

BEAM PROFILING

Overview of the different models

BEAM PROFILING CAMERAS



Profiling a laser beam is a convenient complement to the measurement of its power or energy because it provides very useful additional information, like spatial energy or intensity distribution, beam widths, centroid, ellipticity and orientation, that may help you determine if your laser-based systems are operating optimally.

The Beamage is the most cost-effective USB3.0 Beam Profiling Camera on the market. It is available for UV to IR wavelengths and in 2 sizes. It comes with an intuitive and complete software that features an array of useful tools and functions. Its calculations are ISO compliant.

MAIN SPECIFICATIONS

| | BEAMAGE-4M | BEAMAGE-4M-IR | BEAMAGE-4M-FOCUS |
|-------------------------|----------------|----------------|------------------|
| Wavelength range | | | |
| Camera only | 350 - 1150 nm | 1495 - 1595 nm | 350 - 1150 nm |
| With UC11-UV filter | 250 - 370 nm | --- | --- |
| With B3-IR-Filter | 1250 - 1350 nm | --- | --- |
| Pixel count | 4.2 MPixels | 4.2 MPixels | 4.2 MPixels |
| H x V | 2048 x 2048 | 2048 x 2048 | 2048 x 2048 |
| Sensor size | 11.3 x 11.3 mm | 11.3 x 11.3 mm | 20.5 x 20.5 mm |

BEAM QUALITY MEASUREMENT



The performance of a laser in practical applications is critical in the design of optical systems and focusing applications, and it can be quantified by measuring M2, the laser beam quality factor, which indicates how close a laser is to being an ideal Gaussian beam.

The Beamage-M2 acquires a sequence of beam profile measurements to automatically perform beam quality measurements within a few seconds. It is equipped with the largest optics on the market for easy alignment and fast measurements that you can trust. Its software is both intuitive and ISO compliant.

ACCESSORIES

Specifications



IF YOUR **LASER SPECIFICATIONS EXCEED THE LIMITS** IN TERMS OF

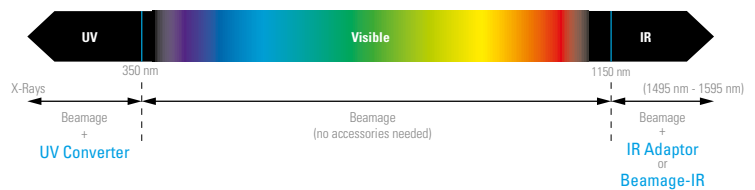
- > **WAVELENGTH**
- > **BEAM SIZE**
- > **LASER POWER**

YOU CAN MANAGE THEM WITH THE ACCESSORIES PRESENTED BELOW

MANAGE THE WAVELENGTH



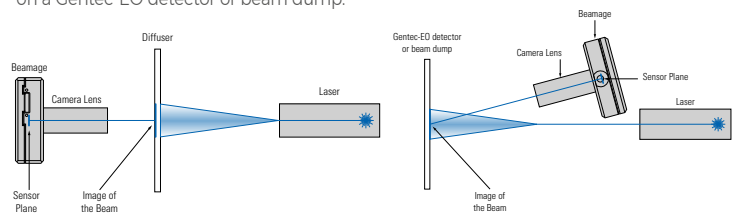
Since CMOS sensors are not sensitive to every frequency of the electromagnetic spectrum, we offer several wavelength management solutions to enhance the capabilities of the Beamage beam profiling cameras.



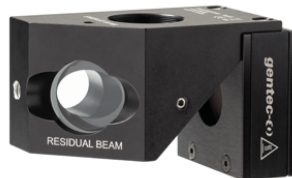
MANAGE THE BEAM SIZE



A simple solution is offered to those who need to profile beams that are larger than the CMOS sensor (> 11.3 mm x 11.3 mm). This solution is a beam reducing optical component called camera lens. It works either by indirectly imaging the transmission of the beam after it has passed through a diffusing element or by directly imaging the beam that is incident on a Gentec-EO detector or beam dump.



MANAGE THE LASER POWER



CMOS sensors have low saturation levels as well as low damage thresholds. It is thus very important that you control your laser power to get the best measurement possible and avoid damaging the Beamage camera.

