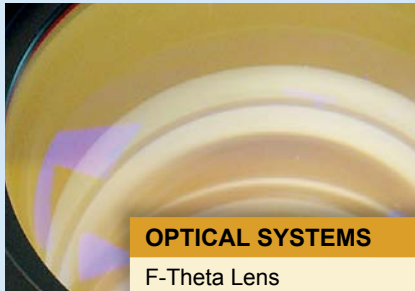
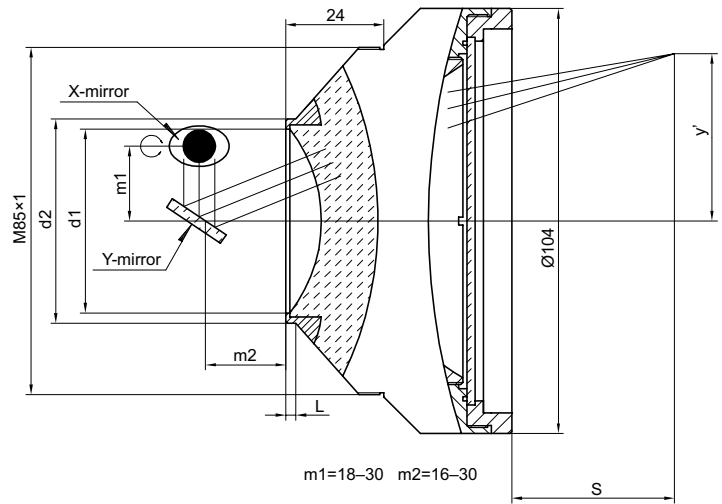


Optical Systems Selection Guide



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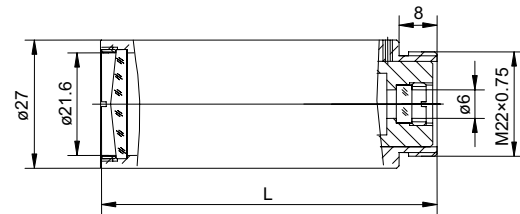
SPECIFICATIONS

Screw Size	M85x1
Best mirror places m1/m2	24/24 mm

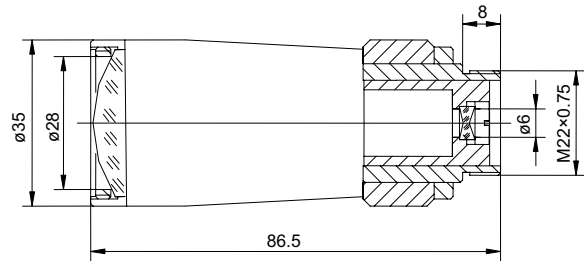
Wavelength – 1064 nm, Lens Diameter – 104 mm

Catalogue number	Focus length, mm	Working distance S, mm	Max. scan area, mm ²	Max. scan angle, θ max	Input beam diameter, mm	Spot size, μ m	d1, mm	d2, mm	L, mm	Price, EUR
151-1631	163	180	110X110	$\pm 28^\circ$	16	20	46	53	4.5	460
151-2541	254	280	175x175	$\pm 28^\circ$	16	31	46	53	4.5	460
151-4201	420	470	300x300	$\pm 28^\circ$	16	55	52	63	5	460
151-6501	650	690	400x400	$\pm 25^\circ$	20	85	52	63	5	460

COMPACT BEAM EXPANDER



Expansion ratio - 2X, 2.5X, 3X, 4X, 5X, 6X, 8X



Expansion ratio - 15X, 20X

A laser beam expander is designed to increase the diameter of a collimated input beam to a larger collimated output beam. EKSMA OPTICS offers compact Galilean type beam expanders for 1064 nm, 532 nm

and 355 nm wavelengths. Compact beam expander has the possibility to be adjusted for the input beam divergence angle to obtain collimated, divergent or focused beam at the output.

SPECIFICATIONS

Lens material	AR coated Fused Silica Lenses
Screw Size	M22x0.75

Catalogue number	Wavelength, nm	Expansion ratio	Beam expander size L, mm	Transmission, %	Price, EUR
160-0021	1064	2X	51	>96	200
160-0251	1064	2.5X	51	>96	200
160-0031	1064	3X	68	>96	200
160-0041	1064	4X	75	>96	200
160-0051	1064	5X	73	>96	200
160-0061	1064	6X	75	>96	200
160-0081	1064	8X	77	>96	200
160-0022	532	2X	51	>96	200
160-0252	532	2.5X	51	>96	200
160-0032	532	3X	68	>96	200
160-0042	532	4X	75	>96	200
160-0052	532	5X	73	>96	200
160-0062	532	6X	75	>96	200
160-0082	532	8X	77	>96	200
160-0152	532	15X	86.5	>96	200
160-0202	532	20X	86.5	>96	200
160-0043	355	4X	75	>96	230
160-0083	355	8X	68	>96	230
160-0063	355	6X	75	>96	230

ZOOM BEAM EXPANDER




- Adjustable expansion ratio
- Adjustable divergence
- Galilean design

EKSMA OPTICS offers compact Galilean type zoom beam expanders for Nd:YAG lasers fundamental and harmonics wavelength: 1064 nm, 532 nm and 355 nm.

Zoom beam expander provides variable expansion ratio of 2x-8x, 1x-8x, 1x-3x with adjustable focus to correct for laser beam divergence.

Catalogue number	Wavelength, nm	Expansion ratio	Input Clear Aperture, mm	Output Clear Aperture, mm	Length, mm
165-0281	1064	2x-8x	10	30	142-149
165-1181*	1064	1x-8x	12	32	167-202
165-0131	1064	1x-3x	14	29	117
165-0282	532	2x-8x	10	30	145-150
165-1282*	532	2x-8x	12	32	186.7
165-1182*	532	1x-8x	12	32	162-196
165-0132	532	1x-3x	10	20	85
165-1283*	355	2x-8x	12	32	157-191
165-1183*	355	1x-8x	12	32	180.3

* made of quartz; other zoom beam expanders are made of BK7

Drawings are available upon request.

SIMPLE TELESCOPE KIT



Simple lenses are subject to optical aberrations. In many cases these aberrations can be compensated for to a great extent by using a combination of simple lenses with complementary aberrations. A compound lens is a collection of simple lenses of different shapes and made of materials of different refractive indices, arranged one after the other with a common axis.

If two thin lenses are separated in air by some distance d (where d is smaller than the focal length of the first lens), the focal length for the combined system is given by

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 \cdot f_2}$$

The distance from the second lens to the focal point of the combined lenses is called the back focal length (BFL).

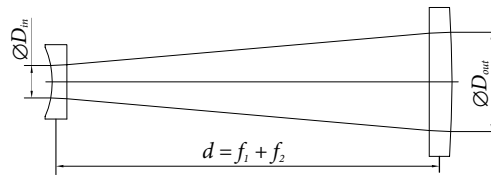
$$BFL = \frac{f_2 \cdot (d - f_1)}{d - (f_1 + f_2)}$$

If the separation distance is equal to the sum of the focal lengths ($d = f_1 + f_2$), the

combined focal length and BFL are infinite. This corresponds to a pair of lenses that transform a parallel (collimated) beam into another collimated beam. This type of system is called an afocal system, since it produces no net convergence or divergence of the beam. Two lenses at this separation form the simplest type of optical telescope. Although the system does not alter the divergence of a collimated beam, it does alter the width of the beam. The magnification of such a telescope is given by

$$M = -\frac{f_2}{f_1} = \frac{D_{out}}{D_{in}} \quad \begin{matrix} \text{(exit diameter)} \\ \text{(input diameter)} \end{matrix}$$

which is the ratio of the input beam width to the output beam width. Note the sign convention: a telescope with two convex lenses ($f_1 > 0, f_2 > 0$) produces a negative magnification, indicating an inverted image. A concave plus a convex lens ($f_1 < 0 < f_2$) produces a positive magnification and the image is upright.



Simple Telescope Kit

Lens material: BK7

Lens 1	Focal length f_1 , mm	Lens 2	Focal length f_2 , mm	Distance between lenses $d=f_1+f_2$, mm	Magnification, M
BK7 bi/cv Ø12.7 mm 114-0104	-12.7	BK7 pl/cx Ø50.8 mm			
		110-0502	+75	62	5.9
		110-0505	+100	87	7.7
		110-0507	+150	137	11.8
		110-0509	+200	187	15.7
110-0511	+250	237	19.7		
BK7 bi/cv Ø25.4 mm 114-0204	-25	BK7 pl/cx Ø50.8 mm			
		110-0502	+75	50	3
		110-0505	+100	75	4
		110-0507	+150	125	6
		110-0509	+200	175	8
110-0511	+250	225	10		
BK7 pl/cv Ø25.4 mm 112-0209	-50	BK7 pl/cx Ø50.8 mm			
		110-0502	+75	25	1.5
		110-0505	+100	50	2
		110-0507	+150	100	3
		110-0509	+200	150	4
110-0511	+250	200	5		

Lens material: FS

Lens 1	Focal length f_1 , mm	Lens 2	Focal length f_2 , mm	Distance between lenses $d=f_1+f_2$, mm	Magnification, M
FS bi/cv Ø12.7 mm 114-3104	-12.7	FS pl/cx Ø50.8 mm			
		110-3505	+75	62	5.9
		110-3509	+100	87	7.7
		110-3511	+150	137	11.8
		110-3515	+200	187	15.7
110-3517	+250	237	19.7		
FS bi/cv Ø25.4 mm 114-3204	-25	FS pl/cx Ø50.8 mm			
		110-3505	+75	50	3
		110-3509	+100	75	4
		110-3511	+150	125	6
		110-3515	+200	175	8
110-3517	+250	225	10		
FS pl/cv Ø25.4 mm 112-3205	-50	FS pl/cx Ø50.8 mm			
		110-3505	+75	25	1.5
		110-3509	+100	50	2
		110-3511	+150	100	3
		110-3515	+200	150	4
110-3517	+250	200	5		

Note that distance between lenses d is the distance between focal planes of the lenses and is given theoretically (the thickness of lenses is not included into calculation). It, also, depends on wavelength. The distance should be adjusted ± 10 mm in each particular case.

