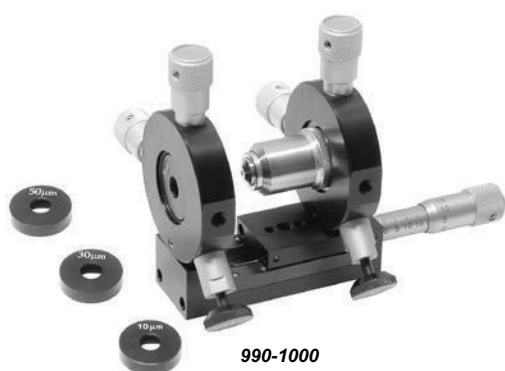
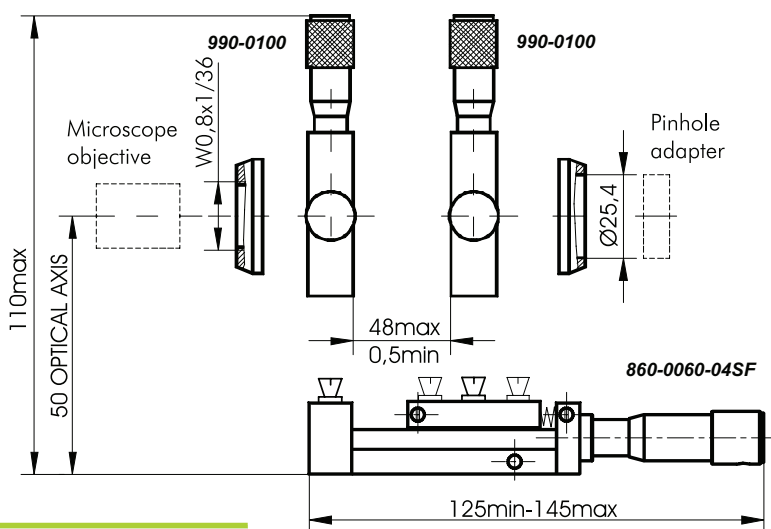




Opto-Mechanics Sets

990-1000
PRECISION SPATIAL FILTER


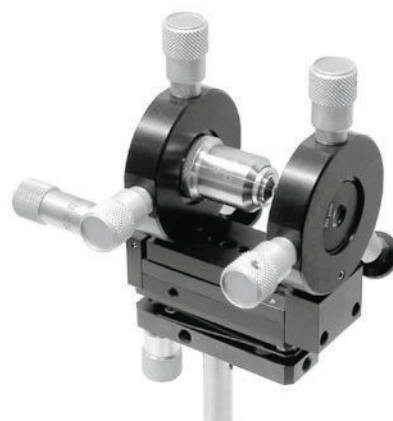
- 3-axes adjustment with micrometers
- Accommodates virtually any microscope objective
- Unobscured view of a pinhole facilitates alignment
- Easy pinhole removal and replacement



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.


Complementary Products

Code	Page
860-0060-04	5.107
990-0100	5.168

Code	Weight, kg
990-1000	0.87

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.

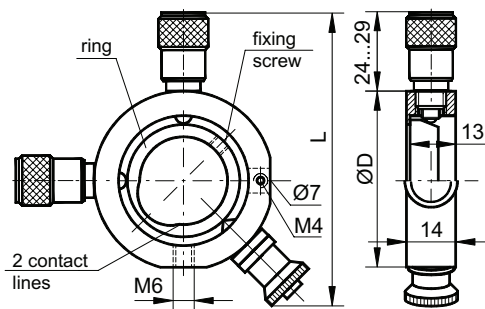
990-0100 may contain one of 1 inch rings: W0.8, A1 or B1.

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

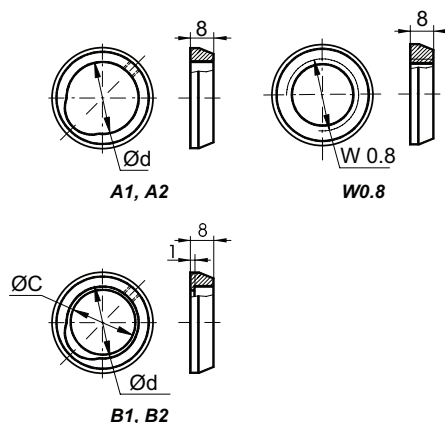
Two adjustment screws 870-0030 are used for positioning. They can be replaced with any screw or micrometer with M10×1 mounting thread.

