DATA SHEET

N1091BSCA IEEE 802.3bs/cd

Measurement and Debug Application

Characterize IEEE 50/100/200/400 Gb/s Electrical TX Designs using N1000A/86100D DCA-X and N109X DCA-M Oscilloscopes

KEYSIGHT TECHNOLOGIES

Table of Contents

Introduction

Several industry and standards bodies have adopted pulse amplitude modulation 4-level (PAM4) technology to increase throughput within a given bandwidth compared to Non-Return-to-Zero (NRZ) technology. As an example, PAM4 technology is used in 50/100/200 Gb/s designs defined by IEEE 802.3cd, and in 200/400 Gb/s designs defined in IEEE 802.3bs.

The Keysight N1091BSCA IEEE 802.3bs/cd software is a measurement application for the DCA-X/DCA-M equivalent-time sampling oscilloscopes designed to save you time and money by automating the task of performing PAM4 and NRZ transmitter (TX) test measurements.

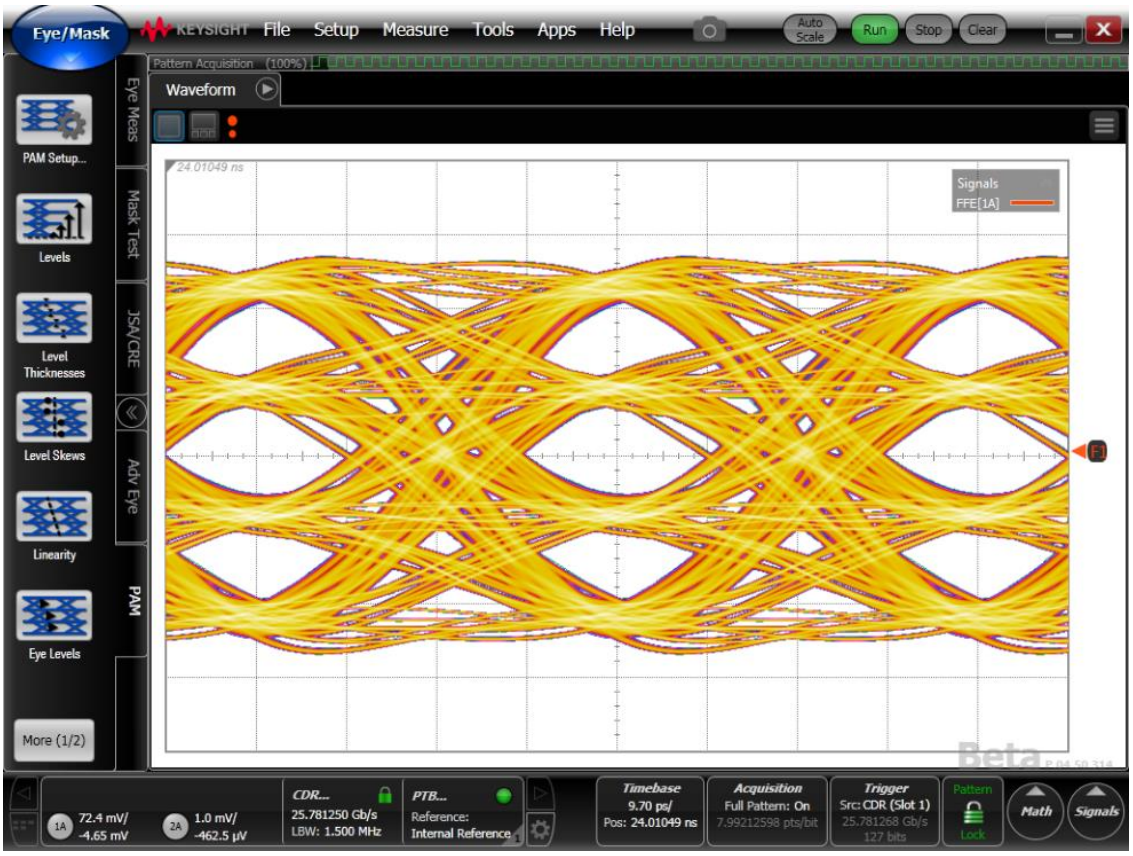
Keysight N1091BSCA IEEE 802.3bs/cd software

The Keysight N1091BSCA IEEE 802.3bs/cd software is a measurement application for the DCA-X/DCA-M equivalent-time sampling oscilloscopes designed to save you time and money by automating the task of performing PAM4 and NRZ transmitter (TX) test measurements

Transform Complexity into Simplicity

The N1091BSCA is an easy-to-use TX test application that:

- Saves time in understanding details of standards
- Reduces the time it takes to characterize your PAM4 and NRZ design from hours to minutes
- Helps debug your device using custom configurations
- Allows you to quickly generate HTML reports that summarize the performance of your device

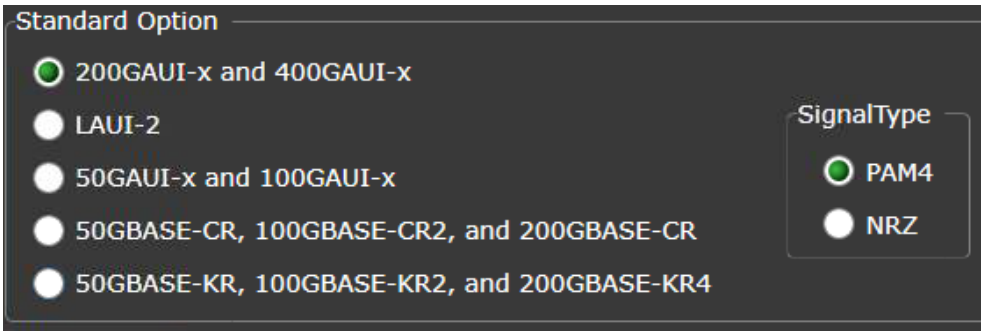


Select Industry-leading Hardware

Configure your oscilloscope for single or multi-channel capability. The N1091BSCA application supports a variety of digital communication analyzer (DCA) oscilloscope configurations, including the N1000A/86100D DCA-X wide-bandwidth oscilloscope platform, and the N109X DCA-M family of oscilloscopes. 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.

