Lasers and Laser Systems

Femtosecond
Picosecond
Nanosecond
Tunable Wavelength
Laser Spectroscopy

ADVANCED LASER TECHNOLOGIES

2023

About Company

Background

EKSPLA focuses on the design and manufacturing of advanced lasers & systems and employs 30 years' experience as well as a close partnership with the scientific community. 76 out of the 100 top universities use EKSPLA lasers. The company is leading in the global market for scientific picosecond lasers.

Clients like CERN, NASA, ELI, Max Planck Institutes, Cambridge University and Massachusetts Institute of Technology have chosen Ekspla as their partner.

For scientist who needs unique instrument for research, we provide parameter tailored laser systems that enable customer to perform complex experiments. In-house design and manufacturing ensures operative design, manufacturing and customization of new products.

Highly stable and reliable EKSPLA lasers combined with our own subsidiaries in the US, UK and China as well as more than 20 approved representative offices with properly trained laser engineers worldwide, ensure short response time and fast laser service as well as maintenance.

History

EKSPLA was founded about 30 years ago by a small team of engineers united around the idea of making the most advanced lasers in the world. EKSPLA was independent company with little money, but lots of creativity, and a deep technical understanding of lasers and how useful they could be for research and industry. From the start, the whole team had a deep mutual respect and believed in and supported each other. The first laser was sold at its first launch event, at an international exhibition in Germany. Soon after, the innovation was noticed by partners in Japan, and supply of the systems to leading universities there has been started. The concept of continuous improvement was admired and embraced, so it has become one of the key principles that apply to everything is done.

Contents

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REV. 20230414

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FemtoLux 30

Femtosecond Industrial Lasers

PERFECT AND VERSATILE TOOL FOR MICROMACHINING

The FemtoLux 30 femtosecond laser has a tunable pulse duration from <350 fs to 1 ps and can operate in a broad AOM controlled range of pulse repetition rates from a single shot to 4 MHz.

The maximum pulse energy is more than 90 µJ operating with single pulses and can reach 250 µJ in burst mode, ensuring higher ablation rates and processing throughput for different materials.

The FemtoLux 30 beam parameters will meet the requirements of the most demanding materials and micro-machining applications.

Innovative laser control electronics ensure simple control of the FemtoLux 30 laser by external controllers that could run on different platforms, be it Windows, Linux or others using REST API commands.

This makes easy integration and reduces the time and human resources required to integrate this laser into any laser micromachining equipment.

INNOVATIVE "DRY" COOLING SYSTEM

The FemtoLux 30 laser employs an innovative cooling system and sets new reliability standards among industrial femtosecond lasers. No additional water chiller is needed.

The chiller requires periodic maintenance – cooling system draining and rinsing and water and particle filter replacement. Moreover, water leakage can cause damage to the laser head and other equipment. Instead of using water for transferring heat from a laser head, the FemtoLux 30 laser uses an innovative Direct Refrigerant Cooling method.

The refrigerant agent circulates from a PSU-integrated compressor and condenser, to a cooling plate via armored flexible lines. The cooling circuit is permanently hermetically sealed and requires no maintenance.

SIMPLE & RELIABLE COOLING PLATE ATTACHMENT

The cooling plate is detachable from the laser head for more convenient laser installation.

The laser cooling equipment is integrated with the laser power supply unit into a single 4U rack-mounted housing with a total weight of 15 kg.

FEATURES

- *Typical max output power* ***30 W at 1030 nm, 11 W at 515 nm***
- ***> 90 µJ at 1030 nm, > 50 µJ at 515 nm***
- ***MHz, GHz burst modes***
- ***> 250 µJ** in a burst mode*
- ***< 350 fs – 1 ps***
- ***Single shot to 4 MHz*** *(AOM controlled)*
- *<0.5% RMS power long term stability over 100 hours*
- *M^2 < 1.2*
- *Beam circularity > 0.85*
- *Zero maintenance*
- *Dry cooling (no water used)*
- *PSU and cooling unit integrated into single 4U rack housing*
- *Easy and quick installation*
- *Compatible with galvo and Polygon scanners as well as PSO controllers*
- *2 years of total warranty*

APPLICATIONS

- *LCD, LED, OLED drilling, cutting and repair*
- *Microelectronics manufacturing*
- *Glass, sapphire and ceramics micro processing*
- *Glass intra volume structuring*
- *Micro processing of different polymers and metals*

Ask for separate brochure

FemtoLux 30

SPECIFICATIONS [1]

Model	FemtoLux 30
MAIN SPECIFICATIONS	
Central wavelength	
Fundamental	1030 nm
With second harmonic option	515 nm
Pulse repetition rate (PRR) [2]	200 kHz – 4 MHz
Pulse repetition frequency (PRF) after frequency divider	PRF = PRR / N, N=1, 2, 3, … , 65000; single shot
Average output power	
At 1030 nm	> 27 W (typical 30 W)
At 515 nm	> 11 W [3]
Pulse energy	
At 1030 nm	> 90 µJ
At 515 nm	> 50 µJ [3]
Total energy in MHz/GHz burst mode	> 250 µJ
Power long term stability (Std. dev.) [4]	< 0.5 %
Pulse energy stability (Std. dev.) [5]	< 1 %
Pulse duration (FWHM)	tunable, < 350 fs [6] – 1 ps
Beam quality	M^2 < 1.2 (typical < 1.1)
Beam circularity, far field	> 0.85
Beam divergence (full angle)	< 1 mrad
Beam pointing thermal stability	< 20 µrad/°C
Beam diameter ($1/e^2$) at 20 cm distance from laser aperture at 1030 nm	2.5 ± 0.4 mm
Triggering mode	internal / external
Pulse output control	frequency divider, pulse picker, burst mode, packet triggering, power attenuation
Control interfaces	RS232 / LAN
Length of the umbilical cord	3 m, detachable
Laser head cooling type	dry (direct refrigerant cooling through detachable cooling plate)
PHYSICAL CHARACTERISTICS	
Laser head (W × L × H)	429 × 569 × 130 mm
Power supply unit (W × L × H)	449 × 376 × 177 mm
OPERATING REQUIREMENTS	
Mains requirements	100 – 240 V AC, single phase, 50/60 Hz
Operating ambient temperature	18 – 27 °C
Relative humidity	10 – 80 % (non-condensing)
Air contamination level	ISO 9 (room air) or better

[1] Due to continuous improvement, all specifications are subject to change without notice. Parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture. All parameters are specified for a shortest pulse duration.

[2] When frequency divider is set to transmit every pulse. Fully controllable by integrated AOM.

[3] At 200 kHz.

[4] Over 100 h after warm-up under constant environmental conditions.

[5] Under constant environmental conditions.

[6] At PRR > 500 kHz. At PRR < 500 kHz shortest pulse duration is < 400 fs.

SEAMLESS USER EXPERIENCE

- *Easy integration.*
  Remote control using REST API commands via RS232 and LAN
- *Reduced integration time.*
  Demo electronics is available for laser control programming in advance
- *Easy and quick installation.*
  No water, fully disconnectable laser head. Can be installed by the end-user
- *Easy troubleshooting.*
  Integrated detectors and constant system status logging
- *No periodic maintenance required.*

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FemtoLux 30

FemtoLux 30 with second harmonic option and power supply

PERFORMANCE

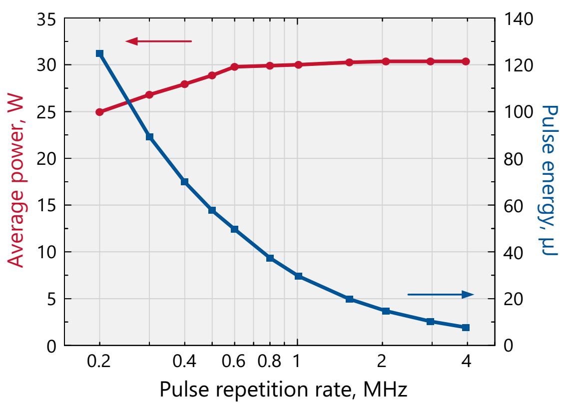


Fig 1. Typical dependence of output power and pulse energy of FemtoLux 30 laser at 1030 nm on pulse repetition rate

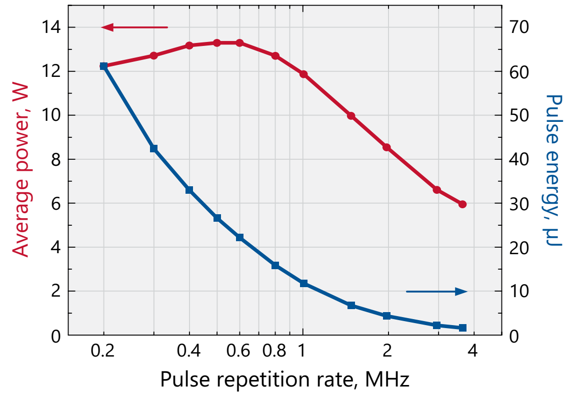


Fig 2. Typical dependence of output power and pulse energy of FemtoLux 30 laser at 515 nm on pulse repetition rate

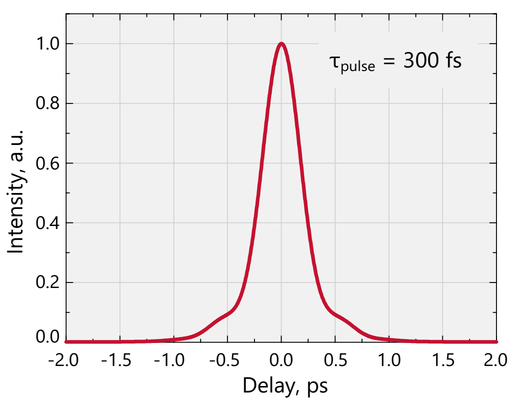


Fig 3. Typical FemtoLux 30 laser (at 1030 nm) output pulse autocorrelation function

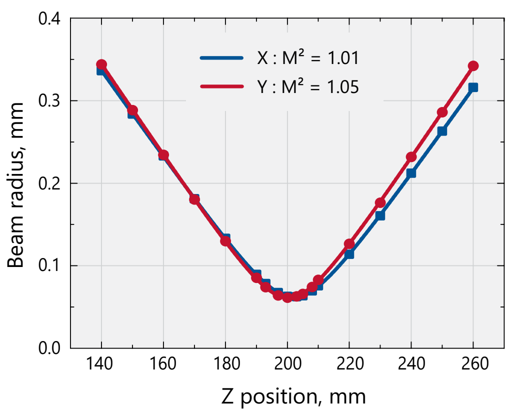


Fig 4. Typical M^2 measurement of FemtoLux 30 laser at 1030 nm

FemtoLux 30

STABILITY

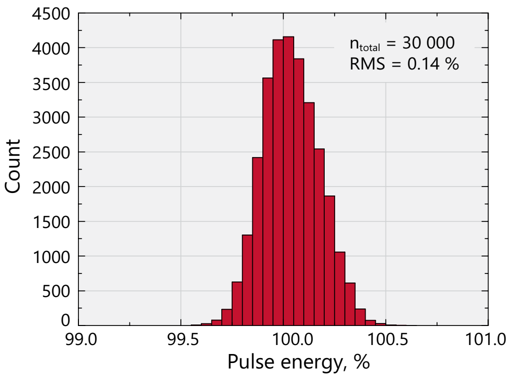


Fig 5. Typical pulse-to-pulse energy stability of FemtoLux 30 laser at 200 kHz over 30 000 pulses. RMS was calculated by using a set of mean values of 10 consecutive laser shots

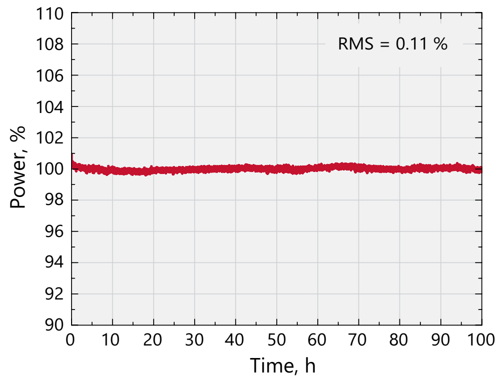


Fig 6. Typical long term average power stability of FemtoLux 30 laser at 1030 nm under constant environmental conditions

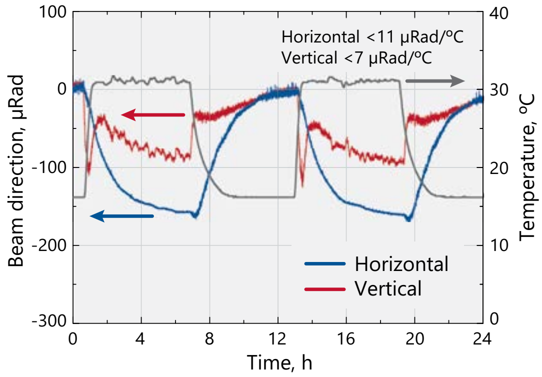


Fig 7. Typical beam direction stability of FemtoLux 30 under harsh environmental conditions

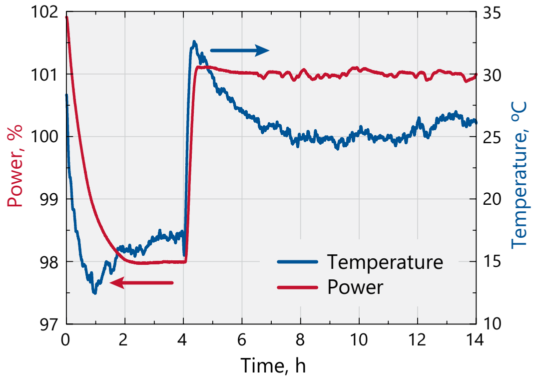
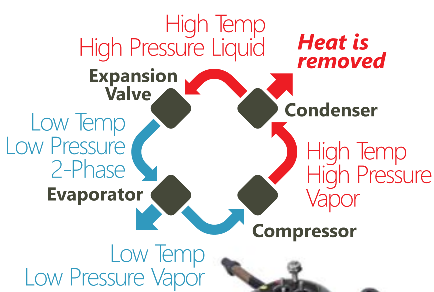


Fig 8. Average output power dependance of FemtoLux 30 laser on ambient temperature at 1030 nm

DIRECT REFRIGERANT COOLING SYSTEM



FEATURES

- *Military-grade reliability*
- *Permanently hermetically sealed system >90,000 hour MTBF*
- *No maintenance*
- *High cooling efficiency*
- *>45% lower power consumption compared to water cooling equipment*
- *Compact and light*

Compressor picture courtesy of Aspen Systems Inc.

Simple and reliable cooling plate attachment

DRAWINGS

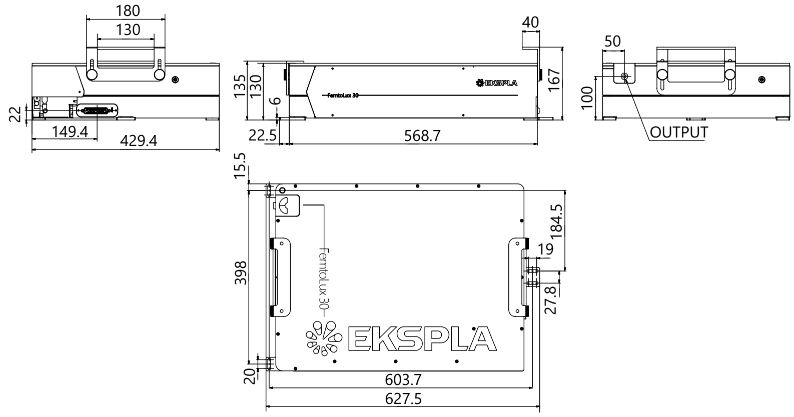


Fig 9. FemtoLux 30 laser head outline drawing

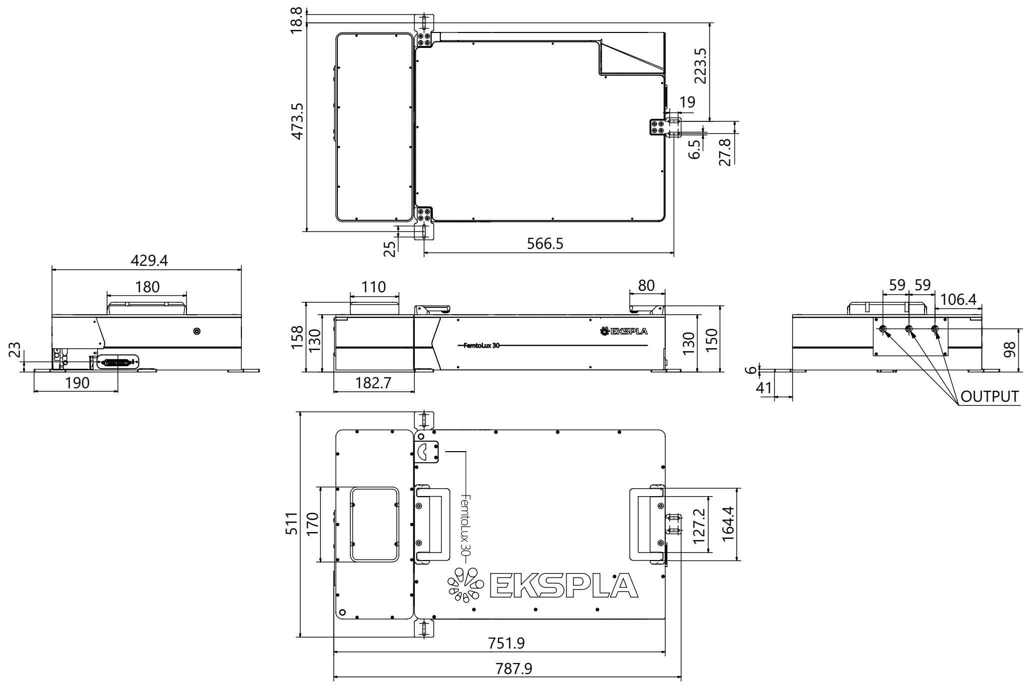


Fig 10. FemtoLux 30 with second harmonic option. Laser head outline drawing

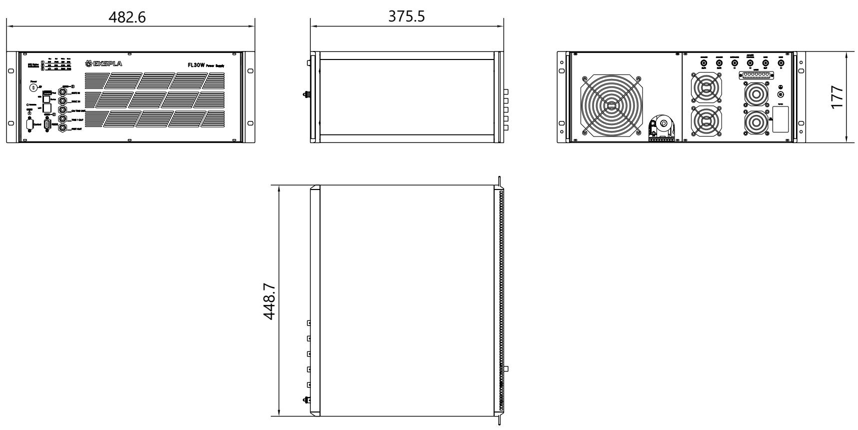


Fig 11. Power supply outline drawing

GHz burst option

A new versatile patent-pending method to form ultra-high repetition rate bursts of ultrashort laser pulses. The developed method is based on the use of an all-in-fiber active fiber loop (AFL). A detailed description of the invention can be found on:

[1] Andrejus Michailovas, and Tadas Bartulevičius. 2021 Int. patent application published under the Patent Cooperation Treaty (PCT) WO2021059003A1.
[2] Tadas Bartulevičius, Mykolas Lipnickas, Virginija Petrauskienė, Karolis Madeikis, and Andrejus Michailovas, (2022), "30 W-average-power femtosecond NIR laser operating in a flexible GHz-burst-regime," Opt. Express 30, 36849-36862.

SPECIFICATIONS

Parameter	Value	
Burst repetition rate	200 – 650 kHz	
Intra-burst pulse repetition rate [1]	2 GHz	
GHz burst mode	short	long
Number of pulses [2]	2 – 22	44 – 1100
Shape	square, rising, falling	falling, pre-shaped [3]

[1] Custom intra-pulse PRR is available upon a request.
[2] Depends on the intra-pulse PRR.
[3] For more information, please inquire sales@ekspla.com.

SHORT GHz BURST

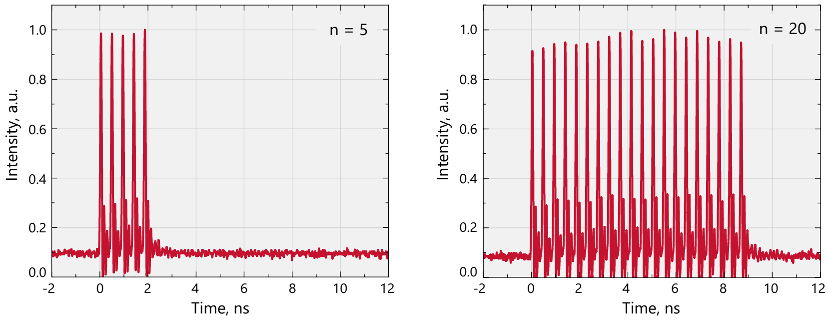


Fig 12. Measured 2.2 GHz intra-burst PRR burst of pulses containing a different number of pulses of equal amplitudes at 31.5 W average output power

LONG GHz BURST

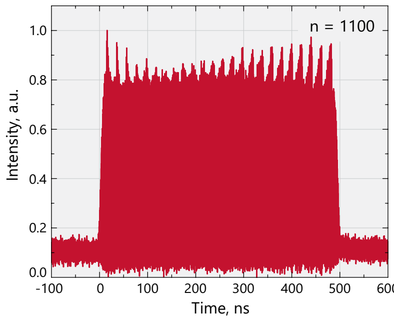


Fig 13. Measured 2.2 GHz pre-shaped bursts of 1000 pulses at 233 kHz burst repetition rate for the desired rectangular-like burst shape

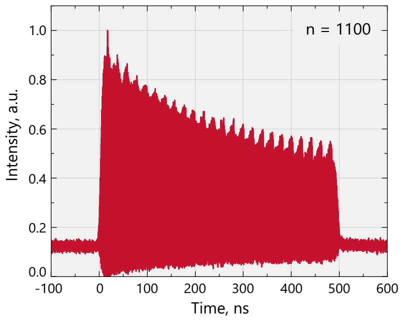


Fig 14. Measured 2.2 GHz non-pre-shaped bursts of 1100 pulses at 233 kHz burst repetition rate

BENEFITS

The Femtolux 30 laser can operate in the single-pulse mode, MHz burst mode and GHz burst mode.

The burst formation technique based on the use of the AFL is a very versatile method as it allows to overcome many limitations encountered by other fiber- and/or solid-state-based techniques. The benefits of this technology:

- *Any desired intra-burst PRR can be achieved independently from the initial PRR of the master oscillator*
- *Identical pulse separation inside the GHz bursts is maintained*
- *Short- and long-burst formation modes can be provided. A short burst is up to about 10 ns burst width (from 2 to tens of pulses in the GHz burst). A long burst is from ~20 ns up to a few hundred ns in burst width (from tens to thousands of pulses in the GHz burst)*
- *An adjustable amplitude envelope of the GHz bursts is provided*
- *No pre/post pulses in GHz burst. Pure GHz bursts*
- *Ultrashort pulse duration is maintained inside the bursts*

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FemtoLux 3

Microjoule Class Femtosecond Industrial Lasers

FemtoLux 3 is a modern femtosecond fiber laser aimed for both R&D use and industrial integration. Tunable pulse duration in a range of 300 fs – 5 ps, adjustable pulse repetition rate up to 10 MHz and adjustable pulse energy up to 3 µJ allows optimization of laser parameters for the desired application. These include marking and volume structuring of transparent materials, photopolymerization, biological imaging, nonlinear microscopy and many others. To expand the scope of applications even further this laser can be equipped with a second harmonics module.

With burst mode enabled, FemtoLux 3 can generate bursts of pulses with energy above 10 µJ with instant burst shape control which can significantly improve the efficiency of processes.

Having a rigid, compact, passive air-cooled laser head and the possibility to control the laser from a wireless tablet, FemtoLux 3 can be integrated with different equipment, be it laser equipment for material micro-processing, microscopy or any other research equipment.

Ask for separate brochure

FEATURES

- *Output power **3 W at 1030 nm, 1.2 W at 515 nm***
- *Up to **3 µJ/pulse** and **10 µJ/burst** (at 1030 nm)*
- *Up to **1.2 µJ/pulse** and **5 µJ/burst** (at 515 nm)*
- *< **300 fs … 5 ps** tunable pulse duration*
- ***M^2 < 1.2***
- *Versatile laser control and syncronisation capabilities*
- *Up to **10 MHz** pulse repetition rate*
- *Smart triggering for synchronous operation with polygon scanner and PSO*
- *Instant amplitude control*
- *Passive air cooling of the laser head*
- *24/7 operation*

APPLICATIONS

- *Inner volume marking of transparent materials*
- *Marking and structuring*
- *Micromachining of brittle materials*
- *Photopolymerization*
- *Ophthalmologic surgery*
- *Biological Imaging*
- *Pumping of femtosecond OPO/OPA*
- *Microscopy*

FemtoLux 3

SPECIFICATIONS [1]

Model	FemtoLux 3
MAIN SPECIFICATIONS	
Central wavelength	
Fundamental	1030 nm
With second harmonic option	515 nm
Minimal pulse duration (FWHM) at 1030 nm	< 300 fs (typical ~230 fs)
Pulse duration tuning range	300 fs – 5 ps
Maximal average output power [2]	
at 1030 nm	> 3 W
at 515 nm	> 1.2 W
Power long term stability (Std. dev.) [3]	≤ 0.5 %
Maximal pulse energy [2]	
at 1030 nm	> 3 µJ
at 515 nm	> 1.2 µJ
Pulse energy stability (Std. dev.) [4]	< 2 %
Laser pulse repetition rate (PRR_L) range [5]	1 – 10 MHz
Pulse repetition rate after pulse picker	$PRR = PRR_L / N$, N=1, 2, 3, ... , min 10 kHz
External pulse gating	via TTL input
Burst mode [6]	1 – 10 pulses
Max burst energy	
at 1030 nm	> 10 µJ
at 515 nm	> 5 µJ
Burst shape control	via analog input
Power attenuation	0 – 100 % from remote control application or via analog input
Polarization orientation	linear, vertical
Polarization extinction ratio	>1000:1
M^2	< 1.2
Beam divergence (full angle)	<1.0 mrad
Beam circularity (far field)	> 0.85
Beam pointing stability (pk-to-pk) [7]	< 30 µrad
Beam diameter ($1/e^2$) at 20 cm distance from laser aperture	
at 1030 nm	2.0 ± 0.3 mm
at 515 nm	1.0 ± 0.2 mm
OPERATING REQUIREMENTS	
Mains requirements	100–240 V AC, single phase 47–63 Hz
Maximal power consumption	< 500 W
Operating ambient temperature	15 – 30 °C
Relative humidity	10 – 80 % (non-condensing)
Air contamination level	ISO 9 (room air) or better
PHYSICAL CHARACTERISTICS	
Cooling of the laser head	air, passive
Laser head size (L×W×H)	
at 1030 nm	464 × 363 × 129 mm
at 515 nm	620 × 363 × 129 mm
Power supply unit size (L×W×H)	449 × 436 × 140 mm (stand-alone) or 483 × 436 × 140 mm (19" rack mountable)
Umbilical length	5 m
CLASSIFICATION	
Classification according EN60825-1	CLASS 4 laser product

1) Due to continuous improvement, all specifications are subject to change without notice. Parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture.

2) See typical power and energy curves for other pulse repetition rates at Fig 1., Fig 2. and Fig 4.

3) At 1 MHz PRR_L during 24 h of operation after warm-up under constant environmental conditions.

4) At 1 MHz PRR_L under constant environmental conditions.

5) When pulse picker is set to transmit every pulse.

6) Pulse separation inside the burst is about 20 ns.

7) Beam pointing stability is evaluated as a movement of the beam centroid in the focal plane of a focusing element.

PERFORMANCE

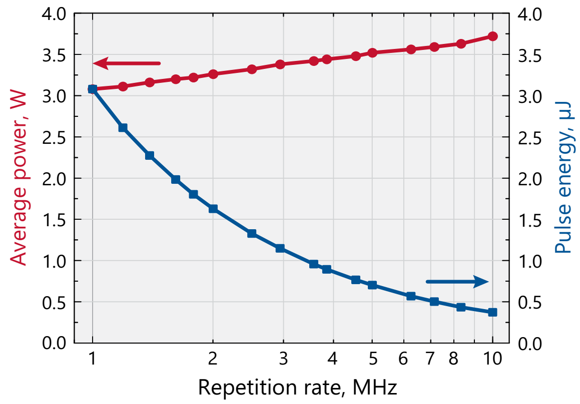

Fig 1. Typical dependence of output power and pulse energy of FemtoLux 3 laser at 1030 nm when changing internal repetition rate of the laser

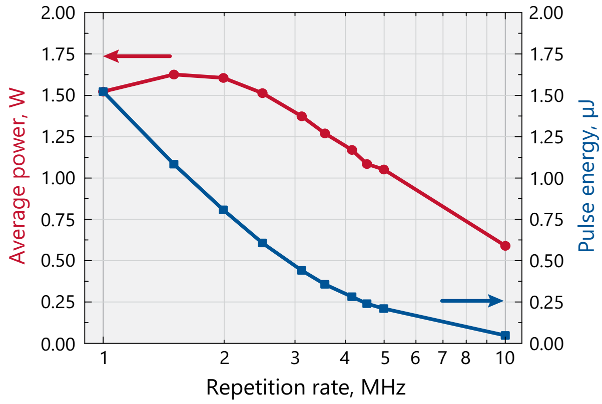

Fig 2. Typical dependence of output power and pulse energy of FemtoLux 3 laser at 515 nm on pulse repetition rate

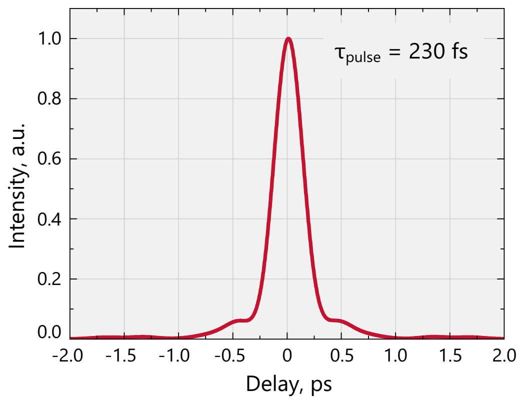

Fig 3. Typical FemtoLux 3 laser (at 1030 nm) output pulse autocorrelation function at 3 μJ pulse energy. Calculated pulse duration is 230 fs

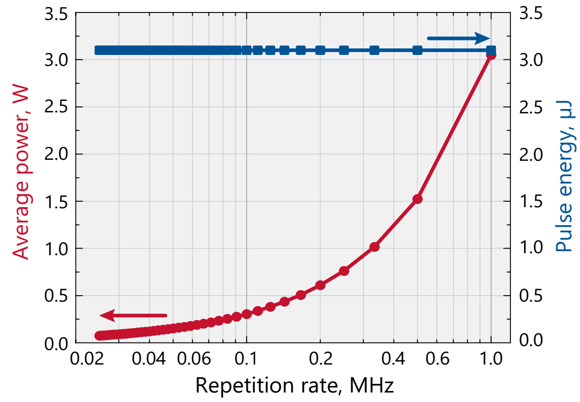

Fig 4. Typical dependence of output power and pulse energy of FemtoLux 3 laser at 1030 nm when repetition rate is reduced by pulse picker. Internal repetition rate of the laser in this case is 1 MHz

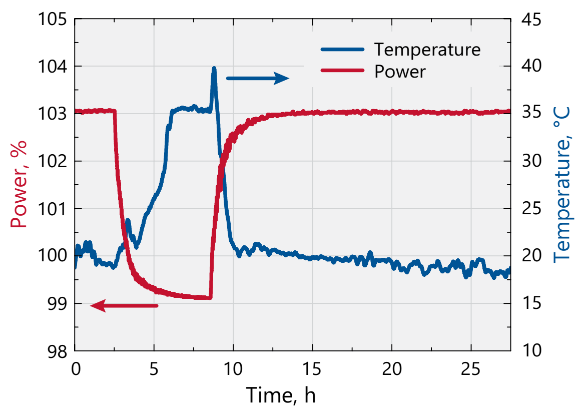

Fig 5. Average output power dependance on ambient temperature at 1030 nm

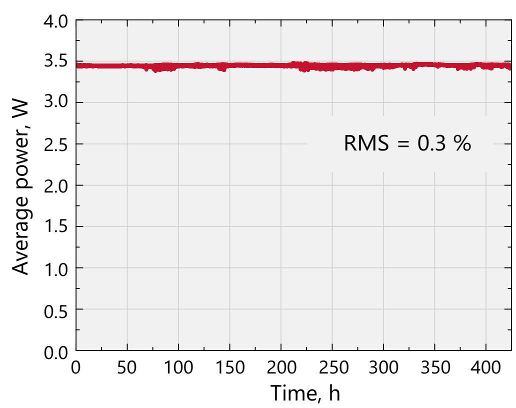

Fig 6. Typical long term average output power stability of FemtoLux 3 laser at 1030 nm under constant environmental conditions

Femtosecond Lasers
Picosecond Lasers
Picosecond Tunable Wavelength Lasers
Nanosecond Lasers
Nanosecond Tunable Wavelength Lasers
Other Ekspla Products

