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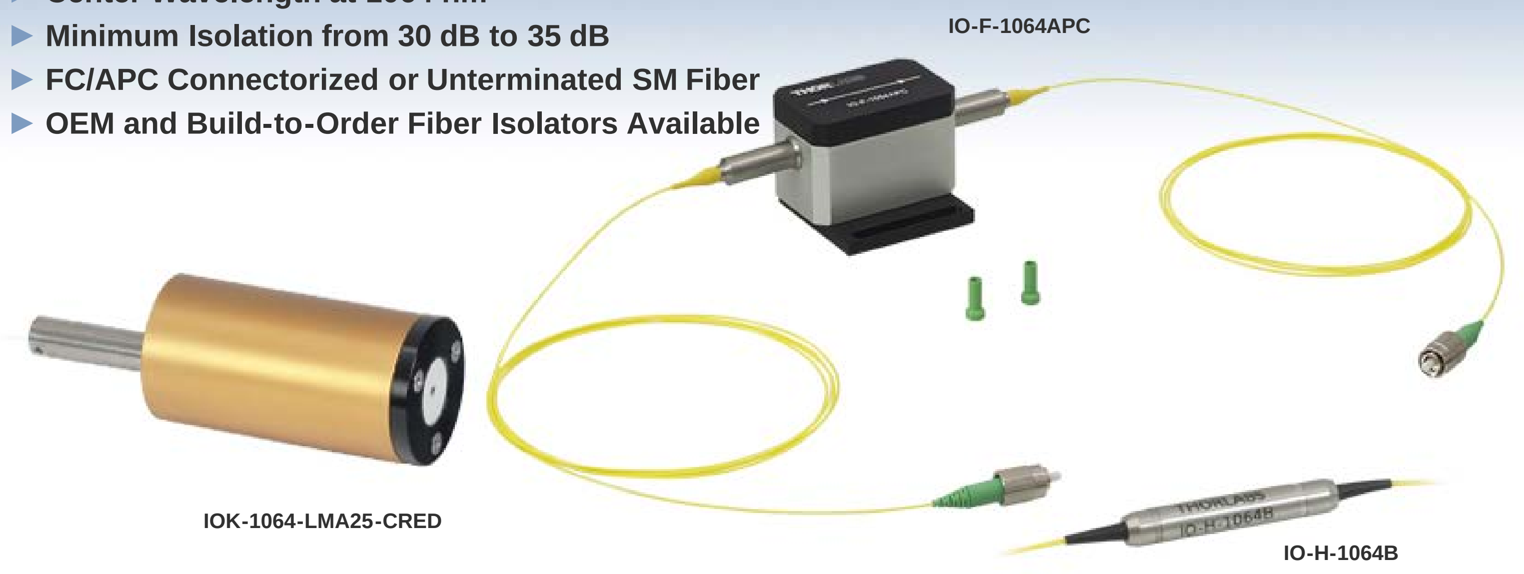
THORLABS

IOK-1064-LMA25-CRED - November 25, 2020

Item # IOK-1064-LMA25-CRED was discontinued on November 25 2020. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

ND:YAG FIBER OPTIC ISOLATORS WITH SM FIBER (1064 NM)

- Center Wavelength at 1064 nm
- Minimum Isolation from 30 dB to 35 dB
- FC/APC Connectorized or Unterminated SM Fiber
- OEM and Build-to-Order Fiber Isolators Available



Hide Overview

OVERVIEW

Features

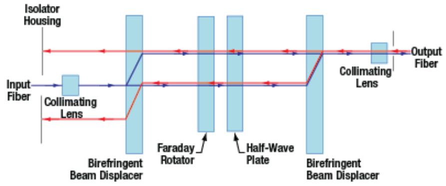
- Minimize Feedback into Optical Systems
- Operating Ranges of 1054 - 1074 nm or 1059 - 1069 nm
- 0.8 m to 1 m of Fiber Built in to Each Side of the Isolator
- Available with 2.0 mm Narrow Key FC/APC Connectors or Unterminated
- Designed for CW Applications
- Each Unit is Individually Tested
- Fiber to Free-Space Option Available
- Custom Isolators Available (See the *Custom Isolators* tab)

Fiber isolators protect light sources from back reflections and signals that can cause intensity noise and optical damage. Optical isolators, also known as Faraday isolators, are magneto-optic devices that preferentially transmit light in the forward direction while absorbing or displacing light propagating in the reverse direction (see the schematic below). Please see the *Isolator Tutorial* tab for an explanation of the operating principles of a Faraday isolator.

