TELEDYNE
Teledyne Princeton Instruments

SpectraPro® HRS Series
Imaging Spectrographs & Scanning Monochromators

Datasheet

Technology for Tomorrow's Spectroscopy

Prior to embarking on the ambitious development of a new generation of high-resolution imaging spectrographs, the engineers and application scientists at Princeton Instruments asked themselves three questions: "First and foremost, can we build an imaging spectrograph that provides all the capabilities required for today's cutting-edge spectroscopic research? Secondly, is it even possible to leverage decades of experience and the very latest optical design technologies to improve the already impressive performance of our original SpectraPro series? And, finally, if we really are able to merge optical, mechanical, and software engineering expertise to produce the next generation of imaging spectrographs, what might that look like?"

Introducing SpectraPro® HRS imaging spectrographs…

For more than 25 years, SpectraPro spectrometers from Princeton Instruments have set new standards for reliable high-performance spectroscopy. Day in and day out, researchers around the world depend on these popular spectrographs and monochromators for a wide variety of scientific and industrial applications. To date, more than 12,000 papers have been published reporting results acquired utilizing SpectraPro spectrometers. Building upon the legacy of these iconic research instruments, Princeton Instruments has now created an even more versatile, higher-resolution spectroscopy solution. New SpectraPro HRS imaging spectrographs are absolutely packed with the latest technology and are capable of facilitating just about any spectroscopy application imaginable.

Applications include:

Raman Spectroscopy | Photoluminescence | Fluorescence | LIBS | Plasma Diagnostics | Transmission | Absorption | Microspectroscopy

Features & Benefits

|	Feature	Benefit(s)
EXCLUSIVE	AccuDrive scan system	Highest accuracy and repeatability of any direct-drive wavelength scanning system. Very robust. Operates in any orientation with rapid wavelength scanning and grating changes under full computer control.
	Dual 14 x 30 mm exit ports	Permits mounting and operation of two array detectors or enables the instrument to operate as both a monochromator and a spectrograph.
	Sliding tube focus	Easy, precise alignment and focus of array detectors. Integrated focus-stop mechanism allows independent focus and rotational adjustments to array detectors.
	Interchangeable triple-grating turrets	Allows as many as nine gratings per spectrometer for optimized system performance. Choose survey and high-resolution gratings, grating sets to extend wavelength range, or different grating sets for specific applications. Unique CTS-Turrets self-align when installed and feature stress-free mounting for high reproducibility.
	Astigmatism correction	Toroidal mirror reduces astigmatism to enable multichannel spectroscopy.
EXCLUSIVE	ResXtreme spectral deconvolution	Improves spectrograph spectral resolution, intensity of spectra, and data consistency across focal plane by as much as 60%.
EXCLUSIVE	IntelliCal calibration system	Push-button wavelength calibration delivers up to 10x greater accuracy than conventional calibration methods. Fast and easy intensity calibration removes unwanted instrument artifacts that can alter spectral data.
	Extended mechanical scanning range	SpectraPro HRS spectrographs now allow operation to 1500 nm with a 1200 g/mm grating.
	High-efficiency optical coatings	Acton #1900 Al+MgF$_2$ coating delivers the highest UV-VIS throughput available on the market. Exclusive enhanced silver offers the highest VIS-NIR throughput available.
EXCLUSIVE	Convenient computer interface	True plug-and-play USB 2.0 interface.
	Dimensions Weight	**HRS 300:** Length: 15.71" (399 mm), Width: 11.0" (279 mm), Height: 8.74" (222 mm), Weight: 43 lbs (19.5 kg) **HRS 500:** Length: 22.13" (562 mm), Width: 11.84" (301 mm), Height: 8.74" (222 mm), Weight: 50 lbs (22.7 kg) **HRS 750:** Length: 31.75" (806 mm), Width: 12.5" (318 mm), Height: 9.16" (233 mm), Weight: 75 lbs (34 kg)
	Operating conditions	0°C to 30°C; 80% RH non-condensing

AccuDrive System Delivers Unmatched Accuracy and Repeatability

SpectraPro HRS imaging spectrographs feature Princeton Instruments' AccuDrive grating scan system for dramatically improved wavelength accuracy and repeatability. This drive system outperforms previous scan systems, yielding significant improvements in accuracy and reproducibility.

On startup, AccuDrive automatically identifies the turret and gratings installed. The system then performs several optical alignment routines to ensure accurate initialization of the spectrometer. The exceptional wavelength reproducibility of the SpectraPro HRS results from using only the highest-quality optomechanical components available.

Scan Cycles
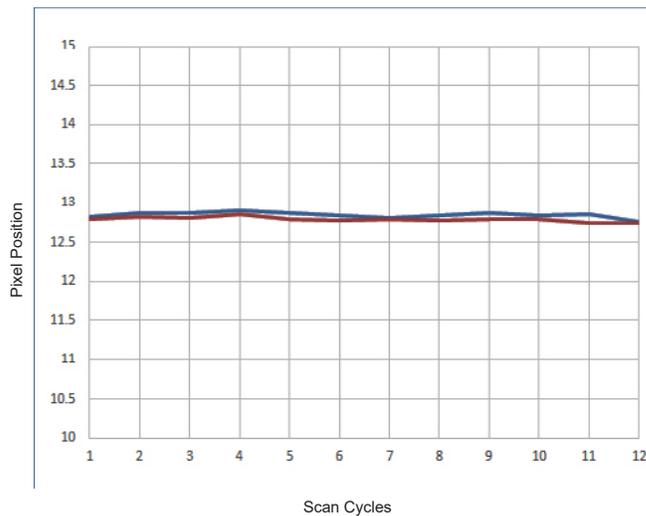
Scan system repeatability test
To show the exceptional accuracy and repeatability of the SpectraPro HRS AccuDrive grating drive system, Princeton Instruments conducted the following 24-cycle scanning test. Each cycle consisted of a scan from zero to 546 nm, then to 1100 nm, and then back to 546 nm. Every time 546 nm was reached, the exact "center of mass" was recorded, allowing scan repeatability to be measured in both scanning directions. In this test, the AccuDrive system provided better than 0.004 nm repeatability in both scanning directions.

Grating change reproducibility
The purpose of a triple-grating turret feature in any spectrograph is to allow as many as three gratings to be mounted on a turret and selected when required for an application. The grating drive system is only useful if it maintains spectral and spatial precision for all gratings installed in the spectrograph. AccuDrive increases the grating-to-grating wavelength precision to sub-pixel repeatability, typically 0.02 nm (1200 g/mm grating).

Robust design
SpectraPro HRS spectrographs are so robust that they can operate in any attitude. It is now possible to run this instrument on its side, on its end, or in virtually any orientation.
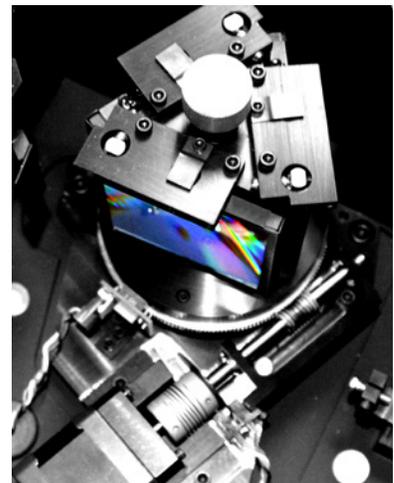
ResXtreme Spectral Deconvolution Improves Spectral and Spatial Resolution and Peak Intensity

Exclusive for SpectraPro HRS spectrographs

Introducing ResXtreme, Princeton Instruments' exclusive 2D spectral deconvolution technology developed specifically to optimize the performance of SpectraPro HRS spectrographs.

ResXtreme is based on the proven and widely accepted Richardson-Lucy deconvolution algorithm. It knows the point spread function (PSF) of SpectraPro HRS spectrographs at all focal plane positions, all wavelengths, available gratings and a variety of aperture ratios. It intelligently utilizes this information to dramatically improve spectral data. With the push of a button, ResXtreme enables up to a 60% improvement in spectral resolution as well as increased peak intensities across the 2D focal plane. Because ResXtreme works across the entire CCD, signal-to-noise performance is improved no matter where the source is positioned on the detector. Exclusive ResXtreme is included with all SpectraPro HRS spectrographs that are purchased with Princeton Instruments LightField software!*

ResXtreme features

New ResXtreme technology offers the following advantages:

- Improves spectral resolution by up to 60%

- Improves peak intensity of spectral lines by up to 60%

- Provides up to a 60% improvement in spectral uniformity at all CCD positions

- Conservation of energy... maintains total signal under the peak

- Improves signal-to-noise performance

- Saves original spectral information, allowing data to be recalled without ResXtreme

- Based on proven, widely accepted Richardson-Lucy deconvolution algorithm

Examples of ResXtreme in action:
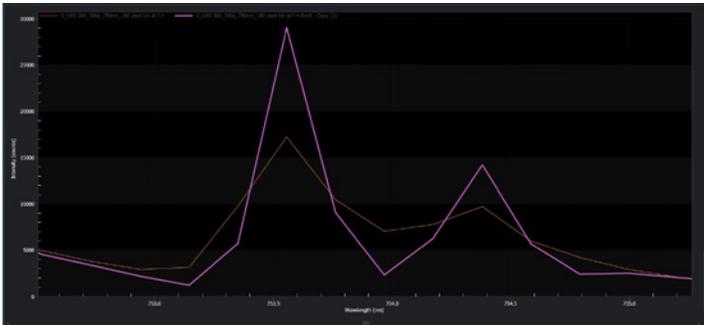
ResXtreme uses powerful spectral 2D deconvolution to improve spectral resolution and signal-to-noise capabilities.
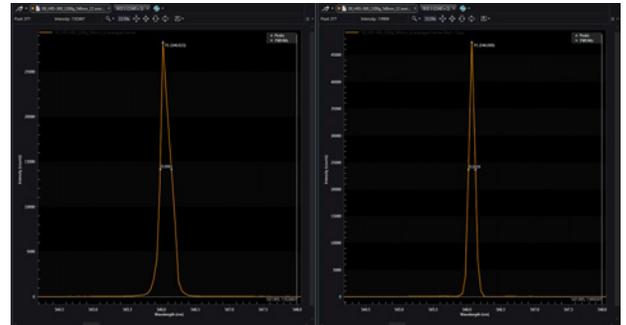
Resolution before ResXtreme: 0.1663 nm

After ResXtreme: 0.1024 nm

ResXtreme Control Panel: The convenient ResXtreme Preview function displays how much improvement is possible based on a number of variables, including aperture ratio, signal-to-noise ratio, and sharpness.
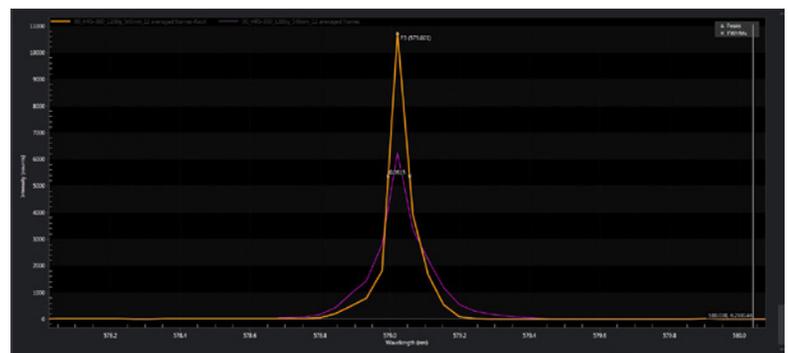
In this example, spectral resolution improves from 0.0934 nm to 0.0615 nm after ResXtreme. (SpectraPro HRS-300, 1200 g/mm grating, ProEM-HS:1K EMCCD with 10 μm pixels.)

* LightField required for operation of ResXtreme.

IntelliCal®

Automated Wavelength and Intensity Calibration Boosts Data Confidence with the Push of a Button

Princeton Instruments IntelliCal is one of the most important tools for SpectraPro HRS spectrographs, enabling wavelength and intensity calibration that are essential to the success of spectroscopic applications. With IntelliCal, calibration is fast and easy, and best of all, it is included with standard SpectraPro HRS spectrographs.*

IntelliCal wavelength calibration achieves up to 10x greater wavelength calibration accuracy than conventional calibration methods, while IntelliCal intensity calibration removes unwanted instrument responses from spectral data. SpectraPro HRS 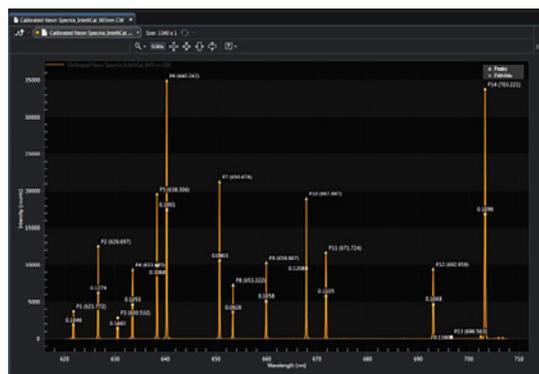spectrographs with IntelliCal ensure authentic spectroscopic data that can be published or shared across multiple user facilities.

