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A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING
A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.
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The Keysight Technologies N109X-series DCA-M sampling oscilloscopes combine the high-performance elements of both the 86100 oscilloscope mainframe acquisition system and the hardware of a receiver plug-in module. The N1010A FlexDCA application provides both the Graphical User Interface (GUI) as well as programming interface either on a PC or on an 86100D.
With a DCA-M, you can perform eye-mask tests, measure eye diagram parameters including extinction ratio, and basic oscilloscope mode measurements of pulses (single-valued waveforms rather than eye diagrams). This is limited to patterns less than 2 ns in duration. You can also perform optical transmitter compliance tests at a variety of standard data rates depending on options installed at the time of order. Installed filter rates must be selected at the time of order and cannot be changed.

Multiple DCA-M instruments can be connected to FlexDCA. But, delta time measurements between channels on separate DCA-M oscilloscopes cannot be compared because each N109X-series oscilloscope (and 86100D if connected) uses an independent trigger. Because the N109X-series oscilloscope has a significantly faster sampling rate when compared to an 86100D, measurement results can be returned up to 50% faster.

As shown in Table 1, a variety of optical and electrical channels are available depending on the model number. Table 2 on page 7 compares the inputs and outputs for the different models. The information in this table is presented to help you see the differences at a glance; it is not meant to be a replacement for the product specifications, which are located in FlexDCA’s help system.

Table 1  DCA-M Channels Compared

<table>
<thead>
<tr>
<th>Model</th>
<th>Channel Count</th>
<th>Minimum FlexDCA Firmware Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Count</td>
<td>Optical</td>
<td>Electrical</td>
</tr>
<tr>
<td>N1090A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>N1090A-EEC</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>N1092A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>N1092B</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>N1092C</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>N1092D</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>N1092E</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>N1094A</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>N1094B</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
Table 2: Inputs/Outputs Compared.
Refer to FlexDCA help system for complete, official specifications.

<table>
<thead>
<tr>
<th>Feature</th>
<th>N1090-Series</th>
<th>N1092-Series</th>
<th>N1094-Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength range (nominal)</td>
<td>750 nm to 1650 nm</td>
<td>830 nm to 1600 nm</td>
<td>—</td>
</tr>
<tr>
<td>Maximum input power (non-destruct)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optical (peak power)</td>
<td>5 mW (+7 dBm)</td>
<td>8 mW (+9 dBm)</td>
<td>—</td>
</tr>
<tr>
<td>Optical (average power)</td>
<td>0.5 mW (-3 dBm)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Electrical (peak power)</td>
<td>±2V (+16 dBm)</td>
<td>±2V (+16 dBm)</td>
<td>±2V (+16 dBm)</td>
</tr>
<tr>
<td>Electrical 3 dB BW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Option 030</td>
<td>—</td>
<td>20 and 33 GHz</td>
<td>20 and 33 GHz</td>
</tr>
<tr>
<td>Option 035</td>
<td>—</td>
<td>20, 33, 40, and 50 GHz</td>
<td>20, 33, 40, and 50 GHz</td>
</tr>
<tr>
<td>N1090-series only</td>
<td>12.4 and 20 GHz</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Data Input</td>
<td>1 to 10 Gb/s</td>
<td>20 to 28 Gb/s</td>
<td>20 to 33 Gb/s (Opt. 030)</td>
</tr>
<tr>
<td>Clock input</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended</td>
<td>&lt; 500 mVp-p to prevent crosstalk between trigger and channel input.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum non-destruct voltage</td>
<td>1.4 Vp-p</td>
<td>1.4 Vp-p</td>
<td></td>
</tr>
<tr>
<td>Frequency (full or sub-rate clocks)</td>
<td>455 MHz to 12 GHz, full or sub-rate clocks</td>
<td>500 MHz to 28.5 GHz, full or sub-rate clocks</td>
<td>500 MHz to 28.5 GHz, full or sub-rate clocks</td>
</tr>
<tr>
<td>Frequency (sub-rate clocks only)†</td>
<td>100 MHz to 455 MHz</td>
<td>100 MHz to 500 MHz</td>
<td>100 MHz to 500 MHz</td>
</tr>
<tr>
<td>Trigger input (maximum)</td>
<td>1.4 Vp-p**</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

* Pattern lock mode on or off.
† Provided that the data rate exceeds 455 Mb/s and the clock divide ratio is a power of two.
‡ Pattern lock off. Provided that the data rate exceeds 500 Mb/s and the clock divide ratio is a power of two.
** < 500 mVp-p recommended.

CAUTION
To avoid damaging front-panel fiber-optic connectors, use proper connection techniques. Refer to “Cleaning the Fiber-Optic Connectors” on page 39.

NOTE
The N1010A FlexDCA interface is free and can be downloaded at "www.keysight.com/find/flexdca_download".
N1090A

The N1090A sampling oscilloscope has one optical channel input and, if option EEC is installed, an electrical channel input. Refer "Options" on page 13 and "Accessories" on page 16 for tables of available options and accessories.

The N1090A can perform the following tasks:

- Eye-mask mote tests and measuring eye diagram parameters including extinction ratio.
- Basic oscilloscope mode measurements of pulses (single-valued waveforms rather than eye diagrams). This is limited to patterns less than 2 ns in duration.
- You can also perform optical transmitter compliance tests at a variety of standard data rates from 1.25 to 11.3 Gb/s.

The N1090A specifications are located in FlexDCA’s help system.

**CAUTION** Maximum Clock In non-destruct input voltage is 1.4Vpp. The recommended input is <500 mVp-p.

![Figure 2 N1090A Front Panel](image)
The N1092A/B/C/D/E sampling oscilloscopes provide 1, 2, or 4 optical channels respectively. If option PLK is installed, you can lock data acquisition on a pattern trigger. Refer “Options” on page 13 and “Accessories” on page 16 for tables of available options and accessories.

The N1092A/B/D/E can perform the following tasks:

- Eye-mask mote tests and measuring eye diagram parameters including extinction ratio.
- Basic oscilloscope mode measurements of pulses (single-valued waveforms rather than eye diagrams). This is limited to patterns less than 2 ns in duration.
- You can also perform optical transmitter compliance tests at a variety of standard data rates from 1.25 to 11.3 Gb/s.
- Use pattern lock if option N1092A/B/D-PLK is installed.

The N1092A/B/D/E specifications are located in FlexDCA’s help system.

