Keysight N1090A and N1092A/B/D DCA-M
Optical Sampling Oscilloscopes

Data Sheet

High accuracy, low cost solutions for optical waveform analysis

- Solutions for 1 through 28 Gb/s
- Very low noise and jitter
- Fast sampling rates for high throughput

KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

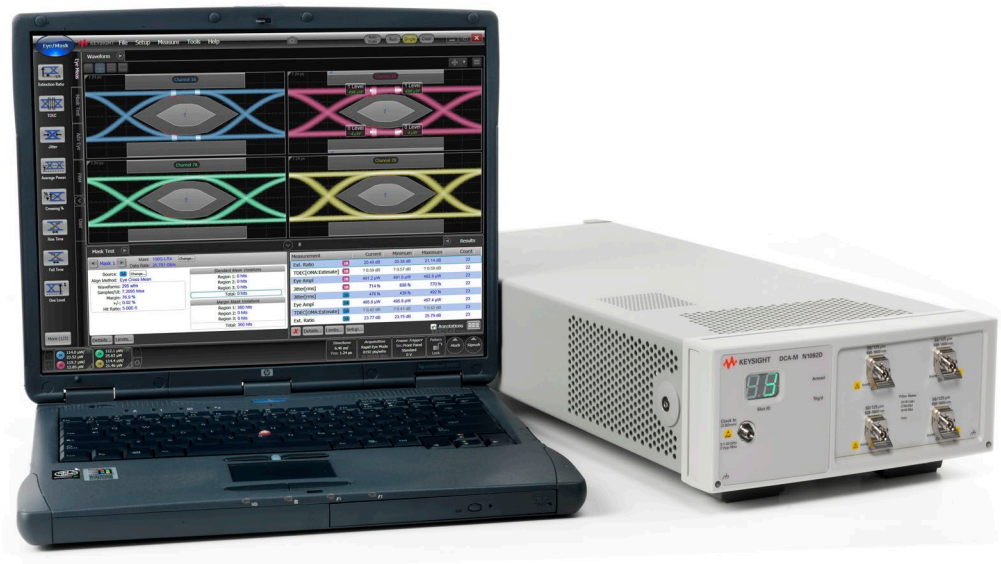
Get 86100 DCA Accuracy with a Test Solution Designed for Manufacturing

The Keysight Technologies, Inc. 86100 digital communication analyzer (DCA) family is recognized as the industry standard for verifying optical transmitter compliance to communications standards. For years engineers have trusted the DCA to provide accurate and easy measurement of digital communication waveforms. The Keysight N1090A and N1092 A/B/D DCA-M family has built on that legacy by using the high-performance elements of both the 86100 oscilloscope mainframe acquisition system and hardware of the 861XX plug-in modules. The N1090A supports 1 to 10 Gb/s measurements, while the N1092 is for use from 20 to 28 Gb/s. (Data rate ranges of the N1092 can be extended using Options PLK and IRC.)

Designed specifically for high-volume manufacturing test applications, the DCA-M provides the measurement accuracy of the 86100, without the extra cost associated with an R&D test solution. Be confident that your test results will never be questioned when performed with the N1090 or N1092 because end users of your transceivers are likely to use similar accurate, high-quality test systems to verify component performance.

Unlike the 86100, which uses modules to create a waveform analysis system, the N1090 and N1092 are completely integrated instruments built in a small form factor. Low-noise, high-sensitivity calibrated reference receivers – compliant to industry standard tolerances – are available for both multimode and single-mode signals at wavelengths from 750 to 1630 nm. N1090A noise is as low as 1 µW, while N1092 noise is as low as 4 µW, creating a measurement system with very high dynamic range. The sensitivity of the N1092 is significantly better than the comparable 86100 system making it an excellent solution for PAM-4 waveform analysis.

The N1090/2 user interface and operating system is identical to the modern FlexDCA interface of the 86100D. A user-provided PC running N1010A FlexDCA software controls the N1090/2 over a simple USB 2.0 or 3.0 connection.

