

VNIR 400 – 1000 nm HYPERSPECTRAL CAMERAS

Middleton Research offers several choices of hyperspectral cameras in the VNIR wavelength range from 400 – 1000 nm (HS, PS, and PFD Series) from Specim Ltd.



The HS Series hyperspectral cameras are designed for VNIR applications which require a high throughput, high spatial and spectral resolutions, and the best imaging optics. The camera consists of an imaging spectrograph (ImSpector V10E), a monochrome camera (sensitive high speed interline CCD sensor) and has a base CameraLink interface. With its solid structure and exceptional performance, the HS hyperspectral camera is suited for industry, laboratory and field applications.

The VNIR cased camera package includes: control unit, power supply, USB cable, Firewire cable (Firewire camera only), National Instruments CameraLink frame grabber and data cable (CameraLink cameras only), control cable, power cord set, and software CD.

Cased Camera Specifications

| Optical Characteristics | HS-CL-30-V10E | PS-FW-11-V10E | PFD-CL-65-V10E |
|---------------------------------|--|----------------------------|----------------------------|
| Range (nm) | 400-1000 | 400-1000 | 400-1000 |
| Resolution (spatial x spectral) | 1600 x 1200 (840 active) | 1392 x 1040 (950 active) | 1312 x 1024 |
| Spectrograph | ImSpector V10E | ImSpector V10E | ImSpector V10E |
| Spectral Resolution | 2.8 nm (30 µm slit) | 6.8 nm (30 µm slit) | 2.8 nm (30 µm slit) |
| Spectral Sampling | 0.72 - 5.8 nm/pixel | 0.63 - 5.06 nm/pixel | 0.78 - 6.27 nm/pixel |
| Spatial Resolution | RMS spot diameter < 9 µm | RMS spot diameter < 18 µm | RMS spot diam. < 9 µm |
| Aberrations | Insignificant astigmatism, keystone or smile (for all) | | |
| Numerical Aperture | F/2.4 | F/2.4 | F/2.4 |
| Slit Width, default | 30 µm (18, 50, 80, 150 µm) | 30 µm (18, 50, 80, 150 µm) | 30 µm (18, 50, 80, 150 µm) |
| Effective Slit Length | 11.84 mm | 8.98 mm | 10.50 mm |
| Total Efficiency (typical) | > 50%, independent of polarization (for all) | | |
| Stray Light | < 0.5% (halogen lamp, 590 nm low-pass filter) for all | | |

Electrical Characteristics

| | | | |
|-----------------------------|-----------------|-------------------------------|----------------------------|
| Sensor | Interline CCD | Interline CCD | CMOS |
| Interface | Base CameraLink | Firewire | Base CameraLink |
| Camera Output | Digital 12-bit | Digital 12-bit | Digital 12-bit |
| Frame rate (full / binning) | 33 Hz / 120 Hz | 11 Hz / 62 Hz (1 x 8 binning) | 65 Hz / (180 Hz w/binning) |
| Cooling | N/A | N/A | N/A |
| Frame Grabber | NI-PCI 1428* | N/A | NI-1429 |
| Pixel Size | 7.4 µm x 7.4 µm | 6.45 µm x 6.45 µm | |
| Camera Control | Base CameraLink | Firewire | CameraLink |
| Exposure Time Range | 0.1 - 100 ms | 1 µm - 120 s | 0.1 - 100 ms |
| Power Consumption | < 5 W | < 5W | < 5 W |
| Input Voltage | 24 V | 24 V | 24 V |

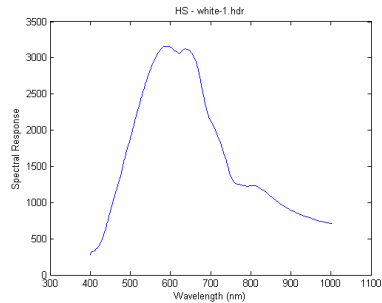
Environmental Characteristics

| | | | |
|--------------|--------------------------|--------------------------|--------------------------|
| Storage | -20 to 50 C | -20 to 50 C | -20 to 50 C |
| Operating | 5 to 40 C non-condensing | 5 to 40 C non-condensing | 5 to 40 C non-condensing |
| Size (LxWxH) | 330 x 85 x 90 mm | 330 x 85 x 90 mm | 330 x 85 x 90 mm |

