

CARBIDE

Femtosecond Lasers for Industrial and Medical Applications

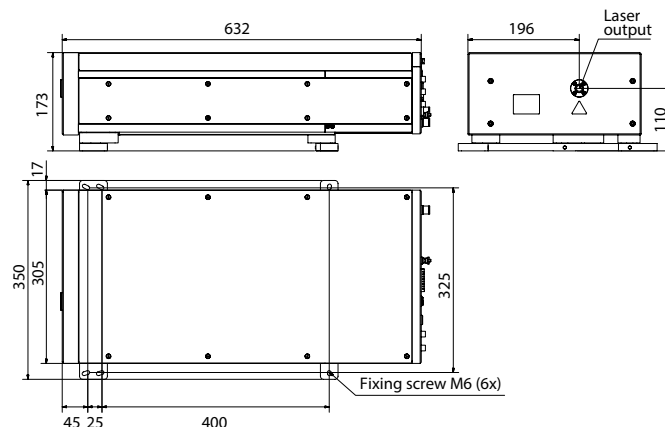


FEATURES

- <290 fs – 10 ps tunable pulse duration
- >400 μJ pulse energies
- >40 W output power
- 60 – 1000 kHz tunable base repetition rate
- Includes pulse picker for pulse-on-demand operation
- Rugged, industrial grade mechanical design
- Air or water cooling
- Automated harmonics generators (515 nm, 343 nm, 257 nm)

CARBIDE industrial femtosecond lasers feature output power of >40 W at 1028 nm wavelength, with >400 μJ highest pulse energies, it maintains all the best features of its predecessor PHAROS: variable pulse repetition rate in the range of 60–1000 kHz (amplifier internal clock) with the built-in pulse picker feature for pulse-on-demand control, computer controllable pulse duration 290 fs – 10 ps. In addition to usual parameters CARBIDE brings in a few new technologies. One of the most important being a few times higher output average power to wall plug efficiency. It also features novel approach to a cavity design where oscillator, stretcher/compressor and amplifier are integrated into a single housing, this way optimized for volume production. It also allows fast warm-up (important for medical applications), easy access to pump LD modules for replacement. Intra-cavity pulse picker allows reduction of cost and power consumption. Highly integrated LD driver and control electronics, along with embedded control computer now provide less electromagnetic noise emission and allow faster assembly during production stage. However, one of the most

impressive features of CARBIDE is its size of 631×324×167 mm air-cooled version and 632×305×173 mm water-cooled version including integrated power supply and air cooling unit. Water-cooled version has external chiller. This represents about 7 times reduction in system volume as compared to PHAROS, already one of the most compact ultrafast lasers on the market. CARBIDE features number of optional components complementing different application requirements: certified safety shutter, beam conditioning unit (beam expander with optional spatial filter), automated attenuator, harmonics unit, additional pulse picker for enhanced contrast. CARBIDE is primarily targeted to the industrial market where relatively low average power cost effective solution with ultrafast pulses is needed. In largest part this is biomedical application with a direct biological tissue processing or biomedical device manufacturing. In addition output parameters of CARBIDE are sufficient to support different wavelength converters starting with harmonic generators to parametric amplifiers.



Outline drawing of water-cooled CARBIDE

SPECIFICATIONS

Cooling method	Air-cooled ¹⁾		Water-cooled	
Max. average power	>5 W	>4 W	>40 W	
Pulse duration (assuming Gaussian pulse shape)	<290 fs			
Pulse duration adjustment range	290 fs – 10 ps			
Max. pulse energy	>85 μJ	>65 μJ	>200 μJ	>400 μJ
Base repetition rate ²⁾	60 – 1000 kHz		200 – 1000 kHz	100 – 1000 kHz
Pulse selection	Single-Shot, Pulse-on-Demand, any base repetition rate division			
Centre wavelength ³⁾	1028±5 nm			
Beam quality	TEM ₀₀ ; M ² < 1.2			
Pulse picker	included	included, enhanced contrast AOM ⁴⁾	included	
Pulse picker leakage	<2 %	<0.1 %	<0.5 %	
Output power stability	<0.5% rms over 24 hours ⁵⁾			

PHYSICAL DIMENSIONS

Laser head	631(L) × 324(W) × 167(H) mm	632(L) × 305(W) × 173(H) mm
Power supply	220(L) × 95(W) × 45(H) mm	

