

High Sensitivity Waveguide HEB Mixers at 2.5 THz

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Abstract—We present the first successful waveguide HEB mixer in the 2.5 THz frequency band. KOSMA has designed and fabricated the mixer and the RF characterization was performed at 2.523 THz using the FIR gas laser local oscillator and the vacuum hot-cold load with thin Mylar beam splitter at SRON-Groningen. The best uncorrected receiver noise temperature $T_{\text{rec}}(\text{IF}, V_{\text{bias}})$ measured is 800 K at 1.25 GHz intermediate frequency (IF). This value is comparable with the results of quasi-optical mixers at this frequency. KOSMA develops waveguide HEB mixers for use in focal plane array receivers for the Stratospheric Terahertz Observatory (STO) and the Stratospheric Observatory for Infrared Astronomy (SOFIA).

The mixer consists of a small NbTiN microbridge of 4 nm in thickness, 0.4 μm in length and 1.55 μm in width on a 2 μm SIN membrane substrate that is contacted and mounted to a waveguide mixer block by beam leads. The device shows a noticeable direct-detection response to the loads, which affects evaluation of mixer sensitivity. During each Y factor measurement we therefore adjusted the LO power by means of an attenuator wire-grid in the LO path, keeping the pump level constant as indicated by the HEB bias current. This manual pump level compensation in either direction (for hot or cold load radiation, respectively) was confirmed by identical noise temperatures obtained from successive continuous LO power scans responding to the hot and cold load.