Record-Purity Microwaves. Now Commercial

TOPTICA Brings Ultra-Pure Photonic Microwave Technology from Lab to Industry

Graefelfing, Germany | March 26, 2026

TOPTICA Photonics announces the launch of its X-band Metrological Microwave Solution (X-MMS), a commercially available ultra-low-noise microwave source that ranks among the purest signals achieved worldwide. Developed using photonic technology, the system transfers the stability of an optical reference into the microwave domain, enabling unprecedented signal purity and stability in an industrial-grade platform.

From Optical Stability to Microwave Precision

Unlike conventional electronic microwave sources, the X-MMS derives its signal from an extremely stable laser using optical frequency division. This approach leverages the superior performance of optical resonators to generate a 9.6 GHz microwave signal with exceptionally low phase noise and high frequency stability.

Benchmark Performance in Phase Noise and Stability

The system achieves a single-sideband phase noise of –102 dBc/Hz at 1 Hz offset and reaches below -166 dBc/Hz at higher offset frequencies, placing it among the top-performing microwave sources reported to date. Its fractional frequency instability is as low as 2.0×10^{-15} at 1 second averaging time.

Such performance is critical for demanding applications including atomic clocks, radio astronomy, frequency metrology, and emerging quantum technologies. These fields rely on ultra-stable microwave signals to ensure precise timing, synchronization, and measurement accuracy.

About TOPTICA

TOPTICA has been developing, producing, and marketing high-end lasers and laser systems for science, research, and industry for over 25 years. The portfolio includes tunable diode lasers, ultrafast fiber lasers, terahertz systems, and optical frequency combs.

Worldwide, TOPTICA has 600 employees, organized into seven business entities with a consolidated group revenue of more than €140 million.

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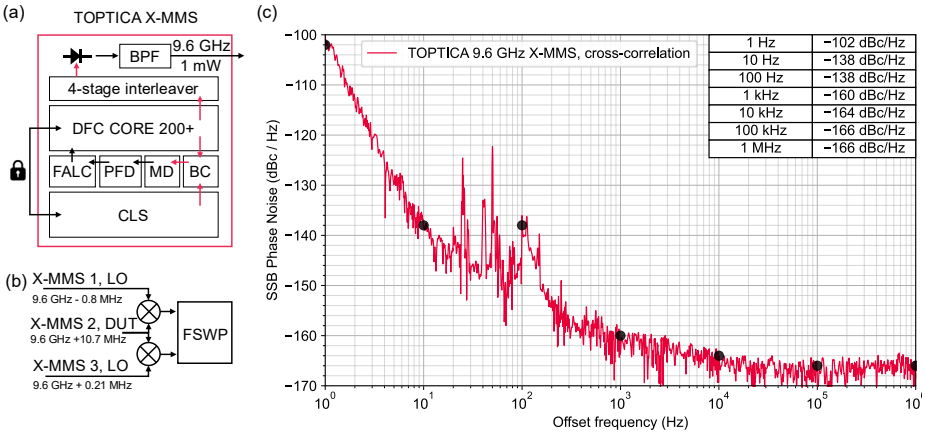

Cross-correlation measurement of 3 independent TOPTICA's X-MMS systems.

Broader impact of Quantum Technologies

"This is an exciting time to see critical advances in quantum technologies benefiting other fields." – says Dr. Mikhail Volkov, Director of Research in Quantum Technologies at TOPTICA. "Built entirely from industry-grade TOPTICA components developed for quantum applications, our commercial X-band microwave solution brings metrology-grade performance to an industry-ready platform. See how our phase-noise compares with the world's best results in the accompanying white paper – you may do a double take."

Core Technology: Difference Frequency Comb

At the core of the system is TOPTICA's Difference Frequency Comb technology, which enables intrinsically offset-free operation and contributes to both low noise and long-term stability. The platform can also be referenced to external standards such as atomic clocks or GPS signals, ensuring SI-traceable measurements for real-world applications.

TOPTICA's DFC CORE + was designed to combine highest stability with reliability at the push of a button. With our award-winning CERO technology, we achieve ultra-low noise performance while reducing complexity.

Bringing Ultra-Pure Microwaves to Applications

Metrology-grade local-oscillator performance opens new possibilities in advanced test and measurement and in the development of compact, high-end RF systems. X-MMS enables faster, more accurate measurements and accelerates high-end RF development.

This development reflects a broader trend in photonics, where advances in laser and frequency comb technologies are enabling the transfer of scientific breakthroughs into practical tools for industry.

The full technical background and performance data are outlined in a recently published **white paper**.