Keysight N77xx Series

N7711A Single-Port Tunable Laser System Source
N7714A 4-Port Tunable Laser System Source

User's Guide

KEYSIGHT TECHNOLOGIES

Notices

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For Assistance and Support

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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 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.

Contents

1
Getting Started

Overview

This chapter helps you start using your N77-Series instrument.

Keysight N7711/4A Single and 4-Port Tunable Laser System Source

The Keysight N7711A and N7714A tunable lasers are single-port and four-port sources, available with C-band or L-band wavelength coverage. The narrow linewidth and offset grid fine-tuning capability of the N7711A and N7714A make them ideal sources for realistic loading of the latest transmission systems.

To owners of Agilent's proven Lightwave Measurement System the 81950A tunable laser source module offers the same features as the N7711A. The 81950A plugs into the 8163B and 8164B mainframes. For additional information about the 81950A please refer to the Compact Tunable Laser data sheet, publication no. 5988-8518EN.

All models can reach any wavelength point within their specified wavelength range just like all other Keysight tunable lasers. In this mode, code compatibility with existing test setups based on Agilent's range of full-size and compact tunable lasers is a great asset. In system loading applications, it may be preferable to grid-tune the lasers like system transmitters, simply by changing the channel index. The channel grid is adjustable to standard ITU-T grid spacing like 50 GHz, and to arbitrary grids. Likewise, the zero frequency (base channel) of the chosen grid is adjustable. A 12 GHz fine-tuning range allows de-tuning the frequency.

Targeted for high test throughput, lowest cost-per-channel, and narrow footprint, all members of Agilent's 77-Series optical test instruments are built on a common platform and a common PC-based user interface. A complete set of control interfaces including LAN, USB2.0 and GPIB simplifies integration with manufacturing control systems. Code compatible to Agilent's Lightwave Measurement System modules, the new instrument generation can serve as plug-in replacements in existing test solutions. The N77 viewer software allows to control all features of the N7711/4A tunable laser sources.

Initial Inspection

Inspect the shipping container for damage. If there is damage to the container or cushioning, keep them until you have checked the contents of the shipment for completeness and verified the instrument both mechanically and electrically. The Function Tests give a procedure for checking the operation of the instrument. If the contents are incomplete, mechanical damage or defect is apparent, or if an instrument does not pass the operator's checks, notify the nearest Keysight Technologies Sales/Service Office.

NOTE To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, and so on).

Safety Considerations

Safety Considerations - Overview

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Keysight Technologies Inc. assumes no liability for the customer's failure to comply with these requirements. This product has been designed and tested in accordance with IEC Publication 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory, and has been supplied in a safe condition. The instruction 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.

Safety Symbols

CAUTION The *caution* sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to or destruction of the product. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

WARNING **The *warning* sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning sign until the indicated conditions are fully understood and met.**

The apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.

Hazardous laser radiation.

Invisible laser radiation.

General

This is a Safety Class 1 instrument (provided with a protective earth terminal) and has been manufactured and tested according to international safety standards.

Before operation, you should review the instrument and manual for safety markings and instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.

Some circuits are powered whenever the instrument is connected to the AC power source. To disconnect from the line power, disconnect the power cord either at the rear power inlet or at the AC line power source (receptacle). One of these must always be accessible. If the instrument is in a cabinet, it must be disconnected from the line power by the system's line power switch.

WARNING **To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, and so on).**

Operating Environment

WARNING **The instrument is not designed for outdoor use. To prevent potential fire or shock hazard, do not expose the instrument to rain or other excessive moisture.**

Line Power Requirements

CAUTION The instrument complies with installation category II and can operate from the single-phase AC power source that supplies between 100 V and 240 V at a frequency in the range 50 to 60 Hz. The maximum voltage fluctuation is 10% of the nominal supply voltage. The maximum power consumption is 60 VA with all options installed.

Initial Safety Information for Tunable Laser Modules

The laser sources specified by this user guide are classified according to IEC 60825-1 (2007). The laser sources comply with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50 dated 2007-June-24.

Table 1

	Keysight N7711A, N7714A, N7721A, N7722A	**Keysight N7711A, N7714A, N7721A, N7722A**
	Options 110, 111, 210, 211, 222, 240	**Options 101, 111, 201, 211, 222, 204**
Laser Type	ECL-Laser InGaAsP	ECL-Laser InGaAsP
Wavelength range	1527nm-1566nm	1570nm-1609nm
Max. CW output power*	50 mW	50 mW
Beam waist diameter	9 µm	9 µm

Table 1

	Keysight N7711A, N7714A, N7721A, N7722A Options 110, 111, 210, 211, 222, 240	Keysight N7711A, N7714A, N7721A, N7722A Options 101, 111, 201, 211, 222, 204
Numerical aperture	0.1	0.1
Laser Class according to IEC 60825-1 (2007)	1 M	1 M
Max. permissible CW output power**	163 mW	163 mW

** Max. CW output power is defined as the highest possible optical power that the laser source can produce at its output connector.*

*** Max. permissible CW output power is the highest optical power that is permitted within the appropriate laser class.*

Laser Safety Labels

Laser class 1M label

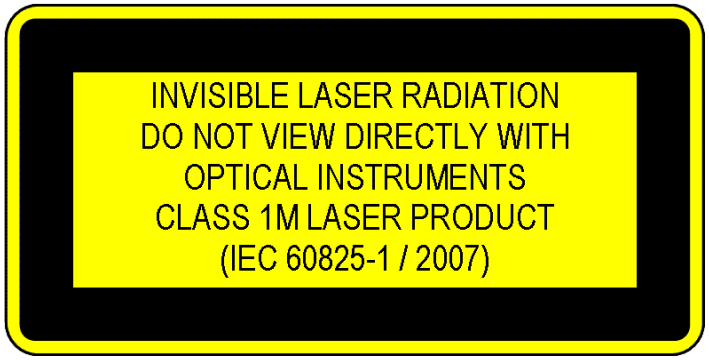


Figure 1 Class 1M Safety Label - N7711/14A, N7721/22A

A sheet of laser safety labels is included with the laser module as required. In order to meet the requirements of IEC 60825-1 we recommend that you stick the laser safety labels, in your language, onto a suitable location on the outside of the instrument where they are clearly visible to anyone using the instrument.

WARNING **Please pay attention to the following laser safety warning: Under no circumstances look into the end of an optical cable attached to the optical output when the device is operational. The laser radiation can seriously damage your eyesight. Do not enable the laser when there is no fiber attached to the optical output connector. The laser is enabled by pressing the 'active' button close to the optical output connector on the front panel of the module. The laser is on when the green LED on the front panel of the instrument is lit. The use of optical instruments with this product will increase eye hazard. The laser module has a built-in safety circuitry which will disable the optical output in the case of a fault condition Refer servicing only to qualified and authorized personnel.**

Input/Output Signals

CAUTION There is one input BNC connector: Trigger In. This is a TTL input.

A maximum of 5 V can be applied as an external voltage to this input connector.

There is one output BNC connector: Trigger Out. This is a TTL output. Do not apply an external voltage to this connector.

Line Power Connectors

In accordance with international safety standards, the instrument has a three-wire power cable. When connected to an appropriate AC power receptacle, this cable earths the instrument cabinet. The type of power cable shipped with each instrument depends on the country of destination. Please refer to "Accessories - Overview" on page 69 for the part numbers of available power cables.

WARNING

To avoid the possibility of injury or death, you must observe the following precautions before switching on the instrument.

- **Insert the power cable plug only into a socket outlet provided with a protective earth contact. Do not negate this protective action by the using an extension cord without a protective conductor.**
- **Do not interrupt the protective earth connection intentionally.**
- **Do not remove protective covers. Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified service personnel.**
- **Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.**
- **Defective, damaged, or malfunctioning laser sources must be returned to an Keysight Technologies Service Center.**

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Instrument Markings

	The instruction manual symbol. The product is marked with this warning symbol when it is necessary for the user to refer to the instructions in the manual.
	The CE mark is the conformity marking of the European Community.
	The CSA mark is the certification mark of the Canadian Standards Association.
 or 	The C-Tick or RCM mark is the certification mark of the Australian Communications Authority.
	The KC mark is the Korean certification mark.

	The recycling symbol indicates the general ease with which the instrument can be recycled.
	Do not dispose in domestic household waste. To return unwanted products, contact your local Keysight office, or see http://about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

AC Line Power Supply Requirements

AC Line Power Supply Requirements - Overview

This secton provides information on:

- Line Power Requirements
- Line Power Cable
- Changing the Fuse

Line Power Requirements

The instrument complies with installation category II and can operate from the single-phase AC power source that supplies between 100 V and 240 V at a frequency in the range 50 to 60 Hz. The maximum voltage fluctuation is 10% of the nominal supply voltage. The maximum power consumption is 60 VA with all options installed.

Line Power Cable

In accordance with international safety standards, the instrument has a three-wire power cable. When connected to an appropriate AC power receptacle, this cable earths the instrument cabinet. For the part number of the power cable for your country and instrument, see “Accessories - Overview” on page 69.

CAUTION

Please note that the switch on the front panel of the instrument does not stop the flow of power to the instrument.

If you need to turn off the power, unplug the instrument at the mains or remove the power cable connector from the appliance coupler at the rear of the instrument. For this reason, the power cable connection should be easily accessible - allowing you to turn off the power quickly. If the instrument is in a cabinet, it must be disconnected from the line power by the system's line power switch.

The power switch allows you to switch between stand-by mode and power-on mode.

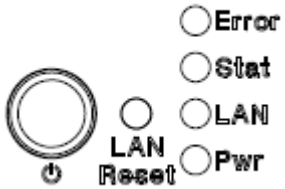


Figure 2 Power Switch

When the instrument is in stand-by mode, the Pwr LED is orange. When the instrument is powered-on, the Pwr LED is green.

WARNING

To avoid the possibility of injury or death, you must observe the following precautions before switching on the instrument.

- **Insert the power cable plug only into a socket outlet provided with a protective earth contact. Do not negate this protective action by using an extension cord without a protective conductor.**
- **Do not interrupt the protective earth connection intentionally.**

The AC power requirements are summarized on the rear panel of the instrument.

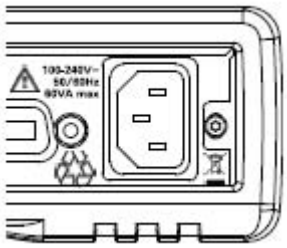


Figure 3 AC Power Requirement Markings

Changing the Fuse

CAUTION There is no user replaceable fuse for the instrument. Changing the fuse should be carried out only by Keysight Technologies service personnel. If you need to get the fuse replaced refer to your nearest Keysight Technologies Sales/Service Office.

Operating and Storage Environment

Operating and Storage Environment - Overview

The following summarizes the operating environment ranges. In order for the instrument to meet specifications, the operating environment must be within these limits.

WARNING **The instrument is not designed for outdoor use. To prevent potential fire or shock hazard, do not expose the instrument to rain or other excessive moisture.**

Temperature

The instrument should be protected from temperature extremes and changes in temperature that may cause condensation within it.

The operating temperature is from 5°C to +40°C.

The storage temperature is from -40°C to +70°C.

Humidity

The operating humidity is 15 to 95%, non-condensing.

Altitude

The maximum operating altitude is 2000 m.

Pollution Protection

The instruments are designed for pollution degree 2.

Instrument Cooling

The instrument has a cooling fan mounted internally.

Mount or position your instrument upright and horizontally, as shown in Figure 4 so that air can circulate through it freely.

Operating Position

When operating the instrument choose a location that provides at least 75 mm (3 inches) of clearance at the rear, and at least 25 mm (1 inch) of clearance at each side. Failure to provide adequate air clearance may result in excessive internal temperature, reducing instrument reliability. The instrument should not be operated when resting on its rear or side panels.

