

CARBIDE



Unibody-Design Femtosecond Lasers for Industry and Science

FEATURES

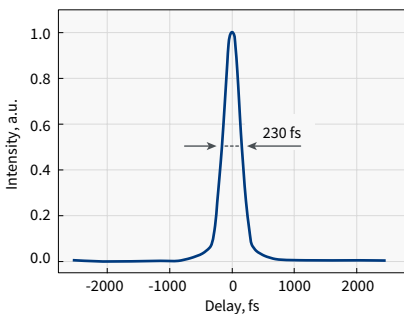
- 190 fs – 20 ps tunable pulse duration
- 2 mJ maximum pulse energy
- 80 W maximum output power
- Single-shot – 2 MHz repetition rate
- Pulse picker for pulse-on-demand mode
- Air-cooled version
- Automated harmonic generators
- Scientific interface module



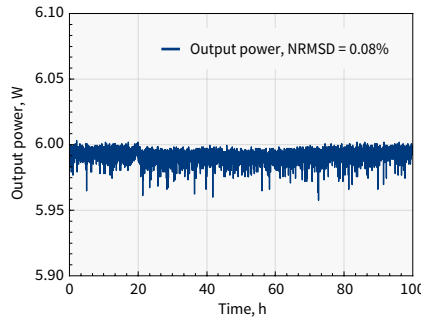
CARBIDE-CB3

CARBIDE is a series of femtosecond lasers combining high average power and excellent power stability. CARBIDE features market-leading output parameters without compromises to beam quality and stability. A compact and robust optomechanical CARBIDE design allows a variety of applications in top-class research centers, as well as display, automotive, LED, medical, and other industries. The reliability of CARBIDE has been proven by hundreds of systems operating 24/7 in the industrial environment.

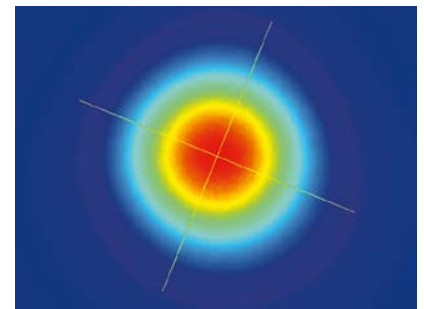
The tunability of CARBIDE lasers enables our customers to discover the most efficient manufacturing processes. Tunable parameters include pulse duration (190 fs – 20 ps), repetition rate (single-shot – 2 MHz), pulse energy (up to 2 mJ), and average power (up to 80 W). A pulse-on-demand mode is available using the built-in pulse picker. The CARBIDE lasers can be equipped with industrial-grade modules, including but not limited to high-power harmonic generators.



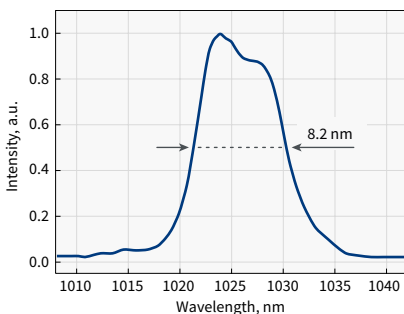
Typical pulse duration of CARBIDE laser



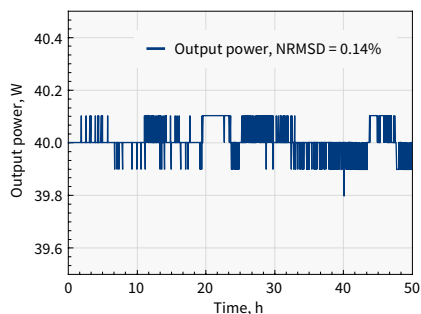
Long-term power stability of CARBIDE-CB5



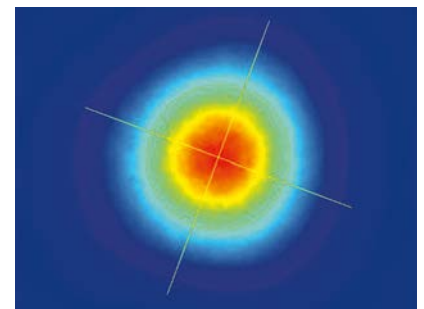
Typical beam profile of CARBIDE-CB5



Typical spectrum of CARBIDE laser



Long-term power stability of CARBIDE-CB3



Typical beam profile of CARBIDE-CB3

SPECIFICATIONS

NEW

Model	CB3-20W	CB3-40W	CB3-80W	CB5	CB5-SP
-------	---------	---------	---------	-----	--------

