# Wavelength-Tunable Sources

LIGHT CONVERSION

Product Catalog

lightcon.com

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

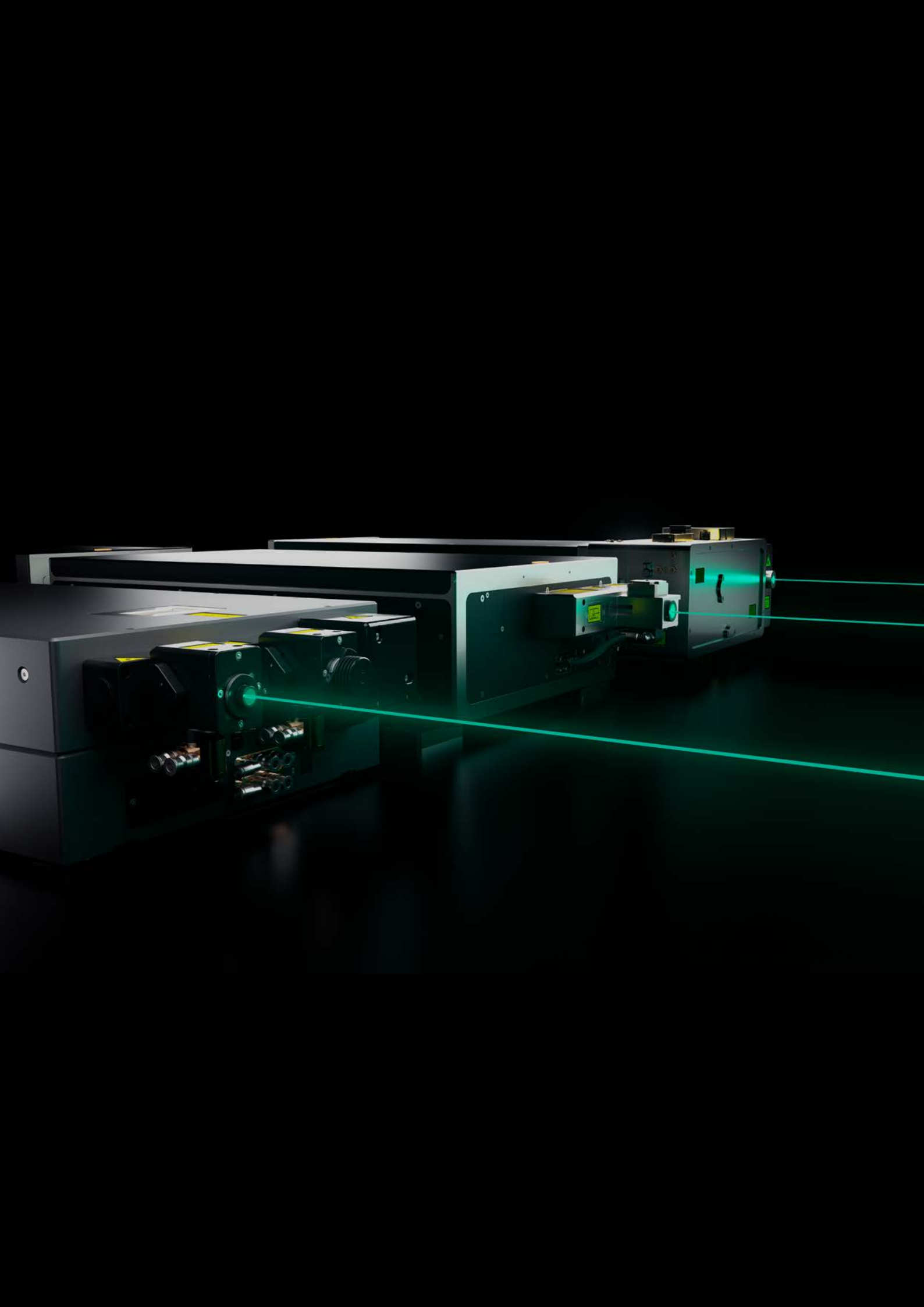
- Femtosecond Lasers
- Wavelength-Tunable Sources
- OPCPA Systems
- Microscopy Sources
- Spectroscopy Systems

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

## About Us

Founded in 1994, LIGHT CONVERSION has evolved into a leading company in ultrafast laser technology with over 9000 systems installed worldwide and 650 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.

# Contents



# 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.

| | |
|---|---|
| **I-OPA** | The only industrial-grade commercial OPA, combining wavelength tunability with robust design. |
| **ORPHEUS \| NEO** | Next-generation OPA featuring exceptional stability and multiple detectors for continuous power monitoring and diagnostics. |
| **ORPHEUS** | A classic OPA platform that many are familiar with – simple to use yet offers an extensive range of parameters. |
| **TOPAS** | Classic OPAs for Ti:Sapphire lasers. |

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

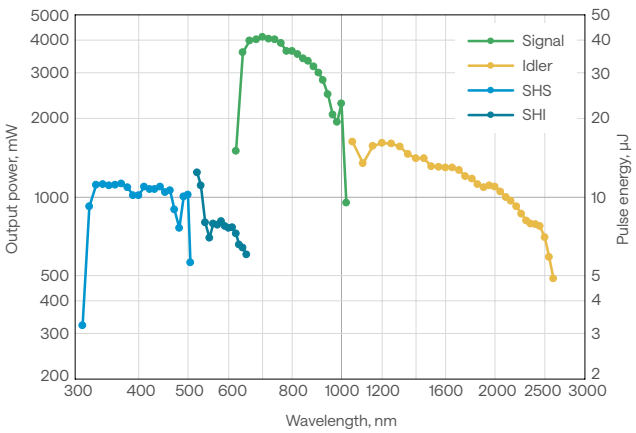
# I-OPA

## Industrial-Grade Optical Parametric Amplifier

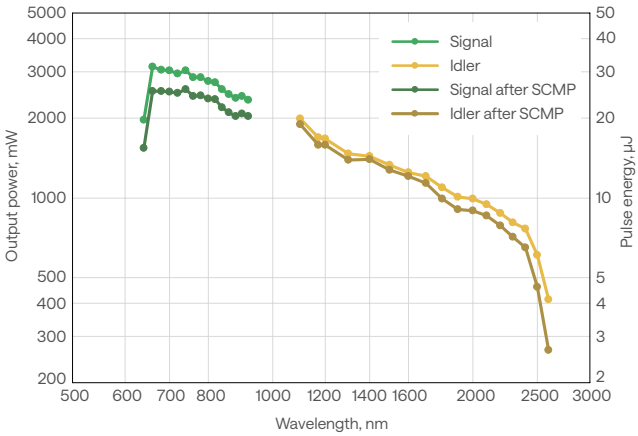
I-OPA-TW on air-cooled CARBIDE-CB5

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

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




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




Optics Toolbox

# 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)<br>1050 – 2600 nm (idler) | 650 – 920 nm (signal)<br>1200 – 2500 nm (idler) | 1350 – 2000 nm (signal)<br>2100 – 4500 nm (idler) |
| Conversion efficiency | > 7% @ 700 nm<br>(40 – 400 µJ pump; up to 1 MHz) | | > 9% @ 1550 nm<br>(40 – 400 µJ pump; up to 1 MHz) |
| | > 3.5% @ 700 nm<br>(20 – 40 µJ pump; up to 2 MHz) | | > 6% @ 1550 nm<br>(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<br>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<br>< 70 fs @ 650 – 800 nm<br>< 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]<br>525 – 640 nm (SHI) [5] | Contact<br>sales@lightcon.com | 4500 – 10 000 nm (DFG) |
| Pulse compression options [2] | n/a | SCMP (signal pulse compressor)<br>ICMP (idler pulse compressor)<br>GDD-CMP (compressor with GDD control) | n/a |

## PUMP LASER REQUIREMENTS

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

## ENVIRONMENTAL & UTILITY REQUIREMENTS

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

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

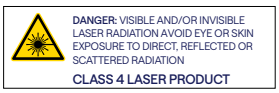
[3] *Output pulse duration depends on the selected wavelength and the pump laser pulse duration.*

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

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

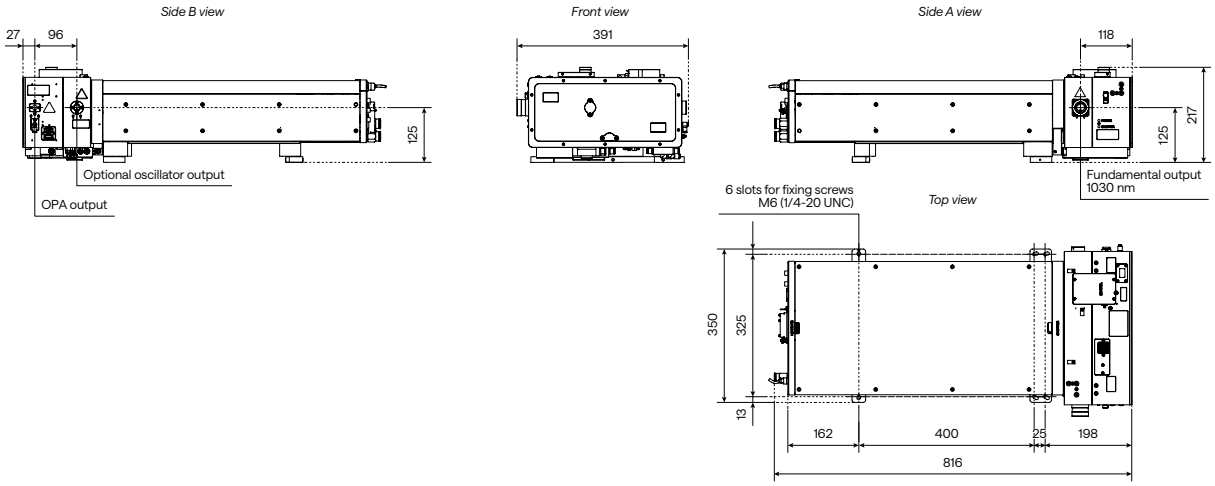
[6] *Specifications are guaranteed for a maximum temperature variation of ± 1 °C and humidity variation of ± 10%.*

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

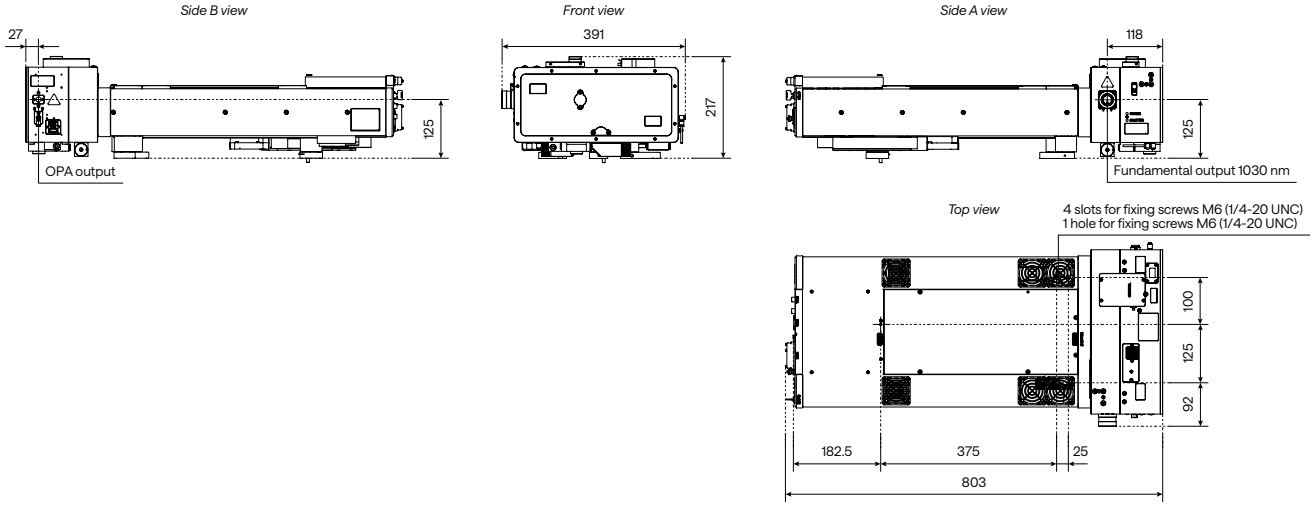


# Drawings

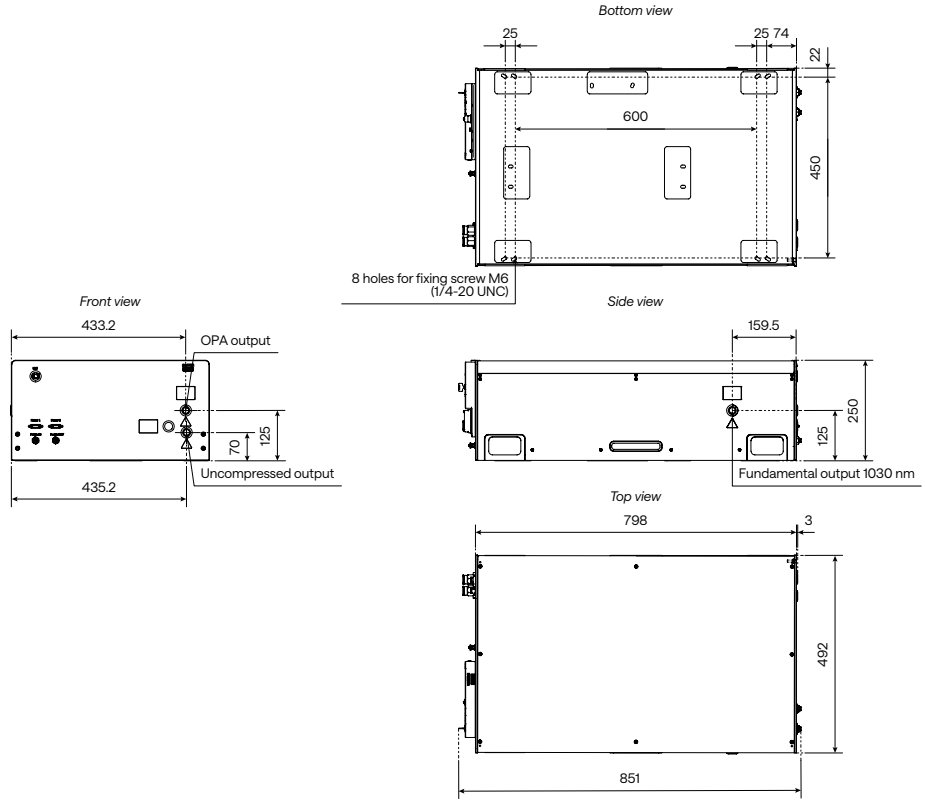
## CARBIDE-CB3 with I-OPA-HP




## CARBIDE-CB5 with I-OPA-HP




## PHAROS-PH2 with I-OPA-HP



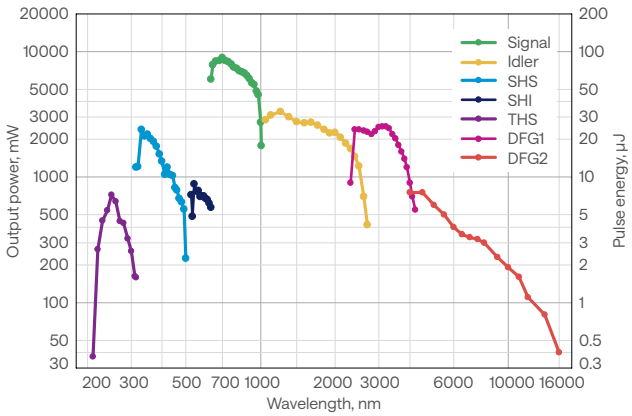

*The drawings depend on the exact configuration. For more options, refer to www.lightcon.com.*