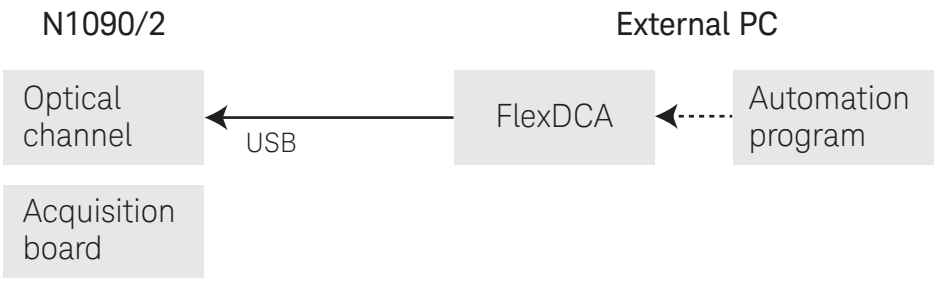


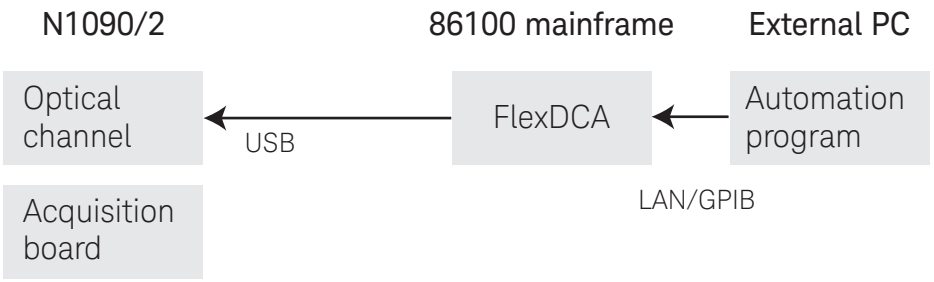
Get 86100 DCA Accuracy with a Test Solution Designed for Manufacturing (Continued)

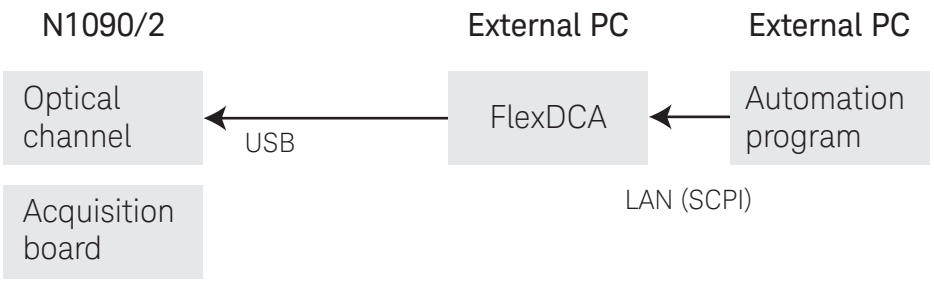
There are three ways to control the N109X system

- A PC directly connected to the N109X with a USB cable
- An 86100D mainframe connected to the N109X with a USB cable. (The 86100D can then be controlled via GPIB or LAN)
- For an automated test system environment, the simplest and preferred method to control the N109X is to connect the primary test system PC to a low-cost modern PC via LAN. The FlexDCA interface resides on the second PC. The second PC is then connected to the N109X via USB. This eliminates most issues of compatibility between an existing test system PC and the N109X hardware

Connection schemes







Get 86100 DCA Accuracy with a Test Solution Designed for Manufacturing (Continued)

System setup

The following guidelines indicate the fundamental requirements for PC's connected to the N109X and running the FlexDCA interface:

For a single channel setup (N1090A or N1092A)
- Intel I3 processor or better
- 4 GB memory
- Windows 7 (32 or 64 bit)

For a parallel test setup (multiple instruments or multiple channels)
- Intel I5 or better
- 8 GB memory
- Windows 7 (64 bit)

