



COMPONENT SPECIFICATION

FARADAY ISOLATOR, 20mm

APPROVALS:	DATE	REV	DCN NO	BY	CHK	DCC	DATE
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CHECKED:							
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1 SCOPE

This is a specification for a Faraday Isolator Assembly, which consists of 1) a housing with external mounting brackets, 2) a permanent magnet subassembly, 3) a Faraday optic subassembly, 4) input/output polarizers, and 5) a return beam port cover. The Faraday Isolator Assembly will be combined with a half-wave plate to provide isolation of orthogonal polarization of a collimated laser beam and to restore the polarization orientation. The Faraday Isolator Assembly will be used in a ground-based high vacuum environment.

2 LIGO DOCUMENTS

LIGO-960641-05, Electronic Submissions to the Document Control Center

- http://ligo.caltech.edu/LIGO_web/dcc/docs/L960641-05.pdf

LIGO-E960022-A, Vacuum Compatibility, Cleaning Methods and Compatibility Procedures

- http://ligo.caltech.edu/LIGO_web/dcc/docs/E960022-03.pdf

LIGO-E960050-A, Vacuum Compatible materials list

- http://ligo.caltech.edu/LIGO_web/dcc/docs/E960050-A.pdf

2.1. Non-LIGO Documents

MIL-C-675C

EOT Mod. No. 1845-20 data sheet

3 REQUIREMENTS

3.1. PERFORMANCE CHARACTERISTICS

3.1.1. Faraday Isolator Performance

3.1.1.1 Transmitted Beam

Wavelength	1064 nm
Clear Aperture	20 mm
Transmissivity across clear aperture	>99%
Extinction ratio across clear aperture	>30dB
Wavefront distortion	< $\lambda/4$ @ 633 nm wavelength



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3.1.1.2 Antireflection Coating

Shall be applied to both surfaces of Faraday optic, purchase from REO (Research Electro Optics)

Wavelength	1064 nm
Incidence angle	0 deg
Transmissivity per surface	>99.9%
Durability	MIL-C-675C

3.1.1.3 Return Beam Port Cover

An optical port shall be provided to allow the retroreflected return beam to exit from the polarizer housing. The port shall be covered with a removable cover to block the return beam.

3.1.2. Input/output Polarizer

The input polarizer and the output polarizer shall be made of optical quality calcite. All optical surfaces shall be oriented at Brewster's angle. The performance characteristics shall be compatible with the specification for the Faraday Isolator. See "Faraday Isolator Performance" on page 1.

3.2. DESIGN AND CONSTRUCTION

3.2.1. Operating Environment

The Faraday Isolator Assembly will operate on a vibration isolated table, in an ultra high vacuum environment, at room temperature $68 \pm 4F$.

3.2.2. Materials

The device will be fabricated in accordance with the document:
LIGO-E960022-A, Vacuum Compatibility, Cleaning Methods and Compatibility Procedures
http://ligo.caltech.edu/LIGO_web/dcc/docs/E960022-03.pdf

3.2.2.1 Allowed materials

The standard materials used in EOT Model No. 1845-20 shall be allowed, except for the listed disallowed materials. See "Disallowed Materials" on page 2.

3.2.2.2 Disallowed Materials

The following materials shall not be used: organic materials, elastomers, vacuum grease, adhesives including epoxy, anodizing, lubricants. All machined parts must be machined dry, or with pure water as a coolant.



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3.2.3. Cleaning and Packaging Procedure

3.2.3.1 Disassembly for Cleaning

The Faraday Isolator assembly will be disassembled for cleaning of the components including: 1) housing with magnet, 2) Faraday optic, and 3) polarizers

3.2.3.2 Optical Surfaces

All optical surfaces shall be cleaned in accordance with good commercial practice. Nothing shall contact the optical surfaces after cleaning, except for lint-free lens tissue.

3.2.3.3 Magnet housing

The Magnet housing with assembled magnet shall be ultrasonically cleaned in appropriate solvents and vacuum baked at 50 deg C with a pressure $< 1 \times 10^{-6}$ Torr for 24 hours.

3.2.3.4 Packaging for Shipment

The cleaned and disassembled optical components shall be protected with 6 layers of lint-free lens tissue. In addition, all components shall be wrapped in UHV quality aluminum foil and placed in a sealed, clean polyethylene bag before shipping.

At the time of this writing, one source for UHV quality aluminum foil is:

ASTM B-479 Dry Annealed A Allfoil
4597 Vanepps Rd.
Brooklyn, OH 44131
(216) 661-0211

3.2.4. Physical Dimensions

3.2.4.1 Overall Size

The overall envelope size shall not exceed 4.0in width X 4.0in height X 12.0in length. See figure 1.

