Lasers and Laser Systems

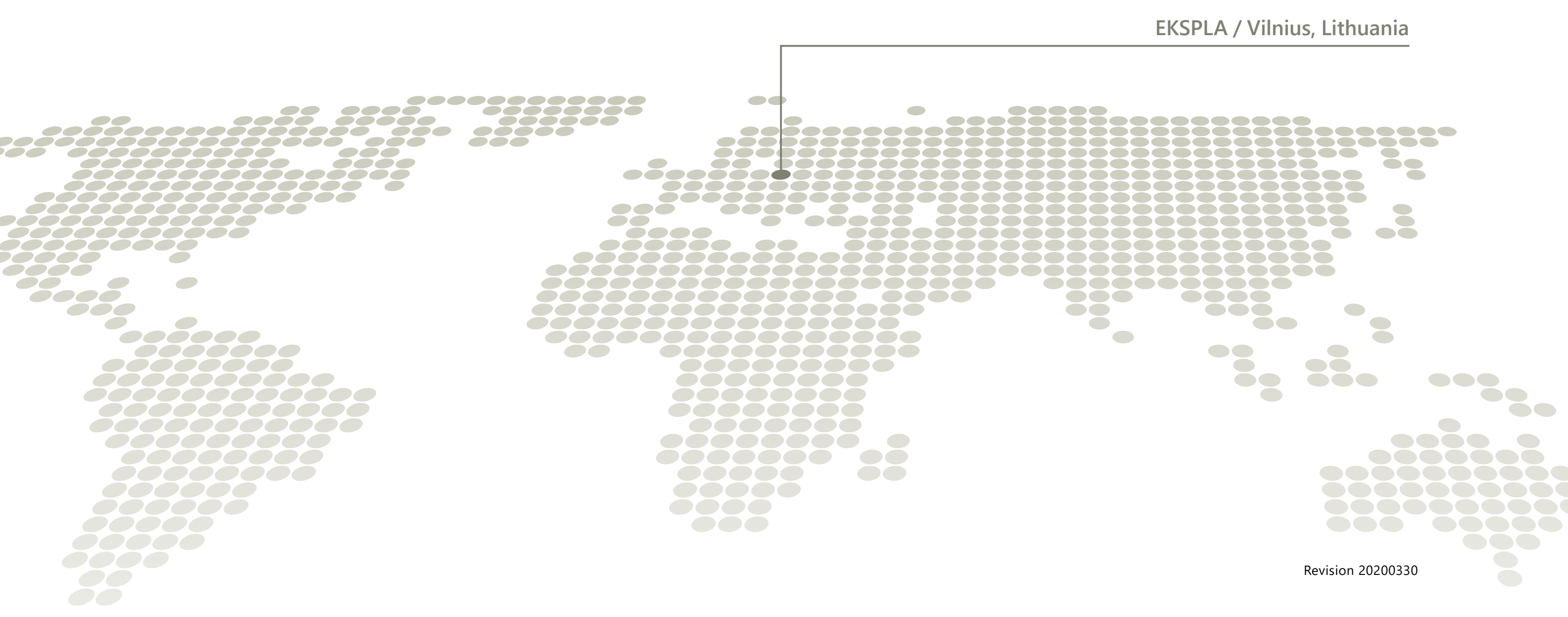
Femtosecond
Picosecond
Nanosecond
Tunable Wavelength
High Intensity
Laser Spectroscopy

2020

EKSPLA

Lasers and Laser Systems

2020



Revision 20200330

About Company

Background

EKSPLA focuses on the design and manufacturing of advanced lasers & systems and employs more than 27 years' experience as well as a close partnership with the scientific community. 66 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 27 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


KSPLA
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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 5 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 some 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

- *__300 fs ... 5 ps__ tunable pulse duration*
- *Output power __3 W at 1030 nm__ or __1.5 W at 515 nm__*
- *Up to __3 μJ/pulse__ and __10 μJ/burst__ (at 1030 nm)*
- *Up to __1.5 μJ/pulse__ and __5 μJ/burst__ (at 515 nm)*
- *Excellent beam quality __M^2 < 1.2__*
- *Versatile laser control and syncronisation capabilities*
- *Up to 5 MHz pulse repetition rate*
- *Smart triggering for synchronous operation with polygon scanner and PSO*
- *Burst shape control*
- *Passive 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 ± 2 nm
With second harmonic option	515 ± 1 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	> 1.5 W
Power long term stability (Std. dev.) [3]	≤ 0.5 %
Maximal pulse energy [2]	
at 1030 nm	> 3 μJ
at 515 nm	> 1.5 μJ
Pulse energy stability (Std. dev.) [4]	< 2 %
Laser pulse repetition rate (PRR_L) range [5]	1 – 5 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 ± 2 nm	464 × 363 × 129 mm
at 515 ± 1 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.

Note: It is recommended to use clean air generator with FemtoLux 3-GR in order to ensure it's performance stability.

PERFORMANCE

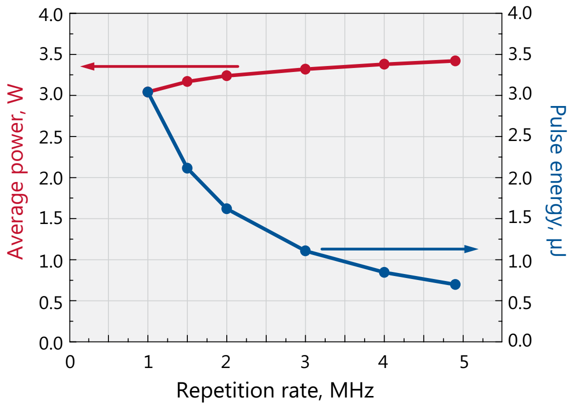


Fig 1. Typical dependence of output power and pulse energy of FemtoLux 3 laser **at 1030 nm** when changing internal repetition rate of the laser

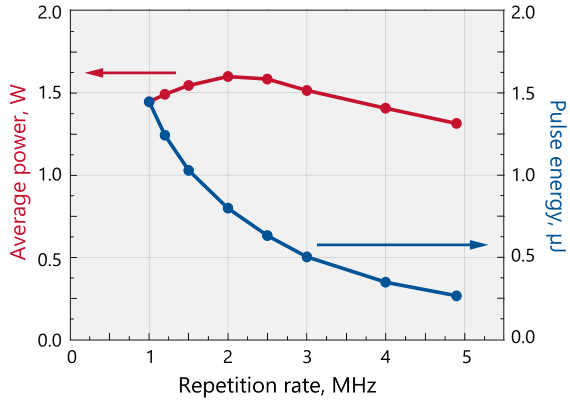


Fig 2. Typical dependence of output power and pulse energy of FemtoLux 3-GR laser **at 515 nm** on pulse repetition rate

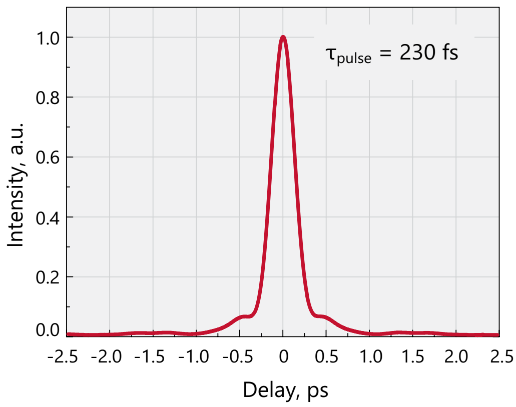


Fig 3. Typical FemtoLux 3 laser (**at 1030 nm**) output pulse autocorrelation function at 3 µJ pulse energy. Calculated pulse duration is 230 fs

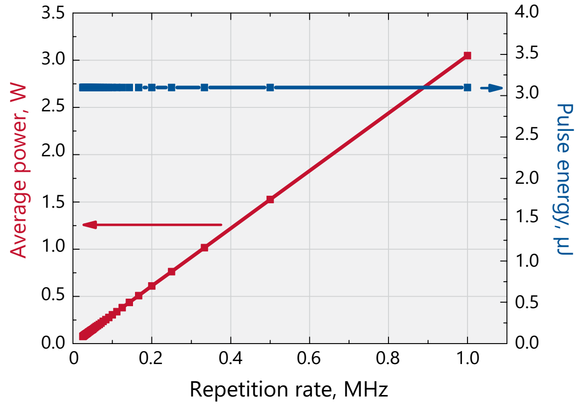


Fig 4. Typical dependence of output power and pulse energy of FemtoLux 3 laser **at 1030 nm** when repetition rate is reduced by pulse picker. Internal repetition rate of the laser in this case is 1 MHz

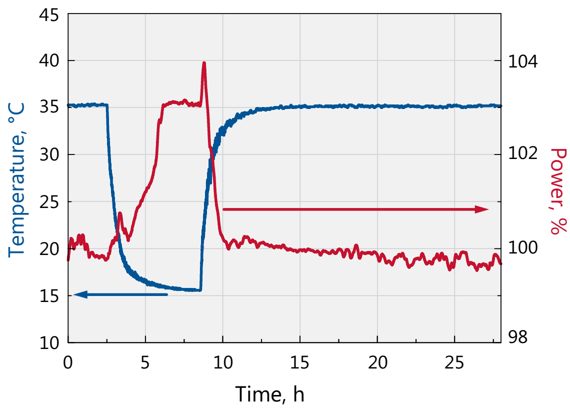


Fig 5. Average output power dependance on ambient temperature **at 1030 nm**

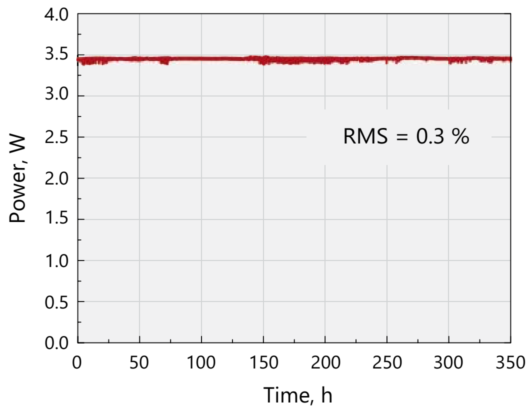


Fig 6. Typical long term average output power stability of FemtoLux 3 laser **at 1030 nm** under constant environmental conditions

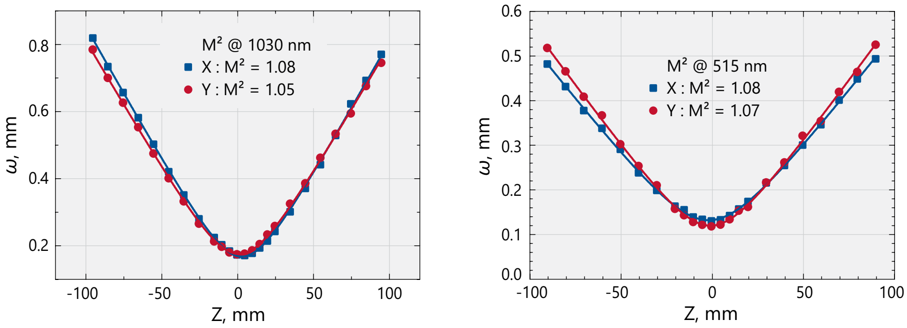


Fig 7. Typical M² measurement of FemtoLux 3 laser

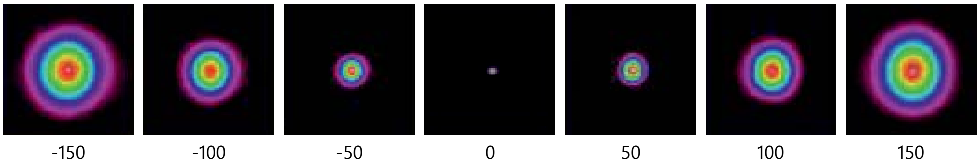


Fig 8. Typical beam profiles along propagation axis of FemtoLux 3 series laser

REMOTE CONTROL APPLICATION

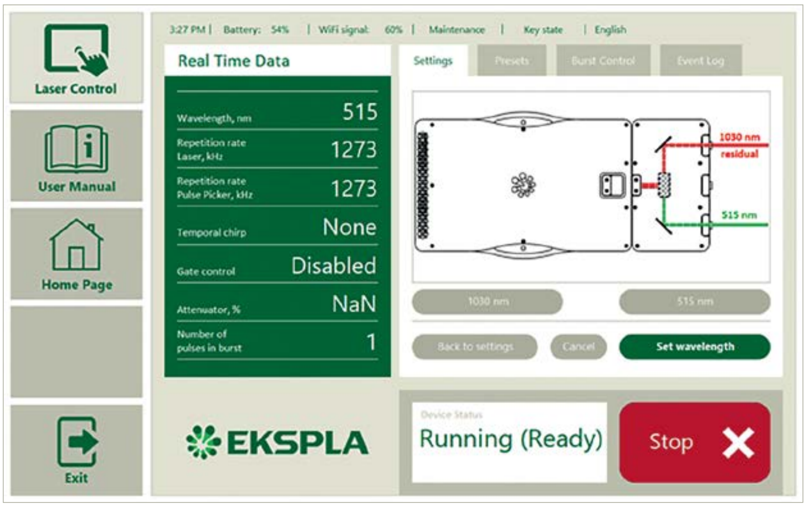


Fig 9. Example of FemtoLux 3 remote control application

FemtoLux 3

DRAWINGS

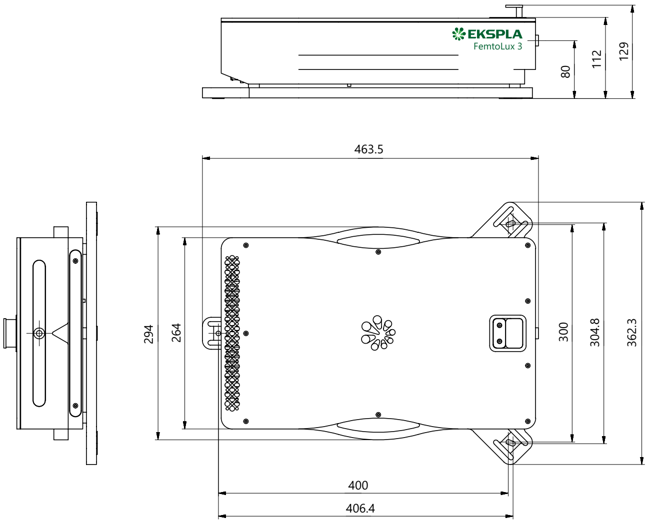


Fig 11. Outline drawings of FemtoLux 3 laser head

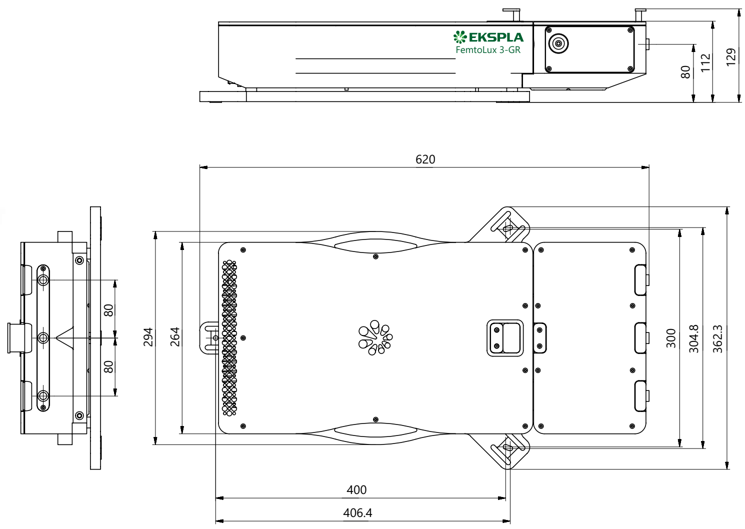


Fig 12. Outline drawings of FemtoLux 3-GR laser head with second harmonic option

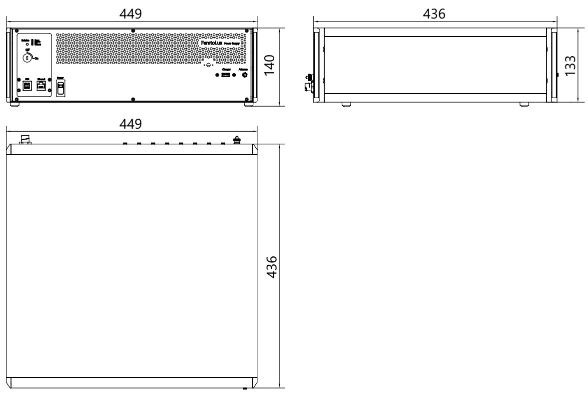


Fig 13. Outline drawings of FemtoLux 3 stand-alone control unit

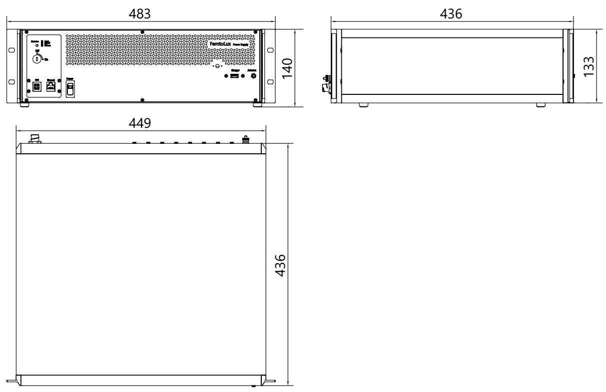


Fig 14. Outline drawings of FemtoLux 3 19" rack mountable control unit

PL2230 series picosecond laser employs innovative DPSS only technology to ensure high pulse energies with longer periods between maintenance

Picosecond Lasers

The first EKSPLA picosecond laser has been sold on its first launch event in exhibition in Germany more than 20 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) or LAN (REST API) interfaces 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	28 ± 3 ps	kHz repetition rate	14
PL2230	40 mJ at 1064 nm	100 Hz	Diode pumped solid state	28 ± 3 ps	High pulse energy employing DPSS only technology	17
PL2250	100 mJ	20 Hz	Hybrid (DPSS master oscillator and flash-lamp pumped power amplifier)	30 ± 3 ps	High pulse energy	21
SL230	500 mJ at 1064 nm	50 Hz	Diode-pumped Q-switched SLM master oscillator	120 ± 15 ps	Employs Stimulated Brillouin Scattering (SBS compression) technology	24
Picosecond Nd:YLF laser	40 or 70 mJ	5 or 10 Hz	Flash-lamp pumped	10 ± 2 ps	Custom product, tailored for specific applications	27

PL2210 SERIES

Diode Pumped Picosecond kHz Pulsed Nd:YAG Lasers

FEATURES

- *High pulse energy at **kHz rates***
- *Diode pumped **solid state** design*
- ***Air cooled** – external water supply is not required*
- *Turn-key operation*
- *Low maintenance costs*
- *Optional streak camera triggering pulse with <10 ps rms jitter*
- *Remote control pad*
- *PC control via USB with supplied LabVIEW™ drivers*
- *Optional temperature stabilized second, third and fourth **harmonic generators***

APPLICATIONS

- *Time resolved fluorescence, pump-probe spectroscopy*
- *OPG/OPA/OPO pumping*
- *Remote Laser Sensing*
- *Other spectroscopic and nonlinear optics applications*

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 standard feature that is designed to provide precise, very low jitter trigger pulses for a streak camera.

Available models

Model	Features
PL2210A-1k	Up to 900 µJ, 28 ps pulses at an up to 1 kHz repetition rate
PL2211	Up to 2.5 mJ energy at a 1 kHz repetition rate at 28 ps pulses
PL2211A	Up to 5 mJ energy at a 1 kHz repetition rate at 28 ps pulses

Custom products, tailored for specific applications [1)]

Model	Features
PL2210A-2k	Up to 400 µJ, 28 ps pulses at an up to 2 kHz repetition rate
PL2210B	Up to 2.5 mJ energy at a 1 kHz repetition rate at 80 ps pulses
PL2210B-TR	Model, in addition to a 1 kHz pulse train, has an output of 88 MHz pulse train that can be used for pumping synchronously pumped OPOs

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

[1)] Inquire for other specifications.

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.

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) or LAN (REST API) interfaces or from remote control pad with backlit display that is easy to read even while wearing laser safety glasses.

SPECIFICATIONS [1]

Model	PL2210A	PL2211	PL2211A
Output energy			
at 1064 nm	0.9 mJ	2.5 mJ	5 mJ
at 532 nm [2]	0.45 mJ	1.3 mJ	2.5 mJ
at 355 nm [3]	0.35 mJ	0.8 mJ	1.6 mJ
at 266 nm [4]	0.16 mJ	0.5 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]	28 ps ± 10 %		
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		
Beam pointing stability [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 with PRETRIG standard 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.

PRETRIG FEATURE

- **PRETRIG** provides low jitter pulse for streak camera triggering with lead/delay in -400...600 µs range and <10 ps rms jitter.

OPTIONS

- **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

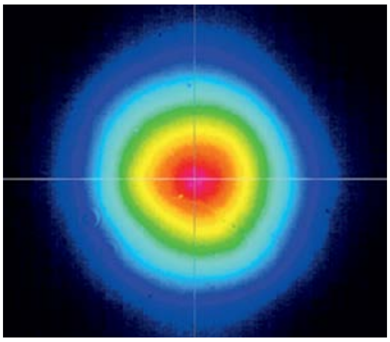


Fig 1. Typical PL2210 series laser near field beam profile at 1064 nm except PL2211, PL2211A

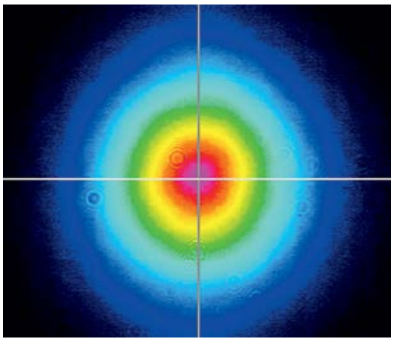


Fig 2. Typical PL2211, PL2211A laser near field beam profile at 1064 nm

OUTLINE DRAWINGS

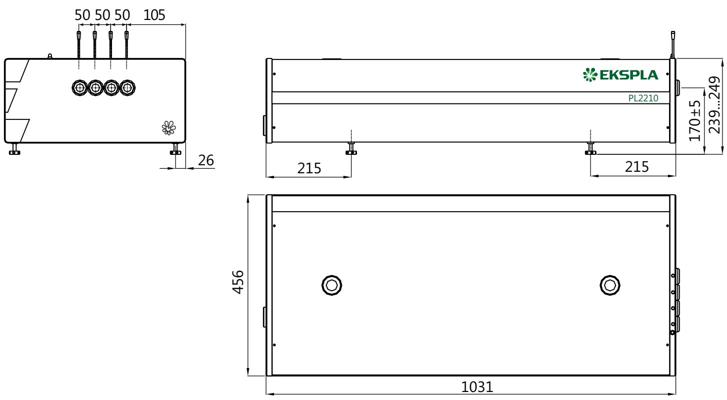


Fig 3. Dimensions of PL2210 series laser head

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

Pulse energy level, A for 0.9 mJ output

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

Other pptions:
P80 → 80 ps pulse duration option
P20 → 20 ps pulse duration option
PC → pulse picker option
PLL → pulse repetition rate locking option
TR → auxiliary quasi-CW train output option

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 (88 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) or LAN (REST API) interfaces 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 trough USB and with supplied LabView™ drivers*
- *Remote control via keypad*

APPLICATIONS

- *Time resolved spectroscopy*
- *SFG/SHG spectroscopy*
- *Nonlinear spectroscopy*
- *OPG pumping*
- *Remote laser sensing*
- *Satellite ranging*
- *Other spectroscopic and nonlinear optics applications*

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]	28 ps ± 10 %			
Pulse duration stability [9]	± 1 %			
Power drift [10]	± 2 %			
Pulse repetition rate	0 – 100 Hz	100 Hz	50 Hz	50 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 [13]	≤ 10 µrad StdDev	≤ 20 µrad StdDev		
Typical beam diameter [14]	~ 2 mm	~ 4 mm		~ 5 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]	built-in 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. Specifications for models PL2231A, B and C 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) 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 with PRETRIG standard 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.

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

Custom products, tailored for specific applications [1]

Model	PL2231B-20 (inquire)	PL2231C-20 (inquire)
Pulse energy [2]		
at 1064 nm	100 mJ	140 mJ
at 532 nm [3]	45 mJ	60 mJ
at 355 nm [4]	28 mJ	35 mJ
at 266 nm [5]	11 mJ	15 mJ
Pulse duration (FWHM) [6]	80 ps ± 10 %	
Pulse repetition rate	20 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 models PL2231B and C 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.

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.

BEAM PROFILE

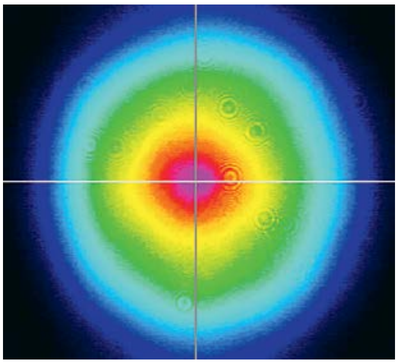


Fig 1. Typical near field output beam profile of PL2230 model laser

OUTLINE DRAWINGS

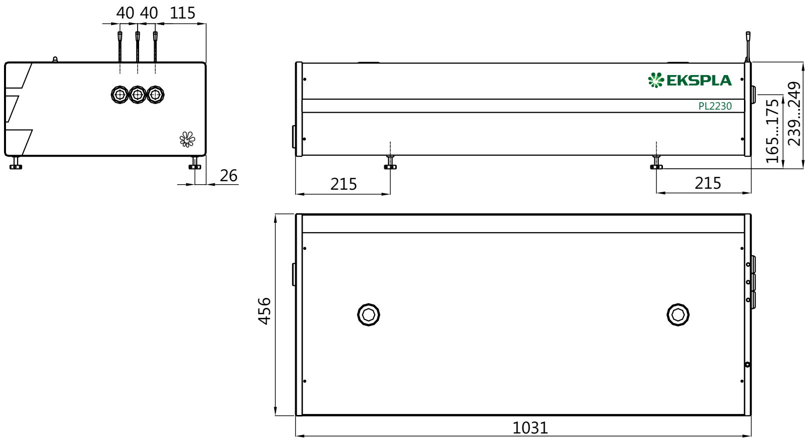


Fig 2. Dimensions of PL2230 series laser head

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

EKSPLA SAVANORIU AV. 237, LT-02300 VILNIUS, LITHUANIA TEL +370 5 2649629 E-MAIL SALES@EKSPLA.COM WWW.EKSPLA.COM REV. 20200330

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) or LAN (REST API) interfaces 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 via USB and LabVIEW™ drivers*
- *Remote control via keypad*

APPLICATIONS

- *Time resolved spectroscopy*
- *SFG/SHG spectroscopy*
- *Nonlinear 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	inquire	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]	30 ± 3 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 jitter [10]	-500 ... 50 ns		
SYNC OUT pulse delay [12]	-500 ... 50 ns		
Beam divergence [13]	< 0.5 mrad		
Beam pointing stability [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 with PRETRIG standard 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

- **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

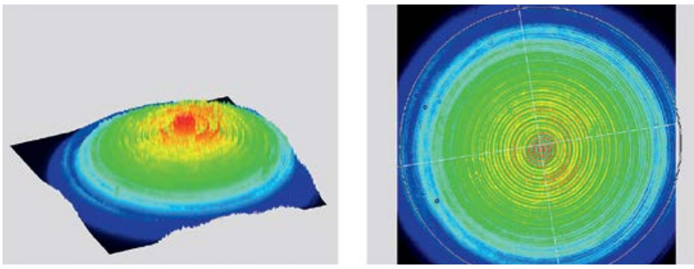


Fig 1. Typical near field output beam profile of PL2250 series laser

OUTLINE DRAWINGS

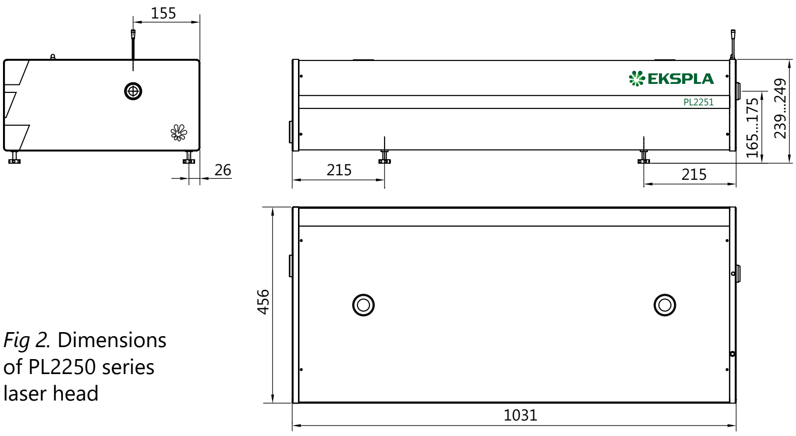


Fig 2. Dimensions of PL2250 series laser head

ORDERING INFORMATION

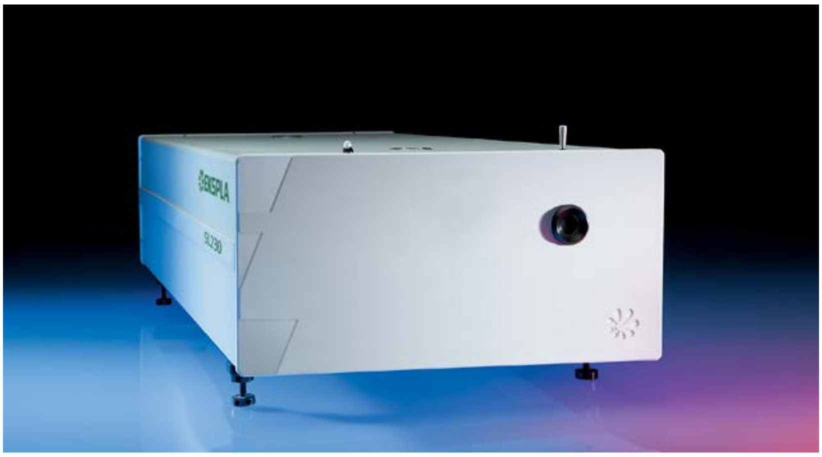
Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

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
  - PLL → pulse repetition rate locking option
  - FS → seeding option

SL230 SERIES

SBS Compressed Picosecond DPSS Nd:YAG Lasers



SL230 series lasers are excellent solution for applications, where high energy picosecond pulses are needed. Not like conventional mode-locked lasers that typically uses saturable nonlinear absorption or Kerr lensing to produce ultrafast pulses, the SL230 series lasers employ backward-stimulated Brillouin scattering (SBS) in liquid for the same purpose.

Innovative design

Diode pumped electro-optically Q-switched single longitudinal mode (SLM) nanosecond generator is the heart of the system. It provides nanosecond optical pulse that is later compressed during SBS in a special cell.

Q-switched master oscillator allows precise external triggering with jitter of less than 0.2 ns rms while mode-locked lasers typically have jitters of at least of tens of nanoseconds or even worse. Precise sync pulses from internal delay generator are also available with less than 200 ps rms jitter with respect to optical pulse.

Pulse compression is done in SBS-cell. The geometry of interaction is designed to produce shortest and most stable pulses with 120 ps duration.

After SBS compression, pulse is directed to multi-pass flashlamp pumped power amplifier for amplification to up to 500 mJ pulse energy. Completely diode pumped version of SL231 is available under special request.

Thermocontrolled harmonic generators, based on angle-tuned KD*P and KDP crystals and harmonic separation optics are available as standard options. Each wavelength has a separate output port.

Build in energy monitors continuously monitors output pulse energy. Data from the energy monitor can be seen on the remote keypad or on PC screen.

Power supply and cooling units are mounted into standard 19" rack.

Simple and convenient laser control

Laser is controlled by PC via USB or RS232 port. Free add-on communication module allows control from Windows and non-Windows OS machines: Windows, Windows CE, Linux, LabVIEW RT, etc. and enables additional LAN and WLAN interfaces. In addition, major settings of laser can be controlled through remote control pad.

FEATURES

- *Diode pumped Q-switched SLM master oscillator*
- *Flashlamp pumped power amplifier for up to* ***500 mJ*** *pulse energy at 1064 nm*
- *Advanced SBS compression produces pulses down to* ***120 ps*** *duration*
- *Excellent pre-pulse contrast ratio*
- *Thermo stabilized second, third or fourth harmonic generator options*
- *Low jitter external triggering*
- *Sync pulses output with < 200 ps rms jitter*
- *Laser control from PC or keypad*

BENEFITS

- *High brightness and intensity pulses are highly suitable for plasma generation*
- *Picosecond pulse duration benefits such applications, as satellite ranging, material ablation, tattoo removal*
- *SLM and narrow linewidth is beneficial for interferometry, holography, DIAL LIDAR*
- *Lots of interfaces USB, RS232, LAN, WLAN ensure easy integration to various equipment*

APPLICATIONS

- *Plasma research*
- *Interferometry*
- *Satellite ranging*
- *Material ablation and deposition*
- *Aesthetics*

SPECIFICATIONS [1]

Model	SL231 [2]	SL234	SL235
Max. pulse energy:			
at 1064 nm	20 mJ	250 mJ	500 mJ
at 532 nm [3]	8 mJ	125 mJ	240 mJ
at 355 nm [4]	5 mJ	70 mJ	140 mJ
at 266 nm [5]	2 mJ	40 mJ	80 mJ
at 213 nm [6]	inquire		
Pulse energy stability (StdDev): [7]			
at 1064 nm	2 %	1.5 %	
at 532 nm	3.5 %	3 %	
at 355 nm	5 %	4 %	
at 266 nm	8 %	7 %	
at 213 nm	inquire		
Pulse duration at 1064 nm (FWHM) [8]	120 ps ± 15 %		150 ps ± 15 %
Pulse duration stability at 1064 nm (StdDev) [7]	5 %		
Repetition rate	50 Hz	10 Hz	5 Hz
Linewidth	≤ 0.2 cm^{-1}		
Polarization ratio at 1064 nm	> 1:100		
Optical pulse jitter (StdDev) [9]	0.2 ns		
Beam profile	near Gaussian	Top Hat [10]	
Beam pointing stability at 1064 nm [11]	< 50 µrad		
Beam divergence [12]	< 1.3 mrad	< 0.5 mrad	
Beam height	170±5 mm		
Contrast ratio	≥ 10^5 : 1		
Beam diameter [13]	~ 4 mm	~ 10 mm	~ 12 mm

PHYSICAL CHARACTERICTICS			
Laser head size (W × L × H)	456 × 810 × 249 mm	456 × 1031 × 249 mm	
Electric cabinet size (W × L × H)	553 × 600 × 519 mm		553 × 600 × 665 mm
Umbilical length	2.5 m		

OPERATING REQUIREMENTS			
Water consumption (max. 20 °C)	< 10 liters/min		
Room temperature	18 – 24 °C		
Relative humidity	10 – 80 % (non-condensing)		
Power requirements	208 or 380 V AC, three phase, 50/60 Hz	208 or 230 V AC, single phase, 50/60 Hz	
Power consumption	< 2 kVA	< 3.5 kVA	< 4 kVA

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 for basic system without options.

