600 GHz Heterodyne Mixer in Waveguide Technology using a GaAs Schottky Diode

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In this paper we will present first measurement results for a 600 GHz heterodyne mixer in split-block waveguide technology. In this mixer design we use a planar GaAs Schottky diode which is flip-chip mounted on a quartz substrate. The split-block structure includes an octagonal horn antenna to feed the signal and local oscillator into the split-block mixer, a waveguide to microstrip transition and coaxial IF output. In addition to the GaAs diode the quartz substrate also includes the required filter structures and DC bias supply. Figure 1 shows the split-block mixer with the mounted octagonal horn antenna.
We will present the field simulations for the designed mixer and compare the results to scaled model measurement at 11 GHz.
The main focus of this paper will be the characterization of the device in both detector and mixer operating mode. First measurements have been carried out in a quasioptical setup using a backward wave oscillator (BWO) to determine the detector characteristics. These measurements show voltage responsivities of over 350 V/W at 625 GHz.
Using a Gunn oscillator based multiplier chain (75 GHz x2 x4) as a signal source and a BWO at 600 GHz as local oscillator we measured an IF signal at 5 GHz with a signal-noise ratio of about 50 dB. A preliminary estimation of the conversion loss of the mixer is less than 22 dB.
Figure 2 shows the IF output spectrum of a 605 GHz signal. In this experiment the signal power was less than -10 dBm.
For further optimization of the mixer we will implement an enhanced diode layout with reduced diode parasitics. For this reason the GaAs diode will be directly integrated on the quartz substrate which carries the waveguide to microstrip transition and the filter structures. We expect a noticeable reduction of the diode parasitic capacitance and a reduction of the series resistance.
Detailed noise characterizations and conversion loss measurements will be presented.

Figure 1: 600 GHz split-block mixer

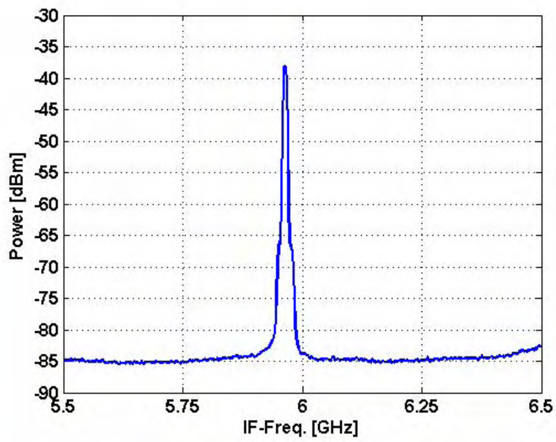

Figure 2: IF spectrum of a 600 GHz signal