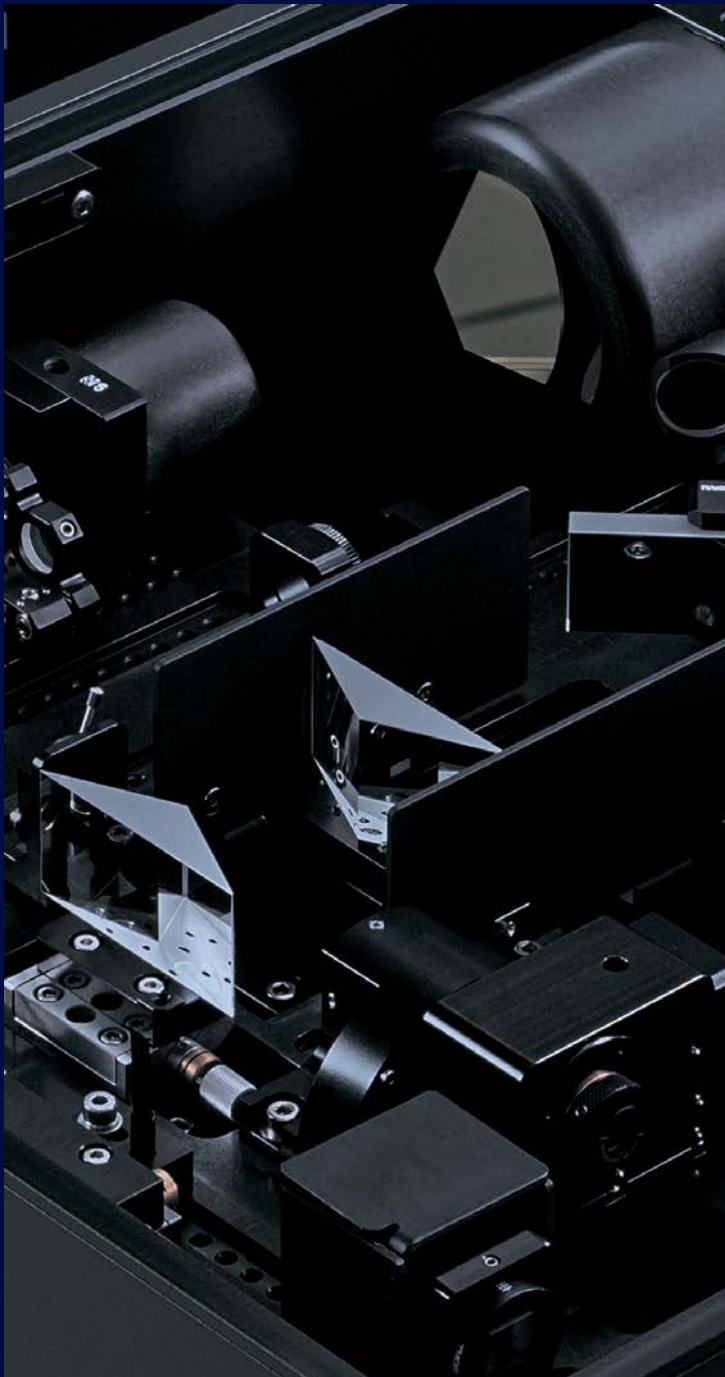


Spectroscopy Systems



Photonic Solutions Ltd
Edinburgh
EH14 4AP
+44 131 664 8122
www.photonicsolutions.co.uk

Product Catalog



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

5 Spectroscopy Systems

HARPIA | TA

- 6 Ultrafast Transient Absorption Spectrometer
- 8 Modules and Accessories

HARPIA | LIGHT

- 10 Tabletop Transient Absorption Spectroscopy System

HARPIA | TG

- 11 Transient Grating Spectrometer
-

13 Femtosecond Lasers

CARBIDE

- 14 Unibody-Design Femtosecond Lasers for Industry and Science
- 22 Automated Harmonic Generators
- 24 HIRO External Harmonic Generator

PHAROS

- 18 Modular-Design Femtosecond Lasers for Industry and Science
 - 23 Automated Harmonic Generators
 - 24 HIRO External Harmonic Generator
-

27 Wavelength-Tunable Sources

I-OPA

- 28 Industrial-Grade Optical Parametric Amplifier

ORPHEUS | NEO

- 31 Next-Generation Optical Parametric Amplifier

ORPHEUS

- 34 Collinear Optical Parametric Amplifier
-

37 Ultrafast Spectroscopy Applications

40 Global Representative Network





HARPIA

AVOID EXPOSURE
LASER RADIATION
CLASS II LASER PRODUCT

Spectroscopy Systems

The HARPIA ultrafast spectrometer conducts a variety of sophisticated time-resolved measurements within a compact footprint. With its intuitive user experience and easy day-to-day operation, it meets the demands of modern scientific applications.

HARPIA | TA

The system, centered around the transient absorption spectrometer, offers expandability through additional modules such as time-correlated single-photon counting, Kerr gate, and fluorescence upconversion, third beam delivery, or microscopy.

HARPIA | LIGHT

NEW

The transient absorption spectroscopy system combines accessibility, versatility, and unparalleled performance in a single-box design, allowing transient event measurement and analysis on a femto-to-nanosecond time scale.

HARPIA | TG

The transient grating spectrometer is designed for measuring carrier diffusion and lifetime using the laser-induced transient grating technique, enabling the characterization of electrically non-conductive or non-fluorescent samples.

Complete single-supplier solutions for sophisticated measurements

Compact and robust systems, powered by industrial-grade lasers

High-level automation and software control

HARPIA | TA

Ultrafast Transient Absorption Spectrometer



Layout example

Excellent performance at a high repetition rate

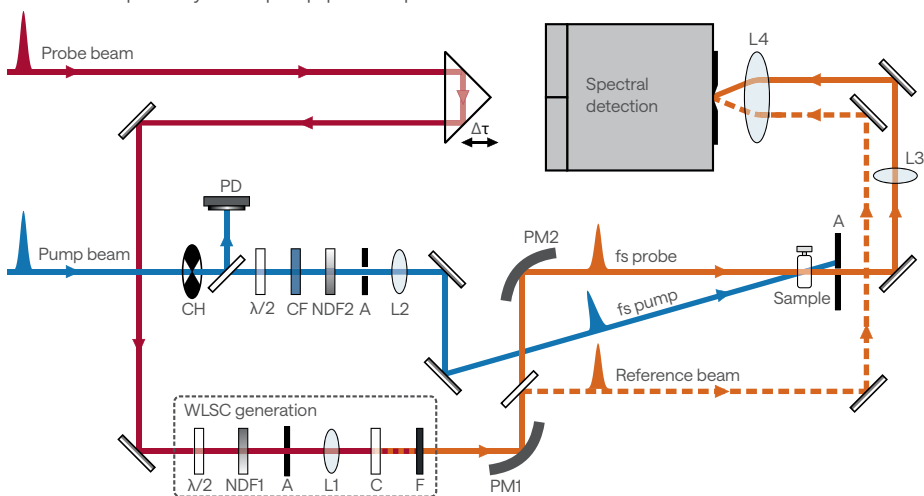
Measurement range from UV to MIR

Market-leading sensitivity

Modules for time-resolved, and multi-pulse experiments

High-level automation in a compact footprint

HARPIA-TA optical layout for pump-probe experiments

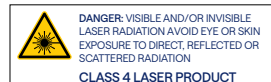


- A – aperture
- C – crystal
- CF – spectral filter
- CH – chopper
- F – filter
- L – lens
- PD – photodiode
- PM – parabolic mirror
- NDF – neutral density filter
- WLSC – white light supercontinuum
- $\Delta\tau$ – delay
- $\lambda/2$ – half-wave plate

Specifications

Configuration	UV-VIS	UV-VIS-NIR	MIR
Probe spectral range	350 – 1100 nm	350 – 1600 nm	2000 – 13000 nm
Pump range	240 – 2200 nm		450 – 2200 nm ¹⁾
Delay range (resolution)	8 ns (8.3 fs)		4 ns (4.2 fs)
Temporal resolution	≤ laser pulse duration or better		
Laser repetition rate	1 – 100 kHz		
Maximum data acquisition rate	3850 Hz		Laser repetition rate
Modes	Reflection and transmission		

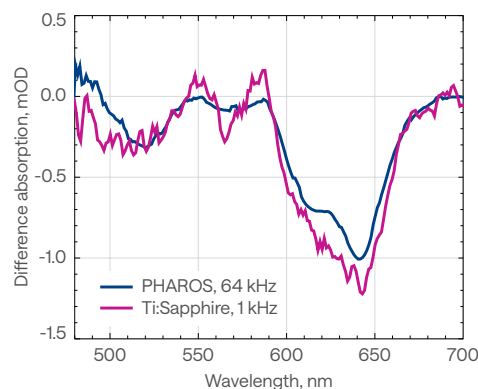
¹⁾ Wavelength range is configurable to 240 – 700 nm.
Contact sales@lightcon.com for more details.



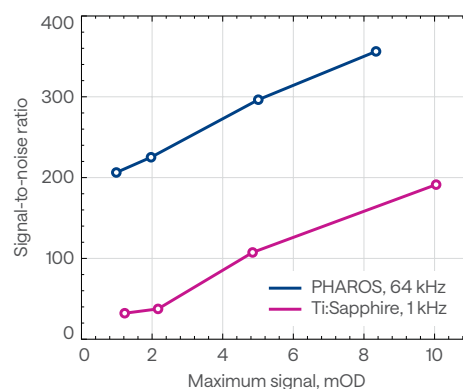
Performance at high repetition rates

The **HARPIA** spectroscopy system achieves an excellent signal-to-noise ratio at a high repetition rate and low energy excitation conditions. The graphs below compare the signal-to-noise ratio (SNR) of difference absorption spectra obtained with a Ti:Sapphire laser operating at 1 kHz and a **PHAROS** laser operating at 64 kHz with the same acquisition time.

Measured difference absorption spectra of CdSe/ZnS quantum dots using low- and high-repetition rate lasers with 5 s acquisition time



Best-effort SNRs, achieved with **HARPIA-TA** spectrometer driven by a Ti:Sapphire laser at 1 kHz (magenta) and a **PHAROS** laser at 64 kHz (blue)



Software

HARPIA Service App

Control and data acquisition software

A single software solution for all measurement modes, featuring:

- User-friendly interface
- Measurement presets
- Measurement noise suppression
- Diagnostics and data export
- Continuous support and updates
- API for remote experiment control using third-party software (LabVIEW, Python, MATLAB)

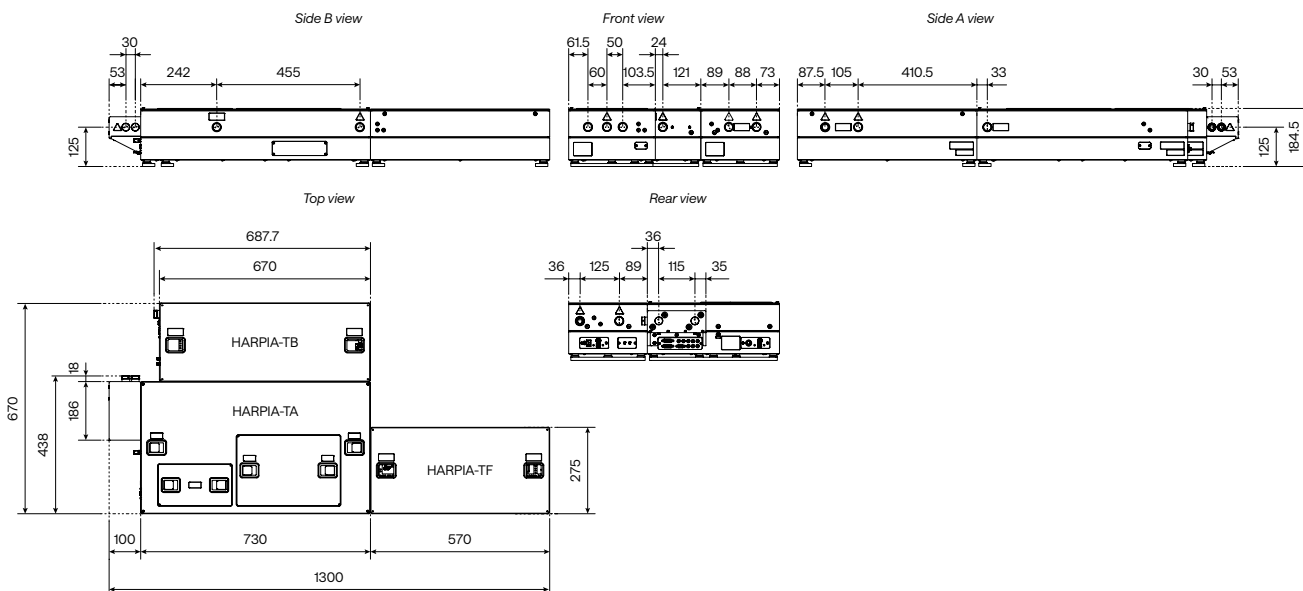
Data analysis software

An ultrafast spectroscopy data analysis software, featuring:

- Advanced data wrangling: slicing, merging, cropping, smoothing, fitting, etc.
- Advanced global and target analysis
- Probe spectral chirp correction, calibration and deconvolution
- Support for 3D data sets (2D electronic spectroscopy, fluorescence lifetime imaging)
- Publication-ready figure preparation and data export

Drawings

Drawings of **HARPIA** system with **HARPIA-TB** and **HARPIA-TF** modules



Modules and accessories

HARPIA | TF

 Time-Resolved Fluorescence Module

Time-resolved fluorescence spectroscopy carries information on the molecular processes in the excited states. **HARPIA-TF** combines different measurement modes, thus allowing the observation of fluorescence dynamics at different time scales.

