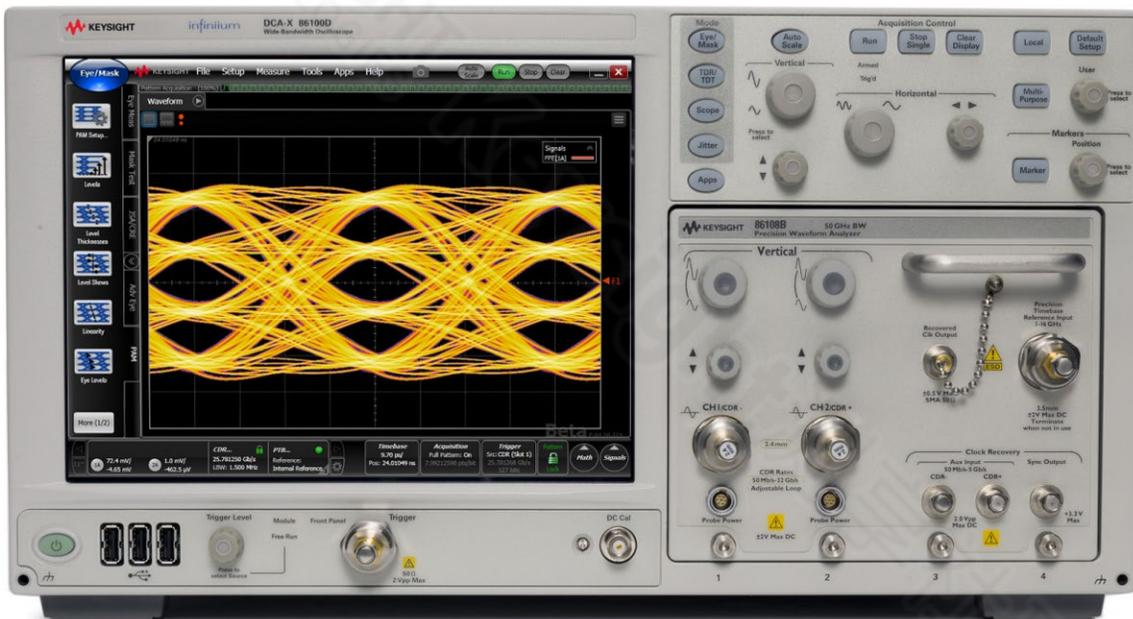


Keysight N1085A

PAM-4 Measurement Application

For 86100D DCA-X Series Oscilloscopes

Data Sheet



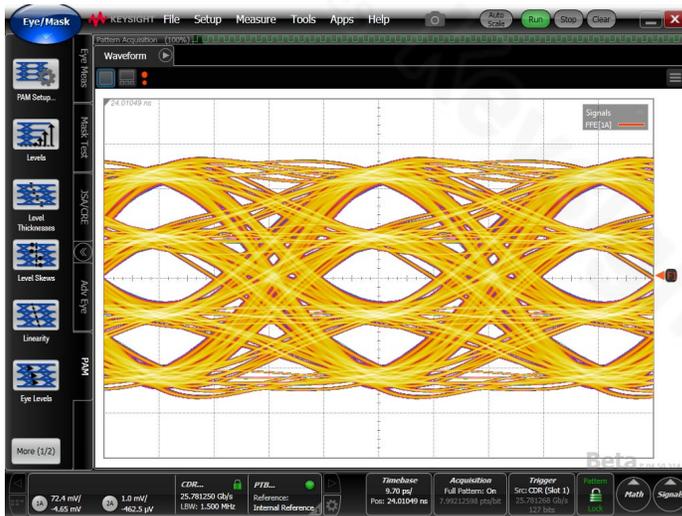
Introduction

Several industry groups and standards bodies are using, or actively considering using, Pulse Amplitude Modulation 4-Level (PAM-4) technology to jump to the next-generation speed class. PAM-4 signaling enables higher throughput for a given channel bandwidth compared to traditional non-return-to-zero (NRZ) signaling.

