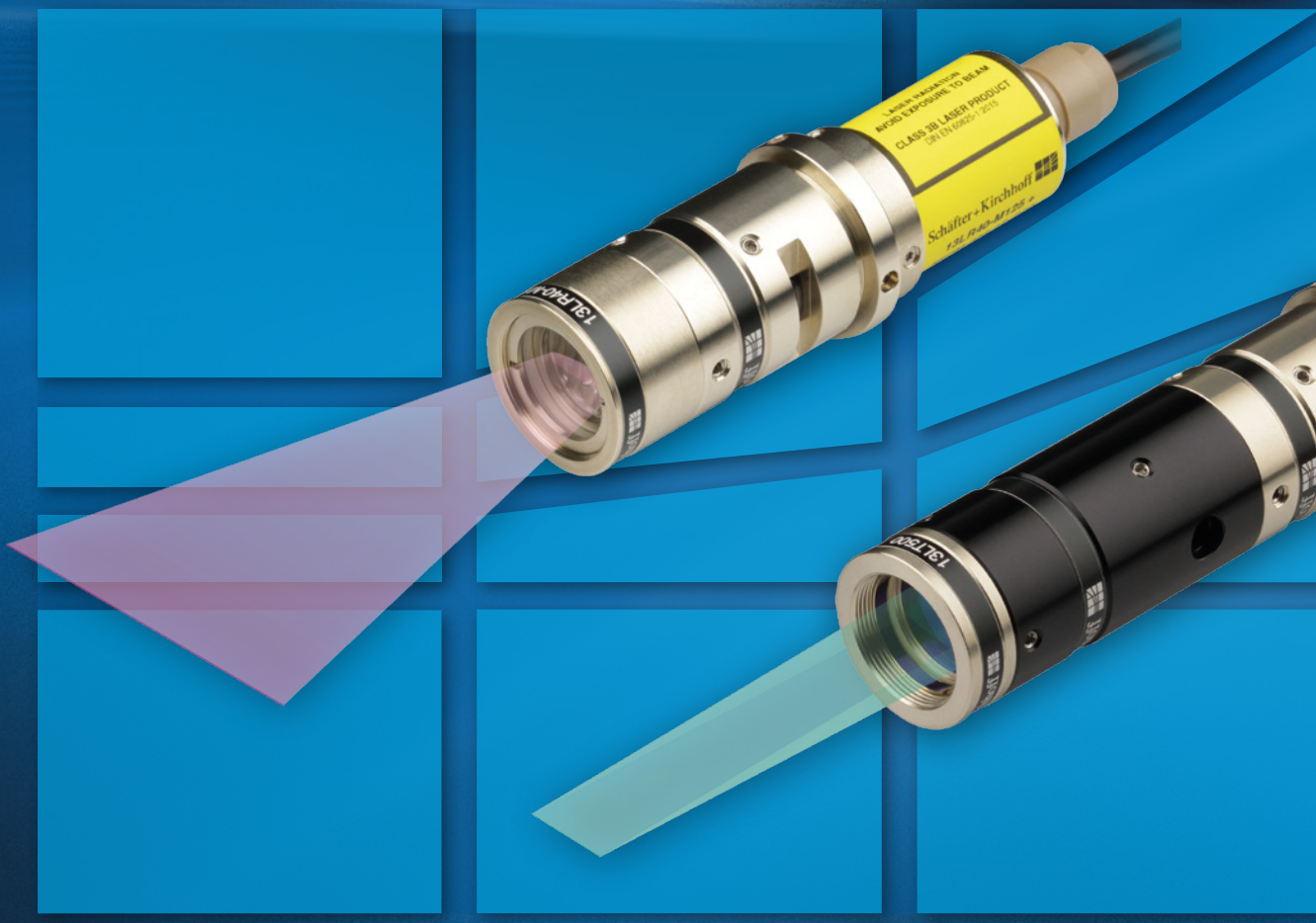
EDITION
24/25

Lasers for Machine Vision



Laser Line Generators · Laser Focus Generators · Laser Diode Collimators

Schäfter+Kirchhoff

About Schäfter+Kirchhoff

Schäfter+Kirchhoff was founded over 65 years ago. The company started with classic lens design and customized optical solutions. The focus has gradually shifted to today's product lines: polarization-maintaining fiber optics, lasers for machine vision, as well as line scan cameras and scanner systems.

Schäfter+Kirchhoff GmbH has its headquarters in Hamburg, Germany. From here, high-quality optical products are developed, manufactured and shipped to customers around the world.

Our customers use our products to conduct basic research, work on quantum computers, they are Nobel Laureates, investigate corrosion phenomena, and so much more. We are a supplier to globally important industry sectors including automotive, solar, aerospace, and semiconductor. Our components are integral part of key technologies driving the global economy.

A major focus is the winning combination of high optical and mechanical precision. This is the basis for the high quality, stability and durability of our products. We are committed to providing the highest quality and reliability possible, a goal continuously improving because of our quality control system.

Extensive know-how and highly qualified, dedicated employees are the driving force of our company. Research and development, manufacturing and technical sales all have a strong technical background and are closely linked, ensuring an exchange at an equal level and a fast and efficient response to customer needs.

Schäfter+Kirchhoff

Contents

Laser Line Generators with a Fan Angle and with Integrated Electronics 33

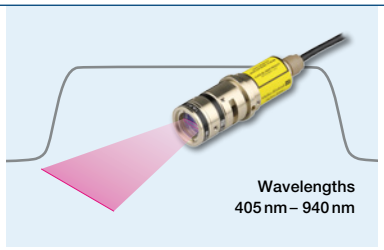
Laser line generators with fan angles between 8° and 84°

Range of working distances (line length and line width), intensity profiles and wavelengths.

- Available as Micro (thin line, small depth of focus) or Macro (larger line, larger depth of focus) line generator
- External modulation: analog and TTL
- Integrated power control

Laser line generators with homogeneous intensity distribution

With optional RS232 interface:



Laser line generators with homogeneous intensity distribution and very thin lines

With optional RS232 interface:

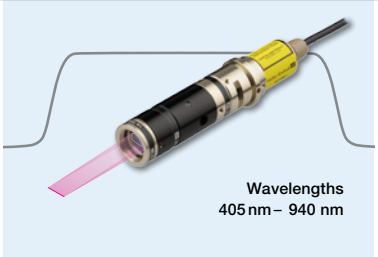
Semi-Telecentric Laser Line Generators 38

with integrated electronics
Range of working distances (line widths), intensity profiles and wavelengths

- Available as Micro (thin line, small depth of focus) or Macro (large line, large depth of focus) line generator
- External modulation: analog and TTL
- Integrated power control

Semi-telecentric laser line generators with constant line length 15 mm

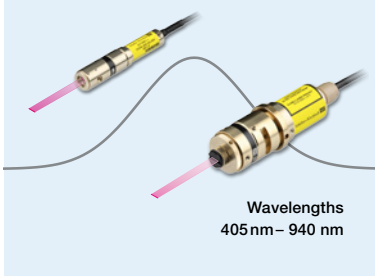
With optional RS232 interface:



Semi-telecentric laser line generators with constant line length 4.8 mm / 2.4 mm

Compact version:

With optional RS232 interface:



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Low Noise LNC-Series
Laser Lines, Micro Focus and Macro Focus Generators 57

LNC

- Low noise
- Reduced coherence
- Low speckle contrast

Low Noise Laser Line Generators with Fan Angle 58

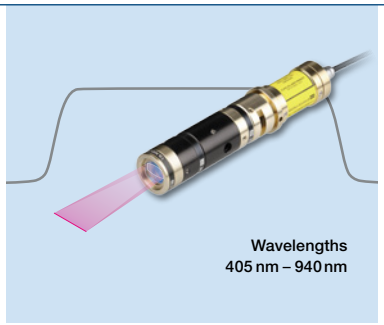
and Integrated Electronics

Low noise laser line generators with fan angles between 8° and 84°
Range of working distances (line length and line width), intensity profiles and wavelengths

LNC

- Available as Micro (thin line, small depth of focus) or Macro (large line, large depth of focus) line generator
- External modulation: analog and TTL
- Integrated power control

Laser line generators with homogeneous intensity distribution and very thin lines



Wavelengths
405 nm – 940 nm

Low Noise Semi-Telecentric Laser Line Generators 60

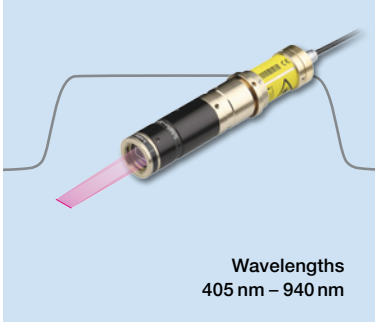
and Integrated Electronics

Laser line generators with constant line length of 2.4, 4.8 or 15 mm
Range of working distances (line widths), intensity profiles and wavelengths

LNC

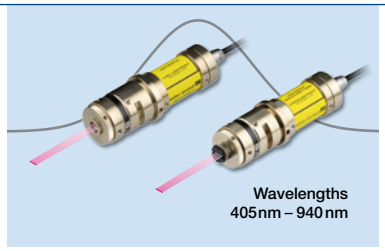
- Available as Micro (thin line, small depth of focus) or Macro (large line, large depth of focus) line generator
- External modulation: analog and TTL
- Integrated power control

Semi-telecentric laser line generators with constant line length 15 mm



Wavelengths
405 nm – 940 nm

Contents



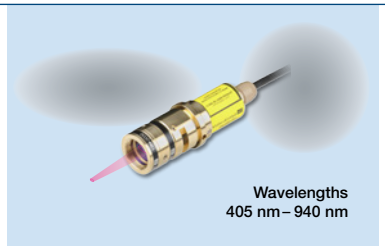
Low Noise Laser Focus Generators 64

with Integrated Electronics

Focussed laser beam with circular/elliptical beam profiles and spot diameters between 4 µm and 400 µm
Range of working distances (spot diameters), intensity profiles and wavelengths

LNC

- Available as Micro (small spot, small depth of focus) or Macro (larger spot, larger depth of focus) focus generator
- External modulation: analog and TTL
- Integrated power control

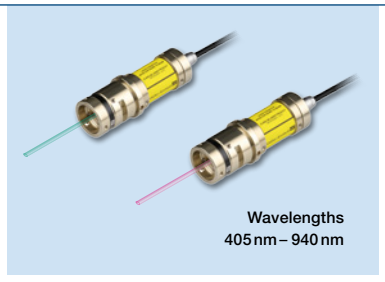


Low Noise Laser Diode Collimators 68

with integrated electronics

LNC

Collimated low noise laser beams with beam diameters between 1 mm and 29 mm
Range of working areas and wavelengths available



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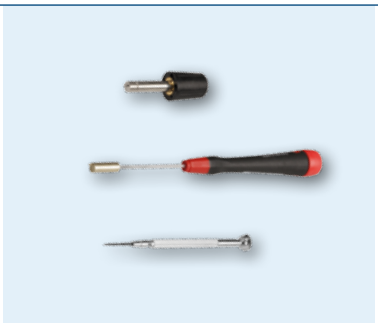

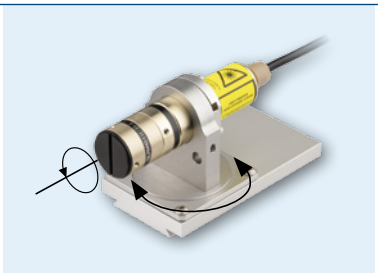

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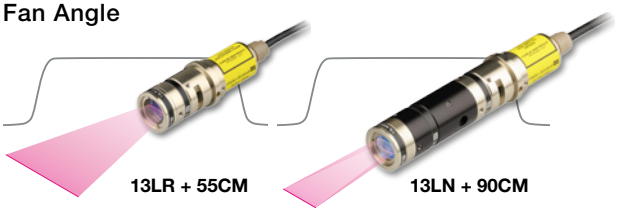
Laser Safety 101

Overview: Standard Laser Line / Micro Focus Generators

Product Configurator for quick and easy product selection: www.sukhamburg.com/products/lasermodules/configurators.html

Laser Lines with a Fan Angle

Micro Line

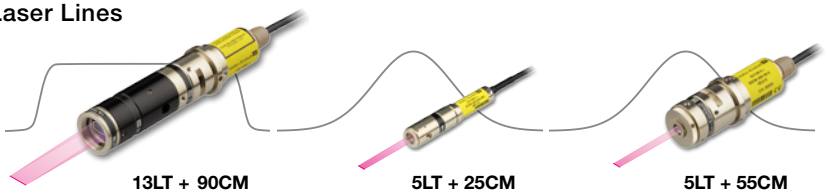


13LR + 55CM | 13LN + 90CM

System	Beam-shaping optics	Laser diode module	Fan angle [°]	Line length min./max. [mm]	Min. line width [mm]	Min. working distance [mm]	Depth of focus	Laser power	Beam profile	Casing Ø [mm]	Electronics type		Supply voltage	Max. modulation frequency (analog)	Max. modulation frequency (TTL)	Page
13LR+55CM	13LR...	55CM	12 - 40	26 / 1400	0.04	120	+	+++		25	no interface	P C	5 V	10 Hz 100 kHz	250 kHz 100 kHz	34
											with interface	PS CS	5 V	1 Hz 1 Hz	250 kHz 250 kHz	
13LN+ 90CM	13LN...	90CM	0-17	14 / 304	0.008	92	+	+++		25	no interface	P C	5 V	10 Hz 100 kHz	250 kHz 100 kHz	36
											with interface	PS CS	5 V	1 Hz 1 Hz	1 MHz 250 kHz	

Semi-Telecentric Laser Lines

Micro Line

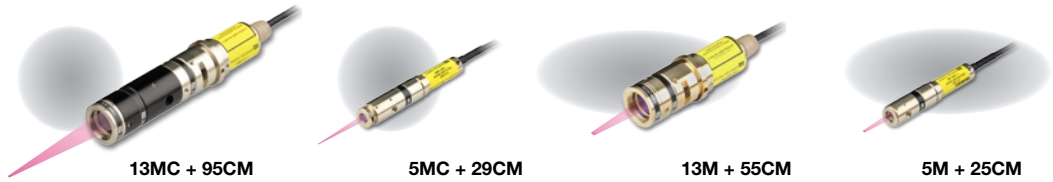


13LT + 90CM | 5LT + 25CM | 5LT + 55CM

System	Beam-shaping optics	Laser diode module	Fan angle [°]	Line length min./max. [mm]	Min. line width [mm]	Min. working distance [mm]	Depth of focus	Laser power	Beam profile	Casing Ø [mm]	Electronics type		Supply voltage	Max. modulation frequency (analog)	Max. modulation frequency (TTL)	Page
13LT+ 90CM	13LT...	90CM	0	15	0.012	160	+	++		25	no interface	P C	5 V	10 Hz 100 kHz	250 kHz 100 kHz	38
											with interface	PS CS	5 V	1 Hz 1 Hz	250 kHz 250 kHz	
5LT+25CM	5LT...	25CM	0	4.8 or 2.0	0.011	45	+	+++		12		S B	5 V 12V	50 kHz -	1 MHz 200 Hz	40
5LT+ 55CM	5LT...	55CM	0	4.8 or 2.0	0.011	45	+	+++		25	without interface	P C	5 V	10 Hz 100 kHz	250 kHz 100 kHz	42
											with interface	PS CS	5 V	1 Hz 1 Hz	250 kHz 250 kHz	

Laser Spots

Micro Line



13MC + 95CM | 5MC + 29CM | 13M + 55CM | 5M + 25CM

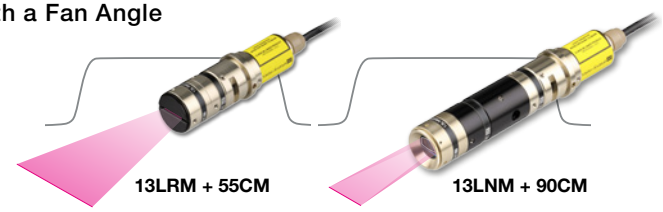
System	Beam-shaping optics	Laser diode module	Laser spot shape	Min. Ø spot diameter [mm]	Min. working distance [mm]	Depth of focus	Laser power	Beam profile	Casing Ø [mm]	Electronics type		Supply voltage	Max. modulation frequency (analog)	Max modulation frequency (TTL)	Page
13MC+95CM	13MC...	95CM	●	0.004	54	+	+++		25	without interface	P C	5 V	10 Hz 100 kHz	250 kHz 100 kHz	44
										with interface	PS CS	5 V	1 Hz 1 Hz	250 kHz 250 kHz	
5MC+29CM	5MC...	29CM	●	0.002	3	+	++		12		P C	5 V	10 Hz 100 kHz	250 kHz 100 kHz	46
13M+55CM	13M...	55CM	⬭	0.008 x 0.020	54	+	+++		25	without interface	P C	5 V	10 Hz 100 kHz	250 kHz 100 kHz	48
										with interface	PS CS	5 V	1 Hz 1 Hz	250 kHz 250 kHz	
5M+25CM	5M...	25CM	⬭	0.001 x 0.003	3	+	++		12		S B	5 V 12V	50 kHz -	1 MHz 200 Hz	50

Overview: Standard Laser Line / Macro Focus Generators

Product Configurator for quick and easy product selection: www.sukhamburg.com/products/lasermodules/configurators.html

Laser Lines with a Fan Angle

Depth of Focus

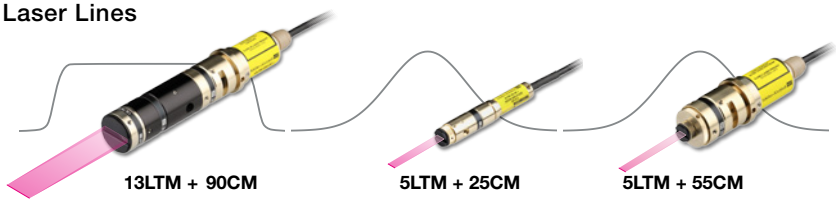


13LRM + 55CM | 13LNM + 90CM

System	Beam Shaping Optics	Laser Diode Module	Fan angle [°]	Line length min./max. [mm]	Min. line width [mm]	Min. working distance [mm]	Depth of focus	Laser power	Beam profile	Casing Ø [mm]	Electronics type		Supply Voltage	Max mod. Frequency (analog)	Max mod. Frequency (TTL)	Page
13LRM+ 55CM	13LRM...	55CM	12 - 40	26 / 1400	0.08	111	+++	+		25	no interface	P C	5 V	10 Hz 100 kHz	250 kHz 100 kHz	**35**
											with interface	PS CS	5 V	1 Hz 1 Hz	250 kHz 250 kHz	
13LNM+ 90CM	13LNM...	90CM	0-17	14 /300	0.014	92	+++	+		25	no interface	P C	5 V	10 Hz 100 kHz	250 kHz 100 kHz	**37**
											with interface	PS CS	5 V	1 Hz 1 Hz	250 kHz 250 kHz	

Semi-Telecentric Laser Lines

Depth of Focus



13LTM + 90CM | 5LTM + 25CM | 5LTM + 55CM

System	Beam Shaping Optics	Laser Diode Module	Fan angle [°]	Line length min./max. [mm]	Min. line width [mm]	Min. working distance [mm]	Depth of focus	Laser power	Beam profile	Casing Ø [mm]	Electronics type		Supply Voltage	Max mod. Frequency (analog)	Max mod. Frequency (TTL)	Page
13LTM+ 90CM	13LTM...	90CM	0	15	0.04	153	+++	+		25	no interface	P C	5 V	10 Hz 100 kHz	250 kHz 100 kHz	**39**
											with interface	PS CS	5 V	1 Hz 1 Hz	250 kHz 250 kHz	
5LTM+ 25CM	5LTM...	25CM	0	4.8 or 2.0	0.02	39	+++	+		12		S B	5 V 12V	50 kHz -	1 MHz 200 Hz	**41**
5LTM+ 55CM	5LTM...	55CM	0	4.8 or 2.0	0.02	39	+++	+		25	without Interface	P C	5 V	10 Hz 100 kHz	250 kHz 100 kHz	**43**
											with interface	PS CS	5 V	1 Hz 1 Hz	250 kHz 250 kHz	

Laser Spots

Depth of Focus

13MMC + 95CM | 13MM + 55CM | 5MM + 25CM

System	Beam Shaping Optics	Laser Diode Module	Shape of laser spot	Min. Ø spot diameter [mm]	Min. working distance [mm]	Depth of focus	Laser power	Beam profile	Casing Ø [mm]	Electronics type		Supply Voltage	Max mod. Frequency (analog)	Max mod. Frequency (TTL)	Page
13MMC+ 95CM	13MMC...	95CM	●	0.008	45	+++	+		25	without Interface	P C	5 V	10 Hz 100 kHz	250 kHz 100 kHz	**45**
										with interface	PS CS	5 V	1 Hz 1 Hz	250 kHz 250 kHz	
13MM+ 55CM	13MM...	55CM	●	0.019	54	+++	+		25	without Interface	P C	5 V	10 Hz 100 kHz	250 kHz 100 kHz	**49**
										with interface	PS CS	5 V	1 Hz 1 Hz	250 kHz 250 kHz	
5MM+ 25CM	5MM...	25CM	●	0.025	16.5	+++	+		12		S B	5 V 12V	50 kHz -	1 MHz 200 Hz	**51**

Overview LNC-series: micro laser line / focus generators, collimators

Product Configurator for quick and easy product selection: www.sukhamburg.com/products/lasermodules/configurators.html

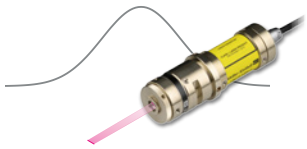
Laser Line with Fan Angle

LNC-13LN + 91CM

System	Beam Shaping Optics	Laser Diode Module	Fan angle [°]	Line length min./max. [mm]	Min. line width [mm]	Min. working distance [mm]	Depth of focus	Laser power	Beam profile	Casing Ø [mm]	Electro-nics type	Supply Voltage	Max mod. Frequency (analog)	Max mod. Frequency (TTL)	Page
LNC-13LN+91CM	13LN...	91CM	0-17	14 / 304	0.008	92	+	+++		25	HP H	12 V 5 V	1 Hz 100 kHz	300 kHz 100 kHz	58

Semi-Telecentric Laser Lines

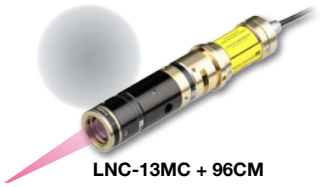
LNC-13LT + 91CM



LNC-5LT + 56CM

System	Beam Shaping Optics	Laser Diode Module	Fan angle [°]	Line length min./max. [mm]	Min. line width [mm]	Min. working distance [mm]	Depth of focus	Laser power	Beam profile	Casing Ø [mm]	Electro-nics type	Supply Voltage	Max mod. Frequency (analog)	Max mod. Frequency (TTL)	Page
LNC-13LT+91CM	13LT...	91CM	0	15	0.012	160	+	++		25	HP H	12 V 5 V	1 Hz 100 kHz	300 kHz 100 kHz	60
LNC-5LT+ 56CM	5LT...	56CM	0	4.8 or 2.0	0.011	45	+	+++		25	HP H	12 V 5 V	1 Hz 100 kHz	300 kHz 100 kHz	62

Semi-Telecentric Laser Lines



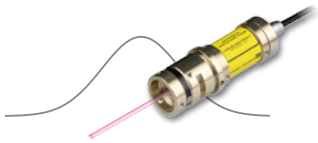
LNC-13MC + 96CM

LNC-13M + 56CM

System	Beam Shaping Optics	Laser Diode Module	Laser spot shape	Min. spot diameter [mm]	Min. working distance [mm]	Depth of focus	Laser power	Beam profile	Casing Ø [mm]	Elec-tronics type	Supply Voltage	Max mod. Frequency (analog)	Max mod. Frequency (TTL)	Page
LNC-13MC+96CM	13MC...	96CM	●	0.004	54	+	+++		25	H	5 V	100 kHz	100 kHz	64
LNC-13M+56CM	13M...	56CM	⬭	0.008 x 0.020	54	+	+++		25	HP H	12 V 5 V	1 Hz 100 kHz	300 kHz 100 kHz	66

Collimators

LNC-91CM



LNC-56CM

Collimator	Beam diameter [mm] (p)	Beam diameter [mm] (s)	Diver-gence [mrad] (p)	Diver-gence [mrad] (s)		Laser beam focussed	Beam profile	Casing Ø [mm]	Elec-tronics type	Supply Voltage	Max mod. Frequency (analog)	Max mod. Frequency (TTL)	Page
LNC-56CM	2.3-11	0.9-4	0.03-0.27	0.06-0.50	25	x		25	HP H	12 V 5 V	1 Hz 100 kHz	300 kHz 100 kHz	68
LNC-91CM	3-9	9-29	0.01-0.03	-	25-45	x		25-45	H	5 V	100 kHz	100 kHz	69

Overview LNC-series: macro laser line / focus generators, collimators

Product Configurator for quick and easy product selection: www.sukhamburg.com/products/lasermodules/configurators.html

Laser Line with a Fan Angle

Depth of Focus

LNC

LNC-13LNM + 91CM

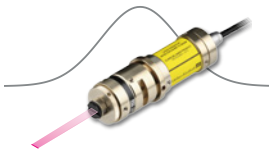
System	Beam Shaping Optics	Laser Diode Module	Fan angle [°]	Line length min./max. [mm]	Min. line width [mm]	Min. working distance [mm]	Depth of focus	Laser power	Beam profile	Casing Ø [mm]	Electro-nics type	Supply Voltage	Max mod. Frequency (analog)	Max mod. Frequency (TTL)	Page
LNC-13LNM+91CM	13LNM...	91CM	0-17	14 /304s	0.014	92	+++	+		25	HP H	12 V 5 V	1 Hz 100 kHz	300 kHz 100 kHz	59

Semi-Telecentric Laser Lines

Depth of Focus

LNC

LNC-13LTM + 91CM



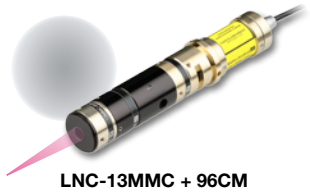
LNC-5LTM + 56CM

System	Beam Shaping Optics	Laser Diode Module	Fan angle [°]	Line length min./max. [mm]	Min. line width [mm]	Min. working distance [mm]	Depth of focus	Laser power	Beam profile	Casing Ø [mm]	Electro-nics type	Supply Voltage	Max mod. Frequency (analog)	Max mod. Frequency (TTL)	Page
LNC13LTM+91CM	13LTM...	91CM	0	15	0.04	153	+++	+		25	HP H	12 V 5 V	1 Hz 100 kHz	300 kHz 100 kHz	61
LNC-5LTM+56CM	5LTM...	56CM	0	4.8 or 2.0	0.02	39	+++	+		25	HP H	12 V 5 V	1 Hz 100 kHz	300 kHz 100 kHz	63

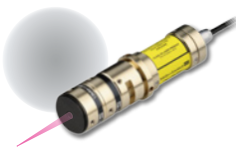
Semi-Telecentric Laser Lines

Depth of Focus

LNC



LNC-13MMC + 96CM



LNC-13MM + 56CM

System	Beam Shaping Optics	Laser Diode Module	Laser spot shape	Min. spot diameter [mm]	Min. working distance [mm]	Depth of focus	Laser power	Beam profile	Casing Ø [mm]	Elec-tronics type	Supply Voltage	Max mod. Frequency (analog)	Max mod. Frequency (TTL)	Page
LNC-13MMC+96CM	13MMC...	96CM	●	0.008	54	+++	+		25	H	5 V	100 kHz	100 kHz	65
LNC-13MM+56CM	13MM...	56CM	●	0.019	54	+++	+		25	HP H	12 V 5 V	1 Hz 100 kHz	300 kHz 100 kHz	67

Overview: Laser Diode Collimators

Product Configurator for quick and easy product selection: www.sukhamburg.com/products/lasermodules/configurators.html

Collimators with integrated electronics

25CM

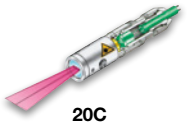
55CM / 55CR

55CR

90CM

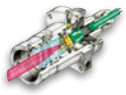
Collimator	Beam diameter [mm] (p)	Beam diameter [mm] (s)	Diver-gence [mrad] (p)	Diver-gence [mrad](s)	Casing Ø [mm]	Supply Voltage	Electronics type		Max mod. Fre-quency (analog)	Max mod. Fre-quency (TTL)	Cus-tomer Mounting /Align-ment	Attach-ment of beam shaping optics	Laser beam fo-cussed	TE-Cooling in Case	for Diodes with in-tegr. TE-Cooler	Page
25CM	2.2-7.1	1.0-2.5	0.06-0.18	0.14-0.44	12	5 V 12 V	no interface	S B	50 kHz -	1 MHz 200 Hz		x	x			52
55CM	2.3-11	1.1-4	0.03-0.27	0.06-0.50	25	5 V	no interface	P C	10 Hz 100 kHz	250 kHz 100 kHz		x	x			53
							with interface	PS CS	1 Hz 1 Hz	250 kHz 250 kHz						
55CR	2.8-11	1.1-3.8	0.03-0.19	0.06-0.36	25	5 V	no interface	P C	10 Hz 100 kHz	250 kHz 100 kHz		x	x			53
90CM	3-6	7-18	0.02-0.03	-	25-42	5 V	no interface	C	100 kHz	100 kHz		x	x			54
							with interface	CS	1 Hz	250 kHz						

Compact modular systems without electronics



20C

21C



50BM

55BC

Collimator	Collima-ting focal lengths [mm]	Beam diameter [mm] (p)*	Beam diameter [mm] (s)*	Diver-gence [mrad] (p)*	Diver-gence [mrad](s)*	Casing Ø [mm]	Electronics	Option Fiber coupling	Cus-tomer Mounting /Align-ment	Attach-ment of beam shaping optics	Laser beam fo-cussed	TE-Cooling in Case	for Diodes with in-tegr. TE-Cooler	Page
20C/20P	3.1 - 12	1.2-3.3	3.4-5	0.13-0.36	0.09 - 0.12	12	without electronics		x	x	x			86
21C / 21P	3.1 - 12	1.2-3.3	3.4-5	0.13-0.36	0.09 - 0.12	12				x	x			87
22P	3.1 - 12	1.2-3.3	3.4-5	0.13-0.36	0.09 - 0.12	11				x	x			88
24PX	3.1 - 12	0.93-1.3	2.6-3.9	0.32-0.46	0.11 - 0.16	12			x		x			89
50BM	3.1 - 60	1.2-17	2.5-17	0.03-0.36	0.03 - 0.12	25		x	x	x	x			93
55BC	3.1 - 60	1.2-17	2.5-17	0.03-0.36	0.03 - 0.12	25		x	x	x	x			94

Schäfter+Kirchhoff

Fundamentals

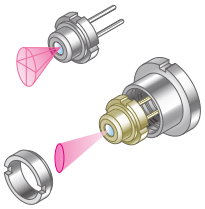
Fundamentals

Fundamentals Laser Diode Characteristics

Technotes and Fundamentals

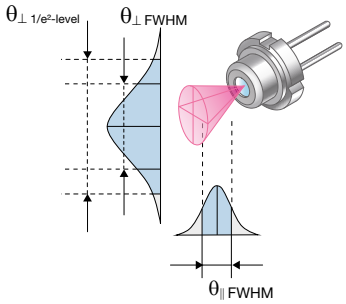
For more information, please refer to the extensive technotes section on:
www.sukhamburg.com/support/technotes

Laser Diodes



Laser Diodes are semiconductor lasers and are available in many different shapes and sizes with laser powers ranging from a few mW to hundreds of watts. The emitted wavelength depends mainly on the semiconductor material of the laser diode cavity and laser diodes are produced to cover the full visible spectrum from blue to red, and even beyond, with some emitting in the infrared. The laser diodes distributed by Schäfter+Kirchhoff cover the whole wavelength range from 370 nm to 2300 nm.

Divergence and Polarization

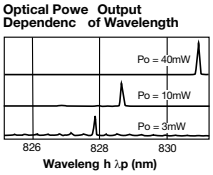


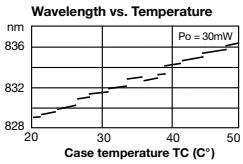
The microscopic cross-section of the laser diode active area of approx. 1 x 3 µm results in emitted radiation that is divergent. Most laser diodes have a cone of divergent radiation with an elliptical cross-section and an approximately Gaussian intensity distribution. The ellipticity can be overcome with the help of anamorphic optics.

Some diodes (e.g. VCSEL or Circular Laser) are designed to produce a circular beam profile.

The polarization of the emitted radiation is linear and typically is parallel to the active area of the diode. The degree of polarization varies with the diode current and is lowest at the threshold.

Temperature and Power Dependence





The emitted spectrum is influenced by the diode temperature and diode current, as well as the geometry of the laser cavity. The front face and the end face serve as a Fabry-Perot cavity allowing multiple longitudinal modes.

When operated just over the threshold, the diodes have a wavelength spectrum with equidistant peaks (longitudinally multimode). On increasing the diode current (to produce a higher power output), one of the longitudinal modes is usually favored and the diode emits in (longitudinally)

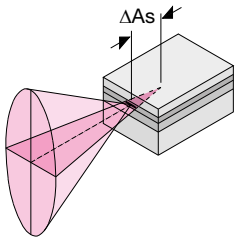
Temperature and Power Dependence (continued)

singlemode. Unfortunately, the gain profile and the refractive index of the semiconductor material are temperature dependent and, so, other longitudinal modes can be amplified and the output wavelength changes rapidly, by up to a few nanometers, resulting in mode hopping.

For a non-stabilized single-mode diode, mode hopping occurs stochastically and the emitted wavelength and output power can change erratically by as much as 3%. For a temperature range of 20 to 30°C, the center wavelength can drift by 2.5 – 3 nm (GaAs).

Since changing the diode current changes the diode temperature, the current/power output dependence of the laser diode is only nominal. When the laser power is increased from the threshold up to the nominal power then the wavelength increases by 2 – 4 nm.

Astigmatism



The non-uniform gain profile within the active layer of the laser diode means that some laser diodes show astigmatism. Here, the laser radiation emitted parallel and perpendicular to the active layer does not emerge from one point at the cavity end, but appears to be emerging from two different positions.

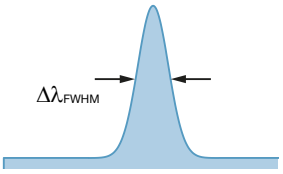
The distance between these is called the astigmatic difference ΔAs and is between 3 – 40 µm. Astigmatism can be corrected by using anamorphic optics (5AN).

Coherence

The particular application determines whether a long coherence L_C (here given for a Gaussian spectrum) or a short coherence is desirable.

Non-stabilized singlemode lasers with stochastic changes of the wavelength also exhibit stochastic changes in coherence behavior.

$$L_c = \frac{\lambda^2}{\Delta\lambda_{FWHM}}$$



Superluminescent diodes use incoherent spontaneous emission to provide short coherence. For interferometry or spectroscopy, a long (or sufficient) coherence is essential, a feature of DFB, DBR VCSEL diodes with integrated or external thermo-electric cooling (TEC).

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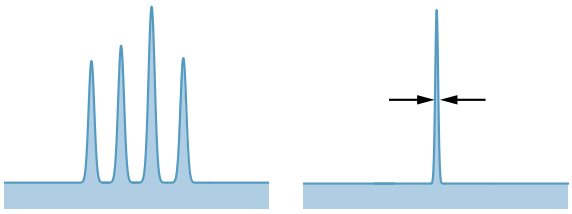
Wavelength Stability



Non-stabilized singlemode diode

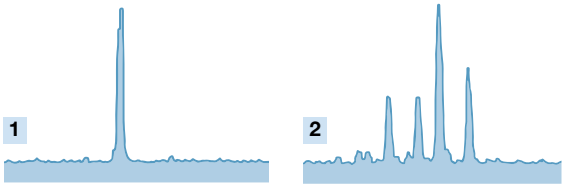
Narrow tunable DFB spectrum

The emitted wavelength can be kept constant in a number of ways. External temperature control is possible using integrated or external Peltier elements and temperature sensors (see 48TE SOT). Most laser diodes also have an integrated monitor photodiode, providing feedback for control of the laser power.

The use of DFB (distributed feedback) or DBR diodes (distributed Bragg reflector) with their spectrally very narrow lines can be advantageous. With the help of a grid structure, only one longitudinal Fabry-Perot mode is amplified (stable singlemode) and mode hopping is suppressed.

VCSEL diodes use DBR structures to produce very narrow lines. The temperature dependence remains, however, and a constant wavelength can only be provided by using an integrated or external temperature control system with integrated monitoring photodiode.

Lifetime and Low Noise Operation



Faraday isolator prevents back-reflection and the diode spectrum is undisturbed

Mode hopping from destabilization of the diode by back-reflections

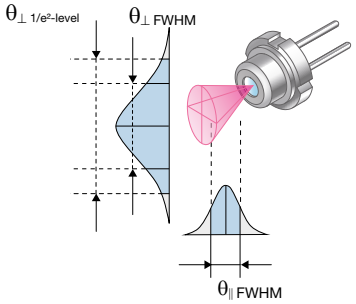
Laser diodes are very sensitive, especially when exposed to an electrostatic discharge. Surges in the current or voltage can damage a diode severely, making extremely stable power sources a necessity.

The life expectancy of the diode is increased at lower diode temperatures and power outputs, making it very important to operate the diode below its maximum current.

Faraday Isolators (48FI) can effectively prevent back-reflection into the diode **1**.

Back-reflections can cause mode hopping **2** and instabilities in the diode wavelength as well as the power output that, in turn, result in faster degradation of the performance and to disturbance of the polarization.

Laser Collimation



The beam can be characterized by the divergence $\theta_\perp$ x $\theta_\parallel$ measured perpendicular and parallel to the active surface area at the 1/e²-level (= 13.5%).

Beam characteristics can also be described at the 50% intensity level and are then defined by the divergence

$$\theta_{\perp FWHM} \times \theta_{\parallel FWHM}$$

(FWHM: full-width at half-maximum).

For laser diodes, the parameters $\theta_{\perp FWHM}$ x $\theta_{\parallel FWHM}$ are usually specified and for a collimated beam, a description at the 1/e²-level is more suitable.

Collimation optics transform a divergent beam with the divergence $\theta_\perp$ x $\theta_\parallel$ into a collimated beam, retaining both its Gaussian intensity distribution and elliptical beam profile with diameters $\varnothing_\perp$ x $\varnothing_\parallel$.

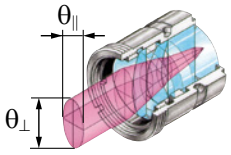
The beam diameter $\varnothing_{\perp,\parallel}$ at the collimator is also given at the 1/e²-level and is defined by the focal length f of the collimating lens and the divergence $\theta_{\perp,\parallel FWHM}$ of the laser diode.

These differing definitions are responsible for the factor 1.7 in the equations above.

$$\varnothing_\parallel = 2 \cdot f \cdot \sin\left(\frac{1}{2} \cdot \theta_{\parallel FWHM} \cdot 1.7\right)$$

$$\varnothing_\perp = 2 \cdot f \cdot \sin\left(\frac{1}{2} \cdot \theta_{\perp FWHM} \cdot 1.7\right)$$

f = focal length of collimating lens
$\varnothing_{\perp\parallel}$ = beam diameter (13.5%-level)
$\theta_{\perp\parallel FWHM}$ = laser diode beam divergence (50%-level)



Even a collimated beam exhibits minimal divergence, since the beam diameter varies (for large distances) with the distance A from the laser diode collimator.

The resulting beam divergences of the collimated beam $\vartheta_\perp$ and $\vartheta_\parallel$ depend on the respective beam diameters at the collimator $\varnothing_\perp$ and $\varnothing_\parallel$ and on the wavelength λ of the emitted radiation. For an ideal Gaussian beam ($M^2 = 1$):

$$\vartheta_{\perp/\parallel} = \frac{2 \cdot \lambda}{\pi \cdot \varnothing_{\perp/\parallel}}$$

$\vartheta_{\perp\parallel}$ = beam divergence of the collimated beam
$\varnothing_{\perp\parallel}$ = beam diameter (13.5%-level)
λ = wavelength

Collimating Lenses

The collimating lenses from Schäfter+Kirchhoff are manufactured from high quality glass. Beam collimation and beam shape are up to 30x more stable in comparison with plastic lenses, which exhibit variations in refractive index and shape with changes in temperature.

Bi-asphere lenses are used for collimating monochromatic radiation and exhibit the same correction and imaging quality as microscope lenses with three or four elements. The particular manufacturing process produces micro structures on the lens surface, which are manifest in the collimated beam but not in a focussed spot. Triplet lenses are three lens systems of spherical elements with high quality surfaces that provide a substantial level of spherical correction and a high numerical aperture.

In the wavelength range 370–2300 nm, lenses are provided with an individual anti-reflex coating that cover a few hundred nm of bandwidth.

Structured Laser Illumination

Laser lines are primarily characterized by their length and their working distance, with other parameters becoming relevant depending on the measuring task.

The measurement resolution is determined by the line width and can be limited by speckle. A sufficient depth of focus has to be taken into account when measuring objects of variable height.

The Schäfter+Kirchhoff laser line generators were developed to satisfy these differing measurement requirements – providing laser micro lines for fine line widths and laser macro lines for extended depth of focus.

The fan angle can also be decisive in the choice of laser line and, for objects with glossy surfaces, Schäfter+Kirchhoff supplies laser line generators that are semi-telecentric. The Schäfter+Kirchhoff laser spot generators are also differentiated in the same manner, with micro focus generators producing small spot sizes and macro focus generators providing extended depth of focus.

Line Length and Line Width Extrapolation

The rule of propagation provides the equation for the extrapolation of line width and length. With the values L_1, B_1 and L_2, B_2 for two working distances A_1 and A_2 then the line length L and line width B for the desired working distance A can be calculated from:

$$L = L_1 + \frac{L_2 \quad L_1}{A_2 \quad A_1} \cdot (A \quad A_1)$$

$$B = B_1 + \frac{B_2 \quad B_1}{A_2 \quad A_1} \cdot (A \quad A_1)$$

Example:

Length L and Width B of 13LR25-S250 at A = 300 mm

A1 = 248 mm A2 = 496 mm L1 = 109 mm

L2 = 217 mm B1 = 0.063 mm

B2 = 0.126 mm and insert into the formulas above

L = 132 mm,
B = 0.076 mm at
A = 300 mm for 13LR25-S250

Please note that these considerations are only valid for laser line or focus generators that have an adjustable focus setting (e.g. Series 13LR, 13M or 13MC).

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Line Width

Ideally, a thin laser line is used in order to maximize the signal intensity at the sensor. Measurement accuracy can be improved by using sub-pixel algorithms with thicker laser lines, assuming any disturbances caused by laser speckle (see below) are small enough.

