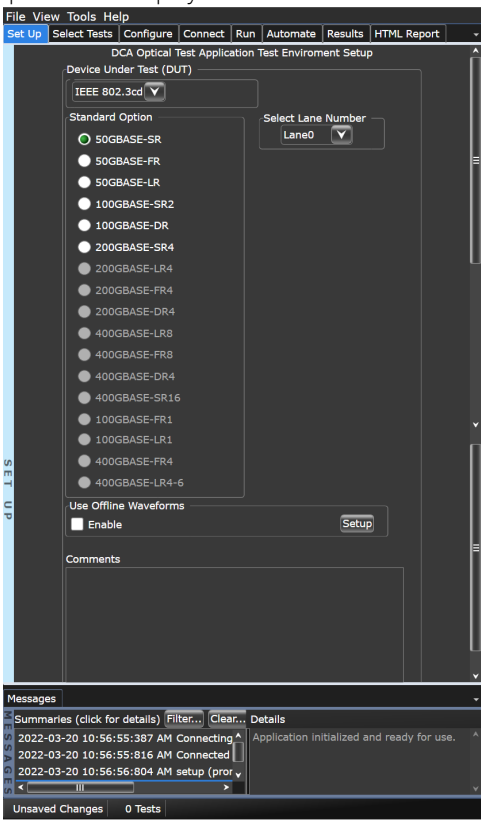

Figure 10 The DCA Optical Compliance Test Application's default window

NOTE If you have installed N1092x-30A option for your DCA-M Oscilloscope, the N1095BSCA application will support both single mode (SM) and multimode (MM) standards and show them as "enabled". However, if you have installed N1092x-40A option for your DCA-M oscilloscope, only SM standards will be enabled. The MM standards will appear “grayed out” in this case.

Figure 9 shows the procedure to launch the DCA Optical Compliance Test Application and Figure 10 shows the DCA Optical Compliance Test Application default window. The tabs in the main pane show the steps you take in running the automated tests:

Tab	Description
Set Up	Lets you identify and set up the test environment, including information about the device under test.
Select Tests	Lets you select the tests you want to run. The tests are organized hierarchically so you can select all tests in a group. After tests are run, status indicators show which tests have passed, failed, or not been run, and there are indicators for the test groups.
Configure	Lets you configure test parameters. This information appears in the HTML report.
Connect	Shows you how to connect the oscilloscope to the device under test for the tests to be run.
Run Tests	Starts the automated tests. If the connections to the device under test need to be changed while multiple tests are running, the tests pause, show you how to change the connection, and wait for you to confirm that the connections have been changed before continuing.
Automation	Lets you construct scripts of commands that drive execution of the application.
Results	Contains more detailed information about the tests that have been run. You can change the thresholds at which marginal or critical warnings appear.
HTML Report	Shows a compliance test report that can be printed.

NOTE The configuration options shown under the **Set Up** tab of the DCA Optical Compliance Test Application main window dictate the availability of various tests under the Select Tests tab.

Making a Measurement

Perform the following steps to make a measurement using the DCA Optical Compliance Test application:

1 In the **Set Up** tab (shown in Figure 10), select the **Standard Option**, **Lane Number**, and whether you want to use offline waveforms. Table 1 shows a comprehensive list of the tests that are filtered in the **Select Tests** tab for each selection of **Standard Option**.

2 In the **Select Tests** tab, select one or more tests, which appear according to the configuration done under the **Set Up** tab.

3 In the **Configure** tab, you may change the values assigned to one or more options to cater to the compliance requirements for the selected tests. By default, the N1095BSCA DCA Optical Compliance Application sets optimum values for each configuration parameter.

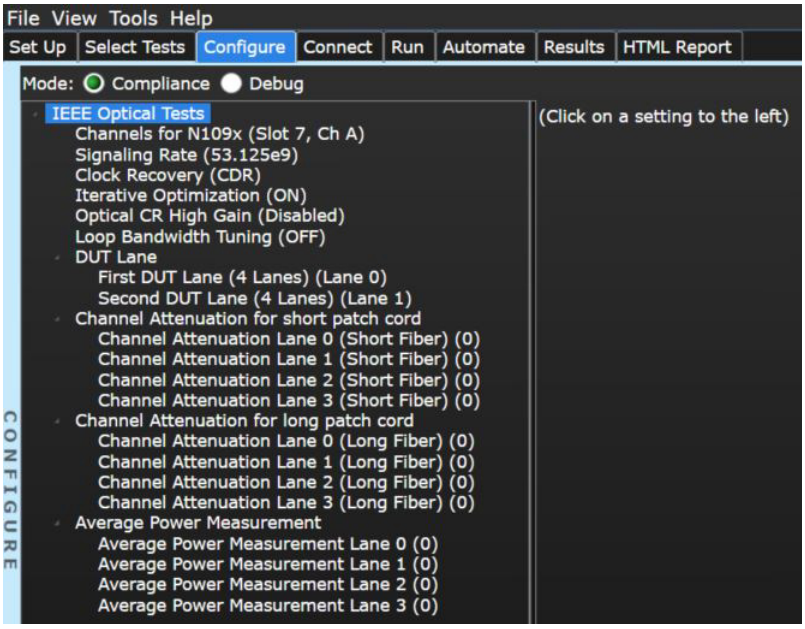

Figure 11 Configure tab in the DCA Optical Compliance Test Application

4 In the **Connect** tab, view the instructions along with the connection digram to ensure that all requirements for the physical setup of the testing instruments and the DUT are met. Click **Connection Completed** to indicate to the Compliance Test Application that the required hardware setup is complete.

5 Click **Run Tests** under this tab if you wish to start running tests. However, if you wish to modify the run settings before performing test runs, switch to the **Run** tab.

6 In the **Run** tab, you may optionally modify one or more settings as described below, else click **Run** to start the test runs:

- Determine the number of times each test must be run.
- Add tags for the test results to provide additional information about the results (such as required measurement settings or test observations). To know more about result tags, refer to the *Configuring Result Tags* section in the *Keysight N1095BSCA DCA Optical Test Application Online Help*.
- Automate specific actions in case of events.
- Store results for certain type of test trials only.
- Send email notifications if the test runs pause or stop during runs.

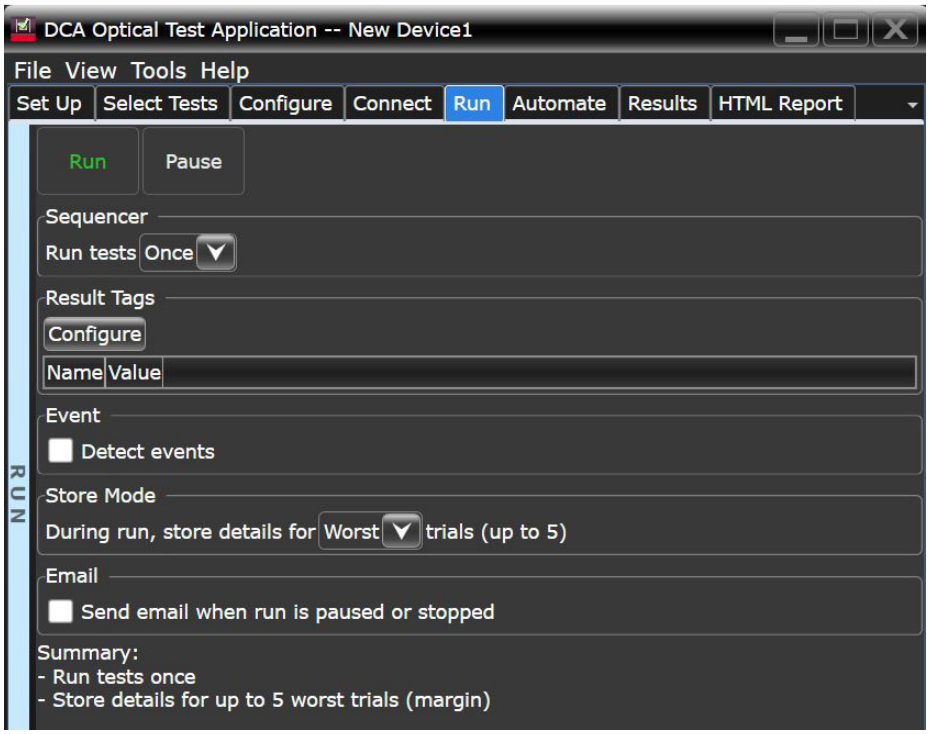

Figure 12 Run tab in the DCA Optical Compliance Test Application

7 In the **Automate** tab, you may optionally configure automation scripts to perform specific actions/sequences within the Compliance Test Application.

8 In the **Results** tab, which appears automatically after test runs are complete, view the test results displayed for each selected test.

9 In the **HTML Report** tab, view a comprehensive report for each test within the Application. The Compliance Test Application enables exporting these results in CSV, PDF, or HTML format for the purpose of analysis.

To perform a high-level analysis on each measurement data, you may upload the results to the KS6800A Data analytics software. Refer to the *Online Help* for this application to understand this feature.

3 200GBASE Tests

This section provides the Methods of Implementation (MOIs) for the 200GBASE tests using a supported Keysight DCA oscilloscope and the DCA Optical Compliance Test Application.

Connection for 200GBASE Tests

When performing the 200GBASE tests, the DCA Optical Compliance Test Application will prompt you to make the proper connections. The connections for these tests depend on the specific options selected under the **Set Up** tab. Refer to the **Connect** tab in the DCA Optical Compliance Test Application for the exact connections. Additionally, refer to "Making Hardware Connections for Compliance Testing" on page 26.

You can configure other settings used in these tests in the **Configure** tab of the DCA Optical Compliance Test Application.

Test Procedure

1. Start the automated test application as described in "Starting the DCA Optical Compliance Test Application" on page 21.
2. In the DCA Optical Compliance Test Application, click the **Set Up** tab.
3. Select the required specification from the drop-down list.
4. Select the specific 200GBASE transmission standard in the **Standard Option section.** The available 200GBASE transmission standards include 200GBASE-DR4, 200GBASE-FR4, 200GBASE-LR4, and 200GBASE-SR4.
5. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.
6. Follow the DCA Optical Compliance Test Application's task flow to set up the configuration options, run the tests, and view the tests results.

