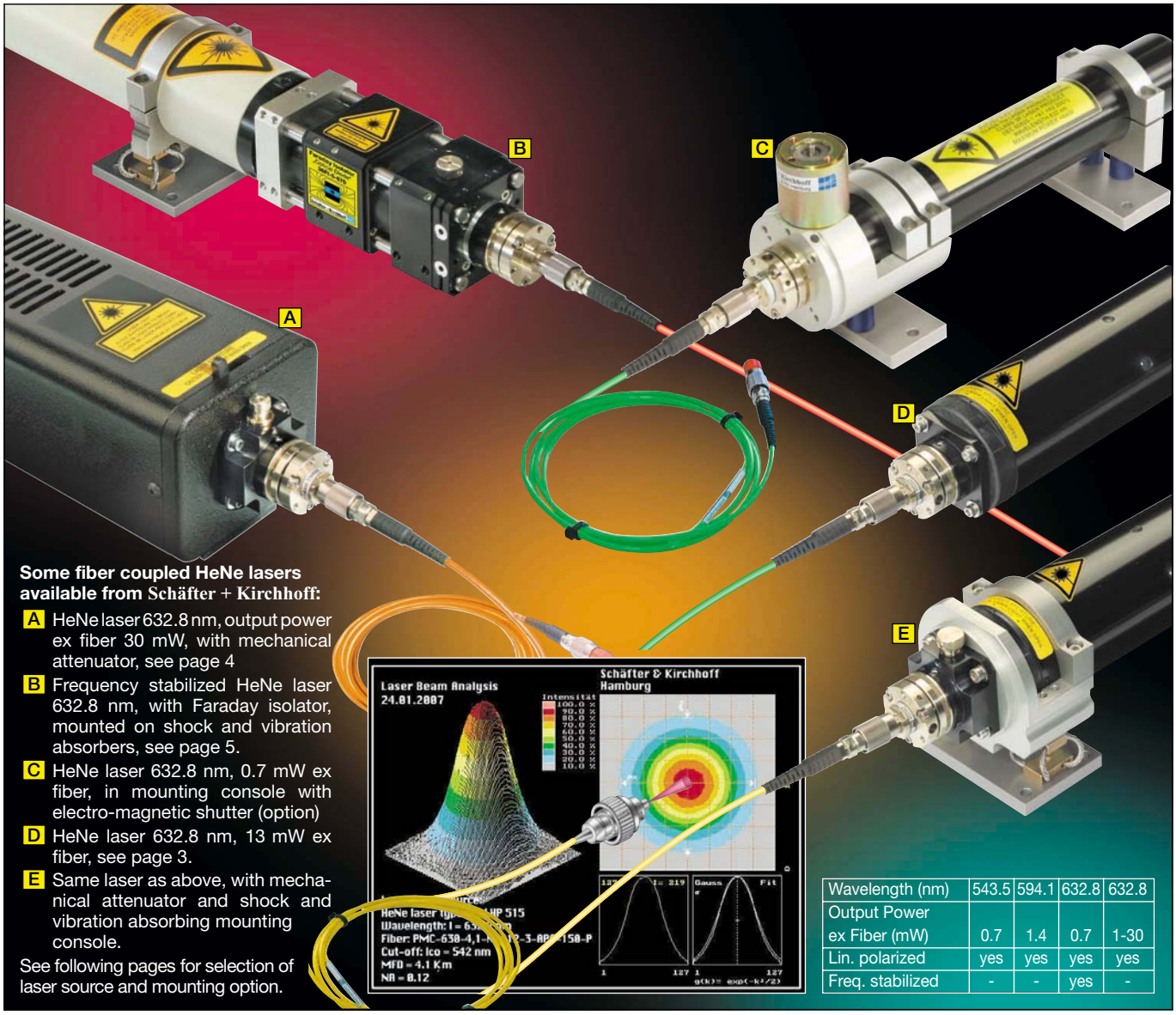
Schäfter + Kirchhoff

HeNe Laser
with polarization maintaining fiber optics

Universal Beam Source for Interferometry and Frequency Standards

High coupling efficiency, transport stability, and polarization maintainance are characteristics of **Schäfter + Kirchhoff** helium-neon (HeNe) lasers with fiber optics. HeNe lasers with wavelength 543.5, 594.1, and 632.8 nm are available with output powers at the fiber ends ranging from approx. 1 mW (all wavelengths) to 30 mW (632.8 nm only). For low-maintenance laser operation in rough environments, **Schäfter + Kirchhoff** provides shock and vibration absorbing mounting consoles.



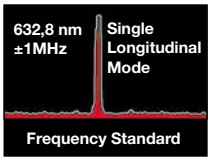
Some fiber coupled HeNe lasers available from Schäfter + Kirchhoff:

- **A** HeNe laser 632.8 nm, output power ex fiber 30 mW, with mechanical attenuator, see page 4
- **B** Frequency stabilized HeNe laser 632.8 nm, with Faraday isolator, mounted on shock and vibration absorbers, see page 5.
- **C** HeNe laser 632.8 nm, 0.7 mW ex fiber, in mounting console with electro-magnetic shutter (option)
- **D** HeNe laser 632.8 nm, 13 mW ex fiber, see page 3.
- **E** Same laser as above, with mechanical attenuator and shock and vibration absorbing mounting console.

See following pages for selection of laser source and mounting option.

