Submillimeter Wave Power Generation Using InP HEMT Technology

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Over the last decade, Indium Phosphide High Electron Mobility Transistors (InP HEMT) technology has pushed to increasingly higher operating frequencies. Significantly, room temperature amplification has been demonstrated to 1 THz, and transistor maximum frequency of oscillation (f_{MAX}) has been reported to 1.5 THz [1]. These terahertz transistors are fabricated in a monolithic integrated circuit technology. Results for amplification have been measured both on-wafer, and in split block packages.

These increases in operating frequency have come through transistor gate scaling and optimization. Described in [1], the highest reported InP HEMT node uses a 25 nm gate length. Earlier generations (100 nm) of this technology are highly mature, and have been used in space applications for many years.

To date, most application of this technology has focused on realizing sensitive receivers. Significant efforts have been made to develop sensitive receivers using this technology [2], [3]. InP HEMT receivers have demonstrated noise temperatures of 2,000-2,500 K at 670 GHz [2] and 4,300 K at 850 GHz [3]. Note that these are LNA based front-ends, and noise temperatures are analogous to mixer single-sideband noise temperature.

Less work has been reported on output power or power generation efficiencies at these frequencies. We will describe results from 100-1,000 GHz. Power benchmarks will be reported, along with DC efficiencies. Recent results on 330-410 GHz solid state power amplifiers will be reported as well. Output powers of 8-10 mW are obtained from 330-380 GHz, and 6-9 mW from 360-410 GHz from two different packaged MMIC designs. These results are obtained from a single packaged MMIC.

We also provide a summary of InP HEMT multiplier chain results. It will be shown that InP HEMT multiplier chains provide significant benefits for DC efficiency at submillimeter wave frequencies because the majority of power is consumed by the power amplifier at the output of the InP HEMT multiplier chain. These InP HEMT multiplier chains provide sufficient power to serve as the local oscillator for mixers.

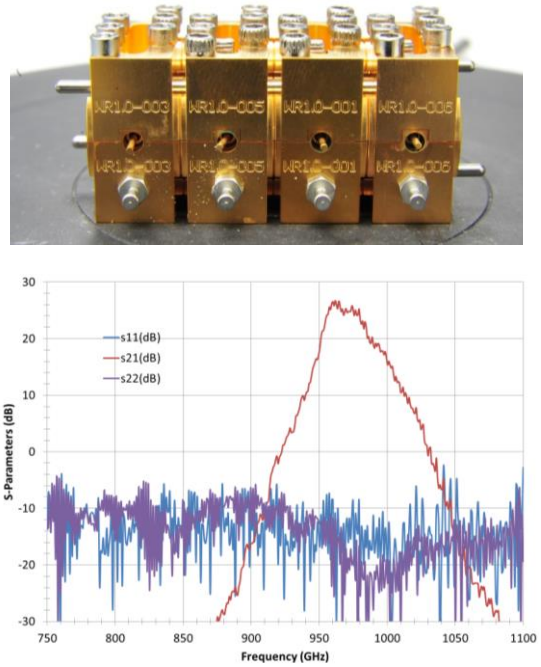

Fig. 1. 1 THz InP HEMT amplifier, including packaged amplifiers (Top) and measured small signal gain response (bottom)

REFERENCES

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