Using a high-repetition-rate **PHAROS** or **CARBIDE** laser, the fluorescence dynamics can be measured while exciting the samples with pulse energies down to several nanojoules.

Kerr gate

Easy to use. Simpler alignment and maintenance. The entire spectrum is measured at once.

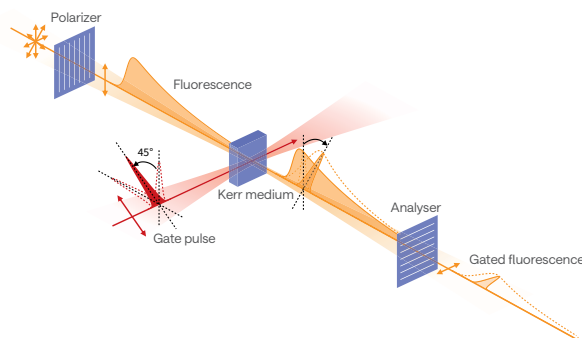
Fluorescence upconversion (FU)

Better temporal resolution for measuring fast fluorescence events.

Time-correlated single-photon counting (TCSPC)

Fluorescence lifetime measurements are extendable to measure phosphorescence signals.

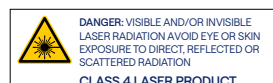
Principle of Kerr gate spectroscopy



Specifications

Module	HARPIA-TF		
Measurement technique	Kerr gate	Fluorescence upconversion	TCSPC
Spectral range	250 – 1100 nm	330 – 820 nm	220 – 820 nm ¹⁾
Pump range	240 – 2200 nm		
Temporal resolution	400 – 500 fs	≤ laser pulse duration or better	< 180 ps or < 50 ps
Max measurement range	8 ns		5 μs
Delay resolution	8.3 fs		n/a
Gate (probe) beam requirements	25 – 30 μJ		n/a
Compatible with	TCSPC		Kerr gate or fluorescence upconversion
Modes	Transmission		

¹⁾ Spectral range is extendable with an additional NIR detector (measurement range 1000 - 1700 nm); contact sales@lightcon.com for more details.



HARPIA | TA-FP

 Flash Photolysis – Nanosecond TA Module

The flash photolysis experiment is designed to measure the long-lived states of molecular systems.

The principle of flash photolysis is analogous to the femtosecond transient absorption (TA) experiment but with a delay in a nanosecond–millisecond range.

Specifications

Module	HARPIA-TA-FP		HARPIA-TA-FP-UV	
HARPIA-TA configuration	UV-VIS	UV-VIS-NIR	UV-VIS	UV-VIS-NIR
Probe spectral range	450 – 1100 nm	450 – 1600 nm	350 – 1100 nm	350 – 1600 nm
Pump range	240 – 2200 nm			
Delay range	up to 8 ms		up to 500 μs	
Delay resolution	100 ps			
Temporal resolution	2 ns		1 ns	
Probe laser repetition rate	1850 Hz			
Maximum data acquisition rate	3850 Hz			
Modes	Reflection and transmission			

HARPIA | TB Third Beam Delivery Module

When standard spectroscopy tools are not enough to unravel the intricate ultrafast dynamics of photoactive systems, multi-pulse time-resolved spectroscopic techniques can be utilized to yield additional insight.

Femtosecond stimulated Raman scattering (FSRS)

Delivering frequency-narrowed picosecond pulses allows to perform FSRS measurements. It is a time-resolved spectroscopy technique for observing changes in the vibrational structure of optically excited molecular systems.

Multi-pulse time-resolved transient absorption

Multi-pulse time-resolved spectroscopic techniques are a way to manipulate the reactions and access new regions of the higher excited states.

Specifications

Module	HARPIA-TB	
Configuration	Pump for multi-pulse experiments	NIR probe
Acceptable wavelength range	450 – 2200 nm ¹⁾	1600 – 2600 nm
Delay range (resolution)	4 ns (4.2 fs)	
Modes	Transmission	

¹⁾ Wavelength range is configurable to 240 – 700 nm. Contact sales@lightcon.com for more details.

Options



Cryostat Mounting

HARPIA-TA supports cryostats that can be mounted externally or internally.



Sample Stirrer

Liquid samples are mixed up to avoid overexposure and ensure fresh samples.



Motorized Pump Mirror

Used to automatically optimize pump and probe overlap.



External Beam Steering

To lock the optical beam paths for OPA wavelengths (350 – 1100 nm).



Beam Profiler

For checking beam shape/size at any position before/after measurement inside HARPIA.

Tabletop Transient Absorption Spectroscopy System



Maintenance-free
single-box solution

Plug-and-play
installation

Intuitive measurement
and data analysis

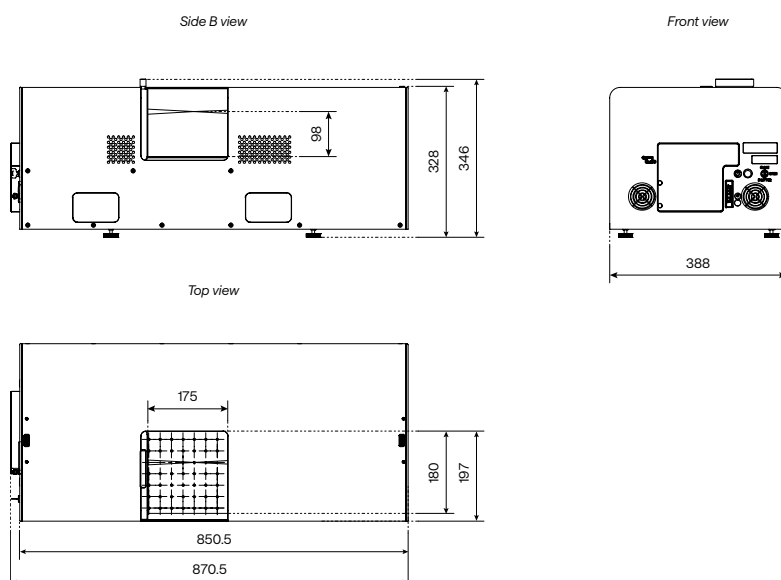
Femto-to-nanosecond
temporal resolution

Specifications

Modes	Transmission and reflection
Probe spectral range	460 – 910 nm
Probe polarization control	Linear (0 – 180°)
Pump wavelengths	515 nm, 343 nm
Delay range (resolution)	7.5 ns (10 fs)
Temporal resolution	≤ 290 fs
Laser repetition rate	60 kHz, any fundamental repetition rate division
Maximum data acquisition rate	3850 Hz
Dimensions	870.5 x 388 x 346 mm

Drawings

HARPIA-LIGHT drawing



CLASS 1
LASER PRODUCT

Transient Grating Spectrometer



Carrier diffusion coefficient
in a matter of minutes

Non-invasive
measurement technique

Fully automated and
computer controlled

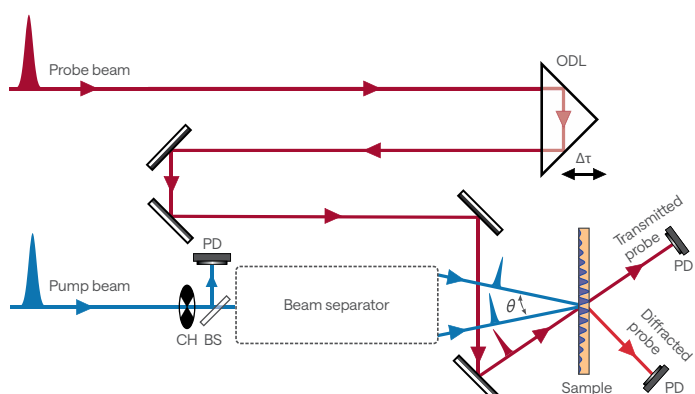
Continuous setting of
grating period

Sensitivity down to $\mu\text{J}/\text{cm}^2$
excitation level

Advanced measurement
and analysis software

Photoluminescence (PL)
measurement option

HARPIA-TG principal scheme



BS – beam splitter
CH – chopper
PD – photodiode

ODL – optical delay line
PM – parabolic mirror

θ – intersection angle
 $\Delta\tau$ – delay

Specifications

Measurement mode	Transmission	Reflection
Grating recording wavelength ¹⁾	340 – 560 nm	
Probe wavelength ²⁾	1030 nm	
Grating period ³⁾	1.05 – 12.5 μm	1.5 – 4.5 μm
Pulse duration	< 290 fs	
Delay range	Up to 8 ns	

MEASUREMENT RANGES

Diffusion coefficient	$\geq 0.1 \text{ cm}^2/\text{s}$
Carrier lifetime	3 ps – 8 ns

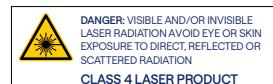
DIMENSIONS

Physical dimensions (L x W x H)	730 x 420 x 188 mm
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¹⁾ Extendable to 750 nm by applying different physical gratings. Contact sales@lightcon.com for more details.

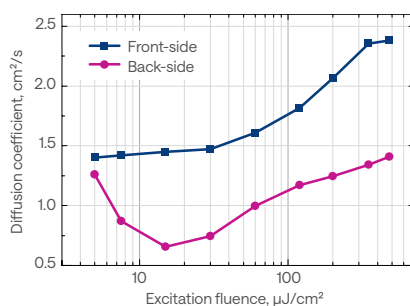
²⁾ OPA-based probe is available upon request. Contact sales@lightcon.com for more details.

³⁾ Depends on the pump wavelength.

