

ORPHEUS | NEO

Next-Generation Optical Parametric Amplifier

FEATURES

- From UV to MIR
- Continuous power monitoring and diagnostics
- Pumped by PHAROS-UP for ultrashort pulses
- Up to 80 W, 800 μ J pump at up to 2 MHz
- Fully integrated wavelength extensions
- Second repetition rate pump option
- Exceptional output stability

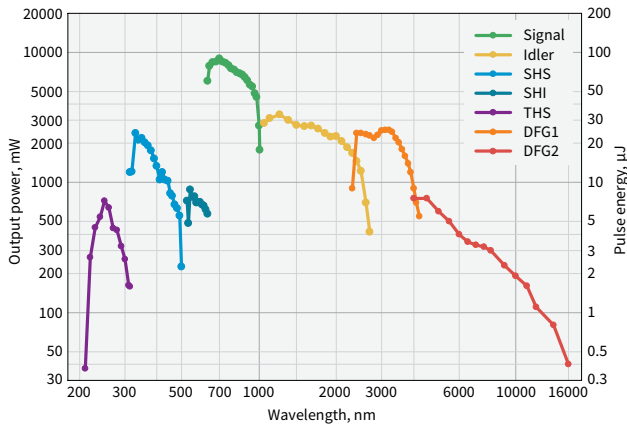


ORPHEUS-NEO is the next-generation optical parametric amplifier. With its simple-to-use and hassle-free design, ORPHEUS-NEO emerges as an invaluable tool in even the most demanding scientific applications.

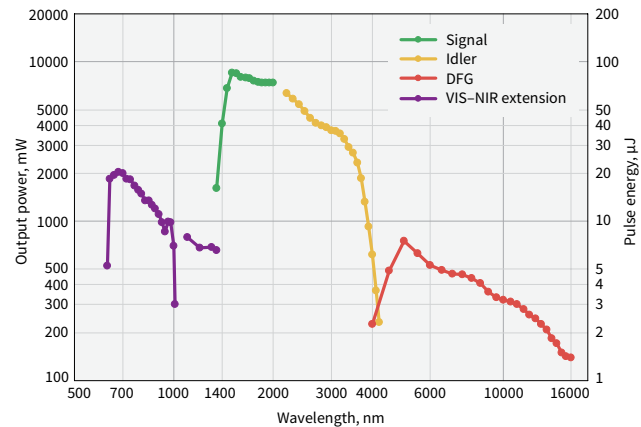
The ORPHEUS-NEO is available in several different configurations providing high-power UV – MIR (210 – 16000 nm). Furthermore, ORPHEUS-NEO can be pumped by sub-100 fs PHAROS-UP, see ORPHEUS-NEO-UP and ORPHEUS-NEO-ONE-UP.

Thanks to its robust industrial design, all configurations ensure remarkable long-term stability. Most importantly, the device is equipped with multiple detectors for pump beam position tracking and continuous monitoring of output parameters. This results in the fastest remote diagnostics and troubleshooting capability.

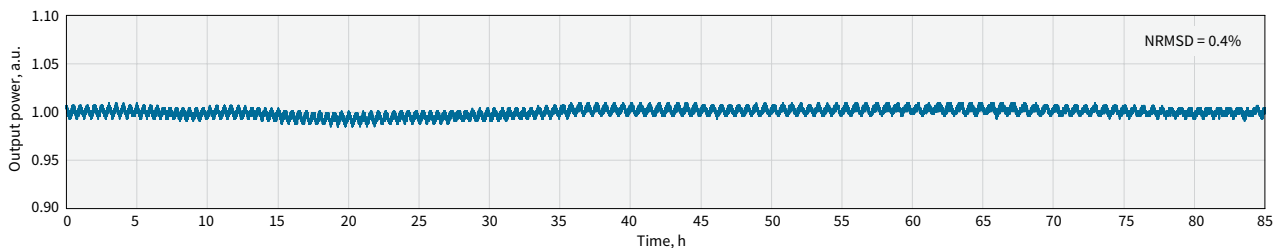
Inspired by the most demanding users, ORPHEUS-NEO has been engineered to become the most stable and versatile tool in ultrafast spectroscopy, and many other scientific applications.



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



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



Typical long-term power stability of **ORPHEUS-NEO** at 800 nm

ORPHEUS-NEO SPECIFICATIONS

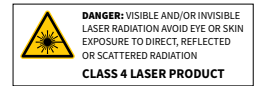
| Model | ORPHEUS-NEO | ORPHEUS-NEO-ONE |
|--|--|---|
| Configuration | ORPHEUS | ORPHEUS-ONE |
| Pump power | Up to 80 W | |
| Pump pulse energy | 20 – 800 μJ | |
| Repetition rate ¹⁾ | Up to 2 MHz | |
| Tuning range | 640 – 1000 nm (Signal) 1050 – 2600 nm (Idler) | 1350 – 2000 nm (Signal) 2100 – 4500 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) |
| | > 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 | 80 – 220 cm ⁻¹ @ 700 – 960 nm | 60 – 150 cm ⁻¹ @ 1450 – 2000 nm |
| Pulse duration ²⁾ | 120 – 250 fs | 100 – 300 fs |
| 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); > 0.4% at 250 nm | 640 – 1000 nm and 1050 – 1350 nm (VIS–NIR); > 1% at 700 nm |
| | 320 – 500 nm (SHS) and 525 – 640 nm (SHI); > 1.2% at 350 nm | |
| | 2500 – 4500 nm (DFG1); > 3% at 3000 nm | |
| | 4500 – 16000 nm (DFG2); > 0.2% at 10000 nm | |

¹⁾ Second repetition rate pump option (up to 20 μJ) is available for signal and extension range in HP configuration; contact sales@lightcon.com

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

³⁾ FW 1/e², measured at laser output, using maximum pulse energy.

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



ORPHEUS-NEO-UP SPECIFICATIONS

NEW

| 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 ¹⁾ | Up to 1 MHz | |
| Tuning range | 640 – 1000 nm (Signal) 1050 – 2600 nm (Idler) | 1450 – 2000 nm (Signal) 2100 – 4500 nm (Idler) |
| Conversion efficiency | > 7% @ 700 nm | > 9% @ 1550 nm |
| Spectral bandwidth | 120 – 250 cm ⁻¹ @ 700 – 2600 nm | 150 – 250 cm ⁻¹ @ 1500 – 1900 nm & 2200 – 3500 nm ²⁾ |
| Pulse duration ³⁾ | < 100 fs @ 700 – 1000 nm < 120 fs @ 1060 – 2000 nm | < 100 fs @ 1500 – 1900 nm |
| Beam quality (M ²) | < 1.3 @ 800 nm | < 1.3 @ 1550 nm |
| Beam diameter ⁴⁾ | 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 ⁵⁾ | < 1% @ 800 nm | < 1% @ 1550 nm |
| Pulse-to-pulse energy stability, 1 min ⁵⁾ | < 1% @ 800 nm | < 1% @ 1550 nm |
| Wavelength extension options; conversion efficiency | 210 – 320 nm (THS); > 0.2% at 250 nm | 640 – 1000 nm and 1050 – 1450 nm (VIS–NIR); > 1% at 700 nm |
| | 320 – 500 nm (SHS) and 525 – 640 nm (SHI); > 1.2% at 350 nm | |
| | 2500 – 4500 nm (DFG1); > 3% at 3000 nm | |
| | 4500 – 14000 nm (DFG2); > 0.1% at 10000 nm | |

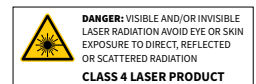
¹⁾ Second repetition rate pump option (up to 20 μJ) is available for signal and extension range in HP configuration; contact sales@lightcon.com

²⁾ Spectral bandwidth is equal to 150 – 250 cm⁻¹ @ 5000 – 12000 nm.

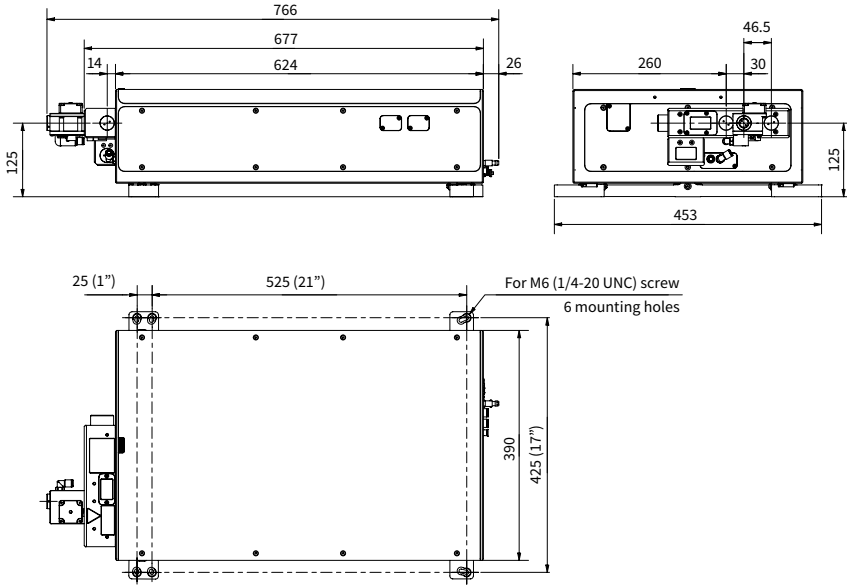
³⁾ Output pulse duration depends on selected wavelength and pump laser pulse duration.

