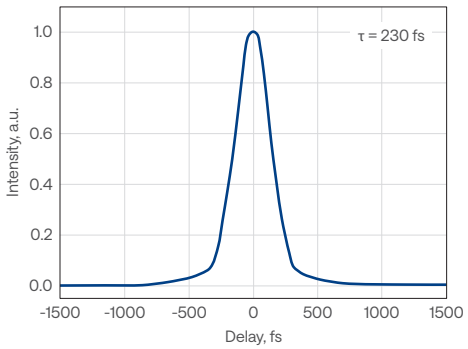
CARBIDE

Industrial Femtosecond Lasers

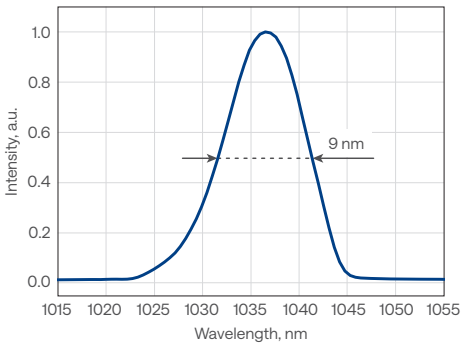
- Maximum output of 120 W (IR) or 50 W (UV)
- NEW — Single-shot – 10 MHz repetition rate
- Pulse-on-demand and BiBurst for pulse control
- Automated harmonics up to the 5th and wavelength-tunable extensions
- Air-cooled or water-cooled models