Working groups within the Optical Networking Forum - Common Electrical Interface (OIF-CEI 4.0) and IEEE 400G Ethernet (P802.3bs) are leveraging many of the PAM-4 measurements outlined in Clause 94 of IEEE Std 802.3bj-2014. Examples of Standards or Implementation Agreements (IA) that propose PAM-4 signaling include:

- IEEE 400G Ethernet (P802.3bs)
- OIF-CEI-4.0 (56G)
 - OIF-CEI-56G-XSR-PAM4 (Extra Short Reach interface)
 - OIF-CEI-56G-VSR-PAM4 (Very Short Reach interface)
 - OIF-CEI-56G-MR-PAM4 (Medium Reach interface)
 - OIF-CEI-56G-LR-PAM4 (Long Reach interface)

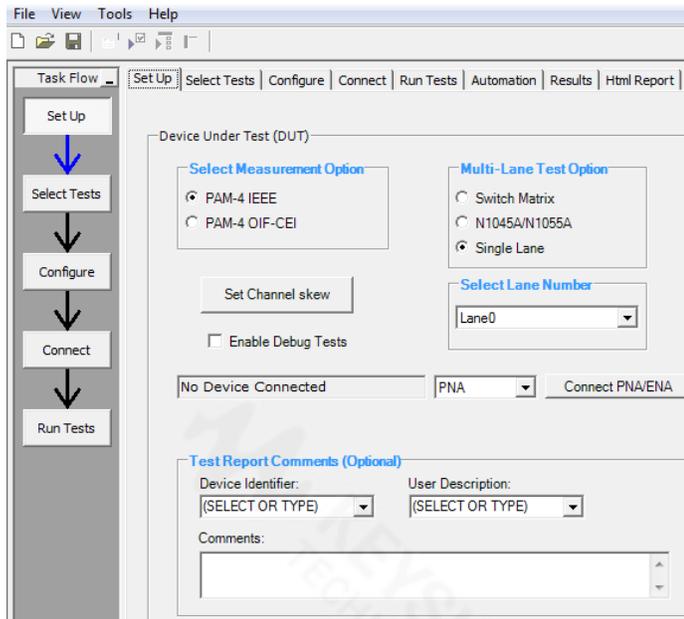
While the PAM-4 parameters are still in the development stages, companies are moving forward with their PAM-4 development and need measurement tools to help analyze their designs quickly and accurately.



Debug and Verify Your Designs Quickly and Easily

Transform complexity into simplicity

Keysight N1085A PAM-4 measurement software saves engineers time and money by automating PAM-4 “pre-compliance” measurements for standards that have not yet been ratified.



Based on the 86100D DCA-X Series oscilloscope platform, N1085A is an easy-to-use oscilloscope application that:

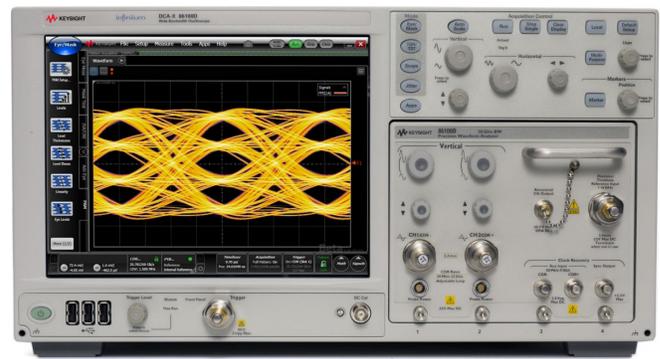
- Saves time in understanding details of standards
- Reduces the time it takes to characterize your PAM-4 design from hours to minutes
- Helps to debug your device using custom configurations
- Characterizes up to four lanes in multi-lane devices

Select industry-leading hardware

Configure your oscilloscope for single or multi-channel capability. The 86100D DCA-X wide-bandwidth oscilloscope is a flexible solution that provides ultra-low jitter performance (as low as 45 fs rms) together with an extremely low noise acquisition system. For return loss, the N1085A software controls an N1055A TDR module (or an economy or performance network analyzer) and performs S-parameter measurements.

Highest accuracy

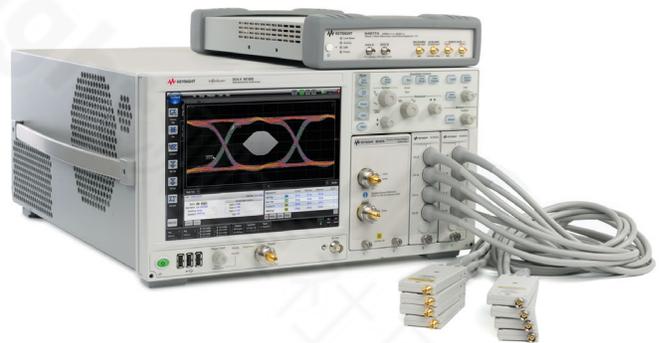
86100D DCA-X + 86108B (fully integrated solution)



