

VNIR SPECTROGRAPHS 400 – 1000 nm



Many spectrograph options are available in the VNIR (400 - 1000nm) wavelength range. The VNIR family of spectrographs provides high optical resolution while minimizing keystone and smile aberrations. The gratings and optics are designed to cover the full wavelength range from 400 to 1000 nm from the first order dispersion. The second order overlaps with first order dispersion and an order blocking filter is necessary to remove the second order dispersion. Inserting an order blocking filter in front of the sensor allows full wavelength coverage with one spectrograph and one camera sensor. Filters are available in different sizes and holders and are ordered separately. Please refer to the Filter section of the Accessories chapter for further details. The VNIR spectrographs can transform a scientific gray scale CCD or CMOS camera into a line-scan spectral imaging device.

VNIR Spectrograph Specifications

Optical Characteristics	V10H	V10	V10E
Spectral Range	400 - 1000 nm	400 - 1000 nm	400 - 1000 nm
Spectral Dispersion	139 nm/mm	93.9 nm/mm	97.5 nm/mm
Spectral Resolution	11.2 nm (w/ 80 μ m slit)	9 nm (w/ 80 μ m slit)	2.8 nm (w/ 80 μ m slit)
Spatial Resolution	RMS spot radius < 40 μ m	RMS spot radius < 40 μ m	RMS spot radius < 9 μ m
Image Size (Spectral x Spatial)	4.8 x 6.6 mm	6.6 x 8.8 mm	max 6.15 x 14.2 mm
Numerical Aperture	F/2.8	F/2.8	F/2.4
Optical Input	Standard	Standard	Telecentric
Average Diffraction Efficiency	> 50%, independent of polarization	> 50%, independent of polarization	> 50%, independent of polarization
Stray Light	< 0.5% (halogen lamp, 633 nm notch filter)	< 0.5% (halogen lamp, 633 nm notch filter)	< 0.5% (halogen lamp, 633 nm notch filter)
Slit Width, default	50 μ m (25, 80, and 150 μ m available on request)	50 μ m (25, 80, and 150 μ m available on request)	30 μ m (13, 18, 50, 80, and 150 μ m available on request)
Slit Length	9.8 mm	9.8 mm	14.3 mm
Magnification	1:1	1:1	1:1

Aberrations

Bending of Spectral Lines Across Spatial Axis	Smile < 30 μ m (0.698%)	Smile < 45 μ m (0.68%)	Smile < 1.5 μ m (0.024%)
Bending of Spatial Lines Across Spectral Axis	Keystone < 20 μ m (0.303%)	Keystone < 40 μ m (0.45%)	Keystone < 1 μ m (0.007%)
Astigmatism	Insignificant	Insignificant	None

Mechanical Characteristics

Body	Anodized Aluminum Tube	Anodized Aluminum Tube	Anodized Aluminum Tube
Size (W x H x L)	35 x 35 x 139 mm	35 x 35 x 139 mm	60 x 60 x 175 mm
Weight	300 g	300 g	1100 g
Lens Mount	Standard C-mount adapter	Standard C-mount adapter	Standard C-mount adapter
Camera Mount	Standard C-mount adapter	Standard C-mount adapter	Standard C-mount adapter
User Adjustments	Image axis rotation relative to detector rows, back focal length adjustable \pm 1 mm (for all)		

