Monday Workshops and Short Courses

- Piezoelectric Aluminum Nitride Contour-Mode MEMS Resonators and Filters, P. Stephanou, Harmonic Devices
- PZT Films for Low Voltage Operation RF MEMS Switch Devices, J. Y. Park, Kwangwoon University

Organizers: S. Pacheco, Freescale Semiconductor, Inc.; G. Piazza, University of Pennsylvania

Sponsor: MTT-21

This workshop will gather leaders in the research area of novel materials for RF MEMS from both academia and industry. The latest advancements on the development of RF MEMS using new classes of materials will be presented. Attendees will be exposed to proven material systems that are being presently commercialized (startups) and to innovative materials that are starting to gain traction in the RF MEMS arena. Finally, this workshop will allow the attendees to foster new networking opportunities. Topics specifically covered in this tutorial workshop include:

- CMOS/MEMS monolithic integration to enable high performance, compact frequency references. Process issues, device performances, and system level advantages will be discussed.
- Review of silicon carbide semiconductor technology for MEMS/NEMS devices and its application in the field of RF communications.
- Piezoelectric/diamond heterostructures based on ultrananocrystalline diamond (UNCD) films for the realization of low-power, high-performance MEMS/NEMS devices. The material science as well as the fabrication and integration of devices will be discussed.
- Introduction to CMOS-compatible, low-loss bandpass filters in the GHz range based on piezoelectric aluminum nitride contour-mode MEMS resonators.
- Low-voltage operation of RF MEMS devices achieved via use of sol-gel based PZT thin films. The design, fabrication methods, and experimental data for MEMS switches with operation biases as low as 2–4 V will be discussed.

08:00–12:00 CMA

RFID – Design of Integrated Passive Transponders

Instructors: Robert Weigel and Kay Seemann, Institute for Electronics Engineering, University Erlangen-Nuremberg, Germany

Topics: Introduction to RFID; Integrated RFID Transponders; Design and Modeling of Passive UHF-Frontend Devices for RFID

Sponsors: MTT-9, MTT-16

Beside several research activities concerning the high integration of multistandard communication devices, a lot of work is in progress to realize inexpensive ubiquitous communication and sensor networks. Recently, the passive radio frequency identification technology (RFID) has gained a lot of interest, since it is a widely used synonym for low-cost wireless identification and sensor devices.

This tutorial outlines general system considerations and specific aspects of the analogue and RF circuit design for the development of integrated passive CMOS-RFID tags. In the first part of the tutorial, the general passive transponder principles, the regulatory background and the existing standards are reviewed and summarized. We also address typical environmental parameters and properties, further we exemplify subsequent restrictions for common applications. Within part two the general architecture of RFID-Transponders and the main important analog and digital building blocks will be explained. Finally, part three deals with specific challenges given by the CMOS technology in the context of UHF-RFID devices. Therefore, the design and the modeling of the main important analog RF-Frontend devices will be discussed. These are the RF power-rectifier, the backscatter modulator and the RF power limiter.

08:00–17:00 CMB

Millimeter-Wave and THz Electromagnetics, Components, and Systems

Instructors: Zoya Popović, University of Colorado, Boulder; Elliott Brown, University of California Santa Barbara

Topics: Fundamental Electromagnetics; THz Transmission Lines and Antennas; Quasi-Optical Techniques and Components; THz Measurements; THz Properties of Materials; Survey of THz Solid-State and Vacuum Coherent Sources; THz Direct Detectors and Mixers; THz Remote Sensing Systems and Trade-Offs

Sponsor: MTT-4

The terahertz region remains as a last frontier of the electromagnetic spectrum where the engineering of components and systems has always been a fringe area involving quasi-optical techniques for radiation coupling and control, frequency multiplication (up conversion) or photomixing (down conversion) to produce coherent sources, and fast (unipolar) Schottky diodes for mixing and rectification. The goal of this short course is first to summarize the fundamental principles and the state of the art for each of these common techniques, particularly the quasi-optical techniques that have been successful in coupling detectors and mixers to free space. Then, the course will cover some of the key issues behind THz systems, such as the different modalities commonly used for point and remote THz sensors, both passive and active. A timely example is THz imaging of concealed objects where the trade-offs between passive heterodyne and direct detection will be analyzed.

