The Femtopower Advantage

- Shortest pulses
- Highest pulse-to-ASE contrast
- Best CEP stabilization

Femtopower™ family of ultrafast multipass Ti:Sapphire amplifiers is designed as the optimal light source for the most demanding applications. Femtopower is the only amplifier proven to consistently provide outstanding CEP stability and highest pulse-to-ASE contrast in a reliable and user-friendly configuration over the longest period of time.

Femtopower incorporates Femtolasers’ unique patented key technologies, and can be seeded by the state-of-the-art Rainbow™ 2 CEP4 oscillator to generate CEP-stable multi-mJ pulses. When used in conjunction with the Kaleidoscope™ to reach sub-7 fs pulse durations, the Femtopower is the ultimate commercial light source for attoscience. Systems not requiring CEP stabilization are seeded by the successful Element™ PRO oscillator. The sub-20 fs provided by the Femtopower PRO set a new benchmark in terms of spectral bandwidth and pulse duration.

Applications

- Attoscience
- High harmonics and X-ray generation
- Ultrafast spectroscopy
- Femtochemistry
- Front-end for TW and PW systems
- Coherent THz generation
- Materials processing
- OPCPA seeding and pumping
- OPA pumping

Unequaled pulse quality is ensured by the Dispersive Mirror based seeder and accurate quantitative dispersion management in the amplifier. This leads to cleanest pulses and highest pulse-to-ASE contrast ratio on the market.

Femtopower amplifiers are equipped with Vactec™ or Vacool™, powerful crystal cooling systems dramatically reducing thermal lens effects while avoiding vibrations. The result is an excellent beam profile and a fast cool down time without adverse effects on the CE-Phase stability.
Each Femtopower is equipped with sub-µm accurate BeamWatch™ position detectors to ease alignment. To further increase user-friendliness, each system can be equipped with our BeamAlign™ active beam pointing stabilization.

Achievement of the shortest pulse duration is guaranteed by the large spectral bandwidth in combination with excellent dispersion management. Femtopower PRO supports more than 70 nm FWHM bandwidth and pulses shorter than 20 fs.

The compact and robust monolithic glass stretcher offers virtually unlimited bandwidth, transmission and stability unparalleled by any other design. The unique compact transmission grating compressor leads to unmatched mechanical and thermal stability and overall efficiency exceeding 80%.

Femtopower systems can be equipped with the Kaleidoscope hollow fiber compressor. This unique device generates few-cycle pulses while maintaining CEP stability. Kaleidoscope has already become the workhorse for attosecond and HHG experiments.

Compact oscillator and amplifier designs lead to a small overall footprint and maximum mechanical stability. Both seed oscillator and multipass amplifier reside on temperature stabilized base plates to minimize warm-up time and maximize long term stability.

The Femtopower system design is based on numerous patented Spectra-Physics key technologies and ensures outstanding long term stability. It allows strongly reduced dependence on the laboratory environment, resulting in prime performance every day.
SETTING THE WORLD’S NEW STANDARDS

Solid CEP Control

The Femtopower ultrafast amplifiers are based on unique design elements in a multipass configuration. Their unsurpassed performance is a prerequisite for a solid CEP control: the complete system benefits from outstanding active and passive stability. With more than 60 systems already installed in the most renowned laboratories, the Femtopower CEP has become the first and only choice among scientists worldwide.

CEP4 — The Direct Feed-Forward Approach

Femtolasers’ exclusive CEP4 generation of ultrafast laser systems is based on independent CEP stabilization of both the Rainbow 2 seeder and the Femtopower amplifier.

CEP4 is Femtolasers latest generation of Carrier Envelope Phase (CEP) stabilization techniques, continuing the tradition of CEP innovation and success established over the past decade by CEP1 - CEP3. The CEP4 system’s outstanding quality opens new realms of CEP stabilization:

• Via a direct feed-forward approach, the CEP drift is corrected on-the-fly after the free-running, passively stable Rainbow 2 ultrafast oscillator.
• Well defined phase relationship for all pulses over day-long experiments.
• Unprecedented performance and reliability, both short- and long-term, are ensured by the CEP4 stabilization operation

(F. Lücking et al., Optics Letters, Vol. 37, pp. 2075, (2012)).
Femtolaser patent

The exceptional CEP stability of the Rainbow™ 2 CEP4 / Femtopower systems allows for long experiment with isolated attosecond pulses.

