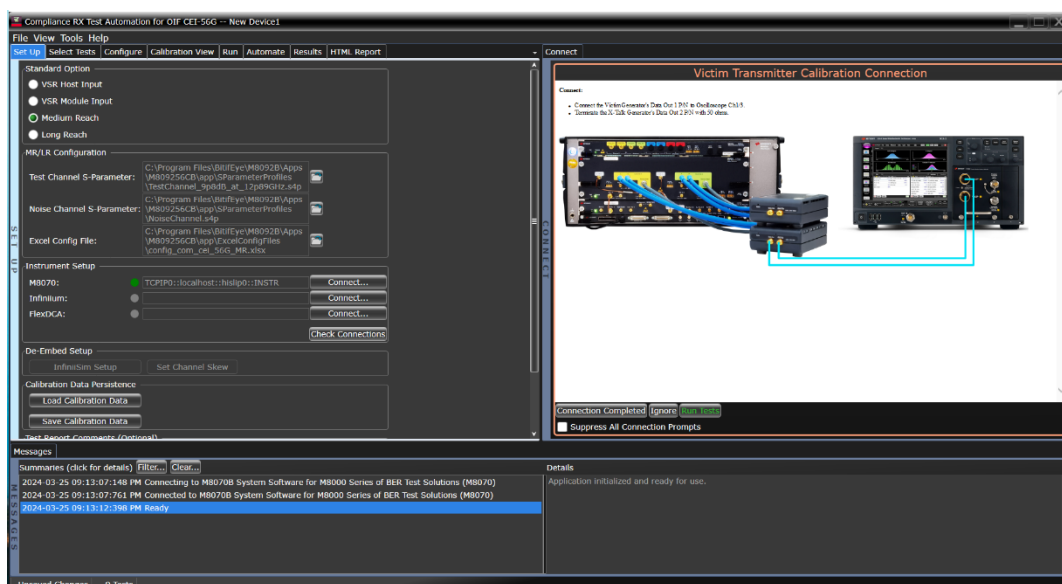


# M809256CB

Receiver conformance test application for OIF-CEI 4.0

## Introduction

Keysight M809256CB is an automated receiver test solution implementing the Channel Operating Margin (COM) and Stressed-Eye methods for OIF CEI-56G-VSR, MR & LR PAM4 interfaces.



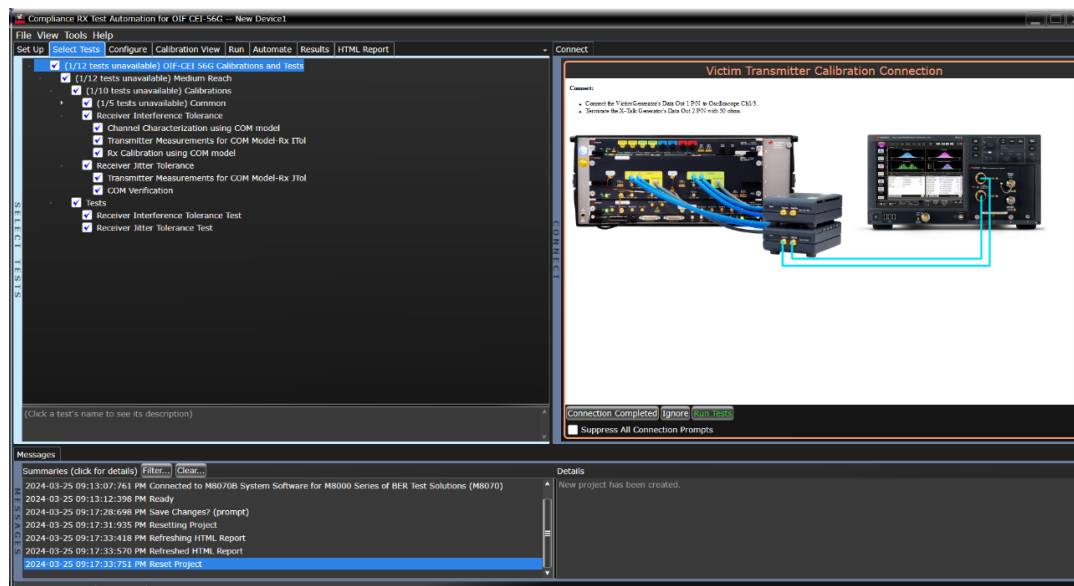
# Key Features

Supported standards include the following:

