



# taccor

Turn-key GHz femtosecond laser



# Laser QUANTUM

- Self-locking and maintaining
- Stable and robust
- True hands off turn-key system
- Wavelength tunable
- Integrated pump laser



## Overview

The **taccor** is a unique turn-key femtosecond laser with a 1 GHz or 10 GHz repetition rate that delivers up to 1.8 W of average power in pulses that can be <15 fs. Tunability is offered between 740 nm and 930 nm. Its innovative design combines a compact hermetically sealed, vibration-resistant laser head that incorporates the Ti:Sapphire oscillator and pump laser, with a full-feature control unit. The control unit houses the field replaceable pump diodes, isolating temperature effects from the **taccor** itself, and provides intelligent control that monitors laser performance and carries out diagnostics analysis. The result is a highly stable and reproducible product with a long lifetime and low cost of ownership.

There are five versions of the **taccor**: The **taccor one** offers a selectable (fixed) wavelength; the **taccor power** and **taccor ultra** are tuned to produce the highest power or the shortest pulse duration respectively; the **taccor tune** offers the flexibility of a tunable wavelength using a touch screen or control software and the **taccor x10** operating at a 10 times higher repetition rate.

## Optional features

### 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 <100 fs. **TL-1000-ASOPS** enables a repetition rate offset lock between two GHz oscillators of 2 kHz to 20 kHz allowing ultrafast time-domain spectroscopy without a mechanical delay stage.

### Pulse train monitoring

An integrated high bandwidth (10 GHz) photodiode can be used for repetition rate monitoring and to supply a signal to the **TL-1000** units 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** unit, this offers precision closed loop stabilisation of the repetition rate. Alternatively, the piezos can be driven by customer supplied electronics.

### CEPLoQ™ technology

CEPLoQ™ is our patented technology that directly modulates the pump power to maintain phase stabilisation without the use of an AOM. This leads to faster and more stable responses than the traditional method.



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



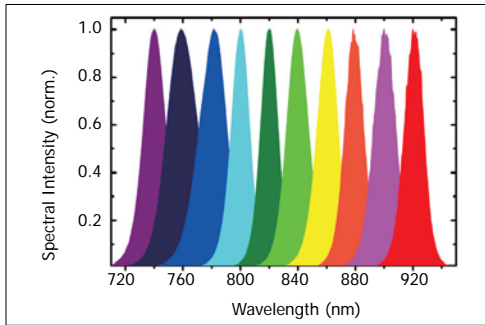
### Pump power modulation

Modulation access to the pump power with a bandwidth of >100 kHz and modulation depth up to ±1% is provided for feedback purposes.

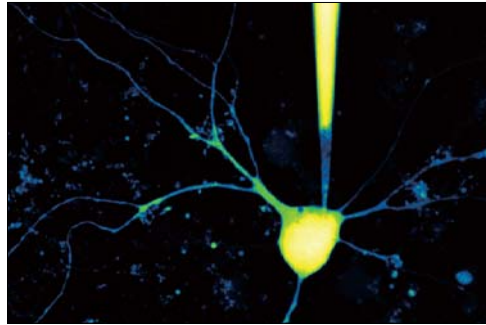


## taccor one

The **taccor one** offers a selectable (fixed) wavelength between 740 nm to 920 nm within a compact design and is both self-mode-locking and stable. At 1 GHz repetition rate, the **taccor one** delivers more than 1.6 W of average power with a pulse duration of <60 fs.



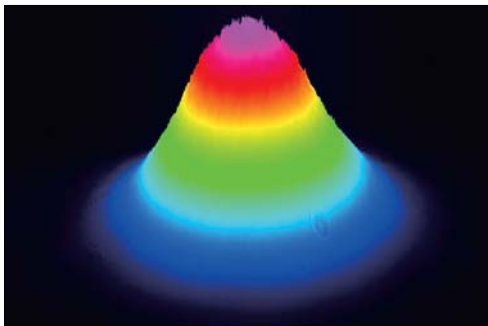
Stacked spectra indicating the wavelength coverage of the **taccor one**.



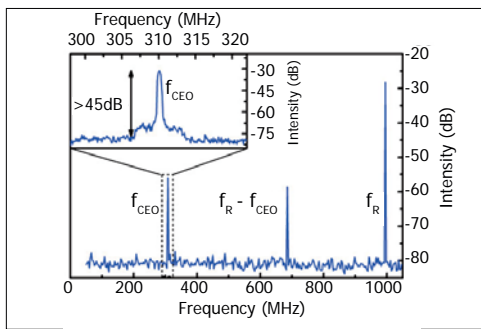
Living mouse neuron imaged with the **taccor one**.

## taccor power

The **taccor power** is optimised for the highest possible output, offering up to 1.8 W at the Ti:Sapphire gain maximum around 800 nm.



