A Low VSWR 340 GHz 2SB Schottky Receiver for Earth Observation Applications

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***Abstract*—A waveguide integrated 2SB Schottky receiver operating in the 320-360 GHz band with a performance similar to state-of-the-art DSB Schottky mixers is demonstrated. The unique receiver topology utilizes a low RF and LO VSWR design leading to better mixer performance and superior response for the radiometer system in general. On average a 15 dB SBR is measured over the RF band and a LO return loss of 15 dB broadband.**

***Index Terms*—Submillimeter wave technology, schottky diode, receivers, radiometers, subharmonic mixers, sideband separating mixers, dual sideband receivers, image rejection mixers**

I. Introduction

We report on the development of a fully integrated 2SB receiver designed for the STEAMR instrument [1], operating at 320-360 GHz. STEAMR is a part of the ESA PREMIER Earth explorer core mission and will provide tomographic limb viewing of the upper troposphere and lower stratosphere UT-LS range from 6 km to 28 km, and will consist of an array of 14-16 receivers with DSB or SSB capability. The receivers will operate at a fixed LO frequency of about 170 GHz with a total IF bandwidth of 12 GHz from 4 to 16 GHz. The instantaneous IF frequency coverage will thus be larger then 192 GHz and we are close to the submilllimeter wave range also in IF bandwidth, not only RF frequency.

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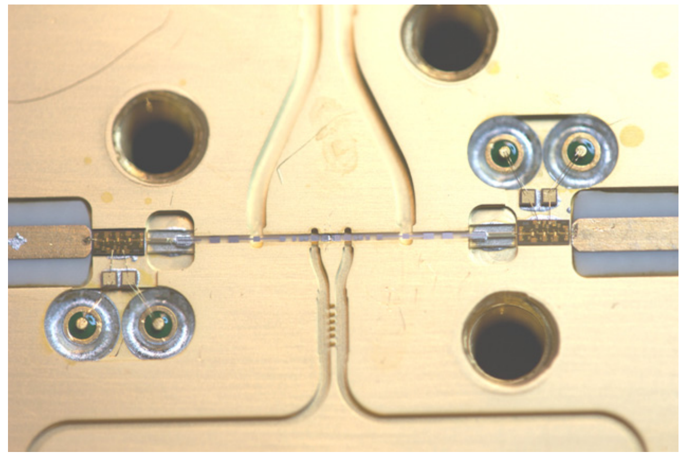

Fig. 1. Front-End receiver module assembly.

II. Design

The unique receiver design exhibits low LO and RF port voltage standing wave ratio as quadrature feeding is employed, see [2-8], of two subharmonic Schottky diode DSB mixers. In the first prototype module commercial IF LNA's with a 1.8 dB minimum noise figure have been integrated to the receiver I and Q paths. The approach of LNA embedding has two advantages, it improves the flatness and bandwidth of the IF response and provides a flexible way for tuning the image rejection by external IF networks, without affecting the receiver sensitivity.

III. Result

Several modules, both SSB and DSB, have been fabricated and tested using both commercial and in house developed Schottky diodes. Results have been consistent and repeatable for all the assembled units, with an optimum 2SB receiver noise below 2800 K(SSB) including the contribution from the RF hybrid termination, and with an estimated DSB mixer noise and conversion loss of 800 K(DSB) and 8 dB(SSB) respectively including all system losses. Thus, the 2SB mixer is found to operate at similar performance as the DSB mixers. The measured sideband ratio was typically around 15 dB without any compensation of the IQ-imbalance and the typical LO input return loss was measured to about 15 dB broadband.

IV. CONCLUSIONS

High performance waveguide integrated sideband separating Schottky receivers can now for the first time be considered for THz applications, enabling new measurement techniques and instrument concepts.

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Peter Sobis (S'05) was born in Göteborg, Sweden in 1978. He received the degrees of M.Sc. in electrical engineering and Licentiate in THz electronics from Chalmers University of Technology, Göteborg, Sweden in 2003 and 2010, respectively.
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