UTILITY REQUIREMENTS

Electric	110 – 220 V AC, 50 – 60 Hz, up to 300 W
Operating temperature	17–27 °C (62–80 °F)
Relative humidity	< 65 % (non-condensing)

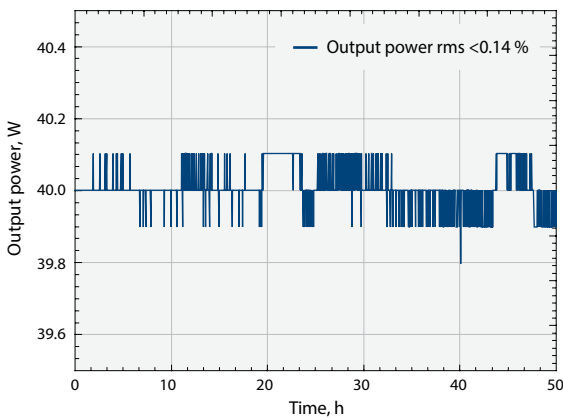
¹⁾ Water-cooled version available on request.

³⁾ 2nd (515 nm) and 3rd (343 nm) harmonic output also available.

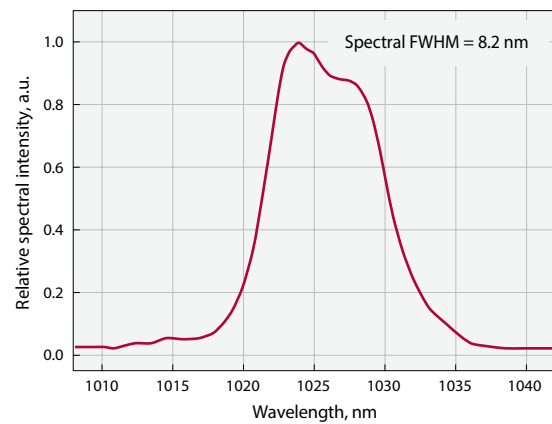
⁵⁾ Under stable environmental conditions.

²⁾ Lower repetition rates are available by controlling pulse picker.

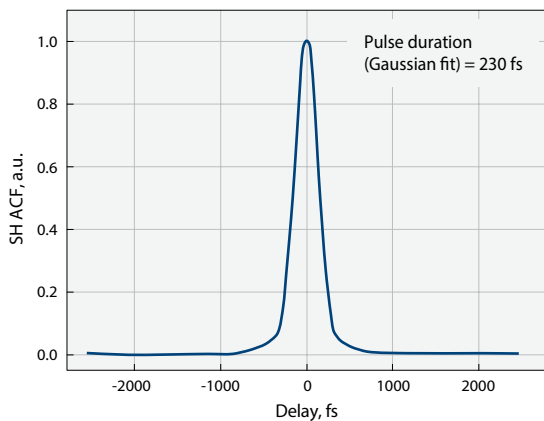
⁴⁾ Provides fast amplitude control of output pulse train.



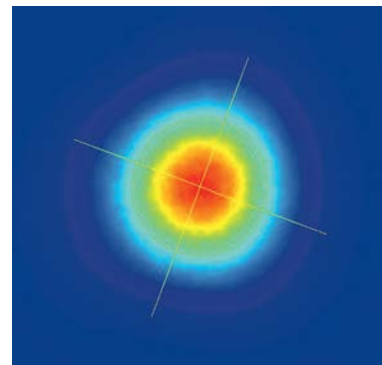
Long term power stability (water-cooled version)



Spectrum of CARBIDE (water-cooled version)



Pulse duration of CARBIDE (water-cooled version)

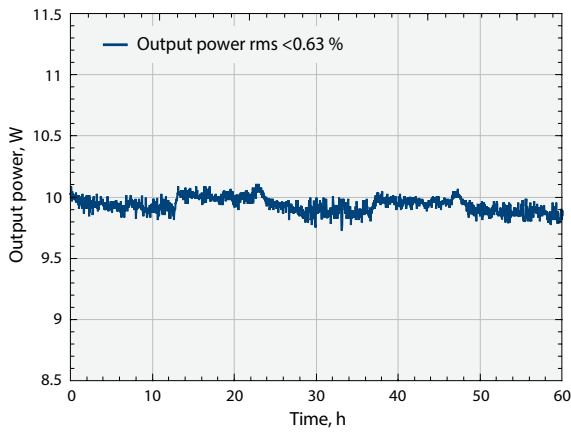


Typical CARBIDE beam profile (water-cooled version)