For both micro and macro line generators, the width of the laser line is proportional to the working distance and the power density decreases for deviations from the specified working distance and line width. The relationship between the square of the line width and depth of focus means that the depth of focus of a laser line required by an application effectively limits the minimum laser line width that can be used and, thereby, the signal intensity at the sensor.

Adjustment of the collimating lens generates a convergent beam. At distance A relative to the fiber collimator, a beam propagation with width B is formed.

$$B = \frac{4 \cdot \lambda \cdot A}{\pi \cdot \varnothing_{\parallel}}$$

B = line width [mm]
A = working distance [mm]
λ = wavelength of the laser emission [mm]
$\varnothing_{\parallel}$ = cross-section [mm] of the collimated laser beam at the $1/e^2$ level parallel to the active diode strip

Correction factor F

The beam properties of the laser line/focus generators are presented for a collimator using a diode example, the diode M26 with a wavelength of 660 nm and its distinct divergence angle; these diode characteristics determine the actual line width/spot size and Rayleigh range/depth of focus available for use.

Thus, for laser diode choices other than M26 with 660 nm the line width/spot size and Rayleigh range/depth of focus values must be recalculated using the correction factor F provided for each diode in the outmost right column of the right table. The other beam parameters remain the same.

For correction of:	
line width/spot size:	multiply by F
Rayleigh range/ depth of focus:	multiply by $F^2 \cdot 660 / \lambda$ (in nm)

Laser Speckle

Laser speckle is interference caused by stochastic lateral displacement of the coherent laser radiation upon reflection from a rough surface. Laser speckle disturbs the edge sharpness and homogeneity of the imaged laser line.

The granularity of the laser speckle depends on the aperture setting of the objective used to image the laser line. With a small f-number / large aperture, the generated speckles have a high spatial frequency and produce a homogeneous image (see Figure 1B), whereas the speckles are more granular and particularly disturbing when using a larger f-number/smaller aperture (see Figure 1C). The generation of laser speckle cannot be avoided as the principle of laser light-sectioning relies upon the imaged surface being roughly textured and diffusely reflecting optically.

A substantial reduction in the speckle effect is achieved by:

- choosing large lens apertures/small aperture numbers for the objective, which improves depth discrimination but at the expense of depth of focus,
- altering the distance between the object and the sensor, which is most convenient when a scanning measurement is being performed anyway, such as profile measurement of railroad tracks while the train is moving,
- using a laser beam source with decreased coherence length, such as a superluminescent diode or laser of the LNC-Series (p. 56f).

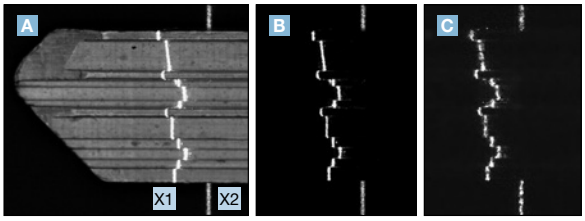

Figure 1:
3D profiling by use of laser light sectioning Improvement of laser speckling with larger aperture objectives

A Measured object with generated laser lines X1 and X2, at an incident angle of 60° and with an additional dome illumination of the object.

B Object imaged with a large aperture, f/# 2.8. The imaging lens acts as a spatial frequency filter, restricting the measurement to a shallower dissecting plane and minimizing the speckle effect.

C Object imaged with a small aperture, f/# 22, which increases speckle and granularity, bringing uncertainty in the contour of the line.

Depth of Focus of a Laser Line

The laser lines are focussed at a defined working distance and attempts at focussing outside of this narrow range produces line broadening and power density reductions.

The range around the nominal working distance, in which the laser line does not increase by more than a factor 1.41, is usually specified as the depth of focus of that laser line and is specified differently for the two types of laser line generator.

Which Laser Line / Focus Generator: Micro or Macro?

Micro lines/spots have a high power density close to their focus but the line width increases and the power density falls drastically when out of focus. In comparison, the power density of a macro line/spot is lower but does not change significantly over a larger range.

A compromise must be found for each application between either the benefits of a larger depth of focus, comparatively large line width/ spot size with a lower power density, or smaller lines/spots with a high power density and a smaller depth of focus.

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Fundamentals Micro and Macro Laser Lines or Spots

Laser Micro Line Generators and Laser Micro Focus Generators

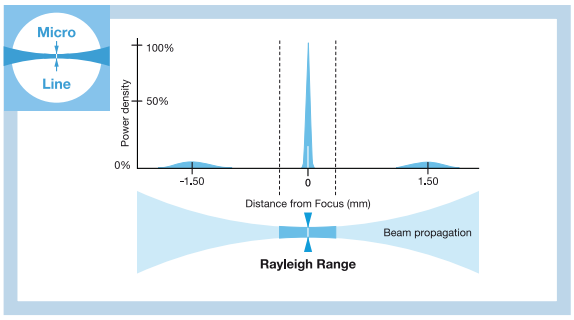


Figure 2: Micro line intensity profile and line width characteristics

- Small laser line widths or small laser spots
- High power density in the focal plane
- Gaussian intensity profile across the laser line or laser spot

Laser Macro Line Generators and Laser Macro Focus Generators

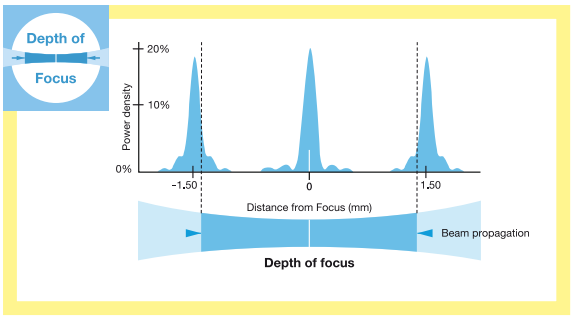


Figure 3: Macro line intensity profile and line width characteristics

- Larger, almost constant laser line widths or spot sizes with lower power density
- Extended depth of focus (7 to 35-times greater)
- Approx. Gaussian intensity profile across the laser line or laser spot

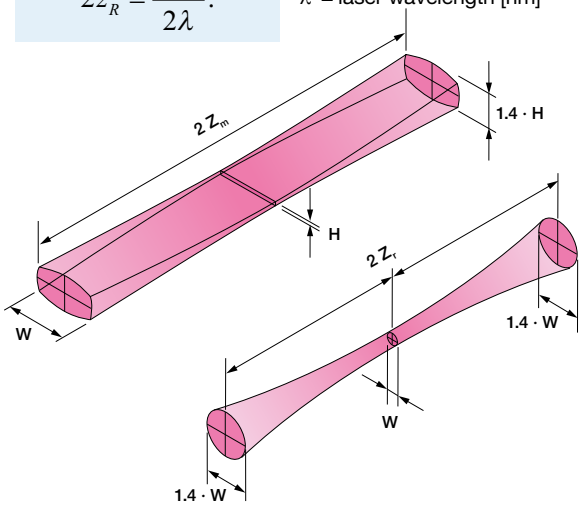
Laser Micro Line Generators (see Figure 2) produce small laser line widths with a high power density and a Gaussian intensity profile across the laser line.

For a laser line with line width B (at the 13.5 % level) and wavelength λ, the depth of focus is defined as the Rayleigh range $2z_R$

Rayleigh range

$$2z_R = \frac{\pi B^2}{2\lambda}.$$

B = line width [mm]
λ = laser wavelength [nm]



Laser Micro Focus Generators produce laser spots with high power density and a Gaussian intensity profile.
The line width B is replaced by the spot diameter in the formula to reveal the Rayleigh range.

Applications for Laser Micro Line/Focus Generators:

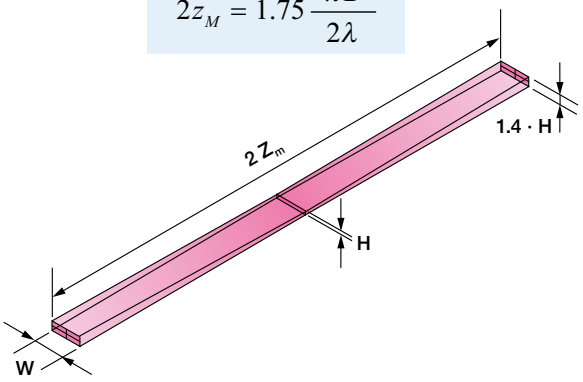
- Scattered light measurements
- Photometry
- Position sensing
- Machine vision
- Laser triangulation / 3D-Profiling: with small laser lines for detecting small changes within a small height range

Laser Macro Line Generators generate laser lines with an extended depth of focus. Within the depth of the focus range, the intensity profile across the laser line is approximately Gaussian and the side lobes caused by diffraction remain below the 13.5% intensity level within the depth of focus range (Fig. 3).

For a laser line with line width B (at the 13.5 % level) and wavelength λ, the depth of focus $2z_M$ is defined as:

Depth of Focus

$$2z_M = 1.75\,\frac{\pi B^2}{2\lambda}$$



For a particular line width B, the depth of focus of a macro line is almost twice that of the equivalent micro line. At the same working distance A, macro lines are 2 to 5-times wider and have a depth of focus 7 to 35- times larger than the equivalent micro line. The output power of a laser macro line generator is generally 50–60% smaller than that of a laser micro line generator.

Laser Macro Focus Generators generate laser spots with lower power density and an extended depth of focus. The intensity profile is approximately Gaussian. The line width B is replaced by the spot diameter in the formula to reveal the depth of focus.

Applications for Laser Micro Line/Focus Generators:

- Machine vision
- Laser triangulation/3D profiling: with larger laser line widths for detecting over a large height measurement range

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RS232 Interface for Laser Line and Micro Focus Generators

Data readout using USB using the Switchbox SBS070701-USB

Schäfter+Kirchhoff also offers laser line generators and micro focus generators with the RS232 interface, to improve access to the laser module, for control of laser power, or to read and store critical data.

By knowing the hours of operation and the current consumption, for example, the degradation of the laser diode can be anticipated and maintenance planned.

Features include:

- RS232 interface for laser control and data readout
- USB interface using the Switchbox SBS070701-USB
- Variety of beam-shaping optics, including lasers with defined fan angle, semi-telecentric laser lines, micro focus generators and collimators
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control. More electronic information can be found on p. 75 (Electronics types CS/ PS).
- Supply Voltage: 5 V DC

Features of the RS232 interface

The RS232 interface (or the USB connection using the switchbox SBS 070701-USB) allows laser control and reading out of laser data:

Input parameters:

- laser power
- laser output power limit
- mode of operation
- laser ON/OFF

Output parameters

- laser current (mA)
- photo diode current (µA)
- temperature
- laser output power (%)
- operating voltage
- hours of operation
- min./max. temperature

Accessory: Switchbox SBS070701-USB

Switchbox SBS070701-USB for laser diode beam sources with 5 V power supply and RS232 interface (electronics type CS/PS).

Features:

- Suitable for lasers with RS232 interface
- Mini USB 2.0 connection for laser control and reading out of laser data, e.g. hours of operation
- Reverse voltage protection
- Dimensions:
  L 56 mm x H 30 mm x D 60 mm

Front

Back

For more information please see page 76

Fundamentals Low Noise Laser Diode Modules LNC-Series

Lasers of Series LNC

The low noise laser diode modules (Series LNC) from Schäfter+Kirchhoff exhibit reduced power noise and reduced coherence length.

The low noise (typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz) and lack of mode hopping make these laser diode modules ideal for particle measurements or advanced medical and biotechnological applications.

(* P_o is the maximum specified output power.)

- **Low noise laser module typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz)**
- **Reduced coherence length**
- **Mode hopping free laser operation**

Low noise laser diode module of the LNC-Series can be found on page 56f or using the Product Configurator on: www.sukhamburg.com

Low noise laser diode beam sources

Conventional single-mode laser diodes are semiconductor lasers and usually operate on one favored longitudinal mode. However, the semiconductor laser material exhibits a temperature dependency, which alters the gain profile and refractive index so that the diode jumps between different longitudinal modes.

This mode hopping causes the output wavelength to jump rapidly by a few picometers. For single-mode diodes that are not stabilized, the output power can change erratically by as much as 3%. This is not relevant for many applications but is relevant for some applications.

Power noise and mode hopping are eliminated in the low noise laser diode module LNC-series because an internal RF-modulation excited numerous longitudinal modes of emission. This simultaneously lowers signal noise significantly, to typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz). P_o is the maximum specified output power. Some diodes even have a noise of typ. < 0.1 % of P_o (RMS, Bandwidth < 1 MHz).

This induced broadening of the spectrum, in a controlled and stable way, has the added advantage of considerably reducing the coherence length of the laser beam. In some cases this can also reduce laser speckle contrast and prevent interference patterns.

Low noise laser diode modules in comparison with standard laser diode beam sources

The notable benefits of lasers of series LNC become more evident when compared with the characteristics of a standard laser diode. The noise, spectrum, laser speckle as well as interference behavior are all improved, see Fig. 4, in comparison with a standard laser diode, Fig. 5.

Low Noise

In Fig. 4A and 5A, the noise profiles (bandwidth of 1MHz, period of 60 minutes) of the two diodes are compared. Peak noise values exceed 1 % for a standard laser diode while the laser of series LNC has reduced noise of typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz). Some diodes even have a noise of typ < 0.1 % of P_o (RMS, Bandwidth < 1 MHz).

No Mode Hopping

In standard laser diodes the laser jumps stochastically between several emitting modes (Fig. 5B, different colors). For lasers of series LNC numerous modes are excited within the gain profile of the resonator (Fig. 4B), producing a broad spectrum with about 1.5 nm FWHM (full-width at half-maximum).

In some cases: Reduced Laser Speckle

The corresponding laser speckle behavior, a frequent problem in optical metrology, is shown in Fig. 4C and 5C. Speckle arises from multiple interference, e.g. diffuse re-flection of laser radiation on optically rough surfaces (> λ/4).
The speckle contrast and size generally depends on

- Line width/spot size
- Size of the aperture of the optics
- Measurement geometry

This means a general statement is not possible:

- For thicker laser lines and larger laser spots when using a fully coherent (standard) laser source, the laser speckle contrast is 1 and there are areas of zero intensity within a laser spot. For a LNC laser source the emission from multiple laser modes results in a reduced coherence length (approximately < 300 µm), and the speckle contrast and size are also less (compare Fig. 4C with Fig. 5C).
- For thinner laser lines and smaller laser spots this benefit is less relevant and there might be little to no difference in speckle behaviour.

Less Interference

Another effect of a reduced coherence length can be observed in Fig. 4D and 5D. The image of a collimated laser beam reveals a disturbing interference pattern when using a standard laser diode (Fig. 5D), as a result of internal reflection within the protective glass window of the detector in a CCD area scan camera.

Since the coherence length of a low noise laser diode module is less than the thickness of the glass then the interference is eliminated (Fig. 5D).

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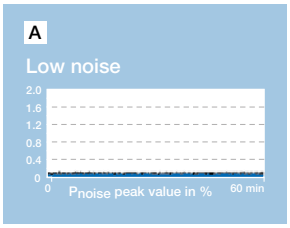
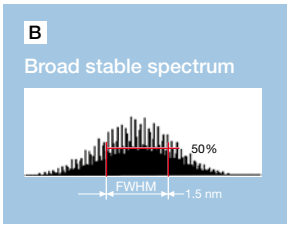
Figure 4
Advantages of lasers of series LNC

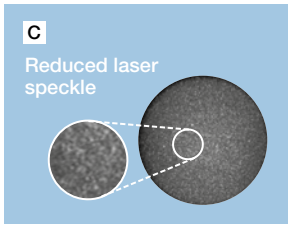
With lower noise, spectral broadening, reduced laser speckle and less interference.



The RF-modulation results in a constant mean laser power. Power noise typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz).

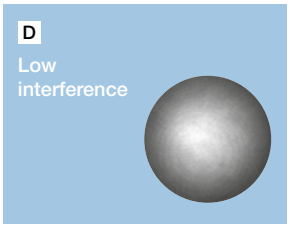


Broadened spectrum (~1.5 nm FWHM) with reduced coherence length (~ 0.3 mm) as a result of using RF-modulation.



Low speckle contrast due to reduced coherence length.

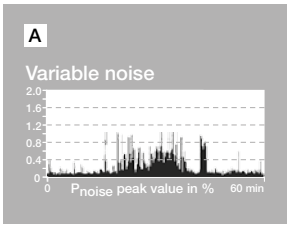
Please note that speckle contrast and size generally depend on factors such as spot size and the aperture of the optics.



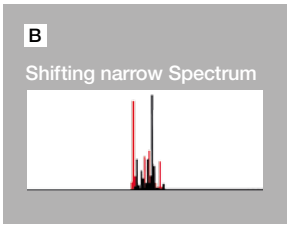
Intensity distribution of a laser spot at a camera sensor. No interference patterns, despite the camera sensor protection window.

Figure 5
Characteristics of a standard laser diode beam source

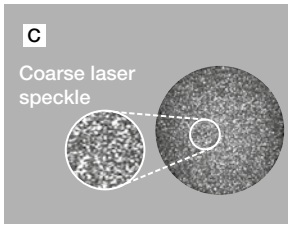
High noise, mode hopping, laser speckle and unwanted interference can constrain the optical resolution.



Power noise from a laser diode module.
Mode hopping increases the power noise.

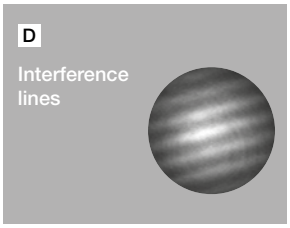


Mode hopping: temporal jumps between modes. The short-term coherence of individual modes is >1 m, but effective coherence length is smaller.



A standard laser diode module produces a laser spot with speckle.

Please note that speckle contrast and size generally depend on factors such as spot size and the aperture of the optics.



The laser spot recorded directly using a camera sensor, with its protection window generating a disturbing pattern of interference.

1. Using the Product Configurator

Fast and easy selection of laser modules on www.sukhamburg.com

The new product configurator for laser line as well as focus generators and collimators, helps select products based on a number of technical specifications and narrows down the search to a few relevant products that meet the customer's need.

- Sliders/checkboxes for different parameters like e.g laser line width, line length or depth of focus etc.
- Wavelength selection
- Selection of laser series
- Selection of serial interface or low noise version
- Electrical features and cable orientation

Technical details can be compared 1:1 by using the product comparison function.

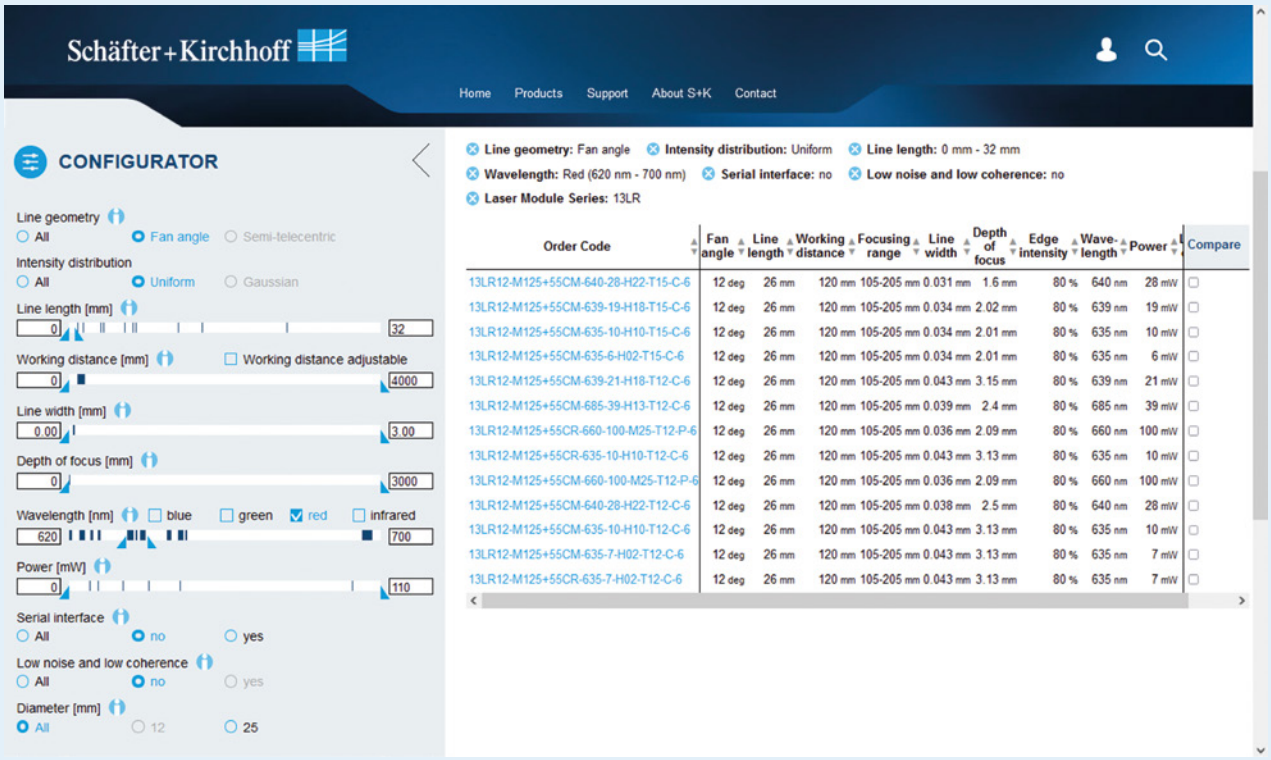
The detailed specific product pages include:

- Detailed description
- Up-to-date technical data
- Technical drawings including step files (step files for registered users only)
- Adequate accessories including tools, power supply, switchbox etc.
- Extensive technotes section
- FAQs

Using the product configurator, all laser parameters can be found on the specific product pages. There is no need for recalculation using the correction factor F.

The data on the website is updated frequently. If you want the latest information on our laser modules, please refer to www.sukhamburg.com/lasermodules.html

Example of the Product Configurator (https://www.sukhamburg.com/products/lasermodules/configurators.html)



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2. Using the Product Catalogue

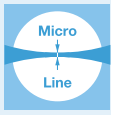
1. Choose the appropriate beam shape

An overview over the different beam shapes can be found on the overview pages 12-15.

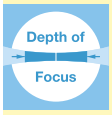
2. Choose between Laser Micro Line/Focus Generator or Laser Macro Line/Focus Generator

Depending on the application a certain depth of focus or a certain power density or line width may be required. For a detailed description of the benefits of each configuration, please see page 24.

- Small laser line widths or small laser spots
- High power density in the focal plane
- Gaussian intensity profile across the laser line or laser spot



or



- Larger, almost constant laser line widths or spot sizes with lower power density
- Extended depth of focus (7 to 35-times greater)
- Approx. Gaussian intensity profile across the laser line or laser spot

3. Choose the right combination of beam shaping optics + laser diode module

Now you have to determine the right wavelength and power as well as the particular beam shaping optics with adequate line length/width, spot size, working distance etc.

Choose: **1** Beam Shaping Optics (left table) and **2** Laser Diode Collimator (right table)

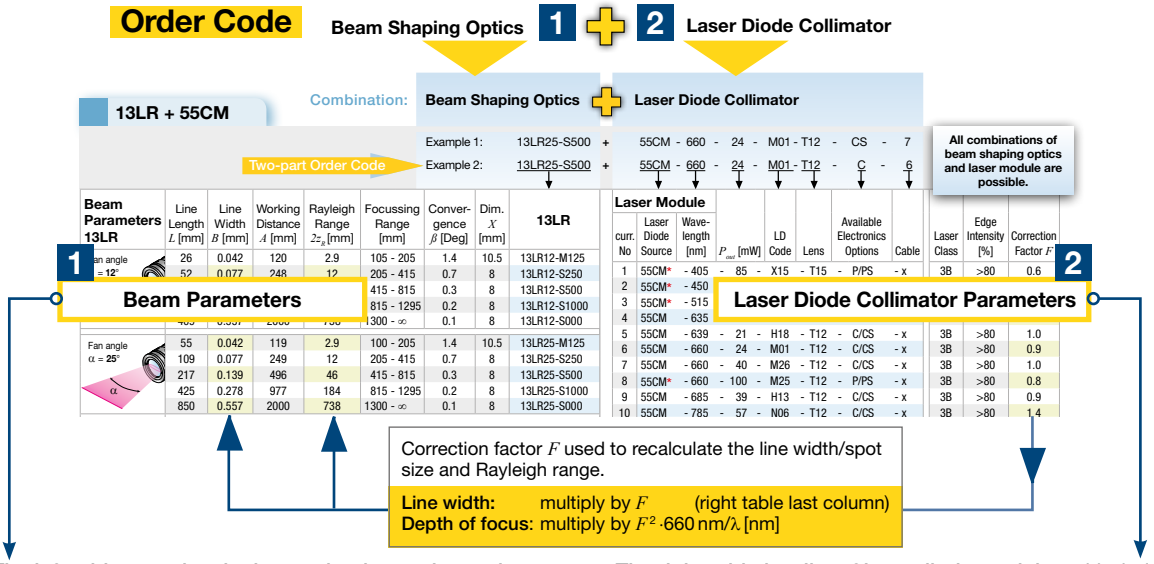
The choice of **laser diode influences** the **beam parameters** line width /spot size as well as Rayleigh range / depth of focus, so they need to be recalculated!

4. Recalculate the beam parameters using the correction factor F

The choice of diode is made according to the required wavelength and laser power. The divergence angle and wavelength affect the beam parameters (given in the left table for a typical diode M26 with 660 nm as an example).

For a different diode line width/spot size and Rayleigh range/depth of focus must be recalculated using the correction factor F (found in the outmost right column of the right table). For details see page 23. The formulae are found on each page in the orange box (see below).

Order Code – The Order Code consists of two parts:



The left table contains the beam shaping optics and specifies beam parameters when using a typical diode. The order code (marked with blue or yellow) on the right-hand column is part 1 of the complete order code.

The right table is a list of laser diode modules with their order codes in the left-hand columns (marked with blue or yellow) as part 2 of the complete order code.

How to Order a Line or Focus Generator: Example

This particular example shows how to choose the correct laser, determine its beam characteristics and determine the correct order code based on a list of desired features

The desired laser module is supposed to possess the following features:

- Laser line with a fan angle
- Relatively small line width
- Homogeneous intensity distribution
- RS232-interface
- Line length L about 220 mm
- Working distance about 500 mm
- Visible laser with 660 nm with about 20 mW

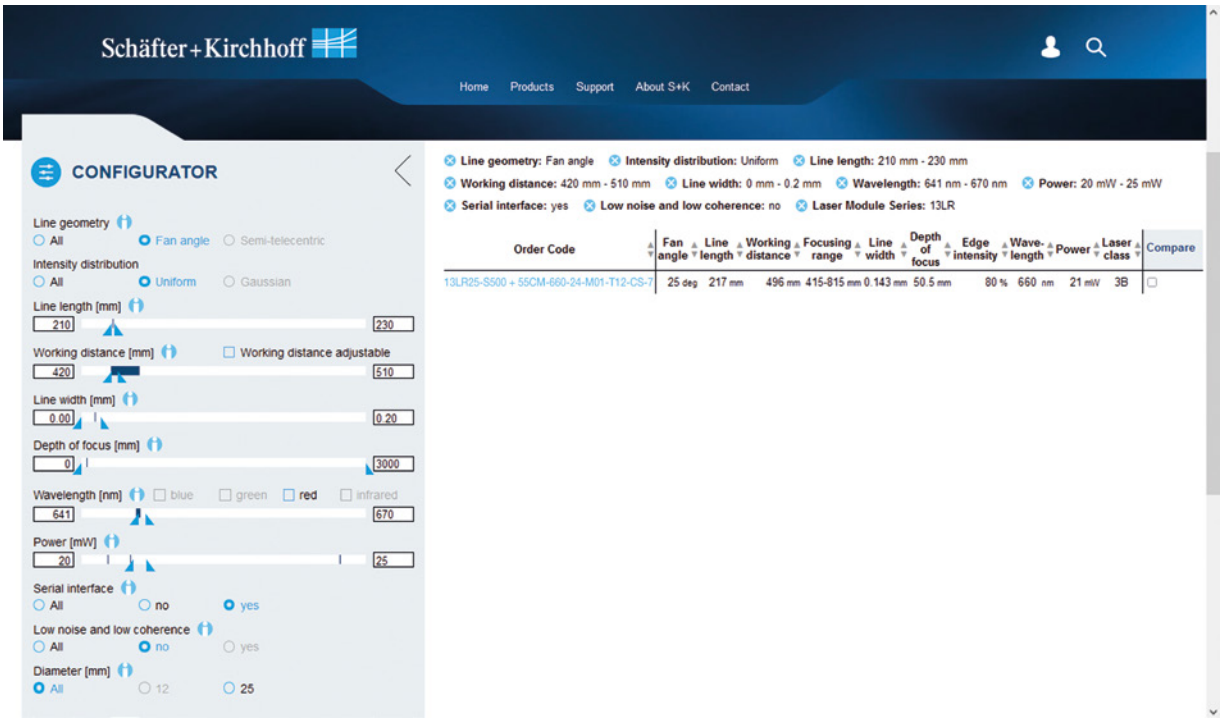
1. Quickly and efficiently: Using the Product Configurator

- Select the features in the Product Configurator using the sliders, radio buttons or checkboxes
- The Product Configurator immediately narrows down the search to all lasers that fit the criteria and shows all relevant data in a table

As only one laser is found, the choice is easy:

Order Code **13LR25-S500 + 55CM-660-24- M01-T12-CS-7**

All key features as well as all up-to-date information is found on the specific product page.



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How to Order a Line or Focus Generator: Example

2. Using the Tables in the Product Catalogue

2.1 Choose the appropriate beam shape

- Looking at the overview on page 12-15 you can see that there are three different types for laser lines with a fan angle: 13LR+55CM (pages 34-35), as well as 13LN+90CM (pages 36-37).
- Since you want a homogeneous intensity distribution only the types 13LR+55CM as well as 13LN+90CM come into consideration.
- Take a look at the left tables specifying the beam parameters on each laser page you can see that the 13LN+90CM does not offer such a long line at the desired working distance (max. line length for about 500 mm working distance is 152 mm).
- Thus the correct choice of laser is the type13LR+55CM.

2.2 Micro line Generator or Macro Line Generator

Since you want a small line you need to choose the micro line generator (smaller lines, high power density) of type 13LR+55CM on page 34.

2.3 Right combination of beam shaping optics + laser diode module

The beam shaping optics with parameters closest to the desired features is 13LR25-S500 (features marked green) with a nominal line length L =217 mm and line width B = 0.134 mm at working distance 496 mm. The first part of the order code is 13LR25-S500.

Looking at the right table the correct choice for a 660 nm laser with about 20 mW is the laser diode module in row 5 (features marked green). After choosing casing type A1 ("55CM"), the electronics with RS232-interface ("CS") and cable option "7" the second part of the order code is 55CM-660-24-M01-T12-CS-7.

The complete Order Code is: 13LR25-S500 + 55CM-660-24- M01-T12-CS-7

2.4 Recalculate the beam parameters

Since the values for the beam parameters in the left table are presented for a typical diode (M26, 660 nm), the line width and Rayleigh range require recalculation using the correction factor F (details page 23). F is specified in the outmost right column (marked green). In this case F = 0.9. Using the formulae given in the box below the tables this results in a line width B = 0.12 mm and Rayleigh range $2z_R$ = 35 mm.

If this laser module were to be used at a working distance of 600 mm, using the formulae on page 22 the line width would be calculated to be B = 0.11 mm and the line length would be L = 250 mm.

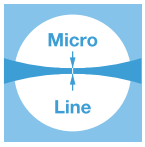
Example of the Laser module table: please see page 34, 13LR+55CM

Standard Laser Lines

Laser Lines, Micro Focus, Macro Focus, and Laser Generators

Laser Micro Line Generators 13LR + 55CM

Laser line with a fan angle and approx. uniform intensity distribution

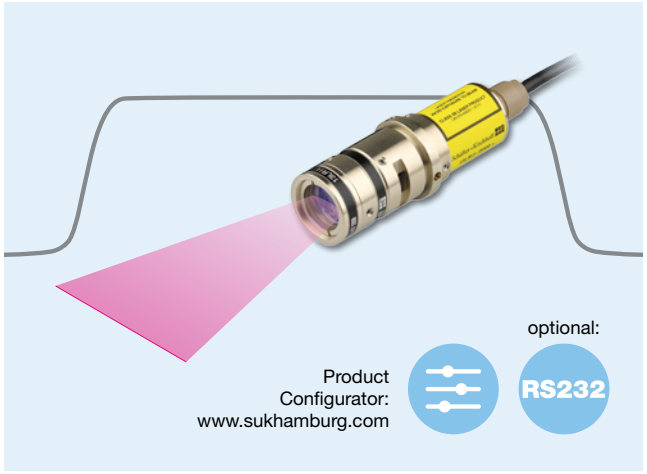


- Fan angles 12°, 25° and 40°
- Constant line width along the entire line length
- Intensity profile approx. uniform in line direction, Gaussian across the laser line
- Fine-Structure: chain of equidistant dots (with a spacing of approx. the line width)
- Line width starting at 40 µm (1/e²)
- Laser wavelengths 405 to 1550 nm
- Laser power output up to 143 mW
- Adjustment of focus setting
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply Voltage: 5 V DC
- Casing Ø 25/28 mm

Option:
- RS232 interface – electronics types CS or PS, see p. 25.

The beam-shaping optics define the beam parameters, fan angle and line length, the optimum working distance and the focussing range, see left table. The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left table) are valid for the nominal working distance of the line optics. The working distance can be adjusted by adjusting the focus setting. Please note that beam parameters like line length and line width increase proportionally to the working distance. A fine-adjustment of the distance between laser and target is recommended for fine-focusing.



Adjustment possibilities:
- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs:
www.sukhamburg.com

13LR + 55CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: 13LR25-S500 + 55CM - 660 - 24 - M01 - T12 - CS - 7
Example 2: 13LR25-S500 + 55CM - 660 - 24 - M01 - T12 - C - 6

All combinations of beam shaping optics and laser modules are possible.

Beam Parameters 13LR	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Focussing Range [mm]	Conver-gence β [Deg]	Dim. X [mm]	13LR
Fan angle α = 12°	26	0.042	120	2.9	105 - 205	1.4	10.5	13LR12-M125
	52	0.077	248	12	205 - 415	0.7	8	13LR12-S250
	103	0.139	496	46	415 - 815	0.3	8	13LR12-S500
	201	0.278	977	184	815 - 1295	0.2	8	13LR12-S1000
	409	0.557	2000	738	1300 - ∞	0.1	8	13LR12-S000
Fan angle α = 25°	55	0.042	119	2.9	100 - 205	1.4	10.5	13LR25-M125
	109	0.077	249	12	205 - 415	0.7	8	13LR25-S250
	217	0.139	496	46	415 - 815	0.3	8	13LR25-S500
	425	0.278	977	184	815 - 1295	0.2	8	13LR25-S1000
	850	0.557	2000	738	1300 - ∞	0.1	8	13LR25-S000
Fan angle α = 40°	90	0.042	120	2.9	100 - 205	1.4	15	13LR40-M125
	180	0.077	245	12	205 - 415	0.7	10.5	13LR40-S250
	357	0.139	492	46	415 - 815	0.3	10.5	13LR40-S500
	698	0.278	973	184	815 - 1295	0.2	10.5	13LR40-S1000
	1400	0.557	2000	738	1300 - ∞	0.1	8	13LR40-S000

Laser Module curr. No	Laser Diode Source	Wave-length [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Edge Intensity [%]	Correction Factor F
1	55CM*	- 405	- 85	- X15	- T15	- P/PS	- x	3B	>80	0.6
2	55CM*	- 450	- 56	- O06	- T15	- P/PS	- x	3B	>80	0.7
3	55CM*	- 488	- 42	- O09	- T15	- C/CS	- x	3B	>80	0.9
4	55CM*	- 520	- 56	- O11	- T15	- P/PS	- x	3B	>80	1.0
5	55CM	- 635	- 10	- H10	- T12	- C/CS	- x	3B	>80	1.0
6	55CM	- 639	- 21	- H18	- T12	- C/CS	- x	3B	>80	1.0
7	55CM	- 660	- 24	- M01	- T12	- C/CS	- x	3B	>80	0.9
8	55CM	- 660	- 40	- M26	- T12	- C/CS	- x	3B	>80	1.0
9	55CM*	- 660	- 100	- M25	- T12	- P/PS	- x	3B	>80	0.9
10	55CM	- 685	- 39	- H13	- T12	- C/CS	- x	3B	>80	0.9
11	55CM	- 785	- 86	- Q06	- T12	- C/CS	- x	3B	>80	1.1
12	55CM	- 830	- 35	- H19	- T12	- C/CS	- x	3B	>80	1.2
13	55CM	- 850	- 143	- G17	- T12	- C/CS	- x	3B	>80	1.2
14	55CM	- 1550	- 28	- Q04	- T12	- C/CS	- x	3B	>80	2.0

Partial selection only. More on www.sukhamburg.com

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the width and Rayleigh range/depth of focus of the laser line:

Line width: multiply by F (right table last column)
Rayleigh range: multiply by $F^2 \cdot 660\,nm/\lambda$ [nm]

Example: 13LR25-S500+55CM-660-24-M01-T12-C-6 $F = 0.9$
Line width $B = 0.139\,mm \cdot F = 0.139\,mm \cdot 0.9 = 0.121\,mm$
Rayleigh range $2z_R = 46\,mm \cdot F^2 \cdot 660\,nm / 660\,nm = 37\,mm$

Please note that all values are typical values and can differ slightly in reality.

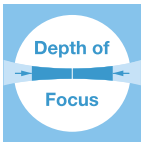
Casing Type:
Casing Type A1 ..... 55CM
Casing Type B1 (only electronics type C) 55CR
* not offered with 55CR (Casing type B1)

Electronics Options: Please choose one of the stated options.
Standard electronics ..... C or P
Electronics with RS232 interface ..... CS or PS

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (only electronics types C, P) 6
1.5 m shielded connection cable, with connector type Lumberg SV70 (only electronics types with interface CS, PS) 7
Customer-specified cable length 5

Laser Macro Line Generators 13LRM + 55CM

Laser line with a fan angle, approx. uniform intensity distribution and extended depth of focus

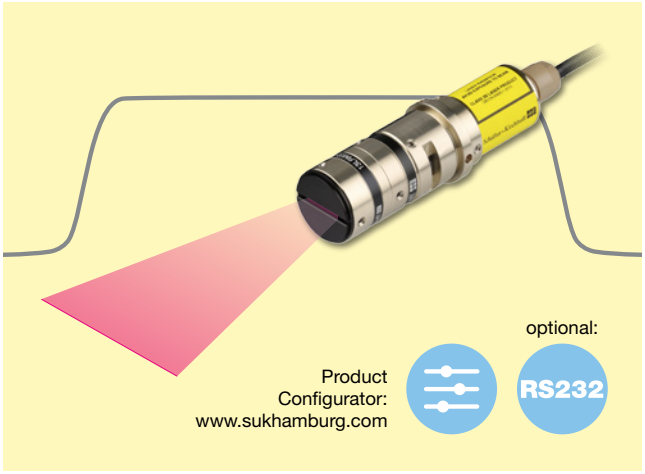


- Extended depth of focus
- Fan angles 12°, 25° and 40°
- Constant line width along the entire line length
- Intensity profile uniform in line direction, approx. Gaussian across the laser line
- Fine-Structure: chain of equidistant dots (with a spacing of approx. 1/2 line width)
- Line width starting at 80 µm (1/e²)
- Laser wavelengths 405 to 1550 nm
- Laser power output up to 94 mW
- Adjustment of focus setting
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply Voltage: 5 V DC
- Casing Ø 25 / 28 mmm

Option:
- PC-interface (RS232) – electr. types CS or PS. For details see p.25.

The beam-shaping optics define the beam parameters, fan angle and line length, the optimum working distance and the focussing range, see left table. The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left table) are valid for the nominal working distance of the line optics. The working distance can be adjusted by adjusting the focus setting. Please note that beam parameters like line length and line width increase proportionally to the working distance. A fine-adjustment of the distance between laser and target is recommended for fine-focusing.



Adjustment possibilities:
- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs:
www.sukhamburg.com

13LRM + 55CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: 13LRM25-S500-1.5 + 55CM - 660 - 14 - M01 - T12 - CS - 7
Example 2: 13LRM25-S500-1.5 + 55CM - 660 - 14 - M01 - T12 - C - 6

All combinations of beam shaping optics and laser modules are possible.

Beam Parameters 13LRM	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Depth of Focus [mm]	Focussing Range [mm]	Convergence β [Deg]	Dim. X [mm]	13LRM
Fan angle α = 12°	26	0.080	111	20	95 - 195	0.7	18.9	13LRM12-M125-1.5
	52	0.160	236	82	195 - 355	0.3	18.9	13LRM12-S250-1.5
	103	0.319	484	327	355 - 780	0.2	18.9	13LRM12-S500-1.5
	201	0.638	965	1307	780 - 1330	0.1	18.9	13LRM12-S1000-1.5
	409	1.277	2000	3000	1330 - ∞	0.04	18.9	13LRM12-S000-1.5
Fan angle α = 25°	55	0.080	111	20	95 - 195	0.7	18.9	13LRM25-M125-1.5
	109	0.160	238	82	195 - 355	0.3	18.9	13LRM25-S250-1.5
	217	0.319	485	327	355 - 780	0.2	18.9	13LRM25-S500-1.5
	425	0.638	966	1307	780 - 1330	0.1	18.9	13LRM25-S1000-1.5
	850	1.277	2000	3000	1330 - ∞	0.04	16.4	13LRM25-S000-1.5
Fan angle α = 40°	90	0.080	111	20	95 - 195	0.7	23.4	13LRM40-M125-1.5
	180	0.160	240	82	195 - 355	0.3	18.9	13LRM40-S250-1.5
	357	0.319	487	327	355 - 785	0.2	18.9	13LRM40-S500-1.5
	698	0.638	968	1307	785 - 1340	0.1	18.9	13LRM40-S1000-1.5
	1400	1.277	2000	3000	1340 - ∞	0.04	18.9	13LRM40-S000-1.5

Laser Module

curr. No	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Edge Intensity [%]	Correction Factor F
1	55CM*	- 405	- 47	- X15	- T15	- P/PS	- x	3B	>80	0.7
2	55CM*	- 450	- 35	- 006	- T15	- P/PS	- x	3B	>80	0.8
3	55CM*	- 488	- 28	- 009	- T15	- C/CS	- x	3B	>80	0.9
4	55CM*	- 520	- 40	- 011	- T15	- P/PS	- x	3B	>80	0.9
5	55CM	- 635	- 7	- H10	- T12	- C/CS	- x	3B	>80	1.0
6	55CM	- 639	- 14	- H18	- T12	- C/CS	- x	3B	>80	1.0
7	55CM	- 660	- 14	- M01	- T12	- C/CS	- x	3B	>80	1.0
8	55CM	- 660	- 27	- M26	- T12	- C/CS	- x	3B	>80	1.0
9	55CM*	- 660	- 61	- M25	- T12	- P/PS	- x	3B	>80	1.0
10	55CM	- 685	- 24	- H13	- T12	- C/CS	- x	3B	>80	1.0
11	55CM	- 785	- 56	- Q06	- T12	- C/CS	- x	3B	>80	1.2
12	55CM	- 830	- 23	- H19	- T12	- C/CS	- x	3B	>80	1.3
13	55CM	- 850	- 94	- G17	- T12	- C/CS	- x	3B	>80	1.3
14	55CM	- 1550	- 17	- Q04	- T12	- C/CS	- x	3B	>80	2.3

Partial selection only. More on www.sukhamburg.com

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the width and Rayleigh range/depth of focus of the laser line:

Line width:	multiply by F (right table last column)
Depth of focus:	multiply by $F^2 \cdot 660\,nm/\lambda$ [nm]

Example: 13LRM25-S500-1.5+55CM-520-40-O11-T15-C-6 $F = 0.9$
Line width B=0.319 mm · F = 0.319 mm · 0.9 = 0.287 mm
Depth of focus $2z_M$ = 327 mm · F^2 · 660 nm / 520 nm = 327 mm

Please note that all values are typical values and can differ slightly in reality.