- For laser power under 1 W, you can attenuate the beam with ND filters
- For laser power up to 1000 W, you can sample a small fraction of the beam with a BA optical sampler

BEAMAGE

CMOS beam profiling cameras



KEY FEATURES

- **USB 3.0 FOR THE FASTEST TRANSFER RATES**
Up to 10X faster than regular USB 2.0 connections
- **HIGH RESOLUTION**
4.2 Mpixels resolution gives accurate profile measurements of very small beams
- **LARGE APERTURES**
 - 11.3 x 11.3 mm for the Beamage-4M
 - 20.5 x 20.5 mm for the Beamage-4M-FOCUS
- **AVAILABLE WITH IR COATING**
Beamage 4M-IR cameras have a special phosphor coating for IR wavelengths (1495-1595 nm)
- **ISO COMPLIANT**
D40 definition of diameter, centroid, ellipticity and orientation are ISO 11146:2004 and 11146:2005 compliant
- **EXTERNAL TRIGGER**
To synchronize the camera with a pulsed laser

INTUITIVE SOFTWARE INTERFACE

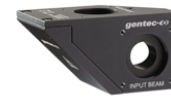
Easy to navigate interface, with many displays and control features:

- 2D, 3D and XY Displays
- Background Subtraction Function
- Unique "Animate" Function
- Gaussian Fit
- Semi-Log Graph

ACCESSORIES



Stand with delrin post



BA series optical attenuators



Stackable ND filters (0.5, 1.0, 2.0, 3.0, 4.0 & 5.0)



UV and IR filters



Pelican carrying case



Fiber adaptors & connectors (FC, ST and SMA)



UV converters & IR adaptors






USB-A to USB-C adaptor

BEAMAGE

Specifications



| | BEAMAGE-4M | BEAMAGE-4M-IR | BEAMAGE-4M-FOCUS |
|--|--|---|---|
| SENSOR TECHNOLOGY | CMOS | CMOS (with phosphor coating) | CMOS (with fiber optic taper) |
| EFFECTIVE APERTURE | 11.3 x 11.3 mm | 11.3 x 11.3 mm | 20.5 X 20.5 mm ^a |
| MEASUREMENT CAPABILITY | | | |
| Wavelength range | | | |
| Camera only | 350 - 1150 nm | 1495 - 1595 nm | 350 - 1150 nm |
| With UG11-UV filter | 250 - 370 nm | --- | --- |
| With B3-IR-filter | 1250 - 1350 nm | --- | --- |
| Pixel count | 4.2 MPixels | 4.2 MPixels | 4.2 MPixels |
| H x V | 2048 x 2048 | 2048 x 2048 | 2048 x 2048 |
| Minimum measurable beam | 55 µm | 70 µm | 120 µm |
| RMS noise | 1000:1 (60 dB) | 1000:1 (60 dB) | 1000:1 (60 dB) |
| DAMAGE THRESHOLDS | | | |
| Maximum average power | 1 W with ND filter | 1 W with ND filter | 1 W with ND filter |
| Maximum density (1064 nm) | 10 W/cm ² 0.1 J/cm ² | 10 W/cm ² 0.1 J/cm ² | 10 W/cm ² 0.1 J/cm ² |
| SOFTWARE | | | |
| Displays | 2D, 3D, XY and Beam Tracking | | |
| Display Features | 2D: Print Screen, Reset View, Show/Hide Beam Diameter 3D: Print Screen, Reset View, Top View XY: Save Data, Zoom, Gaussian Fit, Semi-Log, Show/Hide Cursor, Show/Hide FWHM, Show/Hide 1/e ² Beam Tracking: Save Data, Print Screen, Reset View, Zoom | | |
| Beam Diameter Definitions | D4σ (ISO compliant), 1/e ² along crosshairs (13.5%) FWHM along crosshairs (50%) Custom (%) | | |
| Buffer Controls | Open File, Save Current Data, Save All Data, Previous/Next Image, Clear Buffer, Animate | | |
| Printing and Reports | Full Report in Print Ready Format (2D, 3D, XY, Measures, Parameters) Print Screen in BMP format (2D and 3D) | | |
| PHYSICAL CHARACTERISTICS | | | |
| Sensor size | 11.3 x 11.3 mm | 11.3 x 11.3 mm | 11.3 x 11.3 mm |
| Sensor area | 1.28 cm ² | 1.28 cm ² | 1.28 cm ² |
| Effective aperture | Same as sensor | Same as sensor | 20.5 x 20.5 mm |
| Dimensions (not including filter) | 61H x 81.1W x 19.7D mm | 61H x 81.1W x 19.7D mm | 61H x 81.1W x 46.5D mm |
| Weight (head only) | 138 g | 138 g | 235 g |
| ORDERING INFORMATION | | | |
| Compatible stand | STAND-D-233 | STAND-D-233 | STAND-D-233 |
| Product page |  |  |  |

