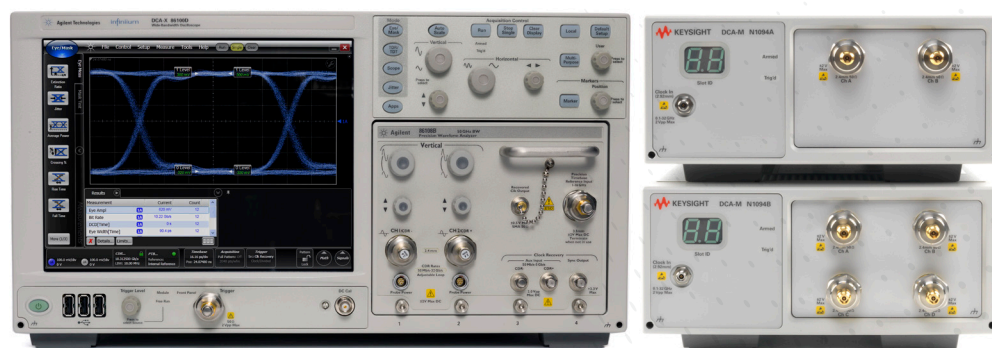


IEEE 802.3 Ethernet Compliance and Debug Applications

For 86100D DCA-X and N109X DCA-M Oscilloscopes



Introduction

Easy-to-use oscilloscope application that lets you:

- Save time in understanding details of standards
- Reduce your IEEE 802.3 test times from hours to minutes
- Debug your device using custom configurations
- Characterize up to 10 lanes in multi-lane devices

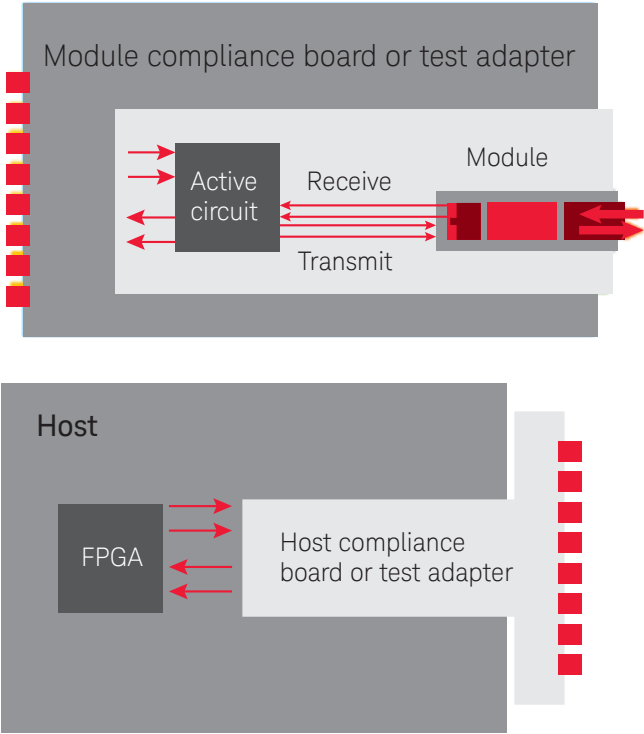
The greatly increased worldwide demand for video and data transfer has created new requirements for network expansion, driving innovative network elements for operation up to 100 Gb/s. New designs are facing more challenges while transferring these signals on printed circuit boards within hosts and modules, even for short distances. Measuring the IEEE 802.3 parameters can take a full day when manually characterized, and recalculating factors and equation-driven limits adds to the time the designer spends on testing.

Keysight Technologies, Inc. created the N1081A, N1082A, N1083A and N1084A IEEE 802.3 Compliance and Debug Applications to simplify measuring 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.

Transform Complexity into Simplicity

Satisfying the comprehensive requirements of the IEEE 802.3 clauses can be very complex. The list of tests and test conditions vary from clause to clause, and each can be challenging to properly set up. The tests for each IEEE 802.3 clause vary, as do the test limits. An example of one group of tests from clause 93 is below. The time for your test development team to read and interpret the specification and then implement that understanding into test plans can take several months of effort.

Parameter	Subclause reference	Value	Units
Signaling rate	93.8.1.2	25.78125 ± 100 ppm	GBd
Differential peak-to-peak output voltage (max.)	93.8.1.3		
– Transmitter disabled		30	mv
– Transmitter enabled		1200	mv
DC common-mode output voltage (max.)	93.8.1.3	1.9	V
DC common-mode output voltage (min.)	93.8.1.3	0	V
AC common-mode output voltage (RMS, max.)	93.8.1.3	12	mV
Differential output return loss (min.)	93.8.1.4	Equation (93-3)	dB
Common-mode output return loss (min.)	93.8.1.4	Equation (93-4)	dB