200GBASE-DR4 Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 3.40 dB.

References

See Table 121-6 and Section 121.8.5 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 13.28125 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use 'IEEE 802.3bs Final' as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 3.40 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that the Average (Optical) Launch Power of the OFF transmitter for the selected lane is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -16 dBm.

References

See Table 121-6 of IEEE 802.3-2018.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -16 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that the signaling rate of the signal transmitted by the DUT for the selected lane is within the conformance limits.

For conformance, the signaling rate for the selected lane should be greater than or equal to 26.562400000 GBd and less than or equal to 26.562600000 GBd.

References

See Table 121-6 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 26.5625 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the signaling rate of the signal transmitted by the DUT must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that the average (optical) launch power of the signal transmitted by the DUT for the selected lane is within the conformance limits.

For conformance, the average (optical) launch power for the selected lane should be greater than or equal to -5.10 dBm and less than or equal to 3.00 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table Reference 121-6 and Section 121.8.3 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -5.10 dBm and 3.00 dBm.

Expected/Observable Results

The measured value of the average (optical) launch power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the outer optical modulation amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer optical modulation amplitude (OMA_{outer}) for the selected lane should be greater than or equal to -3.00 dBm and less than or equal to 2.80 dBm.

References

See Table 121-6 and Section 121.8.4 of IEEE 802.3-2018.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer OMA in dBm.
6 Compare the Outer OMA with respect to the range between -3.00 dBm and 2.80 dBm.

Expected/Observable Results

The measured value of the outer optical modulation amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the outer extinction ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer extinction ratio (OER) should be greater than 3.50 dB.

References

See Table 121-6 and Section 121.8.6 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dBm.
6 Compare the Outer Extinction Ratio with 3.50 dBm.

Expected/Observable Results

The measured value of the outer extinction ratio (OER) for the selected lane must be within the conformance limit.

Launch power in OMAouter minus TDECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the Launch power in OMAouter minus TDECQ, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Launch power in OMAouter minus TDECQ should be greater than -4.40 dBm.

References

See Table 121-6 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the OOMA and TDECQ results.
4 The reporting value will be the result of OOMA – TDECQ.

Expected/Observable Results

The measured value of the Launch power in OMAouter minus TDECQ for the selected lane must be within the conformance limit.

Relative Intensity Noise (RIN21.4 OMA)

Test Overview

The purpose of this test is to verify that the Relative Intensity Noise (RIN21.4 OMA) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Relative Intensity Noise (RIN21.4 OMA) should be less than or equal to -132.00 dB/Hz.

References

See Table 121-6 in Section 121.8.7 of IEEE 802.3-2018.

Test Procedure

1 Set device to square wave.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope.
5 Measure RIN test in Jitter Mode.
6 Compare the RIN with -132 dB/Hz.

Expected/Observable Results

The measured value of the Relative Intensity Noise (RIN21.4 OMA) of the signal transmitted by the DUT must be within the conformance limit.

200GBASE-FR4 Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 3.30 dB.

References

See Table 122-9 and Section 122.8.5 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 13.28125 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use ‘IEEE 802.3bs Final’ as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 3.30 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -30 dBm.

References

See Table 122-9 of IEEE 802.3-2018.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -30 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the signaling rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the signaling rate for the selected lane should be greater than or equal to 26.562400000 GBd and less than or equal to 26.562600000 GBd.

References

See Table 122-9 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 26.5625 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the signaling rate of the signal for the selected lane must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the average (optical) launch power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the average (optical) launch power for the selected lane should be greater than or equal to -4.20 dBm and less than or equal to 4.70 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table Reference 122-9 and Section 122.8.3 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -4.20 Bm and 4.70 dBm.

Expected/Observable Results

The measured value of the average (optical) launch power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the outer optical modulation amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer optical modulation amplitude (OMA_{outer}) for the selected lane should be greater than or equal to -1.20 dBm and less than or equal to 4.50 dBm.

References

See Table 122-9 and Section 122.8.4 of IEEE 802.3-2018.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.
2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer OMA in dBm.
6 Compare the Outer OMA with respect to the range between -1.20 dBm and 4.50 dBm.

Expected/Observable Results

The measured value of the outer optical modulation amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the outer extinction ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer extinction ratio (OER) should be greater than 3.50 dB.

References

See Table 122-9 and Section 122.8.6 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dBm.
6 Compare the Outer Extinction Ratio with 3.50 dBm.

Expected/Observable Results

The measured value of the outer extinction ratio (OER) for the selected lane must be within the conformance limit.

Launch power in OMAouter minus TDECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the Launch power in OMAouter minus TDECQ, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Launch power in OMAouter minus TDECQ should be greater than or equal to -2.6 dBm for extinction ratio >= 4.5 dB and greater than or equal to -2.5 dBm for extinction ratio < 4.5 dB.

References

See Table 122-9 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the OOMA and TDECQ results.
4 The reporting value will be the result of OOMA – TDECQ.

Expected/Observable Results

The measured value of the Launch power in OMAouter minus TDECQ for the selected lane must be within the conformance limit.

Relative Intensity Noise (RIN17.1 OMA)

Test Overview

The purpose of this test is to verify that the Relative Intensity Noise (RIN17.1 OMA) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Relative Intensity Noise (RIN17.1 OMA) should be less than or equal to -132.00 dB/Hz.

References

See Table 122-9 and Section 122.8.7 of IEEE 802.3-2018.

Test Procedure

1 Set device to square wave.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope.
5 Measure RIN test in Jitter Mode.
6 Compare the RIN with -132 dB/Hz.

Expected/Observable Results

The measured value of the Relative Intensity Noise (RIN17.1 OMA) of the signal transmitted by the DUT must be within the conformance limit.

Difference in Launch Power for any two lanes

Test Overview

The purpose of this test is to verify that the difference in Launch Power of the signal transmitted by the DUT for any two lanes is within the conformance limits.

For conformance, the difference in Launch Power for any two lanes should be less than or equal to 4 dB.

References

See Table 122-9 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c DUT Lane (default value = Lane 0 for first Lane and Lane 1 for second Lane)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the First DUT Lane in dBm.
6 Measure Average Power of the Second DUT Lane in dBm.
7 The reporting value will be the Average Power of the First DUT Lane - Average Power of the Second DUT Lane.
8 Compare the result with 4 dB.

Expected/Observable Results

The measured value of the difference in Launch Power for any two lanes must be within the conformance limit.

200GBASE-LR4 Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 3.40 dB.

References

See Table 122-9 and Section 122.8.5 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 13.28125 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use ‘IEEE 802.3bs Final’ as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 3.40 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -30 dBm.

References

See Table 122-9 of IEEE 802.3-2018.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -30 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the signaling rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the signaling rate for the selected lane should be greater than or equal to 26.562400000 GBd and less than or equal to 26.562600000 GBd.

References

See Table 122-9 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 26.5625 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the signaling rate of the signal for the selected lane must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the average (optical) launch power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the average (optical) launch power for the selected lane should be greater than or equal to -3.40 dBm and less than or equal to 5.30 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table Reference 122-9 and Section 122.8.3 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -3.40 dBm and 5.30 dBm.

Expected/Observable Results

The measured value of the average (optical) launch power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the outer optical modulation amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer optical modulation amplitude (OMA_{outer}) for the selected lane should be greater than or equal to -400 mdBm and less than or equal to 5.10 dBm.

References

See Table 122-9 and Section 122.8.4 of IEEE 802.3-2018.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.

5 Measure Outer OMA in dBm.

6 Compare the Outer OMA in the range between -400 mdBm and 5.10 dBm.

Expected/Observable Results

The measured value of the outer optical modulation amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the outer extinction ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer extinction ratio (OER) should be greater than 3.50 dB.

References

See Table 122-9 and Section 122.8.6 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.

a Set Signaling Rate to 26.5625e9.

b Clock Recovery (default value = CDR)

c Channel Attenuation (default value = 0 dB)

4 Acquire signal in Eye mode.

5 Measure Outer Extinction Ratio in dBm.

6 Compare the Outer Extinction Ratio with 3.50 dBm.

Expected/Observable Results

The measured value of the outer extinction ratio (OER) for the selected lane must be within the conformance limit.

Launch power in OMAouter minus TDECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the Launch power in OMAouter minus TDECQ, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Launch power in OMAouter minus TDECQ should be greater than or equal to -1.8 dBm for extinction ratio >= 4.5 dB and greater than or equal to -1.7 dBm for extinction ratio < 4.5 dB.

References

See Table 122-9 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the OOMA and TDECQ results.
4 The reporting value will be the result of OOMA – TDECQ.

Expected/Observable Results

The measured value of the Launch power in OMAouter minus TDECQ for the selected lane must be within the conformance limit.

Relative Intensity Noise (RIN15.6 OMA)

Test Overview

The purpose of this test is to verify that the Relative Intensity Noise (RIN15.6 OMA) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Relative Intensity Noise (RIN15.6 OMA) should be less than or equal to -132.00 dB/Hz.

References

See Table 122-9 and Section 122.8.7 of IEEE 802.3-2018.

Test Procedure

1 Set device to square wave.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope.
5 Measure RIN test in Jitter Mode.
6 Compare the RIN with -132 dB/Hz.

Expected/Observable Results

The measured value of the Relative Intensity Noise (RIN15.6 OMA) of the signal transmitted by the DUT must be within the conformance limit.

Difference in Launch Power for any two lanes

Test Overview

The purpose of this test is to verify that the difference in Launch Power of the signal transmitted by the DUT for any two lanes is within the conformance limits.

For conformance, the difference in Launch Power for any two lanes should be less than or equal to 4dB.

References

See Table 122-9 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c DUT Lane (default value = Lane 0 for first Lane and Lane 1 for second Lane)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the First DUT Lane in dBm.
6 Measure Average Power of the Second DUT Lane in dBm.
7 The reporting value will be the Average Power of the First DUT Lane - Average Power of the Second DUT Lane.
8 Compare the result with 4 dB.

Expected/Observable Results

The measured value of the difference in Launch Power for any two lanes must be within the conformance limit.

200GBASE-SR4 Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 4.50 dB.

References

See Table 138-8 and Section 138.8.5 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4 MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 11.20 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use ‘IEEE 802.3cd-2018’ as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 4.50 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) for the selected lane must be within the conformance limit.

