

# venteon

Ultra-short pulse lasers



- Few-cycle femtosecond pulses
- Stable performance with minimal intervention
- Measured pulses approaching transform limit
- Broadest spectral bandwidth commercially available
- Integrated pump laser



## Overview

The **venteon** range of femtosecond lasers uses ultra-short pulse laser technology and offers the shortest commercially available pulses at 5fs (FTL), bandwidths of nearly 400nm and average powers as high as 600mW. The highly compact monolithic design is optimised for low pump thresholds and contains an integrated pump laser. With long operational lifetimes, these instruments are highly reliable and extremely robust.

All **venteon** lasers show an exceptional stability (Fig. 1) and beam shape (Fig. 2).

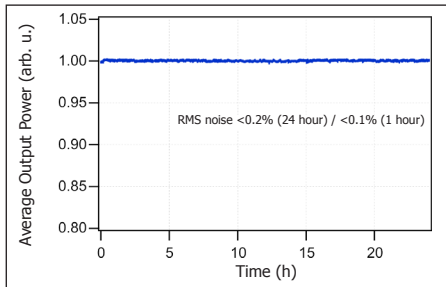


Fig. 1 Exceptional stability of the **venteon ultra** laser system resulting from the optimised thermal and mechanical design.

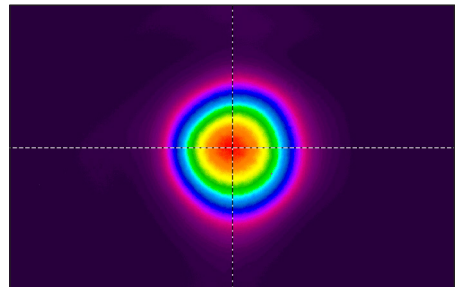


Fig. 2 Beam profile of the **venteon ultra** laser system measured with a CCD camera.

The **venteon** cavity exclusively uses DCM mirrors that are created by ion beam sputtering techniques to ensure unsurpassed phase control and pulses that approach the theoretical values available. Laser Quantum supports clarity in reporting pulse duration and we always detail whether our figures are theoretical values based on Fourier transform calculations, or actual measured durations using SPIDER technology and instrumentation.

## Options and Upgrades

### Pulse train monitoring

An integrated high bandwidth (10GHz) photodiode can be used for repetition rate monitoring and to supply a signal to a **TL-1000** unit or external electronics.

### Repetition rate control

Control of the repetition rate and active feedback is enabled by cavity mirrors mounted on a fast and slow piezo crystal enabling rapid feedback and drift control simultaneously. In combination with the **TL-1000** repetition rate stabilisation unit, timing jitter below 100fs can be achieved. Alternatively, the piezos can be driven by customer supplied electronics.

### Active locking of repetition rate and pulse timing

The **TL-1000** is an optional supporting unit that enables tight phase-locking of the repetition rate to an external reference with jitter below 100fs.

### CEPLoQ™ technology for the venteon CEP5

CEPLoQ™ technology directly modulates the pump power to maintain phase stabilisation



The **venteon** family is compatible with the Laser Quantum RemoteCom software that allows connection to the Laser Quantum support team for monitoring laser performance, diagnosing opportunities and carrying out laser optimisation.

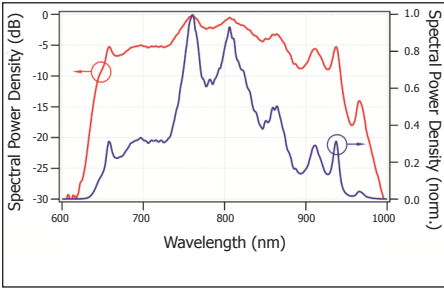


### Pump power modulation

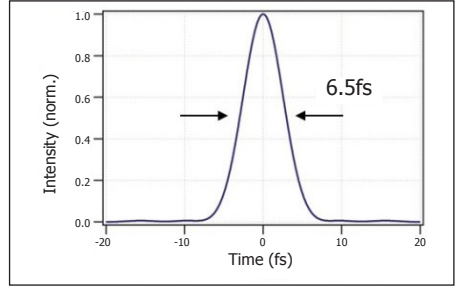
Modulation access to the pump power with a bandwidth in excess of 100kHz and modulation depth up to  $\pm 1\%$  is provided for feedback purposes.

