

## Polarization Stabilizers

### Q. What does a polarization stabilizer or tracker do?

**A.** The function of a polarization stabilizer or tracker is to find a target output state of polarization, and to maintain that SOP against variations in input polarization. A polarization stabilizer generally consists of a polarization controller, polarization monitor, and feedback circuit. It uses the polarization monitor and feedback circuit to detect how far the current SOP is from the target and direct the polarization controller to return it to the target state.

### Q. What is the difference between an internal feedback and an external feedback stabilizer?

**A.** An internal feedback stabilizer has an integrated polarization monitor, and the feedback circuit uses the information from the monitor to control the polarization controller. General Photonics' internal feedback stabilizers and trackers (POS-202, POS-002-I) have a PM output fiber and stabilize the output SOP to linear, aligned to the slow axis of the output PM fiber. This configuration is useful if the stabilizer is being used to align a signal to a PM fiber or simply to provide a linear SOP.

In an external feedback stabilizer, the polarization monitor is decoupled from the polarization controller. The user taps the signal at the point in the system at which the SOP needs to be maintained, and provides either an optical or electrical control signal to the stabilizer. The stabilizer then actively adjusts the polarization to maximize or minimize the control signal. This configuration requires more setup by the user, but is more flexible in that the control signal can be correlated to secondary polarization-related parameters such as output DOP in a PMD compensation system or interference signal strength when used for polarization matching in an interferometer. Also, the tap can be placed at any point in the system, allowing the stabilizer to be used to maintain the SOP at a point far from the location of the controller. One example of this is a laser amplifier system, in which a stabilizer placed between the laser and amplifier can be used to maintain the output polarization of the amplifier by placing the tap after the amplifier. The POS-002-E and POS-203 are examples of external feedback stabilizers. The POS-002-E accepts an electrical control signal, and tunes the polarization state to maximize that signal. The POS-203 can accept either an optical or electrical control signal, and can be set to either maximize or minimize the control signal.

### Q. What is the difference between SM and PM output stabilizers?

**A.** The effect of an SM output stabilizer can be seen directly in the polarization state of the output beam. With stabilization disabled, the stabilizer does not actively modify the SOP of the input beam; any polarization changes

to the input will be seen at the output. With stabilization enabled, the output polarization state will remain constant, regardless of changes to the input polarization.

The PM output stabilizer uses a polarizer to align the output to the slow axis of the output PM fiber. Therefore, the output polarization state is always constant (linear, aligned to the slow axis of the PM fiber), and any changes in polarization are translated into changes in output power. Therefore, the output power will fluctuate with changes in input polarization state while the stabilization is disabled, but will remain constant with stabilization enabled.

The internal feedback stabilizers (POS-002-I, POS-202) are PM output. The external feedback stabilizers (POS-002-E, POS-203) are SM at the controller output.

### Q. Does the stabilizer affect the DOP of the input light?

**A.** The POS-002-E or POS-203's main light path consists of a fiber-squeezer polarization controller. Its effect on DOP is negligible. This also means that it can only stabilize the polarized portion of the input light.

Because of its alignment polarizer, a PM output stabilizer's (POS-002-I or POS-202) output is fully polarized.

### Q. How do I use the tunable control parameters?

**A.** For internal feedback stabilizers, in general, the user does not have to adjust control parameters. For external feedback stabilizers, control parameters can be used to optimize the stabilizer response for particular systems. The principal control parameters are:

**Step size:** This controls the size of the voltage step applied to the polarization controller, and thus the size of the polarization change, during each control cycle. For highly variable signals, a larger step size can provide faster response, while for stable signals, a smaller step size can increase the stability of the output.

**Delay offset:** The user can insert a controllable delay offset between a polarization step and the next read of the control signal. This is useful if the response of the control signal circuit is slow or if the tap point for the feedback signal is far from the controller. Delay should be set such that the control signal circuit has time to respond to the polarization step before the next readout.

**Threshold:** The threshold controls the size of the tolerance for deviation from the target state before the stabilizer acts to correct the SOP. In general, the threshold should be set larger than the noise level of the control circuit.