

PAVOS

User Guide



Faraday Rotators & Optical Isolators
1010 nm to 1080 nm
Small Aperture (≤ 5 mm)



Thank you for purchasing your PAVOS Faraday Rotator or Optical Isolator from EOT. This user guide will help answer questions you may have regarding the safe use and optimal operation of your device.

TABLE OF CONTENTS

I. PAVOS Optical Isolator Overview	2
II. Safe Use of your PAVOS Optical Isolator.....	2
III. Using your PAVOS Faraday Rotator.....	3
IV. Using your PAVOS Optical Isolator	4
V. Installation of your device.....	7
VI. Warranty Statement and Repair.....	7

I. PAVOS Optical Isolator Overview

The PAVOS Faraday Rotators are optical assemblies that rotate the polarization of light 45° clockwise from input to output using the Faraday Effect. This is accomplished through the use of a proprietary optical material mounted inside a magnetic assembly.

The Optical Isolators build on the technology found inside Faraday Rotators by adding two high power polarizers creating an optical assembly that is polarization-dependent and allows transmission of light in only one direction with minimal losses.

As an additional benefit, PAVOS Optical Isolators have been designed to reject any isolated light orthogonally to the input beam with a pointing accuracy of < 5 mrad. This allows for efficient optical isolation of subsystems or for passing high power beams to beam traps.

Finally, the products have been designed with several mounting options. These include a precision mounting option for customers who are interested in a drop-in alignment solution.

II. Safe Use of your PAVOS Optical Isolator

Due to the powerful magnetic field that exists inside the products, care must be taken while working within their vicinity. Please carefully review the following warnings and recommendations. ***Failure to follow these recommendations may result in permanent damage to the product or serious injury to the user.***

1. Ferromagnetic tools and objects should not be used or placed in the proximity of the rotators and isolators. These items will be forcefully attracted to the internal magnets, causing damage or injury.

2. **Do not** pick up the isolator by its ends where the magnetic field and risk of attraction to other objects is the greatest.
 3. Never attempt to disassemble your device. The internal magnets will be ejected outward possibly causing serious injury.
 4. The port covers should be opened if any of the following conditions are met:
 - a. Forward propagating beam >25 W average power
 - b. Reverse propagating beam >1 W average power
 - c. Reverse pulsed energy density > 0.15 J/cm² @ 10 ns pulse width
- Once opened, it is the responsibility of the user to properly terminate all beams in a safe manner.
5. **Always** wear personal protective equipment that provides protection against the wavelengths and powers being used in your application.
 6. **Never** sight through the products to align them with laser sources or other optical components.
 7. Personnel with any magnetically-sensitive implants such as pacemakers should consult their medical doctor regarding any potential complications which could arise from the isolator's external magnetic fields.
 8. Keep all magnetically-sensitive materials and devices such as watches, computer hard drives, and magnetic strips away from the products.

III. Using your PAVOS Faraday Rotator

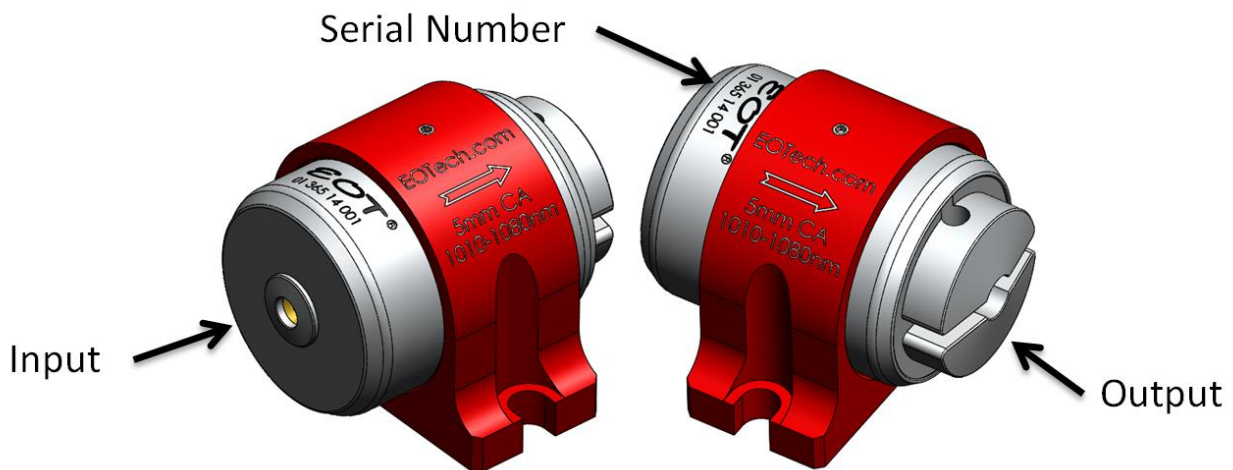


Figure 1: PAVOS Faraday Rotator

Your rotator has been optimized at the factory to provide 45° clockwise, non-reciprocal rotation of linearly polarized light from the input to the output at the ordered wavelength and operating temperature.

