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PolaRite™ Polarization Controllers

Introduction

General Photonics Corporation's Polarization Controllers use a mechanical fiber squeezer (shown in the following figures), which can be rotated about the fiber to convert an arbitrary input polarization to any desired output polarization. Tightening the knob on the fiber squeezer applies pressure to the fiber sandwiched between two pressure plates in the center portion of the device, producing a linear birefringence in this portion of the fiber with its slow axis in the direction of applied pressure. The retardation between the slow and fast axes can be varied between 0 and 2π by changing the applied pressure. In addition, the angle of the induced birefringent axes can be rotated over a range of 0 to more than $\pi/2$ by rotating the fiber squeezer about the fiber. In this way, an all-fiber Babinet-Soleil compensator is created.

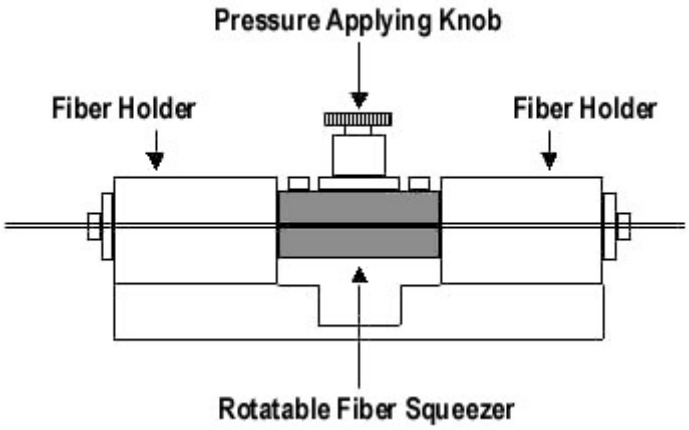


Figure 1 Diagram of manual polarization controller with functional parts labeled

Three fiber configurations are available for manual polarization controllers:

1. Configuration: Drop-in
   Models: PLC-003 (standard size), PLC-006 (miniature).
   Drop-in (in-line) polarization controllers do not have built-in fiber, but act on a segment of fiber inserted into the slot on the top of the device. These polarization controllers can therefore be inserted at any location in a fiber optic system to control the polarization state of light without disconnecting any part of the system or changing the optical path.
2. Configuration: Pigtailed
   Models: PLC-002 (standard size), PLC-M02 (miniature).
   Pigtailed polarization controllers have a length of specially coated fiber built into the device. External pigtails have 900μm loose tube for protection. These polarization controllers can be incorporated into a system either by fusion splicing or by using standard fiber optic connectors.

3. Configuration: NoTail
   Models: PLC-004 (female connectors), PLC-005 (male connectors).
   NoTail polarization controllers come with a connector terminated length of specially coated fiber built into the device. Because there are no external fiber pigtails, the NoTail polarization controllers are extremely temperature-stable and durable.

Setup

Drop-in Polarization Controllers (PLC-003/PLC-006):

Caution: There are four (4) screws on the center cap of PLC-003/006 devices, as shown in the drawings below. The two larger (2-56) screws hold the center cap in place and may be removed for fiber placement. The two small (0-80) screws hold in place an internal pressure plate within the cap. *DO NOT TIGHTEN OR LOOSEN THESE TWO SMALL SCREWS UNDER ANY CIRCUMSTANCES.* They are tuned at the factory for optimum performance, and any adjustment may adversely affect the performance of the controller.

For drop-in polarization controllers, setup consists of placing the segment of fiber in which the polarization is to be controlled into the polarization controller. The process is illustrated below.

