Design and Characterization of a Sideband-Separation SIS Mixer/IF Module for use on a Focal-Plane Array

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A dual polarization 16-pixel heterodyne focal-plane array receiver is proposed to be built to operate in the 210 – 275 GHz ($\sim$ 1mm wavelength band) atmospheric window for use on the Large Millimeter Telescope (LMT). The LMT is a 50 m diameter millimeter-wavelength telescope being built in Mexico as a joint project between UMass and Instituto Nacional de Astrofisica, Optica, y Electronica (INAOE) in Mexico. Each pixel of the proposed focal-plane array receiver will feature SIS mixers operated in a novel sideband-separation mode with wideband low-noise IF amplifiers (4 – 12 GHz). In this paper, we will present design details, test results, and characterization of the components that make up the novel array mixer-block.

The array mixer-block is a highly integrated assembly (see Figure 1) that has been optimized for use and integration into a 4×4 array. The mixer-preamplifier (MPA) block consists of a input RF 90° waveguide hybrid, a dual-directional LO coupler, two SIS junctions, two hybrid IF LNAs with a IF 3dB 90° Lange coupler interspersed between the stages. Two SMA outputs from the mixer block bring out the separated upper and lower sidebands. Two magnetic coils that are used to suppress Josephson noise are also embedded in this integrated mixer-preamplifier (MPA) block. A hybrid IF LNA with a discrete JFET followed by a MMIC amplifier has been designed, fabricated and tested. The integrated implementation of the IF Lange hybrid coupler between the stages of the hybrid IF LNAs considerably eases the amplitude and phase balance requirements of components in the rest of the IF chain.

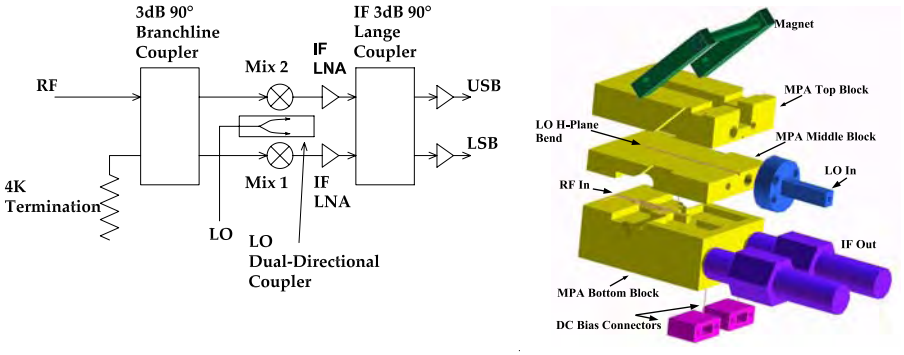

Figure 1: Array Mixer block (a) Schematic of the sideband separation mixer configuration (b) A 3-d exploded view of the Split-block construction of the array mixer-block.