Femtosecond Lasers for Industry

Product Catalog

lightcon.com

LIGHT CONVERSION is a global leader in ultrafast technology, designing and manufacturing:

- Femtosecond Lasers,
- Wavelength-Tunable Sources,
- OPCPA Systems,
- Microscopy Sources,
- Spectroscopy Systems.

The comprehensive portfolio represents the best-in-class lasers tailored for industry, science, and medicine.

About Us

Founded in 1994, LIGHT CONVERSION has evolved into a leading company in ultrafast laser technology with over 9000 systems installed worldwide and 600 employees, 15% of whom focus on R&D. The company's lasers are used in all of the top 50 universities worldwide, highlighting its commitment to state-of-the-art research, while also ensuring the reliability and performance in 24/7 industrial applications. With international offices in the US, China, and Korea, along with a global representative network, the company ensures worldwide sales and service.

Contents


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LIGHT CONVERSION
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Femtosecond Lasers

LIGHT CONVERSION is world-renowned for its industrial-grade Yb-based femtosecond lasers, covering a wide range of scientific, industrial, and medical applications.

CARBIDE	Compact industrial design in air-cooled and water-cooled models, providing up to 120 W, 1 mJ or 80 W, 2 mJ with excellent output stability.
PHAROS	Scientific flexibility and process-tailored output parameters, providing pulse duration down to 100 fs and pulse energy of up to 4 mJ.
FLINT	Expanding the parameter range with repetition rates ranging from 10 to 100 MHz, with power up to 20 W and pulse duration down to 50 fs.

High average power and high pulse energy at a high repetition rate

Market-proven industrial-grade stability and reliability

Tailored to the needs of industry and science

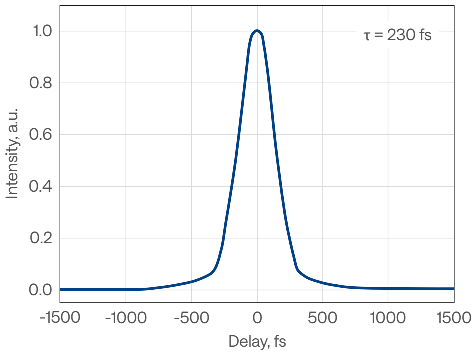
CARBIDE

Unibody-Design Femtosecond Lasers for Industry and Science

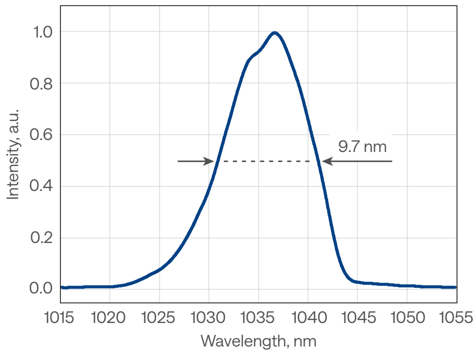
CARBIDE-CB3

- Tunable pulse duration, 190 fs – 20 ps
- Maximum output of 120 W, 1 mJ or 80 W, 2 mJ
- Single-shot – 10 MHz repetition rate NEW
- Pulse-on-demand and BiBurst for pulse control
- Up to 5^{th} harmonic or tunable extensions
- Air-cooled and water-cooled models
- Compact industrial-grade design

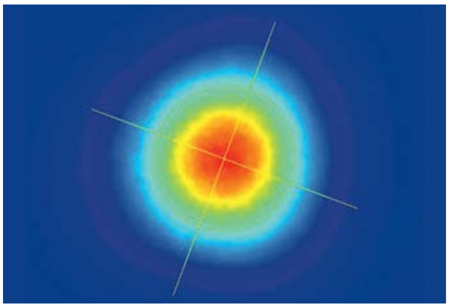
CARBIDE-CB3
Typical pulse duration



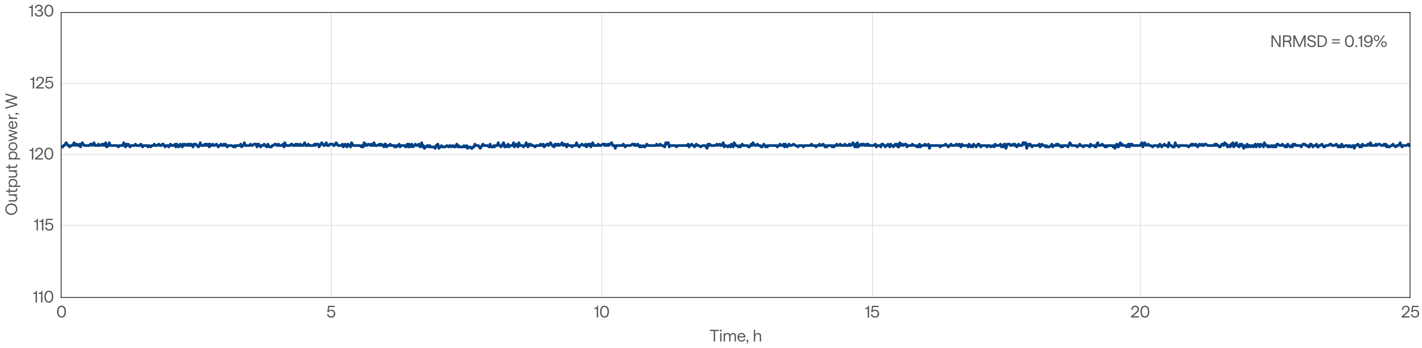
CARBIDE-CB3
Typical spectrum



CARBIDE-CB3
Typical beam profile



CARBIDE-CB3-120W
Long-term power stability



CARBIDE-CB3 specifications

<table>
<tr><th colspan="2">Model</th><th>CB3-20W</th><th colspan="2">NEW
CB3-40W</th><th colspan="2">CB3-80W</th><th>CB3-120W</th></tr>
</table>

OUTPUT CHARACTERISTICS

<table>
<tr><td colspan="2">Cooling method</td><td colspan="6">Water-cooled</td></tr>
<tr><td colspan="2">Center wavelength</td><td colspan="6">1030 ± 10 nm</td></tr>
<tr><td colspan="2">Maximum output power</td><td>20 W</td><td colspan="2">40 W</td><td colspan="2">80 W</td><td>120 W</td></tr>
<tr><td colspan="2">Pulse duration [1]</td><td colspan="4">< 250 fs</td><td>< 350 fs [2]</td><td>< 250 fs</td></tr>
<tr><td colspan="2">Pulse duration tuning range</td><td colspan="4">250 fs – 10 ps</td><td>350 fs – 10 ps</td><td>250 fs – 10 ps</td></tr>
<tr><td colspan="2">Maximum pulse energy</td><td colspan="2">0.4 mJ</td><td>0.2 mJ</td><td>0.8 mJ</td><td>2 mJ</td><td>1 mJ</td></tr>
<tr><td colspan="2">Repetition rate</td><td>Single-shot – 1 MHz</td><td>Single-shot–1 MHz (2 MHz on request)</td><td>Single-shot – 10 MHz</td><td colspan="3">Single-shot – 2 MHz</td></tr>
<tr><td colspan="2">Pulse selection</td><td colspan="6">Single-shot, pulse-on-demand, any fundamental repetition rate division</td></tr>
<tr><td colspan="2">Polarization</td><td colspan="6">Linear, vertical; 1 : 1000</td></tr>
<tr><td colspan="2">Beam quality, M^2</td><td colspan="6">< 1.2</td></tr>
<tr><td colspan="2">Beam diameter [3]</td><td colspan="3">3.9 ± 0.4 mm</td><td>4.2 ± 0.4 mm</td><td>5.1 ± 0.7 mm</td><td>5 ± 0.5 mm</td></tr>
<tr><td colspan="2">Beam pointing stability</td><td colspan="6">< 20 µrad/°C</td></tr>
<tr><td colspan="2">Pulse energy control</td><td colspan="2">FEC [4]</td><td>Attenuator [5]</td><td colspan="3">FEC [4]</td></tr>
<tr><td colspan="2">Pulse picker leakage</td><td colspan="2">< 0.25%</td><td>< 0.5%</td><td colspan="3">< 0.25%</td></tr>
<tr><td colspan="2">Pulse-to-pulse energy stability, 24 h [6]</td><td colspan="6">< 0.5%</td></tr>
<tr><td colspan="2">Long-term power stability, 100 h [6]</td><td colspan="6">< 0.5%</td></tr>
</table>

MAIN OPTIONS

<table>
<tr><td colspan="2">Oscillator output</td><td colspan="6">< 0.5 W, 120 – 250 fs, 1030 ± 10 nm, ≈ 65 MHz [7]</td></tr>
<tr><td colspan="2">Harmonic generator [8]</td><td colspan="6">515 nm, 343 nm, 257 nm, or 206 nm; see page 22</td></tr>
<tr><td colspan="2">Optical parametric amplifier [9]</td><td colspan="5">320 – 10000 nm; see page 26</td><td>n/a</td></tr>
<tr><td colspan="2">BiBurst option</td><td colspan="6">Tunable GHz and MHz burst with burst-in-burst capability; see page 13</td></tr>
</table>

PHYSICAL DIMENSIONS

<table>
<tr><td colspan="2">Laser head (L × W × H)</td><td colspan="6">633 × 350 × 174 mm</td></tr>
<tr><td colspan="2">Chiller (L × W × H)</td><td colspan="2">585 × 484 × 221 mm</td><td colspan="4">680 × 484 × 307 mm</td></tr>
<tr><td colspan="2">24 V DC power supply (L × W × H)</td><td colspan="2">280 × 144 × 49 mm [10]</td><td colspan="3">320 × 200 × 75 mm</td><td>376 x 449 x 88 mm</td></tr>
</table>

ENVIRONMENTAL AND UTILITY REQUIREMENTS

<table>
<tr><td colspan="2">Operating temperature</td><td colspan="6">15 – 30 °C</td></tr>
<tr><td colspan="2">Relative humidity</td><td colspan="6">< 80% (non-condensing)</td></tr>
<tr><td rowspan="2">Electrical requirements</td><td>Laser</td><td colspan="2">100 V AC, 7 A – 240 V AC, 3A; 50 – 60 Hz</td><td colspan="3">100 V AC, 12 A – 240 V AC, 5 A 50 – 60 Hz</td><td>100 V AC, 15 A – 240 V AC, 7 A 50 – 60 Hz</td></tr>
<tr><td>Chiller</td><td colspan="2">100 – 230 V AC; 50 – 60 Hz</td><td colspan="4">200 – 230 V AC; 50 – 60 Hz</td></tr>
<tr><td rowspan="2">Rated power</td><td>Laser</td><td colspan="2">600 W</td><td colspan="3">1000 W</td><td>2000 W</td></tr>
<tr><td>Chiller</td><td colspan="2">1400 W</td><td colspan="4">2000 W</td></tr>
<tr><td rowspan="2">Power consumption</td><td>Laser</td><td colspan="2">500 W</td><td colspan="3">900 W</td><td>1500 W</td></tr>
<tr><td>Chiller</td><td colspan="2">1000 W</td><td colspan="3">1300 W</td><td>1800 W</td></tr>
</table>

[1] *Assuming Gaussian pulse shape.*
[2] *Pulse duration can be reduced to < 250 fs if pulse peak intensity of > 50 GW/cm^2 is tolerated by the customer setup.*
[3] *FW $1/e^2$, using maximum pulse energy.*
[4] *Fast energy control (FEC) provides fast, full-scale individual pulse energy control; an external analog control input is available.*
[5] *Waveplate-based variable optical attenuator (VOA); an external analog control input is available.*
[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 external harmonic generator, refer to HIRO.*
[9] *Integrated. For more options and OPAs, refer to www.lightcon.com.*
[10] *Power supply can be different if optional 2 MHz version is selected.*

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

CARBIDE-CB5 (air-cooled) specifications

Model	CB5		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, 24 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 page 22*		
Optical parametric amplifier [8)]	320 – 10000 nm; *see page 26*		
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 AND 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	300 W		
Power consumption	150 W		

1) *Water-cooled version available on request.*
2) *Assuming Gaussian pulse shape.*
3) *FW 1/e², using maximum pulse energy.*
4) *Waveplate-based variable optical attenuator (VOA); an external analog control input is available.*
5) *Enhanced contrast AOM. Provides fast amplitude control of output pulse train.*
6) *Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).*
7) *Integrated. For external harmonic generator, refer to HIRO.*
8) *Integrated. For stand-alone OPAs, refer to www.lightcon.com.*