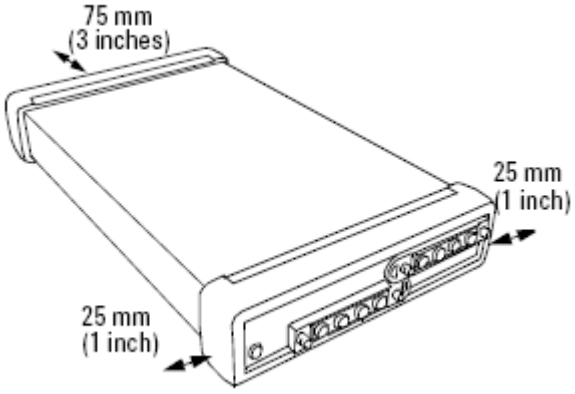


Figure 4 Correct Operating Position

(shown here for the Keysight N7744/5A, valid also for the N7751/2A, Keysight N7761/2/4A, N7766/68A, N773xA and the N7711/4A)

Input and Output Connectors

Input and Output Connectors - Overview

This section provides information on:

- Front Panels - Tunable Laser Source
- Rear Panel

Front Panels - Tunable Laser Source

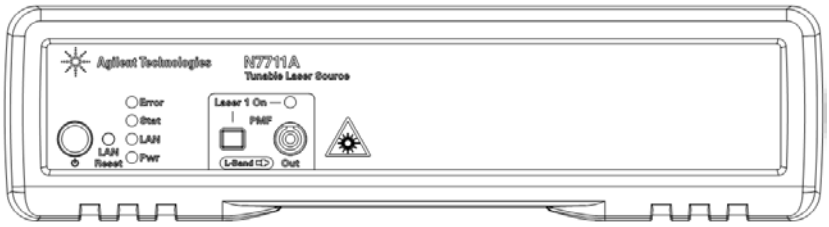


Figure 5 Front panel of the Keysight N7711A Single-Port Tunable Laser System Source

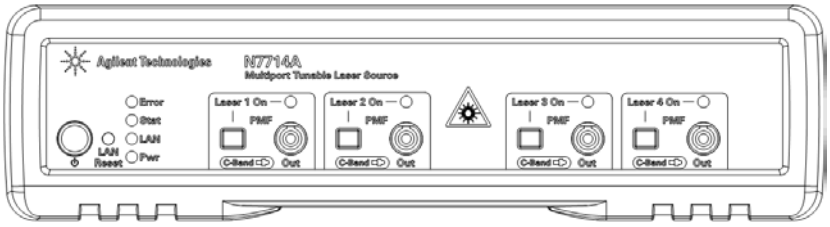


Figure 6 Front panel of the Keysight N7714A Single-Port Tunable Laser System Source

Rear Panel

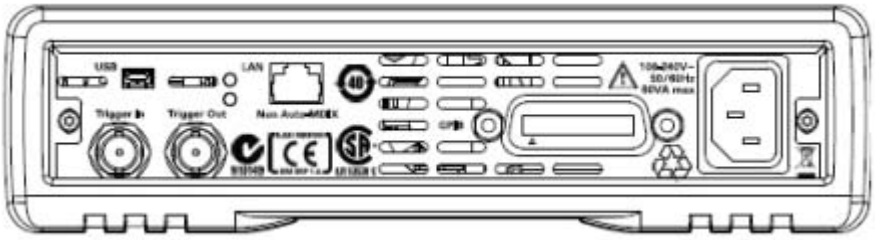


Figure 7 Rear panel of the Keysight N77xx Series instruments

Making Optical Connections

Making Optical Connections

The tunable lasers are designed for use with FC connectors.

Lasers ordered with option 071 have straight connector interfaces.

Lasers ordered with option 072 have angled connector interfaces.

CAUTION

If the connectors on your attenuator or lasers are angled, you can only use cables with angled connectors with the instrument.

If the connectors on your attenuator are straight, you can only use cables with straight connectors with the instrument.

Figure 8 Angled and Straight Connector Symbols

The above figure shows the symbols that tell you whether the optical connectors of your instrument are angled or straight. The angled contact connector symbol is colored green.

You should connect straight contact fiber end connectors with neutral sleeves to straight contact connectors, or connect angled contact fiber end connectors with green sleeves to angled contact connectors.

NOTE

You cannot connect angled non-contact fiber end connectors with orange sleeves directly to the laser.

For further details on connector interfaces and accessories, refer to "Accessories - Overview" section, described in this manual.

Optical Output

Polarization Maintaining Fiber

A Polarization maintaining fiber (PMF) output is standard for Keysight N7711/4A tunable laser system sources. PMF is aligned to maintain the state of polarization. A well defined state of polarization helps ensure constant measurement conditions. The fiber is of Panda type, with TE mode in the slow axis in line with the connector key.

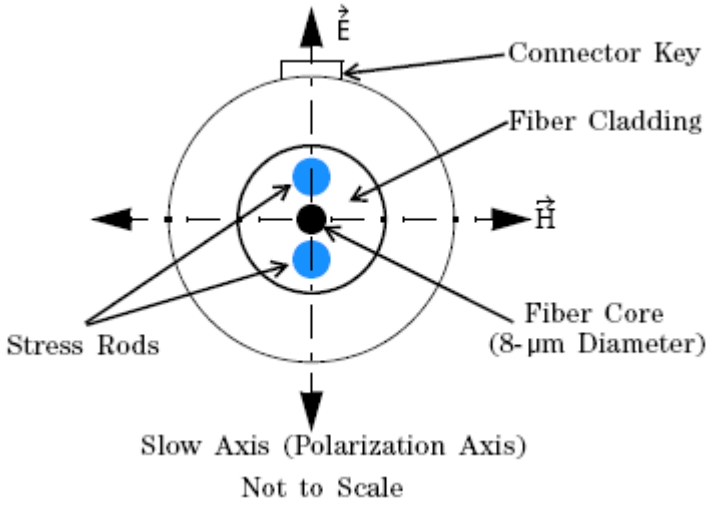


Figure 9 Polarization maintaining fiber

Electrical Connectors

There are two BNC connectors on the rear panel of your instrument. These are the Trigger Out and the Trigger In connectors.

CAUTION

The Trigger In is a TTL input. A maximum of 5 V can be applied as an external voltage to this input connector.

The Trigger Output is the only output BNC connector. This is a TTL output. Do not apply an external voltage to this connector.

LAN Interface

LAN Interface

This section explains the concept of LAN in details.

Selecting a LAN Network

For the purposes of this guide, a private (isolated) LAN network is defined as a network configuration in which instrument access is a direct connection between the computer and the instrument, or to multiple instruments connected via a *dedicated* router or switch. A site (company-wide) LAN is defined as a network in which instrument access is available to many users at on-site and remote locations. The instrument's application and/or your company's IT (Information Technology) department may have guidelines that help decide the type of network (private or site) used. If a network configuration has not been determined, refer to the following considerations concerning each type.

Private LAN Considerations

Among the basic parameters of a private LAN network to consider are security, performance, reliability, and IP address availability.

Security

A private network generally involves a direct connection between the computer and the instrument, or to multiple instruments using switches or routers. Access to the instrument is limited to users on the private network, as opposed to users on a site network that could locate and access the instrument from any location.

Private networks can reduce the possibility of tests being disrupted by unplanned or unauthorized access. Code generation for test systems on a private network is often simplified, as provisions against unauthorized users may not be required.

Performance

Test systems where large amounts of data are transferred usually have faster throughput on a private network. On a site network, heavy and unpredictable LAN traffic affects each instrument (node) on the network. The impact on a test system is that repeatability is difficult to achieve as latencies are difficult to account for.

Reliability

Private networks are fundamentally more reliable than site networks as they host fewer users and are less complex than site networks.

Private networks are isolated from conditions that could bring down (crash) a site network.

IP Address Availability

Every instrument (node) on a LAN (private or site) has an IP (Internet Protocol) address. Due to the expanding use of the internet, the number of site network IP addresses available is limited. By using a router with Dynamic Host Configuration Protocol (DHCP) capability on a private network, the router can assign an IP address to each instrument thus creating a sub-network (subnet) that does not consume site IP addresses.

Site LAN Considerations

For applications requiring access by many users or by users at distributed sites, a site LAN network is required. In addition to supporting multiple users, site LANs often offer the advantage of being maintained by IT departments. When using a site LAN, consult your IT department regarding LAN configuration and security issues.

Connecting the LAN Cable

LAN cables are connected between the LAN terminal on the instrument and the computer, or between the instrument and a router or switch if included in your network.

Private Network Connections

The figure below shows typical LAN cable connections for a private network.

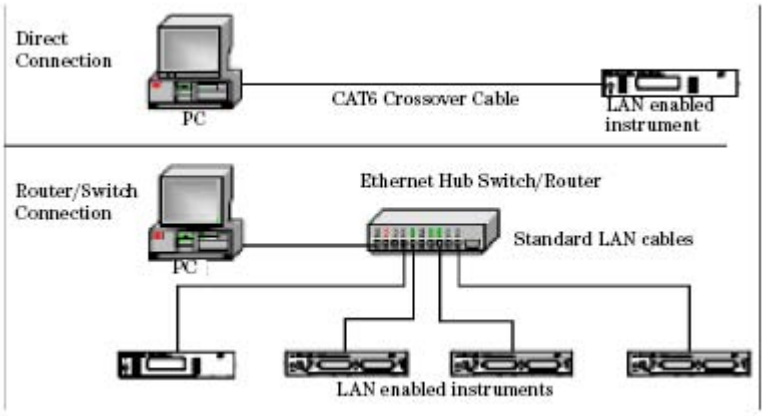


Figure 10 Typical Private (isolated) LAN Network Connections

If the instrument is connected directly to the PC, use a LAN crossover cable, as provided with the instrument. If your computer supports Auto-MDIX or contains a LAN card with gigabit data transfer rates, the (blue) crossover cable is not required. A standard LAN cable can be used instead.

For private LAN networks that include a switch or router, use standard LAN cables for all network connections. Do not use a crossover cable.

Site Network Connections

The following figure shows a typical LAN cable connection for a site network.

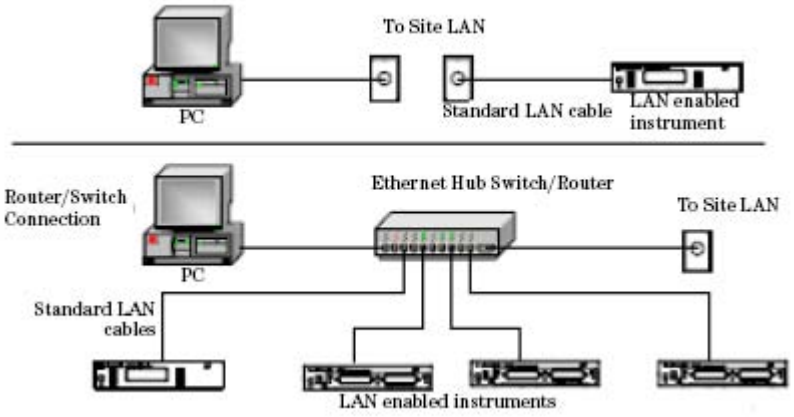


Figure 11 Typical Site LAN Network Connections.

On site networks, the instrument and the computer are connected directly to site LAN ports, or are connected to the site LAN through a switch. In each site network configuration, standard LAN cables are used.

The LAN LED

As the LAN connection is made, the DHCP server assigns an address and the LXI device identification proceeds you will see the following indicators:,

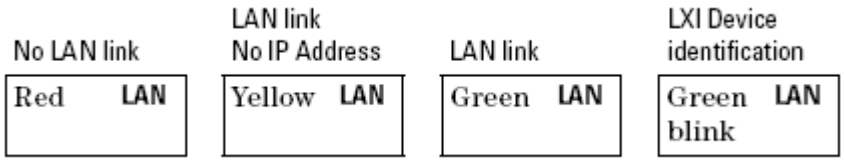


Figure 12 The LAN LED

There may be a delay between making the LAN link (yellow status) and getting the IP address (green status). This delay may be longer if there is no DHCP server, for example when the instrument is connected directly to a PC.

The LAN Reset button

This recessed button has two functions.

- Pressing the button briefly invokes a preset of the instrument and restores default measurement settings. This is equivalent to the programming command

  ```
  :SYSTem:PRESet
  ```

- Pressing and holding the button for 3 seconds will reset the LAN parameters to the factory default. This includes changing the password for modifying the configuration via LAN back to the default "Keysight". This is equivalent to the following sequence of programming commands:

  ```
  :SYSTem:COMMunicate:ETHernet:RESet
  ```

GPIB Interface

GPIB Interface

You can connect your GPIB interface into a star network, a linear network, or a combination star and linear network. The limitations imposed on this network are as follows:

- The total cable length cannot exceed 20 meters.
- The maximum cable length between devices is 4 meters, with an average separation of 2m between devices over the whole bus.
- No more than 15 devices may be interconnected on one bus.

Cables and Adapters

See “Cables” on page 71 for details on cables and adapters.

Connector

The following figure shows the connector and pin assignments.

Connector Part Number: 1251-0293

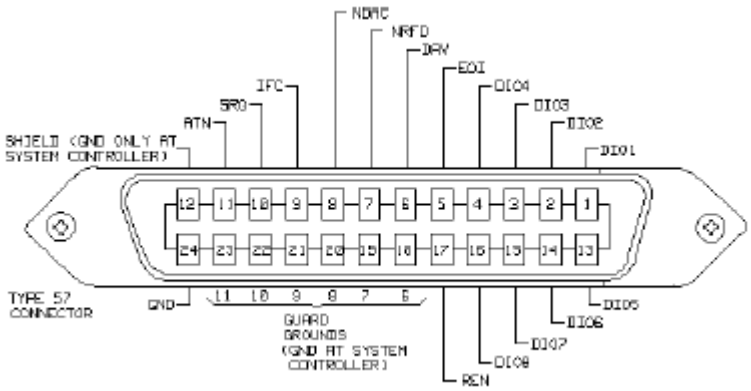


Figure 13 GPIB Connector

CAUTION Keysight Technologies products delivered now are equipped with connectors having ISO metric-threaded lock screws and stud mounts (ISO M3.5×0.6) that are black in color. Earlier connectors may have lock screws and stud mounts with English-threaded lock screws and stud mounts (6-32 UNC) that have a shiny nickel finish.

CAUTION It is recommended that you do not stack more than three connectors, one on top of the other.

Hand-tighten the connector lock screws. Do not use a screwdriver.