TDECQ minus Ceq

Test Overview

The purpose of this test is to verify that for the selected lane, the TDECQ minus Ceq, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ minus Ceq should be less than or equal to 4.5 dB.

References

See Table 138-8 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the TDECQ and Ceq results.

4 The reporting value will be the result of TDECQ – Ceq.

Expected/Observable Results

The measured value of the TDECQ minus Ceq for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -30 dBm.

References

See Table 138-8 of IEEE 802.3cd-2018.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -30 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the signaling rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the signaling rate for the selected lane should be greater than or equal to 26.562400000 GBd and less than or equal to 26.562600000 GBd.

References

See Table 138-8 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 26.5625 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the signaling rate of the signal for the selected lane must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the average (optical) launch power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the average (optical) launch power for the selected lane should be greater than or equal to -6.50 dBm and less than or equal to 4.00 dBm.

NOTE **The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.**

References

See Table 138-8 and Section 138.8.3 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -6.50 dBm and 4.00 dBm.

Expected/Observable Results

The measured value of the average (optical) launch power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the outer optical modulation amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer optical modulation amplitude (OMA_{outer}) for the selected lane should be greater than or equal to -4.50 dBm and less than or equal to 3.00 dBm.

References

See Table 138-8 and Section 138.8.4 of IEEE 802.3cd-2018.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.

d Set Signaling Rate to 26.5625e9.

e Clock Recovery (default value = CDR)

f Channel Attenuation (default value = 0 dB)

4 Acquire signal in Eye mode.

5 Measure Outer OMA in dBm.

6 Compare the Outer OMA in the range between -4.50 dBm and 3.00 dBm.

Expected/Observable Results

The measured value of the outer optical modulation amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the outer extinction ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer extinction ratio (OER) should be greater than 3.00 dB.

References

See Table 138-8 and Section 138.8.6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dBm.
6 Compare the Outer Extinction Ratio with 3.00 dBm.

Expected/Observable Results

The measured value of the outer extinction ratio (OER) for the selected lane must be within the conformance limit.

Transmitter transition time

Test Overview

The purpose of this test is to verify that the transmitter transition time of the signal transmitted by the DUT is within the conformance limits.

For conformance, the transmitter transition time should be less than or equal to 34 ps.

References

See Table 138-8 and Section 138.8.7 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to square wave or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Transition Time.
6 Compare the Transition Time with 34 ps.

Expected/Observable Results

The measured value of the transmitter transition time must be within the conformance limit.

Launch power in OMAouter minus TDECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the Launch power in OMAouter minus TDECQ, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Launch power in OMAouter minus TDECQ should be greater than -5.9 dBm.

References

See Table 138-8 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the OOMA and TDECQ results.
4 The reporting value will be the result of OOMA – TDECQ.

Expected/Observable Results

The measured value of the Launch power in OMAouter minus TDECQ for the selected lane must be within the conformance limit.

Relative Intensity Noise (RIN12 OMA)

Test Overview

The purpose of this test is to verify that the Relative Intensity Noise (RIN12 OMA) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Relative Intensity Noise (RIN12 OMA) should be less than or equal to -128.00dB/Hz.

References

See Table 138-8 and Section 138.8.8 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to square wave.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope.
5 Measure RIN test in Jitter Mode.
6 Compare the RIN with -128 dB/Hz.

Expected/Observable Results

The measured value of the Relative Intensity Noise (RIN12 OMA) of the signal transmitted by the DUT must be within the conformance limit.

4 400GBASE Tests

This section provides the Methods of Implementation (MOIs) for the 400GBASE tests using a supported Keysight DCA oscilloscope and the DCA Optical Compliance Test Application.

Connection for 400GBASE Tests

When performing the 400GBASE tests, the DCA Optical Compliance Test Application will prompt you to make the proper connections. The connections for these tests depend on the specific transmission standard selected under the **Set Up** tab. Refer to the **Connect** tab in the DCA Optical Compliance Test Application for the exact connections. Additionally, refer to “Making Hardware Connections for Compliance Testing" on page 26.

You can configure other settings used in these tests in the **Configure** tab of the DCA Optical Compliance Test Application.

Test Procedure

1. Start the automated test application as described in “Starting the DCA Optical Compliance Test Application" on page 21.
2. In the DCA Optical Compliance Test Application, click the **Set Up** tab.
3. Select the required specification from the drop-down list.
4. Select the specific 400GBASE transmission standard in the **Standard Option section.** The available 400GBASE transmission standards include 400GBASE-FR8, 400GBASE-LR8, 400GBASE-SR16, and 400GBASE-DR4.
5. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.
6. Follow the DCA Optical Compliance Test Application’s task flow to set up the configuration options, run the tests, and view the tests results.

400GBASE-FR8 Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 3.10 dB.

References

See Table 122-10 and Section 122.8.5 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 13.28125 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use 'IEEE 802.3bs Final' as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 3.10 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -30 dBm.

References

See Table 122-10 of IEEE 802.3-2018.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -30 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the signaling rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the signaling rate for the selected lane should be greater than or equal to 26.562400000 GBd and less than or equal to 26.562600000 GBd.

References

See Table 122-10 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 26.5625 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the signaling rate of the signal transmitted by the DUT must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the average (optical) launch power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the average (optical) launch power for the selected lane should be greater than or equal to -3.50 dBm and less than or equal to 5.30 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table 122-10 and Section 122.8.3 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -3.50 dBm and 5.30 dBm.

Expected/Observable Results

The measured value of the average (optical) launch power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the outer optical modulation amplitude (OMA) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer optical modulation amplitude (OMA_{outer}) for the selected lane should be greater than or equal to -500 mdBm and less than or equal to 5.50 dBm.

References

See Table 122-10 and Section 122.8.4 of IEEE 802.3-2018.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros..
2 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)

3 Acquire signal in Eye mode.
4 Measure Outer OMA in dBm.
5 Compare the Outer OMA in the range between -500 mdBm and 5.50 dBm.

Expected/Observable Results

The measured value of the outer optical modulation amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the outer extinction ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer extinction ratio (OER) should be greater than 3.50 dB.

References

See Table 122-10 and Section 122.8.6 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dBm.
6 Compare the Outer Extinction Ratio with 3.50 dBm.

Expected/Observable Results

The measured value of the outer extinction ratio (OER) for the selected lane must be within the conformance limit.

Launch power in OMAouter minus TDECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the Launch power in OMAouter minus TDECQ, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Launch power in OMAouter minus TDECQ should be greater than or equal to -1.9 dBm for extinction ratio >= 4.5 dB and greater than or equal to -1.8 dBm for extinction ratio < 4.5 dB.

References

See Table 122-10 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the OOMA and TDECQ results.
4 The reporting value will be the result of OOMA – TDECQ.

Expected/Observable Results

The measured value of the Launch power in OMAouter minus TDECQ for the selected lane must be within the conformance limit.

Relative Intensity Noise (RIN17.1 OMA)

Test Overview

The purpose of this test is to verify that the Relative Intensity Noise (RIN17.1 OMA) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Relative Intensity Noise (RIN17.1 OMA) should be less than or equal to -132.00 dB/Hz.

References

See Table 122-10 and Section 122.8.7 of IEEE 802.3-2018.

Test Procedure

1 Set device to square wave.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope.
5 Measure RIN test in Jitter Mode.
6 Compare the RIN with -132 dB/Hz.

Expected/Observable Results

The measured value of the Relative Intensity Noise (RIN17.1 OMA) of the signal transmitted by the DUT must be within the conformance limit.

Difference in Launch Power for any two lanes

Test Overview

The purpose of this test is to verify that the difference in Launch Power of the signal transmitted by the DUT for any two lanes is within the conformance limits.

For conformance, the difference in Launch Power for any two lanes should be less than or equal to 4dB.

References

See Table 122-10 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c DUT Lane (default value = Lane 0 for first Lane and Lane 1 for second Lane)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the First DUT Lane in dBm.
6 Measure Average Power of the Second DUT Lane in dBm.
7 The reporting value will be the Average Power of the First DUT Lane - Average Power of the Second DUT Lane.
8 Compare the result with 4 dB.

Expected/Observable Results

The measured value of the difference in Launch Power for any two lanes must be within the conformance limit.

400GBASE-LR8 Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 3.30 dB.

References

See Table 122-10 and Section 122.8.5 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 13.28125 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use ‘IEEE 802.3bs Final’ as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 3.30 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -30 dBm.

References

See Table 122-10 of IEEE 802.3-2018.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -30 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the signaling rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the signaling rate for the selected lane should be greater than or equal to 26.562400000 GBd and less than or equal to 26.562600000 GBd.

References

See Table 122-10 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 26.5625 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the signaling rate of the signal for the selected lane must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the average (optical) launch power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the average (optical) launch power for the selected lane should be greater than or equal to -2.80 dBm and less than or equal to 5.30 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table Reference 122-10 and Section 122.8.3 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -2.80 dBm and 5.30 dBm.

Expected/Observable Results

The measured value of the average (optical) launch power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the outer optical modulation amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer optical modulation amplitude (OMA_{outer}) for the selected lane should be greater than or equal to 200 mdBm and less than or equal to 5.70 dBm.

References

See Table 122-10 and Section 122.8.4 of IEEE 802.3-2018.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.
2 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
3 Acquire signal in Eye mode.
4 Measure Outer OMA in dBm.
5 Compare the Outer OMA with respect to the range between 200 mdBm and 5.70 dBm.

Expected/Observable Results

The measured value of the outer optical modulation amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the outer extinction ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer extinction ratio (OER) should be greater than 3.50 dB.

References

See Table 122-10 and Section 122.8.6 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dBm.
6 Compare the Outer Extinction Ratio with 3.50 dBm.

Expected/Observable Results

The measured value of the outer extinction ratio (OER) for the selected lane must be within the conformance limit.

Launch power in OMAouter minus TDECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the Launch power in OMAouter minus TDECQ, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Launch power in OMAouter minus TDECQ should be greater than or equal to -1.2 dBm for extinction ratio >= 4.5 dB and greater than or equal to -1.1 dBm for extinction ratio < 4.5 dB.

References

See Table 122-10 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Get the OOMA and TDECQ results.
4 The reporting value will be the result of OOMA – TDECQ.