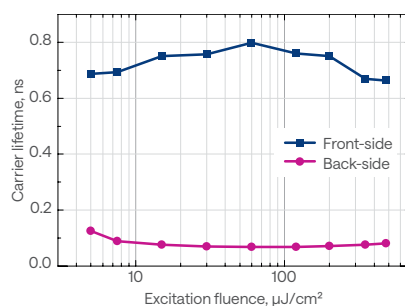


Performance

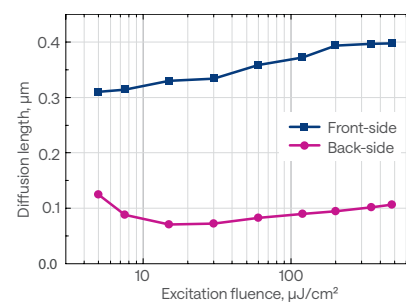
Diffusion coefficient of GaN
as a function of fluence



Carrier lifetime of GaN
as a function of fluence



Diffusion length of GaN
as a function of fluence





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

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

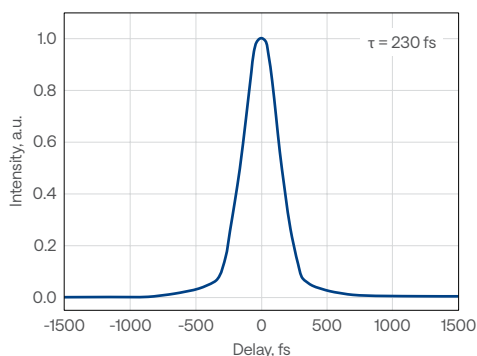
Pulse-on-demand and
BiBurst for pulse control

Up to 5th harmonic or
tunable extensions

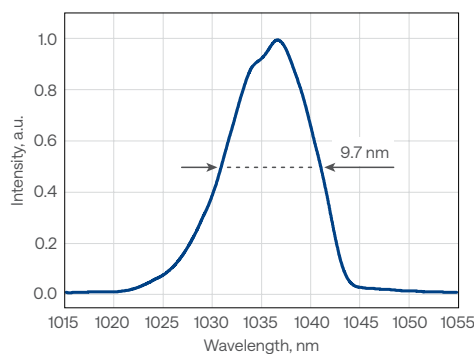
Air-cooled and
water-cooled models

Compact industrial-grade design

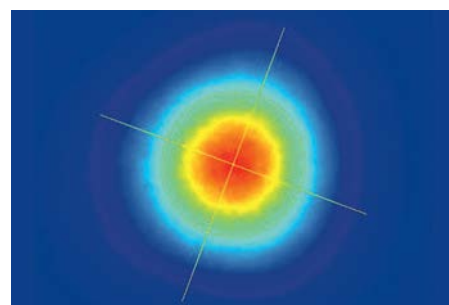
CARBIDE-CB3
Typical pulse duration



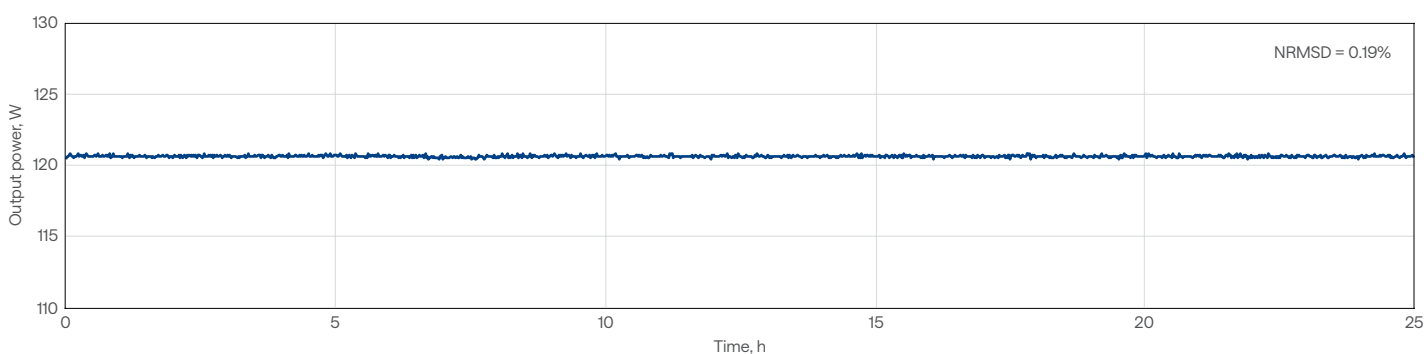
CARBIDE-CB3
Typical spectrum



CARBIDE-CB3
Typical beam profile



CARBIDE-CB3-120W
Long-term power stability



Model	CB3-20W	CB3-40W	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	
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
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, 24 h ⁶⁾	< 0.5%				
Long-term power stability, 100 h ⁶⁾	< 0.5%				

MAIN OPTIONS

Oscillator output	< 0.5 W, 120 – 250 fs, 1030 ± 10 nm, ≈ 65 MHz ⁷⁾			
Harmonic generator ⁸⁾	515 nm, 343 nm, 257 nm, or 206 nm; see page 22			
Optical parametric amplifier ⁹⁾	320 – 10000 nm; see page 28			n/a
BiBurst option	Tunable GHz and MHz burst with burst-in-burst capability			

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)	280 × 144 × 49 mm ¹⁰⁾	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, 7 A – 240 V AC, 3A; 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	600 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 Gaussian pulse shape.

²⁾ Pulse duration can be reduced to < 250 fs if 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.

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 28		
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.

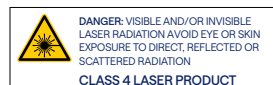
³⁾ FW 1/e², using maximum pulse energy.

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.

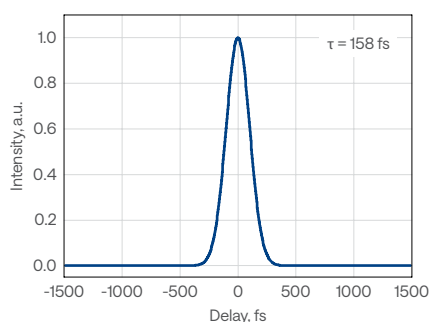
⁶⁾ Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).

⁷⁾ Integrated. For external harmonic generator, refer to HIRO.

⁸⁾ Integrated. For stand-alone OPAs, refer to www.lightcon.com.


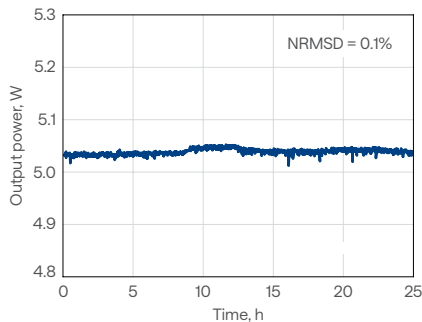
CARBIDE-CB5-SP

Typical pulse duration



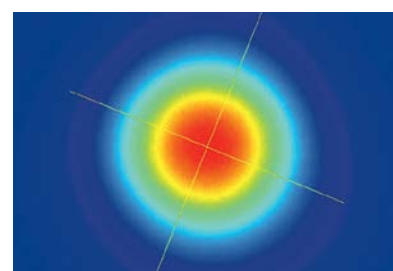
CARBIDE-CB5

Long-term power stability



CARBIDE-CB5

Typical beam profile



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

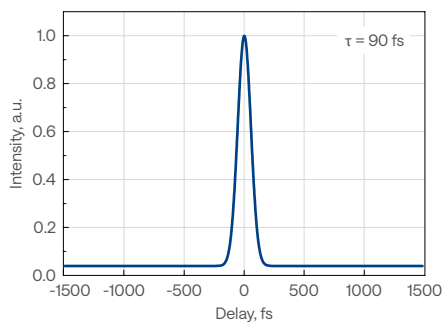
Pulse-on-demand and
BiBurst for pulse control

Up to 5th harmonic or
tunable extensions

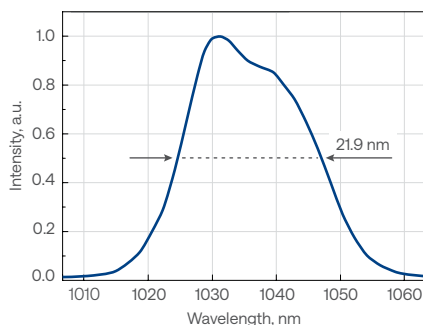
CEP stabilization or
repetition rate locking

Thermally-stabilized and
sealed design

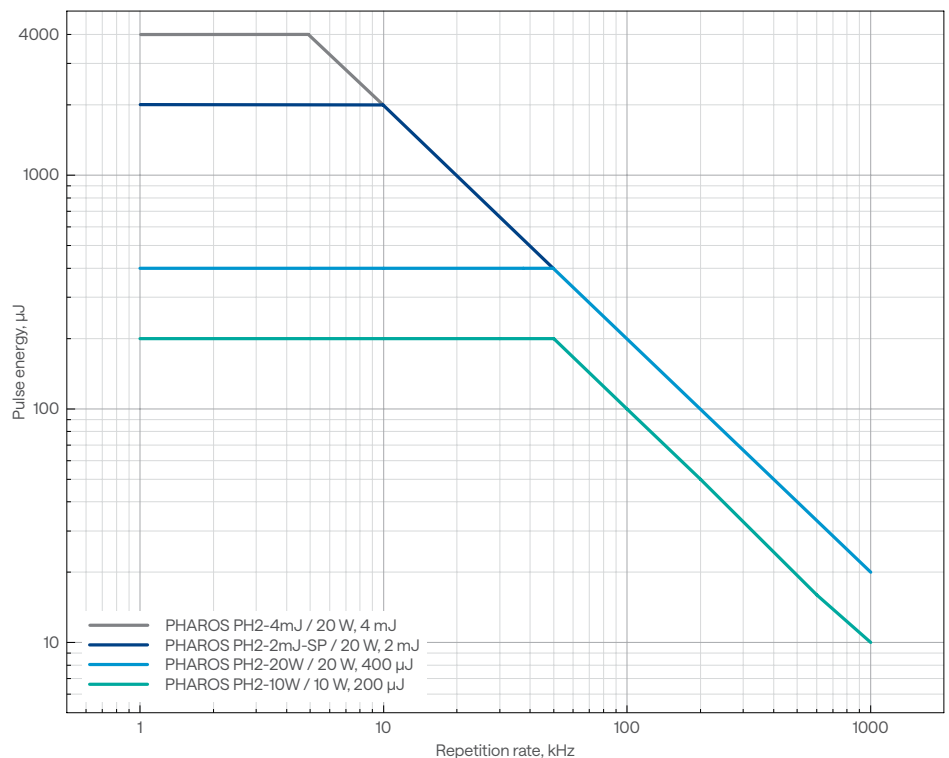
PHAROS-PH2-UP
Typical pulse duration



PHAROS-PH2-UP
Typical spectrum



PHAROS
Pulse energy vs fundamental repetition rate



Specifications

Model	PH2-10W	PH2-20W-SP	PH2-4mJ	PH2-UP
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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 28					
BiBurst option	Tunable GHz and MHz burst with burst-in-burst capability					
CEP stabilization	Optional					
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/cm² is tolerated by the customer setup.

⁴⁾ FW 1/e², measured at laser output, using maximum pulse energy.

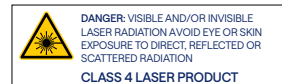
⁵⁾ Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSE).

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.

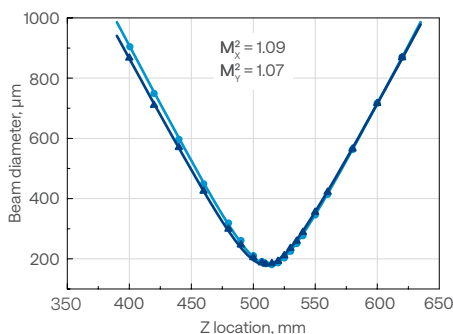
⁹⁾ Dimensions depend on laser configuration and integrated options.



