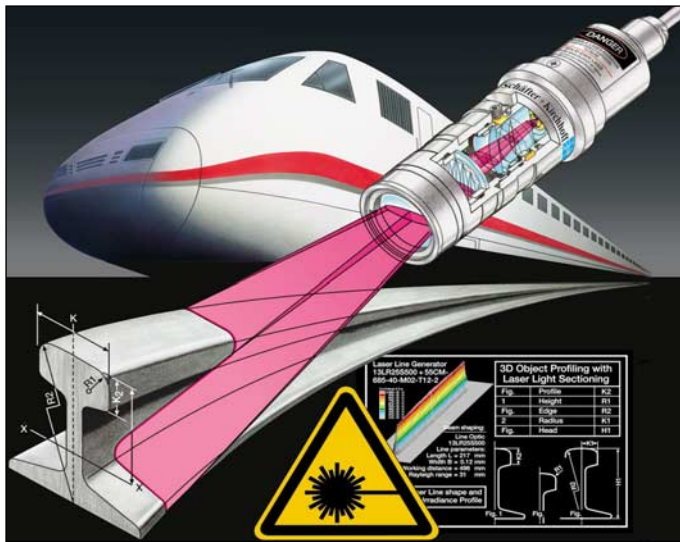


# Laser Micro Line Generator 13LR... Laser Macro Line Generator 13LRM...

A key component for the 3D laser measurement technique



**Characteristics:**  
Laser line with homogeneous intensity distribution and constant line width  
Beam and intensity profile see figure 1

**Integrated electronics for laser power control**

**External modulation TTL up to 250 kHz – analog up to 100 kHz**

Fig. 1

**Application:**  
Laser Microline Generator for measurement of 3D-Profile and gage exactness.

## Depth of Focus of a Laser Line

The laser line is focussed to a fixed working distance. With actual working distances diverging from the setting the laser line widens and the power density of the radiation decreases. The region around the nominal working distance, where linewidth does not increase by more than a factor of 1.41, is according to agreement characterized as the depth of focus of a laser line.

There are two types of laser line generators (see Fig. 4). Laser micro line generators create thin laser lines with Gaussian intensity profile orthogonal to the laser line. The depth of focus of a laser line at wavelength  $\lambda$  and of width B (at 13.5% -level) is given by the so called Rayleigh Range  $2z_R$ :

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

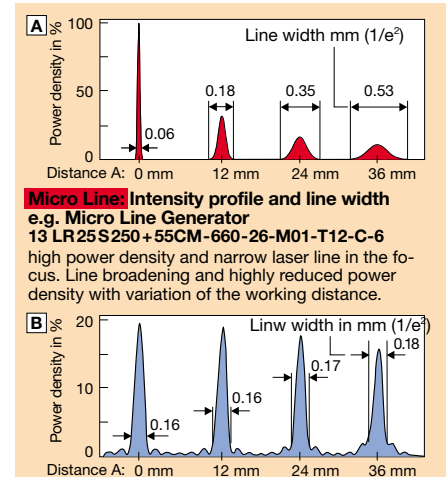
Laser macro line generators create laser lines with increased depth of focus.

At the same working distance macro laser lines are wider than micro laser lines (factor 2-5). At the same working distance, their depth of focus is enlarged by a factor of 7 to 35.

## Line Width

Within the two design types, macro resp. micro line generator, the line width is proportional to the working distance. Due to the theoretical relation between line width and the depth of focus, the minimum line width of the laser line is limited by the depth of focus required.

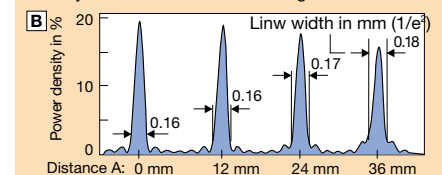
Fig. 4 Intensity profile and line width



### Micro Line: Intensity profile and line width

e.g. Micro Line Generator 13 LR25S250+55CM-660-26-M01-T12-C-6

high power density and narrow laser line in the focus. Line broadening and highly reduced power density with variation of the working distance.