- Clause 16 OIF-CEI 56G-VSR-PAM4 Very Short Reach Interface
- Clause 17 OIF-CEI 56G-MR-PAM4 Medium Reach Interface
- Clause 21 OIF-CEI 56G-LR-PAM4 Long Reach Interface
- Guided setup, automated stress signal calibration and conformance measurement
- HTML test report
- Data analytics enabled
- Choose between Node-locked, Transportable, Network, USB-dongle license types of the Perpetual License Term

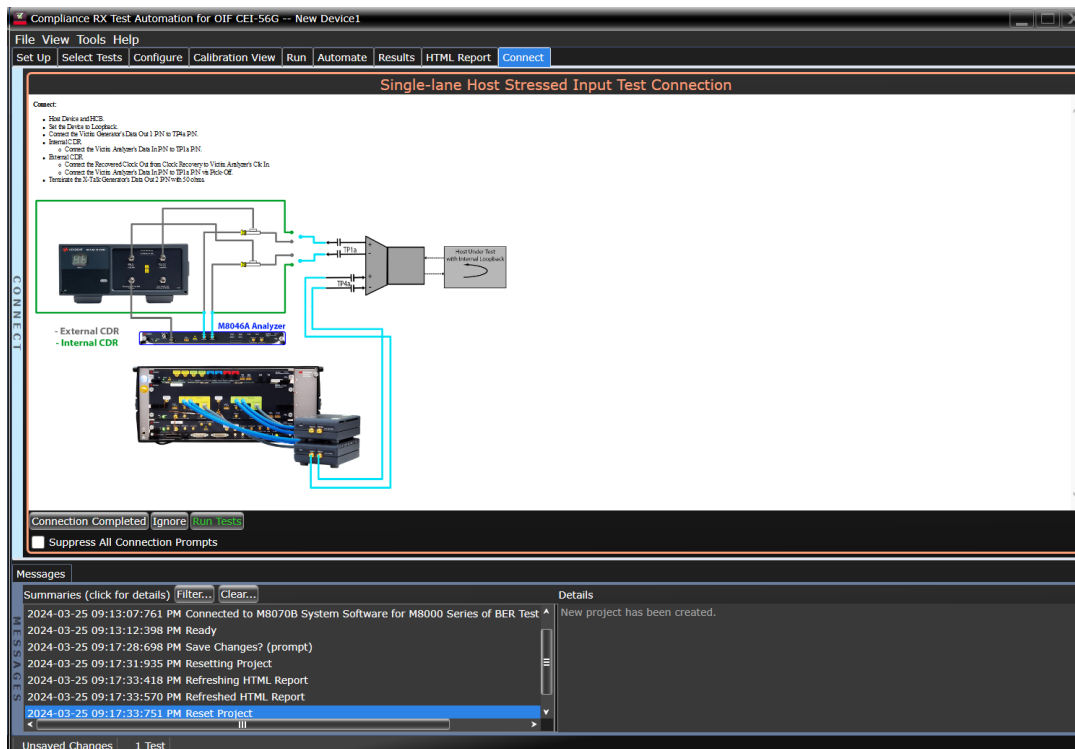
## Description

The M809256CB electrical receiver conformance test application is designed to assist and simplify the stress signal calibration used for testing the inputs of CEI-56G-VSR/-MR/-LR PAM4 electrical interfaces using a Keysight M8050A 64Gbaud Higher Performance BERT and a Keysight Oscilloscope. Supported oscilloscope models include Keysight N1060A DCA-X oscilloscope as well as UXR series real-time oscilloscopes. The test application helps to reduce user interaction to a minimum and performs all required calibration routines and compliance testing automatically by remote-controlling all required instruments. A wide range of hardware configuration is supported, thus protecting your investment.