Beam properties

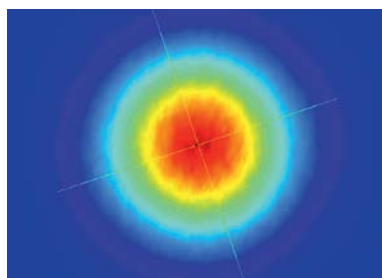
PHAROS

Typical M^2 measurement data



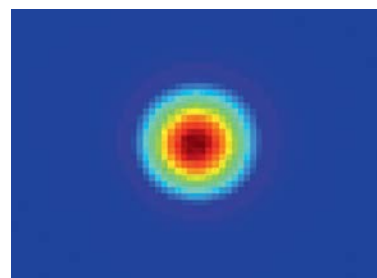
PHAROS

Typical near-field beam profile



PHAROS

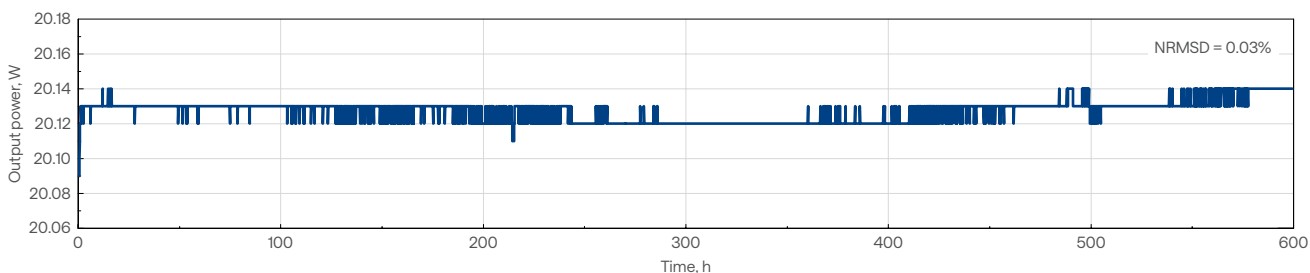
Typical far-field beam profile



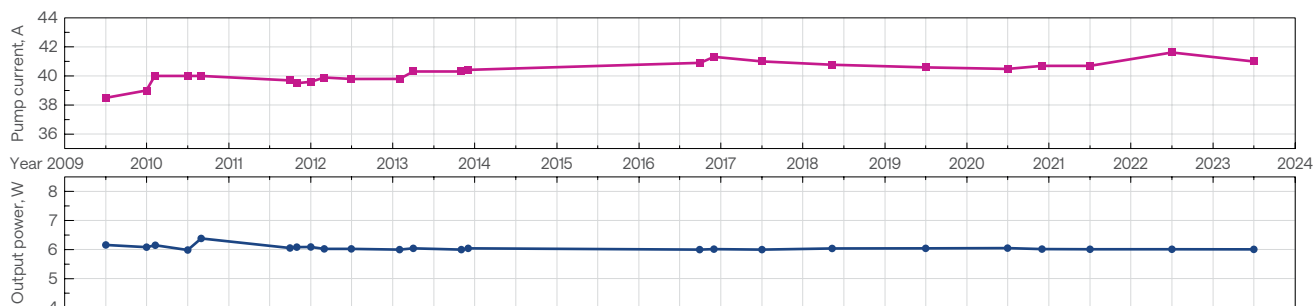
Stability measurements

PHAROS

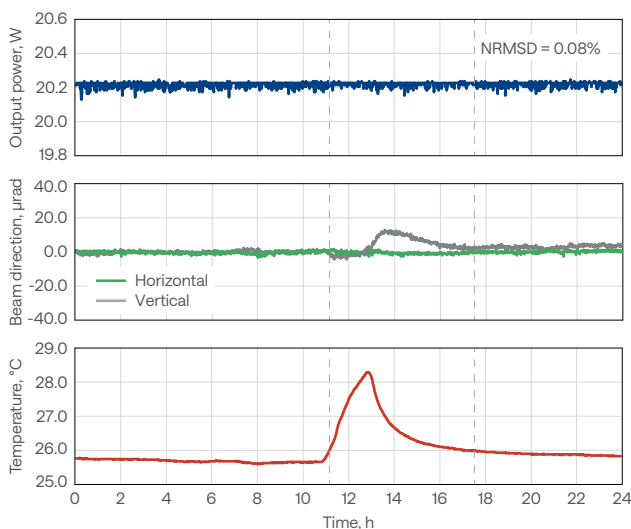
Long-term power stability



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

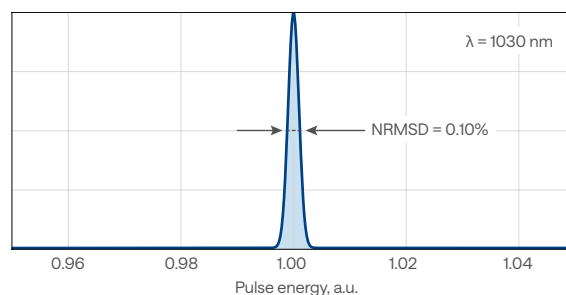


PHAROS output power and the stability of beam direction with power lock enabled, across varying environmental conditions



PHAROS

Typical pulse-to-pulse energy stability



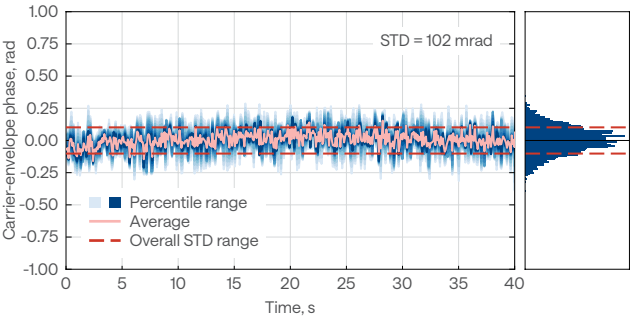
CEP stabilization

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.

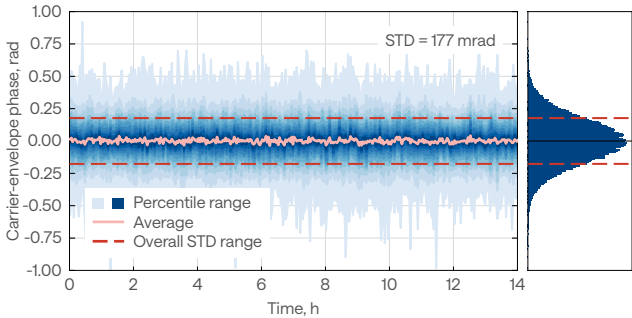
PHAROS

Short-term CEP stability operating at 200 kHz repetition rate



PHAROS

Long-term CEP stability operating at 200 kHz repetition rate

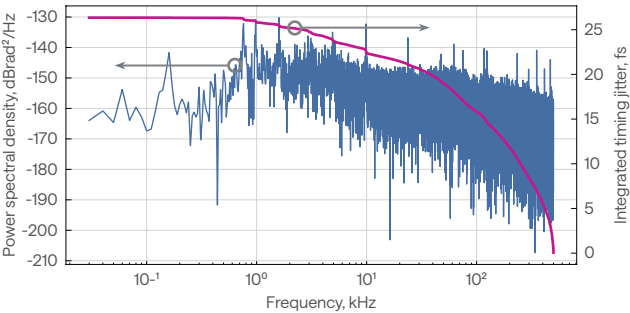


Repetition rate locking

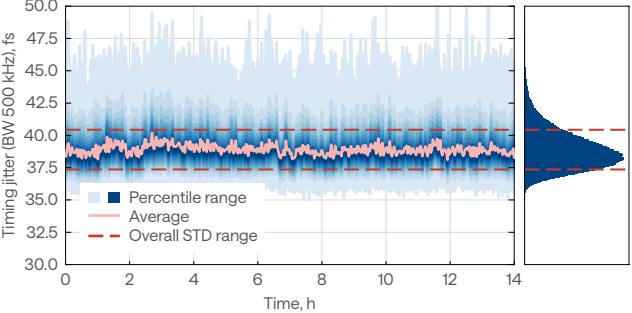
The oscillator of **PHAROS** laser can be customized for repetition rate locking applications. Coupled with the necessary feedback electronics, the repetition rate is synchronized to an external RF source using the two piezo stages installed inside the cavity.

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

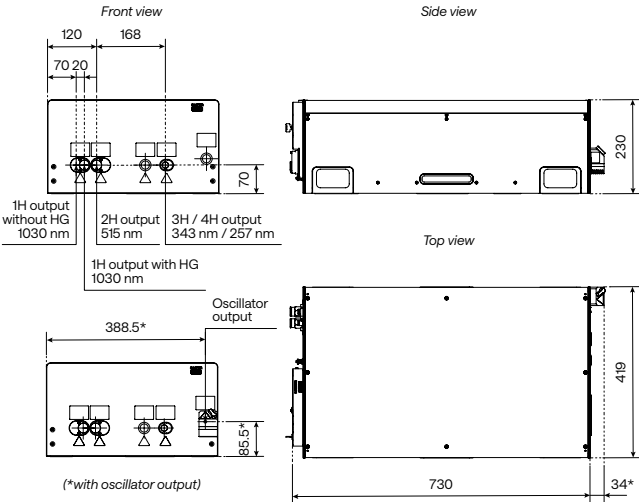


Timing jitter stability over 14 h
PHAROS oscillator locked to a 2.8 GHz RF source

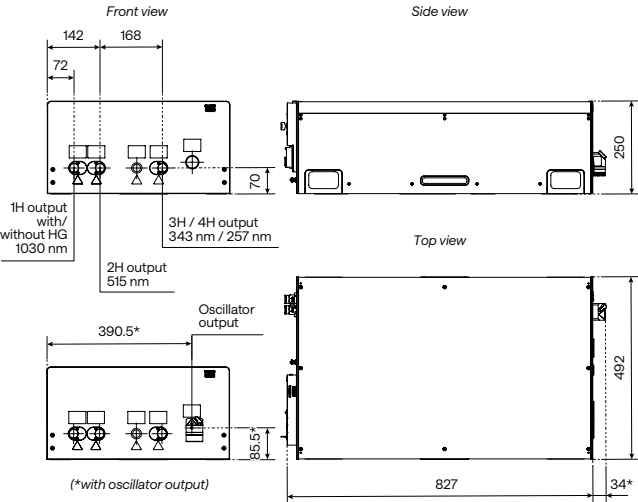


Drawings

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



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.

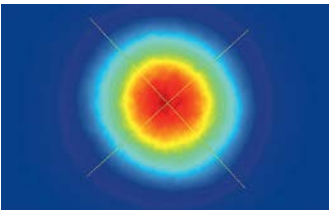
³⁾ Maximum output power of 5 W. More than 4 W is available at 50 – 400 µJ pump energies and ≈ 500 fs pump pulse duration.

⁴⁾ Maximum output power of 0.2 W.

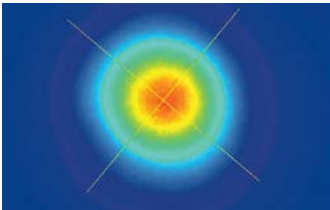
DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION

CLASS 4 LASER PRODUCT

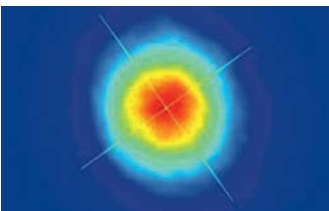
CARBIDE-CB5 (100 kHz, 6 W)
Typical 1H beam profile



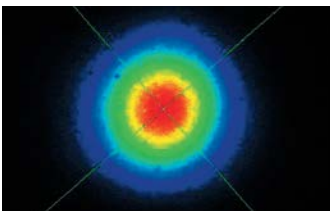
CARBIDE-CB5 (100 kHz, 3.4 W)
Typical 2H beam profile



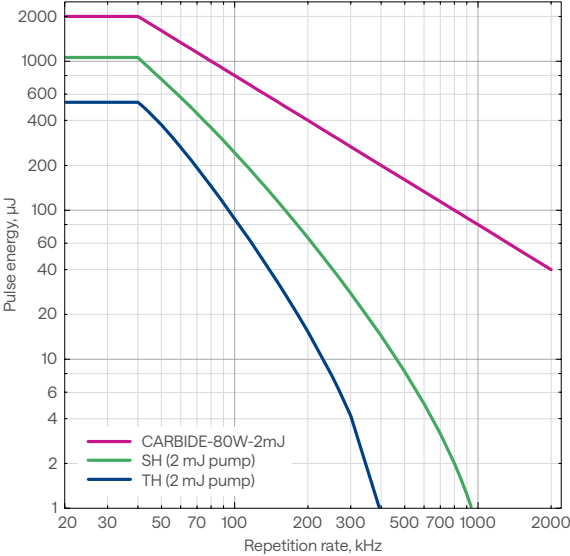
CARBIDE-CB5 (100 kHz, 2.2 W)
Typical 3H beam profile