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

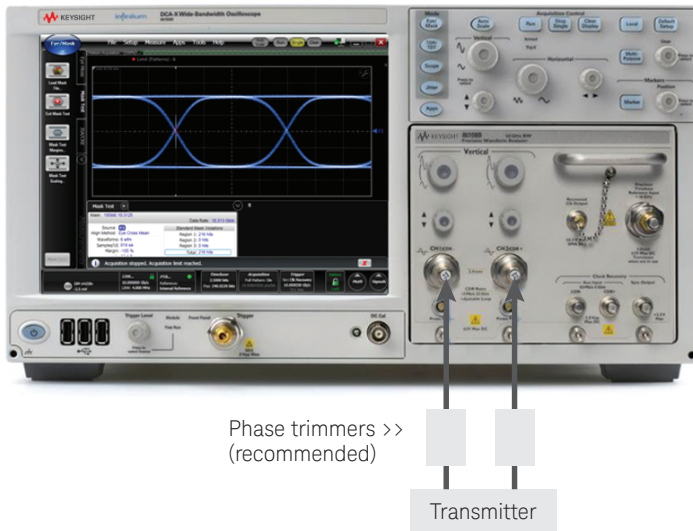
The N108xA software also supports a variety of other DCA configurations (see ordering guide), including the N1094A DCA-M oscilloscope and N1076B Electrical Clock Recovery.

Debug and Verify Your Designs Quickly and Easily

The N1012A software will control the 86100D DCA-X, N109X DCA-M, or ENA/PNA/TDR and readily measure your device.

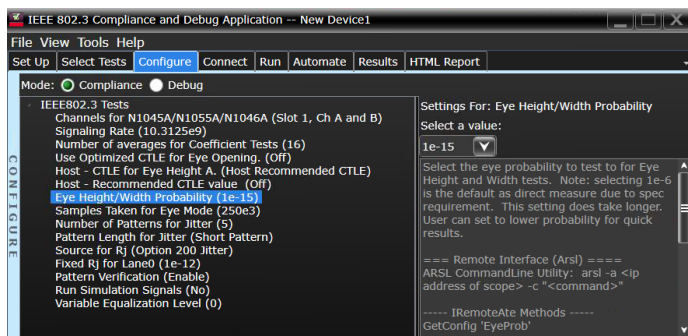
Select industry-leading hardware

Configure your oscilloscope for a single module (as below) or multi-module (listed in ordering guide). Connect your device through the recommended phase trimmers to have access to measurements with intrinsic jitter as low as 50 fs. For return loss, also connect the Economy or Performance Network Analyzer, which are controlled by the DCA-X for S-parameter measurements.



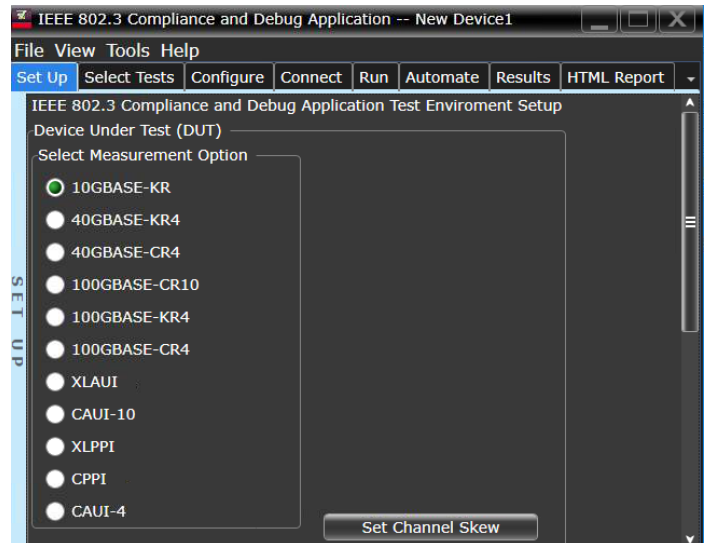
Configure your measurements

Customize parameters that are specific to your setup, such as data rate and attenuation. Use default values or enter your own settings including number of waveforms or patterns taken; type of pattern; and whether or not to remove the effects of test cables. Choose Compliance mode to test within compliance limits or choose Debug mode to test to your custom limits and adjust other test parameters.



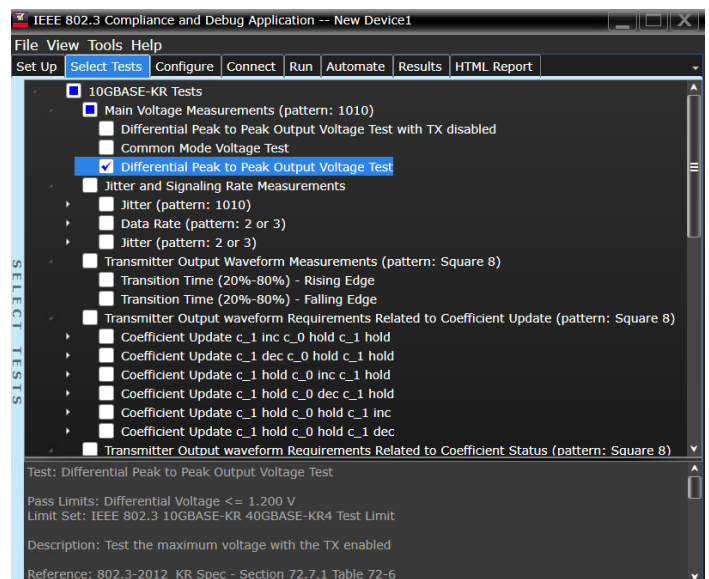
Select desired 10G/25G transmit clause

The N108xA IEEE 802.3 applications cover all transmitter tests for 12 clauses and conveniently organize the tests by clause. Click on the desired test group, and the appropriate tests are offered in Select Tests.



