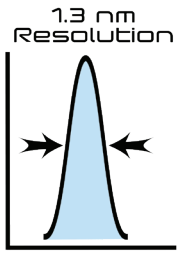
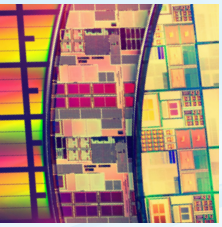
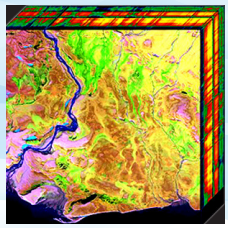
HORIBA

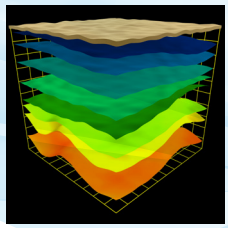


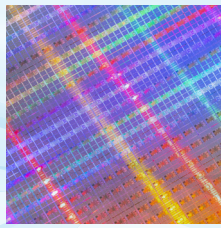
PoliSpectra® 27

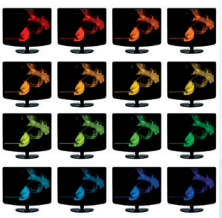
Hyperspectral Line Imager











For OEM
Industrial Applications

horiba.com/oem

PoliSpectra® 27 Spectrometer

Overview

HORIBA has developed a compact industrial spectrometer platform that is factory-configurable for use in a hyperspectral imaging system.

In hyperspectral imaging applications, this system can be used as a line-scanning instrument (push-broom) that collects full spectral data simultaneously across the input slit height.

Variations

- VIS and VIS-NIR spectral ranges
- C-mount, F-mount, and bare slit or custom inputs

Applications

- Hyperspectral Line Imaging
- Inspection and Metrology
- Process Monitoring
- Aerial Reconnaissance
- Agricultural Inspection

Features

Small, Compact, and Lightweight Design

Designed for Industrial Volume Manufacturing

High Throughput Combined with Low Stray Light

Excellent Peak Symmetry

General Spectrometer Specifications

Optical Specifications	VIS	VIS-NIR
Spectral Range	350-730 nm	350-920 nm
Spectral Resolution (20 µm slit)	1.3 nm	
Spectral Bands (20 µm slit)	284	425
F/#	2.3	
Focal Length	157.7 mm	
Grating Dispersion	51.8 nm/mm	
Grating Blaze	575 nm	
Grating Groove Density	401 g/mm	
Max Keystone	<15 µm	
Spectral Tilt [1]	<15 µm	
Smile	<15 µm	
Spectrometer Magnification	1:1	
RMS Spot Radius (at 500 nm)	<12 µm	
Max Spatial Image Height	4 mm	
Wavelength Accuracy	<0.1 nm	

Electronic Specifications	VIS	VIS-NIR
Sensor Model	IMX 226	IMX 174
Sensor Type	CMOS	CMOS
Digital Resolution	0.09 nm/px	0.29 nm/px
Pixel Size	1.85 x 1.85 µm	5.86 x 5.86 µm
Active Pixels [2]	2160 x 4024	682 x 1936
Dynamic Range	65 dB	71.7 dB
Full Well	10.5 ke-	30 ke-
Frame Rate [2]	35 FPS (8 bit)	220 FPS (8 bit)
	28.2 FPS (10 bit)	167 FPS (12 bit)
ADC	8, 10 bits	8, 10, 12 bits
Shutter	Rolling shutter, Global reset shutter	Global shutter
Power	USB bus power 5 VDC	

Dimensions and Weight [3]	VIS	VIS-NIR
Weight	1.5 lbs (680 g)	
Dimensions (WxDxH)	2 x 3.5 x 2 in (51 x 90 x 51 mm)	

[1] Versus a sensor row.
[2] For the maximum 4 mm image height.
[3] Not including a lens.