Friday Workshops and Short Courses

08:00–17:00 WFA

Reconfigurable and Smart Antennas

Topics and Speakers:

- Impact of Smart Antenna Characteristics on Network Throughput and Communication Channel BER, C.A. Balanis, Arizona State University
- Reconfigurable Antennas for Universal Wireless Receivers, S. El-Ghazaly, University of Tennessee
- Smart Antennas and Digital Beam Forming, M. Salazar-Palma, Universidad Carlos III de Madrid
- Results from Experimental Trials Involving Smart Antenna and MIMO-based Testbeds, B. Daneshrad, UCLA
- Analog Smart Antenna System, H. Arai, Yokohama National University
- MEMS-based Reconfigurable Antennas – State of the Art and Future Potential, J. T. Bernhard, University of Illinois
- MEMS-Reconfigurable Reflect Arrays, R. Sorrentino, University of Perugia
- Wireless Smart Antennas for Noise Cancellation, S. Kanalamuru, Herley Industries
- Antenna Design and Optimizations for Modern Wireless and MIMO Applications, Y. Rahmat-Samii, UCLA

Organizers: A. Fathy, University of Tennessee; V. K. Nair, Intel; S. El-Ghazaly, University of Tennessee

Sponsors: MTT-15, MTT-20

Extensive efforts are under way to develop compact low cost multifunctional antennas for wireless systems including cell phones, laptops, and base stations. Well-known expert in the field will represent an overview of the latest breakthroughs in developing reconfigurable and smart antennas to address market needs. Detailed discussions of various design issues of developing low cost, compact products for multiband, multiservice, and diversity applications will be conducted.

08:00–17:00 WFB

Recent Advances in Electromagnetic Metamaterials: Theory, Computation, and Applications

Topics and Speakers:

- Advances in Subdiffraction Imaging by Magnetic Metamaterial Structures, R. Marqués and M. J. Freire, Univ. de Sevilla
- Field Energy Density and Effective Parameter Dispersion in Artificial Materials, S. Tretyakov and P. Ikonen, Helsinki University of Technology
- Computational Transmission Line (TLM) Models of Negative Refractive Index Metamaterials, W. J. R. Hoefer, University of Victoria
- Fundamental Structures of Two- and Three-dimensional Metamaterials, P. Russer, Technische Universität München
- Recent Advances in Negative-Refractive-Index Transmission-Line Metamaterials, G. V. Eleftheriades and A. K. Iyer, University of Toronto
- Metamaterial-Based Waveguides: Principles and Applications, S. Hrabar, University of Zhagreb.
- Recent Advances in Resonant type Metamaterial Transmission Lines, F. Martín and J. Bonache, Univ. Autònoma de Barcelona
- A Few Directions Towards the Next Generation of Electromagnetic Metamaterials, C. Caloz, École Poly. de Montréal
- Recent Progress on Dielectric Based Left Handed Structures, T. Ueda, Kyoto Institute of Technology, N. Michishita and T. Itoh, University of California Los Angeles.
- Metamaterials and Plasmonics: Bridging Microwaves to Optics, N. Engheta, University of Pennsylvania
- Metamaterial-Based Electrically Small Antenna Systems: Designs, Simulations and Experiments, R. W. Ziolkowski, University of Arizona

Organizers: C. Caloz, École Polytechnique de Montréal; F. Martín, Universitat Autònoma de Barcelona

Sponsors: MTT-15, MTT- 4

The workshop will focus on the latest results of metamaterials research carried out by leading experts. The scheduled talks allow for a wide vision of metamaterials, including the main challenging aspects for microwave and optical technology (computation and implementation of 3D metamaterials, conception of new subwavelength imaging devices, the development of new metamaterial based components and antennas, and the search for new directions and fields of applications).

08:00–17:00 WFC

Low-Cost, Integrated Automotive and Industrial Radar Sensors

Topics and Speakers:

- Introduction of Automotive Radar Sensors - Challenges, Solutions, and Benefits, J. Wenger, DaimlerChrysler AG
- Low Cost SiGe Technology for Automotive Radar Sensors in the 76-81 GHz Band, R. Lachner, Infineon AG
- Advances in Microsystems Technology and RF Microelectronics for Highly Integrated 77 GHz Automotive Radar Sensors, M. Schneider, University Bremen
- FMCW Radar Transceiver System Design and Simulation, O. Günther, University Erlangen-Nuremberg
- Front-End Concepts, Linearization Methods, and Systematical Errors in FMCW Radar Sensors, A. Stelzer, Johannes Kepler University Linz
- 24GHz UWB Radar Sensor Design, I. Gresham, M/A-COM
- Wideband Radar Sensors and its Antennas, S. Lindenmeier, Universität der Bundeswehr
- Challenges in Metrology for Automotive Radar SiGe-MMICs, E. Kolmhofer, DICE GmbH
- Pulsed Microwave and Millimeter Wave Measurements for Radar Component Characterization, L. Betts, Agilent