Expected/Observable Results

The measured value of the Launch power in OMAouter minus TDECQ for the selected lane must be within the conformance limit.

Relative Intensity Noise (RIN15.6 OMA)

Test Overview

The purpose of this test is to verify that the Relative Intensity Noise (RIN15.6 OMA) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Relative Intensity Noise (RIN15.6 OMA) should be less than or equal to -132.00 dB/Hz.

References

See Table 122-10 and Section 122.8.7 of IEEE 802.3-2018.

Test Procedure

1 Set device to square wave.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope.
5 Measure RIN test in Jitter Mode.
6 Compare the RIN with -132 dB/Hz.

Expected/Observable Results

The measured value of the Relative Intensity Noise (RIN15.6 OMA) of the signal transmitted by the DUT must be within the conformance limit.

Difference in Launch Power for any two lanes

Test Overview

The purpose of this test is to verify that the difference in Launch Power of the signal transmitted by the DUT for any two lanes is within the conformance limits.

For conformance, the difference in Launch Power for any two lanes should be less than or equal to 4dB.

References

See Table 122-10 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c DUT Lane (default value = Lane 0 for first Lane and Lane 1 for second Lane)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the First DUT Lane in dBm.
6 Measure Average Power of the Second DUT Lane in dBm.
7 The reporting value will be the Average Power of the First DUT Lane - Average Power of the Second DUT Lane.
8 Compare the result with 4 dB.

Expected/Observable Results

The measured value of the difference in Launch Power for any two lanes must be within the conformance limit.

400GBASE-SR16 Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure (TDEC) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDEC should be less than or equal to 4.30 dB.

References

See Table 95-6 and Section 95.8.5 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS31or Scrambled idle Connection.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 10 MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 12.6 GHz.
5 Measure TDECQ and Ceq results.
   a Set Histogram window width to 0.04 UI.
   b Set Left Histogram Position to 0.40 UI.
   c Set Right Histogram Position to 0.60 UI.
   d Set BER to 2.4E-4.
6 Compare the TDECQ with 4.30 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure (TDEC) for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -30 dBm.

References

See Table 95-6 of IEEE 802.3-2018.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -30 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the signaling rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the signaling rate for the selected lane should be greater than or equal to 26.562400000 GBd and less than or equal to 26.562600000 GBd.

References

See Section 123.7.1 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 26.5625 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the signaling rate of the signal for the selected lane must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the average (optical) launch power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the average (optical) launch power for the selected lane should be greater than or equal to -8.40 dBm and less than or equal to 2.40 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table Reference 95-6 and Section 95.8.3 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -8.40 dBm and 2.40 dBm.

Expected/Observable Results

The measured value of the average (optical) launch power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the optical modulation amplitude (OMA) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the optical modulation amplitude (OMA) for the selected lane should be greater than or equal to -6.40 dBm and less than or equal to 3.00 dBm.

References

See Table 95-6 and Section 95.8.4 of IEEE 802.3-2018.

Test Procedure

1 Refer to the Connect tab to connect the scope to the DUT signals.
2 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
3 Acquire signal in Eye mode.
4 Measure Outer OMA in dBm.
5 Compare the Outer OMA in the range between -6.40 dBm and 3.00 dBm.

Expected/Observable Results

The measured value of the optical modulation amplitude (OMA) for the selected lane must be within the conformance limit.

Extinction Ratio

Test Overview

The purpose of this test is to verify that for the selected lane, the extinction ratio (ER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the extinction ratio (ER) should be greater than 2.00 dB.

References

See Table 95-6 and Section 95.8.6 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS13Q or Scrambled Idle.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Extinction Ratio in dBm.
6 Compare the Extinction Ratio with 2.00 dBm.

Expected/Observable Results

The measured value of the extinction ratio (ER) for the selected lane must be within the conformance limit.

Launch power in OMAouter minus TDEC

Test Overview

The purpose of this test is to verify that for the selected lane, the Launch power in OMAouter minus TDEC, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Launch power in OMAouter minus TDEC should be greater than -7.30 dBm.

References

See Table 95-6 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the OOMA and TDECQ results.
4 The reporting value will be the result of OMA – TDEC.

Expected/Observable Results

The measured value of the Launch power in OMAouter minus TDEC for the selected lane must be within the conformance limit.

400GBASE-DR4 Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 3.40 dB.

References

See Table 124-6 and Section 124.8.5 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 26.5625 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use ‘IEEE 802.3bs Final’ as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 3.40 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -15 dBm.

References

See Table 124-6 of IEEE 802.3-2018.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -15 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the signaling rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the signaling rate for the selected lane should be greater than or equal to 53.119687500 GBd and less than or equal to 53.130312500 GBd.

References

See Table 124-6 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 53.125 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the signaling rate of the signal for the selected lane must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the average (optical) launch power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the average (optical) launch power for the selected lane should be greater than or equal to -2.90 dBm and less than or equal to 4.00 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table 124-6 and Section 124.8.3 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -2.90 dBm and 4.00 dBm.

Expected/Observable Results

The measured value of the average (optical) launch power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the outer optical modulation amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer optical modulation amplitude (OMA_{outer}) for the selected lane should be greater than or equal to -800 mdBm and less than or equal to 4.20 dBm.

References

See Table 124-6 and Section 124.8.4 of IEEE 802.3-2018.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.
2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer OMA in dBm.
6 Compare the Outer OMA in the range between -800 mdBm and 4.20 dBm.

Expected/Observable Results

The measured value of the outer optical modulation amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the outer extinction ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer extinction ratio (OER) should be greater than 3.50 dB.

References

See Table 124-6 and Section 124.8.6 of IEEE 802.3-2018.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dBm.
6 Compare the Outer Extinction Ratio with 3.50 dBm.

Expected/Observable Results

The measured value of the outer extinction ratio (OER) for the selected lane must be within the conformance limit.

Launch power in OMAouter minus TDECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the Launch power in OMAouter minus TDECQ, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Launch power in OMAouter minus TDECQ should be greater than -2.20 dBm.

References

See Table 124-6 of IEEE 802.3-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the OOMA and TDECQ results.
4 The reporting value will be the result of OOMA – TDECQ.

Expected/Observable Results

The measured value of the Launch power in OMAouter minus TDECQ for the selected lane must be within the conformance limit.

5 50GBASE Tests

This section provides the Methods of Implementation (MOIs) for the 50GBASE tests using a supported Keysight DCA oscilloscope and the DCA Optical Compliance Test Application.

Connection for 50GBASE Tests

When performing the 50GBASE tests, the DCA Optical Compliance Test Application will prompt you to make the proper connections. The connections for these tests depend on the specific transmission standard selected under the **Set Up** tab. Refer to the **Connect** tab in the DCA Optical Compliance Test Application for the exact connections. Additionally, refer to “Making Hardware Connections for Compliance Testing" on page 26.

You can configure other settings used in these tests in the **Configure** tab of the DCA Optical Compliance Test Application.

Test Procedure

1. Start the automated test application as described in “Starting the DCA Optical Compliance Test Application" on page 21.
2. In the DCA Optical Compliance Test Application, click the **Set Up** tab.
3. Select the required specification from the drop-down list.
4. Select the specific 50GBASE transmission standard in the **Standard Option section.** The available 50GBASE transmission standards include 50GBASE-SR, 50GBASE-FR, and 50GBASE-LR.
5. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.
6. Follow the DCA Optical Compliance Test Application’s task flow to set up the configuration options, run the tests, and view the tests results.

50GBASE-SR Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 4.50 dB.

References

See Table 138-8 and Section 138.8.5 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4 MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 11.2 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use 'IEEE 802.3cd-2018' as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 4.50 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) for the selected lane must be within the conformance limit.

TDECQ minus Ceq

Test Overview

The purpose of this test is to verify that for the selected lane, the TDECQ minus Ceq, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ minus Ceq should be less than or equal to 4.5 dB.

References

See Table 138-8 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Get the TDECQ and Ceq results.
4 The reporting value will be the result of TDECQ – Ceq.

Expected/Observable Results

The measured value of the TDECQ minus Ceq for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -30 dBm.

References

See Table 138-8 of IEEE 802.3cd-2018.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -30 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the signaling rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the signaling rate for the selected lane should be greater than or equal to 26.562400000 GBd and less than or equal to 26.562600000 GBd.

References

See Table 138-8 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 26.5625 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the signaling rate of the signal for the selected lane must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the average (optical) launch power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the average (optical) launch power for the selected lane should be greater than or equal to -6.50 dBm and less than or equal to 4.00 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table 138-8 and Section 138.8.3 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -6.50 dBm and 4.00 dBm.

Expected/Observable Results

The measured value of the average (optical) launch power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the outer optical modulation amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer optical modulation amplitude (OMA_{outer}) for the selected lane should be greater than or equal to -4.50 dBm and less than or equal to 3.00 dBm.

References

See Table 138-8 and Section 138.8.4 of IEEE 802.3cd-2018.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.

a Set Signaling Rate to 26.5625e9.

b Clock Recovery (default value = CDR)

c Channel Attenuation (default value = 0 dB)

4 Acquire signal in Eye mode.

5 Measure Outer OMA in dBm.

6 Compare the Outer OMA in the range between -4.50 dBm and 3.00 dBm.

Expected/Observable Results

The measured value of the outer optical modulation amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the outer extinction ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer extinction ratio (OER) should be greater than 3.00 dB.

References

See Table 138-8 and Section 138.8.6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dBm.
6 Compare the Outer Extinction Ratio with 3.00 dBm.

Expected/Observable Results

The measured value of the outer extinction ratio (OER) for the selected lane must be within the conformance limit.

Transmitter transition time

Test Overview

The purpose of this test is to verify that the transmitter transition time of the signal transmitted by the DUT is within the conformance limits.

For conformance, the transmitter transition time should be less than or equal to 34 ps.

References

See Table 138-8 and Section 138.8.7 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to square wave or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Transition Time.
6 Compare the Transition Time with 34 ps.

Expected/Observable Results

The measured value of the transmitter transition time must be within the conformance limit.

Launch power in OMAouter minus TDECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the Launch power in OMAouter minus TDECQ, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Launch power in OMAouter minus TDECQ should be greater than -5.90 dBm.

