

Product Catalog

# OPCPA Systems

LIGHT CONVERSION is a global leader in ultrafast technology, designing and manufacturing femtosecond lasers, wavelength-tunable sources, optical parametric chirped-pulse amplifiers, spectroscopy systems, and microscopy sources.

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



10 000

Femtosecond laser systems installed worldwide



17 500

Square meters designated for manufacture and R&D

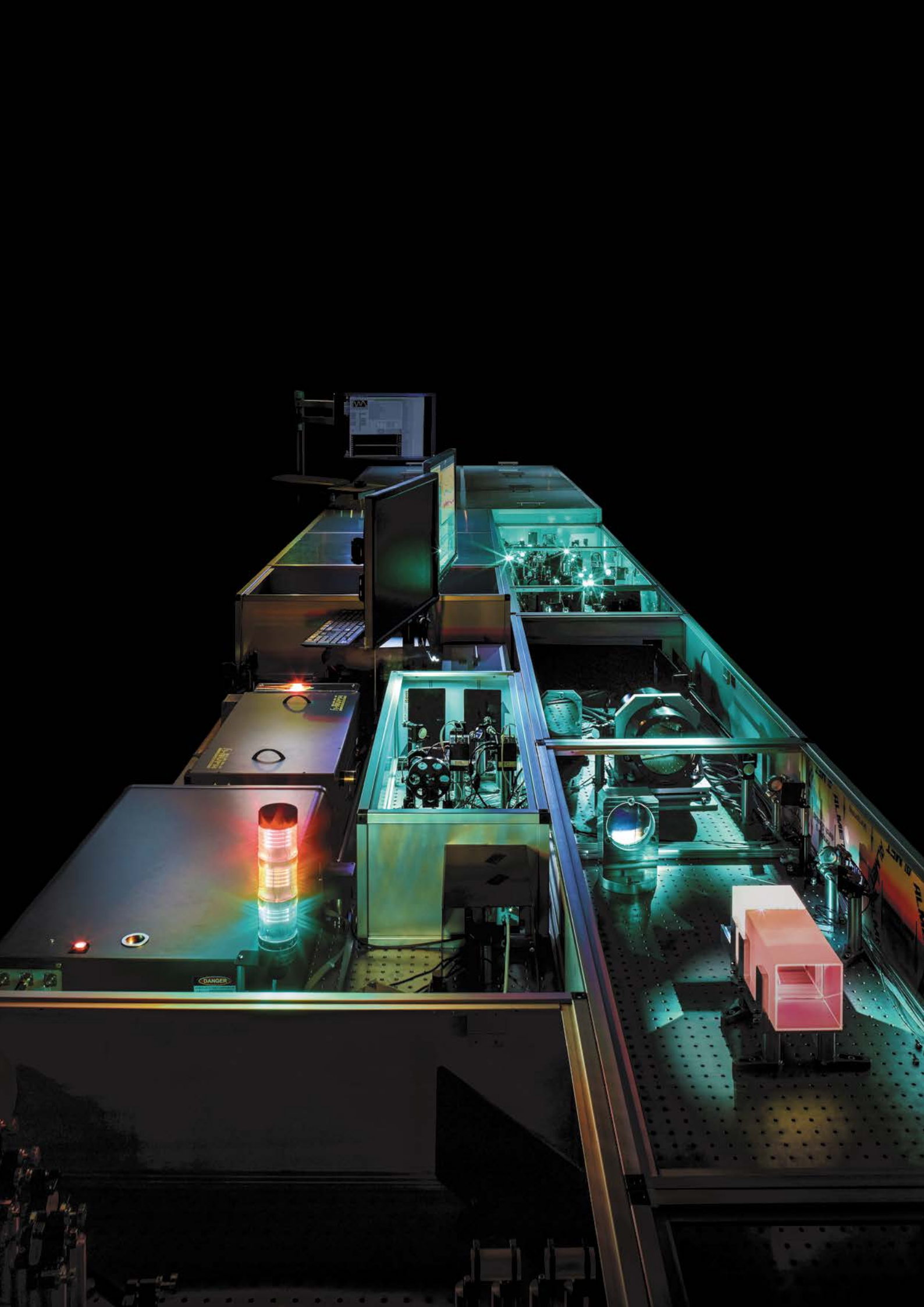


750

Employees, of whom 15% focus on R&D

## About Us

Founded in 1994, LIGHT CONVERSION has evolved into a leading company in ultrafast laser technology with over 10 000 systems installed worldwide and 750 employees, 15% of whom focus on R&D. The company's lasers are used by all of the world's top 50 universities, 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.



# OPCPA Systems

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Optical parametric chirped-pulse amplification is currently the only laser technology that can simultaneously provide high peak and average power with a few-cycle pulse duration, required for the most demanding scientific applications.

From tabletop systems to extreme light infrastructures

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High peak and average power with few-cycle pulse durations

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State-of-the-art CEP and pulse energy stability

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## **ORPHEUS** | OPCPA

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Delivers few-cycle, high-contrast, CEP-stable pulses at a chosen wavelength within the 800 – 2000 nm range in a package as compact as our standard parametric amplifiers.

## **OPCPA** | HE

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High-energy OPCPA systems, scalable to multi-TW peak powers at kHz repetition rates, maintain few-cycle pulse durations, meeting the most demanding requirements with stability and reliability unprecedented for systems of this scale.

## Compact, Few-Cycle, CEP-Stable OPCPA Systems

Few-cycle pulses in a compact footprint

Industrial-grade pump:  
up to 480 W, 20 mJ

High repetition rate, up to MHz

High-contrast variable-bandwidth seed  
source for CPA and OPCPA systems

CEP stabilization option



### Specifications

Center wavelength <sup>1)</sup>	800 nm	1050 nm	1600 nm	2000 nm
Pump source	CARBIDE or PHAROS			
Pump power	20 – 480 W			
Pump pulse energy	0.2 – 20 mJ			
Repetition rate	1 kHz – 1 MHz			
Conversion efficiency <sup>2)</sup>	> 7%	> 6%	> 10%	> 9%
Pulse duration <sup>2) 3)</sup>	< 10 fs / < 15 fs	< 40 fs / < 300 fs	< 40 fs	< 25 fs
CEP stability, 1 h <sup>2) 4)</sup>	< 250 mrad			
Temporal contrast	$\geq 10^{10} : 1$ , from –500 to –50 ps $\geq 10^9 : 1$ , from –50 to –15 ps $\geq 10^6 : 1$ , from –15 to –5 ps		n/a <sup>5)</sup>	
Long-term power stability, 8 h <sup>2) 6)</sup>	< 1.5%			
Pulse-to-pulse energy stability, 1 min <sup>2) 6)</sup>	< 1%			

<sup>1)</sup> Typical wavelengths, other wavelengths are available. For custom inquiries, contact sales@lightcon.com.

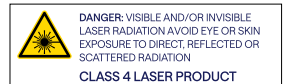
<sup>2)</sup> Typical values. For custom inquiries, contact sales@lightcon.com.

<sup>3)</sup> Uncompressed pulses available for seeding larger amplifiers.

