

# SPECTROMETERS

## PRODUCT OVERVIEW

Spectrometers are used in a variety of applications to measure different optical properties of light, including wavelength spectra and intensity. Mightex uses high-sensitivity sensors to collect light efficiently through a SMA connected fiber. We also offer a wide range of slit widths and wavelength sensitivity. Together with an easy-to-use software package, our spectrometers offer a complete solution to meet your application needs.

### High Resolution High Stability CCD Spectrometers

HRS Series  
UV/VIS/NIR (200-1050nm)  
Sub-nm resolution

HRS-BD1-xxx  
300nm-1070nm

HRS-IR1-xxx  
700nm-870nm

HRS-NIR-xxx  
600nm-1000nm

HRS-UV1-xxx  
200nm-400nm

HRS-VIS-xxx  
390nm-780nm

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### Optical Spectrometer Sensor Engine

SSE Series  
Silicon linear CCD array  
8μm x 200μm pixel size

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### Spectrometer Accessories

Cuvette holders  
Cosine corrector  
Direct Coupling Collimators & more!

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### Multi Channel CCD Spectrometers

Multiple (6) spectral channels  
High spectral resolution  
High throughput

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# HIGH-RESOLUTION HIGH-STABILITY CCD SPECTROMETERS

Compact CCD spectrometers are widely used in process control, environment monitoring, and scientific research applications. Mightex HRS series compact CCD spectrometers features a high-resolution 100mm Czerny-Turner optical platform coupled with a Toshiba 3648-element CCD array. The optimized optical path yields both high spectral resolution and high light collection efficiency.

Wavelength and amplitude stability is often a critical requirement for many spectrometer applications. All optical components in the HRS series spectrometers are mounted directly on a single-piece base without using screws. A box enclosure structure further increases stiffness of the base. The proprietary mounting method ensures high stability over time and temperature change.

The spectrometer takes input through an SMA connector port. Usually a fiber patch cord is used to transmit light into the spectrometer. However, it's also possible to send the input light directly into the spectrometer through the input slit. Input ports are interchangeable so that ports with different slit size (or without slit) can be used. Note that wavelength calibration is necessary after changing the input port.

A 16-bit DAC is used to convert the analog signal from the CCD array into a digital stream. The electronics hardware also includes trigger input and four programmable digital I/Os for interfacing with other equipment, such as a light source. The spectrometer is controlled through a USB2.0 interface which also supplies all the electric power needed to operate the spectrometer. The standard software package includes a full-featured PC software as well as a software development kit (SDK) for further software development.

## FEATURES

- Superb temperature and long-term stability
- Interchangeable slit by customers
- Fiber input with SMA connector
- UV/VIS/NIR (200-1050nm), sub-nm resolution
- External trigger and GPIOs
- Full-featured SDK for OEM
- USB2.0 for both data and power
- LabView Support
- Low-level USB protocol for embedded system

## MODELS

### HRS Series CCD Spectrometers

<b>HRS-BD1-xxx</b>	<b>  300-1070nm</b>
<b>HRS-IR1-xxx</b>	<b>  700-870nm</b>
<b>HRS-NIR-xxx</b>	<b>  600-1000nm</b>
<b>HRS-UV1-xxx</b>	<b>  200-400nm</b>
<b>HRS-VIS-xxx</b>	<b>  390-780nm</b>