**Figure 1.** Graphical user interface of the M809256CB CEI-56G PAM4 conformance receiver test application

The test application utilizes the same framework for the graphical user interface as most Keysight transmitter test applications, reducing training time by providing a common look and feel. When a user is required to perform setup changes, the user is guided by diagrams as well as text to minimize errors. Results of the individual calibration steps and tests are presented in tabular form as well as graphical form, where appropriate. Calibrations and test results can be stored in projects and recalled at a later point in time. The application can generate an HTML-based test report.



**Figure 2.** Connection diagram for 56G-VSR Host receiver stress test

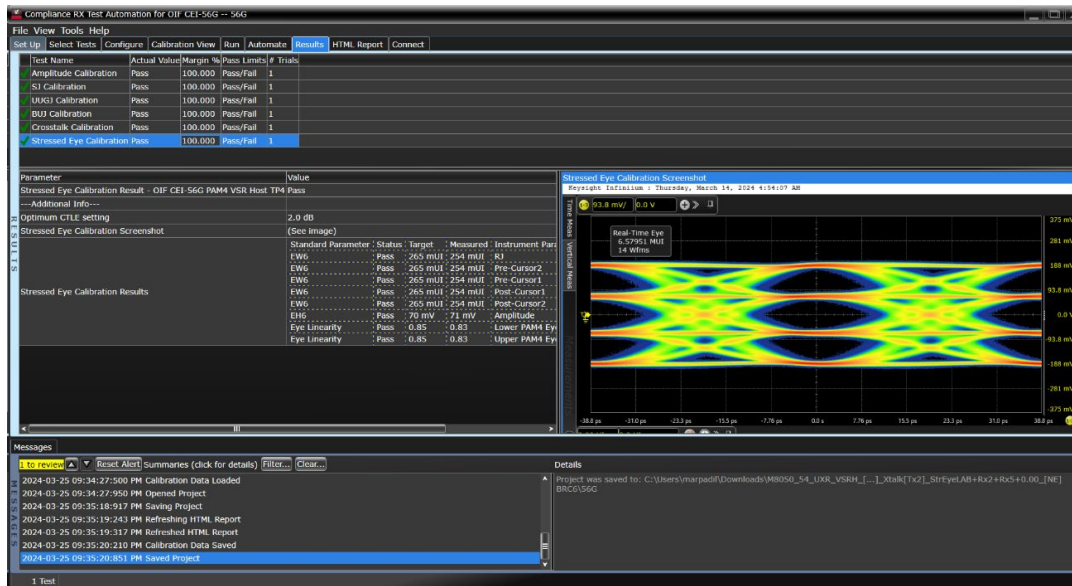


Figure 3. Results of the stress eye calibration procedure for 56G-VSR Host

# Calibrations and Tests Covered by M809256CB Receiver Test

## Application CEI-56G-VSR (host or module)

OIF CEI-56G-VSR PAM4 defines the stress signal through a mated host compliance board (HCB) and module compliance board (MCB) connection. Both the receiver side and the transmitter side have equalization capabilities. The definition of the stress signal assumes an optimized link. Therefore, the transmitter of the receiver test equipment as well as the receiver of the signal measurement device must be optimized for the given stress channel. This must be done iteratively for each test setup. The standard requires the transmitter equalization (TxEQ) to be kept as small as possible to increase the stress on the device under test's receiver (DUT Rx). If performed manually, this procedure is very time consuming. However, the M809256CB Receiver test application performs this task automatically.

### Example setup for VSR Host input stress eye calibration

- Connect
- MCB and HCB
- X-Talk Generator Data Out 2 P/N to TPI P/N of MCB
- Termination via 50 Ohm to TP1a P/N of HCB
- Victim Generator Data Out 1 P/N to TP4aP/N of HCB
- Oscilloscope CVH1/CH2 to TP4 P/N of MCB

