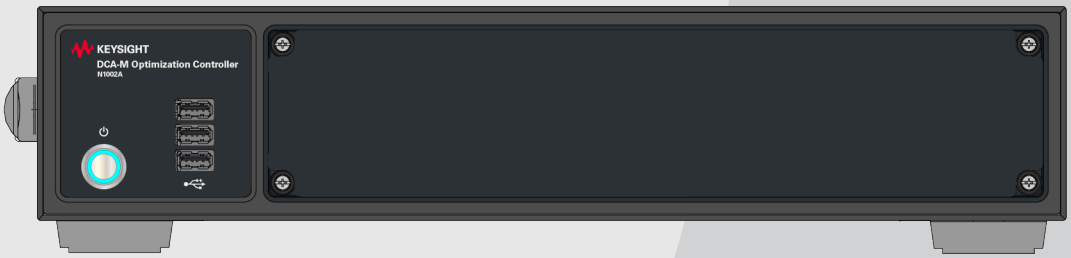
N1002A DCA-M Optimization Controller

with FlexOTO and available solution bundles



This document describes N1002A installation steps, environmental requirements, and safety as well as information on solution bundles.

KEYSIGHT

QUICK START GUIDE

Notices

Manual Part Number

N1002-90001

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Safety Notices

CAUTION 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** 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.

NOTE A NOTE calls the user’s attention to an important point or special information in the text.

Contents

1 N1002A Introduction

The N1002A DCA-M Optimization Controller and FlexOTO (Optical Test Optimizer) application optimize optical testing using DCA-M extended modules (such as the N1092A optical sampling oscilloscope and the N1078A Optical/Electrical Clock Recovery module). The FlexOTO application provides a powerful user interface on a customer-provided external display, but you can also run and configure FlexOTO entirely from remote programs over LAN. The N1002A has the following key features:

- Provides the control, waveform processing, measurement, and communication portions of the oscilloscope system.
- Front and rear panel USB ports for connecting to DCA-M extended modules which provide channel, trigger, and time base portions of the oscilloscope.
- LAN port for FlexOTO and FlexDCA remote control over a LAN.
- Display, keyboard, and pointing device connectors for optional control of the N1002A's FlexOTO graphical user interface.

Figure 1 and *Figure 2* on page 6 identify features on the N1002A's front and rear panels.

Front-Panel Features

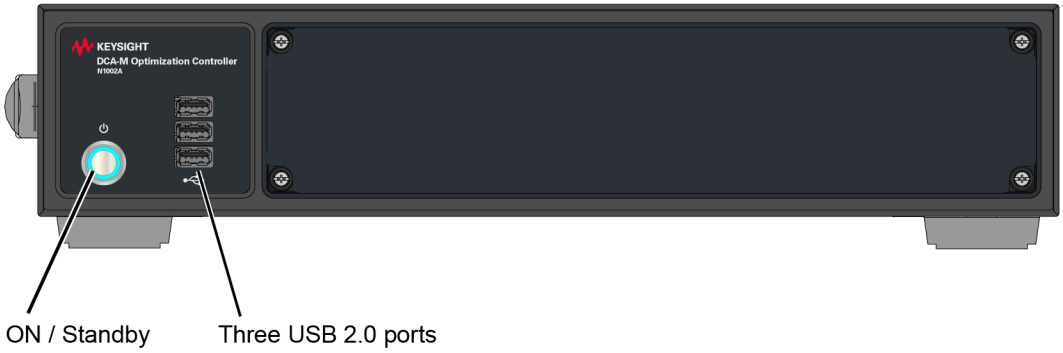


Figure 1. Front-Panel Features

Rear-Panel Features

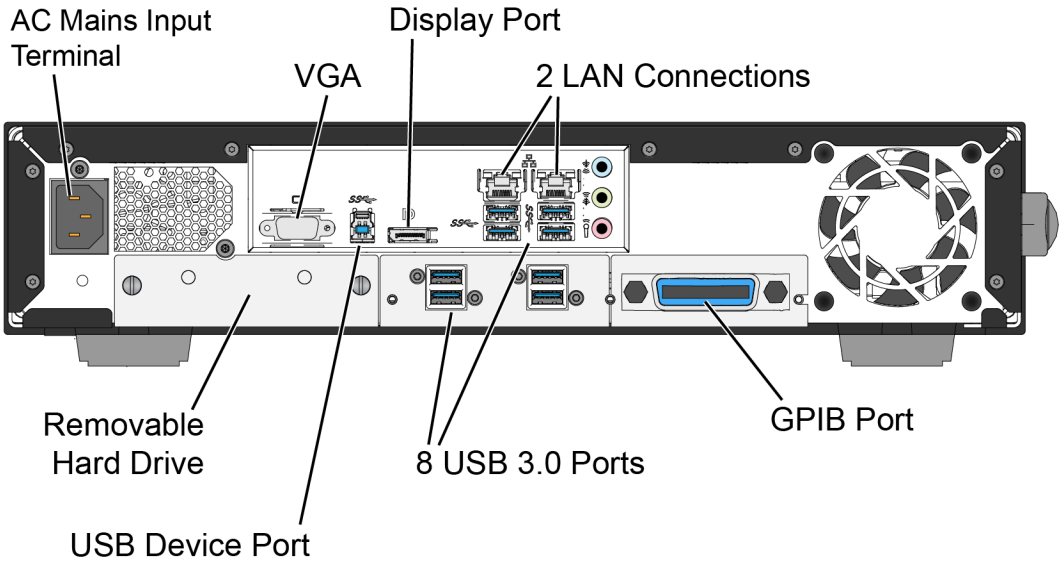


Figure 2. Rear-Panel Features

Accessories

Table 1. Supplied Accessories

Description	Qty.	Keysight Part Number
Keyboard	1	0960-3245
Optical mouse with scroll wheel, USB	1	0960-3246
Quick Start Guide *(this document)*	1	N1002-90001
Keysight safety leaflet	1	9320-6797

Table 2. Available Accessories

Option	Description
1CP104A	Rack mount flange and handle kit 88.1mm H (2U). Includes brackets, handles, hole plugs.
1CM110A	Rack mount flange kit 88.1mm H (2U). Includes two flange brackets and four hole plugs.
1CN106A	Handle kit 88.1mm H (2U). Includes two front handles.
N1027A-USB	USB type A to USB type B cable, 2m long.

Contacting Keysight

To contact Keysight for sales and technical support, refer to support links on the following Keysight websites: *http://www.keysight.com/find* (product specific information and support, software and documentation updates) *http://www.keysight.com/find/assist* (worldwide contact information for repair and service).

For technical assistance with the, contact your local Keysight Call Center.

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

Returning the N1002A for Service

The instructions in this section show you how to contact Keysight Technologies and how to properly package an N1002A for return to a Keysight Technologies service office. Always contact the Keysight Technologies Instrument Contact Center to initiate service *before* returning the N1002A to a service office. This ensures that the repair can be properly tracked and that your N1002A will be returned to you as quickly as possible. For technical assistance, contact your local Keysight Call Center.

If the N1002A is still under warranty or is covered by a maintenance contract, it will be repaired under the terms of the warranty or contract. If the N1002A is no longer under warranty or is not covered by a maintenance plan, Keysight Technologies will notify you of the cost of the repair after examining the unit.

NOTE Remember to always make backups of important files. Data stored on the N1002A hard disk may be erased after a repair. You can restore the files from the backup.

1. Write a complete description of the failure and attach it to the N1002A. Include any specific performance details related to the problem. The following information should be returned with the N1002A.
   - Type of service required.
   - Date N1002A was returned for repair.
   - Description of the problem:
   - Whether problem is constant or intermittent.
   - Whether problem is temperature-sensitive.

- Whether problem is vibration-sensitive.
- Performance data.
- Company name and return address.
- Name and phone number of technical contact person.
- Model number.
- Full serial number of returned N1002A.
- List of any accessories returned with N1002A.

CAUTION N1002A damage can result from using packaging materials other than the original materials. Never use styrene pellets as packaging material. They do not adequately cushion the instrument or prevent it from shifting in the carton. They may also cause instrument damage by generating static electricity.

2. Pack the N1002A in the original shipping containers. Original materials are available through any Keysight Technologies office. Or, use the following guidelines:
   - Wrap the N1002A in anti-static plastic to reduce the possibility of damage caused by electrostatic discharge.
   - Use a double-walled, corrugated cardboard carton of 159 kg (350 lb) test strength.
   - The carton must be large enough to allow approximately 7 cm (3 inches) on all sides of the instrument for packing material, and strong enough to accommodate the weight of the N1002A.
   - Surround the equipment with approximately 7 cm (3 inches) of packing material, to protect the N1002A and prevent it from moving in the carton. If packing foam is not available, the best alternative is S.D-240 Air Cap from Sealed Air Corporation (Commerce, California 90001). Air Cap looks like a plastic sheet filled with air bubbles. Use the pink (antistatic) Air Cap to reduce static electricity. Wrapping the instrument several times in this material will protect the instrument and prevent it from moving in the carton.
3. Seal the carton with strong nylon adhesive tape.
4. Mark the carton "FRAGILE, HANDLE WITH CARE".
5. Retain copies of all shipping papers.

2 N1002A Installation

Complete the steps in this chapter to install the N1002A. For important safety information, refer to *Safety Information* on page 11. This chapter also includes the complete N1002A specifications in the following tables:

- *Table 7 N1002A LINE Power Specifications* on page 20
- *Table 5 N1002A Environmental Specifications* on page 17
- *Table 3 N1002A front-panel inputs and outputs specifications* on page 16
- *Table 6 N1002A rear-panel inputs and outputs specifications* on page 19
- *Table 4 N1002A computer system specifications* on page 16

Safety Information

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.

CAUTION 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.

NOTE A NOTE calls the user's attention to an important point or special information in the text.

NOTE 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.

NOTE Only Keysight approved accessories shall be used.

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 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 Safety of any system incorporating the equipment is the responsibility of the assembler of the system.

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 an Keysight Field Engineer should be consulted to assure instrument(s) temperature compliance and performance.

NOTE The input terminals for this product are classified as Measurement Category None.

NOTE Install the instrument according to the enclosure protection provided. This instrument does not protect against the ingress of water. This instrument protects against finger access to hazardous parts within the enclosure.

NOTE Is your product software up-to-date? Keysight periodically releases software updates to fix known defects and include product enhancements. To search for software updates for your product, go to www.keysight.com/find/TechSupport.

Step 1. Inspect the Shipment

- Inspect the shipping container and instrument for damage.
- Keep the shipping container and cushioning material until you have inspected the contents of the shipment for completeness and have checked the instrument mechanically and electrically. In the unlikely event that you must return the instrument to Keysight, as described in *Returning the N1002A for Service* on page 8, you'll need to use the original packaging or comparable.
- Locate the shipping list. Verify that you received all the accessories and options that you ordered. The following list shows some of the items that may be on the shipping list. The information on your actual shipping list is more accurate and should supersede the information in this list.