# ORPHEUS | NEO

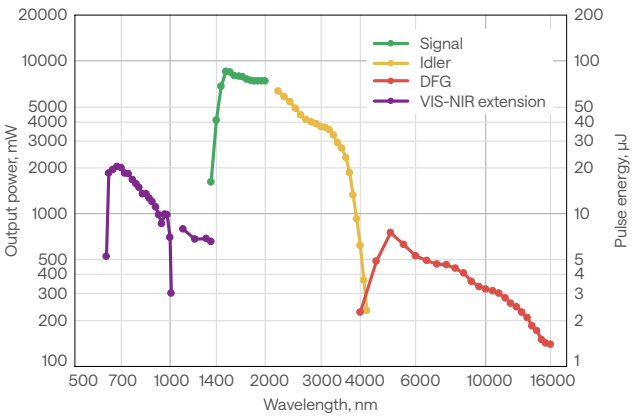
## Next-Generation Optical Parametric Amplifier


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

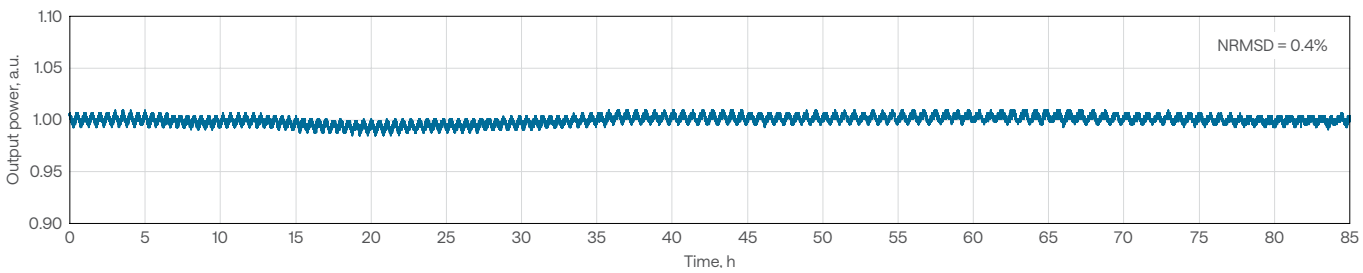
**ORPHEUS-NEO** typical tuning curves in HP configuration
Pump: 80 W, 800 µJ, 100 kHz




**ORPHEUS-NEO-ONE** typical tuning curves in ONE configuration
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 |
|---|---|---|
| Configuration | ORPHEUS | ORPHEUS-ONE |
| Pump power | Up to 80 W | |
| Pump pulse energy | 20 – 800 µJ | |
| Repetition rate | Up to 2 MHz | |
| Tuning range | 640 – 1000 nm (signal)<br>1050 – 2600 nm (idler) | 1400 – 2000 nm (signal)<br>2100 – 4200 nm (idler) |
| Conversion efficiency | > 7% @ 700 nm<br>(40 – 800 µJ pump; up to 1 MHz) | > 9% @ 1550 nm<br>(40 – 800 µJ pump; up to 1 MHz) |
| | > 3.5% @ 700 nm<br>(20 – 40 µJ pump; up to 2 MHz) | > 6% @ 1550 nm<br>(20 – 40 µJ 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 ± 0.6 mm @ 800 nm | 2.1 ± 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 – 16 000 nm (DFG); > 0.3% @ 10 000 nm (for > 40 µJ pump) |
| | 4000 – 16 000 nm (DFG2); > 0.2% @ 10 000 nm | |

## PUMP LASER REQUIREMENTS

| | |
|---|---|
| Configuration | PHAROS or CARBIDE |
| Center wavelength | 1030 ± 10 nm |
| Maximum pump power | 80 W |
| Maximum repetition rate | 2 MHz |
| Pump pulse energy | 20 – 800 µJ |
| Pump pulse duration | 180 – 500 fs |

## ENVIRONMENTAL & UTILITY REQUIREMENTS

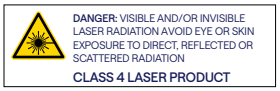
| | |
|---|---|
| Operating temperature [4] | 19 – 25 °C (air conditioning recommended) |
| Relative humidity [4] | 20 – 70% (non-condensing) |
| Electrical requirements | 100 – 240 V AC, 4.5 A; 50 – 60 Hz |
| Rated power | 280 W |
| Power consumption | Standby: 20 W<br>Max during wavelength tuning: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

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

[2] *FW 1/$e^2$, 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 ± 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 µJ | |
| Repetition rate | Up to 1 MHz | |
| Tuning range | 640 – 1000 nm (signal)<br>1050 – 2600 nm (idler) | 1450 – 2000 nm (signal)<br>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<br>< 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 ± 0.6 mm @ 800 nm | 2.1 ± 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 – 14 000 nm (DFG); 0.2% @ 10 000 nm |
| | 4500 – 14 000 nm (DFG2); > 0.1% @ 10 000 nm | |

## PUMP LASER REQUIREMENTS

| | |
|---|---|
| Configuration | PHAROS-UP |
| Center wavelength | 1030 ± 10 nm |
| Maximum pump power | 20 W |
| Maximum repetition rate | 1 MHz |
| Pump pulse energy | 20 – 400 µJ |
| Pump pulse duration | 80 – 100 fs |

## ENVIRONMENTAL & UTILITY REQUIREMENTS

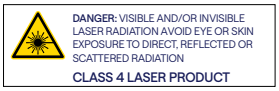
| | |
|---|---|
| | Refer to www.lightcon.com |

[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.*

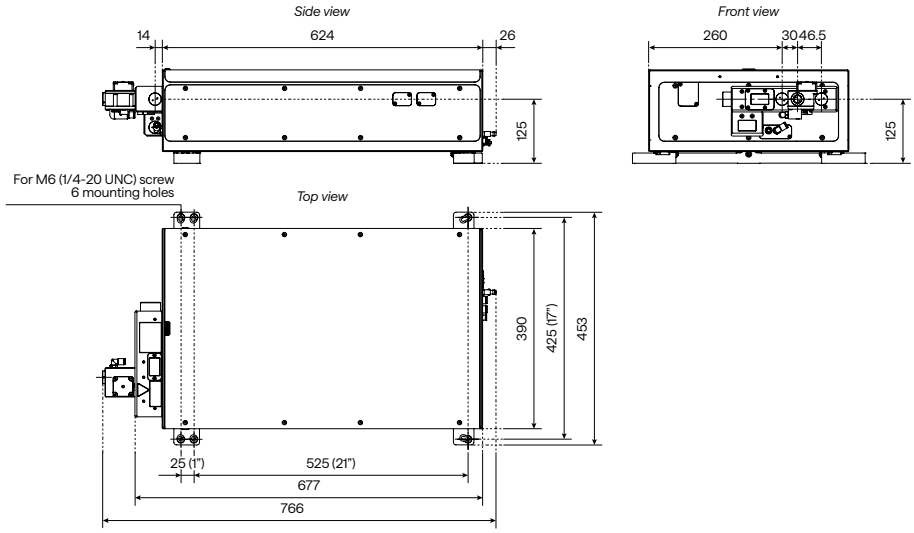
[3] *FW 1/e², measured at laser output, using maximum pulse energy.*

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




# Drawings

ORPHEUS-NEO / ORPHEUS-NEO-UP

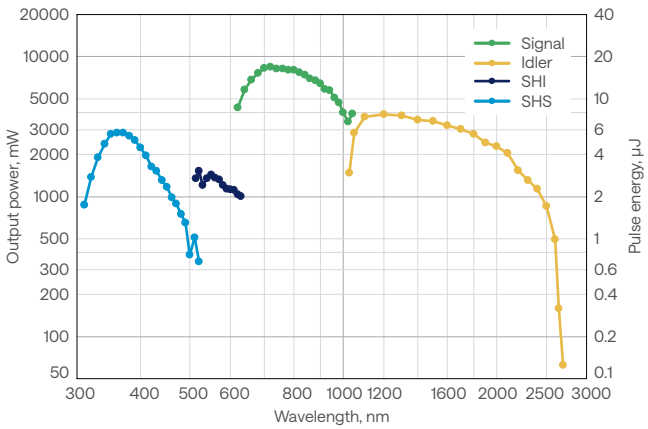


# ORPHEUS

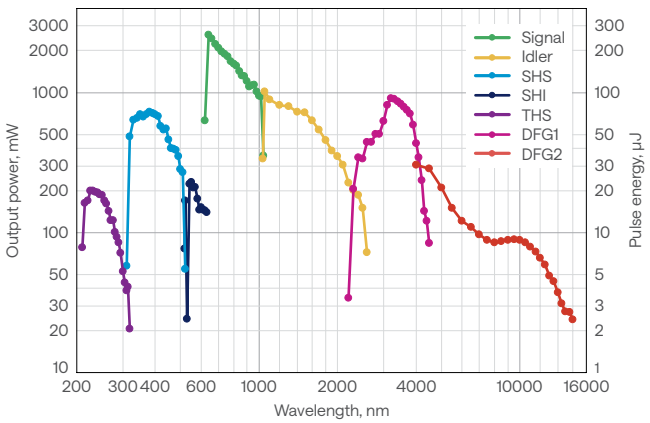
## Collinear Optical Parametric Amplifier


- Continuous tunability from UV to MIR, 190 – 16 000 nm
- High energy and high power models
- 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 µJ, 500 kHz




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




Optics Toolbox

# Specifications

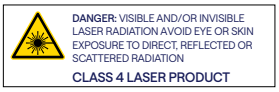
| Model | ORPHEUS-HP | | ORPHEUS-HE |
|---|---|---|---|
| **MAIN OUTPUT (630 – 2600 nm)** | | | |
| Tuning range | 630 –1030 nm (signal)<br>1030 – 2600 nm (idler) | | |
| Maximum pump power | 80 W | | |
| Pump pulse energy | 8 – 20 µJ | 20 – 400 µJ | 400 – 2000 µJ |
| Conversion efficiency at peak | > 4.5% (signal)<br>> 2% (idler) | > 9% (signal)<br>> 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 – 16 000 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<br>sales@lightcon.com |
| 2200 – 4200 nm (DFG1) | > 1.5% @ 3000 nm | > 3% @ 3000 nm | |
| 4000 – 16 000 nm (DFG2) | > 0.1% @ 10 000 nm | > 0.2% @ 10 000 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 | |
| Pump 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.*

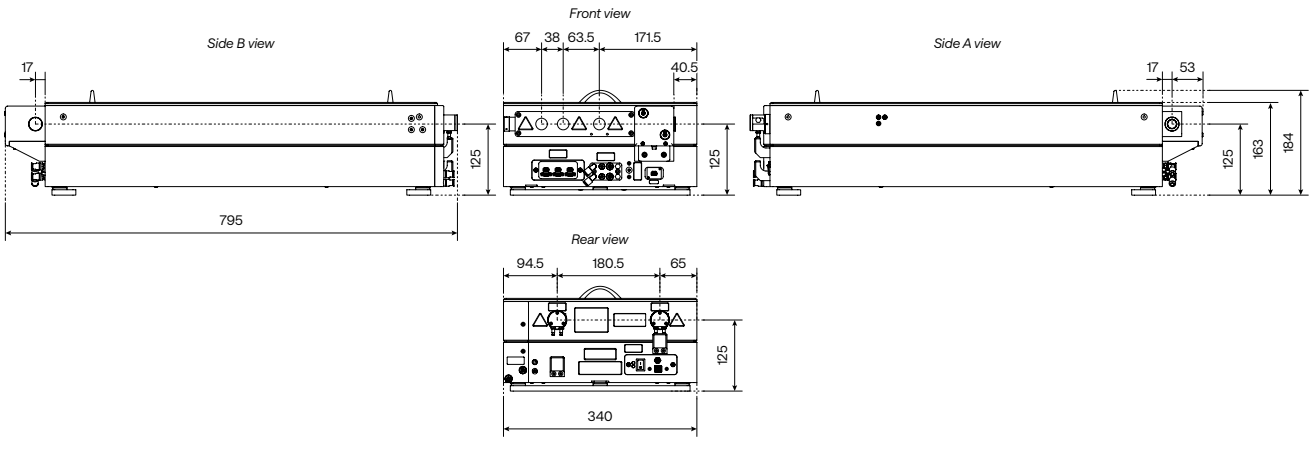
[3] *DUV conversion efficiency is specified for pump power up to 10 W and frequencies up to 200 kHz. In case of higher pump power, conversion efficiency decreases. The maximum output power is 40 mW at 200 nm.*

