PL2230 SERIES



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 (90 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 106. After the regenerative amplifier, the pulse is directed to a multipass power amplifier that is optimized for efficient stored energy extraction from the Nd:YAG rod, while maintaining a near Gaussian beam profile and low wavefront distortion. The output pulse energy can be adjusted in approximately 1% steps, while pulse-to-pulse energy stability remains at less than 0.5% rms at 1064 nm.

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

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

Simple and convenient laser control

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

Diode Pumped High Energy Picosecond Nd:YAG Lasers

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</p>
- Excellent pulse duration stability
- ▶ Up to 100 Hz repetition rate
- Streak camera triggering pulse with <10 ps jitter
- Excellent beam pointing stability
- Thermo stabilized second, third or fourth harmonic generator options
- ► PC control
- Remote control via keypad

APPLICATIONS

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



SPECIFICATIONS 1)

Pulse energy 3 at 1064 nm	Model	PL2230-100	PL2230A-100	PL2231-50	PL2231A-50	
at 1064 nm 3 mJ 6 mJ 30 mJ 40 mJ at 532 nm 3 13 mJ 13 mJ 18 mJ at 355 nm 4 0.9 mJ 2 mJ 9 mJ 13 mJ at 266 nm 9 0.3 mJ 0.6 mJ 3 mJ 5 mJ at 213 nm 6 0.3 mJ 0.6 mJ 3 mJ 5 mJ at 213 nm 6 0.3 mJ 0.6 mJ 3 mJ 5 mJ at 213 nm 6 0.3 mJ 0.6 mJ 3 mJ 5 mJ at 213 nm 6 0.3 mJ 0.6 mJ 3 mJ 5 mJ at 213 nm 6 0.5 mJ at 231 nm 6 0.0 mJ 0.6 mJ 3 mJ 5 mJ at 213 nm 6 0.0 mJ 0.6 mJ 3 mJ 5 mJ at 21064 nm 4 0.0 mJ 0.6 mJ 4 0.6 mJ 3 mJ 5 mJ at 21064 nm 4 0.0 mJ 0.6 mJ 0.6 mJ 3 mJ 5 mJ 5 mJ at 21064 nm 4 0.0 mJ 0.6						
at 355 nm ⁴0		3 mJ	6 mJ	30 mJ	40 mJ	
at 266 nm % on the problem of the p	at 532 nm ³⁾	1.3 mJ	3 mJ	13 mJ	18 mJ	
at 213 mm 6	at 355 nm ⁴⁾	0.9 mJ	2 mJ	9 mJ	13 mJ	
Pulse energy stability (StdDev) ⁷⁹ at 1064 mm	at 266 nm ⁵⁾	0.3 mJ	0.6 mJ	3 mJ	5 mJ	
at 1064 nm	at 213 nm ⁶⁾		inquir	е		
at 532 nm	Pulse energy stability (StdDev) 7)					
at 355 nm	at 1064 nm	< 0.2 %	< 0.6 %	< 0.5	5 %	
at 266 nm	at 532 nm	< 0.4 %		3 %		
Pulse duration (FWHM) 10	at 355 nm	< 0.5 %		< 1.1 %		
Pulse duration (FWHM) ®	at 266 nm			< 1.2 %		
Pulse duration stability ®	at 213 nm			< 1.5	< 1.5 %	
Power drift ¹⁰⁾	Pulse duration (FWHM) 8)	29 ± 5 ps				
Pulse repetition rate At 1064, 532, 355 nm 0 − 100 Hz 100 Hz 50 Hz At 266, 213 nm 100 Hz 10 Hz 10 Hz Polarization vertical, >99 % at 1064 nm Pre-pulse contrast > 200 : 1 (peak-to-peak with respect to residual pulses) Beam profile ¹¹⁰ close to Gaussian in near and far fields Beam propagation ratio M² < 1.5 mrad	Pulse duration stability 9)	·				
At 1064, 532, 355 nm At 266, 213 nm Polarization Pre-pulse contrast Beam profile ¹¹⁰ Beam propagation ratio M² Peam propagation ratio M² Polariza beam diameter ¹⁴⁰ Internal triggering regime ¹⁰ External triggering regime ¹⁰ Typical warm-up time PHYSICAL CHARACTERISTICS Laser head size (W × L × H) PHYSICAL CHARACTERISTICS Laser head size (W × L × H) POPERATING REQUIREMENTS Cooling ¹® Room temperature Room temperature Relative humidity Power requirements Pool : 100 Hz	Power drift 10)	± 2 %				
At 266, 213 nm 100 Hz 10 Hz Polarization	Pulse repetition rate	I				
