AN IMPROVED 1 THZ WAVEGUIDE MIXER.

Summary for the 7th Int. Symp. on Space THz Techn., Charlottesville, 1996.

H. van de Stadt 1), A. Baryshev 3), J.R. Gao 1,2), H. Golstein 1), Th. de Graauw 1),
W. Hulshoff 1), S. Kovtanyuk 3), H. Schaeffer 1), N. Whyborn 1).

1) Space Research Organization of the Netherlands, PO Box 800, 9700 AV Groningen, The
Netherlands.
2) Department of Applied Physics and Materials Science Center, University of Groningen,
Nijenborgh 4, 9747 AG Groningen, The Netherlands.
3) Institute for Radio Engineering and Electronics, Russian Academy of Sciences, Mochoyova
str. 11, Moscow 103907, Russia.

In our experiments we use a classical waveguide mixer with a diagonal horn, a
contacting, adjustable backshort and 95 x 190 and 90 x 75 µm² crosssections of waveguide and
substrate channels, as described in [1]. Measured DSB noise temperatures have recently been
improved due to better optical coupling and improved fabrication processes. Results are given
in the figure below for two junctions with different length of microstrip lines. The data are
corrected for the reflection losses of our 20 µm thick mylar beamsplitter. No correction for the
Planck radiation law has been applied. As an example we mention that the Y-factor for
1005 GHz was measured to be 0.58. This corresponds to an uncorrected DSB noise temperature
of 1460 K and a corrected value of 1055 K.

1.0 THz waveguide mixer at 4.2 K.

[Graph showing DSB noise temperature vs. frequency for two different microstrip lines.
SRON, Jan 10, 1996.]
Nb SIS junctions of 1 μm² area on fused quartz substrates are used with tuning elements made of aluminium. The tuning consists of 10 μm wide, so-called end-loaded microstriplines of different lengths. Above the gap frequency of Nb (700 GHz) the use of normal metals provides lower losses than the use of Nb. First results at high frequencies with striplines made of aluminium were reported in ref [1], and their use is now reported by several other groups [2,3] as well. The present results are improved with respect to the previous ones by using optical elements (dewar window, heat filter and lens) with higher transmission. Another improvement is the application of evaporated aluminium instead of sputtered aluminium. This may reduce the loss due to a decrease of the surface impedance of the stripline. In both cases we apply a thin Nb layer underneath the bottom Al layer as well as on top of the upper Al layer in order to decrease the series resistance seen by the DC and IF signals.

As local oscillator (LO) we use two Backward Wave Oscillators (BWO’s), one tunable from 840 to 940 GHz, the other from 927 to 1085 GHz. The increase in Noise temperature above 1060 GHz is partly because of the limited bandwith of our tuning circuit, but also because of strongly increasing atmospheric absorption due to water vapour lines at frequencies of 1097, 1113 and 1154 GHz.

A paper with more detailed information is in preparation.

We acknowledge the financial support of the European Space Agency via contract No. 7898/88/NL/PB(SC) and the Stichting for Technische Wetenschappen contract GTN 33.2971.

References: