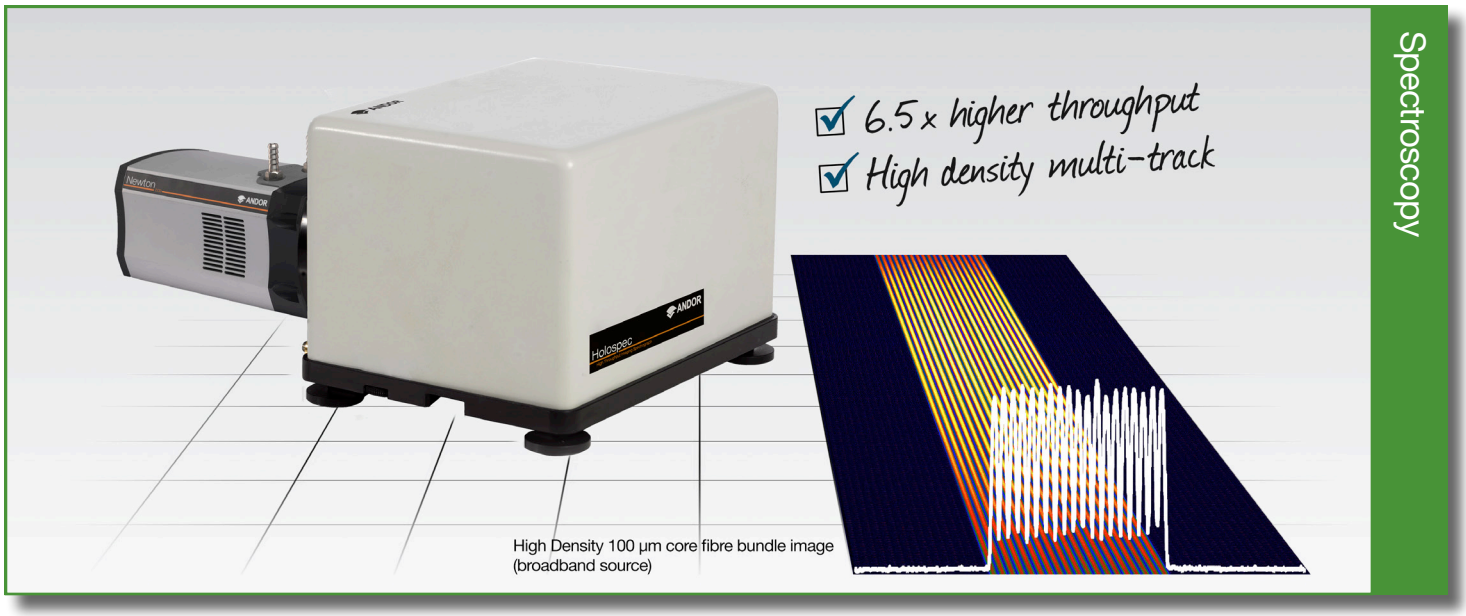
Andor HoloSpec

On-axis high throughput imaging spectrograph

ANDOR
an Oxford Instruments company



Features and Benefits

- **High collection efficiency ultrafast F/1.8 aperture**
  Up to 6.5 times better light collection efficiency than traditional 1/3rd m Czerny-Turner designs

  100 % light collection from NA=0.22 fibre optics
- **On-axis imaging-corrected design**
  Superb optical aberration correction across a large focal plane for superior spatial resolution and high density, low crosstalk multi-track (multi-fibre) acquisitions