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

⁵⁾ Expressed as NRMSD (normalized root mean squared deviation).



DRAWINGS



ORPHEUS-NEO / ORPHEUS-NEO-UP drawings

ORPHEUS

Collinear Optical Parametric Amplifier

FEATURES

- Continuous tunability from UV to MIR, 190 – 16000 nm
- High energy and high power models for all needs
- Single-shot – 2 MHz repetition rate
- Up to 80 W pump power
- Up to 2 mJ pump pulse energy

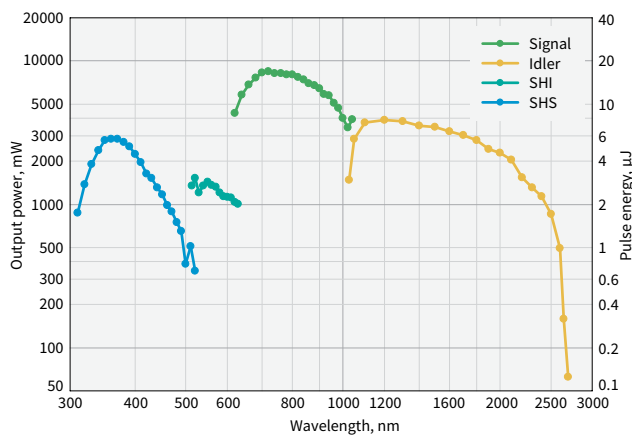


ORPHEUS is a collinear optical parametric amplifier (OPA). Coupled with a PHAROS or CARBIDE femtosecond laser, ORPHEUS emits femtosecond pulses tunable from UV to MIR at a repetition rate of up to 2 MHz. Thus, it is an invaluable tool for ultrafast spectroscopy, nonlinear microscopy, and microstructuring applications.

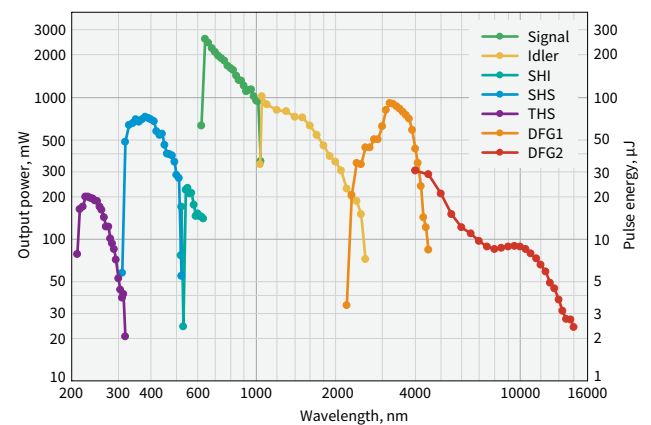
The ORPHEUS collinear OPA comes in different configurations to perfectly match the scientific needs. The ORPHEUS-HP accepts high-power pump and provides a wide tuning

range from 630 to 2600 nm, which is extendable from 210 to 16000 nm using wavelength extensions option integrated into a thermally-stabilized housing. Its wavelength tuning and separation is completely hands-free. The ORPHEUS-HE configuration brings the aforementioned automation but also accepts high pulse energy and goes down to 190 nm with DUV extension.

For compact single-box solution, refer to I-OPA. For the PHAROS-UP ultrashort-pulse laser, refer to ORPHEUS-NEO.



Typical tuning curves of **ORPHEUS-HP**.
Pump: 80 W, 160 µJ, 500 kHz



Typical tuning curves of **ORPHEUS-HE**.
Pump: 20 W, 2 mJ, 10 kHz

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

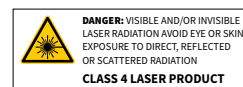
SPECIFICATIONS

| Model | ORPHEUS-HP | | ORPHEUS-HE |
|--|--|-------------------------------|-------------------------------|
| MAIN OUTPUT (630 – 2600 nm) | | | |
| Tuning range | 630 – 1030 nm (Signal) 1030 – 2600 nm (Idler) | | |
| Maximum pump power | 80 W | | |
| Pump pulse energy | 8 – 20 μJ | 20 – 400 μJ | 400 – 2000 μJ |
| Conversion efficiency at peak | > 4.5% (Signal) > 2% (Idler) | > 9% (Signal) > 4% (Idler) | |
| Pulse duration | 120 – 250 fs | | |
| Spectral bandwidth @ 700 – 960 nm | 75 – 220 cm ⁻¹ | | |
| Long-term power stability, 8 h ¹⁾ | < 2% @ 800 nm | | |
| Pulse-to-pulse energy stability, 1 min ¹⁾ | < 2% @ 800 nm | | |
| WAVELENGTH EXTENSIONS (190 – 16000 nm) | | | |
| Pump pulse energy | 8 – 20 μJ | 20 – 400 μJ | 400 – 2000 μJ |
| SH package at peak 315 – 515 nm (SHS) 515 – 630 nm (SHI) | > 1.2% | > 2.4% | |
| 210 – 315 nm (THS) | > 0.4% ²⁾ | > 0.8% ²⁾ | |
| 190 – 215 nm (DUV) | n/a | > 0.3% ³⁾ | Contact sales@lightcon.com |
| 2200 – 4200 nm (DFG1) | > 1.5% @ 3000 nm | > 3% @ 3000 nm | |
| 4000 – 16 000 nm (DFG2) | > 0.1% @ 10000 nm | > 0.2% @ 10000 nm | |

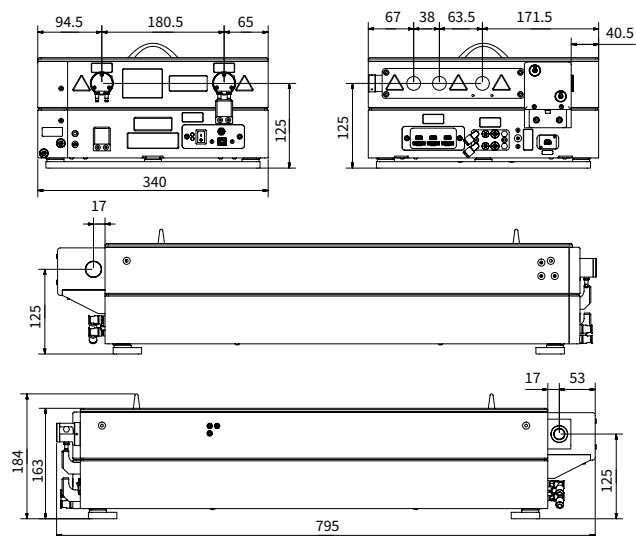
¹⁾ Expressed as NRMSD (normalized root mean squared deviation).

²⁾ Maximum output power of 400 mW.

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



DRAWINGS



ORPHEUS-HP drawings


www.phototechnica.co.jp
 フォトテクニカ株式会社
 〒336-0017 埼玉県さいたま市南区南浦和 1-2-17
 TEL:048-871-0067 FAX:048-871-0068
 e-mail:voc@phototechnica.co.jp

ORPHEUS | F

Broad-Bandwidth Hybrid Optical Parametric Amplifier

FEATURES

- Combination of best collinear and non-collinear OPA features
- 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



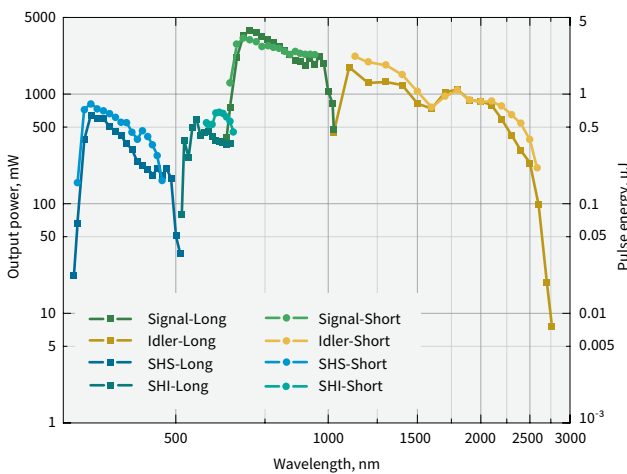
ORPHEUS-F is a hybrid optical parametric amplifier (OPA), combining the short pulse duration produced by a non-collinear OPA (NOPA) and the wide tuning range offered by a collinear OPA.

The Signal pulses of ORPHEUS-F are tunable in a 650 – 900 nm range and can be compressed with a simple prism-based compressor down to 25 – 70 fs pulse duration. The Idler pulses are tunable in a 1200 – 2500 nm range and reach pulse duration of 40 – 100 fs. In addition, a long-pulse mode is

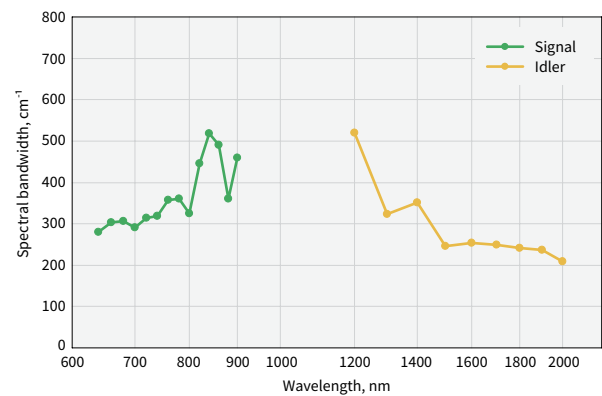
available for accessing the 900 – 1200 nm tuning range; thus, enabling a gap-free tunability.

