Agilent 8169A
Polarization Controller

Technical Specifications
December 2004

Agilent's 8169A Polarization controller enables automatic polarization state adjustments for measurements of polarization dependent loss (PDL) and polarization mode dispersion (PMD), and for polarization synthesis applications.

Agilent Technologies

Introduction

Developing and manufacturing competitive, high-value components and systems for today's optical industries require precise attention to polarization sensitivity. The Agilent 8169A Polarization Controller can help by saving time, money and effort when measuring and working with polarization sensitive devices.

Polarization sensitive devices include EDFAs, single-mode fiber, and polarization maintaining fiber, isolators, switches, lasers, couplers, modulators, interferometers, retardation plates and polarizers. Device performance will be affected by polarization dependent efficiency, loss, gain and polarization mode dispersion.

These polarization phenomena enhance or degrade performance depending on the application area, whether it is communications, sensors, optical computing or material analysis.

An Important Part of a Measurement System

A polarization controller is an important building block of an optical test system because it enables the creation of all possible states of polarization. The polarized signal stimulates the test device while the measurement system receiver monitors the test device's responses to changing polarization.

Sometimes polarization must be adjusted without changing the optical power. At other times, polarization must be precisely synthesized to one state of polarization (SOP) and then adjusted to another SOP according to a predetermined path. Each of these needs is met separately using the Agilent 8169A Polarization Controllers (refer to Table 1 for application details).

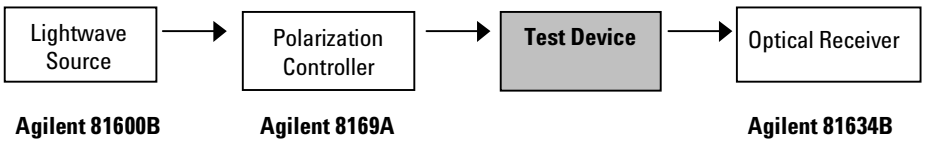

Figure 1: Conceptual block diagram of polarization measurements.

The Agilent 8169A Polarization Controller

The Agilent 8169A provides polarization synthesis relative to a built-in linear polarizer. The quarter-wave plate and half-wave plate are individually adjusted to create all possible states of polarization. Pre-deterministic algorithms within the Agilent 8169A enable the transition path from one state of polarization on the Poincare[1] sphere to another to be specified along orthogonal great circles. These features are important because device response data can be correlated to specific states of polarization input to the test device.

PDL measurement of DWDM components using Mueller method is one of the main applications. The Mueller method stimulates the test path with four precisely known states. Precise measurement of the corresponding output intensities allows calculation of the upper row of the Mueller matrix, from which PDL is in turn calculated. This method is fast, and ideal for swept wavelength testing of PDL.

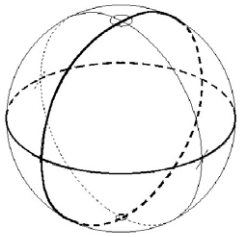

Figure 2: Orthogonal circles on the Poincare sphere[1] show how the Agilent 8169A synthesizes relative state-of-polarization points according to a specified path.

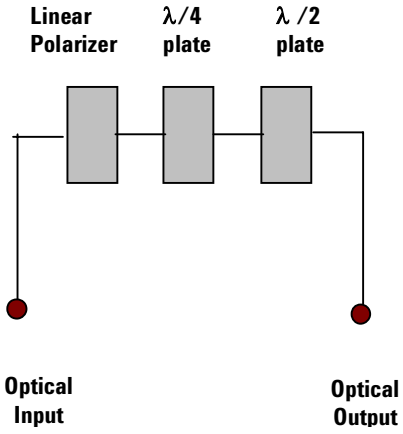

Figure 3: Agilent 8169A block diagram

[1]The Poincare Sphere is a three-dimensional graphing system for viewing all possible states of polarization.

To Match Your Application Requirements

Ease of Use, Flexibility and Speed

Four adjustment techniques enhance the ease of use, flexibility and speed of the Agilent 8169A.

- Precise manual adjustments are made while watching the front-panel display and adjusting the front panel knobs.
- Nine Save/Recall registers enable random and rapid SOP hopping between nine different, user-set states of polarization.
- Autoscanning continuously sweeps over all states of polarization, tuning the SOP across the entire Poincare sphere. Multiple polarization scan rates are available to match the speed of the application; be it a five-second, single-wave PDL measurement or a three-minute, wavelength-scanning PDL measurement.
- Autoscanning rates are also fast enough to produce polarization scrambling for some applications.

Remote interrogation of all instrument settings and remote control of all adjustment procedures are provided via GPIB.

General-Purpose Polarization Controller For a Wide Range of Applications

The Agilent 8169A Polarization Controller offers general-purpose performance for a variety of applications:

- Polarization synthesis
- Complete and automatically stepped adjustments of polarization over the entire Poincare sphere
- Swept wavelength polarization-dependent loss measurement (Mueller method)
- Fixed-wavelength “min-max” PDL measurements
- Polarization-dependent gain measurements for EDFA
- Polarization sensitivity measurements
- Optical waveguide TE/TM mode testing
- Polarization adjustment of optical launch conditions for polarization mode dispersion measurements

Measurement systems are created by combining the Agilent 8169A with other Agilent instruments.

Specifications

Specifications describe the instruments' warranted performance over the 0° C to + 55° C temperature range after a one-hour warm-up period. Characteristics provide information about non-warranted instrument performance. Specifications are given in normal type. Characteristics are stated in italicized type. Spliced fiber pigtail interfaces are assumed for all cases except where stated otherwise.

Description	**Agilent 8169A**
Operating Wavelength Range	1400 nm to 1640 nm
Insertion loss [1, 2] Variation over 1 full rotation Variation over complete wavelength range	< 1.5 dB $\leq \pm$ 0.03dB [2] $\leq \pm$ 0.1 dB
Polarization Extinction Ratio [3] Characteristic	> 45 dB (1530 nm to 1560 nm) > 40dB (1470 nm to 1570 nm) > 30dB (1400 nm to 1640 nm)
Polarization Adjustment Resolution [3] Fast axis alignment accuracy at home position [4,5] Angular adjustment accuracy: minimum step size Greater than minimum step size [4] Settling time (characteristic) Memory Save /recall registers Angular repeatability after Save/Recall [4,5] Number of scan rate settings Maximum rotation rate [5]	 0.18º (360/2048 encoder positions) $\pm$ 0.2º $\pm$ 0.09º $\leq \pm$ 0.5º < 200 ms 9 $\pm$ 0.09º 2 3600 /sec
Maximum Operating Power Limitation	+ 23 dBm
Operating Port Return Loss (characteristic): Individual reflections	 > 60 dB
Power requirements	48 Hz to 60 Hz, 100/120/220/240 V rms 45 VA max
Weight:	9 kg (20 lbs)
Dimensions: (H x W x D)	10 cm x 42.6 cm x 44.5 cm (3.9 in 16.8 in x 17.5 in)

[1] Guaranteed over a wavelength range from 1470 nm to 1570 nm; characteristic for a wavelength range from 1400 nm to 1640 nm
[2] Only with 8169A #020 option
[3] Extinction ration only refers to polarized portion of the optical signal
[4] Guaranteed by design (DAC resolution)
[5] Angles are mechanical rotation angles of the wave plates

Ordering Information

Agilent 8169A Lightwave Polarization Controller

Connector Options (One of the following is required)

8169A #020	Pigtailed fiber ports
8169A #021	Straight contact connectors [1]
8169A #022	Angled contact connectors [1]

[1] Two Agilent 81000xl-series connector interfaces are required for options 021 and 022.

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