

# N1092A/B/C/D/E DCA-M

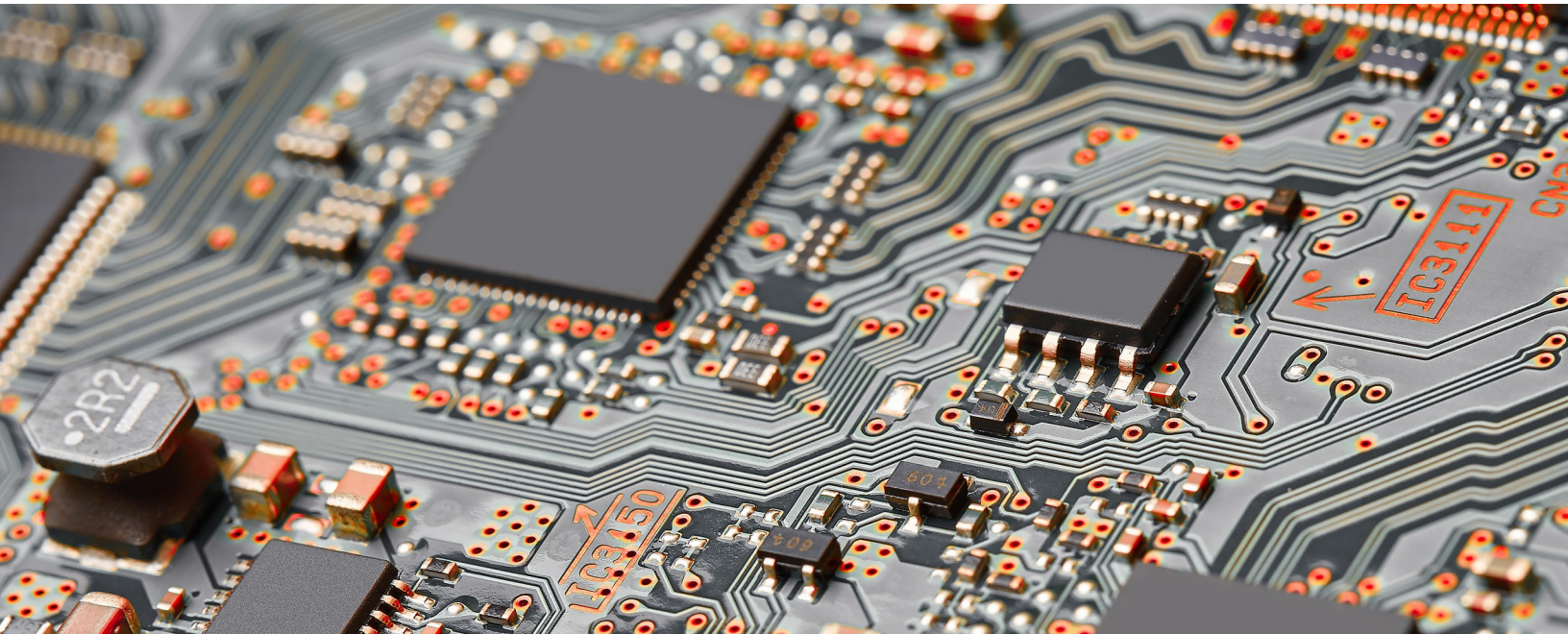
## Optical and Electrical Sampling Oscilloscopes

High accuracy, low cost solutions for optical and electrical waveform analysis including solutions for 20 Gb/s through 53 GBaud, very low noise and jitter, and fast sampling rates for high throughput.



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## Legendary DCA Accuracy

The Keysight Technologies, Inc. N1000 and 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 N1092A/B/C/D/E DCA-M has built on that legacy by using the high-performance elements of both the N1000 and 86100 oscilloscope mainframe acquisition system and the optical and electrical channel hardware of the 861XX and N104X plug-in modules.

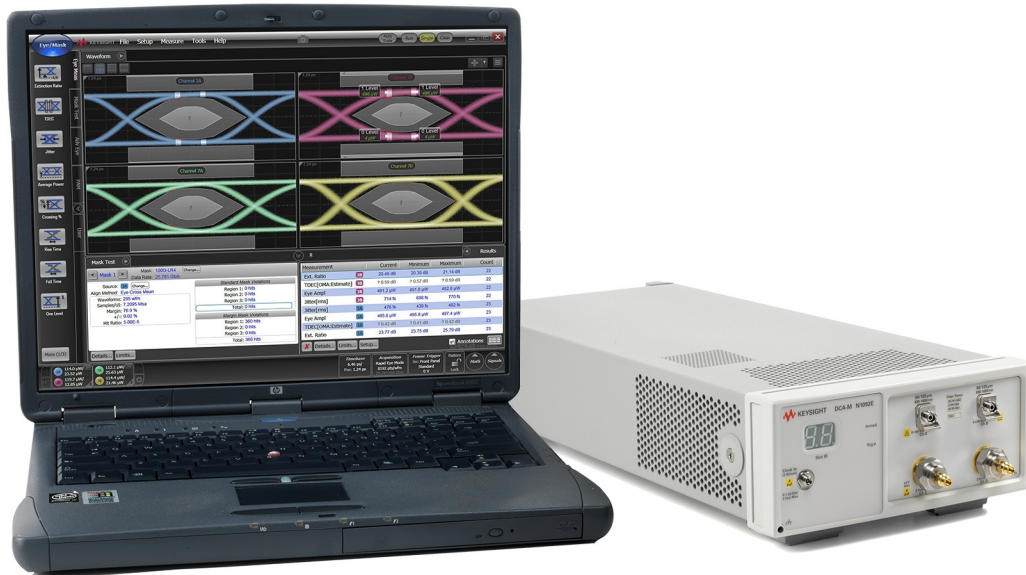
## Small Form Factor Ideal for Both Manufacturing and R&D Applications

Unlike the 86100D and N1000A, which use modules to create a waveform analysis system, the N109X are completely integrated instruments built in a small form factor. Low noise, high-sensitivity calibrated optical reference receivers — compliant to industry standard tolerances — are available for both multimode and single-mode, creating a measurement system with very high dynamic range. Electrical channels are available with 30 GHz and 50 GHz bandwidths.



