

# PL2210 SERIES



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.

## 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

### 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 <sup>1)</sup>

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

<sup>1)</sup> Inquire for other specifications.

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

**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 <sup>1)</sup>**

Model	PL2210A	PL2211	PL2211A
<b>Output energy</b>			
at 1064 nm	0.9 mJ	2.5 mJ	5 mJ
at 532 nm <sup>2)</sup>	0.45 mJ	1.3 mJ	2.5 mJ
at 355 nm <sup>3)</sup>	0.35 mJ	0.8 mJ	1.6 mJ
at 266 nm <sup>4)</sup>	0.16 mJ	0.5 mJ	1 mJ
<b>Pulse energy stability (StdDev) <sup>5)</sup></b>			
at 1064 nm		0.5 %	
at 532 nm		0.8 %	
at 355 nm		1 %	
at 266 nm		2 %	
<b>Pulse duration (FWHM) <sup>6)</sup></b>			
		28 ps ± 10 %	
<b>Pulse repetition rate</b>			
		1 kHz	
<b>Triggering mode</b>			
		internal/external	
<b>Typical TRIG1 OUT pulse delay <sup>8)</sup></b>			
		-500 ... 50 ns	
<b>TRIG1 OUT pulse jitter</b>			
		< 0.1 ns rms	
<b>Spatial mode <sup>9)</sup></b>			
		Close to Gaussian	
<b>Beam divergence <sup>10)</sup></b>			
		<1 mrad	
<b>Beam diameter <sup>11)</sup></b>			
		1.7 ± 0.3 mm	
<b>Beam pointing stability <sup>12)</sup></b>			
		< 30 µrad	
<b>Pre-pulse contrast</b>			
		> 200 : 1	
<b>Polarization</b>			
		linear, >100 : 1	

**PHYSICAL CHARACTERISTICS**

Laser head size (W × L × H) <sup>13)</sup>	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 <sup>14)</sup>	<1 kW	<1.5 kW	

<sup>1)</sup> 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.

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

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

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

<sup>5)</sup> Averaged from pulses, emitted during 30 sec time interval.

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

<sup>7)</sup> With respect to optical pulse. <10 ps rms jitter is provided with PRETRIG standard feature.

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

<sup>9)</sup> Near field Gaussian fit is >90%.

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

<sup>11)</sup> Beam diameter is measured at 1064 nm at the 1/e<sup>2</sup> point.

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

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

<sup>14)</sup> At 1 kHz pulse repetition rate.



**PRETRIG FEATURE**

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

**OPTIONS**

- ▶ **Option P80** provides 80 ps  $\pm$  10 % output pulse duration. Inquire for pulse energy specifications.
- ▶ **Option P20** provides 22 ps  $\pm$  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**

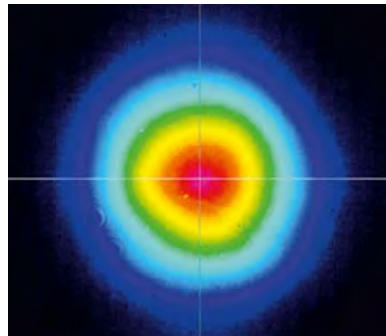


Fig 1. Typical PL2210 series laser near field beam profile at 1064 nm except PL2211, PL2211A

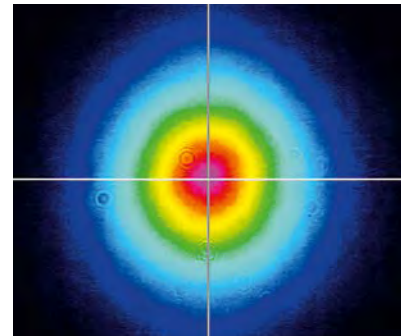


Fig 2. Typical PL2211, PL2211A laser near field beam profile at 1064 nm

**OUTLINE DRAWINGS**

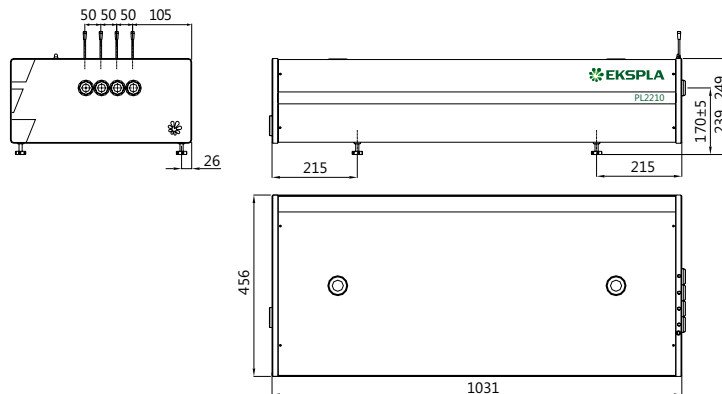
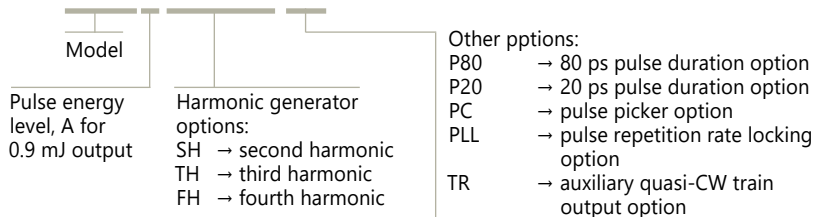


Fig 3. Dimensions of PL2210 series laser head

**ORDERING INFORMATION**

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

**PL2210A-SH/TH/FH-P20**



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# 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 (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  $\sim 0.25$  ns steps from 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.