Lens material: UVFS

Lens 1	Focal length $f_{1,}$ mm	Lens 2	Focal length $f_{2,}$ mm	Distance between lenses $d=f_{1}+f_{2,}$ mm	Magnification, M
UVFS bi/cv Ø12.7 mm 114-1104	-12.7	UVFS pl/cx Ø50.8 mm			
		110-1505	+75	62	5.9
		110-1509	+100	87	7.7
		110-1511	+150	137	11.8
		110-1515	+200	187	15.7
		110-1517	+250	237	19.7
UVFS bi/cv Ø25.4 mm 114-1204	-25	UVFS pl/cx Ø50.8 mm			
		110-1505	+75	50	3
		110-1509	+100	75	4
		110-1511	+150	125	6
		110-1515	+200	175	8
		110-1517	+250	225	10
UVFS pl/cv Ø25.4 mm 112-1205	-50	UVFS pl/cx Ø50.8 mm			
		110-1505	+75	25	1.5
		110-1509	+100	50	2
		110-1511	+150	100	3
		110-1515	+200	150	4
		110-1517	+250	200	5

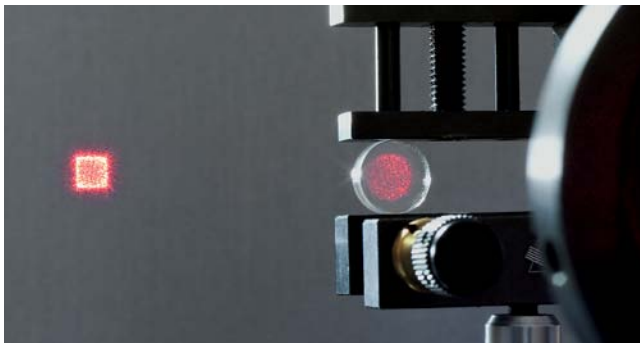
Each kit includes 8 lenses, Aluminium Optical Rail 810-0005-02, two Aluminium Rail Carriers 810-0007-06, Self Centering Lens Mounts 830-0010 and 830-0020, two Rod Holders 820-0050-02 and two Rods 820-0050-02.

Net weight: 1.4 kg

Code	Material	Coating	Price, EUR
140-0008	BK7	Uncoated	771
141-0008	BK7	1064 nm, R<0.2%	1075
142-0008	BK7	532 nm + 1064 nm, R<0.5%	1110
147-0008	BK7	400-700 nm, R<0.9%	1260
140-3008	FS	Uncoated	1160
143-3008	FS	355 nm, R<0.25%	1465
141-3008	FS	532 nm + 1064 nm, R<0.5%	1485
145-3008	FS	350-900 nm, R<1.5%	1685
148-3008	FS	650-950 nm, R<1%	1645
140-1008	UVFS	Uncoated	1170
144-1008	UVFS	266 nm, R<0.4%	1470
149-1008	UVFS	266 nm + 355 nm, R<0.6%	1480
146-1008	UVFS	210-400 nm, R<1.5%	1680

Any other antireflection coating wavelength region is available on request.

GAUSS-TO-TOP HAT BEAM SHAPING LENS



Gauss-to-Top Hat Beam Shaping Lens is special form lens used to distribute energy of Gaussian beam to Top Hat profile.

LENS SPECIFICATIONS

Material	LF5 Schott glass n = 1.5659 @ 1060 nm, n = 1.5848 @ 546 nm, n = 1.6192 @ 365 nm
Lens diameter	12.0 +0.0/-0.1 mm
Thickness	4.0 ± 0.1 mm
Clear aperture	Ø11.0 mm
Damage threshold (uncoated)	>3J/cm ² @ 532 nm, 10 ns
Mounting	Mounted in to 1" ring holder

OPERATION SPECIFICATIONS

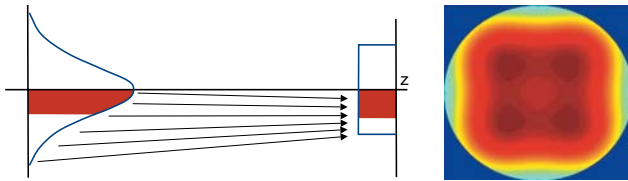
Recommended operation wavelength range	400-1500 nm
Input beam	TEM ₀₀ , diameter (1/e ²): 5.0 ± 0.15 mm
Output beam	Top hat size at 250 mm working distance: 4 × 4 mm ² (adjustable with additional lens)
Working distance	250 mm (adjustable with additional lens)
Beam energy distribution efficiency	> 95% of input energy within Top Hat profile
Beam homogeneity	± 5 % (rel. to average intensity within top hat)

Catalogue number	Description	Price, EUR
GTH-5-250-4	uncoated lens	450
GTH-5-250-4-VIS	VIS coated lens (400-700 nm (R<1% per face))	495
GTH-5-250-4-IR	IR coated lens (700-1300 nm (R<1% per face))	495

Other specific laser wavelengths are available on request.

GAUSS-TO-TOP HAT BEAM SHAPING LENS OPERATION INSTRUCTIONS

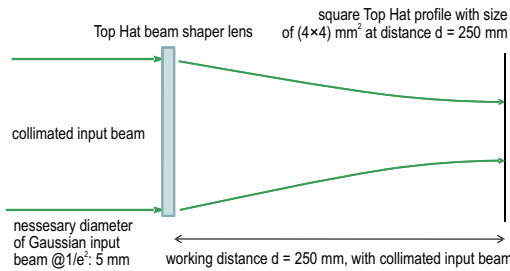
Principles of Beam Shaper Operation and Lens Shape



The beam shaper lens is a free form refractive glass optic which redistributes the energy of a Gaussian input beam to a Top Hat beam profile (mapping).

Surface contour plot of beam shaper lens (free form optic).

Optical Setup for Gauss-toTop Hat Beam Shaper Lens

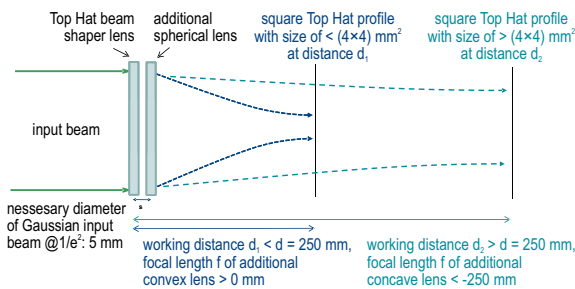


If a collimated Gaussian beam is used the Top Hat beam shaper lens delivers at the working distance $d = 250$ mm a square Top Hat beam profile with the size of (4×4) mm².

The Top Hat beam shaper lens works also for divergent and convergent Gaussian beams. Important: One has to consider that input beam diameter at beam shaper lens plane must be 5 mm @ $1/e^2$.

For divergent (or convergent) beams the size of Top Hat and working distance increase (or decrease).

Adjustment of Square Top Hat Size by Additional Spherical Lens



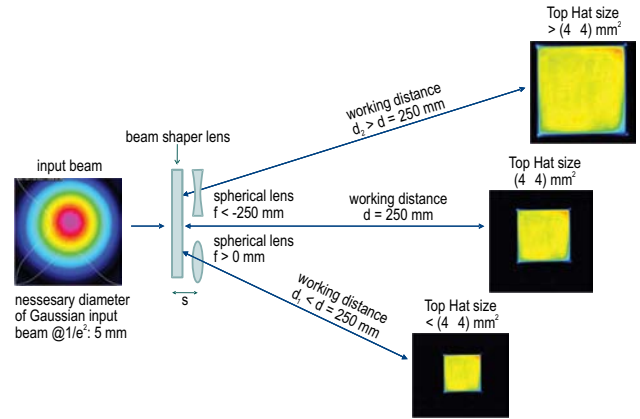
The working distance and the size of the Top Hat profile can be changed (same ratio) by an additional spherical lens. For a convex lens the size of the Top Hat profile and the working distance becomes smaller. For a concave lens the size of the Top Hat profile and the working distance becomes bigger.

The new working distance and the size of the Top Hat profile can be calculated:

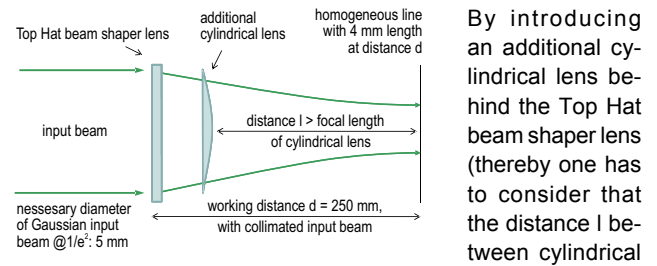
$$\text{Working distance} = \frac{250 \text{ mm} \cdot f}{250 \text{ mm} + f}$$

for focal length $f > 0$ mm (additional convex lens) respectively focal length $f < -250$ mm (additional concave lens); $s > 0$

$$\text{Square Top Hat Size} = \left(\frac{4 \text{ mm} \cdot \text{working distance}}{250 \text{ mm}} \right)^2 = \left(\frac{4 \text{ mm} \cdot f}{250 \text{ mm} + f} \right)^2$$

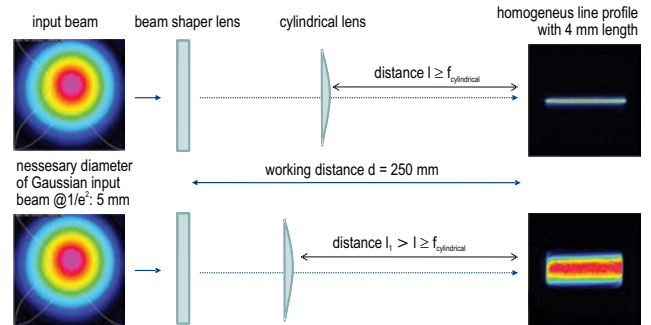


Homogeneous Line Generation with Top Hat Beam Shaper Lens and Additional Cylindrical Lens



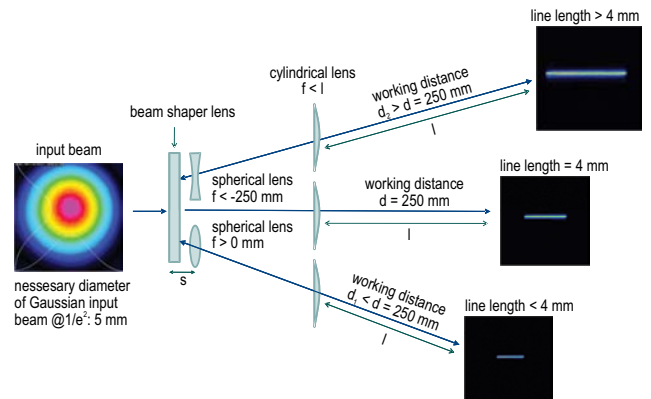
By introducing an additional cylindrical lens behind the Top Hat beam shaper lens (thereby one has to consider that the distance l between cylindrical

lens and working plane must be bigger or same as focal length of cylindrical lens) it's possible to generate a line profile at working plane. Along the long axis the intensity profile is homogeneous. Along short axis, which is focused by cylindrical lens, the profile is near Gaussian.



