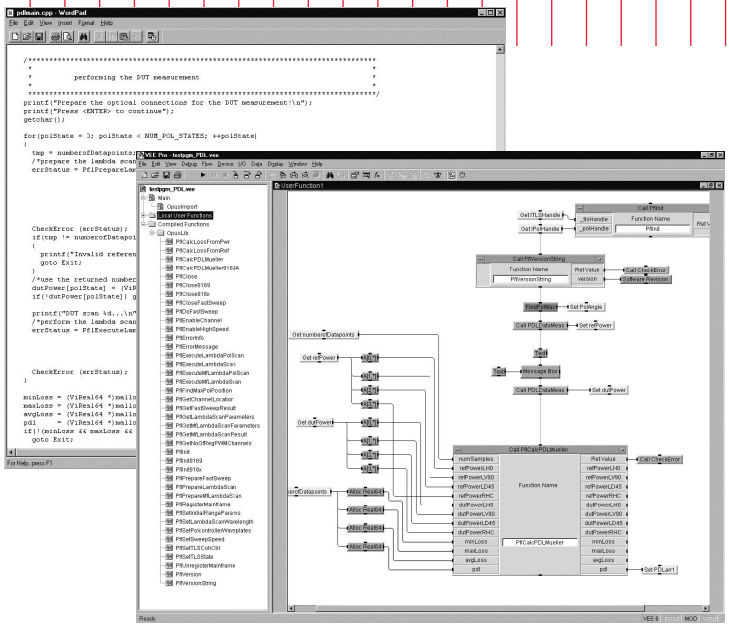
Keysight N4150A, N4151A
Photonic Foundation Library

Technical Specifications

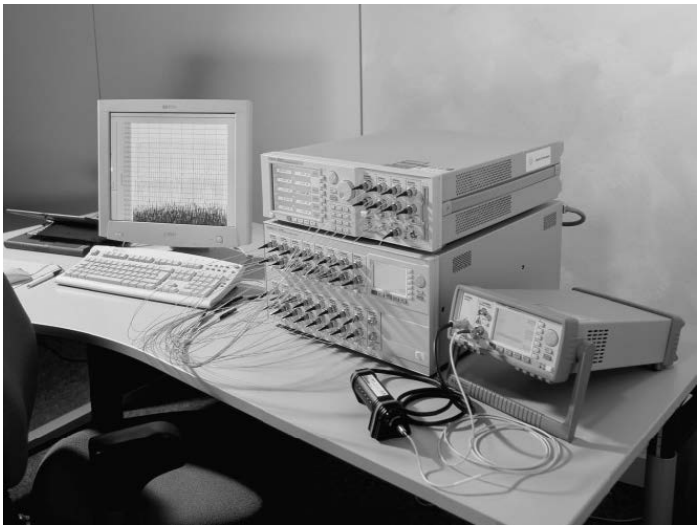
A More Efficient Way to Test Passive Optical Components



KEYSIGHT TECHNOLOGIES

Introduction

The Photonic Foundation Library from Keysight Technologies, Inc. is a comprehensive collection of today's most in demand measurement and analysis functions for the test of optical components. It is a software library that resides on a test station controller and is compatible with most test software environments. The Photonic Foundation Library makes it quick and easy to implement volumecapable test solutions; it optimizes the use of Keysight's Lightwave Measurement System for best accuracy and throughput.



Cutting Cost of Test per Device

Better profitability and manufacturing throughput are competitive advantages every component manufacturer is seeking. In many cases, test and measurement are in the critical path for increasing production capacities. The Photonic Foundation Library not only saves implementation time when setting up a test station, it also optimizes for shorter test and measurement times. Specifically designed to suit the speed, automation and reliability requirements of the manufacturing floor, it seamlessly integrates into the most common programming environments. More good devices in a shorter time is what can increase your profit margins, while your competitiveness benefits from narrower test margins.