WORKSHOPS

Friday Workshops and Short Courses

Organizers: A. Stelzer, Johannes Kepler University Linz, R. Weigel, University Erlangen-Nurember, R. Knoechel, University of Kiel

Sponsors: MTT-16, MTT-2

Recent developments in semiconductor technology have made available integrated Si and SiGe components that function at frequencies of 100 GHz and beyond. Smaller and less costly then their predecessors, typically put to use in military and civilian-aviation applications, these components have direct application to next-generation mass-marketed products such as industrial sensors, sport sensors, automobile guidance systems.

In this workshop an overview of state-of-the-art integrated radar sensors, especially for automotive and industrial applications, will be presented. Discussions will include modern systems, advanced semiconductor technologies, and the design and simulation challenges of upcoming 24 and 77 to 79 GHz. systems Design methodolgy of radar sensors will be treated, as well as the difficulties in measuring highly integrated systems at high frequencies.

08:00–17:00 WFD

Advances in Imaging Radar Technology

Topics and Speakers:
- Light Weight, Low Cost SAR for UAV Applications, J. C. Kirk, Goleta Engineering
- Real-Aperture Imaging Radar for Landing Guidance, L. Q. Bui, MMCOMM
- Full-Resolution Real-Time Processing of SAR Data, G. Franceschetti, Universutat Federico II
- History of Spaceborne SAR, Celebrating 25 Years Since SIR-A, D. L. Evans, JPL
- Using ATR Performance as a Measure to Improve ISAR Imaging of Small Craft, T. Sparr, FFI-III Land and Air Systems Division
- ISAR Imaging Paper, R. Samaniego, Raytheon
- New Results for Through-the-Wall Impulse SAR Imaging, J. Tatoian, Eureka Aerospace
- Passive MMW Imaging, L. Yujiri, NGC
- A Low-Complexity Radar Sensor for Human Tracking, H. Ling, University of Texas

Organizers: J. C. Kirk, Goleta Engineering; L. Q. Bui, MMCOMM, Inc.

Sponsor: MTT-16

Imaging radar is now an extremely broad field combining advances in microwave/millimeter-wave and beyond technology with digital processing and computing technology. This workshop seeks to bring together a broad spectrum of researchers to address specific areas of wide bandwidth, 2-D imaging, 3-D imaging, super-resolution, automatic recognition and identification, SAR, ISAR, millimeter-wave imaging, and submillimeter-wave imaging.

08:00–17:00 WFE

Terahertz Device Characterization and Security Applications

Topics and Speakers:
- Progress Towards a THz Imager, M. Rosker, DARPA
- Generation of THz by Frequency Multiplication, A. Maestrini, Université Pierre et Marie Curie
- Trends in the Development of THz Receiver Technology, D. Matheson, Rutherford Appleton Laboratory
- Terahertz Spectroscopy: Applications, Potentials in Chemical and Biochemical Sensing, T. Vo-Dinh, Duke University
- Terahertz Scattering Parameter Measurement Systems for Device and Material Characterization, R. Weikle, Univ. of Virginia
- Imaging of Concealed Weapons at Sub-millimeter and THz Wavelengths with Arrays of Cryogenic Antenna-Coupled Microbolometers, A. Luukanen, VTT Technical Research Centre of Finland
- The Potential for Stand-off Detection of IEDs Between 100 GHz and 1 THz, R. Appleby, Qinetiq LTD
- THz Emission Detection for Standoff Sensing of Improvised Explosive Devices, D. H. Wu, Naval Research Lab
- Atmospheric Correction of THz Signals for Explosives Traces Detection, S. G. Kong, University of Tennessee

Organizers: A. E. Fathy, University of Tennessee; V. F. Hanna, Université Pierre et Marie Curie; A. Maestrini, Université Pierre et Marie Curie

Sponsors: MTT-4, MTT-15

There have been lots of efforts to explore the Advanced THz Sensing (ATS) technology for use in security screening and rapid detection of hidden improvised explosive devices (IED). ATS is capable of probing intermolecular interactions and large amplitude vibrational and rotational modes, and is polarization sensitive. ATS can see through materials considered opaque to other optical techniques, and rich in its interaction with chemical materials including explosive residue. The goal of the proposed workshop is to investigate the techniques for rapid and non-intrusive IED detection.

