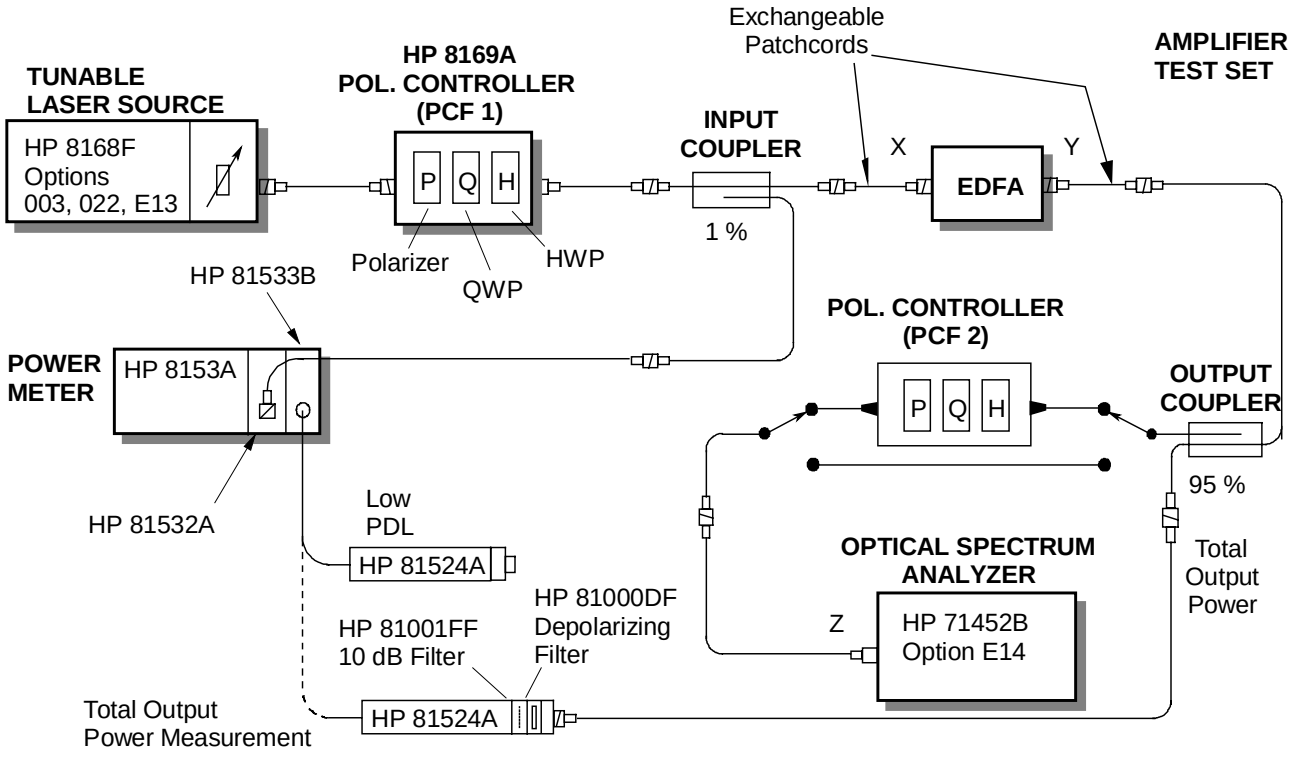
Testing Polarization Mode Dispersion and Polarization Dependent Gain of Erbium Doped Fiber Amplifiers

HP 81600 Series 200
Product Information

Option 110 of the HP 81600 EDFA test system automatically characterizes the polarization mode dispersion (PMD) and the polarization dependent gain (PDG) of erbium doped fiber amplifiers.



The Device

EDFAs are broadband optical amplifiers, which are increasingly replacing conventional optoelectronic regenerators. In high-speed data transmission they have to be designed for low polarization dependence to prevent a rise in the bit error rate.