  Gather more photons per pixel- increased signal-to-noise ratio
- **High throughput optical design**
  High transmission volume phase holographic (VPH) gratings with state-of-the art optics - maximum optical efficiency for visible or near-infrared range
- **Low scattered light**
  'Smooth' sinusoidal refractive index VPH gratings profile greatly reduces stray light - maximizes detection dynamic range and signal-to-noise
- **Compact and rugged design**
  Pre-aligned and pre-calibrated, out-of-the-box operation, excellent thermal stability and easily transportable
- **Easily interchangeable accessories**
  'Snap-in' accessories, including precision slits and pre-aligned grating assemblies
- **Specialized Raman grating options**
  Optimized for Stokes/Anti-Stokes, low-frequency or high-frequency Stokes operation, 514.5 to 830 nm laser options
- **Optional integrated Rayleigh filtering unit**
  Fully-enclosed SuperNotch Plus Kaiser filter compartment with user-friendly external adjustment
- **Seamless integration with Andor's world class Spectroscopy detectors**
  Combine high optical throughput and ultra-sensitive CCD, ICCD and EMCCDs cameras for maximum photon collection

Gathering more photons... at pace!

Working with challenging photon fluxes? Need results in milliseconds, not minutes?

The superb light collection efficiency capabilities of the superfast F/1.8 Andor HoloSpec spectrograph platform provides a perfect match to Andor's ultra-sensitive CCD, EMCCD and ICCDs detectors, offering the most sensitive and versatile detection solution on the market for Visible or Near-Infrared spectroscopy.

The Andor HoloSpec is the ideal solution for collecting more light and achieving better signal-to-noise ratio faster, which is critical for applications such as micro-Raman mapping, microfluidics, real-time medical diagnosis (point-of-care analyzers) or stand-off bacteriological agents or explosives detection.

The HoloSpec also offers aberration-corrected optics for excellent multi-track capabilities, with high density fibre optics to enable simultaneous acquisitions with extremely low crosstalk, even on narrow spectroscopy sensors.

Its rugged and compact design makes it an ideal tool for challenging industrial or in-the-field applications, while still offering research-grade performance suitable for academic research.

Application focus

- ✓ **Chemical mapping – micro-Raman (e.g. SERS or TERS-based) or micro-fluorescence mapping**
- ✓ **Microfluidics – e.g. spectral flow cytometry**
- ✓ ***In-vivo* medical diagnosis**
- ✓ **Stand-off gated Raman or LIBS**
- ✓ **Process control**

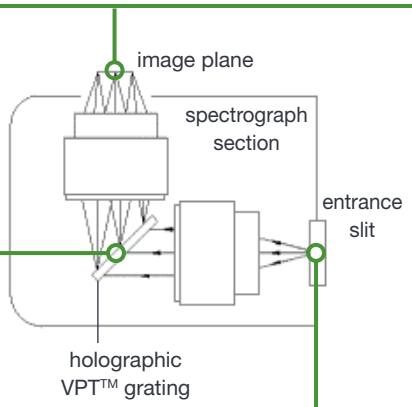
Superior detection capabilities- 4 reasons to make every photon count

2 Superb multi-track capabilities

Imaging-corrected optical system for superior, high density multi-channel spectroscopy (See page 3 for details).

3 Low stray light gratings- higher dynamic range

The 'smooth' refractive index structure of volume phase holographic (VPH) gratings scatters less unwanted light than the typical surface relief structure of conventional 'ruled' gratings.



4 Choose the most sensitive detectors on the market

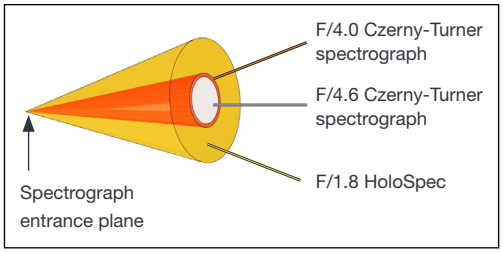
iDus 416 'low-dark current deep-depletion' CCD- superior near-IR detection with up to 95% QE at 800 nm.

Newton EMCCD- unmatched sensitivity in the UV-visible range, superfast kHz acquisition capabilities, single photon sensitive.

iStar ICCD- nanosecond-gated detector for recording fast transient phenomena.

iDus 416 | Newton EMCCD | iStar ICCD

1 Superior light gathering power- when every photon counts



Light collection varies with $1/(F/\#)^2$- the lower the F/# the higher the accepted light cone angle into the system, therefore the higher the collection power (see figure above).