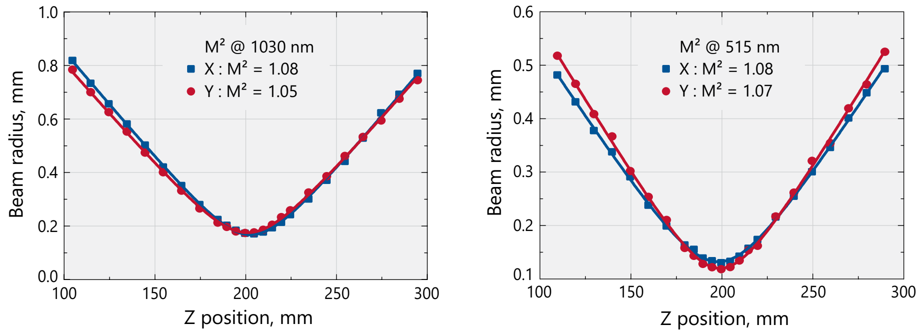

Fig 7. Typical M² measurement of FemtoLux 3 at 1030 nm (left) and 515 nm (right)

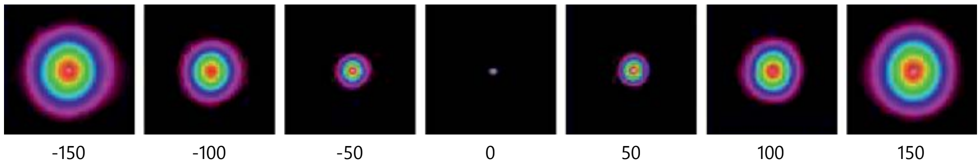

Fig 8. Typical beam profiles along propagation axis of FemtoLux 3 series laser

REMOTE CONTROL APPLICATION

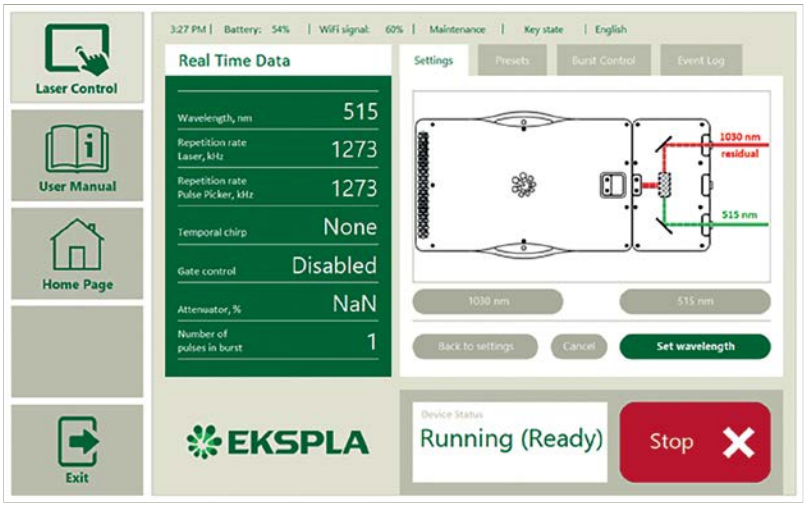

Fig 9. Example of FemtoLux 3 remote control application

DRAWINGS

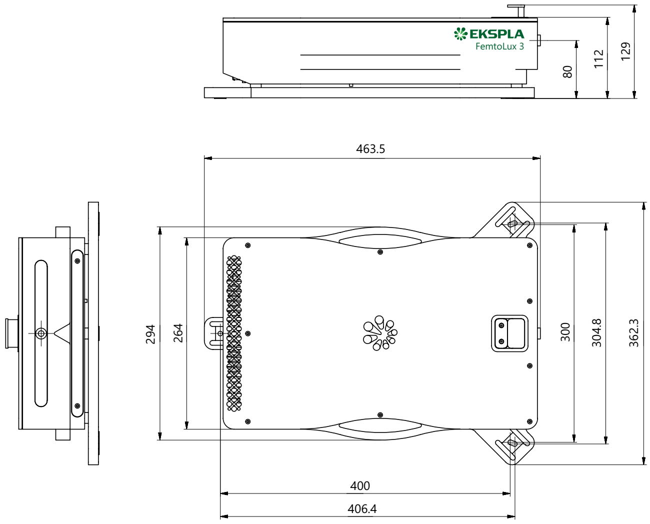

Fig 11. Outline drawings of FemtoLux 3 laser head

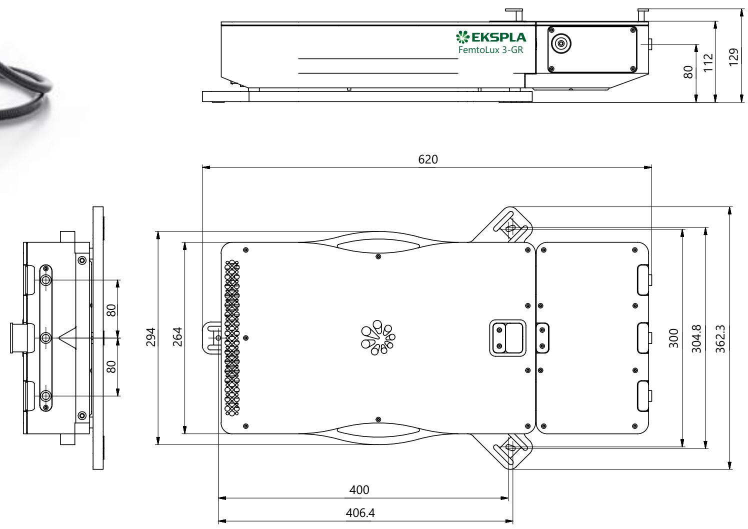

Fig 12. Outline drawings of FemtoLux 3 laser head with second harmonic option

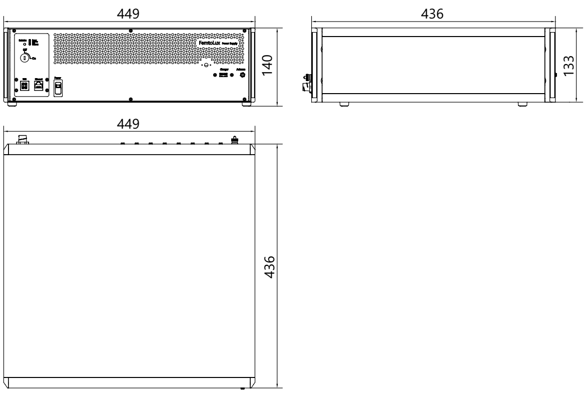

Fig 13. Outline drawings of FemtoLux 3 stand-alone control unit

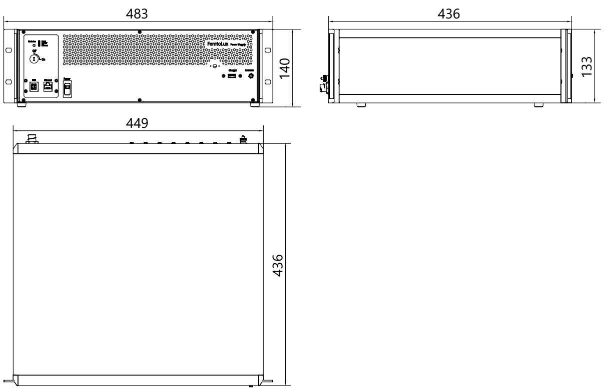

Fig 14. Outline drawings of FemtoLux 3 19" rack mountable control unit

Picosecond Lasers

The first EKSPLA picosecond laser has been sold on its first launch event in exhibition in Germany more than 30 years ago. Due to their excellent stability and high output parameters EKSPLA scientific picosecond lasers established their name as "Gold Standard" among scientific picosecond lasers.

Innovative design of new generation of picosecond mode-locked lasers feature diode-pumping-only technology, thus reducing maintenance costs and improving output parameters.

Second, third, fourth and fifth (on some versions) harmonic options combined with various accessories, advanced electronics (for streak camera synchronization, phase-locked loop, synchronization of fs laser) and customization possibilities make these lasers well suited for many scientific applications, including optical parametric generator pumping, time-resolved spectroscopy, nonlinear spectroscopy, remote sensing, metrology…

For customer convenience the laser can be operated from master device or personal computer through USB (VCP, ASCII commands), RS232 (ASCII commands), LAN (REST API) or RS232 (ASCII commands), LAN (REST API) depending on the system configuration or from remote control pad with backlit display that is easy to read even while wearing laser safety glasses.

SHORT SELECTION GUIDE

For Your convenience, table contains all available options and highest parameter values. Not all output specifications are available at the same time simultaneously. Please refer to the catalog page for exact specifications and available options.

Model	Max pulse energy at fundamental wavelength	Repetition rate, up to	Pumping	Pulse duration	Special feature	Page
PL2210	5 mJ at 1064 nm	1000 Hz	Diode pumped solid state	29 ± 5 ps	kHz repetition rate	18
PL2230	40 mJ at 1064 nm	100 Hz	Diode pumped solid state	29 ± 5 ps	High pulse energy employing DPSS only technology	21
PL2250	100 mJ	20 Hz	Hybrid (DPSS master oscillator and flash-lamp pumped power amplifier)	29 ± 5 ps	High pulse energy	25

PL2210 SERIES

Diode Pumped Picosecond kHz Pulsed Nd:YAG Lasers

PL2210 series diode-pumped, air-cooled, mode-locked Nd:YAG lasers provide picosecond pulses at a kilohertz pulse repetition rate.

Short pulse duration, excellent pulse-to-pulse stability, superior beam quality makes PL2210 series diode pumped picosecond lasers well suited for many applications, including material processing, time-resolved spectroscopy, optical parametric generator pumping, and other tasks.

Flexible design

PL2210 series lasers offer a number of optional items that extend the capabilities of the laser.
A pulse picker option allows control of the pulse repetition rate of the laser and operation in single-shot mode.

The repetition rate and timing of pulses can be locked to an external RF source (with –PLL option) or other ultrafast laser system (with –FS option). The laser provides a triggering pulse for synchronization of the customer's equipment. A low jitter SYNC OUT pulse has a lead up to 500 ns that can be adjusted in ~0.25 ns steps from a PC. Up to 400 µs lead of triggering pulse is available as a PRETRIG feature that is designed to provide precise, very low jitter trigger pulses for a streak camera.

Built-in harmonic generators

Motorised switching of wavelength for PL2210A. Non-linear crystals mounted in temperature stabilized heaters are used for second, third and fourth high spectral purity harmonic generation.

FEATURES

- *High pulse energy at **kHz rates***
- *Diode pumped **solid state** design*
- ***Air cooled** – external water supply is not required (for PL2210A-1k only)*
- *Turn-key operation*
- *Low maintenance costs*
- *Optional streak camera triggering pulse with <10 ps rms jitter*
- *Remote control pad*
- *PC control*
- *Optional temperature stabilized second, third and fourth **harmonic generators***

APPLICATIONS

- *Time resolved fluorescence (including streak camera measurements), pump-probe spectroscopy*
- *OPG/OPA/OPO pumping*
- *Remote Laser Sensing*
- *Other spectroscopic and nonlinear optics applications*

Available models [1)]

Model	Features
PL2210A-1k	Up to 900 µJ, 29 ps pulses at an up to 1 kHz repetition rate
PL2211A	Up to 5 mJ energy at a 1 kHz repetition rate at 28 ps pulses

1) Custom-built models with higher pulse energy are available on request.

Simple and convenient laser control

For customer convenience the laser can be operated from master device or personal computer through USB (VCP, ASCII commands), RS232 (ASCII commands), LAN (REST API) or RS232 (ASCII commands), LAN (REST API) depending on the system configuration or from remote control pad with backlit display that is easy to read even while wearing laser safety glasses.

SPECIFICATIONS [1]

Model	PL2210A	PL2211A
Output energy		
at 1064 nm	0.9 mJ	5 mJ
at 532 nm [2]	0.45 mJ	2.5 mJ
at 355 nm [3]	0.35 mJ	1.6 mJ
at 266 nm [4]	0.16 mJ	1 mJ
Pulse energy stability (StdDev) [5]		
at 1064 nm	0.5 %	
at 532 nm	0.8 %	
at 355 nm	1 %	
at 266 nm	2 %	
Pulse duration (FWHM) [6]	29 ± 5 ps	
Pulse repetition rate	1 kHz	
Triggering mode	internal/external	
Typical TRIG1 OUT pulse delay [8]	-500 ... 50 ns	
TRIG1 OUT pulse jitter	< 0.1 ns rms	
Spatial mode [9]	Close to Gaussian	
Beam divergence [10]	<1 mrad	
Beam diameter [11]	1.7 ± 0.3 mm	~3 mm
Beam pointing stability (RMS) [12]	< 30 µrad	
Pre-pulse contrast	> 200 : 1	
Polarization	linear, >100 : 1	
PHYSICAL CHARACTERISTICS		
Laser head size (W × L × H) [13]	456 × 1031 × 249 mm	
Power supply size (W × L × H)	365 × 392 × 290 mm	550 × 600 × 550 ±3 mm (19" standard, MR-9)
OPERATING REQUIREMENTS		
Water service	not required, air cooled	
Relative humidity	20–80 % (non condensing)	
Ambient temperature	22 ± 2 °C	
Power requirements	100–240 V AC, single phase 50/60 Hz	
Power consumption [14]	<1 kW	<1.5 kW

1) Due to continuous improvement, all specifications are subject to change without notice. Parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 1064 nm and for basic system without options.

2) For PL2210 series laser with –SH, -SH/TH, -SH/FH or -SH/TH/FH option. Outputs are not simultaneous.

3) For PL2210 series laser with –TH, -SH/TH or -SH/TH/FH option. Outputs are not simultaneous.

4) For PL2210 series laser with -SH/FH or -SH/TH/FH option. Outputs are not simultaneous.

5) Averaged from pulses, emitted during 30 sec time interval.

6) Optional 80 or 22 ps ± 10% duration. Pulse energy specifications may differ from indicated here.

7) With respect to optical pulse. <10 ps rms jitter is provided optionally with PRETRIG feature.

8) TRIG1 OUT lead or delay can be adjusted with 0.25 ns steps in specified range.

9) Near field Gaussian fit is >90%.

10) Average of X- and Y-plane full angle divergence values measured at the $1/e^2$ level at 1064 nm.

11) Beam diameter is measured at 1064 nm at the $1/e^2$ point.

12) Beam pointing stability is evaluated from fluctuations of beam centroid position in the far field.

13) 456×1233×249 mm (W×L×H) laser head size might be required for some optional configurations.

14) At 1 kHz pulse repetition rate.

OPTIONS

- **PRETRIG** provides low jitter pulse for streak camera triggering with lead/delay in -400...600 µs range and <10 ps rms jitter.
- **Option P80** provides 80 ps ± 10 % output pulse duration. Inquire for pulse energy specifications.
- **Option P20** provides 22 ps ± 10 % output pulse duration. Inquire for pulse energy specifications.
- **Option PC** allows reduction of the pulse repetition rate of the PL2210 series laser by integer numbers. Single shot mode is also possible. In addition, the –PC option reduces the low-intensity quasi-CW background that is present at laser output at 1064 nm wavelength. Please note that the output of fundamental wavelength and harmonic will be reduced by approx. 20% with installation of the –PC option.

BEAM PROFILE

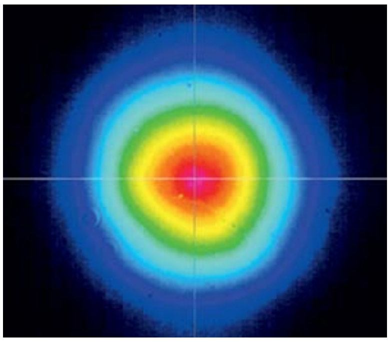

Fig 1. Typical PL2210 series laser near field beam profile at 1064 nm except PL2211A

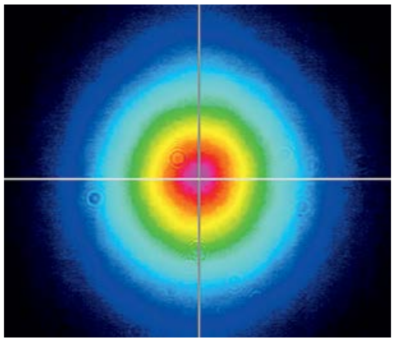

Fig 2. Typical PL2211A laser near field beam profile at 1064 nm

OUTLINE DRAWINGS

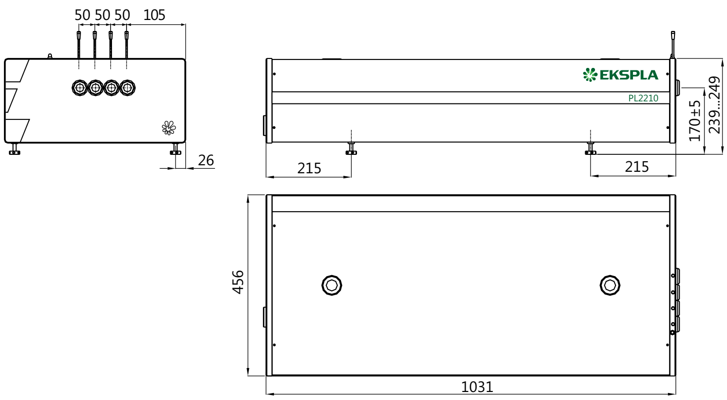

Fig 3. Dimensions of PL2210 series laser head

ORDERING INFORMATION

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

PL2210A-SH/TH/FH-P20

Model

Harmonic generator options:
SH → second harmonic
TH → third harmonic
FH → fourth harmonic

Other options:
P80 → 80 ps pulse duration option
P20 → 20 ps pulse duration option
PC → pulse picker option
PLL → pulse repetition rate locking option

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PL2230 SERIES

Diode Pumped High Energy Picosecond Nd:YAG Lasers

Innovative design

The heart of the system is a diode pumped solid state (DPSS) master oscillator placed in a sealed monolithic block, producing high repetition rate pulse trains (87 MHz) with a low single pulse energy of several nJ. Diode pumped amplifiers are used for amplification of the pulse to 30 mJ or up to 40 mJ output. The high-gain regenerative amplifier has an amplification factor in the proximity of 10^6. After the regenerative amplifier, the pulse is directed to a multipass power amplifier that is optimized for efficient stored energy extraction from the Nd:YAG rod, while maintaining a near Gaussian beam profile and low wavefront distortion. The output pulse energy can be adjusted in approximately 1% steps, while pulse-to-pulse energy stability remains at less than 0.5% rms at 1064 nm.

Angle-tuned KD*P and KDP crystals mounted in thermostabilised ovens are used for second, third, and fourth harmonic generation. Harmonic separators ensure the high spectral purity of each harmonic guided to different output ports.

Built-in energy monitors continuously monitor output pulse energy. Data from the energy monitor can be seen on the remote keypad or on a PC monitor. The laser provides triggering pulses for the synchronisation of your equipment. The lead of the triggering pulse can be up to 500 ns and is user adjustable in ~0.25 ns steps from a personal computer. Up to 1000 µs lead of triggering pulse is available as a pretrigger feature. Precise pulse energy control, excellent short-term and long-term stability, and a 50 Hz repetition rate makes PL2230 series lasers an excellent choice for many demanding scientific applications.

Simple and convenient laser control

For customer convenience the laser can be operated from master device or personal computer through USB (VCP, ASCII commands), RS232 (ASCII commands), LAN (REST API) or RS232 (ASCII commands), LAN (REST API) depending on the system configuration or from remote control pad with backlit display that is easy to read even while wearing laser safety glasses.

FEATURES

- *Diode pumped power amplifier producing up to **40 mJ** per pulse at 1064 nm*
- *Beam profile improvement using advanced beam shaping system*
- *Hermetically sealed DPSS master oscillator*
- *Diode pumped regenerative amplifier*
- *Air-cooled*
- *<**30 ps** pulse duration*
- *Excellent pulse duration stability*
- *Up to **100 Hz** repetition rate*
- *Streak camera triggering pulse with <10 ps jitter*
- *Excellent beam pointing stability*
- *Thermo stabilized second, third or fourth harmonic generator options*
- *PC control*
- *Remote control via keypad*

APPLICATIONS

- *Time resolved fluorescence (including streak camera measurements)*
- *SFG/SHG spectroscopy*
- *Nonlinear spectroscopy*
- *Laser-induced breakdown spectroscopy*
- *OPG pumping*
- *Remote laser sensing*
- *Satellite ranging*
- *Other spectroscopic and nonlinear optics applications*

Femtosecond Lasers
Picosecond Lasers
Picosecond Tunable Wavelength Lasers
Nanosecond Lasers
Nanosecond Tunable Wavelength Lasers
Other Ekspla Products

SPECIFICATIONS [1]

Model	PL2230-100	PL2231-100	PL2231-50	PL2231A-50
Pulse energy [2]				
at 1064 nm	3 mJ	12 mJ	30 mJ	40 mJ
at 532 nm [3]	1.3 mJ	5 mJ	13 mJ	18 mJ
at 355 nm [4]	0.9 mJ	3.5 mJ	9 mJ	13 mJ
at 266 nm [5]	0.3 mJ	1.2 mJ	3 mJ	5 mJ
at 213 nm [6]	inquire			
Pulse energy stability (StdDev) [7]				
at 1064 nm	< 0.2 %	< 0.5 %		
at 532 nm	< 0.4 %	< 0.8 %		
at 355 nm	< 0.5 %	< 1.1 %		
at 266 nm	< 0.5 %	< 1.2 %		
at 213 nm	< 1.5 %	< 1.5 %		
Pulse duration (FWHM) [8]	29 ± 5 ps			
Pulse duration stability [9]	± 1 %			
Power drift [10]	± 2 %			
Pulse repetition rate				
At 1064, 532, 355 nm	0 – 100 Hz	100 Hz	50 Hz	50 Hz
At 266, 213 nm	0 – 100 Hz	10 Hz		
Polarization	vertical, >99 % at 1064 nm			
Pre-pulse contrast	> 200 : 1 (peak-to-peak with respect to residual pulses)			
Beam profile [11]	close to Gaussian in near and far fields			
Beam divergence [12]	< 1.5 mrad	< 0.7 mrad		
Beam propagation ratio M^2	< 1.3	< 2.5		
Beam pointing stability (RMS) [13]	≤ 10 µrad	≤ 20 µrad		
Typical beam diameter [14]	~ 2 mm	~ 6 mm		~ 7 mm
Optical pulse jitter				
Internal triggering regime [15]	<50 ps (StdDev) with respect to TRIG1 OUT pulse			
External triggering regime [16]	~3 ns (StdDev) with respect to SYNC IN pulse			
TRIG1 OUT pulse delay [17]	-500 ... 50 ns			
Typical warm-up time	5 min	15 min		
PHYSICAL CHARACTERISTICS				
Laser head size (W × L × H)	456×1031×249 ± 3 mm			
Electrical cabinet size (W × L × H)	12 V DC power adapter, 85×170×41 ± 3 mm	471×391×147 ± 3 mm		
Umbilical length	2.5 m			
OPERATING REQUIREMENTS				
Cooling [18]	stand-alone chiller			
Room temperature	22±2 °C			
Relative humidity	20 – 80 % (non-condensing)			
Power requirements	110–240 V AC, 50/60 Hz	Single phase, 110–240 V AC, 5 A, 50/60 Hz		
Power consumption	< 0.15 kVA	< 1.0 kVA		

1) Due to continuous improvement, all specifications are subject to change without notice. Parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 1064 nm and for basic system without options.

2) Outputs are not simultaneous.

3) For PL2230 series laser with –SH, -SH/TH, -SH/FH or -SH/TH/FH option or –SH/TH/FH/FiH module.

4) For PL2230 series laser with –TH, -SH/TH or -SH/TH/FH option or –SH/TH/FH/FiH module.

5) For PL2230 series laser with -SH/FH or -SH/TH/FH option or –SH/TH/FH/FiH module.

6) For PL2230 series laser with –SH/TH/FH/FiH module.

7) Averaged from pulses, emitted during 30 sec time interval.

8) FWHM. Inquire for optional pulse durations in 20 – 90 ps range. Pulse energy specifications may differ from indicated here.

9) Measured over 1 hour period when ambient temperature variation is less than ±1 °C.

10) Measured over 8 hours period after 20 min warm-up when ambient temperature variation is less than ± 2 °C.

11) Near field Gaussian fit is >80%.

12) Average of X- and Y-plane full angle divergence values measured at the $1/e^2$ level at 1064 nm.

13) Beam pointing stability is evaluated from fluctuations of beam centroid position in the far field.

14) Beam diameter is measured at 1064 nm at the $1/e^2$ level.

15) With respect to TRIG1 OUT pulse. <10 ps jitter is provided optionally with PRETRIG feature.

16) With respect to SYNC IN pulse.

17) TRIG1 OUT lead or delay can be adjusted with 0.25 ns steps in specified range.

18) Air cooled. Adequate room air conditioning should be provided.

Custom products, tailored for specific applications [1]

Model	PL2231C-20 (inquire)	PL2231A-10 (inquire)
Pulse energy [2]		
at 1064 nm	140 mJ	80 mJ
at 532 nm [3]	60 mJ	50 mJ
at 355 nm [4]	35 mJ	inquire
at 266 nm [5]	15 mJ	inquire
Pulse duration (FWHM) [6]	80 ps ± 10 %	29 ± 5 ps
Pulse repetition rate	20 Hz	10 Hz

1) Due to continuous improvement, all specifications are subject to change without notice. Parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 1064 nm and for basic system without options. Specifications for model PL2231C and PL2231A-10 are preliminary and should be confirmed against quotation and purchase order.

2) Outputs are not simultaneous.

3) For PL2230 series laser with –SH, -SH/TH, -SH/FH or -SH/TH/FH option or –SH/TH/FH/FiH module.

4) For PL2230 series laser with –TH, -SH/TH or -SH/TH/FH option or –SH/TH/FH/FiH module.

5) For PL2230 series laser with -SH/FH or -SH/TH/FH option or –SH/TH/FH/FiH module.

6) FWHM. Inquire for optional pulse durations in 20 – 90 ps range. Pulse energy specifications may differ from indicated here.

If laser is optimised for pumping parametrical generator, maximum output energy may be different than specified for stand alone application.

OPTIONS

- **Option P20** provides 20 ps ±10% output pulse duration. Pulse energies are ~ 30 % lower in comparison to the 28 ps pulse duration version. See table below for pulse energy specifications:

Model	PL2231-50	PL2231A-50
1064 nm	23 mJ	28 mJ
532 nm	9 mJ	13 mJ
355 nm	6 mJ	9 mJ
266 nm	2 mJ	4 mJ

- **Option P80** provides 80 ps ± 10% output pulse duration. Pulse energy specifications are same as those of 28 ps lasers.

- **Option PLL** allows locking the master oscillator pulse train repetition rate to an external RF generator, enabling precise external triggering with low jitter. Inquire for more information.

BEAM PROFILE

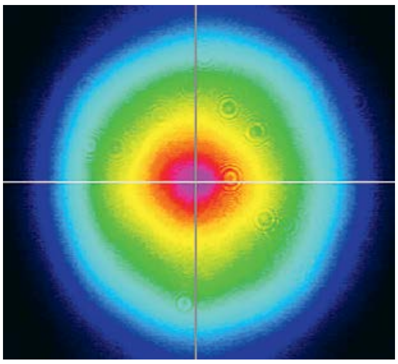


Fig 1. Typical near field output beam profile of PL2230 model laser

OUTLINE DRAWINGS

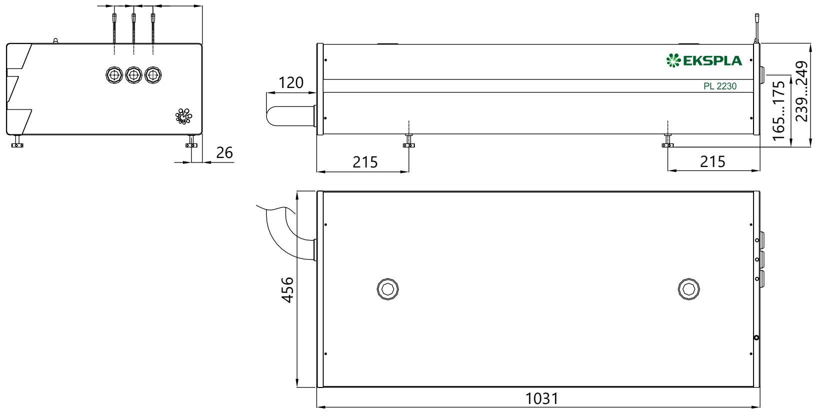


Fig 2. Dimensions of PL2230 series laser head

ORDERING INFORMATION

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

PL2231-50-SH/TH/FH-P20

- Model
- Pulse repetition rate in Hz
- Harmonic generator options:
  - SH → second harmonic
  - TH → third harmonic
  - FH → fourth harmonic
- Other options:
  - P20 → 20±2 ps pulse duration option
  - P80 → 80 ps pulse duration option
  - PLL → pulse repetition rate locking option

PL2250 SERIES

Flash-Lamp Pumped Picosecond Nd:YAG Lasers

PL2250 series lasers cost-effective design improves laser reliability and reduces running and maintenance costs.

Innovative design

The heart of the system is a diode pumped solid state (DPSS) master oscillator placed in a hermetically sealed monolithic block. The flashlamp pumped regenerative amplifier is replaced by an innovative diode pumped regenerative amplifier. Diode pumping results in negligible thermal lensing, which allows operation of the regenerative amplifier at variable repetition rates, as well as improved long-term stability and maintenance-free operation.

The optimized multiple-pass power amplifier is flashlamp pumped and is optimized for efficient amplification of pulse while maintaining a near Gaussian beam profile and low wavefront distortion. The output pulse energy can be adjusted in approximately 1% steps, at the same time as pulse-to-pulse energy stability remains less than 0.8% rms at 1064 nm.

Angle-tuned KD*P and KDP crystals mounted in thermostabilised ovens are used for second, third and fourth harmonic generation. Harmonic separators ensure the high spectral purity of each harmonic directed to different output ports.

Built-in energy monitors continuously monitor output pulse energy. Data from the energy monitor can be seen on the remote keypad or PC monitor. The laser provides several triggering pulses for synchronization of the customer's equipment. The lead or delay of the triggering pulse can be adjusted in 0.25 ns steps from the control pad or PC. Up to 1000 µs lead of triggering pulse is available as a pretrigger feature.

Precise pulse energy control, excellent short-term and long-term stability, and up to 20 Hz repetition rate makes PL2250 series lasers an excellent choice for many demanding scientific applications.

Simple and convenient laser control

For customer convenience the laser can be operated from master device or personal computer through USB (VCP, ASCII commands), RS232 (ASCII commands), LAN (REST API) or RS232 (ASCII commands), LAN (REST API) depending on the system configuration or from remote control pad with backlit display that is easy to read even while wearing laser safety glasses.

FEATURES

- *Hermetically sealed DPSS master oscillator*
- *Diode pumped regenerative amplifier*
- *Flashlamp pumped power amplifier producing up to **100 mJ** per pulse at 1064 nm*
- ***30 ps** pulse duration (20 ps optional)*
- *Excellent pulse duration stability*
- *Up to **20 Hz** repetition rate*
- *Streak camera triggering pulse with <10 ps jitter*
- *Excellent beam pointing stability*
- *Thermo-stabilized second, third, fourth and fifth harmonic generator options*
- *PC control*
- *Remote control via keypad*

APPLICATIONS

- *Time resolved fluorescence (including streak camera measurements)*
- *SFG/SHG spectroscopy*
- *Nonlinear spectroscopy*
- *Laser-induced breakdown spectroscopy*
- *OPG pumping*
- *Remote laser sensing*
- *Satellite ranging*
- *Other spectroscopic and nonlinear optics experiments*

SPECIFICATIONS [1]

Model	PL2251A	PL2251B	PL2251C
Pulse energy			
at 1064 nm	50 mJ [2]	80 mJ [2]	100 mJ
at 532 nm [3]	25 mJ	40 mJ	50 mJ
at 355 nm [4]	15 mJ	24 mJ	30 mJ
at 266 nm [5]	7 mJ	10 mJ	12 mJ
at 213 nm [6]	inquire		
Pulse energy stability, (StdDev.) [7]			
at 1064 nm	< 0.8 %		
at 532 nm	<1.0 %		
at 355 nm	< 1.1 %		
at 266 nm	< 1.2 %		
Pulse duration (FWHM) [8]	29 ± 5 ps		
Pulse duration stability [9]	± 1.0 ps		
Repetition rate	20 or 10 Hz		10 Hz
Polarization	linear, vertical, >99 %		
Pre-pulse contrast	>200:1 (peak-to-peak with respect to residual pulses)		
Optical pulse jitter	internal / external		
Internal triggering regime [10]	<50 ps (StdDev) with respect to TRIG1 OUT pulse		
External triggering regime [11]	~3 ns (StdDev) with respect to SYNC IN pulse		
SYNC OUT pulse delay [12]	-500 ... 50 ns		
Beam divergence [13]	< 0.5 mrad		
Beam pointing stability (RMS) [14]	≤ 20 µrad		
Beam diameter [15]	~ 8 mm	~10 mm	~12 mm
Typical warm-up time	30 min		
PHYSICAL CHARACTERISTICS			
Laser head size (W × L × H)	456×1233×249 mm ±3 mm (for PL2251A, B with harmonic and C models) 456×1031×249 mm ±3 mm (for PL2251A, B models without harmonic)		
Electric cabinet size (W × L × H)	550×600×550 ±3 mm (19" standard, MR-9)		
Umbilical length	2.5 m		
OPERATING REQUIREMENTS			
Water consumption (max 20 °C)	water cooled, water consumption (max. 20 °C), <8 l/min, 2 bar		
Room temperature	22 ± 2 °C		
Relative humidity	20–80 % (non-condensing)		
Power requirements [16]	single phase, 200–240 V AC, 16 A, 50/60 Hz		
Power [17]	< 1.5 kVA	< 2.5 kVA	< 2.5 kVA

1) Due to continuous improvement, all specifications are subject to change without notice. Parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 1064 nm and for basic system without options.

2) PL2251B-20 has 70 mJ at 1064 nm output energy. Inquire for these energies at other wavelengths.

3) For -SH option. Outputs are not simultaneous. Please inquire for pulse energies at other wavelengths.

4) For -TH option. Outputs are not simultaneous. Please inquire for pulse energies at other wavelengths.

