

N1091CKCA IEEE 802.3ck Measurement and Debug Application

Characterize IEEE 100/200/400 Gb/s Electrical TX Designs
using N1000A DCA-X Wide-Bandwidth Oscilloscopes

Introduction

Several industry and IEEE standard associations have defined specifications for 100 Gb/s and over one lane on the Physical Medium Attachment (PMA) Sublayer & Physical layer. As an example, chip-to-chip or chip-to-module interface of 100/200/400 Gb/s designs, or backplane (KR) or shielded balanced copper cabling (CR) defined by IEEE 802.3ck.

The Keysight N1091CKCA IEEE 802.3ck software is a measurement application for the DCA-X equivalent-time sampling oscilloscopes designed to save time and money by automating 53 Gbaud PAM4 transmitter (TX) test measurements.



Table of Contents

Introduction	1
Transform Complexity into Simplicity	3
Select Industry-leading Hardware	4
Select the Desired Software Test Suite	5
Configure Your Measurements	6
Choose Your Tests	7
Return Loss Measurement.....	9
Automated Tuning for Optimal Eye Opening	10
Guided Connection Diagrams for Easy Setup	11
More Features Streamline Development	12
Control Your Device or Other Equipment	13
Configure Your Solution in Three Ways.....	14
Oscilloscope Compatibility	15
Ordering Information	19
Required Software Options	20

Transform Complexity into Simplicity

The N1091CKCA is an easy-to-use TX test application that:

- Saves time in understanding details of standards
- Reduces the time it takes to characterize your 53 Gbaud PAM4 design from hours to minutes
- Helps debug your device using custom configurations
- Automates optimization of CTLE + DFE equalizer settings
- Allows you to quickly generate HTML reports that summarize the performance of your device

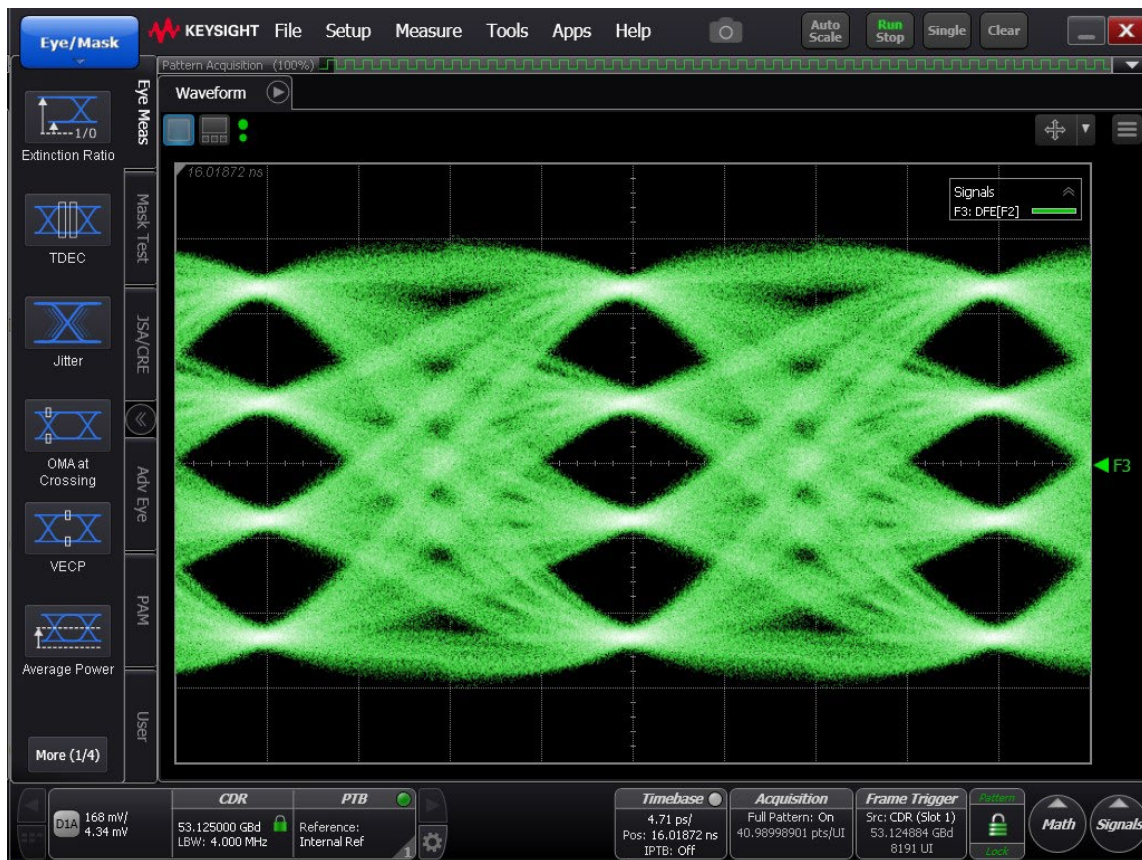


Figure 1. 53 Gbaud PAM4 eye diagram with PRBS13Q pattern length

Select Industry-leading Hardware

Configure your oscilloscope for single or multi-channel capability. The N1091CKCA application supports a variety of digital communication analyzer (DCA) oscilloscope configurations, including the N1000A DCA-X wide-bandwidth oscilloscope platform, N1060A precision waveform analyzer or the N104X 1/2/4 port remote heads and DCA-M family clock data recovery module. For return loss, the software controls an N1055A TDR module (or an economy or performance network analyzer) and performs S-parameter measurements. For more hardware configuration details, refer to the Ordering Guide in this document.



