SLM

Spatial Light Modulators

HOLOEYE **Pioneers in Photonic Technology**

Spatial Light Modulators

HOLOEYE´s Spatial Light Modulator (SLM) systems are based on translucent or reflective liquid crystal microdisplays. These devices can modulate light spatially in amplitude or phase, so they act as a dynamic optical element. The optical function or information to be displayed can be taken directly from the optic design software or an image source and can be transferred by a computer interface.

Implementation is accomplished using the DVI or HDMI port of a standard PC graphics card. The SLM can be used just like an external plug & play monitor.

SLM Software Features

All HOLOEYE Spatial Light Modulators can be controlled by a Configuration Manager (Windows). This software gives the opportunity to control all relevant image parameters and provides an easy gamma control to configure the device for different applications and wavelengths.

Aditionally an SLM Pattern Generator Software is delivered with the SLM. Key features are:

- computation of computer generated holograms (CGH) from user defined images
- generation of SLM signals representing basic optical functions such as lenses, gratings, axicon and vortex functions
- superposition of CGH's with basic optical functions to combine functionalities

For easy display of images and image sequences on the Spatial Light Modulator an SLM Slideshow Player software is also delivered with the kit.

Besides that an SLM Display Software Development Kit (SDK) is availalbe which provides APIs (Application Programming Interface) for National Instruments™ LabVIEW, MathWorks® MATLAB®, Octave and Python™ environments.

PLUTO-2 - Phase Only Spatial Light Modulator Series

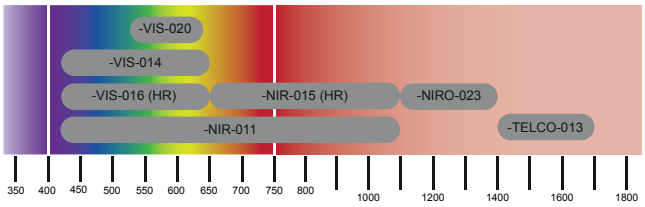
The PLUTO-2 phase modulator models are based on reflective LCOS microdisplays with 1920 x 1080 pixel resolution and 8.0 µm pixel pitch.

Display Type	Reflective LCOS
Resolution	1920 x 1080 Pixel
Pixel Pitch	8.0 µm
Active Area / Diagonal	15.36 x 8.64 mm / 0.7”
Fill Factor	93%
Addressing Bit Depth	8 Bit
Input Frame Rate	60 Hz / (180 Hz)
Signal Format	HDMI - HDTV Res.

The PLUTO-2 series covers different versions optimized for different applications and wavelength ranges from 350 nm up to 1700 nm. Furthermore high retardation display panels are available (VIS and NIR) which enable a modulo 4 π or 6 π encoding of optical functions depending on the wavelength.

The pulse code modulation for digitally addressed devices leads to a slight superimposed phase flicker. For some applications a stable phase response is required. This can be accomplished driving the high retardation panels with low voltage settings for 2 π phase retardation, however compromising the response time.

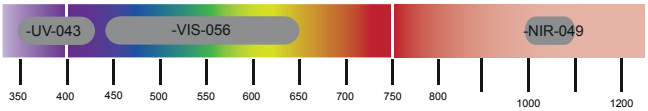
All different phase display versions can be driven with the same PLUTO-2 driver units which use fast full digital addressing to assure high reliability and a compact driver unit.



Device	λ Range	Fill Factor	Maximum Phase	Average Reflectivity
PLUTO-2-VIS-014	420-650 nm	93 %	2.7 π @ 633 nm	65 %
PLUTO-2-VIS-016	420-650 nm	93 %	5.4 π @ 633 nm	65 %
PLUTO-2-VIS-020	530-640 nm	93 %	8.2 π @ 633 nm	75 - 80 %
PLUTO-2-NIR-011	420-1100 nm	93 %	2.0 π @ 1064nm	65 - 75 %
PLUTO-2-NIR-015	650-1100 nm	93 %	3.7 π @ 1064 nm	65 - 75 %
PLUTO-2-NIRO-023	1100-1400 nm	93 %	4.1 π @ 1300 nm	74 %
PLUTO-2-TELCO-013	1400-1700 nm	93 %	3.5 π @ 1550 nm	80 %

PLUTO-2 - High Reflectivity Versions

Some PLUTO-2 SLM display versions are equipped with a dielectric mirror coating to increase the reflectivity. Due to the increased reflectivity less absorption occurs and these display versions can be used with higher incident laser power compared to the standard versions.



