

CARBIDE

Femtosecond Lasers for Industry and Science



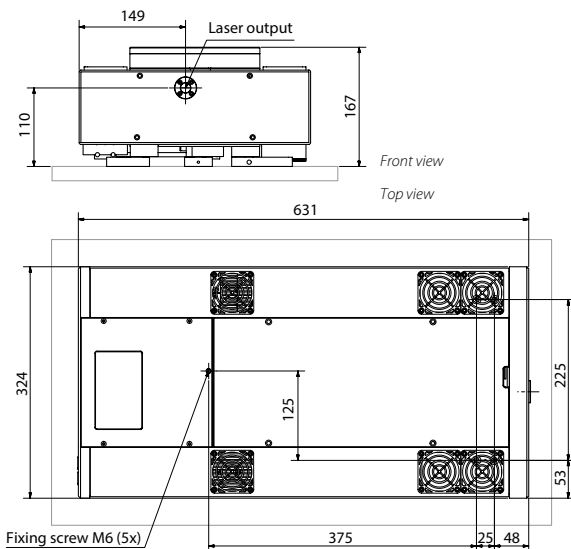
FEATURES

- < 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)
- Scientific interface enhancing system flexibility

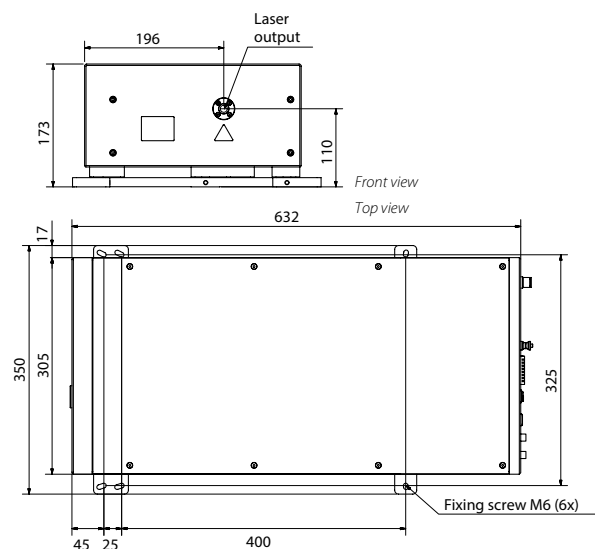
CARBIDE industrial femtosecond laser features an output power of > 40 W at 1028 nm wavelength. The laser emits single pure temporal contrast (>1:200) and up to 400 μJ energy pulses without any compromises to the beam quality, industrial grade reliability and beam stability regardless of the environment it is put in. Continuously tunable base repetition rate in a range of 60 – 1000 kHz is combined with an in-built pulse picker for convenient output pulse control. Software adjustable pulse duration can be easily set in a range of 290 fs – 10 ps in seconds. Excellent power stability of < 0.5 % RMS is standard.

Single monolithic housing allows fast warm-up times. Laser is maintenance free. Electronical and most optical components in the laser are field accessible and upgradeable.

Carbide ships with an integrated shutter fulfilling performance level d requirements according to EN 13849-1 by default. Due to an in-built computer laser control is smooth via the provided extensive software package. Multiple custom laser control options are also available; they are convenient when lasers are being integrated in medical or industrial processing applications. CARBIDE can be equipped with a growing number of optional features: a beam expansion unit, an automated attenuator, harmonics or can be used as a seed source for parametric amplifiers and OPCPA systems.



Outline drawing of air-cooled CARBIDE



Outline drawing of water-cooled CARBIDE

SPECIFICATIONS

Product name	CB5-05	CB5-04	CB3-40-200	CB3-40-400
OUTPUT CHARACTERISTICS				
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 μ J	> 65 μ J	> 200 μ J	> 400 μ J
Base repetition rate ²⁾	60 – 1000 kHz		200 – 1000 kHz	100 – 1000 kHz
Pulse selection	Single-shot, any base repetition rate division			
Centre wavelength ³⁾	1028 \pm 5 nm			
Output pulse-to-pulse stability	< 0.5 % rms over 24 hours ⁴⁾			
Output power stability	< 0.5 % rms over 100 hours			
Beam quality	TEM ₀₀ ; M ² < 1.2			
Pulse picker	included	included, enhanced contrast AOM ⁵⁾	included	
Pulse picker leakage	< 2 %	< 0.1 %	< 0.5 %	
Beam pointing stability	< 20 μ rad/ $^{\circ}$ C			
ENVIRONMENTAL & UTILITY REQUIREMENTS				
Operating temperature	17 – 27 $^{\circ}$ C (62 – 80 $^{\circ}$ F)		15 – 30 $^{\circ}$ C (59 – 86 $^{\circ}$ F)	
Relative humidity	< 65 % (non condensing)		< 80 % (non condensing)	
Electric	110 – 220 VAC, 50 – 60 Hz			
Power consumption	100 W		1.5 kW	
DIMENSIONS				
Laser head	631 (L) \times 324 (W) \times 167 (H) mm		632 (L) \times 305 (W) \times 173 (H) mm	
Power supply	220 (L) \times 95 (W) \times 45 (H) mm		280 (L) \times 144 (W) \times 49 (H) mm	
Chiller	–		590 (L) \times 484 (W) \times 267 (H) mm	

