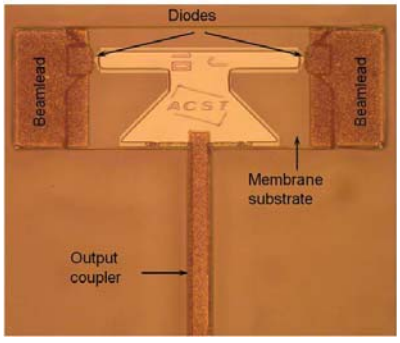
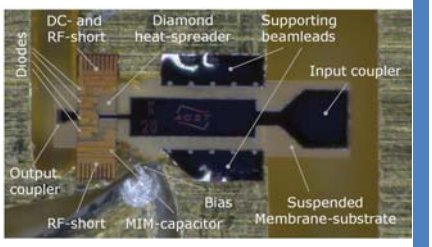
Activity Title:	***Frequency Multipliers for Sub-MM Waves***		
Contract type	**4000104583**	**Budget** *(k€)*	**450**
Company (-ies) *(including country)*	ACST GmbH, Germany. GMD EURL, France.		
Team *(name of the participants in the project)*	Ion Oprea, ACST Oleg Cojocari, ACST Hugh Gibson, GMD		
(*) **Speaker (s)**	Oleg Cojocari	**Email**	oleg.cojocari@acst.de
Short Speaker Information *(experience and involvement in this project – maximum 60 words)*	Oleg Cojocari has joint the Department of Microwave Engineering, Technical University of Darmstadt, Germany, in year 2000. In 2006 he received the PhD degree on topic "Schottky Technology for Terahertz Electronics". In 2006 Oleg co-founded ACST GmbH, the first European commercial supplier of Schottky diodes for THz applications. In this project Oleg mainly was involved in design of new fabrication processes and THz-MIC.		
Summary of the activity *(maximum 400 words and 2 pictures)*	Schottky diodes are components that are used in practically all non-cryogenic millimetre and sub-millimetre wave receivers in Earth Observation and Space Science. While Schottky mixers have been shown to operate well at several terahertz, the lack of local oscillator power from solid-state sources has often hindered good performance at the highest frequencies. The objective of the activity was to develop two frequency multiplier demonstrators for Sub-mm wave frequencies (440GHz and 600GHz) using Schottky varactors, with sufficient power (5mW) to comfortably drive a Schottky mixer. While this appears a trivial task, the modest power of 5mW at 600GHz was, (until this project) an unreachable goal. The task of building high power varactor multipliers for the sub-mm band is extremely challenging. A design has to be developed which not only matches the extremely reactive varactor impedances, but also has to take into account the effects of severe current crowding and velocity saturation, which dominate the performance (efficiency) at the sub-mm part of the band. Much effort has also gone into understanding and controlling heat flow, particularly the 600GHz tripler, which is essential to the final efficiency and power handling of the device. A novel Film-Diode (FD) Process developed by ACST GmbH was used, which allows fabrication of both discrete diodes and integrated circuits for mm/Sub-mm-Wave multipliers on just a few microns thin transparent film membrane. This approach aims at ultimate performance at mm and Sub-mm-waves. A major problem in high powered multipliers is dissipating the heat of the input pump power which is not converted into output power. For the simpler doubler design, with only 2 diodes, the diodes are embedded in a thick beam-lead which is clamped between the two halves of the metal block. A peak power of over 10mW was achieved at 440GHz, with a peak efficiency of 28%. The efficiency and output power are excellent considering the high frequency. To our knowledge this is a record for a single (not power combined) multiplier at this frequency. A novel approach using thin diamond sheets as a partially substituted substrate was tried for the 600GHz tripler. The diamond dissipates heat from the diode anodes to the metal block. The tripler has a peak output power in excess of 5mW and an average power of 3.5mW. Efficiency is between 4 – 6% which is unprecedented for this frequency. The results track the simulation exceedingly well. The tripler was not fully saturated and we expect that with even more input power, up to 6.5mW may be obtained. These excellent results illuminate the path to substantially higher power sources at THz frequencies by careful RF and thermal design. First picture shows the 440GHz Doubler MIC. The second picture illustrates the 600GHz tripler MIC mounted in a metallic WG split-block.  		

(*) The speaker needs to do the registration through this website