Package Contents

- N1002A DCA-M Optimization Controller
- Keyboard, USB
- Mouse, USB
- Power cord
- Functional Test Certificate
- Software Entitlement Certificate *(for installing a license that was not installed at the factory)*
- Keysight safety leaflet
- N1002A Quick Start Guide *(this document)*

CAUTION Instrument damage can result from using packaging materials other than the original materials. Never use styrene pellets as packaging material. They do not adequately cushion the instrument or prevent it from shifting in the carton. They may also cause instrument damage by generating static electricity.

Step 2. Work at a Static-Safe Workstation

Electrostatic discharge (ESD) can damage or destroy electronic components. All work on instruments and electronic components should be performed at a static-safe workstation as shown in Figure 3. The static-safe workstation uses two types of ESD protection:

- Conductive table-mat and wrist-strap combination.
- Conductive floor-mat and heel-strap combination.

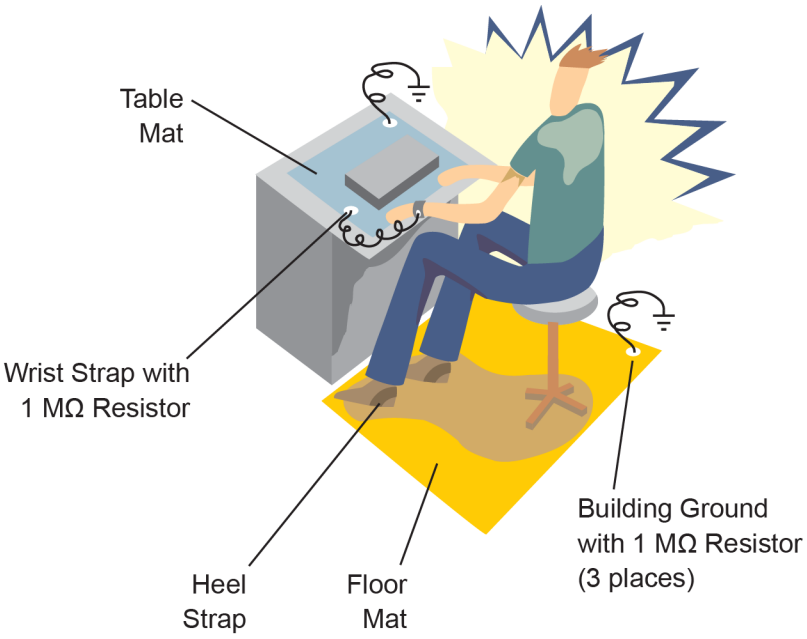


Figure 3. Example of Static-Safe Workstation

The following suggestions may reduce ESD damage that occurs during testing and servicing operations.

- Personnel should be grounded with a resistor-isolated wrist strap.
- Be sure all instruments are properly earth-grounded to prevent a buildup of static charge.

WARNING **These techniques for a static-safe workstation should not be used when working on circuitry with a voltage potential greater than 30V rms, 42.4V peak, or 60V DC volts.**

CAUTION Only the table-mat and wrist-strap combination provides adequate ESD protection when used alone. To ensure your safety, the static-safe accessories must provide at least 1 MΩ of isolation from ground. Purchase acceptable ESD accessories from your local supplier.

Daily ESD Self Check

1. Visually check your work area to see that there are no static-generating materials, insulating work surfaces, or static-generating tools.
2. Clear your work area of static charge generators for a distance of at least 1 meter from ESD sensitive items.
3. Visually check that the ground wiring to the workstation has not been disconnected or damaged.
4. If applicable, make certain that your work station air ionizer is activated and correctly positioned.
5. Make sure that there are no static generators inside conductive containers with ESD sensitive items.
6. Visually check that all ESD sensitive parts, assemblies, or products are completely inside closed conductive containers.
7. Make sure that all shielding containers have an approved static attention label on the outside.
8. Make sure that all cleaners, solvents, coatings, and sprays used at your workstation are types approved by your ESD Coordinator.
9. Put on wrist strap and conductive footwear, and any special garments which are required in your job.
10. Don’t allow anyone who is not grounded closer than 1 meter to your static safe area.

Step 3. Position

Position the N1002A so that it will have sufficient clearance for airflow around the rear panel, left side panel (side without handle), and bottom. Review Table 5 to confirm that your operating or storage environment is suitable for the instrument.

CAUTION

The N1002A can only be operated (or placed in Standby mode), when orientated as show in the following picture (resting on it's bottom feet). To avoid thermal damage, position the N1002A so that it will have sufficient clearance for airflow around the rear panel and bottom. Review Table 5 to confirm that your operation of storage environment is suitable for the instrument. The N1002A can be stored (power cord not connected) in any orientation as long as care is taken to avoid damaging the front or rear panels..

Figure 4. Required Operating or Standby Position

Table 3. N1002A front-panel inputs and outputs specifications

Item	Description
USB	Three USB 3.0 ports

Table 4. N1002A computer system specifications

Item	Description
CPU	Intel i7 Octal-Core
RAM	32 GB
Operating System	Win10 LTSC, 64-bit
Mass Storage	480 GB SSD

Table 5. N1002A Environmental Specifications

Item	Description
Use	indoor
Temperature (Operating)	10 °C to +40 °C (50 °F to +104 °F)
Temperature (Non-operating)	–40 °C to +70 °C (–40 °F to +158 °F)
Altitude (Operating)	Up to 4,600 meters (15,000 ft)
Humidity [1]	Type tested at 85%, +40 °C (non-condensing)
Weight	*6.5 kg (14.4 lbs), characteristic*
Dimensions (excluding handle)	101 mm H x 426 mm W x 491 mm D (3.98 inch x 16.77 inch x 19.33 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.

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. The front panel switch is only a standby switch and is not a LINE switch. Alternatively, an externally installed switch or circuit breaker (which is readily identifiable and is easily reached by the operator) may be used as a disconnecting device.

CAUTION Windows registry: If the N1002A is mounted in a rack or cabinet, do not use the system power switch to disconnect power from the instrument. Instead, use the N1002A front-panel power switch. Using the system power switch may corrupt the Windows registry requiring you to perform the recovery procedure to restore normal operation to the N1002A.

NOTE Should the Declaration of Conformity (DOC) be required, contact an Keysight Sales Representative or the closest Keysight Sales Office. Alternately, contact www.keysight.com.

Step 4. Connect a Display, Keyboard, and Mouse

Connect a display, keyboard, and mouse to the N1002A's front or rear-panel connectors shown in Figure 5. Front-panel operation is only required to confirm that your N1002A properly boots up if you are manually using the N1002A and for confirming that a LAN connection is made. After completing this chapter, you can remove the display, keyboard, and mouse and remotely control the N1002A.

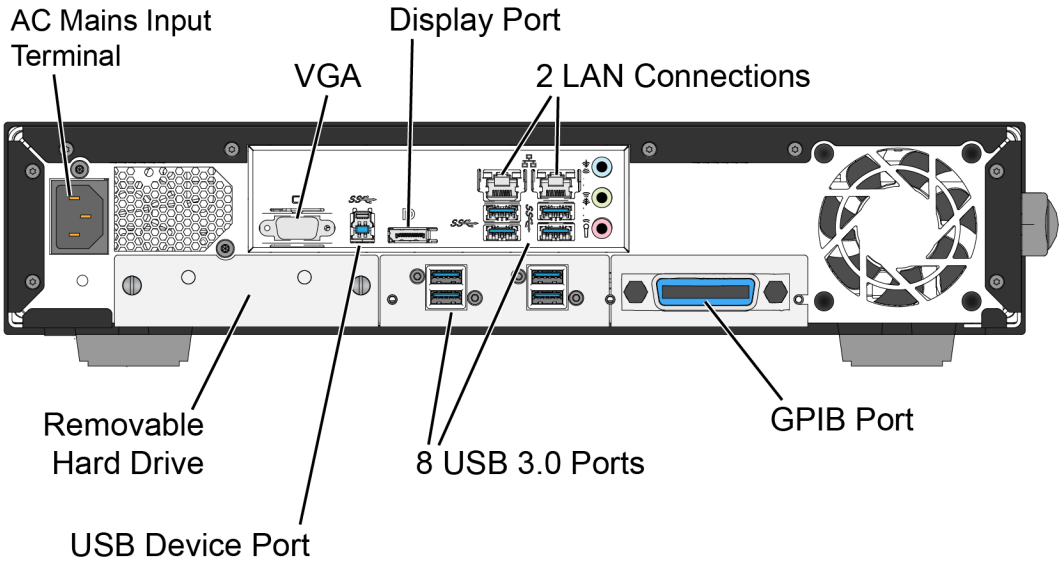


Figure 5. Rear-Panel Connections

NOTE A display is not provided by Keysight.

NOTE When connecting or using a mouse or keyboard, always consider ergonomic principles as explained in FlexOTO's help system. After completing the installation, in FlexOTO click **Help** > **User's Guide** to access the help. In the Help's menu, click **Quick Start** > **Safety** > **Working in Comfort**.

Table 6. N1002A rear-panel inputs and outputs specifications

Item	Description
GPIB	Fully programmable, complies with IEEE 488.2
Display Port	For connecting external displays
VGA Port	Analog, full color, 15 pin D-sub (female)
LAN	Two Gigabit Ethernet ports
USB	Eight USB 3.0 ports
USB Device Port	Instrument control over USB

Step 5. Turn on

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

CAUTION Do not connect ac power until you have verified the line voltage is correct as described in Table 7. Damage to the equipment could result.

CAUTION Protect Windows registry. If the N1002A is mounted in a rack or cabinet, do not use the system power switch to disconnect power from the instrument. Instead, use the N1002A front-panel power switch. Using the system power switch may corrupt the Windows registry requiring you to perform the recovery procedure to restore normal operation to the N1002A.

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

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

CAUTION This instrument has auto-ranging line voltage input; be sure the supply voltage is within the specified range and that voltage fluctuations do not to exceed 10 percent of the nominal supply voltage.

Table 7. N1002A LINE Power Specifications

Item	Description
Line Power	100/120 Vac, 50/60 Hz
	220/240 Vac, 50/60 Hz
Power in Watts	185 Watts Maximum
The products can operate with mains supply voltage fluctuations up to ± 10% of the nominal voltage.	

1. Connect the line cord as shown in *Figure 6* on page 21. The N1002A automatically adjusts for line input voltages. There is no voltage selection switch. The line cord provided is matched by Keysight to the country in which the order originates.

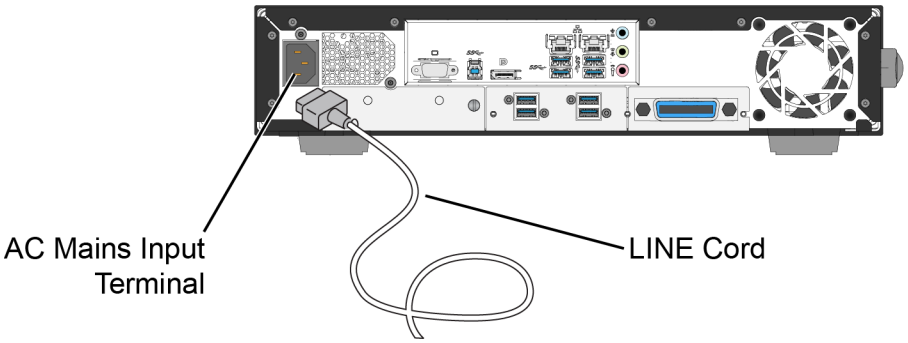


Figure 6. LINE Power Cord Connection to N1002A

2. Press the front panel **ON/Standby** switch to turn on the N1002A.
3. Wait while the N1002A boots up. During the process, you will be asked to accept the Windows 10 End User License Agreement (EULA). Once accepted the N1002A will continue to configure itself.

