

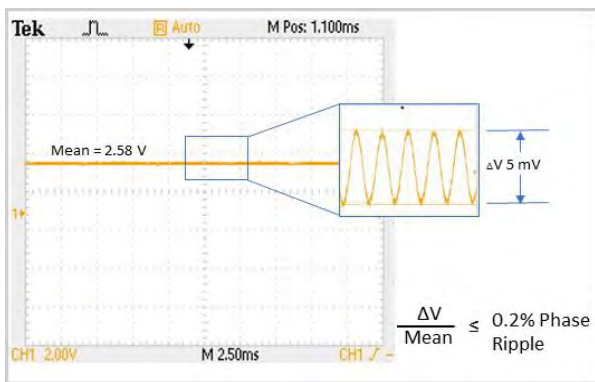
Spatial Light Modulator – 1920 x 1152

High Speed Analog

Meadowlark Optics’ Liquid Crystal on Silicon (LCoS) Spatial Light Modulators (SLMs) are uniquely designed for pure phase applications and incorporate analog data addressing with high refresh rates. This combination provides users with the fastest response times with high phase stability. Meadowlark offers both transmissive and reflective SLMs in either one or two dimensions. Phase-only SLMs can also be used for amplitude-only or a combination of both. The 1920 x 1152 SLM is good for applications requiring high speed, high diffraction efficiency, low phase ripple and high-power lasers.

High Speed with High Phase Stability - Great care was taken in the design of the 1920 x 1152 silicon backplane to enable high speed operation while simultaneously maximizing phase stability. Engineers successfully incorporated high refresh rates with analog drive schemes to suppress phase instabilities to an unprecedented 0.50 – 2.0% which, until recently, rivaled our standard speed systems. With the launch of our new 19x12 SLM, phase ripple was reduced even further to 0.10 – 0.30%. If your application requires extremely low phase ripple, please contact a Meadowlark Solutions Engineer for more information on the 19x12 SLM.

Phase ripple is quantified by measuring the variation in intensity of the 1st order diffracted spot as compared to the mean intensity while writing a blazed phase grating to the SLM.



1st order Intensity when writing a phase ramp to the SLM

Hardware Interface - The 1920 x 1152 SLM system includes a PCIe controller with input and output triggers and low latency image transfers.



PCIe Controller supports high frame rates (up to 844 Hz)



SLM Features

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- High resolution
- High speed
- High Phase Stability
- Pure analog phase control
- High first order efficiency
- High reflectivity
- High power handling
- Compact design
- Wavelengths from 488-1650 nm

Software Features

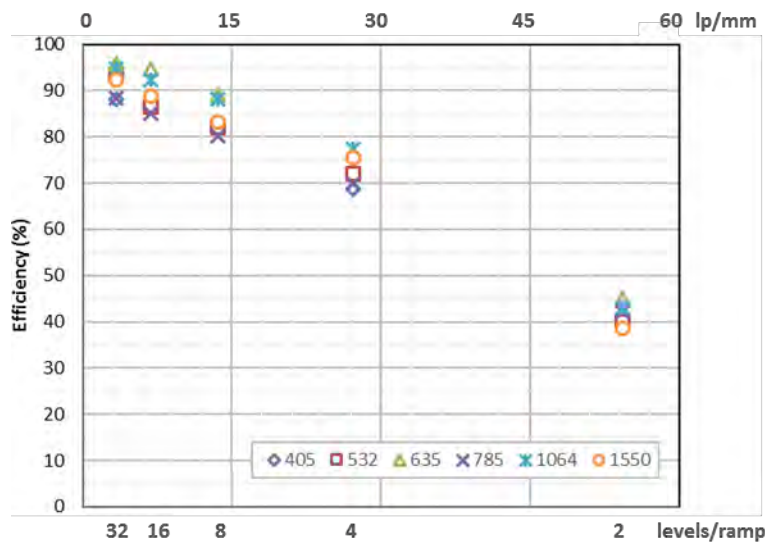
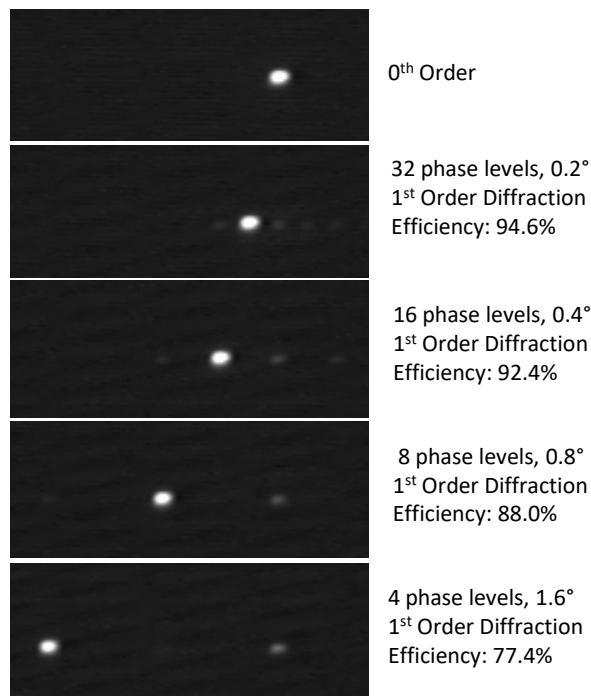
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- Input and Output Triggers
- Image Generation
- Automated Sequencing
- Wavefront Calibration
- Global and Regional Look Up Tables