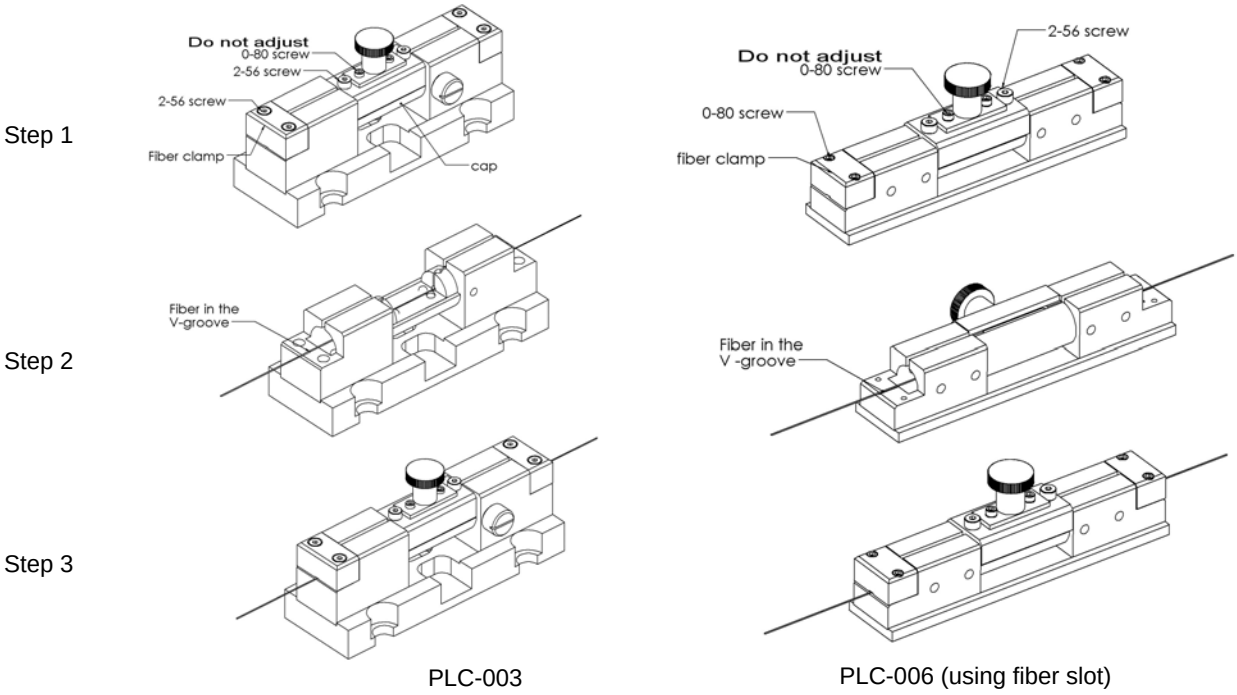


Figure 2 Fiber placement in drop-in polarization controllers

Step 1 Remove the two fiber clamps on the left and right ends of the device.
The fiber clamps may be held in place by screws or magnets.

Model	Screw type
PLC-003-S-25 or S-90	2-56 hex screws
PLC-003-M-25	Magnet clamp- no screws
PLC-006-S-25	0-80 hex screws

Step 2 Expose fiber slot or metal platform in center section.

PLC-003

Remove the center cap. It is held in place by two 2-56 hex cap screws near both ends of the cap. Be careful to prevent small parts in the cap from dropping out and getting lost while removing screws and moving the center cap. **Do not adjust (tighten, loosen, or remove) the two small 0-80 screws close to the center thumb screw.**

Rotate the center section so that the metal plate is horizontal (see step 2 on the left in Figure 2).

PLC-006

On the PLC-006, the fiber can be inserted either by removing the center cap to expose the metal plate, as for the PLC-003, or via a side slot in the center section of the device. The fiber slot is more convenient, but requires more care in fiber placement. It can be easier to place the fiber properly by removing the center cap.

Method A: Fiber slot.

PLC-006 devices have a fiber slot on one side of the center section so that fiber can be inserted without disassembly of the center section. To insert fiber via the fiber slot, loosen the center thumb screw until it rotates freely (it is not necessary to completely remove it) and then rotate the center section until its fiber slot is aligned with those on the two side blocks (see step 2 on the right in Figure 2). Tilt the PLC-006 such that the thumb screw faces down in order to open a gap between the pressure plates inside the center section to allow fiber insertion.

Method B: Remove center cap.

The center cap of the PLC-006 is held in place by two 2-56 hex cap screws located one on each end of the center cap, as described above for the PLC-003. Follow the same procedure as for the PLC-003, making sure not to let any interior parts drop out while removing screws or moving the cap. **Do not adjust (tighten, loosen, or remove) the two small 0-80 screws close to the center thumb screw.**

On the PLC-006, one side of the center cap is longer than the other. When replacing the center cap, make sure that the shorter side lines up with the fiber slot on the center cylinder, so that the fiber slot is exposed. If the cap is reversed, the fiber slot will be covered.

