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ALMA Band 2 Receiver Automated Test System

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***Abstract*—As part of the ALMA Band 2 project, an automated test system was developed to fully qualify state-of-the-art Band 2 receivers, based on heritage of the Band 9 and Band 5 productions. The RF range of this receiver is 67 - 116 GHz, with a goal IF band of 4-18 GHz. Each receiver will undergo a thorough acceptance testing to verify its operation and performance prior to delivery. The core of the test system are a single-cartridge test cryostat, a dual-channel intermediate frequency signal processor, a vector near-field test system, and script-based measurement and control software that enables automated testing. We present details of the test system and measurement results of the first Band 2 receivers.**

Keywords— automatic test equipment, Sideband rejection ratio, Noise temperature, Sub-mm receivers

I. Introduction

In contrast to the higher ALMA bands (3-10), which use cryogenic mixers for heterodyne downconversion, the Band 2 receiver employs cryogenic waveguide amplifiers in the Cold Cartridge Assembly (CCA) [1], while the sideband-separating downconversion happens in the air-side Warm Cartridge Assembly (WCA). The CCA is constructed by a consortium of NOVA (Netherlands), GARD (Sweden) and INAF (Italy) [2], while the WCA is built at NOVA using a wide-band downconverter developed by RPG [3].

The key receiver specifications to be qualified before delivery are: heterodyne sensitivity and cartridge output power as a function of local oscillator (LO) frequency and intermediate frequency (IF), sideband rejection ratio, aperture and polarization efficiency, output power and signal path phase stability, and gain compression. The two most important ones are shown in the tables below.

Noise Specifications	
Range (GHz)	***Tnoise (K)***
67-90	≤ 47
67-90	80% ≤ 30
90-116	≤ 43

Sideband Rejection Ratio	
Range (GHz)	***SRR (dB)***
67-116	> 7 dB
67-116	90% of the IF > 10

An example of the measured noise temperature is shown in Fig. 1. The noise temperature is measured over 4-18GHz IF at 5 GHz LO spacings and, corrected for residual image response and averaged over bins of 4GHz. Fig. 2 shows the sideband rejection ratio measured over 4-18GHz at the LO frequencies 79, 84, 89,… 104 GHz.

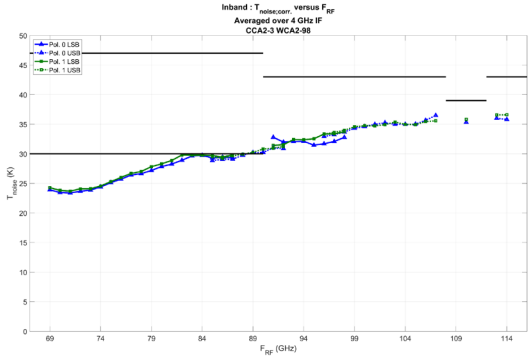

Fig. 1. Corrected Receiver noise temperature vs. RF frequency averaged over 4GHz bins, including specification markers.

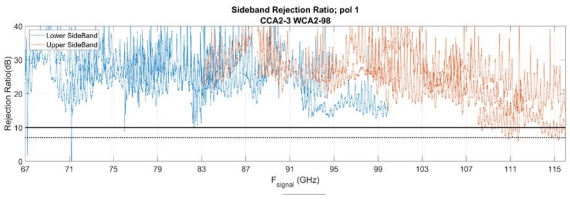

Fig. 2. Cartridge sideband rejection ratio vs. RF frequency. The upper graph shows polarization 0 and the lower graph polarization 1. The black line indicates a rejection ratio of 10 dB and the dotted black line 7 dB.

References

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