[4] *Full width at half maximum (FWHM), assuming a Gaussian pulse shape.*




# Drawings

ORPHEUS-HP

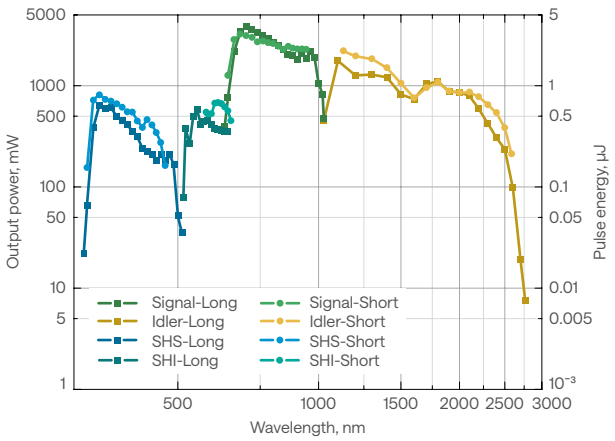


# ORPHEUS | F

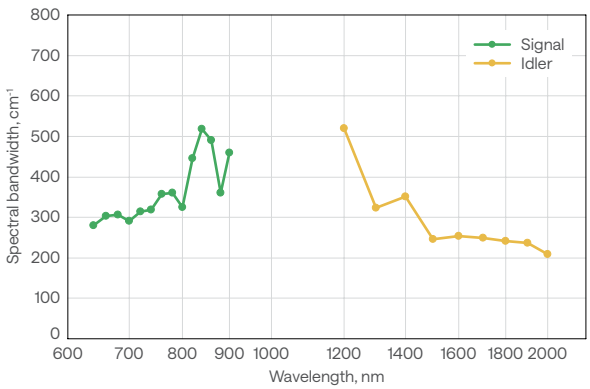
## Broad-Bandwidth Hybrid Optical Parametric Amplifier


- Combines the best features of collinear and non-collinear OPAs
- Ultrashort pulses in NIR, 650 – 900 nm and 1200 – 2500 nm
- Single-shot – 2 MHz repetition rate
- < 100 fs pulse duration
- Adjustable spectral bandwidth
- Optional long pulse mode for gap-free tunability

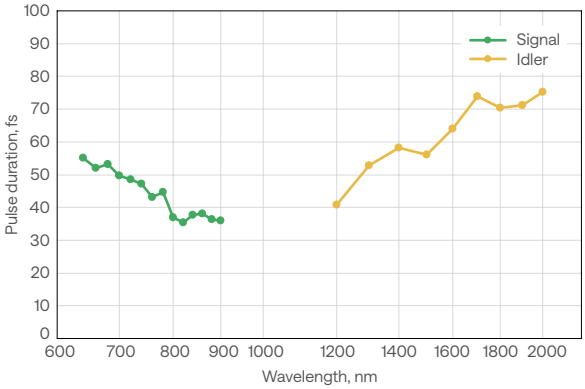
**ORPHEUS-F** typical tuning curves
Pump: 40 W, 40 µJ, 1000 kHz




**ORPHEUS-F** typical spectral bandwidth




**ORPHEUS-F** pulse duration after compression




Optics Toolbox

# Specifications

## MAIN OUTPUT (650 – 900 nm and 1200 – 2500 nm)

| Mode of operation | Short pulse mode [1] | Long pulse mode |
|---|---|---|
| Tuning range | 650 – 900 nm (signal)<br>1200 – 2500 nm (idler) | 650 – 1010 nm (signal)<br>1050 – 2500 nm (idler) |
| Maximum pump power | 80 W | |
| Pump pulse energy | 10 – 400 µJ | |
| Conversion efficiency [2] | > 7% @ 700 nm | |
| Integrated 2H (515 nm) generation efficiency [3] | > 35% | |
| Pulse duration before compression [1] | < 290 fs | |
| Spectral bandwidth | 200 – 750 $cm^{-1}$ @ 650 – 900 nm | 60 – 220 $cm^{-1}$ @ 650 – 900 nm |
| Pulse duration after compressor [1] | < 55 fs @ 800 – 900 nm<br>< 70 fs @ 650 – 800 nm<br>< 100 fs @ 1200 – 2000 nm | n/a |
| Compressor transmission | > 65% @ 650 – 900 nm<br>> 80% @ 1200 – 2000 nm | |
| Long-term power stability, 8 h [4] | < 2% @ 800 nm | |
| Pulse-to-pulse energy stability, 1 min [4] | < 2% @ 800 nm | |

## WAVELENGTH EXTENSION OPTIONS (325 – 15 000 nm) [5]

| | | |
|---|---|---|
| 325 – 450 nm (SHS) | > 1% | n/a |
| 325 – 505 nm (SHS) | n/a | > 1% |
| 525 – 650 nm (SHI) | | > 0.5% |
| 600 – 650 nm (SHI) | > 0.5% | n/a |
| 210 – 252 nm (FHS) | n/a | > 0.1% |
| 263 – 325 nm (FHI) | | |
| 2500 – 15 000 nm | See ORPHEUS-MIR; *page 42* | |

## PUMP LASER REQUIREMENTS

| | |
|---|---|
| Pump laser | PHAROS or CARBIDE |
| Center wavelength | 1030 ± 10 nm |
| Maximum pump power | 80 W |
| Repetition rate | Single-shot – 2 MHz |
| Pump pulse energy | 10 – 400 µJ |
| Pump pulse duration [6] | 180 – 500 fs |

## ENVIRONMENTAL & UTILITY REQUIREMENTS

Refer to www.lightcon.com

[1] *In short pulse mode, broadband 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.*

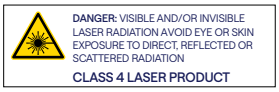
[2] *Specified as a percentage of pump power, before the compressor. Conversion efficiency at peak is 10% for signal and idler combined.*

[3] *At the designated output port; not simultaneous to OPA output.*

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

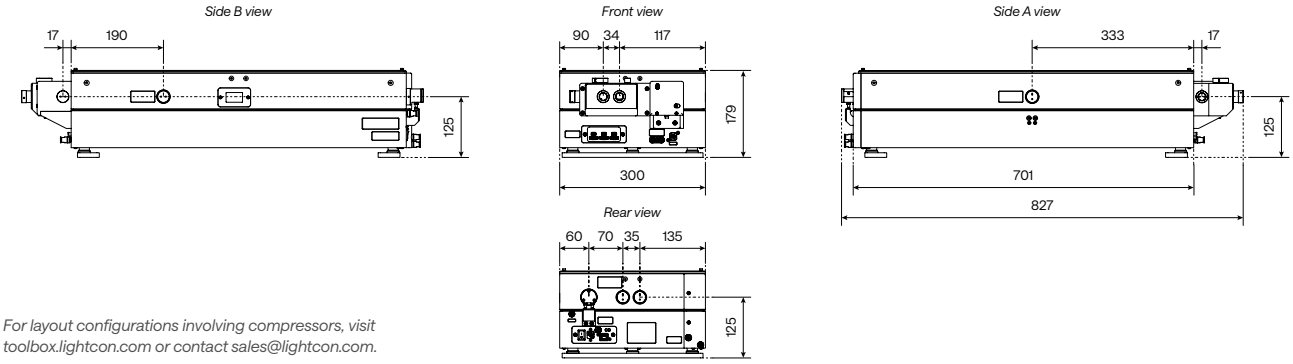
[5] *For > 15 µJ pump pulse energy.*

[6] *Full width at half maximum (FWHM), assuming a Gaussian pulse shape.*




# Drawings

ORPHEUS-F



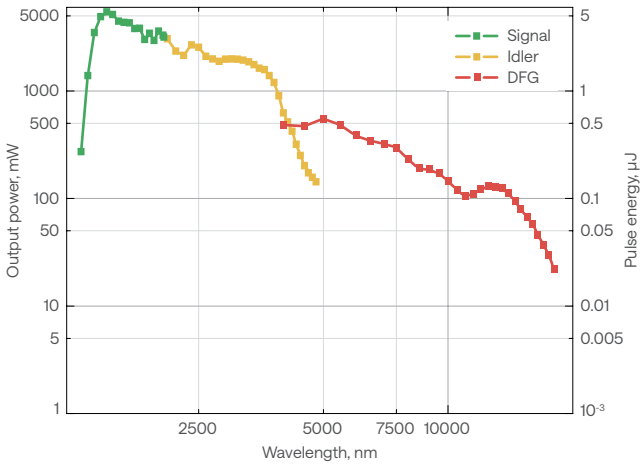

*For layout configurations involving compressors, visit toolbox.lightcon.com or contact sales@lightcon.com.*

# ORPHEUS | ONE

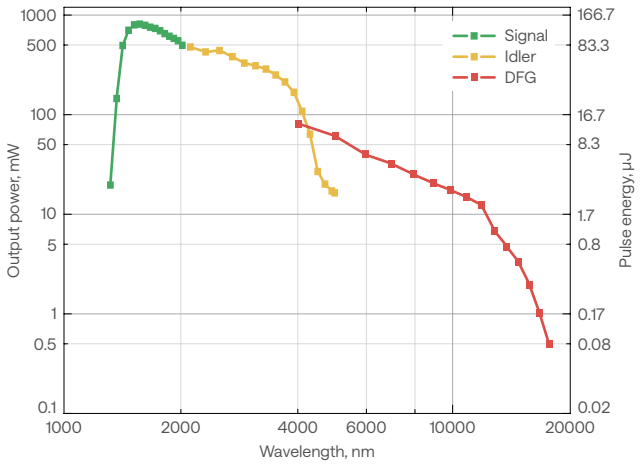
## Mid-Infrared Collinear Optical Parametric Amplifier


- High conversion efficiency in MIR, 1400 – 16 000 nm
- High energy and high power models for all needs
- Single-shot – 2 MHz repetition rate
- Supports up to 80 W, 2 mJ pump

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




**ORPHEUS-ONE-HE** typical tuning curves
Pump: 6 W, 1 mJ, 6 kHz

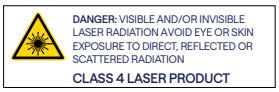



Optics Toolbox

# Specifications

| Model | ORPHEUS-ONE-HP | ORPHEUS-ONE-HE |
|---|---|---|
| **MAIN OUTPUT** | | |
| Tuning range | 1400 – 2000 nm (signal)<br>2100 – 4200 nm (idler) | |
| Maximum pump power | 80 W | |
| Pump pulse energy | 12 – 400 µJ | 400 – 2000 µJ |
| Conversion efficiency [1] @ 1550 nm | > 9%, 30 – 2000 µJ pump<br>> 6%, 12 – 30 µJ pump | |
| Spectral bandwidth | 50 – 150 $cm^{-1}$ @ 1450 – 2000 nm | |
| Long-term power stability, 8 h [2] | < 2% @ 1550 nm | |
| Pulse-to-pulse energy stability, 1 min [2] | < 2% @ 1550 nm | |
| **WAVELENGTH EXTENSION (MIR)** | | |
| Tuning range | 4000 – 16 000 nm (DFG) | |
| Conversion efficiency [1] | > 0.3% @ 10 000 nm, 30 – 2000 µJ pump<br>> 0.2% @ 10 000 nm, 12 – 30 µJ pump | |
| Spectral bandwidth | 50 – 120 $cm^{-1}$ @ 5000 – 8000 nm | |
| **PUMP 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 | 12 – 400 µJ | 400 – 2000 µJ |
| Pump pulse duration [3] | 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, 1.4 A; 50 – 60 Hz | |
| Rated power | 120 W | |
| Power consumption | Standby: 10 W<br>Max during wavelength tuning: 100 W | |

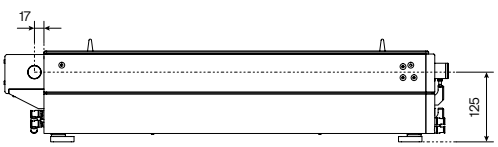
[1] *Specified as a percentage of pump power.*
[2] *Expressed as normalized root mean squared deviation (NRMSD).*
[3] *Full width at half maximum (FWHM), assuming a Gaussian pulse shape.*
[4] *Specifications are guaranteed for a maximum temperature variation of ± 1 °C and humidity variation of ± 10%.*



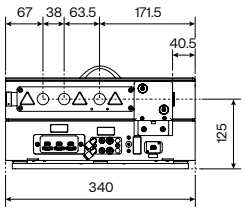

# Drawings

ORPHEUS-ONE-HP / HE

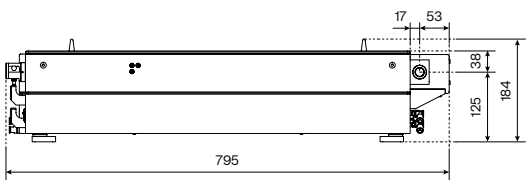
*Side B view*



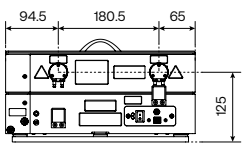

*Front view*




*Side A view*




*Rear view*

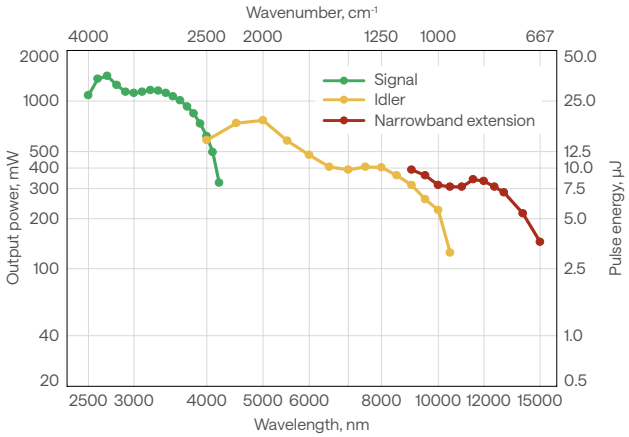


# ORPHEUS | MIR

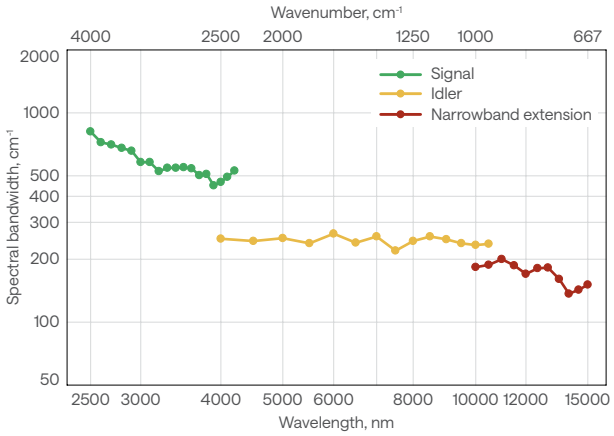
## Broad-Bandwidth Mid-Infrared Optical Parametric Amplifier


