

NEW SLM-128 MODELS!

Same mask size,
but in a much smaller enclosure



Simultaneous Phase and Amplitude modulation of your VIS or NIR beam with no moving parts, and now easier to integrate with a 128-pixel SLM enclosure **less than half the size** of before!

CRI has been manufacturing Spatial Light Modulators (SLMs) for the ultrafast laser community for over a decade—the leader in liquid crystal (LC) linear-array SLMs. Based on proven industry-leading designs, CRI offers both single-mask and dual-mask configurations for phase, amplitude, or simultaneous phase/amplitude pulse shaping.

CRI collaborated with the Massachusetts Institute of Technology (MIT) on the initial development of modern LC SLMs, and is the exclusive worldwide licensee of MIT's technology for bonded optical masks providing simultaneous phase and amplitude control in a single device. CRI's SLMs feature a fast, plug-and-play USB interface with a free Software Developer's Kit (SDK) that includes Windows® DLL support, LabVIEW™ and Matlab® drivers, as well as a full serial command set for use with other operating systems.

Features & Benefits

- Solid-state for rapid, vibrationless operation
- Single-mask or dual-mask designs for Phase, Amplitude, or simultaneous Phase/Amplitude control
- VIS or NIR wavelength ranges
- Smaller SLM-128 enclosure for easier integration
- USB interface for efficient low-power operation and easy software integration

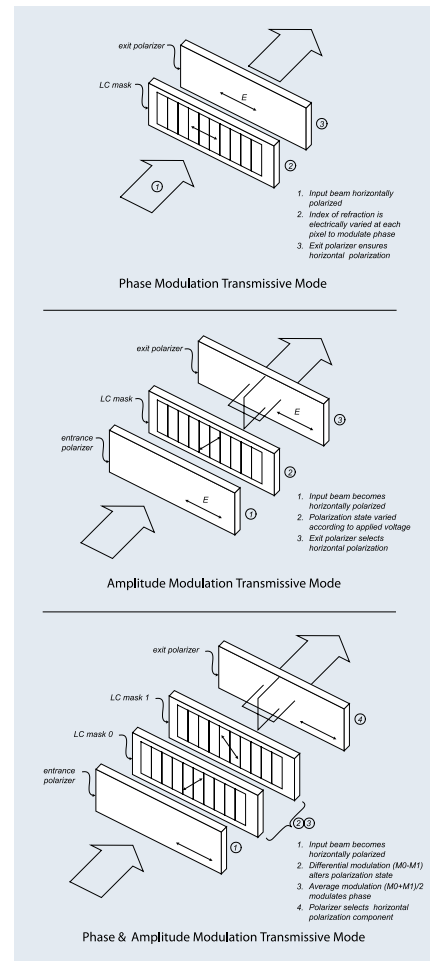
Liquid Crystal Optical Modulation

CRI's SLM optics use nematic LC to alter the phase or the polarization state of light. The LC provides an electrically variable index of refraction for light that is polarized along the crystal's "extraordinary" axis. The refractive index of light that is polarized along the "ordinary" axis (also called the orthogonal axis), is not changed.

Depending on the orientation of the extraordinary axis of the LC and the placement of linear polarizers in front and/or behind the LC, a single-mask SLM can modulate a beam's Phase or Amplitude.

CRI's dual-mask models use a patented arrangement where a pair of LC masks are bonded together in precise registration and proximity of 1.03 mm. The masks are oriented orthogonal to one another and 45 degrees to the polarization of incident light. This arrangement enables the independent adjustment of both Phase and Amplitude. Removing the polarizers and driving both masks with the same patterns so the differential is zero allows the SLM to be used as a pure Phase modulator for arbitrarily polarized light.

An available surface-coated mirror allows the beam to pass through the system twice. This so-called "double-pass" configuration doubles the optical modulation of the SLM and can result in faster time response when changing between different drive patterns.



