

SLM

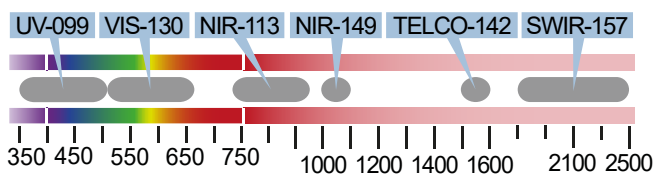
Spatial Light Modulators



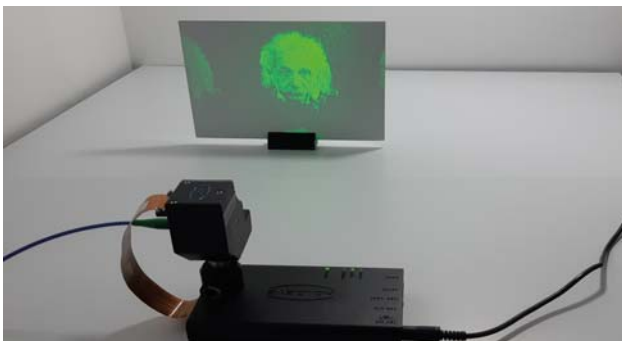
Pioneers in Photonic Technology

High Reflectivity Versions

Some PLUTO-2.1 SLM display versions are equipped with a dielectric mirror coating to increase the reflectivity. Due to the increased reflectivity less absorption occurs and these versions can be used with higher incident laser power compared to the standard versions.



Device	λ Range	Maximum Phase	Average Refl.
UV-099	350-500 nm	4.9π @ 405 nm	90%
VIS-130	500-660 nm	2.5π @ 633 nm	94%
NIR-113	730-940 nm	2.5π @ 800nm	95%
NIR-149	1000-1100 nm	2.9π @ 1064 nm	93%
TELCO-142	1500-1600 nm	3.0π @ 1550 nm	90%
SWIR-157	1700-2500 nm	2.0π @ 2500 nm	90%



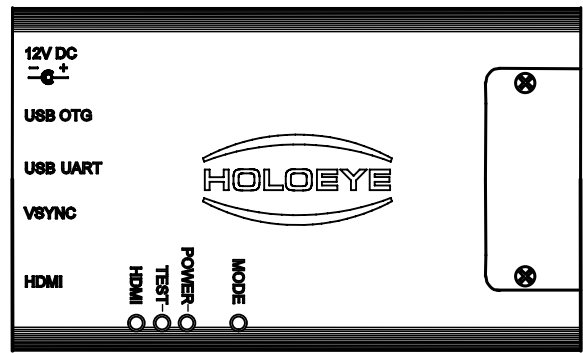
PLUTO-2.1 Flexible Driver

All PLUTO phase display versions can be driven with the same PLUTO-2.1 driver unit. This provides the flexibility to upgrade / adapt the SLM device to another version for different applications without the need to purchase a complete new SLM kit.

The PLUTO-2.1 driver uses an HDMI interface for addressing phase functions and an USB connection to communicate with the driver (to

change the voltage vs. gray level distribution (gamma control) and dynamic range (voltage across the LC cell) in order to calibrate the SLM for different wavelengths).

The driver has a trigger sync output to synchronize the device with external devices.



The PLUTO-2.1 driver features a dual-core ARM® Cortex™-A9 processor which includes on-chip memory. This enables the user to program additional functionality which is directly processed on the SLM device.

The dual-core system runs an embedded Linux™ SMP operating system and includes a library which provides full control and supervision of the display and driver board.



LUNA

Phase Only Spatial Light Modulator Series



The LUNA Spatial Light Modulator is our most compact SLM platform for integration into small sized or even portable solutions.

The LUNA SLM is based on a small sized 0.39" LCOS microdisplay with a resolution of 1920 x 1080 pixels and 4.5 μm pixel pitch. The small pixel pitch of 4.5 μm enables high diffraction angles and a spatial resolution of 111 lp/mm.

Display Type	Reflective LCOS
Resolution	1920 x 1080 Pixel
Pixel Pitch	4.5 μm
Active Area / Diagonal	8.64 mm x 4.86 / 0.39"
Fill Factor	91%
Addressing Bit Depth	8 Bit
Input Frame Rate*	60 Hz / (180 Hz - CFS)*
Signal Format	DisplayPort - HD Res.

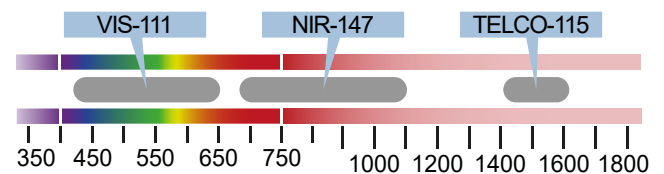
*Please note that this is the input frame rate. The actual response time of the LC material depends on the version and configuration.

LUNA Series Versions

HOLOEYE offers three versions of the LUNA Spatial Light Modulator optimized for different wavelength ranges.

- The LUNA-VIS-111 version is optimized for 420 to 650 nm and CFS mode
- The LUNA-NIR-147 version covers the wavelength range from 680 to 1100 nm
- The LUNA-TELCO-115 version is designed for typical telecommunication wavelengths in the area of 1400 - 1600 nm

The LUNA SLM is addressed at 60 Hz input frame rate using a state-of-the-art DisplayPort interface. The driver also features an USB connector for power supply and advanced configurations / calibrations.