	HoloSpec	300 mm CZT spectrograph	320 mm CZT spectrograph
F/#	1.8	4.0	4.6
Numerical aperture (NA)	0.28	0.11	0.22
Cone angle (air)	32.3	14.4	12.5
Light gathering power comparison	-	HoloSpec is 4.3x better	HoloSpec is 6.5x better

AND

HoloSpec gathers 100% of light from traditional silica-silica F/2.22 (NA=0.22) fibre optics

See technical note *Andor HoloSpec- the high throughput spectrograph*

Spectroscopy applications where throughput matters:

✓ **Intrinsically photon-starved experiments...**
e.g. Quantum dot photoluminescence, micro-Raman of biosamples, micro-photoluminescence of carbon nanostructures, plasmonics spectroscopy of light harvesting complex or organic light-emitting diode (OLEDs), cathodoluminescence, stand-off chemical detection.

✓ **When acquisition time is a constraint...**
Gather enough photons in short periods of time while accessing meaningful signal-to-noise ratio.
e.g. micro-spectroscopy chemical mapping, micro-fluidics such as spectrally-resolved flow cytometry, on-line process control.

✓ **Minimizing photodamage of photo-sensitive samples...**
Protect samples from photodegradation and phototoxicity – achieve meaningful signal-to-noise ratio in shorter timescales to minimize over-exposure to excitation sources e.g. biomaterials such as live cells or luminescent biotags.

Exceptional high-density multi-track capabilities- for superior photon collection

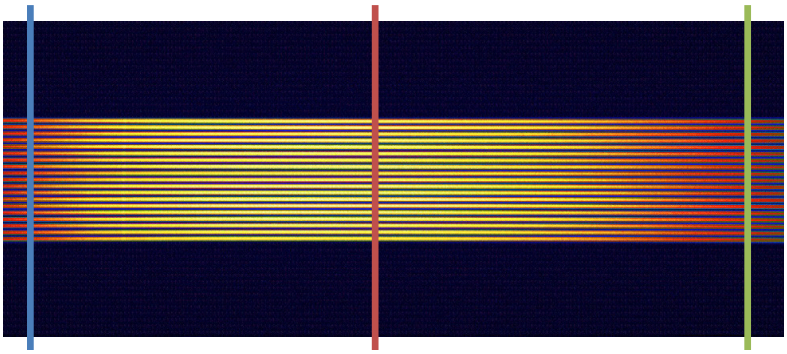


Figure 1: Image of a very high density 19 x 100 µm core (125 µm inc. cladding) fibre optic bundle at the output focal plane of a HoloSpec. Broadband source captured from 532 - 609 nm with a Newton EMCCD DU971P-BV.

High-density multi-track AND high throughput

The HoloSpec advanced imaging corrected optics allow clear separation of individual channel images from densely packed fibre optics bundles.

Up to 32 x 100 µm core fibre channels can be individually resolved over a 4 mm high sensor with low crosstalk despite the high density fibre bundle configuration. Crosstalk can be further reduced by:

- Reading the sensor in multi-track mode with narrow track height
- Using fibre bundle with alternating 'Live' and 'Dead' channels to offer ***zero*** crosstalk between consecutive tracks

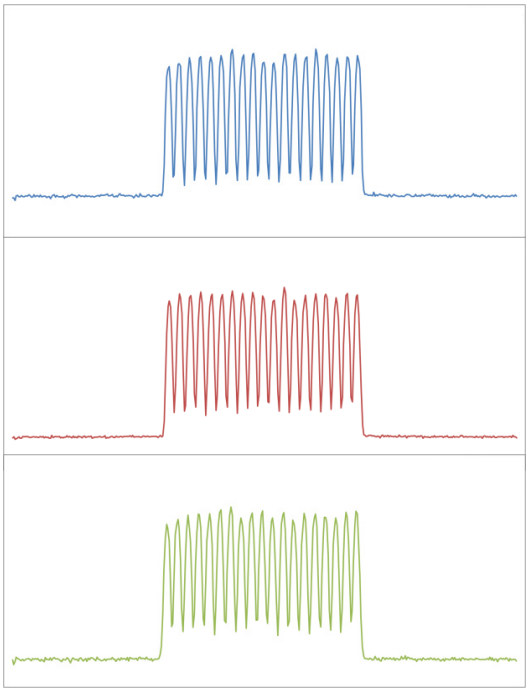


Figure 2: Vertical intensity profile cross section of image in figure 1 at centre and edges of the focal plane.