3.3. MARKING

3.3.1. Part Number/Serial Number

A part number and serial number shall be etched, ground or sandblasted on the top of the housing in the following format E980131-R XX, where

XX is incremental for each Faraday Isolator starting at 01



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R is the current revision letter of this specification

4 TEST PROCEDURES

4.1. Optical Surfaces

4.1.1. Visual Surface Inspection Test

All optical surfaces shall be free of visible stains and surface defects, when illuminated with a high-intensity lightsource and viewed in a darkened environment with the unaided eye.

4.1.2. Extinction Ratio Test

Extinction ratio for orthogonal polarizations shall be measured, using the specified light source. See "Light Source" on page 4.

4.1.2.1 Light Source

A collimated laser beam with 1064 nm wavelength and >9.0 mm Gaussian beam waist diameter measured at $1/e^2$ power diameter shall fill the clear aperture when making transmissivity and extinction ratio measurements.

4.1.3. Transmissivity Test

Transmissivity through the clear aperture shall be measured with the specified light source. See "Light Source" on page 4.

4.1.4. Wavefront Distortion Test

Wavefront distortion over the clear aperture shall be measured at 633 nm wavelength with an appropriate interferometer.

4.2. Mechanical Component Cleanliness Test

4.2.1. Ultrasonic Cleaning Test

The mechanical components of the Faraday Isolator Assembly shall yield no visible debris in an ultrasonic bath after a single cleaning, done in the following manner.

- Ultrasonic clean in Alconox (1 tbs to 1 gal water) or Liquinox for 10 minutes
- Rinse in distilled water
- Ultrasonic clean in ethanol for 10 minutes
- Rinse in distilled water



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4.2.2. Q-Tip test

The mechanical components of the Faraday Isolator Assembly shall yield no debris or visible contamination to a manually applied Q-Tip wipe, following the ultrasonic cleaning procedure. See “Ultrasonic Cleaning Test” on page 4.

5 DOCUMENTATION

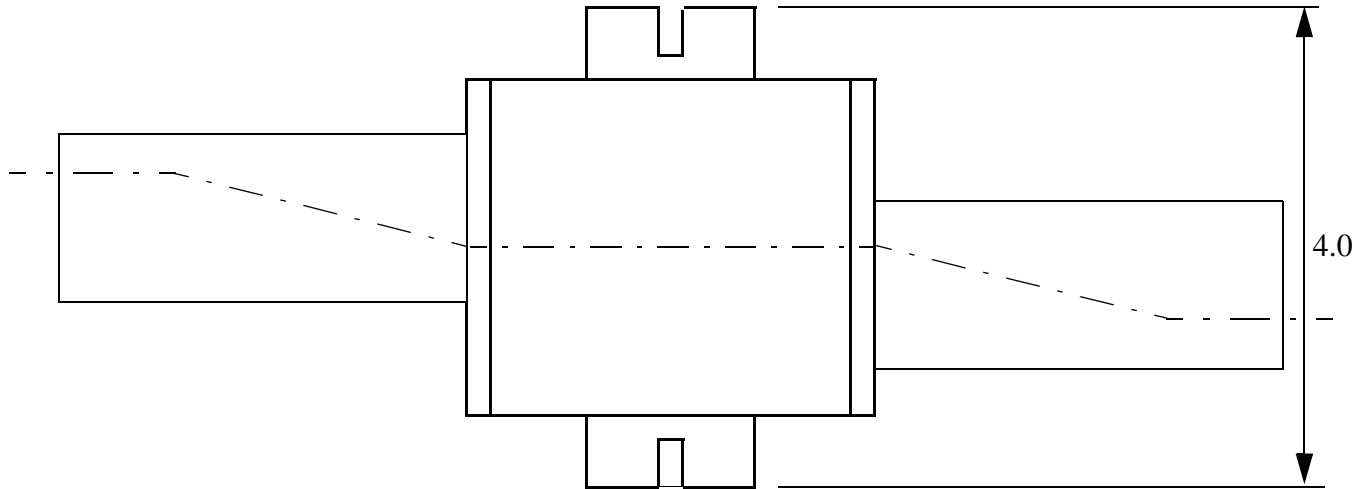
- 1) Interferogram of transmitted wavefront across clear aperture. See “Wavefront Distortion Test” on page 4.
- 2) Transmissivity through clear aperture. See “Transmissivity Test” on page 4.
- 3) Extinction ratio for orthogonal polarizations through clear aperture. See “Extinction Ratio Test” on page 4.
- 4) Compliance Certification for this specification
- 5) Calibration certification for the test equipment, as appropriate
- 6) Inspection report
 - dimensional verification
 - test results
 - materials list
 - vacuum bakeout results
 - inspection test procedure



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TOP VIEW



12.0

3.8

SIDE VIEW

3.5

Figure 1: Figure 1: Approximate outline dimensions of Faraday Rotator Assembly