Spectral Resolution vs. Slit Size

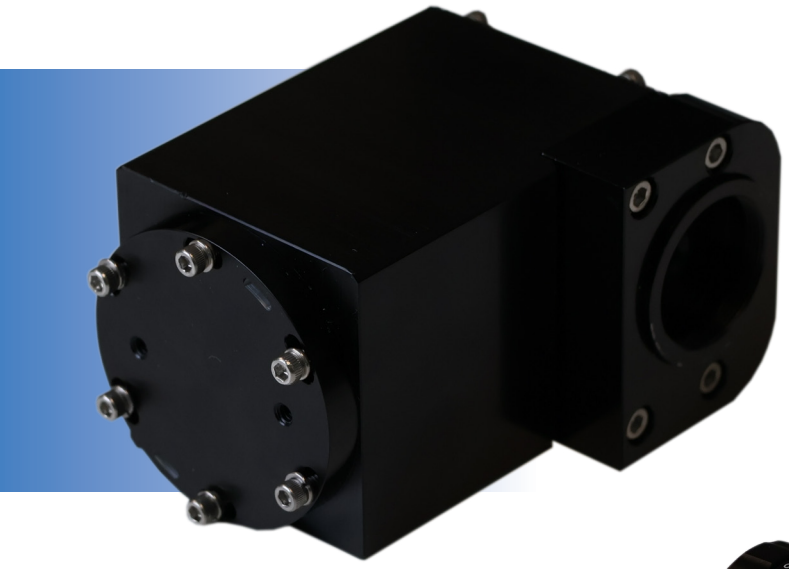
Slit Width [1]	20 µm	32 µm	45 µm	100 µm	200 µm
Spectral Resolution [2] (FWHM)	1.3 nm	1.9 nm	2.6 nm	5.5 nm	10.7 nm
Spectral Bands [3] (VIS)	284	200	146	69	36
Spectral Bands [3] (VIS-NIR)	425	300	219	104	53

[1] Custom slit widths available upon request.
[2] Max spectral line width (FWHM) for all peaks in the image.
[3] The number of spectral bands is the wavelength range/wavelength resolution (FWHM).

PoliSpectra 27 Naming Guide

H27-Sensor-OSF-SLIT-INPUT

Example: H27-226-N-35/4000-C-mount



Slit Size: Width / Height

20/4000
25/4000
35/4000
45/4000
100/4000
200/4000

Camera Options

IMX 174
IMX 226

Input

C-mount
F-mount
Bare Slit
Custom input for OEM quantities

Order Sorting Filter

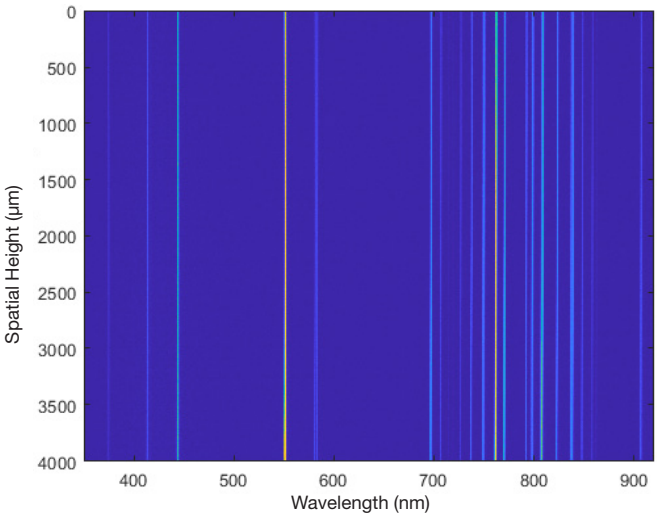
None: N
OSF: O

Hyperspectral Imaging Examples

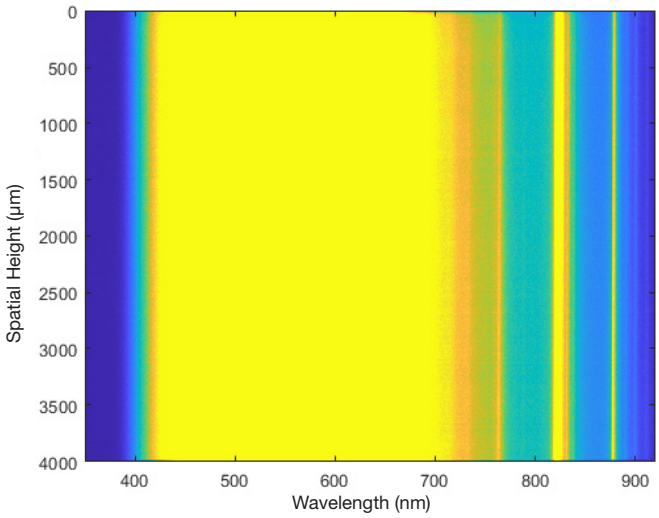
Field of View	5 mm		300 mm		1000 mm	
Example Targets	Capillaries, Minerals, Plants		Semiconductor Wafers, Industrial, Food		Film Thickness, Recycling	
Example Lens	VST VS-5026VM		VST VS-0818VM		VST VS-0620VM	
Focal Length	50 mm		8 mm		6 mm	
Magnification	0.8X		0.013X		0.004X	
Image Height	4 mm		4 mm		4 mm	
Working Distance	97.5 mm		600 mm		1500 mm	
Spatial Pixels	VIS	VIS-NIR	VIS	VIS-NIR	VIS	VIS-NIR
	2160	680	2160	680	2160	680
Digital Pixel Scale	0.002 mm/px	0.007 mm/px	0.14 mm/px	0.44 mm/px	0.46 mm/px	1.5 mm/px
Spatial Resolution [1]	0.016 mm	0.022 mm	0.97 mm	1.3 mm	3.2 mm	4.4 mm