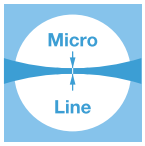
Casing Type:
Casing Type A1 ..... 55CM
Casing Type B1 (only electronics type C) 55CR
* not offered with 55CR (Casing type B1)

Electronics Options: Please choose one of the stated options.
Standard electronics ..... C or P
Electronics with RS232 interface ..... CS or PS

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (only electronics types C, P) 6
1.5 m shielded connection cable, with connector type Lumberg SV70 (only electronics types with interface CS, PS) 7
customer-specified cable length 5

Laser Micro Line Generators 13LN + 90CM

Laser line with a small fan angle, approx. uniform intensity distribution and very thin lines.



- Fan angles 0°-16.8° (depending on working distance)
- Line width constant with along 60% of the central area, outside this area the line width differs up to 30%
- Intensity profile approx. uniform in line direction (Gaussian clipped by an aperture with typ. 80% edge intensity); Gaussian across the laser line
- Line width starting at 8 µm ($1/e^2$)
- Laser power output up to 69 mW
- Laser wavelengths 635 to 1550 nm
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply Voltage: 5 V DC
- Casing Ø 25/28 mm

Option:
- RS232 interface – electronics types CS or PS, see p. 25.

Product Configurator: www.sukhamburg.com

optional: RS232 optional: LNC

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The beam-shaping optics define the beam parameter fan angle and line length and the optimum working distance, see left tables.

The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left tables) are valid for the nominal working distance of the line optics. For this laser type the working distance is fixed. A fine-adjustment of the distance between laser and target is recommended for fine-focusing in order to achieve minimal line width.

Adjustment possibilities:
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

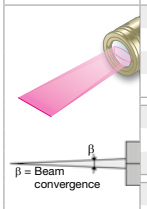
13LN + 90CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: 13LN40-S250 + 90CM - 660 - 19 - M26 - M60 - C - 6
Example 2: 13LN40-S250 + 90CM - 830 - 15 - H19 - M60 - P - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 13LN	Fan Angle α [°]	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Convergence β [Deg]	Dim. X [mm]	13LN
	10	32	0.008	92	0.1	8.6	12	13LN40-M100
	14.3	76	0.020	244	0.5	3.5	12	13LN40-S250
	15.8	152	0.038	492	2.1	1.7	12	13LN40-S500
	16.8	304	0.075	972	8.6	0.9	12	13LN40-S1000
	1.7	20	0.020	249	0.5	3.5	8	13LN165-S250
	3.4	40	0.038	424	2.1	1.7	8	13LN165-S500
	3.8	80	0.075	977	8.6	0.9	8	13LN165-S1000
	0	14	0.020	249	0.5	3.5	8	13LN250-S250
	1.7	30	0.038	424	2.1	1.7	8	13LN250-S500
	2.5	56	0.075	977	8.6	0.9	8	13LN250-S1000

β = Beam convergence

Laser Module curr. No	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Edge Intensity [%]	Correction Factor F
1	90CM	- 635	- 4	- H10	- M60	- C/CS	- x	3R	85	1.0
2	90CM	- 639	- 7	- H18	- M60	- C/CS	- x	3B	87	1.0
3	90CM	- 660	- 10	- M01	- M60	- C/CS	- x	3B	77	0.9
4	90CM	- 660	- 19	- M26	- M60	- C/CS	- x	3B	74	1.0
5	90CM*	- 660	- 52	- M25	- M60	- P/PS	- x	3B	65	0.9
6	90CM	- 685	- 17	- H13	- M60	- C/CS	- x	3B	76	0.9
7	90CM	- 785	- 49	- Q06	- M60	- C/CS	- x	3B	61	1.1
8	90CM	- 830	- 15	- H19	- M60	- C/CS	- x	3B	77	1.2
9	90CM	- 850	- 69	- G17	- M60	- C/CS	- x	3B	73	1.2
10	90CM	- 1550	- 9	- Q04	- M60	- C/CS	- x	3B	86	2.0

Partial selection only. More on www.sukhamburg.com

Blue/green lasers (405 nm - 520 nm) on request.

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the width and Rayleigh range/depth of focus of the laser line:

	Line width:	multiply by F (right table last column)
	Rayleigh range:	multiply by $F^2 \cdot 660\ nm/\lambda$ [nm]
Example:	13LN40-S250+90CM-830-15-H19-M60-C-6	F = 1.2 (right table last column)
	Line width	B=0.020 mm · F = 0.020 mm · 1.2 = 0.024 mm
	Rayleigh Range	$2z_R$ = 0.5 mm · F^2 · 660 nm / 830 nm = 0.6 mm

Please note that all values are typical values and can differ slightly in reality.

Casing Type:

Casing Type E1 ..... **90CM**

Casing Type F1 (only electronics type C) **90CR**

* not offered with 90CR (Casing type F1)

Electronics Options: Please choose one of the stated options.

Standard electronics ..... **C or P**

Electronics with RS232 interface ..... **CS or PS**

Cable Options:

1.5 m shielded connection cable 1

As 1, with connector type Lumberg SV50 (only electronics types C, P) **6**

1.5 m shielded connection cable, with connector type Lumberg SV70 (only electronics types with interface CS, PS) 7

customer-specified cable length 5

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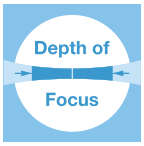
Laser Macro Line Generators 13LNM + 90CM

Laser line with a small fan angle, approx. uniform intensity distribution, and extended depth of focus.



- Extended depth of focus
- Fan angles 0°-16.8° (depending on working distance)
- Line width constant along 60% of the central area, outside this area the line width differs up to 30%
- Intensity profile approx. uniform in line direction (Gaussian clipped by an aperture with typ. 80% edge intensity); Gaussian across the laser line
- Line width starting at 14 µm (1/e²)
- Laser power output up to 52 mW
- Laser wavelengths 635 to 1550 nm
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply Voltage: 5 V DC
- Casing Ø 25/28 mm

Option:
- RS232 interface – electronics types CS or PS, see p. 25.

The beam-shaping optics define the beam parameter fan angle and line length and the optimum working distance, see left tables.

The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left tables) are valid for the nominal working distance of the line optics. For this laser type the working distance is fixed. A fine-adjustment of the distance between laser and target is recommended for fine-focusing in order to achieve minimal line width.

Product Configurator: www.sukhamburg.com

optional: RS232 optional: LNC

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Adjustment possibilities:
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

13LNM + 90CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: 13LNM40-S250-7 + 90CM - 830 - 12 - H19 - M60 - CS - 7
Example 2: 13LNM40-S250-7 + 90CM - 830 - 12 - H19 - M60 - C - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 13LNM	Fan Angle α [°]	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Depth of Focus [mm]	Convergence β [Deg]	Dim. X [mm]	13LNM
	10	30	0.014	84	1	4.0	20.5	13LNM40-M100-7
	14.3	75	0.034	227	4	1.6	20.5	13LNM40-S250-7
	15.8	150	0.068	483	15	0.8	20.5	13LNM40-S500-7
	16.8	300	0.136	964	60	0.4	20.5	13LNM40-S1000-7
	1.5	20	0.034	236	4	1.6	20.5	13LNM165-S250-7
	3	40	0.068	412	15	0.8	20.5	13LNM165-S500-7
	3.8	80	0.136	964	60	0.4	20.5	13LNM165-S1000-7
	0	14	0.034	236	4	1.6	20.5	13LNM250-S250-7
	1.7	30	0.068	412	15	0.8	20.5	13LNM250-S500-7
	2.5	56	0.136	965	60	0.4	20.5	13LNM250-S1000-7

β = Beam convergence

Laser Module curr. No	Laser Diode Source	Wavelength [nm]	P_{mod} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Edge Intensity [%]	Correction Factor F
1	90CM	- 635	- 3	- H10	- M60	- C/CS	- x	3R	85	1.0
2	90CM	- 639	- 6	- H18	- M60	- C/CS	- x	3B	87	1.0
3	90CM	- 660	- 8	- M01	- M60	- C/CS	- x	3B	77	1.0
4	90CM	- 660	- 15	- M26	- M60	- C/CS	- x	3B	74	1.0
5	90CM*	- 660	- 38	- M25	- M60	- P/PS	- x	3B	65	1.0
6	90CM	- 685	- 12	- H13	- M60	- C/CS	- x	3B	76	1.0
7	90CM	- 785	- 37	- Q06	- M60	- C/CS	- x	3B	61	1.2
8	90CM	- 830	- 12	- H19	- M60	- C/CS	- x	3B	77	1.3
9	90CM	- 850	- 52	- G17	- M60	- C/CS	- x	3B	73	1.3
10	90CM	- 1550	- 7	- Q04	- M60	- C/CS	- x	3B	86	2.3

Partial selection only. More on www.sukhamburg.com

Blue/green lasers (405 nm - 520 nm) on request.

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the width and Rayleigh range/depth of focus of the laser line:

Line width: multiply by F (right table last column)
Depth of focus: multiply by $F^2 \cdot 660\ nm/\lambda\ [nm]$

Example: 13LNM40-S250-7+90CM-830-12-H19-M60-C-6 F = 1.3 (right table last column)
Line width B=0.034 mm · F = 0.034 mm · 1.3 = 0.044 mm
Depth of focus $2z_M$ = 4.0 mm · F^2 · 660 nm / 830 nm = 5.4 mm

Casing Type:
Casing Type E1 ..... **90CM**
Casing Type F1 (only electronics type C) **90CR**
* **not offered with 90CR (Casing type F1)**

Please note that all values are typical values and can differ slightly in reality.

Electronics Options: Please choose one of the stated options.
Standard electronics ..... **C or P**
Electronics with RS232 interface ..... **CS or PS**

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (only electronics types C, P) **6**
1.5 m shielded connection cable, with connector type Lumberg SV70 (only electronics types with interface CS, PS) 7
customer-specified cable length 5

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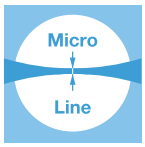
Laser Micro Line Generators 13LT + 90CM

Semi-telecentric laser line with constant line length 15 mm and approx. uniform intensity distribution



- Semi-telecentric (Fan angle 0°)
- Line length constant 15 mm
- Intensity profile approx. uniform in line direction (Gaussian clipped by an aperture with typ. 80% edge intensity); Gaussian across the laser line
- Line width starting at 12 µm (1/e²)
- Laser power up to 71 mW
- Laser wavelengths 405 – 1550 nm
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply Voltage: 5 V DC
- Casing Ø 25/28 mmm

Option:
- RS232 interface – electronics types CS or PS, see p. 25.

Product Configurator: www.sukhamburg.com

optional: RS232 optional: LNC

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The beam-shaping optics define the beam parameter line length, the optimum working distance and the focussing range, see left table. The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left table) are valid for the nominal working distance of the line optics. For this laser type the working distance is fixed. A fine-adjustment of the distance between laser and target is recommended for fine-focusing in order to achieve minimal line width.

Adjustment possibilities:
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

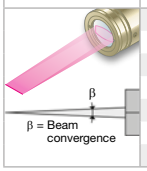
13LT + 90CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: 13LT-250 + 90CM - 660 - 20 - M26 - M60 - CS - 7
Example 2: 13LT-250 + 90CM - 660 - 20 - M26 - M60 - C - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 13LT	Fan Angle α [°]	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Rayleigh Range 2z_R [mm]	Convergence β [Deg]	Dim. X [mm]	13LT
	0	15	0.012	160	0.2	5.2	8	13LT-165
	0	15	0.017	243	0.5	3.5	8	13LT-250
	0	15	0.020	323	0.9	2.6	8	13LT-330
	0	15	0.030	493	2.1	1.7	8	13LT-500
	0	15	0.060	993	8.6	0.9	8	13LT-1000
	0	15	0.120	1993	34	0.4	8	13LT-2000
	0	15	0.240	3993	137	0.2	8	13LT-4000

Laser Module curr. No.	Laser Diode Source	Wave-length [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Edge Intensity [%]	Correc-tion Factor F
1	90CM*	- 405	- 43	- X15	- M60	- P/PS	- x	3B	72	0.7
2	90CM*	- 450	- 28	- 006	- M60	- P/PS	- x	3B	76	0.9
3	90CM*	- 488	- 20	- 009	- M60	- C/CS	- x	3B	78	1.1
4	90CM*	- 520	- 29	- 011	- M60	- P/PS	- x	3B	78	1.3
5	90CM	- 635	- 4	- H10	- M60	- C/CS	- x	3R	85	1.0
6	90CM	- 639	- 8	- H18	- M60	- C/CS	- x	3B	87	1.0
7	90CM	- 660	- 10	- M01	- M60	- C/CS	- x	3B	77	0.9
8	90CM	- 660	- 20	- M26	- M60	- C/CS	- x	3B	74	1.0
9	90CM*	- 660	- 54	- M25	- M60	- P/PS	- x	3B	65	0.9
10	90CM	- 685	- 17	- H13	- M60	- C/CS	- x	3B	76	0.9
11	90CM	- 785	- 51	- Q06	- M60	- C/CS	- x	3B	61	1.1
12	90CM	- 830	- 16	- H19	- M60	- C/CS	- x	3B	77	1.2
13	90CM	- 850	- 71	- G17	- M60	- C/CS	- x	3B	73	1.2
14	90CM	- 1550	- 9	- Q04	- M60	- C/CS	- x	3B	86	2.0

Partial selection only. More on www.sukhamburg.com

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the width and Rayleigh range/depth of focus of the laser line:

	Line width:	multiply by F (right table last column)
	Rayleigh range:	multiply by $F^2 \cdot 660\ nm/\lambda$ [nm]
Example:	13LT-165+90CM-405-43-X15-M60-P-6	F = 0.7 (right table last column)
	Line width	B=0.012 mm · F = 0.012 mm · 0.7 = 0.009 mm
	Rayleigh Range	$2z_R$ = 0.2 mm · F^2 · 660 nm / 405 nm = 0.16 mm

Please note that all values are typical values and can differ slightly in reality.

Casing Type:

Casing Type E2 ..... **90CM**
Casing Type F2 (only electronics type C) **90CR**

* **not offered with 90CR (Casing type F2)**

Electronics Options: Please choose one of the stated options.

Standard electronics ..... **C or P**
Electronics with RS232 interface ..... **CS or PS**

Cable Options:

1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (only electronics types C, P) **6**
1.5 m shielded connection cable, with connector type Lumberg SV70 (only electronics types with interface CS, PS) 7
customer-specified cable length 5

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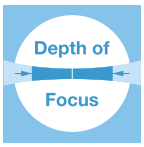
Laser Macro Line Generators 13LTM + 90CM

Semi-telecentric laser line with constant line length 15 mm, approx. uniform intensity distribution and extended depth of focus



- Extended depth of focus
- Semi-telecentric (Fan angle 0°)
- Line length constant 15 mm
- Intensity profile approx. uniform in line direction (Gaussian clipped by an aperture with typ. 80% edge intensity); Gaussian across the laser line
- Line width starting at 39 µm (1/e²)
- Laser power up to 30 mW
- Laser wavelengths 405 – 1550 nm
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply Voltage: 5 V DC
- Casing Ø 25/28 mmm

Option:

- RS232 interface – electronics types CS or PS, see p. 25.

Product Configurator: www.sukhamburg.com

optional: RS232

optional: LNC

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The beam-shaping optics define the beam parameter line length, the optimum working distance and the focussing range, see left table. The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left table) are valid for the nominal working distance of the line optics. For this laser type the working distance is fixed. A fine-adjustment of the distance between laser and target is recommended for fine-focusing in order to achieve minimal line width.

Adjustment possibilities:

- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

www

13LTM + 90CM

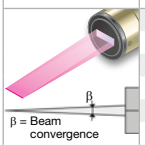
Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: 13LTM-500-41 + 90CM - 830 - 7 - H19 - M60 - CS - 7

Example 2: 13LTM-500-41 + 90CM - 830 - 7 - H19 - M60 - C - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 13LTM	Fan Angle α [°]	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Depth of Focus [mm]	Convergence β [Deg]	Dim. X [mm]	13LTM
	0	15	0.039	153	5	1.4	13.4	13LTM-165-41
	0	15	0.060	238	11	0.9	13.4	13LTM-250-41
	0	15	0.079	318	20	0.7	13.4	13LTM-330-41
	0	15	0.119	488	46	0.5	13.4	13LTM-500-41
	0	15	0.238	988	184	0.2	13.4	13LTM-1000-41
	0	15	0.476	1988	735	0.1	13.4	13LTM-2000-41
	0	15	0.953	3988	2941	0.1	13.4	13LTM-4000-41

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the width and Rayleigh range/depth of focus of the laser line:

Line width: multiply by F (right table last column)
Depth of focus: multiply by $F^2 \cdot 660\ \text{nm}/\lambda$ [nm]

Example: 13LTM-165-41+90CM-405-18-X15-M60-P-6 $F = 0.7$ (right table last column)
Line width B=0.039 mm · F = 0.039 mm · 0.7 = 0.027 mm
Depth of focus $2z_M$ = 5 mm · F^2 · 660 nm / 405 nm = 4.0 mm

Please note that all values are typical values and can differ slightly in reality.

Laser Module

curr. No.	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Edge Intensity [%]	Correction Factor F
1	90CM*	- 405	- 18	- X15	- M60	- P/PS	- x	3B	72	0.7
2	90CM*	- 450	- 13	- 006	- M60	- P/PS	- x	3B	76	0.8
3	90CM*	- 488	- 10	- 009	- M60	- C/CS	- x	3B	78	0.9
4	90CM*	- 520	- 15	- 011	- M60	- P/PS	- x	3B	78	0.9
5	90CM	- 635	- 2	- H10	- M60	- C/CS	- x	3R	85	1.0
6	90CM	- 639	- 3	- H18	- M60	- C/CS	- x	3R	87	1.0
7	90CM	- 660	- 4	- M01	- M60	- C/CS	- x	3R	77	1.0
8	90CM	- 660	- 9	- M26	- M60	- C/CS	- x	3B	74	1.0
9	90CM*	- 660	- 22	- M25	- M60	- P/PS	- x	3B	65	1.0
10	90CM	- 685	- 7	- H13	- M60	- C/CS	- x	3B	76	1.0
11	90CM	- 785	- 21	- Q06	- M60	- C/CS	- x	3B	61	1.2
12	90CM	- 830	- 7	- H19	- M60	- C/CS	- x	3B	77	1.3
13	90CM	- 850	- 30	- G17	- M60	- C/CS	- x	3B	73	1.3
14	90CM	- 1550	- 4	- Q04	- M60	- C/CS	- x	3B	86	2.3

Partial selection only. More on www.sukhamburg.com

Casing Type:

Casing Type E2 . . . . . **90CM**
Casing Type F2 (only electronics type C) **90CR**
* **not offered with 90CR (Casing type F2)**

Electronics Options: Please choose one of the stated options.

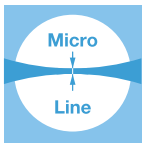
Standard electronics . . . . . **C or P**
Electronics with RS232 interface . . . . . **CS or PS**

Cable Options:

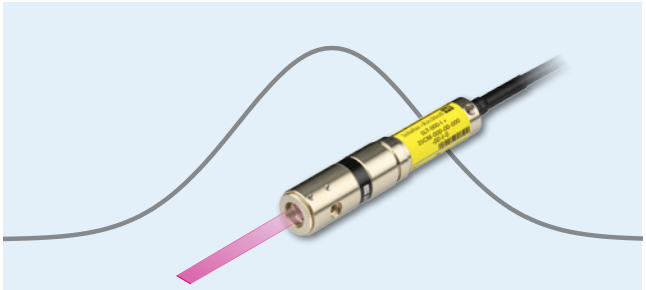
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (only electronics types C, P) **6**
1.5 m shielded connection cable, with connector type Lumberg SV70 (only electronics types with interface CS, PS) 7
customer-specified cable length 5

Laser Micro Line Generators 5LT + 25CM

Semi-telecentric, compact laser line with Gaussian intensity distribution and constant line length of approx. 4.8 or 2.0 mm



- Semi-telecentric (Fan angle 0°)
- Constant line lengths of approx. 4.8 or 2.0 mm
- Intensity profile 5LT...-1: Gaussian in line direction, clipped by an aperture with <40% edge intensity, Gaussian across the laser line
- Intensity profile 5LT...-2: Gaussian in line direction (line length is given on the 13.5%-level), Gaussian across the laser line
- Line width starting at 11 µm ($1/e^2$)
- Laser power up to 146 mW
- Laser wavelengths 405 – 850 nm
- Integrated electronics with two modulation input ports (TTL and analog, in case of electronics type B TTL only) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (12 V DC for electronics type B)
- Casing Ø 12 mm



optional:

Product Configurator: www.sukhamburg.com

RS232

The beam-shaping optics define the beam parameter fan angle and line length and the optimum working distance, see left tables.

The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left tables) are valid for the nominal working distance of the line optics. For this laser type the working distance is fixed. A fine-adjustment of the distance between laser and target is recommended for fine-focusing in order to achieve minimal line width.

Adjustment possibilities:

- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: www.sukhamburg.com

WWW

5LT + 25CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

All combinations of beam shaping optics and laser module are possible.

Two-part Order Code

Example 1: 5LT-330-1 + 25CM - 635 - 5 - H02 - A8 - S - 6
Example 2: 5LT-330-1 + 25CM - 660 - 23 - M01 - A8 - S - 6

Beam Parameters 5LT...-1	Fan Angle α [°]	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Convergence β [Deg]	Dim. X [mm]	5LT...-1
Line optics 5LT...-1 1	0	4.8	0.026	45	1.0	2.3	1.2	5LT-50-1
	0	4.8	0.039	74	2.3	1.5	1.2	5LT-75-1
	0	4.8	0.050	96	4.2	1.2	1.2	5LT-100-1
	0	4.8	0.075	145	9.3	0.8	1.2	5LT-150-1
	0	4.8	0.115	250	26	0.5	1.2	5LT-250-1
	0	4.8	0.138	324	45	0.3	1.2	5LT-330-1
	0	4.8	0.209	491	104	0.2	1.2	5LT-500-1

Beam Parameters 5LT...-2	Fan Angle α [°]	Line Length L [mm] (13.5%-level)	Line Width B [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Convergence β [Deg]	Dim. X [mm]	5LT...-2
Line optics 5LT...-2 2	0	2.0	0.011	45	0.2	2.3	1.2	5LT-50-2
	0	2.0	0.016	74	0.4	1.5	1.2	5LT-75-2
	0	2.0	0.021	96	0.7	1.2	1.2	5LT-100-2
	0	2.0	0.032	145	1.6	0.8	1.2	5LT-150-2
	0	2.0	0.048	250	4.6	0.5	1.2	5LT-250-2
	0	2.0	0.058	324	8.0	0.3	1.2	5LT-330-2
	0	2.0	0.088	491	18	0.2	1.2	5LT-500-2

Laser Module

curr. No	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Electronics	Cable	Laser Class	For 5LT-1: Edge Intensity [%]	Correction Factor F
1	25CM	- 405	- 14	- Y07	- A7.5	- B	- x	3B	10	0.8
2	25CM	- 635	- 9	- H10	- A8	- S	- x	3B	33	1.0
3	25CM	- 639	- 16	- H18	- A8	- S	- x	3B	40	1.0
4	25CM	- 640	- 28	- H22	- A8	- S	- x	3B	15	0.9
5	25CM	- 660	- 23	- M01	- A8	- S	- x	3B	17	0.9
6	25CM	- 660	- 40	- M26	- A8	- S	- x	3B	13	1.0
7	25CM	- 685	- 25	- M21	- A8	- S	- x	3B	10	0.8
8	25CM	- 685	- 39	- H13	- A8	- S	- x	3B	16	0.9
9	25CM	- 785	- 3	- M10	- A8	- S	- x	3B	36	0.9
10	25CM	- 785	- 90	- Q06	- A8	- S	- x	3B	4	1.1
11	25CM	- 830	- 35	- H19	- A8	- S	- x	3B	17	1.2
12	25CM	- 850	- 146	- G17	- A8	- S	- x	3B	12	1.2

Electronics Type

Electronics specifications differ for electronics type B. Details are found on page 67.

For 5LT...-2 (left lower table) the free aperture is larger than the line length L. L is here given on the 13.5%-level.

For Configuration Options 1 / 2 please see p.41

Partial selection only. More on www.sukhamburg.com

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the width and Rayleigh range/depth of focus of the laser line:

	Line width:	multiply by F (right table last column)
	Rayleigh range:	multiply by $F^2 \cdot 660\,nm/\lambda\,[nm]$
Example:	5LT-330-1+25CM-685-25-M21-A8-S-6	$F = 0.8$ (right table last column)
	Line width	B=0.138 mm · F = 0.138 mm · 0.9 = 0.110 mm
	Rayleigh Range	$2z_R$ = 45 mm · F^2 · 660 nm / 685 nm = 28 mm

Cable Options:

1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV40 . . . . . (electronics type B only) 4
As 1, with connector type Lumberg SV50 . . . . . (electronics type S only) 6
customer-specified cable length 5

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Laser Macro Line Generators 5LTM + 25CM

Semi-telecentric, compact laser line with a constant line length of approx. 4.8 or 2.0 mm and extended depth of focus

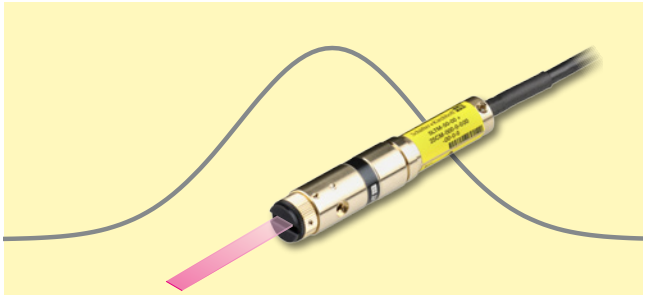
Depth of Focus

- Extended depth of focus
- Semi-telecentric (Fan angle 0°)
- Constant line lengths of approx. 4.8 or 2.0 mm
- Intensity profile 5LT...-1: Gaussian in line direction, clipped by an aperture with <40% edge intensity, approx. Gaussian across the laser line
- Intensity profile 5LT...-2: Gaussian in line direction (line length is given on the 13.5%-level), approx. Gaussian across the laser line
- Line width starting at 24 µm (1/e²)
- Laser power up to 96 mW
- Laser wavelengths 405 – 850 nm
- Integrated electronics with two modulation input ports (TTL and analog, in case of electronics type B TTL only) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (12 V DC for electronics type B)
- Casing Ø 12 mm

The beam-shaping optics define the beam parameter fan angle and line length and the optimum working distance, see left tables.

The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left tables) are valid for the nominal working distance of the line optics. For this laser type the working distance is fixed. A fine-adjustment of the distance between laser and target is recommended for fine-focusing in order to achieve minimal line width.



Product Configurator: www.sukhamburg.com

optional: RS232

Adjustment possibilities:
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: www.sukhamburg.com

5LTM + 25CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

All combinations of beam shaping optics and laser module are possible.

Two-part Order Code

Example 1: 5LTM-50-11 + 25CM - 830 - 23 - H19 - A8 - S - 6
Example 2: 5LTM-50-11 + 25CM - 660 - 27 - M26 - A8 - S - 6

Beam Parameters 5LTM...-11	Fan Angle α [°]	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Depth of focus [mm]	Convergence β [Deg]	Dim. X [mm]	5LTM...-11
Line optics 5LTM...-11 1	0	4.3	0.048	39	7	2.3	6.6	5LTM-50-11
	0	4.8	0.072	68	17	1.5	6.6	5LTM-75-11
	0	4.8	0.096	91	29	1.2	6.6	5LTM-100-11
	0	4.8	0.144	139	66	0.8	6.6	5LTM-150-11
	0	4.8	0.239	245	184	0.5	6.6	5LTM-250-11
	0	4.8	0.316	319	320	0.3	6.6	5LTM-330-11
	0	4.8	0.479	486	729	0.2	6.6	5LTM-500-11

Beam Parameters 5LTM...-22	Fan Angle α [°]	Line Length L [mm] (13.5%-level)	Line Width B [mm]	Working Distance A [mm]	Depth of focus [mm]	Convergence β [Deg]	Dim. X [mm]	5LTM...- 22
Line optics 5LTM...-22 2	0	2.0	0.024	39	2	2.3	6.6	5LTM-50-22
	0	2.0	0.036	68	4	1.5	6.6	5LTM-75-22
	0	2.0	0.048	91	7	1.2	6.6	5LTM-100-22
	0	2.0	0.071	139	17	0.8	6.6	5LTM-150-22
	0	2.0	0.119	245	46	0.5	6.6	5LTM-250-22
	0	2.0	0.157	319	80	0.3	6.6	5LTM-330-22
	0	2.0	0.238	486	184	0.2	6.6	5LTM-500-22

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the width and Rayleigh range/depth of focus of the laser line:

Line width: multiply by F (right table last column)
Depth of focus: multiply by $F^2 \cdot 660\,nm/\lambda\,[nm]$

Laser Module

curr. No.	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Electronics	Cable	Laser Class	For 5LTM...-11: Edge Intensity [%]	Correction Factor F
1	25CM	- 405	- 10	- Y07	- A7.5	- B	- x	3B	10	0.7
2	25CM	- 635	- 6	- H10	- A8	- S	- x	3B	33	1.0
3	25CM	- 639	- 11	- H18	- A8	- S	- x	3B	40	1.0
4	25CM	- 640	- 18	- H22	- A8	- S	- x	3B	15	1.0
5	25CM	- 660	- 14	- M01	- A8	- S	- x	3B	17	1.0
6	25CM	- 660	- 27	- M26	- A8	- S	- x	3B	13	1.0
7	25CM	- 685	- 14	- M21	- A8	- S	- x	3B	10	1.0
8	25CM	- 685	- 24	- H13	- A8	- S	- x	3B	16	1.0
9	25CM	- 785	- 2	- M10	- A8	- S	- x	3B	36	1.2
10	25CM	- 785	- 59	- Q06	- A8	- S	- x	3B	4	1.2
11	25CM	- 830	- 23	- H19	- A8	- S	- x	3B	17	1.3
12	25CM	- 850	- 96	- G17	- A8	- S	- x	3B	12	1.3

Electronics Type
Electronics specifications differ for electronics type B.

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV40 (electronics type B only) 4
As 1, with connector type Lumberg SV50 (electronics type S only) 6
customer-specified cable length 5

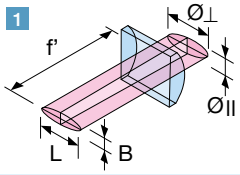
For 5LTM-...-22 (left lower table) the free aperture is larger than the line length L. L is here given on the 13.5%-level.

Partial selection only. More on www.sukhamburg.com

Configuration Options

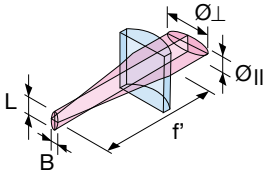
Line optics 5LT...-1: Configuration 1
Line length L = Ø⊥

The beam diameter Ø∥ of the collimated beam is focussed. The line length is constant and is equal to the beam diameter Ø⊥.



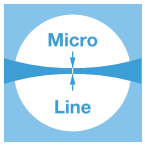
Line optics 5LT...-2: Configuration 2
Line length L = Ø∥

The beam diameter Ø⊥ of the collimated beam is focussed. Line length is constant and is equal to the beam diameter Ø∥. Line length and width are less than in configuration 1.



Laser Micro Line Generators 5LT + 55CM

Semi-telecentric laser line with Gaussian intensity distribution and constant line length of approx. 4.8 or 2.0 mm



- Semi-telecentric (Fan angle 0°)
- Constant line lengths of approx. 4.8 or 2.0 mm
- Intensity profile 5LT...-1: Gaussian in line direction, clipped by an aperture with <40% edge intensity, Gaussian across the laser line
- Intensity profile 5LT...-2: Gaussian in line direction (line length is given on the 13.5%-level), Gaussian across the laser line
- Line width starting at 11 µm ($1/e^2$)
- Laser power up to 146 mW
- Laser wavelengths 405 – 1550 nm
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply Voltage: 5 V DC
- Casing Ø 25/28 mm

Option:
- RS232 interface – electronics types CS or PS, see p. 25.

The beam-shaping optics define the beam parameter fan angle and line length and the optimum working distance, see left tables.

The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left tables) are valid for the nominal working distance of the line optics. For this laser type the working distance is fixed. A fine-adjustment of the distance between laser and target is recommended for fine-focusing in order to achieve minimal line width.

Product Configurator: www.sukhamburg.com

optional: RS232

optional: LNC

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Adjustment possibilities:
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: www.sukhamburg.com

WWW

5LT + 55CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

All combinations of beam shaping optics and laser module are possible.

Two-part Order Code

Example 1: 5LT-330-1 + 55CM - 660 - 23 - M01 - A8 - CS - 7

Example 2: 5LT-330-1 + 25CM - 660 - 23 - M01 - A8 - C - 6

Beam Parameters 5LT...-1

Line optics 5LT...-1 1

Fan Angle α [°]	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Convergence β [Deg]	Dim. X [mm]	5LT...-1
0	4.8	0.026	45	1.0	2.3	1.2	5LT-50-1
0	4.8	0.039	74	2.3	1.5	1.2	5LT-75-1
0	4.8	0.050	96	4.2	1.2	1.2	5LT-100-1
0	4.8	0.075	145	9.3	0.8	1.2	5LT-150-1
0	4.8	0.115	250	26	0.5	1.2	5LT-250-1
0	4.8	0.138	324	45	0.3	1.2	5LT-330-1
0	4.8	0.209	491	104	0.2	1.2	5LT-500-1

Beam Parameters 5LT...-2

Line optics 5LT...-2 2

Fan Angle α [°]	Line Length L [mm] (13.5%-level)	Line Width B [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Convergence β [Deg]	Dim. X [mm]	5LT...-2
0	2.0	0.011	45	0.2	2.3	1.2	5LT-50-2
0	2.0	0.016	74	0.4	1.5	1.2	5LT-75-2
0	2.0	0.021	96	0.7	1.2	1.2	5LT-100-2
0	2.0	0.032	145	1.6	0.8	1.2	5LT-150-2
0	2.0	0.048	250	4.6	0.5	1.2	5LT-250-2
0	2.0	0.058	324	8.0	0.3	1.2	5LT-330-2
0	2.0	0.088	491	18	0.2	1.2	5LT-500-2

Laser Module

curr. No.	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	For 5LT...-1: Edge Intensity [%]	Correction Factor F
1	55CM*	- 405	- 88	- X15	- A7.5	- P/PS	- x	3B	11	0.7
2	55CM*	- 450	- 57	- 006	- A7.5	- P/PS	- x	3B	16	1.0
3	55CM*	- 488	- 42	- 009	- A7.5	- C/CS	- x	3B	20	1.1
4	55CM*	- 520	- 56	- 011	- A7.5	- P/PS	- x	3B	19	1.4
5	55CM	- 635	- 10	- H10	- A8	- C/CS	- x	3B	33	1.0
6	55CM	- 639	- 18	- H18	- A8	- C/CS	- x	3B	40	1.0
7	55CM	- 660	- 23	- M01	- A8	- C/CS	- x	3B	17	0.9
8	55CM	- 660	- 40	- M26	- A8	- C/CS	- x	3B	13	1.0
9	55CM*	- 660	- 105	- M25	- A8	- P/PS	- x	3B	6	0.9
10	55CM	- 685	- 39	- H13	- A8	- C/CS	- x	3B	16	0.9
11	55CM	- 785	- 90	- Q06	- A8	- C/CS	- x	3B	4	1.1
12	55CM	- 830	- 35	- H19	- A8	- C/CS	- x	3B	17	1.2
13	55CM	- 850	- 146	- G17	- A8	- C/CS	- x	3B	12	1.2
14	55CM	- 1550	- 25	- Q04	- A8	- C/CS	- x	3B	38	2.0

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the width and Rayleigh range/depth of focus of the laser line:

Line Width: multiply by F (right table last column)
Rayleigh Range: multiply by $F^2 \cdot 660\ \text{nm}/\lambda\ [\text{nm}]$

Casing Type:
Casing Type A3 ..... 55CM
Casing Type B3 (only electronics type C) 55CR
* not offered with 55CR (Casing type B3)

For 5LT...-2 (lower left table) the free aperture is larger than the line length L. L is here given on the 13.5%-level.

For Configuration Options 1 / 2 please see p. 41

Partial selection only. More on www.sukhamburg.com

Electronics Options: Please choose one of the stated options.
Standard electronics ..... C or P
Electronics with RS232 interface ..... CS or PS

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (only electronics types C, P) 6
1.5 m shielded connection cable, with connector type Lumberg SV70 (only electronics types with interface CS, PS) 7
customer-specified cable length 5

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Laser Macro Line Generators 5LTM + 55CM

Semi-telecentric laser line with Gaussian intensity distribution, constant line length approx. 4.8 / 2.0 mm and extended depth of focus

Depth of Focus

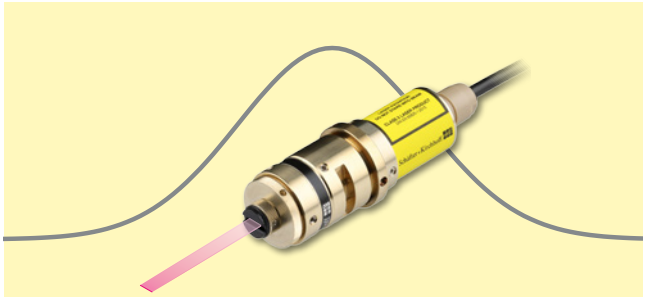
- Extended depth of focus
- Semi-telecentric (Fan angle 0°)
- Constant line lengths of approx. 4.8 or 2.0 mm
- Intensity profile 5LT...-1: Gaussian in line direction, clipped by an aperture with <40% edge intensity, approx. Gaussian across the laser line
- Intensity profile 5LT...-2: Gaussian in line direction (line length is given on the 13.5%-level), approx. Gaussian across the laser line
- Line width starting at 24 µm (1/e²)
- Laser power up to 96 mW
- Laser wavelengths 405 – 1550 nm
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply Voltage: 5 V DC
- Casing Ø 25/28 mm

Option:
- RS232 interface – electronics types CS or PS, see p. 25.

The beam-shaping optics define the beam parameter fan angle and line length and the optimum working distance, see left tables.

The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left tables) are valid for the nominal working distance of the line optics. For this laser type the working distance is fixed. A fine-adjustment of the distance between laser and target is recommended for fine-focusing in order to achieve minimal line width.



Product Configurator: www.sukhamburg.com

optional: RS232 optional: LNC

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Adjustment possibilities:
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

www

5LTM + 55CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: 5LTM-50-11 + 55CM - 660 - 27 - M26 - A8 - CS - 7
Example 2: 5LTM-50-11 + 55CM - 660 - 27 - M26 - A8 - C - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 5LTM...-11	Fan Angle α [°]	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Depth of focus [mm]	Convergence β [Deg]	Dim. X [mm]	5LTM...-11
Line optics 5LTM...-11 1	0	4.3	0.048	39	7	2.3	6.6	5LTM-50-11
	0	4.8	0.072	68	17	1.5	6.6	5LTM-75-11
	0	4.8	0.096	91	29	1.2	6.6	5LTM-100-11
	0	4.8	0.144	139	66	0.8	6.6	5LTM-150-11
	0	4.8	0.239	245	184	0.5	6.6	5LTM-250-11
	0	4.8	0.316	319	320	0.3	6.6	5LTM-330-11
	0	4.8	0.479	486	729	0.2	6.6	5LTM-500-11

Beam Parameters 5LTM...-22	Fan Angle α [°]	Line Length L [mm] (13.5%-level)	Line Width B [mm]	Working Distance A [mm]	Depth of focus [mm]	Convergence β [Deg]	Dim. X [mm]	5LTM...-22
Line optics 5LTM...-22 2	0	2.0	0.024	39	2	2.3	6.6	5LTM-50-22
	0	2.0	0.036	68	4	1.5	6.6	5LTM-75-22
	0	2.0	0.048	91	7	1.2	6.6	5LTM-100-22
	0	2.0	0.071	139	17	0.8	6.6	5LTM-150-22
	0	2.0	0.119	245	46	0.5	6.6	5LTM-250-22
	0	2.0	0.157	319	80	0.3	6.6	5LTM-330-22
	0	2.0	0.238	486	184	0.2	6.6	5LTM-500-22

Laser Module

curr. No.	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	For 5LTM...-11: Edge Intensity [%]	Correction Factor F
1	55CM*	405	60	X15	A7.5	P/PS	x	3B	11	0.7
2	55CM*	450	44	006	A7.5	P/PS	x	3B	16	0.8
3	55CM*	488	33	009	A7.5	C/CS	x	3B	20	0.9
4	55CM*	520	48	011	A7.5	P/PS	x	3B	19	0.9
5	55CM	635	7	H10	A8	C/CS	x	3B	33	1.0
6	55CM	639	13	H18	A8	C/CS	x	3B	40	1.0
7	55CM	660	14	M01	A8	C/CS	x	3B	17	1.0
8	55CM	660	27	M26	A8	C/CS	x	3B	13	1.0
9	55CM*	660	64	M25	A8	P/PS	x	3B	6	1.0
10	55CM	685	24	H13	A8	C/CS	x	3B	16	1.0
11	55CM	785	59	Q06	A8	C/CS	x	3B	4	1.2
12	55CM	830	23	H19	A8	C/CS	x	3B	17	1.3
13	55CM	850	96	G17	A8	C/CS	x	3B	12	1.3
14	55CM	1550	15	Q04	A8	C/CS	x	3B	38	2.3

Correction factor F: Properties of the laser diode, such as divergence angle and wave-length, affect the width and Rayleigh range/depth of focus of the laser line:

Line Width: multiply by F (right table last column)
Depth of focus: multiply by $F^2 \cdot 660\ nm/\lambda$ [nm]

Casing Type:
Casing Type A3 ..... 55CM
Casing Type B3 (only electronics type C,P) 55CR
* not offered with 55CR (Casing type B3)

For 5LTM...-22 (lower left table) the free aperture is larger than the line length L. L is here given on the 13.5%-level.