- Broad-bandwidth mid-IR pulses at high repetition rates
- Continuously tunable from 2500 to 15 000 nm
- Short-pulse high-energy auxiliary output at 2000 nm
- Pumped by industrial-grade lasers for high stability
- CEP-stable option

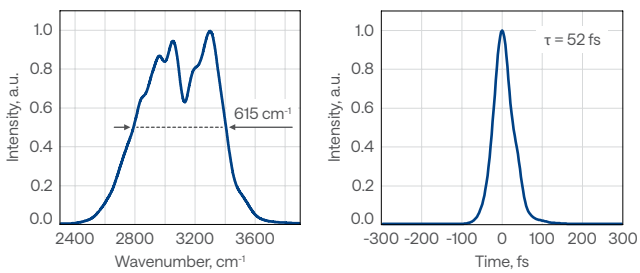
**ORPHEUS-MIR** typical tuning curves
Pump: 80 W, 2 mJ, 40 kHz



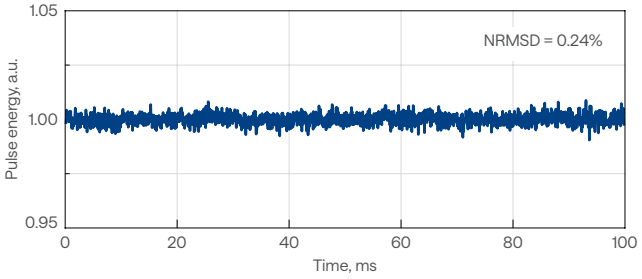

**ORPHEUS-MIR** typical spectral bandwidth




**ORPHEUS-MIR** typical output spectrum (left) and pulse duration (right) measured at ≈ 3000 nm




**ORPHEUS-MIR** pulse-to-pulse energy stability measured at ≈ 3000 nm



# Specifications

## MAIN OUTPUT (2500 – 10 000 nm)

| Mode of operation | Non-collinear | Collinear [1] |
|---|---|---|
| Tuning range | 2500 – 4000 nm (signal)<br>4000 – 10 000 nm (idler) | 2500 – 4500 nm (signal)<br>4500 – 10 000 nm (idler) |
| Maximum pump power | 80 W | |
| Pump pulse energy | 200 µJ – 3 mJ | |
| Maximum repetition rate | 100 kHz | |
| Pulse duration | < 100 fs | < 400 fs<br>(< 100 fs with dispersion compensation) [1] |
| Conversion efficiency [2] | > 1.2% @ 3000 nm<br>> 1.0% @ 3500 nm<br>> 0.6% @ 5000 nm<br>> 0.3% @ 9000 nm | |
| Spectral bandwidth [3] | > 300 $cm^{-1}$ @ 3000 – 4000 nm<br>> 200 $cm^{-1}$ @ 4000 – 10 000 nm | |
| Long-term power stability, 8 h [4] | < 2% @ 5000 nm | |
| Pulse-to-pulse energy stability, 1 min [4] | < 2% @ 5000 nm | |

## AUXILIARY OUTPUT (2000 nm)

| | |
|---|---|
| Output wavelength [5] | 2000 ± 100 nm |
| Pulse duration | < 50 fs |
| Conversion efficiency [2] | > 8% |
| Spectral bandwidth | > 350 $cm^{-1}$ |

## WAVELENGTH EXTENSION (10 000 – 15 000 nm)

| | | |
|---|---|---|
| Tuning range [6] | 10 000 – 15 000 nm | n/a |
| Conversion efficiency [2] | > 0.2% @ 12 000 nm | |
| Spectral bandwidth | > 100 $cm^{-1}$ | |

## PUMP LASER, ENVIRONMENTAL & UTILITY REQUIREMENTS

Refer to www.lightcon.com

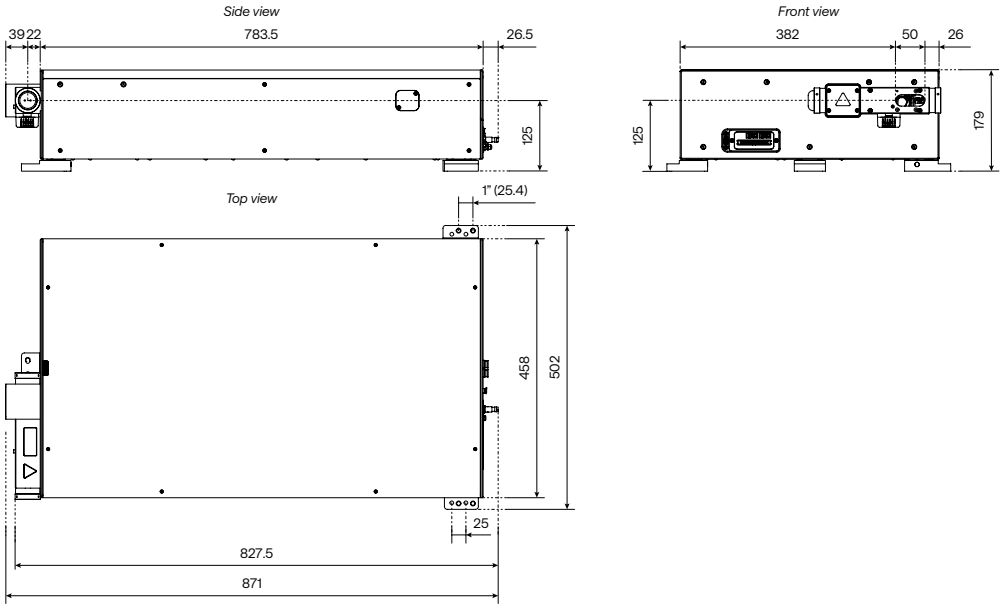
[1] *Collinear mode is achieved with an additional external separator box. Dispersion compensation is optional.*
[2] *Specified as a percentage of pump power.*
[3] *Full width at half maximum (FWHM).*
[4] *Expressed as normalized root mean squared deviation (NRMSD).*
[5] *Not tunable, optimized for best overall performance. Not simultaneous to OPA output.*
[6] *Not available in collinear-output configuration.*

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

**CLASS 4 LASER PRODUCT**

# Drawings

ORPHEUS-MIR

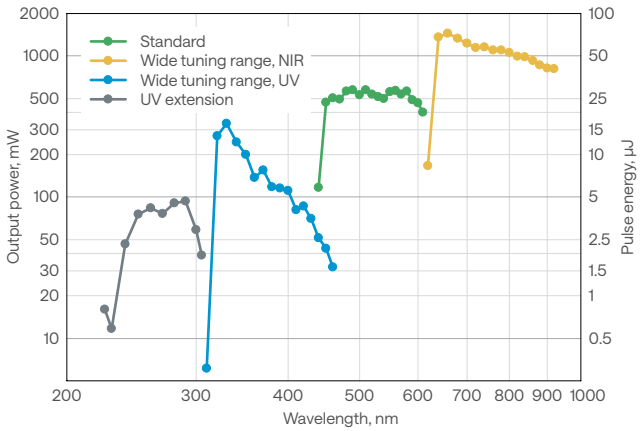


# ORPHEUS | VIS

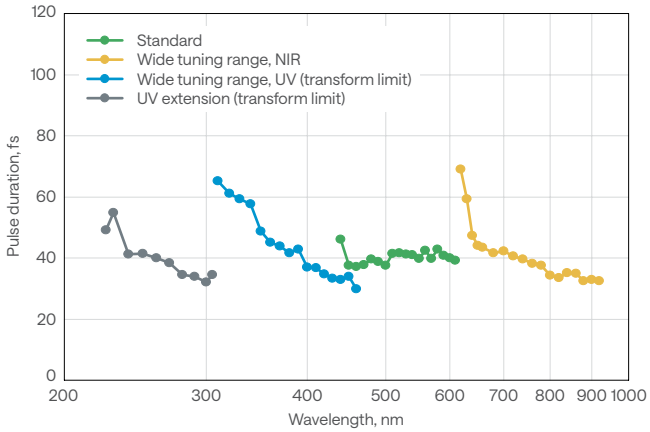
## Ultrashort-Pulse VIS Optical Parametric Amplifier


- Ultrashort UV – VIS – NIR pulses
- < 50 fs pulse duration at 500 nm
- Up to 100 kHz repetition rate
- Up to 20 W, 1 mJ pump
- Optional UV extension down to 250 nm

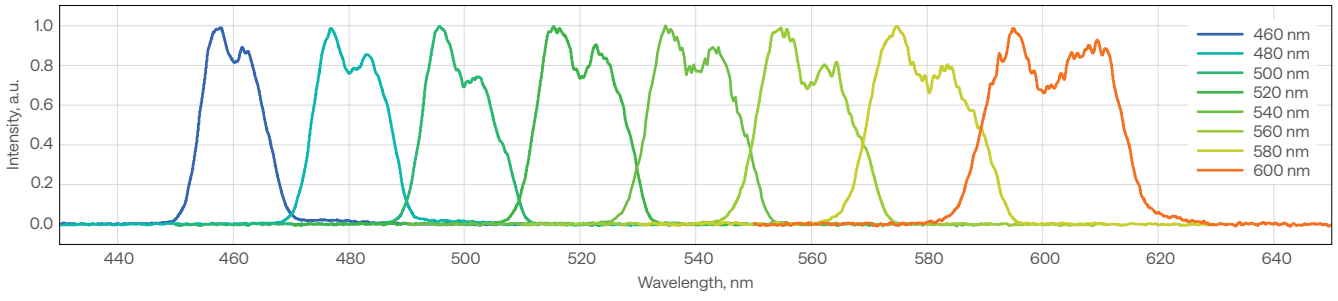
**ORPHEUS-VIS** tuning curves
Pump: 20 W, 1 mJ




**ORPHEUS-VIS** typical pulse duration




**ORPHEUS-VIS** standard configuration's typical spectra set



# Specifications

## MAIN OUTPUT

| Configuration | Standard | Wide tuning range |
|---|---|---|
| Tuning range | 450 – 600 nm | 320 – 900 nm |
| Maximum pump power | 20 W | |
| Pump pulse energy | 200 – 1000 µJ | |
| Conversion efficiency [1] | > 1.5 % @ 500 nm | > 1.5% @ 500 nm<br>> 5.0% @ 660 nm<br>> 0.5% @ 350 nm |
| Pulse duration | < 50 fs @ 500 – 600 nm | < 50 fs @ 500 – 600 nm<br>< 55 fs @ 800 – 900 nm<br>< 70 fs @ 650 – 800 nm |
| Spectral bandwidth [2] | 200 – 700 $cm^{-1}$ | |
| Long-term power stability, 8 h [3] | < 2% @ 500 nm | |

## OPTIONAL EXTENSION (UV)

| | |
|---|---|
| Tuning range | 250 – 300 nm |
| Conversion efficiency [1] | > 0.15% @ 280 nm |
| Spectral bandwidth [2] | 200 – 600 $cm^{-1}$ |

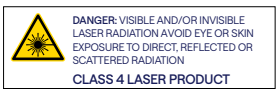
## PUMP LASER REQUIREMENTS

| | |
|---|---|
| Pump laser | PHAROS or CARBIDE |
| Center wavelength | 1030 ± 10 nm |
| Maximum pump power | 20 W |
| Maximum repetition rate | 100 kHz |
| Pump pulse energy | 200 – 1000 µJ |
| Pump pulse duration [4] | 200 – 350 fs |

## ENVIRONMENTAL & UTILITY REQUIREMENTS

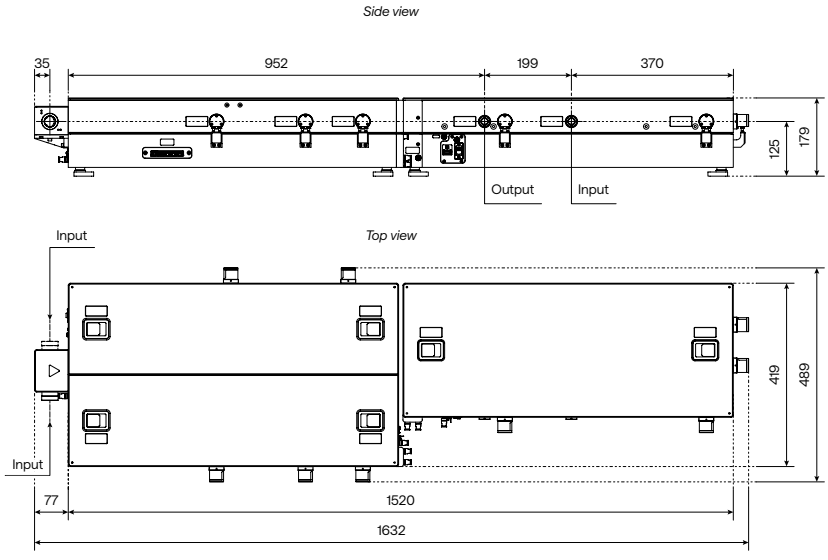
| | |
|---|---|
| Operating temperature [5] | 19 – 25 °C (air conditioning recommended) |
| Relative humidity [5] | 20 – 70% (non-condensing) |
| Electrical requirements | 100 – 240 V AC, 1.4 A; 50 – 60 Hz |
| Rated power | 120 W |
| Power consumption | Standby: 10 W<br>Max during wavelength tuning: 100 W |

*[1] Specified as a percentage of pump power.*
*[2] Full width at half maximum (FWHM).*
*[3] Expressed as normalized root mean squared deviation (NRMSD).*
*[4] FWHM, assuming a Gaussian pulse shape.*
*[5] Specifications are guaranteed for a maximum temperature variation of ± 1 °C and humidity variation of ± 10%.*