5) For -FH option. Outputs are not simultaneous. Please inquire for pulse energies at other wavelengths.

6) For PL2250 series laser with custom -FiH option.

7) Averaged from pulses, emitted during 30 sec time interval.

8) FWHM. Inquire for optional pulse durations in 20 – 90 ps range. Pulse energy specifications may differ from indicated here.

9) Measured over 1 hour period when ambient temperature variation is less than ±1 °C.

10) With respect to TRIG1 OUT pulse. <10 ps jitter is provided optionally with PRETRIG feature.

11) With respect to SYNC IN pulse.

12) TRIG1 OUT lead or delay can be adjusted with 0.25 ns steps in specified range.

13) Average of X- and Y-plane full angle divergence values measured at the $1/e^2$ level at 1064 nm.

14) Beam pointing stability is evaluated from fluctuations of beam centroid position in the far field.

15) Beam diameter is measured at 1064 nm at the $1/e^2$ point.

16) Three phase 208 or 380 VAC mains are required for 50 Hz versions.

17) For 10 Hz version.

If laser is optimised for pumping parametrical generator, maximum output energy may be different than specified for stand alone application.

OPTIONS

- **Option P20** provides 20 ps ± 10% output pulse duration. Pulse energies are 30% lower in comparison to the 30 ps pulse duration version. Linewidth <2 cm^{-1} at 1064 nm. See table below for pulse energy specifications:

Model	PL2251A-10	PL2251B-10	PL2251C -10
1064 nm	35 mJ	60 mJ	80 mJ
532 nm	17 mJ	30 mJ	40 mJ
355 nm	12 mJ	18 mJ	24 mJ
266 nm	5 mJ	8 mJ	10 mJ

- **Option P80** provides 80 ps ±10% output pulse duration. Pulse energy specifications as below:

Model	PL2251A	PL2251B	PL2251C
Pulse energy at 1064 nm	70 mJ	100 mJ	160 mJ

BEAM PROFILE

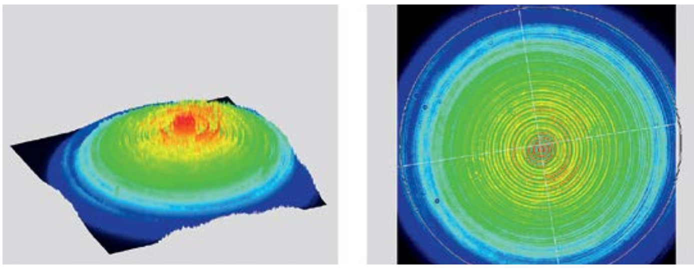
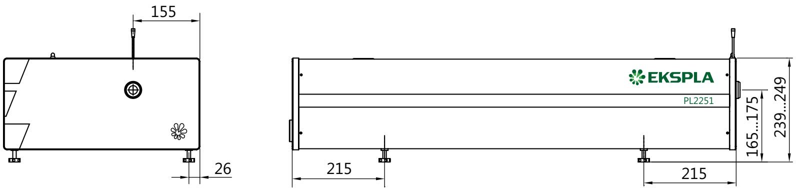


Fig 1. Typical near field output beam profile of PL2250 series laser

OUTLINE DRAWINGS



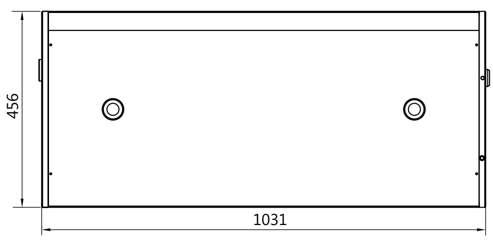


Fig 2. Dimensions of PL2250 series laser head

ORDERING INFORMATION

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

PL2251A-50-SH/TH/FH-P20

- Model
- Pulse energy level, A for 50 mJ output
- Pulse repetition rate in Hz
- Harmonic generator options:
  - SH → second harmonic
  - TH → third harmonic
  - FH → fourth harmonic
- Other options:
  - P20 → 20 ps pulse duration option
  - P80 → 80 ps pulse duration option
  - AW → water-air heat exchanger option
  - FS → seeding option

Photo: Single Housing MIR Tunable Picosecond Laser PT277-XIR integrate a picosecond optical parametric oscillator and DPSS pump laser into a single compact housing.

Picosecond Tunable Wavelength Lasers

For researchers demanding wide tuning range, high conversion efficiency and narrow line-width, EKSPLA PG&PT series optical parametric generators is an excellent choice. All models feature hands-free wavelength tuning, valuable optical components protection system as well as wide range of accessories and extension units.

Long-term experience and close cooperation with scientific institutions made it possible to create range of models, offering probably the widest tuning range: from 193 nm to 16000 nm. Versions, offering near transform limited line-width as well as operating at kHz repetition rates are available.

For customer convenience the wavelength can be set from personal computer through USB (VCP, ASCII commands), RS232 (ASCII commands), LAN (REST API) or RS232 (ASCII commands), LAN (REST API) depending on the system configuration or from remote control pad with backlit display that is easy to read even while wearing laser safety glasses.

EKSPLA PL series picosecond mode-locked lasers are recommended for pumping of PG series Optical Parametric Generators. Combining together, researchers get complete tunable wavelength system, capable to assist researchers in wide range of spectroscopy applications: time-resolved pump-probe, nonlinear, infrared spectroscopy, laser-induced fluorescence.

SHORT SELECTION GUIDE

For Your convenience, table contains all available options and highest parameter values. Not all output specifications are available at the same time simultaneously. Please refer to the catalog page for exact specifications and available options.

Model	Output wavelength range	Max pulse repetition rate	Linewidth	Special feature	Page
PGx01	193 – 16 000 nm	50 Hz	< 6 cm^{-1}	High peak power (>50 MW), ideal for non-linear spectroscopy	30
PGx11	193 – 16 000 nm	50 Hz or 1000 Hz	< 2 cm^{-1}	Narrow linewidth (<0.8 cm^{-1} on some versions)	34
PT277-XIR	1400 – 16000 nm	87 MHz	< 5 cm^{-1}	Picosecond MHz rate MIR range laser system	39
PT277	1400 – 2 050, 2 200 – 4 450 nm	87 MHz	< 2.5 cm^{-1}	Optional intensity modulation up to 2 MHz	41
PT403	210 – 2300 nm	1000 Hz	< 9 cm^{-1}	Pump laser and OPG integrated in 2-in-1 combo housing	43

PGx01 SERIES

High Energy Broadly Tunable OPA

FEATURES

- *Ultra-wide spectral range from **193** to **16 000 nm***
- *High peak power (>**50 MW**) ideal for non-linear spectroscopy applications*
- *Narrow linewidth <**6 cm^{-1}** (for UV < 9 cm^{-1})*
- *Motorized hands-free tuning in 193–2300 nm or 2300–16 000 nm range*
- *PC control*
- *Remote control via keypad*

APPLICATIONS

- *Nonlinear spectroscopy: vibrational-SFG, surface-SH, Z-scan*
- *Pump-probe experiments*
- *Laser-induced fluorescence (LIF)*
- *Other laser spectroscopy applications*

Travelling Wave Optical Parametric Generators (TWOPG) are an excellent choice for researchers who need an ultra-fast tunable coherent light source from UV to mid IR.

Design

The units can be divided into several functional modules:

- optical parametric generator (OPG);
- diffraction grating based linewidth narrowing system (LNS);
- optical parametric amplifier (OPA);
- electronic control unit.

The purpose of the OPG module is to generate parametric superfluorescence (PS). Spectral properties of the PS are determined by the properties of a nonlinear crystal and usually vary with the generated wavelength. In order to produce narrowband radiation, the output from OPG is narrowed by LNS down to 6 cm^{-1} and then used to seed OPA.

Output wavelength tuning is achieved by changing the angle of the nonlinear crystal(s) and grating. To ensure exceptional wavelength reproducibility, computerized control unit driven precise stepper motors rotate the nonlinear crystals and diffraction grating. Nonlinear crystal temperature stabilization ensures long-term stability of the output radiation wavelength.

In order to protect nonlinear crystals from damage, the pump pulse energy is monitored by built-in photodetectors, and the control unit produces an alert signal when pump pulse energy exceeds the preset value.

For customer convenience the laser can be operated from master device or personal computer through USB (VCP, ASCII commands), RS232 (ASCII commands), LAN (REST API) or RS232 (ASCII commands), LAN (REST API) depending on the system configuration or from remote control pad with backlit display that is easy to read even while wearing laser safety glasses.

Available models

Model	Features
PG401	Model has a tuning range from 420 to 2300 nm and is optimized for providing highest pulse energy in the visible part of the spectrum. The wide tuning range makes PG401 units suitable for many spectroscopy application.
PG501-DFG	Model has a tuning range from 2300 to 16000 nm. The PG501-DFG1 model is the optimal choice for vibrational-SFG spectroscopy setups.

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SPECIFICATIONS [1)]

Model	PG401	PG401-SH	PG401-DUV	PG501-DFG1	PG501-DFG2
Tuning range					
DUV	–		193–209.95 nm	–	
SH	–	210–340, 370–419 nm	–		
Signal	420 – 680 nm	–			
Idler	740 – 2300 nm	–			
DFG	–			2300–10000 nm	2300–16000 nm
Output pulse energy [2)]	> 1000 µJ at 450 nm	> 100 µJ at 300 nm	> 50 µJ at 200 nm	> 250 µJ at 3700 nm, > 40 µJ at 10000 nm	> 250 µJ at 3700 nm, > 80 µJ at 10000 nm
Linewidth	< 6 cm^{-1}	< 9 cm^{-1}		< 6 cm^{-1}	
Max pulse repetition rate	50 Hz				
Scanning step					
Signal	0.1 nm	–			
Idler	1 nm	–			
Typical beam size [3)]	~4 mm	~3 mm		~9 mm	
Beam divergence [4)]	< 2 mrad			–	
Beam polarization	–	vertical		horizontal	
Signal	horizontal	–			
Idler	horizontal	–			
Typical pulse duration	~20 ps				
PUMP LASER REQUIREMENTS					
Pump energy					
at 355 nm	10 mJ			–	
at 532 nm	–			10 mJ	
at 1064 nm	–		2 mJ	6 mJ	15 mJ
Recommended pump source [5)]	PL2231-50-TH, PL2251A-TH			PL2231-50-SH, PL2251A-SH	PL2231A-50-SH, PL2251B-SH
Beam divergence	< 0.5 mrad				
Beam profile	homogeneous, without hot spots, Gaussian fit >90 %				
Pulse duration [6)]	29 ± 5 ps				
PHYSICAL CHARACTERISTICS					
Size (W x L x H)	456 × 633 × 244 mm	456 × 1031 × 249 ± 3 mm			
OPERATING REQUIREMENTS					
Room temperature	15 – 30 °C				
Power requirements	100 – 240 V AC single phase, 47 – 63 Hz				
Power consumption	< 100 W				

1) Due to continuous improvement, all specifications are subject to change without notice. Parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 450 nm for PG401 units, 3000 nm for PG501 units and 300 nm for PG401SH units and for basic system without options.

2) See tuning curves for typical pulse energies at other wavelengths. Higher energies are available, please contact Ekspla for more details.

3) Beam diameter is measured at the $1/e^2$ level.

4) Full angle measured at the FWHM point.

5) If a pump laser other than PL2250 or PL2230 is used, measured beam profile data should be presented when ordering.

6) Should be specified if non-EKSPLA pump laser is used.

CUSTOMIZED FOR SPECIFIC REQUIREMENTS

Please note that these products are custom solutions tailored for specific applications or specific requirements.

Interested? Tell us more about your needs and we will be happy to provide you with tailored solution.

PG401-DFG1 provides:

- The broadest hands-free tuning range – from 420 to 10000 nm
- It can be further extended up to 16000 nm with -DFG2 option. It should be noted, that for the 8000 – 16000 nm range a different nonlinear crystal is used, and exchange of the crystals needs to be done manually

PG402 features:

- Gap-free tuning range 410 – 709, 710 – 2300 nm
- Linewidth < 18 cm^{-1}

TUNING CURVES

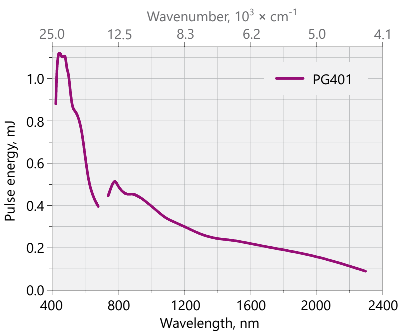


Fig 1. Typical PG401 model tuning curve
Pump energy: 10 mJ at 355 nm

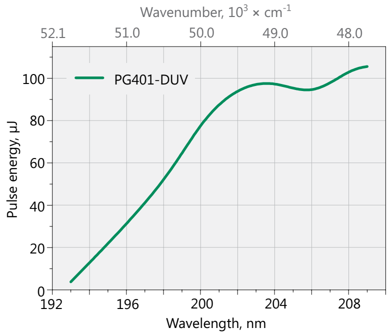


Fig 2. Typical PG401-DUV model tuning curve

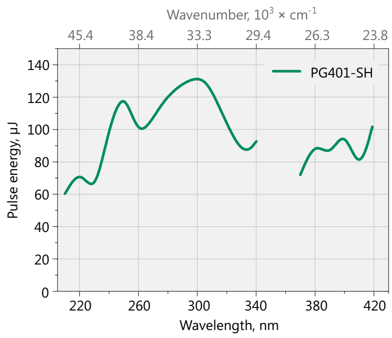


Fig 3. Typical PG401-SH model tuning curve. *Pump energy: 10 mJ at 355 nm*

Note: The energy tuning curves are affected by air absorption due narrow linewidth. These pictures present pulse energies where air absorption is negligible.

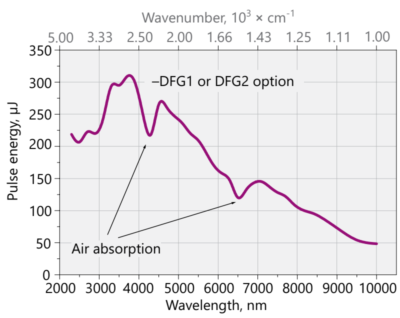


Fig 4. Typical PG501-DFG1 tuning curve in 2300–10000 nm range
Pump energy: 7 mJ at 1064 nm

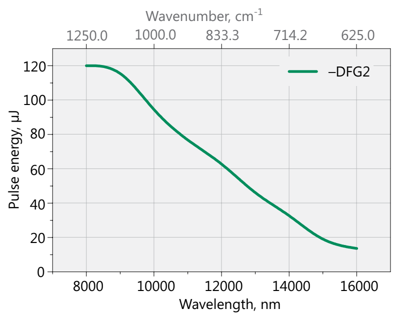


Fig 5. Typical PG501-DFG2 tuning curve in 8000–16000 nm range
Pump energy: 15 mJ at 1064 nm

RECOMMENDED UNITS ARRANGEMENT ON OPTICAL TABLE

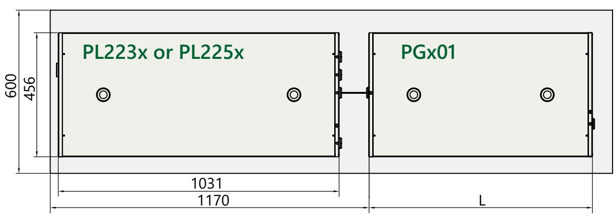


Fig 6a. Arrangement of pump laser and PGx01 unit on optical table

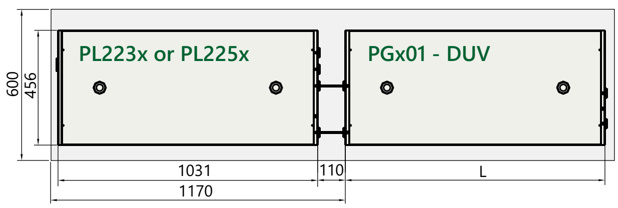


Fig 6b. Arrangement of pump laser and PGx01-DUV unit on optical table

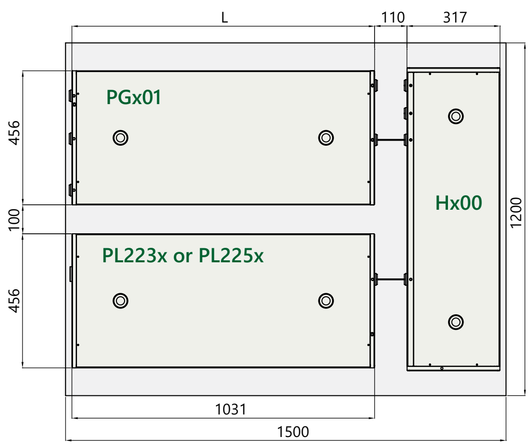


Fig 7. Recommended arrangement of pump laser and PGx01-DFGx unit on optical table

OUTLINE DRAWINGS

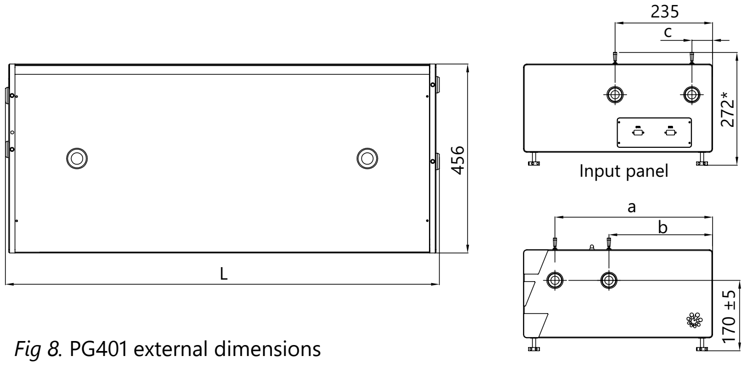


Fig 8. PG401 external dimensions

OUTPUTS PORTS

Model	L, mm	a, mm	b, mm	c, mm	Port 1	Port 2
PG401	633	380	×	×	420–680 nm, 740–2300 nm	–
PG401-SH	838	380	×	×	210–340 nm, 370–419.9 nm, 420–680 nm, 740–2300 nm	–
PG401-SH/DUV	1026	380	250	50	210–340 nm, 370–419 nm, 420–680 nm, 740–2300 nm	192–209.95 nm

For SFG optional 532 nm output port 2.

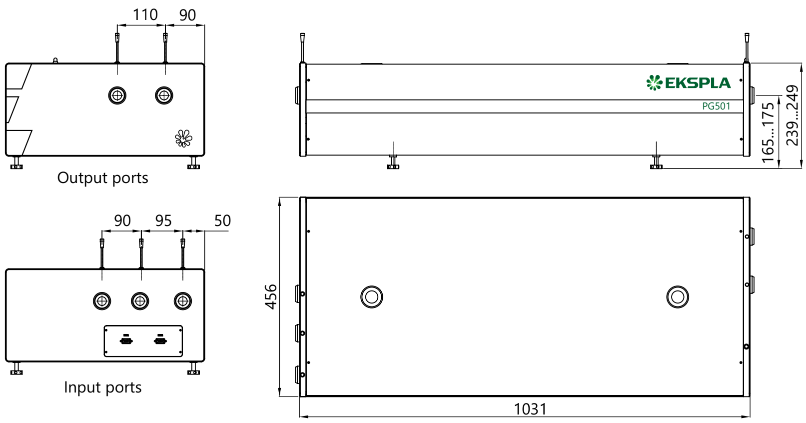


Fig 9. PG501 external dimensions

ORDERING INFORMATION

PG401-DUV

Model
PG4xx → 355 nm pump

01 → travelling wave, narrowed linewidth
02 → travelling wave, not narrowed
11 → synchronous pumping, narrowed

Optional tuning range extension
DUV → 193–209.95 nm
SH → 210-340 nm & 370-420 nm

Custom products, tailored for specific applications. Inquire for other specifications.

DFG1 → 2300–10000 nm; >250 μJ at 3700 nm
DFG2 → 2300–16000 nm

PG501-DFG1

Model
PG5xx → 532 nm pump

01 → travelling wave, narrowed linewidth

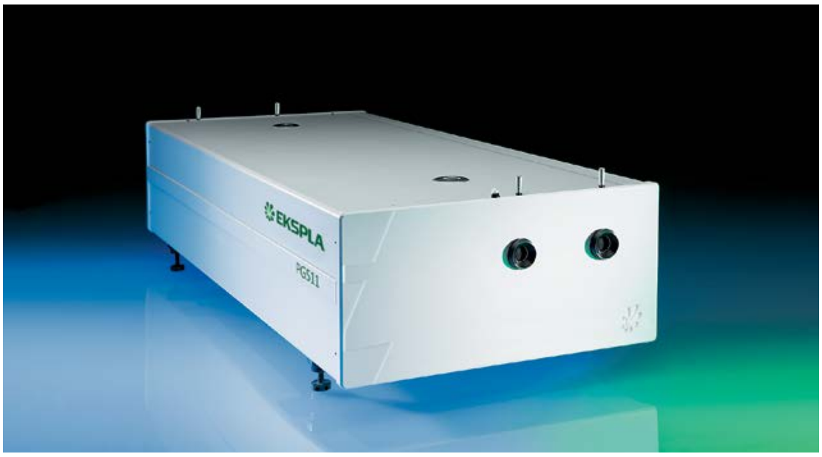
Tuning range
DFG1 → 2300–10000 nm; >250 μJ at 3700 nm
DFG2 → 2300–16000 nm

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

Femtosecond Lasers
Picosecond Lasers
Picosecond Tunable Wavelength Lasers
Nanosecond Lasers
Nanosecond Tunable Wavelength Lasers
Other Ekspla Products

PGx11 SERIES

Transform Limited Broadly Tunable Picosecond OPA



PGx11 series optical parametric devices employ advanced design concepts in order to produce broadly tunable picosecond pulses with nearly Fourier-transform limited linewidth and low divergence. High brightness output beam makes the PGx11 series units an excellent choice for advanced spectroscopy applications.

Optical layout of PGx11 units consists of Synchronously pumped Optical Parametric Oscillator (SOPO) and Optical Parametric Amplifier (OPA). SOPO is pumped by a train of pulses at approx. 87 MHz pulse repetition rate. The output from SOPO consists of a train of pulses with excellent spatial and spectral characteristics, determined by the SOPO cavity parameters.

OPA is pumped by a single pulse temporally overlapped with SOPO output. After amplification at SOPO resonating wavelength, the PGx11 output represents a high intensity single pulse on top of a low-intensity train, while in all other spectral ranges (idler for PG411 and PG711, signal for PG511, also DFG stages) only a single high intensity pulse is present.

Three models designed for pumping by up to the 3rd harmonic of Nd:YAG laser are available.

FEATURES

- *2 cm⁻¹ or **1 cm⁻¹** linewidth*
- *High brightness picosecond pulses at 50 Hz or at up to **1 kHz** pulse repetition rate*
- *Nearly Fourier-transform limited linewidth*
- *Low divergence <2 mrad*
- *Hands-free wavelength tuning*
- *Tuning range from **193 nm** to **16000 nm***
- *PC control*
- *Remote control via keypad*

APPLICATIONS

- *Time resolved pump-probe spectroscopy*
- *Laser-induced fluorescence*
- *Infrared spectroscopy*
- *Nonlinear spectroscopy: vibrational-SFG, surface-SH, Z-scan, pump probe*
- *Other laser spectroscopy applications*

Available models

Model	Features
PG411	Model has a tuning range from 410 to 2300 nm and is optimized for providing highest pulse energy in the visible part of the spectrum. When combined with an optional Second Harmonic Generator (SHG) and Sum Frequency Generator (-DUV), it offers the widest possible tuning range – from 193 to 2300 nm.
PG511	Model has a tuning range 2300–10000 nm. PG411 and PG511 models are designed to be pumped by PL2230 series lasers with a 50 Hz pulse repetition rate.
PG711	Model has 1 kHz pulse repetition rate and uses DPSS mode-locked laser of the PL2210 series for pumping. When pumped with pulses of 90 ps duration, linewidths of less than 1 cm^{-1} were measured in the spectral range up to 16 µm, which makes this device an excellent choice for time-resolved or nonlinear infrared spectroscopy.

Microprocessor based control system provides automatic positioning of relevant components, allowing hands free operation. Nonlinear crystals, diffraction grating and filters are rotated by ultra-precise stepper motors in microstepping mode, with excellent reproducibility.

Precise nonlinear crystal temperature stabilization ensures long-term stability of generated wavelength and output power.

For customer convenience the system can be controlled through USB (VCP, ASCII commands), RS232 (ASCII commands), LAN (REST API) or RS232 (ASCII commands), LAN (REST API) depending on the system configuration or a remote control pad. Both options allow easy control of system settings.

Available standard models are summarized in a table below. Please inquire for custom-built versions.

SPECIFICATIONS [1]

<table>
<tr><th>Model</th><th>PG411</th><th>PG411-SH</th><th>PG411-SH-DUV</th><th>PG511-DFG</th><th>PG711</th><th>PG711-DFG</th></tr>
<tr><td colspan="7">Output wavelength tuning range</td></tr>
<tr><td>SH, DUV</td><td>–</td><td>210–410 nm</td><td>193–410 nm</td><td colspan="3">–</td></tr>
<tr><td>Signal</td><td colspan="3">410–709 nm</td><td>–</td><td colspan="2">1550–2020 nm</td></tr>
<tr><td>Idler</td><td colspan="3">710–2300 nm</td><td>–</td><td colspan="2">2250–3350 nm</td></tr>
<tr><td>DFG</td><td colspan="3">–</td><td>2300–10000 nm</td><td>–</td><td>3350–16000 nm</td></tr>
<tr><td>DFG2
(up to 16000 nm)</td><td colspan="3">–</td><td>inquire</td><td colspan="2">–</td></tr>
<tr><td colspan="7">Output pulse energy [2]</td></tr>
<tr><td>SH, DUV</td><td>–</td><td>100 µJ [3]</td><td>50 µJ [3]</td><td colspan="3">–</td></tr>
<tr><td>Signal</td><td colspan="3">700 µJ</td><td>–</td><td colspan="2">500 µJ</td></tr>
<tr><td>Idler [4]</td><td colspan="3">250 µJ</td><td>–</td><td colspan="2">100 µJ</td></tr>
<tr><td>DFG</td><td colspan="3">–</td><td>> 200 µJ at 3700 nm,
> 40 µJ at 10000 nm</td><td>–</td><td>20 µJ [5]</td></tr>
<tr><td>Max pulse repetition rate</td><td colspan="3">50 Hz</td><td>50 Hz</td><td colspan="2">1000 Hz</td></tr>
<tr><td>Linewidth</td><td colspan="3">< 3 cm^{-1} [6]</td><td>< 2 cm^{-1}</td><td colspan="2">< 1 cm^{-1}</td></tr>
<tr><td>Linewidth Idler</td><td colspan="3">< 5 cm^{-1} [6]</td><td colspan="3">–</td></tr>
<tr><td>Typical pulse duration [7]</td><td colspan="3">~20 ps</td><td>~20 ps</td><td colspan="2">~70 ps</td></tr>
<tr><td colspan="7">Scanning step</td></tr>
<tr><td>SH, DUV</td><td>–</td><td colspan="2">0.01 nm</td><td colspan="3">–</td></tr>
<tr><td>Signal</td><td colspan="6">0.1 nm</td></tr>
<tr><td>Idler</td><td colspan="6">1 nm</td></tr>
<tr><td>DFG</td><td colspan="5">–</td><td>1 nm</td></tr>
<tr><td>Typical beam diameter [8]</td><td colspan="3">~ 4 mm</td><td>~ 9 mm</td><td colspan="2">~ 3 mm</td></tr>
<tr><td>Beam divergence [9]</td><td colspan="6">< 2 mrad</td></tr>
<tr><td colspan="7">Beam polarization [9]</td></tr>
<tr><td>SH, DUV</td><td>–</td><td colspan="2">vertical</td><td colspan="3">–</td></tr>
<tr><td>Signal</td><td colspan="3">horizontal</td><td>vertical</td><td colspan="2">horizontal</td></tr>
<tr><td>Idler</td><td colspan="3">vertical</td><td>horizontal</td><td colspan="2">vertical</td></tr>
<tr><td>DFG</td><td colspan="3">–</td><td>horizontal</td><td>–</td><td>horizontal</td></tr>
</table>

1) Due to continuous improvement, all specifications are subject to change without notice. Parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 450 nm for PG411 units, 800 nm for PG511 units, and 1620 nm for PG711 units and for basic system without options.

2) Pulse energies are specified at selected wavelengths. See typical tuning curves for pulse energies at other wavelengths.

3) Measured at 280 nm for SH and 200 nm for DUV.

4) Measured at 1000 nm for PG411 units, 1620 nm for PG511, and 3000 nm for PG711 units.

5) Measured at 10000 nm.

6) Linewidth for signal (409 – 710 nm) < 3 cm^{-1}, linewidth for idler and SH-DUV (710 – 2300 nm and 193 – 409 nm) < 5 cm^{-1}.

7) Estimated FWHM assuming pump pulse duration 30 ps at 1064 nm for PG411 and PG511 units, and 90 ps at 1064 nm for PG711 units.

8) Beam diameter is measured at 1/e^2 level and can vary depending on the pump pulse energy.

9) Full angle measured at FWHM level.

SPECIFICATIONS [1)]

Model	PG411	PG411-SH	PG411-SH-DUV	PG511-DFG	PG711	PG711-DFG
PUMP LASER REQUIREMENTS						
Recommended pump source	PL2231 + APL2100-TRAIN-H411			PL2231 + H500-APL2100-TRAIN	PL2211A TR	
Min. pump energy or power [10)]						
at 1064 nm	–		2 mJ	(10 mJ)	5 mJ at 1 kHz	
at 532 nm	–			5 mJ (8 mJ)	5 mJ at 1 kHz	
at 355 nm	5 mJ (10 mJ)			–		
Pulse duration [11)]	29 ± 5 ps				90 ps	
Bream polarization at pump wavelength	vertical			horizontal		
Beam size [12)]	7 mm				2.5 mm	
Beam divergence	< 0.5 mrad					
Beam profile	homogeneous, without hot spots					
PHYSICAL CHARACTERISTICS						
Size (W × L × H)	456 × 1026 × 244 mm	456 × 1226 × 244 mm		PL2231: 456 × 1026 × 244 mm H500-APL2100-TRAIN: 456 × 1026 × 244 mm		456 × 1026 × 244 mm
OPERATING REQUIREMENTS						
Room temperature	15–30 °C					
Room temperature stability	± 2 °C					
Power requirements	100–240 V single phase, 47–63 Hz					
Power consumption	< 300 W					

10) The first number represents pulse train energy or power, while the value in brackets represents single pulse energy.

11) At FWHM level. Inquire for other available pulse duration options.

12) Beam diameter measured at $1/e^2$ level.

RECOMMENDED UNITS ARRANGEMENT ON OPTICAL TABLE

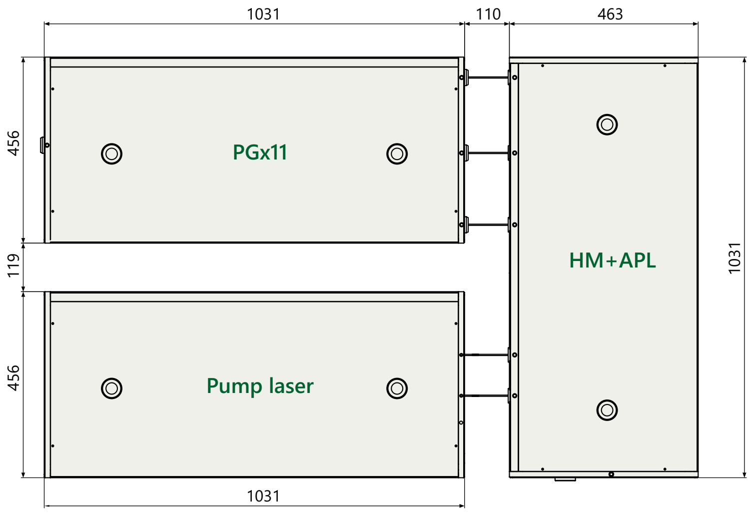


Fig 1. Arrangement of pump laser and PGx11 unit on optical table

TUNING CURVES

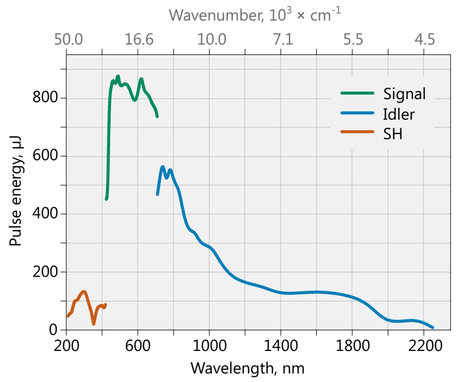


Fig 2. Typical PG411-SH model tuning curve

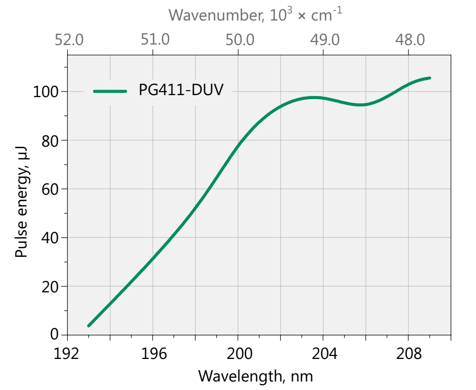


Fig 3. Typical PG411-DUV model tuning curve

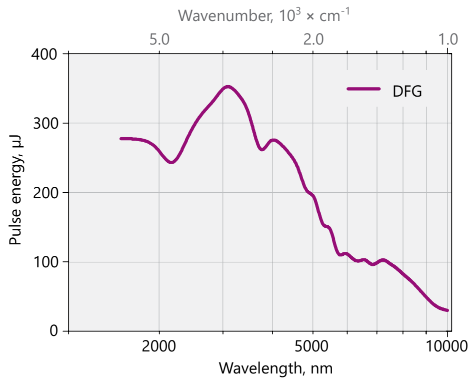


Fig 4 Typical PG511-DFG model tuning curve

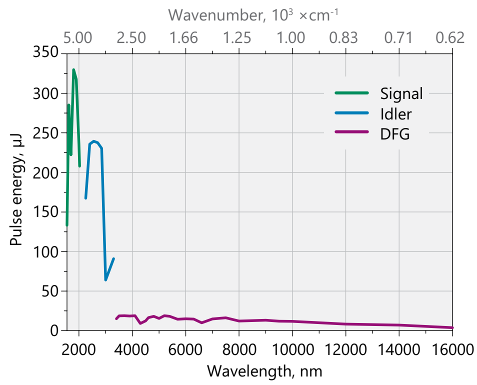


Fig 5. Typical PG711-DFG model tuning curve.
Pump energy: 2.5 mJ at 1064 nm, 1 kHz repetition rate

Note: The energy tuning curves are affected by air absorption due narrow linewidth. These pictures present pulse energies where air absorption is negligible.