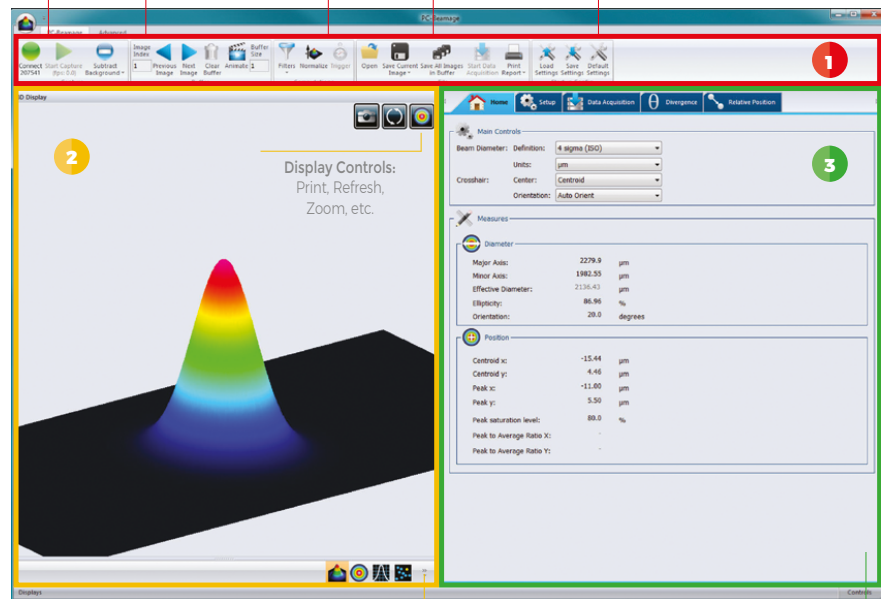
a. With a typical pixel multiplication factor (PMF) of 1.8.

Specifications are subject to change without notice

BEAMAGE

Software features

Capture Controls: Start/Stop, Subtract Background
 Buffer Controls: View Data Offline
 Data: Computation
 File Controls: Save and Open Data
 Startup Configuration: Save and Load Settings



Displays: 3D, 2D, XY Graphs and Beam Tracking
 Home, Setup and Acquisition Tabs: Set your capture parameters and get the resulting measurements

1 MAIN CONTROLS

The upper part of the software includes all the main controls in a ribbon format. These controls are grouped by family: Capture Controls, File Controls, Buffer Controls, M2 Controls and Data Computations. The last includes very useful filters and a normalization function.

2 DISPLAYS

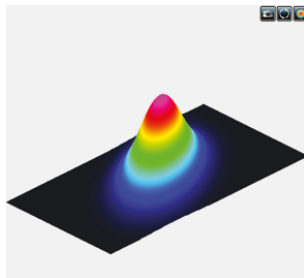
The left-hand side of the software is the display panel. Four displays are available: 3D, 2D, XY (cross-sectional graphs along the crosshairs) and Beam Tracking. The desired display is selected by clicking on the corresponding icon at the bottom of the panel. Print screen controls are available for the 3D, 2D and Beam Tracking displays. They allow the user to save an image of the current view in BMP format.

3 HOME AND SETUP TABS

The right-hand side of the software contains the Home, Setup and Data Acquisition tabs. The Home tab allows the user to select the main controls for his measurements (Beam Diameter Definition, Crosshair Center and Orientation) and displays the resulting measurements below. The Setup tab allows the user to set the measurement parameters (Exposure Time, Image Orientation and Averaging, Active Area, etc.) and the Data Acquisition tab allows the user to save measurements with or without full images, to enter the Sampling Rates and a Total Duration for the Acquisition. More tabs with advanced controls are available when clicking on the Show/Hide Options button in the Computations panel.

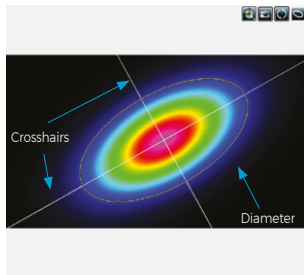
BEAMAGE

Software features



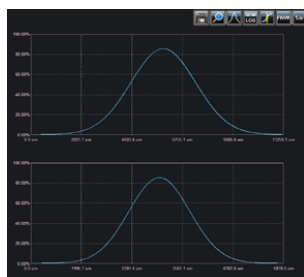
3D DISPLAY

The 3D display shows the actual shape of the beam. It is possible to easily zoom, pan and rotate the image. The Reset button puts the data back in its original configuration. This display also features a Print Screen button to save the latest image in BMP format.



