Warranted Specifications

The warranted specifications on the lightwave polarization analyzer are valid over the temperature range of 23°C ±5°C, with the instrument oriented upright on a horizontal surface and warmed up for at least one hour.

Polarization mode dispersion (PMD) specifications, JME method

The Jones matrix eigenanalysis (JME) method measures the differential group delay (DGD) of the test device as a function of wavelength. Average DGD (or PMD) is taken as the average of the DGD values across the wavelength range. The measurement requires a tunable wavelength, single-line laser source such as the Agilent 8168A Tunable Laser Source. The JME measurement is operational over the ranges of 1280 to 1340 nm and 1470 to 1640 nm, however, the DGD uncertainty specification is warranted over the wavelength range of 1540 to 1560 nm.

Table 9-2. Maximum Measurable DGD Using JME Delay

Maximum Measurable DGD Using JME Method[a]		
Wavelength Step	**1310 nm**	**1550 nm**
0.01 nm	280 ps	400 ps
0.10 nm	28 ps	40 ps
1.0 nm	2.8 ps	4 ps
10.0 nm	0.28 ps	0.4 ps

a. Maximum measurable PMD delay = π / radian optical frequency interval.

Table 9-3. PMD Measurement Uncertainty Using the JME Method

PMD Measurement Uncertainty [a,b,c,d]	
Wavelength Step	**Uncertainty (±)**
0.10 nm	310 fs
1.0 nm	90 fs
10.0 nm	60 fs

a. Receiver input level –20 to –40 dBm.
b. Does not include external laser tuning accuracy.
c. Measurement averaging set to 500 points.
d. PMD is the average value of DGD across the measurement wavelength range.

Characteristics

Jones matrix eigenanalysis PMD measurement

Table 9-4 shows the repeatability of a measurement of a 0.218 ps quartz PMD standard in which the fibers do not move between measurements.

Table 9-4. Repeatability of JME PMD Measurement with Fixed Pigtail Positions

Repeatability of JME PMD Measurement [a,b,c,d]	
Number of measurements	*20 measurements*
Expected value of DGD	*0.218 ± 0.010 ps* [e]
Mean	*0.2173525 ps*
Standard deviation	*0.0000085 ps*
Maximum - minimum	*0.00003 ps*
Maximum	*0.21737 ps*
Minimum	*0.21734 ps*

a. Test device is a pigtailed quartz PMD standard, under development.
b. Measurement wavelength range of 1500 to 1560 nm.
c. Measurement wavelength interval of 10 nm.
d. No movement of test device or pigtails between measurements.
e. The ± 0.010 ps tolerance is provided to allow for the effects of pigtails and packaging.

Table 9-5 shows the repeatability of 20 measurements of a pigtailed quartz PMD standard in which Pigtail positions are randomized before each measurement.

Table 9-5. Repeatability of JME PMD Measurement with Randomized Pigtail Positions

Repeatability of JME PMD Measurement [a,b,c,d]	
Number of measurements	*20 measurements*
Expected value of DGD	*0.218 ± 0.010 ps* [e]
Mean	*0.21821 ps*
Standard deviation	*0.00246 ps*
Maximum - minimum	*0.00787 ps*
Maximum	*0.22271 ps*
Minimum	*0.21484 ps*

a. Test device is a pigtailed quartz PMD standard, under development.
b. Measurement wavelength range of 1500 to 1560 nm.
c. Measurement wavelength interval of 10 nm.
d. Reposition pigtails randomly before each measurement.
e. The ± 0.010 ps tolerance is provided to allow for the effects of pigtails and packaging.

Wavelength scanning PMD measurement

Table 9-6 shows the minimum measurable PMD for the wavelength scanning method for two types of devices. Non-mode coupled devices include most components. Highly mode coupled devices include most long, single-mode optical fibers.

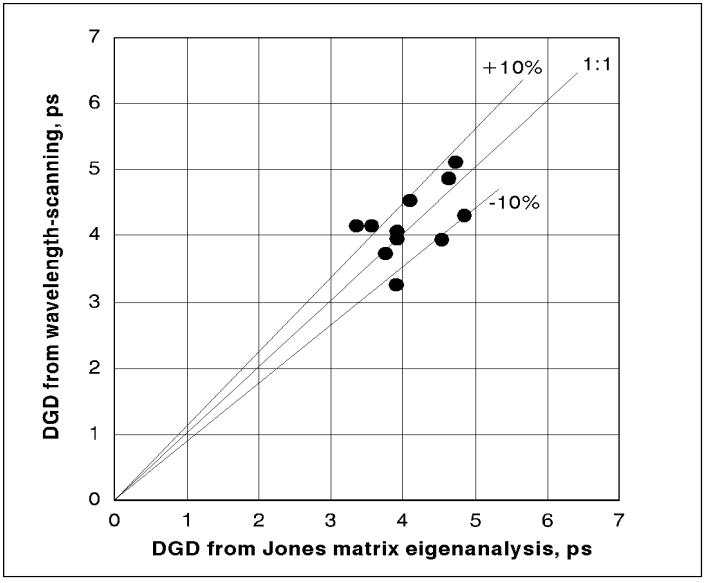
Table 9-6. Minimum Measurable PMD Using the Wavelength Scanning Method