2) Completely diode pumped version of SL231 is available under special request.

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 custom -FiH option. Outputs are not simultaneous. Please inquire for pulse energies at other wavelengths.

7) Averaged from 300 pulses.

8) Inquire for optional variable pulse durations in 150 – 400 ps or 400 – 1000 ps range (does not apply for SL231). Some of laser specifications with this option may differ from those without it.

9) In external triggering mode with two separate triggering pulses for flashlamps and Q-switch.

10) Near Gaussian fit profile with lower energy is available by request.

11) RMS value measured from 300 shots. Beam pointing stability is evaluated from fluctuations of beam centroid position in the far field.

12) Full angle measured at the $1/e^2$ point at 1064 nm.

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

OPTIONS

▶ Variable pulse duration options -VPx and -VPCx

SL series lasers offer a unique capability for tuning pulse duration. The tuning is done by changing the geometry of interaction in the SBS compressor. Two tuning ranges – 150–400 ps (option -VP1) and 400–1000 ps (option -VP2) – are available as standard options.

While the -VPx option requires manual tuning of optical layout components for pulse duration change, the -VPCx option provides motorized tuning that allows a change in pulse duration from a personal computer (purchased separately) or laser control pad.

Note. Certain specifications may change when the laser is configured for variable pulse duration. Contact Ekspla for detailed data sheets.

OUTLINE DRAWINGS

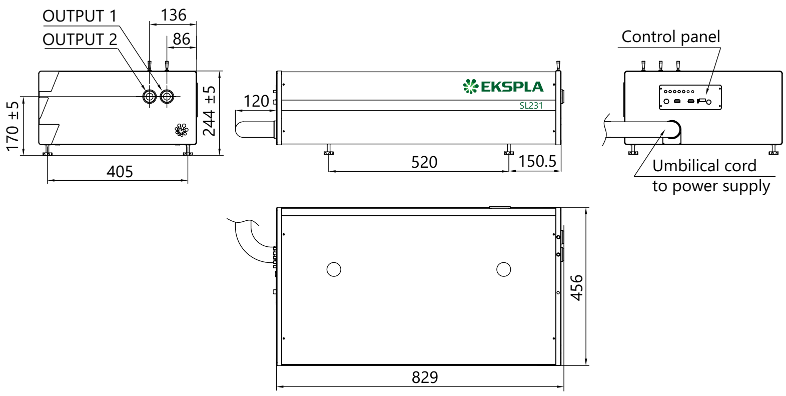


Fig 1. SL231 laser head outline drawing

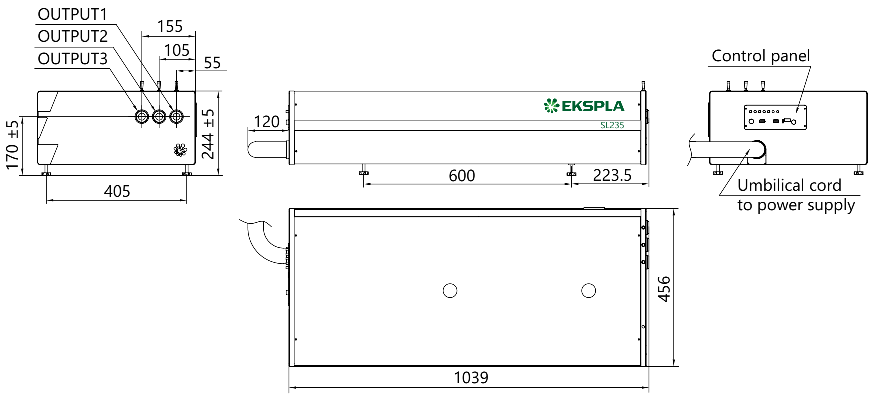


Fig 2. SL234, SL235 lasers head outline drawing

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.

Picosecond Nd:YLF Lasers

Custom product, tailored for specific applications

Nd:YLF mode-locked picosecond lasers produces high energy pulses with as short as 10 ps pulse duration.

Rugged and reliable design

Diode pumped mode-locked quasi-CW master oscillator produces the train of the pulses that is guided to the regenerative amplifier for further amplification. The single pulse is cavity-dumped from regenerative amplifier and then amplified by linear amplifiers to up to 80 mJ pulse energy. The output pulse energy can be adjusted in approximately 1 % steps from 1 mJ to nominal output, at the same time pulse-to-pulse energy stability remains less than 1.5 % rms at 1053 nm.

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

Build in energy monitors continuously monitors output pulse energy. Data from the energy monitor can be seen on the remote keypad or on PC monitor.

The laser provides triggering pulse for synchronization of customer's equipment with lead up to 500 ns. The lead of triggering pulse can be adjusted in ~0.25 ns steps from control pad or PC.

PRETRIG is standard feature for streak camera triggering and can provide pulse with up to 1000 μs lead that can be adjusted from PC with approx. 33 ns step.

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) or LAN (REST API) interfaces or from remote control pad with backlit display that is easy to read even while wearing laser safety glasses.

FEATURES

- *__10 ps__ pulse duration*
- *Fiber master oscillator*
- *Diode pumped regenerative amplifier*
- *Flashlamp pumped power amplifier producing up to __70 mJ__ per pulse at 1053 nm*
- *Excellent pulse duration stability*
- *Up to __10 Hz__ repetition rate*
- *PC control via USB (RS232 is optional) and LabView™ drivers*
- *Remote control pad*
- *Optional streak camera triggering pulse with <10 ps rms jitter*
- *Optional thermostabilized second, third or fourth harmonic generators*
- *Optical parametric generators for tunable wavelength output in 210–2600 nm range are available*

APPLICATIONS

- *Time resolved spectroscopy*
- *Nonlinear spectroscopy*
- *OPG pumping*
- *Other spectroscopic and nonlinear optics experiments*

Picosecond Nd:YLF Lasers

SPECIFICATIONS [1]

Model	PL3143	PL3143A
Pulse energy		
at 1053 nm	40 mJ	70 mJ
at 526.5 nm [2]	20 mJ	35 mJ
at 351 nm [3]	10 mJ	17 mJ
at 263 nm [3]	Contact Ekspla	
Pulse duration (FWHM) [4]	10±2 ps	
Repetition rate	10 Hz	5 Hz
Triggering mode	internal / external	
SYNC OUT pulse jitter [5]	< 100 ps	
SYNC OUT pulse lead/delay [6]	-500...50 ns	
PHYSICAL CHARACTERISTICS		
Laser head size (W × L × H)	462 × 1245 × 255 mm	
Electric cabinet size (W × L × H)	550 × 600 × 835 mm	
Umbilical length	2.5 m	
OPERATING REQUIREMENTS		
Water consumption (max 20 °C)	< 5 l/min	
Room temperature	22±2 °C	
Relative humidity	20–80 % (non-condensing)	
Power requirements [7]	three phase, 208 or 380 V AC, 20 A, 50/60 Hz	
Power consumption	< 2.5 kVA	< 3 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 1053 nm and for basic system without options.

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

3) With auxiliary H400 harmonic generator unit. Outputs are not simultaneous. Please inquiry for pulse energies at other wavelengths.

4) Inquiry for optional pulse durations in 20–80 ps range.

5) With respect to optical pulse. <10 ps jitter is provided with PRETRIG standard feature.

6) SYNC OUT lead or delay can be adjusted with ~0.25 ns steps in specified range. PRETRIG standard feature provide -1000..5000 µs lead/delay time adjustment range.

7) Mains voltage should be specified when ordering.

PRETRIG FEATURE

- **PRETRIG** standard feature provides low jitter pulse for streak camera triggering with delay in -1000...5100 µs range and <10 ps rms jitter.

BEAM PROFILE

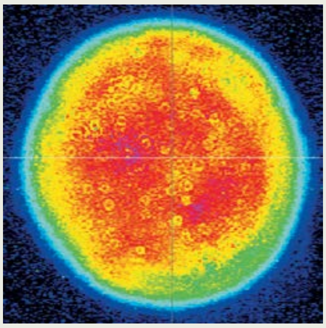


Fig 1. Typical beam profile at 1053 nm at 20 cm from PL3143B laser output at 80 mJ pulse energy

Picosecond Nd:YLF Lasers

OUTLINE DRAWINGS

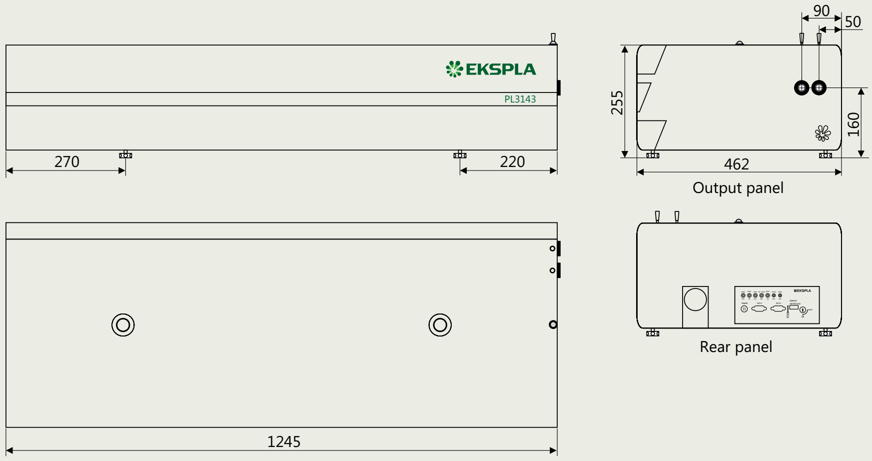


Fig 2. Dimensions of PL3143 and PL3143A lasers

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.

PL3143A-5-SH/TH/FH-AW

Model

Pulse energy level:
A → 50 mJ output
no letter → 30 mJ output

Pulse repetition rate in Hz

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

Options:
AW → water-air heat exchanger

Photo: PT series tunable wavelength laser features pump laser and OPG integrated into single/rugged housing for better performance and easy integration in other systems

Picosecond Tunable Systems

For researchers demanding wide tuning range, high conversion efficiency and narrow line-width, EKSPLA PG 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 (RS-232 is optional) interface using supplied LabVIEW™ drivers 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	32
PGx03	210 – 2 300 nm	1000 Hz	< 6 cm^{-1}	Operating at kHz repetition rate	36
PGx11	193 – 16 000 nm	50 Hz or 1000 Hz	< 2 cm^{-1}	Narrow linewidth (<0.8 cm^{-1} on some versions)	39
PT277	1400 – 2 050, 2 200 – 4 450 nm	87 MHz	< 1 cm^{-1}	Optional intensity modulation up to 2 MHz	44

PGx01 SERIES

High Energy Broadly Tunable OPA

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) or LAN (REST API) interfaces or from remote control pad with backlit display that is easy to read even while wearing laser safety glasses.

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 via USB port (RS232 is optional) and LabVIEW™ drivers*
- *Remote control via keypad*

APPLICATIONS

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

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.

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, > 50 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	~15 ps	~12 ps	~12 ps	~20 ps	~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-TH, PL2251A-TH	PL2231A-50-SH, PL2251B-SH
Beam divergence	< 0.5 mrad				
Beam profile	homogeneous, without hot spots, Gaussian fit >90 %				
Pulse duration [6)]	30 ± 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

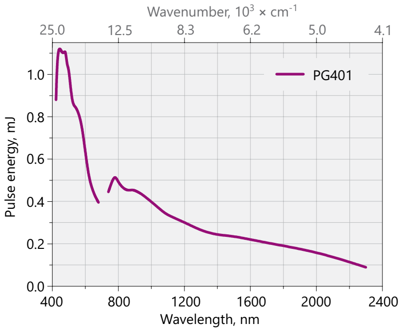


Fig 1. Typical PG401 model tuning curve
Pump energy: 10 mJ at 355 nm

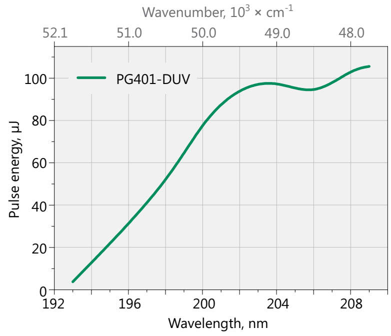


Fig 2. Typical PG401-DUV model tuning curve

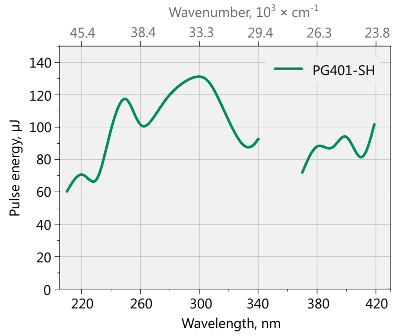


Fig 3. Typical PG401-SH model tuning curve. *Pump energy: 10 mJ at 355 nm*

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

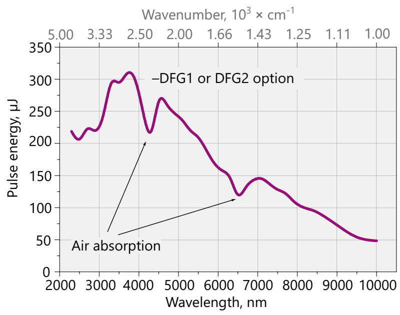


Fig 4. Typical PG501-DFG1 tuning curve in 2300–10000 nm range
Pump energy: 7 mJ at 1064 nm

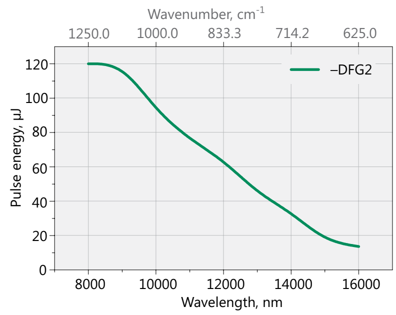


Fig 5. Typical PG501-DFG2 tuning curve in 8000–16000 nm range
Pump energy: 15 mJ at 1064 nm

RECOMMENDED UNITS ARRANGEMENT ON OPTICAL TABLE

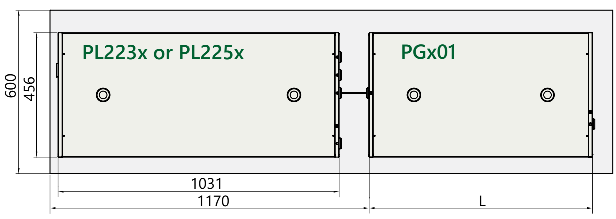


Fig 6. Arrangement of pump laser and PGx01 unit on optical table

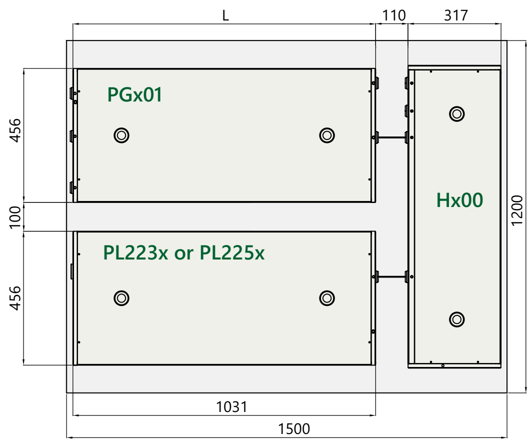


Fig 7. Recommended arrangement of pump laser and PGx01-DFGx unit on optical table

OUTLINE DRAWINGS

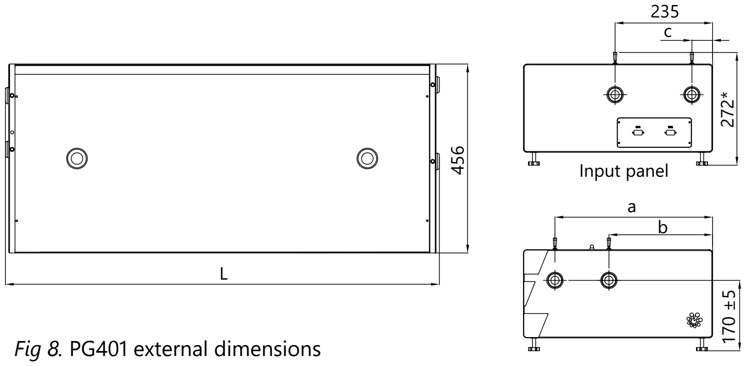


Fig 8. PG401 external dimensions

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.

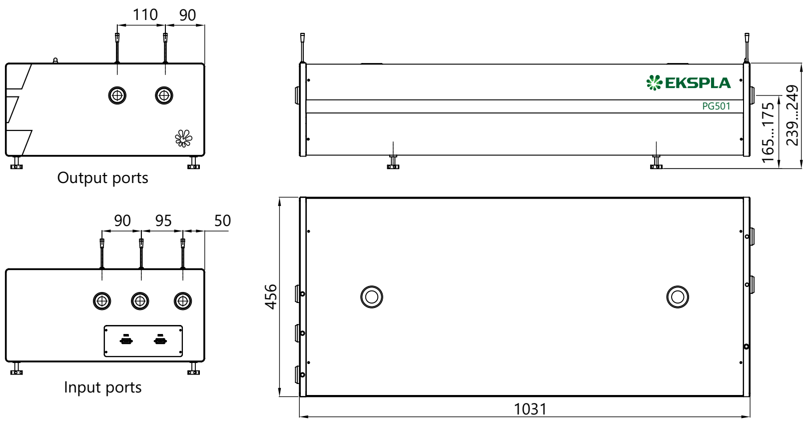


Fig 9. PG501 external dimensions

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.

PGx03 SERIES

kHz Repetition Rate Broadly Tunable OPA

FEATURES

- *Picosecond pulses at **1 kHz** pulse repetition rate*
- *Hands-free wavelength tuning*
- *Tuning range from **210 nm** to **2300 nm***
- *Narrow linewidth **<6 cm⁻¹***
- *Low divergence <2 mrad*
- *PC control using USB (RS232 is optional) and LabVIEW™ drivers*
- *Remote control via keypad*

APPLICATIONS

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

PGx03 series Optical Parametric Generators (OPG) are designed to be pumped by 1 kHz mode-locked lasers with 1 W average power. An excellent choice is the PL2210A series mode-locked picosecond laser from EKSPLA.

The optical design is optimized to produce low divergence beams with moderate linewidth (typically 12 cm^{-1}) at approximately 15 – 20 ps pulse duration. Due to the unique broad tunability range from 210 to 2300 nm these devices are an excellent choice for many spectroscopic applications.

Upon request the optical layout can be easily modified for pumping by other mode-locked lasers with high pulse energy or longer pulse duration.

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

Microprocessor based control system provides automatic positioning of relevant components for hands free operation. Nonlinear crystals, diffraction grating and filters are rotated by ultra-precise stepper motors in the 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 its USB type PC interface (RS232 is optional) with LabView™ drivers 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.

Available models

Model	Features
PG403	Model has a tuning range from 410 to 2300 nm and is optimized for providing the highest pulse energy in the visible part of the spectrum. When combined with an optional Second Harmonic Generator (SHG), it offers the widest possible tuning range – from 210 to 2300 nm.
PG503	Model has a tuning range from 700 to 2200 nm and the highest pulse energy in the near-IR spectral range. PG503 is a cost-effective alternative to the narrow-band mode-locked Ti:S lasers.

SPECIFICATIONS 1)

Model	PG403	PG403-SH	PG503
OPA SPECIFICATIONS			
Output wavelength tuning range			
SH	–	210 – 410 nm	–
Signal	410 – 709 nm		700 – 1000 nm
Idler	710 – 2300 nm		1150 – 2200 nm
Output pulse energy 2)			
SH 3)	–	10 μJ	–
Signal	50 μJ		70 μJ
Idler 4)	15 μJ		25 μJ
Pulse repetition rate	1000 Hz		
Linewidth	$< 12\ cm^{-1}$		
Typical pulse duration 5)	15 ps		20 ps
Scanning step			
SH	–	0.05 nm	–
Signal	0.1 nm		
Idler	1 nm		
Typical beam size 6)	~ 3 mm		
Beam divergence 7)	< 2 mrad		
Beam polarization 8)			
SH	–	horizontal	–
Signal	horizontal		
Idler	vertical		
PUMP LASER REQUIREMENTS			
Min pump energy 9)			
at 532 nm	–		0.45 mJ
at 355 nm	0.3 mJ		–
Pulse duration 10)	30 ps		
Beam size 10)	2 – 3 mm		
Beam divergence	< 1 mrad		
Beam profile	homogeneous, without hot spots, Gaussian fit > 90 %		
Recommended pump source	PL2210A-TH	PL2210A-TH	PL2210A-SH
PHYSICAL CHARACTERISTICS			
Size (W × L × H)	456 × 820 × 273 mm		456 × 632 × 273 mm
OPERATING REQUIREMENTS			
Room temperature	15 – 30 °C		
Power requirements	100 – 240 V single phase, 47 – 63 Hz		
Power consumption	< 120 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 PG403 units, at 800 nm for PG503 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 250 nm.

4) Measured at 1000 nm.

5) Estimated assuming 30 ps at 1064 nm pump pulse. Pulse duration varies depending on wavelength and pump energy.

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

7) Beam divergence measured at 450 nm.

8) Separate output ports for SH, signal and idler ranges.

9) Max pump energy is limited by available non-linear crystal sizes.

10) Should be specified while ordering if non-Ekspla pump laser is used.

TUNING CURVES

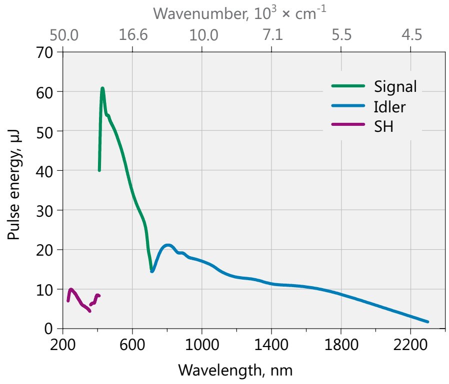


Fig 1. Typical PG403-SH model tuning curve.
Pump energy – 0.3 mJ at 355 nm

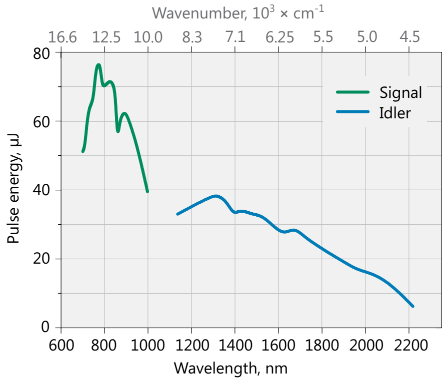


Fig 2. Typical PG503 model tuning curve.
Pump energy – 0.45 mJ at 532 nm

RECOMMENDED UNITS ARRANGEMENT ON OPTICAL TABLE

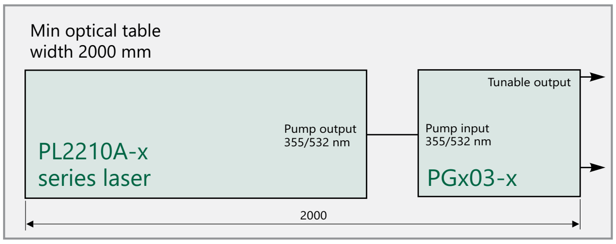


Fig 3. Arrangement of pump laser and PGx03 unit on optical table

OUTLINE DRAWINGS

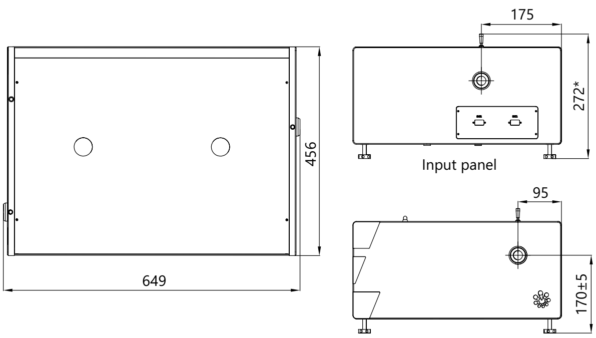


Fig 4. PGx03 model external dimensions

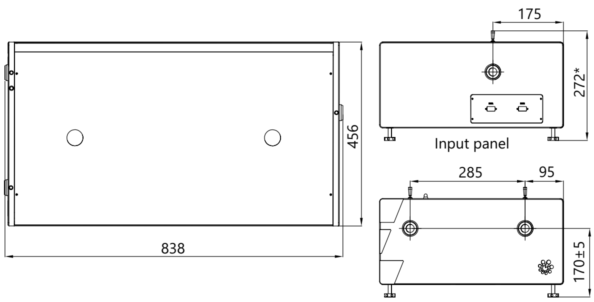


Fig 5. PGx03-SH model external dimensions

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.

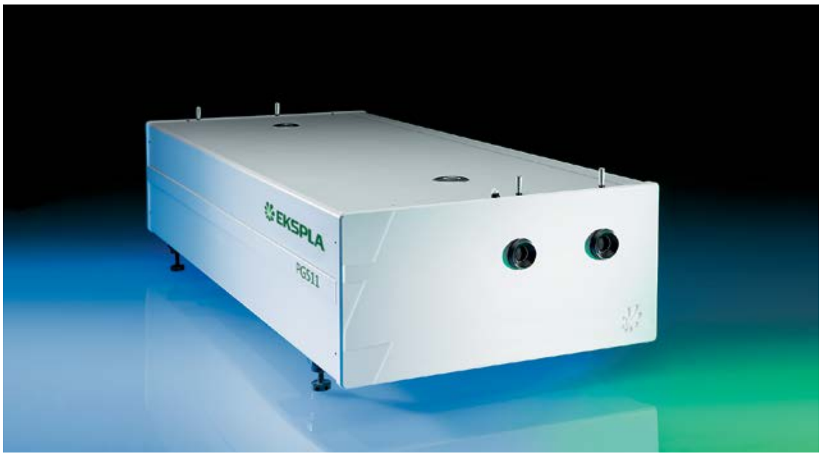
PG403-SH

Model
PG403 → 355 nm pump
PG503 → 532 nm pump

Optional tuning range extension
SH → 210–410 nm

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 **0.8 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 using USB (RS232 is optional) and LabVIEW™ drivers*
- *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 its USB type PC interface (RS232 is optional) with LabView™ drivers 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]

Model	PG411	PG411-SH	PG411-SH-DUV	PG511-DFG	PG711	PG711-DFG
Output wavelength tuning range						
SH, DUV	–	210–410 nm	193–410 nm	–		
Signal	410–709 nm			–	1550–2020 nm	
Idler	710–2300 nm			–	2250–3350 nm	
DFG	–			2300–10000 nm	–	3350–16000 nm
DFG2 (up to 16000 nm)	–			inquire	–	
Output pulse energy [2]						
SH, DUV	–	100 µJ [3]	50 µJ [3]	–		
Signal	700 µJ			–	500 µJ	
Idler [4]	250 µJ			–	100 µJ	
DFG	–			> 200 µJ at 3700 nm, >50 µJ at 10000 nm	–	20 µJ [5]
Max pulse repetition rate	50 Hz			50 Hz	1000 Hz	
Linewidth	< 3 cm^{-1} [6]			< 2 cm^{-1}	< 0.8 cm^{-1}	< 1 cm^{-1}
Linewidth Idler	< 5 cm^{-1} [6]			–		
Typical pulse duration [7]	~15 ps			~20 ps	~70 ps	
Scanning step						
SH, DUV	–	0.01 nm		–		
Signal	0.02 nm					
Idler	0.1 nm					
DFG	–					1 nm
Typical beam diameter [8]	~ 4 mm			~ 9 mm	~ 3 mm	
Beam divergence [9]	< 2 mrad					
Beam polarization [9]						
SH, DUV	–	vertical		–		
Signal	horizontal			vertical	horizontal	
Idler	vertical			horizontal	vertical	
DFG	–			horizontal	–	horizontal

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) <2 cm^{-1} in signal (420–709 nm) and <4 cm^{-1} in idler (710–2300 nm).

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)]

<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">PUMP LASER REQUIREMENTS</td></tr>
<tr><td>Recommended pump source</td><td colspan="3">PL2231A + APL2100-TRAIN-H411</td><td>PL2231 + H500-APL2100-TRAIN</td><td colspan="2">PL2211A TR</td></tr>
<tr><td colspan="7">Min. pump energy or power [10)]</td></tr>
<tr><td>at 1064 nm</td><td colspan="2">–</td><td>2 mJ</td><td>(10 mJ)</td><td colspan="2" rowspan="2">5 mJ at 1 kHz</td></tr>
<tr><td>at 532 nm</td><td colspan="3">–</td><td>5 mJ (8 mJ)</td></tr>
<tr><td>at 355 nm</td><td colspan="3">5 mJ (10 mJ)</td><td colspan="3">–</td></tr>
<tr><td>Pulse duration [11)]</td><td colspan="4">30 ps</td><td colspan="2">90 ps</td></tr>
<tr><td>Bream polarization at pump wavelength</td><td colspan="3">vertical</td><td colspan="3">horizontal</td></tr>
<tr><td>Beam size [12)]</td><td colspan="4">7 mm</td><td colspan="2">2.5 mm</td></tr>
<tr><td>Beam divergence</td><td colspan="6">< 0.5 mrad</td></tr>
<tr><td>Beam profile</td><td colspan="6">homogeneous, without hot spots</td></tr>
<tr><td colspan="7">PHYSICAL CHARACTERISTICS</td></tr>
<tr><td>Size (W × L × H)</td><td>456 × 1026 × 244 mm</td><td colspan="2">456 × 1226 × 244 mm</td><td colspan="2">PL2231: 456 × 1026 × 244 mm
H500-APL2100-TRAIN:
456 × 1026 × 244 mm</td><td>456 × 1026 × 244 mm</td></tr>
<tr><td colspan="7">OPERATING REQUIREMENTS</td></tr>
<tr><td>Room temperature</td><td colspan="6">15–30 °C</td></tr>
<tr><td>Room temperature stability</td><td colspan="6">± 2 °C</td></tr>
<tr><td>Power requirements</td><td colspan="6">100–240 V single phase, 47–63 Hz</td></tr>
<tr><td>Power consumption</td><td colspan="6">< 300 W</td></tr>
</table>

[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

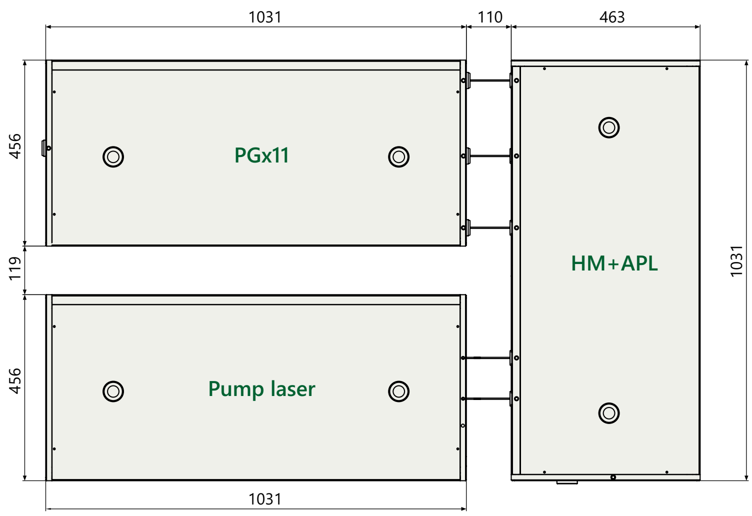


Fig 1. Arrangement of pump laser and PGx11 unit on optical table

TUNING CURVES

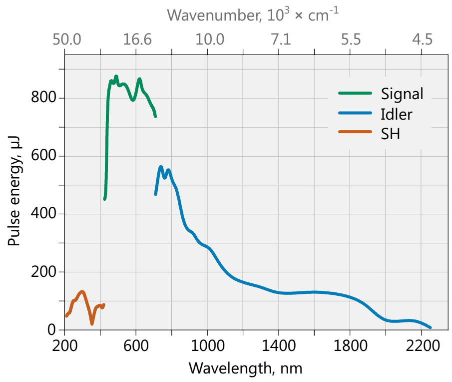


Fig 2. Typical PG411-SH model tuning curve

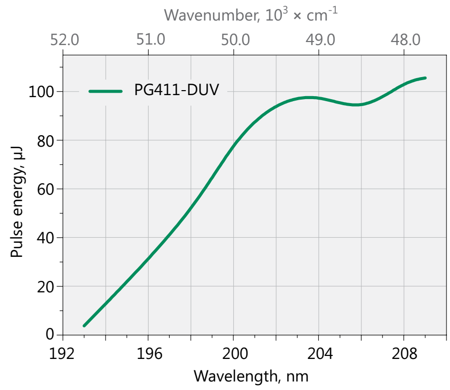


Fig 3. Typical PG411-DUV model tuning curve

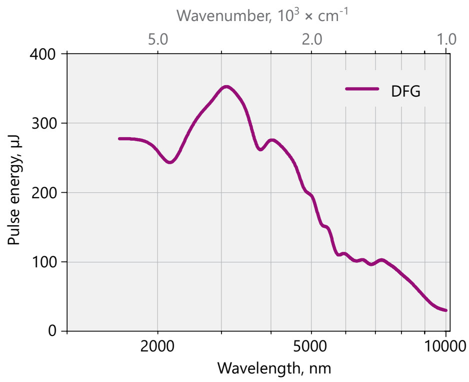


Fig 4 Typical PG511-DFG model tuning curve

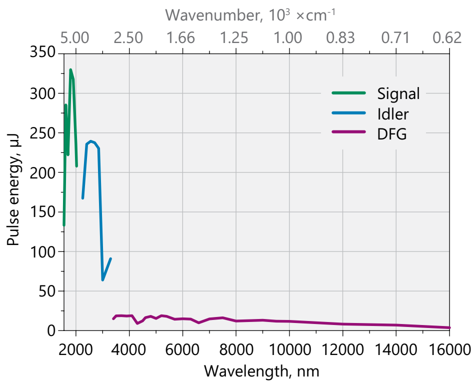


Fig 5. Typical PG711-DFG model tuning curve.