Selection Guide for Isolators (Click Here for Our Full Selection)		
Fiber Isolators		
Spectral Region	**Wavelength Range**	**Fiber Type**
Visible	650 - 670 nm	SM
NIR	770 - 1060 nm	SM
		PM
Nd:YAG	1064 nm	SM
		PM
IR	1290 - 2010 nm	SM
		PM
Fiber Isolators for Broadband SLDs[a]		
Free-Space Isolators		
Custom Isolators		

- a. Superluminescent Diodes

Thorlabs' polarization-independent Nd:YAG isolators, sold on this page, are compatible with single mode (SM) fibers. In contrast, our



Click for Details

Isolator Schematic A polarization independent isolator. Light is deflected away from the input path and stopped by the housing. See the *Isolator Tutorial* tab for more information. Click the schematic to show polarization states.

polarization-dependent Nd:YAG isolators are designed to connect to polarization-maintaining (PM) fibers. Our high-power units are built using a specialized fiber end face process that increases the maximum power. There is 0.8 m to 1 m of fiber built in to each side of the isolator, and an arrow on the body indicates the transmission direction. In addition, each unit is tested before shipment to ensure compliance with our specifications and a complete test report comes with every serialized part.

Thorlabs also manufactures free-space isolators and fiber isolators designed for the infrared range. Please use the Selection Guide table above for more information. If you do not see an isolator that suits your application, please refer to the *Custom Isolators* tab for information on our build-to-order options, or contact Tech Support.

Hide Isolator Tutorial

ISOLATOR TUTORIAL

Optical Isolator Tutorial

Function

An optical isolator is a passive magneto-optic device that only allows light to travel in one direction. Isolators are used to protect a source from back reflections or signals that may occur after the isolator. Back reflections can damage a laser source or cause it to mode hop, amplitude modulate, or frequency shift. In high-power applications, back reflections can cause instabilities and power spikes.

An isolator's function is based on the Faraday Effect. In 1842, Michael Faraday discovered that the plane of polarized light rotates while transmitting through glass (or other materials) that is exposed to a magnetic field. The direction of rotation is dependent on the direction of the magnetic field and not on the direction of light propagation; thus, the rotation is non-reciprocal. The amount of rotation β equals *V* x B x d, where *V*, B, and d are as defined below.

Faraday Rotation

$$\beta = V \times B \times d$$

V: the Verdet Constant, a property of the optical material, in radians/T • m.

B: the magnetic flux density in teslas.

d: the path length through the optical material in meters.

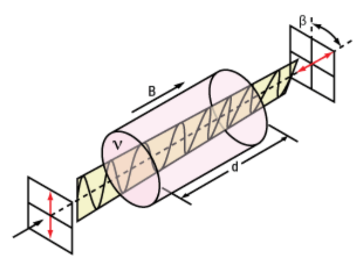


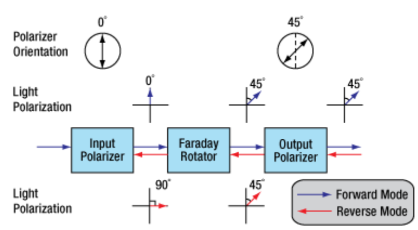
Figure 1. Faraday Rotator's Effect on Linearly Polarized Light

An optical isolator consists of an input polarizer, a Faraday rotator with magnet, and an output polarizer. The input polarizer works as a filter to allow only linearly polarized light into the Faraday rotator. The Faraday element rotates the input light's polarization by 45°, after which it exits through another linear polarizer. The output light is now rotated by 45° with respect to the input signal. In the reverse direction, the Faraday rotator continues to rotate the light's polarization in the same direction that it did in the forward direction so that the polarization of the light is now rotated 90° with respect to the input signal. This light's polarization is now perpendicular to the transmission axis of the input polarizer, and as a result, the energy is either reflected or absorbed depending on the type of polarizer.

