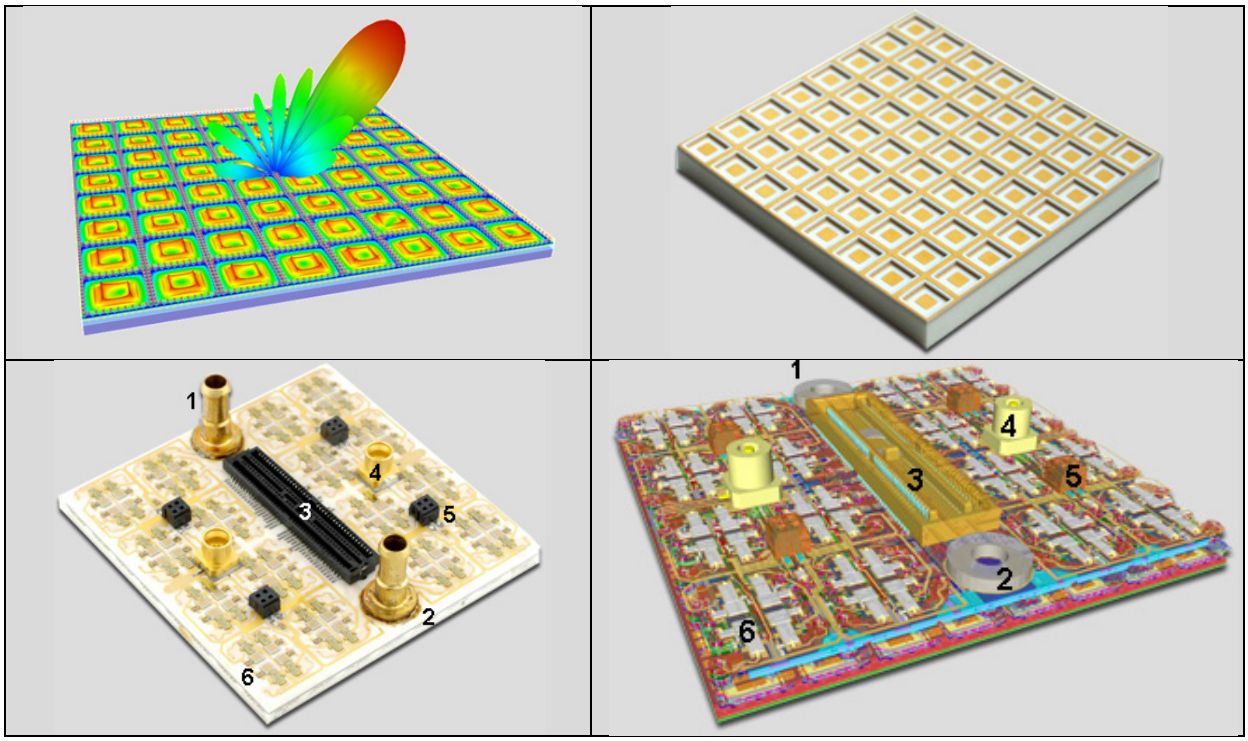
Dipl.-Ing. Reinhard Kulke, IMST GmbH, Germany

Reinhard Kulke received his Dipl.-Ing. degree in electrical engineering from the Ruhr-University in Bochum, Germany, in 1991. He started his scientific carrier in the microwave company ArguMens in Duisburg with focus in software development and modeling for RF circuits. Since the foundation of IMST GmbH in Kamp-Lintfort in 1993 he is working for this company in research and development for microwave applications. He is the head of the team RF-Modules and assistant department head for RF-Circuits and System Integration. LTCC technology was introduced at IMST in 2000 firstly with RF circuit and antenna design and soon followed by a prototyping line to enhance the R&D capabilities. Since that time he is responsible for advanced circuit developments in LTCC with focus in satellite communication modules in Ka-band. The research results were published and acknowledged in the international community and were used in specific LTCC training courses including theory and practice parts over the past 8 years. Current R&D activities are related to smart radar applications with focus on 24 GHz and 77 GHz sensors. He is author/co-author of about 100 publications since 1993.