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.

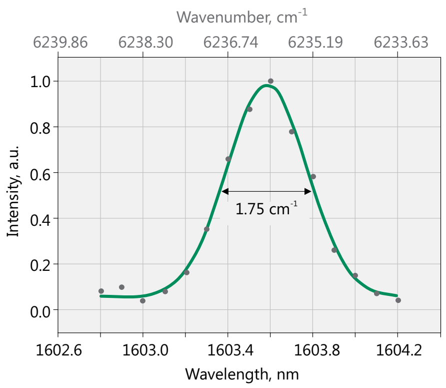
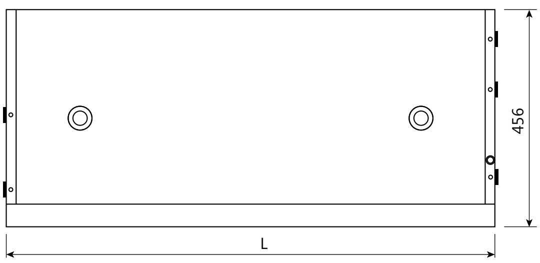


Fig 6. PG511-DFG model typical output linewidth

OUTLINE DRAWINGS



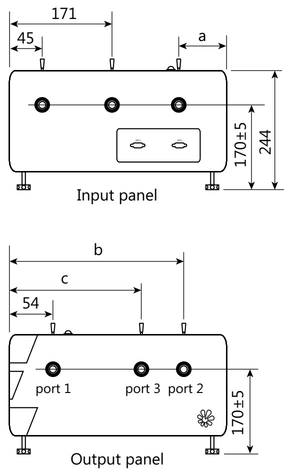


Fig 7. PG411 model external dimensions

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 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 via USB (RS232 is optional) and LabView™ drivers*

APPLICATIONS

- *Infrared microscopy*
- *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 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 its USB type PC interface (RS232 is optional) with LabView™ drivers or a remote control pad. Both options allow easy control of system settings.

TUNING CURVES

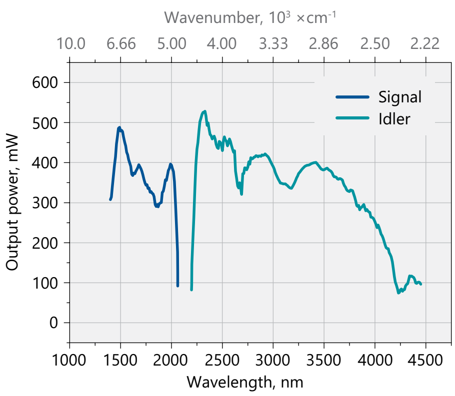


Fig 1. Typical output power of PT277 tunable laser.
The power is shown only at the wavelengths where ambient air absorption is negligible

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SPECIFICATIONS [1]

Model	PT277
Pulse repetition rate [2]	87 MHz
Tuning range	
Signal	1400 – 2050 nm
Idler	2200 – 4450 nm
Output power [3]	
OPO/OPG [4]	> 500 mW
Linewidth [4]	< 1 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 1620 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

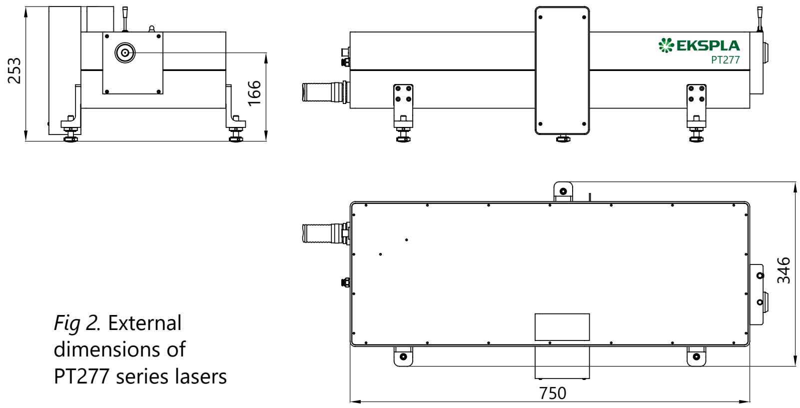


Fig 2. External dimensions of PT277 series lasers

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	48
NL210	10 mJ at 1064 nm	1000 Hz	Diode pumped solid state	3 – 4 ns	High pulse energy at kHz repetition rate	51
NL230	150 mJ at 1064 nm	100 Hz	Diode pumped solid state	2 – 5 ns	Diode pumped only	54
NL300	1200 mJ at 1064 nm	20 Hz	Flash-lamp pumped	3 – 6 ns	Versatile, compact nanosecond laser	57
NL740	100 mJ at 1064 nm	100 Hz	Diode pumped solid state	3 – 10 ns	Providing superior pulse temporal and spatial stability	64
NL120	up to 10 J at 1064 nm	10 Hz	Diode pumped oscillator, flash-lamp pumped amplifier	~2 ns	SLM	112
NL310	up to 10 J at 1064 nm	10 Hz	Flash-lamp pumped	4 – 7 ns	Hat-top beam profile	115
NL940	up to 10 J at 1064 nm	10 Hz	Flash lamp pumped amplifiers	3 – 10 ns	Temporal pulse shaping	118
NL941 NL942	up to 2 J	up to 20 kHz	Diode pumped	~5 ns	Temporal pulse shaping	125

NL200 SERIES

Compact Q-switched DPSS Lasers

FEATURES

- *Up to **4 mJ** pulse energy at **1064 nm***
- *Up to **2500 Hz** variable repetition rate*
- ***532 nm, 355 nm, 266 nm, 213 nm** wavelengths as standard options*
- *<**10 ns** pulse duration at 1064 nm*
- *Electro-optical Q-switching*
- *Turn-key operation*
- *Rugged sealed cavity*
- *Extremely compact size*
- *Simple and robust*
- *Air cooled*
- *External TTL triggering*
- *Remote control via keypad and/or PC with supplied LabVIEW™ drivers*
- *Remote control pad*

BENEFITS

- *Continuous tuning of repetition rate while maintaining constant pulse energy, superior beam pointing and energy stability make the NL200 the first choice for micromachining, marking and thin film removal applications*
- *Close to Gaussian smooth beam profile with low value M^2 < 1.3 and good focusability are beneficial for applications such as LCD pixel repair*
- *Easy to transport and saves on valuable laboratory space due to compact and light design*
- *Fast wavelength selection is superior for applications where alternating wavelengths are required, like material ablation and LIBS*
- *Air cooling, cost-effective and reliable end-pumping technology and amplifier-free DPSS design guarantee easy operation and alignment simple installation and low maintenance costs*
- *Variety of control interfaces: USB, RS232, LAN and WLAN ensures easy control and integration with laboratory or OEM equipment*

NL200 series DPSS Q-switched nanosecond lasers offer high pulse energy at kHz repetition rates. End-pumped design makes this laser compact and easy to integrate. Harmonic generation modules for 532 nm, 355 nm, 266 nm and 213 nm wavelengths are easily attached to the laser frame.

Featuring short pulse duration, variable repetition rate and external TTL triggering, nanosecond diode pumped NL200 series Q-switched lasers are excellent cost effective sources for specific applications like pulsed laser deposition, ablation through mask or intravolume marking of transparent materials, when higher pulse energy is required. Excellent energy stability and a wide range of wavelength options make this laser a perfect tool for spectroscopy and remote sensing applications.

Mechanically stable and hermetically sealed design ensures reliable operation and long lifetime of laser components.

APPLICATIONS

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

SPECIFICATIONS [1]

Model	NL201 [2]	NL202 [3]	NL204 [3]
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	0.04 mJ	0.1 mJ	0.2 mJ
Pulse to pulse energy stability (StdDev) [4]			
at 1064 nm	<0.5 %		
at 532 nm	<2.5 %		
at 355 nm	<3.5 %		
at 266 nm	<4.0 %		
at 213 nm	<5.0 %		
Typical pulse duration [5]	7 – 10 ns		
Power drift [6]	± 2 %		
Pulse repetition rate	10–2500 Hz	10–1000 Hz	500–1000 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 [7]	<3 mrad		
Polarization	linear		
Typical beam diameter [8]	0.7 mm		
Beam pointing stability (StDev) [9]	≤10 μrad		
Optical jitter (StdDev) [10]	<0.5 ns		
PHYSICAL CHARACTERISTICS			
Laser head (W × L × H) [11]	164 × 320 × 93 mm		
Power supply unit (W × L × H)	365 × 415 × 290 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		

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 for basic system without options.

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

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

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

5) FWHM at 1064 nm.

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

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

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

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

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

11) Without optional harmonic module.

PERFORMANCE

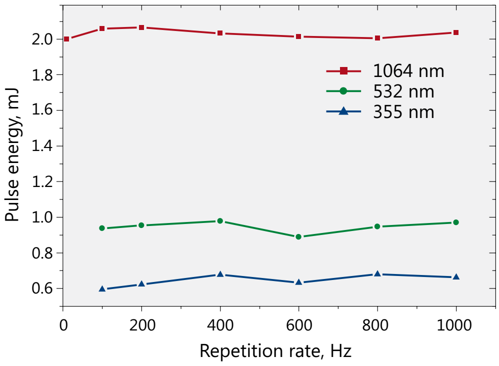


Fig 1. Typical performance data of model NL202 laser

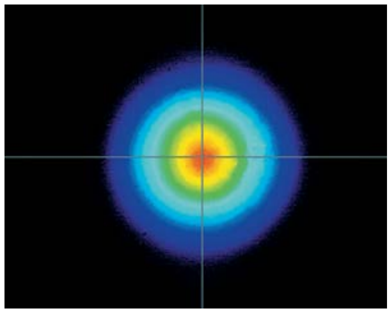


Fig 2. Typical beam intensity profile in the far field

OUTLINE DRAWINGS

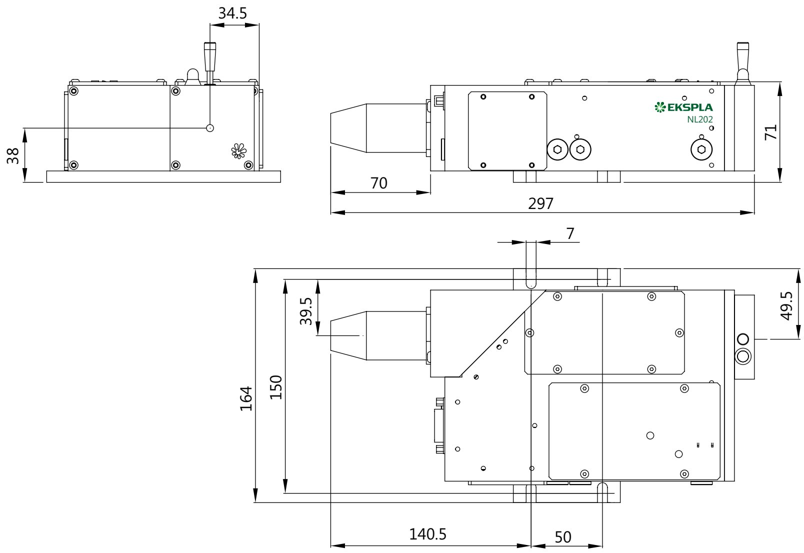


Fig 3. NL202 laser head drawing

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
H200FiHC → fifth harmonic

NL210 SERIES

High Energy kHz Pulsed Cavity Dumped DPSS Nd:YAG Lasers

FEATURES

- **10 mJ** at 1064 nm
- **1 kHz** pulse repetition rate
- **All-solid-state** design
- Internal/external triggering
- Short warm-up time
- Air cooled
- Optional temperature stabilized second, third and fourth harmonic generators
- Remote control via keypad or PC with supplied LabVIEW™ drivers

BENEFITS

- *High 10 mJ pulse energy and nanosecond pulse-width ensures strong nonlinear response*
- *Smooth beam profile with optimal M^2 value suitable for OPO pumping*
- *1 kHz repetition rate enables fast material processing and data collection*
- *Air cooling, cost-effective and reliable end-pumping technology and amplifier-free DPSS design guarantee easy operation and alignment, simple installation and low maintenance costs*
- *Variety of control interfaces: USB, RS232, LAN and WLAN ensures easy control and integration with laboratory or OEM equipment*

APPLICATIONS

- *OPO pumping*
- *Laser spectroscopy*
- *Remote sensing*
- *Material ablation*
- *Micromachining*

NL210 series diode pumped Q-switched lasers produce up to 10 mJ at 1000 Hz pulse repetition rate. The laser is designed to produce high intensity, high brightness pulses and is targeted for applications like OPO pumping, nonlinear spectroscopy, material ablation, micromachining, and other tasks.

Employing electro-optical type of the cavity dumping, the master oscillator can produce pulses with a short pulse duration of 3 – 4 ns, the uniform beam profile and low divergence. The M^2 factor of 3 – 4 and uniform beam profile is useful for OPO pumping.

Angle-tuned LBO and/or BBO crystals mounted in temperature stabilized heaters are used for optional second, third or fourth harmonic generation. The harmonic separation system is designed to ensure a high spectral purity of radiation directed to separate output ports.

For customer convenience the laser can be controlled from a remote control pad or PC. The remote pad allows easy control of all parameters and features a backlit display that is easy to read even wearing laser safety eyewear. Alternatively, the laser can be controlled from a personal computer with supplied software for a Windows™ operating system, LabVIEW™ drivers are supplied as well.

SPECIFICATIONS [1]

Model	NL210
MAIN SPECIFICATIONS	
Pulse energy:	
at 1064 nm	10 mJ
at 532 nm [2]	5 mJ
at 355 nm [3]	3 mJ
at 266 nm [4]	1 mJ
Pulse to pulse energy stability [5]	
at 1064 nm	< 1.0 % rms
at 532 nm [2]	< 2.0 % rms
at 355 nm [3]	< 2.5 % rms
at 266 nm [4]	< 4.0 % rms
Pulse duration [6]	3 – 4 ns
Pulse repetition rate	1000 Hz
Beam profile	multimode
Elipticity	0.9 – 1.1 at 1064 nm
M^2	< 4
Beam divergence [7]	< 2 mrad
Beam pointing stability, StDev	< 50 µrad
Polarization	linear, > 95 %
Typical beam diameter [8]	2 mm
Pulse jitter wrt to SYNC OUT, StDev [9]	< 0.5 ns
Pulse jitter wrt to ext. trigger, StDev [10]	< 0.5 ns
PHYSICAL CHARACTERISTICS	
Laser head (W × L × H)	456 × 1031 × 260 mm
Power supply unit (W × L × H)	520 × 400 × 290 mm
Umbilical length	3 m
OPERATING REQUIREMENTS	
Cooling [11]	Built-in chiller
Ambient temperature	18–27 °C
Relative humidity	20–80 % (non-condensing)
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 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 NL210 with -SH option. Outputs are not simultaneous.
3) For NL210 with -SH/TH option. Outputs are not simultaneous.
4) For NL210 with -SH/FH option. Outputs are not simultaneous.
5) Averaged from pulses, emitted during 30 sec time interval.
6) FWHM.
7) Full angle measured at the $1/e^2$ point at 1064 nm.
8) Beam diameter is measured at 1064 nm at the $1/e^2$ point.
9) Optical pulse jitter with respect to SYNC OUT in internal triggering mode.
10) Optical pulse jitter with respect to QSW IN in external triggering mode.
11) Air cooled

PERFORMANCE

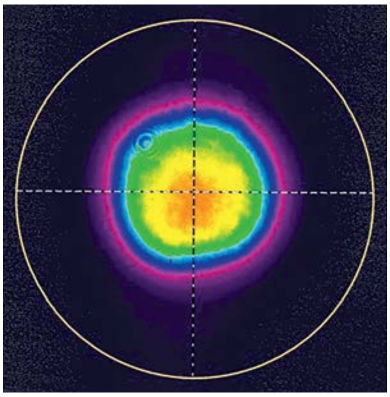


Fig 1. Typical near field beam profile of NL210 series laser

OUTLINE DRAWINGS

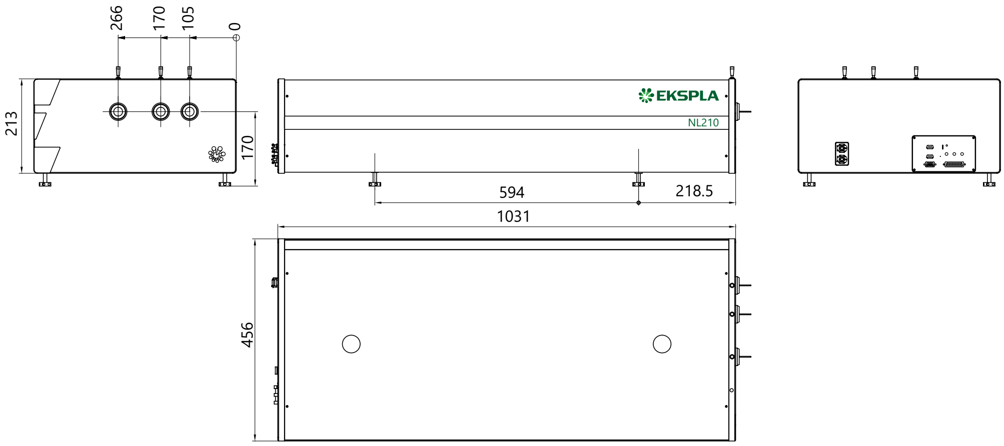


Fig 2. NL210 series laser head dimensions

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.

NL210-SH

Model

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

NL230 SERIES

High Energy Q-switched DPSS Nd:YAG Lasers

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 **2–4 ns** range*
- *Variable reflectivity output coupler for low-divergence beam*
- *Quiet operation: no more flashlamp firing sound*
- *Remote control via keypad and/or PC with supplied LabVIEW™ drivers*
- *Optional temperature-stabilized second and third harmonic generators*

BENEFITS

- *Short duration pulses (2 – 4 ns) ensures strong interaction with material and are highly suitable for LIBS*
- *User selectable wavelength single axis output is superior for experiments where alternating wavelengths are required such as material ablation and LIBS*
- *Rugged, monolithic design enables usage in harsh environments*
- *Diode pumped design provides quiet operation and eliminates flashlight irritation*
- *Variety of interfaces: USB, RS232, LAN and WiFi ensures easy control and integration with other equipment*

APPLICATIONS

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

The NL230 series diode-pumped Q-switched lasers produce up to 150 mJ at 100 Hz or up to 190 mJ at 50 Hz pulse repetition rate. 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). The typical pump diode lifetime is more than 1 billion shots.

Lasers are designed to produce high-intensity, high-brightness pulses and are targeted for applications such as LIBS, material ablation, remote sensing, OPO pumping. Due to an electro optical Q-switch, the master oscillator generates short duration pulses in the 2–4 ns range. The oscillator cavity optical design features a variable reflectivity output coupler, giving a low-divergence laser beam.

A closed-loop air-cooled chiller is used for laser cooling, eliminating the need for external cooling water and reducing running costs.

Angle-tuned non-linear crystals mounted in temperature stabilized heaters are used for optional second or third harmonic generation. The harmonic separation system is designed to ensure radiation with a high spectral purity and to direct it to the separate output ports.

For customer convenience the laser can be controlled via a remote control pad or PC. The remote pad allows easy control of all parameters and features a backlit display that is easy to read even through laser safety eyewear. Alternatively, the laser can be controlled from a personal computer via supplied Windows™ compatible software. LabVIEW™ drivers are also included with each laser installation package.

SPECIFICATIONS [1)]

Model	NL231-50	NL231-100
Pulse energy (not less than) [2)]		
at 1064 nm	190 mJ	150 mJ
at 532 nm [3)]	110 mJ	90 mJ
at 355 nm [4)]	55 mJ	40 mJ
Pulse energy stability (StdDev) [5)]		
at 1064 nm	< 1 %	
at 532 nm	< 2.5 %	
at 355 nm	< 3.5 %	
Pulse repetition rate	50 Hz	100 Hz
Power drift [6)]	< ±1 %	
Pulse duration [7)]	2 – 4 ns	
Linewidth	< 1 cm^{-1} at 1064 nm	
Beam profile [8)]	"Top Hat" in near field and close to Gaussian in far field	
Beam divergence [9)]	< 0.8 mrad	
Beam pointing stability (StdDev) [10)]	≤ 60 µrad	
Polarization	linear, > 95 % at 1064 nm	
Typical beam diameter [11)]	5 mm	
Optical pulse jitter (StdDev)		
Internal triggering regime [12)]	< 0.5 ns	
External triggering regime [13)]	< 0.5 ns	
SYNC OUT pulse delay	-100 ms ... 100 ms	
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	471 × 391 × 147 mm ± 3 mm	
19" module	483 × 355 × 133 mm ± 3 mm	
External chiller	inquire	
Umbilical length	2.5 m	
OPERATING REQUIREMENTS		
Cooling (air cooled) [14)]	external chiller	
Ambient temperature	18 – 27 °C	
Relative humidity (non-condensing)	20 – 80 %	
Power requirements	100 – 240 V AC, single phase, 50/60 Hz	
Power consumption	< 1.0 kVA	

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) With H230SHC or H230STHC harmonic generator module.
4) With H230THC or H230STHC generator modules.
5) Averaged from pulses, emitted during 30 sec time interval.
6) Measured over 8 hours period after 20 min warm-up when ambient temperature variation is less than ± 2 °C.
7) FWHM.
8) Near field (at the output aperture) TOP HAT fit is >80%.
9) Full angle measured 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) Beam diameter is measured at 1064 nm at the $1/e^2$ level.
12) With respect to SYNC OUT pulse.
13) With respect to QSW IN pulse.
14) Adequate room air conditioning should be provided.

Notes: 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 one side should be ensured. Intensive sources of vibration should be avoided near the laboratory (ex. railway station or similar).

PERFORMANCE

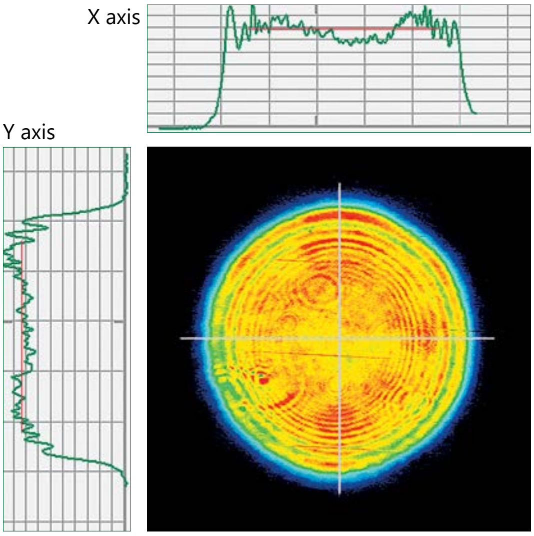


Fig 1. NL230 laser typical near field beam profile

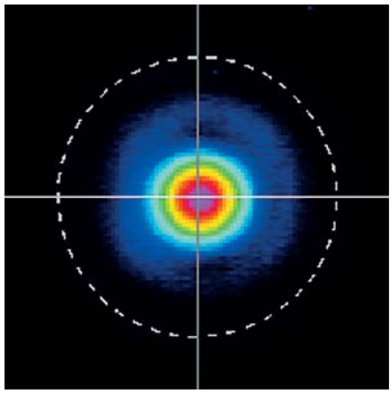


Fig 2. NL230 laser typical far field beam profile

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

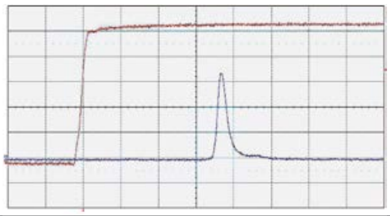


Fig 3. NL230 laser pulse waveform

OUTLINE DRAWINGS

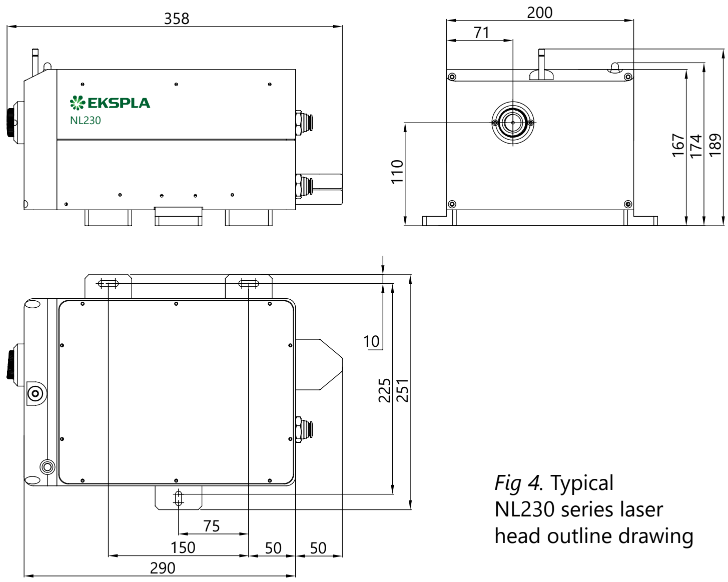


Fig 4. Typical NL230 series laser head outline drawing

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

FEATURES

- *Rugged sealed laser cavity*
- *Up to **1200 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*

BENEFITS

- *High pulse energy (up to 1.2 J at 1064 nm, 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, LAN and WiFi ensures easy integration with other equipment*

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 1200 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 59.

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	5 Hz	10 Hz
Pulse energy:				
at 1064 nm	800 mJ	700 mJ	1200 mJ	1100 mJ
at 532 nm [2]	380 mJ	320 mJ	700 mJ	500 mJ
at 355 nm [3]	250 mJ	210 mJ	450 mJ	320 mJ
at 266 nm [4]	80 mJ	60 mJ	120 mJ	100 mJ
at 213 nm [5]	13 mJ	10 mJ	25 mJ	20 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, >90 %	vertical, >65 %
Optical pulse jitter [9]	<0.5 ns rms			
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	<6 l/min	<10 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 kVA	<1.5 kVA

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 59 for more detailed information.

3) With H300THC, H300STH and H300ST harmonic generator modules. See harmonic generator selection guide on the page 59 for more detailed information.

4) With H300SH and H400FHC harmonic generator modules. See harmonic generator selection guide on the page 59 for more detailed information.

5) With H300FiHC harmonic generator module. See harmonic generator selection guide on the page 59 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.

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 59 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.

OPTIONAL HARMONIC GENERATOR AND ATTENUATOR MODULES

The following are suggested optimal configurations of H300 series modules for various output wavelengths:

1. For **2nd harmonic** output only: the H300SHC module.

2. For **2nd and 3rd harmonic**:
   a) H300SH+H300S+H300THC – for SH and TH output as specified in the NL300 series brochure.
   b) H300STH+H300ST – a cost-effective solution not requiring the replacement of modules when changing from a 532 nm to 355 nm beam and vice versa. The 532 nm beam specification will, however, be 15% lower relative to the values in the NL300 series brochure due to extra components in the beam path.

3. For **2nd and 4th harmonic**: H300SH+H300S+H300FHC modules.

4. For **all harmonic including 4th**:
   a) H300STH+H300ST+H300FHC – a cost-effective solution. The 266 nm and 532 nm beam specifications will be 15% lower relative to the values in the NL300 series brochure.
   b) H300SH+H300S+H300THC+H300FHC – a slightly more expensive solution with output values adhering to those in the NL300 series brochure.

5. For **all harmonic including 5th**: modules described in paragraph #4 plus the H300FiHC module.

6. For **attenuators** for all wavelengths up to the 4th harmonic: H300SH+H300A2+H300TH+H300A3+H300A4 modules.

MODULES SELECTION GUIDE

Module	Description	Output ports	Output pulse energy specifications	Dimensions W×L×H, mm	Extension possible?	Notes
H300SH	Second harmonic generator	Port 1: 1064, 532 nm	N/A	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	
H300TH	Third harmonic generator	Port 1: 1064, 532 & 355 nm	N/A	154×160×128	Yes	Should be used with H300SH
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
H300STH	Second and third harmonic generator	Port 1: 1064, 532 & 355 nm	N/A	154×210×128	Yes	
H300ST	355 nm beam separator	Port 1: 355 nm Port 2: residual 532 nm	See NL300 specifications for 355 nm beam	154×160×128	No	Recommended to use with H300STH
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	154×290×128	No	Should be used with H300SH
H300FiHC	Fifth harmonic 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	
H300A1	Attenuator for 1064 nm beam	Port 1: 1064 nm beam	Transmission in 5-90% range at 1064 nm	154×210×128	No	
H300A2	Attenuator and beam separator for 532 nm beam	Port 1: 532 nm Port 2: residual 532 nm	Transmission in 5-90% range at 532 nm	154×210×128	No	Should be used with H300SH
H300A3	Attenuator and beam separator for 355 nm beam	Port 1: 355 nm Port 2: residual 355 nm	Transmission in 5-90% range at 355 nm	154×210×128	No	Should be used with H300TH or H300STH
H300A4	Fourth harmonic generator, beam sepa-rator and attenuator for 266 nm beam	Port 1: 266 nm Port 2: residual 266 nm	Transmission in 5-90% range at 266 nm	154×350×128	No	Should be used with H300SH

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.

OUTLINE DRAWINGS

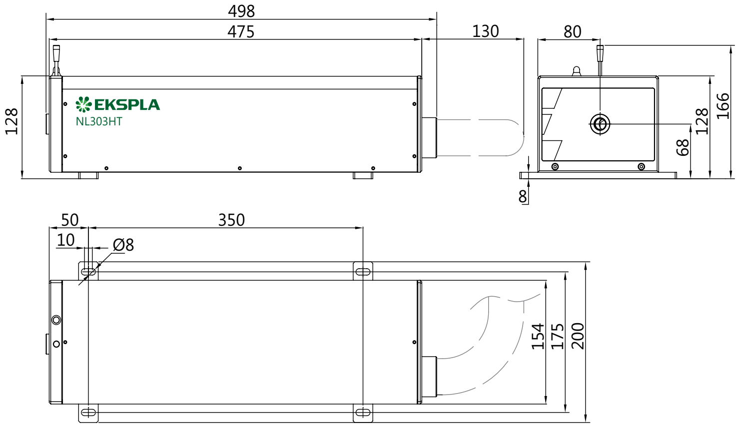


Fig 1. Typical NL300 series laser head outline drawing

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

HARMONIC GENERATORS

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.

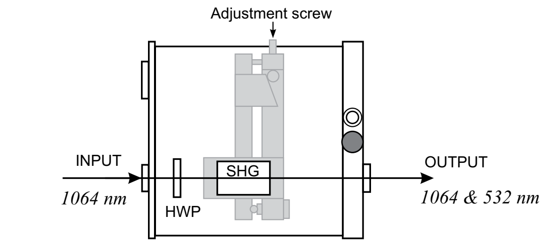
It should be noted that only modules with a single output port can be joined together: it is possible to attach a H300S module to a H300SH unit for 532 nm beam separation, or a H300FHC module for 4th harmonic generation (see detailed description below). Modules with two output ports (e.g., H300SHC) cannot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

FEATURES

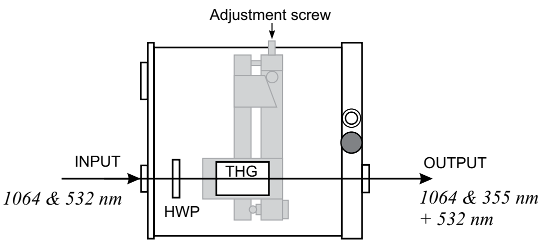
- *Compact harmonic modules*
- *Thermo stabilized crystals for long lifetime*
- *Dichroic mirrors*
- *AR coatings on crystals*
- *Phase matching by mechanical adjustment*
- *High conversion efficiency*
- *Wide selection of different configurations*

H300SH, H300TH harmonic generators

H300SH or H300TH modules contain a SH or TH crystal with a half-wave plate for input polarization adjustment. The output of the H300SH module has both 532 nm and 1064 nm wavelengths; the output of the H300SH+H300TH modules also has a 355 nm wavelength.



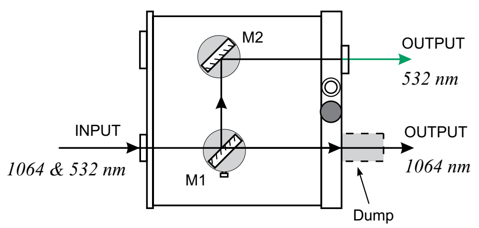
H300SH



H300TH

H300S harmonic separator

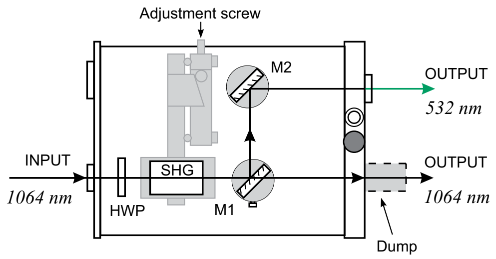
The H300S module has two output ports for the separation of 1064 nm and 532 nm wavelengths.