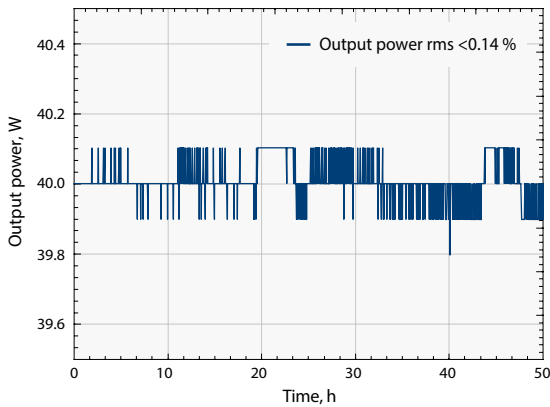
¹⁾ Water-cooled version available on request.

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

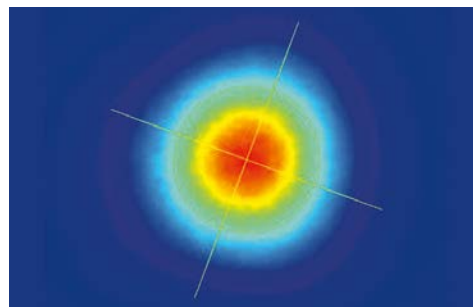
³⁾ 2nd (515 nm) and 3rd (343 nm) harmonic output also available.

⁴⁾ Under stable environmental conditions.

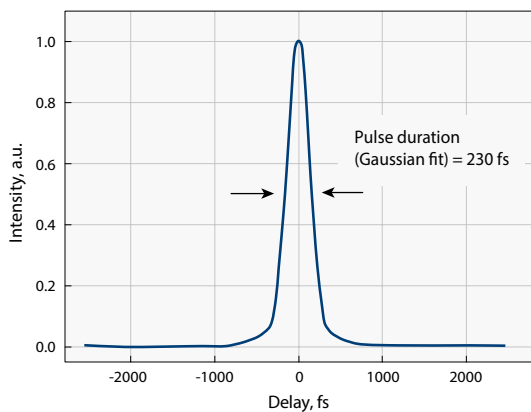
⁵⁾ Provides fast amplitude control of output pulse train.



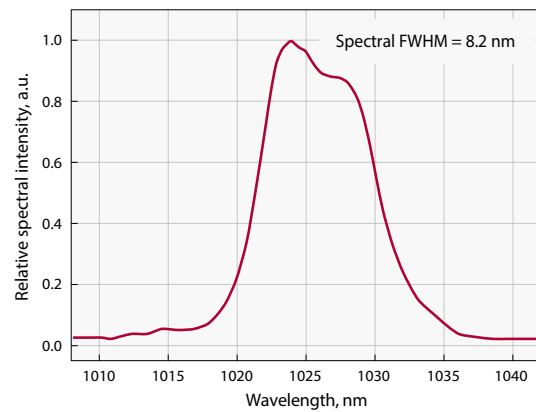
Long term power stability (water-cooled version)



Typical CARBIDE beam profile (water-cooled version)

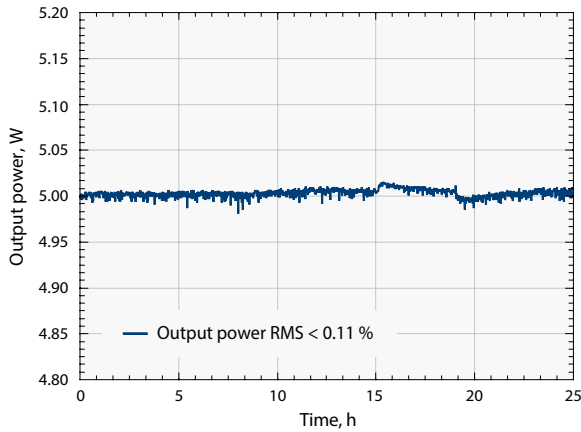


Pulse duration of CARBIDE (water-cooled version)