ORPHEUS-F provides significantly shorter pulses compared to the standard ORPHEUS model and a wider tuning range compared to the non-collinear ORPHEUS-N. Thus, for many scientific applications, ORPHEUS-F is the optimal choice.

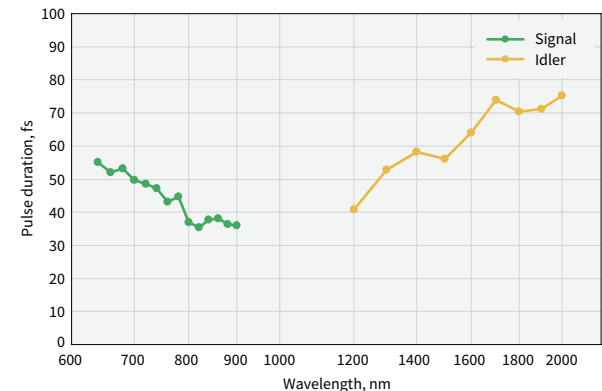
For compact single-box solution, refer to I-OPA in ORPHEUS-F configuration.



Typical tuning curves of **ORPHEUS-F**.
Pump: 40 W, 40 μJ, 1000 kHz



Typical spectral bandwidth of ORPHEUS-F



Pulse duration after compression of ORPHEUS-F

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

SPECIFICATIONS

| | | |
|--|---|--|
| Model | ORPHEUS-F | |
| 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) 1200 – 2500 nm (Idler) | 650 – 1010 nm (Signal) 1050 – 2500 nm (Idler) |
| Maximum pump power | 80 W | |
| Pump pulse energy | 10 – 500 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 | 75 – 220 cm ⁻¹ @ 650 – 900 nm |
| Pulse duration after compressor ¹⁾ | < 55 fs @ 800 – 900 nm < 70 fs @ 650 – 800 nm < 100 fs @ 1200 – 2000 nm | n/a |
| Compressor transmission | > 65% @ 650 – 900 nm > 80% @ 1200 – 2000 nm | |
| Long-term power stability, 8h ⁴⁾ | < 2% @ 800 nm | |
| Pulse-to-pulse energy stability, 1 min ⁴⁾ | < 2% @ 800 nm | |

WAVELENGTH EXTENSION OPTIONS (325 – 15000 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) | | > 0.1% |
| 263 – 325 nm (FHI) | n/a | |
| 2500 – 15000 nm | See ORPHEUS-MIR (page 42) | |

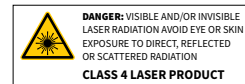
¹⁾ In short pulse mode, broadband pulses are compressed externally. Typical pulse duration before compression: 120 – 250 fs, after compression: 25 – 70 fs @ 650 – 900 nm, 40 – 100 fs @ 1200 – 2000 nm.

²⁾ Specified as percentage of pump power, before compressor. Conversion efficiency at peak is equal to 10% for signal and idler combined.

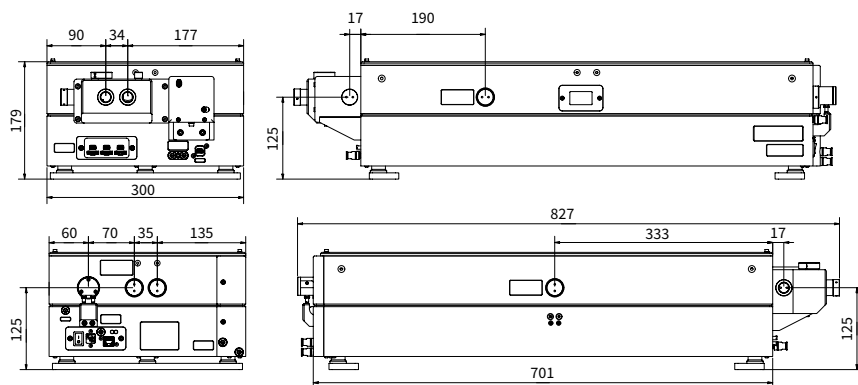
³⁾ At designated output port; not simultaneous to OPA output.

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

⁵⁾ For > 15 μJ pump pulse energy.



DRAWINGS



ORPHEUS-F drawings

**PHOTO
TECHNICA** www.phototechnica.co.jp
フォトテクニカ株式会社
 〒336-0017 埼玉県さいたま市南区南浦和 1-2-17
 TEL:048-871-0067 FAX:048-871-0068
 e-mail:voc@phototechnica.co.jp

ORPHEUS | MIR



Broad-Bandwidth Mid-Infrared Optical Parametric Amplifier

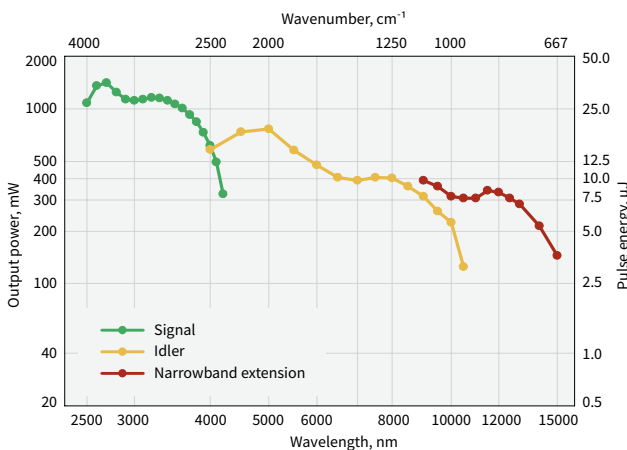
FEATURES

- Broad-bandwidth MIR pulses at high repetition rate
- Continuously tunable in 2500 – 15000 nm range
- Short-pulse high-energy auxiliary output at 2000 nm
- Pumped by industrial-grade lasers for high stability
- CEP-stable option

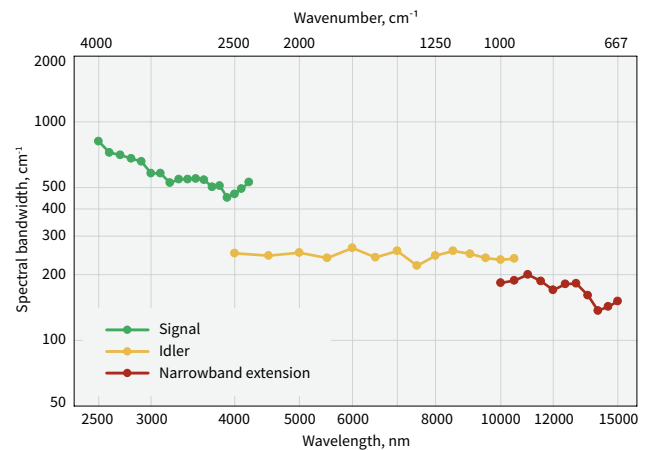


ORPHEUS-MIR is an optical parametric amplifier (OPA) optimized for the efficient generation of broad-bandwidth MIR pulses. The laser system provides ultrashort pulses in the tuning range of 2.5 – 10 μm and reaches up to 15 μm with a narrow-bandwidth extension. Due to the novel system design, ORPHEUS-MIR provides < 100 fs pulses directly at the output. Signal and Idler outputs are available simultaneously. The system architecture is well-suited for high-energy and high-power PHAROS and CARBIDE femtosecond pump lasers. ORPHEUS-MIR serves as an excellent high-repetition-rate

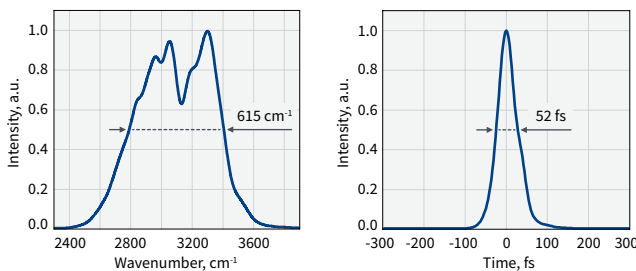
source for spectroscopy, such as two-dimensional infrared (2D IR) and vibrational sum-frequency generation (SFG) spectroscopy. Combined with a narrow-bandwidth output of SHBC, it forms a compact laser system for SFG measurements, covering most of the MIR spectrum in a single shot and providing high spectral resolution. In addition, its high output stability is the key to fast and high-quality SFG imaging. Furthermore, for MIR applications requiring CEP-stable pulses, ORPHEUS-MIR provides unique CEP-stable option in the complete 2500 – 15000 nm range.



