N4917BACA 100G Optical Receiver Test Application - User Guide

KEYSIGHT

USER GUIDE

Notices

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Contents

1 Introduction

This chapter provides an introduction to the Keysight N4917BACA 100G Optical Receiver Test Application and the related documents that can be consulted to gather more background information.

N4917BACA 100G Optical Receiver Test Application—At a Glance

Compliance Tests for Optical Transceivers

The relevant IEEE 802.3 and MSA's standards define a series of procedures to test the correct operation of optical transceivers at the physical layer to ensure minimum required performance and interoperability (see Figure 1). Keysight solution software is available for each interface: Chip-to-module (C2M) interface including electrical transmitter and receiver tests and the optical interface with transmitter and receiver tests.

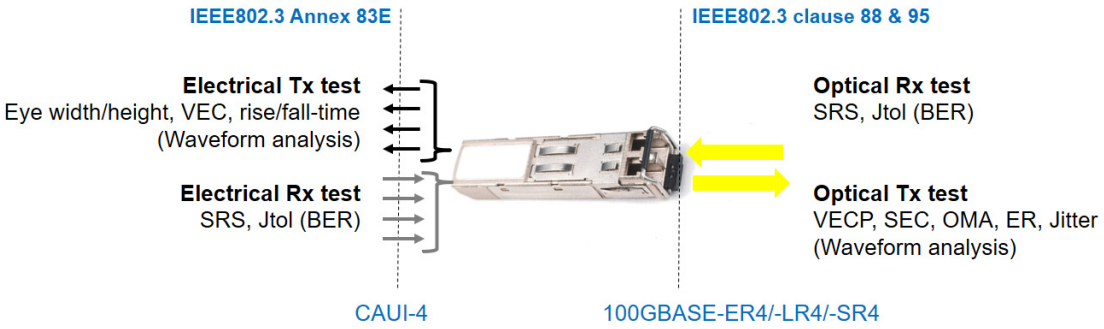


Figure 1 Overview of physical layer compliance tests for a typical 100GBASE-ER4/-LR4/-SR4 transceiver

In particular, the purpose of the optical receiver test is to test the receiver sensitivity and jitter tolerance with a stress optical signal, whose characteristics are defined by the standard. This stress signal is supposed to emulate the signal coming out of a standard-compliant transceiver after the worst possible optical channel.

N4917BACA Optical Receiver Stress Test

N4917BACA 100G Optical Receiver Stress Test Application provides a platform for stressed receiver sensitivity test, which is compliant to automated standards for 100GBASE and related MSAs and 10GBASE, 40GBASE Optical Receiver Stress Testing. The N4917BACA 100G Optical Receiver Test solution consists of several test instruments such as a Bit Error Rate Tester (BERT), an arbitrary waveform generator (AWG), Digital

Sampling Scope (DCA), Optical Reference Transmitter, Tunable Laser, and Optical Attenuator operating together with the N4917BACA software package.

Salient features of the N4917BACA 100G Optical Receiver Test Application include:

- Remote control of all the test instrumentation
- Automated calibration of the optical stressed eye parameters following the procedure recommended by IEEE
- Adjustable target values for ER, VECP/SEC, TDEC, J2, J4, J9, and OMA
- Automated Stress Receiver Sensitivity test
- Automated jitter tolerance compliance and margin tests

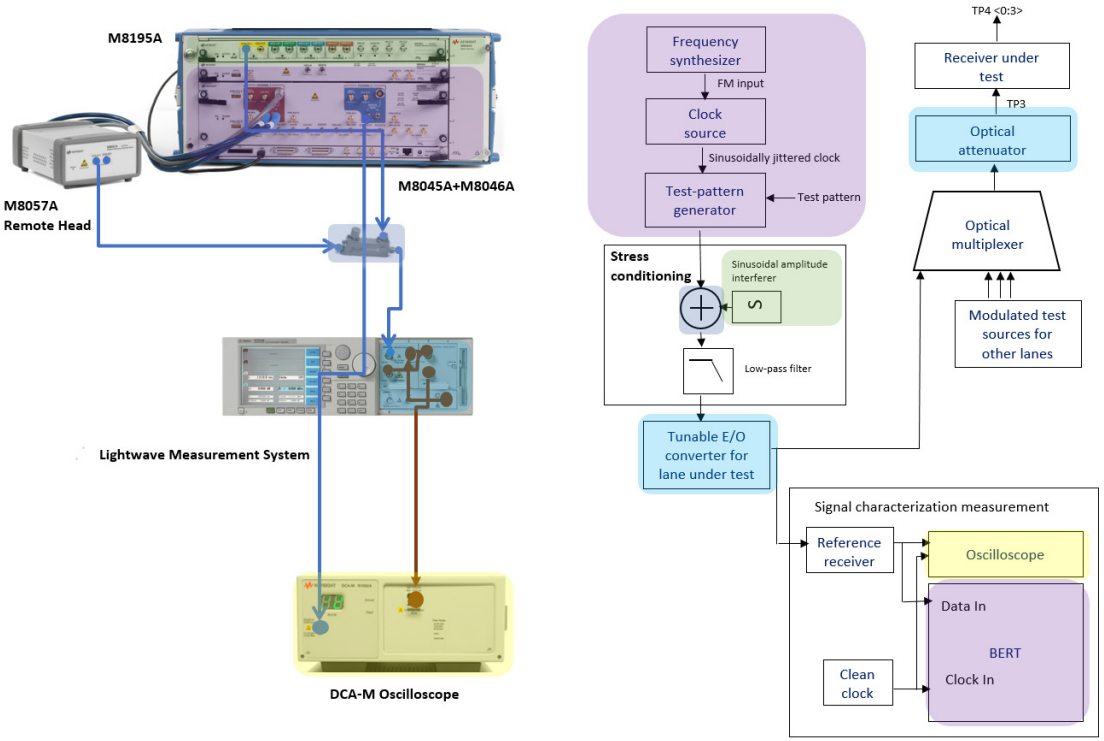


Figure 2 Stress receiver conformance test according to the IEEE and an example N4917BACA equipment configuration for 100GBASE -LR4/ER4

Applicable Standards

The N4917BACA 100G Optical Receiver Test Application supports automated optical stressed receiver sensitivity test, based on the following standards:

Test Name	Reference Standard	Fiber Type
100GBASE-LR4	IEEE 802.3-2015 Clause 88	single mode
100GBASE-ER4	IEEE 802.3-2015 Clause 88	single mode
100GBASE-SR4	IEEE 802.3-2015 Clause 95	multi mode
100GBASE CLR4	100G-CLR4 MSA Rev 1.5.2 3/22/2015	single mode
100GBASE CLR4 - FEC	100G-CLR4 MSA Rev 1.5.2 3/22/2015	single mode
100GBASE CWDM4	100G CWDM4 MSA Rev 1.1 11/23/2015	single mode
100GBASE 4WDM-10	100G 4WDM-10 MSA Rev 1 3/10/2017	single mode
100GBASE 4WDM-20	100G 4WDM-20 MSA Rev 1 7/28/2017	single mode
100GBASE 4WDM-40	100G 4WDM-40 MSA Rev 1 7/28/2017	single mode
100GBASE-PSM4	100G PSM4 Specification Version 2.0 9/15/2014	single mode
25GBASE-LR	IEEE 802.3cc Clause 114	single mode
25GBASE-ER	IEEE 802.3cc Clause 114	single mode
25GBASE-SR	IEEE 802.3by Clause 112 IEEE (802.3by)	multi mode
CPRI-Option 10	IEEE P802.3 Clause 88	single mode
10GBASE-LR	10GBASE IEEE 802.3ae Clause 52	single mode
10GBASE-ER	10GBASE IEEE 802.3ae Clause 52	single mode
10GBASE-SR	10GBASE IEEE 802.3ae Clause 52	multi mode
40GBase-LR4	40GBase IEEE 802.3ba Clause 87	single mode
40GBase-ER4	40GBase IEEE 802.3ba Clause 87	single mode
40GBase-SR4	40GBase IEEE 802.3ba clause 86	multi mode

NOTE

In the current version of the N4917BACA 100G Optical Receiver Test Application, the Stressed Eye Calibration procedure for 10GBASE-SR is following the below recommendations of *IEEE 802.3ae clause 52:*

i. The pattern generator de-emphasis is tuned to emulate Inter-symbol interference (ISI) which should lead to > 2/3 of the VECP target. While tuning the pattern generator de-emphasis is sufficient, Keysight recommends using in addition a frequency-dependent attenuator or low pass filter with 2dB Insertion loss at the Nyquist frequency.

ii. 50mUI 4MHz Sinusoidal Jitter (SJ) is injected into the signal. The amount of SJ can be changed within the valid range of [50mUI-150mUI].

iii. A sinusoidal Interferer (SI) and Random Jitter (RJ) are injected into the signal. Their magnitude is iterated to meet the J2 and VECP targets.

iv. Optionally, the random jitter can be replaced by Bounded Uncorrelated Jitter (BUJ).

System Description

The N4917BACA Test Solution for Optical Stressed Eye consists of:

- An M8045A pattern generator
- An Arbitrary Waveform Generator or an Analog Waveform Generator for stress conditioning
- An electrical-optical converter that modulates the optical signal from a fixed or tunable laser
- A digital sampling oscilloscope for calibration of the stressed eye
- The N4917BACA 100G Optical Receiver Test Application
- An M8046A error detector and N107x optical/electrical clock recovery module

Contacting Keysight Technologies

For more information on products, applications or services associated with Keysight Technologies, contact your local Keysight office.

The complete list is available at: www.keysight.com/find/contactus.

2 Installing the N4917BACA 100G Optical Receiver Test Application

As a prerequisite for installing the N4917BACA 100G Optical Receiver Test Application, you require the necessary hardware and software along with various licenses. This chapter describes these requirements and steps for installing the application.

KEYSIGHT TECHNOLOGIES

Hardware and Software Requirements

PC Hardware Requirements

Operating system

- Microsoft Windows 7 (64 bit)
- Microsoft Windows 8 (64 bit)
- Microsoft Windows 10 (64 bit)

Memory

- 8 GB RAM [minimum]

Monitor Resolution

- WXGA+ (1440 x 900) [minimum]

PC Software Requirements

Keysight IO Libraries Suite (Software)

- Ver. 18.1

M8070B system software for M8000 series

- Ver. 9.5.560.12

M8070ADVB Advanced Measurement Package for M8000 Series

- Ver. 1.07.0- Refer to Table 2 to view a list of available licenses for this mandatory package

FlexDCA

- A.07.40.319

M8195A Soft Front Panel

- Ver. 4.0.0.0

M8196A Soft Front Panel

- Ver. 2.1.1.0

N1010A FlexDCA Remote Access System

- A.06.60

M8054A, Interference Source, 32 GHz

- 1.0.23.0

PC Interfaces

- USB
- LAN
- GPIB (optional)

Instrument Firmware Requirements

M8040A BERT

- M8070B System Software as specified earlier.
- Ensure that you install M8070ADVB Advanced Measurement Package for M8000 Series, as well.

8163B LMS

- Ver.V5.25 or later

8164B LMS

- Ver.V5.25 or later

81491A Reference Transmitter

- Ver.V5.01 or later

Supported Equipment

As mentioned earlier, the N4917BACA Optical Receiver Test Solution comprises of a variety of instruments. For some of the instruments, alternative selections are supported. The following sections detail the equipment, including the **minimum** option requirements, which are compatible with the N4917BACA Optical Receiver Test Solution.

BERT

- M8040A/M8040A-BU2 mainframe with USB option
- M8070ADVB-1FP/1TP/1NP/1UP System Software. For a comprehensive list, see Table 2.
- M8045A-G32/0G3/0G4/801 High Performance BERT module
- M8057A/B Remote head for M8045A pattern generator, 1 channel
- M8046A-A32/801 Analyzer module

Signal Generator for Interference

- M8054A 32 GHz Interference Source or
- M8195A-002 Arbitrary Waveform Generator or
- M8196A-002 Arbitrary Waveform Generator or
- 81150A-001 Pulse Function Arbitrary Noise Generator or
- 81160A 1 or 2 Channel Pulse Function Arbitrary Generator or
- 81160A-001 1 Channel 330 MHz Pulse Function Arbitrary Generator or
- N5171B-503 EXG X-series RF Analog Signal Generator
- N5172B EXG X-Series RF Vector Signal Generator

Lightwave Measurement System

- 8163B 2-slot lightwave multimeter
- 8164B 5-slot lightwave measurement system mainframe

Tunable lasers

- N7776C Tunable Laser 1240-1380 nm or
- N7778C Tunable Laser 1240-1380 nm or
- N7779C Tunable Laser 1240-1380 nm or
- 81602A-013 Tunable Laser 1250-1370 nm or

- 81606A-113 Tunable Laser 1240-1380 nm or
- 81608A-113 Tunable Laser 1240-1380 nm or
- 81609A-113 Tunable Laser 1240-1380 nm

Reference Transmitters

- 81491A-085 Reference Transmitter (multimode - for SR only)
- 81491A-135 Reference Transmitter
- 81492A-E01 Reference Transmitter (56GBaud)
- 81492A-135 Reference Transmitter (56GBaud)

- 81000FI Optical Connector Interface
- 81000NI Optical Connector Interface

Optical attenuators:

- 81576A Attenuator module (straight SMF) or
- 81577A Attenuator module (angled SMF) or
- N7761A external Attenuator (1 ch straight SMF) or
- N7762A external Attenuator (2 ch straight SMF) or
- N7764A external Attenuator (4 ch straight SMF)
- N7751A external Attenuator (1 ch with 2 optical power meter channels, SMF)
- N7752A external Attenuator (2 ch with 2 optical power meter channels, SMF)
- N7766A external Attenuator (2 ch multimode)
- N7768A external Attenuator (4 ch multimode)

DCA-M Oscilloscope

- N1092A one optical channel or
- N1092B two optical channels or
- N1092C one optical, two electrical channels or
- N1092D four optical channels or
- N1092E two optical, two electrical channels
- options LOJ/PLK/IRC/200/201/300/401/500

Clock Recovery

- N1077A-232/SMS/JSA Optical/Electrical Clock Recovery

For the complete list of available hardware options and accessories, refer to the Configuration Guide section in the N4917BACA Data Sheet.

License Requirements

The N4917BACA 100G Optical RX Test software is a BERT compliance test application which requires a valid license installed in Keysight License Manager and an active VISA connection to an M8070B session connected to a M8040A 32 or 64 GBaud High-performance BERT with the module licenses shown below installed. Most of the required licenses have also been listed in the “Supported Equipment” section. For a comprehensive list, refer to the N4917BACA 100G Optical Receiver Stress Test Solution - Data Sheet.