OUTPUT CHARACTERISTICS

Cooling method	Water-cooled			Air-cooled ¹⁾		
Maximum output power	20 W	40 W	80 W	6 W	5 W	
Pulse duration ²⁾	< 250 fs		< 350 fs ³⁾	< 290 fs	< 190 fs	
Pulse duration tuning range	250 fs – 10 ps		350 fs – 10 ps	290 fs – 20 ps	190 fs – 20 ps	
Maximum pulse energy	0.4 mJ	0.8 mJ	2 mJ	100 µJ	83 µJ	
Repetition rate	Single-shot – 1 MHz	Single-shot – 1 MHz (2 MHz on request)	Single-shot – 2 MHz	Single-shot – 1 MHz		
Pulse selection	Single-shot, pulse-on-demand, any fundamental repetition rate division					
Center wavelength ⁴⁾	1030 ± 10 nm					
Polarization	Linear, vertical; 1 : 1000					
Beam quality, M ²	< 1.2					
Beam diameter ⁵⁾	4.3 mm	4.6 mm	5.6 mm	2.3 mm		
Beam pointing stability	< 20 µrad/°C					
Pulse picker	FEC ⁶⁾			included	included ⁷⁾	included
Pulse picker leakage	< 0.5%			< 2%	< 0.1%	< 2%
Pulse-to-pulse energy stability ⁸⁾	RMS deviation ⁹⁾ < 0.5% over 24 h					
Long-term power stability ⁸⁾	RMS deviation ⁹⁾ < 0.5% over 100 h					

OPTIONAL EXTENSIONS

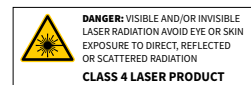
Harmonic generators	Integrated, optional (see page 13)				
Output wavelength	515 nm, 343 nm, or 257 nm				
Optical parametric amplifier	Integrated, optional (see page 14)				
Tuning range	320 – 10000 nm				
BiBurst option	Tunable GHz and MHz burst with burst-in-burst capability, optional (see page 9)				
GHz-Burst					
Intra burst pulse period ¹⁰⁾	440 ± 40 ps				n/a
Number of pulses, P ¹¹⁾	1 – 10				
MHz-Burst					
Intra burst pulse period	≈ 15 ns				
Number of pulses, N	1 – 10				

PHYSICAL DIMENSIONS

Laser head (L × W × H)	632 × 305 × 173 mm		631 × 324 × 167 mm	
Chiller (L × W × H)	680 × 484 × 307 mm		Not required	
24 V DC power supply (L × W × H)	280 × 144 × 49 mm	320 × 200 × 75 mm	220 × 95 × 46 mm	

ENVIRONMENTAL & UTILITY REQUIREMENTS

Operating temperature	15 – 30 °C (59 – 86 °F)		17 – 27 °C (62 – 80 °F)	
Relative humidity	< 80% (non-condensing)			
Electrical requirements	100 V AC, 7 A – 240 V AC, 3 A; 50 – 60 Hz	100 V AC, 12 A – 240 V AC, 5 A; 50 – 60 Hz	100 V AC, 3 A – 240 V AC, 1.3 A; 50 – 60 Hz	
Rated power	600 W	1000 W	300 W	
Power consumption	500 W	700 W	150 W	
Electrical requirements (chiller)	100 – 230 V AC; 50 – 60 Hz	200 – 230 V AC; 50 – 60 Hz	Not required	
Rated power (chiller)	1400 W	2000 W		
Power consumption (chiller)	1000 W	1300 W		



¹⁾ Water-cooled version available on request.

²⁾ Assuming Gaussian pulse shape.

³⁾ Pulse duration can be reduced to < 250 fs if pulse peak intensity of > 50 GW/cm² is tolerated by customer setup.

⁴⁾ Precise center wavelength for specific models available upon request.

⁵⁾ FW 1/e², using maximum pulse energy.

⁶⁾ Provides fast energy control; external analog control input available. Response time – next available RA pulse.

⁷⁾ Enhanced contrast AOM. Provides fast amplitude control of output pulse train.

