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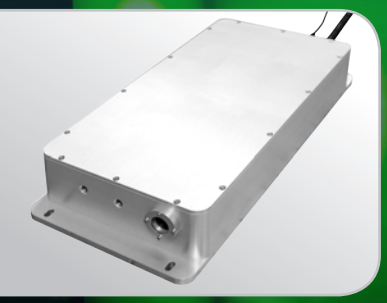
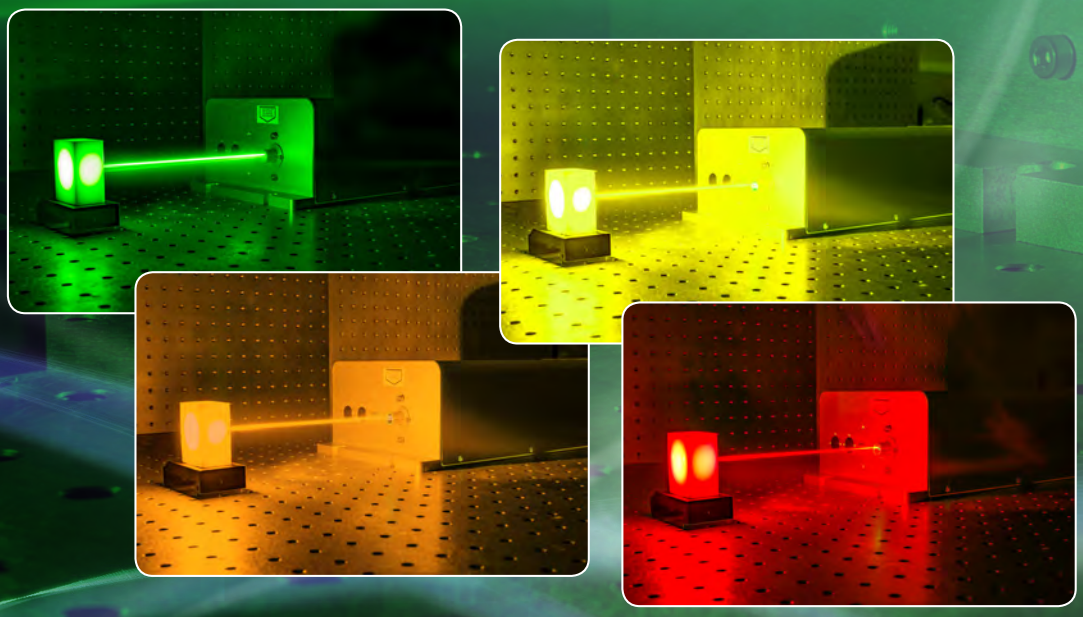
TETRA – rapidly tunable DPSS laser

four wavelengths, pulse-by-pulse selectable



- four visible, biologically useful wavelengths:
  532 nm, 555 nm, 579 nm, 606 nm
- pulse-by-pulse wavelength selection
- repetition rate 2 kHz
- energy 20 µJ for each wavelength*
- pulse width < 5 ns



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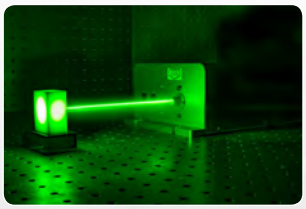
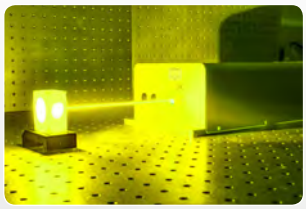
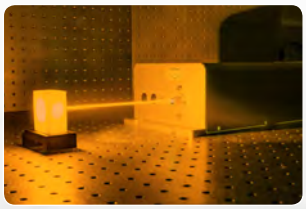
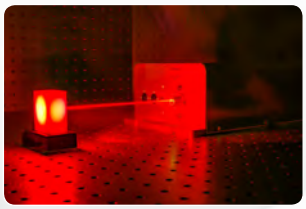

four wavelengths – pulse-by-pulse selectable


Our rapidly tunable DPSS laser system TETRA (by Elforlight, an AMS Technologies company) emits visible laser pulses with four different wavelengths that are particularly suitable for use in life science applications. With a high pulse repetition frequency of 2 kHz, TETRA can switch between these four wavelengths from pulse to pulse. In addition, pulse widths of less than 5 ns and pulse energies of up to 20 µJ can be achieved.

