Meadowlark Optics' award-winning Spatial Light Modulators provide precision retardance control for spatially varying phase or amplitude. Our Spatial Light Modulators consist of liquid crystal pixels, each independently addressed, acting as separate variable retarders. These Spatial Light Modulators are easily incorporated into optical systems requiring programmable masks and variable input/output devices. Applications include correlation, spectroscopy, data storage, ultrafast pulse shaping, optical computing, beam steering and wavefront correction for active and adaptive optics.

Basic construction and operation of a Spatial Light Modulator is similar to our standard Liquid Crystal Variable Retarder. The ITO transparent conductor is photolithographically patterned into individual electrodes, creating independently controllable pixels. Standard SLM geometries are shown on page 48 and 49.

Minimizing pixel spacing is critical to optimize performance and resolution. Proprietary designs and techniques enable Meadowlark Optics to offer tight interpixel spacing. Custom pixel configurations are possible.

Phase Control

Spatial phase control or modulation is accomplished without altering the intensity profile of an incident beam. Light linearly polarized parallel to the extraordinary axis of the material is phase modulated by the voltage applied across individual pixels. An optical path difference between adjacent pixels, tunable to one full-wave, is easily accomplished.

Amplitude Control

Spatial Light Modulators are also used for amplitude control or modulation. The SLM modifies the beam intensity, but also spatially alters the phase profile, which may be undesirable. Correction is accomplished by using two spatial light modulators in series. The first performs the necessary amplitude modulation, also introducing a phase change. The second SLM restores the original, or desired phase relationship between pixels.

Polarizers are optional with an amplitude spatial light modulator. These polarizers are both rotatable and removable from the spatial light modulator housing.

The compact optical head is designed so that two units can be placed back-to-back, minimizing the path distance between modulators. Electrical connections exit one side of the optical head for convenience in handling and mounting.

All Meadowlark Optics' spatial light modulators conveniently interface with our D Series Multi-channel.

Call for mechanical specifications.

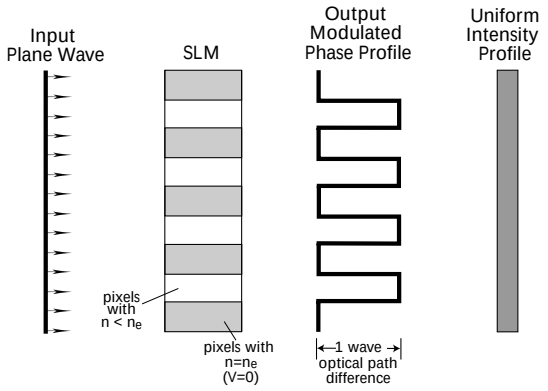


Fig. 5-1 With phase modulation, an optical path difference of up to one full-wave is produced between adjacent pixels of the Spatial Light Modulators. The output intensity remains uniform.

Spatial Light Modulator Applications

Spatial Light Modulators are being used in a diverse range of new applications including:

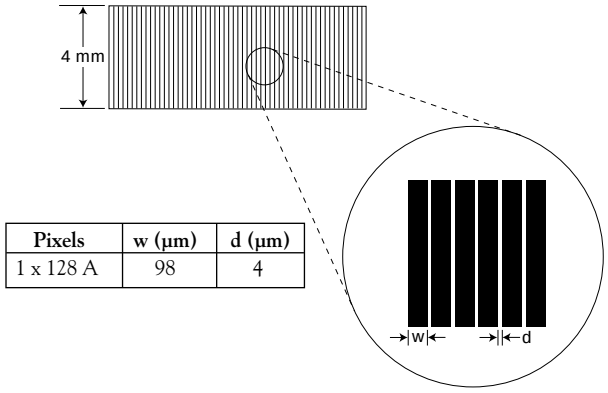
- WDM add/drop modulators
- Beam steering for live cell manipulation
- Optical data storage
- Arbitrary pulse shaping
- WDM gain flattening
- Wavefront correction
- Imaging polarimetry
- Multi-channel PMD correction
- Optical transform masks
- Microscopy

Standard Spatial Light Modulators

Meadowlark Optics' Spatial Light Modulator consists of patterned arrays of independently controlled liquid crystal variable retarders. Our high-resolution spatial light modulators are electronically programmable and interface to our Model D3128 Multi-Channel Liquid Crystal Digital Interface. Meadowlark offers both linear and hex pixel geometries.

Shapeshifter Linear Array Spatial Light Modulator

The ShapeShifter Spatial Light Modulator has a linear pixel array geometry. This two-time award-winner can be used to alter the temporal profile of femtosecond light pulses via computer control. Applications requiring these short pulses include analysis and quantum control of chemical events, optical communication, and biomedical imaging. These Spatial Light Modulators find use in other applications including Hadamard spectroscopy, optical data storage, and wavefront compensation.



Pixels	w (µm)	d (µm)
1 x 128 A	98	4

Fig. 5-2 ShapeShifter Spatial Light Modulator pixel geometry

Hex Spatial Light Modulators

Our two dimensional spatial light modulators are designed for adaptive optics applications. A two dimensional array of liquid crystal variable retarders acts as a real time programmable phase mask for wavefront correction of a linear polarized source.