### User Interface

The N109X user interface and operating system is identical to the modern FlexDCA interface of the 86100D and N1000A. A user-provided PC running N1010A FlexDCA software controls the N1092A/B/C/D/E over a simple USB 2.0 or 3.0 connection.





## Controlling the N1092A/B/C/D/E

There are three ways to control the N109X system

- A PC directly connected to the N1092A/B/C/D/E with a USB cable
- An 86100D or N1000A mainframe connected to the N1092A/B/C/D/E with a USB cable. (The mainframe can then be controlled via GPIB or LAN)
- For an automated test system environment, the simplest and preferred method to control the N1092A/B/C/D/E 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 N1092A/B/C/D/E via USB. This eliminates most issues of compatibility between an existing test system PC and the N1092A/B/C/D/E hardware and can greatly simplify converting an 86100D system to an N1092A/B/C/D/E system

### Connection schemes

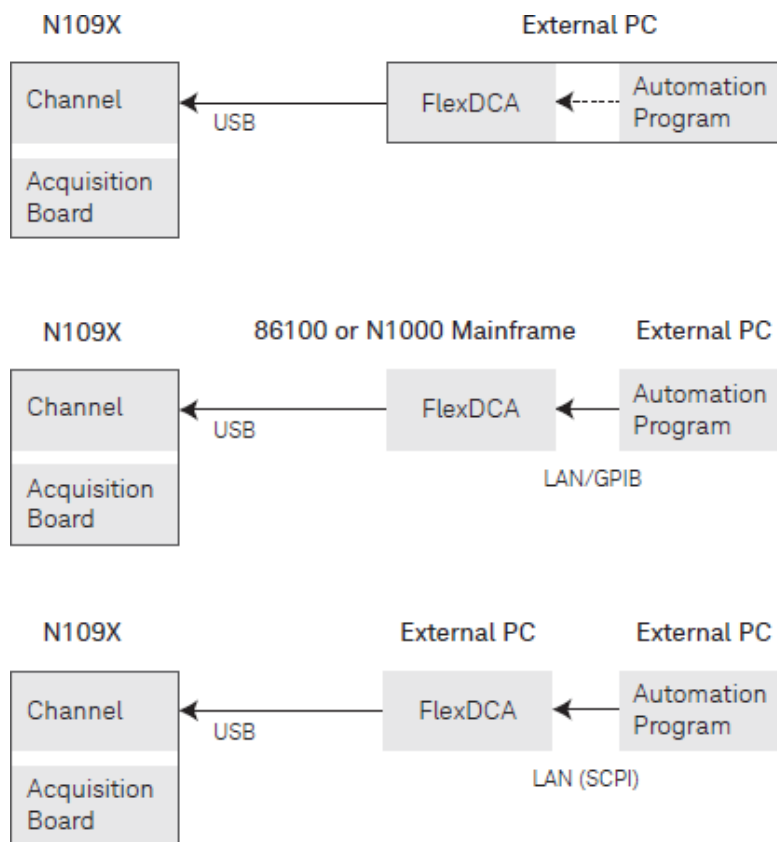


Figure 1. Connection Schemes

## 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

- 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 (64bit)

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](http://www.keysight.com/find/flexdca_download). Remote programs previously developed using the 86100 or N1000 FlexDCA interface can be leveraged directly to control an automated N1092A/B/C/D/E system. Use FlexDCA SCPI programming tools to simplify conversion of legacy 86100-based automation to FlexDCA compatible code. Measurement results are generally faster with the new N1092A/B/C/D/E due to significantly faster sampling rates.

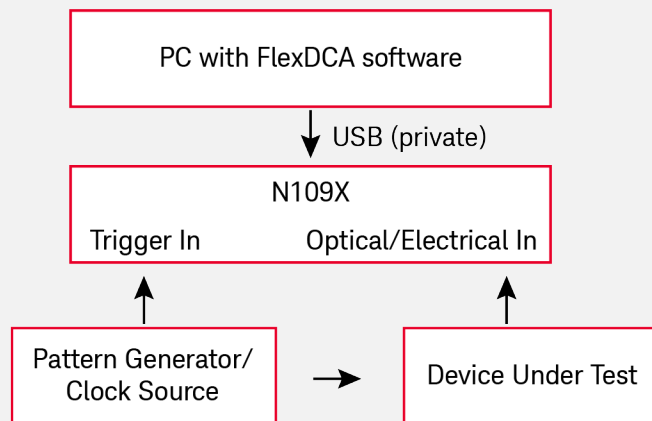


Figure 2. N1090X Test Setup

Similar to the 86100 and N1000, a reference clock, synchronous with the signal being measured, is required to trigger the N109X. Timebase calibration, previously performed at service centers, can now be performed by users, reducing cost of ownership and instrument down time

## Module SIRC Filters

System Impulse Response Correction (SIRC) filters provide channel SIRC measurement and data files to give an ideal channel response. SIRC data can be applied in FlexDCA's System Impulse Response Correction dialog. The SIRC correction data feature is a digital filter that is used to:

- Improve the response of module reference filters to more closely match an ideal receiver.
- Enable non-standard reference receiver rates or bandwidths.
- Increase the bandwidth of the channel by up to 50%.
- Ensures that an eye diagram will look identical between different modules.

SIRC correction data is unique to a specific N1092A/B/C/D/E serial number. The data can be purchased with new modules or purchased as an upgrade for your existing modules. Purchasing data for an existing module requires that the module be returned to Keysight Technologies. To order SIRC data, contact your Keysight representative or visit <http://www.keysight.com/Find/FlexDCA>.

### N1092-Series SIRC filter ranges

| Module/Option                     | Channel     | Range <sup>1</sup>   |                       |
|-----------------------------------|-------------|----------------------|-----------------------|
|                                   |             | Min SIRC Freq.       | Max SIRC Freq.        |
| N1092x Option 30A                 | All Optical | 12.89 GBd (9.67 GHz) | 53.125 GBd (39.8 GHz) |
| N1092x Option 40A                 | All Optical | 12.89 GBd (9.67 GHz) | 64 GBd (48 GHz)       |
| N1092x Options 30A <i>and</i> 168 | All Optical | 8.4 GBd (6.3 GHz)    | 53.125 GBd (39.8 GHz) |

<sup>1</sup> Only available with option IRC and compliance not guaranteed.