Wavelength (nm)	543.5	594.1	632.8	632.8
Output Power ex Fiber (mW)	0.7	1.4	0.7	1-30
Lin. polarized	yes	yes	yes	yes
Freq. stabilized	-	-	yes	-

Applications



HeNe Laser with singlemode fiber

All-round beam source for interferometry and frequency standards

For more than 40 years HeNe lasers are the base of interferometers, spectroscopic, and holographic measurement setups. If wavelength and frequency stability are required, HeNe lasers are superior over many other laser sources with respect to costs, live-time, and reliability.

For HeNe lasers with polarization maintaining fiber optics, there is an increased number of possible applications in research and industry. Coupling the laser beam to a singlemode fiber cable makes a spatial separation of laser beam source and measurement setup possible.

Voluminous, heat dissipating lasers can be placed in a safe distance from the experiment. An additional advantage there is from a laser safety point of view. Even in large setups, it is possible to confine all laser beams to optical fibers, and to completely avoid free space beams.

Made in Germany

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Overview: HeNe lasers 633, 543, 594, and 1523 nm - output power 0.6 - 28 mW ex fiber

Table 1 HeNe Laser

Column		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
No		Wave-length [nm]	Power ex fiber [mW]	Polari-zation	Type	Supply Voltage	Shutter/ Attenua-tor	Fiber Type	Fiber Con-nector Option	Fiber Length [cm]	Laser					Power Supply Style	Fiber Cable		
											Shutter *	Laser Diameter [mm]	Length [mm]	Drawing see Page	Laser Class		NA	MFD 1/e² [µm]	
		Red																	
1	HeNe	633	0.6	P	1107 P	..	..	..	..	..	-	31.6	178	4	2	A	0.12	4.1	1107P-0,5-0,8-A2,7
2	HeNe	633	1.5	P	LHP 121	..	..	..	..	..	x	44.5	272	3	3B	B	0.12	4.1	LHP121-2-0,6-A3,1
3	HeNe	633	3.5	P	LHP 151	..	..	..	..	..	x	44.5	396	3	3B	B	0.12	4.1	LHP151-5-1-A6,2S
4	HeNe	633	7	P	LHP 991	..	..	..	..	..	x	44.5	484	3	3B	C	0.12	4.1	LHP991-10-1,2-A6,2S
5	HeNe	633	12	P	LHP 925	..	..	..	..	..	x	44.5	637	3	3B	C	0.12	4.1	LHP925-17-0,8-A4,5S
6	HeNe	633	28	P	LHP 928	..	..	..	..	..	x	rect.	1030	4	3B	C	0.12	4.1	LHP928-35-1,2-A6,2S
		Green																	
7	HeNe	543	0.7	P	LGP 121	..	..	..	..	..	x	44.5	510	3	3B	B	0.12	3.5	LGP121-1-0,9-A4,5S
		Yellow																	
8	HeNe	594	1.0	P	LYP 173	..	..	..	..	..	x	44.5	456	3	3B	B	0.12	3.9	LYP173-1-0,6-A4
		Infrared																	
9	HeNe	1523	0.6	P	LIP 171	..	..	..	..	..	x	44.5	456	3	3B	C	0.13	9.1	LIP171-0,8-1,3-M8

Order Code

HeNe - 633 - 3,5 - P - LHP151 - 2 - A - 28 - 0 - 150

Wavelength [nm]

Optical power ex fiber [mW]

Polarization:
linear (standard) . . . . . **P**
random (option) . . . . . R

Laser type

Supply voltage:
230V (standard) **2**
110 V 1
12 V ** 3

Shutter/Attenuator
mechanical shutter * . . . . . S
mechanical attenuator . . . . . **A**
w/o 0

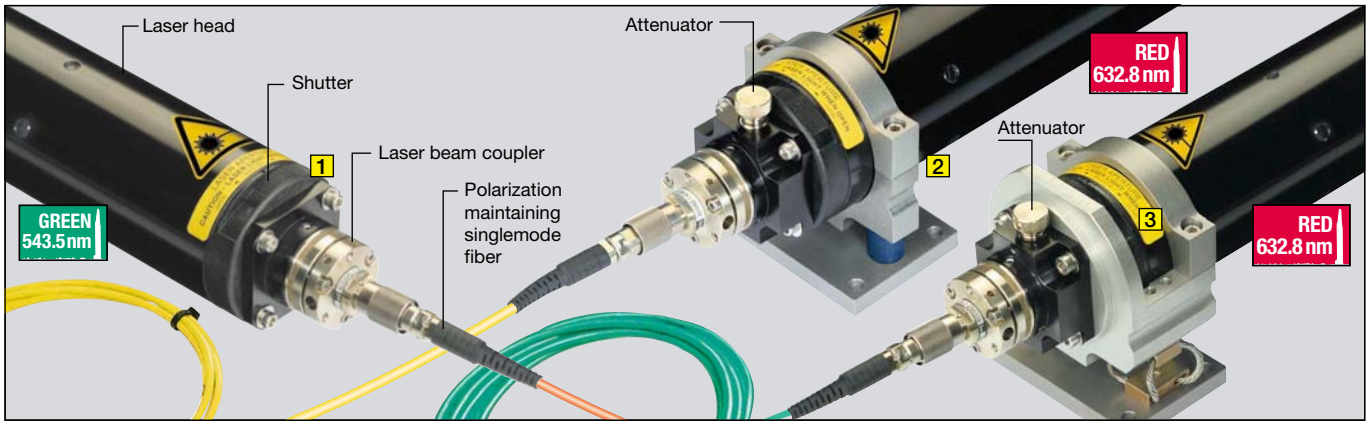
Fiber / connector type:
10 = singlemode fiber cable, FC-PC connector (0° polish)
18 = singlemode fiber cable, FC-APC connector (8° polish)
20 = PM singlemode fiber cable, FC-PC connector (0°-polish)
28 = PM singlemode fiber cable, FC-APC connector (8°-polish), standard
Connector type ST, DIN-Avio, and E-2000 on request