Two ways to fasten positioner: on mounting posts 820-0010 by an M6 hole; on a connecting cone 820-0256 by a Ø7 hole.

Material: anodized aluminium.



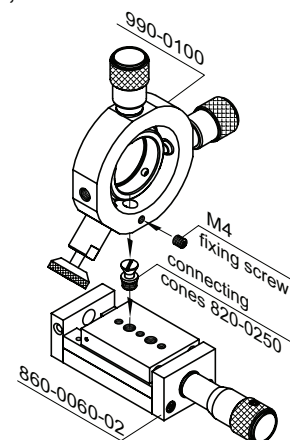
Insert rings



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

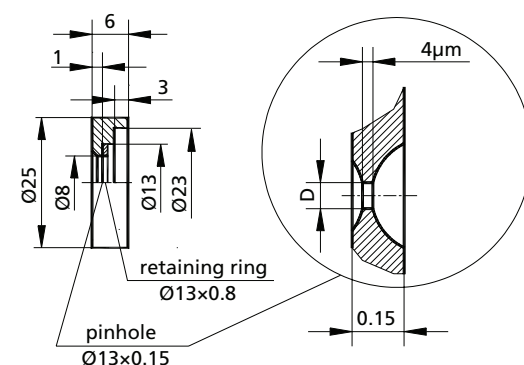
ORDERING INFORMATION

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



OPTICAL TABLES
BRACKETS & RAILS
BASE MOUNTS & ACCESSORIES
OPTICAL MOUNTS
OPTICAL POSITIONERS
BASE POSITIONERS
TRANSLATION & ROTATION STAGES
ADJUSTMENT SCREWS
MOTORIZED POSITIONERS
OPTO-MECHANICS SETS

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



Complementary Products

Code	Page
990-1000	5.167
990-0100	5.168

MICROSCOPE OBJECTIVES



Model	Magnification	Numerical aperture	Focal length, mm	Working distance, mm	S, mm	System
990-0012	3.7	0.11	33.10	27.20	50	dry
990-0042	8	0.20	18.14	8.57	33	dry
990-0027	20	0.40	8.40	1.70	33	dry
990-0001	40	0.65	8.25	0.41	33	dry
990-0023	40	0.75	4.32	1.80	32.7	water immersion
990-0041	90	1.25	1.96	0.10	32.7	oil immersion

990-0050
990-0051

**Y-Z POSITIONERS
FOR LENS, PINHOLES AND OBJECTIVES**



990-0050

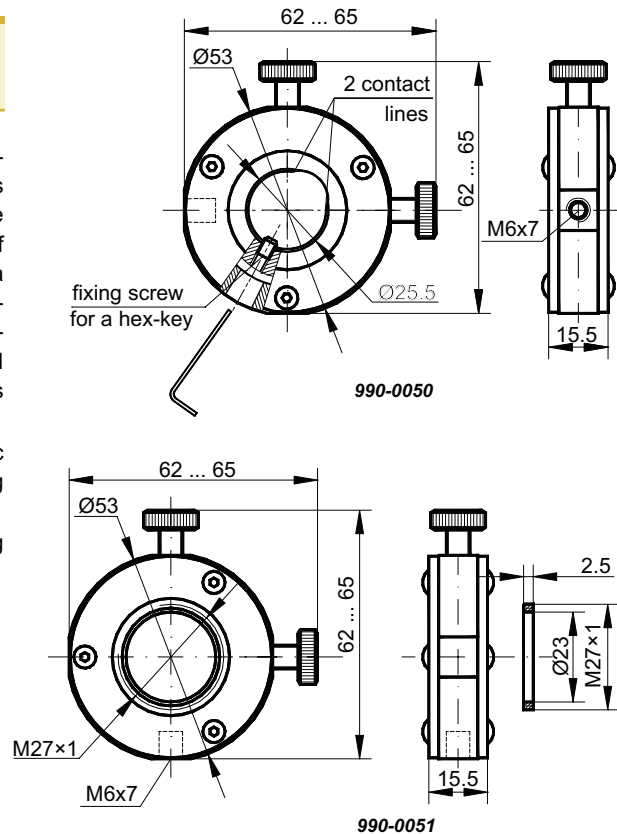


990-0051

- Travel range 3 mm
- Weight 0.12 kg

Y-Z Positioner 990-0050 accepts optics $\varnothing 25.4$ 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 M27x1 to fix the optics. A tightening key for the retaining ring is available on request.