Version	λ Range	Maximum Phase	Average Refl.
VIS-111	420-650 nm	2.4 π @ 635nm	61-67 %
NIR-147	680-1100 nm	2.3 π @ 1064nm	60-75 %
TELCO-115	1400-1600 nm	2.3 π @ 1550nm	70 %

Small Design & Integrated ASIC

For the LUNA Spatial Light Modulator series the driver ASIC is embedded in the LCOS microdisplay itself. This saves board space which enables a very compact driver, makes integration more convenient and enables implementation into small sized and portable solutions. The standard driver box has a size of only 85 x 47 x 28.8 mm.

The microdisplay can even accept video data input via a 4-lane MIPI DSI. This novel approach brings phase only Spatial Light Modulator technology to a new level of potential for industrial implementations.



ERIS

Analog Phase Only Spatial Light Modulator Series



The analog ERIS Spatial Light Modulator shows extreme phase stability, low latency and the display architecture allows low crosstalk LCOS-cell designs.

The ERIS phase only Spatial Light Modulator is based on an 0.717" LCOS microdisplay with a resolution of 1920x1200 pixels and 8 μm pixel pitch. The SLM provides 8-bit phase levels but can also be operated in 10-bit phase mode.

Display Type	Reflective LCOS
Resolution	1920 x 1200 Pixel
Pixel Pitch	8.0 μm
Active Area / Diagonal	15.42 x 9.66 mm / 0.717"
Fill Factor	>92%
Addressing Bit Depth	8 Bit / 10 Bit
Input Frame Rate*	60 Hz
Signal Format	HDMI

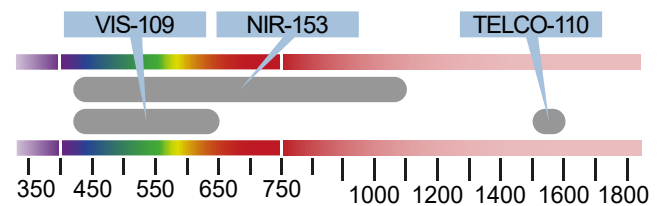
*Please note that this is the input frame rate. The actual response time of the LC material depends on the version and configuration.

ERIS SLM Series Versions

The ERIS series covers 3 versions optimized for different wavelength ranges.

- ➔ The ERIS-VIS-109 version can be used between 420 and 650 nm
- ➔ The ERIS-NIR-153 version covers a broad wavelength range from 420 to 1100 nm
- ➔ The ERIS-TELCO-110 version is designed for typical telecommunication wavelengths in the area of 1500 - 1600 nm (e.g. C-Band 1550 nm).

The ERIS SLM is addressed at 60 Hz input frame rate using 256 (8-bit) phase levels. The device can also be configured for 1024 (10-bit) phase levels.



Version	λ Range	Maximum Phase	Average Refl.
VIS-109	420-650 nm	2.9 π @ 633nm	73%
NIR-153	420-1100 nm	2.4 π @ 1064nm	76-90 %
TELCO-110	1500-1600 nm	2.1 π @ 1550nm	89 %

ERIS Flexible Driver

The ERIS driver provides an HDMI interface, a USB connection for calibration and a trigger sync output.

The driver features an embedded dual-core ARM® Cortex™-A9 processor running an embedded Linux operating system, which provides USB and network interfaces to address phase functions and do calibrations without the need for an HDMI interface.

In addition, the embedded system can be used to compute or store phase functions / images directly on the device.



TMS

Thermal Management Systems



SLM Thermal Management Solutions

HOLOEYE SLMs are based on Liquid Crystal microdisplays. Physical properties of LC materials show a certain temperature dependence and a change in temperature may influence different optical SLM properties (phase shift, switching speed, phase stability...). SLM displays have their own power dissipation which varies between products and configurations.

To keep the performance / temperature stable an active thermal management system should be used.

Dependent on the device model and its power dissipation, the device version's reflectivity and the laser power used, HOLOEYE offers a thermal management system with passive heat sink or a system based on an active water cooling.



All HOLOEYE LCOS SLM displays feature an integrated temperature sensor. A USB connection is used to connect the temperature control unit to the PC.

The SLM Configuration Manager software can be used to read out the microdisplay temperature and keep it stable at a defined temperature.

TMS 001

The TMS 001 thermal management system is based on a Peltier element (thermoelectric cooler) in combination with a passive heat sink and can both cool and heat up the SLM display.



TMS 002

Even using HOLOEYE's high reflectivity SLM versions (with dielectric mirror) an active thermal management is required for high laser power applications. The TMS 002 thermal management system with active water cooling is especially designed for the use with higher laser power.



The up-to date display versions of all these SLM platforms use a standardized display packaging with a ceramic stiffener / back plate with excellent thermal conductivity. The displays can be mounted using the integrated magnets or by screws if required.

SLM Software

Software for HOLOEYE Spatial Light Modulators

All HOLOEYE Spatial Light Modulators are addressed like a monitor via standard HDMI or DisplayPort. Meaning the SLM actually acts like a standard monitor device and no special software or drivers are necessary to operate the SLM (standard image viewer software can be used).

For an easy start and even more convenient operation HOLOEYE provides a Pattern Generator software (for calculation of different optical functions), a Slideshow Player software (for easy addressing of precalculated functions

or images on the SLM) and an SDK for different programming environments.

The SLM Display SDK also supports the use of multiple SLMs simultaneously and offers a canvas mode to address different functions/content on tiled SLM display area.

Of course also a convenient Configuration Manager software for configuration, calibration and temperature management is delivered with each Spatial Light Modulator device.



SLM DISPLAY SDK

SDK for LabView, Matlab, Python Octave and GCC environments



SLM CONFIGURATION MANAGER

Software for device configuration and calibration



SLM PATTERN GENERATOR

Generation of different optical functions



SLM SLIDESHOW PLAYER

Image slideshow software for HOLOEYE SLMs