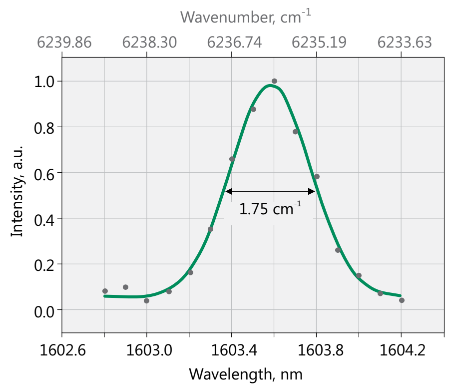
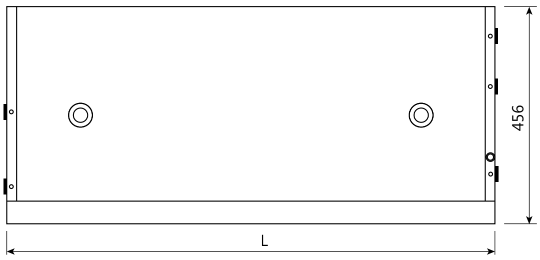


Fig 6. PG511-DFG model typical output linewidth

Femtosecond Lasers
Picosecond Lasers
Picosecond Tunable Wavelength Lasers
Nanosecond Lasers
Nanosecond Tunable Wavelength Lasers
Other Ekspla Products

OUTLINE DRAWINGS



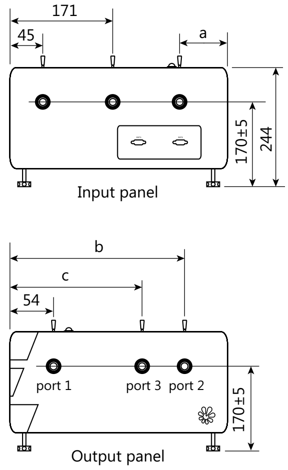


Fig 7. PG411 model external dimensions

OUTPUTS PORTS

Model	L, mm	a, mm	b, mm	c, mm	Port 1	Port 2	Port 3
PG411	1026	×	411	×	420–709 nm, 710–2300 nm	420–709 nm, 710–2300 nm	–
PG411-SH	1226	×	411	×	420–709 nm, 710–2300 nm	210–419 nm, 420–709 nm, 710–2300 nm	–
PG411-SH/DUV	1226	235	411	331	420–709 nm, 710–2300 nm	210–419 nm, 420–709 nm, 710–2300 nm	192–209.95 nm

ORDERING INFORMATION

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

PGx11-SH

Model
PG411 → ps 355 nm pump
PG511 → ps 532 nm pump
PG711 → ps 1064 nm pump

Optional tuning range extension
SH (PG411) → 210–420 nm
SH/DUV (PG411) → 193–420 nm
DFG (PG511) → 2300–10000 nm
DFG (PG711) → 3350–16000 nm

PT277-XIR SERIES

Single Housing MIR (mid infrared range) Tunable Picosecond Laser

FEATURES

- ***1405 – 16000 nm (7115 – 625 cm^{-1})*** *tuning range*
- *Linewidth* ***<5 cm^{-1}*** *in the full tuning range*
- *Nearly diffraction limited divergence*
- *Remote control via keypad and/or any controller running on any OS using REST API commands*
- *PC control via USB (virtual com port), RS232, LAN*

APPLICATIONS

- *Infrared spectroscopy*

PT277 series laser systems integrate a picosecond optical parametric oscillator and DPSS pump laser into a single compact housing. Mounting the components into one frame provides a cost-effective and robust solution. It makes laser installation shorter and improves long-term stability, reduces maintenance costs. The tuning range for the model PT277-XIR 1405 – 2020 nm, 2250 – 4400 nm, 5000 – 16000 nm (7115 – 4950 cm^{-1}, 4444 – 2253 cm^{-1}, 2000 – 625 cm^{-1}) with linewidth <5 cm^{-1} in the full tuning range.

The fast wavelength tuning is based on the microprocessor-control and wavelength tuning is fully automatic. The wavelength tuning elements are mounted on precise closed loop micro stepping motors. The temperatures of the non linear crystals is controlled by a precise thermocontrollers. For customer convenience the system can be controlled via keypad and/or any controller running on any OS using REST API commands. Variety of interfaces USB, RS232, LAN, WLAN (optionally) ensures easy control and integration with other equipment.

TUNING CURVES

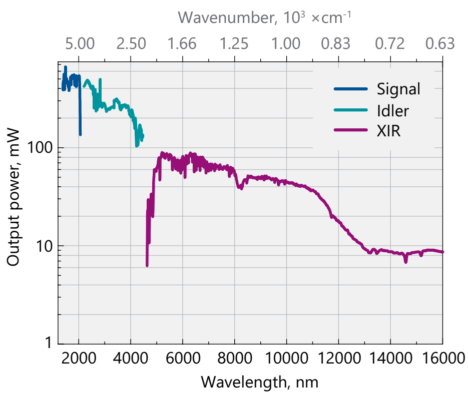


Fig 1. Typical output PT277-XIR tuning curve.
The actual tuning curve might differ from presented here.

SPECIFICATIONS

Model	PT277 - XIR
SYNCHRONOUSLY PUMPED OPO SPECIFICATIONS 1)	
Tuning range	
Signal	1405 – 2020 nm (7115 – 4950 cm^{-1})
Idler	2250 – 4400 nm (4444 – 2253 cm^{-1})
XIR	5000 – 16000 nm (2000 – 625 cm^{-1})
Linewidth	< 5 cm^{-1}
Output power 2)	
OPO @ 4000 nm (2500 cm^{-1})	> 100 mW @ 2200 – 4000 nm
OPO @ 12500 nm (800 cm^{-1})	> 10 mW
Pulse repetition rate	87 MHz
Pulse duration (pump laser)	~8 ps
Scanning step	
Signal	0.1 nm
Idler, XIR	1 nm
Polarization	vertical
Typical beam diameter 3) 4)	~3 mm
Typical beam divergence 5)	< 5 mrad (for signal)
Beam pointing stability	< 50 µrad rms @ 1596 nm
AOM modulation	0 Hz – 2 MHz
Fast spectral scan, scan speed (for spectral range)	
Idler	< 2 s
XIR	< 1 s
PHYSICAL CHARACTERISTICS	
Unit size (W×L×H)	320 × 766 × 241 mm
Power supply size (W×L×H)	483 × 140 × 390 mm
Umbilical length	2.5 m
OPERATING REQUIREMENTS	
Cooling	water-air (by provided chiller)
Room temperature	22 ± 2 °C
Room temperature stability	± 1 °C
Relative humidity	20 – 80 % (noncondensing)
Power requirements	100 – 240 VAC (-10% / +5%), single phase, 50/60 Hz
Power consumption	< 1 kVA
Cleanness of the room	not worse than ISO Class 9

1) All specifications are subject to change without notice. The parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise all specifications are measured at 1596 nm.

2) Output powers are specified at selected wavelengths. See typical tuning curves for power at other wavelengths.

3) Measured at 3000 nm.

4) Beam diameter at the 1/e^2 level and can vary depending on the pump pulse energy.

5) Full angle measured at the FWHM level.

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on. The laser and auxiliary units must be settled in such a place void of dust and aerosols. It is advisable to operate the laser in air conditioned room, provided that the laser is placed at a distance from air conditioning outlets. The laser should be positioned on a solid worktable. Access from both sides should be ensured. Intensive sources of vibration should be avoided, like railways station etc nearby laboratory.

OUTLINE DRAWINGS

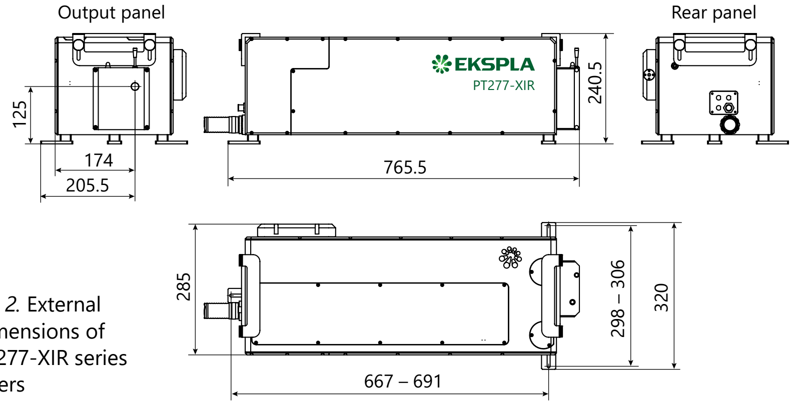


Fig 2. External dimensions of PT277-XIR series lasers

PT277 SERIES

Single Housing NIR-IR Range Tunable Picosecond Laser

FEATURES

- ***1400–4450 nm** tuning range*
- *Nearly Fourier transform-limited linewidth*
- *Nearly diffraction limited divergence*
- *Output wavelength monitoring (optional)*
- *PC control*

APPLICATIONS

- *Infrared microscopy*
- *Infrared spectroscopy*
- *Near field spectroscopy*

PT277 series laser systems integrate a picosecond optical parametric oscillator and DPSS pump laser into a single compact housing. Mounting the components into one frame provides a cost-effective and robust solution with improved long-term stability and reduced maintenance costs.

The tuning range is for the model PT277 1400 – 2050 and 2200 to 4450 nm with nearly Fourier transform limited linewidth.

The microprocessor-controlled wavelength tuning is fully automatic. The wavelength controlling elements are mounted on precise micro-stepping motors. The temperature of the non-linear crystal is controlled by a precise thermocontroller with a bidirectional Peltier element, resulting in the fast tuning of crystal temperature. For customer convenience the system can be controlled through USB (VCP, ASCII commands), RS232 (ASCII commands), LAN (REST API) or RS232 (ASCII commands), LAN (REST API) depending on the system configuration or a remote control pad. Both options allow easy control of system settings.

TUNING CURVES

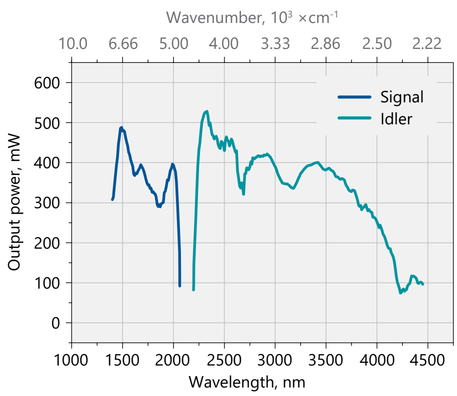


Fig 1. Typical output power of PT277 tunable laser.
The power is shown only at the wavelengths where ambient air absorption is negligible

SPECIFICATIONS [1]

Model	PT277
Pulse repetition rate [2]	87 MHz
Tuning range	
Signal	1400 – 2050 nm
Idler	2200 – 4450 nm
Output power [3]	
OPO [4]	> 500 mW
Linewidth [4]	< 2.5 cm^{-1}
Typical pulse duration [4] [5]	70 ps
Scanning step	
Signal	0.1 nm
Idler	0.1 nm
Polarization	
Signal beam	horizontal
Idler beam	horizontal
Typical beam diameter [4] [6]	~2 mm
Typical beam diameter, Idler [4] [6]	~5 mm
Typical beam divergence [4] [7]	< 2 mrad
PHYSICAL CHARACTERISTICS	
Unit size (W × L × H)	370 × 800 × 260 mm
Power supply size (W × L × H)	520 × 500 × 290 mm
Umbilical length	2 m
OPERATING REQUIREMENTS	
Cooling	water-air
Room temperature	22 ± 2 °C
Relative humidity	20 – 80 % (noncondensing)
Power requirements	100 – 240 V AC, single phase 50/60 Hz
Power consumption	< 1 kVA

1) Due to continuous improvement, all specifications are subject to change without notice. Parameters marked 'typical' are indications of typical performance (not specifications) and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 1064 nm and for basic system without options.

2) Inquire for custom pulse repetition rates.

3) Output powers are specified at selected wavelengths. See typical tuning curves for power at other wavelengths.

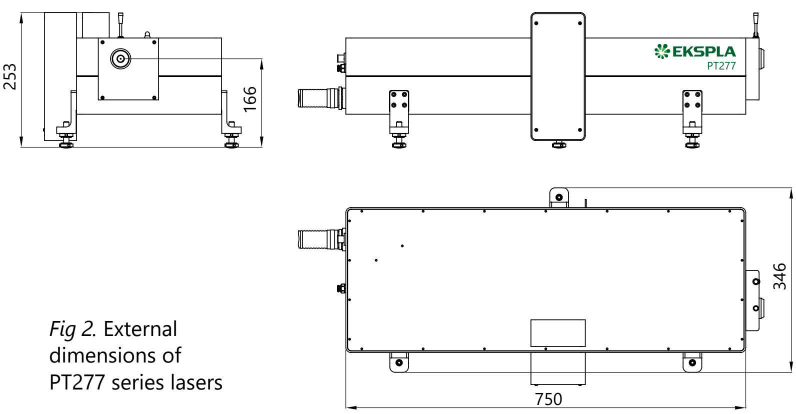
4) Measured at 1600 nm for PT277 model at signal range.

5) Pulse duration can vary depending on wavelength and pump energy.

6) Beam diameter at the 1/e^2 level and can vary depending on the pump pulse energy.

7) Full angle measured at the FWHM level.

OUTLINE DRAWINGS



Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

Fig 2. External dimensions of PT277 series lasers

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PT403 SERIES

Tunable Wavelength Picosecond Laser

PT403 series laser systems integrate a picosecond 1 kHz repetition rate DPSS pump laser and optical parametric generator into a single housing. New picosecond tunable wavelength laser system provide from 210 to 2300 nm from the one box.

Unlike other solutions in the market, offering laser and OPO in different units, new approach features pump laser and OPO integrated into one unit. That delivers almost twice smaller footprint, shorter installation, better stability and other substantial benefits for user.

All-in one-box solution features all components placed into one compact housing. It means better overall stability because all potential causes for misalignment between separate units of pump laser and optical parametric generator are eliminated.

To ensure reliability industry and market tested solutions were employed during the build-up of PT403.

Pump laser is based on industry "gold standard" diode pumped Ekspla PL2210 series picosecond mode-locked laser. Improved output parameters and reduced maintenance costs are achieved by employing diode-pumped-only technology.

Optical parametric generator is based on PGx03 picosecond optical parametric amplifier systems. Fully automatized and microprocessor based control system ensures hands free precise wavelength tuning.

PT403 was built without sacrificing any parameters or reliability. The optical design is optimized to produce low divergence beams with moderate linewidth (typically < 9 cm^{-1}) at approximately 20 ps pulse duration. Featuring 1 kHz repetition rate PT403 tuneable laser is versatile cost-efficient tool for scientists researching various kind of disciplines like time resolved fluorescence, pump-probe spectroscopy, laser-induced fluorescence, Infrared spectroscopy and other aplications.

Simple and convenient laser control

For customer convenience the laser can be operated from master device or personal computer through USB (VCP, ASCII commands), RS232 (ASCII commands), LAN (REST API) or RS232 (ASCII commands), LAN (REST API) depending on the system configuration or from remote control pad with backlit display that is easy to read even while wearing laser safety glasses.

FEATURES

- *Tuning range: 210 – 2300 nm*
- *Motorized hands-free tuning*
- *High pulse energy at 1 kHz rates*
- *Diode pumped solid state design*
- *Narrow linewidth < 9 cm^{-1}*
- *Remote control via keypad*
- *PC control*
- *Optional streak camera triggering pulse with < 10 ps rms jitter*
- *Turn-key operation*
- *Air cooled – external water supply is not required*
- *Low maintenance costs*

APPLICATIONS

- *Time resolved fluorescence (including streak camera measurements), pump-probe spectroscopy*
- *Laser-induced fluorescence*
- *Infrared spectroscopy*
- *Nonlinear spectroscopy: surface-SH, Z-scan*
- *Other spectroscopic and nonlinear optics applications*

BENEFITS

- *Better long term stability (compared with layout where laser and OPO are in different units)*
- *Higher safety – all beams are in the box*
- *Shorter installation time*
- *Almost twice smaller footprint*

SPECIFICATIONS [1]

Model	PT403	PT403-SH
OPA SPECIFICATIONS		
Output wavelength tuning range		
SH	–	210 – 409 nm
Signal	410 – 709 nm	
Idler	710 – 2300 nm	
Output pulse energy [2]		
SH [3]	–	15 μJ
Signal [4]	80 μJ	
Idler [5]	25 μJ	
Pulse repetition rate	1000 Hz	
Linewidth	< 9 cm^{-1}	< 12 cm^{-1}
Typical pulse duration [6]	~ 20 ps	
Scanning step		
SH	–	0.05 nm
Signal	0.1 nm	
Idler	1 nm	
Typical beam size [7]	~ 2 mm	
Beam divergence [8]	< 2 mrad	
Beam pointing stability	≤ 100 μrad rms	
Beam polarization		
SH	–	horizontal
Signal	horizontal	
Idler	vertical	
Optical pulse jitter		
Internal triggering regime [9]	< 50 ps (StDev) in respect to TRIG1 OUT pulse	
External triggering regime	~ 3 ns (StDev) in respect to SYNC IN pulse	
TRIG1 OUT pulse delay [10]	-400 ... 150 ns	
OPERATING REQUIREMENTS		
Room temperature	22 ± 2 °C	
Relative humidity	20 – 80% (non-condensing)	
Power requirements	100 – 240 V single phase, 47 – 63 Hz	
Power consumption	< 0.6 kW	
Water service	air cooled	
Cleanness of the room	not worse than ISO Class 9	

1) Due to continuous improvement, all specifications are subject to change without notice. Parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 450 nm for PT403 units for basic system without options.
2) Pulse energies are specified at selected wavelengths. See typical tuning curves for pulse energies at other wavelengths.
3) Measured at 260 nm.
4) Measured at 450 nm.
5) Measured at 1000 nm.
6) Estimated assuming 30 ps at 1064 nm pump pulse. Pulse duration varies depending on wavelength and pump energy.
7) Beam diameter at the $1/e^2$ level. Can vary depending on the wavelength.
8) Beam divergence measured at FWHM.
9) < 10 ps jitter is provided with PRETRIG option.
10) TRIG1 OUT lead or delay can be adjusted with 0.25 ns steps in specified range.

Communication module interfaces

Interface	Description
USB	virtual serial port, ASCII commands
RS232	ASCII commands

Interface	Description
LAN	REST API
WLAN	REST API

DESIGN

The units can be divided into several functional parts:

1. 1 kHz repetition rate DPSS pump laser,
2. Optical parametric generator (OPG),
3. Electronic control unit.

Fig 1. PT403 unit

PT403 series laser systems integrate a picosecond 1 kHz repetition rate DPSS pump laser and optical parametric generator into a single housing. As pump laser is used PL2210 series diode-pumped, air-cooled, mode-locked Nd:YAG laser. Picosecond tunable wavelength laser system provide from 210 to 2300 nm from the single optical unit.

OPTIONS

▶ **Option SF**

Energy increasing in 300 – 409 nm range by sum-frequency generation.
> 20 μJ @ 340 nm. Pulse energies are ~ 10 % lower in comparison to the system without SF option. See table below for pulse energy specifications:

Model [1]	PT403	PT403-SH
SH [2]	–	> 13 μJ
Signal [3]	> 70 μJ	
Idler [4]	> 22 μJ	

[1] Due to continuous improvement, all specifications are subject to change without notice. Parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture.

[2] Measured at 260 nm.

[3] Measured at 450 nm.

[4] Measured at 1000 nm.

▶ **Options -H, -2H, -3H**

1064 nm or 532 nm, or 355 nm outputs [1] [2]

– H output energy 0.7 mJ;

– 2H output energy 0.3 mJ;

– 3H output energy 0.3 mJ.

[1] Outputs are not simultaneous.

[2] Inquire for outputs simultaneously with PG.

CUSTOMIZED FOR SPECIFIC REQUIREMENTS

Please note that these products are custom solutions tailored for specific applications or specific requirements.

Interested? Tell us more about your needs and we will be happy to provide you with tailored solution.

PT503 FEATURES

- ▶ The higher pulse energy in the near-IR spectral range
- ▶ Tuning range from 700 to 2200 nm

TUNING CURVES

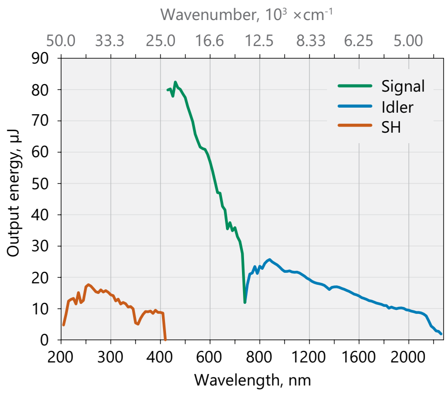

Fig 2. Typical PT403 tuning curves in signal (420 – 709 nm) and idler (710 – 2300 nm) ranges.

Note: The energy tuning curves are affected by air absorption due narrow linewidth. These pictures present pulse energies where air absorption is negligible.

OUTLINE DRAWINGS

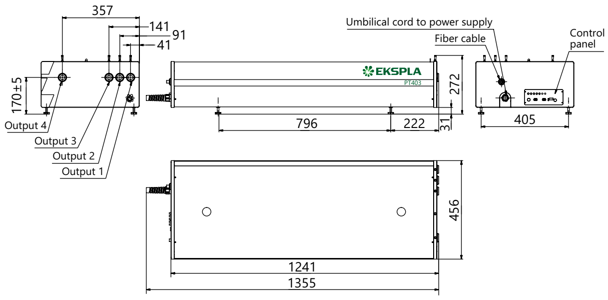

Fig 3. PT403 series laser head typical outline drawing

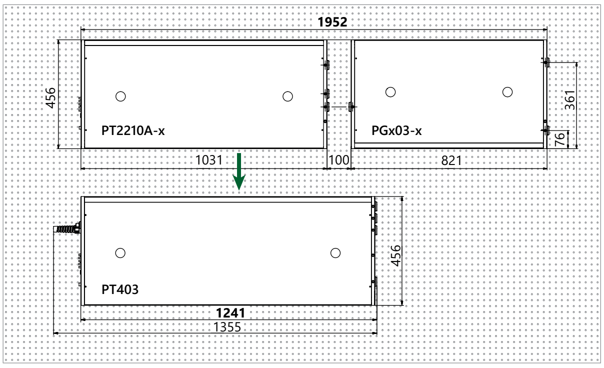

Fig 4. Compared with layout where laser and OPO are in different units, PT403 features almost twice smaller footprint

OUTPUTS PORTS

Model	L, mm	Port 1	Port 2	Port 3	Port 4
PT403	1241	1064 / 532 nm	–	355 nm	410 – 2300 nm
PT403-SH/SF	1441	1064 / 532 nm	210 – 2300 nm	355 nm	410 – 2300 nm

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

Nanosecond Lasers

Short pulse duration, wide range of customization options and high stability are distinctive features of EKSPLA nanosecond lasers. Employing latest achievements in laser technologies, team of dedicated engineers designed wide range of products tailored for specific applications: from compact, simple and robust DPSS NL200 series lasers for OEM manufacturers to high energy customized flash-lamp or diode pumped multijoule systems for research laboratories.

The laser can be controlled from remote control pad with backlit display that is easy to read even while wearing laser safety glasses. Alternatively, the laser can be operated also from personal computer using supplied LabVIEW™ drivers.

Second (532 nm), third (355 nm), fourth (266 nm) and fifth (213 nm) (where available) harmonic options combined with various accessories and customization possibilities make these lasers well suited for many OEM and laboratory applications like OPO, OPCPA, Ti:Sapphire and dye laser pumping, spectroscopy, remote sensing, plasma research ...

SHORT SELECTION GUIDE

For Your convenience, table contains all available options and highest parameter values. Not all output specifications are available at the same time simultaneously. Please refer to the catalog page for exact specifications and available options.

Model	Max. pulse energy at fundamental wavelength	Repetition rate, up to	Pumping	Pulse duration	Special feature	Page
NL200	4 mJ at 1064 nm	10 – 2500 Hz	Diode pumped solid state	<10 ns	Compact and robust	50
NL230	190 mJ at 1064 nm	100 Hz	Diode pumped solid state	3 – 6 ns	Diode pumped only	53
NL300	1100 mJ at 1064 nm	20 Hz	Flash-lamp pumped	3 – 6 ns	Versatile, compact nanosecond laser	56

NL200 SERIES

Compact Q-switched DPSS Lasers

BENEFITS

- *Continuous tuning of repetition rate while maintaining constant pulse energy, superior beam pointing and energy stability make the laser the first choice for micromachining, marking, thin film removing applications*
- *Close to Gaussian smooth beam profile with low value $M^2 < 1.3$ and good focusability is beneficial for such applications, as LCD and OLED display repair*
- *Compactness and lightness make a laser easy transportable, saves on valuable laboratory space*
- *Fast wavelength selection is superior for applications where alternating wavelengths are required, like material ablation, LIBS*
- *Air cooling, cheap and reliable end-pumping technology, amplifiers free DPSS design guarantee easy operation and alignment of laser, simple installation and low life-time ownership cost*
- *Variety of control interfaces USB, RS232, LAN, WLAN ensure easy control and integration of laser with laboratory or OEM equipment*

NL200 series DPSS air-cooled nanosecond lasers offer high pulse energy at kHz repetition rates. End-pumped design makes this laser compact and easy to integrate into various laser equipment both industrial and R&D. Featuring short nanosecond pulse duration, variable repetition rate and external TTL triggering, nanosecond diode pumped NL200 series Q-switched lasers are excellent and cost-effective sources for specific applications, when higher pulse energy is required, like material processing, LCD and OLED display panel repair, ablation, marking, engraving, laser cleaning, laser deposition and many more.

This laser can be equipped with harmonic generation modules for 532 nm, 355 nm, 266 nm and 213 nm wavelengths. Excellent energy stability and a wide range of wavelength options make this laser a perfect tool for spectroscopy, photoacoustic imaging and remote sensing applications. The mechanically stable and hermetically sealed design ensures reliable operation and long lifetime of the laser components.

FEATURES

- *Up to **4 mJ** pulse energy at **1064 nm***
- *Up to **2500 Hz** variable repetition rate*
- ***532 nm, 355 nm, 266 nm** wavelengths as standard options*
- ***<10 ns** pulse duration at 1064 nm*
- *Electro-optical Q-switching*
- *Turn-key operation*
- *Rugged sealed cavity*
- *Compact size*
- *Simple and robust*
- *Air cooled*
- *External TTL triggering*
- *Remote control via keypad and/or any controller running on any OS using REST API commands*

APPLICATIONS

- *Material processing*
- *LCD and OLED display panel repair*
- *Marking*
- *Micromachining*
- *Engraving*
- *Laser deposition*
- *Laser cleaning*
- *Ablation*
- *Spectroscopy*
- *OPO pumping*
- *Remote sensing*

Because of its robust design and diode-pumped technology this laser can work 24/7 with minimal down time and low ownership cost.

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SPECIFICATIONS [1]

Model [2]	NL201 [3]	NL202 [4]	NL204 [4]
Pulse energy			
at 1064 nm	0.9 mJ	2.0 mJ	4.0 mJ
at 532 nm	0.3 mJ	0.9 mJ	2.0 mJ
at 355 nm	0.2 mJ	0.6 mJ	1.3 mJ
at 266 nm	0.08 mJ	0.2 mJ	0.6 mJ
at 213 nm	inquire		
Pulse to pulse energy stability (StdDev) [5]			
at 1064 nm	<0.5 %		
at 532 nm	<2.5 %		
at 355 nm	<3.5 %		
at 266 nm	<4.0 %		
at 213 nm	inquire		
Typical pulse duration [6]	7 – 10 ns		
Power drift [7]	± 2 %		
Pulse repetition rate	0–2500 Hz	0–1000 Hz	
Beam spatial profile	close to Gaussian in near and far fields		
Ellipticity	0.9–1.1 at 1064 nm		
M^2	<1.3		
Beam divergence [8]	<3 mrad		
Polarization	linear		
Typical beam diameter [9]	0.7 mm		
Beam pointing stability (RMS) [10]	≤10 µrad		
Optical jitter (StdDev) [11]	<0.5 ns		
PHYSICAL CHARACTERISTICS			
Laser head (W × L × H) [12]	164 × 320 × 93 mm		
Power supply unit (W × L × H)	470 × 390 × 140 mm		
Umbilical length	3 m		
OPERATING REQUIREMENTS			
Cooling	air cooled		
Ambient temperature	18–30 °C		
Realtive humidity	20–80 % (non-condensing)		
Power requirements	100–240 V AC, single phase, 50/60 Hz		
Power consumption	<600 W		
Cleanliness of the room	not worse than ISO Class 9		

1) Due to continuous improvement, all specifications are subject to change. Parameters marked typical are illustrative; they are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise all specifications are measured at 1064 nm and maximal pulse repetition rate and for basic system without options.

2) Please indicate clearly if 1064 nm output is required in case harmonics options are ordered (except H200STHC module). In such a case, the energy of 1064 nm is optimized for harmonics generation and may differ from specified in the table.

3) Unless stated otherwise all specifications are measured at 2500 Hz pulse repetition rate.

4) Unless stated otherwise all specifications are measured at 1000 Hz pulse repetition rate.

5) Averaged from pulses emitted during 30 sec time interval.

6) FWHM at 1064 nm.

7) Measured over 8 hours period after 20 min warm-up when ambient temperature variation is less than ± 2 °C and humidity <± 5%.

8) Full angle measured at the $1/e^2$ level at 1064 nm.

9) Beam diameter is measured at 1064 nm at the $1/e^2$ level.

10) Beam pointing stability is evaluated as movement of the beam centroid in the focal plane of a focusing element.

11) With respect to QSW IN or SYNC OUT pulse.

12) Without optional harmonic module.

PERFORMANCE

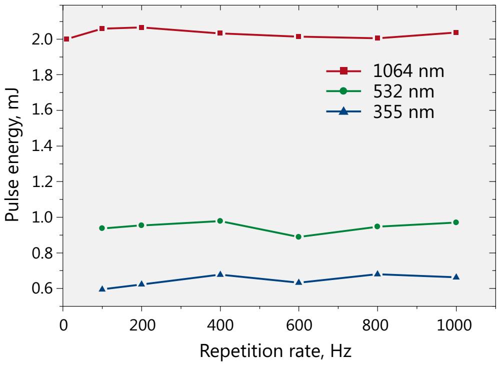

Fig 1. Typical performance data of model NL202 laser

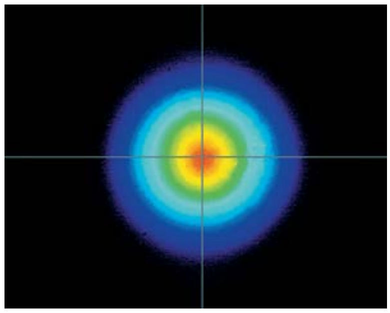

Fig 2. Typical beam intensity profile in the far field

OUTLINE DRAWINGS

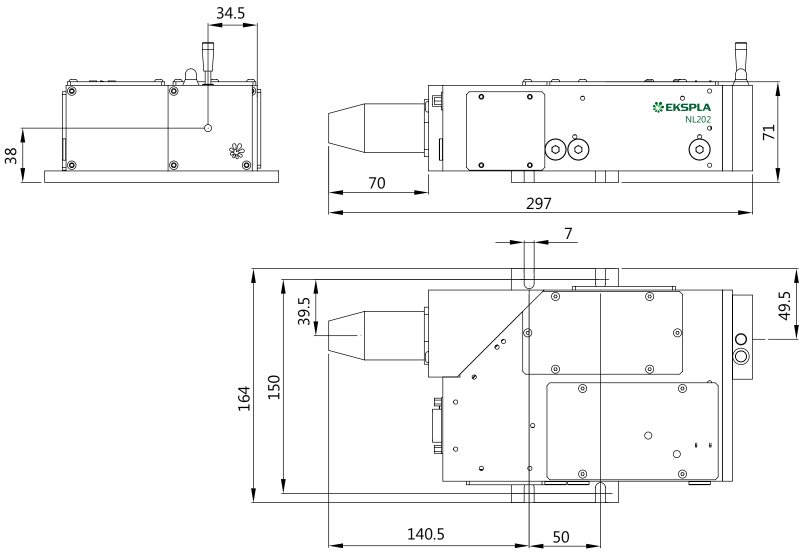

Fig 3. NL202 laser head drawing

ORDERING INFORMATION

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

NL201-H200SHC

Model

Harmonic generator options:
H200SHC → second harmonic
H200THC → third harmonic
H200FHC → fourth harmonic

NL230 SERIES

High Energy Q-switched DPSS Nd:YAG Lasers

BENEFITS

- *Short duration 3 – 6 ns pulses ensures strong interaction with material, are highly suitable for LIBS*
- *User selectable wavelength single axis output is superior for experiments, where alternating wavelengths are required, like material ablation, LIBS*
- *Rugged, monolithic design enables laser usage in hash environment*
- *Diode pumped design provides quiet operation, eliminates the irritation of flash light*
- *Variety of interfaces USB, RS232, LAN, WLAN ensures easy control and integration with other equipment*

The NL230 series diode-pumped short nanosecond lasers are designed to produce high-intensity, high-brightness pulses and are targeted for applications such as material ablation, Light Detection And Ranging (LIDAR), remote sensing, mass spectroscopy, OPO, Ti:Sapphire or dye laser pumping and many more. Diode pumping allows maintenance-free laser operation for an extended period of time - more than 3 years for an estimated eight working hours per day.