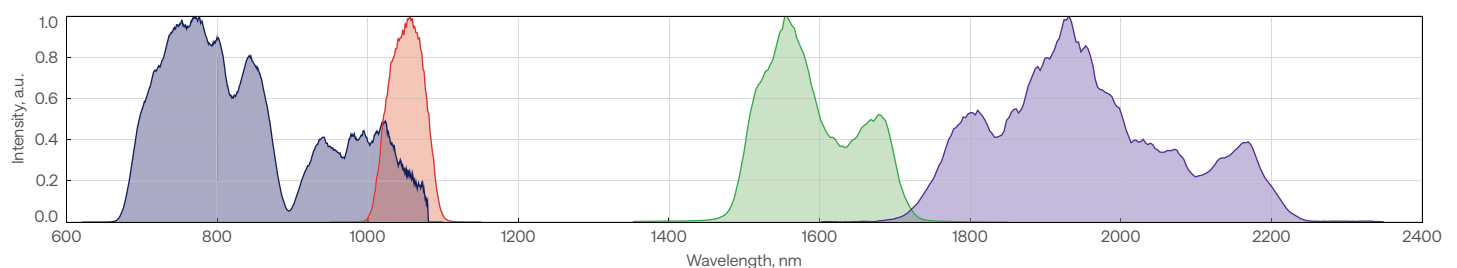
<sup>4)</sup> CEP values calculated from unaveraged, single-shot measurements.

<sup>5)</sup> Although the pulse contrast is not quantified, the identical OPA architecture is already validated at 800 nm and 1050 nm.

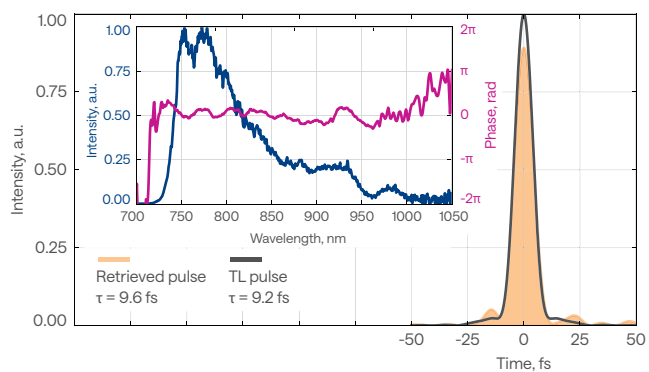
<sup>6)</sup> Expressed as normalized root mean squared deviation (NRMSD).



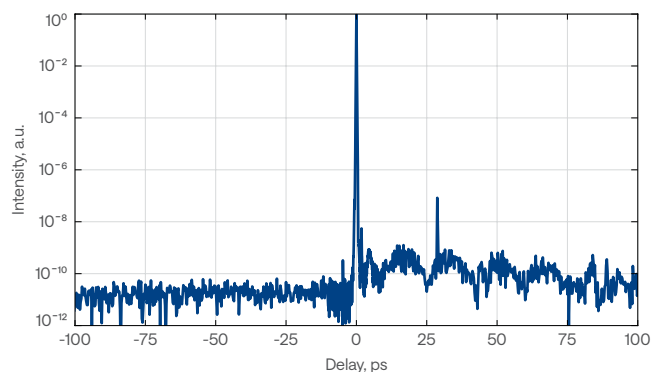
### ORPHEUS-OPCPA example spectra of four models



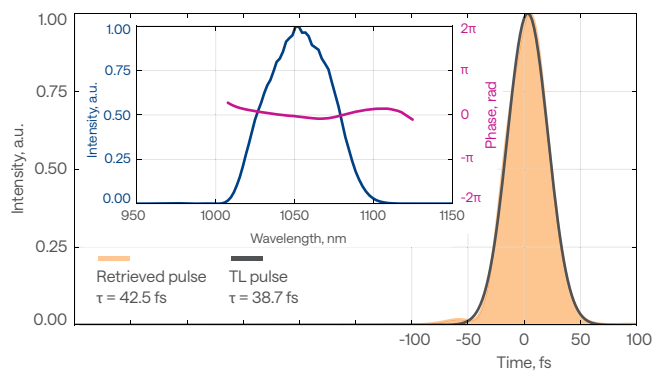
ORPHEUS-OPCPA temporal pulse profile at 800 nm



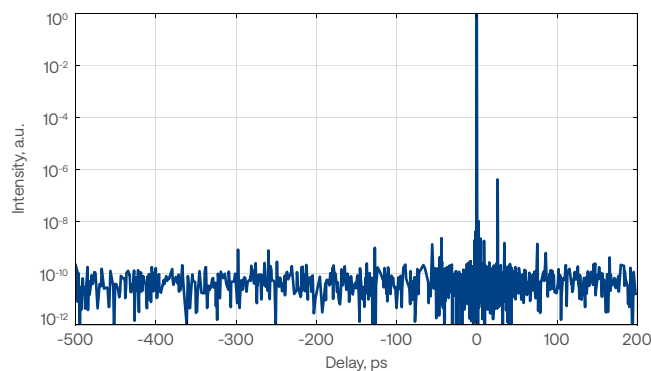
ORPHEUS-OPCPA pulse contrast measurement using a high-dynamic-range third-order autocorrelator at 800 nm



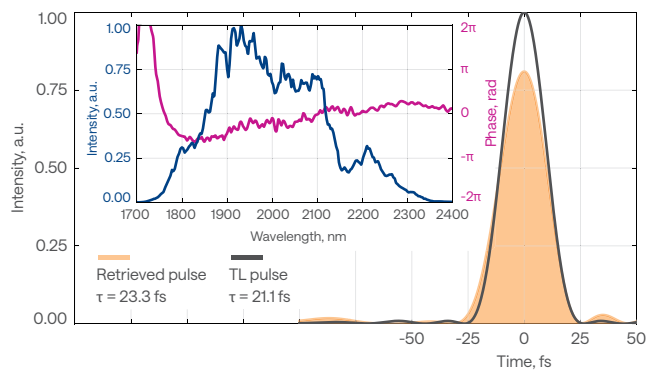
ORPHEUS-OPCPA temporal pulse profile at 1050 nm



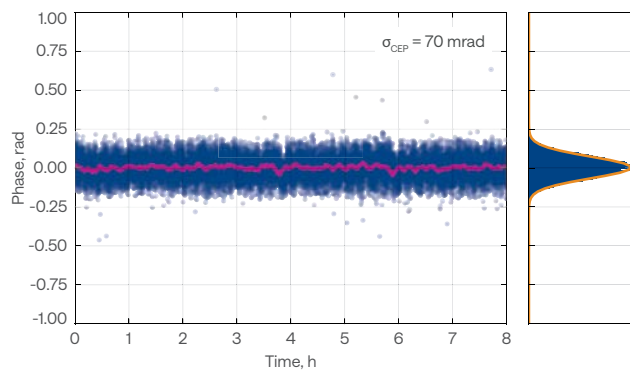
ORPHEUS-OPCPA pulse contrast measurement at 1050 nm



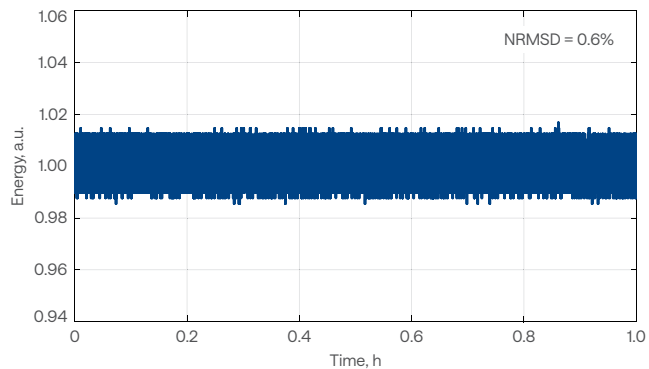
ORPHEUS-OPCPA temporal pulse profile at 2  $\mu$ m



