USER MANUAL

BA Series - Optical Attenuators

gentec-eo
PARTNERS for ACCURACY

121-106018

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 request:

https://www.gentec-eo.com/contact-us/support-rma-request

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.

SYMBOLS

The following international symbols are used in this manual:

Refer to the manual for specific warning or caution information to avoid any damage to the product.

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1. INTRODUCTION

The Gentec-EO BA series optical attenuator includes two optical attenuators: one model with a 16-mm aperture for lower power and a 1-kW model with a 32-mm aperture. The optical attenuator BA series is expressly designed to be used simultaneously with a BEAMAGE beam profiler. For further information about the BEAMAGE profiler, refer to the corresponding manual on gentec-eo.com/resources/download-center.

BA16-60S
with included cover plate

BA16-60S
with UP19K-15S-H5-D0

BA16-60S
with UP19K-110F-H9-D0

BA32-1KW

Model	Maximum power	When used with
BA16-60S	60 W	Included cover plate
	150 W	UP19K-15S-H5-D0
	500 W	UP19K-110F-H9-D0 UP19K-200W-H9-D0
BA32-1KW	1000 W	UP55N-40S-H9-D0

Can also be combined with an INTEGRA for USB capability or BLU for Bluetooth capability. Contact Gentec-EO or your local representative for more information.

2. WARNINGS AND DISCLAIMER

In no event shall Gentec-EO or any of its affiliates be liable for any indirect, special, incidental or consequential injury to persons or for any damage to property caused by the use of any of our products. By purchasing from Gentec-EO or any of its affiliates, you hereby indicate that you understand and agree to the following disclaimer.

I am fully responsible for the safe application and use of this product and agree to such by completing the sales process.

I will not use a laser device without wearing approved laser safety goggles designed for such a purpose.

I am aware and responsible of safely dealing with any back reflections.

I will not use the product in violation of any local, state or federal law and I understand that it is my responsibility to know and abide by those laws relating to the ownership and use of the product in my jurisdiction.

Attenuator temperature while in operation

During usage, the attenuator (especially the beam dump) can become hot enough to cause burns.

Warning

Be careful not to exceed the maximum levels and densities stated in the specifications.

3. BA16 OPTICAL ATTENUATOR SERIES

3.1. INCLUDED WITH YOUR BA16

The following items are included with your BA16 optical attenuator.

Description
BA16 optical attenuator
Protective covers for optical apertures
Tube coupler for BEAMAGE camera

The following items can be purchased separately.

Description	Part name	Part number
Stand	See website	See website
BEAMAGE-4M laser beam profiler	BEAMAGE-4M	202880
UP19K laser power detector	Various	Various

3.2. POWER DETECTOR

BA series beam attenuators can be combined with a UP power detector. For further information about the UP-power detector itself, refer to the UP manual (available at gentec-eo.com/resources/download-center).

The screws for the included cover plate or power detector will require a 2-mm hex key.

3.3. SPECIFICATIONS

The following specifications are based on an operating temperature of 15 ºC to 28 ºC (59 ºF to 82 ºF) and a relative humidity not exceeding 80%. Attenuators must be stored in an environment between 10 ºC to 65 ºC and a relative humidity not exceeding 90%.

Gentec-EO	BA16-60S		
	Measurement capability		
Spectral range	200 nm – 2100 nm		
Spectral range with BEAMAGE camera	350 nm – 1150 nm		
Sampled percentage[1]	0.0588% (1/1700) at 1.064 µm		
Integrated power meter	None		
Maximum power	60 W when used with included cover plate	150 W when used with UP19K-15S-H5-D0	500 W when used with UP19K-110F-H9-D0 or UP19K-200W-H9-D0
Aperture diameter	16 mm		
Maximum beam diameter	16 mm		
Optical wedges material	UV fused silica (uncoated)		
Sampled beam lateral shift	21 mm		
Sampled beam deviation	90°		
Residual beam deviation	5.6°		
CW laser damage thresholds on the optical wedge 1.064 µm, CW	Average power density 10 MW/cm^2		
Pulsed laser damage thresholds on the optical wedge 1.064 µm, 7 ns, 10 Hz	Maximum energy density 10 J/cm^2		
Maximum average power density on the included cover plate 1.064 µm, 10 W CW 10.6 µm, 10 W CW	 45 kW/cm^2 14 kW/cm^2		
	Physical characteristics		
Dimensions H x W x D	81 x 47 x 45 mm		
Weight	0.26 kg		
Mounting	¼ - 20 (imperial) threaded holes 30-mm cage system		
Input and output aperture threading	SM1		
Product number	203791		

Specifications are subject to change without notice

[1] Considering 0° AOI referred to the input aperture.