For Configuration Options 1 / 2 please see p.41

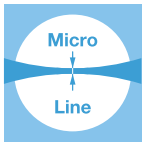
Partial selection only. More on www.sukhamburg.com

Electronics Options: Please choose one of the stated options.
Standard electronics ..... C or P
Electronics with RS232 interface ..... CS or PS

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV40 (electronics type B only) 4
As 1, with connector type Lumberg SV50 (electronics type S only) 6
customer-specified cable length 5

Laser Micro Focus Generators 13MC + 95CM

Laser spot with rotationally symmetric, Gaussian intensity profile



- Rotationally symmetric circular laser spot
- Gaussian intensity profile
- Focus Ø starting at 7 µm
- Laser wavelengths 635 – 828 nm
- Laser power up to 105 mW
- Adjustment of focus setting
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply Voltage: 5 V DC
- Casing Ø 25/28 mm

Option:
- RS232 interface – electronics types CS or PS, see p. 25.

Product Configurator: www.sukhamburg.com

optional: RS232 optional: LNC

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These focus generators employ special diodes with integrated micro-optics. The micro-optics transform the elliptical radiation emitted by the laser diode into circular radiation with a deviation of maximum of 1:1.2.

The beam-shaping optics define the optimum working distance and the focussing range, see left table. The chosen laser module determines the wavelength and the output power and, thereby, the laser safety class, see right table.

The spot sizes (left table) are valid for the nominal working distance of the focus optics. The working distance can be adjusted by adjusting the focus setting. Please note that the spot diameter increases proportionally to the working distance. A fine-adjustment of the distance between laser and target is recommended for fine-focusing.

Adjustment possibilities:
- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information
Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

13MC + 95CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: 13MC-M60 + 95CM - 635 - 3 - B08 - M60 - CS - 7
Example 2: 13MC-M60 + 95CM - 635 - 3 - B08 - M60 - C - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 13MC	Spot Diameter [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Focussing Range [mm]	Convergence β [Deg]	Dim. X [mm]	13MC
	0.007	54	0.03	40 - 80	13.5	8	13MC-M60
	0.011	93	0.08	80 - 110	8.1	8	13MC-M100
	0.014	120	0.13	110 - 205	6.5	8	13MC-M125
	0.016	245	0.50	205 - 410	3.3	8	13MC-S250
	0.028	492	2	410 - 815	1.6	8	13MC-S500
	0.057	973	8	815 - 1290	0.8	8	13MC-S1000
	0.114	2000	32	1290 - ∞	0.4	8	13MC-S000

Laser Module curr. No	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Beam Diameter at Collimator [mm]	Correction Factor F
1	95CM	- 635	- 3	- B08	- M60	- C/CS	- x	3R	14.0	1.0
2	95CM	- 635	- 10	- B07	- M60	- C/CS	- x	3B	14.0	1.0
3	95CM	- 639	- 23	- B21	- M60	- C/CS	- x	3B	14.0	1.0
4	95CM*	- 658	- 21	- B09	- M60	- P/PS	- x	3B	14.0	1.1
5	95CM	- 660	- 67	- B28	- M60	- C/CS	- x	3B	14.0	0.9
6	95CM	- 690	- 22	- B12	- M60	- C/CS	- x	3B	14.0	1.0
7	95CM	- 785	- 61	- B32	- M60	- C/CS	- x	3B	14.0	1.1
8	95CM	- 828	- 105	- B30	- M60	- C/CS	- x	3B	12.4	1.5

Partial selection only. More on www.sukhamburg.com

Correction factor F:
Properties of the laser diode, such as divergence angle and wavelength, affect the spot diameter and Rayleigh range/depth of focus of the laser focus.

Spot diameter: multiply by F (right table last column)
Rayleigh range: multiply by $F^2 \cdot 660\ nm/\lambda\ [nm]$

Example: 13MC-M125+95CM-660-67-B28-M60-C-6 F = 0.9 (right table last column)
Spot diameter $Ø = 0.014\ mm \cdot F = 0.014\ mm \cdot 0.9 = 0.013\ mm$
Rayleigh range $2z_R = 0.13\ mm \cdot F^2 \cdot 660\ nm / 660\ nm = 0.11\ mm$

Casing Type:
Casing Type G1 . . . . . **95CM**
Casing Type H1
(only electronics type C) **95CR**
* not offered with 95CR (Casing type H1)

Electronics Options: Please choose one of the stated options.
Standard electronics . . . . . **C or P**
Electronics with RS232 interface . . . . . **CS or PS**

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50
(only electronics types C, P) **6**
1.5 m shielded connection cable, with connector type Lumberg SV70
(only electronics types with interface CS, PS) 7
customer-specified cable length 5

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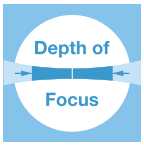
Laser Macro Focus Generators 13MMC + 95CM

Laser spot with rotationally symmetric beam profile and extended depth of focus



- Extended depth of focus
- Rotationally symmetric focus
- Approx. Gaussian intensity profile
- Focus Ø starting at 8 µm
- Laser wavelengths 635 – 828 nm
- Laser power up to 62 mW
- Adjustment of focus setting
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply Voltage: 5 V DC
- Casing Ø 25/28 mm

Option:
- RS232 interface – electronics types CS or PS, see p. 25.

These focus generators employ special diodes with integrated micro-optics. The micro-optics transform the elliptical radiation emitted by the laser diode into circular radiation with a deviation of maximum of 1:1.2.

The beam-shaping optics define the optimum working distance and the focussing range, see left table. The chosen laser module determines the wavelength and the output power and, thereby, the laser safety class, see right table.

The spot sizes (left table) are valid for the nominal working distance of the focus optics. The working distance can be adjusted by adjusting the focus setting. Please note that the spot diameter increases proportionally to the working distance.
A fine-adjustment of the distance between laser and target is recommended for fine-focusing.

Product Configurator: www.sukhamburg.com

optional: RS232 optional: LNC

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Adjustment possibilities:
- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information
Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

13MMC + 95CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: 13MMC-M60-8 + 95CM - 635 - 1.5 - B08 - M60 - CS - 7
Example2: 13MMC-M60-8 + 95CM - 635 - 1.5 - B08 - M60 - C - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 13MMC	Spot Diameter [mm]	Working Distance A [mm]	Depth of Focus [mm]	Focussing Range [mm]	Convergence β [Deg]	Dim. X [mm]	13MMC
	0.008	45	0.2	30 - 70	7.6	16.4	13MMC-M60-8
	0.013	84	0.4	70 - 100	4.6	16.4	13MMC-M100-8
	0.017	111	0.7	100 - 195	3.7	16.4	13MMC-M125-8
	0.033	233	2.8	195 - 400	1.8	16.4	13MMC-S250-8
	0.066	483	11.1	400 - 805	0.92	16.4	13MMC-S500-8
	0.133	964	44.2	805 - 1285	0.46	16.4	13MMC-S1000-8

Laser Module

curr. No	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Beam Diameter at Collimator [mm]	Correction Factor F
1	95CM	- 635 -	1.5 -	B08	- M60	- C/CS	- x	3R	8.0	1.0
2	95CM	- 635 -	5.0 -	B07	- M60	- C/CS	- x	3B	8.0	1.0
3	95CM	- 639 -	11 -	B21	- M60	- C/CS	- x	3B	8.0	1.0
4	95CM*	- 658 -	11 -	B09	- M60	- P/PS	- x	3B	8.0	1.1
5	95CM	- 660 -	29 -	B28	- M60	- C/CS	- x	3B	8.0	0.9
6	95CM	- 690 -	10 -	B12	- M60	- C/CS	- x	3B	8.0	1.0
7	95CM	- 785 -	29 -	B32	- M60	- C/CS	- x	3B	8.0	1.1
8	95CM	- 828 -	62 -	B30	- M60	- C/CS	- x	3B	8.0	1.5

Partial selection only. More on www.sukhamburg.com

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the spot diameter and Rayleigh range/depth of focus of the laser focus:

	Line width:	multiply by F (right table last column)
	Depth of focus:	multiply by $F^2 \cdot 660\ nm/\lambda$ [nm]
Example:	13MMC-M125-8+95CM-660-29-B28-M60-P-6	F = 0.9 (right table last column)
	Spot diameter	$Ø$=0.017 mm · F = 0.017 mm · 0.9 = 0.015 mm
	Depth of focus	$2z_M$ = 0.7 mm · F^2 · 660 nm / 660 nm = 0.57 mm

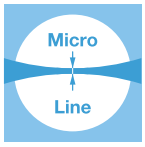
Casing Type:
Casing Type G1 ..... **95CM**
Casing Type H1 (only electronics type C) **95CR**
* **not offered with 95CR (Casing type H1)**

Electronics Options: Please choose one of the stated options.
Standard electronics ..... **C or P**
Electronics with RS232 interface ..... **CS or PS**

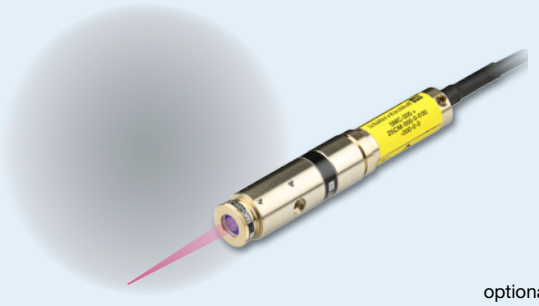
Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (only electronics types C, P) **6**
1.5 m shielded connection cable, with connector type Lumberg SV70 (only electronics types with interface CS, PS) 7
customer-specified cable length 5

Laser Focus Generators 5MC + 29CM

Compact laser spot generator with rotationally symmetric beam profile and Gaussian intensity profile



- Rotationally symmetric circular laser spot
- Gaussian intensity profile
- Focus Ø starting at 2 µm
- Laser wavelenghths 635 – 828 nm
- Laser power up to 110 mW
- Integrated electronics with two modulation input ports (TTL and analog, in case of electronics type B TTL only) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (12 V DC for electronics type B)
- Casing Ø 12 mm



optional:

Product Configurator: www.sukhamburg.com

RS232

These focus generators employ special diodes with integrated micro-optics. The micro-optics transform the elliptical radiation emitted by the laser diode into circular radiation with a deviation of maximum of 1:1.2.

The beam-shaping optics define the optimum working distance and the focussing range, see left table. The chosen laser module determines the wavelength and the output power and, thereby, the laser safety class, see right table.

The spot sizes (left table) are valid for the nominal working distance of the focus optics. The working distance can be adjusted by adjusting the focus setting. Please note that the spot diameter increases proportionally to the working distance. A fine-adjustment of the distance between laser and target is recommended for fine-focusing.

Adjustment possibilities:

- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

www

5MC + 29CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: 5MC-A11 + 29CM - 785 - 72 - B32 - M12 - S - 6

Example 2: 5MC-A11 + 29CM - 635 - 3 - B08 - M12 - S - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 5MC	Spot Diameter [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Focussing Range [mm]	Convergence β [Deg]	Dim. X [mm]	5MC
	0.002	3	0.01	2-6	25.8	4.5	5MC-A6.2
	0.004	7.4	0.02	6-15	14.7	4.5	5MC-A11
	0.006	16.5	0.06	15-35	9.0	4.5	5MC-A18
	0.018	46	0.50	35-70	3.3	1.2	5MC-S50
	0.031	82	1.6	70-125	1.9	1.2	5MC-S88
	0.051	147	4.5	125-260	1.1	1.2	5MC-S150
	0.094	317	22	260-430	0.5	1.2	5MC-S330

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the spot diameter and Rayleigh range/depth of focus of the laser focus.

	Line width:	multiply by F (right table last column)
	Rayleigh range:	multiply by $F^2 \cdot 660\ nm/\lambda$ [nm]
Example:	5MC-A11+29CM-785-72-B32-M12-S-6	F = 1.1 (right table last column)
	Spot diameter	$Ø$=0.004 mm · F = 0.004 mm · 1.1 = 0.004 mm
	Rayleigh range	$2z_R$ = 0.02 mm · F^2 · 660 nm / 785 nm = 0.02 mm

Laser Module

curr. No	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Electronics	Cable	Laser Class	Beam Diameter at Collimator [mm]	Correction Factor F
1	29CM	- 635	- 3	- B08	- M12	- S	- x	3R	2.8	1.0
2	29CM	- 635	- 10	- B07	- M12	- S	- x	3B	2.8	1.0
3	29CM	- 639	- 25	- B21	- M12	- S	- x	3B	2.8	1.0
4	29CM	- 658	- 23	- B09	- M12	- S	- x	3B	2.8	1.1
5	29CM	- 660	- 84	- B28	- M12	- S	- x	3B	3.5	0.9
6	29CM	- 690	- 25	- B12	- M12	- S	- x	3B	3.0	1.0
7	29CM	- 785	- 72	- B32	- M12	- S	- x	3B	3.2	1.1
8	29CM	- 828	- 110	- B30	- M12	- S	- x	3B	2.5	1.5

Cable Options:

1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV40 (electronics type B only) 4
As 1, with connector type Lumberg SV50 (electronics type S only) 6
customer-specified cable length 5

Partial selection only. More on www.sukhamburg.com

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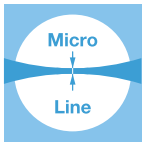
Schäfter+Kirchhoff

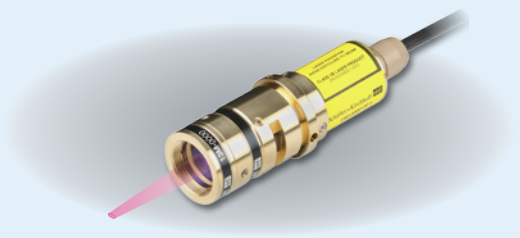
Laser Micro Focus Generators 13M + 55CM

Laser spot with elliptical Gaussian beam profile



- Elliptical laser spot
- Elliptical, Gaussian intensity profile
- Focus Ø starting at 9 x 21 µm
- Laser wavelengths 405–1550 nm
- Laser power up to 153 mW
- Integrated focussing mechanism
- Adjustment of focus setting
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply Voltage: 5 V DC
- Casing Ø 25/28 mm

Option:
- RS232 interface – electronics types CS or PS, For details see p. 25.



Product Configurator: www.sukhamburg.com

optional: RS232 optional: LNC

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The beam-shaping optics define the optimum working distance and the focussing range, see left table. The chosen laser module determines the wavelength and the output power and, thereby, the laser safety class, see right table.

The spot sizes (left table) are valid for the nominal working distance of the focus optics. The working distance can be adjusted by adjusting the focus setting. Please note that the spot diameter increases proportionally to the working distance. A fine-adjustment of the distance between laser and target is recommended for fine-focusing.

Adjustment possibilities:
- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

13M + 55CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: 13M-M60 + 55CM - 660 - 25 - M01 - T12 - CS - 7
Example 2: 13M-M60 + 55CM - 660 - 25 - M01 - T12 - C - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 13M	Spot Width W [mm]	Spot Height H [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Focussing Range [mm]	Convergence β [Deg] perp.	Convergence β [Deg] par.	Dim. X [mm]	13M
	0.009	0.021	54	0.1	40-80	6.9	2.9	8	13M-M60
	0.014	0.033	93	0.3	80-110	4.1	1.7	8	13M-M100
	0.018	0.042	120	0.5	110-205	3.3	1.4	8	13M-M125
	0.032	0.077	245	2.0	205-410	1.6	0.7	8	13M-S250
	0.058	0.139	492	8.1	410-815	0.8	0.3	8	13M-S500
	0.117	0.278	973	33	815-1295	0.4	0.2	8	13M-S1000

Correction factor F:
Properties of the laser diode, such as divergence angle and wavelength, affect the spot diameter and Rayleigh range/depth of focus of the laser focus.

Spot width/height: multiply by F (right table last column)
Rayleigh range: multiply by $F^2 \cdot 660\ \text{nm}/\lambda$ [nm]

Example: 13M-M60+55CM-660-25-M01-T12-C-6 F = 0.9 (right table last column)
Spot width W=0.009 mm · F = 0.009 mm · 0.9 = 0.008 mm
Rayleigh Range $2z_R$ = 0.1 mm · F^2 · 660 nm / 660 nm = 0.1 mm

Laser Module curr. No	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Beam Diameter at Collimator [mm] perp.	Beam Diameter at Collimator [mm] par	Correction Factor F
1	55CM*	- 405 -	91 -	X15 -	T15 -	P/PS	- x	3B	8.6	4.0	0.6
2	55CM*	- 450 -	60 -	O06 -	T15 -	P/PS	- x	3B	9.4	3.3	0.7
3	55CM*	- 488 -	45 -	O09 -	T15 -	C/CS	- x	3B	10.0	3.1	0.9
4	55CM*	- 520 -	60 -	O11 -	T15 -	P/PS	- x	3B	9.8	2.8	1.0
5	55CM	- 635 -	11 -	H10 -	T12 -	C/CS	- x	3B	9.7	2.8	1.0
6	55CM	- 639 -	22 -	H18 -	T12 -	C/CS	- x	3B	10.7	2.8	1.0
7	55CM	- 660 -	25 -	M01 -	T12 -	C/CS	- x	3B	7.7	3.4	0.9
8	55CM	- 660 -	42 -	M26 -	T12 -	C/CS	- x	3B	7.2	3.0	1.0
9	55CM*	- 660 -	107 -	M25 -	T12 -	P/PS	- x	3B	6.0	3.5	0.9
10	55CM	- 685 -	41 -	H13 -	T12 -	C/CS	- x	3B	7.5	3.4	0.9
11	55CM	- 785 -	91 -	Q06 -	T12 -	C/CS	- x	3B	5.6	3.2	1.1
12	55CM	- 830 -	38 -	H19 -	T12 -	C/CS	- x	3B	7.7	3.2	1.2
13	55CM	- 850 -	153 -	G17 -	T12 -	C/CS	- x	3B	7.0	3.2	1.2
14	55CM	- 1550 -	30 -	Q04 -	T12 -	C/CS	- x	3B	10.3	3.5	2.0

Partial selection only. More on www.sukhamburg.com

Casing Type:
Casing Type A4 ..... **55CM**
Casing Type B4 (only electronics type C) **55CR**
* **not offered with 55CR (Casing type B4)**

Electronics Options: Please choose one of the stated options.
Standard electronics ..... **C or P**
Electronics with RS232 interface ..... **CS or PS**

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (only electronics types C, P) **6**
1.5 m shielded connection cable, with connector type Lumberg SV70 (only electronics types with interface CS, PS) 7
customer-specified cable length 5

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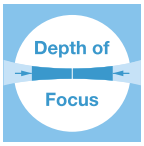
Laser Macro Focus Generators 13MM + 55CM

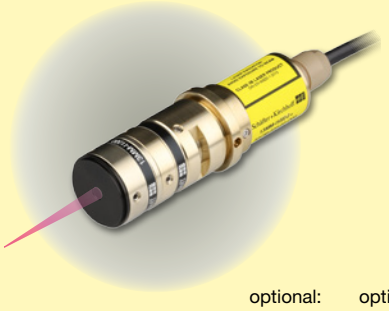
Circular laser spot with extended depth of focus



- Extended depth of focus
- Circular laser spot
- Approx. Gaussian intensity profile: Elliptical intensity distribution clipped by a circular aperture
- Focus Ø starting at 20 µm

- Laser wavelengths 405–1550 nm
- Laser power up to 102 mW
- Adjustment of focus setting
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply Voltage: 5 V DC
- Casing Ø 25/28 mmm

Option:
- PC-interface (RS232) – electr. types CS or PS. For details see p.25.



Product Configurator: www.sukhamburg.com

optional: RS232 optional: LNC

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The beam-shaping optics define the optimum working distance and the focussing range, see left table. The chosen laser module determines the wavelength and the output power and, thereby, the laser safety class, see right table.

The spot sizes (left table) are valid for the nominal working distance of the focus optics. The working distance can be adjusted by adjusting the focus setting. Please note that the spot diameter increases proportionally to the working distance.
A fine-adjustment of the distance between laser and target is recommended for fine-focusing.

Adjustment possibilities:
- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information
Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

www

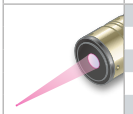
13MM + 55CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: 13MM-M60-4 + 55CM - 660 - 15 - M01 - T12 - CS - 7
Example 2: 13MM-M60-4 + 55CM - 660 - 15 - M01 - T12 - C - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 13MM	Spot Diameter [mm]	Working Distance A [mm]	Depth of Focus [mm]	Focussing Range [mm]	Convergence β [Deg]	Dim. X [mm]	13MM
	0.020	45	0.7	40 - 80	2.9	16.4	13MM-M60-4
	0.033	84	1.8	80 - 110	1.7	16.4	13MM-M100-4
	0.041	111	2.9	110 - 205	1.4	16.4	13MM-M125-4
	0.082	233	11	205 - 410	0.7	16.4	13MM-S250-4
	0.165	483	46	410 - 815	0.3	16.4	13MM-S500-4
	0.330	964	184	815 - 1295	0.2	16.4	13MM-S1000-4

Laser Modules

curr. No.	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Beam Diameter at Collimator [mm]	Correction Factor F
1	55CM*	- 405	- 49	- X15	-T15	- P/PS	- x	3B	4.0	0.6
2	55CM*	- 450	- 32	- 006	-T15	- P/PS	- x	3B	3.3	0.7
3	55CM*	- 488	- 23	- 009	-T15	- C/CS	- x	3B	3.1	0.9
4	55CM*	- 520	- 32	- 011	-T15	- P/PS	- x	3B	2.8	1.0
5	55CM	- 635	- 6	- H10	- T12	- C/CS	- x	3B	2.8	1.0
6	55CM	- 639	- 11	- H18	- T12	- C/CS	- x	3B	2.8	1.0
7	55CM	- 660	- 15	- M01	- T12	- C/CS	- x	3B	3.4	0.9
8	55CM	- 660	- 28	- M26	- T12	- C/CS	- x	3B	3.0	1.0
9	55CM*	- 660	- 77	- M25	- T12	- P/PS	- x	3B	3.5	0.9
10	55CM	- 685	- 26	- H13	- T12	- C/CS	- x	3B	3.4	0.9
11	55CM	- 785	- 70	- Q06	- T12	- C/CS	- x	3B	3.2	1.1
12	55CM	- 830	- 23	- H19	- T12	- C/CS	- x	3B	3.2	1.2
13	55CM	- 850	- 102	- G17	- T12	- C/CS	- x	3B	3.2	1.2
14	55CM	- 1550	- 14	- Q04	- T12	- C/CS	- x	3B	3.5	2.0

Partial selection only. More on www.sukhamburg.com

Correction factor F:
Properties of the laser diode, such as divergence angle and wavelength, affect the spot diameter and Rayleigh range/depth of focus of the laser focus.

Spot diameter: multiply by F (right table last column)
Depth of focus: multiply by $F^2 \cdot 660\ nm/\lambda\ [nm]$

Example: 13MM-M60-4+55CM-660-15-M01-T12-C-6 $F = 0.9$ (right table last column)
Spot diameter $\varnothing = 0.020\ mm \cdot F = 0.020\ mm \cdot 0.9 = 0.018\ mm$
Depth of focus $2z_M = 0.7\ mm \cdot F^2 \cdot 660\ nm / 660\ nm = 0.6\ mm$

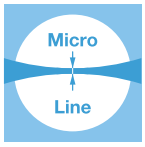
Casing Type:
Casing Type A4 ..... **55CM**
Casing Type B4 (only electronics type C) **55CR**
* **not offered with 55CR (Casing type B4)**

Electronics Options: Please choose one of the stated options.
Standard electronics ..... **C or P**
Electronics with RS232 interface ..... **CS or PS**

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (only electronics types C, P) **6**
1.5 m shielded connection cable, with connector type Lumberg SV70 (only electronics types with interface CS, PS) 7
customer-specified cable length 5

Laser Micro Focus Generators 5M + 25CM

Compact laser spot with elliptical Gaussian beam profile



- Elliptical laser spot
- Elliptical, Gaussian intensity profile
- Focus Ø starting at 1 x 3 µm
- Laser wavelengths 405–850 nm
- Laser power up to 146 mW
- Integrated electronics with two modulation input ports (TTL and analog, in case of electronics type B TTL only) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (12 V DC for electronics type B)
- Casing Ø 12 mm

Product Configurator: www.sukhamburg.com

optional: RS232

The beam-shaping optics define the optimum working distance and the focussing range, see left table. The chosen laser module determines the wavelength and the output power and, thereby, the laser safety class, see right table.

The spot sizes (left table) are valid for the nominal working distance of the focus optics. The working distance can be adjusted by adjusting the focus setting. Please note that the spot diameter increases proportionally to the working distance. A fine-adjustment of the distance between laser and target is recommended for fine-focusing.

Adjustment possibilities:
- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com** WWW

5M + 25CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: 5M-A11 + 25CM - 830 - 35 - H19 - A8 - S - 6

Example 2: 5M-A11 + 25CM - 660 - 40 - M26 - A8 - S - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 5M	Spot Width W [mm]	Spot Height H [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Focussing Range [mm]	Convergence β [Deg] perp.	Convergence β [Deg] par.	Dim. X [mm]	5M
	0.001	0.003	3	0.003	2 - 6	42	18	4.5	5M-A6.2
	0.002	0.006	7.4	0.009	6 - 15	25	10	4.5	5M-A11
	0.004	0.009	16.5	0.02	15 - 35	15	6.4	4.5	5M-A18
	0.011	0.026	46	0.18	35 - 70	5.5	2.3	1.2	5M-S50
	0.019	0.046	82	0.57	70 - 125	3.1	1.3	1.2	5M-S88
	0.032	0.075	147	1.6	125 - 260	1.8	0.77	1.2	5M-S150
	0.057	0.136	317	7.7	260 - 430	0.84	0.35	1.2	5M-S325

Laser Module

curr. No.	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Electronics	Cable	Laser Class	Beam Diameter at Collimator [mm] perp.	Beam Diameter at Collimator [mm] par.	Correction Factor F
1	25CM	- 405	- 14	- Y07	- A7.5	- B	- x	3B	1.9	4.2	0.8
2	25CM	- 635	- 9	- H10	- A8	- S	- x	3B	1.9	6.5	1.0
3	25CM	- 639	- 16	- H18	- A8	- S	- x	3B	1.9	7.1	1.0
4	25CM	- 640	- 28	- H22	- A8	- S	- x	3B	2.1	4.9	0.9
5	25CM	- 660	- 23	- M01	- A8	- S	- x	3B	2.2	5.1	0.9
6	25CM	- 660	- 40	- M26	- A8	- S	- x	3B	2.0	4.8	1.0
7	25CM	- 685	- 25	- M21	- A8	- S	- x	3B	2.5	4.5	0.8
8	25CM	- 685	- 39	- H13	- A8	- S	- x	3B	2.2	5.0	0.9
9	25CM	- 785	- 3	- M10	- A8	- S	- x	3B	2.6	6.7	0.9
10	25CM	- 785	- 90	- Q06	- A8	- S	- x	3B	2.1	3.8	1.1
11	25CM	- 830	- 35	- H19	- A8	- S	- x	3B	2.1	5.1	1.2
12	25CM	- 850	- 146	- G17	- A8	- S	- x	3B	2.1	4.7	1.2

Partial selection only. More on www.sukhamburg.com

Correction factor F:
Properties of the laser diode, such as divergence angle and wavelength, affect the spot diameter and Rayleigh range/depth of focus of the laser focus.

	Spot width/height:	multiply by F (right table last column)
	Rayleigh range:	multiply by $F^2 \cdot 660\ nm/\lambda$ [nm]
Example:	5M-S150+25CM-830-35-H19-A8-S-6	F = 1.2 (right table last column)
	Spot width	W=0.032 mm · F = 0.032 mm · 1.2 = 0.038 mm
	Rayleigh Range	$2z_R$ = 1.6 mm · F^2 · 660 nm / 830 nm = 1.8 mm

Please note that all values are typical values and can differ slightly in reality.

Electronics Type

Electronics specifications differ for electronics type B. Details are found on page 67.

Cable Options:

1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV40 (electronics type B only) 4
As 1, with connector type Lumberg SV50 (electronics type S only) 6
customer-specified cable length 5

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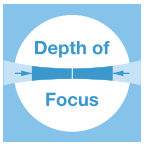
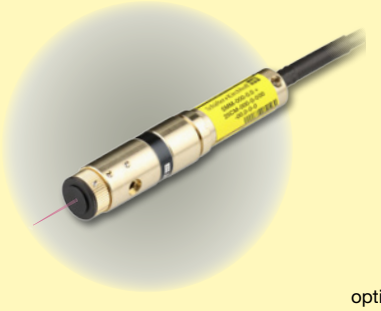
Laser Macro Focus Generators 5MM + 25CM

Compact circular laser spot with extended depth of focus



- Extended depth of focus
- Circular laser spot
- Approx. Gaussian intensity profile: Elliptical intensity distribution clipped by a circular aperture
- Focus Ø starting at 21 µm

- Laser wavelenghts 405 – 850 nm
- Laser power up to 46mW
- Integrated electronics with two modulation input ports (TTL and analog, in case of electronics type B TTL only) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (12 V DC for electronics type B)
- Casing Ø 12 mm



optional:

Product Configurator: www.sukhamburg.com

RS232

The beam-shaping optics define the optimum working distance and the focussing range, see left table. The chosen laser module determines the wavelength and the output power and, thereby, the laser safety class, see right table.

The spot sizes (left table) are valid for the nominal working distance of the focus optics. The working distance can be adjusted by adjusting the focus setting. Please note that the spot diameter increases proportionally to the working distance.
A fine-adjustment of the distance between laser and target is recommended for fine-focusing.

Adjustment possibilities:
- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information
Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

www

5MM + 25CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: 5MM-A18-0.8 + 25CM - 635 - 3 - H10 - A4.5 - S - 6
Example 2: 5MM-A18-0.8 + 25CM - 660 - 13 - M26 - A4.5 - S - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 5MM	Spot Diameter [mm]	Working Distance A [mm]	Depth of Focus [mm]	Focussing Range [mm]	Convergence β [Deg]	Dim. X [mm]	
	0.021	13.4	1.0	15 - 35	3.1	4.8	5MM-A15-0.8
	0.025	16.5	1.5	15 - 35	2.5	5.9	5MM-A18-0.8
	0.071	46	11	35 - 70	0.9	5.9	5MM-S50-0.8
	0.124	82	36	70 - 125	0.5	5.9	5MM-S88-0.8
	0.212	147	103	125 - 260	0.3	5.9	5MM-S150-0.8
	0.459	317	476	260 - 430	0.1	5.9	5MM-S325-0.8

Correction factor F:
Properties of the laser diode, such as divergence angle and wavelength, affect the spot diameter and Rayleigh range/depth of focus of the laser focus.

Spot diameter: multiply by F (right table last column)
Depth of focus: multiply by $F^2 \cdot 660$ nm/λ [nm]

Example: 5MM-S150-0.8+25CM-830-10-H19-A8-S-6 $F = 1.2$ (right table last column)
Spot diameter $Ø = 0.212$ mm $\cdot F = 0.212$ mm $\cdot 1.2 = 0.25$ mm
Depth of focus $2z_M = 103$ mm $\cdot F^2 \cdot 660$ nm / 830 nm = 118 mm

Please note that all values are typical values and can differ slightly in reality.

Laser Module

curr. No.	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Electronics	Cable	Laser Class	Beam Diameter at Collimator [mm]	Correction Factor F
1	25CM	- 405	- 5	- Y07	A4.5	- B	- x	3B	0.8	0.7
2	25CM	- 635	- 3	- H10	A4.5	- S	- x	3R	0.8	1.0
3	25CM	- 639	- 5	- H18	A4.5	- S	- x	3B	0.8	1.0
4	25CM	- 640	- 9	- H22	A4.5	- S	- x	3B	0.8	0.9
5	25CM	- 660	- 7	- M01	A4.5	- S	- x	3B	0.8	0.9
6	25CM	- 660	- 13	- M26	A4.5	- S	- x	3B	0.8	1.0
7	25CM	- 685	- 8	- M21	A4.5	- S	- x	3B	0.8	0.8
8	25CM	- 685	- 11	- H13	A4.5	- S	- x	3B	0.8	0.9
9	25CM	- 785	- 0.7	- M10	A4.5	- S	- x	3B	0.8	0.9
10	25CM	- 785	- 34	- Q06	A4.5	- S	- x	3B	0.8	1.1
11	25CM	- 830	- 10	- H19	A4.5	- S	- x	3B	0.8	1.2
12	25CM	- 850	- 46	- G17	A4.5	- S	- x	3B	0.8	1.2

Partial selection only.
More on www.sukhamburg.com

Electronics Type
Electronics specifications differ for electronics type B. Details are found on page 67.

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV40 (electronics type B only) 4
As 1, with connector type Lumberg SV50 (electronics type S only) 6
customer-specified cable length 5

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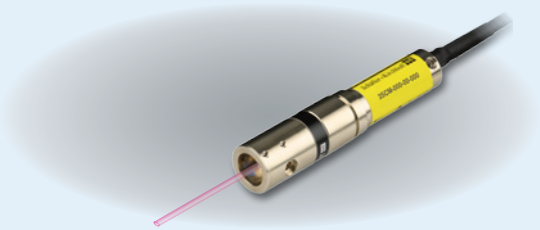
Laser Diode Collimator 25CM

Compact collimator with elliptical Gaussian beam profile

- Collimated laser beam
- Elliptical Gaussian intensity profile
- Laser output power up to 156 mW
- Laser wavelengths from 405 to 850 nm
- Integrated electronics with two modulation input ports (TTL and analog, in case of electronics type B TTL only) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (12 V DC for electronics type B)
- Casing Ø 12 mm

Laser diode collimators transform the divergent light of a laser diode into a collimated beam, while maintaining the Gaussian intensity distribution and the elliptical intensity profile. From the two emission angles $\vartheta_{\perp}$ and $\vartheta_{//}$ of the laser diode and the focal length of the collimation optics, the orthogonal and parallel divergence angles and beam diameter can be determined, which are a function of the laser diode used for the collimation.

In the table the beam diameter and divergence values are set in parentheses if the beam is truncated above the $1/e^2$ level.



optional:

Product Configurator: www.sukhamburg.com

RS232

Adjustment possibilities:
- Collimation adjustment
- Locking/unlocking of the focus position
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

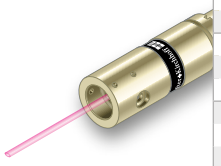
Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

www

25CM — Laser Diode Collimator

All combinations of beam shaping optics and laser module are possible.

Order Code Example 1: 25CM - 660 - 41 - M26 - A8 - S - 6



Beam Parameters 25CM	curr. No.	Laser Diode Source	Wave-length [nm]	P_{out} [mW]	LD Code	Lens	Elec-tronics	Cable	Laser Class	Collimated Beam Diameter $1/e^2$ [mm] perp.	Collimated Beam Diameter $1/e^2$ [mm] par.	Beam Divergence $1/e^2$ [mrad] perp.	Beam Divergence $1/e^2$ [mrad] par.	Collimating Lens f [mm]	Clear Aperture [mm]
	1	25CM	405	15	Y07	A4	B	x	3B	1.0	2.2	0.26	0.12	4	4.6
	2	25CM	405	14	Y07	A7.5	B	x	3B	1.9	4.2	0.14	0.06	7.5	4.5
	4	25CM	405	15	Y07	A6.2	B	x	3B	1.6	3.4	0.17	0.07	6.2	4.8
	7	25CM	635	10	H10	A6.2	S	x	3B	1.5	(5.0)	0.28	(0.08)	6.2	4.8
	10	25CM	635	9	H10	A8	S	x	3B	1.9	(6.5)	0.21	(0.06)	8	4.8
	11	25CM	635	11	H10	A4.5	S	x	3B	1.1	3.6	0.38	0.11	4.51	4.8
	15	25CM	639	21	H18	A6.2	S	x	3B	1.5	(5.5)	0.28	(0.07)	6.2	4.8
	18	25CM	639	18	H18	A8	S	x	3B	1.9	(7.1)	0.21	(0.06)	8	4.8
	19	25CM	639	22	H18	A4.5	S	x	3B	1.1	4.0	0.38	0.10	4.51	4.8
	23	25CM	660	25	M01	A6.2	S	x	3B	1.7	4.0	0.24	0.11	6.2	4.8
	26	25CM	660	24	M01	A8	S	x	3B	2.2	(5.1)	0.19	(0.08)	8	4.8
	27	25CM	660	26	M01	A4.5	S	x	3B	1.3	2.9	0.33	0.15	4.51	4.8
	31	25CM	660	43	M26	A6.2	S	x	3B	1.6	3.7	0.27	0.11	6.2	4.8
	34	25CM	660	41	M26	A8	S	x	3B	2.0	4.8	0.21	0.09	8	4.8
	35	25CM	660	43	M26	A4.5	S	x	3B	1.1	2.7	0.37	0.16	4.51	4.8
	39	25CM	685	27	M21	A6.2	S	x	3B	1.9	3.4	0.23	0.13	6.2	4.8
	42	25CM	685	26	M21	A8	S	x	3B	2.5	4.5	0.18	0.10	8	4.8
	43	25CM	685	27	M21	A4.5	S	x	3B	1.4	2.5	0.31	0.17	4.51	4.8
	47	25CM	685	42	H13	A6.2	S	x	3B	1.7	3.9	0.25	0.11	6.2	4.8
	50	25CM	685	40	H13	A8	S	x	3B	2.2	(5.0)	0.19	(0.09)	8	4.8
	51	25CM	685	42	H13	A4.5	S	x	3B	1.3	2.8	0.34	0.15	4.51	4.8
	55	25CM	785	3	M10	A6.2	S	x	3B	2.0	(5.2)	0.25	(0.10)	6.2	4.8
	58	25CM	785	3	M10	A8	S	x	3B	2.6	(6.7)	0.19	(0.07)	8	4.8
	59	25CM	785	4	M10	A4.5	S	x	3B	1.5	3.8	0.34	0.13	4.51	4.8
	63	25CM	785	93	Q06	A6.2	S	x	3B	1.7	2.9	0.30	0.17	6.2	4.8
	66	25CM	785	92	Q06	A8	S	x	3B	2.1	3.8	0.23	0.13	8	4.8
	67	25CM	785	93	Q06	A4.5	S	x	3B	1.2	2.1	0.42	0.24	4.51	4.8
	71	25CM	830	38	H19	A6.2	S	x	3B	1.7	4.0	0.32	0.13	6.2	4.8
	74	25CM	830	36	H19	A8	S	x	3B	2.1	(5.1)	0.25	(0.10)	8	4.8
	75	25CM	830	38	H19	A4.5	S	x	3B	1.2	2.9	0.44	0.18	4.51	4.8
	79	25CM	850	149	G17	A8	S	x	3B	2.1	4.7	0.25	0.12	8	4.8
	80	25CM	850	156	G17	A4.5	S	x	3B	1.2	2.6	0.45	0.21	4.51	4.8
	84	25CM	850	155	G17	A6.2	S	x	3B	1.7	3.6	0.33	0.15	6.2	4.8

Please note that all values are typical values and can differ slightly in reality.

Beam diameter and divergence values are set in parentheses if the beam is truncated above the $1/e^2$ level.

Electronics Type

Cable Options:

1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV40 (electronics type B only) 4
As 1, with connector type Lumberg SV50 (electronics type S only) 6
customer-specified cable length 5

Laser Diode Collimator 55CM / 55CR

Collimator with elliptical Gaussian beam profile

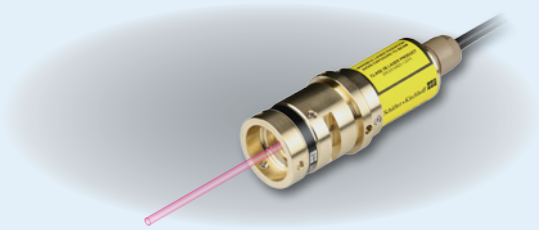
- Collimated laser beam
- Elliptical Gaussian intensity profile
- Laser wavelengths from 405 to 830 nm
- Laser output power up to 109 mW
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply voltage: 5V DC
- Casing Ø 25/28 mm
- **Laser Diode Collimator 55CM:** Axial cable connection
- **Laser Diode Collimator 55CR:** Cable connection set to 90°

Option:

- PC-interface (RS232) – electr. types CS or PS. Details see p. 25.

Laser diode collimators transform the divergent light of a laser diode into a collimated beam, while maintaining the Gaussian intensity distribution and the elliptical intensity profile.

From the two emission angles $\vartheta_\perp$ and $\vartheta_\parallel$ of the laser diode and the focal length of the collimation optics, the orthogonal and parallel divergence angles and beam diameter can be determined, which are a function of the laser diode used for the collimation.



Product Configurator: www.sukhamburg.com

optional: RS232 optional: LNC

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Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

Adjustment possibilities:

- Collimation adjustment
- Locking/unlocking of the focus position
- Potentiometer for laser power output

Accessories and further information

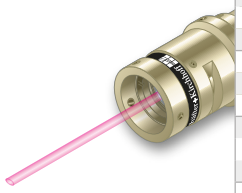
Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

55CM /55CR — Laser Diode Collimator

All combinations of beam shaping optics and laser module are possible.