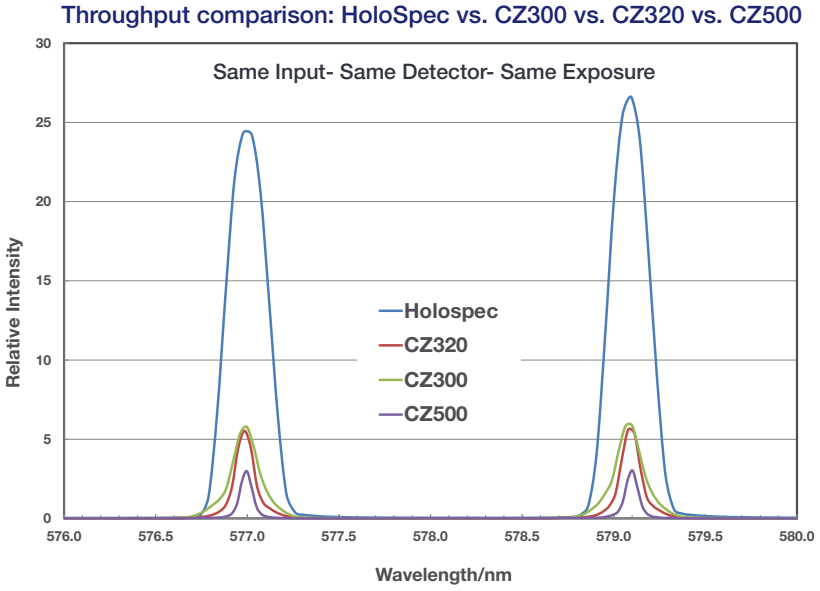


Figure 3: Direct comparison of HoloSpec throughput with Czerny Turner (CZT) systems. Each with 1200 g/mm gratings optimized for the 500-600 nm region. Numbers refer to focal lengths (mm).

Holospec in action

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Fundamentals of stand-off Raman scattering spectroscopy for explosive fingerprinting, J. Moros *et al*, *J. Raman Spectrosc*., 44: 121–130. doi: 10.1002/jrs.4138 [2013]

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Wrapping and dispersion of multiwalled carbon nanotubes improves electrical conductivity of protein–nanotube composite biomaterials, C. M. Voge *et al*, *Journal of Biomedical Materials Research* Part A, 101A(1) 231–238. doi: 10.1002/jbm.a.34310 [2013]

In situ Raman spectroscopy for the evaluation of solubility in supercritical carbon dioxide mixtures, I. Rodriguez-Meizoso *et al*, *The Journal of Supercritical Fluids*, 65: 87-92. doi: 10.1016/j.supflu.2012.03.002 [2012]

Synthesis of graphene-CoS electro-catalytic electrodes for dye sensitized solar cells, Santanu Das *et al, Carbon*, 50(13): 4815–4821. doi: 10.1016/j.carbon.2012.06.006 [2012]

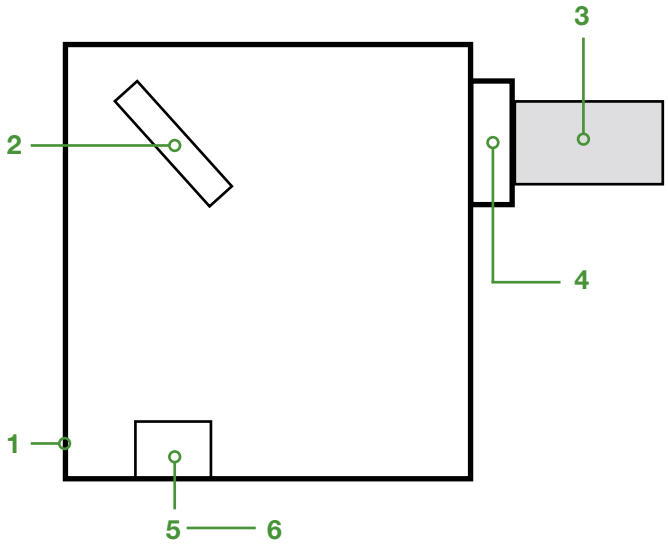
Have you found what you are looking for?