## N1092A/B/C/D/E Specifications

### N1092A/B/C/D/E (Option 30A) optical channel specifications

| Item   | Description   |         |         |
|--|---|---------|---------|
| Optical Channel Count                                    | 1 (N1092A/C)<br>2 (N1092B/E)<br>4 (N1092D)              |         |         |
| Optical Channel Bandwidth, -3 dBo                        | 28 GHz(characteristic) <sup>1</sup>                     |         |         |
| Nominal Wavelength Range                                 | 830 nm to 1600 nm                                       |         |         |
| Factory calibrated wavelengths <sup>2</sup>              | 850 nm (±20 nm)<br>1310 nm (±20 nm)<br>1550 nm (±20 nm) |         |         |
| User calibration wavelength range                        | 830 nm to 1600 nm                                       |         |         |
| <b>RMS Noise (Characteristic)</b>                        | 850 nm  | 1310 nm | 1550 nm |
| 100GBASE-SR4 TDEC (12.6 GHz filter)                      | 5 µW  | 3 µW    | 3.5 µW  |
| 20.625 Gb/s  | 7 µW  | 5 µW    | 5 µW    |
| 25 Gb/s Ethernet (25.78125 Gb/s)                         | 8 µW  | 5.5 µW  | 5.5 µW  |
| 400GBASE-SR16 (26.5625 Gb/s)                             | 8 µW  | 5.5 µW  | 5.5 µW  |
| Ethernet OTU4 FEC/ITU-T G.959.1 (27.952493 Gb/s)         | 9.5 µW  | 6 µW    | 6 µW    |
| 32G Fibre Channel (28.05 Gb/s)                           | 9.5 µW  | 6 µW    | 6 µW    |
| <b>RMS Noise (Maximum)</b>                               | 850 nm  | 1310 nm | 1550 nm |
| 100GBASE-SR4 TDEC (12.6 GHz filter)                      | 7 µW  | 5 µW    | 5.5 µW  |
| 20.625 Gb/s  | 9 µW  | 7 µW    | 7.5 µW  |
| 25 Gb/s Ethernet (25.78125 Gb/s)                         | 10 µW   | 7 µW    | 7.5 µW  |
| 400GBASE-SR16 (26.5625 Gb/s)                             | 10 µW   | 7 µW    | 7.5 µW  |
| Ethernet OTU4 FEC/ITU-T G.959.1 (27.952493 Gb/s)         | 11 µW   | 8 µW    | 8.5 µW  |
| 32G Fibre Channel (28.05 Gb/s)                           | 11 µW   | 8 µW    | 8.5 µW  |
| <b>Optical Sensitivity (Characteristic) <sup>3</sup></b> | 850 nm  | 1310 nm | 1550 nm |

|  |   |           |           |
|--|---|-----------|-----------|
| 20.625 Gb/s  | -11.5 dBm   | -13.0 dBm | -13.0 dBm |
| 25 Gb/s Ethernet (25.78125 Gb/s)                               | -11 dBm   | -12.5 dBm | -12.5 dBm |
| 400GBASE-SR16 (26.5625 Gb/s)                                   | -11 dBm   | -12.5 dBm | -12.5 dBm |
| Ethernet OTU4 FEC/ITU-T G.959.1 (27.952493 Gb/s)               | -10 dBm   | -12 dBm   | -12 dBm   |
| 32G Fibre Channel (28.05 Gb/s)                                 | -10 dBm   | -12 dBm   | -12 dBm   |
| <b>Scale Factor Specifications (per division, 8 divisions)</b> |   |           |           |
| Minimum  | 5 $\mu$ W   |           |           |
| Maximum  | 500 $\mu$ W   |           |           |
| CW Offset Range <sup>4</sup>                                   | +1.0 mW to -3 mW  |           |           |
| CW Accuracy <sup>5</sup>                                       |   |           |           |
| Single-Mode  | $\pm 15 \mu\text{W} \pm 1.5\%$ of reading $\pm$ connector uncertainty (Characteristic)<br>$\pm 30 \mu\text{W} \pm 3\%$ of reading $\pm$ connector uncertainty |           |           |
| Multimode  | $\pm 25 \mu\text{W} \pm 10\%$ of reading $\pm$ connector uncertainty (Characteristic)   |           |           |
| <b>Maximum Measureable Input Power</b>                         |   |           |           |
| 100GBASE-SR4 TDEC (12.6 GHz filter) <sup>6</sup>               | 4 mW at 500 $\mu$ W/division scale factor (Characteristic)<br>3 mW at 500 $\mu$ W/division scale factor   |           |           |
| 20.625 Gb/s  | 4 mW at 500 $\mu$ W/division scale factor   |           |           |
| 25 Gb/s Ethernet (25.78125 Gb/s)                               | 4 mW at 500 $\mu$ W/division scale factor   |           |           |
| 400GBASE-SR16 (26.5625 Gb/s)                                   | 4 mW at 500 $\mu$ W/division scale factor   |           |           |
| Ethernet OTU4 FEC/ITU-T G.959.1 (27.952493 Gb/s)               | 4 mW at 500 $\mu$ W/division scale factor   |           |           |
| 32G Fibre Channel (28.05 Gb/s)                                 | 4 mW at 500 $\mu$ W/division scale factor   |           |           |
| <b>Average Power Monitor Range</b>                             | -30 dBm to 0 dBm (850 nm)<br>-30 dBm to +6 dBm (1310 nm)<br>-30 dBm to +6 dBm (1550 nm)   |           |           |
| <b>Average Power Monitor Accuracy <sup>7, 8</sup></b>          |   |           |           |
| Single-Mode  | 200 nW $\pm 5\%$ of reading $\pm$ connector uncertainty   |           |           |
| Multimode  | 200 nW $\pm 10\%$ of reading $\pm$ connector uncertainty (Characteristic)   |           |           |



|                                 |                |
|---------------------------------|----------------|
| Maximum Non-destruct Peak Power | 8 mW (+9 dBm)  |
| Fiber Input <sup>9</sup>        | 50/125 $\mu$ m |
| Fiber Input Connector           | FC             |
| Channel ADC                     | 16 bits        |

<sup>1</sup> With the 32G Fibre Channel reference receiver filter selected, -3 dBo is calculated from the -6 dBe point.