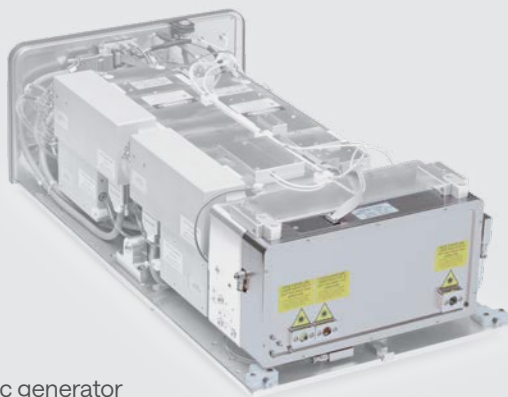
CARBIDE-CB5 (100 kHz, 100 mW)
Typical 4H beam profile



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



Automated Harmonic Generators



PHAROS with a harmonic generator

515 nm, 343 nm, 257 nm,
or 206 nm output

Automated harmonic selection

Industrial-grade design

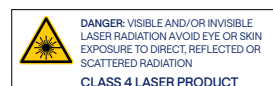
Specifications

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 μ J	50 – 4000 μ J	20 – 4000 μ J	200 – 1000 μ J
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	$\leq 400 \mu$ J pump	< 1.15 (2H)	< 1.15 (2H) < 1.2 (3H)	< 1.15 (2H) n/a (4H)	n/a
	> 400 μ J pump	< 1.2 (2H)	< 1.2 (2H) < 1.3 (3H)	< 1.2 (2H) n/a (4H)	

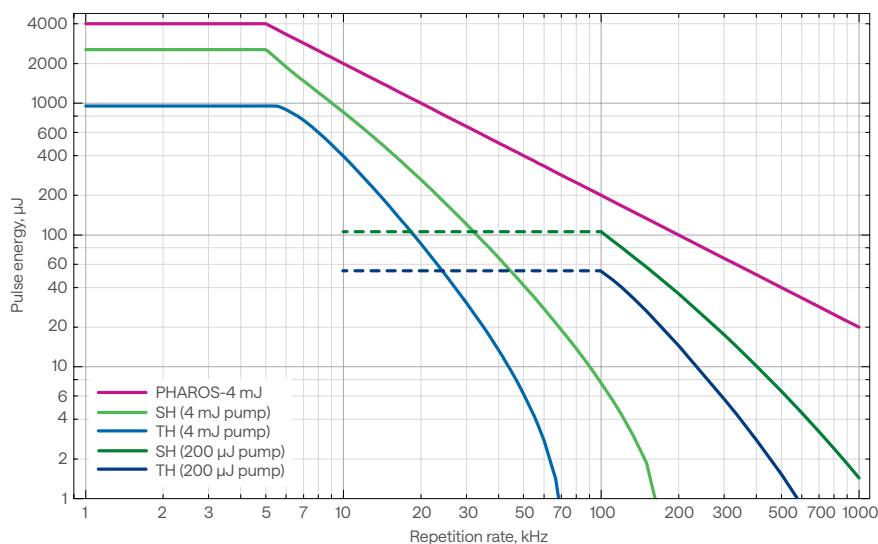
¹⁾ Depends on pump laser model.

²⁾ Maximum output power of 2 W at 20 – 1000 μ J pump
or 1 W at 1000 – 4000 μ J pump.

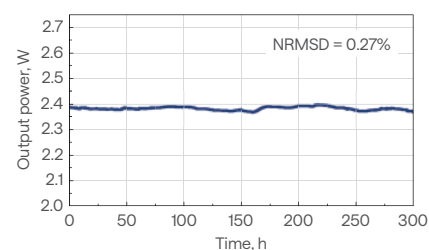
³⁾ Maximum output power of 150 mW.



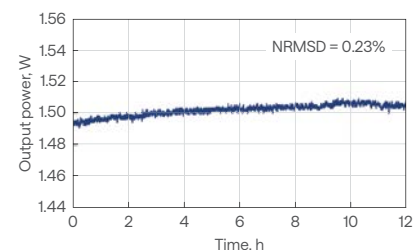
PHAROS with HG pulse energy vs repetition rate



3H output power stability



4H output power stability



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 μ J	200 – 1000 μ J	1000 – 4000 μ J
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
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¹⁾ For harmonic combinations and simultaneous outputs, contact sales@lightcon.com.

²⁾ Residual fundamental output available upon request.

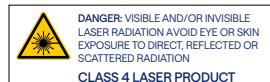
³⁾ White light continuum output available upon request.

⁴⁾ Percentage of pump power, for repetition rate of up to 200 kHz.

⁵⁾ Maximum output power of 1 W.

⁶⁾ Maximum output power of 150 mW. Only for HIRO-HP/HE.

⁷⁾ Different polarization is available upon request.



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

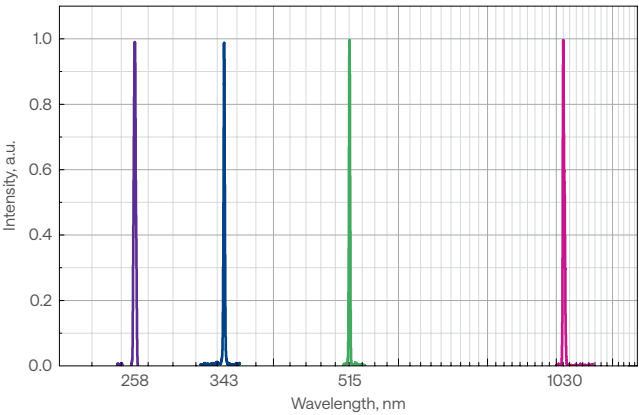
Dimensions (L × W × H)	487 × 176 × 180 mm
------------------------	--------------------

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

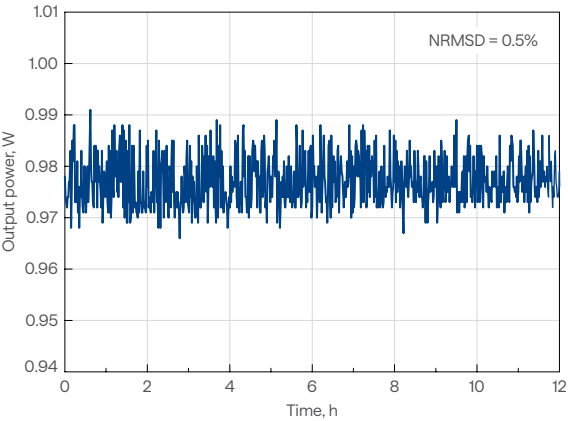


DANGER: VISIBLE AND/OR INVISIBLE
LASER RADIATION AVOID EYE OR SKIN
EXPOSURE TO DIRECT, REFLECTED OR
SCATTERED RADIATION
CLASS 4 LASER PRODUCT

HIRO outputs

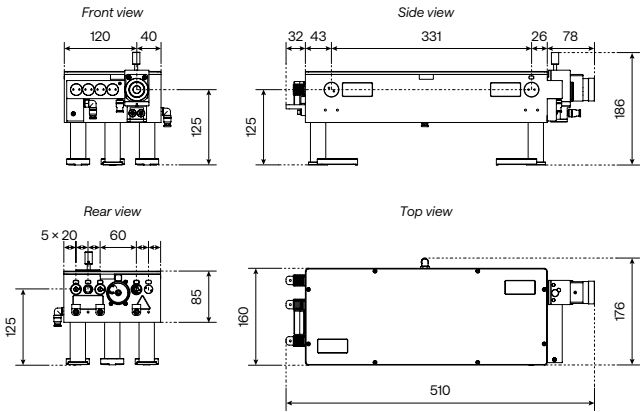


4H output power stability

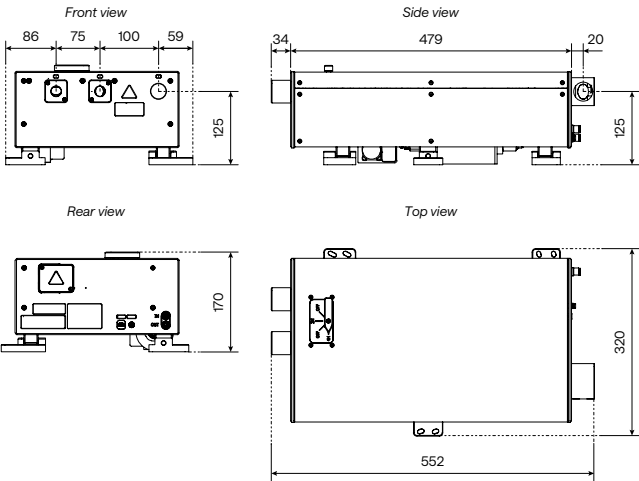


Drawings

HIRO drawing



HIRO-HP/HE drawing





Wavelength-Tunable Sources

LIGHT CONVERSION's OPAs offer a broad tuning range from deep-UV to mid-IR. Coupled with our femtosecond lasers, these OPAs provide an invaluable source for ultrafast spectroscopy, nonlinear microscopy, and a variety of other scientific applications.

I-OPA

The only commercial industrial-grade OPA combines wavelength tunability with robust industrial design.

ORPHEUS | NEO

The next-generation of OPAs with exceptional stability and multiple detectors for continuous power monitoring and diagnostics.

ORPHEUS

Classic OPAs that many are used to. Just like TOPAS, they are quite simple yet offer an extensive range of parameters.

Continuous wavelength tunability from UV to MIR

Pulse duration from tens of femtoseconds to a few picoseconds

Leading OPA manufacturer for more than 30 years

I-OPA

Industrial-Grade Optical Parametric Amplifier



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

Wavelength tunability
in an industrial design

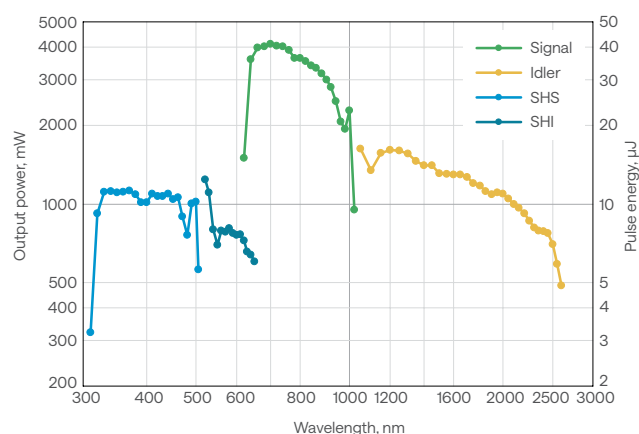
Single-box solution

Tunable or fixed-wavelength
models

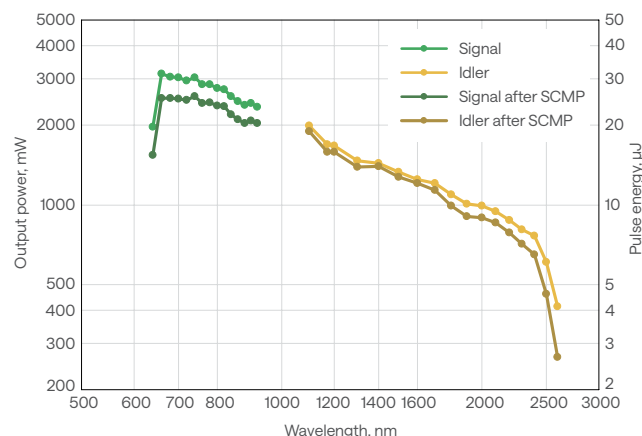
Plug-and-play installation and
robust performance

The most compact OPA
in the market

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



I-OPA-F typical tuning curves
Pump: 40 W, 400 μ J, 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 μ J		
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 μ J pump; up to 1 MHz)		> 9% @ 1550 nm (40 – 400 μ J pump; up to 1 MHz)
	> 3.5% @ 700 nm (20 – 40 μ J pump; up to 2 MHz)		> 6% @ 1550 nm (20 – 40 μ J 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 $\pm$ 10 nm
Maximum pump power	40 W
Maximum repetition rate	Up to 2 MHz
Pump pulse energy	20 – 400 μ J
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.