### Macro Line: Intensity profile and line width

e.g. Macro Line Generator 13LRM25S250-1.5+55CM-660-23-M01-T12-C-6

Power density and line width remain nearly constant under changing working distances. The possible working range can be a factor of 35 larger compared to the micro line generator (A)

The 13LR... laser line generator was specially developed for the 3D profile measurement using the laser light-sectioning method. Its specific characteristics are the homogeneous intensity distribution, and the constant line width throughout the whole measuring area. This ideal beam and intensity profile increases the accuracy and resolution of the measurements and reduces the calculation time for the image analysis.

The laser micro line generator or laser macro line generator is chosen to accommodate to the measurement application. The laser micro line generator generates laser lines from 0.025 mm width with high power density and a small depth of focus. With the laser macro line generator the laser line is wider by a factor of 2-3, the depth of focus larger by a factor of 10. The power density is constant throughout the whole depth of focus (fig. 2).

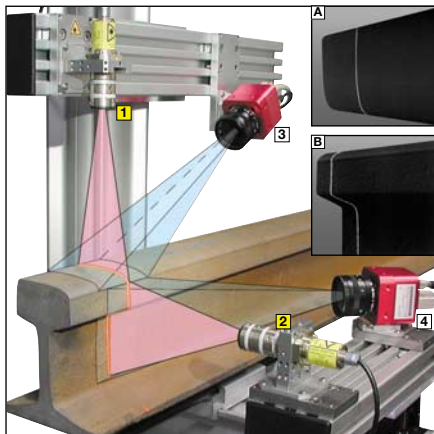


Fig 2: 3D profile measurements of a rail track with the laser light sectioning method

- 1 Laser Microline Generator 13LR... (for objects with small elevation profile variations)
- 2 Laser Macroline Generator 13LRM... (for objects with large elevation profile variations)
- 3 and 4 CCD/CMOS area camera
- A Line contour of the contact surface (cam. 3)
- B Line contour of the side-face (camera 4)

**Laser light sectioning - Measurement technique**  
Disturbing influence by laser speckle  
Depth of focus of camera and lens  
Laser Light Sectioning in Scheimpflug-Configuration  
see [www.SuKHamburg.de/dl/lightsect-e.pdf](http://www.SuKHamburg.de/dl/lightsect-e.pdf)

## Characteristics and parameters of performance

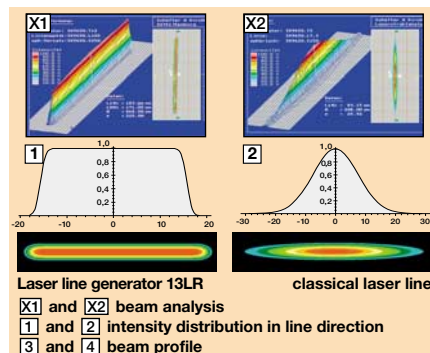
The beam shaping optics determine the parameters fan angle and line length as well as the optimal working distance and the focussing range of the laser line generator.

The laser diode used determines the wavelength, the emitted power, and therefore also the laser protection class.

Main characteristics:

- Fan angle 12°, 25°, and 40°
- Homogeneous intensity distribution in line direction, Gaussian perpendicular to laser line
- Constant line width along the laser line
- Line width down to 0.04 mm (1/e2)
- Line length from 26 mm up to 2840 m
- Focusable, adjustment of the focus position by internal lens focussing (within the focussing range specified in the tables on next page)
- Metal housing, Ø 25/28 mm
- Spectral range: 635 - 980 nm, optional 405 nm and 1064-1550 nm
- Laser power: up to 100 mW in the visible range (660 nm)  
up to 105 mW in the IR range (830 nm)
- Integrated electronics for laser power control
- Laser output power adjustable with potentiometer <1 - 100%
- External modulation TTL up to 250 kHz, analog up to 100 kHz
- Power supply: +5V

