

Report on Progress of the Development of MMIC Receivers for Observation in the 3-mm Band at CARMA

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CARMA, the Combined Array for Research in Millimeter-wave Astronomy, provides observational facilities in the 1-cm, 3-mm, and 1-mm bands. The current receivers in the 3-mm band are single polarization, double sideband SIS mixers and cooled MMIC IF amplifiers that deliver 8 GHz of instantaneous bandwidth. We are in the process of developing a new generation of receiver based on 3-mm MMIC amplifiers followed by image separating mixers, which will be capable of delivering 17 GHz of bandwidth in each sideband for two polarizations, or 68 GHz total instantaneous bandwidth per antenna.

We will present results of the continuing development. The amplifiers are integrated blocks incorporating three MMICs, waveguide input and output probes, and gain slope equalizers, as well as an integrated bias protection circuit. Results of measurements on prototype amplifiers will be compared with simulations based on cryogenic probe station measurements of s -parameters of the MMIC dice.

Designs for waveguide components including a quadrature hybrid splitter and an in-phase splitter required for sideband separation will be described, along with VNA measurements of the s -parameters. Measurements on phase and amplitude matching of commercial broadband solid state mixers will be shown. Experimental characterization of complete sideband separating mixers using the components will be compared with the performance expected from the component designs, as well as the system requirements.

Methods of improving the phase and amplitude balance will be discussed, including cable delay adjusters, and bias control on the solid-state mixers. Finally, we will outline remaining issues to resolve and possible solutions presented.