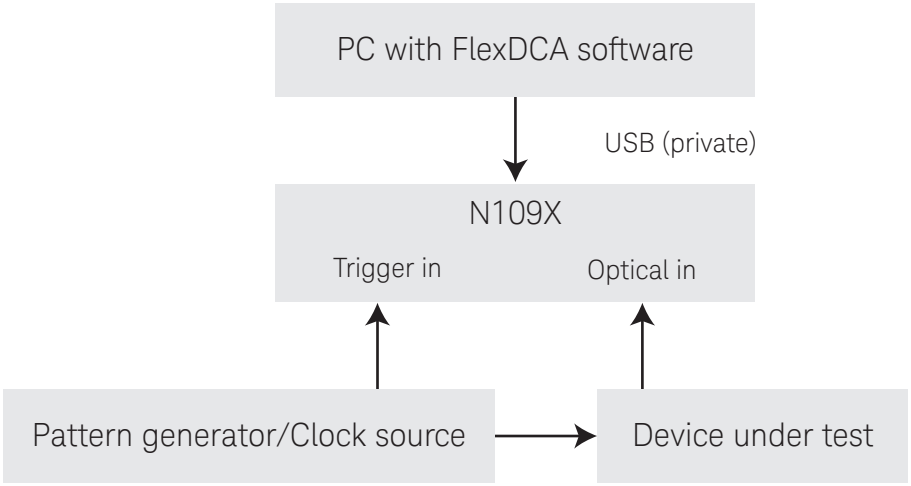
The communication API between your system controller and the PC is SCPI over LAN, either VXI-11 or HiSlip. If NI-VISA or IO Libraries are used to communicate with GPIB instruments, the switch to SCPI/LAN is very simple. It is important to note that there is no need to do any USB programming. This is all handled by the FlexDCA interface.

The FlexDCA interface is free and can be downloaded at **www.keysight.com/find/flexdca_download**. Remote programs previously developed using the 86100 FlexDCA interface can be leveraged directly to control an automated N1090/2 system. Use FlexDCA SCPI programming tools to simplify conversion of legacy 86100-based automation to FlexDCA compatible code. Measurement results are generally 50 percent faster with the new N1090A, and up to 300 percent faster with the N1092 due to significantly faster sampling rates.

Similar to the 86100, a reference clock, synchronous with the signal being measured, is required to trigger the N1090/2. The clock input range for the N1090A is 500 MHz to 12 GHz, and the N1092 is 0.455 to 32 GHz. Timebase calibration, previously performed at service centers, can now be performed by users, reducing cost of ownership and instrument down time.

Get 86100 DCA Accuracy with a Test Solution Designed for Manufacturing (Continued)

System setup (Continued)



Fundamental measurements required to perform transmitter compliance tests such as eye-masks, extinction ratio, and other eye diagram parameters, are standard features of the N1090/2 with N1010A system. To reduce cost, the pattern lock feature of the 86100 is not available in the N1090A, but is optionally available with the N1092A/B/D Option PLK. Features that require pattern lock include Options 200 (advanced jitter analysis), 201 (advanced waveform analysis), 300 (advanced amplitude analysis/RIN), Option IRC (extends the operating range of the optical channels ±50% and creates reference receivers at arbitrary data rates between 10 and 42 Gb/s), and SIM (Infinisim waveform transformation software). Measurement features that require pattern lock will not operate when used with the N1090A system. Basic oscilloscope mode measurements of pulses rather than eye diagrams are limited to patterns less than 2 ns in duration with the N1090A.

N1090A Configurations

Choose from the following reference receiver options to best meet your measurement needs. Select one option. Options cannot be combined. However if test needs change, the N1090A can be returned to a Keysight service center to convert from any of the five reference receiver options to one of the other four options listed. Unfiltered mode is not available in any option.