Unwanted aberration effects are removed by introducing the opposite phase shift. The most common applications involve high-resolution imaging where viewing through an aberrant medium is unavoidable. Examples include astronomical imaging with ground-based telescopes and medical imaging through body fluids. High-energy laser users also benefit from active phase compensation for beam profile correction.

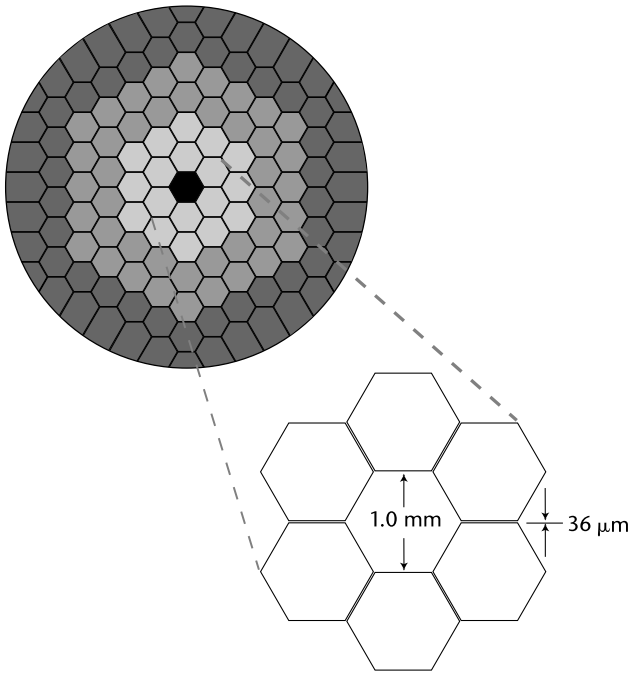


Fig. 5-3 Hex127 pixel geometry

Custom pixel geometries available. Call for more information.

Standard Spatial Light Modulators

Key Benefits

- Computer controlled
- Phase or amplitude modulation
- High transmission
- Slim housing design
- Uses D3128 SLM Digital Interface

Specifications

Retarder Material:	Nematic liquid crystal
Substrate Material:	Optical quality synthetic fused silica
Center Wavelength:	450-1800 nm (specify)
Retardance Range:	
Phase:	Minimum 1 wave optical path difference
Amplitude:	Minimum 0-100%
Retardance Uniformity:	< 2% rms variation over clear aperture
Transmitted Wavefront Distortion (at 632.8 nm):	< λ/4
Surface Quality:	40-20 scratch and dig
Beam Deviation:	< 2 arc min
Transmittance:	> 90% (without polarizers)
Reflectance (per surface):	< 0.5% at normal incidence
Dimensions (L x W x H):	7.00 x 2.96 x 0.74 in
Dimensional Tolerance:	±0.005 in.
Recommended Safe Operating Limit:	500 W/cm^2 CW 300 mJ/cm^2 10 ns, 532 nm
Temperature Range:	10 °C to 45 °C

Ordering Information

SLM Geometry	Pixel Width (µm)	Part Number
Phase Version (at least 1 wave optical path difference)		
1 x 128 A	98	SSP - 128A - λ
Hex 127	1000	Hex - 127P - λ
Amplitude Version (0-100%)		
1 x 128 A	98	SSA - 128A - λ
Hex 127	1000	Hex - 127A - λ

Optional Polarizers

Type	Wavelength Range (nm)	Part Number
Visible	450 - 700	SDP - VIS
Near infrared	775 - 890	SDP - NIR
Near infrared	890 - 1800	SDP - IR

Please specify your operating wavelength λ in nanometers when ordering.

A temperature sensor and control option is available. Please be sure to append 'TSC' to the part number when ordering.

Please contact our sales department to obtain a price list for our standard components.

Spatial Light Modulator Controller

The Meadowlark Optics' D-Series Multi-Channel Digital Interface allows for independent voltage control of up to 128 Liquid Crystal cells or pixels. The model is available with 128 channels for use with Meadowlark Spatial Light Modulators.

The D-Series Interface is connected via USB 1.1 cable to an MS Windows™ based computer. Supplied software allows for ease in setting of individual pixel retardance and for the programming of retardance profiles across a pixilated device. Custom software can be written using the included LabVIEW Virtual Instrument library to allow for integration into custom applications.

Temperature Control Option – available

Optional temperature sensing and control is available. Often the performance of a spatial light modulator is affected by thermal variations. Add a Temperature Sensing and Control option to both the Spatial Light Modulator and to the drive electronics to improve the retardance accuracy and control.

The D3128-TSC will control the temperature of one pixel plane.

Temperature sensing range is 0-100 °C (±0.1 °C).

Note that the Temperature Sensing and Control option must also be included with the Spatial Light Modulator.

Specifications

Output Voltage:	2 kHz AC square wave digitally adjustable 0-10 V rms 50% duty cycle minimal DC bias
Voltage Resolution:	2.44 mV (12 bit)
Computer Interface:	USB 1.1
Power Requirements:	100-240 VAC 47-63 Hz < 5W
Dimensions (L x W x H):	9.5" x 6.25" x 1.5"
Weight:	2 lbs

Ordering Information

Output Channels	Part Number
128	D3128
Temperature Sensing Option	D3128-TSC

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