The attenuation between the input aperture and the sampled beam is polarization insensitive, but it varies with the wavelength. The graph below presents the attenuation factor as a function of the wavelength considering an angle of incidence of 0° with the input aperture.

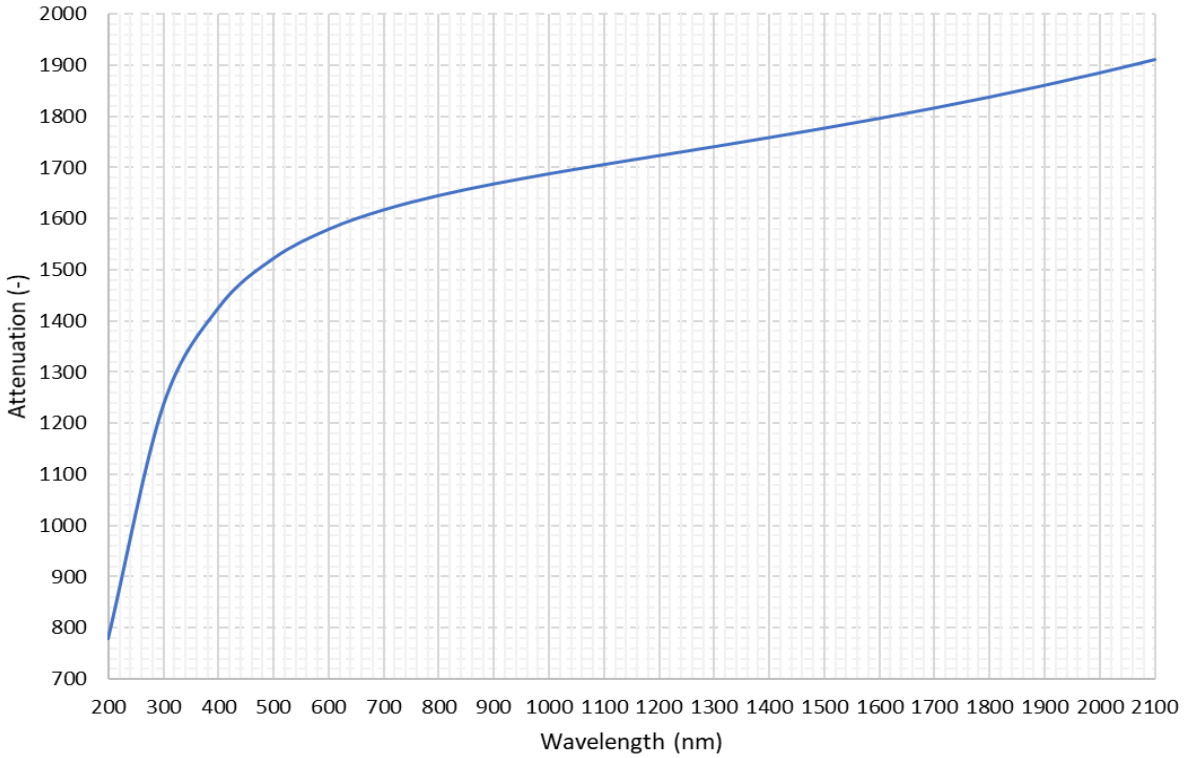
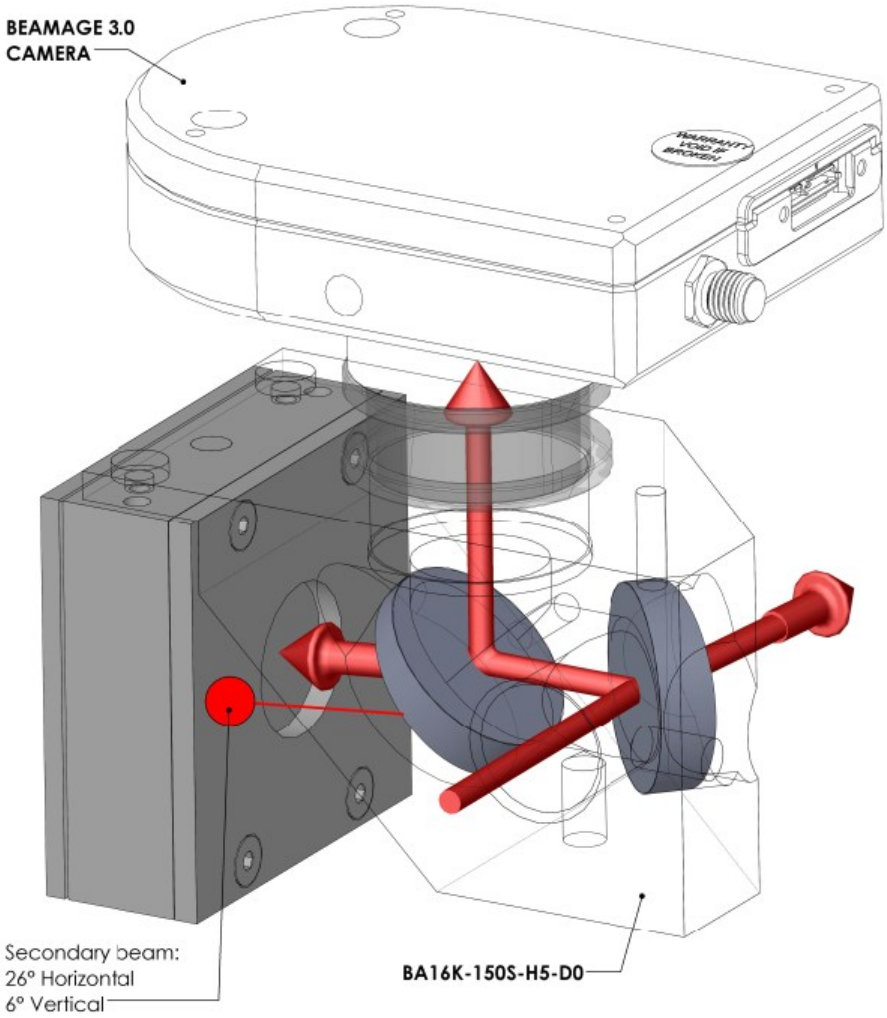
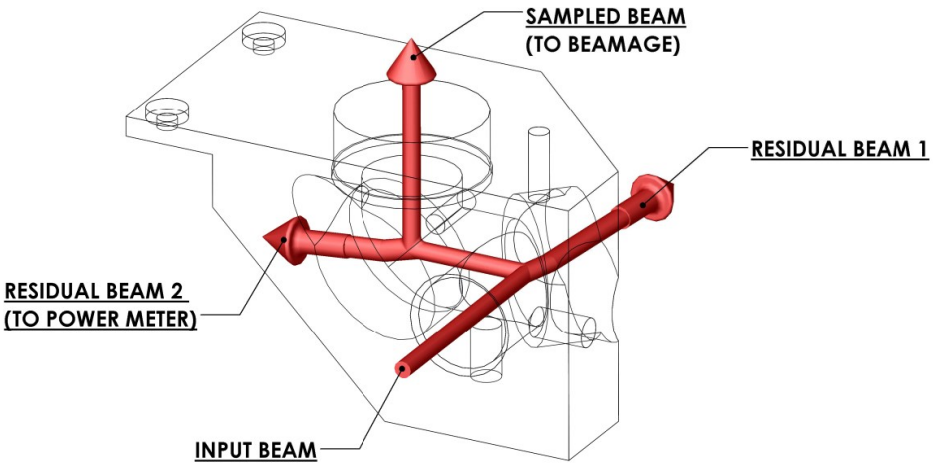
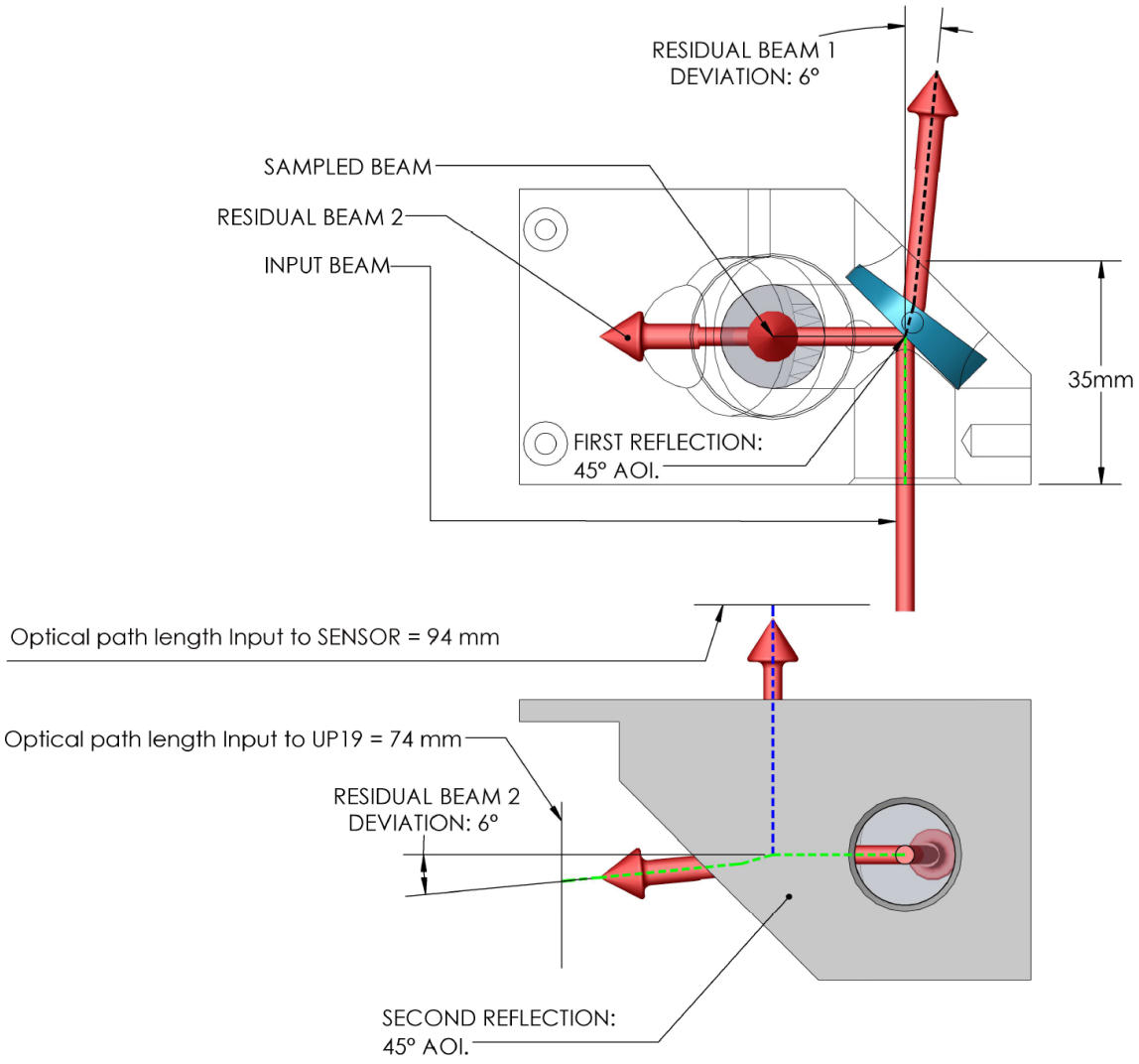