Because laser head components are placed in a robust, sealed and precisely machined monolithic aluminium block, this laser can reliably work in a harsh industrial environment with applications such as laser-induced breakdown spectroscopy (LIBS).

Second and third harmonic options allows for an expanded range of applications, where high pulse energy and high pulse to pulse stability are required.

For easy and seamless control and integration with other industrial equipment, the NL230 series laser is equipped with USB/RS232 interfaces and can be externally triggered with a jitter as low as < 0.5 ns StDev.

NL230 series lasers are designed to work reliably 24/7 in an industrial environment.

FEATURES

- *Diode-pumped*
- *Rugged sealed laser cavity*
- *Up to **190 mJ** at **1064 nm** pulse energy*
- *Up to **100 Hz** pulse repetition rate*
- *Short pulse duration in the **3–6 ns** range*
- *Variable reflectivity output coupler for low-divergence beam*
- *Quiet operation: no more flashlamp firing sound*
- *Remote control via keypad and/or any controller running on any OS using REST API commands*
- *Optional temperature-stabilized second and third harmonic generators*
- *Electromechanical shutter (optional)*
- *Easy replaceable output window*

APPLICATIONS

- *LIBS (Light Induced Breakdown Spectroscopy)*
- *Material ablation*
- *OPO pumping*
- *Remote Sensing*
- *LIDAR (Light Detection And Ranging)*
- *Mass Spectroscopy*
- *LIF (Light Induced Fluorescence)*

SPECIFICATIONS [1]

Model	NL231-50	NL231-100
Pulse energy (not less than) [2]		
at 1064 nm	190 mJ	150 mJ
at 532 nm	110 mJ	90 mJ
at 355 nm	55 mJ	40 mJ
Pulse energy stability (StdDev) [3]		
at 1064 nm	< 1 %	
at 532 nm	< 2.5 %	
at 355 nm	< 3.5 %	
Pulse repetition rate	50 Hz	100 Hz
Power drift [4]	< ±1 %	
Pulse duration [5]	3 – 6 ns	
Linewidth	< 1 cm^{-1} at 1064 nm	
Beam profile [6]	"Top Hat" in near field and close to Gaussian in far field	
Beam divergence [7]	< 0.8 mrad	
Beam pointing stability (RMS) [8]	≤ 60 µrad	
Polarization	linear, > 90 % at 1064 nm	
Typical beam diameter [9]	5 mm	
Optical pulse jitter (StDev)		
Internal triggering regime	< 0.5 ns	
External triggering regime	< 0.5 ns	
Typical warm-up time	10 min	
PHYSICAL CHARACTERISTICS		
Laser head size (W × L × H)	251 × 291 × 167 ± 3 mm	
Power supply unit (W × L × H)		
Desktop case	470 × 390 × 140 ± 3 mm	
19" module	483 × 390 × 140 ± 3 mm	
External chiller	inquire	
Umbilical length	3 m	
OPERATING REQUIREMENTS		
Cooling (air cooled) [10]	external chiller	
Ambient temperature	18 – 30 °C	
Relative humidity (non-condensing)	20 – 80 %	
Power requirements	100 – 240 V AC, single phase, 50/60 Hz	
Power consumption	< 1.0 kW	
Cleanliness of the room	not worse than ISO Class 9	

1) Due to continuous improvement, all specifications are subject to change. The parameters marked typical may vary with each unit we manufacture. Unless stated otherwise all specifications are measured at 1064 nm and for basic system without options.

2) Outputs are not simultaneous. Inquire for higher energy (up to 350 mJ at 50 Hz, 250 mJ at 100 Hz) custom models.

3) Averaged from pulses, emitted during 30 sec time interval.

4) Measured over 8 hours period after 20 min warm-up when ambient temperature variation is less than ± 2 °C and humidity <± 5%.

5) FWHM.

6) Near field (at the output aperture) TOP HAT fit is >80%.

7) Full angle measured at the $1/e^2$ level.

8) Beam pointing stability is evaluated as movement of the beam centroid in the focal plane of a focusing element.

9) Beam diameter is measured at 1064 nm at the $1/e^2$ level.

10) Adequate room air conditioning should be provided.

PERFORMANCE

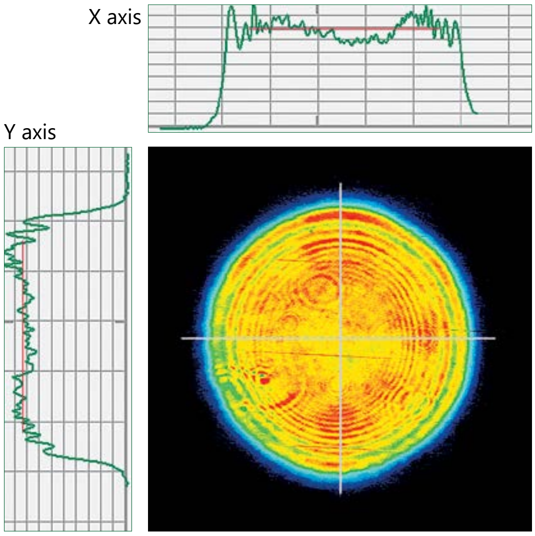

Fig 1. NL231-50 laser typical near field beam profile

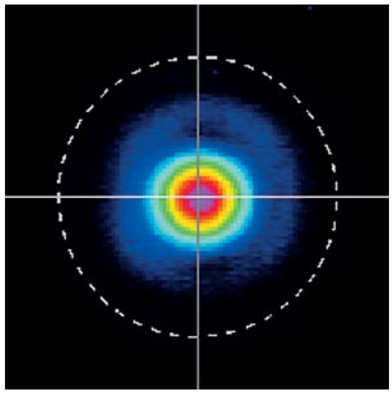

Fig 2. NL231-50 laser typical far field beam profile

Measure	P1.ddelay	P2.width	P3.area
value	72.011 ns	5.507 ns	2.358455 mVs
mean	72.044 ns	5.482 ns	2.355738 mVs
min	71.456 ns	5.167 ns	2.277066 mVs
max	72.552 ns	5.970 ns	2.409653 mVs
sdev	156.11 ps	81.27 ps	16.89196 pVs
num	4.697×10^3	4.697×10^3	4.697×10^3

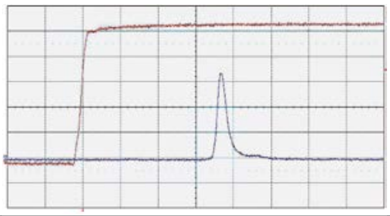

Fig 3. NL230 laser pulse waveform

OUTLINE DRAWINGS

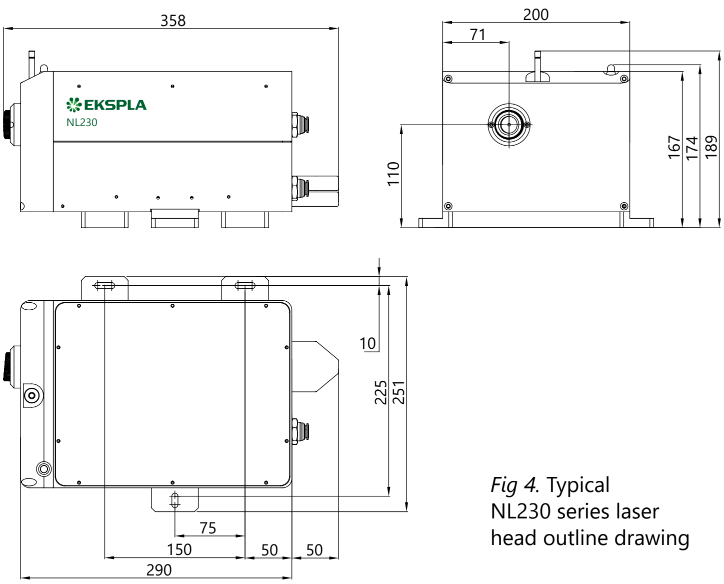

Fig 4. Typical NL230 series laser head outline drawing

ORDERING INFORMATION

NL231-H230THC

Model — Optional harmonic generator modules

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

NL300 SERIES

Compact Flash-Lamp Pumped Q-switched Nd:YAG Lasers

BENEFITS

- *High pulse energy (up to 1100 mJ at 1064 nm, 700 mJ at 532 nm and 450 mJ at 355 nm) ensures strong interaction with material which is excellent for LIBS and material ablation applications*
- *Cost-effective, single-cavity design with no amplifiers for easy alignment, high reliability and low maintenance costs*
- *Small size saves valuable space in the laboratory room*
- *Fast flashlamp replacement without realignment of laser cavity ensures easy maintenance*
- *Air cooling enables simple installation, easy operation and low maintenance costs*
- *Variety of interfaces: USB, RS232, optional LAN and WLAN ensures easy integration with other equipment*

FEATURES

- *Rugged sealed laser cavity*
- *Up to **1100 mJ** pulse energy*
- *Better than 1 % StDev pulse energy stability*
- ***5–20 Hz** pulse repetition rate*
- ***3–6 ns** pulse duration*
- *Thermo stabilized second, third, fourth and fifth harmonic generator modules*
- *Optional attenuators for fundamental and/or harmonic wavelengths*
- *Water-to-water or water-to-air cooling options*
- *Replacement of flashlamps without misalignment of laser cavity*
- *Remote control via keypad and/or RS232/USB port*

APPLICATIONS

- *Material ablation*
- *LIBS (Light Induced Breakdown Spectroscopy)*
- *OPO pumping*
- *Remote Sensing*
- *LIDAR (Light Detection And Ranging)*
- *Mass Spectroscopy*
- *LIF (Light Induced Fluorescence)*

NL300 series electro-optically Q-switched nanosecond Nd:YAG lasers produce high energy pulses with 3–6 ns duration. Pulse repetition rate can be selected in range of 5–20 Hz. NL30×HT models are designed for maximum energy extraction from the active element. Up to 1100 mJ pulse energy can be produced at a 5 Hz pulse repetition rate.

A wide range of harmonic generator modules for generation up to a 5th harmonic is available. Harmonic generators can be combined with attenuators that allow smooth output energy adjustment without changing other laser parameters, i.e. pulse duration, pulse-to-pulse stability, divergence or beam profile. For a more detailed description of harmonic and attenuator modules please check our harmonic generators selection guide on the page 58.

The extremely compact laser head is approximately 480 mm long and can be fitted into tight spaces. The laser power supply has a 330 × 490 mm footprint. Easy access to the water tank from the back side of the power supply facilitates laser maintenance. Replacement of flashlamp does not require removal of pump chamber from the laser cavity and does not lead to possible misalignment.

The powering unit can be configured with water-to-water or water-to-air heat exchangers. The latter option allows for laser operation without the use of tap water for cooling.

For customer convenience the laser can be controlled via PS with LabView™ drivers (included) or a remote control pad. Both options allow easy control of laser settings.

SPECIFICATIONS [1]

Model	NL303HT		NL305HT	
Pulse repetition rate	10 Hz	20 Hz	10 Hz	5 Hz
Pulse energy:				
at 1064 nm	750 mJ	700 mJ	1000 mJ	1100 mJ
at 532 nm [2]	380 mJ	320 mJ	500 mJ	700 mJ
at 355 nm [3]	250 mJ	210 mJ	320 mJ	450 mJ
at 266 nm [4]	80 mJ	60 mJ	100 mJ	120 mJ
at 213 nm [5]	13 mJ	10 mJ	20 mJ	25 mJ
Pulse energy stability (StdDev) [6]				
at 1064 nm	1 %			
at 532 nm	1.5 %			
at 355 nm	3 %			
at 266 nm	3.5 %			
at 213 nm	6 %			
Power drift [7]	±2 %			
Pulse duration [8]	3–6 ns			
Polarization	vertical, >90 %		vertical, >65 %	vertical, >90 %
Optical pulse jitter [9]	<0.5 ns StDev			
Linewidth	<1 cm^{-1}			
Beam profile [10]	Hat-Top in near and near Gaussian in far fields			
Typical beam diameter [11]	~8 mm		~10 mm	
Beam divergence [12]	<0.6 mrad			
Beam pointing stability [13]	50 µrad RMS			
Beam height	68 mm			
PHYSICAL CHARACTERISTICS				
Laser head size (W × L × H) [14]	154 × 475 × 128 mm			
Power supply unit (W × L × H)	330 × 490 × 585 mm			
Umbilical length	2.5 m			
OPERATING REQUIREMENTS				
Water consumption (max 20 °C) [15]	<8 l/min	<12 l/min	<10 l/min	<6 l/min
Ambient temperature	15–30 °C			
Relative humidity	20–80 % (non-condensing)			
Power requirements [16] [17]	208–240 V AC, single phase 50/60 Hz			
Power consumption [18]	<1 kVA	<1.5 kVA	<1.5 kVA	<1 kVA
Cleanliness of the room	not worse than ISO Class 9			

1) Due to continuous improvement, all specifications are subject to change without notice. The parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise all specifications are measured at 1064 nm and for basic system without options.

2) With H300SH, H300S or H300SHC harmonic generator modules. See harmonic generator selection guide on the page 58 for more detailed information.

3) With H300THC harmonic generator modules. See harmonic generator selection guide on the page 58 for more detailed information.

4) With H300SH and H400FHC harmonic generator modules. See harmonic generator selection guide on the page 58 for more detailed information.

5) With H300FiHC harmonic generator module. See harmonic generator selection guide on the page 58 for more detailed information.

6) Averaged from pulses, emitted during 30 sec time interval.

7) Measured over 8 hours period after 20 min warm-up when ambient temperature variation is less than ± 2 °C and humidity <± 5%.

8) FWHM.

9) Relative to SYNC OUT pulse.

10) Near field (at the output aperture) TOP HAT fit is >70%.

11) Beam diameter is measured at 1064 nm at the $1/e^2$ level.

12) Full angle measured at the $1/e^2$ level.

13) Beam pointing stability is evaluated as movement of the beam centroid in the focal plane of a focusing element.

14) See harmonic generator selection guide on the page 58 for harmonic generators units sizes.

15) For water cooled version. Air cooled version does not require tap water for cooling.

16) Power requirements should be specified when ordering.

17) 110 V AC powering is available, please inquiry for details.

18) Required current rating can be calculated by dividing power value by mains voltage value.

OPTIONS

- **Option -AW** – air-cooled power supply option. An adequate air conditioner should be installed in order to keep room temperature stable.
- **Harmonic generator options** – an extensive selection of harmonic generators up to 5th harmonic.
- **Attenuator options** allow a smooth change of laser pulse energy, while other laser pulse parameters, such as pulse duration, jitter, pulse-to-pulse stability, beam divergence and profile remain the same.

OPTIONAL HARMONIC GENERATOR AND ATTENUATOR MODULES

Module	Description	Output ports	Output pulse energy specifications	Dimensions W×L×H, mm	Extension possible?	Notes
H300A	Attenuator for 1064 nm beam	Port 1: 1064 nm beam	Transmission in 5–90% range at 1064 nm		No	Integrated into a laser head
H300SH	Second harmonic generator	Port 1: 1064, 532 nm	n/d	154×160×128	Yes	
H300S	532 nm beam separator	Port 1: 532 nm Port 2: residual 1064 nm	See NL300 specifications for 532 nm beam	154×160×128	No	Should be used with H300SH
H300SHC	Second harmonic generator with 532 nm beam separator	Port 1: 532 nm Port 2: residual 1064 nm	See NL300 specifications for 532 nm beam	154×210×128	No	
H300SHA	Second harmonic generator, beam separator and attenuator for 532 nm beam	Port 1: 532 nm Port 2: residual 532 nm	Transmission in 5–90% range at 532 nm	154×260×128	No	
H300THC	Third harmonic generator with 355 nm beam separator	Port 1: 355 nm Port 2: residual 1064 & 532 nm	See NL300 specifications for 355 nm beam	154×210×128	No	Should be used with H300SH
H300THA	Third harmonic generator, beam separator and attenuator for 355 nm beam	Port 1: 355 nm Port 2: residual 355 nm	Transmission in 5–90% range at 355 nm	154×260×128	No	Should be used with H300SH
H300FHC	Fourth harmonic generator with 266 nm beam separator	Port 1: 266 nm Port 2: residual 532 nm	See NL300 specifications for 266 nm beam	154×260×128	No	Should be used with H300SH
H300FHA	Fourth harmonic generator, beam separator and attenuator for 266 nm beam	Port 1: 266 nm Port 2: residual 266 nm	Transmission in 5–90% range at 266 nm	154×430×128	No	Should be used with H300SH
H300FiHC	Fifth harmonics generator with 213 nm beam separator	Port 1: 213 nm Port 2: residual 1064, 532 & 266 nm	See NL300 specifications for 213 nm beam	154×350×128	No	

OUTLINE DRAWINGS

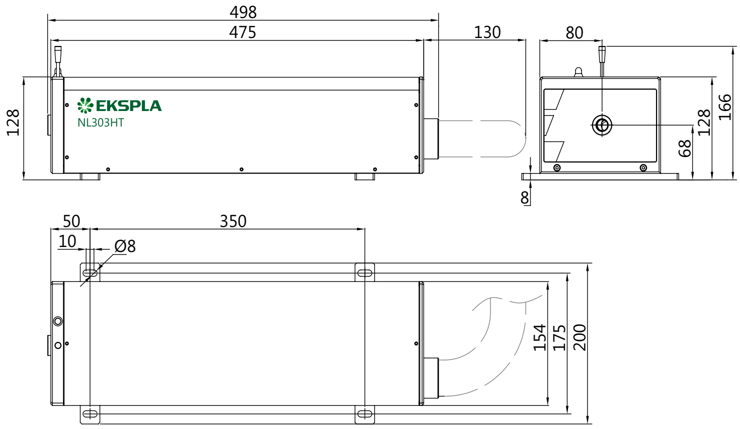

Fig 1. Typical NL300 series laser head outline drawing

ORDERING INFORMATION

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

NL303HT-10-AW-H300SH-H300THC

- Model
- Pulse repetition rate in Hz
- Options: AW → water-air heat exchanger
- Optional harmonic generator modules and other accessories

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REV. 20230414

HARMONIC GENERATORS & ATTENUATORS

For NL300 Series Lasers

Nanosecond Q-switched lasers enable simple and cost effective laser wavelength conversion to shorter wavelengths through harmonic generation. EKSPLA offers a broad selection of wavelength conversion accessories for NL300 series lasers. The purpose of this guide is to help configure available harmonic generator and attenuator modules for NL300 series lasers for optimal performance.

The harmonic module uses a modular design that allows reconfiguration of laser output for the appropriate experiment wavelength. A typical module houses a non-linear crystal together with a set of dichroic mirrors for separating the harmonic beam from the fundamental wavelength. Nonlinear crystals used for the purpose of wavelength conversion are kept at an elevated temperature in a thermo-stabilized oven.

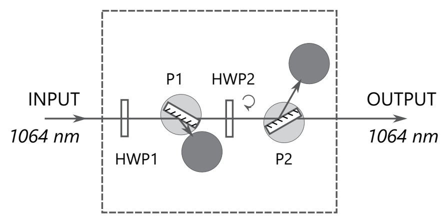
Two or more modules can be joined together for higher harmonic generation: attaching one extra module to a second harmonic generator allows for the generation of 3rd or 4th harmonic wavelengths. It should be noted that only modules with a single output port can be joined together: it is possible to attach a H300S module to a H300SH unit for 532 nm beam separation, or a H300FHC module for 4th harmonic generation (see detailed description below). Modules with two output ports (e.g., H300SHC) cannot be attached to extra units.

FEATURES

- *Compact harmonic modules*
- *Thermo stabilized crystals for long lifetime*
- *Dichroic mirrors*
- *AR coatings on crystals*
- *Phase matching by mechanical adjustment*
- *High conversion efficiency*
- *Wide selection of different configurations*
- *Smooth adjustment of output pulse energy with attenuator*

H300A attenuator

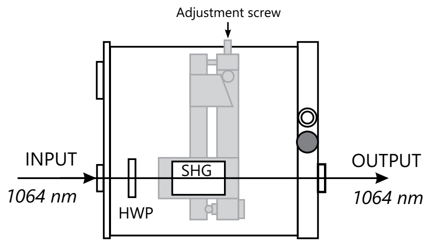
The H300A1 module is integrated into the laser head and designed to attenuate a 1064 nm.
Beam (the length of the laser head extends to 619 mm). Optical layout includes half-wave plates HWP1, HWP2 and polarizers P1, P2. Rotation of the HWP2 half-wave plate changes the polarization of the laser beam and its transmission factor via the P2 polarizer.



H300A

H300SH harmonic generators

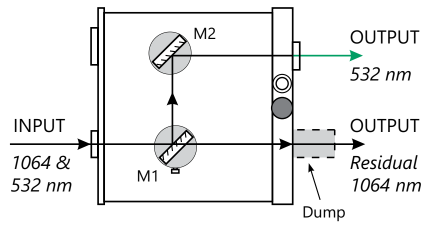
H300SH module contains a SH crystal with a half-wave plate for input polarization adjustment. The output of the H300SH module has both 532 nm and 1064 nm wavelengths.



H300SH

H300S harmonic separator

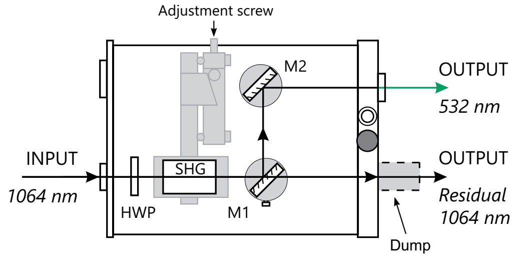
The H300S module has two output ports for the separation of 1064 nm and 532 nm wavelengths.



H300S

H300SHC harmonic generator

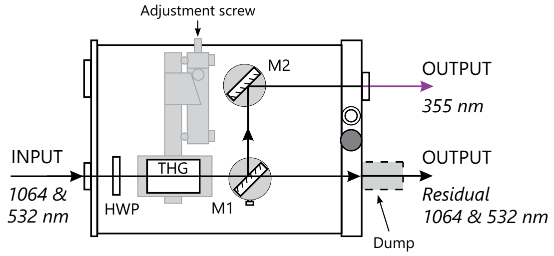
The most cost-effective solution for customers who need a 532 nm wavelength only, the H300 SHC module combines a SHG crystal and beam separators and has two output ports for 532 nm and 1064 nm beams.



H300SHC

H300THC harmonic generator

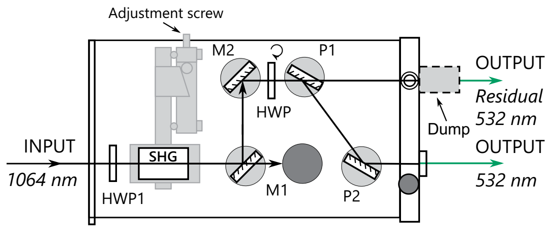
The H300THC module is a third harmonic generator and beam separator with two output ports for a 355 nm beam, and for a residual 532 nm + 1064 nm beam. This module should be used with the H300SH module.



H300THC

H300SHA harmonic generator & attenuator

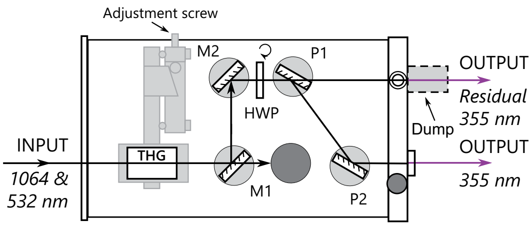
The cost-effective solution for customers who need an attenuated 532 nm wavelength, the H300SHA module combines a SHG generator with attenuator.



H300SHA

H300THA harmonic generator & attenuator

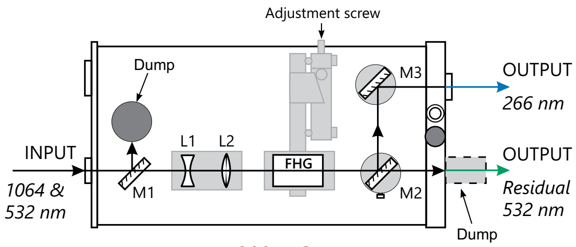
The cost-effective solution for customers who need an attenuated 355 nm wavelength, the H300THA module combines a THG generator with attenuator.



H300THA

H300FHC harmonic generator

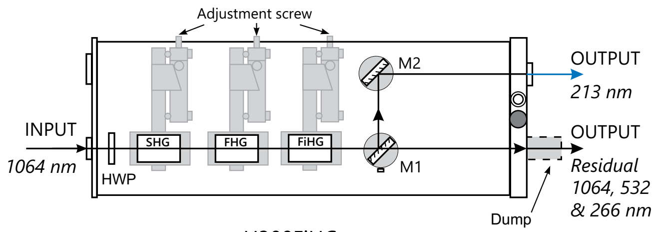
The H300FHC module is a fourth harmonic generator and beam separator for a 266 nm wavelength, with two output ports for a 266 nm beam, and for a residual 532 nm beam. This module should be used with the H300SH module.



H300FHC

H300FiHC harmonic generator

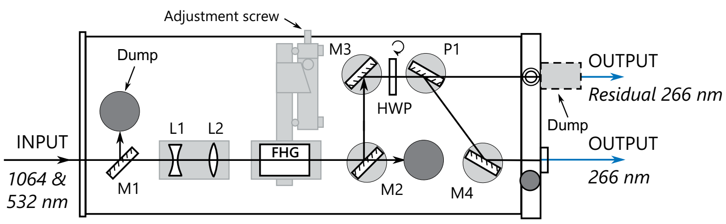
The H300FiHC module is designed to produce a 5th harmonic output. As it requires only a 1064 nm input, the unit contains SH, FH and FiH crystals together with a beam separator for a 213 nm beam.



H300FiHC

H300FHA harmonic generator & attenuator

The cost-effective solution for customers who need an attenuated 266 nm wavelength, the H300FHA module combines a FHG generator with attenuator.



H300FHA

Nanosecond Tunable Wavelength Lasers

NT series tunable lasers offer tunable, automated wavelength output from UV to IR out of the one small-footprint box. Integrated into a single compact housing, the diode or flash-lamp pumped Q-switched Nd:YAG laser and OPO offer hands-free, no-gap tuning across the specified range.

The output wavelength can be set from control pad with backlit display that is easy to read even while wearing laser safety glasses. Alternatively, the laser can be controlled also from personal computer using supplied LabVIEW™ drivers.

Most of the pump lasers do not require water for cooling, thus further reducing running and maintenance costs. A built-in OPO pump energy monitor allows monitoring of pump laser performance without the use of external power meters.

Wide range of available options, accessories and modifications enable to tailor laser to better fit for your requirement. High conversion efficiency, stable output, easy maintenance, robust design and compact size make NT series systems an excellent choice for many applications including laser induced fluorescence, flash photolysis, photobiology, metrology, remote sensing and many others.

In the year 2011 the NT series systems has received the Photonics Oscar – Prism Award for Photonics Innovation in Scientific lasers category.

SHORT SELECTION GUIDE

For Your convenience, table contains all available options and highest parameter values. Not all output specifications are available at the same time simultaneously. Please refer to the catalog page for exact specifications and available options.

Model	Output wavelength range	Repetition rate, up to	Pump laser	Special feature	Page
NT260	210–2600 nm	10 kHz	Diode pumped solid state	Narrow linewidth at kHz repetition rate	64
NT230	192–2600 nm	100 Hz	Diode pumped solid state	High, up to 15 mJ pulse energy from OPO	67
NT240	210–2600 nm	1000 Hz	Diode pumped solid state	Broadly tunable kHz pulsed DPSS lasers	71
NT250	335–2600 nm	1000 Hz	Diode pumped solid state	UV-NIR range DPSS lasers	75
NT270	2500–4475 nm	1000 Hz	Diode pumped solid state	Wide IR tuning range at kHz repetition rate	78
NT340	192–4400 nm	20 Hz	Flash-lamp pump laser	Wide range of modifications to tailor for specific applications	81

NT260 SERIES

Narrow Linewidth 10 kHz Tunable Lasers

FEATURES

- *Hands-free no gap wavelength tuning in 210 – 2600 nm range*
- *High repetition rate 10 kHz*
- *Narrow linewidth down to 1.5 cm^{-1}*
- *Up to 0.7 W output*
- *Monolithic rugged frame*
- *Motorized output shutters*
- *Mixed Q-switched/ mode-locked operation*
- *Easy control via keypad or PC*

BENEFITS

- *Super reliable*
- *Wide tuning range 210 – 2600 nm without gaps*
- *Output peak in VIS range (useful for popular applications, like LIF)*
- *Hands-free wavelength tuning – no need for physical intervention*

APPLICATIONS

- *Laser-induced fluorescence spectroscopy*
- *Photoacoustic microscopy*
- *Metrology & equipment calibration*
- *Pump-probe spectroscopy, photolysis*
- *Mass spectroscopy*
- *Environment monitoring, LIDAR*

NT262 is a unique narrow linewidth 10 kHz OPO. Pioneering patented technology enables powerful up to 0.7 W output in 210 – 2600 nm wavelengths range while maintaining < 3 cm^{-1} (typically < 2 cm^{-1} at most wavelengths) linewidth that is highly beneficial for traditional and specific applications requiring narrow linewidth and high spectral brightness pulses. Thus, besides the most of popular applications, like fluorescence and pump-probe, the system is also suitable for such demanding applications where high resolution and narrow linewidth are required, like the calibration of detectors and spectroradiometers, metrology or gas spectroscopy. High 10 kHz repetition rate and hands-free wavelength tuning makes easy and fast experiment data collection as never before. The system is highly stable, ensures excellent short and long-term energy and power stability, has smaller M^2 value if compared with traditional OPO systems.
In addition to superior specifications, the laser is highly reliable due to low generation threshold and easy running regime. The system fits into monolithic, rugged housing that ensure high reliability and low costs of maintenance.

SPECIFICATIONS [1]

Model	NT262
OPO	
Wavelength range [2]	
Signal	405 – 710 nm
Idler	710 – 2600 nm
SH/SF generator (optional)	210 – 405 nm
Output pulse energy/ average power	
OPO [3]	70 μJ / 700 mW
SH/SF generator (optional) [4]	6 μJ / 60 mW
Tuning resolution [5]	
Signal (405 – 710 nm)	0.5 cm^{-1}
Idler (710 – 2600 nm)	1 cm^{-1}
SH/SF (210 – 405 nm)	1 cm^{-1}
Pulse and beam parameters	
Pulse duration [6]	~7 ns
Linewidth [7]	<3 cm^{-1}
Typical beam diameter [8]	4.5 mm × 2.5 mm
Beam pointing stability [9]	≤ 50 μrad RMS
Polarization	
Signal beam	Horizontal
Idler beam	Horizontal
SH/SF	Horizontal
PUMP LASER [10]	
Pump wavelength	355 nm
Typical pump pulse energy	0.3 mJ
Pulse duration	~7 ns
Beam quality	Near Gaussian in near and far fields
Beam divergence	< 1.5 mrad
Pulse energy stability (StdDev)	< 2.5 %
Pulse repetition rate	10 kHz
Nominal lifetime for pump diodes	20 000 hours
Typical warm-up time [11]	15 min
PHYSICAL CHARACTERISTICS	
Laser head size (W × L × H)	400 × 790 × 166 ± 3 mm
Power supply unit size (W × L × H)	553 × 510 × 529 ±3 mm
Umbilical length	3 m
OPERATING REQUIREMENTS	
Cooling [12]	Built-in chiller
Clean air purge	Built-in
Room temperature	18 – 27 °C
Ambient temperature stability	±2°C
Relative humidity	20 – 80 % (non-condensing)
Power requirements	100 – 240 VAC, single phase 50/60 Hz
Power consumption	<1 kW
Cleanliness of the room	Not worse than ISO Class 9

1) Due to continuous improvement, all specifications are subject to change. Parameters marked typical are illustrative; they are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 450 nm.

2) Hands-free tuning range is from 210 nm to 2600 nm. Wavelengths values at margins are rounded.

3) Measured at 450 nm. See tuning curves for typical outputs at other wavelengths.

4) Measured at 230 nm. See tuning curves for typical outputs at other wavelengths.

5) For manual input from PC.

6) FWHM measured with photodiode featuring 1 ns rise time and 300 MHz bandwidth oscilloscope.

7) In signal and idler range. Linewidth is <5 cm^{-1} for 210–405 nm range.

8) Beam diameter is measured at 450 nm at the $1/e^2$ level and can vary depending on the pump pulse energy.

9) Beam pointing stability is evaluated as movement of the beam centroid in the focal plane of a focusing element.

10) Laser output will be optimized for OPO operation and specifications may vary with each unit we manufacture.

11) Starting from 22 °C.

12) Air cooled. Water cooled under request.

Note: The laser and auxiliary units must be settled in such a place void of dust and aerosols. It is advisable to operate the laser in air conditioned room, provided that the laser is placed at a distance from air conditioning outlets. The laser should be positioned on a solid and flat worktable in horizontal position. Access from one side should be ensured. Intensive sources of vibration should be avoided near the laboratory (ex. railway station or similar).