By varying the distance l the width of line profile (short axis) can be changed from near diffraction limited size to several millimeters.

Adjustment of Length of Homogeneous Line by Additional Spherical Lens



990-0060**CONTINUOUSLY VARIABLE
ATTENUATOR / BEAMSPLITTER**

- Divides laser beam into two beams of manually adjustable intensity ratio
- Convenient 90° angle between reflected and transmitted beams
- Negligible beam deviation
- Large dynamic range
- Broadband transmission
- Weight – 0.16 kg

Continuously Variable Attenuator/Beamsplitter is designed for down to 100 fs laser pulses. It consists of 2 high-performance polarizing optics components placed in

precision opto-mechanical holder 840-0197. Variable attenuator/beamsplitter incorporates a high-performance Polarizing Cube Beamsplitter which reflects s-polarized light at 90° while transmitting p-polarized light.

A rotating $\lambda/2$ waveplate is placed in the incident polarized laser beam. The intensity ratio of those two beams may be continuously varied without alteration of other beam parameters by rotating the waveplate. The intensity of either exit beam, and their intensity ratio, can be controlled over a wide dynamic range. Pure p-polarization could be selected for maximum transmission, or pure s-polarization for maximum attenuation of the transmitted beam.

Multiple Order Half Waveplate and Cube Polarizing Beamsplitters**SPECIFICATIONS**

Damage threshold	200 mJ/cm ² pulsed at 1064 nm, typical
Antireflection coating	R < 0.25% all entrance and exit surfaces
Extinction ratio	T _s /T _p < 1:200

Catalogue number	Central wavelength, nm	Clear aperture, mm	Price, EUR
990-0061-10	1064	9	465
990-0061-15	1064	14	495
990-0061-20	1064	17	515
990-0064-10	532	9	465
990-0064-15	532	14	495
990-0064-20	532	17	515
990-0065-10	355	9	596
990-0065-15	355	14	656
990-0065-20	355	17	706

Achromatic Air-Spaced Waveplate and Glan-Taylor Laser Polarizing Prism**SPECIFICATIONS**

Damage threshold	0.5 mJ/cm ² 10 ns, 10 Hz at 1064 nm
Antireflection coating	R < 1% all entrance and exit surfaces
Extinction ratio	T _s /T _p < 1:10000

for Broadband Region

Catalogue number	Central wavelength, nm	Clear aperture, mm	Price, EUR
990-0060-10VIS	450-680	9	1290
990-0060-12VIS	450-680	11	1395
990-0060-10IR	700-1000	9	1290
990-0060-12IR	700-1000	11	1395
990-0060-10FIR	950-1300	9	1290
990-0060-12FIR	950-1300	11	1395

990-0070

VARIABLE ATTENUATORS FOR LINEARLY POLARIZED LASER BEAM

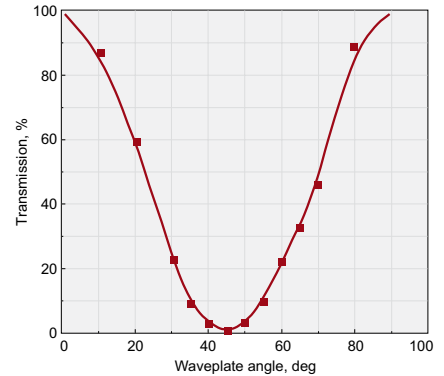
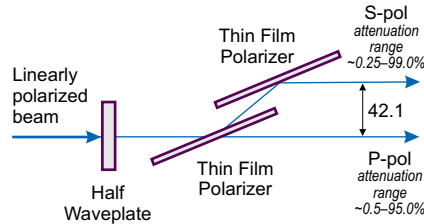


Note: Movable base 820-0090, Rod Holder 820-0050-02 and standard rod should be ordered separately.

This variable attenuator/beamsplitter consists of special design opto-mechanical Adapter and precision opto-mechanical holder 840-0197. Two Thin Film Brewster type polarizers, which reflect s-polarized light while transmitting p-polarized light, are housed into Adapter. Quartz Half Waveplates are housed in rotating holder 840-0197.

The intensity ratio of those two beams may be continuously varied without alteration of other beam parameters by rotating the waveplate. The intensity of either exit beam, or their intensity ratio, can be controlled over a wide dynamic

range. P-polarization could be selected for maximum transmission, or high-purity s-polarization could be reflected when maximum attenuation of the transmitted beam takes place. The holder 840-0197 allows to adjust Angle Of Incidence of the Thin Film Brewster type polarizers by $\pm 2^\circ$ and to get the maximum polarization contrast.



For Nd:YAG Laser Applications

Aperture diameter	17 mm
Damage threshold	5 J/cm ² pulsed at 1064 nm, typical
Polarization Contrast (after 1st polarizer)	>1:200
Polarization Contrast (after 2nd polarizer)	>1:500

For Femtosecond Applications

Aperture diameter	17 mm
Damage threshold	>10 mJ/cm ² , 50 fs pulse at 800 nm, typical >100 mJ/cm ² , 50 fs pulse at 800 nm, typical for high power laser applications
Time dispersion	t<4 fs for 100 fs Ti:Sapphire laser pulses
Polarization Contrast (after 1st polarizer)	>1:200
Polarization Contrast (after 2nd polarizer)	>1:500

For Nd:YAG Laser Applications

Catalogue number	Wavelength, nm	Price, EUR
990-0070-266	266	850
990-0070-355	355	750
990-0070-532	532	650
990-0070-1064	1064	650

Multi order half waveplate is housed in rotating holder 840-0197 for Nd:YAG laser pulses (laser damage threshold: 5 J/cm² pulsed at 1064 nm, typical).

For Femtosecond Applications

Catalogue number	Wavelength, nm	Price, EUR
990-0070-343	343	840
990-0070-400	400	740
990-0070-400B	390-410	890
990-0070-515	515	740
990-0070-515B	505-525	890
990-0070-800	800	740
990-0070-800B	780-820	890
990-0070-1030	1030	740
990-0070-1030B	1010-1050	890

Zero order optically contacted half waveplate is housed in rotating holder 840-0197 for femtosecond laser pulses (laser damage threshold: >10 mJ/cm², 50 fsec pulse, 800 nm typical).

For High Power Femtosecond Laser Applications

Catalogue number	Wavelength, nm	Price, EUR
990-0070-266H	266	1020
990-0070-343H	343	915
990-0070-400H	400	815
990-0070-400HB	390-410	965
990-0070-515H	515	815
990-0070-515HB	505-525	965
990-0070-800H	800	815
990-0070-800HB	780-820	965
990-0070-1030H	1030	815
990-0070-1030HB	1010-1050	965

Zero Order Air-Spaced half waveplate is housed in rotating holder 840-0197 for high power femtosecond applications (laser damage threshold: >100 mJ/cm², 50 fsec pulse, 800 nm typical).

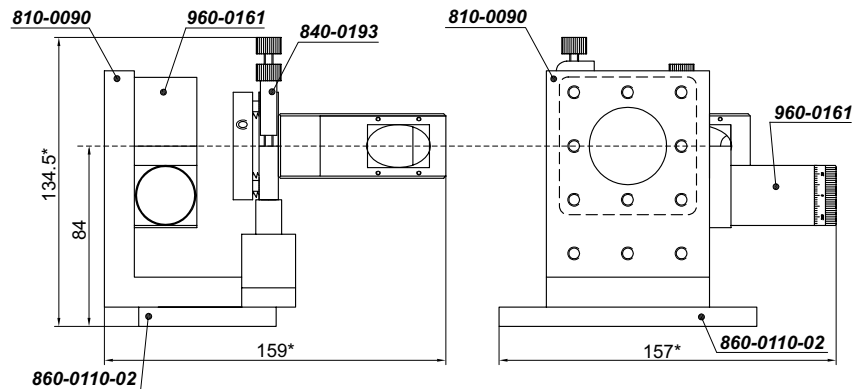
RELATED PRODUCTS

- Beam dumps
990-0800, 990-0820
See page 6.24

990-0070M
**MOTORIZED VARIABLE ATTENUATOR
FOR LINEARLY POLARIZED LASER BEAM**


This motorized variable attenuator/beamsplitter consists of special design opto-mechanical Adapter and precision opto-mechanical holder 840-0193. Two Thin Film Brewster type polarizers, which reflect s-polarized light while transmitting p-polarized light, are housed into Adapter. Quartz Half Waveplates are housed in motorized rotation stage 960-0161.

The intensity ratio of those two beams may be continuously varied without alteration of other beam parameters by rotating the waveplate. The intensity of either exit beam, or their intensity ratio, can be controlled over a wide dynamic range. P-polarization could be selected for maximum transmission, or high-purity s-polarization could be reflected when maximum attenuation of the transmitted beam takes place. The holder 840-0193 allows to adjust Angle Of Incidence of the Thin Film Brewster type polarizers by $\pm 2^\circ$ and to get the maximum polarization contrast.


For Nd:YAG Laser Applications

Catalogue number	Wavelength, nm	Price, EUR
990-0070-266M	266	1630
990-0070-355M	355	1530
990-0070-532M	532	1430
990-0070-1064M	1064	1430

Multi order half waveplate is housed in Motorized Rotation Stage 960-0161 and Polarizer with adapter in Kinematic Optical Mount 840-0193 for Nd:YAG laser application (laser damage threshold: 5 J/cm², 10 ns pulses, 10 Hz at 1064 nm, typical).

For Femtosecond Applications

Catalogue number	Wavelength, nm	Price, EUR
990-0070-343M	343	1620
990-0070-400M	400	1520
990-0070-400BM	390-410	1670
990-0070-515M	515	1520
990-0070-515BM	505-525	1670
990-0070-800M	800	1520
990-0070-800BM	780-820	1670
990-0070-1030M	1030	1520
990-0070-1030BM	1010-1050	1670

Zero order optically contacted half waveplate is housed in Motorized Rotation Stage 960-0161 and Polarizer with adapter in Kinematic Optical Mount 840-0193 for femtosecond laser application (laser damage threshold: >10 mJ/cm², 50 fsec pulse, 800 nm typical).