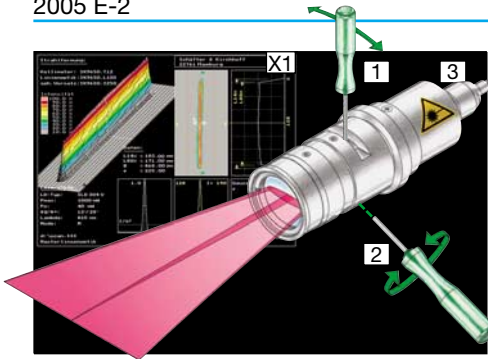
Fig. 3 Beam and intensity profile



**Laser line and micro focus generators for optical metrology**  
For this purpose Schäfter + Kirchhoff offers a product range well accommodated to the requirements of the measuring tasks e.g.,

- semi-telescopic laser lines with high edge intensity and const. line width
- Micro focus generators for laser spots ≈ 0.001 mm
- Collimator 90CM... for laser diffraction, and edge detection systems

**Info see: data sheets [www.SuKHamburg.de](http://www.SuKHamburg.de)**



## Laser Micro Line Generator 13LR...

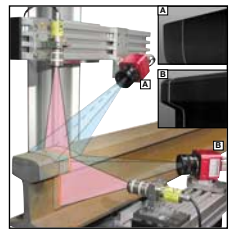
Laser fan with homogeneous intensity distribution and constant line width

## Laser Macro Line Generator 13LRM...

Laser line with extended depth of focus

- Fan angle 12°, 25°, and 40°
- Intensity profile homogeneous in direction of line, perpendicular Gaussian (type 13LRM... approx. Gaussian)
- Constant line width along the entire line length (s. Fig. X1)
- Line width starting at 0.04 mm (1/e<sup>2</sup>)
- Line length from 26 mm to 2840 m
- Integrated focussing mechanism
- Metal housing  $\varnothing$  25/28 mm
- Laser output power up to 100 mW
- Laser wavelength 635 to 980 nm optional 408 nm or 1064 – 1550 nm
- Integrated power control
- Output power adjustable <1 - 100 %
- External modulation TTL up to 250 kHz and analog up to 100 kHz
- Supply voltage 5V DC

### Application



3D profile measurement with the laser light section method

### Line width factor F

Properties of the laser diode beam source, like beam diameter and wavelength, affect width and Rayleigh range/ depth of focus of the laser line:  
line width: multiply by  $F$   
Rayleigh range/ depth of focus: multiply by  $1/F^2$

### Laser micro line generator 13LR.../13LRM...

- 1 Focussing the laser line to the working distance
- 2 Locking/unlocking of the focus position,
- 3 Potentiometer for laser output power, X1 Line shape

The line lengths and line widths listed in table 1 and table 3 are valid for the nominal working distance of the line optics. Deviating working distances can be reached by refocussing, considering the given focussing range. The line length and line width approximately change proportional with the working distance.

Laser micro line generators 13LR... and laser macro line generators 13LRM... are characterized by a homogeneous intensity distribution and a constant line width along the entire line length. In addition, type 13LRM... has an extended depth of focus. The laser line generators have an integrated electronics and can be modulated externally. The beam shaping optics defines the beam parameter fan angle and line length, the optimum working distance, and the focussing range, see table 1 and table 3 respectively. The used laser module defines the wavelength and the output power and so the laser safety class, see table 2 and table 4 respectively.