# Drawings

ORPHEUS-VIS

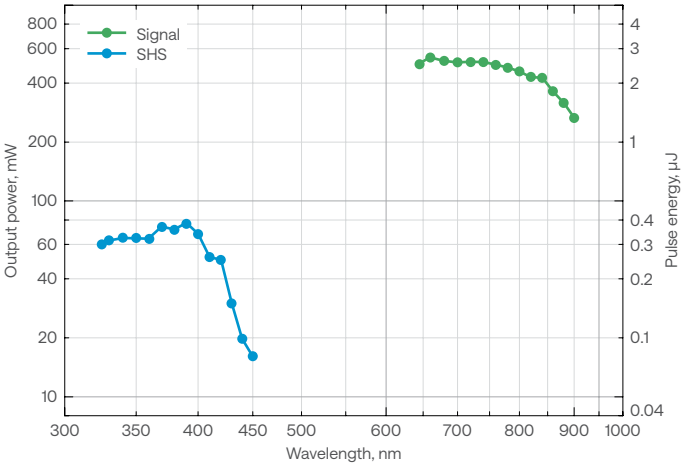


# ORPHEUS | N

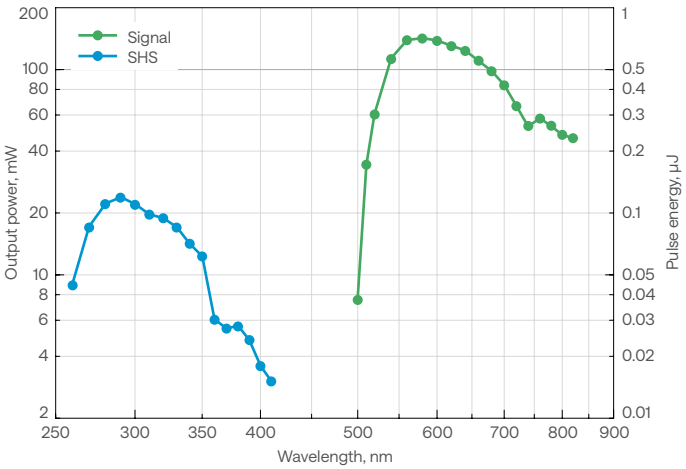
## Non-Collinear Optical Parametric Amplifier


- NOPA for the shortest tunable pulses
- Pulse duration down to < 30 fs
- Integrated prism compressor
- Adjustable spectral bandwidth and pulse duration
- Wavelength feedback with an internal spectrometer

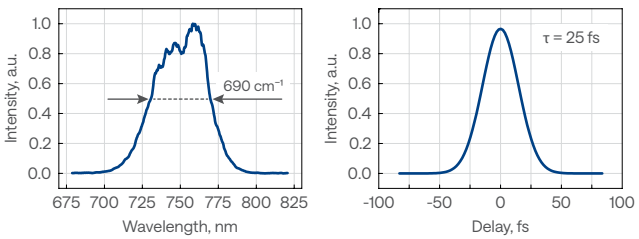
**ORPHEUS-N-2H** typical tuning curves
Pump: 6 W, 30 µJ, 200 kHz



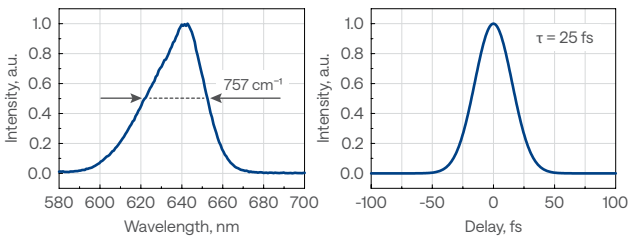

**ORPHEUS-N-3H** typical tuning curves
Pump: 6 W, 30 µJ, 200 kHz




**ORPHEUS-N-2H** typical output




**ORPHEUS-N-3H** typical output



# Specifications

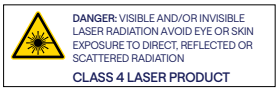
| Model | ORPHEUS-N-2H | ORPHEUS-N-3H |
|---|---|---|
| **MAIN OUTPUT** | | |
| Tuning range | 650 – 900 nm (signal) | 520 – 900 nm (signal) |
| Maximum pump power | 8 W | |
| Pump pulse energy | 10 – 200 µJ | 12 – 200 µJ |
| Conversion efficiency | > 7% @ 700 nm<br>> 5% @ 800 nm | > 1.3% @ 580 nm<br>> 0.7% @ 700 nm<br>> 0.3% @ 800 nm |
| Integrated 2H / 3H generation efficiency [1] | > 35% (515 nm) | > 25% (343 nm) |
| Pulse duration after compressor | < 30 fs @ 700 – 850 nm | < 30 fs @ 540 – 660 nm<br>< 70 fs @ 660 – 800 nm |
| Long-term power stability, 8 h [2] | < 2% @ 800 nm | < 2% @ 580 nm |
| Pulse-to-pulse energy stability, 1 min [2] | < 2% @ 800 nm | < 2% @ 580 nm |
| **WAVELENGTH EXTENSIONS** | | |
| Tuning range (SHS) | 325 – 450 nm | 260 – 450 nm |
| Conversion efficiency | > 0.7% @ 350 nm | > 0.15% @ 290 nm |
| **PUMP LASER REQUIREMENTS** | | |
| Pump laser | PHAROS or CARBIDE | |
| Center wavelength | 1030 ± 10 nm | |
| Maximum pump power | 8 W | |
| Repetition rate | Single-shot – 800 kHz | Single-shot – 600 kHz |
| Pump pulse energy | 10 – 200 µJ | 12 – 200 µJ |
| Pump pulse duration [3] | 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, 1.4 A; 50 – 60 Hz | |
| Rated power | 120 W | |
| Power consumption | Standby: 10 W<br>Max during wavelength tuning: 100 W | |
| Purging requirements | Nitrogen purge – optional | Nitrogen purge – required,<br>1 – 3 liters per minute |

[1] *Not simultaneous to NOPA output.*

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

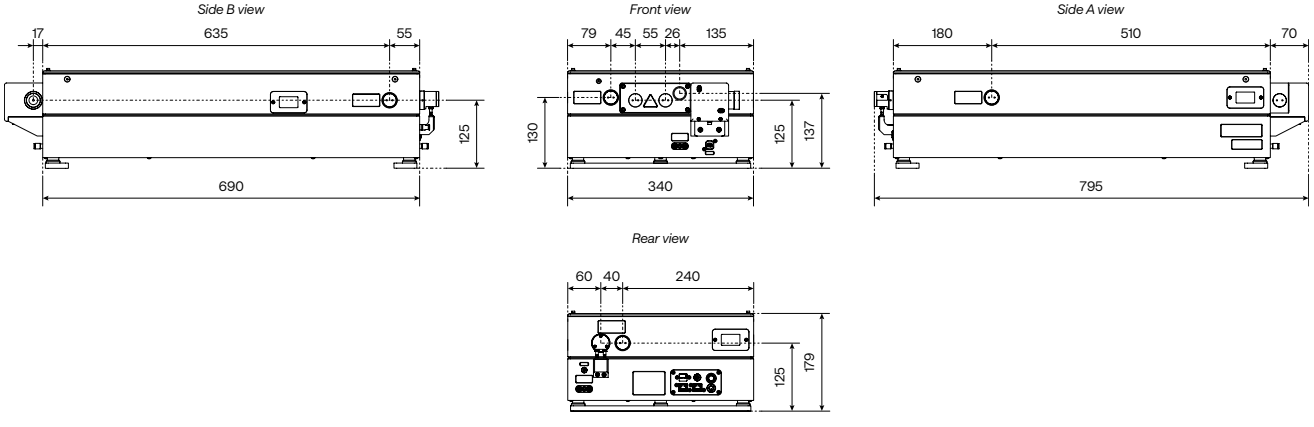
[3] *Full width at half maximum (FWHM), assuming a Gaussian pulse shape.*

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




# Drawings

ORPHEUS-N



# ORPHEUS | TWINS

## Dual Optical Parametric Amplifier


- Two simultaneous independently tunable outputs
- 210 – 16 000 nm tuning range
- Single-shot – 2 MHz repetition rate
- Up to 60 W, 0.5 mJ pump
- CEP-stable option

## Specifications

### MAIN OUTPUT

| | |
|---|---|
| Tuning range | Choice between ORPHEUS, ORPHEUS-F, and ORPHEUS-ONE configurations |
| Output pulse energy | Depends on the configuration, see the specifications of the chosen models |
| Spectral bandwidth | Depends on the configuration, 100 – 750 $cm^{-1}$ |
| Pulse duration | Depends on the configuration, down to < 50 fs |
| Repetition rate | Single-shot – 2 MHz |

### PUMP LASER REQUIREMENTS

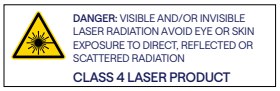
| | |
|---|---|
| Pump laser | PHAROS or CARBIDE |
| Center wavelength | 1030 ± 10 nm |
| Maximum pump power | 60 W |
| Repetition rate | Single-shot – 2 MHz |
| Pump pulse energy | 16 – 500 µJ |
| Pump pulse duration [1] | 180 – 300 fs |

### ENVIRONMENTAL & UTILITY REQUIREMENTS

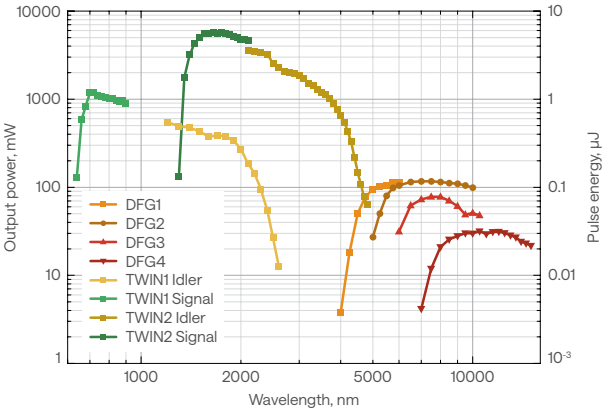
| | |
|---|---|
| Operating temperature [2] | 19 – 25 °C (air conditioning recommended) |
| Relative humidity [2] | 20 – 70% (non-condensing) |
| Electrical requirements | 100 – 240 V AC, 4.5 A; 50 – 60 Hz |
| Rated power | 280 W |
| Power consumption | Standby: 20 W<br>Max during wavelength tuning: 200 W |

[1] *Full width at half maximum (FWHM), assuming a Gaussian pulse shape.*

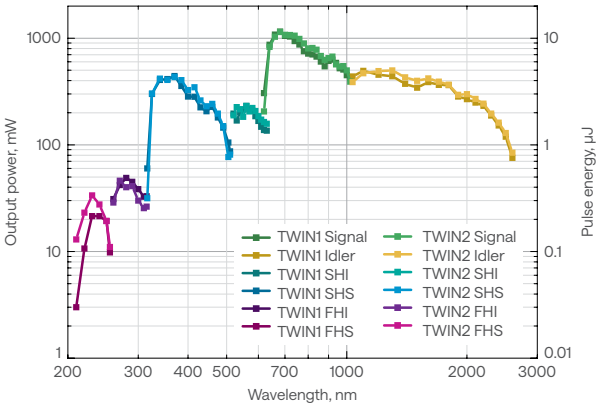
[2] *Specifications are guaranteed for a maximum temperature variation of ± 1 °C and humidity variation of ± 10%.*



**ORPHEUS-TWINS** (-ONE/-F configuration) tuning curves
Pump: 40 W, 40 µJ, 1000 kHz



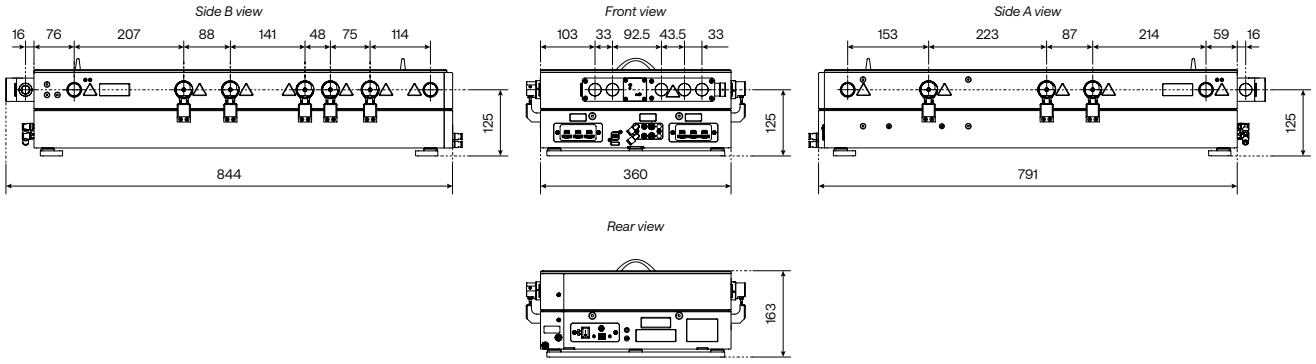

**ORPHEUS-TWINS** (ORPHEUS / ORPHEUS configuration) tuning curves
Pump: 20 W, 20 µJ, 100 kHz




Optics Toolbox

## Drawings

### ORPHEUS-TWINS

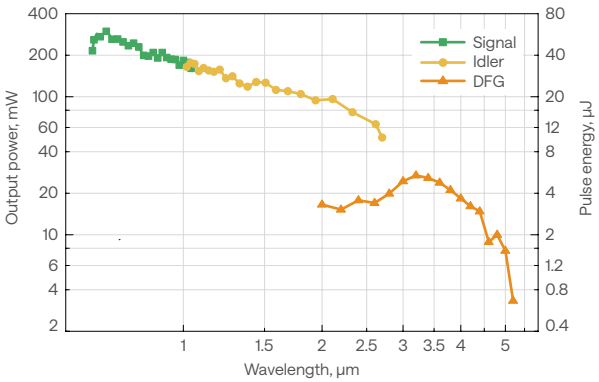


# ORPHEUS | PS

## Narrow-Bandwidth Optical Parametric Amplifier

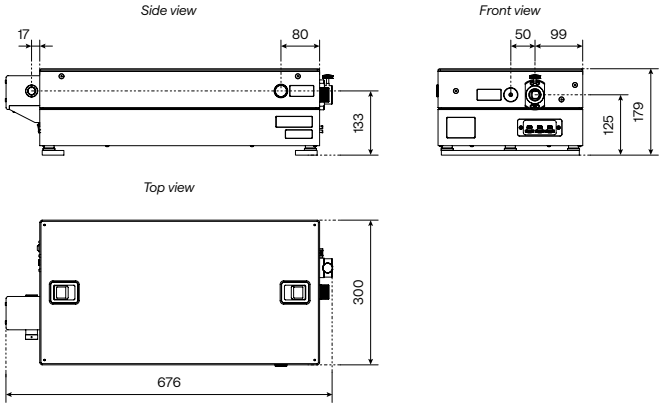

- Picosecond pulses from a femtosecond pump
- 210 – 4800 nm tuning range
- 800 fs – 3 ps pulse duration
- < 20 $cm^{-1}$ spectral bandwidth
- Up to 100 kHz repetition rate
- High output stability