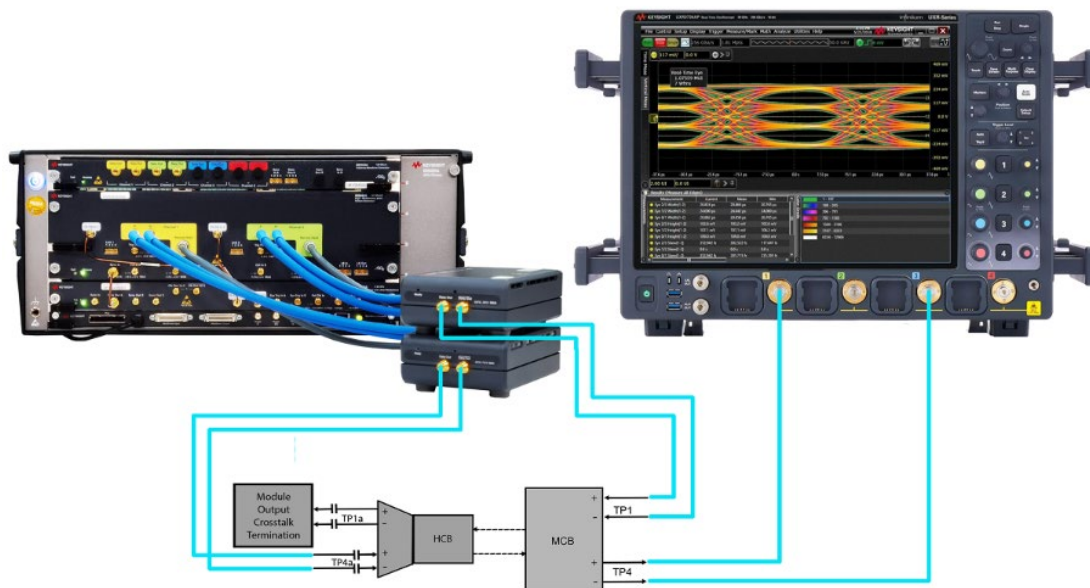


Figure 4. Setup configuration for VSR stress eye calibration (Host test)

All calibration steps are automated. The test application prompts the user whenever user interaction is required for connecting or modifying the test setup. Detailed connection diagrams and instructions are provided by the test application.

OIF CEI-56G-VSR host and module

Calibrations are implemented according to OIF-CEI-4.0 Common Electrical I/O (CEI) - Electrical and Jitter Interoperability Agreements, December 29, 2017

- Crosstalk amplitude and transition time<sup>1</sup>
- Victim lane amplitude
- Victim lane UUGJ
- Victim lane SJ
- Victim lane BUJ
- Stressed eye

Test is implemented according to

- 16.3.10.3 Stressed input
- 16.3.11 Voltage tolerance

## OIF CEI-56G-MR/-LR PAM4

Both 56G-LR and -MR test procedures rely on the Channel Operating Margin (COM) method<sup>2</sup>. COM was first introduced to measure the performance margin of a channel and then extended to digital systems. Interoperability of a digital receiver can be expressed in terms of COM requirements. COM is calculated out of channel 4-ports S-parameters (for victim and aggressor lanes) as well as the noise and equalization functionality of the considered transmitter and receiver. The resulting COM metric is the ratio of the signal amplitude (after equalization) to the noise and crosstalk peak-to-peak amplitude measured during a time interval depending on the target BER.

### OIF CEI-56G-MR/-LR PAM4 receiver test calibration procedure consists of three steps<sup>3</sup>:

1. S-parameter measurements (only once per system)
2. System calibration: Calibrate the equipment used to generate the victim transmitter and the broadband noise
3. COM-related calibration: Following steps are performed to complete the COM model
  - a. Check channel characteristics (S-parameters)
  - b. Measure Tx characteristics (jitter & electrical characteristics)

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1. Refer to the note on page 8.

2. IEEE Standard for Ethernet, IEEE 802.3, Annex 93A.

3. For more details on these standards, refer to Optical Internetworking Forum - Clauses 16, 17 and 21 of the OIF-CEI-04.0 Common Electrical I/O (CEI) - Electrical and Jitter Interoperability Agreements, December 29, 2017.

Finally, the COM model computes the amount of broadband noise to be injected in the noise path, and the Rx test (BER measurement for different levels of noise or jitter) can be performed.