## PERFORMANCE SPECIFICATIONS

Model <sup>1</sup>	HRS-UV1-xxx	HRS-VIS-xxx	HRS-NIR-xxx	HRS-IR1-xxx	HRS-BD1-xxx
<b>Optical Platform</b>	f/4, Czerny-Turner				
<b>Focal Length   mm</b>	100				
<b>Wavelength Range   nm</b>	200 ~ 400	390 ~ 780	600 ~ 1,000	700 ~ 870	300 ~ 1,050
<b>Order Sorting Filter</b>	Longpass	Longpass	Longpass	Longpass	Spatially Variable Filter
<b>Entrance Slit   <math>\mu\text{m}</math></b>	5, 10, 25, 50, 100, 200 or no slit				
<b>Input Fiber Connector</b>	SMA 905				
<b>Input Fiber NA</b>	0.22				
<b>Detector</b>	Toshiba TCD1304AP Linear CCD Array				
<b>Pixel Number</b>	3648				
<b>Pixel Size   <math>\mu\text{m}</math></b>	8 x 200				
<b>Pixel Well Depth   electron</b>	100,000				
<b>Signal-to-noise Ratio</b>	1,000:1 (at full scale)				
<b>A/D Resolution   bit</b>	16				
<b>Integration Time   ms</b>	0.1 to 6,500				
<b>Frame Rate   fps</b>	up to 138				
<b>GPIO</b>	4 programmable digital I/Os				
<b>Trigger Input</b>	Yes				
<b>Trigger/GPIO Interface</b>	DIN8				

<sup>1</sup> xxx is the code for the entrance slit size of choice: 005, 010, 025, 050, 100, and 200.

## SPECTRAL RESOLUTION VS. SLIT WIDTH

Slit Width   $\mu\text{m}$	Spectral Resolution   FWHM, nm				
	HRS-UV1-xxx	HRS-VIS-xxx	HRS-NIR-xxx	HRS-IR1-xxx	HRS-BD1-xxx
5	0.15	0.25	0.25	0.12	0.5
10	0.2	0.3	0.3	0.15	0.6
25	0.25	0.4	0.5	0.2	0.9
50	0.45	0.8	0.9	0.38	1.7
100	0.85	2	2.1	0.9	4.1
200	1.65	4.8	4.9	2.1	9.7

## DIMENSIONS

Models	Weight   g	Size (hxxwd)   mm
<b>HRS series</b>	550	138x108x37

## RECOMMENDED CONFIGURATIONS

<b>Processor</b>	Pentium 4 1.8 GHz or higher
<b>Operating System</b>	Windows 2000, XP, Vista, 7, 8, and 10
<b>RAM</b>	512MB or greater
<b>Hard Disk Space</b>	50MB for software installation, plus additional space for storing captured images
<b>Power Consumption</b>	300 mA at 5V
<b>USB2.0 Host Controller</b>	USB2.0 Enhanced Controller, which supports USB2.0 High-Speed (480Mbps)

# MULTI-CHANNEL CCD SPECTROMETERS

**M**ulti-channel spectrometers are used to monitor or measure multiple samples or sources simultaneously. Traditionally, multi-channel imaging spectrometers have been expensive and bulky instruments used only in demanding laboratory and industrial applications. Mightex has leveraged the state-of-the-art optics and CCD cameras to bring to the market a compact and low-cost multi-channel fiber spectrometer that features high spectral resolution and high light throughput.

At the heart of Mightex multi-channel spectrometers is a high-throughput flat-field imaging spectrograph.

Multiple input fibers, each represents an independent signal channel, are aligned along the input slit of the imaging spectrograph. Spectrum of each channel is dispersed by a high-efficiency diffraction grating and then imaged on to a 2D CCD sensor. Light from each channel occupies different rows on the CCD sensor. All channels are exposed simultaneously, then rows associated with each channel are binned together to produce a spectrum for the channel. Fiber channels are spaced out properly to essentially eliminate crosstalk between adjacent channels.

The standard CCD camera features a ½" 1.3MP Sony ICX205 imager with a 12-bit ADC. Exposure time (integrating time) can be varied between 50µs and 200s. The electronics hardware also includes trigger input and four programmable digital I/Os for interfacing with other equipment, such as a light source. The spectrometer is controlled through a USB2.0 interface which also supplies all the electric power needed to operate the spectrometer. Mightex also integrates other cameras to build custom multi-channel spectrometers.