Figure 2. N1000A DCA-X Wide-Bandwidth Oscilloscope Mainframe and N1060A Precision Waveform Analyzer

Select the Desired Software Test Suite

The N1091CKCA IEEE 802.3ck TX test application covers PAM4 transmitter measurements outlined in IEEE 802.3ck specifications. The tests are sorted conveniently by clause. Click on the desired test group, and the appropriate tests are offered in Select Tests (factory-installed options shown).

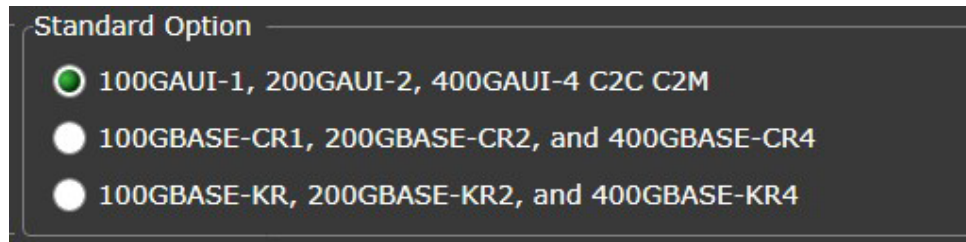


Figure 3. Standard option of N1091CKCA IEEE802.3ck TX test application.

The N1091CKCA test application covers most TX tests outlined in the tables below. For a comprehensive and up-to-date list of specific tests covered by the application, download the N1091CKCA application from www.keysight.com, install it on a PC, and run the application in “Demo Mode”. No license (or hardware) is required to run the software application in “Demo Mode”.

IEEE 802.3ck 100Gb/s, 200 Gb/s and 400 Gb/s operation

IEEE Reference	Description
120F.3.1	100GAUI-1, 200GAUI-2 and 400GAUI-4 C2C transmitter characteristics
120G.3.1	100GAUI-1, 200GAUI-2 and 400GAUI-4 C2M host output characteristics
120G.3.2	100GAUI-1, 200GAUI-2 and 400GAUI-4 C2M module output characteristics
162.9.3	Transmitter characteristics, 100GBASE-CR1, 200GBASE-CR2, and 400GBASE-CR4
163.9.2	Transmitter characteristics, 100GBASE-KR1, 200GBASE-KR2, and 400GBASE-KR4

Configure Your Measurements

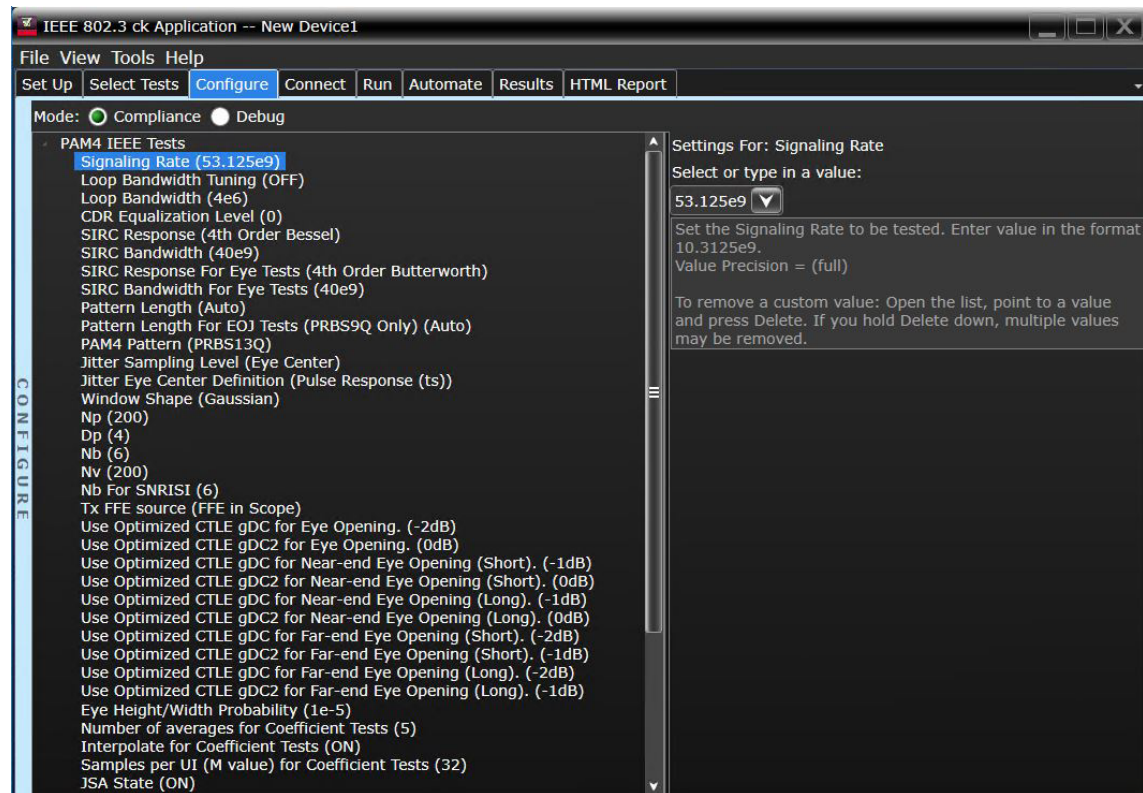


Figure 4. Configuration page of N1091CKCA IEEE802.3ck TX test application

Customize parameters that are specific to your setup, such as signaling rate, CTLE gain settings, and coefficient parameters used to determine linear fit pulse & steady-state voltage. Use default values or enter your own settings including the number of waveforms taken, jitter eye center definition, window shape and pattern symbol length. Choose Compliance mode to test within limits or choose Debug mode to test to your custom limits and adjust other test parameters.