Option	Description
Channels	2
Bandwidth	50 GHz
Jitter	< 45 fs typ.
Clock recovery	Integrated, 50 M to 32 Gbaud

Highest channel count

86100D DCA-X + N1045A/N1055A TDR (remote head solution)



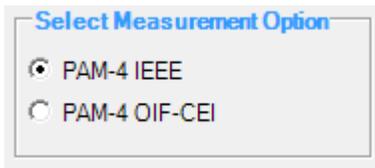
Option	Description
Channels	16
Bandwidth	60 GHz/50 GHz
Jitter	< 100 fs typ. (86100-PTB)
Clock recovery	External (N4877A 32G CDR)
TDR/TDT/S-Parameters	Using N1055A

Debug and Verify Your Designs Quickly and Easily (Continued)

Select the desired PAM-4 test suite

The N1085A software application covers PAM-4 transmitter measurements outlined in IEEE P802.3bs and four OIF-CEI-4.0 (56G) clauses. The tests are conveniently organized by clause. Click on the desired test group, and the appropriate tests are offered in Select Tests.

1. N1085A-1TP
 - Performs PAM-4 transmitter tests outlined in:
 - IEEE P802.3bs, Annex 120D, CDAUI-8 chip-to-chip
 - IEEE P802.3bs, Annex 120E, CDAUI-8 chip-to-module



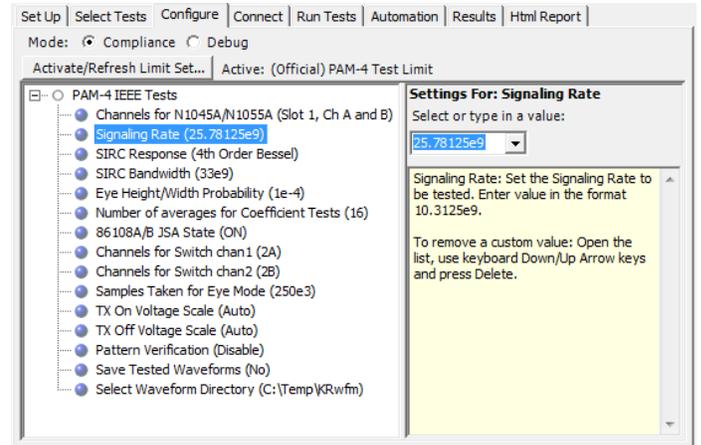
2. N1085A-4TP
 - Performs PAM-4 transmitter tests outlined in:
 - OIF-CEI-56G-XSR-PAM4 (Extra Short Reach interface)
 - OIF-CEI-56G-VSR-PAM4 (Very Short Reach interface)
 - OIF-CEI-56G-MR-PAM4 (Medium Reach interface)
 - OIF-CEI-56G-LR-PAM4 (Long Reach interface)

3. N1085A-7TP
 - Provides the ability to control a switch, allowing users to use a single channel to test multiple channels.



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 taken; type of pattern; and whether or not to remove the effects of test cables. Choose Normal mode to test within limits or choose Debug mode to test to your custom limits and adjust other test parameters.



Debug and Verify Your Designs Quickly and Easily (Continued)

Choose your tests

N1085A software provides comprehensive coverage of all PAM-4 tests that are specific to the Clause you are testing. You may click on all tests, a group of tests, or individual tests. 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/IA are shown for each test.

- Level Noise, Thickness, RMS, Linearity (RLM)

- Output Voltage Measurements (pattern: Linearity Pattern)**
 - Level - Linearity pattern
 - Level RMS - Linearity pattern
 - Level Separation Mismatch Ratio - RLM

- Eye Width (EW), Eye Height(EH) Measurements

- Eye Height/Width Measurements (pattern: PRBSn)**
 - Eye Height
 - Eye Width

- Output Waveform Measurements

- Output Waveform Measurements (pattern: PRBSn)**
 - Steady-State Voltage Vf
 - Linear Fit Pulse Peak
 - Signal-to-noise-and-distortion ratio
 - Normalized Coefficient Step Size
 - abs Coefficient Step Size c(1)inc c(0)hold c(-1)hold
 - abs Coefficient Step Size c(1)dec c(0)hold c(-1)hold
 - abs Coefficient Step Size c(1)hold c(0)inc c(-1)hold
 - abs Coefficient Step Size c(1)hold c(0)dec c(-1)hold
 - abs Coefficient Step Size c(1)hold c(0)hold c(-1)inc
 - abs Coefficient Step Size c(1)hold c(0)hold c(-1)dec
 - Full Scale Range Tests
 - Minimum Pre-cursor Full-scale Ratio
 - Minimum Post-cursor Full-scale Ratio

