

## Why Choose Meadowlark Reflective SLMs?

**High Voltage Backplanes = Fastest Response Times** Meadowlark Optics SLMs use custom backplanes, and proprietary drive schemes to achieve response times down to 1 ms (wavelength dependent). Most other liquid crystal spatial light modulators utilize display backplanes built with standard Nematic liquid crystal, limiting response time to >30 ms.

**Highest Phase Stability Commercially Available** - Our backplanes are custom designed to allow high refresh rates (up to 6 kHz), and direct analog drive schemes. Refreshing the voltage at the pixel at rates far surpassing the response time of the liquid crystal ensures high temporal phase stability. Further, use of direct analog drive schemes, as opposed to digital dithering, reduces optical flicker as low as 0.1% (0.001  $\pi$  radians).

**Low Inter-pixel Cross Talk** - Our backplanes are custom designed to offer high voltage at the pixel (5 – 12 V), and a large pixel pitch. Further, our SLMs are built with Meadowlark Optics proprietary liquid crystal which minimizes the required thickness of the LC layer in the SLM. By maximizing the ratio of pixel pitch to LC thickness we are able to offer SLMs with minimal inter-pixel effects.

**Broad Wavelength Capabilities** - Meadowlark Optics is the only SLM supplier capable of offering SLMs designed for use from UV (>365 nm) up to the LWIR (8 - 12  $\mu$ m).

**Analog is Better** - All Meadowlark SLMs have been designed for phase modulation. Unlike many display LCoS backplanes which require a pulse width modulation (PWM) scheme, Meadowlark backplanes utilize analog voltages at each pixel. This results in a very stable phase response over time.

**High Bit Depth Controllers** - Meadowlark offers 8, 12, and 16-bit controllers to provide the most linear resolvable phase levels commercially available (up to 500). Fast transfer speeds from the computer to the SLM are offered up to 2 kHz.

### Small 512 x 512 Analog Spatial Light Modulator

**Resolution:** 512 x 512  
**Array Size:** 7.68 x 7.68 mm  
**Pixel Pitch:** 15 x 15  $\mu$ m  
**Fill Factor:** 83.4 - 100%  
**Diffraction Efficiency\*:** 61 - 99%  
**Controller:** PCIe 8-bit, PCIe 16-bit, DVI 16-bit

Wavelength	Wavefront Distortion	Liquid Crystal Response Time (Standard Efficiency / High Efficiency)			AR Coatings (Ravg <1%)
		Model E512/PDM512	Model HSP512/HSPDM512	Model ODP512/ODPDM512	
405 nm	$\lambda/5$	25 ms / 33.3 ms	N/A	3 ms / 4 ms	350 – 850 nm
532 nm	$\lambda/7$	33.3 ms / 45 ms	7 ms / 10 ms	3.5 ms / 4.5 ms	450 – 850 nm
635 nm	$\lambda/8$	33.3 ms / 45 ms	12 ms / 16.7 ms	4 ms / 5 ms	450 – 850 nm
785 nm	$\lambda/10$	55.5 / 80 ms	17.2 ms / 22.2 ms	4.5 ms / 5.5 ms	600 – 1300 nm
1064 nm	$\lambda/10$	66.7 / 100 ms	10 ms / 16.7 ms	5 ms / 6 ms	600 – 1300 nm
1550 nm	$\lambda/12$	100 / 130 ms	20 ms / 28.5 ms	6 ms / 7 ms	850 – 1650 nm

\*Silicon backplane, performance varies as a function of wavelength.

### Large 512 x 512 Analog Spatial Light Modulator

**Resolution:** 512 x 512  
**Array Size:** 12.8 x 12.8 mm  
**Pixel Pitch:** 25 x 25  $\mu$ m  
**Fill Factor:** 96%  
**Diffraction Efficiency\*:** 92%  
**Controller:** PCIe 8/16-bit, DVI 16-bit

Wavelength	Wavefront Distortion	Liquid Crystal Response Time (Standard Efficiency / High Efficiency)		AR Coatings (Ravg <1%)
		Model P512L/PDM512L	Model HSP512L/HSPDM512L	
405 nm	$\lambda/5$	3.0 ms / 4.5 ms	N/A	350 – 850 nm
532 nm	$\lambda/5$	4.0 ms / 6.0 ms	1.2 ms / 2.0 ms	450 – 850 nm
635 nm	$\lambda/6$	4.5 ms / 7.0 ms	1.7 ms / 3.0 ms	450 – 850 nm
785 nm	$\lambda/7$	7.5 ms / 12.0 ms	2.5 ms / 4.0 ms	600 – 1300 nm
1064 nm	$\lambda/10$	10.0 ms / 15.0 ms	3.3 ms / 5.0 ms	600 – 1300 nm
1550 nm	$\lambda/12$	15.0 ms / 25.0 ms	4.2 ms / 6.5 ms	850 – 1650 nm