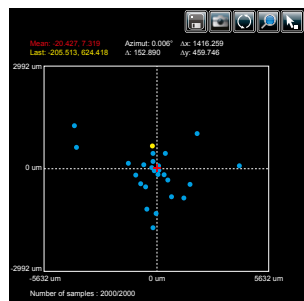
2D DISPLAY

The 2D display features the crosshairs (set to the major and minor axis or along a specific angle) and the measured diameters of the beam. These diameters vary with the chosen definition (4-sigma, FWHM, 1/e2, etc.) and the display can be turned ON or OFF. The Print Screen button allows to save a picture of the current screen in BMP format.



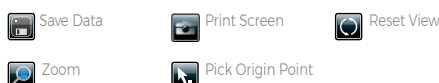
XY DISPLAY

The XY display plots cross-sectional graphs of the beam along the crosshairs. This display features many useful tools like zoom, cursor, and FWHM and 1/e2 level bars. It is also possible to display the graphs in semi-log format to enhance the details in the low intensity parts of the beam.



BEAM TRACKING DISPLAY

The Beam Tracking Display allows the user to visualize the variation of the beam's centroid position on the sensor. This display shows the latest calculated position as well as the previous ones, until the user resets the view. The display also shows the mean position of all computed values and gives information regarding position stability for both X and Y axes. This tool is great to monitor the beam pointing stability over time.



ND

Neutral density (ND) filters - up to 1 W



KEY FEATURES

- **FOR ALL BEAMAGE MODELS**
We offer various SM1-threaded absorptive ND filters that can be fixed directly on the aperture of the Beamage camera via a SM1 to C-mount adaptor. We also offer SM2-threaded filters that can be fixed on the Beamage-4M-FOCUS via a SM2 to T-Mount adaptor.
- **HIGH-QUALITY OPTICS**
These filters reduce the intensity of all wavelengths without affecting the wavefront of the beam or distorting the image.
- **STACKABLE ATTENUATION**
Subsequent filters can be stacked directly on each other. Sets of 3 filters or 6 filters as well as individual filters are available.

COMPATIBLE PRODUCTS



BEAMAGE-4M



BEAMAGE-4M-FOCUS



PH series

OVERVIEW OF THE MODELS


| MODEL NAME | | EQUIVALENT ATTENUATION | TRANSMITTANCE AT 633 NM |
|---|--------------------|------------------------|-------------------------|
| SM1 FILTERS | SM2 FILTERS | | |
| ND0.5 | ND0.5-FOCUS | (1/3.16) | ~32% |
| ND1.0 | ND1.0-FOCUS | (1/10) | ~10% |
| ND2.0 | ND2.0-FOCUS | (1/100) | ~1% |
| ND3.0 | ND3.0-FOCUS | (1/1000) | ~0.1% |
| ND4.0 | ND4.0-FOCUS | (1/10 000) | ~0.01% |
| ND5.0 | ND5.0-FOCUS | (1/100 000) | ~0.001% |
| NDSET-6 (Set of 6 filters) | | | |
| NDSET-3 (Set of 3 filters: ND1, ND2, ND3) | | | |
| ND-H (ND filter holder) | | | |