Order Code

Example 1: 55CR - 660 - 26 - M01 - T12 - CS - 7
Example 2: 55CM - 660 - 26 - M01 - T12 - C - 6



Beam Parameters 55CM / 55CR	curr. No.	Laser Diode Source	Wave-length [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Collimated Beam Diameter [mm] perp.	Collimated Beam Diameter [mm] par.	Beam Divergence [mrad] perp.	Beam Divergence [mrad] par.	Collimating Lens *f* [mm]	Clear Aperture [mm]
	1	55CM*	405	93	X15	A4	P/PS	x	3B	1.1	2.3	0.24	0.11	4	4.6
	2	55CM*	405	89	X15	A7.5	P/PS	x	3B	2.0	4.3	0.13	0.06	7.5	4.5
	4	55CM*	405	93	X15	A15	P/PS	x	3B	4.0	8.6	0.06	0.03	15	11.5
	5	55CM*	450	62	O06	A4	P/PS	x	3B	0.9	2.5	0.32	0.11	4	4.6
	6	55CM*	450	58	O06	A7.5	P/PS	x	3B	1.7	(4.7)	0.17	(0.06)	7.5	4.5
	8	55CM*	450	61	O06	A15	P/PS	x	3B	3.3	9.4	0.09	0.03	15	11.5
	9	55CM*	488	46	O09	A4	C/CS	x	3B	0.8	2.7	0.37	0.12	4	4.6
	10	55CM*	488	43	O09	A7.5	C/CS	x	3B	1.6	(5.0)	0.20	(0.06)	7.5	4.5
	12	55CM*	488	45	O09	A15	C/CS	x	3B	3.1	10.0	0.10	0.03	15	11.5
	13	55CM*	520	62	O11	A4	P/PS	x	3B	0.7	2.6	0.45	0.13	4	4.6
	14	55CM*	520	58	O11	A7.5	P/PS	x	3B	1.4	(4.9)	0.24	(0.07)	7.5	4.5
	16	55CM*	520	61	O11	A15	P/PS	x	3B	2.8	9.8	0.12	0.03	15	11.5
	17	55CM	635	10	H10	A6.2	C/CS	x	3B	1.5	(5.0)	0.28	(0.08)	6.2	4.9
	20	55CM	635	11	H10	A8	C/CS	x	3B	1.9	6.5	0.21	0.06	8	8.0
	21	55CM	635	11	H10	T12	C/CS	x	3B	2.8	9.7	0.14	0.04	12	13.0
	22	55CM	639	21	H18	A6.2	C/CS	x	3B	1.5	(5.5)	0.28	(0.07)	6.2	4.9
	25	55CM	639	22	H18	A8	C/CS	x	3B	1.9	7.1	0.21	0.06	8	8.0
	26	55CM	639	22	H18	T12	C/CS	x	3B	2.8	10.7	0.14	0.04	12	13.0
	27	55CM	660	25	M01	A6.2	C/CS	x	3B	1.7	4.0	0.24	0.11	6.2	4.9
	30	55CM	660	26	M01	A8	C/CS	x	3B	2.2	5.1	0.19	0.08	8	8.0
	31	55CM	660	26	M01	T12	C/CS	x	3B	3.4	7.7	0.12	0.05	12	13.0
	32	55CM	660	43	M26	A6.2	C/CS	x	3B	1.6	3.7	0.27	0.11	6.2	4.9
	35	55CM	660	43	M26	A8	C/CS	x	3B	2.0	4.8	0.21	0.09	8	8.0
	36	55CM	660	43	M26	T12	C/CS	x	3B	3.0	7.2	0.14	0.06	12	13.0
	37	55CM*	660	109	M25	A6.2	P/PS	x	3B	1.8	3.1	0.23	0.14	6.2	4.9
	40	55CM*	660	109	M25	A8	P/PS	x	3B	2.4	4.0	0.18	0.11	8	8.0
	41	55CM*	660	109	M25	T12	P/PS	x	3B	3.5	6.0	0.12	0.07	12	13.0
	42	55CM	685	42	H13	A6.2	C/CS	x	3B	1.7	3.9	0.25	0.11	6.2	4.9
	45	55CM	685	42	H13	A8	C/CS	x	3B	2.2	5.0	0.19	0.09	8	8.0
	46	55CM	685	42	H13	T12	C/CS	x	3B	3.4	7.5	0.13	0.06	12	13.0
	47	55CM	785	93	Q06	A6.2	C/CS	x	3B	1.7	2.9	0.30	0.17	6.2	4.9
	50	55CM	785	93	Q06	A8	C/CS	x	3B	2.1	3.8	0.23	0.13	8	8.0
	51	55CM	785	93	Q06	T12	C/CS	x	3B	3.2	5.6	0.16	0.09	12	13.0
	52	55CM	830	38	H19	A6.2	C/CS	x	3B	1.7	4.0	0.32	0.13	6.2	4.9
	55	55CM	830	38	H19	A8	C/CS	x	3B	2.1	5.1	0.25	0.10	8	8.0
	56	55CM	830	38	H19	T12	C/CS	x	3B	3.2	7.7	0.17	0.07	12	13.0

Casing Type
A 55CM
B (only electronics type C) 55CR
* not offered with 55CR (Casing type B)

Electronics Options: Please choose one of the stated options.
Standard electronics ..... C or P
Electronics with RS232 interface ..... CS or PS

Cable Options:
1 ..... 1.5 m shielded connection cable
6 ..... As 1, with connector type Lumberg SV50 (only electron. types C, P)
7 ..... 1.5 m shielded connection cable, with connector type Lumberg SV70 (only electronics types with interface CS, PS)
5 ..... customer-specified cable length

Laser Diode Collimator flatbeam® 90CM-M90

Laser Diode Collimator with telecentric laser beam and reduced coherence

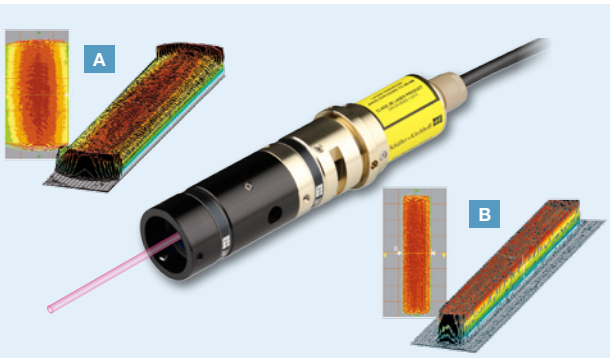
- Laser Diode Collimators flatbeam® with telecentric laser beam and flat top intensity distribution A along the large collimated axis
- Gaussian intensity distribution along the smaller collimated axis
- Collimators with minimal divergence
- Flat top intensity distribution - central area of almost constant lighting intensity
- Beam apertures: 17 - 32 mm
- Typ. edge intensity: > 80%
- Wavelengths: 635 - 785 nm
- Laser powers: up to 77 mW
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply voltage: 5V DC
- Casing Ø 25/28 mm
- Optional aperture: Beam/intensity profile B

Option:

- PC-interface (RS232) – electr. types CS or PS. Details see p. 25.

The laser collimator flatbeam® 90CM-projects a collimated laser beam with high edge intensity and minimal beam divergence.

The correct choice of aperture can ensure the production of an illuminated area of almost constant lighting intensity. Applications include shadow-edge analysis and measurement methods relying upon diffraction.



optional: optional:

Product Configurator: www.sukhamburg.com

RS232 LNC

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Adjustment possibilities:

- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

90CM-M60- Laser Diode Collimator flatbeam®

Order Code Example 1: 90CM - M60 - 660 - 13 - M01 - C - 6

Beam Parameters 90CM-M60-	curr. No.	Laser Diode Source	Lens	Wave-length [nm]	P_{out} [mW]	LD Code	Available Electronics Options	Cable	Laser Class	Aperture [mm]	Edge Intensity [%]	90% Range [mm] perp.	90% Range [mm] par.	Beam Divergence [mrad]
	1	90CM	M60	635	3	H02	C/CS	- x	3R	17	82	12.2	3.3	0.03
	2	90CM	M60	640	17	H22	C/CS	- x	3B	17	65	8.4	3.7	0.03
	3	90CM	M60	660	13	M01	C/CS	- x	3B	17	68	8.8	3.9	0.02
	4	90CM	M60	785	64	Q06	C/CS	- x	3B	17	48	6.5	3.7	0.03

90CM-M90- Laser Diode Collimator

Order Code Example 1: 90CM - M90 - 660 - 17 - M01 - CS - 6

Beam Parameters 90CM-M90-	curr. No.	Laser Diode Source	Lens	Wave-length [nm]	P_{out} [mW]	LD Code	Available Electronics Options	Cable	Laser Class	Aperture [mm]	Edge Intensity [%]	90% Range [mm] perp.	90% Range [mm] par.	Beam Divergence [mrad]
	1	90CM	M90	635	4	H02	C/CS	- x	3R	32	73	18.3	4.9	0.02
	2	90CM	M90	640	21	H22	C/CS	- x	3B	32	51	12.7	5.5	0.02
	3	90CM	M90	660	17	M01	C/CS	- x	3B	32	54	13.2	5.8	0.02
	4	90CM	M90	785	77	Q06	C/CS	- x	3B	32	32	9.7	5.5	0.02

Please note that all values are typical values and can differ slightly in reality.

Beam diameter and divergence values are set in parentheses if the beam is truncated above the $1/e^2$ level.

Electronics Type

Cable Options:

1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (only electronics type C) 6
As 1, with connector type Lumberg SV70 (only electronics types with interface CS) 7
customer-specified cable length 5

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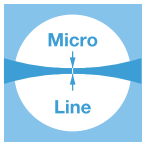
Schäfter+Kirchhoff

Low Noise

Low Noise Laser Line, Micro Focus and Macro Focus Generators LNC-Series

Low Noise Laser Micro Line LNC-13LN + 91CM

Low noise laser line with a small fan angle, approx. uniform intensity distribution and very thin lines.



- Low noise laser module with noise typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz; P_o is the maximum laser outpur power), reduced coherence and mode hopping free laser operation
- Fan angles 0°-16.8° (depending on working distance)
- Line width constant with along 60% of the central area, outside this area the line width differs up to 30%
- Intensity profile approx. uniform in line direction (Gaussian clipped by an aperture with typ. 80% edge intensity); Gaussian across the laser line
- Line width starting at 8 µm (1/e²)
- Laser power output up to 26 mW
- Laser wavelengths 635 to 1550 nm
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (> 600 nm) or 12 V DC (< 600 nm)
- Casing Ø 25/28 mm

The lasers of series LNC are low noise (typ. < 0.15 % of P_o* (RMS, Bandwidth < 1 MHz) and operate mode-hopping free. Due to the reduced coherence length, the speckle contrast is lowered (details see p. 26). However this effect is smaller for smaller lines. (* P_o is the maximum specified output power.)

The beam-shaping optics define the beam parameter fan angle and line length and the optimum working distance, see left tables.

The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left tables) are valid for the nominal working distance of the line optics. For this laser type the working distance is fixed. A fine-adjustment of the distance between laser and target is recommended for fine-focusing in order to achieve minimal line width.

optional:

LNC

Product Configurator: www.sukhamburg.com

RS232

Adjustment possibilities:

- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

www

LNC-13LN + 91CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: LNC - 13LN40-S250 + 91CM - 830 - 6 - H19 - M60 - H - 6

Example 2: LNC - 13LN40-S250 + 91CM - 660 - 6 - M26 - M60 - H - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 13LN	Fan Angle α [°]	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Convergence β [Deg]	Dim. X [mm]	13LN
	10	32	0.008	92	0.1	8.6	12	13LN40-M100
	14.3	76	0.020	244	0.5	3.5	12	13LN40-S250
	15.8	152	0.038	492	2.1	1.7	12	13LN40-S500
	16.8	304	0.075	972	8.6	0.9	12	13LN40-S1000
	1.7	20	0.020	249	0.5	3.5	8	13LN165-S250
	3.4	40	0.038	424	2.1	1.7	8	13LN165-S500
	3.8	80	0.075	977	8.6	0.9	8	13LN165-S1000
	0	14	0.020	249	0.5	3.5	8	13LN250-S250
	1.7	30	0.038	424	2.1	1.7	8	13LN250-S500
	2.5	56	0.075	977	8.6	0.9	8	13LN250-S1000

β = Beam convergence

Laser Module curr. No.	Laser Diode Source	Wave-length [nm]	P_{out} [mW]	LD Code	Lens	Available Electro-nics Options	Cable	Laser Class	Edge Intensity [%]	Line Width Factor F
1	91CM	- 635	- 2	- H10	- M60	- H	- x	3R	85	1.0
2	91CM	- 639	- 4	- H18	- M60	- H	- x	3R	87	1.0
3	91CM	- 660	- 3	- M01	- M60	- H	- x	3R	77	0.9
4	91CM	- 660	- 6	- M26	- M60	- H	- x	3B	74	1.0
5	91CM	- 660	- 26	- M25	- M60	- H	- x	3B	65	0.9
6	91CM	- 685	- 9	- H13	- M60	- H	- x	3B	76	0.9
7	91CM	- 785	- 16	- Q06	- M60	- H	- x	3B	61	1.1
8	91CM	- 830	- 6	- H19	- M60	- H	- x	3B	77	1.2
9	91CM	- 850	- 13	- G17	- M60	- H	- x	3B	73	1.2
10	91CM	- 1550	- 2	- Q04	- M60	- H	- x	3B	86	2.0

Partial selection only. More on www.sukhamburg.com

Blue/green lasers (405 nm - 520 nm) on request.

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the width and Rayleigh range/depth of focus of the laser line:

Line width: multiply by F (right table last column)
Rayleigh range: multiply by $F^2 \cdot 660\ nm/\lambda$ [nm]

Example: LNC-13LN40-S250+91CM-830-6-H19-M60-H-6 F = 1.2 (right table last column)
Line width B=0.020 mm · F = 0.020 mm · 1.2 = 0.024 mm
Rayleigh Range $2z_R$ = 0.5 mm · F^2 · 660 nm / 830 nm = 0.6 mm

Casing Type:
Casing Type K1 ..... **91CM**
Casing Type L1 ..... **91CR**

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (electronics type 'H', 5 V) **6**
As 1, with connector type Lumberg SV40 (electronics type 'HP', 12 V) 4
customer-specified cable length 5

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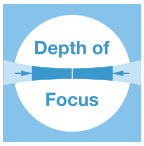
Low Noise Laser Macro Line LNC-13LNM + 91CM

Low noise laser line with a small fan angle, approx. uniform intensity distribution, and extended depth of focus.



- Extended depth of focus
- Low noise laser module with noise typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz; P_o is the maximum laser outpur power), reduced coherence and mode hopping free laser operation
- Fan angles 0°-16.8° (depending on working distance)
- Line width constant along 60% of the central area, outside this area the line width differs up to 30%
- Intensity profile approx. uniform in line direction (Gaussian clipped by an aperture with typ. 80% edge intensity); Gaussian across the laser line
- Line width starting at 14 µm (1/e²)
- Laser power output up to 18 mW
- Laser wavelengths 635 to 1550 nm
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (> 600 nm) or 12 V DC (< 600 nm)
- Casing Ø 25/28 mm

The lasers of series LNC are low noise (typ. < 0.15 % of P_o* (RMS, Bandwidth < 1 MHz) and operate mode-hopping free. Due to the reduced coherence length, the speckle contrast is lowered (details see p. 26). However this effect is smaller for smaller lines. (* P_o is the maximum specified output power.)

The beam-shaping optics define the beam parameter fan angle and line length and the optimum working distance, see left tables.

The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left tables) are valid for the nominal working distance of the line optics. For this laser type the working distance is fixed. A fine-adjustment of the distance between laser and target is recommended for fine-focusing in order to achieve minimal line width.

Adjustment possibilities:

- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs:
www.sukhamburg.com

LNC-13LNM + 91CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: LNC- 13LNM40-S250-7 + 91CM - 830 - 5 - H19 - M60 - H - 6

Example 2: LNC- 13LNM40-S250-7 + 91CM - 660 - 4 - M26 - M60 - H - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 13LNM	Fan Angle α [°]	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Depth of Focus [mm]	Convergence β [Deg]	Dim. X [mm]	13LNM
	10	30	0.014	84	1	4.0	20.5	13LNM40-M100-7
	14.3	75	0.034	227	4	1.6	20.5	13LNM40-S250-7
	15.8	150	0.068	483	15	0.8	20.5	13LNM40-S500-7
	16.8	300	0.136	964	60	0.4	20.5	13LNM40-S1000-7
	1.5	20	0.034	236	4	1.6	20.5	13LNM165-S250-7
	3	40	0.068	412	15	0.8	20.5	13LNM165-S500-7
	3.8	80	0.136	964	60	0.4	20.5	13LNM165-S1000-7
	0	14	0.034	236	4	1.6	20.5	13LNM250-S250-7
	1.7	30	0.068	412	15	0.8	20.5	13LNM250-S500-7
	2.5	56	0.136	965	60	0.4	20.5	13LNM250-S1000-7

β = Beam convergence

Laser Module curr. No.	Laser Diode Source	Wave-length [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Edge Intensity [%]	Line Width Factor F
1	91CM	- 635	- 1	- H10	- M60	- H	- x	2	85	1.0
2	91CM	- 639	- 3	- H18	- M60	- H	- x	3R	87	1.0
3	91CM	- 660	- 3	- M01	- M60	- H	- x	3R	77	1.0
4	91CM	- 660	- 4	- M26	- M60	- H	- x	3R	74	1.0
5	91CM	- 660	- 18	- M25	- M60	- H	- x	3B	65	1.0
6	91CM	- 685	- 6	- H13	- M60	- H	- x	3B	76	1.0
7	91CM	- 785	- 12	- Q06	- M60	- H	- x	3B	61	1.2
8	91CM	- 830	- 5	- H19	- M60	- H	- x	3B	77	1.3
9	91CM	- 850	- 10	- G17	- M60	- H	- x	3B	73	1.3
10	91CM	- 1550	- 2	- Q04	- M60	- H	- x	3B	86	2.3

Partial selection only. More on www.sukhamburg.com

Blue/green lasers (405 nm - 520 nm) on request.

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the width and Rayleigh range/depth of focus of the laser line:

Line width: multiply by F (right table last column)
Depth of focus: multiply by $F^2 \cdot 660\,nm/\lambda$ [nm]

Example:
LNC-13LNM40-S250-7+91CM-830-5-H19-M60-H-6 $F = 1.3$ (right table last column)
Line width B=0.034 mm · F = 0.034 mm · 1.3 = 0.044 mm
Depth of focus $2z_M$ = 4 mm · F^2 · 660 nm / 830 nm = 5 mm

Casing Type:
Casing Type K1 ..... **91CM**
Casing Type L1 ..... **91CR**

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (electronics type 'H', 5 V) **6**
As 1, with connector type Lumberg SV40 (electronics type 'HP', 12 V) 4
customer-specified cable length 5

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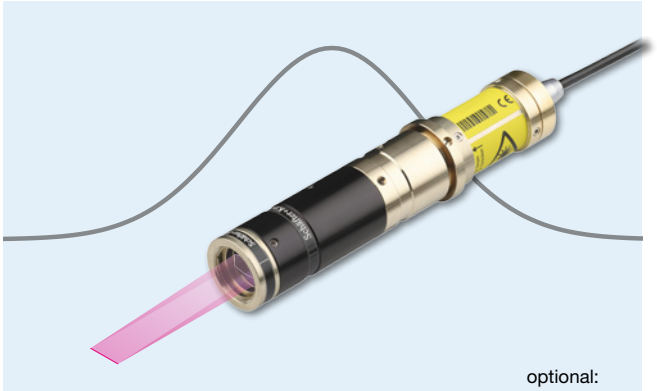
Low Noise Micro Line Generators LNC-13LT + 91CM

Low noise semi-telecentric laser line with constant line length 15 mm

Micro Line

- Low noise laser module with noise typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz; P_o is the maximum laser outpur power), reduced coherence and mode hopping free laser operation
- Semi-telecentric (Fan angle 0°)
- Line length constant 15 mm
- Intensity profile approx. uniform in line direction (Gaussian clipped by an aperture with typ. 80% edge intensity); Gaussian across the laser line
- Line width starting at 12 µm (1/e²)
- Laser power up to 18 mW
- Laser wavelengths 405 – 1550 nm
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (> 600 nm) or 12 V DC (< 600 nm)
- Casing Ø 25/28 mm



optional:

LNC

Product Configurator: www.sukhamburg.com

RS232

The lasers of series LNC are low noise (typ. < 0.15 % of P_o* (RMS, Bandwidth < 1 MHz) and operate mode-hopping free. Due to the reduced coherence length, the speckle contrast is lowered (details see p. 26). However this effect is smaller for smaller lines. (* P_o is the maximum specified output power.)

The beam-shaping optics define the beam parameter fan angle and line length and the optimum working distance, see left tables.

The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left tables) are valid for the nominal working distance of the line optics. For this laser type the working distance is fixed. A fine-adjustment of the distance between laser and target is recommended for fine-focusing in order to achieve minimal line width.

Adjustment possibilities:

- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

www

LNC-13LT + 91CM

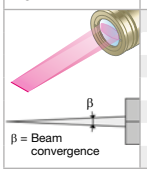
Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: LNC - 13LT-250 + 91CM - 830 - 6 - H19 - M60 - H - 6

Example 2: LNC - 13LT-250 + 91CM - 660 - 6 - M26 - M60 - H - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameter 13LT	Fan Angle α [°]	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Convergence β [Deg]	Dim. X [mm]	13LT
 β = Beam convergence	0	15	0.012	160	0.2	5.2	8	13LT-165
	0	15	0.017	243	0.5	3.5	8	13LT-250
	0	15	0.020	323	0.9	2.6	8	13LT-330
	0	15	0.030	493	2.1	1.7	8	13LT-500
	0	15	0.060	993	8.6	0.9	8	13LT-1000
	0	15	0.120	1993	34	0.4	8	13LT-2000
	0	15	0.240	3993	137	0.2	8	13LT-4000

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the width and Rayleigh range/depth of focus of the laser line:

	Line width:	multiply by F (right table last column)
	Rayleigh range:	multiply by $F^2 \cdot 660$ nm/λ [nm]
Example:	LNC-13LT-165+91CM-830-6-H19-M60-H-6	F = 1.2 (right table last column)
	Line width	B=0.012 mm · F = 0.012 mm · 1.2 = 0.014 mm
	Rayleigh Range	$2z_R$ = 0.2 mm · F^2 · 660 nm / 830 nm = 0.2 mm

Please note that all values are typical values and can differ slightly in reality.

Laser Module curr. No.	Laser Diode Source	Wave-length [nm]	P_{out} [mW]	LD Code	Lens	Available Electro-nics Options	Cable	Laser Class	Edge Intensity [%]	Correction Factor F
1	91CM	- 405	- 18	- X15	- M60	- HP	- x	3B	72	0.7
2	91CM	- 450	- 12	- 006	- M60	- HP	- x	3B	76	0.9
3	91CM	- 488	- 10	- 009	- M60	- HP	- x	3B	78	1.1
4	91CM	- 635	- 2	- H10	- M60	- H	- x	3R	85	1.0
5	91CM	- 639	- 4	- H18	- M60	- H	- x	3R	87	1.0
6	91CM	- 660	- 4	- M01	- M60	- H	- x	3R	77	0.9
7	91CM	- 660	- 6	- M26	- M60	- H	- x	3B	74	1.0
8	91CM	- 685	- 9	- H13	- M60	- H	- x	3B	76	0.9
9	91CM	- 785	- 17	- Q06	- M60	- H	- x	3B	61	1.1
10	91CM	- 830	- 6	- H19	- M60	- H	- x	3B	77	1.2
11	91CM	- 850	- 14	- G17	- M60	- H	- x	3B	73	1.2
12	91CM	- 1550	- 2	- Q04	- M60	- H	- x	3B	86	2.0

Partial selection only. More on www.sukhamburg.com

Casing Type:

Casing Type K1 ..... **91CM**

Casing Type L1 ..... **91CR**

Cable Options:

1.5 m shielded connection cable 1

As 1, with connector type Lumberg SV50 (electronics type 'H', 5 V) **6**

As 1, with connector type Lumberg SV40 (electronics type 'HP', 12 V) 4

customer-specified cable length 5

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Low Noise Macro Line Generators LNC-13LTM + 91CM

Low noise semi-telecentric laser line with constant line length 15 mm and extended depth of focus

Depth of Focus

- Extended depth of focus
- Low noise laser module with noise typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz; P_o is the maximum laser output power), reduced coherence and mode hopping free laser operation
- Semi-telecentric (Fan angle 0°)
- Line length constant 15 mm
- Intensity profile approx. uniform in line direction (Gaussian clipped by an aperture with typ. 80% edge intensity); Gaussian across the laser line
- Line width starting at 39 µm (1/e²)
- Laser power up to 8 mW
- Laser wavelengths 405 – 1550 nm
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (> 600 nm) or 12 V DC (< 600 nm)
- Casing Ø 25/28 mm

The lasers of series LNC are low noise (typ. < 0.15 % of P_o* (RMS, Bandwidth < 1 MHz) and operate mode-hopping free. Due to the reduced coherence length, the speckle contrast is lowered (details see p. 26). However this effect is smaller for smaller lines. (* P_o is the maximum specified output power.)

The beam-shaping optics define the beam parameter fan angle and line length and the optimum working distance, see left tables.

The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left tables) are valid for the nominal working distance of the line optics. For this laser type the working distance is fixed. A fine-adjustment of the distance between laser and target is recommended for fine-focusing in order to achieve minimal line width.

Adjustment possibilities:

- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

www

LNC-13LTM + 91CM

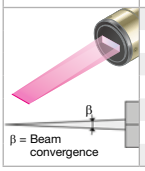
Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: LNC - 13LTM-500-41 + 91CM - 830 - 3 - H19 - M60 - H - 6

Example 2: LNC - 13LTM-500-41 + 91CM - 660 - 2 - M26 - M60 - H - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameter 13LTM	Fan Angle α [°]	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Depth of Focus [mm]	Convergence β [Deg]	Dim. X [mm]	13LTM
	0	15	0.039	153	5	1.4	13.4	13LTM-165-41
	0	15	0.060	238	11	0.9	13.4	13LTM-250-41
	0	15	0.079	318	20	0.7	13.4	13LTM-330-41
	0	15	0.119	488	46	0.5	13.4	13LTM-500-41
	0	15	0.238	988	184	0.2	13.4	13LTM-1000-41
	0	15	0.476	1988	735	0.1	13.4	13LTM-2000-41
	0	15	0.953	3988	2941	0.1	13.4	13LTM-4000-41

β = Beam convergence

Laser Module

curr. No.	Laser Diode Source	Wave-length [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Edge Intensity [%]	Correction Factor F
1	91CM	- 405	- 8	- X15	- M60	- HP	- x	3B	72	0.7
2	91CM	- 450	- 6	- 006	- M60	- HP	- x	3B	76	0.8
3	91CM	- 488	- 5	- 009	- M60	- HP	- x	3R	78	0.9
4	91CM	- 635	- 1	- H10	- M60	- H	- x	2	85	1.0
5	91CM	- 639	- 2	- H18	- M60	- H	- x	3R	87	1.0
6	91CM	- 660	- 1	- M01	- M60	- H	- x	2	77	1.0
7	91CM	- 660	- 2	- M26	- M60	- H	- x	3R	74	1.0
8	91CM	- 685	- 4	- H13	- M60	- H	- x	3R	76	1.0
9	91CM	- 785	- 7	- Q06	- M60	- H	- x	3B	61	1.2
10	91CM	- 830	- 3	- H19	- M60	- H	- x	3B	77	1.3
11	91CM	- 850	- 6	- G17	- M60	- H	- x	3B	73	1.3
12	91CM	- 1550	- 1	- Q04	- M60	- H	- x	3B	86	2.3

Partial selection only. More on www.sukhamburg.com

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the width and Rayleigh range/depth of focus of the laser line:

Line width: multiply by F (right table last column)
Depth of focus: multiply by $F^2 \cdot 660\ nm/\lambda$ [nm]

Example: LNC-13LT-250-41+91CM-830-3-H19-M60-H-6 $F = 1.3$ (right table last column)
Line width $B = 0.060\ mm \cdot F = 0.060\ mm \cdot 1.3 = 0.078\ mm$
Depth of focus $2z_M = 11\ mm \cdot F^2 \cdot 660\ nm / 830\ nm = 15\ mm$

Please note that all values are typical values and can differ slightly in reality.

Casing Type:
Casing Type K2 ..... **91CM**
Casing Type L2 ..... **91CR**

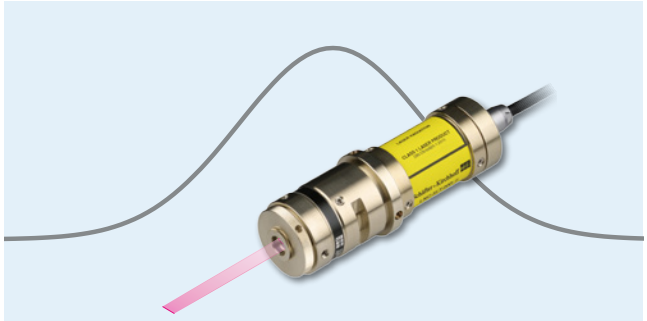
Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (electronics type 'H', 5 V) **6**
As 1, with connector type Lumberg SV40 (electronics type 'HP', 12 V) 4
customer-specified cable length 5

Low Noise Micro Line Generators LNC-5LT + 56CM

Low noise semi-telecentric laser line with Gaussian intensity distribution and constant line length of approx. 4.8 or 2.0 mm

Micro Line

- Low noise laser module with noise typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz; P_o is the maximum laser outpur power), reduced coherence and mode hopping free laser operation
- Semi-telecentric (Fan angle 0°)
- Constant line lengths of approx. 4.8 or 2.0 mm
- Intensity profile 5LT...-1: Gaussian in line direction, clipped by an aperture with <40% edge intensity, Gaussian across the laser line
- Intensity profile 5LT...-2: Gaussian in line direction (line length is given on the 13.5%-level), Gaussian across the laser line
- Line width starting at 11 µm ($1/e^2$)
- Laser power up to 37 mW
- Laser wavelengths 405 – 1550 nm
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (> 600 nm) or 12 V DC (< 600 nm)
- Casing Ø25 mm / Ø28 mm



optional:

LNC

Product Configurator: www.sukhamburg.com

RS232

The lasers of series LNC are low noise (typ. < 0.15 % of P_o* (RMS, Bandwidth < 1 MHz) and operate mode-hopping free. Due to the reduced coherence length, the speckle contrast is lowered (details see p. 26). However this effect is smaller for smaller lines. (* P_o is the maximum specified output power.)

The beam-shaping optics define the beam parameter fan angle and line length and the optimum working distance, see left tables.

The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left tables) are valid for the nominal working distance of the line optics. For this laser type the working distance is fixed. A fine-adjustment of the distance between laser and target is recommended for fine-focusing in order to achieve minimal line width.

Adjustment possibilities:

- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

www

LNC-5LT + 56CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: LNC - 5LT-330-1 + 56CM - 830 - 14 - H19 - A8 - H - 6

Example 2: LNC - 5LT-330-1 + 56CM - 660 - 12 - M26 - A8 - H - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameter 5LT	Fan Angle α [°]	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Convergence β [Deg]	Dim. X [mm]	5LT...-1
Line optics 5LT...-1 1	0	4.8	0.026	45	1.0	2.3	1.2	5LT-50-1
	0	4.8	0.039	74	2.3	1.5	1.2	5LT-75-1
	0	4.8	0.050	96	4.2	1.2	1.2	5LT-100-1
	0	4.8	0.075	145	9.3	0.8	1.2	5LT-150-1
	0	4.8	0.115	250	26	0.5	1.2	5LT-250-1
	0	4.8	0.138	324	45	0.3	1.2	5LT-330-1
	0	4.8	0.209	491	104	0.2	1.2	5LT-500-1

Beam Parameter 5LT	Fan Angle α [°]	Line Length L [mm] (13.5%-level)	Line Width B [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Convergence β [Deg]	Dim. X [mm]	5LT...-2
Line optics 5LT...-2 2	0	2.0	0.011	45	0.2	2.3	1.2	5LT-50-2
	0	2.0	0.016	74	0.4	1.5	1.2	5LT-75-2
	0	2.0	0.021	96	0.7	1.2	1.2	5LT-100-2
	0	2.0	0.032	145	1.6	0.8	1.2	5LT-150-2
	0	2.0	0.048	250	4.6	0.5	1.2	5LT-250-2
	0	2.0	0.058	324	8.0	0.3	1.2	5LT-330-2
	0	2.0	0.088	491	18	0.2	1.2	5LT-500-2

Correction factor F: Properties of the laser diode, such as divergence angle and wavelength, affect the width and Rayleigh range/depth of focus of the laser line:

Line Width:	multiply by F	(right table last column)
Rayleigh Range:	multiply by $F^2 \cdot 660\,nm/\lambda$ [nm]	

Please note that all values are typical values and can differ slightly in reality.

Laser Module curr. No.	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Edge Intensity [%]	Correction Factor F
1	56CM	- 405	- 37	- X15	- A7.5	- HP	- x	3B	11	0.7
2	56CM	- 450	- 25	- 006	- A7.5	- HP	- x	3B	16	1.0
3	56CM	- 488	- 21	- 009	- A7.5	- HP	- x	3B	20	1.1
4	56CM	- 635	- 5	- H10	- A8	- H	- x	3R	33	1.0
5	56CM	- 639	- 9	- H18	- A8	- H	- x	3B	40	1.0
6	56CM	- 660	- 8	- M01	- A8	- H	- x	3B	17	0.9
7	56CM	- 660	- 12	- M26	- A8	- H	- x	3B	13	1.0
8	56CM	- 685	- 19	- H13	- A8	- H	- x	3B	16	0.9
9	56CM	- 785	- 30	- Q06	- A8	- H	- x	3B	4	1.1
10	56CM	- 830	- 14	- H19	- A8	- H	- x	3B	17	1.2
11	56CM	- 850	- 29	- G17	- A8	- H	- x	3B	12	1.2
12	56CM	- 1550	- 7	- Q04	- A8	- H	- x	3B	38	2.0

Casing Type:

Casing Type I2 . . . . . **56CM**

Casing Type J2 . . . . . **56CR**

Cable Options:

1.5 m shielded connection cable 1

As 1, with connector type Lumberg SV50 (electronics type 'H', 5V). **6**

Lumberg SV40 (electronics type 'HP', 12V) . . . 4

customer-specified cable length 5

For 5LT...-2 (lower left table) the free aperture is larger than the line length L. L is here given on the 13.5%-level.

For Configuration Options 1 / 2 please see p. 69

Partial selection only. More on www.sukhamburg.com

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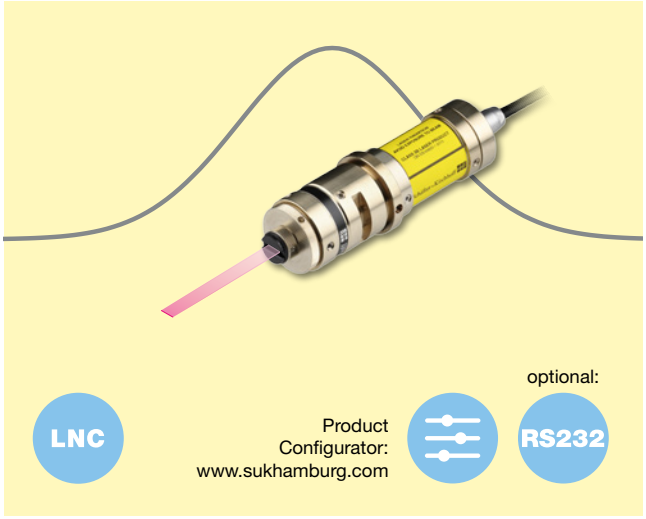
Low Noise Macro Line Generators LNC-5LTM + 56CM

Low noise semi-telecentric line with Gaussian intensity distribution, constant line length appr. 4.8 / 2.0 mm and extended depth of focus

Depth of Focus

- Extended depth of focus
- Low noise laser module with noise typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz; P_o is the maximum laser outpur power), reduced coherence and mode hopping free laser operation
- Semi-telecentric (Fan angle 0°)
- Constant line lengths of approx. 4.8 or 2.0 mm
- Intensity profile 5LT...-1: Gaussian in line direction, clipped by an aperture with <40% edge intensity, approx. Gaussian across the laser line
- Intensity profile 5LT...-2: Gaussian in line direction (line length is given on the 13.5%-level), approx. Gaussian across the laser line
- Line width starting at 24 µm (1/e²)
- Laser power up to 25 mW
- Laser wavelengths 405 – 1550 nm
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (> 600 nm) or 12 V DC (< 600 nm)
- Casing Ø 25/28 mm



LNC

Product Configurator: www.sukhamburg.com

optional: RS232

The lasers of series LNC are low noise (typ. < 0.15 % of P_o* (RMS, Bandwidth < 1 MHz) and operate mode-hopping free. Due to the reduced coherence length, the speckle contrast is lowered (details see p. 26). However this effect is smaller for smaller lines. (* P_o is the maximum specified output power.)

The beam-shaping optics define the beam parameter fan angle and line length and the optimum working distance, see left tables.

The chosen laser module defines the wavelength and the power output and, thereby, the laser safety class, see right table.

The line lengths and line widths (left tables) are valid for the nominal working distance of the line optics. For this laser type the working distance is fixed. A fine-adjustment of the distance between laser and target is recommended for fine-focusing in order to achieve minimal line width.

Adjustment possibilities:

- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 748.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

www

LNC-5LTM + 56CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: LNC - 5LTM-50-11 + 56CM - 830 - 9 - H19 - A8 - H - 6

Example 2: LNC - 5LTM-50-11 + 56CM - 660 - 8 - M26 - A8 - H - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameter 5LTM	Fan Angle α [°]	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Convergence β [Deg]	Dim. X [mm]	5LTM
Line optics 5LTM...-11 1	0	4.3	0.048	39	7	2.3	6.6	5LTM-50-11
	0	4.8	0.072	68	17	1.5	6.6	5LTM-75-11
	0	4.8	0.096	91	29	1.2	6.6	5LTM-100-11
	0	4.8	0.144	139	66	0.8	6.6	5LTM-150-11
	0	4.8	0.239	245	184	0.5	6.6	5LTM-250-11
	0	4.8	0.316	319	320	0.3	6.6	5LTM-330-11
	0	4.8	0.479	486	729	0.2	6.6	5LTM-500-11

Beam Parameter 5LTM	Fan Angle α [°]	Line Length L [mm] (13.5%-level)	Line Width B [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Convergence β [Deg]	Dim. X [mm]	5LTM
Line optics 5LTM...-22 2	0	2.0	0.024	39	2	2.3	6.6	5LTM-50-22
	0	2.0	0.036	68	4	1.5	6.6	5LTM-75-22
	0	2.0	0.048	91	7	1.2	6.6	5LTM-100-22
	0	2.0	0.071	139	17	0.8	6.6	5LTM-150-22
	0	2.0	0.119	245	46	0.5	6.6	5LTM-250-22
	0	2.0	0.157	319	80	0.3	6.6	5LTM-330-22
	0	2.0	0.238	486	184	0.2	6.6	5LTM-500-22

Laser Module

curr. No.	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Edge Intensity [%]	Correction Factor F
1	56CM	- 405	- 25	- X15	- A7.5	- HP	- x	3B	11	0.7
2	56CM	- 450	- 19	- 006	- A7.5	- HP	- x	3B	16	0.8
3	56CM	- 488	- 16	- 009	- A7.5	- HP	- x	3B	20	0.9
4	56CM	- 635	- 3	- H10	- A8	- H	- x	3R	33	1.0
5	56CM	- 639	- 7	- H18	- A8	- H	- x	3B	40	1.0
6	56CM	- 660	- 5	- M01	- A8	- H	- x	3R	17	1.0
7	56CM	- 660	- 8	- M26	- A8	- H	- x	3B	13	1.0
8	56CM	- 685	- 12	- H13	- A8	- H	- x	3B	16	1.0
9	56CM	- 785	- 20	- Q06	- A8	- H	- x	3B	4	1.2
10	56CM	- 830	- 9	- H19	- A8	- H	- x	3B	17	1.3
11	56CM	- 850	- 19	- G17	- A8	- H	- x	3B	12	1.3
12	56CM	- 1550	- 4	- Q04	- A8	- H	- x	3B	38	2.3

Casing Types: see page 68

Cable Options: see page 68

For 5LTM...-22 (lower left table) the free aperture is larger than the line length L. L is here given on the 13.5%-level.

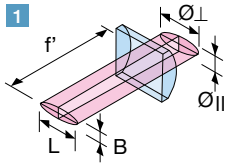
Partial selection only. More on www.sukhamburg.com

Configuration Options

Line optics 5LT...-1: Configuration 1

Line length L = Ø⊥

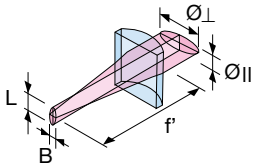
The beam diameter Ø∥ of the collimated beam is focussed. The line length is constant and is equal to the beam diameter Ø⊥.



Line optics 5LT...-2: Configuration 2

Line length L = Ø∥

The beam diameter Ø⊥ of the collimated beam is focussed. Line length is constant and is equal to the beam diameter Ø∥. Line length and width are less than in configuration 1.



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Low Noise Micro Line Generators LNC-13MC +96CM

Low noise laser focus generator with rotationally symmetric, Gaussian intensity profile

Micro Line

- Low noise laser module with noise typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz; P_o is the maximum laser outpur power), reduced coherence and mode hopping free laser operation
- Rotationally symmetric circular laser spot
- Gaussian intensity profile
- Focus Ø starting at 7 µm
- Laser wavelengths 635 – 828 nm
- Laser power up to 18 mW
- Adjustment of focus setting
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (> 600 nm) or 12 V DC (< 600 nm)
- Casing Ø 25/28 mm

The lasers of series LNC are low noise (typ. < 0.15 % of P_o* (RMS, Bandwidth < 1 MHz) and operate mode-hopping free. Due to the reduced coherence length, the speckle contrast is lowered (details see p. 26). However this effect is smaller for smaller spots. (* P_o is the maximum specified output power.)

These focus generators employ special diodes with integrated micro-optics. The micro-optics transform the elliptical radiation emitted by the laser diode into circular radiation with a deviation of maximum of 1:1.2.

The beam-shaping optics define the optimum working distance and the focussing range, see left table. The chosen laser module determines the wavelength and the output power and, thereby, the laser safety class, see right table.

The spot sizes (left table) are valid for the nominal working distance of the focus optics. The working distance can be adjusted by adjusting the focus setting. Please note that the spot diameter increases proportionally to the working distance. A fine-adjustment of the distance between laser and target is recommended for fine-focusing.

LNC

Product Configurator: www.sukhamburg.com

optional: RS232

Adjustment possibilities:

- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

www

LNC-13MC + 96CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: LNC - 13MC-M60 + 96CM - 658 - 8 - B09 - M60 - H - 6

Example 2: LNC - 13MC-M60 + 96CM - 635 - 1 - B08 - M60 - H - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameter 13MC	Spot Diameter [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Focussing Range [mm]	Convergence β [Deg]	Dim. X [mm]	13MC
	0.007	54	0.03	40 - 80	13.5	8	13MC-M60
	0.011	93	0.08	80 - 110	8.1	8	13MC-M100
	0.014	120	0.13	110 - 205	6.5	8	13MC-M125
	0.016	245	0.50	205 - 410	3.3	8	13MC-S250
	0.028	492	2	410 - 815	1.6	8	13MC-S500
	0.057	973	8	815 - 1290	0.8	8	13MC-S1000
	0.114	2000	32	1290 - ∞	0.4	8	13MC-S000

Laser Module

curr. No.	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Beam Diameter at Collimator [mm]	Correction Factor F
1	96CM	- 635	- 1	- B08	- M60	- H	- x	2	14.0	1.0
2	96CM	- 635	- 5	- B07	- M60	- H	- x	3R	14.0	1.0
3	96CM	- 639	- 11	- B21	- M60	- H	- x	3B	14.0	1.0
4	96CM	- 658	- 8	- B09	- M60	- H	- x	3B	14.0	1.1
5	96CM	- 660	- 14	- B28	- M60	- H	- x	3B	14.0	0.9
6	96CM	- 690	- 9	- B12	- M60	- H	- x	3B	14.0	1.0
7	96CM	- 785	- 18	- B32	- M60	- H	- x	3B	14.0	1.1
8	96CM	- 828	- 17	- B30	- M60	- H	- x	3B	12.4	1.5

Partial selection only. More on www.sukhamburg.com

Correction factor F:
Properties of the laser diode, such as divergence angle and wavelength, affect the spot diameter and Rayleigh range/depth of focus of the laser focus.