**CAUTION**

Maximum Clock In non-destruct input voltage is 1.4Vpp.
N1094A/B

The N1094A/B sampling oscilloscopes provide 2 or 4 electrical channels respectively. If option PLK is installed, you can lock data acquisition on a pattern trigger. Refer “Options” on page 13 and “Accessories” on page 16 for tables of available options and accessories.

The N1094A/B can perform the following tasks:
- Eye-mask mote tests and measuring eye diagram parameters including extinction ratio.
- Basic oscilloscope mode measurements of pulses (single-valued waveforms rather than eye diagrams). This is limited to patterns less than 2 ns in duration.
- You can also perform optical transmitter compliance tests at a variety of standard data rates from 1.25 to 11.3 Gb/s.
- Use pattern lock if option N1094A/B-PLK is installed.

The N1094A/B specifications are located in FlexDCA’s help system.

**CAUTION** Maximum Clock In non-destruct input voltage is 1.4Vpp.
Front-Panel Indicator Lights

### Table 3  DCA-M Front-Panel Indicator Lights

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displays the FlexDCA extended module slot where the DCA-M is installed. The number indicates the slot, which in this picture would indicate slot 6 resulting in channel 6A, 6B, and so forth.</td>
<td></td>
</tr>
</tbody>
</table>

- **Trig’d** light light color indicates the state of the DCA-M:
  - **Green**: The DCA-M is being triggered. As with the 86100D, this does not indicate that the trigger signal is synchronous with the channel input signal. In single acquisition, the light momentarily turns green each time **Single** is pressed.
  - **Red**: The clock input signal is missing.
  - **Off**: The channel is turned off or FlexDCA is in single/stop acquisition mode or the clock is missing.

- **Trigger armed light. This light is red if FlexDCA is in single/stop acquisition mode.**

- **Channel indicator light. This light is next to the fiber-optic input connector. When on, the light indicates that the associated FlexDCA channel is turned on and that the waveform is displayed. The light is the same color as the displayed waveform. The Trig’d and Armed indicators do not light unless the channel is turned on.**
Rear Panel

![DCA-M Rear Panel Diagram](image)

**Figure 5** DCA-M Rear Panel
### Options

**Table 4  Options (Sheet 1 of 2)**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>N1090A</th>
<th>N1092A/B/C/D/E</th>
<th>N1094A/B</th>
</tr>
</thead>
<tbody>
<tr>
<td>140</td>
<td>Reference Filter Options (available only at time of order and cannot be changed)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>GPON, 1.244 Gb/s, Gigabit Ethernet, 1.250Â Gb/s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>168</td>
<td>OC-48/STM-16, 2.488 Gb/s, 2 Gb Ethernet, 2.500 Gb/s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>180</td>
<td>10Gb Ethernet LX-4, 3.125 Gb/s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>8x Fibre Channel, 8.500 Gb/s, OC-192/STM-64, 9.953 Gb/s, 10Gb 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, 10Gb Ethernet FEC 11.0957 Gb/s, 10x Fibre Channel FEC 11.317Gb/s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>204</td>
<td>8x Fibre Channel, 8.500 Gb/s, OC-192/STM-64, 9.953 Gb/s, 10Gb Ethernet FEC 10.3125 Gb/s, 10x Fibre Channel FEC 10.51875 Gb/s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>206</td>
<td>Additional 20.625 Gb/s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>280</td>
<td>25 to 29 GBaud</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IRC</td>
<td>Impulse response correction to provide ideal channel response</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>030</td>
<td>33 GHz electrical bandwidth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>050</td>
<td>50 GHz electrical bandwidth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30A</td>
<td>30 GHz amplified</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Impulse response correction**

- IRC Impulse response correction to provide ideal channel response

**Electrical Bandwidth**

- 030 33 GHz electrical bandwidth
- 050 50 GHz electrical bandwidth

**Amplification**

- 30A 30 GHz amplified
**Introduction**

**Pattern Lock**
- PLK Pattern lock trigger hardware. Requires option LOJ.

**Timebase and Sampling Rate**
- LOJ Low jitter timebase
- STB Standard timebase
- FS1 Fast sampling rate

**Channel**
- EEC Add an electrical channel

**Software**
- 200 Enhanced jitter analysis software, fixed perpetual license
- 201 Advanced waveform analysis software, fixed perpetual license
- 300 Advanced amplitude analysis/RIN/Q-factor, fixed perpetual license
- 401 Advanced eye analysis software, fixed perpetual license
- 500 Productivity package, fixed perpetual license
- 9FP PAM-N analysis software, fixed perpetual license
- ALL Internal software options
- EFP FlexEye independent channel acquisition and control
- SIM InfiniiSim-DCA waveform transformation software, fixed perpetual license

---

**Table 4  Options (Sheet 2 of 2)**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>N1090A</th>
<th>N1092A/B/C/D/E</th>
<th>N1094A/B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pattern Lock</td>
<td>Pattern lock trigger hardware. Requires option LOJ.</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Timebase and Sampling Rate</td>
<td>Low jitter timebase</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>STB</td>
<td>Standard timebase</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>FS1</td>
<td>Fast sampling rate</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Channel</td>
<td>Add an electrical channel</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software</td>
<td>Enhanced jitter analysis software, fixed perpetual license</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>Advanced waveform analysis software, fixed perpetual license</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>201</td>
<td>Advanced amplitude analysis/RIN/Q-factor, fixed perpetual license</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>Advanced eye analysis software, fixed perpetual license</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>401</td>
<td>Productivity package, fixed perpetual license</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>PAM-N analysis software, fixed perpetual license</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>9FP</td>
<td>Internal software options</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>ALL</td>
<td>FlexEye independent channel acquisition and control</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>EFP</td>
<td>InfiniiSim-DCA waveform transformation software, fixed perpetual license</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5  Available Rack Mount Options for all DCA-M Products

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1CM</td>
<td>Rack-mount kit for a single DCA-M</td>
</tr>
<tr>
<td>1CN</td>
<td>Rack-mount kit for mounting any combination of two of the N109X-series DCA-M products.</td>
</tr>
</tbody>
</table>
## Accessories

### Table 6  Supplied Accessories

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB cable, USB-A plug to right-angle USB-B plug (3m long)</td>
<td>N1090A: 1, N1092A: 1, N1092B: 1, N1092D: 1, N1094A: 1, N1094B: 1</td>
</tr>
<tr>
<td>RF SMA 50-ohm cap (male)</td>
<td>N1090A: 2, N1092A: 1, N1092B: 1, N1092D: 1*, N1094A: 1†</td>
</tr>
<tr>
<td>FC fiber-optic dust cap</td>
<td>N1090A: 1, N1092A: 1, N1092B: 2, N1092D: 4</td>
</tr>
</tbody>
</table>

* 3 with option 030  
† 5 with option 030
Safety and Regulatory Information

This product has been designed and tested in accordance with accepted industry standards, and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Only Keysight approved accessories shall be used.