Choose from more than 400 tests

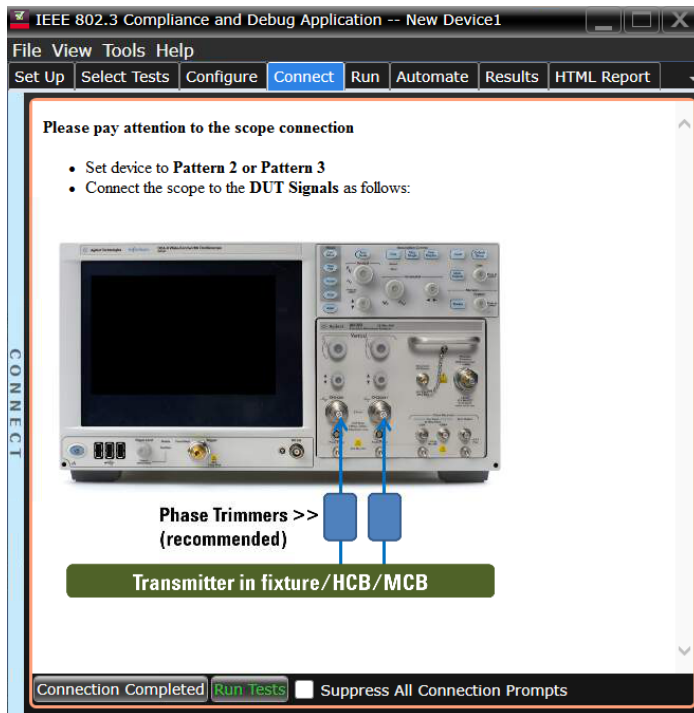
The tests required for each of the transmit and test signal groups are available. You can click on all tests, a group of tests or individual tests. The full test name appears in the test list and is shown in the test results and reports. A description of the test and reference to the IEEE 802.3 clauses are shown for each test.



Debug and Verify Your Designs Quickly and Easily (Continued)

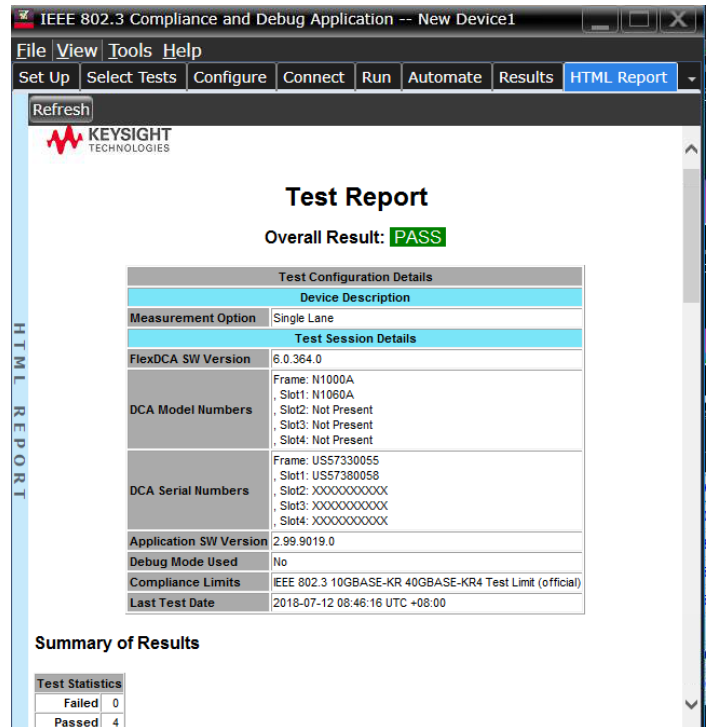
Measure challenging parameters fast

Simply follow the steps and click Run Tests. The N108xA software will control the 86100D DCA-X, N109X DCA-M, and/or ENA/PNA/TDR and readily measure your device.



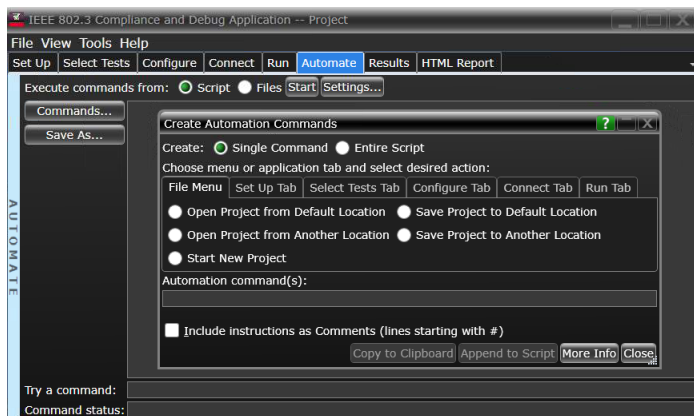
Obtain concise compliance reports

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



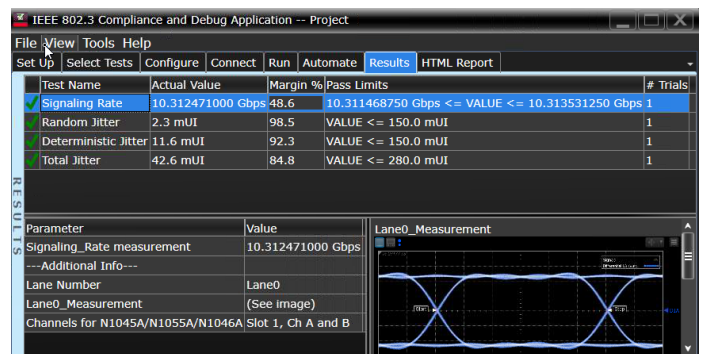
Control your device or other equipment

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



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 insight into how you'll need to improve your design to meet the challenging tests in the IEEE 802.3 clauses.