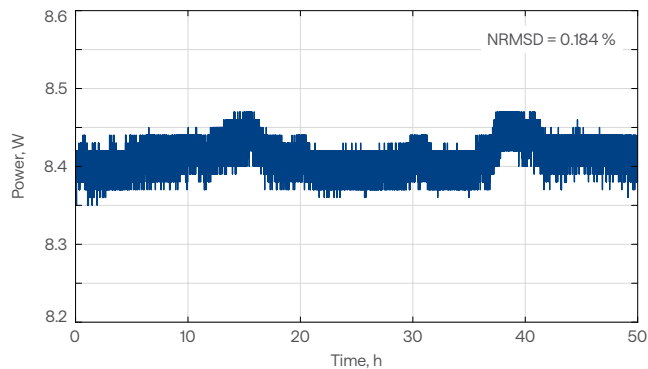
ORPHEUS-OPCPA CEP stability at 2  $\mu$ m



ORPHEUS-OPCPA pulse-to-pulse energy stability at 2  $\mu$ m



ORPHEUS-OPCPA long-term output stability at 2  $\mu$ m



## High-Energy OPCPA Systems

Multi-TW peak-power pulses at up to 1 kHz

Few-cycle pulse duration and high pre-pulse contrast

Exceptional CEP and pulse energy stability

800 nm, 1600 nm, 2000 nm output

Robust design with a warm-up time of < 1 hour

Spectral-temporal pulse shaping options



# Specifications

Center wavelength	800 nm	1600 nm	2000 nm
Pump source	Picosecond Nd:YAG lasers, seeded by ORPHEUS-OPCPA		
Repetition rate	10 Hz – 1 kHz		
Maximum output pulse energy <sup>1)</sup>	250 mJ	100 mJ	50 mJ
Pulse duration <sup>1)</sup>	< 9 fs	< 50 fs	< 30 fs
CEP stability, 1 h <sup>1) 2)</sup>	< 250 mrad		
Long-term power stability, 8 h <sup>1) 3)</sup>	< 1.5%		
Pulse-to-pulse energy stability, 1 min <sup>1) 3)</sup>	< 1.5%		

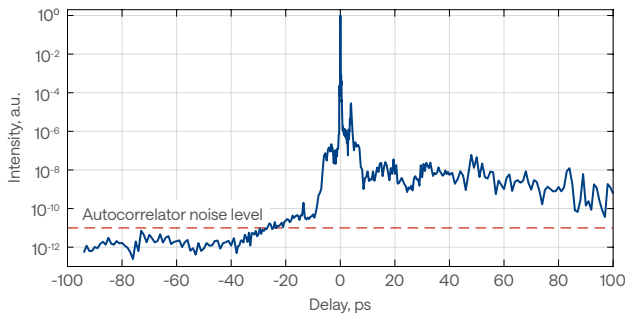
<sup>1)</sup> Typical values. For custom inquiries, contact sales@lightcon.com.

<sup>2)</sup> CEP values calculated from unaveraged, single-shot measurements.

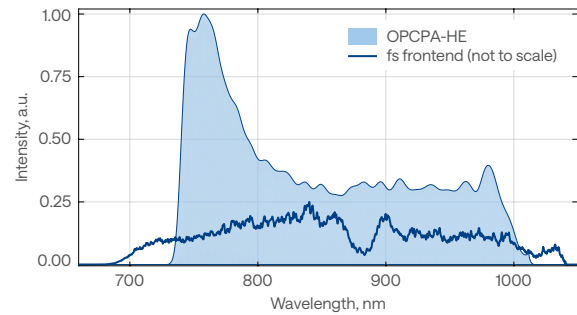
<sup>3)</sup> Expressed as as normalized root mean squared deviation (NRMSD).



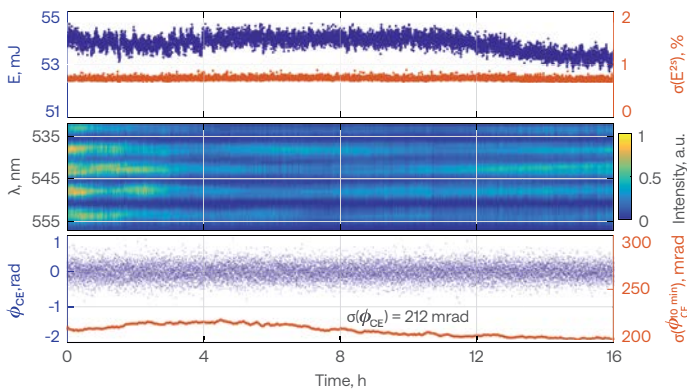
OPCPA-HE system high-dynamic-range third order autocorrelation measurement at 800 nm



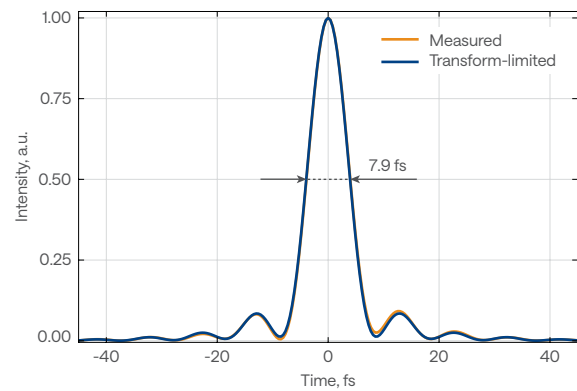
OPCPA-HE output spectrum at 800 nm



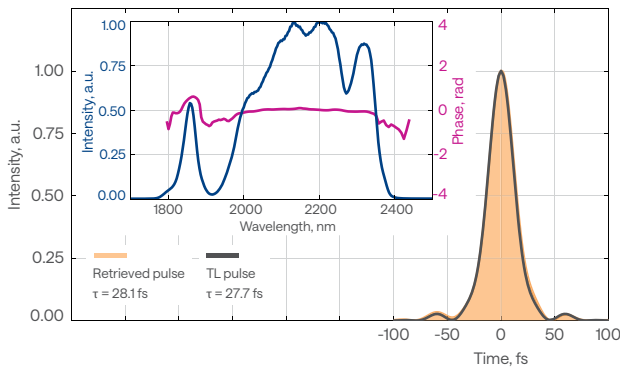
OPCPA-HE pulse energy, f-2f interferogram and CEP stability measured over 16 h at 800 nm



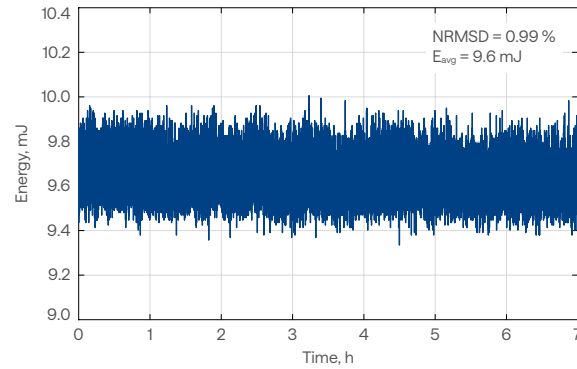
OPCPA-HE output pulses' temporal profile measured with a self-referenced spectral interferometry device at 800 nm



OPCPA-HE output pulses' temporal profile at 2 μm



OPCPA-HE pulse-to-pulse energy stability at 2 μm





# Femtosecond Lasers

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

High average power and pulse energy at high repetition rates

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Market-proven industrial-grade stability and reliability

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Automated harmonics and wavelength-tunable extensions

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## **CARBIDE**

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Compact industrial design in air- or water-cooled models, providing up to 120 W, 1 mJ or 80 W, 2 mJ with excellent output stability.