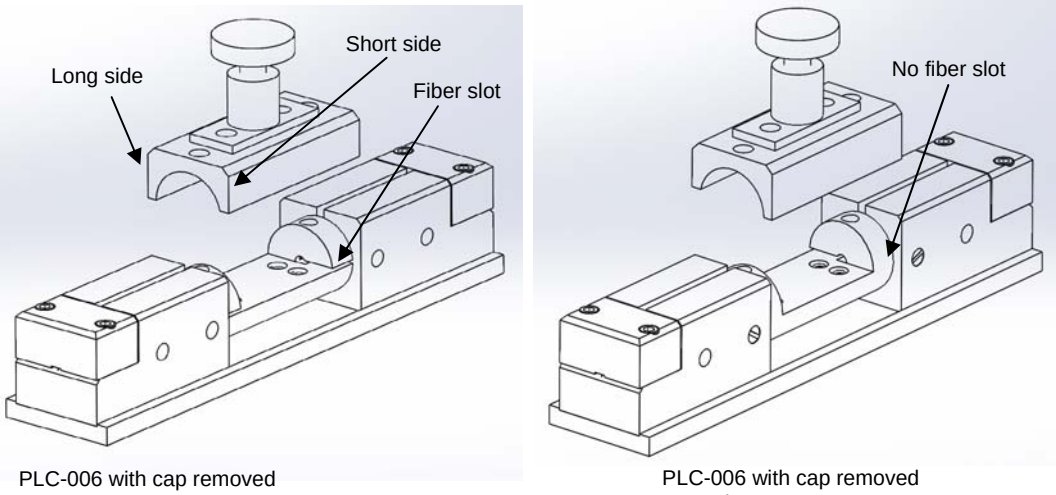


Figure 3 Center cap alignment for PLC-006

Step 3 Place a section of the fiber in which the polarization is to be controlled into the slot. Make sure that the fiber is straight and lying across the center of the fiber platform in the center section of the device. Put the two fiber clamps back on top of the fiber. Check that the section of fiber in the device is straight and securely held by the fiber clamps in the V-grooves on the side blocks. The pressure on the fiber clamps should be just enough to hold the fiber in place. Do not over-tighten the screws.

Note: If the fiber does not lie straight across the V-grooves when first placed, adjust it by pulling it back and forth a few times in the slots before replacing the fiber clamps. It can be helpful to place one of the fiber clamps first (without fully tightening it, if using a screw clamp) and then readjust the fiber before placing the second fiber clamp and adjusting the tension on the fiber clamp screws on both sides. If using the PLC-006 center section's side slot rather than removing the center cap, after inserting the fiber, it can also be helpful to rotate the center section so that the thumb screw faces up before performing fiber adjustments.

Step 4 If the center cap was removed for fiber placement, replace it on top of the stainless steel plate and tighten the two 2-56 hex cap screws. The polarization controller is now ready for use.

Please note that for the 900µm fiber version of the in-line polarization controller, only fibers with a 900µm tight buffer should be used. The polarization controller will not function properly with a 900µm loose tube.

<u>Pigtailed or NoTail Polarization Controllers (PLC-002/M02 and PLC-004/005):</u>

Step 1 Connect the polarization controller at the desired point in the setup using the fiber connectors (pigtailed versions with connectors or NoTail versions) or by splicing (pigtailed versions without connectors). Follow standard fiber connector cleaning procedures when making connections. The polarization controller is now ready for use.

Operation

The polarization of the light in the fiber can be changed by changing the pressure applied to the fiber and/or the axis along which the pressure is applied, as described in the first paragraph of this instruction note. The procedure outlined below explains how to use the polarization controller to maximize the light output from a polarization sensitive device such as a polarizer.

Step 1 Launch light into the fiber going through the polarization controller, which in turn should be connected to the polarization sensitive device. Monitor the output power from the polarization sensitive device using an optical power meter. Follow steps 2-3 below to optimize the polarization state for the device, as indicated by a maximum power reading.