Diffraction Efficiency (1st-order) - This is the percentage of light measured in the 1st-order when writing a linear repeating phase ramp to the SLM as compared to the light in the 0th order when no pattern is written to the SLM. Diffraction efficiency varies as a function of the number of phase levels in the phase ramp. An example measurement, taken at 1064 nm is shown below left, for phase ramps with 4 to 32 phase levels between 0 and 2π . The plot below right shows sample 1st order diffraction efficiency measurements, as a function of the phase ramp period, taken at various wavelengths.

Measured 1st Order Diffraction Efficiency

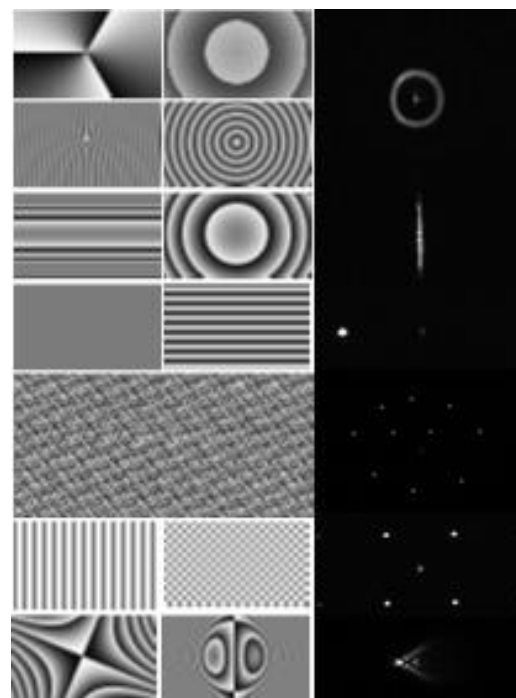


Software - Meadowlark Optics' SLMs are supplied with a graphical user interface and software development kits that support LabVIEW, Matlab, Python, and C++. The software allows the user to generate images, to correct aberrations, to calibrate the global and/or regional optical response over 'n' waves of modulation, to sequence at a user defined frame rate, and to monitor the SLM temperature.

Global or Regional Calibrations - Regional calibrations provide the highest spatial phase fidelity commercially available by regionally characterizing the phase response to voltage and calibrating on a pixel by pixel basis.