ND

Specifications

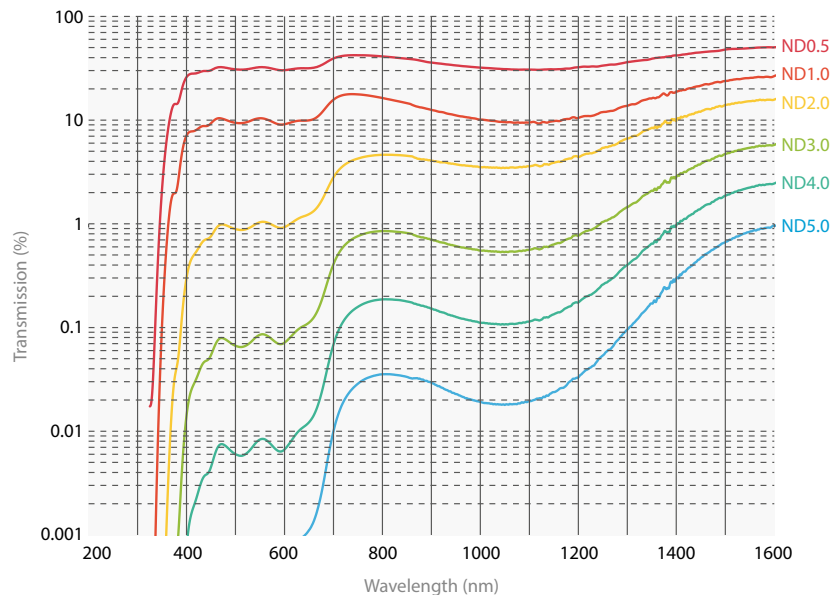


ND0.5 TO ND5.0

| | |
|-----------------------------|--|
| Spectral range | 400 nm* - 1595 nm |
| Filter diameter | 25 mm ϕ |
| Clear aperture | 22.5 mm ϕ (90% of diameter) |
| Dimensional tolerance | +0.0/-0.25 mm |
| Optical density tolerance | $\pm 5\%$ |
| Parallelism | <10 arcsec |
| Transmitted wavefront error | < $\lambda/10$ at 633 nm |
| Surface flatness | < $\lambda/4$ |
| Surface quality | 40 - 20 Scratch-Dig |
| Maximum power | 1 W |
| Damage thresholds | 100 W/cm ² or 3 J/cm ² |
| Product page |  |

* Data specified at 633 nm
a. For ND4.0 filter, lower limit with other models.

SPECTRAL TRANSMISSION OF ALL FILTERS



Specifications are subject to change without notice

BA

Optical attenuators - up to 1 kW



MULTIPLES USES

- Monitor power and beam profile simultaneously
- Polarization insensitive beam-splitter with no back-reflections
- Optical pick-off for use with our energy or power detectors
- Attenuator for our high sensitivity detectors like M6 series and PH series

COMPATIBLE PRODUCTS



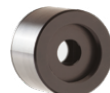
BEAMAGE-4M



BEAMAGE-4M-FOCUS
(for BA32-1KW only)



UP55N-40S-H9
(for BA32-1KW only)



PH series



M6 series

KEY FEATURES

- **MANAGE THE LASER POWER**
CMOS sensors have low saturation levels as well as low damage thresholds. It is thus very important that you control your laser power to get the best measurement possible and avoid damaging the BEAMAGE camera.
- **SAMPLE YOUR LASER BEAM**
The BA series optical attenuators use Fresnel reflections on two orthogonal wedges to pick off a small fraction of the input beam. The incoming beam polarization state and irradiance are preserved.
- **IMPROVED MECHANICS**
The BA16 models are now compatible with 30-mm cage systems and also include SMI threads on the input face

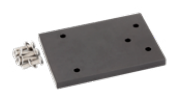
ACCESSORIES



BA32 mounting kit for
BEAMAGE-4M



BA32 mounting kit for
BEAMAGE-4M-FOCUS







BA32 mounting kit for
UP55N-40S-H9

BA

Specifications



| | BA16-60S | BA16K-150S-H5-D0 | BA16K-500F-H9-D0 | BA32-1KW |
|--------------------------------------|---|---|---|---|
| MAXIMUM POWER | 60 W | 150 W | 500 W | 1000 W |
| EFFECTIVE APERTURE | 16 mm ϕ | 16 mm ϕ | 16 mm ϕ | 32 mm ϕ |
| COOLING METHOD | Convection | Convection | Fan | Water |
| MEASUREMENT CAPABILITY | | | | |
| Spectral range | 200 - 2100 nm | 200 - 2100 nm | 200 - 2100 nm | 200 - 2100 nm |
| Integrated power detector | N/A | UPI9K-15S-H5-D0 | UPI9K-110F-H5-D0 | Compatible with UP55 series (not included) |
| Fan input voltage | N/A | N/A | 12 VDC | N/A |
| Equivalent attenuation | 1/1700 @ 1064 nm | 1/1700 @ 1064 nm | 1/1700 @ 1064 nm | 1/1900 @ 1064 nm |
| Optical wedges material | UV fused silica (uncoated) | UV fused silica (uncoated) | UV fused silica (uncoated) | UV fused silica (uncoated) |
| Residual beam deviation | 5.6° | 5.6° | 5.6° | 3.6° @ 1064 nm |
| Polarization correction | Yes (pair of orthogonal wedges) | Yes (pair of orthogonal wedges) | Yes (pair of orthogonal wedges) | Yes (pair of orthogonal wedges) |
| DAMAGE THRESHOLDS | | | | |
| Maximum power | 60 W | 150 W | 500 W | 1000 W |
| Maximum average power density | 10 MW/cm ² | 10 MW/cm ² | 10 MW/cm ² | 10 MW/cm ² |
| Maximum energy density | 10 J/cm ² | 10 J/cm ² | 10 J/cm ² | 10 J/cm ² |
| PHYSICAL CHARACTERISTICS | | | | |
| Aperture diameter | 16 mm ϕ | 16 mm ϕ | 16 mm ϕ | 32 mm ϕ |
| Dimensions | 45H x 47W x 81D mm | 54H x 50W x 91D mm | 54H x 54H x 126D mm | 145H x 250W x 132D mm |
| Weight | 0.26 kg | 0.37 kg | 0.46 kg | 5.5 kg |
| Mounting thread | SM1 | SM1 | SM1 | SM2 |
| Included adaptor | SM1 external threaded tube | SM1 external threaded tube | SM1 external threaded tube | N/A |
| ORDERING INFORMATION | | | | |
| Compatible Stand | STAND-S-233 | STAND-S-233 | STAND-S-233 | 2x STAND-S-443-C-M |
| Product Page |  |  |  |  |