Step 2 Apply pressure to the center portion of the fiber by tightening the thumb screw on the rotatable fiber squeezer while monitoring the optical power. If applying pressure causes an increase in monitored optical power, keep increasing the pressure until the monitored optical power starts to decrease.

NOTE

Do not apply excessive pressure to the fiber by overtightening the screw. In most cases, sufficient pressure can be generated by tightening the screw half way.

Step 3 Rotate the fiber squeezer while maintaining the applied pressure on the fiber, to fine-tune the output polarization. Adjust the pressure and orientation of the fiber squeezer iteratively until the maximum monitored optical power is obtained. This indicates that the optimal polarization state has been reached. In most cases, the desired polarization can be achieved in 2 or 3 iterations.

Step 4 If applying additional pressure causes little change in the monitored optical power, or causes the optical power to decrease, release the pressure and rotate the center section of the polarization controller to a new position. Repeat Steps 2 and 3 if turning the knob causes an increase in monitored optical power. Following this procedure will result in a minimum number of iterations.

Once the desired polarization state is achieved, the set screw(s) can be used to fix the position. Most PLC devices have one plastic set screw on the side of the device. The PLC-006 has two 4-40 metal set screws located one on either side of the center section.

The set screws can be adjusted to control the tightness or looseness of the rotation of the center section of the polarization controller.

Dimensions

The dimensions and mounting hole information for the various models of manual polarization controllers are listed below. All dimensions are in inches.

