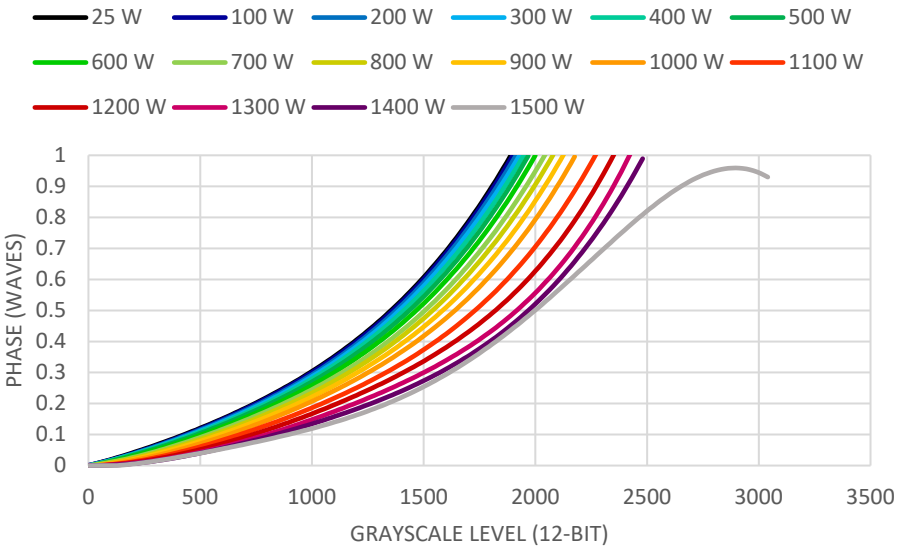
Spatial Light Modulator – 1024 x 1024

Ultra-High Power – ≥ 1 kW at 1070nm

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 (1400 Hz). This combination provides users with the fastest response times with high phase stability.

High average power handling - The newest SLM from Meadowlark Optics boasts CW power handling of ≥ 1 kW at 1070 nm. In tests at SPICA, the SLM retained its full >1 wave range of phase modulation at powers up to 1.4 kW. With sapphire coverglass, built-in water cooling and a suite of calibration tools, the high power SLM can maintain calibrated performance under extreme laser power loads.

Maintaining full phase modulation under high power loads



Measured phase-voltage response at 1070 nm showing the SLM's ability to maintain a full wave of calibrated phase control. Tools are available so the SLM can be calibrated for well-controlled performance at every operating power level in range.

SLM Features

- 17.4 x 17.4 mm active array
- 1024 x 1024 pixel count
- 97.20% fill factor
- Water-cooled
- TEC active heat dissipation
- AR-coated sapphire coverglass
- Dielectric mirrored backplane
- 750-850 nm or 980-1150 nm
- Pure analog phase control
- On-board Memory

Software Features

- Input and Output Triggers
- Image Generation
- Automated Sequencing
- Wavefront Calibration
- Global and Regional Look Up Tables
- Temperature Monitoring
- Look-up-table Calibration Kit

Designed for high power– The Ultra-High Power SLM is designed for performance under high laser power loads.

Active TEC cooling – The UHP SLM includes active thermoelectric cooling to stabilize operating temperature (at lower heat loads) and to combat laser-induced heating at higher temperatures.

Water cooling – The UHP SLM includes a water-cooled copper heat sink with quick-disconnect tubing to connect to an external chiller.

Sapphire coverglass – The high thermal conductivity of the sapphire coverglass allows heat to be directed away from the active area. The SLM housing is designed to thermally contact the coverglass and provide a heat dissipation path into the water-cooled heat sink.

High-temperature liquid crystal – The UHP SLM has a custom liquid crystal formulation that maintains its performance at elevated temperatures, allowing the usable power range of the SLM to be extended.

Real-time temperature reporting – On-chip temperature sensors allow the user to monitor the SLM temperature either through the example program or the software developer kits.

Calibration for high performance at high power – A lookup table calibration kit allows the user to calibrate the SLM at their laser's wavelength and power level.

