VU90 Spectrometer
Most Compact Far UV
CCD Spectrometer

For OEM VUV
Industrial Applications

horiba.com/oem
Overview
HORIBA has developed a compact size Vacuum Ultraviolet (VUV) Spectrometer with a dedicated deep-cooled CCD camera, Syncerity-VUV, all manufactured in its NJ facility. This unique system features a special CCD sensor with high sensitivity in the far UV wavelength range with capability to measure from 115 nm with a resolution better than 0.5 nm under vacuum, or high purity nitrogen. The system’s internal optical cavity can be black coated for ultimate suppression of stray light.

Far UV Applications (Vacuum UV or N₂ purge)
• VUV Emission & Fluorescence
• VUV Transmission & Reflectance
• GC-VUV: Alternative to conventional gas chromatography

Examples:
• Metrology
• Photolithography
• Petrology
• Environmental Monitoring
• Flavors & Fragrances
• Food & Beverage Safety

Optical and Mechanical Layout
Based on concave holographic grating

Features
- First portable and most affordable VUV spectrometer
- Deep-cooled CCD with high quantum efficiency
- High resolution of 0.5 nm selectable resolution and throughput
- Smallest VUV system footprint on the market
- Ultra high throughput combined with unmatched low stray light performance
- Extendable wavelength coverage from Far UV to UV-VIS-NIR

High sensitivity and very low stray light are achieved in a short focal length (90 mm) CCD spectrometer.
# General Spectrometer Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectral Coverage</td>
<td>115 - 230 nm; full coverage on CCD: 115 - 320 nm (No order sorting filter available)</td>
</tr>
<tr>
<td>Spectral Resolution</td>
<td>0.5 nm with 22 µm pinhole, 0.75 nm with 40 µm pinhole</td>
</tr>
<tr>
<td>Spectral Dispersion</td>
<td>12 nm/mm; 0.17 nm/pix</td>
</tr>
<tr>
<td>Focal Length</td>
<td>90 mm</td>
</tr>
<tr>
<td>VUV Optics</td>
<td>MgF$_2$ coated grating and mirror</td>
</tr>
<tr>
<td>Vacuum or Nitrogen-purged Mode</td>
<td>~ 10$^{-6}$ Torr with turbomolecular pump. Helium leak test performed at factory. N$_2$ high purity nitrogen constant purge required</td>
</tr>
<tr>
<td>Options</td>
<td>Selection of different heights of VUV CCDs</td>
</tr>
<tr>
<td></td>
<td>Kinematic mounts to interchange pinholes (or slits)</td>
</tr>
<tr>
<td></td>
<td>Bare metal finish is standard; Optional super black coating reduces stray light</td>
</tr>
<tr>
<td>F/#</td>
<td>~ F/10</td>
</tr>
<tr>
<td>Software</td>
<td>LabVIEW acquisition software for initial evaluation (DLLs provided for software integration)</td>
</tr>
</tbody>
</table>