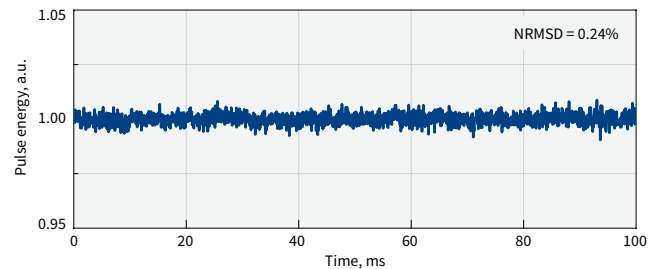
Typical tuning curves of **ORPHEUS-MIR**.
Pump: 80 W, 2 mJ, 40 kHz



Typical spectral bandwidth of **ORPHEUS-MIR**



Typical output spectrum (left) and pulse duration (right).
Measured at ≈ 3000 nm



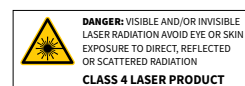
Pulse-to-pulse energy stability of **ORPHEUS-MIR**.
Measured at ≈ 3000 nm

SPECIFICATIONS

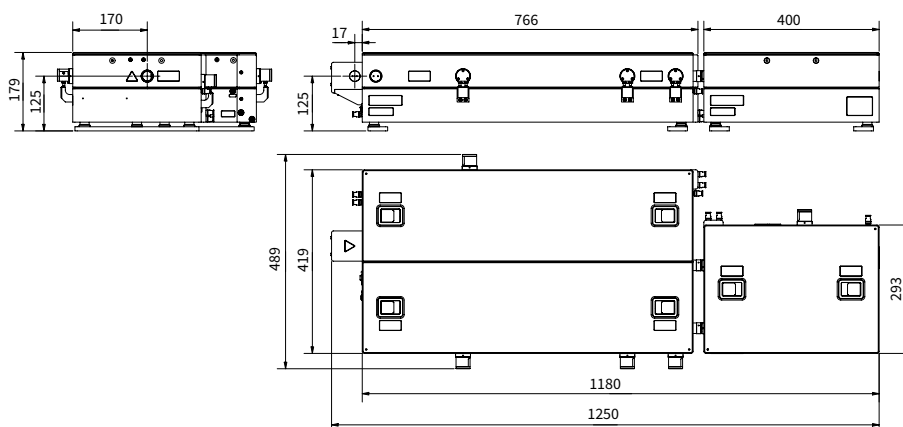
| Model | ORPHEUS-MIR | |
|--|---|--|
| MAIN OUTPUT (2500 – 10000 nm) | | |
| Mode of operation | Non-collinear | Collinear ¹⁾ NEW |
| Tuning range | 2500 – 4000 nm (Signal) 4000 – 10000 nm (Idler) | 2500 – 4500 nm (Signal) 4500 – 10000 nm (Idler) |
| Maximum pump power | 80 W | |
| Pump pulse energy | 200 μJ – 3 mJ | |
| Pulse duration | < 100 fs | < 400 fs (< 100 fs with dispersion compensation) ¹⁾ |
| Conversion efficiency ²⁾ | > 1.2% @ 3000 nm > 1.0% @ 3500 nm > 0.6% @ 5000 nm > 0.3% @ 9000 nm | |
| Spectral bandwidth ³⁾ | > 300 cm ⁻¹ @ 2500 – 4000 nm > 200 cm ⁻¹ @ 4000 – 10000 nm | |
| Long-term power stability, 8 h ⁴⁾ | < 2% @ 5000 nm | |
| Pulse-to-pulse energy stability, 1 min ⁴⁾ | < 2% @ 5000 nm | |
| AUXILIARY OUTPUT 1 (2000 nm) | | |
| Output wavelength ⁵⁾ | 2000 ± 100 nm | |
| Pulse duration | < 50 fs | |
| Conversion efficiency ²⁾ | > 8% | |
| Spectral bandwidth | > 350 cm ⁻¹ | |
| AUXILIARY OUTPUT 2 (1350 – 2000 nm) | | |
| Tuning range ⁶⁾ | 1350 – 2000 nm | |
| Pulse duration | < 300 fs | |
| Conversion efficiency ²⁾ | Contact sales@lightcon.com | |
| Spectral bandwidth | 60 – 150 cm ⁻¹ | |
| WAVELENGTH EXTENSION (10000 – 15000 nm) | | |
| Tuning range ⁷⁾ | 10000 – 15000 nm | n/a |
| Pulse duration | < 300 fs | |
| Conversion efficiency ²⁾ | > 0.2% @ 12000 nm | |
| Spectral bandwidth | 100 – 200 cm ⁻¹ | |

¹⁾ Collinear mode is achieved with additional external separator box. Dispersion compensation is optional.
²⁾ Specified as a percentage of pump power.
³⁾ FWHM (full width at half maximum).
⁴⁾ Expressed as NRMSD (normalized root mean squared deviation).

⁵⁾ Not tunable, optimized for best overall performance. Not simultaneous to OPA output.
⁶⁾ Simultaneous to OPA output. Available on request.
⁷⁾ Not available in collinear-output configuration.



DRAWINGS



ORPHEUS-MIR drawings

ORPHEUS | ONE

Mid-Infrared Collinear Optical Parametric Amplifier

FEATURES

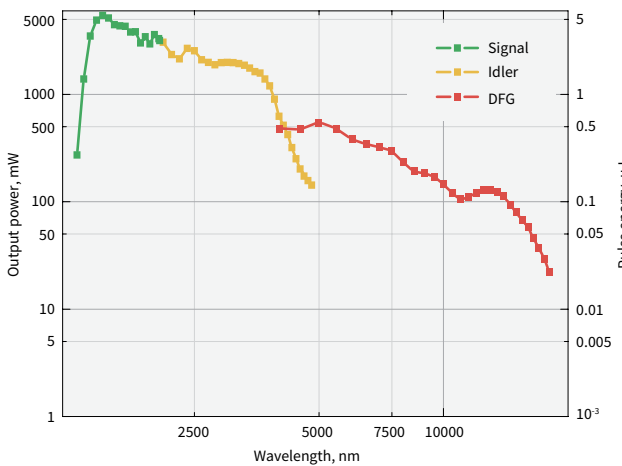
- High conversion efficiency in MIR, 1350 – 16000 nm
- High energy and high power models for all needs
- Single-shot – 2 MHz repetition rate
- Up to 80 W pump power
- Up to 2 mJ pump pulse energy



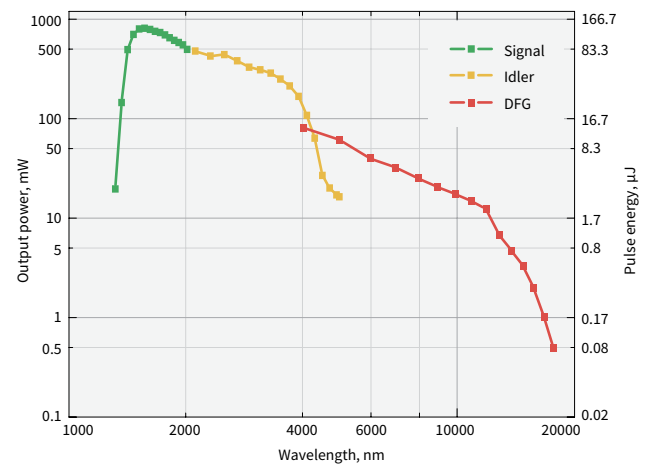
ORPHEUS-ONE is an optical parametric amplifier (OPA) designed for the mid-infrared (MIR) spectral range from 1350 to 16000 nm. Compared to ORPHEUS-HP, it has fewer wavelength extension options but provides higher pump laser conversion efficiency into MIR.

The ORPHEUS-ONE offer the same tuning range, are reliable and easy to use, but vary based on the design automation and pump parameters. The ORPHEUS-ONE-HP enables up to 80 W

pump power, while the ORPHEUS-ONE-HE accepts the same pump power but also pulse energy of up to 2 mJ. The spectral bandwidth of ORPHEUS-ONE output is defined by the pump laser pulses; thus, for sum-frequency generation (SFG) spectroscopy and other applications requiring broad-bandwidth infrared pulses – refer to ORPHEUS-MIR. For compact single-box solution, refer to I-OPA. For the PHAROS-UP ultrashort-pulse laser, refer to ORPHEUS-NEO.