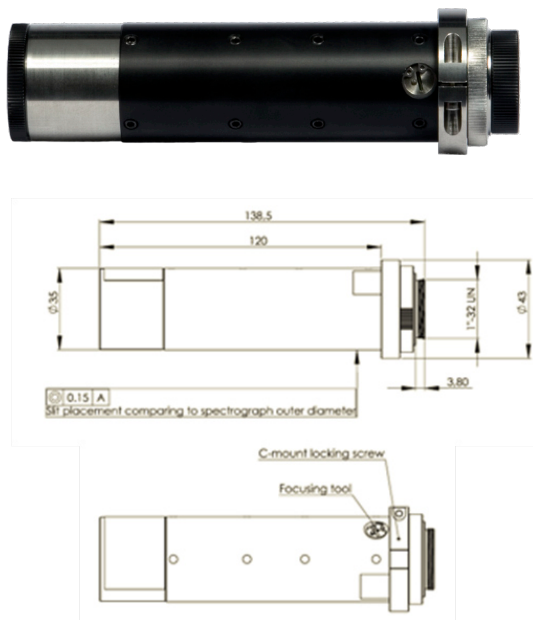
Environmental Characteristics

Storage Temperature, non-condensing	-20 $^{\circ}$ C ... + 85 $^{\circ}$ C	-20 $^{\circ}$ C ... + 85 $^{\circ}$ C	-20 $^{\circ}$ C ... + 85 $^{\circ}$ C
Operating Temperature, non-condensing	+ 5 $^{\circ}$ C ... + 40 $^{\circ}$ C	+ 5 $^{\circ}$ C ... + 40 $^{\circ}$ C	+ 5 $^{\circ}$ C ... + 40 $^{\circ}$ C



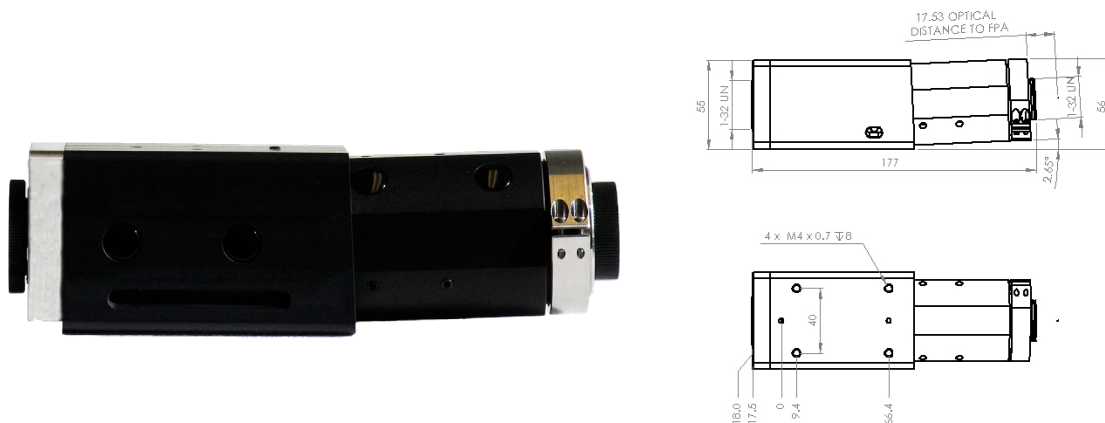
ImSpectors V10H and V10

As with the visible range of spectrographs, there are two separate models for the standard VNIR spectrograph, the V10 for 2/3" sensors and the V10H for 1/2" sensors. Both of these models share the same mechanical characteristics as shown in these drawings.



ImSpecter V10E

The VNIR range of spectrographs also includes an E-Series model suitable for imaging applications that require higher spatial or spectral fidelity than available with a standard spectrograph.



VNIR Spectrographs Ordering Information		
Part Number	Description	Product Name
MRC-304-002-01	ImSpector – Standard VNIR Spectrograph V10, 50 μm slit* (default)	ImSpector V10
MRC-304-002-02	ImSpector – Standard VNIR Spectrograph V10H, for 1/2" image sensor, 50 μm slit* (default)	ImSpector V10H
MRC-305-002-01	ImSpector – Enhanced VNIR Spectrograph V10E, 30 μm slit* (default)	ImSpector V10E

* When ordering please specify if different slit width is needed.

VNIR 400 – 1000 nm, continued

In addition to the standard and enhanced models available for the VNIR region, two unique spectrographs are also available from the Fast and M-Series lines. These additional models expand the options available to meet the specific needs of particular applications.