## 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
- ▶ 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 through 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 <sup>1)</sup>**

Model	PL2230-100	PL2231-100	PL2231-50	PL2231A-50
<b>Pulse energy <sup>2)</sup></b>				
at 1064 nm	3 mJ	12 mJ	30 mJ	40 mJ
at 532 nm <sup>3)</sup>	1.3 mJ	5 mJ	13 mJ	18 mJ
at 355 nm <sup>4)</sup>	0.9 mJ	3.5 mJ	9 mJ	13 mJ
at 266 nm <sup>5)</sup>	0.3 mJ	1.2 mJ	3 mJ	5 mJ
at 213 nm <sup>6)</sup>	inquire			
<b>Pulse energy stability (StdDev) <sup>7)</sup></b>				
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) <sup>8)</sup>	28 ps ± 10 %			
Pulse duration stability <sup>9)</sup>	± 1 %			
Power drift <sup>10)</sup>	± 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 <sup>11)</sup>	close to Gaussian in near and far fields			
Beam divergence <sup>12)</sup>	< 1.5 mrad		< 0.7 mrad	
Beam propagation ratio M <sup>2</sup>	< 1.3		< 2.5	
Beam pointing stability <sup>13)</sup>	≤ 10 μrad StdDev		≤ 20 μrad StdDev	
Typical beam diameter <sup>14)</sup>	~ 2 mm	~ 4 mm		~ 5 mm
<b>Optical pulse jitter</b>				
Internal triggering regime <sup>15)</sup>	<50 ps (StdDev) with respect to TRIG1 OUT pulse			
External triggering regime <sup>16)</sup>	~3 ns (StdDev) with respect to SYNC IN pulse			
TRIG1 OUT pulse delay <sup>17)</sup>	-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 <sup>18)</sup>	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	

<sup>1)</sup> 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.

<sup>2)</sup> Outputs are not simultaneous.

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

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

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

<sup>6)</sup> For PL2230 series laser with -SH/TH/FH/FiH module.

<sup>7)</sup> Averaged from pulses, emitted during 30 sec time interval.

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

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

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

<sup>11)</sup> Near field Gaussian fit is >80%.

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

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

<sup>14)</sup> Beam diameter is measured at 1064 nm at the 1/e<sup>2</sup> level.



<sup>15)</sup> With respect to TRIG1 OUT pulse. <10 ps jitter is provided with PRETRIG standard feature.

<sup>16)</sup> With respect to SYNC IN pulse.

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

<sup>18)</sup> 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 <sup>1)</sup>

Model	PL2231B-20 (inquire)	PL2231C-20 (inquire)
Pulse energy <sup>2)</sup>		
at 1064 nm	100 mJ	140 mJ
at 532 nm <sup>3)</sup>	45 mJ	60 mJ
at 355 nm <sup>4)</sup>	28 mJ	35 mJ
at 266 nm <sup>5)</sup>	11 mJ	15 mJ
Pulse duration (FWHM) <sup>6)</sup>	80 ps ± 10 %	
Pulse repetition rate	20 Hz	

<sup>1)</sup> 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.

<sup>2)</sup> Outputs are not simultaneous.

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

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

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

<sup>6)</sup> 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**

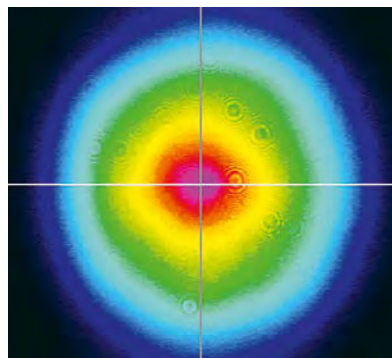


Fig 1. Typical near field output beam profile of PL2230 model laser

**OUTLINE DRAWINGS**

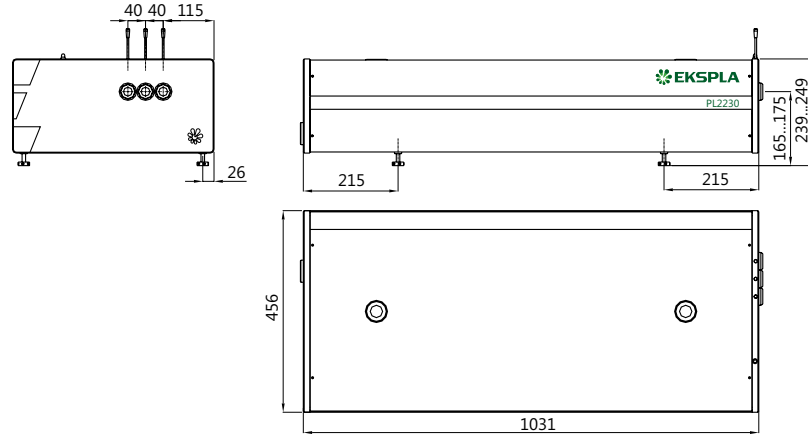
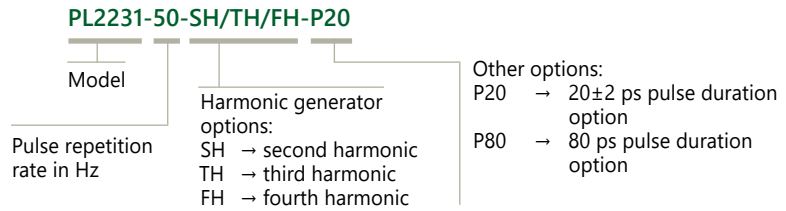


Fig 2. Dimensions of PL2230 series laser head

**ORDERING INFORMATION**

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



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