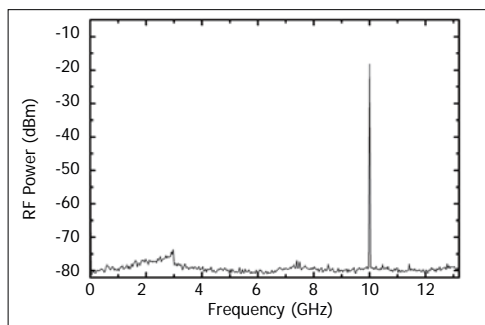
3D beam profile from a **taccor** series laser.



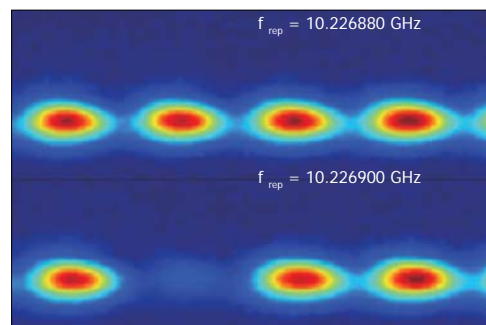
RF spectrum showing the  $f_{\text{CEO}}$  beat, the difference frequency of the repetition rate with the  $f_{\text{CEO}}$  beat and the repetition rate. The noise floor is given by the spectrum analyser. The zoom in shows the  $f_{\text{CEO}}$  beat without limitation by the spectrum analyser.

## taccor x10

The high repetition rate (10 GHz) version of the **taccor**. Giving up to 1 mW per comb line spaced by 10 GHz, the **taccor x10** is unique to the market and opens a wide field of new applications such as resolved mode spectroscopy, low-noise microwave generation, astrocombs or arbitrary waveform generation. Analogue to the other version of the **taccor**, the **taccor x10** can also be configured to allow the control of the repetition rate and gives modulation access for the pump power to enable an easy control of the carrier offset frequency.



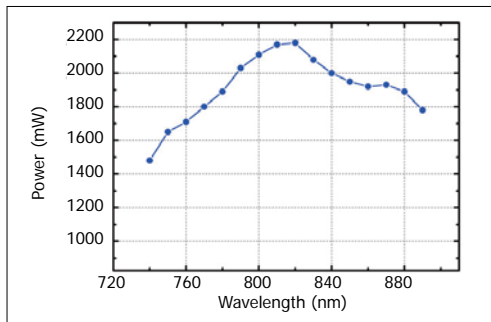
RF spectrum of the signal from the high bandwidth repetition rate measurement photodiode in the **taccor** (PD option). The noise floor is given by the spectrum analyser.



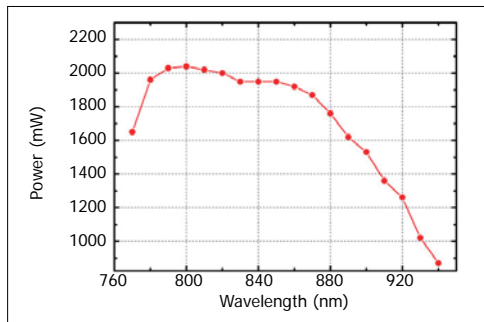
Individually resolved comb modes after passing the **taccor x10** beam through a Rb cell. In the lower image, one mode is on resonance with an absorption line.

## taccor tune

The **taccor tune** offers the flexibility of a tunable wavelength using a touch screen or control software; a true hands free laser covering the wavelength regime from 740 nm to 930 nm which is unique to the market.



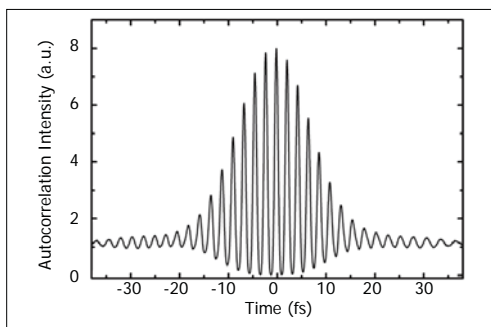
Power tuning curve for the short wavelength **taccor tune** (example shown is **taccor tune 10**).



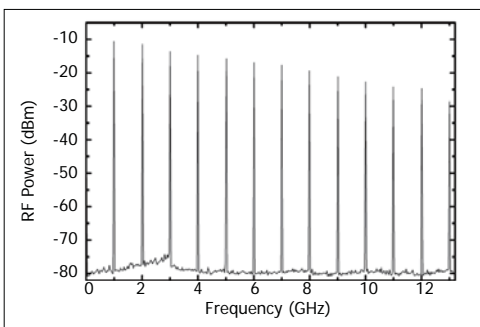
Power tuning curve for the long wavelength **taccor tune** (example shown is **taccor tune 10**).

## taccor ultra

The **taccor ultra** produces the shortest pulse duration within the family. With a 1 GHz repetition rate and delivering 1.6 W of average power, the pulses can be as short as <15 fs.



Autocorrelation trace of **taccor ultra** indicating emission of pulses with <15 fs duration.



RF spectrum of the signal from the high bandwidth repetition rate measurement photodiode in the **taccor** (PD option). The noise floor is given by the spectrum analyser.