GPIB Logic Levels

The instrument's GPIB lines use standard TTL logic, as follows:

True = Low = digital ground or 0 Vdc to 0.4 Vdc

False = High = open or 2.5 Vdc to 5 Vdc

All GPIB lines have LOW assertion states. High states are held at 3.0 Vdc by pull-ups within the instrument. When a line functions as an input, it requires approximately 3.2 mA to pull it low through a closure to digital ground. When a line functions as an output, it will sink up to 48 mA in the low state and approximately 0.6 mA in the high state.

NOTE The GPIB line screens are not isolated from ground.

USB Interface

NOTE Before connecting the instrument over USB, install the Keysight I/O Libraries Suite, which is included on a CD with the instrument.

The instrument is a USB device, with a mini-USB connector.

Powering Up the Instrument

Powering Up the Instrument

When you switch on the instrument, the LEDs on the front panel show the various stages of booting.

Standby	Power On	FPGAs loaded	Analog Board 1 loaded	Analog Board 2 loaded
Error	Yellow Error	Green Error	Green Error	Green Error
Stat	Yellow Stat	Yellow Stat	Green Stat	Green Stat
LAN	Yellow LAN	Yellow LAN	Yellow LAN	Green LAN
Yellow Pwr	Green Pwr	Green Pwr	Green Pwr	Green Pwr

Figure 14 Powering Up the Instrument

Front Panel Indicators

During operation, you may notice the following LED indicators:

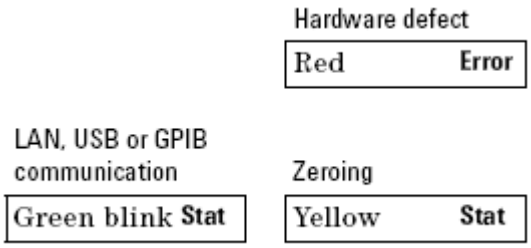


Figure 15 Front Panel Indicators

Connecting to the Instrument

Connecting to the Instrument - Overview

When you are first connecting the instrument, we recommend you use the Keysight Connection Expert included with the Keysight I/O libraries (available on the CD supplied with the instrument, or from www.keysight.com).

Connecting over USB

NOTE The screenshots show the Keysight N7745A Multiport Power Meter. The same procedure applies when connecting an Keysight N7744A Multiport Power Meter, an Keysight N7751/2A Optical Attenuator and Power Meter, or an Keysight N7761/2/4/6/8A Optical Attenuator or an Keysight N7711/4A Tunable Laser System Source or an N773x Optical Switch.

1 If it is not already running, start the Keysight Connection Expert software.

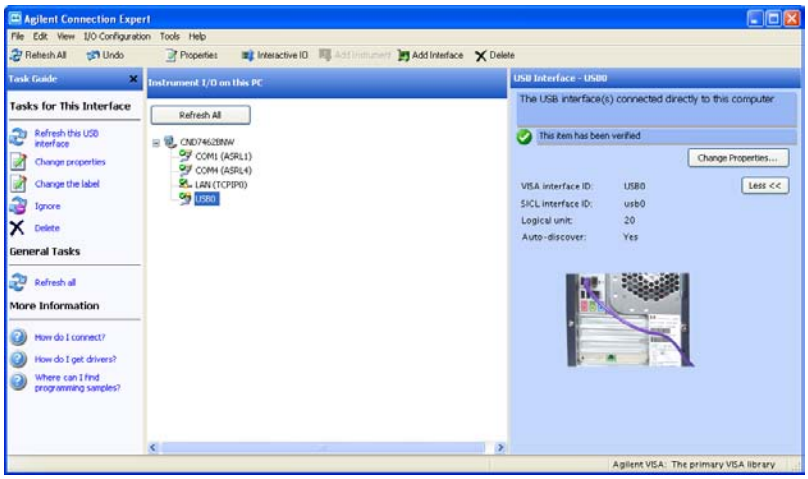


Figure 16 Keysight Connection Expert software

2 Attach the instrument to the USB. The first time you attach the instrument, follow the instructions on the screen to select the driver for this instrument.

When the instrument is connected, it is shown in the list.

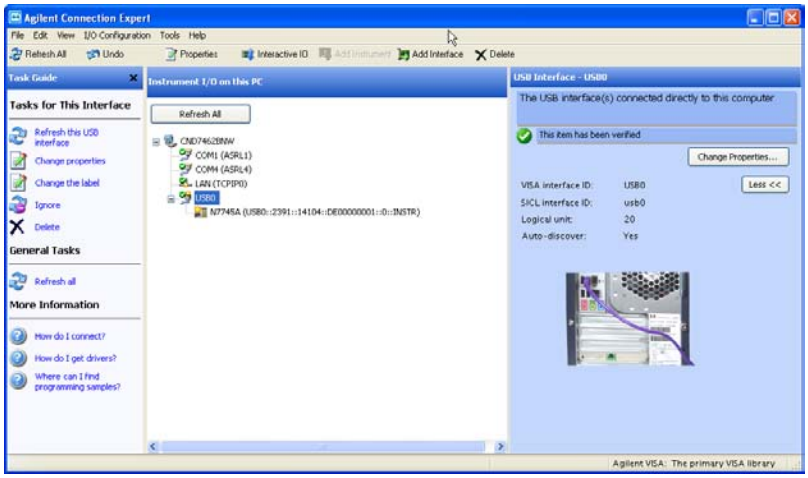


Figure 17 Select the instrument in the list

3 Select the instrument in the list to see the associated tasks (in the Task Guide on the left) and information (on the right).

Finding the IP Address of an instrument

1 Connect to the instrument over USB, as described above.

2 Select the instrument in the list.

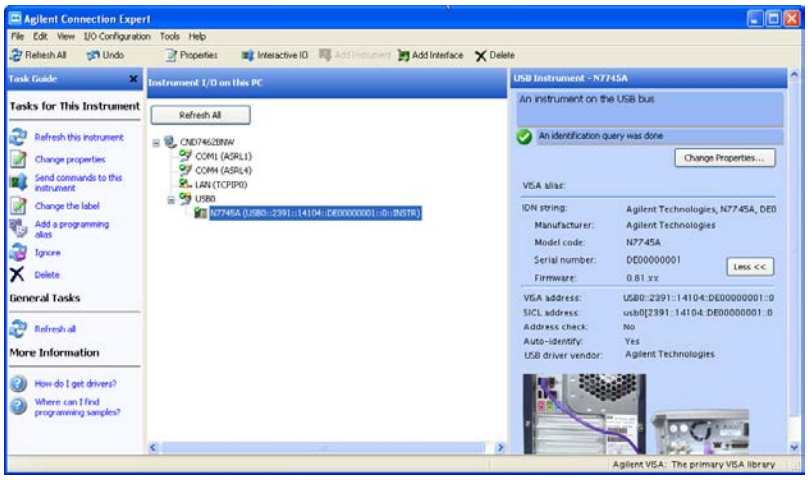


Figure 18 Select the instrument

3 Click on “Send commands to this instrument”.

The default command is the *IDN? query.

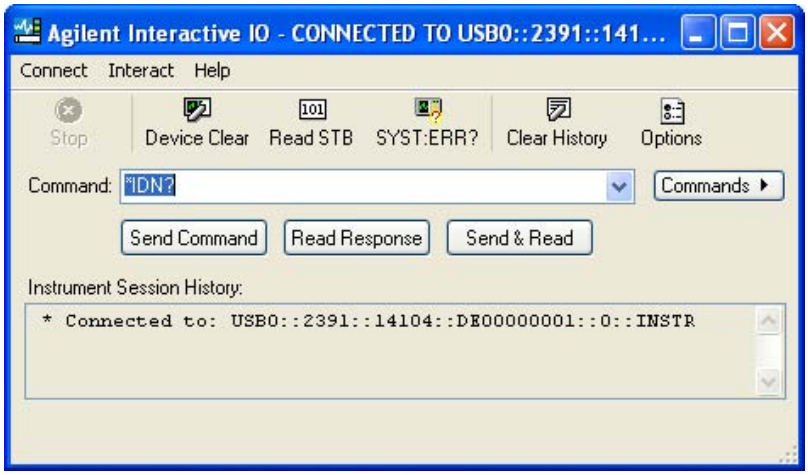


Figure 19 *IDN? query

4 Enter the command

`:SYSTem:COMMunicate:ETHernet:IPADdress:CURRent?`

then click on [Send & Read].

The instrument returns its current IP address.

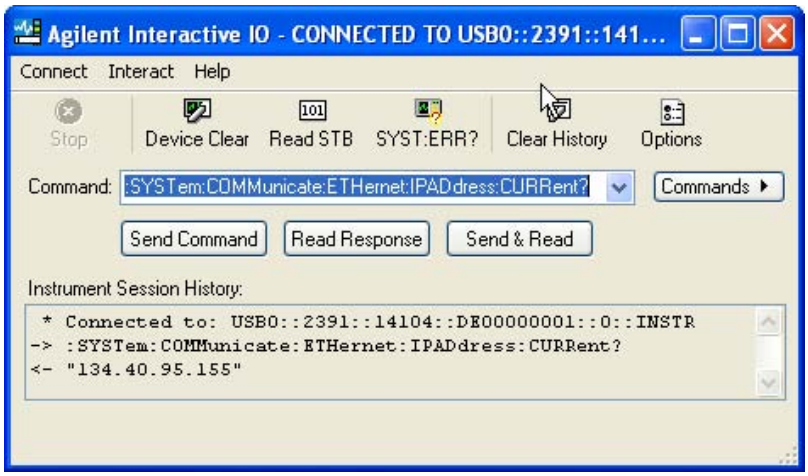


Figure 20 :SYSTem:COMMunicate:ETHernet:IPADdress:CURRent?

Connecting over LAN

NOTE The screenshots show the Keysight N7745A Multiport Power Meter. The same procedure applies when connecting to other N77xx instruments like attenuators, switches and laser sources.

1. Make sure the instrument is connected to the LAN, and that the LAN LED on the front panel is green. See, " LAN Interface" on page 23 for more information to connecting over LAN.
2. If it is not already running, start the Keysight Connection Expert software.
3. Select "LAN (TCPIP0)" in the list.

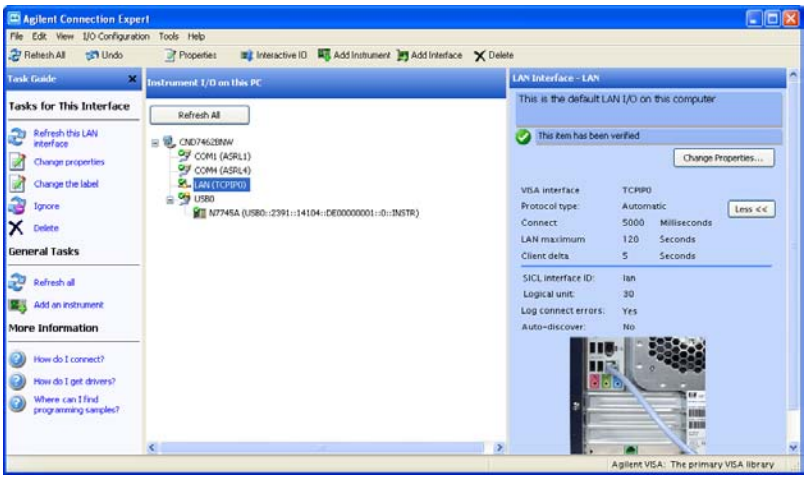


Figure 21

4 Click on “Add an instrument” in the Task Guide.

5 Wait for the scan to finish.

6 Select the instrument in the list.

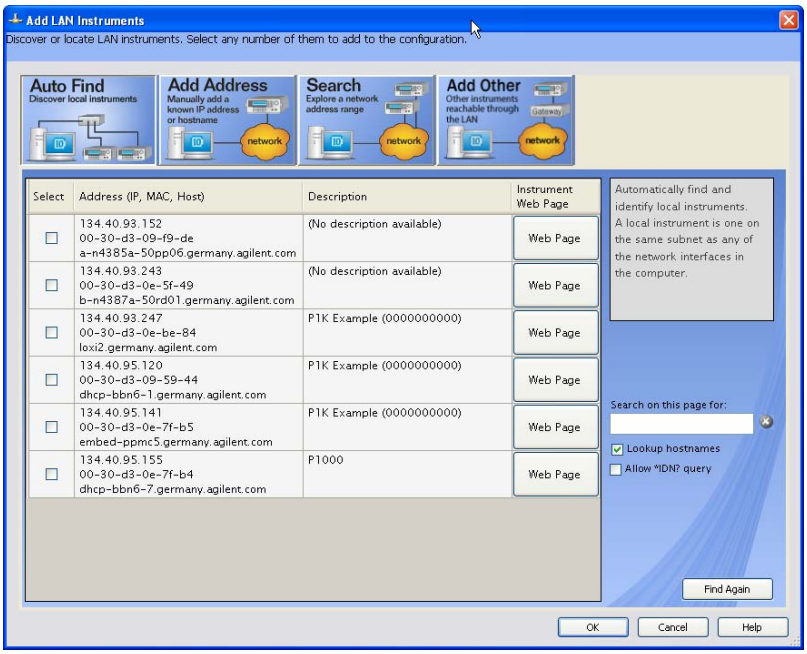


Figure 22

7 To show the description of the instrument, check the box for *IDN? query and click on "Find Again".

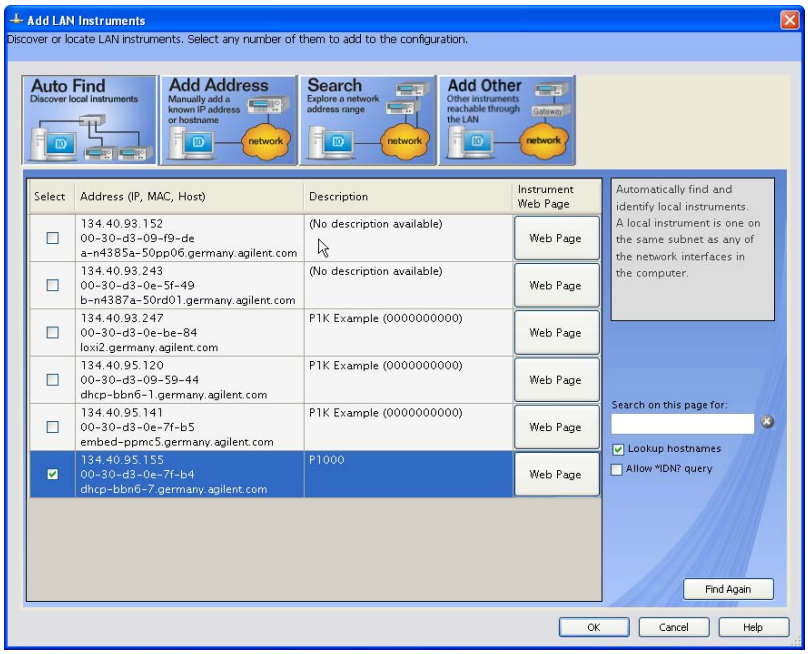


Figure 23

8 Select the instrument in the list to see the associated tasks (in the Task Guide on the left) and information (on the right).