IntelliCal calibration light sources can be mounted directly to the SpectraPro HRS entrance slit, or can be used at the sample/source location.

IntelliCal calibrates wavelength for every pixel across the CCD. The result is greater accuracy across the entire wavelength region of interest.
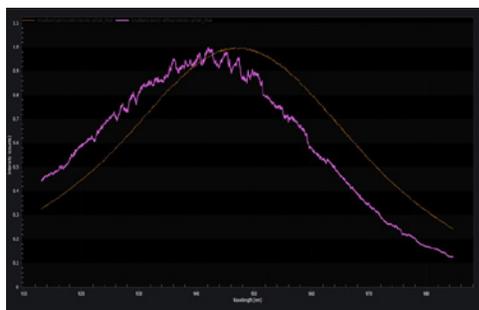
Intensity calibration eliminates system artifacts to show the correct spectral response of the light source or sample.
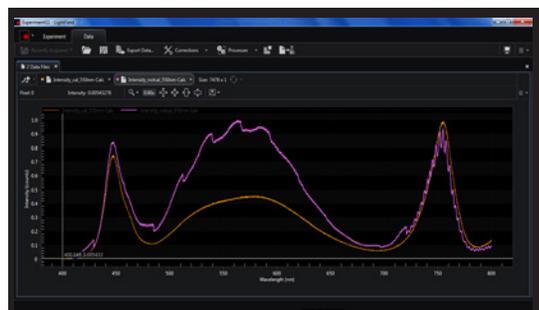
Intensity calibration can eliminate fringe patterns (etaloning), fixed pattern detector noise, and other instrument artifacts that can degrade spectral data.

* IntelliCal is provided with SpectraPro HRS-300-S, HRS-300-SS, and HRS-300-MS spectrographs. IntelliCal requires LightField software for operation.

LightField®

Powerful Functionality Combined with Easy-To-Use Interface and Support for Third-Party Software Integration
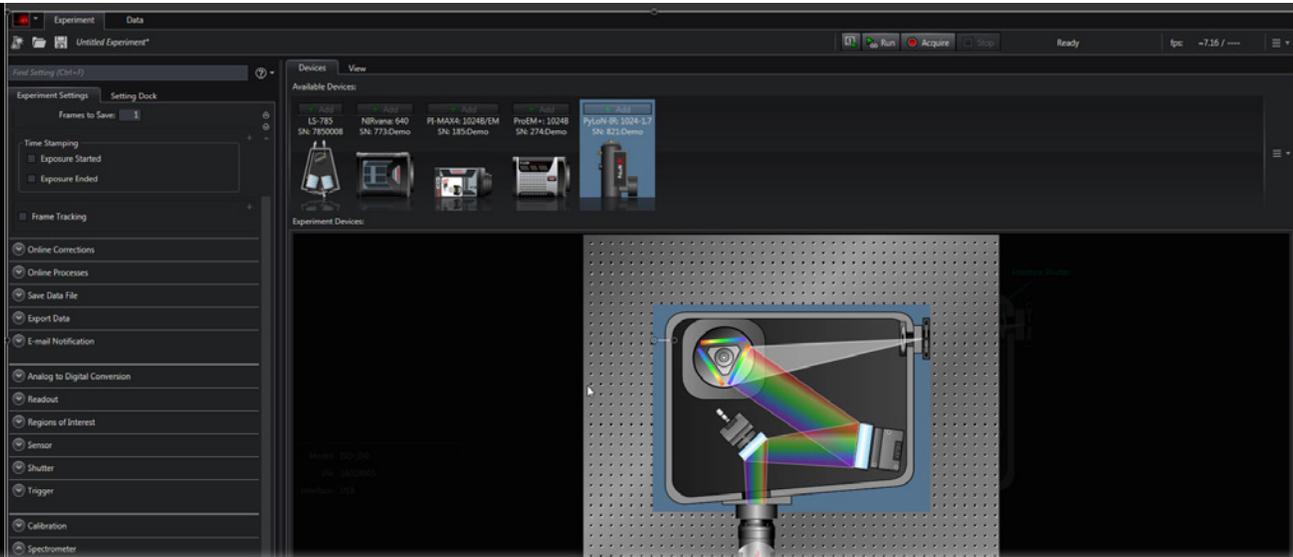
▶ The complete spectroscopy solution

Princeton Instruments LightField is an intelligent and easy-to-use software package loaded with powerful features. This "command center" provides complete control of the entire spectroscopy system and experiment: the Princeton Instruments spectrometer, array detector, spectral acquisition, data processing, and more.

▶ Smart, intuitive interface

LightField's plug-and-play interface makes it easy to add hardware. Simply plug in the USB or GigE cable and LightField automatically adds the device. Unplug the cable and LightField removes the device. When a camera or spectrometer is connected, LightField automatically recognizes Princeton Instruments hardware and sets up all the controls required.

The 64-bit software's intuitive user interface puts everything right at the researcher's fingertips. Either select experimental controls from the convenient pull-down menus or use "smart search" to find whatever's needed.

Features for spectroscopy

- Shutter control
- Sensor temperature
- Spectrometer center wavelength
- Step-and-glue
- Grating selection
- Background correction
- Multiple regions of interest (ROI)
- Find center wavelength
- Time stamping

- SuperSynchro timing for PI-MAX4 ICCDs and time-resolved measurements
- Powerful data acquisition and processing features
- Data display (spectra, images, spectra plus images, spectral overlays, zoom)
- Formulas (select from pre-defined formulas or customize)
- Synchronize spectra with images for dynamic evaluation of data
- Works seamlessly with IntelliCal to enable accurate wavelength and intensity calibration

SpectraPro HRS Specifications

Specifications	HRS-300	HRS-500	HRS-750
Focal length	300 mm	500 mm	750 mm
Aperture ratio	f/3.9	f/6.5	f/9.7
Spectral resolution with PMT*	0.09 nm with 10 µm wide slits	0.05 nm with 10 µm wide slits	0.03 nm with 10 µm wide slits
CCD spectral resolution**	0.10 nm	0.07 nm	0.05 nm
CCD spectral resolution with ResXtreme	0.07 nm or better (typ.)	0.05 nm or better (typ.)	0.03 nm or better (typ.)
Reciprocal linear dispersion	2.38 nm/mm	1.52 nm/mm	1.03 nm/mm
Wavelength coverage across 26.8 mm wide CCD	64 nm (nominal)	41 nm (nominal)	27 nm (nominal)
Focal plane size	14 mm x 30 mm (both exit ports)		
Scan range	0 to 1500 nm		
Drive step size	0.002 nm/step		
Wavelength accuracy	+/-0.2 nm (up to 0.02 nm with IntelliCal wavelength calibration)		+/-0.01 nm
Wavelength reproducibility	+/-0.05 nm (both scan directions, typ.)		
Turret	Triple-grating interchangeable CTS-Turrets self-align to system when installed		
Grating change repeatability	0.02 nm (typ.)		
Grating size	68 mm x 68 mm standard; 68 mm x 84 mm optional		
Number of turrets allowed	Accepts as many as 3 turrets, each with 3 gratings		
Astigmatism correction†	Toroidal mirror reduces astigmatism to permit multichannel spectroscopy		
Computer interface	USB 2.0		
Certification	CE tested to the following standards: EN 55022:2010/AC:2011, EN 61000-3-2:2014, EN 61000-3-3:2013, EN 61000-6-3:2007/A1:2011, EN 61326-1:2013		
Dimensions			
Length	15.71" (399 mm)	22.13" (562 mm)	31.75" (806 mm)
Width	11.00" (279 mm)	11.84" (301 mm)	12.50" (318 mm)
Height	8.74" (222 mm)	8.74" (222 mm)	9.16" (233 mm)
Weight	43 lbs (19.5 kg)	50 lbs (22.7 kg)	75 lbs (34.0 kg)
Optical axis height	6.155" +/- 0.435" (156 mm +/- 11 mm), adjustable		

Note: Unless otherwise noted, specifications with a 1200 g/mm grating @ 435.8 nm

Specifications are subject to change.

* PMT resolution measured with a 1200 g/mm grating @ 435.8 nm, 10 µm slit width, and 4 mm slit height.
** CCD resolution measured at the focal plane center with 10 µm slit and a Princeton Instruments PIXIS:400F with 20 µm pixels @ 546 nm.
† For astigmatism-free performance, please see our IsoPlane 320 and 160 spectrographs.

HRS-300 Configurations

HRS-300-S
Spectrograph
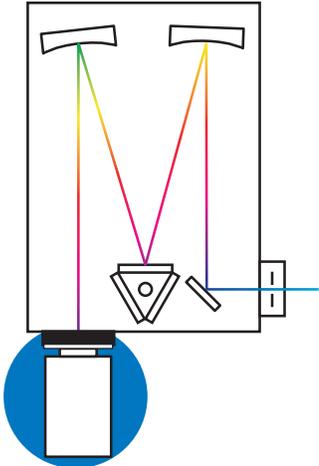
HRS-300-SS
Dual-Exit Spectrograph
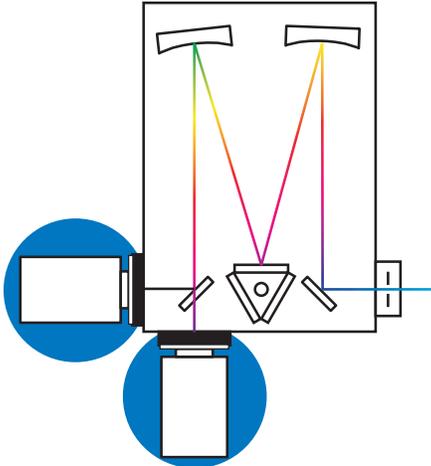
HRS-300-MS
Monochromator/Spectrograph
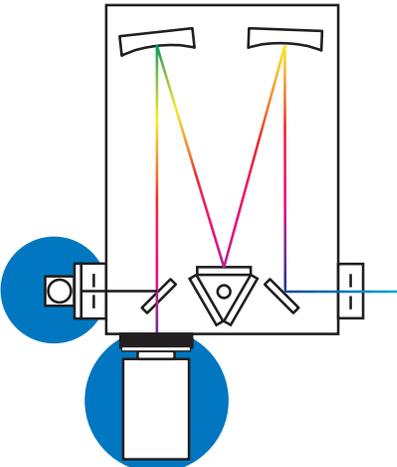
HRS-300-M
Monochromator
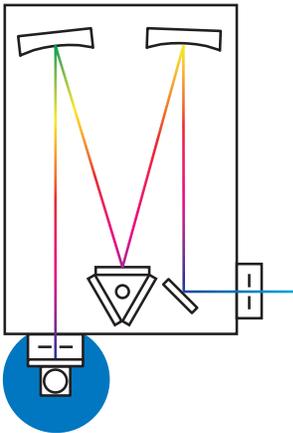
HRS-300-MM Dual-Exit
Monochromator
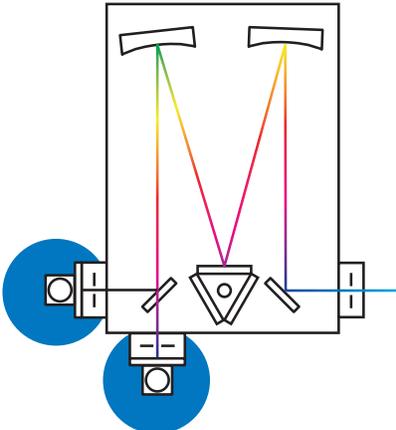
HRS-500/750 Configurations

HRS-500-S / HRS-750-S
Spectrograph

Optional Side
Entrance Slit
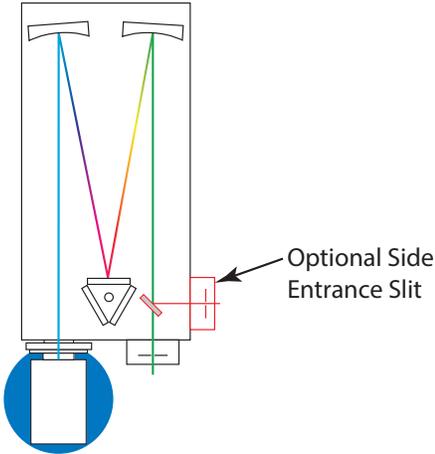
HRS-500-SS / HRS-750-SS
Dual-Exit Spectrograph