User Accounts

Windows is configured with the following two user accounts: **dca-admin** and **dca-service**. Both accounts are password protected. The **dca-admin** account is for customer use and has the following password: `N1000A`.

To clean the N1002A

WARNING To prevent electrical shock, disconnect the Keysight Technologies Model N1002A 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.

To remove the drive

The N1002A has a removable SSD hard drive which includes Window 10, the FlexOTO and FlexDCA applications, and any data or other user files. If for whatever reason you need to remove the N1002A from a secure area, you can quickly and easily remove the drive. The drive includes both drive C (INFINIIUM) and drive D (USER). Drive C contains the operating system, N1000300A FlexOTO application, the N1010A FlexDCA application, and any factory or user installed applications. Drive D contains backup files and user files including data files.

CAUTION Use standard anti-static precautions when handling the drive to avoid damaging the drive.

1. Turn off the N1002A.
2. Remove the power cord.
3. Locate the drive on the N1002A's rear panel as shown in Figure 7.

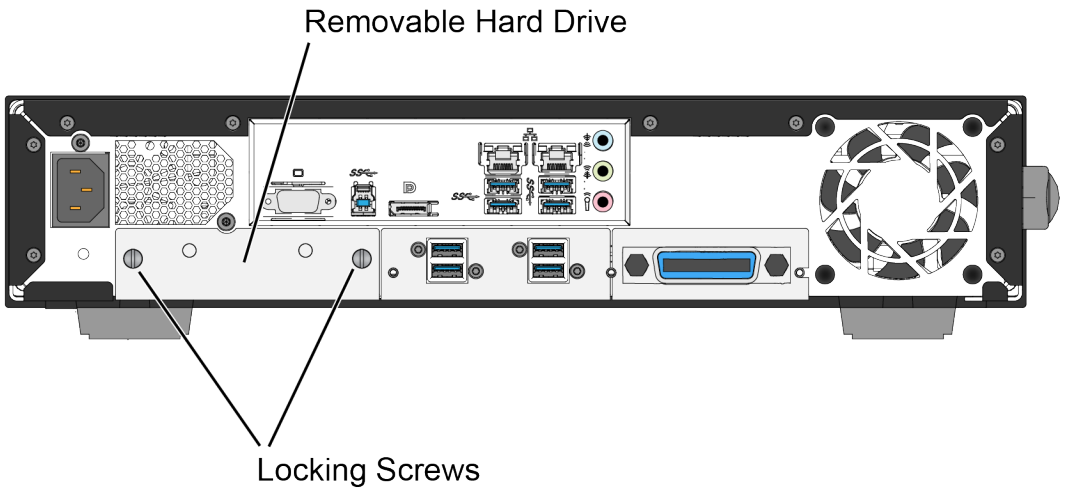


Figure 7. Removable Hard Drive

4. Turn the locking screws counter-clockwise to release the drive.
5. Pull out the drive.

To Declassify Instrument Memory

The declassification process is simply to remove the instrument's drive.

Network Security Guidelines for the Keysight Sampling Oscilloscope Products

As cyber security threats continue to evolve, many businesses and laboratories are evaluating the networking security of their measurement instruments. The following information provides networking security guidelines for the following Keysight products:

- N1000A and 86100D DCA-X sampling oscilloscopes
- N1002A DCA-M Optimization Controller

To provide overlapping protection from vulnerabilities, a multilayered approach to network security is recommended. Securing the measurement instruments on your network is just one piece in a larger picture of IT cybersecurity, which includes firewalls, network segmentation, gateway antivirus scanning, and intrusion detection. As cyber threats continue to evolve, continued updates to network security tools and techniques are required.

The products listed above use the Microsoft Windows operating system, which allows standard IT networking security defenses to be used. Each of the following sections covers standard practices for improving networking security.

Use Antivirus software

- Install antivirus software on your instrument, and schedule regular scans. This is important to do even if your instrument is not connected to a network, because instruments will still be susceptible to malware transported by removable media such as USB flash drives.
- To further reduce the risk of removable media malware, you can also disable AutoPlay and AutoRun in Windows.
- On N1000A and N1002A instruments, some antivirus products block USB devices by default, which can disable the USB device communication Keysight instrumentation. To resolve this issue, use the antivirus software to create a policy to allow these USB devices to communicate.
- For more information, refer to the Keysight Computer Virus Control Program description at: *https://about.keysight.com/en/quality/Keysight_Computer_Virus_Control_Program.pdf*

NOTE

The N1000A and N1002A comes with antivirus software already installed (Windows Defender).

NOTE Some antivirus software can negatively impact the computational performance (speed) of the computer. Many of our customers successfully use the Symantec Endpoint Protection antivirus with minimal impact to their measurement speeds. Scans should be performed during non-critical hours at least once a week.

Update your software regularly

- Keep your antivirus and malware scanning software current by setting them to automatically update.
- Microsoft security updates should be applied on a monthly basis (more often for critical updates). This can be done manually on a regular schedule, or by configuring the updates to automatically install.
- Update the instrument's firmware regularly to have the latest security updates. Keysight releases instrument firmware updates multiple times per year.
- Some instrument security updates may require an update to the BIOS. Please contact Keysight Technical Support to determine if your BIOS version needs to be updated.
- Any other software you have installed on your instrument should also be updated when new versions are available to address security issues.

Use Password Authentication

- By default, the instruments do not have screen saver locks configured. You can configure screen locks to automatically require access if the instrument is idle for more than a set number of minutes.
- Auto-logon is configured by default on the instruments, but this can be changed so that login is required when Windows restarts. You can also change the default Windows account passwords to unique, strong passwords that expire at set intervals. There are two default accounts: *dca-admin*, and *dca-service*. Ths *dca-service* account is for Keysight service personnel only. To require a login,

  1. Click the search icon in the Windows taskbar.
  2. Enter `Run`.
  3. In the displayed dialog, enter "*control userpasswords2*".
  4. Click OK.
  5. In the dialog, locate the *Users must enter a user name and password...* field. Select this field and click OK. This selection forces the instrument to require a login. Contact your systems administrator for further information.

- The Windows Event Viewer automatically creates an audit log for logons and logoffs. For additional security, you can monitor your audit log for unauthorized access attempts.
- Allowing a web browser to store passwords is *not* a recommended security practice.

Disable and Reduce Unnecessary Access

- The instrument comes configured to allow access for remote services which allows flexible measurement configurations and access to data. You can disable these features if you don't use them.
- Windows Firewall is automatically configured with open ports which can be closed, depending on your test application needs. The FlexDCA software configures an Inbound firewall rule for its use. Other Inbound ports used by Keysight Software are listed in the following table.

Table 8. Open Inbound Ports Used By Keysight Software

Port Number	Service Used By
4880	Instrument HiSLiP
5024	Instrument Telnet
5025	Instrument Socket
8000	Keysight License Service Management
8001	Keysight License Manager Notifications
8020	Keysight License Service Alerts
8766	Keysight Communications Fabric
9944	Agilent Automated DigtialTest App (Primary)
49944	Agilent Automated DigtialTest App (Alternate)

- The Keysight license service allows licenses to be added to or removed from an instrument remotely over the network. You can disable the firewall rules for this feature if you don’t need it.
- For ease of data file usage, SCPI allows file manipulation by default (both instrument and PC) of all files with that user's permission. Disable SCPI access if you are not using this feature.
- The following Networking services can be disabled, depending on your application:
  - Keysight Remote I/O Port Mapper
  - Keysight Remote I/O Server

- By default, the N1000A/N1002A's ethernet port is configured with the Windows 10 Public Network setting, which disables network discovery and file sharing services. This provides better network security than the Private setting. Responses to network pings (ICMP Echo Requests) are blocked by the default firewall settings in Windows 10.
- The Telnet application *does not* encrypt data or passwords sent over the network. Telnet is susceptible to man-in-the-middle attacks and other vulnerabilities. You can stop the Telnet service or remove it completely if not needed for your application.
- Windows 10 includes the OneDrive cloud-based file hosting. Your organization may have security policies established for sensitive data being stored or shared via OneDrive. If you do not use OneDrive, OneDrive can be disabled via the Local Group Policy Editor in Windows.
- Avoid installing additional software programs on your instrument because they can increase the cyber attack surface of your instrument.
- Avoid installing Virtual Network Computing (VNC) programs such as TightVNC or RealVNC, which allow anyone with possession of the password to remotely take control of the instrument, access its data, and access the network. If VNC must be used for a short time, disable the VNC Server when the remote session is finished.
- Browsing to untrusted websites from the instrument is *not recommended* due to the risk of malware.
- Don't connect instruments directly to untrusted or public networks. Measurement instruments are designed for use on a private network, behind corporate NAT/PAT routers and firewalls. Any public IP address on the Internet *will immediately be attacked* by a multitude of malicious scripts searching for vulnerabilities.

Regularly Backup Your Data

Use backup software to automatically backup your measurement data on a frequent basis, and regularly verify that the backup is working. Store valuable data securely in external media or off-site.

Protect Sensitive Data

Removable media such as USB flash drives present data security risks if the media is lost or stolen and present a means for malicious software to be transported to the instrument. For these reasons, some businesses and laboratories have removable media security policies established by their IT departments to help prevent such risks.

The instrument's hard drive *does not* utilize disk encryption to guard the internal contents of the drive against unauthorized copying. If the physical security of your instrument is at risk, do not store sensitive data on it.

If sensitive files need to be securely deleted from the hard drive, Keysight recommends using the Windows 10's Cipher utility for the N1000A/N1002A.

To secure sensitive data before the instrument is transported out of your facility or shipped to Keysight for servicing, you can easily remove the hard drive via the N1000A/N1002A's rear panel. For more information, refer to the Keysight instrument declassification procedure documents available at: *http://rfmw.em.keysight.com/aerospace/index.aspx*

Instrument Markings

The following table lists the definitions of markings that may be on the instrument.

