
THORLABS

**IO-5-405-LP
Free-Space Isolator**

User Guide



Table of Contents

Chapter 1	Safety	2
Chapter 2	Setup	3
	2.1. Unpacking	3
	2.2. Initial Alignment	3
	2.3. Fine Tuning to Optimize Isolation	3
Chapter 3	Description	4
Chapter 4	Operation	6
	4.1. Forward Mode	6
	4.2. Reverse Mode	6
Chapter 5	Warranty	6
Chapter 6	Specifications	7
Chapter 7	Drawing	8
Chapter 8	Regulatory	9
	8.1. Waste Treatment is Your Own Responsibility	9
	8.2. Ecological Background	9
Chapter 9	Thorlabs Worldwide Contacts	10

Chapter 1 Safety



WARNING



This isolator contains a powerful permanent magnet. Keep all steel objects and anything affected by a magnetic field at a minimum distance of 2" (50 mm) from the isolator.

The isolator magnet must remain contained by the isolator body.

The polarizer cells can be safely removed from the rest of the isolator.



WARNING



Any other disassembly of the isolator voids the warranty and can be unsafe.

Chapter 2 Setup

2.1. Unpacking

Please check that you have received the Isolator and a Hex Wrench

Note: Thorlabs aligns the isolator for horizontal input polarization unless requested otherwise.



ATTENTION



Do not place the isolator less than 6" from the laser. LP polarizers reject at 7° from the passing beam, and the rejected feedback can strike a close laser.

2.2. Initial Alignment

- 1) Remove the protective tape from the polarizer cells.
- 2) Place the isolator in the laser beam.
- 3) Place a detector at least 8" from the output polarizer. Center the beam.
- 4) Loosen the cap screw holding the isolator in the slip ring.
- 5) Rotate the isolator until transmission is maximized. This occurs when the input polarizer is aligned to the laser's plane of polarization. Lock down the slip ring cap screw.

2.3. Fine Tuning to Optimize Isolation

- 6) Reverse the isolator so the output polarizer faces the laser and the detector is a few inches from the input polarizer. Center the beam.
- 7) Loosen the output polarizer setscrew.
- 8) Adjust the output polarizer (now facing the laser) by 1-2° until transmission is minimized. Lock down the setscrew.
- 9) Return the isolator to the operating position. Center the beam.
- 10) The isolator is now aligned and ready for use.

Chapter 3 Description

Isolators are used to reduce or eliminate the effects of optical feedback: reflections of a laser's energy back into itself. These effects include noise, amplitude fluctuation, and laser damage. Isolators protect the laser, while maintaining beam alignment and providing maximum forward transmission and reverse isolation.

An isolator consists of a Faraday rotator and at least two polarizers:

Faraday Rotator

The central black cylinder is the **Faraday rotator case**. The Faraday rotator, which rotates non-reciprocally, consists of a magneto-optic material within a magnetic field.

Polarizer Cells

The two black 1" cylinders on the end of the Faraday Rotator are the **polarizer cells**. The cell's engraved lines indicate the axis of polarization

Housing

The isolator is mounted in a black slip ring (Item # SM1RC), which has an 8-32 tapped hole for post mounting (an M4 tapped hole is available upon request).

Part Number

The part number consists of the following:

- **IO** (The Isolator Code)
- **Aperture** (mm, Approximate)
- **Center Wavelength** (nm)
- **Polarizer Type**

Example: an **IO-5-405-LP** has a **5 mm aperture**, a **405 nm center wavelength**, and **LP polarizers**.

Wavelength

The IO-5-405-LP isolator can be tuned for use near the central wavelength. Thorlabs presets the isolator for maximum isolation at the center wavelength. If the laser deviates from this wavelength, rotation is no longer the ideal 45° and isolation decreases. However, within ±5% of the central wavelength, the isolator can be tuned to maintain full isolation and near-optimal transmission (97% of peak).

Example: An isolator centered at 815 nm rotates 45°. If its isolation and transmission are 40 dB and 94%, what are these values when retuned for full isolation at 780 nm?

Over a small wavelength range, rotation is proportional to $1/\lambda^2$. Therefore, rotation at 780 nm is ~49°. However, if the output polarizer is set at 49°, any feedback will be at 98° with respect to the input polarization plane. Isolation will decrease. But if the output polarizer is set at 41° (90°-49°), the feedback will be at 90°. Isolation will remain 40 dB.

Finally, the Law of Malus shows that transmittance through two polarizers is proportional to the \cos^2 of the angle between their polarization planes. This angle is 8° (49°-41°), so the \cos^2 is 0.98. Thus, transmission is reduced by 2%, from 94% to 92%.

Optical Surfaces

The polarizers and Faraday rotator in this isolator have optical surfaces at non-normal incidence to redirect even the weak reflections from their AR-coated surfaces by 1 - 2°.

Output Polarization

This isolator has an output polarization of ~45° relative to that of the input. If another polarization plane is desired (usually horizontal or vertical), 1/2-wave retarders are available. These retarders can rotate the output polarization to any desired linear orientation.

Temperature

Rotation is affected by both changes in wavelength and temperature. Please contact technical support if you plan to use your isolator at temperatures other than the specified test temperature.