This is a sensitive measurement apparatus by design and may have some performance loss when exposed to ambient continuous electromagnetic phenomenon.

The N1090A is in compliance with CAN/CSA-C22.2 No. 61010-1 and UL Std. 61010-1 and with IEC 61010-1.

The N1092A/B/D is in compliance with CAN/CSA-C22.2 No. 61010-1 and UL Std. 61010-1 and with IEC 61010-1.

The N1094A/B is in compliance with CAN/CSA-C22.2 No. 61010-1 and UL Std. 61010-1 and with IEC 61010-1.

COMPLIANCE WITH CANADIAN EMC REQUIREMENTS

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme a la norme NMB du Canada.

Acoustic statement: (European Machinery Directive)

Acoustic noise emission
LpA < 70 dB
Operator position
Normal operation mode per ISO 7779

WARNING
This is a Safety Protection Class I Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

WARNING
To prevent electrical shock, disconnect the Keysight Technologies Model N1090A, N1092A/B/C/D/E, N1094A/B from mains before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.
If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.

WARNING

No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.

WARNING

For continued protection against fire hazard, replace fuses, and or circuit breakers only with same type and ratings. The use of other fuses, circuit breakers or materials is prohibited.
Environmental Specifications

The following table lists the environmental specifications. Performance specifications for the DCA-M are documented in FlexDCA’s help system.

**Table 7 Environmental Specifications**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use</td>
<td>For indoor use only</td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
</tr>
<tr>
<td>Operating</td>
<td>10°C to +40°C (50°F to +104°F)</td>
</tr>
<tr>
<td>Non-operating</td>
<td>-40°C to +70°C (-40°F to +158°F)</td>
</tr>
<tr>
<td>Altitude</td>
<td>Up to 4,600 meters (15,000 ft)</td>
</tr>
<tr>
<td>Maximum relative humidity</td>
<td>80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C</td>
</tr>
<tr>
<td>Weight (Characteristic)</td>
<td></td>
</tr>
<tr>
<td>N1090A</td>
<td>6.20 kg (13.68 lb)</td>
</tr>
<tr>
<td>N1092A</td>
<td>6.071 kg (13.384 lb)</td>
</tr>
<tr>
<td>N1092B</td>
<td>6.159 kg (13.578 lb)</td>
</tr>
<tr>
<td>N1092C</td>
<td>6.1 kg (13.5 lb)</td>
</tr>
<tr>
<td>N1092D</td>
<td>6.344 kg (13.986 lb)</td>
</tr>
<tr>
<td>N1092E</td>
<td>6.1 kg (13.5 lb)</td>
</tr>
<tr>
<td>N1094A</td>
<td>6.0 kg (13.4 lb)</td>
</tr>
<tr>
<td>N1094B</td>
<td>6.1 kg (13.6 lb)</td>
</tr>
<tr>
<td>Without front connectors and rear feet</td>
<td>88.26 mm H x 207.40 mm W x 485 mm D (3.48 inch x 8.17 inch x 19.01 inch)</td>
</tr>
<tr>
<td>With front connectors and rear feet</td>
<td>103.31 mm H x 219.56 mm W x 517.80 mm D (4.07 inch x 8.64 inch x 20.39 inch)</td>
</tr>
<tr>
<td>With front cover and rear feet</td>
<td>110.18 mm H x 219.56 mm W x 550.71 mm D (4.34 inch x 8.64 inch x 21.68 inch)</td>
</tr>
</tbody>
</table>
**Instrument Markings**

**Table 8 Instrument Markings**

<table>
<thead>
<tr>
<th>Marking</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>~</td>
<td>The AC symbol is used to indicate the required nature of the line module input power.</td>
</tr>
<tr>
<td></td>
<td>This symbol indicates that the power line switch is ON.</td>
</tr>
<tr>
<td></td>
<td>This symbol indicates that the power line switch is in the OFF position.</td>
</tr>
<tr>
<td></td>
<td>The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instruction in the documentation.</td>
</tr>
<tr>
<td></td>
<td>The chassis ground symbol. The chassis ground symbol is used to indicate a chassis connection.</td>
</tr>
<tr>
<td><img src="Image" alt="CE" /></td>
<td>The CE indicates of the European Community. ISM GRP 1-A: This is a symbol of an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 4) ICES/NMB-001: Cet appareil ISM est conforme a la norme NMB du Canada. This is a marking to indicate product compliance with the Canadian Interference-Causing Equipment Standard (ICES-001)</td>
</tr>
<tr>
<td><img src="Image" alt="CSA" /></td>
<td>The CSA indicates Canadian Standards Association.</td>
</tr>
<tr>
<td><img src="Image" alt="RCM" /></td>
<td>The RCM mark indicates the Australian Communications and Media Authority.</td>
</tr>
<tr>
<td><img src="Image" alt="WEEE" /></td>
<td>This symbol indicates separate collection for electrical and electronic equipment, mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive, 2002/96/EC).</td>
</tr>
<tr>
<td><img src="Image" alt="EPUP" /></td>
<td>This symbol indicates the Environmental Protection Use Period (EPUP) for the product's toxic substances for the China RoHS requirements.</td>
</tr>
<tr>
<td><img src="Image" alt="Recycling" /></td>
<td>Packaging recycling symbol.</td>
</tr>
<tr>
<td><img src="Image" alt="Korean EMC" /></td>
<td>South Korean Class A EMC Declaration This equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home.</td>
</tr>
</tbody>
</table>
Returning the instrument for service

If the probe is found to be defective we recommend sending it to an authorized service center for all repair and calibration needs. Perform the following steps before shipping the probe back to Keysight Technologies for service.

1. Contact your nearest Keysight sales office for information on obtaining an RMA number and return address.

2. Write the following information on a tag and attach it to the malfunctioning equipment.
   - Name and address of owner
   - Product model number (for example, N1092D)
   - Product Serial Number (for example, MYXXXXXXXX)
   - Description of failure or service required

3. Protect the probe by wrapping in plastic or heavy paper.

4. Pack the probe in the original carrying case or if not available use bubble wrap or packing peanuts.

5. Place securely in sealed shipping container and mark container as "FRAGILE".

NOTE

Use original packaging or comparable.