Polarization Pre-pulse contrast Pre-pulse close to Gaussian in near and far fields Pre-pulse close to Gaussian in near and far fields Pre-pulse close to Gaussian in near and far fields Pre-pulse close to Gaussian in near and far fields Pre-pulse close to Gaussian in near and far fields Pre-pulse close to Gaussian in near and far fields Pre-pulse close to Gaussian in near and far fields Pre-pulse close to Gaussian in near and far fields Pre-pulse close to Gaussian in near and far fiels Pre-pulse close to Gaussian in near and far fields Pre-pulse close to Gaussian in near and far fields Pre-pulse close to Gaussian in near and far fields Pre-pulse close to Gaussian in near and far fields Pre-pulse close to Gaussian in near and far fields Pre-pulse close to Gaussian in near and far fields Pre-pulse close to Gaussian in a contract to Gaussian contract to Gaussian close to Gaussian contract to Gaussian contract to Gaussi	At 1064, 532, 355 nm	0 – 100 Hz	100 Hz	50 H	Hz	
Pre-pulse contrast Pre-pulse contrast and far fields Pre-pulse Pre-pulse contrast and far fields Pre-pulse contrast and far field Pre-pulse contrast and far fie	At 266, 213 nm	100 H	Z	10 H	l z	
Beam profile ¹¹¹ Close to Gaussian in near and far fields Beam divergence ¹²² < 1.5 mrad < 0.7 mrad Beam propagation ratio M² < 1.3 < 2.5 Beam pointing stability (RMS) ¹³² ≤ 10 µrad ≤ 20 µrad Typical beam diameter ¹⁴² ~ 2 mm ~ 2.5 mm ~ 6 mm ~ 7 mm Optical pulse jitter Internal triggering regime ¹⁵⟩ <50 ps (StdDev) with respect to TRIG1 OUT pulse External triggering regime ¹⁵⟩ ~ 3 ns (StdDev) with respect to SYNC IN pulse TRIG1 OUT pulse delay ¹¹⟩ −500 50 ns Typical warm-up time 5 min 10 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 Umbilical length 2.5 m OPERATING REQUIREMENTS Cooling ¹® not required, air cooled stand-alone chiller Room temperature 22 ± 2 °C Relative humidity 20 − 80 % (non-condensing) Power requirements 110−240 V AC, 50/60 Hz Single phase, 110−240 V AC, 5 A, 50/60 Hz	Polarization					
Beam divergence ¹²² < 1.5 mrad	Pre-pulse contrast	> 200	: 1 (peak-to-peak with r	espect to residual pulses)		
Beam propagation ratio M² < 1.3 < 2.5 Beam pointing stability (RMS) ¹³⁾ ≤ 10 μrad ≤ 20 μrad Typical beam diameter ¹⁴⁾ ~ 2 mm ~ 2.5 mm ~ 6 mm ~ 7 mm Optical pulse jitter Internal triggering regime ¹⁵⁾ < 50 ps (StdDev) with respect to TRIG1 OUT pulse External triggering regime ¹⁶⁾ ~ 3 ns (StdDev) with respect to SYNC IN pulse TRIG1 OUT pulse delay ¹⁷⁾ -500 50 ns Typical warm-up time 5 min 10 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 Umbilical length 2.5 m OPERATING REQUIREMENTS Cooling ¹⁸⁾ not required, air cooled stand-alone chiller Room temperature 22 ± 2 °C Relative humidity 5 not requirements 110−240 V AC, 50/60 Hz Single phase, 110−240 V AC, 50/60 Hz	Beam profile 11)	· · · · · · · · · · · · · · · · · · ·				
Beam pointing stability (RMS) ¹³⁾ ≤ 10 µrad ≤ 20 µrad Typical beam diameter ¹⁴⁾ ~ 2 mm ~ 2.5 mm ~ 6 mm ~ 7 mm Optical pulse jitter Internal triggering regime ¹⁵⁾ <50 ps (StdDev) with respect to TRIG1 OUT pulse External triggering regime ¹⁶⁾ ~3 ns (StdDev) with respect to SYNC IN pulse TRIG1 OUT pulse delay ¹⁷⁾ -500 50 ns Typical warm-up time 5 min 10 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 Umbilical length 2.5 m OPERATING REQUIREMENTS Cooling ¹⁸⁾ not required, air cooled stand-alone chiller Room temperature 22 ± 2 °C Relative humidity 20 − 80 % (non-condensing) Power requirements 110−240 V AC, 50/60 Hz	Beam divergence 12)	< 1.5 mrad		< 0.7 mrad		
Typical beam diameter ¹⁴⁾	Beam propagation ratio M ²	< 1.3		< 2.5		
Optical pulse jitter Internal triggering regime ¹⁵⁾ External triggering regime ¹⁶⁾ FIRIGI OUT pulse delay ¹⁷⁾ Typical warm-up time TRIGI OUT pulse delay ¹⁷⁾ To min Thin PHYSICAL CHARACTERISTICS Laser head size (W × L × H) Laser head size (W × L × H) Trigical cabinet s	Beam pointing stability (RMS) 13)	≤ 10 µrad		≤ 20 µrad		
Internal triggering regime ¹⁵⁾ External triggering regime ¹⁶⁾ FIG1 OUT pulse delay ¹⁷⁾ Typical warm-up time Finin PHYSICAL CHARACTERISTICS Laser head size (W × L × H) Electrical cabinet size (W × L × H) Umbilical length OPERATING REQUIREMENTS Cooling ¹⁸⁾ Room temperature Room temperature Relative humidity Power requirements 10 min	Typical beam diameter 14)	~ 2 mm	~ 2.5 mm	~ 6 mm	~ 7 mm	
