HEAD ASSEMBLIES

GMP
GENERAL MICROTECHNOLOGY & PHOTONICS

HINDS™ INSTRUMENTS

PRODUCT BULLETIN

OVERVIEW

PEM photoelastic modulators change the polarization state of a light beam at frequencies between 20 and 100 kHz. The modulator optical element acts as a "dynamic waveplate" to produce an oscillating birefringence. This can convert linear polarized light into light which oscillates between circular, elliptical and linear states. For example, light which oscillates between left and right circular polarized light can be produced for use in circular dichroism measurements.

PEM photoelastic modulators feature a "split-head" configuration; the electronic and optical components are housed in separate enclosures. This minimizes the size of the unit which is placed in the optical train. It also simplifies making the optical head magnetic field compatible or vacuum compatible when this is necessary.

SERIES I AND II MODULATORS

Series I modulators use rectangular optical elements and are useful in the ultraviolet, visible and infrared to 1 or 2 microns.

Series II modulators use symmetrical or octagonal optical elements and are primarily intended for use in the visible and infrared (to far-IR) spectral regions. Special models have been used in the ultraviolet.

Modulators are offered with optical elements made of various optical materials. The choice of optical material is made primarily on the basis of the spectral transmission requirements of the instrument. A list of commonly available materials is given in Table 1.

TABLE 1 – HEAD ASSEMBLIES

Spectral Region	Series	Material
Vacuum UV, UV	I	Lithium Fluoride
Vacuum UV to mid-IR	I, II	Calcium Fluoride
Vacuum UV to near-IR	I, II	Fused Silica
Mid-visible to mid-IR	II	Zinc Selenide
Near to mid and far-IR	II	Silicon

Compared to the Series II octagonal optical elements, the rectangular optical elements used in Series I modulators provide lower levels of peak retardation for a given optical element thickness. This is a drawback when working in the

infrared, but an asset when working in the UV, especially the vacuum UV.

Octagonal (Series II) optical elements are much more efficient for a given thickness, and thus have a significant advantage in the infrared. Operation of Series II modulators at low retardation levels (e.g. the deep UV) may present some problems.

When a PEM is used with a laser, modulated interference effects may occur. These can produce spurious optical/electronic signals which may hamper certain measurements. Hinds engineers should be consulted for techniques to eliminate or minimize such signals in applications where laser light sources are used with PEMs.

Antireflection coatings may be used to increase the throughput of light through the modulator, to reduce interference effects, and to reduce the fraction of light which passes through the modulator at an undesired peak retardation. In particular, zinc selenide and silicon modulators benefit from antireflection coatings because of their high indices of refraction. (Note: An antireflection coating may significantly reduce the usefulness of the modulator outside the spectral band of the coating.)coating may significantly reduce the usefulness of the modulator outside the spectral band of the coating.)

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OPTIONS

The specifications and prices for all of the options may vary depending on user requirements. Consult Hinds engineers when specifying these items.

- **Antireflection Coatings, Model ARC.** AR coatings can be provided on a custom basis for any of our modulator optical elements. Both narrow-band and broad-band coatings are available. Please contact us with your spectral range and transmission requirements.
- **Non-Interference Option, Model NIO.** This option deflects internally reflected beams from the primary beam path, thereby eliminating modulated interference (see PEM Newsletter #8).
- **Special Frequency, Model SFO.** Standard modulator heads can be supplied with custom frequencies.
- **Special Length Optical Head/Electronic Head Cable, Model SLHH.**
- **Special Head Enclosures, Model SHE.** The Optical Head enclosure can be provided with custom geometries as re quired by the user's application or OEM requirement.
- **Vacuum Operation.** PEM optical heads may be operated in a vacuum. Consult Hinds for details.
- **Magnetic Field Compatibility, Model MFC.** Optical Head manufactured without any ferromagnetic materials, for compatibility with strong magnetic fields.

FEATURES

Optical Characteristics:

- Wide aperture (1.5 to 3.0 cm for standard units)
- Wide acceptance angle (+/- 20°)
- Wide selection of optical materials, spectral bands

Electrical Characteristics:

- Extended retardation performance at high and low levels
- Controller determines retardation
- Precise frequency matching of electronic, optical components
- Optical and Electronic Heads are matched pairs and should not be interchanged

Mechanical Characteristics

- Minimum Optical Head size
- The Optical Head may be used in any orientation desired

ORDERING INFORMATION

PEM Modulator Head Model	Shipping Weight*
I/FS50	9.1 kg/20 lbs
I/FS20	9.1 kg/20 lbs
I/CF50	9.1 kg/20 lbs
I/LF50	9.1 kg/20 lbs
II/FS20	10 kg/22 lbs
II/FS42	10 kg/22 lbs
II/FS84	10 kg/22 lbs
II/CF57	10 kg/22 lbs
II/ZS37	10 kg/22 lbs
II/ZS50	10 kg/22 lbs
II/SI50	10 kg/22 lbs

**Includes Controller*

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OPTICAL HEAD SPECIFICATIONS

Model	Optical Material	Retardation Range		Useful Aperture[1]
		Quarter Wave	Half Wave	
I/FS50	Fused Silica	170 nm - 2 μm	170 nm - 1 μm	16 mm
I/FS20	Fused Silica	170 nm - 2 μm	170 nm - 1 μm	22 mm
I/CF50	Calcium Fluoride	130 nm - 1 μm	130 nm - 500 nm	16 mm
II/FS20A	Fused Silica	170 nm - 2 μm	170 nm - 1 μm	56 mm
II/FS20B	Fused Silica	1.6 μm - 2.6 μm	800 nm - 2.5 μm	56 mm
II/FS42A	Fused Silica	170 nm - 2 μm	170 nm - 1 μm	27 mm
II/FS42B	Fused Silica	1.6 μm - 2.6 μm	800 nm - 2.5 μm	27 mm
II/FS47A	Fused Silica	170 nm - 2 μm	170 nm - 1 μm	24 mm
II/FS47B	Fused Silica	1.6 μm - 2.6 μm	800 nm - 2.5 μm	24 mm
II/FS50LR	Fused Silica	170 nm - 2 μm	170 nm - 1 μm	22 mm
II/FS84	Fused Silica	170 nm - 2.5 μm	170 nm - 2.5 μm	13 mm
II/IS42B	Fused Silica	1.6 μm - 3.5 μm	800 nm - 2.5 μm	27 mm
II/IS84	Fused Silica	800 nm - 2.5 μm	400 nm - 2.5 μm	13 mm
II/CF57	Calcium Fluoride	2 μm - 8.5 μm	1 μm - 5.5 μm	23 mm
II/ZS37	Zinc Selenide	2 μm - 18 μm	1 μm - 9 μm	19 mm
II/ZS50	Zinc Selenide	2 μm - 18 μm	1 μm - 10 μm	14 mm
II/SI40	Silicon	FIR - THz	FIR - THz	36 mm
II/SI50	Silicon	FIR - THz	FIR - THz	29 mm