Choose Your Tests

The N1091CKCA IEEE 802.3ck TX test application provides comprehensive coverage of PAM4 tests that are specific to the clause you are testing. You may click on all available tests, a group of tests, or select individual tests to run. The full test name appears in the test list and is also shown in the test results and reports. A description of the test and reference to the Standard is shown for each test.

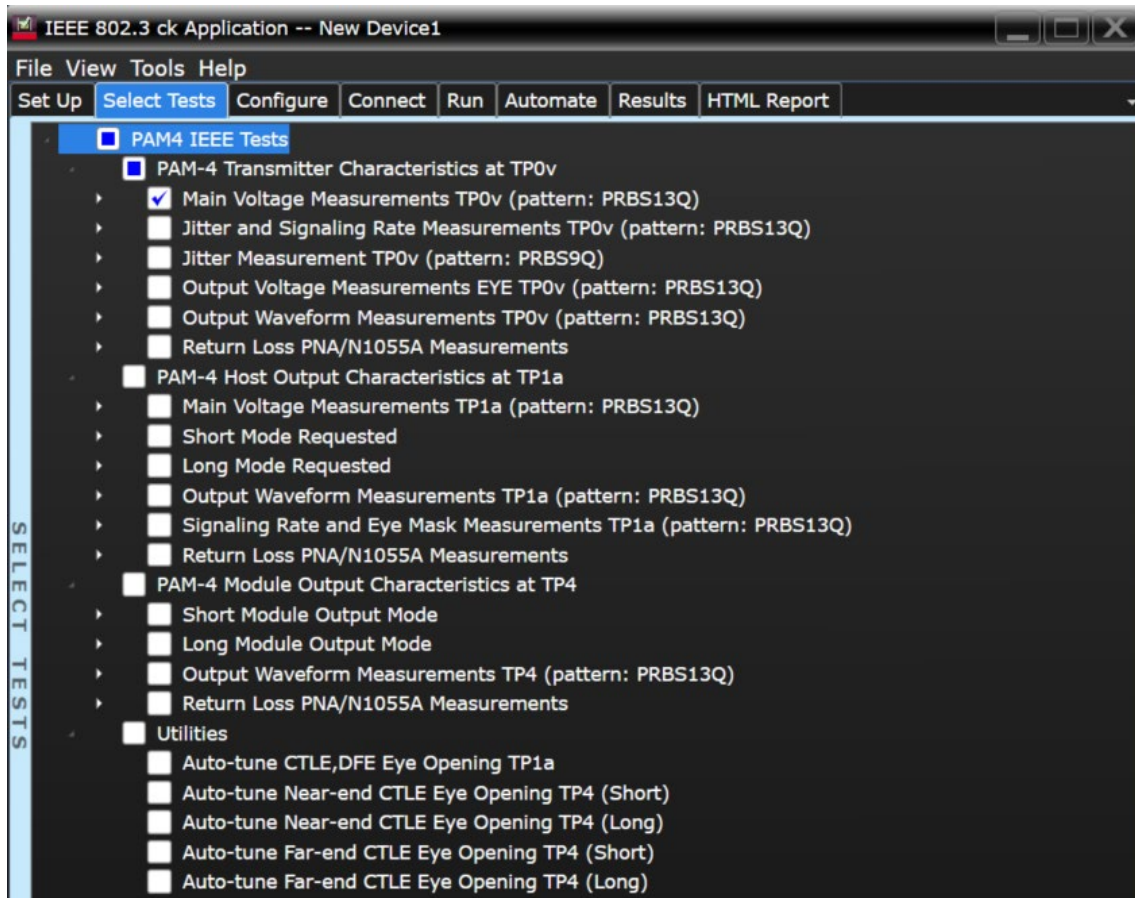


Figure 5. A group of tests were selected in N1091CKCA IEEE802.3ck TX test application, under 100GAUI-1, 200GAUI-2, 400GAUI-4 C2C TP0v standard option