Option	Description
Option 140	1.244/1.25/1.229 Gb/s
Option 160	2.458/2.488/2.5 Gb/s
Option 180	3.072/3.125 Gb/s
Option 200	8.5/9.95/10.3/10.5/10.66/10.71/11.1/11.3 Gb/s
Option 204	8.5/9.95/10.3/10.5 Gb/s

A 20 GHz electrical channel is also available:

Option	Description
Option EEC	Add 20 GHz electrical channel

N1092 Configurations

All optical channels include optical reference receivers at 20.6, 25.78, 26.56, 27.95, and 28.05 Gb/s. Using the FlexDCA user interface, simultaneous measurements of multiple channels can be performed in parallel without any degradation in speed or accuracy.

Model number	Description
N1092A	One optical channel
N1092B	Two optical channels
N1092D	Four optical channels

N1092 Configurations (Continued)

The N1092A/B/D models have the following options available.

Option	Description
Option 168	25.78 Gb/s TDEC filter (100GBASE-SR4)
Option 206	20.6 Gb/s reference receiver
Option FS1	Increase sampling rate from 100 to 250 kSa/s
Option LOJ	Reduce residual jitter from 400 to < 200 fs
Option PLK	Add pattern lock capability
Option IRC	Extend optical channel bandwidth to 45 GHz and allow creation of reference receiver filters at any data rate from 8 to 42 Gb/s
Option 200	Advanced jitter analysis. Provides extensive and accurate jitter decomposition, which is increasingly important as data rates increase and margins reduce. Quickly customize your view of many parameters and take advantage of advanced features such as jitter spectrum analysis
Option 201	Advanced waveform analysis. Its powerful features allow you to generate much deeper waveform files, integrate MATLAB analysis, and use the built-in linear feed-forward equalizer
Option 300	Advanced amplitude/noise analysis. Extends jitter mode capabilities into the amplitude domain and allows you to see the decomposition of the amplitude into several factors. Option 300 also reports relative intensity noise (RIN) and Q-factor
Option 401	Advanced eye analysis. For device testing with long patterns and obtaining BER-contour mask testing, Option 401 integrates with the classic or FlexDCA interfaces to decompose the jitter and amplitude interference measurements into the key parameters. When using the embedded capability within FlexDCA or the included automation application, you may characterize jitter on simultaneous multiple lanes and obtain concise and visual results
Option 500	Productivity package (Rapid eye, TDEC). Enables rapid eye acquisition, providing two significant benefits. First, unlike conventional sampling and data display, when an eye mask test is performed, every acquired sample will be compared to the mask, as the central eye is composed of all acquired samples. Effective throughput is improved at least 60 percent. Second, incomplete eye diagram displays that can occur when triggering at sub-rates are eliminated. Option 500 also includes the TDEC analysis required for 100GBASE-SR4 test
Option 9FP	PAM-N analysis. Eye width, eye height, eye skew, level amplitude, level noise, level skew, and linearity measurements
Option SIM	Infinisim Waveform Transformation software

Note that operation of Options 200, 201, 300, 401, 500, 9FP, and SIM can be achieved by having the appropriate licenses installed on the N1092, the computer controlling the N1092, or an 86100 mainframe used to control the N1092.

N1090A Optical Channel Specifications

Item	Description
Nominal wavelength range	750 to 1650 nm
Factory-calibrated wavelengths (OE conversion gains)	850/1310/1550 nm (± 20 nm)
Reference receiver filter options (select one)	
N1090A-140	GPON, 1.244 Gb/s and Gb Ethernet, 1.250 Gb/s
N1090A-160	OC-48/STM-16, 2.488 Gb/s, 2 Gb Ethernet, 2.500 Gb/s
N1090A-180	10 Gb Ethernet LX-4, 3.125 Gb/s
N1090A-200	8x fibre channel, 8.500 Gb/s OC-192/STM-64, 9.953 Gb/s 10 Gb Ethernet, 10.3125 Gb/s 10x fibre channel, 10.51875 Gb/s OC-192/STM-64 FEC, 10.664 Gb/s OC-192/STM-64 FEC, 10.709 Gb/s 10 Gb Ethernet FEC, 11.0957 Gb/s 10x fibre channel FEC, 11.317 Gb/s
N1090A-204	8x fibre channel, 8.500 Gb/s OC-192/STM-64, 9.953 Gb/s 10 Gb Ethernet, 10.3125 Gb/s 10x fibre channel, 10.51875 Gb/s

Measured frequency response data during recertification falls within performance test line limits with allowance for system-to-system measurement uncertainty.

