

A 67-116 GHz MMIC-based dual-polarized 2SB down-converter for the ALMA Band 2 Warm Cartridge Assembly prototype development

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Abstract—We present here the development of a dual-polarized 2SB down-converter covering the extended frequency range 67-116 GHz for the ALMA Band 2 Warm Cartridge Assembly prototype. The 2SB down-converter operates at room temperature and relies on MMIC technology for the ultra-wideband mixers and LNAs as well as powerful PAs. The gain measurements show a flat response with <5dB p-p average variation over 2-20 GHz IF ranges. The sideband ratio ranges between 17 and 30 dB in average in the nominal configuration.

Keywords—MMIC, sideband separating, down-converter, dual-polarized, ultra-broadband

I. INTRODUCTION

ALMA Band 2 receiver is one of the key milestones in the ALMA 2030 development roadmap [1]. Prototypes for the Cold Cartridge Assembly (CCA) and Warm Cartridge Assembly (WCA) are currently under development in Europe. One of the key features of this band is the use of semi-conductor MMICs for amplification at cryogenic temperatures in the CCA, and for down-conversion at room temperature in the WCA. A pre-prototype of the ALMA Band 2 Receiver has demonstrated very broad instantaneous RF & IF bandwidths [2]. The 2SB down-converter prototype developed here is an evolution of the original pre-prototype presented at the ISSTT 2018 and described in [3].

II. DEVELOPMENT AND PRELIMINARY TEST RESULTS

The 2SB down-converter prototype relies on a full-MMIC approach covering the extended 67-116 GHz range. A careful optimization of the RF, LO and IF components has been performed in order to maximize the side-band ratio, and improve the gain flatness response over a 2-20 GHz IF range. The gain and sideband characterization for each channel and polarization has been done with a Vector Network Analyzer and associated extender heads, using a novel UOSM calibration method (Unknown-Open-Short-Match) which allows a full S-parameters measurement to be performed on the 2SB down-converter. This results in very accurate amplitude and phase gain and sideband measurements from 60 GHz to 120 GHz, and can be scaled up to 1100 GHz with the corresponding VNA extenders. An example of the measured gain response and sideband ratio is shown in Fig.1.

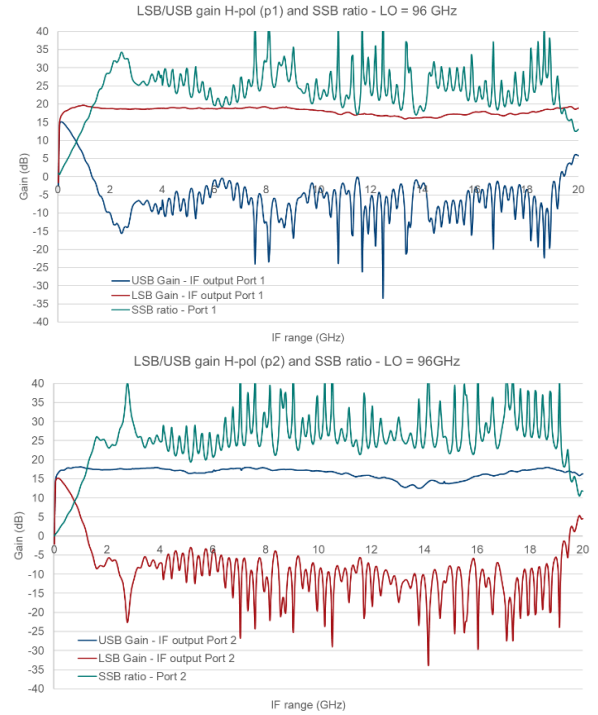


Figure 1. Measured gain response and sideband ratio for the Port 1 (top graph) and Port 2 (bottom graph) vs IF output range. Configuration: H-Polarization 1 - LO= 96 GHz - RF = 76-116 GHz – IF = 10 MHz- 20 GHz.

A summary of the 2SB down-converter test results will be presented, along with the novel UOSM measurement method used. Suggestions for further improvements such as highly integrated IQ-mixer modules under development and LO power control capabilities will be addressed.

REFERENCES

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