Select the Desired Software Test Suite

The N1091BSCA IEEE 802.3bs/cd TX test application covers PAM4 and NRZ transmitter measurements outlined in IEEE 802.3bs and IEEE 802.3cd 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).



The N1091BSCA 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 N1091BSCA 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”.

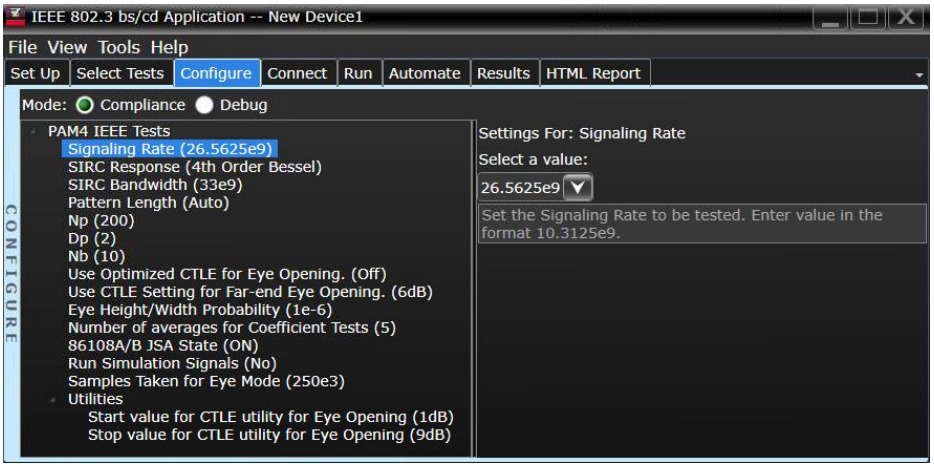
IEEE 802.3bs 200 Gb/s and 400 Gb/s Operation

IEEE Reference	Description [1,2]
120B.3.1	200GAUI-8 and 400GAUI-16 C2C transmitter characteristics
120C.3.1	200GAUI-8 and 400GAUI-16 C2M host output characteristics
120C.3.2	200GAUI-8 and 400GAUI-16 C2M module output characteristics
120D.3.1	200GAUI-4 and 400GAUI-8 C2C transmitter characteristics
120E.3.1	200GAUI-4 and 400GAUI-8 C2M host output characteristics
120E.3.2	200GAUI-4 and 400GAUI-8 C2M module output characteristics

IEEE 802.3cd 50 Gb/s, 100 Gb/s, and 200 Gb/s Operation

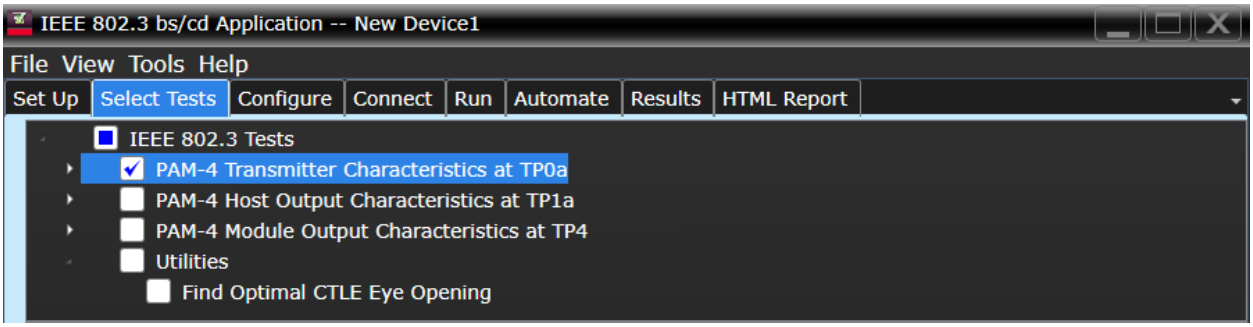
IEEE Reference	Description [1,2]
136.9.3	Transmitter characteristics, 50GBASE-CR, 100GBASE-CR2, and 200GBASE-CR4
137.9.2	Transmitter characteristics, 50GBASE-KR, 100GBASE-KR2, and 200GBASE-KR4
Annex 135B, 135B.3.1	LAUI-2 C2C transmitter characteristics
Annex 135C, 135C.3.1	LAUI-2 C2M host output characteristics
Annex 135C, 135C.3.2	LAUI-2 C2M module output characteristics
Annex 135D, 135D.3.1	50GAUI-2 C2C and 100GAUI-4 C2C transmitter characteristics
Annex 135E, 135E.3.1	50GAUI-2 C2M and 100GAUI-4 C2M host output characteristics
Annex 135E, 135E.3.2	50GAUI-2 C2M and 100GAUI-4 C2M module output characteristics
Annex 135F, 135F.3.1	50GAUI-1 C2C and 100GAUI-2 C2C transmitter characteristics
Annex 135G, 135G.3.2	50GAUI-1 C2M and 100GAUI-2 C2M module output characteristics
Annex 135G, 135G.3.1	50GAUI-1 C2M and 100GAUI-2 C2M host output characteristics