	Option 140	Option 160	Option 180	Options 200 and 204
RMS noise at 850 nm				
Characteristic	1.3 µW	1.5 µW	2.5 µW	2.5 µW
Maximum	2.0 µW	2.5 µW	4.0 µW	4.0 µW
RMS noise at 1310/1550 nm				
Characteristic	0.8 µW	1.0 µW	1.4 µW	1.4 µW
Maximum	1.3 µW	1.5 µW	2.5 µW	2.5 µW
Sensitivity [1] at 850 nm (Characteristic – smallest average power for mask test)	–20 dBm	–20 dBm	–19 dBm	–16 dBm
Sensitivity [1] at 1310/1550 nm (Characteristic – smallest average power for mask test)	–21 dBm	–21 dBm	–20 dBm	–17 dBm

1. Generally represents the power level where an ideal eye diagram will approach 0% mask margin due to noise of the oscilloscope. Provides a non-specified figure of merit to compare sensitivities of various optical channels.

N1090A Optical Channel Specifications (Continued)

Scale factor (per division)	
Minimum	2 µW
Maximum	100 µW
CW accuracy (single marker, referenced to average power monitor)	
Single-mode	± 25 µW ± 3%
Multimode	± 25 µW ± 10%
CW offset range (referenced two divisions from screen bottom)	+0.2 to –0.6 mW
Average power monitor	–30 to 0 dBm
Average power monitor accuracy	
Single-mode	± 5% ± 200 nW ± connector uncertainty
Multimode (characteristic)	± 10% ± 200 nW ± connector uncertainty
Due to variations in mode-filling conditions, the measured power in multimode fiber will vary more than the measured power in single-mode fiber. For users needing the most accurate power measurements, use an optical power meter for multimode power measurements	
User-calibrated accuracy (assumes connector is continually attached)	
Single-mode	± 3% ± 200 nW ± power meter uncertainty, < 5 °C change
Multimode (characteristic)	± 10% ± 200 nW ± power meter uncertainty, < 5 °C change
Maximum input power	
Maximum non-destruct average	0.5 mW (–3 dBm)
Maximum non-destruct peak	5 mW (+7 dBm)
Input return loss (FC/PC connector fully filled fiber)	
Fiber input	62.5/125 µm
1310/1550 nm	> 24 dB

Electrical Channel Specifications (Requires Option EEC)

Electrical channel specifications	
Electrical channel bandwidth	12.4 and 20 GHz
Transition time (10 to 90% calculated from TR = 0.35/BW)	28.2 ps (12.4 GHz) 17.5 ps (20 GHz)
RMS noise	
Characteristic	0.25 mV (12.4 GHz) 0.5 mV (20 GHz)
Maximum	0.5 mv (12.4 GHz) 1 mV (20 GHz)
Scale factor (per division)	
Minimum	1 mV/division
Maximum	100 mV/division
DC accuracy (single marker)	± 0.4% of full scale ± 2 mV ± 1.5% of (reading-channel offset), 12.4 GHz ± 0.4% of full scale ± 2 mV ± 3% of (reading-channel offset), 20 GHz
DC offset range (referenced to center of screen)	± 500 mV
Input dynamic range (relative to channel offset)	± 400 mV
Maximum input signal	± 2 V (+16 dBm)
Nominal impedance	50 Ω
Reflections (for 30 ps rise time)	5%
Electrical input	3.5 mm (male)

