HORIBA
Scientific

4.2 MP

22.528 mm
22.528 mm

11 µm x 11 µm

2048 x 2048 Pixels

4.2 MP

13.3 mm
13.3 mm

6.5 µm x 6.5 µm

2048 x 2048 Pixels

190–1100 nm

Spectral Coverage

UV-C | UV-B UV-A | NIR
100 nm | 280 nm 300 nm 400 nm 500 nm 600 nm 700 nm 800 nm 900 nm 1000 | 1100nm

Sylent™
Ultra–compact
Scientific CMOS Camera

HORIBA
Scientific

Sylent

sCMOS Internal Structure — Simplified Block Diagram

Low Gain | High Gain | Low Gain | High Gain | Low Gain | High Gain
ADC | ADC | ADC | ADC | ADC | ADC
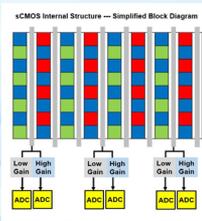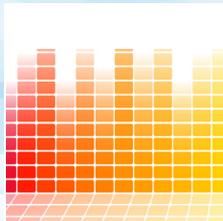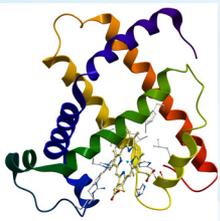
For OEM
Industrial Applications

Sylent
The Quiet Camera

JOBIN YVON Technology

horiba.com/oem

Sylent™ Scientific CMOS Camera

Overview

The HORIBA Sylent scientific CMOS (sCMOS) uncooled camera line provides end-users with three novel high QE back-illuminated sensor models that provide diversified solutions to successfully meet the most demanding photonic applications for the scientific and industrial sectors.

All uncooled Sylent sCMOS models boast an ultra-compact design geared towards field-deployed robustness, offering end users high resolution, fast frame rate acquisitions that tout ultra-low noise, good full well capacity, enhanced dynamic range (> 90 dB) and high quantum efficiencies (up to 95%) ... all captured in an image with large field of view.

Uncooled Sylent Model	Effective Pixels	Pixel Size (µm)	Active Pixels	Active Photosensitive Area (mm x mm)	Read Noise Median		Full Well
					STD (e-)	CMS (e-)	
1.3MP-U-9.76-BI	1.3 MP	9.76	1280 x 1024	12.493 x 9.994	1.6	0.85	48 ke-
4.2MP-U-6.5-BI	4.2 MP	6.50	2048 x 2048	13.300 x 13.300	1.6	1.20	53 ke-
4.2MP-U-11-BI	4.2 MP	11	2048 x 2048	22.528 x 22.528	1.6	N/A	80 ke-

For end-user applications requiring longer integration times and the lowest noise contribution from sensor dark current, peltier-cooled Sylent BLUE vacuum style camera solutions are available upon request, as well as options for nitrogen back-filled sCMOS variants … especially where mid-level cooling performance can adequately meet a customer's more modest performance challenges at hand.

Applications

Microscopy: Fluorescence, Light Sheet Fluorescence Microscopy (LSFM), FRET, TRIF, FRAP, Live Cell Imaging, Spinning Disk Confocal, Structured Illumination, Hyperspectral Imaging, Bright-Field, Calcium Imaging, Bio-Luminescence, Biomedical Imaging, STORM

Inspection: Food, Manufacturing, Electronics, Flat Panel Displays, Low Light Machine Vision, Ophthalmology, Low Light Surveillance

Spectroscopy: Fluorescence, Phosphorescence, Photoluminescence, Raman, Hyperspectral Imaging, Semiconductor Inspection and Metrology

Industrial, Machine Vision, Robotics, Medical and Scientific Applications, Quality Inspection and Process Automation

Features

Ultra-compact size

Back-illuminated monochrome sCMOS sensors

Unparalleled performance: Low noise floor High full well

Exceptional UV to NIR response with QE up to 95%

High frame rates @ full resolution with quality images ensuring collection of all data