## **PHAROS**

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Scientific flexibility with process-tailored output parameters, offering up to 1 mJ pulse energy at < 100 fs or up to 5 mJ at < 250 fs.

## 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

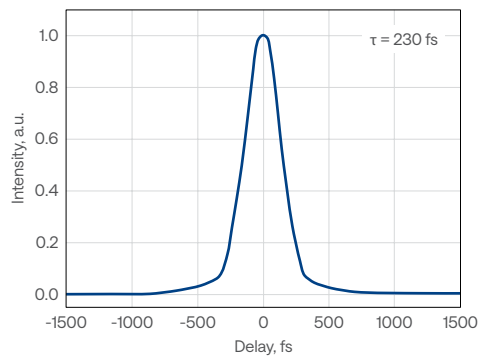
Automated harmonics up to the 5<sup>th</sup>  
and wavelength-tunable extensions

Air-cooled or water-cooled models

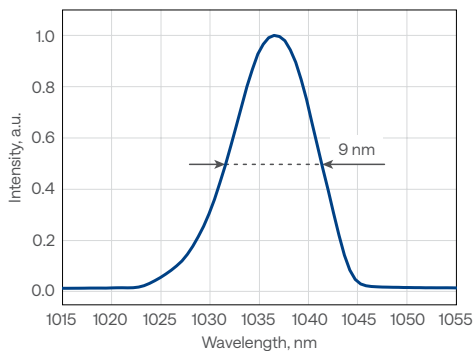


CARBIDE-CB3

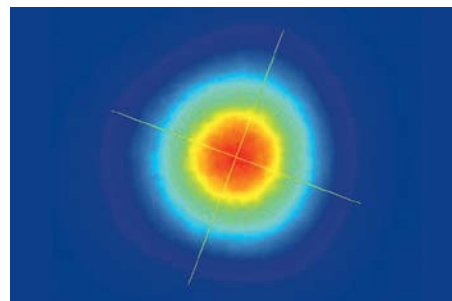
**CARBIDE-CB3**  
Typical pulse duration



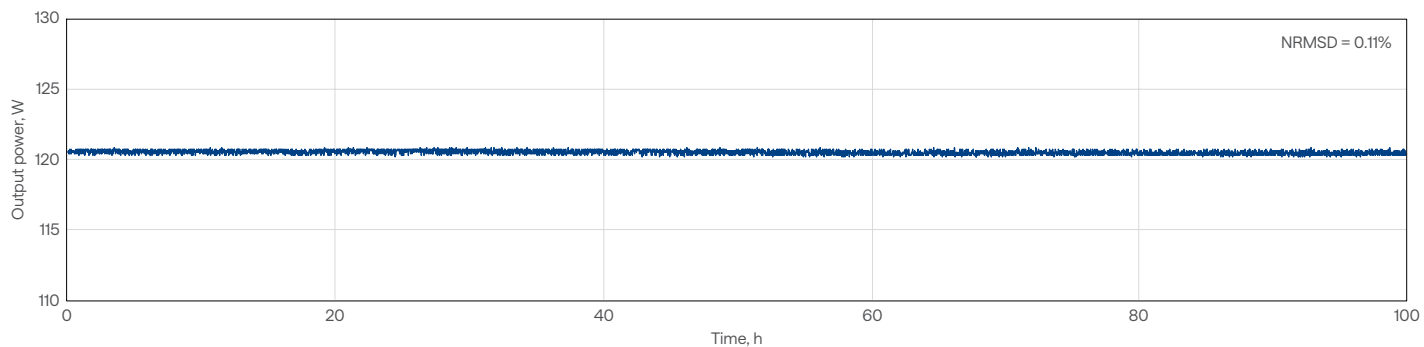
**CARBIDE-CB3**  
Typical spectrum



**CARBIDE-CB3**  
Typical beam profile



**CARBIDE-CB3-120W**  
Long-term power stability





Model	CB3-20W	CB3-40W	CB3-40W-10MHz	CB3-80W	CB3-120W
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**OUTPUT CHARACTERISTICS**

Cooling method	Water-cooled				
Center wavelength	1030 ± 10 nm				
Maximum output power	20 W	40 W		80 W	120 W
Pulse duration <sup>1)</sup>	< 250 fs			< 350 fs <sup>2)</sup>	< 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
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 <sup>2</sup>	< 1.2				
Beam diameter <sup>3)</sup>	3.9 ± 0.4 mm			4.2 ± 0.4 mm	5.1 ± 0.7 mm
Beam pointing stability	< 20 µrad/°C				
Pulse energy control	FEC <sup>4)</sup>		Attenuator <sup>5)</sup>	FEC <sup>4)</sup>	
Pulse picker leakage	< 0.25%		< 0.5%	< 0.25%	
Pulse-to-pulse energy stability, 12 h <sup>6)</sup>	< 0.5%				
Long-term power stability, 100 h <sup>6)</sup>	< 0.5%				

**MAIN OPTIONS**

Oscillator output <sup>7)</sup>	< 0.5 W, 120 – 250 fs, 1030 ± 10 nm, ≈ 65 MHz				
Harmonic generator <sup>8)</sup>	515 nm, 343 nm, 257 nm, or 206 nm; refer to CARBIDE HG				
Optical parametric amplifier <sup>9)</sup>	UV – MIR; refer to I-OPA or ORPHEUS				
BiBurst option	Tunable GHz and MHz burst with burst-in-burst capability; refer to BiBurst				

**PHYSICAL DIMENSIONS**

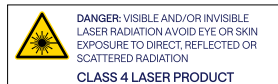
Laser head (L × W × H)	633 × 350 × 174 mm				
Chiller (L × W × H)	585 × 484 × 221 mm		680 × 484 × 307 mm		
24 V DC power supply (L × W × H)	352 × 195 × 75 mm				376 × 449 × 88 mm

**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	

<sup>1)</sup> Assuming a Gaussian pulse shape.  
<sup>2)</sup> Pulse duration can be reduced to < 250 fs if a pulse peak intensity of > 50 GW/cm<sup>2</sup> is tolerated by the customer setup.  
<sup>3)</sup> FW 1/e<sup>2</sup>, using maximum pulse energy.  
<sup>4)</sup> 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.  
<sup>5)</sup> Waveplate-based variable optical attenuator (VOA); an external analog control input is available. FEC is available for repetition rates up to 2 MHz.

<sup>6)</sup> Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).  
<sup>7)</sup> Available simultaneously, requires a scientific interface. Contact sales@lightcon.com for more details or customized solutions.  
<sup>8)</sup> Integrated. For an external harmonic generator, refer to HIRO.  
<sup>9)</sup> Integrated. For more details and stand-alone OPAs, refer to wavelength-tunable sources.



