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MICROWAVE WEEK

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Like us on Facebook: http://www.facebook.com/IEEE.MTTS.IMS

Engage with fellow attendees on LinkedIn: https://www.linkedin.com/groups/2375668/ (Group Name: IEEE MTT-S International Microwave Symposium (IMS))

https://www.linkedin.com/company/ieee-mtt-s-international-microwave-symposium-ims/?viewAsMember=true

Follow us on YouTube: http://www.youtube.com/user/mttims

Don't forget to use the official IMS hashtag: **#IMS2023**

IMS MICROWAVE WEEK:

There's an app for that! Download papers in real time!

The IMS Microwave Week app is now available in the Apple App Store and Google Play store. Install the app on your Android or iOS device to view the full schedule of Workshops; Technical Lectures; IMS, RFIC, and ARFTG Technical Sessions; Panel Sessions; Social Events; and Exhibition Information. You will be able to download the technical content that you registered for, e.g., IMS and/or RFIC papers, workshop notes; as well as locate exhibitors and explore everything that IMS has to offer! The app now includes an opt-in Social Networking Feature that lets you search for fellow attendees who opted-in to be contacted for networking. Download the app today!

To download the app, search for 'IMS Microwave Week' on the app store for your device or scan a QR code below.

Download on the App Store

ANDROID APP ON Google play

For assistance, please email: support@mtt.org

Wifi is available throughout the San Diego Convention Center!

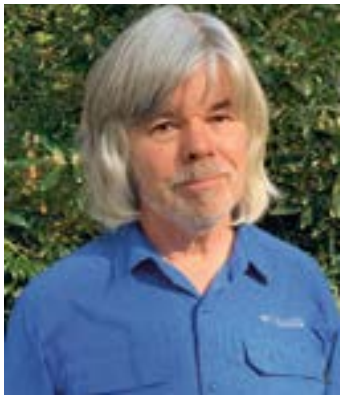
SSID: IMS2023

Password: SanDiego

IMS2023 Table of Contents

WELCOME TO IMS2023 IN SUNNY SAN DIEGO!

JOHN WOOD, GAYLE COLLINS, IMS2023 GENERAL CHAIRS



It is our pleasure to welcome you to the 2023 IEEE MTT-S International Microwave Symposium (IMS2023), the centerpiece of a Microwave Week that is bookended by the Radio Frequency Integrated Circuits (RFIC) Symposium, and the Automatic RF Techniques Group (ARFTG) microwave measurements conference. The IMS week is the world's largest technical conference and industry exhibition for RF, microwave, millimeter-wave and THz researchers and practicing engineers from academia, industry and government.

IMS2023 is a live, in-person event with an exciting technical program of some 360 technical papers, presenting "the Coolest Ideas under the Sun" in the RF and microwave field, and the industry exhibition with 550 vendors, demonstrating their latest products. We will also have multiple great networking events, and plenty of opportunities for attendees and exhibitors to re-establish old connections and make new ones.

This year's event takes place from Sunday 11 June through Friday 16 June, and will be held in the San Diego Convention Center, which is on the Bayfront in San Diego.

While several aspects of the microwave week will be comfortably familiar, at IMS2023 we will introduce several innovations. We have focus themes to highlight a number of areas of RF and microwave engineering that are of topical interest, with a continued emphasis on RF and microwave Systems and Applications. These themes include:

- Wireless Communications, including 6G developments, Wi-Fi, RF and microwave system-on-chip integration, massive MIMO systems and subsystems, and more
- Artificial Intelligence and Machine Learning (AI/ML) Technologies for Microwaves
- Model-Based Systems Engineering, including Digital Twins
- Space and Aerospace
- Wireless Power Transfer
- RF and Microwave Technology in Biomedical Applications

Each theme will have focused technical sessions, workshops, a keynote speaker, a panel session, and a technical lecture. Additionally, we will have a "Systems Pavilion" in the industry exhibition, showcasing wireless, with demos by the finalists in the 'MTT-Sat Challenge'. And since San Diego is a stone's throw from Latin America, one of our IMS2023 focus themes is to highlight advances in RF and Microwave research in Latin America.

IMS2023 also features the "Connected Future Summit" on Tuesday. This is a conference-within-a-conference, co-sponsored by the IEEE Communications Society. The focus is on strategic and tactical developments in 5G/6G technologies for future wireless communication systems, with several invited speakers. The theme for 2023 is "Connected Transportation."

At IMS2023, we are encouraging greater participation by industry. We will host an Industry Showcase, where authors of the best technical papers from industry will present their work in a poster and demo session, giving attendees the opportunity to see the latest results and projects in industry, and to meet the authors and discuss their work.

New for 2023 are the Industrial Keynote Speakers, who will provide the featured presentations on the major technical tracks of IMS. The speakers are invited technical leaders from industry, and they will be providing an overview of the latest developments in their topics. Also new in IMS2023 is the "Early Career" Best Paper award, encouraging younger engineers in industry to publish their work.

In post-conference surveys, the most frequently-cited reason for attending IMS is "networking." IMS2023 will be an in-person conference, and we are looking forward to the return of face-to-face networking at IMS2023. There will be several networking receptions held on the Tuesday evening, including the Women in Microwaves reception, the Young Professionals mixer, the Ham Radio Social, and the MTT Society Reviewers' Reception. Top marks if you make it to all of them. All of these events will be held in the Hilton Bayfront Conference Hotel, which has some great open spaces and bay-view terraces for hosting, so you can easily move from one event to another to meet old friends and make new ones. The Convention Center is adjacent to the famous Gaslamp Quarter, which is the lively social center of San Diego, with plenty of restaurants and bars for all tastes. Many of the industry-sponsored social and networking events will be held in the Gaslamp Quarter.

And finally, a brief comment on diversity and inclusion: the IMS2023 Steering Committee, which organizes the technical program and our social and networking events, is probably the most diverse ever. The committee comprises about 25 percent women participants, with women co-chairs of all of the sub-committees, and, of course, Gayle is the General Co-Chair. We definitely have the "international" in IMS, with about 25 percent of our Steering Committee being located outside the USA, including Australia, Austria, Belgium, Canada, China, Germany, India, Ireland, Italy, Mexico, The Netherlands, Portugal, Spain, and UK.

We look forward to meeting you in San Diego, 11-16 June 2023!

SAN DIEGO OVERVIEW

Navigating around San Diego, you will find evidence of the area's rich history. Turn a corner and you might see an old mission. At one point in San Diego's past the town was a fort. The area of "Presidio Hill" housed California's first Franciscan Mission. Other firsts include the first flight school, born out of a blossoming interest in aviation. In 1927, Charles A. Lindbergh built, tested, flew, and equipped the monoplane "Spirit of St. Louis." In fact, San Diego International Airport is the site of the former Lindbergh field.

San Diego Bay, about 12 miles long, is also a busy port with a history of fishing and seafood processing. The last of the sardine and tuna canneries closed in the 1980's, as the area transformed into an innovation hub for wireless technologies, biotech, cleantech and life sciences. Qualcomm was founded here in 1985, focused on QUALity COMMunications.

Today San Diego is a community with diverse interests, but the city boasts being all about "good vibes." https://youtu.be/e3gGG6zNJsk

IMS will take place in the Embarcadero district, along the San Diego Bay. The Embarcadero (or "landing place" in Spanish) lines the western edge of downtown. Its boardwalk hugs the Bay, and is home to the cruise terminal, the Navy Pier, Seaport Village and The Rady Shell at Jacobs Park, the permanent outdoor home of the San Diego Symphony. Climb aboard to explore the ships at the USS Midway Museum and the Star of India at the Maritime Museum of San Diego. If a moving sea vessel is more your style, enjoy a harbor cruise and explore the bay, while taking in the skyline views. For fun on land, head to the "The Headquarters at Seaport" to grab a gourmet bite or browse for one-of-a-kind take-home treasures.

Directly opposite the entrance to IMS at the San Diego Convention Center, is 5th Street, the entrance to San Diego's famous "Gaslamp" district: the social center of San Diego. Here you will find a range of restaurants and bars to suit all tastes, from fine dining to al fresco burgers, and craft beers of all flavors. For more details, please look at the San Diego section on the IMS website. And just further south from the Hilton Bayfront Hotel, is the Barrio district, with plenty of Latin American restaurants and bars, so you can continue the IMS2023 Latin America theme in the evening.

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Markus Gardill, *Space Focus/Theme*
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Xinyu Zhou
Anding Zhu
Volker Ziegler
Samet Zihir

Coffee Breaks

Sunday	**AM—09:40-10:10**	Upper Level near Meeting Rooms
	PM—15:10-15:40	Upper Level near Meeting Rooms
Monday	**AM—09:40-10:10**	Upper Level near Meeting Rooms
	PM—15:10-15:40	Upper Level near Meeting Rooms
Tuesday	**AM—09:40-10:10**	IMS Exhibit Floor
	PM—15:10-15:40	IMS Exhibit Floor
Wednesday	**AM—09:40-10:10**	IMS Exhibit Floor
	PM—15:10-15:40	IMS Exhibit Floor
Thursday	**AM—09:40-10:10**	IMS Exhibit Floor
	PM—15:10-15:40	Upper Level near Meeting Rooms

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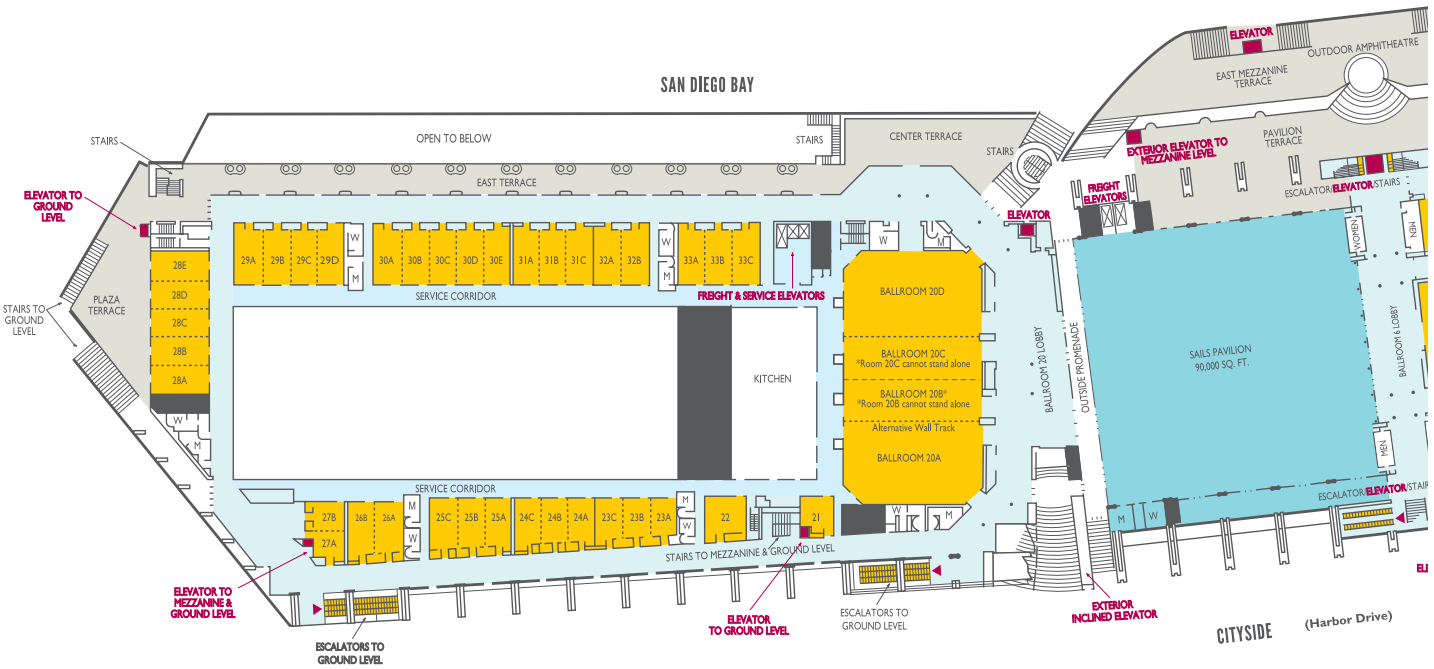
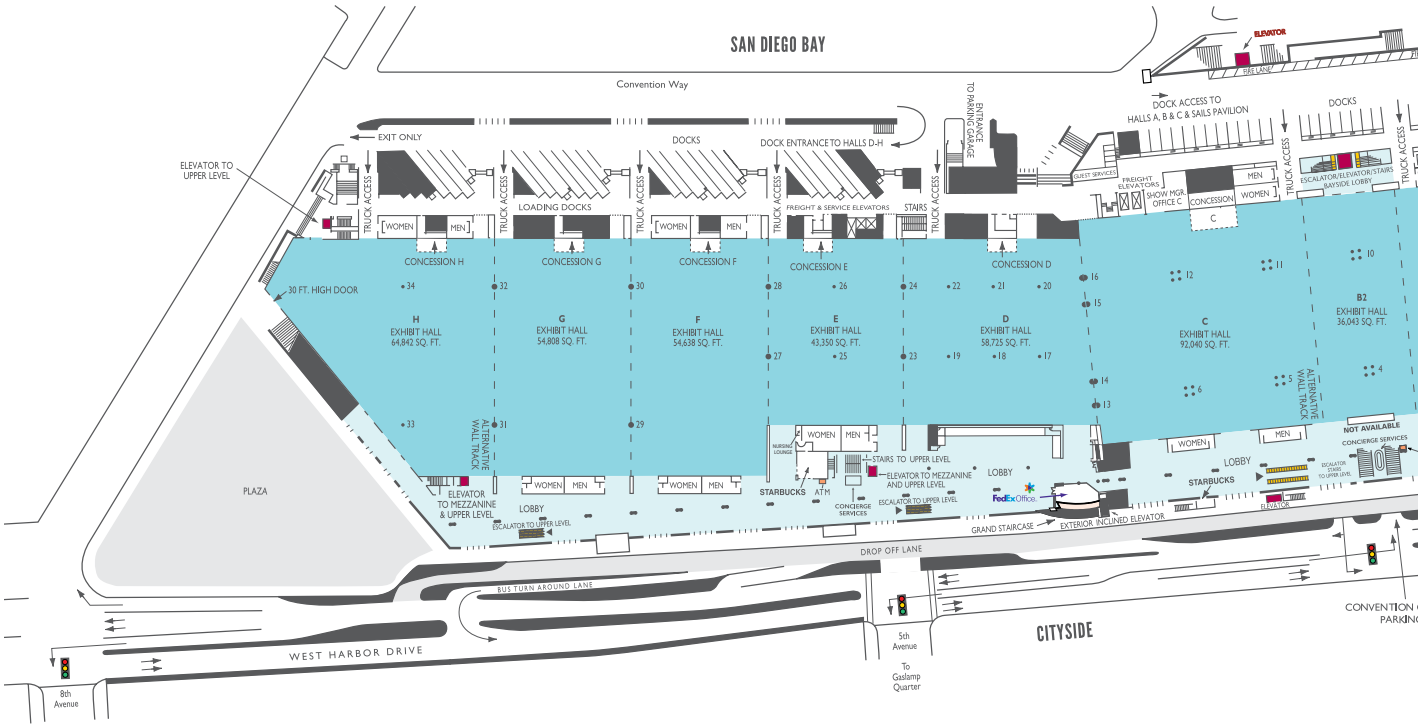
GETTING AROUND AT IMS2023

UPPER LEVEL VIEW



GROUND LEVEL VIEW

SAN DIEGO convention center CORPORATION



San Diego Convention Center Maps have been cropped to show the space being utilized by IMS2023 and Microwave Week

WEEK **AT-A-GLANCE**

	Sunday 11 June 2023	Monday 12 June 2023	Tuesday 13 June 2023	Wednesday 14 June 2023	Thursday 15 June 2023	Friday 16 June 2023
Workshops						
Technical Lectures						
RFIC Plenary Session, Reception, Industry Showcase						
Quantum Bootcamp						
AI/ML Bootcamp						
RF Bootcamp						
RFIC Technical Sessions						
Three Minute Thesis						
IMS Industry Showcase, Plenary and Welcome Reception						
IMS Technical Sessions and Interactive Forum						
Panel Sessions						
Connected Future Summit						
Exhibition						
MicroApps and Industry Workshops						
Amateur Radio Reception						
Young Professionals Reception						
Industry Hosted Reception						
Women In Microwaves Reception						
IMS Closing Ceremony						
101st ARFTG						

Workshops Technical Lectures RFIC Bootcamp Three Minute Thesis IMS Panel Sessions
Connected Future Summit Exhibitor Activities Focus Groups ARFTG

On-site registration for all events will be available in Lobby D of the San Diego Convention Center.

ON-SITE REGISTRATION HOURS

Saturday, 10 June	08:00 - 17:00
Sunday, 11 June	07:00 - 18:00
Monday, 12 June	07:00 - 18:00
Tuesday, 13 June	07:00 - 18:00
Wednesday, 14 June	07:00 - 18:00
Thursday, 15 June	07:00 - 16:00
Friday, 16 June	07:00 - 10:00

BOXED LUNCH DISTRIBUTION:

Boxed Lunch Distribution will take place Sunday-Friday in the Meeting Room Foyer (Terrace Side) of the San Diego Convention Center.
Note: Boxed Lunches are included with Workshops and Boot Camps. They are also available for pre-purchase in the registration system through 8 June 2023 (the advance registration deadline).

SUNDAY WORKSHOPS

08:00 – 17:20 | Sunday, 11 June 2023

	WORKSHOP TITLE	WORKSHOP ABSTRACT
WSA	**Recent Advances in Ultra-Low-Power Wireless Communication Technology** **Organizers:** Sai-Wang Rocco Tam, *NXP Semiconductors*; Yao-Hong Liu, *IMEC*; Oren Eliezer, *Samsung*; Minyoung Song, *IMEC* **ROOM: 23ABC** **13:30 – 17:20**	Ultra-Low-Power (ULP) wireless communication technology provides many unique features over conventional wireless communication such as high energy efficiency, low cost, small form factor, large scale deployments, reconfigurability and simple architecture. This workshop will bring together experts from academia and industry to highlight recent works and applications in this exciting technology. In the first topic, we are going to review the industry impacts on the most successful and large-scale commercialization using ULP wireless communication technologies such as RFID and Near-Field Communication (NFC). After that, we are going to shift our focus to recent research advances in using RF backscattering techniques in Reconfigurable Intelligent Surface (RIS) and WLAN/BT connectivity solutions. In the last topic of this workshop, we will discuss recent advances from medical, industrial and academic fields in biomedical implants with technologies such as co-optimizing antenna and RFIC to miniaturize radio module volume. Unconventional wireless propagation methods are also introduced, such as body channel communication, Magnetoelectric, ultrasound, etc.
WSB	**A Deep Dive into Circuit Design for Wireline/Optical and Wireless Transceivers: Commonalities and Differences** **Organizers:** Mahdi Parvizi, *Cisco*; Bahar Jalali Farahani, *Cisco* **ROOM: 23ABC** **08:00 – 11:50**	This workshop presents the similarities and differences between wireless and wireline/optical communication along with circuit design innovations that enable the next generation of these systems. There are undeniable similarities between the systems and electronic building blocks in wireline/optical and wireless transceivers. In this event, first commonalities and differences of wireline/optical system versus an advanced wireless link will be discussed, next advanced modulation schemes to close the gap with Shannon limit in wireline links will be reviewed. Next, advanced circuit design techniques for wireless and optical transmitters, which is power amplifiers and modulator drivers will be presented. The last talk covers the optical and wireless receiver front-ends where novel circuit design techniques for low-noise, low-power LNAs and TIAs will be highlighted.
WSC	**6G Challenge: Overpass RF Bandwidth Limitation to Reach 100Gbs to 1Tbs** **Organizers:** Didier Belot, *CEA-LETI*; Hao Gao, *Technische Universiteit Eindhoven*; Pierre Busson, *STMicroelectronics* **ROOM: 31AB** **08:00 – 17:20**	Wireless systems with small RF bandwidths, high-order modulations, and advanced signal-processing techniques have reached a saturation point. They run into spectrum saturation and interference troubles under the sub-6GHz frequency band. International Telecommunication Union (ITU) announced the opening of 275 to 450 GHz for super high data-rate communication applications. 5G is becoming a reality worldwide, and 6G is in a championship worldwide. The complete paradigm change of this new generation implies the evolution from today, and one of the elements to be defined will be the revolution in the transceiver functions: The data-rate is targeted beyond 100Gbps, and the carrier frequency to support such data transfer will be in the combination of mm-wave and sub-THz. In the 6G, the mm-wave/sub-THz front-end has challenges on bandwidth, power consumption, antenna coupling, array integration, etc. In this workshop, we also dedicate attention to silicon-based building blocks' present realizations targeting 5G to 6G evolution.
WSD	**EM Circuit Co-Design and Conflation of Passive/Active Circuits at mm-Wave Frequency** **Organizers:** Vadim Issakov, *Technische Universität Braunschweig*; Ruonan Han, *MIT* **ROOM: 29AB** **08:00 – 11:50**	Integration of passive electromagnetic structures and particularly integration of antennas on silicon becomes feasible at frequencies above 100GHz due to wavelength-related size reduction. The goal of this workshop is to give inspiration on the various novel circuit techniques relying on conflation of passive and active devices. Furthermore, this workshop discusses potential emerging applications towards THz and presents the latest developments on integrated EM devices and co-design with active circuits at high mm-wave frequencies. We discuss how to realize passive on-chip components, such as transformers, coupler baluns and antennas and how to combine them with the active circuitry. Furhermore, novel techniques involving antennas to realize certain functions are discussed. Antennas can be co-designed synergistically with active circuits to realize novel hybrid antenna-electronics with "on-radiator" and near-field functions, such as power combining/splitting, impedance scaling/filtering, active load modulation, noise cancellation and reconfigurability. A significant research challenge in hybrid active circuit/electromagnetic electronics is the application of suitable multi-physics simulation tools and co-design/co-optimization methodologies. This requires 3D full-physics solutions for electromagnetic simulation. Several world renowned speakers will provide an overview on the techniques, applications and the practical design considerations on realization of these approaches. In this half-day workshop we will discuss emerging techniques for on-chip mm-wave active/passive circuit co-design and applications of these new techniques. Distinguished speakers from leading companies and academia will present a wide range of topics to cover various aspects of EM-circuit co-design. A brief concluding discussion will round-off the workshop to summarize the key learnings of aspects presented during the day.
WSE	**FDSOI CMOS Energy Efficient 5G and IoT Design Techniques and Related Technology** **Organizers:** Andreia Cathelin, *STMicroelectronics*; Wanghua Wu, *Samsung* **ROOM: 29AB** **13:30 – 17:20**	Thanks to the extended body biasing feature, FDSOI process has enabled new system and circuit design techniques to drastically improve the RF and mm-wave system performance. Tremendous industry collaboration efforts have committed to bring up the FDSOI to higher volumes of production to serve the wireless, IoT, and automotive market in the near future. This workshop includes an overview introductory presentation followed by 4 talks on FDSOI technology and its industry design examples for RF and mm-wave applications. The introduction provides the overview on FDSOI technology and its benefits for analog/RF/mm-wave circuit design, focusing on a technology perspective. The following three talks demonstrate RF and mm-wave system design examples using FDSOI technology, for 5G infrastructure and user terminal as well as for ULP IoT. The last talk reveals the advanced FDSOI process design roadmap and what is expected in the near future.
WSF	**Enabling Quantum Computing: A Survey of Readout Technologies** **Organizers:** Duane Howard, *Amazon*; Fabio Sebastiano, *Technische Universiteit Delft*; Kevin Tien, *IBM Quantum* **ROOM: 25ABC** **08:00 – 17:20**	The continued prevalence of microwave system techniques for interacting with superconducting transmon qubits and spin qubits have driven a resurgence of interest in cryogenic circuit and systems for quantum computing. Moreover, quantum computing applications demand low power, high scalability, and high precision in control signal generation and readout signal processing, which has led to several recent demonstrations of innovative system building blocks, as well as end-to-end control and readout chains. In this workshop, we introduce the state-of-the-art in system architectures for qubit control and readout, and then focus on the recent developments in technologies related to qubit readout. We will examine current building blocks found in high-end systems, then look at the next generation of high performance cryo-LNA technologies. Finally, we conclude with deep dives into full readout chain construction, and test and metrology for this very challenging ecosystem of components.

SUNDAY WORKSHOPS

08:00 – 17:20 | Sunday, 11 June 2023

	WORKSHOP TITLE	WORKSHOP ABSTRACT
WSG	**Fundamentals of RF Power Amplifiers: From the Basics to Advanced PA Architectures, Practical Design Aspects, and Process Technologies** **Organizers:** Debopriyo Chowdhury, *Broadcom*; Jennifer Kitchen, *Arizona State University* **ROOM: 33ABC** **08:00 – 17:20**	The RF Power Amplifier (PA) is a performance bottleneck of most RF wireless transmit systems and a critical design component of any RF system. Fundamental PA design knowledge and realization expertise are highly desired and regarded skills in the RF community. With their numerous process technologies, architectures, and implementation "tricks", the design of RF PAs may quickly become overwhelming. Moreover, the knowledge is typically acquired through years of design experience and multiple failed design attempts. This workshop jump-starts you into the world of PA design by walking you through the various aspects of RF PA design, starting from the basics and then introducing the most popular forms of advanced PA architectures. The various tutorials within the workshop will categorize the different PA design methodologies to give you a better understanding behind their motivations. Experts from industry and academia will also summarize the strengths of various process technologies, enabling you to better select processes depending on your target application. Finally, PA designers with decades of experience will provide insight into successfully implementing RF PAs, including practical design aspects ("tricks of the trade"), accounting for PA memory and thermal effects (the big "gotcha"), and effectively simulating PA designs to closely predict performance. This workshop will provide design insights not obtained from textbook reading, thus benefiting those who are new to the RF PA design field and seasoned warriors who would like a rapid refresher.
WSH	**Integration of 6G Systems from BB to Antenna for 6G Phased Arrays** **Organizers:** Gernot Hueber, *United Micro Technology*; Shahriar Shahramian, *Nokia Bell Labs* **ROOM: 29D** **08:00 – 17:20**	Wireless networks have enabled socio-economic growth worldwide and are expected to further advance to foster new applications such as autonomous vehicles, virtual/augmented-reality, and smart cities. Due to limitations of further growth in capacity in the sub-6GHz spectrum, mm-wave and sub-Thz frequencies are gaining an important role in the emerging 6G and the communication-on-the-move applications. In 6G, RF/mm-wave/sub-THz front-ends have challenges on bandwidth, power consumption, antenna coupling, array integration, etc. We examine the integration technologies and packaging challenges. 6G covering from sub-10GHz to high frequency as well the complexity of systems is increasing, which demands implementations in the right technology (CMOS, SiGe, ...) and integration of chipsets heterogeneously from basedband, transceiver to the antenna. The heterogeneous integration will be important with the multitude of frequency bands covered, eg 7–14GHz bands up to frequencies >100GHz.
WSI	**mm-Wave Integrated Radars: Opportunities and Challenges** **Organizers:** Yahya Tousi, *University of Minnesota*; Vito Giannini, *Uhnder* **ROOM: 30AB** **08:00 – 17:20**	The unique sensing capabilities of mm-wave radars bolstered by modern nano-scale silicon technology and advanced image processing has created the opportunity for integrated radar technology to create substantially improved image perception at a considerably lower size and cost compared to the radars of the 20th century. There is a growing effort in both academia and industry to bring this technology to fruition. In this workshop, we overview the existing opportunities in this field and the challenges that need to be overcome in order to standardize and commercialize integrated radar technology. The workshop brings together a complementary mix of top academic and industry speakers with a breadth of expertise and experience in this field ranging from the fundamental aspects of circuit design, system integration to sensor fusion, product design and testing.
WSJ	**mm-Wave and Sub-THz PA Design for Next-Gen Wireless and Sensing Applications** **Organizers:** Steven Callender, *Intel*; Sungwon Chung, *Neuralink* **ROOM: 30DE** **08:00 – 17:20**	There is no silver bullet power amplifier (PA) design that provides a one-size-fits-all solution for next-gen communication and sensing systems due to the diversity of applications and their associated PA specs (eg output power, linearity, bandwidth, and back-off efficiency). The goal of this workshop is to explore leading mm-wave and sub-THz applications and the associated PA specs for these systems. The applications of focus are massive MIMO and large-scale phased-arrays, sub-orbital satellite communication (SATCOM), and mm-wave radar. A balanced mix of both industry and academic perspectives will be provided, offering both a high-level familiarization of the application and associated specifications, along with deeper technical dives into PA design techniques in modern process nodes.
WSK	**To 100Gb/s and Beyond: High-Data-Rate Interconnect Technologies, Who Will Win at Which Scenario?** **Organizers:** Jane Gu, *University of California, Davis*; Wooram Lee, *Penn State University* **ROOM: 30C** **08:00 – 17:20**	Interconnect bottlenecks have been a long-standing grand challenge over decades, caused by the increasing gap between exponentially growing data generation and transmission demand, and slowly-increasing supporting data bandwidth supply. Both Electrical Interconnect (EI) and Optical Interconnect (OI) have been investigated extensively to try to combat the challenge, however, both of them face their own inherent constraints. The newly emerging sub-THz/THz Interconnect (TI) aims to complement the existing EI and OI to close the interconnect gap. This workshop plans to bring experts from different domains, OI, EI, and emerging TI, to discuss the challenges, opportunities and best use scenarios of each interconnect scheme.
WSL	**State-of-the-Art mm-Wave GaN Transistor and MMIC Technologies and Future Perspective** **Organizers:** Farid Medjdoub, *IEMN (UMR 8520)*; Keisuke Shinohara, *Teledyne Scientific & Imaging* **ROOM: 24ABC** **08:00 – 17:20**	Owing to superior electrical and thermal properties of GaN-on-SiC material systems, tremendous progress has been made on GaN-based transistor and MMIC technologies. Advanced heterostructure material designs, epitaxial growth techniques, and transistor scaling processes enabled GaN MMICs to extend their applications from microwave to mm-wave frequencies (up to W-band). Next-generation RF systems require high efficiency and high linearity for more complex modulation schemes to support very high data-rates. The traditional trade-off among efficiency, linearity, and power density imposes performance limitations on GaN MMICs, which become more pronounced at mm-wave frequencies. In this workshop, world-leading experts will discuss the present status, challenges, and future perspective of mm-wave GaN transistor and MMIC technologies, covering emerging materials and devices, device modeling, thermal management, reliability, and circuit designs.

SUNDAY WORKSHOPS

08:00 – 17:20 | Sunday, 11 June 2023

	WORKSHOP TITLE	WORKSHOP ABSTRACT
WSM	**Advances in Microwave and mm-Wave Wideband Measurements for Radar and Communications Applications** **Organizers:** Gian Piero Gibiino, *Università di Bologna*; Nicholas C. Miller, *AFRL* **ROOM: 31C** **08:00 – 17:20**	Wideband measurement and characterization techniques at microwave and mm-wave frequencies are becoming increasingly demanding to satisfy the specifications of the ever-evolving communications and radar industry. This workshop presents recent research and technology advancements from industry, research centers, and academia, by discussing relevant performance metrics and their experimental evaluation across different hardware platforms. Advanced characterization techniques are presented for transistors, power amplifiers, and beamformers, encompassing over-the-air testing, linearity, load-pull, and calibration of precision radar. The first half of the workshop is dedicated to state-of-the-art wideband device characterization techniques and load-pull. The second half of the workshop is focused on beamformers and over-the-air characterization techniques and standards. Both the morning and afternoon sessions of this workshop will end with open interactive discussions useful to outline future trends and research on these topics.
WSN	**Engineered Surfaces and Materials for Electromagnetic Propagation Control in Emerging Applications** **Organizers:** Ryan Cadwell, *Corning*; Connor Devitt, *Purdue University* **ROOM: 32AB** **08:00 – 11:50**	Engineered surfaces and materials have shown interesting qualities in electromagnetic propagation that may be useful in various applications. Characteristics such as reflection, transmission, and absorption can be designed by control of properties including metal and dielectric geometry, material permittivity or refractive index, and consideration of phenomena such as surface-waves. New or reconsidered electromagnetic design perspectives, newly enabled geometries from additive manufacturing approaches, and new material compositions including flexible or tunable (such as phase-change) materials, present emerging opportunities for investigation. These areas of exploration may yield advances in communication and sensing ranging from microwave to optical frequencies — including potential applications in 5G and 6G technology.
WSO	**Advanced Wafer-Level Heterogeneous Integration and Packaging for mm-Wave 5G and 6G Applications** **Organizers:** Kamal Samanta, *Sony*; Kevin Xiaoxiong Gu, *Metawave* **ROOM: 32AB** **13:30 – 17:20**	This workshop will cover various recently developed technologies and the state-of-the-art performance in wafer-level integration and packaging technologies and manufacturing techniques with challenges and possible future directions and solutions. In particular, it will highlight the latest advances in the areas such as embedded wafer-level ball grid array (eWLB) technology for system integration with high Q interconnects and passives in thin-film Re-Distribution Layers (RDL), wafer-level heterogeneous integration of different substrates, BiCMOS embedded TSVs, sub-THz on-chip antenna integration, innovative Fan-Out technologies for wafer-level package, RF IPD, and FOSiP, and embedding various chips within the silicon Metal-Embedded Chip/Chiplet Assembly. Further, the workshop will present the practical realization of highly integrated systems, including 60GHz and 77GHz eWLB transceiver modules with integrated antennas, 3D wafer-level packaging for mm-wave and sub-mm-wave space systems, and hetero-integration technology solutions to enable a full 2D array of phased array systems above 120GHz.
WSP	**Radio-Frequency Devices Exploiting Intimately Coupled MultiPhysics** **Organizers:** Christopher Nordquist, *Sandia National Laboratories*; Roy H. Olsson, *University of Pennsylvania* **ROOM: 29C** **08:30 – 17:20**	Advances in materials, fabrication, modeling, and test have enabled devices that achieve new functionality through coupling of multiple physical phenomena. These devices combine piezoelectric, ferroelectric, magnetostatic, acoustoelectric, and other physics to achieve performance beyond that of mass-produced bulk and surface-wave devices. These unique attributes provide potential for significant impact on future RF applications. Interactions between different types of physics provides coupling and exchange of energy between complementary mediums and modes. Examples include integrating piezoelectric and semiconductor materials to couple acoustic and electronic traveling waves, integrating ferromagnetic and piezoelectric materials to couple acoustic and magnetic domains, incorporating ferroelectric materials to change and tune piezoelectric orientation, and strain tuning of magnetostatic waves. Devices using these effects provide the potential for miniature high-Q tunable resonators and filters, non-reciprocal devices, and single-chip analog signal processors. This workshop will provide perspectives on the physics and application potential for these technologies.

SAN DIEGO CONVENTION CENTER

QUANTUM BOOT CAMP

08:00 – 12:00 | Sunday, 11 June 2023 | Room: 26AB

The quantum computing industry relies heavily on microwave technologies, yet the connection between MTT-S and the quantum efforts is still nascent. For the quantum computing industry to succeed, it is essential to train multidisciplinary engineers who understand both quantum physics and microwave engineering. Quantum engineering is a fast-growing interdisciplinary field of research in which microwave and RF engineers can play an important role, especially in the areas of Quantum Sensing, Quantum Communications, and in the Microwave Control of Quantum Computing platforms.

The Quantum Boot Camp will introduce the basics of quantum engineering, targeting microwave engineers who want to understand how they can make an impact in this emerging field. It features speakers covering quantum engineering basics with a focus on the design, fabrication, control, and measurement of quantum system, with a focus on superconducting qubits. The course will conclude with an industry perspective from one of the leading commercial providers of quantum computing.

The intended audience includes new engineers, engineers who may be changing their career path, marketing and sales professionals seeking a better understanding of quantum technology, as well as current college students looking to learn more about the practical aspects of Quantum technology.

Speakers:

Prof. Kevin O'Brien, *MIT* | **Prof. Will Oliver, *MIT*** | **Dr. Ofer Naaman, *Google***

SAN DIEGO CONVENTION CENTER

RFIC TECHNICAL LECTURE

12:00 – 13:20 | Sunday, 11 June 2023 | Ballroom Section 20A

	LECTURE TITLE	ABSTRACT
TL1	**Modern Radio Receivers: From WiFi to 5G and Beyond** **Speaker:** Behzad Razavi, *University of California, Los Angeles*	CMOS radios continue to evolve so as to satisfy the demands of new applications. Below 7 GHz, cellular and WiFi standards have been pushing the performance to support increasingly higher data rates while consuming less power. Such endeavors require novel architectures that also lend themselves to efficient circuit design. In addition, new radios have emerged around 30 GHz for 5G, around 60 GHz for WiGig, around 140 GHz for 6G, and around 300 GHz for sub-terahertz communications. Each of these frequency bands presents interesting and unique challenges, but a unifying principle among them is the need for beamforming. This presentation deals with recent developments in receiver design for this broad range of applications. We examine the shortcomings of standard direct-conversion architectures and draw concepts from the state of the art to improve their performance. We also contend that heterodyne reception may outperform direct conversion in some cases. We then study beamforming techniques with emphasis on solutions that draw minimal power.

SAN DIEGO CONVENTION CENTER

AI/ML BOOT CAMP

13:30 – 17:30 | Sunday, 11 June 2023 | Room: 26AB

The AI/ML Boot Camp will present the basics of Artificial Intelligence (AI)/Machine Learning (ML) for microwaves. The course is targeted to general audiences in the microwave community who are not necessarily experts in AI/ML. To start with, the course addresses basic questions such as: what is AI/ML. Why are AI/ML tools relevant for microwave community. How can AI/ML be used in microwave design, and how can it be adopted in microwave circuits and systems. We also address what the benefits and limitations of using AI/ML in microwave technologies are.

The course will introduce basic types of machine learning methods such as multilayer perceptrons, radial basis function networks, convolutional neural networks, time-delay neural networks, recurrent neural networks, long-short term memory networks, generative adversarial networks, and reinforcement learning. Examples of applications of AI/ML to microwaves will be presented.

This course is intended for engineers who want to learn the basics of AI/ML or are interested in using AI/ML for microwave applications, marketing and sales professionals who are interested in understanding the basics and relevance of AI/ML for microwaves, and university students who would like to acquire the basic knowledge of AI/ML. The course will provide ample opportunities for audience interaction and Q&A.

Organizers:

Qi-Jun Zhang, *Carleton University* | **Costas Sarris, *University of Toronto*** | **Ulf Gustavsson, *Ericsson***

RFIC PLENARY SESSION | 17:30 – 19:00 | Sunday, 11 June 2023 | Ballroom 20, B-D

The Roaring 20s: A Renaissance for the Semiconductor Industry?

KEYNOTE SPEAKER: Dr. Todd Younkin, *President and CEO, Semiconductor Research Corporation (SRC)*

ABSTRACT: Dr. Younkin will share his vision for the future of global semiconductor technologies and design, especially those that will enable future RFIC breakthroughs. Dr. Younkin will discuss the status of government investments and opportunities arising from the CHIPS and SCIENCE ACT of 2022, Korea's K-Belt strategy, Europe's CHIPS ACT, and more.

SPEAKER BIO: Dr. Todd Younkin is a talented and seasoned executive with more than 20 years of experience in technology innovation. His extensive Research and Development experience spans Intel's 0.18µm to 5 nm nodes with technical contributions in novel materials, nanotechnology, integration, advanced lithography, and integrated photonics. Todd brings a wealth of expertise with strengths in areas such as cultivating relationships with strategic partners, entrepreneurship and investment strategies, technology innovation, operational excellence, and talent management. He has spent much of his career working alongside young minds that are aspiring to influence the ever-changing world of smart and autonomous electronics. He has built programs from the ground up, leveraging his entrepreneurial leadership to drive new business development that has generated multi-millions in funding. He has been a key contributor in introducing new technology advances and starting new global research in the U.S., Europe, and Asia.

Dr. Younkin holds a Ph.D. from the California Institute of Technology in Pasadena, California. He completed his Bachelor of Science at the University of Florida in Gainesville, Florida. He aspires to continue to influence the next generation of technology and inventors, bringing ideas and investors together to drive heterogeneous electronic solutions that will deliver a smarter, shared future.

In August of 2020, Dr. Todd Younkin became the President & CEO of SRC. Recently, he engineered, launched, and led all programmatic aspects of the five-year, $240 million JUMP research initiative. It has six multi-university, multi-disciplinary innovation Centers with 133 faculty, 835 students, and 360 industrial engineering liaisons. It emphasizes the advancement of Computer Science, Electrical Engineering, and Materials to secure continued U.S. thought leadership.

Following his appointment, SRC released its 2030 Decadal Plan for Semiconductors, where it identified the five "seismic shifts" shaping the future of information and communication technologies (ICT). Working closely with SIA, SRC called for greatly increased federal investments throughout the decade to establish a smarter pipeline for semiconductor R&D, aligned to SRC's Decadal Plan. This drove and resulted in the passage of the CHIPS and SCIENCE ACT of 2022 on 9 August 2022.

Dr. Todd Younkin is excited by the worldwide call for a renewed investment in semiconductor materials, hardware, and design, as well as the equally important calls for an emphasis on education and workforce development and our need for environmental sustainability. Only by investing in a bright, collective future, will we rise to the meet the opportunities presented by the next industrial revolution.

Future System-on-Chip for Full Spectrum Utilization from RF to Optics

KEYNOTE SPEAKER: Prof. Mau-Chung Frank Chang, *Wintek Chair in Electrical Engineering and Distinguished Professor, University of California, Los Angeles (UCLA); Former President, National Yang Ming Chiao Tung University (NYCU), Hsinchu, Taiwan*

ABSTRACT: Prof. Chang will deliver his exciting vision on "Future System-on-Chip for Full Spectrum Utilization from RF to Optics." As the RFIC industry is investigating and moving into and beyond the Terahertz (THz) sensing/communication era, he will highlight the multi-facet challenges and opportunities for system and technology revolutions, including the "Best Junction for the Function" device technology breakthroughs that may enable the full spectrum utilization from RF to optics on a single chip.

SPEAKER BIO: Dr. M.-C. Frank Chang is the Wintek Chair in Electrical Engineering and Distinguished Professor at the University of California, Los Angeles. Prior to joining UCLA, he was the Assistant Director of the High Speed Electronics Laboratory of Rockwell Science Center (1983-1997), Thousand Oaks, California. In this tenure, he led the team to develop and transfer the MOCVD based AlGaAs/GaAs & InGaP/GaAs Heterojunction Bipolar Transistor (HBT) and BiFET (Planar HBT/MESFET) integrated circuit technologies from the research laboratory to production line (later became Skyworks Solutions). The HBT/BiFET productions have grown into multi-billion dollar businesses and dominated the cellphone power amplifier and front-end module markets for the past 30 years (currently exceeding 10 billion units/year and exceeding 50 billion units in the past decade).