Special HDR mode: Simultaneous image capture of bright and dim signals

High volume U.S.A. production capacity

General Camera Specifications* – 6.5 µm pixel size

Scientific CMOS Camera Attribute	Sylent Model 4.2MP-U-6.5-BI	
Scientific CMOS Sensor Type	Monochrome/Back-Illuminated (Front-Illuminated Mono or Color upon request)	
Effective Pixels	4.2 Mega Pixel / Monochrome	
Active Pixels	2048 x 2048	
Pixel size (µm)	6.5 x 6.5	
Active Photosensitive Area (mm)	13.3 x 13.3 (Optical format: 1.2" / Diagonal 18.9 mm)	
Full Well	55 ke⁻ typ	50 ke⁻ min
Linear Full Well	53 ke⁻ typ	48 ke⁻ min
Read Noise Median (STD)	1.6 e⁻ typ	2.5 e⁻ max
Read Noise Median (2-CMS)	1.2 e⁻ typ	
Dynamic Range (HDR)	31,623:1 (90 dB) typ	
Non-linearity	<0.6%	
Quantum Efficiency	Up to 95%	
Shutter Mode	Rolling	
Exposure Time	11.2 micro-second to seconds (defined only by Dark Current)	
Image Time Stamp Accuracy	Coarse: 1 micro-second	Fine: 20 nano-second
Triggering Modes (Frame Synchronization)	Internal Sync	
	External Sync --- Single or Multiple Triggers	
	External Sync --- Single / Multiple Triggers with Delays	
Pixel Readout Rates	50 MHz	
Frame Rates (fps)	16 / 12 Bit	
2048 x 2048	43	
2048 x 1024	87	
2048 x 512	174	
Communication	USB 3.0	
External I/O Connector	9-Pin Micro D-Sub	
Power Connector	3-Pin M8	
Power On / Off Switch	Yes	
Environmental Conditions	Operating Temperature Range: +15 °C to +40 °C	
	Operating Humidity Range: <70% (non-condensing)	
	Storage Temperature Range: -20 °C to +60 °C	
Input Voltage Range	+9 to +24 Vdc	
Input Power	7.5 W typ (24 Vdc @ 0.313 Adc)	
Cooling	Fan (standard) / TE-cooled Sylent BLUE variant available upon request	
Window Material	Selectable / UV Grade Fused-Silica (Standard)	
Window Coating	Available AR Coating on request	
Lens Mount Adapter	C-Mount (Standard) / F-Mount (Optional) / Customizable on request	
Camera Size Without C-Mount	Inches: 2.38 x 2.87 x 2.94	mm: 60.4 x 72.9 x 74.7
Camera Size With C-Mount	Inches: 2.38 x 2.87 x 3.31	mm: 60.4 x 72.9 x 84.1
Weight	Lbs: 0.70	Grams: 318
Software Support	Custom API/SDK support for easy integration to C#, C++ applications and container applications supporting standard DLL library interface. Consult factory for 3rd party imaging software support.	

* Specification values subject to change

General Camera Specifications* – 11 µm pixel size

Scientific CMOS Camera Attribute	Sylent Model 4.2MP-U-11-BI	
Scientific CMOS Sensor Type	Monochrome / Back-illuminated (Front-illuminated upon request)	
Effective Pixels	4.2 Mega Pixel / Monochrome	
Active Pixels	2048 x 2048	
Pixel size (µm)	11 x 11	
Active Photosensitive Area (mm)	22.528 x 22.528 (Optical format: 2" / Diagonal 31.859 mm)	
Full Well	80 ke⁻ typ	
Read Noise Median	1.6 e⁻ typ	2.0 e⁻ max
Dynamic Range (HDR)	50,000:1 (93.9 dB) typ	
Non-Linearity	<1%	
Quantum Efficiency	Up to 95%	
Shutter Mode	Rolling	
Exposure Time	20.52 micro-second to seconds (defined only by Dark Current)	
Image Time Stamp Accuracy	Coarse: 1 micro-second	Fine: 20 nano-second
Triggering Modes (Frame Synchronization)	Internal Sync	
	External Sync --- Single or Multiple Triggers	
	External Sync --- Single / Multiple Triggers with Delays	
Pixel Readout Rates	25 MHz	
Frame Rates (fps)	16 / 12 Bit	
2048 x 2048	22	
2048 x 1024	44	
2048 x 512	94	
Communication	USB 3.0	
External I/O Connector	9-Pin Micro D-Sub	
Power Connector	3-Pin M8	
Power On / Off Switch	Yes	
Environmental Conditions	Operating Temperature Range: +15 ^{0}C to +40 ^{0}C	
	Operating Humidity Range: <70% (non-condensing)	
	Storage Temperature Range: -20 ^{0}C to +60 ^{0}C	
Input Voltage Range	+9 to +24 Vdc	
Input Power	7.5 W typ (24 Vdc @ 0.313 Adc)	
Cooling	Fan (standard) / TE-cooled Sylent BLUE variant available upon request	
Window Material	Selectable / UV Grade Fused-Silica (Standard)	
Window Coating	Available AR Coating on request	
Lens Mount Adapter	C-Mount (Standard) / F-Mount (Optional) / Customizable on request	
Camera Size Without C-Mount	Inches: 2.38 x 2.87 x 2.94	mm: 60.4 x 72.9 x 74.7
Camera Size With C-Mount	Inches: 2.38 x 2.87 x 3.31	mm: 60.4 x 72.9 x 84.1
Weight	Lbs: 0.70	Grams: 318
Software Support	Custom API/SDK support for easy integration to C#, C++ applications and container applications supporting standard DLL library interface. Consult factory for 3rd party imaging software support.	