- Jitter and Signaling Rate Measurements

- Jitter and Signaling Rate Measurements (pattern: JP03A/B)**
 - Signaling Rate
 - Even-Odd Jitter
 - Random Jitter
 - Deterministic Jitter

Automated return loss measurements

When used in conjunction with an N1055A TDR or ENA/PNA vector network analyzer, the N1085A software can perform differential and common mode return loss measurements.

- Return Loss PNA/ENA/N1055A Measurements**
 - Differential Output Return Loss
 - Common-mode to Differential Output Return Loss

Guided connection diagrams for easy setup

Simply follow the steps to connect and configure your device under test (DUT) and click Run Tests. The N1085A and the DCA will automatically measure your device using a wide range of DCA plug-in modules such as the 86108B, N1045A and N1055A. If 86100D-SIM is installed, the N1085A software can also be configured to de-embed the effects of cables and fixtures.

Instructions for Connection: PRBS9 Connection

Please pay attention to the scope connection

- This test is testing with Tx Enabled. Make sure Tx is enabled.
- Set device to a PRBS pattern.
- Connect the scope to the DUT Signals as follows:

Phase trimmers >> (recommended)

Transmitter in fixture/HCB/MCB

I have completed these instructions Suppress all connection prompts

More Features to Further Streamline Your Development

Generate reports

Users and your 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 a test-specific screen shot of the measured parameter.



PAM-4 App Test Report

Overall Result: PASS

Test Configuration Details	
Device Description	
Enable Debug Test	No
Switch Option	Single Lane
Measurement Option	PAM-4 IEEE
Test Session Details	
FlexDCA SW Version	05.30.159
DCA Model Numbers	Frame: 86100D Slot1: 86108B Slot2: Not Present Slot3: Not Present Slot4: Not Present
DCA Serial Numbers	Frame: MY50100113 Slot1: MY51460108 Slot2: XXXXXXXXXXXX Slot3: XXXXXXXXXXXX Slot4: XXXXXXXXXXXX
Application SW Version	0.99.9012
Debug Mode Used	Yes
Compliance Limits (official)	PAM-4 Test Limit
Last Test Date	2015-10-22 12:04:04 UTC -07:00

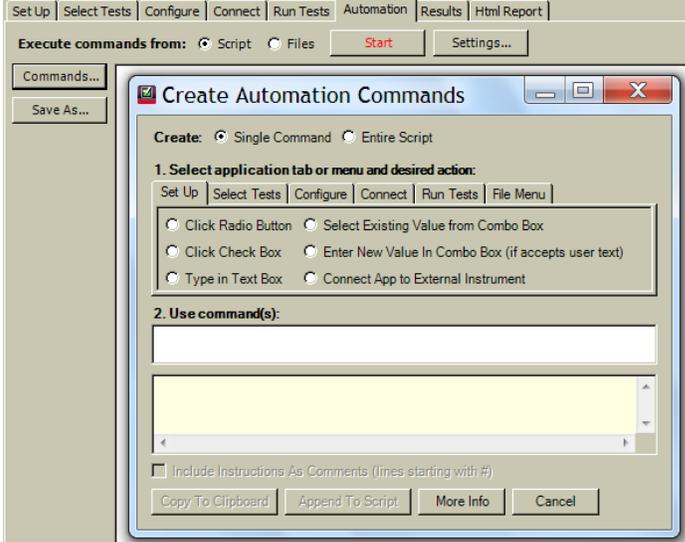
Summary of Results

Test Statistics	
Failed	0
Passed	4
Total	4

Margin Thresholds	
Warning	< 2 %
Critical	< 0 %

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.