N4917BACA 100G Optical Receiver Stress Test Software Configuration

Table 1 License Requirements for N4917BACA

Product	Option	Description
N4917BACA-1FP	1FP	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, node-locked, perpetual license
N4917BACA-1TP	1TP	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, transportable, perpetual license
N4917BACA-1NP	1NP	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, network/floating, perpetual license
N4917BACA-1UP	1UP	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, USB portable, perpetual license
N4917BACA-1FL	1FL	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, node-locked, 12 month license
N4917BACA-1TL	1TL	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, transportable, 12 month license
N4917BACA-1NL	1NL	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, network/floating, 12 month license
N4917BACA-1UL	1UL	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, USB portable, 12 month license
N4917BACA-1FX	1FX	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, node-locked, 24 month license
N4917BACA-1TX	1TX	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, transportable, 24 month license
N4917BACA-1NX	1NX	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, network/floating, 24 month license
N4917BACA-1UX	1UX	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, USB portable, 24 month license
N4917BACA-1FY	1FY	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, node-locked, 36 month license
N4917BACA-1TY	1TY	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, transportable, 36 month license
N4917BACA-1NY	1NY	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, network/floating, 36 month license
N4917BACA-1UY	1UY	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, USB portable, 36 month license

Product	Option	Description
N4917BACA-1FF	1FF	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, node-locked, 6 month license
N4917BACA-1TF	1TF	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, transportable, 6 month license
N4917BACA-1NF	1NF	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, network/floating, 6 month license
N4917BACA-1UF	1UF	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, USB portable, 6 month license
N4917BACA-TRL	TRL	Optical Receiver Stress Test compliance app for 100G IEEE and MSAs, USB portable, 30 days free trial license
M8045A	G32 or G64 0G3 or UG3 0G4 or UG4	32GBaud or 64GBaud PG Jitter Deemphasis
M8046A	A32 or A64	32GBaud or 64GBaud ED

Table 2 on page -22 shows licenses available for M8070ADVB Advanced Measurement Package for M8000 Series:

Table 2 Advanced Measurement Package Licenses

License	Description
M8070ADVB-1FP	Advanced Measurement Package for M8000 Series BERT Test Solutions, node-locked perpetual license
M8070ADVB-1TP	Advanced Measurement Package for M8000 Series BERT Test Solutions, transportable perpetual license
M8070ADVB-1NP	Advanced Measurement Package for M8000 Series BERT Test Solutions, floating perpetual license
M8070ADVB-1UP	Advanced Measurement Package for M8000 Series BERT Test Solutions, USB portable perpetual license
M8070ADVB-1FL	Advanced Measurement Package for M8000 Series BERT Test Solutions, node-locked 12 month license
M8070ADVB-1TL	Advanced Measurement Package for M8000 Series BERT Test Solutions, transportable 12 month license
M8070ADVB-1NL	Advanced Measurement Package for M8000 Series BERT Test Solutions, floating 12 month license
M8070ADVB-1UL	Advanced Measurement Package for M8000 Series BERT Test Solutions, USB portable 12 month license
M8070ADVB-1FX	Advanced Measurement Package for M8000 Series BERT Test Solutions, node-locked 24 month license
M8070ADVB-1TX	Advanced Measurement Package for M8000 Series BERT Test Solutions, transportable 24 month license
M8070ADVB-1NX	Advanced Measurement Package for M8000 Series BERT Test Solutions, floating 24 month license
M8070ADVB-1UX	Advanced Measurement Package for M8000 Series BERT Test Solutions, USB portable 24month license
M8070ADVB-1FY	Advanced Measurement Package for M8000 Series BERT Test Solutions, node-locked 36 month license
M8070ADVB-1TY	Advanced Measurement Package for M8000 Series BERT Test Solutions, transportable 36 month license

License	Description
M8070ADVB-1NY	Advanced Measurement Package for M8000 Series BERT Test Solutions, floating 36 month license
M8070ADVB-1UY	Advanced Measurement Package for M8000 Series BERT Test Solutions, USB portable 36 month license
M8070ADVB-1FF	Advanced Measurement Package for M8000 Series BERT Test Solutions, node-locked 6 month license
M8070ADVB-1TF	Advanced Measurement Package for M8000 Series BERT Test Solutions, transportable 6 month license
M8070ADVB-1NF	Advanced Measurement Package for M8000 Series BERT Test Solutions, floating 6 month license
M8070ADVB-1UF	Advanced Measurement Package for M8000 Series BERT Test Solutions, USB portable 6 month license
M8070ADVB-TRL	Advanced Measurement Package for M8000 Series BERT Test Solutions, 30 days free Trial

Table 3 on page -23 describes which of the above discussed licenses are mandatory for some features of the N4917BACA application.

Table 3 N4917BACA License Configuration

License	Description	Description
N4917BACA-1xx	Application license	Mandatory
M8080ADVB-1xx	Advanced Measurement Package for M8000 Series BERT Test Solutions	Mandatory for the following features: - External CDR control - Jitter tolerance testing - DUT control interface (DCI)
M8045A-G32	32 GBd PG	Mandatory
M8045A-G64	64 GBd PG	Not required
M8045A-0G3 or UG3	Jitter	Mandatory
M8045A-0G4 or UG4	Deemphasis	Mandatory
M8054A-0P3 or UP3	PAM4 32GBd	Not required
M8045A-0P6 or UP6	PAM4 extension to 64 GBd	Not required
M8046A-A32	32 GBd ED	Mandatory for receiver testing with M8046A error detector
M8046A-A64	64GBd ED	Not required
M8046A-0P3 or UP3	PAM4 32 GBd	Not required
M8046A-0A4 or UA4	Clock Recovery for 32GBd	Mandatory for ED BER measurements with internal clock recovery

You can install the required licenses for the N4917BACA application using Keysight License Manager.

Keysight License Manager

Keysight License Manager is a software utility that enables end users to easily manage right-to-use licenses for software and hardware capabilities on Keysight instruments or systems. The graphical user interface (GUI) gives you a visual representation of the licenses installed on your Keysight Technologies systems and provides access to the following features:

- View the licenses installed on a system
- Install licenses for new capabilities
- Transport licenses from one controller to another
- Borrow the licenses
- Remove licenses for capabilities no longer needed

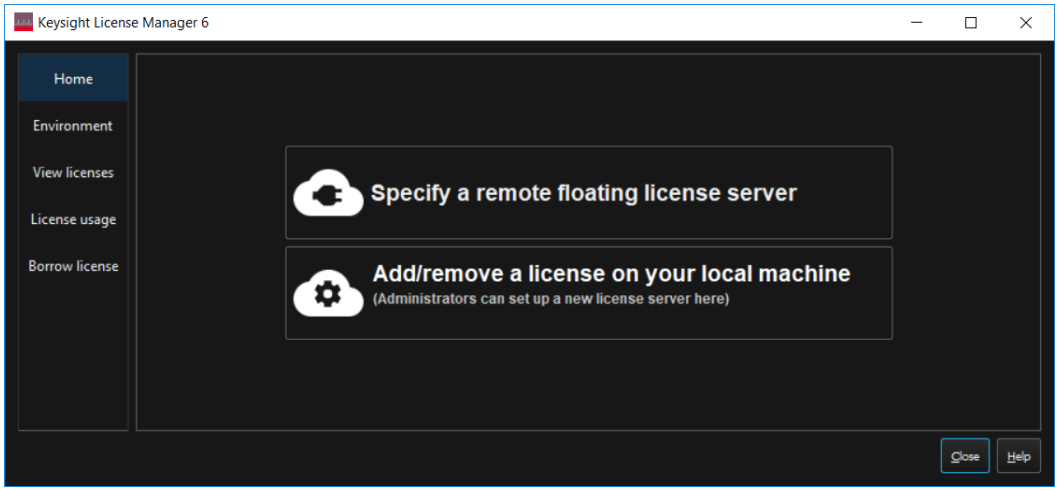
For detailed information on **Keysight License Manager**, refer to the *Keysight License Manager Help*. You can access the *Keysight License Manager Help* from the **Keysight License Manager** web page: http://www.keysight.com/find/LicenseManager

NOTE **Please note that the Keysight License Manager 6 and Keysight License Manager 5 are installed on your system when you install N4917BACA software.**

There are two versions of Keysight License Manager, which can be used to manage the licenses:

Keysight License Manager 6

This license management application allows you to manage floating and USB portable licenses for a variety of software products and instruments.



USB portable licenses:	Install, view, delete
Floating licenses:	Install, view, delete, borrow, and configure license server

You can use the Keysight License Manager 6 to configure remote license servers for sharing licenses across a network, or to configure a local license server (used with certain types of node-locked licenses) on the computer or instrument where your Keysight software is installed.

Although, the Keysight License Manager 6 is installed on your system when you install the N4917BACA software, however, you can download it at: Keysight License Manager 6.

Keysight License Manager 5

This license management application allows you to manage node-locked and transportable licenses for a variety of software products and instruments.

Node-locked licenses:	Install, view, delete
Transportable licenses:	Install, view, delete, and transport

Although, the Keysight License Manager 5 is installed on your system when you install the N4917BACA software, however, you can download it at: Keysight License Manager 5.

Installing the Licenses

Adding License using Keysight License Manager 6

Adding a Floating License

1 On the license server machine, start **Keysight License Manager 6** from your computer's **Start** screen or **Start** menu.

2 Click **Add a license to your local machine**.

3 Select **Add a license to this floating license server**.

4 In the **Add (install) a license window**, click **Browse...** and browse to the location of your license file. You can repeat this as many times as needed to install all your licenses.

5 If you want the license server process to start automatically each time the server machine is restarted, make sure that **Automatically start license server after every reboot** is selected.

For more information, you can also refer the *Keysight Licensing Administrator's Guide*:
https://literature.cdn.keysight.com/litweb/pdf/5951-5739.pdf

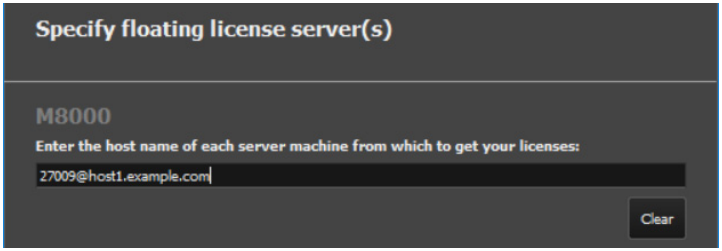
Specify remote license servers

To tell your Keysight product where to get its floating (network) licenses, do the following.

1 From the **Keysight License Manager 6** home screen, click Specify remote license server(s).

2 If you did not run **License Manager** from a menu in a Keysight product, you will see a product selection dialog box. Select the product to be licensed from the drop-down list.

3 In the **License Setup Wizard** for <Product Name> dialog box, type in the port_number@host_name of each server. If you have more than one server, separate them with semicolons (;). For example:



4 Once you've entered your server name(s), click **Next** to complete your setup.

Adding a USB License

Before adding a USB license, you must ensure that:

- Your Keysight product software is installed on this machine.
- You have a license file on this machine. If you don't have a license file, go to **Keysight Software Manager** to get one.
- If your license is locked to a dongle (USB key) rather than to a host ID:
  - The dongle driver is installed on this machine. To install:
    - Run Setup64.exe and accept the defaults.
    - Get the FLEXID10 USB Dongle Driver from http://www.keysight.com/find/LicensingUsbDriver.
    - Extract the .zip file to this machine.
  - The dongle is connected to a USB port on this machine.

To license a Keysight product for use on this machine, select the product from the drop-down menu. Once you have selected your product, browse to the license file, then click **Next** to add the license.

Counted node-locked or USB portable licenses require a license server process: your local machine is both server and client for this license type. If your local machine was not already running a license server process, that process will be started when you click **Next** to complete the operation. To make sure the server process starts automatically each time you reboot the machine, ensure that **Automatically start license server after every reboot** is selected.

For more information, you can also refer the *Keysight Licensing Administrator's Guide*: https://literature.cdn.keysight.com/litweb/pdf/5951-5739.pdf

Adding License using Keysight License Manager 5

Adding a Node-Locked License

You can add a license to your system by installing a license (*.lic) file if you receive one from Keysight.

1 Select the > **Install License File...** menu option. This displays a Windows file selection window.

2 Use the file window to browse to and select the license file (<filename>.lic) that you want to add.

3 Click **Open**. License Manager automatically installs the license file in the folder and notifies you with a pop-up that the license has been stored in your license directory. The license now appears on the main license view.

For more information, you can also refer the *Keysight Licensing Administrator's Guide*:
https://literature.cdn.keysight.com/litweb/pdf/5951-5739.pdf

Transporting a License

Transportable licenses are licenses that can be moved from one host controller to another using the **Keysight License Manager**.

1 Start the **Keysight License Manager** by double clicking the **Keysight License Notifier** icon or click **Start** > **(All) Programs** > **Keysight License Manager** > **Keysight License Manager**.

2 In the **Keysight License Manager**, click on **Help** > **Keysight License Manager Help** and perform the procedure in the **Transporting Licenses** help topic.

3 Additionally, you can also refer the *Keysight Licensing Administrator's Guide*: https://literature.cdn.keysight.com/litweb/pdf/5951-5739.pdf

NOTE Click **Help** > **Technical Support** > **My Support Subscriptions** to view a list of license subscriptions for your application.

Installing the Software

The installer for the N4917BACA 100G Optical Receiver Test Application can be downloaded from the Keysight website.

To install the N4917BACA 100G Optical Receiver Test Application, perform the following steps:

1 Double-click the downloaded installer file on your PC. If your computer does not have Keysight License Manager 6.0 installed, the N4917BACA installer prompts you to install it as a requirement.

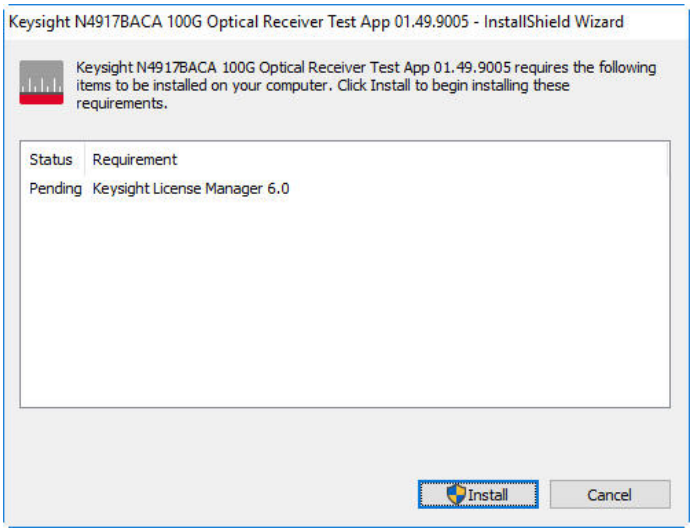


Figure 3 Installation of Keysight License Manager 6.0

NOTE The installer version displayed on your installation screens will depend on the version of the N4917BACA software you have downloaded from the Keysight website.

NOTE Please note that the Keysight License Manager 6 and Keysight License Manager 5 are installed on your system when you install N4917BACA software.

2 Click **Install** to install Keysight License Manager 6.0. After the installation of Keysight License Manager 6.0 is finished, the installation of N4917BACA software is resumed.

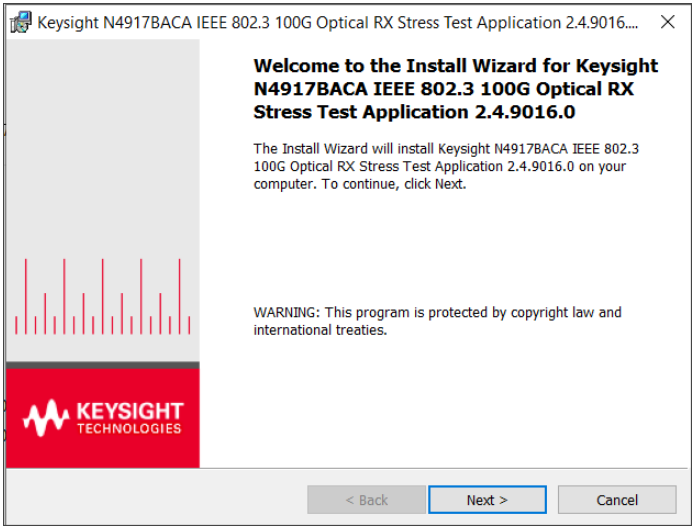


Figure 4 Welcome screen

3 Click **Next**. The **Keysight Software End-User License Agreement** window is displayed.

4 Select **Agree** to agree to the license agreement and to enable the **Next** button.

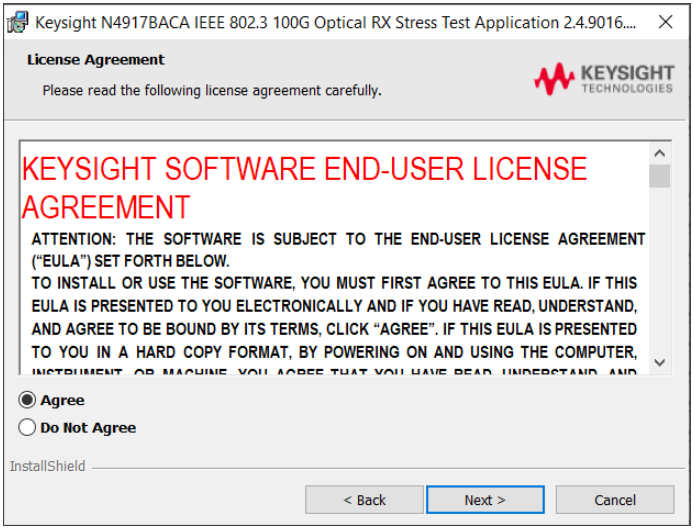


Figure 5 License Agreement window

5 Click **Install**.

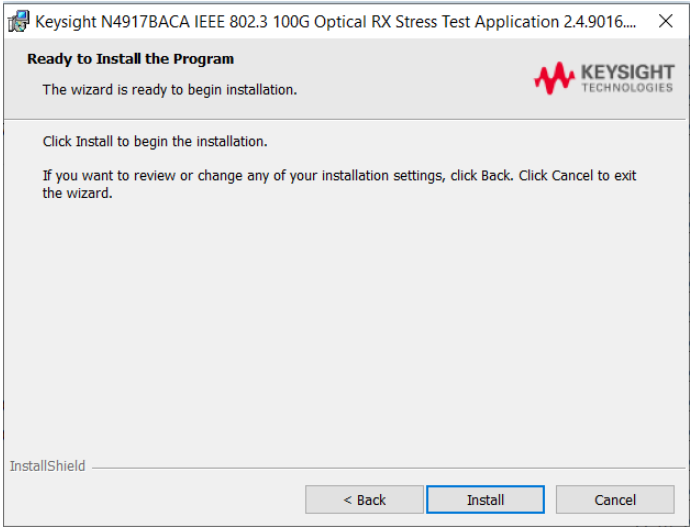


Figure 6 Ready to install

6 Once the installation of the N4917BACA 100G Optical Receiver Test Application begins, its status is displayed.

7 Once the installation is complete, the following window is displayed. Click **Finish** to complete the installation and exit the wizard.

