

# 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
<b>Wavelength range</b>			
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	---	---
<b>Pixel count</b>	4.2 MPixels	4.2 MPixels	4.2 MPixels
<b>H x V</b>	2048 x 2048	2048 x 2048	2048 x 2048
<b>Sensor size</b>	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



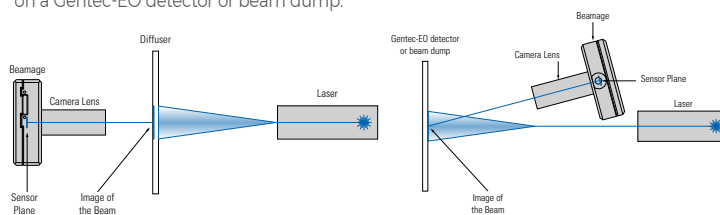
Since CMOS sensors are not sensitive to every frequency of the electromagnetic spectrum, we offer several wavelength management solutions to enhance the capabilities of the Beamage beam profiling cameras.



## 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**  
D4 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 x11.3 mm	11.3 x 11.3 mm	20.5 X 20.5 mm <sup>a</sup>
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 <sup>2</sup> 0.1 J/cm <sup>2</sup>	10 W/cm <sup>2</sup> 0.1 J/cm <sup>2</sup>	10 W/cm <sup>2</sup> 0.1 J/cm <sup>2</sup>
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 <sup>2</sup> Beam Tracking: Save Data, Print Screen, Reset View, Zoom		
Beam Diameter Definitions	D4σ (ISO compliant), 1/e <sup>2</sup> 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 <sup>2</sup>	1.28 cm <sup>2</sup>	1.28 cm <sup>2</sup>
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

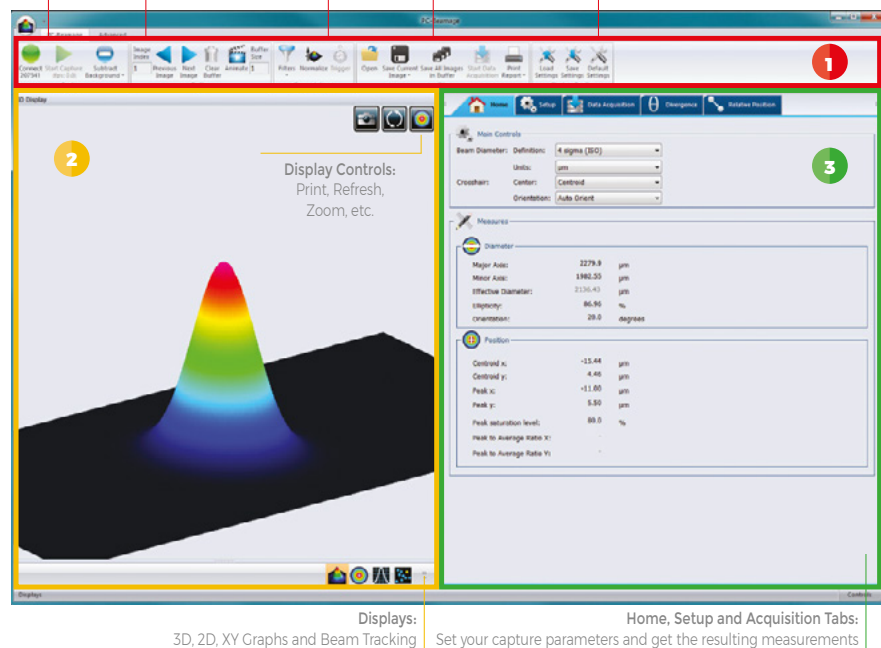
Capture Controls:  
Start/Stop,  
Subtract Background

Buffer Controls:  
View Data Offline

Data:  
Computation

File Controls:  
Save and Open Data

Startup Configuration:  
Save and Load Settings



## 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

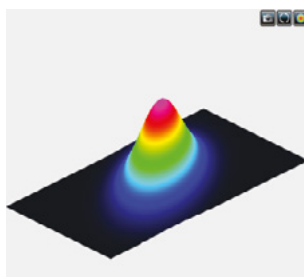
The left-hand side of the software is the display panel. Four displays are available: 3D, 2D, XY (cross-sectional graphs along the crosshairs) and Beam Tracking. The desired display is selected by clicking on the corresponding icon at the bottom of the panel. Print screen controls are available for the 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.



