

Sideband Separating Mixer Characterization based on SIS junction properties.

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Abstract—For high-frequency observational bands like ALMA Band 9 (600—720 GHz), dominated by atmospheric noise, implementation of sideband-separating mixers can reduce, up to a factor of two, the integration time needed to reach a certain signal-to-noise ratio for spectral line observations. Because of very high oversubscription factor for observation in ALMA Band 9, mixer upgrade to a Sideband Separating (2SB) configuration is an attractive option for ALMA future development.

We have built a 2SB mixer, which has demonstrated a sideband rejection ratio as high as 15 dB over the full RF band, well within the ALMA specifications of 10 dB. The SSB noise temperature is, also within the ALMA requirements of 336 K over 80% of the band, and 500 K over the entire band.

Using the SIS junction properties the full characterization of the 2SB receiver was made. The sideband rejection ratio is determined mainly by the RF and IF hybrid amplitude misbalances, which we have measured separately. To determine RF hybrid misbalance the test signal was applied in the RF port and ratio of the SIS pumping currents was measured. For IF hybrid characterization SIS junctions were used as a known noise level sources, while biased at 5 mV and 8 mV. We have also approved experimentally and theoretically that the bias inversion of one of the SIS junctions is switching upper and lower sidebands in the IF chain and can be used as a fast method to measure the sideband rejection ratio.

We will present the 2SB mixer in details and will discuss the possible schemes of the ALMA Band 9 upgrade.