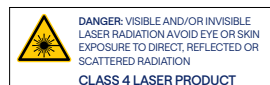
³⁾ Output pulse duration depends on selected wavelength and pump laser pulse duration.

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

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

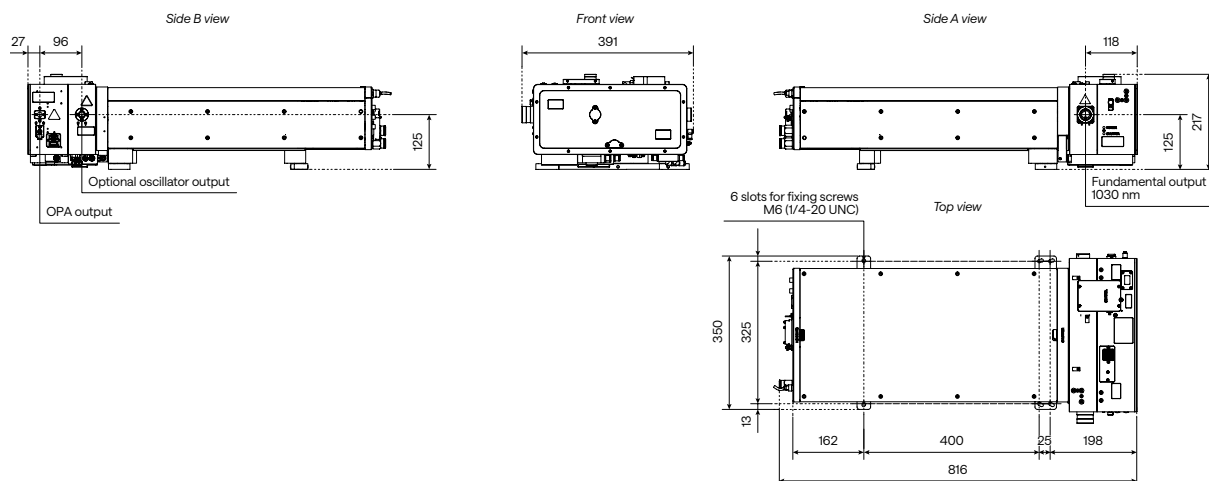
⁶⁾ Specifications are guaranteed for a maximum temperature variation of $\pm 1^\circ\text{C}$ and humidity variation of $\pm 10\%$.

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

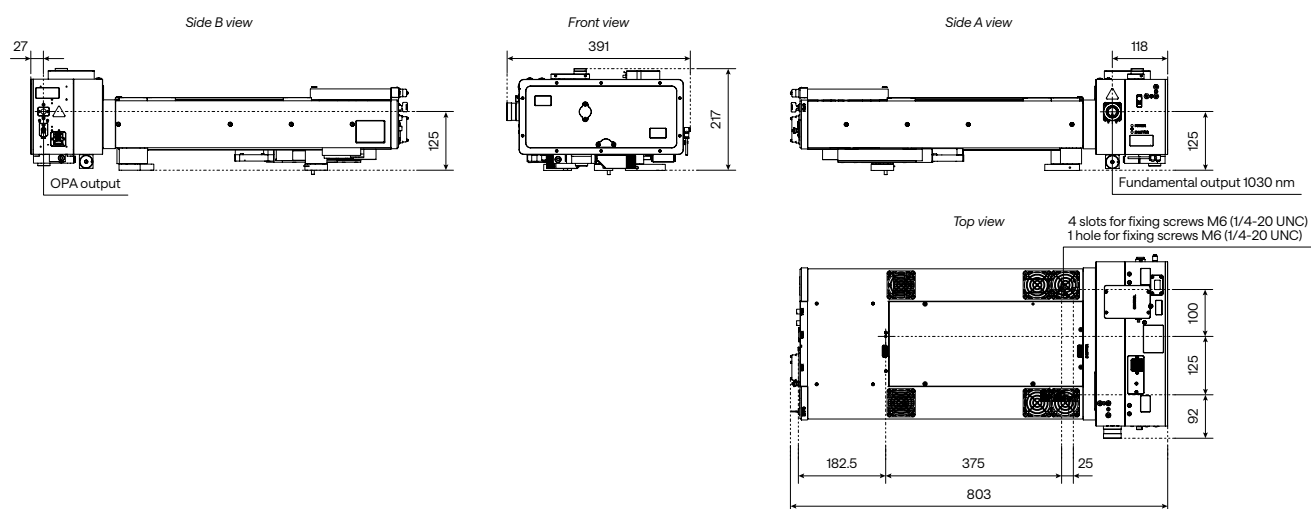


Drawings

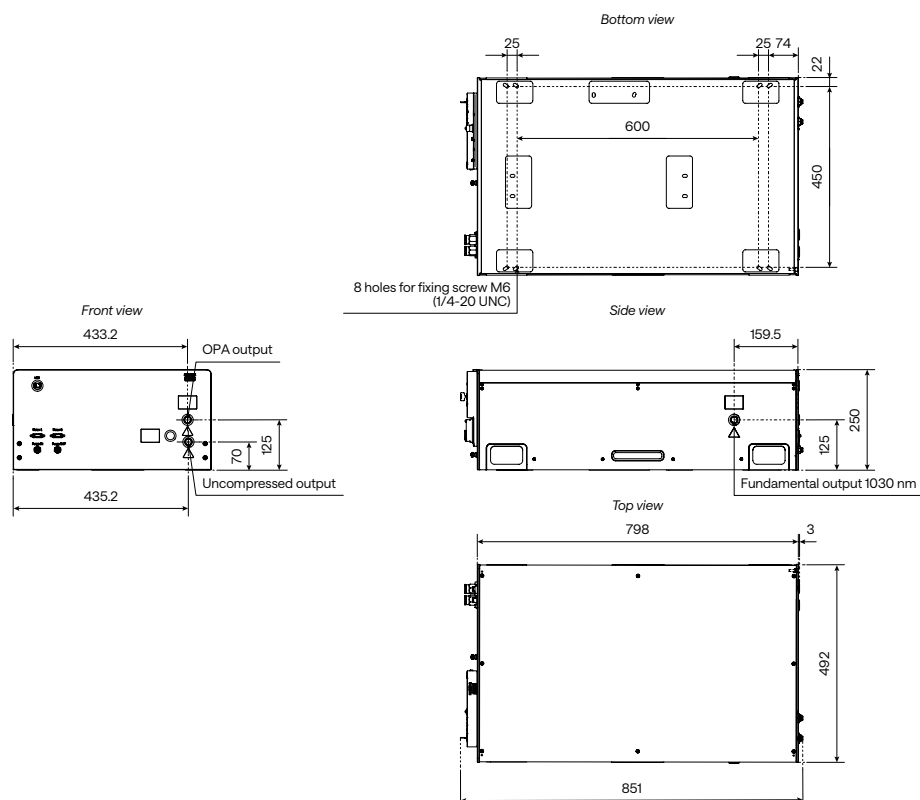
CARBIDE-CB3 with I-OPA-HP drawing and output ports



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



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



Next-Generation Optical Parametric Amplifier



From UV to MIR

Continuous power monitoring and diagnostics

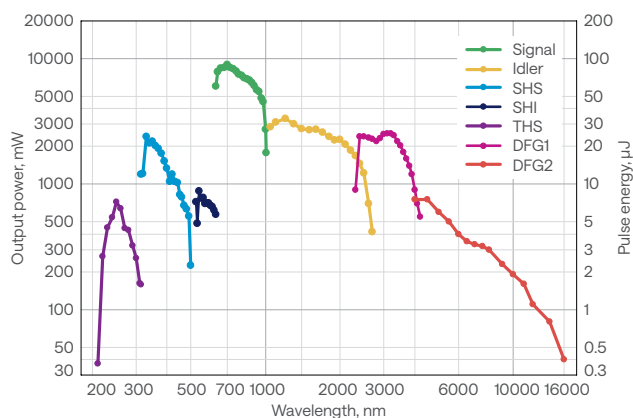
Pumped by PHAROS-UP for ultrashort pulses

Up to 80 W, 800 μ J pump at up to 2 MHz

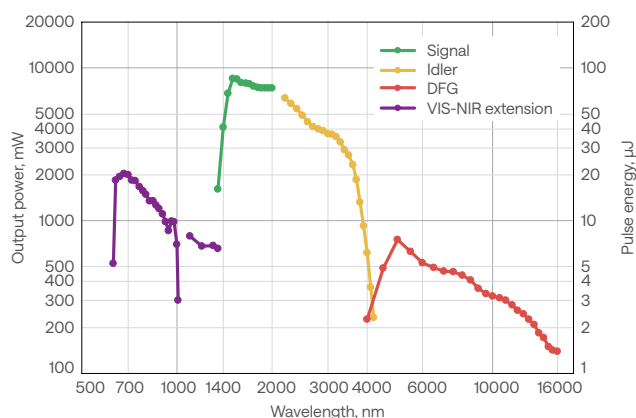
Fully integrated wavelength extensions

Exceptional output stability

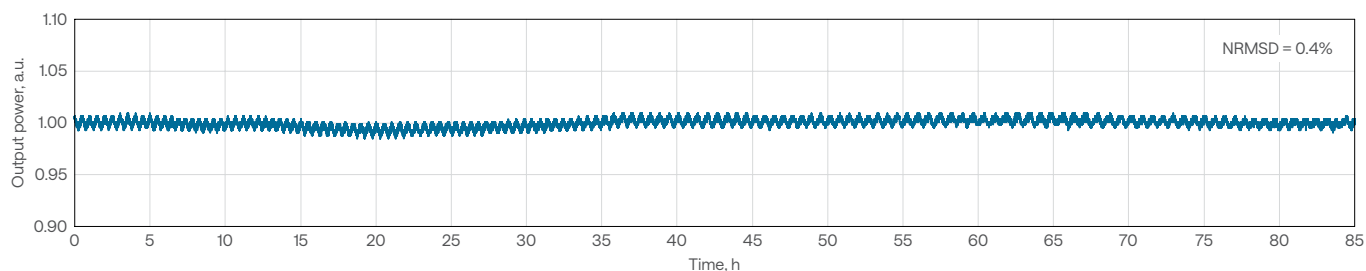
ORPHEUS-NEO typical tuning curves in HP configuration.
Pump: 80 W, 800 μ J, 100 kHz



ORPHEUS-NEO-ONE typical tuning curves in ONE configuration.
Pump: 80 W, 800 μ J, 100 kHz



ORPHEUS-NEO typical long-term power stability at 800 nm



ORPHEUS-NEO specifications

Model	ORPHEUS-NEO	ORPHEUS-NEO-ONE
Configuration	ORPHEUS	ORPHEUS-ONE
Pump power	Up to 80 W	
Pump pulse energy	20 – 800 μ J	
Repetition rate	Up to 2 MHz	
Tuning range	640 – 1000 nm (signal) 1050 – 2600 nm (idler)	1400 – 2000 nm (signal) 2100 – 4200 nm (idler)
Conversion efficiency	> 7% @ 700 nm (40 – 800 μ J pump; up to 1 MHz)	> 9% @ 1550 nm (40 – 800 μ J pump; up to 1 MHz)
	> 3.5% @ 700 nm (20 – 40 μ J pump; up to 2 MHz)	> 6% @ 1550 nm (20 – 40 μ J pump; up to 2 MHz)
Spectral bandwidth	60 – 220 cm^{-1} @ 700 – 960 nm	50 – 150 cm^{-1} @ 1450 – 2000 nm
Pulse duration ¹⁾	120 – 400 fs	100 – 400 fs
Beam quality, M^2	< 1.3 @ 800 nm	< 1.3 @ 1550 nm
Beam diameter ²⁾	2.1 $\pm$ 0.6 mm @ 800 nm	2.1 $\pm$ 0.6 mm @ 1550 nm
Beam divergence (full-angle)	< 2 mrad @ 800 nm	< 4 mrad @ 1550 nm
Long-term power stability, 8 h ³⁾	< 1% @ 800 nm	< 1% @ 1550 nm
Pulse-to-pulse energy stability, 1 min ³⁾	< 1% @ 800 nm	< 1% @ 1550 nm
Wavelength extension options; conversion efficiency	210 – 320 nm (THS); > 0.4% @ 250 nm	640 – 1000 nm and 1050 – 1350 nm (VIS-NIR); > 1% @ 700 nm
	320 – 500 nm (SHS) and 525 – 640 nm (SHI); > 1.2% @ 350 nm	
	2500 – 4200 nm (DFG1); > 3% @ 3000 nm	4000 – 16000 nm (DFG); > 0.3% @ 10000 nm (for > 40 μ J pump)
	4000 – 16000 nm (DFG2); > 0.2% @ 10000 nm	

PUMP LASER REQUIREMENTS

Configuration	PHAROS or CARBIDE
Center wavelength	1030 $\pm$ 10 nm
Maximum pump power	80 W
Maximum repetition rate	2 MHz
Pump pulse energy	20 – 800 μ J
Pump pulse duration	180 – 500 fs

ENVIRONMENTAL & UTILITY REQUIREMENTS

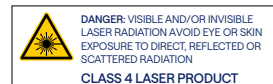
Operating temperature ⁴⁾	19 – 25 °C (air conditioning recommended)
Relative humidity ⁴⁾	20 – 70% (non-condensing)
Electrical requirements	100 – 240 V AC, 4.5 A; 50 – 60 Hz
Rated power	280 W
Power consumption	Standby: 20 W Max during wavelength tuning: 200 W

¹⁾ Output pulse duration depends on selected wavelength and pump laser pulse duration.