Connector option:
0 = standard
C = core centered < 0.25 µm (singlemode only)

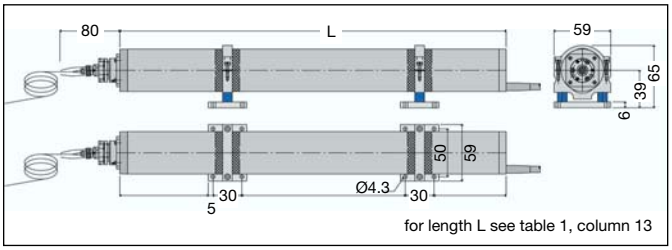
Fiber length [cm]

* In case the laser has its own shutter, see table, column 11, an external shutter is dispensable

** 12 V OEM power supply only available for laser type1107P, Table 1 row 1



HeNe laser, wavelength 632.8, 545.5, 543.5, 594.1, or 1523 nm (Tab. 1, No. 2 - 6 and 7 - 9).
with laser beam coupler and polarization maintaining singlemode fiber cable. A diameter of 44.5 mm is common to these lasers, the tube length varies with laser power and wavelength. The **laser beam coupler 60SMS-...** is held by the adapter **60A19,5-F-AT** (with integrated attenuator, as shown), or the **adapter 60A19,5-F** (without attenuator, see p. 6).
For mounting of the adapter and the laser, several options are available (see p. 6).



for length L see table 1, column 13

1 **Simple configuration:** four screws are used to fasten the adapter to the laser's front plate

2 **Same as before, additionally, mounting consoles MC-MG-44,5-R** with elastomer shock mounts (set of two). Shock and vibrations are damped, thermal deformation of the laser housing, which would be present in case of a rigid mounting of the laser, is prevented.

3 **Optimum configuration for maximum stability:** a metallic mounting console MC-MG-44,5-F-S holds both laser and adapter. The mounting console rests on wire rope isolators, thrusts and accelerations are absorped in all directions.

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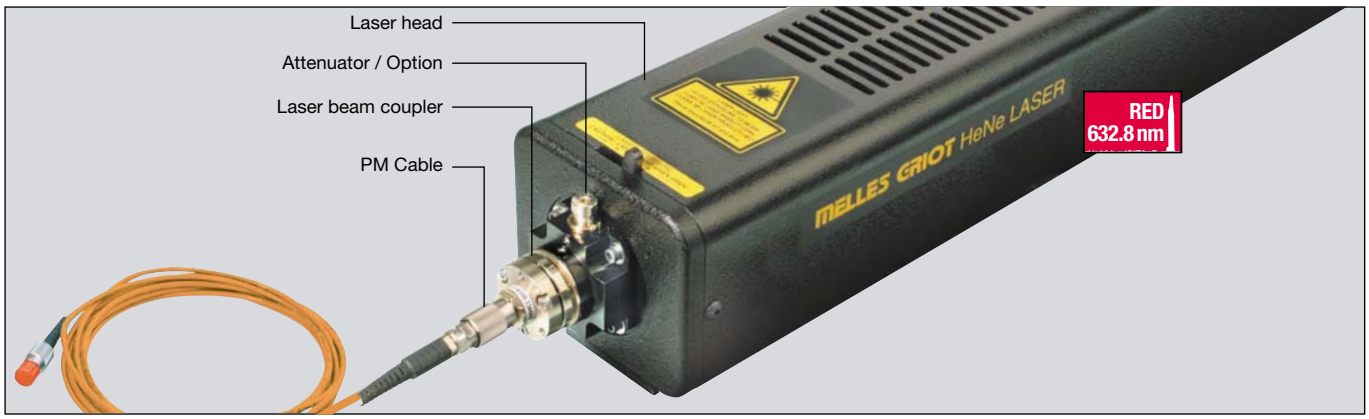
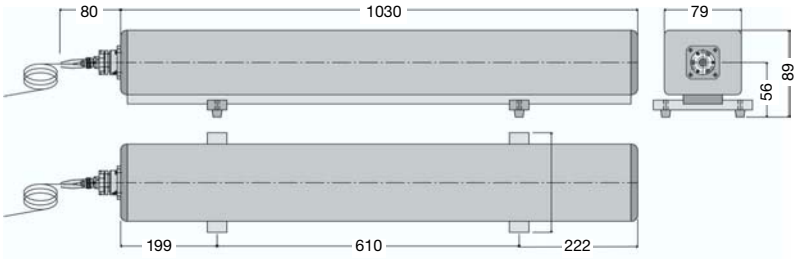
Schäfter + Kirchhoff

High power HeNe laser 633 nm - output power 28 mW ex fiber



High power **HeNe 632.8 nm** laser with polarization maintaining singlemode fiber. Up to 30 mW laser power ex fiber.

The laser is shown with the optionally available **mechanical attenuator 60A19,5-F-AT**. Due to the singlemode fiber, adjustment of the laser power with the mechanical attenuator has no influence on the shape of the emerging Gaussian beam profile.