Options

Option	Features
-SH/SF	Tuning range extension in 210 – 405 nm range by combining second harmonics and sum-frequency generator outputs for maximum possible pulse energy
-H	1064 nm output via separate port

PERFORMANCE

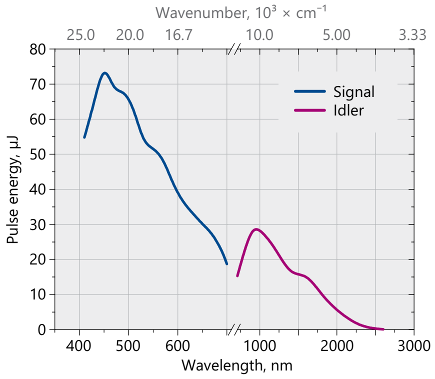


Fig 1. Typical (smoothed) NT262 laser tuning curves in signal (405 – 710 nm), idler (710 – 2600 nm) ranges

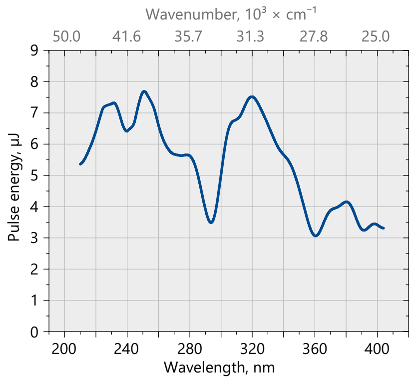


Fig 2. Typical (smoothed) NT262 laser output with –SH/SF option (210 – 405 nm) range

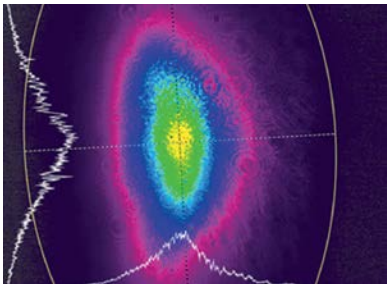


Fig 3. NT262 series laser beam profile at 450 nm in near field

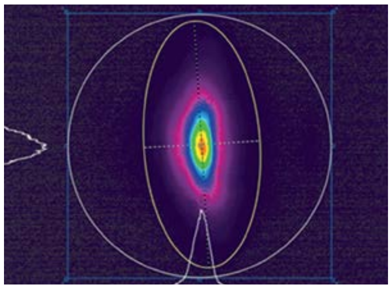


Fig 4. NT262 series laser beam profile at 450 nm in far field

ORDERING INFORMATION

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

NT262-SH/SF-H

Model

Optional tuning range extension:
SH/SF → 210–405 nm

Options:
H → extra 1064 nm output

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NT230 SERIES

High Energy Broadly Tunable DPSS Lasers

BENEFITS

- *Hands-free wavelength tuning – no need for physical intervention*
- *The system is widely tunable; 192 – 2600 nm and delivers high pulse energy (up to 15 mJ) which allows investigation of an extensive range of materials*
- *High repetition rate (up to 100 Hz) and output power enable fast data collection and intensive excitation of materials*
- *Narrow linewidth (down to 3 cm^{-1}) and superior tuning resolution (1 – 2 cm^{-1}) allow recording of high quality spectra*
- *High integration level saves valuable space in the laboratory*
- *Diode pumping reduces maintenance frequency*
- *Auto-calibration makes easy operation and maintenance*
- *Optional integrated energy meter verifies energy data readings*
- *Automatic electromechanical output shutters ensure high level of safety*
- *User friendly extendable handles ease transportation and repositioning of laser*
- *In-house design and manufacturing of complete systems, including pump lasers, guarantees on-time warranty and post warranty services and spares supply*
- *Variety of control interfaces: USB, RS232, LAN and WLAN ensures easy control and integration with other equipment*
- *Attenuator and fiber coupling options facilitate incorporation of NT230 systems into various experimental environments*

FEATURES

- *Integrates DPSS pump laser and OPO into a single housing*
- *Hands-free no-gap wavelength tuning* ***from 192 to 2600 nm******
- *Up to* ***15 mJ*** *pulse energy from OPO*
- *Up to* ***100 Hz*** *pulse repetition rate*
- *Up to* ***2 mJ*** *output pulse energy* ***in UV***
- *Less than* ***5 cm^{-1}*** *linewidth*
- ***2–5 ns*** *pulse duration*
- *Electromechanical output shutters*
- *Transportation handles*
- *355 nm & 1064 nm laser outputs*
- *532 nm output (optional)*
- *Remote control via key pad or PC*

* *Automatic wavelength scan is optional*

APPLICATIONS

- *Laser-induced fluorescence*
- *Flash photolysis*
- *Photobiology*
- *Remote sensing*
- *Metrology*
- *Non-linear spectroscopy*
- *Photo acoustic imaging*

NT230 series lasers deliver high up to 10 mJ energy pulses at 100 Hz pulse repetition rate, tunable over a broad spectral range. Integrated into a single compact housing, the diode pumped Q-switched Nd:YAG laser and Optical Paramteric Oscillator (OPO) offers hands free, no-gap tuning from 192 to 2600 nm. With its 100 Hz repetition rate, the NT230 series laser establishes itself as a versatile tool for many laboratory applications, as laser induced fluorescence, flash photolysis, photobiology, metrology, remote sensing, etc.

Due to the innovative diode pumped design, NT230 series lasers feature maintenance-free laser operation for an extended period of time and improved stability (compared with flash-lamp pumped counterparts).

NT230 series systems can be controlled from a remote control pad or/and a computer. The control pad allows easy control of all parameters and features on a backlit system display that is easy to read even with laser safety eyewear.

SPECIFICATIONS [1]

Model	NT230-50	NT230-100
OPO		
Wavelength range		
Signal	405 – 710 nm	
Idler	710 – 2600 nm	
SH and SF	210 – 405 nm [2]	
DUV	192 – 210 nm	
Pulse energy [3]		
OPO	15 mJ	10 mJ
SH and SF [4]	1.8 mJ	1.3 mJ
DUV	0.4 mJ	0.27 mJ
Pulse repetition rate	50 Hz	100 Hz
Pulse duration [5]	2 – 5 ns	
Linewidth [6]	<5 cm^{-1}	
Tuning resolution [7]		
Signal	1 cm^{-1}	
Idler	1 cm^{-1}	
SH / SF / DUV	2 cm^{-1}	
Polarization		
Signal	horizontal	
Idler	vertical	
SH / SF	horizontal	
DUV	vertical	
OPO beam divergence [8]	<2 mrad	
Typical beam diameter [9]	5 mm	
PUMP LASER		
Pump wavelength [10]	355 nm	
Typical pump pulse energy [11]	50 mJ	35 mJ
Pulse duration [6]	2 – 5 ns	
PHYSICAL CHARACTERISTICS		
Unit size (W × L × H)	451 × 705 × 172 mm	
Power supply size (W × L × H)	449 × 376 × 140 mm	
External chiller	inquire	
Umbilical length	2.5 m	
OPERATING REQUIREMENTS		
Cooling	external chiller	
Room temperature	18 – 30 °C	
Relative humidity	20 – 80 % (non-condensing)	
Power requirements	100 – 240 V AC, single phase, 50/60 Hz	
Power consumption	<1.8 kW	
Cleanliness of the room	not worse than ISO Class 9	

1) Due to continuous improvement, all specifications are subject to change. Parameters marked typical are illustrative. They are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 450 nm and for basic system without options.

2) Separate –SH and –SF options are available.

3) See tuning curves for typical outputs at other wavelengths.

4) Measured at 260 nm wavelength.

5) FWHM measured with photodiode featuring 1 ns rise time and 300 MHz bandwidth oscilloscope.

6) Linewidth is <8 cm^{-1} for 210 – 405 nm range.

7) When wavelength is controlled from PC. When wavelength is controlled from keypad, tuning resolution is 0.1 nm for signal, 1 nm for idler and 0.05 nm for SH, SF and DUV.

8) Full angle measured at the FWHM level at 450 nm.

9) Beam diameter is measured at 450 nm at the $1/e^2$ level and can vary depending on the pump pulse energy.

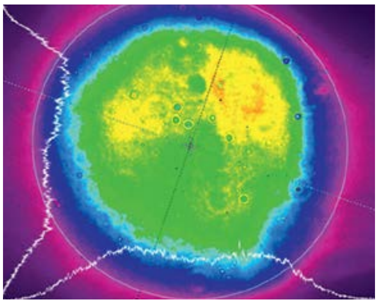
10) Separate output port for the fundamental and 3rd harmonic beam is standard. Output ports for other harmonic are optional.

11) The pump laser pulse energy will be optimized for best OPO performance and can vary with each unit we manufacture.

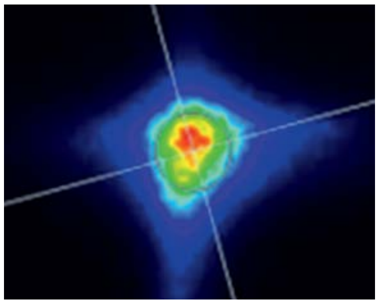
Accessories and optional items

Option	Features
-SH	Tuning range extension in UV range (210–405 nm) by second harmonic generation
-SF	Tuning range extension in 300–405 nm range by sum-frequency generation
-SH/SF	Tuning range extension in 210–405 nm range by combining second harmonic and sum-frequency generator outputs for maximum possible pulse energy
-DUV	Deep UV option for 192 – 210 nm range output
-2H	532 nm output
-FC	Fiber coupled output in 300–2000 nm range
-ATTN	Attenuator
-SCU	Spectral filtering accessory for improved spectral purity of pulses
-FWS	Fast wavelength scanning option

PERFORMANCE



Near field



Far field

Fig 1. Typical beam profiles of NT230 series lasers at 450 nm

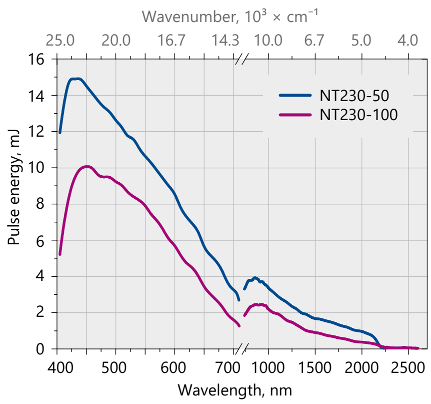


Fig 2. Typical output pulse energy of NT230 laser

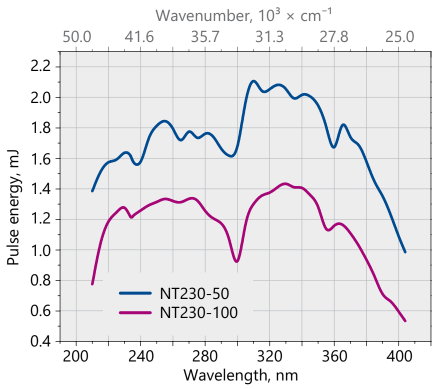


Fig 3. Typical output pulse energy of NT230 laser with SH/SF extension

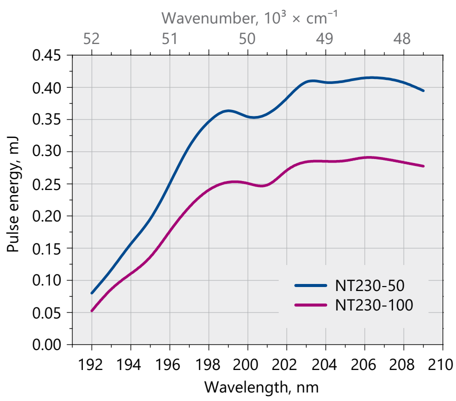


Fig 4. Typical output pulse energy of NT230 laser with DUV extension

OUTLINE DRAWINGS

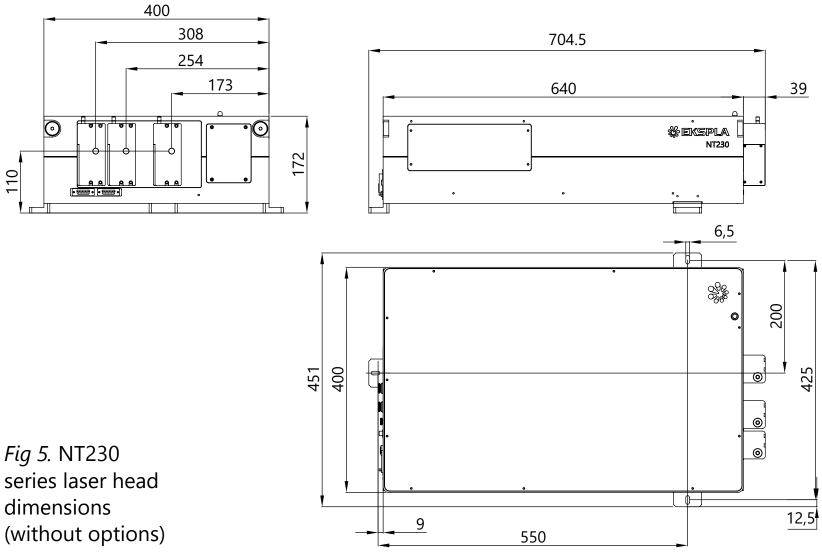


Fig 5. NT230 series laser head dimensions (without options)

Fig 6. For easier transportation laser features integrated carrying handles, which can be hidden inside, when not in need

ORDERING INFORMATION

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

NT230-50-SH-2H-SCU

Model

Pulse repetition rate in Hz

Options:
2H → extra 532 nm output
SCU → spectral filtering accessory

Optional tuning range extension:
SH → 210–405 nm
SF → 300–405 nm
SH/SF → 210–405 nm
DUV → 192–210 nm

NT240 SERIES

Broadly Tunable kHz Pulsed DPSS Lasers

FEATURES

- *Integrates DPSS pump laser and OPO into a single housing*
- *Hands-free no-gap wavelength tuning from **210** to **2600 nm****
- ***1000 Hz** pulse repetition rate*
- *More than **60 µJ** output pulse energy in UV*
- *Less than **5 cm^{-1}** linewidth*
- ***3–6 ns** pulse duration*
- *Remote control via key pad or PC*
- *Optional separate output for the OPO pump beam 355 nm, 532 nm or 1064 nm*

* *Automatic wavelength scan is optional*

BENEFITS

- *Hands-free wavelength tuning – no need for physical intervention*
- *High repetition rate 1000 Hz enables fast data collection*
- *End pumping with diode technology ensures high reliability and low maintenance costs*
- *Narrow linewidth (down to 3 cm^{-1}) and superior tuning resolution (1 – 2 cm^{-1}) allow recording of high quality spectra*
- *High integration level saves valuable space in the laboratory*
- *In-house design and manufacturing of complete systems, including pump lasers, guarantees on-time warranty and post warranty services and spares supply*
- *Variety of control interfaces: USB, RS232, LAN and WLAN ensures easy control and integration with other equipment*
- *Attenuator and fiber coupling options facilitate incorporation of NT240 systems into various experimental environments*

APPLICATIONS

- *Laser-induced fluorescence spectroscopy*
- *Pump-probe spectroscopy*
- *Non-linear spectroscopy*
- *Time-resolved spectroscopy*
- *Photobiology*
- *Remote sensing*
- *Determination of the telescope throughput*

NT240 series lasers produce pulses at an unprecedented 1 kHz pulse repetition rate, tunable over a broad spectral range. Integrated into a single compact housing, the diode pumped Q-switched Nd:YAG laser and OPO offers hands-free, no-gap tuning from 210 to 2600 nm. With its 1000 Hz repetition rate, the NT240 series laser establishes itself as a versatile tool for many laboratory applications, including laser induced fluorescence, flash photolysis, photobiology, metrology, remote sensing, etc.

NT240 series systems can be controlled from a remote control pad or/and a computer using supplied LabVIEW™ drivers. The control pad allows easy control of all parameters and features on a backlit display that is easy to read even with laser safety eyewear.

Thanks to a DPSS pump source, the laser requires little maintenance. It is equipped with air-cooled built-in chiller, which further reduces running costs. A built-in OPO pump energy monitor allows monitoring of pump laser performance without the use of external power meters. The optional feature provides a separate output port for the 1064, 532 or 355 nm beam.

SPECIFICATIONS [1)]

Model	NT242	NT242-SH	NT242-SF	NT242-SH/SF
OPO				
Wavelength range				
Signal	405 – 710 nm			
Idler	710 – 2600 nm			
SH and SF	—	210 – 300 nm	300 – 405 nm	210 – 405 nm
Pulse energy [2)]				
OPO	450 µJ			
SH and SF	—	40 µJ at 230 nm	60 µJ at 320 nm	
Pulse repetition rate	1000 Hz			
Pulse duration [3)]	3 – 6 ns			
Linewidth [4)]	< 5 cm^{-1}			
Tuning resolution [5)]				
Signal	1 cm^{-1}			
Idler	1 cm^{-1}			
SH and SF	—	2 cm^{-1}		
Polarization				
Signal	horizontal			
Idler	vertical			
SH and SF	—	vertical		
Typical beam diameter [6)]	3 × 6 mm			
PUMP LASER				
Pump wavelength [7)]	355 nm		355 / 1064 nm	
Typical pump pulse energy [8)]	3 mJ		3 / 1 mJ	
Pulse duration [3)]	4 – 6 ns at 1064 nm			
PHYSICAL CHARACTERISTICS				
Unit size (W × L × H)	456 × 1040 × 297 mm			
Power supply size (W × L × H)	520 × 400 × 286 mm			
Umbilical length	2.5 m			
OPERATING REQUIREMENTS				
Cooling	built-in chiller			
Room temperature	18 – 27 °C			
Relative humidity	20 – 80 % (non-condensing)			
Power requirements	100 – 240 V AC, single phase 50/60 Hz			
Power consumption	< 1.5 kW			
Cleanliness of the room	not worse than ISO Class 9			

1) Due to continuous improvement, all specifications are subject to change. Parameters marked typical are illustrative; they are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 450 nm and for basic system without options.

2) See tuning curves for typical outputs at other wavelengths.

3) Measured at FWHM level with photodiode featuring 1 ns rise time and 300 MHz bandwidth oscilloscope.

4) Linewidth is <8 cm^{-1} for 210 – 405 nm range.

5) For manual input from PC. When wavelength is controlled from keypad, tuning resolution is 0.1 nm for signal, 1 nm for idler and 0.05 nm for SH and SF.

6) Beam diameter is measured at 450 nm at the $1/e^2$ level and can vary depending on the pump pulse energy.

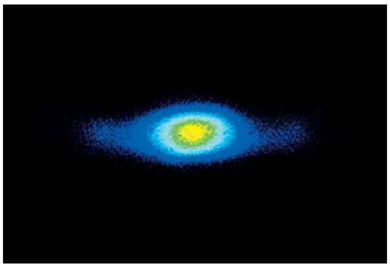
7) Separate output port for the 3rd and other harmonic is optional.

8) The pump laser pulse energy will be optimized for best OPO performance. The actual pump laser output can vary with each unit we manufacture.

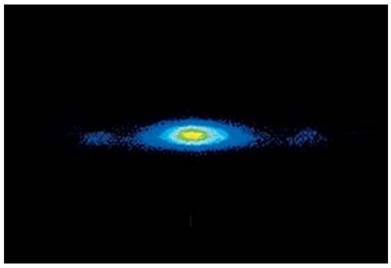
Accessories and optional items

Option	Features
-SH	Tuning range extension in UV range (210–300 nm) by second harmonic generation
-SF	Tuning range extension in 300–405 nm range by sum-frequency generation
-SH/SF	Tuning range extension in 210 – 405 nm range by combining second harmonics and sum-frequency generator outputs for maximum possible pulse energy
-SCU	Spectral filtering accessory for improved spectral purity of pulses
-H, -2H, -3H	1064, 532 and 355 nm output via separate port
-FC	Fiber coupler
-Attn	Attenuator option

PERFORMANCE



Near field



Far field

Fig 1. Typical beam profiles of NT242 series lasers at 500 nm

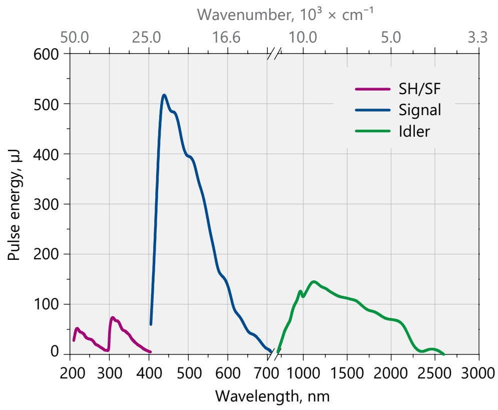


Fig 2. Typical output pulse energy of NT242 series tunable laser

OUTLINE DRAWINGS

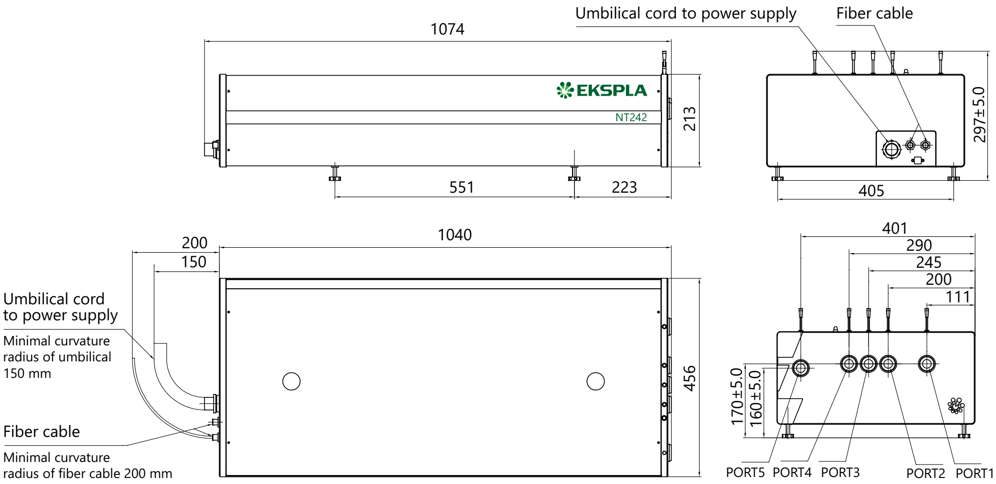


Fig 3. NT242 series laser head dimensions

ORDERING INFORMATION

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

NT242-SH-H-2H-SCU

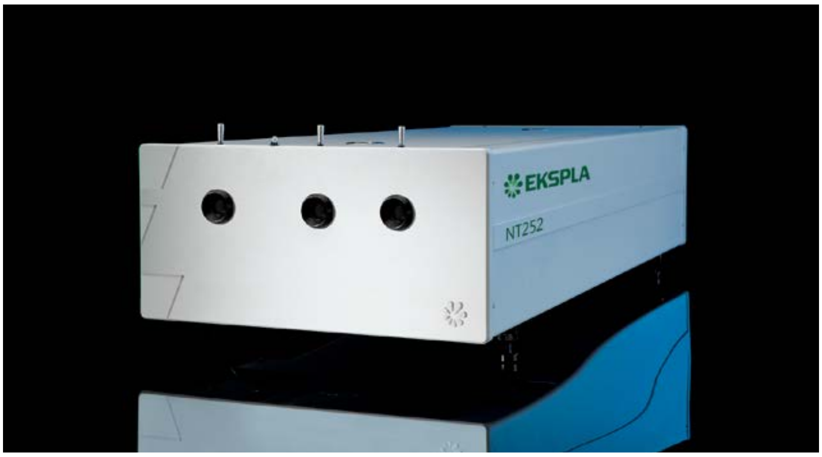
Model

Optional tuning range extension:
SH → 210–300 nm
SF → 300–405 nm
SH/SF → 210–405 nm

Options:
H → extra 1064 nm output
2H → extra 532 nm output
SCU → spectral filtering accessory

NT250 SERIES

Tunable Wavelength UV-NIR Range DPSS Lasers



FEATURES

- *Integrates DPSS pump laser and OPO into a single housing*
- *Dry, no water inside!*
- *Hands-free no-gap wavelength tuning from **335** to **2600 nm****
- ***1000 Hz** pulse repetition rate*
- *More than **1.1 mJ** output pulse energy in NIR*
- ***1–4 ns** pulse duration*
- *Remote control via key pad or PC*

* *Automatic wavelength scan is optional*

BENEFITS

- *Hands-free wavelength tuning – no need for physical intervention*
- *High repetition rate (1000 Hz) enables fast data collection*
- *End diode pumping and water-free technology ensure high reliability and low maintenance costs*
- *Superior tuning resolution (1 – 2 cm^{-1}) allows recording of high quality spectra*
- *High integration level saves valuable space in the laboratory*
- *In-house design and manufacturing of complete systems, including pump lasers, guarantees on-time warranty and post warranty services and spares supply*
- *Variety of control interfaces: USB, RS232, LAN and WLAN ensures easy control and integration with other equipment*
- *Attenuator and fiber coupling options facilitate incorporation of NT250 systems into various experimental environments*

APPLICATIONS

- *Photoacoustic imaging*
- *Laser-induced fluorescence spectroscopy*
- *Pump-probe spectroscopy*
- *Photobiology*
- *Remote sensing*
- *Metrology*

NT250 series tunable laser systems integrates into a single compact housing a nanosecond Optical Parametric Oscillator (OPO) and Diode-Pumped Solid–State (DPSS) Q-switched pump laser.

Diode pumping enables fast data acquisition at high pulse repetition rates up to 1 kHz while avoiding frequent flashlamp changes that are common when flashlamp pumped lasers are used. Special cooling technology eliminates the need for tap water, thus further reducing running and maintenance costs.

All lasers feature motorized tuning across the specified tuning range. The output wavelength can be set from control pad with backlit display that is easy to read even while wearing laser safety glasses. Alternatively, the laser can be also controlled from personal computer using supplied LabVIEW™ drivers.

High conversion efficiency, stable output, easy maintenance and compact size make our systems excellent choice for many applications.

Accessories and Optional Items

Option	Features
-SH	Tuning range extension in UV range (335 – 670 nm) by second harmonic generation
-H, -2H	1064 and 532 nm output via separate port
-FC	Fiber coupler
-Attn	Attenuator option

SPECIFICATIONS [1]

Model	NT252
OPO	
Wavelength range	
Signal	670–1064 nm
Idler	1065–2600 nm
SH	335–669 nm
Pulse energy	
OPO [2]	1100 µJ
SH [3]	200 µJ
Pulse duration [4]	1–4 ns
Pulse repetition rate	1000 Hz
Linewidth [5]	<10 cm^{-1}
Tuning resolution [6]	
Signal	1 cm^{-1}
Idler	1 cm^{-1}
SH	2 cm^{-1}
Polarization	
Signal	horizontal
Idler	vertical
SH	horizontal
Typical beam diameter [7] [8]	3 × 6 mm
PUMP LASER	
Pump wavelength [9]	532 nm
Typical pump pulse energy [10]	4 mJ
Pulse duration [11]	2 – 5 ns
Pulse energy stability (StdDev)	<2.5 %
PHYSICAL CHARACTERISTICS	
Unit size (W × L × H)	456 × 1040 × 297 mm
Power supply size (W × L × H)	520 × 400 × 286 mm
Umbilical length	2.5 m
OPERATING REQUIREMENTS	
Cooling	air-cooled
Room temperature	18–27 °C
Relative humidity	20–80 % (non-condensing)
Power requirements	100–240 V AC, single phase 50/60 Hz
Power consumption	<1.5 kW
Cleanliness of the room	not worse than ISO Class 9

1) Due to continuous improvement, all specifications are subject to change. Parameters marked typical are illustrative; they are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 750 nm and for basic system without options.

2) Measured at maximum in the interval 700 – 750 nm. See tuning curves for typical outputs at other wavelengths.

3) Measured at 400 nm. See tuning curves for typical outputs at other wavelengths.

4) Measured at FWHM level with photodiode featuring 1 ns rise time and 300 MHz bandwidth oscilloscope.

5) In signal and idler range.

6) For manual input from PC. When wavelength is controlled from keypad, tuning resolution is 0.1 nm for signal, 1 nm for idler and 0.05 nm for SH.

7) Measured at the wavelength indicated in the “Pulse energy” specification row.

8) Beam diameter is measured at the 1/e^2 level at the laser output and can vary depending on the pump pulse energy.

9) Separate output port for the 2nd and other harmonic are optional.

10) The pump laser pulse energy will be optimized for best OPO performance. The actual pump laser output can vary with each unit we manufacture.

11) Measured at FWHM level with photodiode featuring 1 ns rise time and 300 MHz bandwidth oscilloscope.

PERFORMANCE

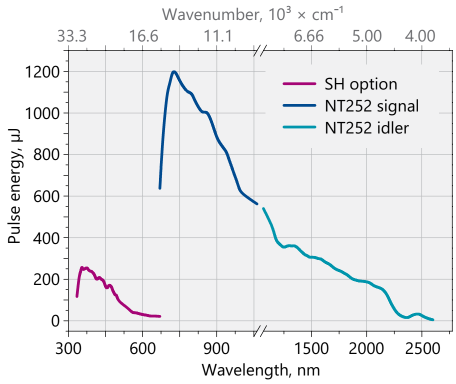


Fig 1. Typical output pulse energy of the NT252-SH tunable laser

OUTLINE DRAWINGS

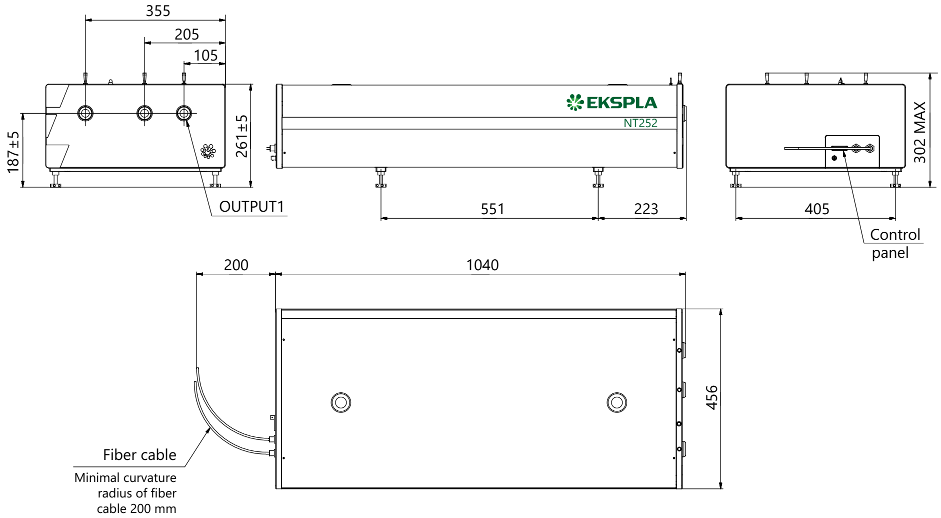
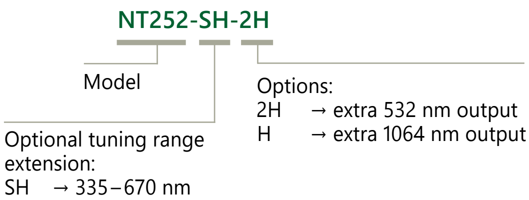


Fig 3. NT252 series laser head dimensions

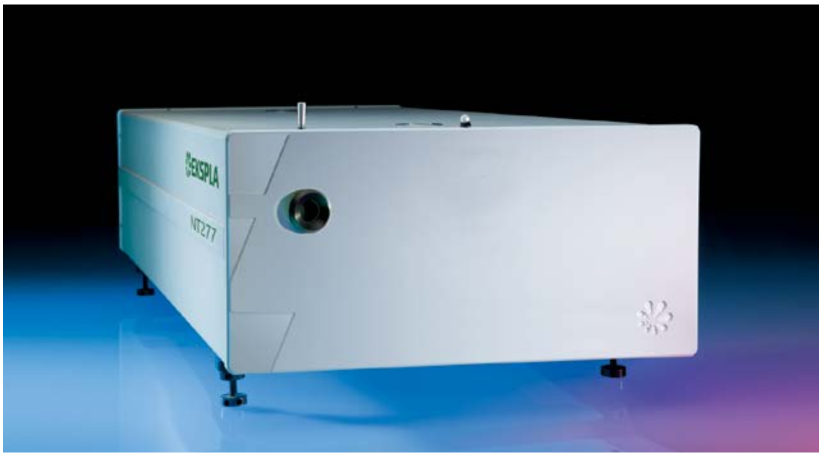
ORDERING INFORMATION

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.



NT270 SERIES

Tunable Wavelength NIR-MIR Range DPSS Lasers



FEATURES

- *Integrates DPSS pump laser and OPO into single housing*
- *Separate output ports for the pump laser and OPO beams*
- *OPO output wavelength range from **2500 nm** to **4475 nm***
- *Narrow linewidth*
- *Hands-free, fast wavelength tuning**
- *<**7 ns** pulse duration*
- *Remote control via key pad or PC*

* *Including automatic wavelength scan*

BENEFITS

- *Hands-free wavelength tuning – no need for physical intervention*
- *Wide (2500 – 4475 nm) tuning range is highly useful for s-SNOM and other IR applications*
- *NT270 is the cost effective solution covering a wide tuning range from a single source*
- *End pumping with diode technology ensures high reliability and lots of fired shots leading to low maintenance costs*
- *High integration level saves valuable space in the laboratory*
- *Air cooling eliminates the need for water, ensuring easy operation and simple installation or integration*
- *In-house design and manufacturing of complete systems, including pump lasers, guarantees on-time warranty and post warranty services and spares supply*
- *Variety of control interfaces: USB, RS232, LAN and WLAN ensures easy control and integration with other equipment*

APPLICATIONS

- *Scanning Near-field Optical Microscopy (s-SNOM) microscopy*
- *Single molecule vibrational spectroscopy*
- *IR spectroscopy*
- *Gas spectroscopy*

NT270 series tunable laser systems integrate into a single compact housing a nanosecond Optical Parametric Oscillator (OPO) and Diode-Pumped Solid–State (DPSS) Q-switched pump laser.

Diode pumping enables fast data acquisition at high pulse repetition rates up to 1 kHz while avoiding frequent flashlamp changes that are common when flashlamp pumped lasers are used.

The pump lasers do not require water for cooling, thus further reducing running and maintenance costs.