- For the N774x Multiport power meters, click on the “Instrument Web Interface” button to control the instrument directly.

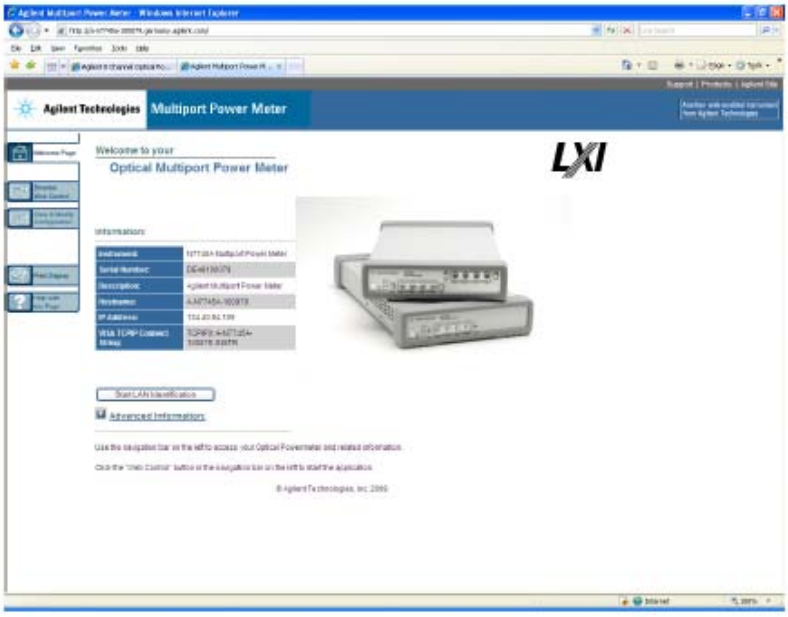


Figure 24

If it is not already installed, you will need to install a Java run-time engine to use this page.

Basic configuration and functionality are available from this web page.

- You can control any of the instruments from the Keysight N77xx Viewer.
  - Connecting and using the N77xx Viewer is described in "Connecting to the Instrument - Overview" on page 30.

More advanced functionality is available through programming with SCPI commands (described in the Programming Guide available on the CD supplied with the instrument or from www.keysight.com), or using the 816x VXI Plug&Play driver, version 4.4 or higher. For the N774x Multiport power meters you can also use the IVI-COM driver.

Claims and Repackaging

Claims and Repackaging

If physical damage is evident or if the instrument does not meet specification when received, notify the carrier and the nearest Keysight Technologies Sales/Service Office. The Keysight Technologies Sales/Service Office will arrange for repair or replacement of the unit without waiting for settlement of the claim against the carrier.

Return Shipments to Keysight Technologies

If the instrument is to be shipped to an Keysight Technologies Sales/Service Office, attach a tag showing owner, return address, model number and full serial number and the type of service required.

The original shipping carton and packing material may be reusable, but the Keysight Technologies Sales/Service Office will provide information and recommendations on materials to be used if the original packing is no longer available or reusable. General instructions for repackaging are as follows:

- Wrap instrument in heavy paper or plastic.
- Use strong shipping container. A double wall carton made of 350-pound test material is adequate.
- Use enough shock absorbing material (3 to 4 inch layer) around all sides of the instrument to provide a firm cushion and prevent movement inside container. Protect control panel with cardboard.
- Seal shipping container securely.
- Mark shipping container FRAGILE to encourage careful handling.
- In any correspondence, refer to instrument by model number and serial number.

Deleting user data

If you need to delete all your logged data and user configurations, that is to reset the instrument completely:

1 Press and hold the Reset/standby button until the instrument starts to reboot.

2 When the instrument reboots, press the Reset/standby button once more briefly, to confirm you want to delete all the stored data.

N77xx Viewer Common User Interface Functions

Connecting to an Instrument

When you first launch the N77xx Viewer, it is not connected to any of your instruments.

1 Click on the “Connect” icon at the top right of the window.

2 Select the instrument to which you want to connect from the list.

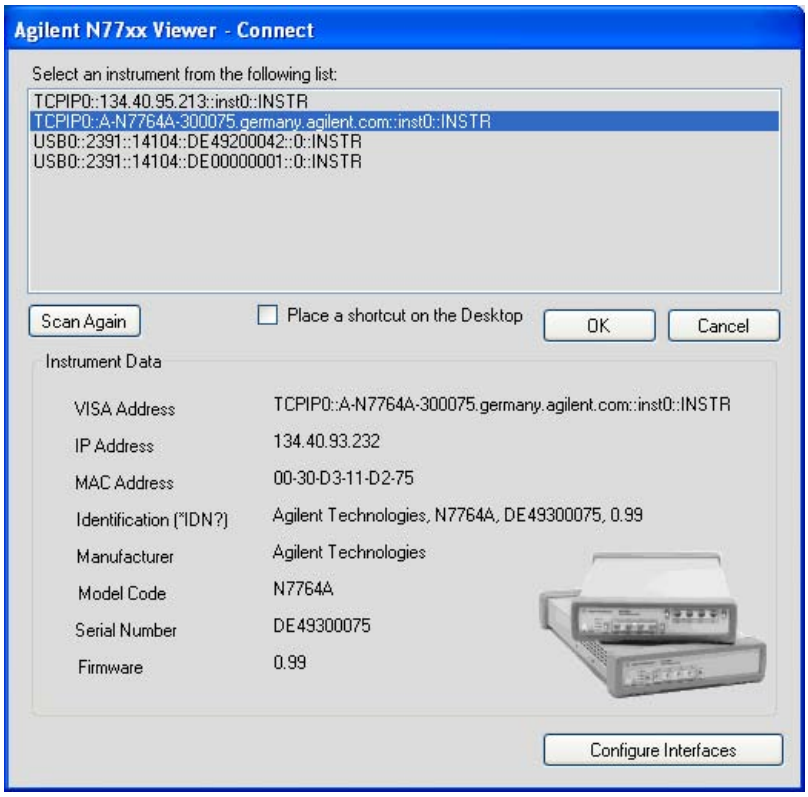


Figure 25 Connecting to an Instrument

3 The list shows instruments that have been given a VISA address.

If your instrument is not in the list,

1 Use the Keysight Connection Expert to check your instrument has a VISA address

2 Click on the “Scan Again” button.

Once communication has been established to the instrument, its details are shown.

4 If you need to change the connection configuration for an instrument on the LAN, click on the “Configure Interfaces” button.

You can only configure the LAN parameters before the instrument is connected.

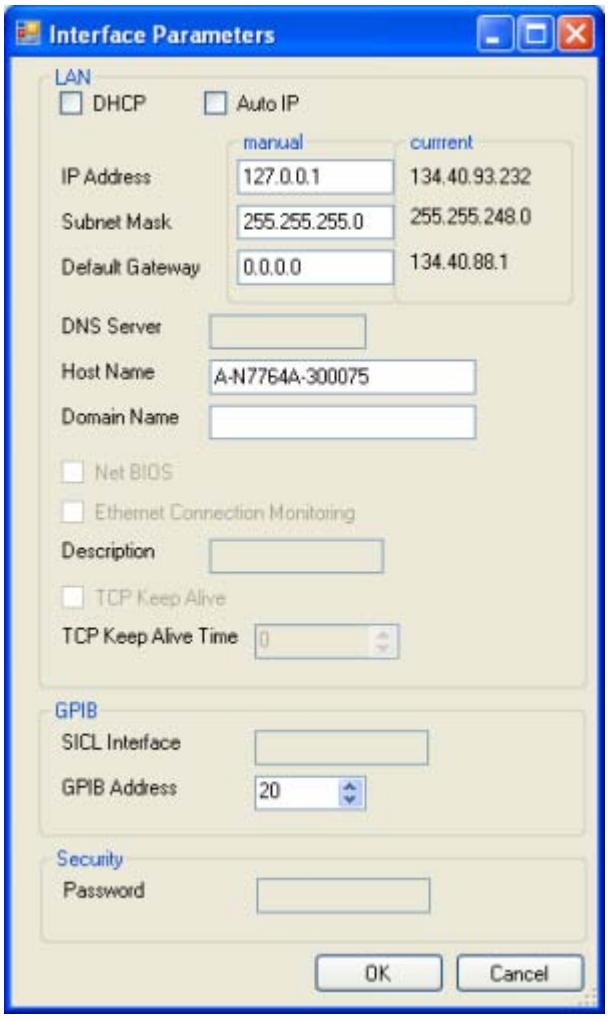


Figure 26 Interface Parameters

- Make sure both DHCP and Auto IP are not selected.
- You can now edit the IP parameters.

5 For instruments you use regularly, you can add a link on your desktop by putting a check mark in the box to “Place a shortcut on the Desktop”.

6 Click on the “OK” button to finish the connection.

Viewing Measurements and Settings

The settings and readings of the instrument can be accessed directly from the main Viewer panel. Instruments with multiple channels have a tab for each channel. In addition, separate windows can be opened for simply viewing the settings and readings, as follows:

Viewing the measurement on a single channel

1 Click on the “New” button to open a window with the current measurement and parameter settings.

Figure 27 Viewing the measurement on a single channel attenuator/power meter (left) or tunable laser (right)

Viewing all channels

1 Click on "Overview" to open a window with the measurements on all channels.

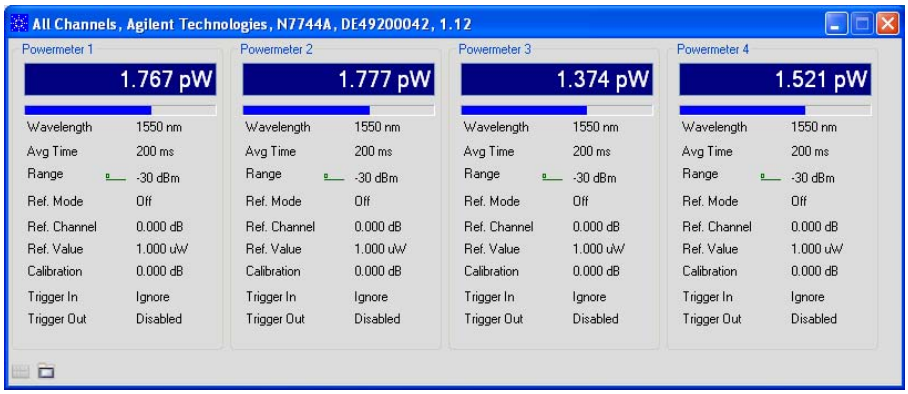


Figure 28 Viewing all channels

Saving and Recalling Configurations

Saving a configuration

You can save the current measurement configuration to either of two settings stored on the instrument.