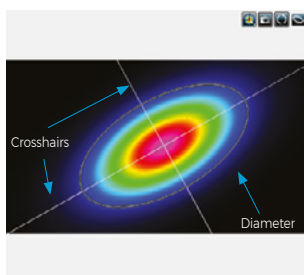
Print Screen



Reset View



Top View



## 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/e<sup>2</sup>, 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.



Select  
Active Area



Print  
Screen



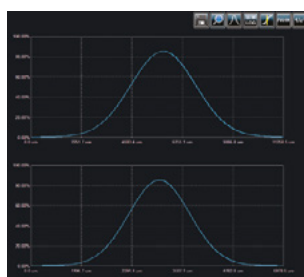
Reset View



Show/Hide  
Diameter



Toggle to  
grayscale



## 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/e<sup>2</sup> 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.



Save Data



Zoom



Gaussian Fit



Semi-Log Graph



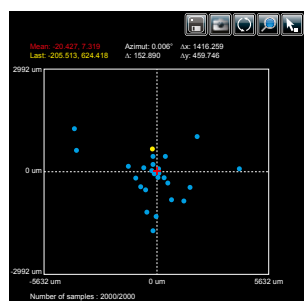
Show/Hide  
Cursor



Show/Hide  
FWHM



Show/Hide  
1/e<sup>2</sup>



## 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.



Save Data



Print Screen



Reset View



Zoom



Pick Origin Point

**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
<b>SM1 FILTERS</b>	<b>SM2 FILTERS</b>		
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