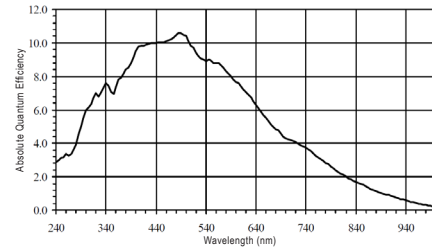
Mechanical Characteristics

| | | | |
|------------------|--|------------------|--------------------|
| Body | Anodized Al w/mounting screw holes (for all) | | |
| Weight | 5.0 kg | 5.0 kg | 2.7 kg |
| Lens Mount | Standard C-mount | Standard C-mount | Standard C-mount |
| User Adjustments | None | None | None |
| Shutter | Yes, w/USB control | Yes | Yes, w/USB control |

The PS Series hyperspectral cameras provide high spatial and spectral resolution, low noise, and a rugged structure for VNIR applications in the laboratory and the field. Each camera is an integration of an imaging spectrograph and a monochrome area camera (sensitive high speed interline CCD sensor) and contains a Firewire interface. The user can choose either a low-cost Standard Series spectrograph (ImSpector V10), or an Enhanced Series spectrograph (ImSpector V10E) that provides higher quality images.



Spectral response of HS camera with spectral flattening filter

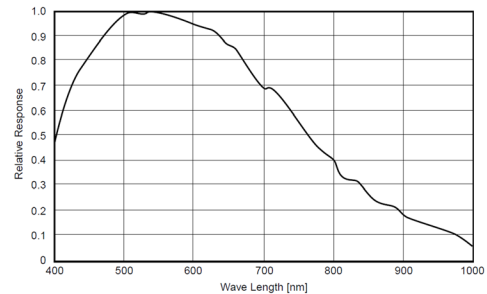


Spectral response of HS camera without flattening filter

The PFD Series of hyperspectral cameras is a new family of visible and VNIR cameras which are based on a CMOS sensor and include a CameraLink interface.

The VNIR camera may be combined with a SWIR hyperspectral camera to extend the wavelength range to the entire 400-2500 nm region.

The VNIR camera extends the capabilities of a visible hyperspectral camera to 1000 nm, thus allowing additional application options and performance.

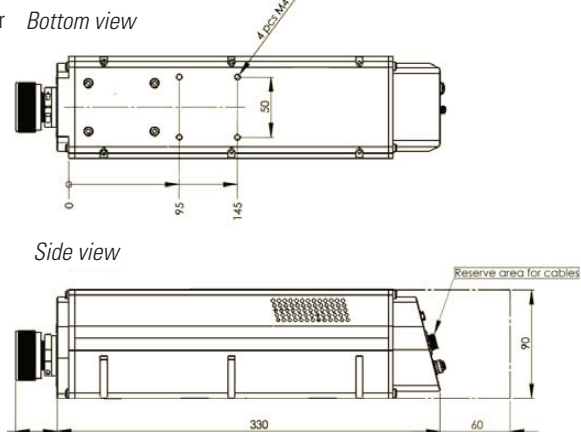


Spectral response of PS camera without flattening filter

Note: All VNIR cameras with enhanced spectrographs can be used with mirror more details.

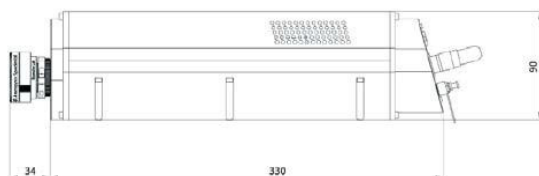
Applications

- Forensics
- Scanning of art works
- Counterfeit detection
- Fruit and vegetable ripeness and bruising
- Life science applications including fluorescence monitoring
- Plant and vegetation research
- Environmental monitoring
- Hyperspectral microscopy

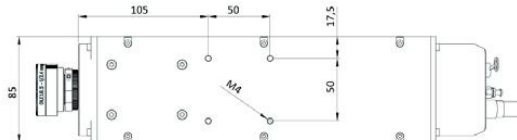


HS V10E & PS V10E Cased cameras

Side view



Bottom view



PFD V10E Cased cameras

| VNIR Cased Cameras Ordering Information | | |
|---|--|----------------|
| Part Number | Description | Product Name |
| MRC-303-002-01 | VNIR Spectral Camera with Enhanced Spectrograph. 11 fps, 1392x1040 IT CCD, Firewire, cables included | PS-FW-11-V10E |
| MRC-303-002-02 | VNIR Spectral Camera with Enhanced Spectrograph. 30 fps, 1600x1200 IT CCD, Cameralink frame grabber + cables | HS-CL-30-V10E |
| MRC-303-002-05 | VNIR Spectral Camera with Enhanced Spectrograph. 65 fps, 1312x1024 CMOS, CameraLink frame grabber + cables | PFD-CL-65-V10E |

