N109228CA OIF CEI 3.1

Compliance and debug application for N1000A/86100D DCA-X and N109X DCA-M oscilloscopes

Reduce Your OIF CEI 3.1 Test Times from Hours to Minutes

KEYSIGHT

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Introduction

Rapidly increasing worldwide demand for video and data transfer is placing new requirements for network expansion. Designers are creating innovative network elements that allow up to 100 Gb/s, which will be delivered using four lanes of 25 to 28 Gb/s. Extra challenges abound when transferring these signals on printed circuit boards, even for short distances. The Implementation Agreement for Optical Internetworking Forum Common Electrical Interface (OIF CEI) specifies the tests and limits for these devices.

These parameters can take a full day when characterized manually, and the recalculation of factors and CTLE values adds to the time the designer spends on testing. Keysight Technologies, Inc. has created the N109228CA OIF CEI 3.1 Compliance and Debug Application for you to simplify measurement of these transmitter parameters and to obtain full results to test limits in a few minutes. This will keep you focused on getting your products to market knowing that your results are built on the heritage and consistency of Keysight measurement technology.

Easy-to-use compliance application that enables you to:

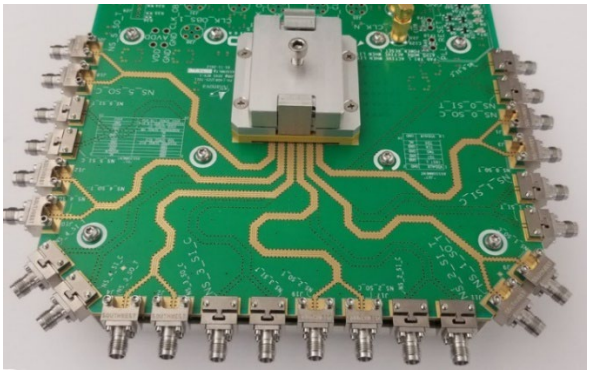
The N109228CA is an easy-to-use electrical TX test application that:

- Quickly set up equipment and make transmitter measurements
- Test your device to compliance or chosen limits
- Debug your device using custom configurations
- Remove effects of cables and fixtures
- Automatically determine optimal value of CTLE Peaking
- Generate reports to share with others

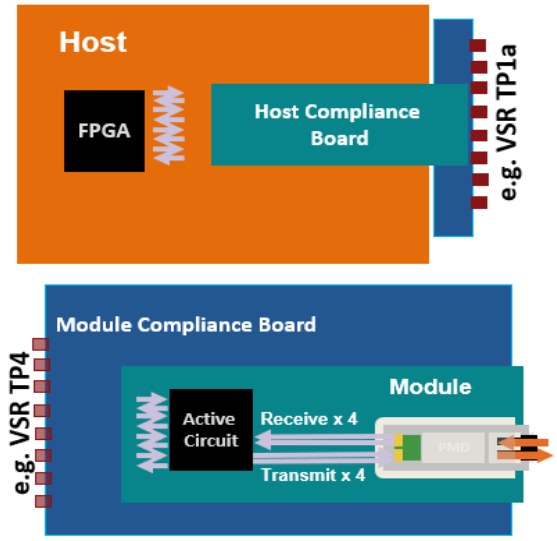
Transform Complexity into Simplicity

Satisfying the broad requirements of the OIF CEI Implementation Agreements can be very complex. The data rates for each interface have a range, rather than a fixed rate common to many standards. The test list between each OIF CEI interface varies as do the test limits; some limits depend upon previous measurements to perform the final calculations. Designers need to satisfy requirements on highly-advanced integrated circuits, host boards and modules when operating over long, medium, short and very short reaches. An extract from the 28G-SR specification table from the OIF CEI Implementation Agreement below.

Characteristics	Symbol	MIN	TYP	MAX	UNIT
Baud rate	T-Baud	19.90		28.05	Gsym/s
Output differential voltage	T_Vdiff	800		1200	mVppd
Differential resistance	T_Rd	80	100	120	Ω
Differential termination resistance mismatch (see table 1 to 3)	T_Rdm			10	%
Output rise and fall time (20% to 80%)	T_tr, T_tf	8			ps
Common mode noise	T_Ncm			12	mVrms
Differential output return loss	T_SDD22			-12	dB
Common mode output return loss	T_SCC22 (Below 10 GHz)			-4	dB
	T_SCC22 (10 GHz to baud rate)			-4	dB
Output common mode voltage	T_Vcm	-100		1700	mV

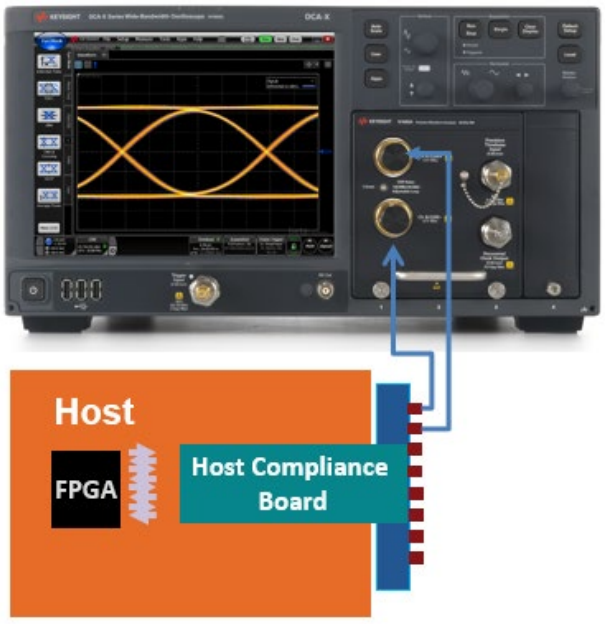


Development and characterization of advanced integrated circuits is time-consuming and expensive. Designers utilize test boards similar to the one shown above to fully characterize their parts for use in their own circuits or in their customer's circuits.