If any correspondence is required, refer to the product by serial number and model number.

Contacting Keysight Technologies

For technical assistance, contact your local Keysight Call Center.

- In the Americas, call 1 (800) 829-4444
- In other regions, visit http://www.keysight.com/find/assist

Before returning an instrument for service, you must first call the Call Center at 1 (800) 829-4444.
1 Introduction
2 Installing

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  Setup 2. Using a controller connected to a PC test system 25
  Setup 3. Using an 86100D 25
  Flex-on-Flex setup does not work 26
To Install the DCA-M 27

PC Requirements

A PC that is controlling the N109XA-series oscilloscope, or any other DCA-M, must meet the following requirements.

Single channel setup

  • Intel I3 processor or better
  • 4 GB memory
  • Windows 7 (32 or 64 bit)

Parallel test setup (multiple DCA-Ms 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.
Select a Controller Setup

Figure 6, Figure 7, and Figure 8 illustrate three different setups for controlling a DCA-M. The USB cable is provided with the DCA-M. The N1010A FlexDCA application *(PC not provided by Keysight)* directly controls the DCA-M.

Setup 1. Using a PC

Figure 6 shows a DCA-M connected to a PC via USB. FlexDCA is running on the PC. This is a typical setup.

![Figure 6](image)

Figure 6 DCA-M connected to a PC
Setup 2. Using a controller connected to a PC test system

Figure 7 shows a DCA-M connected to a PC via USB. FlexDCA on this PC is being controlled over LAN by the primary test system’s controller.

Figure 7  DCA-M connected to an a PC (with FlexDCA) controlled by a test system PC

Setup 3. Using an 86100D

Figure 8 shows a DCA-M connected to an 86100D via USB. FlexDCA is running on the 86100D.

Figure 8  DCA-M connected to an 86100D
Flex-on-Flex setup does not work

Figure 9 shows a setup that does not work. This is known as a “Flex-on-Flex” connection, because, N1010A FlexDCA on the PC is connected to and controlling FlexDCA on the 86100D. A Flex-on-Flex setup works great for standard 86100D modules, but not for DCA-M instruments. The DCA-M in this picture cannot be identified, accessed, or controlled from FlexDCA on the PC. The solution is to connect the DCA-M directly to the PC.

Figure 9  DCA-M cannot be “seen” with a Flex-on-Flex connection
To Install the DCA-M

Before attempting the following procedure, read “Safety and Regulatory Information” on page 17.

**CAUTION**
This product is designed for use in INSTALLATION CATEGORY II and POLLUTION DEGREE 2 environment.

**CAUTION**

CAUTION, VENTILATION REQUIREMENTS: When installing the instrument(s) into a cabinet consideration shall be given to the convection flow into and out of the cabinet. Consideration shall also be given to the individual instruments to avoid having the heated discharge of one instrument, now becoming the cooling intake air for another instrument. Another area of concern is verification that the maximum ambient operating temperature of the instrument(s) is not exceeded by cabinet installation. Keysight recommends forced air convection whenever an instrument(s) are installed in a cabinet and further recommends that the maximum operating temperature of the cabinet be reduced 10°C from the lowest, of the maximum operating temperature of a single instrument. If there are any concerns or special requirements a Keysight Field Engineer should be consulted to assure instrument(s) temperature compliance and performance.

**Procedure**

1. Confirm that your site satisfies the LINE power requirements shown in Table 9.

**Table 9**  LINE Power Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage and/or range</td>
<td>100/120 VAC, 50/60/400 Hz</td>
</tr>
<tr>
<td></td>
<td>220/240 VAC, 50/60 Hz</td>
</tr>
<tr>
<td>Power in Watts</td>
<td>290 Watts Maximum</td>
</tr>
</tbody>
</table>

The instruments can operate with mains supply voltage fluctuations up to ±10% of the nominal voltage.

**WARNING**
The Mains wiring and connectors shall be compatible with the connector used in the premise electrical system. Failure, to ensure adequate earth grounding by not using the correct components may cause product damage, and serious injury.
Installing

**WARNING**

Use Keysight supplied power cord or one with same or better electrical rating.

**CAUTION**

This instrument has auto-ranging line voltage input, be sure the supply voltage is within the specified range.

**NOTE**

Install the instrument so that the detachable power cord is readily identifiable and is easily reached by the operator. The detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument.

**NOTE**

The main power cord can be used as the system disconnecting device. It disconnects the mains circuits from the mains supply.

1. Connect the supplied LINE power cord.

   ![Figure 10 DCA-M Connected to PC](image)

   **Figure 10** DCA-M Connected to PC

2. If you will be controlling the DCA-M from a PC, install FlexDCA on the PC and start FlexDCA.

3. Use the supplied USB cable to connect the DCA-M to the PC or 86100D, depending on the setup. See **Figure 10**. If connecting to an 86100D, be sure to connect the USB cable to one of the 86100D's rear-panel USB ports.
5 Turn on the DCA-M. A device driver that is installed with FlexDCA will automatically detect the DCA-M. The DCA-M is installed in FlexDCA's first available virtual slot. The slot number is shown on the DCA-M's front-panel LED readout. Available FlexDCA slots depend on the installation:
   - If the DCA-M is connected to a PC and an 86100D is not connected, slots 1 through 8 are available.
   - If the DCA-M is connected to an 86100D, slots 5 through 8 are available.

6 Locate the slot button for your installed N109X-series in FlexDCA's slot button tray as shown in Figure 11. Click the gear button is you want to re-assign the DCA-M to a different slot.

![Figure 11 Slot buttons at bottom of FlexDCA application](image)

7 If the DCA-M has an optical input, connect an optical signal to the DCA-M's front-panel fiber-optic connector.

8 Connect a clock signal to the DCA-M's front-panel Clock In SMA connector. As with the 86100D, use a reference clock that is synchronous with the input signal being measured. The clock input range is 100 MHz to 32 GHz. The DCA-M's front-panel Trig'd light should turn from orange to green indicating that the signal is locked. If the oscilloscope’s acquisition is in stopped or single mode, the Trig'd indicator will not be lit.

9 In FlexDCA's Trigger Setup dialog box, select the General Trigger Setup tab. In the Source field, select Front Panel.

**CAUTION**

The maximum non-destruct amplitude of the clock input is 1.4 Vpp. For best results, keep the amplitude below 500 mVpp.