## venteon one

The **venteon one** laser system is a versatile and robust option as an entry level to few cycle ultra-short pulses. Highly compact (a footprint of 285 x 690mm), it offers a wide spectral bandwidth of over 200nm leading to pulse durations below 8fs with typical values around 6.5fs. It is ideally suited to microscopy, spectroscopy and pump probe experiments that require a reliable, simple, turn-key laser solution for ultra-short pulses with a moderate power.



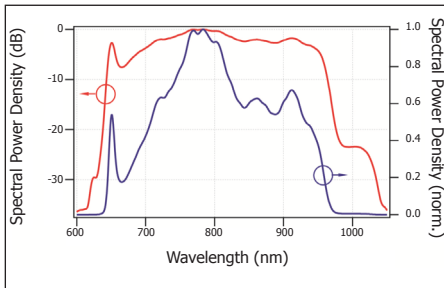
**venteon one** laser system spectrum shown on a logarithmic (red) and linear (blue) scale.



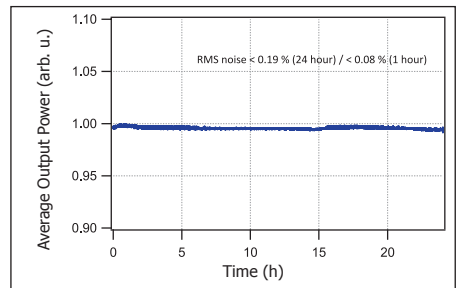
Fourier-limited pulse as supported by the **venteon one** laser system, featuring a pulse duration below 7fs.

## venteon power

The **venteon power** laser system has been optimised to provide the highest power available from the **venteon** range of ultra-short pulse lasers. The **venteon power** can be supplied with CEP stabilised performance or state-ready for a CEP upgrade. It can also be equipped with a piezo transducer/stepper motor that allows for resonance free repetition rate locking of up to 30kHz to a suitable microwave standard.



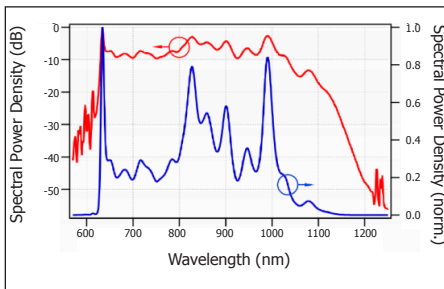
**venteon power** spectrum spanning from 650 - 950nm. This output is ideally suited for nonlinear spectroscopy and amplifier seeding.



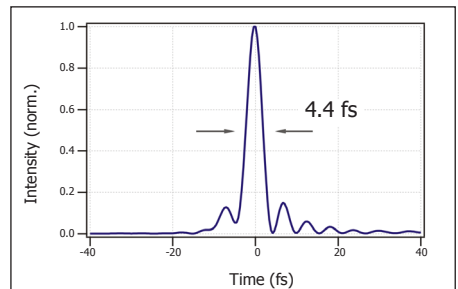
Noise performance and exceptional stability of the **venteon power** laser system resulting from the optimised thermal management and mechanical stability.

## venteon ultra

The **venteon ultra** laser system delivers >240mW of sub-5fs short pulses with an unrivalled spectral bandwidth ranging from 600 - 1200nm specified with >380nm @-10dBc. Due to this octave spanning output spectrum, the **venteon ultra** can be used for direct CEP stabilisation without any additional spectral broadening. The system can be purchased as a fully CEP stabilised laser, or with the necessary components to allow CEP upgrade at a later date.