Spot diameter: multiply by F (right table last column)
Rayleigh range: multiply by $F^2 \cdot 660\ \text{nm}/\lambda\ [\text{nm}]$

Example: LNC-13MC-M125+96CM-658-8-B09-M60-H-6 F = 1.1 (right table last column)
Spot diameter $\varnothing = 0.014\ \text{mm} \cdot F = 0.014\ \text{mm} \cdot 1.1 = 0.015\ \text{mm}$
Rayleigh range $2z_R = 0.13\ \text{mm} \cdot F^2 \cdot 660\ \text{nm} / 658\ \text{nm} = 0.16\ \text{mm}$

Please note that all values are typical values and can differ slightly in reality.

Casing Type:
Casing Type M1 . . . . . 96CM
Casing Type N1 . . . . . 96CR

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type
Lumberg SV50 (electronics type 'H', 5V). 6
Lumberg SV40 (electronics type 'HP', 12V) . . . 4
customer-specified cable length 5

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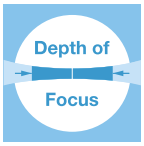
Low Noise Macro Line Generators LNC-13MMC +96CM

Low noise laser focus generator with rotationally symmetric beam profile and extended depth of focus



- Extended depth of focus
- Low noise laser module with noise typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz; P_o is the maximum laser outpur power), reduced coherence and mode hopping free laser operation
- Rotationally symmetric focus
- Approx. Gaussian intensity profile
- Focus Ø starting at 8 µm
- Laser wavelengths 635 – 828 nm
- Laser power up to 9 mW
- Adjustment of focus setting
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (> 600 nm) or 12 V DC (< 600 nm)
- Casing Ø 25/28 mm

The lasers of series LNC are low noise (typ. < 0.15 % of P_o* (RMS, Bandwidth < 1 MHz) and operate mode-hopping free. Due to the reduced coherence length, the speckle contrast is lowered (details see p. 26). However this effect is smaller for smaller spots. (* P_o is the maximum specified output power.)

These focus generators employ special diodes with integrated micro-optics. The micro-optics transform the elliptical radiation emitted by the laser diode into circular radiation with a deviation of maximum of 1:1.2.

The beam-shaping optics define the optimum working distance and the focussing range, see left table. The chosen laser module determines the wavelength and the output power and, thereby, the laser safety class, see right table.

The spot sizes (left table) are valid for the nominal working distance of the focus optics. The working distance can be adjusted by adjusting the focus setting. Please note that the spot diameter increases proportionally to the working distance. A fine-adjustment of the distance between laser and target is recommended for fine-focusing.

Adjustment possibilities:

- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs:
www.sukhamburg.com

LNC-13MMC + 96CM

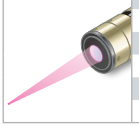
Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: LNC - 13MMC-M60-8 + 96CM - 658 - 4.3 - B09 - M60 - H - 6

Example 2: LNC - 13MMC-M60-8 + 96CM - 635 - 0.6 - B08 - M60 - H - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameter 13MMC	Spot Diameter [mm]	Working Distance A [mm]	Depth of Focus [mm]	Focussing Range [mm]	Convergence β [Deg]	Dim. X [mm]	13MMC
	0.008	45	0.2	30 - 70	7.6	16.4	13MMC-M60-8
	0.013	84	0.4	70 - 100	4.6	16.4	13MMC-M100-8
	0.017	111	0.7	100 - 195	3.7	16.4	13MMC-M125-8
	0.033	233	2.8	195 - 400	1.8	16.4	13MMC-S250-8
	0.066	483	11.1	400 - 805	0.92	16.4	13MMC-S500-8
	0.133	964	44.2	805 - 1285	0.46	16.4	13MMC-S1000-8

Laser Module

curr. No.	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Beam Diameter at Collimator [mm]	Correction Factor F
1	96CM	- 635 -	0.6 -	B08 -	M60 -	H -	x	2	8.0	1.0
2	96CM	- 635 -	2.4 -	B07 -	M60 -	H -	x	3R	8.0	1.0
3	96CM	- 639 -	5.9 -	B21 -	M60 -	H -	x	3B	8.0	1.0
4	96CM	- 658 -	4.3 -	B09 -	M60 -	H -	x	3R	8.0	1.1
5	96CM	- 660 -	6.0 -	B28 -	M60 -	H -	x	3B	8.0	0.9
6	96CM	- 690 -	4.2 -	B12 -	M60 -	H -	x	3R	8.0	1.0
7	96CM	- 785 -	8.9 -	B32 -	M60 -	H -	x	3B	8.0	1.1
8	96CM	- 828 -	10 -	B30 -	M60 -	H -	x	3B	8.0	1.5

Partial selection only. More on www.sukhamburg.com

Correction factor F:
Properties of the laser diode, such as divergence angle and wavelength, affect the spot diameter and Rayleigh range / depth of focus of the laser focus.

Spot diameter: multiply by F (right table last column)
Rayleigh range: multiply by $F^2 \cdot 660$ nm/λ [nm]

Example: LNC-13MMC-M125-8+95CM-658-4.3-B09-M60-H6 F = 1.1 (right table last column)
Spot diameter $\varnothing = 0.017 \text{ mm} \cdot F = 0.017 \text{ mm} \cdot 1.1 = 0.019 \text{ mm}$
Depth of focus $2z_M = 0.7 \text{ mm} \cdot F^2 \cdot 660 \text{ nm} / 658 \text{ nm} = 0.8 \text{ mm}$

Please note that all values are typical values and can differ slightly in reality.

Casing Type:
Casing Type M1 . . . . . **96CM**
Casing Type N1 . . . . . **96CR**

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type
Lumberg SV50 (electronics type 'H', 5V). **6**
Lumberg SV40 (electronics type 'HP', 12V) . . . 4
customer-specified cable length 5

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Low Noise Micro Line Generators LNC-13M + 56CM

Low noise laser spot with elliptical Gaussian beam profile

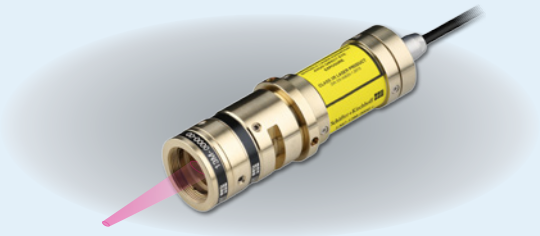
Micro Line

- Low noise laser module with noise typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz; P_o is the maximum laser outpur power), reduced coherence and mode hopping free laser operation
- Elliptical laser spot
- Elliptical, Gaussian intensity profile
- Focus Ø starting at 9 x 21 µm
- Laser wavelengths 405 – 1550 nm
- Laser power up to 39 mW
- Integrated focussing mechanism
- Adjustment of focus setting
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (> 600 nm) or 12 V DC (< 600 nm)
- Casing Ø 25/28 mm
- Small laser spot diameters
- High power density in the focal plane
- Casing Ø25 mm / Ø28 mm

The lasers of series LNC are low noise (typ. < 0.15 % of P_o* (RMS, Bandwidth < 1 MHz) and operate mode-hopping free. Due to the reduced coherence length, the speckle contrast is lowered (details see p. 26). However this effect is smaller for smaller spots. (* P_o is the maximum specified output power.)

The beam-shaping optics define the optimum working distance and the focussing range, see left table. The chosen laser module determines the wavelength and the output power and, thereby, the laser safety class, see right table.

The spot sizes (left table) are valid for the nominal working distance of the focus optics. The working distance can be adjusted by adjusting the focus setting. Please note that the spot diameter increases proportionally to the working distance.
A fine-adjustment of the distance between laser and target is recommended for fine-focusing.



optional:

LNC

Product Configurator: www.sukhamburg.com

RS232

Adjustment possibilities:

- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

www

LNC-13M + 56CM

Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: LNC - 13M-M60 + 56CM - 830 - 15 - H19 - T12 - H - 6
Example 2: LNC - 13M-M60 + 56CM - 660 - 9 - M01 - T12 - H - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 13M	Spot Width w [mm]	Spot Height h [mm]	Working Distance A [mm]	Rayleigh Range $2z_R$ [mm]	Focussing Range [mm]	Convergence β [Deg] perp.	Convergence β [Deg] par.	Dim. X [mm]	
	0.009	0.021	54	0.1	40-80	6.9	2.9	8	13M-M60
	0.014	0.033	93	0.3	80-110	4.1	1.7	8	13M-M100
	0.018	0.042	120	0.5	110-205	3.3	1.4	8	13M-M125
	0.032	0.077	245	2.0	205-410	1.6	0.7	8	13M-S250
	0.058	0.139	492	8.1	410-815	0.8	0.3	8	13M-S500
	0.117	0.278	973	33	815-1295	0.4	0.2	8	13M-S1000

Laser Module

curr. No.	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Beam Diameter at Collimator [mm] perp.	Beam Diameter at Collimator [mm] par.	Correction Factor F
1	56CM	- 405	- 39	- X15	- T15	- HP	- x	3B	8.6	4.0	0.6
2	56CM	- 450	- 27	- 006	- T15	- HP	- x	3B	9.4	3.3	0.7
3	56CM	- 488	- 22	- 009	- T15	- HP	- x	3B	10.0	3.1	0.9
4	56CM	- 635	- 5	- H10	- T12	- H	- x	3R	9.7	2.8	1.0
5	56CM	- 639	- 11	- H18	- T12	- H	- x	3B	10.7	2.8	1.0
6	56CM	- 660	- 9	- M01	- T12	- H	- x	3B	7.7	3.4	0.9
7	56CM	- 660	- 12	- M26	- T12	- H	- x	3B	7.2	3.0	1.0
8	56CM	- 685	- 20	- H13	- T12	- H	- x	3B	7.5	3.4	0.9
9	56CM	- 785	- 31	- Q06	- T12	- H	- x	3B	5.6	3.2	1.1
10	56CM	- 830	- 15	- H19	- T12	- H	- x	3B	7.7	3.2	1.2
11	56CM	- 850	- 30	- G17	- T12	- H	- x	3B	7.0	3.2	1.2
12	56CM	- 1550	- 8	- Q04	- T12	- H	- x	3B	10.3	3.5	2.0

Partial selection only.
More on www.sukhamburg.com

Correction factor F:
Properties of the laser diode, such as divergence angle and wavelength, affect the spot diameter and Rayleigh range /depth of focus of the laser focus.

Spot width/height: multiply by F (right table last column)
Rayleigh range: multiply by $F^2 \cdot 660\ nm/\lambda$ [nm]

Example: LNC-13M-M60+56CM-660-9-M01-T12-H-6 F = 0.9 (right table last column)
Spot width W=0.008 mm · F = 0.008 mm · 0.9 = 0.007 mm
Rayleigh Range $2z_R$ = 0.1 mm · F^2 · 660 nm / 660 nm = 0.1 mm

Casing Type:
Casing Type I3 ..... **56CM**
Casing Type J3 ..... **56CR**

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (electronics type ‚H', 5 V) **6**
As 1, with connector type Lumberg SV40 (electronics type ‚HP', 12 V) 4
customer-specified cable length 5

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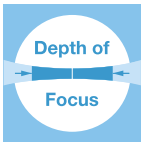
Low Noise Macro Line Generators LNC-13MM + 56CM

Low noise circular laser spot with extended depth of focus



- Extended depth of focus
- Low noise laser module with noise typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz; P_o is the maximum laser outpur power), reduced coherence and mode hopping free laser operation
- Circular laser spot
- Approx. Gaussian intensity profile: Elliptical intensity distribution clipped by a circular aperture
- Focus Ø starting at 20 µm
- Laser wavelengths 405 – 1550 nm
- Laser power up to 23 mW
- Adjustment of focus setting
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply voltage: 5 V DC (> 600 nm) or 12 V DC (< 600 nm)
- Casing Ø 25/28 mmm
- Extended depth of focus
- Larger spot diameters with lower power density
- Casing Ø25 mm / Ø28 mm

The lasers of series LNC are low noise (typ. < 0.15 % of P_o* (RMS, Bandwidth < 1 MHz) and operate mode-hopping free. Due to the reduced coherence length, the speckle contrast is lowered (details see p. 26). However this effect is smaller for smaller spots. (* P_o is the maximum specified output power.)

The beam-shaping optics define the optimum working distance and the focussing range, see left table. The chosen laser module determines the wavelength and the output power and, thereby, the laser safety class, see right table.

The spot sizes (left table) are valid for the nominal working distance of the focus optics. The working distance can be adjusted by adjusting the focus setting. Please note that the spot diameter increases proportionally to the working distance.
A fine-adjustment of the distance between laser and target is recommended for fine-focusing.

optional:

LNC

Product Configurator: www.sukhamburg.com

RS232

Adjustment possibilities:

- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

www

LNC-13MM + 56CM

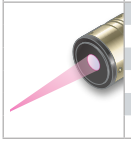
Combination: **Beam Shaping Optics** + **Laser Diode Collimator**

Two-part Order Code

Example 1: LNC - 13MM-M60-4 + 56CM - 830 - 9 - H019 - T12 - H - 6

Example 2: LNC - 13MM-M60-4 + 56CM - 660 - 5 - M01 - T12 - H - 6

All combinations of beam shaping optics and laser module are possible.

Beam Parameters 13MM	Spot Diameter [mm]	Working Distance A [mm]	Depth of Focus [mm]	Focussing Range [mm]	Convergence β [Deg]	Dim. X [mm]	13MM
	0.020	45	0.7	40 - 80	2.9	16.4	13MM-M60-4
	0.033	84	1.8	80 - 110	1.7	16.4	13MM-M100-4
	0.041	111	2.9	110 - 205	1.4	16.4	13MM-M125-4
	0.082	233	11	205 - 410	0.7	16.4	13MM-S250-4
	0.165	483	46	410 - 815	0.3	16.4	13MM-S500-4
	0.330	964	184	815 - 1295	0.2	16.4	13MM-S1000-4

Laser Module curr. No.	Laser Diode Source	Wavelength [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable	Laser Class	Beam Diameter at Collimator [mm]	Correction Factor F
1	56CM	- 405	- 21	- X15	- T15	- HP	- x	3B	4.0	0.6
2	56CM	- 450	- 14	- 006	- T15	- HP	- x	3B	3.3	0.7
3	56CM	- 488	- 11	- 009	- T15	- HP	- x	3B	3.1	0.9
4	56CM	- 635	- 3	- H10	- T12	- H	- x	3R	2.8	1.0
5	56CM	- 639	- 5	- H18	- T12	- H	- x	3B	2.8	1.0
6	56CM	- 660	- 5	- M01	- T12	- H	- x	3B	3.4	0.9
7	56CM	- 660	- 8	- M26	- T12	- H	- x	3B	3.0	1.0
8	56CM	- 685	- 13	- H13	- T12	- H	- x	3B	3.4	0.9
9	56CM	- 785	- 23	- Q06	- T12	- H	- x	3B	3.2	1.1
10	56CM	- 830	- 9	- H19	- T12	- H	- x	3B	3.2	1.2
11	56CM	- 850	- 20	- G17	- T12	- H	- x	3B	3.2	1.2
12	56CM	- 1550	- 4	- Q04	- T12	- H	- x	3B	3.5	2.0

Partial selection only. More on www.sukhamburg.com

Correction factor F:
Properties of the laser diode, such as divergence angle and wavelength, affect the spot diameter and Rayleigh range /depth of focus of the laser focus.

Spot width/height: multiply by F (right table last column)
Rayleigh range: multiply by $F^2 \cdot 660$ nm/λ [nm]

Example: LNC-13M-M60+56CM-660-5-M01-T12-H-6 F = 0.9 (right table last column)
Spot diameter $Ø$=0.019 mm · F = 0.019 mm · 0.9 = 0.017 mm
Depth of focus $2z_M$ = 0.7 mm · F^2 · 660 nm / 660 nm = 0.6 mm

Casing Type:
Casing Type I3 . . . . . **56CM**
Casing Type J3 . . . . . **56CR**

Cable Options:
1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (electronics type ‚H', 5 V) **6**
As 1, with connector type Lumberg SV40 (electronics type ‚HP', 12 V) 4
customer-specified cable length 5

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Low Noise Laser Diode Collimators LNC-56CM

Low noise laser diode collimator with elliptical Gaussian beam profile (For details on the LNC-series please see page 18)

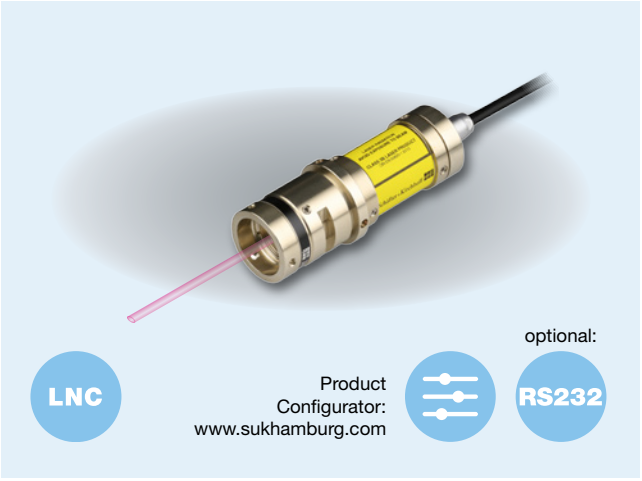
- Low noise laser module with noise typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz; P_o is the maximum laser outpur power), reduced coherence and mode hopping free laser operation
- Collimated laser beam
- Ellip. Gaussian intensity profile
- Laser wavelength 405 to 1550 nm
- Power up to 40 mW
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply voltage: 5V DC
- Casing Ø 25/28 mm

The lasers of series LNC are low noise (typ. < 0.15 % of P_o* (RMS, Bandwidth < 1 MHz) and operate mode-hopping free. Due to the reduced coherence length, the speckle contrast is lowered (details see p. 26). However this effect is smaller for smaller beams. (* P_o is the maximum specified output power.)

Laser diode collimators transform the divergent light of a laser diode into a collimated beam, while maintaining the Gaussian intensity distribution and the elliptical intensity profile.

From the two emission angles $\vartheta_\perp$ and $\vartheta_\parallel$ of the laser diode and the focal length of the collimation optics, the orthogonal and parallel divergence angles and beam diameter can be determined, which are a function of the laser diode used for the collimation.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**



Adjustment possibilities:
- Collimation adjustment
- Locking/unlocking of the focus position
- Potentiometer for laser power output

Accessories and further information

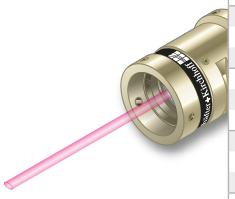
Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

LNC-56CM — Laser Diode Collimator

All combinations of beam shaping optics and laser module are possible.

Example 1: LNC - 56CR - 660 - 12 - M26 - A6.2 - H - 1

Order Code **Example 1:** LNC - 56CM - 660 - 12 - M26 - T12 - H - 6



Beam Parameters elliptical	curr. No.	Laser Diode Source	Wave-length [nm]	P_{out} [mW]	LD Code	Lens	Available Electronics Options	Cable
	1	56CM	405	40	X15	A4	HP	x
	2	56CM	405	38	X15	A7.5	HP	x
	3	56CM	405	39	X15	A15	HP	x
	4	56CM	450	27	O06	A4	HP	x
	5	56CM	450	26	O06	A7.5	HP	x
	6	56CM	450	27	O06	A15	HP	x
	7	56CM	488	23	O09	A4	HP	x
	8	56CM	488	21	O09	A7.5	HP	x
	9	56CM	488	22	O09	A15	HP	x
	10	56CM	635	5	H10	A6.2	H	x
	11	56CM	635	6	H10	A8	H	x
	12	56CM	635	6	H10	T12	H	x
	13	56CM	639	10	H18	A6.2	H	x
	14	56CM	639	11	H18	A8	H	x
	15	56CM	639	11	H18	T12	H	x
	16	56CM	660	9	M01	A6.2	H	x
	17	56CM	660	9	M01	A8	H	x
	18	56CM	660	9	M01	T12	H	x
	19	56CM	660	12	M26	A6.2	H	x
	20	56CM	660	12	M26	A8	H	x
	21	56CM	660	12	M26	T12	H	x
	22	56CM	685	21	H13	A6.2	H	x
	23	56CM	685	21	H13	A8	H	x
	24	56CM	685	21	H13	T12	H	x
	25	56CM	785	31	Q06	A6.2	H	x
	26	56CM	785	31	Q06	A8	H	x
	27	56CM	785	31	Q06	T12	H	x
	28	56CM	830	15	H19	A6.2	H	x
	29	56CM	830	15	H19	A8	H	x
	30	56CM	830	15	H19	T12	H	x
	31	56CM	850	30	G17	A6.2	H	x
	32	56CM	850	31	G17	A8	H	x
	33	56CM	850	31	G17	T12	H	x
	34	56CM	1550	8	Q04	A6.2	H	x
	35	56CM	1550	8	Q04	A8	H	x
	36	56CM	1550	8	Q04	T12	H	x

Laser Class	Collimated Beam Diameter [mm] perp.	Collimated Beam Diameter [mm] par.	Beam Divergence [mrad] perp.	Beam Divergence [mrad] par.	Collimating Lens *f* [mm]	Clear Aperture [mm]
3B	1.1	2.3	0.24	0.11	4	4.6
3B	2.0	4.3	0.13	0.06	7.5	4.5
3B	4.0	8.6	0.06	0.03	15	11.5
3B	0.9	2.5	0.32	0.11	4	4.6
3B	1.7	(4.7)	0.17	(0.06)	7.5	4.5
3B	3.3	9.4	0.09	0.03	15	11.5
3B	0.8	2.7	0.37	0.12	4	4.6
3B	1.6	(5.0)	0.20	(0.06)	7.5	4.5
3B	3.1	10.0	0.10	0.03	15	11.5
3R	1.5	(5.0)	0.28	(0.08)	6.2	4.9
3B	1.9	6.5	0.21	0.06	8	8.0
3B	2.8	9.7	0.14	0.04	12	13.0
3B	1.5	(5.5)	0.28	(0.07)	6.2	4.9
3B	1.9	7.1	0.21	0.06	8	8.0
3B	2.8	10.7	0.14	0.04	12	13.0
3B	1.7	4.0	0.24	0.11	6.2	4.9
3B	2.2	5.1	0.19	0.08	8	8.0
3B	3.4	7.7	0.12	0.05	12	13.0
3B	1.6	3.7	0.27	0.11	6.2	4.9
3B	2.0	4.8	0.21	0.09	8	8.0
3B	3.0	7.2	0.14	0.06	12	13.0
3B	1.7	3.9	0.25	0.11	6.2	4.9
3B	2.2	5.0	0.19	0.09	8	8.0
3B	3.4	7.5	0.13	0.06	12	13.0
3B	1.7	2.9	0.30	0.17	6.2	4.9
3B	2.1	3.8	0.23	0.13	8	8.0
3B	3.2	5.6	0.16	0.09	12	13.0
3B	1.7	4.0	0.32	0.13	6.2	4.9
3B	2.1	5.1	0.25	0.10	8	8.0
3B	3.2	7.7	0.17	0.07	12	13.0
3B	1.7	3.6	0.33	0.15	6.2	4.9
3B	2.1	4.7	0.25	0.12	8	8.0
3B	3.2	7.0	0.17	0.08	12	13.0
3B	1.8	(5.3)	0.54	(0.18)	6.2	4.9
3B	2.4	6.9	0.42	0.14	8	8.0
3B	3.5	10.3	0.28	0.10	12	13.0

Casing Type
- I 56CM
- J 56CR

Cable Options:
- 1.5 m shielded connection cable. 1
- As 1, with connector type Lumberg SV50 6
- customer-specified cable length 5

Beam diameter and divergence values are set in parentheses if the beam is truncated above the $1/e^2$ level.

Please note that all values are typical values and can differ slightly in reality.

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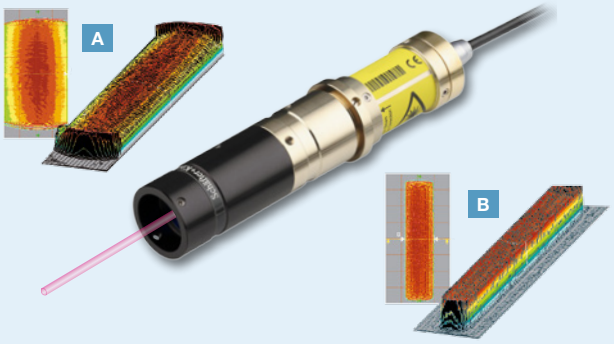
Low noise LD Collimators flatbeam® LNC-91CM-M90

Laser Diode Collimator with telecentric laser beam and reduced coherence

- Low noise laser module with noise typ. < 0.15 % of P_o (RMS, Bandwidth < 1 MHz; P_o is the maximum laser outpur power), reduced coherence and mode hopping free laser operation
- Laser Diode Collimators flatbeam® with telecentric laser beam and flat top intensity distribution A along the large collimated axis
- Gaussian intensity distribution along the smaller collimated axis
- Collimators with minimal divergence
- Flat top intensity distribution - central area of almost constant lighting intensity
- Beam apertures: 17 - 32 mm
- Typ. edge intensity: > 80%
- Wavelengths: 635 - 785 nm
- Laser powers: up to 26 mW
- Integrated electronics with two modulation input ports (TTL and analog) and potentiometer for power control, see p. 74
- Supply voltage: 5V DC
- Casing Ø 25/28 mm
- Optional aperture: Beam/intensity profile B

The low noise laser collimator flatbeam® LNC-91CM-... projects a collimated laser beam with high edge intensity and minimal beam divergence.

The correct choice of aperture can ensure the production of an illuminated area of almost constant lighting intensity. Applications include shadow-edge analysis and measurement methods relying upon diffraction.



LNC

Product Configurator: www.sukhamburg.com

optional: RS232

Adjustment possibilities:

- Adjusting the focus setting for adjusting the working distance
- Locking/unlocking of the focus setting
- Potentiometer for laser power output

Accessories and further information

Adjustment tools: p. 80f, power supply / switchbox: p. 76f, electronic features: p. 74.

Detailed data sheets, up-to-date technical information, tech. drawings incl. step files, accessories, technotes section, FAQs: **www.sukhamburg.com**

LNC-91CM-M60- Laser Diode Collimator flatbeam®

Order Code Example 1: 91CM - M60 - 660 - 5 - M01 - H - 6

Beam Parameters 91CM-M60-	curr. No.	Laser Diode Source	Lens	Wavelength [nm]	P_{out} [mW]	LD Code	Available Electronics Options	Cable	Laser Class	Aperture [mm]	Edge Intensity [%]	90% Range [%] perp.	90% Range [%] par.	Beam Divergence [mrad]
	1	91CM	M60	635	1	H02	H	- x	2	17	82	12.2	3.3	0.03
	3	91CM	M60	640	9	H22	H	- x	3B	17	65	8.4	3.7	0.03
	5	91CM	M60	660	5	M01	H	- x	3R	17	68	8.8	3.9	0.02
	7	91CM	M60	785	21	Q06	H	- x	3B	17	48	6.5	3.7	0.03

LNC-91CM-M90- Laser Diode Collimator

Order Code Example 2: 91CM - M90 - 660 - 6 - M01 - H - 6

Beam Parameters 91CM-M90-	curr. No.	Laser Diode Source	Lens	Wavelength [nm]	P_{out} [mW]	LD Code	Available Electronics Options	Cable	Laser Class	Aperture [mm]	Edge Intensity [%]	90% Range [%] perp.	90% Range [%] par.	Beam Divergence [mrad]
	1	91CM	M90	635	2	H02	H	- x	3R	32	73	18.3	4.9	0.02
	2	91CM	M90	640	10	H22	H	- x	3B	32	51	12.7	5.5	0.02
	3	91CM	M90	660	6	M01	H	- x	3B	32	54	13.2	5.8	0.02
	4	91CM	M90	785	26	Q06	H	- x	3B	32	32	9.7	5.5	0.02

Please note that all values are typical values and can differ slightly in reality.

Beam diameter and divergence values are set in parentheses if the beam is truncated above the $1/e^2$ level.

Electronics Type

Cable Options:

1.5 m shielded connection cable 1
As 1, with connector type Lumberg SV50 (only electronics type C) 6
As 1, with connector type Lumberg SV70 (only electronics types with interface CS) 7
customer-specified cable length 5

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Application: Laser Diffraction Measurement

Laser diffraction measurements of the diameter, geometry and perimeter of a shadow

One of the most popular applications in laser measurement is the evaluation of the shadow thrown by an illuminated object.

A line sensor is set up to receive a collimated laser beam so that an object crossing the beam produces a shadow.

The overlapping shadows are captured on the line sensor as Fresnel interference patterns.

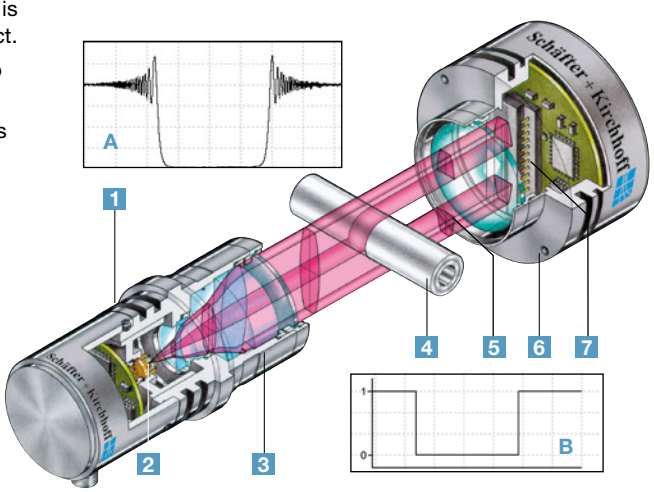

Figure 1:
Schematic laser diffraction measurement and illumination.
The collimated beam is elliptical (beam height = 32 mm).

1. laser diode collimator
2. laser diode
3. lens for collimation of the divergent laser diode beam
4. object to be measured
5. partially blocked laser beam
6. line scan camera
7. line sensor

Figure 2

Shows the magnified edge of the characteristic interference patterns of the measured object **A** captured by the line sensor. In the absence of an object, the continually falling elliptical form of the collimated laser beam impinges on the line sensor. Determination of the shadow edge can be calculated in two ways depending on the speed and accuracy required.

The threshold value assessment concentrates on the flank of the interference pattern and determines the intensity threshold beneath the oscillating area. A binary signal is produced (cf. **B**) from the camera exposure and is output as the pixel position of the shadow edge in the line signal. Measurement frequencies of over 30 kHz can be achieved at accuracies below 7 µm.

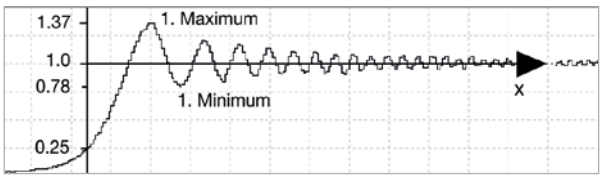

Figure 2:
Intensity of the beam perpendicular to the interference patterns

The laser diffraction method uses the oscillating area of the Fresnel interference patterns. Evaluation of the position and the intensities of the minima and maxima increases the precision of the measurements to under 1 µm.

The increased CPU overhead, resulting from the calculations, reduces the frequency of measurements using laser diffraction by less than 3 kHz, in comparison with the assessment by threshold value. The interference patterns at a defined wavelength can also provide information about the precise distance between the measured object and the line sensor.

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Schäfter+Kirchhoff

Electronics and Accessories

Electronics and Accessories

Electronics for Laser Line, Laser Spot, and Laser Generators

Electronics type S/B

For more information, please refer to the extensive technotes section on: www.sukhamburg.com/support/technotes. The information below describes general electronic features. Please refer to the individual laser web pages or the individial laser manuals for laser specific details.

Integrated Electronics type S

		S
Supply voltage		+5 V ± 0.25 V
Current consumption *	max.	250 mA
Max. modulation frequency	analog	50 kHz
	TTL	1 MHz
Laser power output potentiometer *		< 30*-100 %
TTL modulation logic	TTL high	Laser ON
TTL or analog input	open or low	Laser OFF
Analog control voltage	P_{min} to P_{max}	0 ... 2.2 V

* Typical value. Depends on specific laser diode.

Integrated Electronics type B

		B
Supply voltage	with connector	+12 V ± 0.5 V
	w/o connector	+9 V ± 0.5 V
Current consumption *	max.	160 mA
Max. modulation frequency	TTL	200 Hz
Laser power output potentiometer *		< 30*-100 %
TTL modulation logic	TTL high	Laser ON
TTL	open or low	Laser OFF

* Typical value. Depends on specific laser diode.

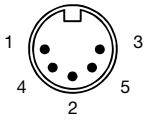
Pin-out for electronics S

Circular connector Lumberg SV50 (IEC 61076-2-106) for power supply and external modulation (pins U_{mod} Analog and U_{mod}TTL). Cable shielding and casing are connected and galvanically decoupled from the laser diode and the electronics.

Pin-out S

Cable	Conn.	
black	1	GND
red	2	+5 V
brown	3	U_{mod} Analog
orange	4	U_{mod} TTL
	5	n.c.
shield	case	⏚

Connector (male) front view



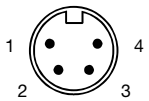
Pin-out for electronics B

Circular connector Lumberg SV40 (IEC 61076-2-106) for power supply and external modulation (pin U_{mod}TTL). Cable shielding and casing are connected and galvanically decoupled from the laser diode and the electronics.

Pin-out B

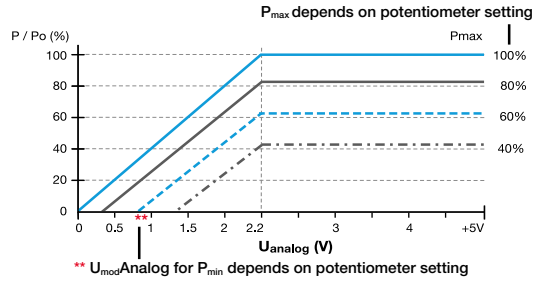
Cable	Conn.	
white	1	GND
brown	2	+12 V
green	3	U_{mod} TTL
	4	n.c.
shield	case	⏚

Connector (male) front view



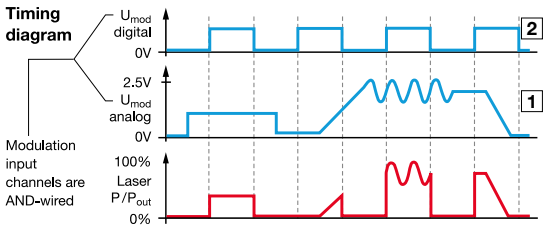
Modulation for electronics S

The laser has two AND-wired modulation input channels, U_{mod} Analog [1] and U_{mod}TTL [2] .
The laser is OFF in case of an open modulation input.
If only one modulation input channel is used the other has to be set to +5 V. (see timing diagram).



Connecting analog voltage

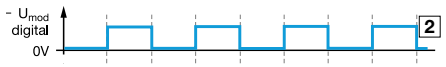
The input for analog modulation allows applying an analog voltage U_{mod}Analog in a range from 0 V** to 2.2 V) which allows a linear control of the laser output power from P_{min} (P_{min} is on the order of < 1% of P_o and includes residual glow and can be taken from the individual data sheet) up to the maximum power given by the potentiometer setting.



Modulation for electronics B

Laser modules with electronics B have one modulation input channel U_{mod}TTL [2] and no analog modulation input.

The laser is OFF in case of an open modulation input.



Electronics for Laser Line, Laser Spot, and Laser Generators

Electronics Types P/C/H/HP/CS/PS

For more information, please refer to the extensive technotes section on: www.sukhamburg.com/support/technotes. The information below describes general electronic features. Please refer to the individual laser web pages or the individual laser manuals for laser specific details.

Integrated Electronics type:

		C	P	H	HP	CS	PS
Supply voltage		+5 V ± 0.2 V		+5 V ± 0.2 V	+12 V ± 0.5 V	+5 V ± 0.2 V	+5 V ± 0.2 V
Current consumption *	max.	250 mA	500 mA	250 mA	300 mA	250 mA	500 mA
Max. modulation frequency	analog TTL	100 kHz 100 kHz	10 Hz 250 kHz	100 kHz 100 kHz	1 Hz 300 kHz	1 Hz 250 kHz	1 Hz 250 kHz
Laser power output potentiometer		< 1-100 %	< 1-100 %	< 1-100 %	< 1-100 %	< 1-100 %	< 1-100 %
TTL modulation logic	TTL high	Laser ON			Laser ON	Laser ON	Laser ON
TTL or analog input	open or low	Laser OFF			Laser OFF	Laser OFF	Laser OFF
Analog control voltage	P_{min} to P_{max}	0 ... 2.5 V			0 ... 2.5 V	0 ... 2.5 V	0 ... 2.5 V

* Typical value. Dependes on specific laser diode.

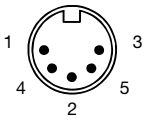
Pin-out for electronics C/P/H

Circular connector Lumberg SV50 (IEC 61076-2-106) for power supply and external modulation (pins U_{mod}Analog und U_{mod} TTL).
Cable shielding and casing are connected and are galvanically decoupled from the laser diode and the electronics.

Pin-out C/P/H

Cable	Conn.	
black	1	GND
red	2	+5 V
brown	3	U_{mod} Analog
orange	4	U_{mod} TTL
	5	n.c.
shield	case	⏚

Connector (male) front view



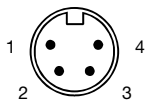
Pin-out for electronics HP

Circular connector Lumberg SV40 (IEC 61076-2-106) for power supply and external modulation (pins U_{mod} Analog and U_{mod}TTL).
Cable shielding and casing are connected and are galvanically decoupled from the laser diode and the electronics.

Pin-out HP

Cable	Conn.	
black	1	GND
red	2	+12 V
brown	3	U_{mod} Analog
orange	4	U_{mod} TTL
shield	case	⏚

Connector (male) front view



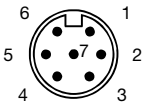
Pin-out for electronics CS/PS

Circular connector **Lumberg SV70** (IEC 61076-2-106) for power supply and external modulation (pins U_{mod}Analog and U_{mod}TTL) and RS232 interface.
Cable shielding and casing are connected and are galvanically decoupled from the laser diode and the electronics.

Pin-out CS/PS

Cable	Conn.	
black	1	GND
red	2	+5 V
brown	3	U_{mod} Analog
orange	4	U_{mod} TTL
yellow	5	RS232Tx
green	6	RS232Rx
	7	n.c.
shield	case	⏚

Connector (male) front view



Software Parameters for RS232 interface (electronics CS/PS)

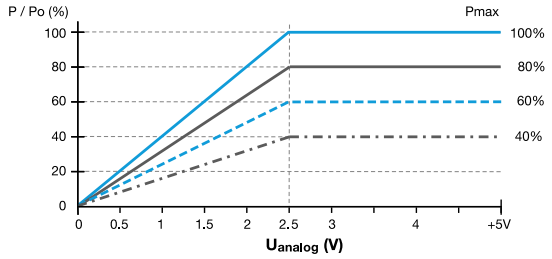
The RS232 interface (or the USB connection using the switchbox SBS 070701-USB) allows laser control and reating out of laser data:

Input parameters:
- laser power
- laser power limit
- mode of operation

Output parameters
- laser current (mA)
- photo diode current (µA)
- temperature
- laser output power (%)
- operating voltage
- hours of operation
- min./max. temperature

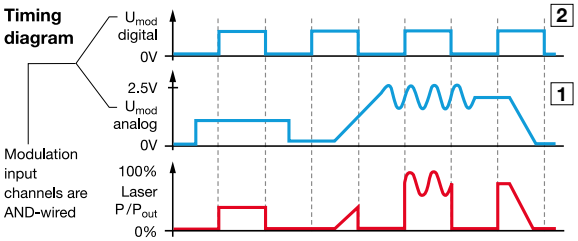
Modulation

The laser has two AND-wired modulation input channels, U_{mod}Analog [1] and U_{mod}TTL [2] .
The laser is OFF in case of an open modulation input. If only one modulation input channel is used, the other has to be set to +5 V. (see timing diagram).



Connecting analog voltage

The input for analog modulation allows applying an analog voltage U_{mod}Analog in a range from 0 V to 2.5 V) which allows a linear control of the laser output power from P_{min} (P_{min} is on the order of < 1% of P_o and includes residual glow and can be taken from the individual data sheet) up to the maximum power given by the potentiometer setting.



Accessories: Switchbox and Power Supply

Switchbox

The switchbox is the interface between power supply and laser diode beam source. The integrated key switch and interlock mechanism ensure concordance with laser safety regulations IEC 825/ EN60825-1. In addition, the inputs for analog and TTL modulation are made available via simple BNC connectors, so that the time-consuming wiring of a special adapter cable is avoided.

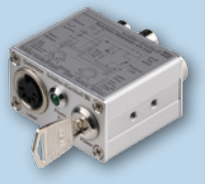
Without the switchbox Schäfter+Kirchhoff laser diode beam sources are off if either one or both modulation inputs are open. Internal pull-up resistors in the switchbox however ensure that the beam source is instantly ready for use without having to apply 5 V(DC) to the input ports just to turn it on. Once modulation is applied using the BNC connectors, the voltage of the modulation dictates if the laser is on or off.

The switchbox can be grounded using either a clamping screw or a 4 mm phone jack. With a grounded switchbox, the phone jack can also be used to connect an antistatic wristband or mat.

The shielded metal housing also isolates the contents from electro-magnetic irradiation.

Features:

- **Interlock chain for the remote deactivation of the laser**
- **Laser power-up is only possible using the key switch**
- **LED status indicator for “Laser ON”**
- **M4 thread for mounting**
- **Reverse voltage protection**
- **Grounding connector**
- **Separate modulation input connectors (BNC)**



Switchbox SBN050501

Detailed data sheets, up-to-date technical information, technical drawings including step files, accessories, extensive technotes section and FAQs: **www.sukhamburg.com**

Laser Interlock:

An external laser interlock is mandatory in most countries for laser class 3B and beyond, so that a break in the laser interlock chain will cause an immediate shutdown of the laser power.

An automatic shutdown system (e.g., a door or enclosure-opening switch) has to be used for the immediate disconnection of the interlock chain in order to prevent any exposure of an unprotected person to the hazardous laser radiation.

The interlock mechanism in the Schäfter+Kirchhoff laser beam sources requires no external power supply and its absence is detected by an integral surge tripswitch that must be bridged by the interlock chain before the laser source can be used!