#### OIF CEI-56G-MR Medium Reach

Calibrations are implemented according to OIF-CEI-4.0 Common Electrical I/O (CEI) - Electrical and Jitter Interoperability Agreements, December 29, 2017<sup>1</sup>

- Victim lane SJ
- Victim lane UUGJ
- Victim lane BUJ

Victim lane amplitude

- Broadband noise
- Receiver Interference Tolerance
- Receiver Jitter Tolerance

Test is implemented according to

- 17.3.2.4 Receiver Interference Tolerance
- 17.3.2.5 Receiver Jitter Tolerance

#### OIF CEI-56G-LR Long Reach

Calibrations are implemented according to OIF-CEI-4.0 Common Electrical I/O (CEI) - Electrical and Jitter Interoperability Agreements, December 29, 2017

- Victim lane SJ
- Victim lane UUGJ
- Victim lane BUJ

Victim lane amplitude

- Broadband Noise
- Receiver Interference Tolerance
- Receiver Jitter Tolerance

Test is implemented according to

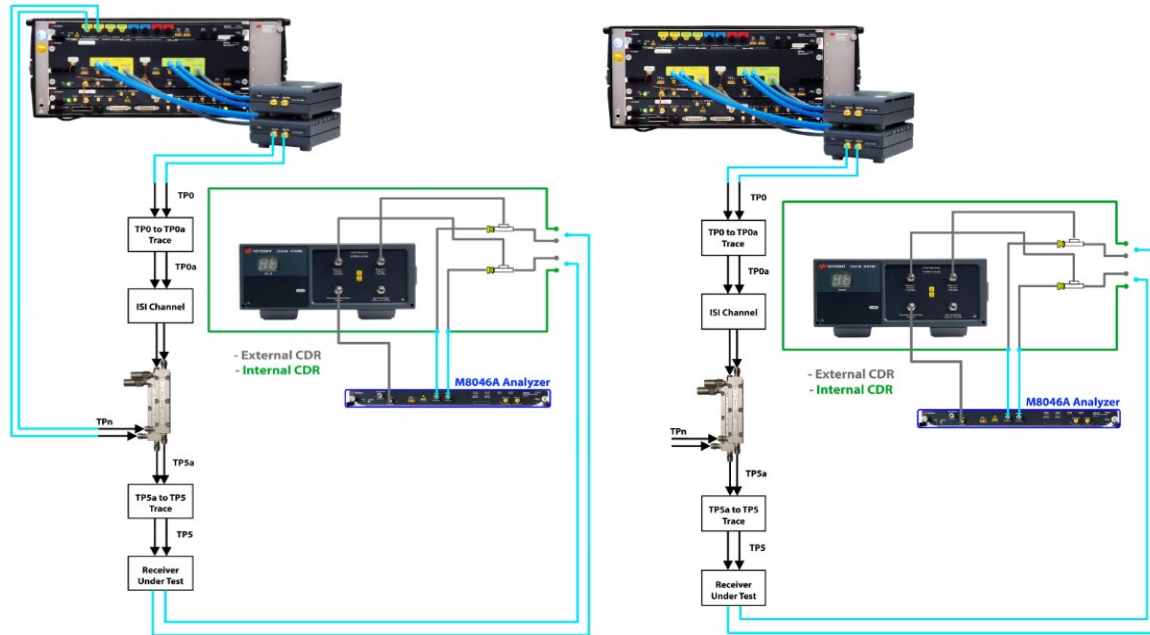
- 21.3.2.4 Receiver Interference Tolerance
- 21.3.2.5 Receiver Jitter Tolerance

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1. The standard recommends carrying out the stress signal calibration with 19ps and 9.5ps slew time at  $\pm 270\text{mV}$  for input stress test calibration for host and module tests, respectively. As acknowledged in the standard document (16.3.10.1.1), realistic implementations may have longer slew times

## Setup for MR receiver interference and jitter tolerance test

- Set Device to Loopback.
- Victim Generator Data Out 1 P/N to test point T P/N of ISI channel.
- ISI channel test point T P/N to thru path of matched directional coupler pair.
- Noise Generator Data Out 1 P/N to couple path of matched directional coupler pair.
- Directional coupler Data Out P/N to Test point T P/N of Receiver test fixture.
- Receiver test fixture Test point T P/N to Receiver under test.
- Victim Analyzer Data In P/N to Test point of looped back signal P/N via Pick-Off.
- Recovered Clock Out from Clock Recovery to Victim Analyzer Clk In.
- Unused ports with 50 ohms.