# Vacuum Camera Specifications (Syncerity® VUV 2048 pixel BI Sensor)*

<table>
<thead>
<tr>
<th>Feature</th>
<th>Standard</th>
<th>Special</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantum efficiency at 20° C (See plots on next page)</td>
<td>2048 x 70</td>
<td>Optional increased CCD sensor heights available</td>
</tr>
<tr>
<td>CCD Sensor Format</td>
<td>2048 x 70</td>
<td></td>
</tr>
<tr>
<td>CCD Pixel Size</td>
<td>14 µm x 14 µm</td>
<td></td>
</tr>
<tr>
<td>CCD Height</td>
<td>1 mm</td>
<td></td>
</tr>
<tr>
<td>CCD QE</td>
<td>3 options - refer to graphs below</td>
<td></td>
</tr>
<tr>
<td>Camera Window</td>
<td>2 options - no window for lowest VUV response or MgF$_2$ window</td>
<td></td>
</tr>
<tr>
<td>Deep Thermoelectric Cooling</td>
<td>-45° C under vacuum (10$^{-6}$ mbar) with +25° C ambient or -25° C under N$_2$ purging</td>
<td></td>
</tr>
<tr>
<td>Single Pixel Well Capacity</td>
<td>50 000 e$^-$/pixel (minimum); 60 000 e$^-$/pixel (typical)</td>
<td></td>
</tr>
<tr>
<td>Serial Register Full Well Capacity</td>
<td>250 000 e$^-$/pixel (minimum); 500 000 e$^-$/pixel (typical output register saturation)</td>
<td></td>
</tr>
<tr>
<td>Scan Rates</td>
<td>45 kHz and 500 kHz</td>
<td></td>
</tr>
<tr>
<td>Readout Noise (at 45 kHz and at -45° C)</td>
<td>10 e$^-$ (typical) to 14 e$^-$ (maximum)</td>
<td></td>
</tr>
<tr>
<td>Readout Noise (at 500 kHz and at -45° C)</td>
<td>20 e$^-$ (typical) to 25 e$^-$ (maximum)</td>
<td></td>
</tr>
<tr>
<td>Maximum Spectral Rate</td>
<td>20 Hz at 45 kHz scan rate; 189 Hz at 500 kHz scan rate</td>
<td></td>
</tr>
<tr>
<td>Digitization</td>
<td>16-bit ADC</td>
<td></td>
</tr>
<tr>
<td>Dynamic Range (Typical for Single Pixel)</td>
<td>50,000:1</td>
<td></td>
</tr>
<tr>
<td>Non-linearity (Measured on Each Camera)</td>
<td>&lt; 0.15% (typical) at 45 kHz (0.4% maximum)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt; 0.20% (typical) at 500 kHz (1% maximum)</td>
<td></td>
</tr>
<tr>
<td>Dark current at -45° C Note: Pixel size = 14 µm</td>
<td>0.1 e$^-$/pixel/s (typical)</td>
<td></td>
</tr>
<tr>
<td>Software-adjustable Gains</td>
<td>2, 4, and 10 e$^-$/count at -45° C</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>USB 2</td>
<td></td>
</tr>
<tr>
<td>Environmental Conditions</td>
<td>Operating temperature 15° C to 40° C ambient</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relative humidity &lt; 70% (non-condensing)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Storage temperature -25° C to 45° C</td>
<td></td>
</tr>
<tr>
<td>Power Requirements</td>
<td>AC/DC power supply (provided)</td>
<td>90-264 VAC, 47–63 Hz</td>
</tr>
</tbody>
</table>

*Specifications, form factor, and spectrometer cover subject to change without notice. No LabVIEW license is needed to run our acquisition software.
Stray light comparison between uncoated and coated cavity (Super Black) measured by far field illumination using tungsten lamp – zero order.

Spectrum of deuterium lamp shows enhanced sensitivity starting from 113 nm with 22 µm slit (0.45 nm resolution).

CCD Quantum Efficiency

UV hardened sensor provides increased lifetime, however no warranty is provided on any sensor exposed to VUV.

The Only Commercial VUV System Using a Super Black Coating

Housing Lid

Baffle treated with super black coating

VUV system slit interchangeability test with 40 µm pinhole and 22 µm slit.
Illustrations of Different Setups of FUV System

**Config #1:** High vacuum setup with turbo pump  
CCD temp: -45˚ C

- Turbo molecular pump
- D$_2$ Lamp
- Spectro Housing
- HVAC valve

**Config #2:** Nitrogen-purged  
CCD temp: -25˚ C

- N$_2$-purged set-up shown with Hamamatsu: L10366 VUV light source

**Adjustable Resolution and Throughput**

Resolution and throughput are adjustable by exchanging optional slit & pinhole holders.

- Pinhole sizes: 22 and 40 µm diameter
- Slit sizes: 22 and 40 µm width

Kinematic interchange is achieved if all components are ordered and pre-aligned at factory.
System Mechanical Drawings

MATING CONNECTION SIZE - KF25

MATING CONNECTION SIZE - DN16CF

MATING CONNECTION SIZE - KF40

REAR VIEW

FRONT MOUNTING HOLES
1/4-20 UNC-2B
TAP 0.5
4X

1/4-20 UNC-2B
TAP 0.5
6X ON Ø 4.437 B.C.

