FemtoLux 30

Femtosecond Industrial Lasers

PERFECT AND VERSATILE TOOL FOR MICROMACHINING

The FemtoLux 30 femtosecond laser has a tunable pulse duration from <350 fs to 1 ps and can operate in a broad AOM controlled range of pulse repetition rates from a single shot to 4 MHz.

The maximum pulse energy is more than 90 µJ operating with single pulses and can reach 250 µJ in burst mode, ensuring higher ablation rates and processing throughput for different materials.

The FemtoLux 30 beam parameters will meet the requirements of the most demanding materials and micro-machining applications.

Innovative laser control electronics ensure simple control of the FemtoLux 30 laser by external controllers that could run on different platforms, be it Windows, Linux or others using REST API commands.

This makes easy integration and reduces the time and human resources required to integrate this laser into any laser micromachining equipment.

INNOVATIVE "DRY" COOLING SYSTEM

The FemtoLux 30 laser employs an innovative cooling system and sets new reliability standards among industrial femtosecond lasers. No additional water chiller is needed.

The chiller requires periodic maintenance – cooling system draining and rinsing and water and particle filter replacement. Moreover, water leakage can cause damage to the laser head and other equipment. Instead of using water for transferring heat from a laser head, the FemtoLux 30 laser uses an innovative Direct Refrigerant Cooling method.

The refrigerant agent circulates from a PSU-integrated compressor and condenser, to a cooling plate via armored flexible lines. The cooling circuit is permanently hermetically sealed and requires no maintenance.

SIMPLE & RELIABLE COOLING PLATE ATTACHMENT

The cooling plate is detachable from the laser head for more convenient laser installation.

The laser cooling equipment is integrated with the laser power supply unit into a single 4U rack-mounted housing with a total weight of 15 kg.

FEATURES

- *Typical max output power* ***30 W at 1030 nm, 11 W at 515 nm***
- ***> 90 µJ at 1030 nm, > 50 µJ at 515 nm***
- ***MHz, GHz burst** modes*
- ***> 250 µJ** in a burst mode*
- ***< 350 fs – 1 ps***
- ***Single shot to 4 MHz** (AOM controlled)*
- *<0.5% RMS power long term stability over 100 hours*
- *M^2 < 1.2*
- *Beam circularity > 0.85*
- *Zero maintenance*
- *Dry cooling (no water used)*
- *PSU and cooling unit integrated into single 4U rack housing*
- *Easy and quick installation*
- *Compatible with galvo and Polygon scanners as well as PSO controllers*
- *2 years of total warranty*

APPLICATIONS

- *LCD, LED, OLED drilling, cutting and repair*
- *Microelectronics manufacturing*
- *Glass, sapphire and ceramics micro processing*
- *Glass intra volume structuring*
- *Micro processing of different polymers and metals*

Ask for separate brochure

SPECIFICATIONS [1]

Model	FemtoLux 30
MAIN SPECIFICATIONS	
Central wavelength	
Fundamental	1030 nm
With second harmonic option	515 nm
Pulse repetition rate (PRR) [2]	200 kHz – 4 MHz
Pulse repetition frequency (PRF) after frequency divider	PRF = PRR / N, N=1, 2, 3, ... , 65000; single shot
Average output power	
At 1030 nm	> 27 W (typical 30 W)
At 515 nm	> 11 W [3]
Pulse energy	
At 1030 nm	> 90 µJ
At 515 nm	> 50 µJ [3]
Total energy in MHz/GHz burst mode	> 250 µJ
Power long term stability (Std. dev.) [4]	< 0.5 %
Pulse energy stability (Std. dev.) [5]	< 1 %
Pulse duration (FWHM)	tunable, < 350 fs [6] – 1 ps
Beam quality	M^2 < 1.2 (typical < 1.1)
Beam circularity, far field	> 0.85
Beam divergence (full angle)	< 1 mrad
Beam pointing thermal stability	< 20 µrad/°C
Beam diameter ($1/e^2$) at 20 cm distance from laser aperture at 1030 nm	2.5 ± 0.4 mm
Triggering mode	internal / external
Pulse output control	frequency divider, pulse picker, burst mode, packet triggering, power attenuation
Control interfaces	RS232 / LAN
Length of the umbilical cord	3 m, detachable
Laser head cooling type	dry (direct refrigerant cooling through detachable cooling plate)
PHYSICAL CHARACTERISTICS	
Laser head (W × L × H)	429 × 569 × 130 mm
Power supply unit (W × L × H)	449 × 376 × 177 mm
OPERATING REQUIREMENTS	
Mains requirements	100 – 240 V AC, single phase, 50/60 Hz
Operating ambient temperature	18 – 27 °C
Relative humidity	10–80 % (non-condensing)
Air contamination level	ISO 9 (room air) or better

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. All parameters are specified for a shortest pulse duration.

