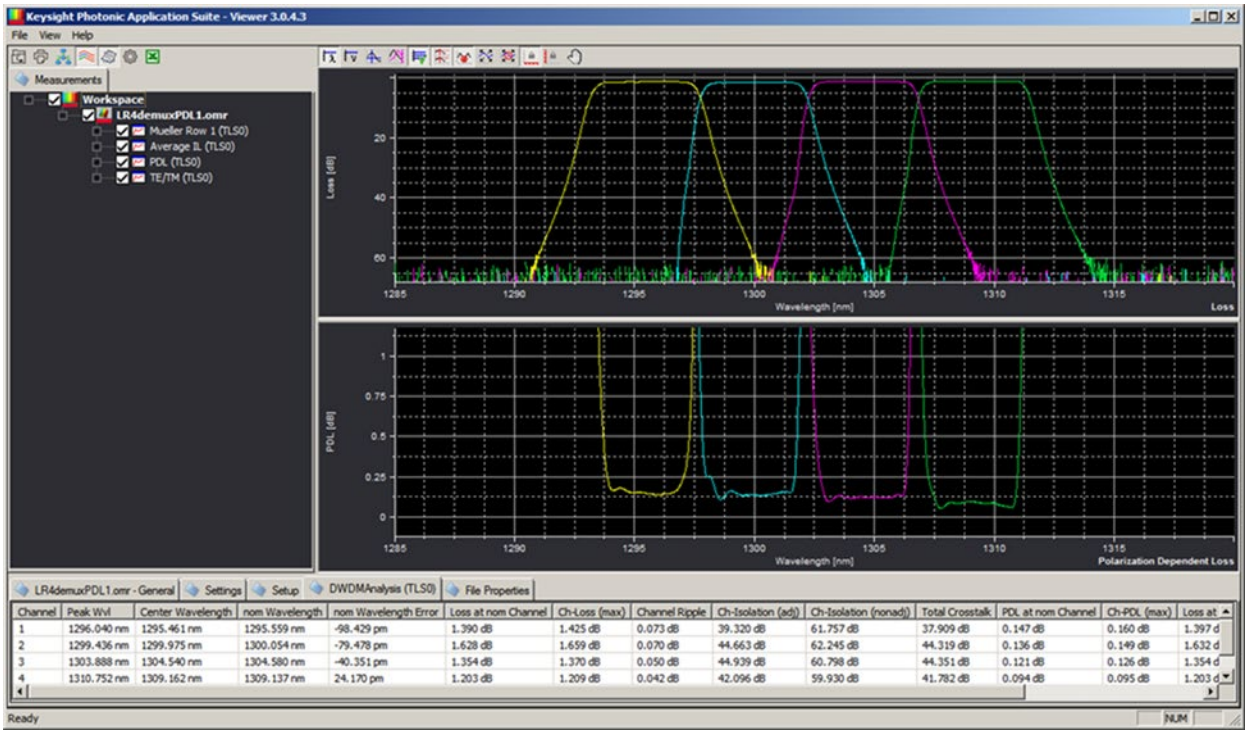
Photonic Application Suite

Lambda Scan Software for Tunable Laser Systems

New and Familiar Application Software

The Keysight Photonic Application Suite is a collection of advanced and basic software tools for automating optical measurements and analysis, especially for determining wavelength and polarization dependence of fiberoptic network components. The PAS Version 3 software adds support for the new N77-C generation of instruments, adopts a new 64-bit implementation and introduces the new Lambda Scan measurement package for enhanced performance and more flexible features. Automation in the same way as with predecessor N7700A PAS software makes updating existing installations easy and fast.



KEYSIGHT

Software packages

- Main Package: analyze results in a powerful viewer, save results in viewable format, installs Photonic Applications Package Manager.
- LS Engine: extends and merges IL/PDL, FSIL and PMD functionality for lambda scans without or with polarization control using the N7786C, N7786B, or N7788C. LS supports two-way sweeps, extended dynamic detection range, and switching of multiple lasers for wider wavelength range and use of optical power meters as well as source/measure units for photocurrent detection, with the M9601A/14A/15A PXI and B2900-series SMU. Now with more flexible step setting resolution! Both polarization-resolved and fixed-polarization sweeps can be made with the N7786C.
- IL Engine: measure insertion loss vs. wavelength with a tunable laser and supported power meters (no license required)
- Fast Spectral Loss Engine (FSIL, legacy): calibrate and adjust devices at repetition rates up to 10x faster than the IL engine using N774x power meters
- IL/PDL Engine (legacy): measure IL and PDL vs. wavelength using the N7786B with the advanced single-sweep Mueller method, also responsivity for integrated detector devices
- N7700 PAS TAP Plugin: easily automate LS and IL/PDL engines in Pathwave Test Automation (TAP) version 8.8.
- Polarization Navigator: use and control N778xB instruments (no license required)
- Drivers, firmware, documents, N77xx Viewer: keep equipment and guides up to date.

