

## Technology platform for micro-integrated, space-compatible diode laser modules with high electro-optical performance

The technology platform facilitates the implementation of various types of electro-optical modules. The main implementation is the ECDL-MOPA configuration with an extended cavity diode laser as master oscillator and a tilted ridge-waveguide amplifier as power amplifier.

The modules consist of a micro-optical bench (MIOB), integrated into a Kovar housing, which can be sealed hermetically by a lid. The MIOB is constructed from lithographically patterned aluminum nitride substrates that are precision-soldered to form a stack setup. Patterning provides printed circuit board (PCB)-like functionality and stacking enables a complex multi-layer electrical design.

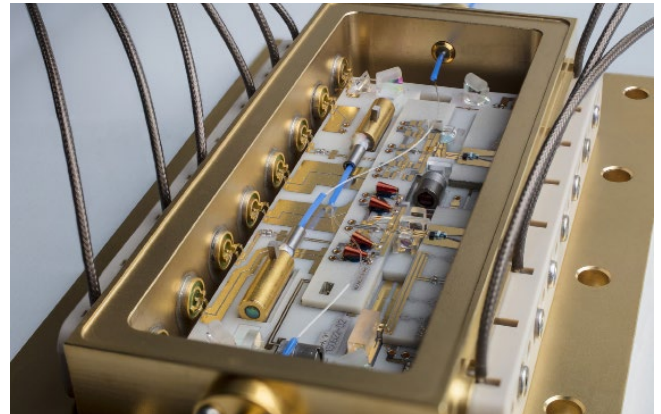
All optical elements, such as lenses, mirrors, optical isolators, and prisms, are actively aligned and adhesively bonded with sub-micrometer resolution and accuracy. Thermal control of critical elements is provided by means of micro-Peltier elements, e.g. for the volume holographic Bragg grating of the extended cavity diode laser (ECDL) master oscillator.

### Technical data for the ECDL MOPA

- output power: > 500 mW at 1064 nm ex single mode, polarization maintaining optical fiber
- linewidth: 26 kHz @ 1 ms, < 1 kHz intrinsic linewidth demonstrated with a 1064 nm ECDL MOPA
- tunability: approx. 6 GHz mode-hop free, up to 50 GHz continuous, depending on mode of operation
- space-compatible technology
- passed random vibration tests at 20 gRMS and thermal vacuum tests between -5 °C and 55 °C (4 cycles, 1K/min)
- wavelengths: 767 / 780 / 1064 nm, others upon request

### Applications

- cold atom-based quantum sensors (atom interferometers, optical clocks...)
- precision laser measurements (interferometry)
- coherent communication



➤ MOPA concept based on an ECDL and a tilted ridge waveguide amplifier used as master oscillator and power amplifier, respectively.

### Advantages

- compact design (125 x 75 x 23 mm<sup>3</sup>, 750 g mass) with high electro-optical performance:
  - fiber-coupled output power up to 500 mW
  - intrinsic linewidth < 1 kHz
- proven robustness and performance for space and quantum technology applications

### Profile

Ferdinand-Braun-Institut (FBH) researches electronic and optical components, modules, and systems based on compound semiconductors. It develops light sources from the near-infrared to the UV spectral range: high-power diode lasers, UV light sources, and hybrid laser systems. Moreover, it manufactures high-frequency devices and circuits for communications, power electronics, and sensor technology. In the field of quantum technologies, FBH translates laboratory-scale proof-of-concept experiments into robust, application-ready systems. Further applications range from medical technology, materials processing and sensors to optical communications in space. In close cooperation with industry, its research results lead to cutting-edge products.

FBH is a member of the Leibniz Association and part of Research Fab Microelectronics Germany (FMD).