CARBIDE-CB3

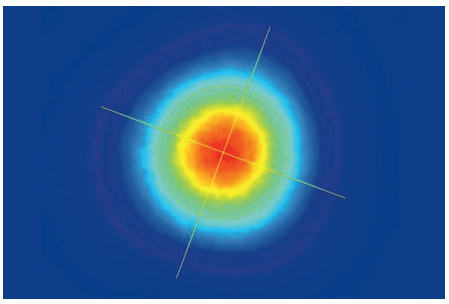
CARBIDE-CB3
Typical pulse duration



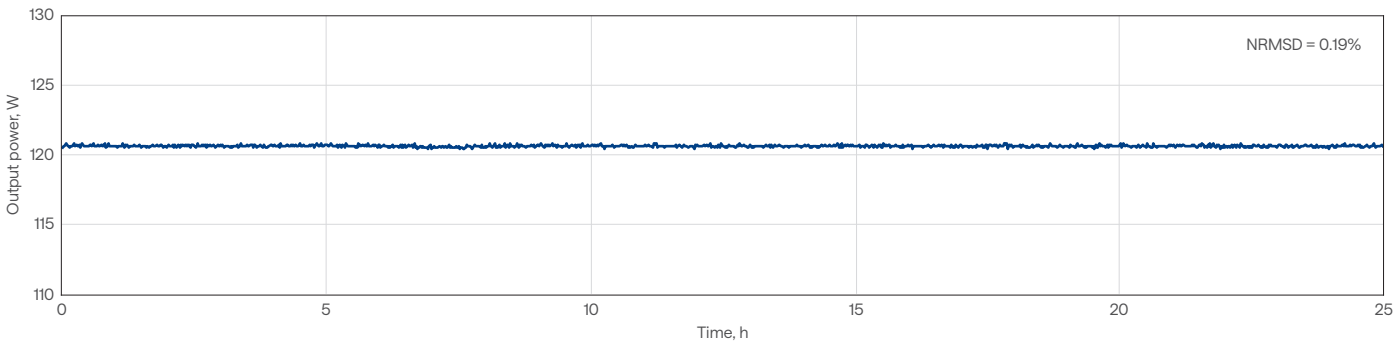
CARBIDE-CB3
Typical spectrum



CARBIDE-CB3
Typical beam profile



CARBIDE-CB3-120W
Long-term power stability



CARBIDE-CB3 specifications

NEW

Model	CB3-20W	CB3-40W	CB3-40W-10MHz	CB3-80W	CB3-120W
OUTPUT CHARACTERISTICS					
Cooling method	Water-cooled				
Center wavelength	1030 ± 10 nm				
Maximum output power	20 W	40 W		80 W	120 W
Pulse duration [1]	< 250 fs			< 350 fs [2]	< 250 fs
Pulse duration tuning range	250 fs – 10 ps			350 fs – 10 ps	250 fs – 10 ps
Maximum pulse energy	0.4 mJ		0.2 mJ	0.8 mJ	2 mJ	1 mJ
Repetition rate	Single-shot – 1 MHz	Single-shot – 1 MHz (2 MHz on request)	Single-shot – 10 MHz	Single-shot – 2 MHz		
Pulse selection	Single-shot, pulse-on-demand, any fundamental repetition rate division				
Polarization	Linear, vertical; 1 : 1000				
Beam quality, M^2	< 1.2				
Beam diameter [3]	3.9 ± 0.4 mm			4.2 ± 0.4 mm	5.1 ± 0.7 mm	5 ± 0.5 mm
Beam pointing stability	< 20 µrad/°C				
Pulse energy control	FEC [4]		Attenuator [5]	FEC [4]	
Pulse picker leakage	< 0.25%		< 0.5%	< 0.25%	
Pulse-to-pulse energy stability, 12 h [6]	< 0.5%				
Long-term power stability, 100 h [6]	< 0.5%				
MAIN OPTIONS					
Oscillator output [7]	< 0.5 W, 120 – 250 fs, 1030 ± 10 nm, ≈ 65 MHz				
Harmonic generator [8]	515 nm, 343 nm, 257 nm, or 206 nm; see CARBIDE HG (page 12)				
Optical parametric amplifier [9]	UV – MIR; see I-OPA (page 30) or ORPHEUS (page 32)				
BiBurst option	Tunable GHz and MHz burst with burst-in-burst capability; see BiBurst (page 14)				
PHYSICAL DIMENSIONS					
Laser head (L × W × H)	633 × 350 × 174 mm				
Chiller (L × W × H)	585 × 484 × 221 mm		680 × 484 × 307 mm		
24 V DC power supply (L × W × H)	352 × 195 × 75 mm				376 x 449 x 88 mm
ENVIRONMENTAL & UTILITY REQUIREMENTS					
Operating temperature	15 – 30 °C				
Relative humidity	< 80% (non-condensing)				
Electrical requirements	Laser	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, 15 A – 240 V AC, 7 A; 50 – 60 Hz
	Chiller	100 – 230 V AC; 50 – 60 Hz		200 – 230 V AC; 50 – 60 Hz	
Rated power	Laser	1000 W		1000 W	2000 W
	Chiller	1400 W		2000 W	
Power consumption	Laser	500 W		900 W	1500 W
	Chiller	1000 W		1300 W	1800 W

[1] *Assuming a Gaussian pulse shape.*

[2] *Pulse duration can be reduced to < 250 fs if a pulse peak intensity of > 50 GW/cm² is tolerated by the customer setup.*

[3] *FW 1/e², using maximum pulse energy.*

[4] *Fast energy control (FEC) provides fast, full-scale individual pulse energy control; an external analog control input is available. An optional integrated waveplate-based variable optical attenuator is available.*

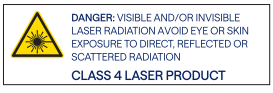
[5] *Waveplate-based variable optical attenuator (VOA); an external analog control input is available. FEC is available for repetition rates up to 2 MHz.*

[6] *Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).*

[7] *Available simultaneously, requires a scientific interface. Contact sales@lightcon.com for more details or customized solutions.*

[8] *Integrated. For an external harmonic generator, see HIRO (page 24).*

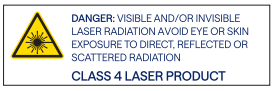
[9] *Integrated. For more details and stand-alone OPAs, see wavelength-tunable sources (page 29).*



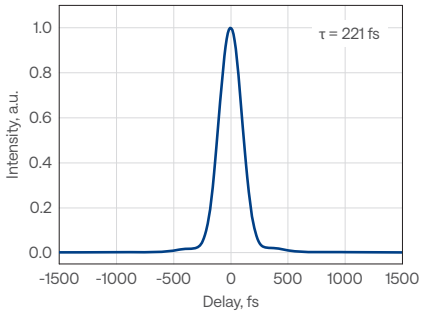
CARBIDE-CB5 specifications

Model	CB5-6W	CB5-5W	CB5-SP
OUTPUT CHARACTERISTICS			
Cooling method	Air-cooled [1]		
Center wavelength	1030 ± 10 nm		
Maximum output power	6 W	5 W	
Pulse duration [2]	< 290 fs		< 190 fs
Pulse duration tuning range	290 fs – 20 ps		190 fs – 20 ps
Maximum pulse energy	100 µJ	83 µJ	100 µJ
Repetition rate	Single-shot – 1 MHz		
Pulse selection	Single-shot, pulse-on-demand, any fundamental repetition rate division		
Polarization	Linear, vertical; 1 : 1000		
Beam quality, M^2	< 1.2		
Beam diameter [3]	2.1 ± 0.4 mm		
Beam pointing stability	< 20 µrad/°C		
Pulse energy control	Attenuator [4]	AOM [5]	Attenuator [4]
Pulse picker leakage	< 2%	< 0.1%	< 2%
Pulse-to-pulse energy stability, 12 h [6]	< 0.5%		
Long-term power stability, 100 h [6]	< 0.5%		
MAIN OPTIONS			
Oscillator output	n/a		
Harmonic generator [7]	515 nm, 343 nm, 257 nm, or 206 nm; see CARBIDE HG (page 12)		
Optical parametric amplifier [8]	UV – MIR; see I-OPA (page 30) or ORPHEUS (page 32)		
BiBurst option	n/a		
PHYSICAL DIMENSIONS			
Laser head (L × W × H)	633 × 324 × 162 mm		
Chiller	Not required		
24 V DC power supply (L × W × H)	220 × 95 × 46 mm		
ENVIRONMENTAL & UTILITY REQUIREMENTS			
Operating temperature	17 – 27 °C		
Relative humidity	< 80% (non-condensing)		
Electrical requirements	100 V AC, 3 A – 240 V AC, 1.3 A; 50 – 60 Hz		
Rated power	280 W		
Power consumption	250 W		