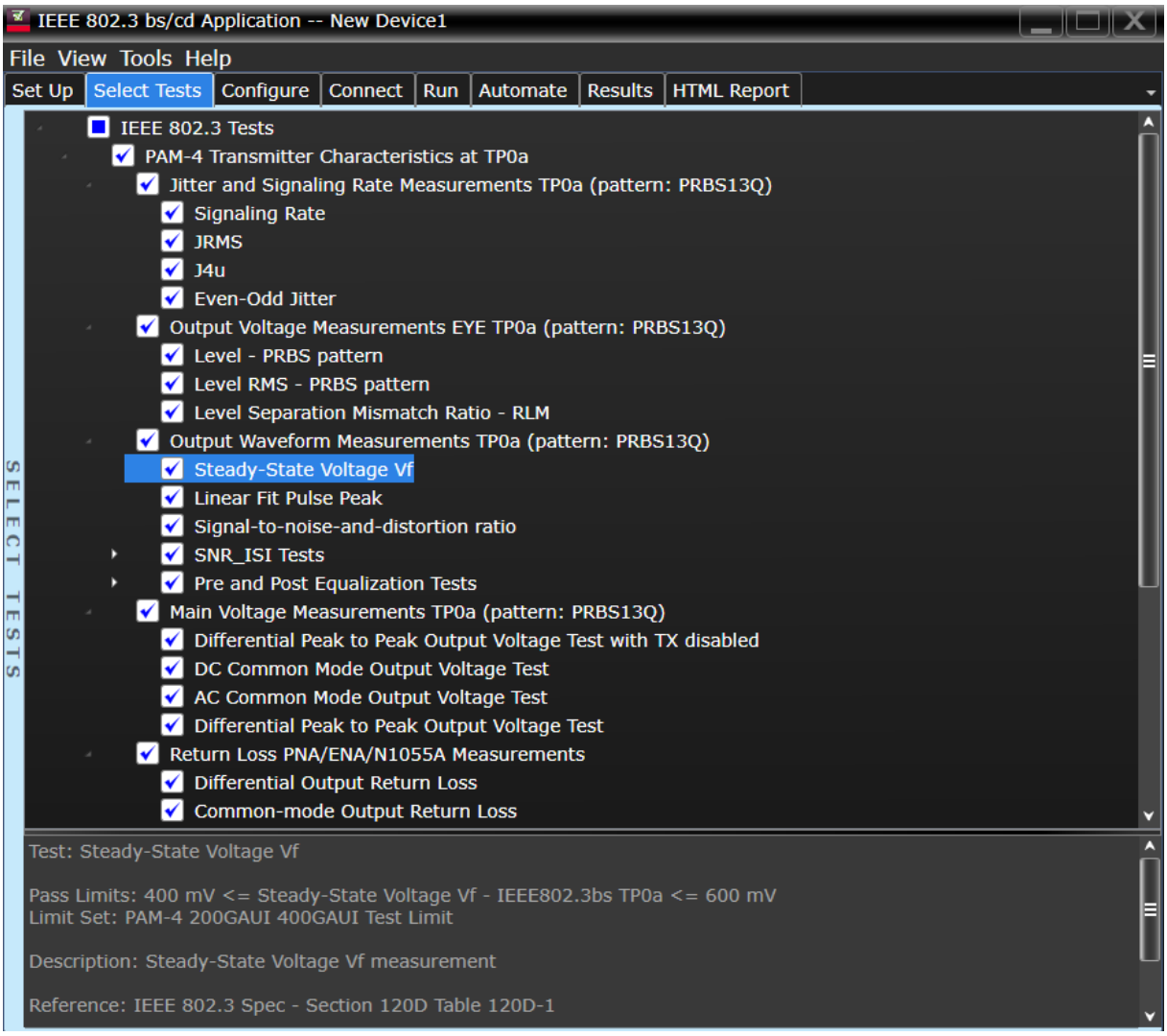
Configure Your Measurements



Customize parameters that are specific to your setup, such as signaling rate and CTLE setting. Use default values or enter your own settings including number of waveforms taken, type of pattern, and pattern symbol length. Choose Normal mode to test within limits or choose Debug mode to test to your custom limits and adjust other test parameters. Choose Your Tests

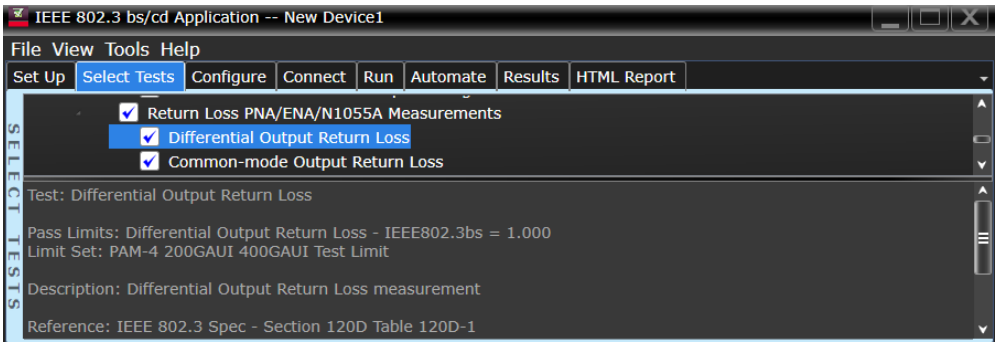
The N1091BSCA IEEE 802.3bs/cd TX test application provides comprehensive coverage of most PAM4 and NRZ tests that are specific to the clause you are testing. You may click on all available tests, a group of tests, or select individual tests to run. The full test name appears in the test list and is also shown in the test results and reports. A description of the test and reference to the Standard is shown for each test.