Need a higher spectral resolution? Andor's motorised, research grade Shamrock Czerny-Turner spectrographs offer 500 & 750 mm focal lengths.

Need to work in the SWIR regions? Andor's Shamrock series can be configured with silver-coated optics for enhanced collection efficiency in the NIR-SWIR with Andor iDus InGaAs detectors.

HoloSpec F/1.8- ideal for general broadband Spectroscopy

Parameter	HOLOSPEC-F/1.8-VIS	HOLOSPEC-F/1.8-NIR
Optimized operation wavelength (nm)	450-730	800-1,060
F/# aperture	F/1.8 (across entire plane)	F/1.4 @ centre F/1.8 @ edges
Focal length (output/input, mm)	85/75	85/75
Magnification	1.13	1.13



Dimensions L x W x H mm [inches]	250 x 190 x 170 [10 x 7.5 x 6.7]
Weight kg [lbs]	5 [11]

Key

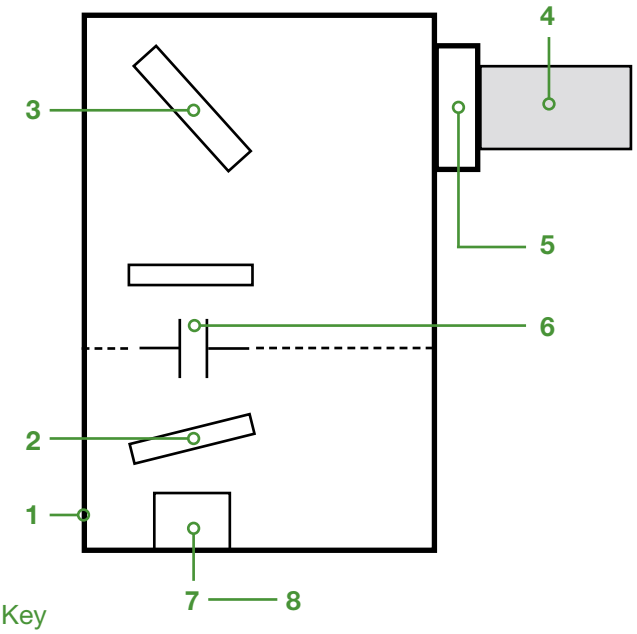
1	Base unit	**HOLOSPEC-F/1.8-VIS** – Visible range **HOLOSPEC-F/1.8-NIR** – Near IR range
2	Gratings	**HS-H**-***** - See *'Broadband' volume phase holographic gratings* table on page 6 for Broadband or Raman-specific options
3	Detector	Please refer to the iDus CCD, Newton CCD & EMCCD and iStar ICCD specification sheets to select the best detector for your wavelength range and desired resolution
4	Detector flange	**HS-FLG-CCD** – For Spectroscopy CCD, EMCCD and ICCD detectors **HS-SHT-9005** - Ø35 mm shutter with flange assembly for Spectroscopy CCD, EMCCD and ICCD detectors (shutter driver **ACC-SD-VDM1000** must be ordered separately)
5	Input accessories	**HS-EXSLIT-INAD**– Entrance slit mount for input slit (one required per system with a slit input configuration) **HS-SLT-INPUT-****** – Entrance slits, (require one **HS-EXSLIT-INAD** to be ordered per system), See *Inputs & Intermediate* Slits table on page 6 for available options **HS-FOI-FC** - FC fibre adapter **HS-FOI-SMA** - SMA fibre adapter **HS-ASM-8081** - Ø11 mm fibre ferrule X-Y adjuster (cannot be used in conjunction with input slit) Ferrule multi-track fibre adapters•1
6	Additional input accessories	Integrated Raman probes•1