Optional Side
Entrance Slit
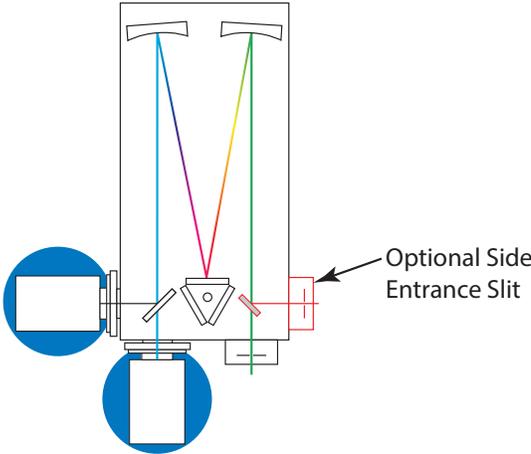
HRS-500-MS / HRS-750-MS
Monochromator/Spectrograph

Optional Side
Entrance Slit
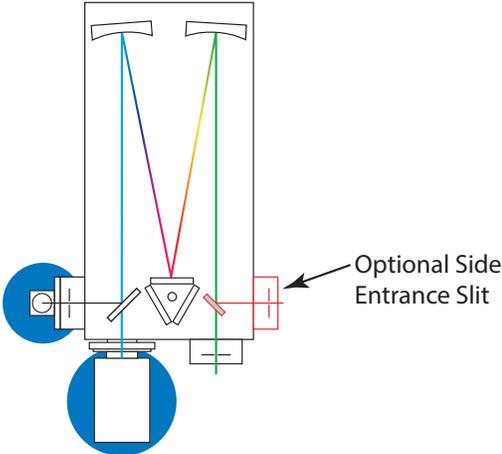
HRS-500-M / HRS-750-M
Monochromator

Optional Side
Entrance Slit
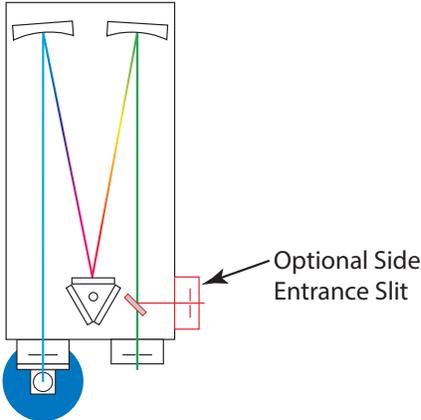
HRS-500-MM / HRS-750-MM Dual-Exit
Monochromator

Optional Side
Entrance Slit
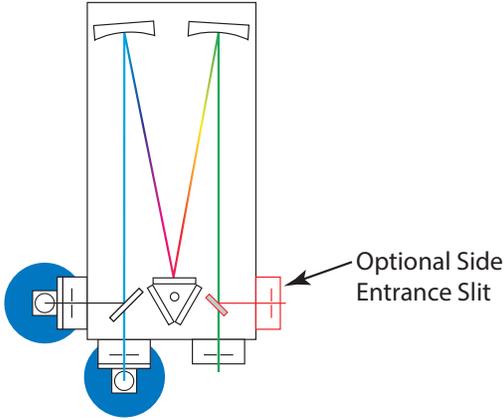
Wide Variety of Gratings Optimized To Enhance Your Specific Application

Choosing the right diffraction gratings is one of the most important steps to ensure the best optical performance in your application.

Diffraction gratings

SpectraPro HRS spectrographs and monochromators use diffraction gratings as the optical element that separates (disperses) polychromatic "white" light into individual wavelengths (colors). When polychromatic light encounters the grating it is dispersed so that each wavelength reflects from the grating at a slightly different angle. The dispersed light is then re-imaged by the monochromator or spectrograph so that individual wavelengths (or a desired band of wavelengths) can be directed to a detection system (CCD, sCMOS, or single-channel detector) or a sample.

Selecting the Proper Grating

Groove density (groove frequency)

The number of grooves contained on a grating surface is expressed in grooves per mm (g/mm) or lines per mm (l/mm). Groove density affects both the wavelength region in which an instrument can operate (mechanical scanning range) and the dispersion properties of a system. It is also a factor in determining the resolution capabilities of a monochromator. Higher groove densities result in greater dispersion as well as higher resolution capabilities. Princeton Instruments recommends selecting a grating that delivers the required dispersion when using a CCD or array detector, or the required resolution (with an appropriate slit width) when using a monochromator.

Mechanical scanning range

The mechanical scanning range refers to the mechanical rotation capability (not the "operating" or "optimum range") of a grating drive system with a specific grating installed. Princeton Instruments recommends selecting a grating groove density that allows operation over a specified application's required wavelength region. This mechanical limit to grating rotation relates directly to grating groove density, and ultimately the longest wavelength allowed for a specific grating.

Blaze wavelength

Diffraction grating efficiency plays an important role in monochromator or spectrograph throughput. Efficiency at a particular wavelength is largely a function of the blaze wavelength if the grating is ruled, or modulation if the grating is holographic. Blaze wavelength relates to the angle in which

the grooves are formed with respect to the grating normal, often termed blaze angle. Modulation is the depth of the grooves formed by holographic methods, assuming the grooves are sinusoidal. The collection of efficiency curves for typical SpectraPro HRS gratings shows the effect that blaze wavelength has on the efficiency of a grating, and ultimately on the throughput of the monochromator or spectrograph.

Optimum wavelength range

The optimum wavelength range is the wavelength region of highest efficiency for a particular grating, normally determined by the blaze wavelength. Princeton Instruments recommends selecting a grating with maximum efficiency over the specified application's required wavelength region.

Selecting the correct blaze wavelength

To determine the correct blaze wavelength for an application, consider the total wavelength region required for current and future applications. From a practical standpoint, Princeton Instruments recommends selecting a blaze wavelength that favors the short wavelength side of the spectral region to be covered.

Advantages of multiple-grating turrets

Quite often it becomes necessary to select two or three gratings to achieve efficient light throughput over a broad spectral region. That's why SpectraPro HRS monochromators and spectrographs are equipped with multiple-grating turrets as a standard feature. Turrets make grating changes an easy push-button or computer-controlled operation, and also reduce the risk inherent in handling the delicate gratings.

Multi-grating versatility

SpectraPro HRS spectrographs with interchangeable CTS-Turrets allow a single instrument to perform a variety of experiments. For example, one turret optimized for UV-VIS-NIR emission spectroscopy and a second optimized for Raman spectroscopy could be selected. A third turret might contain gratings for NIR experiments, microspectroscopy, fluorescence, or photoluminescence. SpectraPro HRS spectrographs accept up to three CTS-Turrets, each capable of holding up to three gratings.

In addition to the versatility of multiple grating sets, CTS-Turrets provide superior installation accuracy and reproducibility. CTS-Turrets feature a stress-free mount, eliminating the risk of over-tightening the screws securing a turret in place and any resultant misalignment of the gratings during installation. Simply insert a turret into the kinematic mount and tighten the center torque screw. These SpectraPro HRS grating turrets self-align to the optical system. An optical turret ID sensor identifies the turret and gratings installed, making it very easy to change from one set of gratings to another without having to re-program the spectrograph. Princeton Instruments LightField software detects and identifies the turret and gratings when installed and automatically sets up controls for operation and calibration.

CTS-Turret for SpectraPro HRS spectrographs

Need help?

Princeton Instruments' experienced technical staff is ready to assist you in selecting the best gratings for your application.

Test: CTS-Turret installed 20 times, with position of an atomic emission line measured after each installation.

Turret interchange reproducibility test results: 0.02 nm (HRS-300 with 1200 g/mm grating and PIXIS 1340x400 CCD camera with 20 µm pixels).
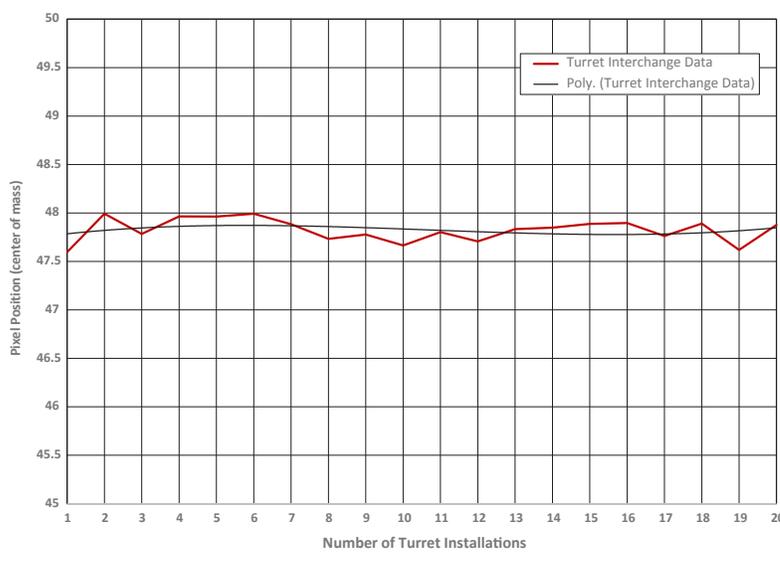
Standard SpectraPro HRS Gratings

Groove density (g/mm)	Blaze wavelength (nm)	Mechanical scanning range	Optimum wavelength range (nm)		Grating part number (68 mm x 68 mm)
50	600	0 – 36 μm	402	950	i1-005-600-P
66.6	740	0 – 27 μm	496	1150	i1-006-740-P
75	1800	0 – 24 μm	1200	2800	i1-007-1800-P
100	450	0 – 18 μm	300	700	i1-010-450-P
100	1500	0 – 18 μm	1000	2350	i1-010-1500-P
120	410	0 – 15 μm	275	650	i1-012-410-P
150	300	0 – 12 μm	200	500	i1-015-300-P
150	500	0 – 12 μm	330	800	i1-015-500-P
150	800	0 – 12 μm	425	1400	i1-015-800-P
150	1250	0 – 12 μm	850	2100	i1-015-1250-P
150	1600	0 – 12 μm	1050	2500	i1-015-1600-P
300	200	0 – 6 μm	135	325	i1-030-200-P
300	500	0 – 6 μm	330	800	i1-030-500-P
300	750	0 – 6 μm	500	1200	i1-030-750-P
300	1000	0 – 6 μm	650	1600	i1-030-1000-P
300	1200	0 – 6 μm	700	2100	i1-030-1200-P
300	1700	0 – 6 μm	1100	2700	i1-030-1700-P
300	2000	0 – 6 μm	1300	4000	i1-030-2000-P
600	150	0 – 3 μm	105	250	i1-060-150-P
600	300	0 – 3 μm	200	500	i1-060-300-P
600	500	0 – 3 μm	330	800	i1-060-500-P
600	750	0 – 3 μm	500	1300	i1-060-750-P
600	1000	0 – 3 μm	670	1600	i1-060-1000-P
600	1600	0 – 3 μm	1050	2500	i1-060-1600-P
900	500	0 – 2 μm	335	800	i1-090-500-P
1200	150	0 – 1500 nm	105	250	i1-120-150-P
1200	300	0 – 1500 nm	200	700	i1-120-300-P
1200	500	0 – 1500 nm	325	1000	i1-120-500-P
1200	750	0 – 1500 nm	475	1500	i1-120-750-P
1200	UV holographic	0 – 1500 nm	200	450	i1-120-HUV-P
1200	VIS holographic	0 – 1500 nm	400	1100	i1-120-HVIS-P
1800	250	0 – 1000 nm	160	400	i1-180-250-P
1800	500	0 – 1000 nm	330	800	i1-180-500-P
1800	670	0 – 1000 nm	450	1100	i1-180-670-P
1800	UV holographic	0 – 1000 nm	200	500	i1-180-HUV-P
1800	VIS holographic	0 – 1000 nm	350	1000	i1-180-HVIS-P
2400	150	0 – 750 nm	105	250	i1-240-150-P
2400	240	0 – 750 nm	160	400	i1-240-240-P
2400	UV holographic	0 – 750 nm	200	500	i1-240-HUV-P
2400	VIS holographic	0 – 750 nm	250	750	i1-240-HVIS-P
3600	240	0 – 500 nm	160	400	i1-360-240-P
3600	UV holographic	0 – 500 nm	200	500	i1-360-HUV-P
MIRROR	—	0 nm	—	—	i1-300-500-MIRROR

* Specifications at 500 nm, 3600 g/mm calculated at 250 nm
Larger 68 mm x 84 mm gratings are available as an option in 1200, 1800, 2400, and 3600 g/mm to maintain throughput at high grating angles
(1200 g/mm at 1000 nm and above, 2400 g/mm at 500 nm and above, etc.)