* Specification values subject to change

General Camera Specifications* – 9.76 µm pixel size

Scientific CMOS Camera Attribute	Sylent Model 1.3MP-U-9.76-BI	
Scientific CMOS Sensor Type	Monochrome / Back-illuminated (Front-illuminated upon request)	
Effective Pixels	1.3 Mega Pixel / Monochrome	
Active Pixels	1280 x 1024	
Pixel size (µm)	9.76 x 9.76	
Active Photosensitive Area (mm)	12.493 x 9.994 (Optical format: 1" / Diagonal 15.998 mm)	
Full Well	48 ke⁻ typ	TBD ke⁻ min
Linear Full Well	TBD ke⁻ typ	TBD ke⁻ min
Read Noise Median (HDR)	1.6 e⁻ typ	TBD e⁻ max
Read Noise Median (2-CMS)	0.85 e⁻ typ	
Dynamic Range (HDR)	29,854:1 (89.5 dB) typ	
Non-Linearity	<0.6%	
Quantum Efficiency	Up to 90%	
Shutter Mode	Rolling	
Exposure Time	10 micro-second to seconds (defined only by Dark Current)	
Image Time Stamp Accuracy	Coarse: 1 micro-second	Fine: 20 nano-second
Triggering Modes (Frame Synchronization)	Internal Sync	
	External Sync --- Single or Multiple Triggers	
	External Sync --- Single / Multiple Triggers with Delays	
Pixel Readout Rates	37.125 MHz	
Frame Rates (fps)	16 / 12 Bit	
1280 x 1024 (HDR)	30	
1280 x 1024 (2-CMS)	25	
Communication	USB 3.0	
External I/O Connector	9-Pin Micro D-Sub	
Power Connector	3-Pin M8	
Power On / Off Switch	Yes	
Environmental Conditions	Operating Temperature Range: +15 °C to +40 °C	
	Operating Humidity Range: <70% (non-condensing)	
	Storage Temperature Range: -20 °C to +60 °C	
Input Voltage Range	+9 to +24 Vdc	
Input Power	7.5 W typ (24 Vdc @ 0.313 Adc)	
Cooling	Fan (standard) / TE-cooled Sylent BLUE variant available upon request	
Window Material	Selectable / UV Grade Fused-Silica (Standard)	
Window Coating	Available AR Coating on request	
Lens Mount Adapter	C-Mount (Standard) / F-Mount (Optional) / Customizable on request	
Camera Size Without C-Mount	Inches: 2.38 x 2.87 x 2.94	mm: 60.4 x 72.9 x 74.7
Camera Size With C-Mount	Inches: 2.38 x 2.87 x 3.31	mm: 60.4 x 72.9 x 84.1
Weight	Lbs: 0.70	Grams: 318
Software Support	Custom API/SDK support for easy integration to C#, C++ applications and container applications supporting standard DLL library interface. Consult factory for 3rd party imaging software support.	

* Specification values subject to change

Salient Design Features:

Scientific 4.2 MP CMOS Sensor
At the heart of each model of HORIBA's new Sylent scientific CMOS camera line lies a novel back-illuminated sensor architecture providing UV to NIR responsivity with quantum efficiencies (QE) of up to 95% … without the use of performance limiting micro-lenses.

Outstanding High Dynamic Range
In addition to the user selectable 12-bit High and Low gain operating modes, all Sylent camera models feature an unprecedented 16-bit High Dynamic Range (HDR) mode (> 89.5 dB) allowing for the accurate capture of weak and bright signal regions simultaneously on a per image basis.

Here, Sylent's HDR mode leverages its sensor's Dual Amplifier/ADC structure to simultaneously sample each pixel's high gain (low noise) and low gain (high capacity) path and merge the appropriate digitized value (on a pixel-by-pixel basis) to extend the captured image's dynamic range to a 16-bit level without compromising sensitivity or linearity. As illustrated in the image collage below, trade-offs traditionally made by scientists and engineers to choose between the limitations of high gain (sensitivity) or low gain (capacity) acquisitions are overcome with this novel feature to meet the challenges of today's imaging and spectroscopic quantitative applications.