**ORPHEUS-PS** tuning curves
Pump: 5 W, 1000 µJ, 5 kHz from **PHAROS-20W-SP**

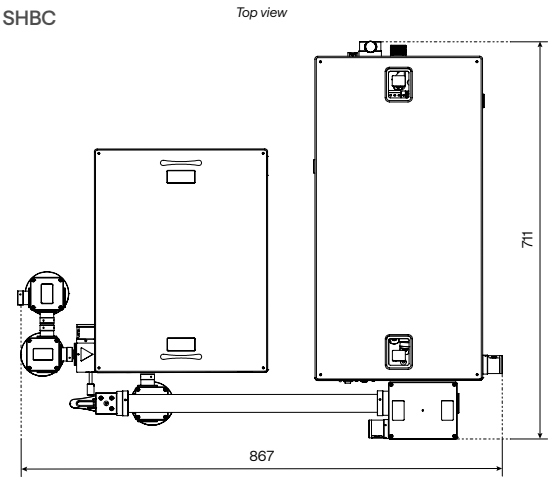



## Drawings

**ORPHEUS-PS**




**ORPHEUS-PS** with **SHBC**



# Specifications



## MAIN OUTPUT

| | |
|---|---|
| Tuning range [1] | 640 – 1000 nm (signal)<br>1060 – 2600 nm (idler) |
| Conversion efficiency | > 6% @ 700 nm |
| Pulse duration | 800 fs – 3 ps |
| Spectral bandwidth | < 20 $cm^{-1}$ @ 800 nm |
| Pulse-to-pulse energy stability [2] | < 2% @ 800 nm |

## AUXILIARY OUTPUT 1 (515 nm)

| | |
|---|---|
| Center wavelength [3] | 515 nm ± 5 nm |
| Generation efficiency [4] | > 15% |

## AUXILIARY OUTPUT 2 (1030 nm)

| | |
|---|---|
| Center wavelength [5] | 1030 ± 10 nm |
| Pulse duration | < 300 fs |
| Pulse energy | > 5 µJ |

## WAVELENGTH EXTENSION

| | |
|---|---|
| SH package<br>320 – 500 nm (SHS), 530 – 640 nm (SHI) | > 3% @ 350 nm |
| FH package<br>210 – 250 nm (FHS), 265 – 320 nm (FHI) | > 0.3% @ 230 nm |
| 2400 – 4800 nm (DFG) | > 0.25% @ 3200 nm [6] |
| 4500 – 1600 nm (DFG3) | Available, contact sales@lightcon.com |

## PUMP LASER REQUIREMENTS

| | |
|---|---|
| Pump laser [7] | PHAROS or CARBIDE with uncompressed output option [8] |
| Center wavelength | 1030 ± 10 nm |
| Repetition rate | Single-shot – 100 kHz |
| Maximum pump power | 20 W |
| Pump pulse energy | 100 µJ – 3.2 mJ |

## ENVIRONMENTAL & UTILITY REQUIREMENTS

| | |
|---|---|
| Operating temperature [9] | 19 – 25 °C (air conditioning recommended) |
| Relative humidity [9] | 20 – 70% (non-condensing) |
| Electrical requirements | 100 – 240 V AC, 1.4 A; 50 – 60 Hz |
| Rated power | 120 W |
| Power consumption | Standby: 10 W<br>Max during wavelength tuning: 100 W |

[1] *For a single wavelength (515 nm) picosecond output, refer to SHBC.*
[2] *Expressed as normalized root mean squared deviation (NRMSD)*
[3] *Direct SHBC output, not simultaneous to OPA; see more details in SHBC specifications.*
[4] *Specified as a percentage of pump pulse energy.*
[5] *Compressed pump output.*
[6] *For > 200 µJ pump pulse energy.*
[7] *The pump laser is first paired with the SHBC module, then the SHBC output is used to pump the OPA. The parameter requirements are for the pump laser.*
[8] *Not compatible with PHAROS-PH2-UP.*
[9] *Specifications are guaranteed for a maximum temperature variation of ± 1 °C and humidity variation of ± 10%.*

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


PHAROS
LIGHT CONVERSION
CARBIDE
LIGHT CONVERSION
FLINT

# 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- or 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, offering pulse durations down to 100 fs and pulse energies up to 4 mJ. |

High average power and pulse energy at high repetition rates

Market-proven, industrial-grade stability and reliability

Tailored to the needs of both industry and science

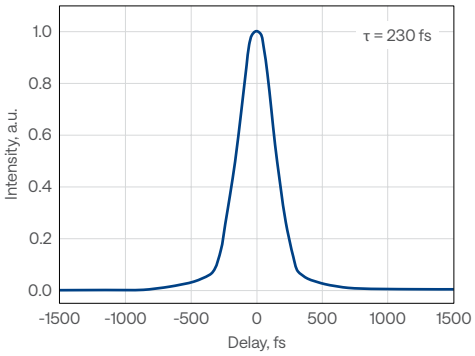
# CARBIDE

## Unibody-Design Femtosecond Lasers for Industry and Science

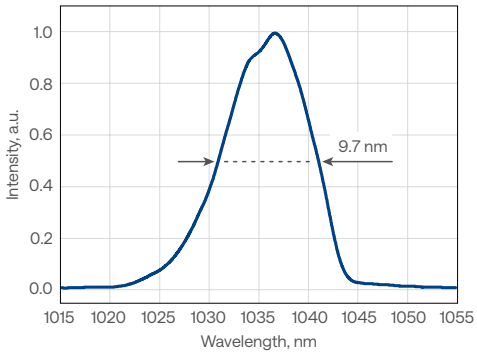

CARBIDE-CB3

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

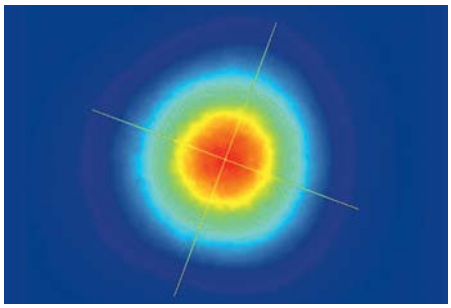
**CARBIDE-CB3**
Typical pulse duration



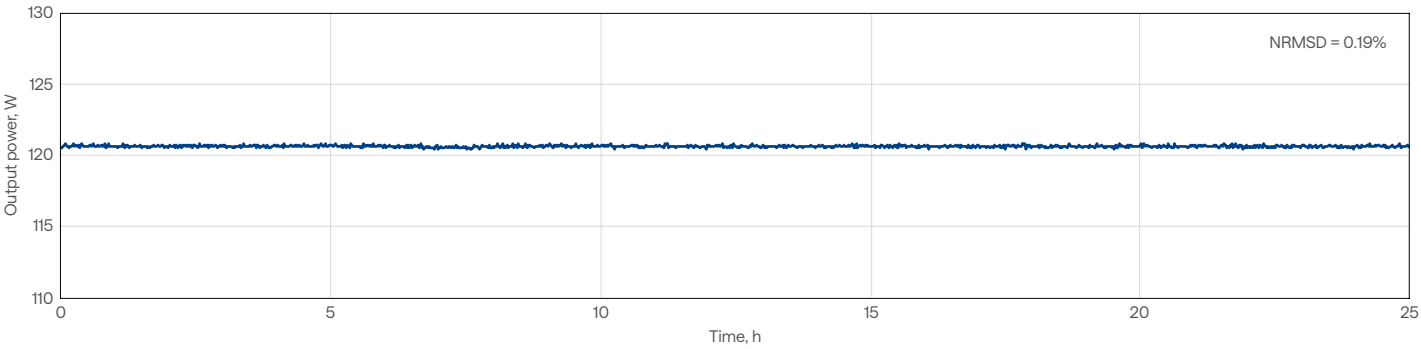

**CARBIDE-CB3**
Typical spectrum




**CARBIDE-CB3**
Typical beam profile



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



| Model | CB3-20W | CB3-40W | CB3-40W-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, 24 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 | | | | |
| Optical parametric amplifier [9] | UV – MIR; *see page 6* | | | | 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 x 449 x 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 |
| Electrical requirements – Chiller | 100 – 230 V AC; 50 – 60 Hz | | 200 – 230 V AC; 50 – 60 Hz | | |
| Rated power – Laser | 600 W | | 1000 W | | 2000 W |
| Rated power – Chiller | 1400 W | | 2000 W | | |
| Power consumption – Laser | 500 W | | 900 W | | 1500 W |
| Power consumption – Chiller | 1000 W | | 1300 W | | 1800 W |

[1] *Assuming a Gaussian pulse shape.*

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

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

[4] *Fast energy control (FEC) provides fast, full-scale individual pulse energy control; an external analog control input is available.*

[5] *Waveplate-based variable optical attenuator (VOA); an external analog control input is available.*

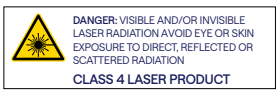
[6] *Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).*

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

[8] *Integrated. For an external harmonic generator, refer to HIRO.*

[9] *Integrated. For more details and stand-alone OPAs, refer to wavelength-tunable sources.*

[10] *Power supply can be different if an optional 2 MHz version is selected.*

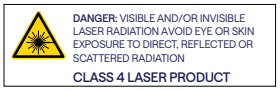


# CARBIDE-CB5 specifications

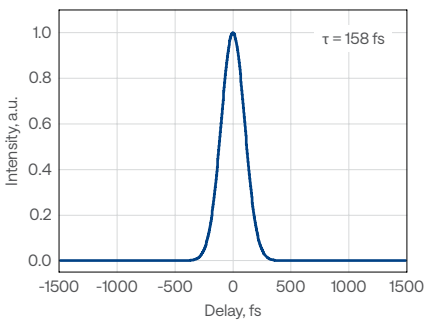


| Model | CB5 | | CB5-SP |
|---|---|---|---|
| **OUTPUT CHARACTERISTICS** | | | |
| Cooling method | Air-cooled [1] | | |
| Center wavelength | 1030 ± 10 nm | | |
| Maximum output power | 6 W | 5 W | |
| Pulse duration [2] | < 290 fs | | < 190 fs |
| Pulse duration tuning range | 290 fs – 20 ps | | 190 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 | | |
| Optical parametric amplifier [8] | UV – MIR; *see page 6* | | |
| 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 | | |

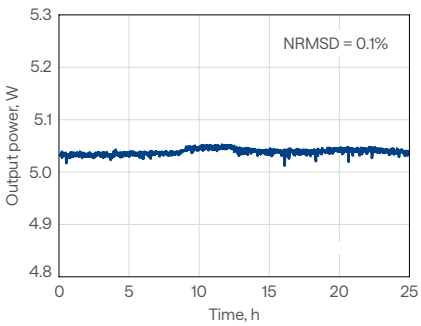
1) *Water-cooled version available on request.*
2) *Assuming a Gaussian pulse shape.*
3) *FW 1/e², using maximum pulse energy.*
4) *Waveplate-based variable optical attenuator (VOA); an external analog control input is available.*
5) *Enhanced contrast AOM. Provides fast amplitude control of output pulse train.*
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.*