For High Power Femtosecond Applications

Catalogue number	Wavelength, nm	Price, EUR
990-0070-266HM	266	1800
990-0070-343HM	343	1695
990-0070-400HM	400	1595
990-0070-400HBM	390-410	1745
990-0070-515HM	515	1595
990-0070-515HBM	505-525	1745
990-0070-800HM	800	1595
990-0070-800HBM	780-820	1745
990-0070-1030HM	1030	1595
990-0070-1030HBM	1010-1050	1745

Zero Order Air-Spaced half waveplate is housed in Motorized Rotation Stage 960-0161 and Polarizer with adapter in Kinematic Optical Mount 840-0193 for high power femtosecond laser application (laser damage threshold: >100 mJ/cm², 50 fsec pulse, 800 nm typical).

990-0071

VARIABLE ATTENUATORS FOR LINEARLY POLARIZED LASER BEAM

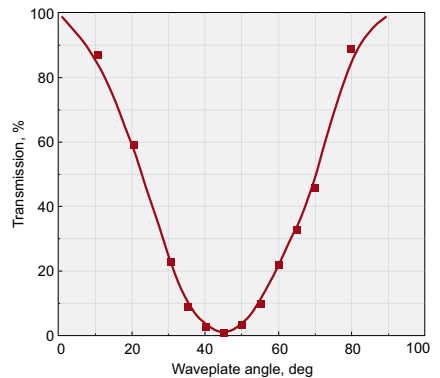
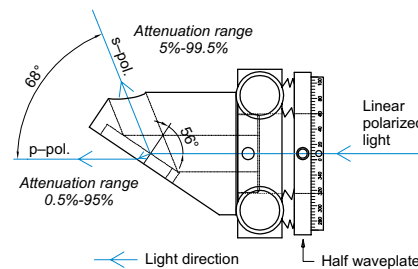


Note: Solid Base Height Extender 820-0210 and Standard Rod 820-0020-20 should be ordered separately

This variable attenuator/beamsplitter consists of special design opto-mechanical adapter for polarizer at 56° 840-0117A or 840-0118A and precision opto-mechanical holder 840-0197. Thin Film Brewster type polarizer, which reflect s-polarized light at 56° while transmitting p-polarized light, is housed into adapter for polarizer at 56°. Quartz Half Waveplates are housed in rotating holder 840-0197.

The intensity ratio of those two beams may be continuously varied without alteration of other beam parameters by rotating the waveplate. The intensity of

either exit beam, or their intensity ratio, can be controlled over a wide dynamic range. P-polarization could be selected for maximum transmission, or high-purity s-polarization could be reflected when maximum attenuation of the transmitted beam takes place. The holder 840-0197 allows to adjust Angle Of Incidence of the Thin Film Brewster type polarizer by ±2° and to get the maximum polarization contrast.



- Divides laser beam into separated by 68° angle two beams of manually adjustable intensity ratio
- Large dynamic range
- Negligible transmitted beam deviation
- High Optical damage threshold
- Weight – 0.25 kg

For Nd:YAG Laser Applications

Aperture diameter	10 mm
Damage threshold	5 J/cm ² pulsed at 1064 nm, typical
Polarization Contrast	>1:200

For Femtosecond Applications

Aperture diameter	10 mm
Damage threshold	>10 mJ/cm ² , 50 fs pulse at 800 nm, typical >100 mJ/cm ² , 50 fsec pulse, 800 nm typical
Time dispersion	t<4 fs for 100 fs Ti:Sapphire laser pulses
Polarization Contrast	>1:200

For Nd:YAG Laser Applications

Catalogue number	Wavelength, nm	Price, EUR
990-0071-266	266	510
990-0071-355	355	475
990-0071-532	532	445
990-0071-1064	1064	445

Multi order half waveplate is housed in rotating holder 840-0197 for Nd:YAG laser pulses (laser damage threshold: 5 J/cm² pulsed at 1064 nm, typical).

For Femtosecond Applications

Catalogue number	Wavelength, nm	Price, EUR
990-0071-343	343	600
990-0071-400	400	550
990-0071-400B	390-410	650
990-0071-515	515	550
990-0071-515B	505-525	650
990-0071-800	800	550
990-0071-800B	780-820	650
990-0071-1030	1030	550
990-0071-1030B	1010-1050	650

Zero order optically contacted half waveplate is housed in rotating holder 840-0197 for femtosecond laser pulses (laser damage threshold: >10 mJ/cm², 50 fs pulse at 800 nm, typical).

For High Power Femtosecond Laser Applications

Catalogue number	Wavelength, nm	Price, EUR
990-0071-266H	266	690
990-0071-343H	343	665
990-0071-400H	400	615
990-0071-400HB	390-410	715
990-0071-515H	515	615
990-0071-515HB	505-525	715
990-0071-800H	800	615
990-0071-800HB	780-820	715
990-0071-1030H	1030	615
990-0071-1030HB	1010-1050	715

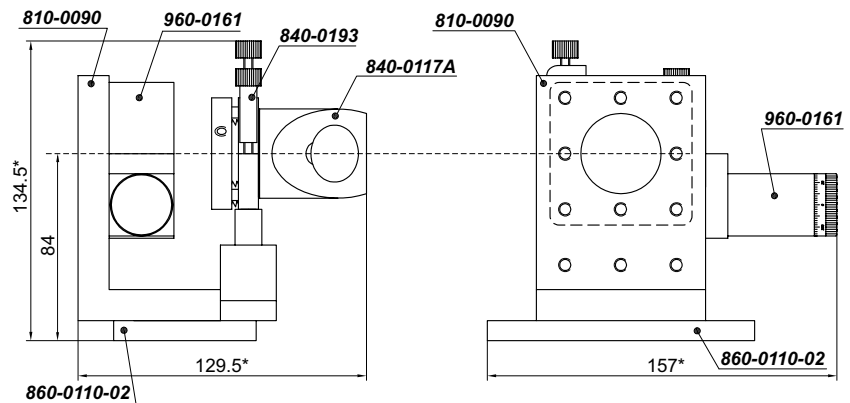
Zero Order Air-Spaced half waveplate is housed in rotating holder 840-0197 for high power femtosecond applications (laser damage threshold: >100 mJ/cm², 50 fsec pulse, 800 nm typical).

990-0071M
**MOTORIZED VARIABLE ATTENUATOR
FOR LINEARLY POLARIZED LASER BEAM**



This motorized variable attenuator/beamsplitter consists of special design opto-mechanical adapter for polarizer at 56° 840-0117A or 840-0118A and precision opto-mechanical holder 840-0193. Thin Film Brewster type polarizer, which reflect s-polarized light at 56° while transmitting p-polarized light, is housed into adapter for polarizer at 56°. Quartz Half Waveplates are housed in motorized rotation stage 960-0161.

The intensity ratio of those two beams may be continuously varied without alteration of other beam parameters by rotating the waveplate. The intensity of either exit beam, or their intensity ratio, can be controlled over a wide dynamic range. P-polarization could be selected for maximum transmission, or high-purity s-polarization could be reflected when maximum attenuation of the transmitted beam takes place. The holder 840-0193 allows to adjust Angle of Incidence of the Thin Film Brewster type polarizer by $\pm 2^\circ$ and to get the maximum polarization contrast.


For Nd:YAG Laser Applications

Catalogue number	Wavelength, nm	Price, EUR
990-0071-266M	266	1295
990-0071-355M	355	1260
990-0071-532M	532	1230
990-0071-1064M	1064	1230

Multi order half waveplate is housed in Motorized Rotation Stage 960-0161 and Polarizer with adapter in Kinematic Optical Mount 840-0193 for Nd:YAG laser application (laser damage threshold: 5 J/cm², 10 ns pulses, 10 Hz at 1064 nm, typical).

For Femtosecond Applications

Catalogue number	Wavelength, nm	Price, EUR
990-0071-343M	343	1380
990-0071-400M	400	1330
990-0071-400BM	390-410	1430
990-0071-515M	515	1330
990-0071-515BM	505-525	1430
990-0071-800M	800	1330
990-0071-800BM	780-820	1430
990-0071-1030M	1030	1330
990-0071-1030BM	1010-1050	1430

Zero order optically contacted half waveplate is housed in Motorized Rotation Stage 960-0161 and Polarizer with adapter in Kinematic Optical Mount 840-0193 for femtosecond laser application (laser damage threshold: >10 mJ/cm², 50 fsec pulse, 800 nm typical).

For High Power Femtosecond Applications

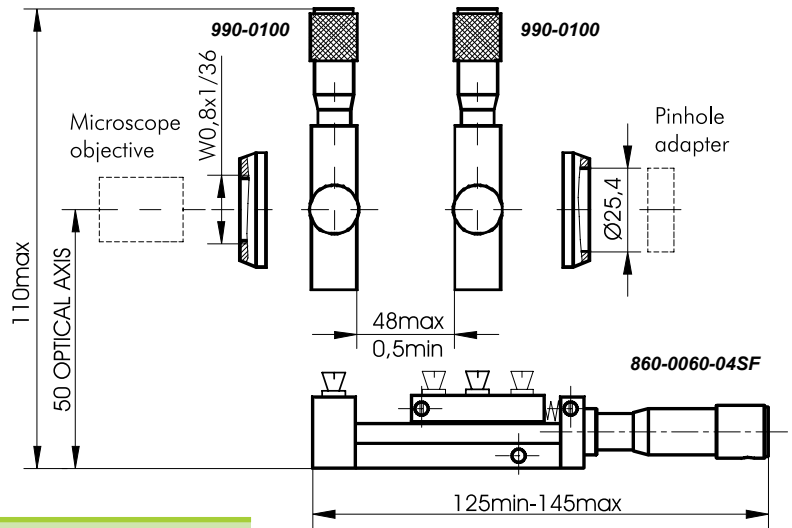
Catalogue number	Wavelength, nm	Price, EUR
990-0071-266HM	266	1470
990-0071-343HM	343	1445
990-0071-400HM	400	1395
990-0071-400HBM	390-410	1495
990-0071-515HM	515	1395
990-0071-515HBM	505-525	1495
990-0071-800HM	800	1395
990-0071-800HBM	780-820	1495
990-0071-1030HM	1030	1395
990-0071-1030HBM	1010-1050	1495

Zero Order Air-Spaced half waveplate is housed in Motorized Rotation Stage 960-0161 and Polarizer with adapter in Kinematic Optical Mount 840-0193 for high power femtosecond laser application (laser damage threshold: >100 mJ/cm², 50 fsec pulse, 800 nm typical).