# CARBIDE-CB5 specifications

# Air-cooled IR lasers

Model	CB5-6W	CB5-5W	CB5-SP
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## OUTPUT CHARACTERISTICS

Cooling method	Air-cooled <sup>1)</sup>		
Center wavelength	1030 ± 10 nm		
Maximum output power	6 W	5 W	
Pulse duration <sup>2)</sup>	< 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 <sup>2</sup>	< 1.2		
Beam diameter <sup>3)</sup>	2.1 ± 0.4 mm		
Beam pointing stability	< 20 µrad/°C		
Pulse energy control	Attenuator <sup>4)</sup>	AOM <sup>5)</sup>	Attenuator <sup>4)</sup>
Pulse picker leakage	< 2%	< 0.1%	< 2%
Pulse-to-pulse energy stability, 12 h <sup>6)</sup>	< 0.5%		
Long-term power stability, 100 h <sup>6)</sup>	< 0.5%		

## MAIN OPTIONS

Oscillator output	n/a
Harmonic generator <sup>7)</sup>	515 nm, 343 nm, 257 nm, or 206 nm; refer to CARBIDE HG
Optical parametric amplifier <sup>8)</sup>	UV – MIR; refer to I-OPA or ORPHEUS
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

<sup>1)</sup> Water-cooled version available on request.

<sup>2)</sup> Assuming a Gaussian pulse shape.

<sup>3)</sup>  $FW 1/e^2$ , using maximum pulse energy.

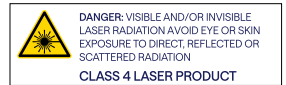
<sup>4)</sup> Waveplate-based variable optical attenuator (VOA); an external analog control input is available.

<sup>5)</sup> Enhanced contrast AOM. Provides fast, full-scale individual pulse energy control; an external analog control input is available.

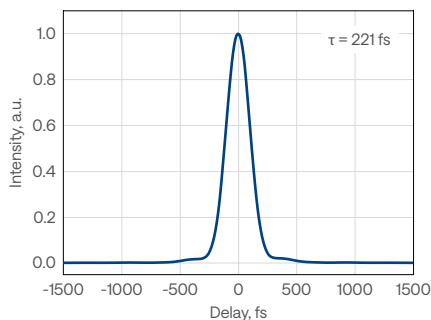
<sup>6)</sup> Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).

<sup>7)</sup> Integrated. For an external harmonic generator, refer to HIRO.

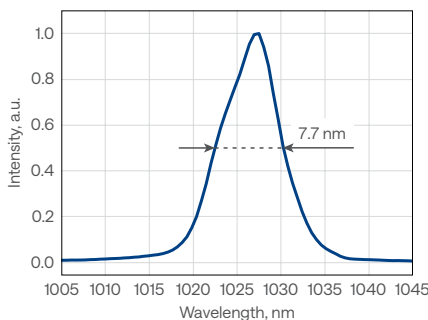
<sup>8)</sup> Integrated. For more details and stand-alone OPAs, refer to wavelength-tunable sources.



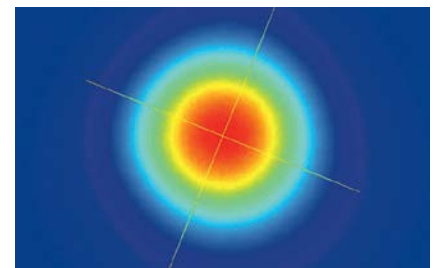
**CARBIDE-CB5**  
Typical pulse duration



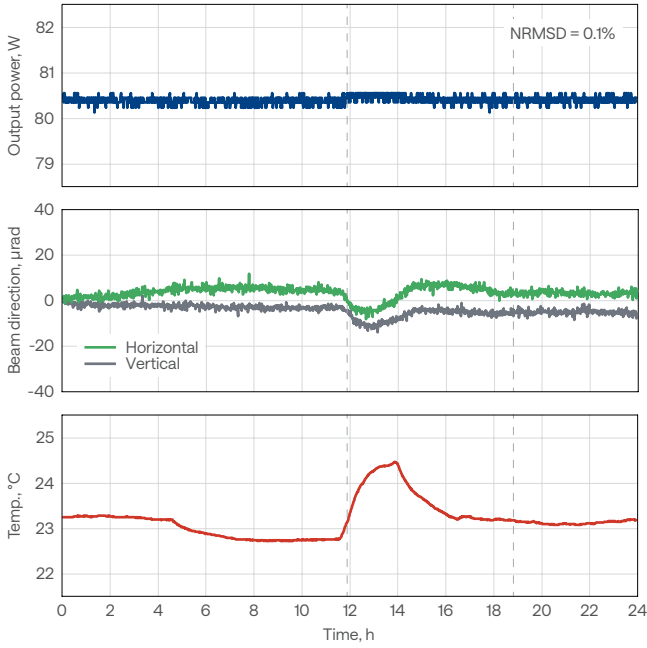
**CARBIDE-CB5**  
Typical spectrum



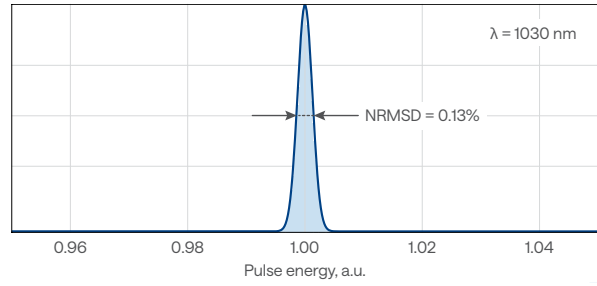
**CARBIDE-CB5**  
Typical beam profile



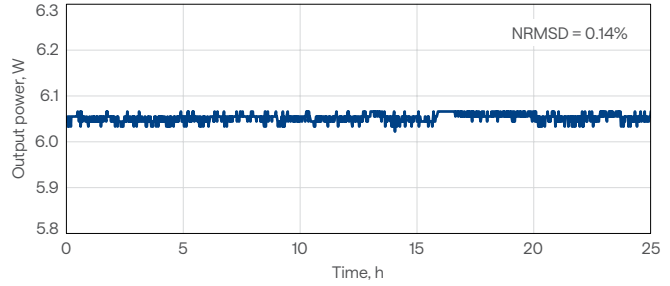
**CARBIDE-CB3** output power and beam direction stability with power lock enabled, across varying environmental conditions



