LIGHT CONVERSION

Product Catalog

Lasers for Microscopy

lightcon.com

2026

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	17 500	750
Femtosecond laser systems installed worldwide	Square meters designated for manufacture and R&D	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.


LIGHT
CONVERSION
CRONUS

Lasers for Microscopy

CRONUS femtosecond lasers support functional neuroimaging, optogenetics, and deep imaging through medium-rep-rate 3P excitation, fast high-rep-rate 2P imaging, and widefield or holographic excitation.

Optimized for advanced multiphoton microscopy

Plug-and-play functionality with automated wavelength and dispersion control

Excellent long-term power and pulse-to-pulse stability

CRONUS | 2P

Tunable laser with watt-level output and a high repetition rate for 2P excitation of a wide range of fluorescent probes and opsins, as well as CARS or SRS.

CRONUS | 3P

A turnkey laser source with µJ-level pulses, covering the biological transparency windows at 1300 and 1700 nm for 3P microscopy, and 1030 nm for optogenetic stimulation.

I-OPA

The only industrial-grade commercial OPA, combining wavelength tunability with compact and robust design.

CARBIDE

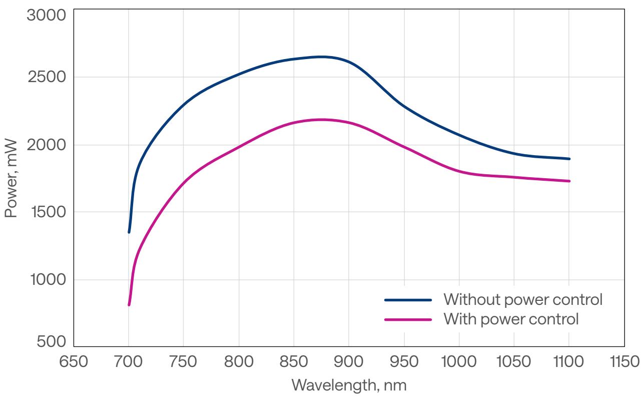
Industrial-grade femtosecond laser operating at 40 W, extends nonlinear microscopy toolkit with optogenetic stimulation.

CRONUS | 2P

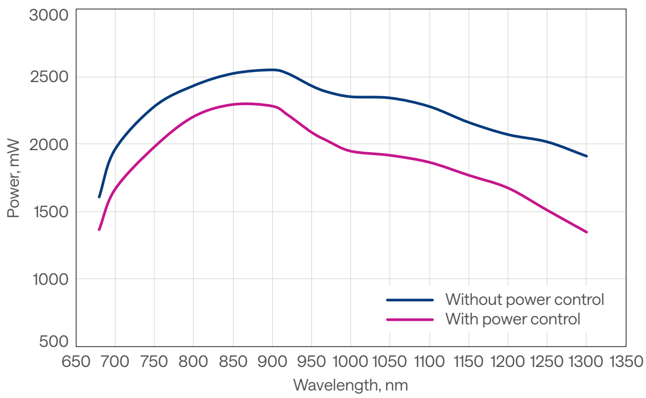
High-Repetition-Rate Wavelength-Tunable Femtosecond Laser

- Watt-level output at high repetition rates for fast imaging
- NEW One or two tunable and one fixed output for simultaneous multibeam excitation
- Automated GDD control for the shortest pulses at the sample
- Feedback-based output power and wavelength stabilization
- Beam steering & power locking

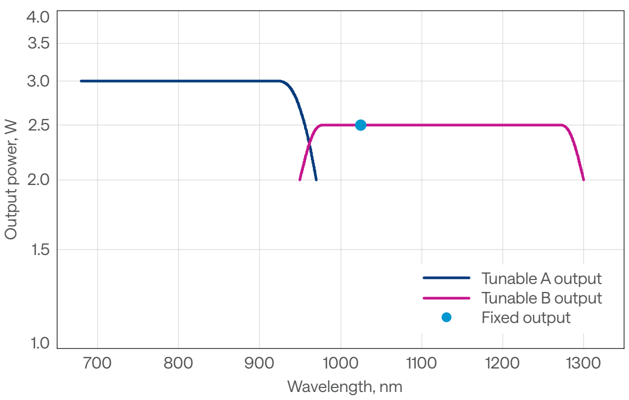
CRONUS-2P typical output power



CRONUS-2P-XR typical output power



CRONUS-2P-DUAL tuning curve



Specifications

Model		CRONUS-2P NEW		CRONUS-2P-XR NEW	
Output		Tunable	Fixed	Tunable	Fixed
Tuning range		700 – 1100 nm	1025 ± 10 nm	680 – 1300 nm	1025 ± 10 nm
Output power [1]		> 2.5 W @ 900 nm	> 1.5 W	> 1.5 W @ 700 nm > 2 W @ 800 nm > 2.5 W @ 900 nm > 2 W @ 1100 nm > 1.7 W @ 1200 nm > 1.2 W @ 1300 nm	> 2 W
Pulse duration [2] [3]		< 120 fs	< 130 fs	< 100 fs	< 130 fs
Repetition rate		80 ± 0.5 MHz			
Beam quality, M^2 [3]		< 1.2			
Polarization		Linear, horizontal			
Beam divergence, full angle [3]		< 1.5 mrad			
Beam diameter, $1/e^2$ [3]		1.2 ± 0.2 mm			
Beam ellipticity [3]		> 0.8			
Beam astigmatism [3]		< 20%			
Beam pointing stability [4]		< 200 μrad	n/a	< 200 μrad	n/a
Long-term power stability, 8 h [3] [5]		< 1%			
GDD control range		−5000 to −40 000 fs² @ 710 nm −3000 to −25 000 fs² @ 800 nm 0 to −15 000 fs² @ 900 nm −3000 to −10 000 fs² @ 1000 nm −3000 to −10 000 fs² @ 1100 nm	n/a	−5000 to −40 000 fs² @ 700 nm 0 to −15 000 fs² @ 900 nm 0 to −10 000 fs² @ 1100 nm 0 to −8000 fs² @ 1300 nm	n/a
OPTIONAL POWER CONTROL					
Output power [6]		> 2 W @ 900 nm	> 1.5 W	> 1 W @ 700 nm > 1.5 W @ 800 nm > 2 W @ 900 nm > 1.7 W @ 1100 nm > 1.5 W @ 1200 nm > 1 W @ 1300 nm	> 2 W
Rise/fall time [7]		< 300 ns	n/a	< 300 ns	n/a
Contrast ratio		1000 : 1	n/a	1000 : 1	n/a
GDD control range		0 to −40 000 fs² @ 710 nm 0 to −20 000 fs² @ 800 nm 0 to −10 000 fs² @ 900 nm 0 to −7000 fs² @ 1000 nm 0 to −5000 fs² @ 1100 nm	n/a	0 to −40 000 fs² @ 700 nm 0 to −10 000 fs² @ 900 nm 0 to −5000 fs² @ 1100 nm 0 to −4000 fs² @ 1300 nm	n/a
OPTIONAL WAVELENGTH EXTENSIONS (UV – VIS)					
Second harmonic tuning range [8]		375 – 550 nm	n/a	375 – 600 nm	n/a
Conversion efficiency at peak		> 30%	n/a	> 30%	n/a
ENVIRONMENTAL & UTILITY REQUIREMENTS					
Temperature, operating		18 – 30 °C			
Temperature, storage		10 – 35 °C			
Relative humidity, operating		< 80% (non-condensing)			
Electrical requirements	Laser	100 – 240 V AC; 50 – 60 Hz; 12 A max			
	Chiller	100 – 230 V AC; 50 – 60 Hz			
Rated power	Laser	1000 W			
	Chiller	1400 W			
Power consumption	Laser	300 W			
	Chiller	1000 W			
DIMENSIONS					
		Refer to lightcon.com			

Specifications

Model	CRONUS-2P-DUAL [9]		
Output	Tunable A	Tunable B	Fixed
Tuning range	680 – 960 nm	940 – 1300 nm	1025 ± 10 nm
Output power [1]	> 3 W @ 900 nm [10]	> 2.5 W @ 1100 nm [10]	> 2.5 W
Pulse duration [2] [11]	< 160 fs		
Repetition rate	77 ± 1 MHz		
Beam quality, M^2 [11]	< 1.2		
Polarization	Linear, horizontal		
Beam divergence, full angle [11]	< 1 mrad		< 1.5 mrad
Beam diameter, $1/e^2$ [11]	3.0 ± 0.4 mm	3.2 ± 0.4 mm	2.8 ± 0.4 mm
Beam ellipticity [11]	> 0.8		
Beam astigmatism [11]	< 20%		
Beam pointing stability [4]	< 200 µrad		n/a
Long-term power stability, 8 h [5] [11]	< 1%		
GDD control range	−10 000 to −35 000 fs^2 @ 700 nm −3000 to −20 000 fs^2 @ 800 nm 0 to −10 000 fs^2 @ 900 nm	0 to −10 000 fs^2 @ 960 nm −3000 to −10 000 fs^2 @ 1100 nm −8000 to −12 000 fs^2 @ 1300 nm	n/a

OPTIONAL POWER CONTROL [12]

Output power	> 2 W @ 900 nm	> 2 W @ 1100 nm	> 2 W
Rise/fall time [7]	< 300 ns		
Contrast ratio	1000 : 1		
GDD control range	0 to −27 000 fs^2 @ 700 nm 0 to −25 000 fs^2 @ 800 nm 0 to −6500 fs^2 @ 900 nm	0 to −8000 fs^2 @ 1100 nm 0 to −10 000 fs^2 @ 1300 nm	n/a

OPTIONAL WAVELENGTH EXTENSIONS (UV – VIS)

Second harmonic tuning range [8]	375 – 480 nm	480 – 600 nm	n/a
Conversion efficiency at peak	> 30%		n/a

ENVIRONMENTAL & UTILITY REQUIREMENTS

Temperature, operating		18 – 30 °C
Temperature, storage		10 – 35 °C
Relative humidity, operating		< 80% (non-condensing)
Electrical requirements	Laser	95 V AC, 16 A – 240 V AC, 7 A; 50 – 60 Hz
	Chiller	100 – 230 V AC; 50 – 60 Hz
Rated power	Laser	1700 W
	Chiller	1400 W
Power consumption	Laser	400 W
	Chiller	1000 W

DIMENSIONS

Refer to lightcon.com

[1] *Power control using AOM is applicable, see the affected specifications below.*

[2] *Pulse duration determined assuming sech2 shape.*

[3] *Specified at 900 nm and 1025 nm for CRONUS-2P and CRONUS-2P-XR, respectively.*

[4] *Beam pointing deviation over the entire tuning and GDD control range.*

[5] *Expressed as normalized root mean squared deviation (NRMSD), with less than ±1 °C temperature change after 1 h warm up.*

[6] *AOM not available for fixed outputs.*

[7] *Specified from 5% to 95%.*

[8] *Extended second harmonic tuning range available upon request. For more information contact sales@lightcon.com.*

[9] *Configurations with either dual-output A or dual-output B are also available for CRONUS-2P-DUAL model. A and B channels can be tuned independently.*

[10] *Simultaneous mode: > 1 W @ 900 nm, > 1 W @ 1100 nm, and > 2.5 W @ 1025 nm.*

[11] *Specified at 900 nm, 1100 nm, and 1025 nm.*

[12] *Power control module for CRONUS-2P-DUAL is external.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
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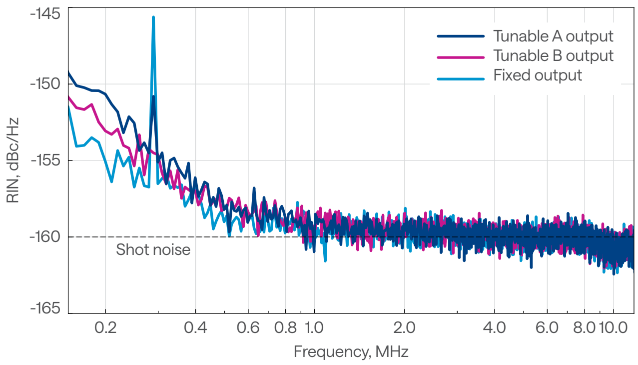
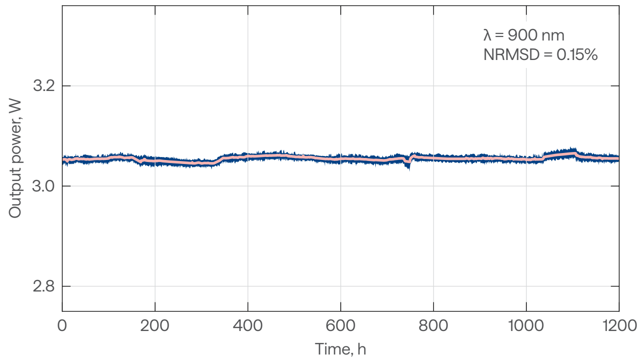
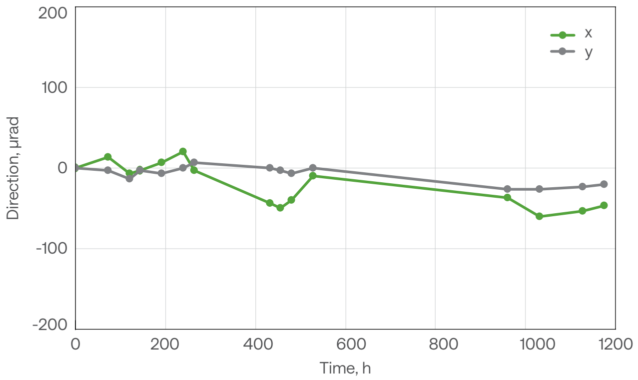
CRONUS-2P-DUAL relative intensity noise (RIN)



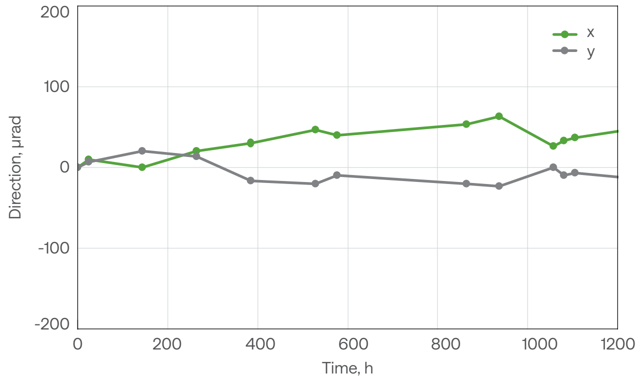
CRONUS-2P-DUAL typical output power stability at 900 nm