Minimum Measurable PMD[a]	
Type of test device	**Minimum measurable PMD value**
non-mode-coupled devices [b] (most components)	*0.040 ps*
highly mode-coupled devices [c] (long fibers)	*0.195 ps*

a. Assumes 100 nm wavelength tuning range.
b. Assumes a single peak and a single valley.
c. Assumes an average of 3 cycles of polarization change (4 peaks).

Comparison of JME and wavelength scanning methods

The figure below is a comparison between the Jones matrix eigenanalysis and wavelength scanning measurement methods. Agilent 8509C JME and WS measurements agree to within approximately +15% for this test device.



pq7146_c

Comparison of JME and WS measurement methods for long optical fiber test

Comparison of JME and WS Measurement Methods for Long Optical Fiber Test

1. The test device was 14 km of loosely-spooled, dispersion-shifted fiber. Eleven measurements of each type were taken with random arrangements of the loose turns of the fiber.
2. Wavelength scanning responses typically exhibited 16 extrema (# of extrema = # of peaks + # of valleys).
3. Wavelength scanning measurements use mode coupling factor of 0.82.

Receiver characteristics

Table 9-7. Receiver Characteristics

Wavelength operating range [a]	*1280 to 1640 nm*
Input power operating range	*+10 to –55 dBm*
Input average power damage level	*+16 dBm*
Average power measurement uncertainty [b]	*±15%*
Degree of polarization measurement uncertainty [c,d,e]	*1280 to 1340 nm, ±2.0%* *1470 to 1580 nm, ±2.0%* *1580 to 1630 nm, ±3.0%* *1630 to 1640 nm, ±5.0%*
Poincare representation uncertainty [d,f,g,h]	*1200 to 1340 nm, ±1.5°* *1470 to 1640 nm, ±1.5°*
Measurement rate	*> 3500 per second*
Display update rate	*> 3500 per second*

a. The Agilent 8509C performs polarization measurements over this range. See individual measurement specifications or characteristics for details.
b. Does not include the effects of optical connectors.
c. Uncertainty introduced in defining an external reference frame in open beam applications is not included.
d. 500 point display averaging (running average).
e. Characteristic applies for 100% polarized light for the purpose of practical verification.
f. Characterized in degrees on the Poincare sphere.
g. For input light at least 98 percent polarized. Uncertainty increases as degree of polarization decreases.
h. For uncertainty in the angle between two displayed points, multiply by two.

Polarization dependence, Jones matrix method

Table 9-8. Measurement of Polarization Dependence Jones Matrix Method

Measurement of Polarization Dependence, Jones Matrix Method [a,b]	
Polarization dependence wavelength operating range	*1280 to 1340 nm* *1470 to 1620 nm*
Polarization dependence uncertainty [c,d,e]	*±0.1 dB*

a. Polarization dependence is the peak to peak variation in transmission of the device under test over all polarization states.
b. Specified with single-line laser source.
c. For measured values less than 3 dB, receiver input level > –20 dBm.
d. Does not include the effect of optical connectors.
e. Measurement averaging set to 500 points.

Polarization dependence, power max–min method

Table 9-9. Measurement of Polarization Dependence Power Max–Min Method

Measurement of Polarization Dependence Power Max - Min Method [a,b]	
Polarization dependence wavelength operating range	*1280 to 1340 nm* *1470 to 1620 nm*
Polarization dependence uncertainty [c,d,e]	*±0.1 dB*

a. Polarization dependence is the peak to peak variation in transmission of the device under test over all polarization states.
b. Specified with single-line laser source.
c. For measured values less than 3 dB, receiver input level > –20 dBm.
d. Does not include the effect of optical connectors.
e. Measurement averaging set to 500 points.

Other characteristics

Table 9-10. External Source Input Port, Fiber Size, and Analog Output Range Characteristics

Wavelength operating range	*1280 to 1640 nm*
Insertion loss [a]	*8.5 dB*
Return loss [b,c]	*35 dB*
Compatible fiber	*9/125 micron*
Analog output range	*±10 volts*

a. Internal path loss between EXTERNAL SOURCE INPUT and OPTICAL OUTPUT connectors with no polarizer selected.
b. Does not include the effects of optical connectors.
c. When optical output is connected with return loss of 30 dB or better.

Regulations and Licensing

Notice for Germany: Noise Declaration

Acoustic Noise Emission/Geraeuschemission	
LpA < 70 dB	LpA < 70 dB
Operator Position	am Arbeitsplatz
Normal Position	normaler Betrieb
per ISO 7779	nach DEN 45635 t. 19