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Agilent 11896A and 8169A Polarization Controllers

Product Overview

Automatic polarization state adjustments for polarization-dependent loss measurements and polarization synthesis applications

Agilent 11896A: 980 nm and 1250 to 1640 nm
Agilent 8169A: 1400 to 1640 nm



Introduction

Developing and manufacturing competitive, high-value components and systems for today's optical industries require precise attention to polarization sensitivity. The Agilent 11896A and 8169A Polarization Controllers can help by saving time, money and effort when measuring and working with polarization sensitive devices.

Polarization sensitive devices include EDFAs, single-mode fiber, 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, be it 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 are met sep-arately using the Agilent 11896A or 8169A Polarization Controllers (refer to Table 1 for application details).

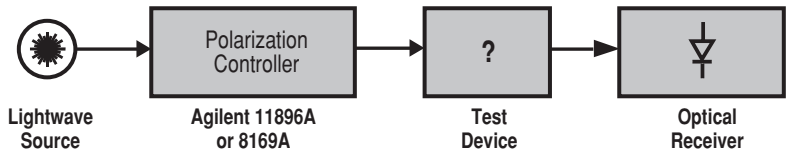


Figure 1. Conceptual block diagram of polarization controller applications.

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Two Types of Polarization Controllers...

The Agilent 11896A Polarization Controller

Measure very low PDL of DWDM components

The Agilent 11896A motorized polarization controller adjusts polarization and not power. It's optical fiber loop design provides all states of polarization with extremely small optical insertion-loss variations (±0.002 dB) over a wide spectral range (980 nm and 1250 to 1640 nm.) This performance combination maximizes measurement accuracy for power sensitive applications, such as polarization-dependent loss and gain, because the measurement uncertainty contributed by the polarization controller is minimized. The 11896A provides fast measurements of DWDM components with a rotation rate of 360° in <0.5 seconds.

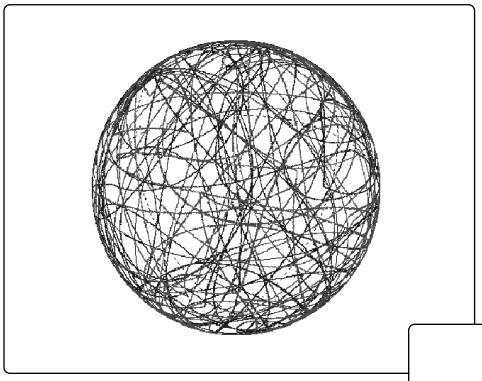


Figure 2. The Agilent 11896A produces all states of polarization and covers the entire Poincare sphere[1] in a pseudo-random manner.

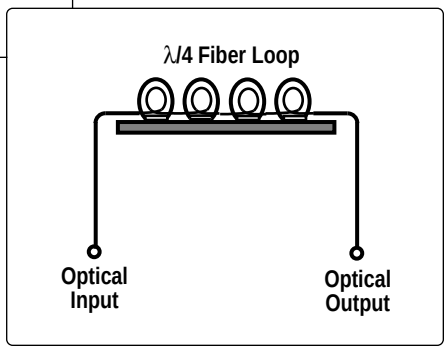


Figure 3. Agilent 11896A Block Diagram

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. Predeterministic algorithms within the Agilent 8169A enable the transition path from one state of polarization on the Poincare 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.

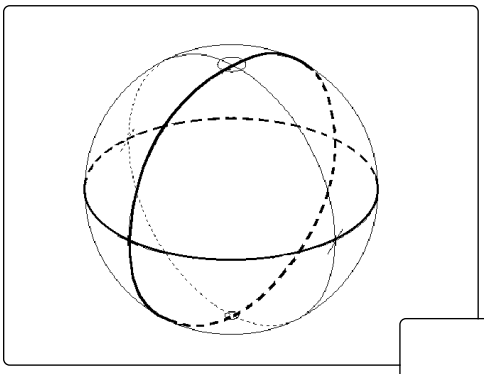


Figure 4. Orthogonal great circles on the Poincare sphere[1] show how the Agilent 8169A synthesizes relative state-of-polarization points according to a specified path.

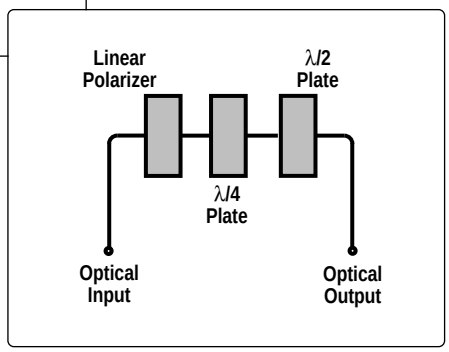


Figure 5. Agilent 8169A Block Diagram

PDL measurement of DWDM components using Mueller method is one of the main applications. The Mueller method stimulates the test path with four precicely 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.

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[1] The Poincare sphere is a three dimensional graphing system for viewing all possible states of polarization. Poincare sphere display is provided by Agilent 8509A/B Lightwave Polarization Analyzer.