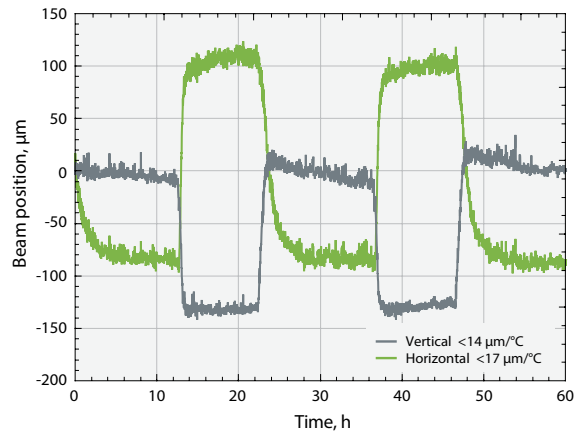
Air-cooled version of **CARBIDE**

FEATURES

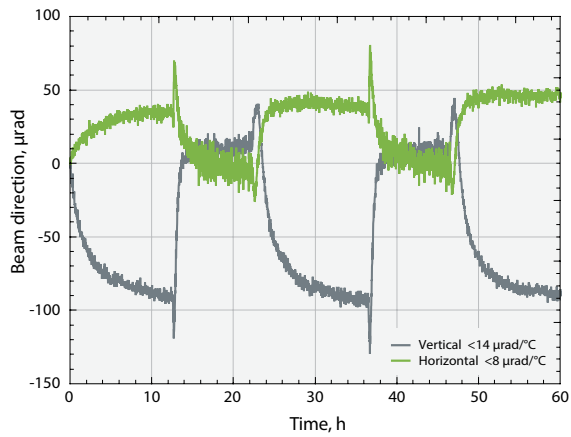
- <290 fs – 10 ps tunable pulse duration
- >85 μJ pulse energies
- >5 W output power
- Air or water cooling



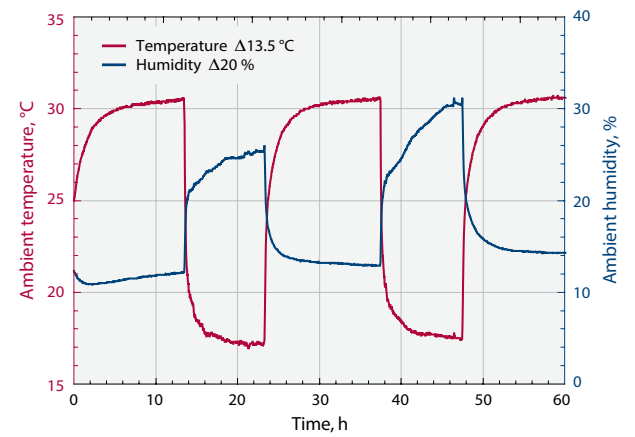
Output power under harsh environment conditions (air-cooled version)



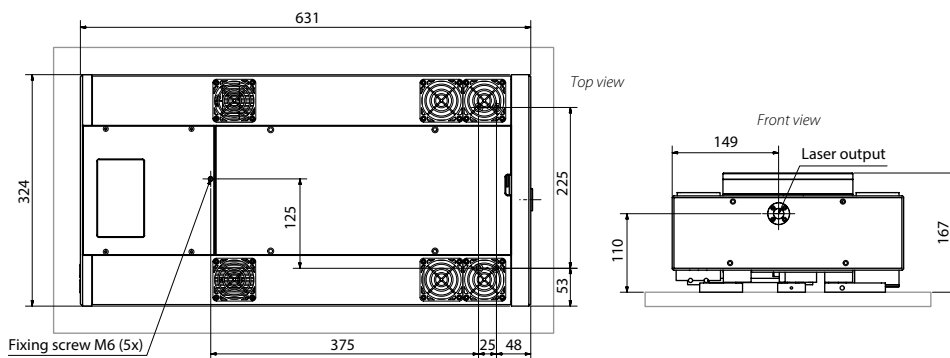
Beam position under harsh environment conditions (air-cooled version)