EOT recommends that light is injected into the input side of the device (Figure 1) and that the customer carefully aligns the rotator to the beam path to insure optimal performance.

Please see the product data sheet for typical performance curves and the product drawings for mounting options and physical dimensions. 3D CAD files are available upon request.

Please contact EOT with any additional questions regarding your Faraday Rotator.

IV. Using your PAVOS Optical Isolator

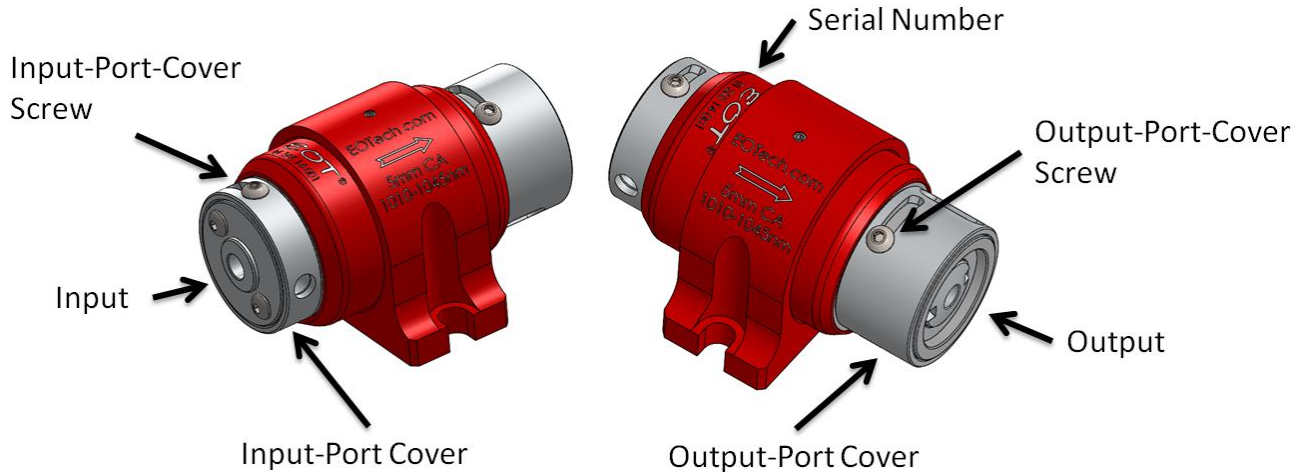


Figure 2: PAVOS Optical Isolator

Your Optical Isolator has been optimized at the factory to provide optimal isolation and transmission at the ordered polarization orientations, operating temperature, and wavelength. In addition, the factory has aligned the input polarizer to provide precision pointing of the isolated light (Figure 3), providing a drop-in solution for OEM customers needing to pass light to subsystems or beam traps.

In a typical application, light traveling from the input to the output (forward light) will pass with minimal losses while reverse light will be highly attenuated. If the port covers are opened, this attenuated or isolated light will be rejected as shown in Figure 3.

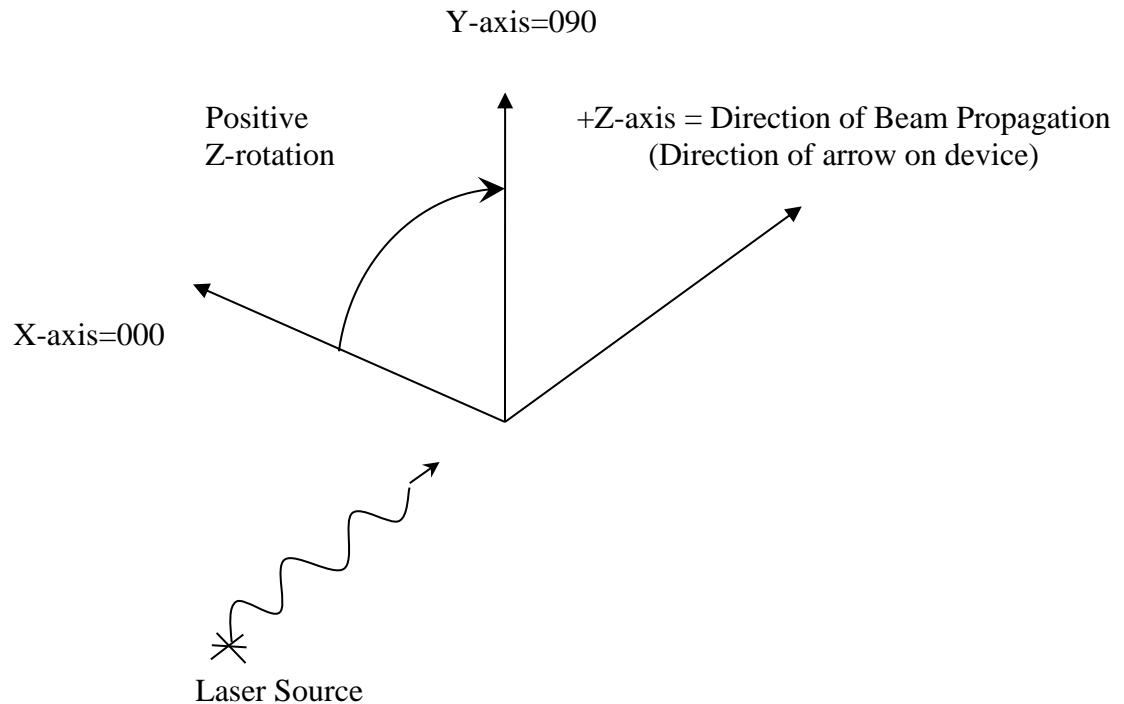
EOT recommends that the customer carefully aligns the Optical Isolator to the beam path to insure optimal performance.