990-0060

**CONTINUOUSLY VARIABLE ATTENUATOR /
BEAMSPLITTER**



- Divides laser beam into two beams of manually adjustable intensity ratio
- Convenient 90 deg angle between reflected and transmitted beams
- Negligible beam deviation
- Large dynamic range

Continuously Variable Attenuator / Beamsplitter for down to 100 fs laser pulses. This Variable Attenuator / Beamsplitter consists of 2 high-performance polarizing optics components placed in precision opto-mechanical Holder 840-0197. 990-0060 incorporates a high-performance Polarizing Cube Beamsplitter which reflects s-polarized light 90 while transmitting p-polarized light.

A rotating quartz Phase 1/2 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.

SPECIFICATIONS

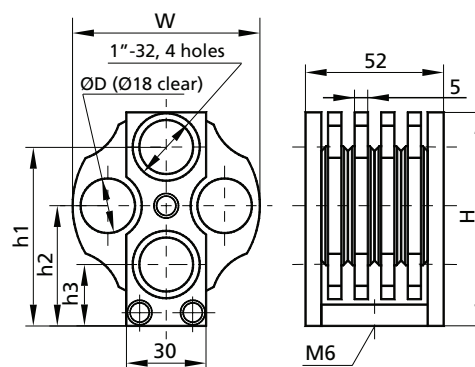
Beam deviation	40×10^{-6} rad, average over range
Damage threshold	200 mJ/cm ² pulsed at 1064 nm, typical
Antireflection coating	R < 0.25% all entrance and exit surfaces
Time dispersion	t > 100 fs for laser pulses
Extinction ratio	T _s /T _p < 1:1000

Standard Models	Central wavelength, nm	Clear aperture, mm
990-0061-10	1064	10
990-0061-15	1064	15
990-0061-20	1064	20
990-0062-10	780	10
990-0062-15	780	15
990-0062-20	780	20
990-0063-10	800	10
990-0063-15	800	15
990-0063-20	800	20

990-0604
VARIABLE WHEEL ATTENUATOR


990-0604-01

- 4 wheels, each contain 3 filters and 1 empty space
- 4 fixed positions per wheel
- NDF diameter 20 or 25.4 mm
- Maximum thickness 3 mm
- Non-parallel filters (inclined by 4°)
- Maximum deviation 0.09 mm
- Clear aperture Ø18/Ø20 mm
- C-mount threads on both ends
- Connecting adapters available

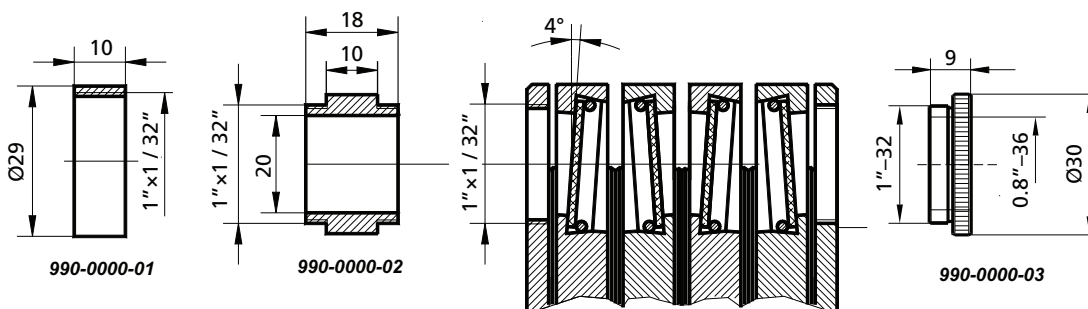


Variable Wheel Attenuator 990-0604 is a basic model with 4 filter-set wheels. Each wheel contains 4 filter slots each of Ø20 mm with clear aperture of Ø18 mm.

Each filter slot is inclined by 4° to avoid reflectors. 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 them.

Both panels have 1"–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
990-0604-01	84	70	67	45	23	Ø20	0.35
990-0604-02	95	80	75	50	25	Ø25.4	0.40

Note:

990-0604-01 is with filters dia 20 mm.

990-0604-02 is without filters. 990-0604-02 is suitable for Neutral Density and Colour Glass filters dia 25.4 mm that should be ordered separately.