Protecting Investment into Test Equipment

The Photonic Foundation Library enhances the way you operate your Lightwave Measurement System. With its built-in expert knowledge about Keysight's tunable laser and power meter modules, the Photonic Foundation Library ensures optimum measurement accuracy at maximum speed. Easy updateability and upgradeability ensure that your measurement solutions can evolve with changing needs and that future measurement standards and definitions are supported.

Choose and Set Up a Test Solution

The Keysight 8164A/B Lightwave Measurement System, together with the 8166A/B Lightwave Multichannel System, a whole range of tunable lasers, and the series 8162x and 8163x power heads and sensor modules, let you choose from a whole scale of solutions with outstanding performance, small footprint, and an excellent price-performance ratio. While the Keysight Photonic Foundation Library is a comprehensive collection of measurement and analysis functions for optical components, its easy-to-use programming interface makes it a simple task to set up even complicated measurement flows.

Turnkey Convenience Combined with Versatility

Evolving from the proven 816x VISA VXI*plug&play* Driver, the Photonic Foundation Library lets you quit studying instrument-specific control codes. Choose the desired function from a function tree in Keysight VEE, or call a well-structured function directly from C.

A set of programming examples provides a jump start even to novice programmers, getting them close to a solution within hours.

Expert measurement software designers will value the freedom of using Photonic Foundation Library routines and native VISA VXI*plug&play* driver functions from the same software application. The Photonic Foundation Library provides access to all levels, avoiding a closed, inflexible, 'black box' approach. The Photonic Foundation Library comes with a preview version of the Photonic Analysis Toolbox, an executable measurement application. The Photonic Analysis Toolbox utilizes and demonstrates the measurement and analysis capabilities of the Photonic Foundation Library.

Improve Over Off-the-Shelf Accuracy

The Photonic Foundation Library includes easy-to-understand measurement routines to acquire the insertion loss and its polarization dependence over wavelength of arbitrary passive optical devices with multiple output ports. Both the polarization dependent portion, and the non-polarized portion, of the insertion loss are extracted using the Mueller method. Proprietary methods are used to improve the Lighwave Measurement System's measurement accuracy at speed, making sure that it gets close to the static performance.

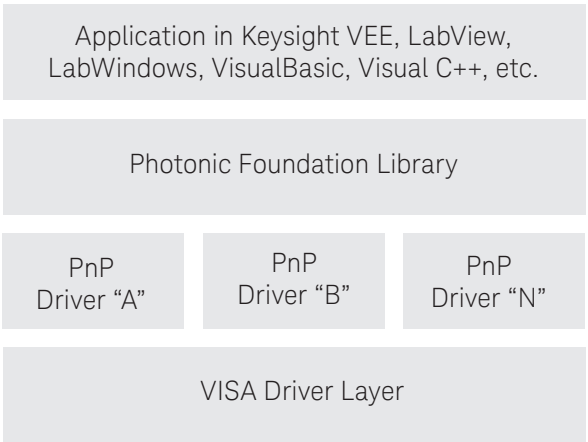


Figure 1: Software layer model

Automated Alignment and Adjustment

A real-time operating mode allows the tunable laser and one or more power sensors to generate a live update of a changing filter curve: a precise tool for the manual or automated adjustment of a device's wavelength performance.

Data Processing Functions

Among the routines for post-processing the acquired data, are functions that determine the bandwidth of a band pass or notch filter, and various methods for determining their center wavelength, following the most popular definitions and measurement standards. Similarly, the crosstalk can be determined for multiplechannel devices.

Built-in error handling, automatic parameter checking, and the online help function, lead to success earlier and help to avoid programming mistakes.

System Specifications

The following pages illustrate the measurement performance achievable with the Photonic Foundation Library and the Lightwave Measurement System. According to our strict understanding of quality, those statements are made with respect to specific test configurations. Should you intend to use hardware or software different from the specified configuration, we recommend you contact our sales organization. Please refer to the last page of this document for contact information.

System specifications describe the test system's typical, non-warranted performance. System specifications apply only if each single instrument is calibrated and within specification. The instruments and software products mentioned in this document are designed and produced to ISO 9001 international quality system standard as part of Keysight's commitment to continually increasing customer satisfaction through improved quality control.