²⁾ $FW1/e^2$, measured at laser output, using maximum pulse energy.

³⁾ Expressed as normalized root mean squared deviation (NRMSD).

⁴⁾ Specifications are guaranteed for a maximum temperature variation of ± 1 °C and humidity variation of $\pm 10\%$.



ORPHEUS-NEO-UP specifications

Model	ORPHEUS-NEO-UP	ORPHEUS-NEO-ONE-UP
Configuration	ORPHEUS	ORPHEUS-ONE
Pump power	Up to 20 W	
Pump pulse energy	20 – 400 μ J	
Repetition rate	Up to 1 MHz	
Tuning range	640 – 1000 nm (signal) 1050 – 2600 nm (idler)	1450 – 2000 nm (signal) 2100 – 4500 nm (idler)
Conversion efficiency	> 7% @ 700 nm	> 9% @ 1550 nm
Spectral bandwidth	120 – 300 cm^{-1} @ 700 – 2600 nm	150 – 300 cm^{-1} @ 1500 – 1900 nm & 2200 – 3500 nm ¹⁾
Pulse duration ²⁾	< 100 fs @ 700 – 1000 nm < 120 fs @ 1060 – 2000 nm	< 120 fs @ 1500 – 1900 nm
Beam quality, M^2	< 1.3 @ 800 nm	< 1.3 @ 1550 nm
Beam diameter ³⁾	2.1 $\pm$ 0.6 mm @ 800 nm	2.1 $\pm$ 0.6 mm @ 1550 nm
Beam divergence (full-angle)	< 2 mrad @ 800 nm	< 4 mrad @ 1550 nm
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; conversion efficiency	210 – 320 nm (THS); > 0.2% @ 250 nm	640 – 1000 nm and 1050 – 1450 nm (VIS-NIR); > 1% @ 700 nm
	320 – 500 nm (SHS) and 525 – 640 nm (SHI); > 1.2% @ 350 nm	
	2500 – 4500 nm (DFG1); > 3% @ 3000 nm	
	4500 – 14000 nm (DFG2); > 0.1% @ 10000 nm	

PUMP LASER REQUIREMENTS

Configuration	PHAROS-UP
Center wavelength	1030 $\pm$ 10 nm
Maximum pump power	20 W
Maximum repetition rate	1 MHz
Pump pulse energy	20 – 400 μ J
Pump pulse duration	80 – 100 fs

ENVIRONMENTAL & UTILITY REQUIREMENTS

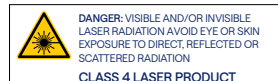
	Refer to www.lightcon.com
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¹⁾ Spectral bandwidth is equal to 150 – 250 cm^{-1} @ 5000 – 12000 nm.

²⁾ Output pulse duration depends on selected wavelength and pump laser pulse duration.

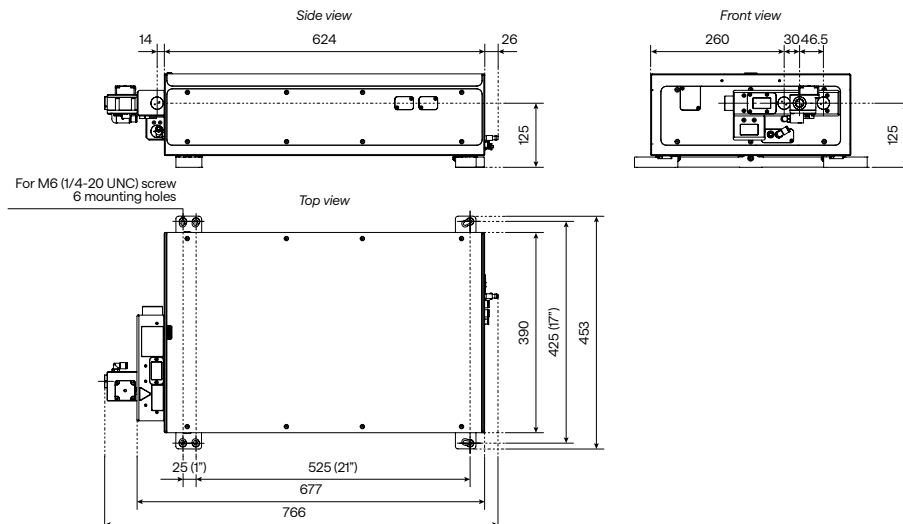
³⁾ FW 1/e^2 , measured at laser output, using maximum pulse energy.

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



Drawings

ORPHEUS-NEO / ORPHEUS-NEO-UP drawings



Collinear Optical Parametric Amplifier



Continuous tunability
from UV to MIR, 190 – 16000 nm

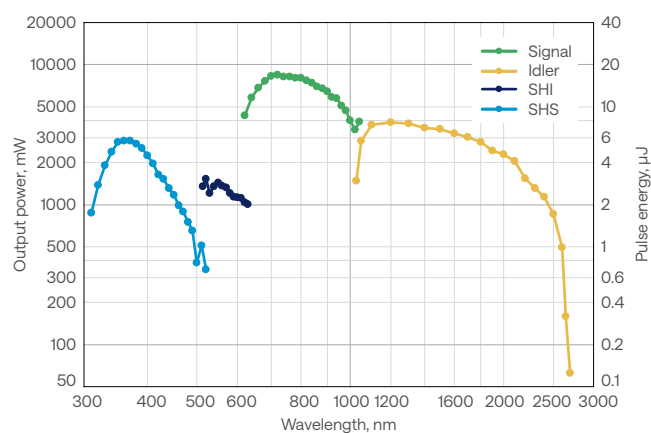
High energy and high power
models for all needs

Single-shot – 2 MHz
repetition rate

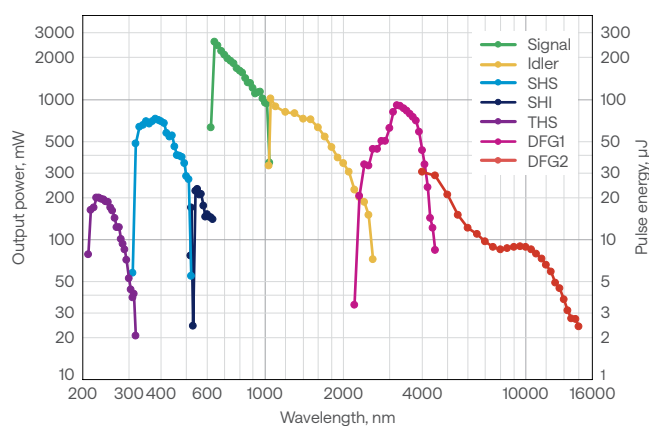
Up to 80 W pump power

Up to 2 mJ pump pulse energy

ORPHEUS-HP typical tuning curves.
Pump: 80 W, 160 μ J, 500 kHz



ORPHEUS-HE typical tuning curves.
Pump: 20 W, 2 mJ, 10 kHz



For custom tuning curves visit
<http://toolbox.lightcon.com/tools/tuningcurves>

Specifications

Model	ORPHEUS-HP	ORPHEUS-HE
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MAIN OUTPUT (630 – 2600 nm)

Tuning range	630 –1030 nm (signal) 1030 – 2600 nm (idler)		
Maximum pump power	80 W		
Pump pulse energy	8 – 20 µJ	20 – 400 µJ	400 – 2000 µJ
Conversion efficiency at peak	> 4.5% (signal) > 2% (idler)	> 9% (signal) > 4% (idler)	
Pulse duration	120 – 400 fs		
Spectral bandwidth @ 700 – 960 nm	60 – 220 cm ⁻¹		
Long-term power stability, 8 h ¹⁾	< 2% @ 800 nm		
Pulse-to-pulse energy stability, 1 min ¹⁾	< 2% @ 800 nm		

WAVELENGTH EXTENSIONS (190 – 16000 nm)

Pump pulse energy	8 – 20 µJ	20 – 400 µJ	400 – 2000 µJ
315 – 630 nm (SHS/SHI)	> 1.2% @ 350 nm	> 2.4% @ 350 nm	
210 – 315 nm (THS)	> 0.4% @ 250 nm ²⁾	> 0.8% @ 250 nm ²⁾	
190 – 215 nm (DUV)	n/a	> 0.3% @ 200 nm ³⁾	Contact sales@lightcon.com
2200 – 4200 nm (DFG1)	> 1.5% @ 3000 nm	> 3% @ 3000 nm	
4000 – 16 000 nm (DFG2)	> 0.1% @ 10000 nm	> 0.2% @ 10000 nm	

PUPM LASER REQUIREMENTS

Pump laser	PHAROS or CARBIDE	
Center wavelength	1030 ± 10 nm	
Maximum pump power	80 W	
Maximum repetition rate	2 MHz	200 kHz
Pump pulse energy	8 – 400 μJ	400 – 2000 μJ
Pulse duration ⁴⁾	180 – 500 fs	

ENVIRONMENTAL & UTILITY REQUIREMENTS

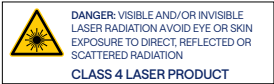
Refer to www.lightcon.com

¹⁾ Expressed as normalized root mean squared deviation (NRMSD).

²⁾ Maximum output power of 400 mW.

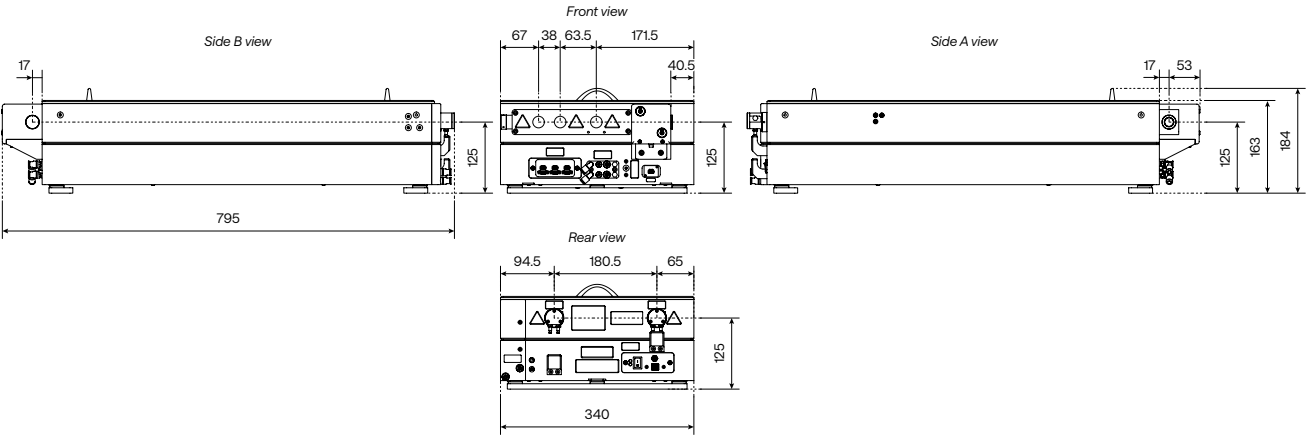
³⁾ DUV conversion efficiency is specified for pump power up to 10 W and up to 200 kHz. In case of higher pump power, conversion efficiency decreases. Maximum output power of 40 mW @ 200 nm.