Figure 1. Spectral attenuation factor

3.4. BEAM PATH DETAILS







Typical power values at 1070 nm (% of incident beam)	
Residual beam 1	92%
Between the two wedges	2 x 4% = 8%
Residual beam 2	2 x 3.7% = 7.4%
Sampled beam	0.1%

Typical optical path length	
Input to residual beam 1 (A)	35 mm
Input to residual beam 2 (B)	56 mm
Input to UP19K (C)	74 mm
Input to sampled beam (D) (without accessory)	69 mm
Input to BEAMAGE's sensor (E)	94 mm

3.5. OPERATING INSTRUCTIONS

Storage

In order to ensure a long lifetime of accurate measurements, it is recommended that attenuators be held within the following ambient conditions:

Storage environment temperature: 10 °C to 60 °C, RH < 90%
Operating environment temperature: 15 °C to 28 °C, RH < 80%

It is possible to store and operate your optical attenuator beyond this range. For any specific requirements, please contact your local Gentec-EO representative.

General operation with BEAMAGE beam profiling camera

1. Remove the protective covers from the attenuator and power detector, if used.
2. Using the supplied coupler, install the BEAMAGE camera on the attenuator's sampled beam aperture. Use the locking rings to secure the BEAMAGE on the coupler and the coupler to the attenuator.
3. Download and install the software PC-BEAMAGE (available at gentec-eo.com).
4. Connect the BEAMAGE to the computer. For further information about PC-BEAMAGE, refer to the corresponding manual on gentec-eo.com/resources/download-center.
5. Align the attenuator in the optical setup using a safe "low-power" laser by centering the beam into the power detector and in the BEAMAGE. In order to ensure an optimum, polarization-independent attenuation, the laser beam should ideally be perfectly aligned and centered within the attenuator input aperture and in the BEAMAGE.

 Warning

Never touch the optics directly or the absorbing surface of the beam dump/power detector.

In the case of a joint use of a BA16 and a BEAMAGE camera in order to profile a high-power beam, an additional neutral density filter to the camera may be necessary. If an additional ND filter is necessary, make sure not to exceed the maximum average power density of the power meter. Refer to section 3.3 or the UP manual (available at gentec-eo.com/resources/download-center) for additional information and specifications about the power meter.

Calibration procedure to use with the optional power detector

In order to use the optional power detector for live input beam power monitoring, you need to determine the attenuation factor by using the following steps:

1. Measure the power of your laser beam before the optical aperture of the optical attenuator.
2. Measure the power of your laser beam with the optional power detector (residual beam 2).
3. Divide the power obtained in 1 by the power obtained in 2 to calculate the attenuation factor "A".
4. Enter the calculated factor "A" in the PC-Gentec-EO software or in your MAESTRO display as a multiplier to get a live measurement of the input beam power.

