

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

Built-in harmonic generators

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

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
- ▶ Optional temperature stabilized second, third and fourth **harmonic generators**

APPLICATIONS

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

Simple and convenient laser control

For customer convenience, the laser can be operated from a master device or a personal computer using various interfaces. Depending on the system configuration, control is available via the USB interface (REST API over RNDIS or VCP with ASCII commands), the RS-232 interface (ASCII commands), the LAN interface (REST API), or from the remote control pad with a backlit display that remains easy to read even while wearing laser safety glasses.

Available models ¹⁾

| Model | Features |
|---------|--|
| PL2210A | Up to 0.9 mJ, 29 ps pulses at an up to 1 kHz repetition rate |
| PL2210B | Up to 2.5 mJ, 29 ps pulses at an up to 1 kHz repetition rate |

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

SPECIFICATIONS ¹⁾

| Model | PL2210A | PL2210B |
|--|-------------------------------------|------------------------|
| Output energy | | |
| at 1064 nm | 0.9 mJ | 2.5 mJ |
| at 532 nm ²⁾ | 0.45 mJ | 1.3 mJ |
| at 355 nm ³⁾ | 0.35 mJ | 0.8 mJ |
| at 266 nm ⁴⁾ | 0.1 mJ | 0.25 mJ |
| Pulse energy stability (StdDev) ⁵⁾ | | |
| at 1064 nm | 0.5 % | |
| at 532 nm | 0.8 % | |
| at 355 nm | 1 % | |
| at 266 nm | 2 % | |
| Pulse duration (FWHM) ⁶⁾ | 29 ± 5 ps | |
| Pulse repetition rate | 1 kHz | |
| Triggering mode | internal/external | |
| Typical TRIG1 OUT pulse delay ⁷⁾ | -500 ... 50 ns | |
| TRIG1 OUT pulse jitter | < 0.1 ns rms | |
| Spatial mode ⁸⁾ | Close to Gaussian | |
| Beam divergence ⁹⁾ | <1 mrad | |
| Beam diameter ¹⁰⁾ | 1.7 mm | ~3 mm |
| Beam pointing stability (RMS) ¹¹⁾ | < 30 µrad | |
| Pre-pulse contrast | > 200 : 1 | |
| Polarization | linear, >100 : 1 | |
| PHYSICAL CHARACTERISTICS | | |
| Laser unit size (W × L × H) | 508 × 1030 × 244 ± 3 mm | |
| Power supply size (W × L × H) | 365 × 392 × 290 ± 3 mm | 450 × 375 × 130 ± 3 mm |
| 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 ¹²⁾ | <1 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 20 ps ± 10% duration. Pulse energy specifications may differ from indicated here.

⁷⁾ TRIG1 OUT lead or delay can be adjusted with 0.25 ns steps in specified range.

⁸⁾ Near field Gaussian fit is >90%.

⁹⁾ Average of X- and Y-plane full angle divergence values measured at the 1/e² level at 1064 nm.

¹⁰⁾ Beam diameter is measured at 1064 nm at the 1/e² point.

¹¹⁾ Beam pointing stability is evaluated from fluctuations of beam centroid position in the far field.

¹²⁾ At 1 kHz pulse repetition rate.



OPTIONS

- ▶ **PRETRIG** provides low jitter pulse for streak camera triggering with lead/delay in -400...600 μ s range and <10 ps rms jitter.
- ▶ **Option P80** provides 80 ps \pm 10 % output pulse duration. Inquire for pulse energy specifications.
- ▶ **Option P20** provides 20 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

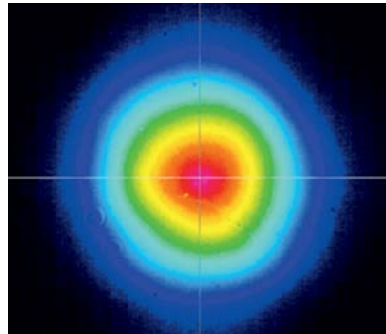


Fig 1. Typical PL2210 series laser near field beam profile at 1064 nm except PL2211A