ImSpector Fast10

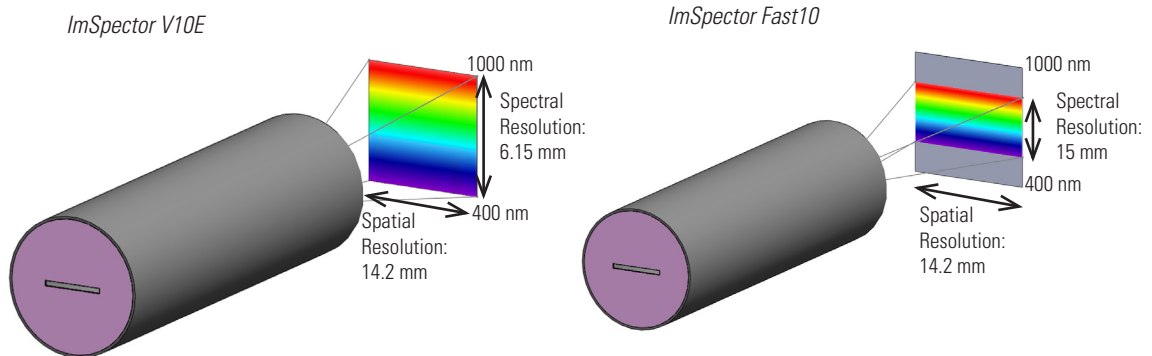
This high intensity imaging spectrograph allows spectral imaging to be used for high-speed industrial applications such as on-line color sorting and agricultural produce inspection. The compressed spectral scale makes high-speed spectral imaging acquisition possible, at speeds of up to 1500 lines per second. Using reduced spectral dispersion, the ImSpector Fast10 allows the highest possible light throughput to create maximum light intensity on the camera pixels, allowing shorter integration time. The compressed spectral scale allows faster readout rates when using cameras with range-of-interest (ROI) readout features. ImSpector Fast10 can also be combined with high speed industrial CCD and CMOS cameras to produce ultra-fast measurements.



Fast10 spectrograph with camera

Comparison of Fast10 and V10E

As seen in the comparison of the spectral dispersion of the two spectrographs in the figure below, the Fast10 spectrograph offers the full VNIR spectrum of 400 – 1000 nm, but it is dispersed over a much narrower region. This allows for shorter, faster readout times while maintaining the same spatial information.



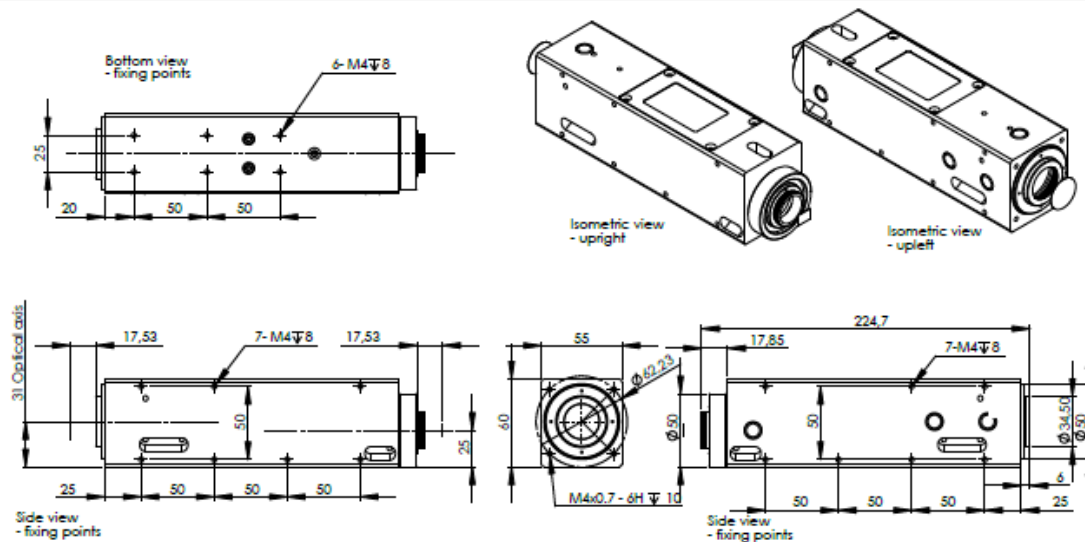
VNIR ImSpector Fast-Series Specifications