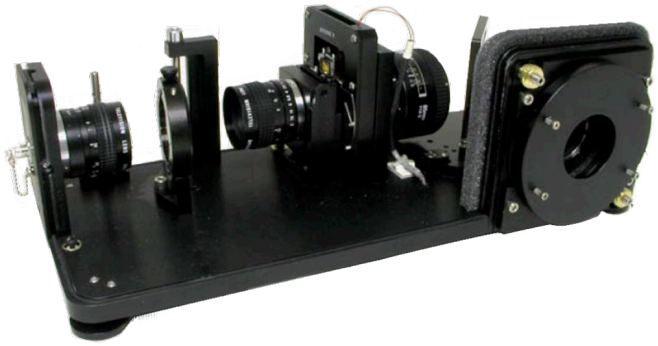
Detector Specification sheets
andor.com/spectroscopy

Resolution calculator
andor.com/calculators

HoloSpec F/1.8i- ideal for Raman applications

Parameter	HOLOSPEC-F/1.8i-VIS	HOLOSPEC-F/1.8i-NIR
Optimized operation wavelength (nm)	450-730	800-1,060
Integrated Notch filter chamber	Yes	
F/# aperture	F/1.8 (across entire plane)	F/1.4 @ centre F/1.8 @ edges
Focal length (output/input, mm)	85/75	85/75
Magnification	1.20	1.20





Dimensions L x W x H mm [inches]	440 x 190 x 170 [17.3 x 7.5 x 6.7]
Weight kg [lbs]	8.2 [18]

Key

1	Base unit	**HOLOSPEC-F/1.8i-VIS** – Visible range **HOLOSPEC-F/1.8i-NIR** – Near IR range
2	Notch filters	**HS-HSPF-***** - See *Notch Filters* table on page 6 for specific laser wavelength options
3	Gratings	**HS-H**-***** - See *'Raman' volume phase holographic gratings* table on page 7 for Raman-specific options
4	Detector	Please refer to the iDus CCD, Newton CCD & EMCCD and iStar ICCD specification sheets to select the best detector for your wavelength range and desired resolution
5	Detector flange	**HS-FLG-CCD** – For Spectroscopy CCD, EMCCD and ICCD detectors **HS-SHT-9005** - Ø35 mm shutter with flange assembly for Spectroscopy CCD, EMCCD and ICCD detectors (shutter driver **ACC-SD-VDM1000** must be ordered separately)
6	Intermediate accessories	**HS-SLT-INTER -****** – Intermediate slits, See *Input & intermediate slits* table on page 6 for available options
7	Input accessories	**HS-EXSLIT-INAD**– Entrance slit mount for input slit (one required per system with a slit input configuration) **HS-SLT-INPUT-****** – Entrance slits, (require one **HS-EXSLIT-INAD** to be ordered per system), See *Input & intermediate slits* table on page 6 for available options **HS-FOI-FC** - FC fibre adapter, **HS-FOI-SMA** - SMA fibre adapter Ferrule multi-track fibre adapters•1
8	Additional input accessories	Integrated Raman probes•1

Detector Specification sheets
andor.com/spectroscopy

Resolution calculator
andor.com/calculators

Input & intermediate slits

Slit size (W x H) •2, 3	Input slit part number	Intermediate slit part number ('i' models only with Rayleigh filtering compartment)
25 µm x 8 mm	HS-SLT-INPUT-0025	HS-SLT-INTER-0025
50 µm x 8 mm	HS-SLT-INPUT-0050	HS-SLT-INTER-0050
100 µm x 8 mm	HS-SLT-INPUT-0100	HS-SLT-INTER-0100
250 µm x 8 mm	HS-SLT-INPUT-0250	HS-SLT-INTER-0250
500 µm x 8 mm	HS-SLT-INPUT-0500	HS-SLT-INTER-0500
1000 µm x 8 mm	HS-SLT-INPUT-1000	HS-SLT-INTER-1000
2000 µm x 8 mm	HS-SLT-INPUT-2000	HS-SLT-INTER-2000
4000 µm x 8 mm	HS-SLT-INPUT-4000	HS-SLT-INTER-4000