LTCC for Microwave Applications with Focus on Satellite Communication

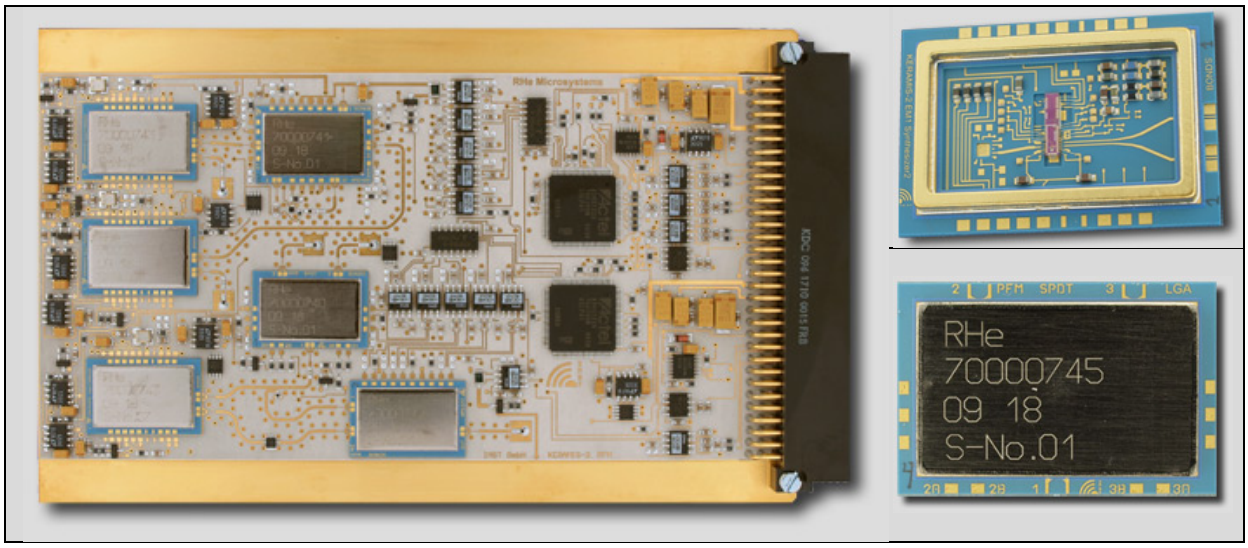
Abstract

This workshop contribution will give an overview about modules, circuits and antennas which have been developed at IMST in the past 15 years mainly in the frame of public funded research projects in cooperation with national and international partners. IMST was responsible for RF circuit and antenna design. The software tool EMPIRE XCcel^{TM} was applied for reliable and fast 3-dimensional FDTD simulation and optimization. In some projects IMST manufactured and assembled the LTCC circuits on its prototyping line. All modules and antennas were measured and evaluated in-house. The examples for presentation will include radar circuits at 11, 24 and 77 GHz as well as communication modules at 25, 27, 40 and 60 GHz. A focus of this contribution will lie on LTCC for satellite communication in Ka-band. There are divider networks at 20 and 30 GHz for antenna feed arrays and the most complex LTCC tile which integrates an 8 x 8 patches antenna for digital beam forming with transmit circuits for each radiator and water cooling for heat dissipation. This development is well known as the SANTANA antenna. Another main topic will be the KERAMIS^{TM} technology. Since 2003 a German consortium funded by the national space agency DLR has developed LTCC circuits for Ka-band satellite communication. Experimental devices were manufactures and qualified for an On-Orbit-Verification program of the DLR. The KERAMIS payload was launched in July 2012 into space and was successfully operated during a 14 months period in a Low-Earth-Orbit on the research platform TET-1. The LTCC modules combine RF functionality, DC supply and integrated circuits in hermetically sealed packages. Finally these developments reached a Technology Readiness Level of TRL=9. This work is carried on with a Ka-band down-converter from 30 to 20 GHz for GEO missions.



1: Liquid cooling inlet, 2: Liquid cooling outlet, 3: IF connector, 4: LO mini-SMP connector, 5: DC connector
6: Transmit circuit

SANTANA Digital Beam-forming Antenna @ 30 GHz
(8 x 8 patch array with circular polarization)



KERAMIS™ Technology: LTCC Modules for Satellite Communication in Ka-band
This experimental board is operating on the DLR research satellite TET-1 since July 2012

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