H300S

H300SHC harmonic generator

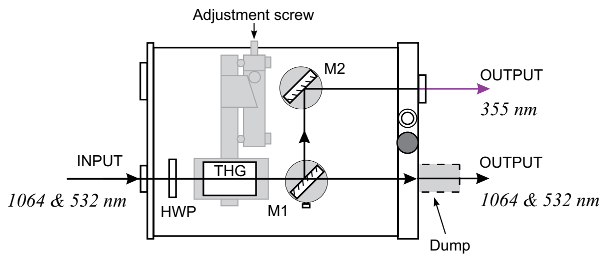
The most cost-effective solution for customers who need a 532 nm wavelength only, the H300 SHC module combines a SHG crystal and beam separators and has two output ports for 532 nm and 1064 nm beams.



H300SHC

H300THC harmonic generator

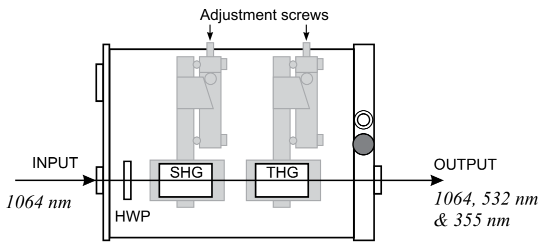
The H300THC module is a third harmonic generator and beam separator with two output ports for a 355 nm beam, and for a residual 532 nm + 1064 nm beam. This module should be used with the H300SH module.



H300THC

H300STH harmonic generator

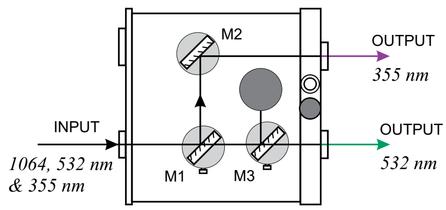
The H300STH module combined with a H300ST separator module is designed for customers who need a 355 nm wavelength only. The H300STH module has an output port for 355 nm, 532 nm and 1064 nm wavelengths, the H300ST module has two output ports for 355 nm and 532 nm wavelengths. In order to separate 355 nm this module should be used with H300ST.



H300STH

H300ST harmonic separator

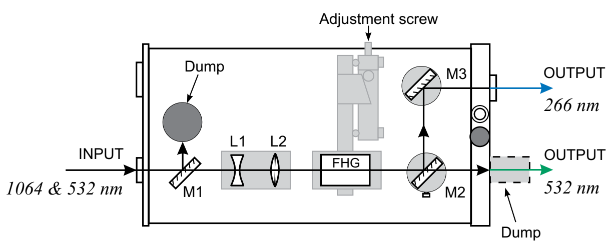
The H300ST module can be used for the separation of 355 nm and/or 532 nm beams from residual 1064 nm, and can be used together with H300STH, H300TH or H300SH modules.



H300ST

H300FHC harmonic generator

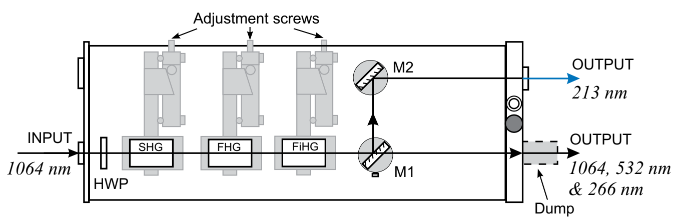
The H300FHC module is a fourth harmonic generator and beam separator for a 266 nm wavelength, with two output ports for a 266 nm beam, and for a residual 532 nm beam. This module should be used with the H300SH module.



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

ATTENUATORS

For NL300 Series Lasers

NL300 series lasers offer several options for changing output pulse energy. The easiest option is to change the timing of the Q-switch opening relative to the flashlamp pump pulse. This option is a standard feature for all NL300 series lasers. A change in Q-switch timing, however, changes other laser pulse parameters along with the pulse energy.

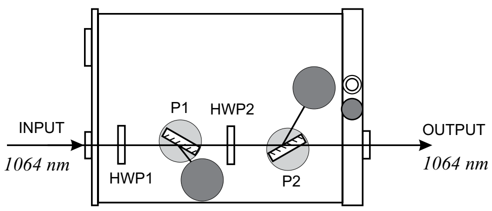
A decrease in pulse energy results in longer pulse duration, decreased pulse-to-pulse-stability, and possible changes in the spatial beam profile. For applications that require smooth adjustment of output pulse energy while keeping other parameters stable, EKSPLA offers H300Ax series attenuator modules.

FEATURES

- *Compact design*
- *Motorized version is available*
- *Smooth adjustment of output pulse energy*

H300A1 attenuator

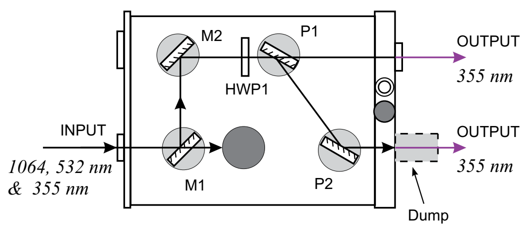
The H300A1 module is designed to attenuate a **1064 nm** beam. Optical layout includes half-wave plates HWP1, HWP2 and polarizers P1, P2 (see picture below). Rotation of the HWP2 half-wave plate changes the polarization of the laser beam and its transmission factor via the P2 polarizer.



H300A1

H300A3 attenuator

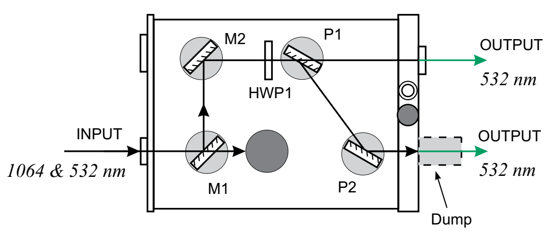
The H300A3 module, designed to attenuate a **355 nm** beam, combines an attenuator with a beam separator and should be used with the H300STH or H300TH modules.



H300A3

H300A2 attenuator

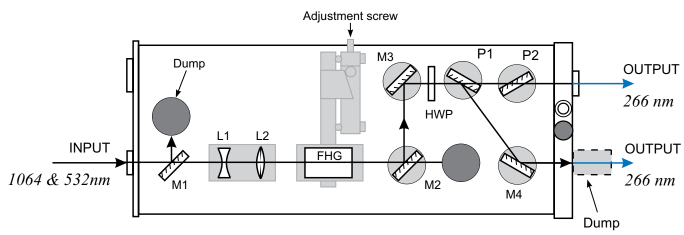
The H300A2 module, designed to attenuate a **532 nm** beam, combines an attenuator with a beam separator and should be used with the H300SH module.



H300A2

H300A4 attenuator

The H300A4 module is designed to attenuate a **266 nm** beam. It combines a FH crystal, beam separator and attenuator and should be used instead of the H300FHC module for attenuation of a 266 nm beam.



H300A4

NL740 SERIES

Ultra-stable Nanosecond Laser

BENEFITS

- Stable SLM pulses make the NL740 suitable for metrology (LIDT), interferometry, holography and DIAL (LIDAR) applications
- Excellent pulse energy and spatial and temporal mode stability ensure high quality experiment statistical data and saves on the cost and time spent for tests and investigation
- High repetition rate (up to 100 Hz) ensures fast acquisition of experiment data
- 3 – 10 ns tunable pulse duration enables experiments using a wide range of durations; no need to purchase separate lasers for experiments requiring different pulse duration
- Reliable 24/7 operation is excellent for metrology, especially Laser-Induced Damage Threshold (LIDT) applications
- Variety of interfaces: USB, RS232, LAN and WiFi ensures easy integration with other equipment

FEATURES

- *Narrow bandwidth, **stable**, true SLM pulses*
- *Excellent pulse energy (typically 0.1 % StDev @ 1064 nm) and pulse duration stability*
- *Excellent spatial mode stability*
- *Excellent output power stability (typically < ±0.5 % peak-to-peak)*
- ***3 – 10 ns tunable** pulse duration*
- *Up to **100 mJ** output energy*
- *Up to **100 Hz** repetition rate*
- *1064, 532 nm or 355 nm output wavelength*
- *Reliable 24/7 operation*

APPLICATIONS

- *Metrology, especially Laser-Induced Damage Threshold (LIDT)*
- *Front end for power amplifiers*
- *Interferometry and holography*
- *Material processing and others*

The main feature of NL740 series is the output of ultra-stable tunable duration (2 – 10 ns) narrow bandwidth nanosecond pulses based on temporally driven CW diode laser seeder and amplification stages.

Start of the system is the single mode DFB laser with temporal output power modulator. Such front-end ensures reliable generation of SLM mode that is highly beneficial for formation of low temporal modulation ultra-stable pulses. Then light is amplified in diode pumped regenerative amplifier in order to reach energy sufficient to amplify in diode pumped amplifiers. Power amplifier is a chain of double pass amplifiers where pulse is amplified up to 100 mJ energy at 100 Hz repetition rate. Before amplification spatial beam shaping is employed in order to get flat top shape at the output. The harmonic generators are based on angle tuned nonlinear crystals placed in a heater. All diode pumped design ensures reliable operation of system at high repetition rates as well as simple and convenient maintenance.

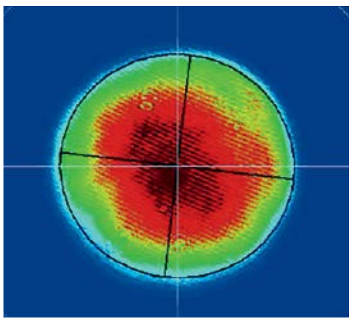


Fig 1. Typical NL740 near field beam profile at 532 nm

SPECIFICATIONS [1]

Model	NL740	NL742
Pulse energy (for 5 ns pulse [5])		
at 1064 nm	2 mJ	100 mJ
at 532 nm [2]	NA	50 mJ
at 355 nm [2]	NA	30 mJ
Pulse energy stability (StdDev) [3]		
at 1064 nm	< 0.5 %	
at 532 nm	< 1.0 %	
at 355 nm	< 1.5 %	
Power drift [4]	± 2 %	
Pulse duration [5]	3 – 10 ns	
Repetition rate	100 Hz	
Polarization at 1064 nm	vertical, > 98 %	
Optical pulse jitter [6]	< 150 ps	
Linewidth	<0.1 cm^{-1}	
Beam profile	Gaussian	Top-Hat (at laser output), without diffraction rings
Typical beam diameter [7]	~2 mm	~5 mm
Beam divergence [8]	1.0 mrad	0.7 mrad
Beam pointing stability (StdDev)	< 30 µrad	
PHYSICAL CHARACTERISTICS		
Laser head (W × L × H)	456 × 1031 × 249 mm	600 × 1200 × 330 mm
Power supply unit (W × L × H)	85 × 170 × 41 mm	520 × 500 × 210 mm
Umbilical length	2.5 m (other length on request)	
OPERATING REQUIREMENTS		
Cooling	air-cooled	air-cooled chiller
Ambient temperature	stabilized; from range 18–25 °C	
Relative humidity	20–80 % (non-condensing)	
Power requirements [9]	100–240 V AC, single phase 50/60 Hz	
Power consumption	< 200 W	< 1.5 kW

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 for basic system without options.

2) Harmonic outputs are not simultaneous; only single wavelength beam is present at the output at once. Manual reconfiguration is required to switch wavelength.

3) Standard deviation value averaged from pulses, emitted during 30 sec time interval after 20 minutes of warm-up.

4) Deviation from average value measured over 8 hours of operation when room temperature variation is less than ±2 °C.

5) FWHM. Measured with photodiode with 100 ps rise time and oscilloscope with 600 MHz bandwidth.

6) Standard deviation value, measured with respect to triggering pulse.

7) Beam diameter is measured at 1064 nm at laser output at the 1/e^2 level.

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

9) Mains voltage should be specified when ordering.

PERFORMANCE

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.

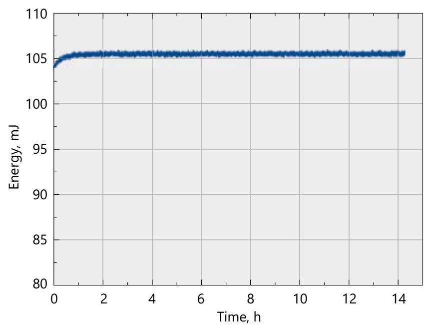


Fig 2. Typical NL740 long-term energy stability

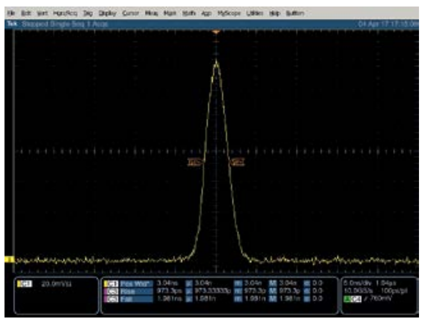
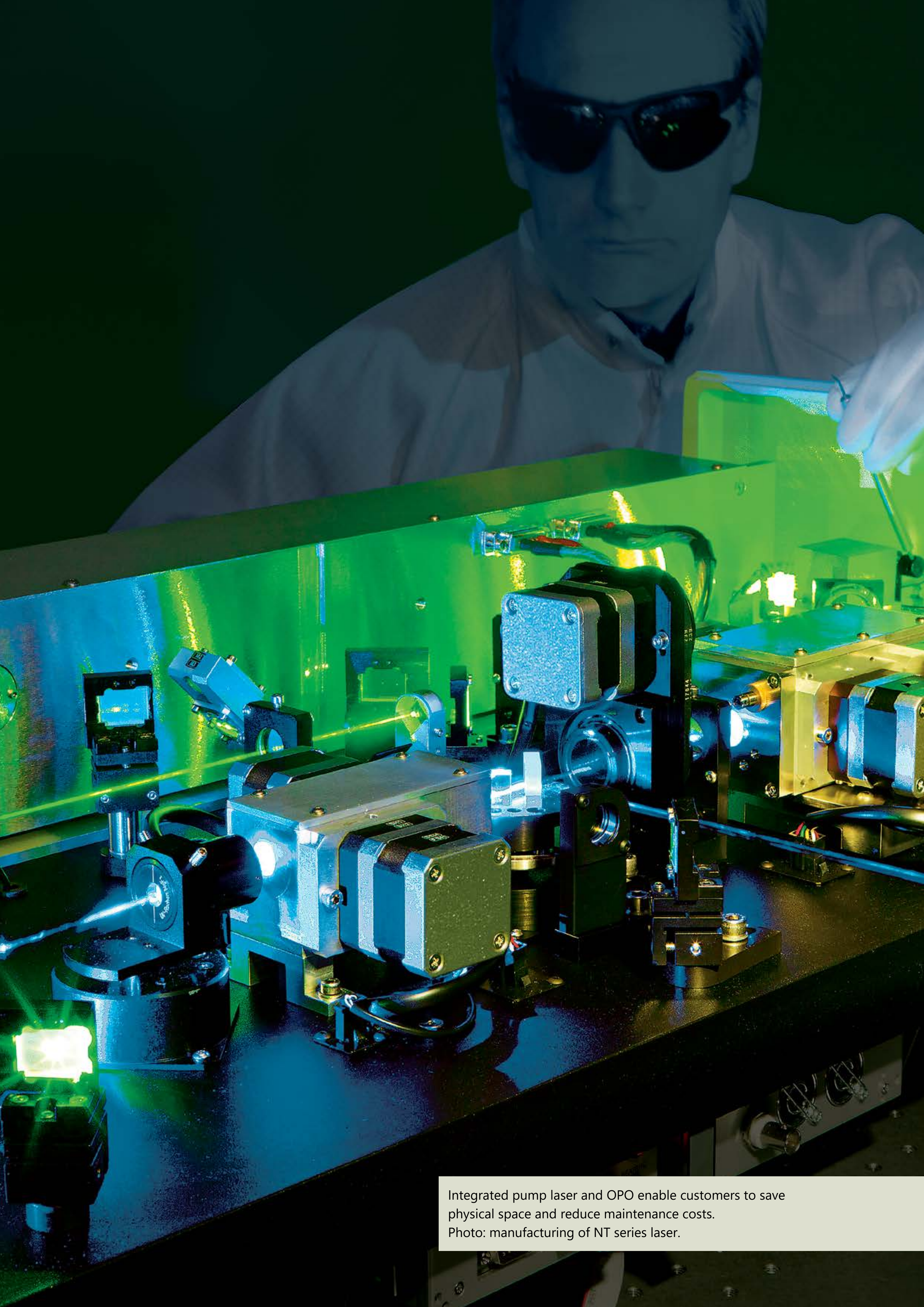


Fig 3. Typical NL740 pulse shape



Integrated pump laser and OPO enable customers to save physical space and reduce maintenance costs.
Photo: manufacturing of NT series laser.

Nanosecond Tunable 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
NT230	192 – 2600 nm	100 Hz	Diode pumped solid state	High, up to 15 mJ pulse energy from OPO	68
NT242	210 – 2600 nm	1000 Hz	Diode pumped solid state	Broadly tunable kHz pulsed DPSS lasers	72
NT252	335 – 2600 nm	1000 Hz	Diode pumped solid state	UV-NIR range DPSS lasers	76
NT270	2500 – 12000 nm	1000 Hz	Diode pumped solid state	Wide IR tuning range at kHz repetition rate	79
NT342	192 – 2600 nm	20 Hz	Flash-lamp pump laser	Wide range of modifications to tailor for specific applications	82
NT350	670 – 2600 nm	20 Hz	Flash-lamp pump laser	High output pulse energy	86
NT370	2500 – 18000 nm	20 Hz	Flash-lamp pump laser	Wide IR tuning range	89
PhotoSonus	660 – 2300 nm	20 Hz	Diode pumped solid state	Mobile tunable wavelength DPSS laser source	92
PhotoSonus X	665 – 2600 nm	100 Hz	Diode pumped solid state	Tunable wavelength NIR range DPSS laser	94

NT230 SERIES

High Energy Broadly Tunable DPSS Lasers

FEATURES

- *Integrates DPSS pump laser and OPO into a single housing*
- *Hands-free no-gap wavelength tuning from **192** to **2600 nm***
- *High, up to **15 mJ** pulse energy from OPO*
- ***100 Hz** pulse repetition rate*
- *More than **1.8 mJ** output pulse energy in UV*
- *Less than 5 cm^{-1} linewidth*
- ***2–5 ns** pulse duration*
- *Remote control via key pad or PC*
- *Optional separate output port for 532/1064 nm beam*

BENEFITS

- *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*
- *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*

APPLICATIONS

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

NT230 series lasers deliver high up to 9 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 using supplied LabVIEW™ drivers. 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.

Due to DPSS pump source, the laser requires little maintenance. It is cooled by a water-air chiller, which further reduces running costs. An OPO pump energy monitor allows monitoring of pump laser performance. A standard feature includes a separate output port for the 355 nm pump beam.

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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	9 mJ
SH and SF [4]	1.8 mJ	1.3 mJ
DUV	0.25 mJ	0.15 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]	4 mm	
PUMP LASER		
Pump wavelength [10]	355 nm	
Typical pump pulse energy [11]	50 mJ	35 mJ
Pulse duration [6]	4 – 6 ns at 1064 nm	
PHYSICAL CHARACTERISTICS		
Unit size (W × L × H)	451 × 696 × 172 mm	
Power supply size (W × L × H)	471 × 391 × 147 mm	
External chiller	inquire	
Umbilical length	2.5 m	
OPERATING REQUIREMENTS		
Cooling	external 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 kVA	

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.

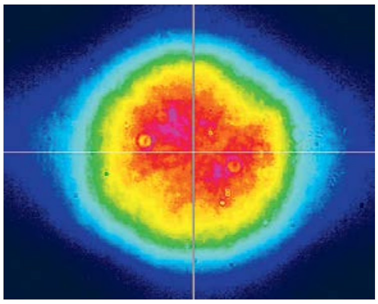
10) Separate output port for the 3rd harmonic beam is standard. Output ports for other harmonic are optional.

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

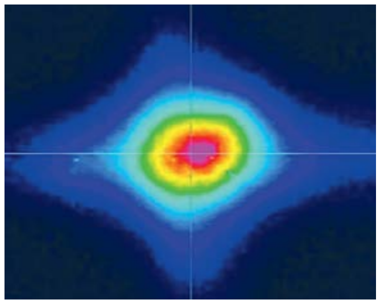
Accessories and optional items

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
-H, -2H	1064 nm or 532 nm output via separate port
-FC	Fiber coupled output in 300–2000 nm range
-ATTN/FC	Fiber coupled attenuator
-SCU	Spectral filtering accessory for improved spectral purity of pulses

PERFORMANCE



At ~1.5 m distance from output



Far field

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

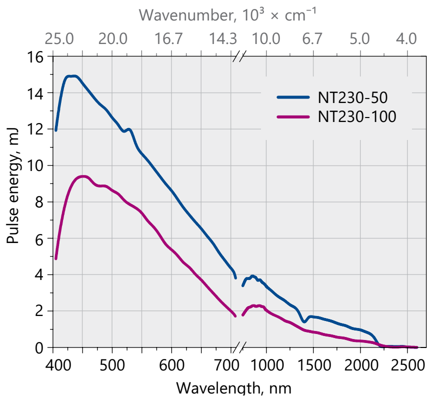


Fig 2. Typical output pulse energy of NT230 laser

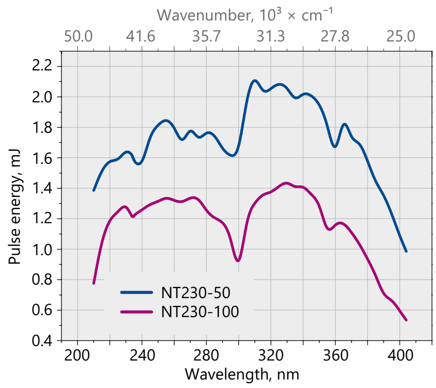


Fig 3. Typical output pulse energy of NT230 laser with SH/SF extension

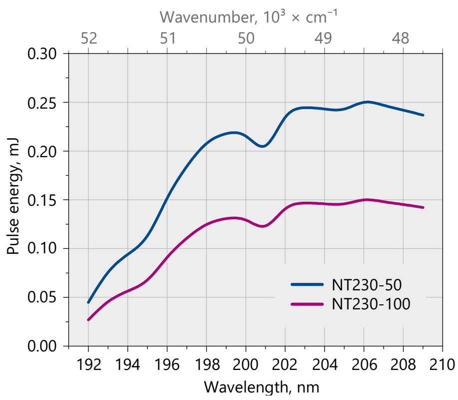


Fig 4. Typical output pulse energy of NT230 laser with DUV extension

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OUTLINE DRAWINGS

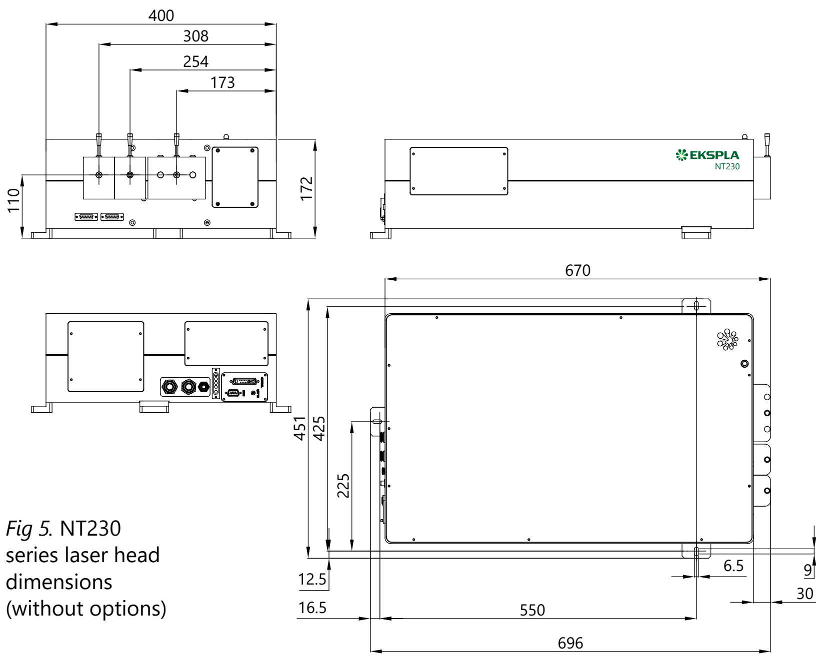

Fig 5. NT230 series laser head dimensions (without options)

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-H-2H-SCU

Model

Pulse repetition rate in Hz

Options:
H → extra 1064 nm output
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

NT242 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*

APPLICATIONS

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

BENEFITS

- *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 NT242 systems into various experimental environments*

NT242 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 NT242 series laser establishes itself as a versatile tool for many laboratory applications, including laser induced fluorescence, flash photolysis, photobiology, metrology, remote sensing, etc.

NT242 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.

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SPECIFICATIONS [1]

<table>
<tr><th>Model</th><th>NT242</th><th>NT242-SH</th><th>NT242-SF</th><th>NT242-SH/SF</th></tr>
<tr><td colspan="5">OPO</td></tr>
<tr><td colspan="5">Wavelength range</td></tr>
<tr><td>Signal</td><td colspan="4">405–710 nm</td></tr>
<tr><td>Idler</td><td colspan="4">710–2600 nm</td></tr>
<tr><td>SH and SF</td><td>—</td><td>210–300 nm</td><td>300–405 nm</td><td>210–405 nm</td></tr>
<tr><td colspan="5">Pulse energy [2]</td></tr>
<tr><td>OPO</td><td colspan="4">450 µJ</td></tr>
<tr><td>SH and SF</td><td>—</td><td>40 µJ at 230 nm</td><td colspan="2">60 µJ at 320 nm</td></tr>
<tr><td>Pulse repetition rate</td><td colspan="4">1000 Hz</td></tr>
<tr><td>Pulse duration [3]</td><td colspan="4">3–6 ns</td></tr>
<tr><td>Linewidth [4]</td><td colspan="4">< 5 cm^{-1}</td></tr>
<tr><td colspan="5">Tuning resolution [5]</td></tr>
<tr><td>Signal</td><td colspan="4">1 cm^{-1}</td></tr>
<tr><td>Idler</td><td colspan="4">1 cm^{-1}</td></tr>
<tr><td>SH and SF</td><td>—</td><td colspan="3">2 cm^{-1}</td></tr>
<tr><td colspan="5">Polarization</td></tr>
<tr><td>Signal</td><td colspan="4">horizontal</td></tr>
<tr><td>Idler</td><td colspan="4">vertical</td></tr>
<tr><td>SH and SF</td><td>—</td><td colspan="3">vertical</td></tr>
<tr><td>Typical beam diameter [6]</td><td colspan="4">3 × 6 mm</td></tr>
<tr><td colspan="5">PUMP LASER</td></tr>
<tr><td>Pump wavelength [7]</td><td colspan="2">355 nm</td><td colspan="2">355 / 1064 nm</td></tr>
<tr><td>Max pump pulse energy [8]</td><td colspan="2">3 mJ</td><td colspan="2">3 / 1 mJ</td></tr>
<tr><td>Pulse duration [3]</td><td colspan="4">4–6 ns at 1064 nm</td></tr>
<tr><td colspan="5">PHYSICAL CHARACTERISTICS</td></tr>
<tr><td>Unit size (W × L × H)</td><td colspan="4">456 × 1040 × 297 mm</td></tr>
<tr><td>Power supply size (W × L × H)</td><td colspan="4">520 × 400 × 286 mm</td></tr>
<tr><td>Umbilical length</td><td colspan="4">2.5 m</td></tr>
<tr><td colspan="5">OPERATING REQUIREMENTS</td></tr>
<tr><td>Cooling</td><td colspan="4">built-in chiller</td></tr>
<tr><td>Room temperature</td><td colspan="4">18–27 °C</td></tr>
<tr><td>Relative humidity</td><td colspan="4">20–80 % (non-condensing)</td></tr>
<tr><td>Power requirements</td><td colspan="4">100–240 V AC, single phase 50/60 Hz</td></tr>
<tr><td>Power consumption</td><td colspan="4">< 1.5 kVA</td></tr>
</table>

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.

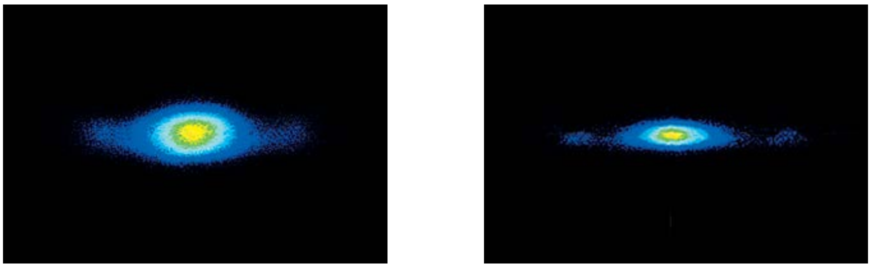
7) Separate output port for the 3rd and other harmonic is optional.

8) The laser max 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

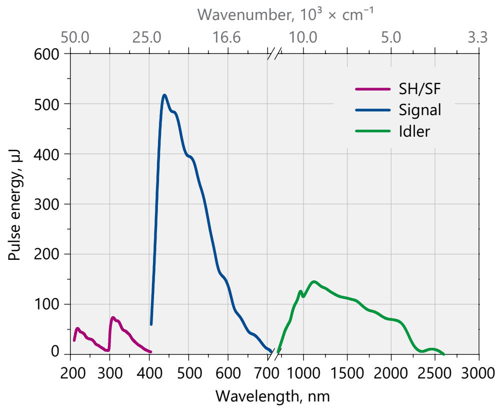


Fig 2. Typical output pulse energy of NT242 series tunable laser

OUTLINE DRAWINGS

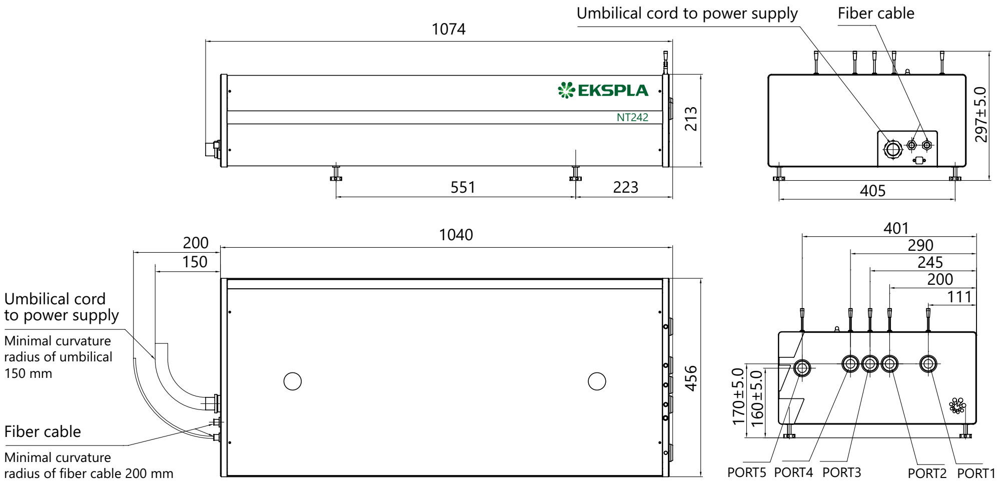


Fig 3. NT242 series laser head dimensions

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

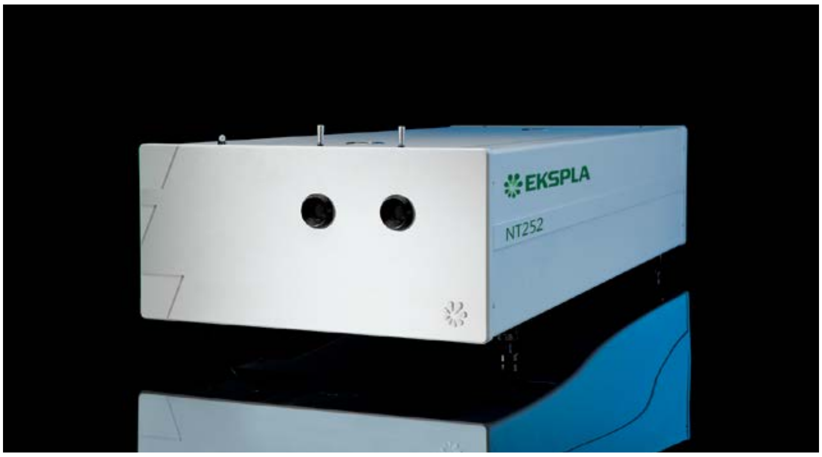
Model

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

NT252 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*
- ***3–6 ns** pulse duration*
- *Remote control via key pad or PC*

BENEFITS

- *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 NT252 systems into various experimental environments*

APPLICATIONS

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

NT252 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	670–1063 nm
Idler	1064–2600 nm
SH	335–670 nm
Pulse energy [2]	
OPO	1100 µJ at 750 nm
SH	200 µJ at 400 nm
Pulse repetition rate	1000 Hz
Linewidth [3]	<8 cm^{-1}
Tuning resolution [4]	
Signal	1 cm^{-1}
Idler	1 cm^{-1}
SH	2 cm^{-1}
Polarization	
Signal	horizontal
Idler	vertical
SH	horizontal
Typical beam diameter [5] [6]	3 × 6 mm
PUMP LASER	
Pump wavelength [7]	532 nm
Max pump pulse energy [8]	4 mJ
Pulse duration [9]	4 – 6 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 × 300 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

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) Please refer to tuning curves for typical outputs at other wavelengths.

3) In signal and idler range.

4) 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.