[1] Cross-track spatial resolution, taking into account the point spread function (PSF) of the spectrometer only.

Example of Spectral Images

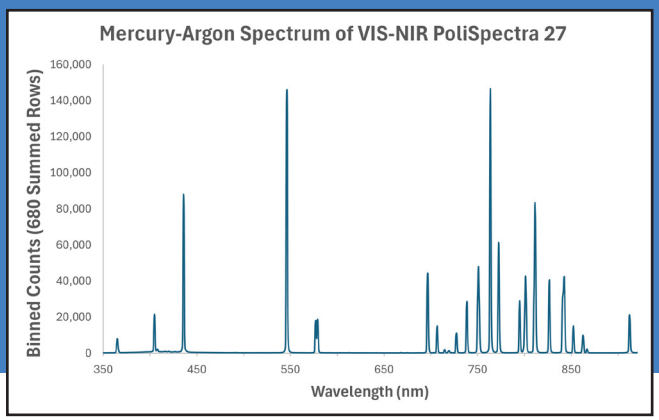


Mercury-Argon Spectrum of VIS-NIR PoliSpectra 27 with Bare Slit

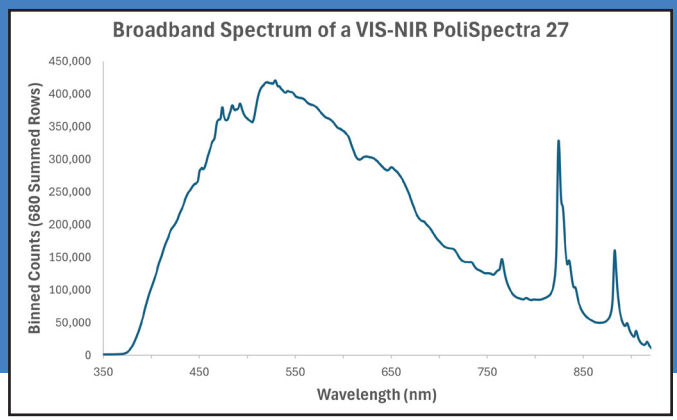


Broadband Spectrum of a VIS-NIR PoliSpectra 27 with VST VS-0818VM Lens

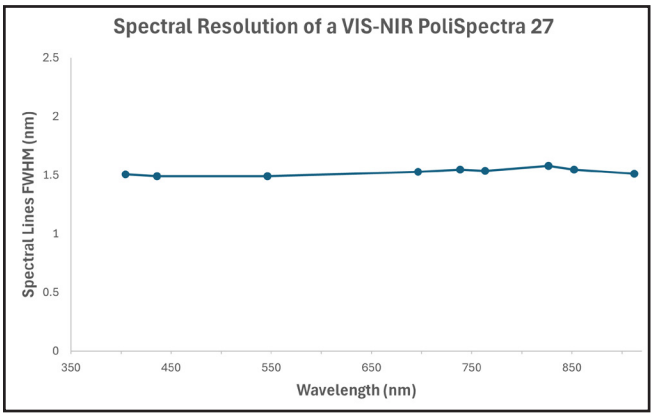
Binned Spectral Examples



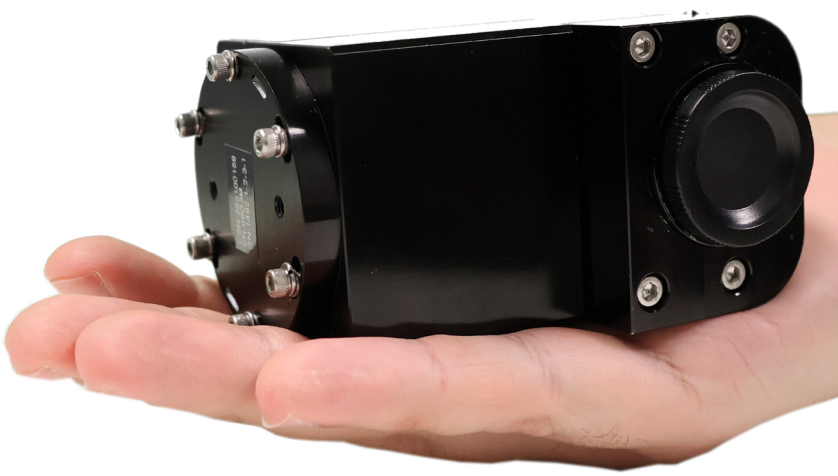
Mercury-Argon Spectrum of VIS-NIR PoliSpectra 27