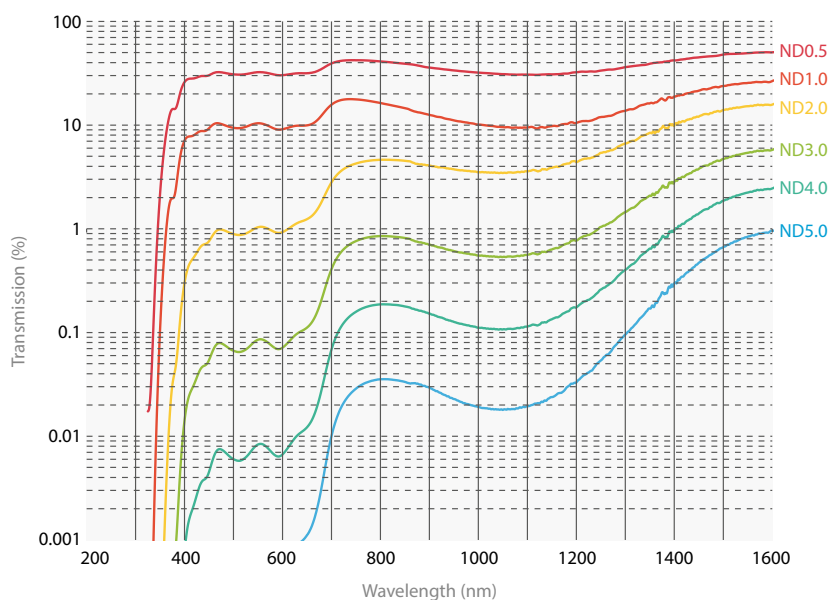
Specifications



ND0.5 TO ND5.0	
Spectral range	400 nm* - 1595 nm
Filter diameter	25 mm Ø
Clear aperture	22.5 mm Ø (90% of diameter)
Dimensional tolerance	+0.0/-0.25 mm
Optical density tolerance	± 5%
Parallelism	<10 arcsec
Transmitted wavefront error	<λ/10 at 633 nm
Surface flatness	<λ/4
Surface quality	40 - 20 Scratch-Dig
Maximum power	1 W
Damage thresholds	100 W/cm² or 3 J/cm²
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 SM1 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
<b>MAXIMUM POWER</b>	60 W	150 W	500 W	1000 W
<b>EFFECTIVE APERTURE</b>	16 mm Ø	16 mm Ø	16 mm Ø	32 mm Ø
<b>COOLING METHOD</b>	Convection	Convection	Fan	Water
<b>MEASUREMENT CAPABILITY</b>				
<b>Spectral range</b>	200 - 2100 nm	200 - 2100 nm	200 - 2100 nm	200 - 2100 nm
<b>Integrated power detector</b>	N/A	UP19K-15S-H5-D0	UP19K-110F-H5-D0	Compatible with UP55 series (not included)
<b>Fan input voltage</b>	N/A	N/A	12 VDC	N/A
<b>Equivalent attenuation</b>	1/1700 @ 1064 nm	1/1700 @ 1064 nm	1/1700 @ 1064 nm	1/1900 @ 1064 nm
<b>Optical wedges material</b>	UV fused silica (uncoated)	UV fused silica (uncoated)	UV fused silica (uncoated)	UV fused silica (uncoated)
<b>Residual beam deviation</b>	5.6°	5.6°	5.6°	3.6° @ 1064 nm
<b>Polarization correction</b>	Yes (pair of orthogonal wedges)	Yes (pair of orthogonal wedges)	Yes (pair of orthogonal wedges)	Yes (pair of orthogonal wedges)
<b>DAMAGE THRESHOLDS</b>				
<b>Maximum power</b>	60 W	150 W	500 W	1000 W
<b>Maximum average power density</b>	10 MW/cm <sup>2</sup>	10 MW/cm <sup>2</sup>	10 MW/cm <sup>2</sup>	10 MW/cm <sup>2</sup>
<b>Maximum energy density</b>	10 J/cm <sup>2</sup>	10 J/cm <sup>2</sup>	10 J/cm <sup>2</sup>	10 J/cm <sup>2</sup>
<b>PHYSICAL CHARACTERISTICS</b>				
<b>Aperture diameter</b>	16 mm Ø	16 mm Ø	16 mm Ø	32 mm Ø
<b>Dimensions</b>	45H x 47W x 81D mm	54H x 50W x 91D mm	54H x 54H x 126D mm	145H x 250W x 132D mm
<b>Weight</b>	0.26 kg	0.37 kg	0.46 kg	5.5 kg
<b>Mounting thread</b>	SM1	SM1	SM1	SM2
<b>Included adaptor</b>	SM1 external threaded tube	SM1 external threaded tube	SM1 external threaded tube	N/A
<b>ORDERING INFORMATION</b>				
<b>Compatible Stand</b>	STAND-S-233	STAND-S-233	STAND-S-233	2x STAND-S-443-C-M
<b>Product Page</b>				

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/cm²	30 mJ/cm²	50 mJ/cm²	10 mJ/cm²
248 nm	N/A	30 mJ/cm²	400 mJ/cm²	10 mJ/cm²
308 nm	N/A	50 mJ/cm²	400 mJ/cm²	50 mJ/cm²
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](http://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).

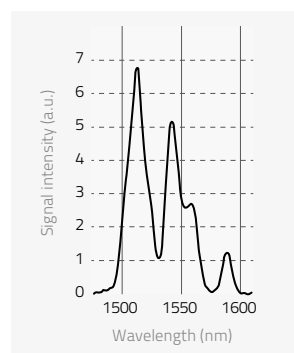
## MAIN CHARACTERISTICS

- 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 Ø
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 µm
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 ~ IR input intensity <sup>1/4</sup>
Spectral transmission	360 nm - 2000 nm at F30.8
Damage threshold	1 W/cm²
Dimensions	46 mm Ø 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

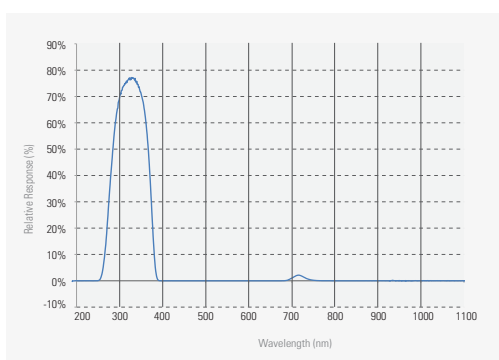
We also offer a color glass filter specially designed for the UV spectrum. Depending on the wavelength, the UG11-UV filter transmits 20 % to 70 % of the input beam power. It is particularly useful for applications with wavelengths contained between 250 nm and 370 nm. Other wavelengths are blocked by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

### SPECIFICATIONS

MODEL	UG11-UV
Spectral range	250 nm - 370 nm
Diameter	25 mm Ø
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 <sup>2</sup> (typical)
Product page	

\* Data specified at 633 nm


### SPECTRAL TRANSMISSION



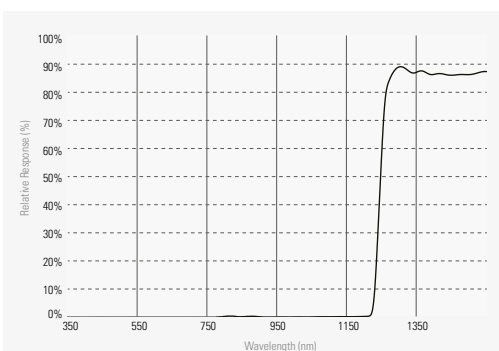
## IR FILTER

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 Ø
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 <sup>2</sup> (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.