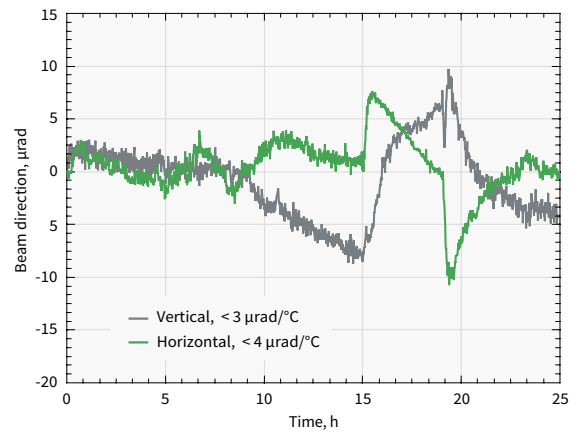
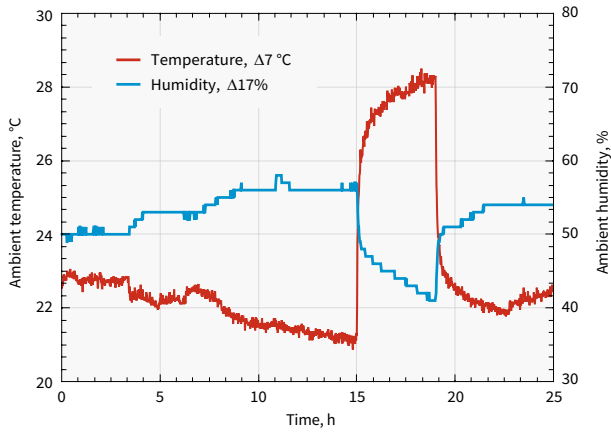
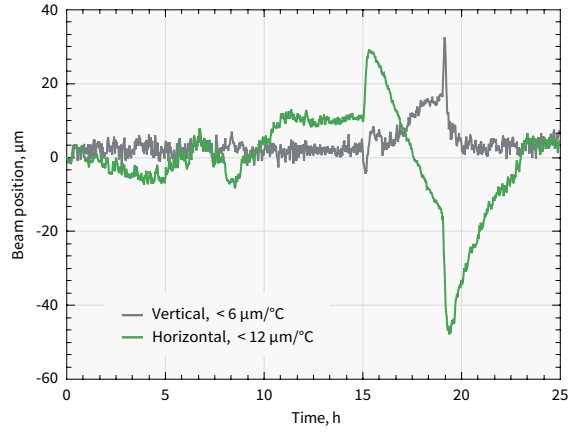
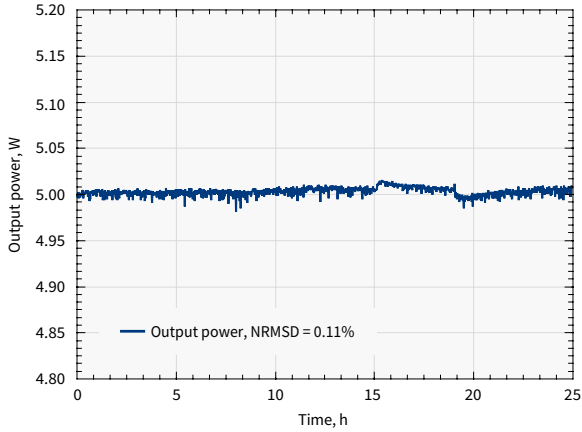
⁸⁾ Under stable environmental conditions.

⁹⁾ Normalized to average pulse energy, NRMSD.

¹⁰⁾ Custom spacing is available on request.

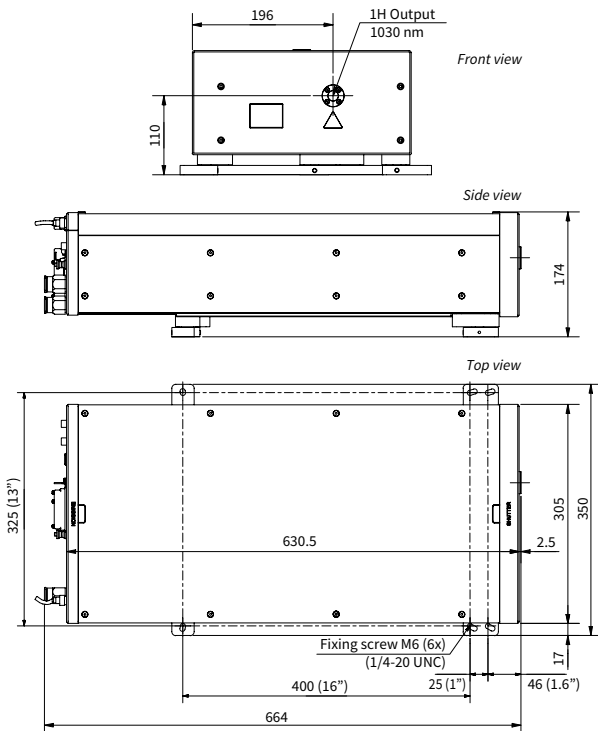
¹¹⁾ Maximum number of pulses in a burst depends on the laser repetition rate. Custom number of pulses is available on request.