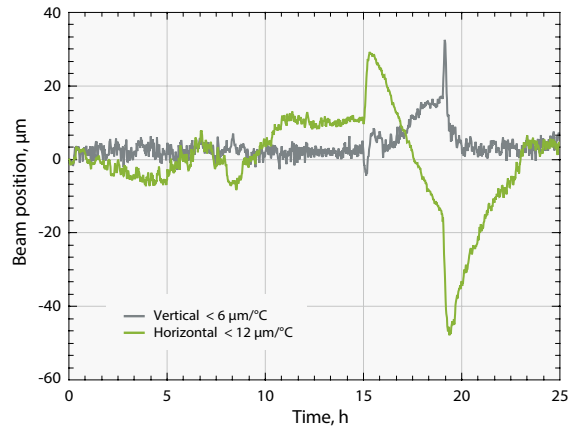


Spectrum of CARBIDE (water-cooled version)

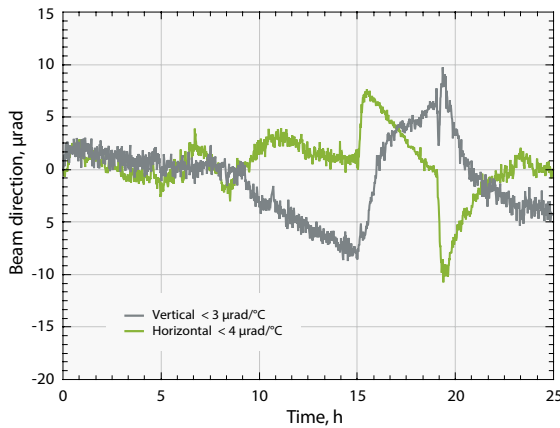
AIR-COOLED CARBIDE STABILITY MEASUREMENTS



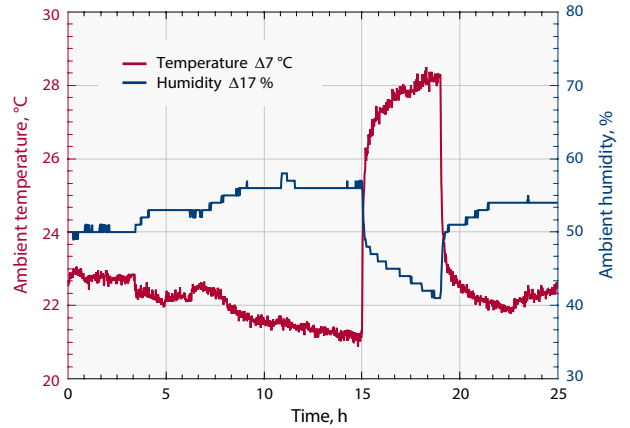
Output power under harsh environment conditions (air-cooled version)



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

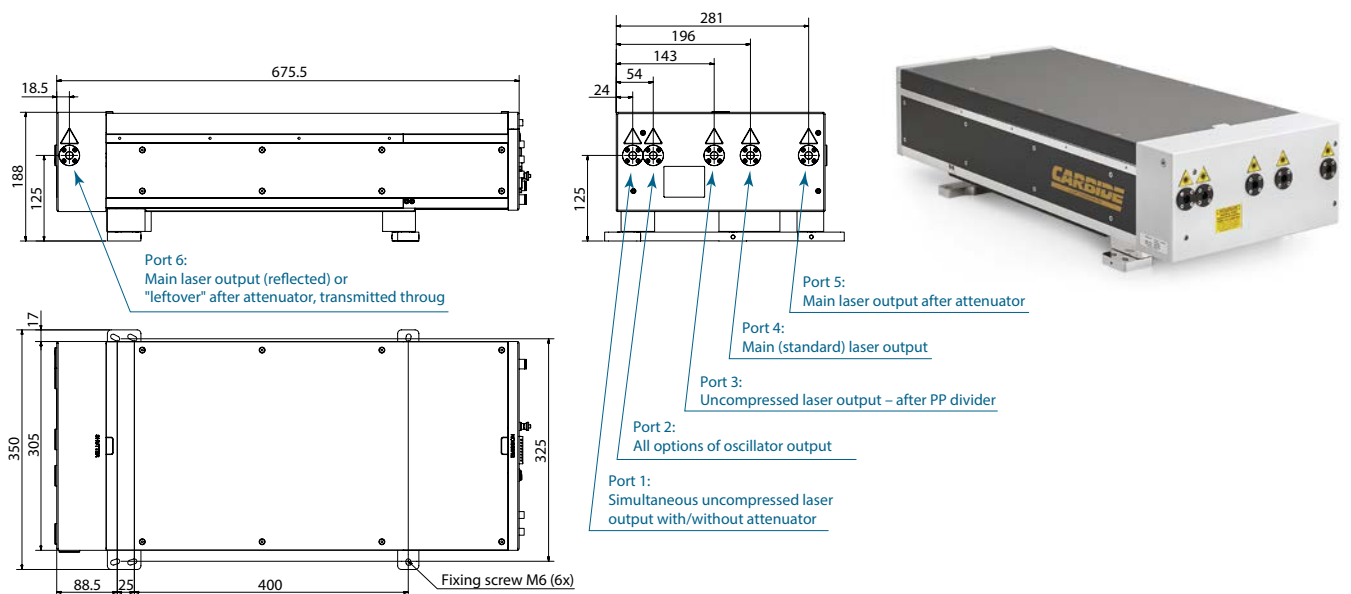


Beam direction under harsh environment conditions (air-cooled version)



