UltraFlux
FF/FT 5000 SERIES

High Energy
Tunable Wavelength
Femtosecond
Laser Systems

UltraFlux FF/FT 5000. Custom high pulse energy femtosecond fixed wavelength laser system delivering up to 40 mJ pulse energy with pulse duration down to 11 fs.

FEATURES

- *Based on the novel **OPCPA** (Optical Parametric Chirped Pulse Amplification) technology – simple and cost-efficient operation*
- *Patented front-end design (patents no. EP2827461 and EP2924500)*
- *Hands free wavelength tuning*
- *Up to **1 kHz** repetition rate*
- *Up to **50 mJ** pulse energy*
  - *Excellent pulse energy stability: < 1.5 % rms*
  - *Excellent long-term average power stability: < 1.5 % rms over > 12 hour period*
- *High contrast pulses without any additional improvement equipment*

APPLICATIONS

- *Broadband CARS and SFG*
- *Femtosecond pump-probe spectroscopy*
- *Nonlinear spectroscopy*
- *High harmonic generation*
- *Particle acceleration in plasma*

The UltraFlux FF/FT 5000 laser is a 2 TW tabletop femtosecond OPCPA (Optical Parametric Chirped Pulse Amplification) based system operating at 10 Hz. Originally built for ELI-ALPS (Extreme Light Infrastructure – Attosecond Light Pulse Source) in Hungary, this laser is now available for a wide variety of applications.

The master oscillator is a patent pending (EP2827461A2) all-in-fiber Yb fiber picosecond laser seed source with two fiber outputs. One seeds the OPCPA Front-End and another seeds the Picosecond Pump Laser (PPL). Both outputs originate from the same fiber so they are synchronized optically. This approach eliminates the need for a complex temporal synchronization system typically present in other OPCPA systems.

The Nd:YAG Picosecond Pump Laser (PPL) system is comprised of several sub-systems: diode pumped Regenerative Amplifier, diode pumped Preamplifier, two flash lamp pumped Amplifiers, and Second Harmonic Generators which convert fundamental 1064 nm wavelength to 532 nm. PPL outputs four beams at 532 nm and 10 Hz pulse repetition rate. One beam is directed to NOPCPA Front-End subsystem and others are directed to NOCPA stages.

The Front-End NOPCPA (Non-collinear Optical Parametric Chirped Pulse Amplifier) consists of several sub-systems: Picosecond Optical Parametric Amplifier (ps-OPA) amplifying oscillator output pulses, Grating Compressor compressing ps-OPA output pulses, White Light Generator (WLG) broadening the spectrum of ps-OPA output pulses and Femtosecond Non-collinear Optical Parametric Amplifier (fs-NOPA) amplifying WLG output pulses.

The Stretcher sub-system is a Grism (diffraction gratings combined together with prisms) based pulse stretcher, which stretches output pulse from NOPCPA Front-End and Dazzler (Acousto-Optic Programmable Dispersive Filter) for high order phase compensation.

Three stages of NOPCPA (Non-collinear Optical Parametric Chirped Pulse Amplifiers) are used to amplify the stretched pulse from the Stretcher up to 50 mJ.

Finally, amplified pulses are compressed down to 11 fs in the Pulse Compressor. Bulk glass compressors are combined together with chirped mirror compressors. Pulse energy after Compressor is >40 mJ.

The built-in Output Diagnostics stage ensures reliable, turn-key operation by monitoring critical parameters such as energy, duration, and beam profile.

SPECIFICATIONS [1]

Model	UltraFlux FT5010	UltraFlux FF50100-SP
MAIN SPECIFICATIONS		
Max. Pulse energy	50 mJ	
SH output [4]	inquire	
TH output [4]	inquire	
FH output [4]	inquire	
Wavelength tuning range		
Standard version	750 – 960 nm, tunable	750 – 960 nm, fixed at desired wavelength
SH output [4]	375 – 480 nm, tunable	375 – 480 nm, fixed at desired wavelength
TH output [4]	250 – 320 nm, tunable	250 – 320 nm, fixed at desired wavelength
FH output [4]	210 – 230 nm, tunable	210 – 230 nm, fixed at desired wavelength
Scanning steps		
SH output [4]	5 nm	
TH output [4]	3 nm	
FH output [4]	2 nm	
Pulse duration	20 – 60 fs	10 – 20 fs
Pulse repetition rate	10 Hz	100 Hz
Pulse energy stability	< 1.5 %, rms	< 2.0 %, rms
Long-term power stability	< 1.5 %, rms	
Spatial mode	Super Gaussian	Top-Hat
Beam diameter (1/e^2)	7 mm	20 mm
Pulse contrast [2]	≥ 10^{-6} : 1 (within ± 50 ps)	
	≥ 10^{-8} : 1 (in ns range)	
Polarization	Linear, horizontal	
Beam pointing stability	≤50 µrad, rms	
Optical to RF signal jitter [3]	< 1 ps	
Footprint on optical table	1.2 × 2.0 m	1.2 × 4.8 m

1) Presented parameters are from delivered systems and can be customized to meet customer's requirements.

