

High-peak-power diode-pumped picosecond lasers for scientific, technological and navigational applications

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PICAR

PICOSECOND HIGH-PEAK-POWER QCW DIODE-ARRAY PUMPED Nd:YAG LASERS WITH ELECTROOPTICAL OPERATION CONTROL



- ✓ All-solid-state technology
- ✓ Excellent beam quality
- ✓ Output and input triggering
- ✓ Widely tunable repetition rate
- ✓ Electro-optical operation control
- ✓ Microcontroller design
- ✓ Internal auto-diagnostics
- ✓ Compactness and ease of operation
- ✓ No water cooling
- ✓ Low power consumption

We realized new approach in all-solid-state ultrashort pulse laser development. Compact picosecond electrooptically controlled Nd:YAG laser, pumped with fiber coupled pulsed diode array, combines generation and regenerative amplification modes in one device.

Electrooptical operation control system based on the set of thermo-compensated electro-optical modulators provides active mode-locking, negative feed-back, switching operation between connected oscillators, and single pulse output from the oscillator. For maximum pulse shortening, passive mode locking based on nonlinear semiconductor mirror is applied.

Combined action of active-passive mode-locking and negative feed-back provide shortening of time which is necessary to form output pulse with required parameters.

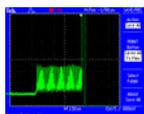
Single ultrashort pulse is produced in each laser shot. This provides conditions for optimal conversion of applied energy into output radiation and precise synchronization of generated pulse with external signal.



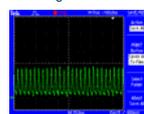
Menu windows examples

Control electronics is microcontroller based.

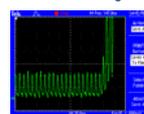
All regulation, adjustment procedures and internal state monitoring are fulfilled in "one knob" regime by means encoder lever through branched menu.



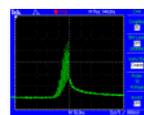
Oscillogram of generation process development up to oscillator switching



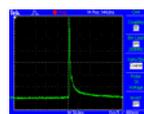
Middle section fragment of the oscillogram



Beginning of amplification stage in the oscillator



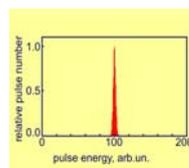
Pulse amplification in the oscillator up to maximal energy



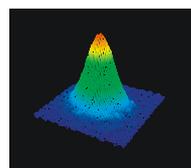
Output single pulse selection

TECHNICAL PARAMETERS

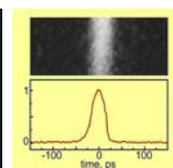
Wavelength, nm	1064
Single pulse energy, mJ	up to 0.5
Energy instability (RMS), %	< 2
Pulse length (FWHM), ps	25
Repetition rate, Hz	up to 500
Output beam diameter, mm	1.1
Beam quality, M^2	1.2
Input and output triggering	
Output triggering pulse delay, ns	-500...+500
Output triggering pulse instability, ns	< 0.2
Optical unit size (WxHxL), mm	225x110x400
Electronic module size (WxHxL), mm	440x90x360
Optical unit weight, kg	5.5
Electronic module weight, kg	5.0
Interface cable length, m	2.5
Power consumption, W	<200



Pulse energy distribution. Repetition rate 300 Hz. Exposition time 8 min. RMS deviation 1.7%



Output beam space profile



Pulse image recorded by streak-camera (on the top) and its time scan (on the bottom). Pulse length 28 ps

POWER SCALING

Tunable repetition rate, high beam quality and high single pulse energy provide simplicity of output pulse energy and power scaling



LASER + AMPLIFIER 1

Frequency, Hz	100
Energy, mJ	10



LASER + AMPLIFIERS 1&2

Frequency, Hz	20
Energy, mJ	>80

OPTIONALLY

- ✓ Flash-lamp pumped amplifier 100 Hz x 10 mJ
- ✓ 2-stage flash-lamp-pumped amplifier 20 Hz x 80 mJ
- ✓ Single-pulse correlator
- ✓ 2nd and 3^d harmonics converters
- ✓ Diode pumped amplifier (in the development) 300 Hz x 3 mJ

APPLICATIONS

- Micromachining of extra-hard materials
- Laser satellite radars and navigational measurements
- Picosecond kinetics
- Biophotonics
- Time-resolved spectroscopy
- 3D diagnostics

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