10 To learn more about using the DCA-M, read Chapter 3, “Using” and refer to FlexDCA's help system.
To avoid damaging a DCA-M's front-panel fiber-optic connector, use proper connection techniques. Refer to "Cleaning the Fiber-Optic Connectors" on page 39.
3 Using

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To Setup the Oscilloscope with Clock Recovery 34
Reference Clock 37
Pattern Lock 37
Reference Filters 37
Aligning Waveforms 38
Cleaning the Fiber-Optic Connectors 39

A N109X-series oscilloscope is controlled using the FlexDCA user interface that is running on a PC or an 86100D. Because, this is the 86100D’s graphical user interface, 86100D users will be familiar with operating an N109X-series oscilloscope.

Multiple DCA-Ms can be connected to FlexDCA, but delta-time measurements between two channels cannot be compared because each DCA-M (and 86100D if connected) uses an independent trigger.

NOTE The N1010A 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 N109X-series oscilloscope. Use FlexDCA SCPI programming tools to simplify conversion of legacy 86100-based automation to FlexDCA compatible code, as noted in Chapter 4, “Programming".
To Setup the Oscilloscope

This example shows an N1092D-series sampling oscilloscope. You can substitute any N109X-series oscilloscope. The input Clock In signal must be a synchronous clock or sub-rate clock. The N109X-series oscilloscope will trigger with any clock signal between 100 MHz and 32 GHz.

In this procedure, the following assumptions are made for simplicity. You can change these parameters to any acceptable values.

Data signal: .......................................................... 10.3125 GBd
N1092D slot: .......................................................... 5

1 In FlexDCA, click Setup > Default Setup.
2 Connect the N109X-oscilloscope as shown in Figure 12. If connecting to an 86100D, be sure to connect the USB cable to an 86100D rear-panel USB port.

**CAUTION**
The maximum non-destruct amplitude of the clock input is 1.4 Vpp.

---

**Figure 12 Typical Connection Setup**

3 In FlexDCA’s signals palette, turn all channels off except for channel 5A.
4 Click Run.
5 Click Setup > Mode > Eye/Mask.
6 Click Auto Scale.
7 The N109X-series oscilloscope’s front-panel Trig’d light should be green. If not, confirm that the amplitude of the signal at channel 5A is not too low due to the “pass through” loss in the N1077A. Consult the specifications listed in the oscilloscope user’s guide.
Configure pattern lock (optional)

The N109X-series oscilloscope must have option PLK.

8 Click Setup > Trigger Setup and select the Pattern Lock tab. In the Data Rate field, turn off Auto Detect and select 10.3125 GBd.

9 In the General Setup tab, click the Pattern Lock button.
To Setup the Oscilloscope with Clock Recovery

This example shows an N1077A-SMS that is connected to an N1092D-series sampling oscilloscope. You can substitute any N109X-series oscilloscope. If you are using an N1077A-SXT, you will need an external optical splitter. If you are using an N1076A, you will connect your electrical data signal to the N1076A’s front-panel Data In + port.

The input Clock In signal must be a synchronous clock or sub-rate clock. The N109X-series oscilloscope will trigger with any clock signal within the range specified in the FlexDCA help system.

**CAUTION**

The *maximum non-destruct* amplitude of the clock input is 1.4 Vpp.

To learn more about using the N1076/7A clock recovery DCA-M, download the N1076/7A user’s guide from [www.keysight.com](http://www.keysight.com).

In this procedure, the following assumptions are made for simplicity. You can change these parameters to any acceptable values.

Data signal: .................................................. 10.3125 GBd
N1092D slot: .......................................................... 5
N1076/7A slot: .................................................... 6

1. In FlexDCA, click **Setup > Default Setup**.
2. Connect the N1076/7A as shown in Figure 13. If connecting to an 86100D, be sure to connect the USB cable to an 86100D rear-panel USB port.

**Figure 13** Typical Connection Setup
Configure clock recovery

3 In FlexDCA, click **Setup > Trigger Setup** and select the General Trigger Setup tab. Confirm that the trigger Source is set to **Front Panel**.

4 Click **Setup > Modules > (Slot 6): Clock Recovery**. The dialog box shown Figure 14 on page 35 is displayed.

5 For the **Input Source**, select **Electrical Data +**, which is used for single-ended or optical signal.

6 In the **Data Rate** field, enter 10.3125 GBd.

7 In the **Clock Recovery** field, click the **Lock** button to lock clock recovery. The N1076/7A front-panel locked light should be green. If not, confirm the input signal's amplitude and baud rate against the values described in **Table 2** on page 7.

![Clock Recovery Setup Dialog Box](image)

**Figure 14 Clock Recovery Setup Dialog Box**

Configure N109X-series oscilloscope

8 In FlexDCA’s signals palette, turn all channels off except for channel 5A.

9 Click **Run**.
10 Click Setup > Mode > Eye/Mask.
11 Click Auto Scale.
12 The N109X-series oscilloscope’s front-panel Trig’d light should be green. If not, confirm that the amplitude of the signal at channel 5A is not too low due to the “pass through” loss in the N1077A. Consult the specifications listed in the oscilloscope user’s guide.

Configure pattern lock (optional)

The N109X-series oscilloscope must have option PLK.
13 Click Setup > Trigger Setup and select the Pattern Lock tab. In the Data Rate field, turn off Auto Detect and select 10.3125 GBd.
14 In the General Setup tab, click the Pattern Lock button.
Reference Clock

Like the 86100D, for proper display of the input signal the input Clock In signal must be a synchronous clock or sub-rate clock. The N109X-series oscilloscope will trigger with any clock signal between 100 MHz and 32 GHz. The clock input range for the N1090A is 500 MHz to 12 GHz, and the N1092 is 0.455 to 28.5 GHz. A timebase calibration, previously performed at service centers, can be performed by users.

Unlike an 86100D, the trigger setting for the N109X-series can only be selected to be Front Panel or Free Run.