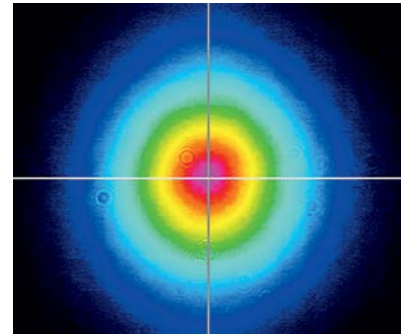


Fig 2. Typical PL2211A laser near field beam profile at 1064 nm

OUTLINE DRAWINGS

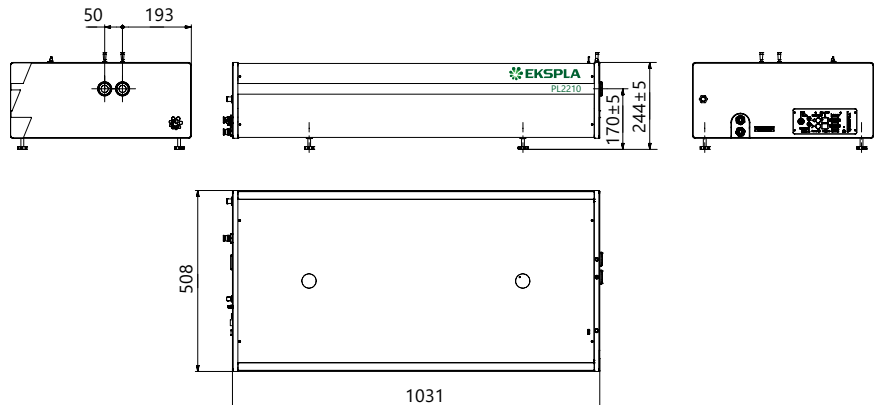


Fig 3. Dimensions of PL2210 series laser head

ORDERING INFORMATION

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

PL2210A-SH/TH/FH-P20

| | |
|-----------------------------|--|
| Model | Other options: |
| Harmonic generator options: | P80 → 80 ps pulse duration option |
| SH → second harmonic | P20 → 20 ps pulse duration option |
| TH → third harmonic | PC → pulse picker option |
| FH → fourth harmonic | PLL → pulse repetition rate locking option |

**PHOTO
TECHNICA** www.phototechnica.co.jp
 フォトテクニカ株式会社

〒336-0017 埼玉県さいたま市南区南浦和 2-18-2
 TEL:048-871-0067 FAX:048-871-0068
 e-mail:voc@phototechnica.co.jp



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 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 μ s 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 a master device or a personal computer using various interfaces. Depending on the system configuration, control is available via the USB interface (REST API over RNDIS or VCP with ASCII commands), the RS-232 interface (ASCII commands), the LAN interface (REST API), or from the remote control pad with a backlit display that remains 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
- ▶ 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⁾

| Model | PL2230-100 | PL2230A-100 | PL2231-50 | PL2231A-50 |
|--|--|---|---------------------|------------|
| Pulse energy ²⁾ | | | | |
| at 1064 nm | 3 mJ | 6 mJ | 30 mJ | 40 mJ |
| at 532 nm ³⁾ | 1.3 mJ | 3 mJ | 13 mJ | 18 mJ |
| at 355 nm ⁴⁾ | 0.9 mJ | 2 mJ | 9 mJ | 13 mJ |
| at 266 nm ⁵⁾ | 0.3 mJ | 0.6 mJ | 3 mJ | 5 mJ |
| at 213 nm ⁶⁾ | inquire | | | |
| Pulse energy stability (StdDev) ⁷⁾ | | | | |
| at 1064 nm | < 0.2 % | < 0.6 % | < 0.5 % | |
| at 532 nm | < 0.4 % | | < 0.8 % | |
| at 355 nm | < 0.5 % | | < 1.1 % | |
| at 266 nm | < 0.5 % | | < 1.2 % | |
| at 213 nm | < 1.5 % | | < 1.5 % | |
| Pulse duration (FWHM) ⁸⁾ | 29 ± 5 ps | | | |
| Pulse duration stability ⁹⁾ | ± 1 % | | | |
| Power drift ¹⁰⁾ | ± 2 % | | | |
| Pulse repetition rate | | | | |
| At 1064, 532, 355 nm | 0 – 100 Hz | 100 Hz | 50 Hz | |
| At 266, 213 nm | 100 Hz | | 10 Hz | |
| Polarization | vertical, >99 % at 1064 nm | | | |
| Pre-pulse contrast | > 200 : 1 (peak-to-peak with respect to residual pulses) | | | |
| Beam profile ¹¹⁾ | close to Gaussian in near and far fields | | | |
| Beam divergence ¹²⁾ | < 1.5 mrad | < 0.7 mrad | | |
| Beam propagation ratio M ² | < 1.3 | | < 2.5 | |
| Beam pointing stability (RMS) ¹³⁾ | ≤ 10 μrad | ≤ 20 μrad | | |
| Typical beam diameter ¹⁴⁾ | ~ 2 mm | ~ 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 unit size (W × L × H) | 508×1030×244 ± 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⁾ | 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 | | |
| Power consumption | < 0.15 kVA | < 1.0 kVA | | |

