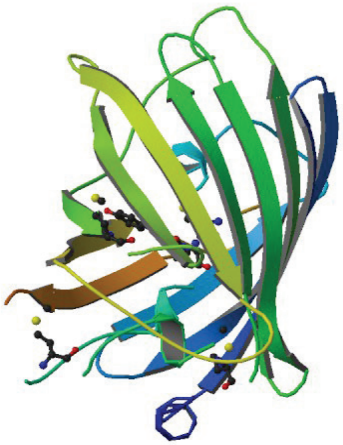
MenloSystems



YLMO-930

Femtosecond Fiber Laser for Microscopy and Life Science Applications

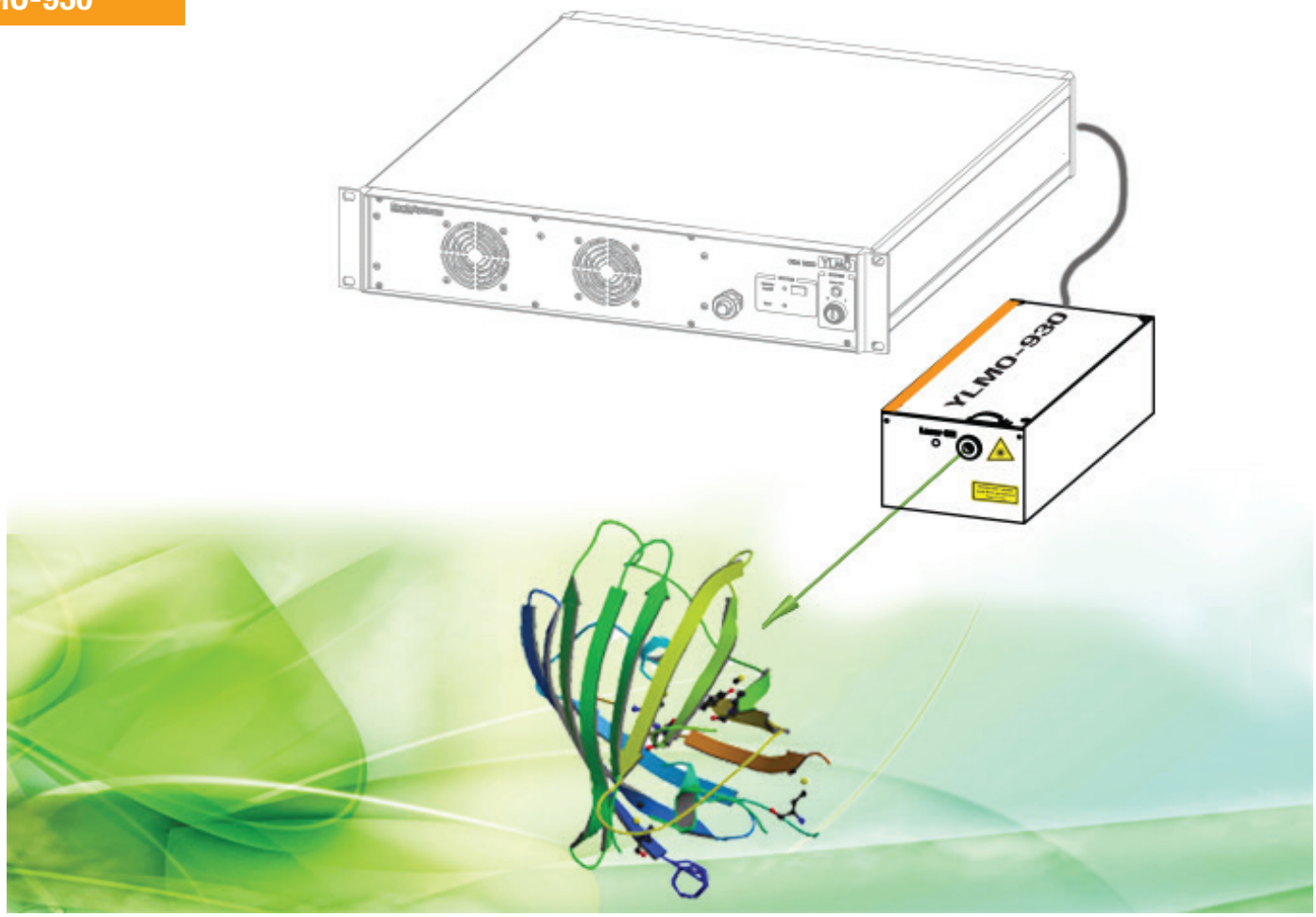
White Paper

Revision 1.3

July 2019

www.menlosystems.com

YLMO-930



OVERVIEW

Menlo Systems' fiber-based femtosecond laser sources integrate latest achievements in fiber technology into easy-to-use products. Menlo Systems' unique figure 9® mode locking technology results in reproducible and long-term stable operation. The YLMO series with its all-PM design guarantees excellent stability and low-noise operation. All lasers are maintenance free, user installed and ready to use at the press of a single button.