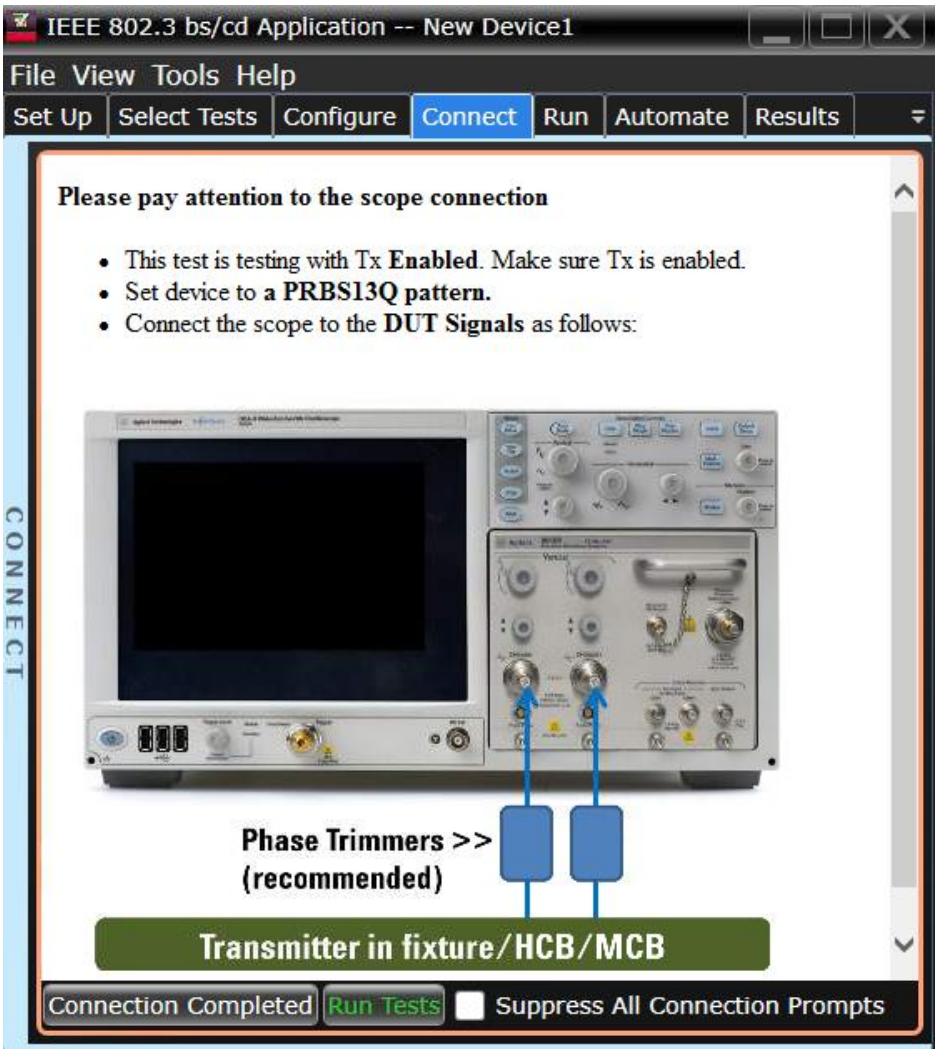
Automated Return Loss Measurements

When used in conjunction with an N1055A TDR module or vector network analyzer (ENA or PNA), the N1091BSCA IEEE802.3bs/cd compliance application performs differential and common mode return loss measurements.



Guided Connection Diagrams for Easy Setup

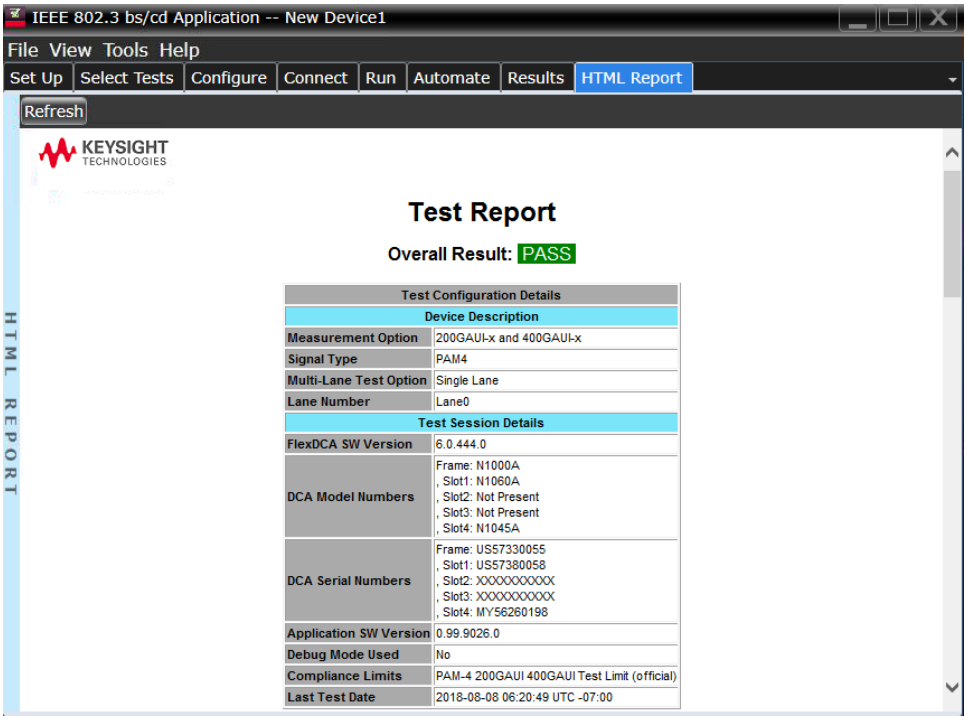
Simply follow the steps to connect and configure your device under test and click Run Tests. The N1091BSCA IEEE 802.3bs/cd TX test application automatically configures and controls your supported DCA-X or DCA-M oscilloscope.