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

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

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

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

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

Femtosecond Lasers
Picosecond Lasers
Picosecond Tunable Systems
Nanosecond Lasers
Nanosecond Tunable Lasers
High Intensity Lasers
Other Ekspla Products

PERFORMANCE

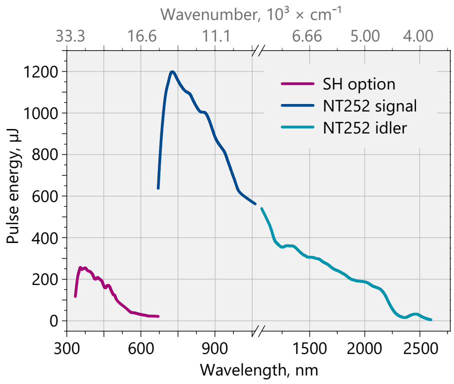


Fig 1. Typical output pulse energy of the NT252-SH tunable laser

OUTLINE DRAWINGS

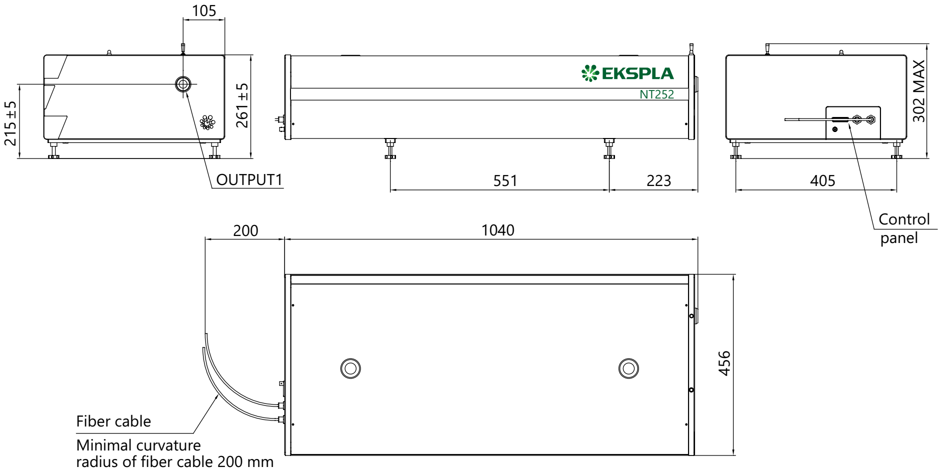


Fig 3. NT252 series laser head dimensions

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.

NT252-SH-2H

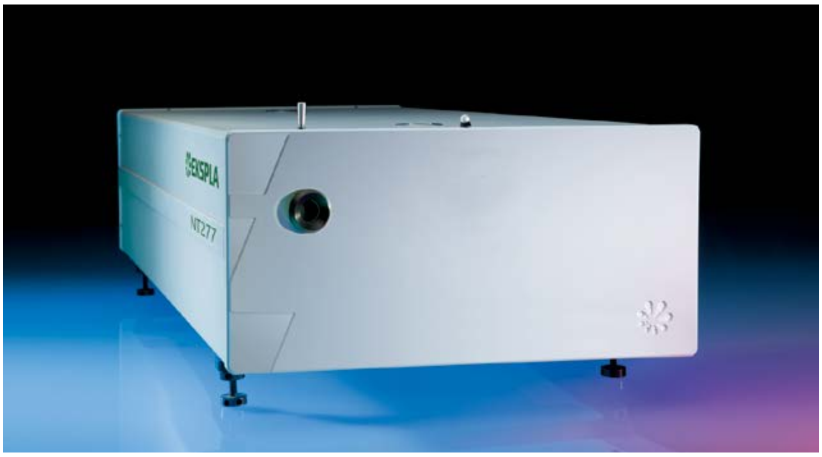
Model

Optional tuning range extension:
SH → 335–670 nm

Options:
2H → extra 532 nm output
H → extra 1064 nm output

NT270 SERIES

Tunable Wavelength NIR-IR 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 **12000 nm** (depending on model)*
- *Narrow linewidth*
- *Hands-free tuning*
- *<**7 ns** pulse duration*
- *Remote control via key pad or PC*

BENEFITS

- *Wide (2500 – 12000 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.

NT270 series available models

Model	Features
NT277	High pulse repetition rate OPO producing tunable output in 2500 – 4475 nm spectral range
NT277-XIR	Tunable output from NIR to far-IR range, 2500 nm to 12 000 nm

SPECIFICATIONS [1]

Model	NT277	NT277-XIR
OPO		
Wavelength range		
Idler	2500–4475 nm	2500–4475 nm 4500–12000 nm [2]
Pulse energy [3]		
Idler	80 µJ at 3000 nm	80 µJ at 3000 nm 20 µJ at 7000 nm
Pulse repetition rate	1000 Hz	
Linewidth [4]	<10 cm^{-1}	<12 cm^{-1}
Tuning resolution [5]		
Idler	1 cm^{-1}	
Polarization		
Idler	vertical	horizontal
Typical beam diameter [6] [7]	4 mm	6 mm
PUMP LASER		
Pump wavelength	1064 nm	
Max pump pulse energy [8]	1.9 mJ	
Pulse duration [9]	<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)	365 × 395 × 290 mm	
Umbilical length	2.5 m	
OPERATING REQUIREMENTS		
Cooling	by air	
Room temperature	18–27 °C	
Relative humidity	20–80 % (non-condensing)	
Power requirements	90–240 V AC, single phase 50/60 Hz	
Power consumption	< 0.5 kVA	

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 for NT277, NT277-XIR unit and at 7000 nm for NT277-XIR units and for basic system without options.

2) Available wavelength range. Custom tuning ranges are available.

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

4) Higher energy 10 – 150 cm^{-1} option is available for 2500 – 4475 nm tuning range.

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

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

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

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

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

PERFORMANCE

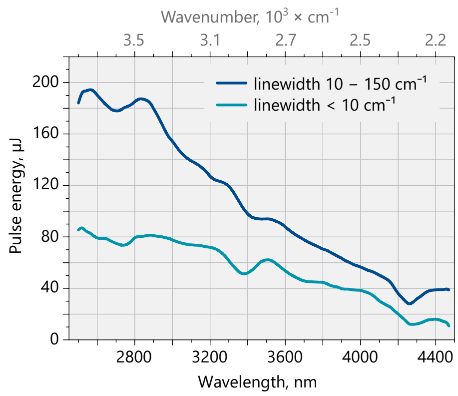


Fig 1. Typical output pulse energy of the NT277 and NT277-XIR tunable laser

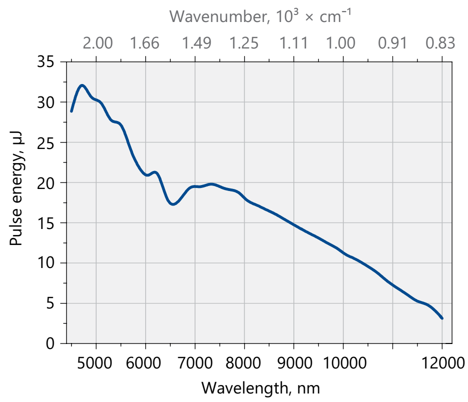


Fig 2. Typical output pulse energy of the NT277-XIR tunable laser

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.

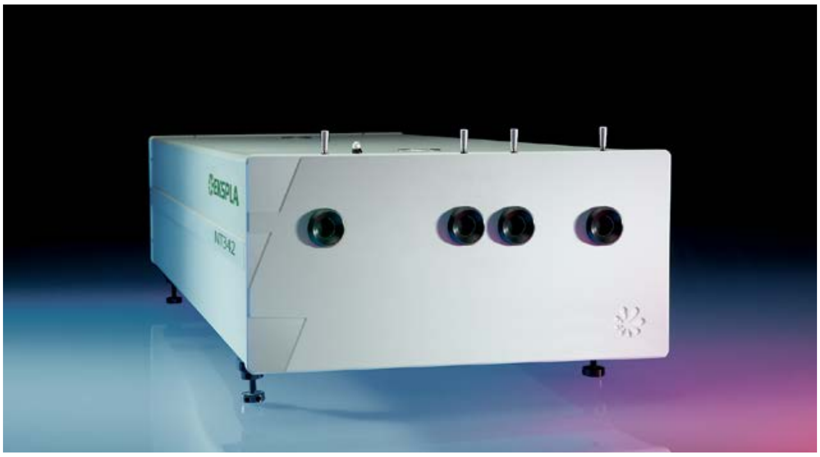
NT277-XIR

Model

Tuning range extension:
XIR → 4500–12000 nm

NT342 SERIES

High Energy Broadly Tunable Lasers



BENEFITS

- *The system is widely tunable 192 – 2600 nm and delivers high pulse energy (up to 50 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, LAN and WLAN ensures easy control and integration with other equipment*
- *Attenuator and fiber coupling options facilitate incorporation of NT342 systems into various experimental environments*

The NT342 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.

NT342 has a linewidth of less than 5 cm^{-1}, which is ideal for many spectroscopic applications.

The laser is designed for convenient use. It can be controlled from remote keypad or PC using LabView™ drivers that are supplied with the system. The remote keypad features a backlit display that is easy to read even through laser safety googles. 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.

FEATURES

- *Hands-free no gap wavelength tuning from **192** to **4400 nm***
- *Up to **50 mJ** pulse energy in visible spectral range*
- *Up to **10 mJ** pulse energy in UV spectral range*
- *Up to **15 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*

APPLICATIONS

- *Laser-induced fluorescence*
- *Flash photolysis*
- *Photobiology*
- *Remote sensing*
- *Time-resolved spectroscopy*
- *Non-linear 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/FC	Fiber coupled 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
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)	2500–4400 nm	
Output pulse energy		
OPO [4]	30 mJ	50 mJ
SH generator (optional) [5]	4 mJ	6.5 mJ
SH/SF generator (optional) [6]	6 mJ	10 mJ
DUV generator (optional) [7]	0.6 mJ	1 mJ
MIR generator (optional) [8]	15 mJ	
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)	1 cm^{-1}	
Pulse duration [11]	3–5 ns	
Typical beam diameter [12]	5 mm	7 mm
Typical beam divergence [13]	< 2 mrad	
Polarization		
Signal	horizontal	
Idler	vertical	
SH/SF	horizontal	
DUV	vertical	
MIR	horizontal	

Femtosecond Lasers
Picosecond Lasers
Picosecond Tunable Systems
Nanosecond Lasers
Nanosecond Tunable Lasers
High Intensity Lasers
Other Ekspla Products

SPECIFICATIONS [1]

Model	NT342B	NT342C
PUMP LASER [14]		
Pump wavelength	355 nm	
Max pump pulse energy	100 mJ	150 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	

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 3000 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.

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REV. 20200330

PERFORMANCE

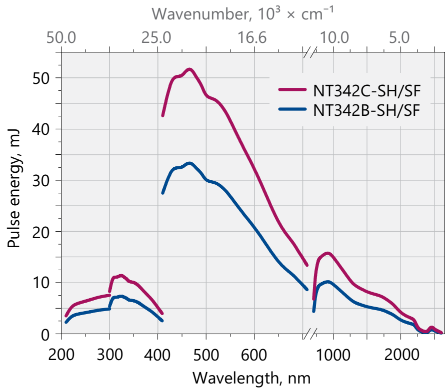


Fig 1. Typical output energy of the NT342 series tunable wavelength systems

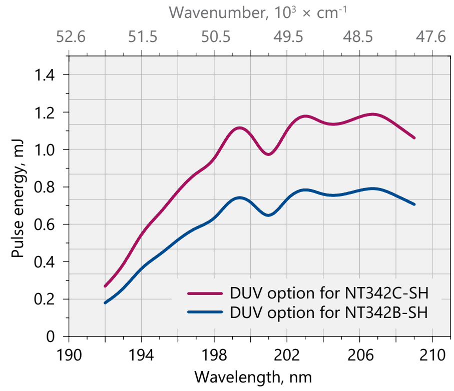


Fig 2. Typical output energy of the NT342 series tunable wavelength systems with SH/DUV extension

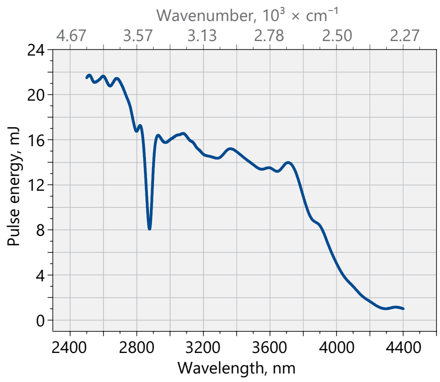


Fig 3. Typical output energy of the NT342 series tunable wavelength systems with MIR extension

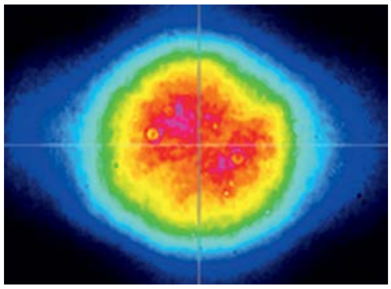


Fig 4. NT342 series laser typical beam profile at 450 nm after ~1.5 m distance from output

OUTLINE DRAWINGS

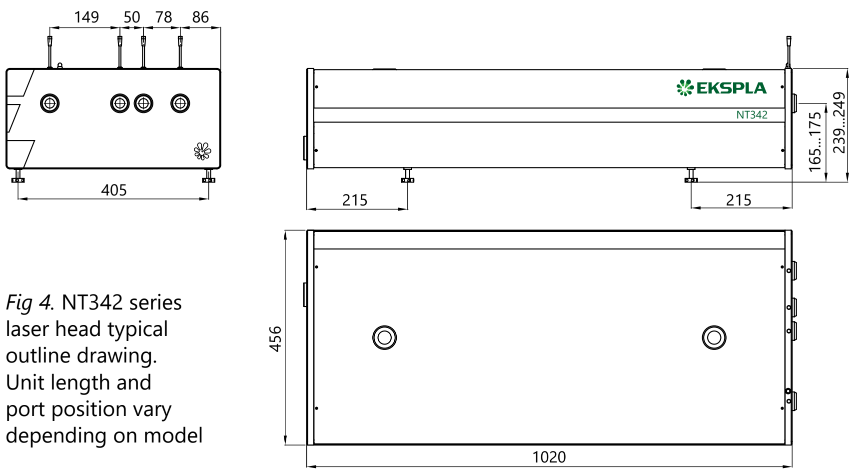


Fig 4. NT342 series laser head typical outline drawing. Unit length and port position vary depending on model

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.

NT342B-SH-10-AW-H/2H

Model

Output pulse energy:
B → 30 mJ
C → 50 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

NT350 SERIES

High Energy NIR Range Tunable Lasers

BENEFITS

- *High pulse energy (up to 230 mJ) is highly beneficial for photoacoustics imaging applications*
- *Superior tuning resolution (1 – 2 cm⁻¹) allows recording of high quality spectra*
- *High integration level saves valuable space in the laboratory*
- *Flashlamps replacement without misalignment of the laser cavity saves on maintenance costs*
- *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 bundle coupling options facilitate incorporation of NT350 systems into various experimental environments*

FEATURES

- *Hands-free, automated wavelength tuning from **330** to **2600 nm***
- *Up to **230 mJ** in range 660 – 2600 nm, **35 mJ** in range 330 – 660 nm*
- *Narrow linewidth across tuning range*
- ***3–5 ns** pulse duration*
- *Remote control via key pad or PC*
- *Separate output port for 532 nm beam. Output for 1064 nm is optional*
- *OPO pump energy monitoring*
- *Hermetically sealed oscillator cavity protects non-linear crystals from dust and humidity*

APPLICATIONS

- *Photoacoustic imaging*
- *Flash photolysis*
- *Photobiology*
- *Remote sensing*
- *Non-linear spectroscopy*

NT352 series tunable laser seamlessly integrates in a compact housing a nanosecond optical parametric oscillator and Nd:YAG Q-switched laser.

Two models with different output pulse energy values are offered. The most powerful model has more than 230 mJ pulse energy at 700 nm. Narrow linewidth (<10 cm^{-1}) is nearly constant trough whole tuning range, which makes laser suitable for many spectroscopy application.

The device is controlled from the remote keypad or PC using LabVIEW™ drivers that are supplied with the system. The remote pad features a backlit display that is easy to read even while wearing laser safety glasses.

System is designed for easy and cost-effective maintenance. Replacement of flashlamps can be done without misalignment of the laser cavity and deterioration of laser performance. OPO pump energy monitoring system helps to increase lifetime of the optical components.

Options

Optional items are available allowing optimization of the laser system for Your application, for example:

- Fiber bundle coupled output in 350–2000 nm range;
- Efficient second harmonic generator for 330–660 nm range;
- Pulse energy attenuator;
- Water-air cooled power supply.

Please inquire custom-build versions and options.

SPECIFICATIONS [1)]

Model	NT352C	NT352E
OPO		
Wavelength range		
Signal	660–1064 nm	
Idler	1065–2600 nm	
SH	330–660 nm	
Output pulse energy [2)]		
OPO	150 mJ	230 mJ
SH	25 mJ	35 mJ
Linewidth [3)]	<10 cm^{-1}	
Tuning resolution [4)]		
Signal (660–1064 nm)	1 cm^{-1}	
Idler (1064–2450 nm)	1 cm^{-1}	
SH (330–530 nm)	2 cm^{-1}	
Pulse duration [5)]	3–5 ns	
Typical beam diameter [6)]	7 mm	9 mm
Typical beam divergence [7)]	<2 mrad	
Polarization		
Signal beam	horizontal	
Idler beam	vertical	
SH beam	vertical	
PUMP LASER [8)]		
Pump wavelength	532 nm	
Max pump pulse energy	450 mJ	700 mJ
Pulse duration	4 – 6 ns	
Beam quality	"Hat-Top" in near field. Close to Gaussian in far field	
Beam divergence	<0.6 mrad	
Pulse energy stability (StdDev)	<2.5 %	
Pulse repetition rate	10 Hz	
PHYSICAL CHARACTERISTICS		
Unit size (W × L × H)	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) [9)]	10 l/min	
Room temperature	18–27 °C	
Relative humidity	20–80 % (non-condensing)	
Power requirements [10)]	200 – 240 VAC, single phase, 50/60 Hz	
Power consumption	< 1.5 kVA	

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 700 nm and for basic system without options.

2) Measured at 700 nm for OPO and 350 nm for SH. See tuning curves for typical outputs at other wavelengths.

3) In signal and idler range.

4) 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 0.5 nm for SH.

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

6) Beam diameter is measured at 700 nm at the 1/e^2 level and can vary depending on the pump pulse energy.

7) Full angle measured at the FWHM level at 700 nm.

8) Separate output port for the 532 nm beam is standard. Output for 1064 nm beam is optional. Pump laser output will be optimized for the best OPO operation and specification may vary with each unit we manufacture.

9) Air cooled power supply is available as option.

10) Mains voltage should be specified when ordering.

PERFORMANCE

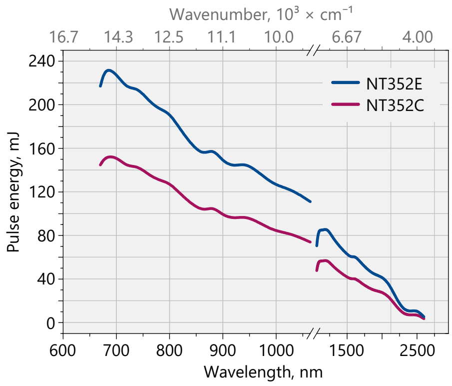


Fig 1. Typical output energy of the NT350 series tunable wavelength systems

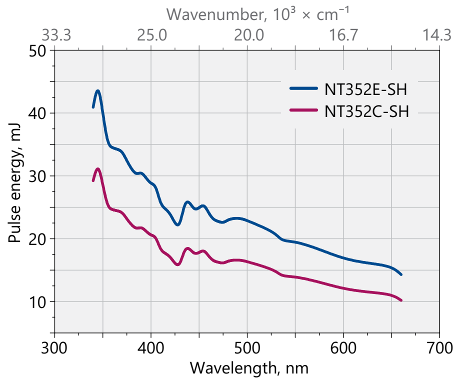


Fig 2. Typical output energy of the NT350 series tunable wavelength systems with SH option

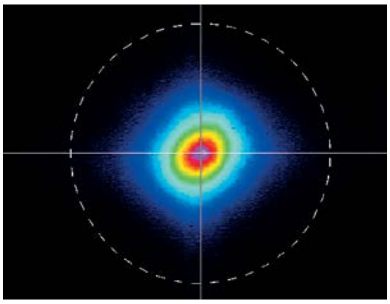


Fig 3. Typical far field beam profile of NT352B laser at 800 nm

ORDERING INFORMATION

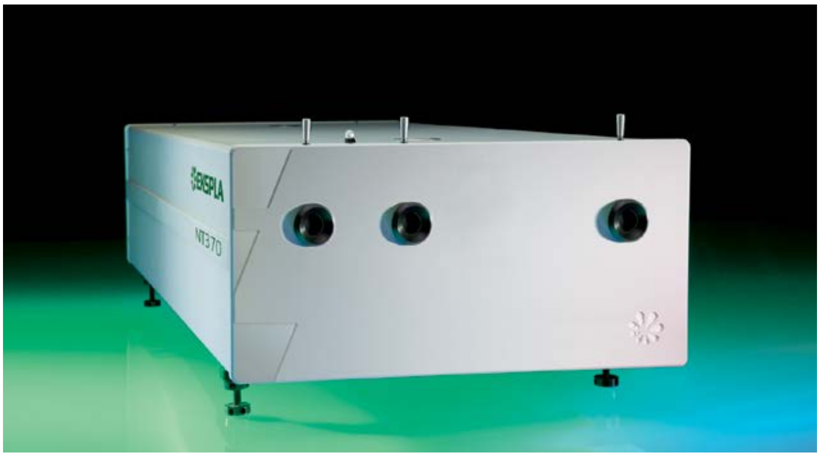
Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

NT352C-10-SH-AW-H

- Model
- Output pulse energy:
  - C → 150 mJ
  - E → 250 mJ
- Pulse repetition rate, in Hz
- Optional tuning range extension
  - SH → 330–660 nm
- Options:
  - AW → water-air heat exchanger
  - H → 1064 nm output

NT370 SERIES

High Energy IR Range Tunable Lasers



BENEFITS

- Wide tuning range in 2500 – 4400 nm or 5500 – 18 000 nm is highly useful for s-SNOM and other IR applications
- NT370 is a cost effective solution covering a wide tuning range from a single source
- Superior tuning resolution (1 cm^{-1}) allows recording of high quality spectra
- High integration level saves on valuable space in the laboratory
- Flashlamps replacement without misalignment of the laser cavity saves on maintenance costs
- 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

FEATURES

- *Hands-free, automated wavelength tuning*
- *Up to* ***15 mJ*** *pulse energy in mid and* ***1 mJ*** *in far IR spectral range*
- *Less than* ***8 cm^{-1}*** *linewidth*
- ***3 – 5 ns*** *pulse duration*
- ***10 or 20 Hz*** *pulse repetition rate*
- *Remote control via key pad or PC*
- *Separate output port for 1064 nm pump beam option*
- *OPO pump energy monitoring*
- *Replacement of the flashlamps without misalignment of the laser cavity*

APPLICATIONS

- *Vibrational spectroscopy*
- *Cavity ring-down CRDS, cavity ring-down laser absorption CRLAS spectroscopy*
- *Infrared spectroscopy*
- *Gas spectroscopy*

NT370 series tunable laser seamlessly integrates in a compact housing the nanosecond optical parametric oscillator and Nd:YAG Q-switched laser. Pumped by fundamental harmonics output the lasers provides tuning in mid- and far-infrared spectral ranges.

NT373-XIR model uses IR crystal based cascade OPO for tunable output in 5500–18000 nm range. Customized tuning ranges are available upon request. The linewidth of NT373-XIR model is nearly constant across tuning range and it is less than 8 cm^{-1}.

NT377 model produces tunable output in 2500–4400 nm range. Pulse energy is exceeding 10 mJ for wavelengths shorter than 3600 nm, while linewidth is below 8 cm^{-1}. Because of narrow linewidth of output radiation the laser is suitable for many infrared spectroscopic applications, for example cavity ring-down spectroscopy, gas detection and remote sensing.

The device is controlled from the remote keypad or from PC using LabView™ drivers that are supplied together with the system. The remote pad features a backlit display that is easy to read even while wearing laser safety glasses. System is designed for easy and cost-effective maintenance. Replacement of flashlamps can be done without misalignment of the laser cavity and deterioration of laser performance. OPO pump energy monitoring system helps to increase lifetime of the optical components.

Accessories and optional add-ons

Option	Features
-AW	Water-air cooling option
-20	20 Hz PRR option
-H	Optional 1064 nm output

SPECIFICATIONS [1)]

Model	NT377	NT373-XIR
OPO		
Wavelength range	2500–4400 nm	5500–18000 nm [2)]
Output pulse energy [3)]	15 mJ	1 mJ
Linewidth [4)]	< 8 cm^{-1}	
Tuning resolution [5)]	1 cm^{-1}	
Typical pulse duration [6)]	3–5 ns	
Typical beam diameter [7)]	8 mm	10 mm
Polarization	horizontal	
PUMP LASER [8)]		
Pump wavelength	1064 nm	
Max pump pulse energy	250 mJ	300 mJ
Pulse duration	4–6 ns	
Beam quality	"Hat-Top" in near field	
Beam divergence	< 0.5 mrad	
Pulse energy stability (StdDev)	< 1 %	
Pulse repetition rate	10 or 20 Hz	
PHYSICAL CHARACTERISTICS		
Unit size (W × L × H)	456 × 820 × 274 mm	456 × 1030 × 274 mm
Power supply size (W × L × H)	330 × 490 × 585 mm	
Umbilical length	2.5 m	
OPERATING REQUIREMENTS		
Water consumption (max 20 °C) [9)]	<10 l/min	
Room temperature	18–27 °C	
Relative humidity	20–80 % (non-condensing)	
Power requirements [10)]	200 – 240 VAC, single phase, 50/60 Hz	
Power consumption	< 1.5 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 3000 nm for NT377 unit and at 7000 nm for NT373-XIR unit and for basic system without options.

2) Additional output in 1780 – 2010 nm and 2300 – 2645 nm ranges is possible. Please contact Ekspla for more detailed specifications.

3) Output is specified at wavelengths defined in note 1. See tuning curves for typical outputs at other wavelengths.

4) Linewidth is specified at wavelengths defined in note 1.

5) When wavelength is controlled from PC. When wavelength is controlled from keypad, tuning resolution is 1 nm

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

7) Beam diameter is measured at the 1/e^2 level and varies depending on the wavelength.

8) Laser output will be optimized for the best OPO operation and specification may vary with each unit we manufacture.

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

10) Should be specified when ordering.

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

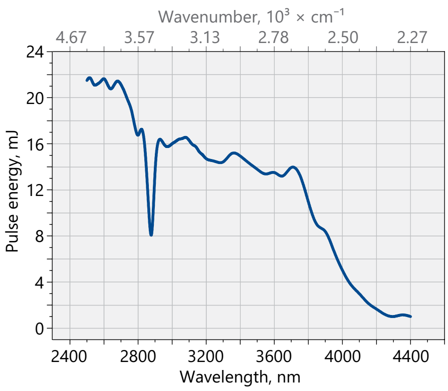


Fig 1. Typical output energy of the NT377 tunable wavelength laser

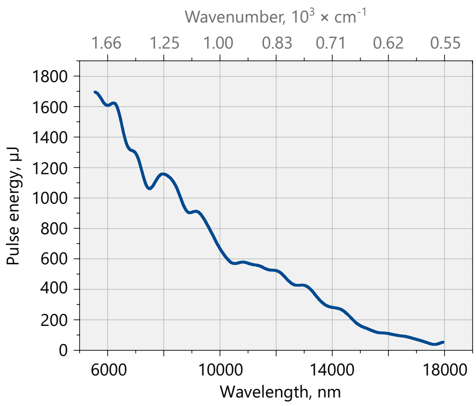


Fig 2. Typical output pulse energy of the NT373-XIR tunable wavelength laser

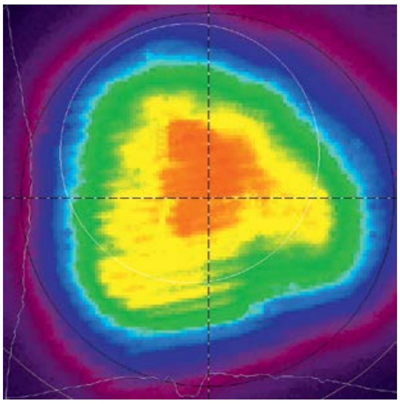


Fig 3. Typical beam profile at 3000 nm and 7000 nm wavelengths in near field

PhotoSonus

High Energy, Mobile, Tunable Wavelength Laser Source for Photoacoustic Imaging

Following the demand for high output energies in the photoacoustic market for imaging larger volumes of tissue, PhotoSonus, an updated high energy tunable laser source for photo-acoustic imaging, was introduced. Time-tested Ekspla nanosecond pump laser, parametric oscillator, power supply and cooling unit are integrated in a single robust housing to provide mobility, ease of use and low maintenance cost. The highly flexible PhotoSonus platform makes it easily integrated and used in a photoacoustic imaging system. It is fully motorized and computer controlled, with user trigger outputs and inputs and special options such as motorized switching between OPO Signal and Idler, motorized attenuator, internal energy meter and electromechanical output shutter.

Recently, a fast wavelength switching option was introduced that enables each laser pulse to have a different wavelength within the entire signal or idler range and at any sequence. This new feature, combining high pulse energy (up to 180 mJ) and wide wavelength tuning range (660 – 2300 nm) makes PhotoSonus the irreplaceable imaging source for any photo acoustic system.

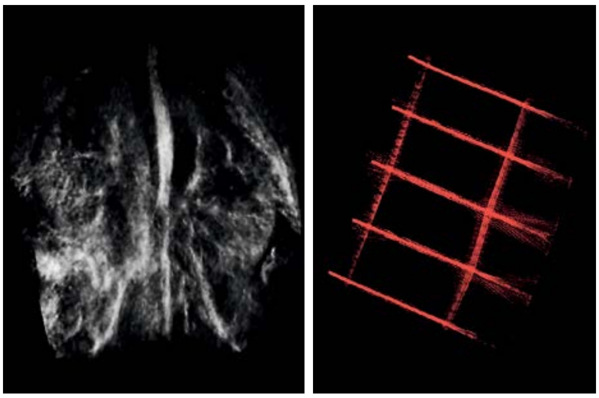
For even higher sample imaging depth and resolution a PhotoSonus+, with up to 250 mJ maximum pulse energy, was introduced.

For convenience, the outputs of PhotoSonus and PhotoSonus+ lasers can be coupled with almost any type of fiber bundle.

FEATURES

- *High **up to 250 mJ** output energy*
- *Wide tuning range **from 660 to 1064 nm** and **from 1065 to 2300 nm***
- ***10 Hz** or **20 Hz** pulse repetition rate*
- *Integrated pump laser, OPO and PSU in single mobile unit*
- *One year warranty*
- *Low maintenance cost*
- *Fiber bundle connectors with safety interlock*
- *Fast Wavelength Switching within entire range between two consecutive pulses (optional)*
- *Electromechanical output shutter with laser self-test capability (optional)*
- *Integrated energy meter (optional)*
- *Motorized attenuator (optional)*
- *Access to pump laser wavelengths 1064/532 nm (optional)*
- *Signal and Idler through the same output (optional)*

SAMPLE PHOTOACOUSTIC IMAGES



Courtesy of PhotoSound Technologies, Inc.

SPECIFICATIONS 1)

Model	PhotoSonus	PhotoSonus+
OPO		
Wavelength range		
Signal	660 – 1064 nm	
Idler (optional)	1065 – 2300 nm	
OPO output MAX pulse energy 2)	> 180 mJ at 10 Hz; or > 160 mJ at 20 Hz	> 250 mJ at 10 Hz
Scanning step:		
Signal (660 – 1064 nm)	0.1 nm	
Idler (1065 – 2450 nm)	1 nm	
Pulse duration 3)	3 – 5 ns	
Signal linewidth	< 10 cm^{-1}	
Typical signal beam diameter ($1/e^2$) 4)	7 ± 2 mm	9 ± 2 mm
PHYSICAL CHARACTERISTICS		
Unit size (W × L × H mm)	434 × 672 × 887 mm	
OPERATING REQUIREMENTS		
Room temperature	18 – 27 °C	
Relative humidity	20 – 80 % (non-condensing)	
Power requirements 5)	208 or 240 VAC, single phase 50/60 Hz	
Power consumption	< 1.0 kVA (10 Hz), < 1.5 kVA (20 Hz)	< 1.5 kVA (10 Hz)

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 700 nm.

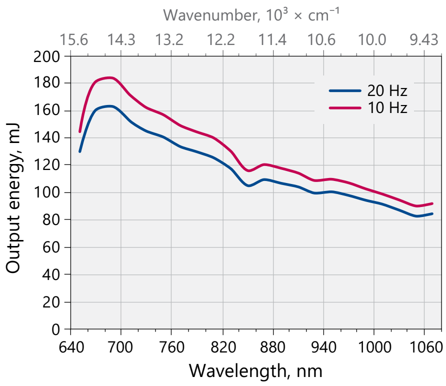
2) Free space measurement at 700 nm. See tuning curves for typical outputs at other wavelengths.

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

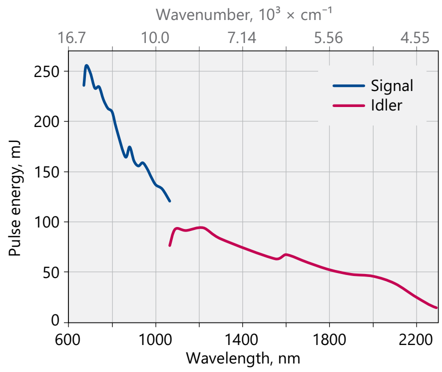
4) Measured at the free space output at 700 nm. Can be adjusted as per request.

5) Mains voltage should be specified when ordering.