Hosts and modules have unique interface connectors and require compliance boards to enable connection to test equipment as shown here. Designers endeavor to minimize the trace lengths on the compliance boards and cable lengths.

The N109228CA software will control the N1000A/86100D DCA-X, N109X DCA-M, or PNA/TDR and readily measure your device.



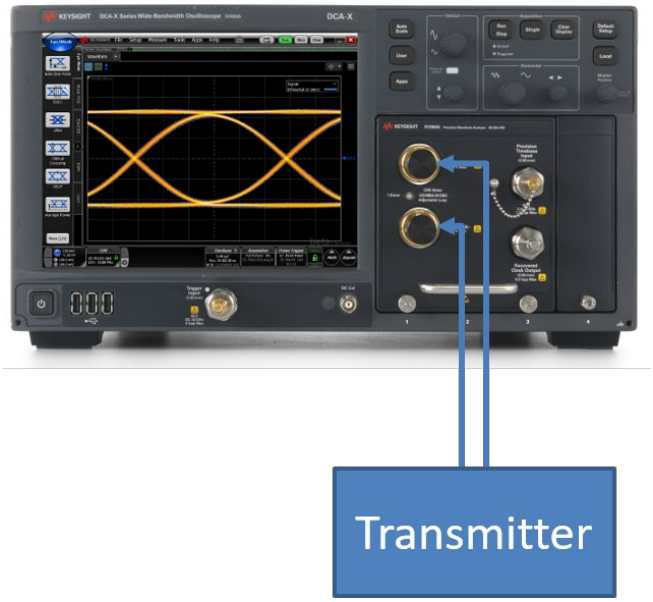
By pairing your test fixture or compliance board with the N1000A/86100D, 86108B and N109228CA software, you will have the simplest and most powerful solution available to optimize your designs and offer the best products to customers. Phase trimmers and a pair of cables complement your set up for the most consistent and accurate measurements. You can easily remove the effects of cables or fixtures through intuitive Configure choices.

The N109228CA software also supports a variety of other DCA configurations (see ordering guide), including the N1094A DCA-M oscilloscope and N1076B Electrical Clock Recovery.

Debug and Verify Your Designs Quickly and Easily

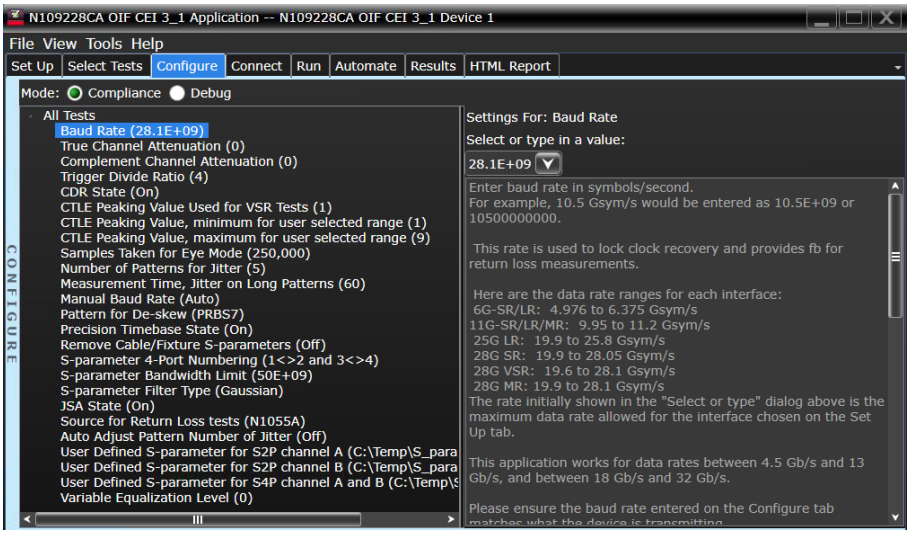
Choose your hardware

Configure your oscilloscope for an integrated “one-box” solution (shown below) or a multi-module solution with external clock recovery (see ordering guide). Also have the PNA available for return loss and differential to common mode measurements.



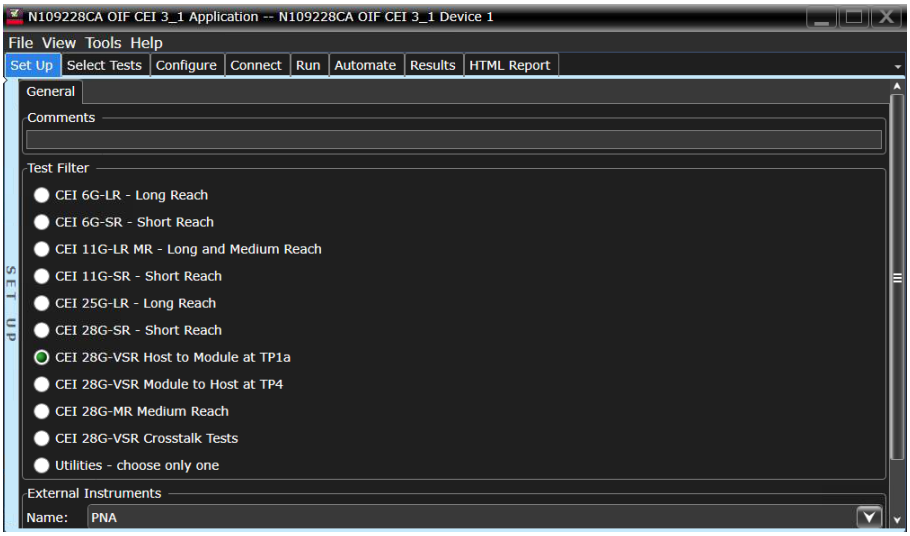
Configure your measurements

Customize parameters that are specific to your set-up such as baud rate and attenuation. Use default values or enter your own for settings such as number of samples or patterns taken and peaking for CTLE. Choose Compliance mode to test within compliance limits and choose Debug mode to test to your custom limits.