Based on a 532 nm laser, the TETRA rapidly tunable laser system additionally generates the wavelengths 555 nm, 579 nm and 606 nm, using the Raman effect. An optical filter then separates the four wavelengths and routes one wavelength at a time onto the optical output of the unit – with a switching frequency in the kilohertz range.
With this high switching frequency, TETRA clearly surpasses tunable lasers based on OPOs (Optical Parametric Oscillators) – typical frequencies of such OPO systems range from 100 Hz to 200 Hz – and is also considerably more cost-effective.

system set-up: two separate units

TETRA consists of two separate units: One box contains the electronics for the entire power supply as well as the pump laser diode. The optical output of this laser diode is coupled via an optical fiber to the second box, which contains the actual laser head. Due to this design, the heat dissipated by the power supply circuit and the pump laser diode remains within the power supply unit, and the laser head benefits from reduced thermal loading. In addition, the pump laser diode can be easily replaced at end of life without affecting the alignment of the geometry in the laser head.

key features

- four visible, biologically useful wavelengths:
  532 nm, 555 nm, 579 nm, 606 nm
- pulse-by-pulse wavelength selection
- repetition rate: 2 kHz – ten times faster than OPO-based systems
- energy: 20 µJ for each wavelength*
- pulse width: < 5 ns
- different wavelengths available on request:
  532 nm, 559 nm, 588 nm, 621 nm, infrared variants around 1200 nm

* 10 µJ for 606 nm

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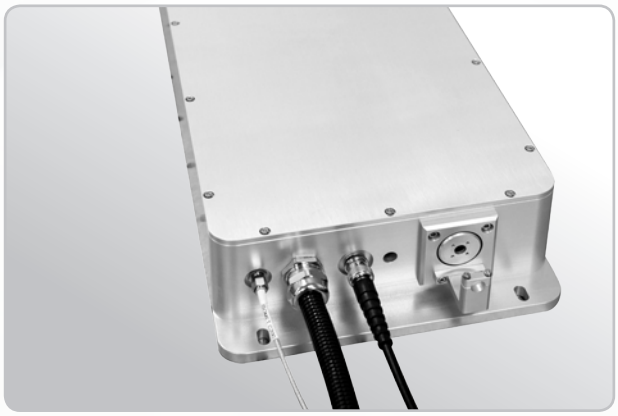
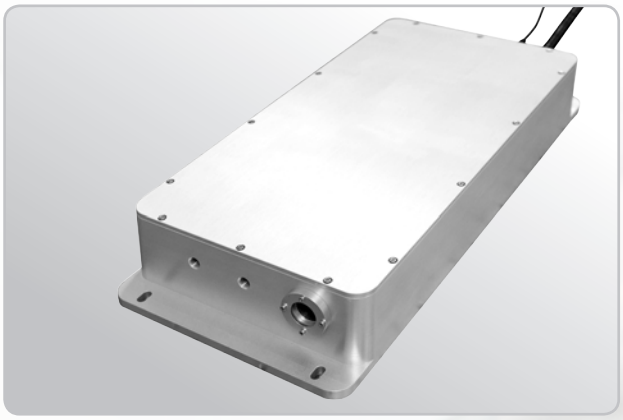
TETRA – rapidly tunable DPSS laser





ideal for photoacoustic tomography in biomedicine

The wavelengths emitted by TETRA are well matched to the absorption curves of many blood components, making the laser particularly suitable for multispectral photoacoustic tomography in biomedicine. In this technology, laser pulses of different wavelengths stimulate organic structures to emit ultrasound waves, which are captured by suitable sensors and converted into image information. Particularly short laser pulses, such as those emitted by TETRA, generate ultrasound signals of higher frequency, which in turn lead to a better spatial resolution of the resulting images.

Here the ability to switch quickly between different wavelengths offers clear advantages: during a scan of biological tissue, the absorption of four different wavelengths instead of one single wavelength can now be measured quasi-simultaneously at each individual pixel at a comparable frame rate. This avoids artifacts that can occur with multiple sequential complete scans with one wavelength each.

AMS Technologies has equipped the laser with a number of features to meet the requirements of medical safety standards for use in clinical environments. For instance a fast, fault-tolerant shutter at the laser output interrupts the beam in the event of a fault in the shortest possible time in order to avoid any hazards to a patient.

Customer-specific variants for many applications

Although TETRA has been developed specifically to meet the requirements of multispectral photoacoustic imaging, the technology can certainly be used for many other applications as well. Based on TETRA, AMS Technologies is ready to develop customer-specific versions that offer different wavelengths or significantly higher repetition frequencies at significantly lower pulse energy – and thus cover an even broader spectrum of requirements.

main specifications	
wavelengths	532 nm, 555 nm, 579 nm, 606 nm (559 nm, 588 nm, 621 nm and infrared variants around 1200 nm on request)
repetition rate	2 kHz total (e.g. each of 4 wavelengths at 500 Hz)
energy	20 µJ for each of the specified wavelengths (606 nm: 10 µJ)
beam quality	close to TEM00, M2 < 1.3. (capable of launch into multimode optical fibre)
beam profile	circular
tuning	laser can be operated in sweep mode, wavelengths tunable for every pulse - sweep order of available wavelengths user-definable, no. of wavelengths within a single sweep user-selectable
triggering	external laser pulse trigger option (input trigger signal 5 V)
pulse width	< 5 ns
pulse-to-pulse stability	< 10% (subsequent pulses of the same wavelength)
control	RS232 interface with: switch laser on/off, set laser energy, set wavelengths of sweep mode, enable/disable emission
laser output	single outlet with collinearity for all wavelengths
power supply	110 VAC to 240 VAC, 50/60 Hz, ~ 200 W
safety features	redundant interlock, warning outputs

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