More Features Streamline Development

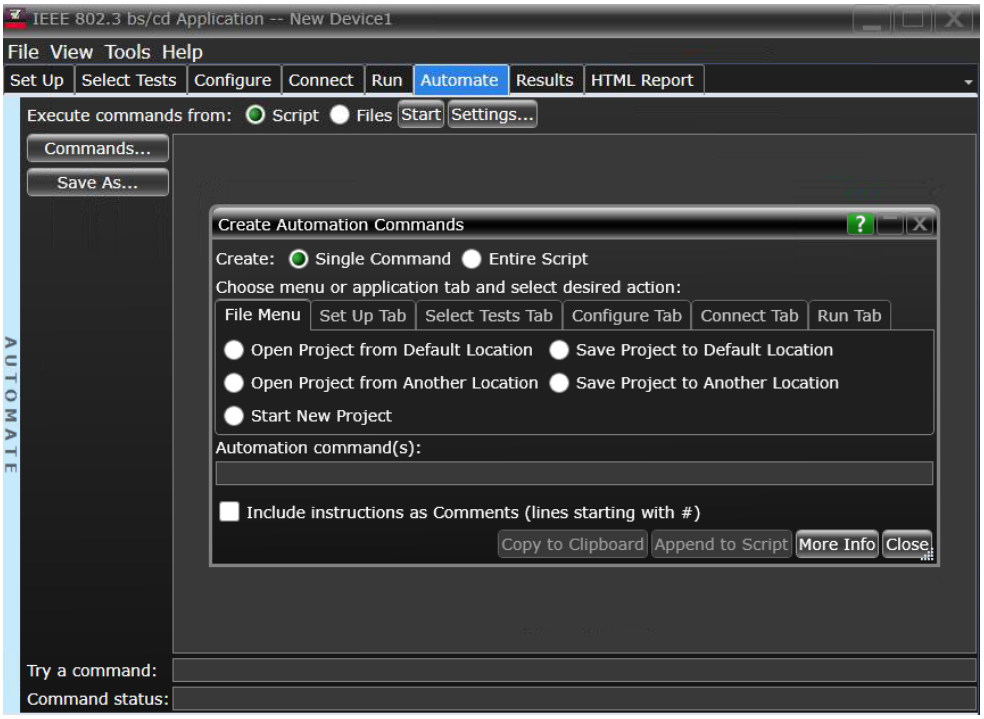
Generate Reports

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.



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.

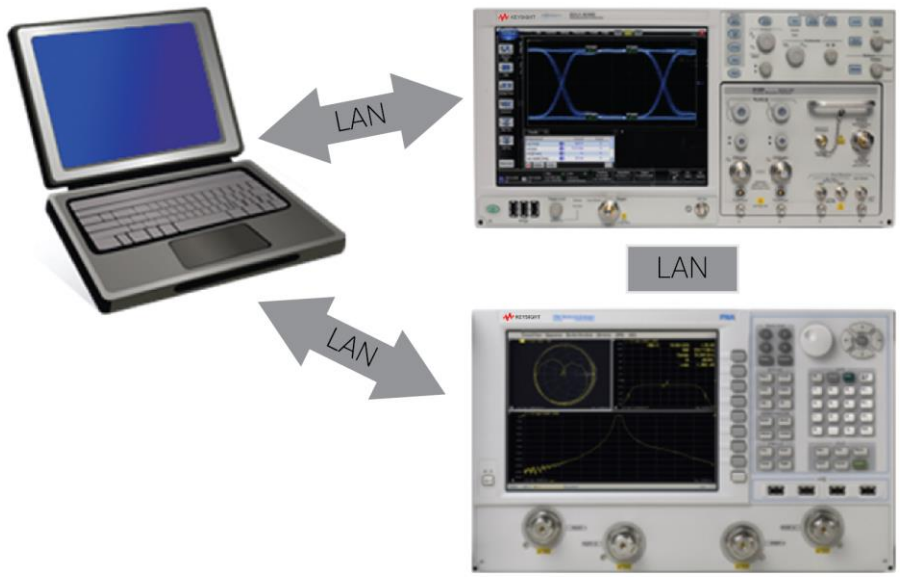


Configure Your Solution in Three Ways

The hardware and software architecture provides wide flexibility. The N1091BSCA TX test application may be run as follows:

1. N1000A/86100D DCA-X runs the N1091BSCA application locally and controls remote ENA/PNA via LAN
2. PC runs the N1091BSCA application and controls remote N1000A/86100D DCA-X, ENA/PNA via LAN
3. PC runs both the N1091BSCA and N1010A FlexDCA software applications and controls remote N1000A/86100D DCA-X and ENA/PNA via LAN, or a DCA-M via USB connection.