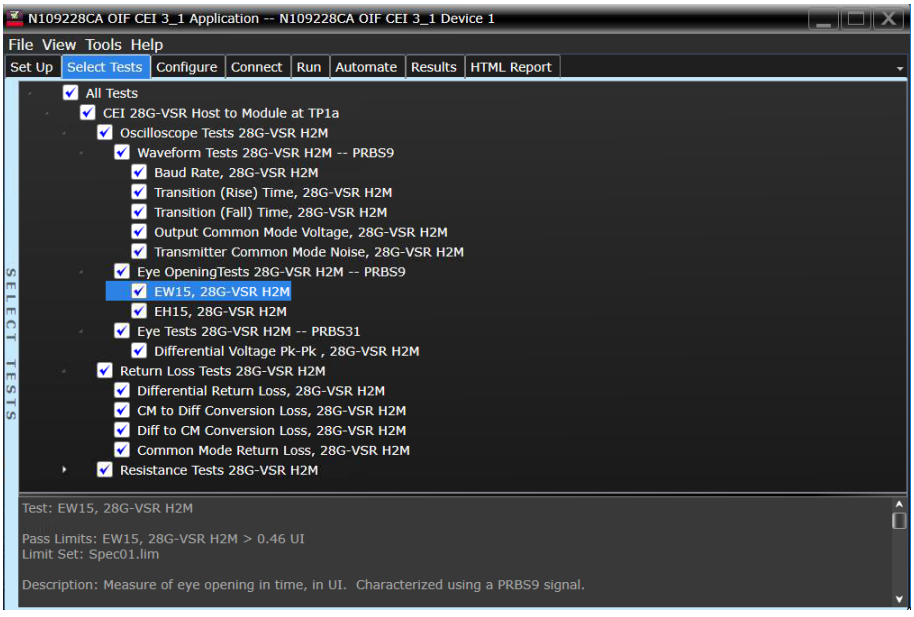
Select any OIF CEI interface

The N109228CA OIF CEI Compliance Application covers all nine OIF CEI 3.1 interfaces, which include rates from 4.9 Gb/s to 28.1 Gb/s. Click on the desired interface and the appropriate tests are offered in Select Tests.



Choose from over 140 tests

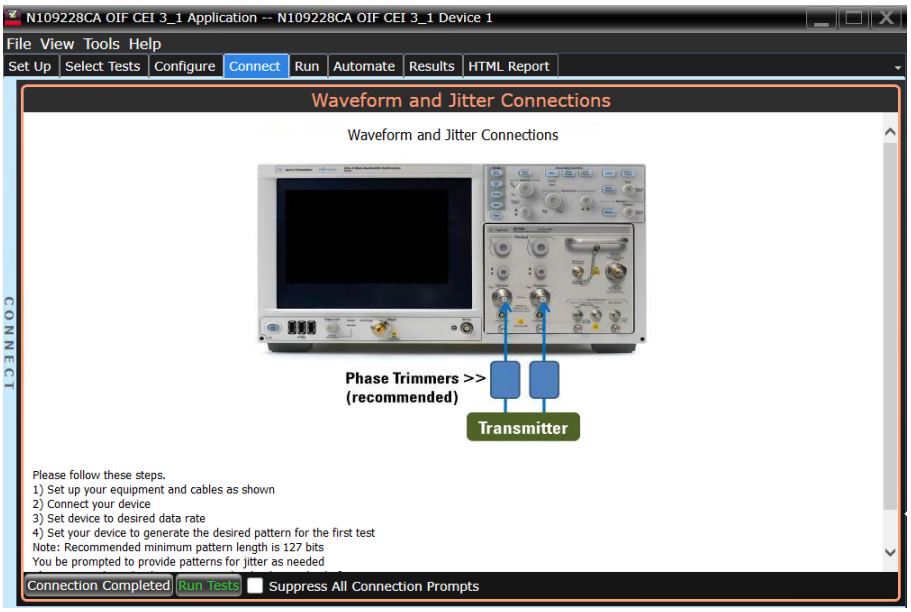
All tests required for each of the eight interfaces are available. You may click on all tests, a group of tests or individual tests. The full test name appears in the test list, and it is also displayed in the test results and reports. A description of the test and reference to the CEI Implementation Agreement are shown for each test.



Measure challenging parameters fast

Simply follow the steps and click Run Tests. The N109228CA and the DCA will automatically measure your device.

Use a wide range of modules such as the N1060A/86108B, N1045A/B and N1055A, as well as the DCA-M oscilloscope. Characterize jitter for PRBS31 signals with integrated Option 401 or the N1010100A R&D package. Remove the effects of cables and fixtures by using convenient Configure choices.