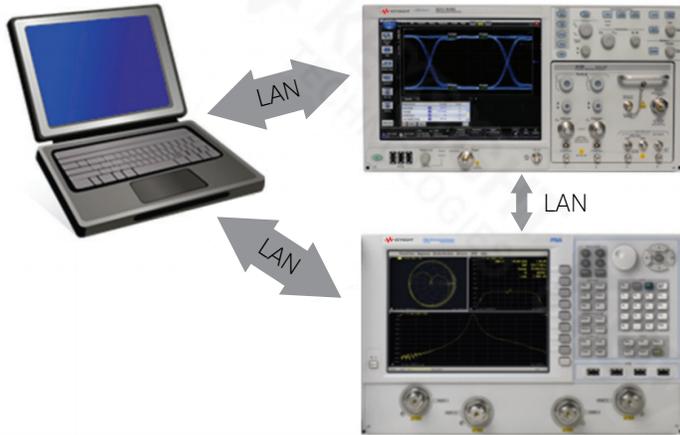
More Features to Further Streamline Your Development (Continued)

Configure your solution in three ways

The hardware and software architecture provides wide flexibility. The N1085A PAM4 measurement application may be run as follows:

1. 86100D DCA-X runs N1085A PAM4 software application locally and controls remote ENA/PNA via LAN
2. PC runs N1085A PAM4 software application and controls remote 86100D DCA-X, ENA/PNA via LAN
3. PC runs both N1085A software application and N1010A FlexDCA and controls remote 86100D DCA-X, ENA/PNA via LAN

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 N1085A 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. When testing PAM-4 electrical designs, you may choose a hardware combination that fits your device data rate and other higher rate tests for other standards. Each row shows the recommended configuration of hardware and software to measure the many parameters. The multi-module approach is useful for designers who may already own a plug-in module.

Recommended hardware and software

86100D DCA-X oscilloscope mainframe

DCA hardware	86100D DCA-X mainframe
	86100D-ETR enhanced trigger
	86100D-PTB internal precision timebase (multi-channel config only)
DCA software	86100D-200 enhanced jitter analysis (JP03A/JP03B patterns)
	86100D-201 advanced waveform analysis (software equalizers such as CTLE)
	86100D-300 advanced amplitude/noise analysis (included with 86100D-200)
	86100D-9FP PAM-N analysis software (performs underlying PAM measurements)
	86100D-401 advanced eye analysis (optional) (jitter on individual PAM-4 eyes)
	86100D-SIM InfiniiSim-DCA (optional) (embedding/de-embedding of cables or fixtures)
	N1085A PAM-4 measurement application (see below for ordering info)

DCA plug-in module

Highest fidelity solution (integrated clock recovery, ultra-low random jitter (< 45 fs typ))	86108B-HBW/232 precision waveform analyzer ("MegaModule")
	86108B-PT2 50 GHz phase shifters
	86108B-CA2 matched cable set (optional)
	86108B-DC2 DC blocks (optional)
Multi-channel solution (remote sampler head)	N1045A, N1055A, or 86118A-H01 remote head receiver
	N4877A-232 clock recovery
	N1027A-MC1 multi-channel accessory kit

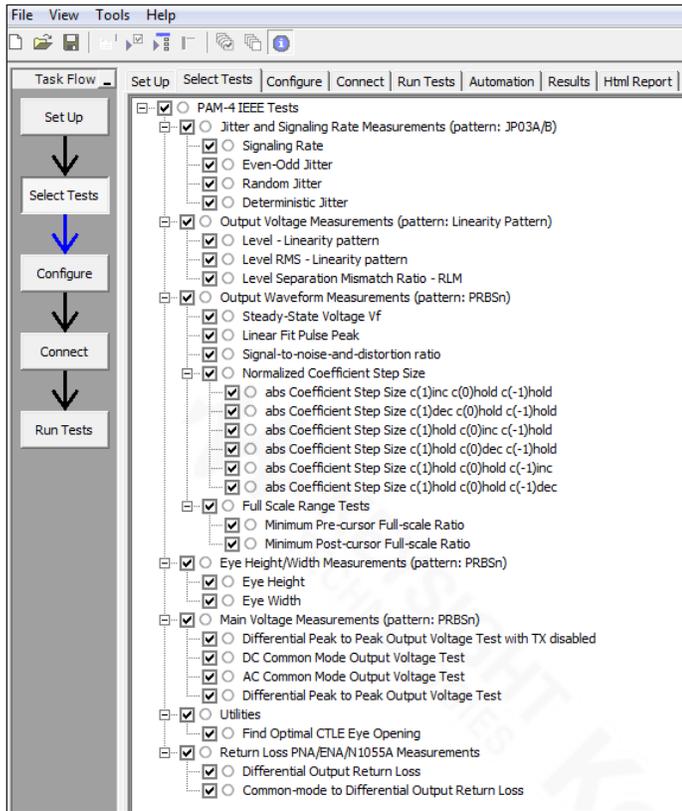
Return loss measurements (optional - pick ONE)

TDR with S-parameters	N1055A 35 or 50 GHz TDR/TDT module
	86100D-202 enhanced impedance and S-parameter
Performance Network Analyzer (PNA)	Any 4-port model with a frequency range of at least 30 GHz

More Features to Further Streamline Your Development (Continued)

Perform key PAM-4 measurements

PAM-4 signaling includes many new measurements and challenging tests. The list below shows the transmit parameters tested by the N1085A software application.