This lets you use your PC for more processing power and other applications, or you can have all measurement capability consolidated into a compact solution. For return loss measurements, the N1091BSCA application can control an N1055A TDR or ENA/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 802.3bs/cd testing, you may choose a hardware combination that addresses your test needs for today, and into the future:

1. N1000A/86100D DCA-X with N1060A/86108B (Integrated “One-Box” solution) - recommended
2. N1000A/86100D DCA-X with DCA module and external clock recovery
3. N109X Electrical DCA-M with external clock recovery

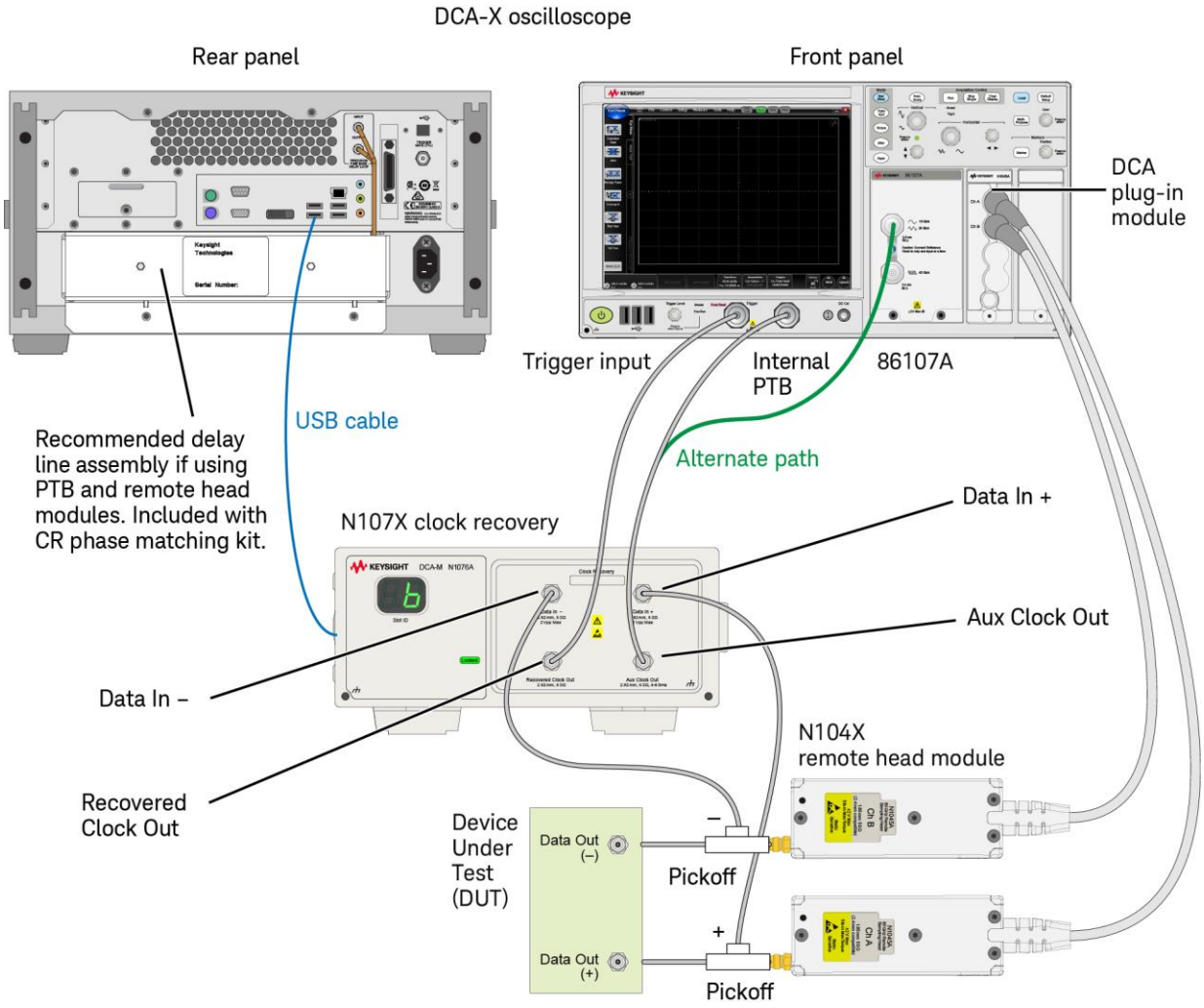
Solution 1: Keysight N1000A DCA-X Mainframe + N1060A “MegaModule” (Recommended)

- Highest accuracy
- Easy setup
- Integrated solution

	Mainframe Model No.	Mainframe Hardware Options	Mainframe Software Options (Fixed or Transportable Licenses)
TX test using digital communications analyzer (DCA)	N1000A DCA-X (or 86100D DCA-X)	Required: STR, PLK (N1000A), ETR (86100D)	Required: N1010100A or 200, 201, 9FP/9TP (for PAM4 analysis)
		Optional: LOJ/PTB (not used with N1060A/86108B)	Optional: SIM (for de-embedding cables)
	Plug-In Module Model No.	**Plug-In Module Options**	**Max # of Modules/Diff Channels**
	N1060A (or 86108B)	232/050 (N1060A) 232/HBW (86108B)	1/1
	Software		
	N1091BSCA	IEEE 802.3bs/cd Measurement and Debug Application	
	N1010A	FlexDCA FW Rev 5.8 or later (included with N1000A/86100D mainframe)	
	Keysight IO libraries	Rev 16.3 or later, automatically installed with FlexDCA installation	
	Accessories		
	N1060A 86108B-PT2 or N1027A-PT2	N1060A: No accessories are required (all modules include integrated de-skew) 86108B: Phase trimmers (Qty 2), for modules with 2.4 mm connectors (86108B)	
	N1060A-DC2, 86108B-DC2, N9399F, or N9399F	DC blocks, 50 GHz (Qty 2)	
	N1060A-CA2 or 86108B-CA2	Matched cable set (Qty 1)	
	Model No. (Pick TDR or PNA)	**Description**	
	N1055A TDR/TDT	35/50 GHz 2/4 Port TDR/TDT Remote Sampling Head for the N1000A/86100D DCA-X (any option) equipped with one of the following SW licenses: N1010200A, N1010300A or 202.	
	Network analyzer (ENA/PNA)	N5224A, N5244A or other 4-port PNA’s greater than 32 GHz N1930B PLTS Software	