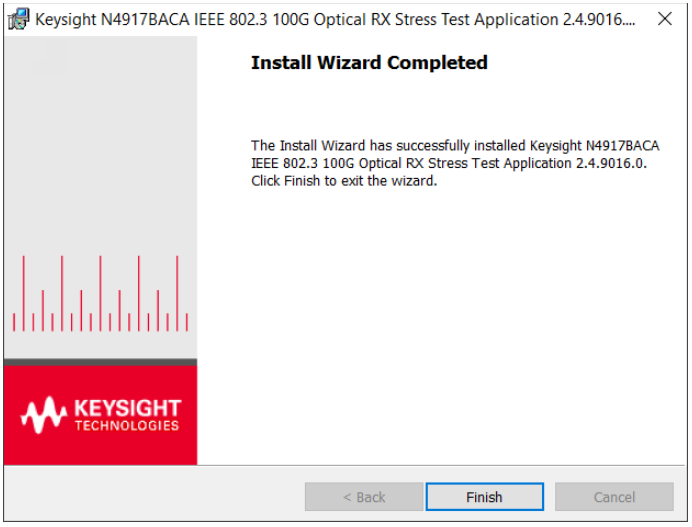


Figure 7 Window indicating end of installation

3 Concepts and Features of N4917BACA Software

This chapter provides an overview of the underlying concepts and features of the N4917BACA 100G Optical Receiver Test Application.

Software Concept and Flow of Optical Receiver Test

The N4917BACA solution software controls the complete hardware required to perform an automated stressed signal calibration and system performance test in accordance with the prescribed specifications for the following transmission formats:

- 100GBASE-LR4
- 100GBASE-ER4
- 100GBASE-SR4 with FEC
- 100GBASE CLR4 without FEC
- 100GBASE CLR4 with FEC
- 100GBASE CWDM4
- 100GBASE 4WDM-10
- 100GBASE 4WDM-20
- 100GBASE 4WDM-40
- 100GBASE-PSM4
- 25GBASE-LR
- 25GBASE-ER
- 25GBASE-SR
- CPRI-Option 10
- 10GBASE-LR
- 10GBASE-ER
- 10GBASE-SR
- 40GBASE-LR4
- 40GBASE-ER4
- 40GBASE-SR4

For the applicable standards, refer to "Applicable Standards" on page 10.

The software is based on a generic framework that already supports a wide range of automated compliance test applications for electrical transmission standards, such as, OIF CEI, XAUI, CAUI and many others.

The workflow of a generic compliance test application consists of five basic steps, which are explained in detail in Chapter 4, "Using the N4917BACA Software".

The following table briefly explains each of these steps in the workflow.

Step	Description
Set Up	Select standard to be tested and specify instrument connection settings
Select Tests	Adjust your equipment setting using Utility Functions and select tasks to perform from the list of available tests. The list of available tasks depends on the selected transmission standard and equipment configuration.
Configure	Adjust specific test settings (in compliance or debug mode)
Connect	Check the actual hardware connection with the provided reference diagram
Run Test	Run the selected tests (either once or multiple times)
Automate	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 test report that can be printed.

The N4917BACA solution software offers different measurement and calibration functions to perform a full 100GBASE, 25GBASE, CPRI, 10GBASE, or 40GBASE optical receiver compliance test in accordance with the prescribed specifications. The following flow chart explains the basic steps to perform a stressed optical receiver test.

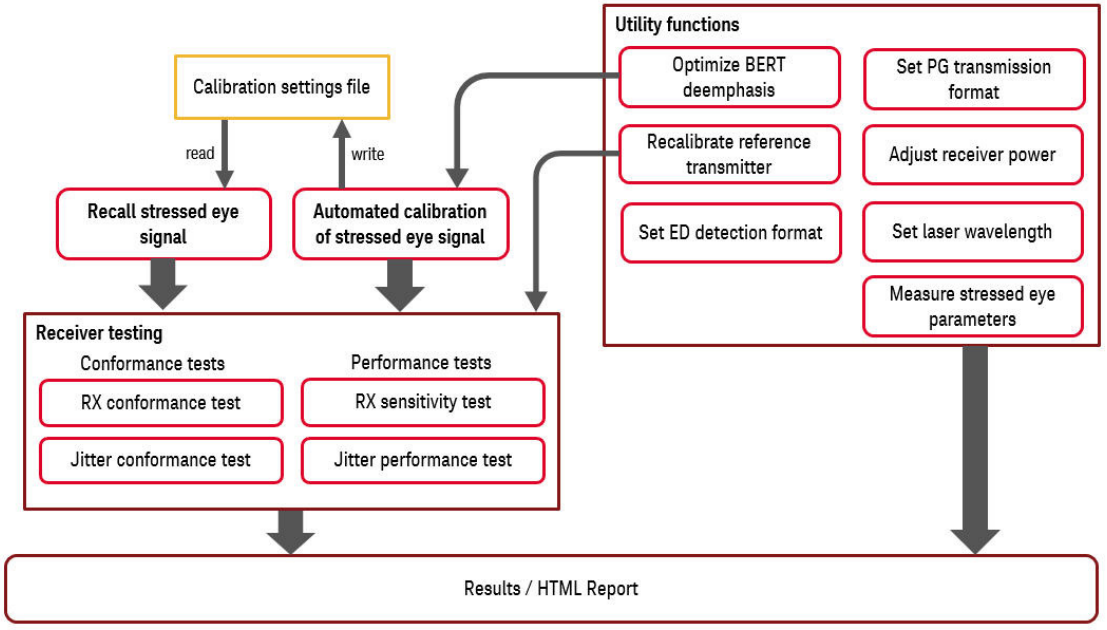


Figure 8 N4917BACA Optical Receiver Testing Flow Chart

Typical Setup for 100GBASE, 25GBASE, CPRI, 10GBASE and 40GBASE Optical Stress Test

The supported equipment described in "Supported Equipment" on page 18 provides the flexibility to assemble the system configuration in various ways.

While some of the transmission standards use a clean clock, some use a recovered clock. Figure 9 and Figure 10 illustrate the recommended configurations using clean clock and recovered clock, respectively. For assistance with other variants of equipment configuration, contact your local Keysight technical support.

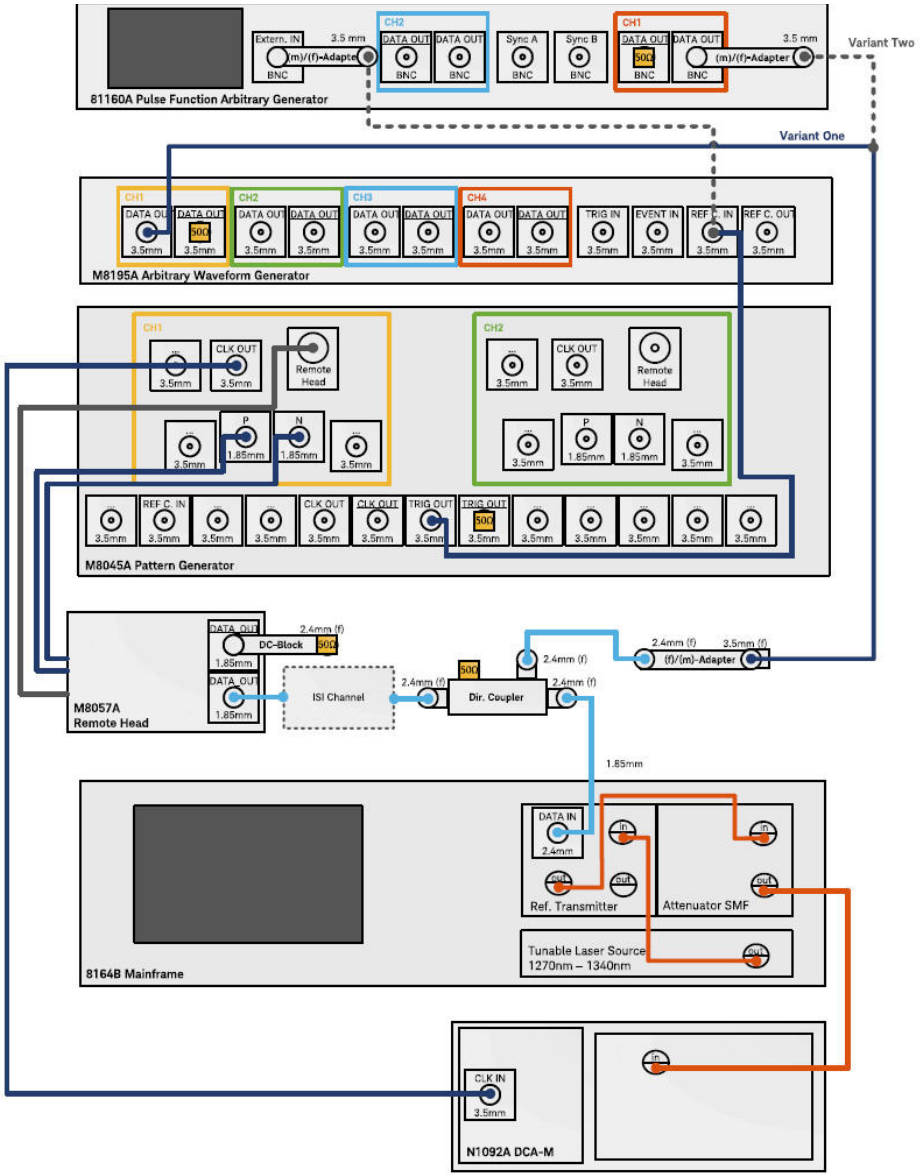


Figure 9 Setup for stressed eye signal calibration for measurements with clean clock

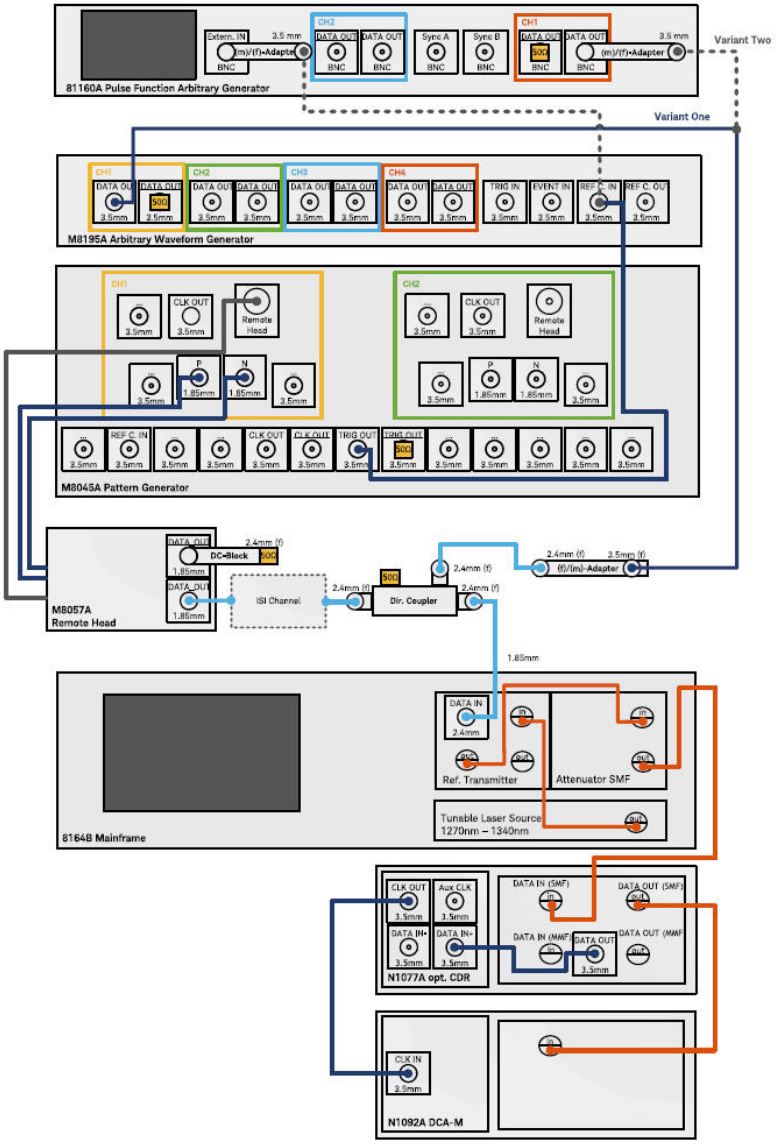


Figure 10 Setup for stressed eye signal calibration for measurements with recovered clock

An example setup for 100GBASE-LR4/-ER4 is shown in Figure 11.

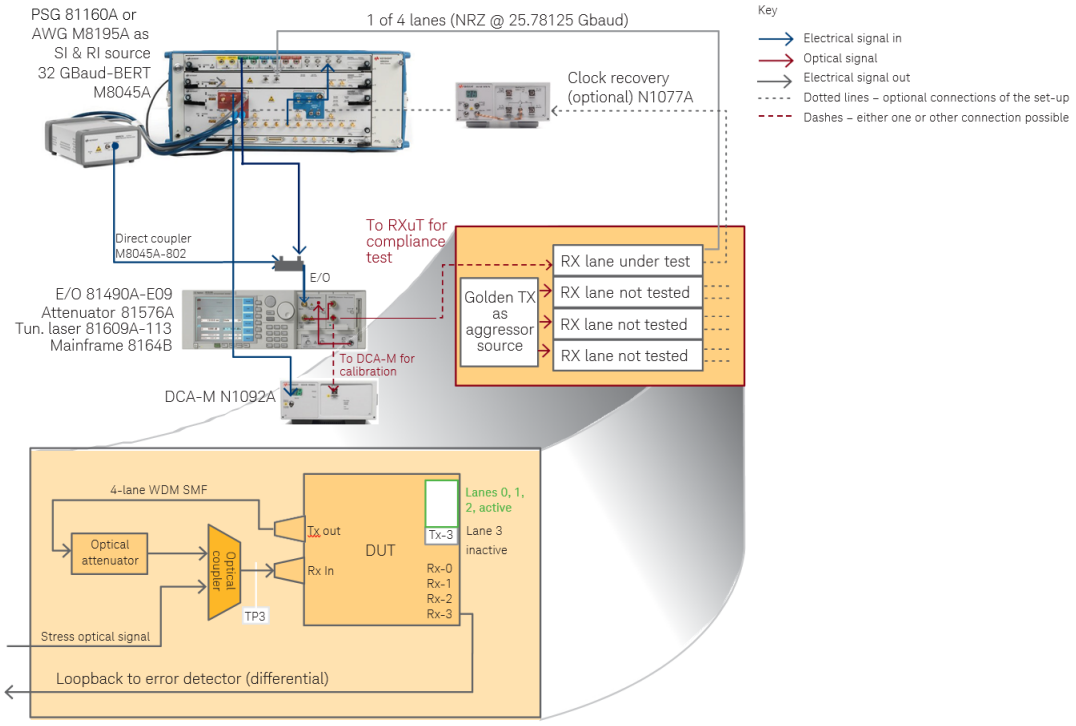


Figure 11 Optical receiver stress test setup for 100 GBASE-LR4/-ER4

Controlling N1076A/77A from M8070B System Software

For seamless integration of clock recovery in the N4917BACA 100G Compliance Application, an instance of the N1076A/77A clock recovery must run the FlexDCA N1000-Series system software prior to starting the M8070B software.

