TopMode

Single-Frequency Diode Lasers

Interferometry & Holography

Precision Metrology

Raman Spectroscopy / Microscopy

Quantum Cryptography

Photonic Down-Conversion

TOPTICA PHOTONICS

TopMode – Performance with CHARM

High Power at a Single Frequency

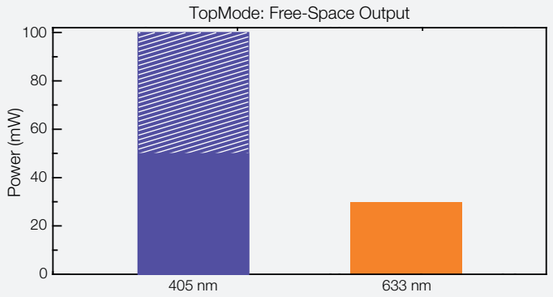
The TopMode lasers employ state-of-the-art diode technology to achieve the **highest single-frequency output power** of any direct diode-based system. The 405 nm model offers as much as 100 mW – an industry record!

The TopMode lasers feature a spectral width of less than 5 MHz, translating into a coherence length greater than 25 m. All models exhibit an excellent stability of wavelength and output power. Users can choose between a free-beam output and optional fiber-coupling, realized with TOPTICA's patented SmartDock™ coupler.

Maintain Your CHARM

Varying ambient conditions – temperature, air pressure and humidity levels – affect the performance of external-cavity diode lasers. Consequences are mode-hopping and occasional incoherent, "multi-mode" emission intervals. TOPTICA's unique CHARM technology provides an active stabilization of the laser's coherence. The design ensures continuous single-frequency operation – and thus excellent longterm stability of the lasing wavelength and output power, as well as an extremely low intensity noise.

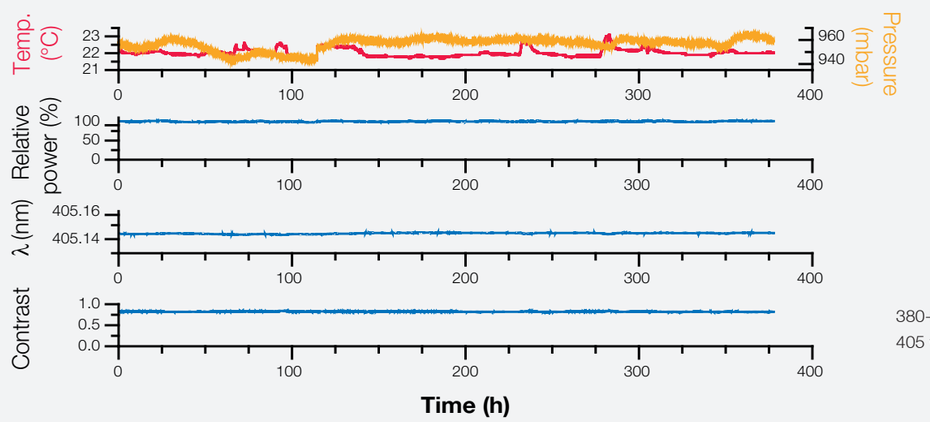
In laser-based inspection and metrology tasks, CHARM ensures accurate measurements by preventing sudden step changes of the laser's power or frequency.



Free-space output power of the TopMode laser family

Key Features

- Diode laser with best wavelength / coherence stability
- 100 mW single-frequency power @ 405 nm
- Includes active coherence stabilization (CHARM)
- For metrology, interferometry, Raman spectroscopy



380-hr long-term test of TopMode 405 with CHARM stabilization.

TopMode – Better than a Blue HeNe

Sophisticated measurement tasks in interferometry, holography, scatterometry and Raman spectroscopy require top performance lasers. The spectral properties must remain extremely stable – a single mode-hop can spoil an ongoing measurement.

TOPTICA's TopMode lasers operate as easily as a HeNe, but also offer higher power and blue wavelengths. The TopMode series sets records in terms of power, coherence and wavelength stability.

The proprietary CoHerence-Advanced Regulation Method (CHARM) provides an active stabilization of the lasers' coherence and ensures continuous single-frequency operation. TopMode and CHARM means nothing less than reliable 24/7 operation.

Replacing bulky, power-consuming gas ion lasers has never been this simple!

CHARM: Active Coherence Control

"CHARM" (CoHerence-Advanced Regulation Method) denotes an active stabilization scheme for the temporal coherence of the TopMode lasers. In the laser head, a beam splitter directs a fraction of the laser beam to a detector unit that monitors the coherence properties of the radiation.
A closed feedback loop then acts on the diode current to maintain stable coherence properties and to achieve narrow-linewidth and single-frequency laser operation.