08:00–12:00 WFF

Wireless Local Positioning

Topics and Speakers:
- Basics of Wireless Local Positioning, M. Vossiek, Clausthal University of Technology
- Relative Position Sensing Between Mobile Units, P. Gulden, Symeo GmbH

Friday Workshops and Short Courses

- High Speed Position Sensing, A. Stelzer, Johannes Kepler University Linz
- UWB Localization and its Application to Ultraprecise Indoor Asset Tracking, A. Fathy, University of Tennessee
- High Precision Local Positioning in Reflective Environment, S. Lindenmeier, Bundeswehr University, Munich

Organizers: R. Knoechel, Christian-Albrechts-University Kiel; G. Boeck, Berlin University of Technology; M. Vossiek, Clausthal University of Technology

Sponsor: MTT-16

Radio localization requires emerging wireless technologies including new data transmission principles and transceiver technologies. Context dependent information services, RF-localization systems for production and logistics, tracking systems for sports applications or guiding of blind people are only some of the numerous application areas. The workshop will focus on principles and challenges referring to the realization of such future systems. Present wireless local position sensing techniques and emerging solutions, such as relative position sensing between mobile units, position sensing within milliseconds and an accuracy of some centimeters using active transponders, as well as a time difference of arrival (TDOA) approach based on UWB signals and the utilization of UWB-technology for high precision local positioning in reflective environment will be presented.

13:00–17:00 WFG

Wireless Power Transmission for Space Solar Power Generation

Topics and Speakers:
- New Antenna Systems for Microwave Power Transmission, T. Takano, Institute of Space and Astronautical Science
- High Efficiency GaN-HEMT PAs for Microwave Solar Power Transmission, S. Nakajima, Eudyna Devices, Inc.
- Development of Wearable Rectenna for Ubiquitous Power Source, N. Shinahora, Kyoto University
- Recent Developments of Rectennas at Texas A&M University, K. Chang, Texas A&M University
- Free-Space Combining Oscillator Arrays, An Approach for Solar Power Conversion to High RF Power for Wireless Transmission, A. Mortazawi, University of Michigan
- GaN Based Material Growth and Devices for Microwave Power Transmission Systems, J. Lin and/or F. Ren, University of Florida

Organizers: A. Mortazawi, University of Michigan; S. Kawasaki, Kyoto University

Sponsor: MTT-16

Global energy demand continues to grow. Space-based, solar power generation may become an important source of energy in the 21st century. Space solar power via wireless power transmission proposes solar-generated, DC power to be converted to microwaves and beamed to earth using a large antenna array. The beam would be captured using a antenna array and converted back into DC power for terrestrial electrical grids.

13:00–17:00 WFH

Miniature, Electronically Tuned Filter Technology

Topics and Speakers:
- An Overview of Miniaturization of Varactor Tuned Printed Filter Technology, H. Dayal, BAE Systems Inc.
- Tunable Microwave Filters Using Thin Film Ferroelectric Varactors, A. Mortazawi, University of Michigan
- High Quality Ferrite-Loaded Dielectric Resonator Tuanable Filters, A. Abramowicz, Warsaw University of Technology
- Tunable and Compact Microwave Filters and Resonators Based on Metamaterials, F. Martin, Univ. Autònoma de Barcelona
- Tunable Filters Based on RF MEMS: An Overview, G. Rebeiz, University of California, San Diego

Organizers: H. Dayal, BAE Systems Inc.; V. Boria, Universidad Politécnica de Valencia

Sponsors: MTT-8, MTT-21

In summary, this workshop plans to address miniaturized filter design and tuning techniques including recent developmental MEMS, BST and printed resonator work using stepped impedance, split ring resonators, and open stubs for spur cancellations, dual mode tuning and other auto tuning techniques.