References

See Table 138-8 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the OOMA and TDECQ results.
4 The reporting value will be the result of OOMA – TDECQ.

Expected/Observable Results

The measured value of the Launch power in OMAouter minus TDECQ for the selected lane must be within the conformance limit.

Relative Intensity Noise (RIN12 OMA)

Test Overview

The purpose of this test is to verify that the Relative Intensity Noise (RIN12 OMA) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Relative Intensity Noise (RIN12 OMA) should be less than or equal to -128.00dB/Hz.

References

See Table 138-8 and Section 138.8.8 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to square wave.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope.
5 Measure RIN test in Jitter Mode.
6 Compare the RIN with -128 dB/Hz.

Expected/Observable Results

The measured value of the Relative Intensity Noise (RIN12 OMA) of the signal transmitted by the DUT must be within the conformance limit.

50GBASE-FR Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 3.30 dB.

References

See Table 139-6 and Section 139.7.5 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 13.28125 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use 'IEEE 802.3cd-2018' as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 3.30 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) for the selected lane must be within the conformance limit.

TDECQ minus Ceq

Test Overview

The purpose of this test is to verify that for the selected lane, the TDECQ minus Ceq, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ minus Ceq should be less than or equal to 3.00 dB.

References

See Table 139-6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the TDECQ and Ceq results.

4 The reporting value will be the result of TDECQ – Ceq.

Expected/Observable Results

The measured value of the TDECQ minus Ceq for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -16 dBm.

References

See Table 139-6 of IEEE 802.3cd-2018.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -16 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the signaling rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the signaling rate for the selected lane should be greater than or equal to 26.562400000 GBd and less than or equal to 26.562600000 GBd.

References

See Table 139-6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 26.5625 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the signaling rate of the signal for the selected lane must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the average (optical) launch power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the average (optical) launch power for the selected lane should be greater than or equal to -4.10 dBm and less than or equal to 3.00 dBm.

NOTE **The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.**

References

See Table Reference 139-6 and Section 139.7.3 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -4.10 dBm and 3.00 dBm.

Expected/Observable Results

The measured value of the average (optical) launch power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the outer optical modulation amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer optical modulation amplitude (OMA_{outer}) for the selected lane should be greater than or equal to -2.50 dBm and less than or equal to 2.80 dBm.

References

See Table 139-6 and Section 139.7.4 of IEEE 802.3cd-2018.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.

a Set Signaling Rate to 26.5625e9.

b Clock Recovery (default value = CDR)

c Channel Attenuation (default value = 0 dB)

4 Acquire signal in Eye mode.

5 Measure Outer OMA in dBm.

6 Compare the Outer OMA in the range between -2.50 dBm and 2.80 dBm.

Expected/Observable Results

The measured value of the outer optical modulation amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the outer extinction ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer extinction ratio (OER) should be greater than 3.50 dB.

References

See Table 139-6 and Section 139.7.6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dBm.
6 Compare the Outer Extinction Ratio with 3.50 dBm.

Expected/Observable Results

The measured value of the outer extinction ratio (OER) for the selected lane must be within the conformance limit.

Transmitter transition time

Test Overview

The purpose of this test is to verify that the transmitter transition time of the signal transmitted by the DUT is within the conformance limits.

For conformance, the transmitter transition time should be less than or equal to 34 ps.

References

See Table 139-6 and Section 139.7.7 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to square wave or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Transition Time.
6 Compare the Transition Time with 34 ps.

Expected/Observable Results

The measured value of the transmitter transition time must be within the conformance limit.

Launch power in OMAouter minus TDECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the Launch power in OMAouter minus TDECQ, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Launch power in OMAouter minus TDECQ should be greater than - 3.90 dBm.

References

See Table 139-6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the OOMA and TDECQ results.
4 The reporting value will be the result of OOMA – TDECQ.

Expected/Observable Results

The measured value of the Launch power in OMAouter minus TDECQ for the selected lane must be within the conformance limit.

Relative Intensity Noise (RIN17.1 OMA)

Test Overview

The purpose of this test is to verify that the Relative Intensity Noise (RIN17.1 OMA) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Relative Intensity Noise (RIN17.1 OMA) should be less than or equal to -132.00dB/Hz.

References

See Table 139-6 and Section 139.7.8 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to square wave.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope.
5 Measure RIN test in Jitter Mode.
6 Compare the RIN with -132 dB/Hz.

Expected/Observable Results

The measured value of the Relative Intensity Noise (RIN17.1 OMA) of the signal transmitted by the DUT must be within the conformance limit.

50GBASE-LR Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 3.20 dB.

References

See Table 139-6 and Section 139.7.5 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4 MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 13.28125 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use 'IEEE 802.3cd-2018' as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 3.20 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) for the selected lane must be within the conformance limit.

TDECQ minus Ceq

Test Overview

The purpose of this test is to verify that for the selected lane, the TDECQ minus Ceq, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ minus Ceq should be less than or equal to 3.20 dB.

References

See Table 139-6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the TDECQ and Ceq results.

4 The reporting value will be the result of TDECQ – Ceq.

Expected/Observable Results

The measured value of the TDECQ minus Ceq for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -16 dBm.

References

See Table 139-6 of IEEE 802.3cd-2018.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -16 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the signaling rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the signaling rate for the selected lane should be greater than or equal to 26.562400000 GBd and less than or equal to 26.562600000 GBd.

References

See Table 139-6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 26.5625 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the signaling rate of the signal for the selected lane must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the average (optical) launch power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the average (optical) launch power for the selected lane should be greater than or equal to -4.50 dBm and less than or equal to 4.20 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table Reference 139-6 and Section 139.7.3 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -4.50 dBm and 4.20 dBm.

Expected/Observable Results

The measured value of the average (optical) launch power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the outer optical modulation amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer optical modulation amplitude (OMA_{outer}) for the selected lane should be greater than or equal to -1.50 dBm and less than or equal to 4.00 dBm.

References

See Table 139-6 and Section 139.7.4 of IEEE 802.3cd-2018.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.

a Set Signaling Rate to 26.5625e9.

b Clock Recovery (default value = CDR)

c Channel Attenuation (default value = 0 dB)

4 Acquire signal in Eye mode.

5 Measure Outer OMA in dBm.

6 Compare the Outer OMA in the range between -1.50 dBm and 4.00 dBm.

Expected/Observable Results

The measured value of the outer optical modulation amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the outer extinction ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer extinction ratio (OER) should be greater than 3.50 dB.

References

See Table 139-6 and Section 139.7.6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dBm.
6 Compare the Outer Extinction Ratio with 3.50 dBm.

Expected/Observable Results

The measured value of the outer extinction ratio (OER) for the selected lane must be within the conformance limit.

Transmitter transition time

Test Overview

The purpose of this test is to verify that the transmitter transition time of the signal transmitted by the DUT is within the conformance limits.

For conformance, the transmitter transition time should be less than or equal to 34 ps.

References

See Table 139-6 and Section 139.7.7 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to square wave or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Transition Time.
6 Compare the Transition Time with 34 ps.

Expected/Observable Results

The measured value of the transmitter transition time must be within the conformance limit.

Launch power in OMAouter minus TDECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the Launch power in OMAouter minus TDECQ, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Launch power in OMAouter minus TDECQ should be greater than - 2.90 dBm.

References

See Table 139-6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the OOMA and TDECQ results.
4 The reporting value will be the result of OOMA – TDECQ.

Expected/Observable Results

The measured value of the Launch power in OMAouter minus TDECQ for the selected lane must be within the conformance limit.

Relative Intensity Noise (RIN15.6 OMA)

Test Overview

The purpose of this test is to verify that the Relative Intensity Noise (RIN15.6 OMA) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Relative Intensity Noise (RIN15.6 OMA) should be less than or equal to -132.00dB/Hz.

References

See Table 139-6 and Section 139.7.8 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to square wave.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope.
5 Measure RIN test in Jitter Mode.
6 Compare the RIN with -132 dB/Hz.

Expected/Observable Results

The measured value of the Relative Intensity Noise (RIN15.6 OMA) of the signal transmitted by the DUT must be within the conformance limit.

6 100GBASE Tests

This section provides the Methods of Implementation (MOIs) for the 100GBASE tests using a supported Keysight DCA oscilloscope and the DCA Optical Compliance Test Application.

Connection for 100GBASE Tests

When performing the 100GBASE tests, the DCA Optical Compliance Test Application will prompt you to make the proper connections. The connections for these tests depend on the specific transmission standard selected under the **Set Up** tab. Refer to the **Connect** tab in the DCA Optical Compliance Test Application for the exact connections. Additionally, refer to "Making Hardware Connections for Compliance Testing" on page 26.

You can configure other settings used in these tests in the **Configure** tab of the DCA Optical Compliance Test Application.

Test Procedure

1. Start the automated test application as described in "Starting the DCA Optical Compliance Test Application" on page 21.
2. In the DCA Optical Compliance Test Application, click the **Set Up** tab.
3. Select the required specification from the drop-down list.
4. Select the specific 100GBASE transmission standard in the **Standard Option** section**.** The available 100GBASE transmission standards include 100GBASE-SR2 and 100GBASE-DR.
5. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.
6. Follow the DCA Optical Compliance Test Application's task flow to set up the configuration options, run the tests, and view the tests results.

100GBASE-SR2 Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 4.50 dB.

References

See Table 138-8 and Section 138.8.5 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 11.20 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use ‘IEEE 802.3cd-2018’ as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 4.50 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) for the selected lane must be within the conformance limit.

TDECQ minus Ceq

Test Overview

The purpose of this test is to verify that for the selected lane, the TDECQ minus Ceq, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ minus Ceq should be less than or equal to 4.5 dB.

References

See Table 138-8 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the TDECQ and Ceq results.

4 The reporting value will be the result of TDECQ – Ceq.

Expected/Observable Results

The measured value of the TDECQ minus Ceq for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -30 dBm.

References

See Table 138-8 of IEEE 802.3cd-2018.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -30 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the signaling rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the signaling rate for the selected lane should be greater than or equal to 26.562400000 GBd and less than or equal to 26.562600000 GBd.