**CARBIDE-CB3** Typical pulse-to-pulse energy stability

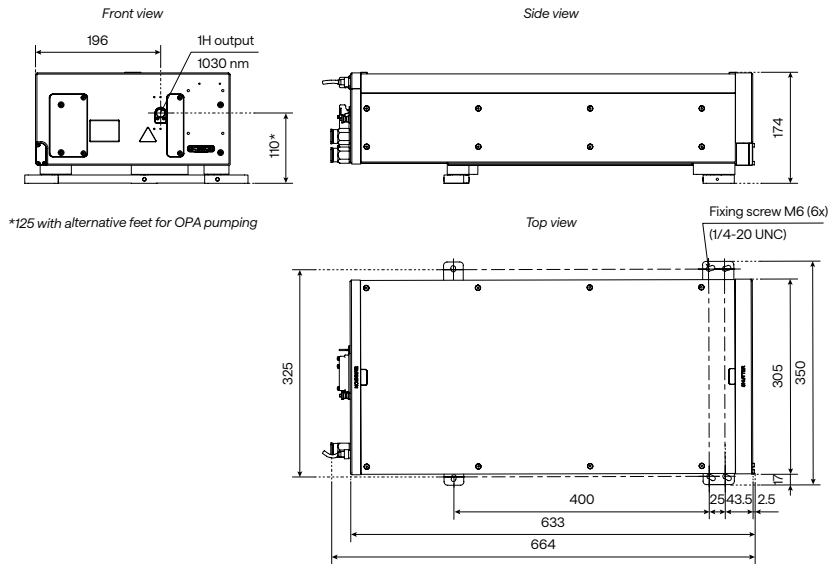


**CARBIDE-CB5-6W** Long-term power stability

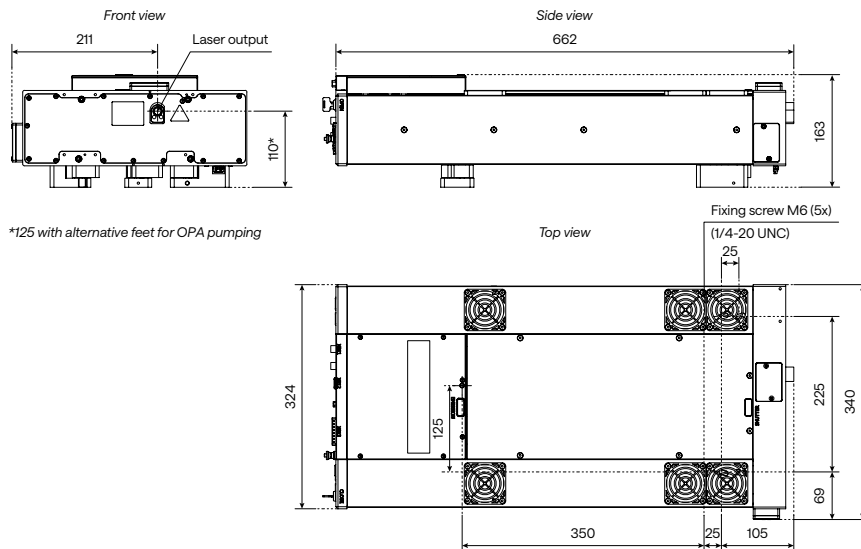


**Drawings**

**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.



## High-Energy Femtosecond Lasers

NEW

Maximum pulse energy of up to 5 mJ

Down to < 100 fs right at the output

Tunable pulse duration, 100 fs – 20 ps

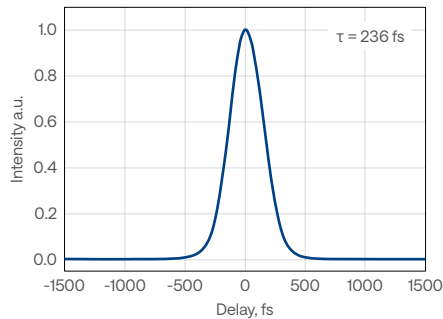
Pulse-on-demand and BiBurst for pulse control

Automated harmonics up to the 5<sup>th</sup> and wavelength-tunable extensions



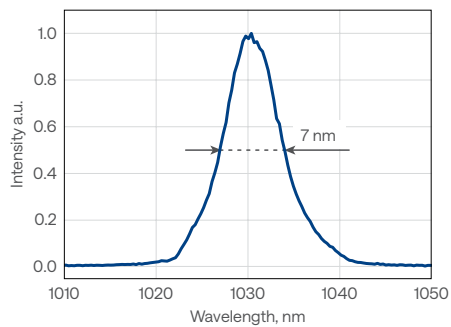
### PHAROS-PH2-5mJ

Typical pulse duration



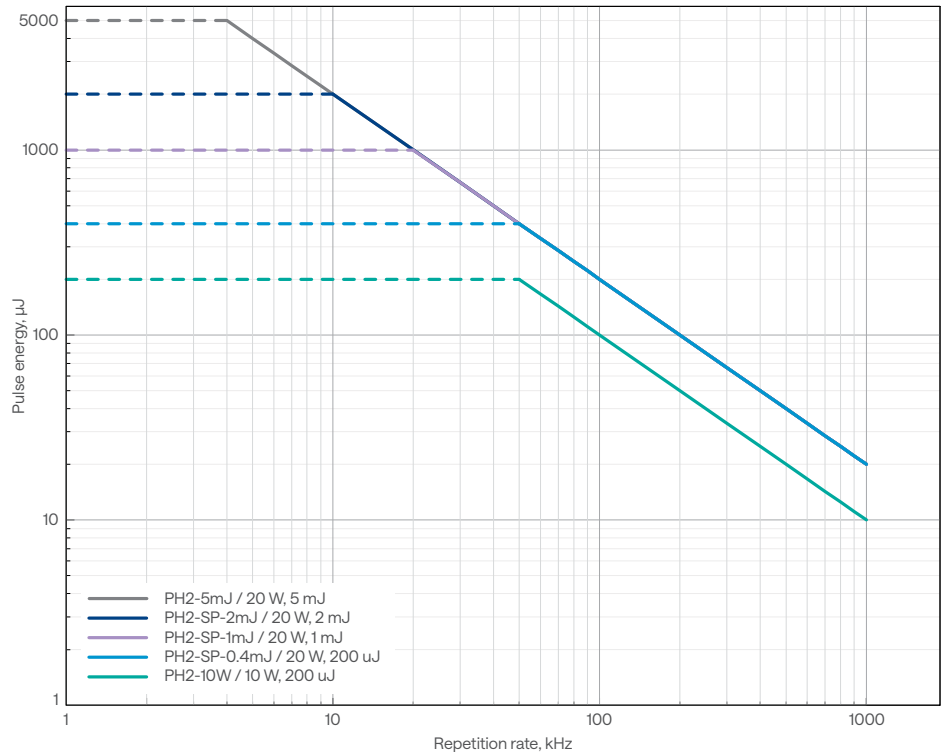
### PHAROS-PH2-5mJ

Typical spectrum



### PHAROS

Pulse energy vs fundamental repetition rate



# Specifications

NEW

Model	PH2-10W	PH2-SP			PH2-5mJ	PH2-UP	
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## OUTPUT CHARACTERISTICS

Center wavelength <sup>1)</sup>	1030 ± 10 nm						
Maximum output power	10 W		20 W				
Pulse duration <sup>2)</sup>	< 290 fs		< 190 fs		< 250 fs		< 100 fs
Pulse duration tuning range	290 fs – 10 ps (20 ps on request)		190 fs – 10 ps (20 ps on request)		n/a		100 fs – 10 ps
Maximum pulse energy	0.2 mJ	0.4 mJ	1 mJ	2 mJ	5 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 <sup>2</sup>	< 1.2		< 1.3			< 1.2	
Beam diameter <sup>3)</sup>	3.3 ± 0.5 mm	4.0 ± 0.5 mm	4.5 ± 0.5 mm	6.8 ± 0.7 mm	11 ± 0.5 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, 12 h <sup>4)</sup>	< 0.5%						
Long-term power stability, 100 h <sup>4)</sup>	< 0.5%						

## MAIN OPTIONS

Oscillator output <sup>5)</sup>	1 – 7 W, 50 – 250 fs, ≈ 1035 nm, ≈ 76 MHz						
Harmonic generator <sup>6)</sup>	515 nm, 343 nm, 257 nm, or 206 nm; refer to PHAROS HG or HIRO						
Optical parametric amplifier <sup>7)</sup>	UV – MIR; refer to I-OPA or ORPHEUS						
BiBurst option	Tunable GHz and MHz burst with burst-in-burst capability; refer to BiBurst						
CEP stabilization	Refer to CEP & RRL Option						
Repetition rate locking							

## PHYSICAL DIMENSIONS

Laser head (L × W × H) <sup>8)</sup>	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) <sup>8)</sup>	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	

<sup>1)</sup> Precise wavelengths for specific models are available upon request.