Specifications are subject to change without notice

UV CONVERTERS

Wavelength management




UV Converters take advantage of a phenomenon called fluorescence to extend the performance range of the Beamage beam profiling camera to ultraviolet wavelengths. A fluorescent crystal located at the entrance of the converter absorbs UV wavelengths and reemits longer wavelengths (in the visible spectrum), which are less energetic and detected by the CMOS sensor.

MAIN CHARACTERISTICS

- Transforms wavelengths contained between X-rays and 400 nm to visible and near-IR wavelengths.
- Images larger beams due to the magnification properties of the optics.
- Built with an iris at the output port for a control of the exposure on the CMOS sensor.
- Removable extension tube that is easily fixed onto the entrance port of the Beamage camera.
- Ready to use within minutes

SPECIFICATIONS

| | BSF23C11.3N | BSF23P11.3N | BSF23R11.3N | BSF23G11.3N |
|----------------------|--|-----------------------|------------------------|-----------------------|
| Input Aperture Ø | 23 mm | 23 mm | 23 mm | 23 mm |
| Overall Length (OAL) | 97 mm | 97 mm | 97 mm | 97 mm |
| Magnification | 1.4 | 1.4 | 1.4 | 1.4 |
| Crystal Type | C | P | R | G |
| Wavelength range | 110 - 225 nm | 10 - 350 nm | 110 - 532 nm | X-ray - 400 nm |
| Saturation level | | | | |
| 193 nm | 400 mJ/cm ² | 30 mJ/cm ² | 50 mJ/cm ² | 10 mJ/cm ² |
| 248 nm | N/A | 30 mJ/cm ² | 400 mJ/cm ² | 10 mJ/cm ² |
| 308 nm | N/A | 50 mJ/cm ² | 400 mJ/cm ² | 50 mJ/cm ² |
| Decay time | 3 - 5 µs | 5 µs | 4000 µs | 0.1 µs |
| Max repetition rate | 20 - 30 kHz | 20 kHz | 25 Hz | 20 kHz |
| Product page |  | | | |

A complete procedure on how to choose the appropriate UV Converter (UV Converter Application Note) is available on our website at www.gentec-eo.com.

IR ADAPTOR

Wavelength management




Typically, a CMOS silicon sensor is operating at its full potential when imaging lasers with wavelengths between 350 nm and 1150 nm. If you want to extend the performance range of your Beamage beam profiling camera to the near-IR telecom wavelengths band, you can use the IR Adaptor. This ideal solution takes advantage of a multi-photon absorption process to extend the sensitivity range of the camera sensor to a portion of the near-IR spectrum (1495 nm - 1595 nm).

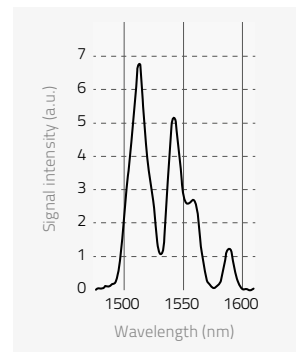
MAIN CHARACTERISTICS

- Converts wavelengths between 1495 nm and 1595 nm to shorter wavelengths between 950 nm and 1075 nm.
- Images larger beams due to the convergent properties of the optics (3.29X).
- Built with a high quality coated anti-reflection input window that allows wavelength conversion with low distortion and maximum image resolution.
- Removable and easily C-mounted onto the entrance port of the camera.
- Ready to use within minutes.