Setting up the required connections involves starting the FlexDCA software and connecting to the CDR module(s), configuring and starting the SCPI server in FlexDCA, giving VISA connection to corresponding FlexDCA session alias name: N1076A_PROXY, and starting the M8070B and observing the new connection to the DCA modules. Refer to the *Controlling N1076A/77A from M8070B* topic in the *Keysight M8070B Advanced Measurement Package User Guide* to understand the procedure for the N1076A/77A control via M8070B and FlexDCA system software.

Figure 12 shows the block diagram depicting the recommended setup to connect an N1076A/77A clock data recovery module to the M8046A error detector module.

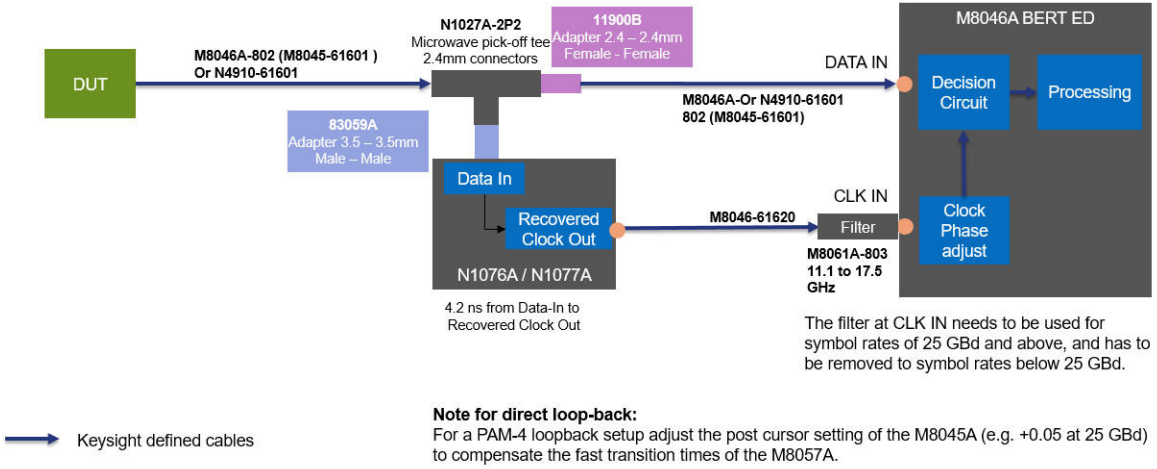


Figure 12 Recommended connection setup for N1076A/77A control

Automated Calibration

One of the main features of the N4917BACA solution software is the automated calibration of stressed receiver conformance test signal as specified in the relevant clauses of the specifications.

Optical receiver stress test procedures, defined by the IEEE, are performed using several instruments such as a bit error ratio tester, digital sampling oscilloscope, optical reference transmitter and tunable laser source. The purpose of the test is to generate a stable and repeatable stressed optical signal with specific characteristics, and send it to the receiver under test to measure the resulting bit error ratio. However, achieving this is not a trivial task as the combination of different stress factors (inter symbol interference, jitter, sinusoidal interferences, optical power level) gives rise to complex dependencies on the target metrics.

Composition of Stressed Receiver Conformance Test Signal

The N4917BACA software calibrates the stressed receiver conformance test signal according to the prescribed definitions in the specifications. Note that you can change the target values of the metrics to be optimized (select **Debug** in the **Configure** tab).

Taking 100GBASE -LR4/-ER4 as an example, the M8045A BERT pattern generator generates a test pattern with the signal parameters listed in the following table. The calibration procedure then performs the following steps to create an impaired signal using the specified stress components and measuring the stress signal calibration metrics listed in the following table.

Table 4 Stressed receiver compliance test signal characteristics

Transmission Standard	Signal Parameter	Value
100GBASE-LR4 and ER4	Signaling rate	25.78125 +/- 100ppm GBd
	Modulation format	NRZ
	Calibration test pattern	PRBS9 (as defined in Table 88-11)
	Stressed receiver test pattern	PRBS31 (as defined in Table 88-11)
	Stress Components	
	Sinusoidal jitter (sinusoidally jittered clock)	as defined in Table 88-13
	Sinusoidal amplitude interferer (SI)	between 100 MHz - 2GHz, non-harmonic to data signal and other stress components
	Inter-symbol-interference (ISI)	Frequency response of low-pass filter and E/O converter should result at least two-thirds of dB value of VECP before SI is added
	Stress Signal Target Metrics	
	Vertical eye closure penalty (VECP)	as defined in Table 88-8
	Extinction ratio (ER)	as defined in Table 88-7
	Receiver power (OMA)	as defined in Table 88-8
	J2 Jitter	as defined in Table 88-8
	J9 Jitter	as defined in Table 88-8

1 The pattern generator output amplitude is adjusted so that the clean eye signal (i.e., sinusoidal jitter and sinusoidal interferer turned off) has approximately the minimum extinction ratio as specified in the standard.

2 The clean eye signal should have greater than or equal to the specified dB value of VECP/SEC (VECP in the current example) due to ISI created by a low-pass filter and the frequency response of the E/O converter. Refer to "Appendix" on page 97 for the specified dB values of initial VECP/SEC for various transmission standards. The N4917BACA software stress signal calibration offers an automated procedure that adjusts the initial VECP/SEC value by means of changing the BERT deemphasis coefficients and thus changing the residual ISI level.

3 After turning on the sinusoidal jitter (SJ) and sinusoidal interferer (SI), the software changes iteratively the amplitudes of the stress components until all stressed signal metrics are met. Additionally for some standards, an Eye Mask measurement is performed on the final stressed eye.

4 The parameters of the stressed receiver test signal are stored in a calibration file to be recalled for the same setup at a later point in time.

The stressed receiver conformance test signal as defined in the IEEE specification allows certain degrees of freedom to meet the specified target metrics VECP/SEC, TDEC, ER, OMA, J2, J4, and J9 jitter. For example, the frequencies of sinusoidal jitter and sinusoidal amplitude interferer are not exactly specified by the standard but can be set in the given range (see table 2).

The N4917BACA also offers to change these parameters by using the calibration configuration variables (explained in Chapter 5, “Performing Stressed Receiver Compliance Tests with N4917BACA Software”).

- Periodic Jitter Frequency (default: PJ1 - 10e6 Hz; PJ2 - 100.07e6 Hz)
- Sinusoidal Interferer Frequency (default: 500e6 Hz)
- Initial VECP (default ~two-thirds of target VECP)

Refer to “Appendix” on page 97 for the Stressed Receiver Sensitivity test specifications for 100GBASE, 25GBASE, CPRI, 10GBASE, and 40GBASE formats.

Automated Compliance and Performance Tests

The automated compliance and performance tests use nearly the same setup as used for the stressed receiver signal calibration. The difference is that the optical fiber from the attenuator output is connected to the optical input of the receiver/lane under test instead of the input of the DCA.

The optical receiver is stressed with the calibrated compliance test signal on the lane under test and the received bit error rate (BER) is measured and compared against the target value under various conditions. Note that all the other optical lanes are supposed to be activated to serve as optical cross-talk source. A possible realization of such requirement is illustrated in Figure 11.

Different approaches to recover the BER are supported:

- The BER can be retrieved from the transceiver internal error counter – if any. In this case the communication between the device under test and the N4917BACA solution software is realized using the DCI interface of the M8070 software.
- If no internal error counter is available on the transceiver, an M8046A error detector should be employed to measure the BER of the lane under test. The clock signal use for the error detector should be extracted from the recovered signal (either provided by the DUT or extracted from another lane using an external CDR). See Figure 12.

The following tests can be performed automatically:

- **Rx Compliance Test**: measures the Rx BER compliance at the stressed receiver sensitivity (OMA) as defined in the specification
- **Jitter Compliance Test**: measures the Rx BER compliance at different jitter frequencies with maximum jitter amplitude as defined in IEEE specifications
- **Rx Sensitivity Measurement**: measures the Rx BER versus stressed receiver sensitivity (OMA)
- **Jitter Performance Measurement**: measures the Rx BER versus jitter frequency and amplitude

Table 5 Stressed receiver compliance target metric

Transmission Standard	Signal Parameter	Value
100GBASE-LR4, ER4, CLR4	Target Error Ratio	1.0E-12
100GBASE CLR4 with FEC	Target Error Ratio	2.1E-05
25GBASE-LR, 25GBASE-ER, 25GBASE-SR 100GBASE CWDM4, 100GBASE 4WDM-10, 100GBASE 4WDM-20, 100GBASE 4WDM-40, 100GBASE-PSM4 100GBASE-SR4	Target Error Ratio	5.0E-05
10GBASE-LR, 10GBASE-ER, 10GBASE-SR 40GBASE-LR4, 40GBASE-ER4, 40GBASE-SR4	Target Error Ratio	1.0E-12

4 Using the N4917BACA Software

As a prerequisite for using the N4917BACA software, ensure that all the required instruments specified in "Supported Equipment" on page 18 are defined in the *Keysight Connection Expert* on the PC, where the Keysight N4917BACA 100G Optical Receiver Test Application is installed.

Starting the N4917BACA 100G Optical Receiver Test Application

The N4917BACA 100G Optical Receiver Test Application is available to be run as a standalone application on a PC, and either connecting locally or remotely to the hardware setup.

Before you launch the N4917BACA 100G Optical Receiver Test Application, make sure that the following software is running and online:

- FlexDCA N1000-Series System Software (used for stressed receiver compliance signal calibration)
- M8195A/M8196A AWG soft front panel software (used to control the sinusoidal interference generator). The M8054A Interference Source is run from within the M8070B instance.
- Keysight M8070B software to connect to M8040A High-performance BERT

NOTE

It is recommended to start the various software tools in the following order to make sure all the connected instruments are recognized and initialized correctly:

1. Start FlexDCA software and configure CDR modules (optional)

2. Start AWG soft front panel. No soft front panel is required when using M8054A as the interference source.

3. Start M8070B system software with option /IgnoreAWG if you perform Step 2

Ensure that proper connections with the testing instruments are established. Ensure that the measurement instruments are connected on the same LAN as the remote PC, where the N4917BACA 100G Optical Receiver Test Application is installed.

To access the N4917BACA 100G Optical Receiver Test Application, perform the following steps:

1 From the **Start** menu of the Windows 10 Operating System, select **Keysight M8070B Applications > Launch Keysight N4917BACA**. Alternatively, type **N4917BACA** in the Windows search box to locate the application.

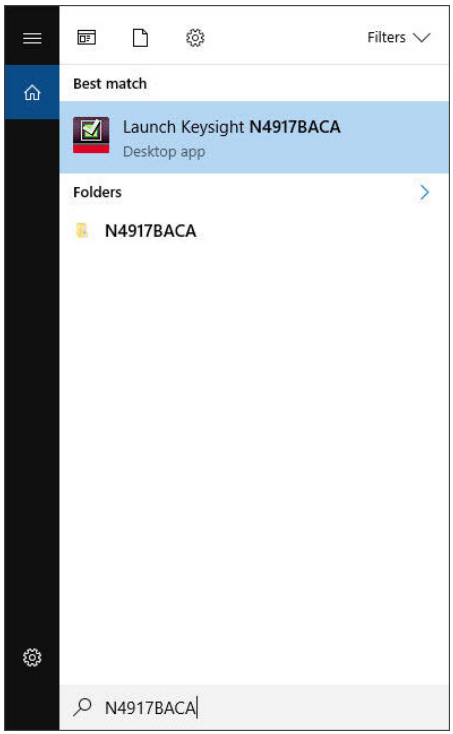


Figure 13 Launching the N4917BACA Rx Test Application

NOTE

If you do not see the links to Keysight N4917BACA listed on the Start menu, the N4917BACA 100G Optical Receiver Test Application has not yet been installed on the PC.

Refer to "Installing the Software" on page 29 for installation instructions.

- If you are launching the Keysight N4917BACA 100G Optical Receiver Test Application for the first time, the End-User License Agreement window appears. Select **Agree** to continue.
- The N4917BACA 100G Optical Receiver Test Application banner is displayed.
- If there is a single instance of the M8070B software running locally, the N4917BACA 100G Optical Receiver Test Application launches after automatically getting connected to the M8070B software.
- If the N4917BACA 100G Optical Receiver Test Application does not detect any instance of the M8070B software running locally, the **Connect to M8070** window appears.

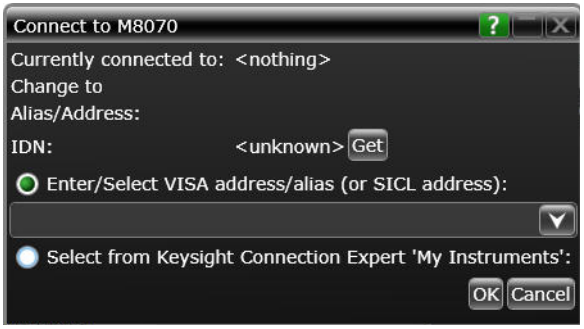


Figure 14 Connecting to M8070B

2 Perform one of the following actions:

- In the **Enter/Select VISA address/alias (or SICL address):** text field, you can either type or copy the VISA/SICL address directly from the Keysight M8070B software and paste it here. To verify the correct VISA address to connect to M8070B, access the **SCPI Server Information** window. by clicking **Utilities > SCPI Server Information...** from the main menu of the Keysight M8070B software.

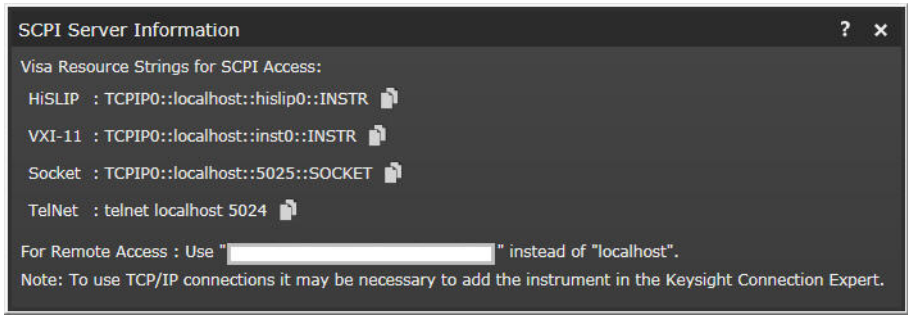


Figure 15 SCPI Server Information window on the M8070B Software

- If the BERT device is online and defined in the *Keysight Connection Expert*, click **Select from Keysight Connection Expert favorites:**. The VISA address list defined in the Keysight Connection Expert software for each online instrument is displayed. After you verify the VISA/SICL address, select the correct VISA Address from the list.

3 Click **Get** on the **Connect to M8070** window. The **IDN:** field displays the instrument name.

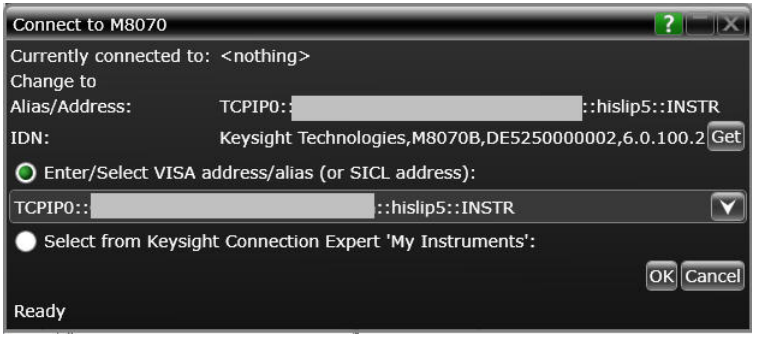


Figure 16 IDN field displaying successful connection to M8070B

4 Click **OK** to establish connection with M8070B and to launch the N4917BACA 100G Optical Receiver Test Application. If the connection cannot be established, the application start will be aborted. If the required licenses are missing, a message is displayed.

5 When the application starts successfully it will start with the default layout and will show the **Set Up** tab.

NOTE The **Message** tab will show info, warning and error messages while running the N4917BACA application as well as intermediate results of measurements. Scroll up and down to display relevant messages.