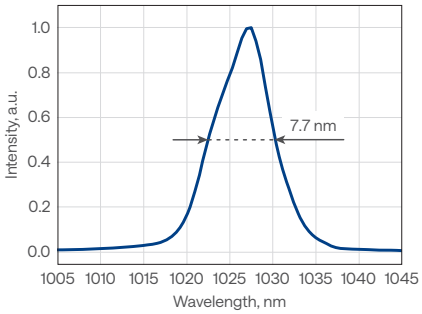
[1] *Water-cooled version available on request.*
[2] *Assuming a Gaussian pulse shape.*
[3] *FW 1/e^2, using maximum pulse energy.*
[4] *Waveplate-based variable optical attenuator (VOA); an external analog control input is available.*
[5] *Enhanced contrast AOM. Provides fast, full-scale individual pulse energy control; an external analog control input is available.*
[6] *Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).*
[7] *Integrated. For an external harmonic generator, see HIRO (page 24).*
[8] *Integrated. For more details and stand-alone OPAs, see wavelength-tunable sources (page 29).*



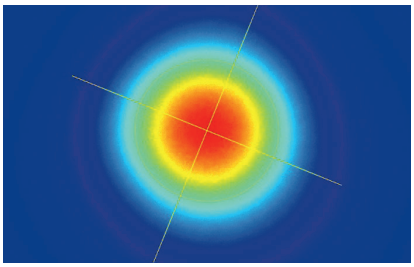
CARBIDE-CB5
Typical pulse duration



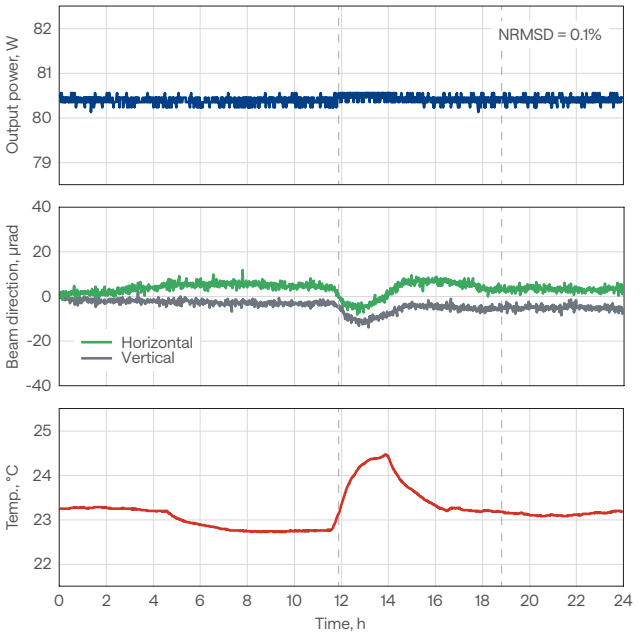
CARBIDE-CB5
Typical spectrum



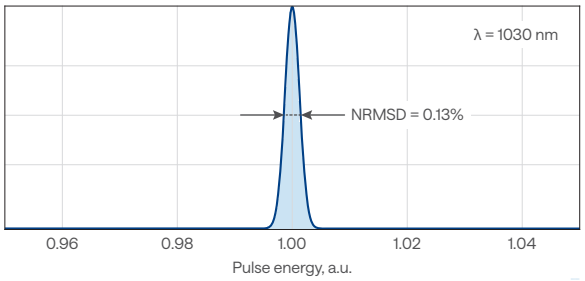
CARBIDE-CB5
Typical beam profile



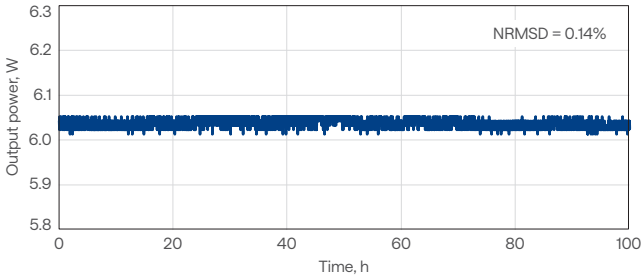
CARBIDE-CB3 output power and beam direction stability with power lock enabled, across varying environmental conditions