Drop-in Polarization Controllers

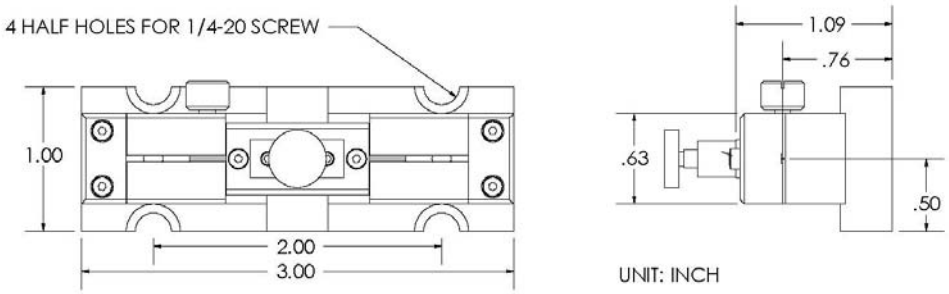


Figure 4 PLC-003

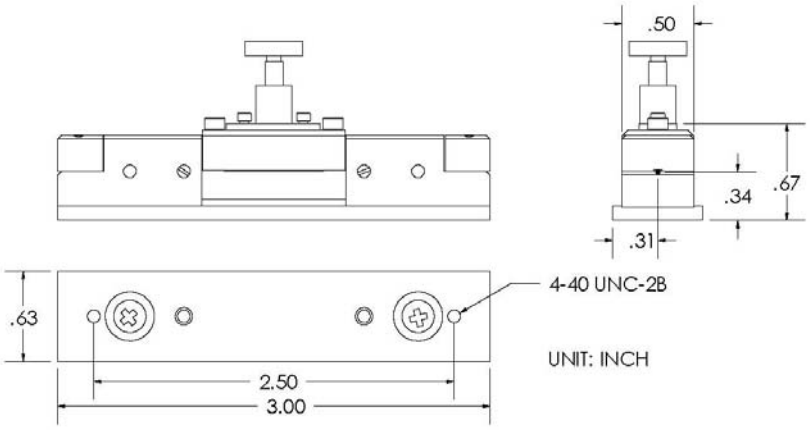


Figure 5 PLC-006

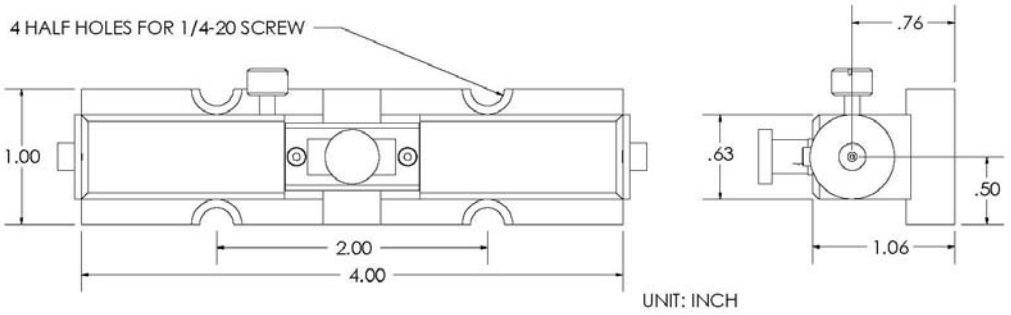


Figure 6 PLC-002

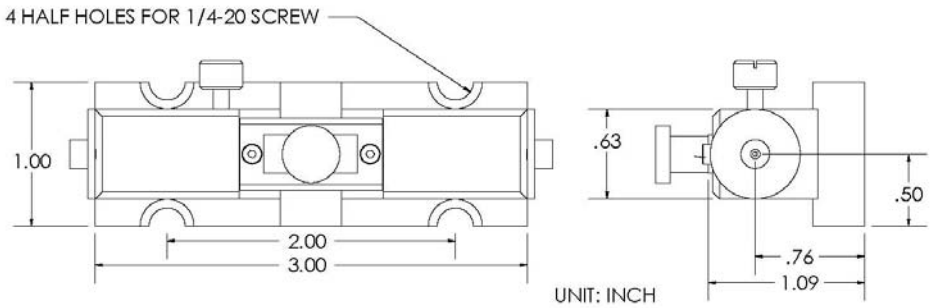


Figure 7 PLC-M02

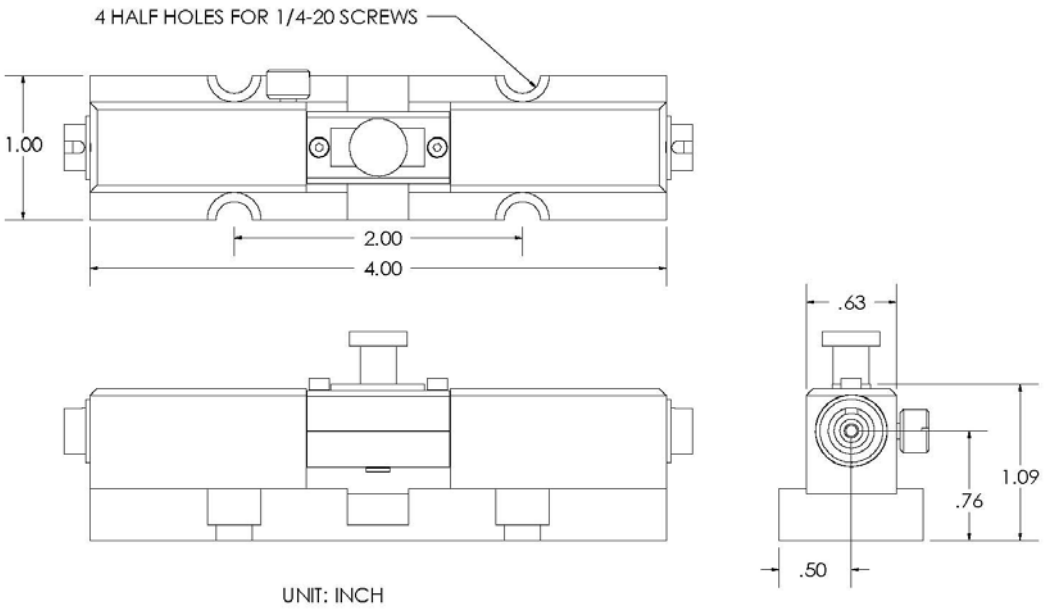


Figure 8 PLC-004

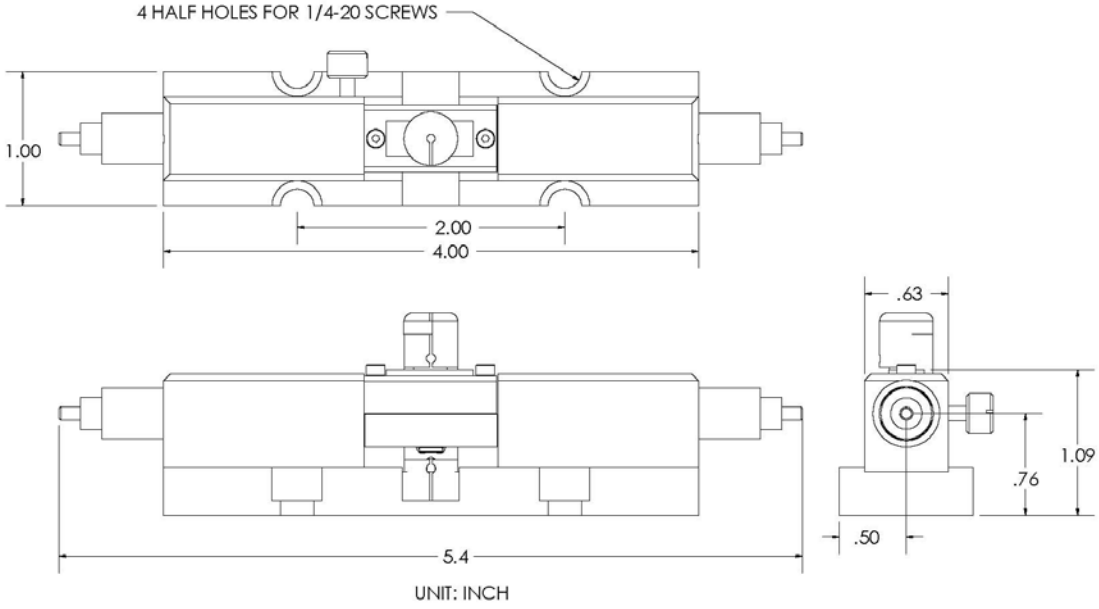


Figure 9 PLC-005

Maintenance and Care of PLC-003/006 Polarization Controllers

Loose Rotation

The set screws on the side of the polarization controller (one plastic set screw for most PLC devices, two metal 4-40 set screws for PLC-006 devices) are used to lock the rotational position of the center section of the polarization controller to maintain one polarization state, and also to adjust the ease of rotation of the center section during