990-1000 PRECISION SPATIAL FILTER



990-1000 with Precision Pinholes and Microscope Objectives



- 3-axes adjustment with micrometers
- Accommodates virtually any microscope objective
- Unobscured view of a pinhole facilitates alignment
- Easy pinhole removal and replacement

Microscope Objective and Precision Pinholes can be supplied as option.

Precision Spatial Filter 990-1000 filters the beam from any low power, visible to near infrared laser. The result – the output beam is delivered with a smooth, near ideal intensity profile. The Spatial Filter consists of two YZ Positioners 990-0100 and Translation Stage 860-0060-04SF (modification of 860-0060-04). YZ Positioner for Lens, Pinholes and Objectives 990-0100 provides adjustment of the pinhole and

objective in two axes. The precision X axis motion is provided by Translation Stage 860-0060-04SF.

The pinhole and the objective should be selected and ordered separately. Provided selection of interchangeable microscope objective lenses and precision pinholes allow to build the best spatial filter for your laser.

Code	Weight, kg	Price, EUR
990-1000	0.87	480

Complementary Products

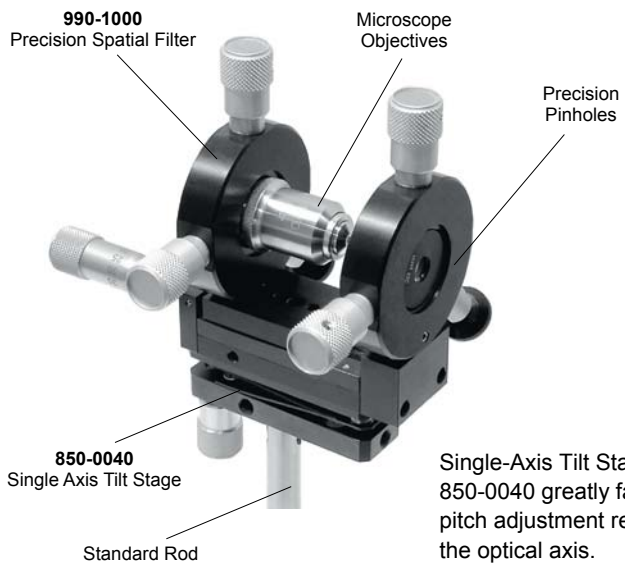
Code	Page
850-0040	7.95
860-0060-04	7.106
990-0100	6.14

RELATED PRODUCTS

- Precision pinholes
See page 6.15



- Microscope objectives
See page 6.15



Single-Axis Tilt Stage 850-0040 greatly facilitates pitch adjustment relative to the optical axis.

990-0100 · 990-0200

Y-Z POSITIONER FOR LENS, PINHOLES AND OBJECTIVES



990-0100

Y-Z Positioners for Lens, Pinholes and Objectives are compact mounts designed to precisely position optical components in the plane orthogonal to the optical axis. Ideal for microscope objectives, mounted pinholes, fiber optics chucks, and diode lasers.

The mounts provide 5 mm translation with sensitivity of 2 μm.

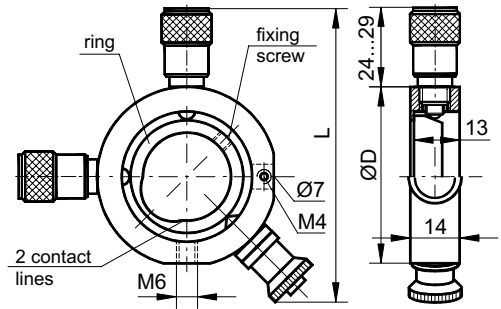
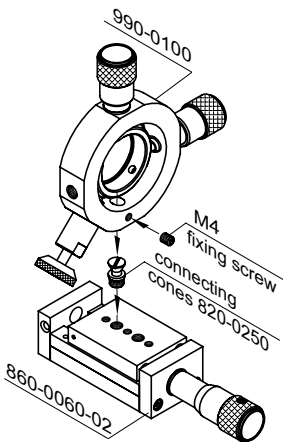
990-0100 may contain one of 1 inch rings: W0.8, A1 or B1.

990-0200 may contain one of 2 inch rings: A2 or B2.

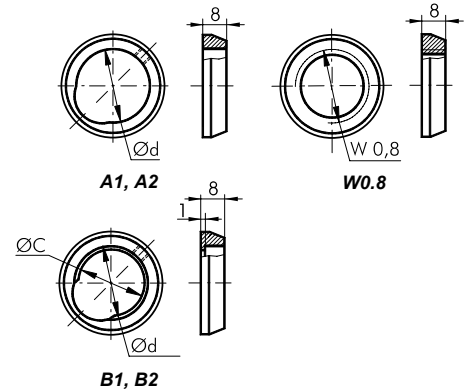
Two adjustment screws 870-0030 are used for positioning. They can be replaced with any screw or micrometer with M10×1 mounting thread.

Two ways to fasten positioner: mounting posts 820-0010 by an M6 hole; on a connecting cone 820-0250; 820-0254 by a Ø7 hole.

Material: black anodized aluminium.



Insert rings



ORDERING INFORMATION

990-0100-A1	1" Positioner with ring A1
990-0200-A2	2" Positioner with ring A2
990-0100-B1	1" Positioner with ring B1
990-0200-B2	2" Positioner with ring B2
990-0100-W0.8	1" Positioner with ring W0.8

Model	D, mm	d, mm	C, mm	L, mm	Weight, kg	Price, EUR
990-0100	58	25.5	24	102	0.26	149
990-0200	83	51	48	127	0.38	159

990-0050 · 990-0051

Y-Z POSITIONERS FOR LENS, PINHOLES AND OBJECTIVES



990-0050

- Travel range 3 mm
- Weight 0.12 kg

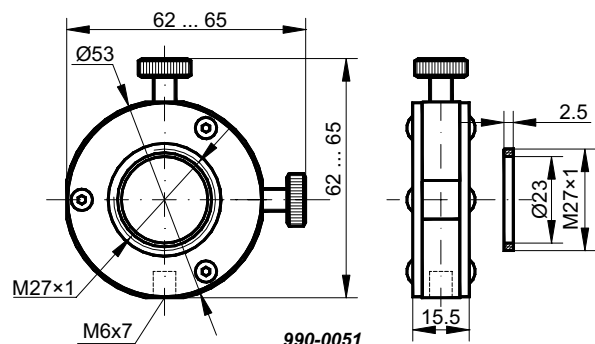
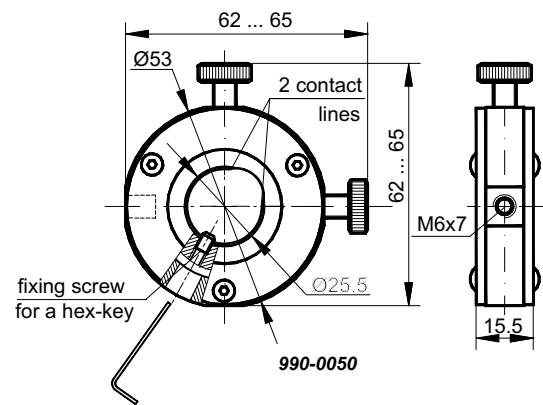
Y-Z Positioner 990-0050 accepts optics Ø25.4 mm. Optics is stopped by a rest-flange inside the central aperture of the platform and is secured by a hex fixing screw with hard plastic tip. 990-0050 is ideal for microscope objectives, mounted pinholes, fiber optics chucks and diode lasers.

990-0051 includes two plastic padding rings and a retaining ring M27×1 to fix the optics.

A tightening key for the retaining ring is available on request.

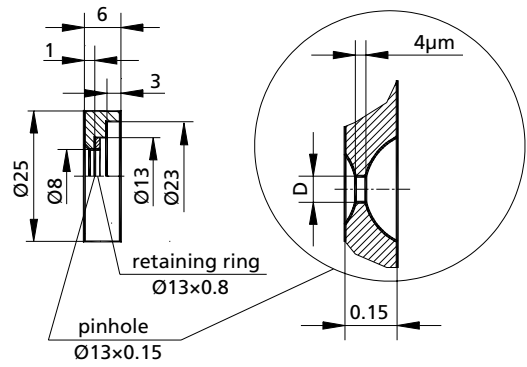


990-0051



Code	Price, EUR
990-0050	119
990-0051	119

PRECISION PINHOLES

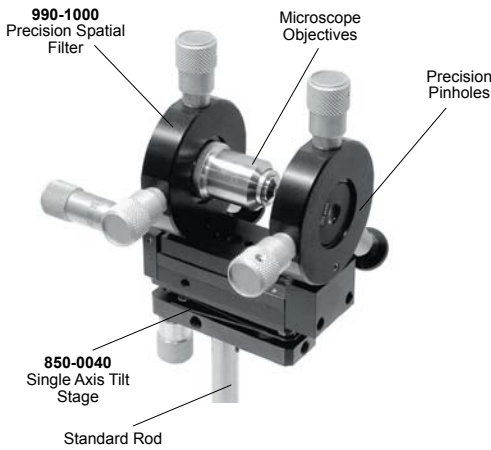


- For diffraction experiments, alignment purposes, projection applications
- Chemically etched apertures
- Apertures formed in vacuum
- 4 μm thick pinhole in a kovar foil
- Ultra-thin substrate minimizes laser power loss
- Chemically inert

Precision Pinhole is a round aperture precisely formed and controlled in a kovar foil. To facilitate handling, a pinhole foil is mounted in Ø25 mm black metal donut. Precision Pinholes can be used in Precision Spatial Filters 990-1000 or YZ Positioner for Lens, Pinholes and Objectives 990-0100.

We also offer pinholes with diameter D in the range of 45–100 μm every 5 μm. Pinholes of custom diameters up-to 200 μm are available on request.

Model	D, μm
990-0005	5±0.5
990-0010	10±0.5
990-0020	20±0.5
990-0030	30±0.5
990-0040	40±0.5
990-0049	50±0.5
990-0075	75±0.5
990-0110	100±0.5



Single-Axis Tilt Stage 850-0040 greatly facilitates pitch adjustment relative to the optical axis.