## Additional capabilities

### taccor comb

The **taccor comb** consists of an f-to-2f interferometer module, locking electronics from Menlo Systems, and either a **taccor power** or **ultra**. The **taccor** is fully stabilised in repetition rate and carrier-envelope offset frequency; in this configuration, the **taccor** is a powerful frequency comb engine offering >1 W stabilised comb average power, centred at 800 nm, with pulse durations of <15 fs available for spectroscopy and metrology applications. The 800 nm beam can be used directly or to drive up to two further nonlinear broadening stages to facilitate optical frequency measurements, direct comb spectroscopy, spectrograph calibration, dual-comb linear or non-linear spectroscopy and many other applications.

### Second harmonic generation

Together with A·P·E Angewandte Physik & Elektronik GmbH, Laser Quantum can offer the HarmoniXX second harmonic frequency converter for use with the **taccor power**. Maintaining the benefits of the 1 GHz repetition rate, it offers up to 250 mW of frequency doubled output.

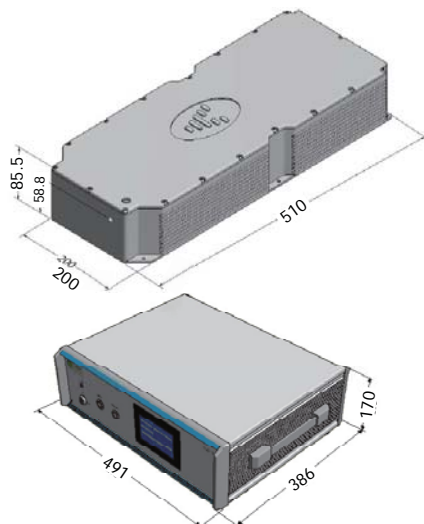
### Pre-chirp module

Careful control of the group delay dispersion (GDD) of an optical setup is crucial to obtaining the desired results from many applications using femtosecond lasers. Our **pre-chirper** allows for GDD control from ~0 to -8600 fs<sup>2</sup> enabling the user to easily compensate for the positive GDD of the setup and obtain the right pulse characteristics at the point of use.

For full details of these options, please see the dedicated data sheets.



## Dimensions (mm)



## Other information

- Umbilical length: 2 m
- Head weight: 15 kgs
- Cooling system included
- Warm-up time: 10 minutes



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

## Specifications\*

	taccor one	taccor power	taccor ultra	taccor tune	taccor x10
Average power output <sup>1</sup>	one 4 >700 mW one 6 >900 mW one 8 >1200 mW one 10 >1600 mW	power 4 >800 mW power 6 >1000 mW power 8 >1400 mW power 10 >1800 mW	ultra 8 >1200 mW ultra 10 >1600 mW	tune 8 >1500 mW tune 10 > 1800 mW	>1000 mW
Center wavelength	740 nm to 920 nm	nominal 800 nm (+/-20 nm)	nominal 800 nm (+/-20 nm)	740 nm to 930 nm (tunable) <sup>2</sup>	nominal 800 nm (+/-20 nm)
Pulse duration <sup>4</sup>	<60 fs	<30 fs	<15 fs	<80 fs	<50 fs
Spectral FWHM	~15 nm	>23 nm	>46 nm	~15 nm	>15 nm
Repetition rate <sup>5</sup>	1 GHz				10 GHz
Pulse energy	0.7 nJ to 1.6 nJ	0.8 nJ to 1.8 nJ	1.2 nJ to 1.6 nJ	1.3 nJ - 1.8 nJ taccor tune 10 1.05 nJ - 1.5 nJ taccor tune 8	>100 pJ
Beam size	~0.8 mm +/-0.3 mm				~0.7mm +/-0.3 mm
Divergence	2.0 mrad +/-0.5 mrad				<10 mrad
M-squared	<1.2 (sag plane), <1.6 (tan plane)	<1.2 (sag plane), <1.2 (tan plane)	<1.2 (sag plane), <1.2 (tan plane)	<1.2 (sag plane), <1.6 (tan plane)	<1.5 (sag plane), <1.5 (tan plane)
Power stability <sup>6</sup>	+/-1%				
Noise (RMS)	<0.1% RMS				
Polarisation ratio	>100:1				
Polarisation direction	Horizontal				
Operating temperature	21° +/- 5°C				
Applications	two photon microscopy, two photon polymerisation, optical precision metrology, ASOPS, optical spectroscopy, ultrafast spectroscopy, frequency comb generation, arbitrary waveform generation, calibration of spectographs (astrometry)				

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

<sup>1</sup> For the **taccor one** and **taccor tune**, the values stated are ~800 nm and will vary across the wavelength range.

<sup>2</sup> Select at time of order, fixed with accuracy ±3 nm, higher accuracy available on request.

<sup>3</sup> Choose between blue (740–880 nm) and red (780–930 nm) tuning range upon order.

<sup>4</sup> Achieved with optional extra cavity dispersion compensation.

<sup>5</sup> Repetition rate: accuracy ±10 MHz and for the **taccor x10** accuracy ±25 MHz, higher accuracy available on request.

<sup>6</sup> Measured over a 8 hours after cold start within operating temperature range.

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