STABILITY MEASUREMENTS

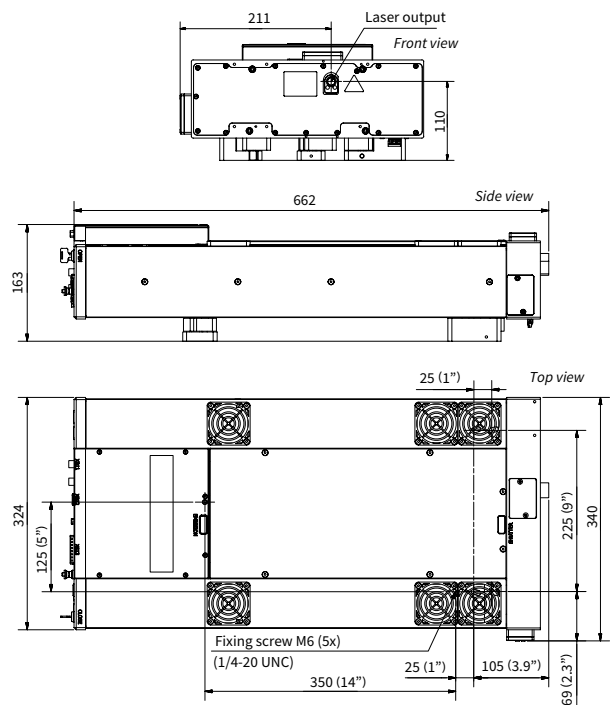


Output power, beam direction, and beam position of CARBIDE-CB5 under harsh environmental conditions

DRAWINGS



Drawing of CARBIDE-CB3



Drawing of air-cooled CARBIDE-CB5 with attenuator

HG | CARBIDE

Automated Harmonic Generators

FEATURES

- 515 nm, 343 nm, or 257 nm output
- Automated harmonic selection
- Mounted directly on the laser head
- Industrial-grade design
- 30 W UV model

CARBIDE lasers equipped with automated harmonic generators (HGs) provide a selection of fundamental (1030 nm), second (515 nm), third (343 nm), or fourth (257 nm) harmonic outputs using software control.



2H-3H HG attached to CARBIDE-CB3 femtosecond laser

HGs are perfect for industrial applications that require a single-wavelength output. Modules, mounted directly at the output of the laser, are fully integrated into the system.

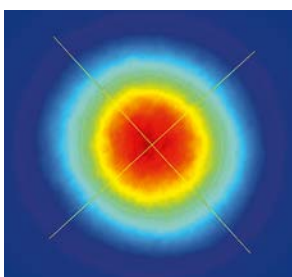
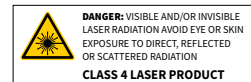
SPECIFICATIONS

Model	2H	2H-3H	2H-4H	2H-3H (30W UV) ¹⁾
Output wavelength ²⁾ (automated selection)	1030 nm 515 nm	1030 nm 515 nm 343 nm	1030 nm 515 nm 257 nm	1030 nm 515 nm 343 nm
Pump pulse energy	20 – 2000 μJ	50 – 2000 μJ	20 – 2000 μJ	80 – 400 μJ
Pump pulse duration		< 300 fs		≈ 500 fs
Conversion efficiency / Output power	> 50% (2H)	> 50% (2H) > 25% (3H)	> 50% (2H) > 10% (4H) ³⁾	40 W (2H) 30 W (3H)
Beam quality (M ²) typical values	≤ 400 μJ pump	< 1.15 (2H) < 1.2 (3H)	< 1.15 (2H) < n/a (4H)	< 1.2 (2H) < 1.3 (3H)
	> 400 μJ pump	< 1.2 (2H)	< 1.2 (2H) < n/a (4H)	n/a

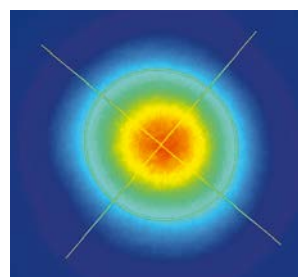
¹⁾ Available only for CARBIDE-CB3-80W with maximum output power; 1 year lifetime.