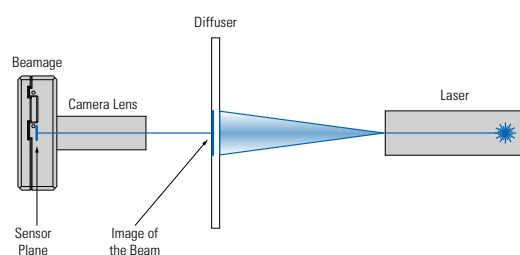


### SPECIFICATIONS

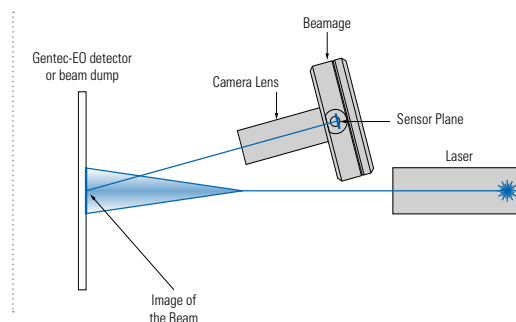
	CL-25	CL-50
Focal length	25 mm	50 mm
Horizontal FOV	14°	7°
FOV at 1m	245 mm	120 mm
Minimum working distance	0.5 m	1 m
Maximum beam size	2000 mm X 2000 mm (not a limiting factor)	2000 mm X 2000 mm (not a limiting factor)
Maximum measurable intensity / energy	Very high because of indirect mechanism	Very 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

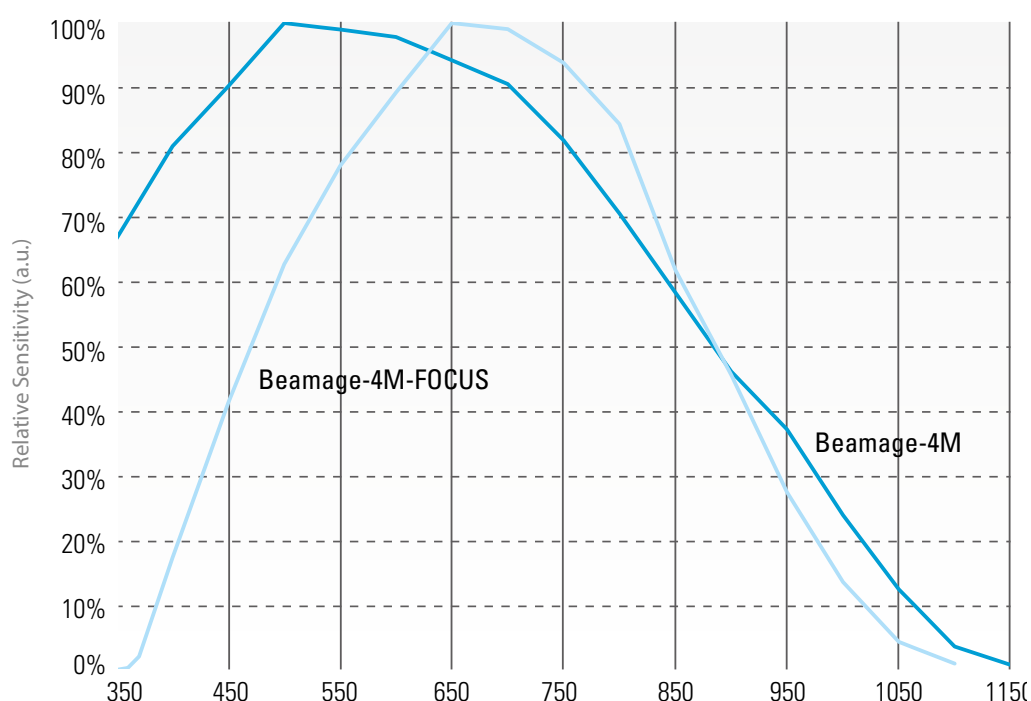


Specifications are subject to change without notice

# ABSORPTION CURVES

Specifications

## Beamage relative response



# ABSORPTION CURVES

Specifications

## Beamage operating range