1 In the File menu, select Save.

2 Enter or select the setting to which you want to save it.

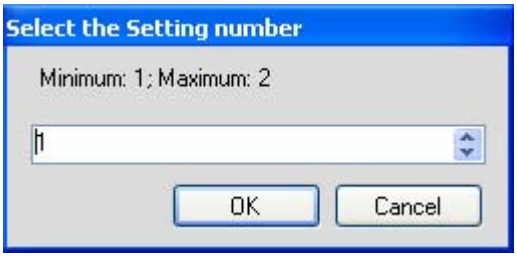


Figure 29 Saving a configuration

3 Click on the “OK” button.

Recalling a configuration

1 In the File menu, select Load.

2 Enter or select the setting you want to retrieve.

3 Click on the “OK” button.

Controlling the Instrument Refresh

1 In the File menu, select Update.

In the dialog, you can :

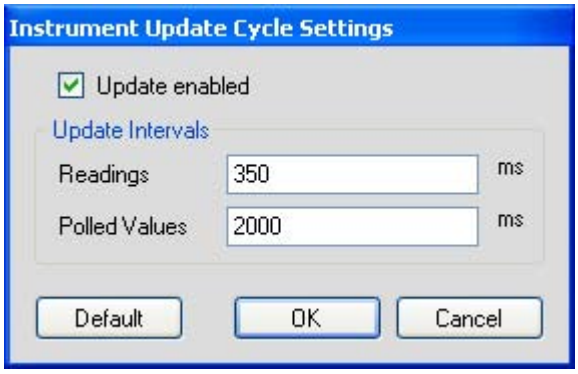


Figure 30 Controlling the Instrument Refresh

- Stop and start the display of all changes. Make sure to put a check in the box for “Update enabled”, to enable the N77xx Viewer to display the status and results from the instrument. If there is no check in the box for “Update enabled”, the display is not updated with the replies to queries sent to the instrument.
- Set the update interval for “Readings” to control how often the result is read from the instrument and the display updated.
- Set the update interval for “Polled Values” to control how often the measurement parameters are read from the instrument and the display updated. This is useful if, for example, more than one person can control the instrument.

2 When you have set all the values, click on the “OK” button.

2
Tunable Laser Source

Tunable Laser Source - Overview

This section describes how to use the Keysight N7711A/ N7714A instruments as Tunable Laser Sources.

Here you will find:

- A brief description of the Tunable Laser Source
- A description of how to use these tunable laser sources, including switching the optical output, setting an output power, tuning, and setting modulation parameters.

Controlling the Tunable Laser Source

The Tunable Laser Source can be controlled in the following ways:

- LAN / USB / GPIB Connection: with the N77xx Viewer
- LAN / USB / GPIB: Programming with SCPI commands (described in the Programming Guide available on the CD supplied with the instrument or from www.keysight.com).

To connect to the instrument, see “ Input and Output Connectors - Overview” on page 19. The most convenient way to control one or more lasers is using the Keysight N77xx Viewer, which is a control and display graphical user interface. The details for each port are shown in a separate tab that can also be opened in a separate window with the “New” button. All ports can be displayed together in the Overview window

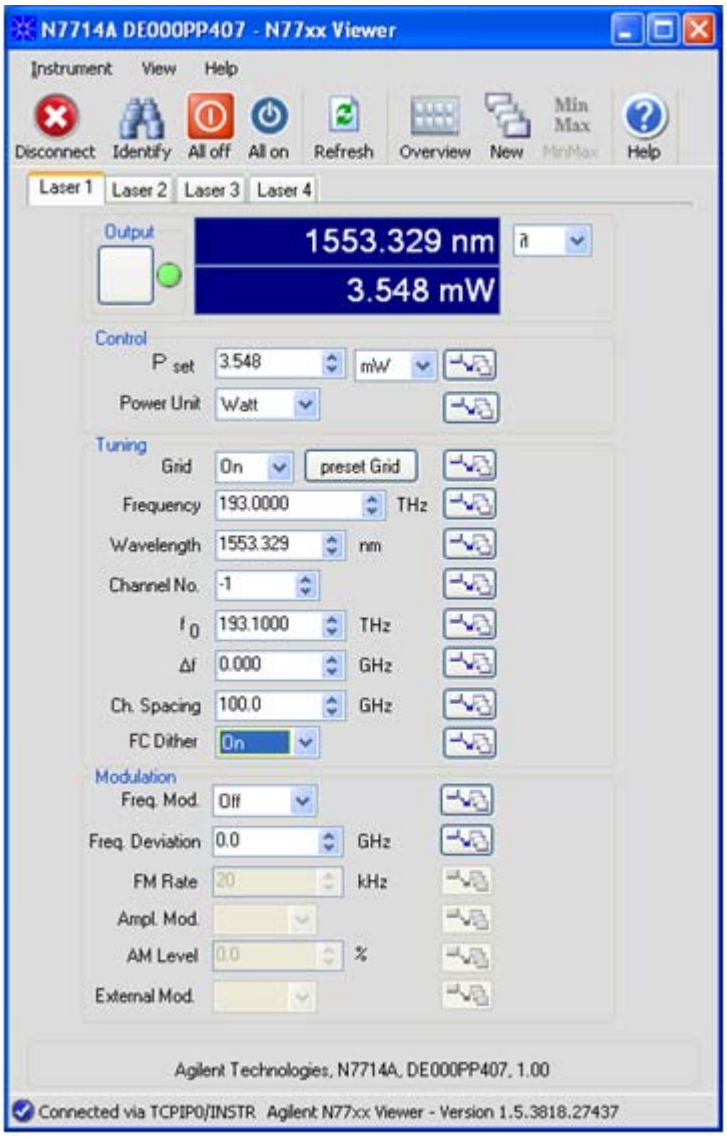


Figure 31 The N77xx viewer

The Viewer is also available on CD and via download from the product webpage which you can access at http://www.keysight.com/find/jet.

Then select the tab “Technical Support” followed by “Drivers & Software”.

On this webpage you will also find additional software tools like:

- Firmware update utility
- Firmware update file
- VXI Plug&Play Drivers

Optical Output

Switch the optical output of the tunable laser module on or off

Click the Output button to toggle the optical laser output between on and off.

All laser ports can also be turned on and off together from the buttons above the tabs.

Check the state of the tunable laser module and the optical output of the laser

The green output LED like output indicator has three states:

- Blinking indicates that the laser module is not yet stable and the optical output power is undefined. This happens e.g. after change of tuning parameters and might take some seconds.
- Dark green indicates that the optical output is off.
- Bright green indicates that the laser module has finished its tuning and the optical output is on.

Check the tuned value

The tuning display shows either the wavelength in nm or the frequency in THz.

Select the scale of the tuning display

Use the following selector to select the scale of the tuning display.

f/λ

NOTE This setting is for displaying purposes only and does not affect any internal states of the laser.

Check the optical power

The power display shows the optical power of the laser.

NOTE The shown scale, dBm or W depends on the power unit selected in the Control group box.

NOTE If the output indicator is blinking or dark green the real optical output power might be different to the displayed value.

Power Control

Set the target optical power

The Pset control allows you to set the target optical power regarding the unit shown right of it.

Select the SI prefix of the Watt unit

NOTE This applies only if the power unit is set to Watt as described below.

The SI prefix selector allows you to select a desired setting between pW and W for subsequent setting of the target optical power.

NOTE The SI prefix selector will stay as you set only if the cursor is in this selector or the Pset control. It might be changed by the N77xx Viewer once the cursor leaves the Pset line.

Select the power scale

Select Watt as the Power Unit for a linear power scale. The unit shown right of the Pset control will change to a SI prefix Watt selector as described above.

Select dBm as the Power Unit for a logarithmic power scale. The unit shown right of the Pset control will change to a fixed “dBm” label.

NOTE Whereas this setting does not change any physical state of the laser module it changes the internal power unit software state. For details see *Programmers Guide*.

The Tuning Field

Switch the grid mode on or off

Select “Off” to switch to the tuning mode that is not affected by any frequency grid. In this case all tuning controls that belong to the grid tuning mode (see below) will be disabled and grayed-out. You can set an arbitrary wavelength or frequency with a granularity of 100MHz.

Select “On” to switch to the grid tuning mode. In this case all tuning controls that belong to the grid mode will be enabled also. In grid tuning mode there is only a set of discrete grid frequencies possible to tune to (see Set the frequency). The wavelength values are also limited to the set of wavelengths that corresponds to the grid frequencies (see Set the wavelength). The frequency grid is determined by the four grid tuning parameters Reference Frequency at channel 0 (or f0), Channel Number (or c), Channel Spacing (or s) and Fine Tune Frequency Offset (or Deltaf). The grid frequencies can be calculated as follows:

$$f = fo + c \times s + \Delta f$$

The tuning mode can only be changed when laser output is “OFF”.

Preset the frequency grid according to ITU (grid tuning mode only)

The grid tuning parameter will be set as follows:

- Channel Spacing: 100 GHz
- Reference Frequency at Channel 0: 193.1 THz

Grid mode off:

Tuning will not change your set value except clipping it to the supported wavelength range.

Grid mode on:

Tuning will first clip your set value to the supported wavelength range. After tuning the value will be changed to wavelength that corresponds to the nearest frequency of the particularly set-up grid (see grid mode parameters).

Set the frequency

The frequency control allows you to set the target frequency in THz. Changing this value might result in a blinking state of the LED during tuning like output indicator (see above) first.

Set the wavelength

The wavelength control allows you to set the target wavelength in nm. Changing this value might result in a blinking state of the LED like output indicator (see above) first.

Set the channel number (grid tuning mode only)

The Channel No. control allows you to set the desired channel number. The value is a dimensionless whole number (negative, 0, or positive) but will be clipped to a range that guarantees that the frequency is in the supported frequency range. Changing this value might result in a blinking state of the LED like output indicator (see above) first.

Set the reference frequency (grid tuning mode only)

The f0 control allows you to set the reference frequency in THz at channel 0. Changing this value will modify the Channel No. control in a way that the laser frequency remains unchanged (within the selected frequency grid).

NOTE Some tunable laser modules do not allow changing this parameter if the laser output is on.

Set the fine tune frequency offset (grid tuning mode only)

The Deltaf control allows you to set the fine tune frequency offset. Changing this value might result in a blinking state of the LED like output indicator (see above) first.

Set the channel spacing frequency (grid tuning mode only)

The Ch. Spacing control allows you to set the channel spacing frequency in GHz. Changing this value will modify the Channel No. control in a way that the laser frequency remains unchanged within the new grid.

NOTE Some tunable laser modules do not allow changing this parameter if the laser output is on.

Switch the frequency control dither modulation on or off

NOTE This tuning feature is not supported on every tunable laser model. In this case the FC Dither control is disabled and grayed out.

Some tunable laser models use a dither tone which is used for controlling the emission frequency at its target value resulting in a very small frequency and output power variation. In case the modulation is unwanted the FC Dither control allows you to switch this modulation off (or on again).

NOTE In the case, FC Dither is supported but switched off, the laser frequency might drift.

Modulation Control

Switch the frequency modulation on or off

The frequency modulation control allows you to switch the frequency modulation on or off.

NOTE This feature might not be supported by your tunable laser module. In this case the control is disabled and grayed-out.

Set the frequency modulation deviation

The frequency deviation control allows you to set the frequency modulation deviation in GHz. The frequency modulation feature can be used for SBS suppression.

NOTE This feature might not be supported by your tunable laser module. In this case the control is disabled and grayed-out.

Set the frequency modulation rate (not supported on all N77xx laser modules)

The FM Rate control allows you to set the repetition rate in kHz of the frequency modulation pattern over time. The pattern (e.g. sinusoidal, or sawtooth) depends on the particular model of your tunable laser module.

NOTE This feature might not be supported by your tunable laser module. In this case the control is disabled and grayed-out.

Switch the amplitude modulation on or off (not supported on all N77xx laser modules)

The Ampl. Mod. control allows you to switch the amplitude modulation on or off.

NOTE This feature might not be supported by your tunable laser module. In this case the control is disabled and grayed-out.

Set the amplitude modulation level (not supported on N77xx laser modules)

The AM Level control allows you to set the modulation level in %.

NOTE This feature might not be supported by your tunable laser module. In this case the control is disabled and grayed-out.

Enable or disable the external modulation (not supported on N77xx laser modules)

The External Mod. control allows you to enable or disable the external modulation. If enabled the laser power/frequency can be modulated by the application of an external electrical signal to the modulation input connector.

NOTE This feature might not be supported by your tunable laser module. In this case the control is disabled and grayed-out.

NOTE If supported, the type of modulation depends on your laser model.

3
Specifications and Regulations Compliance

Definition of Terms

(Applicable) fiber type

Connection type for which the specifications and characteristics apply (if not differently stated).

Absolute wavelength (frequency) accuracy

The maximum difference between the displayed wavelength (frequency) and the actual wavelength (frequency) of the tunable laser source. Wavelength is defined as wavelength in vacuum.

Constant operating conditions

This generally includes constant values of temperature, humidity, wavelength, input power level, polarization state and mode distribution, if the quantity is not explicitly subject to variation.

Linewidth

The 3 dB width of the optical spectrum, expressed in Hertz.

Conditions: SBS suppression off.

Measurement:

Using a self-heterodyning technique: The output of the laser under test is sent through a Mach-Zehnder interferometer in which the length difference of the two arms is longer than the coherence length of the laser. The electrical noise spectrum of the photodetector current is measured with Keysight lightwave signal analyzer, and the linewidth is calculated from the heterodyne spectrum.

Alternatively, *Using a heterodyning technique:* The output of the laser under test is mixed with another laser of the same type on a wide

bandwidth photodetector. The electrical noise spectrum of the photodetector current is measured with Keysight Lightwave signal analyzer, and the linewidth is calculated from the heterodyne spectrum. (Lightwave signal analyzer settings: resolution bandwidth 1 MHz, video bandwidth 10 kHz, sweep time 20 ms, single scan).