Table 9. Instrument Markings

Marking	Description
	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
	The ON/STANDBY symbol. The ON, OFF and STANDBY symbols are used to mark the positions of the instrument power line switch.
	The AC symbol is used to indicate the required nature of the line module input power.
	The chassis ground symbol. The chassis ground symbol is used to indicate a chassis connection.
	The CE marking is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven). It indicates that the product complies with all relevant directives.
	The CSA mark is a registered trademark of the CSA International.
	The RCM mark is a registered trademark of the Australian Communications and Media Authority.
ISM 1A	This is a symbol of an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 5)
ICES/NMB-001	This is a marking to indicate product compliance with the Canadian Interference-Causing Equipment Standard. Cet appareil ISM est conforme a la norme NMB du Canada.
	China Restricted Substance Product Label. The EPUP (environmental protection use period) number in the center indicates the time period during which no hazardous or toxic substances or elements are expected to leak or deteriorate during normal use and generally reflects the expected useful life of the product.
	South Korean Certification (KC) mark; includes the marking's identifier code which follows this format: MSIP-REM-YYY-ZZZZ.

	The crossed out wheeled bin symbol indicates that separate collection for waste electric and electronic equipment (WEEE) is required, as obligated by DIRECTIVE 2012/19/EU and other National legislation. Please refer to *keysight.com/go/takeback* to understand your Trade in options with Keysight in addition to product takeback instructions.
	Universal recycling symbol. This symbol indicates compliance with the China standard GB 18455-2001 as required by the China RoHS regulations for paper/fiberboard packaging.
	UK conformity mark is a UK government owned mark. Products showing this mark comply with all applicable UK regulations.
	The Keysight email address is required by EU directives applicable to our product.

N1002A Regulatory Information

To find a current Declaration of Conformity for a specific Keysight product, go to:

http://www.keysight.com/go/conformity

SAFETY: Complies with the essential requirements of the European Low Voltage Directive as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity):

- IEC/EN 61010-1
- Canada: CSA C22.2 No. 61010-1
- USA UL std no. 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.

EMC

Complies with the essential requirements of the European EMC Directive as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity):

- IEC/EN 61326-1
- CISPR Pub 11 Group 1, Class A
- AS/NZS CISPR 11
- ICES/NMB-001

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est conforme a la norme NMB-001 du Canada.

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.

A 급 기기 (업무용 방송통신기자재)

이 기기는 업무용 (A 급) 전자파적합기기로서
판 매자 또는 사용자는 이 점을 주 의하시기 바라
며 ,가정외의 지역에서 사용하는 것을 목적으 로
합니다 .

Acoustic statement: (European Machinery Directive)

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

3 Configuring the FlexOTO Application

This chapter describes how to configure and setup the FlexOTO application. FlexOTO does not require the N1002A as FlexOTO can be downloaded from Keysight and installed on any PC that meets or exceeds the requirements listed in *Table 4 N1002A computer system specifications* on page 16.

Step 1. Configure the N1002A's LAN Connection

You can configure the N1002A on a local area network (LAN) so that FlexOTO can be remotely controlled. This also allows for file sharing and the use of network printers.

1. Connect your LAN cable to one of two N1002A rear-panel RJ-45 connectors.

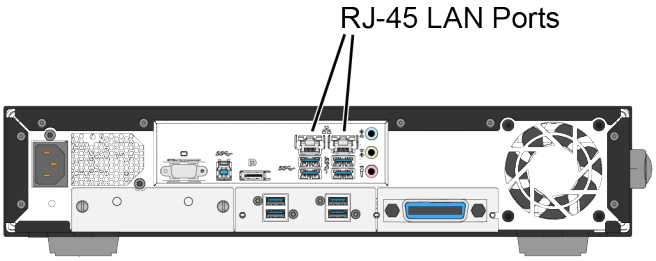


Figure 8. LAN Connector

2. Turn on the N1002A.
3. Close any open applications and view the Windows desktop.
4. Use Windows to setup your N1002A with the appropriate client, protocol, and configuration for your LAN.

NOTE If you do not know how to set up a network, contact your network administrator. If you plan on sharing the N1002A's hard disk drive with other computers on your LAN, the network administrator should enable file sharing as part of the network setup.

NOTE You can share any folder on the USER (D:) drive.

Step 2. Install a Feature License

Locate any Software Entitlement Certificate that was shipped with the N1002A, and use the certificate to install any licenses. Refer to the N1002A's help system for information on licenses. In FlexOTO click **Help** > **User's Guide** to access the help.

Step 3. Enable FlexOTO's SCPI Servers

Depending on your SCPI programming environment, you will need to confirm that any desired SCPI Servers (VXI-11, Telnet, Sockets, or HiSLIP) on FlexOTO are enabled.

1. From the Windows Start menu, start the FlexOTO application.
2. On FlexOTO's menu, click **Tools** > **SCPI Programming Tools** > **SCPI Server Setup** to open the **SCPI Server Setup** dialog as shown in Figure 9.
3. In the dialog, check the **Enabled** selections for the interfaces that you want to use.
4. Click the **Setup** buttons to configure an interface's settings.

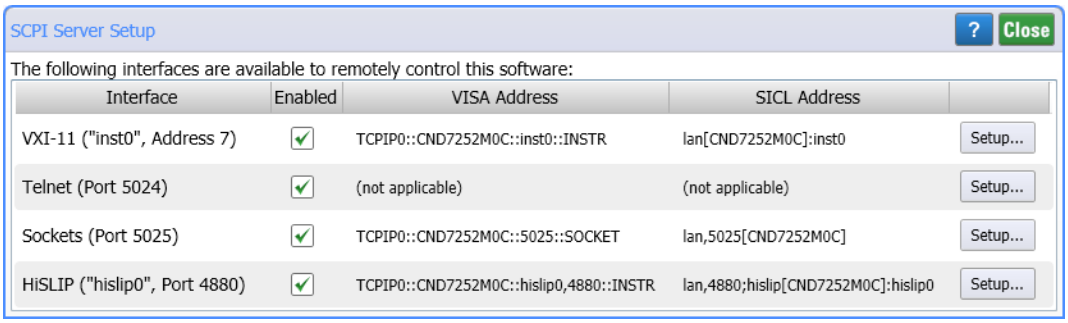


Figure 9. SCPI Server Setup

NOTE

FlexOTO's hardware configuration can be set up through VXI-22, Telnet, Sockets, or HiSLIP. FlexOTO's Test Stations can only be accessed via HiSLIP.

Step 4. Confirm Supported Hardware

Confirm that your DCA-Ms are listed in *Table 10* on page 36. You will need at least one N109x-series DCA-M oscilloscope. If you DCA-M oscilloscope does *not* have clock recovery, you will also need an N107x-series clock recovery DCA-M.

Confirm that your optical switch is listed in *Table 11* on page 37. If your switch is not listed, you must write a switch driver (*.py or *.exe). Instructions for writing the driver are found in FlexOTO's programmer's help. In FlexOTO's menu, click SCPI Intro > Writing a Switch Driver.

External DCA-M Modules

At least one DCA-M acquisition group is required in the test setup. An acquisition group is a set of DCA-M modules that provide clock recovery *and* optical input channels. Here are two examples:

- A single N1092B with the clock recovery option CDR. *(includes both clock recovery and an input channel).*
- An N1078A clock recovery with an N1092D oscilloscope.

Table 10. Recognized DCA-M Modules

DCA-M Module	Number of Optical Channels	Clock Recovery				Required Options	Connection Peripheral
		Data In	Data Out	Clock In	Clock Out		
Oscilloscope Modules							
N1092E	4			•		PLK, IRC, 30A/40A	USB[1]
N1092D	4			•		PLK, IRC, 30A/40A	USB[1]
N1092C	1			•		PLK, IRC, 30A/40A	USB[1]
N1092B	2			•	•[2]	PLK, IRC, CDR, 30A/40A	USB[1]
N1092A	1			•	•[2]	PLK, IRC, CDR, 30A/40A	USB[1]
Clock Recovery Modules							
N1078A		•	•		•	S50 or SXT[3]	USB[1]
N1077B		•	•		•	SMM or SXT[3]	USB[1]
N1077A		•	•		•	SMS or SXT[3]	USB[1]

1 Supports automatic detection via USB by FlexOTO.
2 Options CDR and 40A required.
3 An N1077A-SXT, N1077B-SXT, or N1078A-SXT requires an external optical splitter to provide an optical data to an input channel of the N109x-series DCA-M oscilloscope.

Optical Switches

The test setup must include a recognized optical switch.

Table 11. Recognized Optical Switches

Model	Switch Ports	Supported Connection Peripheral
Keysight Switches		
N7731A/C switch	2 channel 1 x 4	LAN, USB[2]
N7733C switch	1 x 16	LAN, USB[2]
N7734A switch	1 x 13	LAN, USB[2]
N7736C switch	4 chanel 2 x 2	LAN, USB[2]
DiCon GP750 switch	Depends on installed modules.	RS-232
DiCon GP600	Depends on installed modules.	RS-232
Polatis Series 6000 Ultra switch	12 x 12 12 x 12	LAN, serial, USB[1]
Switch *(not listed above)*. The user must write a switch driver (*.py or *.exe). Instructions for writing the driver are found in FlexOTO's programmer's help. Open the help and click **SCPI Intro** > **Writing a Switch Driver**. .		

1 Supports automatic detection via USB by FlexDCA.

NOTE

Third-party optical switches are not provided by Keysight and must be purchased from their manufacturer. The N1002A, when purchased as part of a solution bundle (refer to *Chapter 4 , Solution Bundles,* on page 47), includes an optical switch. If the N1002A is purchased separately, not in a solution bundle, the Keysight switch, if desired, must be separately purchased.

Step 5. Connect DCA-M Modules and an Optical Switch

1. Start the FlexOTO application.
2. Apply power to your optical switch and to the DCA-M modules that you plan to use. Do not connect any USB/RS232 cables at this time. Only one optical switch can be used. The optical switch and DCA-M modules must be recognized by FlexOTO. If your optical switch is *not* recognized, you can write your own optical switch driver.
3. Allow time for the optical switch and DCA-Ms to boot up *before* proceeding to the next step.
4. Connect the USB/RS232 cables for the optical switch and DCA-Ms to the PC where FlexOTO is running.
5. FlexOTO automatically detects the optical switch and DCA-M modules via the LAN, USB, or RS-232 connections. In the unlikely event that FlexOTO does *not* detect a switch or DCA-M, you can open the FlexDCA application and manually establish the connections using FlexDCA's Extended Module Configuration dialog. Confirm that the optical switch and DCA-Ms have been automatically installed as extended modules. A Switch slot tile (and DCA-M tile) should be displayed in along FlexDCA's bottom tray.

