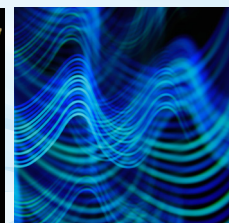
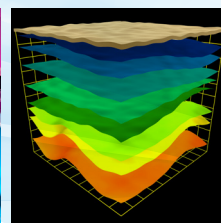
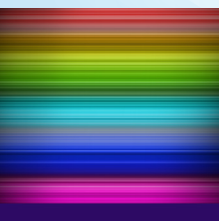


## PoliSpectra® M116 MultiTrack Spectrometer

8-16-32 Simultaneous UV-NIR Spectra



For OEM  
Industrial Applications

# PoliSpectra® MultiTrack Spectrometers

## 8-16-32 Simultaneous UV-NIR Spectra

### Overview

HORIBA designs and manufactures a large range of custom OEM fiber-coupled, multi-spectra spectrometers capable of simultaneous measurement of up to 96 fiber channels. Utilizing a concentric imaging spectrometer with a broadband spectral range and a customized fiber bundle, the HORIBA OEM multifiber spectrometers provide excellent imaging quality with minimum crosstalk.

The Polispectra® MultiTrack systems feature high throughput/sensitivity and a 2-D Scientific back-illuminated CMOS sensor which can be configured with 8, 16 or 32 fiber input channels for simultaneous acquisition of UV-NIR spectra.

With an optional Nitrogen purge, the System can be configured for low UV. Additionally the high QE sCMOS sensor and an integrated order sorting filter allow wavelength coverage beyond 1µm.

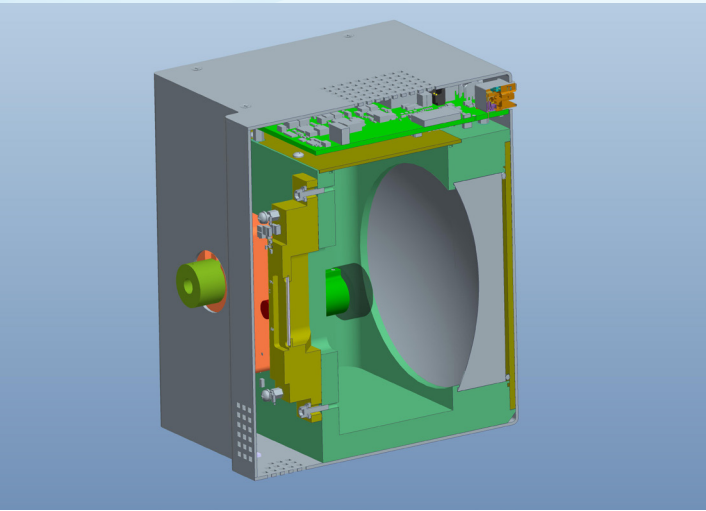
### Applications

- Multitrack Spectroscopy
- From fluorescence to reflectance

Some examples from semiconductor applications to life sciences:

- Quality Control
- Plasma Monitoring
- Light Source calibration monitoring
- Blood/DNA multisampling

### Optical and Mechanical Layout



Concentric spectrometers layout providing excellent spacial imaging.

### Features

Simultaneous measurement  
Up to 32 fiber channels

Extended UV capability  
below 200 nm

High spectral and spatial  
resolution combined with  
high throughput

Minimal cross-talk

High speed and  
low noise sCMOS  
2048 pixels sensor

USB 3 Interface

Stable and robust

### 8-channel Spectrometer Specifications

Spectral Coverage	185 - 1050 nm (configurable based on customer's need)
Spectrometer Input	8 channel, $\phi 200\ \mu\text{m}$ core fibers with $\phi 220\ \mu\text{m}$ clad, separated by a $\phi 220\ \mu\text{m}$ dead fiber
Spectral Resolution	1 nm (22 $\mu\text{m}$ slit width) and up depending on fiber core and slit sizes
Spectral Dispersion	34.6 nm/mm; 0.38 nm/pixel
Crosstalk (Adjacent Channel)*	< 0.1% (measured @ 600 nm)
Crosstalk (Non-adjacent Channel)*	< 0.1% (measured @ 600 nm)
Focal Length	116 mm
F/#	F/2.3
Smile and Keystone	1.5 pixel (typical)
Stray Light	< 0.1% (typical)
Wavelength Accuracy	0.1 nm (using 8 channel wavelength calibration)
Software	LabVIEW™ acquisition software for initial evaluation (DLLs provided for software integration)