CRONUS-2P-DUAL
Long-term beam direction stability at 950 nm

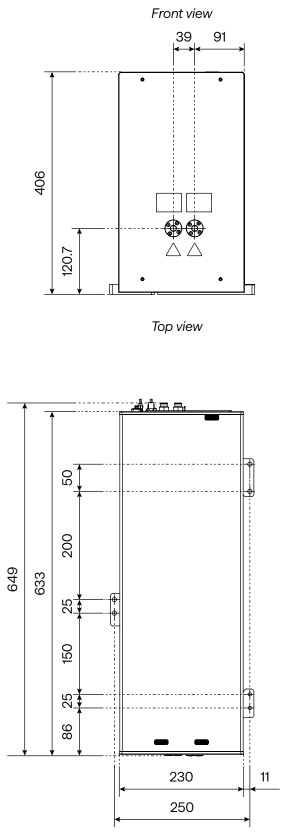


CRONUS-2P-DUAL
Long-term beam direction stability at 1100 nm

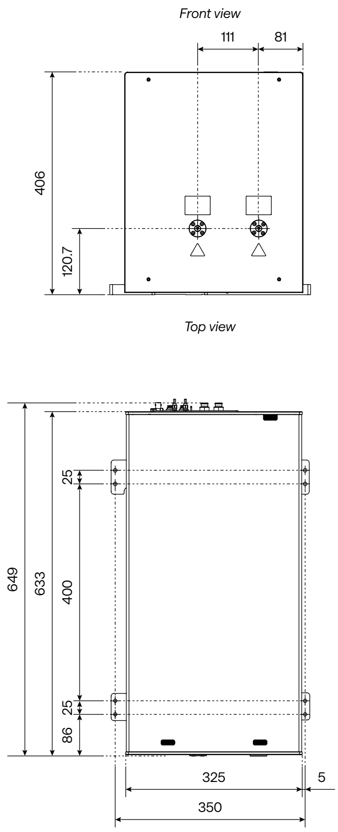


Drawings

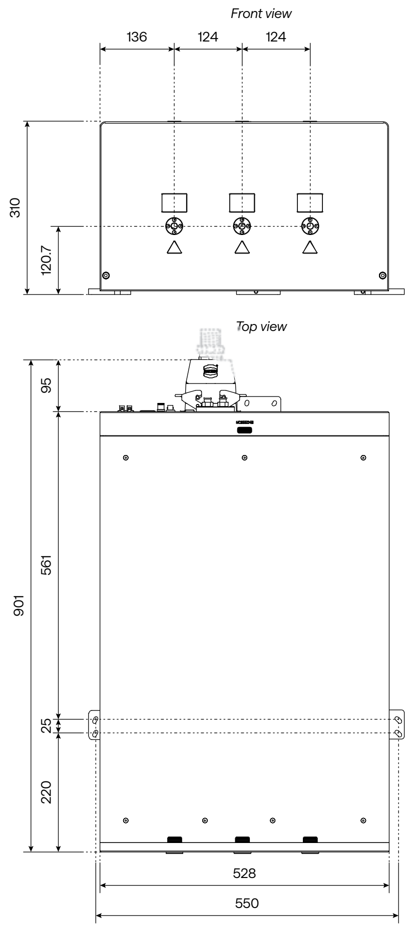
CRONUS-2P



CRONUS-2P-XR



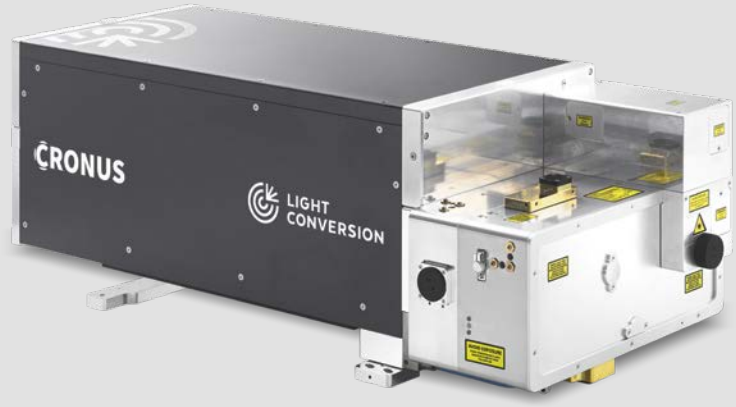
CRONUS-2P-DUAL



CRONUS | 3P

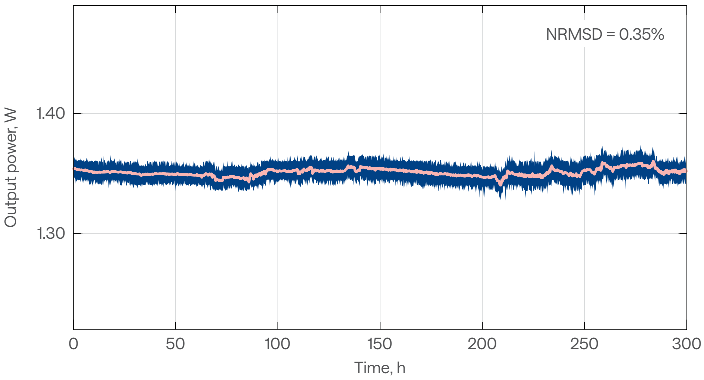
Femtosecond Laser for Advanced Nonlinear Microscopy

- High pulse energy for deep imaging
- 1250 – 1800 nm tuning range for 3P imaging
- Down to 50 fs pulse duration for high peak power
- Automated wavelength and GDD control for optimal signal
- Maintenance-free single-box solution

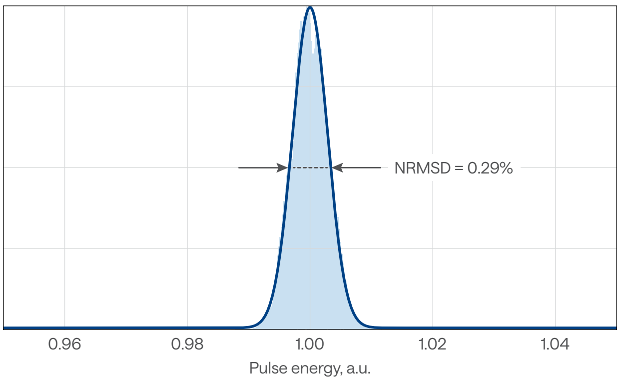


Stability

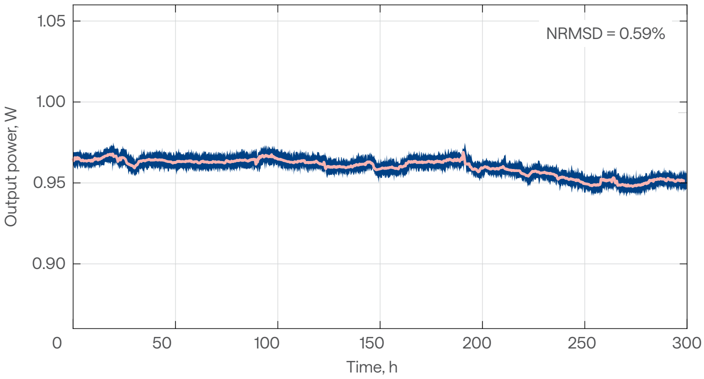
CRONUS-3P
Typical long-term power stability at 1300 nm



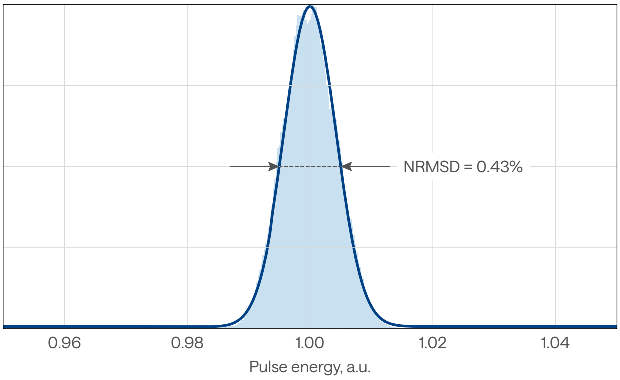
CRONUS-3P
Typical pulse-to-pulse energy distribution at 1300 nm



CRONUS-3P
Typical long-term power stability at 1700 nm



CRONUS-3P
Typical pulse-to-pulse energy distribution at 1700 nm



Specifications

NEW

Model	CRONUS-3P		CRONUS-3P-HP [1]	
Power control	No	Yes	No	Yes
Tuning range	1250 – 1800 nm			
Repetition rate [2]	Single-shot – 1 MHz or 2 MHz			
Output power @ 1 MHz [3]	> 1100 mW @ 1300 nm > 800 mW @ 1700 nm	> 1000 mW @ 1300 nm > 700 mW @ 1700 nm	> 2000 mW @ 1300 nm > 1500 mW @ 1700 nm	> 1900 mW @ 1300 nm > 1400 mW @ 1700 nm
Pulse duration [4]	< 50 fs @ 1300 nm < 65 fs @ 1700 nm		< 55 fs @ 1300 nm < 80 fs @ 1700 nm	
GDD control range [5]	–4500 to +500 fs² @ 1300 nm –12 000 to +3500 fs² @ 1700 nm			
Beam diameter [6]	1.5 – 4 mm			
Beam quality, M^2	< 1.2			
Beam ellipticity	> 0.8			
Beam divergence	< 1 mrad			
Long-term power stability, 24 h [7]	< 1%			
Pulse-to-pulse energy stability, 1 min [7]	< 1%			

ADDITIONAL OUTPUTS

Auxiliary 1030 nm amplifier output	1030 ± 10 nm, up to 40 W, up to 2 MHz, < 250 fs	1030 ± 10 nm, up to 80 W, up to 2 MHz, < 250 fs
Optional 680 – 920 nm amplifier output	680 – 920 nm, > 1500 mW @ 1 MHz or > 1000 mW @ 2 MHz (@ 920 nm), < 290 fs (compressible to < 50 fs) [8]	n/a
Optional 1030 nm oscillator output	1030 ± 10 nm, up to 500 mW, ≈ 65 MHz, ≈ 200 fs	

ENVIRONMENTAL & UTILITY REQUIREMENTS, DIMENSIONS

Refer to lightcon.com

1) *680 – 920 nm output is not available for the higher power version.*
2) *Lower repetition rate with a higher pulse energy option available.*
3) *Contact sales@lightcon.com for power specifications at 2 MHz.*
4) *Pulse duration determined assuming a Gaussian shape.*
5) *Continuous dispersion control; −4000 fs² compensates a microscope with +4000 fs².*
6) *1/e², measured at compressor output.*
7) *Expressed as normalized root mean squared deviation (NRMSD).*
8) *With external compressor without GDD control, > 70% transmission at 920 nm.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
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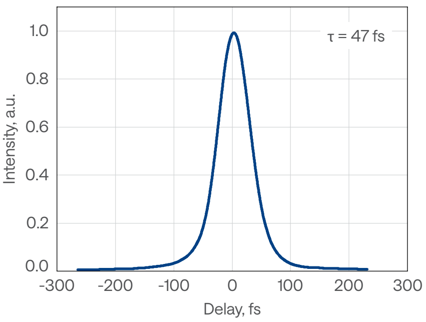
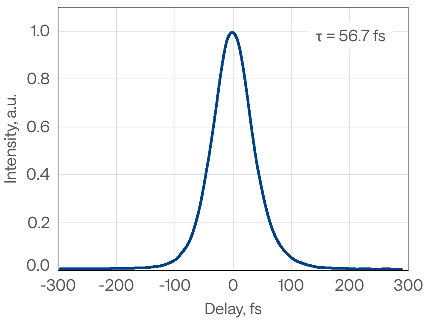
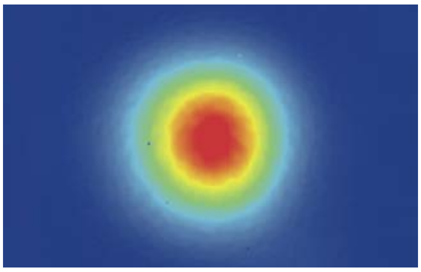
CRONUS-3P
Typical pulse duration at 1300 nm



CRONUS-3P
Typical pulse duration at 1700 nm

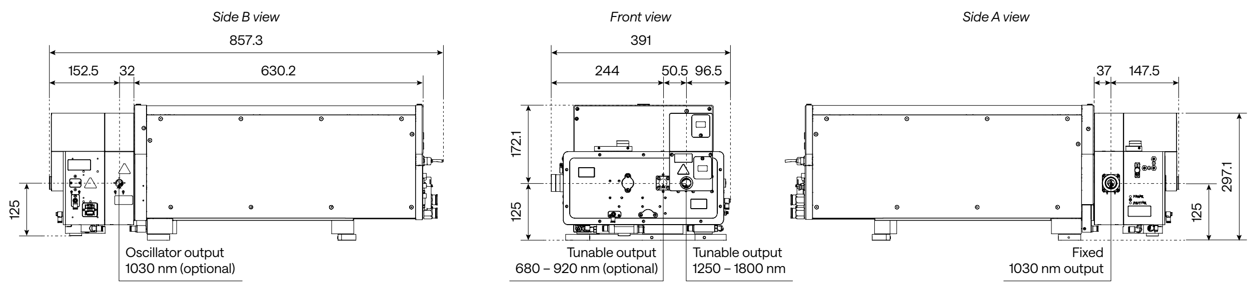


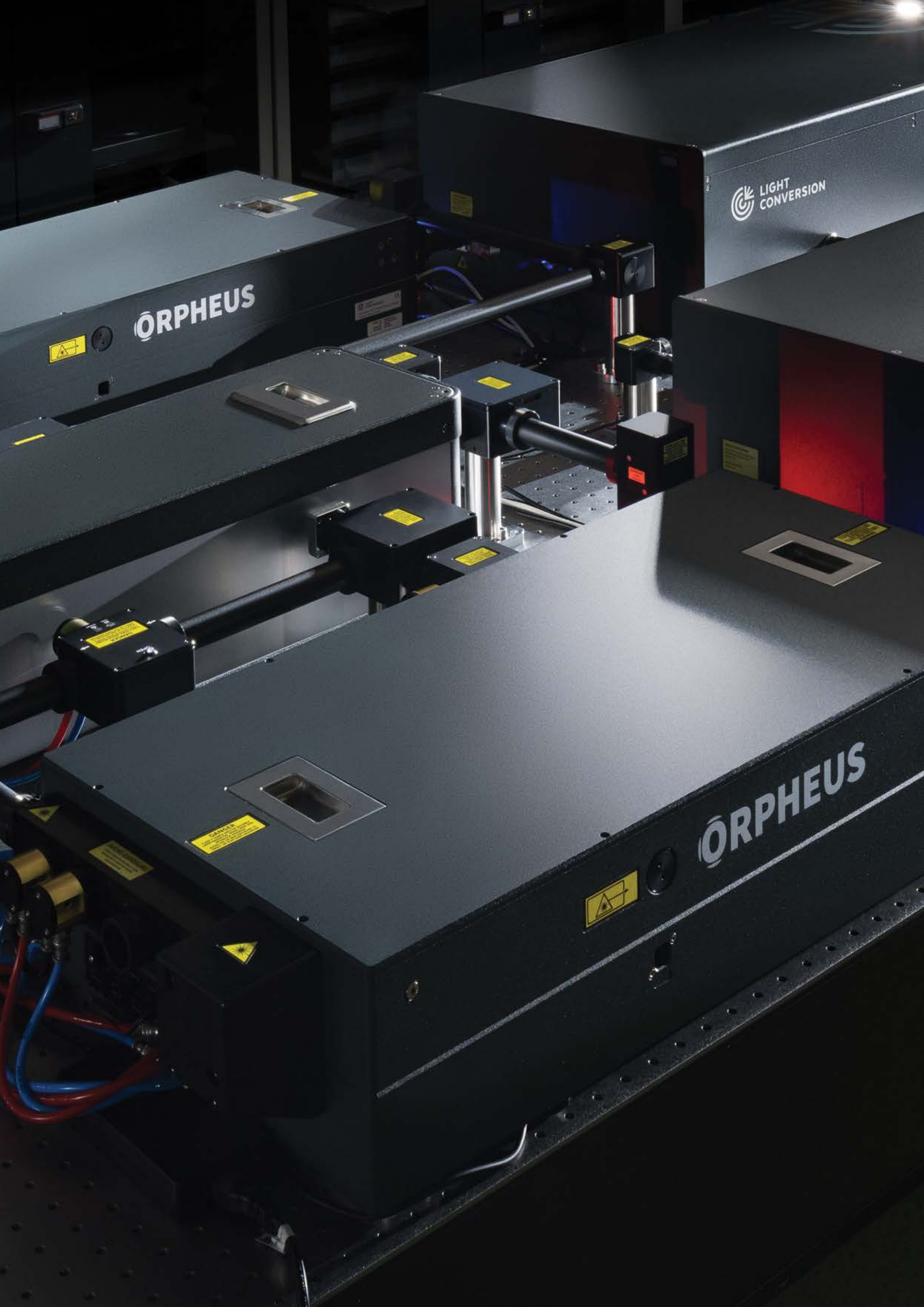
CRONUS-3P
Typical beam profile at 1300 nm



Drawings

CRONUS-3P




LIGHT CONVERSION
ORPHEUS
ORPHEUS

Wavelength-Tunable Sources

Coupled with femtosecond lasers, these OPAs provide an invaluable source for ultrafast spectroscopy, nonlinear microscopy, and a variety of other scientific applications.