Notch filters

Laser wavelength (nm) •3	Diameter	Optical Density at laser wavelength	Spectral bandwidth (cm^{-1})	Andor part number
514.5	Ø 50 mm (2")	> 6	< 350	HS-HSPF-514.5
532				HS-HSPF-532.0
632.8				HS-HSPF-632.8
785				HS-HSPF-785.0

'Broadband' volume phase holographic gratings*

Central wavelength (nm)•3	Nominal dispersion (nm/mm)	Bandpass (nm) [λ min, λ max]•6, 7	Resolution at centre (nm)•8	Andor part number	Recommended Holospec model
539.5	10	401 to 678 nm	0.59	HS-HFG-539.5	VIS
550	10	412 to 688 nm	0.59	HS-HFG-550	VIS
590	16.15	367 to 813 nm•4	0.96	HS-HVG-590	VIS
600	11.15	446 to 754 nm	0.66	HS-HFG-600	VIS
650	11.92	485 to 815 nm	0.71	HS-HFG-650	VIS
730.8	13.46	545 to 917 nm	0.80	HS-HFG-730.8	VIS
750	13.85	559 to 942 nm	0.82	HS-HFG-750	NIR
800	21.54	502 to 1098 nm•5	1.28	HS-HVG-800	NIR
821	22.31	513 to 1129 nm•5	1.33	HS-HVG-821	NIR
850	15.77	632 to 1068 nm•5	0.94	HS-HFG-850	NIR