Complementary Products

Code	Page
850-0040	7.95
990-1000	6.13
990-0100	6.14

MICROSCOPE OBJECTIVES



Model	Magnification	Numerical aperture	Focal length, mm	Working distance, mm	S, mm	System	Price, EUR
990-0012	3.7	0.11	33.1	27.2	50	dry	93
990-0042	8	0.2	18.14	8.57	33	dry	124
990-0027	20	0.4	8.4	1.7	33	dry	134
990-0001	40	0.65	8.25	0.41	33	dry	157
990-0023	40	0.75	4.32	1.8	32.7	water immersion	172
990-0041	90	1.25	1.96	0.10	32.7	oil immersion	222

Thread size W0.8x1/36".

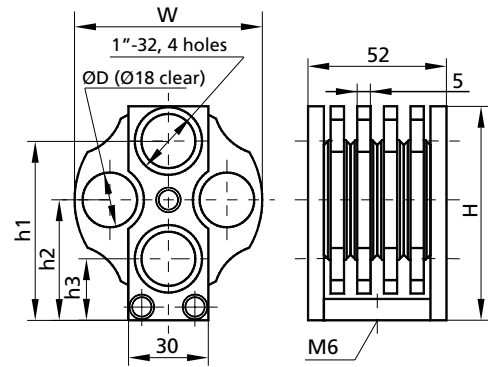
990-0604

VARIABLE WHEEL ATTENUATOR



990-0604-01

- 4 wheels
- 3 filter per wheel (12 filters in total)
- Filter diameter 20 or 25.4 mm
- Maximum deviation 0.09 mm
- Clear aperture $\text{Ø}18/\text{Ø}20$ mm
- C-mount threads on both ends
- Connecting adapters available



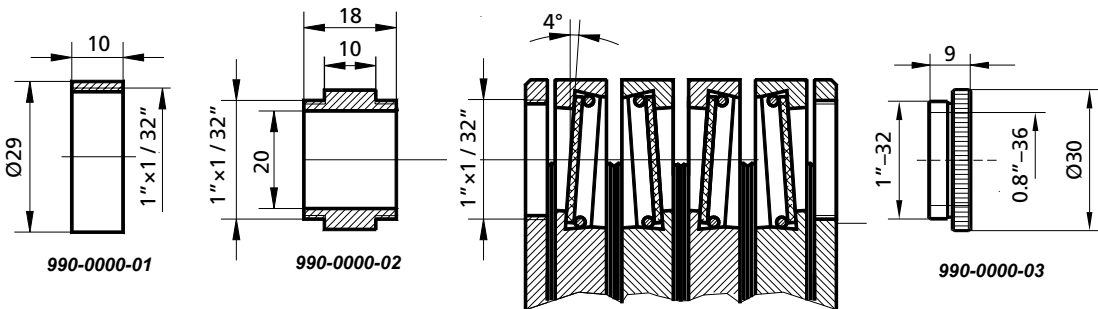
Variable Wheel Attenuator 990-0604 is a basic model with 4 filter-set wheels. Each wheel contains 4 filter slots each for $\text{Ø}20$ mm with clear aperture of $\text{Ø}18$ mm.

Each filter slot is inclined by 4° to avoid retroreflections.

Each wheel has 4 fixed positions. You can use any of these 4 filter positions as an optical axis. The back and front panels do not to obscure.

Both panels have $1''\text{-}32$ threaded holes (C-Mounts). Separately you may order standard connecting adapters 990-0000-01, 990-0000-02 and 990-0000-03. Custom adapters are available.

Mounting M6 hole is provided in the bottom plate. 990-0604-02 model is designed to accept $1''$ (25.4 mm) filters with maximum thickness of 3 mm. This model comes without filters.



Model	H, mm	W, mm	h1, mm	h2, mm	h3, mm	D, mm	Weight, kg	Price, EUR
990-0604-01	84	70	67	45	23	$\text{Ø}20$	0.35	457
990-0604-02	95	80	75	50	25	$\text{Ø}25.4$	0.40	297

Note:

990-0604-01 is with filters $\text{Ø}20$ mm.

990-0604-02 is without filters. 990-0604-02 is suitable for Neutral Density and Colour Glass filters $\text{Ø}25.4$ mm that should be ordered separately.

RELATED PRODUCTS

- Neutral Density Filters $\text{Ø}25.4$ mm *see page 1.33*
- Colour Glass Filters $\text{Ø}25.4$ mm *see page 1.35*

990-0704
CLOSED VARIABLE WHEEL ATTENUATOR


990-0704



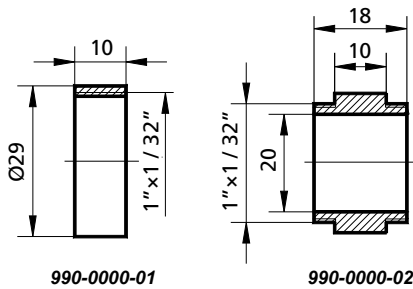
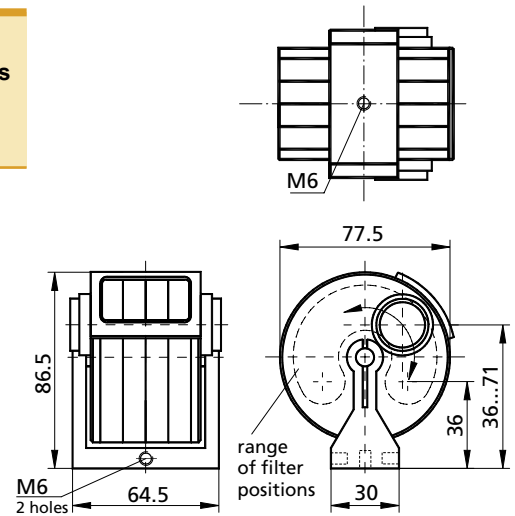
- Stray light fully eliminated
- Variable height of the optical axis
- Three mounting holes
- C-mount threads

Close Variable Wheel Attenuator

is used when it is necessary to fully eliminate the side background lighting when using photodetectors with high sensitivity (e.g. CCD, photomultiplier, etc.). You may order standard connecting adapters 990-0000-01 and 990-0000-02 separately. Custom adapters are available too.

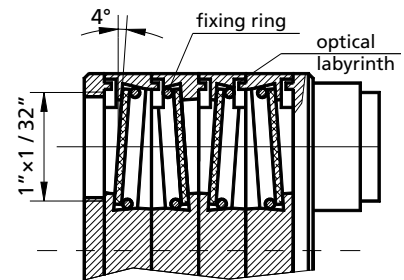
Loosen the central axis and rotate the whole body of the filter to set the desired position of an optical axis at a height between 36–71 mm.

The base of the attenuator has M6 holes on 3 sides for mounting versatility.



990-0000-01

990-0000-02



Code	Weight, kg	Price, EUR
990-0704	0.55	549

SOME APPLICATIONS OF OPTICAL FILTERS

- In systems for laser beam diagnostics with CCD-cameras
- Measurement of laser power, pulse energy and pulse duration
- Spectroscopy
- We can offer a set of bandpass filters for mercury lamp, laser lines, and for your other needs

A choice of filters is available for our standard 4-wheel attenuators, allowing 256 relative positions of wheels, rendering 99 different transmission values, of which you can find a very close match to the desired value. Discrete filters permit to establish accurate optical density.

Also we can offer designs with 1, 2, 3 and more wheels.

Variable wheel attenuators come with a standard, most popular, set of filters listed in Table 1. The standard filters are made of neutral grey glass with spectral characteristics according to Figure 3.

Alternatively, attenuators (wheels and optics) can be manufactured according individual orders. We can also supply variable wheel attenuators without filters, which you can fit by yourself.

Table 1. List of a standard filter-set

	Transmission	Filter #1	Filter #2	Filter #3	Filter #4
Wheel #1	T	1.00	0.90	0.80	0.50
	dB	0.00	0.46	0.97	3.00
Wheel #2	T	1.00	0.30	0.10	0.03
	dB	0.00	5.20	10.00	15.20
Wheel #3	T	1.00	0.01	0.003	0.001
	dB	0.00	20.00	25.00	30.00
Wheel #4	T	1.00	0.0003	0.0001	0.00003
	dB	0.00	35.00	40.00	45.00

In most cases detectors (CCDs, photodiodes, photomultipliers, etc.), used for diagnostics of laser radiations, are too delicate for direct measurement of high powers, such as from ion lasers or pulsed solid-state lasers. An attenuator may be required to reduce laser power density at the surface of detector. Optical attenuators must be used when the laser output-power or power density exceeds working (linear) range or damage threshold of a detector. (Draft International Standard ISO/TC172/SC9/WG1)

For example, the damage threshold for a typical commercially available CCD is about 100 mW/cm², for the ultra high speed photodetectors series AR-S (Antel Optronics Inc.) it is about 200 mW/cm². On the other hand, laser power must be adjusted to the optimum point, which is typically just below the saturation level of the detector. For example, a typical commercially available CCD saturates at only 0.05 mW/cm² at 632.8 nm and at 5.5 mW/cm² at 1.06 μm (see R. Rypma "Dimming the Light ...", in Photonics Spectra N.10, 1995, p.145).

For preliminary attenuation of very high power lasers the simplest approach is to use just the first surface reflection of an uncoated laser-grade substrate.

It is useful to have an intensity adjustment range of at least 1000:1 or more in this final stage. Even when working with a single-wavelength laser, operated at one power level, this range may be encountered when making measurements at different points in the optical train.

After major reduction in intensity by reflection off an uncoated substrate is achieved, some of the low-power neutral density filters of the high optical quality can bring the beam power to the exact level necessary for optimum measurement by detection system.