Continuous wavelength tunability from UV to MIR

Pulse durations from tens of femtoseconds to a few picoseconds

Leading OPA manufacturer for more than 30 years

I-OPA

The only industrial-grade commercial OPA, combining wavelength tunability with compact and robust design.

ORPHEUS

A classic OPA platform that many are familiar with – simple to use yet offers an extensive range of parameters.

ORPHEUS | NEO

Next-generation OPA featuring exceptional stability and multiple detectors for continuous power monitoring and diagnostics.

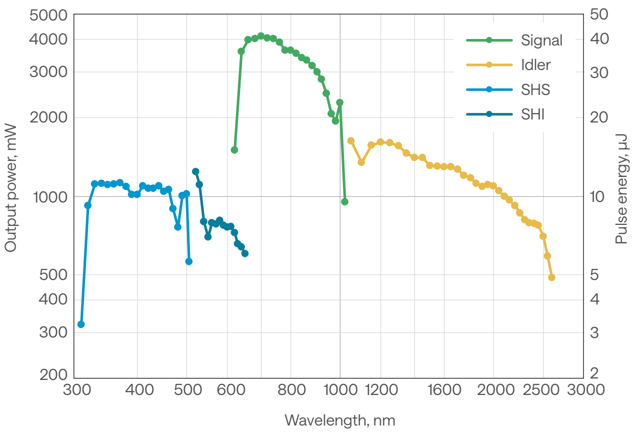
I-OPA

Industrial-Grade Optical Parametric Amplifier

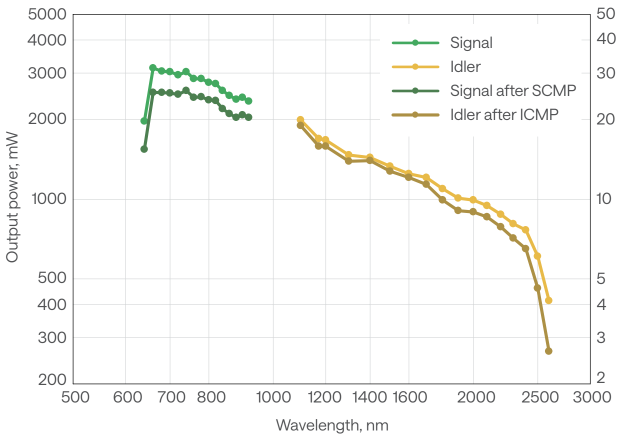
- Wavelength tunability in an industrial design
- Single-box solution
- Tunable or fixed-wavelength models
- Plug-and-play installation and robust performance
- The most compact OPA in the market

CARBIDE-CB3 with I-OPA-HP

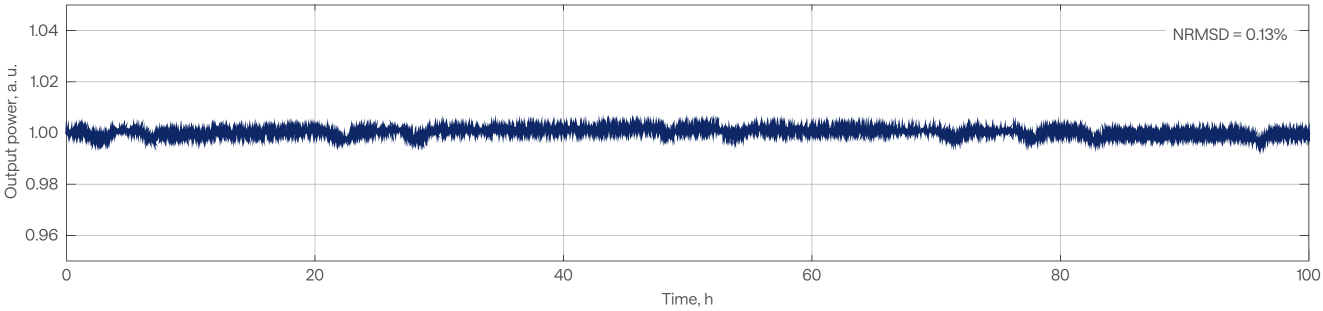
I-OPA-HP typical tuning curves
Pump: 40 W, 400 µJ, 100 kHz



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



I-OPA-HP
Typical power stability at 1300 nm



Specifications

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

PUMP LASER REQUIREMENTS

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

ENVIRONMENTAL & UTILITY REQUIREMENTS

	Refer to lightcon.com

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

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

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

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

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

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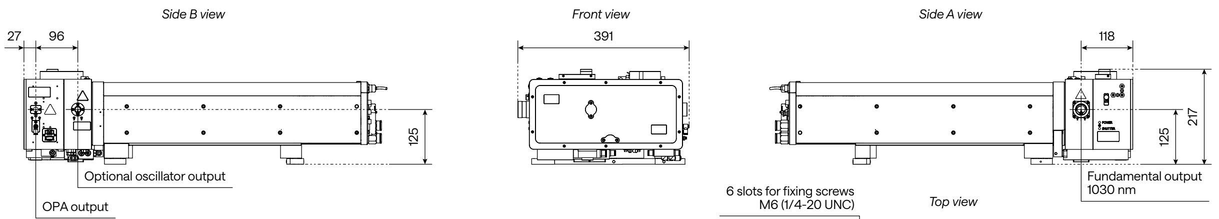
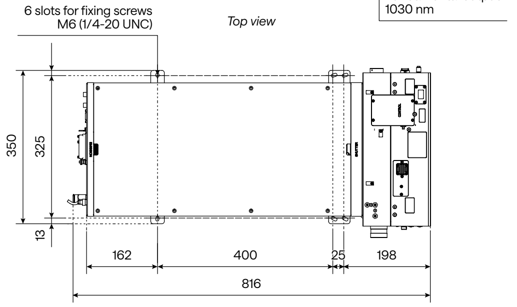
Drawings

CARBIDE-CB3 with I-OPA-HP





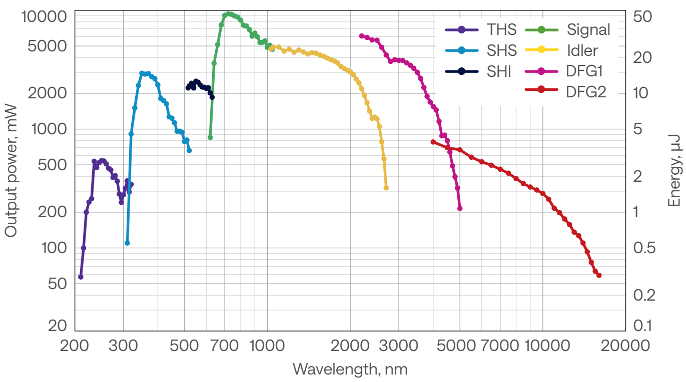
The drawings depend on the exact configuration. For more options, refer to lightcon.com.

ORPHEUS

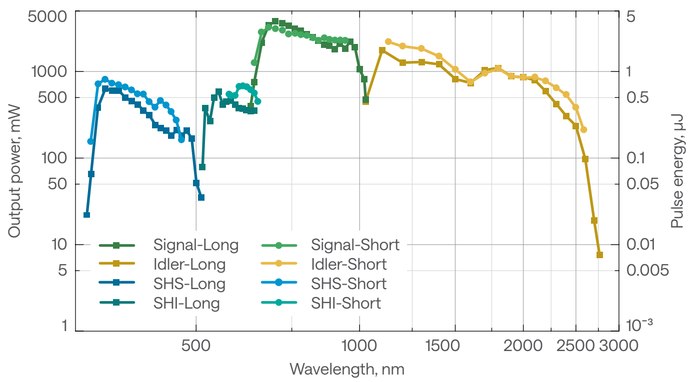
Optical Parametric Amplifier

- Continuous tunability from UV to MIR, 190 – 16 000 nm
- Single-shot – 2 MHz repetition rate
- Up to 80 W pump power
- Up to 0.4 mJ pump pulse energy

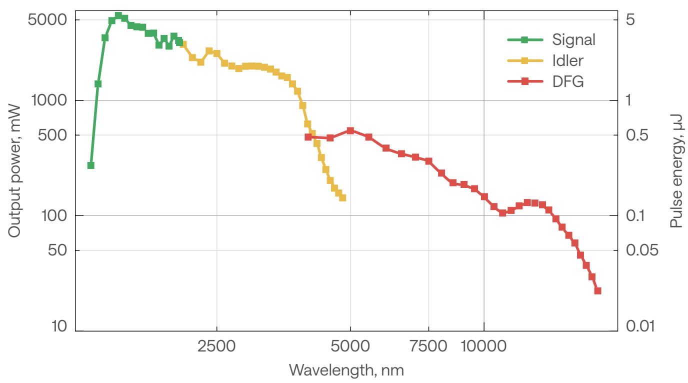
ORPHEUS typical tuning curves
Pump: 80 W, 400 µJ, 200 kHz



ORPHEUS-F typical tuning curves
Pump: 40 W, 40 µJ, 1000 kHz



ORPHEUS-ONE typical tuning curves
Pump: 40 W, 40 µJ, 1000 kHz



Optics Toolbox

Specifications

Model	ORPHEUS		ORPHEUS-F	ORPHEUS-ONE
Tuning range [1]	630 – 1030 nm (signal) 1030 – 2600 nm (idler)		650 – 900 nm (signal) 1200 – 2500 nm (idler) [2]	1400 – 2000 nm (signal) 2100 – 4200 nm (idler)
Pump power	Up to 80 W			
Repetition rate	Up to 2 MHz			
Pump pulse energy [3]	8 – 20 µJ	20 – 400 µJ	10 – 400 µJ	12 – 400 µJ
Conversion efficiency	> 4.5% @ peak (signal) > 2% @ peak (idler)	> 9% @ peak (signal) > 4% @ peak (idler)	> 7% @ 700 nm [4]	> 9%, 30 – 40 µJ pump @ 1550 nm > 6%, 12 – 30 µJ pump @ 1550 nm
Pulse duration	120 – 400 fs		< 55 fs @ 800 – 900 nm [5] < 70 fs @ 650 – 800 nm [5] < 100 fs @ 1200 – 2000 nm [5]	100 – 300 fs
Spectral bandwidth	60 – 220 cm^{-1}		200 – 750 cm^{-1} @ 650 – 900 nm	50 – 150 cm^{-1} @ 1450 – 2000 nm
Long-term power stability, 8 h [6]	< 2% @ 800 nm			< 2% @ 1550 nm
Pulse-to-pulse energy stability, 1 min [6]	< 2% @ 800 nm			< 2% @ 1550 nm
Compressor transmission	n/a		65% @ 650 – 900 nm 80% @ 1200 – 2000 nm	n/a

WAVELENGTH EXTENSIONS

DUV	n/a	190 – 215 nm: > 0.3% @ 200 nm [7]	n/a	n/a
THS	210 – 315 nm: > 0.4% @ 250 nm [8]	210 – 315 nm: > 0.8% @ 250 nm [8]	n/a	n/a
SHS, SHI	315 – 630 nm: > 1.2% @ 350 nm	315 – 630 nm: > 2.4% @ 350 nm	325 – 450 nm: > 1% @ peak 600 – 650 nm: 0.5% @ peak	n/a
DFG	2200 – 4200 nm: > 1.5% @ 3000 nm 4000 – 16 000 nm: > 0.1% @ 10 000 nm	2200 – 4200 nm: > 3% @ 3000 nm 4000 – 16 000 nm: > 0.2% @ 10 000 nm	n/a	4000 – 16 000 nm: > 0.3% @ 10 000 nm, 30 – 2000 µJ pump > 0.2% @ 10 000 nm, 12 – 30 µJ pump

PUPM LASER, ENVIRONMENTAL & UTILITY REQUIREMENTS

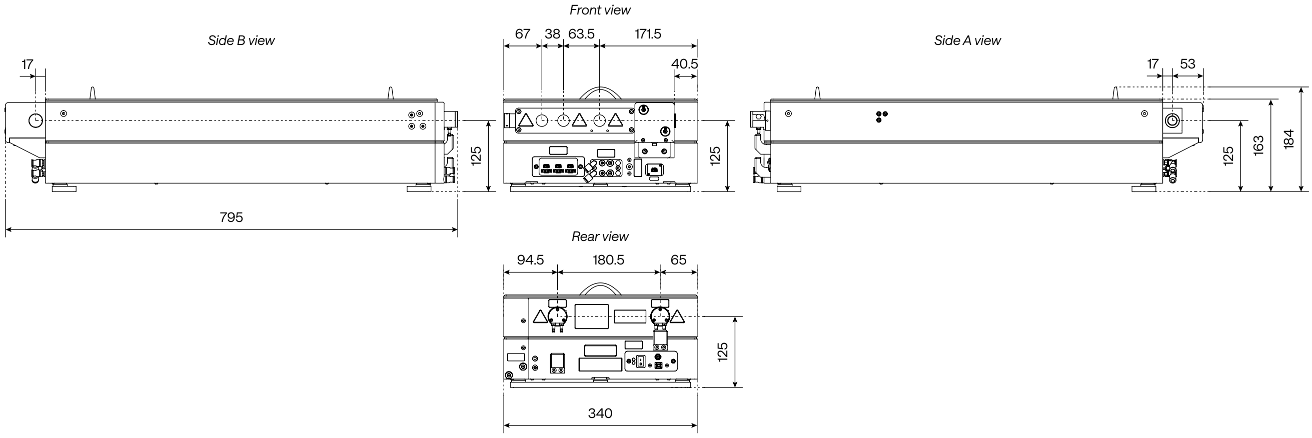
Refer to lightcon.com

1) *Dual output model (-TWINS) available, providing two optically synchronized and simultaneous outputs.*
2) *Long pulse mode is optional, providing 650 – 1010 nm (signal) and 1050 – 2500 nm (idler) range at < 290 fs.*
3) *Pump pulse energy up to 5 mJ applicable, refer to ORPHEUS-HE.*
4) *Specified before pulse compressor. Conversion efficiency at peak is 10% for signal and idler combined.*
5) *After pulse compression. Typical pulse duration before compression: 120 – 250 fs, after compression: 25 – 70 fs @ 650 – 920 nm, 40 – 100 fs @ 1200 – 2000 nm.*
6) *Expressed as normalized root mean squared deviation (NRMSD).*
7) *DUV conversion efficiency is specified for pump power up to 10 W and frequencies up to 200 kHz. In the case of higher pump power, conversion efficiency decreases. The maximum output power is 40 mW at 200 nm.*
8) *For > 15 µJ pump pulse energy.*