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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/e² 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/e² level.

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

¹⁶⁾ With respect to SYNC IN pulse.

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

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



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 ~ 50% 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 ~75% higher compared to the laser PL2231A. 29±5 ps output pulse duration. See table below for pulse energy specifications:

| Model ^{1) 2)} | PL2231A-50 HE |
|------------------------|---------------|
| 1064 nm | up to 70 mJ |

- **Option PL2231A-10**
Pulse repetition rate 10 Hz. The pulse energy is ~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 |

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

²⁾ Outputs are not simultaneous.

³⁾ For PL2231A-10 series laser with -SH module.

BEAM PROFILE

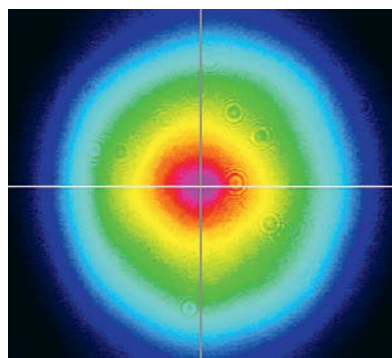


Fig 1. Typical near field output beam profile of PL2230 model laser

OUTLINE DRAWINGS

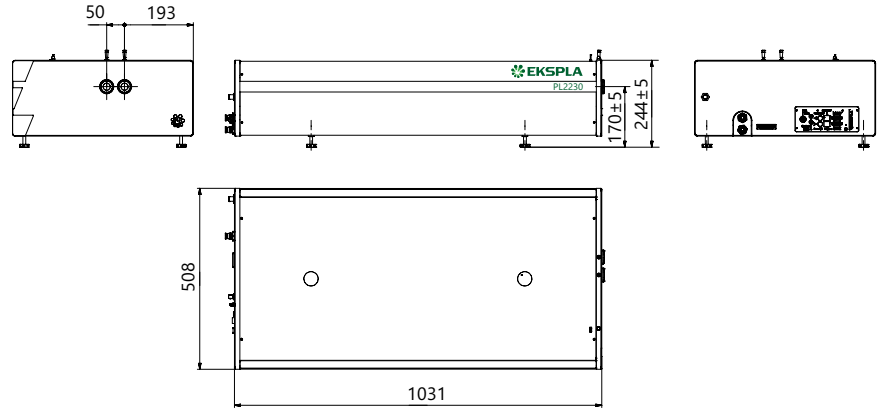
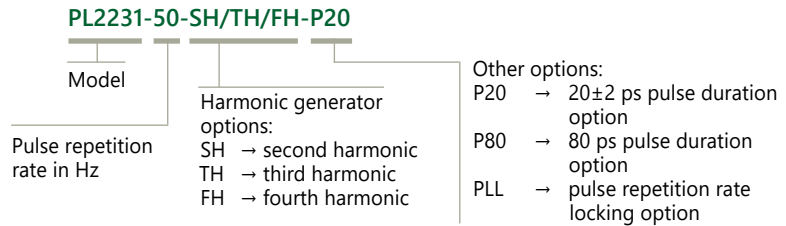


Fig 2. Dimensions of PL2230 series laser head

ORDERING INFORMATION

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



**PHOTO
TECHNICA** www.phototechnica.co.jp
フォトテクニカ株式会社
 〒336-0017 埼玉県さいたま市南区南浦和 2-18-2
 TEL:048-871-0067 FAX:048-871-0068
 e-mail:voc@phototechnica.co.jp