Grating Information

Spectroscopy grating sets*

	Grating 1	Blaze wavelength	Grating 2	Blaze wavelength	Grating 3	Blaze wavelength
UV set	600 g/mm	300 nm	1200 g/mm	300 nm	2400 g/mm	240 nm
High-resolution UV set	1200 g/mm	300 nm	2400 g/mm	240 nm	3600 g/mm	240 nm
UV-VIS-NIR set	1200 g/mm	300 nm	1200 g/mm	500 nm	1200 g/mm	750 nm
Visible set	300 g/mm	500 nm	600 g/mm	500 nm	1200 g/mm	500 nm
NIR set	600 g/mm	1000 nm	1200 g/mm	750 nm	1800 g/mm	1600 nm
SWIR set	150 g/mm	1600 nm	300 g/mm	1700 nm	600 g/mm	1600 nm

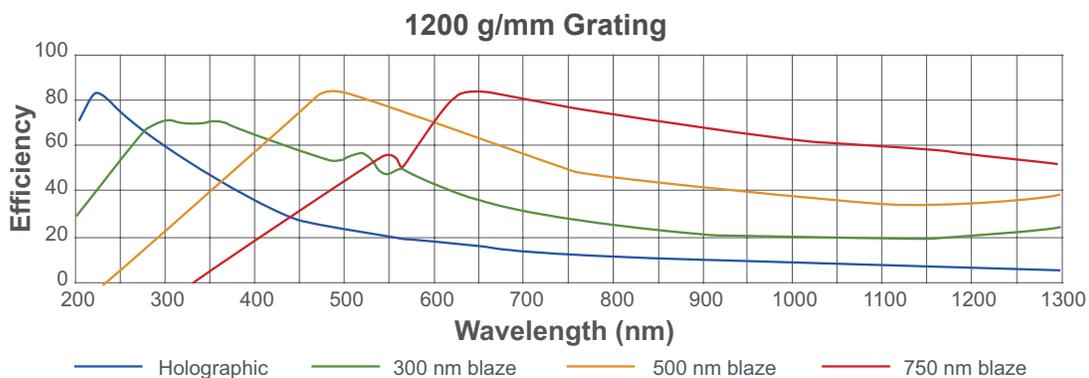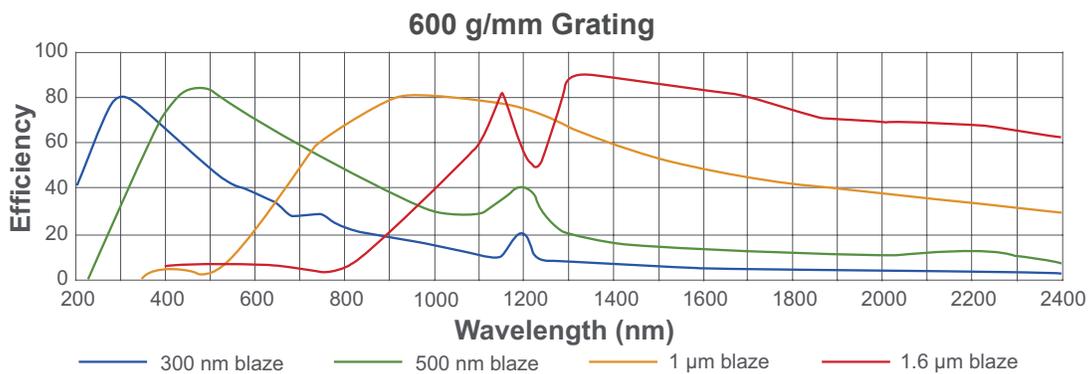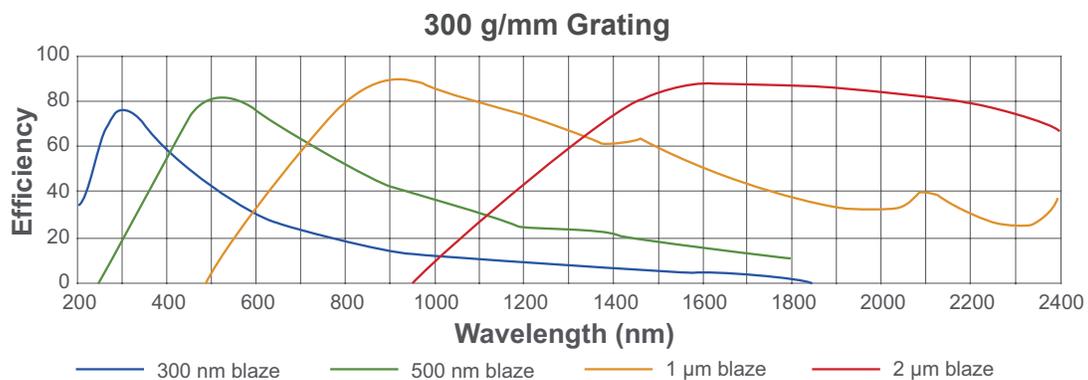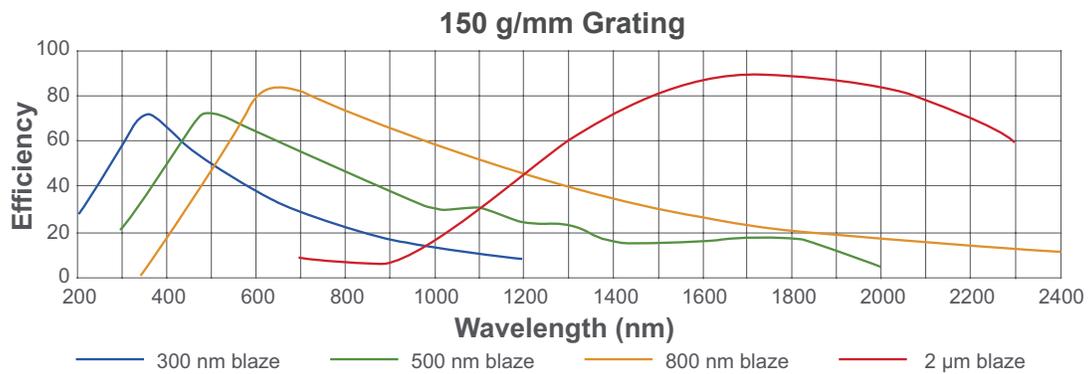* Suggested grating sets. Build your own sets or contact us to help define the best gratings for your application.

Dispersion and Resolution Information

Groove Density (g/mm)	Mechanical Scanning Range*	Dispersion (nm/mm)		CCD Spectral Resolution (nm)**	
		HRS-300	HRS-500	HRS-300	HRS-500
50	0 to 36 μm	64.12	39.5	2.4	1.2
66.6	0 to 27 μm	48.08	29.6	1.8	0.9
75	0 to 24 μm	42.67	26.3	1.6	0.8
100	0 to 18 μm	31.94	19.7	1.2	0.6
120	0 to 15 μm	26.57	16.4	1	0.5
150	0 to 12 μm	21.1	13	0.8	0.4
300	0 to 6 μm	10.4	6.5	0.4	0.2
600	0 to 3 μm	5.1	3.2	0.2	0.1
900	0 to 2 μm	3.25	2.1	0.133	0.067
1200	0 to 1500 nm	2.38	1.5	0.1	0.05
1800	0 to 1000 nm	1.4	0.9	0.068	0.033
2400	0 to 750 nm	0.8	0.6	0.05	0.025
3600	0 to 500 nm	0.7	0.5	0.034	0.0166

* Mechanical scanning range is the full range of rotation for each grating, typically ~60 degrees. Efficiency and optimum operating range for each grating are determined by the grating blaze. This information can be found on page 13 of this brochure.

** Typical spectral resolution at 500 nm with 20 μm wide entrance slit and PIXIS:400F CCD camera with 20 μm pixels; 3600 g/mm data calculated at 250 nm.

Grating Efficiency Curves

150 g/mm Grating

Efficiency vs Wavelength (nm)

- 300 nm blaze
- 500 nm blaze
- 800 nm blaze
- 2 µm blaze

300 g/mm Grating

Efficiency vs Wavelength (nm)

- 300 nm blaze
- 500 nm blaze
- 1 µm blaze
- 2 µm blaze

600 g/mm Grating

Efficiency vs Wavelength (nm)

- 300 nm blaze
- 500 nm blaze
- 1 µm blaze
- 1.6 µm blaze

1200 g/mm Grating

Efficiency vs Wavelength (nm)

- Holographic
- 300 nm blaze
- 500 nm blaze
- 750 nm blaze

High-Efficiency Optical Coatings

Princeton Instruments operates its own state-of-the-art coating laboratory, Acton Optics & Coatings, which provides high-efficiency mirrors and coatings for use in the UV, VIS, and NIR. The coating facility is renowned for producing some of the highest-efficiency UV mirrors and coatings commercially available. Acton coatings are utilized by industrial customers, universities, space agencies, and government research facilities worldwide.

This exclusive coating capability enhances the performance of Princeton Instruments spectrographs and monochromators. Whether the broadband performance of the Acton #1900 enhanced aluminum or the superior VIS-NIR reflectance of the Acton protected silver is selected, maximum throughput is ensured!

A

Coating Options for Princeton Instruments Spectrographs and Monochromators

The standard coating provided with SpectraPro HRS spectrographs and monochromators is the #1900 enhanced aluminum. Silver and gold coatings are available as an option.

B

Acton #1900 UV-Enhanced Al+MgF$_2$ vs. Bare Aluminum

The Acton #1900 coating provides superior reflection in the UV compared to conventional aluminum coatings. At 200 nm, reflection throughput can be up to 1.65x greater with exclusive Princeton Instruments coatings. Calculated reflection at 200 nm shows that the #1900 coating will have 1.65x greater light throughput than aluminum after only three reflections!

C

Acton Protected Silver vs. Conventional Protected Silver

Acton protected silver actually enhances reflectance (and light throughput) down to 400 nm whereas conventional silver absorbs significantly. After only three reflections, calculated throughput at 400 nm using Acton protected silver can be ~1.48x greater than conventional protected silver coatings.
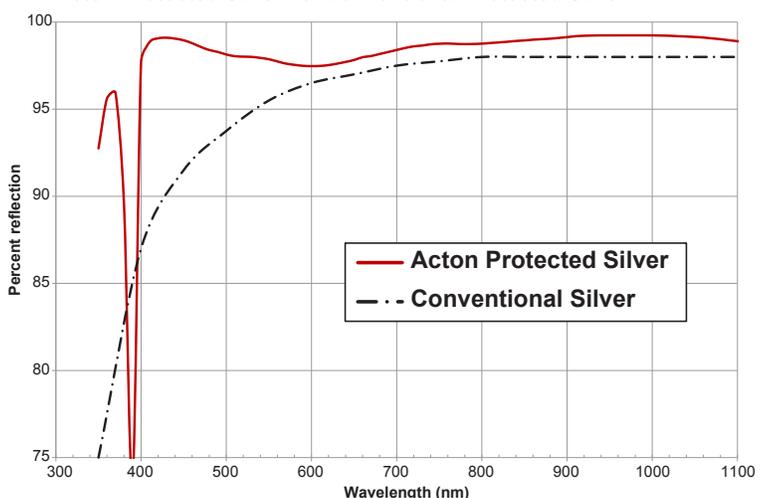
A

Coating Options for Princeton Instruments Spectrographs and Monochromators

B
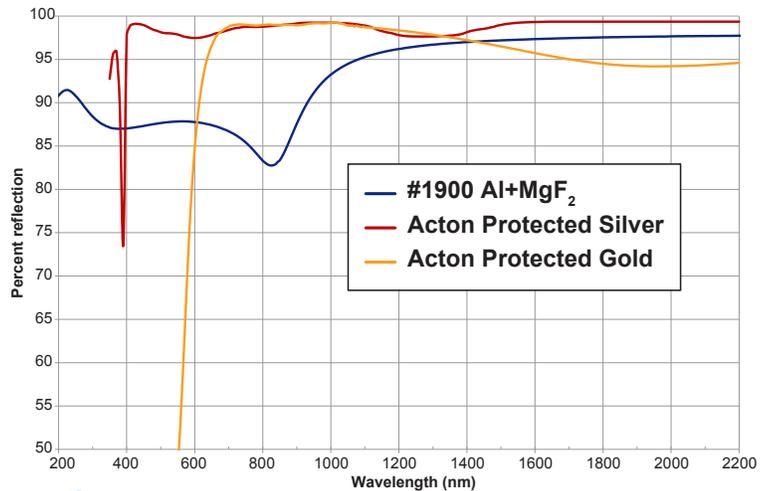
Acton #1900 UV-Enhanced Al+MgF$_2$ vs. Bare Aluminum