Throughout his career, his research has focused on the research and development of high-speed semiconductor devices and integrated circuits for radio, radar, imager, spectrometer and interconnect System-on-Chip applications. He invented the multiband, reconfigurable RF-Interconnects for Chip-Multi-Processor (CMP) inter-core communications and inter-chip CPU-to-Memory communications. He and his students were the first to demonstrate CMOS active and passive imagers at mm-Wave (100-180GHz) frequencies. His Lab also pioneered the development of self-healing 57-64GHz radio-on-a-chip (DARPA's HEALICS program) with embedded sensors, actuators and self-diagnosis/curing capabilities; and invented the Digitally Controlled Artificial Dielectric (DiCAD) embedded in CMOS technologies to vary transmission-line permittivity in real-time (up to 20X in practice) for realizing reconfigurable multiband/mode radios in (sub)-mm-Wave frequency bands.

His UCLA Lab also realized the first CMOS Frequency Synthesizer for Terahertz operation (PLL at 560GHz) and devised the first tri-color CMOS active imager at 180-500GHz based on a Time-Encoded Digital Regenerative Receiver and the first 3-dimensional SAR imaging radar with sub-centimeter range resolution at 144GHz. More recently, his Lab has devised a Reconfigurable Convolution Neuron Network (RCNN) Accelerator for IoT applications, spun-off an Edge-AI startup company Kneron in San Diego, and won IEEE's 2021 Darlington Best Paper Award.

He is a Member of the US National Academy of Engineering, the European Academy of Sciences and Arts, the US National Academy of Inventors, the Academia Sinica of Taiwan, and a Fellow of the IEEE. He was also recognized with the IEEE David Sarnoff Award (2006), IET JJ Thomson Medal for Electronics (2017) and IEEE/RSE James Clerk Maxwell Medal (2023) for his seminal contributions to the heterojunction technology and realizations of (sub)-mm-Wave System-on-Chip with unprecedented bandwidth and re-configurability.

Prof. Chang has published more than 460 peer-reviewed technical papers and 60 US patents in various areas of high speed electronic devices and integrated circuits & systems. During his tenure with UCLA, he has graduated more than 50 Ph.D. students and 100 MS students. He also served as the President of the National Chiao Tung University, Hsinchu, Taiwan. (2015-2019)

RFIC RECEPTION AND SYMPOSIUM SHOWCASE

Featuring Systems & Applications Forum and Best Student/Industry Paper Showcase

19:00–21:00 Sunday, 11 June 2023

Sails Pavilion, San Diego Convention Center

The RFIC Interactive Reception starts immediately after the Plenary Session and will highlight the Student Paper Awards finalists, the Industry Paper Awards finalists, and the Systems and Applications Forum in an engaging social and technical evening event with food and drinks. Authors of these showcases will present their innovative work, summarized in poster format. Some showcase papers will also offer live demonstrations or be presented via a monitor.

Student Paper Awards Finalists' Showcase/Demonstrations:

=Showcase (D)=Demonstration

A 112-Gbps, 0.73-pJ/Bit Fully-Integrated O-Band I-Q Optical Receiver in a 45-nm CMOS SOI- Photonic Process | RMo1A-1
Ghazal Movaghar, Viviana Arrunategui, Junqian Liu, Aaron Maharry, Clint Schow, James F. Buckwalter, *University of California, Santa Barbara, USA*

A 100-Gb/s 3-m Dual-Band PAM-4 Dielectric Waveguide Link with 1.9 pJ/Bit/m Efficiency in 28-nm CMOS | RMo1A-3
Kristof Dens[1], Joren Vaes[1], Christian Bluemm[2], Gabriel Guimaraes[1], Berke Gungor[1], Changsong Xie[2], Alexander Dyck[2], Patrick Reynaert[1]
[1]KU Leuven, Belgium, [2]Huawei Technologies, Germany

A 140GHz Scalable On-Grid 8×8-Element Transmit-Receive Phased-Array with Up/Down Converters and 64QAM/24Gbps Data Rates | RMo2C-2
Amr Ahmed, Linjie Li, Minjae Jung, Gabriel M. Rebeiz, *University of California, San Diego, USA*

A 0.75mW Receiver Front-End for NB-IoT | RMo4B-1
Hossein Rahmanian Kooshkaki, Patrick P. Mercier, *University of California, San Diego, USA*

A 26–40GHz 4-Way Hybrid Parallel-Series Role-Exchange Doherty PA with Broadband Deep Power Back-Off Efficiency Enhancement | RMo4C-1
Edward Liu, Hua Wang, *ETH Zürich, Switzerland*

Mono/Multistatic Mode-Configurable E-Band FMCW Radar Transceiver Module for Drone- Borne Synthetic Aperture Radar | RTu1C-2
Kangseop Lee, Sirous Bahrami, Kyunghwan Kim, Jiseul Kim, Seung-Uk Choi, Ho-Jin Song, *POSTECH, Korea*

(D) **A Diamond Quantum Magnetometer Based on a Chip-Integrated 4-Way Transmitter in 130- nm SiGe BiCMOS** | RTu2B-1
Hadi Lotfi[1], Michal Kern[1], Nico Striegler[2], Thomas Unden[2], Jochen Scharpf[2], Patrick Schalberger[1], Ilai Schwartz[2], Philipp Neumann[2], Jens Anders[1]
[1]Universität Stuttgart, Germany, [2]NVision Imaging Technologies, Germany

(D) **A D-Band Calibration-Free Passive 360° Phase Shifter with 1.2° RMS Phase Error in 45nm RFSOI** | RTu3B-2
Mohammadreza Abbasi, Wooram Lee, *Pennsylvania State University, USA*

A D-Band 20.4dBm OP1dB Transformer-Based Power Amplifier with 23.6% PAE in a 250-nm InP HBT Technology | RTu3C-3
Senne Gielen[1], Yang Zhang[2], Mark Ingels[2], Patrick Reynaert[1]
[1]KU Leuven, Belgium, [2]imec, Belgium

Industry Paper Awards Finalists Showcase/Demonstrations:

=Showcase (D)=Demonstration

Optimizing RFSOI Performance Through a T-Shaped Gate and Nano-Second Laser Annealing Techniques | RMo2A-2
L. Lucci[1], S. Crémer[2], B. Duriez[1], T. Fache[1], S. Kerdiles[1], Y. Morand[1], J.-M. Hartmann[1], J. Azevedo-Goncalves[2], F. Gaillard[1], P. Chevalier[2]
[1]CEA-Leti, France, [2]STMicroelectronics, France

A Fast-Startup 80MHz Crystal Oscillator with 96×/368× Startup-Time Reductions for 3.0V/1.2V Swings Based on Un-Interrupted Phase-Aligned Injection | RMo3A-3
Chien-Wei Chen, Chao-Ching Hung, Yu-Li Hsueh, *MediaTek, Taiwan*

(D) **Transformer-Coupled 2.5GHz BAW Oscillator with 12.5fs RMS-Jitter and 1-kHz Figure-of-Merit (FOM) of 210dB** | RMo3A-4
Bichoy Bahr, Sachin Kalia, Baher Haroun, Swaminathan Sankaran, *Texas Instruments, USA*

A Double Balanced Frequency Doubler Achieving 70% Drain Efficiency and 25% Total Efficiency | RMo4A-1
Jesse Moody, *Sandia National Laboratories, USA*

A Wi-Fi Tri-Band Switchable Transceiver with 57.9fs-RMS-Jitter Frequency Synthesizer, Achieving -42.6dB EVM Floor for EHT320 4096-QAM MCS13 Signal | RMo4B-3
Tsung-Ming Chen[1], Ming-Chung Liu[1], Pi-An Wu[1], Wei-Kai Hong[1], Ting-Wei Liang[1], Wei-Pang Chao[1], Po-Yu Chang[1], Yu-Ting Chou[1], Chien-Wei Chen[1], Sen-You Liu[1], Chang-Cheng Huang[1], Hsiu-Hsien Ting[1], Min-Shun Hsu[1],Yao-Chi Wang[1], Chao-Ching Hung[1], Yu-Li Hsueh[1], Eric Lu[2], Yuan-Hung Chung[1], Jing-Hong Conan Zhan[1]
[1]MediaTek, Taiwan, [2]MediaTek, USA

(D) **A 28nm CMOS Dual-Band Concurrent WLAN and Narrow Band Transmitter with On-Chip Feedforward TX-to-TX Interference Cancellation Path for Low Antenna-to-Antenna Isolation in IoT Devices** | RTu1B-1
Sai-Wang Tam, Alireza Razzaghi, Alden Wong, Sridhar Narravula, Weiwei Xu, Timothy Loo, Akash Kambale, Andrew Liu, Ovidiu Carnu, Yui Lin, Randy Tsang, *NXP Semiconductors, USA*

A 14-nm Low-Cost IF Transceiver IC with Low-Jitter LO and Flexible Calibration Architecture for 5G FR2 Mobile Applications | RTu2C-3
Wanghua Wu[1], Jeiyoung Lee[2], Pak-Kim Lau[1], Taeyoung Kang[1], Kim Kiu Lau[1], Si-Wook Yoo[1], Xingliang Zhao[1], Ashutosh Verma[1], Ivan Siu-Chuang Lu[1], Chih-Wei Yao[1], Hou-Shin Chen[1], Gennady Feygin[1], Pranav Dayal[1], Kee-Bong Song[1], Sangwon Son[1]
[1]Samsung, USA, [2]Samsung, Korea

(D) **A 140GHz RF Beamforming Phased-Array Receiver Supporting >20dB IRR with 8GHz Channel Bandwidth at Low IF in 22nm FDSOI CMOS** | RTu3B-3
Shenggang Dong[1], Navneet Sharma[1], Sensen Li[1], Michael Chen[1], Xiaohan Zhang[2], Yaolong Hu[2], Jiantong Li[1], Yong Su[1], Xinguang Xu[1], Vitali Loseu[1], Eunyoung Seok[1], Taiyun Chi[2], Won-Suk Choi[1], Gary Xu[1]
[1]Samsung, USA, [2]Rice University, USA

(D) **A 110–170GHz Phase-Invariant Variable-Gain Power Amplifier Module with 20–22dBm Psat and 30dBm OIP3 Utilizing SiGe HBT RFICs** | RTu3C-2
Mustafa Sayginer, Michael Holyoak, Mike Zierdt, Mohamed Elkhouly, Joe Weiner, Yves Baeyens, Shahriar Shahramian, *Nokia Bell Labs, USA*

Systems and Applications Forum Showcase/Demonstrations:

=Showcase (D)=Demonstration

A CMOS 183GHz Millimeter-Wave Spectrometer for Exploring the Origins of Water and Evolution of the Solar System | RMo2C-1
Adrian Tang[1], Mau-Chung Frank Chang[2], Yanghyo Kim[3], Goutam Chattopadhyay[1]
[1]JPL, USA, [2]University of California, Los Angeles, USA, [3]Stevens Institute of Technology, USA

A 57.6Gb/s Wireless Link Based on 26.4dBm EIRP D-Band Transmitter Module and a Channel Bonding Chipset on CMOS 45nm | RMo2C-3
Jose Luis Gonzalez-Jimenez, Alexandre Siligaris, Abdelaziz Hamani, Francesco Foglia-Manzillo, Pierre Courouve, Nicolas Cassiau, Cedric Dehos, Antonio Clemente, *CEA-Leti, France*

A 14.2mW 29–39.3-GHz Two-Stage PLL with a Current-Reuse Coupled Mixer Phase Detector | RMo3A-1
Yuan Liang[1], Chirn Chye Boon[2], Qian Chen[2]
[1]Guangzhou University, China, [2]NTU, Singapore

A C-Band Compact High-Linearity Multibeam Phased-Array Receiver with Merged Gain- Programmable Phase Shifter Technique | RMo4B-2
Jingying Zhou[1], Nayu Li[1], Yuexiaozhou Yuan[1], Huiyan Gao[1], Shaogang Wang[1], Hang Lu[1], Chunyi Song[1], Yen-Cheng Kuan[2], Qun Jane Gu[3], Zhiwei Xu[1]
[1]Zhejiang University, China, [2]NYCU, Taiwan, [3]University of California, Davis, USA

A CMOS 160GHz Integrated Permittivity Sensor with Resolution of 0.05% $\Delta\varepsilon r$ | RTu1C-4
Hai Yu[1], Xuan Ding[1], Jingjun Chen[2], Sajjad Sabbaghi Saber[1], Qun Jane Gu[1]
[1]University of California, Davis, USA, [2]Qualcomm, USA

A mm-Wave CMOS/Si-Photonics Hybrid-Integrated Software-Defined Radio Receiver Achieving >80-dB Blocker Rejection of <-10dBm In-Band Blockers | RTu2B-3
Ramy Rady, Yu-Lun Luo, Christi Madsen, Samuel Palermo, Kamran Entesari, *Texas A&M University, USA*

A Quad-Band RX Phased-Array Receive Beamformer with Two Simultaneous Beams, Polarization Diversity, and 2.1–2.3dB NF for C/X/Ku/Ka-Band SATCOM | RTu2C-4
Zhaoxin Hu, Oguz Kazan, Gabriel M. Rebeiz, *University of California, San Diego, USA*

(D) **A mm-Wave Blocker-Tolerant Receiver Achieving <4dB NF and -3.5dBm B1dB in 65-nm CMOS** | RTu3B-4
Erez Zolkov, Nimrod Ginzberg, Emanuel Cohen, *Technion, Israel*

SAN DIEGO CONVENTION CENTER

2023 **RF BOOT CAMP**

08:00 – 17:00 | Monday, 12 June 2023 | Room: 26AB

Industry and Academia recognize the critical need for RFMW knowledge in optimizing and accurately characterizing products. Often embedded with high-speed digital, software and firmware elements, our designs require knowledge of the impact on RFMW system performance across all aspects of development, from simulation to prototyping, layouts and testing.

The MTT-S International Microwave Symposium's RF Boot Camp is designed to grow RFMW skills in an educational forum that is focused on the fundamentals of Microwave Theory and Techniques.

RF Boot Camp focuses on teaching the fundamentals, terminology, and applications of RF and microwave design, simulation, and measurement – for those new to RFMW and those wishing to stay current with new technologies and applications. Two IEEE continuing education credits (CEUs) are offered to RF Bootcamp attendees.

The main agenda for RF Boot Camp 2023 includes a series of tutorials, delivered by experts from Keysight Technologies, Modelithics, Inc., University of South Florida, Eindhoven University of Technology, and Ericsson Research Sweden. The refreshed and updated topics for RF Boot Camp at IMS2023 will include:

- The RF/Microwave Signal Chain
- Network Characteristics, Analysis and Measurement
- Fundamentals of RF Simulation
- Device Modeling and Impedance Matching Basics
- Spectral Analysis and Receiver Technology
- Signal Generation
- Modulation and Vector Signal Analysis
- Microwave Antenna Basics
- RFMW Application Focus (Ericsson Research)

Organizers/Speakers:

Dr. Larry Dunleavy, *Modelithics, Inc.*

Joanne Mistler, *Keysight Technologies*

Dr. Ulf Johannsen, *TU Eindhoven*

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23ABC

RMo1A: Circuits and Systems for High-Speed Optical and Wireline Communication

Chair: Bahar Jalali Farahani, *Cisco*
Co-Chair: Antoine Frappé, *Université de Lille*

08:00

RMo1A-1: A 112-Gbps, 0.73-pJ/Bit Fully-Integrated O-Band I-Q Optical Receiver in a 45-nm CMOS SOI-Photonic Process

G. Movaghar, *Univ. of California, Santa Barbara*; V. Arrunategui, *Univ. of California, Santa Barbara*; J. Liu, *Univ. of California, Santa Barbara*; A. Maharry, *Univ. of California, Santa Barbara*; C. Schow, *Univ. of California, Santa Barbara*; J.F. Buckwalter, *Univ. of California, Santa Barbara*

08:20

RMo1A-2: A 42.7Gb/s Optical Receiver with Digital CDR in 28nm CMOS

H. Kang, *Texas A&M Univ.*; I. Kim, *Texas A&M Univ.*; R. Liu, *Texas A&M Univ.*; A. Kumar, *Texas A&M Univ.*; I.-M. Yi, *Texas A&M Univ.*; Y. Yuan, *Hewlett Packard Enterprise*; Z. Huang, *Hewlett Packard Enterprise*; S. Palermo, *Texas A&M Univ.*

08:40

RMo1A-3: A 100-Gb/s 3-m Dual-Band PAM-4 Dielectric Waveguide Link with 1.9 pJ/Bit/m Efficiency in 28-nm CMOS

K. Dens, *KU Leuven*; J. Vaes, *KU Leuven*; C. Bluemm, *Huawei Technologies*; G. Guimaraes, *KU Leuven*; B. Gungor, *KU Leuven*; C. Xie, *Huawei Technologies*; A. Dyck, *Huawei Technologies*; P. Reynaert, *KU Leuven*

09:00

RMo1A-4: A 12-Bit 1.1GS/s Single-Channel Pipelined-SAR ADC with Adaptive Inter-Stage Redundancy

X. Wen, *Southern Methodist Univ.*; T. Fu, *Southern Methodist Univ.*; P. Gui, *Southern Methodist Univ.*

09:20

09:40

24ABC

RMo1B: Silicon-Based Front-Ends and Building-Blocks

Chair: Hao Gao, *Technische Universiteit Eindhoven*
Co-Chair: Ramesh Harjani, *University of Minnesota*

08:00

RMo1B-1: A 65nm CMOS Current-Mode Receiver Frontend with Frequency-Translational Noise Cancelation and 425MHz IF Bandwidth

B. Guo, *CUIT*; H. Wang, *CUIT*; L. Li, *UESTC*; W. Zhou, *UESTC*

08:20

RMo1B-2: IIP2-Enhanced Receiver Front-End with Notch-Filtered Low-Noise Transconductance Amplifier for 5G New Radio Cellular Applications

D. Lee, *Kangwon National University*; S. Yun, *Kangwon National University*; K. Kwon, *Kangwon National University*

08:40

RMo1B-3: A Band-Shifting Millimeter-Wave T/R Front-End with Enhanced Imaging and Interference Rejection Covering 5G NR FR2 n257/n258/n259/n260/n261 Bands

F. Zhao, *Tsinghua Univ.*; W. Deng, *Tsinghua Univ.*; H. Jia, *Tsinghua Univ.*; W. Ye, *Tsinghua Univ.*; R. Wan, *Tsinghua Univ.*; B. Chi, *Tsinghua Univ.*

09:00

RMo1B-4: A 6–22GHz CMOS Phase Shifter with Integrated mm-Wave LO

N. Ershengoren, *Tel Aviv University*; E. Socher, *Tel Aviv University*

09:20

RMo1B-5: A 300–320GHz Sliding-IF I/Q Receiver Front-End in 130nm SiGe Technology

S.P. Singh, *Univ. of Oulu*; M. Jafari Nokandi, *Univ. of Oulu*; M.H. Montaseri, *Univ. of Oulu*; T. Rahkonen, *Univ. of Oulu*; M.E. Leinonen, *Univ. of Oulu*; A. Pärssinen, *Univ. of Oulu*

09:40

25ABC

RMo1C: 5G & mm-Wave Transceivers and Beamforming ICs

Chair: Hongtao Xu, *Fudan University*
Co-Chair: Gernot Hueber, *United Micro Technology*

08:00

RMo1C-1: A V-Band Four-Channel Phased Array Transmitter Beamforming IC with 0.7-Degree Phase Step in 20dB Dynamic Range

C. So, *KAIST*; E.-T. Sung, *KAIST*; S. Hong, *KAIST*

08:20

RMo1C-2: A 28/37GHz Frequency Reconfigurable Dual-Band Beamforming Front-End IC for 5G NR

J. Lee, *KAIST*; H. Jin, *KAIST*; G. Lee, *KAIST*; E.-T. Sung, *Samsung*; S. Hong, *KAIST*

08:40

RMo1C-3: A 26.5-GHz 4×2 Array Switched Beam-Former Based on 2-D Butler Matrix for 5G Mobile Applications in 28-nm CMOS

Y. Lee, *Yonsei Univ.*; J. Kim, *Yonsei Univ.*; S. Kwon, *Yonsei Univ.*; B. Suh, *Yonsei Univ.*; J. Hwang, *Yonsei Univ.*; K. Park, *Yonsei Univ.*; D. Chun, *Yonsei Univ.*; K. Choi, *Yonsei Univ.*; H. Choi, *Yonsei Univ.*; D. Yoo, *Yonsei Univ.*; B.-W. Min, *Yonsei Univ.*

09:00

RMo1C-4: A Phased-Array Receiver Front-End Using a Compact High Off-Impedance T/R Switch for n257/n258/n261 5G FR2 Cellular

Y. Chen, *Samsung*; X. Yu, *Samsung*; S. Dey, *Samsung*; V. Bhagavatula, *Samsung*; C. Kuo, *Samsung*; T. Chang, *Samsung*; I.S.-C. Lu, *Samsung*; S. Son, *Samsung*

09:20

09:40

23ABC

RMo2A: GaN Modeling, RFSOI Device and Chip Layout Automation

Chair: Alvin Joseph, *GLOBALFOUNDRIES*
Co-Chair: Renyuan Wang, *BAE Systems*

10:10

RMo2A-1: Exploration of Design/Layout Tradeoffs for RF Circuits Using ALIGN

J. Poojary, *University of Minnesota Twin Cities*; S. Ramprasath, *University of Minnesota Twin Cities*; S.S. Sapatnekar, *University of Minnesota Twin Cities*; R. Harjani, *University of Minnesota Twin Cities*

10:30

RMo2A-2: Optimizing RFSOI Performance Through a T-Shaped Gate and Nano-Second Laser Annealing Techniques

L. Lucci, *CEA-LETI*; S. Crémer, *STMicroelectronics*; B. Duriez, *CEA-LETI*; T. Fache, *CEA-LETI*; S. Kerdiles, *CEA-LETI*; Y. Morand, *CEA-LETI*; J.-M. Hartmann, *CEA-LETI*; J. Azevedo-Goncalves, *STMicroelectronics*; F. Gaillard, *CEA-LETI*; P. Chevalier, *STMicroelectronics*

10:50

RMo2A-4: Artificial Neural Networks for GaN HEMT Model Extraction in D-Band Using Sparse Data

A. Arias-Purdue, *Univ. of California, Santa Barbara*; E. Lam, *Univ. of California, Santa Barbara*; J. Tao, *Univ. of California, Santa Barbara*; E. O'Malley, *Univ. of California, Santa Barbara*; J.F. Buckwalter, *Univ. of California, Santa Barbara*

11:10

RMo2A-5: Benchmarking Measurement-Based Large-Signal FET Models for GaN HEMT Devices

R. Perez Martinez, *Stanford Univ.*; M. Iwamoto, *Keysight Technologies*; J. Xu, *Keysight Technologies*; P. Pahl, *Keysight Technologies*; S. Chowdhury, *Stanford Univ.*

24ABC

RMo2B: III/V Front-Ends and Building-Blocks

Chair: Marcus Granger-Jones, *Qorvo*
Co-Chair: Emanuel Cohen, *Technion*

RMo2B-1: A DC-to-12GHz 1.4–2.5dB IL 4×8 Switch Matrix with Three-Port Reconfigurable Inter-Stage Matching Network

Z. Wang, *UESTC*; Z. Wang, *UESTC*; Y. Wang, *UESTC*; X. Tang, *New Mexico State Univ.*; Y. Wang, *UESTC*

RMo2B-2: A DC-to-18GHz High Power and Low Loss Band-Divided SP3T Switch with Reconfigurable Pole-to-Throw Network in 0.25-µm GaN

Z. Wang, *UESTC*; Y. Wang, *UESTC*; Z. Wang, *UESTC*; X. Tang, *New Mexico State Univ.*; Y. Wang, UESTC

RMo2B-3: A 4.8–6.4-GHz GaN MMIC Front-End Module with Enhanced Back-Off Efficiency and Compact Size

G. Lv, *Tsinghua Univ.*; W. Chen, *Tsinghua Univ.*; X. Chen, *Tsinghua Univ.*; L. Chen, *Tsinghua Univ.*; Z. Feng, *Tsinghua Univ.*

RMo2B-4: A 280GHz InP HBT Direct-Conversion Receiver with 10.8dB NF

U. Soylu, *Univ. of California, Santa Barbara*; A. Alizadeh, *Univ. of California, Santa Barbara*; M. Seo, *Sungkyunkwan Univ.*; M.J.W. Rodwell, *Univ. of California, Santa Barbara*

25ABC

RMo2C: Systems and Applications at RF and mm-Wave

Chair: Mona Mostafa Hella, *Rensselaer Polytechnic Institute*
Co-Chair: Rocco Tam, *NXP Semiconductors*

RMo2C-1: A CMOS 183GHz Millimeter-Wave Spectrometer for Exploring the Origins of Water and Evolution of the Solar System

A. Tang, *JPL*; M.-C.F. Chang, *Univ. of California, Los Angeles*; Y. Kim, *Stevens Institute of Technology*; G. Chattopadhyay, *JPL*

RMo2C-2: A 140GHz Scalable On-Grid 8×8-Element Transmit-Receive Phased-Array with Up/Down Converters and 64QAM/24Gbps Data Rates

A. Ahmed, *Univ. of California, San Diego*; L. Li, *Univ. of California, San Diego*; M. Jung, *Univ. of California, San Diego*; G.M. Rebeiz, *Univ. of California, San Diego*

RMo2C-3: A 57.6Gb/s Wireless Link Based on 26.4dBm EIRP D-Band Transmitter Module and a Channel Bonding Chipset on CMOS 45nm

J.L. Gonzalez-Jimenez, *CEA-LETI*; A. Siligaris, *CEA-LETI*; A. Hamani, *CEA-LETI*; F. Foglia-Manzillo, *CEA-LETI*; P. Courouve, *CEA-LETI*; N. Cassiau, *CEA-LETI*; C. Dehos, *CEA-LETI*; A. Clemente, *CEA-LETI*

11:30

RMo2C-4: A mm-Sized Implantable Glucose Sensor Using a Fluorescent Hydrogel

H. Lee, *LIG Nex1*; H. Park, *Silicon Mitus*; T. Kim, *Kyung Hee Univ.*; M.S. Nam, *Kyung Hee Univ.*; Y.J. Heo, *Kyung Hee Univ.*; S. Kim, *Kyung Hee Univ.*

11:50

23ABC

RMo3A: Reference Clock and Frequency Generation Techniques

Chair: Salvatore Finocchiaro, *Qorvo*
Co-Chair: Teerachot Siriburanon, *University College Dublin*

13:30

RMo3A-1: A 14.2mW 29–39.3-GHz Two-Stage PLL with a Current-Reuse Coupled Mixer Phase Detector

Y. Liang, *Guangzhou University*; C.C. Boon, *NTU*; Q. Chen, *NTU*

13:50

RMo3A-2: A Radiation-Hardened by Design 15–22GHz LC-VCO Charge-Pump PLL Achieving -240dB FoM in 22nm FinFET

D. Dolt, *Texas A&M Univ.*; S. Palermo, *Texas A&M Univ.*

14:10

RMo3A-3: A Fast-Startup 80MHz Crystal Oscillator with 96×/368× Startup-Time Reductions for 3.0V/1.2V Swings Based on Un-Interrupted Phase-Aligned Injection

C.-W. Chen, *MediaTek*; C.-C. Hung, *MediaTek*; Y.-L. Hsueh, *MediaTek*

14:30

RMo3A-4: Transformer-Coupled 2.5GHz BAW Oscillator with 12.5fs RMS-Jitter and 1-kHz Figure-of-Merit (FOM) of 210dB

B. Bahr, *Texas Instruments*; S. Kalia, *Texas Instruments*; B. Haroun, *Texas Instruments*; S. Sankaran, *Texas Instruments*

14:50

15:10

24ABC

RMo3B: High-Performance mm-Wave Low-Noise Amplifiers

Chair: Vadim Issakov, *Technische Universität Braunschweig*
Co-Chair: Andrea Bevilacqua, *Università di Padova*

RMo3B-1: A mm-Wave Wideband/Reconfigurable LNA Using a 3-Winding Transformer Load in 22-nm CMOS FDSOI

M. Ghaedi Bardeh, *Texas A&M Univ.*; J. Fu, *Texas A&M Univ.*; N. Naseh, *Texas A&M Univ.*; J. Paramesh, *Texas A&M Univ.*; K. Entesari, *Texas A&M Univ.*

RMo3B-2: High-Performance Broadband CMOS Low-Noise Amplifier with a Three-Winding Transformer for Broadband Matching

J.-H. Kim, J.-T. Son, J.-T. Lim, J.-E. Lee, J.-H. Song, M.-S. Baek, H.-W. Choi, E.-G. Lee, S. Choi, *Chungnam National University*; C.-M. Lee, *Samsung*; S.-K. Yeo, *Samsung*; C.-Y. Kim, *Chungnam National University*

RMo3B-3: A 28-GHz 12-dBm IIP3 Low-Noise Amplifier Using Source-Sensed Derivative Superposition of Cascode for Full-Duplex Receivers

J. Myeong, *Yonsei Univ.*; B.-W. Min, *Yonsei Univ.*

RMo3B-4: A SiGe BiCMOS D-Band LNA with Gain Boosted by Local Feedback in Common-Emitter Transistors

G. De Filippi, *Università di Pavia*; L. Piotto, *Università di Pavia*; A. Bilato, *Università di Pavia*; A. Mazzanti, *Università di Pavia*

RMo3B-5: A D-Band to J-Band Low-Noise Amplifier with High Gain-Bandwidth Product in an Advanced 130nm SiGe BiCMOS Technology

M. Andree, *Bergische Universität Wuppertal*; J. Grzyb, *Bergische Universität Wuppertal*; B. Heinemann, *IHP*; U. Pfeiffer, *Bergische Universität Wuppertal*

25ABC

RMo3C: THz & mm-Wave Communication Transceivers & Circuits

Chair: Omeed Momeni, *University of California, Davis*
Co-Chair: Hossein Hashemi, *University of Southern California*

RMo3C-1: A 0.32-THz 6.6-dBm Single-Chain CW Transmitter Using On-Chip Antenna with 2.65% DC-to-THz Efficiency

G. Zachl, *Johannes Kepler Universität Linz*; C. Mangiavillano, *Johannes Kepler Universität Linz*; R.K.R. Mitta, *Johannes Kepler Universität Linz*; T. Schumacher, *Johannes Kepler Universität Linz*; H. Pretl, *Johannes Kepler Universität Linz*; A. Stelzer, Johannes Kepler *Universität Linz*

RMo3C-2: A 26-Gb/s 140-GHz OOK CMOS Transmitter and Receiver Chipset for High-Speed Proximity Wireless Communication

Q. Peng, *Tsinghua Univ.*; H. Jia, *Tsinghua Univ.*; R. Fang, *BriRadio Technology*; P. Guan, *Tsinghua Univ.*; M. Deng, *Tsinghua Univ.*; J. Xue, *Tsinghua Univ.*; W. Deng, *Tsinghua Univ.*; X. Liang, *BriRadio Technology*; B. Chi, *Tsinghua Univ.*

RMo3C-3: A 189GHz Three-Stage Super-Gain-Boosted Amplifier with Power Gain of 10.7dB/Stage at Near-fmax Frequencies in 65nm CMOS

F. He, *UESTC*; M. Ni, *UESTC*; Q. Xie, *UESTC*; Z. Wang, *UESTC*

RMo3C-4: A Fully Integrated 400GHz OOK Transceiver with On-Chip Antenna in 90nm SiGe BiCMOS for Multi Gbps Wireless Communication

S. Thomas, *Univ. of California, Los Angeles*; S. Razavian, *Univ. of California, Los Angeles*; A. Babakhani, *Univ. of California, Los Angeles*

23ABC

RMo4A: CMOS mm-Wave Frequency Multipliers

Chair: Andrea Mazzanti, *Università di Pavia*
Co-Chair: Foster Dai, *Auburn University*

RMo4A-1: A Double Balanced Frequency Doubler Achieving 70% Drain Efficiency and 25% Total Efficiency

J. Moody, *Sandia National Laboratories*

RMo4A-2: A 47GHz to 70GHz Frequency Doubler Exploiting 2nd-Harmonic Feedback with 10.1dBm Psat and ηtotal of 22% in 65nm CMOS

A. Aghighi, *Oregon State Univ.*; M. Essawy, *Oregon State Univ.*; A. Natarajan, *Oregon State Univ.*

RMo4A-3: A 91.9–113.2GHz Compact Frequency Tripler with 44.6dBc Peak Fundamental Harmonic-Rejection-Ratio Using Embedded Notch-Filters and Area-Efficient Matching Network in 65nm CMOS

X. Huang, *Tsinghua Univ.*; H. Jia, *Tsinghua Univ.*; W. Deng, *Tsinghua Univ.*; Z. Wang, *Tsinghua Univ.*; B. Chi, *Tsinghua Univ.*

RMo4A-4: A Compact 70–86GHz Bandwidth Frequency Quadrupler with Transformer-Based Harmonic Reflectors in 28nm CMOS

P. Ricco, *Università di Pavia*; G. Avitabile, *Politecnico di Bari*; D. Manstretta, *Università di Pavia*

24ABC

RMo4B: Advances in NB-IoT and WiFi Radios

Chair: Arun Paidimarri, *IBM T.J. Watson Research Center*
Co-Chair: Roxann Broughton-Blanchard, *Analog Devices*

RMo4B-1: A 0.75mW Receiver Front-End for NB-IoT

H.R. Kooshkaki, *Univ. of California, San Diego*; P.P. Mercier, *Univ. of California, San Diego*

RMo4B-2: A C-Band Compact High-Linearity Multibeam Phased-Array Receiver with Merged Gain-Programmable Phase Shifter Technique

J. Zhou, *Zhejiang Univ.*; N. Li, *Zhejiang Univ.*; Y. Yuan, *Zhejiang Univ.*; H. Gao, *Zhejiang Univ.*; S. Wang, *Zhejiang Univ.*; H. Lu, *Zhejiang Univ.*; C. Song, *Zhejiang Univ.*; Y.-C. Kuan, *NYCU*; Q.J. Gu, *Univ. of California, Davis*; Z. Xu, *Zhejiang Univ.*

RMo4B-3: A Wi-Fi Tri-Band Switchable Transceiver with 57.9fs-RMS-Jitter Frequency Synthesizer, Achieving -42.6dB EVM Floor for EHT320 4096-QAM MCS13 Signal

T.-M. Chen, *MediaTek*; M.-C. Liu, *MediaTek*; P.-A. Wu, *MediaTek*; W.-K. Hong, *MediaTek*; T.-W. Liang, *MediaTek*; W.-P. Chao, *MediaTek*; P.-Y. Chang, *MediaTek*; Y.-T. Chou, *MediaTek*; C.-W. Chen, *MediaTek*; S.-Y. Liu, *MediaTek*; C.-C. Huang, *MediaTek*; H.-H. Ting, *MediaTek*; M.-S. Hsu, *MediaTek*; Y.-C. Wang, *MediaTek*; C.-C. Hung, *MediaTek*; Y.-L. Hsueh, *MediaTek*; E. Lu, *MediaTek*; Y.-H. Chung, *MediaTek*; J.-H.C. Zhan, *MediaTek*

25ABC

RMo4C: High-Efficiency and Linear 5G mm-Wave Power Amplifiers

Chair: Debopriyo Chowdhury, *Broadcom*
Co-Chair: Patrick Reynaert, *KU Leuven*

RMo4C-1: A 26–40GHz 4-Way Hybrid Parallel-Series Role-Exchange Doherty PA with Broadband Deep Power Back-Off Efficiency Enhancement

E. Liu, *ETH Zürich*; H. Wang, *ETH Zürich*

RMo4C-2: A 26GHz Balun-First Three-Way Doherty PA in 40nm CMOS with 20.7dBm Psat and 20dB Power Gain

A.K. Kumaran, *Technische Universiteit Delft*; M. Pashaeifar, *Technische Universiteit Delft*; H.M. Nemati, *Huawei Technologies*; L.C.N. de Vreede, *Technische Universiteit Delft*; M.S. Alavi, *Technische Universiteit Delft*

RMo4C-3: A 26-GHz Linear Power Amplifier with 20.8-dBm OP1dB Supporting 256-QAM Wideband 5G NR OFDM for 5G Base Station Equipment

Z. Chen, *Sanechips Technology*; X. Wang, *ZTE*; X. Ma, *Sanechips Technology*; M. Lu, *Sanechips Technology*; J. Hu, *Sanechips Technology*; K. Ouyang, *Sanechips Technology*; Z. Long, *Sanechips Technology*

RMo4C-4: A 23–30GHz 4-Path Series-Parallel-Combined Class-AB Power Amplifier with 23dBm Psat, 38.5% Peak PAE and 1.3° AM-PM Distortion in 40nm Bulk CMOS

J. Gu, *Fudan Univ.*; H. Qin, *Fudan Univ.*; H. Xu, *Fudan Univ.*; W. Liu, *Fudan Univ.*; K. Han, *Jiashan Fudan Institute*; R. Yin, *Fudan Univ.*; L. Deng, *NICIC*; X. Shen, *NICIC*; Z. Duan, *ECRIEE*; H. Gao, *Technische Universiteit Eindhoven*; N. Yan, *Fudan Univ.*

15:40 16:00 16:20 16:40 17:00

MONDAY WORKSHOPS

08:00 – 17:20 | Monday, 12 June 2023

	WORKSHOP TITLE	WORKSHOP ABSTRACT
WMA	**Modulation Characterization Enabling Design of High-Efficiency and Linear Power Amplifier Systems** **Organizers:** Marc Vanden Bossche, *National Instruments*; Zoya Popović, *University of Colorado Boulder* **ROOM: 30DE** **08:00 – 11:50**	RF Power Amplifiers (PAs) play a dominant role in the system performance of wireless transmitters. PA designers are faced with the intractable goal of providing simultaneous high linearity and efficiency, as communications standards adopt ever higher modulation orders and bandwidths. Traditional PA design begins with a non-linear transistor model based on CW measurements. When the PA is measured under the desired modulated signals, degraded performance compared to simulation is commonly observed. Commercial adoption of phased arrays increases the disparity between traditional simulation and realistic measurements; coupling between antenna elements affects the PA performance in ways not accounted for in simulation. This workshop presents the next steps in improving design using modulation characterization to optimize global realistic performance of a system of PAs. The goal is to provide theoretical and practical background that can be applied directly at the lab bench. The workshop includes a practical demonstration using a commercial GaN device.
WMB	**Innovative and Compact Methods for Over-the-Air Characterization of Active Antenna Array Systems** **Organizers:** Thomas Deckert, *National Instruments*; Okay Schierhorn, *National Instruments* **ROOM: 30DE** **13:30 – 17:20**	Active array antennas have become mature technology in communication and radar applications. The spatial radiation characteristics are typically measured "over the air" using anechoic chambers and positioning gear to perform far- or near-field measurements. These approaches have long been used by engineers to characterize classic, passive antennas while measurements of RF front-ends and baseband circuitry could be performed conductively, bypassing the antenna. As frequencies continue to increase to sub-THz, designers need to integrate antennas with beamforming chips, making a separate characterization of antennas and RF chips impossible. Additionally, the classical methods do not scale well to test the high volumes that will come with active antennas becoming more ubiquitous. The classical methods are slow, large and mechanically challenging, all driving up the test cost significantly. This workshop highlights key advances in alternative multi-probe testers, near-field sockets, and quantum-sensing probes to overcome these limitations.
WMC	**AI and Machine Learning for RF Power Amplifier Design and Digital Predistortion** **Organizers:** Anding Zhu, *University College Dublin*; Rui Ma, *pSemi* **ROOM: 33ABC** **08:00 – 17:20**	Artificial Intelligence (AI) and Machine Learning (ML) have transformed technologies across all sectors and are offering solutions to many complex problems. In RF design, many AI/ML-based solutions have been proposed. This workshop brings researchers from both academia and industry to discuss how the newly developed AI/ML algorithms can be used in RF Power Amplifier (PA) design and Digital Pre-Distortion (DPD). The topics include using multi-dimensional search algorithms to automate matching network synthesis, post-layout generation using fully automated optimization methods, AI-based signal control technology and deep learning based inverse design in mm-wave PAs. We will also discuss the latest development of DPD algorithms using machine learning, including DPD model simplification, long term memory effect compensation, model extraction data selection, closed-loop adaptation and neural networks based DPD for linearizing multi-band MIMO phased array transmitters.
WMD	**Device Thermal Noise Metrology: Needs, Challenges and Opportunities** **Organizers:** Tom McKay, *GLOBALFOUNDRIES*; Leonard Hayden, *Qorvo* **ROOM: 29D** **08:00 – 17:20**	Availability of high-volume, extremely low-noise transistor VLSI technologies with minimum noise figures as low as 0.2dB (Te, min 14K) at Cellular, WiFi and SATCOM frequencies challenge existing noise metrology practice. State-of-the-art device noise metrology systems are unable to provide system architects and technology developers the ability to clearly discern performance of one device technology over another at these low noise levels. Recent investments by the EU and the US governments in semiconductor manufacturing including RF, microwave and mm-wave applications underscore the need and opportunity for further public-private collaboration in this area. This workshop begins with the motivation for extremely low minimum noise figure technology from applications such as LEO SATCOM and remote sensing, followed by technology developers' experience with existing metrology practice, culminating with discussions on ways forward from commercial vendors and NIST.
WME	**Microwave/RF Sensors for Nearfield and Long-Range Sensing Applications** **Organizers:** Mohammad H. Zarifi, *University of British Columbia*; Valentina Palazzi, *Università di Perugia* **ROOM: 30AB** **08:00 – 17:20**	This workshop will provide a comprehensive overview of the latest results on sensing, monitoring and characterization capability of RF/microwave-based devices operating from 30MHz to 300GHz. Microwave-based sensors have demonstrated great potential for non-destructive and non-ionizing monitoring of physical parameters and characterization of materials in liquid and solid phases. The main advances and results in this multi-disciplinary field, involving chemistry, material science and microwave engineering, will be illustrated. Microwave resonator sensors, RFID sensors, and antenna-based sensors for non-destructive, non-ionizing and contactless sensing and characterization applications will be covered, to provide the audience with an in-depth understanding of the subject, and of the potential synergies among different approaches.
WMF	**Emerging Synthesis-Based Design Techniques for Filters in Advanced Communication Systems** **Organizers:** Giuseppe Macchiarella, *Politecnico di Milano*; Ming Yu, *SUSTech*; Fabien Seyfert, *HighFSolutions* **ROOM: 30C** **08:00 – 11:50**	The evolution of communication technologies in recent years has required more and more performing subsystems and devices. The proposed workshop is focused on the latest solutions devised for the filtering subsystems required in the latest generation of communication systems. Developing these subsystems is challenging, expensive and increases time-to-market for new equipment. The scope of the workshop is to show how a synthesis-based approach may beneficially affect the development of new filters (as an alternative to brute-force optimization of full-wave models). In the first part of the workshop, five presentations show novel synthesis solutions for filters used in modern and future communication systems. In the second part, the goal is to involve interactively the audience showing the synthesis of some previously introduced filters, using an in-house developed software. This interactive moment is conceived to highlight the benefits of a synthesis-based design approach and familiarize attendees with this technique.