Laser Micro Line Generator 13LR... Order Code 13 LR 25 S500 +								55CM - 660 - 26 - M01-T12 - C - 6											
Beam Parameters						Line Optics		Table 2											
Table 1						13LR		Table 2											
Line Optics 13LR...	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Rayleigh Range 2z <sub>R</sub> [mm]	Focusing Range [mm]	Convergence $\beta$ [Deg]	Dim. X [mm]	Order Code	curr. no.	Laser Diode Source	Wave-length [nm]	P <sub>out</sub> [mW]	LD Code	Lens	Electronics	Cable	Safety Classification	Edge Intensity [%]	Line Width Factor F
Table 1.1 $\alpha = 12^\circ$	26	0.043	120	3.0	100 - 205	1.4	12	13LR12M125	1	55CM	- 635	- 10	H10	- T12	- C	- ...	3B	>80	0.95
	52	0.072	248	12.2	205 - 415	0.7	8	13LR12S250	2	55CM	- 638	- 22	N09	- T12	- C	- ...	3B	>80	1.09
	103	0.144	496	48.8	415 - 815	0.3	8	13LR12S500	3	55CM	- 660	- 26	M01	- T12	- C	- 6	3B	>80	0.79
	201	0.288	977	195	815 - 1300	0.2	8	13LR12S1000	4	55CM	- 660	- 100	M25	- T12	- P	- ...	3B	>80	0.79
Table 1.2 $\alpha = 25^\circ$	55	0.043	119	3.0	100 - 205	1.4	12	13LR25M125	5	55CM	- 660	- 44	M26	- T12	- C	- ...	3B	>80	0.88
	109	0.072	249	12.2	205 - 415	0.7	8	13LR25S250	6	55CM	- 685	- 26	M21	- T12	- C	- ...	3B	>80	0.86
	217	0.144	496	48.8	415 - 815	0.3	8	13LR25S500	7	55CM	- 780	- 39	H06	- T12	- C	- ...	3B	>80	0.98
	425	0.288	977	195	815 - 1300	0.2	8	13LR25S1000	8	55CM	- 785	- 7	Y03	- T12	- C	- ...	3B	>80	0.72
Table 1.3 $\alpha = 40^\circ$	90	0.065	120	3.0	100 - 205	1.4	15	13LR40M125	9	55CM	- 785	- 61	N08	- T12	- C	- ...	3B	>80	1.17
	180	0.108	245	12	205 - 410	0.7	10.5	13LR40S250	10	55CM	- 830	- 105	N07	- T12	- C	- ...	3B	>80	1.42
	357	0.216	492	49	410 - 815	0.3	10.5	13LR40S500	11	55CM	- 980	- 9	W01	- T12	- C	- ...	3B	>80	1.46
	698	0.433	973	195	815 - 1290	0.2	10.5	13LR40S1000											
Each line optics can be combined with all laser modules																			

- Electr. Cable:**
- 1.5 m shielded conn. cable 4xAWG 26CUL 0.14 mm<sup>2</sup> ... 1
  - as 1, with connector type Lumberg SV50 6
  - cabel specified by customer. .... 5

Y03: Laser diodes with low coherence lengths in the lower power range. Further wavelengths/ output powers on request.