Important

The laser beam alignment and power must be steady for steps 1 and 2.

Note: The attenuation factor “A” between the input beam and the integrated power detector depends on the polarization and the alignment of your laser beam. The attenuation factor “A” should be recalculated (steps 1 to 4) after any alignment modification.

Compatibility

The attenuators of the BA series are compatible with many Gentec-EO detectors.

In addition, the BA series attenuators can easily be used with any detector or device threaded according to SM1 standard and specifically with the following Gentec-EO detectors:

- PRONTO-Si with the threaded adaptor accessory
- Photodetectors PH and PE series
- Thermal power detector XLP12 and UP10 series

For more information about compatibility, please contact your local Gentec-EO representative.

Damage to the optical absorber material

Damage to the optical absorber material is usually caused by exceeding the manufacturer’s specifications, such as:

- Incident average power density
- Incident pulse energy density

Refer to the specification pages for the optical attenuator BA series. Damage may also be caused if the absorber surface or optics are contaminated. A slight discoloration of the coating does not affect the absorption.

In any case, the beam incident area should not be less than 10% of the beam dump aperture. Please contact Gentec-EO to make measurements with such smaller beams.

In the event of significant damage to the coating, the UP sensors or the beam dump can be recoated. Contact your local Gentec-EO representative for information on repair and recalibration.

4. BA32 OPTICAL ATTENUATOR SERIES

4.1. INCLUDED WITH YOUR BA32

The following items are included with your BA32 optical attenuator.

Description
BA32 optical attenuator
Protective covers for optical apertures
Heavy duty carrying case

The following items can be purchased separately.

Description	Part name	Part number
Stand	See website	See website
Mounting kit for UP55	BA32-UP55	205320
Mounting kit for BEAMAGE FOCUS	BA32-FOCUS	205321
Mounting kit for BEAMAGE 3.0 or 4M	BA32-B3	205322
BEAMAGE-4M laser beam profiler	BEAMAGE-4M	202880
BEAMAGE-4M-FOCUS laser beam profiler	BEAMAGE-4M-FOCUS	203191
UP55N/M laser power detector	Various	Various

4.2. POWER DETECTOR

The BA32 series can be used with an optional UP power detector. Call us for more information. For further information about the UP-power detector itself, refer to the UP manual (available at gentec-eo.com/resources/download-center).

4.3. COOLING WATER

The fluid used to cool the optical attenuators of the BA32 series must be clean water.

Water fittings and tubing

- The BA32 is equipped with 10-mm (OD) push-to-connect fittings.
- It must be used with plastic pressure tube systems (like PE tubes).

The fittings are not compatible with copper or stainless-steel tubes.

Water quality

- The BA32 cooling fluid must be water. Do not use glycol or other additives.
- Use filtered (< 50 µm) water to avoid any residue.

Gentec-EO can provide an external water filter if water quality is an issue (202290 metric or 202984 imperial). If you require an external water filter, please contact your local Gentec-EO representative.

Note: The water filter provided by Gentec-EO is a chemical resistant filter. However, it is not compatible with mineral acids.

- The resistivity of the water must be over 100 kΩ-cm.
- Distilled water can be used, but it is not recommended to use highly deionized ultra-pure water because the water cavity is not completely inert.
- If an algaecide must be used in the chiller, we recommended OptiShield Plus or equivalent.
- If chloride is present in the system, the concentration should not exceed 25 PPM and the pH maintained between 6.0 and 8.0 (low pH will remove the protective oxide layer).

Water temperature

- The cooling water can be between 15 °C and 25 °C, but must always remain above the dew point.
- The temperature should be regulated with a chiller or a re-circulator.

Water flow rate

- The water flow rate should be monitored.
- NOTE: The water pressure at the BA32 input must never exceed 60 psi/413 kPa.

Note: All these parameters should remain in the range stated in the specifications.

4.4. SPECIFICATIONS

The following specifications are based on an operating temperature of 15 °C to 28 °C (59 °F to 82 °F) and a relative humidity not exceeding 80%. Attenuators must be stored in an environment between 10 °C to 65 °C and a relative humidity not exceeding 90%.