<sup>2</sup> For the average power monitor and the channel vertical path.

<sup>3</sup> Generally represents the power level where an ideal eye diagram will approach 0% mask margin due to the noise of the oscilloscope. Provides a *non-specified* figure of merit to compare sensitivities of various optical channels. These values are calculated from the characteristic noise values.

<sup>4</sup> Referenced two divisions from screen bottom.

<sup>5</sup> Single marker, referenced to power sensor.

<sup>6</sup> When a TDEC filter is used any portion of the signal that is displayed above 3 mW is not warranted.

<sup>7</sup> 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.

<sup>8</sup> Average power monitor accuracy is tied to the calibration accuracy of the power sensor.

<sup>9</sup> Compatible with external fibers with <50  $\mu$ m cores.

## N1092A/B/C/D/E (Option 40A) optical channel specifications without Option CDR

| Item   | Description                                |           |
|--|--|-----------|
| Optical Channel Count                                    | 1 (N1092A/C)<br>2 (N1092B/E)<br>4 (N1092D) |           |
| Optical Channel Bandwidth, -3 dBo                        | 45 GHz (characteristic) <sup>1</sup>       |           |
| Nominal Wavelength Range                                 | 1250 nm to 1600 nm                         |           |
| Factory calibrated wavelengths <sup>2</sup>              | 1310 nm (±20 nm)<br>1550 nm (±20 nm)       |           |
| User calibration wavelength range                        | 1250 nm to 1600 nm                         |           |
| <b>RMS Noise (Characteristic)</b>                        | 1310 nm                                    | 1550 nm   |
| 25 Gb/s Ethernet (25.78125 Gb/s)                         | 5.5 µW                                     | 6.5 µW    |
| 400GBASE-SR16 (26.5625 Gb/s)                             | 5.5 µW                                     | 6.5 µW    |
| Ethernet OTU4 FEC/ITU-T G.959.1 (27.952493 Gb/s)         | 6 µW                                       | 6.5 µW    |
| 32G Fibre Channel (28.05 Gb/s)                           | 6 µW                                       | 6.5 µW    |
| 53.125 GBaud PAM4 TDECQ (26.6 GHz)                       | 6 µW                                       | 7.0 µW    |
| Unfiltered   | 11 µW                                      | 14 µW     |
| <b>RMS Noise (Maximum)</b>                               | 1310 nm                                    | 1550 nm   |
| 25 Gb/s Ethernet (25.78125 Gb/s)                         | 7 µW                                       | 7.5 µW    |
| 400GBASE-SR16 (26.5625 Gb/s)                             | 7 µW                                       | 7.5 µW    |
| Ethernet OTU4 FEC/ITU-T G.959.1 (27.952493 Gb/s)         | 8 µW                                       | 8.5 µW    |
| 32G Fibre Channel (28.05 Gb/s)                           | 8 µW                                       | 8.5 µW    |
| 53.125 GBaud PAM4 TDECQ (26.6 GHz)                       | 9 µW                                       | 9.5 µW    |
| Unfiltered   | 14 µW                                      | 17 µW     |
| <b>Optical Sensitivity (Characteristic) <sup>3</sup></b> | 1310 nm                                    | 1550 nm   |
| 25 Gb/s Ethernet (25.78125 Gb/s)                         | -12.5 dBm                                  | -12.5 dBm |
| 400GBASE-SR16 (26.5625 Gb/s)                             | -12.5 dBm                                  | -12.5 dBm |

|  |   |         |
|--|---|---------|
| Ethernet OTU4 FEC/ITU-T G.959.1<br>(27.952493 Gb/s)            | -12 dBm   | -12 dBm |
| 32G Fibre Channel (28.05 Gb/s)                                 | -12 dBm   | -12 dBm |
| <b>Scale Factor Specifications (per division, 8 divisions)</b> |   |         |
| Minimum  | 5 $\mu$ W   |         |
| Maximum  | 500 $\mu$ W   |         |
| CW Offset Range <sup>4</sup>                                   | +1.0 mW to -3 mW  |         |
| CW Accuracy (single mode) <sup>5</sup>                         | $\pm 15 \mu\text{W} \pm 1.5\%$ of reading $\pm$ connector uncertainty<br><b>(Characteristic)</b><br>$\pm 30 \mu\text{W} \pm 3\%$ of reading $\pm$ connector uncertainty |         |
| <b>Maximum Measureable Input Power</b>                         |   |         |
| 25 Gb/s Ethernet (25.78125 Gb/s)                               | 4 mW at 500 $\mu$ W/division scale factor   |         |
| 400GBASE-SR16 (26.5625 Gb/s)                                   | 4 mW at 500 $\mu$ W/division scale factor   |         |
| Ethernet OTU4 FEC/ITU-T G.959.1<br>(27.952493 Gb/s)            | 4 mW at 500 $\mu$ W/division scale factor   |         |
| 32G Fibre Channel (28.05 Gb/s)                                 | 4 mW at 500 $\mu$ W/division scale factor   |         |
| 53.125 GBaud PAM4 TDECQ (26.6 GHz)                             | 4 mW at 500 $\mu$ W/division scale factor   |         |
| Unfiltered   | 4 mW at 500 $\mu$ W/division scale factor   |         |
| Average Power Monitor Range                                    | -30 dBm to +6 dBm (1310 nm)<br>-30 dBm to +6 dBm (1550 nm)  |         |
| Average Power Monitor Accuracy <sup>6</sup>                    |   |         |
| For $0 \text{ mW} \leq P_{\text{input}} \leq 2 \text{ mW}$     | 200 nW $\pm$ 5% of reading $\pm$ connector uncertainty  |         |
| For $2 \text{ mW} \leq P_{\text{input}} \leq 4 \text{ mW}$     | 200 nW $\pm$ 10% of reading - 100 $\mu$ W $\pm$ connector uncertainty   |         |
| Maximum Non-destruct Peak Power                                | 5 mW (+7 dBm)   |         |
| Fiber Input  | 9/125 $\mu$ m   |         |
| Fiber Input Connector  | FC  |         |
| Channel ADC  | 16 bits   |         |

<sup>1</sup> With the unfiltered setting selected, -3 dBo is calculated from the -6 dBc point.