MONDAY WORKSHOPS

08:00 – 17:20 | Monday, 12 June 2023

	WORKSHOP TITLE	WORKSHOP ABSTRACT
WMG	**Recent Advances in Industrial Microwave Power Applications** **Organizers:** Zoya Popović, *University of Colorado Boulder*; Vadim V. Yakovlev, *Worcester Polytechnic Institute*; Malgorzata Celuch, *QWED* **ROOM: 30C** **13:30 – 17:20**	Applications of microwave power span an increasing number of research and industrial sectors. They include the widely known microwave heating, cooking, sterilization, vulcanization, etc. Microwave sintering of particulate materials, microwave plasma generation, microwave acceleration of chemical reactions for applications such as waste treatment are among the new disciplines showing the potential for new efficient technologies. Additionally, traditional S-band magnetron high-power sources are being challenged by semiconductor technologies that have some advantages, but are still more costly. The workshop has speakers from industry who will compare existing technologies, discuss the most recent applications, and multiphysics tools used to address them. One academic talk will discuss the main fundamental challenges on a few examples such as pyrolysis of mixed waste.
WMH	**Microwave Measurements in Extreme Environments for Emerging Applications in Computing, Energy, and Life Sciences** **Organizers:** Kamel Haddadi, *Université de Lille*; T. Mitch Wallis, *NIST*; Luca Pierantoni, *Università Politecnica delle Marche* **ROOM: 29AB** **08:00 – 17:20**	Microwaves have a vital role to play in a diverse collection of emerging application areas far beyond wireless communications and conventional microelectronics, spanning from quantum computing to energy storage to medical diagnostics. To unlock these potential applications, reliable microwave measurements are critical. Quantitative, functional data is required at each step of development to transform conceptual designs into fully engineered, validated, and optimized products. While microwave measurement techniques are generally well-established, new applications that are emerging today present new measurement challenges. This workshop will explore the current state-of-the-art in microwave metrology techniques that are extended to new and novel measurement environments and scenarios. The event will bring together researchers from across academia, industry, and government laboratories who work in varied application spaces. While these emerging applications may appear disparate, convening experts for detailed discussions of their microwave measurement challenges may uncover previously unseen connections and commonalities.
WMI	**Quantum Circuits, Methods, and Algorithms in Electromagnetics and Microwave Applications** **Organizers:** Johannes A. Russer, *Technische Universität München*; Vladimir Okhmatovski, *University of Manitoba*; Zhen Peng, *University of Illinois at Urbana-Champaign* **ROOM: 31AB** **08:00 – 17:20**	In recent years significant advances have been made in quantum computing, quantum sensing, and quantum communications. Circuit quantum electrodynamical models provide tools for modeling quantum devices. Superconducting electronics exhibit special quantum properties and, when monolithically integrated, extend the possibilities for integrated microwave circuits and devices, deeply rooted in microwave engineering, to a quantum level. For RF microwave engineers, this signifies an extension and transfer of microwave engineering concepts to the quantum realm. Using quantum circuit electrodynamics, key devices in microwave quantum engineering can be modeled. On the other hand, within quantum computing (QC), new quantum-based algorithms can harness problem-solving also in electromagnetics. In recent years, the remarkable progress made in QC hardware has defined a new, Noisy Intermediate-Scale Quantum (NISQ), QC era. By exploiting fundamental properties of quantum mechanics, these QC systems have the potential to deliver significant speedup against classical computing hardware for solving hard electromagnetic problems.
WMJ	**History and Recent Advances in Reflectarrays for SATCOM, 5G/6G and Imaging Systems (also known as Intelligent Reflect Surfaces)** **Organizers:** Gabriel M. Rebeiz, *University of California, San Diego* **ROOM: 31C** **08:00 – 17:20**	Reflectarrays, invented in the 1980s, have been predominantly used for satellite communications, high-speed imaging systems at 24GHz (airport security systems) and for mm-wave radars. Recently, they have been proposed as programmable reflect surfaces for 5G communication systems, and renamed as "Intelligent Reflect Surfaces" or IRS. This workshop presents the previous work in this area, and the new work being done from 24GHz to 300GHz. Some of the new work is geared towards large reflect surfaces for 5G/6G, some towards THz imaging systems, and some towards space applications. What is important is that with new low-loss silicon technologies and the high level of integration offered by silicon, one can now demonstrate large, low-power, low-loss reflect surfaces. The new reflectarrays are expanding this classic steerable antenna technology to a wide range of application areas spanning 5G, 6G, FMCW radars and THz systems.
WMK	**Transitioning from Microwave to mm-Wave Acoustic Wave Devices: Future Roadmap and Challenges** **Organizers:** Jordi Verdú, *Universitat Autònoma de Barcelona*; Pedro de Paco, *Universitat Autònoma de Barcelona* **ROOM: 29C** **08:00 – 17:20**	The complexity of the requirements in advanced 5G and forthcoming scenarios has a direct impact in the design of acoustic wave filters. Latest developments have pushed acoustic technology to an unprecedented situation that requires facing the incoming challenges from different perspectives. Taking this into account, the workshop aims to present the latest developments related to synthesis methodologies, linear and non-linear modeling, reconfigurability, and new orthogonal markets that may consider the use of acoustic wave resonators. The affiliation of the presenters will give the talks a more industrial focus, but also with an academic approach which may contribute to a more enriching discussion.
WML	**Recent Advances in Low Phase Noise and High Stability Microwave Oscillators** **Organizers:** Alexander Chenakin, *Anritsu*; Amarpal Paul Khanna, *Apionics* **ROOM: 32AB** **08:00 – 17:20**	This workshop will address a timely subject of low-phase-noise and high-stability microwave oscillators that are key building blocks of virtually any RF/microwave system. State-of-the-art low-noise and high-stability microwave oscillators are particularly important in high-speed telecommunications, wireless spectrum management and high-resolution imaging systems. Overall performance of most microwave subsystems depends on, and is often limited by, phase noise fluctuations in oscillators. In respect to phase noise and stability performance, designers primarily rely on ovenized crystal oscillators. However, recent advances in using other physical principles and materials are expected to enable oscillators with performance never imagined before. Various oscillator types, techniques, new materials along with their main characteristics will be reviewed.

RFIC PANEL SESSION

12:00 – 13:30 | Monday, 12 June 2023 | Room: 20A

How Soon Will We Become Cyborgs?

PANEL ORGANIZERS:
Alyssa Apsel, *Cornell University*
Travis Forbes, *Sandia National Laboratories*
Oren Eliezer, *Samsung Semiconductor, Inc.*

PANELISTS:
Renaldi Winoto, *Mojo Vision*
Carlos Morales, *Ambiq Micro*
Larry Larson, *Brown University*
Gert Cauwenberghs, *University of California, San Diego*
J.-C. Chiao, *Southern Methodist University*

ABSTRACT: Augmented-reality contact lenses, cochlear implants, AI-aided earbuds, and thought-activated prosthetics have already demonstrated the restoration and enhancement of human capabilities, and the incorporation of artificial intelligence (AI) into these technologies can further increase their potential. This lunchtime panel will host academia researchers and industry pioneers who are developing these technologies and will debate how they will affect our near- and long-term lifestyles.

IEEE FELLOWS CLASS OF 2023

SAN DIEGO CONVENTION CENTER | BALLROOM 20

THE IEEE GRADE OF FELLOW is conferred by the Board of Directors upon a person with an extraordinary record of accomplishments in any of the IEEE fields of interest. The total number selected in any one year does not exceed one-tenth of one percent of the total voting Institute membership. The accomplishments that are being honored have contributed importantly to the advancement or application of engineering, science and technology, bringing the realization of significant value to society. Fellow grade is effective 1 January 2023. Fellows will be recognized at the IMS Plenary Session tonight at 17:30-19:00 in Ballroom 20, San Diego Convention Center.

EVALUATED BY MTT-S	
Jaleel Akhtar	*for contributions in microwave planar sensors and nano-composites-based microwave absorbers*
Walid Ali-Ahmad	*for leadership in development of low-cost direct-conversion cellular RF systems*
Roberto Gomez-Garcia	*for contributions to planar multi-function microwave filters*
Shilong Pan	*for contributions to high-performance microwave-photonic imaging radar*
Smail Tedjini	*for contributions to the development of harmonic backscattering RFID systems and chipless tag solutions*
Miguel Urteaga	*for contributions to terahertz heterojunction bipolar transistor integrated circuit technology*
Hua Wang	*for contributions to high-efficiency microwave and millimeter-wave power amplifiers*
EVALUATED BY OTHER IEEE SOCIETIES/COUNCILS	
Francesco Andriulli	*for contributions to computational electromagnetics*
Mauro Ettorre	*for contributions to large antenna arrays based on quasi-optical beam formers*
Wonbin Hong	*for contributions to millimeter-wave mobile and base station antennas*
Ahmad Hoorfar	*for contributions to sensing and imaging in stratified media and optimization in electromagnetics*
Christina Lim	*for contributions in hybrid fiber-wireless communications technology*
Kenichi Okada	*for contributions to millimeter-wave communication circuits design*
Boon Ooi	*for contributions to broadband light emitters and visible light communications*
Oscar Quevedo-Teruel	*for contributions to glide symmetry based metasurfaces and lens antennas*
Jack Schuss	*for leadership in the development of antennas for satellite communications and radars*

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Sapphire Ballroom, MN, Hilton San Diego Bayfront Hotel

THREE MINUTE THESIS 14:00 – 16:00 Monday, 12 June 2023

In its seventh year, the IMS2023 3MT competition is designed to stimulate interest in the wide range of applications of microwave technology. Contestants will make a presentation of three minutes or less, supported only by one static slide, in a language appropriate to a non-specialist audience. The winners of the 3MT competition will receive their prizes at the Student Awards Luncheon on Thursday, 15 June 2023.

THIS YEAR'S FINALISTS ARE:

Overcoming the Barriers of the Galaxy's Harsh Environment for Radiometer Satellites
IF2-9 Alvaro Urain, *TECNUN - University of Navarra*

RRR: Reaching Remote Regions, 5g for All
Th2G-4 Bharath kumar Cimbili, *Fraunhofer IAF/Ericsson*

Electromagnetic Metamaterials: The Emerging Technology for Next-Generation Wireless Devices
We1E-1 Shrey Thakkar, *University of Michigan*

Zero-Powered Environmental RF Transceivers Combining Wireless Power and Information
Th2D-3 Helena Ribeiro, *Universidade de Aveiro*

Magic Begins with Microwave World
Th3A-2 Jo Tamura, *Yokohama National University*

PCB based Microwave Cold Plasma
We3H-4 Kazi Sadman Kabir, *University of Toledo, Ohio*

Mode Division Multiplexing for Multi-access Communication
We2F-5 Mohamed Elsawaf, *University of Southern California*

Development of Superconducting Resonators for Quantum Technologies and Astrophysics
We3B-3 Marina Calero de Ory, *Centro de Astrobiología (CSIC-INTA)*

Water Resources: We Need to Know More!
IF1-27 Giordano Cicioni, *University of Perugia*

Capturing the Future of IoT with My 5G Camera
Th3B-1 Charles Lynch, *Georgia Institute of Technology*

How Can We Make 5g Power Amplifiers More Environmentally Friendly? Overcoming the Efficiency Limitations of Their Current Designs.
IF1-17 Inês Lopes, *Universidade de Aveiro*

Divide and Conquer. The Crucial Role of Frequency Dividers in Harnessing the Power of Terahertz Waves.
Tu3E-3 Lukas Polzin, *Ruhr University Bochum*

Fast Lens Antenna Simulator Inspired by Optics
We3E-4 Wei Wang, *University of Notre Dame*

3D Printing Makes it Better, Does it Faster, Makes Us Stronger
Th3B-5 Giulia Battistini, *Alma Mater Studiorum - University of Bologna*

360 Degrees of Data Transfer: The Wireless Fully Rotatable 60GHz Connector
Tu2C-4 Caleb Romero, *Stevens Institute of Technology*

Making THz Sensors Mobile and Performant
Tu3E-4 Marcel van Delden, *Ruhr University Bochum*

Human Well Being Through Ultra High Speed Communication.
RMo1B-5 Sumit Pratap Singh, *University of Oulu*

Breaking the Cold Barrier: Overcoming the Scalability Bottleneck in Quantum Computing with Cryogenic Electronics
RTu2B-2 Niels Fakkel, *Delft University of Technology*

Ultrafast Photonic Filters
RTu2B-3 Ramy Rady, *Texas A&M University*

IMS INDUSTRY SHOWCASE | 15:10–17:00 | Monday, 12 June 2023 | Ballroom 20 Foyer

Join us before the IMS Plenary Session for the Industry Showcase where selected IMS paper authors will present their work.

PAPER TITLE	SPEAKER
Model Based Design for Frequency Scanning Array | **IF1-30**	Sourabh Joshi, *Mathworks India Pvt. Ltd.*
Model-Based Design of Next Generation RF and mmWave Systems | **We2A-1**	Girogia Zucchelli, *Mathworks Inc.*
Unique RF Modeling Enhances 5G Network Scenario Simulation | **We2A-1**	Ian Rippke, *Keysight Technologies*
Precision DPD Measurements and Modeling of Non-Linear Amplifiers | **Th2F-5**	Joel Dunsmore, *Keysight Technologies*
A New Class of Inline Microwave Filter with Transmission Zeros | **IF1-9**	Peng Wen Wong, FILPAL
Plasma Windowing for Hypersonic Radio Communications | **IF1-28**	Scott Sifferman, *Systems & Processes Engineering Corporation (SPEC)*
Fast Simultaneous Distortion Measurement Technique for Mismatch Compensation of Doherty Phased-Array Beamformers | **Th2F-5**	Yuuichi Aoki, *Samsung Electronics Co., Ltd.*
D-Band Air-Filled Substrate Integrated Waveguide (AFSIW) and Broadband Stripline to AFSIW Launcher Embedded in Multi-Layer PCBs | **Tu3B-5**	Siddhartha Sinha, *IMEC*
System Model-to-Lab Methodology for GNSS Desensitization Testing | **We2A-2**	Andrew Compston, *oneNav, Inc.*
4-Way Microstrip Wilkinson Power Splitter at Frequencies of Millimeter Waves | **IF1-2**	Mo Hasanovic, *Smiths Interconnect Americas, Inc.*
A Dual-Band Micromachined On-Wafer Probe with Integrated Diplexer for Ultra-Broadband Measurements to 220 GHz | **IF1-6**	Matthew Bauwens, *Dominion MicroProbes, Inc.*
A 25.5-31GHz Power Amplifier Using Enhancement-Mode High-K Dielectric GaN MOS-HEMTs in 300mm GaN-on-Si Technology | **Th1G-1**	Qiang Yu, *Intel Corporation*
Use of Cavity Perturbation Techniques to Characterize Via-Plate Behavior | **IF1-1**	Timothy Reeves, *MathWorks, Inc.*
Continuous Quasi-Load Insensitive Class-E Mode for Wideband Doherty Power Amplifiers | **We2C-2**	Xuan Anh Nghiem, *Ampleon*
A Manufacturable AlScN Periodically Polarized Piezoelectric Film Bulk Acoustic Wave Resonator (AlScN P3F BAW) Operating in Overtone Mode at X and Ku band | **Th1E-2**	Ramakrishna Vetury, *Akoustis, Inc.*
Ku-K-Band Low Power Dual-Channel LNAs With Less Than 1.4dB NF for SATCOM Phased Array Applications | **Tu1D-2**	Mohammad Ghadiri Sadrabadi, *Renesas Electronics America*
A Low Power V-Band LNA with Wide Supply Voltage Range Exploiting Complementary Current Reuse and Power Efficient Bias Point | **Tu2D-5**	Jesse Moody, *Sandia National Laboratories*
A Software-Defined 1TX-2RX FDD Transceiver Employing Frequency-Selective Dual-Band Self-Interference Cancellation | **Tu1C-3**	Nimrod Ginzberg, *Technion - Israel Institute of Technology*

SAN DIEGO CONVENTION CENTER

IMS PLENARY SESSION | 17:30 – 19:00 | Monday, 12 June 2023 | Ballroom 20

The Role of the Transmission Lines in Connecting People

IMS KEYNOTE SPEAKER:

Ed Godshalk, PhD, *Consultant and Engineer in Residence, George Fox University*

ABSTRACT: This presentation traces the formative years of electrical engineering and the evolution of transmission line engineering that enabled a global communications network over 120 years ago. The story begins with the invention of the "Victorian internet", the telegraph, generally regarded as the first practical use of electronics. This is followed by transatlantic telegraph cable, which some historians equate as the 19th century equivalent of landing a man on the moon. These were a catalyst for technologies such as improved battery design, insulated wire, coaxial cable, modulation schemes, and using the earth as a conductor. The transatlantic cable gave engineers a rude introduction to the concept of the RC time constant, which had a detrimental effect on data rate. Many great minds of the 19th century worked to understand and solve the telegraph data rate problem, resulting in the Telegrapher's equations that enable increased data rates and long distance telephone service. The author has replicated some of the original systems to illustrate the data rate problems. The culmination is the modern transoceanic fiber optic cable, which form the backbone of the global communications network, having data rates of over 500 Tbps (terabits per second).

SPEAKER BIO: Ed has been an Electrical Engineer for over 40 years and worked at several startups, Tektronix and Maxim Integrated. While at Cascade Microtech (1989-94), he invented the world's first waveguide input wafer probe and later the Air Coplanar Probe (ACP), which has been widely imitated. During his 22 years at Maxim, from which he retired in 2019, he created the Electromagnetics Group. He has over a dozen issued patents.

In 2020 he was elevated to the grade of Fellow by the Institute of Electrical and Electronic Engineers (IEEE) "For the development of microwave on-wafer probing and measurement techniques" which helped to enable microwave integrated circuits for commercial use.

Ed finds great pleasure in mentoring students and helping them achieve success in engineering and life. Helping students understand the origin of technical ideas is important to him, since he believes that this helps them to innovate and have a deeper understanding of the profession.

He also restores vintage sports cars and enjoys backcountry skiing and being in the mountains. In his younger days he was a climbing guide and organized an expedition that successfully climbed Denali, the tallest peak in North America (20,310'). He also climbed Kilimanjaro (19,341') in Africa, and numerous other peaks in North America.

SAN DIEGO CONVENTION CENTER

IMS WELCOME RECEPTION | 19:00 – 21:00 | Monday, 12 June 2023 | Sails Pavilion

IMS2023 starts with a welcome event on Monday for all attendees, which will be hosted in the Sails Pavilion at the San Diego Convention Center immediately following the IMS2023 Plenary Session. Join us for a Latin American Street Party that will feature food, drinks, music and entertainment inspired by the cultures of Latin America!

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23ABC

RTu1A: RF to THz LO Generation Solutions

Chair: Andreia Cathelin, *STMicroelectronics*
Co-Chair: Wanghua Wu, *Samsung*

08:00

RTu1A-1: A 15.6-GHz Quad-Core VCO with Extended Circular Coil Topology for Both Main and Tail Inductors in 8-nm FinFET Process

S. Hu, *Samsung*; Z. Chen, *Samsung*; W. Wu, *Samsung*; P.-Y. Chiang, *Samsung*; Z. Bai, *Samsung*; C.-W. Yao, *Samsung*; S. Son, *Samsung*

08:20

RTu1A-2: A 10.8–14.5GHz 8-Phase 12.5%-Duty-Cycle Non-Overlapping LO Generator with Automatic Phase-and-Duty-Cycle Calibration for 60-GHz 8-Path-Filtering Sub-Sampling Receivers

K.T. Phan, *HKUST*; Y. Gao, *HKUST*; H.C. Luong, *HKUST*

08:40

RTu1A-3: A 4.4mW Inductorless 2–20GHz Single-Ended to Differential Frequency Doubler in 45nm RFSOI CMOS Technology

A. Meyer, *Technische Univ. Braunschweig*; M.L. Leyrer, *Infineon Technologies*; C. Ziegler, *Technische Univ. Braunschweig*; M. Maier, *Technische Univ. Braunschweig*; V. Lammert, *Infineon Technologies*; V. Issakov, *Technische Univ. Braunschweig*

09:00

RTu1A-4: An Efficient 0.4THz Radiator with 20.6dBm EIRP and 0.2% DC-to-THz Efficiency in 90nm SiGe BiCMOS

S. Thomas, *Univ. of California, Los Angeles*; S. Razavian, *Univ. of California, Los Angeles*; A. Babakhani, *Univ. of California, Los Angeles*

09:20

09:40

24ABC

RTu1B: Self-Interference Cancellation Techniques

Chair: Jin Zhou, *MediaTek*
Co-Chair: Oren Eliezer, *Samsung*

RTu1B-1: A 28nm CMOS Dual-Band Concurrent WLAN and Narrow Band Transmitter with On-Chip Feedforward TX-to-TX Interference Cancellation Path for Low Antenna-to-Antenna Isolation in IoT Devices

S.-W. Tam, A. Razzaghi, A. Wong, S. Narravula, W. Xu, T. Loo, A. Kambale, A. Liu, O. Carnu, Y. Lin, R. Tsang, *NXP Semiconductors*

RTu1B-2: A Distributed Cascode Power Amplifier with an Integrated Analog SIC Filter for Full-Duplex Wireless Operation in 65nm CMOS

I. Melamed, *Technion*; N. Ginzberg, *Technion*; O. Malka, *Technion*; E. Cohen, *Technion*

RTu1B-3: Frequency-Domain-Equalization-Based Full-Duplex Receiver with Passive-Frequency-Shifting N-Path Filters Achieving >53dB SI Suppression Across 160MHz BW

S. Garimella, *Columbia Univ.*; S. Garikapati, *Columbia Univ.*; A. Nagulu, *Washington Univ. in St. Louis*; I. Kadota, *Columbia Univ.*; A. Davidson, *Columbia Univ.*; G. Zussman, *Columbia Univ.*; H. Krishnaswamy, *Columbia Univ.*

RTu1B-4: A Frequency-Tunable Dual-Path Frequency-Translated Noise-Cancelling Self-Interference Canceller RX with >16dBm SI Power-Handling in 65nm CMOS

M. Essawy, *Oregon State Univ.*; K. Rashed, *Oregon State Univ.*; A. Aghighi, *Oregon State Univ.*; A. Natarajan, *Oregon State Univ.*

25ABC

RTu1C: mm-Wave & Sub-THz Circuits & Systems for Radar Sensing and Metrology

Chair: Zeshan Ahmad, *Texas Instruments*
Co-Chair: Ruonan Han, *MIT*

RTu1C-1: High-Linearity 76–81GHz Radar Receiver with an Intermodulation Distortion Cancellation and High-Power Limiter

N. Landsberg, *Mobileye*; M. Gordon, *Mobileye*; O. Asaf, *Mobileye*; N. Weisman, *Mobileye*; K. Ben-Atar, *Mobileye*; S. Levin, *Mobileye*; S. Pellerano, *Intel*; W. Shin, *Apple*; D. Nahmanny, *Mobileye*

RTu1C-2: Mono/Multistatic Mode-Configurable E-Band FMCW Radar Transceiver Module for Drone-Borne Synthetic Aperture Radar

K. Lee, *POSTECH*; S. Bahrami, *POSTECH*; K. Kim, *POSTECH*; J. Kim, *POSTECH*; S.-U. Choi, *POSTECH*; H.-J. Song, *POSTECH*

RTu1C-3: A W-Band Spillover-Tolerant Mixer-First Receiver for FMCW Radars

J. Zhang, *Stanford Univ.*; S.S. Ahmed, *Stanford Univ.*; A. Arbabian, *Stanford Univ.*

RTu1C-4: A CMOS 160GHz Integrated Permittivity Sensor with Resolution of 0.05% $\Delta\varepsilon r$

H. Yu, *Univ. of California, Davis*; X. Ding, *Univ. of California, Davis*; J. Chen, *Qualcomm*; S. Sabbaghi Saber, *Univ. of California, Davis*; Q.J. Gu, *Univ. of California, Davis*

RTu1C-5: A 160-GHz FMCW Radar Transceiver with Slotline-Based High Isolation Full-Duplexer in 130nm SiGe BiCMOS Process

X. Li, *Tsinghua Univ.*; H. Wu, *Tsinghua Univ.*; S. Li, *Tsinghua Univ.*; W. Chen, *Tsinghua Univ.*; Z. Feng, *Tsinghua Univ.*

24ABC

RTu2B: Emerging Circuits and Systems for Quantum Computing, Quantum Sensing, Photonics, and Built-In Self-Test (BIST) Applications

Chair: Fabio Sebastiano, *Technische Universiteit Delft*
Co-Chair: Duane Howard, *Amazon*

RTu2B-1: A Diamond Quantum Magnetometer Based on a Chip-Integrated 4-Way Transmitter in 130-nm SiGe BiCMOS

H. Lotfi, *Univ. Stuttgart*; M. Kern, *Univ. Stuttgart*; N. Striegler, *NVision Imaging Technologies*; T. Unden, *NVision Imaging Technologies*; J. Scharpf, *NVision Imaging Technologies*; P. Schalberger, *Univ. Stuttgart*; I. Schwartz, *NVision Imaging Technologies*; P. Neumann, *NVision Imaging Technologies*; J. Anders, *Univ. Stuttgart*

RTu2B-2: A Cryo-CMOS DAC-Based 40Gb/s PAM4 Wireline Transmitter for Quantum Computing Applications

N. Fakkel, *Technische Universiteit Delft*; M. Mortazavi, *Technische Universiteit Delft*; R. Overwater, *Technische Universiteit Delft*; F. Sebastiano, *Technische Universiteit Delft*; M. Babaie, *Technische Universiteit Delft*

RTu2B-3: A mm-Wave CMOS/Si-Photonics Hybrid-Integrated Software-Defined Radio Receiver Achieving >80-dB Blocker Rejection of <-10dBm In-Band Blockers

R. Rady, *Texas A&M Univ.*; Y.-L. Luo, *Texas A&M Univ.*; C. Madsen, *Texas A&M Univ.*; S. Palermo, *Texas A&M Univ.*; K. Entesari, *Texas A&M Univ.*

RTu2B-4: Mixer-Free Phase and Amplitude Comparison Method for Built-In Self-Test of Multiple Channel Beamforming IC

S. Park, *KAIST*; E.-T. Sung, *KAIST*; S. Wang, *KAIST*; S. Hong, *KAIST*

25ABC

RTu2C: Systems for Applications: 5G and SATCOM

Chair: Bodhisatwa Sadhu, *IBM T.J. Watson Research Center*
Co-Chair: Raja Pullela, *MaxLinear*

RTu2C-1: A 24–30GHz 4-Stream CMOS Transceiver Based on Dual-LO Phase-Shifting Fully Connected Architecture

Q. Zhang, *UESTC*; Y. Yu, *UESTC*; D. Duan, *UESTC*; X. Xie, *UESTC*; S. Meng, *UESTC*; H. Wang, *UESTC*; C. Zhao, *UESTC*; H. Liu, *UESTC*; Y. Wu, *UESTC*; W. Che, *SCUT*; Q. Xue, *SCUT*; K. Kang, *UESTC*

RTu2C-2: A 39GHz 2×16-Channel Phased-Array Transceiver IC with Compact, High-Efficiency Doherty Power Amplifiers

J. Jung, J. Lee, D. Kang, J. Kim, W. Lee, H. Oh, J.-H. Park, K. Kim, D.-H. Lee, S. Lee, J.H. Lee, J.H. Kim, Y. Kim, T. Kim, S. Park, S. Park, S. Baek, B. Suh, S. Oh, D. Lee, J. Son, S.-G. Yang, *Samsung*

RTu2C-3: A 14-nm Low-Cost IF Transceiver IC with Low-Jitter LO and Flexible Calibration Architecture for 5G FR2 Mobile Applications

W. Wu, *Samsung*; J. Lee, *Samsung*; P.-K. Lau, *Samsung*; T. Kang, *Samsung*; K.K. Lau, *Samsung*; S.-W. Yoo, *Samsung*; X. Zhao, *Samsung*; A. Verma, *Samsung*; I.S.-C. Lu, *Samsung*; C.-W. Yao, *Samsung*; H.-S. Chen, *Samsung*; G. Feygin, *Samsung*; P. Dayal, *Samsung*; K.-B. Song, *Samsung*; S. Son, *Samsung*

RTu2C-4: A Quad-Band RX Phased-Array Receive Beamformer with Two Simultaneous Beams, Polarization Diversity, and 2.1–2.3dB NF for C/X/Ku/Ka-Band SATCOM

Z. Hu, *Univ. of California, San Diego*; O. Kazan, *Univ. of California, San Diego*; G.M. Rebeiz, *Univ. of California, San Diego*

10:10
10:30
10:50
11:10
11:30
11:50

TUESDAY

30AB

Tu1A: AI/Machine-Learning Technologies for Microwaves

Chair: Qi-Jun Zhang, *Carleton University*
Co-Chair: Costas D. Sarris, *University of Toronto*

08:00 – 08:10
Tu1A-1: Brain-Inspired Learning for Intelligent Spectrum Sensing
L. Katehi, *Texas A&M Univ.*; C. He, *Texas A&M Univ.*

08:40 – 08:50
Tu1A-2: Modeling of Heterogeneously Integrated Systems: Challenges and Strategies for Rapid Design Exploration
S.S. Ganti, *Purdue Univ.*; M.J. Smith, *Purdue Univ.*; C.-K. Koh, *Purdue Univ.*; D. Jiao, *Purdue Univ.*; G. Subbarayan, *Purdue Univ.*

09:00 – 09:10
Tu1A-3: Augmented Intelligence for End-to-End Design
J. Zhu, *Intel*

09:20 – 09:30
Tu1A-4: AI and Machine Learning for Microwaves — A Highlight of Past, Present and Future Trends
Q.-J. Zhang, *Carleton Univ.*

30C

Tu1B: Recent Advancements in HBTs and HEMTs for RF Applications

Chair: Peter Magnee, *NXP Semiconductors*
Co-Chair: Julio Costa, *GLOBALFOUNDRIES*

08:00 – 08:10
Tu1B-1: RF Reliability of SiGe and InP HBTs: A Comparative Study
C. Weimer, *Technische Universität Dresden*; M. Müller, *Technische Universität Dresden*; E. Vardarli, *Technische Universität Dresden*; M. Claus, *Infineon Technologies*; M. Schröter, *Technische Universität Dresden*

08:20 – 03:30
Tu1B-2: Temperature and Process Calibration of HBT-Based Square-Law Power Detectors for Millimeter-Wave Built-In Self-Test
Y. Wenger, *Keysight Technologies*; B. Meinerzhagen, *Technische Univ. Braunschweig*; V. Issakov, *Technische Univ. Braunschweig*

08:40 – 08:50
Tu1B-3: Investigation of Drain Noise in InP pHEMTs Using Cryogenic On-Wafer Characterization
B. Gabritchidze, K. Cleary, A. Readhead, A.J. Minnich, *Caltech*

Tu1B-4: Modeling and Measurement of Dual-Threshold N-Polar GaN HEMTS for High-Linearity RF Applications
R.R. Karnaty, P. Shrestha, M. Guidry, B. Romanczyk, U.K. Mishra, J.F. Buckwalter, *University of California Santa Barbara*

09:00 – 09:10
Tu1B-5: mm-Wave GaN-on-Si HEMTs with a PSAT of 3.9W/mm at 28GHz
R. ElKashlan, A. Khaled, S. Yadav, H. Yu, U. Peralagu, A. Alian, N. Collaert, P. Wambacq, B. Parvais, *IMEC*

Tu1B-6: Low-Voltage Operation AlInN/GaN HEMTs on Si with High Output Power at Sub-6GHz
K. Takeuchi, K. Saruta, S. Morita, K. Matsumoto, M. Yanagita, S. Taniguchi, S. Wada, K. Tasai, M. Shimada, K. Yanashima, *Sony*

09:20 – 09:30
Tu1B-7: InP HBT Technologies for Next Generation mmWave and THz Systems
M. Urteaga, Z. Griffith, A. Arias-Purdue, A. Carter, P. Rowell, J. Hacker, B. Brar, *Teledyne Scientific & Imaging*

30DE

Tu1C: Advanced Techniques in Multichannel and MIMO Systems

Chair: Kenneth E. Kolodziej, *MIT Lincoln Laboratory*
Co-Chair: Georgios Dogiamis, *Intel*

08:00 – 08:10
Tu1C-1: Cancellation of Air-Induced Passive Intermodulation in FDD MIMO Systems: Low-Complexity Cascade Model and Measurements
V. Lampu, *Tampere Univ.*; L. Anttila, *Tampere Univ.*; M. Turunen, *Tampere Univ.*; M. Fleischer, *Nokia*; J. Hellmann, *Nokia*; M. Valkama, *Tampere Univ.*

08:20 – 03:30
Tu1C-2: 2×2 MIMO In-Band Full Duplex Radio Front-End with 55-dB/60-dB Self-Interference Cancellation Over 200-MHz/100-MHz Bandwidth
G. Yang, *Yonsei Univ.*; D. Lee, *Yonsei Univ.*; H. Lim, *Yonsei Univ.*; B.-W. Min, *Yonsei Univ.*

08:40 – 08:50
Tu1C-3: A Software-Defined 1TX/2RX FDD Transceiver Employing Frequency-Selective Dual-Band Self-Interference Cancellation
N. Ginzberg, *Elbit Systems*; A. Lax, *Elbit Systems*; E. Cohen, *Elbit Systems*

09:00 – 09:10
Tu1C-4: Spatial Division Selectivity for High Density Users with Millimeter-Wave Massive Collocated- and Distributed-MIMO
N. Tawa, *NEC*; T. Kuwabara, *NEC*; Y. Maruta, *NEC*; T. Ando, *SoftBank*; T. Kaneko, *NEC*

31AB

Tu1D: mm-Wave CMOS LNAs and Receivers

Chair: Roee Ben-Yishay, *Intel*
Co-Chair: Damla Dimlioglu, *Cornell University*

08:00 – 08:10
Tu1D-1: A 115.7–139.7GHz Amplifier with 19.7dB Peak Gain and 7.9dB NF in 40-nm CMOS
K. Kim, *POSTECH*; J. Kang, *POSTECH*; K. Lee, *POSTECH*; S.-U. Choi, *POSTECH*; J. Kim, *POSTECH*; H.-J. Song, *POSTECH*

08:20 – 03:30
Tu1D-2: Ku/K-Band Low Power Dual-Channel LNAs with Less Than 1.4dB NF for SATCOM Phased Array Applications
M. Ghadiri-Sadrabadi, *Renesas Electronics*; H. Khatri, *Renesas Electronics*; C.-H. Ko, *Renesas Electronics*; W.-T. Wong, *Renesas Electronics*; U. Kodak, *Renesas Electronics*; T. Kanar, *Renesas Electronics*

08:40 – 08:50
Tu1D-3: A Flip-Chip W-Band On-Off Keying Receiver in 90-nm CMOS
H.-S. Chen, *National Tsing Hua Univ.*; H.-W. Wu, *National Tsing Hua Univ.*; Y.-T. Tseng, *National Tsing Hua Univ.*; J.Y.-C. Liu, *National Tsing Hua Univ.*

09:00 – 09:10
Tu1D-4: A 74.8–88.8GHz Wideband CMOS LNA Achieving +4.73dBm OP1dB and 6.39dB Minimum NF
L. Zou, *East China Normal Univ.*; K. Zhao, *East China Normal Univ.*; Z. Fang, *East China Normal Univ.*; L. Huang, *East China Normal Univ.*; B. Liu, *East China Normal Univ.*; C. Shi, *East China Normal Univ.*; G. Chen, *Shanghai Eastsoft Microelectronics*; J. Chen, *Univ. of Houston*; R. Zhang, *East China Normal Univ.*

09:20 – 09:30
Tu1D-5: A 0.4-to-30 GHz CMOS Low-Noise Amplifier with Input-Referred Noise Reduction and Coupled-Inductive-Peaking Technique
Haitang Dong, *Tianjin Univ.*; Keping Wang, *Tianjin Univ.*; Geliang Yang, *CETC54*; Shiyue Ma, *Tianjin Univ.*; Kaixue Ma, *Tianjin Univ.*

09:40

Denotes Industry Keynote Presentation

31C

Tu1E: Advanced Techniques for mm-Wave Signal Generation

Chair: José Luis Gonzalez-Jimenez, *CEA-LETI*

Co-Chair: Danny Elad, *Indie Semiconductor*

08:00

Tu1E-1: Advances in Microwave Synthesizer Technology

A. Chenakin, *Anritsu*

08:10

08:20

Tu1E-2: A V-Band CMOS Sextuple Sub-Harmonically Injection-Locked VCO Using Transformer and Cascade-Series Coupling with FTL

W.-C. Chen, *National Central Univ.*; H.-Y. Chang, *National Central Univ.*

08:30

08:40

Tu1E-3: A 67GHz High Output Power QVCO with 9.9% Efficiency and Improved Phase Noise in a 130nm SiGe:C Technology

D. Starke, *Ruhr-Universität Bochum*; S. Thomas, *Stadtwerke Bochum*; C. Bredendiek, *Fraunhofer FHR*; K. Aufinger, *Infineon Technologies*; N. Pohl, *Ruhr-Universität Bochum*

08:50

09:00

Tu1E-4: A V-Band LC-VCO and Doubler with Wide Tuning Range and Low Phase Noise Using Series-Shunt Anti-Parallel SiGe HBT Switches

W. Lim, *Georgia Tech*; A. Moradinia, *Georgia Tech*; S. Lee, *Georgia Tech*; C.D. Cheon, *Georgia Tech*; C.T. Coen, *Georgia Tech*; N.E. Lourenco, *Georgia Tech*; J.D. Cressler, *Georgia Tech*

09:10

09:20

Tu1E-5: A 110-GHz Push-Push Balanced Colpitts Oscillator Using 0.15-µm GaN HEMT Technology

J. Wang, *National Tsing Hua Univ.*; Y.-C. Chang, *NARLabs-TSRI*; Y. Liu, *National Tsing Hua Univ.*; S.-H. Li, *National Tsing Hua Univ.*; D.-C. Chang, *NARLabs-TSRI*; Y. Huang, *University of Liverpool*; S.S.H. Hsu, *National Tsing Hua Univ.*

09:30

09:40

INDUSTRY WORKSHOPS

08:00 – 17:20 | Tuesday, 13 June 2023

SESSION CODE	TIME & LOCATION	TITLE AND ABSTRACT	SPEAKER/S, AFFILIATION
IWTU1	08:00 – 09:40 Room: 29C	**5G Front End Modules Principles—**Mobile cellular subscribers reached more than 6 billion in 2022 and 5G NR brings high data capacity as low latency using sub-6 GHz and mmWave spectrum. The proliferation of worldwide smartphones has been in part possible due to increase computational power of CMOS in 3nm/5nm nodes. There is a shift in terms of what parts of the RF system are portioned in advanced CMOS nodes and what blocks are left and integrated in a RF front end module (RFFEMs). The workshop presents RFFEM architectures currently used and the challenges for the 5G deployment as well as the evolution to 6G.	Florinel Balteanu and Tom Valencia, *Skyworks Solutions*
IWTU2	08:00 - 09:40 Room 29D	**Advances in Multi-Technology Design Flow to Sign-Off—**Most designs cannot justify s small node processes, nodes<10nm. Regardless the business and system requirements call for greater functionality and lower costs. The industry is turning to unique packaging design and Multi-Technology IC to achieve goals. Tightly integrated simulation and analysis capabilities within a Sign-Off capable flow are required. In this workshop, the latest advances in the co-design of die, package, and board will be demonstrated in an evolving design flow taking advantage of the Virtuoso and APD+ platforms. The resulting flow reduces in-design errors and increases productivity, all inside a Design Managed flow.	Michael Thompson, *Cadence Design Systems, Inc.*
IWTU3	10:10 – 11:50 Room: 29C	**6G: Enabling the Path Towards THz Frequencies—**The roll-out of 5G networks is in full swing, academia and key industry players already look into what may become the next generation of wireless communication, aka 6G. The support of THz frequencies is one of the revolutionary aspects that dominate current research worldwide. The hunger for higher data rates demands access to wider bandwidths, which causes the research community and industry to push into the (sub-)THz regime. The D-Band (110 to 170 GHz) is a first hot candidate. The proposed workshop focuses on actual research activities looking at semiconductor technologies, RF transceiver design and test approaches.	Amelie Hagelauer, *Technical University of Munich (TUM);* Henri Happy, *University of Lille;* Marco Dietz, *Fraunhofer EMFT Research Institution for Microsystems and Solid State Technologies;* Markus Loerner, *Rohde & Schwarz;* Navneet Sharma, *Samsung Research America;* Paul Peterson, *Rohde & Schwarz*
IWTU4	10:10 – 11:50 Room: 29D	**.01-20 GHz Small Form Factor Multiport Network Analyzer Design Accelerators—**Analog Devices and Richardson RFPD are designing .01-20GHz, small, multiport, network analyzer signal chains for industrial, portable and production test applications. .01-20GHz network analyzers are complicated, which translates to being large and expensive. ADI has released the ADL5960; a .01-20GHz, integrated vector network analyzer front end on a chip, which enables small network analyzers. The design accelerators include all components necessary for a network analyzer; including highspeed converters, FPGA, signal generation, and the ADL5960. The designs goal was to remove our customers risk and reduce their design time. We will be discussing and demonstrating the designs at the workshop.	Ed Woytaszek, *Analog Devices;* Larry Hawkins, *Richardson RFPD*
IWTU5	13:30 – 15:10 Room: 29C	**Production OTA and ORAN Testing for 5G mMIMO Radio—**Massive MIMO radio is a key enabling technology of 5G networks. mMIMO radios are highly complex and integrated. The number of transceivers on a mMIMO radio can be 10-200 times more than a 4G radio. Baseband, RF front-end, and antenna are integrated in one unit. OTA and ORAN testing are two salient challenges in mMIMO radio manufacturing. In this workshop, the presenters will first analyze the problems from radio design and test system development perspectives. Then they will provide an automated solution to fast mMIMO radio calibration and testing in a compact OTA chamber with an integrated ORAN emulator.	Lin Lin, *Jabil*; Ben Smythe, *Keysight Technologies*; Kevin Loughran, *Jabil*
IWTU6	13:30 – 15:10 Room: 29D	**GaN-on-SiC: From Technology to System Design through Systematic and Accurate Modeling of Device Building Blocks—**There are challenges in dealing with device behaviors at different design levels--from device physics to application specifics and system level interactions. In this workshop, an overview of the Wolfspeed design process, from technologies to systems will be presented. From material to technology, and the final product; each development step involves simulation analysis to understand the design parameter interactions impacts on systems. The design process usually involves trade-offs in order to achieve the optimum performance. Strategically choosing the right design tools and modeling strategy is the key to unlocking the superior quality of the technology.	Yueying Liu, *Wolfspeed*
IWTU7	15:40 – 17:20 Room: 29C	**Validating a CATR Benchtop OTA Test System for 5G FR2 Phased Array Antenna R&D Testing—**Phased array antenna modules (PAAMs) require OTA tests to measure EIRP and EIS in addition to the traditional radiation patterns. Anechoic chambers are permanently in use because they are also needed for FW/SW testing. Fujikura develops 5G FR2 PAAMs with integrated ICs for beamforming, frequency conversion, and filters. They built their direct far-field chambers for radiation patterns and OTA tests. Rohde & Schwarz and Avnet automated mmWave RFSoC testing. In this workshop, the three companies will validate a CATR benchtop test system for the 5G FR2 PAAM R&D test. Metrics include ACLR, EVM, AMAM, AMPM with and without DPD.	Fabricio Dourado, *Rohde & Schwarz GmbH & Co KG;* Luc Langlois, *Avnet;* Shinnosuke Tsuchiya, *Fujikura Ltd.*
IWTU8	15:40 – 17:20 Room: 29D	**Design Technology Co-Optimization (DTCO) of RF Power Amplifier Designs with GaN Device Technology—**GaN HEMTs are leading candidates for high frequency high power amplifiers for 5G/6G base stations. TCAD simulation helps GaN device developers optimize epitaxial structure and layout parameters to achieve transistor DC and small signal (Ft) targets. The TCAD simulation generates I-V, C-V, S-parameter curves and large signal power sweeps. ASM compact model parameters are extracted from the TCAD simulation data, from which the PA circuit design is optimized with HB load pull simulation. The device-level insights into nonlinearity physics are revealed by Fourier coefficients of solution variables.	Nelson Braga, *Synopsys*

STUDENT DESIGN COMPETITIONS

09:00 – 17:00 | Tuesday, 13 June 2023

SAILS PAVILION, SAN DIEGO CONVENTION CENTER

All attendees are invited to the annual IMS Student Design Competitions on Tuesday, 13 June 2023. Students have been busy over the past several months designing and building solutions to the challenging engineering problems presented in the six student design competitions listed below. Judges will measure the students' designs at this event to determine the winners of the various competitions. Come to this event to cheer on the students, celebrate their hard work, and learn about their innovative designs.

