Press Release

Compact, efficient, robust and reliable: FBH developments for space applications

The Ferdinand-Braun-Institut presents its space-compatible, ultra-narrow linewidth diode laser modules and systems along with further III-V components for satellite applications at "Space Tech Expo Europe" (STEE)

Berlin, October 21, 2019
The Ferdinand-Braun-Institut (FBH) will be showcasing its developments at the STEE in Bremen. From November 19 to 21, FBH is exhibiting at the joint Berlin-Brandenburg stand H20.

Compact and stable laser systems for quantum-optical precision experiments

FBH has extensive experience in the development and fabrication of diode laser modules for space applications. These modules have already proven their capability in experiments under zero-gravity conditions several times. With them, a Bose-Einstein condensate and the first iodine-based optical frequency reference were demonstrated in space for the first time. The central element of the laser modules realized for this purpose are FBH laser diodes, which are assembled together with optics and other passive elements with the highest stability and precision – in some cases well below 100 nm. Thanks to the institute's unique micro-integration technique, the modules are extremely robust and thus ideally suited for use under challenging conditions in space. Moreover, they feature small dimensions of only 130 x 80 x 25 mm³, a low mass of 750 g, and excellent performance parameters – output powers exceed 500 mW with a narrow intrinsic linewidth smaller than 1 kHz. In close cooperation with Humboldt-Universität zu Berlin, the modules are being assembled into compact and stable laser systems for precision experiments in space. This cooperation is currently being expanded towards integrated quantum technologies. Proof-of-concept demonstrators from the laboratory shall be transferred into industrial solutions in the fields of quantum sensor technology, quantum communications, quantum simulation, and quantum computing. At its booth, FBH will present micro-integrated laser modules and a laser system that was successfully operated in the KALEXUS experiment on a sounding rocket.

Laser modules for satellites: from communications to climate protection

Further laser modules are developed by FBH for satellite applications. For many years, laser benches from the Ferdinand-Braun-Institut have been successfully used as pump sources in Tesat-Spacecom's laser communication terminals. High data volumes originating from Earth observation can be transmitted particularly fast between satellites and to Earth with them. At its stand, FBH will be exhibiting a current pump laser designed for use on MERLIN. The climate satellite will measure methane concentrations in the atmosphere from 2024 onwards. The pump laser delivers an output power of more than 60 W in double pulses with a repetition rate of 20 Hz and a pulse width of 150 µs. Performance and reliability have been verified through extensive technology qualifications. Even with a long operation time of more than four billion pulses, the power degrades only insignificantly. Two of these lasers are then integrated into a module delivering a pumping power of 120 W.

Energy-efficient components for satellite communications and sensors

FBH researches further components for satellite applications in the field of microwave technology and power electronics. This includes a newly developed aluminum nitride high-speed power core that boosts the switching speed of gallium nitride power switching transistors in half-bridge configurations. Using this technology, turn-on and turn-off switching times can be reduced by typically 50%. The power core also features extremely compact hetero-integration and very low parasitic oscillation effects. It is suitable for space-compatible energy converters on satellites, transforming, for example, electricity generated by solar panels quickly and efficiently to different voltage levels required for various appliances. Power converters can thus be further miniaturized thanks to the higher conversion speed. A decisive advantage, since weight is key in space.

Energy consumption and dissipated power are further critical issues when operating power amplifiers in space. FBH presents concepts for envelope tracking (ET) – a well-proven technique for increasing the efficiency of solid-state power amplifiers, which modulate the supply voltage of the RF power amplifier in accordance to the instantaneous signal envelope. Together with the European Space Agency, FBH has developed a novel ET demonstrator at 1.62 GHz for communications in space. The amplifier has a peak output power of more than 90 W with a modulation bandwidth of 40 MHz. With an 8.6 PAPR (peak-to-average power ratio) signal, the overall efficiency reaches 40%.

FBH has also transferred the supply modulation concept to millimeter wave amplifiers. The corresponding module consists of two identical MMICs connected in series. Each consists of a single-stage amplifier with an integrated two-stage voltage switch that modulates the supply voltage of the amplifier in discrete levels. The module operates in the 20 - 26 GHz range with 14 dB gain and more than 2 W/mm at 20 V supply voltage.

Press pictures are available here for download. We will gladly provide you with further press photos at short notice. All images are copyrighted.

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Background information – the FBH

The Ferdinand-Braun-Institut, Leibniz-Institut fuer Hoechstfrequenztechnik (FBH) researches electronic and optical components, modules and systems based on compound semiconductors. These devices are key enablers that address the needs of today's society in fields like communications, energy, health, and mobility. Specifically, FBH develops light sources from the visible to the ultra-violet spectral range: high-power diode lasers with excellent beam quality, UV light sources and hybrid laser systems. Applications range from medical technology, high-precision metrology, and sensors to optical communications in space and integrated quantum technology. In the field of microwaves, FBH develops high-efficiency multi-functional power amplifiers, and millimeter wave frontends targeting energy-efficient mobile communications as well as car safety systems. The FBH has a strong international reputation and ensures rapid transfer of technology by working closely with partners in industry and research. The institute has a staff of 300 employees and a budget of 37.9 million euros. It is part of the Forschungsverbund Berlin e.V., a member of the Leibniz Association and part of »Research Fab Microelectronics Germany«.
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