References

See Table 138-8 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 26.5625 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the signaling rate of the signal for the selected lane must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the average (optical) launch power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the average (optical) launch power for the selected lane should be greater than or equal to -6.50 dBm and less than or equal to 4.00 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table 138-8 and Section 138.8.3 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -6.50 dBm and 4.00 dBm.

Expected/Observable Results

The measured value of the average (optical) launch power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the outer optical modulation amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer optical modulation amplitude (OMA_{outer}) for the selected lane should be greater than or equal to -4.50 dBm and less than or equal to 3.00 dBm.

References

See Table 138-8 and Section 138.8.4 of IEEE 802.3cd-2018.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.

a Set Signaling Rate to 26.5625e9.

b Clock Recovery (default value = CDR)

c Channel Attenuation (default value = 0 dB)

4 Acquire signal in Eye mode.

5 Measure Outer OMA in dBm.

6 Compare the Outer OMA in the range between -4.50 dBm and 3.00 dBm.

Expected/Observable Results

The measured value of the outer optical modulation amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the outer extinction ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer extinction ratio (OER) should be greater than 3.00 dB.

References

See Table 138-8 and Section 138.8.6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dBm.
6 Compare the Outer Extinction Ratio with 3.00 dBm.

Expected/Observable Results

The measured value of the outer extinction ratio (OER) for the selected lane must be within the conformance limit.

Transmitter transition time

Test Overview

The purpose of this test is to verify that the transmitter transition time of the signal transmitted by the DUT is within the conformance limits.

For conformance, the transmitter transition time should be less than or equal to 34 ps.

References

See Table 138-8 and Section 138.8.7 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to square wave or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Transition Time.
6 Compare the Transition Time with 34 ps.

Expected/Observable Results

The measured value of the transmitter transition time must be within the conformance limit.

Launch power in OMAouter minus TDECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the Launch power in OMAouter minus TDECQ, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Launch power in OMAouter minus TDECQ should be greater than -5.90 dBm.

References

See Table 138-8 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the OOMA and TDECQ results.
4 The reporting value will be the result of OOMA – TDECQ.

Expected/Observable Results

The measured value of the Launch power in OMAouter minus TDECQ for the selected lane must be within the conformance limit.

Relative Intensity Noise (RIN12 OMA)

Test Overview

The purpose of this test is to verify that the Relative Intensity Noise (RIN12 OMA) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Relative Intensity Noise (RIN12.1 OMA) should be less than or equal to -128.00dB/Hz.

References

See Table 138-8 and Section 138.8.8 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to square wave.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 26.5625e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope.
5 Measure RIN test in Jitter Mode.
6 Compare the RIN with -128 dB/Hz.

Expected/Observable Results

The measured value of the Relative Intensity Noise (RIN12OMA) of the signal transmitted by the DUT must be within the conformance limit.

100GBASE-DR Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 3.40 dB.

References

See Table 140-6 and Section 140.7.5 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 26.5625 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use 'IEEE 802.3cd-2018' as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 3.40 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) for the selected lane must be within the conformance limit.

TDECQ minus Ceq

Test Overview

The purpose of this test is to verify that for the selected lane, the TDECQ minus Ceq, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ minus Ceq should be less than or equal to 3.40 dB.

References

See Table 140-6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Get the TDECQ and Ceq results.
4 The reporting value will be the result of TDECQ – Ceq.

Expected/Observable Results

The measured value of the TDECQ minus Ceq for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -15 dBm.

References

See Table 140-6 of IEEE 802.3cd-2018.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -15 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the signaling rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the signaling rate for the selected lane should be greater than or equal to 53.119687500 GBd and less than or equal to 53.130312500 GBd.

References

See Table 140-6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 53.125 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the signaling rate of the signal for the selected lane must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the average (optical) launch power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the average (optical) launch power for the selected lane should be greater than or equal to -2.90 dBm and less than or equal to 4.00 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table Reference 140-6 and Section 140.7.3 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -2.90 dBm and 4.00 dBm.

Expected/Observable Results

The measured value of the average (optical) launch power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the outer optical modulation amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer optical modulation amplitude (OMA_{outer}) for the selected lane should be greater than or equal to -800 mdBm and less than or equal to 4.20 dBm.

References

See Table 140-6 and Section 140.7.4 of IEEE 802.3cd-2018.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.

a Set Signaling Rate to 53.125e9.

b Clock Recovery (default value = CDR)

c Channel Attenuation (default value = 0 dB)

4 Acquire signal in Eye mode.

5 Measure Outer OMA in dBm.

6 Compare the Outer OMA in the range between -800 mdBm and 4.20 dBm.

Expected/Observable Results

The measured value of the outer optical modulation amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the outer extinction ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the outer extinction ratio (OER) should be greater than 3.50 dB.

References

See Table 140-6 and Section 140.7.6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dBm.
6 Compare the Outer Extinction Ratio with 3.50 dBm.

Expected/Observable Results

The measured value of the outer extinction ratio (OER) for the selected lane must be within the conformance limit.

Transmitter transition time

Test Overview

The purpose of this test is to verify that the transmitter transition time of the signal transmitted by the DUT is within the conformance limits.

For conformance, the transmitter transition time should be less than or equal to 17 ps.

References

See Table 140-6 and Section 140.7.7 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to square wave or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Transition Time.
6 Compare the Transition Time with 17 ps.

Expected/Observable Results

The measured value of the transmitter transition time must be within the conformance limit.

Launch power in OMAouter minus TDECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the Launch power in OMAouter minus TDECQ, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Launch power in OMAouter minus TDECQ should be greater than or equal to -2.2 dBm for extinction ratio >= 5 dB and greater than or equal to -1.9 dBm for extinction ratio < 5 dB.

References

See Table 140-6 of IEEE 802.3cd-2018.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Get the OOMA and TDECQ results.
4 The reporting value will be the result of OOMA – TDECQ.

Expected/Observable Results

The measured value of the Launch power in OMAouter minus TDECQ for the selected lane must be within the conformance limit.

7 IEEE P802.3cu Tests

This section provides the Methods of Implementation (MOIs) for the supported IEEE P802.3cu tests using a supported Keysight DCA oscilloscope and the DCA Optical Compliance Test Application.

Connection for IEEE P802.3cu Tests

When performing the IEEE P802.3cu tests, the DCA Optical Compliance Test Application will prompt you to make the proper connections. The connections for these tests depend on the specific transmission standard selected under the **Set Up** tab. Refer to the **Connect** tab in the DCA Optical Compliance Test Application for the exact connections. Additionally, refer to "Making Hardware Connections for Compliance Testing" on page 26.

You can configure other settings used in these tests in the **Configure** tab of the DCA Optical Compliance Test Application.

Test Procedure

1. Start the automated test application as described in "Starting the DCA Optical Compliance Test Application" on page 21.
2. In the DCA Optical Compliance Test Application, click the **Set Up** tab.
3. Select **IEEE 802.3cu** from the drop-down list.
4. Select the required transmission standard in the **Standard Option** section. The available IEEE 802.3cu transmission standards include 100GBASE-FR1, 100GBASE-LR1, 400GBASE-FR4, and 400GBASE-LR4-6.
5. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.
6. Follow the DCA Optical Compliance Test Application's task flow to set up the configuration options, run the tests, and view the tests results.

100GBASE-FR1 Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 3.40 dB.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 26.5625 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use 'IEEE 802.3bs Final' as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 3.40 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure (TDECQ) for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -15 dBm.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -15 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the Signaling Rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Signaling Rate for the selected lane should be greater than or equal to 53.119687500 GBd and less than or equal to 53.130312500 GBd.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 53.125 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the Signaling Rate of the signal transmitted by the DUT must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (optical) Launch Power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Average (optical) Launch Power for the selected lane should be greater than or equal to -3.10 dBm and less than or equal to 4.00 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -3.10 dBm and 4.00 dBm.

Expected/Observable Results

The measured value of the Average (optical) Launch Power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the Outer Extinction Ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Outer Extinction Ratio (OER) should be greater than 3.50 dB.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dB.
6 Compare the Outer Extinction Ratio with 3.50 dB.

Expected/Observable Results

The measured value of the Outer Extinction Ratio (OER) for the selected lane must be within the conformance limit.

Transmitter transition time

Test Overview

The purpose of this test is to verify that the Transmitter transition time of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter transition time should be less than or equal to 17 ps.

References

See Table 140-6 of IEEE 802.3cu D3.2

Test Procedure

1 Set device to square wave or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Transition Time.
   - With SSPRQ pattern, the Transmitter transition time test will report the slowest transition (either Fall time or Rise time) as a result.
   - With SQ8 pattern, the Transmitter transition time test will report the maximum value of Rise and Fall time and compare them and get the worst as a result.
6 Compare the Transition Time with 17 ps.

Expected/Observable Results

The measured value of the Transmitter transition time must be within the conformance limit.

Transmitter Overshoot

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Overshoot of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Overshoot should be less than or equal to 22.00%.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set the device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR).
   c Channel Attenuation (default value = 0dB).
4 Acquire signal in Eye mode.
5 Measure Transmitter Overshoot in percentage.
6 Compare the measured value with 22.00 %.

Expected/Observable Results

The measured value of the Transmitter Overshoot for the selected lane must be within the conformance limit.

Transmitter Undershoot

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Undershoot of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Undershoot should be less than or equal to 22.00%.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set the device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR).
   c Channel Attenuation (default value = 0dB).
4 Acquire signal in Eye mode.
5 Measure Transmitter Undershoot in percentage.
6 Compare the measured value with 22.00%.

Expected/Observable Results

The measured value of the Transmitter Undershoot for the selected lane must be within the conformance limit.

Transmitter Power Excursion

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Power Excursion of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Power Excursion should be less than or equal to 2 dBm.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set the device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR).
   c Channel Attenuation (default value = 0dB).
4 Acquire signal in Eye mode.
5 Measure Transmitter Power Excursion.
6 Compare the measured value with 2 dBm.

Expected/Observable Results

The measured value of the Transmitter Power Excursion for the selected lane must be within the conformance limit.

Transmitter Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Eye Closure (TECQ), of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Eye Closure should be less than or equal to 3.40 dB.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

NOTE **The TECQ measurement is performed using the same steps as TDECQ, except that the test fiber is not used.**

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 26.5625 GHz.
5 TECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use 'IEEE 802.3bs Final' as Preset.
6 Measure TECQ and Ceq results.
7 Compare the TECQ with 3.40 dB.