PERFORMANCE



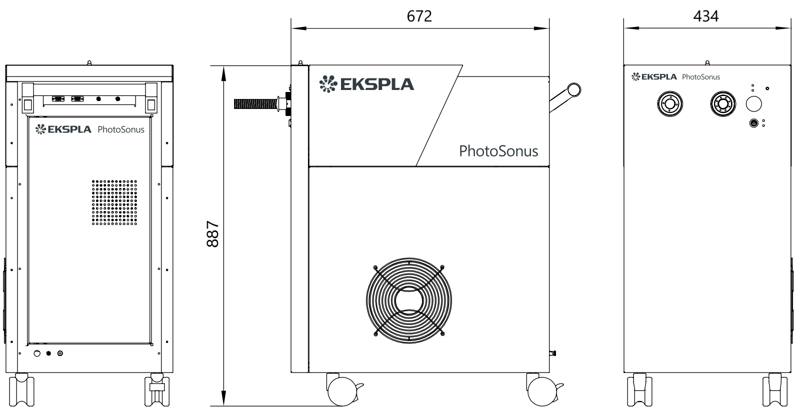
Typical PhotoSonus signal output pulse energy vs. wavelength curve



Typical PhotoSonus+ signal and idler output pulse energy vs. wavelength curve

DRAWINGS

PhotoSonus outline drawings (mm)



PhotoSonus X

High Output Power DPSS Tunable Laser for Photoacoustic Imaging

PhotoSonus X is a perfect solution for photoacoustic imaging in pre-clinical and clinical use and when fast sample scanning is required. Having high output energy of up to 65 mJ at the peak, a broad wavelength tuning range from 665 to 2600 nm, high pulse repetition rate up to 100 Hz and fast wavelength switching makes it a perfect photoacoustic imaging source for gaining high-resolution images and ensuring high data acquisition rate. Moreover, being built on a diode pumped solid-state laser platform, PhotoSonus X assures significantly quieter operation (< 65 db) compared with flash-lamp pumped lasers, which is very beneficial for clinical use.

Diode pumped laser technology and well-engineered system design ensures high reliability and low-cost system operation. PhotoSonus X output can be coupled with almost any type of fiber bundle.

With additional options of an internal energy meter and electromechanical shutter with laser self-test capability, PhotoSonus X can be ready for certification in clinical photoacoustic applications.

FEATURES

- *Hands-free wavelength tuning from **665 to 1064 nm** and **1065 – 2600 nm***
- *Fully motorized wavelength tuning*
- *Externally triggerable*
- *High, up to **65 mJ** pulse energy from OPO*
- ***100 Hz** or **50 Hz** pulse repetition rate*
- *Low-cost maintenance*
- *Certification ready*
- *Quite operation < **65 dB***
- *Integrated DPSS pump laser and OPO into a single housing*
- *Fiber bundle holder with safety interlock*
- *Signal and Idler through the same output (optional)*
- *Fast Wavelength Switching of up to 300 nm range between two consecutive pulses (optional)*
- *Motorized attenuator (optional)*
- *Integrated energy meter (optional)*
- *Electromechanical output shutter with laser self-test capability (optional)*

PERFORMANCE

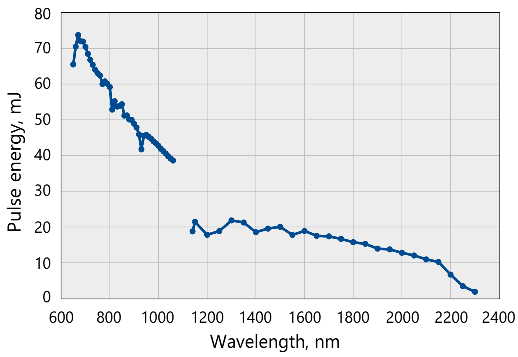


Fig 1. PhotoSonus X signal output typical energy at 50 Hz pulse repetition rate

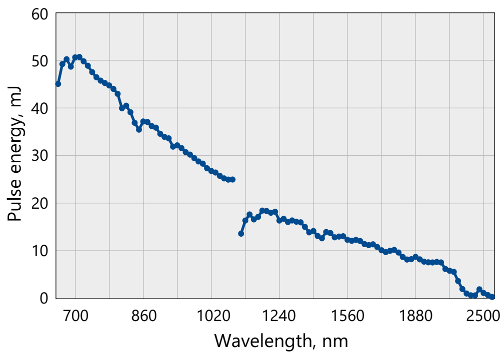


Fig 2. PhotoSonus X signal output typical energy at 100 Hz pulse repetition rate

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SPECIFICATIONS [1]

Model	PhotoSonus X
OPO	
Wavelength range	
Signal	665 – 1064 nm
Idler (optional)	1065 – 2600 nm
OPO output pulse energy [2]	> 50 mJ at 100 Hz or > 65 mJ at 50 Hz
Pulse repetition rate [3]	100 Hz or 50 Hz
Scanning step	
Signal (665–1064 nm)	0.1 nm
Idler (1065 – 2600 nm)	1 nm
Pulse duration [4]	2 – 5 ns
Signal linewidth [5]	< 10 cm^{-1} at 100 Hz or < 15 cm^{-1} at 50 Hz
Typical signal beam diameter ($1/e^2$) [6]	5 ± 1 mm
Control interfaces	USB, LAN, RS232
PHYSICAL CHARACTERISTICS	
Cooling	Closed loop air-water cooled [7]
Unit size (W × L × H)	551 × 400 × 162 mm
Power supply size (W × L × H)	2 units, 483 × 390 × 140 mm each
Umbilical length	2.5 m
OPERATING REQUIREMENTS	
Room temperature	18 – 27 °C
Relative humidity	20 – 80 % (non-condensing)
Power requirements	100 – 240 VAC, single phase 50/60 Hz
Power consumption	< 2 kW

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 700 nm.

2) Free space measurement at 700 nm. See tuning curves for typical outputs at other wavelengths.

3) Other fixed pulse repetiton rates are available upon request.

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

5) At 700 nm or higher wavelength.

6) Measured at the free space output at 700 nm wavelength.

7) Using external chiller.

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.

OUTLINE DRAWINGS

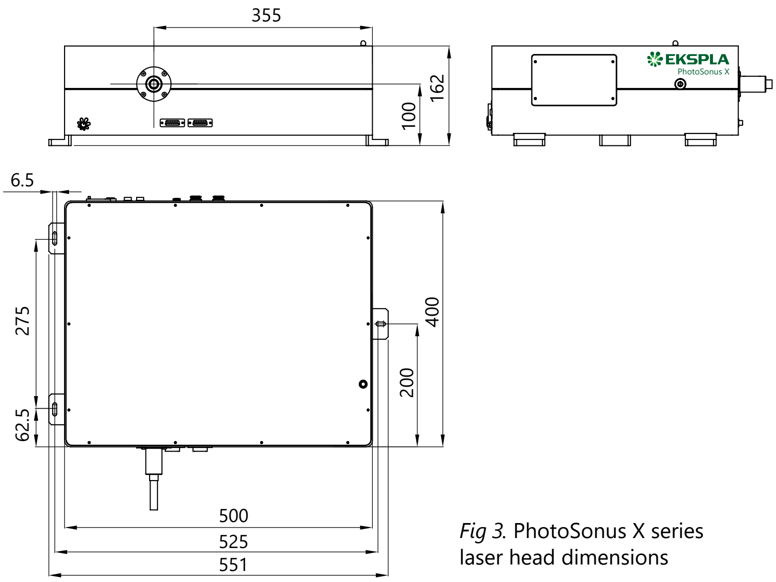


Fig 3. PhotoSonus X series laser head dimensions

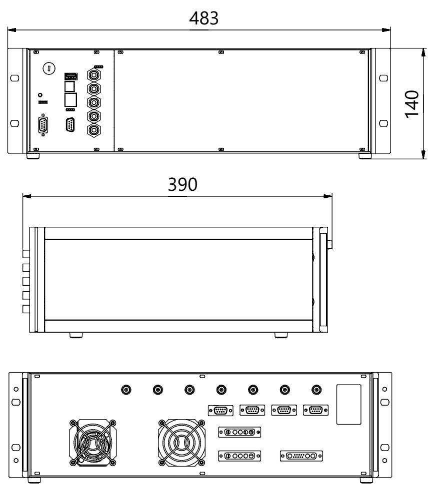


Fig 4. Outline drawing of PhotoSonus X power supply unit

Tuning up the OPCPA laser system NAGLIS at Vilnius University Laser Research Center

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 more that 27 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.

SHORT SELECTION GUIDE

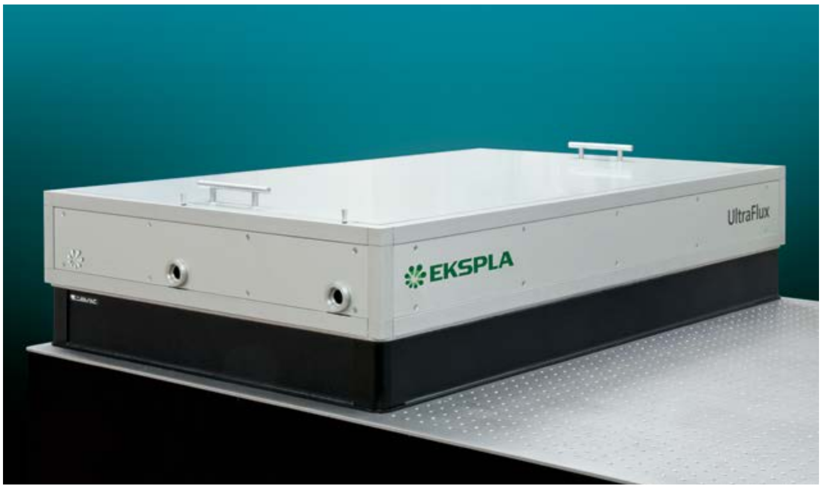
For Your convenience, table contains all available options and highest parameter values. Not all output specifications are available at the same time simultaneously. Please refer to the catalog page for exact specifications and available options.

Series	Pulse duration	Pulse energy at 1064 nm	Repetition rate, up to	Special feature	Page
UltraFlux	down to 11 fs	up to 50 mJ	1 kHz	Patented fiber based front end	98
APL2100	90 ± 10 ps	up to 2.2 J	10 Hz	DPSS regenerative amplifier	104
APL2200	90 ± 10 ps	up to 130 mJ	1 kHz	High power amplifiers	107
APL4206	90 ± 10 ps	up to 8 channels 130 mJ each	1 kHz	Spatial and temporal beam profiles tailored for OPCPA pumping	110
NL120	2 ± 0.5 ns	up to 10 J	10 Hz	High energy single longitudinal mode Q-switched Nd:YAG laser	112
NL310	4 – 6 ns	up to 10 J	10 Hz	High pulse energy, cost effective solution	115
NL940	3 – 10 ns (adjustable)	up to 10 J	10 Hz	Temporaly shaped pulse based on electrooptical modulator driven by programmable arbitrary waveform generator (AWG)	118
ANL	2 – 4 ns	up to 1 J	up to 1 kHz	High energy and high repetition rate DPSS	121
Nd:Glass	500 ps – 20 ns	up to 160 J	1 shot in 1 – 20 min	DPSS master oscillator and Nd:Glass power amplifiers	123
NL941 **NL942**	5 ns 50 ns	up to 2 J	20 kHz	High energy temporaly shaped DPSS nanosecond lasers	125

UltraFlux

FT300 SERIES

Tunable Wavelength Femtosecond Laser Systems



UltraFlux FT300 series is a compact high energy tunable wavelength femtosecond laser system which incorporates the advantages of ultrafast fiber laser, solid-state and parametric amplification technologies. Novel OPCPA front-end technology uses the same picosecond fiber laser for seeding both picosecond DPSS pump laser and femtosecond parametric amplifier by spectrally broadened output. This approach greatly simplifies the system – excludes femtosecond regenerative amplifier and eliminates the need of pump and seed pulse synchronization. In addition to that, contrast of the output pulses in picosecond to nanosecond time scale is potentially increased.

All UltraFlux series laser systems are assembled on a rigid breadboard to ensure excellent long-term stability. Modular internal design offers high level of customization and easy scalability. These systems can be customized according to customer requirements.

Incorporation of parametric amplification technology together with a novel ultrafast fiber laser helped to create and bring to the market a new tool for femtosecond pump-probe, nonlinear spectroscopy, emerging high harmonic generation experiments and other femtosecond and nonlinear spectroscopy applications. With this laser ultrafast science breakthrough is closer to any photonics lab than ever before.

FEATURES

- *Based on the novel **OPCPA** (Optical Parametric Chirped Pulse Amplification) technology – simple and cost-efficient operation*
- *Patented front-end design (patents no. EP2827461 and EP2924500)*
- *Hands free wavelength tuning*
- *Up to **1 kHz** repetition rate*
- *Up to **3 mJ** pulse energy*
  - *Excellent pulse energy stability: < 1.5 % rms*
  - *Excellent long-term average power stability: < 1.5 % rms over > 12 hour period*
- *High contrast pulses without any additional improvement equipment*

APPLICATIONS

- *Broadband CARS and SFG*
- *Femtosecond pump-probe spectroscopy*
- *Nonlinear spectroscopy*
- *High harmonic generation*

OPTIONS

- ***SH/TH** harmonics module: **SH 375 – 480 nm, TH 250 – 320 nm***
- ***SH/TH/FH** harmonics module: **SH 375 – 480 nm, TH 250 – 320 nm FH 210 – 230 nm***
- *Optically synchronized ps output*
- *PLL (Phase Locking Loop) for precise (<1 ps, rms) locking with external synchronization pulse*

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SPECIFICATIONS 1)

Model	UltraFlux FT031k	UltraFlux FT31k	UltraFlux FT310
MAIN SPECIFICATIONS			
Max. Pulse energy	300 µJ	3 mJ	
SH output 4)	–	20 % conversion at 440 nm	
TH output 4)		5 % conversion at 290 nm	
FH output 4)		1 % conversion at 220 nm	
Wavelength tuning range			
Standard version	700 – 1010 nm	750 – 960 nm	
SH output 4)	–	375 – 480 nm	
TH output 4)		250 – 320 nm	
FH output 4)		210 – 230 nm	
Scanning steps			
SH output 4)	–	5 nm	
TH output 4)		3 nm	
FH output 4)		2 nm	
Pulse duration	35 – 60 fs	20 – 60 fs	
Pulse repetition rate	1 kHz		10 Hz
Pulse energy stability	< 1.5 %, rms		
Long-term power stability	< 1.5 %, rms		
Spatial mode	Super Gaussian		
Beam diameter (1/e²)	2 mm	7 mm	
Pulse contrast 2)	≥ 10^{-6} : 1 (within ± 50 ps)		
	≥ 10^{-8} : 1 (in ns range)		
Polarization	Linear, horizontal		
Beam pointing stability	≤50 µrad, rms		
Optical to RF signal jitter 3)	< 1 ps		
Footprint on optical table	1.2 × 0.75 m	1.2 × 2.0 m	

1) Presented parameters are from delivered systems and can be customized to meet customer's requirements.

2) Pulse contrast is only limited by amplified parametric fluorescence (APF) in the temporal range of ~90 ps which covers OPCPA pump pulse duration and is better than 10^6 : 1. APF contrast depends on OPCPA saturation level (Fig. below). Our system is ASE-free and pulse contrast value in nanosecond range is limited only by measurement device capabilities (third-order autocorrelator). There are no pre-pulses generated in the system and post-pulses are eliminated by using wedged transmission optics.

3) With -PLL option purchased.

4) With SH/TH or SH/TH/FH module.

PERFORMANCE

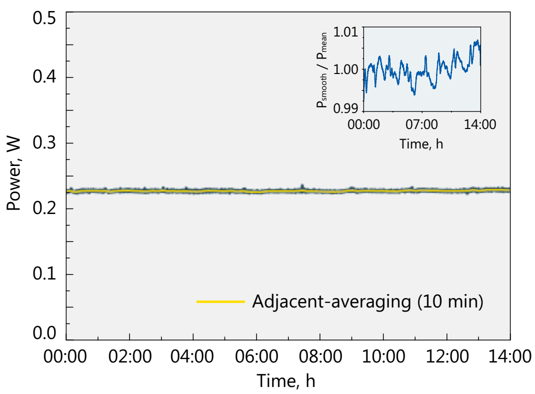

Fig 1. Long-term power stability measurement at 800 nm wavelength

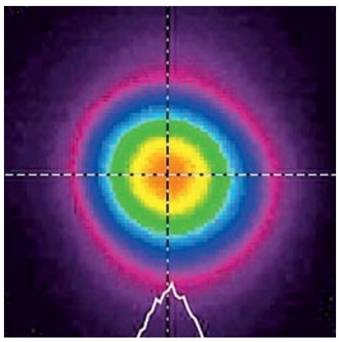

Fig 2. Typical beam profile of FT031k. Output pulse energy 0.3 mJ at 890 nm

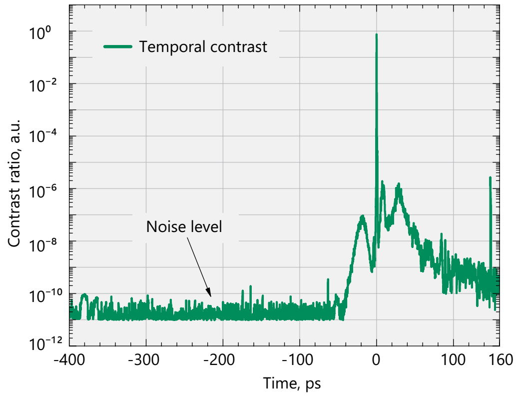

Fig 3. Typical temporal contrast of UltraFlux systems

DELIVERED SYSTEMS

UltraFlux FT310. Customised compact (1.2 × 0.9 m), fully diode pumped, tunable wavelength femtosecond laser system delivering up to 2.5 mJ pulse energy with pulse duration down to 20 fs. Optically synchronized (low jitter) fs and ps outputs available.

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UltraFlux

FF/FT 5000 SERIES

High Energy Tunable Wavelength Femtosecond Laser Systems

UltraFlux FF/FT 5000. Custom high pulse energy femtosecond fixed wavelength laser system delivering up to 40 mJ pulse energy with pulse duration down to 11 fs.

FEATURES

- *Based on the novel **OPCPA** (Optical Parametric Chirped Pulse Amplification) technology – simple and cost-efficient operation*
- *Patented front-end design (patents no. EP2827461 and EP2924500)*
- *Hands free wavelength tuning*
- *Up to **1 kHz** repetition rate*
- *Up to **50 mJ** pulse energy*
  - *Excellent pulse energy stability: < 1.5 % rms*
  - *Excellent long-term average power stability: < 1.5 % rms over > 12 hour period*
- *High contrast pulses without any additional improvement equipment*

APPLICATIONS

- *Broadband CARS and SFG*
- *Femtosecond pump-probe spectroscopy*
- *Nonlinear spectroscopy*
- *High harmonic generation*
- *Particle acceleration in plasma*

The UltraFlux FF/FT 5000 laser is a 2 TW tabletop femtosecond OPCPA (Optical Parametric Chirped Pulse Amplification) based system operating at 10 Hz. Originally built for ELI-ALPS (Extreme Light Infrastructure – Attosecond Light Pulse Source) in Hungary, this laser is now available for a wide variety of applications.

The master oscillator is a patent pending (EP2827461A2) all-in-fiber Yb fiber picosecond laser seed source with two fiber outputs. One seeds the OPCPA Front-End and another seeds the Picosecond Pump Laser (PPL). Both outputs originate from the same fiber so they are synchronized optically. This approach eliminates the need for a complex temporal synchronization system typically present in other OPCPA systems.

The Nd:YAG Picosecond Pump Laser (PPL) system is comprised of several sub-systems: diode pumped Regenerative Amplifier, diode pumped Preamplifier, two flash lamp pumped Amplifiers, and Second Harmonic Generators which convert fundamental 1064 nm wavelength to 532 nm. PPL outputs four beams at 532 nm and 10 Hz pulse repetition rate. One beam is directed to NOPCPA Front-End subsystem and others are directed to NOCPA stages.

The Front-End NOPCPA (Non-collinear Optical Parametric Chirped Pulse Amplifier) consists of several sub-systems: Picosecond Optical Parametric Amplifier (ps-OPA) amplifying oscillator output pulses, Grating Compressor compressing ps-OPA output pulses, White Light Generator (WLG) broadening the spectrum of ps-OPA output pulses and Femtosecond Non-collinear Optical Parametric Amplifier (fs-NOPA) amplifying WLG output pulses.

The Stretcher sub-system is a Grism (diffraction gratings combined together with prisms) based pulse stretcher, which stretches output pulse from NOPCPA Front-End and Dazzler (Acousto-Optic Programmable Dispersive Filter) for high order phase compensation.

Three stages of NOPCPA (Non-collinear Optical Parametric Chirped Pulse Amplifiers) are used to amplify the stretched pulse from the Stretcher up to 50 mJ.

Finally, amplified pulses are compressed down to 11 fs in the Pulse Compressor. Bulk glass compressors are combined together with chirped mirror compressors. Pulse energy after Compressor is >40 mJ.

The built-in Output Diagnostics stage ensures reliable, turn-key operation by monitoring critical parameters such as energy, duration, and beam profile.

UltraFlux FF/FT 5000 SERIES

SPECIFICATIONS 1)

Model	UltraFlux FT5010	UltraFlux FF50100
MAIN SPECIFICATIONS		
Max. Pulse energy	50 mJ	
SH output 4)	inquire	
TH output 4)	inquire	
FH output 4)	inquire	
Wavelength tuning range		
Standard version	750 – 960 nm, fixed at desired wavelength	
SH output 4)	375 – 480 nm	
TH output 4)	250 – 320 nm	
FH output 4)	210 – 230 nm	
Scanning steps		
SH output 4)	5 nm	
TH output 4)	3 nm	
FH output 4)	2 nm	
Pulse duration	20 – 60 fs	10 – 20 fs
Pulse repetition rate	10 Hz	100 Hz
Pulse energy stability	< 1.5 %, rms	< 2.0 %, rms
Long-term power stability	< 1.5 %, rms	
Spatial mode	Super Gaussian	Top-Hat
Beam diameter (1/e²)	7 mm	20 mm
Pulse contrast 2)	≥ 10^{-6} : 1 (within ± 50 ps)	
	≥ 10^{-8} : 1 (in ns range)	
Polarization	Linear, horizontal	
Beam pointing stability	≤50 µrad, rms	
Optical to RF signal jitter 3)	< 1 ps	
Footprint on optical table	1.2 × 2.0 m	1.2 × 4.8 m

1) Presented parameters are from delivered systems and can be customized to meet customer's requirements.

2) Pulse contrast is only limited by amplified parametric fluorescence (APF) in the temporal range of ~90 ps which covers OPCPA pump pulse duration and is better than 10^6 : 1. APF contrast depends on OPCPA saturation level (Fig. below). Our system is ASE-free and pulse contrast value in nanosecond range is limited only by measurement device capabilities (third-order autocorrelator). There are no pre-pulses generated in the system and post-pulses are eliminated by using wedged transmission optics.

3) With -PLL option purchased.

4) With SH/TH or SH/TH/FH module.

BLOCK DIAGRAM

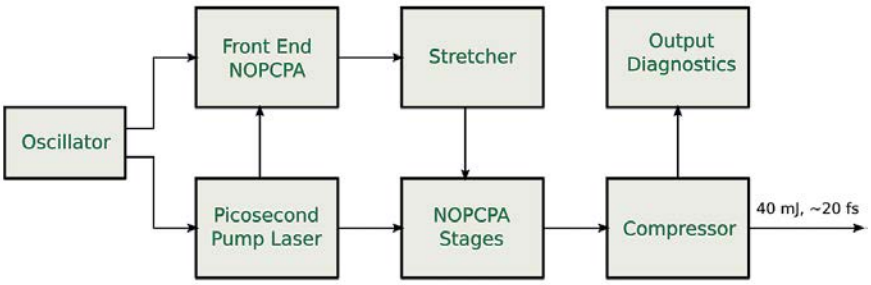

Fig. 1. UltraFlux FF/FT 5000 laser block diagram

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PERFORMANCE

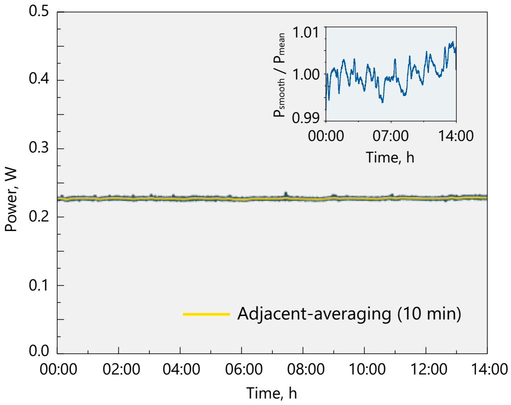

Fig 2. Long-term power stability measurement at 800 nm wavelength

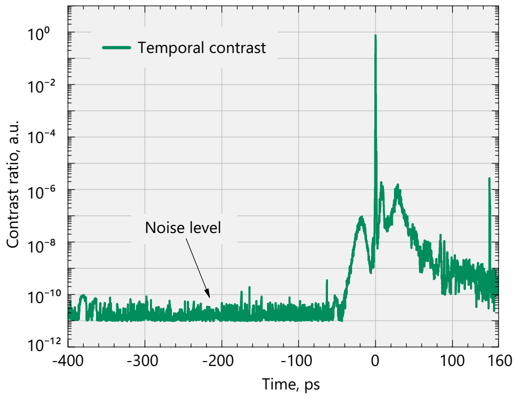

Fig 3. Typical temporal contrast of UltraFlux systems

BEAM PROFILE

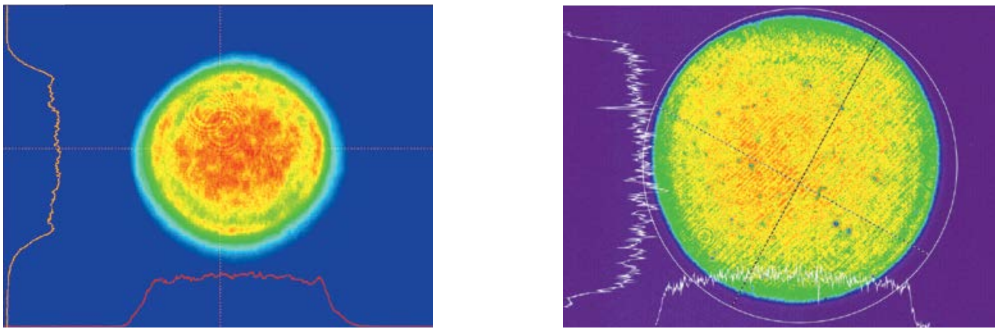

Fig 4. Typical UltraFlux system output at ~60 mJ energy (left) and 532 nm pump beam at 2.5 J energy (right) beam profiles

APL2100 SERIES

High Energy Picosecond Amplifiers

APL210x series amplifiers are designed to produce up to 2200 mJ picosecond pulses. High pulse energy, excellent pulse-to-pulse energy stability, superior beam quality makes APL210x series picosecond amplifiers well suited for applications like OPCPA pumping, non-linear optics and others. Ekspla can offer a seeder meeting customer's requirements.

Regenerative amplifier / Power amplifier design

APL210x series amplifiers are designed to be seeded by external seeding source. Diode pumped regenerative amplifier ensures amplification of seed signal to stable mJ level pulse for amplification in linear amplifiers. Advanced beam shaping ensures smooth, without hot spots beam spatial profile at the laser output. Low light depolarization level allows high efficiency generation of up to 4th harmonic with optional build-in harmonic generators.

Build-in harmonic generators

Angle-tuned DKDP crystals harmonic generators mounted in temperature stabilized heaters are used for second, third and fourth harmonic generation.

Harmonic separation system is designed to ensure high spectral purity of radiation and direct it to the output ports.

Simple and convenient laser control

For customer convenience the amplifier can be controlled through remote control pad or USB interface. The control pad features a backlit display that is easy to read even while wearing laser safety eyewear. Alternatively, the amplifier can be controlled from personal computer with supplied software for Windows™ operating system. LabVIEW™ drivers are supplied as well.

Repetition rate and timing of the pulses can be locked to the external RF source (with –PLL option) or other ultrafast laser system (with –FS option).

APL2100 series available models

Model	Features
APL2101	Delivers 200 mJ, 90 ps pulses at 10 Hz repetition rate
APL2103	Delivers 300 mJ, 90 ps pulses at 10 Hz repetition rate
APL2105	Delivers 550 mJ, 90 ps pulses at 10 Hz repetition rate
APL2106	Delivers 1000 mJ, 90 ps pulses at 10 Hz repetition rate
APL2107	Delivers 2200 mJ, 90 ps pulses at 10 Hz repetition rate

FEATURES

- *Diode pumped regenerative amplifier*
- *Seeding of regenerative amplifier with customers super-continuum seeding source*
- *Wide selection of seeders available*
- *Flashlamp pumped power amplifier*
- *Advanced beam shaping for high pulse energy*
- *Thermally induced birefringence compensated design for high pulse repetition rates*
- *Low jitter synchronisation pulses for streak camera triggering with 10 ps rms jitter (optional)*
- *Water-water heat exchanger for cooling of pump chambers*
- *Remote control pad*
- *Control through CAN or USB interface (RS232 and LAN is optional)*
- *Optional temperature stabilized second, third and fourth harmonic generators*

APPLICATIONS

- *OPCPA pumping*
- *OPG/OPA pumping*
- *Other spectroscopic and nonlinear optics applications...*

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APL2100 SERIES

SPECIFICATIONS [1]

Model	APL2101	APL2103	APL2105	APL2106	APL2107
Output energy					
at 1064 nm	200 mJ	300 mJ	550 mJ	1000 mJ	2200 mJ
at 532 nm [2]	100 mJ	150 mJ	250 mJ	500 mJ	1100 mJ
at 355 nm [3]	60 mJ	90 mJ	170 mJ	300 mJ	inquire
at 266 nm [4]	20 mJ	30 mJ	60 mJ	100 mJ	inquire
Pulse energy stability (StdDev) [5]					
at 1064 nm	1.5 %				
at 532 nm	2.5 %				
at 355 nm	5 %				
at 266 nm	7 %				
Pulse duration (FWHM) [6]	90 ± 10 ps				
Pulse repetition rate [7]	10 Hz				
Triggering mode	external				
Spatial mode [8]	super-Gaussian				
Beam divergence [9]	< 0.5 mrad				
Typical beam diameter [10]	~ 11 mm			~ 17 mm	~ 24 mm
Beam pointing stability [5]	< ±60 µrad				
Pre-pulse contrast	> 200 : 1				
Polarization	linear, > 100 : 1				
INPUT					
Wavelength	1064 nm				
Pulse duration range (FWHM)	20 – 90 ps				
Pulse repetition rate	50 – 95 MHz				
Average power	> 20 mW				
PHYSICAL CHARACTERISTICS					
Laser head size (W×L×H)	600 × 1500 × 350 mm			600 × 1800 × 350 mm	TBA
Power supply size (W×L×H)	550 × 600 × 1100 mm			550 × 600 × 1230 mm	TBA
OPERATING REQUIREMENTS					
Water service	< 12 l/min, below 20 °C				< 25 l/min, below 20 °C
Relative humidity	20–80 % (non condensing)				
Operating ambient temperature	22 ± 2 °C				
Mains voltage	208 or 230 V AC, single phase, 50/60 Hz				220, 380 or 400 V AC, three phases, 50/60 Hz
Power rating [11]	< 2 kVA	< 2 kVA	< 2.5 kVA	< 4.5 kVA	< 12 kVA

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 for basic system without options.

2) For APL210x-SH and APL210x-SH/FH options. Outputs are not simultaneous.

3) For APL210x-TH option. Outputs are not simultaneous.

4) For APL210x-SH/FH option. Outputs are not simultaneous.

5) Rms, measured over 30 s.

6) Optional 30 ps duration. Inquire for pulse energies.

7) Should be specified when ordering. Inquire for custom pulse repetition rates.

8) Gaussian fit >80%.

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

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

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

OPTIONS

- **Option P30.** Provides 30±3 ps output pulse duration. Contact EKSPLA for pulse energy specifications.
- **Seeder.** Optional seeder can be provided on request.
- **Option FS.** External seeder input via motorized spectral broadening stage for APL2100 series.
- **Option PLL.** Precise trigger to external RF signal with jitter < 1 ps.
- **AW Water-air cooling option.** Water-air cooling unit or chiller for APL2100 series.
- **20 Hz option.** 20 Hz output at all wavelengths with reduced energy output
- **Multiple channel option.** Multiple outputs of same or different wavelength/energy are available.

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.

APL2105-P90-10-SH/TH/FH

Model

Pulse duration:
P90 → 90 ps
P30 → 30 ps

Pulse repetition rate in Hz

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

APL2200 SERIES

High Energy kHz Repetition Rate Picosecond Amplifiers

APL2200 series amplifiers are designed to produce up to 130 mJ picosecond pulses at kilohertz pulse repetition rate. Short pulse duration, excellent pulse-to-pulse stability, superior beam quality makes APL2200 series diode pumped picosecond amplifiers well suited for applications like OPCPA pumping, non-linear optics and others.

Regenerative amplifier / Power amplifier design

APL2200 series amplifiers consist of regenerative amplifier and power amplifiers. System could be seeded by built-in picosecond oscillator or other ultrafast laser system. Pulses from regenerative amplifier are spatially shaped and amplified in double-pass amplifiers with thermally induced birefringence compensation. Advanced optical design ensures smooth, without hot spots beam spatial profile at the laser output. Low light depolarization level allows high efficiency generation of up to 4th harmonic with build-in harmonic generators. Repetition rate and timing of the pulses can be locked to the external RF source (with –PLL option) or other ultrafast laser system (with –FS option).

Build-in harmonic generators

Angle-tuned LBO and/or BBO crystals mounted in temperature stabilized heaters are used for second, third and fourth harmonic generation. Harmonic separation system is designed to ensure high spectral purity of radiation and direct it to the output ports.

Simple and convenient laser control

For customer convenience the amplifier can be controlled through remote control pad or USB interface. Alternatively, the amplifier can be controlled from personal computer with supplied software for Windows™ operating system. LabVIEW™ drivers are supplied as well.