08:00–12:00 WFI

GaN Device and Circuit Reliability

Topics and Speakers:
- The Physics of AlGaN/GaN Reliability, R. J. Trew, North Carolina State University
- Designing GaN for Reliability, A. A. Immorlica, BAE Systems
- Production GaN HEMTs for High-Reliability Applications, A. Ward, CREE
- Performance and Reliability of AlGaN/GaN HFETs on s.i. SiC Substrates, R. Quay, Fraunhofer Institute
- Drift, Stability and Robustness Issues of GaN HFETs, J. Wurfl, Ferdinand-Braun-Institut für Hochstfrequenztechnik
- AlGaN/GaN HEMT Technology and Reliability Status, E. Morvan, Alcatel Thales III-V Lab/TIGER

Organizers: F. J. Sullivan, Raytheon; R. Jansen, ITHE RWTH Aachen University

Sponsors: MTT-6, MTT-7

WORKSHOPS

Friday Workshops and Short Courses

This workshop will address the reliability issues associated with GaN devices and MMICs. The technology is being pushed hard toward actual field operation in the near future. Some of the device reliability topics include leakage currents, both surface and subsurface, trap generation and nitrogen impact. Understanding the reliability effects of using different substrate materials will also be considered. These include GaN on SiC, on native GaN and on silicon substrates.

08:00–12:00 TFA

Microwave and Millimeter-Wave Packaging and Manufacturing 202

Topics and Speakers:
- Interconnnect Technologies with Selected Performance Issues
- Accuracy of Package and Interconnect Simulation Models, M. Heimlich, Applied Wave Research Inc.
- Thermal and Mechanical Analysis and Simulation, J. Carter, StratEdge Corporation
- Electrical Variability Due to Interconnect and Material Technologies, A. Lindner, REMEC Defense & Space
- Measurement and Tuning Repeatability for Calibration and Assembly, R. Ginley, NIST
- Novel Coatings and Encapsulation, O. Sneh, Sundew Technologies, LLC

Organizer: A. Lindner, REMEC Defense & Space

Sponsor: MTT-12

Packaging, assembly and test of most microwave and millimeter-wave devices are a challenging task. The variability of interconnects and temperature variations can further complicate the design and testing. This tutorial workshop expands on what was presented last year and gives the attendees the opportunity to review the issues and increase their design capability on this important issue.

13:00–17:00 TFB

Multidomain Physics Modeling of MEMS and NEMS

Topics and Speakers:
- The State of Commercial Tools for Simulation-Driven Design of MEMS devices, D. Ostergaard, ANSYS
- Multiphysics Modeling of Dielectric Charging in RF Switches, J. Hwang, Lehigh University, C. Goldsmith, MEMtronics
- In-Situ Process Characterization for Accurate MEMS Modeling, D. Peroulis and J. V. Clark, Purdue University
- Multiphysics Modeling of MEMS, N. Aluru, University of Illinois at Urbana-Champaign
- Simulation and Physical Co-Design of MEMS Devices and Electronics M. A. Maher, SoftMEMS
- System-Level Modeling and Simulation of Micro- and Nano-Scale Systems, J. V. Clark, Pudue University
- The Broad Role of System-Level Modeling in RF-MEMS: From Robust Electromechanical Device Design to MEMS/IC Cosimulation, M. Kamon, Coventor

Organizers: A. C. Cangellaris, University of Illinois at Urbana-Champaign; N. Aluru, University of Illinois at Urbana-Champaign

Sponsors: MTT-15, MTT-21

Efficient design and prototyping of MEMS is critically dependent on accurate modeling of the different physical domains (electrical, magnetic, mechanical, thermal, fluidic) that govern the operation of the devices and their nonlinear coupling. The purpose of this tutorial is to present the state of the art in such modeling, highlight recent advances and discuss future challenges, needs, and opportunities. More specifically, recent advances will be reported in the incorporation of uncertainties in material/geometric parameters and operating conditions in the modeling of MEMS devices; experiment-based, multiphysics modeling of dielectric charging in RF switches; methodology for accurate characterization of the impact of fabrication process on material and geometric parameters of MEMS devices; methodologies for MEMS-IC cosimulation, in support of tradeoffs in design between the MEMS, packaging and electronics, subject to performance-driven optimization constraints; and exploitation of the nonlinearity of the coupled multiphysics attributes of MEMS for the computer-aided design exploration of new device concepts.

08:00–12:00 TFC

Nanoelectronic Devices: RF Characterization, Modeling, and Applications

Topics and Speakers:
- Carbon Nanotubes as Microwave and Millimeter-wave Antennas, P. Burke, University of California, Irvine
- Modeling DC and AC Transport of Carbon Nanotube Field Effect Transistors, P. Wong, Stanford University
- Carbon Nanotubes for Thin Film Electronics, J. Rogers, University of Illinois at Urbana Champaign
- Theory and Performance of Nanocomposite Transistors, M. A. Alam, Purdue University
- Microwave Measurements of Nanotube Devices, G. Dambrine, University of Lille

Organizer: I. Amlani, Motorola, Inc.