Optical Characteristics	Fast10
Spectral Range	400 - 1000 nm
Spectral Dispersion	750 nm/mm
Spectral Resolution	15 nm (with 18 μ m slit)
Spatial Resolution	RMS spot radius < 9 μ m
Image Size (Spectral x Spatial)	0.78 x 14.3 mm
Numerical Aperture	F/3.2
Optical Input	Telecentric
Average Diffraction Efficiency	> 50%, independent of polarization
Stray Light	< 0.5% (halogen lamp, 633 nm long-pass filter)
Slit Width, default	18 μ m (13 and 30 μ m available on request)
Slit Length	14.3 mm
Magnification	1:1

Aberations	
Bending of Spectral Lines Across Spatial Axis	< 4 μ m (0.51%)
Bending of Spatial Lines Across Spectral Axis	< 4 μ m (0.028%)
Astigmatism	None
Vignetting	\approx 0%

Mechanical Characteristics	
Body	Anodized Aluminum
Size (W x H x L)	55 x 60 x 225 mm
Weight	1530 g
Lens Mount	Standard C-mount adapter
Camera Mount	Standard C-mount adapter
User Adjustments	Image axis rotation relative to detector rows, back focal length adjustable \pm 1 mm

Environmental Characteristics	
Storage Temperature, non-condensing	- 20 $^{\circ}$ C ... + 80 $^{\circ}$ C
Operating Temperature, non-condensing	+ 5 $^{\circ}$ C ... + 40 $^{\circ}$ C



VNIR Fast10 Spectrograph Ordering Information		
Part Number	Description	Product Name
MRC-306-002-01	ImSpector – Fast VNIR Spectrograph Fast10, 18 μ m slit* (default)	ImSpector Fast10

* When ordering please specify if different slit width is needed.

VNIR 400 – 1000 nm, continued

ImSpector V10M

This ImSpector model from the new M-series line of imaging spectrographs supports a large spatial image size for sensor sizes up to 24 mm and has an extended operating range of 350 to 1000 nm. The V10M combines excellent performance with a lightweight, compact size in an off-the-shelf spectrograph that can be used in defense, security, and industrial applications. This spectrograph provides high resolution hyperspectral imaging performance in a compact format required for unmanned aerial vehicles (UAV's) and other demanding applications. Due to the larger format and the unique optical design, the light throughput of the V10M is superior to the Standard or Enhanced Series spectrographs, allowing for an even higher signal-to-noise ratio.



ImSpector V10M integrated with fore optics and high resolution camera



VNIR ImSpector M-Series Specifications

Optical Characteristics	V10M
Spectral Range	350 - 1000 nm
Spectral Dispersion	111 nm/mm
Spectral Resolution	1.5 nm (with 18 μ m slit)
Spatial Resolution	RMS spot diam. < 7 μ m
Image Size (Spectral x Spatial)	Max. 7.0 x 24.0 mm
Numerical Aperture	F/2.4
Optical Input	Telecentric
Average Diffraction Efficiency	> 50%
Stray Light	< 0.5% (halogen lamp, 633 nm long-pass filter)
Slit Width, default	18 μ m (30 μ m available on request)
Slit Length	30.0 mm
Magnification	3:4

Aberrations

Bending of Spectral Lines Across Spatial Axis	Smile < 2 μ m (0.029%)
Bending of Spatial Lines Across Spectral Axis	Keystone < 2 μ m (0.008%)
Astigmatism	None
Vignetting	None

Mechanical Characteristics

Body	Anodized Aluminum Tube
Size (W x H x L)	115 x 95 x 100 mm
Weight	600 g
Lens Mount	M42 or F-Mount
Camera Mount	Custom adapter
User Adjustments	Back focal length adjustable \pm 1 mm

Environmental Characteristics

Storage Temperature, non-condensing	- 40 $^{\circ}$ C ... + 71 $^{\circ}$ C
Operating Temperature, non-condensing	+ 5 $^{\circ}$ C ... + 40 $^{\circ}$ C

* This product line is under development. The above specifications may change without notice.

VNIR V10M Spectrograph Ordering Information		
Part Number	Description	Product Name
MRC-317-002-01	ImSpector – V10M VNIR Spectrograph, 18 μ m slit* (default)	V10M

* When ordering please specify if different slit width is needed.