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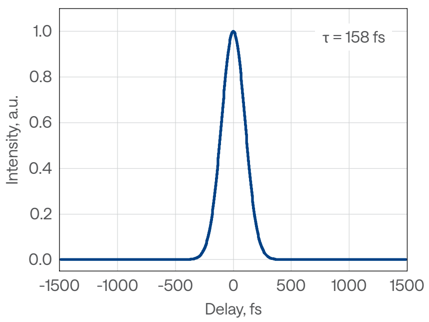
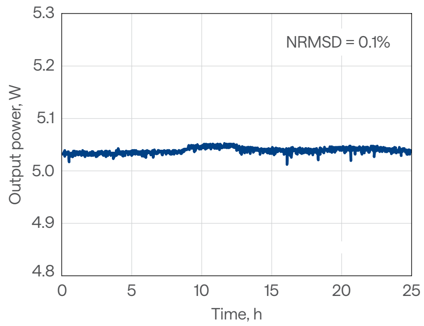
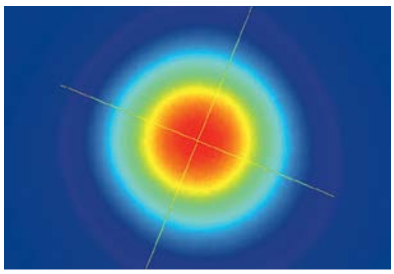
CARBIDE-CB5-SP
Typical pulse duration



CARBIDE-CB5
Long-term power stability

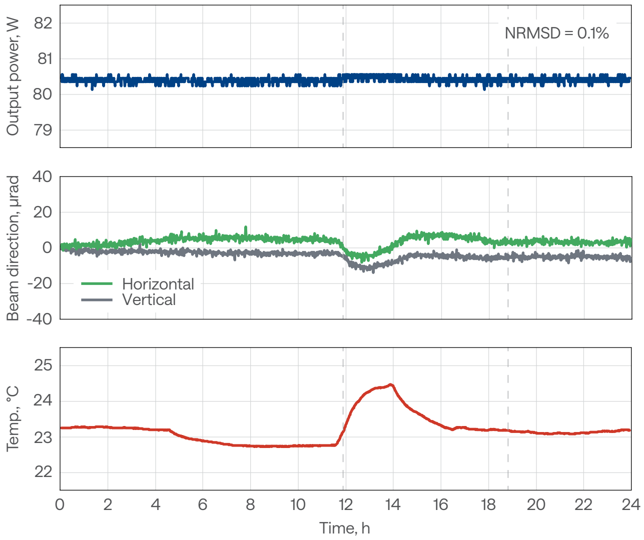


CARBIDE-CB5
Typical beam profile

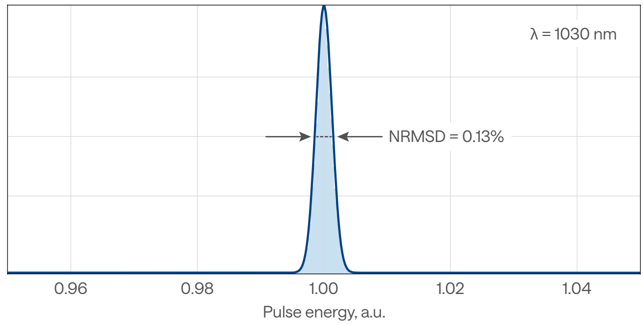


Stability measurements

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

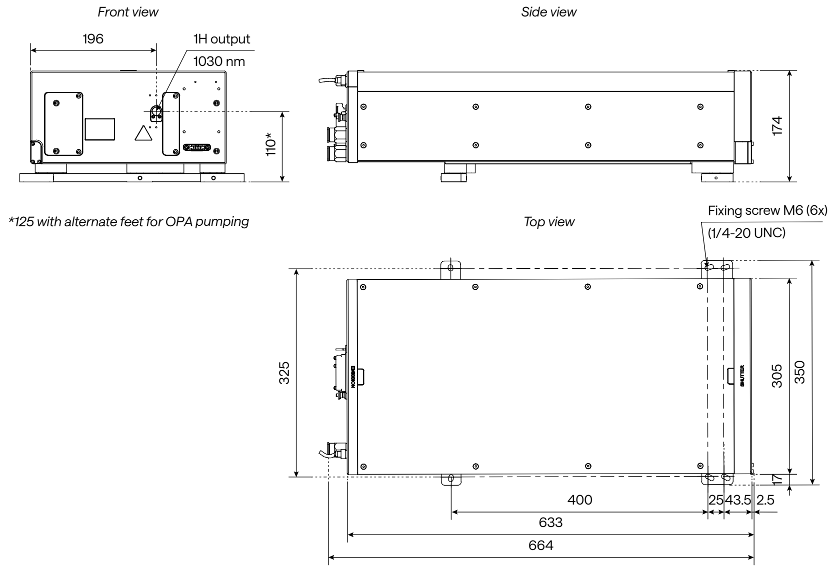


CARBIDE-CB3
Typical pulse-to-pulse energy stability

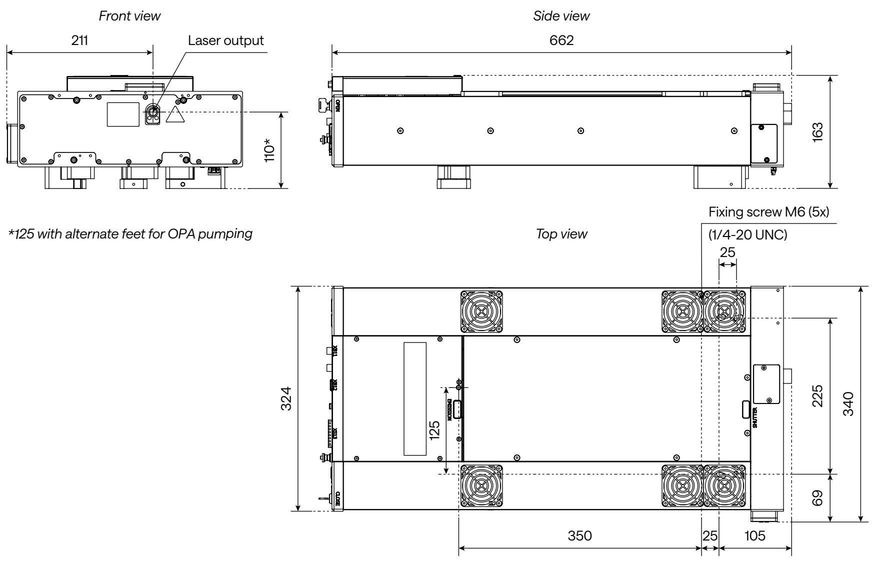


Drawings

CARBIDE-CB3 drawing



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



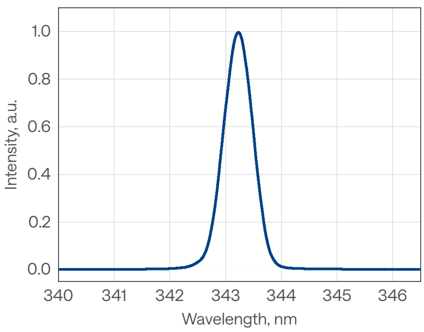
CARBIDE | CB3-UV

High-Power UV Femtosecond Lasers

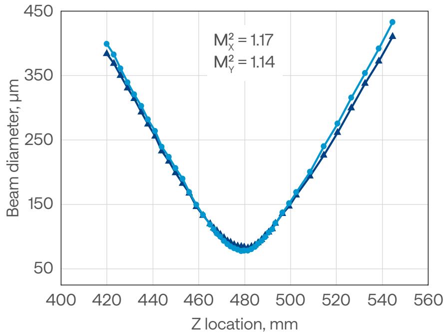
CARBIDE-CB3-UV

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

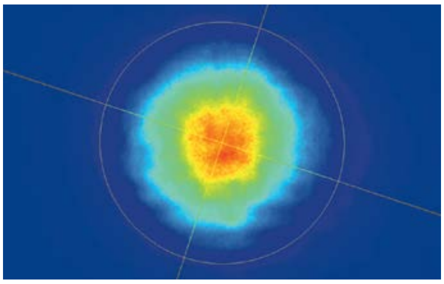
CARBIDE-CB3-UV
Typical spectrum



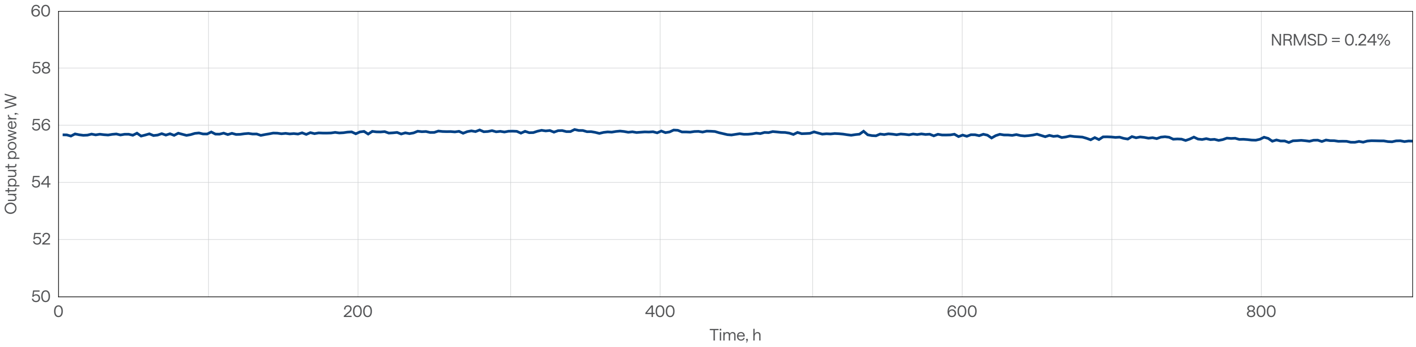
CARBIDE-CB3-UV
Typical M^2 measurement data



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	
Output pulse energy		35 – 150 µJ	
Repetition rate [2]		200 – 800 kHz	300 – 1000 kHz
Polarization		Linear, vertical; 1 : 200	
Beam quality, M^2, typical values		< 1.3	
Beam diameter [3]		2 - 5 mm	
Long-term power stability, 12 h [4]		< 0.5%	
Lifetime		10000 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)		320 × 200 × 75 mm	376 × 449 × 88 mm
ENVIRONMENTAL AND 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 Gaussian pulse shape.*
2) *Repetition rate available up to 2 MHz at lower power.*
3) *FW $1/e^2$, using maximum pulse energy.*
4) *Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).*

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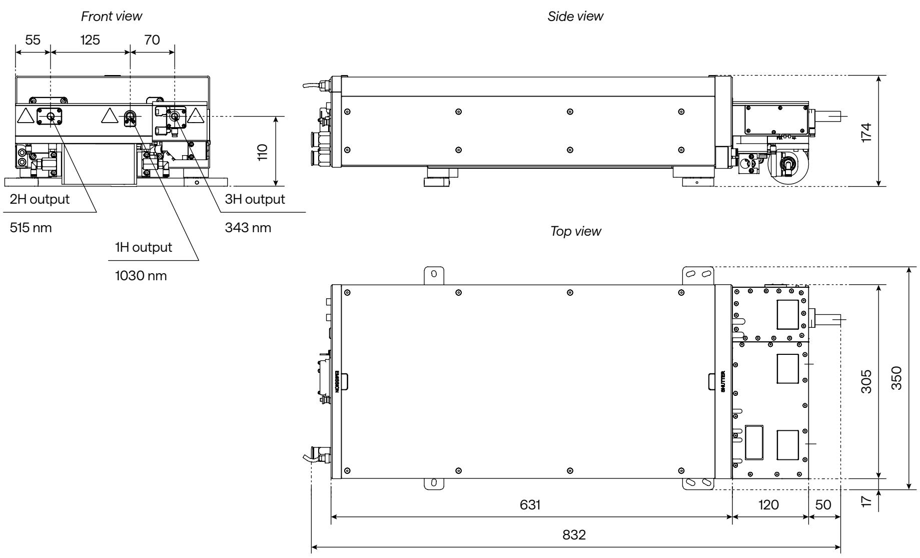
Drawings

CARBIDE-CB3-UV drawing



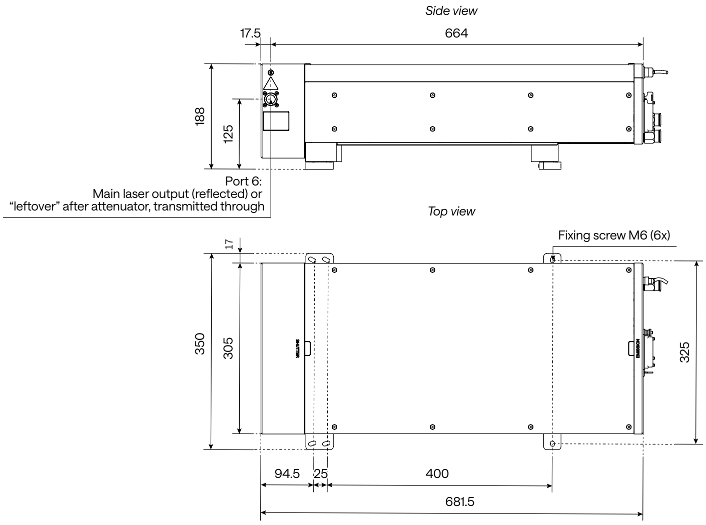
SCI-M | CARBIDE

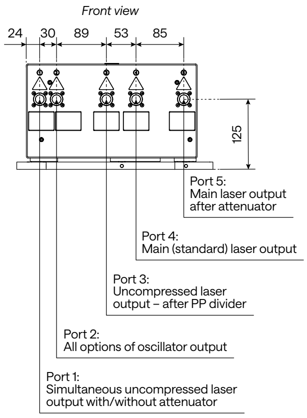
Scientific Interface Module for CARBIDE

- Simultaneous or separate oscillator output
- Uncompressed laser output
- Seeding by an external oscillator
- Beam-splitting options

Drawings

CARBIDE-CB3-40W with a scientific interface module drawing





BiBurst | OPTION

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

PHAROS and **CARBIDE-CB3** lasers offer an option for tunable GHz and MHz burst with burst-in-burst capability, known as BiBurst.