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### 1920 x 1152 Analog Spatial Light Modulator

**Resolution:** 1920 x 1152  
**Array Size:** 17.6 x 10.7 mm  
**Pixel Pitch:** 9.2 x 9.2  $\mu$ m  
**Fill Factor:** 95.7%  
**Diffraction Efficiency\*:** 88%  
**Controller:** PCIe 8/12-bit, HDMI 8/12-bit

Wavelength	Wavefront Distortion	Liquid Crystal Response Time (Standard Speed / High Speed)		AR Coatings (Ravg <1%)
		Model P1920	Model HSP1920	
405 nm	$\lambda/3$	6 ms	N/A	400 – 800 nm
532 nm	$\lambda/5$	9 ms	1.4 ms	400 – 800 nm
635 nm	$\lambda/6$	12 ms	1.8 ms	400 – 800 nm
785 nm	$\lambda/7$	19 ms	2.5 ms	600 – 1300 nm
1064 nm	$\lambda/10$	25 ms	3.3 ms	600 – 1300 nm
1550 nm	$\lambda/12$	33 ms	5.0 ms	850 – 1650 nm

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### 1 x 12,288 Analog Spatial Light Modulator

**Resolution:** 1 x 12,288  
**Array Size:** 19.66 x 19.66 mm  
**Pixel Pitch:** 1.6  $\mu$ m x 19.66 mm  
**Fill Factor:** 100%  
**Diffraction Efficiency\*:** 99%  
**Controller:** PCIe 16-bit

Wavelength	Liquid Crystal Response Time	AR Coatings (Ravg <1%)
405 nm	N/A	N/A
532 nm	4.5 ms	450 – 850 nm
635 nm	5 ms	450 – 850 nm
785 nm	8.5 ms	600 – 1300 nm
1064 nm	15 ms	600 – 1300 nm
1550 nm	30 ms	850 – 1650 nm

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# SPATIAL LIGHT MODULATORS

## Reflective Analog SLMs

All of Meadowlark's liquid crystal on silicon (LCoS) backplanes incorporate analog data addressing with high refresh rates to provide the lowest phase ripple SLMs available. Users can select standard or high speed liquid crystal for optimal performance. Liquid cooling systems are available to remove heat via the back of the SLM chip in order to maximize optical power handling capabilities.

**1920 x 1152** – New! This SLM offers large format, high fill factor (high optical efficiency), high-speed (as fast as 1.4 ms), low phase ripple (.2 – 3%), high optical power handling (up to 15 GW/cm<sup>2</sup> peak power density), and high refresh rate. This analog, high voltage backplane produces very stable phase patterns, coupled with fast liquid crystal response times.



**Large 512 x 512** – This high voltage, large pixel SLM is optimized for high power applications requiring faster response times. The analog, high fill factor, high refresh rate backplane provides better optical efficiency and high temporal stability. Large pixels reduce pixel-to-pixel crosstalk.

## Small 512 x 512 – Entry Level – Educational – Economical

Our legacy SLM is now available as our E-Series model. It is ideally suited for labs with a limited budget or researchers who do not require the high speed features of our premium SLMs, yet still demand high performance. This entry-level SLM is affordably priced without sacrificing quality.



**1 x 12,288** – The only high resolution linear array on a silicon backplane available on the market. The high refresh rate analog backplane provides excellent temporal stability. Our production process results in 100% fill factor, giving high optical efficiency.

**Optics Kit** – Includes optics & mounts for simple phase or amplitude experiments. Available pre-aligned and ready to use over 405 - 1550 nm. Available with optional camera and laser.



# SPATIAL LIGHT MODULATORS

## Transmissive SLMs

All of Meadowlark's liquid crystal on glass (LCoG) SLMs enable simple optical systems when low pixel counts are sufficient. Users can select single-mask or configurations for phase or amplitude modulation, or a dual-mask configuration for combined phase and amplitude modulation.

**1 x 128** – The Linear SLM has a linear pixel array geometry. This system 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. This linear SLM offers high fill factor, good transmitted wavefront distortion, and options for single or dual-plane for modulating phase, amplitude, or both simultaneously.



**Hex-127** – Our two dimensional hexagonal pixel transmissive SLMs are designed for adaptive optics applications. The SLM 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 through the Hex SLM. The most common applications involve high-resolution imaging where viewing through an aberrant medium is unavoidable.



Pixel Format	Response Time	Pixel Pitch	Efficiency	Fill Factor	Active Area (mm)
1 x 128	35 – 70 ms	100 μm	85 - 92%	98.0%	12.80 x 5.00
Hex	35 – 70 ms	1 mm	>90%	93.1%	12.00 Ø

# SPATIAL LIGHT MODULATORS

meadowlark optics

product snapshot

meadowlark optics

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SG01.18



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