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

Drawings

ORPHEUS

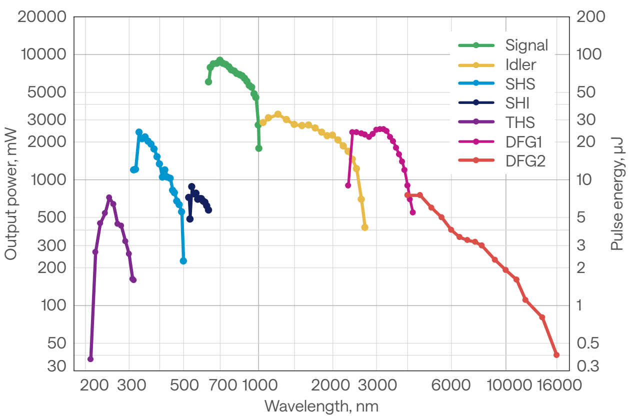


ORPHEUS | NEO

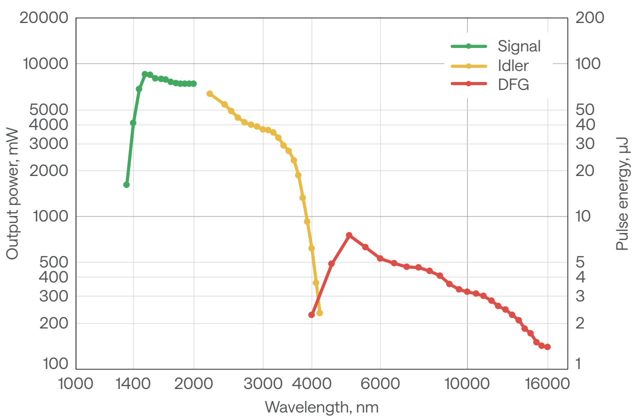
Next-Generation Optical Parametric Amplifier

- Wavelength range from UV to MIR, 210 – 16 000 nm
- Continuous power monitoring and diagnostics
- Pumped by PHAROS-UP for 100 fs pulses
- Supports up to 80 W, 800 μJ pump at 2 MHz
- Fully integrated wavelength extensions

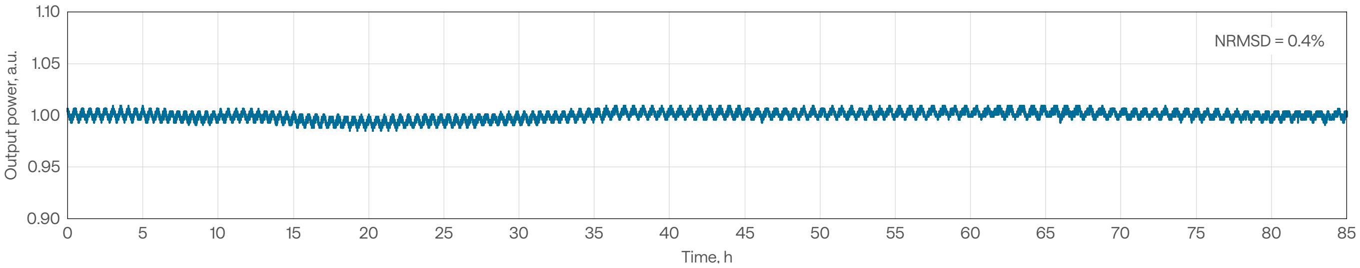
ORPHEUS-NEO typical tuning curves
Pump: 80 W, 800 μJ, 100 kHz



ORPHEUS-NEO-ONE typical tuning curves
Pump: 80 W, 800 μJ, 100 kHz



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



ORPHEUS-NEO specifications

Model	ORPHEUS-NEO	ORPHEUS-NEO-ONE	ORPHEUS-NEO-UP	ORPHEUS-NEO-ONE-UP
Configuration	ORPHEUS	ORPHEUS-ONE	ORPHEUS	ORPHEUS-ONE
Pump laser	CARBIDE or PHAROS		PHAROS-UP	
Pump power	Up to 80 W		Up to 20 W	
Pump pulse energy	20 – 800 µJ		20 – 400 µJ	
Repetition rate	Up to 2 MHz		Up to 1 MHz	
Tuning range	640 – 1000 nm (signal) 1050 – 2600 nm (idler)	1400 – 2000 nm (signal) 2100 – 4200 nm (idler)	640 – 1000 nm (signal) 1050 – 2600 nm (idler)	1450 – 2000 nm (signal) 2100 – 4500 nm (idler)
Conversion efficiency	> 7% @ 700 nm (40 – 800 µJ pump; up to 1 MHz)	> 9% @ 1550 nm (40 – 800 µJ pump; up to 1 MHz)	> 7% @ 700 nm	> 9% @ 1550 nm
	> 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	60 – 220 cm^{-1} @ 700 – 960 nm	50 – 150 cm^{-1} @ 1450 – 2000 nm	120 – 300 cm^{-1} @ 700 – 2600 nm	150 – 300 cm^{-1} @ 1500 – 1900 nm; 2200 – 3500 nm [1]
Pulse duration [2]	120 – 400 fs	100 – 400 fs	< 110 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	< 1.3 @ 800 nm	< 1.3 @ 1550 nm
Beam diameter [3]	2.1 ± 0.9 mm @ 800 nm	2.1 ± 0.9 mm @ 1550 nm	2.1 ± 0.9 mm @ 800 nm	2.1 ± 0.9 mm @ 1550 nm
Beam divergence (full-angle)	< 2 mrad @ 800 nm	< 4 mrad @ 1550 nm	< 2 mrad @ 800 nm	< 4 mrad @ 1550 nm
Long-term power stability, 8 h [4]	< 1% @ 800 nm	< 1% @ 1550 nm	< 1% @ 800 nm	< 1% @ 1550 nm
Pulse-to-pulse energy stability, 1 min [4]	< 1% @ 800 nm	< 1% @ 1550 nm	< 1% @ 800 nm	< 1% @ 1550 nm

WAVELENGTH EXTENSIONS

Conversion efficiency	210 – 320 nm (THS) > 0.4% @ 250 nm	n/a	210 – 320 nm (THS) 0.2% @ 250 nm	n/a
	320 – 500 nm (SHS) and 525 – 640 nm (SHI) > 1.2% @ 350 nm		320 – 500 nm (SHS) and 525 – 640 nm (SHI) 1.2% @ 350 nm	
	n/a	640 – 1000 nm and 1050 – 1350 nm > 1% @ 700 nm	n/a	640 – 1000 nm and 1050 – 1450 nm (VIS-NIR) > 1% @ 700 nm
	2500 – 4200 nm (DFG1) > 3% @ 3000 nm	4000 – 16 000 nm (DFG) [5] > 0.3% @ 10 000 nm (for > 40 µJ pump)	2500 – 4500 nm (DFG1) 3% @ 3000 nm	4500 – 14 000 nm (DFG) [5] 0.2% @ 10 000 nm
	4000 – 16 000 nm (DFG2) [5] > 0.2% @ 10 000 nm		4500 – 14 000 nm (DFG2) [5] 0.1% @ 10 000 nm	

PUMP LASER, ENVIRONMENTAL & UTILITY REQUIREMENTS

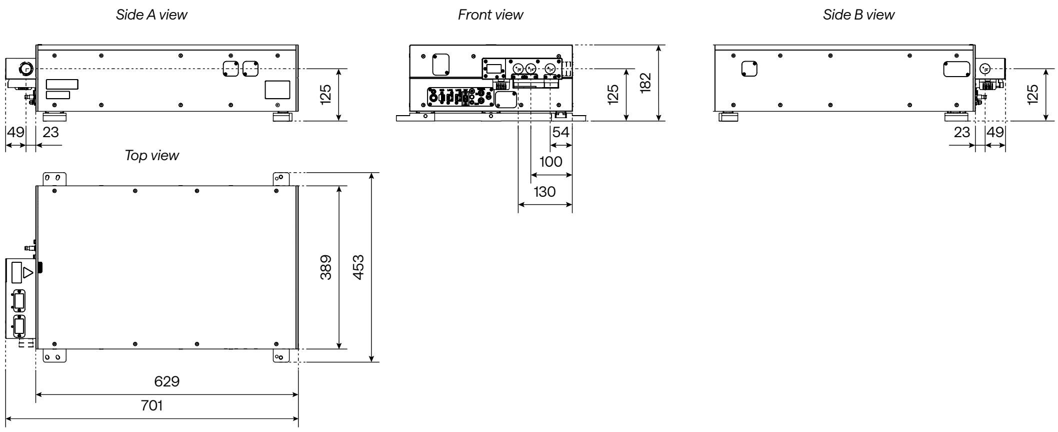
	Refer to lightcon.com

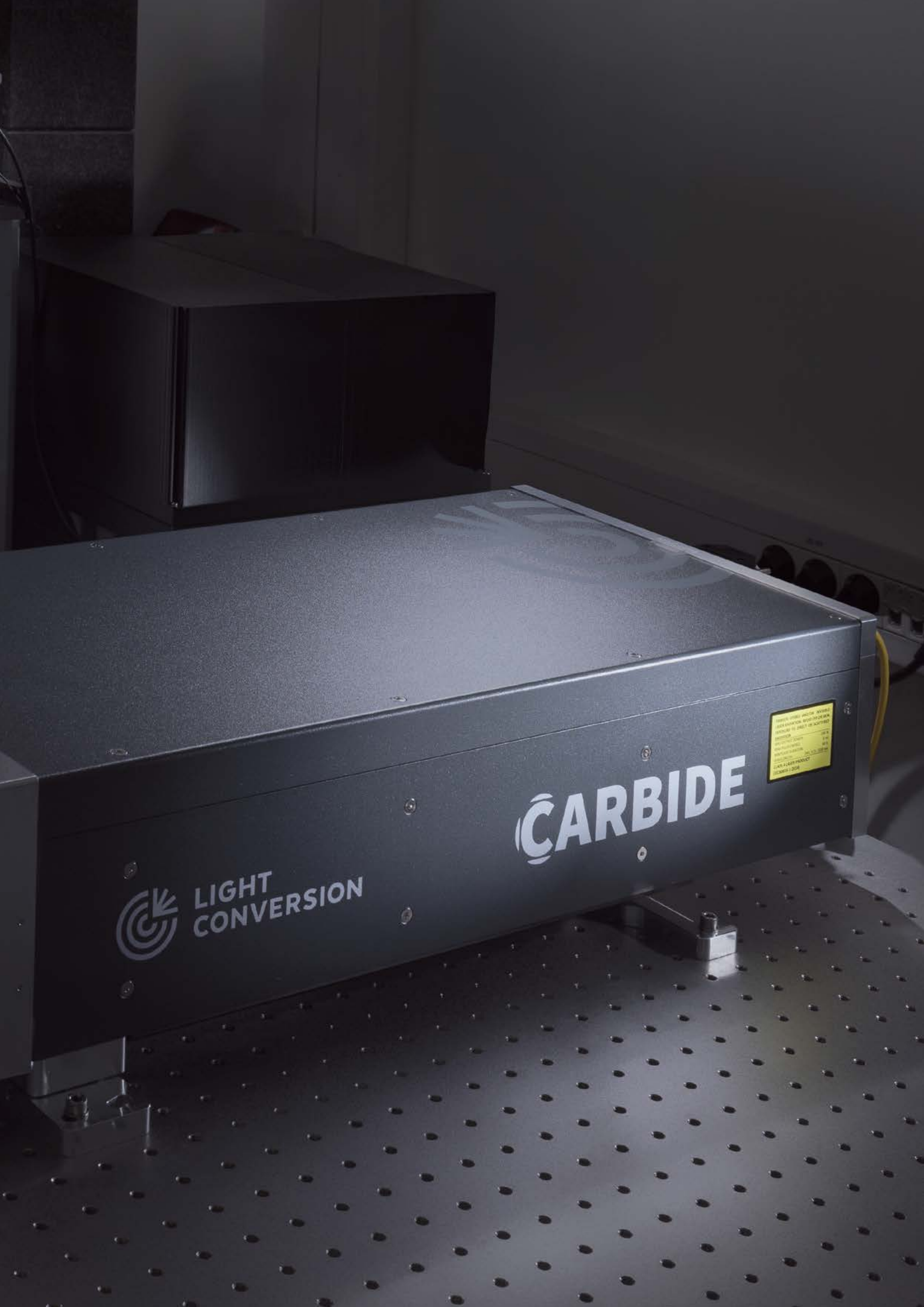
[1] *Spectral bandwidth is equal to 150 – 250 cm^{-1} @ 5000 – 12 000 nm.*
[2] *Output pulse duration depends on the selected wavelength and the pump laser pulse duration.*
[3] *FW 1/e^2, measured at laser output, using maximum pulse energy.*
[4] *Expressed as normalized root mean squared deviation (NRMSD).*
[5] *Pre-installed output window limits the tuning range to 12 µm. The window is used for dust protection and output power diagnostics, but it can be removed to access the full wavelength range.*

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

Drawings

ORPHEUS-NEO / ORPHEUS-NEO-UP




CARBIDE
LIGHT CONVERSION

Femtosecond Lasers

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

Market-proven industrial-grade stability and reliability

Automated harmonics and wavelength-tunable extensions

CARBIDE

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

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.

FLINT

Expanding the parameter range with repetition rates from 10 to 90 MHz, output power up to 20 W, and pulse durations down to 50 fs.

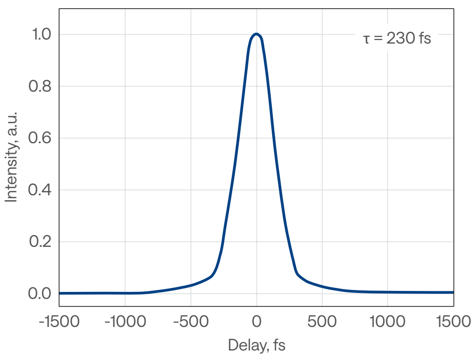
CARBIDE

Industrial Femtosecond Lasers

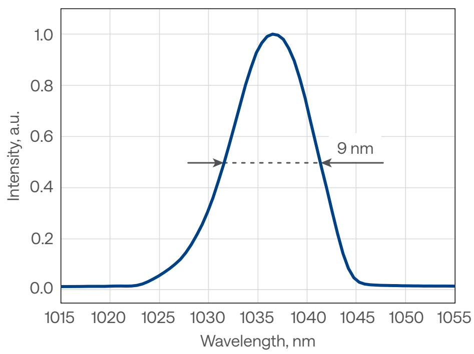
- Maximum output of 120 W (IR) or 50 W (UV)
- NEW Single-shot – 10 MHz repetition rate
- Pulse-on-demand and BiBurst for pulse control
- Automated harmonics up to the 5th and wavelength-tunable extensions
- Air-cooled or water-cooled models