In standard mode, a single pulse is emitted at a fixed frequency. In burst mode, the output consists of pulse packets rather than single pulses. Each packet comprises a certain number of equally spaced pulses. MHz-Burst contains N pulses with a nanosecond period, while GHz-Burst contains P pulses with a picosecond period. When both GHz and MHz burst modes are used simultaneously, the equally spaced pulse packets contain sub-packets of pulses, known as burst-in-burst or BiBurst.

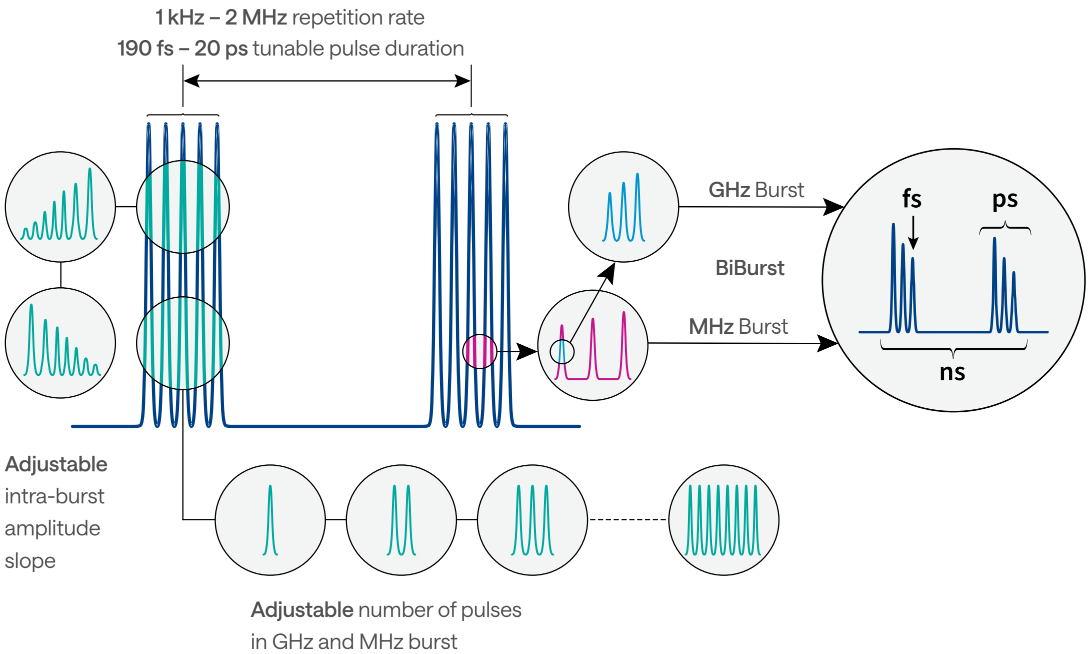
PHAROS and **CARBIDE** lasers with the BiBurst option bring new capabilities to high-tech manufacturing industries such as consumer electronics, integrated photonic chip manufacturing, future display manufacturing, and quantum technologies. The applications include:

- brittle material drilling and cutting
- deep engraving
- selective ablation
- volume modification of transparent materials
- hidden marking
- surface polishing
- 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 [3]	1 – 25
MHz Burst	Intra burst pulse period	≈ 15 ns	
	Number of pulses, N	1 – 10	1 – 9 (7 with FEC [4])

[1] *Custom spacing is available upon request.*
[2] *The maximum number of pulses in a burst depends on the laser repetition rate and energy.*
[3] *A custom number of pulses (up to 400) is available upon request.*
[4] *Fast energy control option. Enables the formation of any pulse envelope at the laser pulse repetition rate.*

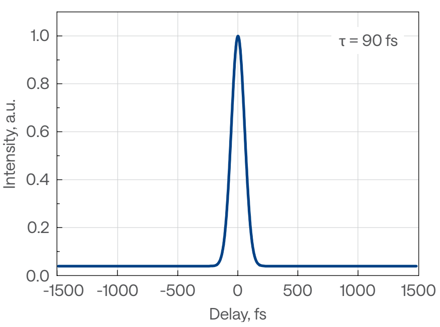


PHAROS

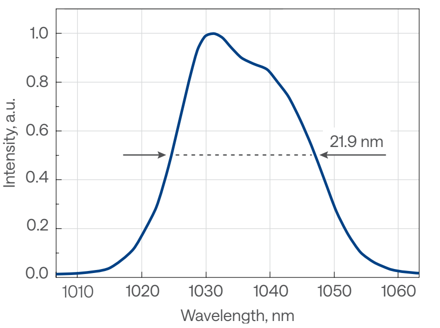
Modular-Design Femtosecond Lasers for Industry and Science

- Tunable pulse duration, 100 fs – 20 ps
- Maximum pulse energy of up to 4 mJ
- Down to < 100 fs right at the output
- Pulse-on-demand and BiBurst for pulse control
- Up to 5th harmonic or tunable extensions
- CEP stabilization or repetition rate locking
- Thermally-stabilized and sealed design

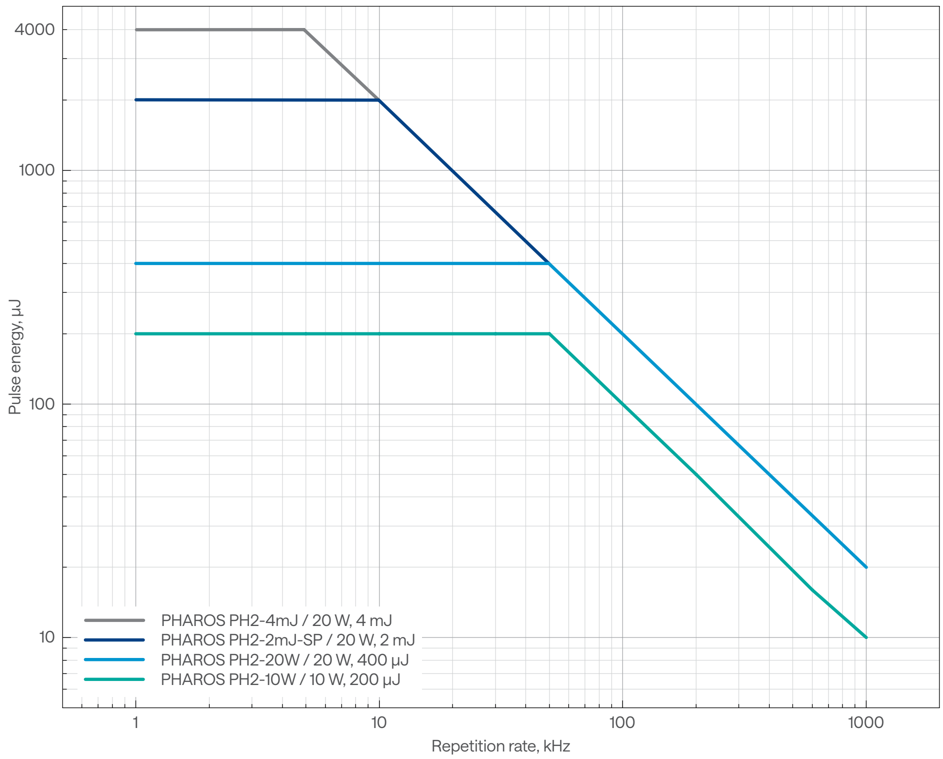
PHAROS-PH2-UP
Typical pulse duration



PHAROS-PH2-UP
Typical spectrum



PHAROS
Pulse energy vs fundamental repetition rate



Specifications

Model	PH2-10W	PH2-20W-SP			PH2-4mJ	PH2-UP	
OUTPUT CHARACTERISTICS							
Center wavelength [1]	1030 ± 10 nm						
Maximum output power	10 W	20 W					
Pulse duration [2]	< 290 fs	< 190 fs			< 450 fs [3]	< 100 fs	
Pulse duration tuning range	290 fs – 10 ps (20 ps on request)	190 fs – 10 ps (20 ps on request)			450 fs – 10 ps	100 fs – 10 ps	
Maximum pulse energy	0.2 mJ	0.4 mJ	1 mJ	2 mJ	4 mJ	0.4 mJ	1 mJ
Repetition rate	Single-shot – 1 MHz						
Pulse selection	Single-shot, pulse-on-demand, any fundamental repetition rate division						
Polarization	Linear, horizontal						
Beam quality, M^2	< 1.2	< 1.3				< 1.2	
Beam diameter [4]	3.3 ± 0.5 mm	4.0 ± 0.5 mm	4.5 ± 0.5 mm	6.8 ± 0.7 mm		4.5 ± 0.5 mm	6 ± 0.5 mm
Beam pointing stability	< 20 µrad/°C						
Pre-pulse contrast	< 1 : 1000						
Post-pulse contrast	< 1 : 200						
Pulse-to-pulse energy stability, 24 h [5]	< 0.5%						
Long-term power stability, 100 h [5]	< 0.5%						
MAIN OPTIONS							
Oscillator output [6]	1 – 7 W, 50 – 250 fs, ≈ 1035 nm, ≈ 76 MHz						
Harmonic generator [7]	515 nm, 343 nm, 257 nm, or 206 nm; *see page 23*						
Optical parametric amplifier [8]	320 – 10000 nm; *see page 26*						
BiBurst option	Tunable GHz and MHz burst with burst-in-burst capability; *see page 13*						
CEP stabilization	*See page 17*						
Repetition rate locking							
PHYSICAL DIMENSIONS							
Laser head (L × W × H) [9]	730 × 419 × 230 mm				827 × 492 × 250 mm	770 × 419 × 230 mm	
Chiller (L × W × H)	590 × 484 × 267 mm						
24 V DC power supply (L × W × H) [9]	280 × 144 × 49 mm						

ENVIRONMENTAL & UTILITY REQUIREMENTS

Operating temperature		15 – 30 °C (air conditioning recommended)
Relative humidity		< 80% (non-condensing)
Electrical requirements	Laser	100 V AC, 12 A – 240 V AC, 5 A, 50 – 60 Hz
	Chiller	100 – 230 V AC, 50 – 60 Hz
Rated power	Laser	1000 W
	Chiller	1400 W
Power consumption	Laser	600 W
	Chiller	1000 W

1) *Precise wavelengths for specific models are available upon request.*
2) *Assuming Gaussian pulse shape.*
3) *Pulse duration can be reduced to < 250 fs if pulse peak intensity of > 50 GW/cm^2 is tolerated by the customer setup.*
4) *FW $1/e^2$, measured at laser output, using maximum pulse energy.*
5) *Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).*
6) *Available simultaneously. Contact sales@lightcon.com for more details or customized solutions.*
7) *Integrated. For external harmonic generator, refer to HIRO.*
8) *Integrated. For more options and OPAs for -4mJ and -UP models, refer to www.lightcon.com.*
9) *Dimensions depend on laser configuration and integrated options.*

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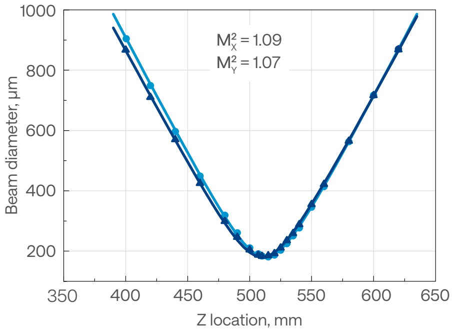
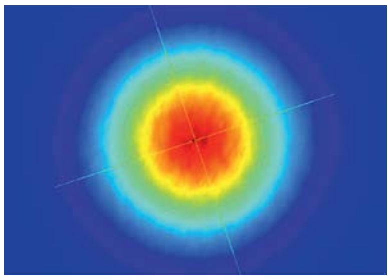
CLASS 4 LASER PRODUCT

