USER MANUAL

Accessories for Beam Diagnostics and Attenuators

gentec-eo
PARTNERS for ACCURACY

121-103866

WARRANTY

All Gentec-EO products carry a one-year warranty from the date of shipment on material or workmanship defects when used under normal operating conditions.

Gentec-EO will repair or replace, at its sole discretion, any product that proves to be defective during the warranty period.

The warranty does not cover damages caused by product misuse, product modifications, accidents, abnormal operating or handling conditions, or third-party battery leakage. Any attempt by an unauthorized person to alter or repair the product voids the warranty. Gentec-EO is not liable for consequential damages of any kind.

CLAIMS

For warranty service, please contact your Gentec-EO representative or fill out an RMA here: Support & RMA request - Gentec-EO.

To help us answer your request more efficiently, please have your product serial number ready before contacting customer support.

Upon receipt of return authorization, ship the product according to the RMA instructions. Do not ship items without a return authorization. Transport is at the customer's expense, in both directions, unless the product has been received damaged or non-functional. Gentec-EO assumes no responsibility for the damage caused in transit.

SAFETY INFORMATION

Do not use a Gentec-EO device if the monitor or the detector looks damaged or if you suspect that the device is not operating properly.

Appropriate installation must be done for water-cooled and fan-cooled detectors. Refer to the specific instructions for more information. Wait a few minutes before handling the detectors after they are powered up. The surfaces of the detectors get very hot, and there is a risk of injury if they have not cooled.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy. If not installed and used in accordance with the instructions, it may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, try to correct the interference by taking one or more of the following steps:

- Reorient or relocate the receiving antenna.
- Increase the distance between the equipment and receiver.
- Connect the equipment to an outlet that is on a different circuit than the receiver.
- Consult the dealer or an experienced radio/TV technician for help.

Caution: Changes or modifications not expressly approved in writing by Gentec-EO Inc. may void the user's authority to operate this equipment.

TABLE OF CONTENTS

1. INTRODUCTION

1.1. HOW TO SAFELY MANIPULATE THE BEAMAGE WHEN USING ACCESSORIES

Profiling a laser beam is a nice and convenient complement to measuring its power or energy because it provides additional useful information that may help you determine if your lasers are operating optimally.

For the most extended and complete use of your BEAMAGE beam profiling camera, optical components that provide attenuation, beam splitting, beam sampling, spectral sensitivity extension and large beam imaging may be required as practical accessories.

In most cases, these optical components are very easy to use and to manipulate. However, as a precaution, it is important to follow a few rules when fixing an accessory onto the camera's aperture or when removing one from it. Doing so will prevent any damage that could be done to the CMOS sensor of the BEAMAGE.

Once they are stuck on the CMOS sensor, dust particles and other contaminants cannot be removed without serious risk of damaging it. Therefore, one must preferably:

Warning

Install or remove accessories in a clean room or very clean environment.

Position the front cover of the camera downwards when installing or removing accessories.

2. POWER MANAGEMENT

2.1. ND FILTERS (< 1 W ATTENUATION)

Gentec-EO offers various SM1-threaded absorptive neutral density (ND) filters that can be stacked directly on the aperture of the BEAMAGE camera via an SM1 to C-mount adaptor included with the BEAMAGE. Subsequent filters can be stacked directly on each other. These filters have the ability to equally reduce the intensity of all wavelengths without affecting the wavefront of the beam or distorting the image.

An empty SM1-threaded filter holder is available for those who would like to use their own ND filters with their camera. It holds 25-mm and 1-inch-wide filters.

Sets of three or six filters are also available.

Optical density varies with the wavelength. To see the complete transmission spectrum, please refer to Figure 1.

For the BEAMAGE-4M-FOCUS, Gentec-EO also offers six ND filters with a diameter of 50 mm, mounted in an SM2-threaded holder and with a T-mount adaptor.