CARBIDE-CB3
Typical pulse-to-pulse energy stability

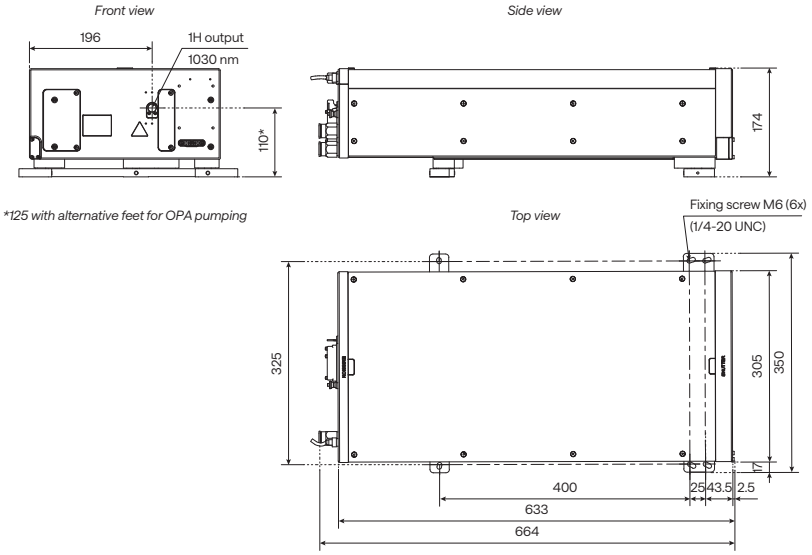


CARBIDE-CB5-6W
Long-term power stability

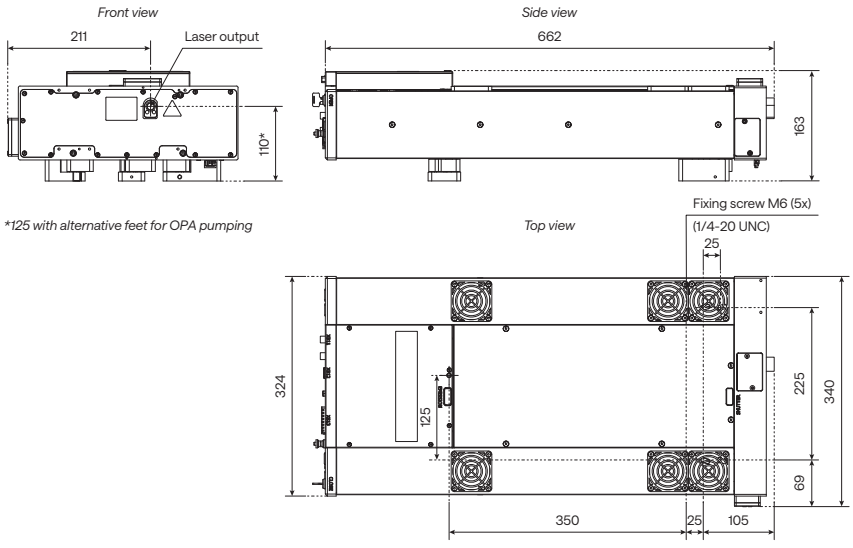


Drawings

CARBIDE-CB3



Air-cooled **CARBIDE-CB5** with an attenuator



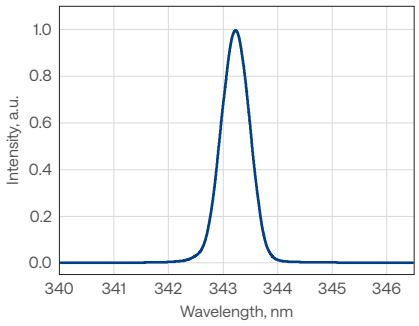
The drawings depend on the exact configuration. If crucial for integration, please contact sales@lightcon.com.

CARBIDE | CB3-UV

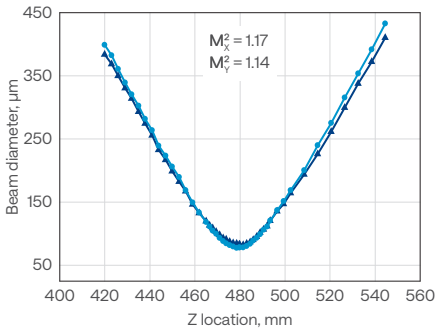
High-Power UV Femtosecond Lasers

- NEW Maximum output of 50 W
- 500 fs pulse duration
- Up to MHz repetition rate
- High beam quality and stability
- Compact industrial-grade design

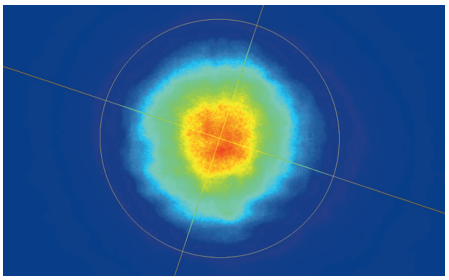
CARBIDE-CB3-UV
Typical spectrum



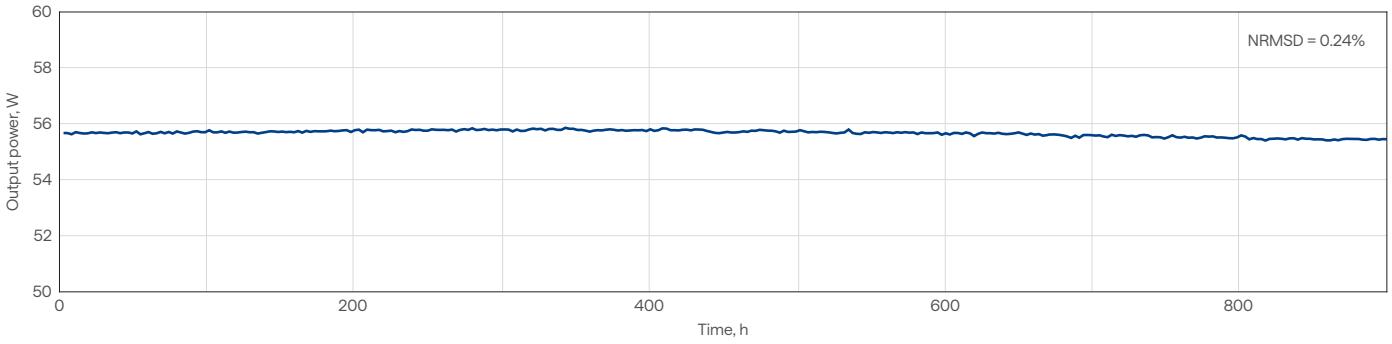
CARBIDE-CB3-UV
Typical M^2 measurement data