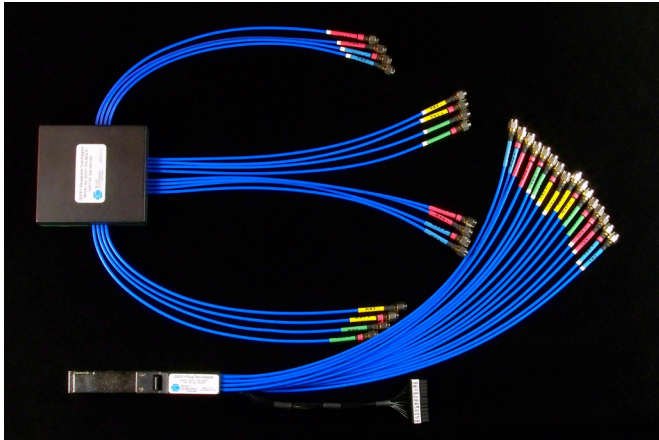


More Features to Further Streamline Your Development

Utilize test adapters

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

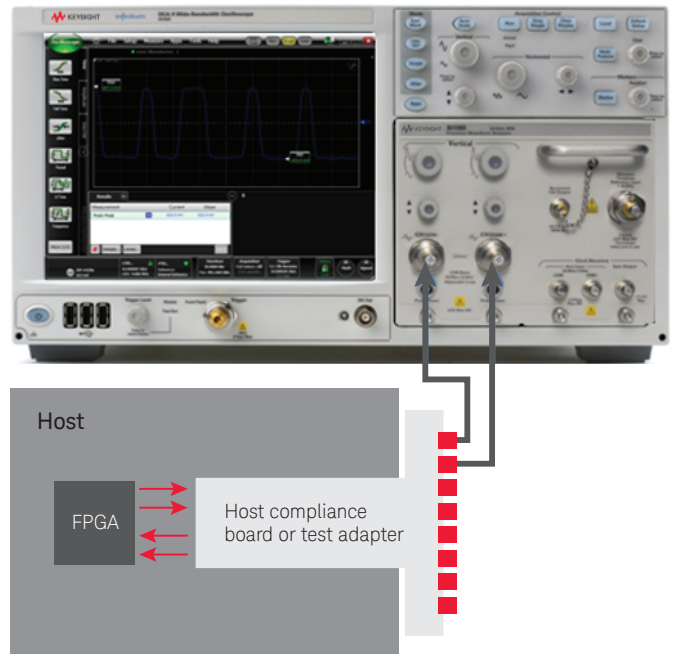
For more information about these adapters, please visit http://shop.wilder-tech.com/category_s/42.htm.



...or host and module compliance boards

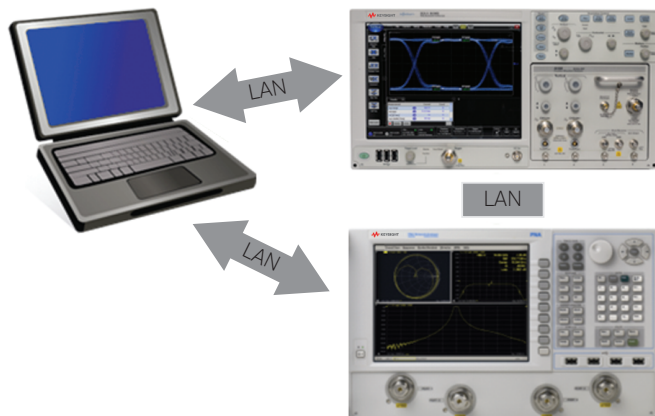
By pairing your test adapter or compliance board with the 86100D, 86108B and N108xA software, you will have the simplest and most powerful solution available to optimize your designs and offer the best products to your customers.

Phase trimmers and a pair of cables complement your setup for the most consistent and accurate measurements.



Configure your solution in three ways

The hardware and software architecture provides wide flexibility. You may install the N108xA on the mainframe, which includes FlexDCA, or the N108xA on your PC, controlling FlexDCA on the DCA, or install both N1010A FlexDCA and N108xA on your PC. 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. The ENA/PNA is controlled by the N108xA via the PC or the DCA.



Conveniently de-skew your cables

Skew between the true and complement signals will often degrade your measured performance. While you need to characterize performance with the DUT skew included, the N108xA guides you to quickly de-skew your test cables using phase trimmers or to de-skew the N1045A or 86118A-H01 remote heads for best results.



Characterize Nearly 400 Parameters

The IEEE 802.3 clauses include many challenging tests, and the table below shows each of the transmit parameters by the appropriate table number required by the standards. The N108xA applications measure all of these parameters; empty cells indicate that the parameter is not required for that clause. Several other parameters such as Energy Efficient Ethernet, coefficient update and coefficient status are also included.