<sup>2</sup> For the average power monitor and the channel vertical path.

<sup>3</sup> Generally represents the power level where an ideal eye diagram will approach 0% mask margin due to the noise of the oscilloscope. Provides a *non-specified* figure of merit to compare sensitivities of various optical channels. These values are calculated from the characteristic noise values.

<sup>4</sup> Referenced two divisions from screen bottom.

<sup>5</sup> Single marker, referenced to power sensor.

<sup>6</sup> Average power monitor accuracy is tied to the calibration accuracy of the power sensor.

## N1092A/B (Option 40A) optical channel specifications with Option CDR

| Item   | Description                          |           |
|--|--------------------------------------|-----------|
| Optical Channel Count                                    | 1 (N1092A)<br>2 (N1092B)             |           |
| Optical Channel Bandwidth, -3 dBo                        | 45 GHz (characteristic) <sup>1</sup> |           |
| Nominal Wavelength Range                                 | 1250 nm to 1600 nm                   |           |
| Factory calibrated wavelengths <sup>2</sup>              | 1310 nm (±20 nm)<br>1550 nm (±20 nm) |           |
| User calibration wavelength range                        | 1250 nm to 1600 nm                   |           |
| <b>RMS Noise (Characteristic)</b>                        | 1310 nm                              | 1550 nm   |
| 25 Gb/s Ethernet (25.78125 Gb/s)                         | 6.5 µW                               | 7 µW      |
| 400GBASE-SR16 (26.5625 Gb/s)                             | 6.5 µW                               | 7 µW      |
| Ethernet OTU4 FEC/ITU-T G.959.1 (27.952493 Gb/s)         | 6.5 µW                               | 7 µW      |
| 32G Fibre Channel (28.05 Gb/s)                           | 6.5 µW                               | 7 µW      |
| 53.125 GBaud PAM4 TDECQ (26.6 GHz)                       | 7.5 µW                               | 8 µW      |
| Unfiltered   | 17 µW                                | 17.5 µW   |
| <b>RMS Noise (Maximum)</b>                               | 1310 nm                              | 1550 nm   |
| 25 Gb/s Ethernet (25.78125 Gb/s)                         | 9 µW                                 | 9.5 µW    |
| 400GBASE-SR16 (26.5625 Gb/s)                             | 9 µW                                 | 9.5 µW    |
| Ethernet OTU4 FEC/ITU-T G.959.1 (27.952493 Gb/s)         | 9 µW                                 | 9.5 µW    |
| 32G Fibre Channel (28.05 Gb/s)                           | 9 µW                                 | 9.5 µW    |
| 53.125 GBaud PAM4 TDECQ (26.6 GHz)                       | 9.5 µW                               | 10 µW     |
| Unfiltered   | 22 µW                                | 22.5 µW   |
| <b>Optical Sensitivity (Characteristic) <sup>3</sup></b> | 1310 nm                              | 1550 nm   |
| 25 Gb/s Ethernet (25.78125 Gb/s)                         | -11.5 dBm                            | -11.0 dBm |

|  |  |           |
|--|--|-----------|
| 400GBASE-SR16 (26.5625 Gb/s)                                   | -11.5 dBm  | -11.0 dBm |
| Ethernet OTU4 FEC/ITU-T G.959.1 (27.952493 Gb/s)               | -11.5 dBm  | -11.0 dBm |
| 32G Fibre Channel (28.05 Gb/s)                                 | -11.5 dBm  | -11.0 dBm |
| <b>Scale Factor Specifications (per division, 8 divisions)</b> |  |           |
| Minimum  | 5 $\mu$ W  |           |
| Maximum  | 500 $\mu$ W  |           |
| CW Offset Range <sup>4</sup>                                   | +1.0 mW to -3 mW   |           |
| CW Accuracy (single mode) <sup>5</sup>                         | $\pm 15 \mu\text{W} \pm 1.5\%$ of reading $\pm$ connector uncertainty<br>(Characteristic)<br>$\pm 30 \mu\text{W} \pm 3\%$ of reading $\pm$ connector uncertainty |           |
| <b>Maximum Measureable Input Power</b>                         |  |           |
| 25 Gb/s Ethernet (25.78125 Gb/s)                               | 4 mW at 500 $\mu$ W/division scale factor  |           |
| 400GBASE-SR16 (26.5625 Gb/s)                                   | 4 mW at 500 $\mu$ W/division scale factor  |           |
| Ethernet OTU4 FEC/ITU-T G.959.1 (27.952493 Gb/s)               | 4 mW at 500 $\mu$ W/division scale factor  |           |
| 32G Fibre Channel (28.05 Gb/s)                                 | 4 mW at 500 $\mu$ W/division scale factor  |           |
| 53.125 GBaud PAM4 TDECQ (26.6 GHz)                             | 4 mW at 500 $\mu$ W/division scale factor  |           |
| Unfiltered   | 4 mW at 500 $\mu$ W/division scale factor  |           |
| Average Power Monitor Range                                    | -30 dBm to +6 dBm (1310 nm)<br>-30 dBm to +6 dBm (1550 nm)   |           |
| Average Power Monitor Accuracy <sup>6</sup>                    |  |           |
| For $0 \text{ mW} \leq P_{\text{input}} \leq 2 \text{ mW}$     | 200 nW $\pm$ 5% of reading $\pm$ connector uncertainty   |           |
| For $2 \text{ mW} \leq P_{\text{input}} \leq 4 \text{ mW}$     | 200 nW $\pm$ 10% of reading - 100 $\mu$ W $\pm$ connector uncertainty  |           |
| Maximum Non-destruct Peak Power                                | 5 mW (+7 dBm)  |           |
| Fiber Input  | 9/125 $\mu$ m  |           |
| Fiber Input Connector  | FC   |           |
| Channel ADC  | 16 bits  |           |

<sup>1</sup> With the unfiltered setting selected, -3 dBo is calculated from the -6 dBc point.

<sup>2</sup> For the average power monitor and the channel vertical path.