CARBIDE-CB3-UV
Beam profile



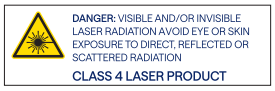
CARBIDE-CB3-UV-50W
Long-term power stability



Specifications

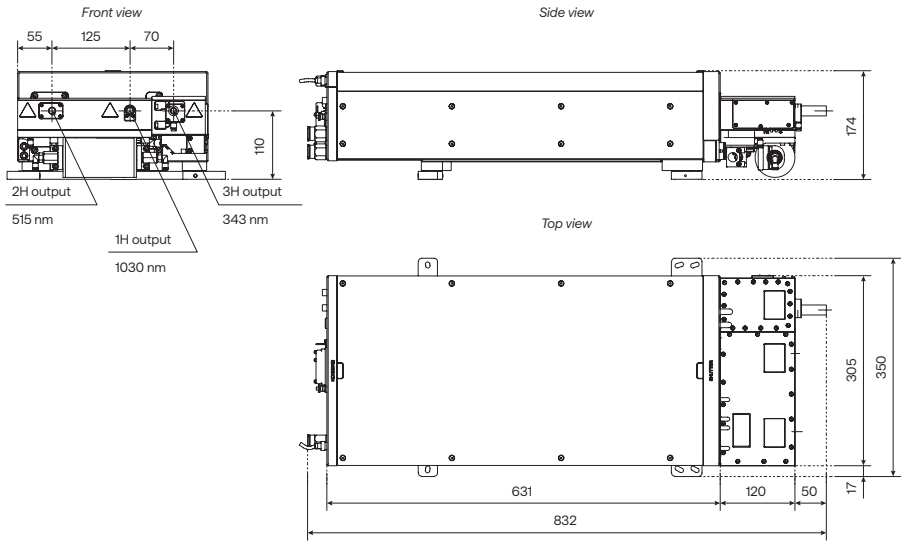
Model		CB3-UV-30W	CB3-UV-50W
OUTPUT CHARACTERISTICS			
Cooling method		Water-cooled	
Center wavelength		343 ± 3 nm	
Output power		> 30 W	> 50 W
Pulse duration [1]		≈ 500 fs	
Maximum output pulse energy [2]		150 µJ	
Repetition rate [3]		200 – 1000 kHz	300 – 1000 kHz
Polarization		Linear, vertical; 1 : 200	
Beam quality, M^2, typical values		< 1.3	
Beam diameter [4]		2 – 5 mm	
Long-term power stability, 12 h [5]		< 0.5%	
Lifetime		10 000 h	
MAIN OPTIONS			
Optional amplifier outputs		1030 nm, 515 nm	
PHYSICAL DIMENSIONS			
Laser head (L × W × H)		801 × 350 × 174 mm	
Chiller (L × W × H)		680 × 484 × 307 mm	
24 V DC power supply (L × W × H)		352 × 195 × 75 mm	376 × 449 × 88 mm
ENVIRONMENTAL & UTILITY REQUIREMENTS			
Operating temperature		15 – 30 °C	
Relative humidity		< 80% (non-condensing)	
Electrical requirements	Laser	100 V AC, 12 A – 240 V AC, 5 A; 50 – 60 Hz	100 V AC, 15 A – 240 V AC, 7 A; 50 – 60 Hz
	Chiller	200 – 230 V AC; 50 – 60 Hz	
Rated power	Laser	1000 W	2000 W
	Chiller	2000 W	
Power consumption	Laser	900 W	1500 W
	Chiller	1300 W	1800 W

[1] *Assuming a Gaussian pulse shape.*
[2] *Depends on the pump energy.*
[3] *Repetition rate available up to 2 MHz at lower power.*
[4] *FW 1/e²; depends on the pump energy.*
[5] *Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).*



Drawings

CARBIDE-CB3-UV



HG | CARBIDE

Integrated Harmonic Generators

- 515 nm, 343 nm, 257 nm, or 206 nm output
- Automated harmonic selection
- Mounted directly on the laser head

CARBIDE-CB3 with a 2H-3H module

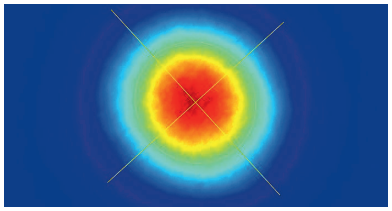
Specifications

Model		2H	2H-3H	2H-4H	2H-5H	30W UV [1]	50W 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 206 nm	1030 nm 515 nm 343 nm	1030 nm 515 nm 343 nm
Pump pulse energy		20 – 2000 µJ	50 – 2000 µJ	20 – 2000 µJ	100 – 1500 µJ	80 – 400 µJ	120 – 400 µJ
Pump pulse duration		< 300 fs				≈ 500 fs	
Conversion efficiency / Output power		> 50% (2H)	> 50% (2H) > 25% (3H)	> 50% (2H) > 10% (4H) [3]	> 50% (2H) > 5% (5H) [4]	30 W (3H)	50 W (3H)
Beam quality, M^2	≤ 400 µJ pump	< 1.3 (2H)	< 1.3 (2H) < 1.4 (3H)	< 1.3 (2H) n/a (4H)	n/a	< 1.3 (3H)	< 1.3 (3H)
	> 400 µJ pump	< 1.4 (2H)	< 1.4 (2H) < 1.5 (3H)	< 1.4 (2H) n/a (4H)	n/a		