2) When frequency divider is set to transmit every pulse. Fully controllable by integrated AOM.

3) At 200 kHz.

4) Over 100 h after warm-up under constant environmental conditions.

5) Under constant environmental conditions.

6) At PRR > 500 kHz. At PRR < 500 kHz shortest pulse duration is < 400 fs.

SEAMLESS USER EXPERIENCE

- *Easy integration.*
  Remote control using REST API commands via RS232 and LAN
- *Reduced integration time.*
  Demo electronics is available for laser control programming in advance
- *Easy and quick installation.*
  No water, fully disconnectable laser head. Can be installed by the end-user
- *Easy troubleshooting.*
  Integrated detectors and constant system status logging
- *No periodic maintenance required.*

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FemtoLux 30

FemtoLux 30 with second harmonic option and power supply

PERFORMANCE

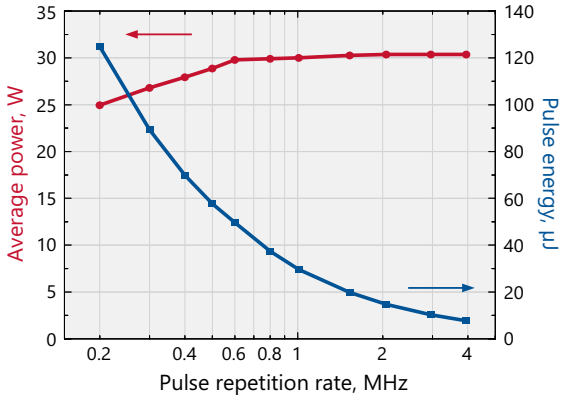


Fig 1. Typical dependence of output power and pulse energy of FemtoLux 30 laser at 1030 nm on pulse repetition rate

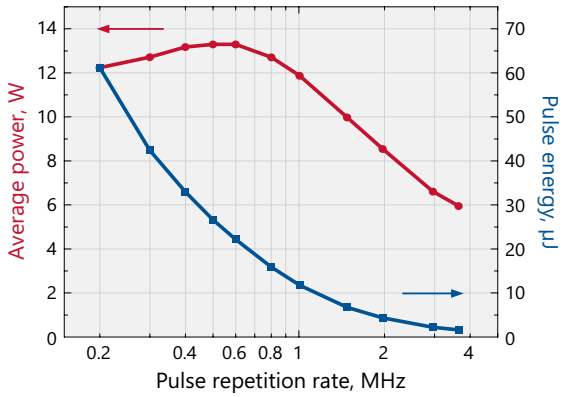


Fig 2. Typical dependence of output power and pulse energy of FemtoLux 30 laser at 515 nm on pulse repetition rate

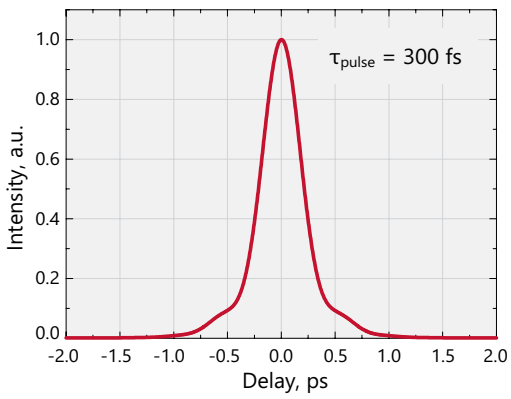


Fig 3. Typical FemtoLux 30 laser (at 1030 nm) output pulse autocorrelation function