Gentec-EO	BA32-1KW
	Measurement capability
Spectral range	200 nm – 2100 nm
Spectral range with a BEAMAGE camera	350 nm – 1150 nm
Sampled percentage[2]	0.0526% (1/1900) at 1.064 µm
Integrated power meter (optional)	Compatible with UP55N/M series
Maximum power With coolant Without coolant	 1 kW 100 W
Aperture diameter	32 mm
Maximum beam diameter	32 mm
Optical wedges material	UV fused silica (uncoated)
Sampled beam lateral shift	4.5 mm
Sampled beam deviation	90°
Residual beams 1 and 2 deviation	3.6° at 1.064 µm
CW laser damage thresholds on the optical wedge 1.064 µm, CW	Average power density 10 MW/cm^2
Pulsed laser damage thresholds on the optical wedge 1.064 µm, 7 ns, 10 Hz	Maximum energy density 10 J/cm^2
	Cooling requirements
Liquid coolant	Water
Cooling flow rate	1 to 2 L/min
Coolant pressure drop	< 5 PSI
Heat load	< 100 W
Coolant temperature	15 °C – 25 °C
Coolant maximum input pressure	60 PSI
	Physical characteristics
Dimensions[3] H x W x D	145 mm x 250 mm x 132 mm
Weight	5.5 kg
Mounting	M6 (metric) threaded holes
Optical apertures threading	SM2
Product number	205319

Specifications are subject to change without notice.

[2] Considering 0° AOI referred to the input aperture.
[3] Overall dimensions and weight while using BEAMAGE and/or power detector will be different.

The attenuation factor between the input aperture and the sampled beam is polarization insensitive, but it varies with the wavelength. The graph below presents the attenuation factor as a function of the wavelength considering an angle of incidence of 0° with the input aperture.