Numbering Fields & Coordinate System for PAVOS Faraday Rotators & Optical Isolators

General Format for Numbering Field: AA-B-CCCC-DDD-EEE

Field Description:

1. “AA” is the aperture size, e.g. 05=5 mm.
2. “B” is the device type. I=isolator; R=rotator.
3. “CCCC” is the operating wavelength in nm.
4. “DDD” is the input polarization axis angle. A right hand X, Y, Z Cartesian coordinate system is used, in which the direction of beam propagation away from the laser source is along the positive Z axis. The X axis is in the plane of the baseplate. The Y axis is vertical, normal to the plane of the baseplate. The XY plane forms the plane of polarization. The XZ plane forms the plane of the baseplate. As an example, a horizontal input polarization is 000 or 0 degrees. A vertical polarization is 090, or 90 degrees. If no polarization is selected by the customer, 000 will be assigned. For rotators, this field does not apply.
5. “EEE” is the output polarization, which is 45 degrees from the input polarization if no waveplate is used. If a waveplate is used and no output polarization is specified, the default setting is the input polarization plus 90 degrees. The angle convention is the same as described for “DDD”. For rotators, this field does not apply.



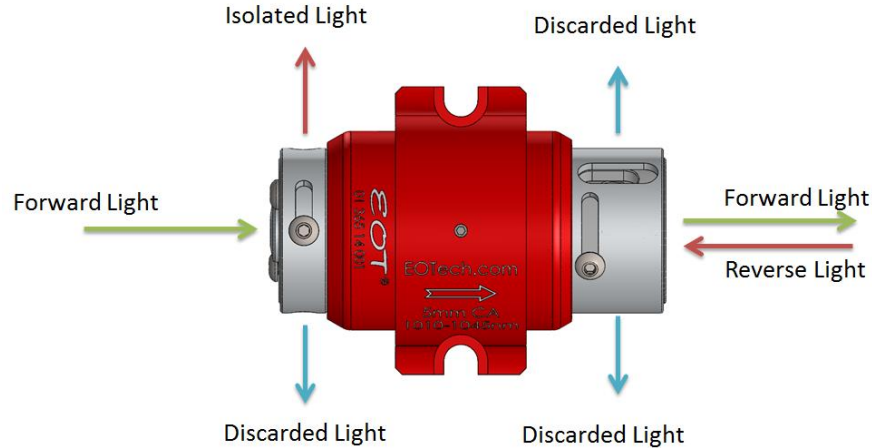


Figure 3: Light Propagation through Optical Isolators

Port Covers:

EOT recommends opening the port covers on your Optical Isolator if any of the following conditions exist in your application. Failure to open the ports when recommended may result in either poor performance or product failure.

- Forward propagating beam >25 W average power
- Reverse propagating beam >0.5 W average power
- Reverse pulsed energy density > 0.15 J/cm² @ 10 ns pulse width

Once opened, the port covers reveal four ports as shown in Figure 3. If incorrectly aligned with the source or if the reverse light has been depolarized, the discarded light ports may contain a significant amount of power. It is the customer's responsibility to analyze their specific application and to properly manage the light from all ports on the product.

To open or close the port covers:

- Loosen the port-cover screw using an M2 hex wrench.
- Rotate the port cover until the optical ports are open or closed.
- Retighten the port-cover screw using an M2 hex wrench.
 - Recommended torque: 2.5 in-lbs.

Waveplate Tuning:

If your device was ordered with a $\lambda/2$ waveplate, it was factory adjusted to provide the output polarization as ordered.