Typical tuning curves of **ORPHEUS-ONE-HP**.
Pump: 40 W, 40 µJ, 1000 kHz



Typical tuning curves of **ORPHEUS-ONE-HE**.
Pump: 6 W, 1 mJ, 6 kHz

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

ORPHEUS | MIR



Broad-Bandwidth Mid-Infrared Optical Parametric Amplifier

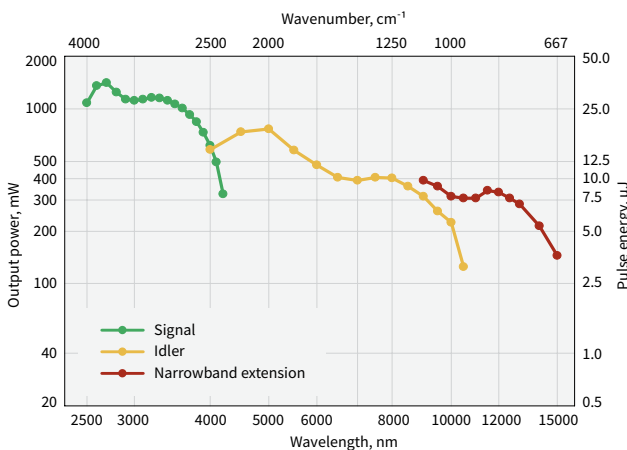
FEATURES

- Broad-bandwidth MIR pulses at high repetition rate
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- CEP-stable option

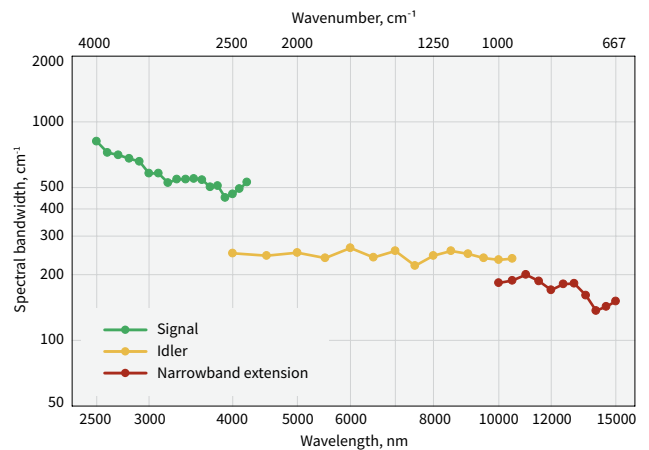


ORPHEUS-MIR is an optical parametric amplifier (OPA) optimized for the efficient generation of broad-bandwidth MIR pulses. The laser system provides ultrashort pulses in the tuning range of 2.5 – 10 μm and reaches up to 15 μm with a narrow-bandwidth extension. Due to the novel system design, ORPHEUS-MIR provides < 100 fs pulses directly at the output. Signal and Idler outputs are available simultaneously. The system architecture is well-suited for high-energy and high-power PHAROS and CARBIDE femtosecond pump lasers. ORPHEUS-MIR serves as an excellent high-repetition-rate

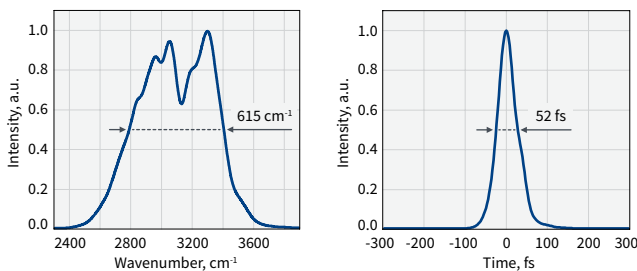
source for spectroscopy, such as two-dimensional infrared (2D IR) and vibrational sum-frequency generation (SFG) spectroscopy. Combined with a narrow-bandwidth output of SHBC, it forms a compact laser system for SFG measurements, covering most of the MIR spectrum in a single shot and providing high spectral resolution. In addition, its high output stability is the key to fast and high-quality SFG imaging. Furthermore, for MIR applications requiring CEP-stable pulses, ORPHEUS-MIR provides unique CEP-stable option in the complete 2500 – 15000 nm range.



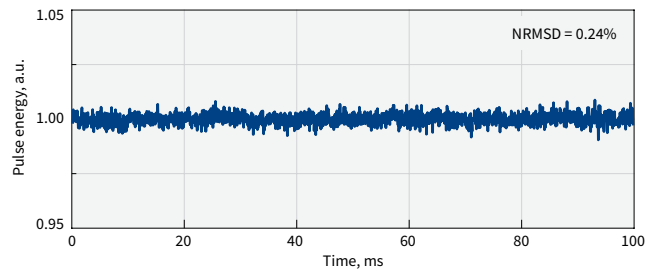
Typical tuning curves of **ORPHEUS-MIR**.
Pump: 80 W, 2 mJ, 40 kHz



Typical spectral bandwidth of **ORPHEUS-MIR**



Typical output spectrum (left) and pulse duration (right).
Measured at ≈ 3000 nm



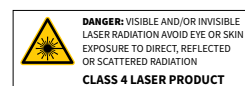
Pulse-to-pulse energy stability of **ORPHEUS-MIR**.
Measured at ≈ 3000 nm

SPECIFICATIONS

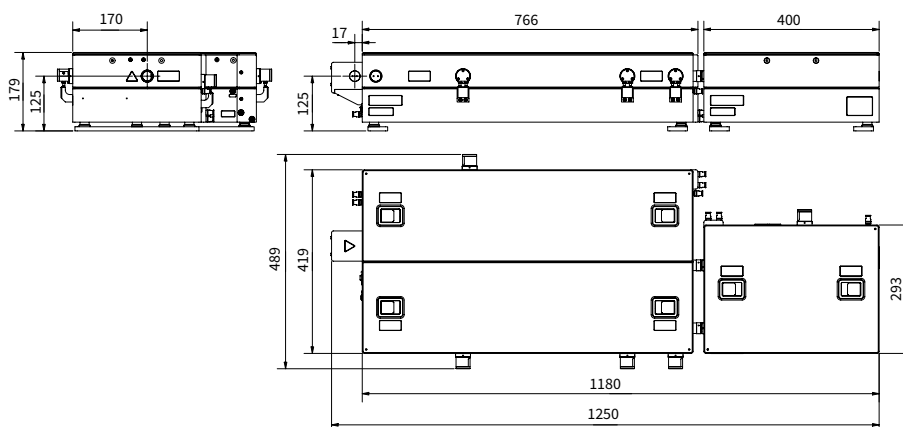
| Model | ORPHEUS-MIR | |
|--|---|--|
| MAIN OUTPUT (2500 – 10000 nm) | | |
| Mode of operation | Non-collinear | Collinear ¹⁾ NEW |
| Tuning range | 2500 – 4000 nm (Signal) 4000 – 10000 nm (Idler) | 2500 – 4500 nm (Signal) 4500 – 10000 nm (Idler) |
| Maximum pump power | 80 W | |
| Pump pulse energy | 200 μJ – 3 mJ | |
| Pulse duration | < 100 fs | < 400 fs (< 100 fs with dispersion compensation) ¹⁾ |
| Conversion efficiency ²⁾ | > 1.2% @ 3000 nm > 1.0% @ 3500 nm > 0.6% @ 5000 nm > 0.3% @ 9000 nm | |
| Spectral bandwidth ³⁾ | > 300 cm ⁻¹ @ 2500 – 4000 nm > 200 cm ⁻¹ @ 4000 – 10000 nm | |
| Long-term power stability, 8 h ⁴⁾ | < 2% @ 5000 nm | |
| Pulse-to-pulse energy stability, 1 min ⁴⁾ | < 2% @ 5000 nm | |
| AUXILIARY OUTPUT 1 (2000 nm) | | |
| Output wavelength ⁵⁾ | 2000 ± 100 nm | |
| Pulse duration | < 50 fs | |
| Conversion efficiency ²⁾ | > 8% | |
| Spectral bandwidth | > 350 cm ⁻¹ | |
| AUXILIARY OUTPUT 2 (1350 – 2000 nm) | | |
| Tuning range ⁶⁾ | 1350 – 2000 nm | |
| Pulse duration | < 300 fs | |
| Conversion efficiency ²⁾ | Contact sales@lightcon.com | |
| Spectral bandwidth | 60 – 150 cm ⁻¹ | |
| WAVELENGTH EXTENSION (10000 – 15000 nm) | | |
| Tuning range ⁷⁾ | 10000 – 15000 nm | n/a |
| Pulse duration | < 300 fs | |
| Conversion efficiency ²⁾ | > 0.2% @ 12000 nm | |
| Spectral bandwidth | 100 – 200 cm ⁻¹ | |

¹⁾ Collinear mode is achieved with additional external separator box. Dispersion compensation is optional.
²⁾ Specified as a percentage of pump power.
³⁾ FWHM (full width at half maximum).
⁴⁾ Expressed as NRMSD (normalized root mean squared deviation).

⁵⁾ Not tunable, optimized for best overall performance. Not simultaneous to OPA output.
⁶⁾ Simultaneous to OPA output. Available on request.
⁷⁾ Not available in collinear-output configuration.