Polarization-Dependent Isolators

The Forward Mode

In this example, we will assume that the input polarizer's axis is vertical (0° in Figure 2). Laser light, either polarized or unpolarized, enters the input polarizer and becomes vertically polarized. The Faraday rotator will rotate the plane of polarization (POP) by 45° in the positive direction. Finally, the light exits through the output polarizer which has its axis at 45°. Therefore, the light leaves the isolator with a POP of 45°.



In a dual-stage isolator, the light exiting the output polarizer is sent through a second Faraday rotator followed by an additional polarizer in order to achieve greater isolation than a single-stage isolator.

Figure 2. A single-stage, polarization-dependent isolator. Light propagating in the reverse direction is rejected by the input polarizer.

The Reverse Mode

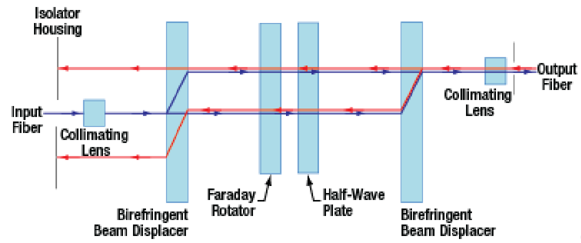
Light traveling backwards through the isolator will first enter the output polarizer, which polarizes the light at 45° with respect to the input polarizer. It then passes through the Faraday rotator rod, and the POP is rotated another 45° in the positive direction. This results in a net rotation of 90° with respect to the input polarizer, and thus, the POP is now perpendicular to the transmission axis of the input polarizer. Hence, the light will either be reflected or absorbed.

Polarization-Independent Fiber Isolators

The Forward Mode

In a polarization independent fiber isolator, the incoming light is split into two branches by a birefringent crystal (see Figure 3). A Faraday rotator and a half-wave plate rotate the polarization of each branch before they encounter a second birefringent crystal aligned to recombine the two beams.

In a dual-stage isolator, the light then travels through an additional Faraday rotator, half-wave plate, and birefringent beam displacer before reaching the output collimating lens. This achieves greater isolation than the single-stage design.



Click for Details

Figure 3. A single-stage, polarization-independent isolator. Light is deflected away from the input path and stopped by the housing.

The Reverse Mode

Back-reflected light will encounter the second birefringent crystal and be split into two beams with their polarizations aligned with the forward mode light. The faraday rotator is a non-reciprocal rotator, so it will cancel out the rotation introduced by the half wave plate for the reverse mode light. When the light encounters the input birefringent beam displacer, it will be deflected away from the collimating lens and into the walls of the isolator housing, preventing the reverse mode from entering the input fiber.

General Information

Damage Threshold

With 25 years of experience and 5 U.S. patents, our isolators typically have higher transmission and isolation than other isolators, and are smaller than other units of equivalent aperture. For visible to YAG laser Isolators, Thorlabs' Faraday Rotator crystal of choice is TGG (terbium-gallium-garnet), which is unsurpassed in terms of optical quality, Verdet constant, and resistance to high laser power. Thorlabs' TGG Isolator rods have been damage tested to 22.5 J/cm^2 at 1064 nm in 15 ns pulses (1.5 GW/cm^2), and to 20 kW/cm^2 CW. However, Thorlabs does not bear responsibility for laser power damage that is attributed to hot spots in the beam.

Magnet

The magnet is a major factor in determining the size and performance of an isolator. The ultimate size of the magnet is not simply determined by magnetic field strength but is also influenced by the mechanical design. Many Thorlabs magnets are not simple one piece magnets but are complex assemblies. Thorlabs' modeling systems allow optimization of the many parameters that affect size, optical path length, total rotation, and field uniformity. Thorlabs' US Patent 4,856,878 describes one such design that is used in several of the larger aperture isolators for YAG lasers. Thorlabs emphasizes that a powerful magnetic field exists around these Isolators, and thus, steel or magnetic objects should not be brought closer than 5 cm.