For further details on specifications, see the Definition of Terms in the product's user's guide.

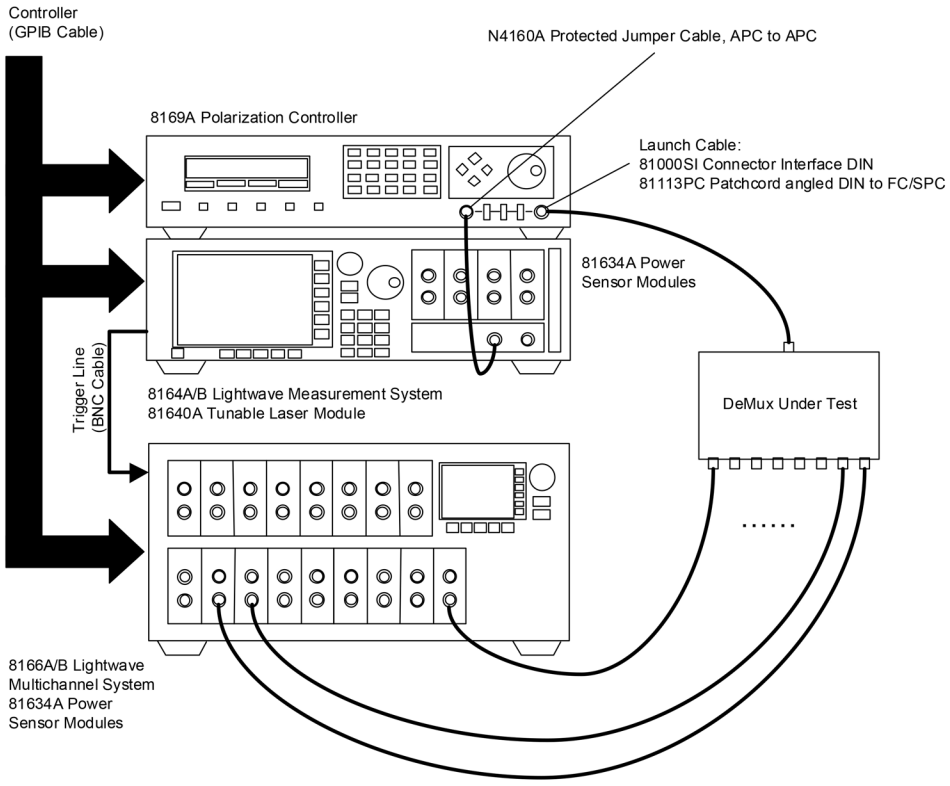


Figure 2: DeMux test setup

Photonic Foundation Library, Release 1.x

Configuration for Measurement of Insertion Loss and Polarization Dependent Loss

The specifications given in this section are valid after warm-up, at the stated operating conditions and measurement settings, at uninterrupted line voltage, and after following the wavelength calibration and adjustment procedure and the insertion loss reference measurement described in the Supplementary Performance Characteristics.

