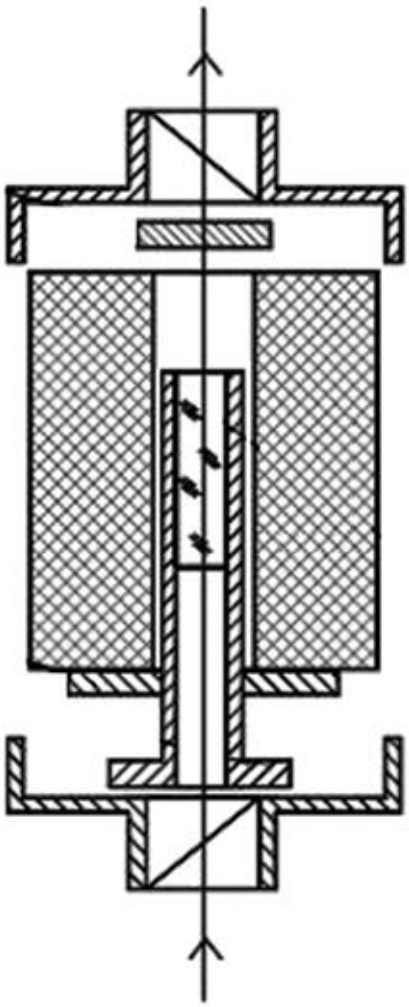
Kirra Faraday Isolators

Optical Rotators and Isolators



GOT FEEDBACK?

Del Mar Photonics optical isolators are designed to attenuate reflected or backscattered light by several orders of magnitude, by taking advantage of the Faraday Effect. Isolators are useful when certain devices or experiments have extremely high sensitivity to optical feedback that causes intensity instability, frequency pulling, or other unwanted effects. A Faraday isolator acts as an optical diode, allowing propagation of linearly polarized light in one direction, while blocking light in the reverse direction. It consists of a Faraday rotator, two polarizers and a body to house the parts. The Faraday rotator, in turn, consists of magneto-optically active material placed inside a permanent magnet (Nd-Fe-B).

The magneto-optical rod can be cut from three types of material: Terbium-doped glass (MOS-10), Terbium-gallium-garnet (TGG) crystals or Yttrium-iron-garnet (YIG) crystals. The rods are polished to a flatness of $\lambda/10$ and have parallelism of better than 10 arc seconds. They are anti-reflection coated with residual reflection less than 0.2% (each side) in the 700-900 nm range. Polarizers are air-spaced Glan prisms made of calcite. Entrance and exit faces of polarizers are anti-reflection coated with residual reflection of less than 0.3% and transmittance > 94%. This gives a total transmittance of >85% for our isolators. Models are offered with reverse isolation of 38 dB or 60 dB.

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Operation of an optical broadband Isolator

Laser light, polarized or not, enters the input polarizer and is linearly polarized in, for instance the horizontal plane (0°). As linearly polarized light enters the Faraday rotator rod, the plane of polarization rotates as the light propagates along the axis of the rod. The Faraday rotator is tuned to rotate the plane of polarization by 45°. The light then passes through the quartz rotator and the net rotation is 90°. The output polarizer is oriented at 90° allowing most of the light to emerge from the output of the Isolator. Any back-reflected light re-enters the isolator through the output polarizer and becomes polarized at 90°. It then passes through the quartz compensator and Faraday rotator, where the quartz compensator rotates the polarization by 45° in one direction, while the Faraday element produces 45° rotation in the opposite direction, the total rotation becomes 0° and the back-reflected radiation is stopped by the input polarizer. Thus, the laser is isolated from retro-reflected beams that may occur in the application part of the optical set. Moreover, the wavelength dependence of Faraday rotation for backward beam is substantially compensated by the rotation in the quartz compensator.

Wavelength tuning

Verdet constant of the magneto-optical rod is wavelength dependent. Thus, tuning of the isolator for the desired wavelength is required. Wavelength tuning is achieved by rotating a threaded housing which contains the magneto-optical rod, thereby moving the rod into or out of the magnet; more or less of the rod is exposed to the magnetic field, thus controlling the amount of rotation.

Isolator options

There are many different options you can choose for the Faraday Isolators. We have clear apertures from 3-12 mm, single stage isolaotrs with 38-44 dB and double stage isolators that have greater than 60 dB of isolation. The center wavelength can be custom tuned from 500-1250 nm, with the option to include a quartz compensator for broadband lasers.

Properties of Typical Faraday Isolators

	MOS-Glass Isolator	Broadband TGG Isolator
Revese Isolation	>38 dB, 60 dB	>38 dB, 60 dB
Central Wavelength	800 nm	800 nm
Bandwidth	30 nm	200 nm
Transmittance of Rod	98%	99%
Transmittance of Polarizer	94%	94%
Transmittance of Quartz Rotator	N/A	99%

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