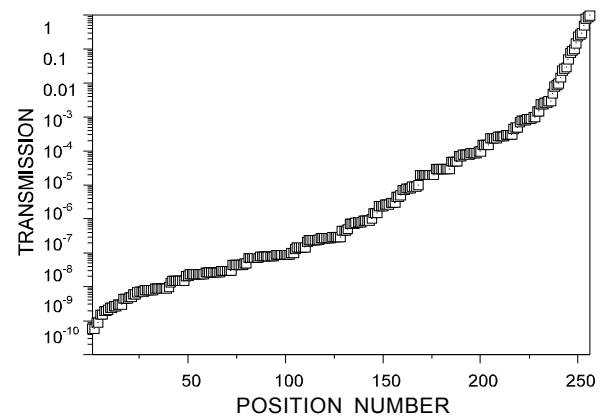


Figure 1

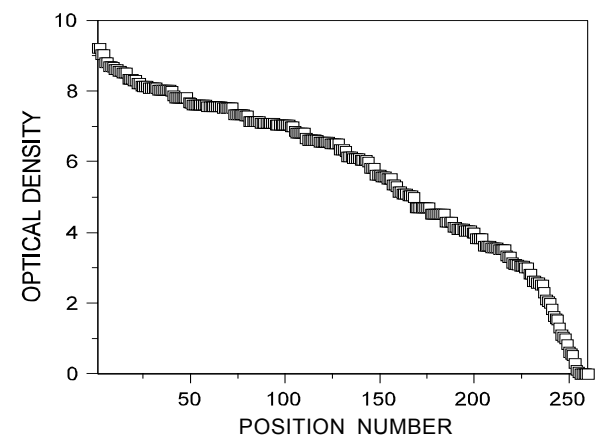


Figure 2

Charts for the standard filter-set: possible filter positions versus resulting transmission/density.

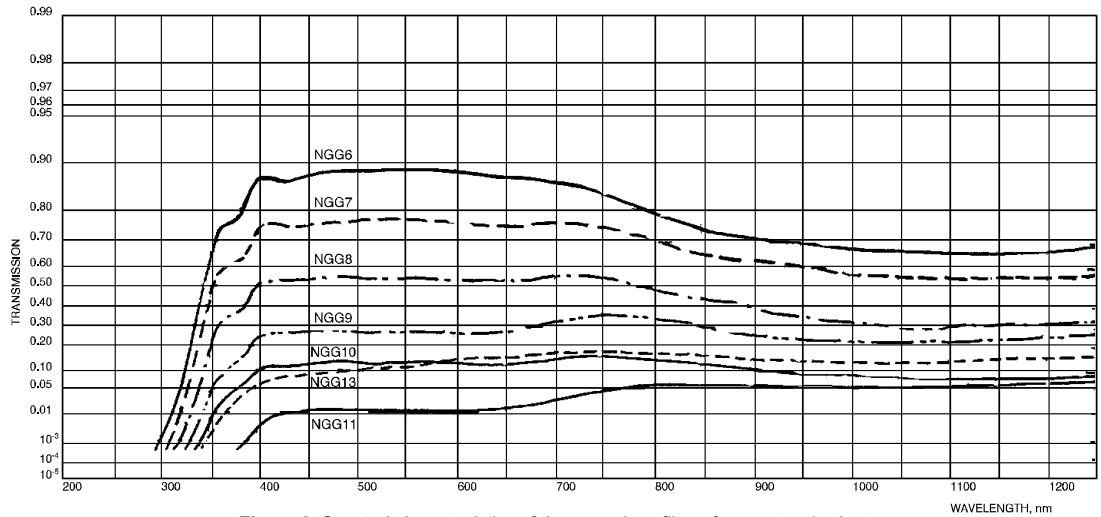


Figure 3. Spectral characteristics of the grey glass filters from a standard set

990-0500

SET OF WHEEL EDGE FILTERS

Set of wheel edge filters is used when it is necessary to reject the shorter or the longer wavelengths.

Also, a combination of short and long wavelength filters allows to construct band pass filters with variable bandwidth (for fluorescence analysis, etc.)

As standard 990-0500 of 4 wheels comes with 6 long-wave pass filters and 6 short-wave pass filters. One hole in each wheel is left open.

Long-wave pass filters are made of absorbing color glass.

Shortwave pass filters are interference filters.

Table 2. Specifications of Filter Set

Wheel number	Type of edge filters	Filter number	Cut-on/off wavelength, nm
1	Short wave pass	1	550
		2	650
		3	750
2	Short wave pass	1	500
		2	600
		3	700
3	Long wave pass	1	450
		2	550
		3	650
4	Long wave pass	1	500
		2	600
		3	700



991-0704 with a CCD camera

Close Variable Wheel Attenuator 991-0704
ideally suits for use with CCD cameras.
Adapters 990-0000-01 or 990-0000-02
are used for connection.



990-0602

According to your request we may design an attenuator with any number of wheels.

990-0400

FILTERS HOLDER WITH 90° FLIP



990-0415



990-0423

The holder of 1 inch filters **990-0415** allows fixation of up to 5 filters into 1 inch optics ring holders. The thickness of optical filters (or any other optical elements) to be held is from 0.5 mm to 8.0 mm. Filters can be easily replaced in ring holders. This filter holder allows fast filter remove from beam path flipping it at 90° position. Any position of filters can be fixed with fixing screw. The firm 0° position can be fixed with the second brass screw (included).

The holder of 2 inch filters **990-0423** allows fixation of up to 3 filters into 2 inch optics ring holders. The thickness of optical filters (or any other optical elements) to be held is from 0.5 mm to 14.0 mm.

The holder **990-0415ND** is the same holder **990-0415** but with Neutral Density filters that operates as step energy attenuator and allows adjusting transmission from 100% (all 5 filters are at 90° position) till 0.015% (all 5 filters are at 0° position) at visible region. If you need other adjustment you can choose any other Neutral Density filter Ø25.4 mm.

Using the holder **990-0415** with various color glass or dielectric filters various transmitted band pass regions can be achieved. The Filters Holder with 90° Flip is made of black anodized aluminium and brass screws.

Catalogue number	Acceptable filters number	Suitable filters diameter, mm	Clear aperture diameter, mm	Weight, kg	Price, EUR
990-0415	5	25.4	23	0.16	155
990-0415ND	5	25.4	23	0.19	250
990-0423	3	50.8	48	0.22	145

- Allows stacking of 5 filters of Ø25,4 mm (1"), or 3 filters of Ø50,8 (2")
- Fast flipping in and out of beam path
- Available to be used in 90° position
- Has one M4, two M6 and two holes Ø 6.4mm for mounting on posts or table bases
- Black Anodized Aluminium and Brass screws

RELATED PRODUCTS

- Neutral Density Filters Ø25.4 mm
see page 1.33



990-0415 at 0° position

(Note: Solid base height extender 820-0210 should be ordered separately)



990-0423 at 0° position

(Note: Solid base height extender 820-0210 should be ordered separately)



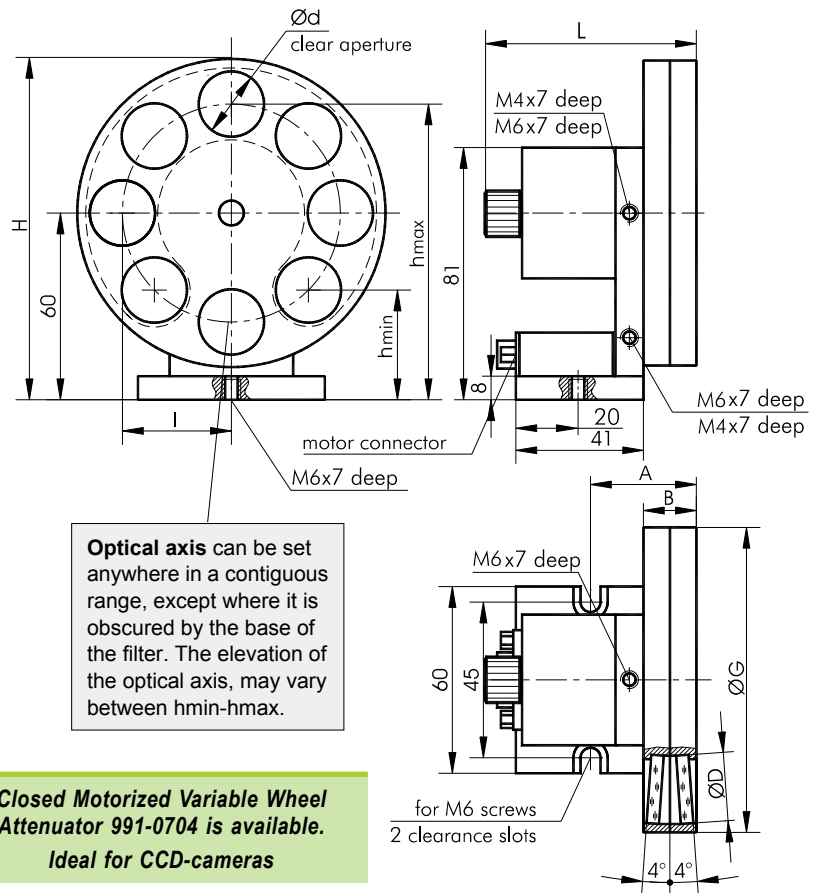
990-0415 at 0° or 90° position

(Note: Solid base height extender 820-0210 should be ordered separately)

991-0602
MOTORIZED VARIABLE TWO WHEELS ATTENUATORS


991-0602-01

- Filter diameter – $\varnothing 20/\varnothing 25.4$ mm
- Clear aperture $\varnothing 18/\varnothing 23$ mm
- Non parallel filters (inclined by 4°)
- Maximum thickness of filters – 2 mm
- Custom design available



Optical axis can be set anywhere in a contiguous range, except where it is obscured by the base of the filter. The elevation of the optical axis, may vary between h_{min} - h_{max} .

Closed Motorized Variable Wheel Attenuator 991-0704 is available. Ideal for CCD-cameras

Motorized Variable Two Wheel Attenuator 991-0602 consists of two filter wheels. Each wheel contains eight filter mounts of $\varnothing D$ mm with clear aperture $\varnothing d$ mm. Each mount is inclined by 4° to prevent mutual reflections between filters.

We supply the attenuators 991-0602-01 with a standard, most popular, set of filters. See the table below. Alternatively, optics can be manufactured according individual orders. Or we can supply the attenuators without filters, which you can fit by yourself.

Bring a filter of each wheel into the optical path easily by hand or using automation. Two wheels are driven by a single step motor. A computer can operate it via a controller. The Step Motor Controller Card 980-0030F-USB / 980-0030-RS232 and Position Control Software come separately.

For fastening, attenuator has clearance slots for M6 and M4 screws. There are also two M6 holes, and one M4 hole (opposite to one of the M6 holes).

Material: black anodized aluminium.