Maximum output power

The maximum achievable output power of the tunable laser source and the maximum output power for which the tunable laser source specifications apply.

Conditions: As specified.

Measurement: Using a power meter at the output of the instrument.

Operating humidity

Humidity range where the instrument is designed to be operated.

The instrument must not be operated outside this range. If previously stored beyond this range, wait for acclimation before turning on the instrument.

Operating temperature

Temperature range for which the specifications apply if not differently stated.

The instrument must not be operated outside this range. If previously stored beyond this range, wait for acclimation before turning on the instrument.

Operating temperature and humidity

The ambient temperature range and humidity range of the tunable laser source for which the specifications apply.

NOTE If the tunable laser source module is rack- mounted the temperature and humidity within the rack apply.

Output isolation

The insertion loss of the built-in isolator in the backward direction.

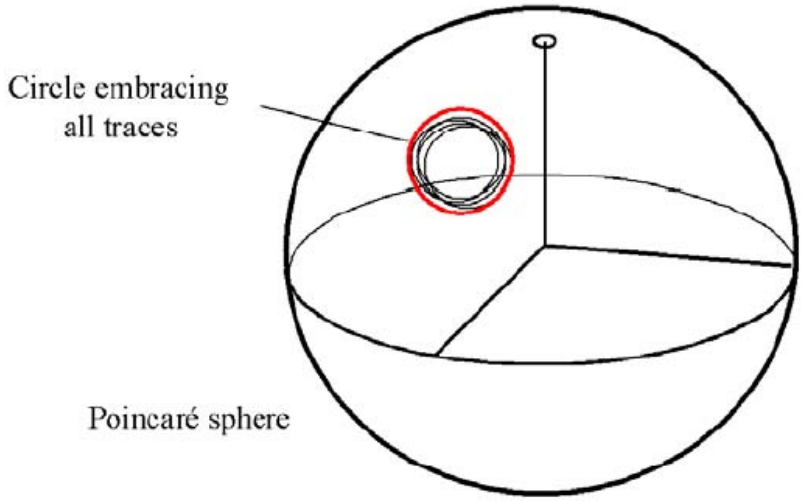
Measurement: This characteristic cannot be measured from outside the module. It is based on known isolator characteristics.

Polarization extinction ratio

Specifies the ratio of the optical power in the slow axis of a connected polarization-maintaining fiber to optical power in the fast axis, expressed in dB

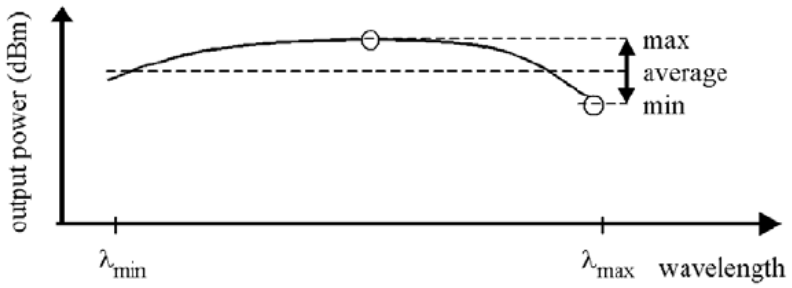
Conditions: Applicable to tunable laser sources utilizing polarization maintaining fiber that has its TE mode in the slow axis and aligned with the connector key.

Measurement: Using a polarization analyzer at the end of a polarization-maintaining patchcord, by sweeping the wavelength to create circular traces on the Poincaré sphere. Calculate the polarization extinction ratio from the diameters of these circles.



Power flatness versus wavelength

Specifies ± half the span (in dB) between the maximum and the minimum actual power levels of the tunable laser source when changing the wavelength.



Conditions: Uninterrupted tunable laser source output power, constant power setting, constant temperature.

Power repeatability

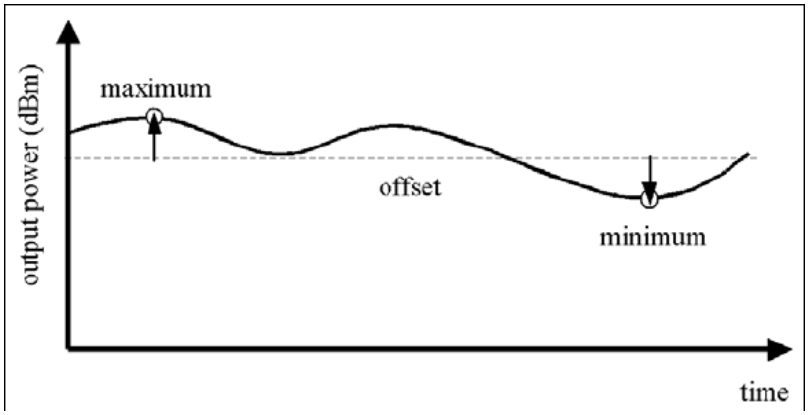
The uncertainty in reproducing the power level after changing and resetting the power level. The power repeatability is ± half the span between the highest and lowest actual power (in dBm).

Conditions: Uninterrupted tunable laser source output power, constant wavelength setting, constant temperature.

NOTE The long-term power repeatability can be obtained by taking the power repeatability and power stability into account.

Power stability

Specifies the change of the power level of the tunable laser source over time, expressed as ± half the span (in dB) between the highest and lowest actual power.



Conditions: Time span as specified. Uninterrupted tunable laser source output power, constant wavelength and power level settings, constant temperature.

Relative intensity noise (RIN)

Specifies the ratio between the mean-square of the optical power fluctuation amplitude Pf,B within a specified frequency range f and for bandwidth B, and the square of the average optical power P_{avg}.

$$RIN = \frac{\left\langle \Delta P_{f,B}^2 \right\rangle}{P_{\text{avg}}{}^2 \cdot B} \left[\frac{1}{\text{Hz}}\right]$$

RIN, if expressed as “dB/Hz”, is calculated by:

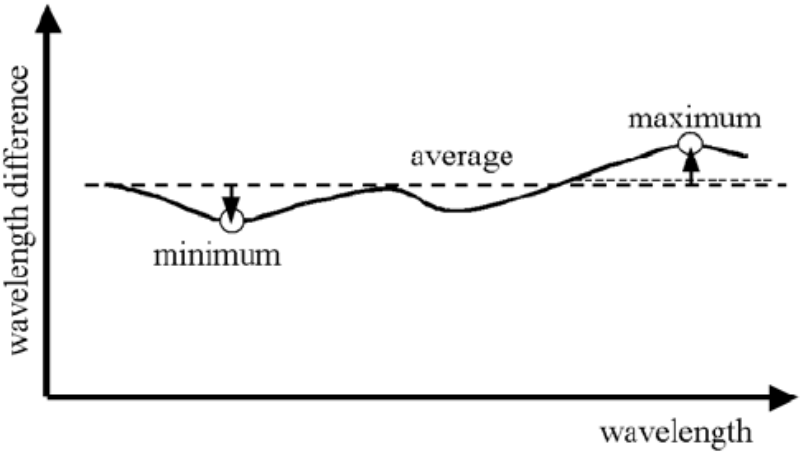
$$RIN_{\text{dB/Hz}} = 10 \cdot \log\left(\frac{\Delta P_{f,B}^2 \cdot 1\text{Hz}}{P_{\text{avg}}{}^2 \cdot B}\right)$$

Conditions: As specified.

Measurement: Using an Keysight Lightwave signal analyzer and bandwidth set to 3 MHz.

Relative wavelength (frequency) accuracy

When randomly changing the wavelength (frequency) of the tunable laser source and measuring the differences between the displayed and the actual wavelength (frequency), the relative wavelength (frequency) accuracy is ± half the span between the maximum and the minimum value of all differences.



Conditions: Uninterrupted tunable laser source output power, constant power setting, constant temperature.

SBS suppression - effective linewidth

Specifies the peak-to-peak change of the periodically modulated wavelength resulting from the SBS suppression feature, expressed in Hertz.

Side-mode suppression ratio

The ratio of optical power in the main mode to the optical power of the highest sidemode, expressed in dB:

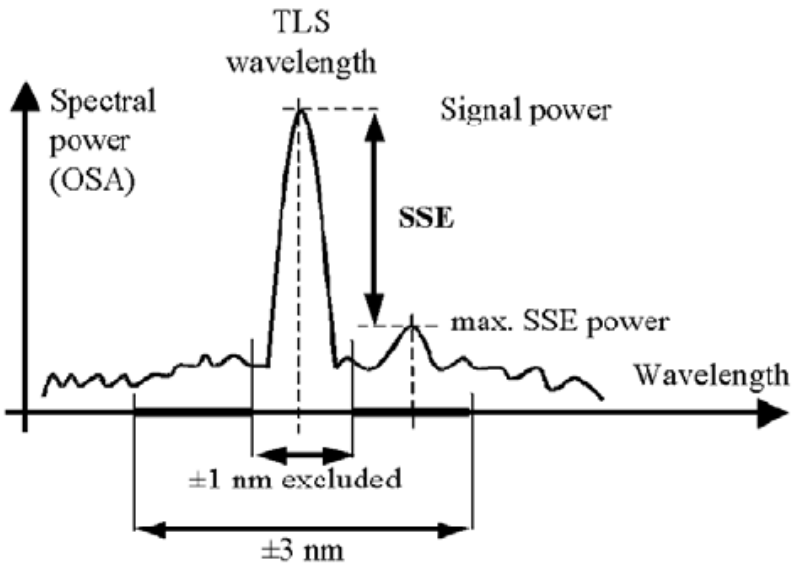
$$SSR_{\mathrm{dB}} = 10 \cdot \log\left(\frac{P_{signal}}{P_{highestsidemode}}\right)$$

Conditions: Within a distance from 0.1 to 6 GHz to the signal's optical frequency.

Measurement: Using the Keysight Lightwave signal analyzer, by analyzing the heterodyning between the main signal and the highest sidemode.

Signal to source spontaneous emission ratio

Specifies the ratio between signal power and maximum spontaneous emission (SSE) power. The SSE power is determined in a specified bandwidth within a ±3 nm window around the signal wavelength, where ±1 nm around the signal wavelength are excluded, expressed in dB per nm.



Conditions: As specified.

Measurement: Using an optical spectrum analyzer at 0.5 nm resolution bandwidth (to address the possibility of higher SSE within a narrower bandwidth), then extrapolated to 1 nm bandwidth.

Storage conditions

Allowed temperature and humidity range for the non-operating instrument. Wait for acclimation to within the “Operating temperature” before turning on the instrument.

Tuning time

Specifies the time needed to tune to another wavelength.

Conditions: Tuning distance as specified. The time is measured from sending the command to the TLS until the tuning operation has finished.

Wavelength range

The range of wavelengths for which the power meter is calibrated, or that can be set at the laser and for which the specifications apply (if not differently stated).

Wavelength (frequency) repeatability

The random uncertainty in reproducing a wavelength (frequency) of the tunable laser source after changing and re-setting the wavelength (frequency). The wavelength (frequency) repeatability is ± half the span between the maximum and the minimum of all actual values of this wavelength (frequency).

Conditions: Uninterrupted tunable laser source output power, constant power setting, constant temperature.

NOTE The long-term wavelength repeatability can be obtained by taking the wavelength repeatability and wavelength stability into account.

Wavelength resolution

The smallest selectable wavelength (frequency) increment or decrement.

Wavelength (frequency) stability

Specifies the change of the actual wavelength (frequency) of the tunable laser source over time, expressed as ± half the span between the maximum and minimum of all wavelengths (frequencies).

Conditions: Time span as specified, uninterrupted tunable laser source output power, constant wavelength and power level settings, constant temperature.

Warm-up time

Time after power-up of the acclimated instrument after which the specifications and characteristics apply.

Literature

1 Fiber Optic Test and Measurement, Hewlett Packard Professional Books, edited by Prentice Hall, ISBN 0-13-534330-5

Technical Specification - Tunable Laser Sources

The following specifications apply to wavelengths on the 50 GHz ITU-T grid, after warm up.