Beam properties

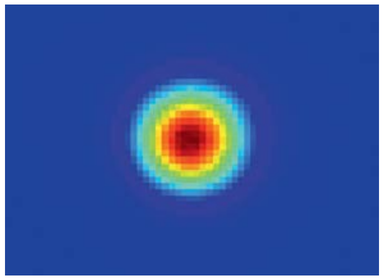
PHAROS
Typical M² measurement data



PHAROS
Typical near-field beam profile

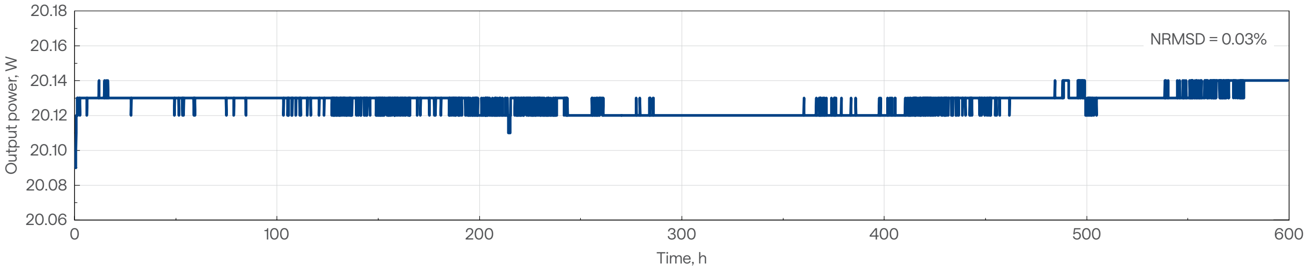


PHAROS
Typical far-field beam profile

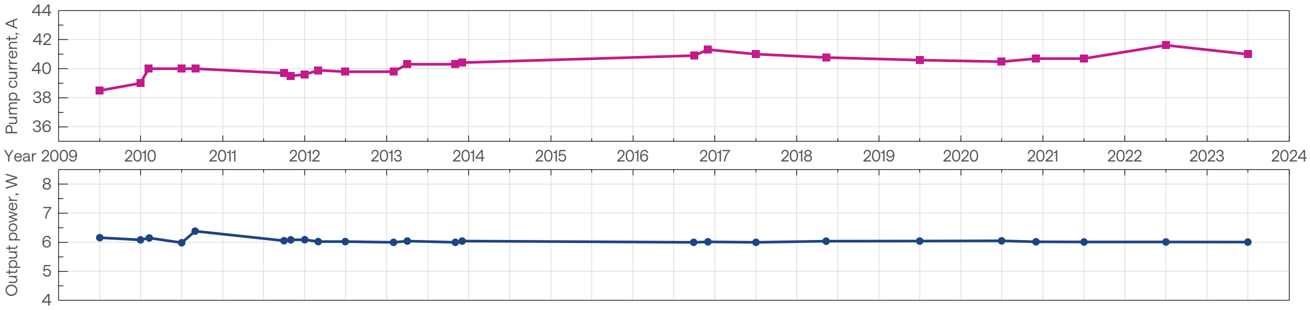


Stability measurements

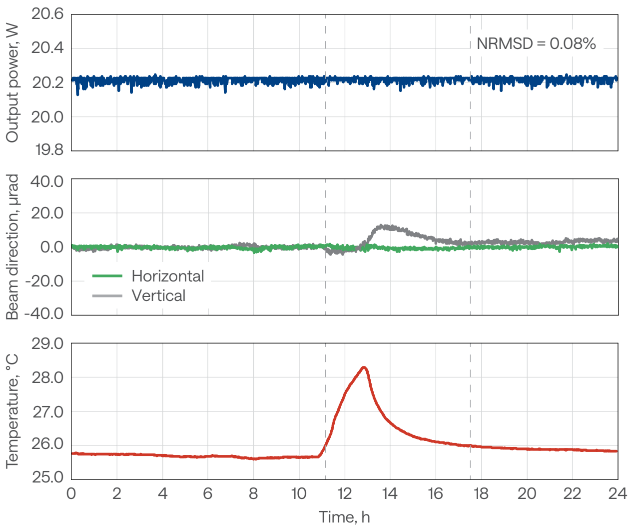
PHAROS
Long-term power stability



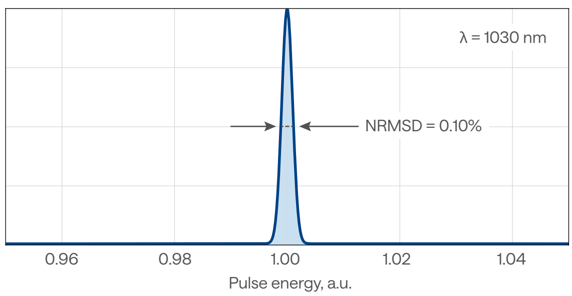
Output power of industrial-grade **PHAROS** lasers operating 24/7 and the current of the pump diodes over the years



PHAROS output power and the stability of beam direction with power lock enabled, across varying environmental conditions



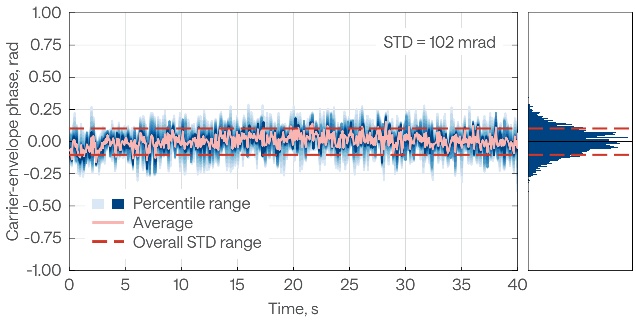
PHAROS
Typical pulse-to-pulse energy stability



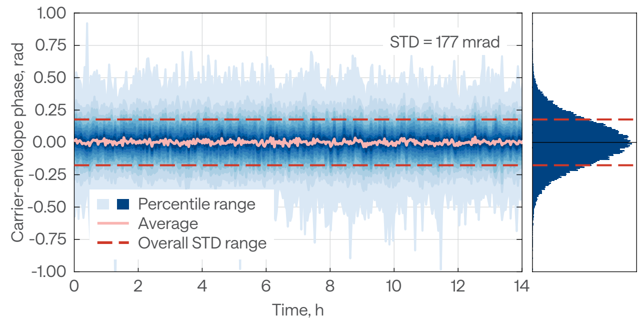
CEP stabilization

PHAROS lasers can be equipped with feedback electronics for carrier-envelope phase (CEP) stabilization of the output pulses. The carrier-envelope offset (CEO) of the **PHAROS** oscillator is actively locked to 1/4th of the repetition rate with a < 100 mrad standard deviation. The CEP stable pulses from the synchronized amplifier have a < 350 mrad standard deviation. The CEP drift occurring inside the amplifier and the user's setup can be compensated with an out of loop f-2f interferometer, which is a part of the complete **PHAROS** active CEP stabilization package.

PHAROS
Short-term CEP stability operating at 200 kHz repetition rate



PHAROS
Long-term CEP stability operating at 200 kHz repetition rate

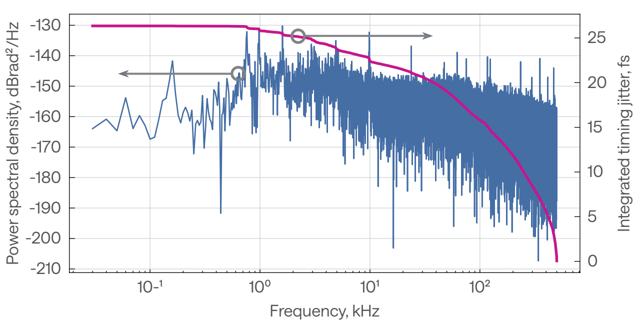


Repetition rate locking

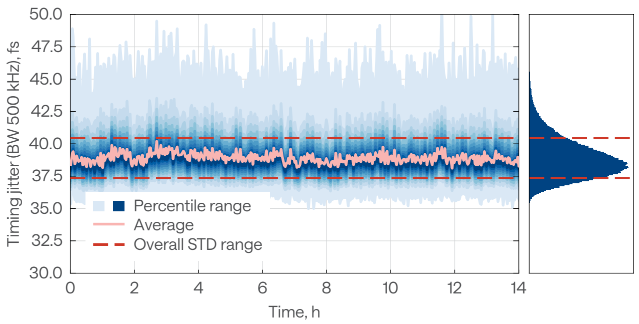
The oscillator of **PHAROS** laser can be customized for repetition rate locking applications. Coupled with the necessary feedback electronics, the repetition rate is synchronized to an external RF source using the two piezo stages installed inside the cavity.

The repetition rate locking system can assure an integrated timing jitter of less than 200 fs for RF reference frequencies larger than 500 MHz. Continuous phase shifting is available on request.

Phase noise data of **PHAROS** oscillator
locked to a 2.8 GHz RF source

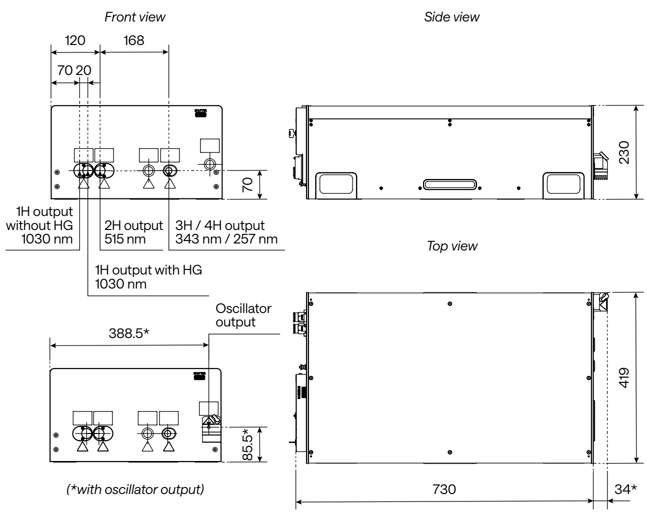


Timing jitter stability over 14 h
PHAROS oscillator locked to a 2.8 GHz RF source

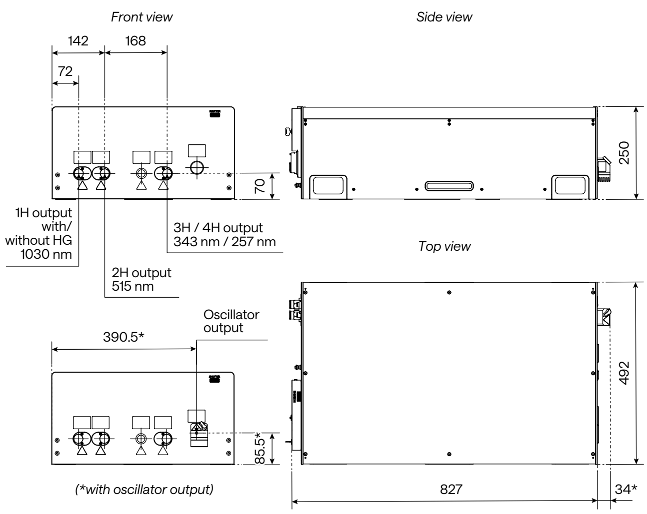


Drawings

PHAROS-PH2-730 drawing.
PH2 or PH2-SP with FEC, BiBurst, or harmonics;
also, PH2-UP without harmonics



PHAROS-PH2-827 drawing
PH2 with -HE harmonics, PH2-4mJ, or PH2-UP with harmonics



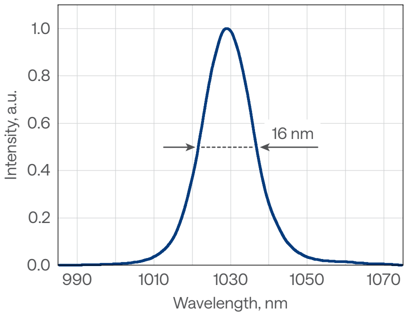
FLINT

High-Repetition-Rate Lasers

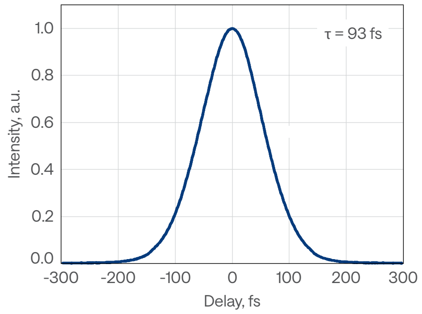
FLINT-FL1

- From 10 to 100 MHz repetition rate
- Down to 50 fs pulse duration
- High-power models, up to 20 W
- High-energy energy models, up to 0.5 μJ
- Industrial-grade design for high output stability
- CEP stabilization or repetition rate locking