SESSION CODE	TOPIC
SDC1	Wearable Backscatter Radio Student Design Competition
SDC2	3D-Printed and Surface-Mounted Bandpass Filter in X-band
SDC3	Component-Less Bias Tee
SDC4	High-Efficiency Power Amplifier for 50 MHz
SDC5	3D-Printed Rectennas for Energy Harvesting Applications
SDC6	High Efficiency Power Amplifier (HEPA) Student Design Competition
SDC7	Reflectionless High-pass Filter Design for Load-Pull Measurement Setups
SDC8	Radar for Non-Contact Vital Sign Sensing
SDC9	mmWave 3D-printed Antenna Design

SAN DIEGO CONVENTION CENTER

IMS TECHNICAL LECTURE

12:00 – 13:20 | Tuesday, 13 June 2023 | Ballroom Section 20A

TUESDAY

	LECTURE TITLE	ABSTRACT
TL2	**Integrated Digital Twins for Design and Test of 5G Networks** **Speaker:** Rajive Bagrodia, *Keysight Technologies*	There is growing interest in the potential of digital engineering, and more specifically Model Based Systems Engineering (MBSE) and digital twins, to shorten product development lifecycles and reduce costs. A primary benefit of such an approach is a SHIFT LEFT, such that many end-end system-level performance, interoperability, and security issues may be investigated earlier in the product development lifecycle than is typically the case using the traditional V-based design model. Digital Twins (DT) leverage high-fidelity software models of physical systems to support design, test, and lifecycle management of complex systems in an efficient and comprehensive manner. A DT uses simulation and emulation but differs from them in that the DT continuously learns and updates itself from multiple sources to represent the near real-time status and operating conditions of the corresponding real-world system. A Network Digital Twin (NDT) is a digital twin of a communications network which uses real-time data to enable understanding, learning, and reasoning across its lifecycle. We use integrated digital twins (IDT) to mean a digital twin that consist of three primary layers: • a software or services twin that represents the middleware and services that must directly satisfy the application-level Service Level Agreements or SLAs • a network digital twin that models the dynamic end-end communication path over a potentially heterogeneous network incorporating the protocols at the transport, network, link, and physical layers, and • an RF digital twin that captures the behavior of the transceiver devices, antennas, and the signal propagation among communicating neighbors. By constructing the IDT in the early stages of system design, perhaps by leveraging MBSE tools and methodologies, system designers and developers can also maintain a trace of the requirement flow from the initial system specification to the final deployed system. In this technical lecture, we will present the concept and primary components of an IDT. We will also demonstrate the application of an IDT to design complex systems using a 5G Non-Terrestrial Network (NTN) as an example case study. NTN design and architectures are being standardized by the 3GPP as an integral part of the 5G infrastructure. Broadly speaking, an NTN refers to a 5G network that includes a segment spanning non-terrestrial objects (e.g., High Altitude Platforms, or HAPS, and satellites) which may optionally host a base station. Various attributes of an NTN like the long communication delays, ground-air-space propagation links, and handoff among space-based platforms, make them an interesting case study for an IDT. Using this case study, we will both present an overall methodology for how the IDT can be applied to look at end-end performance of an NTN from the purview of applications like streaming videos, and describe the composabiity of models from the RF, network, and services domains. The case study will also illustrate how IDTs can support the Shift Left approach to early investigations of end-end system-level performance, interoperability, and security issues. Towards the end of the talk, we consider areas for ongoing research including multi-fidelity models, model composition, automated model generation, and model scalability.

TUESDAY

30AB

Tu2A: Machine Learning for RF to mm-Wave Systems

Chair: Adrian Tang, *JP*
Co-Chair: Qi-Jun Zhang, *Carleton University*

10:10 – 10:20
Tu2A-1: Beam-Dependent Active Array Linearization by Global Feature-Based Machine Learning
M. Mengozzi, *Univ. of Bologna*; G.P. Gibiino, *Univ. of Bologna*; A.M. Angelotti, *Univ. of Bologna*; C. Florian, *Univ. of Bologna*; A. Santarelli, *Univ. of Bologna*

10:30 – 10:40
Tu2A-2: Experimental Demonstration of a Machine Learning-Based Piece-Wise Digital Predistortion Method in 5G NR Systems
S.S.K.C. Bulusu, *Univ. of Oulu*; B. Khan, *Univ. of Oulu*; N. Tervo, *Univ. of Oulu*; M.E. Leinonen, *Univ. of Oulu*; M.J. Sillanpää, *Univ. of Oulu*; O. Silvén, *Univ. of Oulu*; M. Juntti, *Univ. of Oulu*; A. Pärssinen, *Univ. of Oulu*

10:50 – 11:00
Tu2A-3: Machine Learning Based Surrogate Modeling for Wave Impedances in Rectangular Dielectric Waveguides
R. Schmitz, B. Hattenhorst, C. Baer, T. Musch, I. Rolfes, *Ruhr-Universität Bochum*

11:00 – 11:10
Tu2A-4: Improved Temperature and Power Dependent Convolutional NN-Based Pa Model
Jose Domingues, *Univ. of Aveiro*; André Prata, Jiri Stulemeijer, *Qualcomm Technologies, Inc.*

11:10 – 11:20
Tu2A-5: A Deep Learning Space Mapping Based Enhancement of Compact Models for Accurate Prediction of Trapping in GaN HEMTs from DC to mm-Wave Frequency
M. Yusuf, S. Singh, B. Sarkar, A. Dasgupta, S. Roy, *IIT Roorkee*

11:30 – 11:40
Tu2A-6: Transistor-Based Modulator Modeling Technique Using Transfer Learning for Backscattered Communication Applications
H. Jeong, *Pusan National Univ.*; S. Kim, *Pusan National Univ.*

30C

Tu2B: Emerging mm-Wave GaN Technologies for DoD and 5G/6G Applications

Chair: Jeong-sun Moon, *HRL Laboratories*
Co-Chair: Fabrizio Bonani, *Politecnico di Torino*

10:10 – 10:20
Tu2B-1: Enhancement-mode 300mm GaN-on-Si(111) with Integrated Si CMOS for Future mm-Wave RF Applications
H.W. Then, M. Radosavljevic, Q. Yu, A. Latorre-rey, H. Vora, S. Bader, I. Momson, D. Thomson, M. Beumer, P. Koirala, J. Peck, A. Oni, T. Hoff, R. Jordan, T. Michaelos, N. Nair, P. Nordeen, A. Vyatskikh, I. Ban, A. Zubair, S. Rami, P. Fischer, *Intel Corp.*

10:30 – 10:40
Tu2B-2: High-Power Density W-Band MMIC Amplifiers Using Graded-Channel GaN HEMTs
J.-S. Moon, B. Grabar, J. Wong, J. Tai, I. Ramos, E. Arkun, C. Dao, D. Fanning, *HRL Laboratories*; N.C. Miller, M. Elliott, R. Gilbert, *AFRL*; N. Venkatesan, P. Fay, *Univ. of Notre Dame*

10:50 – 11:00
Tu2B-3: GaN SLCFET Technology for Next Generation mmW Systems, Demonstrating Pout of 10.87 W/mm with 43% PAE at 94 GHz
Robert Howell, Brian Novak, Timothy Vasen, Patrick Shea, Josephine Chang, Shamima Afroz, *Northrop Grumman Corp.*

11:10 – 11:20
Tu2B-4: Millimeter Wave GaN MMIC Technologies for Next-Gen Defense Applications
D.F. Brown, *BAE Systems* ; P. Srivastava, *BAE Systems* ; K. Chu, *BAE Systems* ; W. Zhu, *BAE Systems* ; D. Dugas, *BAE Systems*; M. Litchfield, *BAE Systems*

30DE

Tu2C: Advances in RF and mm-Wave Phased Array Antennas and Modules

Chair: Taiyun Chi, *Rice University*
Co-Chair: Kaushik Dasgupta, *Amazon*

10:10 – 10:20
Tu2C-1: Future Trends in Cellular Infrastructure and Radio Technology for Sustainable Networks
K. Chuang, *Analog Devices*; H. Yektaii, *Analog Devices*; N. Outaleb, *Analog Devices*

10:30 – 10:40
Tu2C-2: Embedded Near-Field Probing Antenna for Enhancing the Performance of 37-41 GHz Linear and Dual-Polarized Phased Antenna Arrays
H. Jin, *Univ. of Waterloo*; A. Ben Ayed, *Univ. of Waterloo*; Z. He, *Univ. of Waterloo*; B. Tung, *Univ. of Waterloo*; S. Boumaiza, *Univ. of Waterloo*

10:50 – 11:00
Tu2C-3: High Accuracy Wireless Time-Frequency Transfer for Distributed Phased Array Beamforming
J.M. Merlo, *Michigan State Univ.*; A. Schlegel, *Michigan State Univ.*; J.A. Nanzer, *Michigan State Univ.*

11:10 – 11:20
Tu2C-4: A 12.5-Gb/s Fresnel Zone Coupled Fully Rotatable 60-GHz Contactless Connector in 65-nm CMOS Process
H. Zaheri, W. Wargacki, C. Romero, Y. Kim, *Stevens Institute of Technology*

11:20 – 11:30
Tu2C-5: Multiband Dual-Polarized Array Antenna Module for 5G Millimeter-Wave Applications
M. Yoon, D. Choi, Y. Lee, K. Kwon, H. Lee, W. Jeong, D. Yang, S. Jung, D. Choi, S. Baek, J. Hur, S. Yoo, *Samsung*

11:30 – 11:40
Tu2C-6: Phased-Array Transceiver Chipsets and Modules for 5G FR2 and 60-GHz Fixed Wireless Access — A Commercial Perspective
A. Chen, *Peraso*

31AB

Tu2D: Microwave and mm-Wave LNAs

Chair: Shirin Montazeri, *Google*
Co-Chair: Kevin Kobayashi, *Qorvo*

10:10 – 10:20
Tu2D-1: Advances in InP HEMT Low Noise Amplifier Technology
W.R. Deal, *Northrop Grumman*

10:30 – 10:40
Tu2D-2: A Monolithic 0.8-to-18GHz Ultra-Wideband Reconfigurable Dual-Mode Transceiver Front-End in 0.15µm GaAs Technology
S. Ma, *UESTC*; T. Yao, *CETC 29*; Z. Wang, *UESTC*; X. Li, *UESTC*; M. Chen, *UESTC*; F. Yan, *UESTC*; K. Peng, *UESTC*; H. Zeng, *UESTC*; T. Yang, *UESTC*; H. Shao, *UESTC*; Y. Wang, *UESTC*

10:50 – 11:00
Tu2D-3: A Cryogenic Four-Channel C-Band Low-Noise Amplifier MMIC in 50-nm Metamorphic High-Electron-Mobility-Transistor Technology
F. Heinz, *Fraunhofer IAF*; F. Thome, *Fraunhofer IAF*; A. Leuther, *Fraunhofer IAF*

11:10 – 11:20
Tu2D-4: A 2.5-to-18GHz Reconfigurable LNA with 1.38-to-1.97dB NF Using Switchable Diplexer and Low-Noise Oriented Input
Z. Wang, *UESTC*; M. Chen, *UESTC*; X. Li, *UESTC*; X. Tang, *New Mexico State Univ.*; X. Li, *Nanhu Laboratory*; Y. Wang, *UESTC*

11:30 – 11:40
Tu2D-5: A Low Power V-Band LNA with Wide Supply Voltage Range Exploiting Complementary Current Reuse and Power Efficient Bias Point
J. Moody, *Sandia National Laboratories*; S. Lepkowski, *Sandia National Laboratories*; T.M. Forbes, *Sandia National Laboratories*

11:50

Denotes Industry Keynote Presentation

31C

Tu2E: Advanced Frequency Conversion and Signal Generation

Chair: Amit Jha, *Qualcomm*

Co-Chair: Yi-Jan Emery Chen, *National Taiwan University*

10:10 **Tu2E-1: A High LO-to-RF Isolation E-Band Mixer with 30GHz Instantaneous IF Bandwidth in 90nm CMOS**

W.-C. Ma, *National Taiwan Univ.*; C.-C. Chiong, *Academia Sinica*; Y.-S. Wang, *National Taiwan Univ.*; H. Wang, *National Taiwan Univ.*

10:20

10:30 **Tu2E-2: A Compact Multi-Channel CMOS Frequency Multiplier for Millimeter-Wave and Terahertz Signal Generation**

D.-W. Kang, *ETRI*

10:40

10:50 **Tu2E-3: A 2.4-GHz MEMS-Based Oscillator with Phase Noise of -138dBc/Hz at 100kHz Offset and 226dBc/Hz FoM**

S. Ma, *Tianjin Univ.*; K. Wang, *Tianjin Univ.*; M. Zhang, *Tianjin Univ.*; K. Ma, *Tianjin Univ.*

11:00

11:10 **Tu2E-4: A Comparison of 25GHz-LC-VCO Circuit Topologies for SEU Mitigation in 22nm FinFET**

D. Dolt, *Texas A&M Univ.*; I. Kim, *Texas A&M Univ.*; S. Palermo, *Texas A&M Univ.*

11:20

11:30 **Tu2E-5: Novel mm-Wave Oscillator Based on an Electromagnetic Bandgap Resonator**

E. Lia, *European Space Agency*; I. Ghosh, *IMST GmbH*; S. Hanham, *Univ. of Birmingham*; B. Walter, *Vmicro SAS*; F. Bavedila, *Vmicro SAS*; M. Faucher, *Institut d'électronique de micro-électronique et de nanotechnologie*; A. Gregory, *National Physical Laboratory*; L. Jensen, *Topsil GlobalWafers A/S*; J. Buchholz, *IMST GmbH*; H. Fischer, *IMST GmbH*; U. Altmann, *IMST GmbH*; R. Follmann, *IMST GmbH*

11:40

11:50

IEEE young professionals

Attention all Young Professionals (YP's)!

The Young Professionals (YP's) will host a reception at the Hilton San Diego Bayfront Hotel. The reception is a place to celebrate the young professionals, the future of the microwave community, network and interact with like-minded people.

Young Professionals Reception

Promenade Plaza, Hilton San Diego Bayfront Hotel 19:00 – 21:00 Tuesday, 13 June 2023

Sponsored By:

Microwaves&RF

CONNECTED FUTURE SUMMIT: **Connected Transportation**

Tuesday, 13 June 2023

This year's Connected Future Summit in San Diego is a collaboration between IEEE MTT-S and the IEEE Communications Society (COMSOC). Future Next G 6G networks will need to deliver a quality of experience through a seamless integration of communication, computation, and artificial intelligence. In addition to the technology advancements toward 6G IMT2030, the wireless connectivity landscape is changing rapidly with the evolution of local area network Wi-Fi and broadband wireless non- terrestrial networks (NTNs) satellite networks based on low-Earth orbit satellite constellations. The Next G technical specifications are transposed into standards by the seven regional Standards Setting Organizations that form the 3rd Generation Partnership Project toward 6G IMT2030 via the International Telecommunication Union Radiocommunication Sector. These standards for Next G deployment, along with R&D of the cellular technologies, are impacting future directions of connectivity in coordination with next-generation Wi-Fi technologies and broadband satellite networks.

MTT-S IEEE MICROWAVE THEORY & TECHNOLOGY SOCIETY

IEEE ComSoc IEEE Communications Society

AGENDA FOR THE CONNECTED FUTURE SUMMIT 2023:

Time	Topic	Speaker & Title
08:00-08:10	**Introduction**	
08:10-09:00	**Keynote on Connected Transportation**	**James Misener,** *Qualcomm* | The Communication Future Can Profoundly and Positively Impact the Transportation Future
09:00-09:40	**Application Specific**	**Ali Sadri,** *Airgain* | The Future of Transportation: Multifaceted Connectivity among Vehicles
09:40-10:10	**AM Coffee Break**	
09:00-09:40	**System Arch/Testbeds**	**Mari Silbey,** *US-Ignite* | PAWR – Driving Innovations in Connectivity
10:45-11:20	**RF/mmW System/FE/Component/Circuit/Antenna**	**Maha Achour,** *MetaWave* | Enhancing Safety and AI Perception using Long-Range High-SNR and Low-Interference 76-81GHz Multi-Functional Radar Sensing and V2V Communication
11:20-11:55	**RF/mmW System/FE/Component/Circuit/Antenna**	**Harish Krishnaswamy,** *University of Columbia and Sivers* | The Path to 6G: What Have We Learned from 5G and Where Do We Go From Here?
12:00-13:30	**Lunch Time Panel Session: Non-Terrestrial Networking**	**Panelists: Ryan Stevenson,** *Kymeta*; **Jim Sowers,** *Maxar*
13:30-14:00	**Space Technology and Devices**	**Ryan Jennings,** *Anokiwave* | Connecting with Space
14:00-14:20		**James Sower,** *MAXAR* | Gallium Nitride MMIC Power Amplifiers for High Throughput Satellite Applications
14:20-14:40		**Pascal Chevalier,** *ST Microelectronics* | SiGe Speaks to the Sky
14:40-15:10	**Heterogeneous Integration**	**Ted Jones,** *QORVO* | Heterogeneous Integration of RF Systems
15:10-15:40	**PM Coffee Break**	
15:40-16:10	**Test and Measurements**	**Ben Coffin,** *Keysight* | Sustainability in 6G: Driving Energy Efficiency in the Radio Access Network
14:10-16:40	**Test and Measurements**	**Dennis Lewis,** *Boeing* | Recent Advances in Robotic Antenna Measurements
14:40-17:10	**Closing Speaker Panel**	

To view the complete schedule please visit https://ims-ieee.org/connectedfuturesummit-2023 or reference the mobile app.

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KEYSIGHT

RF Globalnet

IMS/RFIC PANEL SESSION

12:00 – 13:30 | Tuesday, 13 June 2023 | Room: 32AB

AI/ML Based Wireless System Design and Operation – Hope or Hype?

PANEL ORGANIZERS:
Costas Sarris, *University of Toronto*
Qi-jun Zhang, *Carleton University*
Bohdi Sadhu, *IBM T. J. Watson*
Oren Eliezer, *Samsung Semiconductor*

PANELISTS:
Mike Shuo-Wei Chen, *USC*
Anding Zhu, *University College Dublin*
Elyse Rosenbaum, *UIUC*
Alberto Valdes Garcia, *IBM T. J. Watson*
Sadasivan Shankar, *Stanford University*
Joonyoung Cho, *Samsung Research America*

ABSTRACT: The use of machine learning (ML), or more broadly, artificial intelligence (AI), has already been demonstrated in a wide range of applications, including even music composition and artistic design. This lunchtime panel, with both industry and academia experts, will explore how we may harness AI in wireless system design and operation, and will attempt to distinguish hope from hype.

24ABC

RTu3B: Advanced Building Blocks for mm-Wave & Beyond

Chair: Yahya Tousi, *University of Minnesota*
Co-Chair: Qun Jane Gu, *University of California, Davis*

RTu3B-1: An Ultra-Wideband and Compact Active Quasi-Circulator with Phase Alternated Differential Amplifier

D. Yoo, *Yonsei Univ.*; J. Hwang, *Yonsei Univ.*; B.-W. Min, *Yonsei Univ.*

RTu3B-2: A D-Band Calibration-Free Passive 360° Phase Shifter with 1.2° RMS Phase Error in 45nm RFSOI

M. Abbasi, *Pennsylvania State Univ.*; W. Lee, *Pennsylvania State Univ.*

RTu3B-3: A 140GHz RF Beamforming Phased-Array Receiver Supporting >20dB IRR with 8GHz Channel Bandwidth at Low IF in 22nm FDSOI CMOS

S. Dong, *Samsung*; N. Sharma, *Samsung*; S. Li, *Samsung*; M. Chen, *Samsung*; X. Zhang, *Rice Univ.*; Y. Hu, *Rice Univ.*; J. Li, *Samsung*; Y. Su, *Samsung*; X. Xu, *Samsung*; V. Loseu, *Samsung*; E. Seok, *Samsung*; T. Chi, *Rice Univ.*; W.-S. Choi, *Samsung*; G. Xu, *Samsung*

RTu3B-4: A mm-Wave Blocker-Tolerant Receiver Achieving <4dB NF and -3.5dBm B1dB in 65-nm CMOS

E. Zolkov, *Technion*; N. Ginzberg, *Technion*; E. Cohen, *Technion*

25ABC

RTu3C: IoT Transmitter and Sub-THz Power Amplifiers

Chair: Alexandre Giry, *CEA-LETI*
Co-Chair: Hyun-Chul Park, *Samsung*

RTu3C-1: A Reactive Passive Mixer for 16-QAM Cartesian IoT Transmitters in 22nm FD-SOI CMOS

L. Tomasin, *Università di Padova*; D. Vogrig, *Università di Padova*; A. Neviani, *Università di Padova*; A. Bevilacqua, *Università di Padova*

RTu3C-2: A 110–170GHz Phase-Invariant Variable-Gain Power Amplifier Module with 20–22dBm Psat and 30dBm OIP3 Utilizing SiGe HBT RFICs

M. Sayginer, *Nokia Bell Labs*; M. Holyoak, *Nokia Bell Labs*; M. Zierdt, *Nokia Bell Labs*; M. Elkhouly, *Nokia Bell Labs*; J. Weiner, *Nokia Bell Labs*; Y. Baeyens, *Nokia Bell Labs*; S. Shahramian, *Nokia Bell Labs*

RTu3C-3: A D-Band 20.4dBm OP1dB Transformer-Based Power Amplifier with 23.6% PAE in a 250-nm InP HBT Technology

S. Gielen, *KU Leuven*; Y. Zhang, *IMEC*; M. Ingels, *IMEC*; P. Reynaert, *KU Leuven*

RTu3C-4: 305-GHz Cascode Power Amplifier Using Capacitive Feedback Fabricated Using SiGe HBT's with fmax of 450GHz

S. Ghosh, *Univ. of Texas at Dallas*; F. Zhang, *Univ. of Texas at Dallas*; H. Guo, *Univ. of Texas at Dallas*; K.K. O, *Univ. of Texas at Dallas*

13:30
13:50
14:10
14:30
14:50
15:10

Don't miss all these great activities happening in the Sails Pavilion!

- ▲IMS Student Design Competitions
- ▲Young Professionals (YP) Lounge and Activities
- ▲Historical Exhibit
- ▲IMS Interactive Forum Sessions
- ▲WIM/YP Joint Panel Session

TUESDAY

30AB

Tu3A: Artificial Intelligence and Machine-Learning Techniques for Signal and Power Integrity

Chair: José E. Rayas-Sánchez, *ITESO*
Co-Chair: Costas D. Sarris, *University of Toronto*

13:30

Tu3A-1: Constrained Gaussian Process for Signal Integrity Applications Using Variational Inference

T. Nguyen, *Univ. of Illinois at Urbana-Champaign*; B. Shi, *Univ. of Illinois at Urbana-Champaign*; H. Ma, *Zhejang University*; E.-P. Li, *Zhejang University*; A. Cangellaris, *Univ. of Illinois at Urbana-Champaign*; J. Schutt-Aine, *Univ. of Illinois at Urbana-Champaign*

13:40

13:50

Tu3A-2: Optimization of Decoupling Capacitors in VLSI Systems Using Granularity Learning and Logistic Regression Based PSO

J.N. Tripathi, *IIT Jodhpur*; D. Junjariya, *IIT Jodhpur*; R. Achar, *Carleton Univ.*

14:00

14:10

Tu3A-3: Efficient Estimation of Stochastic Power Supply Noise Induced Jitter in CMOS Inverters via Knowledge-Based Neural Networks

A. Javaid, *Carleton Univ.*; R. Achar, *Carleton Univ.*; J.N. Tripathi, *IIT Jodhpur*

14:20

14:30

Tu3A-4: Physics-Informed Neural Networks for Multiphysics Simulations: Application to Coupled Electromagnetic-Thermal Modeling

S. Qi, *Univ. of Toronto*; C.D. Sarris, *Univ. of Toronto*

14:40

14:50

Tu3A-5: A Fast Rank-Revealing Method for Solving High-Dimensional Global Optimization Problems

D. Jiao, *Purdue Univ.*

15:00

15:10

30C

Tu3B: Integrated Passive Devices

Chair: Charles Campbell, *Qorvo*
Co-Chair: Pei-Ling Chi, *NYCU*

Tu3B-1: A 450W GaN-Based Limiter for S-Band Applications

R. Mathieu, *UMS*; H. Debergé, *UMS*; E. Richard, *UMS*; N. Belouchrani, *UMS*; C. Chang, *UMS*; M. Camiade, *UMS*; A. Bessemoulin, *UMS*; M. Olivier, *Thales*; J.-F. Goupy, *Thales*; M. Stanislawiak, *Thales*

Tu3B-2: A 26–32GHz Differential Attenuator with 0.23dB RMS Attenuation Error and 11.2dBm IP1dB in 40nm CMOS Process

A. Sun, *Fudan Univ.*; J. Gu, *Fudan Univ.*; H. Xu, *Fudan Univ.*; W. Liu, *Fudan Univ.*; K. Han, *Jiashan-Fudan Joint Research Institute*; R. Yin, *Fudan Univ.*; Z. Duan, *ECRIEE*; H. Gao, *Technische Universiteit Eindhoven*; N. Yan, *Fudan Univ.*

Tu3B-3: A 26–44GHz 28nm CMOS FD-SOI Slow-Wave Tunable Hybrid Coupler for 5G Application

G. Diverrez, *IMS (UMR 5218)*; E. Kerhervé, *IMS (UMR 5218)*; M. De Matos, *IMS (UMR 5218)*; A. Cathelin, *STMicroelectronics*

Tu3B-4: A Balun-Integrated On-Chip Differential Pad for Full/Multi-Band mmWave/THz Measurements

J. Grzyb, *Bergische Universität Wuppertal*; M. Andree, *Bergische Universität Wuppertal*; P. Hillger, *Bergische Universität Wuppertal*; T. Bücher, *Bergische Universität Wuppertal*; U.R. Pfeiffer, *Bergische Universität Wuppertal*

Tu3B-5: D-Band Air-Filled Substrate Integrated Waveguide (AFSIW) and Broadband Stripline to AFSIW Launcher Embedded in Multi-Layer PCBS

Siddhartha Sinha, *IMEC*; Heinrich Trischler, *AT&S*; Ilja Ocket, *IMEC*; Erich Schlaffer, *AT&S*

30DE

Tu3C: Emerging mm-Wave Integrated Transceivers and Beamformers

Chair: Najme Ebrahimi, *University of Florida*
Co-Chair: Kenneth Mays, *Boeing*

Tu3C-1: Millimeter Wave Circuits for Phased Array Communication Systems in 28nm CMOS Technology

F. Padovan, *Infineon Technologies*

Tu3C-2: A Compact Ka-Band Eight-Element Four-Beam Receiver for Low-Earth-Orbit Satellite Communications in 65-nm CMOS

Yuexiaozhou Yuan, *Zhejiang Univ.*; Nayu Li, *Zhejiang Univ.*; Jingying Zhou, *Zhejiang Univ.*; Huiyan Gao, *Zhejiang Univ.*; Shaogang Wang, *Zhejiang Univ.*; Hang Lu, *Zhejiang Univ.*; Qun Jane Gu, *Univ. of California, Davis*; Chunyi Song, *Zhejiang Univ.*; Zhiwei Xu, *Zhejiang Univ.*

Tu3C-3: A CMOS Low Power K-Band FMCW Radar Transceiver Front-End for AIOT Application

S. Yuan, *Zhejiang Univ.*; S. Wang, *Zhejiang Univ.*; J. Chen, *Zhejiang Univ.*; J. Liu, *Zhejiang Univ.*; Q. Li, *Zhejiang Univ.*; Q. Yang, *Zhejiang Univ.*; Q.J. Gu, *Univ. of California, Davis*; C. Song, *Zhejiang Univ.*; Z. Xu, *Zhejiang Univ.*

Tu3C-4: A 26–32GHz 6-Bit Bidirectional Passive Phase Shifter with 14dBm IP1dB and 2.6° RMS Phase Error for Phased Array System in 40nm CMOS

Y. Tian, *Fudan Univ.*; J. Gu, *Fudan Univ.*; H. Xu, *Fudan Univ.*; W. Liu, *Fudan Univ.*; Z. Duan, *ECRIEE*; H. Gao, *Technische Universiteit Eindhoven*; N. Yan, *Fudan Univ.*

Tu3C-5: Beam Control Free 28GHz 5G Relay Transceiver and 24GHz Wireless Power Receiver Using On-Chip Butler Matrix

K. Yuasa, *Tokyo Tech*; M. Ide, *Tokyo Tech*; S. Kato, *Tokyo Tech*; K. Okada, *Tokyo Tech*; A. Shirane, *Tokyo Tech*

31AB

Tu3D: Power Amplifier Design Solutions for Sub-6GHz Applications

Chair: Vittorio Camarchia, *Politecnico di Torino*
Co-Chair: Ali M. Darwish, *Army Research Laboratory*

Tu3D-1: Performance Modeling and Shaping Function Extraction for Dual-Input Load Modulated Power Amplifiers

W. Li, *Univ. Politècnica de Catalunya*; A. Bogusz, *Cardiff University*; J. Lees, *Cardiff University*; R. Quaglia, *Cardiff University*; S. Cripps, *Cardiff University*; G. Montoro, *Univ. Politècnica de Catalunya*; P.L. Gilabert, *Univ. Politècnica de Catalunya*

Tu3D-2: A Differential Amplifier with Enhanced Linearity of Average Power Region Using Dynamic Cross-Coupled Capacitor for 5G NR-U

S. Hwang, *Hanyang Univ.*; J. Jeon, *Gangneung-Wonju National University*; S. Bae, *Hanyang Univ.*; B. Yoon, *Hanyang Univ.*; J. Kim, *Hanyang Univ.*

Tu3D-3: PA Output Power and Efficiency Enhancement Across the 2:1 VSWR Circle Using Static Active Load Adjustment

G.D. Singh, *Technische Universiteit Delft*; H.M. Nemati, *Huawei Technologies*; M.S. Alavi, *Technische Universiteit Delft*; L.C.N. de Vreede, *Technische Universiteit Delft*

Tu3D-4: Load Modulated Balanced Amplifier Design for Handset Applications

Kiichiro Takenaka, *Murata Manufacturing Co., Ltd.*; Yuuma Noguchi, *Murata Manufacturing Co., Ltd.*; Satoshi Arayashiki, *Murata Manufacturing Co., Ltd.*; Takaya Wada, *Murata Manufacturing Co., Ltd.*

Tu3D-5: Design of Highly-Efficient Dual-Band GaN HEMT Power Amplifier with Dual-Class E/F-1 Operation

D.-A. Nguyen, *Soongsil Univ.*; G.T. Bui, *Soongsil Univ.*; C. Seo, *Soongsil Univ.*

Denotes Industry Keynote Presentation

31C

Tu3E: Advanced High-Frequency Mixed-Signal Circuits and Systems

Chair: Christian Carlowitz, *FAU Erlangen-Nürnberg, Germany*
Co-Chair: Manjunath Kareppagoudr, *AMD*

Tu3E-1: Low Jitter Frequency Generation for 5G mm-Wave Cellular Applications

W. Wu, *Samsung*

Tu3E-2: An All-Digital Carrier Synthesis for Stepped OFDM Radars

D. Werbunat, *Universität Ulm*; B. Schweizer, *Universität Ulm*; M. Maier, *Universität Ulm*; C. Bonfert, *Universität Ulm*; D. Schindler, *Robert Bosch*; P. Hinz, *Universität Ulm*; J. Hasch, *Robert Bosch*; C. Waldschmidt, *Universität Ulm*

Tu3E-3: A 142 GHz 4/5 Dual-Modulus Prescaler for Wideband and Low Noise Frequency Synthesizers in 130 nm SiGe:C BiCMOS

L. Polzin, *Ruhr Univ. Bochum*; M. van Delden, *Ruhr Univ. Bochum*; N. Pohl, *Ruhr Univ. Bochum*; H. Rücker, *IHP Microelectronics*; T. Musch, *Ruhr Univ. Bochum*

Tu3E-4: A Fast and Highly-Linear Phase-Frequency Detector with Low Noise for Fractional Phase-Locked Loops

M. van Delden, L. Polzin, B. Walther, N. Pohl, *Ruhr-Universität Bochum*; K. Aufinger, *Infineon Technologies*; T. Musch, *Ruhr-Universität Bochum*

Tu3E-5: 120 GBd 2.8 Vpp, Diff Low-power Differential Driver for InP Mach-Zehnder Modulator using 55 nm SiGe HBTs

J.H. Choi, *Fraunhofer Heinrich Hertz Institute*; N. Nijanandi, *Fraunhofer Heinrich Hertz Institute*

Tu3E-6: A 21Gb/s Arbitrary Binary Sequence Generator for PMCW Radar Based on a TSPC Serializer in 22nm FDSOI

F. Probst, *FAU Erlangen-Nürnberg*; A. Engelmann, *FAU Erlangen-Nürnberg*; V. Issakov, *Technische Univ. Braunschweig*; R. Weigel, *FAU Erlangen-Nürnberg*

RFIC INDUSTRY CHIP CHAT (Student Program)

17:00 – 19:00 | Tuesday, 13 June 2023 | 32AB, San Diego Convention Center

3 Things to Start Your Career with a Bang

13:30

Come and join the RFIC2023 special event customized by and for students in the RF industry!

13:50

A Chip-Chat and reception, where future leaders meet prominent industry professionals to confess their secrets about their first years in their career. Bring your questions for an open discussion about the metamorphosis from student to professional RFIC designer, negotiate your salary and how to manage your talent to impact lives and more especially yours. Not enough time to extract all the secrets? Everyone is invited to continue chip chatting at the RFIC nacho station.

IMS STUDENT PAPER COMPETITION

14:10

THIS YEAR'S IMS STUDENT PAPER COMPETITION FINALISTS:

A 26-44GHz 28nm CMOS FD-SOI Slow-Wave Tunable Hybrid Coupler for 5G Application | Tu3B-3
Student Finalist: Gwennaël Diverrez, *University of Bordeaux*
Advisor: Eric Kerhervé, *University of Bordeaux*

14:30

Displacement Monitoring Using Phase- and Quadrature Self-Injection-Locked (PQSIL) Radar | Th1C-2
Student Finalist: Ji-Xun Zhong, *National Sun Yat-sen University*
Advisor: Fu-Kang Wang, *National Sun Yat-sen University*

A Compact Ka-Band Eight-Element Four-Beam Receiver for Low-Earth-Orbit Satellite Communications in 65-nm CMOS | Tu3C-2
Student Finalist: Yuexiaozhou Yuan, *Zhejiang University*
Advisor: Zhiwei Xu, *Zhejiang University*

14:50

High Accuracy Wireless Time-Frequency Transfer For Distributed Phased Array Beamforming | Tu2C-3
Student Finalist: Jason Merlo, *Michigan State University*
Advisor: Jeffrey Nanzer, *Michigan State University*

A 13-GHz "3D" Near-field Imager employing Programmable Fringing Fields for Cancer Imaging | Th1B-3
Student Finalist: Zong-Jun Cheng, *National Taiwan University*
Advisor: Jun-Chau Chien, *National Taiwan University*

15:10

A 142 GHz 4-5 Dual-Modulus Prescaler for Wideband and Low Noise Frequency Synthesizers in 130 nm SiGe:C BiCMOS | Tu3E-3
Student Finalist: Lukas Polzin, *Ruhr University Bochum*
Advisor: Thomas Musch, *Ruhr University Bochum*

A W-Band Single-Pole Double-Throw Photoconductive Evanescent-Mode Waveguide Switch | Th2E-3
Student Finalist: Erik Der, *University of Alberta*
Advisor: Kambiz Moez, *University of Alberta*

A 10 Gb-s 275 fsec Jitter Charge-Sampling CDR for Quantum Computing Applications | We3A-1
Student Finalist: Joachim Bas, *Technische Universiteit Delft*
Advisor: Masoud Babaie, *Technische Universiteit Delft*

A Ka-Band 64-element Deployable Active Phased Array Transmitter on a Flexible Hetero Segmented Liquid Crystal Polymer for Small-Satellites | We1A-1
Student Finalist: Dongwon Yu, *Tokyo Institute of Technology*
Advisors: Kenichi Okada, *Tokyo Institute of Technology;* Atsushi Shirane, *Tokyo Institute of Technology*

A 220 GHz Code-Domain Focal-Plane Imaging Radar with 0.78 Degree Angular Resolution for Automotive Applications | We2B-5
Student Finalist: Yinuo Xu, *Stanford University*
Advisor: Thomas Lee, *Stanford University*

SAN DIEGO CONVENTION CENTER

MICROAPPS

10:00 – 16:30 | Tuesday, 13 June 2023 | IMS Exhibit Floor: Booth 2447

SESSION CODE	TIME	TITLE	SPEAKER/S, AFFILIATION
TUMA3	10:00 – 10:15	AI-Based Digital Predistortion in MATLAB	Mike McLernon, *MathWorks, Inc.*
TUMA4	10:15 – 10:30	Introducing the Spectre S-Parameter Quality Checker and RFM Model Generator	Tawna Wilsey, *Cadence Design Systems*
TUMA6	10:45 – 11:00	Modern Design and Verification Flow for Silicon RF & Millimeter Wave ICs	Jian Yang, Synopsys
TUMA7	11:00 – 11:15	RF-Sampling MxFE for Multi-function Use in EW, Radar, Comms, and Instrumentation	Robert Dandaraw, *Analog Devices Inc.*
TUMA8	11:15 – 11:30	SiGe BiCMOS Technologies for Cryogenic Applications	René Scholz, *IHP*
TUMA9	11:30 – 11:45	SiGe BiCMOS Technologies for Integration of THz and Power Efficient mm-wave Systems	Andreas Mai, *IHP*
TUMA10	11:45 – 12:00	Modern 5G Millimeter Wave Antenna Array Evaluation in Near- and Far-Field Environments	Jari Vikstedt, *ETS-Lindgren*
TUMA12	12:15 – 12:30	Comparison of Analytical Solutions and Numerical Optimization in Beamforming	Jussi Rahola, Olli Pekonen, *Optenni Ltd*
TUMA13	12:30 – 12:45	The Challenges and Benefits of Active Antenna Tuning	Jarred Moore, *pSemi Corporation*
TUMA14	12:45 – 13:00	Matching Network Design in XFdtd	Justin Newton, *Remcom, Inc.*
TUMA15	13:00 – 13:15	A 16-Channel Transmit, 16-Channel Receive Direct X-Band Sampling Phased Array Development Platform	Mike Jones, *Analog Devices, Inc.*
TUMA16	13:15 – 13:30	Broadband On-wafer Differential VNA Measurements to 220 GHz: Concepts and Solutions	Steve Reyes, *Anritsu Co.*
TUMA17	13:30 – 13:45	Faster Modulation Testing in Characterization and Production	Markus Loerner, *Rohde & Schwarz*
TUMA18	13:45 – 14:00	From Design to Hardware	Markus Loerner, *Rohde & Schwarz*
TUMA19	14:00 – 14:15	The Vector Channel Analyzer - A New Synthetic Instrument for Versatile, Near-Real-Time RF Channel Measurement	Tom Costello, *Astronics Test Systems*
TUMA20	14:15 – 14:30	Multi-Channel Measurement Visualization in Frequency and Time Domain	Alejandro Buritica, Alex Krauska, *Tektronix*
TUMA21	14:30 – 14:45	Dielectric and Cavity Resonators for Accurate Characterization of Liquids in the 1-50 GHz Frequency Range	Marzena Olszewska-Placha, *QWED Sp. z o.o*
TUMA22	14:45 – 15:00	Learn How to Improve Throughput and Accuracy of Electromagnetic Interference Testing using Real-Time Scan Measurements	Steve Narciso, *Keysight Technologies*
TUMA23	15:00 – 15:15	A New Non-Destructive Microwave Technique for Quantitative Testing of Large-Scale Panels of Graphene-based Polymer Composites for EMI Applications	Malgorzata Celuch, *QWED Sp. z o.o*
TUMA24	15:15 – 15:30	Contactless Flanges Reaching 325 GHz	Andrew Laundrie, *Eravant*
	15:30 – 16:30	IMS Executive Forum: Emerging Trends and Markets	Bryan Goldstein, *Analog Devices;* Dr. Gangadhar Burra, *Qorvo;* Lucas Hansen, *Keysight Technologies;* Robert Wanner, *Rohde & Schwarz*

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Microwave Journal

IMS EXHIBIT FLOOR, MICROAPPS THEATER (BOOTH 2447)

NEW! IMS EXECUTIVE FORUM— 15:30 – 16:30 | Tuesday, 13 June 2023

Emerging Technology Trends and Markets

This in-depth panel session will be moderated by Microwave Journal Technical Editor Eric Higham. The panelists will consist of senior executives from Keysight Technologies, Rohde & Schwarz, Analog Devices, and Qorvo. Research on emerging technology trends and markets will be discussed. Panelists will share their company's visions and insights into the markets that will fuel future growth.