HeNe - 633 - 28 - P - LHP 928 - 2 - A - 28 - 0 - 300 Order Code

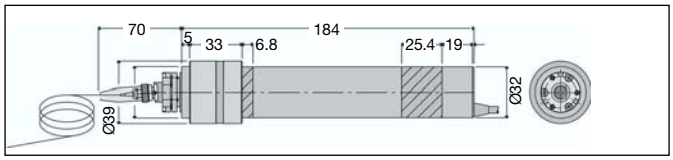
Supply voltage:
230V (standard) **2**
110V 1

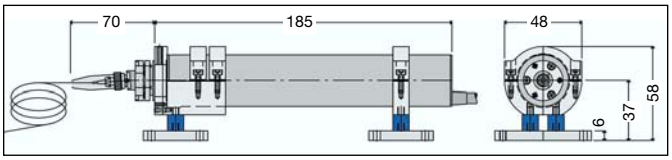
Attenuator
mechanical attenuator . . . . . **A**
w/o 0

Fiber / connector type:
20 = PM singlemode fiber cable, FC-PC connector (0°-polish)
28 = PM singlemode fiber cable, FC-APC connector (8°-polish), standard

Fiber length [cm]

Compact HeNe laser 633 nm/ 0.6 mW ex fiber - standard and ruggedized industrial version





HeNe laser 632.8 with polarization maintaining singlemode fiber. Laser power ex fiber typically > 0.6 mW.
In the standard version (left) a special adapter provides a stable connection of laser beam coupler to the laser housing. On the right, a ruggedized industrial version with an integrated electro-magnetic shutter is shown, mounted on a vibration absorbing console.

* Mechanical shutter, electrical shutter and attenuator available with mounting console only

HeNe - 633 - 0,7 - P - 1107 P - 2 - A - 28 - 0 - 150 Order Code

Polarization:
linear (standard) . . . . . **P**
random (option) . . . . . R

Supply voltage:
230V (standard) **2**
110 V 1
230 V OEM 3
110 V OEM 4
12 V OEM 5

Shutter/Attenuator
mechanical shutter * . . . . . S
electrical shutter * . . . . . E
mechanical attenuator * . . . . . **A**
w/o 0

Fiber / connector type:
10 = singlemode fiber cable, FC-PC connector (0° polish)
18 = singlemode fiber cable, FC-APC connector (8° polish)
20 = PM singlemode fiber cable, FC-PC connector (0°-polish)
28 = PM singlemode fiber cable, FC-APC connector (8°-polish), standard
Connector type ST, DIN-Avio, and E-2000 on request

Connector option:
0 = standard
C = core centered < 0.25 µm (singlemode only)

Fiber length [cm]

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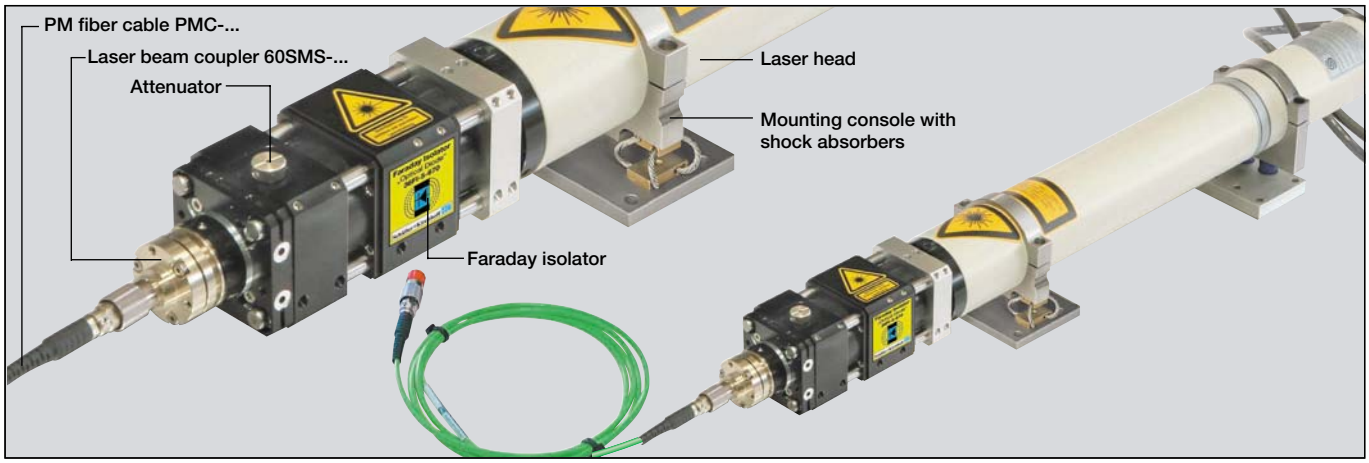
Frequency Stabilized HeNe Laser with polarization maintaining fiber optics

In frequency stabilized HeNe lasers a difference signal of two adjacent, orthogonally polarized modes is used for thermically correcting the resonator length and so compensating frequency variations. After selecting one of these modes by means of a polarizer, at output there is radiation with high polarization extinction and high frequency stability (typ. < 500 kHz over some minutes, <5 MHz over some hours.

Schäfter+Kirchhoff couples frequency stabilized HeNe laser with high coupling efficiency (>75%) to polarization maintaining singlemod fiber cables. Since even marginal back scattering from a measurement object or from the laser beam coupler affects the control loop of the laser, a Faraday isolator (optical diode) is placed in between laser and fiber coupling.