RELATED PRODUCTS

- Neutral Density Filters dia 25.4 mm *see page 1.32*
- Colour Glass Filters dia 25.4 mm *see page 1.33*

990-0704 **CLOSED VARIABLE WHEEL ATTENUATOR**



990-0704

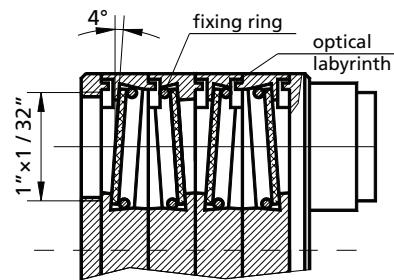
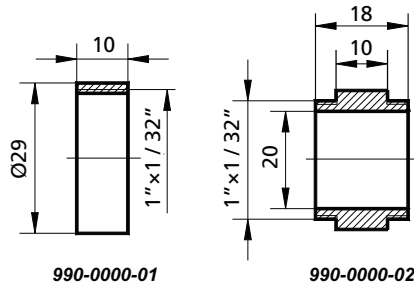
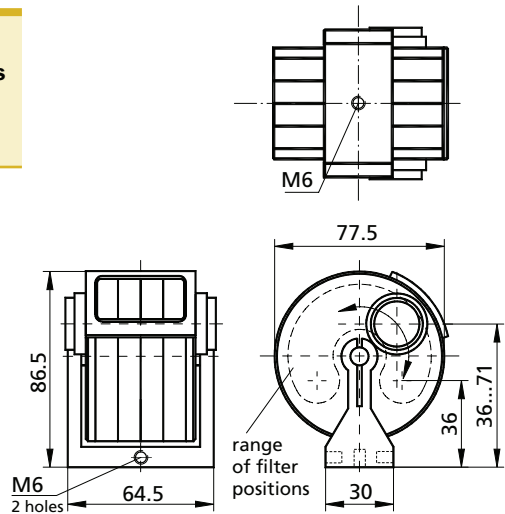


- Stray light fully eliminated
- Variable height of the optical axis
- Three mounting holes
- C-mount threads

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.



Code	Weight, kg
990-0704	0.55

OPTICAL TABLES

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ADJUSTMENT SCREWS

MOTORIZED POSITIONERS

OPTO-MECHANICS SETS

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.