<sup>3</sup> Generally represents the power level where an ideal eye diagram will approach 0% mask margin due to the noise of the oscilloscope. Provides a *non-specified* figure of merit to compare sensitivities of various optical channels. These values are calculated from the characteristic noise values.

<sup>4</sup> Referenced two divisions from screen bottom.

<sup>5</sup> Single marker, referenced to power sensor.

<sup>6</sup> Average power monitor accuracy is tied to the calibration accuracy of the power sensor.



## N1092C/E electrical channel specifications

| Item   | Description   |
|--|---|
| Electrical Channel Count   | 2 (N1092C/E)  |
| Electrical Input Connectors                                      | 2.4 mm (m) bulkhead                                       |
| Bandwidth, -3 dB (user selectable)                               | 20, 33, 40, and 50 GHz <sup>1</sup>                       |
| <b>Transition Time (10% to 90% calculated from TR = 0.35/BW)</b> |   |
| 20 GHz BW  | 17.5 ps (Calculated)                                      |
| 33 GHz BW  | 10.6 ps (Calculated)                                      |
| 40 GHz BW  | 8.8 ps (Calculated)                                       |
| 50 GHz BW  | 7.0 ps (Calculated)                                       |
| Channel-to-Channel Skew Range                                    | ±100 ps   |
| <b>RMS Noise</b>   |   |
| 20 GHz BW  | 275 μV (Characteristic)                                   |
| 33 GHz BW  | 420 μV (Characteristic)                                   |
| 40 GHz BW  | 450 μV (Characteristic)                                   |
| 50 GHz BW  | 500 μV (Characteristic)                                   |
| RMS Noise (Maximum)  | 700 μV  |
| <b>Scale Factor (per division)</b>                               |   |
| Minimum  | 1 mV/division   |
| Maximum  | 100 mV/division   |
| DC Accuracy (V <sub>AVG</sub> Measurement)                       | ±2 mV ±4% (reading – offset)<br>±1.15 mV (Characteristic) |
| DC Offset Range<br>(referenced to center of screen)              | ±500 mV   |
| Input Dynamic Range<br>(relative to channel offset)              | ±400 mV   |
| Maximum Input Signal   | ± 2V (+16 dBm)  |
| Nominal Input Impedance  | 50Ω   |

<sup>1</sup> Tuned to be -3 dB (±measurement uncertainty) at stated bandwidth(s) using NIST traceable swept-sine test system.

## N1092A/B/C/D/E horizontal timebase specifications

| Item   | Description  |
|--|--|
| Scale Factor                                   | Full scale is ten divisions  |
| Minimum  | 100 fs/div   |
| Maximum  | 100 $\mu$ s/div  |
| Sample Delay <sup>1</sup>                      | < 10 ns  |
| Time Interval Accuracy (in pattern lock mode)  | $\pm 0.3\%$ of $1/(\text{clock input frequency})$ or $\pm 1.2$ ps (whichever is smaller) (Characteristic) <sup>2</sup><br>$\pm 150$ fs $\pm 1\%$ of $1/(\text{clock input frequency})$ or $\pm 4$ ps (whichever is smaller) <sup>3</sup> |
| Time Interval Accuracy (in clock trigger mode) | $\pm 0.3\%$ of timespan or $\pm 1.2$ ps (whichever is smaller) (Characteristic) <sup>2</sup><br>$\pm 150$ fs $\pm 1\%$ of timespan or $\pm 4$ ps (whichever is smaller) <sup>3</sup>   |
| Time Interval Resolution <sup>4</sup>          | (screen diameter)/(record length) or 50 fs, whichever is larger  |
| Jitter <sup>5</sup>                            |  |
| Option STB                                     | 400 fs rms (Characteristic)  |
|  | 450 fs rms   |
| Option LOJ                                     | 160 fs rms (Characteristic)  |
|  | 200 fs rms   |
| Display Units                                  | Bits or Time   |
| Record length                                  | 16 to 131,072 samples. Increments of 1   |
| Sample rate <sup>6</sup>                       |  |
| Standard                                       | Up to 100 kHz  |
| Option FS1                                     | Up to 250 kHz  |

<sup>1</sup> Time delay between the front panel clock input and when a sample is taken on the front panel channel input.

<sup>2</sup> Dual marker measurement performed at a temperature within  $\pm 1$ C of horizontal calibration temperature.

<sup>3</sup> Dual marker measurement performed at a temperature within  $\pm 5$ C of horizontal calibration temperature.

<sup>4</sup> The time interval resolution is the smallest time spacing between two points.

<sup>5</sup> Verified with a clock slew rate greater than 40V/ns and optical signal slew rate greater than 150  $\mu$ W/ps.

<sup>6</sup> Each channel samples at the specified sample rate regardless of the number of channels.

## N1092A/B/C/D/E clock input specifications

| Item                             | Description   |
|----------------------------------|---|
| Clock Input Non-destruct Voltage | 1.4 Vp-p  |
| Clock Input Frequency            | 500 MHz to 32 GHz (28.5 GHz for all units with serial number prefix US5614 or less) (full rate or sub-rate clocks, pattern lock mode on or off)<br>100 MHz to 500 MHz (sub-rate clocks only, pattern lock off, provided that the data rate exceeds 500 Mb/s and the clock divide ratio is a power of two) |
| Clock Input Sensitivity          | 200 mVp-p   |
| Minimum Clock Slew Rate          | 0.5 V/ns  |
| Nominal Input Impedance          | 50Ω (AC coupled)  |
| Clock Input Connector            | 2.92 mm (female)  |