Low Gain Mode   High Gain Mode   HDR Gain Mode
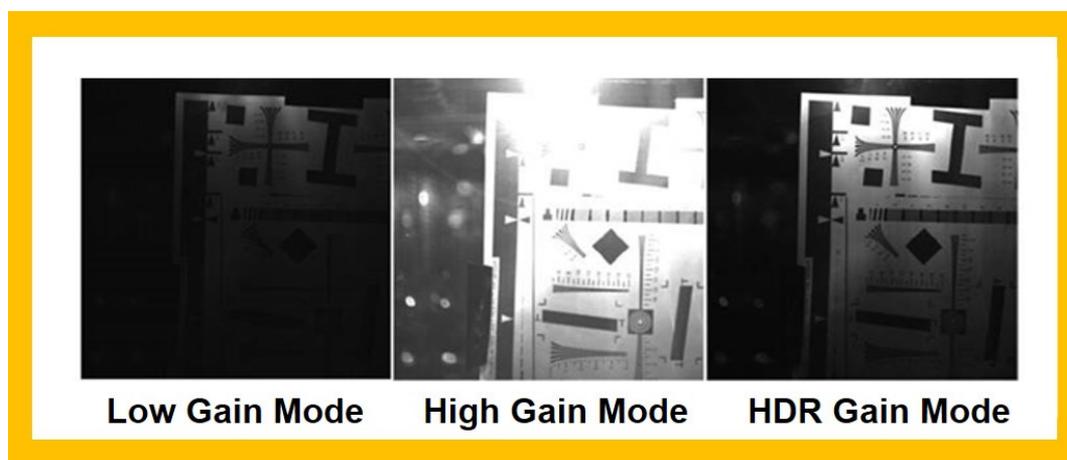
USB 3.0 Interface
From a host communication standpoint, all Sylent camera models incorporate a USB 3.0 interface to handle the high data rates and full resolution images associated with its mega pixel scientific CMOS sensor offerings as shown in the table below. For the most demanding applications that require enhanced temporal resolution, increased frame rates are achieved by user selectable smaller ROI sizes.

Uncooled Sylent Model	Effective Pixels	Pixel Size (µm)	Full Image Size	Frame Rate (FPS)
1.3MP-U-9.76-BI	1.3 MP	9.76	1280 x 1024	30
4.2MP-U-6.5-BI	4.2 MP	6.50	2048 x 2048	43
4.2MP-U-11-BI	4.2 MP	11	2048 x 2048	23

Timestamp Feature

All camera models for HORIBA's new Sylent sCMOS camera product line provide a user selectable coarse or fine "Timestamp" function per image that is accurate to 1 µSec and 20 nSec respectively. This "Timestamp" feature allows the user to have precise knowledge of acquired frame times as they relate to an application's temporal dynamics and is especially important for fast events … to eliminate the ill effects of computer and interface latencies.

Low Noise Mode

Sylent models 1.3MP-U-9.76-BI and 4.2MP-U_6.5-BI employ a Low Noise Mode of operation that utilizes the two-gain channel structure of their respective novel sCMOS back-illuminated sensors to significantly reduce the typical / normal 1.6 e- read noise of these cameras in High Sensitivity / HDR modes. In this Low Noise camera operating mode, also referred to as Two Times Correlated Multisampling Mode (2-CMS), simultaneous sampling is performed on both sensor gain channels set for "High Gain", which effectively cuts the read noise level down to 0.85 e$^-$ and 1.2 e$^-$ respectively for the 1.3MP-U-9.76-BI and 4.2MP-U_6.5-BI Sylent camera models ... without sacrificing high frame rate capability.

This Low Noise Mode is especially valuable to end-user applications that require the highest sensitivity and lowest possible noise floor for imaging the weakest of signals.