Harsh environment conditions (air-cooled version)

WATER-COOLED CARBIDE WITH A SCIENTIFIC INTERFACE



Drawings of CARBIDE with scientific interface

CARBIDE

Automated Harmonics Generators



Air-cooled CARBIDE with harmonics generator module

FEATURES

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

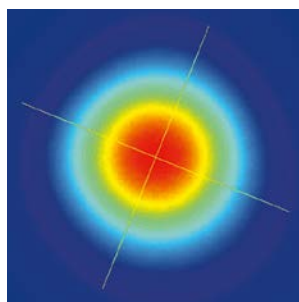
CARBIDE laser can be equipped with automated harmonics modules. Selection of fundamental (1030 nm), second (515 nm), third (343 nm) or fourth (257 nm) harmonics outputs

are available by software control. Harmonics generators are designed to be used in industrial applications where a single output wavelength is desired.

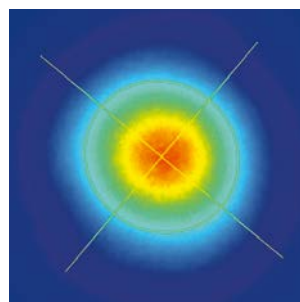
SPECIFICATIONS

Product name	2H	2H-3H	2H-4H
Output wavelength (automated selection)	1030 nm 515 nm	1030 nm 515 nm 343 nm	1030 nm 515 nm 257 nm
Input pulse energy	20 – 400 μ J		
Pump pulse duration	< 300 fs		
Conversion efficiency	> 50 % (2H)	> 50 % (2H) > 25 % (3H)	> 50 % (2H) > 10% (4H) ¹⁾
Beam quality (M^2)	< 1.3 (2H), typical < 1.15	< 1.3 (2H), typical < 1.15 < 1.4 (3H), typical < 1.2	< 1.3 (2H), typical < 1.15 n/a (4H)

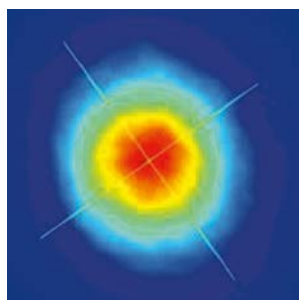
¹⁾ Maximum output power 1 W.



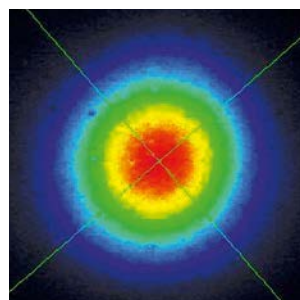
Typical CARBIDE 1H beam profile.
60 kHz, 5W



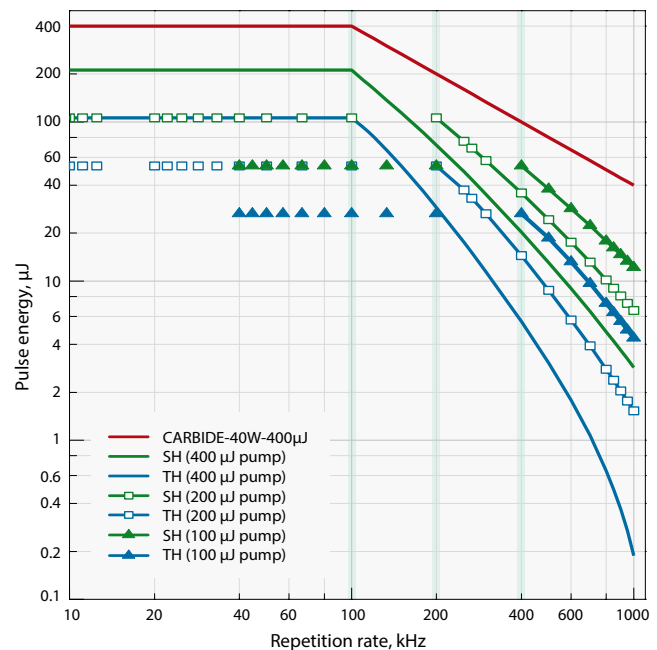
Typical CARBIDE 2H beam profile.
100 kHz, 3.4 W



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



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



CARBIDE harmonics energy vs pulse repetition rate