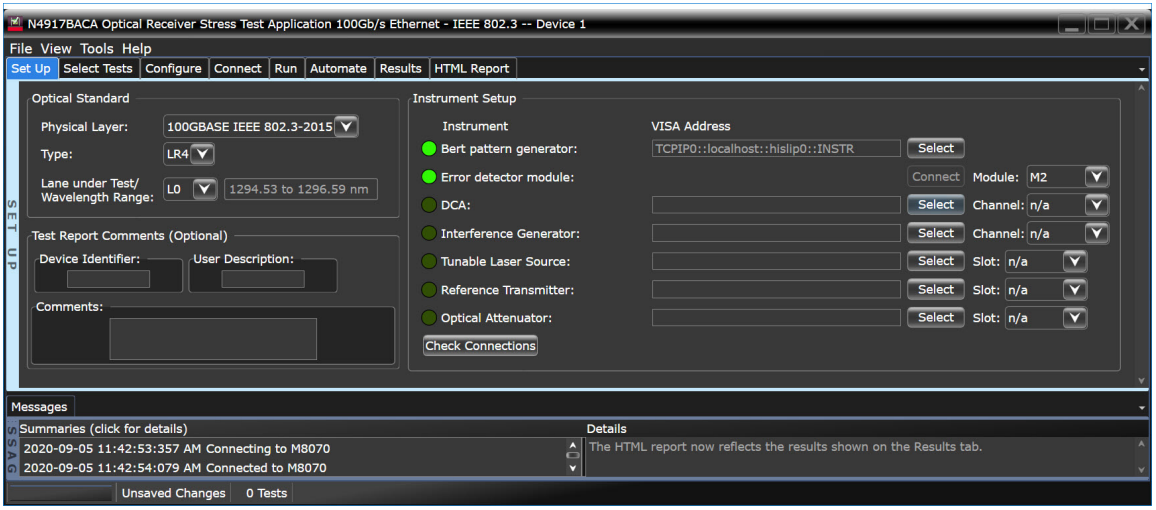


Figure 17 Default view of the N4917BACA Optical Receiver Stress Test Application

NOTE The application framework enables you to use docking and floating windows, so the GUI can be customized to meet your requirements. If you want to reset the GUI to its default layout, select **View > Reset > Tab Layout** in the application menu.

For more information on how to use the various features in the N4917BACA 100G Optical Receiver Test Application, refer to the *Keysight N4917BACA 100G Optical Receiver Test Application Online Help*.

Setup tab - Setting up the N4917BACA 100G Optical Receiver Test Application

Before you start any stressed signal calibrations or receiver testing with the N4917BACA application, you must set up the application first.

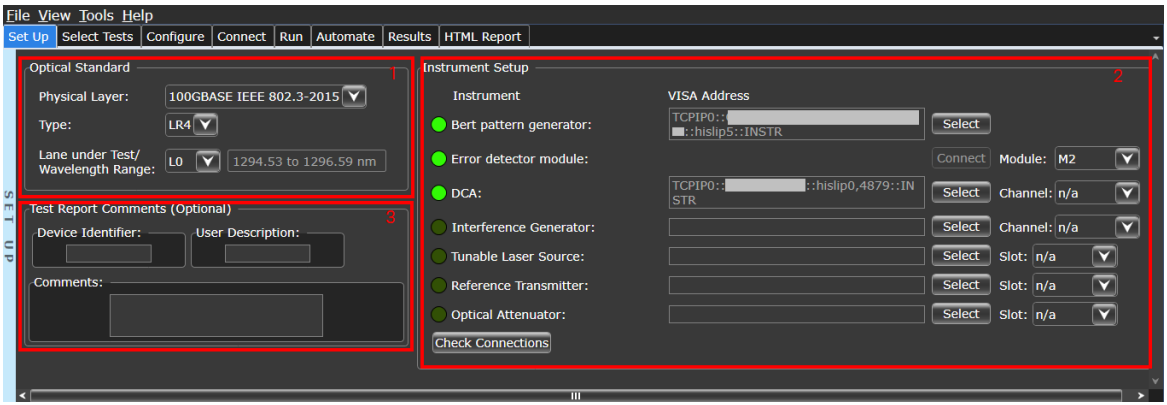


Figure 18 Setting up the N4917BACA Optical Receiver Stress Test BERT Compliance App

Under the **Set Up** tab,

1 In the **Optical Standard** area,

i Select **100GBASE IEEE 802.3-2015**, **100GBASE IEEE 802.3-2015 MSA**, **25GBASE IEEE 802.3cc**, **CPRI**, **10GBASE IEEE 8023ae,** or **40GBASE IEEE 802.3ba** in the **Physical Layer** area, to indicate the physical medium attachment (PMA) sublayer type on which the calibrations/tests are to be performed. The **Select Tests** tab displays the respective calibrations and tests. By default, **100GBASE IEEE 802.3-2015** is selected.

ii Select the physical medium dependent (PMD) sublayer. The following table displays the available PMD sublayers for the

physical layer standards:

Physical Layer	Type
100GBASE IEEE 802.3-2015	LR4, ER4, SR4
100GBASE IEEE 802.3-2015 MSA	CLR4, CLR4-FEC, CWDM4, 4WDM-10, 4WDM-20, 4WDM-40, PSM4
25GBASE IEEE 802.3cc	LR, ER, SR
CPRI	Option 10
10GBASE IEEE 802.3ae	LR, ER, SR
40GBASE IEEE 802.3ba	LR4, ER4, SR4

iii Specify the lane under test for the selected optical standard and type. The transmission lane refers to the center transmission wavelength for a wavelength-division-multiplexed physical layer type. Hence the number of available lanes might vary between selected transmission standards. **SR4** and **SR** sublayer types do not have lanes assignments but use multiple fiber pairs for transmission and will show “n/a” instead.

2 In the **Instrument Setup** area, specify the VISA/SICL address for the following instruments:

- BERT Pattern Generator
- BERT Error Detector
- DCA
- Interference Generator
- Tunable Laser Source
- Reference Transmitter
- Optical Attenuator

NOTE In the FlexDCA software, go to **Tools-> SCPI Programming Tools-> SCPI server** to activate the SCPI server or retrieve its information.

NOTE In the M819xA soft front panel, go to **Help-> About** to find the AWG SCPI server address. The M8054A Interference Source is run from within the M8070B instance. Hence, specify the M8070B VISA address in this case.

NOTE The Tunable Laser Source can be ignored if the internal laser source of the reference transmitter is used. In this case, the exact emission wavelength must be specified in the "Transmitter Wavelength" configuration variable under the Configure tab. For more information, see "Connecting to the Internal Laser Source of the Reference Transmitter" on page 56.

i Click **Select...** corresponding to the above instruments to connect to them using the SICL/VISA address, if not connected already. By default, when you start the N4917BACA 100G Optical Receiver Test Application, a connection dialog is displayed to connect at least to the BERT device, else the application fails to launch. A green LED indicates that the instrument has been connected successfully.

ii Select an appropriate module, channel, or slot, wherever appropriate.

iii Click **Check Connections** to verify that the instruments are properly connected to the N4917BACA 100G Optical Receiver Test Application.

NOTE Some instruments might be a module in a multi-module mainframe (e.g. tunable laser source as module in Keysight's 8164B Lightwave Measurement System) and thus shares the same VISA address as other instruments in that mainframe. Select the appropriate module, channel or slot to connect to these instruments. A message in the logging tab might give more information about the model code of the connected module.

In the **Test Report Comments (Optional)** area, enter appropriate values in the **Device Identifier:**, **Device User Description:** and **Comments:** text fields, respectively, such that they appear in the HTML Report that is generated after test runs. Performing this step is optional. However, Keysight recommends entering these values to identify the test results for the corresponding DUT when there are large number of DUTs to be tested.

Connecting to the Internal Laser Source of the Reference Transmitter

The internal laser source of the reference transmitter can be used instead of the tunable laser source. Perform the following steps:

1. If a TLS is available and has been connected in the test application, set the slot selector to "not used". If no TLS is available or the test application has not been connected to it yet, leave slot selector at "n/a".
2. Provide the exact laser wavelength of the internal reference transmitter source in the “Transmitter Wavelength” configuration variable under the Configure tab.
3. Connect the optical laser output of the reference transmitter to the optical modulator input.

Select Tests tab – Select test and measurement task to be performed

The **Select Tests** tab is the main area in the N4917BACA software where tests can be selected to be performed during the next **Run** command. Each test is part of a test group which can be expanded or collapsed by clicking on the preceding arrow. The info area below the test tree shows additional information about the selected test.

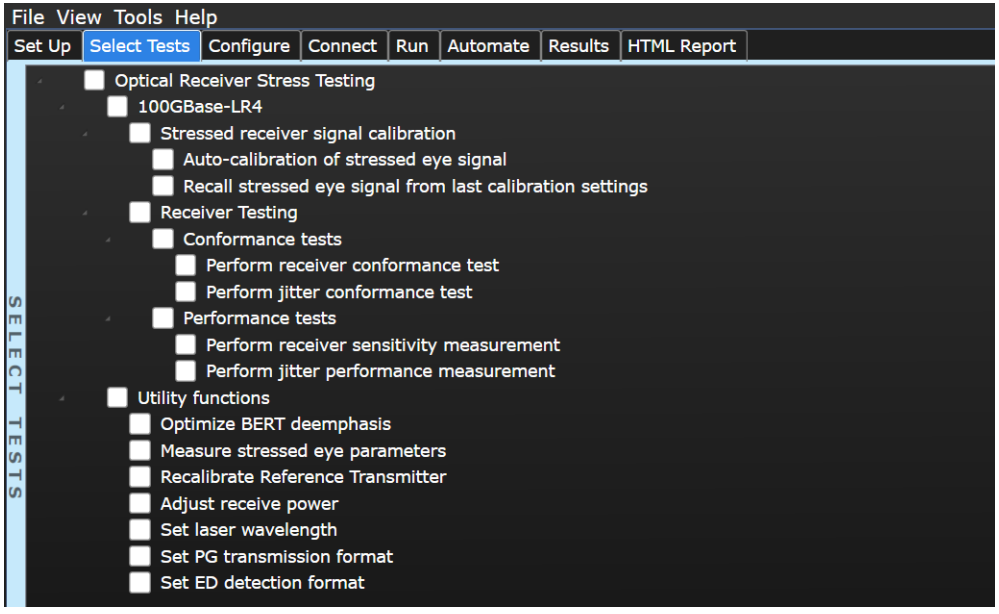


Figure 19 Select Tests tab

NOTE

All selected tests will be performed successively (from top to bottom of list) during the next Run command. If a certain test needs be performed before other tests (e.g. optimization of BERT deemphasis), please run this test separately with all other tests deactivated. In the current release, the Optimize BERT deemphasis test can be configured to run automatically before Stressed receiver signal calibration using the “Optimize deemphasis on calibration start” configuration parameter.

NOTE When activating/deactivating a test group, all child tests will be activated/deactivated accordingly.

Configure tab – Configure application and test specific settings

The **Configure** tab lists all user configuration variables available for the selected transmission standard and sublayer. The configuration variables are subdivided into the same groups as the test structure and can likewise be expanded or collapsed by clicking on the small preceding arrow. The groups of configuration variables are further divided into logical subgroups. For example, the Stressed receiver signal calibration group contains some variables and four subgroups called Sequence Control, Connection Settings, Calibration target values and Stress signal parameters. Likewise, the Receiver Testing group contains some variables and BERT Settings, Jitter Measurement Settings, and RX Sensitivity Measurement subgroups.

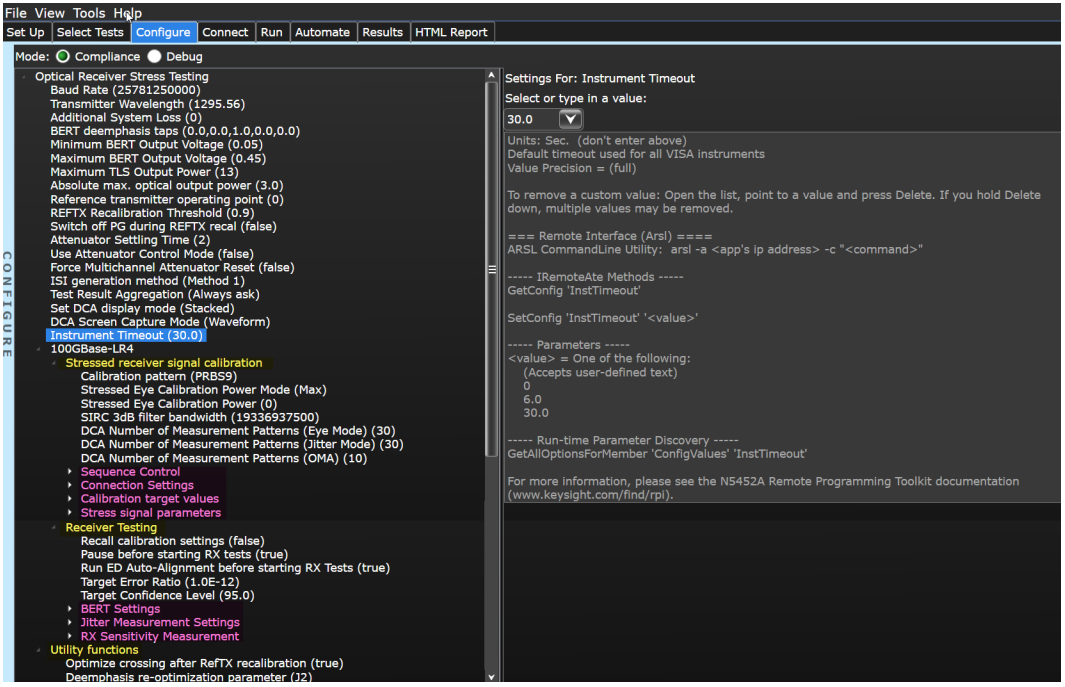


Figure 20 Configure tab

The current value of a variable is shown in round brackets behind the variable name. To change a value, select an existing value from the corresponding drop down box or type in a new one.

The information text below the drop box shows additional information about the configuration variable, for example, its minimum or maximum value as well as its precision (only applicable for numeric types)

The N4917BACA compliance test application offers two configuration modes:

- Compliance mode and Debug mode

In Compliance mode, specific user variables which represent specifications cannot be edited. To allow changing these values (thus deviating from the standard), switch to Debug mode.

Connect tab – Display hardware connection diagrams and test specific information

The **Connect** tab displays hardware connection diagrams before the start of a test. This optional step allows the user to check the physical connections between the devices to ensure compliance with the standards.

Run tab – Run selected tests or measurements

The **Run** tab defines various settings to run tests and starts the selected tests or the automation script created in the **Automate** tab. The user-defined “Tags” can be added for each calibration or test.

Automate tab – Run automated scripts

The **Automate** tab starts any automation scripts created in the Test Application. Refer to the *Keysight N4917BACA 100G Optical Receiver Test Application Online Help* for more information.

Results & HTML Report tabs – Display test results

The **Results** tab and the **HTML Report** tab display the high-level and detailed test and measurement results. Some tests return only a pass/fail value and others return detailed measurement results (such as, scalar values, tables or images).

The N4917BACA 100G Optical Receiver Test Application also facilitates exporting the measurement results and HTML reports into CSV files, PDF, or even to a Web Dataset Repository. For a detailed understanding of the

functionality of each tab and various features within the N4917BACA 100G Optical Receiver Test Application, refer to the *Keysight N4917BACA 100G Optical Receiver Test Application Online Help*.

NOTE

The functionality of the **Upload Results to Repository** feature is not fully supported in the current version of the N4917BACA 100G Optical Receiver Test Application.

Technical Support

Check the **Help** menu for various user assistance documents. For technical support, contact Keysight Technical Support (**Help > Support > Technical Support**) or your Keysight representative. When reporting a software crash, go to **Help > Support > Collect Files**. Send the zip file to Keysight.

5 Performing Stressed Receiver Compliance Tests with N4917BACA Software

This section describes the calibration and test procedures corresponding to the prescribed specifications in the N4917BACA 100G Optical Receiver Test Application.