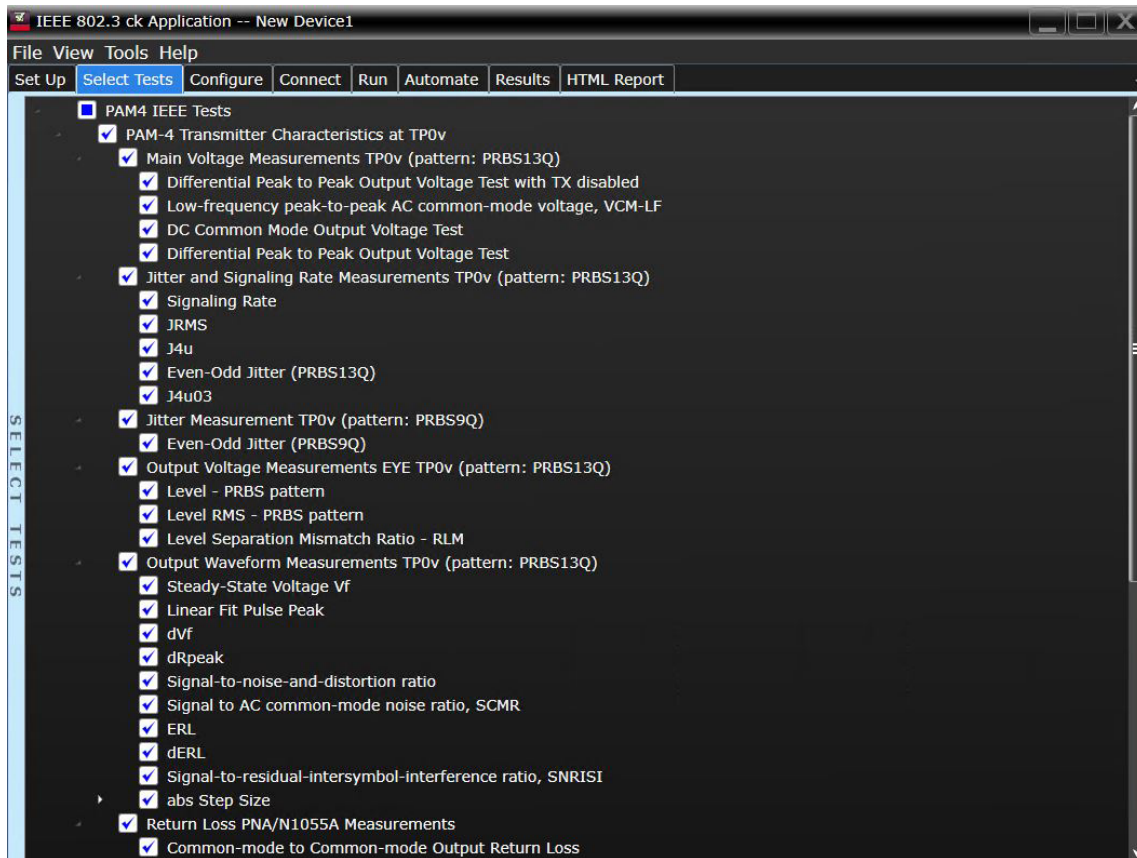


Figure 6. All available tests were selected in N1091CKCA IEEE802.3ck TX test application, under 100GAUI-1, 200GAUI-2, 400GAUI-4 C2C TP0v standard option

Return Loss Measurement

When used in conjunction with an N1055A TDR module or vector network analyzer (PNA), the N1091CKCA IEEE802.3ck test application performs common-mode to common-mode output return loss and common-mode to differential output return loss measurements.

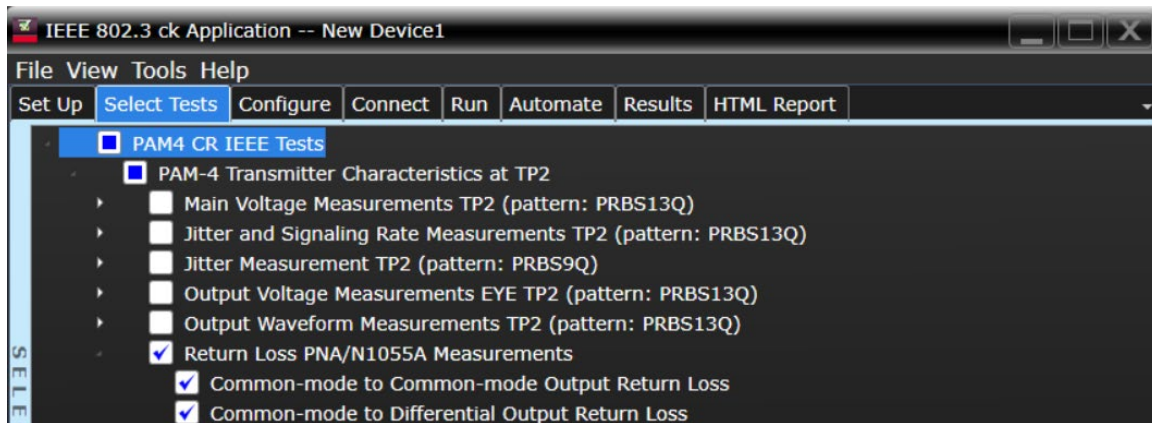


Figure 7. Return loss measurement selection of N1091CKCA IEEE802.3ck TX test application