CARBIDE-CB3

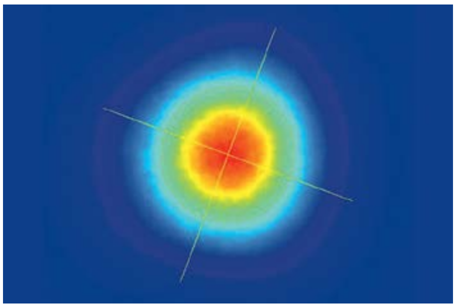
CARBIDE-CB3
Typical pulse duration



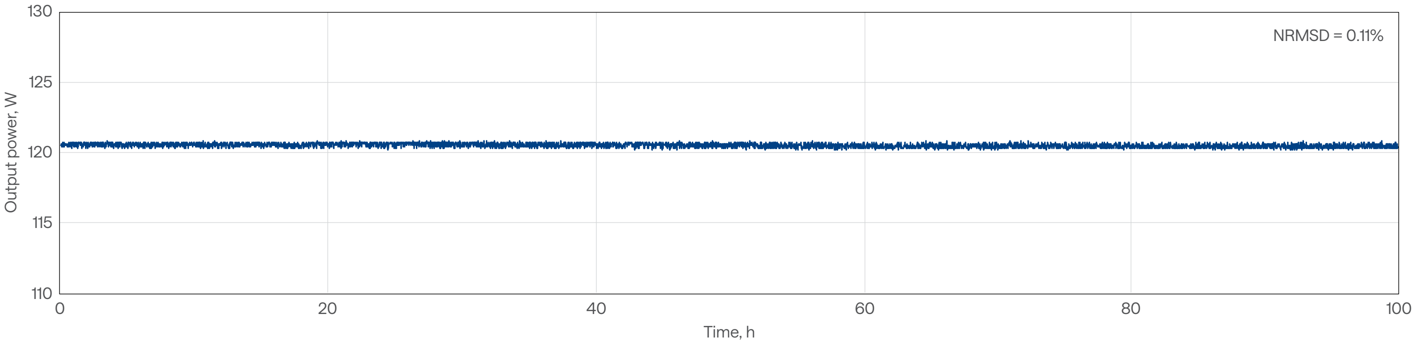
CARBIDE-CB3
Typical spectrum



CARBIDE-CB3
Typical beam profile



CARBIDE-CB3-120W
Long-term power stability



NEW

Model	CB3-20W	CB3-40W	CB3-40W-10MHz	CB3-80W		CB3-120W
OUTPUT CHARACTERISTICS						
Cooling method	Water-cooled					
Center wavelength	1030 ± 10 nm					
Maximum output power	20 W	40 W		80 W		120 W
Pulse duration [1]	< 250 fs				< 350 fs [2]	< 250 fs
Pulse duration tuning range	250 fs – 10 ps				350 fs – 10 ps	250 fs – 10 ps
Maximum pulse energy	0.4 mJ		0.2 mJ	0.8 mJ	2 mJ	1 mJ
Repetition rate	Single-shot – 1 MHz	Single-shot – 1 MHz (2 MHz on request)	Single-shot – 10 MHz	Single-shot – 2 MHz		
Pulse selection	Single-shot, pulse-on-demand, any fundamental repetition rate division					
Polarization	Linear, vertical; 1 : 1000					
Beam quality, M^2	< 1.2					
Beam diameter [3]	3.9 ± 0.4 mm			4.2 ± 0.4 mm	5.1 ± 0.7 mm	5 ± 0.5 mm
Beam pointing stability	< 20 µrad/°C					
Pulse energy control	FEC [4]		Attenuator [5]	FEC [4]		
Pulse picker leakage	< 0.25%		< 0.5%	< 0.25%		
Pulse-to-pulse energy stability, 12 h [6]	< 0.5%					
Long-term power stability, 100 h [6]	< 0.5%					
MAIN OPTIONS						
Oscillator output [7]	< 0.5 W, 120 – 250 fs, 1030 ± 10 nm, ≈ 65 MHz					
Harmonic generator [8]	515 nm, 343 nm, 257 nm, or 206 nm; refer to CARBIDE HG					
Optical parametric amplifier [9]	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 x 449 x 88 mm

ENVIRONMENTAL & UTILITY REQUIREMENTS

		CB3-20W	CB3-40W	CB3-40W-10MHz	CB3-80W	CB3-120W
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	1000 W		1000 W		2000 W
	Chiller	1400 W		2000 W		
Power consumption	Laser	500 W		900 W		1500 W
	Chiller	1000 W		1300 W		1800 W

1) *Assuming a Gaussian pulse shape.*
2) *Pulse duration can be reduced to < 250 fs if a pulse peak intensity of > 50 GW/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. An optional integrated waveplate-based variable optical attenuator is available.*
5) *Waveplate-based variable optical attenuator (VOA); an external analog control input is available. FEC is available for repetition rates up to 2 MHz.*
6) *Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).*
7) *Available simultaneously, requires a scientific interface. Contact sales@lightcon.com for more details or customized solutions.*
8) *Integrated. For an external harmonic generator, refer to HIRO.*
9) *Integrated. For more details and stand-alone OPAs, refer to wavelength-tunable sources.*

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

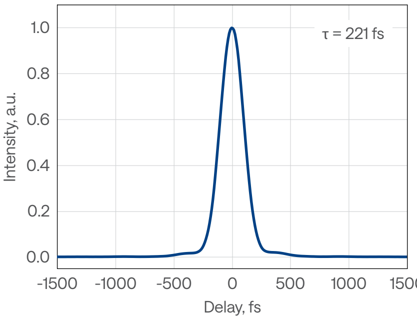
CARBIDE-CB5 specifications

Model	CB5-6W	CB5-5W	CB5-SP
OUTPUT CHARACTERISTICS			
Cooling method	Air-cooled [1]		
Center wavelength	1030 ± 10 nm		
Maximum output power	6 W	5 W	
Pulse duration [2]	< 290 fs		< 190 fs
Pulse duration tuning range	290 fs – 20 ps		190 fs – 20 ps
Maximum pulse energy	100 µJ	83 µJ	100 µJ
Repetition rate	Single-shot – 1 MHz		
Pulse selection	Single-shot, pulse-on-demand, any fundamental repetition rate division		
Polarization	Linear, vertical; 1 : 1000		
Beam quality, M^2	< 1.2		
Beam diameter [3]	2.1 ± 0.4 mm		
Beam pointing stability	< 20 µrad/°C		
Pulse energy control	Attenuator [4]	AOM [5]	Attenuator [4]
Pulse picker leakage	< 2%	< 0.1 %	< 2%
Pulse-to-pulse energy stability, 12 h [6]	< 0.5%		
Long-term power stability, 100 h [6]	< 0.5%		
MAIN OPTIONS			
Oscillator output	n/a		
Harmonic generator [7]	515 nm, 343 nm, 257 nm, or 206 nm; refer to CARBIDE HG		
Optical parametric amplifier [8]	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		

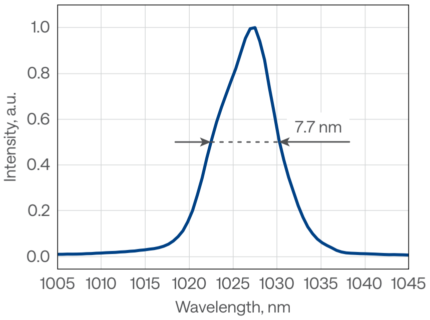
[1] *Water-cooled version available on request.*
[2] *Assuming a Gaussian pulse shape.*
[3] *FW 1/e², using maximum pulse energy.*
[4] *Waveplate-based variable optical attenuator (VOA); an external analog control input is available.*
[5] *Enhanced contrast AOM. Provides fast, full-scale individual pulse energy control; an external analog control input is available.*
[6] *Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).*
[7] *Integrated. For an external harmonic generator, refer to HIRO.*
[8] *Integrated. For more details and stand-alone OPAs, refer to wavelength-tunable sources.*

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

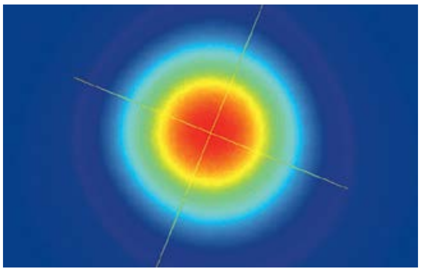
CARBIDE-CB5
Typical pulse duration



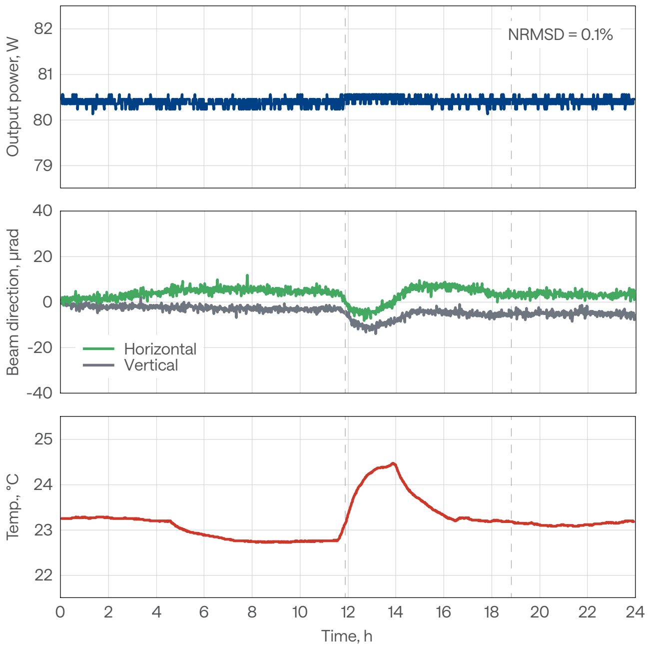
CARBIDE-CB5
Typical spectrum



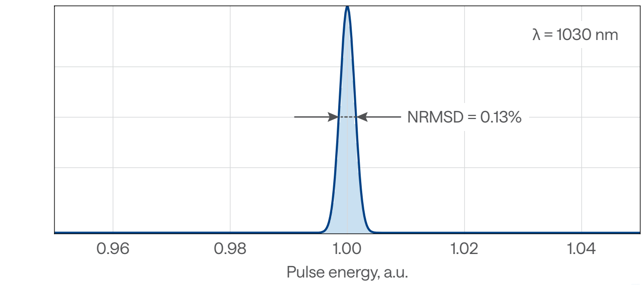
CARBIDE-CB5
Typical beam profile



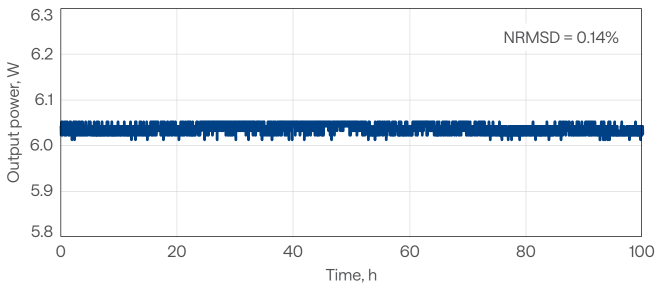
CARBIDE-CB3 output power and beam direction stability with power lock enabled, across varying environmental conditions



CARBIDE-CB3
Typical pulse-to-pulse energy stability

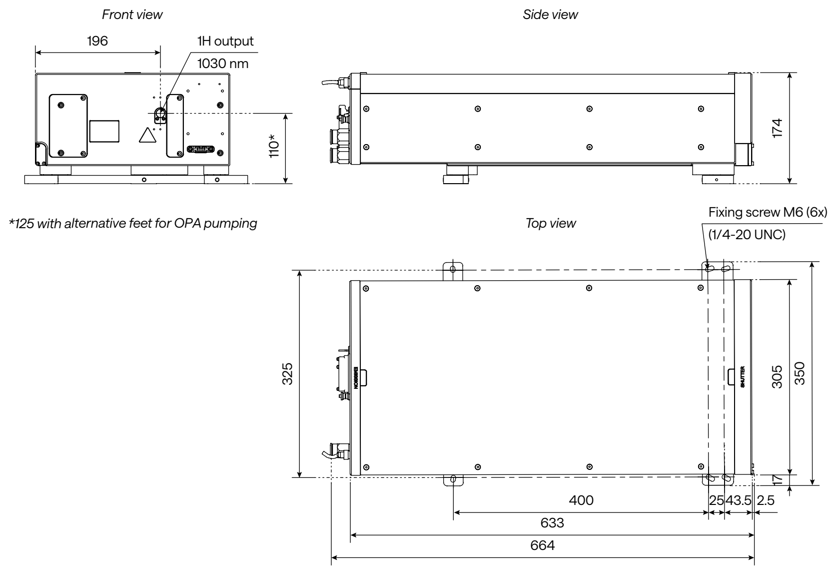


CARBIDE-CB5-6W
Long-term power stability

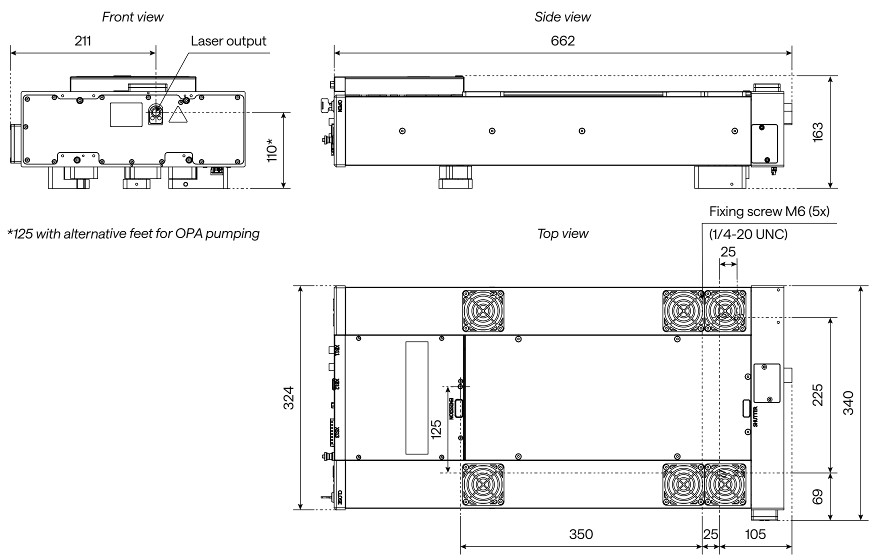


Drawings

CARBIDE-CB3



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



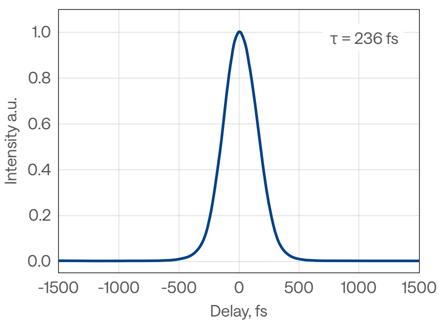
The drawings depend on the exact configuration. If crucial for integration, please contact sales@lightcon.com.