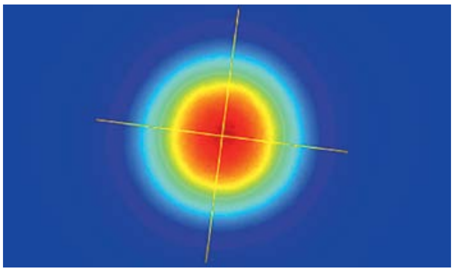
FLINT-FL1
Typical spectrum



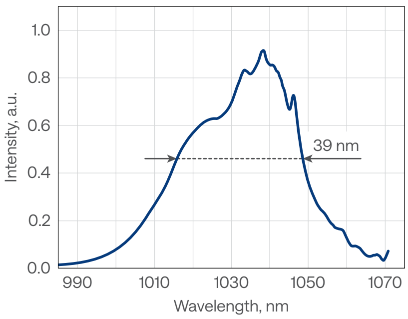
FLINT-FL1
Typical pulse duration



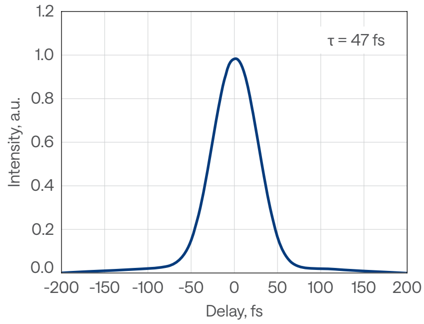
FLINT-FL1
Typical beam profile



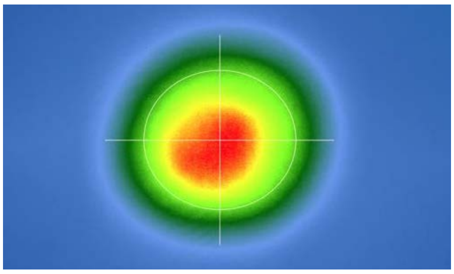
FLINT-FL2-SP
Typical spectrum



FLINT-FL2-SP
Typical pulse duration



FLINT-FL2-SP
Typical beam profile



Specifications

Model	FL1			FL2-SP	FL2		
Key feature	CEP	RRL	Compact	Short pulse	High power and high energy		
Pulse duration	< 100 fs		< 120 fs	< 50 fs	< 120 fs	< 170 fs [1)]	
Repetition rate	60 – 100 MHz [2)]			10 MHz	10 MHz	40 MHz	80 MHz
Maximum output power	0.5 W	1 W	8 W	4 W	5 W	20 W	
Maximum pulse energy	6 nJ [3)]	12.5 nJ [3)]	100 nJ [3)]	0.4 µJ	0.5 µJ		0.25 µJ
Center wavelength	1035 ± 10 nm			1030 ± 10 nm	1030 ± 10 nm		
Polarization	Linear, horizontal						
Beam quality, M^2	< 1.2			< 1.3	< 1.2		
Beam pointing stability	< 10 µrad/°C						
Long-term power stability, 100 h [4)]	< 0.5%						
Integrated 2H generator [5)]	n/a				Optional; conversion efficiency > 30% [6)]; *see page 21*		
External 2H, 3H, or 4H generator [5)]	Optional; *see page 24*						
Integrated attenuator	n/a			Included			

PHYSICAL DIMENSIONS

Laser head (L × W × H)	448 × 206 × 115 mm	543 × 322 × 146 mm
Power supply and chiller rack (L × W × H)	642 × 553 × 540 mm	642 × 553 × 673 mm
Chiller	Different options available. Contact sales@lightcon.com	

ENVIRONMENTAL AND UTILITY REQUIREMENTS

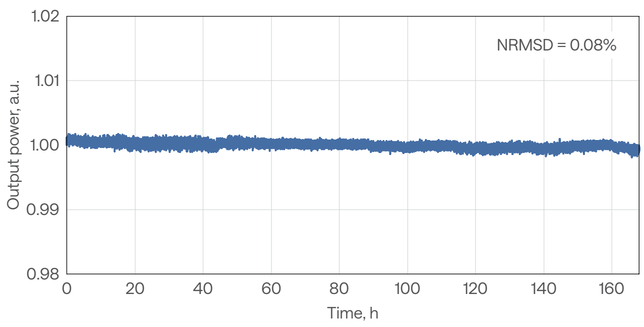
Operating temperature		15 – 30 °C (air conditioning recommended)	
Relative humidity		< 80% (non-condensing)	
Electrical requirements		100 V AC, 7 A – 240 V AC, 3 A; 50 – 60 Hz	100 V AC, 12 A – 240 V AC, 5 A; 50 – 60 Hz
Rated power		200 W	
Power consumption	Laser	100 W	150 W
	Chiller	600 W	1000 W

1) *For 20 W output power. Lower power models: 8 W and 12 W, are available upon request.*
2) *Standard repetition rate is 80 MHz; custom repetition rate can be factory preset from the given range.*
3) *Depends on the repetition rate. Values are given for 80 MHz.*
4) *With enabled power-lock, under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).*
5) *For external 2H, or even 3H and 4H generation, refer to HIRO for FLINT.*
6) *Conversion efficiency specified at maximum power.*

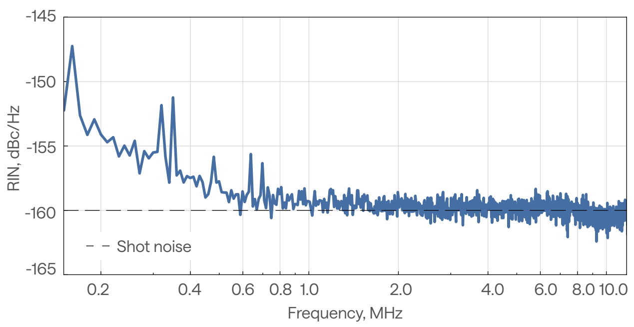
DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

Stability

FLINT-FL2 (20 W) output power stability under harsh environmental conditions over 7 days



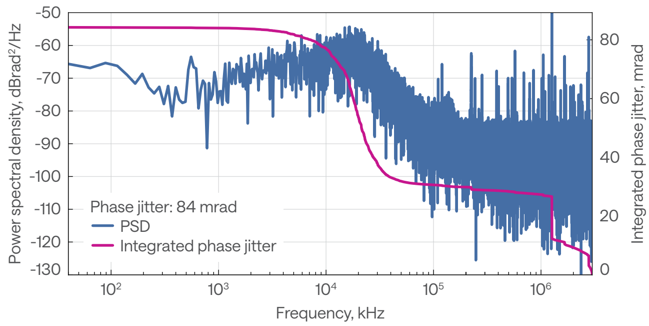
FLINT oscillator relative intensity noise (RIN), shot-noise limited at -160 dBc/Hz above 1 MHz



CEP stabilization

FLINT oscillators can be equipped with feedback electronics for carrier-envelope phase (CEP) stabilization of the output pulses. The carrier-envelope offset (CEO) of the oscillator is actively locked to 1/4th of the repetition rate with a < 100 mrad standard deviation.

CEP-locked **FLINT** oscillator phase noise data

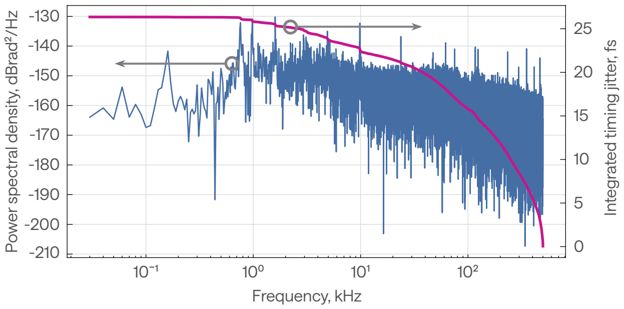


Repetition rate locking

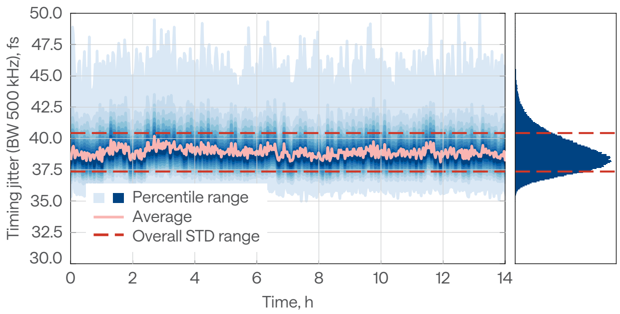
FLINT oscillators are customizable for repetition rate locking applications. Coupled with the necessary feedback electronics, the repetition rate can be synchronized to an external RF source using the two piezo stages installed inside the cavity.

The repetition rate locking system can assure an integrated timing jitter of less than 200 fs for RF reference frequencies larger than 500 MHz. Continuous phase shifting is available upon request.

FLINT oscillator phase noise data
locked to a 2.8 GHz RF source

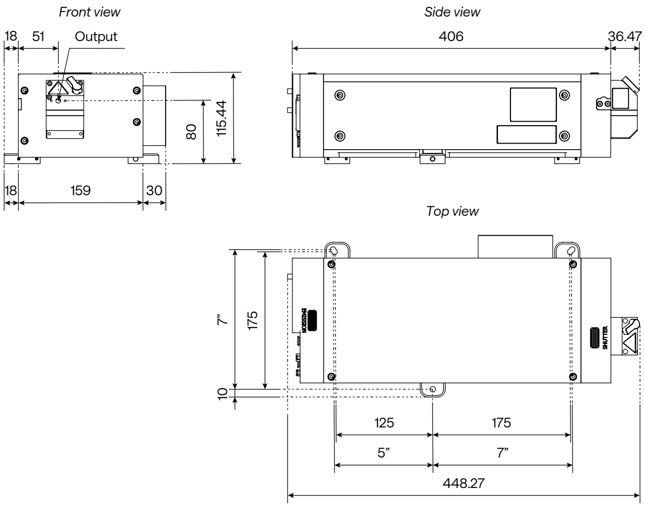


Timing jitter stability over 14 h;
FLINT oscillator locked to a 2.8 GHz RF source

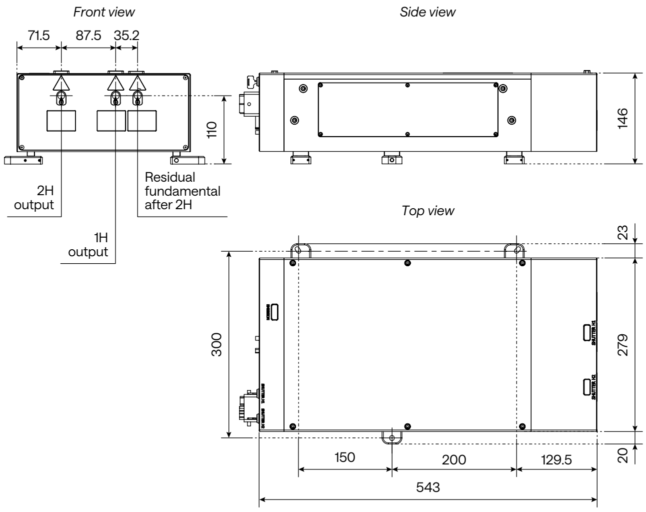


Drawings

FLINT-FL1 drawing



FLINT-FL2 drawing



HG | FLINT

Second Harmonic Generator

FLINT-FL2 with integrated HG

- 515 nm output
- Automated harmonic selection
- Integrated into the housing
- Industrial-grade design

Specifications

Model	FL1	FL2-SP	FL2		
Available harmonic			2H		
Pump repetition rate			10 MHz	40 MHz	80 MHz
Maximum pump power	Refer to HIRO; *see page 24*		5 W	20 W	
Center wavelength			515 ± 10 nm		
Conversion efficiency [1]			> 30%		
Polarization			Linear, horizontal		

[1] *Conversion efficiency specified at maximum power.*

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

HG | CARBIDE

Automated Harmonic Generators

CARBIDE-CB3 with 2H-3H

- 515 nm, 343 nm, 257 nm, or 206 nm output
- Automated harmonic selection
- Mounted directly on the laser head
- Industrial-grade design
- 50 W UV model

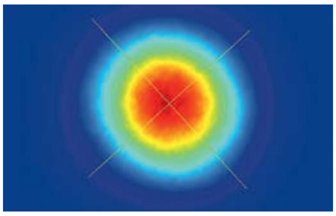
Specifications

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, typical values	≤ 400 µJ pump	< 1.15 (2H)	< 1.15 (2H) < 1.2 (3H)	< 1.15 (2H) n/a (4H)	n/a	< 1.3 (3H)	< 1.3 (3H)
	> 400 µJ pump	< 1.2 (2H)	< 1.2 (2H) < 1.3 (3H)	< 1.2 (2H) n/a (4H)	n/a		

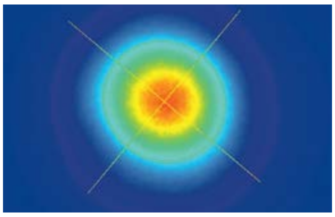
1) *Refer to CARBIDE-CB3-UV for more details.*
2) *Depends on pump laser model. Up to 5th harmonic available; contact sales@lightcon.com for more details.*
3) *Maximum output power of 5 W. More than 4 W is available at 50 – 400 µJ pump energies and ≈ 500 fs pump pulse duration.*
4) *Maximum output power 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

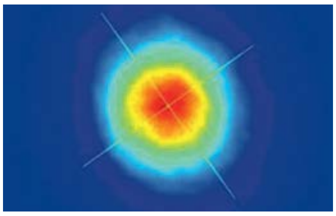
CARBIDE-CB5 (100 kHz, 6 W)
Typical 1H beam profile