VNIR 400 – 1000 nm, continued

HYPERSPETRAL CAMERAS

The uncased VNIR camera models are fully functional hyperspectral cameras without the housing. These models are more economical but lack the protection provided by the exterior casing. Uncased models also lack the computer controlled shutter that is included in complete cameras for the purpose of establishing the dark background levels.

The VNIR uncased camera package includes: power supply (CameraLink cameras only), Firewire cable (Firewire cameras only), National Instruments CameraLink frame grabber and data cable (CameraLink cameras only), power cord set, and software CD.

Uncased Camera Specifications

| Optical Characteristics | PS-FW-11-V10-OEM | HS-CL-30-V10E-OEM | PS-FW-11-V10E-OEM | PFD-CL-65-V10E-OEM |
|---------------------------------|---|---|---|---|
| Range (nm) | 400-1000 | 400-1000 | 400-1000 | 400-1000 |
| Resolution (spatial x spectral) | 1392 x 1040 (990 active) | 1600 x 1200 (840 active) | 1392 x 1040 (950 active) | 1312 x 1024 |
| Spectrograph | ImSpector V10 | ImSpector V10E | ImSpector V10E | ImSpector V10E |
| Spectral Resolution | 6.8 nm (30 µm slit) | 2.8 nm (30 µm slit) | 2.8 nm (30 µm slit) | 2.8 nm (30 µm slit) |
| Spectral Sampling | 0.63 - 5.0 nm/pixel | 0.72 - 5.8 nm/pixel | 0.63 - 5.06 nm/pixel | 0.78 - 6.27 nm/pixel |
| Spatial Resolution | RMS spot diameter < 80 µm | RMS spot diameter < 9 µm | RMS spot diameter < 18 µm | RMS spot diameter < 9 µm |
| Aberrations | Smile < 45 µm, keystone < 40 µm | Insignificant astigmatism, keystone or smile | Insignificant astigmatism, keystone or smile | Insignificant astigmatism, keystone or smile |
| Numerical Aperture | F/2.8 | F/2.4 | F/2.4 | F/2.4 |
| Slit Width, default | 50 µm (25, 80, 150 µm) | 30 µm (18, 50, 80, 150 µm) | 30 µm (18, 50, 80, 150 µm) | 30 µm (18, 50, 80, 150 µm) |
| Effective Slit Length | 8.98 mm | 11.84 mm | 8.98 mm | 10.50 mm |
| Total Efficiency (typical) | > 50%, independent of polarization | > 50%, independent of polarization | > 50%, independent of polarization | > 50%, independent of polarization |
| Stray Light | < 0.5% (halogen lamp, 590 nm low-pass filter) | < 0.5% (halogen lamp, 590 nm low-pass filter) | < 0.5% (halogen lamp, 590 nm low-pass filter) | < 0.5% (halogen lamp, 590 nm low-pass filter) |

Electrical Characteristics

| | | | | |
|-----------------------------|-------------------------------|-----------------|-------------------------------|----------------------------|
| Sensor | Interline CCD | Interline CCD | Interline CCD | CMOS |
| Interface | Firewire | Base CameraLink | Firewire | Base CameraLink |
| Camera Output | Digital 12-bit | Digital 12-bit | Digital 12-bit | Digital 12-bit |
| Frame rate (full / binning) | 11 Hz / 62 Hz (1 x 8 binning) | 33 Hz / 120 Hz | 11 Hz / 62 Hz (1 x 8 binning) | 65 Hz / (180 Hz w/binning) |
| Cooling | N/A | N/A | N/A | N/A |
| Frame Grabber | N/A | NI-PCI 1428* | N/A | NI-1429 |
| Pixel Size | 6.45 µm x 6.45 µm | 7.4 µm x 7.4 µm | 6.45 µm x 6.45 µm | |
| Camera Control | Firewire | Base CameraLink | Firewire | CameraLink |
| Exposure Time Range | 1 µm - 120 s | 0.1 - 100 ms | 1 µm - 120 s | 0.1 - 100 ms |
| Power Consumption | < 5W | < 5 W | < 5W | < 5W |
| Input Voltage | 12 V | 12 V | 12 V | 12 V |