Figure 10. FlexDCA's Bottom Tray Showing Switch Tile

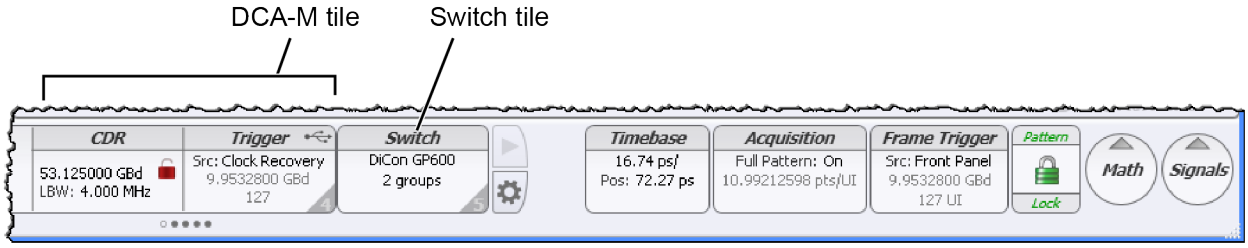
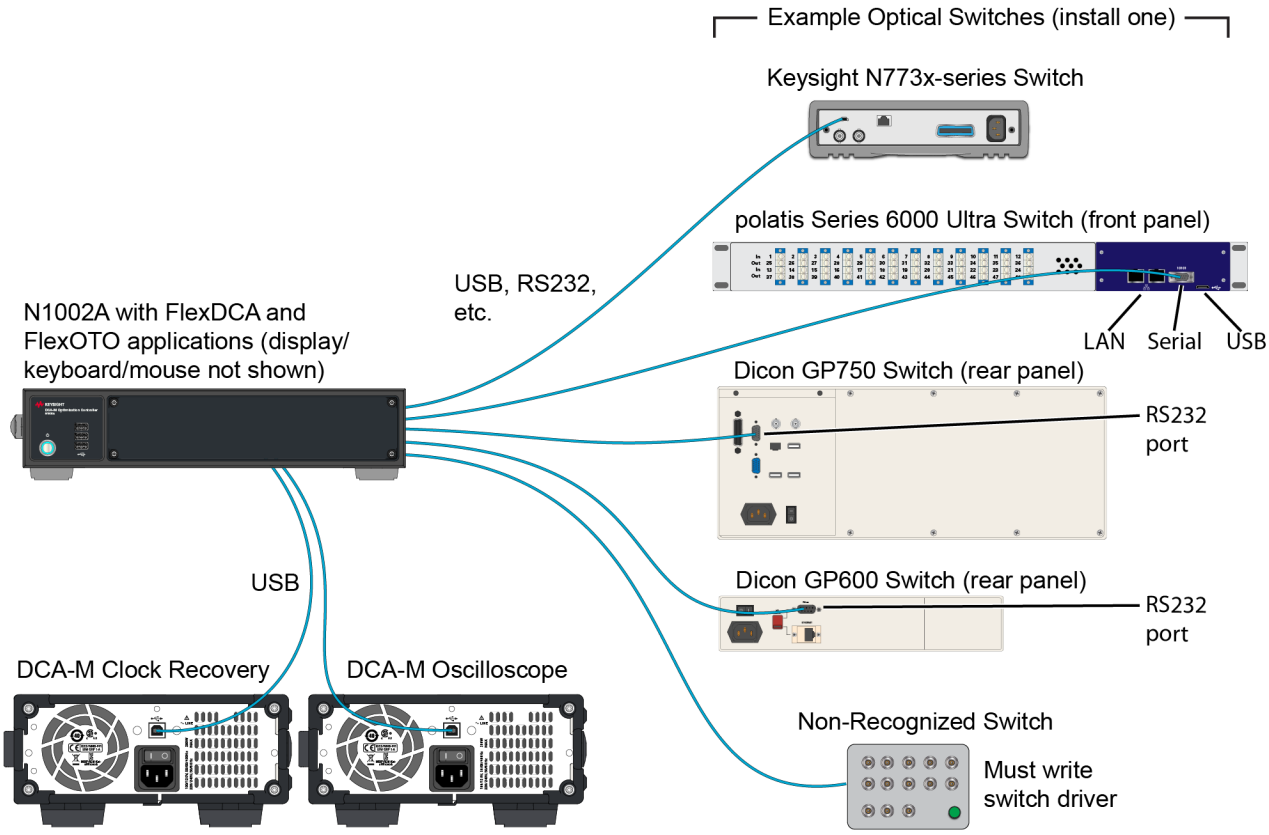


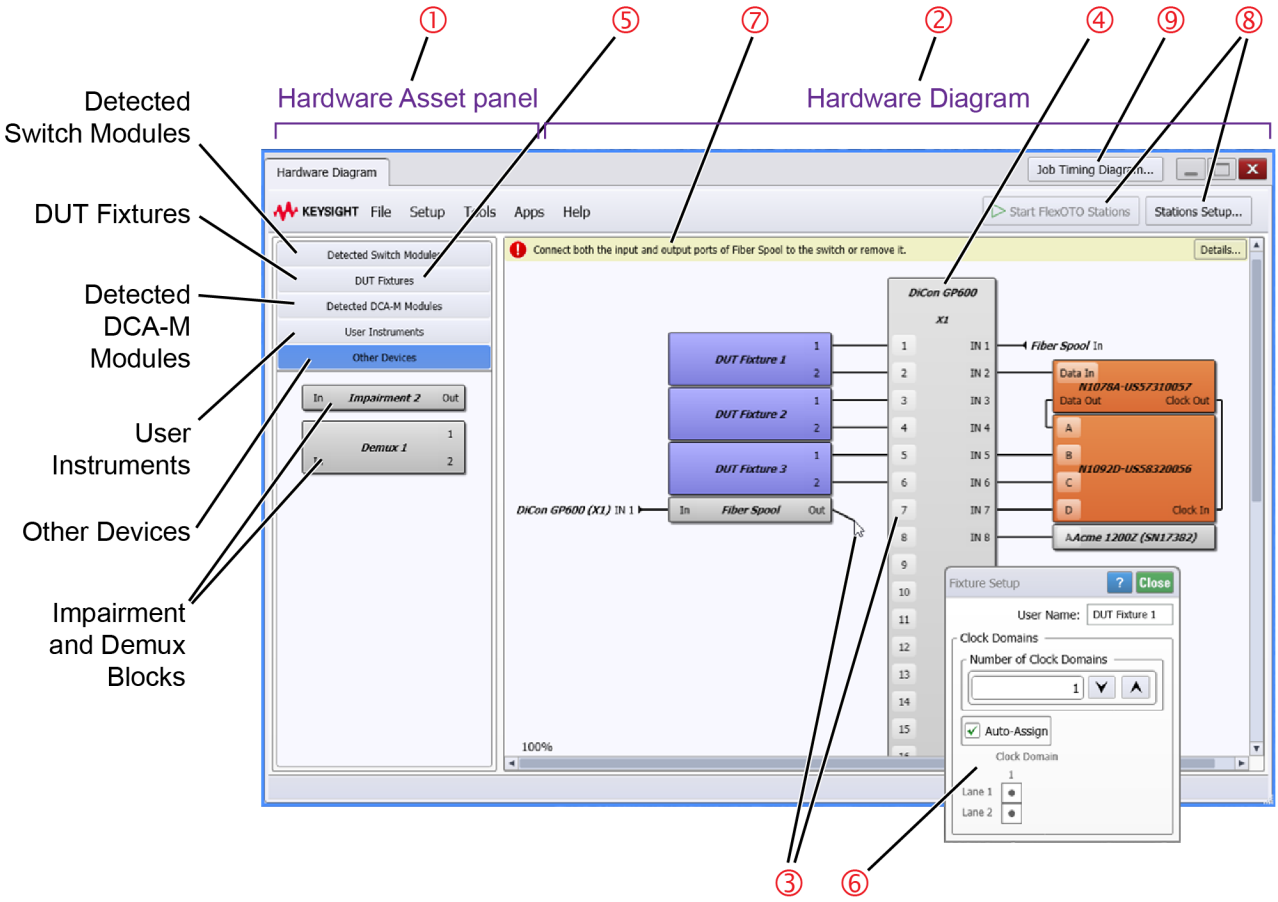
Figure 11. Example Connections (Only One Optical Switch Allowed)



6. Turn on each DUT Fixture that you will use in your setup.
7. Optional steps:
   a. Use a patch cord to connect one DUT Fixture output directly to your DCA-M modules.
   b. Open the FlexDCA application, and configure your DCA-M modules settings so that the DCA-M oscilloscope can trigger on and view the signal.
   c. Remove the patch cord.
   d. Return to FlexOTO.

Step 6. Build FlexOTO Hardware Diagram

FlexOTO does not allow invalid Hardware Diagram connections. Because of the Hardware Diagram's guided setup, it is recommended that you always connect all the ports on the Hardware Diagram *before* connecting the actual physical fiber optic cables in your test setup.



1. FlexOTO has two panels: **Hardware Asset Panel** 1 and the **Hardware Diagram** 2 as shown in the following picture.
2. Click on the **DUT Fixtures panel** 5 and enter the number lanes that your DUT Fixtures have.
3. Drag hardware blocks, for example the switch 4, from the Hardware Assets panel to the Hardware Diagram.

NOTE The goal is to have the Hardware Diagram model your actual test setup including DUTs, DCA-Ms, demultiplexers, impairments, instruments, and switch connections.

4. Make port connections on the Hardware Diagram by clicking a hardware block's port and then clicking the desired port on the Switch or other hardware block. This is shown as item 3 in the above figure.

NOTE Press the keyboard's **SHIFT** key while dragging blocks onto the Hardware Diagram and FlexOTO automatically make the necessary switch connections. You can easily change them if you want.

NOTE When you click a port on a hardware block or Switch, *all possible valid* connections are highlighted. Select the highlighted port that matches your test setup.

5. If a placed DUT or WDM DUT fixture has multiple clock domains, click on the **Fixture** block to open the Fixture Setup dialog 6 where you can assign the clock domains to different lanes.

NOTE When you click on placed hardware blocks other than switch and DCA-M modules, a dialog 6 opens that allows you to enter a custom name for the block and may also include other options.

Table 12. Placement of Hardware Blocks on Hardware Diagram

Hardware Block	Switch's Side		Setup Dialog
	Switch Input	Switch Output	
DUT Fixture	•		•
WDM DUT Fixture	•		•
DCA-M Modules		•	—
Demultiplexer	•	•	•
Impairment	•	•	•
Instrument		•	•

6. Click **Stations Setup** 8 to open the FlexOTO Stations Setup dialog. Select the number of **Stations** that you have. If Stations have multiple DUTs, assign the DUT Fixtures to your Stations. The **Wavelength** selection in this dialog selects FlexDCA's wavelength setting. If you want to select the wavelength setting of a Switch (if this setting exists for your switch), click on the **Switch** block.
7. After modeling your setup and *messages no longer appear* above the Hardware Diagram 7, click **Start FlexOTO Stations** which is next to the **Stations**

Setup button. FlexOTO Hardware Diagram then creates and starts the number of child processes, represented by Stations tabs in the GUI, that you have specified.