DRAWINGS



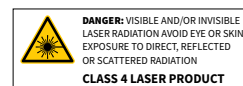
ORPHEUS-MIR drawings

SPECIFICATIONS

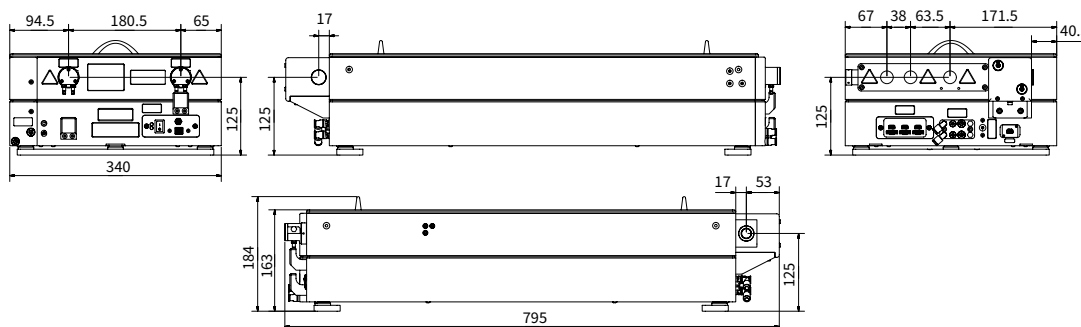
| Model | ORPHEUS-ONE-HP | ORPHEUS-ONE-HE |
|--|--|--------------------|
| MAIN OUTPUT | | |
| Tuning range | 1350 – 2000 nm (Signal) 2100 – 4500 nm (Idler) | |
| Maximum pump power | 80 W | |
| Pump pulse energy | 12 – 400 μ J | 400 – 2000 μ J |
| Conversion efficiency ¹⁾ @ 1550 nm | > 9%, 30 – 2000 μ J pump > 6%, 12 – 30 μ J pump | |
| Spectral bandwidth | 60 – 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 | 4500 – 16000 nm (DFG) | |
| Conversion efficiency ¹⁾ | > 0.3% @ 10000 nm, 30 – 2000 μ J pump > 0.2% @ 10000 nm, 12 – 30 μ J pump | |
| Spectral bandwidth | 60 – 120 cm^{-1} @ 5000 – 8000 nm | |

¹⁾ Specified as percentage of pump power.

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



DRAWINGS



ORPHEUS-ONE-HP drawings


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 TEL:048-871-0067 FAX:048-871-0068
 e-mail:voc@phototechnica.co.jp

ORPHEUS | N

Non-Collinear Optical Parametric Amplifier

FEATURES

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

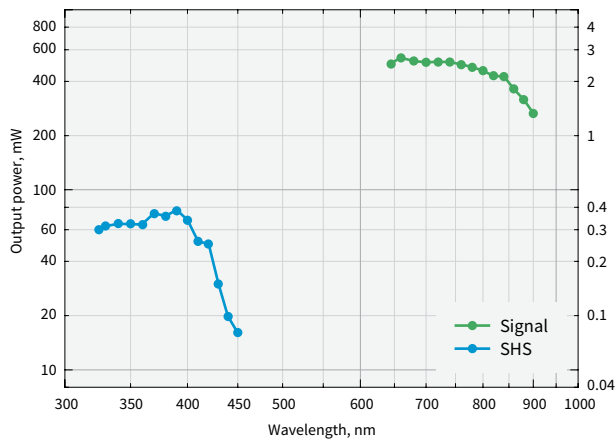


ORPHEUS-N is a non-collinear optical parametric amplifier (NOPA). Depending on the model, ORPHEUS-N has an integrated second- or third-harmonic generator producing a 515 nm or 343 nm pump, respectively. ORPHEUS-N with a second-harmonic pump (ORPHEUS-N-2H) delivers < 30 fs pulses in the 700 – 850 nm range. ORPHEUS-N with a third harmonic pump (ORPHEUS-N-3H) delivers < 30 fs pulses in the 530 – 670 nm range. Both have built-in prism-based pulse compressor. Furthermore, an optional second harmonic

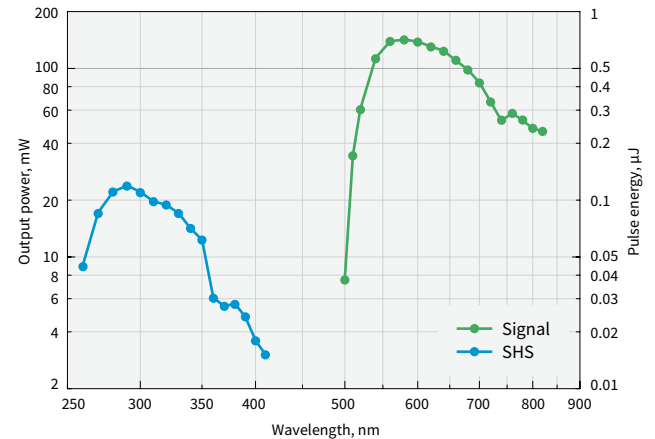
generator is available, extending the tuning range down to ultraviolet (UV) spectral range.

A single PHAROS or CARBIDE femtosecond laser can pump multiple NOPAs, providing pump and/or probe with independent wavelength tuning for your state-of-the-art experiments.

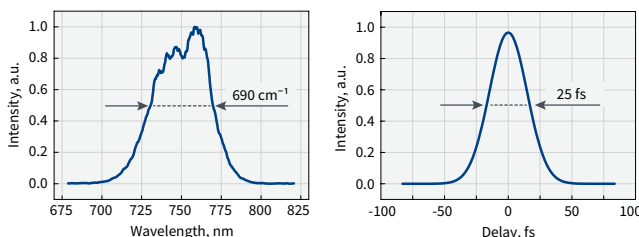
For broader tunability range, refer to ORPHEUS-F. For ultrashort pulses tunable around 500 nm, refer to ORPHEUS-VIS.



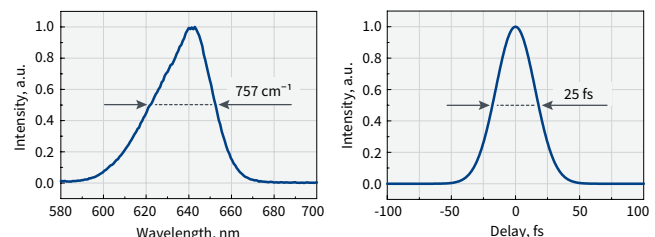
Typical tuning curves of **ORPHEUS-N-2H**
Pump: 6 W, 30 µJ, 200 kHz



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



Typical output of **ORPHEUS-N-2H**



Typical output of **ORPHEUS-N-3H**

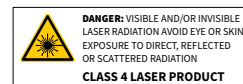
For custom tuning curves visit <http://toolbox.lightcon.com/tools/tuningcurves/>

SPECIFICATIONS

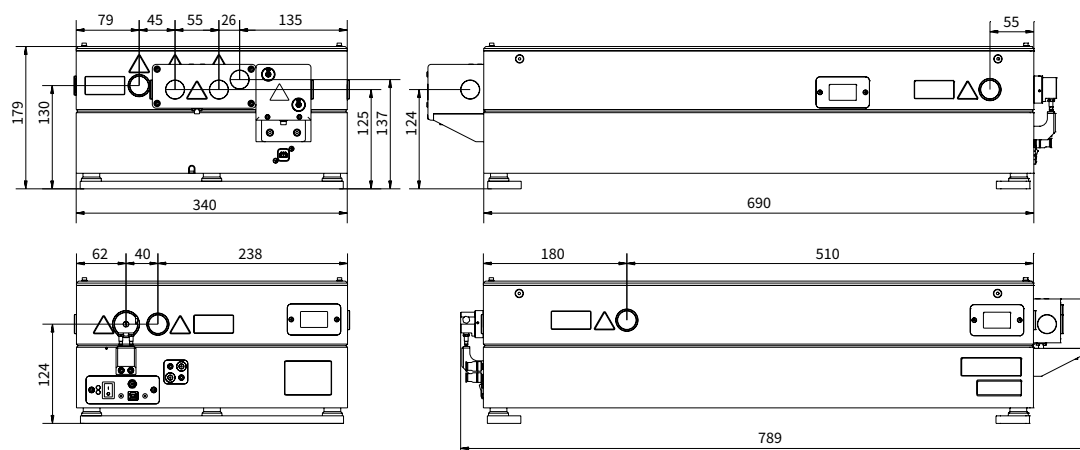
| Model | ORPHEUS-N-2H | ORPHEUS-N-3H |
|--|--------------------------------|---|
| MAIN OUTPUT | | |
| Tuning range | 650 – 900 nm (Signal) | 520 – 900 nm (Signal) |
| Maximum pump power | 8 W | |
| Pump pulse energy | 10 – 200 μ J | 12 – 200 μ J |
| Conversion efficiency | > 7% @ 700 nm > 5% @ 800 nm | > 1.3% @ 580 nm > 0.7% @ 700 nm > 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 @ 530 – 670 nm < 80 fs @ 670 – 900 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 |

¹⁾ Not simultaneous to NOPA output.

