Abstracts

A 850-GHz waveguide receiver employing a niobium SIS junction fabricated on a 1-/spl mu/m Si/sub 3/N/sub 4/ membrane

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We report on a 850-GHz superconducting-insulator-superconducting (SIS) heterodyne receiver employing an RF-tuned niobium tunnel junction with a current density of 14 kA/cm/sup 2/, fabricated on a 1-/spl mu/m Si/sub 3/N/sub 4/ supporting membrane. Since the mixer is designed to be operated well above the superconducting gap frequency of niobium (2/spl Delta//h/spl ap/690 GHz), special care has been taken to minimize niobium transmission-line losses. Both Fourier transform spectrometer (FTS) measurements of the direct detection performance and calculations of the IF output noise with the mixer operating in heterodyne mode, indicate an absorption loss in the niobium film of about 6.8 dB at 822 GHz. These results are in reasonably good agreement with the loss predicted by the Mattis-Bardeen theory in the extreme anomalous limit. From 800 to 830 GHz, we report uncorrected receiver noise temperatures of 518 or 514 K when we use Callen and Welton's law to calculate the input load temperatures. Over the same frequency range, the mixer has a 4-dB conversion loss and 265 K/spl plusmn/10 K noise temperature. At 890 GHz, the sensitivity of the receiver has degraded to 900 K, which is primarily the result of increased niobium film loss in the RF matching network. When the mixer was cooled from 4.2 to 1.9 K, the receiver noise temperature improved about 20% 409-K double sideband (DSB). Approximately half of the receiver noise temperature improvement can be attributed to a lower mixer conversion loss, while the remainder is due to a reduction in the niobium film absorption loss. At 982 GHz, we measured a receiver noise temperature of 1916 K.

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