Model	D, mm	d, mm	H, mm	G, mm	A, mm	B, mm	L, mm	h_{min} , mm	h_{max} , mm	I, mm	Price, EUR
991-0602-01	$\varnothing 20$	$\varnothing 18$	110	$\varnothing 100$	35	16.5	73.5	34	97	37	893
991-0602-02	$\varnothing 25.4$	$\varnothing 23$	115	$\varnothing 110$	39	20.5	78	32	99.5	39.5	713

Note:
991-0602-01 is with filters dia 20 mm.

991-0602-02 is without filters. 991-0602-02 is suitable for Neutral Density and Colour Glass Filters $\varnothing 25.4$ mm that should be ordered separately.

RELATED PRODUCTS

- Neutral Density Filters $\varnothing 25.4$ mm
see page 1.33
- Colour Glass Filters $\varnothing 25.4$ mm
see page 1.35

Standard set filters transmittance

Wheel N1	Wheel N2
1	1
0	0
0.9	0.8
0.5	0.3
0.1	0.03
0.01	0.003
0.001	0.0003
0.0001	0.00003

Standard stepping motor specifications

Rated current	0.4 A
Resistance	33 Ω
Inductance	52 mH
Holding torque	0.12 N·m
Step angle	1.8°
Step angle accuracy	5 min
Required electrical power	5.6 W
Weight:	
991-0602-01	0.61 kg
991-0602-02	0.65 kg

Motors of other types are available.

991-0702

**MOTORIZED CLOSED VARIABLE
TWO WHEELS ATTENUATORS**


991-0702-01

- Filter diameter – $\varnothing 20/\varnothing 25.4$ mm
- Clear aperture $\varnothing 18/\varnothing 23$ mm
- Non parallel filters (inclined by 4°)
- Maximum thickness of filters – 2 mm
- C-mount threads on both ends

Motorized Closed Variable Two Wheel Attenuator 991-0702 consists of two filter wheels. Each wheel contains eight filter mounts of $\varnothing D$ mm with clear aperture of $\varnothing d$ mm. Each mount is inclined by 4 degrees to prevent mutual reflections between filters.

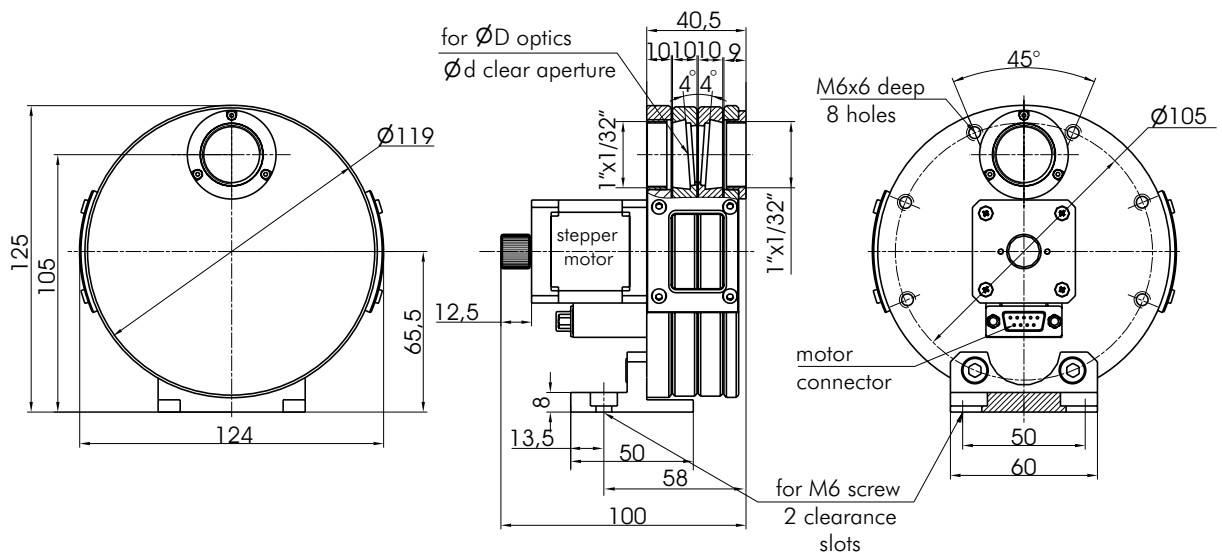
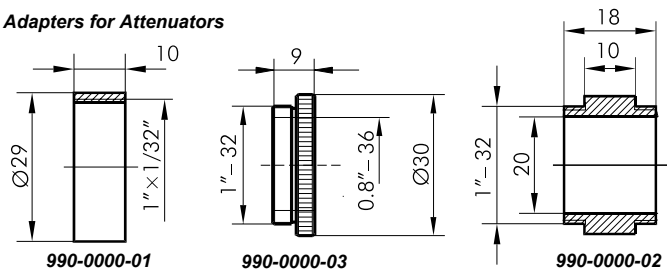
We supply the attenuator 991-0702-01 with a standard, most popular, set of filters. See the table below. Alternatively, optics could be manufactured to individual orders. Or we could supply the attenuator without filters, which you can fit by yourself.

You bring a filter of each wheel into the optical path easily by hand or using automation. The two wheels are driven by a single step motor. A computer can operate it via a controller and Computer Software come separately.

For fastening, the attenuator has clearance slots for M6 and M4 screws. There are also two M6 holes, and one M4 hole (opposite to one of the M6 holes).

Material: black anodized aluminium.

Adapters for Attenuators



Model	D, mm	d, mm	Price, EUR
991-0702-01	$\varnothing 20$	$\varnothing 18$	1093
991-0702-02	$\varnothing 25.4$	$\varnothing 23$	913

Note:

991-0702-01 is with filters $\varnothing 20$ mm.

991-0702-02 is without filters. 991-0702-02 is suitable for Neutral Density and Colour Glass Filters $\varnothing 25.4$ mm that should be ordered separately.

RELATED PRODUCTS

- Neutral Density Filters $\varnothing 25.4$ mm
see page 1.33
- Colour Glass Filters $\varnothing 25.4$ mm
see page 1.35

Standard set filters transmittance

Wheel N1	Wheel N2
1	1
0	0
0.9	0.8
0.5	0.3
0.1	0.03
0.01	0.003
0.001	0.0003
0.0001	0.00003

Standard stepping motor specifications

Rated current	0.4 A
Resistance	33 Ω
Inductance	52 mH
Holding torque	0.12 N·m
Step angle	1.8 $^\circ$
Step angle accuracy	5 min
Required electrical power	5.6 W
Weight:	
991-0702-01	0.7 kg
991-0702-02	0.75 kg

Motors of other types are available.

COMPUTER SOFTWARE FOR MOTORIZED ATTENUATORS

- Control of single stepper motor with two wheels and up to 8 filters in every wheel
- Three different transmittance tables can be configured for three different wavelengths
- Operation in transmittance and optical density modes
- Program can choose the best combination for required transmittance or optical density, or filters defined by user can be set
- Different speed and step division options

Computer Software is designed to control motorized attenuator unit with one of our stepper motor controllers:

- 980-0030F-USB (page 7.184);
- 980-0030-RS232 (page 7.187).

Motorized attenuator together with program can be applied in all kinds of optical circuitry where variable transmittance has to be achieved.

Program allows to change easily transmittance or optical density of an attenuator **991-0602** and **991-0702**. Just enter transmittance or optical density values, and the program will select the closest two filters. Or you can select the filters directly.

The simple interface allows to use the program right away. For each of the three different wavelengths it stores a set of filter transmittance values, which a user can modify. **“Density/Transmittance”** button switches between these modes at any time.

All system configuration information and current state of an attenuator is stored in a file and is automatically reloaded after the program starts.

Any of our software works only with our controllers.



REQUIREMENTS

PC compatible computer with any minimal Windows 95/98/ME/2000/XP installation

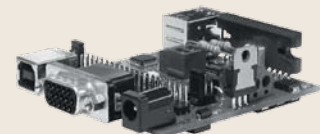
Display

Step Motor Controllers

Stepper Motor Controllers for MOTORIZED VARIABLE TWO WHEELS ATTENUATORS



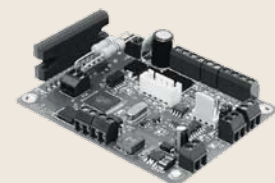
*Motorized Variable Two Wheels Attenuator **991-0602** see page 6.21*



980-0030F-USB see page 7.178



*Motorized Closed Variable Two Wheels Attenuators **991-0702** see page 6.22*



980-0030-RS232 see page 7.181

990-0800

AIR-COOLED BEAM DUMP



990-0800

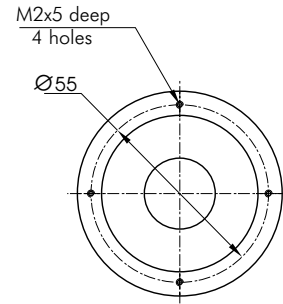
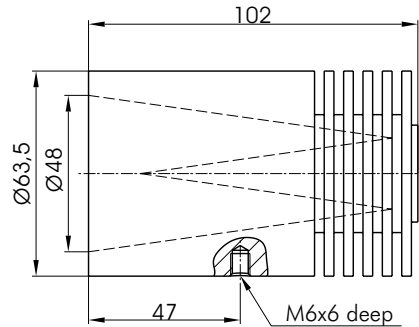
Beam Dump 990-0800 is designed to block a CW or a pulsed laser beam. It can be used on beams of up to 50 W in the wavelength range from 0.1 to 30 μm .

The design is such, that, even if the non-reflective coating is damaged by high intensity pulses, there's no backward reflection.

SPECIFICATIONS

Wavelength range	0.1-30 μm
Max. Handling power	50 W
Max. Energy	2.5 J (20 Hz)
Acceptance aperture	48 mm (1.89")
Laser type	pulsed, CW

Code	Weight, kg	Price, EUR
990-0800	0.57	169



990-0820

WATER-COOLED BEAM DUMP



990-0820

Beam Dump 990-0820 blocks a CW or a pulsed laser beam. It is mainly intended for beams 2 inch wide.

Water absorbs much energy. So, the dump is best suited for beams of up to 1 kW. The wavelength range is from 0.1 to 30 μm .

Even if the non-reflective coating is damaged by high intensity pulses, the beam is not reflected back into your optical scheme.

The dump mounts on M6 hole on its back.

SPECIFICATIONS

Wavelength range	0.1-30 μm
Max. Handling power	1 kW
Max. Energy	50 J (20 Hz)
Acceptance aperture	48 mm (1.89")
Laser type	pulsed, CW

Code	Weight, kg	Price, EUR
990-0820	1.2	239