### 32-channel and 16-channel Spectrometer Specifications

Spectral Coverage	185 - 950 nm (configurable based on customer's need)
Spectrometer Input	16 channel, $\phi 100\ \mu\text{m}$ core fibers with $\phi 110\ \mu\text{m}$ clad 32 channel, $\phi 70\ \mu\text{m}$ core fibers with $\phi 77\ \mu\text{m}$ clad
Spectral Resolution	1 nm and up depending on fiber core size
Spectral Dispersion	34.6 nm/mm; 0.38 nm/pixel
Focal Length	116 mm
F/#	F/2.3
Smile and Keystone	1.5 pixel (typical)
Stray Light	< 0.1% (typical)
Wavelength Accuracy	0.1 nm (using 32 channel wavelength calibration)
Software	LabVIEW™ acquisition software for initial evaluation (DLLs provided for software integration)

### Specifications for Scientific Back-Illuminated CMOS Image Sensor with High Speed Electronics

Detector Model	sCMOS BI sensor with electronic rolling shutter (All the parameters are specified at normal room temperature of 25° C unless otherwise noted)	
Sensor Format	2048 x 512	
CMOS Pixel Size	11 $\mu\text{m}$ x 11 $\mu\text{m}$	
CMOS Height	5.6 mm	
CMOS QE	The peak QE is 77% at 275 nm and 95% at 560 nm (refer to graphs below)	
Thermoelectric Cooling	No, Uncooled	
Frame Rate	94 fps (HDR mode), 188 fps (STD mode) on 2D sCMOS sensor	
Full Well Capacity	> 93 000 e <sup>-</sup> /pixel (Typical)	
Communication	USB 3	
Readout Noise	1.7 e <sup>-</sup> (typical)	
Digitization	16-bit ADC	
Dynamic Range (HDR mode)	> 93 dB	
Non-linearity (measured on each system)	< 1.8% (maximum) at low gain	<0.9% (maximum) at high gain
Environmental Conditions	Operating temperature 15°C to 40°C ambient; Relative humidity <70% (non-condensing); Storage temperature -25°C to 45°C	
Power requirements AC/DC power supply (provided)	90-264 VAC, 47-63 Hz	



