High Repetition Rate Diode Pumped Picosecond Amplifiers

APL HP SERIES

APPLICATIONS

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

FEATURES

- *Diode pumped picosecond amplifiers*
- *Pulse energies up to **150 mJ***
- ***20 – 300 ps** pulse duration*
- *High pulse energy up to **2 kHz** pulse repetition rate*
- *Diode pumped solid state design*
- *Advanced beam shaping for high pulse energy*
- *Internal or external seeding source*
- *Thermally induced birefringence compensated*
- *Low maintenance costs*
- *Less than **10 ps RMS** jitter synchronization pulses for streak camera triggering*
- *Control through USB and LAN interfaces with supplied Windows control software (RS232 optional)*
- *Vacuum image relay system*
- *Optional temperature stabilized second, third and fourth harmonic generators*
- *Optional extremely precise synchronization to external RF signal with PLL option*
- *Optional Gaussian like spatial beam profile with Gaussian fit > 85 % in near field*
- *Optional reduced pulse duration to 20 ps*

High repetition rate APL series amplifiers are designed to produce up to 150 mJ picosecond pulses at 1 kHz repetition rate (or 500 mJ at 100 Hz repetition rate). High pulse energy, excellent pulse-to-pulse energy stability, superior beam quality makes these amplifiers well suited for applications like OPCPA pumping, non-linear optics and others.

Regenerative amplifier / Power amplifier design

APL 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. Alternatively Ekspla can offer an internal seeder meeting customer's requirements.

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 USB and LAN interfaces (RS232 as optional). The amplifier can be controlled from personal computer with supplied software for Windows operating system.

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SPECIFICATIONS

Model	APL500100	APL301k	APL601k	APL1301k
MAIN SPECIFICATIONS [1]				
Output energy				
Fundamental	500 mJ	30 mJ	60 mJ	130 mJ
SH output [2] [3]	300 mJ	20 mJ	40 mJ	85 mJ
TH output [2]	200 mJ	10 mJ	20 mJ	50 mJ
FH output [2]	50 mJ	3 mJ	6 mJ	15 mJ
Pulse repetition rate	100 Hz	1 kHz	1 kHz	1 kHz
Pulse duration [4]	90 ± 10 ps	90 ± 10 ps	90 ± 10 ps	90 ± 10 ps
Pulse energy stability [5]				
Fundamental	≤ 0.5 %	≤ 0.5 %	≤ 0.5 %	≤ 0.5 %
SH output [2]	≤ 0.8 %	≤ 0.8 %	≤ 0.8 %	≤ 0.8 %
TH output [2]	≤ 2 %	≤ 2 %	≤ 2 %	≤ 2 %
FH output [2]	≤ 3 %	≤ 3 %	≤ 3 %	≤ 3 %
Long-term power drift [6]	± 1.5 %	± 1.5 %	± 1.5 %	± 1.5 %
Beam spatial profile	Super-Gaussian [7]	Super-Gaussian [7]	Super-Gaussian [7]	Super-Gaussian [7]
Beam diameter [8]	~ 12 mm	~ 5 mm	~ 7 mm	~ 7 mm
Beam pointing stability [9]	≤ 20 µrad	≤ 20 µrad	≤ 20 µrad	≤ 20 µrad
Beam divergence	≤ 0.5 mrad	≤ 0.6 mrad	≤ 0.5 mrad	≤ 0.5 mrad
Pre-pulse contrast [10]	> 200:1	> 200:1	> 200:1	> 200:1
Optical pulse jitter [11]				
Trig out	≤ 100 ps	≤ 100 ps	≤ 100 ps	≤ 100 ps
Pre-Trig out	≤ 50 ps	≤ 50 ps	≤ 50 ps	≤ 50 ps
With –PLL option	≤ 2 ps	≤ 2 ps	≤ 2 ps	≤ 2 ps
Polarization	Linear	Linear	Linear	Linear
PHYSICAL CHARACTERISTICS [12]				
Laser head size (W×L×H mm)	1200 × 2400 × 300	600 × 1500 × 300	900 × 1500 × 300	900 × 1800 × 300
Power supply size (W×L×H mm)	553 × 600 × 832 377 × 1015 × 1080	553 × 600 × 830	553 × 600 × 1230	553 × 600 × 1230
Umbilical length [13]	2.5 m	2.5 m	2.5 m	2.5 m
OPERATING REQUIREMENTS [14]				
Electrical power	208, 380 or 400 V AC, three-phase, 50/60 Hz [15]	208, 380 or 400 V AC, three-phase, 50/60 Hz [15]	208, 380 or 400 V AC, three-phase, 50/60 Hz [15]	208, 380 or 400 V AC, three-phase, 50/60 Hz [15]
Power consumption [16]	≤ 5 kW	≤ 5 kW	≤ 10 kW	≤ 22 kW
Water supply	≤ 8 l/min, 2 Bar, max 20 °C	≤ 14 l/min, 2 Bar, max 20 °C	≤ 25 l/min, 2 Bar, max 20 °C	≤ 40 l/min, 2 Bar, max 15 °C
Operating ambient temperature	22 ± 2 °C	22 ± 2 °C	22 ± 2 °C	22 ± 2 °C
Storage ambient temperature	15 – 35 °C	15 – 35 °C	15 – 35 °C	15 – 35 °C
Relative humidity (non-condensing)	≤ 80 %	≤ 80 %	≤ 80 %	≤ 80 %
Cleanness of the room	ISO Class 7	ISO Class 7	ISO Class 7	ISO Class 7