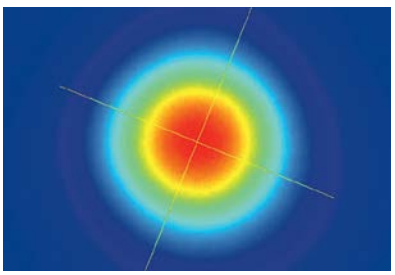

CARBIDE-CB5-SP
Typical pulse duration




CARBIDE-CB5
Long-term power stability

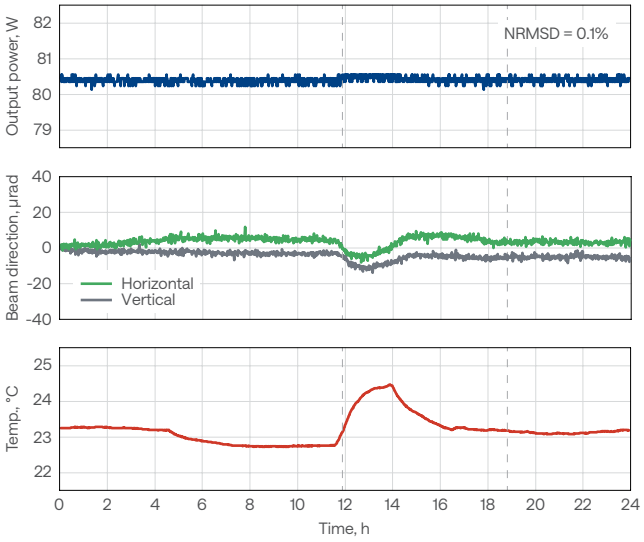



CARBIDE-CB5
Typical beam profile

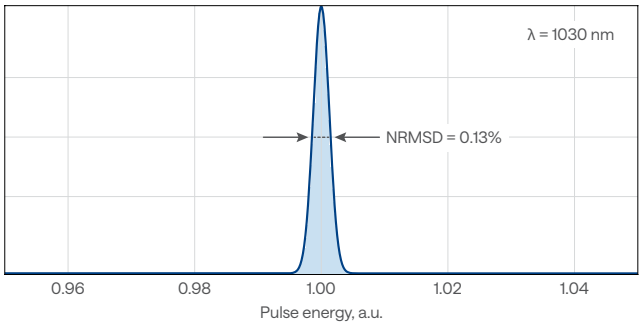


## Stability measurements

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

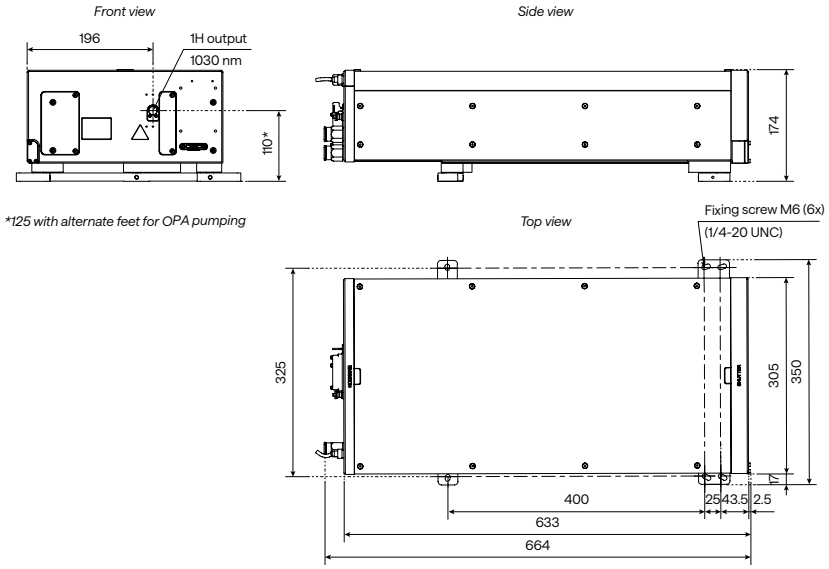



**CARBIDE-CB3**
Typical pulse-to-pulse energy stability

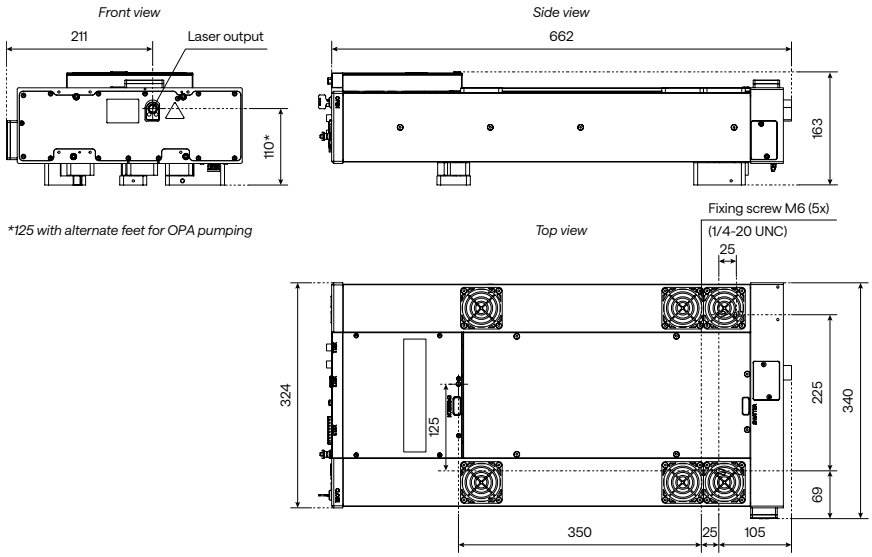



## Drawings

**CARBIDE-CB3**




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



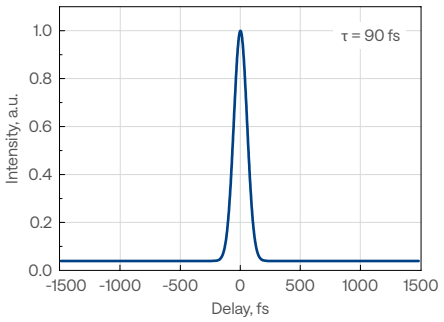

*The drawings depend on the exact configuration. If crucial for integration, please contact sales@lightcon.com.*

# PHAROS

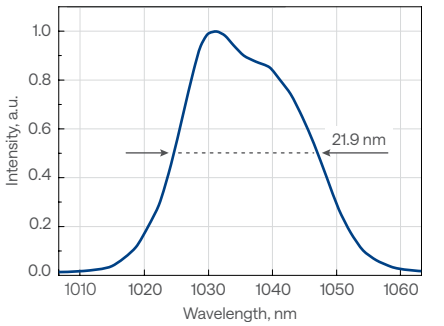
## Modular-Design Femtosecond Lasers for Industry and Science


- Maximum pulse energy of up to 4 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 or tunable extensions
- CEP stabilization or repetition rate locking
- Thermally-stabilized and sealed design

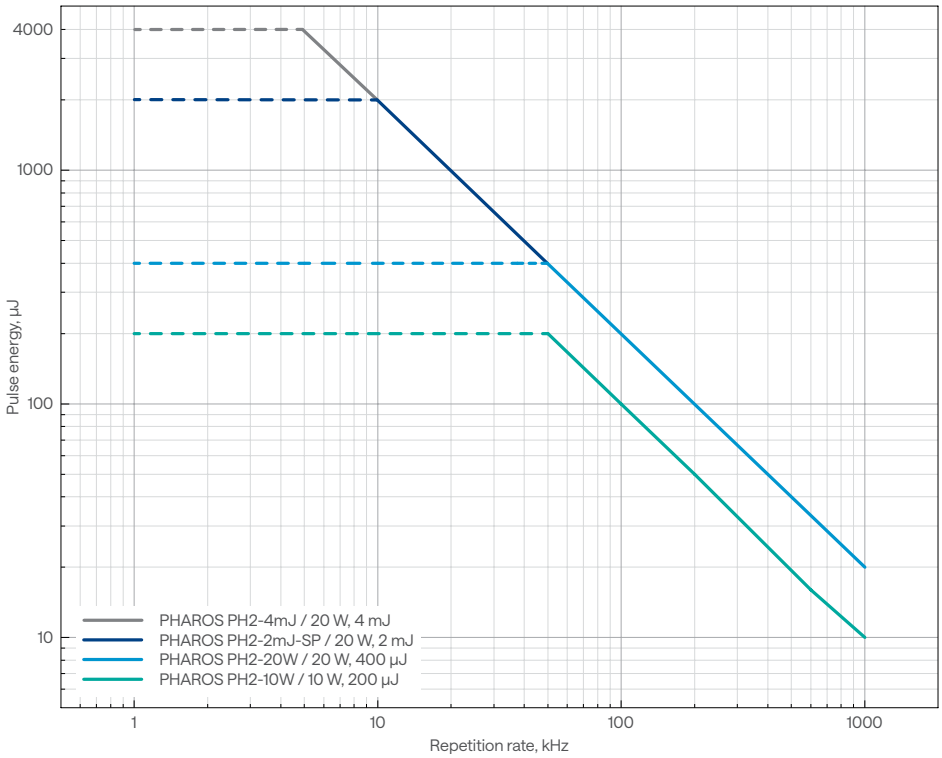
**PHAROS-PH2-UP**
Typical pulse duration




**PHAROS-PH2-UP**
Typical spectrum




**PHAROS**
Pulse energy vs fundamental repetition rate



# Specifications

NEW

| Model | PH2-10W | PH2-SP | | | PH2-4mJ | PH2-UP | |
|---|---|---|---|---|---|---|---|
| **OUTPUT CHARACTERISTICS** | | | | | | | |
| Center wavelength [1] | 1030 ± 10 nm | | | | | | |
| Maximum output power | 10 W | 20 W | | | | | |
| Pulse duration [2] | < 290 fs | < 190 fs | | | < 450 fs [3] | < 100 fs | |
| Pulse duration tuning range | 290 fs – 10 ps (20 ps on request) | 190 fs – 10 ps (20 ps on request) | | | 450 fs – 10 ps | 100 fs – 10 ps | |
| Maximum pulse energy | 0.2 mJ | 0.4 mJ | 1 mJ | 2 mJ | 4 mJ | 0.4 mJ | 1 mJ |
| Repetition rate | Single-shot – 1 MHz | | | | | | |
| Pulse selection | Single-shot, pulse-on-demand, any fundamental repetition rate division | | | | | | |
| Polarization | Linear, horizontal | | | | | | |
| Beam quality, $M^2$ | < 1.2 | < 1.3 | | | | < 1.2 | |
| Beam diameter [4] | 3.3 ± 0.5 mm | 4.0 ± 0.5 mm | 4.5 ± 0.5 mm | 6.8 ± 0.7 mm | | 4.5 ± 0.5 mm | 6 ± 0.5 mm |
| Beam pointing stability | < 20 µrad/°C | | | | | | |
| Pre-pulse contrast | < 1 : 1000 | | | | | | |
| Post-pulse contrast | < 1 : 200 | | | | | | |
| Pulse-to-pulse energy stability, 24 h [5] | < 0.5% | | | | | | |
| Long-term power stability, 100 h [5] | < 0.5% | | | | | | |
| **MAIN OPTIONS** | | | | | | | |
| Oscillator output [6] | 1 – 7 W, 50 – 250 fs, ≈ 1035 nm, ≈ 76 MHz | | | | | | |
| Harmonic generator [7] | 515 nm, 343 nm, 257 nm, or 206 nm | | | | | | |
| Optical parametric amplifier [8] | UV – MIR; *see page 6* | | | | | | |
| BiBurst option | Tunable GHz and MHz burst with burst-in-burst capability | | | | | | |
| CEP stabilization | *See page 37* | | | | | | |
| 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 | | | | | | |
| Electrical requirements – Chiller | 100 – 230 V AC, 50 – 60 Hz | | | | | | |
| Rated power – Laser | 1000 W | | | | | | |
| Rated power – Chiller | 1400 W | | | | | | |
| Power consumption – Laser | 600 W | | | | | | |
| Power consumption – Chiller | 1000 W | | | | | | |

[1] *Precise wavelengths for specific models are available upon request.*

[2] *Assuming a Gaussian pulse shape.*

[3] *Pulse duration can be reduced to < 250 fs if a 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 (NRMSD).*

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

[7] *Integrated. For an external harmonic generator, refer to HIRO.*

[8] *Integrated. For more details and stand-alone OPAs, refer to wavelength-tunable sources.*

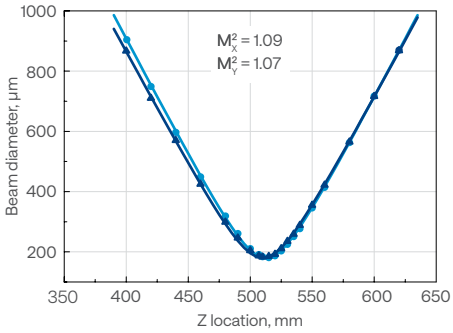
[9] *Dimensions depend on laser configuration and integrated options.*

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

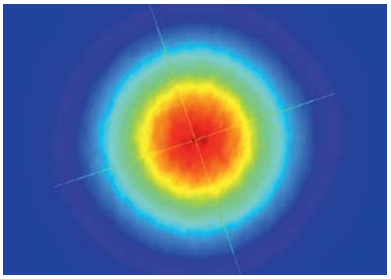
CLASS 4 LASER PRODUCT

# Beam properties

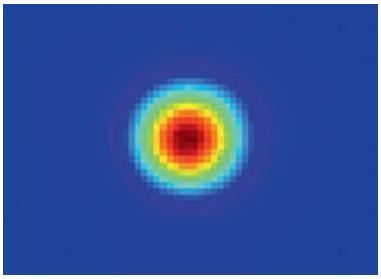
**PHAROS**
Typical $M^2$ measurement data




**PHAROS**
Typical near-field beam profile

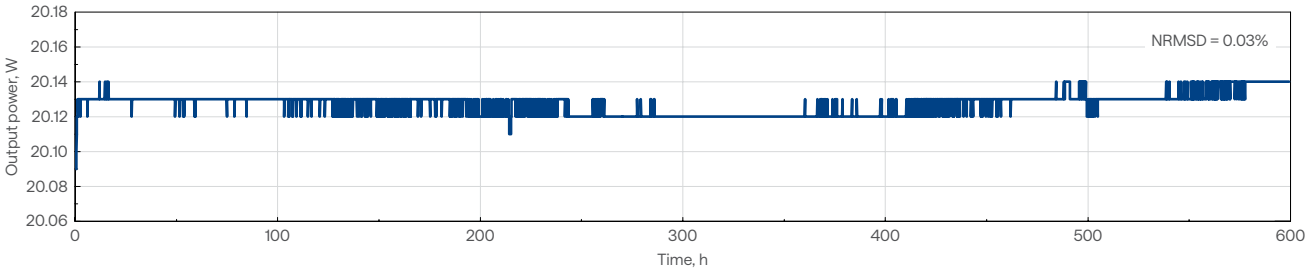


**PHAROS**
Typical far-field beam profile

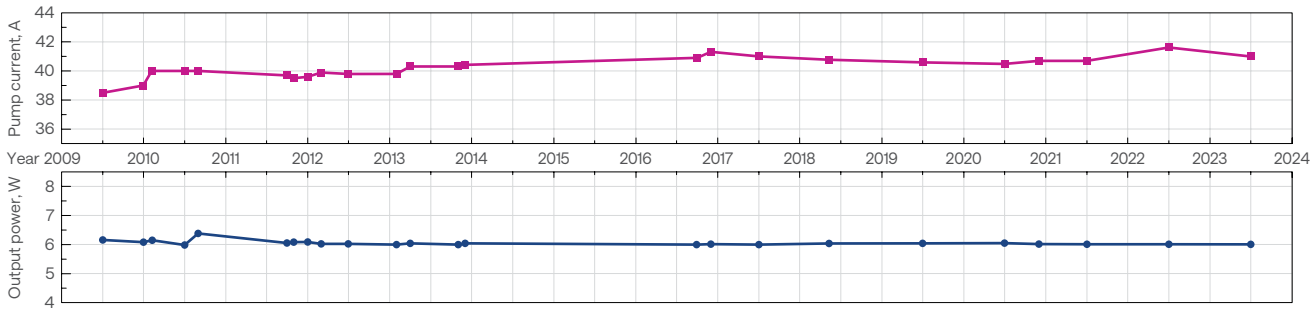


# Stability measurements

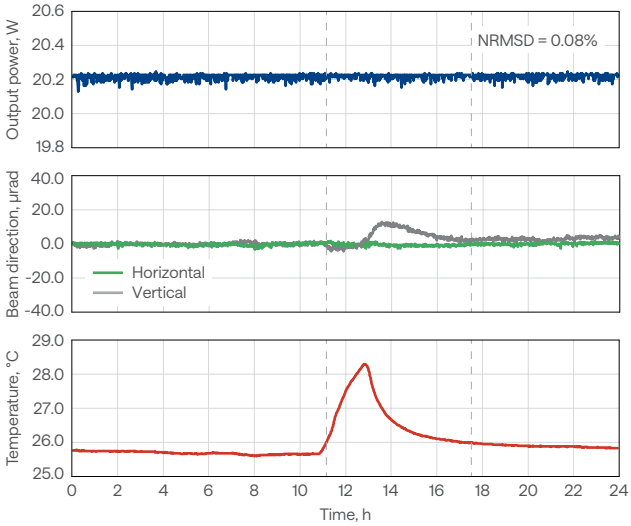
**PHAROS**
Long-term power stability



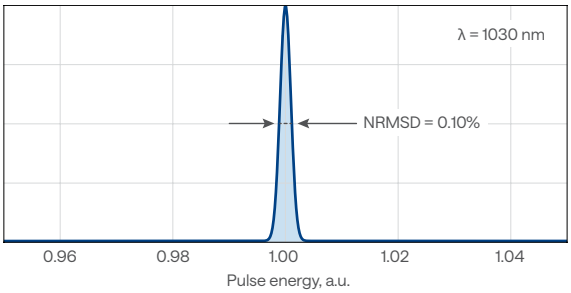

Output power of industrial-grade **PHAROS** lasers operating 24/7 and the current of the pump diodes over the years