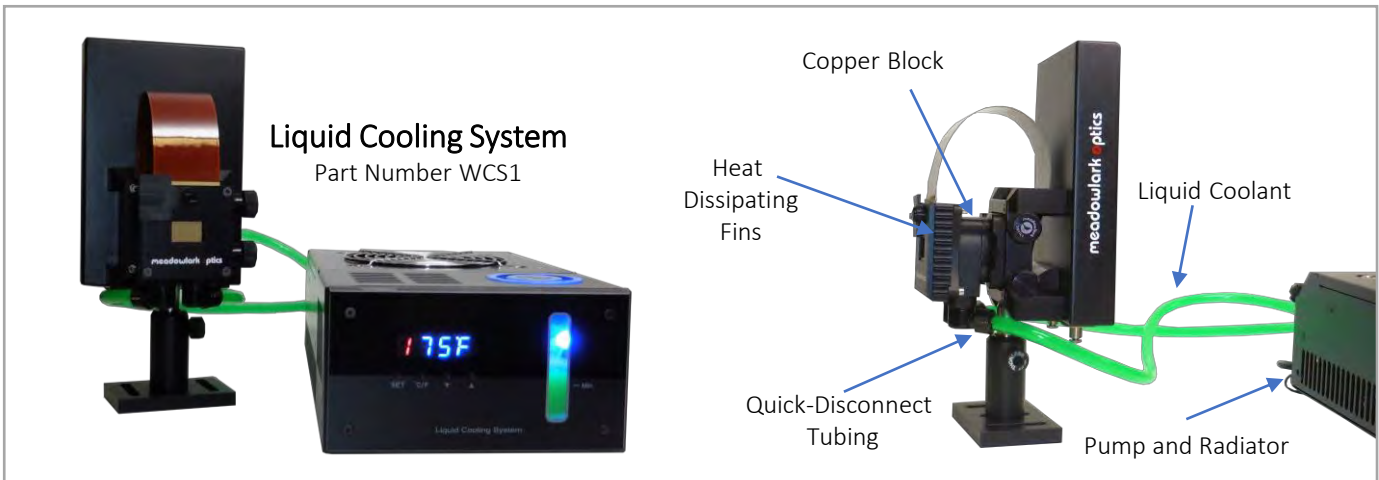
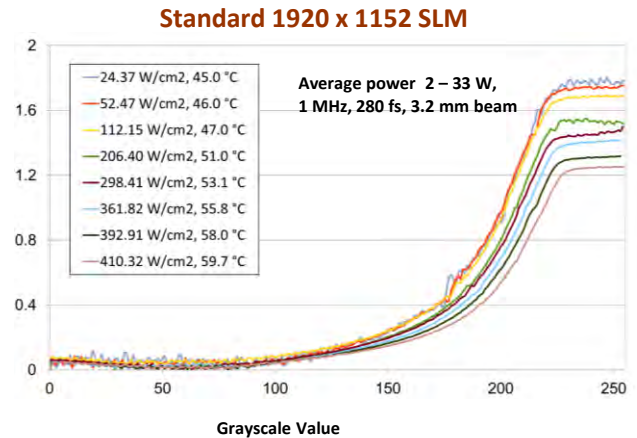
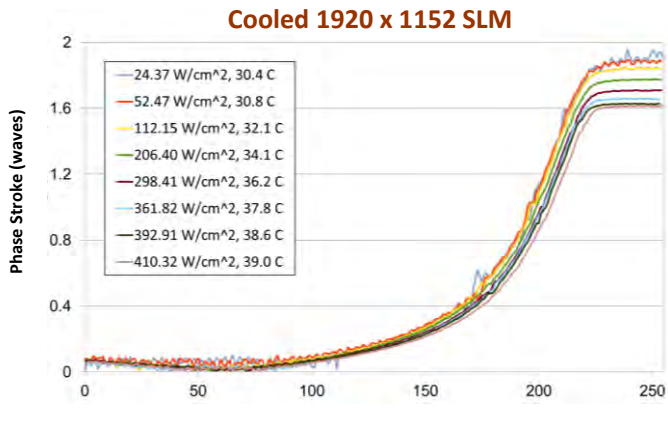
Image Generation Capabilities

- Bessel Beams: Spiral Phase, Fork, Concentric Rings, Axicons
- Lens Functions: Cylindrical, Spherical
- Gratings: Blazed, Sinusoid
- Diffraction Patterns: Stripes, Checkerboard, Solid, Random Phase
- Holograms, Zernike Polynomials, Superimpose Images





High Power Capability - Meadowlark Optics' Spatial Light Modulators have been tested for compatibility with high power pulsed and CW lasers. In the graphs below, the optical response of the 1920 x 1152 pixel SLM with and without liquid cooling was measured as the incident power was incremented up to 15 GW/cm² peak power or 410 W/cm² average power.



A copper block is attached to the back of the SLM to draw heat out of the SLM. The copper block is attached with 2 meters of quick-disconnect tubing to cooling unit containing an external pump, radiator, and fan to cool the liquid down to ambient temperature. Includes one bottle of liquid coolant.