Features

Scientific CMOS Back-Illuminated  
Sensor Quantum Efficiency

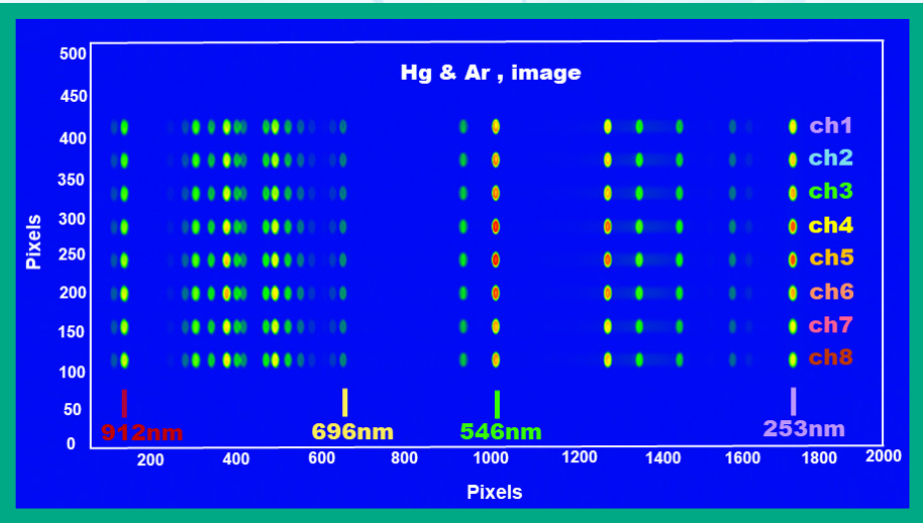
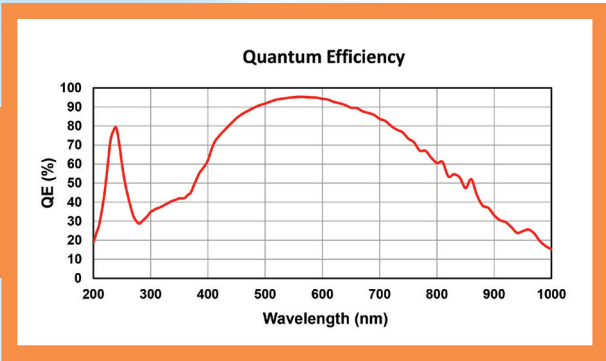
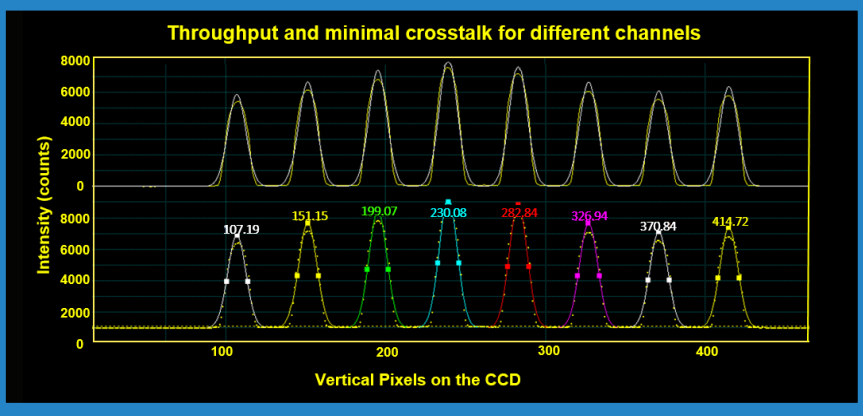
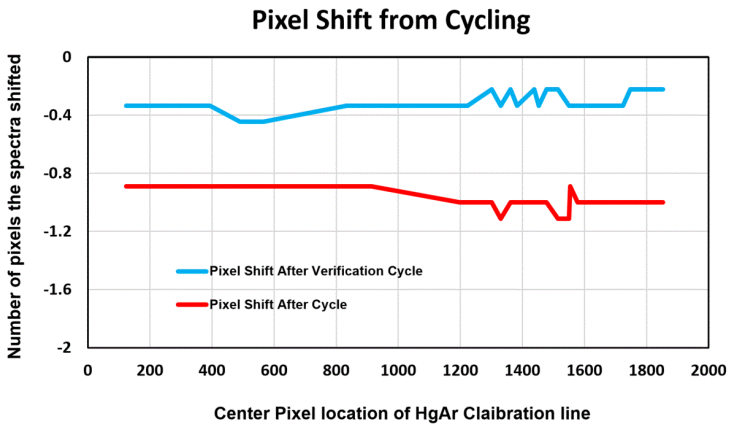


Image of 8-channel  
Fiber Bundle Illuminated  
with Hg and Ar Lamp



Throughput Differences  
and Crosstalk between  
Input Fiber Channels



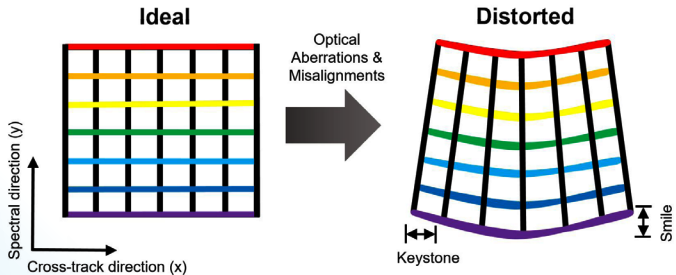
Thermal stability study  
cycling from  
-20°C to 50°C

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]