Setting Up and Preparing the Compliance Test Setup

Before launching the N4917BACA Optical Receiver Stress Test software and performing an optical receiver compliance test you need to set up the required instruments and make the physical connections shown in Figure 21. To ensure stable operation, observe the specified warm up times of the instruments being used. Also ensure that the BERT M8070B System software, the DCA N1010A FlexDCA software, and optionally, the M8195A/M8196A Soft Front Panel software are running. Refer to the Note below on the order of starting the software.

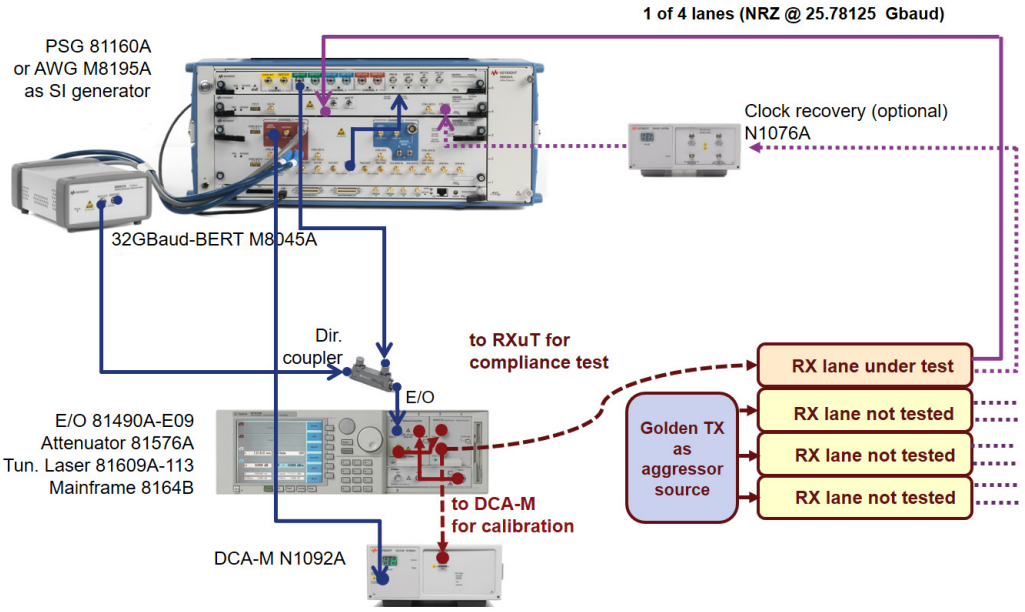


Figure 21 Equipment connections for IEEE802.3ba calibrations and tests

NOTE

The required system software must be started in the following order:
1. DCA N1010A FlexDCA software
2. M8195A/M8196A Soft Front Panel software. Not required when using M8054A interference source, as it is launched from M8070B.
3. M8070B System software

Configure global test settings

After selecting the transmission standard in the **Set Up** tab, the N4917BACA software loads the corresponding test limit file (check also: **Tools-> Compliance limits -> Activate/Refresh** limit set) and sets the respective configuration variables in the **Configure** tab. All global test settings, such as the signal baud rate, transmission wavelength or the BERT deemphasis tap values are listed in the root group (see Figure 22). Please note that some value cannot be changed in Compliance mode but only in Debug mode.

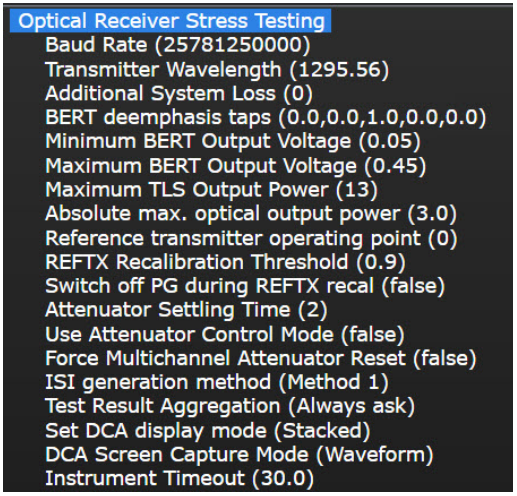


Figure 22 Global configuration variables

Calibrating the stressed receiver conformance test signal

The normative requirement for optical receivers to be compliant according to the IEEE 802.3 and MSA standards is the stressed receiver sensitivity which is measured with the methods defined in the sections of the specifications listed in the "Applicable Standards" on page 10.

Starting your first calibration

The N4917BACA compliance test solution offers a fully automated calibration procedure to generate the compliance test signal which is then used to perform the stressed receiver sensitivity measurement and determine the receiver compliance.

The calibration procedure of the N4917BACA software offers many features, such as transmitter bias optimization, automated deemphasis, and automated initial (i.e., intersymbol interferences - induced) VECP/SEC adjustment. These steps can be switched off in the **Configure** tab to speed up the calibration process. However, in such a case, the user has to ensure that the calibration can be performed with the current system state.

Note that calibration procedures for 100GBASE-SR4 and -ER4 require specific deemphasis and VECP/SEC adjustment procedures. For these transmission standards, it is recommended to use the default settings for calibration.

NOTE In general, it is recommended to not alter the calibration target values under the Configure tab for a specific compliance standard; otherwise, this might lead to erroneous results.

NOTE To run the automated calibration from the test tree (Select tests tab), all instruments in the Set Up tab must be connected and configured successfully, otherwise one or more tests will be unavailable.

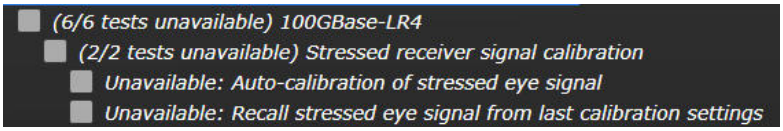


Figure 23 Unavailable tests due to missing instrument connections

Optimizing the BERT deemphasis

Running the automated conformance test signal calibration requires an optimized BERT output that compensates the non-ideal frequency response on the signal path due to amplifiers and E/O converter.

Hence, it is recommended to run an automated BERT deemphasis optimization prior to the stressed receiver conformance test signal calibration. By default, running the "Auto-calibration of stressed eye signal" automatically performs a BERT deemphasis optimization prior to starting the actual calibration procedure. This feature can be disabled by changing the value of the "Optimize deemphasis on calibration start" configuration variable to false. Alternatively, the BERT deemphasis optimization can be performed separately by running the "Optimize BERT deemphasis" test from the Utility functions.

The BERT deemphasis optimization procedure generates an NRZ test pattern and determines the optimum 4 tap (2 pre-cursor, 1 post-cursor) deemphasis coefficients. After successfully running the test, the measurement result is reported in the Results tab (applies only when running it as a separate test from the Utility functions) and automatically set as active values in the corresponding configuration variable (*Optimized (clean eye) deemphasis* in main group).

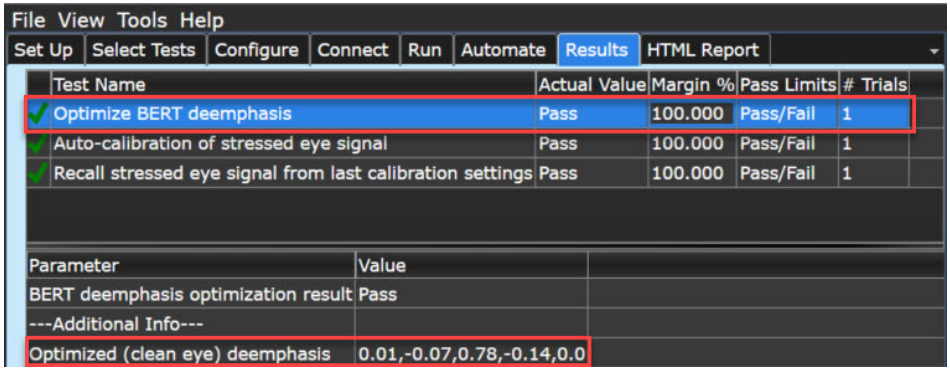


Figure 24 Exemplary BERT deemphasis optimization result

Configuring calibration specific settings

The calibration specific configuration variables such as the calibration data pattern and the calibration target metrics can be found in the Stressed receiver signal calibration settings. Figure 25 shows the exemplary

calibration settings for the 100GBASE-LR4 transmission standard. The Stressed receiver signal calibration settings are logically grouped in the following categories:

- General variables (These do not have an associated category name.)
- Sequence Control
- Connection Settings
- Calibration target values
- Stress signal parameters

Highlighted in blue are generic configuration settings which control the overall behavior of the calibration procedure. The Sequence Control and Connection Settings subgroups are the next groups displaying the relevant parameters for optimizations and clock-related settings.

Highlighted in yellow are the calibration target values (according to IEEE 802.3 standard) and the corresponding calibration tolerances.

- Transmitter Extinction ratio (ER)
- Target Initial Vertical Eye Closure Penalty (VECP)
- Target Vertical Eye Closure Penalty (VECP)
- Target Receiver Power (OMA)
- Target Stressed Eye J2 Jitter (J2)
- Target Stressed Eye J9 Jitter (J9)

Shown in green are the stress component settings (periodic jitter and sinusoidal interferer frequency) to be used for the calibration.

NOTE

To ensure the optimum measurement results, it is recommended to activate the Perform dark level calibration feature. This feature checks the DCA channel calibration status prior to each test and triggers a recalibration, if required.

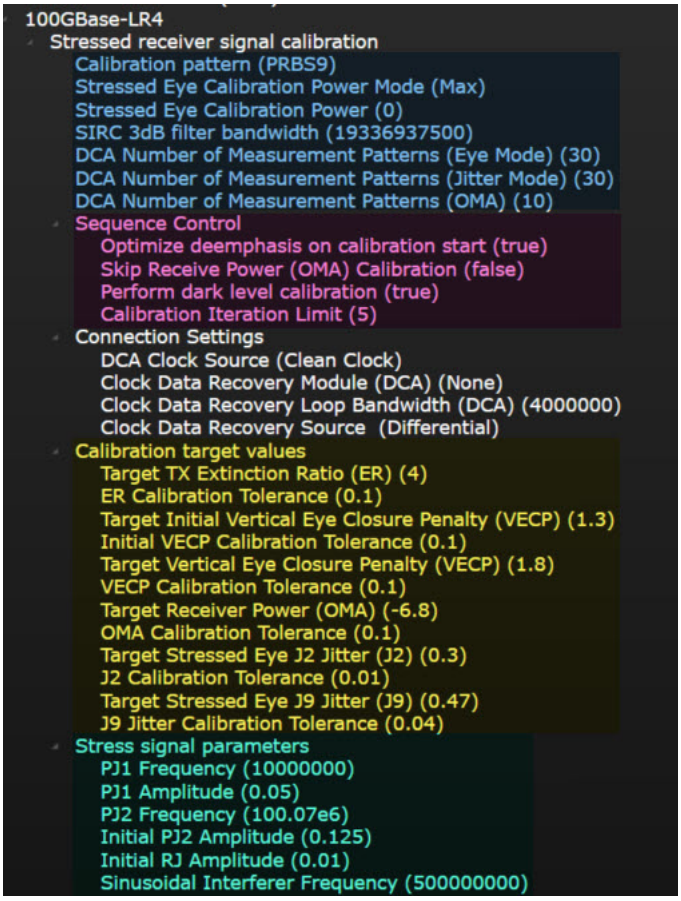


Figure 25 Exemplary stressed receiver signal calibration configuration variables for 100GBASE-LR4

Starting the stressed receiver conformance test signal calibration

To start the actual stressed receiver conformance test signal calibration, activate the corresponding check box in the test tree and click the **Run** button on the **Run** tab or right-click in the test tree and select **Run checked tests**.

During the calibration, status messages in the message window show the progress of the run and display the currently performed action and intermediate measurement results.

NOTE The automated stress signal calibration will reset and reconfigure all used hardware instruments at the beginning of each calibration run. Hence any manual settings will be lost. So, make sure to save these settings prior to start a calibration run.

NOTE The automated stress signal calibration might take several minutes (more than 20 min), depending on the used hardware and calibration settings. In case the calibration aborts during the run due to a timeout error, please try to increase the instrument timeout variable in global settings in the Configuration tab.

NOTE The running calibration process can be aborted by clicking the Stop button on the Run tab.

NOTE The intrinsic VECP/SEC must be lower than initial target VECP/SEC. Therefore, BERT deemphasis optimization is recommended before each calibration.

Table 6 Exemplary configuration variables for 100GBASE-ER4

Calibration step	Class	Relevant configuration variables	Access	Default value
Instrument Initializations	BERT	Baud Rate	Debug Mode	25.78125 GBaud
		Calibration Pattern	Debug Mode	PRBS9
		Optimize deemphasis on calibration start		TRUE
		BERT deemphasis taps		0.0,0.0,1.0,0.0, 0.0
	DCA	Use SIRC reference filter	Debug Mode	TRUE
		SIRC 3dB filter bandwidth	Debug Mode	19.34e9 Hz
		Set DCA display mode		Stacked
		Perform dark level calibration		TRUE
	TLS	Transmitter Wavelength		Set by standard
	ATT	Stressed Eye Calibration Power Mode		Max
		Stressed Eye Calibration Power		0 dBm
		Use Attenuator Control Mode		FALSE
Initial ER Optimization				
REFTX Operating Point Optimization				
Clean Eye Measurement				
Generate Stressed Eye Signal	SJ	PJ1 Frequency		10 MHz
		PJ1 Amplitude		0.05 UI
		PJ2 Frequency		100.07 MHz
		Initial PJ2 Amplitude		0.125 UI
	SI	Sinusoidal Interferer Frequency		500 MHz
	RJ	Initial RJ Amplitude		0.01 UI

Calibration step	Class	Relevant configuration variables	Access	Default value
Stressed Eye Parameter Optimization		Target TX Extinction Ratio (ER)		Set by standard
		ER Calibration Tolerance		0.1 dB
		Target Vertical Eye Closure Penalty (VECP)		Set by standard
		VECP Calibration Tolerance		0.1 dB
		Target Receiver Power (OMA)		Set by standard
		OMA Calibration Tolerance		0.1 dBm
		Target Stressed Eye J2 Jitter (J2)		Set by standard
		J2 Calibration Tolerance		0.01 UI
		Target Stressed Eye J9 Jitter (J9)		Set by standard
		J9 Jitter Calibration Tolerance		0.04 UI

After successful completion of the calibration run, the calibration results are reported in the **Results** tab.

The calibration results include the following measurements:

- Currently used BERT deemphasis tabs
- Measured NRZ crossing points (from reference transmitter operating point optimization)
- Measured initial clean eye VECP/SEC
- Measured calibration target metrics
- Screen shots of Initial clean eye (ISI only), Stressed eye mask test (wherever applicable), and Stressed receiver test signal

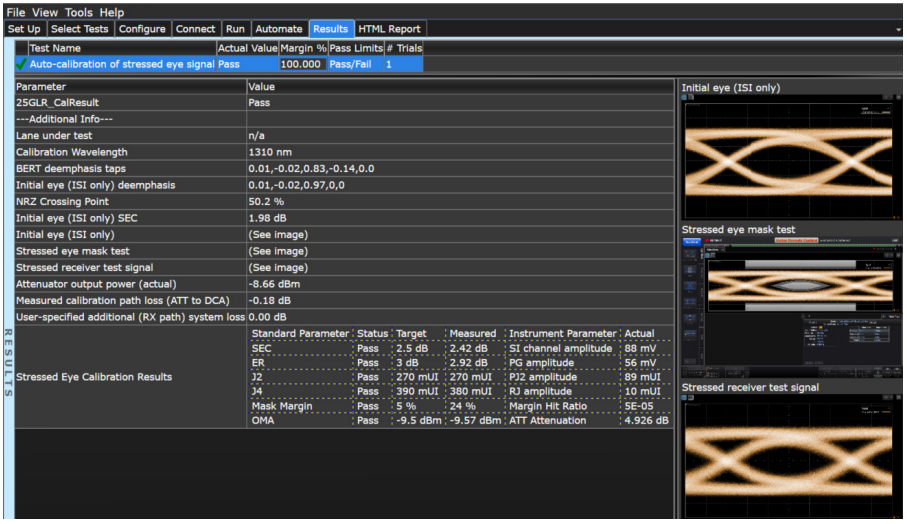


Figure 26 Calibration results

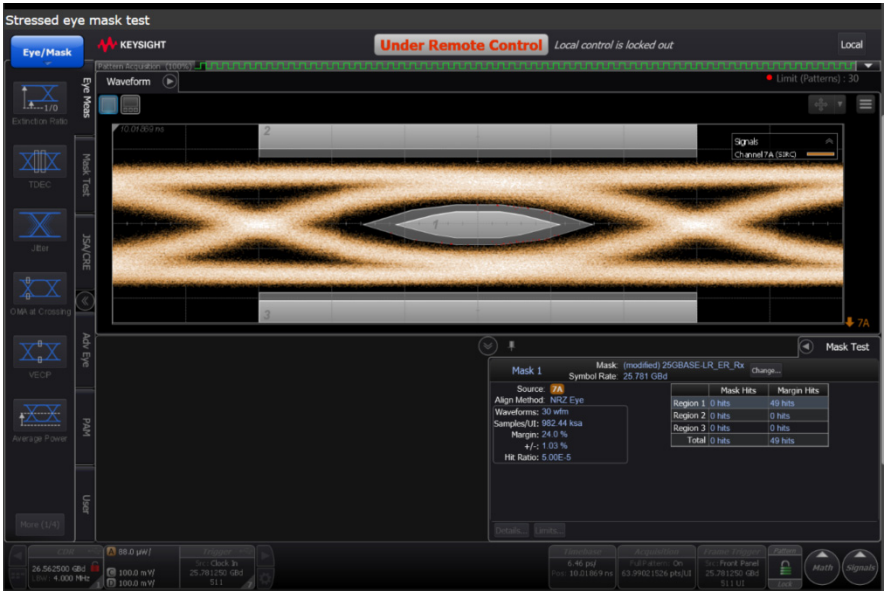


Figure 27 Calibration results showing image for Stressed Eye Mask Test

Calibration tasks

Auto calibration of stressed eye signal

Overview This calibration automatically adjusts the applicable stress parameters (ER, TDEC, VECP/SEC, OMA, J2, J4, J9) for a stressed eye signal.