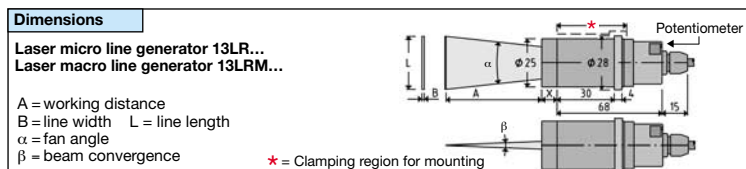
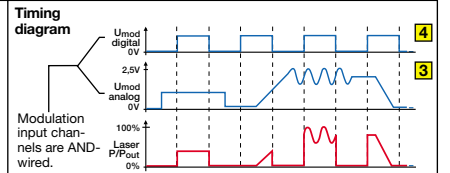
Laser Macro Line Generator 13LRM... Order Code 13 LRM 25 S500-1,5 +								55CM - 660 - 23 - M01-T12 - C - 6											
Beam Parameters						Line Optics		Table 4											
Table 3						13LRM		Table 4											
Line Optics 13LRM...	Line Length L [mm]	Line Width B [mm]	Working Distance A [mm]	Depth of Focus [mm]	Focusing Range [mm]	Convergence $\beta$ [Deg]	Dim. X [mm]	Order Code	curr. no.	Laser Diode Source	Wave-length [nm]	P <sub>out</sub> [mW]	LD Code	Lens	Electronics	Cable	Safety Classification	Edge Intensity [%]	Line Width Factor F
Table 3.1 $\alpha = 12^\circ$	26	0.08	113	21	95 - 195	0.69	18.9	13LRM12M125-1,5	1	55CM	- 635	- 7	H10	- T12	- C	- ...	3B	>80	0.95
	52	0.16	236	83	195 - 355	0.34	18.9	13LRM12S250-1,5	2	55CM	- 638	- 16	N09	- T12	- C	- ...	3B	>80	0.95
	103	0.32	472	332	355 - 780	0.17	18.9	13LRM12S500-1,5	3	55CM	- 660	- 23	M01	- T12	- C	- 6	3B	>80	0.99
	201	0.65	945	1327	780 - 1330	0.09	18.9	13LRM12S1000-1,5	4	55CM	- 660	- 53	M25	- T12	- P	- ...	3B	>80	0.99
Table 3.2 $\alpha = 25^\circ$	55	0.08	111	21	95 - 195	0.69	18.9	13LRM25M125-1,5	5	55CM	- 660	- 28	M26	- T12	- C	- ...	3B	>80	0.99
	109	0.16	238	83	195 - 355	0.34	18.9	13LRM25S250-1,5	6	55CM	- 685	- 16	M21	- T12	- C	- ...	3B	>80	0.86
	217	0.32	472	332	355 - 780	0.17	18.9	13LRM25S500-1,5	7	55CM	- 780	- 24	H06	- T12	- C	- ...	3B	>80	1.16
	425	0.65	946	1327	780 - 1330	0.09	18.9	13LRM25S1000-1,5	8	55CM	- 785	- 3	Y03	- T12	- C	- ...	3B	>80	1.17
Table 3.3 $\alpha = 40^\circ$	90	0.08	111	21	105 - 195	0.69	23.4	13LRM40M125-1,5	9	55CM	- 785	- 42	N08	- T12	- C	- ...	3B	>80	1.17
	180	0.16	240	83	195 - 355	0.34	18.9	13LRM40S250-1,5	10	55CM	- 830	- 79	N07	- T12	- C	- ...	3B	>80	1.24
	357	0.32	472	332	355 - 785	0.17	18.9	13LRM40S500-1,5	11	55CM	- 980	- 6	W01	- T12	- C	- ...	3B	>80	1.46
	698	0.65	968	1327	785 - 1340	0.09	18.9	13LRM40S1000-1,5											
Each line optics can be combined with all laser modules																			

- Electr. Cable:**
- 1.5 m shielded conn. cable 4xAWG 26CUL 0.14 mm<sup>2</sup> ... 1
  - as 1, with connector type Lumberg SV50 6
  - cabel specified by customer. .... 5

Y03: Laser diodes with low coherence lengths in the lower power range. Further wavelengths/ output powers on request.

Integrated electronics		
Electronics type	P	C
Supply voltage	+5 V $\pm$ 0.2 V	
Current consumption	max.	250 mA
Max. modulation analog	10 Hz	100 kHz
frequency	TTL	250 kHz
With potentiometer adjustable outp. power	<5-100%	<1-100%
TTL modulation logic	Laser ON	TTL high
Analog control voltage	P <sub>min</sub> to P <sub>max</sub>	0...2.5 V

**Modulation:** The laser has two AND-wired modulation input channels, U<sub>analog</sub> [3] and U<sub>TTL</sub> [4]. The laser is OFF in case of an open modulation input. Using the digital modulation input the laser can be modulated. If only one modulation input channel is used the other has to be set to +5 V. (see timing diagram). The voltage U<sub>analog</sub> at analog modulation input [3] linearly controls the laser output power between  $\leq$  1% and 100% of the optical power set with the potentiometer.



Pin-out		
Cable	Conn.	
black	1	GND
red	2	+5V
br	3	U <sub>mod</sub> analog
or	4	U <sub>mod</sub> TTL
	5	n.c.
shield	case	

Circular connector Lumberg SV50 (IEC-60130-9) for power supply and external modulation (pin U<sub>mod</sub>). Cable shielding and housing are connected. Both are galvanically decoupled from the laser diode and electronics.