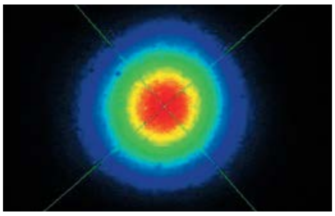
CARBIDE-CB5 (100 kHz, 3.4 W)
Typical 2H beam profile



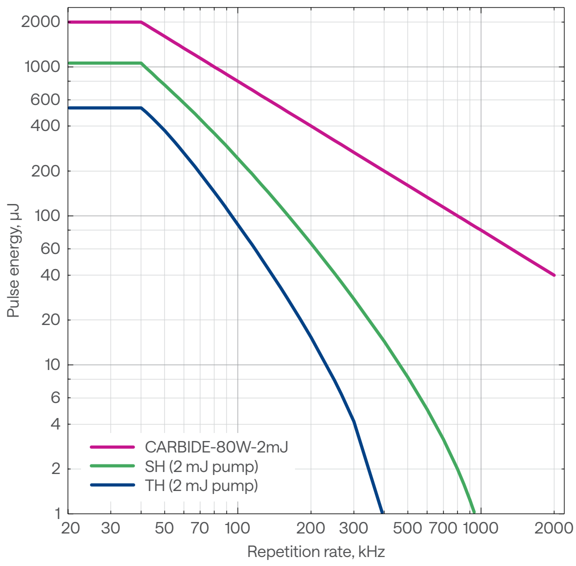
CARBIDE-CB5 (100 kHz, 2.2 W)
Typical 3H beam profile



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

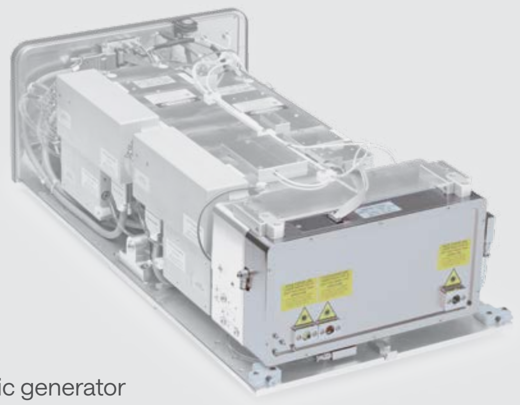


CARBIDE-CB3-80W with HG
Pulse energy vs repetition rate



HG | PHAROS

Automated Harmonic Generators



PHAROS with a harmonic generator

- 515 nm, 343 nm, 257 nm, or 206 nm output
- Automated harmonic selection
- Industrial-grade design

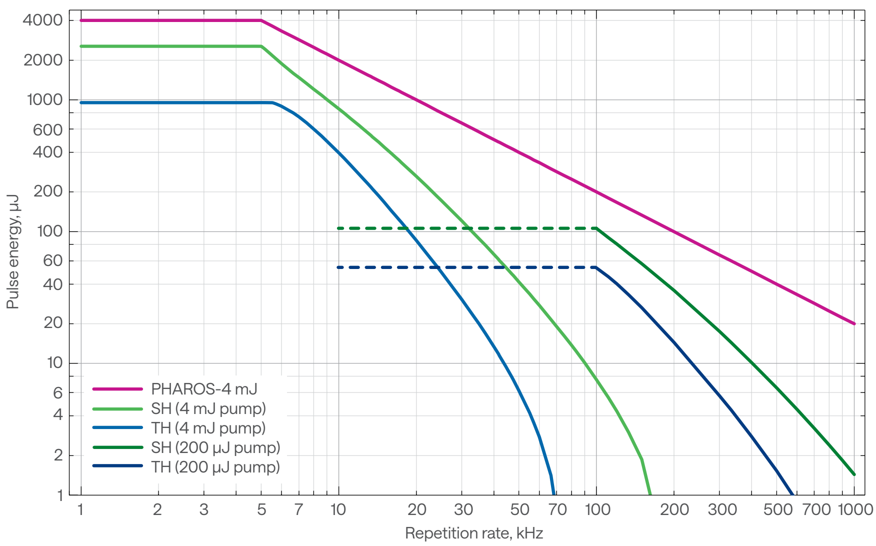
Specifications

Model		2H (-HE)	2H-3H (-HE)	2H-4H (-HE)	4H-5H
Output wavelength [1] (automated selection)		1030 nm 515 nm	1030 nm 515 nm 343 nm	1030 nm 515 nm 257 nm	1030 nm 257 nm 206 nm
Pump pulse energy		20 – 4000 µJ	50 – 4000 µJ	20 – 4000 µJ	200 – 1000 µJ
Pump pulse duration		100 – 500 fs			
Conversion efficiency		> 50% (2H)	> 50% (2H) > 25% (3H)	> 50% (2H) > 10% (4H) [2]	> 10% (4H) [2] > 5% (5H) [3]
Beam quality, M^2, typical values	≤ 400 µJ pump	< 1.15 (2H)	< 1.15 (2H) < 1.2 (3H)	< 1.15 (2H) n/a (4H)	n/a
	> 400 µJ pump	< 1.2 (2H)	< 1.2 (2H) < 1.3 (3H)	< 1.2 (2H) n/a (4H)	

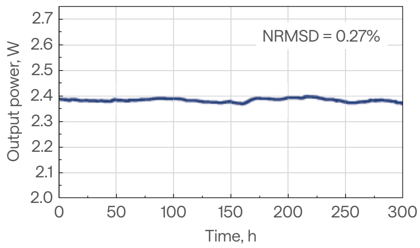
[1] *Depends on pump laser model.*
[2] *Maximum output power of 2 W at 20 – 1000 µJ pump or 1 W at 1000 – 4000 µJ pump.*
[3] *Maximum output power of 150 mW.*

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

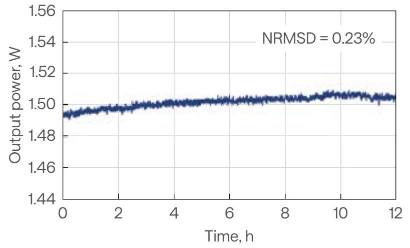
PHAROS with HG pulse energy vs repetition rate



3H output power stability



4H output power stability



HIRO

External Harmonic Generator

- 515 nm, 343 nm, 257 nm, and 206 nm outputs
- Simple selection of the active harmonic
- Simultaneous or switchable outputs
- Standalone harmonics for PHAROS / CARBIDE and FLINT

HIRO for PHAROS / CARBIDE

Model	HIRO	HIRO-HP	HIRO-HE
Maximum pump power	20 W	80 W	
Pump pulse energy	8 – 400 µJ	200 – 1000 µJ	1000 – 4000 µJ
Available outputs [1) 2)]	Up to 4H [3)]	Up to 5H	
Conversion efficiency [1) 4)]	> 50% (2H) > 25% (3H) > 10% (4H) [5)] > 5% (5H) [6)]		
Polarization [7)]	Linear, horizontal (2H, 5H) Linear, vertical (3H, 4H)		
PHYSICAL DIMENSIONS			
Dimensions (L × W × H)	487 × 176 × 180 mm	552 × 320 × 170 mm	

1) *For harmonic combinations and simultaneous outputs, contact sales@lightcon.com.*
2) *Residual fundamental output available upon request.*
3) *White light continuum output available upon request.*
4) *Percentage of pump power, for repetition rate of up to 200 kHz.*
5) *Maximum output power of 1 W.*
6) *Maximum ouput power of 150 mW. Only for HIRO-HP/HE.*
7) *Different polarization is available upon request.*

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

HIRO for FLINT

Model	HIRO
Available harmonic [1]	Up to 4H
Maximum pump power	4 W
Conversion efficiency [2]	> 35% (2H) > 5% (3H) > 1% (4H)

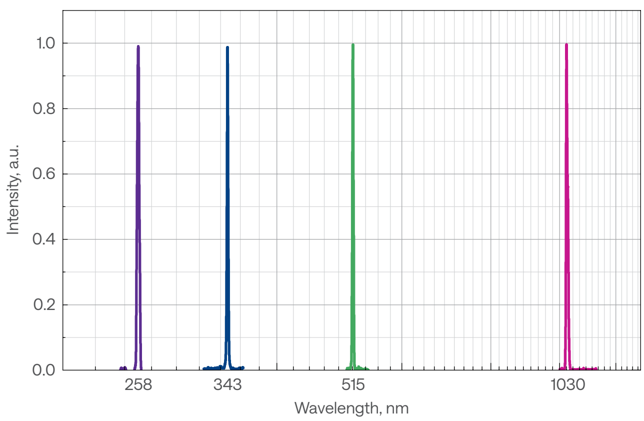
PHYSICAL DIMENSIONS

Dimensions (L × W × H)	487 × 176 × 180 mm

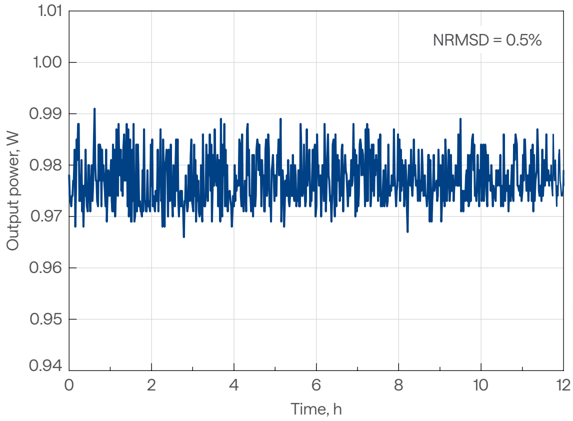
[1] *For high power 2H, refer to HG for FLINT.*
[2] *For pump power of > 500 mW.*

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

HIRO outputs

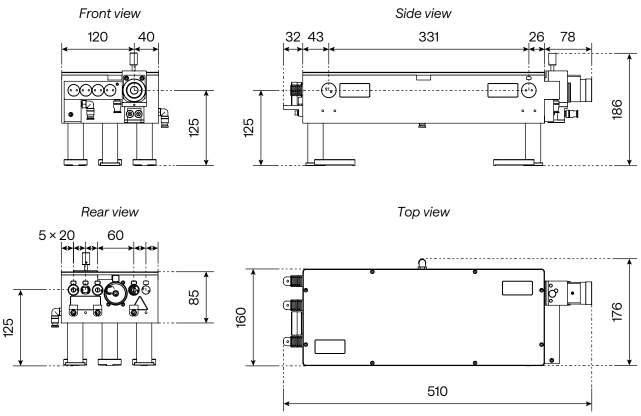


4H output power stability

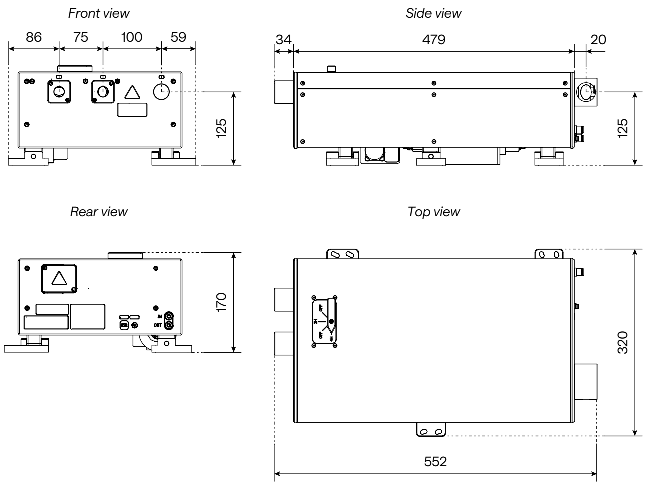


Drawings

HIRO drawing

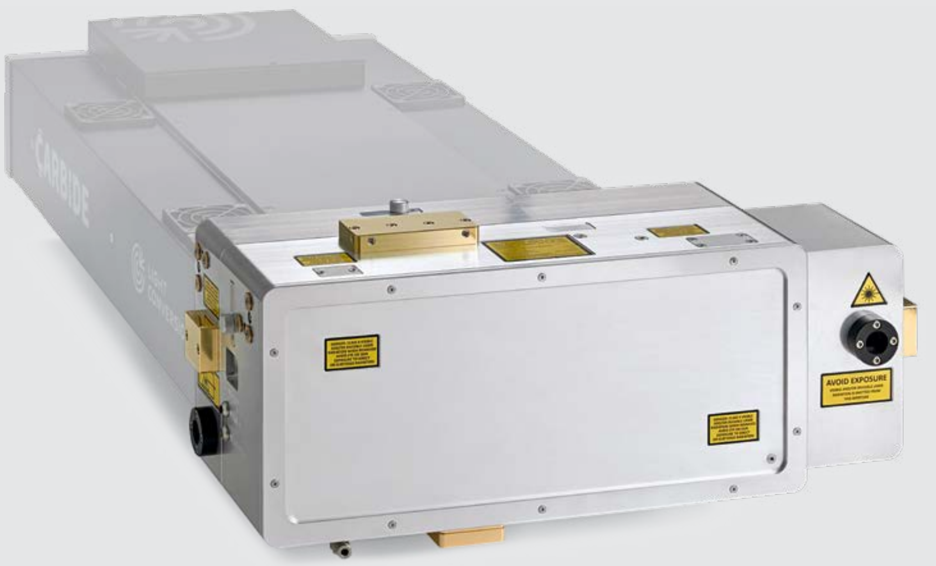


HIRO-HP/HE drawing



I-OPA

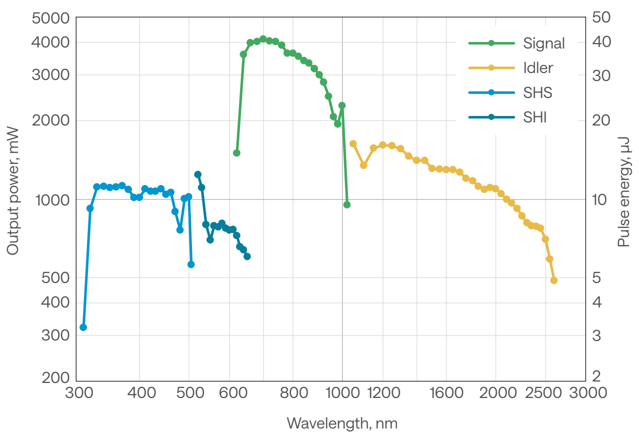
Industrial-Grade
Optical Parametric Amplifier