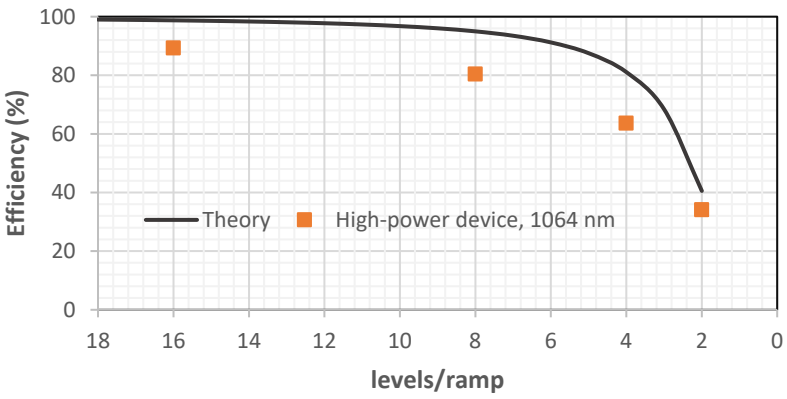
1024 x 1024 Analog Spatial Light Modulator Specifications

Resolution: 1024 x 1024
Fill Factor: 97.2%

Array Size: 17.40 x 17.40 mm
Pixel Pitch: 17 x 17 µm

Zero-Order Diffraction Efficiency:
95% (at 1064 nm)

Standard Calibration Wavelengths	Coating range	Average power rating	HIGH AVERAGE POWER Liquid crystal response time vs operating temperature		
			19 C	44 C	70 C
785 nm	750 – 850 nm	(tests pending)	(tests pending)	(tests pending)	(tests pending)
1064 nm	980 – 1150 nm	≥ 1000 W (at 1070 nm)	≤ 100 ms	≤ 22 ms	≤ 8.1 ms



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. 1st-order diffraction efficiency varies as a function of the number of phase levels, or pixels, in the phase ramp.

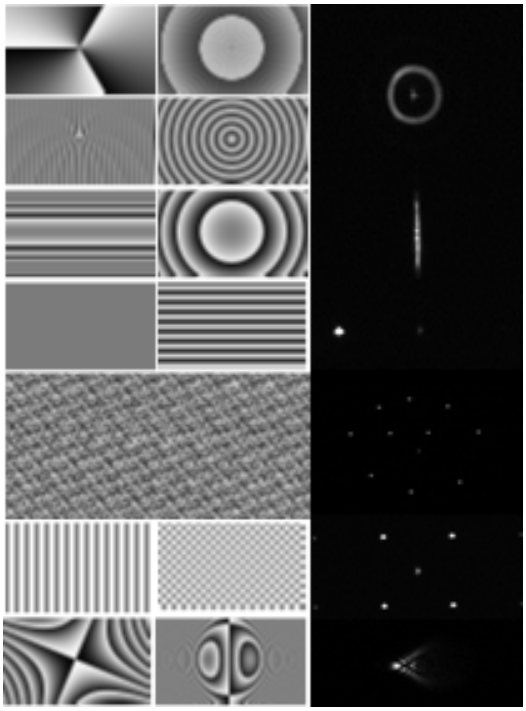
***0th order diffraction efficiency** at 1064 nm: 95%*

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.