**venteon ultra** spectrum spanning more than 600nm. This spectrum supports the shortest pulses commercially available and is ideally suited e.g. for a direct CEP stabilisation.

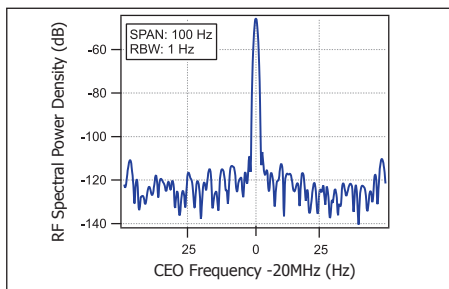


**venteon ultra** pulse as short as 4.4fs, measured with a **venteon SPIDER**.

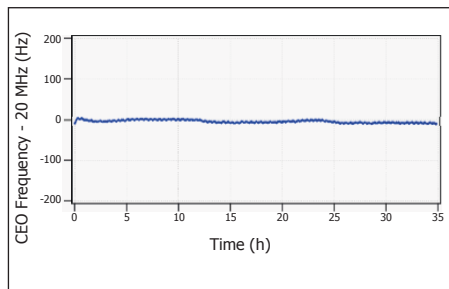
## venteon CEP5

The **venteon CEP5** is a fully configured ultra-short pulse carrier envelope phase (CEP) stabilised laser system. Comprising the **venteon ultra** octave spanning laser, the **venteon CEP5** system includes an f-to-2f interferometer for  $f_{\text{CEO}}$  beat generation, the ultra-low noise **finesse pure CEP** pump laser, featuring CEPLoQ™ technology that enables CEP stabilisation without AOM modulation control, and all the electronic controls necessary.

The spectral bandwidth of this laser system supports pulse durations well below 5fs directly from the oscillator. Its octave-spanning output is sufficiently broad for a direct CEP stabilisation of the pulses, realising the f-to-2f beating without any additional spectral broadening by either a PCF or PPLN device. Only 10% of the output power is used by filtering the edges of the output spectrum, leaving more than 220mW for subsequent experiments. This is the most natural, direct and reliable approach for achieving a CEP stabilisation without distorting the laser output beam and giving an excellent long-term locking performance.



Stabilised  $f_{\text{CEO}}$ -beat at 20MHz shown in a 100MHz span with 1Hz resolution bandwidth featuring a unique SNR >60dB.



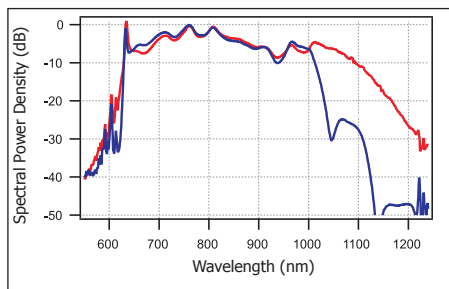
Long term tracking of a stabilised CEO frequency beat note at 20MHz showing the exceptional stability.

## venteon dual

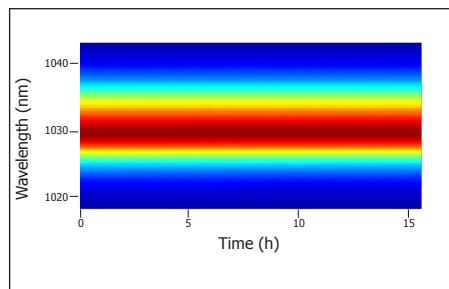
The **venteon dual** represents the ideal front end for broadband few-cycle Optical Parametric Chirped Pulse Amplifier (**OPCPA**) applications. The spectral bandwidth of this laser allows for the generation of broadband sub-6fs pulses as a signal for a subsequent NOPA stage and provides additional sufficient pulse energy (>30pJ @ 1030nm) for seeding a Yb-based amplifier pump stage. The pulses are delivered by two separate output ports and are intrinsically self-synchronised with ultra-low timing jitter.