2) Pulse contrast is only limited by amplified parametric fluorescence (APF) in the temporal range of ~90 ps which covers OPCPA pump pulse duration and is better than 10^6 : 1. APF contrast depends on OPCPA saturation level (Fig. below). Our system is ASE-free and pulse contrast value in nanosecond range is limited only by measurement device capabilities (third-order autocorrelator). There are no pre-pulses generated in the system and post-pulses are eliminated by using wedged transmission optics.

3) With -PLL option purchased.

4) With SH/TH or SH/TH/FH module.

BLOCK DIAGRAM

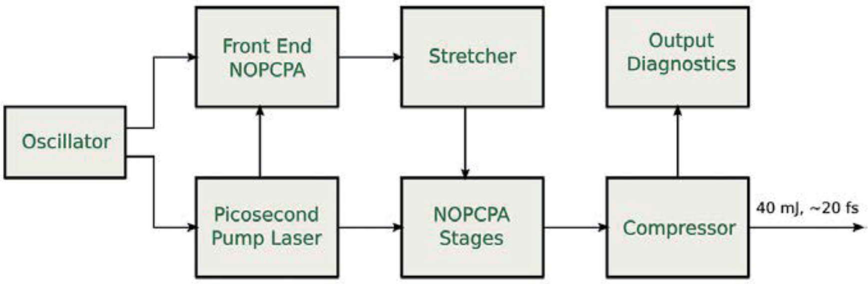

Fig. 1. UltraFlux FF/FT 5000 laser block diagram

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PERFORMANCE

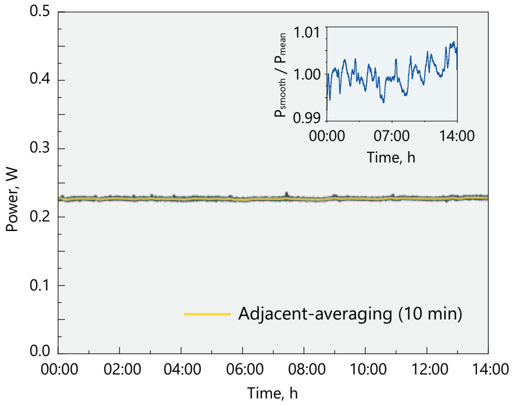

Fig 2. Long-term power stability measurement at 800 nm wavelength

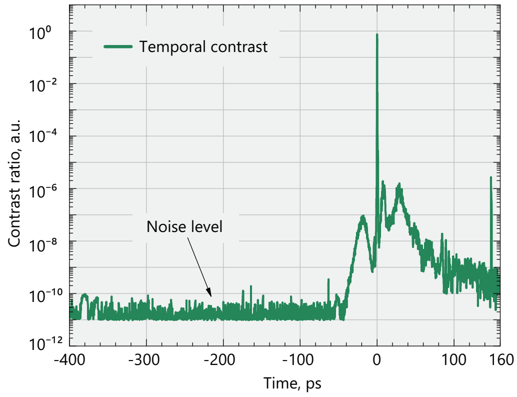

Fig 3. Typical temporal contrast of UltraFlux systems

BEAM PROFILE

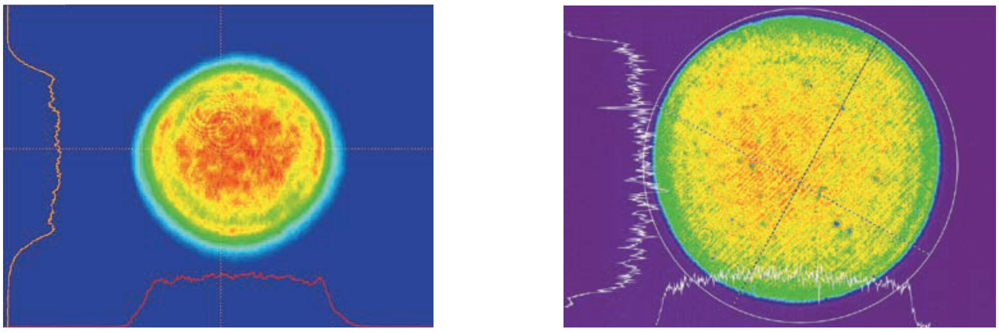

Fig 4. Typical UltraFlux system output at ~60 mJ energy (left) and 532 nm pump beam at 2.5 J energy (right) beam profiles

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