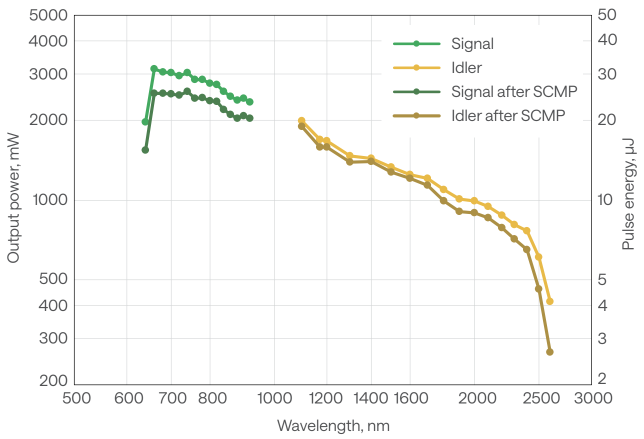
I-OPA-TW on air-cooled CARBIDE-CB5

- 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

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



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 – 10000 nm (DFG)
Pulse compression options [2]	n/a	SCMP (signal pulse compressor) ICMP (idler pulse compressor) GDD-CMP (compressor with GDD control)	n/a

PUMP LASER REQUIREMENTS

Pump laser	PHAROS or CARBIDE
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

Operating temperature [6]	19 – 25 °C (air conditioning recommended)
Relative humidity [6]	20 – 70% (non-condensing)
Electrical requirements	n/a [7]

[1] *In case of 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 – 900 nm, 40 – 100 fs @ 1200 – 2000 nm.*

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

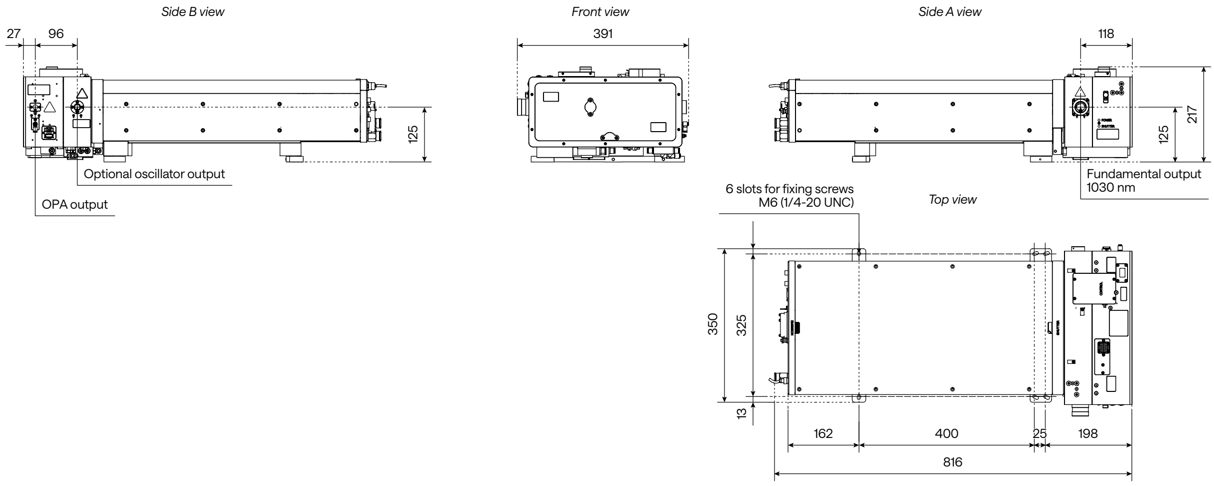
[6] *Specifications are guaranteed for a maximum temperature variation of ± 1 °C and humidity variation of ± 10%.*

[7] *I-OPA is powered by the same electrical source as the pump laser. Thus, refer to the pump laser electrical requirements.*

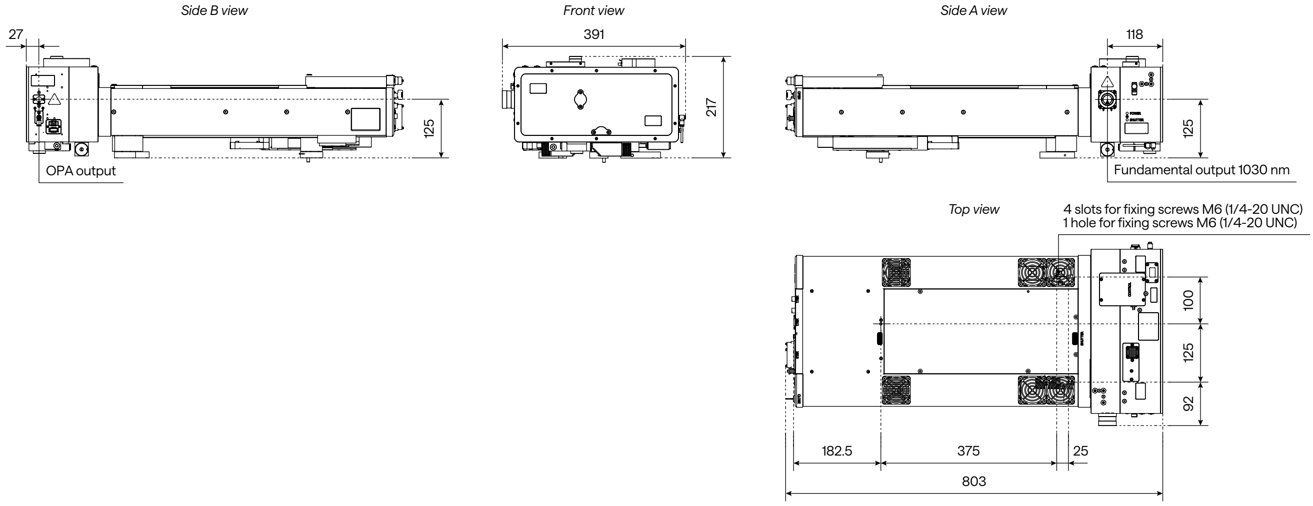
DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

Drawings

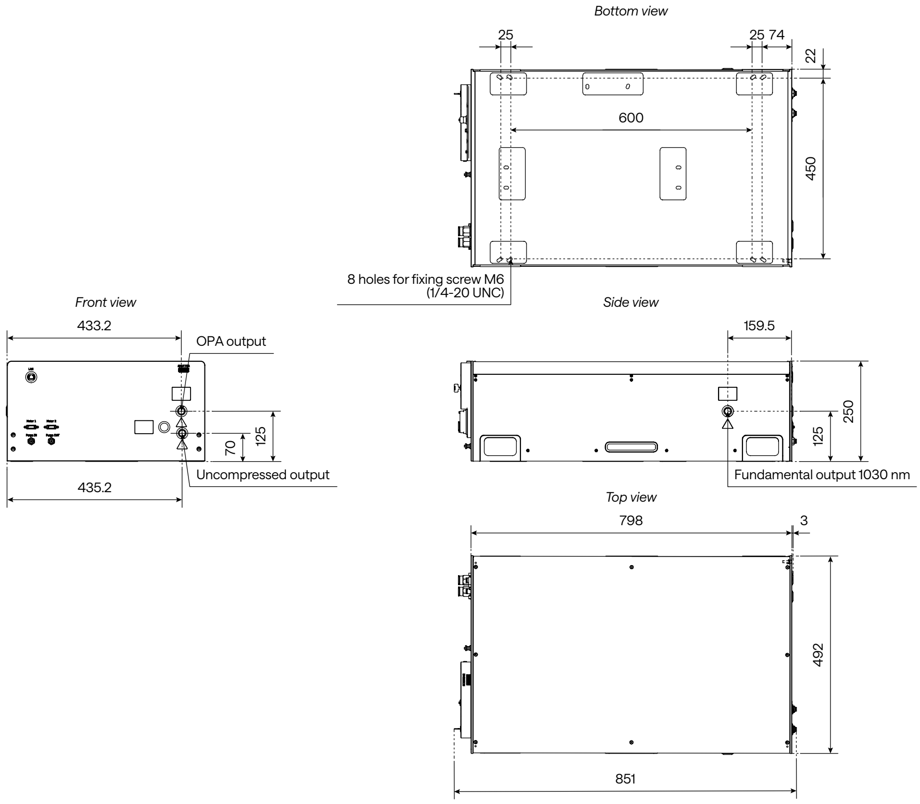
CARBIDE-CB3 with I-OPA-HP drawing and output ports



CARBIDE-CB5 with I-OPA-HP drawing and output ports



PHAROS-PH2 with I-OPA-HP drawing and output ports



Micromachining Applications

LIGHT CONVERSION delivers best-in-class lasers for today's most demanding applications.

This section provides examples of micromachining driven by ultrafast light-matter interaction, including drilling, cutting, welding, surface structuring, and marking, for industries such as consumer electronics, semiconductors, medical, luxury goods, automotive & aerospace.

Cutting & drilling

Volume modification

Surface structuring

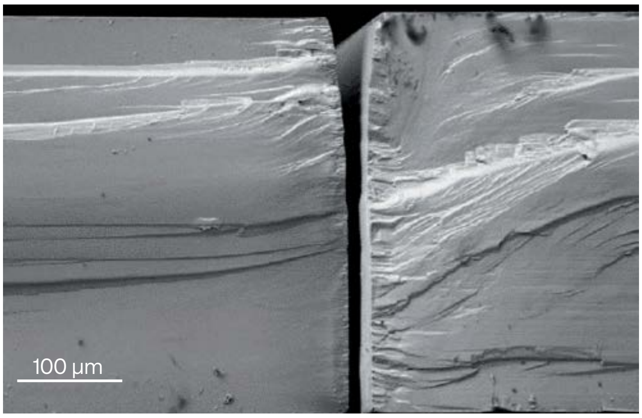
Selective ablation

Selective ablation of tungsten carbide.

High-contrast marking

Corrosion-free black-and-white marking on a stainless steel hemostatic clamp using the BiBurst option.

Brittle & highly thermally sensitive material cutting



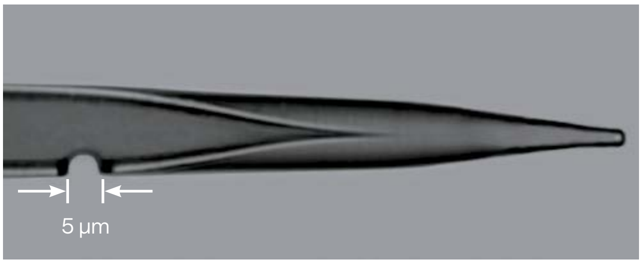
Multi-pass cadmium tungstate cutting.
No cracks. All thermal trace effects eliminated.

Source: Micronanics Laser Solutions Centre.

Stainless steel stent cutting

Example of a stent cut from stainless steel.

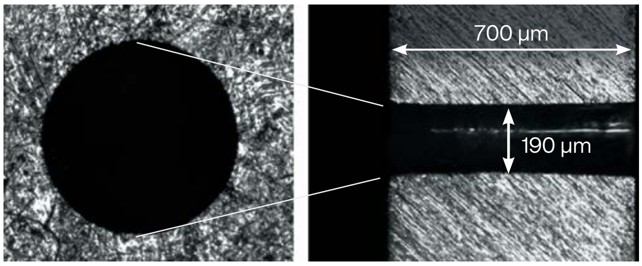
Glass needle micro-drilling



Glass needle micro-drilling.

Source: Workshop of Photonics.

Steel drilling



Taperless hole micro-drilling in stainless steel alloys.