SPECIFICATIONS

| IR ADAPTOR | |
|-----------------------------|---|
| Active area | 27.5 mm ϕ |
| IR spectral range | 1495 nm - 1595 nm |
| Peak IR sensitivity | 1510 nm and 1540 nm |
| Converted wavelengths | 950 nm - 1075 nm |
| Pixel Multiplication Factor | 3.29 |
| Minimum beam size | 230 μ m |
| Maximum beam size | 19 mm |
| Maximum resolution | 12 lp/mm over active area 40 lp/mm at sensor focal plane |
| Distortion | -1.0% barrel distortion (inverted image) |
| Linearity | Non-Linear, IR converted output \sim IR input intensity ^{1,4} |
| Spectral transmission | 360 nm - 2000 nm at F30.8 |
| Damage threshold | 1 W/cm ² |
| Dimensions | 46 mm ϕ x 97 mm L |
| Operating temperature | -10°C to +40°C |
| Weight | 210 g |
| Product page |  |

EXCITATION SPECTRUM



Specifications are subject to change without notice


FILTERS

Wavelength management

UV BANDPASS FILTER

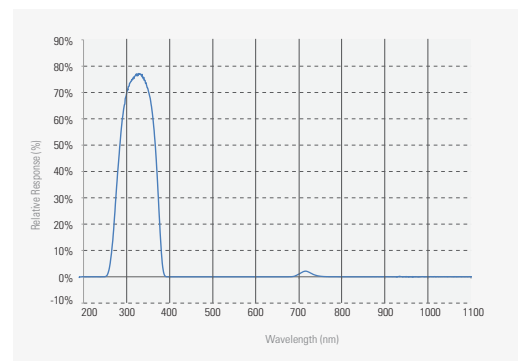
We also offer a color glass filter specially designed for the UV spectrum. Depending on the wavelength, the UG11-UV filter transmits 20 % to 70 % of the input beam power. It is particularly useful for applications with wavelengths contained between 250 nm and 370 nm. Other wavelengths are blocked by the filter.

SPECIFICATIONS

| MODEL | UG11-UV |
|-----------------------|---|
| Spectral range | 250 nm - 370 nm |
| Diameter | 25 mm \varnothing |
| Clear aperture | 80% of area |
| Dimensional tolerance | +0.0 / -0.2 mm |
| Thickness | 3 mm |
| Thickness tolerance | +0.0 / -0.2 mm |
| Parallelism | < 3 arcmin |
| Surface flatness | < $\lambda/4$ |
| Maximum power | 1 W |
| Surface quality | 40 - 20 Scratch-Dig |
| Damage threshold | 30 W/cm ² (typical) |
| Product page |  |

* Data specified at 633 nm


SPECTRAL TRANSMISSION



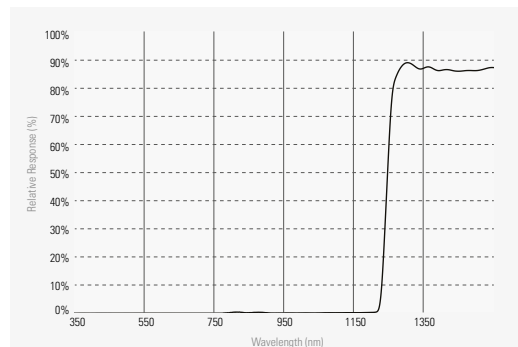
IR FILTER

The B3-IR-FILTER is a color glass filter specifically designed for IR applications. Acting as a longpass filter, the B3-IR-FILTER cuts all the wavelengths below 1250 nm and only lets the IR wavelengths pass. It transmits approximately 70 % of the incident light.

SPECIFICATIONS

| MODEL | B3-IR-FILTER |
|-----------------------|---|
| Spectral range | 1250 - 1350 nm |
| Diameter | 25 mm \varnothing |
| Clear aperture | 80% of area |
| Dimensional tolerance | +0.0/-0.2 mm |
| Thickness | 6.3 mm max |
| Parallelism | < 3 arcmin |
| Surface flatness | < $\lambda/4$ |
| Maximum power | 1 W |
| Surface quality | 80-50 Scratch-Dig |
| Damage threshold | 30 W/cm ² (Typical) |
| Product page |  |

SPECTRAL TRANSMISSION



CL
Beam size management



CAMERA LENSES

Camera lenses work by indirectly imaging on the sensor the reflection or the transmission of a beam that previously went through a diffusing material such as glass (see diagrams below).

It is necessary to use a camera lens to image beams that are larger than the CMOS sensor (11.3 mm X 11.3 mm) of the Beamage beam profiling camera. A camera lens can be directly C-mounted onto the aperture of the Beamage camera.