Environmental Characteristics

| | | | | |
|--------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Storage | -20 to 50 C | -20 to 50 C | -20 to 50 C | -20 to 50 C |
| Operating | 5 to 40 C non-condensing | 5 to 40 C non-condensing | 5 to 40 C non-condensing | 5 to 40 C non-condensing |
| Size (LxWxH) | 220 x 60 x 70 | 260 x 70 x 79 mm | 241 x 73 x 79 mm | 231 x 80.5 x 78 mm |

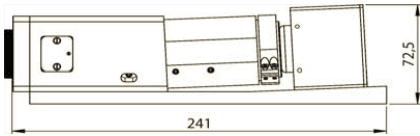
Mechanical Characteristics

| | | | | |
|------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| Weight | 1.8 kg | 1.8 kg | 1.8 kg | 1.8 kg |
| Body | Anodized Al w/mounting screw holes | Anodized Al w/mounting screw holes | Anodized Al w/mounting screw holes | Anodized Al w/mounting screw holes |
| Lens Mount | Standard C-mount | Standard C-mount | Standard C-mount | Standard C-mount |
| User Adjustments | None | None | None | None |
| Shutter | No | Optional | Optional | Optional |

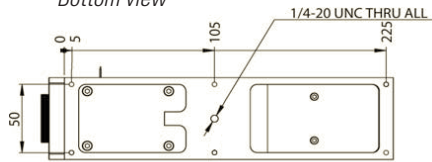
PS V10E OEM



Side view



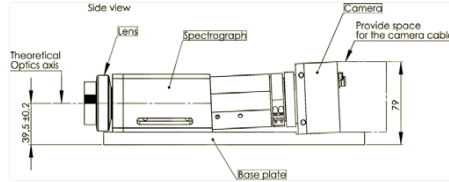
Bottom view



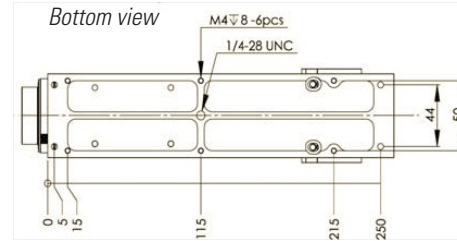
HS V10E OEM



Side view



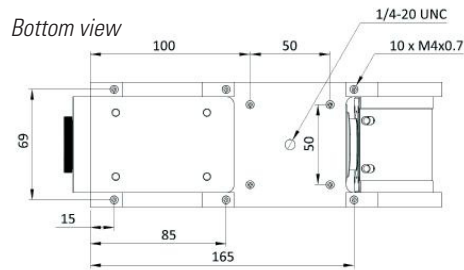
Bottom view



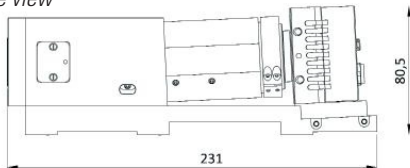
PFD V10E OEM



Bottom view



Side view



PS V10 OEM



VNIR Uncased Cameras Ordering Information

| Part Number | Description | Product Name |
|----------------|---|--------------------|
| MRC-301-002-01 | OEM VNIR Spectral Camera, with Standard Spectrograph. 11 fps, 1392x1040 IT CCD, Firewire, cables included | PS-FW-11-V10-OEM |
| MRC-302-002-03 | OEM VNIR Spectral Camera, with Enhanced Spectrograph. 30 fps, 1600x1200 IT CCD, CameraLink frame grabber + cables | HS-CL-30-V10E-OEM |
| MRC-302-002-01 | OEM VNIR Spectral Camera, with Enhanced Spectrograph. 11 fps, 1392x1040 IT CCD, Firewire, cables included | PS-FW-11-V10E-OEM |
| MRC-302-002-06 | OEM VNIR Spectral Camera, with Enhanced Spectrograph. 65 fps, 1312x1024 CMOS, CameraLink frame grabber + cables | PFD-CL-65-V10E-OEM |