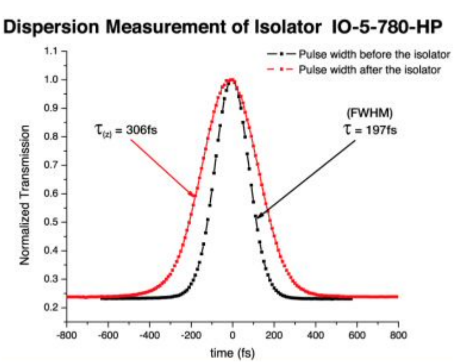


Figure 4. Pulse Dispersion Measurements Before and After an IO-5-780-HP Isolator

Temperature

The magnets and the Faraday rotator materials both exhibit a temperature dependence. Both the magnetic field strength and the Verdet Constant decrease with increased temperature. For operation greater than ±10 °C beyond room temperature, please contact Technical Support.

Pulse Dispersion

Pulse broadening occurs anytime a pulse propagates through a material with an index of refraction greater than 1. This dispersion increases inversely with the pulse width and therefore can become significant in ultrafast lasers.

τ: Pulse Width Before Isolator

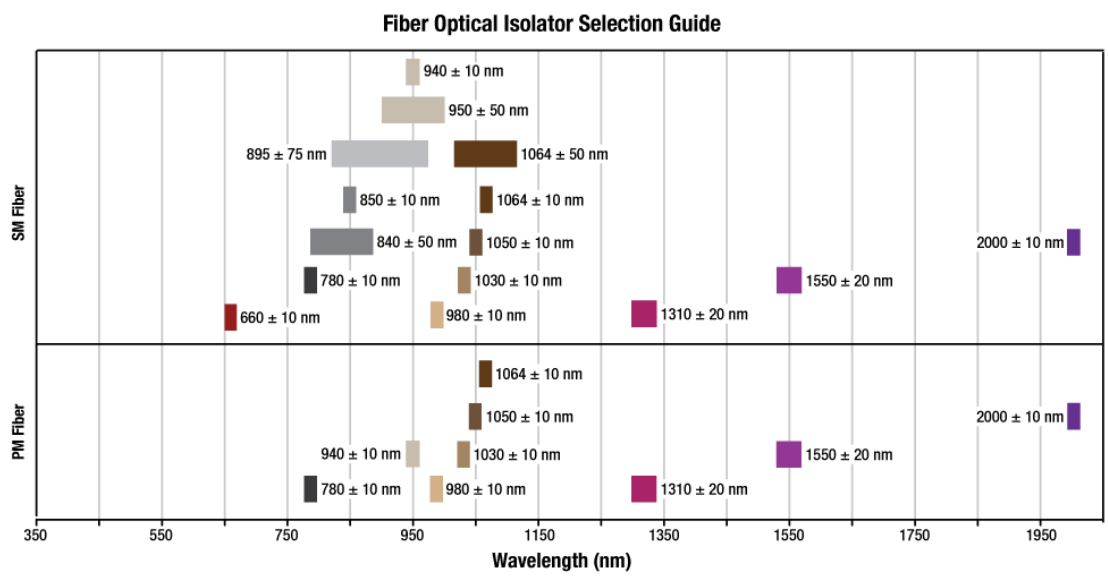
$\tau_{(z)}$: Pulse Width After Isolator

Example:
$t = 197$ fs results in $t_{(z)} = 306$ fs (pictured to the right)
$t = 120$ fs results in $t_{(z)} = 186$ fs

Hide Fiber Isolator Guide

FIBER ISOLATOR GUIDE

The following selection guide contains all of Thorlabs' Fiber Optical Isolators. Click the colored bars below to to see specifications and options for each wavelength range and isolator type. Please note that Thorlabs also offers free space optical isolators and custom optical isolators.