* values shown for a 50 µm x 4 mm (W x H) slit

‘Raman’ volume phase holographic gratings*

Laser wavelength (nm) •3	Specific coverage	Average reciprocal dispersion (cm^{-1}/mm)	Nominal dispersion (nm/mm)	Bandpass (cm^{-1}) [shift min, shift max] •6, 7	Bandpass (nm) [λ min, λ max] •6, 7	Average resolution (cm^{-1}) •8	Resolution at centre (nm) •8	Andor part number	Recommended Holospec model
514.5	Stokes Anti-Stokes	103.9	2.60	-1112 to 1761 cm^{-1}	487 to 566 nm	6.17	0.15	HS-HSG-514.5-SA	VIS
514.5	Low-frequency	100.0	2.71	-272 to 2493 cm^{-1}	507 to 590 nm	5.94	0.16	HS-HSG-514.5-LF	VIS
514.5	High-frequency	84.6	3.11	2277 to 4616 cm^{-1}	583 to 675 nm	5.03	0.18	HS-HSG-514.5-HF	VIS
532	Stokes Anti-Stokes	100.0	2.69	-1032 to 1733 cm^{-1}	504 to 586 nm	5.94	0.16	HS-HSG-532-SA	VIS
532	Stokes Anti-Stokes (high dispersion)	40.4	1.14	-617 to 503 cm^{-1}	515 to 547 nm	2.40	0.07	HS-HDG-532	VIS
532	Low-frequency	92.3	2.83	-34 to 2517 cm^{-1}	531 to 614 nm	5.48	0.17	HS-HSG-532-LF	VIS
532	High-frequency	80.8	3.22	2263 to 4497 cm^{-1}	605 to 699 nm	4.80	0.19	HS-HSG-532-HF	VIS
632.8	Stokes Anti-Stokes	84.6	3.14	-1179 to 1160 cm^{-1}	589 to 683 nm	5.03	0.19	HS-HSG-632.8-SA	VIS
632.8	Low-frequency	80.8	3.37	-57 to 2177 cm^{-1}	631 to 734 nm	4.80	0.20	HS-HSG-632.8-LF	VIS
632.8	High-frequency	69.23	3.85	1930 to 3844 cm^{-1}	721 to 836 nm	4.11	0.23	HS-HSG-632.8-HF	NIR
647	Stokes Anti-Stokes	80.8	3.24	-993 to 1241 cm^{-1}	608 to 704 nm	4.80	0.19	HS-HSG-647-SA	VIS
647	Low-frequency	79.9	3.44	-99 to 2110 cm^{-1}	643 to 749 nm	4.75	0.20	HS-HSG-647-LF	VIS
647	High-frequency	69.23	3.92	1831 to 3745 cm^{-1}	734 to 854 nm	4.11	0.23	HS-HSG-647-HF	NIR
752	Stokes Anti-Stokes	84.6	4.51	-1035 to 1304 cm^{-1}	698 to 834 nm	5.03	0.27	HS-HSG-752-SA	NIR
752	Low-frequency	79.9	4.82	-98 to 2112 cm^{-1}	747 to 894 nm	4.75	0.29	HS-HSG-752-LF	NIR
752	High-frequency	65.38	5.64	1891 to 3698 cm^{-1}	877 to 1042 nm	3.88	0.34	HS-HSG-752-HF	NIR
785	Stokes Anti-Stokes	80.8	4.68	-1025 to 1209 cm^{-1}	727 to 867 nm	4.80	0.28	HS-HSG-785-SA	NIR
785	Stokes Anti-Stokes (high dispersion)	27.5	1.69	-422 to 341 cm^{-1}	760 to 807 nm	1.63	0.10	HS-HDG-785	NIR
785	Low-frequency	79.9	5.03	-145 to 2064 cm^{-1}	776 to 937 nm	4.75	0.30	HS-HSG-785-LF	NIR
785	High-frequency	65.4	5.87	1743 to 3551 cm^{-1}	909 to 1088 nm •5	3.88	0.35	HS-HSG-785-HF	NIR
830	Stokes Anti-Stokes	79.9	4.94	-1070 to 1139 cm^{-1}	762 to 917 nm	4.75	0.29	HS-HSG-830-SA	NIR
830	Low-frequency	69.2	5.34	0.9 to 1914 cm^{-1}	830 to 987 nm	4.11	0.32	HS-HSG-830-LF	NIR
830	High-frequency	61.5	6.24	1708 to 3408 cm^{-1}	967 to 1157 nm •5	3.65	0.37	HS-HSG-830-HF	NIR

* values shown for a 50 µm x 4 mm (W x H) slit

Order Today

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North America
Connecticut, USA
Phone +1 (860) 290 9211
Fax +1 (860) 290 9566

China
Beijing
Phone +86 (10) 8271 9066
Fax +86 (10) 8271 9055

Items shipped with your Spectrograph

1x Spectrograph base unit (with integrated Notch compartment for 'i' models), including set of 4 clamping feet
1x Grating fitted as selected at time of ordering
1x Input accessory (slit or fibre-optics connector) fitted as selected at time of ordering
1x Detector flange fitted as selected at time of ordering
1x Quick start guide
1x User guide (on CD)
1x Individual performance sheet

Footnotes: Specifications are subject to change without notice

1. Please contact your Andor representative to discuss available options
2. For alternative slit height options, please contact your local Andor representative
3. Special designs are available on request - please contact your local Andor representative
4. The HoloSpec transmission decreases rapidly below 400 nm, so the full wavelength range displayed may not be achievable
5. Silicon-based detectors are sensitive to around 1,050 nm, so the full wavelength range displayed will not be achievable
6. Typical values quoted for a 27.6 mm wide sensor, e.g. Newton DU940
7. Useful focal plane width defined as 27.6 mm
8. Typical values quoted for a 50 µm x 4 mm (W x H) slit and a 13.5 um pixel sensor, e.g. Newton DU940

Operating & Storage Conditions

- Operating Temperature: 10°C to 40°C ambient
- Relative Humidity: < 80% (non-condensing)
- Ingress Protection: IP20
- Storage Temperature: -20°C to 70°C