- Wavelength 632.8 nm
- Laser power ex fiber >0.7 mW
- Polarization extinction at fiber end > 200:1
- Switchable between operation mode constant frequency and constant power
- Faraday isolator for protecting the control loop of disturbing back reflections, isolation > 30 dB, insertion loss > 0.5 dB
- Mechanical attenuator for reproducibly reducing the output power
- Polarization maintaining fiber type PANDA, mode field diameter 4.1 mm, numerical aperture 0.12
- Fiber cable Ø 3 mm with Keflar strain relief
- Fiber connector type FC-APC (8° polish)
- option: fiber cable with vacuum feed-through
- Mounting console with polymer shock absorbers (steel spring absorbers optionally)

HeNe - 633 - 0,7 - F - 117A - 2 - A - 28 - 0 - 150 **Order Code**

Supply voltage:
230V (standard) **2**
110V 1

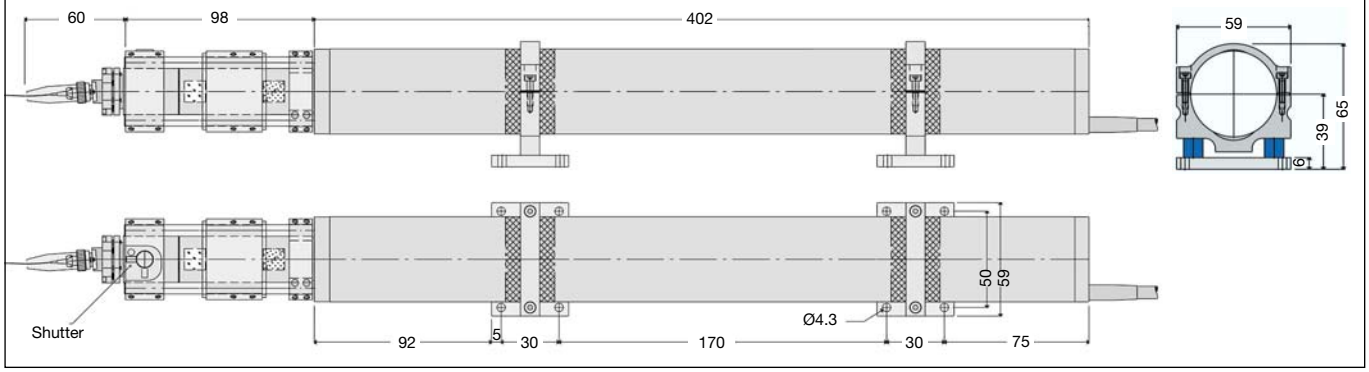
Fiber length [cm]

Fiber / connector type:
20 = PM singlemode fiber cable, FC-PC connector (0°-polish)
28 = PM singlemode fiber cable, FC-APC connector (8°-polish), standard

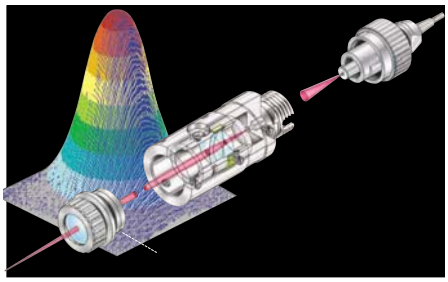
Fiber Connectors Type FC-APC

In order to avoid back reflection directly into the laser source, the fiber connector of type FC-APC has an 8° angled polish of the fiber ferrule.
For fiber cables with this type of connectors **Schäfter+Kirchhoff** provides fiber collimators and laser beam couplers with inclined coupling axis.

Dimensional drawings laser head



Accessories Fiber Collimators 60FC-...



Fiber collimators made by **Schäfter+ Kirchhoff** transform radiation emitted divergently at the end of a singlemode fiber to a collimated beam. Standard collimators have a FC input connector, with inclined or coaxial coupling axis for FC-APC (angled polish) or FC-PC (plane polish) fiber connectors, respectively. Fiber collimators with ST, DIN AVIO or F-SMA are also available. On the front, the collimators have a receptacle to connect optics attachments such as micro focus optics for generation of micro spots down to 0.6 µm, or polarizers.

- Choice of 20 different collimating lenses, focal length ranging from 2.7 to 150 mm, for collimated beam diameters from 0.5 to 28 mm
- Various AR coatings in the range 370 - 2300 nm, with a bandwidth of a several 100 nm each.
- Lens focussing with indirect clamping, change of focus with attachements adapted