Device	λ Range	Fill Factor	Maximum Phase	Average Reflectivity
PLUTO-2-UV-043	350-420 nm	93 %	2.3 π @ 405 nm	90 %
PLUTO-2-VIS-056	450-650 nm	93 %	2 π @ 650 nm	93 %
PLUTO-2-NIR-049	1000-1100 nm	93 %	2 π @ 1064 nm	93 %

LETO - Phase Only Spatial Light Modulator

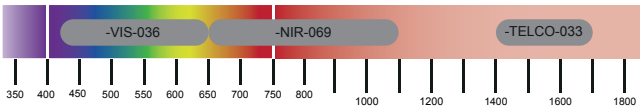
The LETO phase modulator is based on reflective LCOS microdisplays with 1920 x 1080 pixel resolution. With a pixel pitch of only 6.4 µm and small interpixel gaps of 0.2 µm the LETO SLM provides a high fill factor of 93% and thereby high light efficiency. The LETO is also prepared to work in color-field-sequential (CFS) mode. For operation with color-switchable LASER the LED connector can be used to synchronize the light source.

Display Type	Reflective LCOS
Resolution	1920 x 1080 Pixel
Pixel Pitch	6.4 µm
Active Area / Diagonal	12.5 x 7.1 mm / 0.55”
Fill Factor	93 %
Addressing Bit Depth	8 Bit
Input Frame Rate	60 Hz / 180 Hz
Signal Format	HDMI - HDTV Res.

GAEA-2 - 10 Megapixel Phase Only Spatial Light Modulator

The GAEA-2 phase modulators are based on reflective LCOS microdisplays with 4160 x 2464 pixel resolution and 3.74 µm pixel pitch.

Currently the GAEA series covers a version for the visible (420 - 650 nm), the near IR (650-1100 nm) and a version for the area of 1400-1700 nm.



Display Type	Reflective LCOS
Resolution	max . 4160 x 2464 Pixel
Pixel Pitch	3.74 µm
Active Area / Diagonal	15.32 x 9.22 mm / 0.7”
Fill Factor	90 %
Addressing Bit Depth	8 Bit
Input Frame Rate	3840 x 2160 Pixel @ 60 Hz 4000 x 2464 Pixel @ 60 Hz 4160 x 2464 Pixel @ 58 Hz
Signal Format	HDMI

LC-R 720: Spatial Light Modulator

The LC-R 720 Spatial Light Modulator is based on a reflective LCOS microdisplay with a resolution of 1280 x 768 pixel.

The device is made for amplitude modulation / projection applications but it can also be used for phase modulation but with limited phase shift (~1π in the visble range). Due to the high image frame rate of 180 Hz and the short response time (< 3 ms) the highest potential of the LC-R 720 Spatial Light Modulator are high speed applications such as one panel color sequential projection.

Display Type	Reflective LCOS
Resolution	1280 x 768 Pixel
Pixel Pitch	20 µm
Active Area / Diagonal	25.6 x 15.4 mm / 1.18”
Fill Factor	92 %
Addressing Bit Depth	8 Bit
Input Frame Rate	60Hz / 180 Hz
Signal Format	DVI - WXGA Res.

LC 2012 Translucent Spatial Light Modulator

The LC 2012 is an easy-to-use Spatial Light Modulator system based on a translucent liquid crystal microdisplay with a resolution of 1024 x 768 pixel (XGA). The device can be used for phase or amplitude modulation in the visible range (however, phase shift may be limited, e.g. ~2 π at 450 nm, ~ 1.8 π at 532 nm). The drive electronics are housed in a compact box. The LC 2012 is addressed by a standard HDMI interface.

Display Type	Translucent LC
Resolution	1024 x 768 Pixel
Pixel Pitch	36 µm
Active Area / Diagonal	36.9 x 27.6 mm / 1.8”
Fill Factor	55 %
Addressing Bit Depth	8 Bit
Input Frame Rate	60 Hz
Signal Format	HDMI - XGA Res.

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