	SM1-threaded	SM2-threaded
Specified OD spectral range	400 nm – 650 nm	
Spectral range	350 nm – 1600 nm	
Filter diameter	25 mm Ø	50 mm Ø
Clear aperture	22.5 mm Ø (90% of the diameter)	45.7 mm Ø
Dimensional tolerance	+ 0.0/- 0.25 mm	
Optical density tolerance	± 5%	
Parallelism	< 10 arcsec	
Transmitted wavefront error	< λ/10 at 633 nm	N/A
Surface flatness	< λ/4	< λ
Surface quality	40-20 scratch-dig	
Maximum power	1 W	
Damage thresholds	100 W/cm^2 or 3 J/cm^2	

Data specified at 633 nm

Warning

When using multiple ND filters, it is necessary for the light to pass through the less attenuating filter first. For example, if you wish to have a 1/10^7 (ND 7.0) attenuation ratio, you need to put the ND3.0 in the front and then the ND4.0 filter between the ND3.0 filter and the BEAMAGE camera.

Model	P/N	Description	Optical density at 633 nm	Equivalent attenuation	Transmittance at 633 nm	Substrate	Substrate thickness
ND0.5 ND0.5-FOCUS	201094 203403	ND filter	0.5	(1/3.16)	~32%	NG4	~0.91 mm
ND1.0 ND1.0-FOCUS	201045 203404	ND filter	1.0	(1/10)	~10%	NG4	~1.89 mm
ND2.0 ND2.0-FOCUS	201046 203405	ND filter	2.0	(1/100)	~1%	NG9	~1.40 mm
ND3.0 ND3.0-FOCUS	201047 203406	ND filter	3.0	(1/1000)	~0.1%	NG9	~2.11 mm
ND4.0 ND4.0-FOCUS	202600 203407	ND filter	4.0	(1/10 000)	~0.01%	NG9	~2.83 mm
ND5.0 ND5.0-FOCUS	202601 203408	ND filter	5.0	(1/100 000)	~0.001%	NG9	~3.55 mm
NDSET-6	202605	Set of all six filters	See above	-	See above	See above	See above
NDSET-3	202606	Set of three filters (ND1, ND2, ND3)	See above	-	See above	See above	See above
ND-H	Call	ND filter holder	-	-	-	-	-

