We measured receiver conversion gain and IF amplifier noise temperature in situ using the junction at the bias voltage behind the gap as a noise source for the calibration of the circuit [13]. Intermediate frequency chain noise temperature in the 1.25-1.75 GHz band is about 4 K. Maximum measured receiver conversion gain between the receiver input port and the IF port of the mixer is about -12 dB.

Measured SSB receiver conversion gain versus frequency dependence $G_{Rec}(F)$ between the reference plane at the cryostat window and the IF port of the mixer is presented in Fig. 8 by a black line. Receiver conversion gain in the 290 -320 GHz band is -12 ÷ -13 dB. Out of this band the mixer matching circuit is no more efficient and the reflection loss and loss in the mixer circuit becomes too important. The gray line in this figure is a calculated coupling gain G_C between the RF input of the mixer and the junction from the Fig. 5. Junction capacitance is included in the mixer circuit. Calculated variation of the coupling explains well the measured frequency dependence of the gain. One can note a nearly constant difference of 5 - 6 dB between the experimental data and the model prediction of the coupling. We may estimate the available mixing conversion gain $G_J = G_{Rec} /(G_C G_{RF})$ in the SINS junction as -5 ÷ -5.5 dB expecting the loss in the input section of this receiver $G_{RF} \approx -0.5$ dB. This estimation of the mixer conversion gain is in a good agreement with the G_J =-6 dB at 320 GHz predicted in [7] for a SIN junction with a similar I-V characteristic. However the noise of our receiver is larger than 10 K minimum predicted at 320 GHz in the same work.

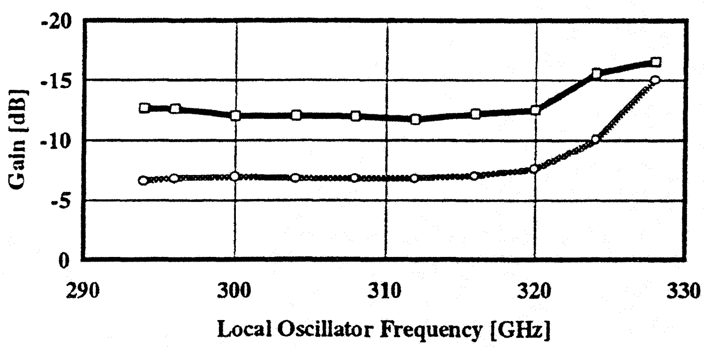

Figure 8. Measured receiver conversion gain (black line) and calculated coupling loss between the mixer waveguide input flange and the SINS junction RF resistance (gray line). The difference between this gain let us estimate the available conversion gain of about -6 dB in the SINS junction.

The first term of expression (1) $T_{RF}+T_M/G_{RF}$ is determined by a method proposed by R. Blundell et al [14] and Qing Ke and M. Feldman [15] for an SIS mixer. Receiver input section contribution in the receiver noise ($T_{RF}+T_M/G_{RF}$) is evaluated as a constant component in the linear relation between the SIS receiver noise and the receiver gain at a low level of the local oscillator power. This rule is based on the independence of the mixer output noise from the local oscillator amplitude at the tunnel junction predicted in [16].

Relation between the receiver gain $G_{Rec} = G_M G_{RF}$ and T_{Rec} measured with SINS mixer at 312 GHz is presented in Fig. 9. Receiver noise versus junction bias current for this experiment is given in Fig. 6. As with the SIS mixer the SINS mixer experimental $T_{Rec}(1/G_{Rec})$ may be well explained by linear function up to the local oscillator amplitude providing the minimum receiver noise temperature (135 K). Black line in Fig. 9 is a linear fit of $T_{Rec}(1/G_{Rec})$. Intersection of this line with the T_{Rec} axis gives $T_{RF}+T_M/G_{RF}$ = 30 K. In experiment with SIS mixer in the same receiver we find a similar value of $T_{RF}+T_M/G_{RF}$. All this confirms the validity of the methods proposed in [14, 15] for the case of the SINS mixer.