All lasers feature motorized tuning across the specified tuning range. The output wavelength can be set from control pad with backlit display that is easy to read even while wearing laser safety glasses. Alternatively, the laser can be controlled also from personal computer using supplied LabVIEW™ drivers.

High conversion efficiency, stable output, easy maintenance and compact size make our systems excellent choice for lots of applications.

SPECIFICATIONS [1]

Model	NT277
OPO	
Wavelength range [2]	
Idler	2500 – 4475 nm
Pulse energy [3]	
Idler	80 µJ at 3000 nm
Pulse duration [4]	5 – 7 ns
Pulse repetition rate	1000 Hz
Linewidth [5]	<10 cm^{-1}
Tuning resolution [6]	
Idler	1 cm^{-1}
Polarization	vertical
Typical beam diameter [7] [8]	4 mm
PUMP LASER	
Pump wavelength	1064 nm
Typical pump pulse energy [9]	1.9 mJ
Pulse duration [10]	<10 ns
Beam quality	fit to Gaussian >90%
Pulse energy stability (StdDev)	<0.5 %
PHYSICAL CHARACTERISTICS	
Unit size (W × L × H)	305 × 701 × 270 mm
Power supply size (W × L × H)	449 × 376 × 140 mm
Umbilical length	2.5 m
OPERATING REQUIREMENTS	
Cooling	by air
Room temperature	18 – 27 °C
Relative humidity	20 – 80 % (non-condensing)
Power requirements	100 – 240 V AC, single phase 50/60 Hz
Power consumption	< 0.5 kW
Cleanliness of the room	not worse than ISO Class 9

1) Due to continuous improvement, all specifications are subject to change. Parameters marked typical are illustrative; they are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise all specifications are measured at 3000 nm and for basic system without options.

2) Available wavelength range. Inquire for custom IR option with tuning up to 12 µm.

3) See tuning curves for typical outputs at other wavelengths.

4) Measured art FWHM level with photodiode featuring 1 ns rise time and 300 MHz bandwidth oscilloscope.

5) Higher energy 10 – 150 cm^{-1} option is available for 2500 – 4475 nm tuning range. Narrow linewidth (<10 cm^{-1}) operation mode is impossible with this option.

6) For manual input from PC. When wavelength is controlled from keypad, tuning resolution is 1 nm.

7) Measured at the wavelength indicated in the "Pulse energy" specification row.

8) Beam diameter is measured at the $1/e^2$ level at the laser output and varies depending on the wavelength.

9) The pump laser pulse energy will be optimized for the best OPO performance. The actual pump laser output can vary with each unit we manufacture.

10) Measured at FWHM level with photodiode featuring 1 ns rise time and 300 MHz bandwidth oscilloscope.

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

PERFORMANCE

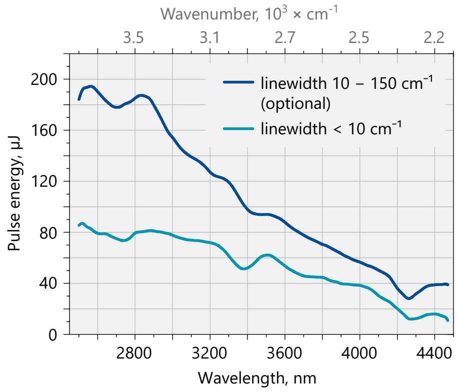


Fig 1. Typical output pulse energy of the NT277 and NT277-XIR tunable laser

OUTLINE DRAWINGS

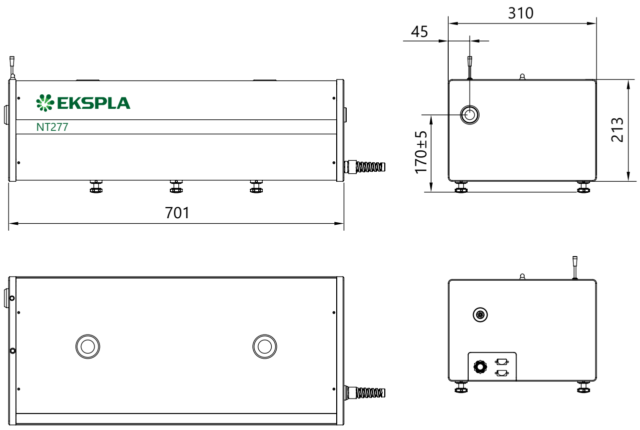
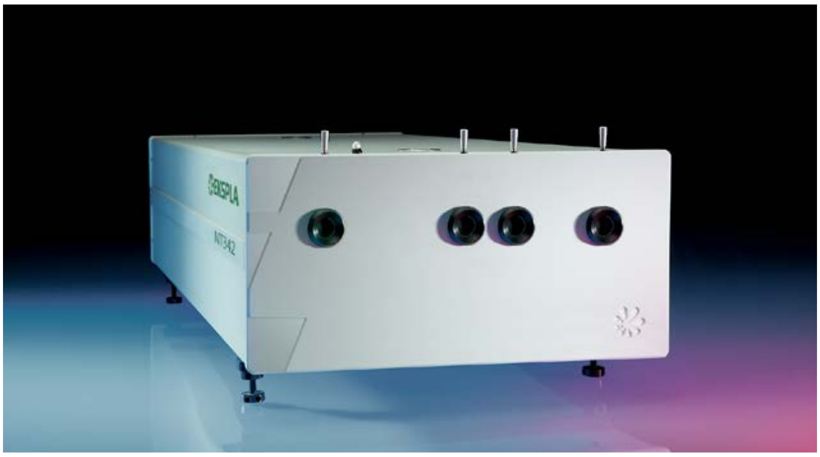


Fig 3. NT277 series laser head dimensions

NT340 SERIES

High Energy Broadly Tunable Lasers



FEATURES

- *Hands-free no gap wavelength tuning from **192** to **4400 nm** **
- *Up to **90 mJ** pulse energy in visible spectral range*
- *Up to **15 mJ** pulse energy in UV spectral range*
- *Up to **20 mJ** pulse energy in MIR spectral range*
- ***3 – 5 ns** pulse duration*
- *Up to **20 Hz** pulse repetition rate*
- *Remote control via key pad or PC*
- *Optional separate shared output port for 532/1064 nm beam (separate output port for the 355 nm beam is standard)*
- *OPO pump energy monitoring*
- *Hermetically sealed oscillator cavity protects non-linear crystals from dust and humidity*

* *Automatic wavelength scan is optional*

BENEFITS

- *Hands-free wavelength tuning – no need for physical intervention*
- *The system is widely tunable 192 – 4400 nm and delivers high pulse energy (up to 90 mJ) that allows the investigation of an extensive range of materials*
- *Up to 18 μm customization possibility enables studies of IR vibrations of molecules*
- *Narrow linewidth (down to 3 cm^{-1}) and superior tuning resolution (1 – 2 cm^{-1}) allows recording of high quality spectra*
- *Flashlamps replacement without misalignment of the laser cavity saves on maintenance costs*
- *High integration level saves valuable space in the laboratory*
- *In-house design and manufacturing of complete systems, including pump lasers, guarantees on-time warranty and post warranty services and spares supply*
- *Variety of control interfaces: USB, RS232 and optional LAN, WLAN ensures easy control and integration with other equipment*
- *Attenuator and fiber coupling options facilitate incorporation of NT340 systems into various experimental environments*

The NT340 series tunable wavelength nanosecond laser seamlessly integrates the nanosecond optical parametric oscillator and the Nd:YAG Q-switched nanosecond laser – all in a compact housing.

The main system features are: hands-free wavelength tuning from UV to IR, high conversion efficiency, optional fiber-coupled output and separate output port for pump laser beam.

NT340 has a linewidth of less than 5 cm^{-1}, which is ideal for many spectroscopic applications.

The laser is designed for convenient use. The OPO pump energy monitoring system helps to control pump laser parameters. Replacement of laser flashlamps can be done without misalignment of the laser cavity and/or deterioration of laser performance.

APPLICATIONS

- *Laser-induced fluorescence*
- *Flash photolysis*
- *Photobiology*
- *Remote sensing*
- *Time-resolved spectroscopy*
- *Non-linear spectroscopy*
- *Vibrational spectroscopy*
- *Cavity ring-down CRDS, cavity ring-down laser absorption CRLAS spectroscopy*
- *Infrared spectroscopy*
- *Gas spectroscopy*

Tuning range extending optional add-ons

Option	Features
-SH	Second harmonic generator for 210–410 nm range
-SF	Sum-frequency generator for 300–410 nm range with high pulse energy
-SH/SF	Combined option for highest pulse energy in 210–410 nm range
-DUV	Deep UV option for 192–210 nm range output
-MIR	Mid infrared option for 2500–4400 nm range output

Accessories and other optional add-ons

Option	Features
-FC	Fiber coupled output in 350–2000 nm range
-ATTN	Attenuator
-H, -2H	Separate shared output port for pump laser harmonic (532 or 1064 nm wavelengths)
-AW	Air cooled power supply

SPECIFICATIONS [1]

Model	NT342B	NT342C	NT342E
OPO			
Wavelength range [2]			
Signal		410–710 nm [3]	
Idler		710–2600 nm	
SH generator (optional)		210–410 nm	
SH/SF generator (optional)		210–410 nm	
DUV generator (optional)		192–210 nm	
MIR generator (optional)	n/a	2500–4400 nm	n/a
Output pulse energy			
OPO [4]	30 mJ	60 mJ	90 mJ
SH generator (optional) [5]	4 mJ	6.5 mJ	10 mJ
SH/SF generator (optional) [6]	6 mJ	10 mJ	15 mJ
DUV generator (optional) [7]	0.6 mJ	1.2 mJ	2 mJ
MIR generator (optional) [8]	n/a	20 mJ	n/a
Linewidth		< 5 cm^{-1} [9]	
Tuning resolution [10]			
Signal (410–710 nm)		1 cm^{-1}	
Idler (710–2600 nm)		1 cm^{-1}	
SH/SF/DUV (192–410 nm)		2 cm^{-1}	
MIR (2500–4400 nm)	n/a	1 cm^{-1}	n/a
Pulse duration [11]		3–5 ns	
Typical beam diameter [12]	5 mm	8 mm	10 mm
Typical beam divergence [13]		< 2 mrad	
Polarization			
Signal		horizontal	
Idler		vertical	
SH/SF		horizontal	
DUV		vertical	
MIR	n/a	horizontal	n/a

SPECIFICATIONS [1)]

Model	NT342B	NT342C	NT342E
PUMP LASER [14)]			
Pump wavelength	355 nm		
Typical pump pulse energy	100 mJ	150 mJ	250 mJ
Pulse duration	4–7 ns		
Beam quality	Hat-top in near field, without hot spots		
Beam divergence	< 0.6 mrad		
Pulse energy stability (StdDev)	< 3.5 %		
Pulse repetition rate	10 or 20 Hz	10 Hz	
PHYSICAL CHARACTERISTICS			
Unit size (W × L × H) [15)]	456 × 821 × 270 mm		
Power supply size (W × L × H)	330 × 490 × 585 mm		
Umbilical length	2.5 m		
OPERATING REQUIREMENTS			
Water consumption (max 20 °C) [16)]	< 10 l/min		
Room temperature	18–27 °C		
Relative humidity	20–80 % (non-condensing)		
Power requirements	200 – 240 VAC, single phase, 50/60 Hz		
Power consumption	< 1.5 kVA		
Cleanliness of the room	not worse than ISO Class 9		

1) Due to continuous improvement, all specifications are subject to change. Parameters marked typical are illustrative; they are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 450 nm and for basic system without options.

2) Hands-free tuning range is from 192 nm to 4400 nm. MIR option is not compatible with SF and DUV option. Inquire for custom IR option with tuning up to 18 µm.

3) Tuning range extension to 400 – 709 nm is optional.

4) Measured at 450 nm. See tuning curves for typical outputs at other wavelengths.

5) Measured at 260 nm. See tuning curves for typical outputs at other wavelengths.

6) Measured at 340 nm. SF generator is optimized for maximum output in 300 – 410 nm range. See tuning curves for typical outputs at other wavelengths.

7) Measured at 200 nm. See tuning curves for typical outputs at other wavelengths.

8) Measured at 2700 nm. See tuning curves for typical outputs at other wavelengths.

9) Linewidth is <8 cm^{-1} for 210–409 nm, 2500–4400 nm ranges.

10) When wavelength is controlled from PC. When wavelength is controlled from keypad, tuning resolution is 0.1 nm for signal, 1 nm for idler, MIR and 0.05 nm for SH, SF and DUV.

11) FWHM measured with photodiode featuring 1 ns rise time and 300 MHz bandwidth oscilloscope.

12) Beam diameter is measured at 450 nm at the FWHM level. It is approximate and can vary depending on the pump pulse energy and wavelength.

13) Full angle measured at the FWHM level at 450 nm, < 5 mrad at 3000 nm with MIR option.

14) Separate output port for the 355 nm beam is standard. Outputs for 1064 nm and 532 nm beams are optional. Laser output will be optimised for the best OPO operation and specifications may vary with each unit we manufacture.

15) Length from 821 to 1220 mm depending on configuration.

16) Air cooled power supply is available as an option.

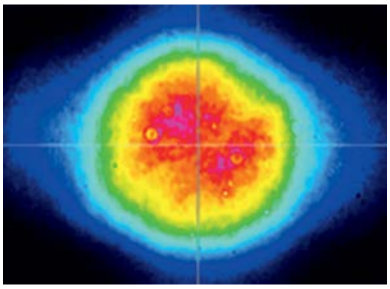


Fig 1. NT340 series laser typical beam profile at 450 nm after ~1.5 m distance from output

PERFORMANCE

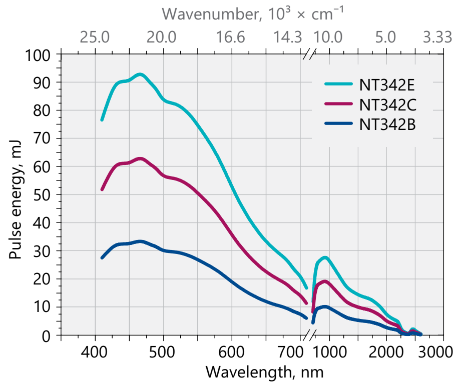


Fig 2. Typical output energy of the NT340 series tunable wavelength systems

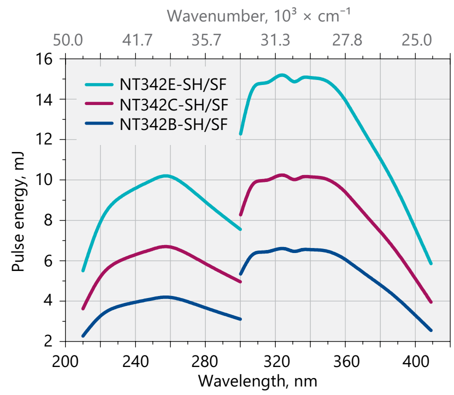


Fig 3. Typical output energy of the NT340 series tunable wavelength systems with SH/SF extension

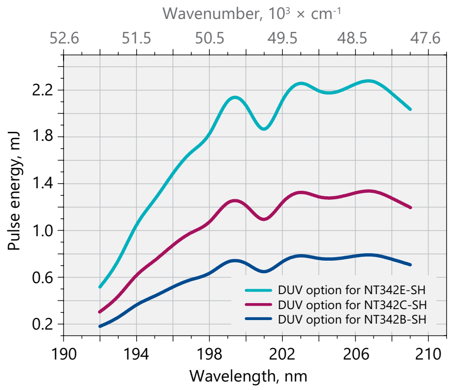


Fig 4. Typical output energy of the NT340 series tunable wavelength systems with SH/DUV extension

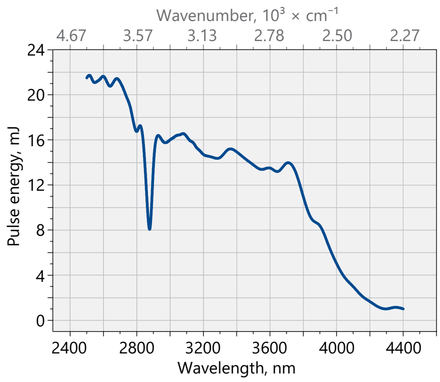


Fig 5. Typical output energy of the NT340 series tunable wavelength systems with MIR extension

OUTLINE DRAWINGS

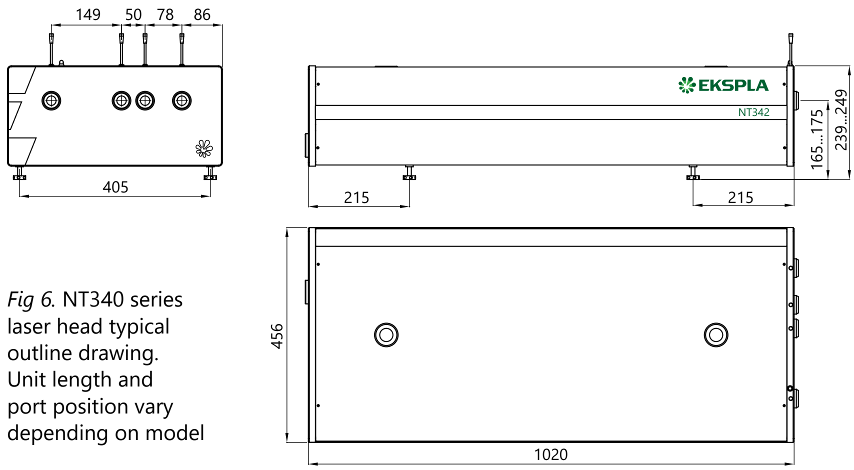


Fig 6. NT340 series laser head typical outline drawing. Unit length and port position vary depending on model

ORDERING INFORMATION

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

NT342C-SH-10-AW-H/2H

- Model
- Output pulse energy:
  - B → 30 mJ
  - C → 50 mJ
  - E → 90 mJ
- Optional tuning range extension
  - SH → 210–410 nm
  - DUV → 192–210 nm
  - MIR → 2500–4400 nm
- Pulse repetition rate, in Hz
- Options:
  - AW → water-air heat exchanger
  - H → 1064 nm output
  - 2H → 532 nm output

Photo: Unique OPCPA based laser system, providing **~5 terawatts** of output power at **1 kHz** repetition rate has been produced by Ekspla and Light Conversion consortium. Sylos 1 named system is generating **7 fs** or shorter pulses and was designed and built for Extreme Light Infrastructure – Attosecond Light Pulse Source facilities (ELI-ALPS) located in Szeged, Hungary

High Intensity Laser Systems

Today laser intensities reached levels where relativistic effects dominate in laser-matter interaction. New applications of high pulse energy lasers emerge in various disciplines ranging from fundamental physics to materials research and life sciences.

Ekspla presents line of nanosecond and picosecond high pulse energy lasers and amplifiers. Our broad knowledge in high energy laser physics, non-linear materials and 30 years of experience in laser design enables us to offer unique solutions for high pulse energy systems.

Our high pulse energy lasers features flash lamp pump for ultra-high pulse energy, diode pump for high average power. Innovative solutions for pulse shaping, precise synchronization between different laser sources enables fit these systems to numerous experiments of modern fundamental science.

Ask for separate brochure

Nonlinear Spectroscopy Systems

SFG SPECTROMETER

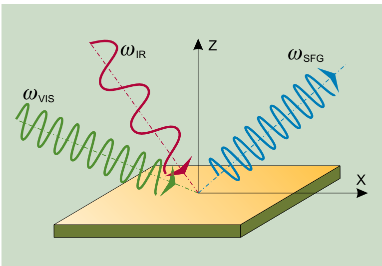
Picosecond Vibrational Sum Frequency Generation Spectrometer

FEATURES

- *Intrinsically surface specific*
- *Selective to adsorbed species*
- *< 6 cm^{-1} (optional < 2 cm^{-1}) spectral resolution*
- *Sensitive to submonolayer of molecules*
- *Applicable to all interfaces accessible to light*
- *Nondestructive*
- *Capable of high spectral and spatial resolution*

Principle of Operation

Sum Frequency Generation Vibrational Spectroscopy (SFG-VS) is a powerful and versatile method to characterize vibrational bonds of molecules at surfaces or interfaces. Sum Frequency signal (SF) is generated in visible spectral range, so it can be efficiently measured using sensitive detectors. In SFG-VS experiment a pulsed tunable infrared IR (ω_{IR}) laser beam is mixed with a visible VIS (ω_{VIS}) beam to produce an output at the sum frequency ($\omega_{SFG} = \omega_{IR} + \omega_{VIS}$). SFG is second order nonlinear process, which is allowed only in media without inversion symmetry. At surfaces or interfaces inversion symmetry is necessarily broken, that makes SFG highly surface specific. As the IR wavelength is scanned, active vibrational modes of molecules at the interface give a resonant contribution to SF signal. The resonant enhancement provides spectral information with resolution < 6 cm^{-1} on surface characteristic vibrational transitions.



APPLICATIONS

- *Investigation of surfaces and interfaces of solids, liquids, polymers, biological membranes and other systems*
- *Studies of surface structure, chemical composition and molecular orientation*
- *Remote sensing in hostile environment*
- *Investigation of surface reactions under real atmosphere, catalysis, surface dynamics*
- *Studies of epitaxial growth, electrochemistry, material and environmental problems*

System Components

- Picosecond mode-locked Nd:YAG laser
- Multichannel beam delivery unit
- Picosecond optical parametric generator
- Spectroscopy module
- Monochromator
- PMT based signal detectors
- Data acquisition system
- Dedicated LabView® software package for system control

SFG Spectrometer Modifications

- **Double resonance SFG spectrometer** – allows investigation of vibrational mode coupling to electron states at a surface
- **Phase sensitive SFG spectrometer** – intensity and phase of the Sum Frequency Generation is measured
- **SFG microscope** – provides spectral and distribution information on the surface with micrometers resolution

Optional Accessories

- Single or double wavelength VIS beam: 532 nm and/or 1064 nm
- One or two detection channels: main signal and reference
- Second harmonic generation surface spectroscopy option
- High resolution option – down to 2 cm^{-1}
- Motorized VIS, SFG and IR beams polarisation control

SPECIFICATIONS [1)]

Version	SFG Classic	SFG Advanced	SFG Double resonance	SFG Phase sensitive
SYSTEM (GENERAL)				
Spectral range	1000 – 4300 cm^{-1}	625 – 4300 cm^{-1}	1000 – 4300 cm^{-1}	1000 – 4300 cm^{-1}
Spectral resolution	<6 cm^{-1} (optional <2 cm^{-1})		<10 cm^{-1}	<6 cm^{-1} (optional <2 cm^{-1})
Spectra acquisition method	Scanning			
Sample illumination geometry	Top side, reflection (optional: bottom side, top-bottom side)			
Incidence beams geometry	Co-propagating, non-colinear			
Incidence angles	Fixed, VIS ~60°, IR ~55° (optional: tunable)			Fixed, VIS ~60°, IR ~55°
VIS beam wavelength	532 nm (optional: 1064 nm)		532 nm and tunable 420 – 680 nm (optional: 210 – 680 nm)	532 nm
Polarization (VIS, IR, SFG)	Linear, selectable "s" or "p", purity > 1:100			
IR Beam spot on the sample	Selectable, ~150 – 600 µm			Fixed
Sensitivity	Air-water spectra			Solid sample
PUMP LASERS [2)]				
Model	PL2231-50	PL2231-50	PL2231A	PL2231-50
Pulse energy	Optimised to pump PG			
Pulse duration	29 ± 5 ps			
Pulse repetition rate	50 Hz			
OPTICAL PARAMETRIC GENERATORS				
IR source with standard linewidth (<6 cm^{-1})	PG501-DFG1P	PG501-DFG2	PG501-DFG1P	
IR source with narrow linewidth (<2 cm^{-1})	PG511-DFG	PG511-DFG2	inquire	PG511-DFG
UV-VIS source for Double resonance SFG	–		PG401 (optional: PG401-SH)	–

For standard specifications please check the brochure of particular model.

PHYSICAL DIMENSIONS (FOOTPRINT)				
Standard	2500 × 1200 mm		3000 × 1500 mm	2600 × 1200 mm
Extended (with special options or large ccessories)	2700 × 1200 mm		3000 × 1500 mm	2700 × 1200 mm

1) Due to continuous improvement, all specifications are subject to change without advance notice.
2) Laser is optimised for pumping parametrical generator, maximum output energy may be different than specified for stand alone application.

AVAILABLE INTEGRATED SFG SYSTEMS

- Classic (Advanced) + Phase sensitive in one unit.
- Classic (Advanced) + Microscope in one unit.

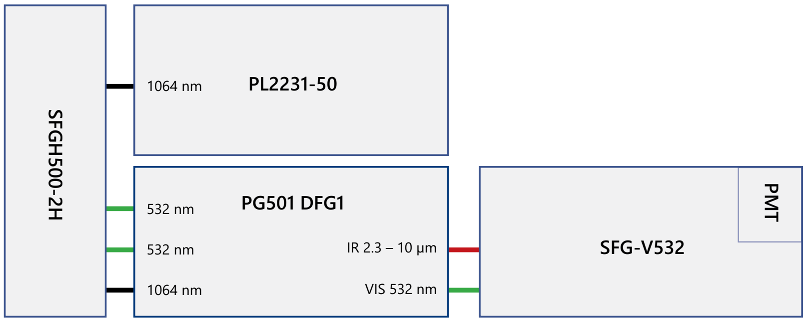
CUSTOM PRODUCTS, TAILORED FOR SPECIFIC APPLICATIONS [1)]

Broadband High Resolution Sum Frequency Generation Spectrometer, "Classic setup"

Broadband femtosecond infrared beam spectral range	4000 – 1250 cm^{-1} (2.5 – 8 µm)
SFG spectral resolution	~4 cm^{-1} (typical)
Single wavelength narrowband (picosecond) VIS beam	515 or 532 nm
Laser repetition rate	1kHz

1) Due to continuous improvement, all specifications are subject to change without advance notice.

SPECTROMETER LAYOUT



EXAMPLES OF SFG SPECTRA

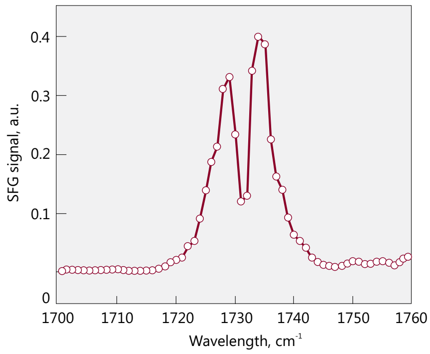


Fig 1. SFG spectra of monoolein surface, 1 cm^{-1} scan step, 200 acquisitions per step. *Courtesy of EKSPLA Ltd.*

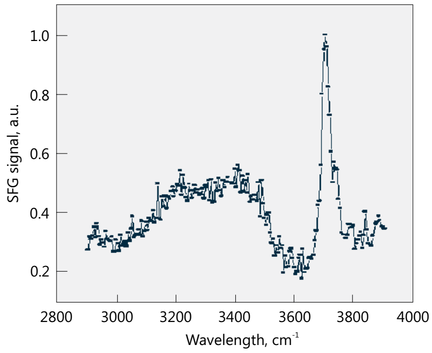
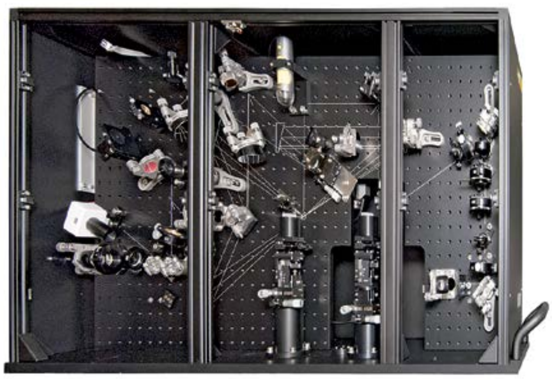


Fig 2. Water-air interface spectra, 200 acquisitions per step. *Courtesy of University of Michigan*

EXAMPLE OF MODIFICATIONS

Ask for separate brochure



SFG spectroscopy module. Classic + Phase sensitive versions in one unit

Classic (Advanced) + Microscope in one unit

Industrial Lasers

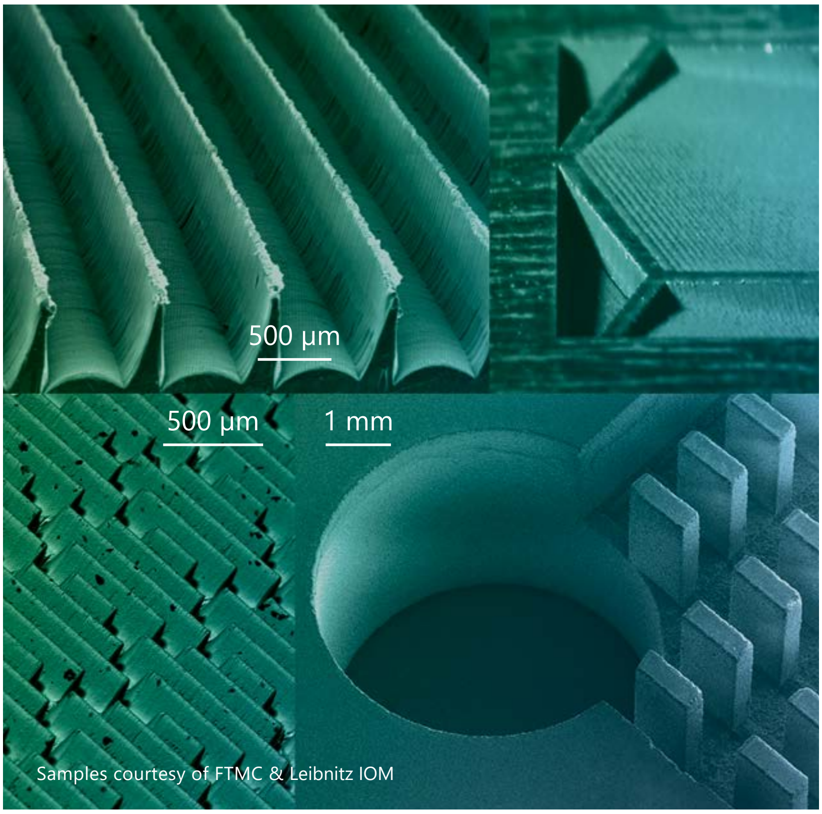
Femtosecond / Picosecond / Nanosecond

FEATURES

- *Tailored for your applications*
- *UV-VIS-IR wavelength options*
- *Build for 24/7 operation*
- *Low ownership costs*

APPLICATIONS

- *Drilling*
- *Cutting*
- *Structuring*
- *Ablation*
- *Patterning*
- *Inspection*
- *Marking*
- *Engraving*
- *Trimming*
- *Mask repair*
- *Cleaning*
- *Amplifier seeding*
- *OPO pumping*
- *Micromachining*
- *Other material processing*



Samples courtesy of FTMC & Leibnitz IOM

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SAVANORIU AV. 237, LT-02300 VILNIUS, LITHUANIA TEL +370 5 2649629 E-MAIL SALES@EKSPLA.COM WWW.EKSPLA.COM

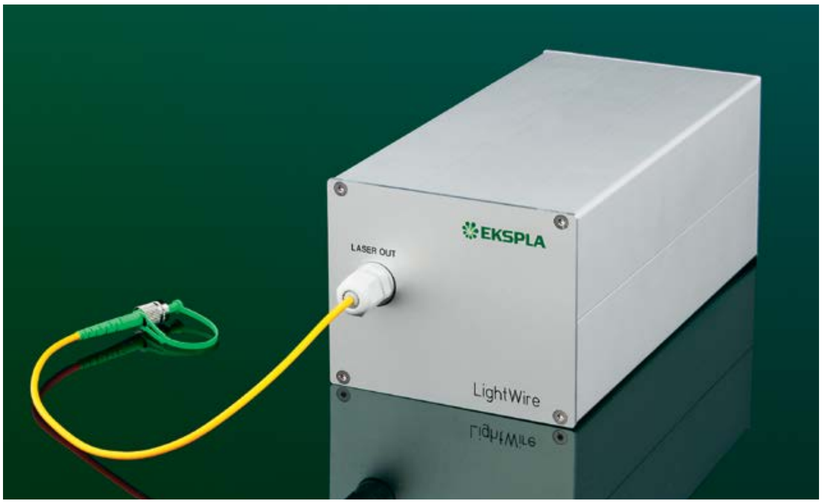
REV. 20230414

Lightwire series

Ultrafast Fiber Lasers

Ask for separate brochures

- *FPS series compact fiber seeders for picosecond lasers*
- *FFS series Compact fiber seeders for femtosecond lasers*



APPLICATIONS

- *Seeding solid state amplifiers*
- *Seeding femtosecond CPA systems*
- *Ultrafast spectroscopy*
- *Time-domain terahertz spectroscopy*

PhotoSonus series

Photoacoustic Imaging Sources

Ask for separate brochures

FEATURES

- *High output energy*
- *Wide output wavelength range*
- *Fast Wavelength Switching*
- *Fiber coupling of the output beam*

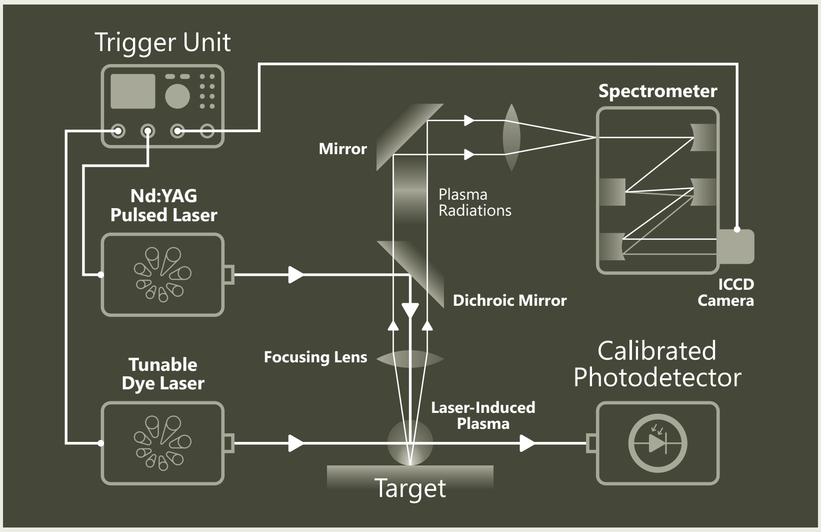
Application examples

Scientific Applications

For reference articles
and more useful information visit
https://ekspla.com/applications/

Plasma Physics

Laser Spectroscopy



Laser-induced plasma has been used for different diagnostic and technological applications as detection, thin film deposition, and elemental identification. Laser-Induced Plasma Spectroscopy (LIPS), or sometimes called Laser-Induced Breakdown (LIBS) or Laser Spark Spectroscopy (LSS) is a powerful tool for rapid in-situ analyses of solid, liquid or gaseous samples. Some examples include on-line monitoring in the steel industry, control of materials and leakages in power plants, environmental analyses (soils, waters), analyses of objects related to Cultural Heritage, explosive identification in the protection against terrorism and planetary exploration (surface characterization).