[1] Due to continuous improvement, all specifications are subject to change without notice. The parameters marked 'typical' are indications of typical performance and will vary with each unit we manufacture. Presented parameters can be customized to meet customer's requirements. All parameters measured at 1064 nm if not stated otherwise.

[2] Harmonic outputs are optional. Specifications valid with respective harmonic module purchased. Outputs are not simultaneous.

[3] Second harmonic specification is valid when only SH option is ordered. If TH/FH options are orders second harmonic efficiency is reduced to ~50 %.

[4] Standard pulse duration is 90 ps. Other pulse durations can be ordered within range of 20 ps – 300 ps. Shortening the pulse duration below 90 ps will reduce the output energy proportionally.

[5] Under stable environmental conditions, normalized to average pulse energy (RMS, averaged from 60 s).

[6] Measured over 8 hours period after 30 min warm-up when ambient temperature variation is less than ±2 °C.

[7] Super-Gaussian spatial mode of 6-11th order in near field.

[8] Beam diameter is measured at signal output at $1/e^2$ level for Gaussian beams and FWHM level for Super-Gaussian beams.

[9] Beam pointing stability is evaluated as movement of the beam centroid in the focal plane of a focusing element (RMS, averaged from 60 s).

[10] 1000:1 contrast available upon request.

[11] Optical pulse jitter with respect to electrical outputs:
– Trig out > 3.5 V @ 50 Ω
– Pre-Trig out > 1 V @ 50 Ω
– PLL option > 1 V @ 50 Ω

[12] System sizes are preliminary and depend on customer lab layout and additional options purchased.

[13] Longer umbilical with up to 5 m available upon request.

[14] 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.

[15] Voltage fluctuations allowed are +10 % / -15 % from nominal value.

[16] Required current rating can be calculated by dividing power rating by mains voltage. Power rating is given in apparent power (kVA) for systems with flash lamp power supplies and in real power (kW) for systems without flash lamp power supplies where reactive power is neglectable.

OPTIONS

Option	Description	Comment
-P20...300	Custom pulse duration between 20 ps and 300 ps	Available with internal and external seeder. Shortening the pulse duration below 90 ps will reduce the output energy proportionally
-50/100	50 Hz or 100 Hz pulse repetition rate	Energy can be increased ~4 times
-2k	2 kHz pulse repetition rate	Reduces the output energy of fundamental by ~50 %
-G	Gaussian like spatial beam profile	Reduces the output energy of fundamental by ~80 %
-FS	External seeder input via motorized spectral broadening stage	Requires > 1.5 nJ per pulse @ 800 nm, 100 fs
-PLL	Phase Lock Loop option for precise lock to external RF signal	Electrical to optical signal jitter ≤ 3 ps
-SH/TH/FH	Second, third and fourth harmonic outputs	Conversion efficiency from fundamental respectively ~50 %, ~30 % and ~10 %. Harmonic outputs not simultaneous with fundamental output
-AW	Water-to-Air cooling	Replaces or supplements Water-to-Water cooling unit. Heat dissipation equals total power consumption

POWER SUPPLY

Cabinet	Usable height	Height H, mm	Width W, mm	Depth D, mm
MR-9	9 U	455.5 (519 [1])	553	600
MR-12	12 U	589 (653 [1])	553	600
MR-16	16 U	768 (832 [1])	553	600
MR-20	20 U	889 (952 [1])	553	600
MR-25	25 U	1167 (1231 [1])	553	600

[1] Full height with wheels.