Moderator: Eric Higham, Technical Editor, *Microwave Journal*
Panelists: Bryan Goldstein, Vice-President of the Aerospace and Defense business unit at *Analog Devices*
Dr. Gangadhar Burra, Chief Architect and Sr. Technology Director for the High-Performance Analog (HPA) BU at *Qorvo*
Lucas Hansen, Vice President & General Manager, Communications Solutions — Wireless at *Keysight Technologies*
Robert Wanner, Director of R&D for Signal and Spectrum Analyzers, Phase Noise Analyzers and EMI Receivers at *Rohde & Schwarz*

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30AB

Tu4A: Advances in Computer-Aided Analysis and Design

Chair: Erin Kiley, *Massachusetts College of Liberal Arts*
Co-Chair: Marco Pirola, *Politecnico di Torino*

15:40 – 15:50

Tu4A-1: Statistical Synthesis of Optimal Coupling Matrix for Robotic Automatic Tuning of Microwave Bandpass Filters

K.F. Lao, *CUHK*; K.-L. Wu, *CUHK*

16:00 – 16:10

Tu4A-2: Adaptive Generation of Rational Function Approximations for Microwave Network Parameters

A. Lemus, *San Diego State Univ.*; A.E. Engin, *San Diego State Univ.*

16:20 – 16:30

Tu4A-3: Substitution Method for the Analysis of Systems based on Two Nonlinear Resonators

A. Suarez, *Universidad de Cantabria*; F. Ramirez, *Universidad de Cantabria*

16:40 – 16:50

Tu4A-4: Analysis of a Sensor Based on an Injection-Locked Oscillator Driven by a Chirp Signal

S. Sancho, *Universidad de Cantabria*; F. Ramírez, *Universidad de Cantabria*; M. Pontón, *Universidad de Cantabria*; A. Suárez, *Universidad de Cantabria*

17:00

Tu4A-5: Geometry Scaling of Microwave Filters Using an Adaptive Homotopy Continuation Method

A. Liu, *Chinese Univ. of Hong Kong*; M. Yu, *SUSTech*

30C

Tu4B: Integrated Filters

Chair: Pei-Ling Chi, *NYCU*
Co-Chair: Kamal Samanta, *Sony*

15:40 – 15:50

Tu4B-1: Intrinsically Switched Multiplexer Based Reconfigurable Filter MMIC

C.F. Campbell, *Qorvo*; D.C. Dumka, *Qorvo*; A.S. Bodade, *Qorvo*; R.D. Kinnison, *Qorvo*; M.S. Essar, *Qorvo*; J.N. Miller, *Qorvo*

16:00 – 16:10

Tu4B-2: Realization of Low-Loss Fully-Passive Harmonic Rejection N-Path Filters

S. Araei, *Massachusetts Institute of Technology*; S. Mohin, *Massachusetts Institute of Technology*; N. Reiskarimian, *Massachusetts Institute of Technology*

16:20 – 16:30

Tu4B-3: An Extended Mason Model for Spurious-Mode Modeling of High Q FBAR Resonators

J. Wang, *UESTC*; X. Zhang, *UESTC*; T. Yang, *UESTC*

16:40 – 16:50

Tu4B-4: High-Q Monolithically-Integrated Bandpass Filters Using Quarter-Spherical Resonators

D. Psychogiou, *Tyndall National Institute*; K. Zhao, *University of Colorado Boulder*

17:00

Tu4B-5: Miniaturized IPD Filter with Flexibly Controllable Transmission Zeros Based on Novel Coupling Theory for 5G Application

Y. Zheng, *UESTC*; H. Tian, *UESTC*; Y. Dong, *UESTC*

31AB

Tu4D: Advanced Linearization Techniques for Power Amplifiers and MIMO Transmitters

Chair: Varish Diddi, *Qualcomm*
Co-Chair: Pere L. Gilabert, *Universitat Politècnica de Cataluny*

15:40 – 15:50

Tu4D-1: On the Viability of Using a Subset of Transmitter-Observation Receivers for Training a Common DPD in Fully Digital MIMO Transmitters

Jin Gyu Lim, *Univ. of Waterloo*; Hoda Barkhordar-pour, *Univ. of Waterloo*; Ahmed Ben Ayed, *Univ. of Waterloo*; Patrick Mitran, *Univ. of Waterloo*; Slim Boumaiza, *Univ. of Waterloo*

16:00 – 16:10

Tu4D-2: Real-Time FPGA-Based Implementation of Digital Predistorters for Fully Digital MIMO Transmitters

H. Barkhordar-pour, *Univ. of Waterloo*; J.G. Lim, *Univ. of Waterloo*; M. Almoneer, *Univ. of Waterloo*; P. Mitran, *Univ. of Waterloo*; S. Boumaiza, *Univ. of Waterloo*

16:20 – 16:30

Tu4D-3: Widen Linearization Angle of Beamforming Arrays with Semi-Partitioned Digital Predistortion

Q. Luo, *Univ. College Dublin*; A. Zhu, *Univ. College Dublin*

16:40 – 16:50

Tu4D-4: New Digital Predistortion Training Method with Cross-Polarization Channel De-Embedding for Linearizing Dual-Polarized Arrays Using Far-Field Observation Receiver

N. Messaoudi, *Univ. of Waterloo*; A. Ben Ayed, *Univ. of Waterloo*; Z. He, *Univ. of Waterloo*; B. Tung, *Univ. of Waterloo*; P. Mitran, *Univ. of Waterloo*; S. Boumaiza, *Univ. of Waterloo*

17:00

Tu4D-5: Incremental DPD Linearization for Mobile Terminals with Non-Flat Frequency Response in Dynamic Bandwidth Re-Allocation Scenarios

W. Li, *Univ. Politècnica de Catalunya*; Y. Guo, *Huawei HiSilicon*; G. Montoro, *Univ. Politècnica de Catalunya*; P.L. Gilabert, *Univ. Politècnica de Catalunya*

25ABC

RTu4C: Invited Industry Presentations

Chair: Debopriyo Chowdhury, *Broadcom*

15:40

RTu4C-1: D-band Circuits and Systems Application in 55nm SiGe BiCMOS

A. Pallotta, *St Microelectronics*; P. Roux, *Nokia Bell-Labs France*; D. Delrio, J.F. Sevillano, *Ceit & Tecnun University of Navarra*; M. Pirbazari, *STMicroelectronics S.R.L.*; A. Mazzanti, *Univ. of Pavia*; V. Ermolov, J. Säily, *VTT Technical Research Centre of Finland Ltd*; M.G. Frecassetti, Maurizio Moretto, *Nokia*

15:50

16:00

RTu4C-2: Thermal Challenges in GaAs PA Design for 5G Applications

S.H. Tsai, *iCana Ltd.*; C.S. Yeh, *iCana*; C. Potier, *iCana*; B. Thota, *iCana*; H. Andersen, *iCana*; B. Francois, *iCana*

16:10

16:20

RTu4C-3: 22 FDSOI Technology Solutions for 5G mmWave

S. Syed, Z. Zhao, S.N. Ong, L. Hock, K. Chan, K. Kheng, S. Tan, C.W. Wan, W.H. Chow, K.W. Chew, A.K. Sahoo, R.K. Nagaraja, A. Knorr, Q. Yang, C. Boyer, S. Moss, M.-C. Chan, *GLOBALFOUNDRIES*

16:30

16:40

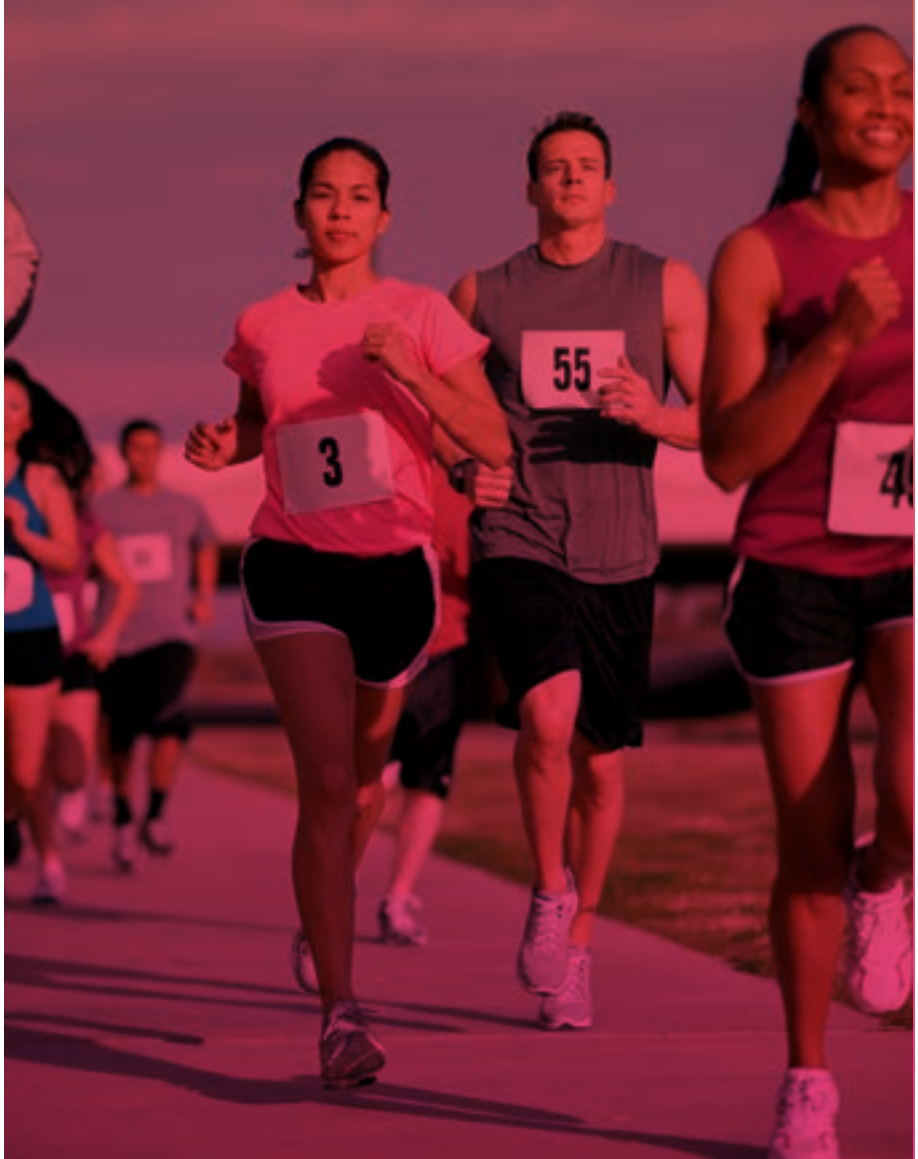
16:50

17:00

NEW! IMS 5K FUN RUN/WALK

On Wednesday 14 June at 06:30, join friends and colleagues for a fun outdoor activity along the San Diego Bay. Start the day off with some exercise while enjoying fresh air and the beauty of San Diego. This is not a timed event, so you can go at your own pace.

Add this FREE event to your registration!



SAN DIEGO CONVENTION CENTER

IMS RUMP SESSION

17:30 – 19:20 Tuesday, 13 June 2023 Ballroom 20A

Meet the MTT-S Editors and Publication Enthusiasts

MODERATORS:

Peter Siegel, *JPL and Caltech*
Ke Wu, *Polytechnique Montréal*

ABSTRACT: The technical publications environment is currently undergoing an enormous upheaval. The tried-and-true subscription journals, which have been the backbone of scientific dissemination for more than three hundred years, are rapidly being challenged by all digital pay-to-publish venues from both reputable, and not so reputable, for-profit enterprises. The number of new journals entering the marketplace is increasing at an exponential rate. Within the MTT-S, we have more than doubled the number of publications within the last ten years, and authors, readers, and technical experts are being overwhelmed both with content choice and demands on peer reviewing. This special rump session, which will be moderated by Dr. Peter Siegel and Dr. Ke Wu, will focus on the growing concerns of our author and end-user communities regarding the future of scientific publishing and the position that IEEE, and specifically MTT-S, should take in moving forward. The session will also focus on the editorial content and practices of our core publications, including manuscript preparation, the peer review process, quality standards, industrial contributions, and editorial practices. We will bring together Editors-in-Chief and/or Editorial Board members from several of our core publications and young professionals to present their perspectives and experiences on publication policies and practices.

THE POINTE, HILTON SAN DIEGO BAYFRONT HOTEL

HAM RADIO SOCIAL 2023

18:00 – 20:00 Tuesday, 13 June 2023

The IEEE Microwave Theory and Techniques Society 2023 International Microwave Symposium (IMS2023) is hosting a ham radio social event in San Diego, California! All radio amateurs and other interested IMS participants are cordially invited to the event. There will be a complimentary buffet with an array of hot and cold appetizers as well as drinks. The Pointe is a lovely outdoor venue steps outside the hotel and it is where you will meet some of the most interesting and dynamic people at IMS.

There will be friendly and accessible technical and operational demonstrations ranging from satellite operations, open source digital microwave systems, contest rigs, to ambitious distance record attempts, and more. If you have a Bluetooth capable phone or device, be sure to bring it. There will be some puzzles hidden at 2.4 GHz. Prizes will be awarded to the top scores. This contest can be done either as an individual or as a team.

Amateur radio is an incredibly diverse hobby. It offers a wide range of opportunities on the microwave bands. Learn about how amateur radio is successfully used in education, what is happening with respect to spectrum allocation, and what experimenters are up to these days from the American Radio Relay League (ARRL). Want to upgrade or renew your license — or learn how to obtain a license and become a ham? Find-out about how online testing has revolutionized license exams from Greater Los Angeles Amateur Radio Group VEC (GLAARG). Have your questions on amateur radio answered at this interactive event!

SAPPHIRE LEVEL TERRACE, HILTON SAN DIEGO BAYFRONT HOTEL

WOMEN IN MICROWAVES (WIM) RECEPTION

18:30 – 21:00 | Tuesday, 13 June 2023

IEEE Women in Engineering

We

Join us for a fun evening at IMS hosted by Women in Microwaves (WIM)!! This event welcomes all members of IMS to promote collaboration, with a spotlight on the work of female RF engineers and researchers. We will continue our traditional social cocktail party, which grows yearly. The reception will also feature social networking opportunities, games, and more!

Sponsored By:

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Microwaves&RF

The IEEE MOVE truck is deployed to respond to hardest hit disaster areas that frequently have no power or communications. MOVE can quickly set up temporary operations and provide the power and communications required to initiate services to the people affected by the disaster. These temporary emergency relief provisions help people stay connected and make sure they can access the help they need. Services include cell phone charging, wi-fi access, and lighting to disaster victims. Come see the application of RF expertise!

Location: Outside of the convention center in front of Halls D/C, along Harbor Drive.

Hours:

Tuesday, 13 June 2023	08:30-17:00
Wednesday, 14 June 2023	08:30-17:00
Thursday, 15 June 2023	08:30-15:00

Young Professionals Program

Tuesday, 13 June 2023	Wednesday, 14 June 2023	Thursday, 15 June 2023
Selfie Competition		
11:00 - 12:00 **"Overview of RFICs for Satellite Communications"** SpaceX *Location: Sails Pavilion – Young Professionals Lounge*	*09:00 - 10:00* **Pub Quiz Style Breakfast** *Location: Sails Pavilion – Young Professionals Lounge*	*10:00 - 11:00* **"ORAN Explained: Latest Trends and Opportunities"** Naveen Yanduru – VP, Renesas Electronics Corporation *Location: Sails Pavilion – Young Professionals Lounge*
14:00 - 15:00 **Startup Founders Panel Session - From Idea to a Thriving Business** *Location: Sails Pavilion – Young Professionals Lounge*	*10:00 - 11:00* **"What's the Secret to a Successful Presentation?"** Andrej Rumiantsev – MPI Corporation *Location: Sails Pavilion – Young Professionals Lounge*	*11:00 - 12:30* **IMS2023 Scavenger Hunt** *Location: Sails Pavilion – Young Professionals Lounge*
15:00 - 16:00 **"Microwave Engineering and Measurement Challenges in Quantum Computing"** Manoj Stanley – National Physical Laboratory (UK) *Location: Sails Pavilion – Young Professionals Lounge*	*11:00 - 12:00* **"History and Trends of RF Front Ends for Mobile Communications"** Qualcomm *Location: Sails Pavilion – Young Professionals Lounge*	*14:00 - 15:00* **Joint Young Professionals & Women in Microwaves Panel Session** *Location: Sails Pavilion – Young Professionals Lounge*
17:00 - 18:30 **The Rump Session — Discussion on Scientific Publishing** *Location: San Diego Convention Center, Room 20A*		
18:30 - 21:00 **Young Professionals Reception** *Location: Hilton San Diego Bayfront Hotel*	*14:00 - 15:00* **"Intellectual Property – A Career Path for Technical Professionals"** Qualcomm Patent Counsel *Location: Sails Pavilion – Young Professionals Lounge*	

IEEE young professionals

SAN DIEGO 2023

Sponsored By: Microwaves&RF

INDUSTRY WORKSHOPS

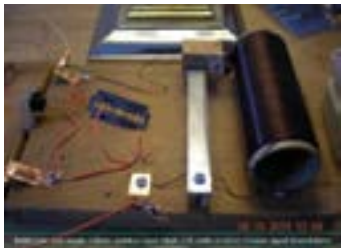
08:00 – 17:20 | Wednesday, 14 June 2023

SESSION CODE	TIME & LOCATION	TITLE AND ABSTRACT	SPEAKER/S, AFFILIATION
IWWE1	08:00 – 09:40 Room: 29C	**MBSE Introduction: Systems to Silicon and Back—**With 80% of new product features delivered via electronics and 50% of a program's delivery time spent on system integration, IMS has asked INCOSE (INternational Council On Systems Engineering) to provide an introduction to Model-Based Systems Engineering (MBSE) application to electronic systems to enable continuous electronic systems integration. The workshop will begin with an introduction to MBSE followed by application of MBSE to electronic systems; flowing product functions from systems to silicon and back for closed loop continuous integration to deliver electronics-driven features on-time, on-schedule.	Mark Malinoski, Mark Sampson, *INCOSE*
IWWE2	08:00 - 09:40 Room 29D	**Maximizing Return on Investment for On-Wafer Over-Temperature millimeter-wave Characterization—**The talk will show the best methods for setting up, calibrating, and evaluating measurement performance for measurements spanning WR15 (75 GHz) to WR1 (1100 GHz) over a broad (-40 to 125c) temperature range. This includes approaches to conveniently swap waveguide bands. We will discuss test executive approaches for multi-wafer over-temperature testing, both using commercial test executives and programming examples using FormFactor Inc. WinCalXE and Velox software to automate on-wafer data measurement and analysis. Single-sweep measurements from 900 Hz to 220 GHz will be highlighted along with measurements at elevated temperatures. Examples in Wincal itself and supporting video will be provided	Gavin Fisher, *FormFactor Inc.*
IWWE3	10:10 – 11:50 Room: 29C	**Silicon to Phased Array Design, Analysis and AiP Implementation—**The availability of advanced node silicon ICs for RF front-ends and highly integrated system-in-package (SiP) technologies are enabling millimeter-wave (mmWave) phased array systems for commercial applications. This workshop explores recent developments in design, analysis and implementation workflows supported by EM/thermal analysis, RF circuit/antenna co-simulation, and phased array synthesis to address silicon-to-antenna co-design. A comprehensive top-down system design methodology is presented and demonstrated with a front-end module (FEM)/antenna-in-package (AiP) design for 5G mobile applications targeting 24 to 29 GHz. The system requirements that drive antenna/front-end architectural decisions for mmWave applications, antenna optimization, and array configuration and generation will be discussed.	David Vye, *Cadence*
IWWE4	10:10 – 11:50 Room: 29D	**Improved DUT Characterization by Virtue of Accurate Vector Signal Generation at a Remote (DUT) Plane—**This workshop discusses and demonstrates an extension to a Vector Signal Generator (VSG) to accurately generate a desired broadband modulation signal at a defined plane of a device under test (DUT), possibly on wafer. The technique ensures the stimulus signal delivered to the DUT is ideal, enabling characterization of non-linear devices while minimizing the signal generator's contribution to key figures of merit, such as EVM and ACPR. This technique eliminates critical measurement uncertainties present in today's VSG + Vector Signal Analyzer setups. It is possible to extend into high-power signal generation, impedance measurement and matching applications and more.	Marc Vanden Bossche, *National Instruments;* Markus Rullmann, *National Instruments;* Matthew Spexarth, *National Instruments*
IWWE5	13:30 – 15:10 Room: 29C	**Phased Array System Modeling and Design using MATLAB and Analog Devices Hardware—**Through both lecture material and instructor-led demos, workshop participants will learn about modeling and simulating antenna-array designs, explore phased-array beamforming concepts and beamforming ICs, and examine real-world impairments and their effect on system performance. Radar design examples will be used to tie the signal processing theory to practical applications.	Babak Memarzadeh, *MathWorks;* Jon Kraft, *Analog Devices, Inc.;* Noam Levine, *MathWorks;* Travis Collins, *Analog Devices, Inc.;* Vishwanath Iyer, *MathWorks*
IWWE6	13:30 – 15:10 Room: 29D	**mmWave Permittivity Standard Reference Material Development—**Workshop discusses results of iNEMI 5G/mmWave project on developing permittivity standard reference material (SRM), allowing industry for calibrating high frequency dielectric characterization tools spanning 10 to 120 GHz. SRM candidates are tested with industry acknowledged material characterization techniques within round-robin routine involving 8 laboratories worldwide. Testing results support development of traceable reference sample. Consortium efforts are in parallel directed to developing roadmap on 5G/6G materials and electrical test technology. Workshop comprises four presentations (5G industry needs and project goals, standardization efforts for traceable material standard, round-robin results, roadmapping efforts) supported with hands-on exercises (involving Keysight and QWED equipment, NIST SRM candidates).	Lucas Enright, *NIST;* Marzena Olszewska-Placha, QWED Sp. z o.o; Say Phommakesone, Keysight Technologies; Urmi Ray, *iNEMI*
IWWE7	15:40 – 17:20 Room: 29C	**Building a Hybrid Beamforming Digital Twin of Commercial Off the Shelf (COTS) Hardware using Commercially Available EDA Software—**This workshop presents step by step approach to create a system level digital twin using Keysight's SystemVue software and COTS hybrid beamforming system hardware from Analog Devices Inc. The X-Band Phased Array Platform is a scalable 32 element hybrid beamforming phased array development platform developed by Analog Devices. The workshop will discuss the hardware architecture and take a deep dive into the steps required to simulate a digital twin in SystemVue including device, sub-system, and system level modeling. The audience will be able to walk away with sufficient knowledge to explore creating their own phased array digital twins.	Murthy Upmaka, *Keysight Technologies;* Sam Ringwood, *Analog Devices*
IWWE8	15:40 – 17:20 Room: 29D	**DC-44 GHz Wireless Test System Design Accelerator Blocks for Wireless Test Systems—**Analog Devices Instrumentation Group along with SignalCraft and Richardson RFPD are working on Modular DC-44 GHz transmit and receive signal chains for Wireless Test Systems to support the latest standards like 5G, Wi-Fi 6 & 7, and UWB. The blocks include all components necessary for signal generation and capture including; up conversion/multiplication, amplification, switching, and filtering. The blocks are designed to remove risks for our customers and accelerate their time to market. We will be discussing and demonstrating the blocks at the workshop.	Bernard Gobeil, *SignalCraft Technologies Inc.;* Bhavin Shah, *Analog Devices;* Larry Hawkins, *Richardson RFPD;* Matt Damato, *Analog Devices*

Build Your Own "Foxhole" Radio Receiver

09:30 – 17:00 | Wednesday, 14 June 2023

PRESENTED BY: PROFESSOR DAVID S. RICKETTS, *NORTH CAROLINA STATE UNIVERSITY*



WIKIPEDIA: RBDIODE.PDF

Ever wanted to build one of the early radios by hand?

Did you know you can do it without special parts, just a coil of wire, a pencil, a piece of metal and a paper towel tube? Join this hands-on experience where you will learn to build the ingenious radio receiver built by Lieutenant M. L. Rupert in the 1940s. The radio doesn't use a local oscillator so as to avoid being detected and was popular in areas (foxholes) where you didn't want to be detected. You will be able to build your own radio on site and take home or simply come by to learn how it operates and take a turn at tuning a radio with a pencil point – the parts are simple, but perhaps not the tuning! This hands-on experience is created by Prof. David S. Ricketts and is part of his work on disseminating wireless education in a more exciting way. See www.interactrf.org for educational materials one wireless systems and circuits.

David S. Ricketts received the PhD in Electrical Engineering from Harvard University. He is currently a Full Professor of Electrical and Computer Engineering at North Carolina State University.

His scientific research focuses on emerging microwave and analog circuits and systems from 1 MHz to 300 GHz. His work has appeared in *Nature* and in numerous IEEE conferences and journals. He is the author of the two books on jitter in high-speed electronics and electrical solutions. He is the recipient of the NSF CAREER Award, the DARPA Young Faculty Award and the George Tallman Ladd research award and is a Harvard Innovation Fellow. In addition as a teacher he is the recipient of the 2009 Wimmer Faculty Teaching Fellow at Carnegie Mellon University, 2013 Harvard University Bok Center Teaching Award and the 2021 William F. Lane Outstanding Teaching award at NCSU. Since 2015, Prof. Ricketts has taught experiential hand-on workshops on building a QAM Radio and a FMCW RADAR across the globe at all of the major microwave conferences.

23ABC

We1A: Space Systems and Technologies

Chair: Jan Budroweit, *DLR*
Co-Chair: KJ Koh, *Boeing Research & Technology*

08:00–08:10

We1A-1: A Ka-Band 64-element Deployable Active Phased Array Transmitter on a Flexible Hetero Segmented Liquid Crystal Polymer for Small-Satellites

D. You, X. Fu, H. Herdian, X. Wang, Y. Narukiyo, A.A. Fadila, H. Lee, M. Ide, S. Kato, Z. Li, Y. Wang, D. Awaji, J. Pang, H. Sakamoto, K. Okada, A. Shirane, *Tokyo Institute of Technology*

08:20–03:30

We1A-2: OTA Evaluation of a K-Band Receive Phased-Array Antenna-in-Package for SATCOM on the Move User Terminal

A. Raeesi, *Univ. of Waterloo*; N. Ghafarian, *Univ. of Waterloo*; A. Palizban, *Univ. of Waterloo*; E. Alian, *C-COM Satellite Systems*; A. Ehsandar, *C-COM Satellite Systems*; M.-R. Nezhad-Ahmadi, *Univ. of Waterloo*; W.M. Abdel-Wahab, *Univ. of Waterloo*; S. Safavi-Naeini, *Univ. of Waterloo*

08:40–08:50

We1A-3: Thinned Spiral-Configuration Ka-Band SATCOM Phased-Arrays with Diffraction-Limited Beams and Wide Scan Angles

J. Park, *Univ. of California, San Diego*; L. Li, *Univ. of California, San Diego*; K.K.W. Low, *Univ. of California, San Diego*; G.M. Rebeiz, *Univ. of California, San Diego*

09:00–09:10

We1A-4: Inter-Satellite Phase and Frequency Synchronization for Software-Defined CubeSat Radio Subsystems

D. Pearson, *Zentrum für Telematik*; J. Scharnagl, *Zentrum für Telematik*; K. Schilling, *Zentrum für Telematik*; M. Gardill, *Brandenburgische Technische Universität*

09:20–09:30

We1A-5: Investigation of Heavy-Ion Induced Single Event Effects for GaAs and GaN-Based RF Amplifiers in Space Applications

J. Budroweit, *DLR*

09:30–09:40

We1A-6: Radiometric Noise Characterization of the 183–664GHz Front-End Receivers for the MetOp-SG Ice Cloud Imager Instrument — Prospects for Future Missions

B. Thomas, G. Sonnabend, N. Wehres, M. Brandt, M. Trasatti, *Radiometer Physics*; A. Andrés-Beivide, M. Bergada, J. Martinez, P. Robustillo, M. Gotsmann, *Airbus*; U. Klein, *ESA-ESTEC*

24ABC

We1B: Enabling Technologies for Sub-THz and THz Systems

Chair: Telesphor Kamgaing, *Intel*
Co-Chair: Joe Qiu, *U.S. Army Research Laboratory*

08:00–08:10

We1B-1: A 220–300GHz Vector Modulator in 35nm GaAs mHEMT Technology

K. Kuliabin, *Albert-Ludwigs-Universität Freiburg*; C. Maurette Blasini, *Albert-Ludwigs-Universität Freiburg*; R. Lozar, *Fraunhofer IAF*; S. Chartier, *Fraunhofer IAF*; R. Quay, *Albert-Ludwigs-Universität Freiburg*

08:20–03:30

We1B-2: Integrated Silicon Lens-Antenna Based on a Top-Hat Leaky-Wave Feed for Quasi-Optical Power Distribution at THz Frequencies

M. Alonso-delPino, *Technische Universiteit Delft*; S. Bosma, *Technische Universiteit Delft*; C. Jung-Kubiak, *JPL*; J. Bueno, *Technische Universiteit Delft*; G. Chattopadhyay, *JPL*; N. Llombart, *Technische Universiteit Delft*

08:40–08:50

We1B-3: Stub-Loaded Via Transition for Wideband Impedance Matching of Sub-THz 6G Antenna-in-Package

D. Jung, *Samsung*; C.J. Park, *Samsung*; T.S. Kwon, *Samsung*; B. Ahn, *Samsung*; J.W. Seo, *Samsung*; S.-H. Wi, *Samsung*; H.-J. Kwon, *Samsung*

09:00–09:10

We1B-4: A 28dBm-EIRP Low-Profile D-Band Transmitting Module with a Folded Transmitarray Antenna

F. Foglia Manzillo, *CEA-LETI*; A. Hamani, *CEA-LETI*; A. Siligaris, *CEA-LETI*; A. Clemente, *CEA-LETI*; J.L. González-Jiménez, *CEA-LETI*

09:20–09:30

We1B-5: 3D Printed Metallized Polymer Slotted Waveguide Antenna Array for Automotive Radar Applications at 140GHz

M. Jozwicka, *HUBER+SUHNER*; A. Garcia-Tejero, *HUBER+SUHNER*; E. Bekker, *KIT*; J. Kowalewski, *HUBER+SUHNER*; F. Merli, *HUBER+SUHNER*; T. Zwick, *KIT*

25ABC

We1C: Broadband and High-Frequency GaN Power Amplifiers

Chair: Peter Asbeck, *University of California, San Diego*
Co-Chair: Sushil Kumar, *National Instruments*

08:00–08:10

We1C-1: A 2W 9.5–16.5GHz GaN Power Amplifier with 30% PAE Using Transformer-Based Output Matching Network

X. Sun, *UESTC*; X. Zhu, *UESTC*; Y. Wang, *UESTC*; P.-L. Chi, *UESTC*; T. Yang, *UESTC*

08:20–03:30

We1C-2: A 1.5-to-17GHz Non-Uniform Distributed Power Amplifier Using Reconfigurable Modules in 0.25µm GaN HEMT

S. Chen, *UESTC*; F. Yan, *UESTC*; Y. Liang, *Guangzhou University*; S. Ma, *UESTC*; D. Shi, *UESTC*; X. Li, *Nanhu Laboratory*; H. Shao, *UESTC*; T. Yang, *UESTC*; Y. Wang, *UESTC*

08:40–08:50

We1C-3: A 3-Way GaN Doherty Power Amplifier for 28GHz 5G FR2 Operation

A. Piacibello, *Politecnico di Torino*; R. Giofrè, *Università di Roma "Tor Vergata"*; P. Colantonio, *Università di Roma "Tor Vergata"*; V. Camarchia, *Politecnico di Torino*

09:00–09:10

We1C-4: A Balanced Stacked GaN MMIC Power Amplifier for 26-GHz 5G Applications

A. Piacibello, *Politecnico di Torino*; C. Ramella, *Politecnico di Torino*; V. Camarchia, *Politecnico di Torino*; M. Pirola, *Politecnico di Torino*

30AB

We1D: Advanced Additively Manufactured RF Systems and Heterogeneous Solutions

Chair: Wolfgang Heinrich, *FBH*
Co-Chair: Arnaud Amadjikpe, *Skyworks*

08:00–08:10

We1D-1: Additively Manufactured Flexible On-Package Phased Antenna Arrays with Integrated Microfluidic Cooling Channels for 5G/mmWave System-on-Package Designs

K. Hu, *Georgia Institute of Technology*; T. Callis, *Georgia Institute of Technology*; M. Tentzeris, *Georgia Institute of Technology*

08:20–03:30

We1D-2: A Fully 3D-Printed Flexible Millimeter-Wave Doppler Radar

H. Tang, *UMass Lowell*; Y. Zhang, *UMass Lowell*; B. Zheng, *UMass Lowell*; S. An, *UMass Lowell*; M. Haerinia, *UMass Lowell*; Y. Dong, *UMass Lowell*; Y. Huang, *UMass Lowell*; W. Guo, *UMass Lowell*; H. Zhang, *UMass Lowell*

08:40–08:50

We1D-3: The Design Process for Monolithically Manufactured Millimeter-Wave Antenna Arrays Using Stereolithography 3D Printing

D. Langer, *Technische Universität Hamburg*; B. Tegowski, *Technische Universität Hamburg*; N.C. Albrecht, *Technische Universität Hamburg*; M. Wenzel, *Technische Universität Hamburg*; A. Koelpin, *Technische Universität Hamburg*

09:00–09:10

We1D-4: Low Insertion Loss Sub-6GHz Heterogeneous GaN/RF-SOI SPDT Switch for High Power Applications

I. Lahbib, *X-FAB*; F. Drillet, *X-FAB*; J. Loraine, *X-FAB*; H. Saleh, *X-FAB*; O. Sow, *X-FAB*; G. U'Ren, *X-FAB*

Denotes Industry Keynote Presentation

30C

We1E: Theory and Inverse Design for Novel Applications

Chair: Vladimir Okhmatovski, *University of Manitoba*
Co-Chair: Costas D. Sarris, *University of Toronto*

We1E-1: Inverse Design of Perfectly-Matched Metamaterials

S. Thakkar, *Univ. of Michigan*; L. Szymanski, *Univ. of Michigan*; J. Ruiz-Garcia, *Univ. of Michigan*; G. Gok, *Raytheon Technologies*; A. Grbic, *Univ. of Michigan*

We1E-2: Ultra-Fast Simulation and Inverse Design of Metallic Antennas

Y. Zheng, *Univ. of Southern California*; C. Sideris, *Univ. of Southern California*

We1E-3: Time-Reversal Source Reconstruction with Arbitrary-Order Kurtosis

X.-Y. Feng, *Dalhousie University*; Z. Chen, *Dalhousie University*; J. Li, *Fuzhou Univ.*; J. Cai, *Fuzhou Univ.*

We1E-4: Constant Impedance Transmission Line with Leaky-Wave Radiation

Y. Pan, *UESTC*; Y. Dong, *UESTC*

We1E-5: Spectral Element Method for Modeling Eccentric Coaxial Waveguides Filled with Anisotropic Media via Conformal Transformation Optics

R.O. Ribeiro, *PUC-Rio*; J.R. Gonçalves, *PUC-Rio*; F.L. Teixeira, *The Ohio State University*; J.R. Bergmann, *PUC-Rio*; G.S. Rosa, *PUC-Rio*

30DE

We1F: Emerging Technologies for Transmission Lines and Planar Components

Chair: David R. Jackson, *University of Houston*
Co-Chair: Bayaner Arigong, *Florida State University*

We1F-1: Testing Dielectric Slab Mode Excitation, Non-Rectangular Conductor Profiles and Edge Roughness as Sources of Additional Loss in mmWave Transmission Lines

F. Bergmann, *NIST*; N. Jungwirth, *NIST*; B. Bosworth, *NIST*; J. Killgore, *NIST*; E. Marksz, *NIST*; T. Karpisz, *NIST*; M. Papac, *NIST*; A. Osella, *NIST*; L. Enright, *NIST*; C.J. Long, *NIST*; N.D. Orloff, *NIST*

We1F-2: Miniaturized 7–12GHz 1-to-4 Differential Power Splitter with Low Amplitude/Phase Imbalances Using Broadside-Coupled CPW/SIDGS Scheme and Embedded CPW Spur-Line

Q. Luo, *UESTC*; Y. Rao, *UESTC*; Y. Shu, *UESTC*; X. Luo, *UESTC*

We1F-3: A Compact and High-Power Frequency-Selective Plasma Limiter with an Ultra-High Isolation

S. Narasapura Ramesh, *Univ. of Toledo*; A. Semnani, *Univ. of Toledo*

We1F-5: A Full Duplex RF Front End Employing an Electrical Balanced Duplexer and a Chebyshev Load-Balancing Filter

D. Regev, *Toga Networks*; I. Melamed, *Technion*; N. Ginzberg, *Technion*; E. Cohen, *Technion*

31AB

We1G: Automotive and MIMO Radar

Chair: Richard Al Hadi, *ÉTS*
Co-Chair: Jacquelyn Vitaz, *Raytheon*

We1G-1: Improving the Short-Range Perception of MIMO Radars with LO Feedthrough Topologies by Complex Sampling

D. Schwarz, *Universität Ulm*; N. Riese, *Universität Ulm*; I. Dorsch, *Universität Ulm*; C. Waldschmidt, *Universität Ulm*

We1G-2: A Compact 77GHz IQ-Modulated Transponder for High Gain and High Dynamic Range Radar Target Simulation

C. Birkenhauer, *FAU Erlangen-Nürnberg*; G. Körner, *FAU Erlangen-Nürnberg*; P. Stief, *FAU Erlangen-Nürnberg*; A. Hofmann, *FAU Erlangen-Nürnberg*; M. Alami El Dine, *FAU Erlangen-Nürnberg*; C. Carlowitz, *FAU Erlangen-Nürnberg*; M. Vossiek, *FAU Erlangen-Nürnberg*

We1G-3: Doppler Ambiguity Robust DOA Estimation Method

S. Choi, *Samsung*; H.-W. Cho, *Samsung*; Y. Cho, *Samsung*

We1G-4: Fast Super-Resolution Burg Algorithm for Increasing the Radar Angular Resolution

H. Paaso, *VTT*; M. Hirvonen, *VTT*

We1G-5: A Next-Generation Hybrid Analog Beamsteering and MIMO Digital Radar for Highly Automated Driving

K. Gu, *Metawave*

31C

We1H: Innovative Non-Planar Filter Topologies and Synthesis

Chair: Cristiano Tomassoni, *Università di Perugia*
Co-Chair: Vicente E. Boria, *Universitat Politècnica de València*

We1H-1: Direct-Coupled TE-TM Waveguide Cavities

S. Bastioli, *RS Microwave*; R. Snyder, *RS Microwave*; C. Tomassoni, *Univ. of Perugia*; V. de la Rubia, *Univ. Politecnica de Madrid*

We1H-2: Dual-Mode Dielectric-Loaded Resonator for Satellite High-Power Filters

P. Vallerotonda, F. Cacciamani, L. Pelliccia, *RF Microtech*; C. Tomassoni, *Università di Perugia*; V. Tornielli di Crestvolant, *ESA ESTEC*

We1H-3: Metal-Dielectric Coaxial Dual-Mode Resonator for Compact Inline Bandpass Filters

Y. Chen, *CUHK*; K.-L. Wu, *CUHK*

We1H-4: Double Notch Filter for GSM-R Applications with Wide Upper Passband

G. Macchiarella, *Politecnico di Milano*; G.G. Gentili, *Politecnico di Milano*; M. Oldoni, *Politecnico di Milano*; C. D'Asta, *Politecnico di Milano*; G. Frisario, *POLOMARCONI.IT*; S. Balzaretti, *POLOMARCONI.IT*

We1H-5: On Searching All Solutions of Microwave Filter Synthesis Based on Interval Arithmetic

Yi Zeng, *Southern Univ. of Science and Technology*; Ming Yu, *Southern Univ. of Science and Technology*

We1H-6: Synthesis of Simplified Cross Coupled Blocks with All Positive Couplings

S. Tamiazzo, *CommScope*; G. Macchiarella, *Politecnico di Milano*; M. Oldoni, *Politecnico di Milano*

08:00
08:10
08:20
03:30
08:40
08:50
09:00
09:10
09:20
09:30
09:40

23ABC

We2A: Model-Based Systems Engineering for RF, Microwave, and mm-Wave Applications

Chair: Dennis Lewis, *Boeing*
Co-Chair: Rob Jones, *BAE Systems*

10:10 – 10:20

We2A-1: Model-Based Design of Next Generation RF and mmWave Systems

B. Katz, *MathWorks*

10:30 – 10:40

We2A-2: System Model-to-Lab Methodology for GNSS Desensitization Testing

A.J. Compston, *oneNav*; A. Tsangaropoulos, *oneNav*

10:50 – 11:00

We2A-3: FPGA-Based High-Performance Real-Time Emulation of Radar System Using Direct Path Compute Model