External triggering regime ¹⁶⁾ TRIG1 OUT pulse delay ¹⁷⁾ Typical warm-up time TRIG1 OUT pulse delay ¹⁷⁾ Typical warm-up time Typical warm-up ti	Optical pulse jitter					
TRIG1 OUT pulse delay ¹⁷⁾ Typical warm-up time 5 min 10 min 15 min PHYSICAL CHARACTERISTICS Laser head size (W × L × H) Electrical cabinet size (W × L × H) Umbilical length 2.5 m OPERATING REQUIREMENTS Cooling ¹⁸⁾ not required, air cooled Room temperature Relative humidity Power requirements 10 min 15 min 15 min 456×1031×249 ± 3 mm 471×391×147 ± 3 mm 2.5 m OPERATING REQUIREMENTS Cooling ¹⁸⁾ Not required, air cooled Stand-alone chiller 22 ± 2 °C Relative humidity Single phase, 110–240 V AC, 5 A, 50/60 Hz	Internal triggering regime 15)	<50 ps (StdDev) with respect to TRIG1 OUT pulse				
Typical warm-up time 5 min 10 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 Umbilical length 2.5 m OPERATING REQUIREMENTS Cooling 18) not required, air cooled stand-alone chiller Room temperature 22 ± 2 °C Relative humidity 20 – 80 % (non-condensing) Power requirements 110 – 240 V AC, 50/60 Hz Single phase, 110 – 240 V AC, 5 A, 50/60 Hz	External triggering regime 16)	~3 ns (StdDev) with respect to SYNC IN pulse				
PHYSICAL CHARACTERISTICS Laser head size (W × L × H) Electrical cabinet size (W × L × H) Umbilical length OPERATING REQUIREMENTS Cooling ¹⁸⁾ Room temperature Room temperature Relative humidity Power requirements 110 – 240 V AC, 50/60 Hz A56×1031×249 ± 3 mm 471×391×147 ± 3 mm 471×391×147 ± 3 mm 2.5 m OPERATING REQUIREMENTS 22 ± 2 °C Relative humidity Single phase, 110 – 240 V AC, 5 A, 50/60 Hz	TRIG1 OUT pulse delay 17)					
Laser head size (W × L × H) 456×1031×249 \pm 3 mm Electrical cabinet size (W × L × H) 12 V DC power adapter, 85×170×41 \pm 3 mm Umbilical length 2.5 m OPERATING REQUIREMENTS Cooling 18) not required, air cooled stand-alone chiller Room temperature 22 \pm 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	Typical warm-up time	5 min	10 min	15 m	nin	
Electrical cabinet size (W × L × H) 12 V DC power adapter, 85×170×41 \pm 3 mm 2.5 m OPERATING REQUIREMENTS Cooling ¹⁸⁾ not required, air cooled stand-alone chiller Room temperature 22 \pm 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	PHYSICAL CHARACTERISTICS					
Umbilical length OPERATING REQUIREMENTS Cooling ¹⁸⁾ Room temperature Relative humidity Power requirements 110–240 V AC, 50/60 Hz 85×170×41 ± 3 mm 4/1×391×14/ ± 3 mm 4/1×391×14/ ± 3 mm 2.5 m Stand-alone chiller 22 ± 2 °C 20 – 80 % (non-condensing) Single phase, 110–240 V AC, 5 A, 50/60 Hz	Laser head size (W × L × H)	456×1031×249 ± 3 mm				
OPERATING REQUIREMENTS Cooling ¹⁸⁾ not required, air cooled stand-alone chiller Room temperature 22 ± 2 °C Relative humidity 20 – 80 % (non-condensing) Power requirements 110 – 240 V AC, 50/60 Hz Single phase, 110 – 240 V AC, 5 A, 50/60 Hz	Electrical cabinet size (W × L × H)					
Cooling $^{18)}$ not required, air cooledstand-alone chillerRoom temperature 22 ± 2 °CRelative humidity $20 - 80$ % (non-condensing)Power requirements $110 - 240$ V AC, $50/60$ HzSingle phase, $110 - 240$ V AC, 5 A, $50/60$ Hz	Umbilical length	2.5 m				
Cooling $^{18)}$ not required, air cooledstand-alone chillerRoom temperature 22 ± 2 °CRelative humidity $20 - 80$ % (non-condensing)Power requirements $110 - 240$ V AC, $50/60$ HzSingle phase, $110 - 240$ V AC, 5 A, $50/60$ Hz	OPERATING REQUIREMENTS					
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		not required, air cooled stand-alone chiller		ne chiller		
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 requirements 110-240 V AC, 50/60 Hz Single phase, 110-240 V AC, 5 A, 50/60 Hz	·	20 – 80 % (non-condensing)				
					60/60 Hz	
	Power consumption					