Model	N1081A	N1082A		N1082A-4TP	N1083A	N1084A	
Parameter	10G-KR/ 40G-KR4	XLAUI/ CAUI-10	nPPI	CAUI-4	40G-CR4/ 100G-CR10	100G-KR4	100G-CR4
Measured on DCA							
Signaling rate	72-6	83A-1	86-2	83D-1, 83E-1, 83E-3	85-5	93-4	92-6
Transition times	72-6	83A-1, 83B-3,5	86A-1,3	83E-1, 83E-3			
Differential output voltage	72-6	83A-1, 83B-3		83D-1, 83E-1, 83E-3	85-5	93-4	92-6
Common mode DC voltage	72-6			83D-1, 83E-1, 83E-3	85-5	93-4	92-6
Common mode AC voltage		83A-1, 83B-3,5	86A-1,3	83D-1, 83E-1, 83E-3	85-5	93-4	92-6
Single-ended output voltage		83A-1	86A-1,3	83E-1			
Transmitted output waveform					85-5	93-4	92-6
Far end output noise					85-5		
Transmitter DC amplitude					85-5		92-6
Linear fit pulse				83D-1	85-5		92-6
De-emphasis		83A-1, 83B-3					
Minimum VMA		83A-1, 83B-3					
Eye mask		83A-1, 83B-3,5	86A-1,3				
Eye width				83E-1, 83E-3			
Eye height				83E-1, 83E-3			
Vertical eye closure				83E-3			
Crosstalk source VMA			86A-1,3				
Crosstalk source transition times			86A-1,3				
Random jitter	72-6			83D-1	85-5	93-4	92-6
Deterministic jitter	72-6	83A-1, 83B-3,5					
Duty cycle distortion	72-6				85-5		
Even odd jitter				83D-1		93-4	92-6
Total jitter	72-6	83A-1, 83B-3,5			85-5		
Bounded uncorrelated jitter				83D-1		93-4	92-6
J2 jitter			86A-1,3				
J9 jitter			86A-1,3				
Data dependent pulse width shrinkage			86A-1				
Signal to noise ratio			86A-1	83D-1		93-4	92-6
ENA/PNA/TDR							
Differential output return loss	72-6	83A-1, 83B-2,4	86A-1,3	83D-1, 83E-1, 83E-3	85-5	93-4	92-6
Common mode output return loss	72-6	83A-1	86A-1,3	83D-1	85-5	93-4	
CM to differential return loss				83E-1, 83E-3			92-6
CM to CM return loss							92-6