Table 10 Valid Clock Input

<table>
<thead>
<tr>
<th>Feature</th>
<th>N1090-Series</th>
<th>N1092-Series</th>
<th>N1094-Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended</td>
<td>&lt; 500 mVp-p</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prevent crosstalk between trigger and channel input</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum non-destruct voltage</td>
<td>1.4 Vpp</td>
<td>1.4 Vpp</td>
<td>1.4 Vpp</td>
</tr>
<tr>
<td>Frequency (full or sub-rate clocks)</td>
<td>455 MHz to 12 GHz, full or sub-rate clocks</td>
<td>500 MHz to 28.5 GHz, full or sub-rate clocks</td>
<td>500 MHz to 28.5 GHz, full or sub-rate clocks</td>
</tr>
<tr>
<td>Frequency (sub-rate clocks only)†</td>
<td>100 MHz to 455 MHz</td>
<td>100 MHz to 500 MHz</td>
<td>100 MHz to 500 MHz</td>
</tr>
</tbody>
</table>

* Pattern lock mode on or off.
† Provided that the data rate exceeds 455 Mb/s and the clock divide ratio is a power of two.
‡ Pattern lock off. Provided that the data rate exceeds 500 Mb/s and the clock divide ratio is a power of two.

Pattern Lock

On N1092-series and N1094-series oscilloscopes, option PLK adds pattern lock capability. The following measurement features require pattern lock:

- Option 200 (Advanced Jitter Analysis)
- Option 201 (Advanced Waveform Analysis)
- Option 300 (Advanced Amplitude Analysis/RIN)
- Option SIM (InfiniiSim-DCA Waveform Transformation Toolset).

Reference Filters

The rates of all installed reference filters are listed on the front panel. These rates correspond to internal, calibrated reference filters that are selected as an instrument option at the time of order. These reference filters allow for optical
transmitter compliance testing at the listed filter rates. The available options cover a variety of standard data rates from 1.25 to 11.3 Gb/s as shown in Table 4 on page 13.

Aligning Waveforms

Because a DCA-M’s acquisition system is independent of the 86100D, if you are using multiple DCA-Ms or a DCA-M with 86100D receiver modules, the input waveforms may not align after an Auto Scale.

The waveforms will align if option 500, Productivity Package Software, is installed on the 86100D or DCA-M and Rapid Eye is turned on. Rapid Eye is enabled from the Acquisition Setup dialog box’s Waveform tab.

If option 500 is not installed, you can manually add software delay to channels to align them. To align the eyes, open the channel’s Setup dialog box, click Advanced, and enter the Software Delay.
Cleaning the Fiber-Optic Connectors

Treat all fiber-optic connectors like the high-quality lens of an expensive camera. Damage to the connectors on calibration and verification devices, test ports, cables, and other devices can:

- Degrade measurement accuracy and repeatability and
- Cause expensive damage to instruments.

Because fiber-optic connectors are susceptible to damage that is not immediately obvious to the naked eye, it is very easy to make bad measurements without being aware of a connector problem. Learning about proper handling and cleaning techniques will help you to avoid any degradation in connector performance. With glass-to-glass interfaces, any damage of the ferrule or end of the fiber, any stray particles, or finger oil can have a significant effect on connector performance.

This picture shows the end of a clean, problem-free fiber-optic connector. The dark center circle is the fiber's 125 mm core and cladding which carries the light. The surrounding area is the soft nickel-silver ferrule.

This picture shows a fiber end that is dirty from neglect or improper cleaning. Loose particles or oils are smeared and ground into the end of the fiber causing light scattering and poor reflection. Not only is the precision polish lost, but this action can also grind off the glass face and destroy the connector.

This picture shows physical damage to the glass fiber end caused by either repeated connections made without removing loose particles from the fiber end or by using improper cleaning tools. This damage can be severe enough to transfer the damage from the connector end to a good connector that comes in contact with it.

The cure for these problems is disciplined connector care. Visual inspection of fiber ends can be helpful. Contamination or imperfections on the cable end face can be detected as well as cracks or chips in the fiber itself. Use a microscope (100X to 200X magnification) to inspect the entire end face for contamination, raised metal, dents in the metal, and any other imperfections. Visible imperfections not touching the fiber core may not affect performance, unless the imperfections keep the fibers from contacting.

**WARNING**
Always remove both ends of fiber-optic cables from any instrument, system, or device before visually inspecting the fiber ends. Disable all optical sources before disconnecting fiber-optic cables. Failure to do so may result in permanent injury to your eyes.
Improper connector care, cleaning, or use of mismatched cable connectors can invalidate the published specifications and damage connectors. Clean all cables before applying to any connector. Repair of damaged connectors due to improper use is not covered under warranty.

To clean a front-panel fiber-optic input connector

Use caution as fiber-optic end surfaces can easily be damaged due to improper cleaning techniques. Repairs can be expensive. To access and clean the fiber-optic end surface:
1. Lift the receptacle latch as shown in the following picture.
2. Carefully pull off the receptacle without touching the ferrule or fiber end.
3. Clean the removed receptacle.
4. To clean the fiber-optic end, use a professional fiber-optic cleaning product. Many products are available and are easily located via an internet search on “fiber optic cleaning products”. You can purchase tools designed specifically for the type of fiber-optic connector or cable that you are using.

Figure 15 Removing the Receptacle to Expose the Fiber End

To avoid damaging a DCA-M's front-panel fiber-optic connector, use proper connection techniques.
4 Programming

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Precision Time Base  45
Recommended Best Practices  46
Using the SCPI Recorder  48
Using the Interactive SCPI Command Tree  50
Finding the VISA Address for HiSLIP  51

The N109X-series oscilloscopes are remotely controlled using the SCPI commands that are documented in FlexDCA’s help system. The commands are sent to N1010A FlexDCA (on a PC) or FlexDCA (on the 86100D). The most common setup is shown in Figure 16 which shows the program running on a PC which controls one or more N109X-series oscilloscopes via N1010A FlexDCA.

This chapter explains the minor differences between programming N109X-series and 86100D sampling oscilloscopes. Complete information including examples are located in FlexDCA’s help system.

Figure 16 Setup for Remote Control of the DCA-M on PC
To help in developing programs, use the following FlexDCA SCPI programming tools:

- SCPI Recorder (page 48)
- Interactive SCPI Command Tree (page 50)

FlexDCA commands work the same regardless if they control an N109X-series or 86100D. For example, the command:

```
:CHANnel2A:YScale 1.0E-1
```

changes the channel’s vertical scale on a N109X-series just like on an 86100D. Refer to FlexDCA’s help system for information comprehensive information on remote control. The help includes a topic for every command.
Unique DCA-M Subsystems

:EMODules Subsystem

FlexDCA’s :EMODules (extended modules) SCPI command subsystem is unique to DCA-M instruments such as N109X-series oscilloscopes and N1076/7A clock recovery. Use this subsystem to assign DCA-M oscilloscopes to FlexDCA slots (1 through 8). On an 86100D, only slots 5 through 8 are available.