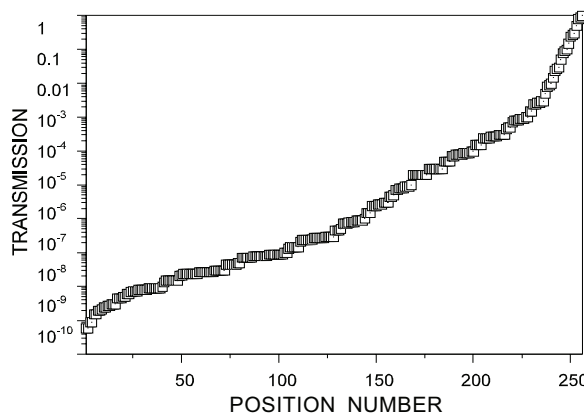


Figure 1

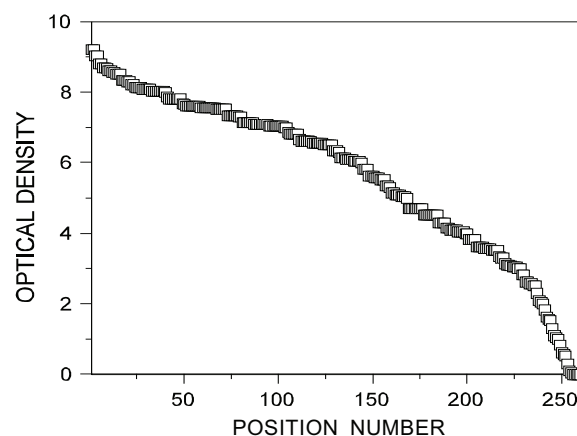


Figure 2

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

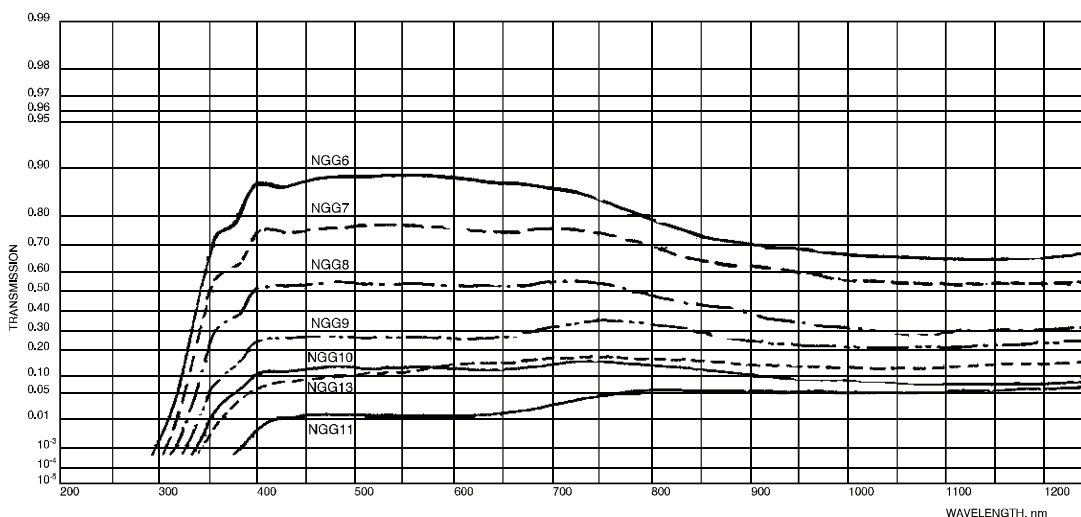


Figure 3. Spectral characteristics of the grey glass filters from a standard set

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.)

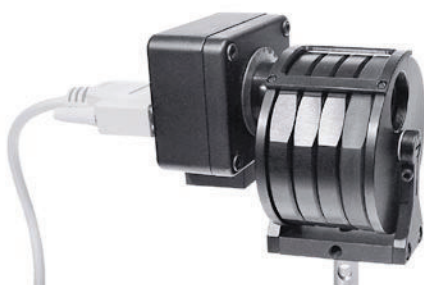
As standard 990-0500 of 4 wheels comes with 6 long-wave pass filters and 6 short-wave pass filters. One hole in each wheel is left open.

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

Shortwave pass filters are interference filters.

Table 2

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.



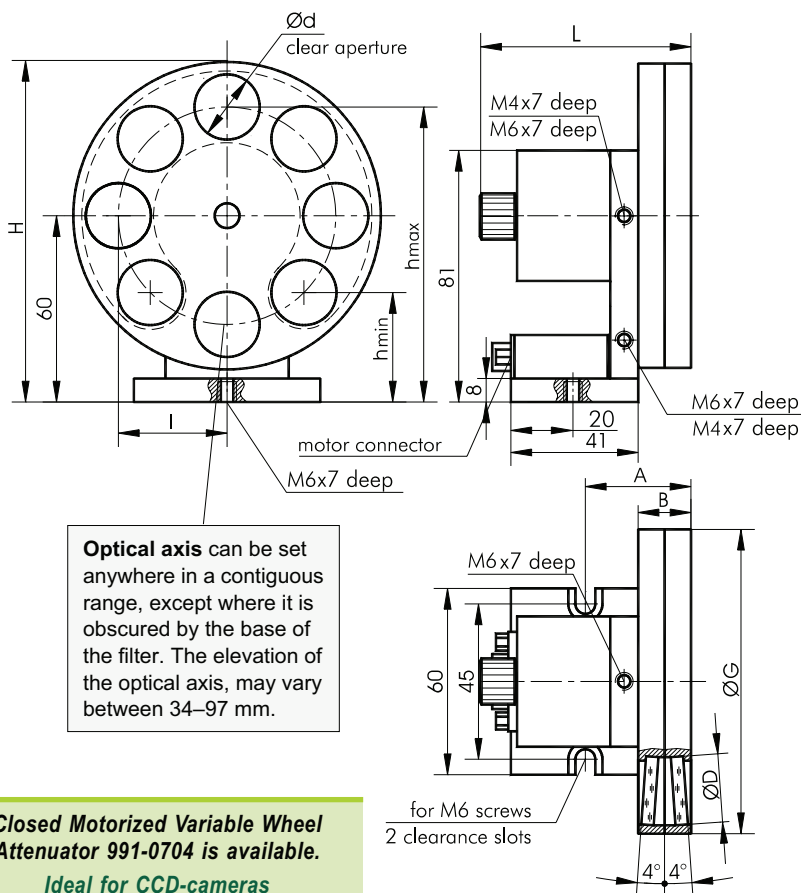
990-0602

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

991-0602
MOTORIZED VARIABLE TWO WHEEL ATTENUATOR


991-0602-01

- 2 wheels contain 6 filters, 1 target plate & 1 empty space each
- 200 fixed positions per wheel (if stepping motor is in full step mode)
- Diameter NDF 20 mm
- Clear aperture $\varnothing 18$ mm
- Non parallel filters (inclined by 4°)
- Maximum thickness of filters – 2 mm
- Custom design available