Obtain concise compliance report

Users and customers are interested in the performance of your device. Share a report that shows the test conditions, summary of pass/fail, summary of all tests, and details for each test. Many include an appropriate screen shot of the measured parameter

Test Report

Pass

Test Configuration Details	
Application	
Name	N109228CA N109228CA OIF CEI 3_1
Version	4.14.3256.0
Test Session Details	
FlexDCA SW Version	P.06.40.415
DCA Model Numbers	Frame: N1000A , Slot1: N1060A , Slot2: Not Present , Slot3: Not Present , Slot4: Not Present
DCA Serial Numbers	Frame: MY58400160 , Slot1: US57380074 , Slot2: XXXXXXXXXX , Slot3: XXXXXXXXXX , Slot4: XXXXXXXXXX
Debug Mode Used	No
Compliance Limits	Spec01.lim (official)
Last Test Date	2019-08-02 17:26:11 UTC -07:00

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Summary of Results

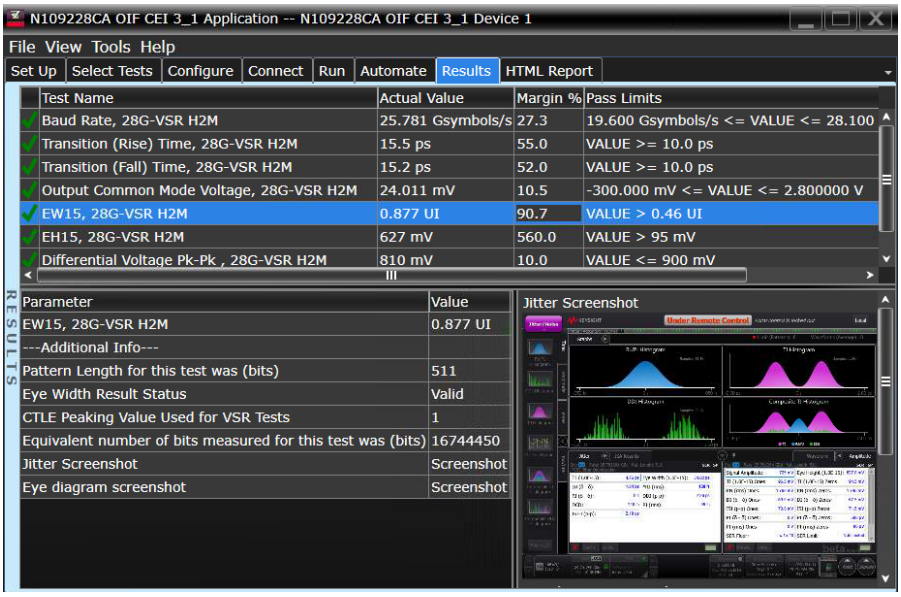
Test Statistics	
Failed	0
Passed	7
Total	7

Margin Thresholds	
Warning	< 5 %
Critical	< 0 %

Pass	# Failed	# Trials	Test Name (click to jump)	Actual Value	Margin	Pass Limits
✓	0	1	Baud Rate, 28G-VSR H2M	25.781 Gsymbols/s	27.3	19.600 Gsymbols/s <= VALUE <= 28.100 Gsymbols/s
✓	0	1	Transition (Rise) Time, 28G-VSR H2M	15.5 ps	55.0	VALUE >= 10.0 ps
✓	0	1	Transition (Fall) Time, 28G-VSR H2M	15.2 ps	52.0	VALUE >= 10.0 ps
✓	0	1	Output Common Mode Voltage, 28G-VSR H2M	24.011 mV	10.5	-300.000 mV <= VALUE <= 2.800000 V
✓	0	1	EW15, 28G-VSR H2M	0.877 UI	90.7	VALUE > 0.46 UI
✓	0	1	EH15, 28G-VSR H2M	627 mV	560.0	VALUE > 95 mV
✓	0	1	Differential Voltage Pk-Pk , 28G-VSR H2M	810 mV	10.0	VALUE <= 900 mV

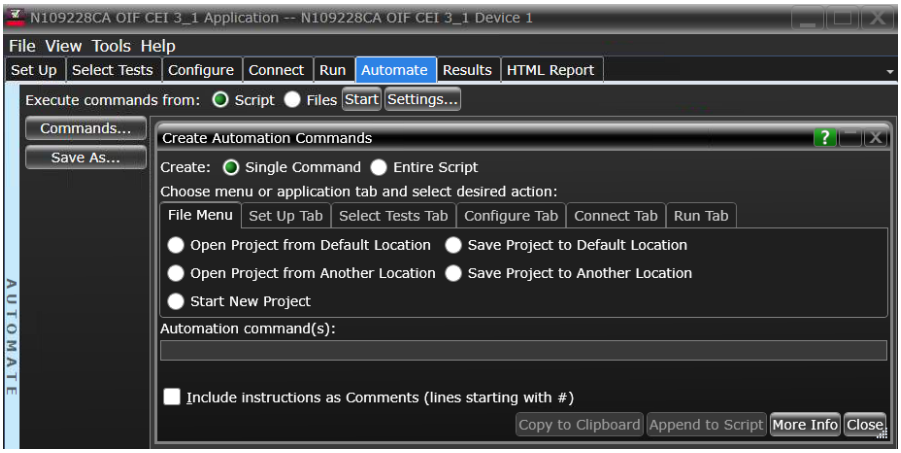
See device performance in one view

In a few minutes, you'll have test results showing which parameters passed or failed, and the margin compared to limits. These results will provide immediate insights into how you'll need to improve your design to meet the challenging tests in the OIF CEI 3.1 Implementation Agreements.