The YLMO series is engineered for OEM integration with 24/7 operation. With >1 W average output power centered around 930 nm the YLMO-930 is optimized for 2-photon fluorescence excitation of Green Fluorescent Protein GFP and its variants. Combined with the very compact footprint the YLMO-930 is the perfect choice for applications in life sciences where reliability counts.

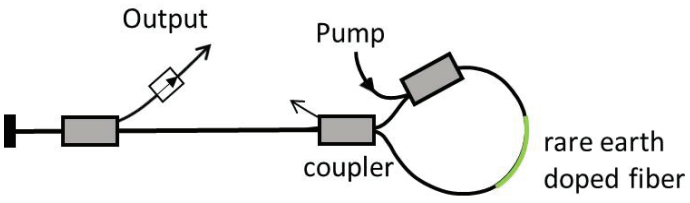
ADVANCED FEATURES AND BENEFITS

- Average power >1 W
- Center wavelength 930 nm
- Pulse width <140 fs (typ.120 fs)
- Adjustable chirp control
- Repetition rate 100 MHz
- Pulse energy >10 nJ
- Low amplitude and phase noise
- All-PM solution
- Menlo Systems proprietary figure 9® laser technology
- Laser output in less than 60 seconds after turn-on
- Excellent beam quality and beam stability
- Radio frequency output for trigger/synchronization
- Ultra compact laser head
- Air cooled – no chiller
- Low power consumption
- Quality “Made in Germany”

BACKGROUND

Menlo Systems is well known for its pioneering and ground-breaking products for metrology. The Optical Frequency Comb product line has fundamentally influenced the world of precision measurements and precision control. Menlo Systems co-founder Prof. Dr. Theodor Hänsch has been awarded with the Nobel prize in physics 2005 for the invention of the technology.
Part of the success story of the product line is connected to the femtosecond fiber laser being the precise clock signal of the instrument.

Menlo Systems has transferred the technology and its products to applications beyond metrology, and in particular to life science applications.
The YLMO femtosecond fiber lasers are based on Menlo Systems proprietary figure 9® technology.
As passively mode-locked laser the YLMO is inherently simple and stable. Reduced to the most fundamental elements and all PM-fiber technology the laser has no moving parts neither components that degrade over time.



Schematics of Menlo Systems figure 9 fiber laser: a linear cavity with improved NOLM based mode-lock mechanism.

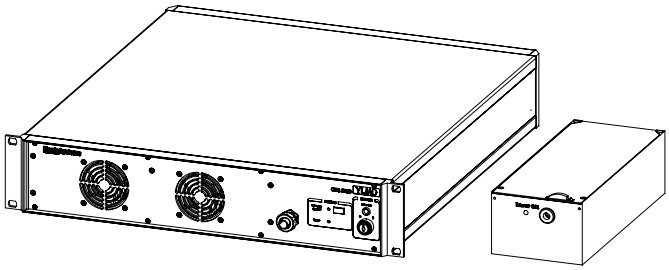
TECHNICAL SPECIFICATIONS - YLMO-930

SPECIFICATIONS	
Repetition rate	100 ± 1 MHz (factory set, fixed)*
Central wavelength	930 ± 10 nm
Average power	>1 W
Spectral bandwidth	>10 nm
Pulse width	<140 fs (typ.120 fs)
Chirp control	-24000 ... 0 fs²
Beam quality	TEM 00, M”<1.2
Beam diameter	2 mm
Beam height	55 mm**
Polarization	p-pol. in free space (PER: typ. 23 dB)
Optical output	Free-space
Trigger output	SMA connector
Modulation input (enable/disable)	SMA connector
Control interface	USB interface + Software
Power consumption	200 W
Supply voltage	110/115/230 VAC, 50 to 60 Hz
Laser head dimension/weight	265 x 110 x 76 mm / <5 kg
Control unit dimension/weight	19”, 2 HU (449 x 496 x 96 mm / <20 kg
Operating ambient temperature	15-30 °C