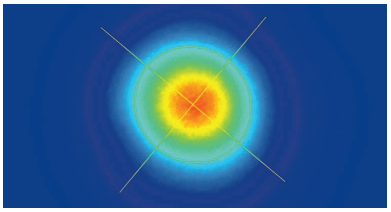
[1] *See CARBIDE-CB3-UV (page 10) for more details.*
[2] *Depends on the pump laser model. Up to the 5th harmonic available; contact sales@lightcon.com for more details.*
[3] *Maximum output power of 5 W.*
[4] *Maximum output power of 0.2 W.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

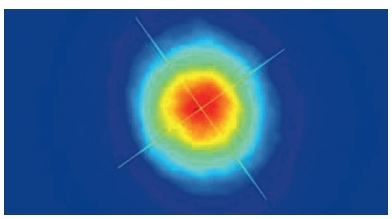
CARBIDE-CB5 (100 kHz, 6 W)
Typical 1H beam profile



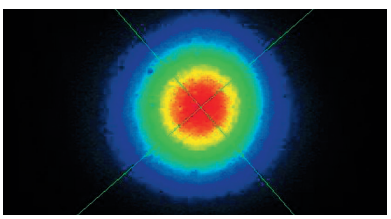
CARBIDE-CB5 (100 kHz, 3.4 W)
Typical 2H beam profile



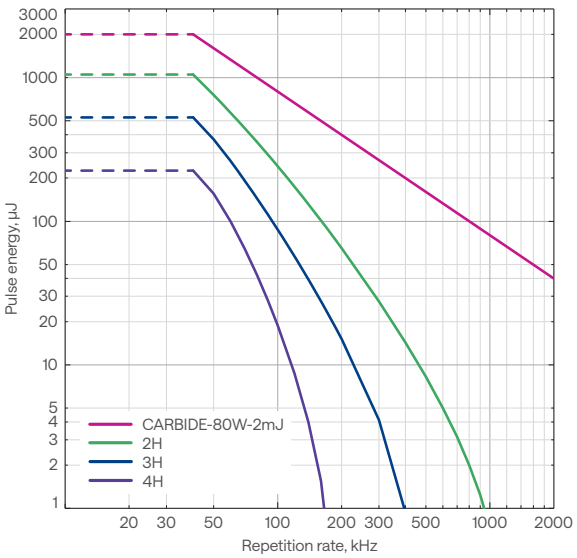
CARBIDE-CB5 (100 kHz, 2.2 W)
Typical 3H beam profile



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



CARBIDE-CB3-80W with a harmonic generator
Pulse energy vs repetition rate



BiBurst

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

Water-cooled **CARBIDE** and **PHAROS** lasers feature the tunable GHz and MHz burst option with burst-in-burst capability, known as BiBurst.

In standard mode, the laser emits a single pulse at a fixed frequency. In burst mode, the output consists of pulse packets instead of single pulses. Each packet consists of a specific number of equally separated pulses. MHz-Burst contains N pulses with a nanosecond period, while GHz-Burst contains P pulses with a picosecond period. When both burst modes are combined, the equally separated pulse packets contain sub-packets of pulses, forming the burst-in-burst or BiBurst.

CARBIDE and **PHAROS** lasers, equipped with tunable GHz and MHz bursts and BiBurst options, bring new capabilities to high-tech manufacturing industries, such as consumer electronics, integrated photonic chip production, advanced display manufacturing, and quantum technologies.

Applications:

- Brittle material drilling and cutting
- Deep engraving
- Selective ablation
- Volume modification of transparent materials
- Hidden marking
- Surface polishing
- Functional surface structuring

Specifications

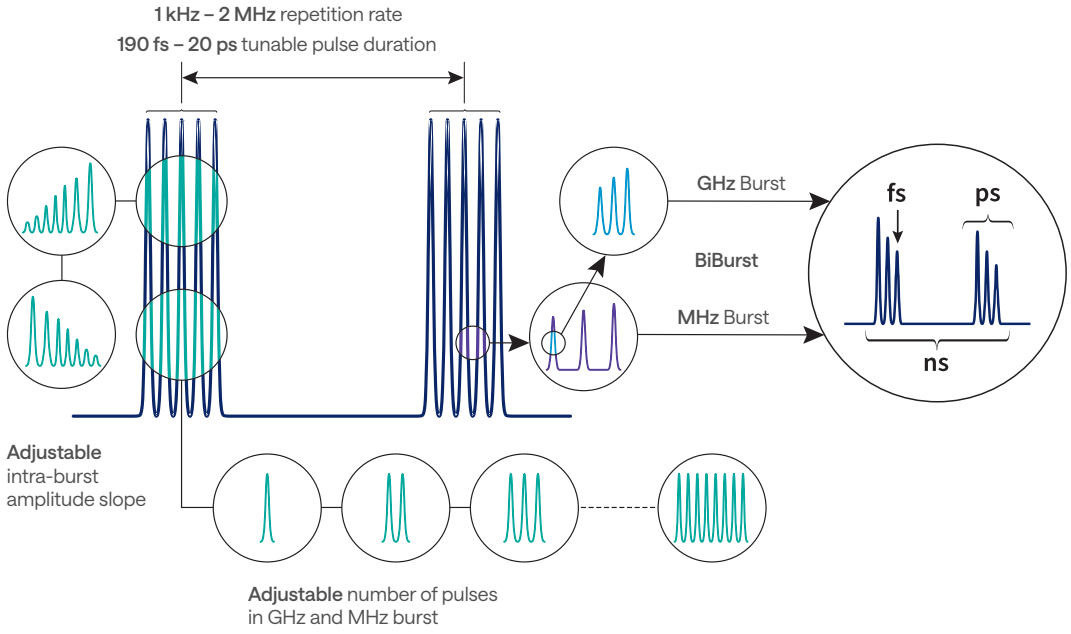
Model		CARBIDE-CB3	PHAROS
GHz Burst	Intra burst pulse period [1]	440 ± 40 ps	200 ± 40 ps
	Number of pulses, P [2]	1 – 10 (up to 400) [3]	1 – 25
MHz Burst	Intra burst pulse period	≈ 15 ns	
	Number of pulses, N [2]	1 – 10	1 – 9 (7 with FEC) [4]