X. Mao, M. Mukherjee, N.M. Rahman, U. Kamal, S. Sharma, P. Behnam, J. Tong, J. Driscoll, T. Krishna, J. Romberg, S. Mukhopadhyay, *Georgia Tech*

11:10 – 11:20

We2A-4: Surrogate Modeling with Complex-Valued Neural Nets and its Application to Design of Sub-THz Patch Antenna-in-Package

O. Akinwande, O.W. Bhatti, K.-Q. Huang, X. Li, M. Swaminathan, *Georgia Tech*

11:30 – 11:40

We2A-5: A Feature-Based Filtering Algorithm with 60GHz MIMO FMCW Radar for Indoor Detection and Trajectory Tracking

W. Li, *SJTU*; Y. Li, *SJTU*; J. Zhang, *SJTU*; J. Lu, *SJTU*; S. Dong, *SJTU*; C. Gu, *SJTU*; J. Mao, *SJTU*

11:40 – 11:50

We2A-6: Unique RF Modeling Enhances 5G Network Scenario Simulation

E. Ribes-Vilanova, *Keysight Technologies*; W. Rivas-Torres, *Keysight Technologies*; P. Blood, *Keysight Technologies*; J. Verspecht, *Keysight Technologies*; O. Kusano, *Keysight Technologies*; W. Liu, *Keysight Technologies*; J. Weaver, *Keysight Technologies*; I. Rippke, *Keysight Technologies*

24ABC

We2B: THz and Sub-THz System Demonstrations

Chair: Lei Liu, *University of Notre Dame*
Co-Chair: Theodore Reck, *Virginia Diodes*

10:10 – 10:20

We2B-1: 300-GHz-Band 4-Element CMOS-InP Hybrid Phased-Array Transmitter with 36° Steering Range

I. Abdo, T. Jyo, A. Pander, H. Wakita, Y. Shiratori, M. Mutoh, H. Hamada, M. Nagatani, *NTT Device Technology Laboratories*; C. da Gomez, C. Wang, K. Hatano, C. Liu, A.A. Fadila, J. Pang, A. Shirane, K. Okada, *Tokyo Institute of Technology*; H. Takahashi, *NTT Device Technology Laboratories*

10:30 – 10:40

We2B-2: Terahertz Wireless Communications Using SiC-Substrate-Based Fermi-Level Managed Barrier Diode Receiver

W. Gao, *Osaka Univ.*; T. Saijo, *Osaka Univ.*; K. Maekawa, *Osaka Univ.*; T. Ishibashi, *Wavepackets*; H. Ito, *Kitasato University*; T. Nagatsuma, *Osaka Univ.*

10:50 – 11:00

We2B-3: High Capacity Dual-Polarization THz-Wireless Transmission in the 300GHz Band Using a Broadband Orthomode Transducer

O. Stiewe, *Fraunhofer HHI*; T. Merkle, *Fraunhofer IAF*; R. Elschner, *Fraunhofer HHI*; J. Hoppe, *Fraunhofer IAF*; C. Schubert, *Fraunhofer HHI*; R. Freund, *Fraunhofer HHI*

11:10 – 11:20

We2B-4: An 80Gbps QAM-16 PMF Link Using a 130nm SiGe BiCMOS Process

F. Strömbeck, *Chalmers Univ. of Technology*; Y. Yan, *Chalmers Univ. of Technology*; H. Zirath, *Chalmers Univ. of Technology*

11:30 – 11:40

We2B-5: A 220GHz Code-Domain Focal Plane Imaging Radar with 0.78° Angular Resolution for Automotive Applications

Y. Xu, *Stanford Univ.*; A. Hassibi, *Stanford Univ.*; T.H. Lee, *Stanford Univ.*

25ABC

We2C: High-Power (>10W) Load Modulated GaN Power Amplifiers

Chair: Taylor Barton, *University of Colorado Boulder*
Co-Chair: Paolo de Falco, *Qualcomm*

10:10 – 10:20

We2C-1: Compact 40% Fractional Bandwidth Doherty PA with Input Group Delay Engineering

M. Cavarroc, *NXP Semiconductors*; A. Lamy, *NXP Semiconductors*; O. Lembeye, *NXP Semiconductors*; R. McLaren, *NXP Semiconductors*; C. Duvanaud, *XLIM - CNRS*; S. Bachir, *XLIM - CNRS*

10:30 – 10:40

We2C-2: Continuous Quasi-Load Insensitive Class-E Mode for Wideband Doherty Power Amplifiers

X.A. Nghiem, *Ampleon*; J. Gajadharsing, *Ampleon*

10:50 – 11:00

We2C-3: Bandwidth Extension of a Doherty Power Amplifier Through Reduction of Packaging-Related Parasitic Effects

I. Peppas, *Technische Universität Graz*; H. Takahashi, *Technische Universität Graz*; S. Sattler, *Infineon Technologies*; M. Kastelic, *AT&S*; E. Schlaffer, *AT&S*; H. Paulitsch, *Technische Universität Graz*; W. Bösch, *Technische Universität Graz*

11:10 – 11:20

We2C-4: A 6-/12-dB Back-Off Multi-Mode GaN MMIC Doherty Power Amplifier for 5G Applications

H. Oh, *Samsung*; W. Choi, *Sungkyunkwan Univ.*; J. Shin, *Sungkyunkwan Univ.*; Y. Chen, *Sungkyunkwan Univ.*; H. Kang, *Samsung*; Y.Y. Woo, *Samsung*; Y. Yang, *Sungkyunkwan Univ.*

11:30 – 11:40

We2C-5: Reconfigurable Hybrid Asymmetrical Load Modulated Balanced Amplifier with High Linearity, Wide Bandwidth, and Load Insensitivity

J. Guo, *Univ. of Central Florida*; K. Chen, *Univ. of Central Florida*

30AB

We2D: Advanced Packaging and Interconnects

Chair: Rhonda R. Franklin, *University of Minnesota, Twin Cities*
Co-Chair: Manos M. Tentzeris, *Georgia Tech*

10:10 – 10:20

We2D-1: Broadband Hetero-Integration of InP Chiplets on SiGe BiCMOS for mm-Wave MMICs up to 325GHz

M. Rausch, *FBH*; M. Wietstruck, *IHP*; C. Stölmacker, *FBH*; R. Doerner, *FBH*; G. Fischer, *IHP*; A. Thies, *FBH*; S. Knigge, *FBH*; H. Yacoub, *FBH*; W. Heinrich, *FBH*

10:30 – 10:40

We2D-2: A Wide-Band Millimeter Wave RWG to Air-Filled SIW Transition

M.S. Alam, *IMSIU*; K. AlMuhanna, *IMSIU*; A. Alam, *Delta International School*; H. Zhang, *KAUST*; A. Shamim, *KAUST*

10:50 – 11:00

We2D-3: A Novel Ultra-Broadband Low-Loss Bond-Wire Interconnect Design Concept Applied to a 2GHz to 135GHz Substrate-to-Substrate Interface

T. Pfahler, *FAU Erlangen-Nürnberg*; A. Scheder, *FAU Erlangen-Nürnberg*; A. Bridier, *Rohde & Schwarz*; J. Schür, *FAU Erlangen-Nürnberg*; M. Vossiek, *FAU Erlangen-Nürnberg*

11:10 – 11:20

We2D-4: Design, Fabrication, and Far-Field Measurement of FOWLP-Based Tightly Coupled Antenna Modules Integrated with CMOS Chipset for mmWave Applications

D. Lee, *POSTECH*; J.-Y. Lee, *POSTECH*; K. Lee, *POSTECH*; M. Kim, *POSTECH*; M. Kim, *POSTECH*; Y. Youn, *POSTECH*; H.-J. Song, *POSTECH*; W. Hong, *POSTECH*

Denotes Industry Keynote Presentation

30C

We2E: Sensors and Models for Microwave and mm-Wave Propagation

Chair: Malgorzata Celuch, *QWED*
Co-Chair: Da Huang, *MathWorks*

We2E-1: Near and Far Field Characteristics of Two In Line Graphene Coated Dielectric Nanowires Excited by Modulated Electron Beam

D.O. Herasymova, *NASU*

We2E-2: An Effective Surface Impedance Concept to Model Arbitrary Roughness Profiles on Printed Circuit Boards up to 110 GHz

F. Sepaintner, A. Scharl, J. Jakob, *Deggendorf Institute of Technology*; M. Schmalzbauer, F. Roehrl, *Rohde & Schwarz GmbH & Co KG*; W. Bogner, *Deggendorf Institute of Technology*; S. Zorn, *Rohde & Schwarz GmbH & Co KG*

We2E-3: OAM Multiplexing of 5GHz Band Microwave Signal Propagating Along PVC Pipe Walls for a Buried Pipe Inspection Robot

A. Hirata, *Chiba Institute of Technology*

We2E-5: Multi-Frequency Resonant Measurements of the Complex Permittivity and Initial Permeability of Barium Ferrite Ceramic

J. Krupka, *Warsaw Univ. of Technology*; A. Pacewicz, *Warsaw Univ. of Technology*; B. Salski, *Warsaw Univ. of Technology*; D. Prusak, *PIT-RADWAR*; A. Magalski, *PIT-RADWAR*

30DE

We2F: Substrate Integration Technology for GHz and THz Applications

Chair: Ke Wu, *Polytechnique Montréal*
Co-Chair: Maurizio Bozzi, *Università di Pavia*

We2F-1: Vertically Stacked Double-Layer Substrate-Integrated Non-Radiative Dielectric Waveguides for THz Applications

C. Liu, *École Polytechnique de Montréal*; K. Wu, *Polytechnique Montreal*

We2F-2: Implementation of SIW Cavity in Commercial CMOS Technology for Sub-Terahertz Band Applications

S.K. Thapa, *Kyushu Univ.*; R.K. Pokharel, *Kyushu Univ.*; A. Barakat, *Kyushu Univ.*; R. Dong, *NICT*; S. Amakawa, *Hiroshima Univ.*; S. Hara, *NICT*; I. Watanabe, *NICT*; A. Kasamatsu, *NICT*

We2F-3: 200GHz-Band Low-Loss Half-Mode SIW CMOS Interconnects and Transmission Lines for Sub-Terahertz Frequency Band Applications

R.K. Pokharel, *Kyushu Univ.*; T. Fukuda, *Kyushu Univ.*; S.K. Thapa, *Kyushu Univ.*; A. Barakat, *Kyushu Univ.*; R. Dong, *NICT*; S. Hara, *NICT*; I. Watanabe, *NICT*; A. Kasamatsu, *NICT*

We2F-4: An Ultrawideband Transition from Substrate Integrated Suspended Parallel Strip Line to Grounded Coplanar Waveguide

S. He, *Tianjin Univ.*; Y. Wang, *Tianjin Univ.*; K. Ma, *Tianjin Univ.*

We2F-5: Concurrent Multi-Mode Excitation for Mode Division Multiplexing Over Substrate Integrated Waveguides

M.H.A. Elsawaf, *Univ. of Southern California*; C. Sideris, *Univ. of Southern California*

31AB

We2G: Advanced mm-Wave Radar Systems

Chair: Nils Pohl, *Ruhr-Universität Bochum*
Co-Chair: Jeffrey A. Nanzer, *Michigan State University*

We2G-1: A Compact 140-GHz Radar MMIC with I/Q Downconverter in SiGe BiCMOS Technology

I. Kraus, *Ruhr-Universität Bochum*; H. Knapp, *Infineon Technologies*; D. Reiter, *Ruhr-Universität Bochum*; N. Pohl, *Ruhr-Universität Bochum*

We2G-2: A Low-Power, Subharmonic Super-Regenerative Receiver Toward a Massive Multichannel FMCW Radar Close to Cut-Off Frequency

L. Hahn, *FAU Erlangen-Nürnberg*; M. Vossiek, *FAU Erlangen-Nürnberg*; C. Carlowitz, *FAU Erlangen-Nürnberg*

We2G-3: An Active Self-Interference Cancellation Coupler with 60dB Isolation Applied in a 24GHz SFCW Radar

P. Fenske, *FAU Erlangen-Nürnberg*; T. Kögel, *FAU Erlangen-Nürnberg*; A. Scheder, *FAU Erlangen-Nürnberg*; K. Root, *FAU Erlangen-Nürnberg*; C. Carlowitz, *FAU Erlangen-Nürnberg*; M. Vossiek, *FAU Erlangen-Nürnberg*

We2G-4: Privacy Preserving Contraband Detection Using a Millimeter-Wave Dynamic Antenna Array

D. Chen, *Michigan State Univ.*; J. Nanzer, *Michigan State Univ.*

We2G-5: A High-Efficiency and High-Accuracy Distance Measurement Technique Based on Phase Differentiation and Accumulation with FMCW Radars

J. Liu, *SJTU*; Z. Zhang, *SJTU*; J. Lu, *SJTU*; Y. Li, *SJTU*; C. Gu, *SJTU*; J.-F. Mao, *SJTU*

31C

We2H: Advanced Waveguide Filters

Chair: Anthony Ghiotto, *Université de Bordeaux*
Co-Chair: Richard V. Snyder, *RS Microwave*

We2H-1: Design of Dual Stopband Filters for Interference Suppression

J.F. Valencia Sullca, *Univ. Politècnica de València*; S. Cogollos, *Univ. Politècnica de València*; V.E. Boria, *Univ. Politècnica de València*; M. Guglielmi, *Univ. Politècnica de València*; S. Bastioli, *RS Microwave*; R. Snyder, *RS Microwave*

We2H-2: Compact Wideband Stepped Impedance Filters with Resonant Apertures

D. Rubio, *Univ. Politècnica de València*; S. Cogollos, *Univ. Politècnica de València*; V.E. Boria, *Univ. Politècnica de València*; M. Guglielmi, *Univ. Politècnica de València*

We2H-3: A Frequency-Variant Coupling Structure for Inline Rectangular Waveguide Filters

E. López-Oliver, *Università di Perugia*; C. Tomassoni, *Università di Perugia*; G. Macchiarella, *Politecnico di Milano*; M. Oldoni, *Politecnico di Milano*

We2H-4: A Novel Multi-Functional Coupled Resonator Based Balun Filter in Waveguide Technology

G. Basavarajappa, *IIT Roorkee*

We2H-5: In-Line Wideband Waveguide Bandpass Filters Using Hybrid Irises and Non-Uniform Resonators with Over-Octave Spurious Suppression

Z. Xu, J. Li, S. Chen, T. Yuan, *Shenzhen Univ.*

We2H-6: A 250GHz Low-Loss Inline Waveguide Bandpass Filter Using Bandstop Resonator Pairs

J.-Y. Lin, *Xiamen Univ.*; Y. Yang, *UTS*; T. Zhang, *CSIRO*; S.-W. Wong, *Shenzhen Univ.*

10:10 10:20 10:30 10:40 10:50 11:00 11:10 11:20 11:30 11:40 11:50

WEDNESDAY

IMS TECHNICAL LECTURE

12:00 – 13:20 | Wednesday, 14 June 2023 | Ballroom Section 20A

	LECTURE TITLE	ABSTRACT
TL3	**The Insight of Spaceborne Solid-State Power Amplifiers: From Semiconductor Technologies to Flight Model Equipment** **Speakers: Iain Davies**, *European Space Agency;* **Elisa Cipriani**, *European Space Agency;* **Natanael Ayllon**, *European Space Agency*	Spaceborne RF high power amplifiers (HPAs) are key building blocks used in telecommunication, navigation, remote sensing, science and human spaceflight applications. Due to their limited efficiency, they often play a central role in the electrical, thermal and mechanical design of complete instrument and payloads onboard the spacecraft. The aim of this technical lecture is to provide, through a real-case scenario, a comprehensive insight of solid-state power amplifiers including key semiconductor technologies and trade-offs, basic principles of HPA operating modes, traditional architectures used in space systems, step-by-step design and integration aspects, validation activities as well as development challenges brought by the different application domains. The technical lecture aims at being an entertaining and interactive forum where participants will have the opportunity to exchange throughout the lecture.

IMS PANEL SESSION

12:00 – 13:30 | Wednesday, 14 June 2023 | Room: 32AB

Model Based System Engineering in Electronics Design: Building Bridges from Micro to Macro

PANEL ORGANIZERS:
Ian Rippke, *Keysight Technologies*
Mark Hepburn, *Cadence*

PANELISTS:
Nate McBee, *Ansys Government Initiatives (AGI)*
Bob Broughton, *Analog Devices*
Brian Haan, *Dassault Systemes*
Giorgia Zucchelli, *The MathWorks*

ABSTRACT: Even as today's sophisticated electronic systems have evolved, the designs behind them have remained largely in multiple silos: digital, analog, RF, package, board, analysis, and more. These disjointed flows involving multiple tools cause delays and design risks. How can these silos be broken down and design-led with integration and optimization at the electronic system level? Model-based systems engineering (MBSE) is a methodology where a set of models are developed for use in the design, analysis, and verification of complex systems. MBSE is having a renaissance, expanding beyond high level requirements capture and system modeling to incorporate detailed, higher fidelity and physics-based modeling techniques. This is already moving forward in major aerospace/defense companies, but also appearing at commercial companies in the space and wireless arenas. But will these advances truly bring us digital twins of our systems and products, or will we fall back to our old ways of siloed design and 'over the wall' information sharing? Join us for a discussion by experts in MBSE practices, leaders in industry and academia, and EDA specialists to explore whether MBSE really is the gateway to digital twinning or is the challenge too big to overcome on the path to success?

IMS PANEL SESSION

12:00 – 13:30 | Wednesday, 14 June 2023 | Room: 33ABC

RF/Microwave Packaging and Interconnect Technologies for Global Integration—Are We on the Right Track?

PANEL ORGANIZERS:
Ke Wu, *Polytechnique Montréal*
Kamal Samanta, *AMWT Ltd UK*
Manos Tentzeris, *Georgia Tech*
Jungchih Chiao, *Southern Methodist University*

PANELISTS:
Kevin Gu, *Metawave*
Patrick Reynaert, *KU Leuven and Imec*
William Chen, *ASE*
Beth Keser, *International Microelectronics Assembly and Packaging Society*
Premjeet Chahal, *National Science Foundation*
Harshpreet Bakshi, *Texas Instruments*
Tim Lee, *The Boeing Company*

ABSTRACT: RF/microwave Front-End Modules (FEM) including antenna systems operating over MHz-through-THz frequency range for sub-7 GHz and 5G/6G applications, continuously require innovative solutions for meeting high electrical, RF, mechanical, and thermal performance at a low cost. This MTT-S Inter-Society Technology Panel (ISTP) will discuss recent advancements in RF/microwave packaging and interconnect technologies enabled by emerging new materials, advanced processing techniques and topological innovations as well as underlying technical challenges. This special panel will bring together industrial and academic experts of various background from different IEEE societies and other organizations, including IEEE MTT-S, EPS, AP-S, SSCS, EMC-S, CASS, and others. While the state-of-the-art achievements in manufacturing, interconnect, and packaging techniques will be reviewed, this panel will debate the critical issues and the relative advantages and suitability of various emerging materials and interconnects (hybrid/metaconductors); processes such as additive and subtractive manufacturing; matured and emerging integration techniques - MCM, AiP/SoC/SiP/SoS, heterogenous and wafer-level packaging and chiplets; considering cost, performance, reliability/repeatability and volume production requirements; and will suggest possible application spaces with time scales and future directions. The panel will also discuss the impact of new technologies on the traditional realm of metal conductors and subtractive manufacturing.

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23ABC

We3A: Quantum Computing/ Sensing Components and Techniques

Chair: Luca Pierantoni, *Università Politecnica delle Marche*
Co-Chair: Joseph Bardin, *UMass Amherst*

13:30

We3A-1: A 10 Gb/s 275 fsec Jitter Charge-Sampling CDR for Quantum Computing Applications

L. de Jong, *Technische Universiteit Delft*; J. Bas, *Technische Universiteit Delft*; J. Gong, *Technische Universiteit Delft*; F. Sebastiano, *Technische Universiteit Delft*; M. Babaie, *Technische Universiteit Delft*

13:40

13:50

We3A-2: A Q-Band SiGe-HBT Cryogenic Colpitts VCO for Frequency-Division Multiplexed Quantum Computing

E. Vardarli, *Technische Universität Dresden*; X. Jin, *Technische Universität Dresden*; A.Y.-K. Chen, *Univ. of California, Santa Cruz*; K. Aufinger, *Infineon Technologies*; M. Schröter, *Technische Universität Dresden*

14:00

14:10

We3A-3: Resistance Ratio Enhancement in Chalcogenide Phase-Change RF Switches at Cryogenic Temperatures

Tejinder Singh, *Univ. of Waterloo*; Raafat Mansour, *Univ. of Waterloo*

14:20

14:30

We3A-4: Field Enhancement for Sensitivity Improvement of a Room-Temperature Rydberg-Atom Receiver

G. Sandidge, *University of Colorado Boulder*; G. Santamaria Botello, *University of Colorado Boulder*; Z. Popovic, *University of Colorado Boulder*

14:40

14:50

We3A-5: Impedance Standard Substrate Characterization and EM Model Definition for Cryogenic and Quantum-Computing Applications

E. Shokrolahzade, F. Sebastiano, *Technische Universiteit Delft*; F. Mubarak, *VSL*; M. Babaie, M. Spirito, *Technische Universiteit Delft*

15:00

15:10

We3A-6: Characterizing Precision Coaxial Air Lines as Reference Standards for Cryogenic S-Parameter Measurements at Milli-Kelvin Temperatures

J. Skinner, *NPL*; M. Stanley, *NPL*; J. Urbonas, *Maury Microwave*; S. de Graaf, *NPL*; T. Lindström, *NPL*; N. Ridler, *NPL*

24ABC

We3B: THz Imagers and Detectors and Microwave Photonics

Chair: Debabani Choudhury, *Intel*
Co-Chair: Wooram Lee, *Penn State University*

We3B-1: Microwave Photonics and Quantum Applications

M.A.R. Hashmi, *Univ. College London*; P.V. Brennan, *Univ. College London*

We3B-2: 16 Frames-per-Second Terahertz Time-Domain Imaging Through a Plasmonic Photoconductive Focal-Plane Array

X. Li, *Univ. of California, Los Angeles*; D. Mengu, *Univ. of California, Los Angeles*; A. Ozcan, *Univ. of California, Los Angeles*; M. Jarrahi, *Univ. of California, Los Angeles*

We3B-3: Development of W-Band Dual-Polarization Kinetic Inductance Detectors on Silicon

M.C. de Ory, D. Rodriguez, *Centro de Astrobiología*; L. de la Fuente, B. Aja, *Universidad de Cantabria*; E. Villa, *Centro de Astrobiología*; D. Bordner, J.P. Pascual, *Universidad de Cantabria*; D. Granados, *IMDEA Nanociencia*; E. Artal, *Universidad de Cantabria*; A. Gomez, *Centro de Astrobiología*

We3B-4: Antenna-Coupled Terahertz Detectors in 16nm FinFET

C. Chen, *Univ. of California, Los Angeles*; R. Al Hadi, *Univ. of California, Los Angeles*; M.-C.F. Chang, *Univ. of California, Los Angeles*

We3B-5: Experimental Demonstration of Multi-Band Comb-Enabled mm-Wave Transmission

D. Nopchinda, *Univ. College London*; Z. Zhou, *Univ. College London*; Z. Liu, *Univ. College London*; I. Darwazeh, *Univ. College London*

25ABC

We3C: Novel Power Amplifier Architectures for High-Power Applications—*Dedicated to John Palmour, co-founder of Cree, now Wolfspeed*

Chair: Xinyu Zhou, *Stanford University*
Co-Chair: Tony G. Ivanov, *Army Research Laboratory*

We3C-1: High-Power (>5W) RF & Microwave Amplifiers, Below 30GHz

D.W. Runton, *Macom*

We3C-2: The Role of Nonlinear Cout in Continuous Class F PAs

Y. Mary Asha Latha, *Instituto de Telecomunicações*; L.C. Nunes, *Instituto de Telecomunicações*; F.M. Barradas, *Instituto de Telecomunicações*; J.C. Pedro, *Instituto de Telecomunicações*

We3C-3: A GaN Gain Enhancement PA with Peak Power Combining

W. Sear, *University of Colorado Boulder*; T. Barton, *University of Colorado Boulder*

We3C-4: A 100W 2.15GHz RF Power Amplifier Device with Novel Matching Network

E.M. Johnson, *NXP Semiconductors*; V. Shilimkar, *NXP Semiconductors*; R. Sweeney, *NXP Semiconductors*

We3C-5: A GaN-Based Solid State Power Amplifier for Satellite Communications

R. Giofrè, *Università di Roma "Tor Vergata"*; L. Cabria, *TTI Norte*; R. Leblanc, *OMMIC*; M. Lopez, *TTI Norte*; F. Vitobello, *European Commission*; P. Colantonio, *Università di Roma "Tor Vergata"*

30C

We3E: Advances in Computational Techniques for Microwave and mm-Wave Applications

Chair: Dan Jiao, *Purdue University*
Co-Chair: Constantine Sideris, *University of Southern California*

We3E-1: Convergence of Simulation, Cloud Computing and Artificial Intelligence in Electromagnetics

C.J. Reddy, *Altair*

We3E-2: A Quantum-Walk-Unitary HHL Matrix Equation Solver and its Challenges in the NISQ Era

X. Li, *Univ. of Manitoba*; C. Phillips, *Univ. of Waterloo*; I. Jeffrey, *Univ. of Manitoba*; V. Okhmatovski, *Univ. of Manitoba*

We3E-3: Vector Single-Source SIE Formulation for Scattering Analysis of Multilayered Objects

Z. Zhu, *Beihang Univ.*; X. Zhou, *Beihang Univ.*; Z. Chen, *Fuzhou Univ.*; S. Yang, *Beihang Univ.*

We3E-4: Geometric Optics with Uniform Asymptotic Physical Optics for Ray Tracing of Compound GRIN Lens Systems

W. Wang, *Univ. of Notre Dame*; J. Chisum, *Univ. of Notre Dame*

We3E-5: Normal Incidence Scattering of Waveguide-Like Periodic Structures in Scalar 2D-FEM Mode-Matching Extracting the Frequency Dependence

G. Garcia-Contreras, *Universidad Autónoma de Madrid*; J. Córcoles, *Universidad Autónoma de Madrid*; J.A. Ruiz-Cruz, *Universidad Autónoma de Madrid*

Denotes Industry Keynote Presentation

30DE

We3F: Emerging Planar Filters: From L-Band to mm-Waves

Chair: Jay McDaniel, *University of Oklahoma*
Co-Chair: Tarek Djerafi, *University of Quebec*

We3F-1: Synthesis of Wideband Cross-Coupled Resonator Filter for Direct Circuit Implementation Using Lumped Elements

B. Liu, *University of Electronic Science and Technology of China*; K. Li, *Univ. of Electronic Science and Technology of China*; X. Chen, *Univ. of Electronic Science and Technology of China*; P.-L. Chi, *National Yang Ming Chiao Tung University*; T. Yang, *Univ. of Electronic Science and Technology of China*

We3F-2: Design of Wideband Hybrid QMSIW and Coupled-Line Filter by Direct-Synthesis Approach in the Bandpass Domain

H. Tian, *UESTC*; Y. Dong, *UESTC*

We3F-3: Compact Hybrid Filter Based on HMSIFW and SICL Technology with Wide-Stopband Suppression

Y. Yang, *UESTC*; Y. Dong, *UESTC*

We3F-4: Compact 12–18-GHz Bandpass Filter with Wide Stopband Using Hybrid Dual-Mode SIDGS/Microstrip Resonant Cell

Y. Yang, *UESTC*; Y. Rao, *UESTC*; D. Tang, *UESTC*; J. Zhou, *UESTC*; X. Luo, *UESTC*

We3F-5: Millimeter-Wave Substrate-Integrated Waveguide Multiplexer with High Channel Scalability and High Isolation

P.-L. Chi, *NYCU*; P.-H. Wang, *NYCU*; T. Yang, *UESTC*

31AB

We3G: RF/Microwave Research in Latin America

Chair: José E. Rayas-Sánchez, *ITESO*
Co-Chair: J. Apolinar Reynoso-Hernández, *CICESE*

We3G-1: Resonance-Related Fluctuations on Experimental Characteristic Impedance Curves for PCB and On-Chip Transmission Lines

Y. Rodríguez-Velásquez, *Intel*; R.S. Murphy-Arteaga, *INAOE*; R. Torres-Torres, *INAOE*

We3G-2: Equalization Tuning of the PCIe Physical Layer by Using Machine Learning in Industrial Post-Silicon Validation

F.E. Rangel-Patiño, *Intel*; A. Viveros-Wacher, *Intel*; C. Rajyaguru, *Intel*; E.A. Vega-Ochoa, *Intel*; S.D. Rodriguez-Saenz, *Intel*; J.L. Silva-Cortes, *Intel*; H. Shival, *Intel*; J.E. Rayas-Sánchez, *ITESO*

We3G-3: Pre-Coded Supervising System Based on Smart Antenna Array for Electric Power Distribution Grid: Optimization Aspects

J.M.A.M. de Oliveira, A. Gomes Barboza, R.G.M. dos Santos, M. de Oliveira Alencar, J.H. de A. Dias Silva, M.F. Bitencourt Pedrosa, D. de Filgueiras Gomes, A.J. Belfort de Oliveira, M.T. de Melo, *Univ. Federal de Pernambuco*; R.J.F.P.V. Padilha, *Neoenergia Cel*

We3G-4: LARGE Characterization of Power GaN FETs and PAs Linearity at Different Load Impedances Under CW Conditions and Multitone Signals Based on the USRP LFTX Daughterboard

T. Niubó Alemán, *CICESE*; J.A. Reynoso-Hernández, *CICESE*; J. Sánchez-García, *CICESE*; J.R. Loo-Yau, *CINVESTAV*; M.d.C. Maya-Sánchez, *CICESE*

We3G-5: X-Parameters: The μ Stability Factor and its Application to Avoid Oscillation Problems During the Characterization of Power GaN FETs

E.A. Hernández-Domínguez, *Cinvestav-GDL*; J.R. Loo-Yau, *Cinvestav-GDL*; A. Sánchez-Ramos, *Cinvestav-GDL*; J.A. Reynoso-Hernández, *CICESE*; P. Moreno, *Cinvestav-GDL*

31C

We3H: Non-Planar Passive Components and Technologies

Chair: Luca Perregrini, *Università di Pavia*
Co-Chair: Simone Bastioli, *RS Microwave*

We3H-1: Hybrid Implementation of a Compact 2-Way Wilkinson Power Divider/Combiner for Applications in the Low RF Band

J.M. Lopez-Villegas, *Universitat de Barcelona*; N. Vidal, *Universitat de Barcelona*

We3H-2: Two-Layer Three-Way Horst Power Divider and Combiner Based-on Microstrip Line with Fixed Impedance Characteristic

A. Zerfaine, *Institut National de la Recherche Scientifique*; A. Moulay, *Institut National de la Recherche Scientifique*; T. Djerafi, *Institut National de la Recherche Scientifique*

We3H-3: Using a 3D-Printed Waveguide Filter with Ridge Resonators as a Dielectric Permittivity Sensor

F. Romano, *Università di Pavia*; N. Delmonte, *Università di Pavia*; L. Perregrini, *Università di Pavia*; M. Bozzi, *Università di Pavia*

We3H-4: A Power-Efficient Microwave Microplasma Jet Utilizing an SIW Evanescent-Mode Cavity Resonator

K.S. Kabir, *Univ. of Toledo*; A. Semnani, *Univ. of Toledo*

We3H-5: N-Way Spatial Power Combiner Using Tapered Antipodal Slotline Feed Array in a Radial Waveguide

I. Karaman, *Aselsan*; V. Acikel, *Aselsan*; M. Koc, *Aselsan*

We3H-6: Basic Study of 79GHz Band Resin Waffle-Iron Ridge Guide

Y. Aoki, *Taiyo Yuden*; H. Tanaka, *Taiyo Yuden*; H. Kamo, *Taiyo Yuden*; T. Shimizu, *Utsunomiya University*

13:30 13:40 13:50 14:00 14:10 14:20 14:30 14:40 14:50 15:00 15:10

23ABC

We4A: Advances in Quantum Devices, Circuits and Systems

Chair: Kavita Goverdhanam, *U.S. Army CCDC C5ISR Center*

Co-Chair: Tejinder Singh, *Dell Technologies*

15:40 – 15:50

We4A-1: Building and Exercising a Superconducting Quantum Processor Prototype 

M. Giustina, *Google*

16:00 – 16:10

We4A-2: Superconducting Non-Reciprocal Bandpass Filter Based on Spatio-Temporal Inductance Modulation

Y. Zhuang, *Washington Univ. in St. Louis*; C. Gaikwad, *Washington Univ. in St. Louis*; D. Kowsari, *Washington Univ. in St. Louis*; E. Henriksen, *Washington Univ. in St. Louis*; K. Murch, *Washington Univ. in St. Louis*; A. Nagulu, *Washington Univ. in St. Louis*

16:20 – 16:30

We4A-3: Quantum Models for Flux-Driven Superconducting Traveling-Wave Parametric Amplifiers with Different Nonlinear Junction Topologies

M. Haider, Y. Yuan, J.A. Russer, C. Jirauschek, *Technische Univ. München*

16:30 – 16:40

We4A-4: A Miniature 10MHz–3GHz Sub 1-dB NF Cryogenic Inductorless Noise-Canceling Low-Noise Amplifier for Qubit Readout

M.K. Chaubey, *National Tsing Hua Univ.*; Y. Liu, *National Tsing Hua Univ.*; P.-C. Wu, *NARLabs-TSRI*; H.-H. Tsai, *NARLabs-TSRI*; S.S.H. Hsu, *National Tsing Hua Univ.*

16:40 – 16:50

We4A-5: A 3.5~7.5GHz GaAs HEMT Cryogenic Low-Noise Amplifier Achieving 5 Kelvin Noise Temperature for Qubits Measurement

Y. Peng, *University of Macau*; Y. Zhong, *Shenzhen International Quantum Academy*; Z. Guo, *Shenzhen International Quantum Academy*; S. Liu, *Shenzhen International Quantum Academy*; D. Yu, *Shenzhen International Quantum Academy*

16:50 – 17:00

We4A-6: Surface Acoustic Wave Filters for Superconducting Qubits

D. Eslava, *Qilimanjaro Quantum Tech*; E. Guerrero, *Univ. Autònoma de Barcelona*; L. Acosta, *Univ. Autònoma de Barcelona*; R. Sagastizabal, *Qilimanjaro Quantum Tech*; P. Jamet, *Qilimanjaro Quantum Tech*; P. Forn-Díaz, *Qilimanjaro Quantum Tech*; P. de Paco, *Univ. Autònoma de Barcelona*

24ABC

We4B: THz Communications Components

Chair: Steven M. Bowers, *University of Virginia*

Co-Chair: William R. Deal, *Northrop Grumman*

15:40 – 15:50

We4B-1: 220-to-320-GHz Fundamental Mixer in 60-nm InP HEMT Technology Achieving 120/152/168-Gbps Data Transmission in Three Bands

T. Jyo, *NTT*; H. Hamada, *NTT DOCOMO*; T. Tsutsumi, *NTT*; I. Abdo, *NTT*; S. Kawahara, *NTT*; D. Kitayama, *NTT*; M. Nagatani, *NTT*; H. Takahashi, *NTT*

16:00 – 16:10

We4B-2: Design and Characterization of Metalized Trench Based Waveguide Technology on Glass Interposer for 6G Applications

X. Li, *Georgia Tech*; X. Jia, *Georgia Tech*; S. Erdogan, *Georgia Tech*; M. Jordan, *Sandia National Laboratories*; M. Swaminathan, *Georgia Tech*

16:20 – 16:30

We4B-3: Broadband THz Switching with Extremely Low Insertion Loss and Superior Isolation

P. Li, *Univ. of Notre Dame*; W. Wu, *Univ. of Notre Dame*; Y. Shi, *Univ. of Notre Dame*; Y. Deng, *Univ. of Notre Dame*; P. Fay, *Univ. of Notre Dame*; L. Liu, *Univ. of Notre Dame*

16:40 – 16:50

We4B-4: A 3D Printed Terahertz Metamaterial Lens for Beam-Steering Applications

J. Lai, *UTS*; Y. Yang, *UTS*

25ABC

We4C: HF Through UHF, Watts to Kilowatts Power Amplifiers and Applications

Chair: Paul J. Draxler, *MaXentric Technologies*

Co-Chair: Ramon A. Beltran, *Ophir RF*

15:40 – 15:50

We4C-1: RF Power at HF/VHF/UHF — Status and Trends 

R. Posner, *Aethercomm*

16:00 – 16:10

We4C-2: Linearity Enhanced Broadband Darlington Power Amplifier IC Using InGaP/GaAs HBT for Handset Modules with Fractional Bandwidth of 50%

S. Bae, *Hanyang Univ.*; J. Jeon, *Gangneung-Wonju National University*; S. Hwang, *Hanyang Univ.*; B. Yoon, *Hanyang Univ.*; J. Kim, *Hanyang Univ.*

16:20 – 16:30

We4C-3: A 30–680-MHz GaAs pHEMT Power Amplifier with Guanella-Type Transformers Integrated on a Flexible Printed Circuit Board

Z. Ma, *Zhejiang Univ.*; B. Lan, *Zhejiang Univ.*; W. Zhou, *Zhejiang Univ.*; J. Chen, *Etra Semiconductor*; Z. Liu, *Etra Semiconductor*; Q.J. Gu, *Univ. of California, Davis*; C. Song, *Zhejiang Univ.*; Z. Xu, *Zhejiang Univ.*

16:40 – 16:50

We4C-4: 200-W 13.56-MHz Class-E PA with Gate-Driver ICs

F.H. Raab, *Green Mountain Radio Research*

 Denotes Industry Keynote Presentation

INTERACTIVE FORUM | IF1

15:10 – 17:00 | Wednesday, 14 June 2023 | Sails Pavilion

Chair: Gian Piero Gibiino, *Università di Bologna* | **Co-Chair:** Andrés Zárate de Landa, *pSemi*

IF1-1: Use of Cavity Perturbation Techniques to Characterize Via-Plate Behavior

T. Reeves, *MathWorks*; M. Tsuk, *MathWorks*; V. Iyer, *MathWorks*

IF1-2: 4-Way Microstrip Wilkinson Power Splitter at Frequencies of Millimeter Waves

M. Hasanovic, *Smiths Interconnect*; J. Ayala, *Smiths Interconnect*; M. Kettner, *Smiths Interconnect*

IF1-3: Input-Reflectionless 2.4–3.8GHz Balun with Low Phase/Amplitude Imbalance Using Stacked-Coupled Microstrip Line

S. Zhang, *UESTC*; Y. Rao, *UESTC*; Y. Dong, *UESTC*; X. Luo, *UESTC*

IF1-4: Characterization of a D-Band Electric-Inductive-Capacitive Metamaterial-Based Transmission Line Phase Shifter

G.M. Zampa, *Università Politecnica delle Marche*; A. Sonara, *Università Politecnica delle Marche*; D. Mencarelli, *Università Politecnica delle Marche*; L. Pierantoni, *Università Politecnica delle Marche*; H.J. Christopher, *Università Politecnica delle Marche*; Z. Cao, *IHP*; R. Al Hadi, *Univ. of California, Los Angeles*; M.-C.F. Chang, *Univ. of California, Los Angeles*; M. Kaynak, *IHP*

IF1-5: A Low Loss Self-Packaged Power Divider Using Right-Angled Isosceles Triangular Patch Based on the SISL Platform

S. Zhang, *Tianjin Univ.*; Y. Wang, *Tianjin Univ.*; K. Ma, *Tianjin Univ.*

IF1-6: A Dual-Band Micromachined On-Wafer Probe with Integrated Diplexer for Ultra-Broadband Measurements to 220GHz

M.F. Bauwens, *Dominion MicroProbes*; N.S. Barker, *Univ. of Virginia*; F. Boes, *KIT*; M.E. Cyberey, *Univ. of Virginia*; R.M. Weikle, *Univ. of Virginia*; T. Zwick, *KIT*; A.W. Lichtenberger, *Univ. of Virginia*

IF1-7: Broadband 770° Phase Shifter for mm-Waves Using Controllable Delocalization of Modal Fields in a Dielectric Rod Waveguide

A. Kumar, *Universidad Carlos III de Madrid*; D.C. Gallego, *Universidad Carlos III de Madrid*; M. Ali, *LeapWave Technologies*; A. Rivera-Lavado, *LeapWave Technologies*; D. Headland, *Universidad Carlos III de Madrid*; G. Carpintero, *Universidad Carlos III de Madrid*

IF1-8: A Fully 3-D-Printing-Compatible E-Plane Elliptical Waveguide Junction for Power Dividing/Combining Applications

S. Chen, *Shenzhen Univ.*; J. Li, *Shenzhen Univ.*; T. Yuan, *Shenzhen Univ.*

IF1-9: A New Class of Inline Microwave Filter with Transmission Zeros

P.W. Wong, *FILPAL*; G.S. Ng, *FILPAL*

IF1-10: Compact 3D-Printed Bandpass Filters Using Coaxial and Dual-Mode Ridged-Waveguide Resonators

K. Zhao, *University of Colorado Boulder*; D. Psychogiou, *Univ. College Cork*

IF1-11: Monolithic Compact Low-Frequency Bandpass Filter Based on Intertwined Helical Resonators

J.L. Medrán del Río, *Universidad de Sevilla*; A. Fernandez-Prieto, *Universidad de Sevilla*; J. Martel, *Universidad de Sevilla*; D. Psychogiou, *Univ. College Cork*

IF1-12: A Monolithically 3-D Printed Waveguide Filter Based on Elliptic Cylindrical Resonators with Enhanced Polarization Rotation Flexibility

Y. Ye, *Shenzhen Univ.*; J. Li, *Shenzhen Univ.*; S. Chen, *Shenzhen Univ.*; Z. Xu, *Shenzhen Univ.*; T. Yuan, *Shenzhen Univ.*

IF1-13: 3D-Printed Multi-Material Multilayer Wideband Microwave Absorber

S.S. Ganti, *Purdue Univ.*; M.J. Smith, *Purdue Univ.*; C.-K. Koh, *Purdue Univ.*; D. Jiao, *Purdue Univ.*; G. Subbarayan, *Purdue Univ.*