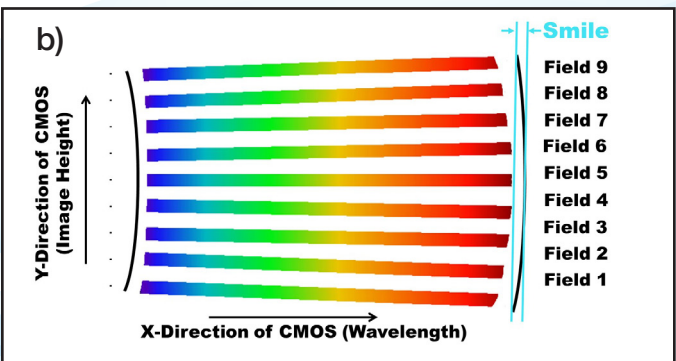
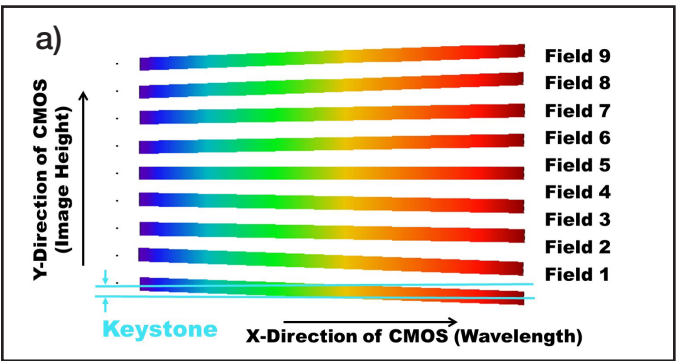
$L_{\lambda}$  = Pixel center location of each Field Identifier slit at a given wavelength

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

$C_{\lambda}$  = Center pixel location of a given wavelength at each Field Identifier location

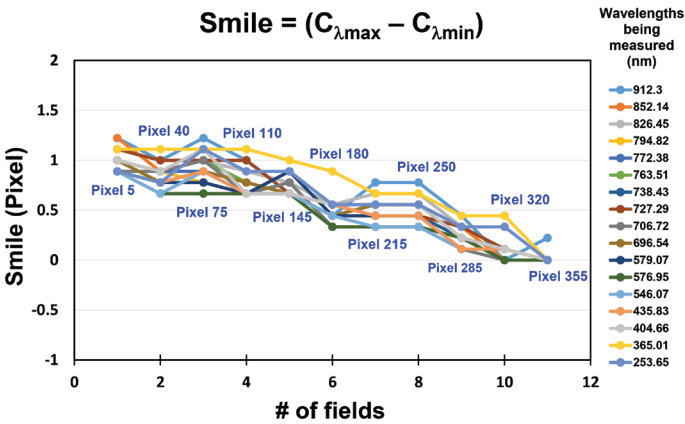
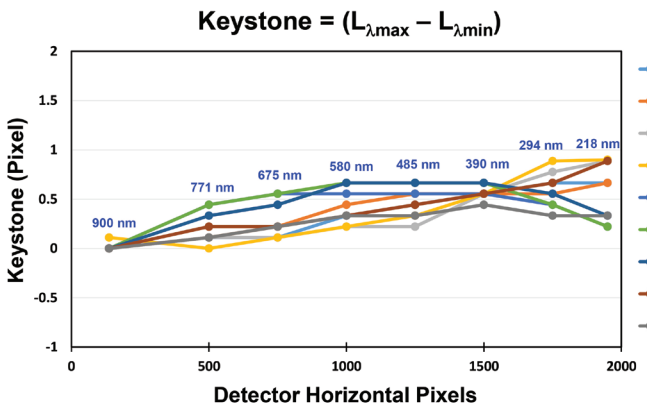
$$\text{Smile} = (C_{\lambda_{\text{max}}} - C_{\lambda_{\text{min}}})$$

**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 MultiTrack system  
showing keystone and smile smaller than 1.5 pixels