C
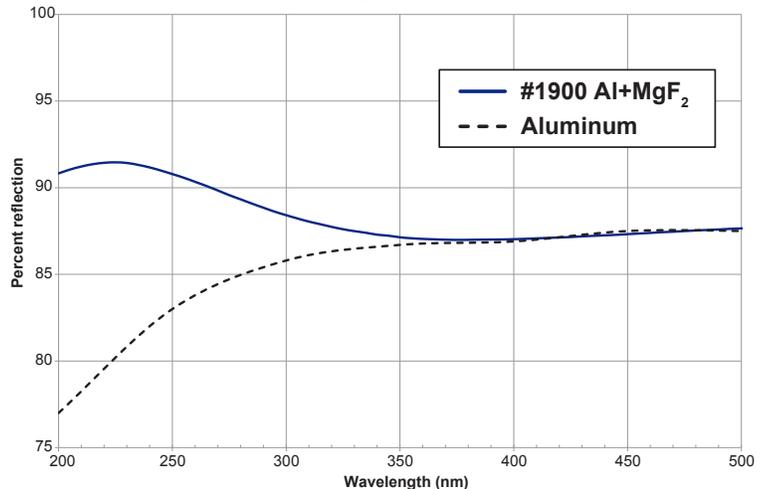
Acton Protected Silver vs. Conventional Protected Silver
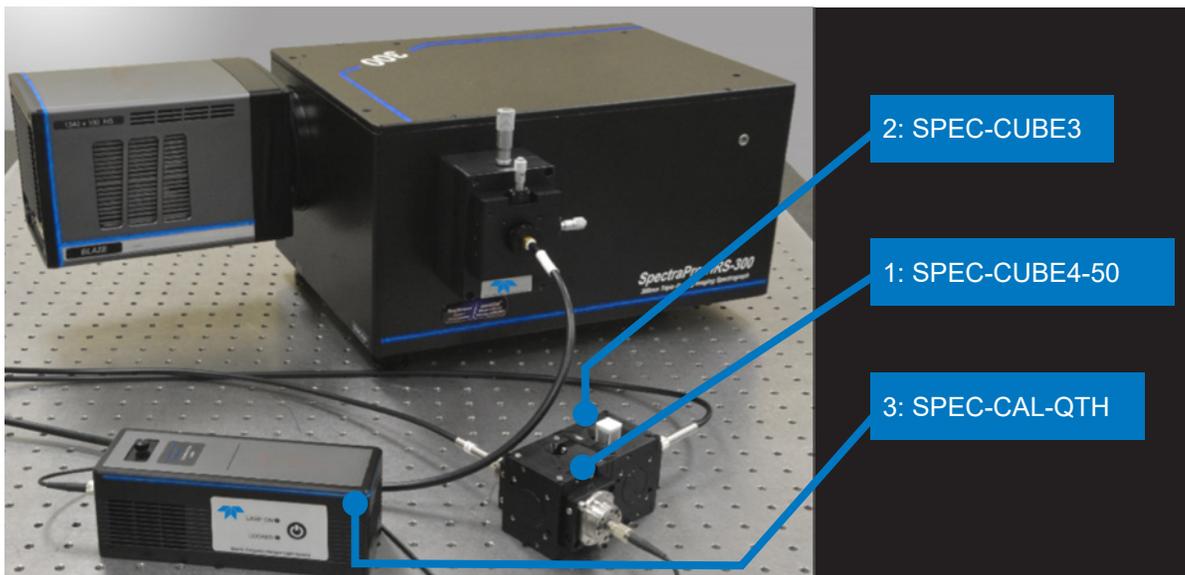
Application CUBES and Accessories

Princeton Instruments offers a comprehensive series of spectroscopy accessories that provide integrated solutions compatible with our wide selection of spectrographs, including SpectraPro, SpectraPro HRS, and all IsoPlane® spectrographs. These accessories afford users flexibility to conduct a variety of applications, such as Raman, absorption, transmission, photoluminescence, and fluorescence, among others.

The image below shows an experimental setup using an IsoPlane 320 spectrograph with a SPEC-CUBE1-NIR (1), SPEC-CUBE2-785 (2), SPEC-CUBE3 (3), and SPEC-LAS-785 (4). This setup provides an integrated solution to study Raman spectra of samples in a cuvette.

1: SPEC-CUBE1-NIR
3: SPEC-CUBE3
2: SPEC-CUBE2-785
4: SPEC-LAS-785
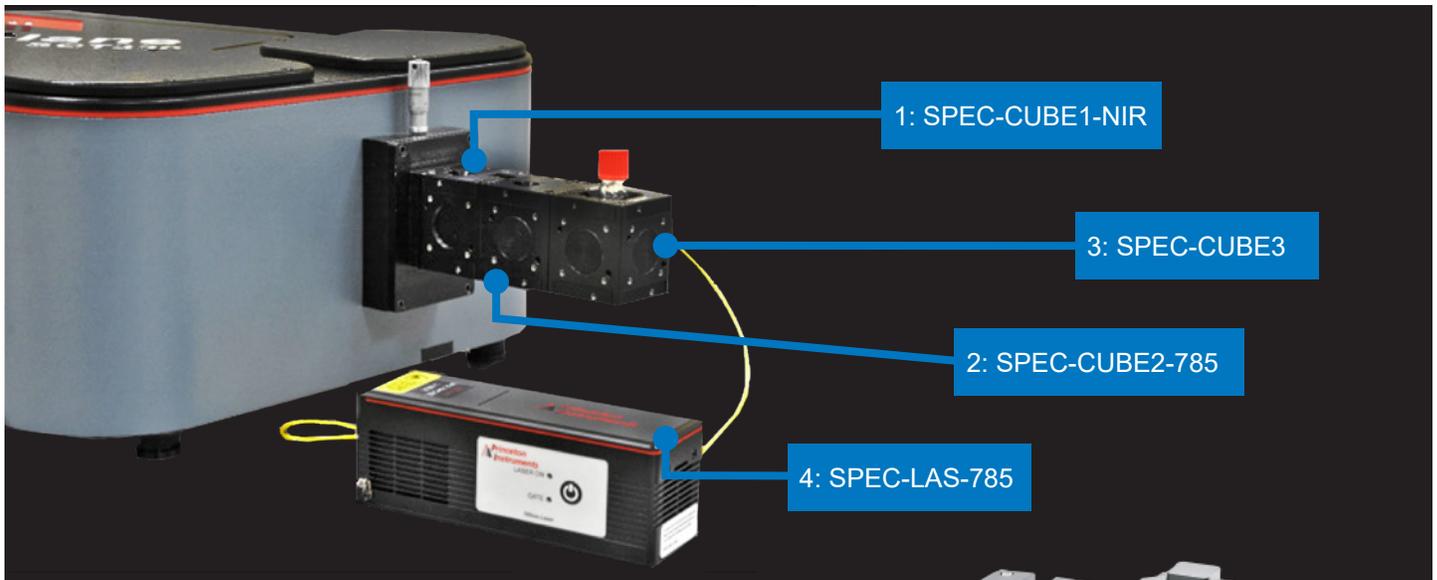
The image below is an example of an experimental setup for studying absorption using a SpectraPro HRS-300 spectrograph with a SPEC-CUBE4-50 (1), SPEC-CUBE3 (2), and SPEC-CAL-QTH (3).

2: SPEC-CUBE3
1: SPEC-CUBE4-50
3: SPEC-CAL-QTH

Application CUBES and Accessories

Part Number	Description
CAGE-SPEC	Adapter plate and 30 mm cage mount to entrance slit. Compatible with IsoPlane, SpectraPro, SpectraPro HRS, and LS-785 spectrometers.
SPEC-CUBE1-UV	Focusing CUBE for PI spectroscopy products, including SpectraPro HRS, SpectraPro, and IsoPlane. Contains achromatic doublet for focusing incoming light onto the slit. Precision X-Z stage for fine focus and slit alignment. Optimized for UV (250 to 425 nm).
SPEC-CUBE1-VIS	Focusing CUBE for PI spectroscopy products, including SpectraPro HRS, SpectraPro, and IsoPlane. Contains achromatic doublet for focusing incoming light onto the slit. Precision X-Z stage for fine focus and slit alignment. Optimized for VIS (400 to 700 nm).
SPEC-CUBE1-NIR	Focusing CUBE for PI spectroscopy products, including SpectraPro HRS, SpectraPro, and IsoPlane. Contains achromatic doublet for focusing incoming light onto the slit. Precision X-Z stage for fine focus and slit alignment. Optimized for NIR (650 to 1050 nm).
SPEC-CAL-QTH	QTH calibration lamp - Allows automated relative intensity calibration - Stabilized optical output - NIST traceable - USB interface
SPEC-CUBE2-785	Raman filter CUBE (785 nm) - Contains mounted 785 nm narrowband laser line filter, PI long-pass dichroic filter (127 cm^{-1} edge), and matching edge filter (OD 6) with precision built-in angle tuning adjustment - Optimized for 785 nm Raman spectroscopy
SPEC-CUBE3	Sample chamber CUBE - Contains two lenses and four optical ports - Contains sample chamber for 12.5 mm cuvette (not included) and light cover
SPEC-CUBE4-50	Beam splitter CUBE - Allows splitting of beam paths in 50:50 optical ratios without beam walk off - Contains precisely aligned and mounted non-polarizing cubic beam splitter
SPEC-CUBE4-70	Beam splitter CUBE - Allows splitting of beam paths in 70:30 optical ratios without beam walk off - Contains precisely aligned and mounted non-polarizing cubic beam splitter
SPEC-CUBE4-90	Beam splitter CUBE - Allows splitting of beam paths in 90:10 optical ratios without beam walk off - Contains precisely aligned and mounted non-polarizing cubic beam splitter
SPEC-CUBE5	Filter CUBE - Three-position CUBE for 1/2-inch-diameter filters - Filters not included
SPEC-FIBER-LAS	Laser excitation fiber - 105 μm multimode fiber for coupling excitation light from laser
SPEC-FIBER-PTH	Fiber patch cable 400 μm multimode fiber for coupling light from QTH lamp for absorption/transmission spectroscopy
SPEC-LAS-785	Wavelength-stabilized multimode 785 nm laser - Fiber coupled - 475 mW power, narrow laser line, ideal for Raman spectroscopy

Light Sources

IntelliCal Atomic Emission (AE) light source

This compact USB-powered AE light source features high stability and spectral line output useful for wavelength calibration. The IntelliCal AE light source includes both Hg and Ne-Ar lamps in a housing designed for mounting to the entrance slit of SpectraPro HRS spectrographs. It includes a toggle switch for lamp selection and a handy reference chart with available emission lines. When used with a Princeton Instruments spectrograph, CCD, and LightField software, this versatile light source enables precise, automated wavelength calibration.

Deuterium light sources

DS-421 / DS-421-220

The 30 watt deuterium light source provides a useful UV continuum from ~190 nm to ~350 nm for the SpectraPro HRS. Negligible visible light output helps minimize stray light. A 110 V or 220 V light source is available.

Quartz Tungsten-Halogen (QTH) light sources

TS-425

The 30 watt QTH light source with DC power supply provides output from ~350 nm to more than 2.5 µm.

TS-428

This 250 watt QTH light source includes variable brightness control, forced-air cooling, and AC power supply.

TS-428-DC

This 250 watt QTH light source features a regulated DC power supply plus variable brightness control and forced-air cooling.

Deuterium & Tungsten-Halogen light sources

TDS-429 / TDS-429-220

The dual light source combines 30 watt deuterium and tungsten-halogen lamps in the same housing for output useful from 190 nm to 2.5 µm. It includes a manually controlled source-selection mirror, power supplies (either 110 V or 220 V), and a forced-air cooling fan.

Xenon light source

XS-432

The 75 watt xenon light source features broad wavelength output from the UV to IR. The advantage of a xenon light source is the small light emission area, which permits efficient light delivery to a monochromator or spectrograph. The XS-432 light source provides a bright continuum from 190 to 750 nm with declining output out to 2.7 µm.

Light Input

Fixed-position fiber adapter
FC-446-010
This fixed-position fiber adapter is designed for general light input to a spectrograph and is not intended for imaging applications. It mounts directly to SpectraPro HRS spectrograph slit assemblies. Optional FC-446-010-FC for fibers with FC-connectors, FC-446-010-SMA for fibers with SMA-905 connectors.

Note: This adapter cannot be used with motorized slit assemblies.

Adjustable fiber adapter
FC-446-020
This adjustable fiber adapter is designed to hold 10 mm diameter fiber bundles directly at the entrance slit of the SpectraPro HRS. It includes a spring-loaded slide mechanism that facilitates precise horizontal alignment of the fibers to the slit opening. Thumb screws on each side control horizontal adjustment. Optional FC-446-020-FC for fibers with FC-connectors, FC-446-020-SMA for fibers with SMA-905 connectors.

Universal fiber coupler
FC-446-021-U
This versatile universal fiber coupler features X-Y micrometer control, 0.12 inches (3 mm) of travel, an interchangeable 10 mm diameter ferrule, an SMA 905 connector, and FC inserts. A slit baffle is included for use with the SpectraPro HRS. Highly recommended for coupling fibers to SpectraPro HRS spectrographs.