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



DRAWINGS



ORPHEUS-N drawings

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フォトテクニカ株式会社
 〒336-0017 埼玉県さいたま市南区南浦和 1-2-17
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 e-mail:voc@phototechnica.co.jp

ORPHEUS | N

Non-Collinear Optical Parametric Amplifier

FEATURES

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

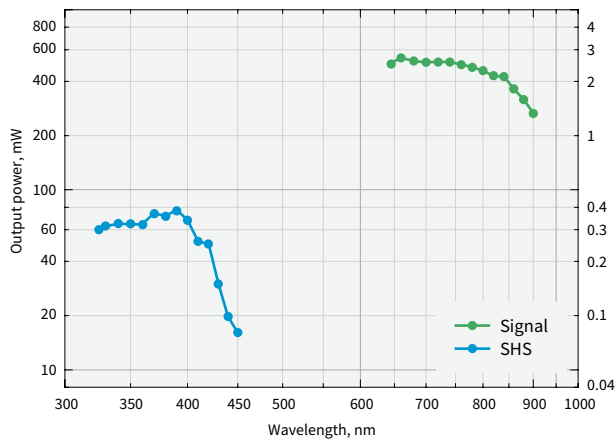


ORPHEUS-N is a non-collinear optical parametric amplifier (NOPA). Depending on the model, ORPHEUS-N has an integrated second- or third-harmonic generator producing a 515 nm or 343 nm pump, respectively. ORPHEUS-N with a second-harmonic pump (ORPHEUS-N-2H) delivers < 30 fs pulses in the 700 – 850 nm range. ORPHEUS-N with a third harmonic pump (ORPHEUS-N-3H) delivers < 30 fs pulses in the 530 – 670 nm range. Both have built-in prism-based pulse compressor. Furthermore, an optional second harmonic

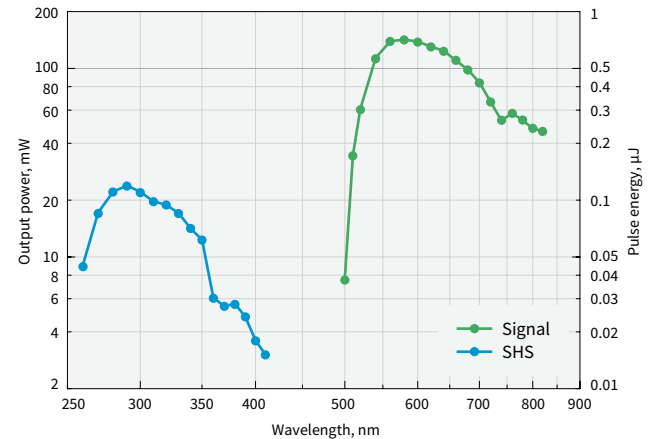
generator is available, extending the tuning range down to ultraviolet (UV) spectral range.

A single PHAROS or CARBIDE femtosecond laser can pump multiple NOPAs, providing pump and/or probe with independent wavelength tuning for your state-of-the-art experiments.

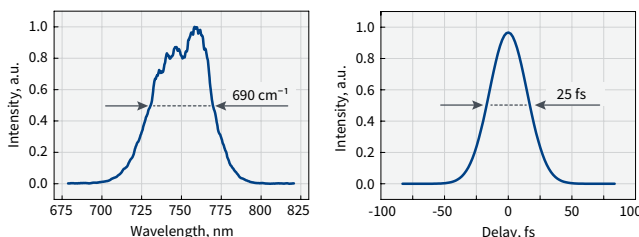
For broader tunability range, refer to ORPHEUS-F. For ultrashort pulses tunable around 500 nm, refer to ORPHEUS-VIS.



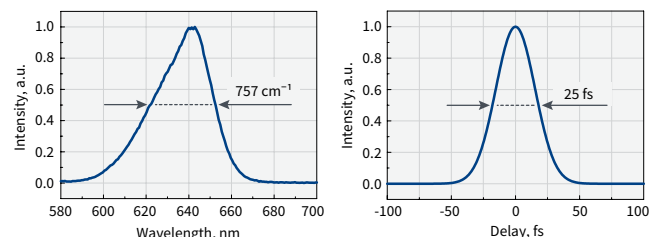
Typical tuning curves of **ORPHEUS-N-2H**
Pump: 6 W, 30 µJ, 200 kHz



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



Typical output of **ORPHEUS-N-2H**



Typical output of **ORPHEUS-N-3H**

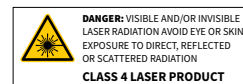
For custom tuning curves visit <http://toolbox.lightcon.com/tools/tuningcurves/>

SPECIFICATIONS

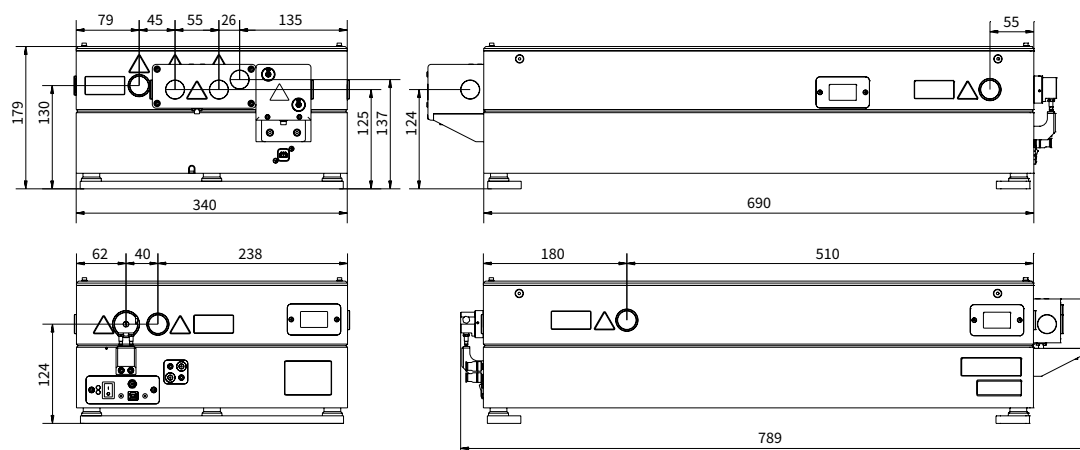
| Model | ORPHEUS-N-2H | ORPHEUS-N-3H |
|--|--------------------------------|---|
| MAIN OUTPUT | | |
| Tuning range | 650 – 900 nm (Signal) | 520 – 900 nm (Signal) |
| Maximum pump power | 8 W | |
| Pump pulse energy | 10 – 200 μ J | 12 – 200 μ J |
| Conversion efficiency | > 7% @ 700 nm > 5% @ 800 nm | > 1.3% @ 580 nm > 0.7% @ 700 nm > 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 @ 530 – 670 nm < 80 fs @ 670 – 900 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 |

¹⁾ Not simultaneous to NOPA output.

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



DRAWINGS



ORPHEUS-N drawings

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 〒336-0017 埼玉県さいたま市南区南浦和 1-2-17
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 e-mail:voc@phototechnica.co.jp

ORPHEUS | VIS

Ultrashort-Pulse VIS Optical Parametric Amplifier

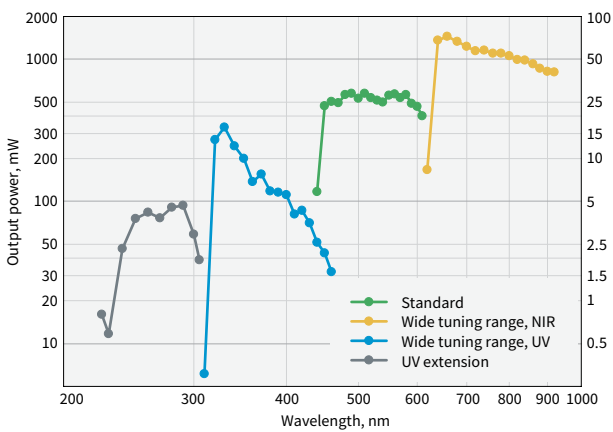
FEATURES

- Ultrashort UV – VIS – NIR output
- < 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

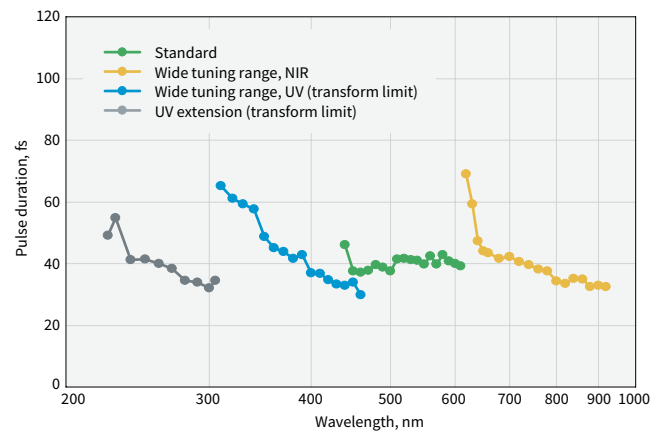


ORPHEUS-VIS is an optical parametric amplifier (OPA) optimized for the generation of high-energy short-pulse VIS output. The laser system provides ultrashort pulses in the tuning range of 450 – 600 nm or 320 – 900 nm, depending on the chosen configuration, and reaches down to 250 nm with optional UV extension. The ORPHEUS-VIS system can be coupled with PHAROS or CARBIDE femtosecond pump lasers and can be pumped with up to 20 W average power

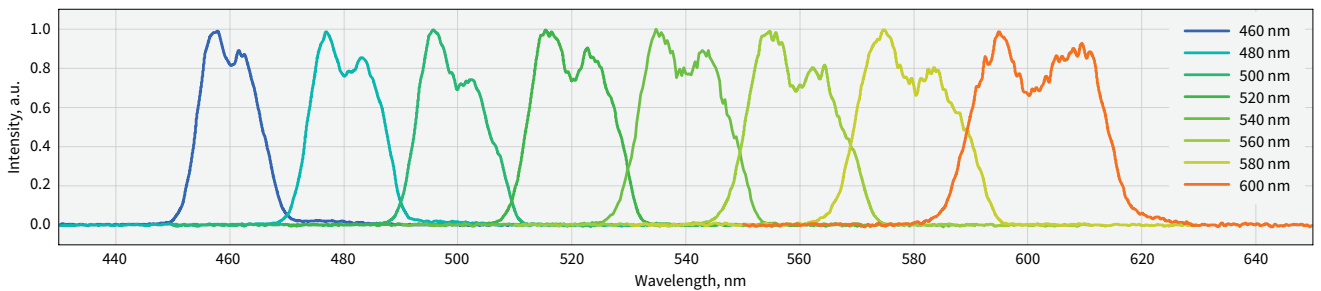
and 1 mJ energy pulses, thus capable of providing up to tens of microjoules in VIS and microjoule-level output in UV. ORPHEUS-VIS serves as an excellent high-repetition-rate source for ultrafast spectroscopy such as two-dimensional electronic spectroscopy (2DES), time-resolved photoemission spectroscopy, and many other applications in the visible spectral range.