Clock Trigger Input Specifications

Item	**Description**
Clock input bandwidth	0.5 to 12 GHz
Clock input sensitivity	200 mVpp
Maximal input signal	± 2 V
Nominal impedance	50 Ω
Clock input connector	SMA (female)

Horizontal Timebase Specifications

Item	Description
Scale factor	Full scale is ten divisions
Minimum	100 fs/div
Maximum	100 us/div
Sample delay	Less than 10 ns. Time offset between the front panel clock input and the front panel channel input
Time interval accuracy (Dual marker measurement performed at a temperature within ± 5 °C of horizontal calibration temperature)	1 ps + 0.2% of the measured time interval while the delay settings is less that the absolute minimum delay plus 1 ns
	If the delay setting is greater than the absolute minimum delay plus 1 ns then the accuracy is 5 ps + 0.1% of the measured time interval
Jitter (slew rate ≥ 2 V/ns)	500 fs rms
Time interval resolution (The time interval resolution is the smallest time you can characterize between two points)	(Screen diameter)/(Record length) or 40 fs, whichever is larger
Display units	Bits or time
Record length	16 to 65,536 samples. Increments of 1
Sample rate	60 kHz

Environmental Specifications

Item	Description
Use	Indoor
Temperature	
Operating	10 to +40 °C (50 to +104 °F)
Non-operating	–40 to +70 °C (–40 to +158 °F)
Altitude (operating)	Up to 4,600 meters (15,000 ft)
Maximum relative humidity	80% for temperatures up to 31 °C (87.8 °F) decreasing linearly to 50% relative humidity at 40 °C (104 °F)
Line power	100/120 Vac 50/60/400 Hz
	220/240 Vac 50/60 Hz
	50 W maximum
	The products can operate with mains supply voltage fluctuations up to ± 10% of the nominal voltage
Weight	
Mainframe (characteristic)	6.20 kg (13.68 lb)
Without front connectors and rear feet	88.26 mm H x 207.40 mm W x 485 mm D (3.48 in x 8.17 in x 19.01 in)
With front connectors and rear feet	103.31 mm H x 219.56 mm W x 517.80 mm D (4.07 in x 8.64 in x 20.39 in)
With front cover and rear feet	110.18 mm H x 219.56 mm W x 550.71 mm D (4.34 in x 8.64 in x 21.68 in)

N1092A/B/D Optical Channel Specifications

Item	Description
Nominal wavelength range	830 to 1650 nm
Factory-calibrated wavelengths (OE conversion gains)	850/1310/1550 nm (± 20 nm)
Reference receiver filter options:	
The standard N1092 includes filters to test the following data rates	25.78 Gb/s (25/50/100 Gb Ethernet)
	26.56 Gb/s (400 Gb Ethernet)
	27.95 Gb/s (OTU4)
	28.05 Gb/s (32x fibre channel)
N1092-168	100GBASE-SR4 TDEC (12.4 GHz)
N1092-206	20.6 Gb/s

Measured frequency response data during recertification falls within performance test line limits with allowance for system-to-system measurement uncertainty.

	20.6 Gb/s filter	25.78/26.56 Gb/s	27.95/28.05 Gb/s
Sensitivity [1] at 850 nm (Characteristic – smallest average power for mask test)	–11 dBm	–10 dBm	–9 dBm
Sensitivity [1] at 1310/1550 nm (Characteristic – smallest average power for mask test)	–12 dBm	–11 dBm	–10 dBm

1. Generally represents the power level where an ideal eye diagram will approach 0% mask margin due to noise of the oscilloscope. Provides a non-specified figure of merit to compare sensitivities of various optical channels.