Overview: Switchboxes and Power Supplies

Electronics type:	S	B	C and P	CS and PS (RS232 interface)	H	HP
Voltage	5V	12V (with conn.)	5V	5V	5V	11...12V
Power Supply Order Code	**PS051003E**	**PS120516E**	**PS051003E**	**PS051007E**	**PS051003E**	**PS120516E**
Key features: details see p. 84	5 V / 2.6 A 5-pin KV 50 connector, female	12 V / 1.25 A 4-pin KV 40 connector, female	5 V / 2.6 A 5-pin KV 50 connector, female	5 V / 2.6 A 7-pin KV 70 connector, female	5 V / 2.6 A 5-pin KV 50 connector, female	12 V / 1.25 A 4-pin KV 40 connector, female
Power Cords	EU, USA/Can and GB, see page 68					
Switchbox Order Code	**SBN 050501**	**SBN 040401**	**SBN 050501**	**SBS 070701-USB**	**SBN 050501**	**SBN 040402**
Key features: details see p. 83	5-pin KV50	4-pin KV40	5-pin KV50	7-pin KV70	5-pin KV50	4-pin KV40
	Two separate modulation input connectors (BNC)	One modulation input connector (BNC)	Two separate modulation input connectors (BNC)			
				Mini USB 2.0 connection for laser control / read out		

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Accessories: Switchbox SBN 050501 / 040401 / 040402

Interface between laser and power supply

Features:

- Interlock chain for the remote deactivation of the laser
- Laser power-up is only possible using the key switch
- LED status indicator for “Laser ON”
- M4 thread for mounting
- Reverse voltage protection
- Grounding connector
- Separate modulation input connectors (BNC)
- Interlock and Lumberg input and output connectors according to IEC 60130-9.

Order Options for Switchboxes

Switchbox Order Code **SBN050501**

with two separate modulation inputs for laser diode beam sources of electronics type S/C/P/H and 5 V power supply.
Power supply: PS051003E.

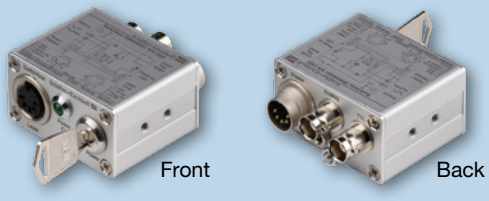
Switchbox Order Code **SBN040401**

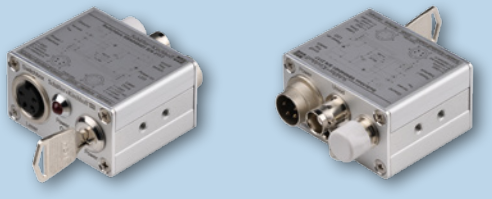
with one separate modulation input for laser diode beam sources of electronics type B and 12 V power supply.
Power supply: PS120516E.

Switchbox Order Code **SBN040402**

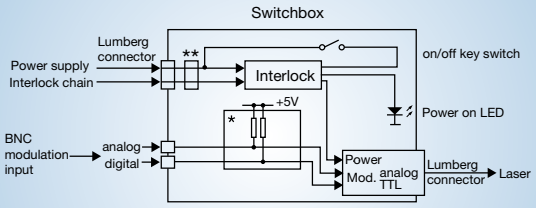
with two separate modulation input for laser diode beam sources of electronics type HP and 12 V power supply.
Power supply: PS120516E.

Switchbox SBN050501





Switchbox SBN040401 Switchbox SBN040402



* Pull up resistors
** Overvoltage /reverse polarity protection

Accessories: Switchbox SBS 070701-USB

For laser diode modules with RS232 interface

Features:

- **Mini USB 2.0 connection for laser control and reading out of laser data, e.g. hours of operation**
- Interlock chain for the remote deactivation of the laser
- Laser power-up is only possible using the key switch
- LED status indicator for “Laser ON”
- M4 thread for mounting
- Reverse voltage protection
- Grounding connector
- Separate modulation input connectors (BNC)
- Interlock and Lumberg input and output connectors according to IEC 60130-9.

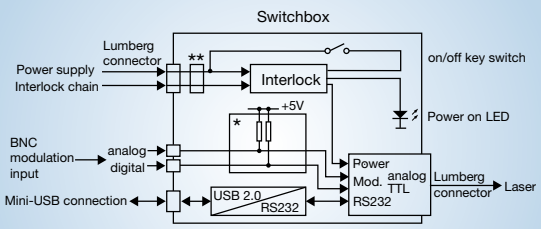
Order Options

Switchbox Order Code **SBS 070701-USB**

for laser diode beam sources with 5 V power supply and RS232 interface (electronics type CS/PS).
Power supply: PS051007E

RS232

Switchbox SBS 070701-USB

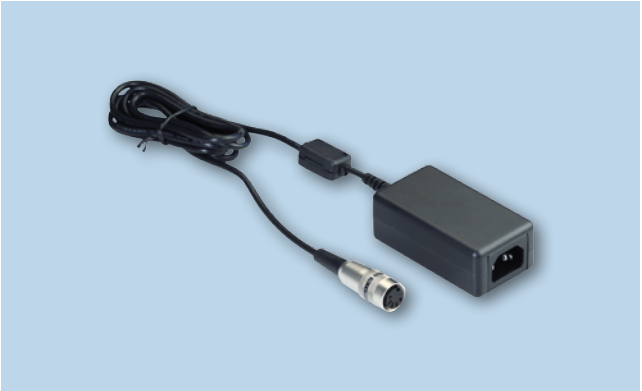


* Pull up resistors
** Overvoltage /reverse polarity protection

Accessories: Power Supply

Specification:

IN: 100-240 V AC, Class 1 protective ground, IEC320-C14 chassis plug
OUT: 1.5 m shielded cable with connector (IEC 60130-9) Lumberg series KV (female)



Order Options for Power Supply

Order Code	PS051003E	5V	
Order Code	PS125016E	12V	
Order Code	PS051007E	5V	for lasers with RS232 interface and operation with or without switchbox SBSxxx

Power supply	Output	Order Code	Connector/female
for lasers w/o RS232 interface and operation with or without switchbox SBN-xx	5 V / 2.6 A	PS051003E	5-pin, KV 50
	12 V / 1.25 A	PS120516E	4-pin, KV 40

Power supply	Output	Order Code	Connector/female
for lasers with RS232 interface and operation with or w/o switchbox SBS-xx	5 V / 2.6 A	PS051007E	7-pin, KV 70

Power cord	Country	Order Code	
for Power Supply PSxx-E IEC320, 3-pin 1.5 m cable, 10 A, 250 V AC	Europe	PC150DE	 DE
	USA / Canada	PC150US	 US
	Great Britain	PC150UK	 UK

Accessories: Lumberg Connectors

Order Options for Lumberg Connectors

Order Code BC 01 09 F

- Type Lumberg KV50 (IEC 61076-2-106)
- 5 pin, female
- Compatible connectors: SV50 and SV30 connector

For connection between a customer power supply and laser (with connector SV30 and SV50) or switchbox.

Order Code BC 01 05 M

- Type Lumberg SV50 (IEC 61076-2-106)
- 5 pin, male
- Compatible connectors: KV50

For connecting a customer laser to the switchbox.

Order Code BC 01 04 F

- Type Lumberg KV40 (IEC 61076-2-106)
- 4 pin, female
- Compatible connectors: SV40

For connection of a customer power supply to the laser or switchbox.

Order Code BC 01 07 F

- Type Lumberg KV70 (IEC 61076-2-106)
- 7 pin, female
- Compatible connectors: SV70
- For laser with electronics CS and PS

For connection of a customer power supply to the laser or switchbox.

Connector type
Lumberg IEC 60130-9

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Schäfter+Kirchhoff

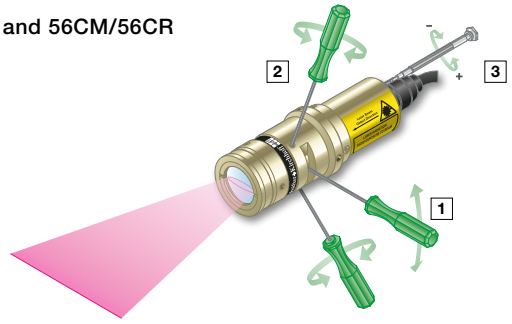
Adjustment Tools for Laser Modules

Adjustment Tools for Laser Modules based on 55CM/55CR and 56CM/56CR

1 Focussing of the laser line to the working distance
Tool: Hex key WS 1.5 Order Code **50HD-15**

2 Locking/unlocking of the focus setting
Tool: Hex key WS 1.5 Order Code **50HD-15**

3 Screwdriver for the adjustment of laser power potentiometer
Tool: Screwdriver WS 1.6 Order Code **9D-16**



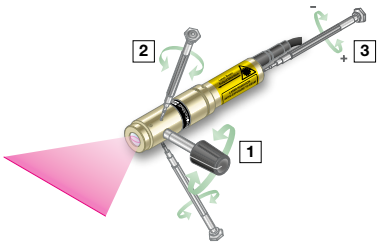
Adjustment Tools for Laser Modules based on 25CM, 29CM

1 Focussing of the laser line to the working distance
Tool: Eccentric key Order Code **60EX-4**
as an alternative: Eccentric key with long handle

Order Code **60EX-4-L**

2 Locking/unlocking of the focus setting
Tool: Screwdriver WS 1.6 Order Code **9D-12**

3 Screwdriver for the adjustment of laser power potentiometer
Tool: Screwdriver WS 1.6 Order Code **9D-16**



Adjustment Tools for Laser Modules based on 90CM/90CR, 91CM/91CR, 95CM/95CR and 96CM/96CR

1 Focussing of the laser line to the working distance
Tool: Eccentric key Order Code **55EX-5**
as an alternative: Eccentric key with long handle

Order Code **55EX-5-L**

2 Locking/unlocking of the focus setting
Tool: Screwdriver WS 1.5 Order Code **50HD-15**

3 Screwdriver for the adjustment of laser power potentiometer
Tool: Screwdriver WS 1.6 Order Code **9D-16**

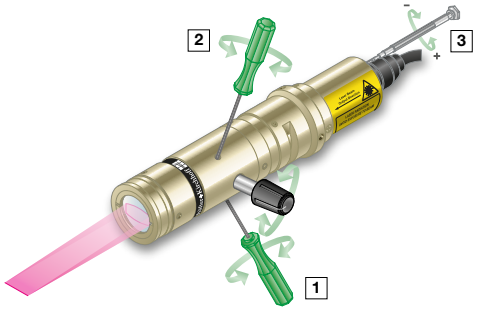


Table 1 Choosing the Adequate Adjustment Tools

row	Laser Line or Focus Generator		Collimator Base	50HD-15	60EX-4 / 60EX-4-L	55EX-5 / 55EX-5-L	9D-12	9D-16	Page
4	5LT+25CM	5LTM+25CM						x	40/41
5	5M+25CM	5MM+25CM			x		x	x	50/51
6	5MC+29CM	-	29CM		x		x	x	46
11	5LT+ 55CM	5LTM+ 55CM	55CM					x	42/43
12	LNC-5LT+ 56CM	LNC-5LTM+ 56CM	LNC-56CM					x	62/63
13	13LR+55CM	13LRM+55CM	55CM	x				x	34/35
15	LNC-13M+56CM	LNC-13MM+56CM	LNC-56CM	x				x	66/67
16	13LN+ 90CM	13LNM+ 90CM	90CM					x	36/37
17	LNC-13LN+ 91CM	LNC-13LNM+ 91CM	LNC-91CM					x	58/59
18	13LT+ 90CM	13LTM+ 90CM	90CM					x	38/39
19	LNC-13LT+ 91CM	LNC-13LTM+ 91CM	LNC-91CM					x	60/61
20	13MC+95CM	13MMC+95CM	95CM			x		x	44/45
21	LNC-13MC+96CM	LNC-13MMC+96CM	LNC-96CM			x		x	64/65
22			25CM		x		x	x	52
23			55CM	x				x	53
24			LNC-56CM	x				x	68
25			90CM					x	54
26			LNC-91CM					x	69

Accessories Mounting console 13MK

for Laser Diode Beam Sources Series 55BC / 55CM (Housing Ø 25/28 mm)

The mounting consoles 13MK-25-36-10 allow a precise and mechanically rugged alignment of the laser beam sources 13xx .

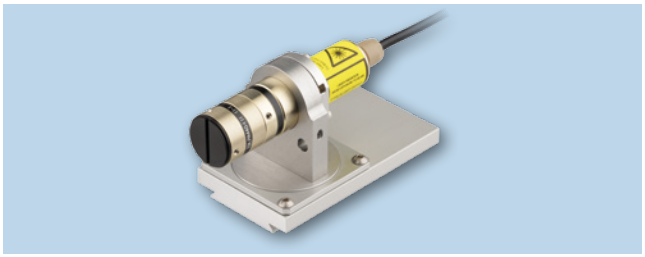
The lasers are held by indirect clamping and the focussing and focus locking mechanisms remain accessible in the clamped state.

The mounting consoles 13ML-25-36-.. supports two degrees of freedom:

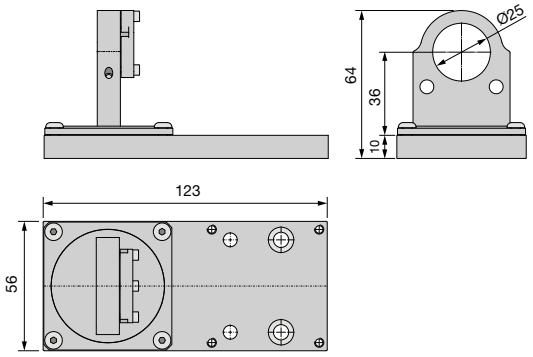
1. Rotation 0 – 360° around the optical axis

2. In-plane rotation 0 – 360°

Note: This console can only be used for Laser Line Generators with a fan angle, e.g. 13LR, 13LN or 5LM and 5LP.



Dimensions



Order Options

Mounting console, flat base plate
Order Code 13MK-25-36-10-F

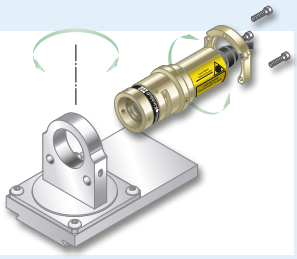
Mounting console, base plate
Order Code 13MK-25-36-10-M

with Montech profile (www.montech.com):
Order Code AP-46-5

Adjustment and tools

Hex key WS 2
Order Code 50HD-20

Hex key WS 2.5
Order Code 50HD-25



Accessories Mounting console 13MK-25-3D

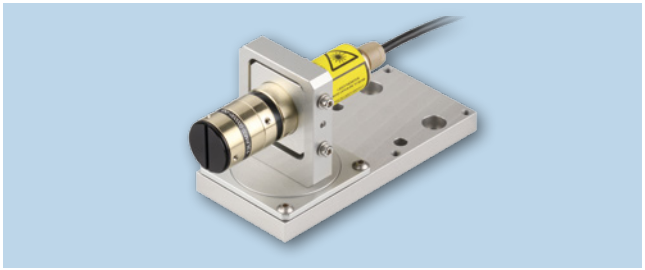
for Laser Diode Beam Sources Series 55BC / 55CM (Housing Ø 25/28 mm)

The Mounting Console of type 13MK-25-3D-F with flat base plate allows a precise and mechanically rugged alignment of Laser Modules with Ø 25/28 mm. The lasers are held by means of a clamp collar in such a way that the focussing and focus locking mechanism remain accessible.

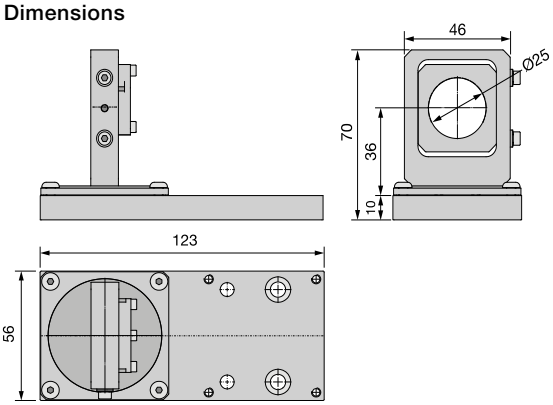
The Mounting Console is designed for all lasers with Ø 25/28 mm and provides 3 degrees of freedom:

1. **Rotation (0 - 360°) around the optical axis**
2. **In-plane rotation (0 - 360°)**
3. **Tilt (inclination, ± 5°)**

Note: This Mounting Console is designed for all lasers with Ø 25/28 mm. For Laser Line Generators with a fan angle, e.g. 13LR, 13LN or 5LM and 5LP the mounting console type 13MK-25-36-10-F might be sufficient.



Dimensions



Order Options

Mounting console, flat base plate
Order Code 13MK-25-3D-F

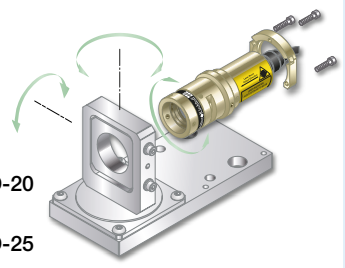
Mounting console, base plate
Order Code 13MK-25-3D-M

with Montech profile (www.montech.com):
Order Code AP-46-5

Adjustment and tools

Hex key WS 2
Order Code 50HD-20

Hex key WS 2.5
Order Code 50HD-25



Modular Laser Diode Collimation Systems

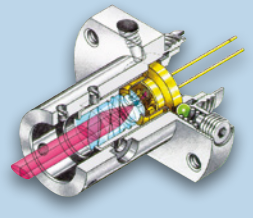
Modular Laser Diode Collimation Systems

Laser Diode Collimators Type 20

Compact modular system for customer-specific electronics

- Designed for use with customer-specific electronics
- Ideal for self-assembly: Modular assembly system for the quick and precise mounting, adjustment and collimation of laser diodes
- Suitable for diodes of Ø 9 mm with wavelengths 375 –1600 nm (Ø 5.6/3.8 mm with adapter)
- Adjustment of focus setting using an eccentric key
- Optional combination with a wide range of beam-shaping optics for the generation of micro focus and laser lines

Ø≤9 mm



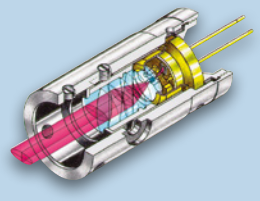
Ideal for self-assembly.
For details see page 86.

Laser Diode Collimators Type 21

Compact modular system for customer-specific electronics

- Designed for use with customer-specific electronics
- Compact Design
- Mounted and aligned by Schäfter+Kirchhoff
- allows attachment of beam-shaping optics.
- Suitable for diodes of Ø 9 mm with wavelengths 375 –1600 nm (Ø 5.6/3.8 mm with adapter)
- Adjustment of focus setting using an eccentric key
- Optional combination with a wide range of beam-shaping optics for the generation of micro focus and laser lines

Ø≤9 mm



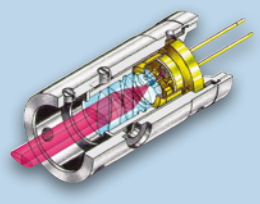
Mounted by Schäfter+Kirchhoff.
For details see page 87.

Laser Diode Collimators Type 22P

Compact modular system for customer-specific electronics

- Designed for use with customer-specific electronics
- Compact design Ø 11mm, short
- Mounted and aligned by Schäfter+Kirchhoff
- Allows attachment of beam-shaping optics.
- Suitable for diodes of Ø 9 mm with wavelengths 375 –1600 nm (Ø 5.6/3.8 mm with adapter)
- Adjustment of focus setting using an eccentric key
- Optional combination with a wide range of beam-shaping optics for the generation of micro focus and laser lines

Ø≤9 mm



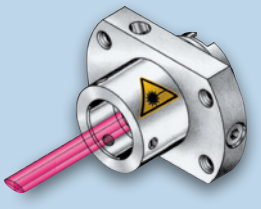
Mounted by Schäfter+ Kirchhoff.
For details see page 88.

Laser Diode Collimators Type 24PX

Compact modular system for customer-specific electronics

- Designed for use with customer-specific electronics
- Ideal for self-assembly: Modular assembly system for the quick and precise mounting, adjustment and collimation of laser diodes
- Suitable for diodes of Ø 9 mm with wavelengths 375 –1600 nm (Ø 5.6/3.8 mm with adapter)
- Adjustment of focus setting using an eccentric key
- Short design

Ø≤9 mm



Ideal for self-assembly, short design.
For details see p. 89.

How to order / Please select:

1. The laser diode: either a customer-specific diode, in any case with the adequate laser diode adapter (p.90)
2. The collimation optics (page 90) according to wavelength and designated beam diameter
3. Adjustment tools and equipment (p.86f)
4. If desired, a cable connection system (page 91) and then from the following options: Beam-shaping optics series 5 (p.97)

All of these items require separate order codes.

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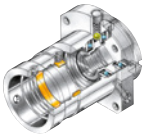
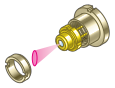
Overview of Collimators

	20C/20P	21C/21P	22P	24PX	Type 50BM	Type 55BC
						
	page 86	page 87	page 88	page 89	page 93	page 94

Laser diodes
  Ø = 9 mm Ø = 5.6 mm Ø = 3.8 mm

Collimation Lens	
 20CL	 50CL / 90CL

Mounting and Alignment / Casing						
Type	20C / 20P	21C / 21P	22P	24PX	50BM	55BC
Adjustable focus setting	x	x	x	x	x	x
LD Customer Mounting / Alignment	x	-	-	x	x	x
Casing Ø [mm]	12(24.5)	12	11	12(24.5)	25/(30)	25
Focal Length [mm]	4 - 8	4 - 8	4 - 8	4 - 8	4 - 60	4 - 60
Galv. isolation of laser diode	x / -	x / -	-	-	x	x
Flange	x / x	-	-	x	x	x
Focusable	x	x	x	x	x	x
Attachable beam sha-ping opics	x	x	x	-	x	x

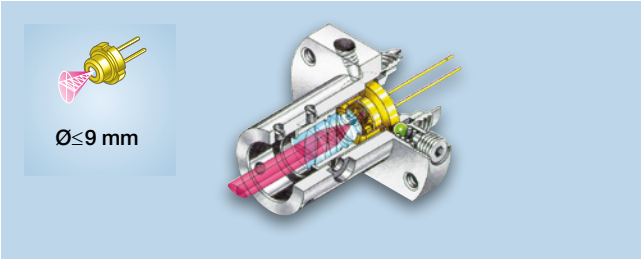
Attachment optics						
	20CL				50CL / 90CL	
Type	20	21	22	24	50BM	55BC
Attachment optics	Series 5				Series 5, 13	Series 5, 13
Fiber optics	-	-	-	-	x	x
Anamorphic beam shaping	-	-	-	-	x	x

Cable Connection System						
						
	20CS/20PS	21CS/21PS	21PS	20PS	50CS	20CS

Laser Diode Collimator Bases, Type 20

Compact modular laser diode collimator systems for customer-specific electronics

The laser diode collimators type 20 are compact modular laser diode collimator systems that allow modular assembly for the rapid and precise mounting, adjustment and collimation of laser diodes. Because of the ease of assembly and accessabilty of adjustment and locking it is ideal for self assembly and for customer specific electronics.



Main specifications:

- Designed for self-assembly: easy and accessible adjustment of laser diode, collimating optics
- Can be used with consumer specific electronics
- Wide range of collimating optics
- Compatible with a wide range of beam shaping optics
- For laser diodes with 9 mm (5.6 mm or 3.8 mm casing with adapter)
- Integrates laser diode, collimation lens and solderless cable connection system for the laser current supply
- Diode galvanically isolated (type C), or diode potential on casing (type P)
- Precise x/y-adjustment of the laser diode using a screwdriver. Laser diode is fastened using a threaded ring.

Option:

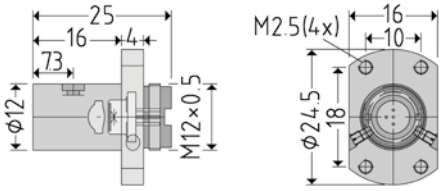
- Cable connection system 20CS/20PS for solderless contact of pins

Order Options

Order Code 20C - A8 - 07 - LD

- optional: LD-Code
- Lens Code: (Table 2, see below)
- Laser diode mounting
  20C = galvanically isolated
  20P = diode potential on casing

Dimensions



Self-Mounting and Adjustment tools

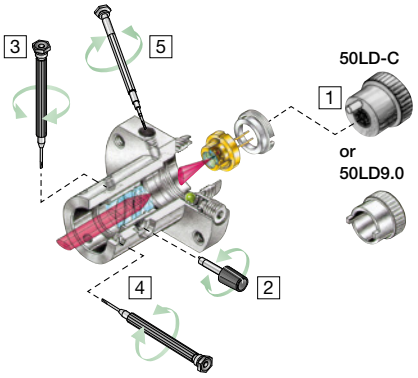
1 Laser diode mounting:
fixed with threaded ring for Ø 9mm diodes
For collimator type 20C:
Tool: Assembly key **Order Code** **50LD-C**
For collimator type 20P:
Tool: Assembly key **Order Code** **50LD9.0**

For Ø5.6 / 3.8 mm a different assembly key and additional adapters are needed (Details p.90)

2 Lens focussing
Tool: Eccentric key **Order Code** **60EX-4**

3 Lens locking (indirect clamping)
Tool: Screwdriver **Order Code** **9D-12**

4 Direct mounting and locking of beam-shaping optics using radially located grub screws.
Tool: Screwdriver **Order Code** **9D-12**



5 x/y-adjustment of the laser diode
Tool: Screwdriver **Order Code** **9D-12**

Adjustment screws (set = 3 pcs.) for type 20C
WS Ø 1.5 mm **Order Code** **20AS-01**

Collimation Lenses Type 20CL

Table 2 Beam parameters Collimation Lens Type 20CL

row	curr. no	1	2	3	4	5	6
1	**Lens code**	**A4**	**A4**	**A4.5**	**A6.2**	**A7.5**	**A8**
2	Focal length f'	4	4	4.5	6.2	7.5	8
3	Numerical aperture NA	0.6	0.6	0.55	0.4	0.3	0.3
4	Clear aperture [mm]	4.8	5	4.95	5	6.5	4.8
5	Max. active area [mm]	0.05	0.05	0.18	0.2	0.1	0.1
6	Lens for UHV application	x	x	x	x	x	x

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Laser Diode Collimator Bases, Type 21

Compact modular laser diode collimator systems for customer-specific electronics

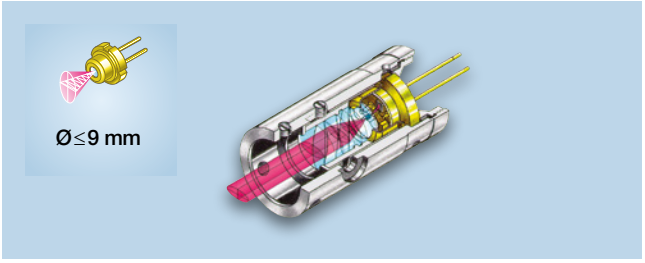
The collimator type 21 is a compact modular laser diode collimator system. It is ideal for customer specific electronics.

Main specifications:

- Compact Ø 12 mm casing
- Can be used with consumer specific electronics
- Wide range of collimating optics
- Compatible with a wide range of beam shaping optics
- For laser diodes with 9 mm (5.6 mm or 3.8 mm with adapter)
- Diode galvanically isolated (type C), or diode potential on casing (type P)
- Lens tube with cylindrical fit. Focus setting using an eccentric key: fine adjustment of the collimation or focus of the laser beam, even with attached beam-shaping optics.
- Frontal system mounting Ø 8 mm with locking screws for the attachment of beam-shaping optics.
- Not suited for customer mounting and alignment

Option:

- Cable connection system 21CS/21PS for solderless contact of pins

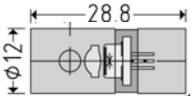


Order Options

Order Code 21P - A8 - 07 - LD

- optional: LD-Code
- Lens Code: (Table 2, see below)
- Laser diode collimor base
  21C = galvanically isolated
  21P = diode potential on casing

Dimensions



Adjustment tools

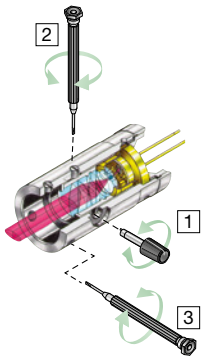
1 Lens focussing
Tool: Eccentric key **Order Code** **60EX-4**

2 Lens locking (indirect clamping)
Tool: Screwdriver **Order Code** **9D-12**

3 Direct mounting and locking of beam-shaping optics using radially located grub screws.
Tool: Screwdriver **Order Code** **9D-12**

Please note:

The laser diode collimators type 21C and 21P are not suited for customer mounting and alignment of the laser diode.



Please note:

For Ø 5.6 / 3.8 mm diodes additional adapters and an additional assembly key is needed (Details page 90)

Collimation Lenses Type 20CL

Table 2 Beam parameters Collimation Lens Type 20CL

row	curr. no	1	2	3	4	5	6
1	**Lens code**	**A4**	**A4**	**A4.5**	**A6.2**	**A7.5**	**A8**
2	Focal length f'	4	4	4.5	6.2	7.5	8
3	Numerical aperture NA	0.6	0.6	0.55	0.4	0.3	0.3
4	Clear aperture [mm]	4.8	5	4.95	5	6.5	4.8
5	Max. active area [mm]	0.05	0.05	0.18	0.2	0.1	0.1
6	Lens for UHV application	x	x	x	x	x	x

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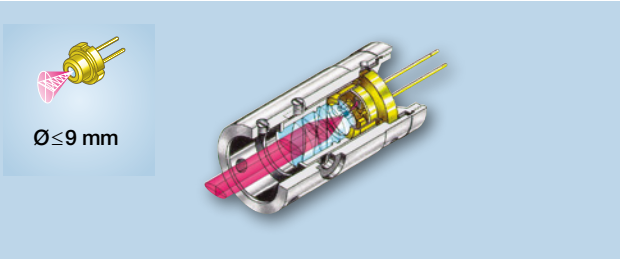
Laser Diode Collimator Type 22P

Special Configuration of Laser Diode Collimator 21P

Compared to the laser diode base type 21P the housing is shorter so that there is a direct acces to the laser diode pins.

Main specifications:

- Compact Ø 11 mm casing
- Direct access to the laser diode pins
- x/y-adjustment of laser diode with special tool
- Focus setting using an eccentric key
- Frontal cylinder mounting for the attachment of beam-shaping optics.
- Direct access to the laser diode pins.
- Not suited for customer mounting/alignment

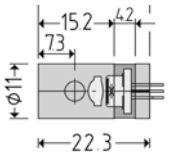


Order Options

Order Code 22P - A8 - 07 - LD

- optional: LD-Code
- Lens Code: (Table 2, see below)
- Laser diode collimor base
  21C = galvanically isolated
  21P = diode potential on casing

Dimensions

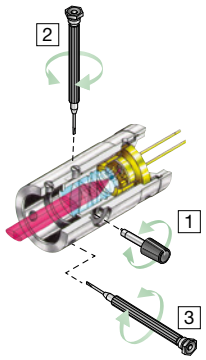


Adjustment tools

1 Lens focussing
Tool: Eccentric key Order Code **60EX-4**

2 Lens locking (indirect clamping)
Tool: Screwdriver Order Code **9D-12**

3 Direct mounting and locking of beam-shaping optics using radially located grub screws.
Tool: Screwdriver Order Code **9D-12**



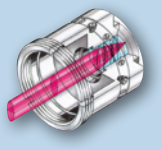
Please note:
For Ø 5.6 / 3.8 mm diodes additional adapters and an additional assembly key is needed (Details page 90)

Please note:
The laser diode collimators type 21C and 21P are not suited for customer mounting and alignment of the laser diode.

Collimation Lenses Type 20CL

Table 2 Beam parameters Collimation Lens Type 20CL

row	curr. no	1	2	3	4	5	6
1	**Lens code**	**A4**	**A4**	**A4.5**	**A6.2**	**A7.5**	**A8**
2	Focal length f'	4	4	4.5	6.2	7.5	8
3	Numerical aperture NA	0.6	0.6	0.55	0.4	0.3	0.3
4	Clear aperture [mm]	4.8	5	4.95	5	6.5	4.8
5	Max. active area [mm]	0.05	0.05	0.18	0.2	0.1	0.1
6	Lens for UHV application	x	x	x	x	x	x



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Laser Diode Collimator Type 24PX

Modular system for customer mounting and alignment of laser diodes short design e.g. for ECL

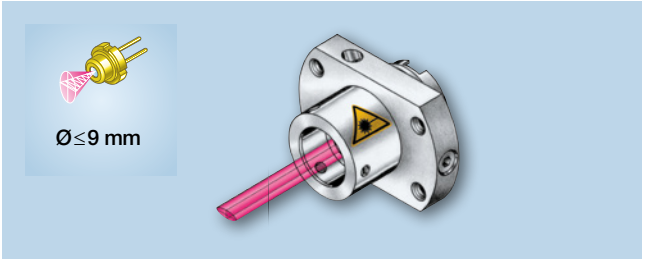
Compared to the laser diode base type 20P the housing is shorter at front side. This short design makes the laser diode collimators appropritae for laser diode systems with an external resonator.

Main specifications:

- Designed for self-assembly: easy and accessible adjustment of laser diode, collimating optics
- Can be used with consumer specific electronics
- Wide range of collimating optics
- Short design
- For laser diodes with 9 mm (5.6 mm or 3.8 mm casing with adapter)
- Integrates laser diode, collimation lens and solderless cable connection system for the laser current supply
- Diode potential on casing
- Precise x/y-adjustment of the laser diode using a screwdriver. Laser diode is fastened using a threaded ring.

Option:

- Cable connection system 20CS/20PS for solderless contact of pins

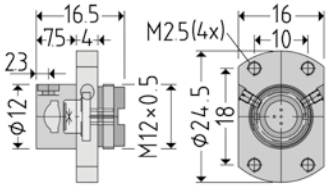


Order Options

Order Code 24PX - A8 - 07 - LD

- LD: optional: LD-Code
- 07: Lens Code: (Table 2, see below)
- 24PX: Laser diode mounting
  - 20C = galvanically isolated
  - 20P = diode potential on casing

Dimensions



Self-Mounting and Adjustment tools

1 Laser diode mounting:
fixed with threaded ring for Ø 9mm diodes

For collimator type 20C:
Tool: Assembly key Order Code **50LD-C**

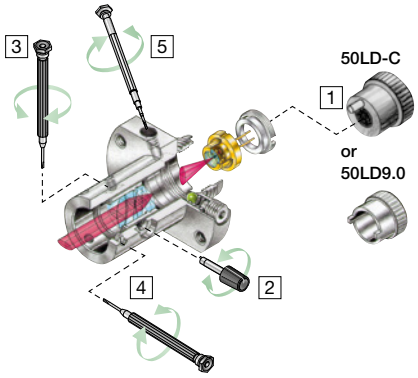
For collimator type 20P:
Tool: Assembly key Order Code **50LD9.0**

For Ø5.6 / 3.8 mm a different assembly key and additional adapters are needed (Details p.90)

2 Lens focussing
Tool: Eccentric key Order Code **60EX-4**

3 Lens locking (indirect clamping)
Tool: Screwdriver Order Code **9D-12**

4 Direct mounting and locking of beam-shaping optics using radially located grub screws.
Tool: Screwdriver Order Code **9D-12**



5 x/y-adjustment of the laser diode
Tool: Screwdriver Order Code **9D-12**

Adjustment screws (set = 3 pcs.) for type 20C
WS Ø 1.5 mm Order Code **20AS-01**

Collimation Lenses Type 20CL

Table 2 Beam parameters Collimation Lens Type 20CL

row	curr. no	1	2	3	4	5	6
1	**Lens code**	**A4**	**A4**	**A4.5**	**A6.2**	**A7.5**	**A8**
2	Focal length f'	4	4	4.5	6.2	7.5	8
3	Numerical aperture NA	0.6	0.6	0.55	0.4	0.3	0.3
4	Clear aperture [mm]	4.8	5	4.95	5	6.5	4.8
5	Max. active area [mm]	0.05	0.05	0.18	0.2	0.1	0.1
6	Lens for UHV application	x	x	x	x	x	x

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Collimation Lenses Type 20CL

Collimating the radiation of laser diodes and beam parameters

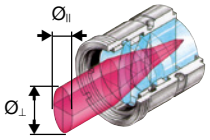
Collimating the radiation of laser diodes

Collimated Beam Diameter

Collimation optics transform a divergent beam into a collimated beam, retaining both its Gaussian intensity distribution and elliptical beam profile.

The beam diameters $Ø_{\perp}$ and $Ø_{\parallel}$ at the collimator are defined at the $1/e^2$-level and are given by the focal length f of the collimating lens and the divergence α and $\alpha_{\parallel}$ (FWHM) of the laser diode.

$$Ø_{\parallel/\perp} = 2 \cdot f \cdot \sin\left\{\frac{1}{2} \cdot \alpha_{\parallel/\perp} \cdot 1.7\right\}$$



The factor 1.7 in the equation accounts for different definitions of the Gaussian beam profiles.

Divergence

Even a collimated beam has a non-vanishing divergence. The beam diameter varies (for large distances) with the distance A from the laser diode collimator linearly.

The resulting beam divergences $\theta_{\perp}$ and $\theta_{\parallel}$ of the collimated beam depend on the beam diameter at the collimator $Ø_{\perp}$ and $Ø_{\parallel}$, respectively and on the wavelength λ of the emitted radiation.

For an ideal Gaussian beam ($M^2 = 1$):

$$\theta_{\parallel/\perp} = \frac{2 \cdot \lambda}{\pi \cdot Ø_{\parallel/\perp}}$$

Table 2 Beam parameters Collimation Lens Type 20CL

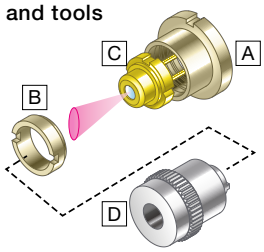
row	curr. no	1	2	3	4	5	6
1	**Lens code**	**A4****	**A4**	**A4.5**	**A6.2**	**A7.5**	**A8**
2	Focal length f'	4	4	4.5	6.2	7.5	8
3	Numerical aperture NA	0.6	0.6	0.55	0.4	0.3	0.3
4	Clear aperture [mm]	4.8	5	4.95	5	6.5	4.8
5	Max. active area [mm]	0.05	0.05	0.18	0.2	0.1	0.1
6	Lens for UHV application	x	x	x	x	x	x

** Lens no. 1 (A4-01) Bi-asphere f = 4 mm, NA 0.6. : optimized for the collimation of 405 nm laser diodes

Accessories:
Adapters for Mounting Laser Diodes Ø 5.6 / Ø 3.8 mm

Laser diodes of Ø 5.6 / Ø 3.8 mm size can be inserted into the slot for laser diodes of Ø 9 mm size without altering the active area nor its position: the laser diode beam axis and the position of the emitter are unchanged.

Adjustment and tools



Order Options for Adapters and Assembly key
2 parts:

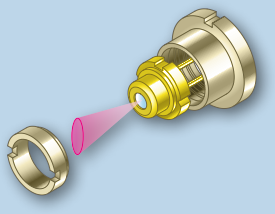
A outer casing Ø 9 mm and

B Retaining ring for laser diode
Adapter Order-Code **50AL-5.6**
Adapter Order-Code **50AL-3.8**

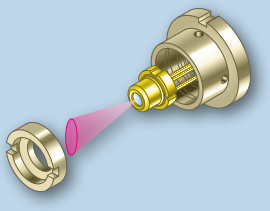
C Laser diode with housing Ø5.6 or Ø3.8 mm

D **Assembly key** Order-Code **50LD5.6**
(for 50AL-5.6 and 50AL-3.8)

Adapters for other diode casings on request.



Type 50AL-5.6



Type 50AL-3.8

Laser Diodes

Laser diodes are available on request.

The laser diode collimators of series 20... and 21... can be supplied with customer-owned laser diodes. Please contact Schäfter+Kirchhoff if these are not part of our product portfolio since specific features (e.g. point of emission, etc.) about the laser diode need to be known before hand in order to ensure compability with the laser diode collimator.

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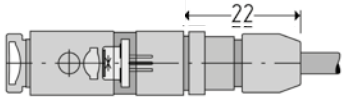
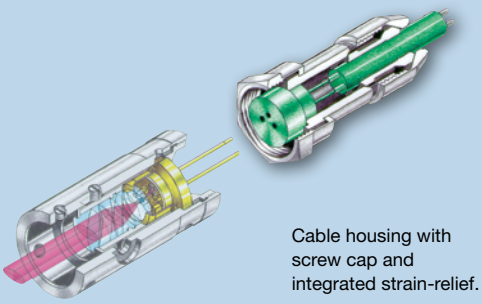
Attachment: Cable Connection System 21CS / 21PS

Electrically isolated, solderless, spring contacts for the laser diode.

Dimensions



Collimators Type 21 with attached beam shaping optics and cable connection system



Cable housing with screw cap and integrated strain-relief.

Order Options for Cable Connection System 21CS / 21PS

Order Code 21 CS - 3 - 150 - 4

Type:
21CS = for coll. type 21C
21PS = for coll. type 21P

Connector:
4 = with 4-pin connector for Power Supply (Type LEMO = FGG.0B.304)
5 = customer-specified configuration
0 = cable end shortened

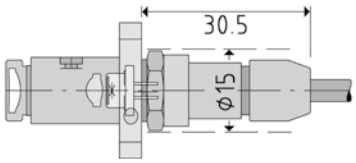
Cable length: Length in cm (standard = 150)

Diode Pin-Out/Cable:
3 = for 3-pin diode shielded cable (Type 3x AWG 26C UL sw, 0.14mm²)
4 = for 4-pin diode (shielded cable (Type 4x AWG 26C UL sw, 0.14mm²)

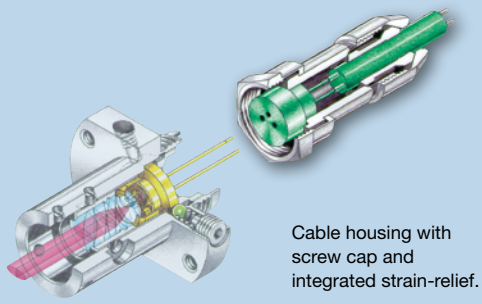
Attachment: Cable Connection System 20CS/20PS

Electrically isolated, solderless, spring contacts for the laser diode.

Dimensions



Collimator Type 20 with attached beam shaping optics and cable connection system



Cable housing with screw cap and integrated strain-relief.

Order Options for Cable Connection System 20CS / 20PS

Order Code 20 CS - 3 - 150 - 4

Type:
20CS = for coll. type 20C
20PS = for coll. type 20P and 24PX

Connector:
4 = with 4-pin connector for Power Supply (Type LEMO = FGG.0B.304)
5 = customer-specified configuration
0 = cable end shortened

Cable length: Length in cm (standard = 150)

Diode Pin-Out/Cable:
3 = for 3-pin diode shielded cable (Type 3x AWG 26C UL sw, 0.14mm²)
4 = for 4-pin diode shielded cable (Type 4x AWG 26C UL sw, 0.14mm²)

Universal Laser Diode Collimators 50BM

for self assembly and with customer electronics

The collimator type 50BM is a universal laser diode collimator system that allows modular assembly for the rapid and precise mounting, adjustment and collimation of laser diodes. Because of the ease of assembly and accessabilty of adjustment and locking it is ideal for self assembly and for **customer** specific electronics.