Solution 2: Keysight N1000A/86100D DCA-X Mainframe with DCA Module + External Clock Recovery

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



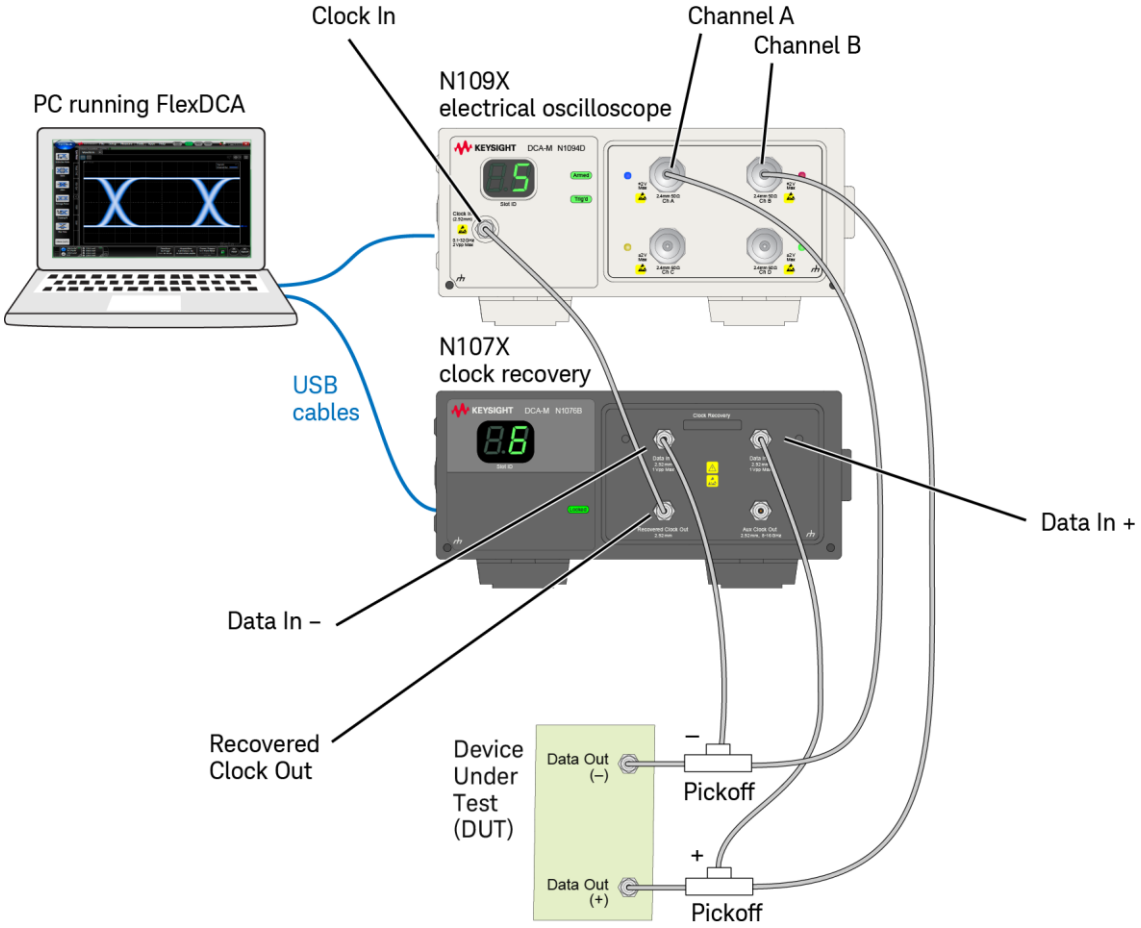
Equipment Configuration for Solution 2:
Keysight N1000A/86100D DCA-X Mainframe with DCA module + External Clock Recovery

	Mainframe Model No	Mainframe Hardware Options	Mainframe Software Options (Fixed or Transportable Licenses)
TX test using digital communications analyzer (DCA)	N1000A DCA-X (or 86100D DCA-X)	Required: PLK/LOJ/PTB (N1000A), ETR/PTB (86100D)	Required: N1010100A or 200, 201, 9FP/9TP (for PAM4 analysis)
			Optional: SIM (for de-embedding cables)
	Plug-In Module Model No (Pick ONE)	**Plug-In Module Options**	**Max # of Modules/Diff Channels**
	86117A	Any	2/2
	86118A	H01	2/2
	N1045A/B	Any	4/8
	N1055A	Any	4/8
	N1046A	12F, 14F, 72F, 74F, 82F, 84F (any 2 or 4 channel config)	4/8
	Clock Recovery Model No (Pick ONE)	**Clock Recovery Options (Pick ONE)**	
	N4877A	232	
	N1076A	232	
	N1076B	232/264	
	N1077A	232	
	N1078A	232/264	
	Software		
	N1091BSCA	IEEE 802.3bs/cd Measurement and Debug Application	
	N1010A	FlexDCA FW Rev 5.8 or later (included with N1000A/86100D mainframe)	
	Keysight IO libraries	Rev 16.3 or later, automatically installed with FlexDCA installation	
	Accessories*		
	N1027A-76B (rec.)	Clock Recovery Phase Matching Kit for use with N104XA remote head and N4877A/N107X CR	
	N1027A-76A	Clock Recovery Phase Matching Kit for use with N104XA remote head and N4877A/N107X CR	
	N1027A-MC1	Clock Recovery Phase Matching Kit for use with N104XA remote head and N4877A CR	
	N1027A-2P2	Pick-Off Tees (Qty 2), for remote head modules with 1.85 mm/2.4 mm connectors (N1045A/B, N1046A, N1055A), (included in N1027A-76A/76B Kit)	
	N1027A-PT2	Phase trimmers, 50 GHz (Qty 2), for 861XX DCA modules with 2.4 mm connectors (86117A)	
	N9399F or N9399F	DC block, 50 GHz (Qty 2)	
Return Loss Measurements	**Mode (TDR or PNA)**	**Description**	
	N1055A TDR/TDT	35/50 GHz 2/4 Port TDR/TDT Remote Sampling Head for the N1000A/86100D DCA-X (any option) equipped with one of the following SW licenses: N1010200A, N1010300A or 202.	
	Network analyzer (ENA/PNA)	4-port ENA/PNA's greater than 19 GHz (e.g. N5230C 140/145, N5224A, N5244A) N1930B PLTS software	