1920 x 1152 Analog Spatial Light Modulator Specifications

Resolution: 1920 x 1152

Array Size: 17.6 x 10.7 mm

Zero-Order Diffraction Efficiency*: 88%

Fill Factor: 95.7%

Pixel Pitch: 9.2 x 9.2 μm

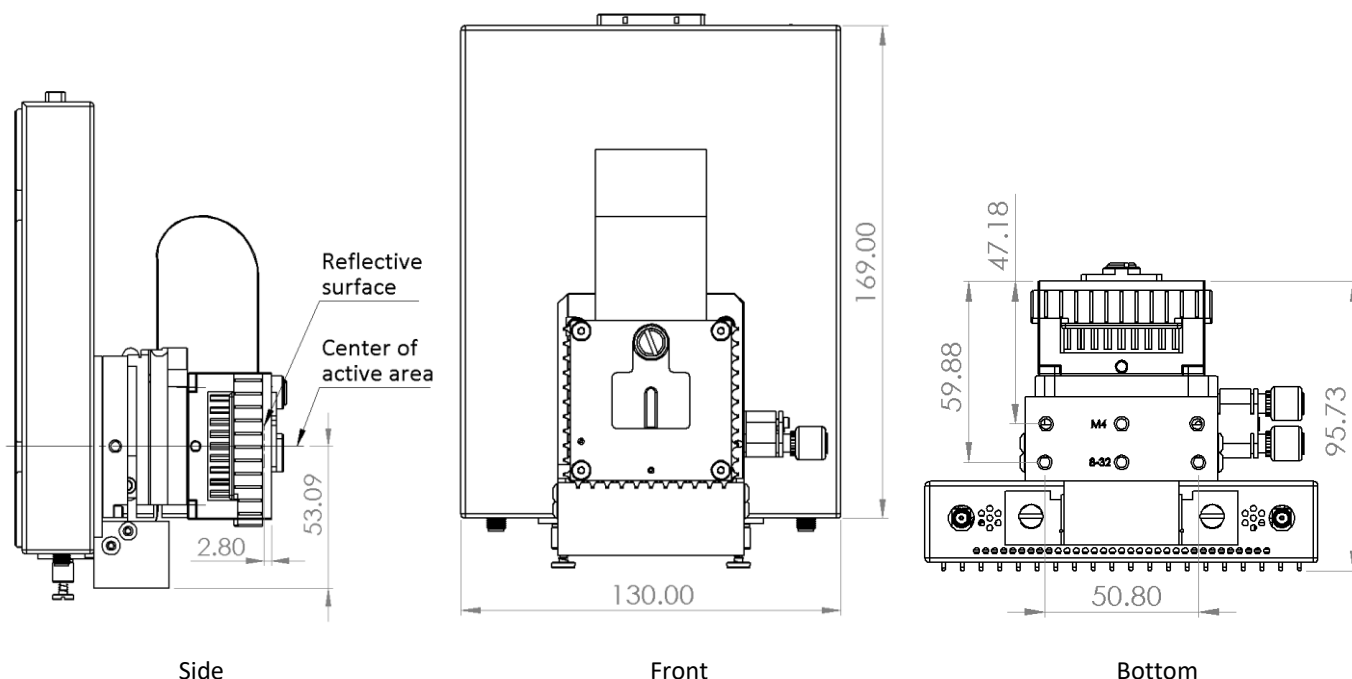
Controller: PCIe 8/12-bit

High Speed System – High Speed Liquid Crystal with High Speed PCIe Controller

Specify Calibration Wavelength	Wavefront Distortion	LC Response Time / System Frame Rate	AR Coatings (Ravg <1%)	Reference this Model Number when Ordering
532 nm	$\lambda/5$	1.4 ms / 422.4 Hz	488 – 800 nm	Model HSP1920-488-800-HSP8
635 nm	$\lambda/6$	1.8 ms / 422.4 Hz	488 – 800 nm	
785 nm	$\lambda/7$	2.3 ms / 422.4 Hz	500 – 1200 nm	Model HSP1920-500-1200-HSP8
1064 nm	$\lambda/10$	3.3 ms / 281.6 Hz	500 – 1200 nm	
1550 nm	$\lambda/12$	4.7 ms / 211.2 Hz	850 – 1650 nm	Model HSP1920-850-1650-HSP8

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

PCIe 1920 x 1152 System Dimensions



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フォトテクニカ株式会社

〒336-0017 埼玉県さいたま市南区南浦和 1-2-17

TEL: 048-871-0067 FAX: 048-871-0068

e-mail: voc@phototechnica.co.jp