

0.5 THz SIS Receiver with Twin junction Tuning Circuit

V.Yu. Belitsky^{*}, S.W. Jacobsson^{**}, L.V. Filippenko^{*},
S.A. Kovtonjuk^{*}, V.P. Koshelets^{*},
and
E.L. Kollberg^{**}.

^{*} Institute of Radio Engineering and Electronics, Russia Academy of Sciences,
Mokhovaja 11, 103907, Moscow, Russia.

^{**} Department of Microwave Technology, Chalmers University of Technology,
S-412 96 Göteborg, Sweden.

Abstract

An open structure SIS mixer has been designed for operation in the frequency band 400–550 GHz and successfully tested in a laboratory receiver setup. A novel type of SIS mixer structure was implemented and integrated with an equiangular spiral antenna. In this structure two identical (twin) SIS junctions are connected so that conjugate impedance of the first exactly compensates the reactance of the second. This tuning circuit was connected to the spiral antenna via an impedance transformer. Using this combination we obtained broadband SIS mixer operation with measured instantaneous frequency range more than 80 GHz without any mechanical tuners. The Nb–AlO_x–Nb SIS junctions have each an area of 4 μm² and an $\omega R_n C$ -product of 7.4 at 500 GHz. The relatively large area SIS junctions together with the particular topology of the twin tuning circuit make it easy to suppress the Josephson effect. The cooling to 3.5 K dramatically improved the receiver performance. Measured SIS mixer receiver noise temperatures, which include **all** losses, were below 300 K DSB across the 450–515 GHz range with the best noise temperatures <250 K DSB at 453 GHz and <270 K DSB at 512 GHz.