License products

- N7700100C Polarization Lambda Scan (PLS) for single-sweep multichannel measurement of polarization-dependent insertion loss and responsivity parameters using the LS engine with N7786C or N7786B or legacy IL/PDL engine with N7786B as well as FLS measurements without additional N7700102C license
- N7700101C DWDM Channel Analysis (DWDM) for determining specified DWDM passband parameters from the spectral measurements
- N7700102C Fast Lambda Scan (FLS) for multichannel measurement of spectral insertion loss or responsivity using the LS engine or the legacy FSIL engine
- N7700103C PMD for single-sweep measurement of differential group delay, polarization mode dispersion, PDL and IL over the wavelength range of one or more tunable lasers

Polarization Lambda Scan

The N7700100C PLS license is used for measurements of the device response to an input optical signal in dependence on wavelength and polarization. The response can be the optical insertion loss or attenuation when the device has optical output or responsivity when the device has integrated photodiodes and has electrical photocurrent output. Wavelength-dependent measurements at fixed polarization or without a polarization controller are also supported.

PLS supports two software engines for polarization-dependent measurements, either the LS engine when used with the N7786C or predecessor N7786B polarization synthesizer or the version 3 upgrade for the IL/PDL engine when used with the N7786B. The LS engine has added support for the multichannel M9614A and M9615A as well as the M9601A PXI SMU, and all N774-C power meters as well as optical power heads that are especially useful for open beam detection. For highest sensitivity, the N7747C and N7748C optical power meters are also supported.

The PLS measurement implements Keysight's advanced single-sweep Mueller Matrix method to measure polarization dependence by rapidly and repeatably switching the polarization to the device under test while the wavelength is scanned at a constant rate. This method obtains the data used to calculate a Mueller Matrix sample in a very short time, like 300 µs, so the measurement is very stable against fiber vibrations and temperature drift. The device under test can have one or multiple output ports that are all measured in parallel at the same time. Similarly, the optical signal can be split or switched to the input of multiple devices for higher throughput. **New with LS 3.4 version**: advanced normalization gives PDL reference data longer stability with **SOP Drift Compensation.**

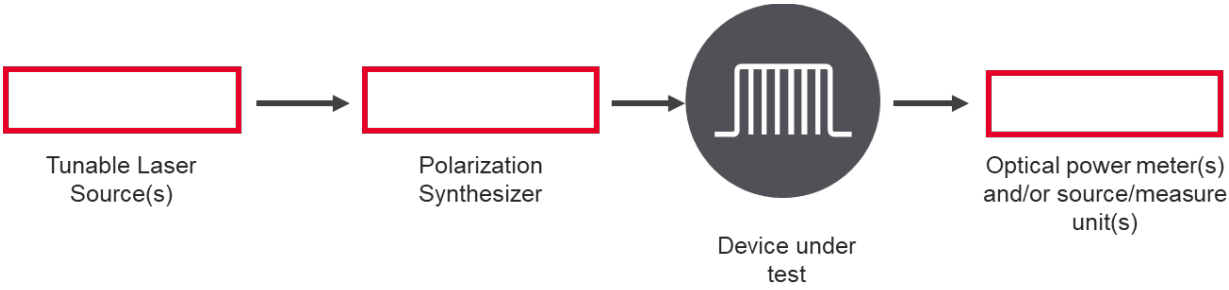


Figure 1. Basic configuration for PLS setup

PLS also supports using either the LS or FSIL engines for measurements without polarization controllers, instead of using the FLS license described below. In addition, the new triggering configurations of the N7786C allow the same hardware setup to be used for measurements with and without polarization dependence. This flexible triggering supports using the N7786C to align the polarization to the DUT, with the Static Mode function, and then running a swept measurement using this alignment. This functionality is provided by the LS engine.