## N1092A/B (Option 40A) clock recovery specifications with Option CDR

| Item  | Description   |                 |                              |                             |
|---|---|-----------------|------------------------------|-----------------------------|
| Data Rates Input Range  |   |                 |                              |                             |
| Option CDR  | 24 GBd - 29 GBd                                       | 48 GBd - 58 GBd |                              |                             |
| Minimum Optical Modulation Amplitude (OMA) to achieve lock (Open eye)<br>NRZ and PAM4 (OMA) 1310 nm/1550 nm, verified with clean open eye at 26.56 GBd and 53.125 GBd |   |                 |                              |                             |
| Option CDR  | 400 $\mu$ W   |                 |                              |                             |
|   | 180 $\mu$ W at 26.56 GBd (Characteristic)             |                 |                              |                             |
|   | 250 $\mu$ W at 53.125 GBd (Characteristic)            |                 |                              |                             |
| PAM4 Stressed Eye 1310 nm/1550 nm (Clock recovery locks under these conditions)   |   |                 |                              |                             |
|   | Baud Rate   | Pattern         | Outer OMA                    | TDECQ                       |
| Option CDR  | 26.56 GBd   | SSPRQ           | -5.1 dBm<br>(Characteristic) | ~3.4 dB<br>(Characteristic) |
|   | 53.125 GBd  | SSPRQ           | -0.8 dBm<br>(Characteristic) | ~3.4 dB<br>(Characteristic) |
| Recovered Clock Out   |   |                 |                              |                             |
| Amplitude   | $\geq$ 200 mVpp                                       |                 |                              |                             |
| Divide ratio (user selectable)  | 1, 2, 4, 8, 16, 32                                    |                 |                              |                             |
| Front panel connector type and interface  | 2.92 mm (m), 50 $\Omega$ , DC coupled                 |                 |                              |                             |
| Random jitter   | 200 fs maximum<br>150 fs @ 26.56 GHz (Characteristic) |                 |                              |                             |
| Clock recovery adjustable loop bandwidth range (user selectable)  | 0.5 MHz to 10 MHz (depends on Baud Rate)              |                 |                              |                             |
| Clock recovery loop peaking range   | Up to 4 settings (dependent on loop BW)               |                 |                              |                             |
| Loop bandwidth accuracy <sup>1, 2</sup>   | $\pm$ 30%, (Characteristic)                           |                 |                              |                             |
| Acquisition range   | $\pm$ 300 ppm, (Characteristic)                       |                 |                              |                             |
| Maximum consecutive identical digits to lock  | 150 (Characteristic)                                  |                 |                              |                             |
| Auto relocking  | Yes (user enabled)                                    |                 |                              |                             |

|  |  |
|--|--|
| Internal frequency counter accuracy      | $\pm 10$ ppm<br>4 ppm (Characteristic) |
| Clock Trigger Out (12.0 - 14.5 GHz)      |  |
| Amplitude                                | 700mV (Characteristic)                 |
| Frequency range                          | 12.0 - 14.5 GHz                        |
| Front panel connector type and interface | 2.92 mm (m), 50 $\Omega$ , DC coupled  |
| Random jitter                            | 80 fs (Characteristic)                 |

<sup>1</sup>PLL bandwidth is calibrated and verified using clean 26.5625 GBd and 53.125 GBd NRZ and PAM4 signals with FlexDCA clock recovery loop tuning enabled.

<sup>2</sup>Actual PLL bandwidth may vary due to several factors, including pattern characteristics (low/high transition density), signaling format (NRZ/PAM4), and signal quality (open/closed eyes).



## N1092A/B/C/D/E environmental specifications

| Item                                   | Description  |                  |                |
|--|--|------------------|----------------|
| Use                                    | Indoor   |                  |                |
| Temperature                            |  |                  |                |
| Operating                              | +10°C to +40°C (+50°F to +104°F)   |                  |                |
| Non-operating                          | -40°C to +70°C (-40°F to +158°F)   |                  |                |
| Altitude (Operating)                   | Up to 4,600 meters (15,000 ft)   |                  |                |
| Humidity <sup>1</sup>                  | Type tested at 95%, +40°C (non-condensing)   |                  |                |
| Line Power                             | 100/120Vac, 50/60/400 Hz   |                  |                |
|  | 220/240Vac, 50/60 Hz   |                  |                |
|  | 290 Watts Maximum  |                  |                |
|  | The products can operate with mains supply voltage fluctuations up to ±10% of the nominal voltage. |                  |                |
| Volts-Amperes (VA)<br>(Characteristic) | Option 30A   | Option 40A       | Option CDR     |
| N1092A                                 | 48 VA  | 48 VA            | 70 VA          |
| N1092B                                 | 52 VA  | 50 VA            | 82 VA          |
| N1092C                                 | 52 VA  | 52 VA            | —              |
| N1092D                                 | 60 VA  | 54 VA            | —              |
| N1092E                                 | 52 VA  | 54 VA            | —              |
| Weight (Characteristic)                | Option 30A   | Option 40A       | Option CDR     |
| N1092A                                 | 6.0 kg (13.4 lb)   | 6.0 kg (13.4 lb) | 6.8 kg (15 lb) |
| N1092B                                 | 6.1 kg (13.6 lb)   | 6.1 kg (13.6 lb) | 6.8 kg (15 lb) |
| N1092C                                 | 6.1 kg (13.6 lb)   | 6.1 kg (13.6 lb) | —              |
| N1092D                                 | 6.3 kg (14.0 lb)   | 6.3 kg (14.0 lb) | —              |
| N1092E                                 | 6.1 kg (13.6 lb)   | 6.1 kg (13.6 lb) | —              |

| Dimensions                             |   |
|--|---|
| Without front connectors and rear feet | 88.26 mm H x 207.40 mm W x 485 mm D<br>(3.48 inch x 8.17 inch x 19.01 inch)     |
| With front connectors and rear feet    | 103.31 mm H x 219.56 mm W x 517.80 mm D<br>(4.07 inch x 8.64 inch x 20.39 inch) |
| With front cover and rear feet         | 110.18 mm H x 219.56 mm W x 550.71 mm D<br>(4.34 inch x 8.64 inch x 21.68 inch) |

1. Samples of this product have been type tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of Storage, Transportation and End-use; those stresses include but are not limited to temperature, humidity, shock, vibration, altitude, and power line conditions. Test Methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-28800F Class 3.

## Ordering Information — N1092A/B/C/D/E

The legacy FlexDCA feature-based software options such as 200, 201, etc. have been replaced with the following new FlexDCA Sampling Oscilloscope Software Packages.

Keysight recommends the use of the FlexDCA software PACKAGES which can be installed on the PC controlling your DCA-M (they cannot be installed directly on the DCA-M).

The legacy FlexDCA feature-based software options such as 200, 201, etc. are available for a limited time and can be installed by the factory on your new DCA-M.