Expected/Observable Results

The measured value of the Transmitter Eye Closure (TECQ) for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the Outer Optical Modulation Amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance:

- If TDECQ < 1.4 dB, the minimum limit for the outer OMA is -0.1 dBm and the maximum limit for the outer OMA is 4.2 dBm.
- If TDECQ > 3.4dB, the minimum limit for the OMA is -0.1 dBm.
- If 1.4 dB <= TDECQ <= 3.4dB, the minimum limit for the outer OMA is -1.5 + TDECQ and the maximum limit for the outer OMA is 4.2 dBm.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.
2 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
3 Acquire signal in Eye mode.
4 Measure Outer OMA in dBm.
5 Compare the Outer OMA based on the compliance criteria.

Expected/Observable Results

The measured value of the Outer Optical Modulation Amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

TDECQ minus TECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the TDECQ minus TECQ value, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ minus TECQ value should be less than or equal to 2.50 dB.

References

See Table 140-6 of IEEE 802.3cu D3.2

Test Procedure

1 Get the TDECQ and TECQ results.
2 Report the TDECQ – TECQ value.

100GBASE-LR1 Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 3.40 dB.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 26.5625 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use 'IEEE 802.3bs Final' as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 3.40 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure (TDECQ) for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -15 dBm.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -15 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the Signaling Rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Signaling Rate for the selected lane should be greater than or equal to 53.119687500 GBd and less than or equal to 53.130312500 GBd.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 53.125 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the Signaling Rate of the signal transmitted by the DUT must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Average (Optical) Launch Power for the selected lane should be greater than or equal to -1.9 dBm and less than or equal to 4.8 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -1.9 dBm and 4.8 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the Outer Extinction Ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Outer Extinction Ratio (OER) should be greater than 3.50 dB.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dB.
6 Compare the Outer Extinction Ratio with 3.50 dB.

Expected/Observable Results

The measured value of the Outer Extinction Ratio (OER) for the selected lane must be within the conformance limit.

Transmitter transition time

Test Overview

The purpose of this test is to verify that the Transmitter transition time of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter transition time should be less than or equal to 17 ps.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to square wave or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Transition Time.
   - With SSPRQ pattern, the Transmitter transition time test will report the slowest transition (either Fall time or Rise time) as a result.
   - With SQ8 pattern, the Transmitter transition time test will report the maximum value of Rise and Fall time and compare them and get the worst as a result.
6 Compare the Transition Time with 17 ps.

Expected/Observable Results

The measured value of the Transmitter transition time must be within the conformance limit.

Transmitter Overshoot

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Overshoot of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Overshoot should be less than or equal to 22.00%.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set the device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR).
   c Channel Attenuation (default value = 0dB).
4 Acquire signal in Eye mode.
5 Measure Transmitter Overshoot in percentage.
6 Compare the measured value with 22.00%.

Expected/Observable Results

The measured value of the Transmitter Overshoot for the selected lane must be within the conformance limit.

Transmitter Undershoot

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Undershoot of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Undershoot should be less than or equal to 22.00%.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set the device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR).
   c Channel Attenuation (default value = 0dB).
4 Acquire signal in Eye mode.
5 Measure Transmitter Undershoot in percentage.
6 Compare the measured value with 22.00%.

Expected/Observable Results

The measured value of the Transmitter Undershoot for the selected lane must be within the conformance limit.

Transmitter Power Excursion

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Power Excursion of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Power Excursion should be less than or equal to 2.800 dBm.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Set the device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR).
   c Channel Attenuation (default value = 0dB).
4 Acquire signal in Eye mode.
5 Measure Transmitter Power Excursion.
6 Compare the measured value with 2.800 dBm.

Expected/Observable Results

The measured value of the Transmitter Power Excursion for the selected lane must be within the conformance limit.

Transmitter Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Eye Closure (TECQ), of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Eye Closure should be less than or equal to 3.40 dB.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

NOTE The TECQ measurement is performed using the same steps as TDECQ, except that the test fiber is not used.

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 26.5625 GHz.
5 TECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use 'IEEE 802.3bs Final' as Preset.
6 Measure TECQ and Ceq results.
7 Compare the TECQ with 3.40 dB.

Expected/Observable Results

The measured value of the Transmitter Eye Closure (TECQ) for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the Outer Optical Modulation Amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance:

- If TDECQ < 1.4 dB, the minimum limit for the outer OMA is 1.1 dBm and the maximum limit for the outer OMA is 5 dBm.
- If TDECQ > 3.4 dB, the minimum limit for the OMA is 1.1 dBm.
- If 1.4 dB <= TDECQ <= 3.4 dB, the minimum limit for the outer OMA is -0.3 + TDECQ And the maximum limit for the outer OMA is 5 dBm.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over

the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

2 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
3 Acquire signal in Eye mode.
4 Measure Outer OMA in dBm.
5 Compare the Outer OMA based on the compliance criteria.

Expected/Observable Results

The measured value of the Outer Optical Modulation Amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

TDECQ minus TECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the TDECQ minus TECQ value, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ minus TECQ value should be less than or equal to 2.50 dB.

References

See Table 140-6 of IEEE 802.3cu D3.2.

Test Procedure

1 Get the TDECQ and TECQ results.
2 Report the TDECQ – TECQ value.

400GBASE-FR4 Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 3.40 dB.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 26.5625 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use 'IEEE 802.3bs Final' as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 3.40 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure (TDECQ) for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -16 dBm.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -16 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the Signaling Rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Signaling Rate for the selected lane should be greater than or equal to 53.119687500 GBd and less than or equal to 53.130312500 GBd.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 53.125 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the Signaling Rate of the signal transmitted by the DUT must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Average (Optical) Launch Power for the selected lane should be greater than or equal to -3.20 dBm and less than or equal to 4.40 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -3.20 dBm and 4.40 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the Outer Extinction Ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Outer Extinction Ratio (OER) should be greater than 3.50 dB.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dB.
6 Compare the Outer Extinction Ratio with 3.50 dB.

Expected/Observable Results

The measured value of the Outer Extinction Ratio (OER) for the selected lane must be within the conformance limit.

Transmitter transition time

Test Overview

The purpose of this test is to verify that the Transmitter transition time of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter transition time should be less than or equal to 17 ps.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to square wave or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Transition Time.
   - With SSPRQ pattern, the Transmitter transition time test will report the slowest transition (either Fall time or Rise time) as a result.
   - With SQ8 pattern, the Transmitter transition time test will report the maximum value of Rise and Fall time and compare them and get the worst as a result.
6 Compare the Transition Time with 17 ps.

Expected/Observable Results

The measured value of the Transmitter transition time must be within the conformance limit.

Transmitter Overshoot

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Overshoot of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Overshoot should be less than or equal to 22.00%.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set the device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR).
   c Channel Attenuation (default value = 0dB).
4 Acquire signal in Eye mode.
5 Measure Transmitter Overshoot in percentage.
6 Compare the measured value with 22.00%.

Expected/Observable Results

The measured value of the Transmitter Overshoot for the selected lane must be within the conformance limit.

Transmitter Undershoot

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Undershoot of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Undershoot should be less than or equal to 22.00%.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set the device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR).
   c Channel Attenuation (default value = 0dB).
4 Acquire signal in Eye mode.
5 Measure Transmitter Undershoot in percentage.
6 Compare the measured value with 22.00%.

Expected/Observable Results

The measured value of the Transmitter Undershoot for the selected lane must be within the conformance limit.

Transmitter Power Excursion

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Power Excursion of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Power Excursion should be less than or equal to 1.800 dBm.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set the device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR).
   c Channel Attenuation (default value = 0dB).
4 Acquire signal in Eye mode.
5 Measure Transmitter Power Excursion.
6 Compare the measured value with 1.800 dBm.

Expected/Observable Results

The measured value of the Transmitter Power Excursion for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the Outer Optical Modulation Amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance:

- If TDECQ < 1.4 dB, the minimum limit for the outer OMA is -0.2 dBm and the maximum limit for the outer OMA is 3.7 dBm.
- If TDECQ > 3.4dB, the minimum limit for the OMA is -0.2 dBm.
- If 1.4 dB <= TDECQ <= 3.4 dB, the minimum limit for the outer OMA is -1.6 + TDECQ and the maximum limit for the outer OMA is 3.7 dBm.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

2 Configure the following parameters under the Configure tab.

a Set Signaling Rate to 53.125e9.

b Clock Recovery (default value = CDR)

c Channel Attenuation (default value = 0 dB)

3 Acquire signal in Eye mode.

4 Measure Outer OMA in dBm.

5 Compare the Outer OMA based on the compliance criteria.

Expected/Observable Results

The measured value of the Outer Optical Modulation Amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

Transmitter Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Eye Closure (TECQ), of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Eye Closure should be less than or equal to 3.40 dB.

References

See Table 151-7 of IEEE 802.3cu D3.2

Test Procedure

NOTE **The TECQ measurement is performed using the same steps as TDECQ, except that the test fiber is not used.**

1 Set device to SSPRQ.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.

a Set Signaling Rate to 53.125e9.

b Clock Recovery (default value = CDR)

c Iterative Optimization (default value = ON)

d Channel Attenuation (default value = 0 dB)

4 Acquire signal in Eye mode.

a Set CDR to 4MHz Loop BW.

b Set 4th Order Bessel Thompson filter to 26.5625 GHz.

5 TECQ measurements are made on the signal after TDECQ Equalizer is applied.

a Use ‘IEEE 802.3bs Final’ as Preset.

6 Measure TECQ and Ceq results.

7 Compare the TECQ with 3.40 dB.

Expected/Observable Results

The measured value of the Transmitter Eye Closure (TECQ) for the selected lane must be within the conformance limit.

Difference in Launch Power for any two lanes

Test Overview

The purpose of this test is to verify that the difference in Launch Power of the signal transmitted by the DUT for any two lanes is within the conformance limits.

For conformance, the difference in Launch Power for any two lanes should be less than or equal to 3.9 dB.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c DUT Lane (default value = Lane 0 for first Lane and Lane 1 for second Lane)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the First DUT Lane in dBm.
6 Measure Average Power of the Second DUT Lane in dBm.
7 The reporting value will be the Average Power of the First DUT Lane - Average Power of the Second DUT Lane.
8 Compare the result with 3.9 dB.