- 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.
- 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.

- Averaged from pulses, emitted during 30 sec time interval.
- 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 \pm 2 °C.
- 11) Near field Gaussian fit is >80%.
- 12) Average of X- and Y-plane full angle divergence values measured at the 1/e² level at 1064 nm.
- 13) Beam pointing stability is evaluated from fluctuations of beam centroid position in the far field.



- Beam diameter is measured at 1064 nm at the 1/e² level.
- With respect to TRIG1 OUT pulse. <10 ps jitter is provided optionally with PRETRIG feature.
- 16) With respect to SYNC IN pulse.
- ¹⁷⁾ TRIG1 OUT lead or delay can be adjusted with 0.25 ns steps in specified range.
- ¹⁸⁾ Air cooled. Adequate room air conditioning should be provided.



OPTIONS

▶ Option P20 provides 20 ps ±10% output pulse duration. Pulse energies are ~ 30 % lower in comparison to the 29 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 29 ps lasers.

▶ Option P10

 10 ± 2 ps pulse duration. Pulse energies are $\sim50\%$ lower in comparison to the 29 ps pulse duration version. Valid only for PL2230A-100.

▶ 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.

▶ Option PL2231A-50 HE

Pulse repetition rate 50 Hz. The pulse energy is \sim 25% higher compared to the laser PL2231A. 29 \pm 5 ps output pulse duration. See table below for pulse energy specifications:

Model 1) 2)	PL2231A-50 HE	
1064 nm	50 mJ	

▶ Option PL2231A-10

Pulse repetition rate 10 Hz. The pulse energy is \sim 2 times higher compared to the 50 Hz laser version. 29±5 ps output pulse duration. See table below for pulse energy specifications:

Model 1) 2)	PL2231A-10
1064 nm	80 mJ
532 nm ³⁾	50 mJ
355 nm	inquire
216 nm	inquire
213 nm	inquire

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- ²⁾ Outputs are not simultaneous.
- For PL2231A-10 series laser with –SH module.

BEAM PROFILE

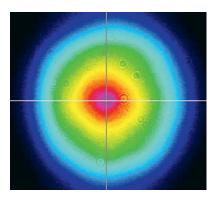


Fig 1. Typical near field output beam profile of PL2230 model laser



OUTLINE DRAWINGS

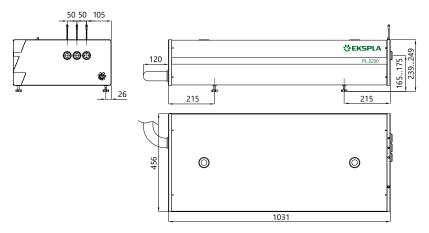


Fig 2. Dimensions of PL2230 series laser head

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.