* For more information on clock-to-data delay matching, refer to the Keysight N1076A/B, N1077A, and N1078A Clock Recovery DCA-M User Guide.

Solution 3: Keysight N109X Electrical DCA-M + External Clock Recovery

- **Flexible configuration**
- **Lowest cost**
- **Scalable**



Equipment Configuration for Solution 3:
Keysight N109X Electrical DCA-M + External Clock Recovery

	Software Model No. (For User-Supplied PC)	Software Options (Install On PC, Or Purchase Fixed SW Licenses for the DCA-M)	
TX test using digital communications analyzer (DCA)	N1010A FlexDCA	Required: N1010100A or 200, 201, 9FP/9TP (for PAM4 analysis)	
		Optional: SIM (for de-embedding cables)	
	Dca-M Model No. (Pick One)	**Dca-M Options**	**# Of Diff Channels**
	N1092C	Required: LOJ, PLK	1
		Optional: FS1	
	N1092E	Required: LOJ, PLK	1
		Optional: FS1	
	N1094A	Required: LOJ, PLK, 030 or 050	1
		Optional: FS1	
	N1094B	Required: LOJ, PLK, 030 or 050	2
		Optional: FS1	
	Clock Recovery Model No. (Pick ONE)	**Clock Recovery Options (Pick ONE)**	
	N4877A	232	
	N1076A	232	
	N1076B	232/264	
	N1077A	232	
	N1078A	232/264	
	Software		
	N1091BSCA	IEEE 802.3bs/cd Measurement and Debug Application	
	N1010A	FlexDCA FW Rev 5.8 or later (included with N1000A/86100D mainframe)	
	Keysight IO libraries	Rev 16.3 or later, automatically installed with FlexDCA installation	
	Accessories [1, 2]		
	N1027A-2P2	Pick-Off Tees (Qty 2), for remote head modules with 1.85 mm/2.4 mm connectors (N1045A/B, N1046A, N1055A), (included in N1027A-76A/76B Kit)	
	N9399F, N9399F	DC block, 50 GHz (Qty 2)	
Return Loss Measurements	**Model No. (Pick TDR or PNA)**	**Description**	
	N1055A TDR/TDT	35/50 GHz 2/4 Port TDR/TDT Remote Sampling Head for the N1000A/86100D DCA-X (any option) equipped with one of the following SW licenses: N1010200A, N1010300A or 202.	
	Network analyzer (ENA/PNA)	4-port ENA/PNA's greater than 19 GHz (e.g. N5230C 140/145, N5224A, N5244A) N1930B PLTS software	

Ordering Information

The N1091BSCA IEEE 802.3bs/cd TX test application is available as a standalone license that is assigned by the user to a single DCA oscilloscope or PC (-1FP), or it may be ordered as a transportable license (-1TP) that can be moved by the user from one oscilloscope, or PC, to another.

If a user has previously purchased an N1085A-1TP PAM4 “Pre-Compliance” SW Application, users may purchase the N1091BSUA upgrade option. In this case, both N1085A-1TP and N1091BSUA-1TP licenses must reside on the same instrument or PC.

SW Model No.	Description	Fixed License	Transportable License
N1091BSCA	Electrical TX Test Automation SW for IEEE 802.3bs/cd	N1091BSCA-1FP	N1091BSCA-1TP
N1091BSUA (requires N1085A-1TP)	Electrical TX Test Automation SW for IEEE 802.3bs/cd, N1085A Upgrade	N/A	N1091BSUA-1TP

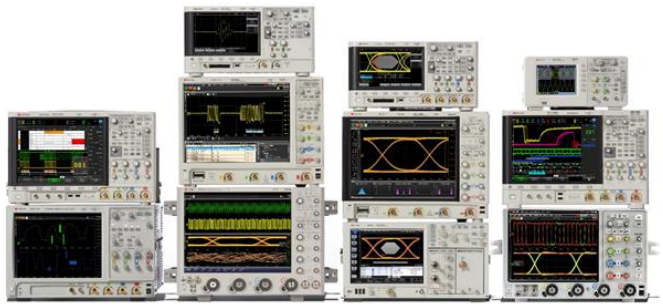
Required Software Options

The N1091BSCA software requires that N1010100A, or 86100D/N1010A-200/201/9FP (Jitter Analysis/Advanced Waveform Analysis/PAM4 Analysis), also be licensed on the platform.

N1010100A SW license also allows users to perform optional features such as de-embedding of cables/fixtures. Alternatively, users may also install 86100D/N1010A-SIM InfiniiSim Waveform Transformation Toolset licenses to enable de-embedding on an DCA-X/DCA-M platform. See Oscilloscope compatibility section for more details.

Keysight Oscilloscopes

Multiple form factors from 20 MHz to > 110 GHz | Industry leading specs | Powerful application



Learn more at: www.keysight.com

For more information on Keysight Technologies’ products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

KEYSIGHT TECHNOLOGIES