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...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 11896A and 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 freeing the user from the tiring, mundane task of manually tuning 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 Controllers For a Wide Range of Applications

The combined capabilities of the Agilent 11896A and 8169A Polarization Controllers offer general-purpose performance for a variety of applications summarized in Table 1. Measurement systems are created by combining the Agilent 11896A and 8169A with other Agilent instruments as indicated in Table 1; namely:

- Agilent 8153A Lightwave Multimeter with Optical Head
- Agilent 71450B, 71451B or 71452B Optical Spectrum Analyzer
- Agilent 8509B Lightwave Polarization Analyzer.

Table 1. Application matrix for Agilent 11896A and 8169A Polarization Controllers

Application Description	Agilent 11896A Application	Agilent 8169A Application
1. Polarization adjustments (manual or automatic) with extemely small power variations	Yes	No
2. Polarization synthesis	No	Yes
3. Complete, automatically stepped, adjustments of polarization over the entire Poincare sphere	Yes (pseudo-random)	Yes (deterministic)
4. Single-wavelength polarization-dependent loss measurement	Yes[1]	Yes
5. Swept-wavelength polarization-dependent loss measurement	Yes	Yes
6. Polarization-dependent gain measurements of EDFA	Yes[1]	Yes
7. Polarization nulling for EDFA characterization	No	Yes
8. Polarization sensitivity measurements of optical coupling factor	Yes (total power delta)	Yes (power delta vs SOP)
9. Optical waveguide TE/TM mode testing	Yes	Yes
10. Polarized beam alignment relative to principal polarization states of the test device	Yes	Yes
11. Polarization adjustment of optical launch conditions for polarization mode dispersion measurements	Yes	Yes
12. Simulate depolarized signals using rapid polarization scanning	Yes	Yes

[1] The 11896A may be better suited for this application.

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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 11896A	Agilent 8169A
Operating Wavelength Range	980 nm and 1250 to 1640 nm	1400 to 1640 nm
Insertion Loss[1,3] Variation over 1 full rotation Variation over complete wavelength range	<1.5 dB ≤±0.002 dB[2] ≤±0.1 dB[1]	<1.5 dB ≤±0.03 dB[3] ≤±0.1 dB
Polarization Extinction Ratio[4] *Characterisitic*	>40 dB	>45 dB (1530 to 1560 nm) >40 dB (1470 to 1570 nm) *>30 dB (1400 to 1640 nm)*
Polarization Adjustment Resolution[4] Fast axis alignment accuracy at home position[5,6] Angular adjustment accuracy: minimum step size greater than minimum step size[5] *Settling time (characteristic)* Memory Save/Recall registers Angular repeatability after Save/Recall[5,6] Number of scan rate settings Maximum rotation rate[6]	 0.18° (180°/1000 encoder positions) ±0.18° ±0.18° ±0.18° *<1 sec* 9 ±0.18° 8 360°/sec	 0.18° (360°/2048 encoder positions) ±0.2° ±0.09° <±0.5° *<200 ms* 9 ±0.09° 2 3600°/sec
Operating Port Return Loss (characteristic): *Total reflection* *Individual reflections*	 *>55 dB*[4] *>60 dB*	 — *>60 dB*
Power Requirements	47 to 63 Hz 90 to 250 Vrms 60 VA max	48 to 60 Hz 100/120/220/240 Vrms 45 VA max
Weight:	4.5 kg (10 lb)	9 kg (20 lb)
Dimensions: (H x W x D)	10 x 21.3 x 36 cm 3.9 x 8.4 x 14.2 in	10 x 42.6 x 44.5 cm 3.9 x 16.8 x 17.5 in

[1] Guaranteed over a wavelength range from 1470 to 1570 nm; characteristic for a wavelength range from 1400 to 1640 nm.
[2] Wavelength range 1250 to 1600 nm with 11896A-025 option only.
[3] Only with 8169A-020 option.
[4] Extinction ratio only refers to polarized portion of the optical signal.
[5] Guaranteed by design (DAC resolution).
[6] Angles are mechanical rotation angles of the wave plates.

Ordering Information

Agilent 11896A Lightwave Polarization Controller

Optical Connectors (choose one)

81000AI	Diamond HMS-10 connector
81000FI	FC/PC/SPC connector
81000SI	DIN 47256/4108 connector
81000VI	ST connector

Accessories

11896A-025	One meter fiber extender with FC/PC connector interfaces
11896A-1CM	Rack mount kit
11896A-1CN	Front handles
11896A-1CP	Rack mount kit with handles
11896A-H98	980 nm wavelength operation (special order)

Agilent 8169A Lightwave Polarization Controller

Polarization controller must be ordered with a connector option.

8169A-020	Pigtailed fiber ports
8169A-021	Straight contact connectors[7]
8169A-022	Angled contact connectors[7]

[7] Two Agilent 81000xI-series connector interfaces required.

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