Pulsed laser deposition is a thin film deposition (specifically a PVD) technique, where a high power pulsed laser beam is focused inside a vacuum chamber to strike a target of the deposit material. Conceptually and experimentally, pulsed laser ablation is an extremely simple technique; probably the simplest among all thin-film growth techniques.

With progress in short-pulse laser techniques, newly generated plasma applications appear. Extreme ultraviolet (EUV) sources based on laser-produced plasmas (LPP) emitting at a wavelength of tens of nm are currently being developed with tremendous effort for the next generation of semiconductor microlithography. Besides high-power sources for high volume manufacturing, compact EUV sources of lower average power are also needed for metrology purposes, for example, for mask inspection, actinic material testing, or optics and sensor characterization. Moreover, tabletop LPP sources are also employed to generate soft x-ray (SXR) radiation for microscopy or absorption spectroscopy in the water window spectral range (2.2–4.4 nm).

The availability of synchrotron x-ray and laser-plasma x-ray sources have revolutionized the capabilities of time-resolved x-ray diffraction investigations, the development of streak camera x-ray detectors, static and streak mode charge-coupled device (CCD) x-ray area detector techniques, and specialized scintillation detection schemes.

RELATED PRODUCTS

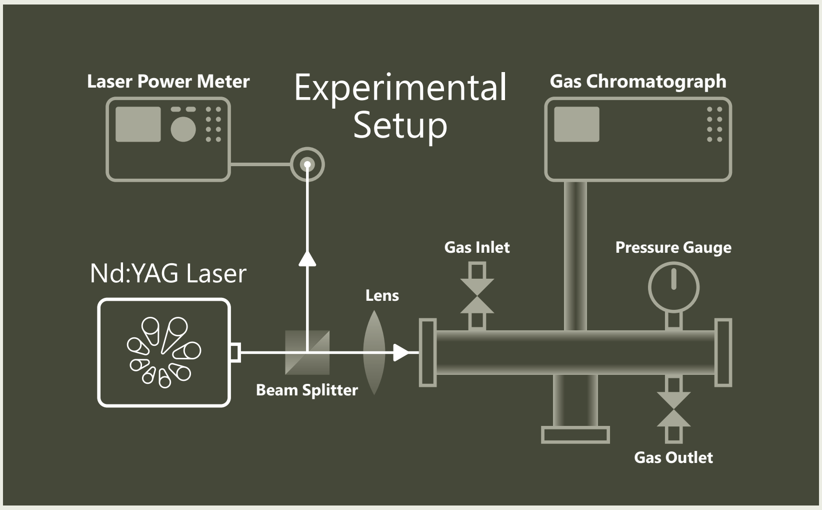
NL300
Compact Flash-lamp Pumped Q-switched Nd:YAG Lasers
Page **56**

PL2250
Flash-Lamp Pumped Picosecond Nd:YAG Lasers
Page **25**

APL
High Energy Picosecond Amplifiers
See www.ekspla.com

Photolysis

Laser Spectroscopy



Photodissociation, photolysis, or photodecomposition is a chemical reaction in which a chemical compound is broken down by photons. It is defined as the interaction of one or more photons with one target molecule. Photolysis plays an important role in photosynthesis, during which it produces energy by splitting water molecules into gaseous oxygen and hydrogen ions. This part of photosynthesis occurs in the granum of a chloroplast where light is absorbed by chlorophyll. This reacts with water and splits the oxygen and hydrogen molecules apart.

Laser Flash Photolysis is a technique for studying transient chemical and biological species generated by the short intense light pulse from a nanosecond/picosecond/femtosecond pulsed laser source (pump pulse). This intense light pulse creates short lived photo-excited intermediates such as excited states, radicals and ions. All these intermediates are generated in concentrations large enough for chemical and physical interaction to occur and for direct observation of the associated temporally changing absorption characteristics. Typically the absorption of light by the sample is recorded within short time intervals (by a so-called test or probe pulses) to monitor relaxation or reaction processes initiated by the pump pulse. Usage of Optical Parametric Oscillators (OPO) opens new possibilities in spectroscopic experiments.

RELATED PRODUCTS

NT230
High Energy Broadly Tunable DPSS Lasers
Page 67

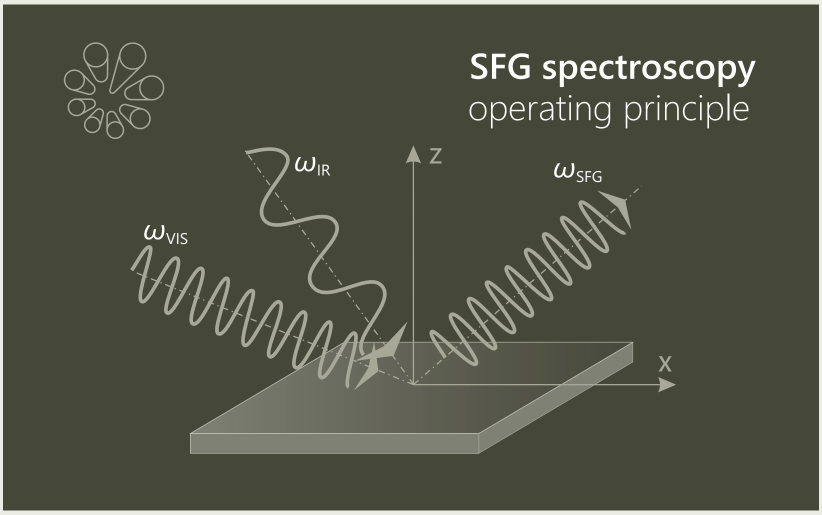
NT240
Broadly Tunable kHz Pulsed DPSS Lasers
Page 71

NT270
Tunable Wavelength NIR-IR Range DPSS Lasers
Page 78

NT340
High Energy Broadly Tunable Lasers
Page 81

SFG spectroscopy

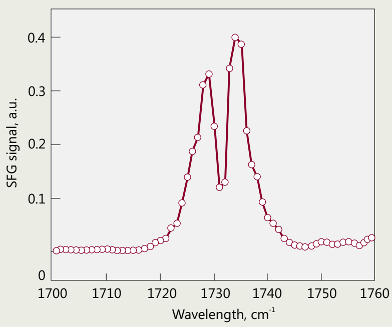
Laser Spectroscopy



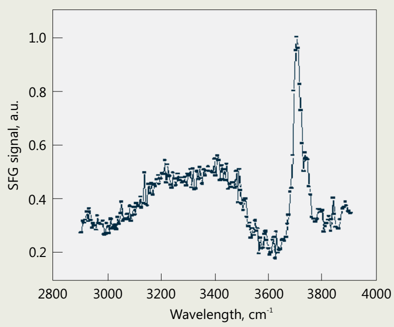
Sum frequency generation vibrational spectroscopy (SFG-VS) is used to characterize vibrational bonds of molecules at surfaces or interfaces. SFG spectroscopy is particularly attractive because of molecular specificity and intrinsic interfacial sensitivity. Surface sensitivity of the technique arises from the fact that within the electric dipole approximation the nonlinear generation of the sum-frequency (SF) signal from the overlapped visible and infrared beams is forbidden in the media of randomly oriented molecules or in the centrosymmetric media but is allowed at the interface where inversion symmetry is broken. Molecular specificity emerges from the ability to record vibrational spectrum.

In SFG-VS measurements, a pulsed tunable infrared IR (ω_{IR}) laser beam is mixed with a visible VIS (ω_{VIS}) beam to produce an output at the sum frequency ($\omega_{SFG} = \omega_{IR} + \omega_{VIS}$). SFG signal is generated in visible spectral range, so it can be efficiently measured using sensitive detectors (PMT or CCD).

EXAMPLES OF SFG SPECTRA



SFG spectra of monoolein surface, 1 cm^{-1} scan step, 200 acquisitions per step.
Courtesy of EKSPLA Ltd.



Water-air interface spectra, 200 acquisitions per step.
Courtesy of University of Michigan

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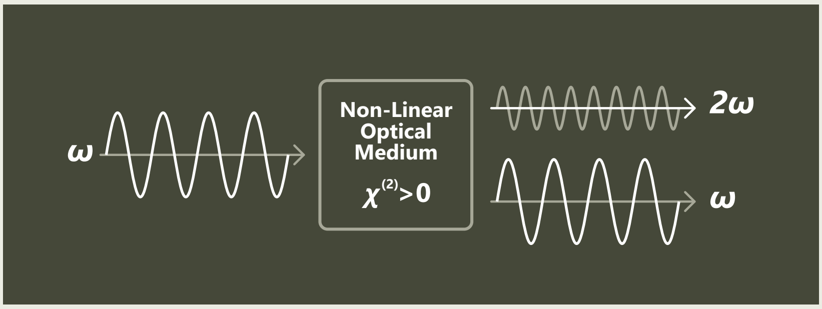
SHG spectroscopy & microscopy

Laser Spectroscopy



Second harmonic generation (SHG) is a second order nonlinear optical effect where two photons of frequency ω are converted to one photon of frequency 2ω. SHG is allowed only in media without inversion symmetry. This optical method it is non-invasive, can be applied in situ, and can provide real time resolution.

SHG measurements provide information about: surface coverage, molecular orientation, adsorbtion-desorbtion processes, and reactions at interfaces. SHG has the ability to detect low concentrations of analytes, such as proteins, peptides, and small molecules, due to its high sensitivity, and the second harmonic response can be enhanced through the use of target molecules that are resonant with the incident (ω) and/or second harmonic (2ω) frequencies.

SHG microscopy allows for selective probing of a non-centrosymmetric area of sample. This type of nonlinear optical microscope was first used to observe ferroelectric domains and has been applied to various specimens including the biological samples to date. Imaging of the endogenous SHG of biological tissue can be utilized for the selective observation of filament systems in tissues such as collagen, myosin, and microtubules, which exhibit a polar structure. It has been reported that, by imaging exogenous SHG of the membrane, sensitive detection of membrane damage could be realized using the SHG microscope.

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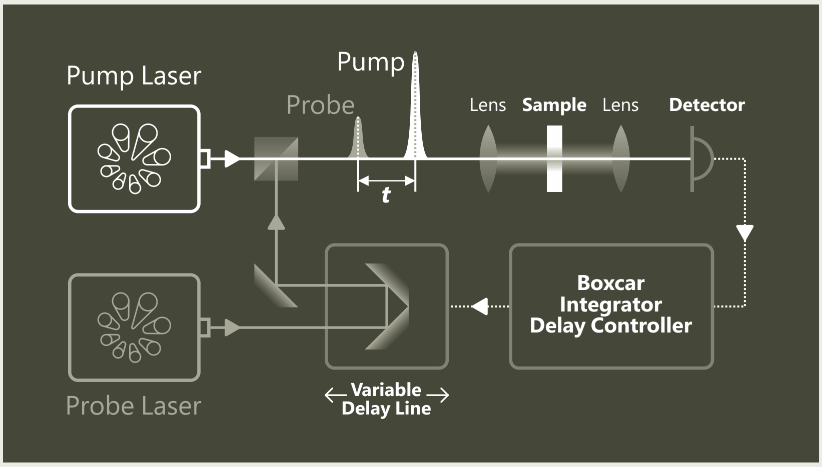
Pump-Probe Spectroscopy

Laser Spectroscopy



Ultrafast spectroscopy is based on the use of light pulses that have shorter temporal duration compared to the underlying dynamics of the system. Shorter pulse- better time resolution, longer pulse- better spectral resolution. Two pulses separated by time delay are used. First pulse excites (electronic and/or vibrational levels, ionises, make Coulombic explosions, creates plasma, etc.) sample, second delayed pulse probes- checks what happened at the certain time moment. Dynamics of investigated system is recorded by changing delay between pulses. Various experimental techniques are employed to record time-resolved signals: for example transient absorption, four-wave mixing, sum frequency generation. Pump and probe spectral range can vary from UV or even X-ray to far infrared.

The advantage of pump-probe spectroscopy is direct investigation of dynamics. For example: excitation relaxation, energy transfer, photochemical reactions dynamics and movement of particles, structural changes. Tunability of pump and probe pulses opens two dimensional pump-probe spectroscopy where is possible to obtain temporally resolved energy map of system which shows separated and coupled states.

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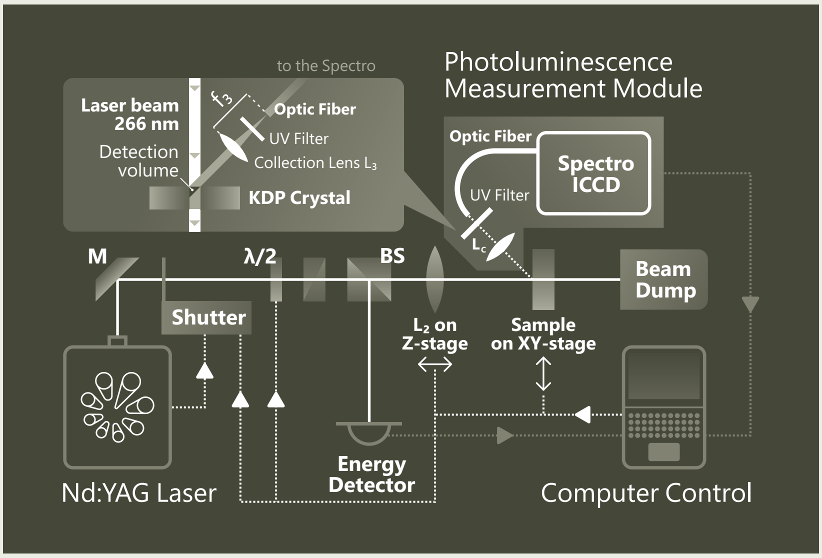
Other Ekspla Products

Solid-phase Photoluminescence Spectroscopy

Laser Spectroscopy



Time-resolved Photoluminescence Spectroscopy (TRPL) is a contactless method to characterize recombination and transport in solid materials. Measuring TRPL requires exciting luminescence from a sample with a pulsed light source and then measuring the subsequent decay in photoluminescence as a function of time. Most experiments excite the sample with a pulsed laser source and detect the PL with a photodiode, streak camera, or photomultiplier tube set up for upconversion or single-photon counting. The system response time, wavelength range and sensitivity vary widely for each configuration.

It is possible to apply the general methodology of time-resolved photoluminescence for lifetime imaging of the charge carrier dynamics. Nonradiative surface recombination at the boundaries of a semiconductor device can be a major factor limiting the efficiency in light-emitting and laser diodes (LEDs and LDs), photovoltaic cells, and photodetectors. Therefore, the effective lifetime is a crucial parameter to obtain solar cells with a high conversion ratio.

Photoluminescence microscopy also is a powerful optical method for the study of crystal defects in semiconductors and organometallic complexes, with important applications in the manufacturing process of nanostructures, optoelectronic devices and solar cell systems.

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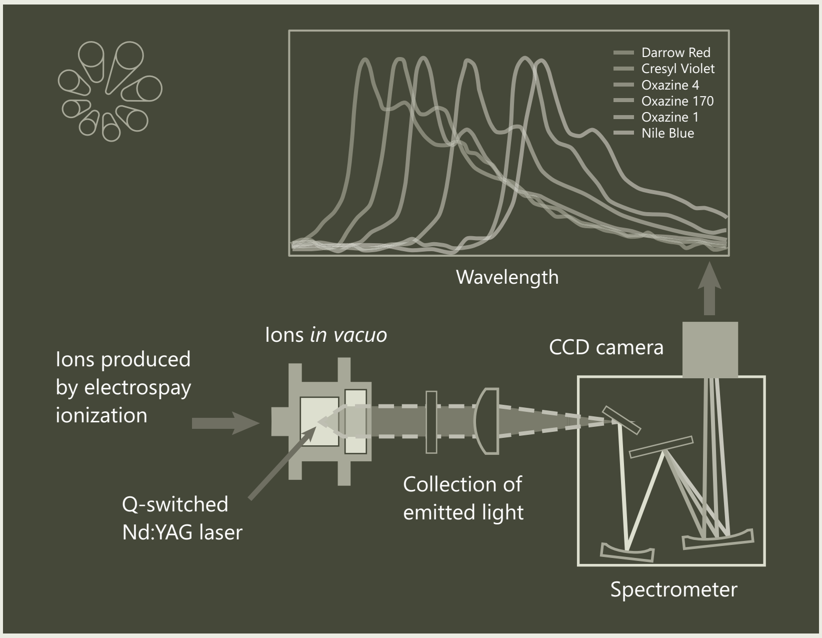
Gas-phase Ion Luminescence Spectroscopy

Laser Spectroscopy



Gas-phase ion luminescence spectroscopy is used to determine intrinsic electronic transition energies in the absence of a disturbing environment. Large ions produced by electrospray ionization are stored and mass-selected in a cylindrical Paul trap. Here they are irradiated by light from a 20-Hz pulsed tunable wavelelength laser from EKSPLA followed by detection of the emitted photons. The 20-Hz repetition rate of the tunable laser allows for mass selection in between every irradiation event, which implies that there is no fluorescence contribution from ion impurities. The tunability of the laser makes it possible to photo-excite a variety of dyes that absorb at different wavelengths. The figure shows spectra of oxazine dye cations that display emissions in a range from 500 nm to 750 nm. The technique can also be used to study three-dimensional structures of peptides and nucleic acids in the gas phase based on Förster Resonance Energy Transfer (FRET). The biomolecules are labeled with donor-acceptor dye pairs such as rhodamines 575 and 640. Structure information is provided as the efficiency of energy transfer depends on the distance between the donor and acceptor to the inverse power of six.

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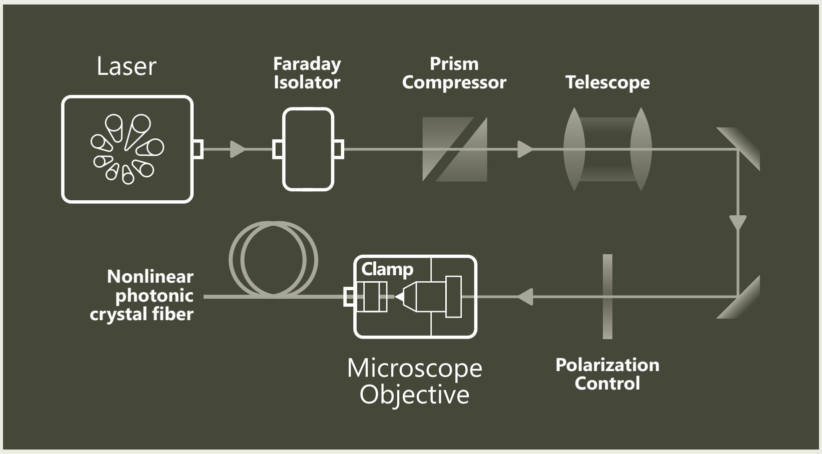
Supercontinuum Generation

Laser Spectroscopy



Supercontinuum "White Light Lasers" have become a well-established turn-key fiber-laser technology addressing a wide range of applications from biomedical imaging to optical device characterization. They add value due to their unique combination of optical parameters, including an extremely wide spectral coverage from 400 nm to 2400 nm, several W of optical output power, and focus down to the diffraction limit of a perfect Gaussian beam.

The majority of commercial supercontinuum lasers are fully fiber-based systems consisting of a modelocked fiber oscillator as the master seed laser, providing ps pulses at ~1064 nm and repetition rates in the tens of MHz regime. Injected into a fiber amplifier giving rise to high peak power, and finally a few meters of a specially designed index-guiding PCF with suitable dispersion landscape. The supercontinuum source, when combined with a tunable spectral filter, transforms into a widely tunable laser, making it a versatile laser tool for a wide range of applications.

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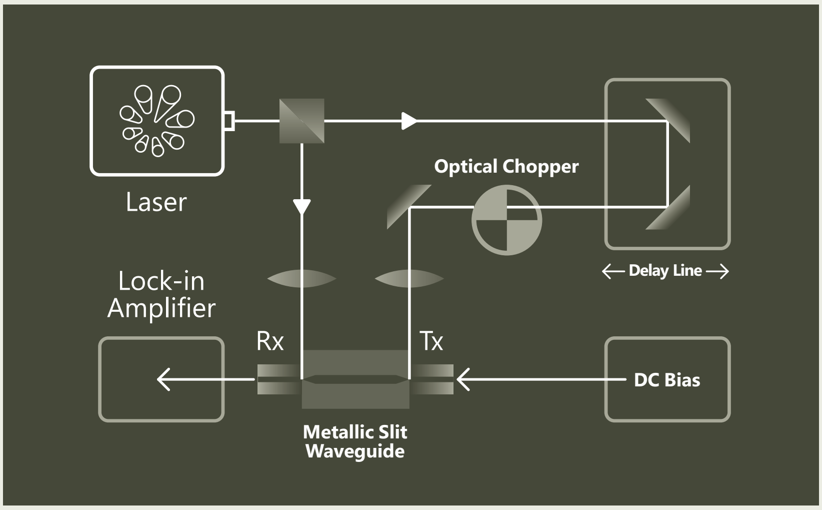
Time-Resolved Photoconductivity

Laser Spectroscopy



Time-resolved photoconductivity (TRMC) are key techniques used to perform the contactless determination of carrier density, transport, trapping, and recombination parameters in charge transport materials such as organic semiconductors and dyes, inorganic semiconductors, and metal-insulator composites, which find use in conductive inks, thin-film transistors, light-emitting diodes, photocatalysts, and photovoltaics.

The behavior of photoconductivity with photon energy, light intensity and temperature, and its time evolution and frequency dependence, can reveal a great deal about carrier generation, transport and recombination processes. Many of these processes now have a sound theoretical basis and so it is possible, with due caution, to use photoconductivity as a diagnostic tool in the study of new electronic materials and devices.

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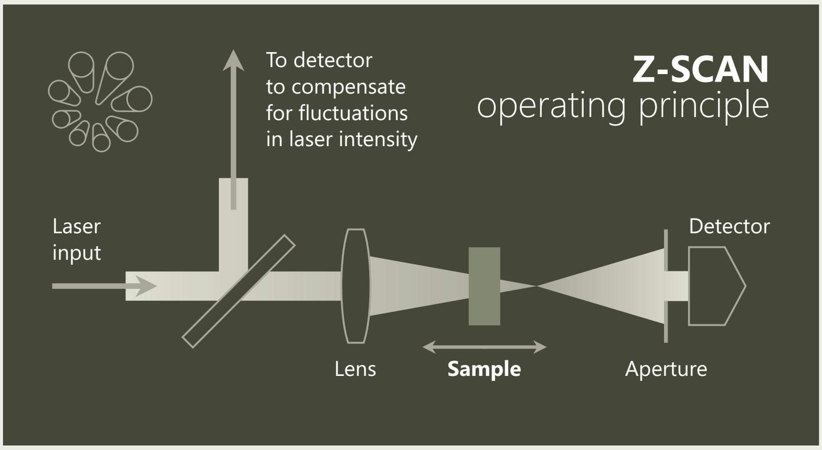
Z-SCAN

Laser Spectroscopy



In nonlinear optics, z-scan technique is used to measure the non-linear index n_2 (Kerr nonlinearity) and the non-linear absorption coefficient Δα via the "closed" and "open" methods to measure both real and imaginary components of the nonlinear refractive index.

For measuring the real part of the nonlinear refractive index, the z-scan setup is used in its closed-aperture form. The sample is typically placed in the focal plane of the lens, and then moved along the z axis, defined by the Rayleigh length. In this form, since the nonlinear material reacts like a weak z-dependent lens, the far-field aperture makes it possible to detect small beam distortions in the original beam. Since the focusing power of this weak nonlinear lens depends on the nonlinear refractive index, it is possible to extract its value by analyzing the z-dependent data acquired by the detector and by interpreting them using an appropriate theory.

For measurements of the imaginary part of the nonlinear refractive index, or the nonlinear absorption coefficient, the z-scan setup is used in its open-aperture form. In open-aperture measurements, the far-field aperture is removed and the whole signal is measured by the detector. By measuring the whole signal, the beam small distortions become insignificant and the z-dependent signal variation is due to the nonlinear absorption entirely.

The main cause of non-linear absorption is two-photon absorption. Due to high pulse intensity and cost effectiveness, picosecond high energy lasers are the most appropriate choice for z-scan measurements.

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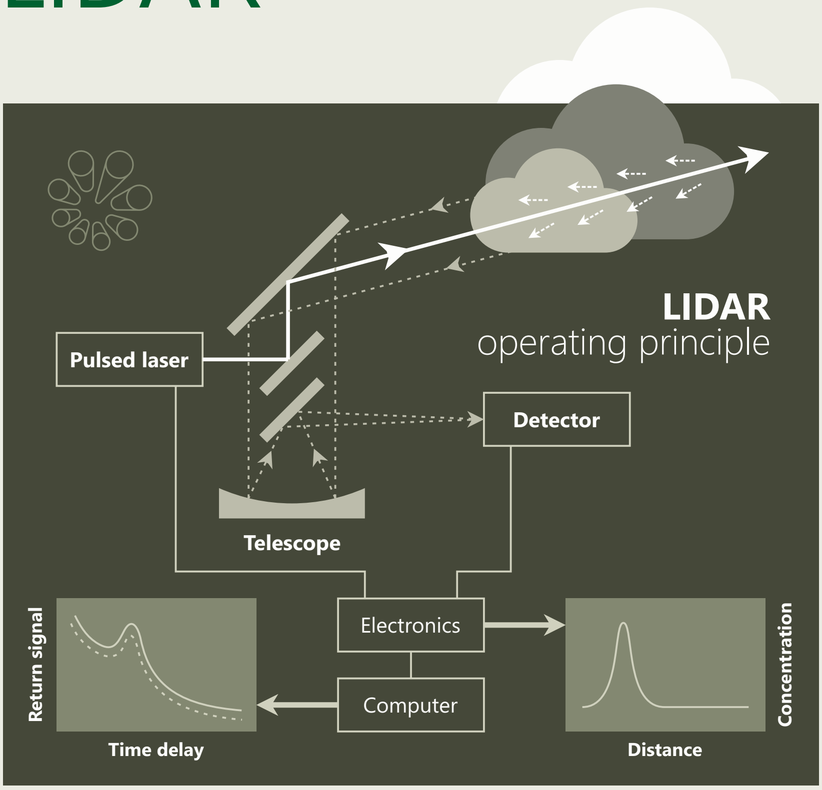
LIDAR

Laser Spectroscopy



LIDAR is an acronym for "LIght Detection And Ranging". LIDAR sends out short laser pulses into the atmosphere, where all along its path, the light is scattered by small particles, aerosols, and molecules of the air and is collected by telescope for analysis. Due to the constant velocity of light, time is related to the scatter's distance, therefore, the spatial information is retrieved along the beam path. LIDAR uses ultraviolet, visible, or near infrared light to image objects. It can target a wide range of materials, including non-metallic objects, rocks, rain, chemical compounds, aerosols, pollutants, clouds, and even single molecules. LIDAR especially helps in those cases where access with conventional methods is troublesome.

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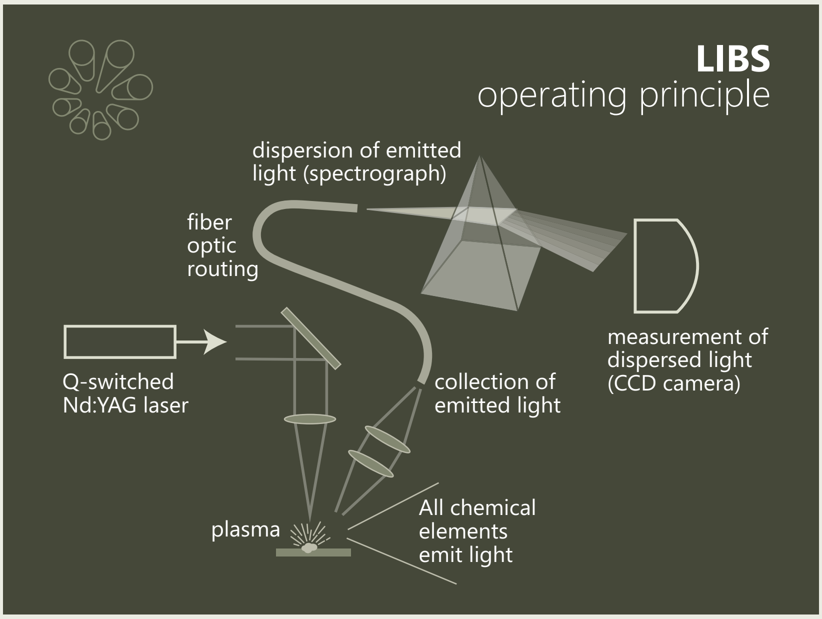
LIBS

Laser Spectroscopy



Laser-induced breakdown spectroscopy (LIBS) utilizes a high intensity short laser pulse to convert a very small amount of target material to plasma for optical analysis of the spectra. LIBS can be used on solid, liquid, or gas samples, and, depending on the spectrograph and detector, can detect all elements. LIBS is non-contact, so it can be used in a wide variety of environments, including remote analysis and micro-sampling.

When coupled with appropriate optics and stages, elemental maps of a surface can be created. Multiple LIBS scans can effectively resolve material composition throughout the volume, building a full three dimensional elemental map.

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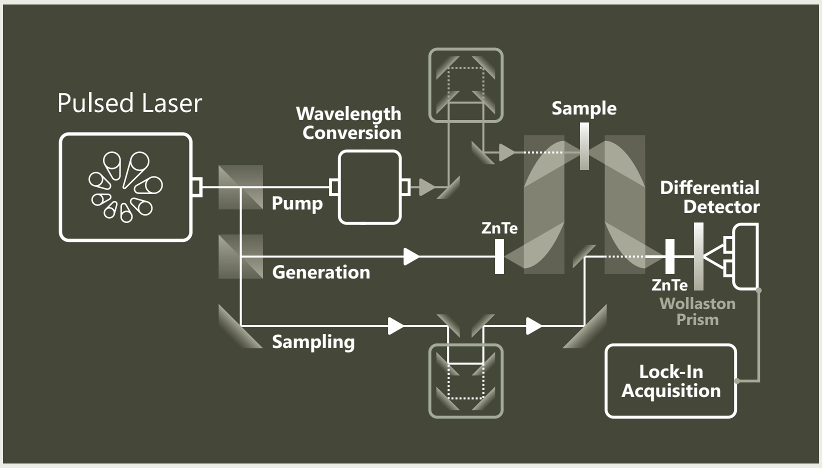
Terahertz Spectroscopy

Laser Spectroscopy



Terahertz time-domain spectroscopy (THz-TDS) probes inter-molecular interactions within solid materials. THz-TDS covers the spectral region of 0.1-10 THz which is a low energy and non-ionizing region of the electromagnetic spectrum. THz-TDS is a powerful technique for material characterization and process control and has several distinct advantages for use in spectroscopy. It can give the amplitude and phase information of the sample simultaneously. Many materials are transparent at terahertz wavelengths, and this radiation is safe for biological tissue being non-ionizing (as opposed to X-rays). It has been used for contact-free conductivity measurements of metals, semiconductors, 2D materials, and superconductors. Furthermore, THz-TDS has been used to identify chemical components such as amino acids, peptides, pharmaceuticals, and explosives, which makes it particularly valuable for fundamental science, security, and medical applications.

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/ Ultrafast X-ray science
/ High density science
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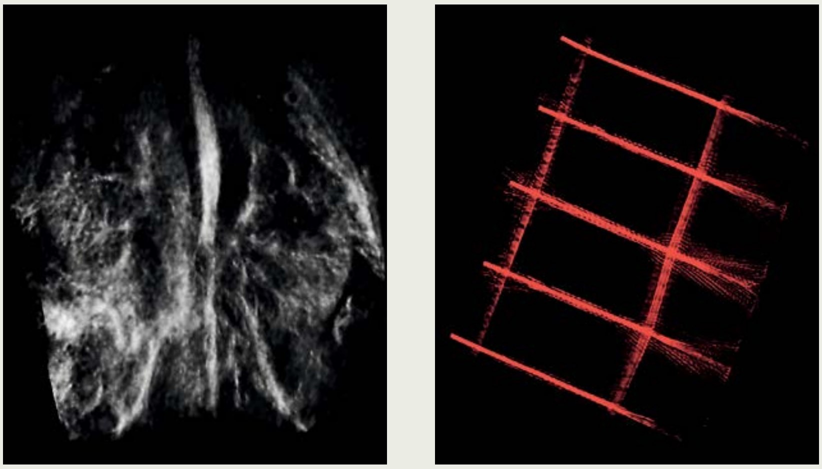
Biomedical Applications

Photoacoustic imaging is a valuable high-contrast in vivo imaging technique for pre-clinical and clinical applications. This technique uses laser-induced ultrasound.

Ultrasound signal is generated in tissue, when it absorbs laser light and expands thermo-elastically, and their waves are detected by ultrasonic transducers. 2D or 3D images are then reconstructed from the accumulated data.

Laser sources for photoacoustic imaging include LPSS OPOs, DPSS OPO systems.

EXAMPLE OF PHOTOACOUSTIC IMAGES



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