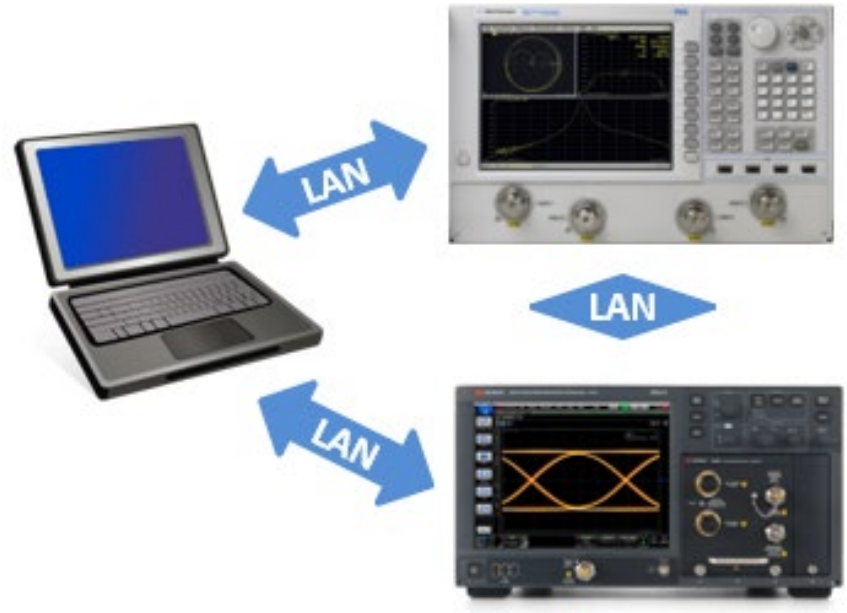
Control your device or other equipment

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



More Features to Further Streamline Your Development

The hardware and software architecture provide wide flexibility. You may install FlexDCA and the N109228CA on the oscilloscope, both on your PC or split between them. This enables you to use your PC for more processing power and other applications, or to have all measurement capability consolidated into a compact solution. The PNA can be controlled by the PC or by the DCA.



Choose CTLE peaking automatically

Enjoy the convenience of the N109228CA determining the optimal value of CTLE (continuous time linear equalizer) peaking, which is required by the CEI 28G Very Short Reach for the Host-to-Module interface. The values for gain, zero and poles are calculated for you and used in the optimization.

Optimize Eye Opening for VSR, user selected range of peaking values

Reference: IA # OIF-CEI-03.1, Section 13.3.11

Test Summary: Info Test Description: This utility determines optimal eye width and height, and reports the corresponding value of CTLE Peaking; enter this value on the Configure tab. TP1a may use a value from 1 to 9 dB.

Pass Limits: Info Only Peaking for optimal eye width and height opening, user range 1 dB

Result Details

Table Data (See table)

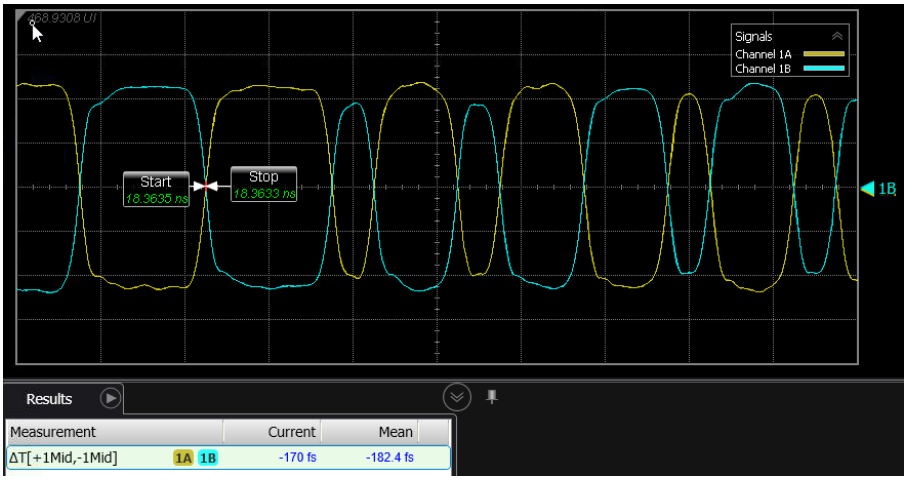
Trial 1

Table Data

CTLE Peaking in dB	EW15 in UI	EH15 in V	EW15*EH15	VEC in dB
1	0.878	0.628	0.551	1.3
2	0.866	0.566	0.490	1.7
3	0.854	0.503	0.430	2.4
4	0.841	0.448	0.376	3.0
5	0.827	0.401	0.331	3.7
6	0.817	0.355	0.290	4.5
7	0.803	0.319	0.256	5.1
8	0.792	0.282	0.224	6.0
9	0.781	0.250	0.195	6.8

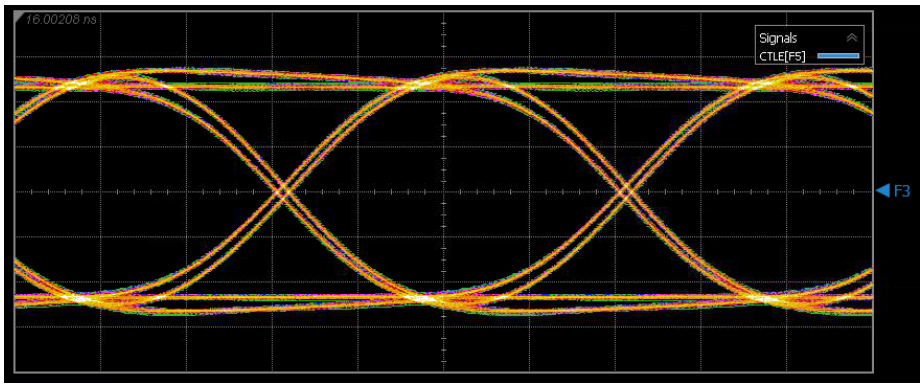
Conveniently de-skew your channel

Skew between the true and complement signals can degrade your measured performance. While you need to characterize performance with DUT skew included, the N109228CA guides you to quickly de-skew your cables or remote heads for best results.