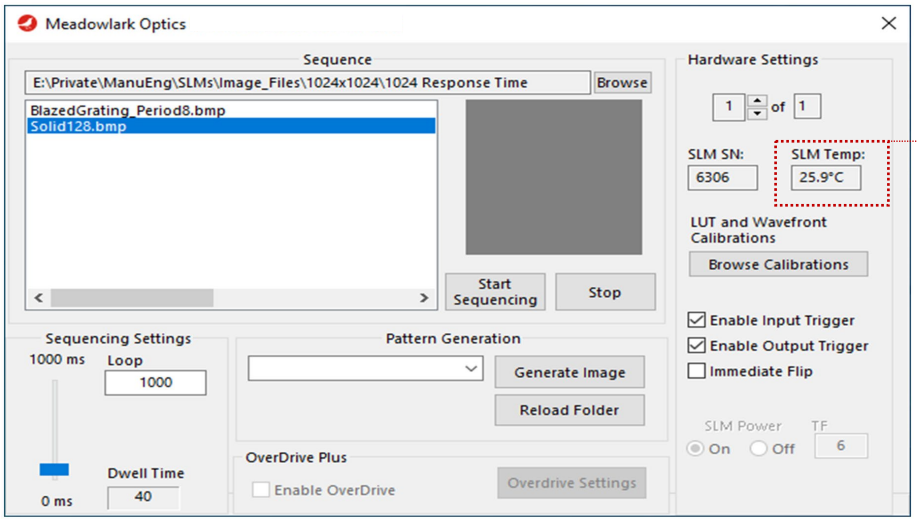
Image Generation Capabilities

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



Example beamshaping and multibeam generation options included in software

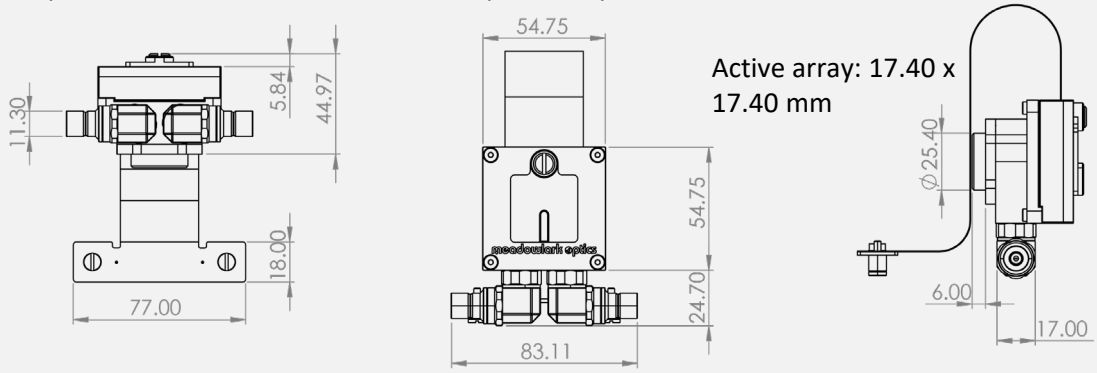
Optional Look-Up-Table Calibration Kit (Part Number LUT1)
Meadowlark includes a calibrated LUT at one of our standard test sources (405, 532, 635, 785, 1064, or 1550 nm). If the user wants to work at a different wavelength or at a high power load, we recommend purchasing our Look-Up-Table Calibration Kit. It provides the tools needed to create a custom LUT based on the user's wavelength and operating temperature for optimal performance. The kit is shipped with software and a National Instruments NI-6000 data acquisition card. The user only needs to provide a photodetector at their desired wavelength.



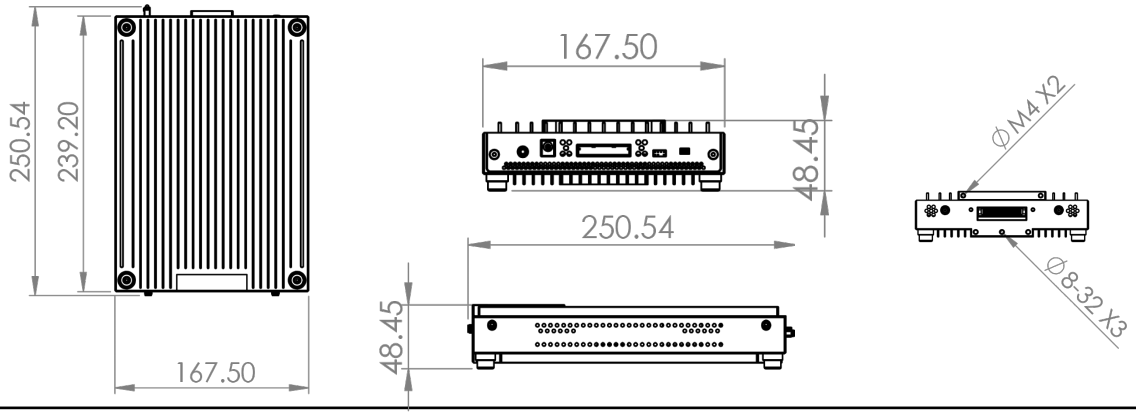
On chip temperature sensors allow the user to monitor the SLM temperature either through the example program or the software developer kits.

Liquid Cooled Optical Head

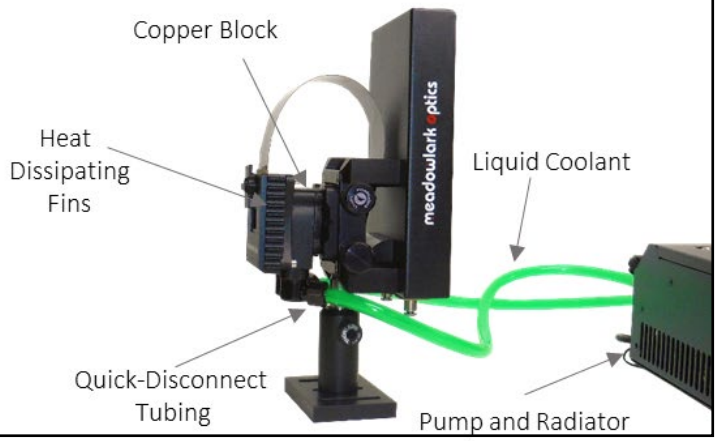
Note: optical head also includes TEC control port (not pictured)



PCIe Controller



Note: radiant cooler/chiller model depends on heat dissipation requirements.



Thermo-electric controller

A thermo-electric controller provides active heat dissipation toward a liquid-cooled copper block.