**Figure 5.** Setup configuration for OIF-CEI-56G-MR interference (left) and jitter (right) tolerance test



# Configuration Guide

The table below shows the required equipment for each standard option under OIF CEI-56G. Required Instrument configuration and required software options are listed in the following section.

Equipment type	VSR	MR/ LR
Victim pattern generator	M8042A	
Crosstalk generator	M8042A 2nd channel or 3rd party crosstalk generator	N/A
Interference source	N/A	M8054A or M8195A or M8196A
Victim error detector	M8043A / DCI (DUT control interface)	
DCA-X oscilloscope	N1000A + N1060A	
Real-time oscilloscope	UXR-series oscilloscopes with 70GHz bandwidth & above	

## Minimum required instrument configuration

### M8050A

M8042A M8042A-0G1	Pattern generator module 32/64/120 GBd, 2 or 3-slot AXIe Pattern generator NRZ and PAM4, 1 channel, 2-slot AXIe module (requires M8058A remote head)
• M8042A-G32	Pattern generator, 32 GBd for NRZ and PAM4, module-wide license
• M8042A-0G4	De-emphasis, module-wide License
• M8042A-0G2 (only required for VSR)	Pattern generator NRZ and PAM4, 2 channel, 3-slot AXIe module (requires M8058A remote head)
• M8058A	Remote head, 32/64 GBd for M8042A pattern generator
M8058A-801	Matched cable pair, 1.85 mm (m) to 1.85 mm (m), 2 ps, 0.15 m
M8009A • M8009A-062	Clock generator module with jitter modulation, 60 GHz, 2 slot AXIe
M8009A-0G3	Advanced jitter modulation for up to two channels, license

### Configure the error analyzer

M8043A	Analyzer module 32/64 Gbaud, NRZ and PAM4 2-slot AXIe
M8043A-A32	Analyzer, one channel, data rate up to 32 GBaud, NRZ and PAM4
M8043A-0A3	Equalizer license

### Select an interference source for 56G-LR or -MR application

M8054A	Interference source 32 GHz
M8195A-001	Arbitrary waveform generator, 1 channel, 65 GSa/s
M8196A-001	Arbitrary waveform generator, 1 channel, 92 GSa/s

### Select DCA configuration – N1000A + N1060A DCA-X

N1000A	DCA-X wide-bandwidth oscilloscope mainframe
N1000A-PLK	Pattern lock trigger hardware model
N1060A	Precision waveform analyzer
N1060A-050	Two 50 GHz channels
N1060A-EVA	Equalizer integrated variable
N1060A-232	Supported input rates: 125 MBd to 32 GBd
N1060A-PTB	Precision timebase, ultra-low random jitter
N1060A-JSA	Jitter spectrum analysis and clock recovery emulation

### FlexDCA N1000-Series system software – choose DCA options or R&D package

DCA options	
N1010AT-200	Enhanced jitter analysis SW
N1010AT-201	Advanced waveform analysis
N1010AT-9FP	PAM-N analysis software
N1010AT-SIM	InfiniiSim-DCA (embedding/de-embedding of cables or fixtures)
R&D package	
N1010100A	Research and development package for FlexDCA DCA-X mainframe minimum configuration

### Select UXR configuration if DCA options are not selected

UXR0702B	70 GHz, 2-CH, 1 mm input Infiniium UXR-Series real-time Oscilloscope
D9020ASIA	Advanced signal integrity software (EQ, InfiniiSimAdv, crosstalk)
D9010PAMA	Pulse amplitude modulation PAM-N analysis software
D9020JITA	Jitter, vertical and phase noise analysis software for 90000, V-, Z- and UXR-series oscilloscopes