Ordering instructions

The N1085A PAM-4 measurement software is a transportable license (-xTP) that can be assigned by the user to an 86100D DCA-X mainframe or a user-supplied PC. The transportable nature of the license allows the user to move the license from one instrument (or PC) to another.

Ordering information

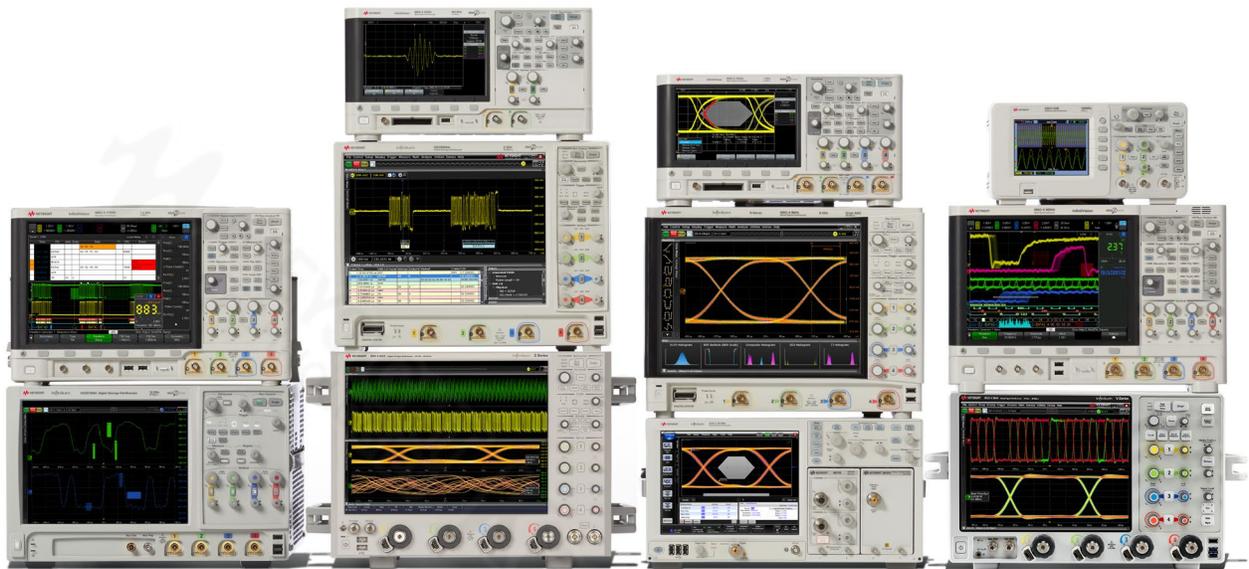
Model	Option	Description
N1085A		PAM-4 measurement application for Ethernet and OIF-CEI
N1085A	1TP	IEEE P802.3bs draft PAM-4 measurements, transportable perpetual license
N1085A	4TP	OIF-CEI 56G draft PAM-4 measurements, transportable perpetual license
N1085A	7TP	Switch control, transportable perpetual license

Required software options

Model	Option	Description
86100D	9FP	PAM-N analysis SW
86100D	200	Enhanced jitter analysis software
86100D	201	Advanced waveform analysis software (FFE/CTLE/DFE equalizers)
86100D	300	Advanced amplitude/Noise analysis

Recommended software options

Model	Option	Description
86100D	SIM	InfiniiSim-DCA waveform transformation (Embedding/De-embedding)



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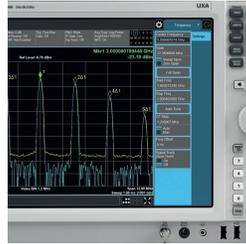
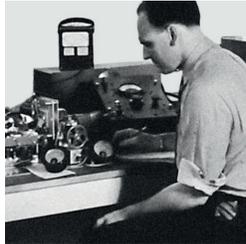
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1939

THE FUTURE

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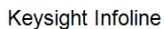


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