Table 11 :EMODules Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>:EMODules:SLOT:CMEThod?</td>
<td>Queries the connection method for the module in the slot. USB is returned if a DCA-M is connected and NONE if one is not connected.</td>
</tr>
<tr>
<td>:EMODules:SLOT:CONNect</td>
<td>Sets the communication connection with a DCA-M.</td>
</tr>
<tr>
<td>:EMODules:SLOT:DISConnect</td>
<td>Disconnects an extended module, simulated module, or mainframe from the indicated slot.</td>
</tr>
<tr>
<td>:EMODules:SLOT:SELection</td>
<td>Assigns an extended module, simulated module, or mainframe to a slot.</td>
</tr>
<tr>
<td>:EMODules:SLOT:STATe</td>
<td>Queries the state of the extended module connection.</td>
</tr>
</tbody>
</table>

:SLOT Subsystem for N109X-Series Oscilloscopes

FlexDCA’s :SLOT SCPI command subsystems is unique to DCA-M instruments. Use this subsystem to control the trigger setting of a DCA-M. Refer to Table 12 on page 44.

N109X-series oscilloscopes with option PLK installed have the ability to pattern lock. Because these oscilloscopes use different internal hardware than the 86100D, the :SLOT subsystem is used rather than the :TRIGger subsystem for pattern lock.
### Table 12: SLOT Commands for N109X-Series Oscilloscopes

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>:SLOT:TRIGger:MODE?</td>
<td>Queries the trigger mode, which is always clock (CLOC) and cannot be set or changed (:TRIGger:MODE command). You can query CLOC (clock) with either the :TRIGger:MODE? or :SLOT:TRIGger:MODE? queries.</td>
</tr>
<tr>
<td>:SLOT:TRIGger:MRATe?</td>
<td>Queries the measured clock rate at the Clock In input of the DCA-M extended module.</td>
</tr>
<tr>
<td>:SLOT:TRIGger:SOURce?</td>
<td>The DCA-M oscilloscope's trigger source can either be front panel or free run as set by this command's FPANel or FRUN arguments. Do not use the CHANnel or SLOT arguments.</td>
</tr>
</tbody>
</table>

#### Commands of for Oscilloscopes with Option PLK (Pattern Lock)

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>:SLOT:TRIGger:BRATe</td>
<td>Enters or queries the bit-rate of the trigger source.</td>
</tr>
<tr>
<td>:SLOT:TRIGger:BRATe:AUTodetect</td>
<td>Enables or disables automatic bit-rate detection.</td>
</tr>
<tr>
<td>:SLOT:TRIGger:DCDRatio</td>
<td>When using pattern lock, enters or queries the trigger-divide ratio.</td>
</tr>
<tr>
<td>:SLOT:TRIGger:DCDRatio:AUTodetect</td>
<td>Enables or disables automatic trigger-divide-ratio detection.</td>
</tr>
<tr>
<td>:SLOT:TRIGger:MRATe?</td>
<td>Queries the measured clock rate at the DCA-M's front-panel Clock In input connector.</td>
</tr>
<tr>
<td>:SLOT:TRIGger:PLANgth</td>
<td>Enters the length of the pattern in bits.</td>
</tr>
<tr>
<td>:SLOT:TRIGger:PLANgth:AUTodetect</td>
<td>Queries the measured clock rate at the Clock In input of the DCA-M extended module.</td>
</tr>
<tr>
<td>:SLOT:TRIGger:TRACking</td>
<td>Turns on pattern lock tracking where pattern lock settings are the same (linked) for all DCA-M oscilloscopes and the 86100D. The clock and data signals should be the same rate and pattern length.</td>
</tr>
</tbody>
</table>
Aligning Waveforms

Because a DCA-M’s acquisition system is independent of the 86100D, if you are using multiple DCA-Ms or a DCA-M with 86100D receiver modules, the input waveforms may not align after an Auto Scale (:SYSTem:AUToscale). To enable :SYSTem:AUToscale to align waveforms:

- If option 500, Productivity Package Software, is installed on the 86100D or DCA-M, turn Rapid Eye is turned on, and the waveforms will align. Option 500 is the most convenient way to align the waveforms and maintains very fast throughput. To enable Rapid Eye and align waveforms, use these commands.

  :ACQuire:REYE:ALIGn ON
  :ACQuire:REYE ON
  :SYSTem:AUToscale:*OPC?

- If option 500 is not installed, you can use the :CHANnel:TDELay command to add software delay to a channels, but the acquisition throughput will be reduced.

  :CHANnel1:2A:TDELay 45.68e-12
  :SYSTem:AUToscale:*OPC?

Precision Time Base

Because the DCA-M has different hardware than the 86100D, the DCA-M does not work with the 86100D’s Internal Precision Time Base (PTB). However, a DCA-M with option LOJ (Low Jitter Timebase) does provide PTB performance without the need for special commands. Therefore, the following FlexDCA commands do not work with DCA-M oscilloscopes:

  :CALibrate:FRAME:PTIMebase:STARt
  :CALibrate:FRAME:PTIMebase:STATus?
  :TIMebase:PTIMebase:RFRequency
  :TIMebase:PTIMebase:RMEthod
  :TIMebase:PTIMebase:RTReference
  :TIMebase:PTIMebase:STATe
  :TIMebase:PTIMebase:VPTBsignals
Recommended Best Practices

The following techniques explicitly set values for selecting an optical channel’s wavelength or filter rate. These methods are recommended for both N109X-series and 86100D oscilloscopes.

Optical wavelength selection commands

:CHANnel:WAVelength

To specify or query the input channel’s wavelength, it is recommended that you do not use the :CHANnel:WAVelength command. For example,

:CHANnel2A:WAVelength WAVelength2

This is because the wavelength argument can differ between modules. For example, the WAVelength2 argument might specify a 1310 nm wavelength on an DCA-M oscilloscope and 1550 nm on an standard receiver module.

Instead, explicitly select the wavelength using the :CHANnel:WAVelength:VALue command. For example,

:CHANnel2A:WAVelength:VALue 1.310E-6

This is the most robust and reliable technique for making these selections and the easiest to read! This command works for both traditional modules and the DCA-M oscilloscopes. If the wavelength is not within 1% of a supported wavelength, an error will be generated.

:CHANnel:WAVelength:VALue:VSET?

You can query the available wavelengths for setting using the :CHANnel:WAVelength:VALue:VSET? query. This query returns a comma separated list of available wavelengths in meters for the selected optical channel. For example,

"1.555E-6,850E-9,1.310E-6,1.550E-6,...."