Expected/Observable Results

The measured value of the difference in Launch Power for any two lanes must be within the conformance limit.

Total Average Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the Total Average Launch Power of the signal transmitted by DUT is within the conformance limits.

For conformance, the Total Average Launch Power for the selected lane should be less than or equal to 10.4 dBm.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm of each lane and get the Total average power.
6 Compare the Average Launch Power with 10.4 dBm.

Expected/Observable Results

The measured value of the Total Average Launch Power for the selected lane must be within the conformance limit.

TDECQ minus TECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the TDECQ minus TECQ value, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ minus TECQ value should be less than or equal to 2.50 dB.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Get the TDECQ and TECQ results.
2 Report the TDECQ – TECQ value.

400GBASE-LR4-6 Tests

Transmitter and Dispersion Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter and Dispersion Eye Closure (TDECQ) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ should be less than or equal to 3.40 dB.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Iterative Optimization (default value = ON)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
   a Set CDR to 4MHz Loop BW.
   b Set 4th Order Bessel Thompson filter to 26.5625 GHz.
5 TDECQ measurements are made on the signal after TDECQ Equalizer is applied.
   a Use 'IEEE 802.3bs Final' as Preset.
6 Measure TDECQ and Ceq results.
7 Compare the TDECQ with 3.40 dB.

Expected/Observable Results

The measured value of the Transmitter and Dispersion Eye Closure (TDECQ) for the selected lane must be within the conformance limit.

Average (Optical) Launch Power (TX OFF)

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the OFF transmitter is within the conformance limits.

For conformance, the Average (Optical) Launch Power with transmitter off should be less than or equal to -16 dBm.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Disable Tx for this test.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Clock Recovery (default value = CDR)
   b Channel Attenuation (default value = 0 dB)
4 Acquire signal in Oscilloscope mode.
5 Ensure that Tx is disabled on the acquired signal (no valid data transitions).
6 Measure Average Power of the signal in dBm.
7 Compare the Average Power with -16 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the OFF transmitter for the selected lane must be within the conformance limit.

Signaling Rate

Test Overview

The purpose of this test is to verify that for the selected lane, the Signaling Rate of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Signaling Rate for the selected lane should be greater than or equal to 53.119687500 GBd and less than or equal to 53.130312500 GBd.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to SSPRQ or any shorter patterns.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure the frequency of the recovered data clock of the CDR.
6 Compare the signaling rate with 53.125 +/- 100 ppm GBd.

Expected/Observable Results

The measured value of the Signaling Rate of the signal transmitted by the DUT must be within the conformance limit.

Average (Optical) Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the Average (Optical) Launch Power of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Average (Optical) Launch Power for the selected lane should be greater than or equal to -2.70 dBm and less than or equal to 5.1 dBm.

NOTE The minimum value is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm.
6 Compare the Average Power with respect to the range between -2.70 dBm and 5.1 dBm.

Expected/Observable Results

The measured value of the Average (Optical) Launch Power of the signal transmitted by the DUT for the selected lane must be within the conformance limit.

Outer Extinction Ratio

Test Overview

The extinction ratio of a PAM4 optical signal is defined as the ratio of the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

The purpose of this test is to verify that for the selected lane, the Outer Extinction Ratio (OER) of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Outer Extinction Ratio (OER) should be greater than 3.50 dB.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to PRBS13Q or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Outer Extinction Ratio in dB.
6 Compare the Outer Extinction Ratio with 3.50 dB.

Expected/Observable Results

The measured value of the Outer Extinction Ratio (OER) for the selected lane must be within the conformance limit.

Transmitter transition time

Test Overview

The purpose of this test is to verify that the Transmitter transition time of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter transition time should be less than or equal to 17 ps.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to square wave or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Transition Time.
   - With SSPRQ pattern, the Transmitter transition time test will report the slowest transition (either Fall time or Rise time) as a result.
   - With SQ8 pattern, the Transmitter transition time test will report the maximum value of Rise and Fall time and compare them and get the worst as a result.
6 Compare the Transition Time with 17 ps.

Expected/Observable Results

The measured value of the Transmitter transition time must be within the conformance limit.

Transmitter Overshoot

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Overshoot of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Overshoot should be less than or equal to 22.00%.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set the device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR).
   c Channel Attenuation (default value = 0dB).
4 Acquire signal in Eye mode.
5 Measure Transmitter Overshoot in percentage.
6 Compare the measured value with 22.00%.

Expected/Observable Results

The measured value of the Transmitter Overshoot for the selected lane must be within the conformance limit.

Transmitter Undershoot

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Undershoot of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Undershoot should be less than or equal to 22.00%.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set the device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR).
   c Channel Attenuation (default value = 0 dB).
4 Acquire signal in Eye mode.
5 Measure Transmitter Undershoot in percentage.
6 Compare the measured value with 22.00%.

Expected/Observable Results

The measured value of the Transmitter Undershoot for the selected lane must be within the conformance limit.

Transmitter Power Excursion

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Power Excursion of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Power Excursion should be less than or equal to 2.5 dBm.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set the device to SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR).
   c Channel Attenuation (default value = 0dB).
4 Acquire signal in Eye mode.
5 Measure Transmitter Power Excursion.
6 Compare the measured value with 2.5 dBm.

Expected/Observable Results

The measured value of the Transmitter Power Excursion for the selected lane must be within the conformance limit.

Outer Optical Modulation Amplitude (OMA)

Test Overview

The purpose of this test is to verify that for the selected lane, the Outer Optical Modulation Amplitude (OMA_{outer}) of the signal transmitted by the DUT is within the conformance limits.

For conformance:

- If TDECQ < 1.4 dB, the minimum limit for the outer OMA is 0.3 dBm and the maximum limit for the outer OMA is 4.4 dBm.
- If TDECQ > 3.4dB, the minimum limit for the OMA is 0.3 dBm.
- If 1.4 dB <= TDECQ <= 3.4 dB, the minimum limit for the outer OMA is -1.1 + TDECQ and the maximum limit for the outer OMA is 4.4 dBm.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 The OMAouter is measured using the PRBS13Q or SSPRQ test pattern specified for OMAouter. It is measured as the difference between the average optical launch power level P3, measured over the central 2 UI of a run of 7 threes, and the average optical launch power level P0, measured over the central 2 UI of a run of 6 zeros.

2 Configure the following parameters under the Configure tab.

a Set Signaling Rate to 53.125e9.

b Clock Recovery (default value = CDR)

c Channel Attenuation (default value = 0 dB)

3 Acquire signal in Eye mode.

4 Measure Outer OMA in dBm.

5 Compare the Outer OMA; it should be less than or equal to 4.4 dBm.

Expected/Observable Results

The measured value of the Outer Optical Modulation Amplitude (OMA_{outer}) for the selected lane must be within the conformance limit.

Transmitter Eye Closure

Test Overview

The purpose of this test is to verify that for the selected lane, the Transmitter Eye Closure (TECQ), of the signal transmitted by the DUT is within the conformance limits.

For conformance, the Transmitter Eye Closure should be less than or equal to 3.40 dB.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

NOTE **The TECQ measurement is performed using the same steps as TDECQ, except that the test fiber is not used.**

1 Set device to SSPRQ.

2 Refer to the Connect tab to connect the scope to the DUT signals.

3 Configure the following parameters under the Configure tab.

a Set Signaling Rate to 53.125e9.

b Clock Recovery (default value = CDR)

c Iterative Optimization (default value = ON)

d Channel Attenuation (default value = 0 dB)

4 Acquire signal in Eye mode.

a Set CDR to 4MHz Loop BW.

b Set 4th Order Bessel Thompson filter to 26.5625 GHz.

5 TECQ measurements are made on the signal after TDECQ Equalizer is applied.

a Use ‘IEEE 802.3bs Final’ as Preset.

6 Measure TECQ and Ceq results.

7 Compare the TECQ with 3.40 dB.

Expected/Observable Results

The measured value of the Transmitter Eye Closure (TECQ) for the selected lane must be within the conformance limit.

Difference in Launch Power for any two lanes

Test Overview

The purpose of this test is to verify that the difference in Launch Power of the signal transmitted by the DUT for any two lanes is within the conformance limits.

For conformance, the difference in Launch Power for any two lanes should be less than or equal to 4 dB.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters in the Configure tab.
   a Set Signaling Rate to 53.125e9.
   b Clock Recovery (default value = CDR)
   c DUT Lane (default value = Lane 0 for first Lane and Lane 1 for second Lane)
   d Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the First DUT Lane in dBm.
6 Measure Average Power of the Second DUT Lane in dBm.
7 The reporting value will be the Average Power of the First DUT Lane - Average Power of the Second DUT Lane.
8 Compare the result with 4 dB.

Expected/Observable Results

The measured value of the difference in Launch Power for any two lanes must be within the conformance limit.

Total Average Launch Power

Test Overview

The purpose of this test is to verify that for the selected lane, the Total Average Launch Power of the signal transmitted by DUT is within the conformance limits.

For conformance, the Total Average Launch Power for the selected lane should be less than or equal to 11.1 dBm.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Set device to PRBS31Q or Scrambled idle or SSPRQ.
2 Refer to the Connect tab to connect the scope to the DUT signals.
3 Configure the following parameters under the Configure tab.
   a Set Signaling Rate to 53.125e9
   b Clock Recovery (default value = CDR)
   c Channel Attenuation (default value = 0 dB)
4 Acquire signal in Eye mode.
5 Measure Average Power of the signal in dBm of each lane and get the Total average power.
6 Compare the Average Launch Power with 11.1 dBm.

Expected/Observable Results

The measured value of the Total Average Launch Power for the selected lane must be within the conformance limit.

TDECQ minus TECQ

Test Overview

The purpose of this test is to verify that for the selected lane, the TDECQ minus TECQ value, of the signal transmitted by the DUT is within the conformance limits.

For conformance, the TDECQ minus TECQ value should be less than or equal to 2.50 dB.

References

See Table 151-7 of IEEE 802.3cu D3.2.

Test Procedure

1 Get the TDECQ and TECQ results.
2 Report the TDECQ – TECQ value.

KEYSIGHT
TECHNOLOGIES

www.keysight.com