IF1-14: Ka-Band EMI Shielding Effectiveness of Ti_3C_2Tx MXene

Y. Liu, *Purdue Univ.*; A. Thakur, *IUPUI*; B. Anasori, *Purdue Univ.*; S. Mohammadi, *Purdue Univ.*

IF1-15: Novel Method for High Reliability Assembly of Microwave QFN Packages for Extreme Thermal Cycling Applications

R. Pino, *ERZIA Technologies*; N. Rodríguez, *ERZIA Technologies*; C. Gómez, *ERZIA Technologies*; A. Rodríguez, *ERZIA Technologies*; R. Baker, *Spur Electron*; C. Chandler, *Spur Electron*

IF1-16: 2.5D Technology Based on Vertically Aligned Carbon Nanotubes for mm-Waves Passive Devices

S.C.K. Goh, *CINTRA*; C.F. Siah, *NTU*; J. De Saxce, *XLIM (UMR 7252)*; Z. Ng, *NTU*; L.L. Shiau, *Temasek Laboratories @ NTU*; L.L.Y. Xiang, *CINTRA*; C.W. Tan, *CINTRA*; E.H.T. Teo, *NTU*; P. Coquet, *CINTRA*; D. Baillargeat, *CNRS@CREATE*; B.K. Tay, *CINTRA*

IF1-17: An Improved Extraction Method for the Trapping Time Constants in GaN HEMTs

I.C. Lopes, *Universidade de Aveiro*; L.C. Nunes, *Universidade de Aveiro*; P.M. Cabral, *Universidade de Aveiro*; J.C. Pedro, *Universidade de Aveiro*

IF1-19: Calibration Fixture Design for Low Intrusive Current Sensors

D. Gapillout, *CEA-Gramat*; P. Pradel, *CEA-Gramat*; P. Coudert, *CEA-Gramat*; A. Collin, *CEA-Gramat*

IF1-20: Dielectric Loaded Decoupling Technique for Multichannel RF Coils

S. Hashemi, *Arizona State Univ.*; S.K. Kandala, *Arizona State Univ.*; S.-M. Sohn, *Arizona State Univ.*

IF1-21: Impact of Emission Time Constant on the Linearizability of AlGaN/GaN HEMTs

Z. Yu, *Ampleon*

IF1-22: A Low-Complexity Digital Predistortion Technique for Digital I/Q Transmitters

M. Beikmirza, *Technische Universiteit Delft*; L.C.N. de Vreede, *Technische Universiteit Delft*; M.S. Alavi, *Technische Universiteit Delft*

IF1-23: Direct Learning Neural Network Digital Predistortion Using Backpropagation Through a Memory Power Amplifier Model

E. Loebl, *Technion*; N. Ginzberg, *Technion*; E. Cohen, *Technion*

IF1-24: Low-Complexity Feedback Data Compression for Closed-Loop Digital Predistortion

A. Fischer-Bühner, *Nokia Bell Labs*; L. Anttila, *Tampere Univ.*; V. Unnikrishnan, *Tampere Univ.*; M.D. Gomony, *Nokia Bell Labs*; M. Valkama, *Tampere Univ.*

IF1-25: Wireless Reading of Additively Manufactured Galinstan-Based Sensor Using a Polarimetric Millimeter-Wave Radar Imaging Technique

D. Henry, *LAAS-CNRS*; A. El Sayed Ahmad, *LAAS-CNRS*; A. Hadj Djilani, *LAAS-CNRS*; P. Pons, *LAAS-CNRS*; H. Aubert, *LAAS-CNRS*

IF1-26: A 1024-Channel Wideband Digital Subsystem Prototype for Large Aperture Array Radio Telescope

R. Cao, *CETC 38*; M. Wu, *CETC 38*; X. Tao, *CETC 38*; G. Peng, *CETC 38*; L. Jiang, *CETC 38*; K. Li, *Anhui Univ.*; J. Zhang, *CETC 38*; H. Zhang, *CETC 38*; X. Xu, *CETC 38*; D. Rong, *CETC 38*; H. Yang, *CETC 38*; M.-A. Ye, *CETC 38*; C. Wang, *CETC 38*; Y. Zhang, *CETC 38*; Y. Xu, *CETC 38*; X. Yu, *CETC 38*; D. Lu, *CETC 38*; D. Zhu, *CETC 38*

IF1-27: Frequency Scanning Surface Velocity Radar for River Monitoring

G. Cicioni, *Università di Perugia*; G. Orecchini, *Università di Perugia*; R.V. Gatti, *Università di Perugia*; C. Saltalippi, *Università di Perugia*; V. Palazzi, *Università di Perugia*; P. Mezzanotte, *Università di Perugia*; L. Roselli, *Università di Perugia*; F. Alimenti, *Università di Perugia*

IF1-28: Plasma Windowing for Hypersonic Radio Communications

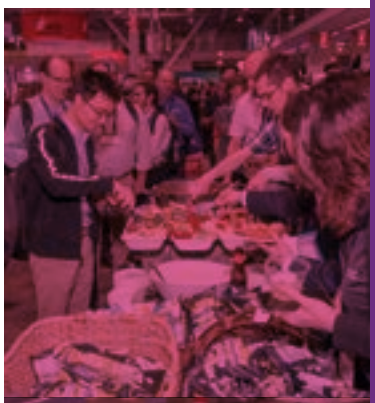
S.D. Sifferman, *SPEC*; B. Sallee, *SPEC*; R. Noster, *SPEC*

IF1-29: Novel Architecture for Beacon Signal Generation in Satellite Applications

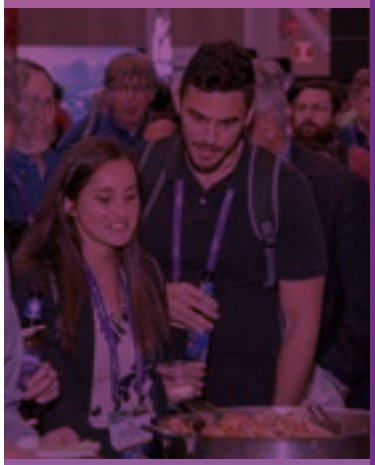
G. Schiavolini, *Università di Perugia*; G. Orecchini, *Università di Perugia*; A. Beltramello, *PICOSATS*; A. Loppi, *PICOSATS*; S. Pauletto, *PICOSATS*; F. Adamo, *PICOSATS*; N. Sesto Gorella, *PICOSATS*; F. Dogo, *PICOSATS*; D. Manià, *PICOSATS*; M. Fragiacomo, *PICOSATS*; V. Palazzi, *Università di Perugia*; L. Roselli, *Università di Perugia*; P. Mezzanotte, *Università di Perugia*; A. Gregorio, *Università di Trieste*; F. Alimenti, *Università di Perugia*

IF1-30: Model Based Design for Frequency Scanning Array

S. Joshi, *MathWorks*; S. Kulkarni, *MathWorks*; V. Iyer, *MathWorks*



Don't Miss the Industry Hosted Reception on Wednesday, 14 June, from **17:00–18:00** on the IMS Exhibit Floor!



WEDNESDAY

SAN DIEGO CONVENTION CENTER

MICROAPPS

09:30 – 17:00 | Wednesday, 14 June 2023 | IMS Exhibit Floor: Booth 2447

SESSION CODE	TIME	TITLE	SPEAKER/S, AFFILIATIONS
WEMA1	09:30 – 09:45	Reference Oscillators for Low Phase Noise and Low Jitter Signal Sources	Ian Collins, Raymond Baker, *Richardson RFPD*
WEMA2	09:45 – 10:00	I know I Need to Measure RF Power – Now What?	Bob Buxton, *Boonton*
WEMA3	10:00 – 10:15	6G Devices, Applications and Related Measurements Challenges	Navneet Kataria, *Anritsu Company*
WEMA4	10:15 – 10:30	D-Band Testing for 6G	Markus Loerner, *Rohde & Schwarz*
WEMA5	10:30 – 10:45	Fast and Comprehensive VCO Testing	Markus Loerner, *Rohde & Schwarz*
WEMA6	10:45 – 11:00	Addressing Thermal and Electromagnetic Challenges with Today's Advanced Devices	Dustin Kendig, *Microsanj LLC;* Sedina Wane, *eV Technologies*
WEMA7	11:00 – 11:15	Fabry-Perot Open Resonator for Single-Sweep Characterization of Dielectric Sheets in the 10-130 GHz Range for 5G/6G Applications	Bartlomiej Salski, *EMARGES SP. Z O.O.*
WEMA8	11:15 – 11:30	A Simplified Methodology for Creation and Reuse of RF & Microwave Package Models for Electromagnetic and Thermal Simulation	Dustin Hoekstra, *Cadence*
WEMA9	11:30 – 11:45	Dynamic Satellite Link Budget Analysis in MATLAB	Mike McLernon, *MathWorks, Inc.*
WEMA10	11:45 – 12:00	CMOS SOI RF Design-Technology Co-Optimization	Nelson Braga, *Synopsys, Inc.*
WEMA11	12:00 – 12:15	Installed Antenna Scenarios and RCS Analysis in MATLAB®	Vishwanath Iyer, *MathWorks, Inc.*
WEMA12	12:15 – 12:30	Removing Excess Heat from Ungrounded Surface Mount Devices	Cory Nelson, *Kyocera-AVX*
WEMA13	12:30 – 12:45	Moving Up in Frequency – D-Band the Next Frontier for the Telecommunications XHaul	Tudor Williams, *Filtronic*
WEMA14	12:45 – 13:00	A 3 kW GaN-SiC Pallet Amplifier for S-Band Direct Energy Applications Operating at 100 V	Jeff Burger, John Walker, Will Veitschegger, *Integra Technologies, Inc.*
WEMA15	13:00 – 13:15	mmWave PAs - Why Sacrifice High Power for Linearity?	Seyed Tabatabaei, *mmTron, Inc.*
WEMA16	13:15 – 13:30	GaN-based RF Switch Improves SWaP and Takes the Complexity Out of High-Power Radio Design	Manish Shah, *Tagore Technology*
WEMA17	13:30 – 13:45	Computational Electromagnetics Methods Applied to Bio-Medical Applications	Yushi Tan, *VIAS3D Inc*
WEMA18	13:45 – 14:00	Tools and Strategies for 3D EM Modeling and Design of Microwave Imaging Systems for Medical Applications	Branislav Ninkovic, *WIPL-D*
WEMA19	14:00 – 14:15	Thermal Co-Simulation of Acoustic Wave Filters for Performance and Reliability	David Vye, *Cadence*
WEMA20	14:15 – 14:30	Sub-THz Waveguide Switches	Andrew Laundrie, *Eravant*
WEMA21	14:30 – 14:45	High Frequency RF Crossover Device	Pierre Nadeau, *Knowles Precision Devices*
WEMA22	14:45 – 15:00	5G C-Band Interference Mitigation Solutions	Edward Liang, *MCV Technologies, Inc.*
WEMA23	15:00 – 15:15	Overview of Integrated Passived Devices (IPD) for RF Front-End Applications	Feng Ling, Lijun Chen, *Xpeedic*
WEMA24	15:15 – 15:30	Introducing a Patented Ceramic Capacitor for Next Generation RF & Microwave	Alex Moalemi, Euan Armstrong, *Quantic Eulex*
WEMA25	15:30 – 15:45	Phase Stabilization in Optical Fiber Frequency Distribution Systems	Bruce Nyman, *Linearizer Technology Inc.*
WEMA26	15:45 – 16:00	Predicting Performance of Xinger Passive Components on Customized PCB Layouts2	Chong Mei, *TTM*
WEMA27	16:00 – 16:15	RF Hot Switching Reliability of MEMS Switches	Teague Kohlbeck, *Menlo Micro*
WEMA28	16:15 – 16:30	Design Guidelines for 3D Printing of Low Loss Dielectric Devices	Philip Lambert, *Fortify*
WEMA29	16:30 – 16:45	3D Printed RF Structures Open the Potential to Think Out of the Box	John Coonrod, *Rogers Corp.*
WEMA30	16:45 – 17:00	Thermal Stability Consistency is Even More Important at Millimeter-Wave Frequencies	John Coonrod, *Rogers Corp.*

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Microwave Journal

IMS EARLY CAREER PAPER COMPETITION

This NEW competition is open to authors from industry, government agencies, and post-doctoral candidates, with less than 10 years of professional experience, and who are not full-time students or faculty members.

THIS YEAR'S IMS EARLY CAREER PAPER COMPETITION FINALISTS:

300-GHz-Band 4-Element CMOS-InP Hybrid Phased-Array Transmitter with 36° Steering Range | We2B-1
Author: Ibrahim Abdo, *NTT Device Technology Laboratories*

A Cryogenic Four-Channel C-Band Low-Noise Amplifier MMIC in 50-nm Metamorphic High-Electron-Mobility-Transistor Technology | Tu2D-3
Author: Felix Heinz, *Fraunhofer IAF*

The Role of Nonlinear Cout in Continuous Class F Pas | We3C-2
Author: Mary Asha Latha Yericharla, *Instituto de Telecomunicacoes*

Dual-band Microstrip Ferrite Circulator | Th2E-2
Author: Vincent Olivier, *INOVEOS*

Experimental Demonstration of Multi-Band Comb-Enabled mm-Wave Transmission | We3B-5
Author: Dhecha Nopchinda, *University College London*

Simplified Over-the-Air Noise Figure Measurement Method for Reduced Uncertainty | Th1F-1
Author: Anouk Hubrechsen, *Eindhoven University Of Technology*

Occupant Entry and Exit Event Extraction Using Continuous Wave (CW) Doppler Radar and Wavelet Analysis | Th2C-5
Author: Dr. Shekh Md Mahmudul Islam, *University of Hawaii at Manoa*

A 3-way GaN Doherty Power Amplifier for 28 GHz 5G FR2 Operation | We1C-3
Author: Anna Piacibello, *Politecnico di Torino*

ADVANCED PRACTICE AND INDUSTRY PAPER COMPETITIONS

The Advanced Practice Paper Competition (APPC) recognizes outstanding technical contributions that apply to practical applications. All finalist papers are on advanced practices and describe an innovative RF/microwave design, integration technique, process enhancement, and/or combination thereof that results in significant improvements in performance and/or in time to production for RF/microwave components, subsystems, or systems.

The Industry Paper Competition (IPC) recognizes outstanding technical contributions from industry sources. All finalist papers are from the RF/microwave industry and describe innovation of a product or system application that potentially has the highest impact on an RF/microwave product and/or system which will significantly benefit the microwave community and society at large.

ADVANCED PRACTICE PAPER FINALISTS:

We2D-1 Broadband Hetero-Integration of InP Chiplets on SiGe BiCMOS for mm-wave MMICs up to 325 GHz
Marko Rausch, *Ferdinand-Braun-Institut*; Matthias Wietstruck, *IHP Microelectronics*; Christoph Stölmacker, Ralf Doerner, *Ferdinand-Braun-Institut*; Gunter Fischer, *IHP Microelectronics*; Steffen Knigge, Hady Yacoub, Wolfgang Heinrich, *Ferdinand-Braun-Institut*

Tu2B-1 Enhancement-mode 300mm GaN-on-Si(111) with Integrated Si CMOS for Future mm-Wave RF Applications
Han Wui Then, Marko Radosavljevic, Qiang Yu, Alvaro Latorre-rey, Heli Vora, Samuel Bader, Ibukun Momson, Derek Thomson, Michael Beumer, Pratik Koirala, Jason Peck, Adedapo Oni, Thomas Hoff, Rob Jordan, *Intel Corporation*; Thoe Michaelos, *Intel*; Nityan Nair, Paul Nordeen, Andrey Vyatskikh, Ibrahim Ban, Ahmad Zubair, Said Rami, Paul Fischer, *Intel Corporation*

Tu2D-3 A Cryogenic Four-Channel C-Band Low-Noise Amplifier MMIC in 50-nm Metamorphic High-Electron-Mobility-Transistor Technology
Felix Heinz, Fabian Thome, Arnulf Leuther, *Fraunhofer IAF*

We4B-2 Design and Characterization of Metalized Trench Based Waveguide Technology on Glass Interposer for 6G Applications
Xingchen Li, Xiaofan Jia, Serhat Erdogan, *Georgia Institute of Technology*; Matthew Jordan, *Sandia National Laboratories*; Madhavan Swaminathan, *Georgia Institute of Technology*

Tu3E-2 An All-Digital Carrier Synthesis for Stepped OFDM Radars
David Werbunat, Benedikt Schweizer, Matthias Maier, Christina Bonfert, *Ulm University*; Daniel Schindler, *Robert Bosch GmbH*; Philipp Hinz, *Ulm University*; Juergen Hasch, *Robert Bosch GmbH*; Christian Waldschmidt, *University of Ulm*

Tu4D-4 New Digital Predistortion Training Method with Cross-Polarization Channel De-Embedding for Linearizing Dual-Polarized Arrays using Far-Field Observation Receiver
Nizar Messaoudi, *Keysight Technologies*; Ahmed Ben Ayed, Ziran He, Bernard Tung, Patrick Mitran, Slim Boumaiza, *University of Waterloo*

Tu4B-1 Intrinsically Switched Multiplexer Based Reconfigurable Filter MMIC
Charles Campbell, *QORVO, Inc.*; Deep Dumka, Ajay Bodade, Randy Kinnison, Matthew Essar, Jeffrey Miller, *Qorvo*

We1H-2 Dual-Mode Dielectric-Loaded Resonator for Satellite High-Power Filters
Paolo Vallerotonda, Fabrizio Cacciamani, Luca Pelliccia, *RF Microtech s.r.l*; Cristiano Tomassoni, *Univ. of Perugia*; Vittorio Tornielli di Crestvolant, *European Space Agency*

We3C-4 A 100W 2.15 GHz RF Power Amplifier Device with Novel Matching Network
Eric Johnson, Vikas Shilimkar, Rick Sweeney, *NXP Semiconductors*

INDUSTRY PAPER FINALISTS:

Th1G-1 A 25.5-31GHz Power Amplifier Using Enhancement-Mode High-K Dielectric GaN MOS-HEMTs in 300mm GaN-on-Si Technology
Qiang Yu, Han Wui Then, Ibukunoluwa Momson, Derek Thomson, Jeffrey Garrett, Said Rami, *Intel Corporation*

We1H-1 Direct-Coupled TE-TM Waveguide Cavities
Simone Bastioli, Richard Snyder, *RS Microwave*; Cristiano Tomassoni, *Univ. of Perugia*; Valentin de la Rubia, *Universidad Politecnica de Madrid*

We4C-4 200-W 13.56-MHz Class-E PA with Gate-Driver ICs
Frederick Raab, *Green Mountain Radio Research*

Th2F-5 Fast Simultaneous Distortion Measurement Technique for Mismatch Compensation of Doherty Phased-Array Beamformers
Yuuichi Aoki, Yonghoon Kim, Yongan Hwang, Sung-Gi Yang, *Samsung Electronics, Co., Ltd.*

Th2A-2 Micro-machined Tunable Magnetostatic Forward Volume Wave Bandstop Filter
Yiyang Feng, Sudhanshu Tiwari, Sunil Bhave, *Purdue University*; Renyuan Wang, *BAE Systems*

We4B-1 220-to-320-GHz Fundamental Mixer in 60-nm InP HEMT Technology Achieving 120-152-168-Gbps Data Transmission in Three Bands
Teruo Jyo, Hiroshi Hamada, Takuya Tsutsumi, Ibrahim Abdo, Satoshi Kawahara, Daisuke Kitayama, Munehiko Nagatani, Hiroyuki Takahashi, *NTT Device Technology Laboratories*

Tu3B-5 D-Band Air-Filled Substrate Integrated Waveguide (AFSIW) and Broadband Stripline to AFSIW Launcher Embedded in Multi-layer PCBs
Siddhartha Sinha, *IMEC*; Heinrich Trischler, *AT&S*; Ilja Ocket, *IMEC*; Erich Schlaffer, *AT&S*

We1A-6 Radiometric Noise Characterization of the 183-664 GHz Front-End Receivers for the MetOp-SG Ice Cloud Imager Instrument – Prospects for Future Missions
Bertrand Thomas, Guido Sonnabend, Nadine Wehres, Michael Brandt, Monica Trasatti, *Radiometer Physics*; Ana Andres, Marc Bergada, Jaione Martinez, *Airbus Defence and Space*; Pedro Robustillo, Michael Gotsmann, *Airbus DS GmbH*; Ulf Klein, *ESA - ESTEC*

Th1E-2 A Manufacturable AlScN Periodically Polarized Piezoelectric Film Bulk Acoustic Wave Resonator (AlScN P3F BAW) Operating in Overtone Mode at X and Ku band
Ramakrishna Vetury, Abhay Kochhar, Jeff Leathersich, Craig Moe, Mary Winters, Jeffrey Shealy, *Akoustis, Inc.*; Roy Olsson III, *University of Pennsylvania*

We2A-6 Unique RF Modeling Enhances 5G Network Scenario Simulation
Eva Ribes-Vilanova, Wilfredo Rivas-Torres, Peter Blood, Jan Verspecht, Osamu Kusano, Wei Liu, Jeffrey Weaver, Ian Rippke, *Keysight Technologies*

MTT-S AWARDS BANQUET

18:30 – 22:00 | Wednesday, 14 June 2023 | Sapphire Ballroom, Hilton Bayfront San Diego

We are delighted to introduce the 2023 recipients of MTT-S Society Awards. Congratulations to all the awardees for being recognized for their outstanding contributions to the field of microwave theory and technology, significant achievements in their career, or distinguished services to the society. The MTT-S Awards Banquet program includes dinner, entertainment, and technical and service awards presented by the MTT-S Awards Committee.

MTT-S AWARDS	2023 AWARD RECIPIENTS AND DESCRIPTIONS
Microwave Career Award	**Peter Russer**—For a Career of Leadership, Meritorious Achievement, Creativity and Outstanding Contributions in the Field of Microwave Theory and Techniques
Distinguished Service Award	**George Ponchak**—In Recognition of a Distinguished Record of Service to the MTT Society and the Microwave Profession over a Sustained Period of Time
Distinguished Educator Award	**Michal Mrozowski**—For Outstanding Achievements as an Educator, Mentor, and Role Model for Microwave Engineers and Engineering Students
Distinguished Educator Award	**Payam Hedydari**—For Outstanding Achievements as an Educator, Mentor, and Role Model for Microwave Engineers and Engineering Students
Microwave Pioneer Award	**Richard Cameron**—For Seminal and Impactful Contributions to the Theories for Direct Synthesis of High-Performance Microwave Filters
Microwave Application Award	**Bumman Kim**—For the Creation of Microwave Amplifications for Wireless Applications
N. Walter Cox Award	**Ramesh K. Gupta**—For Exemplary Service to the Society in a Spirit of Selfless Dedication and Cooperation
IEEE MTT-S Outstanding Young Engineer Award	**Arnaud Amadjikpe**—For Outstanding Early Career Achievements in Millimeter Wave Phased Array in Low-Cost Organic Package
IEEE MTT-S Outstanding Young Engineer Award	**Timo Jaeschke**—For Outstanding Early Career Achievements in Advancing Wideband Millimeter-Wave Radar Sensors for Industrial Applications
IEEE MTT-S Outstanding Young Engineer Award	**Dimitra Psychogiou**—For Outstanding Early Career Achievements in the Development of 3D and Planar RF Filtering Devices with Multi-Configurable and Multi-Functional Capabilities and Exemplary Service to the Society
IEEE MTT-S Outstanding Young Engineer Award	**Taylor W. Barton**—For Outstanding Early Career Achievements in High-Efficiency and Reconfigurable Power Amplifiers
IEEE MTT-S Outstanding Young Engineer Award	**Changzhan Gu**—For Outstanding Early Career Achievements in the Short-Range Microwave Radar Sensing for Biomedical Applications and Innovative Human-Computer Interaction
Microwave Prize	**Wael A. Ahmad, Maciej Kucharski, Arzu Ergintav, Salah Abouzaid, Jan Wesse, Herman Jalli Ng, Dietmar Kissinger**—The 2023 Microwave Prize is awarded to W. Ahmad, M. Kucharski, A. Ergintav, S. Abouzaid, J. Wesse, H. Jalli Ng and D. Kissinger for their paper entitled "Multimode W-Band and D-Band MIMO Scalable Radar Platform," *IEEE Transactions on Microwave Theory and Techniques*, Vol. 69, Issue: 1, pp. 1036-1047, January 2021.
IEEE Microwave Magazine Best Paper Award	**Ho-Jin Song**—The 2023 IEEE Microwave Magazine Best Paper Award is awarded to Ho-Jin Song for the paper entitled "Terahertz Wireless Communications: Recent Developments Including a Prototype System for Short-Range Data Downloading," *IEEE Microwave Magazine*, Vol. 22, Issue: 5, pp. 88-99, May 2021.
IEEE Microwave and Wireless Components Letters Tatsuo Itoh Prize	**Fabian Thome, Arnulf Leuther**—The 2023 IEEE Microwave and Wireless Components Letter Tatsuo Itoh Prize is awarded to F. Thome and A. Leuther for their paper entitled "A 75–305-GHz Power Amplifier MMIC With 10–14.9-dBm Pout in a 35-nm InGaAs mHEMT Technology," *IEEE Microwave and Wireless Components Letters*, Vol. 31, Issue: 6, pp. 741-743, June 2021.
IEEE Transactions on Terahertz Science & Technology Best Paper Award	**Caitlyn Cooke, Kevin M. K. Leong, Alexis Zamora, Ben S. Gorospe, Gerry X. B. Mei, Pekka Kangaslahti, Erich Schlect, Mehmet Ogut, Yuriy Goncharenko, Steven C. Reising, William R. Deal**—The 2023 THz Science and Technology Best Paper Award is awarded C. Cooke, K. M. K. Leong, A. Zamora, B.S. Gorospe, X.B. Mei, P. Kangaslahti, E. Schlect, M. Ogut, Y. Goncharenko, S. C. Resing and W. R. Deal for their paper entitled "A 670 GHz Integrated InP HEMT Direct-Detection Receiver for the Tropospheric Water and Cloud Ice Instrument," in *IEEE Transactions on Terahertz Science and Technology*, Vol. 11, Issue: 5, pp. 566-576, Sept 2021.
IEEE Journal of Microwaves Best Paper Award Best paper Award	**Christopher T. Rodenbeck, Paul I. Jaffe, Bernd H. Strassner II, Paul E. Hausgen, James O. McSpadden, Hooman Kazemi, Naoki Shinohara, Brian B. Tierney, Christopher B. DePuma, Amanda P. Self**—The 2023 IEEE Journal of Microwaves Best Paper Award is awarded to C. T. Rodenbeck, P.I. Jaffe, B.H. Strassner II, P.E. Hausgen, J.O. McSpadden, H. Kazemi, N. Shinohara, B.B. Tierney, C.B. DePuma, A.P. Self for their paper entitled "Microwave and Millimeter Wave Power Beaming," *IEEE Journal of Microwaves*, Vol. 1, Issue: 1, pp. 229-259, January 2021.

23ABC

Th1A: Reconfigurable Planar Filters and Diplexers

Chair: Hjalti H. Sigmarsson, *University of Oklahoma*

Co-Chair: Julien Lintignat, *University of Limoges*

08:00 – 08:10

Th1A-1: Multi-Configurable Bandpass Filters with Tune-All Single-, Dual-Band Transfer Functions and Reconfigurable Directionality

Z. Zhang, *Tyndall National Institute*; D. Psychogiou, *Tyndall National Institute*

08:20 – 08:30

Th1A-2: Independently Tunable Compact Dual-Band Bandpass Filter with High Selectivity and Wide Stopband Using Multilayer Folded Dual-Mode SIDGS Resonator

Y. Wan, *UESTC*; J. Zhou, *UESTC*; Y. Rao, *UESTC*; J. Xie, *UESTC*; Q. Li, *UESTC*; X. Luo, *UESTC*

08:40 – 08:50

Th1A-3: A Novel Filter Architecture with Five Reconfigurable Filtering Functions

Y. Ning, *UESTC*; Z. Wei, *UESTC*; P.-L. Chi, *National Chiao Tung University*; T. Yang, *UESTC*

09:00 – 09:10

Th1A-4: 1.26–2-GHz Miniaturized Tunable Bandpass Filter with Constant Absolute Bandwidth and Wide Stopband Using Two-Path Electrical Complementary Coupling

J. Xie, *UESTC*; W. Chen, *UESTC*; D. Tang, *UESTC*; Y. Shu, *UESTC*; X. Luo, *UESTC*

09:20 – 09:30

Th1A-5: A 1.32 to 1.89GHz Diplexer/ Filtering-Switch for Reconfigurable FDD/TDD Operations

Z. Wei, *UESTC*; Y. Ning, *UESTC*; P.-L. Chi, *National Chiao Tung University*; R. Xu, *UESTC*; T. Yang, *UESTC*

24ABC

Th1B: Advances in Biomedical Sensing and Wave Interaction

Chair: Christian Damm, *Universität Ulm*

Co-Chair: Mohammad H. Zarifi, *University of British Columbia*

08:00 – 08:10

Th1B-1: A Microwave System for the Extraction and Measurement of Candida Cells in Blood

N. Dahal, *Clemson Univ.*; C. Peak, *Clemson Univ.*; C. Ehrett, *Clemson Univ.*; N. Harikumar, *Clemson Univ.*; R. Divan, *Argonne National Lab*; P. Wang, *Clemson Univ.*

08:20 – 08:30

Th1B-2: A Waveguide Resonator Sensor for Bacterial Growth Monitoring: Towards Antibiotic Susceptibility Testing

O. Niksan, *Univ. of British Columbia*; J.D. Fowler, *Univ. of British Columbia*; V. Balasubramanian, *Univ. of British Columbia*; A. Shah, *Univ. of British Columbia*; S. Pakpour, *Univ. of British Columbia*; M.H. Zarifi, *Univ. of British Columbia*

08:40 – 08:50

Th1B-3: A 13-GHz "3D" Near-field Imager employing Programmable Fringing Fields for Cancer Imaging

Z.-J. Cheng, S.-Y. Chuang, W.-Y. Weng, G.-Y. Huang, F.-S. Yu, Y.-H. Li, Y.-C. Lin, H.-C. Yeh, Y.-J. Chang, H.-Y. Hou, Y.-T. Chen, J.-C. Chien, *National Taiwan Univ.*

09:00 – 09:10

Th1B-4: Non-Invasive Internal Body Thermometry with On-Chip GaAs Dicke Radiometer

J. Lee, *Univ. of Colorado*; G.S. Botello, *Univ. of Colorado*; R. Streeter, *Univ. of Colorado*; Z. Popovic, *Univ. of Colorado*

09:20 – 09:30

Th1B-5: Evaluation of MRI RF-Induced for Active Implantable Medical Implants in the Vicinity of Other Implantable Devices

L. Yang, *Univ. of Houston*; M.K. Akter, *Univ. of Houston*; R. Guo, *Univ. of Houston*; J. Zheng, *Univ. of Houston*; J. Chen, *Univ. of Houston*

25ABC

Th1C: Recent Advances in Injection Locked Radar Sensing

Chair: Chung-Tse Michael Wu, *Rutgers University*

Co-Chair: Chia-Chan Chang, *National Chung Cheng University*

08:00 – 08:10

Th1C-1: Cosine Transform with Frequency-Domain Correction Technique for Radar-Based Short-Time Vital Sign Monitoring

J.-Y. Shih, *National Sun Yat-sen Univ.*; J.-X. Zhong, *National Sun Yat-sen Univ.*; F.-K. Wang, *National Sun Yat-sen Univ.*

08:20 – 08:30

Th1C-2: Displacement Monitoring Using Phase- and Quadrature Self-Injection-Locked (PQSIL) Radar

J.-X. Zhong, *National Sun Yat-sen Univ.*; J.-Y. Shih, *National Sun Yat-sen Univ.*; F.-K. Wang, *National Sun Yat-sen Univ.*

08:40 – 08:50

Th1C-3: Low-IF Doppler Radar Using Delay- and Self-Injection-Locking Technology with Clutter Cancellation for Biomedical Monitoring

W.-C. Su, *National Sun Yat-sen Univ.*; C.-H. Chang, *National Sun Yat-sen Univ.*; Y.-Y. Wu, *National Sun Yat-sen Univ.*; T.-S. Horng, *National Sun Yat-sen Univ.*; S.-H. Yu, *National Sun Yat-sen Univ.*

09:00 – 09:10

Th1C-4: An Ambiguity-Free Depth Detection Method for Wireless Capsule Endoscopy by Combining Frequency Locking and Signal Strength Tracking of Self-Injection-Locked Radars

J.-Y. Lai, *National Chung Cheng Univ.*; H.-P. Li, *National Chung Cheng Univ.*; S.-F. Chang, *National Chung Cheng Univ.*; C.-C. Chang, *National Chung Cheng Univ.*; S.-C. Lin, *National Chung Cheng Univ.*

09:20 – 09:30

Th1C-5: A W-Band Self-Injection-Locked Vital Sign Radar Sensor with On-Chip SIW Monopole Antenna in 0.1-µm GaAs pHEMT

D. Gao, *Rutgers Univ.*; S. Li, *Rutgers Univ.*; A.Y.-K. Chen, *California State University*; C.-T.M. Wu, *Rutgers Univ.*

30AB

Th1D: Advanced Near-Field Wireless Power Transfer

Chair: Kenjiro Nishikawa, *Kagoshima University*

Co-Chair: Amir Mortazawi, *University of Michigan*

08:00 – 08:10

Th1D-1: Electrode Design Theory Using Highly Accurate Equivalent Circuits in Biological Capacitive WPT

T. Segawa, *Toyohashi University of Technology*; R. Aoyama, *Toyohashi University of Technology*; M. Tamura, *Toyohashi University of Technology*

08:20 – 08:30

Th1D-2: High Sensitivity RF Energy Harvesting System with Self-Calibrate Network

Y. An, *Xidian Univ.*; X. Li, *Xidian Univ.*; X. Feng, *Xidian Univ.*; H. Xu, *Xidian Univ.*; Y. Zhuang, *Xidian Univ.*

08:40 – 08:50

Th1D-3: Adaptive NFC WPT System Implementing Neural Network-Based Impedance Matching with Bypass Functionality

J. Romero Lopera, *Silicon Austria Labs*; R. Fischbacher, *Silicon Austria Labs*; R. Pestros, *Silicon Austria Labs*; D. Pommerenke, *Silicon Austria Labs*; B. Auinger, *Silicon Austria Labs*; J. Grosinger, *Technische Universität Graz*

09:00 – 09:10

Th1D-4: Capacitive Wireless Power Transfer Independent of Load Impedance Fluctuation with Transfer Distance

Y. Naka, *Toyohashi University of Technology*; A. Ishiwata, *Toyohashi University of Technology*; M. Tamura, *Toyohashi University of Technology*

09:20 – 09:30

Th1D-5: Extended Embedded Depth Using Cascaded Resonators Near-Field WPT System with High Efficiency for Biomedical Implants

M. Aboualalaa, *Kyushu Univ.*; R.K. Pokharel, *Kyushu Univ.*; T. Kaho, *Shonan Institute of Technology*

09:40

Denotes Industry Keynote Presentation

30C

Th1E: Recent Advances on Microwave Acoustics

Chair: Amelie Hagelauer, *Technische Universität München*

Co-Chair: Holger Maune, *OvG Universität Magdeburg*

Th1E-1: A mm-Wave Trilayer AlN/ScAlN/AlN Higher Order Mode FBAR

S. Nam, *Univ. of Michigan*; W. Peng, *Univ. of Michigan*; P. Wang, *Univ. of Michigan*; D. Wang, *Univ. of Michigan*; Z. Mi, *Univ. of Michigan*; A. Mortazawi, *Univ. of Michigan*

Th1E-2: A Manufacturable AlScN Periodically Polarized Piezoelectric Film Bulk Acoustic Wave Resonator (AlScN P3F BAW) Operating in Overtone Mode at X and Ku Band

R. Vetury, *Akoustis Technologies*; A. Kochhar, *Akoustis Technologies*; J. Leathersich, *Akoustis Technologies*; C. Moe, *Akoustis Technologies*; M. Winters, *Akoustis Technologies*; J. Shealy, *Akoustis Technologies*; R.H. Olsson III, *Univ. of Pennsylvania*

Th1E-3: A 20.4-GHz Lithium Niobate A3-Mode Resonator with High Electromechanical Coupling of 6.95%

F. Lin, *USTC*; K. Yang, *USTC*; C. Zuo, *USTC*

Th1E-4: A 6.4-GHz Spurious-Free Acoustic Filter Based on Lithium Niobate S1-Mode Resonator

X. Liu, *USTC*; Z. Dai, *USTC*; Z. Su, *USTC*; C. Zuo, *USTC*

Th1E-5: Extracting Acoustic Loss of High-Order Lamb Modes at Millimeter-Wave Using Acoustic Delay Lines

J. Kramer, *Univ. of Texas at Austin*; S. Cho, *Univ. of Texas at Austin*; K. Huynh, *Univ. of California, Los Angeles*; V. Chulukhadze, *Univ. of Texas at Austin*; O. Barrera, *Univ. of Texas at Austin*; M.S. Goorsky, *Univ. of California, Los Angeles*; R. Lu, *Univ. of Texas at Austin*

Th1E-6: Twist Piezoelectric Coupling Properties to Suppress Spurious Modes for Lithium Niobate Thin-Film Acoustic Devices

F. Qian, *HKUST*; T.F. Ho, *HKUST*; Y. Yang, *HKUST*

30DE

Th1F: Advances in Over-the-Air and mm-Wave Measurements

Chair: Jon Martens, *Anritsu*

Co-Chair: Marco Spirito, *Technische Universiteit Delft*

Th1F-1: Simplified Over-the-Air Noise Figure Measurement Method for Reduced Uncertainty

A. Hubrechsen, *Technische Universiteit Eindhoven*; T. Stek, *Technische Universiteit Eindhoven*; A.B. Smolders, *Technische Universiteit Eindhoven*

Th1F-2: Hierarchical Code-Modulated Embedded Test and Calibration on a 64-Element Phased Array

Z. Hong, *North Carolina State Univ.*; B.A. Floyd, *North Carolina State Univ.*

Th1F-3: Over-the-Air Characterization Techniques for Antenna-Coupled Direct-Detectors at Terahertz Frequencies

M. Hoogelander, *Technische Universiteit Delft*; M. Alonso-delPino, *Technische Universiteit Delft*; N. Llombart, *Technische Universiteit Delft*; M. Spirito, *Technische Universiteit Delft*

Th1F-4: An All-Electronically-Scanned Antenna Measurement Technique for Rapid Performance Characterization by Using a Circular Array of Reflection Surfaces

Y.-C. Lin, *National Chung Cheng Univ.*; T.H. Shin, *National Chung Cheng Univ.*; Y.-T. Chang, *National Chung Cheng Univ.*; C.-C. Chang, *National Chung Cheng Univ.*; S.-C. Lin, *National Chung Cheng Univ.*; S.-F. Chang, *National Chung Cheng Univ.*

Th1F-5: A D-Band Vector Network Analyzer Extension Module Based on a SiGe Reflectometer MMIC

J. Romstadt, *Ruhr-Universität Bochum*; S. Hauptmeier, *Ruhr-Universität Bochum*; T.T. Braun, *Ruhr-Universität Bochum*; A. Zaben, *Ruhr-Universität Bochum*; M. Krüner, *Ruhr-Universität Bochum*; K. Aufinger, *Infineon Technologies*; J. Barowski, *Ruhr-Universität Bochum*; N. Pohl, *Ruhr-Universität Bochum*

Joint Session with ARFTG

31AB

Th1G: High-Linearity mm-Wave Power Amplifiers

Chair: Laya Mohammadi, *Qualcomm*

Co-Chair: Zoya Popović, *University of Colorado Boulder*

Th1G-1: A 25.5–31GHz Power Amplifier Using Enhancement-Mode High-K Dielectric GaN MOS-HEMTs in 300mm GaN-on-Si Technology

Q. Yu, *Intel*; H.W. Then, *Intel*; I. Momson, *Intel*; D. Thomson, *Intel*; J. Garrett, *Intel*; S. Rami, *Intel*

Th1G-2: 37–43GHz Wide-Band Doherty Power Amplifier with Enhanced AM-PM Characteristic

H. Yu, *Univ. of Waterloo*; M. Hazer Sahlabadi, *Univ. of Waterloo*; E. Traore, *Univ. of Waterloo*; M. Eladwy, *Univ. of Waterloo*; H. Ma, *Univ. of Waterloo*; S. Boumaiza, *Univ. of Waterloo*

Th1G-3: A 24–31GHz 28nm FD-SOI CMOS 3:1 VSWR Resilient Inductive Hybrid Coupler-Based Doherty Power Amplifier

G. Diverrez, *IMS (UMR 5218)*; E. Kerhervé, *IMS (UMR 5218)*; M. De Matos, *IMS (UMR 5218)*; A. Cathelin, *STMicroelectronics*

Th1G-4: Highly-Linear and Efficient mm-Wave GaN MMICs: Challenges in Model and Validation

J.-S. Moon, *HRL Laboratories*

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IMS TECHNICAL SESSIONS 10:10 – 11:50 Thursday, 15 June 2023 San Diego Convention Center

Microwave Field, Device & Circuit Techniques | Passive Components | Active Components | Systems & Applications | Emerging Technologies & Applications | Focus & Special Sessions

23ABC

Th2A: Advanced Reconfigurable Filters

Chair: Roberto Gómez-García, *Universidad de Alcalá*

Co-Chair: Mohammad Abu Khater, *Purdue University*

10:10 – 10:20

Th2A-1: Bandwidth-Reconfigurable Coaxial Bandpass Filter With Multi-Octave Tuning Using a Single Element

A. Widaa, *Univ. of Kiel*; A. Sharma, *Univ. Politècnica de València*; C. Bartlett, *Univ. of Kiel*; S. Cogollos, *Univ. Politècnica de València*; V. Boria-Esbert, *Univ. Politècnica de València*; M. Guglielmi, *Univ. Politècnica de València*; M. Höft, *Univ. of Kiel*

10:30 – 10:40

Th2A-2: Micro-machined Tunable Magnetostatic Forward Volume Wave Bandstop Filter

Y. Feng, *Purdue Univ.*; S. Tiwari, *Purdue Univ.*; S. Bhave, *Purdue Univ.*; R. Wang, *BAE Systems*

10:50 – 11:00

Th2A-3: High-Power Tunable FDD Front-End Employing a Balanced CMOS N-Path Receiver and Evanescent-Mode Cavity Filters

N. Ginzberg, *Technion*; T.R. Jones, *Purdue Univ.*; A. Lax, *Technion*; E. Zolkov, *Technion*; M.D. Sinanis, *Purdue Univ.*; D. Peroulis, *Purdue Univ.*; E. Cohen, *Technion*