Long links like undersea or transcontinental cables contain many EDFAs, this way multiplying their polarization dependencies. Therefore, EDFAs have to be characterized carefully for polarization mode dispersion (PMD) and polarization dependent gain (PDG).

The Measurement System

The HP 81600 series 200 is a fully automatic, turnkey EDFA test system for fast, easy and accurate device characterization. It includes the necessary test hardware, a controller and application software. Together with an HP 8169A polarization controller you can use the option 110 software to perform PMD/PDG measurements of EDFAs. If you have the booster version of the EDFA test system (option 003) you can perform these measurements without an additional polarization controller since two units are already integrated into the test system.

Measurement Procedure

The PMD measurement is achieved with a modified Stokes vector method. In this method, the first polarization controller is used to generate a number of input polarization states, all of which are located on an arbitrary great circle on the Poincare sphere. For each state, a small wavelength step is applied. Using the second polarization controller, the arc on the Poincare sphere, which is caused by changing the wavelength, is determined. The arc is known to vary sinusoidally with the input polarization state. The widest arc is the measure for the PMD:

$$\Delta\tau = \frac{\Delta\Theta_{max}}{2\pi\ \Delta\nu}$$

where $\Delta\tau$ is the PMD, $\Delta\theta_{max}$ is the widest arc and $\Delta\nu$ is the change of optical frequency.

The PDG is measured by using the Mueller-Matrix method. In this method a calibration is performed at the beginning of each measurement. Four dedicated polarization states (0° lin., 45° lin., 90° lin., circular) are set and the power without device-under-test (DUT) is measured. Then the EDFA is inserted and the power is measured again. This delivers the first row of the Mueller-Matrix from which the PDG can be calculated.

Specifications

In addition to the specifications of the standard HP 81600 EDFA test system the following also apply. All specifications are only valid at a constant temperature.

Polarization Mode Dispersion	
Measurement range	0.05 to 10 ps
Resolution	0.001 ps
Repeatability	± 0.02 ps (typ.)
Uncertainty	± 0.1 ps for PMD < 0.5 ps ± 0.4 ps for PMD < 2 ps ± 3.0ps for PMD < 10 ps
Wavelength range [1]	1538 to 1557 nm for PMD 0.05 to 0.1 ps 1532 to 1563 nm for PMD 0.1 to 0.5 ps 1525 to 1570 for PMD 0.5 to 10 ps
Input power at DUT	- 10 to 0 dBm [2]
Measurement speed per wavelength	3 minutes (typ.)

Polarization Dependent Gain (PDG)	
Measurement range	0 to 3 dB
Resolution	0.001 dB
Repeatability	± 0.02 dB (typ.)
Uncertainty [3]	± 0.05 dB
Wavelength range	1525 to 1570 nm
Input power at DUT	- 10 to 0 dBm [2] - 10 to + 10 dBm [4]
Measurement speed Per wavelength Per power level	 10 s (typ.) 5 s (typ.)

Notes:
[1] Depends on DUT's gain in the border areas.
[2] Max. power depends on hardware.
[3] Only valid if the ratio signal-power to total-ASE-power is larger than 17 dB at DUT output.
[4] With booster option.

Related HP Literature

Testing Gain and Noise Figure of Erbium Doped Fiber Amplifiers for DWDM Applications, p/n 5967-5965E.

Automatic Test System for Erbium Doped Fiber Amplifiers, p/n 5967-5983E.

Testing Erbium Doped Fiber Amplifiers for High Power Applications, p/n 5968-1142E.

Dynamic Gain and Noise Figure Measurement of Erbium Doped Fiber Amplifiers, p/n 5968-1143E

Literature

J. Dupre, "Characterization of optical components for D-WDM applications", NIST Symposium on Optical Fiber Measurements Oct. 96.

For more information about Hewlett-Packard test and measurement products, applications, services, and for a current sales office listing, visit our web site, http://www.hp.com/go/tmdir. You can also contact one of the following centers and ask for a test and measurement sales representative.

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