…….or manually select the CTLE peaking

The CEI 28G Very Short Reach Module-to-Host interface requires a peaking value of 1 dB or 2 dB. Select the value from the manual utility. Whether automatic or manual, you'll put your best eye forward for your customers.



Characterize Over 140 Parameters

The OIF CEI 3.1 Implementation Agreement includes many challenging tests. The table below shows the nine interfaces and the tests required for each interface. The N109228CA measures all of these parameters; empty cells indicate that parameter is not required for that interface.

	Parameter	CEI-6G-SR	CEI-6G-LR	CEI-11G-SR	CEI-11G-LR/MR	CEI-28G-SR	CEI-25G-LR	CEI-28G-VSR H2M/M2H	CEI-28G MR
Measured on DCA	Baud rate	6.4.1	7.4.1	8.3.1	9.3.1	10.3.1	11.3.1	13.1	14.3.1
	Rise times / fall times	6.4.1	7.4.1	8.3.1	9.3.1	10.3.1	11.3.1	13.3.2 / 3	14.3.1
	Differential output voltage		7.4.1	8.3.1	9.3.1	10.3.1	11.3.1	13.3.2 / 3	14.3.1
	Output common mode voltage	6.4.1	7.4.1	8.3.1	9.3.1	10.3.1	11.3.1	13.3.2 / 3	14.3.1
	Single-ended output voltage								14.3.1
	Transmitter common mode noise	6.4.1	7.4.1	8.3.1	9.3.1	10.3.1	11.3.1	13.3.2 / 3	14.3.1
	Eye mask	6.4.1	7.4.1	8.3.1	9.3.1				
	Uncorrelated unbounded Gaussian jitter (RJ)			8.3.1	9.3.1	10.3.1	11.3.1		14.3.1
	Uncorrelated bounded high probability jitter	6.4.1	7.4.1	8.3.1	9.3.1	10.3.1	11.3.1		14.3.1
	Duty cycle distortion	6.4.1	7.4.1	8.3.1	9.3.1	10.3.1	11.3.1		
	Total jitter	6.4.1	7.4.1	8.3.1	9.3.1	10.3.1	11.3.1		14.3.1
	Even-odd jitter								14.3.1
	UUGJ – FIR off and on					12.1	12.1		
	UBHPJ – FIR off and on					12.1	12.1		
	DCD – FIR off and on					12.1	12.1		
	Total jitter – FIR off and on					12.1	12.1		
	Eye width (EW15)							13.3.2 / 3	
	Eye height (EW15)							13.3.2 / 3	
	Vertical eye closure								
	Jitter transfer BW			8.4					
	Jitter transfer peaking			8.4					

	Parameter	CEI-6G-SR	CEI-6G-LR	CEI-11G-SR	CEI-11G-LR/MR	CEI-28G-SR	CEI-25G-LR	CEI-28G-VSR H2M/M2H	CEI-28G MR
PNA	Differential output return loss	6.4.1	7.4.1	8.3.1	9.3.1	10.3.1	11.3.1	13.3.2 / 3	14.3.1
	Common mode output return loss	6.4.1	7.4.1	8.3.1	9.3.1	10.3.1	11.3.1		14.3.1
	CM to differential conversion loss							13.3.2 / 3	
	Differential to CM conversion loss							13.3.2 / 3	
	Differential resistance	6.4.1	7.4.1	8.3.1	9.3.1	10.3.1	11.3.1		14.3.1
	Differential termination mismatch			8.3.1	9.3.1	10.3.1	11.3.1	13.3.2 / 3(1 MHz)	14.3.1

Choosing Industry Leading Solutions

Keysight offers a wide range of electrical and optical test solutions to address current and emerging communications standards. For OIF-CEI-3.1, you may choose a hardware combination that addresses your test needs for today, and into the future:

1. N1000A/86100D DCA-X with 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

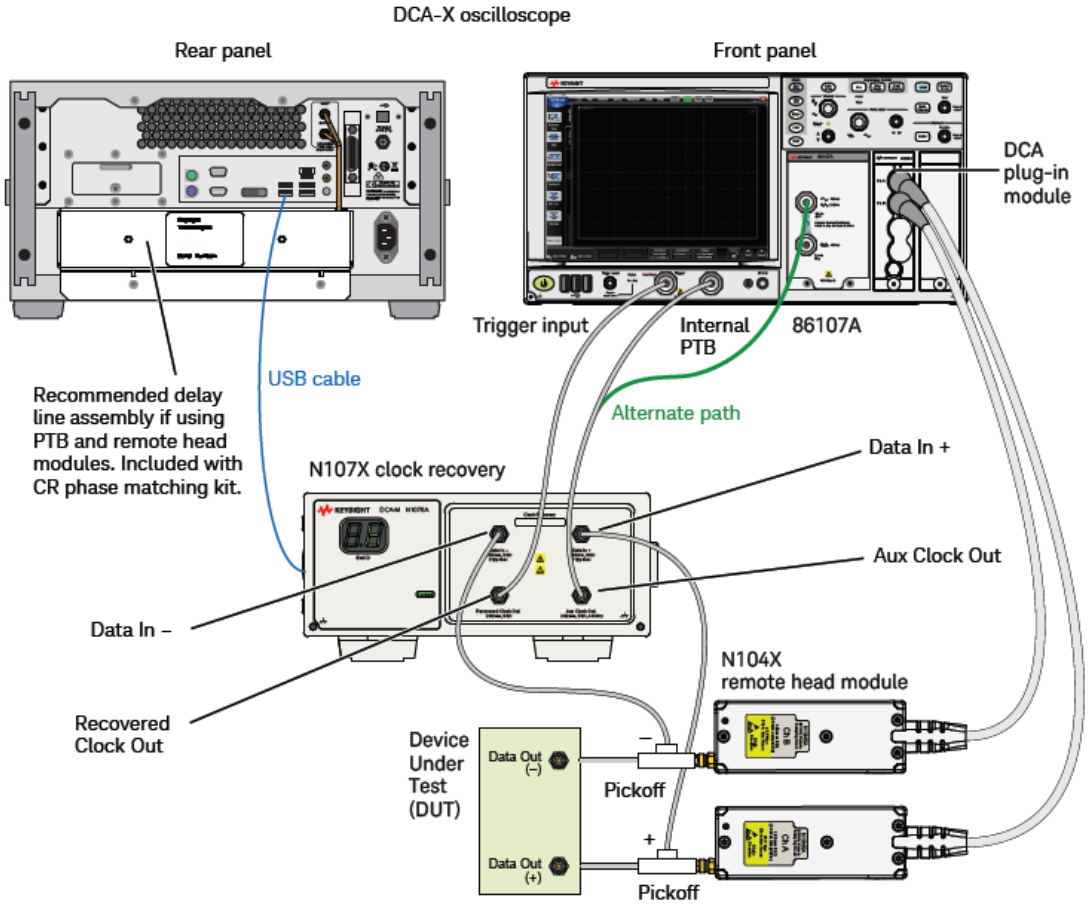
Solution 1: Keysight N1000A/86100D DCA-X mainframe + N1060A/86108B “MegaModule” (recommended)

- Highest accuracy
- Easy setup
- Integrated solution

TX Test using Digital Communications Analyzer (DCA)	**Mainframe model number**	**Mainframe hardware options**	**Mainframe software options (fixed or transportable licenses)**
	N1000A DCA-X (or 86100D DCA-X)	Required: STR, PLK (N1000A), ETR (86100D)	Required: N1010100A or legacy 200,201,401
		Optional: LOJ/PTB (not used with 86108B)	Optional: Legacy SIM (for de-embedding cables)
	Plug-in module model number	**Plug-in module options**	**Max # of modules/diff channels**
	N1060A (or 86108B)	216/050 (or 216/LBW) for CEI 6G/11G	1/1
		232/050 (or 232/HBW) for CEI 6G/11G/25G/28G	
	Software		
	N109228CA	Electrical TX Test SW for OIF-CEI-3.1	
	N1010A	FlexDCA FW Rev 6.4 or later (included with N1000A/86100D mainframe)	
	Keysight IO Libraries	Rev 16.3 or later, automatically installed with FlexDCA installation	
	Accessories		
	N1060A 86108B-PT2, 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, N9398F, or N9399F	DC blocks, 50 GHz (Qty 2)	
	86108B-DC3, N9398C, N9399C or 11742A	DC blocks, 26.5 GHz (Qty 2)	
	N1060A-CA2 or 86108B-CA3	Matched cable set (Qty 1)	
Impedance Measurements	**Module number (Pick ONE)**	**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 legacy 202.	
	Performance Network Analyzer (PNA)	Any 4-port model with frequency range of at least 12 GHz	

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

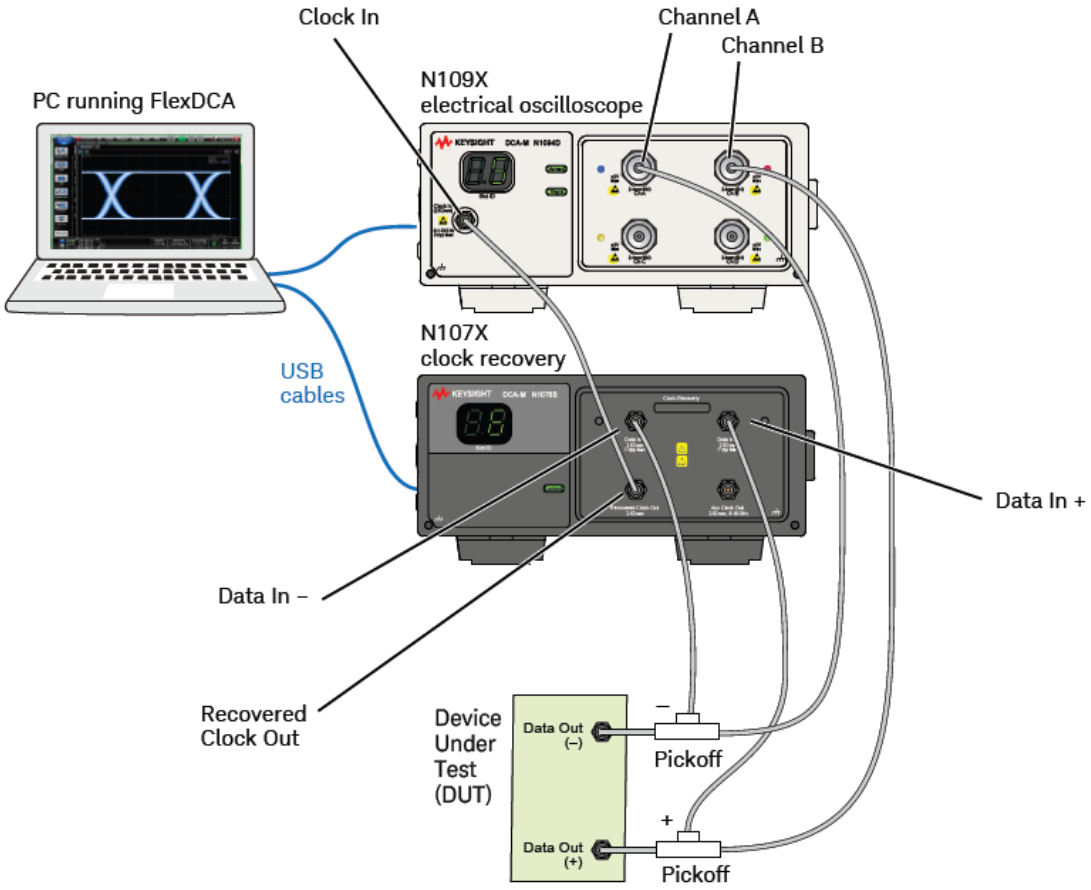
TX Test using Digital Communications Analyzer (DCA)