Specifications

	SLM-128-P / SLM-128-A	SLM-128-D	SLM-640-P / SLM-640-A	SLM-640-D
LC optics masks	1	2	1	2
Pixels per mask	128		640	
Pixel height	5000 μm (5 mm)			
Pixel pitch	100 \pm 0.005 μm			
Interpixel gap ¹	2.0 μm			
Intermask alignment ^{2,3}	n/a	\pm 2.0 μm	n/a	\pm 2.0 μm
Intermask separation ^{2,4}	n/a	1.03 mm	n/a	1.03 mm
Spectral range ⁵	488—900 nm (VN models), 900 nm—1620 nm (NM models)			
Transmission (VN) ¹³	> 88%	> 85%	> 88%	> 85%
Transmission (NM) ¹³	> 92%	> 90%	> 92%	> 90%
Pulse damage threshold	100 $\mu\text{J}/\text{cm}^2$ (490 nm, 50 fs, 1 kHz), 200 $\mu\text{J}/\text{cm}^2$ (890 nm, 50 fs, 1 kHz)			
Maximum modulation ^{6,7}	3 π radians at longest wavelength			
Modulation temperature coefficient ⁸	-0.3% modulation per $^{\circ}\text{C}$			
Response time ⁹⁻¹²	35 ms (2 π radians at 900 nm, VN models), 70 ms (2 π radians at 1620 nm, NM models)			
Drive waveform	Bipolar 3.3 kHz square wave			
Drive resolution	12-bit, 2.44 mV per step			
Frame buffers	128		32	
Interfaces	USB 1.1, 5V / 3.3V logic trigger (TTL compatible)			
Power	+24V DC via worldwide switching transformer (4 plugs included)			
Mechanical mounting	3 x 1/4" -20 and 2 x M6 threaded holes			
Overall size	5.29" x 6.90" x 0.98"		7.2" x 12.8" x 1.54"	
Operating temp	18—35 $^{\circ}\text{C}$			
Storage temp	-15—50 $^{\circ}\text{C}$			

Notes

- Median size of the photolithographic gap between adjacent pixel electrodes. Actual optical response within this gap and in the adjacent region is determined by electrostatics and the liquid crystal material properties.
- Applies to dual-mask models only.
- Lateral misalignment between pixel 0 of the first and second mask.
- Separation along the optical path between first and second mask, in medium (n=1.51).
- For standard models. Operation over the range of 400—1650 nm is possible with derated performance due to reduced coating and polarizer efficiency outside the optimal range.
- Used single-pass, (i.e. in transmission). Modulation is doubled when the SLM is used in reflection, since the light traverses the optics twice.
- Specified at the longest wavelength in the operating range. Maximum modulation is greater at shorter wavelengths.
- Properties of liquid crystal vary with temperature which, in turn changes the modulation response of the SLM. The temperature coefficient is typically decrease in 0.3 % modulation per increase in 1 $^{\circ}\text{C}$.
- All response times are measured at 25 $^{\circ}\text{C}$, and improve at higher temperatures.
- Settling time to 95% for step from minimum modulation to listed modulation.
- Settling is faster for transition in the opposite direction, (i.e., from stated modulation to minimum modulation).
- Includes the electronic circuitry response from trigger pulse or P (frame-select) command.
- Without polarizers.

Your local CRI sales representative or distributor is:



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Spatial Light Modulators

SLM Available Configurations

SLM - xxx - m - ww

xxx = number of pixels per mask (128 or 640)

m = modulation mode (P = phase, A = amplitude, or D = dual)

ww = wavelength range (VN = 488—900 nm or NM = 900—1620 nm)

Examples

SLM-128-A-VN = Spatial light modulator with a single 128-pixel mask configured for amplitude modulation in the 488—900 nm wavelength range.

SLM-640-D-NM = Spatial light modulator with dual 640-pixel masks (640 pixels x 2 masks) configured for simultaneous phase and amplitude modulation in the 900—1620 nm wavelength range.

Standard items included with all models

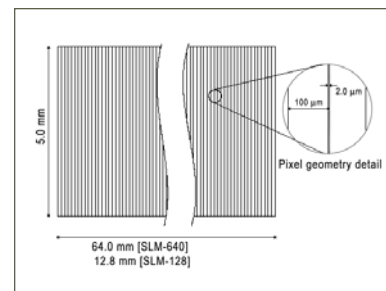
All SLM models include integral control electronics with USB 1.1 interface, cables, worldwide switching power transformer, and software drivers. Phase modulators include one removable polarizer. Amplitude and Dual-Mask modulators include two removable polarizers.

Accessories

An optional reflective surface is available to enable a reflective (double-pass) configuration.

How can I obtain more technical information?

Contact CRI by e-mail or telephone or visit our website at www.cri-inc.com/slm for more information.



CRI's Spatial Light Modulators utilize liquid crystal (LC) masks manufactured in CRI's own state-of-the-art fabrication facility in the USA. Dual-mask models feature precisely aligned optical masks providing simultaneous phase and amplitude control in a single device.

About CRI

Cambridge Research & Instrumentation, Inc. (CRI) is a Boston-based company providing innovative optical imaging solutions to our customers for more than 20 years. Our multidisciplinary team is dedicated to working with our academic and commercial customers to provide high-value solutions. With over 80 patents pending and issued, our innovations are being utilized around the world to enable new breakthroughs in research, health and medicine.

We offer a broad array of tunable, solid-state optical components and modules for use in wavelength selection, polarization optics, telecommunications, and light modulation in optical processing applications.

CRI services a global network of distributors and partners through direct sales of systems and through strategic alliances as an OEM supplier.

Contact us at +1-781-935-9099 or visit www.cri-inc.com/slm to learn more about our Spatial Light Modulators or to obtain a sales quotation.

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