Input ends of the fibers are connectorized with SMA905 connectors. Sleeves are available to connect the fibers to other SMA connectors. Standard software package includes a full-featured multi-channel spectrometer PC software as well as a software development kit (SDK) for further software development. The software also supports radiometric calibration and photometric calculations.

## FEATURES

- Multiple (6) spectral channels in one compact package
- No moving parts
- High spectral resolution
- High throughput
- USB2.0 interface
- No external power required
- Trigger input
- Full-featured SDK
- GPIOs for interfacing with other equipment

## MODELS

### ISP Series CCD Spectrometers

**ISP-VIS-MC006-A |**

**ISP-VIS-MC006-A-CAL | individual channel irradiance calibration**



## PERFORMANCE SPECIFICATIONS

<b>Model<sup>1</sup></b>	ISP-VIS-MC006-A-xxx
<b>Number of Channel</b>	6
<b>Optical Platform</b>	F/2 High-resolution flat-field imaging spectrograph
<b>Wavelength Range   nm</b>	380 ~ 780
<b>Order Sorting Filter</b>	Long-pass
<b>Entrance Slit   <math>\mu\text{m}</math></b>	5, 10, 25, 50, 100, 200 or no slit
<b>Input Fiber Connectors</b>	SMA 905
<b>Input Fiber NA</b>	0.22
<b>Detector</b>	Sony ICX205AL
<b>Pixel Number</b>	1,392 x 1,040
<b>Pixel Size   <math>\mu\text{m}</math></b>	4.65 x 4.65
<b>Effective Pixel Well Depth<sup>2</sup>   electron</b>	200,000
<b>Signal-to-noise Ratio</b>	1,000:1(at full scale)
<b>A/D Resolution   bit</b>	12
<b>Integration Time   ms</b>	0.05 to 200,000
<b>Frame Rate   fps</b>	15 @ 8bit, 9 @ 12bit
<b>Hardware Gain   dB</b>	6 ~ 43
<b>GPIO</b>	4 programmable digital I/Os
<b>Trigger Input</b>	Yes
<b>Trigger Delay   <math>\mu\text{s}</math></b>	< 25
<b>Trigger/GPIO Interface</b>	DIN8

<sup>1</sup> xxx is the code for the entrance slit size of choice: 005, 010, 025, 050, 100, and 200.

<sup>2</sup> After binning.

## SPECTRAL RESOLUTION VS. SLIT WIDTH

Slit Width   $\mu\text{m}$	Spectral Resolution   FWHM, nm
	ISP-VIS-MC006-A-xxx
5	1.1
10	1.2
25	1.7
50	2.4
100	4.0
200	7.1

## DIMENSIONS

Models	Weight   g
<b>ISP series</b>	840

# RECOMMENDED CONFIGURATIONS

Processor	Pentium 4 1.8 GHz or higher
Operating System	Windows 2000, XP, Vista, 7, 8, and 10
RAM	512MB or greater
Hard Disk Space	50MB for software installation, plus additional space for storing captured images
Power Consumption	1.8W
USB2.0 Host Controller	USB2.0 Enhanced Controller, which supports USB2.0 High-Speed (480Mbps)

# OPTICAL SPECTROMETER SENSOR ENGINE

**M**ightex's Optical Spectrometer Sensor Engine includes a cost-effective high-performance B/W board-level line camera, based on a single-line, 3648-pixel CCD chip with USB2.0 (480 Mb/s) interface. Setting up the Optical Spectrometer is very easy: the user simply installs the Mightex spectrometer software onto any desktop or notebook PC and then connects the USB cable from the line camera to the PC. There is no need for installing a DAC card, or using an external power supply. The spectrometer sensor also comes with a line camera SDK for further development by the user.

The 'window-less' version of the spectrometer sensor engine has the glass plate in front of the image sensor removed, and hence it is more sensitive to UV and is also more suitable for applications where coherent light sources such as lasers are used.