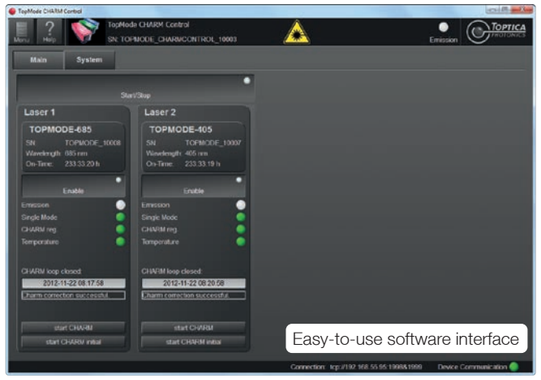
In the case of strongly varying environmental conditions, users can choose to run a proactive CHARM correction sequence (e.g., 1-2 times per day), allowing the regulator to determine the best-suited set-point for the stabilization scheme. The long-term measurement shown on this page demonstrates the extreme stability of clsed-loop operation even without any intervening correction runs.

TopMode CHARM Control

CHARM under Control

An ultra-low-noise laser driver with full digital control? Sounds impossible? Not with the TopMode CHARM control! The compact flatpack design comes with a powerful built-in microprocessor. This hardware “brain” not only accomplishes highly precise electric and thermal management – the current and temperature regulators employ 18-bit and 21-bit outputs, respectively – but also provides the required “intelligence” for the CHARM coherence stabilization.

The control unit recognizes the connected TopMode laser head, and automatically adjusts all operating parameters, such as laser temperature, diode current and polarity, or “safety clip” levels for voltage and current.
One TopMode CHARM Control unit can power two laser heads simultaneously, offering an attractive feature for applications that require multiple beams or wavelengths.



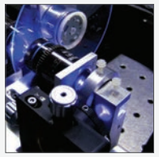
Professional Software Interface

The TopMode rack features both Ethernet and USB ports for remote control. A professional graphic user interface (GUI) allows starting and stopping the laser with just a mouse click. Users can also activate the CHARM feedback loop, or retrieve information on the product details or hours of operation via the GUI.

On the other hand, users can just as easily control the TopMode laser with their own software platform. With a few simple commands, they can address all relevant functions and apply them into various software architectures (e.g. LabView or C++ program code). The system can even be operated without an external PC at all, due to the simple “push-button” function calls.

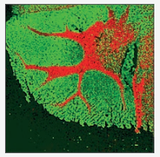
Flexible operation and top-class performance – that’s TopMode!

Applications



Holography
Holographic data storage with terabyte capacity.

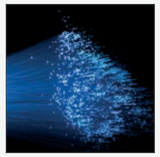
(Image: S. Orlic, TU Berlin, Germany



Raman Spectroscopy
Chemical analysis of samples.

(Image: WITec, Ulm, Germany)

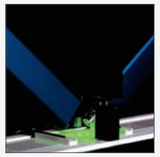
Interferometry
Quality control of optics via phase-shifting interferometry.



Quantum Cryptography
Information transfer with secure quantum keys.

Photonic Down-Conversion
Entangled photon pairs.

(Image: A. Zeilinger, University Vienna, Austria)



Metrology
Optical thin film analysis by polarization and angle-selective Fresnel reflections

Specifications

Model	TopMode 405
Operation	cw, single (fixed) frequency
Wavelength	405 nm
Wavelength tolerance	± 2 nm
Wavelength selection	upon request, accuracy +/- 0.25 nm
Wavelength tuning	No
Wavelength stability*	< 1 pm/h (< 0.5 pm/h typ.), peak-peak
Linewidth	< 5 MHz (< 0.01 pm)
Coherence length	> 25 m
ASE suppression	40 dB typ.
Output power, free-space	50 mW (100 mW**)
Output power, fiber-coupled	25 mW (50 mW**)
CHARM	Active coherence stabilization, included
Power stability *	Typ. < 0.5% (STD/mean) / h
Intensity noise (RMS)	≤ 0.1% @ 10 Hz - 10 MHz
Polarization	Linear, > 100 : 1, 90° (free-space version)
Beam shape	Collimated, circular, typ. diameter 1 mm (FWHM), 1.7 mm ($1/e^2$), ellipticity < 10% ***
Spatial mode	M^2 < 1.5 (< 1.2 typ.)
Optical isolation	Built-in, > 30 dB
Fiber coupling	Optional, typ. 50% in SM fiber
Electronics	TopMode CHARM Control
Warm-up time	< 10 min from standby
Dimensions laser head (H x W x D)	Free-beam: 192 x 80 x 60 mm, fiber-coupled: 218 x 80 x 60 mm
Weight laser head	1.5 kg
Dimensions control unit (H x W x D)	45 mm x 480 mm x 290 mm
Weight control unit	4 kg
Power supply	100 .. 120 V / 220 .. 240 V AC, 50 .. 60 Hz (auto detect)
Power consumption	typ. < 70 W, max. 150 W (incl. CHARM control)
PC Interface	Ethernet, USB
Environment temperature	15 - 30 °C, stability ± 3 °C (operating), 0 - 40 °C (storage and transport)
Environment humidity	Non-condensing

* With CHARM activated ** Optional high-power version *** In the far field, i.e. 2 m after the source.

Specifications are subject to change without notice.

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