Imaging fiber adapter
FC-446-030
The imaging fiber adapter refocuses fiberoptic input and is designed for use with filter wheels or other devices placed between the fiber end and the SpectraPro HRS entrance slit. The adapter accepts a 10 mm diameter ferrule and provides horizontal and vertical alignment capabilities. The all-reflective design eliminates chromatic aberrations and the aspheric mirror cancels astigmatism, allowing precise imaging of fibers to the spectrograph entrance slit. There is also a 0.75" (19 mm) thick removable spacer to allow use with filter wheels or other accessories.

Raman notch filter chamber
NFC-446-040
The Raman notch filter chamber offers an efficient and easy method for using Raman notch or edge filters with the SpectraPro HRS spectrograph. The chamber collects the output of fibers and collimates the beam, which passes through the filter. A second lens focuses the beam on the entrance slit of the SpectraPro HRS. The chamber includes an adapter for 1.0" (25.4 mm) filters. A micrometer controls the filter angle from 0 to 10° for precise rejection of unwanted Raleigh scatter. The chamber can also accept non-fiber sources or focused sample images.
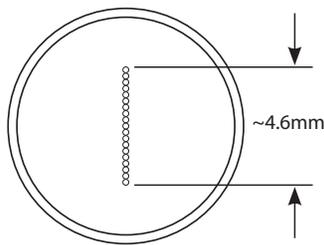
Sample chamber
SC-447
The sample chamber features ports with light-tight covers and two quartz lenses. It includes one mounting port for the SpectraPro HRS entrance/exit slit, and two mounting ports for light sources or detection. Requires sample holder.

Fiberoptic Bundles
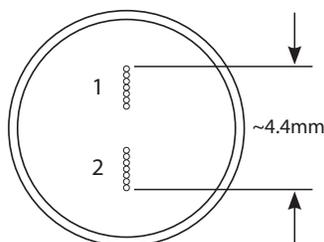

Single-leg fiber bundles (190–1100 nm)
LG-455-020-1 / LG-455-020-3
This single-leg fiberoptic bundle is designed for use with the SpectraPro HRS when working in the wavelength range from 190 to 1100 nm. It comprises nineteen 200 μm fibers and has an SMA connector at the illumination end and a 10 mm ferrule at the slit end. Fiber configuration is round at the light source input end to a line (column) at the output (slit) end. The bundle is available with a length of either 1 meter (LG-455-020-1) or 3 meters (LG-455-020-3).

~4.6mm

Single-leg fiber bundles (400–2200 nm)
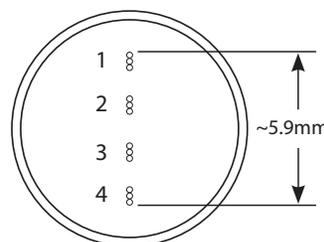**LG-456-020-1 / LG-456-020-3**
This single-leg fiberoptic bundle is designed for use with the SpectraPro HRS when working in the wavelength range from 400 to 2200 nm. It comprises nineteen 200 μm fibers and has an SMA connector at the illumination end and a 10 mm ferrule at the slit end. Fiber configuration is round at the light source input end to a line (column) at the output (slit) end. The bundle is available with a length of either 1 meter (LG-456-020-1) or 3 meters (LG-456-020-3).

Two-leg fiber bundle
BFB-455-7
The two-leg fiberoptic bundle is 1 meter long with seven 200 μm fibers per leg. Designed for use with the SpectraPro HRS when working in the wavelength range from 190 to 1100 nm, it has an SMA connector at the illumination end and a 10 mm ferrule at the slit end. Fiber configuration is round at the two light source input ends to a line (column) at the common output end, with ~1 mm spacing between fiber groups. See illustration.

~4.4mm

Four-leg fiber bundle
QFB-455-3
The four-leg fiberoptic bundle is 1 meter long with three 200 μm fibers per leg. Designed for use with the SpectraPro HRS when working in the wavelength range from 190 to 1100 nm, it has an SMA connector at the illumination end and a 10 mm ferrule at the slit end. Fiber configuration is round at each of the four light source input ends to a line (column) at the common output end, with ~1 mm spacing between each fiber group.

~5.9mm

Custom fibers available on request

Filter Wheel Assemblies

Motorized filters wheels

FA-2448

Motorized six-position filter wheel for 1.0" (25.4 mm) diameter samples with stepping motor and controller, plus RS-232 interface for computer-controlled filter indexing. Filters not included.

FA-2448-1

Motorized six-position order sorting filter wheel. Includes 320 nm, 590 nm, 665 nm, and 715 nm order sorting filter set in motorized filter wheel assembly.
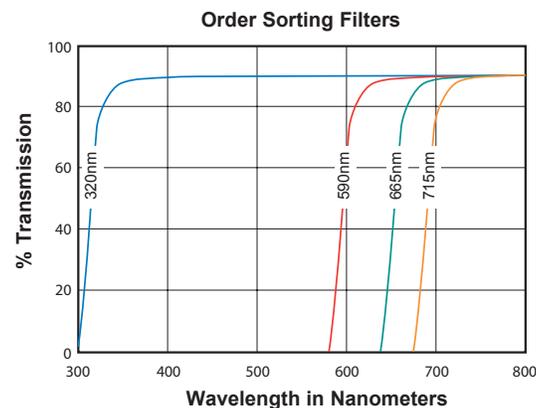
Motorized filter wheels are controlled by computer through the SpectraPro HRS-300 interface panel.
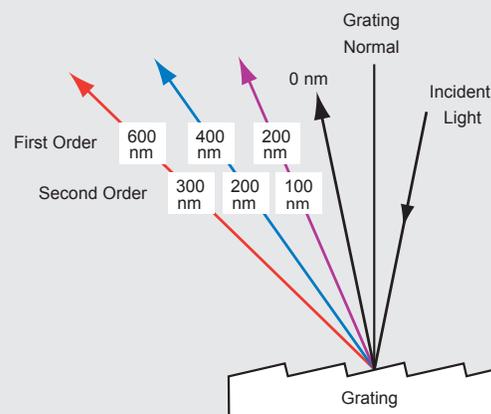
Filter set

FA-2448-F

This standalone filter set is compatible with the FA series of filter wheels available for the SpectraPro HRS (described above). The set consists of 1.0" (25.4 mm) diameter cut-off filters at 320 nm, 590 nm, 665 nm, and 715 nm.

Order Sorting Filters

Why do I need order sorting filters?

Diffraction gratings produce multiple orders of diffracted light where constructive interference permits light of one wavelength to appear at more than one angle of diffraction. This superposition of wavelengths can lead to ambiguous spectral data because the detector cannot normally distinguish between light of either wavelength. Order sorting filter sets are designed to eliminate unwanted second order radiation.

Scientific-Grade Cameras Provide Unmatched Performance

PIXIS

MULTICHANNEL ARRAY

High-QE, low-noise PIXIS cameras are ideal for spectroscopy applications from the deep UV to NIR spectral regions. Utilizing Princeton Instruments' XP cooling technology, PIXIS cameras provide deep cooling for low noise plus an all-metal vacuum seal with a lifetime vacuum guarantee for peace of mind. These proven cameras are available with proprietary eXcelon® technology for a dramatic increase in sensitivity with excellent suppression of etalon interference fringes common to back-illuminated sensors in the NIR.

- Highest sensitivity from 120 nm to 1100 nm
- Wide variety of CCD array sizes
- All-metal seals with permanent vacuum guarantee
- Fully compatible with all SpectraPro HRS spectrographs
- Seamlessly integrated into LightField data acquisition and control software

BLAZE®

MULTICHANNEL ARRAY

Highly advanced BLAZE CCD cameras for spectroscopy integrate low-noise electronics and proprietary ArcTec thermoelectric cooling technology to allow air-cooled operation down to -95ºC (-100ºC with 20ºC water). Proprietary sensors with multiport readout allow these cameras to operate at spectral rates greater than 16 MHz. The speed and sensitivity of BLAZE cameras make them ideal for a wide range of demanding spectroscopic applications.

- Dual 16 MHz readout ports for highest spectral rates
- Exclusive ArcTec technology for deep cooling and low dark current
    - Cools to -95ºC with air, without chillers or cryo-coolers
- Exclusive new sensor technology
    - **LD-Sensors:** IMO deep-depletion devices for low dark current and excellent broadband performance
    - **HR-Sensors:** Unmatched quantum efficiency in the near infrared! Up to 75% QE @ 1000 nm!

PyLoN®

MULTICHANNEL ARRAY

Cryogenically cooled, ultra-low-noise PyLoN cameras include all the essentials for low-light spectroscopy applications. With dark current levels at 0.3 e-/pixel/hour, these cameras are ideal for photon-starved applications that require long exposure times (i.e., minutes to hours). PyLoN cameras are available with eXcelon sensor technology to boost sensitivity and reduce etalon interference fringes.

- Sensitivity from 120 nm to 1100 nm
- CCD cooled with LN_2 down to -120ºC
- Flexible readout speeds from 50 kHz to 4 MHz
- Digital correlated double sampling and bias stabilization
- Fully compatible with all SpectraPro HRS spectrographs
- Seamlessly integrated into LightField data acquisition and control software

PyLoN-IR

LINEAR ARRAY

Cryogenically cooled PyLoN-IR linear InGaAs cameras are a superb choice for NIR and SWIR spectroscopy. The photodiode array (PDA) detectors supported by this platform provide exceptional sensitivity from 0.8 µm to 1.7 µm or from 1.0 µm to 2.2 µm, respectively. Benefits include the fastest spectral rate and lowest system read noise of any deep-cooled InGaAs camera, 16-bit digitization, and the use of indium metal seals to extend vacuum longevity. An integrated cryogenic cold shield reduces ambient thermal noise by increasing background rejection.

- Highest NIR and SWIR sensitivity
- Greatly reduced dark current
- Up to 6600 spectra/sec
- 16-bit digitization
- Fully compatible with all SpectraPro HRS spectrographs
- Seamlessly integrated into LightField data acquisition and control software

Scientific-Grade Cameras Provide Unmatched Performance

NIRvana®

2D InGaAs CAMERAS

MULTICHANNEL ARRAY

NIRvana cameras utilize a two-dimensional InGaAs focal plane array (FPA) detector optimized for NIR and SWIR spectroscopy. Thermoelectrically cooled NIRvana models provide high sensitivity from 0.9 μm to 1.7 μm; LN_2 cooling reduces dark current even further while providing sensitivity from 0.9 μm to 1.55 μm. Camera benefits include flexible scan rates as well as low system read noise and 16-bit digitization for wide dynamic range.

- High sensitivity from 0.9 μm to 1.55 μm or 1.7 μm
- 640 x 512 InGaAs FPA with 20 μm^2 pixel pitch
- Thermoelectrically cooled version achieves -85ºC
- Cryogenically cooled version achieves -190ºC
- Fully compatible with all SpectraPro HRS spectrographs
- Seamlessly integrated into LightField data acquisition and control software

ProEM®-HS

HIGH-SENSITIVITY EMCCD CAMERAS

MULTICHANNEL ARRAY

Thermoelectrically cooled ProEM-HS cameras incorporate electron-multiplying CCDs (EMCCDs) with eXcelon3, a proprietary sensor technology that reduces etaloning while increasing sensitivity in the UV and NIR. EM gain enables these high-resolution, back-illuminated EMCCD cameras to deliver single-photon sensitivity. Sustained spectral rates of up to 20 kHz are achievable.

- Patented eXcelon3 technology for highest UV-to-NIR sensitivity
- Unique vacuum technology backed by a lifetime guarantee
- Spectra-kinetics mode and ultra-high-speed readout mode
- EM gain calibration via OptiCAL with built-in light source
- Fully compatible with all SpectraPro HRS spectrographs
- Seamlessly integrated into LightField data acquisition and control software

PI-MAX®4

GATED ICCD & emICCD CAMERAS

MULTICHANNEL ARRAY

PI-MAX4 intensified CCD (ICCD) and intensified EMCCD (emICCD) cameras challenge the status quo in time-resolved spectroscopy applications. The PI-MAX4 camera platform offers high-precision gating capabilities to <500 psec, a sustained intensifier gating repetition rate of 1 MHz, the ability to perform frequency-domain measurements using RF modulation, and unsurpassed experimental control via LightField's unique, oscilloscope-like timing interface.