Automated Tuning for Optimal Eye Opening

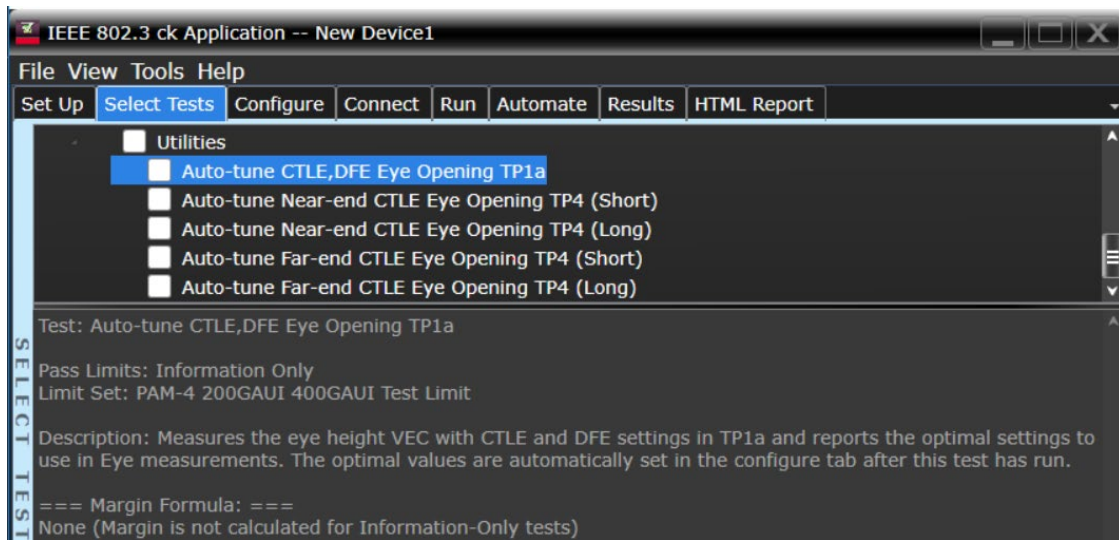


Figure 8. New automated tuning of CTLE & DFE for eye opening feature in N1091CKCA IEEE802.3ck TX test application

The N1091CKCA IEEE802.3ck TX test application provides utility test, to find the optimal eye opening for eye mask measurement at C2M's TP1a & TP4 (near-end & far-end host channel type with short & long module output mode). It leverages the COM method to calculate optimal TX FFE, RX CTLE & DFE value, then performs the tuning on the CTLE & DFE in DCA hardware based on estimated values from COM, measures the eye height & VEC, and reports all the eye measurement result that are tested. You can select to run using COM method, or choose to run all the CTLE combination options, to find the optimal eye opening CTLE settings.

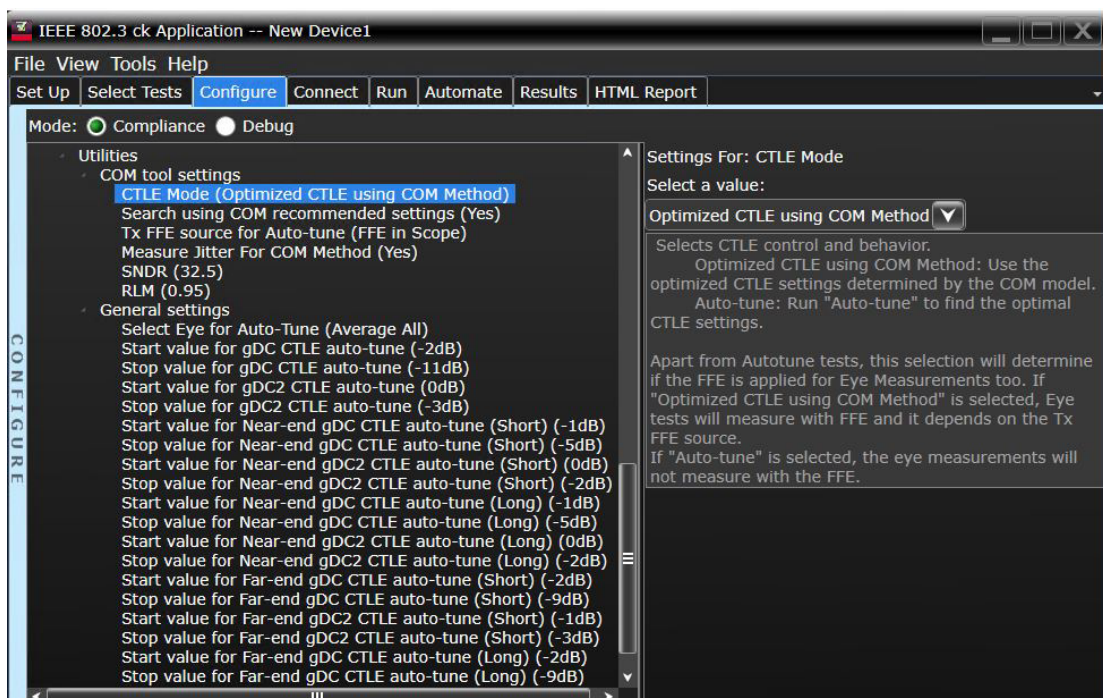


Figure 9. Configuration setting for automated tuning process in N1091CKCA IEEE802.3ck TX test application

Guided Connection Diagrams for Easy Setup

Simply follow the steps to connect and configure your device under test and click Run Tests. The N1091CKCA IEEE 802.3ck TX test application automatically configures and controls your supported DCA-X oscilloscope.



Figure 10. Connection diagram in N1091CKCA IEEE802.3ck TX test application

More Features Streamline Development

Generate reports

Your team members and your customers are interested in the performance of your device. Share a test results report with them that shows the test conditions, summary of pass/fail, summary of all tests, and details for each test. Many include a test-specific screen shot of the measured parameter.