If additional tuning of the output polarization is desired:

- Close the output-port cover per the instructions.
 - This reveals an M3 set screw which secures the waveplate holder (Figure 4).

- Loosen the set screw with an M1.5 hex wrench.
- Adjust the waveplate holder to the desired output polarization (Figure 4).
- Tighten the set screw with an M1.5 hex wrench.
 - Recommended torque: 2.5 in-lbs.

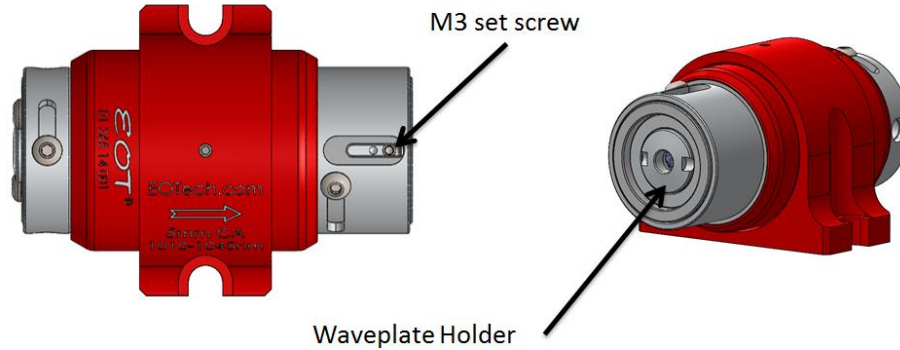


Figure 4: Waveplate Tuning

V. Installation of your device

The products are fully compatible with both metric and English breadboards. For OEM customers, EOT recommends installing the products using the precision dowel pin holes provided on the bottom of the clamp. EOT uses these features during final testing and use of this mounting option will provide drop-in precision.

For more information, please see the drawing.

VI. Warranty Statement and Repair

EOT warrants its products to be free from defects in material and workmanship and complies with all specifications. EOT will at its option, repair or replace any product or component found to be defective during the warranty period. This warranty applies only to the original purchaser and is not transferrable for a period of one year after date of original shipment. The foregoing warranties shall not apply, and EOT reserves the right to refuse warranty service, should malfunction or failure result from:

- a. Damage caused by improper installation, handling or use.
- b. Unauthorized product modification or repair.
- c. Operation outside the environmental or damage specifications of the product.
- d. Contamination not reported to EOT within 30 days of the original ship date.
- e. EOT's output isolators contain a "spacer" at the end of the isolator. Under certain conditions, an off-axis back-reflection from the workpiece could focus down onto the output displacer or polarizer inside the isolator. The purpose of the spacer is to eliminate the conditions under which this could happen. Should EOT's output isolators be purchased without the spacer, or should the spacer be removed, damage to the output displacer or polarizer will not be covered under warranty and the customer will be responsible for all costs associated with such an occurrence.



This warranty is exclusive in lieu of all other warranties whether written, oral, or implied. EOT specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. In no event shall EOT be liable for an indirect, incidental, or consequential damages in connection with its products.

If the customer believes there is a problem with the rotator/isolator, they should immediately contact EOT's Sales/Customer department at 231-935-4044 or customerservice@eotech.com. EOT's Customer Service department will either issue an RMA for the device, or provide the customer with a procedure and authorize the customer to modify the device. All returns should reference the RMA number on the outside of the shipping container and should be sent to:

Electro-Optics Technology, Inc.
Attn: Sales/Customer Service
3340 Parkland Ct.
Traverse City, MI 49866 USA

EOT reserves the right to inspect rotators/isolators returned under warranty to assess if the problem was caused by a manufacturer defect. If EOT determines the problem is not due to a manufacturer defect (an example would be damage to an optical element caused by impact from a loose ball driver or exceeding the damage threshold of the device), repairs will be done at the customer's expense. EOT will always provide a written quote for repair prior to performing repairs at the customer's expense. **Never attempt to disassemble the magnetic housing of your Faraday Rotator/Isolator. Injury could result.** Any indications that an attempt to disassemble the magnetic housing was made will render the warranty null and void.

Notes:

1. **Operating Temperature:** Performance of EOT's Faraday Rotators/Isolators is related to operating temperature. For information on the effect of operating temperature on EOT's Faraday Rotators/Isolators, please review our application note, *Thermal Lensing Analysis of TGG*.
2. **For higher incident powers or aperture sizes other than those specified, or other custom requirements, please consult EOT.** You may either contact EOT's sales department at sales@eotech.com or view our *Custom Solutions* page on our website, eotech.com. EOT has a designated Custom Solutions department with the expertise and capability of manufacturing custom Faraday Rotators and Isolators.
3. **Pulsed Damage Threshold:** The pulsed damage threshold of your free space Faraday Rotator or Isolator can be determined at pulsewidths other than 10 ns by using the "Root T" scaling method.