PHAROS

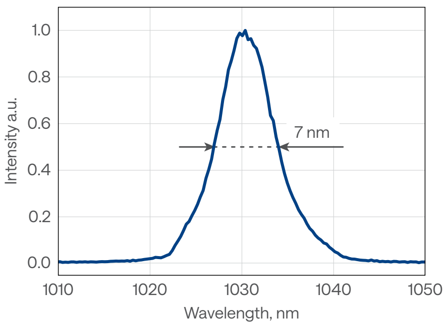
High-Energy Femtosecond Lasers

- 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 5th and wavelength-tunable extensions

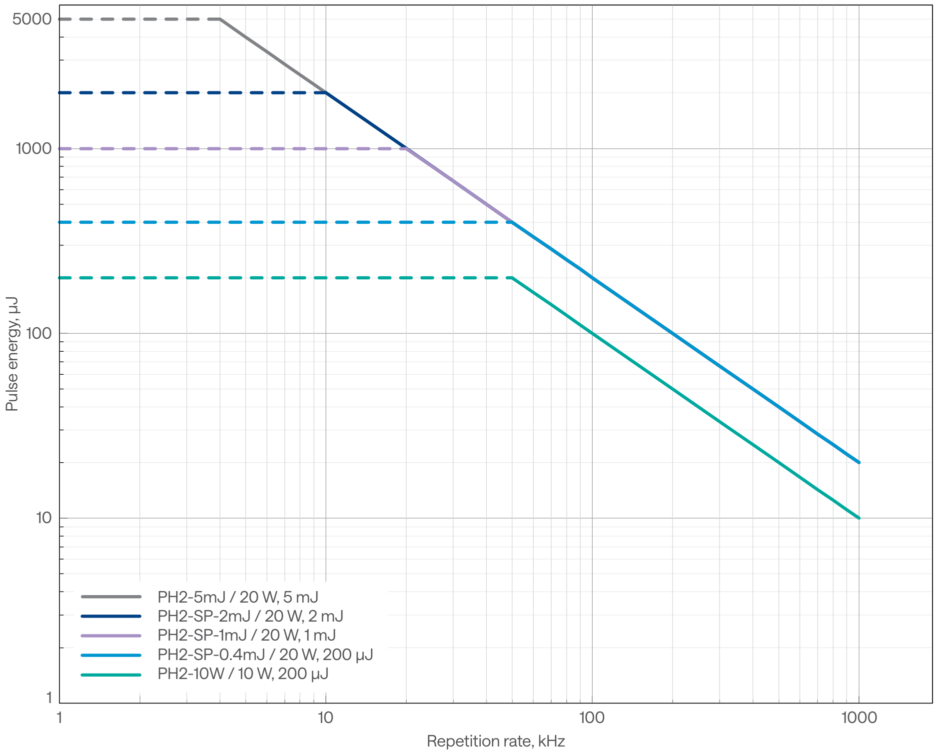
PHAROS-PH2-5mJ
Typical pulse duration



PHAROS-PH2-5mJ
Typical spectrum



PHAROS
Pulse energy vs fundamental repetition rate



Specifications

Model	PH2-10W	PH2-SP			PH2-5mJ (NEW)	PH2-UP	
OUTPUT CHARACTERISTICS							
Center wavelength [1]	1030 ± 10 nm						
Maximum output power	10 W	20 W					
Pulse duration [2]	< 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^2	< 1.2		< 1.3			< 1.2	
Beam diameter [3]	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 [4]	< 0.5%						
Long-term power stability, 100 h [4]	< 0.5%						
MAIN OPTIONS							
Oscillator output [5]	1 – 7 W, 50 – 250 fs, ≈ 1035 nm, ≈ 76 MHz						
Harmonic generator [6]	515 nm, 343 nm, 257 nm, or 206 nm; refer to PHAROS HG or HIRO						
Optical parametric amplifier [7]	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) [8]	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) [8]	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 a Gaussian pulse shape.*

[3] *FW 1/e², measured at laser output, using maximum pulse energy.*

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

[5] *Available simultaneously. Contact sales@lightcon.com for more details or customized solutions.*

[6] *Integrated except for PH2-5mJ. For an external harmonic generator, refer to HIRO.*

[7] *Integrated except for PH2-5mJ. For more options and OPAs for -5mJ and -UP models, refer to the ORPHEUS series of OPAs.*

[8] *Dimensions depend on the laser configuration and integrated options.*

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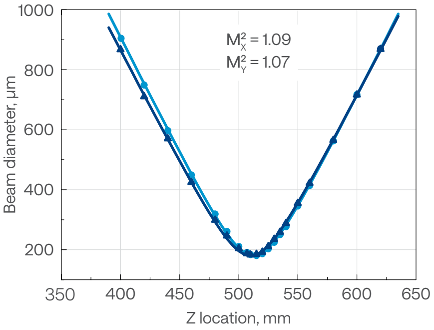
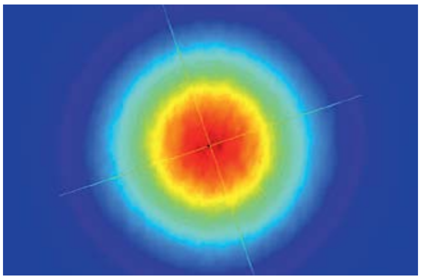
CLASS 4 LASER PRODUCT

Beam properties

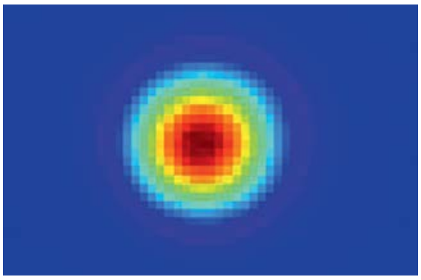
PHAROS
Typical M² measurement data



PHAROS
Typical near-field beam profile

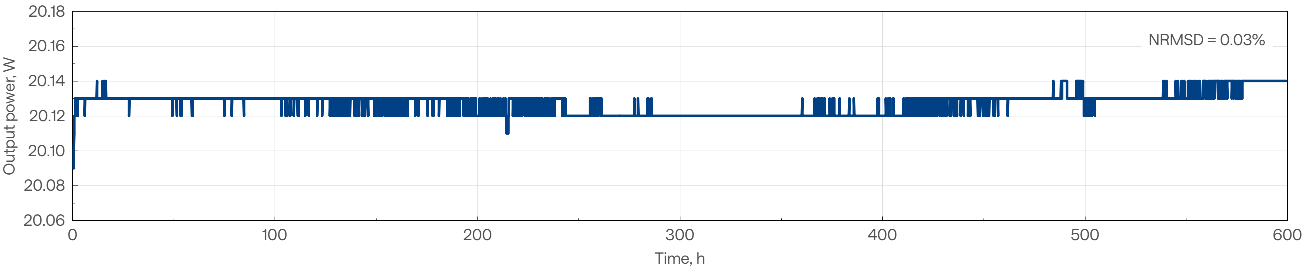


PHAROS
Typical far-field beam profile

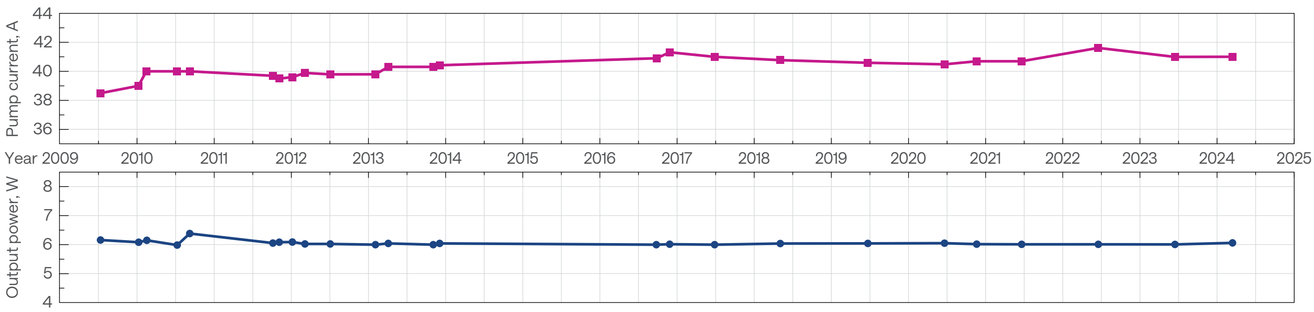


Stability measurements

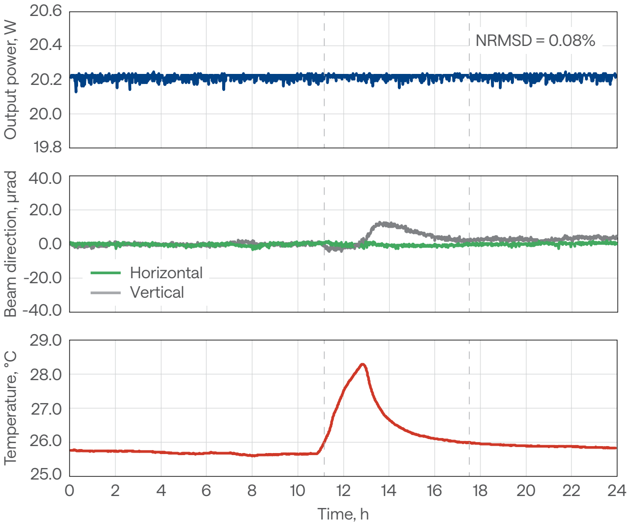
PHAROS
Long-term power stability



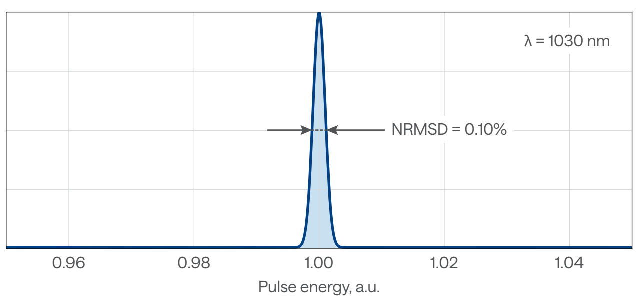
Output power of industrial-grade **PHAROS** lasers operating 24/7 and the current of the pump diodes over the years



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



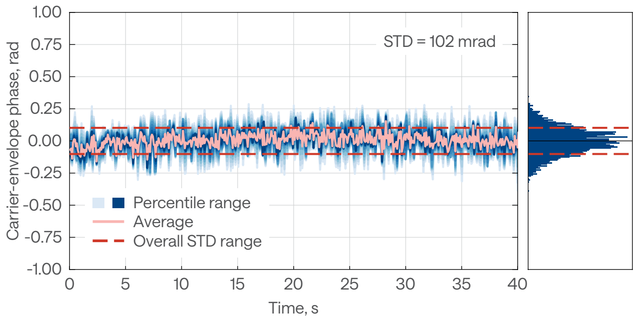
PHAROS
Typical pulse-to-pulse energy stability



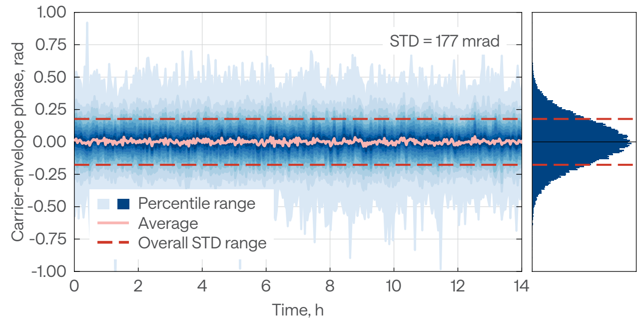
CEP stabilization

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 1/4th 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

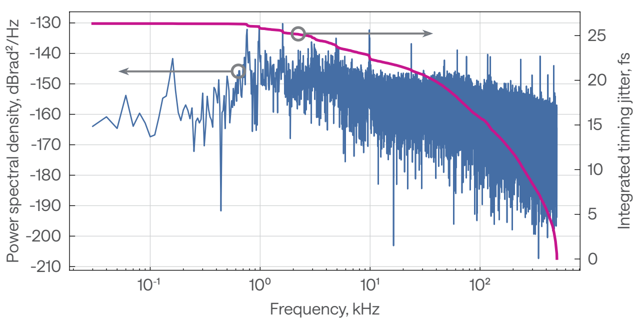


Repetition rate locking

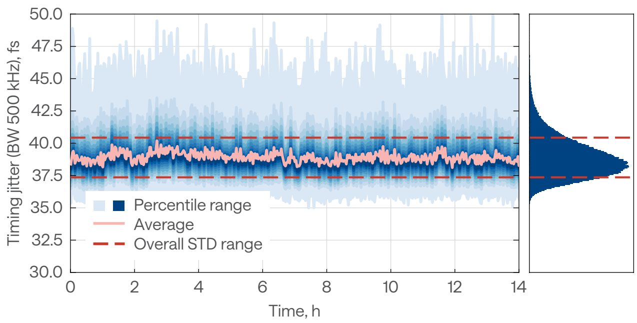
The oscillators in **PHAROS** lasers can be customized for repetition rate locking applications. Coupled with the necessary feedback electronics, the oscillator's repetition rate can be synchronized to an external RF source using the two piezo stages installed within the cavity.

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

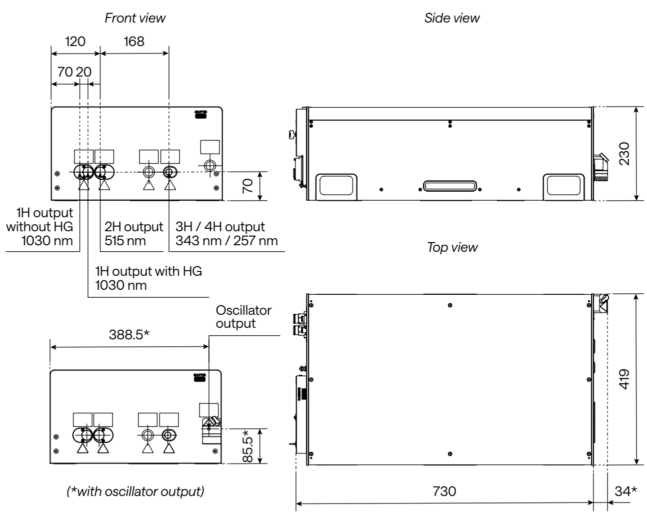


Timing jitter stability over 14 h
PHAROS oscillator locked to a 2.8 GHz RF source

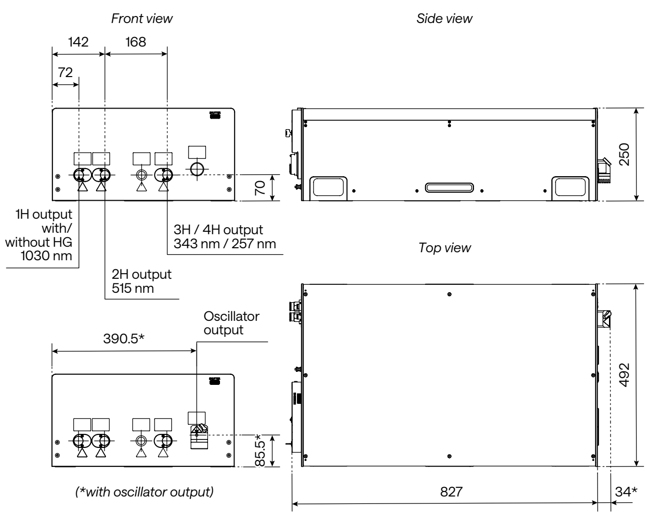


Drawings

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.