Parameter	Agilent N7711A, N7714A	
Wavelength	Options #210, #222, #240	Options #201, #222, #204
Wavelength (frequency) range	1527.60 nm to 1565.50 nm (196.25 THz to 191.50 THz)	1570.01 nm to 1608.76 nm (190.95 THz to 186.35 THz)
Frequency (wavelength) resolution	100 MHz (0.8 pm at 1550 nm)	
Fine tuning range	Typical ± 6 GHz	
Fine tuning resolution	Typical 1 MHz	
Absolute wavelength (frequency) accuracy	± 22 pm (± 2.5 GHz)	
Relative wavelength (frequency) accuracy	± 12 pm (± 1.5 GHz)	
Wavelength (frequency) repeatability	Typical ± 2.5 pm (± 0.3 GHz) [2]	
Wavelength (frequency) stability	Typical ± 2.5 pm (± 0.3 GHz), 24 hours [2]	
	Typical ± 0.5 pm, 1 minute [2]	
Tuning time	Typical < 30 sec [3]	
Optical power		
Max. output power	≥ +13.5 dBm	
	Typical ≥ +15 dBm	
Power stability	Typical ± 0.03 dB over 24 hours [2]	
	Typical ± 0.03 dB over 1 hour [2]	
Power flatness	Typical ± 0.2 dB (full wavelength range)	
Power repeatability	Typical ± 0.08 dB [2]	
Spectral		
Linewidth	Typical < 100 kHz (SBS suppression off)	
Side mode suppression ratio (SMSR)	Typical 50 dB	
Source spontaneous emission (SSE)	Typical 50 dB/ 1 nm [1]	
	Typical 60 dB/ 0.1 nm [1]	
Relative intensity noise (RIN)	Typical –145 dB/Hz [1] (10 MHz to 40 GHz)	

1. *At maximum specified output power, as specified per wavelength range*
2. *At constant temperature ± 0.5 K*
3. *Including power stabilization*

Supplementary Performance Characteristics, Non-warranted

Parameter	Agilent N7711A, N7714A
Grid spacing	100 GHz, 50 GHz, 25 GHz, or arbitrary grid
Fine tuning speed	15 sec from -6 GHz to +6 GHz
Warm-up time	1 hour, immediate operation after boot-up
Output power	
Power attenuation range	8 dB
Power setting resolution	0.1 dB
Residual output power (shutter closed)	≤ –45 dBm
Stimulated Brillouin scattering suppression	
SBS suppression FM p-p modulation range	0 GHz to 1 GHz
SBS suppression dither frequency	20.8 kHz

General Characteristics

Parameter	Agilent N7711A, N7714A
Connectivity	FC/APC angled (option #072) or FC/PC straight (option #071) connector interface
Fiber type	9/125 µm panda PMF, TE mode in slow axis, in line with connector key
Polarization extinction ratio	16 dB typical
Output isolation	30 dB typical
Laser safety	Class 1M
Recommended recalibration period	24 months
Operating conditions	+10 °C to +35 °C
	< 80% relative humidity, non-condensing
Altitude	Max 2000 m
Pollution protection	Designed for pollution detection degree 2
Storage conditions	–40 °C to +70 °C
	< 80% relative humidity, non-condensing
Form factor	One rack unit, ½ 19" width
Dimensions (H x W x D)	43 mm x 212 mm x 372 mm
Weight	3.8 kg (6 lbs)
Front panel	Status LEDs, laser on/off buttons, line power on/off switch
Connectivity, rear panel	USB 2.0, LAN 10/100 Mbit/s, GPIB
User interface	PC user interface application, SCPI commands, Agilent IO libraries
Power consumption	AC 100-240 V ±10%, 50 Hz/60 Hz, 60 VA maximum
Laser safety information	All laser sources specified by this data sheet are classified as Class 1M according to IEC 60825-1 (2007). All laser sources comply with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50, dated 2007, June 24.

Declaration of Conformity

KEYSIGHT TECHNOLOGIES	DECLARATION OF CONFORMITY According to EN ISO/IEC 17050-1:2004	CE

Manufacturer's Name: Keysight Technologies Deutschland GmbH
Manufacturer's Address: Herrenberger Strasse 130
D-71034 Boeblingen
Germany

Declares under sole responsibility that the product as originally delivered

Product Name: **Tunable Laser Source**
Model Number: **N771(x)A** (x) = 0 … 9
N772(x)A (x) = 0 … 9
Product Options: *This declaration covers all options of the above system.*

complies with the essential requirements of the following applicable European Directives, and carries the CE marking accordingly:

- *The Low Voltage Directive 2006/95/EC*
- *The EMC Directive 2004/108/EC*

and conforms with the following product standards:

	Standard	***Limit***
EMC	*IEC 61326-1:2012 / EN 61326-1:2013*	
	Reference Standards	
	CISPR 11:2009+A1:2010 / EN 55011:2009+A1:2010	*Group 1 Class A*
	IEC 61000-4-2:2008 / EN 61000-4-2:2009	*4 kV CD, 8 kV AD*
	IEC 61000-4-3:2006+A1:2007+A2:2010 / EN 61000-4-3:2006+A1:2008+A2 :2010	*3 V/m / 80 MHz-2 GHz, 1V/m / 2-2.7 GHz*
	IEC 61000-4-4:2004+A1:2010 / EN 61000-4-4:2004+A1 :2010	*0.5 kV signal lines, 1 kV power lines*
	IEC 61000-4-5: 2005 / EN 61000-4-5:2006	*0.5 kV line-line, 1 kV line-ground*
	IEC 61000-4-6:2008 / EN 61000-4-6:2009	*3 V, 0.15-80 MHz*
	IEC 61000-4-11:2004 / EN 61000-4-11:2004	*0% for 1 / 0.5 (0°, 180°) cycle* *0% for 250 / 300 cycles* *70% for 25 / 30 cycles*
	Canada: ICES/NMB-001:2006 *Australia/New Zealand: AS/NZS CISPR 11:2011*	
Safety	*IEC 61010-1:2010 / EN 61010-1:2010* *IEC 60825-1:2007 / EN 60825-1:2007* *Canada: CAN/CSA-C22.2 No. 61010-1-04* *USA: ANSI/UL 61010-1:2004; FDA 21CFR1040.10+Laser Notice No. 50*	

Supplementary Information:

FDA Accession Number 9521220
The product was tested in a typical configuration with Keysight Technologies test systems.
This DoC applies to above-listed products placed on the EU market after:

2014-August-01
Date

Hans-Martin Fischer
Product Quality & Compliance

For further information, please contact your local Keysight Technologies sales office, agent or distributor.
Or Keysight Technologies Deutschland GmbH, Herrenberger Strasse 130, 71304 Boeblingen, Germany

Year of first marking: 2010 Revision: A

The latest version of the Declaration of Conformity can be found here
http://www.keysight.com/go/conformity

Regulations Information

EMC Canada

These ISM devices comply with Canadian ICES-001. Ces appareils ISM sont conformes à la norme NMB-001 du Canada.

Acoustic Noise Information Germany

ISO 7779 L_{pA} < 70 dB(A), normal operation, operator position.

Remove all doubt

Remove all doubt

Our repair and calibration services will get your equipment back to you, performing like new, when promised. You will get full value out of your Keysight equipment throughout its lifetime. Your equipment will be serviced by Keysight-trained technicians using the latest factory calibration procedures, automated repair diagnostics and genuine parts. You will always have the utmost confidence in your measurements. Keysight offers a wide range of additional expert test and measurement services for your equipment, including initial start-up assistance, onsite education and training, as well as design, system integration, and project management. For more information on repair and calibration services, go to

www.keysight.com/find/removealldoubt

Keysight E-mail Updates

Get the latest information on the products and applications you select.

www.keysight.com/find/emailupdates

Keysight Direct

Quickly choose and use your test equipment solutions with confidence.

www.keysight.com/find/mykeysight

Keysight Open

Keysight Open simplifies the process of connecting and programming test systems to help engineers design, validate and manufacture electronic products. Keysight offers open connectivity for a broad range of systemready instruments, open industry software, PC-standard I/O and global support, which are combined to more easily integrate test system development.

www.keysight.com/find/open

LXI

LXI is the LAN-based successor to GPIB, providing faster, more efficient connectivity. Keysight is a founding member of the LXI consortium.

www.lxistandard.org

www.keysight.com

For more information on Keysight Technologies products, applications and services, please contact your local Keysight office. The complete list is available at:

www.keysight.com/find/contactus

4
Accessories

Accessories - Overview

The instruments are available in various configurations for the best possible match to the most common applications.

This chapter provides information on the available options and accessories.

Instrument and Options - Keysight N7711A, N7714A

All systems have 3 year warranty

Model number	
N7711A	Tunable laser source, 1 port
N7714A	Tunable laser source, 4 ports

Connector interface option	
-071	Straight connector interface, PMF
-072	Angled connector interface, PMF

Wavelength (frequency) option	
N7711A	
-210	C-band laser
-201	L-band laser
N7714A	
-240	4 C-band lasers
-204	4 L-band lasers
-222	2 C-band lasers and 2 L-band lasers

Accessories	
N7744-100	Rack mount kit for 1 or 2 units of same depth

Warranty	
All systems have 3 year warranty	
R-51B-001-3C	1 year return-to-Agilent warranty extended to 3 years
R-51B-001-5C	1 year return-to-Agilent warranty extended to 5 years

Calibration	
R-50C-011-3	Agilent calibration upfront support plan 3 years coverage
R-50C-011-5	Agilent calibration upfront support plan 5 years coverage

Cables

- GPIB Cable, 10833A, 1 m (3.3 feet)
- GPIB Cable, 10833B, 2 m (6.6 feet)
- GPIB Cable, 10833C, 4 m (13.2 feet)
- GPIB Cable, 10833D, 0.5 m (1.6 feet)
- GPIB Adapter, 10834A, 2.3 cm extender. Use this adapter if there is no space to connect your GPIB cable directly to a GPIB interface.
- USB Cable, 8121-1243, 2 m (6.6 feet)
- Cross-over LAN cable, 5061-0701, 2.1 m (7 feet)

5
Maintenance and Troubleshooting

Maintenance and Troubleshooting - Overview

This section provides detailed information on:

- Cleaning Instructions
- Firmware Upgrades
- Error Messages
- Data Sanitation

Cleaning Instructions

Cleaning Instructions

The following Cleaning Instructions contain some general safety precautions, which must be observed during all phases of cleaning. Consult your specific optical device manuals or guides for full information on safety matters.

Please try, whenever possible, to use physically contacting connectors, and dry connections. Clean the connectors, interfaces, and bushings carefully after use.

If you are unsure of the correct cleaning procedure for your optical device, we recommend that you first try cleaning a dummy or test device.

Keysight Technologies assume no liability for the customer’s failure to comply with these requirements.

Cleaning Instructions for this Instrument

The Cleaning Instructions apply to a number of different types of Optical Equipment. Most relevant for this instrument is the section "How to clean connector adapters" on page 83 for cleaning the quad-adapters, and "How to clean optical glass plates" on page 84 for cleaning the front of the instrument.

Safety Precautions

Please follow the following safety rules:

- Do not remove instrument covers when operating.
- Ensure that the instrument is switched off throughout the cleaning procedures.
- Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.
- Make sure that you disable all sources when you are cleaning any optical interfaces.
- Under no circumstances look into the end of an optical device attached to optical outputs when the device is operational. The laser radiation is not visible to the human eye, but it can seriously damage your eyesight.
- To prevent electrical shock, disconnect the instrument from the 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.
- Do not install parts or perform any unauthorized modification to optical devices.
- Refer servicing only to qualified and authorized personnel.

Why is it important to clean optical devices?

In transmission links optical fiber cores are about 9 µm (0.00035") in diameter. Dust and other particles, however, can range from tenths to hundredths of microns in diameter. Their comparative size means that they can cover a part of the end of a fiber core, and as a result will reduce the performance of your system.

Furthermore, the power density may burn dust into the fiber and cause additional damage (for example, 0 dBm optical power in a single mode fiber causes a power density of approximately 16 million W/m2). If this happens, measurements become inaccurate and non-repeatable.

Cleaning is, therefore, an essential yet difficult task. Unfortunately, when comparing most published cleaning recommendations, you will discover that they contain several inconsistencies. In this section, we want to suggest ways to help you clean your various optical devices, and thus significantly improve the accuracy and repeatability of your lightwave measurements.

What do I need for proper cleaning?

Some Standard Cleaning Equipment is necessary for cleaning your instrument. For certain cleaning procedures, you may also require certain Additional Cleaning Equipment.

Standard Cleaning Equipment

Before you can start your cleaning procedure you need the following standard equipment:

- Dust and shutter caps
- Isopropyl alcohol
- Cotton swabs
- Soft tissues
- Pipe cleaner
- Compressed air

Dust and shutter caps

All of Keysight Technologies' lightwave instruments are delivered with either laser shutter caps or dust caps on the lightwave adapter. Any cables come with covers to protect the cable ends from damage or contamination.

We suggest these protected coverings should be kept on the equipment at all times, except when your optical device is in use. Be careful when replacing dust caps after use. Do not press the bottom of the cap onto the fiber too hard, as any dust in the cap can scratch or pollute your fiber surface.

If you need further dust caps, please contact your nearest Keysight Technologies sales office.

Isopropyl alcohol

This solvent is usually available from any local pharmaceutical supplier or chemist's shop.

If you use isopropyl alcohol to clean your optical device, do not immediately dry the surface with compressed air (except when you are cleaning very sensitive optical devices). This is because the dust and the dirt is solved and will leave behind filmy deposits after the alcohol is evaporated. You should therefore first remove the alcohol and the dust with a soft tissue, and then use compressed air to blow away any remaining filaments.

If possible avoid using denatured alcohol containing additives. Instead, apply alcohol used for medical purposes. Never try to drink this alcohol, as it may seriously damage to your health.

Do not use any other solvents, as some may damage plastic materials and claddings. Acetone, for example, will dissolve the epoxy used with fiber optic connectors. To avoid damage, only use isopropyl alcohol.

Cotton swabs

We recommend that you use swabs such as Q-tips or other cotton swabs normally available from local distributors of medical and hygiene products (for example, a supermarket or a chemist's shop). You may be able to obtain various sizes of swab. If this is the case, select the smallest size for your smallest devices.