Broadband Spectrum of a VIS-NIR PoliSpectra 27

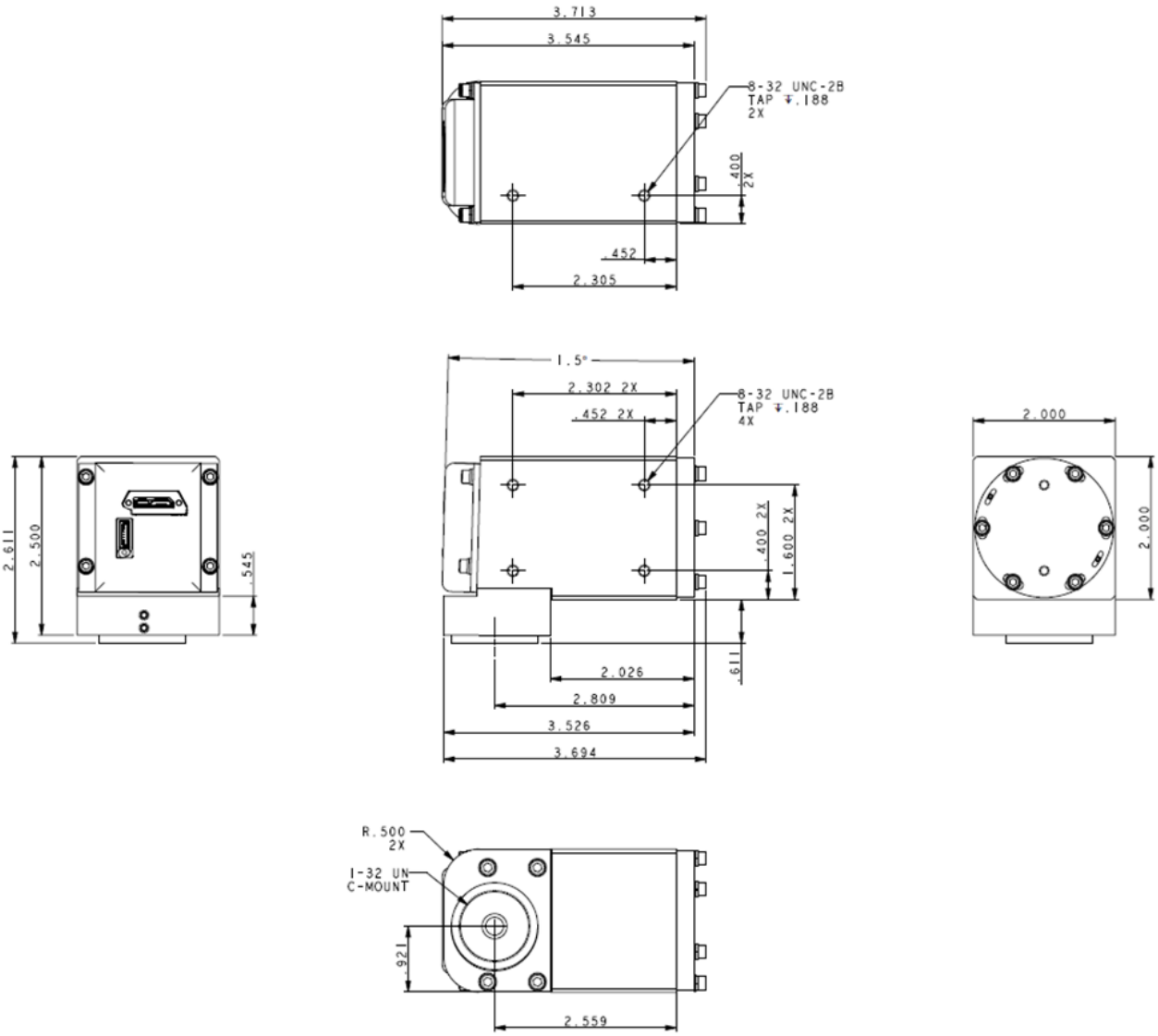


Spectral Resolution of a VIS-NIR PoliSpectra 27



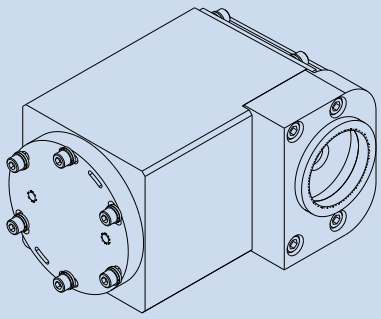
System Mechanical Drawings

VIS and VIS-NIR Variants

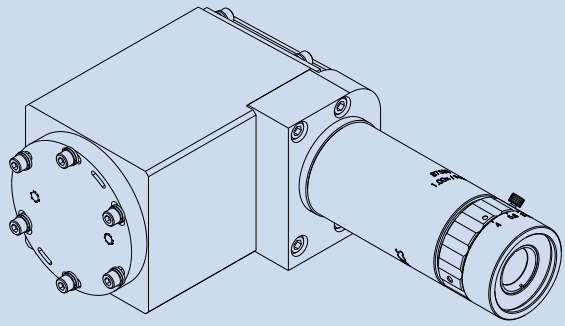


VIS and VIS-NIR variants have the same exterior dimensions and connector placement.

Lens Configurations



C-mount



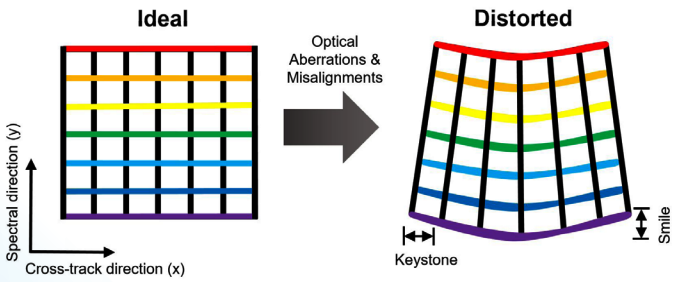
C-mount with Lens

Hyperspectral Imaging Distortions: Keystone and Smile

Definitions:

The **KEYSTONE** property is a band-to-band magnification that changes with wavelength. This involves mixing of spectra from adjacent field positions.

The **SMILE** property is a wavelength shift caused by a change in dispersion with field position [1].



Schematic showing an ideal image compared to a real image with optical distortions [2]

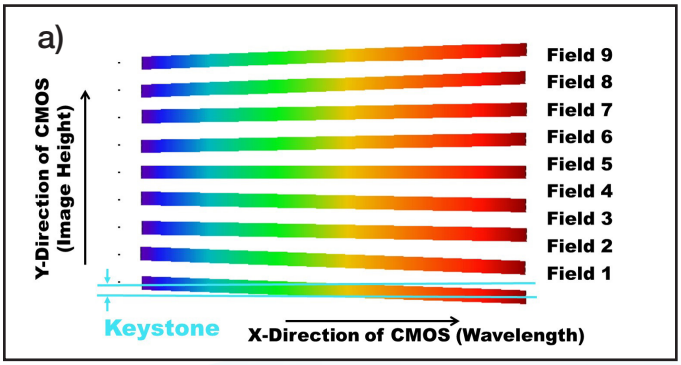
Lλ= Pixel center location of each field identifier slit at a given wavelength