Input Power

All Sylent uncooled camera models provide end-users with a wide input DC voltage operating range of +9 to +24 Vdc via a 3-pin M8 style female connector (MFG Part 2-2172089-2) and typically utilize 7.5 watts of input power. Uncooled Sylent's M8 input voltage pin assignment is universal across all camera models as specified in the table below:

M8 Input Power Connector	Input Power Signal Description
PIn 1	+Vin_Return
Pin 2	+Vin_Return
Pin 3	+Vin
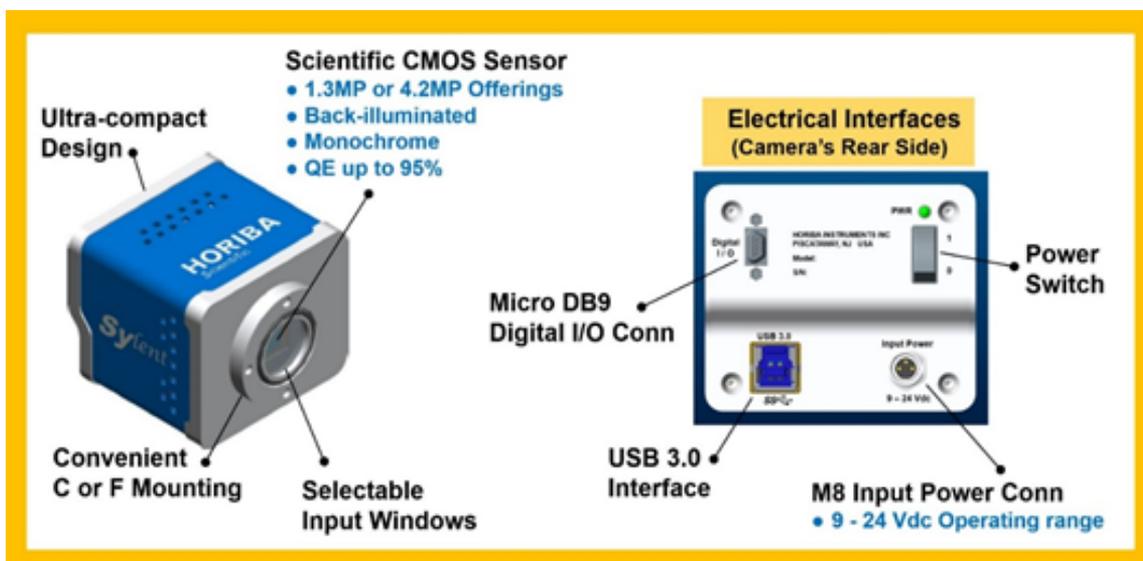
Imaging Mode Frame Rates

Sensor ROI Size	4.2MP-U-6.5-BI		4.2MP-U-11-BI	
W x H (Pixels)	Frame Rate (fps)	ROI Area mm x mm	Frame Rate (fps)	ROI Area mm x mm
2048 x 2048	43	13.3 x 13.3	23	22.5 x 22.5
1400 x 1400	63	9.1 x 9.1	34	15.4 x 15.4
1200 x 1200	74	7.8 x 7.8	40	13.2 x 13.2
1024 x 1024	87	6.7 x 6.7	47	11.3 x 11.3
512 x 512	174	3.3 x 3.3	95	5.6 x 5.6
256 x 256	348	1.7 x 1.7	187	2.8 x 2.8
128 x 128	697	0.8 x 0.8	367	1.4 x 1.4

Spectroscopy Mode Spectral Rates

Sensor Array Size	USB 3.0 Maximum Spectral Rate	
W x H	4.2MP-U-6.5-BI 16 / 12 Bit	4.2MP-U-11-BI 16 / 12 Bit
Any x 8	6,944	3,891
Any x 16	4,255	2,375
Any x 32	2,415	1,335
Any x 64	1,294	711
Any x 1200	74	40
Any x 2048	43	23