* Typical performance, not a guaranteed or warranted spec.
Femtopower™ CEP

Specifications¹, 4

<table>
<thead>
<tr>
<th></th>
<th>Compact™</th>
<th>HR</th>
<th>HE</th>
<th>HE/HR</th>
<th>V</th>
<th>X</th>
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</thead>
<tbody>
<tr>
<td>Pulse Duration</td>
<td>&lt;30 fs</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Bandwidth (FWHM) @ 800 nm</td>
<td>&gt;40 nm</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Pulse Energy</td>
<td>1 mJ</td>
<td>0.5 mJ</td>
<td>0.8 mJ</td>
<td>1.6 mJ</td>
<td>2 mJ</td>
<td>1.6 mJ</td>
</tr>
<tr>
<td></td>
<td>3 mJ</td>
<td>5 mJ</td>
<td>10 mJ</td>
<td>15 mJ</td>
<td>10 mJ</td>
<td></td>
</tr>
<tr>
<td>Repetition Rate</td>
<td>1 kHz</td>
<td>3 kHz</td>
<td>4 kHz</td>
<td>5 kHz</td>
<td>10 kHz</td>
<td>1 kHz</td>
</tr>
<tr>
<td></td>
<td>3 kHz</td>
<td>1 kHz</td>
<td>1 kHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Power</td>
<td>&gt;33 GW</td>
<td>&gt;15 GW</td>
<td>&gt;25 GW</td>
<td>&gt;50 GW</td>
<td>&gt;0.1TW</td>
<td>&gt;0.1 TW</td>
</tr>
<tr>
<td></td>
<td>&gt;50 GW</td>
<td>&gt;0.1 TW</td>
<td>&gt;0.16 TW</td>
<td>&gt;0.33 TW</td>
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<tr>
<td>Beam Diameter</td>
<td>15–20 mm</td>
<td>15–20 mm</td>
<td>20 mm</td>
<td>20 mm</td>
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<td>25 mm</td>
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<td></td>
<td>25 mm</td>
<td>35 mm</td>
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<tr>
<td>Beam Pointing Stability</td>
<td>&lt;10 µrad</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>@ full beam diameter</td>
<td></td>
<td></td>
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<tr>
<td>Spatial Mode</td>
<td>M² &lt;1.6</td>
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<tr>
<td>Polarization</td>
<td>Linear</td>
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<tr>
<td>Pulse-to-Pulse Energy Stability</td>
<td>&lt;1.5% rms</td>
<td></td>
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<tr>
<td>Pulse/ASE Contrast Ratio²</td>
<td>&gt;1:10⁰</td>
<td>&gt;1:10⁰</td>
<td>&gt;1:10⁰</td>
<td>&gt;1:10⁰</td>
<td>&gt;1:10⁰</td>
<td>&gt;1:10⁰</td>
</tr>
<tr>
<td>CEP Stability over 3 hours (rms single shot³)</td>
<td>&lt;250 mrad</td>
<td>&lt;350 mrad</td>
<td></td>
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<tr>
<td>Pulse Duration for PRO Versions³</td>
<td>&lt;20 fs or &lt;25 fs</td>
<td>&lt;25 fs</td>
<td></td>
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</tbody>
</table>

1. Due to continuous product improvements, specifications are subject to change without notice.
2. With optional active BeamAlign™ stabilization.
3. Optional
4. Femtopower is a Class IV – High-Power Laser, whose beam is, by definition, a safety and fire hazard. Take precautions to prevent exposure to direct and reflected beams. Diffuse as well as specular reflections can cause severe skin or eye damage.

Femtopower Layouts

Examples of complete layouts for Femtopower amplifier systems:

A. Femtopower PRO with integrated seed oscillator
B. Femtopower HE PRO with Kaleidoscope (option)
C. Femtopower V PRO CEP two stage CEP stabilized amplifier