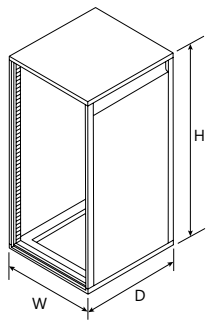

Fig 1. Typical APL laser system power supply dimensions (MR rack used depends on the laser model)

Fig 2. Typical external view of APL1301k laser system (actual design might vary)

PERFORMANCE

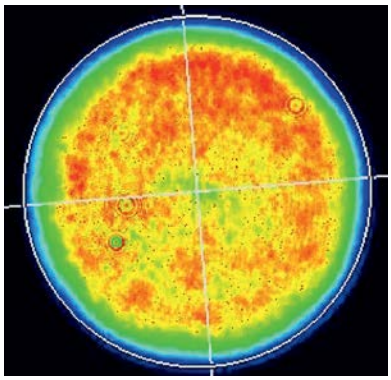

Fig 3. Typical High repetition rate APL amplifier system near field beam profile at 1064 nm (imaged from laser output)

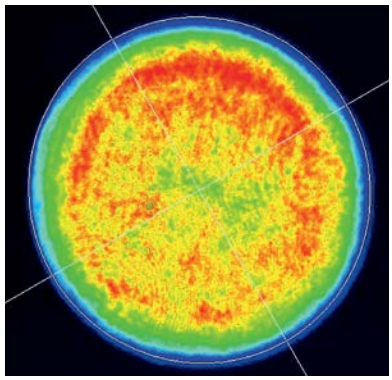

Fig 4. Typical High repetition rate APL amplifier system near field beam profile at 532 nm (imaged from SH crystal)

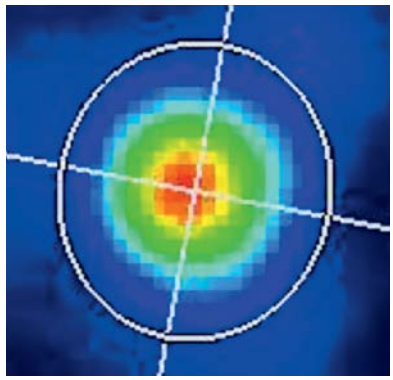

Fig 5. Typical High repetition rate APL amplifier system far field beam profile at 532 nm

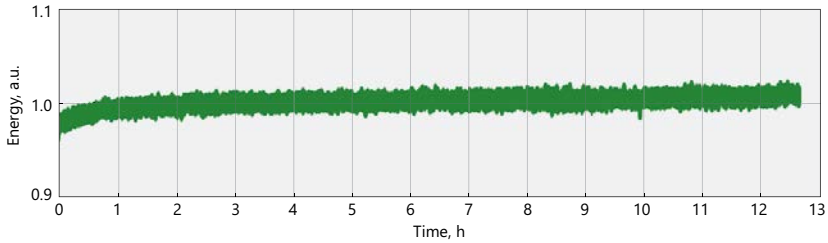

Fig 6. Typical long-term energy stability of High repetition rate APL amplifier system

OUTLINE DRAWINGS

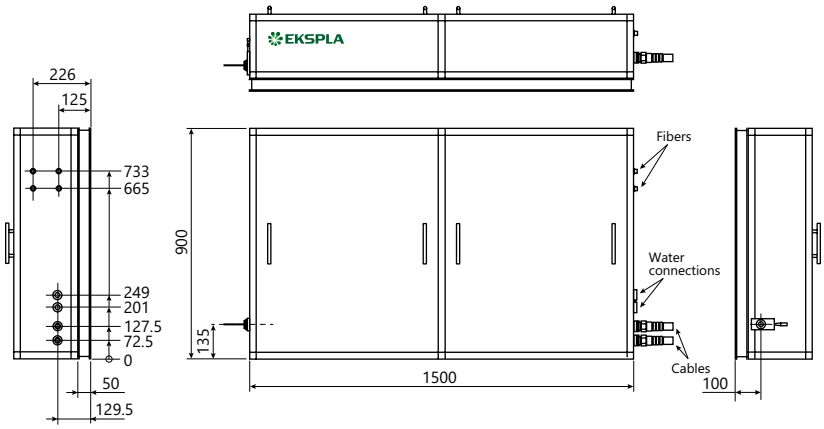

Fig 7. Typical APL601k laser system external dimensions

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.

APL (1)(2)-(3)

Model

Energy level:
100 → 10 mJ
30 → 30 mJ
60 → 60 mJ
130 → 130 mJ
500 → 500 mJ

Pulse repetition rate:
50 → 50 Hz
100 → 100 Hz
1k → 1 kHz
2k → 2 kHz

Any additional options:
See 'Options' table