Selecting a Photoelastic Modulator Optical Head

TECHNICAL NOTE

There are several considerations to keep in mind when selecting an optical head for your photoelastic modulator system. The following document outlines these concerns. Please contact Hinds Instruments if you have any questions.

SPECTRAL RANGE CONSIDERATIONS

The two primary considerations in the selection of a PEM are the spectral region in which the modulator must operate and the range of retardance required. In general, series modulators are designed for use in UV and visible applications, but also may be used for many IR laser diode applications. Model I/CF50 is specifically intended for the vacuum UV region.

Series II modulators are primarily intended for the near- and mid-IR regions, but some may be used in the visible spectrum. Consult the Specifications Table for details regarding transmission limits and available retardation.

RETARDATION REQUIREMENTS

A PEM intended for half-wave and quarter-wave applications should be capable of providing half-wave retardation throughout the spectral region of interest. Standard linear dichroism setups require half-wave operation, and it should be possible to achieve half-wave operation at any wavelength where calibration of the retardation is required.

Many modulator applications require only quarter-wave retardation. These include circular dichroism, optical rotation, polarimetry, birefringence, and amplitude modulation or chopping.

Some advanced techniques use a third modulator setting: the first retardation setting at which the Bessel Function $J_0(A_0)=0$. This occurs at a retardation setting of $A_0=2.405$ radians or 0.383 waves. For this setting, the average DC signal may be used for signal normalization.

OPTICAL CONSIDERATIONS

Aperture. Hinds can supply custom modulators with special size apertures. For a given optical element material, the aperture (and optical assembly size) is inversely proportional to the operating frequency. Standard apertures range from 1.5 to 3.0 cm.

Use with lasers. Laser light sources are monochromatic and have high spatial coherence, which can lead to undesirable interference effects. Reflections between the optical element surfaces may cause spurious detector signals at the fundamental and other harmonic frequencies. Use of antireflective coatings, tilting the modulator, or a special “non-interference” option which deflects internally reflected beams can reduce or eliminate this problem. Contact Hinds engineers for assistance with laser applications.

Antireflection coatings. 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 will significantly reduce the usefulness of the modulator outside the spectral band of the coating.*

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OPTICAL HEAD SPECIFICATIONS

MODEL	OPTICAL MATERIAL	NOMINAL FREQUENCY	RETARDATION RANGE		USEFUL APERTURE[1]
			QUARTER WAVE	HALF WAVE	
I/FS50 [2]	Fused Silica	50 kHz	170 nm - 2 μm	170 nm - 1 μm	16 mm
I/FS60	Fused Silica	60 kHz	170 nm - 2 μm	170 nm - 1 μm	16 mm
I/FS20	Fused Silica	20 kHz	170 nm - 2 μm	170 nm - 1 μm	22 mm
I/CF50	Calcium Fluoride	50 kHz	130 nm - 1 μm	130 nm - 500 nm	16 mm
II/FS20A	Fused Silica	20 kHz	170 nm - 2 μm	170 nm - 1 μm	56 mm
II/FS42 [3]	Fused Silica	42 kHz	170 nm - 2.6 μm	170 nm - 2.5 μm	27 mm
II/FS47 [3]	Fused Silica	47 kHz	170 nm - 2.6 μm	170 nm - 2.5 μm	24 mm
II/FS50LR	Fused Silica	50 kHz	170 nm - 2 μm	170 nm - 1 μm	22 mm
II/FS50B	Fused Silica	50 kHz	170 nm - 2.6 μm	170 nm - 2.5 μm	22 mm
II/FS84	Fused Silica	84 kHz	800 nm - 2.6 μm	400 nm - 1.8 μm	13 mm
II/IS42	Infrasil	42 kHz	1.6 μm - 3.5 μm	800 nm - 2.5 μm	27 mm
II/IS84	Infrasil	84 kHz	800 nm - 3.5 μm	400 nm - 1.8 μm	13 mm
II/CF57	Calcium Fluoride	57 kHz	2 μm - 8.5 μm	1 μm - 5.5 μm	23 mm
II/ZS37 [2]	Zinc Selinide	37 kHz	2 μm - 18 μm	1 μm - 9 μm	19 mm
II/ZS42 [2]	Zinc Selenide	42 kHz	2 μm - 18 μm	1 μm - 10 μm	16 mm
II/ZS50 [2]	Zinc Selinide	50 kHz	2 μm - 18 μm	1 μm - 10 μm	14 mm
II/SI50	Silicon	50 kHz	28 μm - 56 μm	N/A	29 mm

[1] For full discussion, consult the Useful Aperture Note
[2] Standard and custom antireflective coatings available
[3] Please contact Hinds Instruments for use in the UV-VIs

Hinds Instruments, Inc | 7245 NE Evergreen Pkwy | Hillsboro, OR 97124 | USA
T: 503.690.2000 | Fax: 503.690.3000 | sales@hindsinstruments.com

www.hindsinstruments.com