The first output provides the broadband signal pulses and a duration of <6fs. The pulses can be optionally CEP stabilised with the typical performance of the **venteon CEP5** laser systems.

The second output at 1030nm delivers - without any additional broadening - more than 30pJ in a spectral bandwidth of 10nm (FWHM) and is ideally suited as a narrowband seed for pump amplifiers. This output can be optionally ordered pre-amplified, delivering pulses with an energy >1nJ.

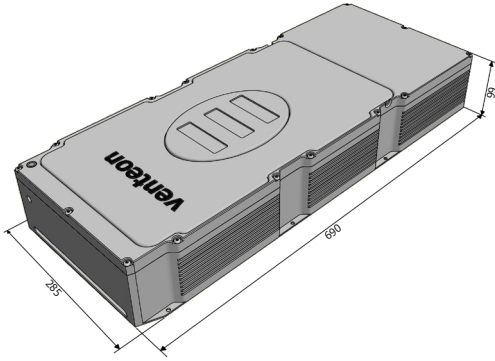


**venteon dual** usable output spectrum (blue) and spectrum without filter for CEP stabilisation and 1030nm output (red).



Spectral stability of the 1030nm seed output shown for 15 hours. The measurement was performed using a single mode fibre.

## Dimensions (mm)



## Other information

- 2 years full specification warranty
- Water cooling included
- Weight: 33kg



Drawings are for illustrative purposes only. Please contact Laser Quantum for complete engineer's drawings.

## Specifications\*

	venteon one	venteon power	venteon ultra	venteon CEP5	venteon dual
Average power output	>240mW	>600mW	>240mW	>220mW	>200mW
Pulse energy (@80MHz)	>3nJ	>7.5nJ	>3nJ	>2.75nJ	>2.5nJ
Spectral bandwidth (FWHM)	>100nm	>100nm			
Spectral bandwidth (@-10dBc)	>200nm	>300nm	>380nm	>380nm	>380nm
Pulse duration (Measured) <sup>1</sup>	<8fs	<7fs	<5.5fs	<5.5fs	<6fs
Pulse duration (FTL)	<7fs	<6fs	<5fs	<5fs	<5.5fs
RMS noise <sup>2</sup>	<0.2% (non-pure pump)	<0.08%	<0.08%	<0.08%	<0.08%
Integrated pump	<b>opus 4W</b>	<b>finesse pure 6W</b>	<b>finesse pure 6W</b>	<b>finesse pure CEP</b>	<b>finesse pure 6W</b>
Divergence	<2mrad	<2mrad	<2mrad	<1mrad	<1mrad
CEP phase noise				<100mrad	
SNR for $f_{\text{ceo}}$ -beat (@100kHz RBW)				>30dB	
Central wavelength	800nm $\pm$ 20nm	800nm $\pm$ 20nm			
M-squared	<1.2				
Power stability (Over 24hrs)	<1% RMS				
Repetition rate	80MHz				

\* Laser Quantum operates a continuous improvement programme which can result in specifications being improved without notice.

<sup>1</sup> Achieved with optional extra cavity dispersion compensation

<sup>2</sup> Noise bandwidth 1Hz to 10MHz measure using **finesse pure** pump laser

## Upgrades

	venteon one	venteon power	venteon ultra	venteon CEP5	venteon dual
Photodiode option	✓	✓	✓	✓	✓
Repetition rate stabilisation option	✓	✓	✓	✓	✓
CEP stabilisation		✓	✓		✓
CEP-zero stabilisation			✓	✓	✓

### LASER QUANTUM LTD

tel: +44 (0) 161 975 5300

email: info@laserquantum.com

web: www.laserquantum.com

### LASER QUANTUM INC

tel: +1 408 510 0079

email: info@laserquantum.com

web: www.laserquantum.com

### LASER QUANTUM GmbH

tel: +49 7531 368371

email: info@laserquantum.com

web: www.laserquantum.com