Multi-track Mode Example Using Sylent

Image of 8-channel Fiber Bundle Illuminated with Hg and Ar Lamp
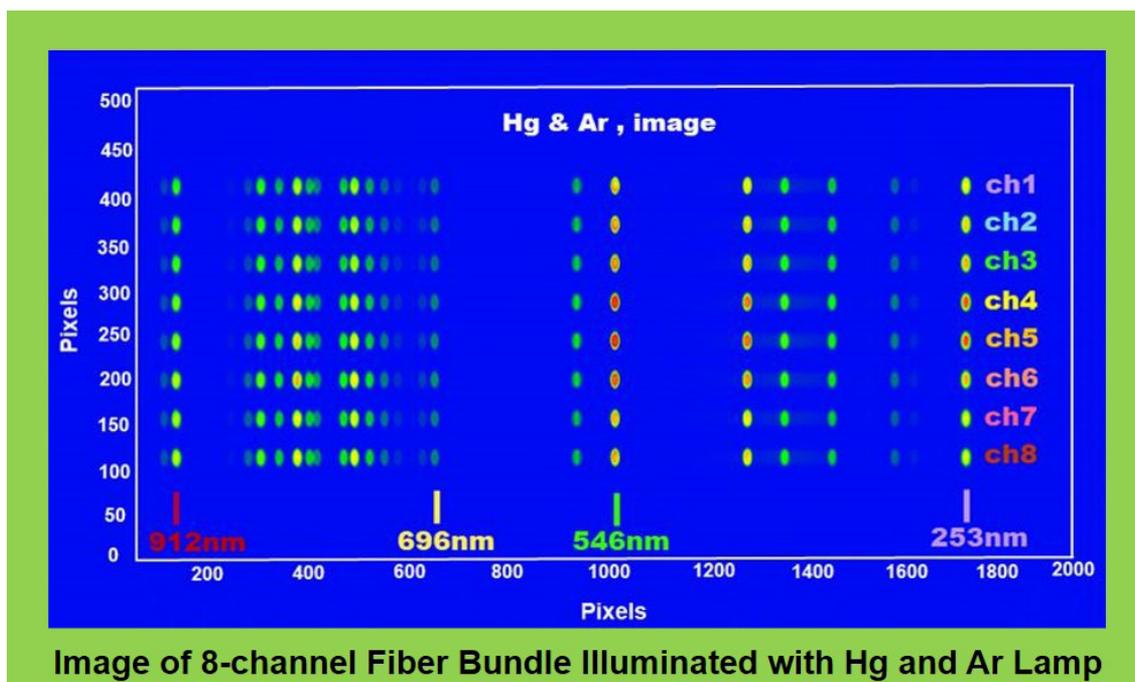
Sylent Quantum Efficiency

Spectral Response Characteristics of Sylent Model 4.2MP-U-6.5-BI

Spectral Response Characteristics of Sylent Model 4.2MP-U-11-BI

Spectral Response Characteristics of Sylent Model 1.3MP-U-9.76-BI
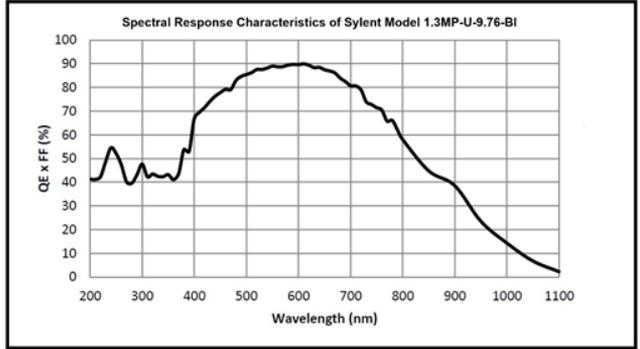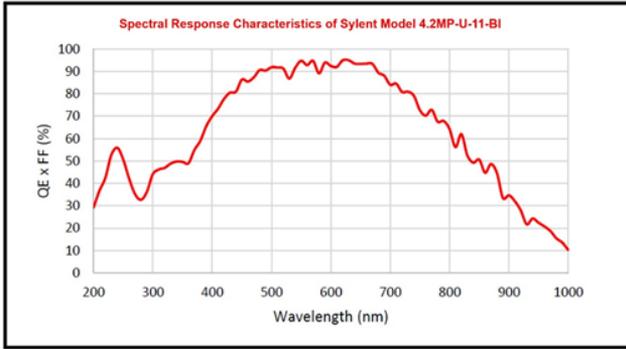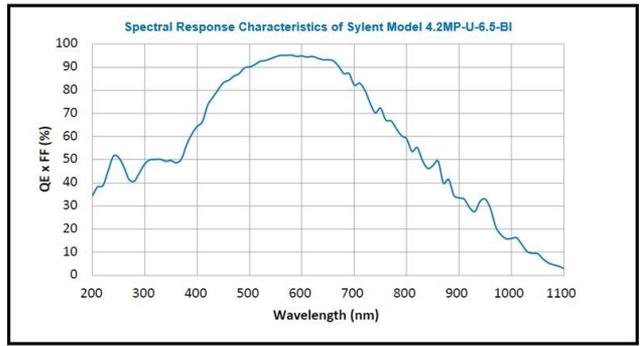
System Mechanical Drawings

3.31
[84.1]

SENSOR SURFACE
TO C-MOUNT
ADAPTER FRONT

.730
[18.55]

Ø1.83
[46.4]

5500358992
C MOUNT ADAPTER

C-MOUNT ADAPTER SCREWS
6-32 X 1/2 FLAT HEAD SCREWS
3X

.37
[9.4]

.125
[3.18]

LOCKING SET SCREW
6-32 X 3/8 NYLON TIP

2.94
[74.7]