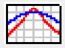
Hide 30 W Polarization-Independent Fiber to Free-Space Isolator with Red Aiming Laser Pass Through

30 W Polarization-Independent Fiber to Free-Space Isolator with Red Aiming Laser Pass Through

Click Image to Enlarge	
Item #	**IOK-1064-LMA25-CRED**
Polarization	Independent
Fiber Type	SM
Center Wavelength	1064 nm
Operating Range	1054 - 1074 nm
Max Power[a]	30 W (CW) 10 kW (Peak) 25 W (Avg.)
Isolation[b]	30 dB (Min)

The IOK-1064-LMA25 is a fiber-to-free-space isolator for high-power applications in the 1064 nm range. Using our experience in high-power fiber manufacturing, this isolator has been fabricated to withstand CW laser powers up to 30 W. This isolator has the added benefit that a red alignment laser with transmission in the 633 to 690 nm range can be coupled into the LMA25 fiber prior to entering the isolator. This aiming feature is extremely useful when working with a free-space IR beam.

Mounting holes on the output port allow components such as beam expanders to be attached. Without a beam expander, a Ø0.5 mm collimated beam will exit the isolator centered on the body with a divergence of 3 to 4 mrad.

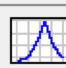
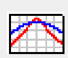
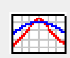
Performance Graph (Click for Plot)	
Insertion Loss	0.45 dB (Max)
Polarization Dependent Loss (PDL)	≤0.20 dB
Return Loss	≥50 dB
Fiber	Nufern 3440 (MM-GDF-25/250-11FA)

- a. For CW or pulsed light sources. The maximum power specification represents the maximum power for the combined forward and reverse directions. Therefore, the sum of the powers in the forward and reverse directions cannot exceed the maximum power specification.
- b. Isolation at Center Wavelength

Part Number	Description	Price	Availability
IOK-1064-LMA25-CRED	**Customer Inspired! Fiber Isolator, 1064 nm, SM, 30 W, Fiber to Free-Space, Red Aiming Laser Pass Through**	**$2,058.19**	**Lead Time**

Hide 1064 nm Polarization-Independent Isolator with SM Fiber

1064 nm Polarization-Independent Isolator with SM Fiber

Click Image to Enlarge			
Item #	**IO-H-1064B** **IO-H-1064B-APC**	**IO-F-1064** **IO-F-1064APC**	**IO-K-1064**[a]
Polarization	Independent	Independent	Independent
Fiber Type	SM	SM	SM
Center Wavelength	1064 nm	1064 nm	1064 nm
Operating Range	1059 - 1069 nm	1054 - 1074 nm	1054 - 1074 nm
Max Power[b]	300 mW (CW)[c]	3 W (CW)[c]	10 W (CW)[d]
Isolation[e]	30 dB (Min)	35 dB (Min) 36 dB (Typ.)	33 dB (Min) 39 dB (Typ.)
Performance Graph (Click for Plot)			
Insertion Loss	1.8 dB (Max) (IO-H-1064B) 2.1 dB (Max) (IO-H-1064B-APC)	1.0 dB (Typ.) 1.2 dB (Max)	1.0 dB (Typ.) 1.2 dB (Max)
Polarization Dependent Loss (PDL)	≤0.15 dB	≤0.15 dB	≤0.25 dB
Return Loss (Input/Output)	≥55/50 dB (IO-H-1064B) ≥50/45 dB (IO-H-1064B-APC)	≥50 dB	≥50 dB
Fiber	HI1060	HI1060	HI1060

- a. FC/APC Terminated Version Available by Contacting Tech Support
- b. The maximum power specification represents the maximum power for the combined forward and reverse directions. Therefore, the sum of the powers in the forward and reverse directions cannot exceed the maximum power specification.
- c. The maximum power is quoted for the unterminated isolator, and will be reduced by the addition of connectors. This isolator is not recommended for high-power pulsed applications.
- d. Ideal for high-power CW or pulsed applications.
- e. Isolation at Center Wavelength

Part Number	Description	Price	Availability
IO-H-1064B	**Fiber Isolator, 1064 nm, SM, 300 mW, No Connectors**	**$236.98**	**Today**

IO-H-1064B-APC	Fiber Isolator, 1064 nm, SM, 300 mW, FC/APC	$282.44	Today
IO-F-1064	Fiber Isolator, 1064 nm, SM, 3 W, No Connectors	$1,638.33	Today
IO-F-1064APC	Fiber Isolator, 1064 nm, SM, 3 W, FC/APC	$1,682.69	Today
IO-K-1064	Fiber Isolator, 1064 nm, SM, 10 W, No Connectors	$2,141.51	Today