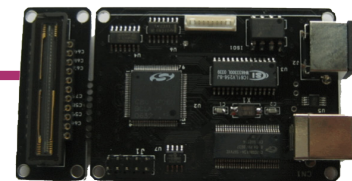
## FEATURES

- USB2.0 compatible
- Board-level camera, ideal for OEM applications
- No external power supply required
- Optical integration time-adjustable from 100ms to 6.5s
- 3648 pixel silicon linear CCD array
- 8µm x 200µm pixel size
- 16-bit A/D converter for high intensity resolution
- High scan rate
- External trigger capability
- 4 GPIOs pins

## MODELS

### SSE Series Spectrometer Sensor Engine

<b>SSE-1304-U</b>	<b>Board-level</b>
<b>SSE-1304-UE</b>	<b>Enclosed</b>
<b>SSE-1304-UW</b>	<b>Board-level, windowless</b>
<b>SSE-1304-UWE</b>	<b>Enclosed, windowless</b>



## PERFORMANCE SPECIFICATIONS

Models	SSE-1304-U SSE-1304-UE	SSE-1304-UW SSE-1304-UWE
<b>CCD</b>	Toshiba TCD1304DG	
<b>Number of Pixels</b>	3,648	
<b>Pixel Size   µm</b>	8 x 200	
<b>Spectral Range   nm</b>	350 ~ 1,000	200 ~ 1,000
<b>Pixel Output Clock   MHz</b>	0.5	
<b>Data Storage On board   frame</b>	4	
<b>ADC Resolution   bit</b>	16	
<b>External Trigger</b>	Yes	
<b>Exposure Time Range   ms</b>	0.1 ~ 6,500	
<b>GPIO</b>	Yes (4 Programmable I/O's)	
<b>Frame Rate<sup>1</sup>   scans/second</b>	138	
<b>Host Interface</b>	USB 2.0	

<sup>1</sup> Frame rate is dependent on exposure time. Value shown when exposure time is set to 0.1ms.

## SDK FEATURES

<b>Operating System</b>	Windows 2000, XP, Vista, 7, 8, and 10
<b>RAM</b>	64MB or greater
<b>Hard Disk Space</b>	10MB for software installation, plus additional space for storing captured images
<b>USB Port</b>	USB2.0
<b>Multiple Cameras</b>	Supported
<b>Device Driver</b>	Yes
<b>Demo Application</b>	Yes
<b>Library Files</b>	Yes (DLL files and Static Library files)
<b>Example Codes</b>	Yes (VC++ and Delphi)
<b>Frame Attributes*</b>	Exposure time, Time Stamp, Trigger Event Count, Over exposure detection

\* SDK will provide call back, which will send the user Frame data and the related attributes of each frame.

# SPECTROMETER ACCESSORIES

## CUVETTE HOLDERS

The SPC-CVH-10-xx Cuvette Holders accept a standard 10-mm path length cuvette for liquid or powder samples. SMA-terminated optical fibers are used to couple light sources and spectrometers to the device. The Cuvette Holder is compatible with Mightex's fiber coupled LED sources, Mightex's spectrometers, as well as any other light sources or spectrometers with SMA termination. The standard configuration of a SPC-CVH-10-xx Cuvette Holder comes with two SMA fiber collimators, with the option of adding up to a total of four (4) SMA fiber collimators. This compact design can easily be inserted into a lab setup, and there is a filter slot on the holder which is perfect for fluorescence applications.