FEATURES

- *High pulse energy at **kHz** rate*
- *Diode pumped **solid state design***
- *Cooled by supplied chiller – tap water is not required (optional)*
- ***Low** maintenance **costs***
- *Remote control pad*
- *PC control via USB with supplied LabVIEW™ drivers*
- *Optional temperature stabilized second, third and fourth harmonic generators*

APPLICATIONS

- *OPG/OPA pumping*
- *OPCPA pumping*
- *Other spectroscopic and nonlinear optics applications...*

APL2200 series available models

Model	Features
APL2201	Delivers 10 mJ, 90 ps pulses at up to 1 kHz repetition rate
APL2203	Delivers 30 mJ, 90 ps pulses at up to 1 kHz repetition rate
APL2205	Delivers 60 mJ, 90 ps pulses at up to 1 kHz repetition rate
APL2206	Delivers 130 mJ, 90 ps pulses at up to 1 kHz repetition rate

Femtosecond Lasers
Picosecond Lasers
Picosecond Tunable Systems
Nanosecond Lasers
Nanosecond Tunable Lasers
High Intensity Lasers
Other Ekspla Products

SPECIFICATIONS [1]

Model	APL2201	APL2203	APL2205	APL2206
Output energy				
at 1064 nm	10 mJ	30 mJ	60 mJ	130 mJ
at 532 nm [2]	5 mJ	15 mJ	30 mJ	70 mJ
at 355 nm [3]	3 mJ	10 mJ	20 mJ	inquire
at 266 nm [4]	1 mJ	2.5 mJ	4 mJ	inquire
Pulse energy stability (StdDev) [5]				
at 1064 nm	1 %			
at 532 nm	1.5 %			
at 355 nm	2 %			
at 266 nm	4 %			
Pulse duration (FWHM) [6]	90±10 ps			
Pulse repetition rate [7]	1000 Hz			
Triggering mode	external			
Spatial mode [8]	super-Gaussian			
Beam divergence [9]	< 1 mrad	< 0.7 mrad		
Typical beam diameter [10]	~ 3 mm	~ 5 mm	~ 6 mm	~ 7 mm
Beam pointing stability [5]	< 100 µrad			
Pre-pulse contrast	> 100 : 1			
Polarization	linear, > 95 %			
INPUT				
Wavelength	1064 nm			
Pulse duration range (FWHM)	20 fs – 90 ps			
Pulse repetition rate	50 – 95 MHz			
Average power	>20 mW			
PHYSICAL CHARACTERISTICS				
Laser head size (W×L×H)	455 × 1035 × 242 mm	900 × 1500 × 350 mm	1200 × 2200 × 350 mm	TBA
Power supply size (W×L×H)	550 × 600 × 680 mm	550 × 600 × 1100 mm	550 × 600 × 1030 mm	TBA
Chiller size (W×L×H)	400 × 430 × 790 mm		500 × 500 × 850 mm	600 × 600 × 600 mm
OPERATING REQUIREMENTS				
Water service	not required, air-cooled			water-cooled
Relative humidity	20–80 % (non condensing)			
Operating ambient temperature	22 ± 2 °C			
Mains voltage	208 or 230 V AC, single phase, 50/60 Hz			208 or 230 V AC, three phases, 50/60 Hz
Power rating [11]	< 1 kVA	< 2.5 kVA	< 5 kVA	< 14 kVA

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 for basic system without options.

2) For APL210x-SH and APL210x-SH/FH options. Outputs are not simultaneous.

3) For APL210x-TH option. Outputs are not simultaneous.

4) For APL210x-SH/FH option. Outputs are not simultaneous.

5) Rms, measured over 30 s.

6) Optional 30 ps duration. Inquire for pulse energies.

7) Should be specified when ordering. Inquire for custom pulse repetition rates.

8) Gaussian fit >80%.

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

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

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

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OPTIONS

- **Option P30.** Provides 30±3 ps output pulse duration. Contact EKSPLA for pulse energy specifications.
- **Option FS.** External seeder input via motorized spectral broadening stage for APL2100 series.
- **Option PLL.** Precise trigger to external RF signal with jitter < 1 ps.
- **AW Water-air cooling option.** Water-air cooling unit or chiller for APL2100 series.
- **Multiple channel option.** Multiple outputs of same or different wavelength/energy are available.

BEAM PROFILE

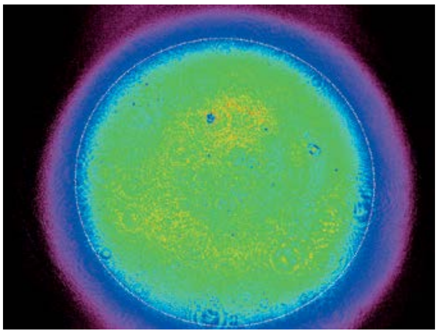

Fig 1. Typical beam profile at APL2200 amplifier output

OPTICAL LAYOUT

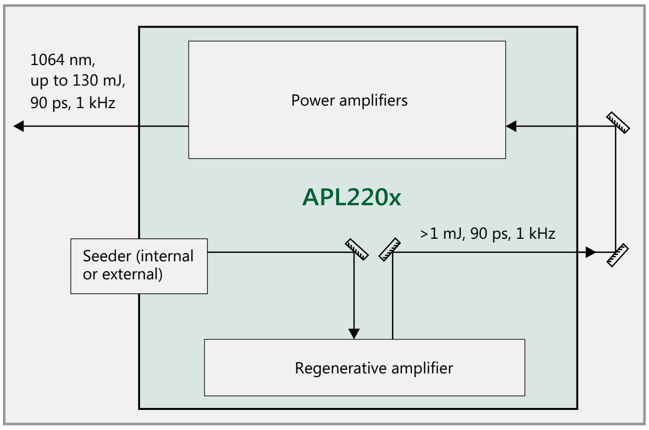

Fig 2. Block optical layout of APL2200 series amplifier

ORDERING INFORMATION

Recommended seed laser for 90 ps is PL2210B. For 30 ps pulse duration use PL2210A as seed laser.

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.

APL2201-P90-1K-SH/TH/FH

- Model
- Pulse duration:
  P90 → 90 ps
  P30 → 30 ps
- Pulse repetition rate in Hz,
  1K = 1000 Hz
- Harmonic generator options:
  SH → second harmonic
  TH → third harmonic
  FH → fourth harmonic

APL4206 SERIES

High Energy Picosecond Amplifiers

APL4200 series amplifiers are designed to produce multiple outputs of up to 130 mJ picosecond pulses at up to 1 kHz pulse repetition rate. Short pulse duration, excellent pulse-to-pulse stability, superior beam quality makes APL4200 series diode pumped picosecond amplifiers well suited for applications like multiple stage OPCPA pumping, non-linear optics and others.

Regenerative amplifier/Power amplifier design

APL4200 series amplifiers consist of regenerative and power amplifiers. System could be seeded by built-in picosecond oscillator or other ultrafast laser system. Pulses from regenerative amplifier are spatially shaped and amplified in double-pass amplifiers with thermally induced birefringence compensation. Advanced optical design ensures smooth, without hot spots beam spatial profile at the laser output. Low light depolarization level allows high efficiency generation of up to 4th harmonic with build-in harmonic generators. Repetition rate and timing of the pulses can be locked to the external RF source (with –PLL option) or other ultrafast laser system (with –FS option).

Simple and convenient laser control

For customer convenience the amplifier can be controlled through Laser Control software via USB interface (control PC included). Alternatively, the amplifier can be controlled from personal computer with supplied software for Windows™ operating system. LabVIEW™ drivers are supplied as well.

Build-in harmonic generators

Angle-tuned LBO and/or BBO crystals mounted in temperature stabilized heaters are used for second, third and fourth harmonic generation. Harmonic separation system is designed to ensure high spectral purity of radiation and direct it to the output ports.

FEATURES

- *High pulse energy up to **1 kHz** rate*
- *Diode pumped solid state design*
- *Cooled by supplied water-to-water chiller*
- *Low maintenance costs*
- *PC control via USB with supplied, LabVIEW™ drivers*
- *Optional temperature stabilized second, third and fourth harmonic generators*

APPLICATIONS

- *Multiple stage OPCPA pumping*
- *Non-linear optics*
- *Other spectroscopic and nonlinear optics applications*

SPECIFICATIONS [1]

Model	APL4206
MAIN SPECIFICATIONS	
Central wavelength	1064 nm
Output energy	up to 8 channels × ≥130 mJ
Pulse energy stability [2]	≤ 1 %
Pulse duration (FWHM)	90 ± 10 ps
Pulse repetition rate	1 kHz
Spectral bandwidth	≤ 1 cm^{-1}
Triggering mode	external
Spatial mode	Top-Hat
Beam divergence	< 0.7 mrad
Beam diameter [3]	~ 8 mm
Beam pointing stability [2]	< 30 µrad
Beam local intensity fluctuation [4]	< ±15 %
Deviation of spatial parameters between beams	±10 %
Pre-pulse contrast [5]	> 200:1
Polarization contrast	> 100:1
Polarization	linear, horizontal
PHYSICAL CHARACTERISTICS	
Laser head size (W×L×H)	1500 × 3000 × 400 mm (preliminary)
Power supply size (W×L×H)	553 × 600 × 1200 mm – 1 unit 553 × 600 × 500 mm – 1 unit
OPERATING REQUIREMENTS	
Warm up time	< 30 min
Total water consumption	< 20 l/min, 2 bar, 20 °C
Relative humidity	20–80 % (non condensing)
Operating ambient temperature	22 ± 2 °C
Mains voltage	208, 380 or 400 V AC, three phases, 50/60 Hz
Power rating	< 22 kVA
Cleanness of the room	ISO Class 7 or 10000 as per U.S. Fed Std. 209 (5 VDI 2083, C GMP)

1) With "-internal oscillator" and "-PLL" options.
2) Rms, measured over 30 s.
3) Beam diameter is measured at the $1/e^2$ level.
4) From the average intensity across 80 % of beam cross-section (or beam diameter measured at $1/e^2$ level).
5) Peak-to-peak in respect to residual pulses.

BEAM PROFILE

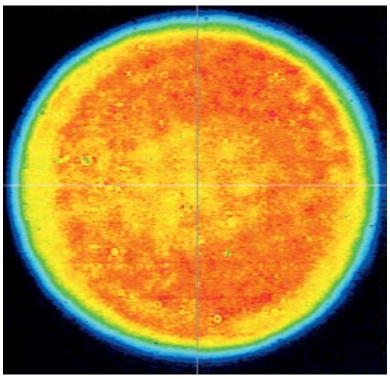

Fig 1. Typical beam profile of APL4206 series laser (measured at the relay image plane)

NL120 SERIES

SLM Q-switched Nd:YAG Lasers

NL120 series electro-optically Q-switched nanosecond Nd:YAG lasers deliver up to 10 J per pulse with excellent stability. The innovative, diode-pumped, self-seeded master oscillator design results in Single Longitudinal Mode (SLM) output without the use of external expensive narrow linewidth seed diodes and cavity-locking electronics. Unlike more common designs that use an unstable laser cavity, the stable master oscillator cavity produces a TEM_{00} spatial mode output that results in excellent beam properties after the amplification stages.

NL120 series Q-switched nanosecond lasers are an excellent choice for many applications, including OPO, OPCPA or dye laser pumping, holography, LIF spectroscopy, remote sensing, optics testing and other tasks.

For tasks that require a smooth and as close as possible to the Gaussian beam profile, models with improved Gaussian fit are available.

The low jitter of the optical pulse with respect to the Q-switch triggering pulse allows the reliable synchronization between the laser and external equipment.

The optional second (SH) (for 532 nm), third (TH) (for 355 nm) and fourth (FH) (for 266 nm) harmonic generators provide access to shorter wavelengths.

The laser is controlled by a supplied PC via USB port with application for Windows™ operating system.

In addition, the main settings of the laser can be controlled through an auxiliary remote control pad. The remote pad features a backlit display that is easy to read even when wearing laser safety eyewear.

FEATURES

- *Up to **10 J** pulse energy*
- *Diode-pumped, self-seeded Single Longitudinal Mode (SLM) master oscillator*
- *Stable master oscillator cavity producing TEM_{00} spatial mode output*
- *Excellent pulse energy stability*
- *Up to **10 Hz** pulse repetition rate*
- ***2 ns** pulse duration (7, 10 or 25 ns are optional)*
- *Temperature stabilized harmonic generator options*
- *Remote control via keypad*
- *Laser control from PC via USB port*

APPLICATIONS

- *Material processing*
- *OPO, OPCPA, Ti:Sapphire, dye laser pumping*
- *Holography*
- *Nonlinear laser spectroscopy*
- *Optics testing*

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SPECIFICATIONS [1]

Model	NL125	NL128	NL129
Pulse energy [2]			
at 1064 nm	1600 mJ	5000 mJ	10000 mJ
at 532 nm [4]	700 mJ	TBA [3]	TBA [3]
at 355 nm [5]	450 mJ	TBA [3]	TBA [3]
at 266 nm [6]	140 mJ	TBA [3]	TBA [3]
Pulse energy stability (StdDev) [7]			
at 1064 nm	< 1 %		
at 532 nm [4]	< 2 %		
at 355 nm [5]	< 3 %		
at 266 nm [6]	< 5 %		
Pulse duration at 1064 nm (FWHM) [8]	2 ± 0.5 ns (7, 10 or 25 ns are optional)		
Pulse repetition rate	10 Hz		
Linewidth	$\le 0.02\ cm^{-1}$ (SLM)		
Polarization at 1064 nm [9]	linear, > 90 %		
Optical pulse jitter (StdDev) [10]	< 0.2 ns		
Beam spatial profile [11]	Hat-Top, > 70 % fit		
Typical beam divergence [12]	< 0.5 mrad		
Beam pointing stability [13]	< 25 μrad		
Typical beam diameter [14]	~ 12 mm	~ 20 mm	~ 27 mm
PHYSICAL CHARACTERISTICS			
Laser head size (W × L × H)	455 × 1220 × 270 mm	600 × 1500 × 300 mm	600 × 2000 × 300 mm
Power supply size (W × L × H)	550 × 600 × 1030 mm	550 × 600 × 1030 mm 2 units	550 × 600 × 1650 mm 2 units
Umbilical length	2.5 m		
OPERATING REQUIREMENTS			
Water consumption (max. 20 °C)	< 20 l/min		
Ambient temperature	22 ± 2 °C		
Relative humidity	10 – 80 % (non-condensing)		
Power requirements [15]	220, 380 or 400 V AC, three-phase 50/60 Hz		
Power consumption	< 5 kVA	< 8 kVA	< 10kVA

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) Contact EKSPLA for more information.
4) For NL12×-SH and NL12×-SH/FH options.
5) For NL12×-TH option.
6) For NL12×-SH/FH option.
7) Averaged over 30 s.
8) Optional 7, 10 or 25 ns pulse duration. Inquire for pulse energy specifications.
9) For models without harmonic generators.
10) With respect to Q-switch triggering pulse.
11) Measured at 1 m distance from the laser output. Improved Gaussian fit beam profile is available (contact Ekspla for details).
12) Full angle measured at the $1/e^2$ point at 1064 nm.
13) Full angle, rms measured over 30 s.
14) Beam diameter is measured at 1064 nm at the $1/e^2$ level.
15) Mains should be specified when ordering.

OPTIONS

▶ **-P7, -P10 and -P25 options — 7 ns, 10 ns or 25 ns pulse duration**

For applications requiring longer pulse duration the laser master oscillator cavity can be modified to produce 7 ns, 10 ns or 25 ns pulses. Note: some of other specifications can be changed. Please contact Ekspla for detailed datasheets.

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.

NL125-10-P8-SH/TH

- Model
- Pulse repetition rate in Hz
- Pulse duration options:
  default → 2 ns pulse duration
  P8 → 8±2 ns pulse duration
- Harmonic generator options:
  SH → second harmonic
  TH → third harmonic

NL310 SERIES

High Energy Q-switched Nd:YAG Lasers

FEATURES

- *Up to **10 J** output energy*
- *Better than 0.5% rms pulse energy stability*
- ***4–6 ns** pulse duration*
- ***10** or **20 Hz** repetition rate*
- *Temperature stabilized second, third, fourth and fifth harmonic generators*
- *Remote control via keypad or USB-CAN port*
- *Low jitter internal/external synchronization*
- *Robust and stable laser head*

APPLICATIONS

- *OPO, Ti: Sapphire, dye laser pumping*
- *Material processing*
- *Plasma generation and diagnostics*
- *Nonlinear spectroscopy*
- *Remote sensing*

High pulse energy NL310 series lasers are targeted for applications like OPO or Ti: Sapphire pumping, material processing and plasma diagnostics. These lasers can produce pulse energies up to 10 J in fundamental wavelength at 10 Hz pulse repetition rate.

For the convenience of customers the NL310 series nanosecond Q-switched laser can be controlled either through a remote keypad or USB-CAN port. The remote keypad allows easy control of all parameters and features a backlit display that is easy to read even wearing laser safety eyewear.

Software for Windows™ operating system is provided to control the laser from PC. LabView™ drivers are supplied as well, allowing laser control integration into existing Labview™ programs.

The optional second (SH, 532 nm), third (TH, 355 nm), fourth (FH, 266 nm) and fifth (FiH, 213 nm) harmonic generators can be integrated into laser head or placed outside laser head into auxiliary harmonic generator module. Output wavelength switching is done manually. Motorized wavelength switching is available by request.

Triggering of the laser is possible from built-in internal or external pulse generator. Pulses with TTL levels are required for external triggering. Laser pulses have less than 0.5 ns rms jitter with respect to Q-switch triggering pulse in both cases.

The simple and field proven design ensures easy maintenance and reliable long-term operation of the NL310 series laser.

Optional Relay Imaging for smooth beam profile is available.

SPECIFICATIONS 1)

Model	NL311	NL313	NL314	NL315	NL317	NL319
Pulse energy:						
at 1064 nm	1300 mJ	1600 mJ	2000 / 1800 mJ	3500 mJ	5000 mJ	10000 mJ
at 532 nm 2) 6)	600 mJ	800 mJ	1000 / 900 mJ	1700 mJ	2500 mJ	5000 mJ
at 355 nm 3) 6)	390 mJ	490 mJ	610 / 600 mJ	1000 mJ	1300 mJ	2000 mJ
at 266 nm 4) 6)	130 mJ	180 / 150 mJ	190 / 160 mJ	270 mJ	400 mJ	700 mJ
at 213 nm 5) 6)	25 / 20 mJ	30 / 25 mJ	40 / 30 mJ	inquire		
Pulse energy stability (StdDev): 7)						
at 1064 nm	0.5 %					
at 532 nm	1.5 %					
at 355 nm	2.5 %					
at 266 nm	4.0 %					
at 213 nm	6.0 %					
Power drift 8)	± 2 %					
Pulse duration 9)	4–6 ns			4–7 ns		
Repetition rate	10 / 20 Hz			10 Hz		
Polarization	vertical, > 90 %					
Optical pulse jitter 10)	< 0.5 ns					
Linewidth	< 1 cm^{-1}					
Beam profile 11)	"Hat-Top" (near field), near Gaussian (far field)					
Typical beam diameter 12)	~ 10 mm	~ 12 mm		~ 18 mm	~ 21 mm	~ 27 mm
Beam divergence 13)	< 0.5 mrad					
Beam pointing stability 14)	± 50 µrad					
PHYSICAL CHARACTERISTICS						
Laser head (W × L × H)	460 × 1250 × 260 mm	310 × 800 × 230 mm / 460 × 1250 × 260 mm	460 × 1250 × 260 mm			600 × 1800 × 300 mm
Power supply unit (W × L × H)	553 × 600 × 653 mm / 553 × 600 × 832 mm		553 × 600 × 832 mm / 553 × 600 × 1020 mm	550 × 600 × 1250 mm		550 × 600 × 1640 mm
Umbilical length	2.5 m					
OPERATING REQUIREMENTS						
Water consumption (max 20 °C) 15)	< 8 / < 12 l/min		< 12 / < 16 l/min	< 12 l/min		
Ambient temperature	22 ± 2 °C					
Relative humidity	20 – 80 % (non-condensing)					
Power requirements 16)	208–240 V AC, single phase 50/60 Hz / 220, 380 or 400 V AC, three phases, 50/60 Hz		220, 380 or 400 V AC, three phases, 50/60 Hz			
Power consumption	<2 / <3.5 kVA	<2.5 / <4 kVA	<4 / <5 kVA	<5 kVA	<6 kVA	<8 kVA

1) Due to continuous improvement, all specifications 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 -SH harmonic generator option.
3) For -SH/TH harmonic generator option.
4) For -SH/FH, -SH/TH/FH or -SH/FH/FiH harmonic generator option.
5) For -SH/FH/FiH harmonic generator option.
6) Harmonic outputs are not simultaneous; only single wavelength beam is present at the output at once. Manual reconfiguration is required to switch wavelength.
7) Averaged from pulses, emitted during 30 sec time interval after 5–15 minutes of warm-up.
8) Measured over 8 hours period after 20 min warm-up when ambient temperature variation is less than ±2 °C.
9) FWHM.
10) Standard deviation value, measured with respect to Q-switch triggering pulse.
11) Near field (at the output aperture) TOP HAT fit is >70%.
12) Beam diameter is measured at 1064 nm at the $1/e^2$ level.
13) Full angle measured at the $1/e^2$ level at 1064 nm.
14) Beam pointing stability is evaluated as movement of the beam centroid in the focal plane of a focusing element.
15) Water air cooling chiller is possible. Inquire for details.
16) Mains voltage should be specified when ordering.

OPTIONS

- **-G option.** For models NL311, NL313. Provides beam profile optimized for applications requiring smooth, without hot spots beam profile in the near and medium field.
  Pulse energies typically are lower by 30% in comparison to standard lasers without -G option.
- Multimode spatial beam profile for smooth envelope. $M^2 > 20$.
- **-RLI.** Optional Relay Imaging for smooth beam profile.

BEAM PROFILE

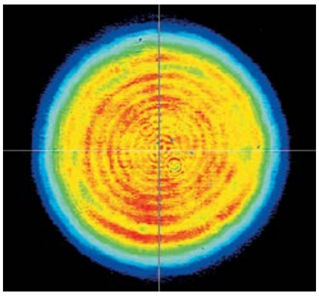


Fig 1. Typical beam profile of NL313 laser output

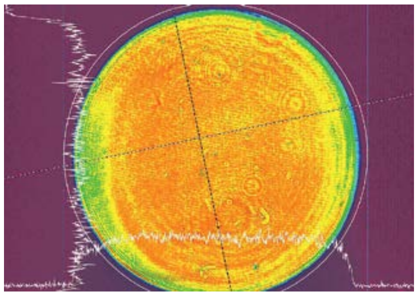


Fig 2. Typical NL319 beam profile after image relay system at 10 J at 1064 nm (with -RLI option)

OUTLINE DRAWINGS

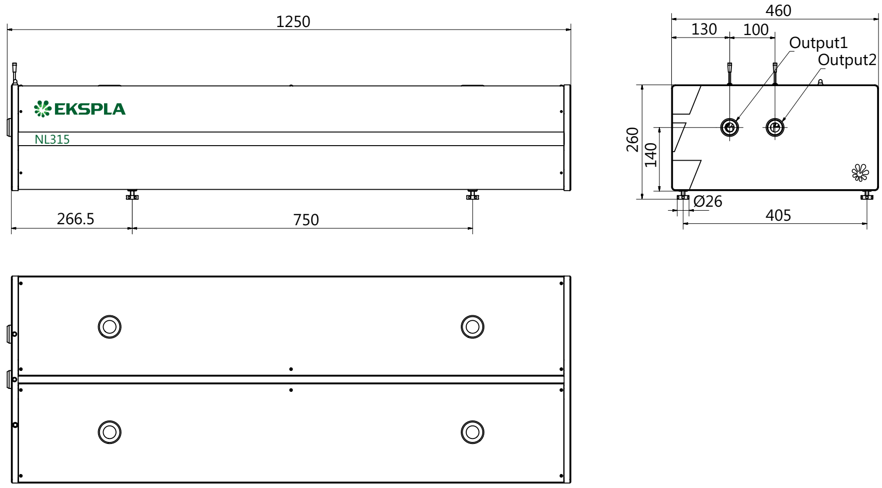


Fig 3. NL315 and NL317 lasers head outline drawing

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.

NL313-10-SH/TH/FH-AW

Model

Pulse repetition rate in Hz

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

Options:
AW → water-air heat exchanger

NL940 SERIES

High Energy Temporaly Shaped Nanosecond Nd:YAG Lasers

Main laser feature is output of temporaly shaped pulses based on electrooptical modulator driven by programmable arbitrary waveform generator (AWG). Pulse shaping resolution is 125 ps, while maximum pulse length is 10 ns. Start of the system is single mode CW laser. Then light is amplified in fiber amplifier, later AWG driven modulator transmits only required temporal shape and duration pulse which is amplified in diode pumped regenerative amplifier in order to reach energy sufficient to amplify in single-pass flash-lamp pumped amplifiers. Power amplifier is a chain of single-pass amplifiers where pulse is amplified up to required energy. During amplification spatial beam shaping is used in order to get flat top shape at the output. Optional second/third harmonic generators are based on angle tuned nonlinear crystals placed in temperature stabilized heaters.

FEATURES

- *Variable temporal pulse shape*
- *Up to **10 J** output energy*
- ***10 Hz** repetition rate*
- ***3 – 10 ns** adjustable pulse duration*
- *1064 or 532 nm output wavelength*
- *Spatial flat top beam profile*
- *Fiber front end output amplified in diode pumped regenerative amplifier*

APPLICATIONS

- *OPCPA pumping*
- *Front end for power amplifiers*
- *Ti: Sapphire pumping*
- *Laser peening – material hardening by laser-induced shock wave*
- *Plasma and shock physics*

SPECIFICATIONS [1]

Model	NL944	NL945	NL949
Pulse energy (rectangular pulse in time domain 5 ns FWHM)			
at 1064 nm	1.6 J	5 J	10 J
at 532 nm [2]	1.0 J	2.5 J	6 J
Pulse energy stability (Std Dev) [3]			
at 1064 nm	0.5 %		
at 532 nm	1.0 %		
Power drift [4]	± 2 %		
Pulse duration [5]	3 – 10 ns, variable with 125 ps resolution		
Repetition rate	10 Hz		
Polarization @ 1064 nm	vertical, > 90 %		
Optical pulse jitter [6]	< 30 ps		
Linewidth	< 0.1 cm^{-1}		
Beam profile	Hat-Top" (at laser output), without diffraction rings		
Typical beam diameter [7]	~ 11 mm	~ 22 mm	~ 33 mm
Beam divergence [8]	< 0.5 mrad		
Beam pointing stability	±50 µrad		
PHYSICAL CHARACTERISTICS			
Laser head (W × L × H)	750 × 1350 × 300 mm	700 × 2100 × 300 mm	1000 × 2100 × 300 mm
Power supply unit (W × L × H)	550 × 600 × 840 mm – 1 unit 550 × 600 × 670 mm – 1 unit	550 × 600 × 1220 mm - 2 units	550 × 600 × 1220 mm - 2 units 550 × 600 × 670 mm – 1 unit
Umbilical length	3 m		
OPERATING REQUIREMENTS			
Water consumption (max 20 °C)	< 8 l/min		< 40 l/min
Ambient temperature	22 ± 2 °C		
Relative humidity	20 – 80 % (non-condensing)		
Power requirements [9]	208/240 V AC, single phase, 50/60 Hz or 220, 380 or 400 V AC, three phases, 50/60 Hz		220, 380 or 400 V AC, three phases, 50/60 Hz
Power consumption	5.5 kW		13.2/6.6 kW

1) Due to continuous improvement, all specifications subject to change without notice. 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) For NL94X-SH harmonic generator option. Harmonic outputs are not simultaneous; only single wavelength beam is present at the output at once. Manual reconfiguration is required to switch wavelength.
Third harmonic available on request.

3) Standard deviation value averaged from 1000 shots after 20 minutes of warm-up.

4) Deviation from average value measured over 8 hours of operation when room temperature variation is less than ±2 °C.

5) Measured with photodiode with 100 ps rise time and oscilloscope with 600 MHz bandwidth.

6) Standard deviation value, measured with respect to triggering pulse.

7) Beam diameter is measured at 1064 nm at laser output at the $1/e^2$ level and can vary with each unit we manufacture.

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

9) Mains voltage should be specified when ordering.

BEAM PROFILE

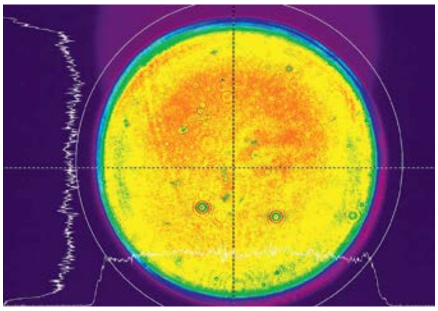


Fig 1. Typical NL949-SH near field beam profile at 5 J at 532 nm

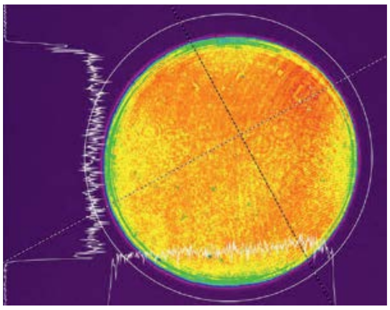


Fig 2. Typical NL945-SH system output beam profile at 532 nm

PERFORMANCE

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.

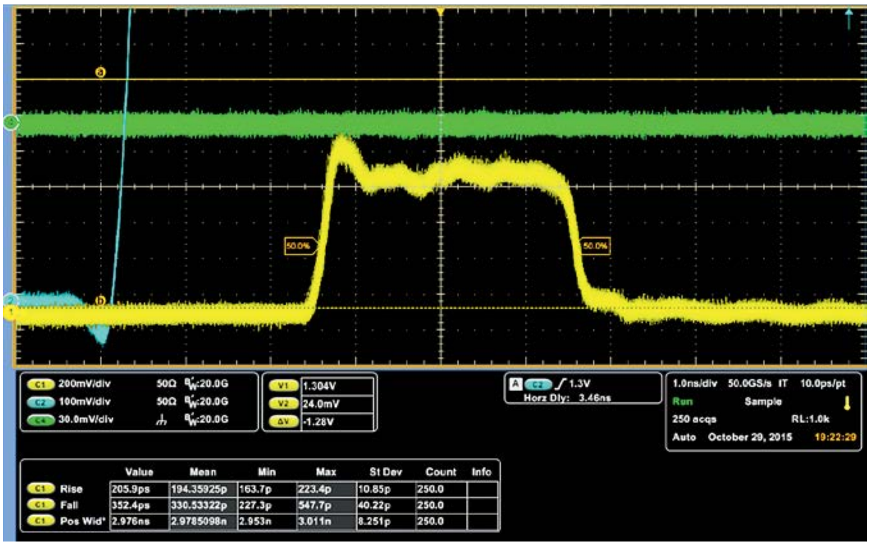


Fig 3. Example of temporal pulse shape, stability of pulse shape and optical pulse jitter

ANL SERIES
High Energy and High Repetition Rate DPSS Nanosecond Lasers

Highly Customizable to Meet Customer Needs

FEATURES

- *Up to **1 J** at **1064 nm** output pulse energy*
- *Up to **1 kHz** repetition rate*
- ***2 – 4 ns** or **5 ns** pulse duration*
- *Spatial flat top beam profile*
- *Low maintenance costs*
- *Various customizing possibilities to tailor for specific applications*
- *Optional second and third harmonics generators*
- *High efficiency diode pumping chambers*
- ***1×2 m** laser head footprint*
- *Internal system diagnostics*
- *Optional industrial grade, portable laser housing with integrated power supplies and cooling units*

ANL series electro-optically Q-switched nanosecond Nd:YAG lasers deliver high energy pulses at high repetition rates.

A diode-pumped Q-switched nanosecond laser, based on industry-tested technology is used as a master oscillator of the system. It produces high-intensity, high-brightness pulses and is well suited for further amplification in linear amplifiers for high-energy flat-top output pulses. Employing electro-optical cavity dumping, the master oscillator can produce pulses which are as short as several ns with uniform beam profile and low divergence.

Power amplifiers are a chain of low-maintenance diode-pumped single and double pass amplifiers where pulses are amplified up to the required energy. During amplification, spatial beam shaping is employed in order to get a flat top shape at the output. Optional second and third harmonic generators are based on angle-tuned nonlinear crystals placed in heaters.

For convenience, PC software for Windows™ (LabVIEW™ drivers are supplied as well) is used for laser operation, monitoring and internal system diagnostics.

To tailor the laser for specific applications or requirements, various customization possibilities are available such as industrial grade, portable laser housing with integrated power supplies and cooling units.

Femtosecond Lasers
Picosecond Lasers
Picosecond Tunable Systems
Nanosecond Lasers
Nanosecond Tunable Lasers
High Intensity Lasers
Other Ekspla Products

SPECIFICATIONS [1)]

Model	ANL 2001k	ANL 4001k	ANL 1k200
MAIN SPECIFICATIONS			
Pulse energy			
at 1064 nm	> 200 mJ	> 400 mJ	> 1000 mJ
at 532 nm [2)]		–	
Pulse energy stability (StdDev): [3)]			
at 1064 nm		1.5 %	
at 532 nm		–	
Power drift [4)]		± 2 %	
Pulse duration [5)]	2 – 4 ns		~ 5 ns
Repetition rate	1000 Hz		200 Hz
Polarization at 1064 nm		horizontal	
Optical pulse jitter [6)]		–	
Linewidth		–	
Beam profile		Hat-Top (at laser output), without diffraction rings	
Typical beam diameter [7)]	~6 mm		~10 mm
Beam divergence [8)]	< 1.0 mrad		< 0.5 mrad
Beam pointing stability		± 30 µrad [3)]	
PHYSICAL CHARACTERISTICS			
Laser head (W × L × H)		1000 × 2000 × 490 mm	
Power supply unit (W × L × H)		553 × 600 × 700 mm	
Umbilical length		2.5 m	
OPERATING REQUIREMENTS			
Facility water consumption (max 20° C)	10 l/min	14 l/min	10 l/min
Ambient temperature		22 ± 2 °C	
Relative humidity		20 – 80 % (non-condensing)	
Power requirements [9)]		208, 380 or 400 V AC, three phase, 50/60 Hz	
Power consumption	<10 kW	<12 kW	<6 kW

1) Due to continuous improvement, all specifications subject to change without notice. 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) For NL94X-SH harmonic generator option. Harmonic outputs are not simultaneous; only single wavelength beam is present at the output at once.