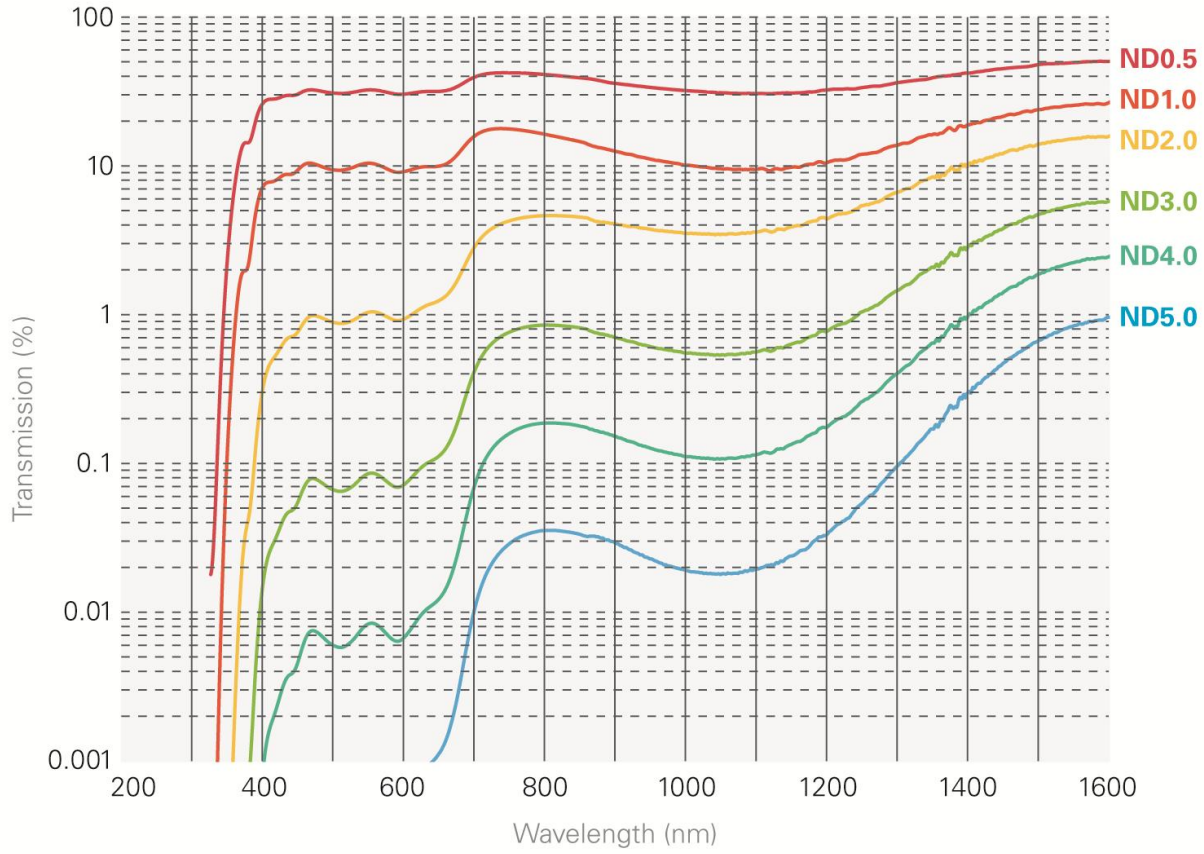

Figure 1. Transmission curve of all ND filters

3. WAVELENGTH MANAGEMENT

3.1. IR FILTER

Gentec-EO offers a color glass filter specially designed for IR wavelengths. The IR filter transmits 85% of the incident light over the specified spectral range. It is useful for applications with wavelengths ranging between 1250 nm and 1600 nm. Other wavelengths are stopped by the filter. The IR filter is SM1-threaded.

	B3-IR-FILTER
Spectral range with IR filter: - BEAMAGE-4M and BEAMAGE-3.0 - BEAMAGE-4M-IR and BEAMAGE-3.0-IR	 1250 nm – 1320 nm 1250 nm – 1595 nm
Diameter	25 mm Ø
Clear aperture	80% of the area
Dimensional tolerance	+ 0.0/- 0.2 mm
Thickness	6.3 mm max
Parallelism	< 3 arcmin
Surface flatness	< λ/4
Maximum power	1 W
Surface quality	80-50 scratch-dig
Damage threshold	30 W/cm^2 (typical)
Part number	202855