New since the LS 3.2 version, extended dynamic range measurements are available by combining more than one power range of the detectors. Measurements both with or without polarization dependent can use this for extending the dynamic range of filter measurements beyond 70 dB or even 80 dB. And this version provides more flexible choice of step size and sweep speed to match resolution and results to the desired wavelength grid.

Optical Parameters Obtained with PLS include:

Optical to Optical Devices	Optical to Electrical Devices
• IL insertion loss vs. wavelength, dB • PDL polarization dependent loss, dB • TE/TM IL spectra for principal pol. axes • Mueller matrix elements (top row) • PER polarization extinction ratio for polarizers • RL polarization-averaged return loss	• Responsivity vs. wavelength, mA/mW • PDR polarization dependent resp., dB • TE/TM resp. spectra for principal pol axes • Mueller matrix elements (top row) • PER Polarization extinction ratio for polarizers • RL polarization-averaged return loss • CMRR common-mode rejection ratio for balanced detectors
Typical test devices • Wavelength selective switches, WSS • DWDM multiplexers, C-band, L-band • CWDM multiplexers, CWDM-4, CWDM-8 • LR multiplexers, LR4, LR8 • Thin film filters, TFF • Array waveguides, AWG • Other passive optical components • Photonic wafers and chips, PIC	**Typical test devices** • Receiver optical subassemblies, ROSA • CWDM ROSA, CWDM-4, CWDM-8 • LR4 ROSA, LR4, LR8 • Integrated coherent receivers, ICR • Channel monitors, DWDM • Photonic wafers and chips, PIC

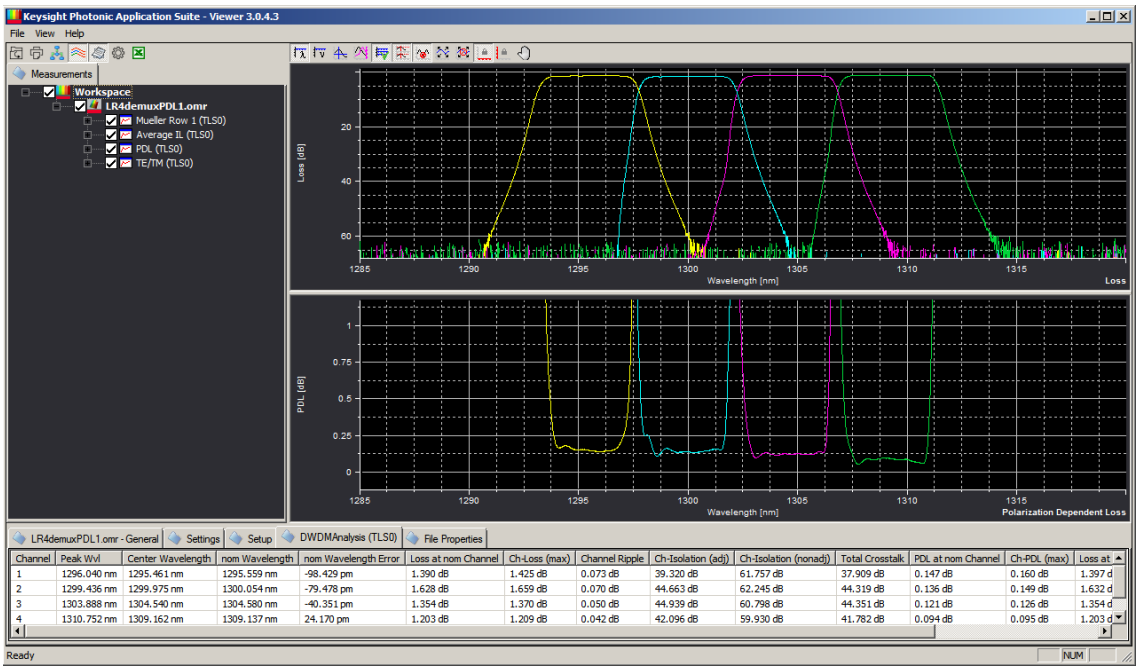


Figure 2. Example PDL measurement with channel analysis

PLS Instrumentation

The PLS uses an instrument configuration based on:

- One or more Keysight tunable lasers chosen to cover the desired wavelength range
- The N7786C polarization synthesizer (or the N7786B predecessor)
- One or more data acquisition detectors: optical power meters or photocurrent meters (SMU)
- Optional return loss module for polarization-averaged RL

Instruments Currently Supported by PLS

Tunable lasers (TLS)

- N7776C, N7778C, 81606A, 81607A, 81608A, 81602A
- Legacy: 81600B, 81960A, 81980A, 81940A, other slot-0 modules for 8164B or 8164A

Polarization synthesizers (N7700100C also support measurements without a synthesizer)

- N7786C or N7786B with LS engine, N7786B with IL/PDL engine

Optical power meters

- N7744C, N7745C, N7744A, N7745A
- N7742C, N7743C, N7749C, N7747C, N7748C, N7747A, N7748A (LS engine)
- 81636B
- 81623C, 81624C, 81626C, 81628C optical power heads (LS engine)
- 81623B, 81624B: trial support (81619A interface module required, not 81618A)

Source/Measurement Units or photocurrent meters

- M9601A, M9614A, M9615A PXI source/measure units (LS engine)
- B2901B, B2902B, B2911B, B2912B, B2901A, B2902A, B2911A, B2912A source/measure units
- B2901BL, B2911BL source/measure units (LS engine)
- N7745A-E02, special option with 4 optical power meters and 4 photocurrent inputs

Optical return loss module

- 81610A, 81613A

Optical switch for multiple-TLS configuration

- 81595B option 009
- N7731A option 009 (N7734A also possible but less appropriate)

Fast Lambda Scan

With the N7700102C FLS license, an automation algorithm is implemented for fast measurements with wavelength scans using either the LS engine or the legacy FSIL engine. Optimized use is made of instrument features including high sweep-speed, bidirectional-sweep measurements, wavelength logging and power meter dynamic range. With the FLS software, it is very easy to quickly start getting the best measurements with a Keysight tunable laser system. Sweep speeds up to 200 nm/s in both directions and sampling times as short as 1 µs provide fast measurements and resolution as fine as 0.1 pm. The software uses the real-time logged wavelength data from the laser to interpolate the measured samples to the chosen wavelength steps. The dynamic range over the sweep, which for example is important for determining the out-of-band isolation of optical filters, can be enhanced with the software support for making a double sweep with an additional power range setting. This is especially fast when combining the two-way sweep with the fast ranging of the N7742C, N7744C and N7745C. As an example, a C-band DWDM measurement takes less than 2 seconds to get more than 80 dB dynamic range.

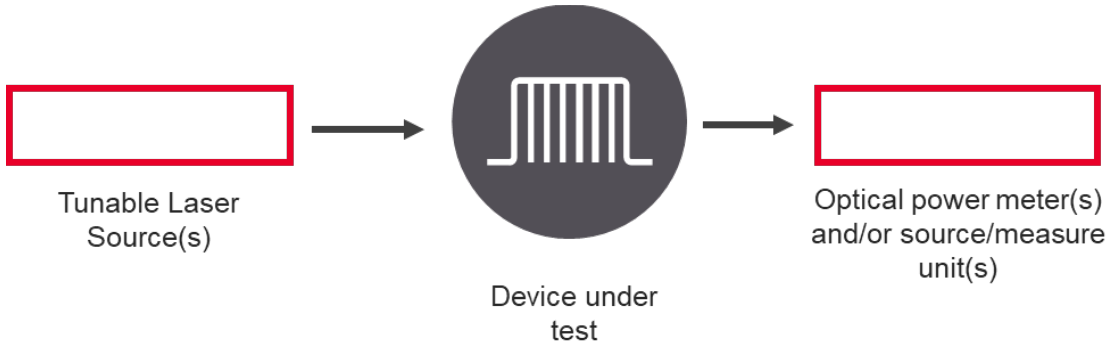


Figure 3. Basic configuration for FLS setup

The FLS license supports using the additional features of the LS engine. These include measurements with 2 or 3 tunable lasers for extended wavelength coverage and use of the SMU instruments for measuring the photocurrent output of O/E devices. Use of the return loss module is also supported.