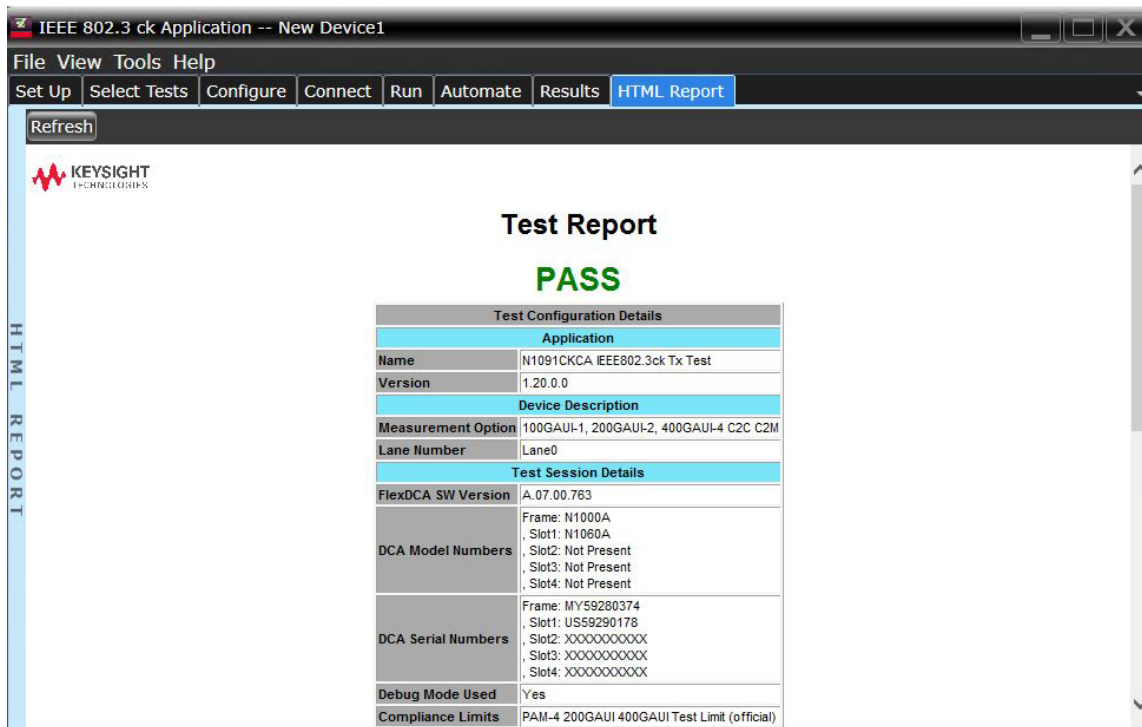


Figure 11. Test report and measurement details

Control Your Device or Other Equipment

The Automation tab enables you to enter commands to control external devices or equipment, and to further sequence your tests or to control timing.

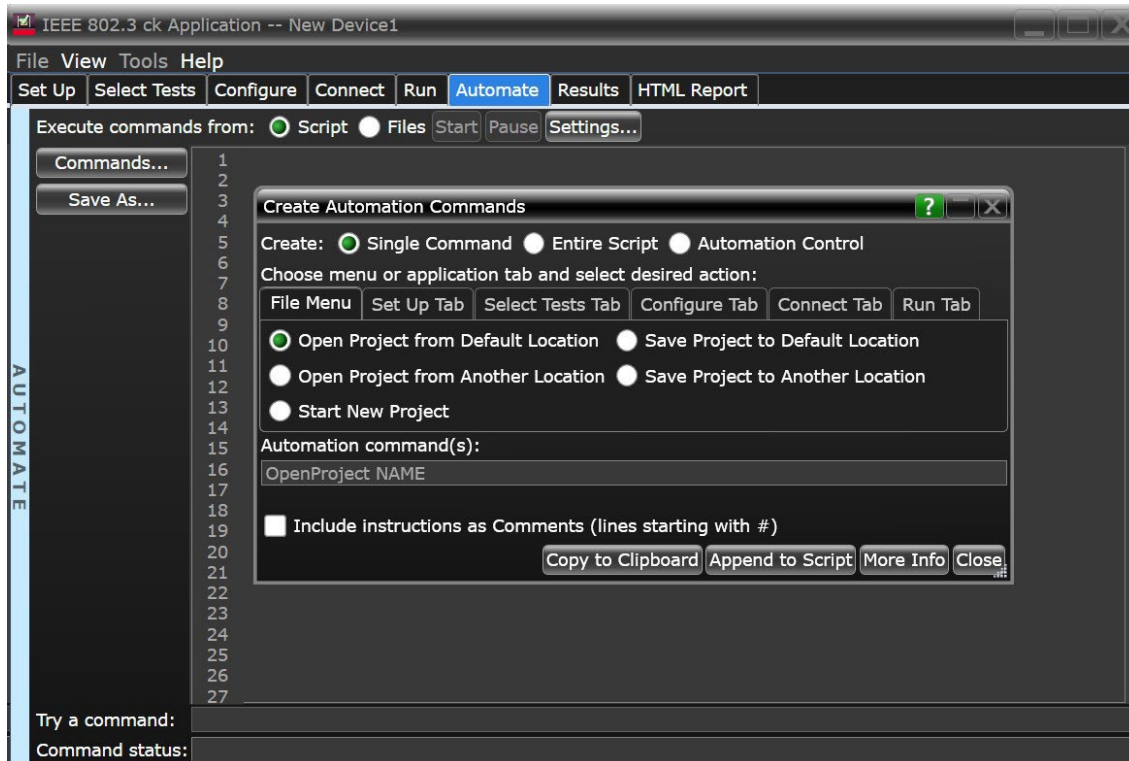


Figure 12. Commands selection on the automation tab of N1091CKCA IEEE802.3ck TX Test Application

Configure Your Solution in Three Ways

The hardware and software architecture provides wide flexibility. The N1091CKCA TX test application may be run as follows:

1. N1000A DCA-X runs the N1091CKCA application locally and controls remote PNA via LAN
2. PC runs the N1091CKCA application and controls remote N1000A DCA-X, PNA via LAN
3. PC runs both the N1091CKCA and N1010A FlexDCA software applications and controls remote N1000A DCA-X and PNA via LAN, or a DCA-M via USB connection.