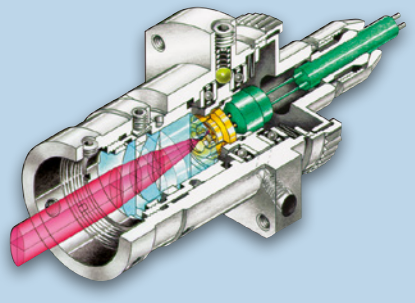
Main features include

- **Ideal for self-assembly:** Modular assembly system for the quick and precise mounting, adjustment and collimation of laser diodes
- Designed for use with customer-supplied electronics
- All laser diode beam source configurations can be realized using the appropriate beam-shaping optics.
- Suitable for diodes of Ø 9 mm (Ø 5.6/3.8 mm with adapter)

Optional:

- Combination with a wide range of beam-shaping optics for the generation of micro focus and laser lines
- Laser beam coupling into polarization-maintaining singlemode fiber cable with mode field diameters

Ø≤9 mm



Type 50BM

Suitable for laser diodes with P<120 mW and diodes with wavelengths >600nm.
For details see page 97.

Universal Laser Diode Collimators 55BC

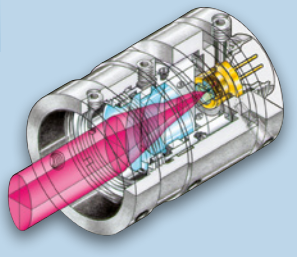
for self assembly and with customer electronics

The collimator type 55BC is a universal laser diode collimator system that allows modular assembly for the rapid and precise mounting, adjustment and collimation of laser diodes. Because of the ease of assembly and accessabilty of adjustment and locking it is ideal for self assembly and for **customer** specific electronics.

Main features include:

- **Designed for self-assembly:** easy and accessible adjustment of laser diode, collimating optics
- Can be used with consumer specific electronics
- Wide range of collimating optics
- Compatible with a wide range of beam shaping optics
- Galvanically decoupled high precision laser diode adjustment
- Good heat dissipation: Suitable for powers P<120 mW or >120 mW and diodes UV-NIR
- For laser diodes with 9 mm (5.6 mm or 3.8 mm casing with adapter)

Ø≤9 mm



Type 55BC

Mounted by Schäfter+ Kirchhoff.
For details see page 98.

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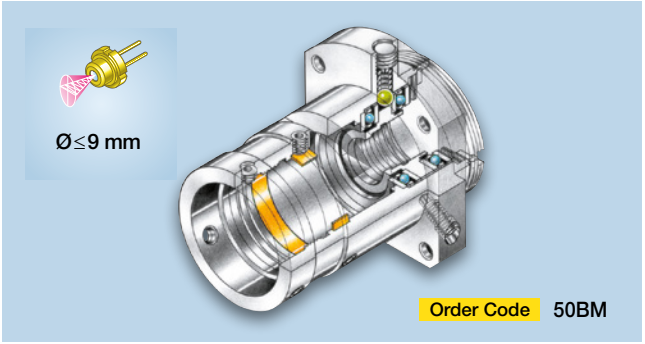
Universal LD Collimator Base Type 50BM

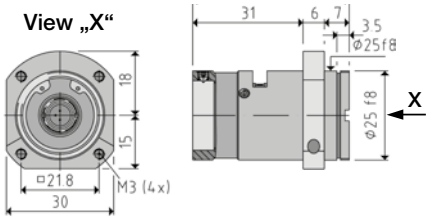
Designed for self-assembly: easy and accessible adjustment of laser diode, collimating optics

Main specifications:

- Can be used with consumer specific electronics
- Wide range of collimating optics
- Compatible with a wide range of beam shaping optics
- For powers < 120 mW and wavelengths > 600 nm
- For laser diodes with 9 mm (5.6 mm or 3.8 mm casing with adapter) Integrates laser diode, collimation lens and solderless cable connection system for the laser current supply.
- Galvanically decoupled laser diode mounting with ball bearing (no backlash). Precise x/y-adjustment of the laser diode, which is fastened using a threaded ring.
- Lens tube with cylindrical fit and finethread. Internal lens focussing of 50CL: left or right-hand turn of the collimation lens provides a fine adjustment of the collimation or focus of the laser beam, even with attached beam-shaping optics.
- Frontal cylinder mounting with locking screws for the attachment of beam-shaping optics. The beam-shaping optics provides laser lines, micro focus optics or laser beam coupler for singlemode fiber cables.
- The laser module can be integrated into the microbench system (30 mm cage system) or with a mounting console.



Dimensions



How to order

Please select:

1. The laser diode with the adequate laser diode adapter (page 96)
2. Proof if collimator base is the right choice (for P>120 mW please choose the 55BC page 94)
3. The collimation optics (page 97) according to wavelength and designated beam diameter
4. If desired, a cable plug system 50CS (page 98)

and then from the following options:

- Beam-shaping optics, series 5 or 13 (see page 97)
- Consoles and mounting brackets (page 99)
- Anamorphic correction (see fiber optics catalogue)
- Faraday isolator (see fiber optics catalogue)
- Fiber optics (see fiber optics catalogue),
- Adjustment tools (see below) and equipment

All of these items require separate order codes.

Self-Mounting and Adjustment Tools

[1] Laser diode mounting: fixed with threaded ring for Ø 9 mm diodes

Tool: Assembly key Order Code **50LD9.0**

For Ø5.6 /3.8 mm additional adapters are needed

[2] Lens mounting and focussing

Tool: Focussing key Order Code **50LF-03**

[3] x/y-adjustment of the laser diode:

Adjustment screws
WS Ø 1.5 mm
(set = 3 pcs.) Order Code **50AS-01**

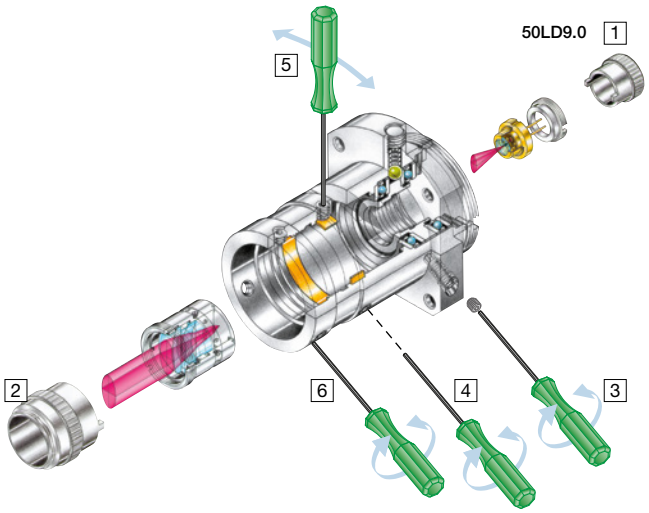
Tool: Allen hex key
WS Ø 1.5 mm Order Code **50HD-15**

[4] Lens locking (indirect clamping)

Tool: Allen hex key
WS Ø 1.5 mm Order Code **50HD-15**

[5] Lens focussing with attached beamshaping optics by left and right-hand turns of the collimation lens.

Tool: Allen hex key
WS Ø 1.5 mm Order Code **50HD-15**



[6] Direct mounting and locking of beam-shaping optics or laser beam coupler using radially located grub screws.

Tool: Allen hex key
WS Ø 1.5 mm Order Code **50HD-15**

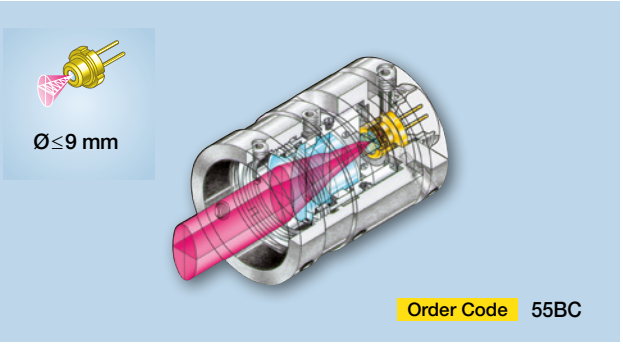
Universal LD Collimator Base Type 55BC

Designed for self-assembly: easy and accessible adjustment of laser diode, collimating optics

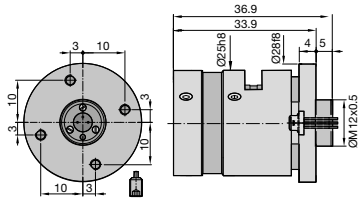
The collimator type 55BC is a universal laser diode collimator system that allows modular assembly for the rapid and precise mounting, adjustment and collimation of laser diodes. Because of the ease of assembly and accessibility of adjustment and locking it is ideal for self assembly and for **customer** specific electronics.

Main specifications:

- Can be used with consumer specific electronics
- Wide range of collimating optics
- Compatible with a wide range of beam shaping optics
- Galvanically decoupled high precision laser diode adjustment
- Good heat dissipation: Suitable for powers P<120 mW or >120 mW and diodes UV-NIR
- For laser diodes with 9 mm (5.6 mm or 3.8 mm casing with adapter)



Dimensions



How to order

Please select:

1. The laser diode with the adequate laser diode adapter (page 96)
2. Proof if collimator base 55BC is the right choice (else choose the 50BM page 93)
3. The collimation optics (page 95) according to wavelength and designated beam diameter
4. If desired, a cable plug system 20CS (page 98)

and then from the following options:

- Beam-shaping optics, series 5 or 13 (see page 97)
- Consoles and mounting brackets (page 99)
- Anamorphic correction (see fiber optics catalogue)
- Faraday isolator (see fiber optics catalogue)
- Fiber optics (see fiber optics catalogue),
- Adjustment tools (see below) and equipment

All of these items require separate order codes.

Self-Mounting and Adjustment Tools

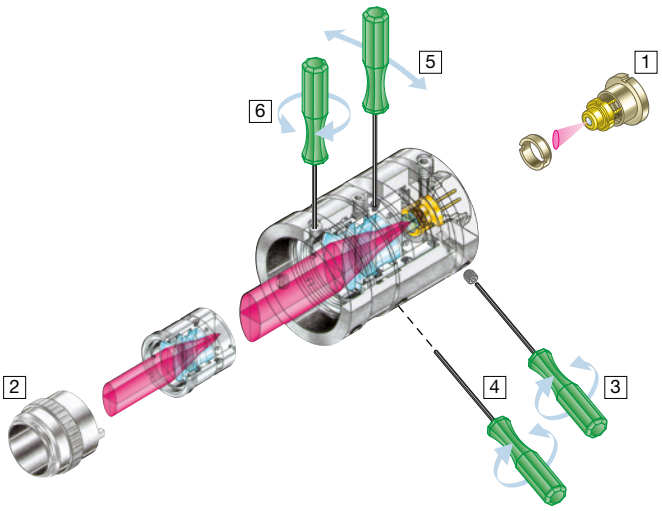
1 Laser diode mounting: fixed with threaded ring for Ø 9 mm diodes
Tool: Assembly key Order Code **50LD-C**
For Ø 5.6 /3.8 mm additional adapters are needed

2 Lens mounting and focussing
Tool: Focussing key Order Code **50LF-03**

3 x/y-adjustment of the laser diode:
Adjustment screws (set = 3 pcs.) WS Ø 1.5 mm Order Code **55AS-01**
Tool: Allen hex key WS Ø 1.5 mm Order Code **50HD-15**

4 Lens locking (indirect clamping)
Tool: Allen hex key WS Ø 1.5 mm Order Code **50HD-15**

5 Lens focussing with attached beamshaping optics by left and right-hand turns of the collimation lens.
Tool: Allen hex key WS Ø 1.5 mm Order Code **50HD-15**



6 Direct mounting and locking of beam-shaping optics or laser beam coupler using radially located grub screws.
Tool: Allen hex key WS Ø 1.5 mm Order Code **50HD-15**

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Attachment Optics: Collimation Lenses 50CL or 90CL

Collimation lenses transform the divergent laser radiation into a collimated beam

Collimation lenses transform the divergent laser radiation into a collimated beam. The beam parameters are determined by the focal length of the lens, its numerical aperture and the divergence of the initially emitted radiation.

The original beam characteristics of the laser diode (elliptical or circular beam profile) are preserved.

Table 3 Beam parameters: Collimation Lens 50CL / 90CL

	curr. no	1	2	3*	4	5	6	7	8	9	10*	11***	12	13	14
row	Collimation lens type	50CL										90CL			
1	Lens code 1)	A4	A4	A4.5	A6.2	A7.5	A8	A8	T12	T12F	T15	M60			
2	Focal length f'	4	4	4.5	6.2	7.5	8	8	12.5	12.5	15	60			
3	Numerical aperture NA	0.6	0.6	0.55	0.4	0.3	0.3	0.5	0.54	0.54	0.4	0.14			
4	Clear aperture [mm]	4.8	4.8	4.95	5	6.5	4.8	8	13.5	13.5	12	17			
5	Max. active area [mm]	0.05	0.05	0.18	0.2	0.1	0.1	0.1	0.2	0.2	0.2	0.2			
6	Lens for UHV application	x	x	x	x	x	x	x	x	x					

	Spectral range	Code No. of AR-Coating													
7	400 - 600 nm	01	01		01	01	01		01						
8	600 - 1050 nm	02	02		02	02	02		02						
9	1050 - 1550 nm	03	03		03	03	03		03						
10	1300 - 1750 nm	45			45	45									
11	650 - 1150 nm	07				07		07							
12	390 - 670 nm	33									33	33			
13	600 - 1020 nm	05													
14	630 - 980 nm	10							10			10			
15	830 - 1550 nm	25													
16	1550 - 1750 nm	22			22	22		22							
17	1750 - 2300 nm	09			09	09	09	09							
18	980 - 1550 nm	08							08	08					
19	1750 - 3000 nm	64		64**											

* Lens no. 3 and 10: special lenses, optics design for laser diodes without terminating windows

** IR chalcogenide lens

*** Dimensions of fully assembled collimator differs

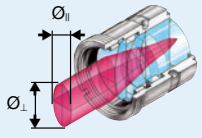
1) A = Aspheric optics

M = Laser monochromat

T = Triplet

Beam parameter for the collimated laser beam using a 670 nm laser diode with beam divergence 10°x 30° (FWHM), beam-Ø 1/e² (13.5%)

20	beam-Ø ∥ [mm] (1/e²)	1.2	1.2	1.3	1.8	2.2	2.4	2.4	3.7	3.7	4.4	#17
21	beam-Ø ⊥ [mm] (1/e²)	3.4	3.4	3.9	#5.0	#6.5	#4.8	#6.9	10.8	10.8	#12	#17
22	divergence ∥ [mrad]	0.36	0.36	0.32	0.23	0.19	0.18	0.18	0.12	0.12	0.1	0.03
23	divergence ⊥ [mrad]	0.12	0.12	0.11	0.09	0.07	0.09	0.06	0.04	0.04	0.03	0.03



beam cross-section restricted by lens aperture

Order Options for Collimation Optics 50CL / 90CL

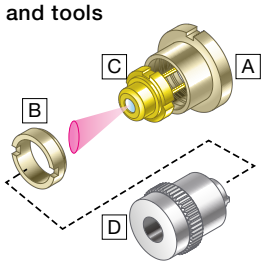
Order Code 50CL - T 12 - 05

- 05: AR-coating, see Table 3
- T 12: Lens Code, see Table 3
- 50CL: Collimation lens type: 50CL 90CL

Accessories:
Adapters for Mounting Laser Diodes Ø 5.6 / Ø 3.8 mm

Laser diodes of Ø 5.6 / Ø 3.8 mm size can be inserted into the slot for laser diodes of Ø 9 mm size without altering the active area nor its position: the laser diode beam axis and the position of the emitter are unchanged.

Adjustment and tools



Order Options for Adapters and Assembly key

2 parts:

A outer casing Ø 9 mm and

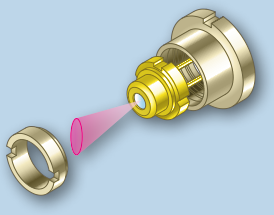
B Retaining ring for laser diode

Adapter	**Order-Code**	**50AL-5.6**
Adapter	**Order-Code**	**50AL-3.8**

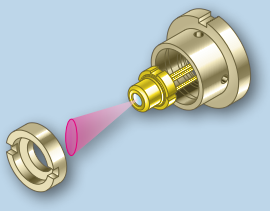
C Laser diode with housing Ø5.6 or Ø3.8 mm

D **Assembly key** **Order-Code** **50LD5.6**
(for 50AL-5.6 and 50AL-3.8)

Adapters for other diode casings on request.



Type 50AL-5.6



Type 50AL-3.8

Laser Diodes

A wide range of laser diodes are available on request.

In case of self-assembly you can, of course, build in your own diode.

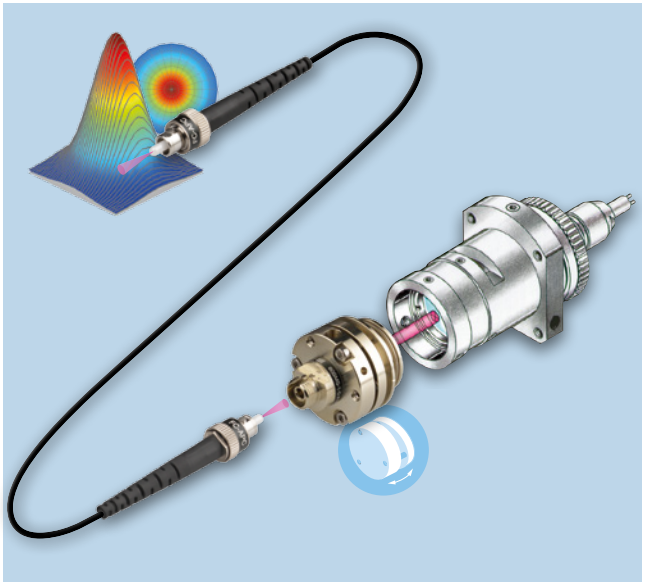
Attachment Fiber Coupling

The universal LD collimators 50BM and 55BC can also be used for fiber-coupling the laser diode radiation

The universal laser diode collimators 50BM and 55BC can also be used for fiber-coupling the laser diode radiation. In order to be successful the right combination of laser diode, collimating optics and coupling optics needs to be found. The laser beam coupler type 60SMS is mounted directly onto the front of the collimator.

Other features include:

- Wide range of coupling optics Type 60SMS (Details see fiber optics catalogue)
- Coupling into single-mode, multi-mode or polarization-maintaining single-mode fibers (Details see fiber optics catalogue)



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Beam-Shaping Optics

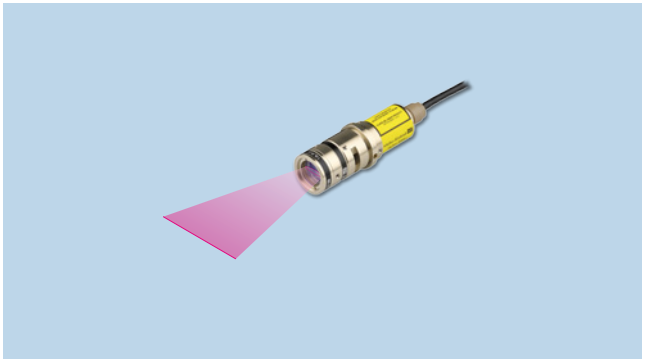
The universal LD collimators type 50BM and 55BC can be equipped with a large variety of beam shaping optics

The universal laser diode collimators type 50BM- and 55BC- can be equipped with all beam shaping optics (including micro and macro configurations) that can be found in the catalogue (page 34 - 59). All configurations are thus also available without integrated electronics. **Beam shaping optics include:**

Line optics with fan angle

Laser line generators with homogeneous intensity distribution

Type 13LR/13LRM page 34f



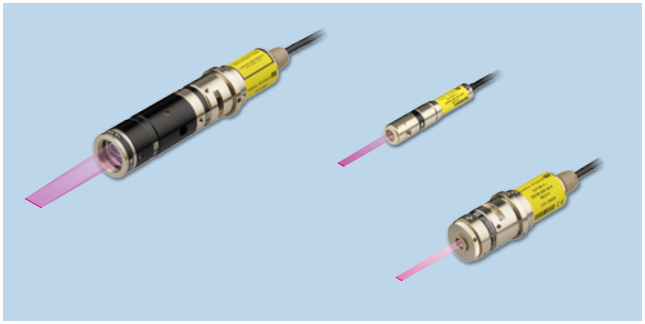
Semi-telecentric laser lines

Semi-telecentric laser line generators with constant line length 15 mm

Type 13LT page 38f

Semi-telecentric laser line generators with constant line length 4.8 mm / 2.4 mm

Type 5LT page 40f



Focus optics

Laser Focus Generators with circular Gaussian beam profile and smaller spots

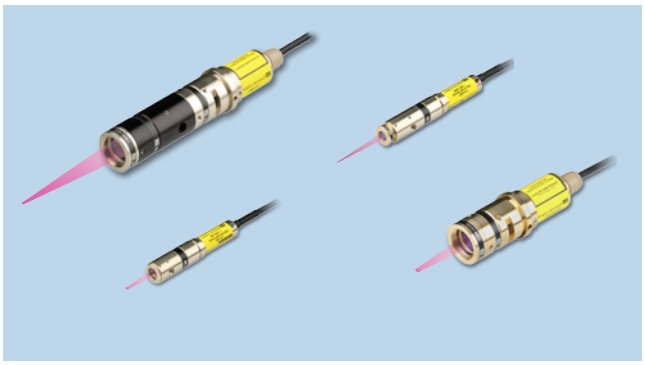
Type 13MC page 44f

Laser Focus Generators with elliptical Gaussian beam profile (Micro) or circular (Macro) spots

Type 5MC page 46f

Type 13MM page 49f

Type 5M page 50f



Collimator type

Telecentric laser beam

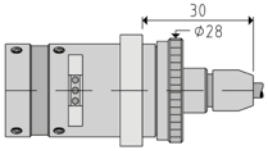
with homogeneous intensity distribution in both directions and with low divergence

flatbeam® page 54

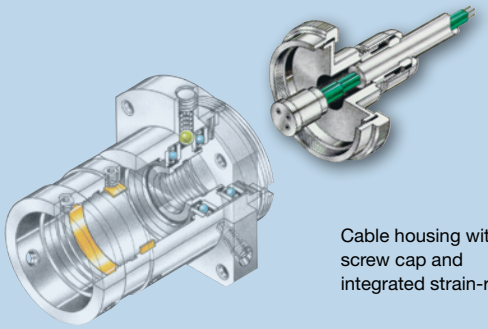
Attachment: Cable Connection System 50CS

Electrically isolated, solderless, spring contacts for the laser diode.

Dimensions



Collimator Type 50BM with cable connection system



Cable housing with screw cap and integrated strain-relief.

Order Options for Cable Connection System 50CS

Order Code 50 CS - 3 - 150 - 4

Type:
50CS = for coll. type 50BM

Connector: 4 = with 4-pin connector for Power Supply (Type LEMO = FGG.0B.304)
5 = customer-specified configuration
0 = cable end shortened

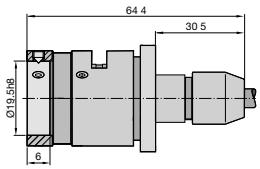
Cable length: Length in cm (standard = 150)

Diode Pin-Out/Cable:
3 = for 3-pin diode shielded cable (Type 3x AWG 26C UL sw, 0.14mm²)
4 = for 4-pin diode shielded cable (Type 4x AWG 26C UL sw, 0.14mm²)

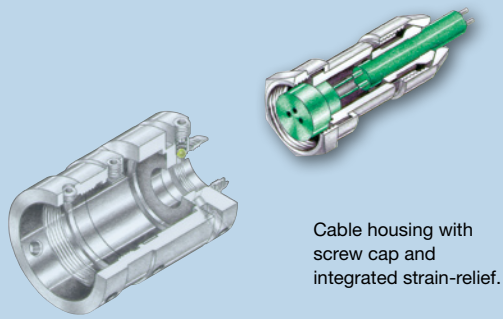
Attachment: Cable Connection System 20CS

Electrically isolated, solderless, spring contacts for the laser diode.

Dimensions



Collimator Type 55BC with cable connection system



Cable housing with screw cap and integrated strain-relief.

Order Options for Cable Connection System 20CS

Order Code 20 CS - 3 - 150 - 4

Type:
20CS = for coll. type 55BC

Connector: 4 = with 4-pin connector for Power Supply (Type LEMO = FGG.0B.304)
5 = customer-specified configuration
0 = cable end shortened

Cable length: Length in cm (standard = 150)

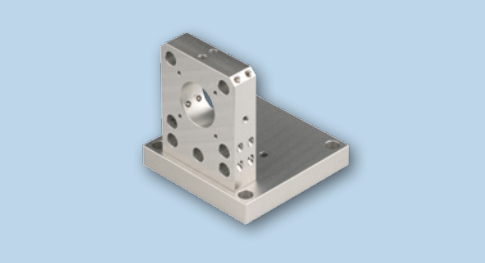
Diode Pin-Out/Cable:
3 = for 3-pin diode shielded cable (Type 3x AWG 26C UL sw, 0.14mm²)
4 = for 4-pin diode shielded cable (Type 4x AWG 26C UL sw, 0.14mm²)

Accessory Bracket 48MB-25-60

Microbench compatible (30 mm cage system)

Order Options

Order Code 48MB-25-60



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Accessories Mounting console 13MK

for Laser Diode Beam Sources Series 55BC / 55CM (Housing Ø 25/28 mm)

The mounting consoles 13MK-25-36-10 allow a precise and mechanically rugged alignment of the laser beam sources 13xx .

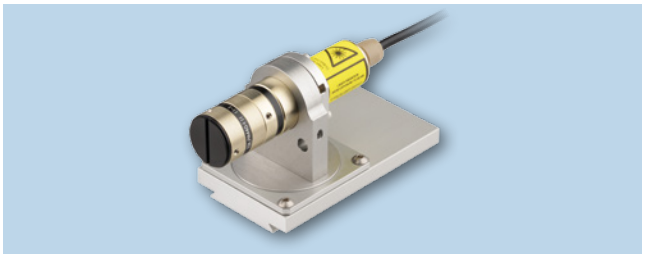
The lasers are held by indirect clamping and the focussing and focus locking mechanisms remain accessible in the clamped state.

The mounting consoles 13ML-25-36-.. supports two degrees of freedom:

1. Rotation 0 – 360° around the optical axis

2. In-plane rotation 0 – 360°

Note: This console can only be used for Laser Line Generators with a fan angle, e.g. 13LR, 13LN or 5LM and 5LP.



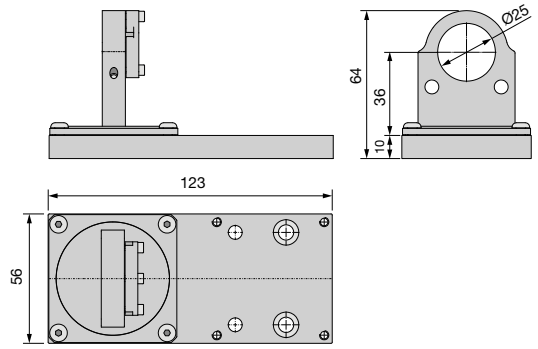
Order Options

Mounting console, flat base plate
Order Code 13MK-25-36-10-F

Mounting console, base plate
Order Code 13MK-25-36-10-M

with Montech profile (www.montech.com):
Order Code AP-46-5

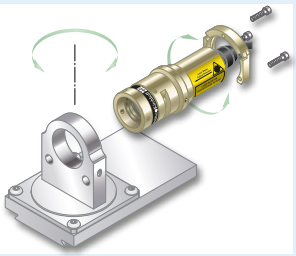
Dimensions



Adjustment and tools

Hex key WS 2
Order Code 50HD-20

Hex key WS 2.5
Order Code 50HD-25



Accessories Mounting console 13MK-25-3D

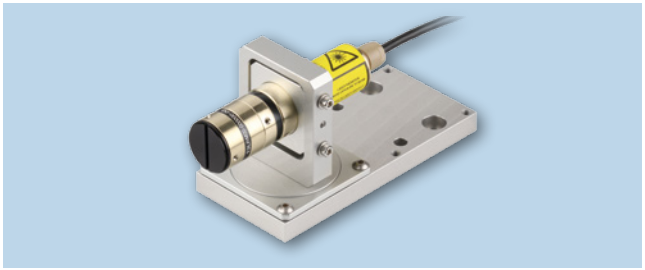
for Laser Diode Beam Sources Series 55BC / 55CM (Housing Ø 25/28 mm)

The Mounting Console of type 13MK-25-3D-F with flat base plate allows a precise and mechanically rugged alignment of Laser Modules with Ø 25/28 mm. The lasers are held by means of a clamp collar in such a way that the focussing and focus locking mechanism remain accessible.

The Mounting Console is designed for all lasers with Ø 25/28 mm and provides 3 degrees of freedom:

1. **Rotation (0 - 360°) around the optical axis**
2. **In-plane rotation (0 - 360°)**
3. **Tilt (inclination, ± 5°)**

Note: This Mounting Console is designed for all lasers with Ø 25/28 mm. For Laser Line Generators with a fan angle, e.g. 13LR, 13LN or 5LM and 5LP the mounting console type 13MK-25-36-10-F might be sufficient.



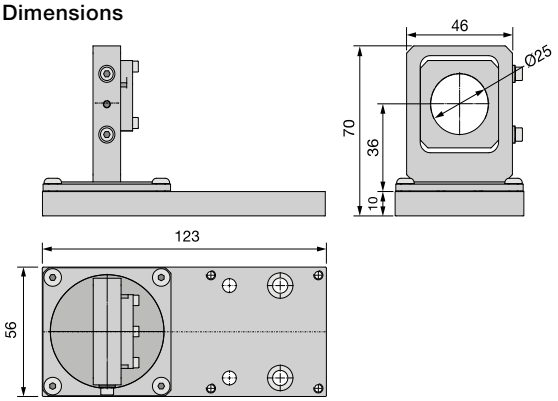
Order Options

Mounting console, flat base plate
Order Code 13MK-25-3D-F

Mounting console, base plate
Order Code 13MK-25-3D-M

with Montech profile (www.montech.com):
Order Code AP-46-5

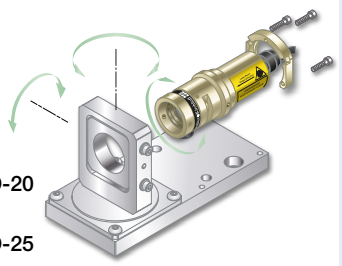
Dimensions



Adjustment and tools

Hex key WS 2
Order Code 50HD-20

Hex key WS 2.5
Order Code 50HD-25



Laser Safety

Laser Safety

Safety at Work: Laser Safety Goggles

Laser safety and laser adjustment goggles

- Laser safety goggles are recommended when working with lower power lasers from laser protection class 3R and beyond, such as all visible lasers from Schäfter+Kirchhoff with up to 5 mW of output power.
- Laser safety goggles are mandatory for protection class 3B and beyond, such as all invisible infrared lasers and all visible lasers from Schäfter+Kirchhoff with more than 5 mW of output power.
- The correct handling and use of laser safety goggles protects you and your colleagues against eye injuries from hazardous laser radiation.
- A selection of CE and GS certified laser safety goggles (manufactured by LaserVision, *www.uvex-laservision.de*) are provided for the lasers manufactured by Schäfter+Kirchhoff.
- The type of frame is dependent upon whether glass or plastic filters are fitted. Laser safety goggles with glass filters (Order Code RX7) have a heavier frame with a facility for attaching personal spectacles, according to individual requirements. Laser safety goggles with plastic filters are lighter and can be worn over normal spectacles.
- The two distinct protective functions of either full protection goggles or alignment protection goggles need emphasizing (see box below).

Accessories – Insert for Spectacles

As an accessory for the laser protection goggles of type R01.T1A01 and R01.T1Q01, the insert RX7 for personal spectacles is available.

Order Code **RX7**

Fundamentals

Laser Safety Goggles – Function and Characteristics

Protective function. Full protection goggles and alignment goggles provide different levels of safety and laser protection.

Full protection goggles, conforming to European standard EN 207, provide personal protection against laser radiation. The laser radiation is blocked and is no longer visible.

The **protection levels** (such as protection level LB..) differ in the maximum spectral transmission of the filter glasses. The EN 207 standard specifies a maximum incident laser power density (power per unit area, in W/m^2) for the laser power that is allowed to irradiate the filter glass.

Alignment protection goggles, conforming to European standard EN 208, reduce the visible laser radiation (400–700 nm wavelengths) to that of the power of laser class 2 (EN 60825-1). The laser radiation remains visible, to allow alignment protection glasses to be used for adjustment tasks, while offering significant laser protection safety.

The **protection levels** (protection level RB..) describe the maximum power (watts) of a collimated laser beam that is allowed to irradiate the goggles.

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

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

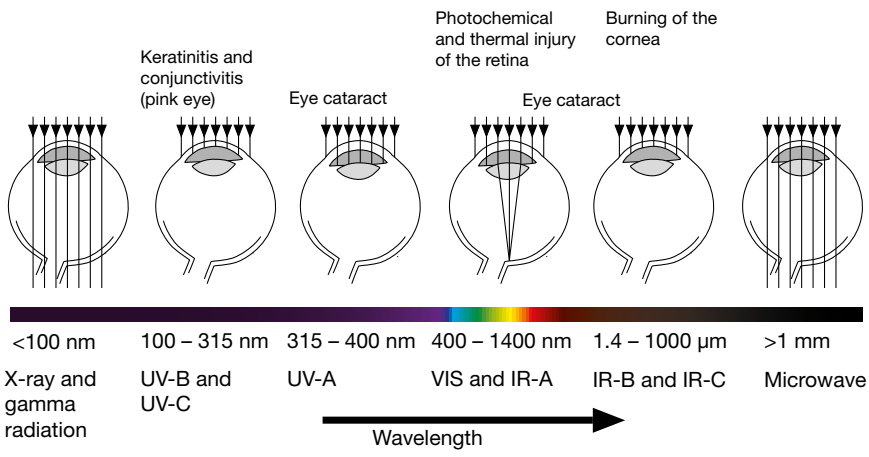
Maximum power density (EN 207): maximum power density that the filter glasses can withstand over a longer period (according to EN 207).

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

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

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

Type of Eye Damage caused by Radiation



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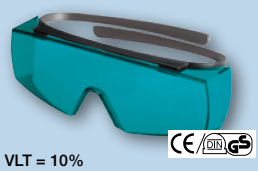
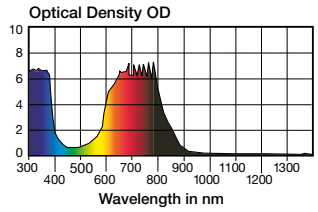
Laser Safety Goggles

Full Protection Goggles DIN EN 207



VLT = 10%



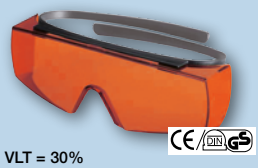
Order Code **F18.P1H03.1001**

Usable Range

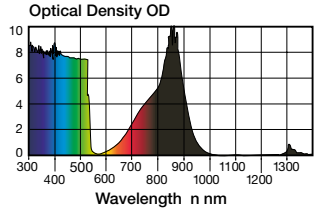
Protection	Wavelength [nm]	Protection Level	max. Transmission (EN 207)	max. Power Density (EN 207)	max. Power (EN 208)
Full	610 - 630	LB5	10^{-5}	10^{6} W/m²	-
Full	630 - 660	LB6	10^{-6}	10^{7} W/m²	-
Full	660 - 775	LB6	10^{-6}	10^{7} W/m²	-
Full	775 - 790	LB6	10^{-6}	10^{7} W/m²	-

Full protection goggles for cw lasers in the 600 - 800 nm wavelength range

Full Protection Goggles DIN EN 207



VLT = 30%



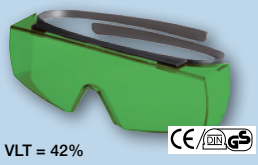
Order Code **F18.P1L02.1001**

Usable Range

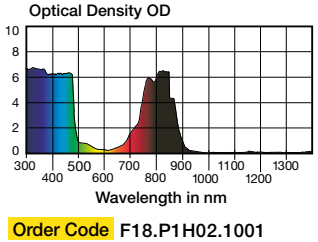
Protection	Wavelength [nm]	Protection Level	max. Transmission (EN 207)	max. Power Density (EN 207)	max. Power (EN 208)
Full	315 - 532	LB6	10^{-6}	10^{7} W/m²	-

Full protection goggles for cw lasers in the 315 – 532 nm wavelength range

Full and Alignment Protection Goggles DIN EN 207 / DIN EN 207



VLT = 42%



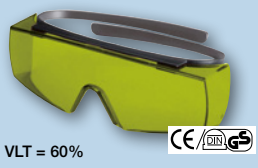
Order Code **F18.P1H02.1001**

Usable Range

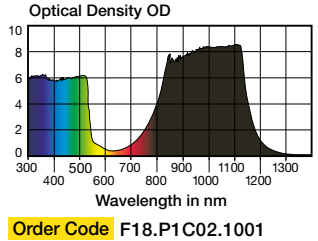
Protection	Wavelength [nm]	Protection Level	max. Transmission (EN 207)	max. Power Density (EN 207)	max. Power (EN 208)
Alignment	660 - 675	RB2	-	-	100 mW
Full	700 - 755	LB5	10^{-5}	10^{6} W/m²	-
Full	755-810	LB6	10^{-6}	10^{7} W/m²	
Full	810-820	LB5	10^{-5}	10^{6} W/m²	

Alignment protection goggles are for lasers in the 660 - 675 nm wavelength range
Full protection goggles for the 700 – 820 nm wavelength range

Full Protection Goggles DIN EN 207



VLT = 60%



Order Code **F18.P1C02.1001**

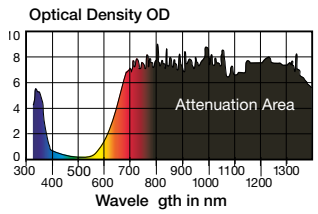
Usable Range

Protection	Wavelength [nm]	Protection Level	max. Transmission (EN 207)	max. Power Density (EN 207)	max. Power (EN 208)
Full	780 - 810	LB3	10^{-3}	10^{4} W/m²	-
Full	810 - 860	LB4	10^{-4}	10^{5} W/m²	-
Full	860 - 900	LB5	10^{-5}	10^{6} W/m²	
Full	800 - 1080	LB6	10^{-6}	10^{7} W/m²	
Full	1080 - 1100	LB4	10^{-4}	10^{5} W/m²	

Full protection goggles for lasers in the 780 – 1100 nm wavelength range

Full Protection Goggles DIN EN 207 / DIN EN 208

VLT = 15%



Order Code **R01.T1Q01**

Usable Range

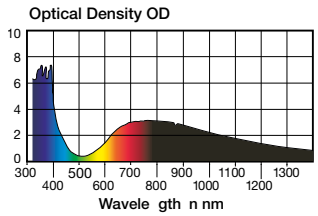
Protection	Wavelength [nm]	Protection Level	max. Transmission (EN 207)	max. Power Density (EN 207)	max. Power (EN 208)
Full	690 - 1320	LB7	10^{-7}	10^{8} W/m²	-
Full	1320 - 1550	LB3	10^{-3}	10^{4} W/m²	-

All-round goggles as full protection for cw lasers in the 690 – 1500 nm wavelength range

Laser Alignment Goggles

Full and Alignment Protection Goggles DIN EN 207 / DIN EN 208

VLT = 25%



Order Code **R01.T1Q02**

Usable Range

Protection	Wavelength [nm]	Protection Level	max. Transmission (EN 207)	max. Power Density (EN 207)	max. Power (EN 208)
Alignment	630 - 635	RB3	-	-	1000 mW
Full	630 - 680	LB2	10^{-2}	10^{3} W/m²	

Alignment/full protection goggles for cw lasers in the 630 – 690 nm wavelength range

Please Note: Typical density curves for the respective filters are shown for information only and are not guaranteed values. Only the protection levels (RB.. or LB..) are guaranteed by Schäfter+Kirchhoff.

Laser classes **EU Standard**

Laser Safety

To be in accordance with DIN IEC 60825-1:2007, every laser system must be labeled with a warning triangle. Additionally, all lasers must be labelled with additional warning information specific to the laser class:

Class 1:
" CLASS 1 LASER PRODUCT "

Class 1M:
" LASER RADIATION, DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS, CLASS 1M LASER PRODUCT "

Class 2:
" LASER RADIATION, DO NOT STARE INTO BEAM, CLASS 2 LASER PRODUCT "

Class 2M:
" LASER RADIATION, DO NOT STARE INTO BEAM OR VIEW DIRECTLY WITH OPTICAL INSTRUMENTS, CLASS 2M LASER PRODUCT "

Class 3R:
" LASER RADIATION, AVOID DIRECT EYE EXPOSURE, CLASS 3R LASER PRODUCT "

Class 3B:
" LASER RADIATION, AVOID EXPOSURE TO THE BEAM, CLASS 3B LASER PRODUCT "

Class 4:
" LASER RADIATION, AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION, CLASS 4 LASER PRODUCT "

Furthermore, all lasers of class 2 to 4 must exhibit a warning that lists the laser specifications, including the laser source, the wavelength and the laser power or pulse energy.

If the laser is enclosed but the housing can be opened then the housing must also be labeled with a warning triangle and the requisite information about the laser class, as listed below:

Class 1: The laser is safe for any form of measurement task and the maximum permitted exposure (MPE) cannot be exceeded. Enclosed high power laser systems, with an integrated automatic shutdown system on opening of the enclosure, are also included in this laser class.

Class 1M: As for class 1, except when magnifying optics such as microscopes and telescopes are used: safety limits may be exceeded and class 3 dangers may be possible.

Class 2: Visible laser light (400–700 nm) with <1 mW continuous wave (CW) and/or <0.25 s exposure time (with an energy limit according to the standard) is considered to be safe. Radiation either side of the 400–700 nm range is considered to be class 1.

Class 2M: As for class 2, except when magnifying optics such as microscopes and telescopes are used.

Class 3R: If handled carefully, the laser is considerd safe because only a low risk of injury exists. Visible CW lasers in Class 3R are limited to 5 mW. For other wavelengths and for pulsed lasers, other limits apply.

Class 3B: Direct exposure is hazardous for the eye, but diffuse reflections such as from paper are not harmful. The limits apply to wavelengths and to operation mode (as for CW and pulsed lasers). Laser safety goggles are absolutely required when a direct view of the laser beam is at all possible. Class 3B lasers must be equipped with an isolating key switch and a safety interlock.

Class 4: Every type of laser beyond class 3B.

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