- Wide choice of front- and back-illuminated CCDs and EMCCDs
- World's first emICCD cameras offer single-photon sensitivity
- Broad selection of Gen II and filmless Gen III intensifiers
- Achieves sustained spectral rates of >10,000 spectra/sec
- Fully compatible with all SpectraPro HRS spectrographs
- Seamlessly integrated into LightField data acquisition and control software
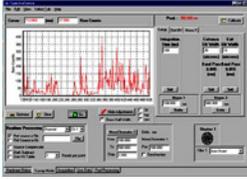
KURO®

BACK-ILLUMINATED sCMOS CAMERAS

MULTICHANNEL ARRAY

KURO is the world's first scientific CMOS camera platform to implement back-illuminated sensor technology. Optimized for spectroscopy, KURO cameras deliver both the high frame rates of front-illuminated CMOS cameras and the exceptional sensitivity of back-illuminated CCD cameras. Unlike front-illuminated CMOS cameras, no microlenses are needed to redirect light into the sensor's pixels. The fixed pattern noise is also greatly reduced.

- Back-illuminated sCMOS detector (>95% peak QE)
- Large pixels and wide dynamic range
- Very high speed and very low read noise
- TTL output signals and flexible trigger modes
- Fully compatible with all SpectraPro HRS spectrographs
- Seamlessly integrated into LightField data acquisition and control software

Single-Channel Light Detection Accessories

SpectraSense data acquisition software

SpectraSense is a spectral acquisition software package designed to work exclusively with Princeton Instruments scanning monochromators, single-channel detectors, and related accessories. SpectraSense software controls and synchronizes monochromator scanning with data acquisition. It also allows control of important scan parameters such as integration time, wavelength scan range, scan step size, and more. Typical spectral scans include intensity vs. wavelength, intensity vs. time, reflection, transmission, and absorption. Data can be saved, printed, or recalled for post-processing.

Detector Interface/Readout System
SpectraHub

This detector interface/readout system is designed for single-channel detector applications and includes RS-232 and USB interfaces, and 12 VDC power. SpectraHub requires SpectraSense software, a scanning monochromator, and a single-channel detector for operation. SpectraHub is required for operation of all single-point detectors except those that require lock-in amplifiers.

PMT power supply
PHV-400

This high-voltage power supply, 0 to 1250 V, is designed for use with Princeton Instruments PMTs (P1, P2, P3) and PMT housings (PD-438, PD-439).

NOTE: All single-channel detectors require SpectraHub readout system and SpectraSense software for operation.

Silicon detector
SI-440

This silicon detector has a 10 mm diameter active area and is provided with a housing that includes BNC signal connector and mounting flange. It offers SpectraPro HRS users sensitivity from 400 to 1100 nm.

UV-enhanced silicon detector
SI-440-UV

This UV-enhanced silicon detector has a 10 mm diameter active area and is provided with a housing that includes BNC signal connector and mounting flange. It offers SpectraPro HRS users sensitivity from 200 to 1110 nm.

PMT detector housing
PD-438

This universal PMT detector housing mounts to the SpectraPro HRS slit assembly. It requires a 1 1/8 side-window PMT and a high-voltage power supply for operation.

PMT detector housing with shutter
PD-439

This universal PMT detector housing has a manual light-tight shutter and mounts to the SpectraPro HRS slit assembly. It requires a 1 1/8 side-window PMT and a high-voltage power supply for operation.

Single-Channel Light Detection Accessories
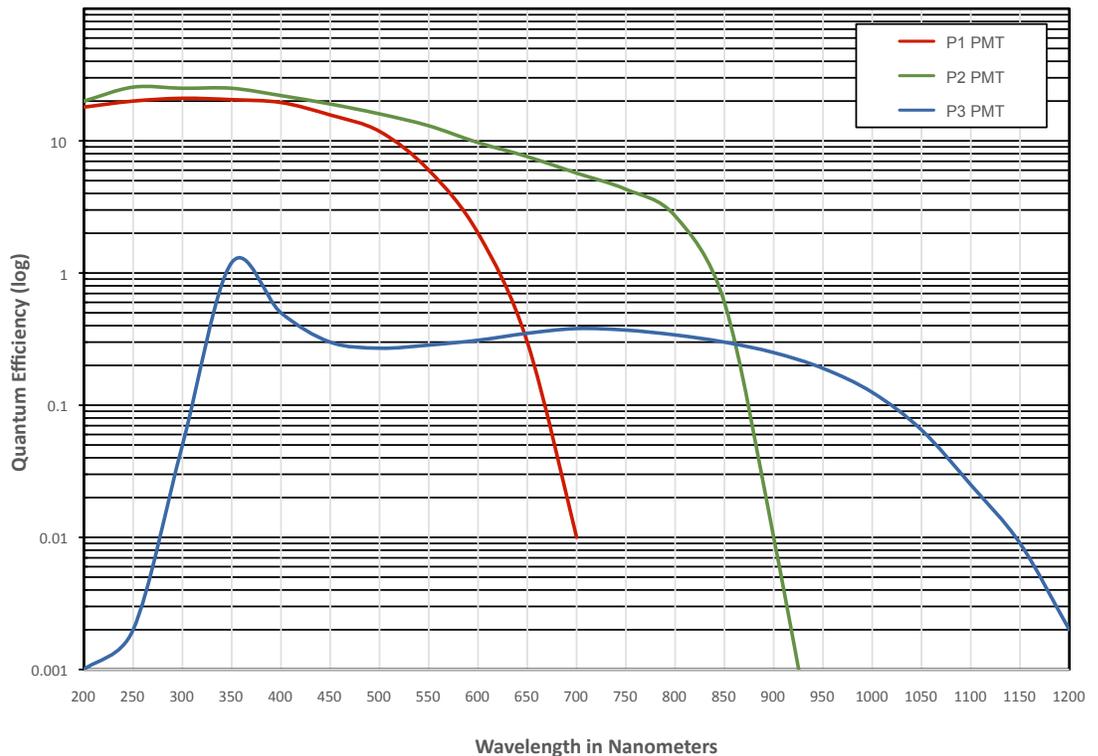
Photomultiplier tube (PMT)
P1 / P2 / P3
Three 1 1/8 side-window photomultiplier tubes are available for the SpectraPro HRS. Each requires a housing and a power supply for operation.
P1: sensitivity from 190 to 650 nm
P2: sensitivity from 190 to 900 nm
P3: sensitivity from 300 to 1100 nm

Integrated PMT detector housing
PD-471
This integrated PMT detector housing has a built-in high-voltage power supply (0 to 1000 V) and mounts to the SpectraPro HRS slit assembly. It requires a 1 1/8 side-window PMT (P1, P2, P3), SpectraHub, and SpectraSense for operation.

Integrated photon-counting detector system
PD-473-1
This integrated photon-counting detector system is designed for use in the range from 185 to 850 nm and includes a PMT, amplifier/discriminator, and built-in high-voltage power supply. It mounts on the SpectraPro HRS slit assembly. SpectraHub and SpectraSense are required for operation.

Single-Channel Light Detection Accessories

Solid-State Infrared Detectors: InGaAs

Princeton Instruments offers two InGaAs detectors covering the wavelength region extending from 800 nm to 1700 nm, in cooled and uncooled versions. *Both require SpectraHub readout system and SpectraSense software for operation.*

Solid-state InGaAs detector
ID-441

This is an uncooled single-channel InGaAs detector with pre-amplifier for 800 to 1700 nm.

Solid-state, cooled InGaAs detector
ID-441-C

This cooled InGaAs detector with pre-amplifier for 800 to 1700 nm requires a 442-1A TE-cooler controller for cooled operation.

Solid-State Infrared Detectors: PbS, InSb, and M-C-T

Solid-state PbS detector
ID-442

This Lead Sulfide (PbS) detector for 1.1 to 2.9 µm includes an adapter to the SpectraPro HRS slit assembly.

Solid-state InSb detector
ID-443

This Indium Antimonide (InSb) detector for 1.5 to 5 µm has a 4 mm diameter active area, LN_2 cooling, dewar, and adapter to the SpectraPro HRS slit assembly.
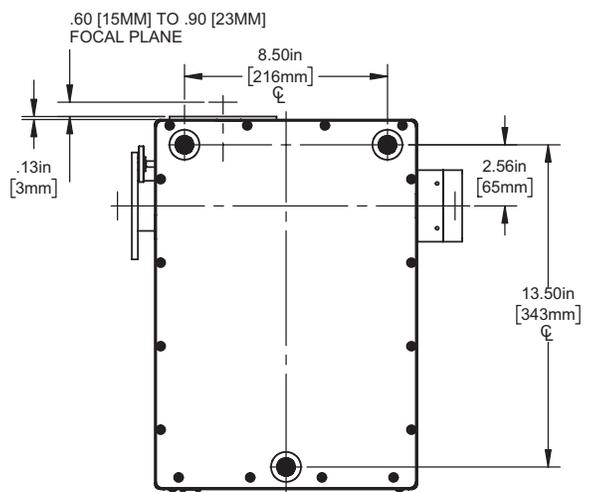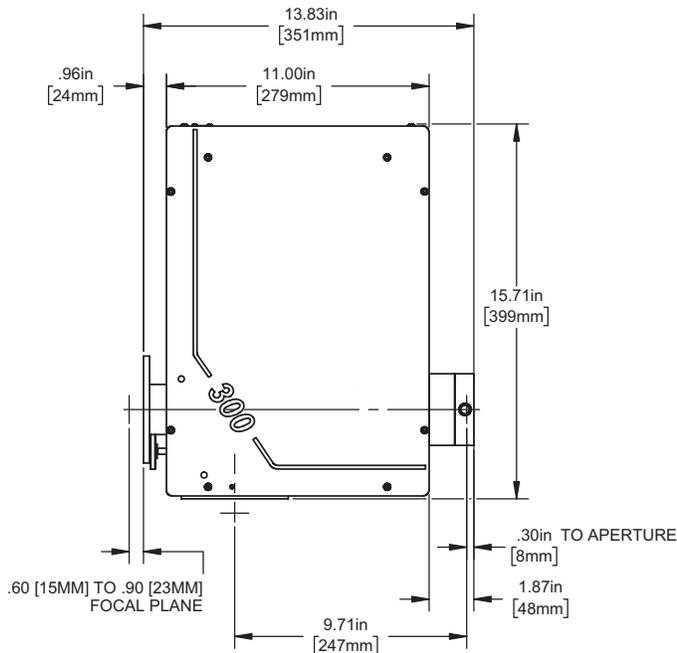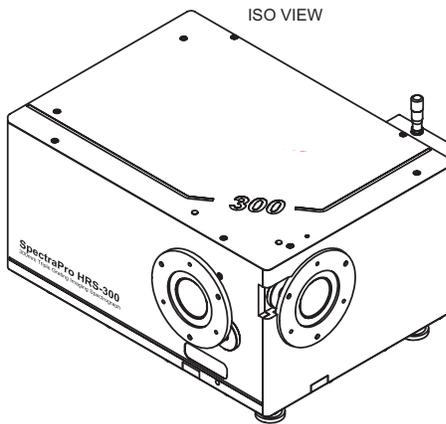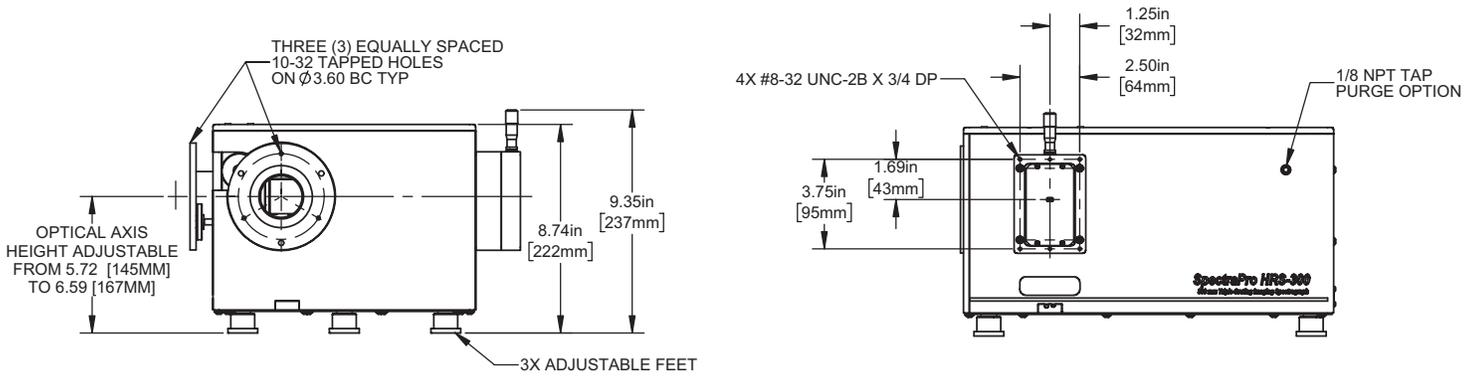
Solid-state M-C-T detector
ID-444

This Mercury-Cadmium-Telluride (M-C-T) detector for 2 to 12 µm includes an adapter to the SpectraPro HRS slit assembly.