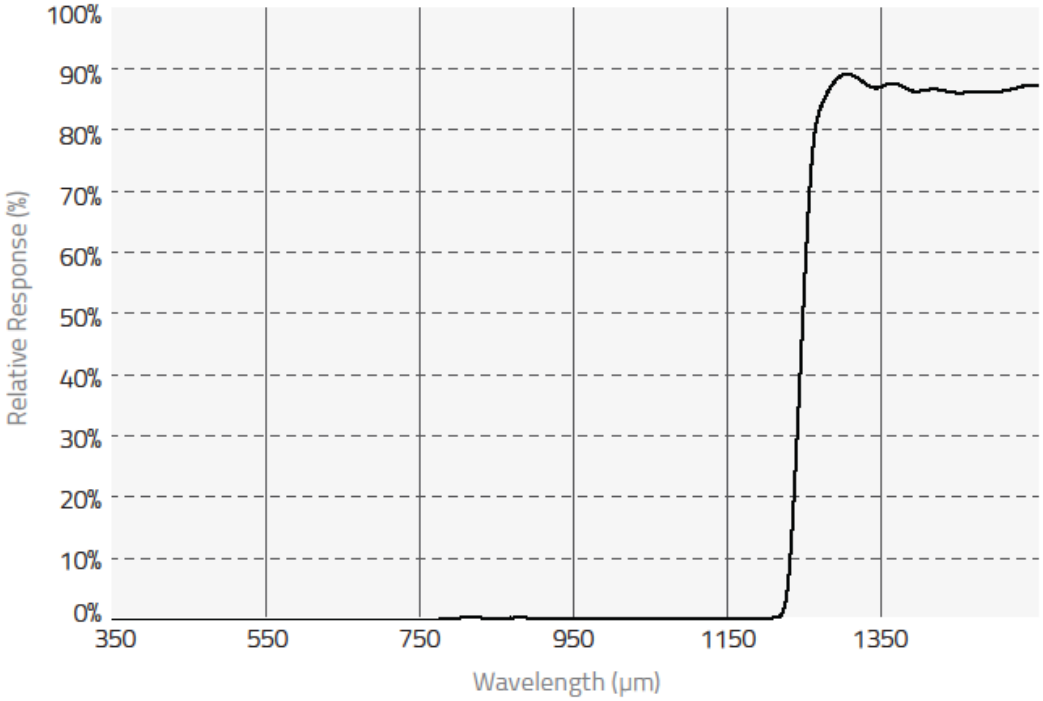

Figure 2. Transmission curve of IR filter

3.2. IR ADAPTOR

The IR Adaptor takes advantage of a multi-photon absorption process to extend the sensitivity of the BEAMAGE beam profiling camera to a portion of the near-IR spectrum.

The module converts wavelengths ranging between 1495 nm and 1595 nm (telecom wavelength band) to shorter wavelengths ranging between 950 nm and 1075 nm.

After going through an anti-reflection coated input window, the laser beam gets instantaneously converted with high resolution, low distortion and good uniformity.

The IR adaptor can be C-mounted onto the entrance port of the BEAMAGE camera.

Important

It is mandatory to factory adjust the IR adaptor to its twin camera.

Figure 3. IR adaptor

	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 ^1.41
Spectral transmission	360 nm – 2000 nm at F30.8
Damage threshold	1 W/cm^2
Dimensions	46 mm Ø x 97 mm L
Operating temperature	-10°C to +40°C
Weight	210 g
Part number	201061

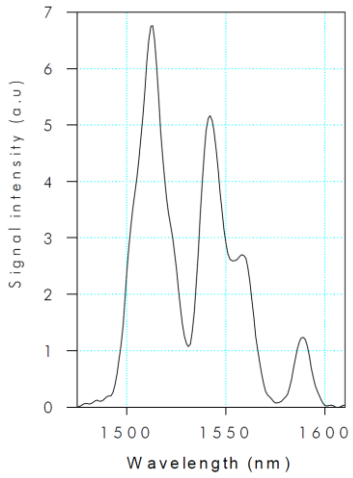

Figure 4. BEAMAGE-IR and IR adaptor excitation spectrum

Important steps to follow when using the IR adaptor

- Remove the ND4.0 filter from the camera before using the IR adaptor.
- Input 3.29 as the pixel multiplication factor.

Warning

When using the IR adaptor, you must enter its pixel multiplication factor in the PC-BEAMAGE software under the **Setup** tab.

- Screw the ND filter in front of the IR adaptor. Depending on the laser source power, screw the appropriate ND filter in front of the IR adaptor.
- Select an active area and make a background subtraction.

  Since this optical component is suitable for ½'' sensor format only (does not work for ⅔'' sensor format), a portion of the sensor will not be available when using it. Therefore, it is necessary to make a background subtraction after selecting an active area via the PC-BEAMAGE software.

- Apply the despeckle filter.

  The phosphor coated glass used inside the IR adaptor produces speckles that may alter the intensity profile of the beam and thus affect the accuracy of the measurements.

  Therefore, it is important to use the despeckle filter when viewing a beam with the IR adaptor because it will remove speckles and noise related to transmission of light through the phosphor coating.

  The despeckle filter is a new and aggressive spatial filter that performs a 9 x 9 pixel simple averaging around each pixel, with all of the pixels having the same relative weight (1/81).

NOTE: using the despeckle filter can slightly reduce the resolution.

Warning

Please note that the minimum measurable beam diameter at a 50% clip level is approximately 230 µm. Any smaller beam will be significantly broadened by the point spread function of the phosphor.

3.3. UG11-UV – UV BANDPASS FILTER

Gentec-EO also offers a color glass filter specially designed for UV wavelengths. The UG11-UV filter transmits 20% to 77% of the incident light, depending on the wavelength. It is particularly useful for applications with wavelengths ranging between 250 nm and 370 nm. Other wavelengths are stopped by the filter. The UG11-UV is SM1 threaded.