	Mainframe hardware options	Mainframe software options (fixed or transportable licenses)
N1000A DCA-X (or 86100D DCA-X)	Required: PLK/LOJ/PTB (N1000A), ETR/PTB (86100D) parentheses	Required: N1010100A or legacy 200,201,401
		Optional: Legacy SIM (for de-embedding cables)
Plug-in module model number (Pick ONE)	**Plug-in module options**	**Max # of modules/diff channels**
86112A	Any	2/2
86117A	Any	2/2
86118A	H01	2/2
54754A	Any	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 number (Pick ONE)	**Clock recovery options (Pick ONE; Option 232 or higher required for CEI 25G/28G)**	
N4877A	216/232	
N1076A	216/232	
N1076B	216/232/264	
N1077A	216/232	
N1078A	216/232/264	
Software		
N109228CA	Electrical TX Test SW for OIF-CEI-3.1	
N1010A	FlexDCA FW Rev 6.4 or later (included with N1000A86100D mainframe)	
Keysight IO Libraries	Rev 16.3 or later, automatically installed with FlexDCA installation	
86100DU-400	PLL and Jitter Transfer SW (a “no cost” download from www.keysight.com/find/jtf)	
Accessories		
N1027A-76B (recommended)	Clock Recovery Phase Matching Kit for use with N104XA remote head and external N4877A/N107X clock recovery	

	N1027A-76A	Clock Recovery Phase Matching Kit for use with N104XA remote head and external N4877A/N107X clock recovery
	N1027A-MC1	Clock Recovery Phase Matching Kit for use with N104XA remote head and external N4877A clock recovery
	N1027A-2P2	Pick-Off Tees (Qty 2), for remote head modules with 1.85 mm/2.4 mm connectors (N1045A, 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)
	N1027A-PT3	Phase trimmers, 26.5 GHz (Qty 2), for 54754A/861XX DCA modules with 3.5 mm connectors (54754A, 86112A)
	N9398F or N9399F	DC block, 50 GHz (Qty 2)
	N9398C, N9399C or 11742A	DC block, 26.5 GHz (Qty 2)
Impedance Measurements	**Model number (Pick ONE)**	**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 legacy 202.
	Performance Network Analyzer (PNA)	Any 4-port model with frequency range of at least 12 GHz

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

TX Test using Digital Communications Analyzer (DCA)	**Software model number (for user-supplied PC)**	**Software options (Install on PC, or purchase fixed SW licenses for the DCA-M)**	
	N1010A FlexDCA	Required: N1010100A or legacy 200, 201, 401	
		Optional: Legacy SIM (for de-embedding cables)	
	Model number (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 number (Pick ONE)	**Clock recovery options (Pick ONE; Option 232 or higher required for CEI 25G/28G)**	
	N4877A	216/232	
	N1076A	216/232	
	N1076B	216/232/264	
	N1077A	216/232	
	N1078A	216/232/264	
	Software		
	N109228CA	Electrical TX Test SW for OIF-CEI-3.1	
	N1010A	FlexDCA FW Rev 6.4 or later (included with N1000A/86100D mainframe)	
	Keysight IO libraries	Rev 16.3 or later, automatically installed with FlexDCA installation	
	86100DU-400	PLL and Jitter Transfer SW (a “no cost” download from www.keysight.com/find/jtf)	

	Accessories [1] [2]	
Impedance Measurements	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)
	N9398F or N9399F	DC block, 50 GHz (Qty 2)
	N9398C, N9399C or 11742A	DC block, 26.5 GHz (Qty 2)
	Model number (Pick ONE)	**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 legacy 202
	Performance Network Analyzer (PNA)	Any 4-port model with frequency range of at least 12 GHz

1. For more information on this hardware configuration, including clock-to-data delay matching, refer to the Keysight N1076A/B, N1077A, and N1078A Clock Recovery DCA-M User Guide.
2. No clock-to-data delay phase matching kit is available for this hardware configuration.

Ordering Information

The N109228CA Electrical TX Test SW for OIF-CEI-3.1 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 Region[1]:** Americas; Europe; Asia;
    c. **Worldwide:** export restriction identified in END User License Agreement (EULA)

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)

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).

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- Software subscription licenses include KeysightCare Software Support through the term of the license

For more information, visit: KeysightCare Software Support Subscriptions, 5992-3419EN.

Required Software Options

The N109228CA software requires that the N1010100A R&D Package (or equivalent legacy licenses, see equipment configuration tables above) be licensed on the platform.