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 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
991-0602-01	$\varnothing 20$	$\varnothing 18$	110	$\varnothing 100$	35	16	73	34	97	37
991-0602-02	$\varnothing 25.4$	$\varnothing 23$	115	$\varnothing 110$	39	20	77	32	99.5	39.5

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:	
991-0602-20	0.61 kg
991-0602-01	0.65 kg

Motors of other types are available.

Computer Software

- Control 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 5.155);

980-0030-RS232 (page 5.157).

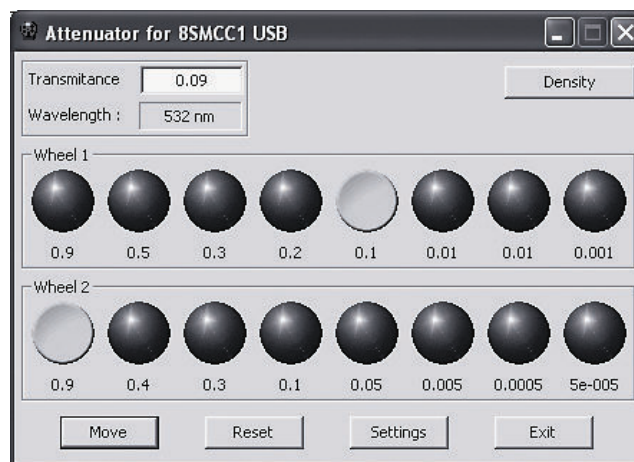
Motorized attenuator together with program can be applied in all kinds of optical circuitry where variable transmittance has to be achieved.

Program allows to change easily transmittance or optical density of an attenuator **991-0602**. 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 wave lengths 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.



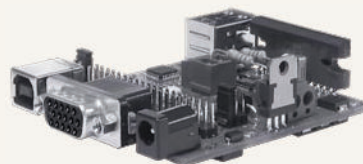
REQUIREMENTS

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

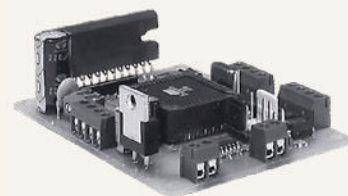
Display

Step Motor Controllers

RELATED CONTROLLERS



980-0030F-USB
see page 5.162



980-0030-RS232
see page 5.164

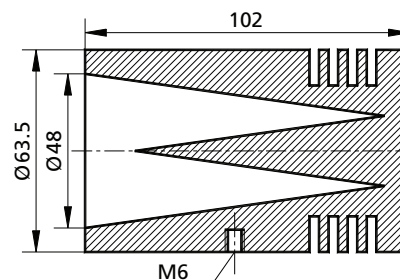
990-0800
AIR-COOLED BEAM DUMP


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.

Code	Weight, kg
990-0800	0.57

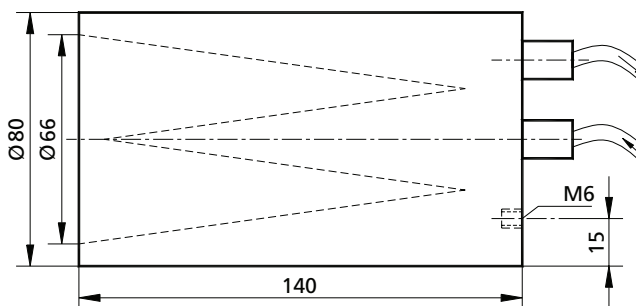

990-0820
WATER-COOLED BEAM DUMP


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 over 1 kW. The wavelength range is from 0.1 to 30 μm .

Code	Weight, kg
990-0820	1.2



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.

990-0840
VISUALIZATOR


990-0840

- Reflects an invisible beam as it is visible in the second harmonic
- High mechanical durability
- High sensitivity to laser radiation

Visualizator transforms an invisible light into visible. When CW or pulsed laser radiation of wavelength 880–1070 nm falls onto the working surface, the latter glows in the second harmonic of the beam.

Use this item to adjust and check a shape of a laser beam. It helps to see the structure of a laser beam intensity distribution. Visualizator working surface diameter is 35 mm.