First Wideband 520-590 GHz Balanced Fundamental Schottky Mixer

Erich Schlecht, John Gill, Robert Dengler, Robert Lin, Ray Tsang, and Imran Mehdi

Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, USA

***Abstract* — We report on the design and performance of a novel broadband, biasable, balanced fundamental 520-590 GHz fix-tuned frequency mixer that utilizes planar Schottky diodes. The suspended stripline circuit is fabricated on a GaAs membrane mounted in a split waveguide block. The chip is supported by thick beam leads that are also used to provide precise RF grounding, RF coupling and DC/IF connections. At room temperature, the mixer has a measured DSB noise temperature of 2200 K at the low end of the band, and less than 4000 K across the design band.**

***Index Terms* — Submillimeter wave mixers, Schottky diode mixers, Submillimeter wave diodes.**

I. Introduction

There is a demand for mixers operating in the submillimeter band between 300 and 1200 GHz for atmospheric remote sensing spectroscopy. Near term missions that might use such mixers include a proposal for water detection observations on Mars, and measurements of middle atmosphere trace gases and gas dynamics on Venus. Schottky submillimeter and Terahertz sensors would be ideal for future proposed missions to Europa and Titan as well.

We have designed, fabricated and tested a variation of the crossbar type of balanced mixer. In this mixer, the waveguides are rotated so that they are both cut in the E-plane by the block split.

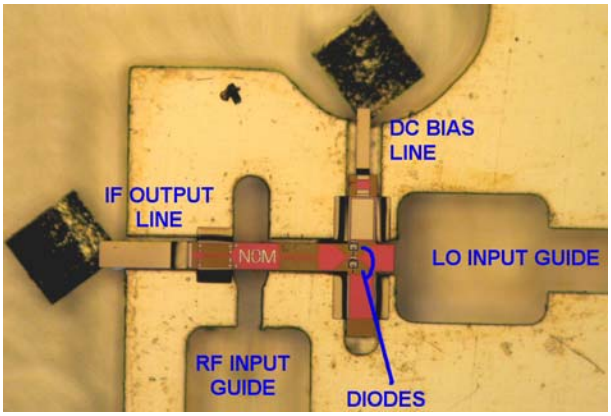

Fig. 1. Balanced mixer mounted in block.

II. Design and Fabrication

The mixer was designed using a combination of commercial software packages and a harmonic balance simulator developed at JPL to allow advanced diode properties such as undepleted epi-layer electron heating to be included in the analysis. The passive portion of the circuit is analyzed with a combination of linear circuit simulators and Ansoft HFSS.

The design itself starts with an optimization of the diode size and terminating impedances, based on the available LO pump power. Then the circuit is designed using a combination of HFSS and linear circuit simulators The completed circuit inside the waveguide block is shown in Fig. 1.

The mixer was fabricated using JPLs planar membrane beam lead process, and the blocks were fabricated from brass using precision machining techniques.

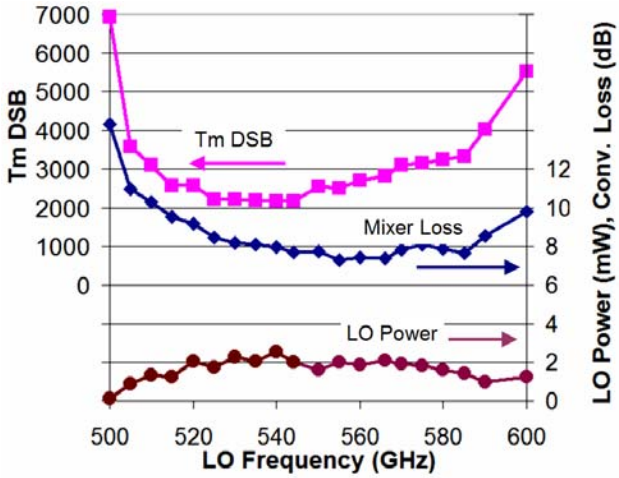

Fig. 2. Mixer performance variation with LO frequency.

III. Mixer Measurements

The mixers' performance is measured using an automatic Y-factor system specifically assembled for mixers. The measured performance of the mixer as a function of LO frequency is shown in Fig. 2. These measurements were taken at the LO power levels as shown. They cover the design bandwidth from 530 to 590 GHz, and indicate the wide RF bandwidth of the mixer.

IV Conclusion

This work presents a description and measured results of a very widely tunable balanced Schottky mixer. As far as the authors know, it is the first of its type in this frequency range.