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



ORPHEUS-VIS typical pulse duration



A set of typical spectra of standard **ORPHEUS-VIS** configuration

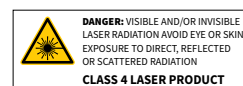
SPECIFICATIONS

| | | |
|---|----------------------------|--|
| Model | ORPHEUS-VIS | |
| 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 μ J | |
| Conversion efficiency ¹⁾ | > 1.5 % @ 500 nm | > 1.5 % @ 500 nm > 5.0 % @ 660 nm > 0.5 % @ 350 nm |
| Pulse duration | < 50 fs @ 500 – 600 nm | < 50 fs @ 500 – 600 nm < 55 fs @ 800 – 900 nm < 70 fs @ 650 – 800 nm |
| Spectral bandwidth ²⁾ | 200 – 700 cm^{-1} | |
| Long-term power stability, 8h 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} | |

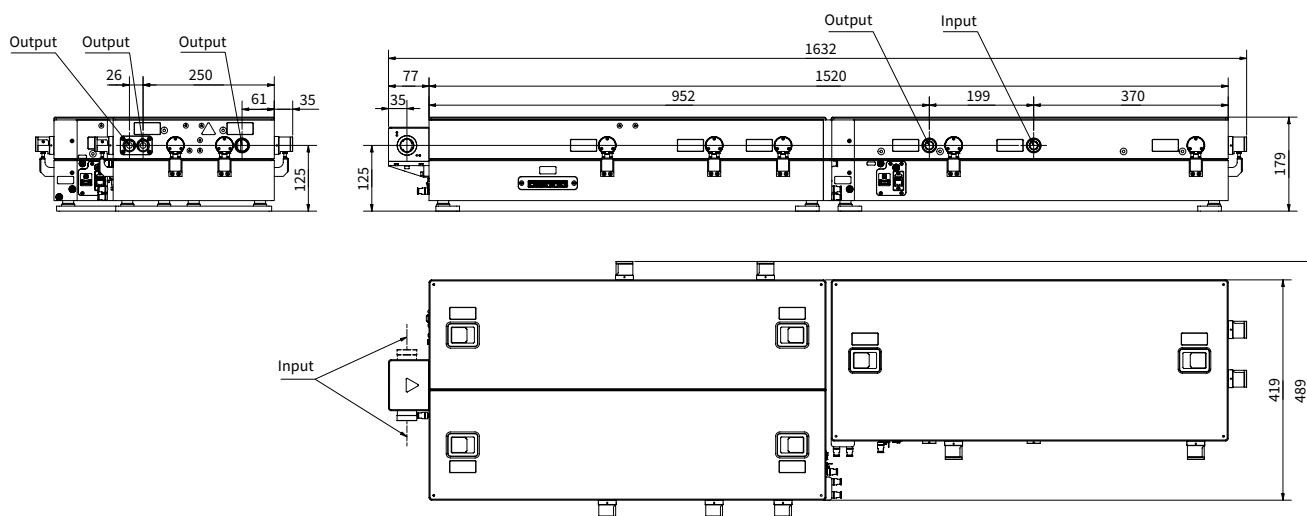
¹⁾ Specified as the percentage of pump power.

²⁾ FWHM (full width at half maximum).

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



DRAWINGS



ORPHEUS-VIS drawings


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ORPHEUS | PS

Narrow-Bandwidth Optical Parametric Amplifier

FEATURES

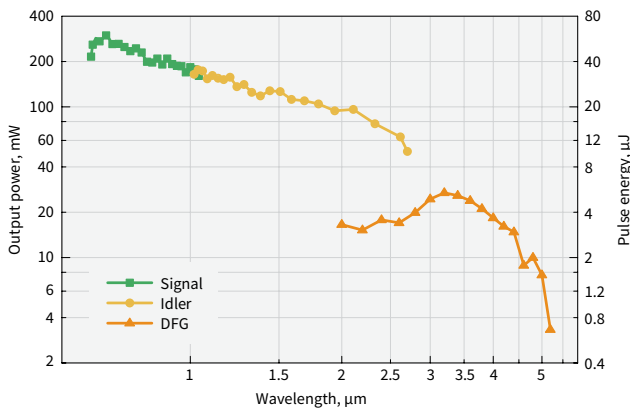
- Picosecond pulses from femtosecond pump
- 210 – 4800 nm tuning range
- 800 fs – 3 ps pulse duration
- <math> < 20 \text{ cm}^{-1}</math> spectral bandwidth
- Up to 100 kHz repetition rate
- High output stability



ORPHEUS-PS is a narrow-bandwidth optical parametric amplifier (OPA), designed for PHAROS and CARBIDE lasers. The device is pumped by picosecond pulses produced in a second harmonic bandwidth compressor SHBC and is seeded by a white-light continuum generated by femtosecond pulses. This enables very high pulse-to-pulse energy stability compared to other methods for generating tunable picosecond pulses. The white-light generation is integrated into the same housing as the amplification, enabling high long-term stability and

ease of use. The system features high conversion efficiency, bandwidth- and diffraction-limited output, and full computer control.

Part of the pump laser radiation can be split to simultaneously pump a femtosecond OPA, giving access to the complete set of beams necessary for versatile spectroscopy applications such as femtosecond stimulated Raman spectroscopy (FSRS) and sum-frequency generation (SFG) spectroscopy.



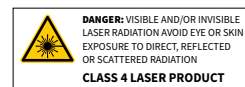
ORPHEUS-PS tuning curves.
Pump: 5 W, 1000 μJ, 5 kHz from PHAROS-SP.

SPECIFICATIONS

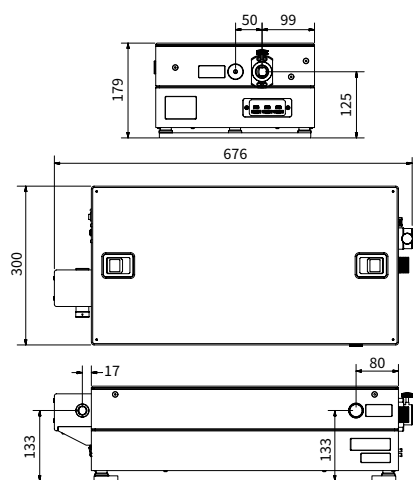
| | |
|--|---|
| Model | ORPHEUS-PS |
| MAIN OUTPUT | |
| Tuning range ¹⁾ | 640 – 1000 nm (Signal) 1060 – 2600 nm (Idler) |
| Conversion efficiency | > 6% @ 700 nm |
| Pulse duration | 800 fs – 3 ps |
| Spectral bandwidth | < 20 cm ⁻¹ @ 700 – 2000 nm |
| Pulse-to-pulse energy stability ²⁾ | < 2% @ 800 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 320 – 500 nm (SHS), 530 – 640 nm (SHI) | > 3% @ 350 nm |
| FH package 210 – 250 nm (FHS), 265 – 320 nm (FHI) | > 0.3% @ 230 nm |
| 2400 – 4800 nm (DFG) | > 0.25% @ 3200 nm ⁶⁾ |
| PUMP LASER REQUIREMENTS | |
| Pump source | PHAROS or CARBIDE with uncompressed output option |
| Center wavelength | 1030 ± 10 nm |
| Repetition rate | Single-shot – 100 kHz |
| Maximum pump power | 20 W |
| Pump pulse energy | 100 μJ – 3.2 mJ |

¹⁾ For single wavelength (515 nm) picosecond output, refer to SHBC.
²⁾ Expressed as NRMSD (normalized root mean squared deviation).
³⁾ Direct SHBC output, not simultaneous to OPA; see details in SHBC specifications.

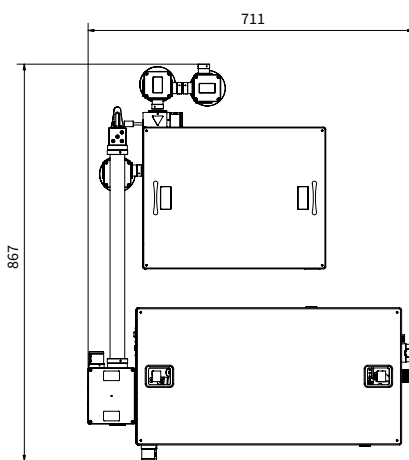
⁴⁾ Specified as percentage of pump pulse energy.
⁵⁾ Compressed pump output.
⁶⁾ For > 200 μJ pump pulse energy.



DRAWINGS



ORPHEUS-PS drawings



ORPHEUS-PS with SHBC drawing