Optical Parameters Obtained with FLS include:

Optical to Optical Devices

- IL insertion loss vs. wavelength, dB
- RL return loss

Typical test devices

- Wavelength selective switches, WSS
- DWDM multiplexers, C-band, L-bandCWDM multiplexers, CWDM-4, CWDM-8
- LR multiplexers, LR4, LR8
- Thin film filters, TFF
- Array waveguides, AWG
- Other passive optical components
- Photonic wafers and chips, PIC

Optical to Electrical Devices (using LS engine)

- R responsivity vs. wavelength, mA/mW
- RL return loss
- CMRR common-mode rejection ratio for balanced detectors

Typical test devices

- Receiver optical subassemblies, ROSA
- CWDM ROSA, CWDM-4, CWDM-8
- LR4 ROSA, LR4, LR8
- Integrated coherent receivers, ICR
- Channel monitors, DWDM
- Photonic wafers and chips, PIC

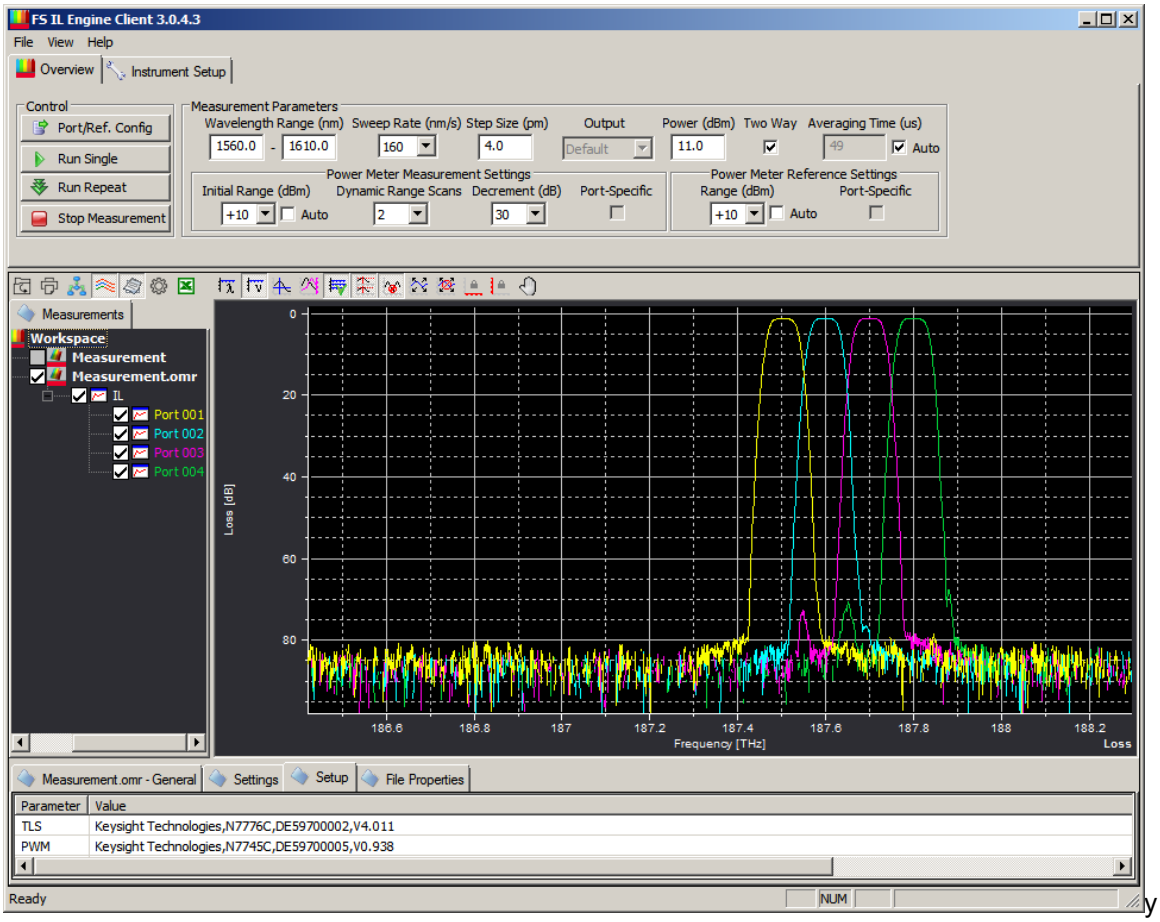


Figure 4. 50nm sweep with >80 dB dynamic range in under 2 seconds

FLS Instrumentation

The FLS uses an instrument configuration based on:

- one or more Keysight tunable lasers chosen to cover the desired wavelength range
- one or more data acquisition detectors: optical power meters or photocurrent meters
- optional return loss module for polarization-averaged RL

Instruments Supported by FLS

Tunable lasers (TLS)

- N7776C, N7778C, 81606A, 81607A, 81608A, 81602A
- Legacy: 81600B, 81960A, 81980A, 81940A, other slot-0 modules for 8164B or 8164A

Optical power meters

- N7744C, N7745C, N7744A, N7745A, N7747C, N7748C, N7747A, N7748A
- N7742C, N7743C, N7749C (LS engine)
- 81636B (LS engine)
- 81623C, 81624C, 81626C, 81628C optical power heads (LS engine)
- 81623B, 81624B trial support (with 81619A and LS engine)

Source/Measure Units or photocurrent meters (LS engine)

- M9601A, M9614A, M9615A PXI source/measure units
- B2901B, B2902B, B2911B, B2912B, B2901BL, B2911BL, B2901A, B2902A, B2911A, B2912A source/measure units
- N7745A-E02, special option with 4 optical power meters and 4 photocurrent inputs

Optical return loss module (LS engine)

- 81610A, 81613A

Optical switch for multiple-TLS configuration (LS engine)

- 81595B option 009
- N7731A option 009 (N7734A also possible but less appropriate)

DWDM Channel Analysis

With the N7700101C DWDM license, additional analysis measurements from passband filters and multiplexers is available. An analysis example is shown in Figure 2. This analysis is performed on IL and PDL spectra from the PAS engines to provide parameters including:

- Peak and center wavelength,
- Wavelength offset from ITU grid,
- IL at ITU wavelength and center wavelength,
- IL ripple,
- Bandwidth,
- Channel isolation from adjacent and non-adjacent channels,
- Total crosstalk,
- PDL at ITU wavelength and max. channel PDL.

PMD Lambda Scan

The N7700103C PMD license supports DGD and PMD measurements with the LS engine, using the N7788C and one or more tunable lasers. The fast spectral measurements use a single-sweep implementation of Jones Matrix eigenanalysis. Results also include insertion loss, polarization dependent loss and 2nd-order PMD. Since detection is done with the polarimeter of the N7788C, this provides a single-port measurement of IL and PDL vs. the multiport configurations using PLS setups. Measurements can be obtained from devices with length from chip-scale to long fiber spans, even including amplified test-bed spans.

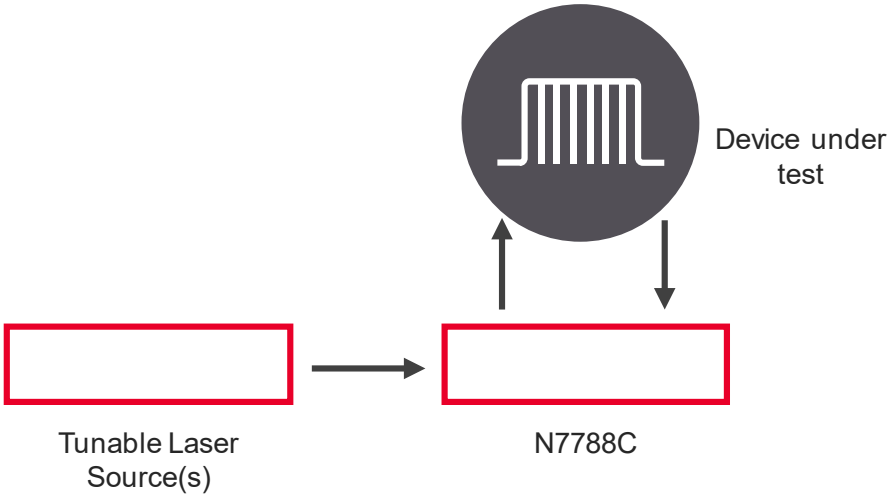


Figure 5. Basic configuration for PMD setup

Instruments Supported by PMD

Tunable lasers (TLS)

- N7776C, N7778C, 81606A, 81607A, 81608A, 81602A
- legacy: 81600B, 81960A, 81980A, 81940A, other slot-0 modules for 8164B or 8164A

Component Analyzer

- N7788C

Optical switch for multiple-TLS configuration

- 81595B option 009
- N7731A option 009 (N7734A also possible but less appropriate)