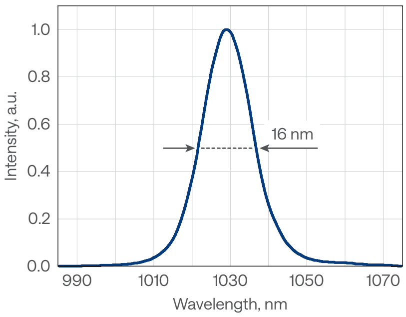
FLINT

High-Repetition-Rate Femtosecond Lasers

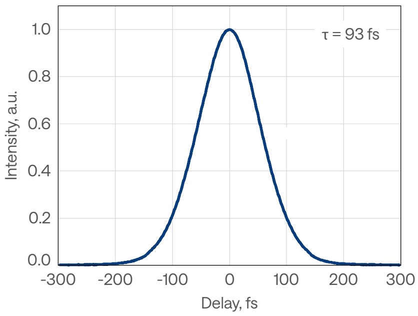
- High-power models, up to 20 W
- High-energy models, up to 0.5 μJ
- 10 – 90 MHz repetition rate
- Down to 50 fs pulse duration
- CEP stabilization or repetition rate locking

FLINT-FL1

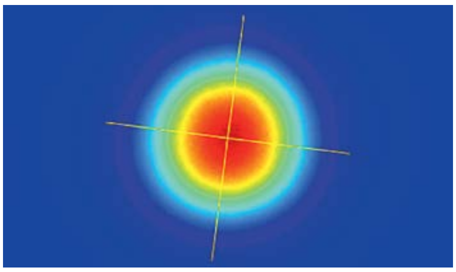
FLINT-FL1
Typical spectrum



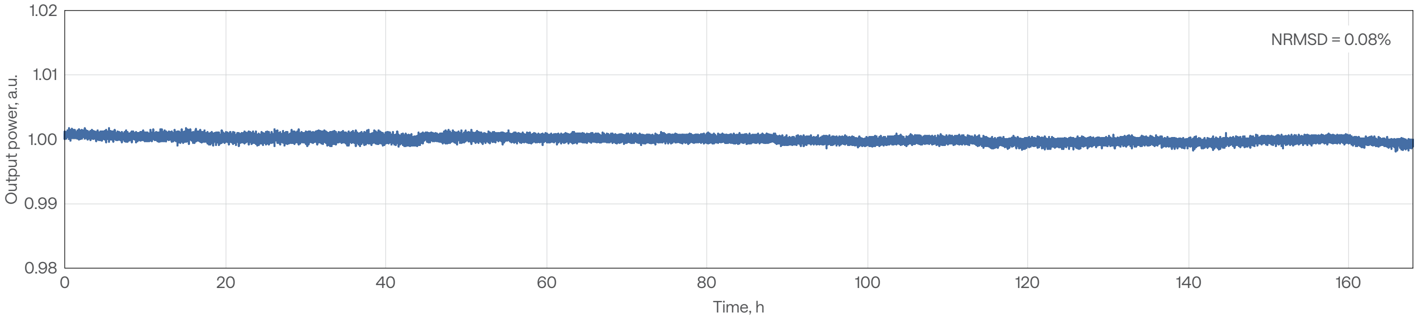
FLINT-FL1
Typical pulse duration



FLINT-FL1
Typical beam profile



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



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 – 90 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] refer to FLINT HG		
External 2H, 3H, or 4H generator	Optional; refer to HIRO						
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 & 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).*

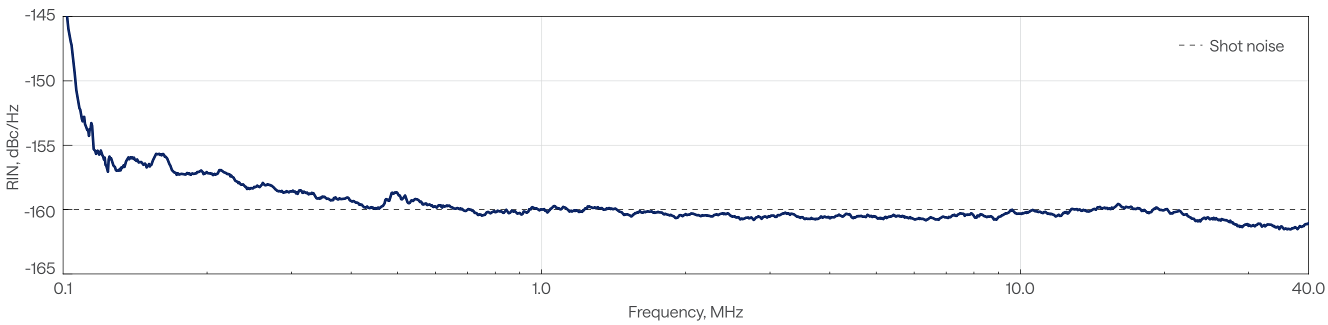
5) *For external 2H, or even 3H and 4H generation, refer to HIRO for FLINT.*

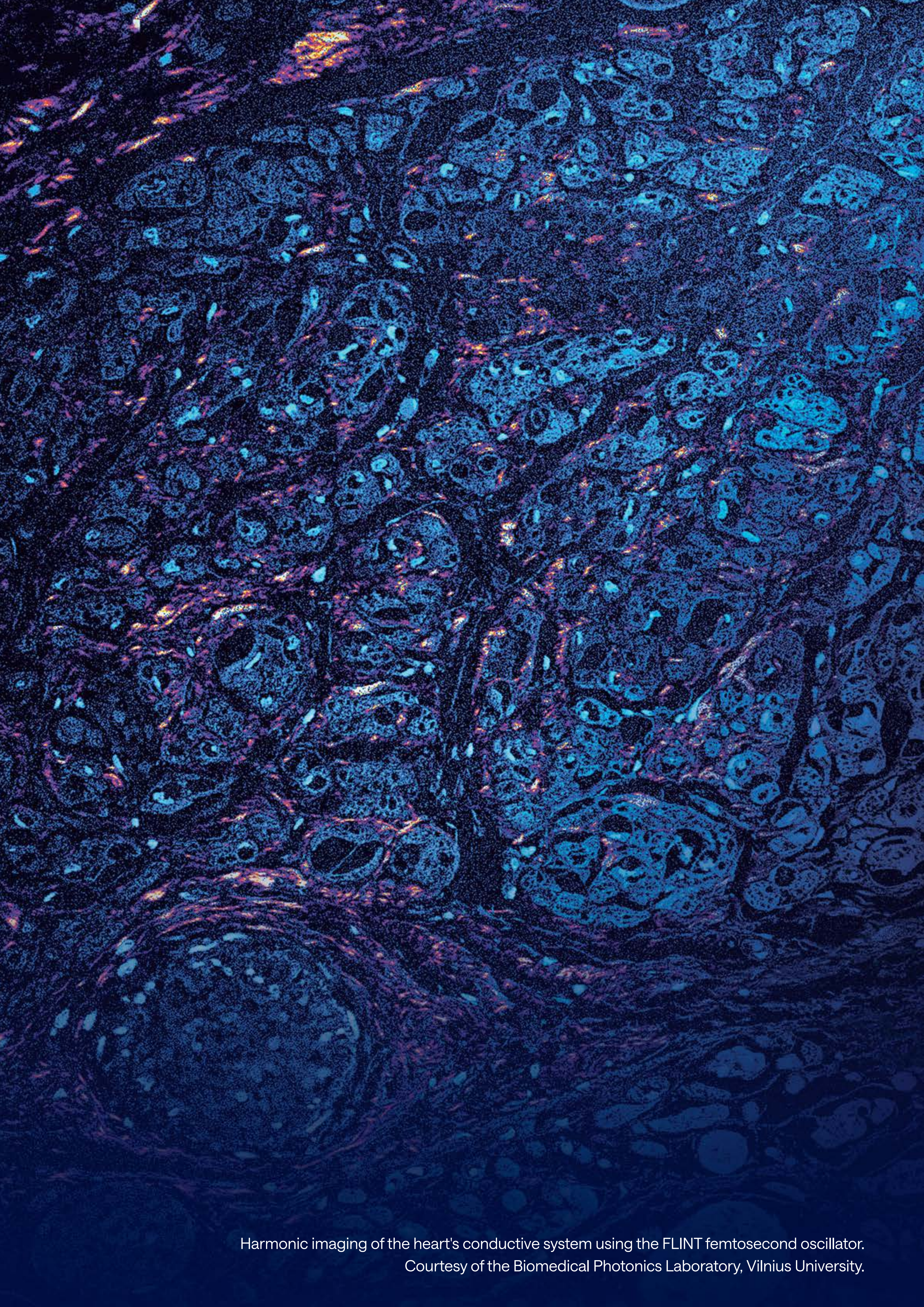
6) *Conversion efficiency specified at maximum power.*

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

CLASS 4 LASER PRODUCT

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





Harmonic imaging of the heart's conductive system using the FLINT femtosecond oscillator.
Courtesy of the Biomedical Photonics Laboratory, Vilnius University.

Nonlinear Microscopy Applications

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

In vivo three-photon imaging

Label-Free In Vivo Imaging

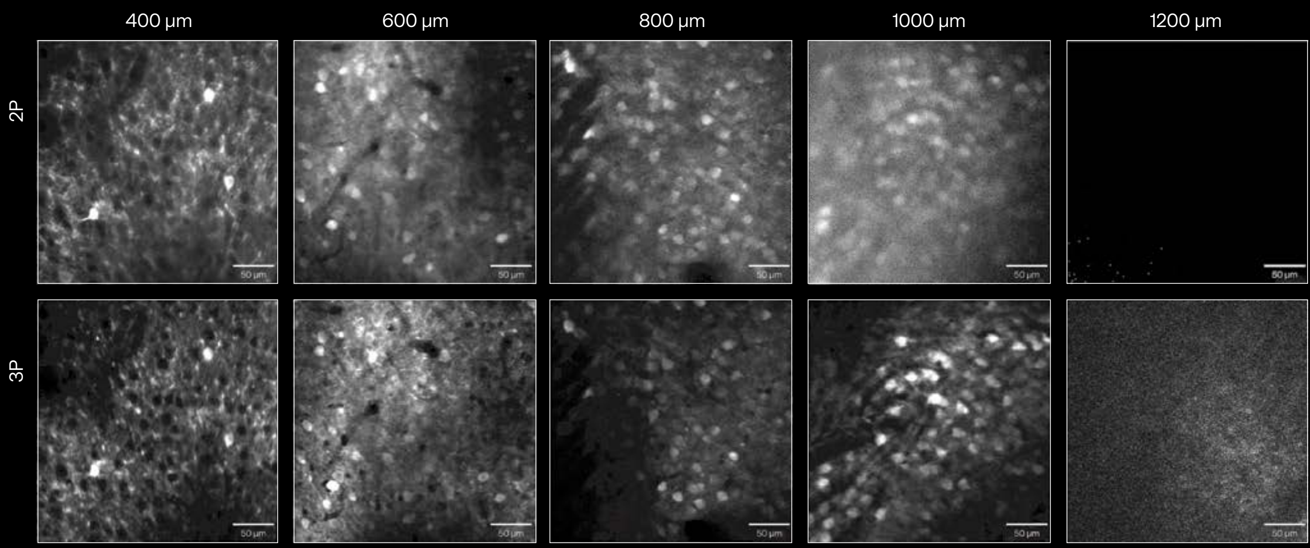
Nonlinear Histopathology

Nonlinear Microscopy

In vivo three-photon imaging

Recording real-time single-neuron activity in deep brain layers of awake animals is crucial for understanding behavior, brain connectivity, and function. These applications have been advanced by neuron imaging and stimulation using high-power, high-pulse-energy, medium-repetition-rate lasers tunable in the SWIR range, which includes the biological transparency windows at 1.3 µm and 1.7 µm. Three-photon microscopy has been shown to provide higher image contrast at greater depths. **CRONUS-2P, CRONUS-3P,** and **ORPHEUS** OPA are state-of-the-art choices for two- and three-photon-excited fluorescence (2PEF, 3PEF) and harmonic-generation (SHG, THG) imaging in deep tissues.

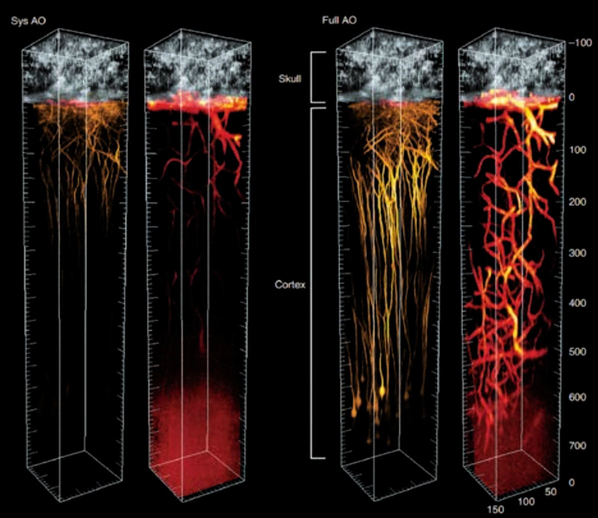
2P and 3P calcium imaging at depth in the mouse brain



Comparison of in vivo 2P and 3P calcium imaging of mouse visual cortex GCaMP neurons on a Thorlabs Bergamo II microscope using a typical 2P laser and Light Conversion's **CRONUS-3P** laser at 920 nm and 1300 nm, respectively.

Courtesy of CSHL ISFNS 2024 school organizers, Willis Broden Jr. and Sergey Matveev (Thorlabs).

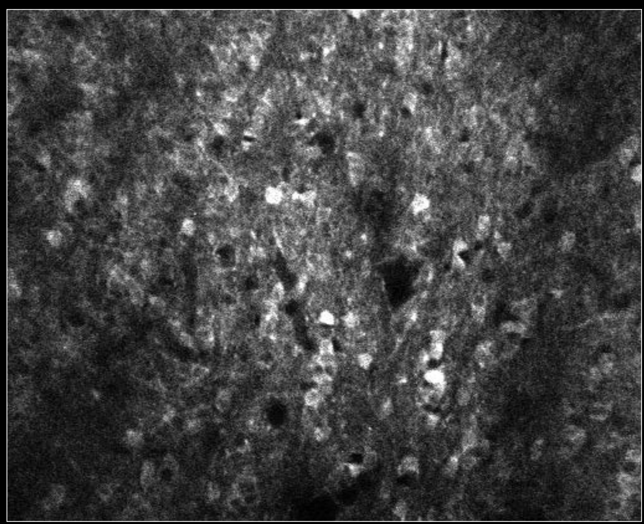
3P AO brain imaging through the intact skull



ORPHEUS-F excitation at 1300 nm enabled imaging up to 1.1 mm below the pia within the intact brain.

Courtesy of Jianan Y. Qu group, the Hong Kong University of Science and Technology. Source: Zh. Qin et al., Deep tissue multi-photon imaging using adaptive optics with direct focus sensing and shaping, Nature Biotechnology 40 (2022).

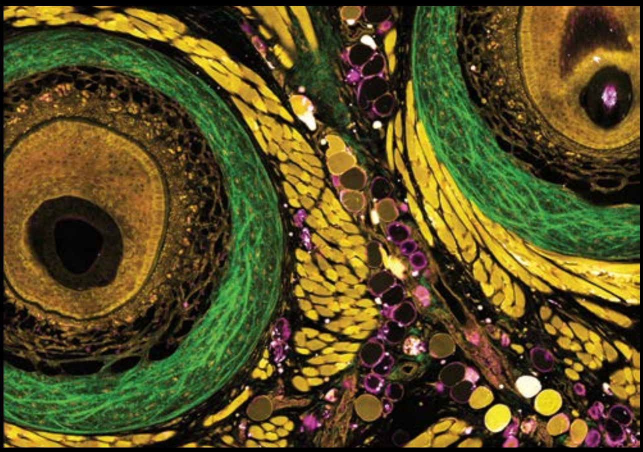
3P anatomical imaging of the mouse olfactory bulb



Mouse olfactory bulb with inhibitory cells labelled with GCaMP8s. Anatomical Z-stack imaged in 3P at 620 µm.

Courtesy of Fred Marbach, Andreas Schaefer lab, The Francis Crick Institute.

Label-Free In Vivo Imaging

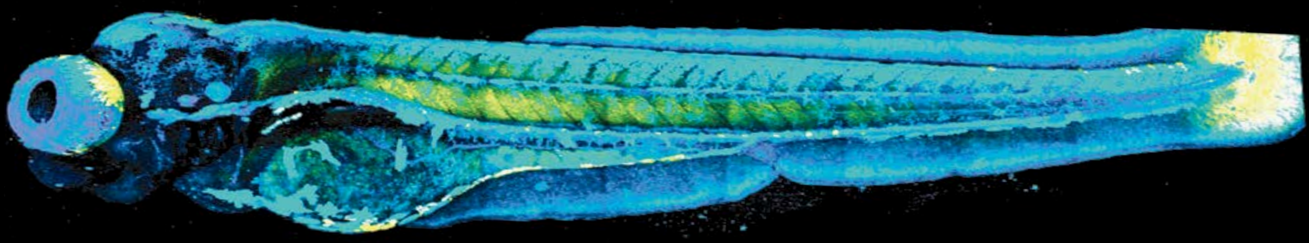


Understanding biological complexity requires minimally invasive imaging tools capable of providing multiplexed molecular contrasts. To address this need, S. You's laboratory at the Massachusetts Institute of Technology is developing a non-invasive, label-free microscopy approach using **CRONUS-3P** to visualize biosystems.

As part of a study on neuropathic pain, the image reveals the rich microenvironment of an unprocessed, intact mouse whisker pad: collagen capsule (green), comprising the follicle with muscles (yellow) supporting it, adipocytes (purple), stromal cells, and immune cells.