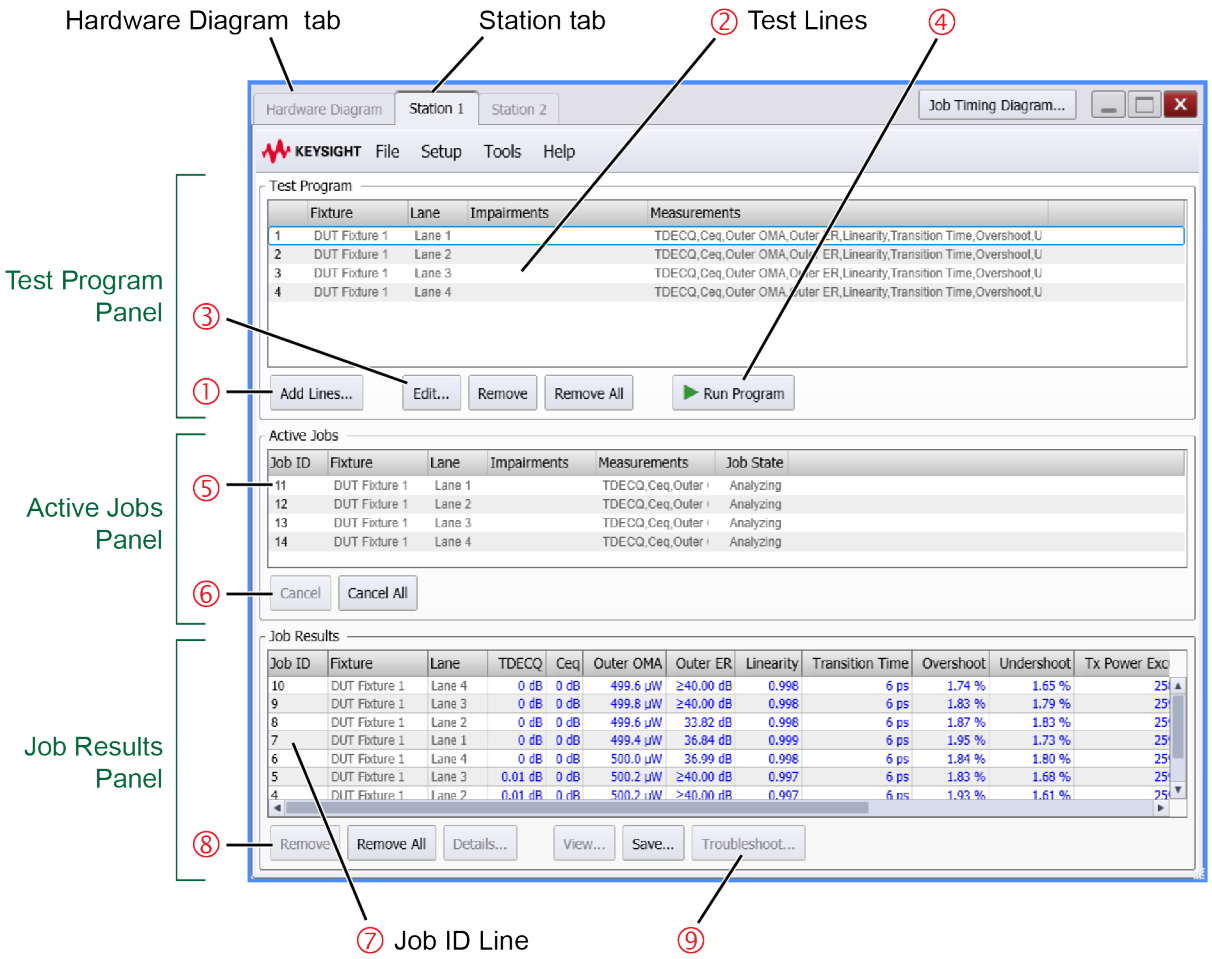
NOTE Alert messages appear above the Hardware Diagram to alert you to errors that invalidate a diagram. FlexOTO will not let you begin testing if your Hardware Diagram has an alert.

NOTE The Start FlexOTO Stations button changes to Stop FlexOTO Stations which you can click at any time to end all running Stations.

8. Click on each Station tab, and configure your Station Test Plans.
9. When you've completed running your Test Plan, click Job Timing Diagram 9. This displays a diagram where you can compare timing between User Stations or Task Breakdown.

Step 7. Create and Run FlexOTO Test Plans

1. Click on a *Station* tab.



2. If you plan to remotely operate FlexOTO, turn on FlexOTO's SCPI Recorder so that you can capture FlexOTO *Station* SCPI commands as you configure the Test Program. The SCPI Recorder quickly lists the commands needed to perform your tasks.

3. In the **Test Program** panel, click **Add Lines** ①. This opens the Test Program Measurement Setup dialog. In the dialog, configure your Test Plan and then click **Add Lines and Close** to add the test lines ②. Each line defines a test of a specific DUT Fixture/Lane combination.

4. If needed, use the **Edit**, **Remove**, and **Remove All** buttons (3) to modify the Test Plan:
   - **Edit** allows you make edits to a *selected* line.
   - **Remove** deletes the *selected* line.
   - **Remove All** deletes the entire test plan.
   - **Add Lines** to append additional lines to the test plan with different conditions.
5. If additional Station tabs are displayed, repeat the above steps to create a Test Plan for each Station.

CAUTION **Avoid damaging the inputs of DCA-M modules.** The front panel of many optical switches list the maximum power above which the switch is damaged. Be aware that the switch's maximum power level may far exceed the maximum safe power limits to DCA-M module inputs. Never exceed the maximum power level shown on the DCA-M module's front panel.

6. After all test plans are created, select each Station tab and click **Run Program** (4) to start the measurements.

NOTE Clicking **Run Program** is equivalent to the `:TPRogram:EXECute?` SCPI command which starts the measurement acquisition and returns a comma delimited string of Job ID numbers. Job ID's identify a line in the **Job Results** panel that lists results for a specific DUT's Lane. You'll pass Job ID numbers to `:JOBS` subsystem commands in order to return various measurement results.

7. Observe each Station's **Active Jobs** panel to see how the Test Plan is progressing (5). While the Test Plan is executing, use the **Cancel** and **Cancel All** buttons (6) to end testing of any of the active jobs.
8. After the Test Plan completes, the measurement results (7) are listed by **Job ID** in the **Job Results** panel. If you run your Test Plan multiple times, all of the results will be listed in the panel until the **Remove** or **Remove All** button (8) is clicked.
9. Click **Save** to save all test results to a zip file that includes a Excel spreadsheet of the results table and eye diagram images if selected to be saved in the *Measurements* field of the Test Program Measurement Setup dialog.
10. Click **Stop** on the **SCPI Recorder**, and click on the list of recorded commands. Type *Ctrl-A* followed by *Ctrl-C* to copy the recorded commands to the Windows clipboard. You can paste the recorded commands into your program.
11. Click **Troubleshoot** (9) to enter troubleshooting mode where FlexOTO is temporarily disabled and the FlexDCA application is displayed. FlexDCA is FlexOTO's measurement engine. Using FlexDCA, you can change

measurement settings including presets to investigate how a measurement result was derived. When you want to return to FlexOTO, simply exit FlexOTO.

Step 8. Continue to Learn

The following two help systems document FlexOTO. To access the help, start the FlexOTO and on FlexOTO's menu click:

- Help > User's Guide... to open the user's help. On the help's home page, click on the Quick Start and Quick Facts! sidebars to learn vital information about using FlexOTO.
- Help > Programmer's Guide... to learn how to use SCPI commands to remotely control FlexOTO.

4 Solution Bundles

The N1002A can be ordered by itself or in one of the following solution bundles:

- FlexOTO Optical Test Optimization 1x16 Bundle (N1002L33A)
- FlexOTO Optical Test Optimization 1x4 Bundle (N1002L31A)

The N1002L33A and N1002L31A bundles provide cost-effective complete software and hardware solutions to minimize cost-of-test for 800G/1.6T and CPO/NPO high lane count testing. Refer to *Table 14* on page 48 and *Table 13* on page 48 for a the contents of each solution bundle.

This chapter also shows example setups for the solution bundles. Configuring and using FlexOTO with or without the solution bundles is identical. For complete information on setting up FlexOTO, refer to FlexOTO's User's Help. On FlexOTO's menu, click **Help** > **User's Guide**.

NOTE

You don't have to manage optical switch signal routing or the N1092B acquisition or analysis timing. FlexOTO automatically determines and implements the fastest algorithm using the test setup.

Table 13. N1002L33A Solution Bundle Contents

Item	Quantity
N1002A-S00 DCA-M Optimization Controller	1
N1002014A FlexOTO license (1 year subscription)	1
N1010200A FlexDCA MFG package (1 year subscription)	1
N7733C optical switch (1 x 16)	1
N1092A with 40A, PLK, IRC, LOJ, JS1, and CDR options	1
N1027A-AFC, SMF FC/APC FC/PC optical patch cord	1

Table 14. N1002L31A Solution Bundle Contents

Item	Quantity
N1002A-S00 DCA-M Optimization Controller	1
N1002014A FlexOTO license (1 year subscription)	1
N1010200A FlexDCA MFG package (1 year subscription)	1
N7731C optical switch (two internal 1 by 4 switches)	1
N1092B with 40A, PLK, IRC, LOJ, JS1, and CDR options	1
N1027A-AFC, SMF FC/APC FC/PC optical patch cord	2

N1002L33A 1x16 Bundle (Example 1)

This example shows a setup with two 800 GBd DUT fixtures each with two groups of four 53 GBd lanes. Each 4-lane group has its own PLL which is indicated by the four colors used to draw the fiber optic cables.