²⁾ Depends on pump laser model. Up to 5th harmonic available; contact sales@lightcon.com for details.

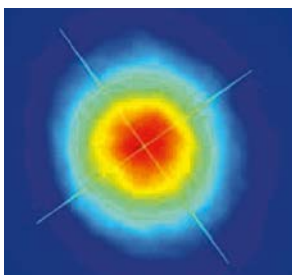
³⁾ Maximum output power of 1 W.



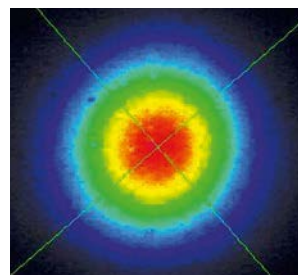
Typical 1H beam profile of CARBIDE-CB5 (100 kHz, 6 W)



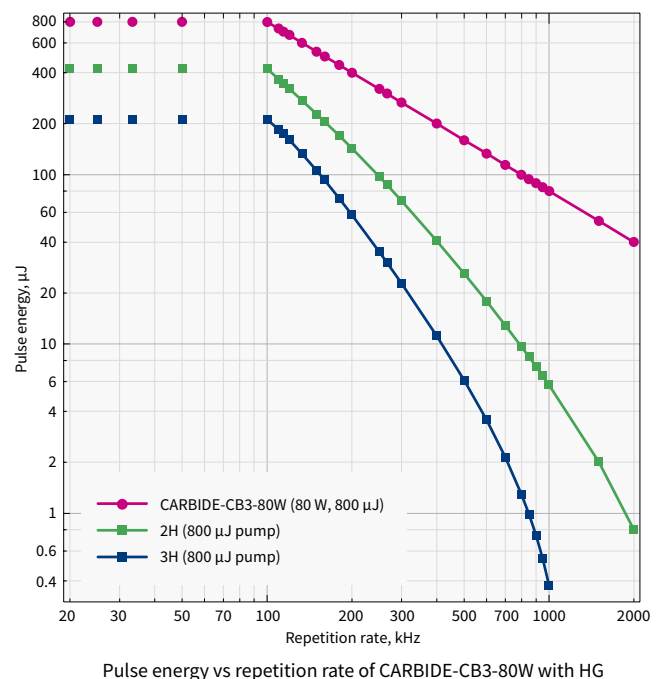
Typical 2H beam profile of CARBIDE-CB5 (100 kHz, 3.4 W)



Typical 3H beam profile of CARBIDE-CB5 (100 kHz, 2.2 W)



Typical 4H beam profile of CARBIDE-CB5 (100 kHz, 100 mW)



BiBurst option

Tunable GHz and MHz Burst with Burst-in-Burst Capability

PHAROS and CARBIDE-CB3 lasers have an option for tunable GHz and MHz burst with burst-in-burst capability – called BiBurst.

In standard mode, a single pulse is emitted at some fixed frequency. In burst mode, the output consists of pulse packets instead of single pulses. Each packet consists of a certain number of equally separated pulses. MHz-Burst contains N pulses with a nanosecond period, GHz-Burst contains P pulses with a picosecond period. If both bursts are used, the equally separated pulse packets contain sub-packets of pulses (burst-in-burst, BiBurst).

PHAROS and CARBIDE lasers with the BiBurst option bring new capabilities to high-tech manufacturing industries such as consumer electronics, integrated photonic chip manufacturing, future display manufacturing, and quantum technologies. The applications include:

- brittle material drilling and cutting
- deep engraving
- selective ablation
- volume modification of transparent materials
- hidden marking
- surface polishing
- surface functionalization

SPECIFICATIONS

Model		CARBIDE-CB3	PHAROS
GHz Burst	Intra burst pulse period ¹⁾	440 ± 40 ps	200 ± 40 ps
	Number of pulses, P ²⁾	1 – 10	1 – 25
MHz Burst	Intra burst pulse period	≈ 15 ns	
	Number of pulses, N	1 – 10	1 – 9 (7 with FEC)

¹⁾ Custom spacing is available on request.

²⁾ Maximum number of pulses in a burst depends on the laser repetition rate. Custom number of pulses is available on request.