	20.6 Gb/s filter	25.78/26.56 Gb/s	27.95/28.05 Gb/s
RMS noise at 850 nm			
Characteristic (preliminary)	7 µW	8 µW	9 µW
Maximum (preliminary)	8 µW	12 µW	12 µW
RMS noise at 1310/1550 nm			
Characteristic (preliminary)	6 µW	6 µW	7 µW
Maximum (preliminary)	10 µW	10 µW	11 µW

N1092A/B/D Optical Channel Specifications (Continued)

Scale factor (per division)	
Minimum	2 µW
Maximum	100 µW
CW accuracy (single marker, referenced to average power monitor)	
Single-mode	± 25 µW ± 3%
Multimode	± 25 µW ± 10%
CW offset range (referenced two divisions from screen bottom)	+0.2 to –0.6 mW
Average power monitor	–30 to 0 dBm
Average power monitor accuracy	
Single-mode	± 5% ± 200 nW ± connector uncertainty
Multimode (characteristic)	± 10% ± 200 nW ± connector uncertainty
Due to variations in mode-filling conditions, the measured power in multimode fiber will vary more than the measured power in single-mode fiber. For users needing the most accurate power measurements, use an optical power meter for multimode power measurements	
User-calibrated accuracy (assumes connector is continually attached)	
Single-mode	± 3% ± 200 nW ± power meter uncertainty, < 5 °C change
Multimode (characteristic)	± 10% ± 200 nW ± power meter uncertainty, < 5 °C change
Maximum input power	
Maximum displayed input	4 mW (6 dBm)
Maximum non-destruct peak	5 mW (+7 dBm)
Input return loss (FC/PC connector fully filled fiber)	
Fiber input	50/125 µm
1310/1550 nm	> 24 dB

Clock Trigger Input Specifications

Item	Description
Clock input bandwidth	0.5 to 32 GHz
Clock input sensitivity	200 mVpp
Maximal input signal	± 2 V
Nominal impedance	50 Ω
Clock input connector	2.92 mm (female)

Horizontal Timebase Specifications

Item	Description
Scale factor	Full scale is ten divisions
Minimum	100 fs/div
Maximum	100 us/div
Sample delay	Less than 10 ns. Time offset between the front panel clock input and the front panel channel input
Time interval accuracy (Dual marker measurement performed at a temperature within ± 5 °C (± 41 °F)of horizontal calibration temperature)	1 ps + 0.2% of the measured time interval while the delay settings is less that the absolute minimum delay plus 1 ns
	If the delay setting is greater than the absolute minimum delay plus 1 ns then the accuracy is 5 ps + 0.1% of the measured time interval
Jitter (Slew rate ≥ 2 V/ns)	< 400 fs rms
Option LOJ	< 200 fs rms
Time interval resolution (The time interval resolution is the smallest time you can characterize between two points)	(Screen diameter)/(Record length) or 40 fs, whichever is larger
Display units	Bits or time
Record length	16 to 65,536 samples. Increments of 1
Sample rate	
Sample rate does not change for multiple channel configurations	100 kHz
Option FS1	250 kHz

Environmental Specifications

Item	Description
Use	Indoor
Temperature	
Operating	10 to +40 °C (50 to +104 °F)
Non-operating	–40 to +70 °C (–40 to +158 °F)
Altitude (operating)	Up to 4,600 meters (15,000 ft)
Maximum relative humidity	80% for temperatures up to 31 °C (87.8 °F) decreasing linearly to 50% relative humidity at 40 °C (104 °F)
Line power	100/120 Vac 50/60/400 Hz
	220/240 Vac 50/60 Hz
	50 W maximum
	The products can operate with mains supply voltage fluctuations up to ± 10% of the nominal voltage
Weight	
Mainframe (characteristic)	6.20 kg (13.68 lb)
Without front connectors and rear feet	88.26 mm H x 207.40 mm W x 485 mm D (3.48 in x 8.17 in x 19.01 in)
With front connectors and rear feet	103.31 mm H x 219.56 mm W x 517.80 mm D (4.07 in x 8.64 in x 20.39 in)
With front cover and rear feet	110.18 mm H x 219.56 mm W x 550.71 mm D (4.34 in x 8.64 in x 21.68 in)

Ordering Information – N1090A

The N1090A, when controlled by a PC through a USB connection, is a complete measurement system. No oscilloscope mainframe is required. Choose one reference receiver option (140, 160, 180, 200 or 204) to complete the configuration.