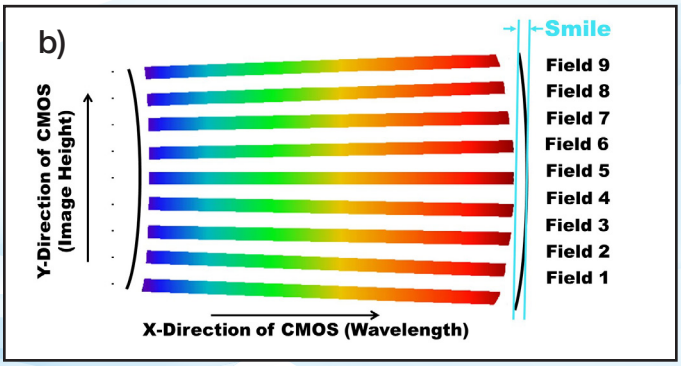
Keystone = $(L_{\lambda max} - L_{\lambda min})$

Cλ= Center pixel location of a given wavelength at each field identifier location

Smile = $(C_{\lambda max} - C_{\lambda min})$

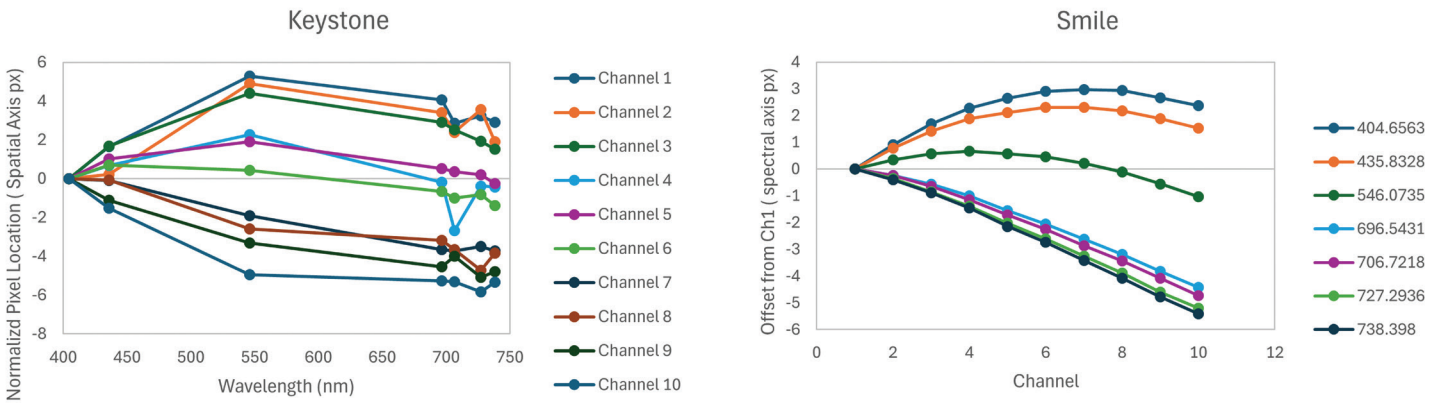
KEYSTONE is measured by calculating the maximum displacement a field slit makes as it moves across the entire spectrum, and the **SMILE** is measured by calculating the maximum displacement a wavelength makes as it moves across the entire height of the region of interest.





The method HORIBA uses to measure a) Keystone and b) Smile

Excellent optical performance for PoliSpectra system showing keystone and smile smaller than 15 µm



An example of the production testing for HORIBA's hyperspectral/multichannel spectroscopy systems based on the method described above.

[1] J. Fischer, M. Baumback, J. Bowles, J. Grossmann, and J. Antoniades, "Comparison of low-cost hyperspectral sensors," Proc SPIE, Vol. 3438, pp. 23-30, 1998.

[2] N. Yokoya, N. Miyamura, and A. Iwasaki, " Detection and correction of spectral and spatial misregistrations for hyperspectral data using phase correlation method ," Applied Optics, vol. 49, no. 24, pp.4568-4575, 2010.

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! Processes (CE!,) 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 input / MultiTrack spectroscopy
- Hyperspectral system with HORIBA camera or customer provided (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 and sCMOS cameras

Syncerity®

Low Cost -50° C
Air-cooled OEM Camera

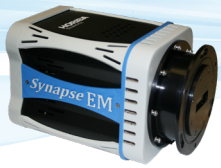
Sylent™ Mini

Ultra-compact 4.2 MP
Monochrome sCMOS Sensor

Sylent™ BLUE

TE-cooled to -25° C
4.2 MP sCMOS Sensor

Synapse® EM



EM CCD
Deep-cooled Camera

VUV Syncerity®

TE-cooled to -50° C (Vacuum)
or -30° C with N2 purge

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