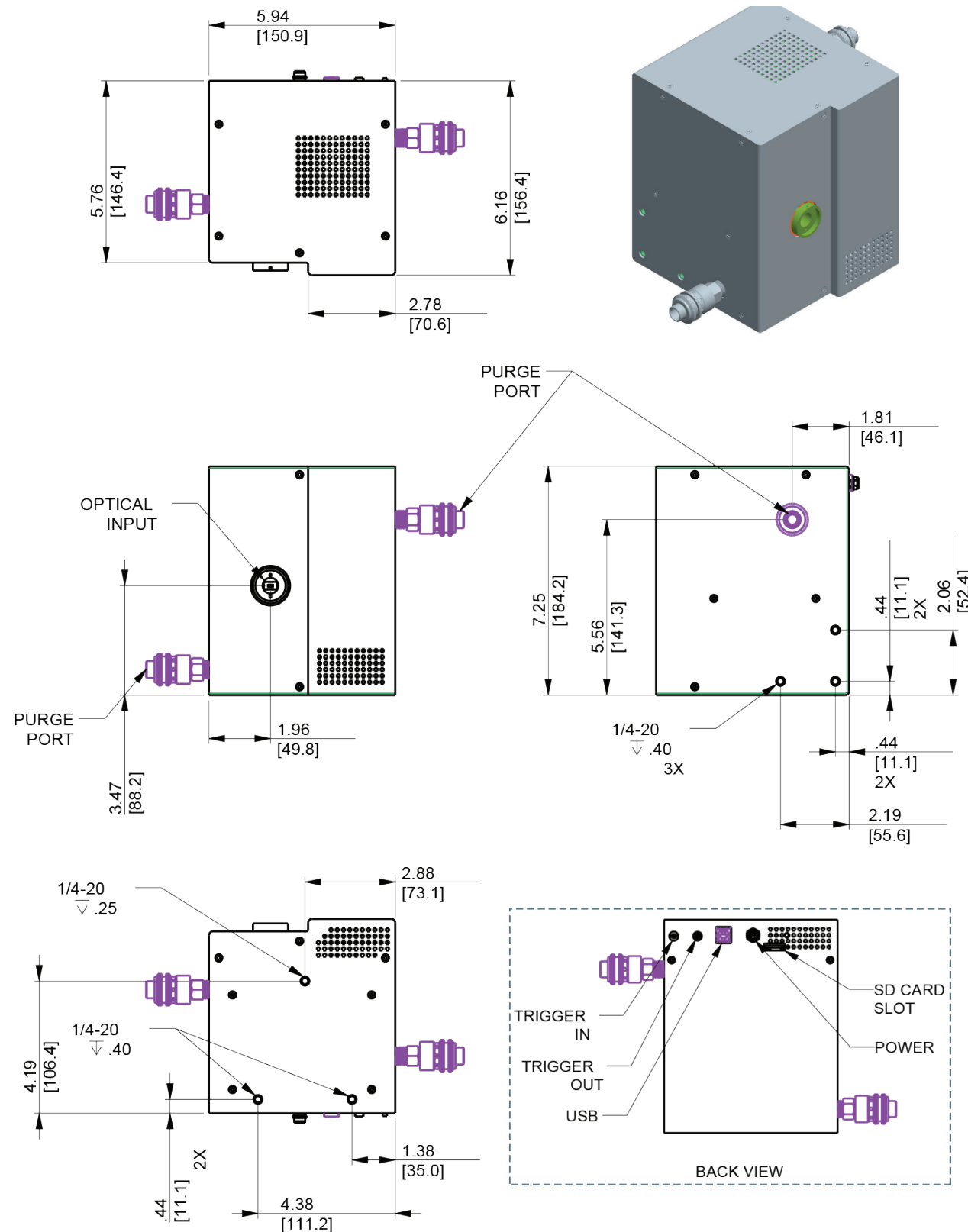


An example of the production testing for HORIBA's hyperspectral/multichannel spectroscopy systems based on the method described above.

[1] J. Fischer, M. Baumbach, J. Bowles, J. Grossmann, and J. Antoniadis, "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.

## System Mechanical Drawings



Customer can specify any number of fiber channels between 4 and 32, fiber bundle type and length.

## Best Selling Miniature Spectrometers for OEM industrial applications

### MiniVS20 Spectrometer with Linear UV-VIS CMOS or NIR INGAAS sensor

5 nm resolution

OEM hand-held spectrometer covering 190 to 1,700nm for various low stray light applications

- Aberrations 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

- 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 785nm

Fiber-coupled  
USB  
Spectrometers

6 cm<sup>-1</sup> resolution

Most compact OEM Raman spectrometer with aberration correction holographic grating

- Covers 150-3,300 cm<sup>-1</sup>
- High efficiency and low stray light
- Available in F/2.3 and in compact F/5 configurations
- -50C deep-cooled scientific CCD camera with minimized etaloning and high NIR QE

### PoliSpectra® M4C 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-Channels 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)