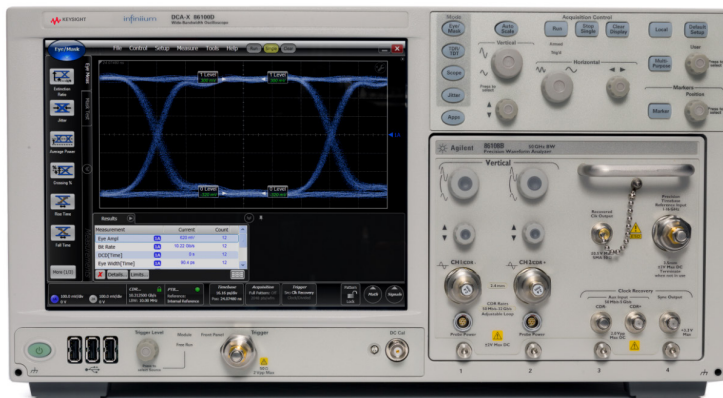
Choose Industry-Leading Solutions

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

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

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

- Highest accuracy
- Easy setup
- Integrated solution

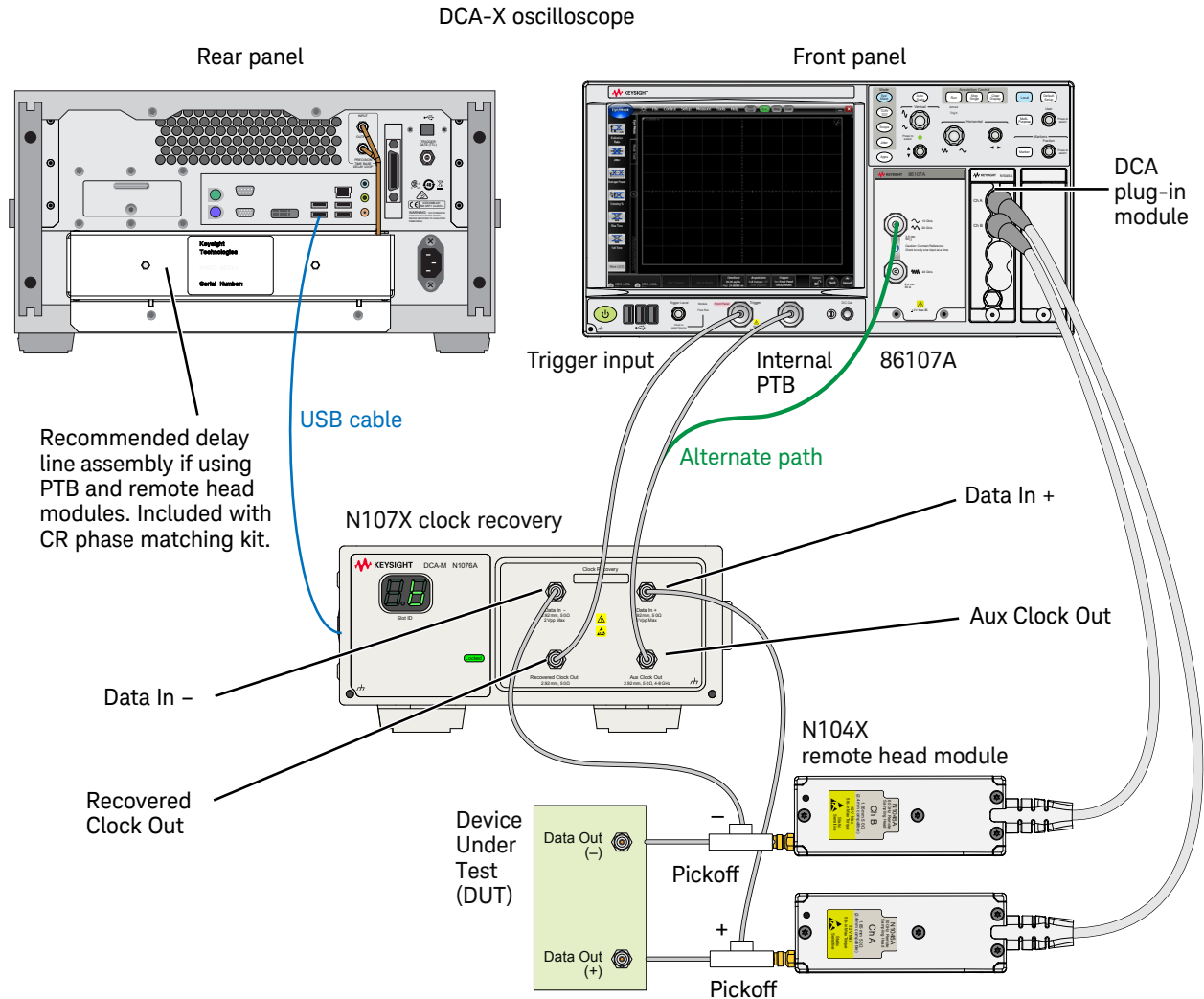


TX test using digital communications analyzer (DCA)	Mainframe model number	Mainframe hardware options	Mainframe software options (Fixed or transportable licenses)
	86100D DCA-X	Required: ETR Optional: PTB (not used with 86108B)	Required: 200, 201, 401 Optional: SIM (for de-embedding cables)
	Plug-in module model number	Plug-in module options	Max # of modules/Diff channels
	86108B	216/LBW (for 10 Gb/s rates) 232/HBW (for 10G/25/28 Gb/s rates)	1/1
	Software		
	N1081A-1TP	IEEE 802.3 10G-KR and 40G-KR4, Compliance and Debug Application	
	N1082A-1TP	IEEE 802.3 XLAUI, CAUI-10 and nPPI, Compliance and Debug Application	
	N1082A-4TP	IEEE 802.3 CAUI-4, Compliance and Debug Application	
	N1083A-1TP	IEEE 802.3 40G-CR4 and 100G-CR10, Compliance and Debug Application	
	N1084A-1TP	IEEE 802.3 100G-KR4 and 100G-CR4, Compliance and Debug Application	
Impedance measurements	N108xA-7TP	IEEE 802.3 Switch control, transportable perpetual license	
	N1010A	FlexDCA FW Rev 5.8 or later (included with 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		
	86108B-PT2, N1027A-PT2	Phase trimmers (Qty 2), for modules with 2.4 mm connectors (86108B)	
	86108B-DC2, N9399F, or N9399F	DC blocks, 50 GHz (Qty 2)	
	86108B-DC3, N9398C, N9399C or 11742A	DC blocks, 26.5 GHz (Qty 2)	
	86108B-CA2 or 86108B-CA3	Matched cable set (Qty 1)	
	Model number (Pick TDR or PNA)	Description	
N1055A TDR/TDT	35/50 GHz 2/4 Port TDR/TDT Remote Sampling Head for the 86100D DCA-X (any option)		
Network analyzer (ENA/PNA)	4-port ENA/PNA's greater than 19 GHz (e.g. N5230C 140/145, N5224A, N5244A) N1930B PLTS software		

Choose Industry-Leading Solutions (Continued)

Solution 2: Keysight 86100D DCA-X mainframe with DCA module + external clock recovery

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



Choose Industry-Leading Solutions (Continued)

Equipment configuration for solution 2: Keysight 86100D DCA-X mainframe with DCA module + external clock recovery