Figure 13. PC runs both DCA time-equivalent oscilloscope and PNA via LAN

This lets you use your PC for additional processing power and other applications, or you can have all the measurement capability consolidated into a compact solution. For return loss measurements, the N1091CKCA application can control an N1055A TDR or PNA vector network analyzer to perform measurements automatically.

Oscilloscope Compatibility

Keysight offers a wide range of electrical and optical test solutions to address current and emerging communications standards. For IEEE 802.3ck testing, you may choose a hardware combination that addresses your test needs for today, and into the future:

1. N1000A DCA-X with N1060A (Integrated “One-Box” solution) - recommended
2. N1000A DCA-X with DCA module and external clock recovery

Solution 1: Keysight N1000A DCA-X Mainframe + N1060A “MegaModule” (Recommended)

- Highest accuracy
- Easy setup
- Integrated solution



TX test using digital communications analyzer (DCA)	Mainframe model no.	Mainframe hardware options	Mainframe software options (fixed or transportable licenses)
	N1000A DCA-X	Required: STB, PLK (N1000A) Optional: LOJ/PTB (not used with N1060A)	Required: N1010100A ¹
	Plug-in module model no.	Plug-in module options	Max # of modules/diff channels
	N1060A ²	Required: PTB/JSA/EVA/264/050 Optional: 085/E33	1/1 (slot 1 only)
	Software		
	N1091CKCA	Electrical TX Test SW for IEEE 802.3ck	
	N1010A	FlexDCA FW Rev 7.41 or later (included with N1000A mainframe)	
	Keysight IO libraries	Rev 18.2 or later, automatically installed with FlexDCA installation	
	Accessories		
	N1060A	N1060A: No accessories are required (all modules include integrated de-skew)	
	N1060A-DC2	DC blocks, 50 GHz (Qty 2)	
N1060A-CA2	Matched cable set (Qty 1)		
Return Loss measurements	Model no. (pick TDR or PNA)	Description	
	N1055A TDR/TDT	50 GHz 2/4 Port TDR/TDT Remote Sampling Head for the N1000A DCA-X (any option) equipped with one of the following SW licenses: N1010200A, N1010300A or legacy 202	
	Network analyzer	4-port PNA's equal or greater than 50 GHz (e.g. N5227B, N5247A)	

1. For the 802.3ck measurement features, required FlexDCA renewable support subscriptions with minimum version of 2022.0615
2. Required a pair of 100MHz low pass hardware filter (not sell by Keysight Technologies; Third-party vendor) for Low-Frequency peak-to-peak AC common mode voltage test, VCM-LF

Solution 2: Keysight N1000A DCA-X Mainframe with DCA Module + External Clock Recovery

- Highest flexibility
- Scalable solution
- High fidelity – remote heads minimize loss between DUT and oscilloscope

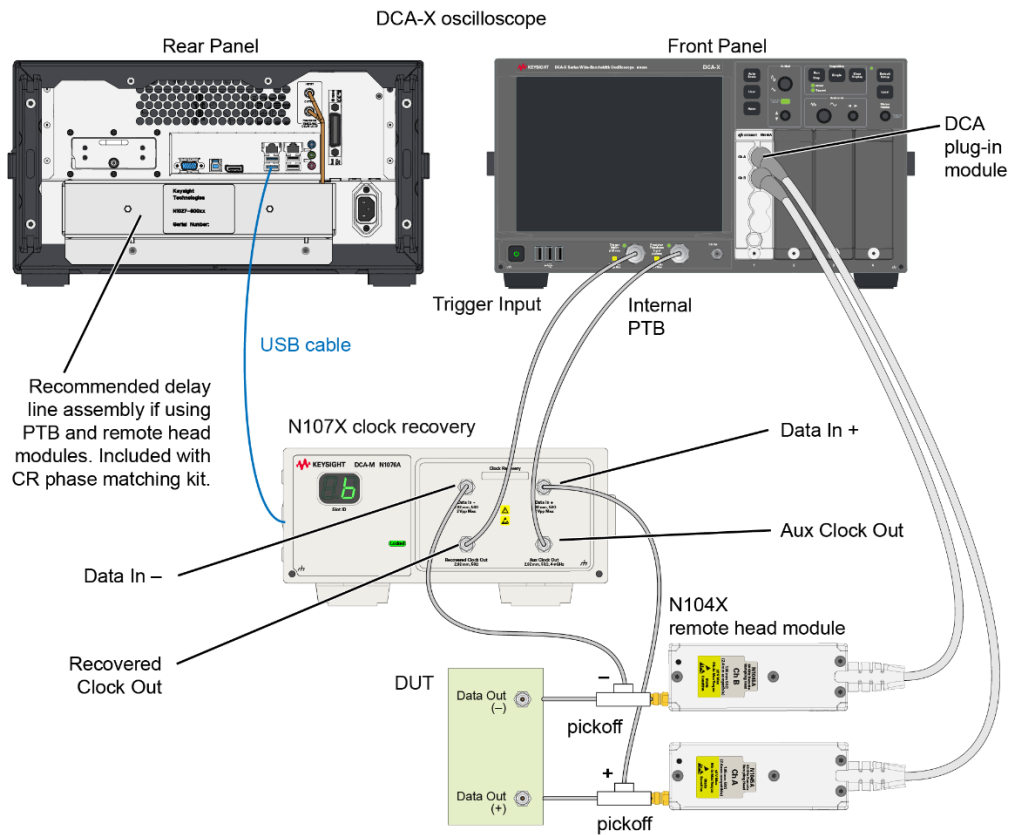


Figure 14. Keysight N1000A DCA-X mainframe with DCA module + external clock recovery