Laser Power

The safe power limit this isolator is 30 W/cm² (CW).

Chapter 4 Operation

4.1. Forward Mode

Laser light enters the isolator via the input polarizer and is linearly polarized. This light then enters the rotator, which rotates the plane of polarization $+45^\circ$. The beam exits through the output polarizer, whose axis is oriented $+45^\circ$.

4.2. Reverse Mode

A portion of the random beam reflections will be directed back towards the laser. This feedback re-enters the isolator through the output polarizer and is polarized at 45° with respect to the input beam. This beam is then rotated $+45^\circ$ by the rotator. The feedback, which is now polarized at 90° relative to the input polarizer, is extinguished, and the laser is effectively isolated from its own reflections.

Chapter 5 Warranty

All Thorlabs free space isolators are covered by Thorlabs' six-month warranty against defects in materials and workmanship.



WARNING



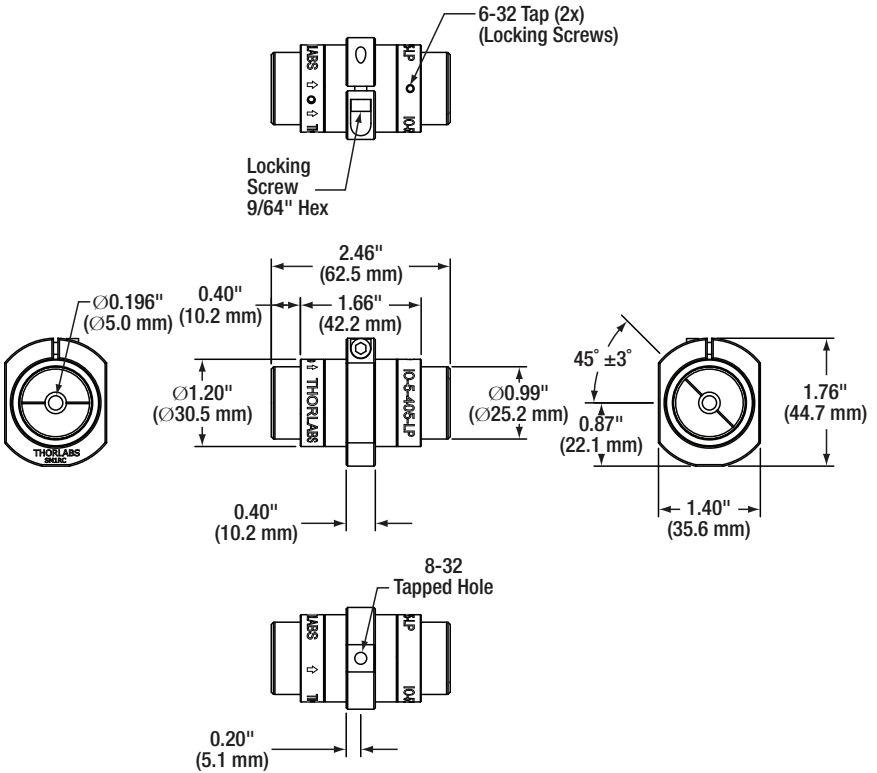
**Do not attempt to disassemble the isolator.
Disassembly of the isolator voids the warranty.**

Please contact technical support if you have questions regarding performance or operations. See page 10 for contact information by region.

Chapter 6 Specifications

Item #	IO-5-405-LP
Isolator Type	Adjustable Narrowband
Wavelength	405 nm
Tuning Range	395 - 420 nm
Operating Range	390 - 425 nm
Polarizer Type	Low Power (LP)
Aperture	5 mm
Weight	0.12 kg
Optical Specifications	
Isolation	32 - 42 dB @ 405 nm
Transmission	84% @ 405 nm
Max Beam Diameter	4.5 mm
Max Power	5 W
Max Power Density	30 W/cm ²

Chapter 7 Drawing



Chapter 8 Regulatory

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

- This offer is valid for Thorlabs electrical and electronic equipment:
- Sold after August 13, 2005
- Marked correspondingly with the crossed out “wheelie bin” logo (see right)
- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- Still complete, not disassembled and not contaminated



Wheelie Bin Logo

As the WEEE directive applies to self-contained operational electrical and electronic products, this end of life take back service does not refer to other Thorlabs products, such as:

- Pure OEM products, that means assemblies to be built into a unit by the user (e.g. OEM laser driver cards)
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB's, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

8.1. Waste Treatment is Your Own Responsibility

If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

8.2. Ecological Background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

Chapter 9 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.



USA, Canada, and South America

Thorlabs, Inc.
sales@thorlabs.com
techsupport@thorlabs.com

Europe

Thorlabs GmbH
europe@thorlabs.com

France

Thorlabs SAS
sales.fr@thorlabs.com

Japan

Thorlabs Japan, Inc.
sales@thorlabs.jp

UK and Ireland

Thorlabs Ltd.
sales.uk@thorlabs.com
techsupport.uk@thorlabs.com

Scandinavia

Thorlabs Sweden AB
scandinavia@thorlabs.com

Brazil

Thorlabs Vendas de Fotônicos Ltda.
brasil@thorlabs.com

China

Thorlabs China
chinasales@thorlabs.com



THORLABS
www.thorlabs.com