	UG11-UV
Spectral range with UV filter: - BEAMAGE-4M and BEAMAGE-3.0	250 nm – 370 nm
Diameter	25 mm Ø
Clear aperture	80% of area
Dimensional tolerance	+0.0/-0.38 mm
Thickness	3 mm
Thickness tolerance	+0.0/-0.2 mm
Parallelism	< 3 arcmin
Maximum power	1 W
Surface quality	80 - 50
Damage threshold	30 W/cm^2 (typical)
Part number	202602

Warning

It is important to remove the ND 4.0 filter that comes with the BEAMAGE before using the UG11-UV bandpass filter.

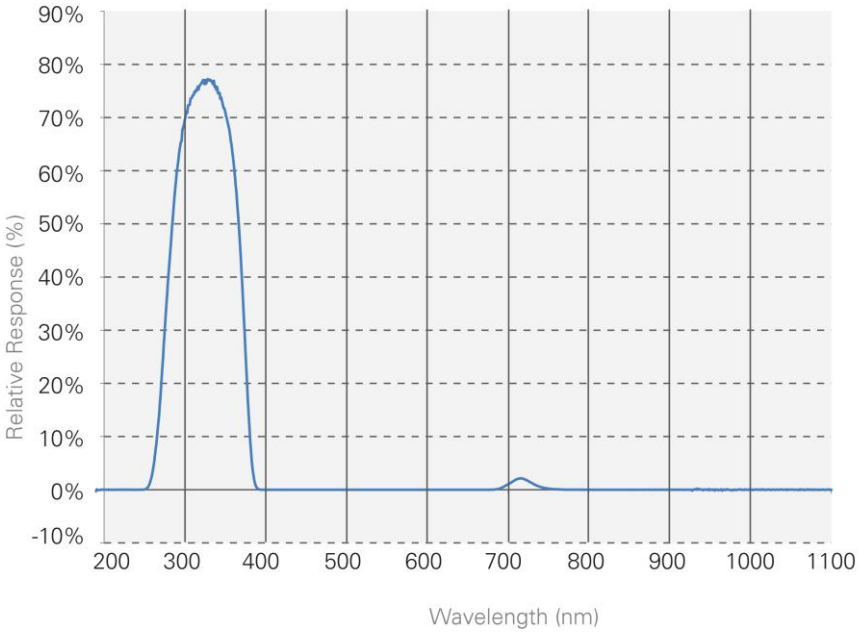

Figure 5. Transmission curve of UG11-UV bandpass filter

3.4. UV CONVERTERS

UV converters take advantage of a phenomenon called fluorescence to extend the wavelength range of the BEAMAGE to the UV wavelengths. The fluorescent crystal is located at the entrance of the converter. It absorbs UV wavelengths and reemits longer wavelengths (visible spectrum), which are less energetic. The rest of the device is mainly composed of optics. An iris aperture at the end controls the exposure on the sensing device.

The light emitted from the fluorescent crystal is non-coherent and non-collimated. The multiple lenses inside the converter compensating for this affect the beam size. Therefore, it is important to know that UV converters have magnification properties.

Like an IR adaptor, a UV converter is an extension tube that is simply fixed onto the aperture of the camera.

Important

It is mandatory to factory-adjust the UV converter to its twin camera.