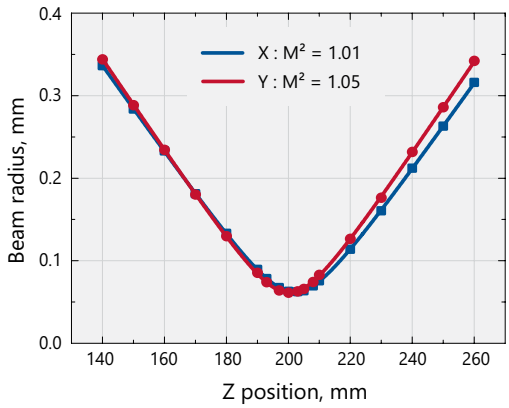


Fig 4. Typical M^2 measurement of FemtoLux 30 laser at 1030 nm

STABILITY

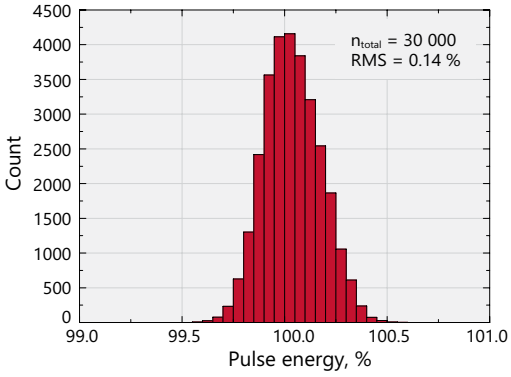


Fig 5. Typical pulse-to-pulse energy stability of FemtoLux 30 laser at 200 kHz over 30 000 pulses. RMS was calculated by using a set of mean values of 10 consecutive laser shots

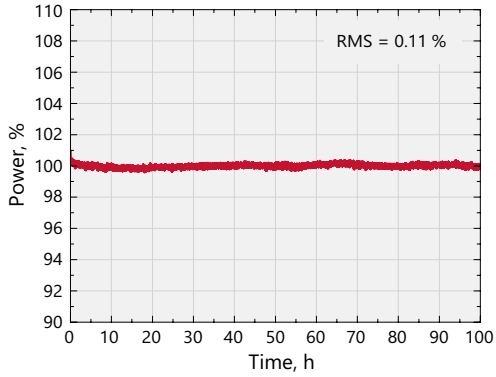


Fig 6. Typical long term average power stability of FemtoLux 30 laser at 1030 nm under constant environmental conditions

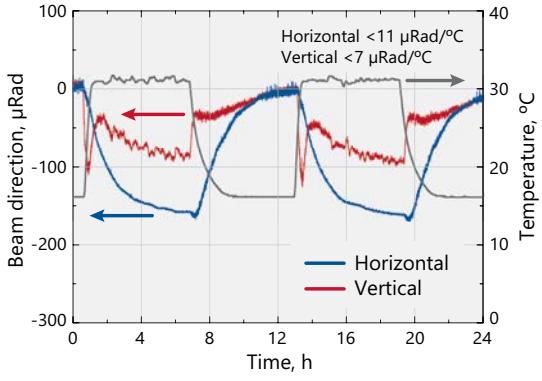


Fig 7. Typical beam direction stability of FemtoLux 30 under harsh environmental conditions

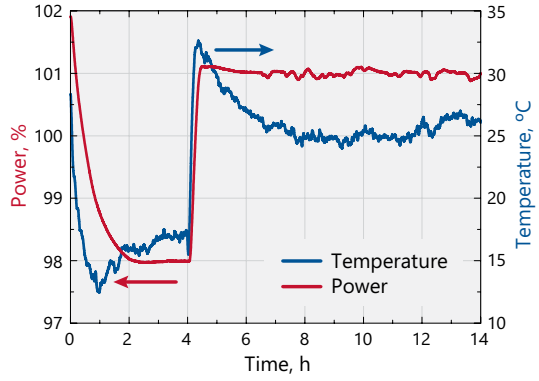
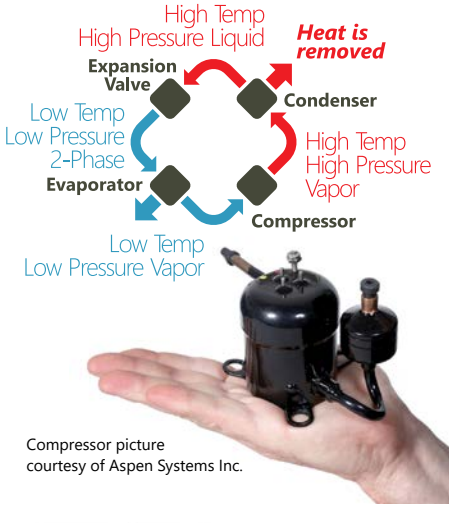


Fig 8. Average output power dependance of FemtoLux 30 laser on ambient temperature at 1030 nm

DIRECT REFRIGERANT COOLING SYSTEM

FEATURES

- *Military-grade reliability*
- *Permanently hermetically sealed system >90,000 hour MTBF*
- *No maintenance*
- *High cooling efficiency*
- *>45% lower power consumption compared to water cooling equipment*
- *Compact and light*



Compressor picture courtesy of Aspen Systems Inc.