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



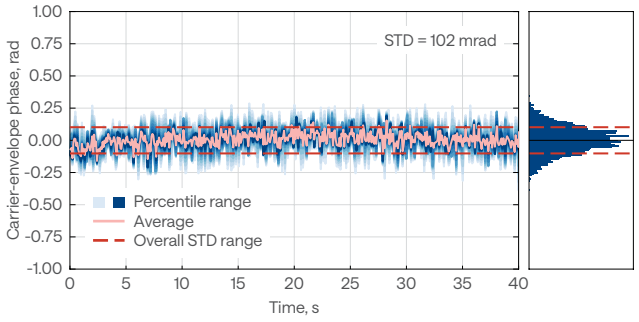

**PHAROS**
Typical pulse-to-pulse energy stability



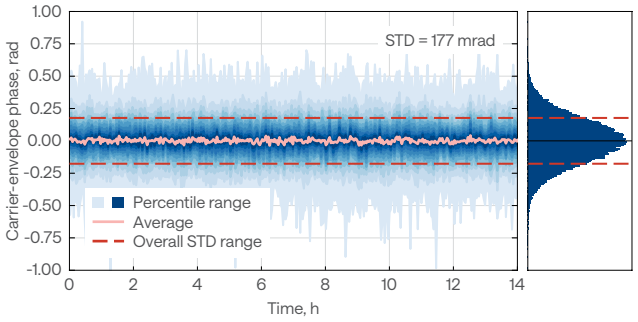
## CEP stabilization

**PHAROS** lasers can be equipped with feedback electronics for carrier-envelope phase (CEP) stabilization of the output pulses. The carrier-envelope offset (CEO) of the **PHAROS** oscillator is actively locked to 1/4$^{th}$ 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

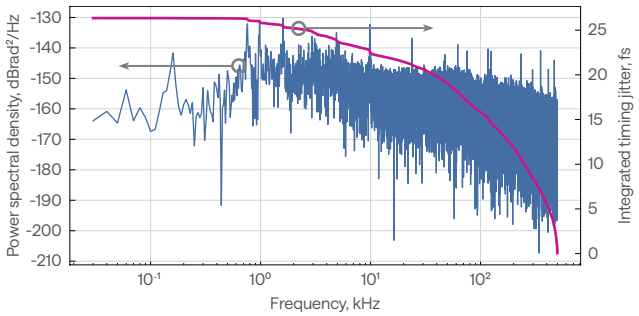



## Repetition rate locking

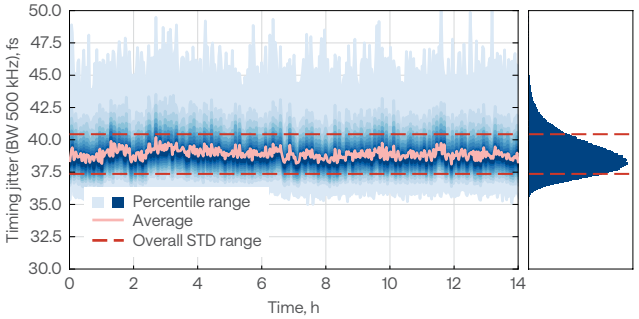
The oscillators in **PHAROS** lasers can be customized for repetition rate locking applications. Coupled with the necessary feedback electronics, the oscillator's repetition rate can be synchronized to an external RF source using the two piezo stages installed within the cavity.

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

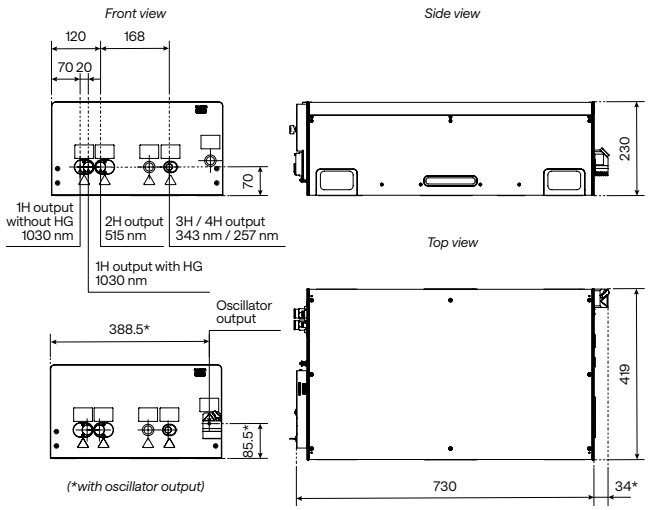



Timing jitter stability over 14 h
**PHAROS** oscillator locked to a 2.8 GHz RF source

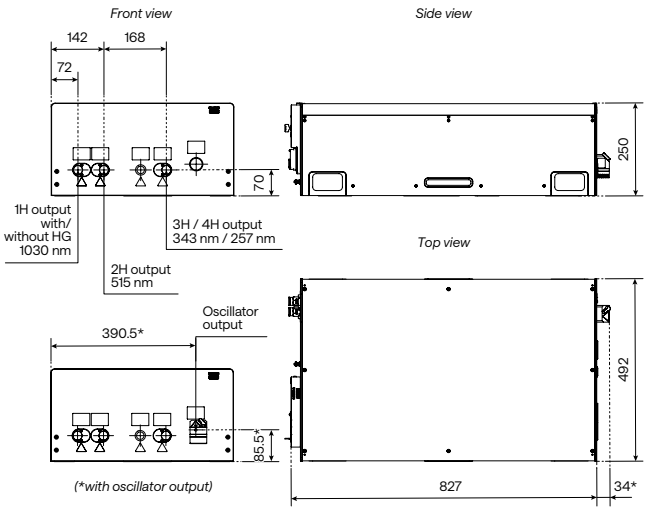



## Drawings

**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 -4mJ




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

# 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

**BELGIUM, NETHERLANDS, LUXEMBOURG**
**Laser 2000 Benelux C.V.**
Vinkeveen, Netherlands
Phone: +31 297 266191
info@laser2000.nl
www.laser2000.nl

**BRAZIL**
**Photonics Ltda**
São Paulo, Brazil
Phone: +55 11 2839 3209
info@photonics.com.br
www.photonics.com.br

**CHINA**
**Light Conversion China**
Shenzhen, China
Phone: +86 189 4874 5558
sales.china@cn.lightcon.com

**Beijing Light-Quantum Technology Co., Ltd.**
Beijing, China
Phone: +86 10 8290 0415
sales@light-quantum.cn
www.light-quantum.cn

**Genuine Optronics Limited**
Shanghai, China
Phone: +86 21 64 325 169
jye@gen-opt.com
www.gen-opt.com

**CZECH REPUBLIC, SLOVAKIA**
**Femtonika s.r.o.**
Zbýšov, Czech Republic
Phone: +420 792 417 400
info@femtonika.cz
www.femtonika.cz

**FRANCE, SWITZERLAND, BELGIUM**
**Jean-François Poisson**
Industrial Market Development Manager
Phone: +33 674 48 0778
jf.poisson@lightcon.com

**FRANCE, SWITZERLAND**
**Frédéric Berthillier**
Scientific Market Development Manager
Phone: +33 745 014 410
frederic.berthillier@lightcon.com

**GERMANY, AUSTRIA, SWITZERLAND**
**Ulrich Höchner**
Industrial Market Development Manager
Phone: +49 157 8202 5058
u.hoechner@lightcon.com

**Christian Hellwig**
Scientific Market Development Manager
Phone: +49 174 204 9053
christian.hellwig@lightcon.com

**Stefan Piontek**
Scientific Market Development Manager
Mobile +49 176 8345 7119
stefan.piontek@lightcon.com

**INDIA**
**Anatech Laser Instruments Pvt. Ltd.**
Mumbai, India
Phone: +91 22 4121 0001 / 02 / 03
sales@anatechlaser.com
www.anatechlaser.com

**ISRAEL**
**ROSH Electroptics Ltd.**
Netanya, Israel
Phone: +972 (0)9 862 7401
info@roshelop.co.il
www.roshelop.co.il

**ITALY**
**Optoprim S.r.l.**
Vimercate, Italy
Phone: +39 039 834 977
info@optoprim.it
www.optoprim.it

**JAPAN**
**Phototechnica Corp.**
Saitama, Japan
Phone: +81 48 871 0067
voc@phototechnica.co.jp
www.phototechnica.co.jp

**KOREA**
**Light Conversion Korea**
Daejeon, Korea
Phone: +82 42 368 1010
jungsik.seo@lightcon.com

**POLAND**
**Amecam**
Warszawa, Poland
Phone: +48 602 500 680
amecam@amecam.pl
www.amecam.pl

**SINGAPORE**
**Acexon Technologies Pte Ltd.**
Singapore
Phone: +65 6565 7300
sales@acexon.com
www.acexon.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

**SWITZERLAND**
**GMP SA**
Renens, Switzerland
Phone: +41 21 633 21 21
info@gmp.ch
www.gmp.ch

**TAIWAN**
**Alaser Co. Ltd.**
Taipei, Taiwan
Phone: +886 2 2377 3118
alexfu@alaser.com.tw
www.alaser.com.tw

**TURKEY**
**Innova Teknoloji Ltd.**
İstanbul, Turkey
Phone: +90 216 315 03 36
eryetistir@innova-teknoloji.com
www.innova-teknoloji.com

**UNITED KINGDOM**
**Photonic Solutions Ltd.**
Edinburgh, United Kingdom
Phone: +44 (0) 131 664 8122
ben.agate@photonicsolutions.co.uk
www.photonicsolutions.co.uk

**USA, CANADA**
**Light Conversion-USA, Inc.**
Bozeman, MT, USA
Phone: +1 833 685 2872
saleslc@lightcon-usa.com

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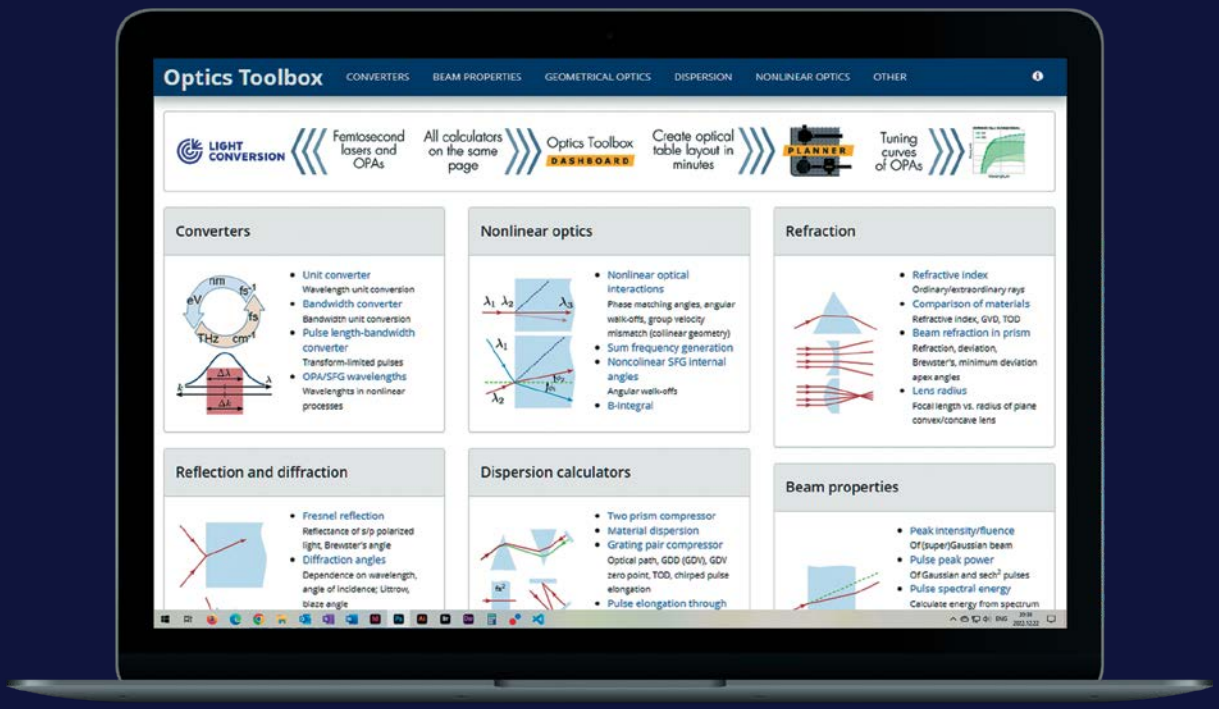


All calculators on the same page  Optical table layout planner  Custom OPA tuning curves