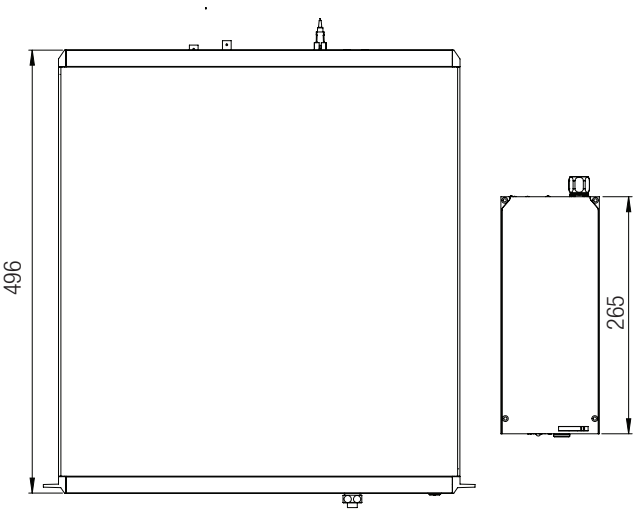
*other repetition rates on request, **other beam heights on request

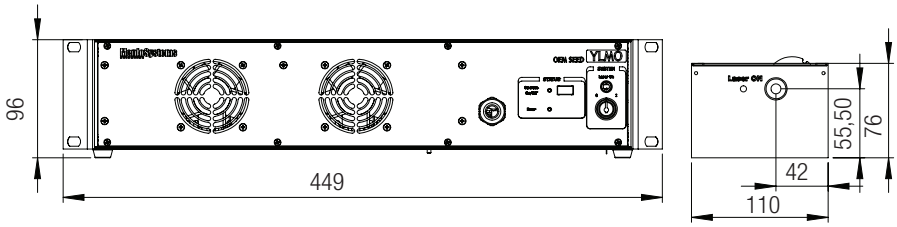
Specifications are subject to change without notice.

TECHNICAL DRAWINGS



Laser head and control unit interconnected by fixed 2m cable

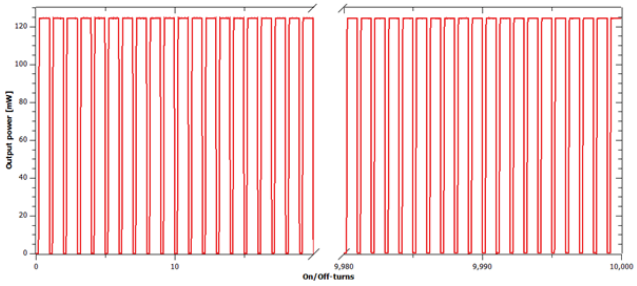




PERFORMANCE OF MENLO FEMTOSECOND FIBER LASERS

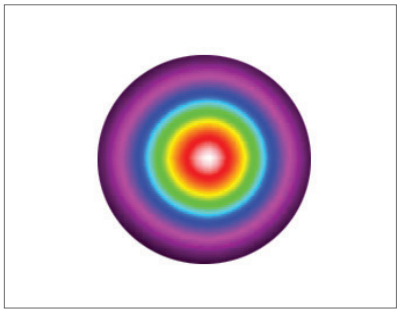
The following data sets are indicators of the reliability, stability and best-in-class performance of Menlo Systems femtosecond fiber lasers.

RELIABILITY



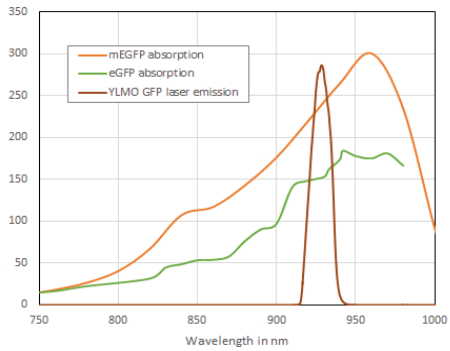
10.000 on/off cycles of the laser oscillator. At any one of the 10.000 events the output power returns to its identical values within seconds

BEAM QUALITY



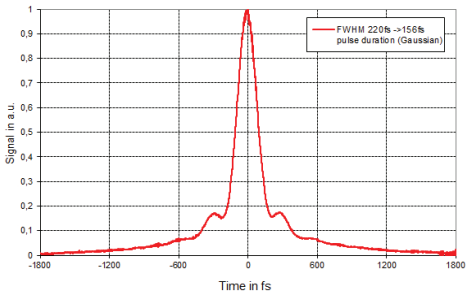
Typical beam quality with an M^2 value of 1.1 or better
(in the plot: $M^2 = 1.03$).

OUTPUT SPECTRUM



Output spectrum of YLMO-930 with a center wavelength of 930 nm and a bandwidth of 15 nm. The spectrum matches perfectly with the 2-photon excitation wavelength of GFP and its variants.