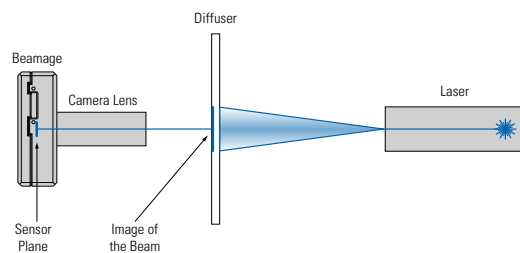


SPECIFICATIONS

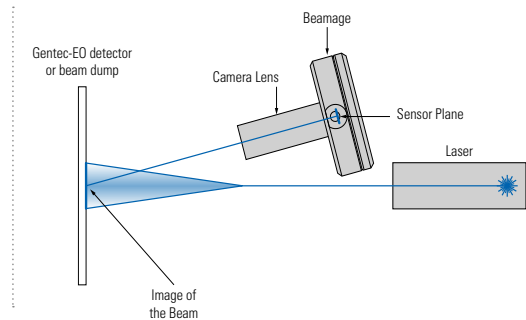
| | CL-25 | CL-50 |
|--|--|--|
| Focal length | 25 mm | 50 mm |
| Horizontal FOV | 14° | 7° |
| FOV at 1m | 245 mm | 120 mm |
| Minimum working distance | 0.5 m | 1 m |
| Maximum beam size | 2000 mm X 2000 mm (not a limiting factor) | 2000 mm X 2000 mm (not a limiting factor) |
| Maximum measurable intensity / energy | Very high because of indirect mechanism | Very high because of indirect mechanism |
| Inverted image | Yes | Yes |
| Beam distortion | Setup, lens aberration and speckles from diffusing glass | Setup, lens aberration and speckles from diffusing glass |
| Diffusing material needed | Yes | Yes |
| Magnification calibration needed | Yes | Yes |
| Possibility of wavelength conversion | Yes | Yes |
| Optical filter needed | Rarely to never | Rarely to never |
| Removable | Yes | Yes |



IMAGING A TRANSMITTED BEAM



IMAGING A REFLECTED BEAM

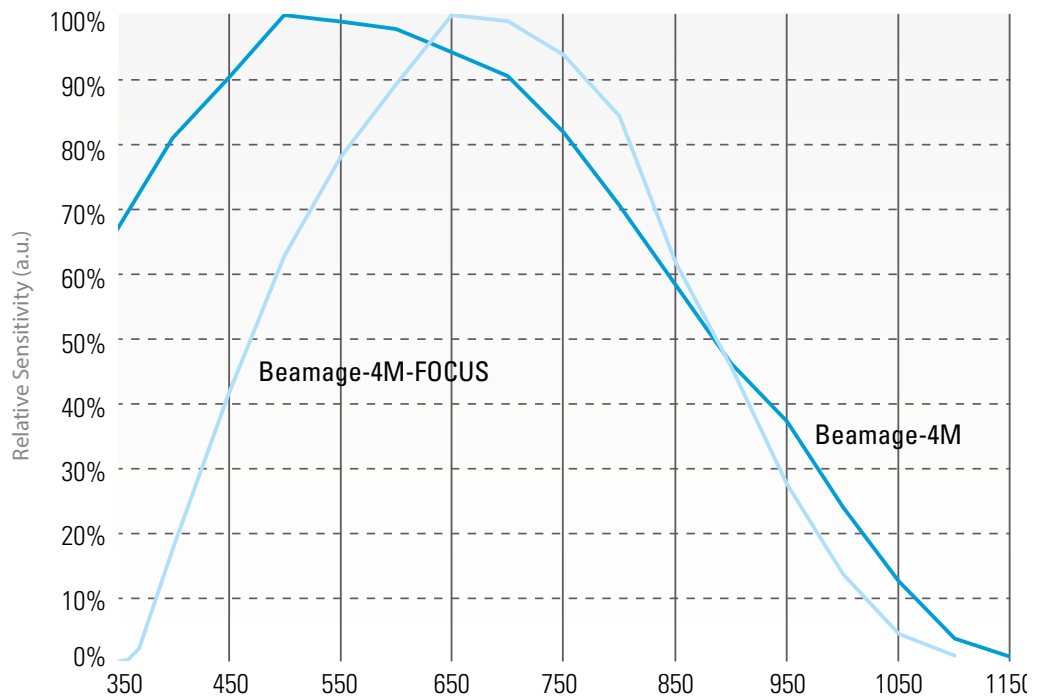


Specifications are subject to change without notice

ABSORPTION CURVES

Specifications

Beamage relative response



ABSORPTION CURVES

Specifications

Beamage operating range