Beam direction under harsh environment conditions (air-cooled version)



Harsh environment conditions (air-cooled version)



Outline drawing of air-cooled CARBIDE

CARBIDE

Automated Harmonics Generators



Air-cooled CARBIDE with harmonics generator module

FEATURES

- 515 nm, 343 nm and 257 nm
- Output selection by software
- Mounts directly on laser head and integrated into the system
- Rugged, industrial grade mechanical design

CARBIDE laser can be equipped with automated harmonics module. Selection of fundamental (1030 nm), second (515 nm), third (343 nm) or fourth (257 nm) harmonic output is available by software control.

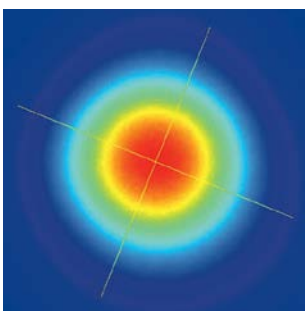
Harmonic generators are designed to be used in industrial applications where a single output wavelength is desired. Modules are mounted directly on the output of the laser and integrated into the system.

SPECIFICATIONS

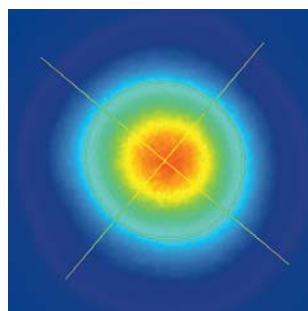
Model	CBM02-2H	CBM01-2H-3H	CBM01-4H
Output wavelength (automated selection)	1030 nm 515 nm	1030 nm 515 nm 343 nm	1030 nm 257 nm
Input pulse energy		20 – 85 μ J	
Pump pulse duration		>300 fs	
Conversion efficiency	> 60 % (2H)	> 60 % (2H) > 30 % (3H)	>15% (4H)
Beam quality (M^2)	< 1.3 (2H)	< 1.3 (2H) < 1.4 (3H)	<1.4 (4H)

PHYSICAL DIMENSIONS

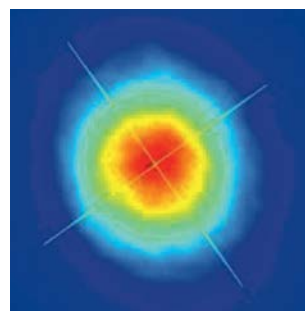
Laser head with harmonics module 751 (L) \times 324 (W) \times 167 (H) mm



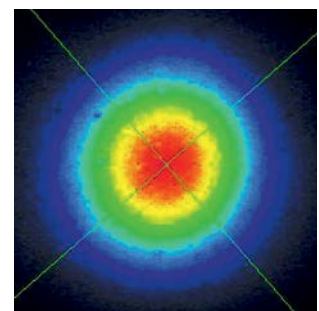
Typical CARBIDE 1H beam profile.
60 kHz, 5W



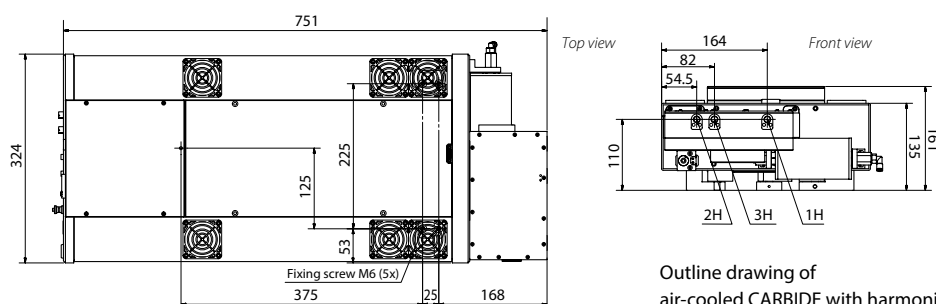
Typical CARBIDE 2H beam profile.
100 kHz, 3.4 W



Typical CARBIDE 3H beam profile.
100 kHz, 2.2 W



Typical CARBIDE 4H beam profile.
100 kHz, 100 mW



Outline drawing of air-cooled CARBIDE with harmonics generator module