PULSE LENGTH



Pulse length at the laser output. User-adjustable chirp-control allows to tune the pulse dispersion for shortest pulses and best performance at the target.

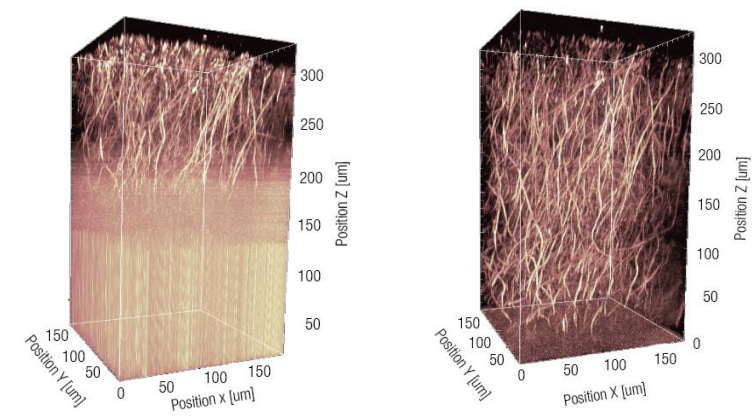
STILL WANT TO READ MORE?

In the following we show more life science applications with Menlo Systems lasers.

2-Photon Excitation: Ultra compact 780 nm laser for 2-photon workstations

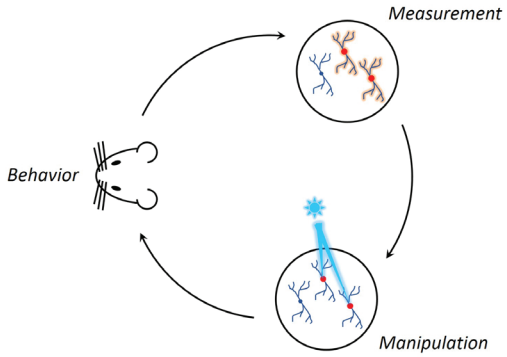
The ultra compact ELMO 780 with <100 fs pulses at center wavelength of 780 nm is enabling 2-photon workstations. Full flexibility in regard to integration. Can be operated in harsh environments and conditions.

2-Photon Excitation: 1300 nm laser for imaging of mouse brain



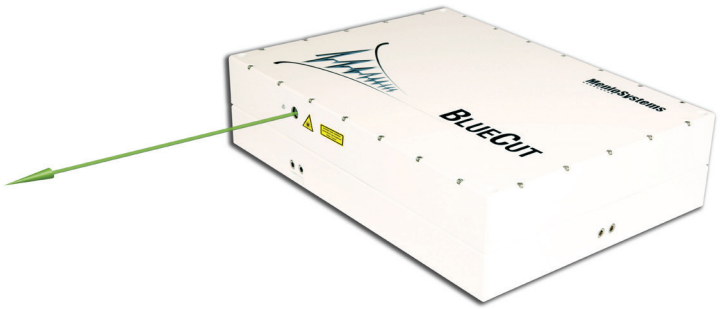
Two-photon excited fluorescence images of a 300 µm thick mouse brain slice stained with Alexa647.
Left side: Excitation at 780 nm.
Right side: Excitation at 1300 nm.
For both images the average excitation power at the sample is a few mW. The advantage of the longer wavelength excitation is clearly visible: High image contrast also in deeper regions of the sample even at very low excitation power.

Optical Control: In-vivo all-optical interrogation of neural networks

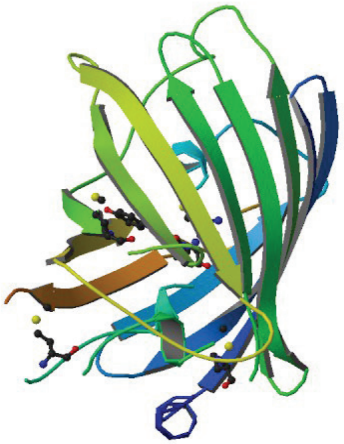


Schematic of all-optical physiology illustrating the interplay between behavioral experiment, imaging of activity patterns in the brain, and the manipulation of specific functionally defined neurons.

Our cognition and behavior is determined by single neurons and groups of neurons communicating with one another. Femtosecond lasers enable us to understand and even to interfere with those communication patters on the microscopic level.



Menlo Systems BlueCut with 10 microJ @ 1030 nm pulse energy and 10 W average output power is the perfect match for photoactivation in applications in optogenetics.



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