[1] *Custom spacing is available on request. For CARBIDE-CB3-10MHz model standard pulse period is 1500 ps.*

[2] *The maximum number of pulses in a burst depends on the laser repetition rate and energy. CARBIDE-CB3-10MHz model is limited up to 5 pulses.*

[3] *The maximum number of P pulses can be increased to 350 – 400 with optional long GHz burst mode.*

[4] *Fast energy control option. Enables formation of any pulse envelope at laser pulse repetition rate.*



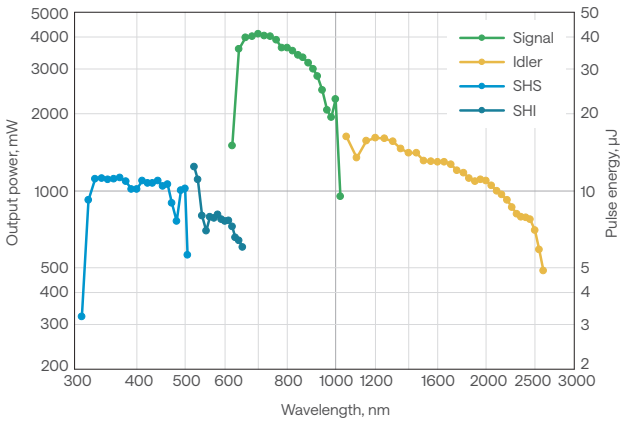
I-OPA

Industrial-Grade Optical Parametric Amplifier

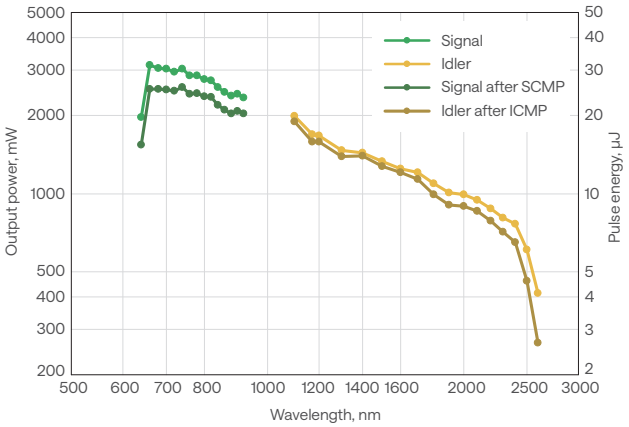
- Wavelength tunability in an industrial design
- Single-box solution
- Tunable or fixed-wavelength models
- Plug-and-play installation and robust performance
- The most compact OPA in the market

CARBIDE-CB3 with I-OPA-HP

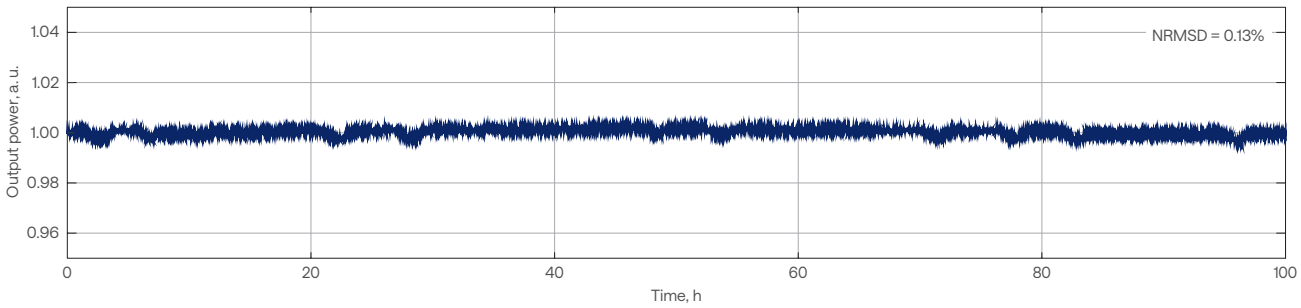
I-OPA-HP typical tuning curves
Pump: 40 W, 400 µJ, 100 kHz