Support subscriptions are available for FlexDCA software PACKAGES which enable both bug fixes and new functionality. The software FEATURE-based options will get no new functionality.

### N1010100A research and development package for FlexDCA sampling oscilloscope software

This package is Intended for R&D engineers who want to characterize their design and gain more insights into why a signal deviates from the expected performance.

### N1010200A manufacturing package for FlexDCA sampling oscilloscope software

This package focuses on cost of test in Optical Transceiver manufacturing applications with capabilities like RapidEye and FlexEye that enhance measurement speed and flexibility and includes measurements like TDECQ.

### N1010300A signal integrity package for FlexDCA sampling oscilloscope software

This package adds powerful tools to measure impedances, transfer characteristics and S-parameter calculations to the basic TDR/TDT measurements.

**NOTE:** For additional details regarding configuring your N1092X DCA-M, refer to the *DCA Wide-Bandwidth Oscilloscope Family Configuration Guide* available on [Keysight.com](http://Keysight.com).

| Model/option number | Description   |
|---------------------|---|
| N1092A              | Single optical channel oscilloscope   |
| N1092B              | Dual optical channel oscilloscope   |
| N1092C              | Single optical, dual electrical channel oscilloscope                          |
| N1092D              | Quad optical channel oscilloscope   |
| N1092E              | Dual optical, dual electrical channel oscilloscope                            |
| N1092x-30A          | 30 GHz amplified  |
| N1092x-40A          | > 40 GHz amplified (includes an unfiltered path and 53 GBd PAM4 TDECQ filter) |
| N1092x-280          | 25.781, 27.739, 27.952, 28.050 Gbaud filters (mandatory)                      |
| N1092x-LOJ          | Low jitter timebase   |
| N1092x-STB          | Standard timebase   |
| N1092x-PLK          | Pattern lock capability   |
| N1092x-FS1          | Fast sampling rate  |
| N1092x-200          | Enhanced jitter analysis software, fixed perpetual license                    |
| N1092A/B-CDR        | 25 to 29 GBd and 53 to 58 GBd Clock data recovery                             |
| N1092x-201          | Advanced waveform analysis software, fixed perpetual license                  |
| N1092x-300          | Advanced amplitude analysis/Rin/Q-Factor, fixed perpetual license             |
| N1092x-401          | Advanced eye analysis software, fixed perpetual license                       |
| N1092x-500          | Productivity package, fixed perpetual license                                 |
| N1092x-9FP          | PAM-N analysis SW, fixed perpetual license                                    |
| N1092x-TFP          | IEEE TDECQ analysis, fixed perpetual license                                  |
| N1092x-PLK          | Pattern lock trigger hardware   |
| N1092x-IRC          | Impulse response correction   |
| N1092x-EFP          | FlexEye Independent Channel Acquisition and Control                           |
| N1092x-SIM          | InfiniiSim-DCA waveform transformation SW, fixed perpetual license            |
| N1092x-168          | Additional 25.78 Gb/s TDEC filter (requires Option 500)                       |
| N1092x-206          | Additional 20.625 Gb/s filter   |

|            |   |
|------------|---|
| N1092x-C0C | Certificate of Calibration                        |
| N1092x-UK6 | Commercial calibration certificate with test data |
| N1092x-1CM | Single instrument rack mount kit                  |
| N1092x-1CN | Dual instrument side-by-side rack mount kit       |

## Application Software

| SW Application Model | SW Application Description<br><i>See the application software datasheet to confirm hardware requirements.</i> |
|----------------------|---|
| N109228CA            | Electrical TX Test SW for OIF-CEI-3.1   |
| N109310CA            | Electrical TX Test SW for SFF-8431 (SFP+)   |
| D9010UDAA            | User Defined Application Software (for DCA-X and RT Scopes)   |
| N1091APCA            | Electrical TX Test SW for IEEE 802.3ap/bj (10G/40G)   |
| N1091BMCA            | Electrical TX Test SW for IEEE 802.3bm  |
| N1091BACA            | Electrical TX Test SW for IEEE 802.3ba (40G/100G)   |
| N1091BJCA            | Electrical TX Test SW for IEEE 802.3bj (100G)   |
| N1091BSCB            | Electrical TX Test SW for IEEE 802.3bs/cd   |
| N109256CB            | Electrical TX Test SW for OIF-CEI-4.0   |
| N1095BSCA            | Optical TX Test SW for IEEE 802.3bs/cd  |
| N1094BS1A            | PAM4 Measurement Software Development Kit.  |
| N1092x-C0C           | Certificate of Calibration  |
| N1092x-UK6           | Commercial calibration certificate with test data   |
| N1092x-1CM           | Single instrument rack mount kit  |
| N1092x-1CN           | Dual instrument side-by-side rack mount kit   |

## Application Software

| SW Application Model | SW Application Description<br><i>See the application software datasheet to confirm hardware requirements.</i> |
|----------------------|---|
| N109228CA            | Electrical TX Test SW for OIF-CEI-3.1   |
| N109310CA            | Electrical TX Test SW for SFF-8431 (SFP+)   |
| D9010UDAA            | User Defined Application Software (for DCA-X and RT Scopes)   |
| N1091APCA            | Electrical TX Test SW for IEEE 802.3ap/bj (10G/40G)   |
| N1091BMCA            | Electrical TX Test SW for IEEE 802.3bm  |
| N1091BACA            | Electrical TX Test SW for IEEE 802.3ba (40G/100G)   |
| N1091BJCA            | Electrical TX Test SW for IEEE 802.3bj (100G)   |
| N1091BSCB            | Electrical TX Test SW for IEEE 802.3bs/cd   |
| N109256CB            | Electrical TX Test SW for OIF-CEI-4.0   |
| N1095BSCA            | Optical TX Test SW for IEEE 802.3bs/cd  |
| N1094BS1A            | PAM4 Measurement Software Development Kit.  |

N1010A FlexDCA software is required on the PC controlling the N1092A/B/C/D/E DCA-M. It is available as a free download at [www.keysight.com/find/flexdca\\_download](http://www.keysight.com/find/flexdca_download).

[www.keysight.com/find/n1092a](http://www.keysight.com/find/n1092a)

Learn more at: [www.keysight.com](http://www.keysight.com)

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