APPLICATION NOTE ON POLARIZATION EXTINCTION RATIO (PER) MEASUREMENT

Polarization extinction ratio (PER), as specified in our product specification sheets, is measured with respect to the system's birefringence axis (i.e. the axis passing through the stress rods of a polarization maintaining (PM) fiber). This measurement is performed with a polarization analyzer while shifting the phase difference between the orthogonally polarized modes from 0^{o} to 360^{o}. This simultaneously identifies the orientation of the proper polarization axes of the component and measures the PER relative to these axes. Also note that this measurement is invariant with respect to the phase difference between the two orthogonally polarized modes. The measurement method is illustrated on Fig. 1[1].

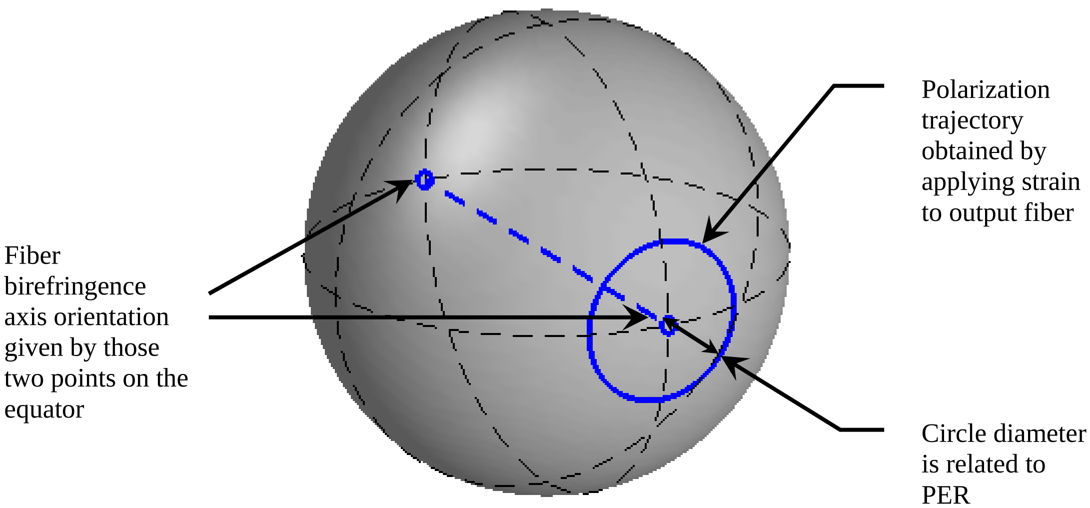

Figure 1: Illustration of the PER measurement method with the polarization analyzer on the Poincaré sphere. The input polarization state into the component is aligned with the PM fiber axis and has a high PER (~30dB). By varying the strain on the output fiber of a component (by applying heat), the polarization state goes through all possible phase differences between the two orthogonal proper polarizations of the system. This draws the blue circle on the Poincaré sphere. The diameter of the circle yields the PER with respect to the fiber axis. The two points linked with a dashed line, one of which is in the center of the polarization trajectory, represent the orientation of the two proper axes of the fiber.

The PER indicated on our product specification sheets are tested using this method. Other measurement methods involving a linear polarizer are to be carefully performed as optimization of the PER could yield misleading and varying results. Aligning the PER along the system's axes by use of a polarization analyzer or by aligning the output

[1] Dennis DERICKSON (Ed.), *Fiber Optic Test and Measurement*, Prentice Hall PTL, New Jersey, 1998, p. 220-244.

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polarizer in the direction that is as invariant as possible is mandatory for stable power output as shown on Fig. 2. As one can see, if an analyzer is used at the output but slightly misaligned with respect to the fiber axes, the “apparent” measured PER can vary considerably with varying phase between the modes and is usually worse than the stable “real” PER. If the analyzer is perfectly aligned with the fiber axis, the PER becomes invariant as the minimum and maximum values of “apparent” PER are equal and can be compared to the PER on our datasheets.

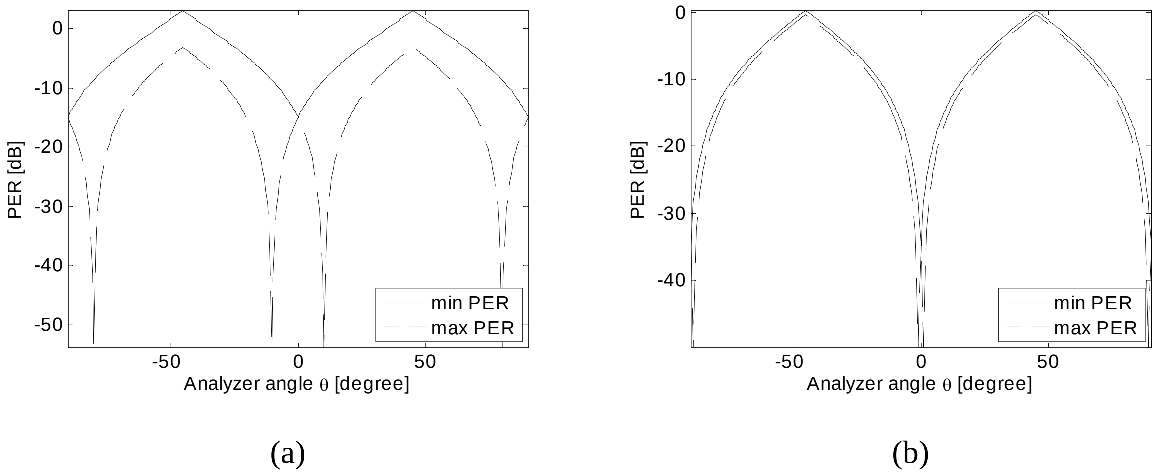

Figure 2 : Variation boundaries of the “apparent” measured PER as a function of analyzer misalignment with respect to the fiber axis. By varying the phase between the two polarized modes travelling in the slow and fast axis, the PER can vary anywhere between the full and dashed curves. (a) Example with an input PER of 15dB; (b) Example with an input PER of 35dB. As we can see, both the maximum and minimum values are equal when the analyzer is perfectly aligned with the fiber axis ($\theta = 0$).

NOTE ON SYSTEM ALIGNMENT AND PER MEASUREMENT : In order to align the system and obtain a more stable PER, it is recommended to find the position of the analyzer axis for which the variation of transmitted power through the analyzer is as invariant as possible when strain is applied to the fiber (by heating it locally for example). This will ensure an optimal performance that will be as invariant as possible to perturbations and phase changes between the slow- and fast-axis modes.

Montréal, May 22, 2008