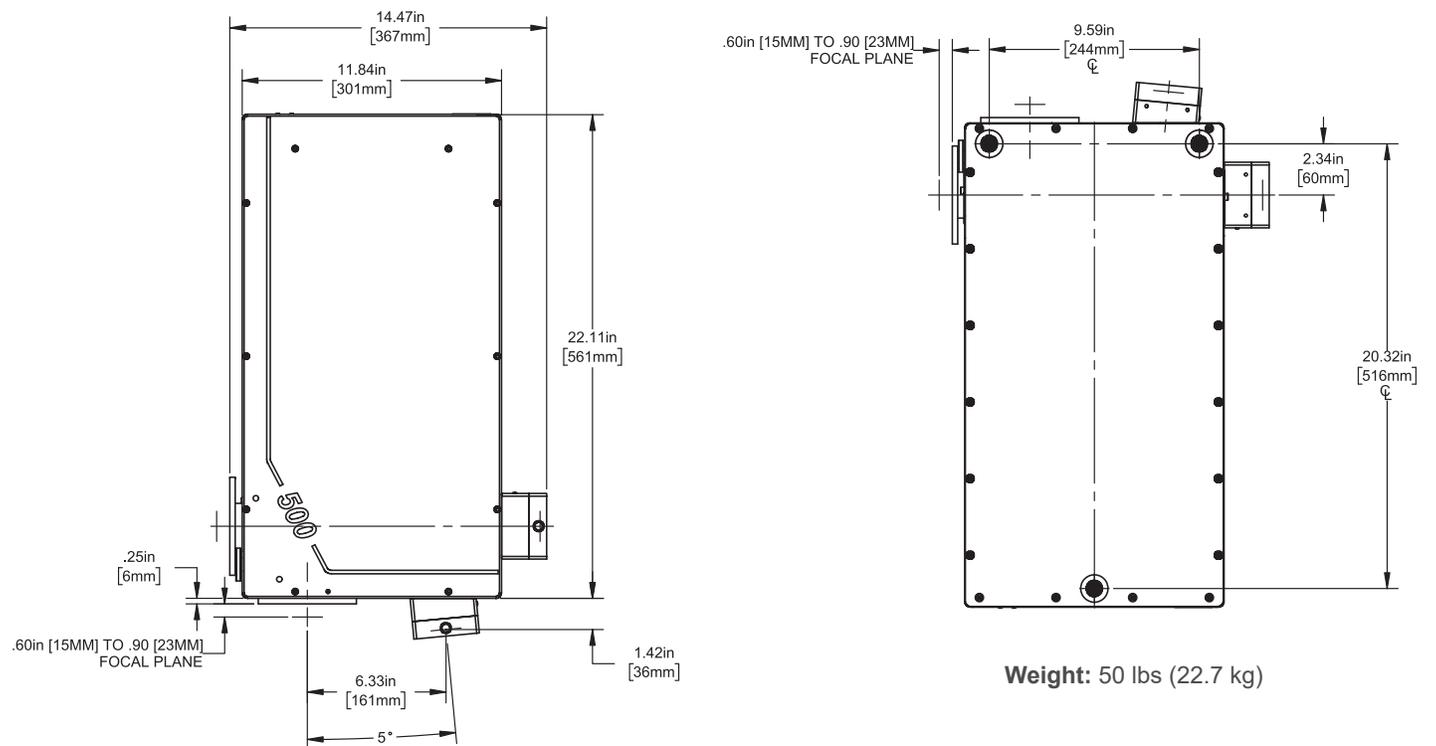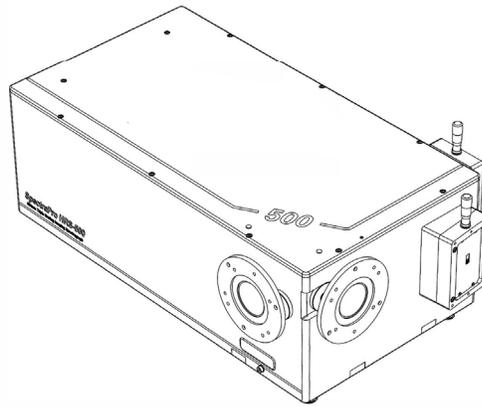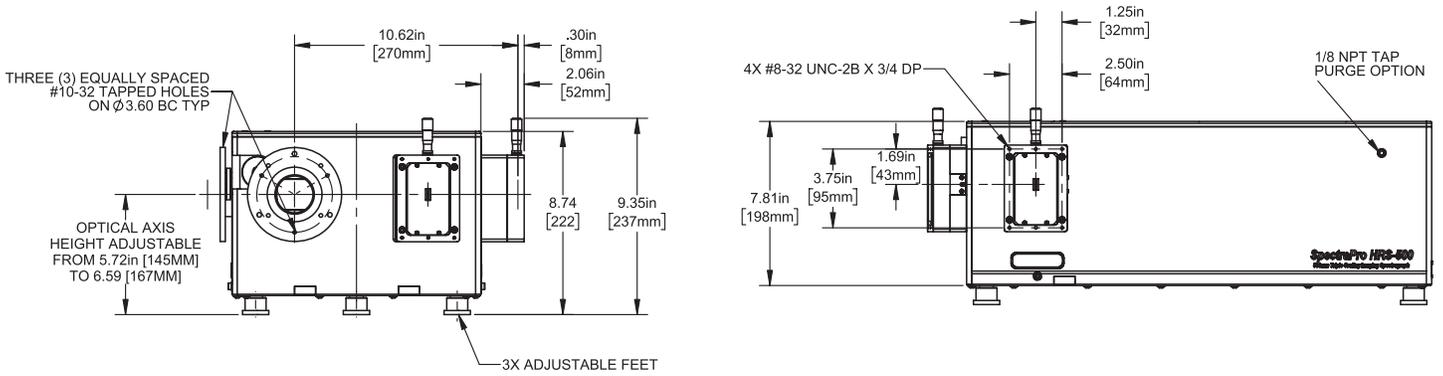*Models ID-442, ID-443, and ID-444 require chopper and lock-in amplifier for operation.*
Note: *SpectraSense is only compatible with the following lock-in amplifiers: Stanford Research SR510 and SR810.*
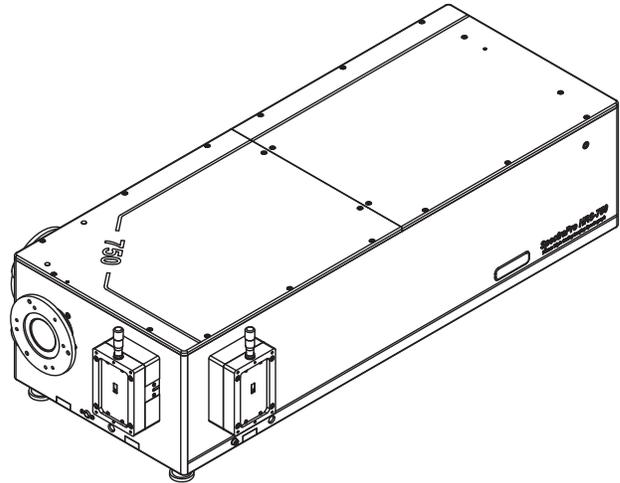
HRS-300 Outline Drawings

THREE (3) EQUALLY SPACED
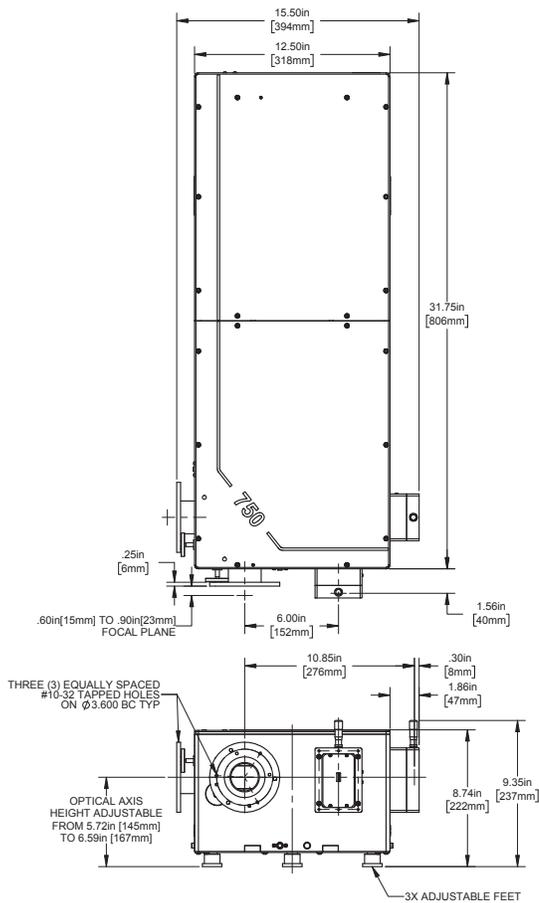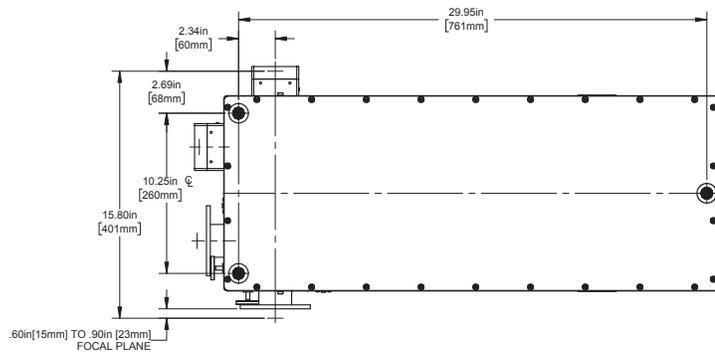10-32 TAPPED HOLES
ON Ø3.60 BC TYP

OPTICAL AXIS
HEIGHT ADJUSTABLE
FROM 5.72 [145MM]
TO 6.59 [167MM]

8.74in
[222mm]

9.35in
[237mm]

3X ADJUSTABLE FEET

1.25in
[32mm]

2.50in
[64mm]

4X #8-32 UNC-2B X 3/4 DP

1/8 NPT TAP
PURGE OPTION

1.69in
[43mm]

3.75in
[95mm]

SpectraPro HRS-300

ISO VIEW

300

SpectraPro HRS-300

13.83in
[351mm]

11.00in
[279mm]

.96in
[24mm]

15.71in
[399mm]

300

.60 [15MM] TO .90 [23MM]
FOCAL PLANE

9.71in
[247mm]

.30in TO APERTURE
[8mm]

1.87in
[48mm]

.60 [15MM] TO .90 [23MM]
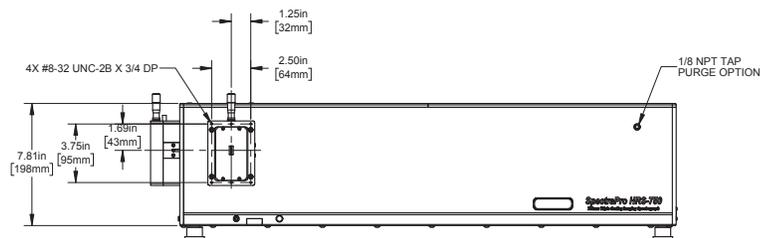FOCAL PLANE

8.50in
[216mm]

.13in
[3mm]

2.56in
[65mm]

13.50in
[343mm]

Weight: 43 lbs (19.5 kg)

HRS-500 Outline Drawings

THREE (3) EQUALLY SPACED
#10-32 TAPPED HOLES
ON Ø3.60 BC TYP

10.62in
[270mm]

.30in
[8mm]

2.06in
[52mm]

OPTICAL AXIS
HEIGHT ADJUSTABLE
FROM 5.72in [145MM]
TO 6.59 [167MM]

8.74
[222]

9.35in
[237mm]

3X ADJUSTABLE FEET

4X #8-32 UNC-2B X 3/4 DP

1.25in
[32mm]

2.50in
[64mm]

1/8 NPT TAP
PURGE OPTION

7.81in
[198mm]

3.75in
[95mm]

1.69in
[43mm]

SpectraPro HRS-500

14.47in
[367mm]

11.84in
[301mm]

22.11in
[561mm]

.25in
[6mm]

.60in [15MM] TO .90 [23MM]
FOCAL PLANE

6.33in
[161mm]

5°

1.42in
[36mm]

.60in [15MM] TO .90 [23MM]
FOCAL PLANE

9.59in
[244mm]

2.34in
[60mm]

20.32in
[516mm]

Weight: 50 lbs (22.7 kg)

HRS-750 Outline Drawings

ISO VIEW

Weight: 75 lbs (34 kg)

SpectraPro® HRS Series
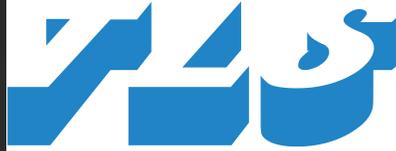
Imaging Spectrographs & Scanning Monochromators

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