Filter rate selection commands

:CHANnel:FSELect

To specify or query the input channel’s reference filter, it is recommended that you do not use the :CHANnel:FSELect command. For example,

:CHANnel2A:FSELect:FILTer2

This is because the filter argument can differ between modules and module options. For example, the FILTer2 argument can specify a different filter based on DCA-M oscilloscope or standard module and with different reference filter rate options. For example, it might be 8.5 Gb/s in one case and 9.953280 Gb/s in another.
Instead, explicitly select the wavelength using the :CHANnel:FSELect:RATE command. For example,

```
:CHANnel12A:FSELect:RATE 10.3125E9
```

This is the most robust and reliable technique for making these selections and the easiest to read! This command works for both traditional modules and the DCA-M oscilloscopes. If the wavelength is not within 1% of a supported reference filter rate, an error will be generated.

```
:CHANnel:FSELect:RATE:VSET?
```

You can query the available reference filters for setting using the :CHANnel:FSELect:RATE:VSET? query. This query returns a comma separated list of available filters in b/s for the selected optical channel. For example,

```
"155.000E+6, 622.000E+6, 1.250000E+9, 2.488000E+9,…"
```

```
:CHANnel:FILTer OFF
```

The :CHANnel:FILTer OFF command does not work with DCA-M oscilloscopes. Instead, select the highest rate filter using either of the following two commands:

```
:CHANnel:FSELect:RATE <highest rate filter>
```

```
:CHANnel:FSELect:RATE:MAXimum
```

Reference filters are low-pass filters and the highest rate filter is essentially the same bandwidth as not having a filter installed. Refer to Table 4 on page 13 for a list of reference filters provided for each option.
Using the SCPI Recorder

FlexDCA’s SCPI recorder is a powerful tool that enables you to quickly discover, record, and learn about the commands needed to perform almost any task remotely. To open the SCPI recorder in FlexDCA, click **Tools > SCPI Programming**

Tools > SCPI Recorder.

When you’ve recorded your commands, you can copy them to the Windows clipboard, play them back, or save them as a macro. Click **REC** and the recorder performs the following tasks:

1. Captures most FlexDCA setting changes (mouse clicks or keyboard presses).
2. Translates the setting into an equivalent SCPI remote-programming command.
3. Records the SCPI command within the dialog box.

Click **REC** to begin recording. The button turns red to alert you that any mouse clicks or keyboard presses will be recorded. When you have captured all your commands, click the record button again to end the recording.

Click **Play** to play back your recording and observe the commands as they are executed. Playback always starts at the highlighted command, which is shown in a blue box as seen in the above figure. Click any command in the dialog box to highlight that command. Use Playback Speed to control the rate that the commands are played: Slow, Normal, or Fast.

During playback, click **PAUSE** to temporarily stop the playback.

During playback, click **Device Clear** when a command is waiting an unacceptable length of time to complete. This can happen, for example, during limit testing if you use a command that locks the remote interface until 100 failed samples are detected, which could take a very long time.

\[ \text{:LTESt:MTESt:FAILures 100; *OPC?} \]

Click **Clear** to delete your recorded commands from the dialog box.
Click **Save** to save your recorded commands into a script file (.scpi) that can be reloaded into the dialog box at any time by clicking Load. SCPI script files are ASCII files, so you can edit them as well as create new script files using a text editor. SCPI scripts are often small snippets of code that may depend on FlexDCA being set to very specific settings. As a result, your scripts may not work in the same manner in different situations. This can be alleviated by starting your scripts with commands that configure starting conditions. For example, the first few lines in the following code configures FlexDCA from a default setup before making a rise time measurement. To include comments in your scripts, precede the comments with two forward-slash characters as shown in this example:

```plaintext
:SYSTem:DEFault
:TRIGger:SOURce FPANel
:TRIGger:BwLimit CLOCK
:SYSTem:MODE EYE         // Place FlexDCA in Eye/Mask mode
:SYSTem:AUToscale
:TRIGger:POLock ON
:MEASure:EYE:RISetime // Measure risetime
:MEASure:EYE:RISetim?
```

**NOTE**

You can use the Windows clipboard to copy your recorded commands. Click on a command to select it. Shift click to select a range of commands. Ctrl click to select non-adjacent commands. Ctrl-A selects all commands. Ctrl-C copies all selected commands. In another application, use Ctrl-V to paste the commands. You can also right-click and then click Copy.

**NOTE**

The default user data folder for saving script files is \SCPI Scripts.

**NOTE**

When FlexDCA is installed, a registry entry is created to associate script files (.SCPI) with Notepad. This makes it easier to open script files.
Using the Interactive SCPI Command Tree

FlexDCA’s SCPI Remote Command Tree Viewer lists all SCPI command subsystems and their commands. You can quickly traverse the tree and test the interaction between any command and FlexDCA.

To open the SCPI recorder in FlexDCA, click **Tools > SCPI Programming Tools > Interactive SCPI Command Tree**.

Click the ![help icon](image) icon to open the help topic for the selected command.

To learn about a command or subsystem, scroll down the command tree to locate the commands that interest you, such as the :SYSTem subsystem. Click on the expand button to view the available commands. You can also expand an entry by double clicking on the row. The following figure shows the :SYSTem:MODE command. Notice that the drop-down list provides all of the available arguments for the command. You can make a selection, and click Run to execute the command. Click **Query** to display the current value in the Run/Query Output field. Some commands, like :ACQuire:RLENght shown in the above figure, take an integer (int) or real (double) value.
Finding the VISA Address for HiSLIP

The VISA Address for the HiSLIP interface is easy to locate and is used to identify the LAN address between your program and FlexDCA.

1. On FlexDCA, click the menu commands Tools > SCPI Programming Tools. The SCPI Server Setup dialog box opens as shown below.

2. From the dialog box, write down the complete listed VISA Address for HiSLIP. As an alternative, you can highlight the string using the mouse cursor and press Ctrl-C to copy it to the clipboard for later use. In the above picture, the string for HiSLIP would be:

   TCPIP0::2UA2421081::hislip0,4880::INSTR

You can substitute the IP address as shown here:

   TCPIP0::141.121.89.103::hislip0,4880::INSTR

If your program is running on the same PC or 86100D as FlexDCA, you can simplify this string by substituting localhost for the computer name. For example, you would modify the above VISA address to be the following string:

   TCPIP0::localhost::hislip0,4880::INSTR
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