polarization adjustment. For general operation, set screw tension should be maintained such that the center section can rotate easily, but maintains its position when released.

The set screws can become loose due to vibration during shipping, or after a long period of continuous use. If the center section rotation is overly loose, tighten the set screws slightly to increase the rotational resistance.



Figure 10 Set screws on PLC-003/006

Screw Summary

The screws labeled below are user-adjustable for fiber placement, polarization adjustment, and position locking. All other screws on the device are factory tuned during device assembly and should not be adjusted by the user.

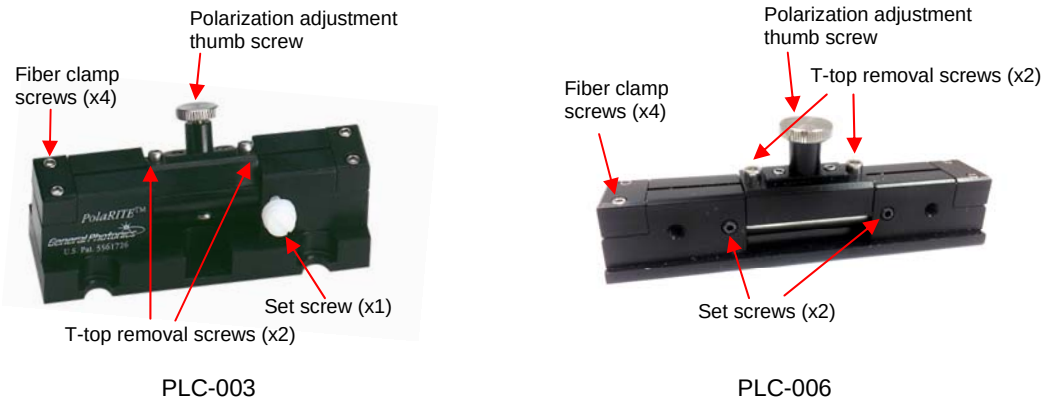


Figure 11 User-adjustable screws on PLC-003/006

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