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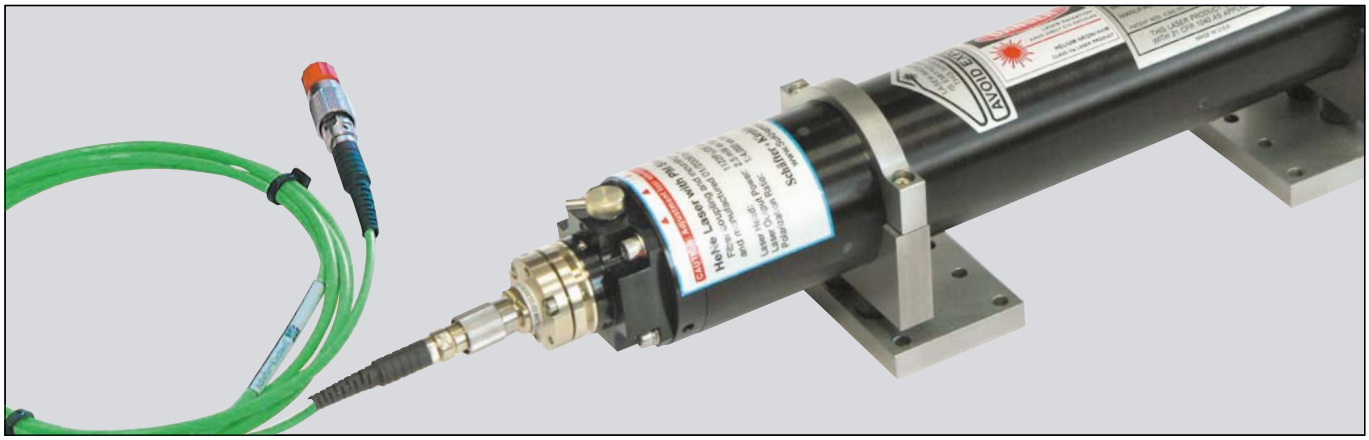
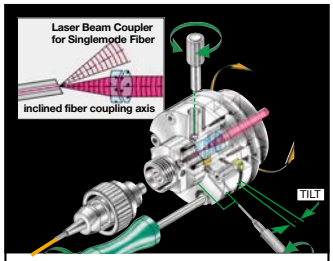
Components for do-it-yourself laser coupling



A fiber coupling increases the possible field of application for existing HeNe lasers. The figure shows a 10 year old laboratory laser which was coupled to a polarization maintaining singlemode fiber with components from **Schäfter + Kirchhoff**.
The necessary components, like laser beam coupler with coupling optics adapted to the diameter of the incoming beam, mechanics adapters, and polarization maintaining singlemode fibers are provided separately.
Additionally, **Schäfter+Kirchhoff** offers the fiber coupling of customer owned lasers as a service.

Components from Schäfter+Kirchhoff



Laser Beam Coupler 60SMS-...
Adjustable and focusable for singlemode fiber cable with FC connector

Inclined or paraxial fiber coupling axis

The inclined fiber coupling axis is designed for fiber connectors of type FC-APC with 8° angled polish, and reducing back reflexion into the laser sources.

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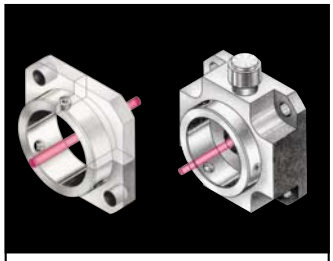
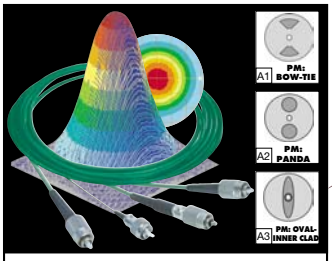
dl/lbc_e.pdf



Adapter Flange
For components with Ø 8 mm and Ø 19.5 mm system mount to adapt to Ø 19.5 mm mount.

Adapter Flange with Attenuator
Aperture Ø 3 mm with
Ø 19.5 mm syst. mount



Polarization maintaining and Singlemode Fiber Cable PMC-.../ SMC-...
Singlemode and polarization maintaining, MFD 3 - 10 µm

λ = 400 - 1800 nm

Fiber connectors:
FC-APC: 8° angled polish of the fiber ferrule, supression of back reflexion into the laser source.

FC-PC: 0° polish

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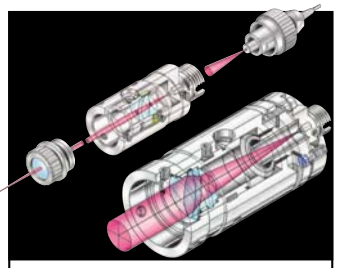
dl/fiber_e.pdf



Fiber Collimator 60FC...
Focusable
Inclined or paraxial fiber coupling axis. Beam diameter and beam divergence are determined by the focal length f' of the collimating lens.

Microfocus Optics, Series 5M-... and 13M-...
These lens attachments focus the collimated laser beam to a diffraction limited micro spot (> 0.001 mm).

Download:
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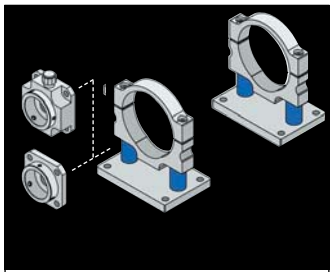
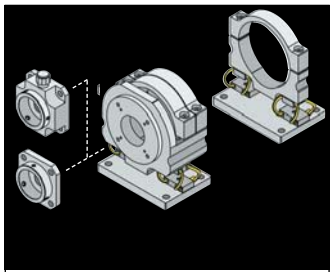
dl/fc_e.pdf

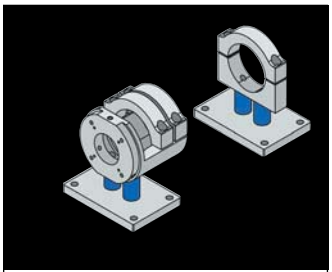
Mounting consoles and accessories



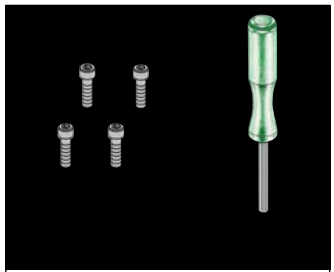
Mounting Console MC-MG-44,5-R for HeNe lasers with diameter 44.5 mm/1.75'' (set of two). Elastomer shock mounts are used for damping of shock and vibrations. Thermal deformation of the laser housing, which would be present in case of a rigid mounting of the laser, is prevented.
The **adapter 60A19,5-F or 60A19,5-F-AT** is attached to the front plate of the laser.