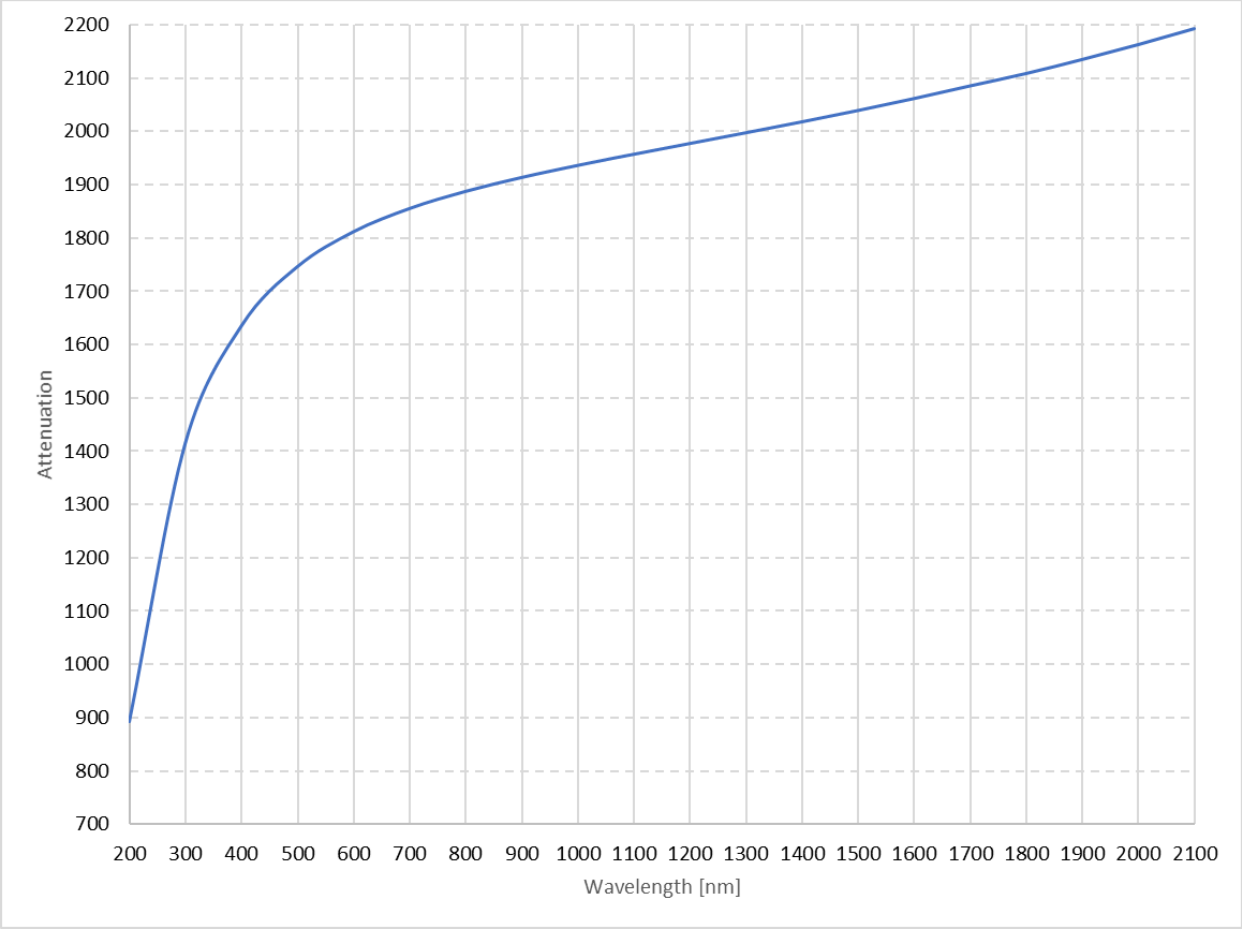
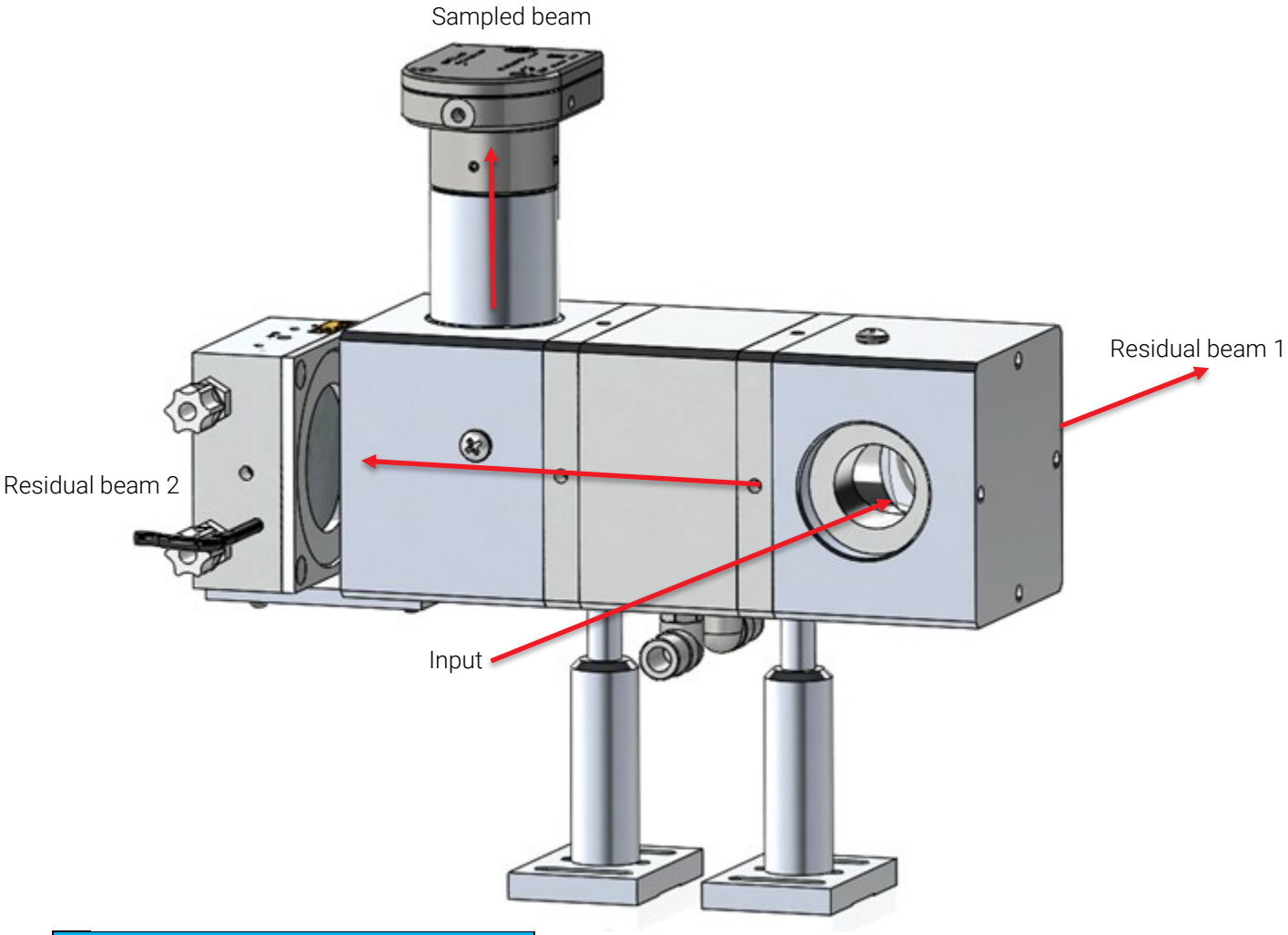


Figure 2. Typical spectral attenuation factor

4.5. BEAM PATH DETAILS



Typical power values at 1,070 nm (% of incident beam)	
Residual beam 1	92%
Between the two wedges	2 x 4% = 8%
Residual beam 2	2 x 3.7% = 7.4%
Sampled beam	0.1 %

Optical path length	
Input to residual beam 1	100 mm
Input to residual beam 2	257 mm
Input to sampled beam (without accessory)	263 mm
Input to BEAMAGE-4M-FOCUS with BA32-FOCUS mounting kit	263 + 123 = 386 mm
Input to BEAMAGE-4M with BA32-B3 mounting kit	263 + 113 = 376 mm

4.6. OPERATING INSTRUCTIONS

Storage

In order to ensure a long lifetime of accurate measurements, it is recommended that attenuators be held within the following ambient conditions:

Storage environment temperature: 10 °C to 60 °C, RH < 90%
Operating environment temperature: 15 °C to 28 °C, RH < 80%.

