Simulation of HTS Josephson Mixers

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Abstract — CSIRO has developed superconducting Microwave Monolithic Integrated Circuit (MMIC) mixers using step-edge Josephson junctions and on-chip filters, made from YBaCuO on MgO substrates. Integration into a MMIC results in a compact and efficiently-coupled structure. These have been shown to have outstanding conversion efficiency, dynamic range and linearity. We report here a range of simulations of this type of mixer. We have mainly used Josephson simulators and analyse the data in both the time and frequency domains. More recently we also use microwave simulators incorporating a novel Verilog-A Josephson junction model that we have developed. We have looked at the interactions of junction bias current, local oscillator power and RF input power with conversion efficiency, dynamic range and linearity. Good agreement is found overall with measurements.

Keywords (Index Terms) — MMIC, Superconducting microwave devices, Josephson mixers, heterodyning.