SENSOR SURFACE
TO CAMERA MOUNTING
SURFACE

.361
[9.17]

.25
[6.4]

2.38
[60.3]

1.44
[36.5]

1.19
[30.2]

5500358992
C MOUNT ADAPTER

6-32 UNC-2B
THREAD
TAPPED THRU
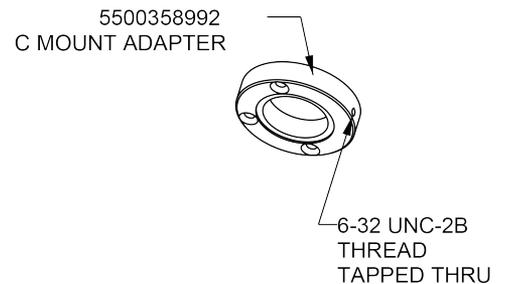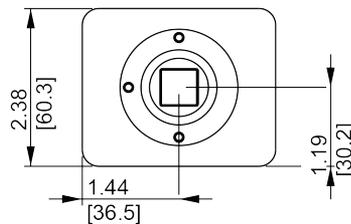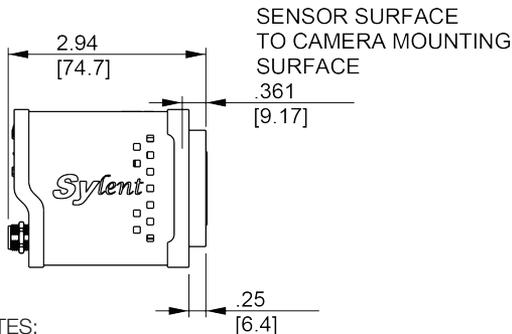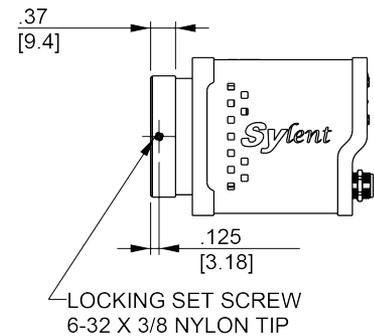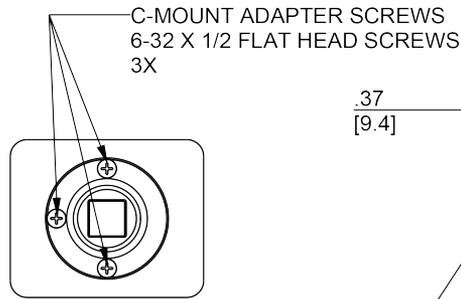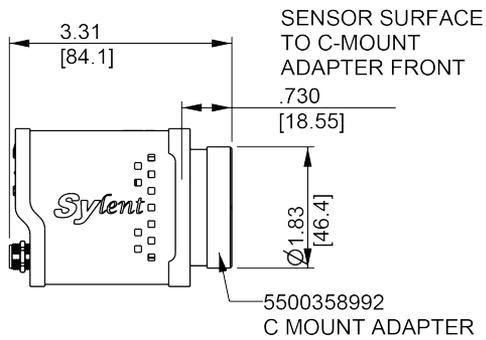
NOTES:

1. UNITS ARE IN INCHES [MILLIMETERS] UNLESS OTHERWISE NOTED.
2. AVAILABLE ADAPTERS: C-MOUNT, F-MOUNT AND CUSTOMIZABLE

Best Selling Miniature Spectrometers for OEM Industrial Applications

Fiber-coupled USB Spectrometers:

MiniVS20 Spectrometer with Linear UV-VIS CMOS or NIR InGaAs Sensor

5 nm resolution

OEM hand-held spectrometer covering 190 to 1,700 nm for various low stray light applications
- Aberration-corrected concave holographic grating options
- VIS configuration featuring a 1.7" x 1.9" x 2" size combined with full F/2.3 optics for high signal-to-noise
- High throughput, compactness and long term reliability

MiniVS70 VIS Spectrometer with FI CMOS or BI CCD

1 nm resolution

NEW miniaturized VS70 configuration
- Based on high performance aberration-corrected concave gratings fitted with a custom order-sorting filter to eliminate higher orders
- Low cost combined with high performance and low stray light
- Long term opto-mechanical stability and choice of front-illuminated linear CMOS or back-illuminated CCD sensors

VS70 UV-VIS-NIR Spectrometer with Uncooled / TE-cooled CCD

1-2 nm resolution

Compact, versatile most popular VS70 OEM spectrometer and OES configurations
- Based on high performance aberration-corrected concave gratings with full F/2.3 aperture
- Affordable, high throughput, robust and stable
- Electronics drivers ranging from **USB-2 to Ethernet and EtherCAT**