### Accessories (recommended)

M8043A-801	Matched Cable Pair, 1.85 mm (m) to 1.85 mm (m), 2 ps, 0.15 m
M8043A-802	Termination 50 Ohm, 1.85 mm (m)
M8042A-801	Clock Cable Semi-rigid for Pattern Generator M8042A, Channel 1
M8195A-810	Cable, 2.92 mm (m) to 2.92 mm (m), length 0.85 m (for combing SI and RI) (2 required, 3 if DCA-X)
M8195A-820	Coaxial termination 50 $\Omega$ DC to 26.5 GHz, 3.5 mm (male) (2 required)
SP0606A	Wilder QSFP-DD 112G/800G MCB 1.85mm Receptacle Test Adapter
SP0607A	Wilder QSFP-DD 112G/800G HCB Plug 1.85mm Test Adapter
M8049A-002	ISI channel board, nine traces from 0.8 to 8.0 inches
M8049A-003	ISI channel board, seven traces from 9.1 to 22.3 inches
M8045A-802	Matched directional coupler pair, 50 GHz, 13 dB, 2.4 mm (for MR and LR)
Y1901B	Adapter, 1.0 mm ruggedized (f) to 1.85 mm (f), DC to 67 GHz
N2125A	Infiniium UXR Real-Time Oscilloscope Calibration Module, 1 mm

### Software configuration

M809256CB-1xx	RX conformance test application for OIF-CEI 4.0
M8070ADVB-1xx	Advanced measurement package for M8000 Series of BERT test solutions (node locked, transportable, floating or USB license, revisions 9.1 or later)

## Minimum PC configuration

The PC running the application should meet following requirements:

### PC hardware requirements

Memory	8 GB RAM minimum
Monitor Resolution	WXGA+ (1140 x 900) minimum

### PC software requirements

Keysight IO Library Suite Rev 18.1  
Keysight License Manager 5 and Keysight License Manager 6  
M8070B system software for M8000 series  
    ° rev. 10.5.180.6  
    ° M8070ADVB Advanced Measurement Package for M8000 Series Ver. 1.6.180.2  
Keysight M8195A Firmware and SFP rev. 4.2.20 or Keysight M8196A Firmware and SFP rev. 2.1.13.0  
Keysight DCA-X Oscilloscope FW rev. A.07.50.258  
Keysight UXR Oscilloscope FW rev. 11.52.00001  
MATLAB Compiler Runtime R2017a (9.2)

# Remote Programming

The M809256CB IEEE 802.3bs Conformance Test Application is part of Keysight's Digital Test Apps and can be programmed via ARSL, any .NET language or through the LabVIEW graphical programming interface. For more information, see [www.keysight.com/find/rpi](http://www.keysight.com/find/rpi).

## Related Products

The M8091BSCB Electrical Receiver Conformance Test Application for IEEE 802.3bs designed to assist and simplify the stress signal calibration used for testing the inputs of 200GAUI-4 and 400GAUI-8.

The [N109256CB TX Test Automation SW Application for OIF-CEI 4.0](#) for the sampling oscilloscopes and the [N6473A OIF-CEI 4.0 Compliance Application for Infinium real-time oscilloscopes](#) offer automated transmitter testing for CEI-56G-VSR host or module, CEI-56G-MR and CEI-56G-LR outputs.

The [N4917BSCB Optical Receiver Stress Test Application](#) addresses test needs for optical input test of transceiver modules for IEEE 400GBASE-based optical interfaces.

The [M8091CKCA](#) is industry's first electrical receiver test application for IEEE 802.3ck which assist and simplify the stress signal calibration used for testing the inputs of IEEE 100G serial interfaces.

The [N1091CKCA Electrical TX Test Software for IEEE 802.3ck \(100/200/400 Gb/s\)](#) for the sampling oscilloscopes offer automated transmitted testing for IEEE PAM-4 based electrical outputs.

The [D90103CKC Electrical TX Test Software for IEEE 802.3ck \(100/200/400 Gb/s\)](#) for the real-time oscilloscopes offer automated transmitter testing for IEEE PAM4-based electrical outputs.

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