I-OPA-F typical tuning curves
Pump: 40 W, 400 µJ, 100 kHz



I-OPA-HP
Typical power stability at 1300 nm



Specifications

Model	I-OPA-HP	I-OPA-F	I-OPA-ONE
Configuration	ORPHEUS	ORPHEUS-F	ORPHEUS-ONE
Pump power	Up to 40 W		
Pump pulse energy	20 – 400 µJ		
Repetition rate	Up to 2 MHz		
Tuning range [1]	640 – 1010 nm (signal) 1050 – 2600 nm (idler)	650 – 920 nm (signal) 1200 – 2500 nm (idler)	1350 – 2000 nm (signal) 2100 – 4500 nm (idler)
Conversion efficiency	> 7% @ 700 nm (40 – 400 µJ pump; up to 1 MHz)		> 9% @ 1550 nm (40 – 400 µJ pump; up to 1 MHz)
	> 3.5% @ 700 nm (20 – 40 µJ pump; up to 2 MHz)		> 6% @ 1550 nm (20 – 40 µJ pump; up to 2 MHz)
Spectral bandwidth [2]	80 – 220 cm^{-1} @ 700 – 960 nm	200 – 1000 cm^{-1} @ 650 – 920 nm 150 – 1000 cm^{-1} @ 1200 – 2000 nm	60 – 150 cm^{-1} @ 1450 – 2000 nm
Pulse duration [2] [3]	120 – 250 fs	< 55 fs @ 800 – 920 nm < 70 fs @ 650 – 800 nm < 100 fs @ 1200 – 2000 nm	100 – 300 fs
Long-term power stability, 8 h [4]	< 1% @ 800 nm		< 1% @ 1550 nm
Pulse-to-pulse energy stability, 1 min [4]	< 1% @ 800 nm		< 1% @ 1550 nm
Wavelength extension options	320 – 505 nm (SHS) [5] 525 – 640 nm (SHI) [5]	Contact sales@lightcon.com	4500 – 10 000 nm (DFG)
Pulse compression options [2]	n/a	SCMP (signal pulse compressor) ICMP (idler pulse compressor)	n/a

PUMP LASER REQUIREMENTS

Pump laser	CARBIDE or PHAROS
Center wavelength	1030 ± 10 nm
Maximum pump power	40 W
Maximum repetition rate	Up to 2 MHz
Pump pulse energy	20 – 400 µJ
Pulse duration	180 – 300 fs

ENVIRONMENTAL & UTILITY REQUIREMENTS

Refer to lightcon.com

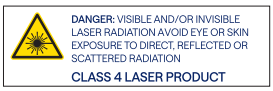
[1] *In the case of a fixed wavelength (FW), a single wavelength can be selected from the signal or idler range. The signal may have an accessible idler pair, and vice versa.*

[2] *I-OPA-F broad-bandwidth pulses are compressed externally. Typical pulse duration before compression: 120 – 250 fs, after compression: 25 – 70 fs @ 650 – 920 nm, 40 – 100 fs @ 1200 – 2000 nm.*

[3] *Output pulse duration depends on the selected wavelength and the pump laser pulse duration.*

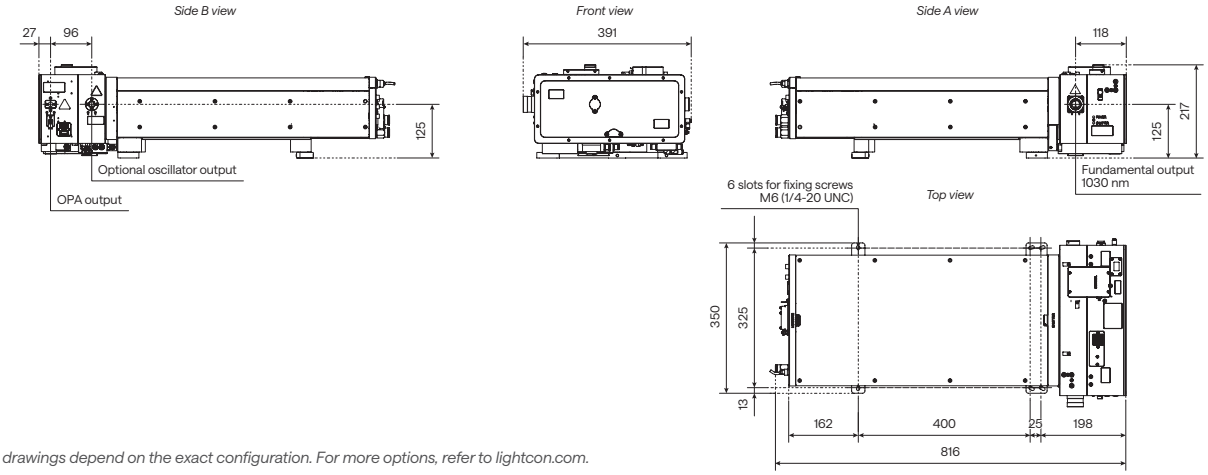
[4] *Expressed as normalized root mean squared deviation (NRMSD).*

[5] *Conversion efficiency is 1.2% at peak; specified as a percentage of pump power.*



Drawings

CARBIDE-CB3 with I-OPA-HP



The drawings depend on the exact configuration. For more options, refer to lightcon.com.