<sup>2)</sup> Assuming a Gaussian pulse shape.

<sup>3)</sup> FW 1/e<sup>2</sup>, measured at laser output, using maximum pulse energy.

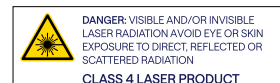
<sup>4)</sup> Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).

<sup>5)</sup> Available simultaneously. Contact sales@lightcon.com for more details or customized solutions.

<sup>6)</sup> Integrated except for PH2-5mJ. For an external harmonic generator, refer to HIRO.

<sup>7)</sup> Integrated except for PH2-5mJ. For more options and OPAs for -5mJ and -UP models, refer to the ORPHEUS series of OPAs.

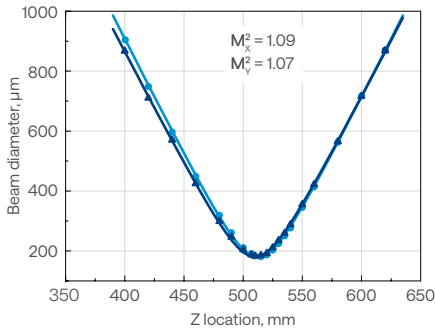
<sup>8)</sup> Dimensions depend on the laser configuration and integrated options.



## Beam properties

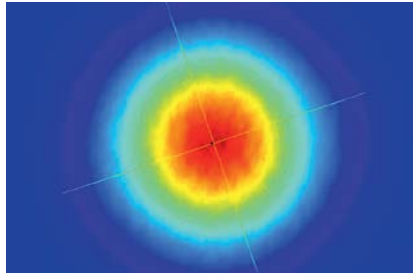
### PHAROS

Typical  $M^2$  measurement data



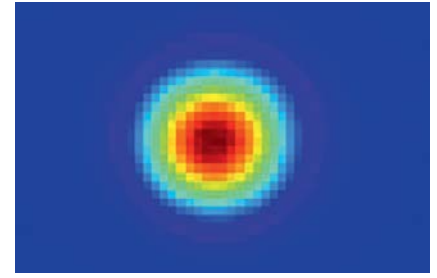
### PHAROS

Typical near-field beam profile



### PHAROS

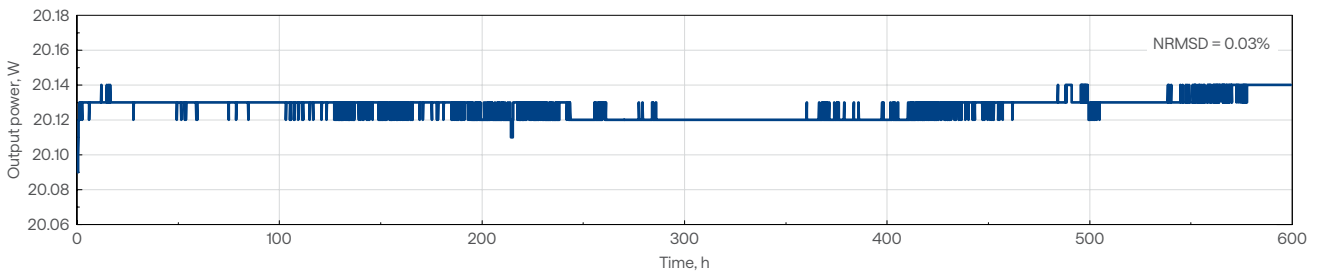
Typical far-field beam profile



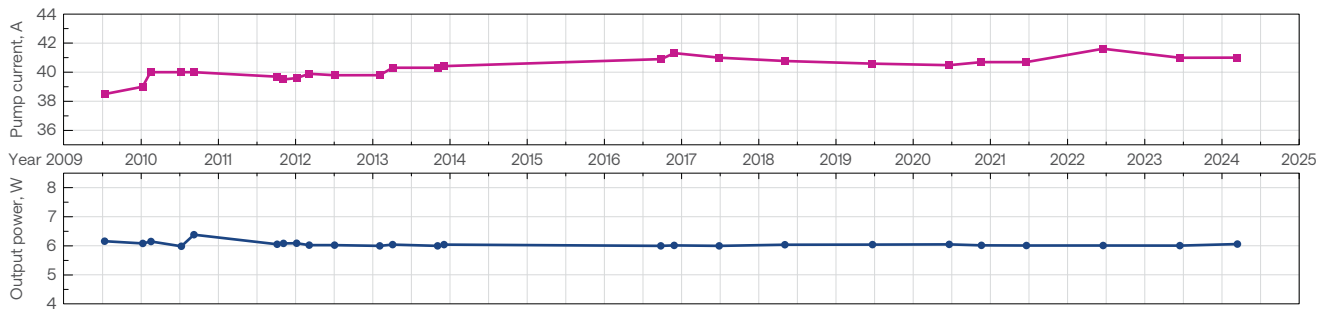
## Stability measurements

### PHAROS

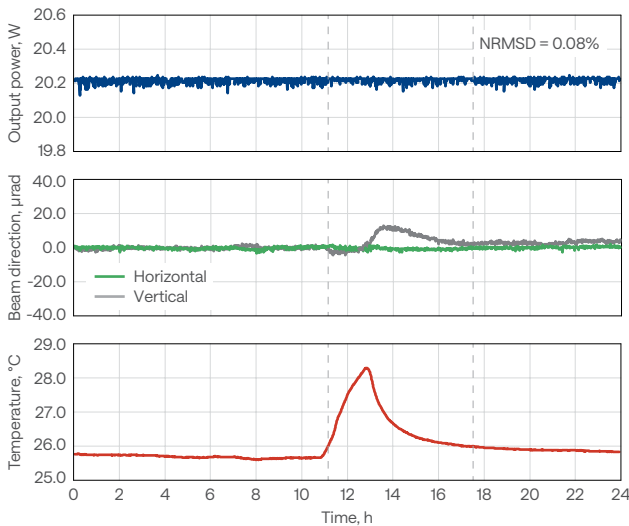
Long-term power stability



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

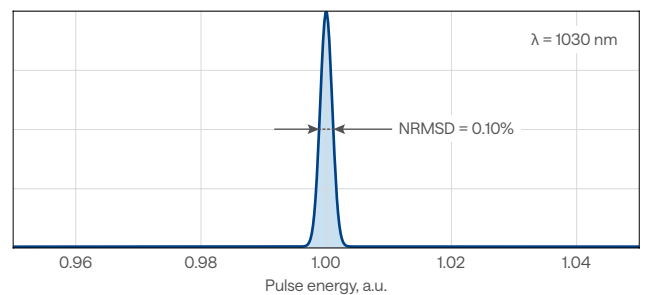


PHAROS output power and beam pointing stability with power lock enabled, across varying environmental conditions



### PHAROS

Typical pulse-to-pulse energy stability



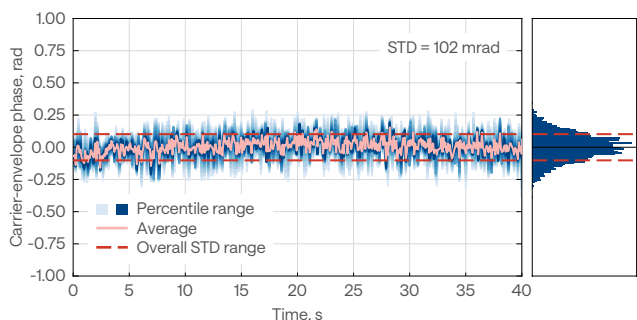
## CEP stabilization

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 1/4<sup>th</sup> 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.