Simple and reliable cooling plate attachment

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DRAWINGS

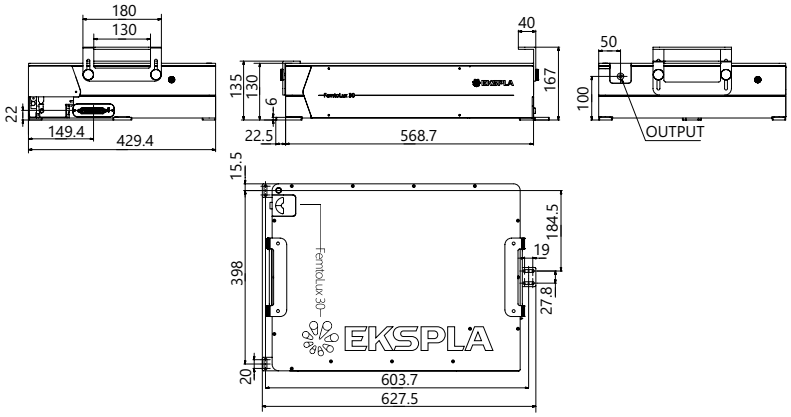

Fig 9. FemtoLux 30 laser head outline drawing

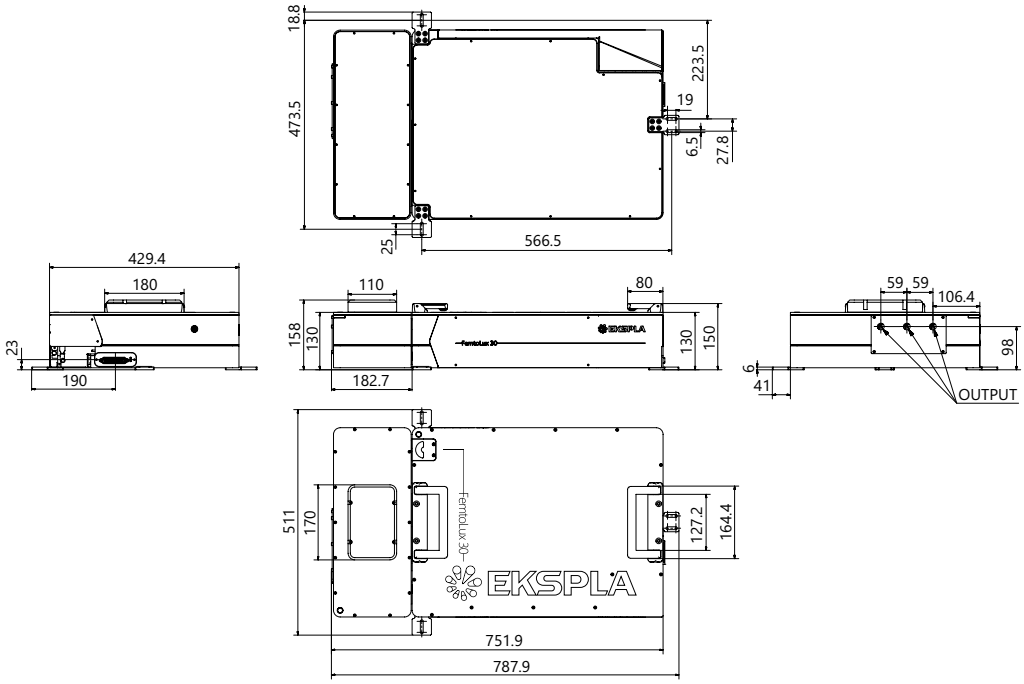

Fig 10. FemtoLux 30 with second harmonic option. Laser head outline drawing

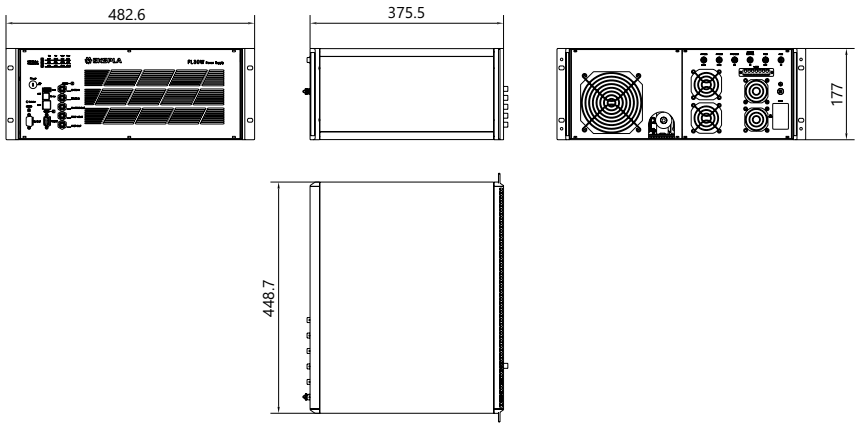

Fig 11. Power supply outline drawing

GHz burst option

A new versatile patent-pending method to form ultra-high repetition rate bursts of ultrashort laser pulses. The developed method is based on the use of an all-in-fiber active fiber loop (AFL). A detailed description of the invention can be found on:

[1] Andrejus Michailovas, and Tadas Bartulevičius. 2021 Int. patent application published under the Patent Cooperation Treaty (PCT) WO2021059003A1.
[2] Tadas Bartulevičius, Mykolas Lipnickas, Virginija Petrauskienė, Karolis Madeikis, and Andrejus Michailovas, (2022), "30 W-average-power femtosecond NIR laser operating in a flexible GHz-burst-regime," Opt. Express 30, 36849-36862.

SPECIFICATIONS

Parameter	Value	
Burst repetition rate	200 – 650 kHz	
Intra-burst pulse repetition rate [1]	2 GHz	
GHz burst mode	**short**	**long**
Number of pulses [2]	2 – 22	44 – 1100
Shape	square, rising, falling	falling, pre-shaped [3]

[1] Custom intra-pulse PRR is available upon a request.

[2] Depends on the intra-pulse PRR.

[3] For more information, please inquire sales@ekspla.com.

SHORT GHz BURST

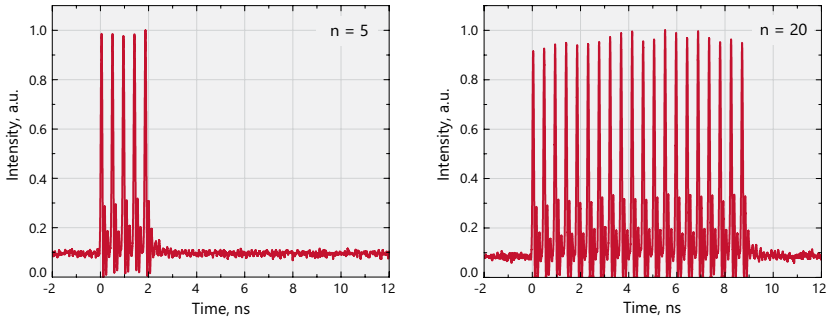

Fig 12. Measured 2.2 GHz intra-burst PRR burst of pulses containing a different number of pulses of equal amplitudes at 31.5 W average output power

LONG GHz BURST

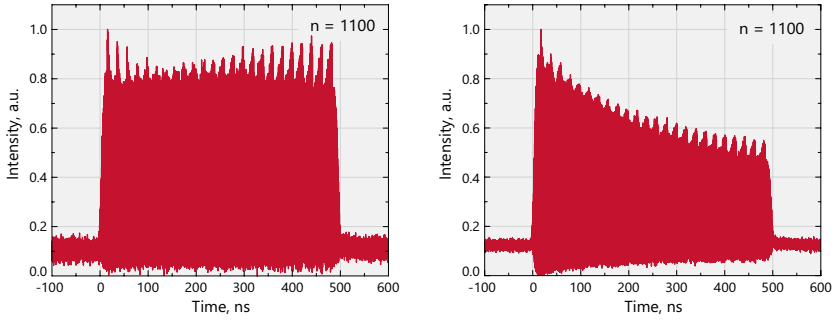

Fig 13. Measured 2.2 GHz pre-shaped bursts of 1000 pulses at 233 kHz burst repetition rate for the desired rectangular-like burst shape

Fig 14. Measured 2.2 GHz non-pre-shaped bursts of 1100 pulses at 233 kHz burst repetition rate

BENEFITS

The Femtolux 30 laser can operate in the single-pulse mode, MHz burst mode and GHz burst mode.

The burst formation technique based on the use of the AFL is a very versatile method as it allows to overcome many limitations encountered by other fiber- and/or solid-state-based techniques. The benefits of this technology:

- *Any desired intra-burst PRR can be achieved independently from the initial PRR of the master oscillator*
- *Identical pulse separation inside the GHz bursts is maintained*
- *Short- and long-burst formation modes can be provided. A short burst is up to about 10 ns burst width (from 2 to tens of pulses in the GHz burst). A long burst is from ~20 ns up to a few hundred ns in burst width (from tens to thousands of pulses in the GHz burst)*
- *An adjustable amplitude envelope of the GHz bursts is provided*
- *No pre/post pulses in GHz burst. Pure GHz bursts*
- *Ultrashort pulse duration is maintained inside the bursts*

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