It is possible to store and operate your optical attenuator beyond this range. For any specific requirements, please contact your local Gentec-EO representative.

The protective covers should always remain on your BA32 optical attenuator while not using.

General operation with BEAMAGE beam profiling camera

Once appropriate cooling is achieved, the attenuator is ready to be aligned in the intended optical setup.

1. Connect your BA32 optical attenuator to the cooling circuit.
2. Ensure your BA32 optical attenuator is cooled adequately (following the specifications in sections 4.3 and 4.4).
3. Remove the protective cover from the residual beam 2 aperture.
4. Install your UP55 power detector with the power detector mounting kit BA32-UP55 (optional).
5. Remove the protective cover from the sampled beam aperture.
6. Using the mounting kit provided for your BEAMAGE (optional mounting kit BA32-FOCUS/BA32-B3), install the BEAMAGE camera on the attenuator sampled beam aperture. Use the locking rings to secure the BEAMAGE on the coupler and the coupler to the attenuator.
7. Download and install the software PC-BEAMAGE (available at gentec-eo.com).
8. Connect the BEAMAGE to the computer. For further information about PC-BEAMAGE, refer to the corresponding manual on gentec-eo.com/resources/download-center.
9. Remove the protective cover from the residual beam 1 aperture.
10. Align the BA32 attenuator in the optical setup using a safe low-power laser by centering both the beam on the target of the input protective cover and in the BEAMAGE. In order to ensure an optimum, polarization-independent attenuation, the laser beam should ideally be perfectly aligned and centered within the attenuator input aperture and in the BEAMAGE.
11. Remove all the protective covers prior to using the optical attenuator BA32.

Warning

Never touch the optics directly or the absorbing surface of the beam dump/power detector.

In the case of a joint use of a BA32 and a BEAMAGE camera in order to profile a high-power beam, an additional neutral density filter to the camera may be necessary. If an additional ND filter is necessary, make sure not to exceed the maximum average power density of the power meter. Refer to section 4.4 or the UP user manual (available at gentec-eo.com/resources/download-center) for additional information and specifications about the power meter.

Calibration procedure to use the integrated power detector

In order to use the integrated power detector for input beam power live monitoring, you need to determine the attenuation factor by using the following steps:

1. Measure the power of your laser beam before the input of the BA32 optical attenuator.
2. Measure the power of your laser beam with the integrated power detector (at the residual beam 2 output).
3. Divide the power obtained in 1 by the power obtained in 2 to calculate the attenuation factor “A”.
4. Enter the calculated factor “A” in the PC-Gentec-EO software or in your MAESTRO display as a multiplier to get a live measurement of the input beam power.

Important

The laser beam alignment and power must be steady for steps 1 and 2.

Note: The attenuation factor “A” between the input beam and the integrated power detector depend on the polarization and the alignment of your laser beam. The attenuation factor “A” should be recalculated (steps 1 to 4) after any alignment modification.

Compatibility

The attenuators of the BA32 series are compatible with many Gentec-EO detectors. For more information about compatibility, please contact your local Gentec-EO representative.

Damage to the optical absorber material

Damage to the optical absorber material is usually caused by exceeding the manufacturer's specifications, such as:

- Incident average power density
- Incident pulse energy density

Refer to the specification pages for the optical attenuator BA32 series. Damage may also be caused if the absorber surface or optics are contaminated. A slight discoloration of the coating does not affect the absorption of the power detector.

In any case, the beam incident area should not be less than 10% of the beam dump aperture. Please contact Gentec-EO to make measurements with such smaller beams.

In the event of significant damage to the coating, the UP sensors or the beam dump can be recoated. Contact your local Gentec-EO representative for information on repair and recalibration.

5. ANNEXE A: WEEE DIRECTIVE

Refer to the UP manual if necessary (available at www.gentec-eo.com) 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 detector reaches its end of life. Breaking the calibration seal or opening the monitor will void the detector warranty.

The complete accessory package can contain:

1 accessory
1 detector with DB-15
1 instruction manual
1 calibration certificate

Separation

Paper: certificates (if applicable)

Wires: detector cable (if applicable)

Printed circuit board: inside the detector (for -MT, -MA, -BT and -CP version only) or DB-15, no need to separate (less than 10 cm2) (if applicable)

Glass: optical component (if applicable)

Aluminum: accessory housing (if applicable)

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