Sponsor: MTT-4

Nanoelectronic devices based on carbon nanotubes, nanowires, and other variations are emerging with interesting and novel properties. Despite tremendous interest and progress, RF characterization and modeling of these devices has proven challenging. This workshop will bring together speakers from industry and academia to discuss progress, opportunities, challenges and potential solutions relating to this exciting and emerging field.

Friday Workshops and Short Courses

08:00–17:00 CFA

Applications of Artificial Neural Networks to RF and Microwave Design

Instructor: Q. J. Zhang, Carleton University

Topics: ANN Basics, Applications to RF/Microwave Design

Sponsor: MTT-1

Artificial Neural Networks (ANNs) are recognized as new vehicles for enhancing the speed, accuracy and flexibility of RF/microwave modeling and CAD. ANN has been applied to modeling and design of microstrip and CPW circuits, multilayer interconnects, embedded passives, printed antennas, LTCC circuits, semiconductor devices, filters, power amplifiers and more. This short course presents the fundamentals of ANN for RF and microwave design, application examples, and emerging trends and directions.

08:00–17:00 CFB

Time-Domain Electromagnetic Simulators

Instructors: Zhizhang (David) Chen, Dalhousie University, Halifax, Canada; Wolfgang J. R. Hoefer and Poman P. M. So, Uni-versity of Victoria, Canada

Topics:
- Time-Domain Simulation
- Time-Domain Formulation of Electromagnetic Theory
- Generalization of a Time-Domain Numerical Methods
- Convergence, Errors and Validation
- FDTD, FIT-TD, TLM, FEM-TD Methods
- Imaging for Computational Electromagnetics
- Architecture of a Time Domain Simulator
- FDTD/FIT Simulators
- TLM Simulators

Sponsors: MTT-1, MTT-15

This short course is intended to introduce microwave professionals and researchers to the theoretical foundations and the effective use of time-domain electromagnetic simulators. More specifically, the Short Course will provide insight into the operating principles of time-domain electromagnetic simulators, and show how these principles are translated or mapped into the functionality and operation of time-domain based CAD tools.

08:00–12:00 CFC

RF Linear Accelerators

Instructor: Samy M. Hanna, Microwave Innovative Accelerators (MINA)

Topic: RF Linear Accelerators

Sponsors: MTT-5, MTT-10

In spite of the wide range of applications for RF accelerators, the number of microwave engineers who have the knowledge and the skill to work in this field is disproportionately low. The goal of this tutorial short course is to motivate more microwave engineers to learn about RF accelerators and their applications to meet the demand for such expertise. These applications include cancer radiation therapy, electron beam medical sterilization, food sterilization, homeland security, cargo inspection, industrial material processing, and nondestructive testing (NDT). In this short course, we will discuss the concept of operation of RF linear accelerators (linacs) and its constituent components such as the electron gun, accelerating structure, RF window, and X-ray target. We will review the associated RF system that provides the RF power to a linac. That system includes an RF source (Klystron or Magnetron), a circulator, an automatic frequency control (AFC), and waveguide transmission system. A survey of different linac applications will be presented.

08:00–17:00 CFD

LTCC for Micro- and Millimeter-Wave Applications

Instructors: Ingo Wolff, Reinhard Kulke, and Peter Uhlig, IMST GmbH; Tim Mobley, DuPont Electronic Technologies

Topics: LTCC Process; 3D-Simulation and Test Methods; Survey of LTCC Material Systems and Manufacturers; Applications in Telecommunication and Sensor Electronics

Sponsors: MTT-1, MTT-15

LTCC as a ceramic multilayer technology has a great potential for micro- and millimeter-wave applications. The dielectric tapes as well as the gold and silver conductors have the appropriate physical and electrical performance. In spite of being a very mature technology, LTCC has recently gone through large improvements in material development and has become available for communication equipment manufacturers through LTCC foundries. The competitive price of materials and production make LTCC an ideal basis for System in a Package (SiP) and Multi Chip Modules (MCM). LTCC circuits can consist of a nearly arbitrary number of layers. Components can be integrated in cavities. LTCC substrates are rugged, hermetic and environmentally stable. These features and further favorable characteristics are utilized to develop compact and efficient modules for communication and sensor applications.