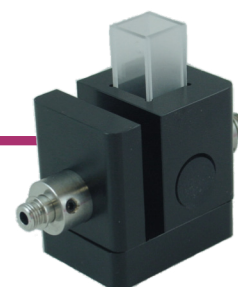
### Key Features

- Designed for 10-mm path length cuvettes
- Up to four (4) SMA ports
- Filter slot accepts filters up to 5mm in thickness
- M4 and 8-32 mounting holes

## MODELS

### SPC Cuvette Holders

<b>SPC-CVH-10-00</b>	<b>No fiber optic collimators</b>
<b>SPC-CVH-10-2V</b>	<b>2 fiber optic collimators, 350-2000nm</b>
<b>SPC-CVH-10-3V</b>	<b>3 fiber optic collimators, 350-2000nm</b>
<b>SPC-CVH-10-4V</b>	<b>4 fiber optic collimators, 350-2000nm</b>
<b>SPC-CVH-10-2U</b>	<b>2 fiber optic collimators, 185-2100nm</b>
<b>SPC-CVH-10-3U</b>	<b>3 fiber optic collimators, 185-2100nm</b>
<b>SPC-CVH-10-4U</b>	<b>4 fiber optic collimators, 185-2100nm</b>



## SPECTROMETER SLITS AND INPUT ADAPTER

Part Number	Description
<b>ACC-SPC-ADP-0000</b>	SMA fiber input adapter for spectrometers without an entrance slit.
<b>ACC-SPC-ADP-0005</b>	Additional spectrometer input adapter with 5um slit.
<b>ACC-SPC-ADP-0010</b>	Additional spectrometer input adapter with 10um slit.
<b>ACC-SPC-ADP-0025</b>	Additional spectrometer input adapter with 25um slit.
<b>ACC-SPC-ADP-0050</b>	Additional spectrometer input adapter with 50um slit.
<b>ACC-SPC-ADP-0100</b>	Additional spectrometer input adapter with 100um slit.
<b>ACC-SPC-ADP-0200</b>	Additional spectrometer input adapter with 200um slit.

Please note that one only needs to order the adapters if one needs an additional input slit, as the original spectrometer already includes a slit. For customers who require spectrometers without an input slit, an input adapter (ACC-SPC-ADP-0000) is required.

## WHITE REFLECTION STANDARD

Part Number	Description
<b>WRS-001</b>	White reflectance standard, 1" in diameter

## COSINE CORRECTOR

Part Number	Description
<b>ACC-SPC-COS1</b>	Cosine corrector for light collection and radiometric/photometric measurement, transmission range: 220nm - 2500nm, SMA connector.

## MECHANICAL HOLDERS FOR FIBER OPTIC COLIMMATORS

Part Number	Description
<b>ACC-FOC-045-100</b>	Mechanical Holder for Holding Two Collimators at 45 Degrees.

## DIRECT-COUPLING COLLIMATORS

### Key Features

Direct-coupling collimators are used to either coupling light from free space into a spectrometer or collimating light from a point light source to form a collimated (parallel) optical beam. Direct-coupling collimators are key components with numerous applications. For example, in spectroscopy, a direct coupling collimator can collect light in a narrow field of view into a spectrometer. In another example, one collimator is connected to a point light source and the collimated beam passes through a cuvette. On the other side of the cuvette a second collimator couples light directly into a spectrometer.

- **BK7 lens, 350nm to 2000nm**
- **UV fused silica lens, 185nm to 2100nm**
- **Adjustable focus**
- **Aluminum alloy construction**
- **Internal SMA thread**

To maximize transmission wavelength range Mightex direct-coupling collimators feature a single BK7 or UV fused silica lens without optical coating. The collimator housing is machined from aluminum alloy for maximum durability. The collimator features an internal SMA thread for direct connecting to spectrometers with popular SMA input ports.

When installed on a spectrometer, the full field of view (FOV) or full divergence angle can be calculated as  $FOV = 2 \arctan(W/2f)$  where  $W$  is the width of the entrance slit of the spectrometer and  $f$  is the focal length of the lens. Alternatively, the linear field of view on an object placed a distance  $L$  away from the collimator is  $W(L/f)$ . Focusing of the collimator is adjustable for object distance between 50mm to infinity.

## MODELS

DCC Collimators | 10mm focal length, 5mm clear aperture

**DCC-010-005-U | UV fused silica, 185-2100nm**  
**DCC-010-005-V | BK7, 350-2000nm**