Mounting Console MC-MG-44,5-F-R for HeNe lasers with diameter 44.5 mm/1.75'' (set of two). Elastomer shock mounts for damping of shock and vibrations, and for avoidance of thermal deformations. For optimum stability, the **console MC-MG-44,5-F-R** holds both laser and adapter.



Mounting Console MC-JDS-31,8-F-R for HeNe lasers with diameter 31.8 mm/1.25'' (set of two). Elastomer shock mounts for damping of shock and vibrations, and for avoidance of thermal deformations. For optimum stability, the **console MC-MG-44,5-F-R** holds both laser and adapter.



Socked head screws DIN912 4-40 UNC x 3/8'', set of 4 pcs.
Order Code
48-4-40-3/8-912-4

fitting tool: hex key
Order Code
50HD-3/32

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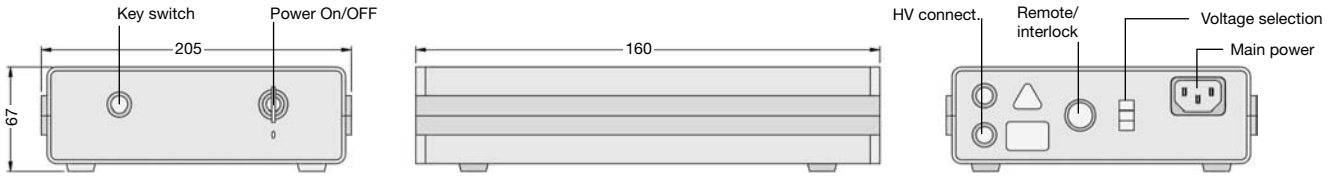
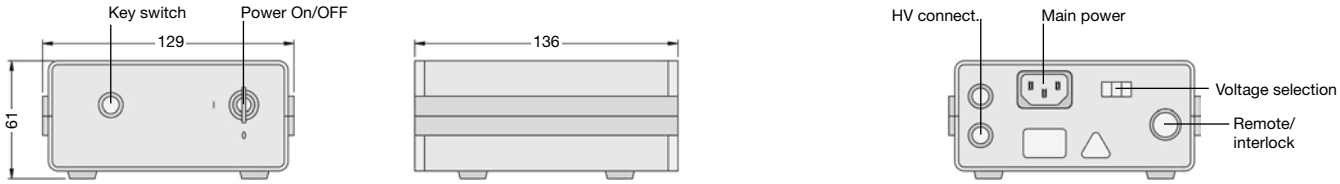
Dimensional Drawings for Power Supplies

HeNe lasers from Schäfter+Kirchhoff are supplied along with power supplies.
Desktop power supplies ate available for 230 V and 110 V line voltage.
For some HeNe lasers there are OEM power supplies with input voltage 12 V DC or 230/100 V AC.

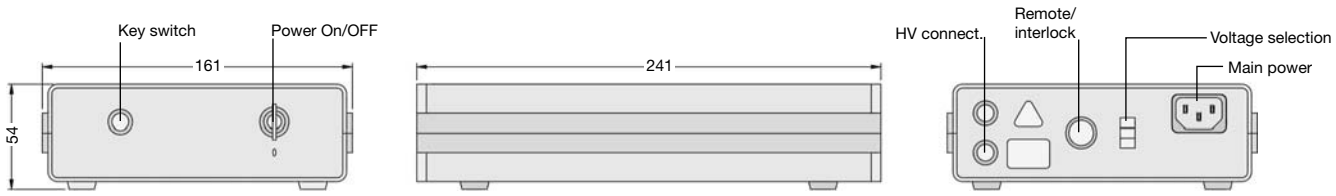
Power Supply Style A



Power Supply Style B



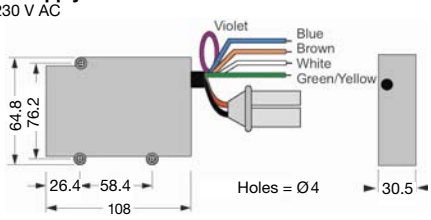
Power Supply Style C



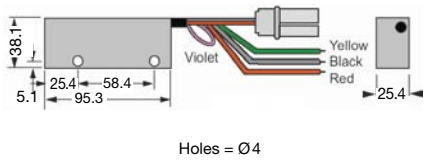
OEM Power Supplies

By now, OEM power supplies with input voltage 12 V DC or 230/100 V AC are available for HeNe laser HeNe-633-0,6-P-1107P (Table 1 line 1). OEM power suplies for other HeNelasers on request.

Power supply
115/230 V AC



Power supply
12 V DC



Notes

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Safety at Work

Laser safety and laser adjustment goggles

The use of laser safety goggles is recommended for work with lasers from laser protection class 3R on, e.g. all visible lasers from **Schäfter+Kirchhoff** with an output power up to 5 mW.

Laser safety goggles are mandatory from protection class 3B on, e.g. for all invisible infrared lasers and all visible lasers with more than 5 mW output power from **Schäfter+Kirchhoff**.