Reference	Description
N1090A	Optical sampling oscilloscope
N1090A-140	1.244/1.25 Gb/s reference receiver
N1090A-160	2.488/2.5 Gb/s reference receiver
N1090A-180	3.125 Gb/s reference receiver
N1090A-200	8.5 to 11.3 Gb/s reference receivers
N1090A-204	8.5 to 10.5 Gb/s reference receivers
1090A-EEC	20 GHz electrical channel
N1090A-1CM	Single instrument rackmount kit
N1090A-1CN	Dual instrument (side-by-side) rackmount kit
The N1090A can also be converted from one reference receiver option to a different option through a return to factory upgrade:	N1090AU-140
	N1090AU-160
	N1090AU-180
	N1090AU-200
	N1090AU-204

Note: The N1090A cannot be upgraded to an N1092.

N1010A FlexDCA software is required on the PC controlling the N101A DCA. It is available as a free download at **www.keysight.com/find/flexdca_download**

Ordering Information – N1092A/B/D

The N1092A/B/D, when controlled by a PC through a USB connection, is a complete measurement system. No oscilloscope mainframe is required. The N1092 comes standard with reference receivers for 25.78, 26.56, 27.95, and 28.05 Gb/s compliance test.

Model number	Description
N1092A	One optical channel
N1092B	Two optical channels
N1092D	Four optical channels

The following options [1] are available on the N1092A/B/D. The price is the same, independent of a one, two, or four channel model number:

Option	Description
Option FS1	Increase sampling rate from 100 to 250 kSa/s
Option LOJ	Reduce residual jitter from 400 fs to < 200 fs
Option PLK	Add pattern lock capability
Option 200	Advanced jitter analysis
Option 201	Advanced waveform analysis
Option 300	Advanced amplitude/noise analysis
Option 401	Advanced eye analysis
Option 500	Productivity package (Rapid eye, TDEC)
Option 9FP	PAM-N analysis
Option SIM	Infinisim waveform transformation software
Option COC	Certificate of calibration
Option UK6	Commercial calibration certificate with test data
Option 1CM	Single instrument rackmount kit
Option 1CN	Dual instrument side-by-side rackmount kit

The following options are available for the N1092A/B/D. Option prices depend on the model number and its number of measurement channels (one, two or four for the N1092A, B, or D respectively).

Option	Description
Option 168	25.78 Gb/s TDEC filter (100GBASE-SR4)
Option 206	20.6 Gb/s reference receiver
Option IRC	Extend optical channel bandwidth to 45 GHz (–3 dBo) and allow creation of reference receiver filters at any data rate from 8 to 42 Gb/s

1. Note that operation of Options 200, 201, 300, 401, 500, 9FP, and SIM can be achieved by having the appropriate licenses installed on the N1092, the computer controlling the N1092, or an 86100 mainframe used to control the N1092.

N1010A FlexDCA software is required on the PC controlling the N101A DCA. It is available as a free download at **www.keysight.com/find/flexdca_download**.

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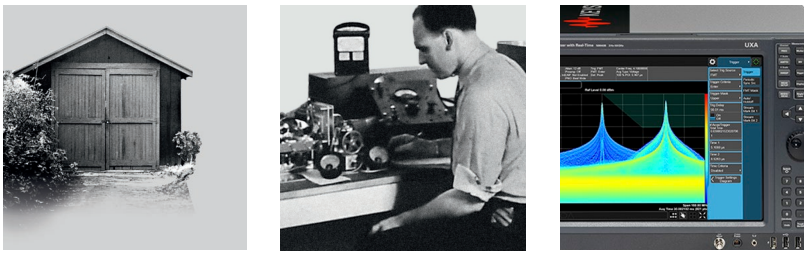

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