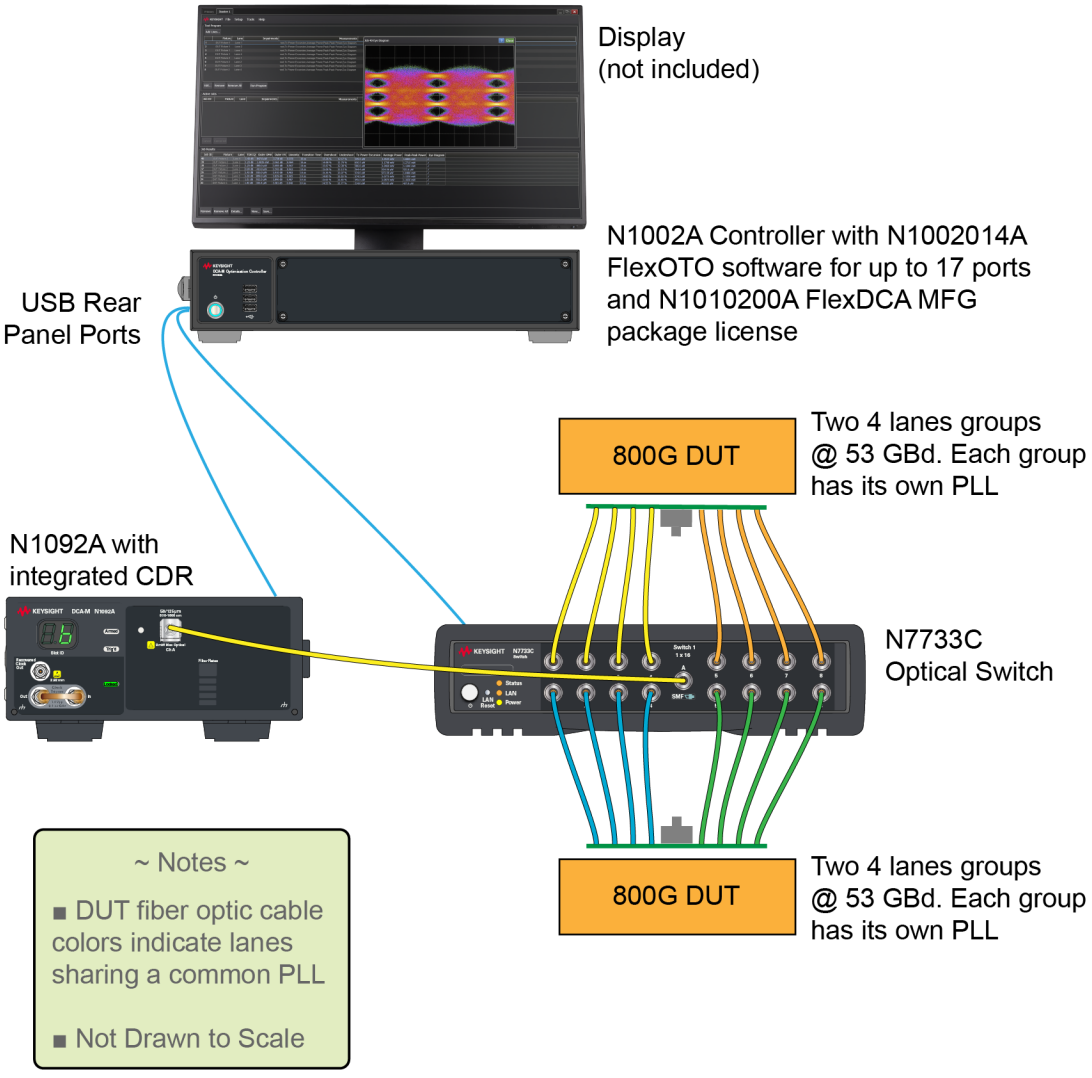


Figure 12. Example 1 Equipment Setup

N1002L33A 1x16 Bundle (Example 2)

This example shows a setup with two 800 GBd DUT fixtures each with eight 53 GBd lanes. Each lane has its own PLL which is indicated by the eight colors used to draw the fiber optic cables.

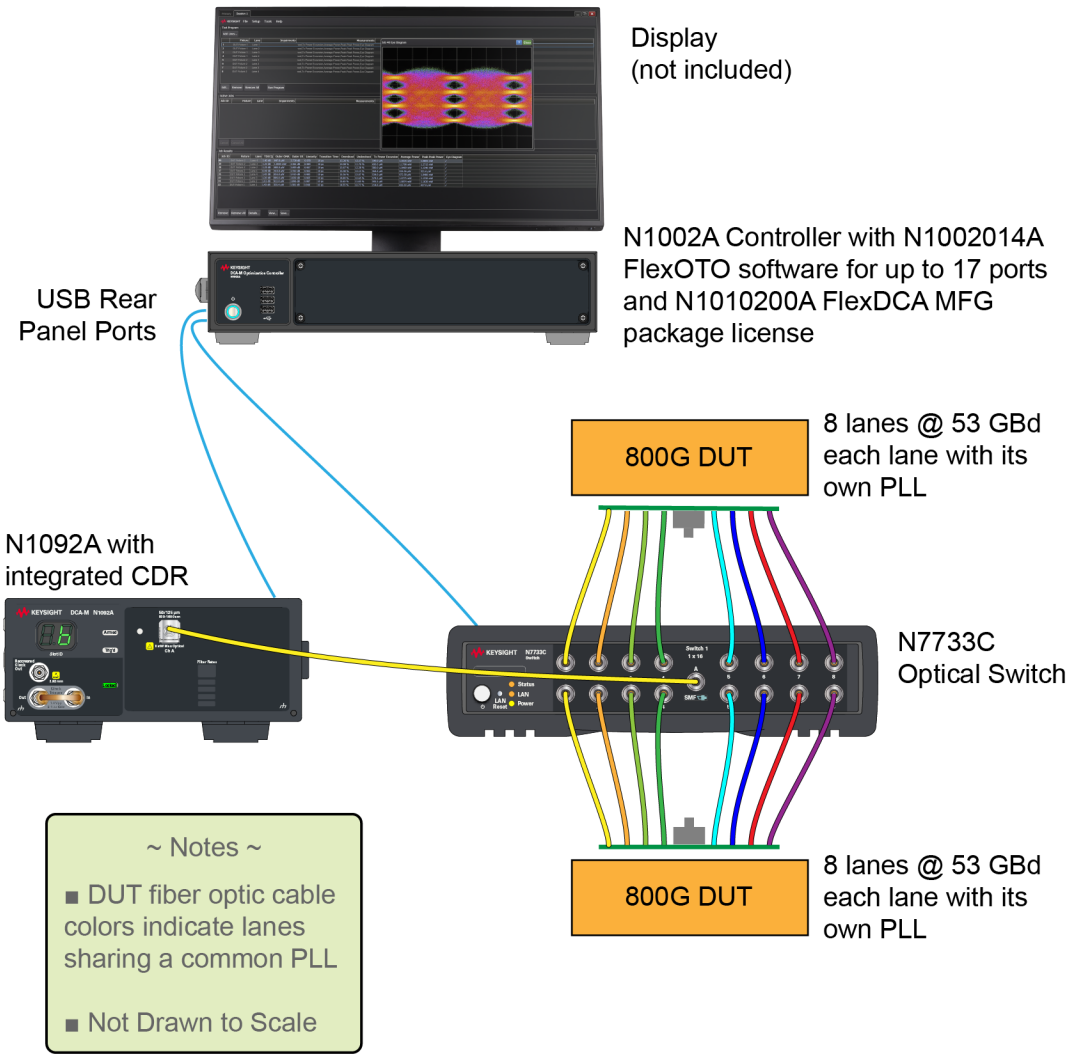


Figure 13. Example 2 Equipment Setup

N1002L33A 1x16 Bundle (Example 3)

This example shows a setup with four 4-lane WDM DUT fixtures. Each DUT's output is demultiplexed and connected to four of the N7733A's 16 input ports.

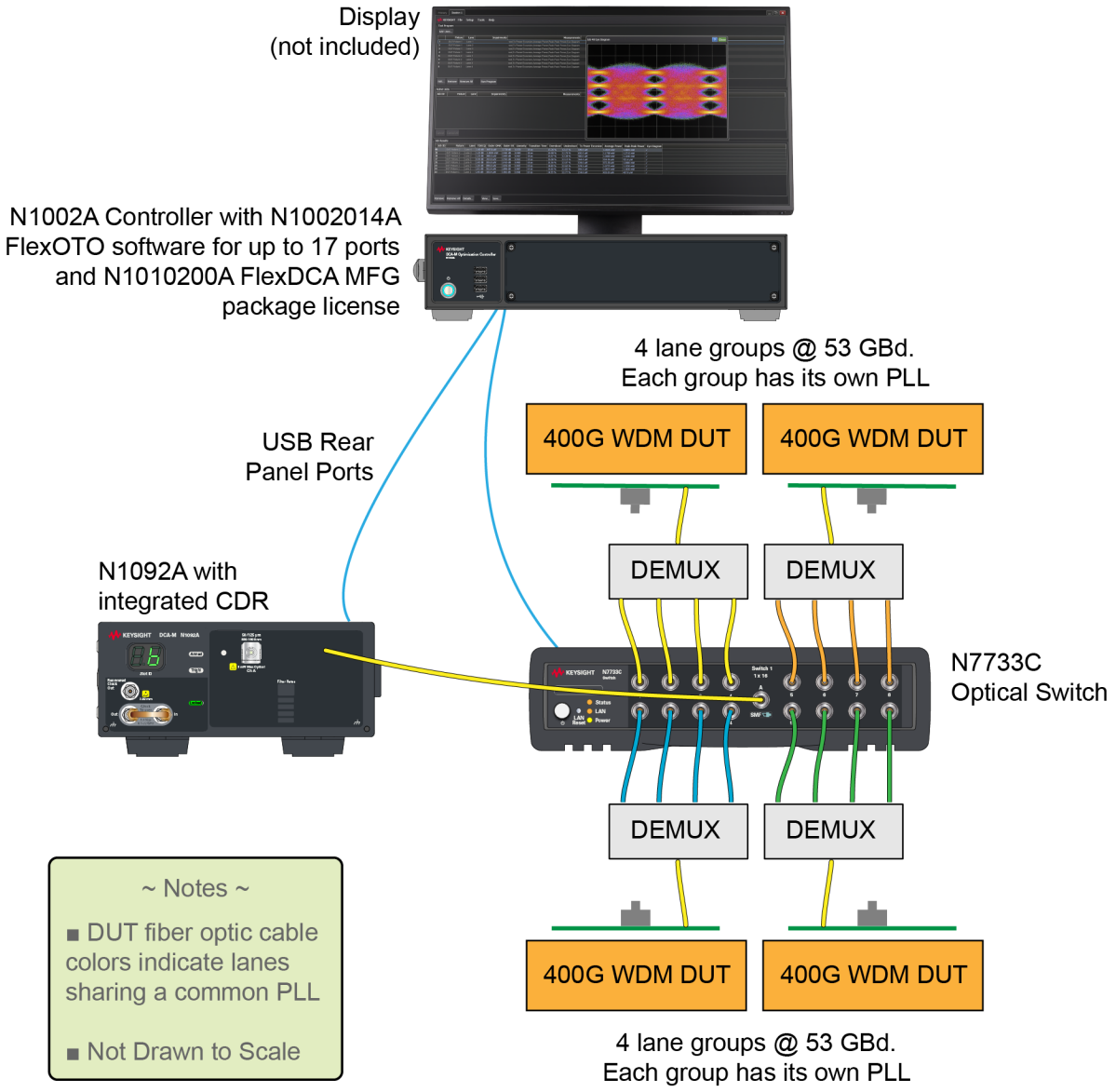


Figure 14. Example 3 Equipment Setup

N1002L31A Dual 1x4 Bundle (Example 1)

This example shows a setup with an 800 GBd DUT fixture which has two groups of 4-lanes each at 53 GBd. Each 4-lane group has its own PLL. Notice that the switch connections of the middle four lanes are swapped. This ensures that each PLL group has at least one lane that will be connected the N7731C's internal switch 1. This is required because switch 1 is connected to the N1092B's Channel A which includes clock recovery. The N1092B's Channel B does not have clock recovery.