The correct handling and use of the laser safety goggles protects you and your colleagues against injuries of the eyes due to hazardous laser radiation.

A selection of CE and GS certified laser safety goggles is available (manufactured by LaserVision, www.lvg.com) for the lasers provided by **Schäfter+Kirchhoff**.

Two different protective functions of laser safety goggles have to be distinguished, full protection goggles and alignment goggles.

Depending on filter type two different frames are supplied.

Laser safety goggles with glass filters have a frame for which an adapter frame (Order Code **RX7**) for individual glasses is available.

Laser safety goggles with plastic filter are more lightweight and can be worn together with glasses.

Laser Safety Goggles - Function and Characteristics

Protective function Two different protective functions of laser safety goggles have to be distinguished, full protection goggles and alignment goggles.

Full protection goggles according to European standard EN 207 provide personal protection against laser radiation. The laser radiation normally is blocked and no longer visible. **Protection levels** (protection level L..) differ in the maximum spectral transmission of the filter glasses. In addition, the standard EN 207 specifies a maximum power density (power devided by area, in W/m²) which is allowed to reach the filter glass.

Alignment protection goggles according to European standard EN 208 attenuate visible laser radiation (wavelength 400 - 700 nm) down to the power of a laser of class 2 (EN 60825-1). The laser radiation remains visible, so that alignment protection glasses can be used for adjustment tasks. The **protection levels** (protection level R..) differ in the maximum power (in Watt) of a collimated laser beam which is allowed to reach the goggles.

Maximum power (EN 208): maximum power of a laser beam in the specified wavelength range which is sufficiently attenuated by the alignment protection goggles (acc. to EN 208).

Maximum transmission (EN 207): maximum transmission (minimum attenuation) in the specified wavelength range (acc. to EN 208).

Maximum power density (EN 207): maximum power density the filter glasses can withstand over a longer period (acc. to EN 207)

VLT: (visible light transmission): in addition to the specified wavelengths, laser protection goggles also attenuate the ambient light. The VLT is the percentage of the daylight transmitted.

OD (optical density): logarithmic scale for the attenuation of a laser beam at the specified wavelength. The OD at wavelength λ is defined as

$$OD(\lambda) = -\log_{10} \tau(\lambda)$$

Goggles Types

Full and Alignment Protection Goggles
acc. DIN EN 208/ DIN EN 207
Order Code **620.P0004.00**

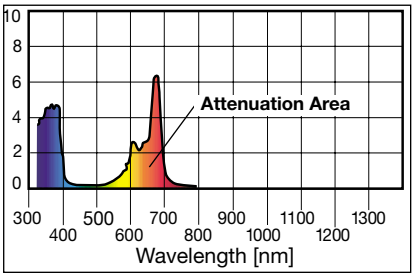
VLT = 40%

Usable Range

Protection	Wave-length [nm]	Protec-tion Level	max. Trans-mission (EN 207)	max.Power Density (EN 207)	max. Power (EN 208)
Alignment	620- 644	R2	-	-	100 mW
Full	665- 685	L4	10^{-4}	10^5 W/m²	-

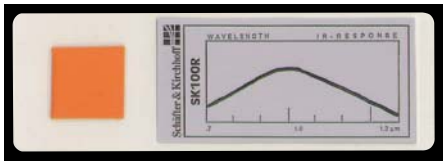
Alignment protection goggles for laser with wavelength 620-644 nm. For 665-685 nm full protection goggles.

Optical Density OD



Please note: Shown are the typical density curves of the respective filters. These are no guaranteed values, only the protection levels (R.. or L..) are guaranteed by **Schäfter+Kirchhoff**.

IR Detection Card

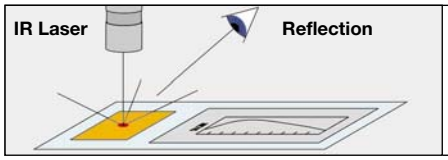


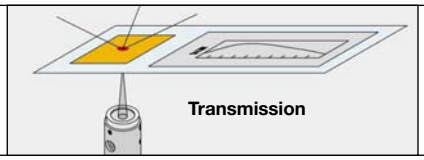
IR Detection Card SK100R Left: active sensor area Right: plot of spectral sensitivity

Invisible infrared radiation in the range 1100 - 1800 nm is converted to visible light by luminescence. The luminescence in the active detector layer indicates the position and approximate size of the beam.

The detector cards should not be used for measurement tasks like the quantitative determination of the beam diameter. With, e.g., high power lasers, also the border area of the beam with less than <1 % of the intensity maximum will be visible, additional widened by scattering processes in the detector layer. On the other hand, of a low power beam only the central area will be shown.

Detector cards of series SK ...R diffusely "reflect" the luminescent radiation at the active layer. These cards are impermeable for the beam. Detector cards of series SK...T are transparent. The beam is transmitted through the layer, the diffusely luminescent radiation is also visible from the back side of the card.





Order Code	Reflection **SK 130R**	Transmission **SK 130T**
max. sensitivity	1300 nm	1300 nm
Spectral range	1100 -1800 nm	1100 -1800 nm
active sensor area	20 x 20 mm²	20 x 20 mm²

Laser Safety

LASER LIGHT
AVOID EXPOSURE TO BEAM
CLASS III B LASER PRODUCT (CDRH)
CLASS 3B LASER PRODUCT (DIN EN 60825-1-2001-11)

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