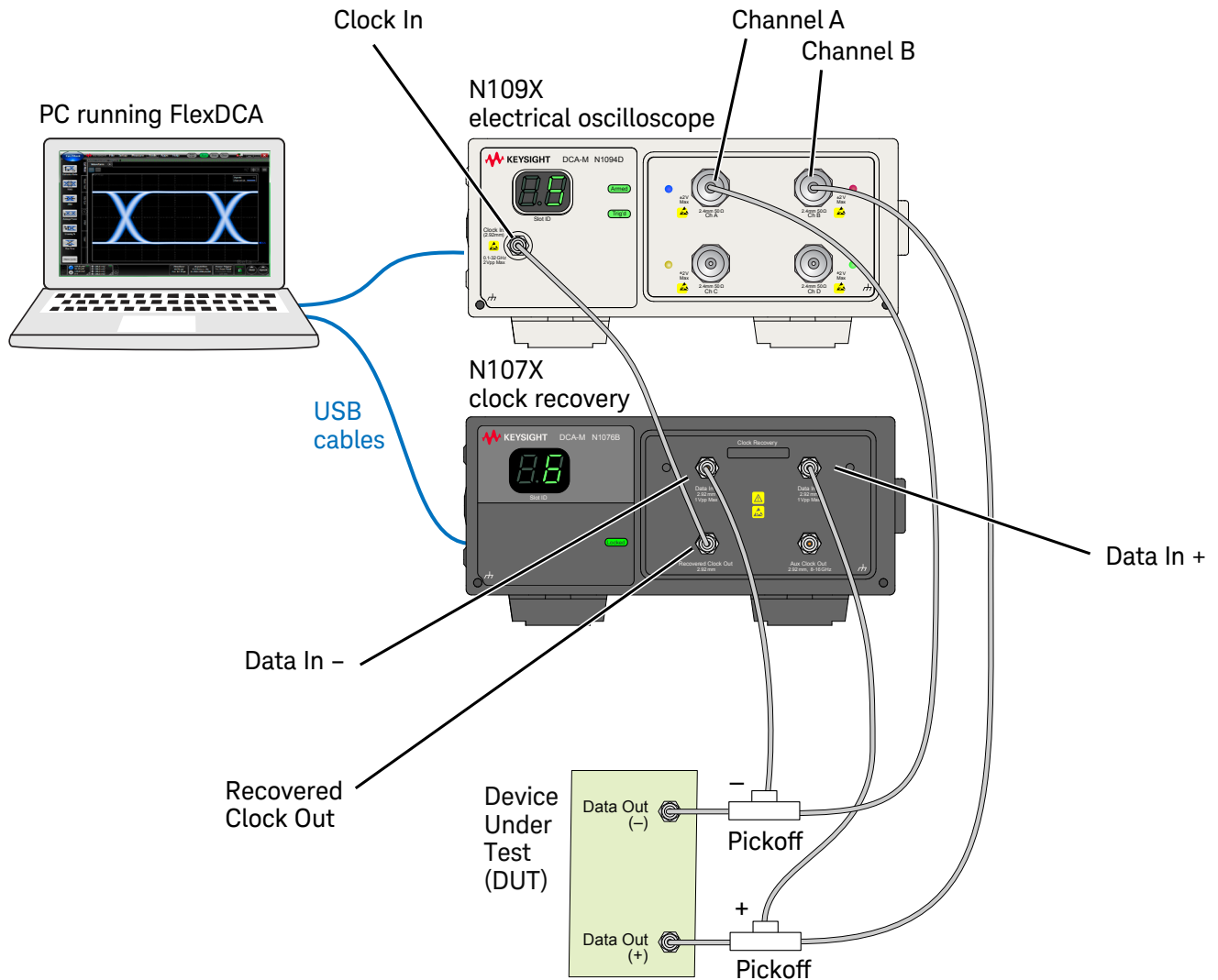
TX test using digital communications analyzer (DCA)	Mainframe model number	Mainframe hardware options	Mainframe software options (Fixed or transportable licenses)
	86100D DCA-X	Required: ETR, PTB	Required: 200, 201, 401 Optional: SIM (for de-embedding cables)
	Plug-in module model number (Pick ONE)	Plug-in module options	Max # of modules/Diff channels
	86112A (covers 10 G only)	Any	2/2
	86117A	Any	2/2
	86118A	H01	2/2
	54754A (covers 10 G only)	Any	2/2
	N1045A	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 25 G/28 G signaling rates)	
	N4877A	216/232	
	N1076A	216/232	
	N1076B	216/232/264	
	N1077A	216/232	
	N1078A	216/232/264	
	Software		
	N1081A-1TP	IEEE 802.3 10G-KR and 40G-KR4, Compliance and Debug Application	
	N1082A-1TP	IEEE 802.3 XLAUI, CAUI-10 and nPPI, Compliance and Debug Application	
	N1082A-4TP	IEEE 802.3 CAUI-4, Compliance and Debug Application	
	N1083A-1TP	IEEE 802.3 40G-CR4 and 100G-CR10, Compliance and Debug Application	
	N1084A-1TP	IEEE 802.3 100G-KR4 and 100G-CR4, Compliance and Debug Application	
	N108xA-7TP	IEEE 802.3 Switch control, transportable perpetual license	
	N1010A	FlexDCA FW Rev 5.8 or later (included with 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		
	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)		
N9399F, N9399F	DC block, 50 GHz (Qty 2)		
N9398C, N9399C or 11742A	DC block, 26.5 GHz (Qty 2)		
Impedance measurements	Model number (Pick TDR or PNA)	Description	
	N1055A TDR/TDT	35/50 GHz 2/4 Port TDR/TDT Remote Sampling Head for the 86100D DCA-X (any option)	
	Network analyzer (ENA/PNA)	4-port ENA/PNA's greater than 19 GHz (e.g. N5230C 140/145, N5224A, N5244A) N1930B PLTS software	