Equipment Configuration for Solution 2:

Keysight N1000A DCA-X Mainframe with DCA module + External Clock Recovery

TX test using digital communications analyzer (DCA)	Mainframe model no.	Mainframe hardware options	Mainframe software options (fixed or transportable licenses)
	N1000A DCA-X	Required: PLK/LOJ/PTB (N1000A)	Required: N1010100A ¹
	Plug-in module model no. ² (pick one)	Plug-in module options	Max # of modules/diff channels³
	N1045A/B	Any	4/8
	N1046A	12F, 14F, 72F, 74F, 82F, 84F (any 2 or 4 channel config)	4/8
	N1040A	060	4/8
	Clock recovery model no. (pick one)	Clock recovery options	
	N1076B	264	
	N1077B	264	
	N1078A	264	
	Software		
	N1091CKCA	Electrical TX Test SW for IEEE 802.3ck	
	N1010A	FlexDCA FW Rev 7.41 or later (included with N1000A mainframe)	
	Keysight IO libraries	Rev 18.2 or later, automatically installed with FlexDCA installation	
	Accessories ⁴		
	N1027A-76B (rec.)	Clock Recovery Phase Matching Kit for use with N104XA remote head and N107X CR	
	N1027A-78A (rec.)	Clock Recovery Phase Matching Kit for use with N104XA remote head and N107X CR	
	N1027A-2P2	Pick-Off Tees (Qty 2), for remote head modules with 1.85 mm/2.4 mm connectors (N1045A/B, N1046A), (included in N1027A-76A/76B Kit)	
	N9398F or N9399F	DC block, 50 GHz (Qty 2)	
	Mode (TDR or PNA)	Description	
	N1055A TDR/TDT	50 GHz 2/4 Port TDR/TDT Remote Sampling Head for the N1000A DCA-X (any option) equipped with one of the following SW licenses: N1010200A, N1010300A or legacy 202	
	Network analyzer	4-port PNA's equal or greater than 50 GHz (e.g. N5227B, N5247A)	

1. For the 802.3ck measurement features, required FlexDCA renewable support subscriptions with minimum version of 2022.0615; For the F-JSA, required FlexDCA renewable support subscriptions with minimum version of 2023.0215
2. Required a pair of 100MHz low pass hardware filter (not sell by Keysight Technologies; Third-party vendor) for Low-Frequency peak-to-peak AC common mode voltage test, VCM-LF
3. App is now supporting module on slot 1/2/3/4. App will only measure one lane/differential pair at a time. User to choose which lane/differential pair for measurement and this can be configured in the app.
4. For more information on clock-to-data delay matching, refer to the Keysight N1076A/B, N1077A, and N1078A Clock Recovery DCA-M User Guide

Ordering Information

The N1091CKCA Electrical TX Test SW for IEEE 802.3ck may be licensed using any of four different methods. Choose a license type and term that best suits your requirements.

License types:

1. **Node-locked:** Allows you to use the license on one specified instrument or computer.
2. **Transportable:** Allows you to move the license from one instrument or computer to another using Keysight's online tool.
3. **USB portable:** Allows you to move the license from one instrument or computer to another with a certified USB dongle.
4. **Floating:** Allows you to access the license on networked instruments or computers from a server, one at a time. Three types of floating license are available:
 - a. **Single Site:** 1-mile radius from the server
 - b. **Single Region¹:** Americas; Europe; Asia;
 - c. **Worldwide:** export restriction identified in END User License Agreement (EULA)

License terms:

Each of the license types are offered as perpetual (licenses can be used indefinitely) or subscription (licenses can be used through the term of the license: 6, 12, 24, or 36 months).

KeysightCare software support subscription:

- Perpetual licenses are sold with a 12 (default), 24, 36, or 60-month KeysightCare software support subscription
- Software subscription licenses include KeysightCare Software Support through the term of the license

For more information, visit: KeysightCare Software Support Subscriptions, [5992-3419EN](#).

1. Americas (North, Central, and South America, Canada); Europe (European Continent, Middle Eastern Europe, Africa, India); Asia (North and South Asia Pacific Countries, China, Taiwan, Japan)

Required Software Options

The N1091CKCA software requires that the N1010100A R&D Package be licensed on the platform.

Subscription based Compliance Test Software Suites

A new ownership model of multiple Compliance Test Software Applications is now available.

With this new subscription-based model, the IEEE software suites bundle the Compliance Test Software Applications under a model number. Using a subscription-based ownership, you can enjoy all the test software features covered under IEEE across multiple generations and variants.

Software support and continuity

Under the subscription plan, software support is made available with no extra support cost. Ensuring your software always stays up to date with the latest enhancements and measurement standards while having access to our team of technical experts when you need support.

On top of that all upgrades are made available to you as the IEEE standards progresses with no additional costs.

Subscription based Compliance Test Software Suites

Each suite comes with a 12, 24, or 36-month software suite subscription.

Model number	Options available
SW00DCAI IEEE802.3 TX Validation License (for DCA)	<ul style="list-style-type: none">• IEEE 802.3ck Electrical TX Test (N1091CKCA)• IEEE 802.3bs/cd Electrical TX Test (N1091BSCB)• IEEE 802.3bs/cd/cu Optical TX Test (N1095BSCA)