	Technical Specificationa		
Required instruments and options	8164A/B Lightwave Measurement System (mainframe); 81640A Tunable Laser module, #072 angled connector interface; One or more 81634A or 81634B Power Sensor(s); 8166A/B Lightwave Multichannel System(s) (mainframe), as many as required; Launch cable (81113PC or comparable), standard single-mode fiber, max. length 2 m, connects directly to power meter (straight cleave or connector) for reference measurement, and to device under test for device measurement (splice or connector); 8169A Polarization Controller, #022 angled connector interface; N4160A Jumper Cable Kit, length 0.4 m, protected standard single-mode fiber, E-2108.6 angled connectors, required to connect tunable laser with polarization controller; Matching connector interfaces and adapters.		
Required test station controller and software	PC as test station controller, according to minimum system requirements; N4150A or N4151A Photonic Foundation Library, release 1.0 or later; Mainframe software release 2.57 or later; Module firmware release 2.62 or later (81640A: release 2.63 or later); 816x VISA VXI*plug&play* driver, release 2.91 or later; 8169A VISA VXI*plug&play* driver, release 1.31 or later.		
Wavelength range	1520 nm to 1620 nm		
Wavelength resolution	0.5 pm, 62.5 MHz at 1550 nm		
Absolute wavelength uncertainty (typ.) [1]	±3 pm		
Relative wavelength uncertainty (typ.) [1]	±2 pm		
Wavelength repeatability (typ.) [1]	±1 pm		
Insertion loss measurement range (typ.) [2]	≥75 dB (3 sweeps) ≥60 dB (2 sweeps) ≥35 dB (1 sweep)		
Operating conditions	ambient temperature 20°C to 30°C, constant ±1 K relative humidity <80%, non-condensing		
Warm-up time	1 hour		
	Insertion loss ≤10 dB PDL ≤0.25 dB_{pp}	**Insertion loss ≤35 dB PDL ≤0.25 dB_{pp}**	**Insertion loss ≤55 dB PDL ≤0.25 dB_{pp}**
Number of sweeps	1	2	3
Relative insertion loss uncertainty (typ.) [3, 4, 5]	±0.022 dB	±0.022 dB	±0.032 dB
Polarization dependent loss (PDL) uncertainty (typ.) device under test connected with fusion splices [3, 5]	±0.020 dB	±0.030 dB	±0.080 dB
Polarization dependent loss (PDL) uncertainty (typ.) device under test connected with physical connectors [3, 5]	±0.035 dB	±0.040 dB	±0.085 dB
Total measurement time (typ) [3, 6]	60 s (1 channel)	110 s (1 channel) 10 min (40 channels)	155 s (1 channel)

1. Wavelength range 1520-1540 nm; sweep speed ≤10 nm/s, step size = sweep speed x 0.1 ms or integer multiples; power meter range ≥-40 dBm
2. Source power set to -8.5 dBm; power meter zeroing prior to measurement.
3. Measurement settings as follows: 20 nm span; 2 pm step size; 5 or 10 nm/s sweep speed; coherence control off; individual reference measurement for each power meter channel prior to measurement. Source power set to -8.5 dBm. Valid where spectral response is flat within a range of ±50 pm.
4. For polarization dependent devices, the measurement result corresponds to the insertion loss for unpolarized light.
5. All optical patchcords and fibers fixed and settled for 3 minutes; launch cable connected directly to power meter.
6. With recommended system configuration, no other application running in parallel. Includes instrument initialization, measurement of device under test at four states of polarization, data acquisition and transmission. Reference measurements excluded.

Minimum System Configuration

Test station controller

Pentium III, min. 300 MHz (recommended: 800 MHz); min. 64 Mbyte RAM (recommended: 256 Mbyte); min. 30 Mbyte free hard disk space; Windows NT 4.0 SP 5; or Windows 2000 SP 1; Internet Explorer 4 or later, installed to display the online help system; GPIB card, VISA compliant; VISA, latest revision recommended.

License Server (N4151A only)

Windows NT 4.0 SP 5 Server installed.

Compatibility

Operating system

Windows NT 4.0 SP 5; Windows 2000 SP 1.
Please refer to the last page of this document for contact information on compatibility to other operating systems.

Programming interface

Keysight VEE, National Instruments
LabVIEW and LabWindows; C, C++, VisualBasic

VISA layer

Keysight, Hewlett-Packard, or National Instruments VISA

Measurement instruments

Mainframes

8164A/B Lightwave Measurement System, 8166A/B Lightwave Multichannel System, 8163A/B Lightwave Multimeter

Tunable lasers

81480A, 81640A, 81642A, 81680A, 81682A Tunable Laser modules

Power meters

Series 8162 Optical Power Heads; Series 8163 Optical Power Sensors

Polarization controller

8169A

Ordering Information

N4150A Photonic Foundation Library Single user license

One license per test station controller is required.