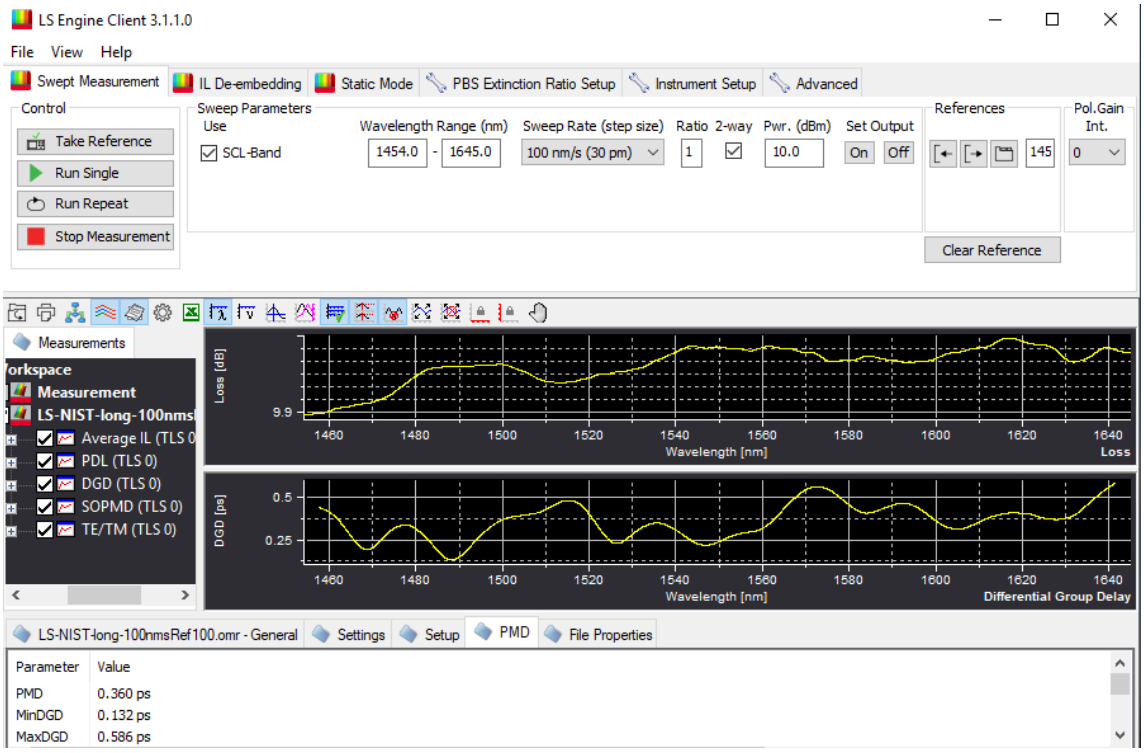


Figure 6. Example PMD measurement with the N7788C and N7776C

Measurement Features in Version 3.4

Key Features	LS Engine	IL/PDL Engine	FSIL Engine
Polarization dependence and alignment	N7786C, N7786B	N7786B	N
Polarization mode dispersion measurements	N7788C	N	N
Wavelength scans without a polarization instrument	Y	N	Y
Bidirectional sweeps	Y	N	Y
Power range stitching - extended dynamic range	Y	N	Y
Multi-TLS support	Y	Y	N
Optical/electrical test	Y	Y	N
PXI SMU Support M9601A, M9614A/15A	Y	N	N
High PER test	Y	Y	N
Return loss module	Y	Y	N

General Details

As with the predecessor N7700A software, a client GUI is provided to operate the measurements and inspect the data manually. The measurements can be saved in the same omr format for use with the File Viewer GUI that can be used on other computers, allowing measurements to be distributed for easy comparison between teams. For automation of the software engine, the engine server has a COM API compatible with programs developed for N7700A automation.

Ordering Information

Step 1. Choose your software product**.**

Step 2. Choose your license term: perpetual or subscription.

Step 3. Choose your license type: node-locked, transportable, USB portable, or floating.

Step 4. Depending on the license term, choose your support subscription duration.

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Products

- N7700100C Polarization-Lambdascan Measurement Software Package (PLS)
- N7700101C DWDM Channel Analysis Software Package (DWDM)
- N7700102C Fast Lambdascan Measurement Software Package (FLS)
- N7700103C PMD Lambdascan Measurement Software Package (PMD)