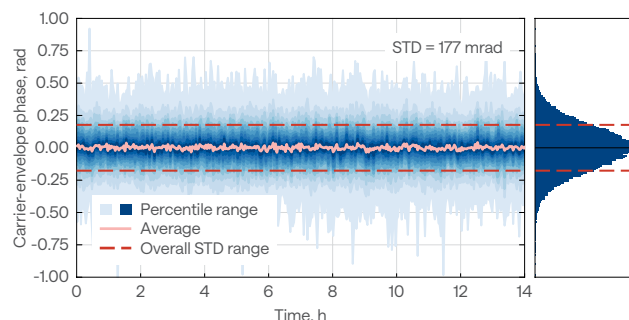
### PHAROS

Short-term CEP stability operating at 200 kHz repetition rate



### PHAROS

Long-term CEP stability operating at 200 kHz repetition rate

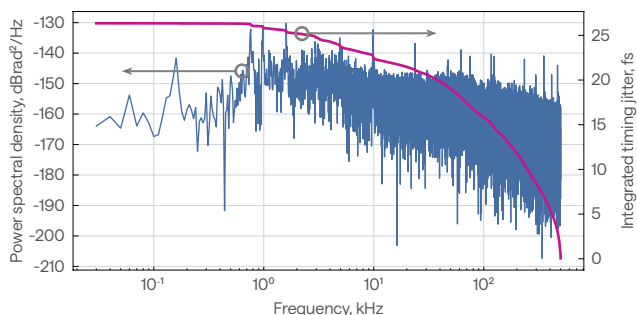


## Repetition rate locking

The oscillators in PHAROS lasers can be customized for repetition rate locking applications. Coupled with the necessary feedback electronics, the oscillator's repetition rate can be synchronized to an external RF source using the two piezo stages installed within the cavity.

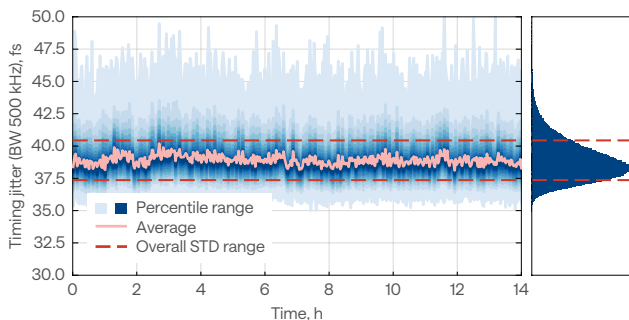
The repetition rate locking system ensures an integrated timing jitter of less than 200 fs for RF reference frequencies above 500 MHz. Additionally, continuous phase shifting is available upon request.

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



Timing jitter stability over 14 h

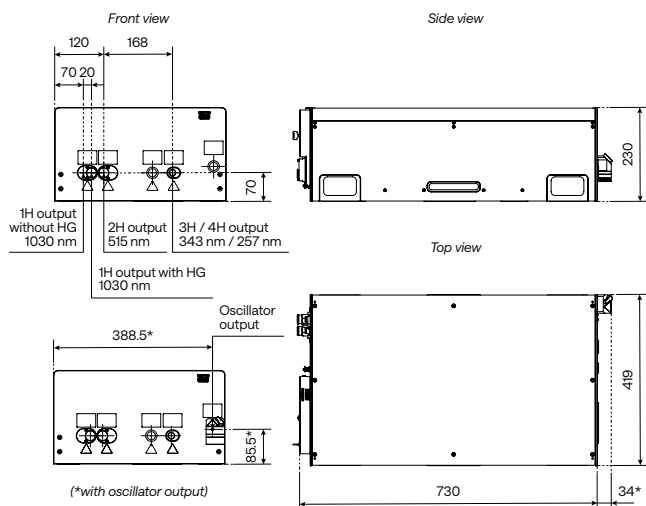
PHAROS oscillator locked to a 2.8 GHz RF source



## Drawings

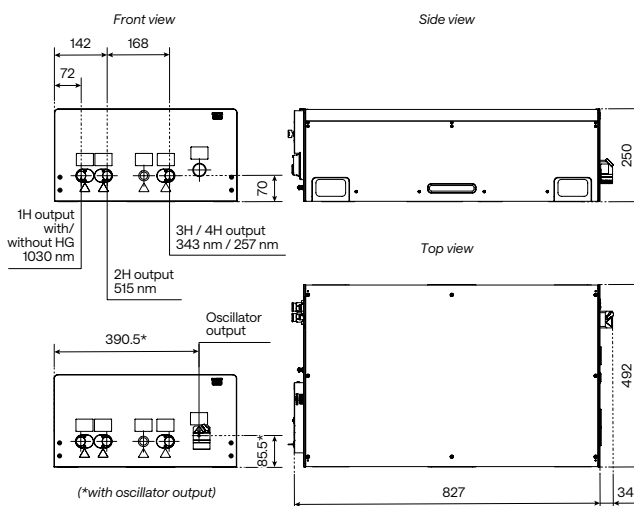
### PHAROS-PH2-730

-10W or -20W-SP with a FEC or BiBurst option, or a harmonic generator



### PHAROS-PH2-827

-10W with an -HE harmonic generator option, or -5mJ



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



# Global Representative Network

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# Lost in calculations?

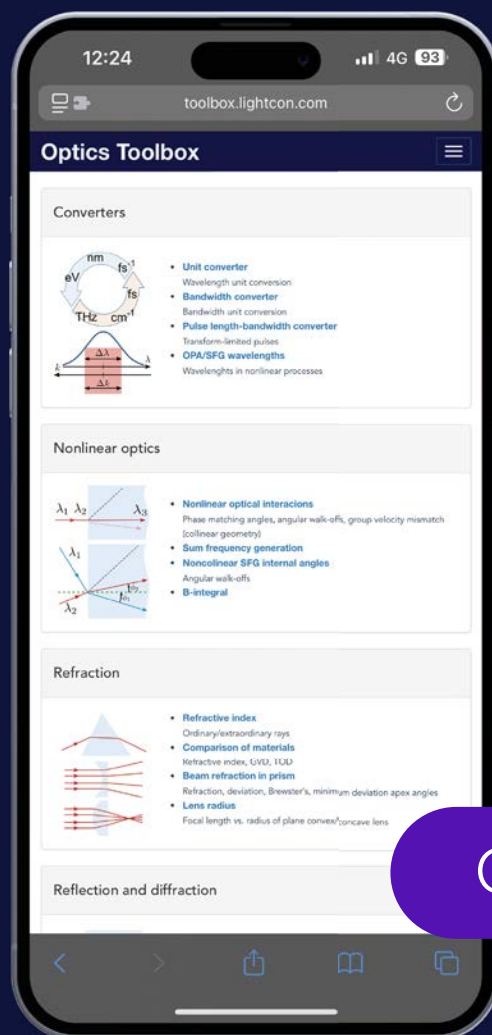
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