CiCi-Raman-NIR with Scientific Camera Optimized for 785 nm

6 cm^{-1} resolution

Most compact OEM Raman spectrometer with aberration-corrected holographic grating
- Covers 150-3,300 cm^{-1}
- High efficiency and low stray light
- Available in F/2.3 and in compact F/5 configurations
- -50° C deep-cooled scientific CCD camera with minimized etaloning and high NIR QE

PoliSpectra® Quad Spectrometer for Simultaneous Acquisition of 4 VIS Spectra

1 nm resolution

CCD spectrometer for simultaneous acquisition from 4 fiber inputs (470-730 nm)
- High-speed electronics (as fast as <1.5 msec readout time for 4 spectra)
- QUAD-channel high throughput system (f/2.3) and ultra-low stray light
- Industrial low-light applications from low light fluorescence to reflectance

PoliSpectra® M116 8-32 Channel MultiTrack UV-VIS-NIR CMOS Spectrometer

1 nm resolution

Fiber-coupled multi-spectra system with 8- to 32-channel simultaneous measurements
- Concentric optical design with UV extended spectral range provides minimized crosstalk
- High throughput USB-3 system featuring a fast 2D scientific BI CMOS running at 94 to 188 frames per second, acquiring 8, 16 or 32 simultaneous spectra (2048 pixels per spectrum)

PoliSpectra® H116 Imaging Spectrometer for Hyperspectral Work from UV to NIR

Free-space coupled 1 nm & 40 µm resolution

Ultra-high performance rugged spectrometer for hyperspectral imaging with a 2D sCMOS Camera
- For line-image scanning, in a push-broom hyperspectral configuration
- High throughput, USB-3 system featuring a fast 2D scientific BI CMOS with rolling shutter, running at 94 (HDR) to 188 (Standard Mode) frames per second (2048 pixels per spectrum)

OEM Philosophy and Mission

3 Centers of Excellence Dedicated to OEM Spectroscopy and Camera Solutions in US, EU, and Asia

Our mission is to provide a complete development and manufacturing experience, from optical simulations to opto-mechanical design and prototyping of spectroscopic and camera systems extending to, and including, electronics, firmware, software design and first articles.

Our products provide superior performance, reliability and stability, combined with robust cost reduction. Capable of flexible high volume production capacity in quantities of hundreds to thousands per year, we offer full confidentiality providing "Black Boxes" or private labelling, using your logo or graphics.

Unmatched customer service is provided by our exceptionally experienced workforce featuring on-time delivery and flexibility, allowing scheduling modifications.

Adhering to Copy Exactly! (CE!) processes, our fully trained staff, from engineering to manufacturing, form a dedicated OEM engineering force that supports you over the lifetime of the product.

Scientific Segment - OEM Products and Capabilities:

- Custom master optical diffraction gratings
- Diffraction grating replicas (concave, convex and flat)
- Spectrometers, optical assemblies with pre-aligned sensors (CCD, PDA, CMOS, InGaAs) using either customers' or HORIBA's OEM electronics
- OES spectrometers
- Spectroscopy systems or modular engines, such as mini fluorometers and mini Raman systems
- Single and double scanning monochromators
- Imaging spectrographs and spectrometers with CCD or CMOS cameras
- Multispectra spectrometers with multiple fiber inputs / MultiTrack spectroscopy
- Hyperspectral system with HORIBA or customer provided camera (Push-broom configurations)
- Cameras: Spectroscopic deep-cooled scientific cameras (1D and 2D CCD & InGaAs – FI and BI)
- OEM electronics for optosensors ranging from PD and PDA to CCD and CMOS sensors
- Imaging cameras: Uncooled and cooled with FI and BI high-end scientific CMOS
- VUV/FUV spectrometers and CCD vacuum and N2-purged cameras

Scientific Deep Cooled CCD, InGaAs and CMOS Cameras

Syncerity®	Synapse® Plus	Synapse® EM	VUV Syncerity®	Sylent®	Synapse® InGaAs
Low Cost -50℃ Air-cooled Camera	Deep-cooled -80℃ to -100℃ Air- or Water-cooled Camera	EM CCD Deep-cooled Camera	TE-cooled to -50℃ (Vacuum) or -30℃ with N2 purge	Ultra-compact 4.2 MP monochrome sCMOS sensor	Deep-cooled NIR Camera to -75℃ (Water-cooled)

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