N4151A Photonic Foundation Library Server based license

Serves a specific number of users on the same network domain. Available for 20 users and more. License belongs to the unique hardware address of the server's Ethernet card.

Please note that an individual quote is required. Refer to the last page of this document for contact information.

Accessories

N4160A
Jumper Cable Kit

Recommended to connect the tunable laser to the polarization controller. Use this cable kit, if both instruments are equipped with angled connectors (options #022 and #072). Includes a 0.4 m protected fiber patchcord with two connector interfaces.

N4161A
Jumper Cable Kit

Recommended to connect the tunable laser to the polarization controller. Use this cable kit, if one of the two instruments is equipped with straight connectors (options #021 and #071). Includes a 0.4 m protected fiber patchcord with two connector interfaces.

Licensing

One license per test station controller is required. The license belongs to a unique hardware address (MAC, Media Access Code) associated with the test controller. If available, the MAC address of the test controller's Ethernet card is used. For your convenience we have created a tool that generates a so-called fingerprint for identification of your test station controller. This fingerprint is already precoded from and significantly shorter than the hardware address. This fingerprinting tool is included with the Photonic Foundation Library, or can be launched from **www.keysight.com/find/n4150a**.

Upon order, you will receive a CD-ROM with the latest product updates, the user's and programmer's guide, and your individual order number. When you install the PFL, a time-limited trial license is installed. Once you have your order number and fingerprint, you can receive a time unlimited license by registering online at **www.keysight.com/find/n4150a**.

Evaluation version

A 60-day evaluation version of the Photonic Foundation Library is included with the support CD-ROM (p/n 08164- 90BCx) that comes with every mainframe 8163A/B, 8164A/B, 8166A/B. Alternatively, an evaluation version is available to download from **www.keysight.com/find/n4150a**.

Supplementary Performance Characteristics

General

Wavelength calibration and adjustment procedure (see figure 3)
To comply with the technical specifications given in the previous section, the test setup must be calibrated against a wavecell (NIST SRM 2517 Acetylene 12C2H2) prior to measurement.
The measured wavelength deviation should be entered into the wavelengthOffset parameter of the relevant PFL functions.

Insertion loss reference measurement (see figure 4)
Prior to measurement, the reference power level is measured subsequently for each power meter channel by connecting the launch cable directly to the power meter. In the dB regime, the reference power level over wavelength is stored and subtracted from the result of the device measurement at each wavelength. This leads to a valid spectral loss measurement.

Real-time update mode

In real-time update mode, the tunable laser constantly sweeps over the desired wavelength span with a maximum sweep speed of 40 nm/s. A spectral loss measurement is acquired after each sweep and can be displayed.

The minimum wavelength resolution in the real-time mode depends on the trigger frequency (i.e. 4pm at 40nm/s, 1pm at 10nm/s, 0.5 at 5nm/s).

The achievable update rate is 1-2 updates per second (typ., at 100 points, 1 nm span, 1 sweep, sweep speed 40 nm/s, 1 or 2 power meter channels).

A demonstrator of the real-time update mode is included with the Photonic Foundation Library.