Connection Diagram Connect the instruments as shown in "Setting Up and Preparing the Compliance Test Setup" on page 64.

ID

Type	Test ID
100GBASE-LR4	1000
100GBASE-ER4	2000
100GBASE-SR4	3000
100GBASE CLR4	4000
100GBASE CLR4 - FEC	5000
100GBASE CWDM4	6000
100GBASE 4WDM-10	7000
100GBASE 4WDM-20	8000
100GBASE 4WDM-40	9000
100GBASE PSM4	10000
25GBASE-LR	12000
25GBASE-ER	13000
25GBASE-SR	14000
CPRI-Option 10	15000
10GBASE-LR	30000
10GBASE-ER	31000
10GBASE-SR	32000
40GBASE-LR4	33000
40GBASE-ER4	34000
40GBASE-SR4	35000

Configuration Parameters

You may modify the following parameters for this calibration:

- Calibration Pattern (PRBS9)
- Stressed Eye Calibration Power Mode
- Stressed Eye Calibration Power
- SIRC 3dB filter bandwidth
- DCA Number of Measurement Patterns (Eye Mode)
- DCA Number of Measurement Patterns (Jitter)
- DCA Number of Measurement Patterns (OMA)

Sequence Control

- Optimize deemphasis on calibration start
- Skip receive power (OMA) calibration
- Perform dark level calibration
- Calibration Iteration Limit
- Optimize ER during stressed eye calibration

Connection Settings

- DCA Clock Source
- Clock Data Recovery Module
- Clock Data Recovery Loop Bandwidth
- Clock Data Recovery Source

Calibration target values

- Target TX Extinction Ratio (ER)
- ER Calibration Tolerance
- Target Initial Vertical Eye Closure Penalty (VECP)
- Initial VECP Calibration Tolerance
- Target Vertical Eye Closure Penalty (VECP)
- VECP Calibration Tolerance
- Target Initial Stressed Eye Closure (SEC)
- Initial SEC Calibration Tolerance
- Target Stressed Eye Closure (SEC)
- SEC Calibration Tolerance
- Target Receiver Power (OMA)
- OMA Calibration Tolerance
- Target Stressed Eye J2 Jitter
- J2 Calibration Tolerance
- Target Stressed Eye J4 Jitter

- J4 Jitter Calibration Tolerance
- Target Stressed Eye J9 Jitter
- J9 Jitter Calibration Tolerance
- Mask Margin Hit Ratio
- Mask Margin Tolerance
- Target Stressed Eye Pulse Width Shrinkage

Stress signal parameters

- PJ1 Frequency
- PJ1 Amplitude
- Primary iterated jitter type
- Initial BUJ Amplitude
- BUJ Polynom
- BUJ PRBS Rate
- BUJ Filter Type
- PJ2 Frequency
- Initial PJ2 Amplitude
- Initial RJ Amplitude
- Sinusoidal Interferer Frequency

Procedure Refer to "Automated Calibration" on page 42.

Results

- Currently used BERT deemphasis tabs
- Measured NRZ crossing points (from reference transmitter operating point optimization)
- Measured initial clean eye VECP/SEC
- Measured calibration target metrics
- Screen shots of Initial clean eye (ISI only), Stressed eye mask test (wherever applicable), and Stressed receiver test signal

Reference Refer to "Applicable Standards" on page 10.

Recall stressed eye signal from last calibration settings

Overview This task recalls and applies the latest stressed eye calibration settings.

Connection Diagram Connect the instruments as shown in "Setting Up and Preparing the Compliance Test Setup" on page 64.

ID

Type	Test ID
100GBASE-LR4	1007
100GBASE-ER4	2007
100GBASE-SR4	3007
100GBASE CLR4	4007
100GBASE CLR4 - FEC	5007
100GBASE CWDM4	6007
100GBASE 4WDM-10	7007
100GBASE 4WDM-20	8007
100GBASE 4WDM-40	9007
100GBASE PSM4	10007
25GBASE-LR	12007
25GBASE-ER	13007
25GBASE-SR	14007
CPRI-Option 10	15007
10GBASE-LR	30007
10GBASE-ER	31007
10GBASE-SR	32007
40GBASE-LR4	33007
40GBASE-ER4	34007
40GBASE-SR4	35007

Configuration Parameters

Procedure Refer to “Automated Calibration” on page 42.

Results Pass/Fail

Reference Refer to “Applicable Standards” on page 10.

Testing the stressed DUT receiver compliance

As introduced in "Automated Compliance and Performance Tests" on page 45, the N4917BACA software offers four automated receiver test procedures divided into the two groups - Conformance Tests and Performance Tests. All the receiver tests imply a calibrated and compliant stress test signal to be connected to the optical lane under test of the receiver under test, whereas the stress test signal can be either recalled from a previous calibration setting file (default) or is assumed to be already running from a previous test.

Configuring receiver tests settings

Depending on the used test setup, different hardware configurations as well as test specific settings must be made prior to starting a receiver test. Figure 28 shows all the receiver test related configuration variables, which have been divided in several sub-groups. The calibration related variables have been highlighted in yellow; the variables highlighted in pink are hardware-related settings that apply to all the receiver tests, whereas the configuration variables highlighted in blue control the behavior of specific receiver tests.

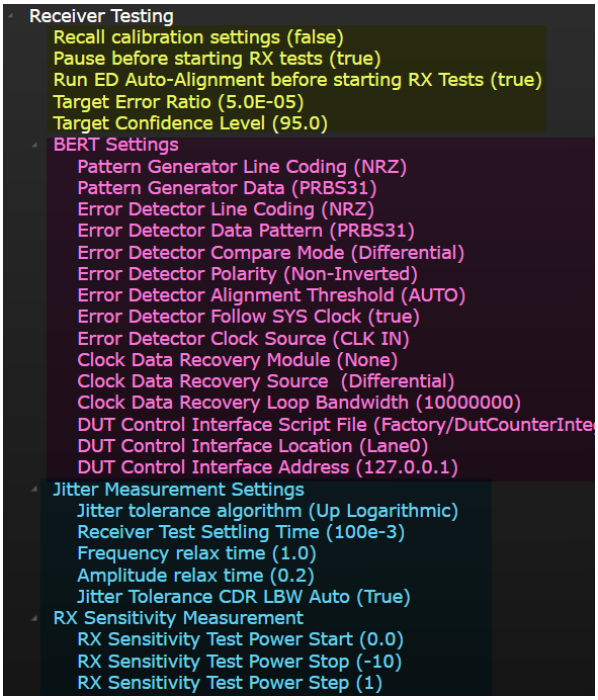
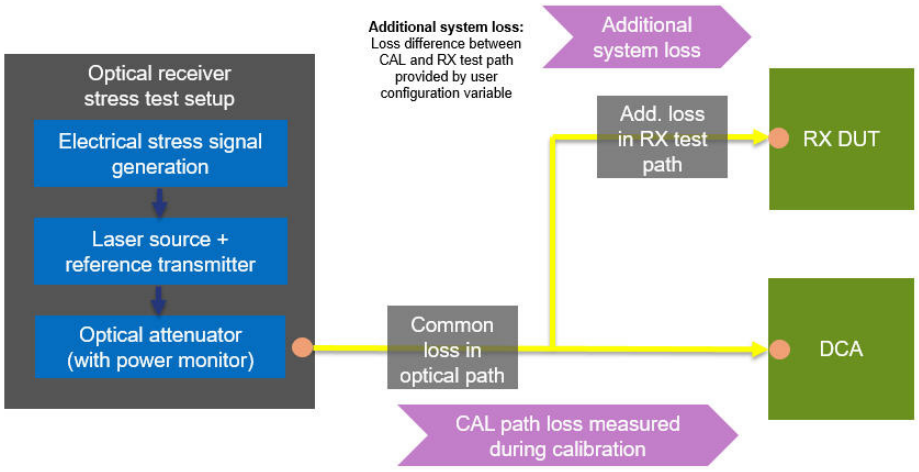


Figure 28 Configuration variables for receiver testing

Compensation of optical loss in receiver test path

To ensure compliant receiver testing, the automated test procedure must compensate for any additional loss in the receiver test path (see Figure 29 for a schematic of stressed receiver optical path loss definitions). Since the calibration procedure can only measure the common loss in the optical path, any additional loss in the receiver test path must be measured manually by the user and provided as dB value (positive numbers represent a loss, negative numbers a gain) in the “Additional System Loss” configuration variable (default is 0dB).



Note to ensure compliant RX testing:
Any optical power loss on the calibration or receiver test path must be compensated by the appropriate optical attenuator output power setting.

Figure 29 Stressed receiver optical path loss definitions

NOTE A full receiver compliance test might require other optical stress signals ("aggressor lanes") to be connected to the other lanes of the receiver under test. For further information, check specification of the corresponding IEEE standard. Also, see Figure 11.

Receiver tests

Conformance Tests

Perform receiver conformance test

Overview This tests measures the receiver conformance.

Connection Diagram Connect the instruments as shown in "Setting Up and Preparing the Compliance Test Setup" on page 64.

ID

Type	Test ID
100GBASE-LR4	1100
100GBASE-ER4	2100
100GBASE-SR4	3100
100GBASE CLR4	4100
100GBASE CLR4 - FEC	5100
100GBASE CWDM4	6100
100GBASE 4WDM-10	7100
100GBASE 4WDM-20	8100
100GBASE 4WDM-40	9100
100GBASE PSM4	10100
25GBASE-LR	12100
25GBASE-ER	13100
25GBASE-SR	14100
CPRI-Option 10	15100
10GBASE-LR	30100
10GBASE-ER	31100
10GBASE-SR	32100
40GBASE-LR4	33100
40GBASE-ER4	34100
40GBASE-SR4	35100

Configuration Parameters

You may modify the following parameters for this test:

- Recall Calibration Settings
- Pause before starting RX tests
- Run ED Auto-Alignment before starting RX tests
- Target Error Ratio
- Target Confidence Level

BERT Settings

- Pattern Generator Line Coding

- Pattern Generator Data
- Error Detector Line Coding
- Error Detector Data Pattern
- Error Detector Compare Mode
- Error Detector Polarity
- Error Detector Alignment Threshold
- Error Detector Follow SYS Clock
- Error Detector Clock Source
- Error Detector Timeout
- Clock Data Recovery Module (ED)
- Clock Data Recovery Source
- Clock Data Recovery Loop Bandwidth
- DUT Control Interface Script File
- DUT Control Interface Location
- DUT Control Interface Address

Jitter Measurement Settings

- Jitter Tolerance Algorithm
- Receiver Test Settling Time
- Frequency Relax Time
- Amplitude Relax Time
- Jitter Tolerance CDR LBW Auto
- Frequency Mode
- Start Frequency
- Stop Frequency
- Number of Steps
- Manual Frequency List

RX Sensitivity Measurement

- RX Sensitivity Test Power Start
- RX Sensitivity Test Power Stop
- RX Sensitivity Test Power Step

Procedure Refer to “Automated Compliance and Performance Tests” on page 45.

Results Pass/Fail

Reference Refer to “Applicable Standards” on page 10.

Perform jitter conformance test

Overview This tests measures the receiver jitter conformance.

Connection Diagram Connect the instruments as shown in "Setting Up and Preparing the Compliance Test Setup" on page 64.

ID

Type	Test ID
100GBASE-LR4	1101
100GBASE-ER4	2101
100GBASE-SR4	3101
100GBASE CLR4	4101
100GBASE CLR4 - FEC	5101
100GBASE CWDM4	6101
100GBASE 4WDM-10	7101
100GBASE 4WDM-20	8101
100GBASE 4WDM-40	9101
100GBASE PSM4	10101
25GBASE-LR	12101
25GBASE-ER	13101
25GBASE-SR	14101
CPRI-Option 10	15101
10GBASE-LR	30101
10GBASE-ER	31101
10GBASE-SR	32101
40GBASE-LR4	33101
40GBASE-ER4	34101
40GBASE-SR4	35101

Configuration Parameters You may modify the following parameters for this test:

- Recall Calibration Settings
- Pause before starting RX tests

- Run ED Auto-Alignment before starting RX tests
- Target Error Ratio
- Target Confidence Level

BERT Settings

- Pattern Generator Line Coding
- Pattern Generator Data
- Error Detector Line Coding
- Error Detector Data Pattern
- Error Detector Compare Mode
- Error Detector Polarity
- Error Detector Alignment Threshold
- Error Detector Follow SYS Clock
- Error Detector Clock Source
- Error Detector Timeout
- Clock Data Recovery Module (ED)
- Clock Data Recovery Source
- Clock Data Recovery Loop Bandwidth
- DUT Control Interface Script File
- DUT Control Interface Location
- DUT Control Interface Address

Jitter Measurement Settings

- Jitter Tolerance Algorithm
- Receiver Test Settling Time
- Frequency Relax Time
- Amplitude Relax Time
- Jitter Tolerance CDR LBW Auto
- Frequency Mode
- Start Frequency
- Stop Frequency
- Number of Steps
- Manual Frequency List

RX Sensitivity Measurement

- RX Sensitivity Test Power Start
- RX Sensitivity Test Power Stop
- RX Sensitivity Test Power Step

Procedure Refer to "Automated Compliance and Performance Tests" on page 45.

Results Pass/Fail

Reference Refer to "Applicable Standards" on page 10.

Performance Tests

Perform receiver sensitivity measurement

Overview This tests measures the receiver sensitivity.

Connection Diagram Connect the instruments as shown in "Setting Up and Preparing the Compliance Test Setup" on page 64.