⁴⁾ FWHM, assuming Gaussian pulse shape.



Drawings

ORPHEUS-HP/HE drawings





Ultrafast Spectroscopy Applications

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

Femtosecond pump-probe

Time-resolved fluorescence
spectroscopy

Flash photolysis

Ultrafast Spectroscopy

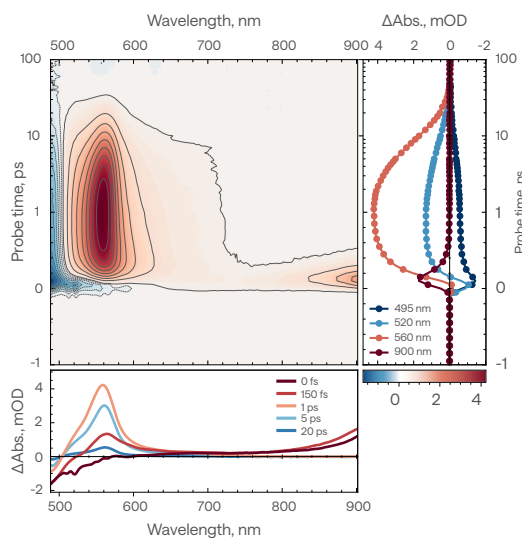
HARPIA | TA

Femtosecond pump-probe

Spectral dynamics of beta-carotene in solution acquired using HARPIA-TA.

MEASUREMENT CONDITIONS

Pulse repetition rate: 100 kHz
Pump wavelength: 490 nm
Pump energy: < 10 nJ
Acquisition time: 13 s per spectrum (per delay point)



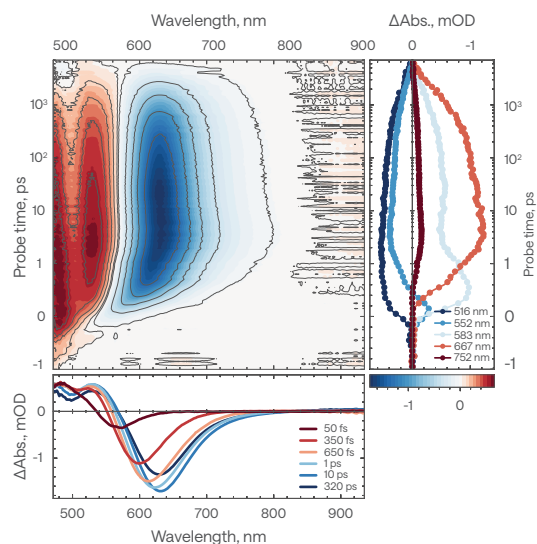
HARPIA | LIGHT

Femtosecond pump-probe

Spectral dynamics of DCM laser dye in solution acquired using HARPIA-LIGHT.

MEASUREMENT CONDITIONS

Pulse repetition rate: 60 kHz
Pump wavelength: 343 nm
Acquisition time: 3 s per spectrum (per delay point)



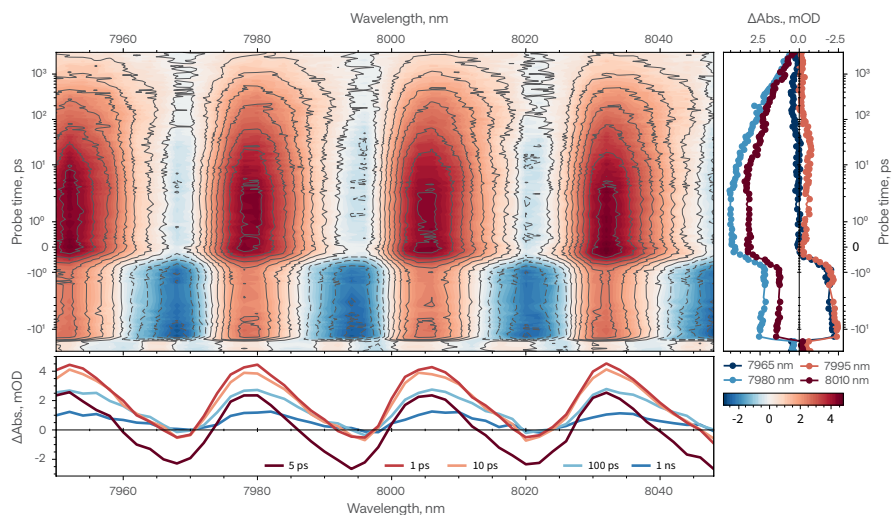
HARPIA | TA

IR femtosecond pump-probe

Pump-probe dynamics of GaAs wafer in IR measured using signal and reference single-channel detectors of HARPIA-TA.

MEASUREMENT CONDITIONS

Pulse repetition rate: 75 kHz
Pump wavelength: 700 nm
Acquisition time: 1 s per point





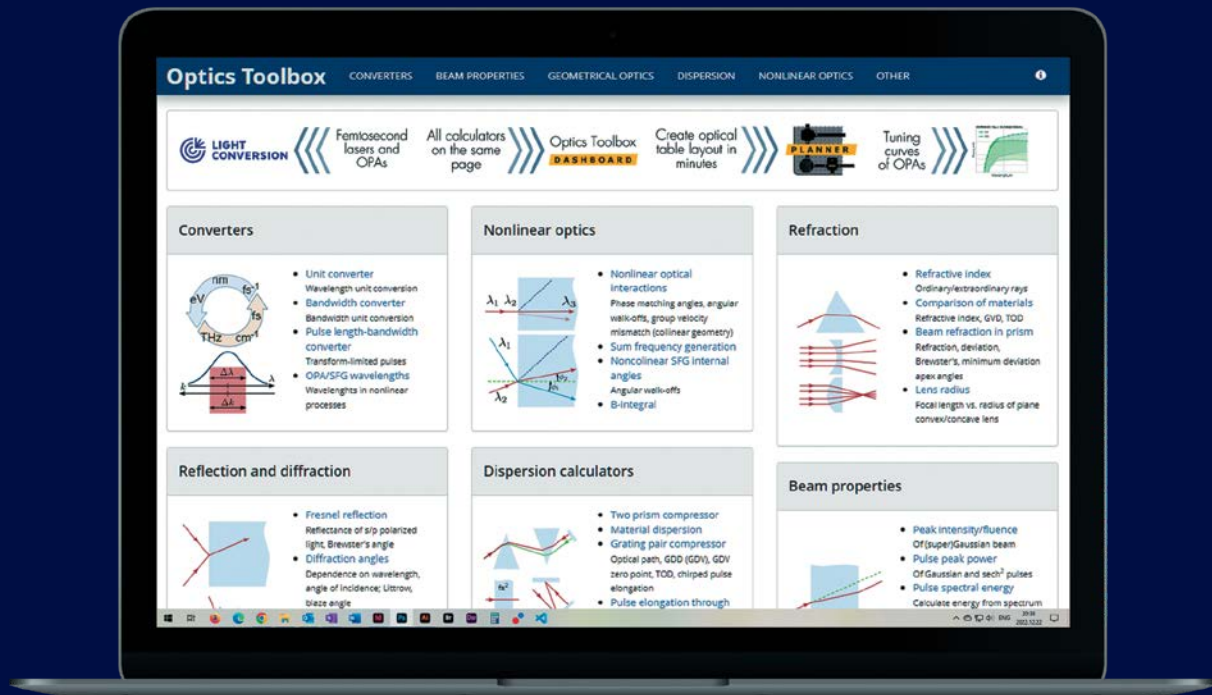
Global Representative Network

AUSTRALIA NEW ZEALAND	Lastek Pty Ltd. Adelaide, Australia Phone: +61 8 84 438 668 ricardas@lastek.com.au www.lastek.com.au	ISRAEL	ROSH Electroptics Ltd. Natanya, Israel Phone: +972 (0)9 862 7401 info@roshelop.co.il www.roshelop.co.il
BELGIUM, NETHERLANDS, LUXEMBOURG	Laser 2000 Benelux C.V. Vinkeveen, Netherlands Phone: +31 297 266191 info@laser2000.nl www.laser2000.nl	ITALY	Optoprim S.r.l. Vimercate, Italy Phone: +39 039 834 977 info@optoprim.it www.optoprim.it
BRAZIL	Photonics Ltda São Paulo, Brazil Phone: +55 11 2839 3209 info@photonics.com.br www.photonics.com.br	JAPAN	Phototechnica Corp. Saitama, Japan Phone: +81 48 871 0067 voc@phototechnica.co.jp www.phototechnica.co.jp
CZECH REPUBLIC, SLOVAKIA	Femtonika s.r.o. Zbýšov, Czech Republic Phone: +420 792 417 400 info@femtonika.cz www.femtonika.cz	KOREA	Light Conversion Korea Daejeon, Korea Phone: +82 42 368 1010 jungsik.seo@lightcon.com
CHINA	Light Conversion China Shenzhen, China Phone: +86 189 4874 5558 sales.china@cn.lightcon.com	POLAND	Amecam Warszawa, Poland Phone: +48 602 500 680 amecam@amecam.pl www.amecam.pl
	Beijing Light-Quantum Technology Co., Ltd. Beijing, China Phone: +86 10 8290 0415 sales@light-quantum.cn www.light-quantum.cn	SINGAPORE	Acexon Technologies Pte Ltd. Singapore Phone: +65 6565 7300 sales@acexon.com www.acexon.com
	Genuine Optronics Limited Shanghai, China Phone: +86 21 64 325 169 jye@gen-opt.com www.gen-opt.com	SPAIN, PORTUGAL	Innova Scientific S.L. Las Rozas de Madrid, Spain Phone: +34 91 710 56 50 rafael.pereira@innovasci.com www.innovasci.com
FRANCE, SWITZERLAND, BELGIUM	Jean-François Poisson Industrial Market Development Manager Phone: +33 674 48 0778 jf.poisson@lightcon.com	SWITZERLAND	GMP SA Renens, Switzerland Phone: +41 21 633 21 21 info@gmp.ch www.gmp.ch
FRANCE	Frédéric Berthillier Scientific Market Development Manager Phone: +33 745 014 410 frederic.berthillier@lightcon.com	TAIWAN	Alaser Co. Ltd. Taipei, Taiwan Phone: +886 2 2377 3118 alexfu@alaser.com.tw www.alaser.com.tw
GERMANY, AUSTRIA, SWITZERLAND	Ulrich Höchner Industrial Market Development Manager Phone: +49 157 8202 5058 u.hoechner@lightcon.com	TURKEY	Innova Teknoloji Ltd. İstanbul, Turkey Phone: +90 216 315 03 36 eryetistir@innova-teknoloji.com www.innova-teknoloji.com
GERMANY, AUSTRIA	Christian Hellwig Scientific Market Development Manager Phone: +49 174 204 9053 christian.hellwig@lightcon.com	UNITED KINGDOM	Photonic Solutions Ltd. Edinburgh, UK Phone: +44 (0) 131 664 8122 ben.agate@photonicsolutions.co.uk www.photonicsolutions.co.uk
	Stefan Piontek Scientific Market Development Manager Mobile +49 176 8345 7119 stefan.piontek@lightcon.com	USA, CANADA	Light Conversion-USA, Inc. Bozeman, MT, USA Phone: +1 833 685 2872 saleslc@lightcon-usa.com
INDIA	Anatech Laser Instruments Pvt. Ltd. Mumbai, India Phone: +91 22 4121 0001 / 02 / 03 sales@anatechlaser.com www.anatechlaser.com		

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Photonic Solutions Ltd
Edinburgh
EH14 4AP
+44 131 664 8122
www.photonicsolutions.co.uk