3) Standard deviation value averaged over 30 s after 20 minutes of warm-up.

4) Deviation from average value measured over 8 hours of operation when room temperature variation is less than ±2 °C.

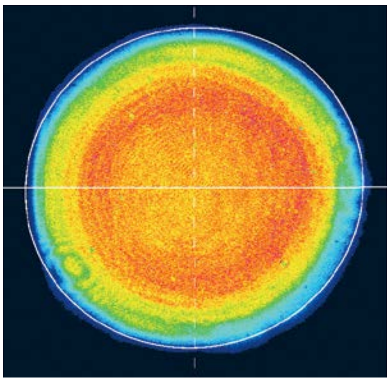
5) Measured with photodiode with 100 ps rise time and oscilloscope with 600 MHz bandwidth.

6) Standard deviation value, measured with respect to triggering pulse.

7) Beam diameter is measured at 1064 nm at laser output at the $1/e^2$ level and can vary with each unit we manufacture.

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

9) Mains voltage should be specified when ordering.



Typical beam profile of ANL4001k laser

Nd:Glass SYSTEMS

Nanosecond High Energy Laser Systems

160 J @ 1053 nm MM laser system

Ekspla offers wide range of high energy Nd:Glass laser systems. Typically Nd:Glass laser comprise SLM diode pumped master oscillator, pre-amplifier, pulse shaper and main lamp pumped amplifiers.

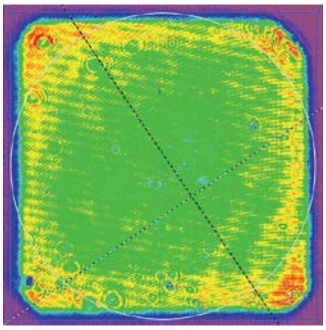
FEATURES

- *Front end options*
  - *Diode pumped SLM or MM master oscillator featuring excellent stability, long lifetime and maintenance-free operation based on Nd:glass or Nd:YLF*
  - *Temporally shaped seeder / regenerative amplifier configuration allowing application of smoothing technics*
  - *Wave front correction system based on DFM*
- *Optional SBS compressor ensuring high contrast pulses and controllable pulse duration*
- *Flashlamp / LD pumped pre-amplifier*
- *Up to Ø60 mm aperture Nd:glass power amplifiers*
- *Laser protection by Faraday isolators preventing damage of laser rods by back-reflected light*
- *Optimized design for maximum pulse energy extraction*
- *Separately controlled PFN circuits for each flash lamp*
- *Diagnostics and monitoring of system status based on microprocessor controller*
- *Software guide for step-by-step performance check at designated control points*
- *Optional second and third harmonic generators*

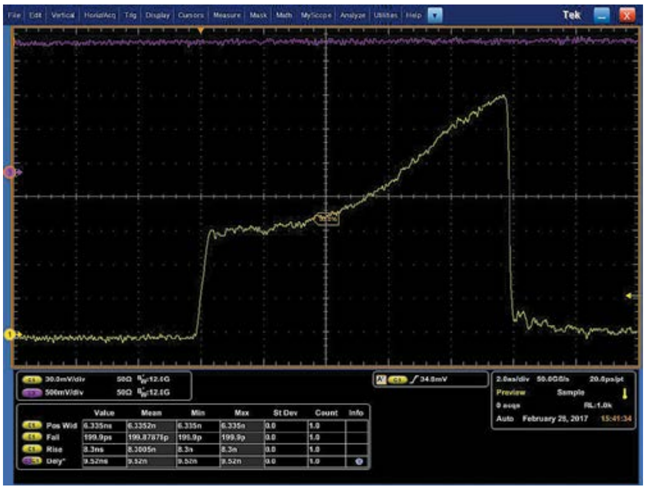
SPECIFICATIONS

Parameter	Value
Center wavelength	1053 – 1060 nm
Pulse width	500 ps – 20 ns
Max pulse energy single channel	160 J
Beam spatial profile (near field)	"Top Hat" across 80% of beam cross-section (beam local intensity fluctuation max ±20% from the average intensity)
Pulse repetition rates	depending on system configuration from 1 shot in 1 min to 1 shot in 20 min for output energies >10 J
Shot to shot stability	below 2.0 % rms @ fundamental in single channel configuration
Linewidth	< 0.02 cm^{-1} @ 2 ns for single longitudinal mode (SLM), < 1 cm^{-1} @ 4 ns for multimode (MM)
Pre-pulse contrast	better than 1 : 10^5
Polarization contrast	> 100 : 1
Output isolation from back-reflected light	> 500 : 1 (Faraday isolator contrast)
Optical pulse jitter	typical < 0.2 ns rms, optional < 10 ps rms
Flashlamp lifetime	2×10^5 shots typical (typically > 3000 hours of non-stop operation at PRR 1 shot/minute)
Pump diode lifetime	> 10 000 hours typical

PERFORMANCE

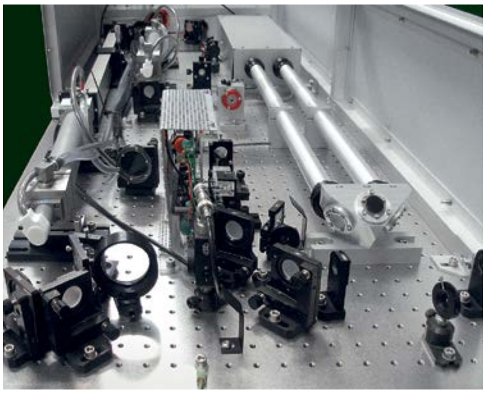


Spatial shaping of 33 J @ 1053 nm output pulses (beam of rectangular shape)

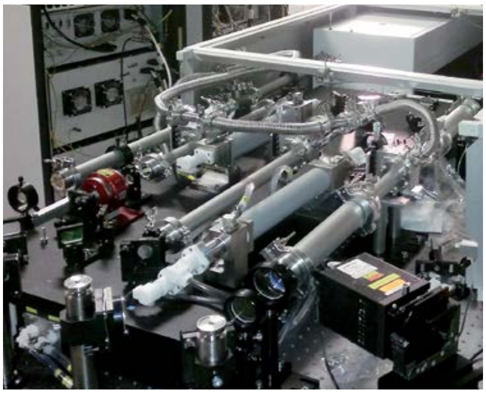


One example of the pulse wave form at the output @ 33 J (fundamental)

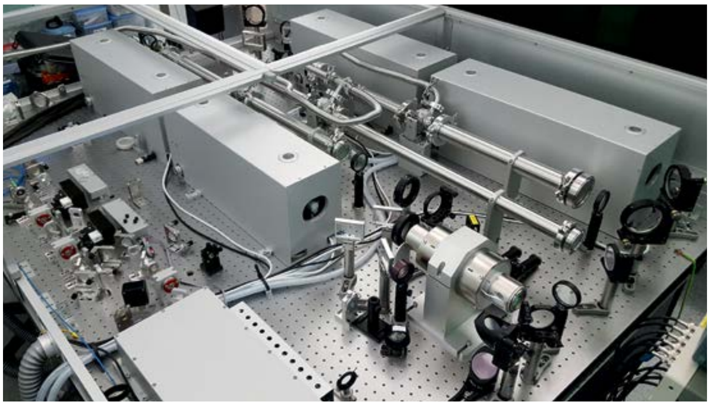
CUSTOM INSTALATIONS



Amplifier system delivering 1 J at center wavelength 1060 nm, pulse width 800 ps and ~ 4 nm (FWHM) gain bandwidth



12 J @ 527 nm laser system during development stage



30 J Nd:glass system featuring arbitrary shaped temporal pulse shape

NL941 SERIES

High Energy Temporaly Shaped DPSS Nanosecond Lasers

Tailored according to specific requirements

NL941 and NL942-SH lasers were designed and manufactured according custom request and are used for plasma research. They are good examples of what can be achieved when long time experience and latest technologies are put together.

Main laser feature is output of temporaly shaped pulses based on electrooptical modulator driven by programable arbitrary wave generator (AWG). Pulse shaping resolution is 125 ps and pulse duration up to 50 ns. Start of the system is a single mode CW laser. Then light is amplified in fiber amplifier, later AWG driven modulator transmits only required temporal shape and duration pulse which is amplified in diode pumped regenerative amplifier in order to reach energy level sufficient to amplify in single-pass / double-pass diode pumped amplifiers. Diode pumping enables generating bursts of pulses with up to 20 kHz frequency in burst mode.

Power amplifier is a chain of diode pumped single-pass amplifiers where pulse is amplified up to required energy. During amplification spatial beam shaping is employed in order to get a flat top shape at the output. Optional second and third harmonic generators are based on angle tuned nonlinear crystals placed in heaters.

NL941 FEATURES

- *Up to **2 J** at **1064 nm** output pulse energy*
- *Bursts of up to **30** pulses at **1 kHz** repetition rate or **4** pulses at **20 kHz** repetition rate in 20 sec periods available in burst mode*
- ***5 ns** pulse duration*
- *Spatial flat top beam profile*
- *Temporal shaping by pulse processing with electrooptical modulator driven by arbitrary wave generator (AWG)*
- *High efficiency diode pumping chambers*
- ***1×2 m** laser head footprint*

NL942-SH FEATURES

- *Two outputs up to **1.7 J** at **1064 nm** each*
- *Two outputs up to **0.9 J** at **532 nm** each*
- ***100 Hz** repetition rate*
- ***50 ns** pulse duration*
- *Spatial flat top beam profile*
- *Temporal shaping by pulse processing with electrooptical modulator driven by arbitrary wave generator (AWG)*
- *Internal system diagnostics*
- *High efficiency diode pumping chambers*
- *Industrial grade, portable laser housing with integrated power supplies and cooling unit*

SPECIFICATIONS [1)]

Model	NL941	NL942-SH
MAIN SPECIFICATIONS		
Pulse energy		
at 1064 nm	2000 mJ	2 × 1700 mJ
at 532 nm [2)]	–	2 × 900 mJ
Pulse energy stability (StdDev): [3)]		
at 1064 nm	1.0 %	1.0 %
at 532 nm	–	2.0 %
Power drift [4)]	± 2 %	
Pulse duration [5)]	5 ns	50 ns
Repetition rate	bursts of 20 kHz every 20 s	100 Hz
Polarization at 1064 nm	vertical, > 90 %	
Optical pulse jitter [6)]	< 30 ps	
Linewidth	< 1 cm^{-1}	
Beam profile	Hat-Top (at laser output), without diffraction rings	
Typical beam diameter [7)]	~12 mm	~10 mm
Beam divergence [8)]	< 0.5 mrad	
Beam pointing stability	± 50 µrad	
PHYSICAL CHARACTERISTICS		
Laser head (W × L × H)	1000 × 2000 × 400 mm	1000 × 2000 × 1800 mm
Power supply unit (W × L × H)	550 × 600 × 500 mm	–
Umbilical length	3 m	–
OPERATING REQUIREMENTS		
Facility water consumption (max 20° C)	8 l/min	20 l/min
Ambient temperature	22 ± 2 °C	
Relative humidity	20 – 80 % (non-condensing)	
Power requirements [9)]	208/240 V AC, single phase 50/60 Hz or 220, 380 or 400 V AC, three phases 50/60 Hz	208, 380 or 400 V AC, three phase, 50/60 Hz
Power consumption	2.0 kW	9.4 kW

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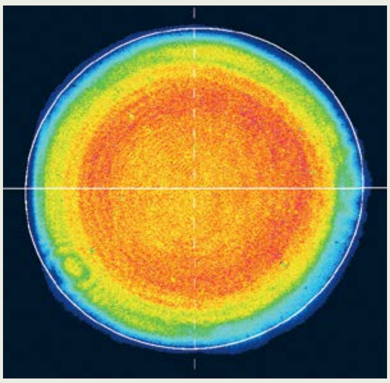
2) For NL94X-SH harmonic generator option. Harmonic outputs are not simultaneous; only single wavelength beam is present at the output at once.
3) Standard deviation value averaged over 30 s after 20 minutes of warm-up.
4) Deviation from average value measured over 8 hours of operation when room temperature variation is less than ±2 °C.
5) Measured with photodiode with 100 ps rise time and oscilloscope with 600 MHz bandwidth.
6) Standard deviation value, measured with respect to triggering pulse.
7) Beam diameter is measured at 1064 nm at laser output at the $1/e^2$ level and can vary with each unit we manufacture.
8) Full angle measured at the $1/e^2$ level at 1064 nm.
9) Mains voltage should be specified when ordering.



Typical beam profile of ANL4001k laser

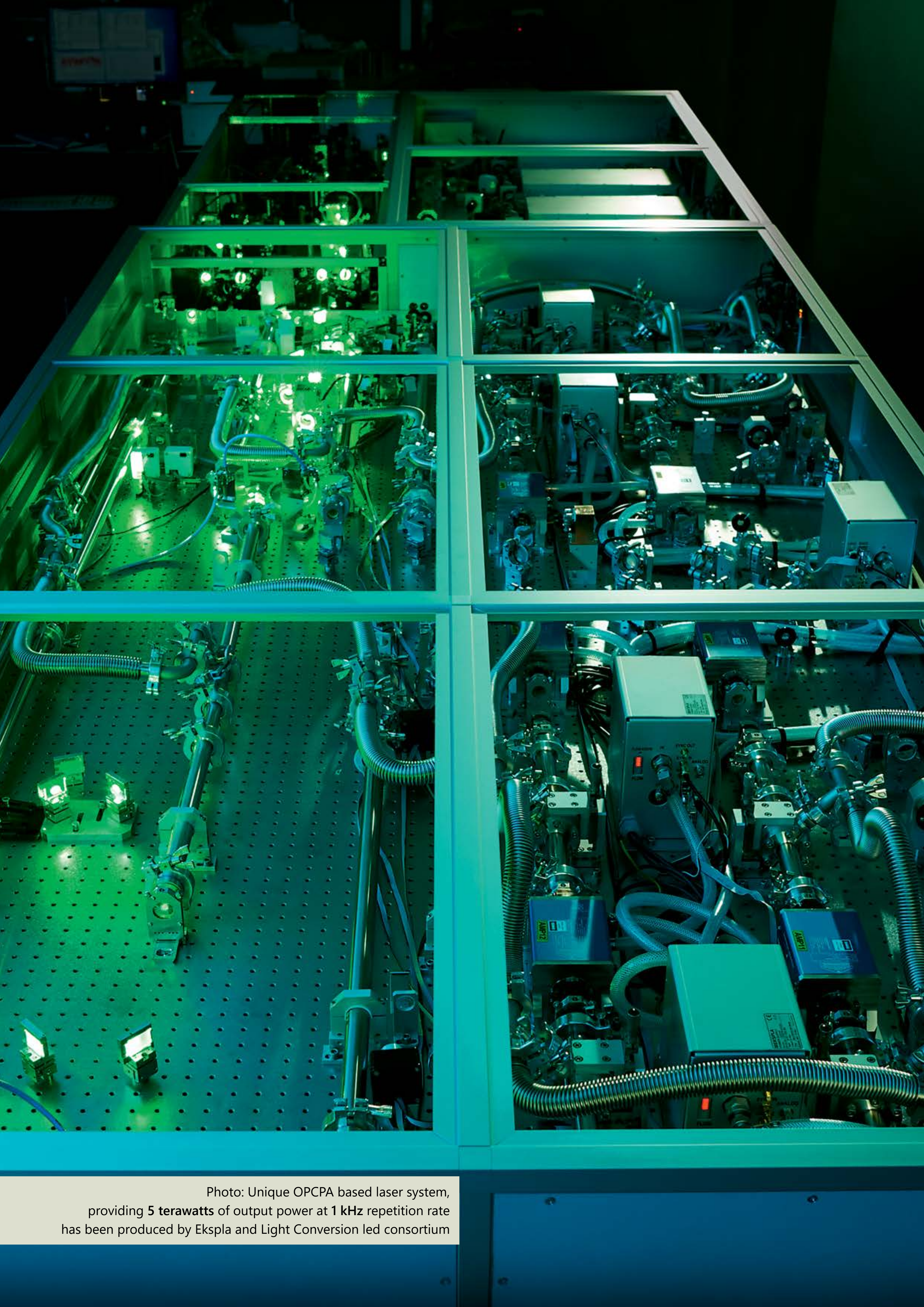


Photo: Unique OPCPA based laser system, providing **5 terawatts** of output power at **1 kHz** repetition rate has been produced by Ekspla and Light Conversion led consortium

Laser Spectroscopy Systems

Photo: SFG microscope – provides spectral and spatial surface information with micrometers resolution

SFG SPECTROMETER

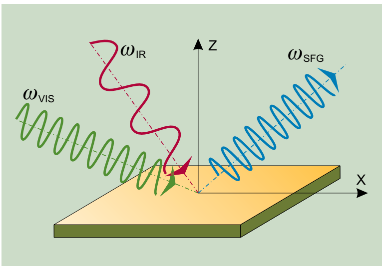
Picosecond Vibrational Sum Frequency Generation Spectrometer

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

SFG SPECTROMETER

SPECIFICATIONS [1)]

Version	SFG Classic	SFG Advanced	SFG Double resonance	SFG Phase sensitive	SFG Microscope
SYSTEM (GENERAL)					
Spectral range	1000 – 4300 cm^{-1}	625 – 4300 cm^{-1}	1000 – 4300 cm^{-1}	1000 – 4300 cm^{-1}	2000 – 4300 cm^{-1}
Spectral resolution	<6 cm^{-1} (optional <2 cm^{-1})	<6 cm^{-1} (optional <2 cm^{-1})	<10 cm^{-1}	<6 cm^{-1} (optional <2 cm^{-1})	<6 cm^{-1}
Spectra acquisition method	Scanning				
Sample illumination geometry	Top side, reflection (optional: bottom side, top-bottom side)				Top side, reflection
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 (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	Fixed, ~1000 µm
Sensitivity	Air-water spectra			Solid sample	
PUMP LASERS [2)]					
Model	PL2230		PL2230, dual output	PL2230	
Pulse energy	Optimised to pump PG				
Pulse duration	28±3 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	inquire
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	2400 × 1000 mm	3000 × 1500 mm	2600 × 1200 mm
Extended (with special options or large accessories)	2700 × 1200 mm	3000 × 1500 mm	2700 × 1200 mm

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

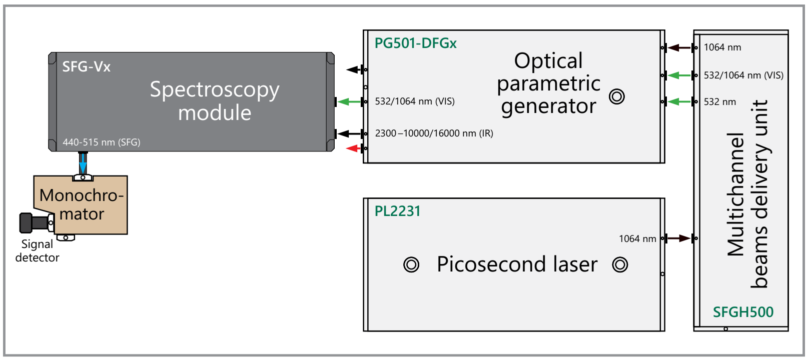
AVAILABLE INTEGRATED SFG SYSTEMS

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

EKSPLA SAVANORIU AV. 237, LT-02300 VILNIUS, LITHUANIA TEL +370 5 2649629 E-MAIL SALES@EKSPLA.COM WWW.EKSPLA.COM REV. 20200330

SFG SPECTROMETER

SPECTROMETER LAYOUT



EXAMPLES OF SFG SPECTRA

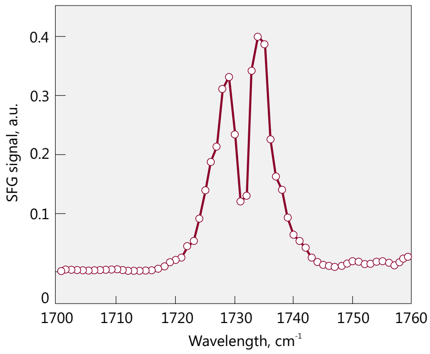


Fig 1. SFG spectra of monoolein surface, 1 cm^{-1} scan step, 200 acquisitions per step. *Courtesy of EKSPLA Ltd.*

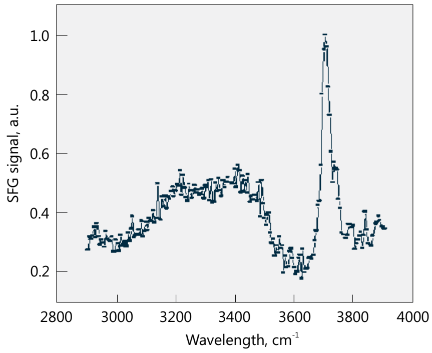
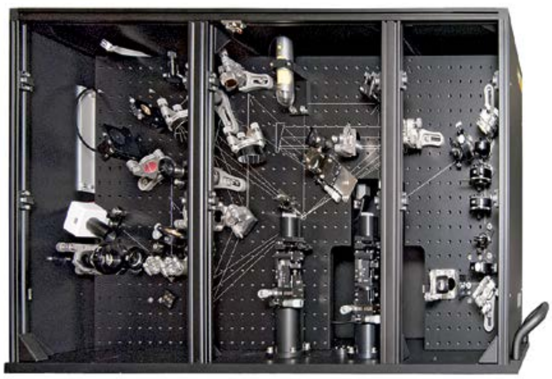


Fig 2. Water-air interface spectra, 200 acquisitions per step. *Courtesy of University of Michigan*

EXAMPLE OF MODIFICATIONS

Ask for separate brochure



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

Classic (Advanced) + Microscope in one unit

Industrial DPSS Lasers

Short Pulse and High Power

FEATURES

- *Rugged and stable*
- *Picosecond pulse duration*
- *1064, 532 or 355 nm output wavelength*

APPLICATIONS

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

Ask for separate brochures

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Ultrafast Fiber Lasers

LightWire & FemtoLux 3 series

APPLICATIONS

- *Ultrafast spectroscopy*
- *Time-domain terahertz spectroscopy*
- *Seeding solid state amplifiers*
- *Seeding femtosecond CPA systems*
- *Ultrafast spectroscopy and microscopy*
- *Metrology*
- *Marking and structuring*
- *Micromachining*
- *Ophtalmologic surgery*
- *Photopolymerization*
- *Biological Imaging*
- *Pumping femtosecond OPO/OPA*

Ask for separate brochures

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

Application examples

Scientific Applications

For reference articles
and more useful information visit
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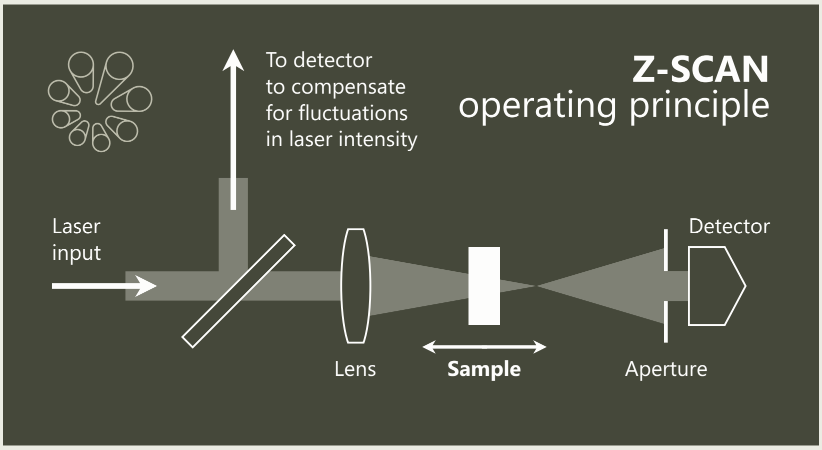
Z-SCAN

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.

RELATED PRODUCTS

PGx01
High Energy Broadly Tunable Picosecond OPA
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PGx03
Picosecond kHz Repetition Rate Broadly Tunable OPA
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PL2210
Diode Pumped Picosecond kHz Pulsed Nd:YAG Lasers
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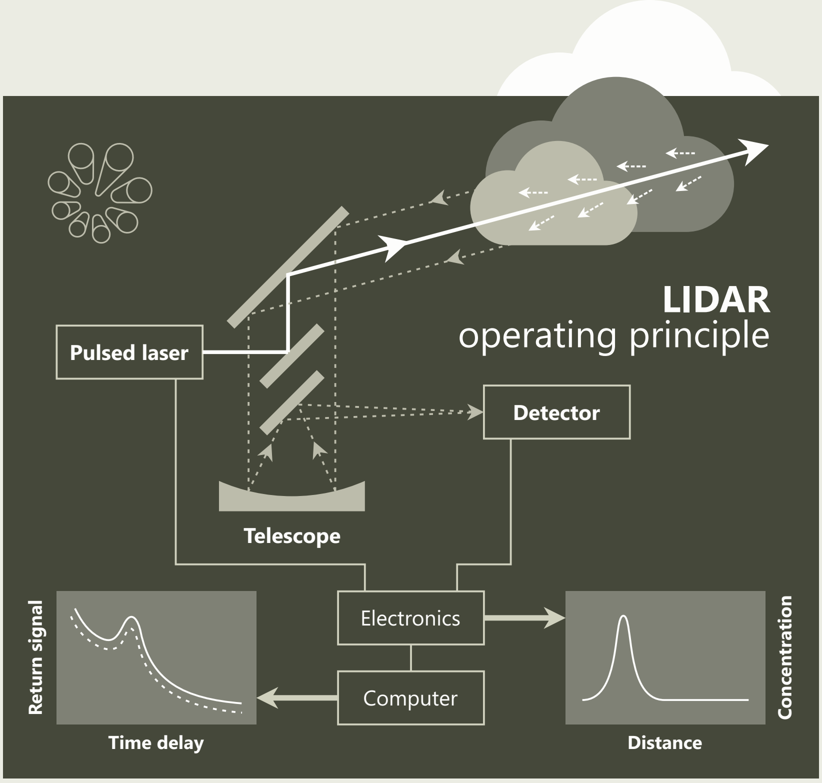
Femtosecond Lasers
Picosecond Lasers
Picosecond Tunable Systems
Nanosecond Lasers
Nanosecond Tunable Lasers
High Intensity Lasers
Other Ekspla Products

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.

RELATED PRODUCTS

NL230
High Energy Q-switched DPSS Nd:YAG Lasers
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NT242
Broadly Tunable kHz Pulsed DPSS Lasers
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NT342
High Energy Broadly Tunable Lasers
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NT350
High Energy NIR Range Tunable Lasers
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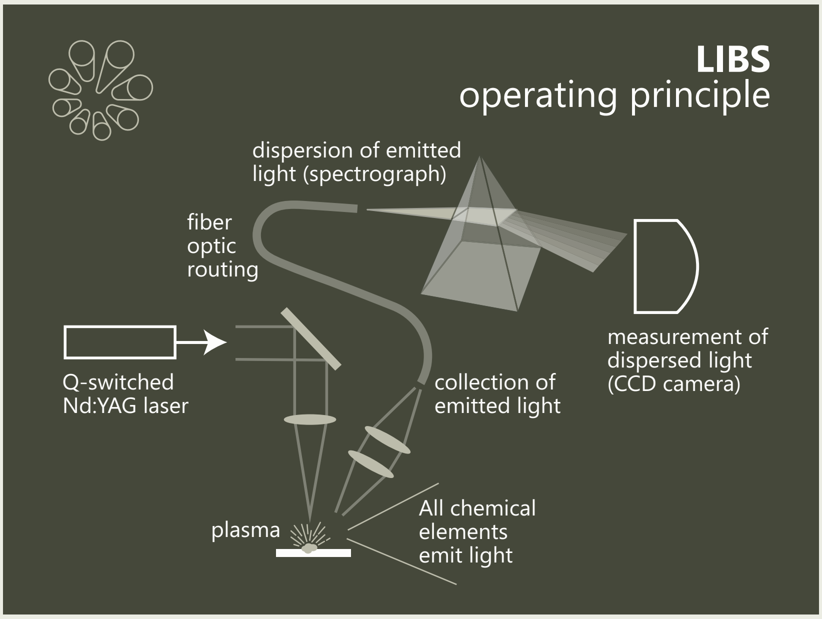
LIBS

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.

RELATED PRODUCTS

NL300
Compact Flash-lamp Pumped Q-switched Nd:YAG Lasers
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NL310
High Energy Q-switched Nd:YAG Lasers
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NL230
High Energy Q-switched DPSS Nd:YAG Lasers
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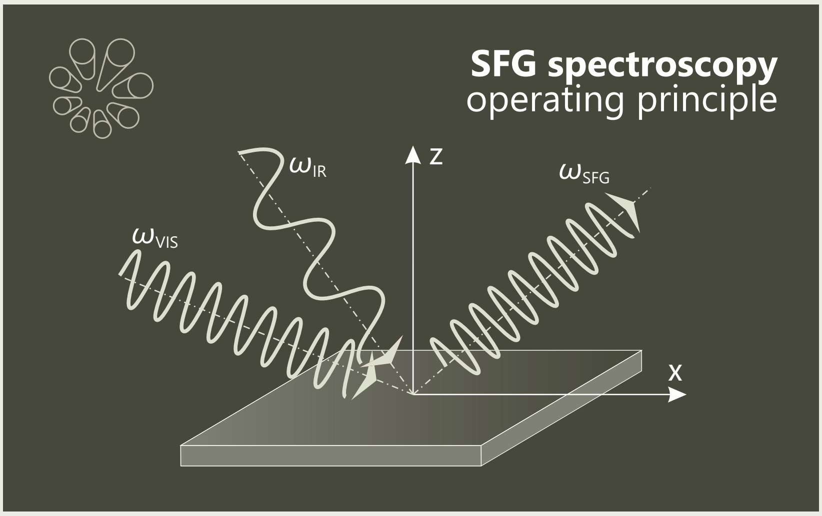
SFG spectroscopy

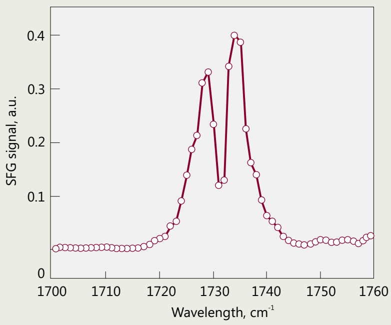
Laser Spectroscopy



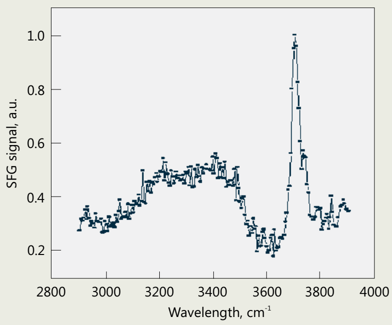
Sum frequency generation vibrational spectroscopy (SFG-VS) is used to characterize vibrational bonds of molecules at surfaces or interfaces. SFG spectroscopy is particularly attractive because of molecular specificity and intrinsic interfacial sensitivity. Surface sensitivity of the technique arises 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

RELATED PRODUCTS

SFG
Sum Frequency Generation (SFG) Vibrational Spectrometer
Page 129

PL2230
Diode Pumped High Energy Picosecond Nd:YAG Lasers
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High Energy Broadly Tunable Picosecond OPA
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PGx03
Picosecond kHz Repetition Rate Broadly Tunable OPA
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PGx11
Transform Limited Broadly Tunable Picosecond OPA
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SHG spectroscopy

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.

SHG is a sensitive method used to characterize molecules at surfaces or interfaces because inversion symmetry is broken at the interface.

SHG measurements provide information about: surface coverage, molecular orientation, adsorbtion-desorbtion processes, and reactions at interfaces.

RELATED PRODUCTS

PL2230
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PGx01
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PGx03
Picosecond kHz Repetition Rate Broadly Tunable OPA
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OPCPA Seeding

Lasers for Seeding and Pumping

A compact femtosecond wavelength-tunable OPCPA system can be built by using a novel front-end, which incorporates a spectrally broadened picosecond all-in-fiber oscillator for seeding picosecond diode-pumped solid-state (DPSS) regenerative amplifier and WLC generator.

This approach eliminates the need of seed and pump pulse synchronisation therefore greatly simplifying the system and uses all-parametric femtosecond pulse amplification stages potentially increasing the temporal contrast of final pulses.

RELATED PRODUCTS

APL2100
High Energy Picosecond Amplifiers
Page 104

APL2200
High Energy kHz Picosecond Amplifiers
Page 107

Ultra-High Intensity

High Energy Applications

Ultra-high intensity laser applications span a number of scientific disciplines, such as plasma physics and fusion research, atomic molecular & optical physics, femtosecond chemistry, astrophysics, high energy physics, materials science, biology, and medicine.

Areas where a strong impact is possible include:

- High harmonic generation and attosecond science
- Relativistic effects in interactions with atoms, molecules and electrons
- Ultrafast X-ray science
- High density science
- Fusion energy research
- Particle accelerators
- Thomson scattering

RELATED PRODUCTS

UltraFlux
Tunable Wavelength Femtosecond Laser System
Page 98

High Intensity Laser Systems
Page 97

Photoacoustic Imaging

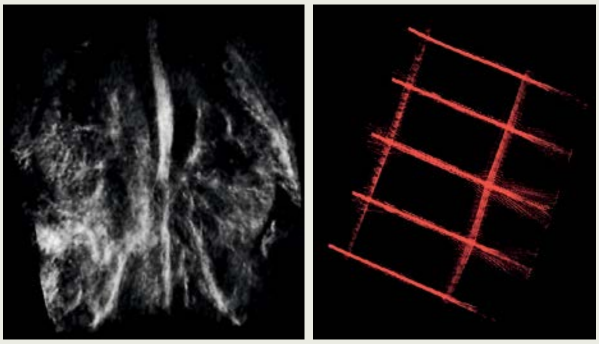
Biomedical Applications

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



Courtesy of PhotoSound Technologies, Inc.

RELATED PRODUCTS

PhotoSonus
Mobile High Energy Tunable Laser System for Photoacoustic Imaging
Page 92

PhotoSonus X
Tunable Wavelength NIR Range DPSS Laser
Page 94

NT350
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