ID

Type	Test ID
100GBASE-LR4	1103
100GBASE-ER4	2103
100GBASE-SR4	3103
100GBASE CLR4	4103
100GBASE CLR4 - FEC	5103
100GBASE CWDM4	6103
100GBASE 4WDM-10	7103
100GBASE 4WDM-20	8103
100GBASE 4WDM-40	9103
100GBASE PSM4	10103
25GBASE-LR	12103
25GBASE-ER	13103
25GBASE-SR	14103
CPRI-Option 10	15103
10GBASE-LR	30103
10GBASE-ER	31103
10GBASE-SR	32103

Type	Test ID
40GBASE-LR4	33103
40GBASE-ER4	34103
40GBASE-SR4	35103

Configuration Parameters

You may modify the following parameters for this test:

- Recall Calibration Settings
- Pause before starting RX tests
- Run ED Auto-Alignment before starting RX tests
- Target Error Ratio
- Target Confidence Level

BERT Settings

- Pattern Generator Line Coding
- Pattern Generator Data
- Error Detector Line Coding
- Error Detector Data Pattern
- Error Detector Compare Mode
- Error Detector Polarity
- Error Detector Alignment Threshold
- Error Detector Follow SYS Clock
- Error Detector Clock Source
- Error Detector Timeout
- Clock Data Recovery Module (ED)
- Clock Data Recovery Source
- Clock Data Recovery Loop Bandwidth
- DUT Control Interface Script File
- DUT Control Interface Location
- DUT Control Interface Address

Jitter Measurement Settings

- Jitter Tolerance Algorithm
- Receiver Test Settling Time
- Frequency Relax Time
- Amplitude Relax Time
- Jitter Tolerance CDR LBW Auto

- Frequency Mode
- Start Frequency
- Stop Frequency
- Number of Steps
- Manual Frequency List

RX Sensitivity Measurement

- RX Sensitivity Test Power Start
- RX Sensitivity Test Power Stop
- RX Sensitivity Test Power Step

Procedure Refer to "Automated Compliance and Performance Tests" on page 45.

Results Pass/Fail

Reference Refer to "Applicable Standards" on page 10.

Perform jitter performance measurement

Overview This tests measures the receiver jitter performance.

Connection Diagram Connect the instruments as shown in "Setting Up and Preparing the Compliance Test Setup" on page 64.

ID

Type	Test ID
100GBASE-LR4	1102
100GBASE-ER4	2102
100GBASE-SR4	3102
100GBASE CLR4	4102
100GBASE CLR4 - FEC	5102
100GBASE CWDM4	6102
100GBASE 4WDM-10	7102
100GBASE 4WDM-20	8102
100GBASE 4WDM-40	9102
100GBASE PSM4	10102
25GBASE-LR	12102

Type	Test ID
25GBASE-ER	13102
25GBASE-SR	14102
CPRI-Option 10	15102
10GBASE-LR	30102
10GBASE-ER	31102
10GBASE-SR	32102
40GBASE-LR4	33102
40GBASE-ER4	34102
40GBASE-SR4	35102

Configuration Parameters

You may modify the following parameters for this test:

- Recall Calibration Settings
- Pause before starting RX tests
- Run ED Auto-Alignment before starting RX tests
- Target Error Ratio
- Target Confidence Level

BERT Settings

- Pattern Generator Line Coding
- Pattern Generator Data
- Error Detector Line Coding
- Error Detector Data Pattern
- Error Detector Compare Mode
- Error Detector Polarity
- Error Detector Alignment Threshold
- Error Detector Follow SYS Clock
- Error Detector Clock Source
- Error Detector Timeout
- Clock Data Recovery Module (ED)
- Clock Data Recovery Source
- Clock Data Recovery Loop Bandwidth
- DUT Control Interface Script File
- DUT Control Interface Location

- DUT Control Interface Address

Jitter Measurement Settings

- Jitter Tolerance Algorithm
- Receiver Test Settling Time
- Frequency Relax Time
- Amplitude Relax Time
- Jitter Tolerance CDR LBW Auto
- Frequency Mode
- Start Frequency
- Stop Frequency
- Number of Steps
- Manual Frequency List

RX Sensitivity Measurement

- RX Sensitivity Test Power Start
- RX Sensitivity Test Power Stop
- RX Sensitivity Test Power Step

Procedure Refer to "Automated Compliance and Performance Tests" on page 45.

Results Pass/Fail

Reference Refer to "Applicable Standards" on page 10.

Utility Functions

Optimize BERT deemphasis

Overview This test performs a BERT deemphasis optimization.

Connection Diagram Connect the instruments as shown in "Setting Up and Preparing the Compliance Test Setup" on page 64.

ID

Type	Test ID
100GBASE-LR4, 100GBASE-ER4,100GBASE-SR4	20004
100GBASE CLR4, 100GBASE CLR4 - FEC, 100GBASE CWDM4, 100GBASE 4WDM-10, 100GBASE 4WDM-20, 100GBASE 4WDM-40, 100GBASE PSM4	
25GBASE-LR, 25GBASE-ER, 25GBASE-SR	
CPRI-Option 10	
10GBASE-LR, 10GBASE-ER, 10GBASE-SR	
40GBASE-LR4, 40GBASE-ER4, 40GBASE-SR4	

Configuration Parameters

- Optimize crossing after RefTX recalibration
- Deemphasis re-optimization parameter
- Deemphasis re-optimization mode

Results Pass/Fail

Measure stressed eye parameters

Overview This step measures the stressed eye parameters - TDEC, ER, OMA, AvgPower.

Connection Diagram Connect the instruments as shown in "Setting Up and Preparing the Compliance Test Setup" on page 64.

ID

Type	Test ID
100GBASE-LR4, 100GBASE-ER4,100GBASE-SR4	20005
100GBASE CLR4, 100GBASE CLR4 - FEC, 100GBASE CWDM4, 100GBASE 4WDM-10, 100GBASE 4WDM-20, 100GBASE 4WDM-40, 100GBASE PSM4	
25GBASE-LR, 25GBASE-ER, 25GBASE-SR	
CPRI-Option 10	
10GBASE-LR, 10GBASE-ER, 10GBASE-SR	
40GBASE-LR4, 40GBASE-ER4, 40GBASE-SR4	

Configuration Parameters You may modify the following parameter for this test:

- Optimize crossing after RefTX recalibration
- Deemphasis re-optimization parameter
- Deemphasis re-optimization mode

Results Pass/Fail

Recalibrate Reference Transmitter

Overview This step recalibrates the reference transmitter.

Connection Diagram Connect the instruments as shown in "Setting Up and Preparing the Compliance Test Setup" on page 64.

ID

Type	Test ID
100GBASE-LR4, 100GBASE-ER4,100GBASE-SR4	20000
100GBASE CLR4, 100GBASE CLR4 - FEC, 100GBASE CWDM4, 100GBASE 4WDM-10, 100GBASE 4WDM-20, 100GBASE 4WDM-40, 100GBASE PSM4	
25GBASE-LR, 25GBASE-ER, 25GBASE-SR	
CPRI-Option 10	
10GBASE-LR, 10GBASE-ER, 10GBASE-SR	
40GBASE-LR4, 40GBASE-ER4, 40GBASE-SR4	

Configuration Parameters

- Optimize crossing after RefTX recalibration
- Deemphasis re-optimization parameter
- Deemphasis re-optimization mode

Results Pass/Fail

Adjust Receive Power

Overview This step adjusts the receive power.

Connection Diagram Connect the instruments as shown in "Setting Up and Preparing the Compliance Test Setup" on page 64.

ID

Type	Test ID
100GBASE-LR4, 100GBASE-ER4,100GBASE-SR4	20001
100GBASE CLR4, 100GBASE CLR4 - FEC, 100GBASE CWDM4, 100GBASE 4WDM-10, 100GBASE 4WDM-20, 100GBASE 4WDM-40, 100GBASE PSM4	
25GBASE-LR, 25GBASE-ER, 25GBASE-SR	
CPRI-Option 10	
10GBASE-LR, 10GBASE-ER, 10GBASE-SR	
40GBASE-LR4, 40GBASE-ER4, 40GBASE-SR4	

Configuration Parameters

- Optimize crossing after RefTX recalibration
- Deemphasis re-optimization parameter
- Deemphasis re-optimization mode

Results Pass/Fail

Set laser wavelength

Overview This step sets the laser wavelength.

Connection Diagram Connect the instruments as shown in "Setting Up and Preparing the Compliance Test Setup" on page 64.

ID

Type	Test ID
100GBASE-LR4, 100GBASE-ER4,100GBASE-SR4	20003
100GBASE CLR4, 100GBASE CLR4 - FEC, 100GBASE CWDM4, 100GBASE 4WDM-10, 100GBASE 4WDM-20, 100GBASE 4WDM-40, 100GBASE PSM4	
25GBASE-LR, 25GBASE-ER, 25GBASE-SR	
CPRI-Option 10	
10GBASE-LR, 10GBASE-ER, 10GBASE-SR	
40GBASE-LR4, 40GBASE-ER4, 40GBASE-SR4	

Configuration Parameters

- Optimize crossing after RefTX recalibration
- Deemphasis re-optimization parameter
- Deemphasis re-optimization mode

Results Pass/Fail

Set PG transmission format

Overview This step sets the line coding and transmission data pattern for the connected pattern generator.

Connection Diagram Connect the instruments as shown in "Setting Up and Preparing the Compliance Test Setup" on page 64.

ID

Type	Test ID
100GBASE-LR4, 100GBASE-ER4,100GBASE-SR4	20009
100GBASE CLR4, 100GBASE CLR4 - FEC, 100GBASE CWDM4, 100GBASE 4WDM-10, 100GBASE 4WDM-20, 100GBASE 4WDM-40, 100GBASE PSM4	
25GBASE-LR, 25GBASE-ER, 25GBASE-SR	
CPRI-Option 10	
10GBASE-LR, 10GBASE-ER, 10GBASE-SR	
40GBASE-LR4, 40GBASE-ER4, 40GBASE-SR4	

Configuration Parameters

- Optimize crossing after RefTX recalibration
- Deemphasis re-optimization parameter
- Deemphasis re-optimization mode
- Pattern Generator Line Coding
- Pattern Generator Data

Results Pass/Fail

Set ED detection format

Overview This step sets the line coding and analysis data pattern for all connected error detectors.

Connection Diagram Connect the instruments as shown in "Setting Up and Preparing the Compliance Test Setup" on page 64.

ID

Type	Test ID
100GBASE-LR4, 100GBASE-ER4,100GBASE-SR4	20010
100GBASE CLR4, 100GBASE CLR4 - FEC, 100GBASE CWDM4, 100GBASE 4WDM-10, 100GBASE 4WDM-20, 100GBASE 4WDM-40, 100GBASE PSM4	
25GBASE-LR, 25GBASE-ER, 25GBASE-SR	
CPRI-Option 10	
10GBASE-LR, 10GBASE-ER, 10GBASE-SR	
40GBASE-LR4, 40GBASE-ER4, 40GBASE-SR4	

Configuration Parameters

- Optimize crossing after RefTX recalibration
- De-emphasis re-optimization parameter
- Deemphasis re-optimization mode
- Error Detector Line Coding
- Error Detector Data Pattern

Results Pass/Fail

6 Appendix

This Appendix contains tables that list the salient conditions required for 100GBASE, 25GBASE, CPRI Option 10, 10GBASE, and 40GBASE stressed receiver sensitivity.

Table 7 Stressed Receiver Sensitivity Test Specifications for 100GBASE formats

	100G BASE -LR4	100G BASE -ER4	CLR4 w/o FEC	CLR4 w/ FEC	CWDM 4	4WDM -10	4WDM -20	4WDM -40	100GB ASE -PSM4	100G BASE -SR4
Conditions for Stressed Receiver Sensitivity Test										
Target TX Extinction Ratio (dB)	4	8	3.5	3.5	3.5	3.5	4.0	4.5	3.5	2
Target Initial Vertical eye closure penalty (dB)	>= 2/3 VECP tgt	>= 2/3 VECP tgt	>= 2/3 VECP tgt	>= 2/3 VECP tgt	>= 2/3 VECP tgt	>= 2/3 VECP tgt	>= 2/3 VECP tgt	>= 2/3 VECP tgt	>= 2/3 VECP tgt	>= 2.5 dB SEC
Target Vertical Eye Closure Penalty (dB), Stressed eye closure for SR4 (dB)	1.8	3.5	1.95	1.95	1.9	2.6	2.5	2.5	1.9	4.3
Target Stressed Eye J2 Jitter (UI)	0.3	0.3	0.3	0.33	0.33	0.33	0.33	0.33	0.27	0.39
Target Stressed Eye J4 Jitter (UI)	-	-	-	0.48	0.48	0.48	0.48	0.48	0.39	0.53 (max)
Target Stressed Eye J9 Jitter (UI)	0.47	0.47	0.5	-	-	-	-	-	-	-
Eye mask {X1,X2,X3,Y1,Y2,Y3}	-	-	-	-	0.39, 0.5,0.5, 0.39, 0.39, 0.4	0.39, 0.5,0.5, 0.39, 0.39, 0.4	0.39, 0.5,0.5, 0.39, 0.39, 0.4	0.39, 0.5,0.5, 0.39, 0.39, 0.4	0.24,0. 5,0.5,0. 24,0.24 ,0.4	0.28, 0.5,0.5 ,0.33, 0.33, 0.4

	100G BASE -LR4	100G BASE -ER4	CLR4 w/o FEC	CLR4 w/ FEC	CWDM 4	4WDM -10	4WDM -20	4WDM -40	100GBASE -PSM4	100G BASE -SR4
Optical Wavelength Assignments										
Spacing (nm)	5	5	20	20	20	20	5	5		
Lane L0 Nominal Wavelength (nm)	1295.56	1295.56	1271	1271	1271	1271	1295.56	1295.56		
Lane L1 Nominal Wavelength (nm)	1300.05	1300.05	1291	1291	1291	1291	1300.05	1300.05	1310	850
Lane L2 Nominal Wavelength (nm)	1304.58	1304.58	1311	1311	1311	1311	1304.58	1304.58		
Lane L3 Nominal Wavelength (nm)	1309.14	1309.14	1331	1331	1331	1331	1309.14	1309.14		
Stressed receiver sensitivity, OMA (dBm)	-6.8	-17.9	-5.6	-8.5	-7.3	-8.6	-10.0	-16.0	-8.79 to -7.04	-5.2
Aggressor lane OMA (dBm)	-1.3	-13.4	-0.1	-3.0	-2.8	-4.1	-4.5	-9.5		+3

Table 8 Stressed Receiver Sensitivity Test Specifications for 25GBASE, CPRI Option 10, 10GBASE, and 40GBASE formats

	25G BASE -LR	25G BASE -ER	25G BASE -SR	CPRI Option 10	10G BASE -LR	10G BASE -ER	10G BASE -SR	40G BASE -LR4	40G BASE -ER4	40G BASE-SR4
Conditions for Stressed Receiver Sensitivity Test										
Target TX Extinction Ratio (dB)	3	4	2	4	3.5	3	3	3.5	5.5	3.0
Target Initial Vertical Eye Closure Penalty (dB)	>=1.5 dB SEC	>=1.5 dB SEC	>=2.5 dB SEC	1.3	>= 2/3 VECP tgt	>= 2/3 VECP tgt	>= 2/3 VECP tgt	>= 2/3 VECP tgt	>= 2/3 VECP tgt	>= 2/3 VECP tgt
Target Vertical Eye Closure Penalty (dB), SEC for 25G (dB)	2.5	2.5	4.3	1.8	2.2	2.7	3.5	1.9	2.2	1.9

	25G BASE -LR	25G BASE -ER	25G BASE -SR	CPRI Option 10	10G BASE -LR	10G BASE -ER	10G BASE -SR	40G BASE -LR4	40G BASE -ER4	40G BASE-SR4
Target Stressed Eye J2 Jitter (UI)	0.27	0.27	0.39	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Target Stressed Eye J4 Jitter (UI)	0.39	0.39	0.53 (max)	-	-	-	-	-	-	-
Target Stressed Eye J9 Jitter (UI)	-	-	-	0.47	-	-	-	0.47	0.47	0.47
Eye mask {X1,X2,X3,Y1,Y2,Y3}	0.31, 0.4, 0.45, 0.34, 0.38, 0.4	0.31, 0.4, 0.45, 0.34, 0.38, 0.4	0.28, 0.5, 0.5, 0.33, 0.33, 0.4	-	-	-	-	-	-	-
Optical Wavelength Assignments										
Spacing (nm)	-	-	-	5	-	-	-	20	20	-
Lane L0 Nominal Wavelength (nm)	1310	1310	850	1295.56	1310	1550	850	1271	1271	850
Lane L1 Nominal Wavelength (nm)				1300.05				1291	1291	
Lane L2 Nominal Wavelength (nm)				1304.58				1311	1311	
Lane L3 Nominal Wavelength (nm)				1309.14				1331	1331	
Stressed receiver sensitivity, OMA (dBm)	-9.5	-16.5	-5.2	-6.8	-10.3	-14.1	-7.5	-9.6	-16.8	-5.4
Aggressor lane OMA (dBm)	-	-	-	-	-	-	-	-2.1	-9.8	-0.4

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