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

Choose Industry-Leading Solutions (Continued)

Solution 3: Keysight N109X electrical DCA-M + external clock recovery

- Flexible configuration
- Lowest cost
- Scalable



Choose Industry-Leading Solutions (Continued)

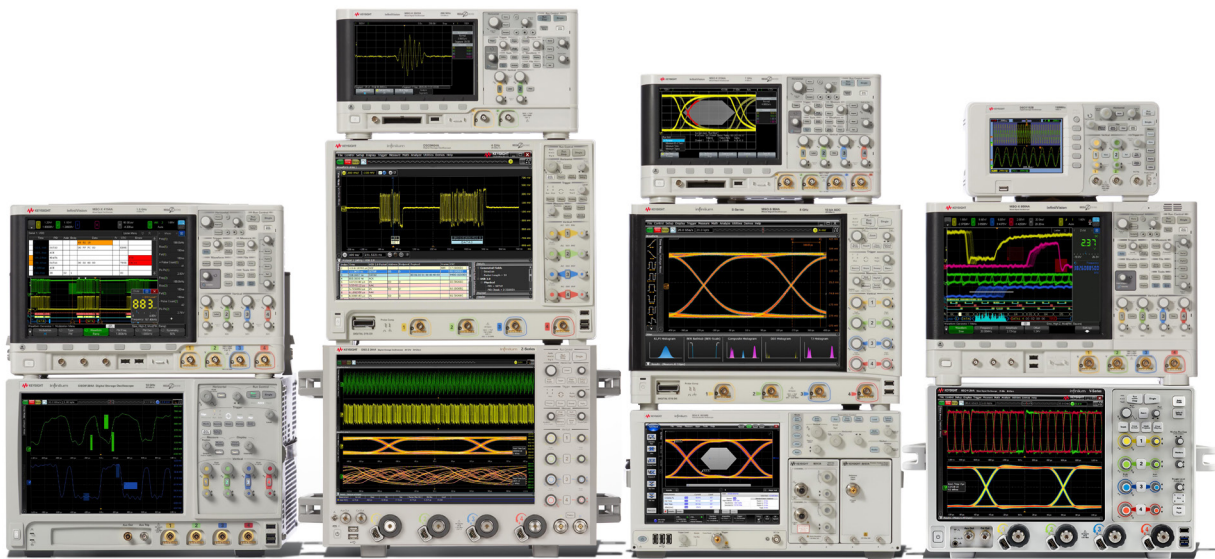
Equipment configuration for solution 3: Keysight N109X electrical DCA-M + external clock recovery

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: 200, 201, 401 Optional: SIM (for de-embedding cables)	
	Model number (Pick ONE)	DCA-M options	# of diff channels
	N1092C	Required: LOJ, PLK Optional: FS1	1
	N1092E	Required: LOJ, PLK Optional: FS1	1
	N1094A	Required: LOJ, PLK, 030 or 050 Optional: FS1	1
	N1094B	Required: LOJ, PLK, 030 or 050 Optional: FS1	2
	Clock recovery model number (Pick ONE)	Clock recovery options (Pick ONE; Option 232 or higher required for 25G/28G signaling rates)	
	N4877A	216/232	
	N1076A	216/232	
	N1076B	216/232/264	
	N1077A	216/232	
	N1078A	216/232/264	
	Software		
	N1081A-1TP	IEEE 802.3 10G-KR and 40G-KR4, Compliance and Debug Application	
	N1082A-1TP	IEEE 802.3 XLAUI, CAUI-10 and nPPI, Compliance and Debug Application	
	N1082A-4TP	IEEE 802.3 CAUI-4, Compliance and Debug Application	
	N1083A-1TP	IEEE 802.3 40G-CR4 and 100G-CR10, Compliance and Debug Application	
	N1084A-1TP	IEEE 802.3 100G-KR4 and 100G-CR4, Compliance and Debug Application	
	N108xA-7TP	IEEE 802.3 Switch control, transportable perpetual license	
	N1010A	FlexDCA FW Rev 5.8 or later (included with 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}			
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)		
N9399F, N9399F	DC block, 50 GHz (Qty 2)		
N9398C, N9399C or 11742A	DC block, 26.5 GHz (Qty 2)		
Impedance measurements	Model number (Pick TDR or PNA)	Description	
	N1055A TDR/TDT	35/50 GHz 2/4 Port TDR/TDT Remote Sampling Head for the 86100D DCA-X (any option)	
	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 this hardware configuration, including clock-to-data delay matching, refer to the Keysight N1076A/B, N1077A, and N1078A Clock Recovery DCA-M User Guide.
- No clock-to-data delay phase matching kit is available for this hardware configuration.

Ordering Information

Model	Description	Transportable license
N1081A	IEEE 802.3 10G-KR and 40G-KR4	1TP
N1082A	IEEE 802.3 XLAUI, CAUI-10 and nPPI	1TP
N1082A	IEEE 802.3 CAUI-4	4TP
N1083A	IEEE 802.3 40G-CR4 and 100G-CR10	1TP
N1084A	IEEE 802.3 100G-KR4 and 100G-CR4	1TP
All	Switch control	7TP



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