Courtesy of Sixian You group, Massachusetts Institute of Technology.

Multimodal 3D in vivo imaging of zebrafish



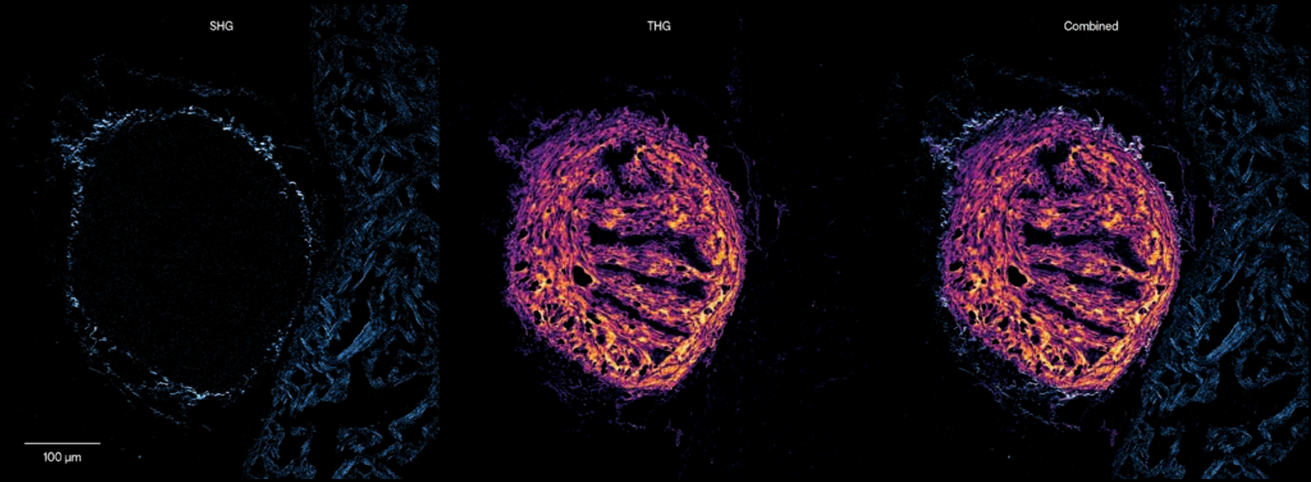
Multimodal 3D label-free imaging of a live 4dpf zebrafish embryo. The embryo was healthy after imaging.
3PF: green, SHG transmission: yellow, THG epi: dark blue, THG transmission: cyan.
Excitation: 1300 nm, XY pixel size: 0.39 µm/px, Z stack: 522 µm range, 1 µm step, Mosaic: 11 x 2 of 400 x 400 µm tiles, Total imaging time: 12 h.

Courtesy of Luigi Bonacina group, University of Geneva.

Combined SHG and THG imaging

Adult zebrafish heart ventricle section from a scar formation study. The brightfield image is stained with Masson's trichrome (MT), connective tissue is blue, muscle is red/brown.

SHG and THG images reveal collagen and muscle structure at the periphery of bulbus arteriosus, while MT-stained elastin is visualized in the center in THG.



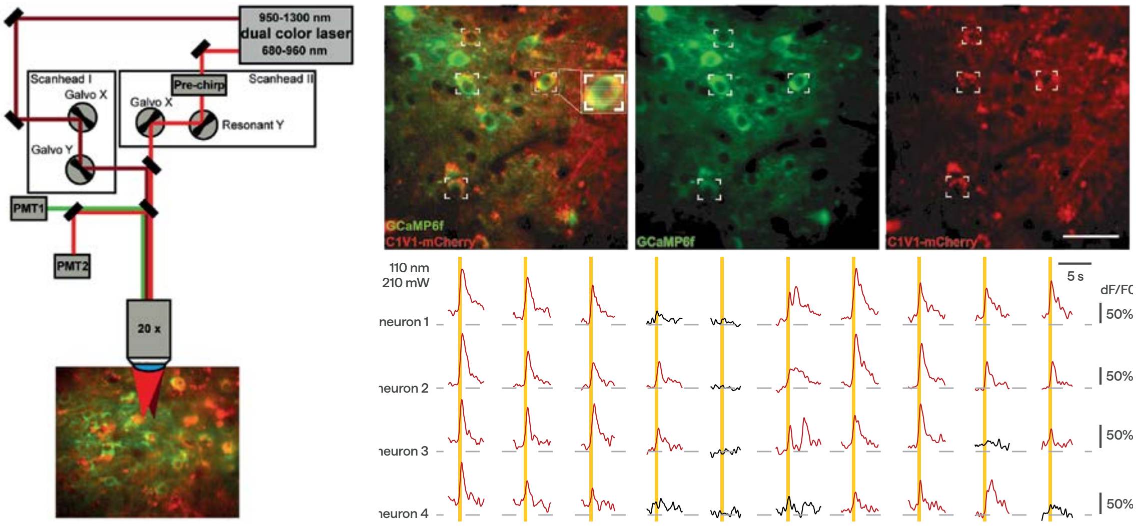
Adult zebrafish heart ventricle section imaged using the **FLINT** femtosecond oscillator.

Samples courtesy of Justas Lazutka, Vilnius University Life Sciences Center.
Imaging courtesy of Virginijus Barzda group, Vilnius University Faculty of Physics.

All-optical physiology

Despite the ability of 3-photon imaging to provide high-contrast within deep tissue, many experimental questions are still better addressed with 2-photon imaging – particularly when video-rate acquisition is required. For these applications, the **CRONUS-2P** laser offers the ultimate solution, featuring three optically synchronized outputs, two of which are independently tunable. This three-beam source enables a wide range of multiphoton excitation pathways, many of which are inaccessible with traditional single- or dual-beam solutions.

For experiments that require simultaneous activation of large numbers of cells, the **CARBIDE** laser remains a proven, high-performance choice for demanding two-photon optogenetics.

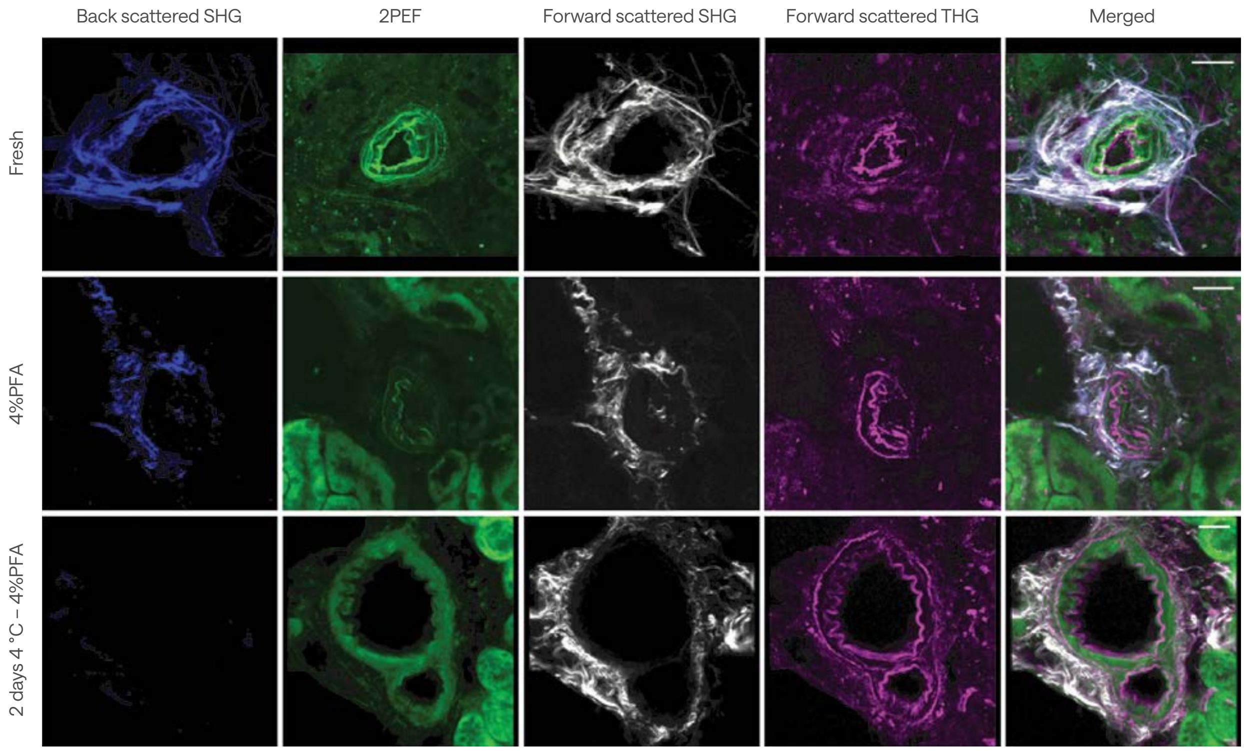


2P optogenetic stimulation of individual neurons using **CRONUS-2P.**

Courtesy of Albrecht Stroh group, University Medical Center Mainz and Leibniz Institute for Resilience Research. Source: T. Fu et al., Exploring two-photon optogenetics beyond 1100 nm for specific and effective all-optical physiology, iScience 24 (2021).

SHG, THG, and 2P imaging

Fixation methods, such as formalin, are commonly used to preserve tissue and keep its structure as close as possible to the native condition. However, fixatives chemically interact with tissue molecules and may modify their structure. Taking advantage of the SHG and THG emission capabilities of such components, nonlinear 2P microscopy and the **CRONUS-2P** femtosecond laser were used to evaluate the effect that preservation methods, such as chemical fixatives, have on the nonlinear capabilities of protein components within mouse tissues.



SHG signals from collagen, 2PEF and THG signals from elastin in vibratome sections of mouse kidney after different treatments, acquired using the **CRONUS-2P** femtosecond laser source.

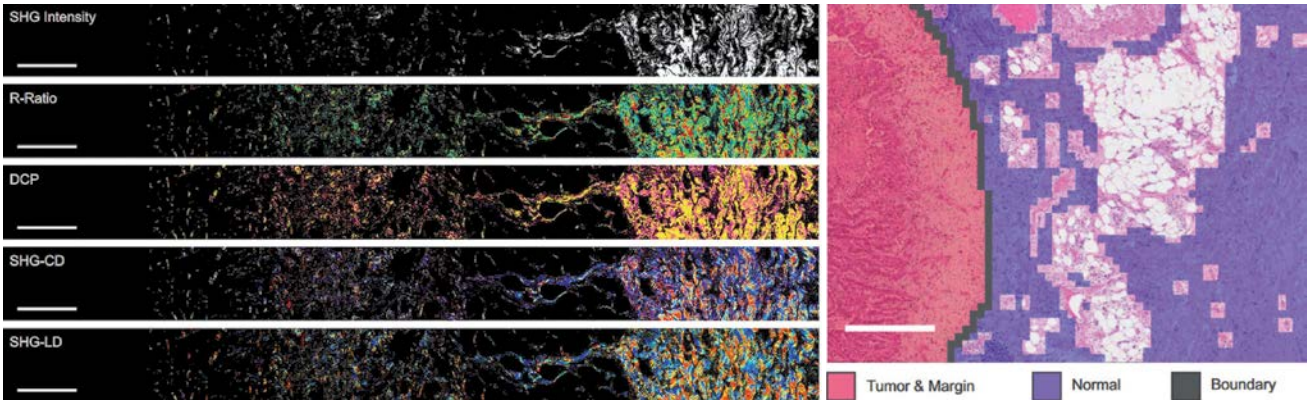
Courtesy of Frauke Alves and Fernanda Ramos-Gomes, Max-Planck Institute for Multidisciplinary Sciences, Germany.

Nonlinear Histopathology

Widefield polarimetric SHG microscopy

Cancer diagnosis and surgical treatment rely on imaging techniques that demand specificity and high throughput. Polarization-resolved second-harmonic generation (P-SHG) microscopy shows potential for visualizing structural changes in collagen networks and the extracellular matrix associated with tumor development. Moreover, P-SHG imaging is label-free and compatible with live tissue imaging at depth. However, traditional raster scanning methods are too slow for clinical applications, and interpreting the structural sensitivity of P-SHG can be challenging.

Nonlinear widefield microscopy addresses these limitations by utilizing amplified femtosecond lasers to increase imaging throughput and field of view. Additionally, machine learning (ML) techniques enable data-driven analysis, facilitating tasks such as automating tumor margin delineation and scoring. By leveraging **CARBIDE** and **PHAROS** lasers in conjunction with ML-augmented widefield microscopy, we can potentially extend the benefits of nonlinear microscopy to the scale required for biomedical and clinical applications.

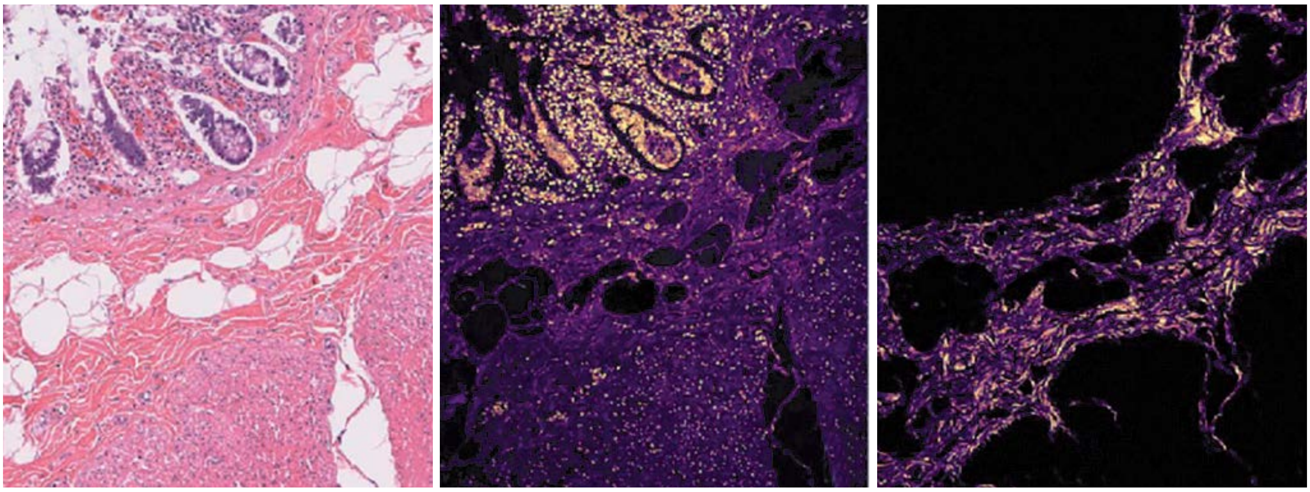


Large-area widefield P-SHG microscopy of human lung tissue tumor margins conducted using the **PHAROS** laser. Image parameters, including SHG intensity, R-ratio, and degree of circular polarization, as well as SHG circular and linear dichroism, are employed in unsupervised ML algorithms to determine the tumor boundary.

Courtesy of Virginijus Barzda group, University of Toronto, and Brian C. Wilson group, Princess Margaret Cancer Centre. Source: Mirsanaye et al., Unsupervised determination of lung tumor margin with widefield polarimetric second-harmonic generation microscopy, Scientific Reports 12 (2022).

Raster-scanning SHG/THG microscopy

For applications requiring a fixed-wavelength femtosecond laser, such as multiphoton-driven fluorescence, excited at 1 µm, and harmonic-generation (SHG, THG) microscopy, the **FLINT** oscillator is a high-performance solid-state source in a proven, industrial-grade package and a compact footprint, providing a stable 24/7 operation with excellent noise performance.



SHG and THG images of H&E-stained colon using the **FLINT** femtosecond oscillator.

Courtesy of Virginijus Barzda group, Vilnius University.

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