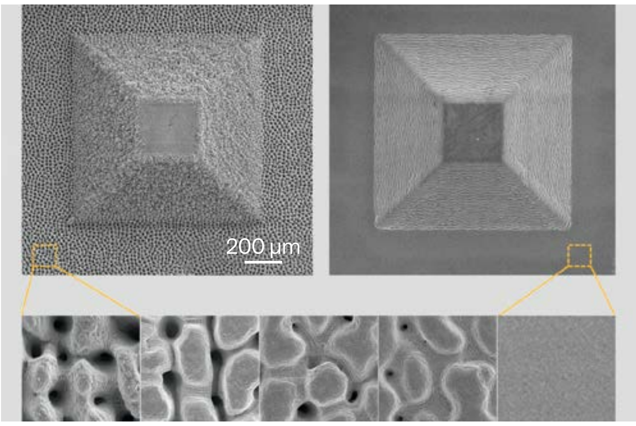
Source: Workshop of Photonics.

Milling of complex 3D surfaces

3D-milled sample in copper. Zoom-in SEM image.

Source: A.Žemaitis, et al. Scientific Reports (2019).

Stainless steel polishing



SEM images of structures ablated in stainless steel, before and after polishing using a GHz burst (from left to right).

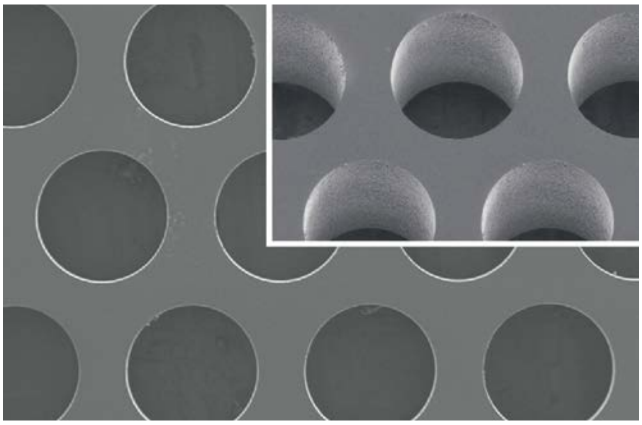
Source: D.Metzner, et al. Applied Surface Science (2020).

Birefringent volume modification in glass

Form induced birefringence-retardance variation results in different colors in parallel-polarized light.

Source: Workshop of Photonics.

High-precision glass drilling



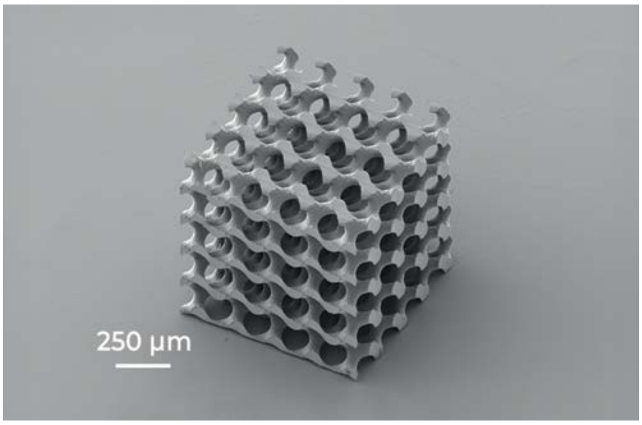
Glass micro-drilling, no taper.

Source: Workshop of Photonics.

3D glass etching

Structure fabricated in fused silica.

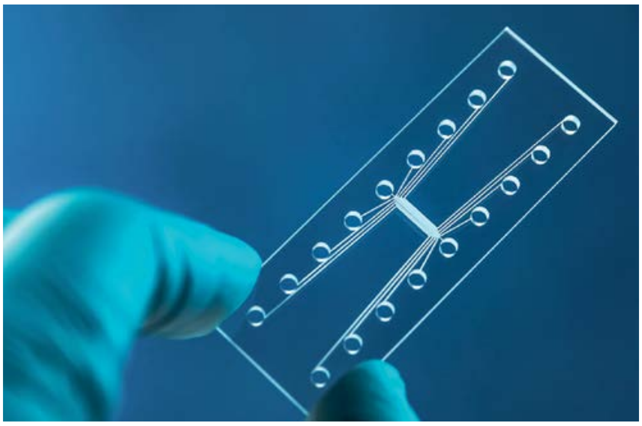
3D multi-photon polymerization



3D structure fabricated from SZ2080 polymer using multi-photon polymerization.

Source: Femtika.

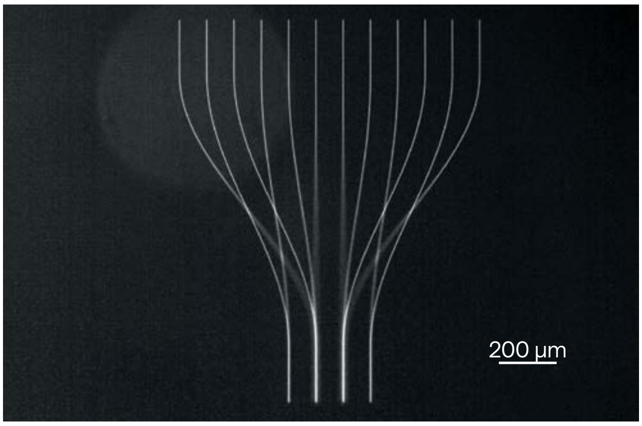
Microfluidic channel ablation and welding



Microfluidic chip manufacturing with channel sealing.

Source: Workshop of Photonics.

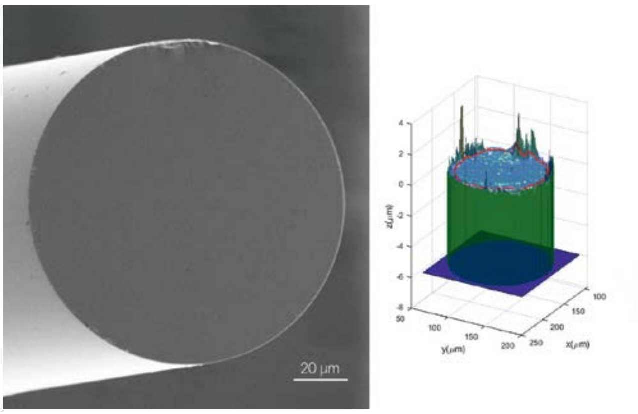
3D waveguides



3D waveguides fabricated in fused silica.

Source: Workshop of Photonics.

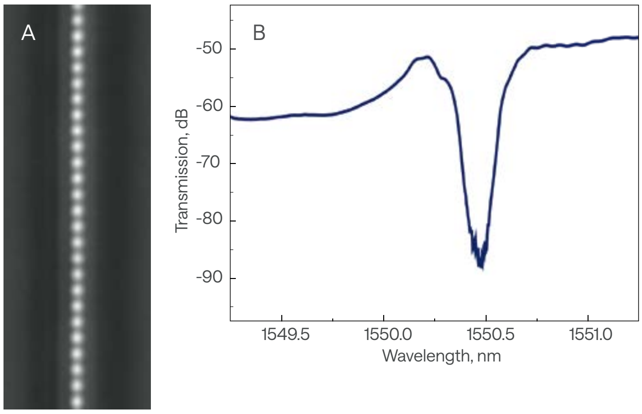
Fiber cleaving



Fiber end-face after laser-based scribing (left) and its surface profile (right).

Source: Swinburne University of Technology.

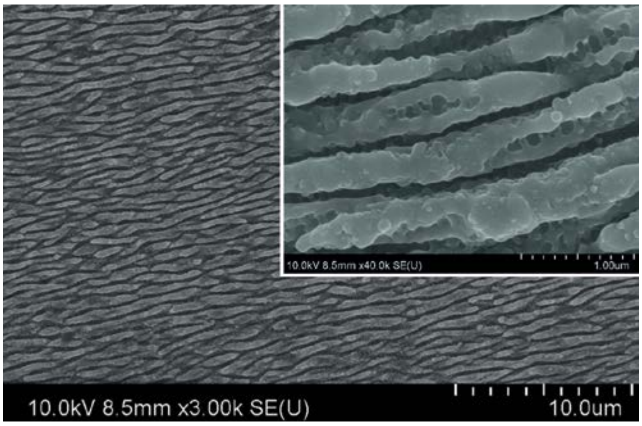
Bragg grating waveguide (BGW) writing



First-order Bragg gratings inscribed in a waveguide (a). Resonant spectral transmission of the inscribed BGW (b).

Source: G.Zhang, et al. Photon. Res. (2019).

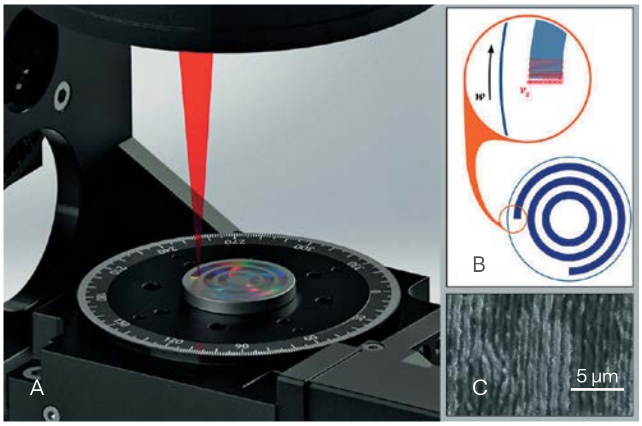
SERS sensor fabrication



SEM image of the Ti-6Al-4V (TC4) surface after irradiation with a progressive laser scan.

Source: L.Lu, et al. Nanomaterials (2019).

Friction and wear reduction



Schematic of the laser treatment (a), laser patterning strategy (b), SEM image of induced LIPSS (c).

Source: I.Gnilitskyi, et al. Lubricants (2019).

Intraocular lens cutting

Laser-cut intraocular lens.

Source: LASEA.

Silicon Carbide dicing

Single-pass (300 mm/s) dicing of a 500 µm thick 4H-SiC wafer.

Cutting and welding

Cut and welded parts from brass using a single laser system.

Silicon dicing

Precise dicing of a silicon wafer.

Surface texturing

Moon-like surface texturing on a watch bezel.

Source: LASEA.

Nozzle drilling

Precision drilling of the nozzle holes.

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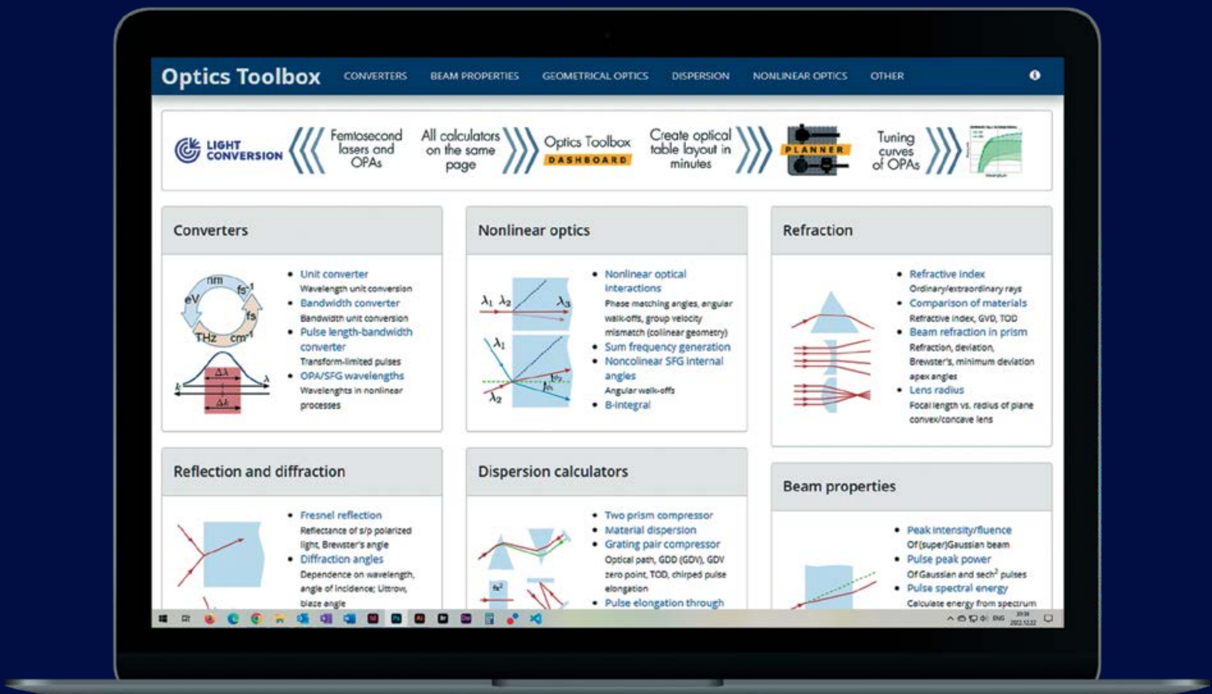
Optics Toolbox



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Optical table layout planner

Custom OPA tuning curves

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