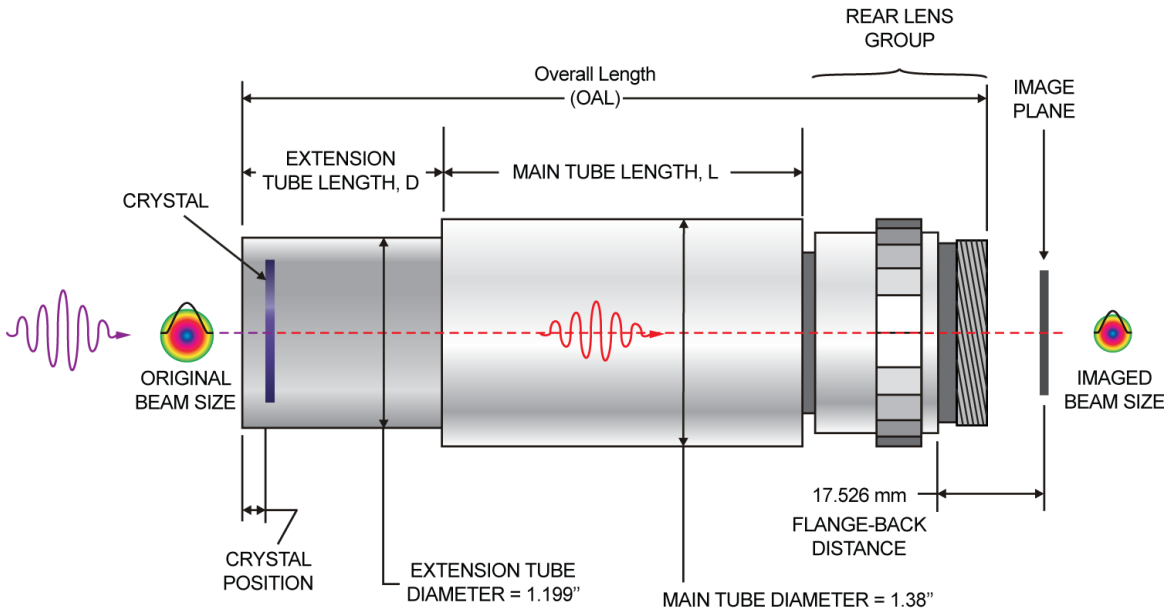

Figure 6. UV converter diagram

		BSF23C23N	BSF23G23N	BSF23P23N	BSF23R23N
Input aperture		23 mm Ø			
Closest standard optical camera format		2/3"			
Main tube length (L)		76.3 mm			
Extension tube length (D)		30 mm			
Overall length (OAL)		108 mm			
Max input beam size		13.8 mm x 18.4 mm			
Max beam size on CMOS		5.3 mm x 7.1 mm			
Magnification (±10%)		2.6			
Crystal type		C	G	P	R
Wavelength range [nm]		110 - 225	X-ray - 400	110 - 350	110 - 535
Relative response	193 nm	22	480	48	100
	248 nm	0.17	480	15	8
	308 nm	0.03	112	1	0.18
Saturation level	193 nm	400 mJ/cm^2	10 mJ/cm^2	30 mJ/cm^2	50 mJ/cm^2
	248 nm	N/A	10 mJ/cm^2	30 mJ/cm^2	400 mJ/cm^2
	308 nm	N/A	50 mJ/cm^2	50 mJ/cm^2	400 mJ/cm^2
Damage threshold		500 mJ/cm^2	250 mJ/cm^2	500 mJ/cm^2	500 mJ/cm^2
Max average power		2 W/cm^2			
Decay time		3 – 5 µs	0.5 µs	5 µs	3000 µs
Max repetition rate		30 - 20 kHz	200 kHz	20 kHz	30 Hz
Part number		202325	202327	202329	202331

Important steps to follow when using a UV converter

- Remove the ND4.0 filter from the camera before using a UV converter.
- Choose the appropriate UV converter. Gentec-EO offers a complete array of UV converters. For more details and information on how to choose the appropriate UV converter, please contact your local Gentec-EO representative.
- Determine and enter the pixel magnification factor.

Warning

When using a UV converter, you must enter its pixel multiplication factor in the PC-BEAMAGE software.

- Enter the value in the software in the **Pixel Multiplication Factor** section in the **Setup** tab. The on-screen dimensions will now be correct.

4. BEAM SIZE MANAGEMENT

4.1. CL-25 AND CL-50 – CAMERA LENSES

A camera lens works by indirectly imaging on the sensor the reflection or the transmission of a beam (see Figures 7 and 8) that previously went through a diffusing material such as glass.

It is necessary to use a camera lens to image beams that are larger than the CMOS sensor (11.3 mm x 6.0 mm) of the BEAMAGE beam profiling camera.

Warning

Please note that the image is inverted on the sensor since the mechanism of this optical device involves convergent lenses.

A camera lens can be directly C-mounted onto the aperture of the BEAMAGE camera as they are both C-mount.