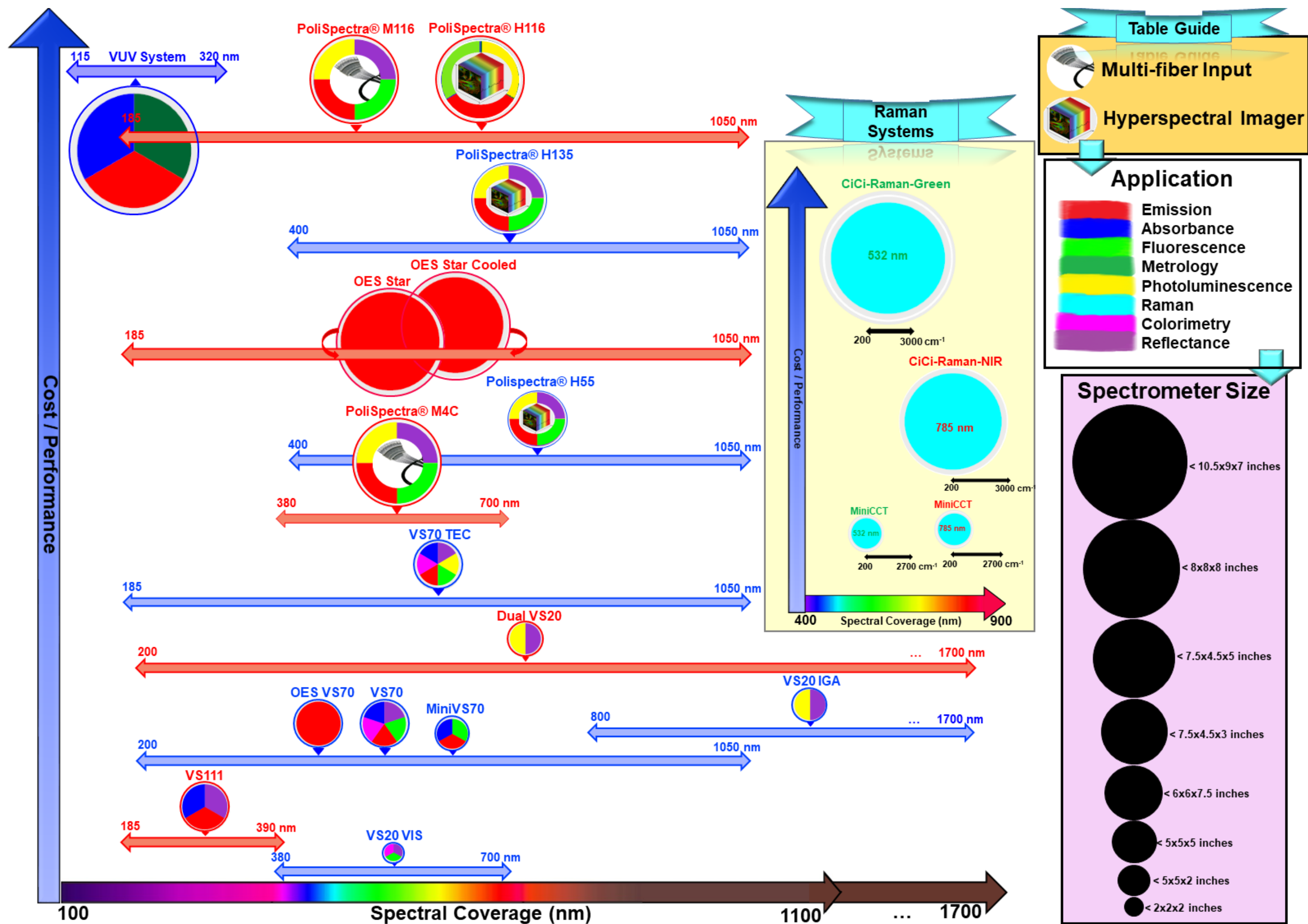
### PoliSpectra® H116 Imaging spectrometer for Hyperspectral from UV to NIR

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 Spectrometer Selection Guide





# 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 & 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 gratings 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, InGaAs and CMOS cameras

Syncerity®



Low Cost -50° C  
Air-cooled OEM Camera

Synapse® Plus



Deep-cooled -80° C to -100° C  
Air or Water-cooled Camera

Synapse® EM



EM CCD  
Deep-cooled Camera

VUV Syncerity®



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

Synapse® InGaAs



Deep Cooled NIR Camera  
to -75° C (Water-cooled)

	USA & Canada	Japan	France and all other countries
	<a href="mailto:OEM.US@horiba.com">OEM.US@horiba.com</a>	<a href="mailto:OEM.JAPAN@horiba.com">OEM.JAPAN@horiba.com</a>	<a href="mailto:OEMSALES.JYFR@horiba.com">OEMSALES.JYFR@horiba.com</a>
	+1 732 494 8660 Ext. 7733	+81 (75) 313 8121	+33 (0)169 74 72 00