Ensure that you use natural cotton swabs. Foam swabs will often leave behind filmy deposits after cleaning.

Use care when cleaning, and avoid pressing too hard onto your optical device with the swab. Too much pressure may scratch the surface, and could cause your device to become misaligned. It is advisable to rub gently over the surface using only a small circular movement.

Swabs should be used straight out of the packet, and never used twice. This is because dust and dirt in the atmosphere, or from a first cleaning, may collect on your swab and scratch the surface of your optical device.

Soft tissues

These are available from most stores and distributors of medical and hygiene products such as supermarkets or chemists' shops.

We recommend that you do not use normal cotton tissues, but multi-layered soft tissues made from non-recycled cellulose. Cellulose tissues are very absorbent and softer. Consequently, they will not scratch the surface of your device over time.

Use care when cleaning, and avoid pressing on your optical device with the tissue. Pressing too hard may lead to scratches on the surface or misalignment of your device. Just rub gently over the surface using a small circular movement.

Use only clean, fresh soft tissues and never apply them twice. Any dust and dirt from the air which collects on your tissue, or which has gathered after initial cleaning, may scratch and pollute your optical device.

Pipe cleaner

Pipe cleaners can be purchased from tobacconists, and come in various shapes and sizes. The most suitable one to select for cleaning purposes has soft bristles, which will not produces scratches.

There are many different kinds of pipe cleaner available from tobacco shops.

The best way to use a pipe cleaner is to push it in and out of the device opening (for example, when cleaning an interface). While you are cleaning, you should slowly rotate the pipe cleaner.

Only use pipe cleaners on connector interfaces or on feed through adapters. Do not use them on optical head adapters, as the center of a pipe cleaner is hard metal and can damage the bottom of the adapter.

Your pipe cleaner should be new when you use it. If it has collected any dust or dirt, this can scratch or contaminate your device.

The tip and center of the pipe cleaner are made of metal. Avoid accidentally pressing these metal parts against the inside of the device, as this can cause scratches.

Compressed air

Compressed air can be purchased from any laboratory supplier.

It is essential that your compressed air is free of dust, water and oil. Only use clean, dry air. If not, this can lead to filmy deposits or scratches on the surface of your connector. This will reduce the performance of your transmission system.

When spraying compressed air, hold the can upright. If the can is held at a slant, propellant could escape and dirty your optical device. First spray into the air, as the initial stream of compressed air could contain

some condensation or propellant. Such condensation leaves behind a filmy deposit.

Please be friendly to your environment and use a CFC-free aerosol.

Additional Cleaning Equipment

Some Cleaning Procedures need the following equipment, which is not required to clean each instrument:

- Microscope with a magnification range about 50X up to 300X
- Ultrasonic bath
- Warm water and liquid soap
- Premoistened cleaning wipes
- Polymer film
- Infrared Sensor Card

Microscope with a magnification range about 50X up to 300X

A microscope can be found in most photography stores, or can be obtained through or specialist mail order companies. Special fiberscopes are available from suppliers of splicing equipment.

Ideally, the light source on your microscope should be very flexible. This will allow you to examine your device closely and from different angles.

A microscope helps you to estimate the type and degree of dirt on your device. You can use a microscope to choose an appropriate cleaning method, and then to examine the results. You can also use your microscope to judge whether your optical device (such as a connector) is severely scratched and is, therefore, causing inaccurate measurements.

Ultrasonic bath

Ultrasonic baths are also available from photography or laboratory suppliers or specialist mail order companies.

An ultrasonic bath will gently remove fat and other stubborn dirt from your optical devices. This helps increase the life span of the optical devices.

Only use isopropyl alcohol in your ultrasonic bath, as other solvents may damage.

Warm water and liquid soap

Only use water if you are sure that there is no other way of cleaning your optical device without corrosion or damage. Do not use hot water, as this may cause mechanical stress, which can damage your optical device.

Ensure that your liquid soap has no abrasive properties or perfume in it. You should also avoid normal washing-up liquid, as it can cover your device in an iridescent film after it has been air-dried.

Some lenses and mirrors also have a special coating, which may be sensitive to mechanical stress, or to fat and liquids. For this reason we recommend you do not touch them.

If you are not sure how sensitive your device is to cleaning, please contact the manufacturer or your sales distributor.

Premoistened cleaning wipes

Use pre-moistened cleaning wipes as described in each individual cleaning procedure. Cleaning wipes may be used in every instance where a moistened soft tissue or cotton swab is applied.

Polymer film

Polymer film is available from laboratory suppliers or specialist mail order companies.

Using polymer film is a gentle method of cleaning extremely sensitive devices, such as reference reflectors and mirrors.

Infrared Sensor Card

Infrared sensor cards are available from laboratory suppliers or specialist mail order companies.

With this card you are able to control the shape of laser light emitted. The invisible laser beam is projected onto the sensor card, then becomes visible to the normal eye as a round spot.

Take care never to look into the end of a fiber or any other optical component, when they are in use. This is because the laser can seriously damage your eyes.

Preserving Connectors

Listed below are some hints on how best to keep your connectors in the best possible condition.

Making Connections

Before you make any connection you must ensure that all cables and connectors are clean. If they are dirty, use the appropriate cleaning procedure.

When inserting the ferrule of a patchcord into a connector or an adapter, make sure that the fiber end does not touch the outside of the mating connector or adapter. Otherwise you will rub the fiber end against an unsuitable surface, producing scratches and dirt deposits on the surface of your fiber.

Dust Caps and Shutter Caps

Be careful when replacing dust caps after use. Do not press the bottom of the cap onto the fiber as any dust in the cap can scratch or dirty your fiber surface.

When you have finished cleaning, put the dust cap back on, or close the shutter cap if the equipment is not going to be used immediately.

Keep the caps on the equipment always when it is not in use.

All of Keysight Technologies' lightwave instruments and accessories are shipped with either laser shutter caps or dust caps. If you need additional or replacement dust caps, contact your nearest Keysight Technologies Sales/Service Office.

Immersion Oil and Other Index Matching Compounds

Where it is possible, do not use immersion oil or other index matching compounds with your device. They are liable to impair and dirty the surface of the device. In addition, the characteristics of your device can be changed and your measurement results affected.

Cleaning Instrument Housings

Use a dry and very soft cotton tissue to clean the instrument housing and the keypad. Do not open the instruments as there is a danger of electric shock, or electrostatic discharge. Opening the instrument can

cause damage to sensitive components, and in addition your warranty will be voided.

Never open the instruments as they can be damaged. Opening the instruments puts you in danger of receiving an electrical shock from your device, and renders your warranty void.

Which Cleaning Procedure should I use?

Light dirt

If you just want to clean away light dirt, observe the following procedure for all devices:

1. Use compressed air to blow away large particles.
2. Clean the device with a dry cotton swab.
3. Use compressed air to blow away any remaining filament left by the swab.

Heavy dirt

If the above procedure is not enough to clean your instrument, follow one of the procedures below. Please consult "Cleaning Instructions for this Instrument" on page 74 for the procedure relevant for this instrument.

If you are unsure of how sensitive your device is to cleaning, please contact the manufacturer or your sales distributor

How to clean connectors

Cleaning connectors is difficult as the core diameter of a single-mode fiber is only about 9 µm. This generally means you cannot see streaks or scratches on the surface. To be certain of the condition of the surface of your connector and to check it after cleaning, you need a microscope.

In the case of scratches, or of dust that has been burnt onto the surface of the connector, you may have no option but to polish the connector. This depends on the degree of dirtiness, or the depth of the scratches. This is a difficult procedure and should only be performed by skilled personal, and as a last resort as it wears out your connector.

WARNING

Never look into the end of an optical cable that is connected to an active source.

To assess the projection of the emitted light beam you can use an infrared sensor card. Hold the card approximately 5 cm from the output of the connector. The invisible emitted light is project onto the card and becomes visible as a small circular spot.

Preferred Procedure

Use the following procedure on most occasions.

1 Clean the connector by rubbing a new, dry cotton-swab over the surface using a small circular movement.

2 Blow away any remaining lint with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the connector:

1 Moisten a new cotton-swab with isopropyl alcohol.

2 Clean the connector by rubbing the cotton-swab over the surface using a small circular movement.

3 Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.

4 Blow away any remaining lint with compressed air.

An Alternative Procedure

A better, more gentle, but more expensive cleaning procedure is to use an ultrasonic bath with isopropyl alcohol.

1 Hold the tip of the connector in the bath for at least three minutes.

2 Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.

3 Blow away any remaining lint with compressed air.

How to clean connector adapters

Preferred Procedure

Use the following procedure on most occasions.

1 Clean the adapter by rubbing a new, dry cotton-swab over the surface using a small circular movement.

2 Blow away any remaining lint with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the adapter:

1 Moisten a new cotton-swab with isopropyl alcohol.

2 Clean the adapter by rubbing the cotton-swab over the surface using a small circular movement.

3 Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.

4 Blow away any remaining lint with compressed air.

How to clean bare fiber adapters

Bare fiber adapters are difficult to clean.

Protect from dust unless they are in use.

CAUTION Never use any kind of solvent when cleaning a bare fiber adapter as solvents can damage the foam inside some adapters.

They can deposit dissolved dirt in the groove, which can then dirty the surface of an inserted fiber.

Preferred Procedure

Use the following procedure on most occasions.

1 Blow away any dust or dirt with compressed air.

How to clean optical glass plates

The multiport power meter has an optical glass plate to protect the sensor. This has a special coating that is sensitive to solvents, grease, liquid and mechanical abrasion. Take extra care when cleaning this plate.

Preferred Procedure

Use the following procedure on most occasions.

1. Clean the plate by rubbing a new, dry cotton-swab over the surface using a small circular movement.
2. Blow away any remaining lint with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the plate:

1. Moisten a new cotton-swab with isopropyl alcohol.
2. Clean the plate by rubbing the cotton-swab over the surface using a small circular movement.
3. Using a new, dry cotton-swab remove the alcohol, any dissolved sediment and dust.
4. Blow away any remaining lint with compressed air.

Additional Cleaning Information

The following cleaning procedures may be used with other optical equipment:

- How to clean bare fiber ends

How to clean bare fiber ends

Bare fiber ends are often used for splices or, together with other optical components, to create a parallel beam. The end of a fiber can often be scratched. You make a new cleave. To do this:

1. Strip off the cladding.
2. Take a new soft-tissue and moisten it with isopropyl alcohol.
3. Carefully clean the bare fiber with this tissue.

4 Make your cleave and immediately insert the fiber into your bare fiber adapter in order to protect the surface from dirt.

Other Cleaning Hints

Selecting the correct cleaning method is an important element in maintaining your equipment and saving you time and money. This Appendix highlights the main cleaning methods, but cannot address every individual circumstance.

This section contain some additional hints which we hope will help you further. For further information, please contact your local Keysight Technologies representative.

Making the connection

Before you make any connection you must ensure that all lightwave cables and connectors are clean. If not, then use appropriate the cleaning methods.

When you insert the ferrule of a patchcord into a connector or an adapter, ensure that the fiber end does not touch the outside of the mating connector or adapter. Otherwise, the fiber end will rub up against something which could scratch it and leave deposits.

Lens cleaning papers

Note that some special lens cleaning papers are not suitable for cleaning optical devices like connectors, interfaces, lenses, mirrors and so on. To be absolutely certain that a cleaning paper is applicable, please ask the salesperson or the manufacturer.

Firmware Upgrades

Updated versions of the firmware for your instrument may be released from time to time. These will then be available from the Keysight web page (www.keysight.com/find/octfirmware) and will include the update application and instructions.

Error Messages

SYST:ERR?

The syst:err? command returns the next error from the error queue (refer to the Programming Guide for details).

Each error has an error code and a short description of the error, separated by comma. Please note that the error codes are returned as signed integer numbers in a range from -32768 to +32767 (INT16). Negative error numbers are defined by the SCPI standard, positive error numbers are device dependent.

Data Sanitation

Memory Inventory

The instruments have the following memory size:

EEPROM 2 Mb. This memory does not contain any customer data.

Flash ROM 16 MB. This memory can contain calibration data, and so on, as well as user parameter settings, zeroing data and logged information (the log contains limited operational information).

DRAM 128 MB volatile working memory. This contains data for current and recent calibrating and measuring.

Clearing User Data

Clearing the DRAM

All data in the DRAM is cleared by powering the instrument off.

Clearing the Flash ROM

The user data can be cleared from the Flash ROM by:

1 Reset the instrument to factory default.

   a Send the command:

   SYSTem:PRESet

   OR

   b Press the LAN Reset button on the front panel briefly (<1 s).

2 Clear the instrument log.

   a Send the special command

   DIAG:SYST:FLAS:LOGF:ERAS

   The contents of the log can be checked with the query READ:LOGF?.

3 Clear the Ethernet settings

   a Connect to the instrument by some means other than the LAN, using VISA Assistant (for example over USB). Send the command:

   SYSTem:COMMunicate:ETHernet:RESet

   OR

   b With the instrument connected over the LAN (the LAN LED is green), press and hold the LAN Reset button for more than 3s.

In either case, the instrument reboots.

Index

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