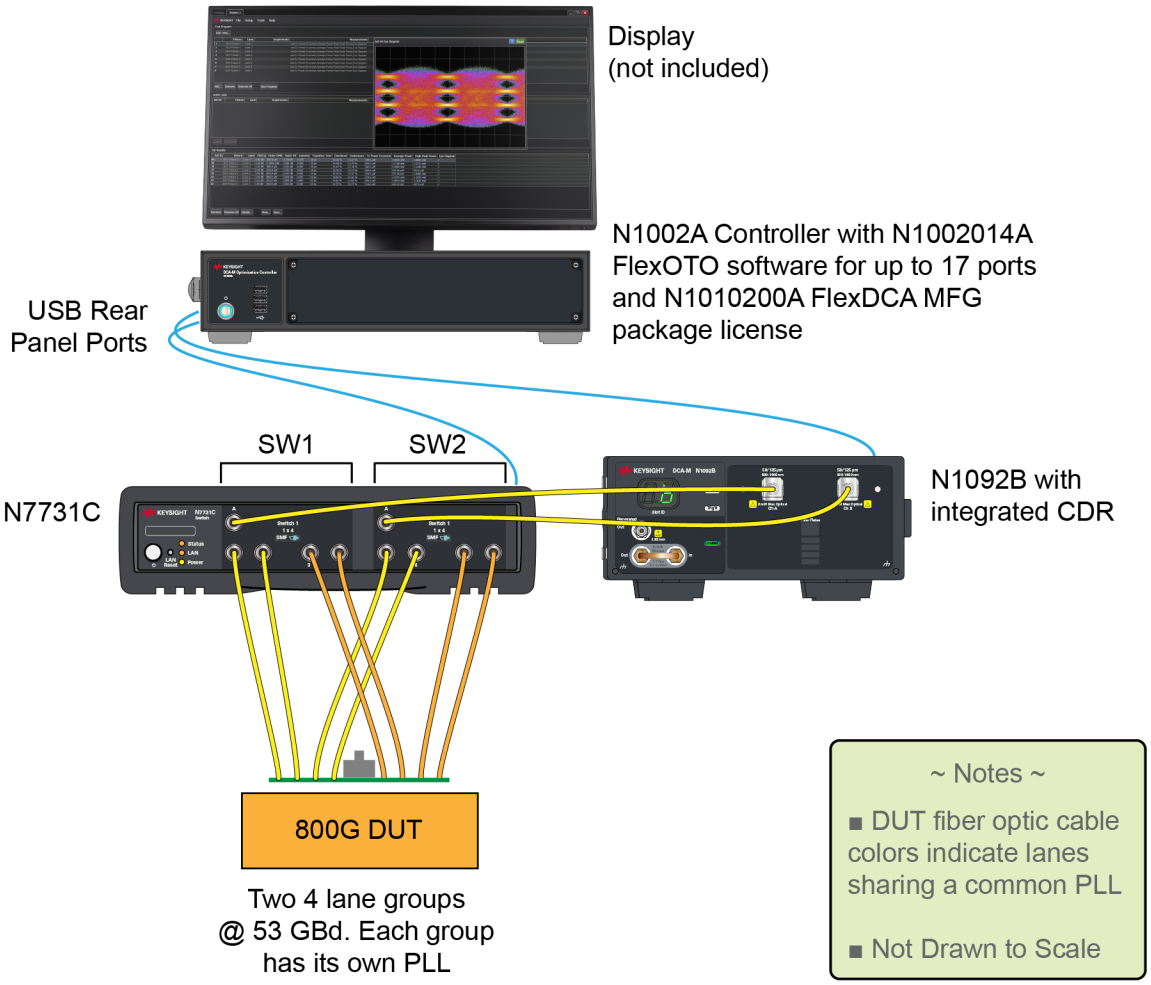


Figure 15. Example 1 Equipment Setup

N1002L31A Dual 1x4 Bundle (Example 2)

This example shows two 800 GBd WDM DUT fixtures. Each DUT has four multiplexed lanes at 53 GBd which are output to a DEMUX. As shown in *N1002L31A Dual 1x4 Bundle (Example 1)* on page 52, the switch connections of the middle four lane are swapped. This ensures that each PLL group has at least one lane that will be connected the the N7731C's internal switch 1. This is required because switch 1 is connected to the N1092B's Channel A which includes clock recovery. The N1092B's Channel B does not have clock recovery.

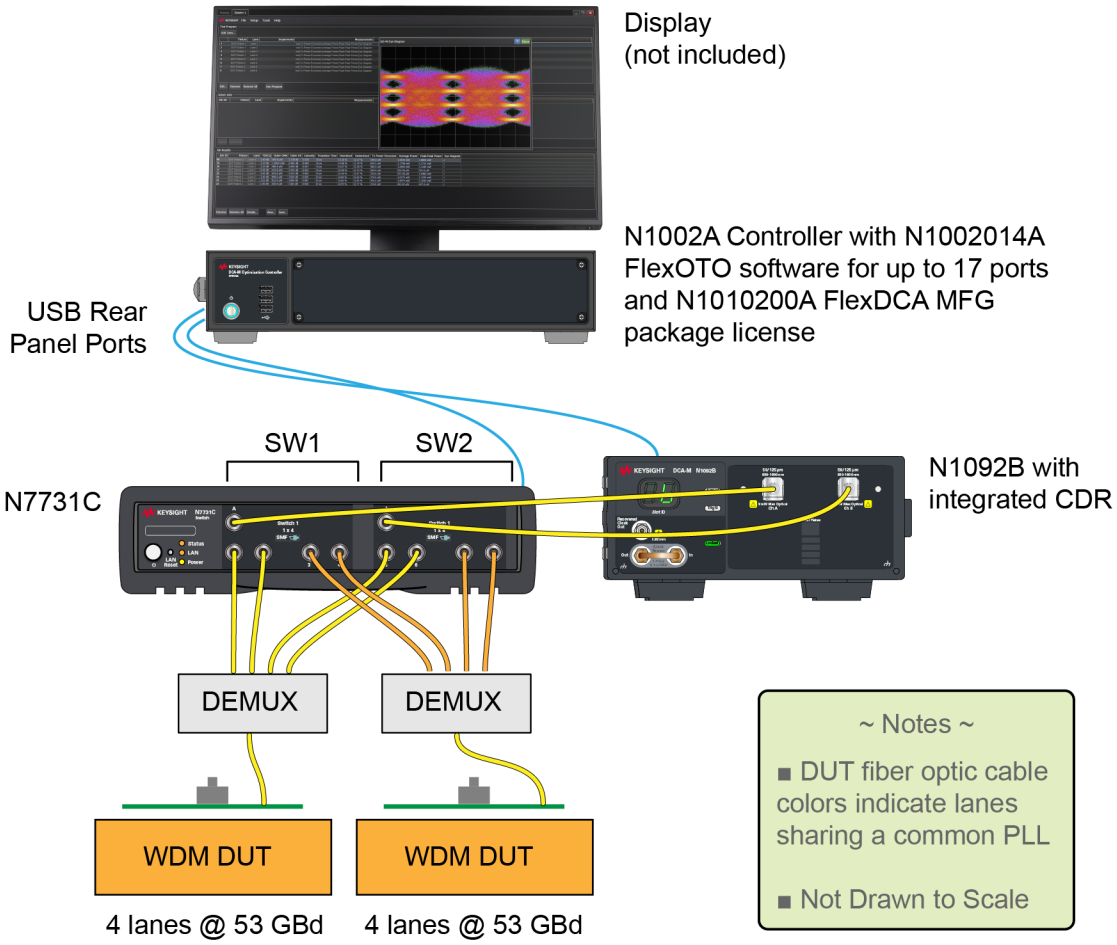


Figure 16. Example 2 Equipment Setup

N1002L31A Dual 1x4 Bundle (Example 3)

This example shows the outputs of four 4-lane WDM DUT fixtures sent via the N7731A's internal switch 1 to a shared DEMUX. The DEMUX's output lanes are connected as inputs to switch 2. This example shows how the N7731C's two internal switches can be cascaded.

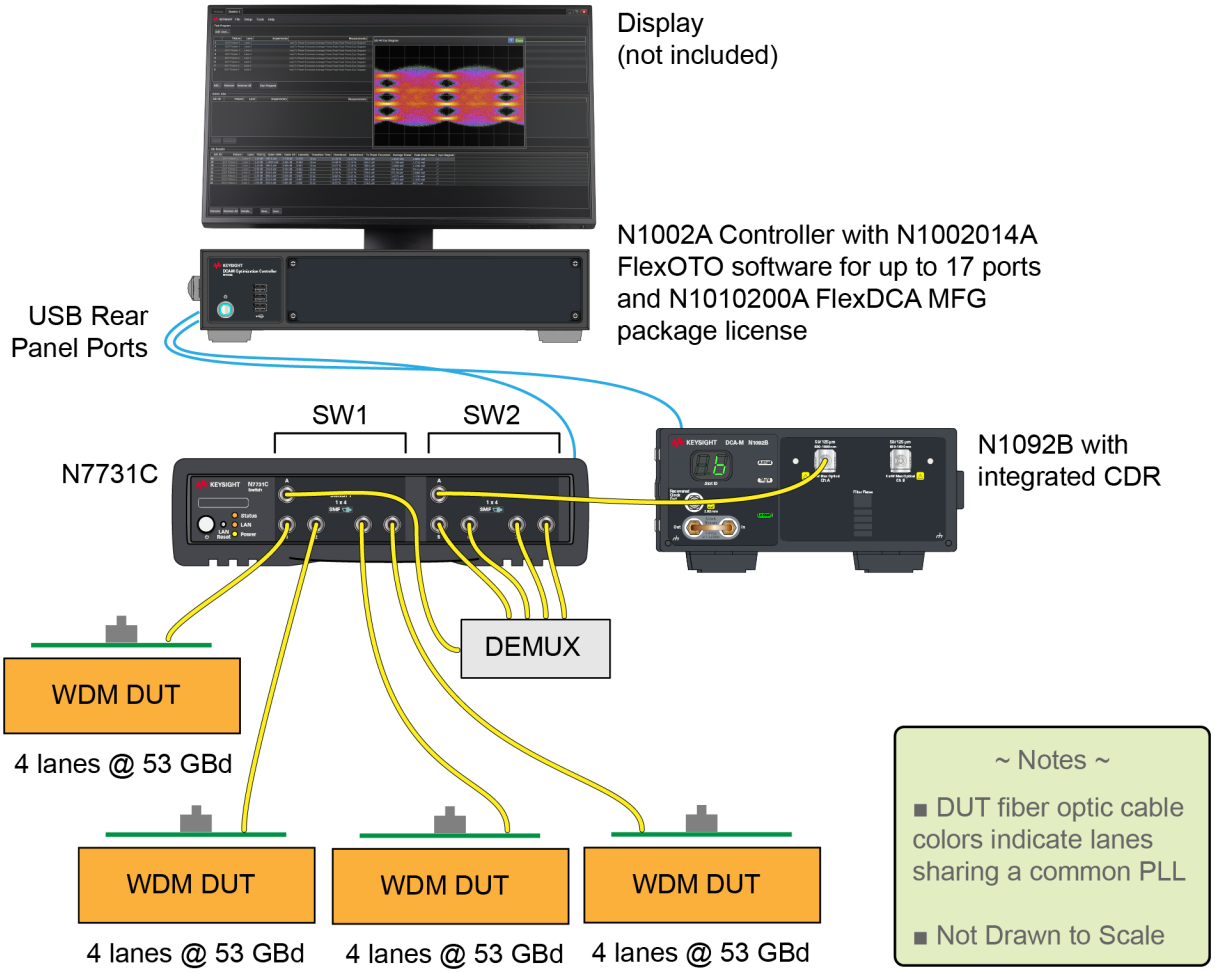


Figure 17. Example 3 Equipment Setup

Index

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