FIBER INPUT

REFERENCE SURFACE

Ø 5.00
[127.0]

Q-RING Ø 3.73 ID
.139 CS FLUOROCARBON
(VITON)

Ø 0.281
[7.14]
3X

MOUNTING HOLES

MOUNTING HOLES

THREADED MOUNTING HOLES - 1/4-20 UNC-2B
6X ON Ø 7.250 B.C.

Ø 0.261
[6.63]
3X

UNITS IN INCHES [MM] UNLESS NOTED
Best Selling Miniature Spectrometers for OEM Industrial Applications

Fiber-coupled USB Spectrometers:

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

Cost & Performance

Spectral Coverage (nm)

1050 nm

1700 nm

Raman Spectrometers

CiCi-Raman-Green

532 nm

200

3300 cm⁻¹

CiCi-Raman-NIR

785 nm

200

3000 cm⁻¹

MinicCT

532 nm

200

3300 cm⁻¹

MinicCT

785 nm

200

2750 cm⁻¹

VU90

VU111

MiniV70

PoliSpectra® H116

PoliSpectra® H135

PoliSpectra® H55

VS70 TEC

VS70

VS20 NIR

Dual VS20 UV - NIR

CiCi-Raman-Green

532 nm

3300 cm⁻¹

CiCi-Raman-NIR

785 nm

2750 cm⁻¹

MiniCCT

532 nm

3300 cm⁻¹

MiniCCT

785 nm

2750 cm⁻¹

Legend

Spectrometer Input Type

S Single-fiber Input

Multi-fiber Input

Hyperspectral Imager

Technique & Application

Emission (OES)

Absorbance

Fluorescence

Reflectance

Raman

Metrology

Photoluminescence

Colorimetry

Spectrometer Size

≤ 10.5x9x7 inches

≤ 8x8x8 inches

≤ 7.5x4.5x5 inches

≤ 7.5x4.5x3 inches

≤ 6x6x7.5 inches

≤ 5x5x5 inches

≤ 5x5x2 inches

≤ 2x2x2 inches
Family of Vacuum Monochromators and CCD Spectrometers

Most popular models: H20UVL, H30UVL and TGS300

Typical applications: High Harmonic Generation, Plasma Characterization

HORIBA Scientific provides a wide variety of vacuum monochromators, spectrographs and VUV cameras. We can customize these VUV designs for OEM volume applications.

We cover a large spectral range from a few nanometers to a few hundred nanometers. Based on toroidal, spherical or plane diffraction gratings, our systems provide unequalled throughput with competitive spectral resolution for Soft X-Ray, EUV, FUV and DUV applications.

<table>
<thead>
<tr>
<th>Spectral range (nm)</th>
<th>Energy range (eV)</th>
<th>Model</th>
<th>Focal Length (nm)</th>
<th>Grating Rotation</th>
<th>Single Chamber Detector</th>
<th>Array Detector</th>
<th>Replica Available</th>
<th>VLS Grating Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>Max</td>
<td>Min</td>
<td>Max</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td>110</td>
<td>11.3</td>
<td>135.5</td>
<td>TGS300</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>50</td>
<td>300</td>
<td>4.1</td>
<td>24.8</td>
<td>H30-UVL</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>100</td>
<td>300</td>
<td>4.1</td>
<td>12.4</td>
<td>H20-UVL</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

VUV Syncerity: The latest addition to our growing family of scientific CCD Cameras with 2 available flange options

VUV Syncerity® with HORIBA VUV flange

- Low Cost OEM Solution
- Available as a Stand Alone Camera
- High QE in VUV Range 58% @120 nm (no ARC)
- Attachable to High Vacuum Chamber with Viton® O-Ring, down to <10⁻⁶ Torr
- TE-cooled to -50°C (vacuum) or -25°C with N₂ purge

VUV Syncerity® with Commercial flange

Up to 2048 x 512 Pixels
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

Scientific Deep Cooled CCD, InGaAs and CMOS Cameras