Wideband Cryogenic Isolators for Sideband-separating Receivers

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***Abstract*— The wideband cryogenic isolators developed in the Submillimeter Receiver Laboratory at the CfA have been deployed in the double-sideband (DSB) receiver system in the Submillimeter Array (SMA) for several years. These isolators play an important role in expanding the Intermediate Frequency (IF) bandwidth of the array. To further enhance our capabilities, we are developing phase-matched isolators for use in a sideband-separating (2SB) receiver system. This abstract outlines the essential requirements of the 2SB receiver system and the challenges inherent in isolator design and fabrication. Finally, we will present the measurement results of an isolator pair to demonstrate that our isolators successfully meet the design requirements for 2SB operations.**

***Keywords*— Calcium Vanadium, Ferrite devices, isolators, millimeter wave and terahertz components, YIG.**

I. Introduction

Cryogenic isolators are crucial components in low-noise heterodyne receiver systems extensively utilized in millimeter and submillimeter telescopes. To meet the increasing need for wider Intermediate Frequency (IF) bandwidths, there is a growing demand for a wideband, low-loss isolator in modern facilities such as the Submillimeter Array (SMA) and the Atacama Large Millimeter/submillimeter Array (ALMA).

The cryogenic isolators developed for the double-sideband (DSB) receivers have been demonstrated to be able to deliver very wideband performance, covering a frequency range from 4 GHz to 22 GHz [1, 2]. They exhibit insertion loss of less than 1 dB, together with return loss below -15 dB. They provide isolation better than 17 dB across most of the band.

In addition to the wideband performance for individual isolator mentioned above, the amplitude and phase of the S_{21} of an isolator pair used in a sideband-separating (2SB) receiver has to be well matched, if the IF quadrature hybrid is to be placed after the low noise IF amplifiers. This is the case for the ALMA Band6v2 development. To achieve a good image rejection ratio in this configuration, the amplitude and phase matching requirement are set to be 0.3 dB and 3 deg for an isolator pair.

In this presentation, we will report on the design, fabrication, and assembly of the isolator pairs to meet the requirements for such a 2SB receiver applications. We will provide measurement results to demonstrate that our isolator design meets the requirements for the ALMA Band6v2 project.

References

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