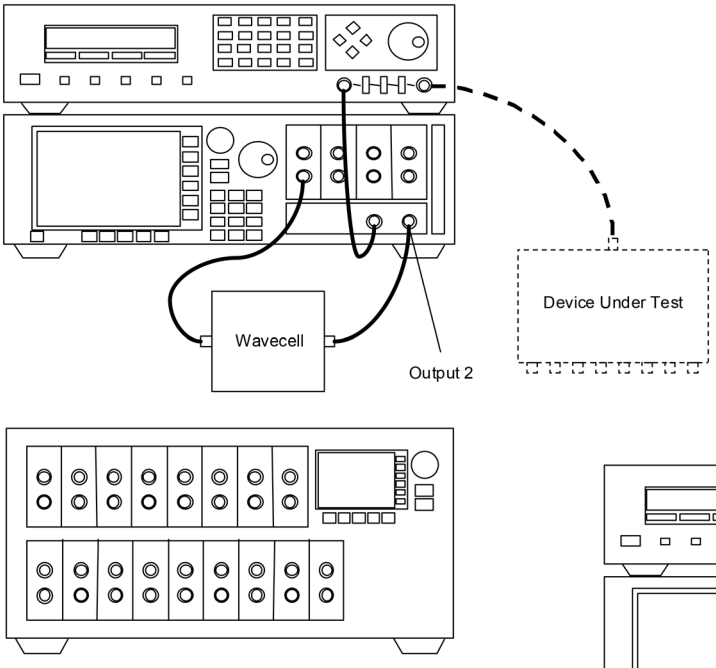


Figure 3: Wavelength calibration and adjustment

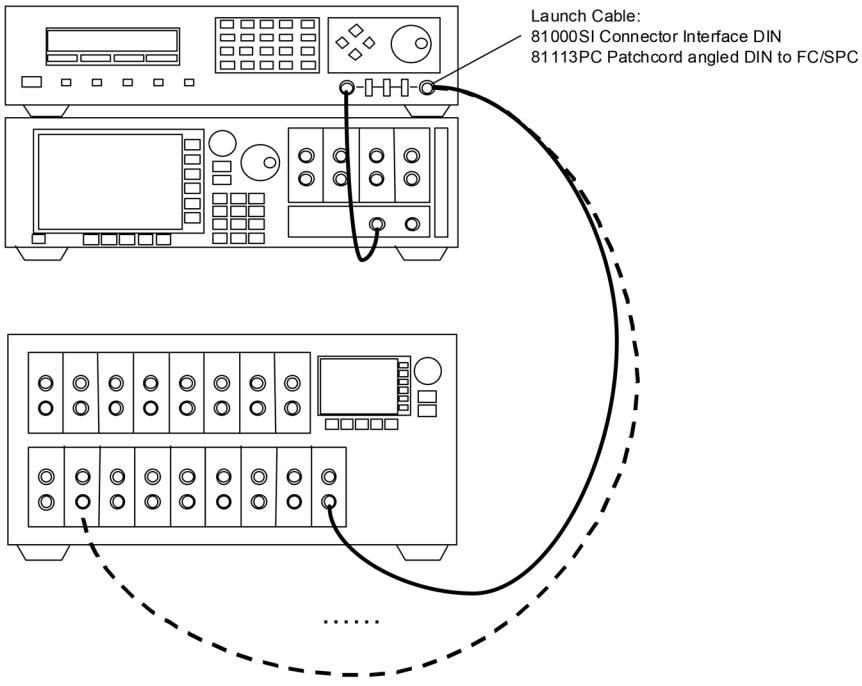


Figure 4: Insertion loss reference measurement

Related Keysight Literature:

Keysight 8163B Lightwave Multimeter
Keysight 8164B Lightwave Measurement System
Keysight 8166B Lightwave Multichannel System
Technical Specifications
p/n 5988-3924EN

8164A Optical Component Test,
Brochure
p/n 5988-1930EN

State of the art characterization of optical components
for DWDM applications,
Application Note
p/n 5980-1454E

Polarization dependent loss measurements of passive
optical components,
Application Note
p/n 5988-1232EN

PDL Measurements using the 8169A polarization controller,
Application Note
p/n 5964-9937E

Photonic Foundation Library: Enhancing Swept Loss
Measurements
Application Note
5988-3622EN

Photonic Foundation library: Creating Software for
Optical Component Tests
Getting Started Guide
5988-4100EN

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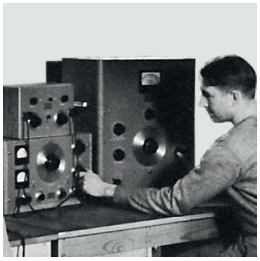

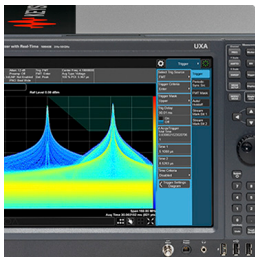

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