	CL-25	CL-50
Focal length	25 mm	50 mm
Maximum beam size	2000 mm x 2000 mm (not a limiting factor)	
Maximum measurable intensity/energy	Very high because of indirect mechanism	
Inverted image	Yes	
Beam distortion	Setup, lens aberration and speckles from diffusing glass	
Diffusing material needed	Yes	
Magnification calibration needed	Yes	
Possibility of wavelength conversion	Yes	
Optical filter needed	Rarely to never	
Removable	Yes	

Important steps to follow when using a camera lens

1) Select the appropriate camera lens

Camera lenses are offered with two different focal lengths, 25 mm and 50 mm. To determine which lens fits your requirements, refer to the table below.

Model	Focal length	Horizontal FOV	FOV at 1 m	Minimum working distance
CL-25	25 mm	14°	245 mm	0.5 m
CL-50	50 mm	7°	120 mm	1 m

To calculate the linear field of view (FOV) at distances other than 1 m, simply multiply the value found in the table by the distance in meters.

NOTE: Remove the ND4.0 filter from the camera before using a camera lens.

2) Install the optical setup

You can set up the BEAMAGE with a camera lens in transmission or reflection mode (see Figures 7 and 8).

NOTE: We recommend installing the BEAMAGE on a graduated translation stage perpendicular to the diffuser. This will simplify Step 4) *Determine and input the pixel multiplication factor*.

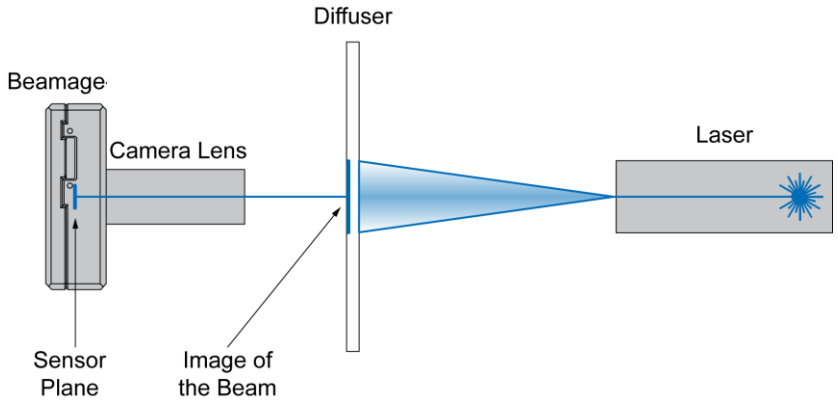

Figure 7. Imaging a transmitted beam

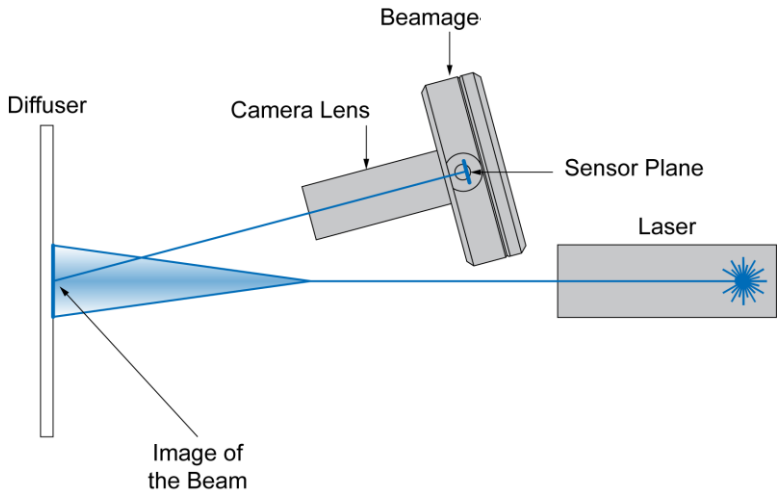

Figure 8: Imaging a reflected beam

Warning

Please note that if the setup is in reflection mode, the viewing angle must be as small as possible to minimize distortion.

When possible, it is preferable to keep the sensor plane and diffusor parallel.

3) Adjust the focus

To have a clear and sharp image, adjust the focus and iris of the camera lens. To do so, place a paper with small text or a business card on the diffusor surface and look at the resulting image in the PC-BEAMAGE software. Adjust the focus until you have a sharp image of the text. You can then lock the focus in place with the small screw on the focus handle and remove the paper.

4) Determine and input the pixel magnification factor

Prior to profiling a beam with a camera lens, one must determine the pixel magnification factor of the lens and enter its value in the PC-BEAMAGE software in order to have the exact beam dimensions. The **Pixel Multiplication Factor** section can be found at the bottom of the **Setup** tab.

It is possible to manually set a value for the pixel multiplication factor. Simply write the desired value in the white box and press enter. The beam dimensions will be adjusted accordingly.

Otherwise, it is possible to follow the camera lens calibration steps in the camera lens panel. This panel can be opened by clicking the **Calibrate** button in the **Pixel Multiplication Factor** section or by selecting it in the **Show/Hide Options** button in the ribbon.

i. Turn on your laser beam. Alternately, a low-power pilot laser can be used for this part of the setup.
ii. Once you are ready to start, click on the **Set Now** button to set the centroid to the current position.
iii. Then, move the BEAMAGE (or the laser source) by a known distance parallel to the diffusion surface.

Warning

Precision is crucial for this step.

The BEAMAGE must be translated parallel to the diffusor, without rotation.

The translation distance can be measured with a ruler, but a linear stage with a micrometer is recommended.

iv. Input this distance (in mm) in the appropriate box.
v. Finally, click on the **Calibrate** button to automatically set the pixel multiplication factor value in the bottom of the **Setup** tab.

Once the pixel multiplication factor is set, the beam dimensions will be adjusted to compensate for the magnification of the camera lens.

For more information about the automatic calibration of the pixel multiplication factor, please refer to section 5.2.8 of the BEAMAGE user manual.

5) Flip the image horizontally.

In the PC-BEAMAGE software select the **Flip Horizontally** option in the **Setup** tab to compensate the camera lens' inversion. Please refer to section 5.2.2 of the BEAMAGE user manual.

6) Subtract background.

Because the camera lens will image the laser, but also the entire scene, it is important to perform a background subtraction to only view the laser.

7) Apply the despeckle filter

Any static diffusing material such as glass will show speckles, typically producing intensity variation of ± 20% and thus significantly affecting the accuracy of measurements. Apply the despeckle filter to remove any unwanted intensity variations and to get the most accurate measurements. It is important to use the despeckle filter when imaging a beam with a camera lens because it will remove speckles and noisy signal related to irregularities of the diffusing material and distortions of the reflection-transmission optical process.

NOTE: Using the despeckle filter can slightly reduce the resolution.

APPENDIX A: WEEE DIRECTIVE

Refer to the UP user manual if necessary (available at 200258-Manual-UP-Rev-6.8.pdf) for the power detector declaration of conformity.

WEEE compliance

These products comply with the European Directive 2012/19/EU – WEEE

Recycling and separation procedure for WEEE directive 2012/19/EU

This section is used by the recycling center when the product reaches its end of life.

The complete accessory package can contain:

- one accessory
- one box
- packaging material

Separation

Paper: box (if applicable)

Plastics: box and packaging material (if applicable)

Glass: optical component (if applicable)

Aluminum: accessory housing (if applicable)

gentec-eo
PARTNERS for ACCURACY

WWW.GENTEC-EO.COM

LEADER IN LASER BEAM MEASUREMENT **SINCE 1972**

POWER & ENERGY METERS

BEAM PROFILING

THZ MEASUREMENT

CANADA

445 St-Jean-Baptiste, Suite 160
Quebec, QC, G2E 5N7
CANADA

T (418) 651-8003
F (418) 651-1174

info@gentec-eo.com

UNITED STATES

5825 Jean Road Center
Lake Oswego, OR, 97035
USA

T (503) 697-1870
F (503) 697-0633

info@gentec-eo.com

JAPAN

Office No. 101, EXL111 building,
Takinogawa, Kita-ku, Tokyo
114-0023, JAPAN

T +81-3-5972-1290
F +81-3-5972-1291

info@gentec-eo.com

CALIBRATION CENTERS

- 445 St-Jean-Baptiste, Suite 160
  Quebec, QC, G2E 5N7, CANADA
- Werner von Siemens Str. 15
  82140 Olching, GERMANY
- Office No. 101, EXL111 building,
  Takinogawa, Kita-ku, Tokyo
  114-0023, JAPAN