11:10 – 11:20

Th2A-4: Design of a Microstrip Dual-/Quad-Band Switchable Bandpass Filter with Dual-Band Bandpass Filters

C.-W. Tang, *National Chung Cheng Univ.*; J.-M. Jiang, *National Chung Cheng Univ.*

11:30 – 11:40

Th2A-5: A Low-Loss High-Speed SIW Cavity SPDT Switch Architecture

K.H. El-Gendy, *Military Technical College*; M. Abu Khater, *Purdue Univ.*; M.A. Abdalla, *Military Technical College*; D. Peroulis, *Purdue Univ.*; M.F. Hagag, *Military Technical College*

24ABC

Th2B: Microwave/mm-Wave Sensing Techniques and Applications

Chair: Dieff Vital, *University of Illinois at Chicago*

Co-Chair: Mohammad H. Zarifi, *University of British Columbia*

10:10 – 10:20

Th2B-1: Design of Spoke Type CSRR Based RF Sensor for Non-Destructive Quality Evaluation of Wood

A. Banerjee, *IIT Kanpur*; P. Azad, *IIT Kanpur*; M.J. Akhtar, *IIT Kanpur*

10:30 – 10:40

Th2B-2: Highly Sensitive Phase-Variation Microwave Sensor for Measuring the Thickness of Dielectric Films on Metals with Micrometer-Scale Resolution

P. Casacuberta, *Univ. Autònoma de Barcelona*; P. Vélez, *Univ. Autònoma de Barcelona*; L. Su, *Univ. Autònoma de Barcelona*; J. Muñoz-Enano, *Univ. Autònoma de Barcelona*; F. Martín, *Univ. Autònoma de Barcelona*

10:50 – 11:00

Th2B-3: Salinity-Independent Multiphase Fraction Metering for the Oil and Gas Industry Using Microwave Sensors

Z. Akhter, *KAUST*; M.A. Karimi, *Saher Flow Solutions*; M. Arsalan, *Aramco*; A. Shamim, *KAUST*

11:10 – 11:20

Th2B-4: A New Microwave Oscillator-Based Microfluidic Sensor for Complex Permittivity Measurement

C.-H. Pai, *Taiwan Tech*; C.-H. Tseng, *Taiwan Tech*

11:30 – 11:40

Th2B-5: A Linear Seismometer Using Octagonal Microwave Sensor Based on Inverted Pendulum Structure for Earthquake Detection

D.-F. Wang, *National Cheng Kung Univ.*; C.-L. Yang, *National Cheng Kung Univ.*

25ABC

Th2C: Recent Advances in Microwave and mm-Wave Biomedical Radar Sensing Techniques

Chair: Changzhi Li, *Texas Tech University*

Co-Chair: Alessandra Costanzo, *Univ. of Bologna*

10:10 – 10:20

Th2C-1: Non-Contact mmWave Physiological Sensor in Eyewear Based on Spoof Localized Surface Plasmons

X. Yang, *NUS*; S.A. Kurt, *NUS*; Q. Zeng, *NUS*; X. Tian, *NUS*; M. Zhao, *Univ. of Pennsylvania*; J.S. Ho, *NUS*

10:30 – 10:40

Th2C-2: Radar Assistive System for People with Neurodegenerative Disorders Through Head Motion and Eyes Blinking Detection

E. Cardillo, *Università di Messina*; G. Sapienza, *Tre Ali Onlus*; L. Ferro, *Università di Messina*; C. Li, *Texas Tech Univ.*; A. Caddemi, *Università di Messina*

10:50 – 11:00

Th2C-3: Noncontact Monitoring of Infant Apnea for Hypoxia Prevention Using a K-Band Biomedical Radar

L. Wen, *SJTU*; S. Dong, *SJTU*; Y. Wang, *SJTU*; C. Gu, *SJTU*; Z. Tang, *SJTU*; Z. Liu, *SJTU*; J. Mao, *SJTU*

11:10 – 11:20

Th2C-4: Heart Rate Detection with Hilbert Vibration Decomposition Algorithm in Large-Scale Random Body Movements Based on FMCW Radars

Pei-Ling Cheng, *National Cheng Kung Univ.*; Chin-Lung Yang, *National Cheng Kung Univ.*

11:30 – 11:40

Th2C-5: Occupant Entry and Exit Event Extraction Using Continuous Wave (CW) Doppler Radar and Wavelet Analysis

S.M.M. Islam, *University of Dhaka*; O. Boric-Lubecke, *University of Hawaii at Manoa*; V.M. Lubecke, *University of Hawaii at Manoa*

30AB

Th2D: Advanced Far-Field Wireless Power Transfer

Chair: Marco Dionigi, *Università di Perugia*

Co-Chair: Etienne Perret, *Université Grenoble Alpes*

10:10 – 10:20

Th2D-1: Rotman-Lens-Based Reconfigurable Intelligence Surface mmID with Energy Harvesting Capability

I.-T. Chen, *Georgia Tech*; C.A. Lynch III, *Georgia Tech*; A. Eid, *Univ. of Michigan*; J.G.D. Hester, *Atheraxon*; M.M. Tentzeris, *Georgia Tech*

10:30 – 10:40

Th2D-2: Comparison of CMOS Bulk-Biased and Cross-Coupled Rectifiers in Wireless Power Receivers

S. Guigue, *IMS (UMR 5218)*; T. Taris, *IMS (UMR 5218)*; J.B. Begueret, *IMS (UMR 5218)*; C. Leroux, *IMS (UMR 5218)*; D. Karolak, *IMS (UMR 5218)*

10:50 – 11:00

Th2D-3: Fully Passive Modulation Technique for SWIPT Scenarios

H. Ribeiro, *Universidade de Aveiro*; S. Hemour, *IMS (UMR 5218)*; N.B. Carvalho, *Universidade de Aveiro*

11:10 – 11:20

Th2D-4: 5.8GHz Band 10W Rectenna with GaAs E-pHEMT Gated Anode Diode on the Aluminum Nitride Antenna for Thermal Dispersion

N. Sakai, *Kanazawa Institute of Technology*; N. Furutani, *Kanazawa Institute of Technology*; K. Uchiyama, *Kanazawa Institute of Technology*; Y. Hirose, *Kanazawa Institute of Technology*; F. Komatsu, *Kanazawa Institute of Technology*; K. Itoh, *Kanazawa Institute of Technology*

11:30 – 11:40

Th2D-5: Design and Characterization of Low-Power Rectifiers at X-Band Using a Low-Barrier Schottky Diode for Wireless Power Transfer Applications

J.M. Kovitz, *Georgia Tech*; M. Grady, *Georgia Tech*; J. Dee, *Georgia Tech*; C.-W. Chan, *Georgia Tech*; C.T. Rodenbeck, *U.S. Naval Research Laboratory*; C.R. Valenta, *Georgia Tech*

11:50

Denotes Industry Keynote Presentation

30C

Th2E: Application of Integrated Magnetic Materials and Control Circuits

Chair: Siva Yegnanarayanan, *MIT Lincoln Laboratory*

Co-Chair: Pierre Blondy, *XLIM (UMR 7252)*

Th2E-1: Self-Biased Ku-Band Circulators

N. Parker, *Lab-STICC (UMR 6285)*; V. Laur, *Lab-STICC (UMR 6285)*; R. Lebourgeois, *Thales*; G. Cibien, *Thales*; L. Roussel, *Thales*; J.L. Mattei, *Lab-STICC (UMR 6285)*; A. Chevalier, *Lab-STICC (UMR 6285)*

Th2E-2: Dual-Band Microstrip Ferrite Circulator

V. Olivier, *INOVEOS*; T. Monédière, *XLIM (UMR 7252)*; B. Lenoir, *INOVEOS*; H. Turki, *INOVEOS*; L. Huitema, *XLIM (UMR 7252)*

Th2E-3: A W-Band Single-Pole Double-Throw Photoconductive Evanescent-Mode Waveguide Switch

E. Der, *Univ. of Alberta*; T. Jones, *Purdue Univ.*; A. Fisher, *Purdue Univ.*; M. Sinanis, *Purdue Univ.*; K. Moez, *Univ. of Alberta*; D. Barlage, *Univ. of Alberta*; D. Peroulis, *Purdue Univ.*

Th2E-4: Symmetrical Multiport mmWave Chalcogenide Phase-Change RF Switches

T. Singh, *Univ. of Waterloo*; R.R. Mansour, *Univ. of Waterloo*

Th2E-5: Optimization of Coplanar Waveguide Integrated PCM Switches

N. Le Gall, *XLIM (UMR 7252)*; I. Bettoumi, *XLIM (UMR 7252)*; M. Lajaate, *XLIM (UMR 7252)*; C. Hallepee, *XLIM (UMR 7252)*; D. Passerieux, *XLIM (UMR 7252)*; P. Blondy, *XLIM (UMR 7252)*

30DE

Th2F: Conducted and Over-the-Air Nonlinear Characterization Techniques

Chair: Patrick Roblin, *The Ohio State University*

Co-Chair: Marcus Da Silva, *National Instruments*

Th2F-1: Precision DPD Measurements and Modeling of Non-Linear Amplifiers

J. Dunsmore, *Keysight Technologies*

Th2F-2: New Real-Time Pulsed-RF NVNA Testbed for Isothermal Characterization of Traps in GaN HEMTs

M. Lindquist, *The Ohio State University*; P. Roblin, *The Ohio State University*; N.C. Miller, *AFRL*

Th2F-3: Instrumentation for the Time and Frequency Domain Characterization of Terahertz Communication Transceivers and their Building Blocks

I. Kallfass, *Univ. Stuttgart*; D. Wrana, *Univ. Stuttgart*; B. Schoch, *Univ. Stuttgart*; J. Hesler, *Virginia Diodes*; M. Kohler, *Keysight Technologies*; J.-P. Teyssier, *Keysight Technologies*; J. Dunsmore, *Keysight Technologies*

Th2F-4: Array Calibration and Digital Predistortion Training Using Embedded Near-Field Feedback Probes and Orthogonal Coding for Enhancing the Performance of Millimeter-Wave Beamforming Arrays

A. Ben Ayed, *Univ. of Waterloo*; H. Jin, *Univ. of Waterloo*; B. Tung, *Univ. of Waterloo*; P. Mitran, *Univ. of Waterloo*; S. Boumaiza, *Univ. of Waterloo*

Th2F-5: Fast Simultaneous Distortion Measurement Technique for Mismatch Compensation of Doherty Phased-Array Beamformers

Y. Aoki, *Samsung*; Y. Kim, *Samsung*; Y. Hwang, *Samsung*; S.-G. Yang, *Samsung*

Joint Session with ARFTG

31AB

Th2G: Broadband mm-Wave MMIC Power Amplifiers

Chair: David Brown, *BAE Systems*

Co-Chair: Munkyo Seo, *Sungkyunkwan University*

Th2G-1: Millimeter-Wave LNA and PA MMICs with 10:1 and 4:1 Bandwidth in a 35-nm Gate-Length InGaAs mHEMT Technology

F. Thome, *Fraunhofer IAF*; H. Massler, *Fraunhofer IAF*; A. Leuther, *Fraunhofer IAF*; S. Chartier, *Fraunhofer IAF*

Th2G-2: A Multi-Stage 19.2-dBm, 30.4%-PAE D-Band Power Amplifier in a 250-nm InP HBT Process

E. Lam, *Univ. of California, Santa Barbara*; K. Ning, *Univ. of California, Santa Barbara*; A.S.H. Ahmed, *Univ. of California, Santa Barbara*; M. Rodwell, *Univ. of California, Santa Barbara*; J.F. Buckwalter, *Univ. of California, Santa Barbara*

Th2G-3: H-Band Differential Cascode Power Amplifier Achieving 9.5-dBm OP1dB at 260GHz in 250-nm InP DHBT Process

C.-G. Choi, *POSTECH*; J. Kim, *POSTECH*; K. Kim, *POSTECH*; H.-J. Song, *POSTECH*

Th2G-4: A 2.6W and a 4W Output Power E-band GaN Power Amplifier with a Peak Efficiency of 22% and 15.3%

B.K. Cimbili, *Fraunhofer Institute for Applied Solid State Physics*; C. Friesicke, *Fraunhofer Institute for Applied Solid State Physics*; F. van Raay, *Fraunhofer Institute for Applied Solid State Physics*; S. Wagner, *Fraunhofer Institute for Applied Solid State Physics*; M. Bao, *Ericsson*; R. Quay, *Fraunhofer Institute for Applied Solid State Physics*

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INDUSTRY WORKSHOPS

08:00 – 15:10 | Thursday, 15 June 2023

SESSION CODE	TIME & LOCATION	TITLE AND ABSTRACT	SPEAKER/S, AFFILIATION
IWTH6	08:00 – 09:40 Room: 29D	**Balancing Tradeoffs: Taming Signal Integrity Challenges in mmWave Antenna-to-Bits Implementations—**Emerging 5G/6G, radar, EW, SATCOM, and instrumentation antenna-to-bits architectures necessitate careful design tradeoffs due to mmWave band sensitivity. System designers must preserve channel signal integrity (SI) while optimizing component selection at reasonable cost. Simulating and testing system architectures at the electrical and protocol layers demands engineering expertise from RF, phased-array antenna design, SI, embedded software, DSP, FPGA and test. In this Industry Workshop, technical experts from Otava, Samtec, MathWorks, Avnet, and Rohde & Schwarz address the challenges of mmWave system design, detailing the interplay between simulation models and real-world signals through design flows that foster collaboration within multi-disciplinary engineering teams.	Giorgia Zucchelli, *Mathworks* Luc Langlois, *Avnet;* Markus Lörner, *Rohde & Schwarz;* Matthew Burns, *Samtec;* Wen Zheng, *Otava*
IWTH2	08:00 – 09:40 Room: 29C	**Low-Loss 3D-Printed Flat Cylindrical GRIN Lens for 5 dB Gain Enhancement of a 20 dBi Horn Antenna—**In this presentation, a specific GRIN (GRadient INdex) lens design workflow is shared from concept, through simulation, fabrication, test, and analysis. This cylindrical Luneburg-like lens is applied to the focal distance of a standard gain horn to increase the total gain from 20 dBi to over 25 dBi at a lower weight and smaller footprint than a pure 25 dBi horn. Fortify's FLUX CORE printer paired with Rogers' Radix™ 2.8 low-loss photocurable polymer are the enabling technologies for the production of a structure with traits of high resolution and low power absorption that make the above performance possible.	Colby Hobart, *Fortify*
IWTH3	10:10 – 11:50 Room: 29C	**Linearization of Upcoming High-Efficient RF Power Amplifiers Using Simulation and Hardware Measurements—**The evolution of 5G and the need for increased capacity drive new transmitter requirements. Power amplifiers must support large instantaneous bandwidths further extended by carrier aggregation, combined with high power and reduced consumption. This workshop introduces a workflow to combine state-of-the-art PA measurements with behavioral models and prototypes for accelerating the design, optimization, and testing of linearization techniques before the entire system is available. We will introduce recent trends in PA architectures and identify linearization techniques, such as DPD, based on hardware characterization and behavioral models to tradeoff design parameters and improve ACLR, EVM, and other metrics for 5GNR waveforms.	Florian Ramian, *Rohde & Schwarz International GmbH;* Giorgia Zucchelli, *MathWorks B.V.;* Markus Loerner, *Rohde & Schwarz International GmbH;* Salvatore Finocchiaro, *Qorvo Inc.*
IWTH4	10:10 – 11:50 Room: 29D	**Optimizing High Performance Wireless RF Front End Products Time-to-Market; From Engineered Substrates to Systems—**Wireless systems - from Wi-Fi to 5G FRX, UWB and several others - need to evolve fast in order to connect an ever growing number of users - people but also smart things - and applications with excellent QoS and QoE. Furthermore, changing regional regulations, e.g. spectrum usage, add to wireless systems products time-to-market constraints. Addressing such constraints requires a comprehensive system design methodology supported by proven semiconductor technologies. This workshop will provide guidelines on the use of performance and supply proven engineered substrates for RF and mmWave to implement a comprehensive Front-End Module design methodology.	Luis Andia, *Soitec*
IWTH5	13:30 – 15:10 Room: 29C	**Co-Design Techniques for Wideband mmWave and SatCom Phased Array Systems—**The new generation of broadband satellite communications equipment must meet specifications over large instantaneous bandwidths and significant channel impairments. These radio systems are being built around multi-channel active antenna arrays requiring complex digital signal processing algorithms for calibration, channel corrections, and beamforming. This workshop introduces a model-based design methodology combining hardware measurements to accelerate the design, optimization, and testing of mmWave wideband radios before the entire system is prototyped. We will use hardware and software examples to optimize the full phased-array signal chain performance, trading off design parameters to achieve acceptable ACLR and EVM for very wide waveforms.	Cecile Masse, *Otava, Inc.;* Fabricio Dourado, *Rohde & Schwarz International GmbH;* Giorgia Zucchelli, *MathWorks B.V.;* Luc Langlois, *Avnet, Inc.*
IWTH1	13:30 – 15:10 Room: 29D	**Efficient Simulation of (Semi)Periodic Microwave Devices using ANSYS HFSS—**Phased array antennas, frequency selective surfaces (FSS), and several other microwave devices are based on periodic arrangement of element structures. Explicit simulation of these devices is usually computationally demanding, and sometimes impossible within the available resources. ANSYS HFSS has powerful features to enable efficient simulation of periodic structures. It also allows a user to break the periodicity and come up with innovative semi-periodic arrangements of the elements. We will present this workflow through examples of phased array antennas with Radome, and semi-periodic FSS simulations.	Faezeh Tork Ladani, *ANSYS Inc.*

MICROAPPS

09:30 – 15:00 | Thursday, 15 June 2023 | IMS Exhibit Floor: Booth 2447

SESSION CODE	TIME	TITLE	SPEAKER/S, AFFILIATIONS
THMA1	09:30 – 09:45	Understanding the Impacts of the Radome on Array Performance Through Advanced EM Simulation	Daniel Faircloth, *Nullspace, Inc.*
THMA2	09:45 – 10:00	IEEE Low-Earth-Orbit (LEO) Satellites & Systems	Carole Graas, *IEEE Technical Activities*; Jan Budroweit, *German Aerospace Center*; Markus Gardill, *Brandenburg University of Technology*; Witold Kinsner, *University of Manitoba*
THMA3	10:00 – 10:15	A Paradigm Shift in Distributed Modular VNA Architecture That Makes Long Distance Measurement Simple and Easy	Navneet Kataria, *Anritsu Company*
THMA4	10:15 – 10:30	Reference Frequency Alignment Made Fast and Easy with Modern Measurement Receivers	Kay-Uwe Sander, *Rohde & Schwarz GmbH & Co KG*
THMA5	10:30 – 10:45	Phase Noise Measurements on Linear FM Chirps or Frequency Hoppers	Wolfgang Wendler, *Rohde & Schwarz GmbH & Co KG*
THMA6	10:45 – 11:00	Dynamic Height Adjustment Using Vector Network Analyzer Based Contact Sensing Using FormFactor WinCal XE and Velox	Gavin Fisher, *FormFactor Inc.*
THMA7	11:00 – 11:15	OTA Probe Antenna for Production Test of Arrays	Matthias Zapatka, *Ingun USA, Inc.*; Wilhelm Schroff, *INGUN Pruefmittelbau GmbH*
THMA8	11:15 – 11:30	Status of Wi-Fi 6, 6E and 7 and Learn about Regulatory Testing Challenges	William Koerner, *Keysight Technologies*
THMA9	11:30 – 11:45	Phase Noise Test Setup for 6G Application at 170 GHz	Wolfgang Wendler, *Rohde & Schwarz GmbH & Co KG*
THMA10	11:45 – 12:00	Rapid Phased Array Prototyping: Crawl -> Walk -> Run	Jon Kraft, *Analog Devices, Inc.*
THMA11	12:00 – 12:15	mmWave Unlocking Potential of LEO satellites for Global Data Connectivity	Tudor Williams, *Filtronic*
THMA12	12:15 – 12:30	Linear Power At V-Band With Advanced Linearizer Technology	Robert Gray, *Linearizer Technology Inc*
THMA13	12:30 – 12:45	Versatile Linearized Miniature TWTAs for Phased Arrays in Space	Christopher Tenev, *Linear Space Technology*
THMA14	12:45 – 13:00	Impact of 5G Networks on GPS Navigation – How to Make GPS Receivers Resilient in Congested Environments	Reena Dahle, *Metamagnetics*
THMA15	13:00 – 13:15	Locating Jammers from A to Z	Gerry Spinelli, *Narda-MITEQ*
THMA16	13:15 – 13:30	Reducing Board Space and Improving RF Performance by Embedding MOS Capacitors	Cory Nelson, *Kyocera-AVX*
THMA17	13:30 – 13:45	Challenges of Designing and Manufacturing Microwave Components for Space Requirements	Scott Hsu, *Teledyne Microwave Solutions*
THMA18	13:45 – 14:00	Practical Design Guidance to Avoid Multipaction in RF Devices	Shaun Moore, *Quantic TRM*
THMA19	14:00 – 14:15	Improving Surface Mount Packaging Design for Microwave Devices	Kyle Chang, *Marki Microwave, Inc.*
THMA20	14:15 – 14:30	Advanced mmWave Packaging with Aerosol Jet Printed Interconnects	Shayna Watson, *Optomec*
THMA21	14:30 – 14:45	Analog Phase-Locked Low Noise Sources and Applications	Charles Pardo, *Narda-MITEQ*
THMA22	14:45 – 15:00	Crystal Oscillators for Low Earth Orbit Applications, What You Need to Know	Michael Sawicki, *Quantic Wenzel | Quantic Electronics*

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TECHNICAL LECTURE

12:00 – 13:20 | Thursday, 15 June 2023 | Ballroom Section 20A

	LECTURE TITLE	ABSTRACT
TL4	**Smart Radar Circuits and Systems for Healthcare and IoT Applications** **Speaker:** Changzhi Li, *Texas Tech University*	This lecture will enable audience to design and analyze modern portable radar systems for healthcare and IoT applications. It will develop understanding of the fundamentals of smart radar systems. The audience will be exposed to various radar systems including Doppler, ultra-wideband, frequency shift keying, and frequency-modulated continuous-wave radars. Furthermore, the audience will be exposed to the fundamentals of synthetic-aperture radar, inverse synthetic-aperture radar, and pulse compression radar. A few examples based on interferometry, Doppler, and FMCW modes at 5.8 GHz, 24 GHz, and 120 GHz will be discussed. Then, the mechanism and applications of nonlinear radar sensing technologies will be illustrated. Case studies at this exciting human-microwave frontier will be given on physiological signal sensing, non-contact human-computer interface, driving behavior recognition, human tracking, and anomaly detection.

IMS PANEL SESSION

12:00 – 13:30 | Thursday, 15 June 2023 | Room: 32AB

Tapping Power WIRELESSLY Everywhere? Technologies, Standards and Impact in Our Life

ORGANIZERS:
Naoki Shinohara, *Kyoto University*
Alessandra Costanzo, *Universite di Bologna*
Jungchih Chiao, *Southern Methodist University*

PANELISTS:
Minoru Furukawa, *Space Power Technologies, Inc.*
Hiroyuki Tani, *Panasonic Holdings Corporation*
Yuji Tanabe, *AETERLINK Corp.*
Hatem Zeine, *Ossia Corp.*
Charlie Greene, *PowerCast Corp.*
Paul Mitcheson, *Imperial College, London*

ABSTRACT: Recently industry of Wireless Power Transfer (WPT), which involves near-field WPT and far-field WPT, has risen significantly. For near-field transfer, we can already buy wireless chargers everywhere and cheaply for smartphones. Startup companies are developing far-field WPT for IoT sensors based on new radio regulations. In THE ITU-R, enthusiastic discussions for new radio regulation of the WPT and safety concerns are taking place every year. WPT is expected as one of the game-changing technologies with electromagnetic waves/fields. Although since 1960s the theory has been established and advanced with a long history, the expectation for WPT market and industry seems to be higher than the reality. The high-power wireless chargers for electric vehicles and battery-less IoT sensors powered by microwaves have not appeared in the mass-production markets. What will be the industrial future of the WPT? What are the innovative technologies needed to create wide-use markets? How do we harmonize the WPT with conventional radio applications? How do we create human safe WPT system? Can we have worldwide universal standards? In this panel, panelists from the WPT and application industries, power electronics society, and antenna propagation society will discuss these important topics from diverse and cross-disciplinarity perspectives.

IMS PANEL SESSION

12:00 – 13:30 | Thursday, 15 June 2023 | Room: 33ABC

5G FR1-FR2 Convergence: Challenges and Outlook for Remote Healthcare and Time-Critical Communications

ORGANIZERS:
Abbas Omar, *University of Magdeburg*
Ali Sadri, *Airgain Inc.*

PANELISTS:
Changzhan Gu, *Shanghai Jiao Tong University*
Sandra Costanzo, *DIMES—University of Calabria*
Souvik Dubey, *Abbott*
Kei Sakaguchi, *Tokyo Institute of Technology*
Adam Chin, *Airgain*
Reza Rezaiesarlak, *Mobix-Labs*

ABSTRACT: The chip and system level coexistence of FR1 (sub-6 GHz) and FR2 (mmWave) wireless standards, including 5G and beyond, is highly debated because of both capital and operational expenditures. On the other hand, these bands are utilized to offer uninterrupted connectivity for relevant time-critical applications that demand Ultra Reliable Low Latency Communications (URLLC). These include for example telesurgery, remote diagnostics, remote monitoring of health conditions of patients and elderlies, virtual clinics, etc. Many of the sensors involved in these applications, such as that used for remotely monitoring vital parameters of patients and elderlies (remote measurement of blood-pressure, blood-sugar, sudden falling, etc.), and communicating their measurements wirelessly, need such a coexistence for a reliable operation. It is the aim of this Panel to present the relevant healthcare applications that rely on the wireless communications offered by 5G and beyond, and to discuss their need for eventual FR1-FR2-coexistence on both chip- and system-levels.

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23ABC

Th3A: Tunable Devices

Chair: Tao Yang, *UESTC*
Co-Chair: Xun Gong, *University of Central Florida*

13:30

Th3A-1: Low Delay and Loss Variation Reflection Type Phase Shifter with Sequentially Controlled Varactor Diodes

G. Yang, *Yonsei Univ.*; D. Lee, *Yonsei Univ.*; B.-W. Min, *Yonsei Univ.*

13:40

13:50

Th3A-2: A Broadband Reflection-Type Phase Shifter with Low Loss Variation Using Magic-T and Anti-Phase Reflection Loads

J. Tamura, *Yokohama National Univ.*; H. Arai, *Yokohama National Univ.*

14:00

14:10

Th3A-3: Silicon-Micromachined Liquid Crystal Variable Capacitors for Tunable RF Devices

H. Kianmehr, *Univ. of Waterloo*; R.R. Mansour, *Univ. of Waterloo*

14:20

14:30

Th3A-4: Reconfigurable Microwave Components Based on Optimization of Field Programmable Microwave Substrate

A. Saifee, *XLIM (UMR 7252)*; C. Durousseau, *XLIM (UMR 7252)*; A. Perigaud, *XLIM (UMR 7252)*; N. Delhote, *XLIM (UMR 7252)*; M.F. Farooqui, *Ontario Tech University*; Y. Wang, *Ontario Tech University*; L. Roy, *Ontario Tech University*

14:40

14:50

Th3A-5: A Reconfigurable Reflective/ Absorptive SPDT Plasma Switch

A. Fisher, *Purdue Univ.*; T.R. Jones, *Purdue Univ.*; D. Peroulis, *Purdue Univ.*

15:00

15:10

24ABC

Th3B: Integrated RFID Systems and Applications

Chair: Victor M. Lubecke, *University of Hawaii at Manoa*
Co-Chair: Kazuya Yamamoto, *Mitsubishi Electric*

Th3B-1: mmIDs Enter the 3rd Dimension: A Camera Inspired Broadbeam High-Gain Retrodirective Backscatter Tag

C.A. Lynch III, *Georgia Tech*; G. Soto-Valle, *Georgia Tech*; J. Hester, *Atheraxon*; M.M. Tentzeris, *Georgia Tech*

Th3B-2: Long-Range Chipless RFID for Objects in Translation Using Doppler-Modulated Depolarizing Tags

A. Azarfar, *LCIS (EA 3747)*; N. Barbot, *LCIS (EA 3747)*; E. Perret, *LCIS (EA 3747)*

Th3B-3: A 27 mW Ka-Band Complex Dielectric Sensor Chip with Readout and Reference Circuits Using 1.2 V Supply in 130-nm SiGe BiCMOS

B. Sutbas, *IHP GmbH*; M. Eissa, *IHP GmbH*; G. Fischer, *IHP GmbH*; G. Kahmen, *IHP GmbH*

Th3B-4: A UHF 1.3 cm2 Passive Subharmonic Tag with a 13 meters Read-Range

Nicolas Casilli, *Northeastern Univ.*; Luca Colombo, *Northeastern Univ.*; Cristian Cassella, *Northeastern Univ.*

Th3B-5: 3D-Printable Rectenna for Passive Tag Localization Exploiting Multi-Sine Intermodulation

G. Battistini, *Univ. of Bologna*; G. Paolini, *Univ. of Bologna*; A. Costanzo, *Univ. of Bologna*; D. Masotti, *Univ. of Bologna*

25ABC

Th3C: High-Accuracy Physiological Sensing and Positioning

Chair: Olga Boric-Lubecke, *University of Hawaii at Manoa*
Co-Chair: Aly E. Fathy, *University of Tennessee*

Th3C-1: Effect of Respiration Harmonics on Beat-to-Beat Analysis of Heart Signal

J.N. Sameera, *University of Hawaii at Manoa*; M.S. Ishrak, *University of Hawaii at Manoa*; V. Lubecke, *University of Hawaii at Manoa*; O. Boric-Lubecke, *University of Hawaii at Manoa*

Th3C-2: Seatbelt-Embroidered Metamaterials for In-Vehicle Vital Sign Monitoring

Q. Zeng, *NUS*; X. Tian, *NUS*; D.T. Nguyen, *NUS*; X. Yang, *NUS*; P. Chia, *NUS*; C. Wu, *NUS*; J.S. Ho, *NUS*

Th3C-3: Convolutional Neural Network-Based MIMO Radar Channel Selection for Improving Robust Remote Heart Rate Estimation Accuracy

C.J. Bauder, *University of Tennessee Knoxville*; T.K. Vo Dai, *University of Tennessee Knoxville*; A.-K. Moadi, *University of Tennessee Knoxville*; A.E. Fathy, *University of Tennessee Knoxville*

Th3C-5: Temporal-Spatial Equivalent Virtual Array Technique for Accurate Vital Sign Monitoring

Y. Li, *SJTU*; J. Lu, *SJTU*; S. Dong, *SJTU*; C. Gu, *SJTU*; J. Mao, *SJTU*

Th3C-6: High-Accuracy Cardiac Activity Extraction Using RLMD-Based Frequency Envelogram in FMCW Radar Systems

J.-F. Li, *National Cheng Kung Univ.*; C.-L. Yang, *National Cheng Kung Univ.*

INTERACTIVE FORUM | IF2

13:30 – 15:30 | Thursday, 15 June 2023 | Sails Pavilion

Chair: Jim Carroll, AmpliTech | **Co-Chair:** Gian Piero Gibiino, Università di Bologna

IF2-1: Millimeter-Wave On-Wafer Large Signal Characterization System for Harmonic Source/Load Pull and Waveform Measurements

A. Baddeley, *Cardiff University*; S. Woodington, *Focus Microwave*; D. Gecan, *Focus Microwave*; A. Sheikh, *Focus Microwave*; J. Lunn, *Rohde & Schwarz*; P. Tasker, *Cardiff University*; R. Quaglia, *Cardiff University*

IF2-2: Detecting Low-Frequency Critical Resonances in Power Amplifiers Using the Periodicity of Floquet Exponents

N. Otegi, *Universidad del País Vasco*; J.-M. Collantes, *Universidad del País Vasco*; M. Grao, *IKERLAN*; J. Feuchtwanger, *Universidad del País Vasco*

IF2-3: A Miniature W-Band Substrate-Integrated Waveguide Cavity Bandpass Filter Using GaAs-Based IPD Technology

Y.-C. Chang, *NARLabs-TSRI*; T.-Y. Lin, *NARLabs-TSRI*; J. Wang, *National Tsing Hua Univ.*; S.-G. Lin, *NARLabs-TSRI*; C.-P. Hsieh, *NARLabs-TSRI*; Y. Huang, *University of Liverpool*; S.S.H. Hsu, *National Tsing Hua Univ.*; D.-C. Chang, *NARLabs-TSRI*

IF2-4: A Ka-Band 35-dBm P0.1dB Low-Loss Monolithic SPDT Switch Using Anti-Series Diode Connection

J. Chou, *National Central Univ.* ; W.-C. Chen, *National Central Univ.* ; Y.-L. Wang, *National Central Univ.* ; Y.-F. Chen, *National Central Univ.* ; H.-Y. Chang, *National Central Univ.*

IF2-5: A Modulation-Defined RF Micro-Acoustic Delay Line Based on ScAlN MEMS Resonators for Self-Interference Cancellation

G. Michetti, *Northeastern Univ.* ; S. Garikapati, *Columbia Univ.*; M. Assylbekova, *Northeastern Univ.* ; H. Krishnaswamy, *Columbia Univ.*; M. Rinaldi, *Northeastern Univ.*

IF2-6: Robust Fulcrum-Type Wafer-Level Packaged MEMS Switches Utilizing Al-Ru/AlCu Contacts Fabricated in a Commercial MEMS Foundry

T. Singh, *Univ. of Waterloo*; R.R. Mansour, *Univ. of Waterloo*

IF2-7: Low-Cost and High Performance Antenna Setup for Updating ePaper Displays on Curved RFID SmartTags Used in Pharmaceutical Studies

S. Peters, *FAU Erlangen-Nürnberg*; C. Hangmann, *SIL System Integration Laboratory*; I. Wüllner, *SIL System Integration Laboratory*; J. Traupe, *SIL System Integration Laboratory*; T. John, *SIL System Integration Laboratory*; R. Weigel, *FAU Erlangen-Nürnberg*; B. Scheiner, *FAU Erlangen-Nürnberg*

IF2-8: Down-Conversion Mixer Using λ/4-TL-C-Based Coupler and BSFB Technique for 28GHz 5G NR

Y.-S. Lin, *National Chi Nan Univ.*; K.-S. Lan, *National Chi Nan Univ.*

IF2-9: A G-Band SiGe BiCMOS LNA with an On-Chip and Compact Temperature Compensation Biasing Circuit

A. Urain, *Universidad de Navarra*; D. Del Río, *Universidad de Navarra*; R. Torres, *Universidad de Navarra*; R. Berenguer, *Universidad de Navarra*

IF2-10: Ultra-Low-Noise InGaAs mHEMT Technology and MMICs for Space Missions and Radio Astronomy

F. Thome, *Fraunhofer IAF*; L. John, *Fraunhofer IAF*; R. Weber, *Fraunhofer IAF*; F. Heinz, *Fraunhofer IAF*; H. Massler, *Fraunhofer IAF*; A. Leuther, *Fraunhofer IAF*; S. Chartier, *Fraunhofer IAF*

IF2-11: A W-Band Phase-Shifter-Embedded PA in 40-nm CMOS for 6G Applications

C. Wang, *National Tsing Hua Univ.*; P.-C. Chiu, *National Taiwan Univ.*; C.-H. Li, *National Taiwan Univ.*

IF2-12: A High Efficiency Q-Band MMIC GaN Power Amplifier for Space Applications

M. Ayad, *UMS*; K. Vivien, *UMS*; H. Debergé, *ESA-ESTEC*; Z. Ouarch, *UMS*; P. Auxemery, *UMS*

IF2-13: A Novel Frequency Reconfigurable Real-Time RF Edge Detector

H. Zhang, *FAMU-FSU*; B. Arigong, *FAMU-FSU*

IF2-15: A 56–67GHz CMOS Phased-Array Transmit Beamformer with 26.2dB Peak Gain, 15 dBm PSAT, and 20% PAE

K.P. Jung, *KAIST*; J.H. Kim, *Kunsan National University*; G.H. Park, *KAIST*; C.S. Park, *KAIST*

IF2-16: A 30–88GHz Phase Shifter with Broadband 90° Hybrid Marchand Balun Network and Common-Base Buffer Achieving 1.34–3.1° RMS Phase Error in 90nm SiGe

Z. Liu, *Princeton Univ.*; E.A. Karahan, *Princeton Univ.*; K. Sengupta, *Princeton Univ.*

IF2-17: Improving Temperature Stability of Dickson Charge Pump Rectifiers for Battery-Free Wireless Sensing Applications

X. Gu, *McGill Univ.*; S. Hemour, *IMS (UMR 5218)*; R. Khazaka, *McGill Univ.*; K. Wu, *Polytechnique Montréal*

IF2-18: Design and Implementation of Near-Field Spatial Wireless Power Transfer Using Orthogonal Multiple Coils

S.-H. Ahn, *Gyeongsang National University*; H.-S. Jeong, *Gyeongsang National University*; W.-S. Lee, *Gyeongsang National University*

IF2-19: High Performance Lamb Wave Resonator Operating in the 900MHz ISM Band for Wireless Sensing Applications

A.-M. Zaccarin, *Univ. of Pennsylvania*; G.M. Iyer, *Univ. of Pennsylvania*; A. Kochhar, *Akoustis*; R. Vetury, *Akoustis*; K.T. Turner, *Univ. of Pennsylvania*; R.H. Olsson III, *Univ. of Pennsylvania*

IF2-20: Enhanced FSK-Modulated Ambient Backscatter Communication System

K. Xu, *Heriot-Watt Univ.*; J. Methapettyparambu Purushothama, *Heriot-Watt Univ.*; Y. Ding, *Heriot-Watt Univ.*; G. Goussetis, *Heriot-Watt Univ.*; J. Thompson, *Univ. of Edinburgh*; S. McLaughlin, *Heriot-Watt Univ.*

IF2-21: Virtual Receiver Matrix for Multifunction Communication and Sensing Wireless Systems Using Simultaneous Incident Waves at the Same Carrier Frequency

S.A. Keivaan, *Polytechnique Montréal*; P. Burasa, *Polytechnique Montréal*; K. Wu, *Polytechnique Montréal*

IF2-22: Directional Modulation Retrodirective Array-Enabled Physical Layer Secured Transponder for Protected Wireless Data Acquisition

S. Vosoughitabar, *Rutgers Univ.*; A. Nooraiepour, *Rutgers Univ.*; W.U. Bajwa, *Rutgers Univ.*; N.B. Mandayam, *Rutgers Univ.*; C.-T.M. Wu, *Rutgers Univ.*

IF2-23: Disposable Planar Microwave Sensor for Real-Time Monitoring of Lubricant Depletion on Lubricant-Infused Coated Medical Implants

A. Yazdanicherati, *Univ. of Calgary*; E.L. Roberts, *Univ. of Calgary*; M. Badv, *Univ. of Calgary*; Z. Abbasi, *Univ. of Calgary*

IF2-24: Chest-Worn Transmitarray Lens for Monitoring Heart Rate Variability with a Remote Self-Injection-Locked Doppler Radar

R. El Arif, *National Sun Yat-sen Univ.*; W.-C. Su, *National Sun Yat-sen Univ.*; T.-S. Horng, *National Sun Yat-sen Univ.*; C.-T.M. Wu, *Rutgers Univ.*

IF2-25: Heart Sound Detection Using an Ultra-Wideband FMCW Radar

M. Wenzel, *Technische Universität Hamburg*; B. Tegowski, *Technische Universität Hamburg*; N.C. Albrecht, *Technische Universität Hamburg*; D. Langer, *Technische Universität Hamburg*; A. Koelpin, *Technische Universität Hamburg*

IF2-26: Accurate Fast Heartrate Detection Based on Fourier Bessel Series Expansion During Radar-Based Sleep Monitoring

S. Dong, *SJTU*; J. Lu, *SJTU*; Y. Li, *SJTU*; C. Ji, *Shanghai Mental Health Center*; C. Yuan, *Shanghai Mental Health Center*; D. Zhao, *China Pacific Insurance*; M. Wang, *China Pacific Insurance*; J. Chen, *SJTU*; C. Gu, *SJTU*; J.-F. Mao, *SJTU*

IF2-27: Tube Positioning System Designed for Nasogastric Intubation

M.-H. Lin, *National Chung Cheng Univ.*; S.-M. Yang, *National Chung Cheng Univ.*; C.-C. Chang, *National Chung Cheng Univ.*; S.-F. Chang, *National Chung Cheng Univ.*

IF2-28: A Thru-Reflect-Series-Resistance (TRS) Calibration for Cryogenic Device Characterization in 40-nm CMOS Technology

Y.-T. Chen, *National Taiwan Univ.*; I. Huang, *National Taiwan Univ.*; M.-J. Lin, *National Taiwan Univ.*; S.-Y. Chuang, *National Taiwan Univ.*; H.L. Ho, *National Taiwan Univ.*; K.-S. Hsu, *National Taiwan Univ.*; P.-Y. Lin, *National Taiwan Univ.*; S.-Y. Chen, *National Taiwan Univ.*; L.-H. Lu, *National Taiwan Univ.*; S.-Y. Chen, *National Taiwan Univ.*; J.-Y. Li, *National Taiwan Univ.*; J.-C. Chien, *National Taiwan Univ.*

IF2-29: Negative Resistance Quasiparticle SIS Amplifiers

P. Russer, *Technische Univ. München*; D. Schuöcker, *Technische Univ. Wien*

IF2-30: A Converged Optical and mm-Wave, Dual-band, Multi-Beam Rotman Lens Antenna System Enabling Simplified Designs of 5G/mmW Base Stations and Network Densification

L. Smith, *Georgia Tech*; C. Lynch, *Georgia Tech*; C.A. Kaylor, *Georgia Tech*; L.A. Campos, *CableLabs*; L. Cheng, *CableLabs*; S. Ralph, *Georgia Tech*; M.M. Tentzeris, *Georgia Tech*

SAN DIEGO CONVENTION CENTER

WIM/YP JOINT PANEL SESSION

14:00 – 15:00 | Thursday, 15 June 2023 | Young Professionals (YP) Lounge, Sails Pavilion

PANEL THEME: We will feature a joint Panel Session between Women in Microwaves and Young Professionals. At the panel session, female tech leaders and entrepreneurs from big companies and start-ups will discuss what young professionals need to champion in the industry. The panelists will give examples of various career paths and answer your questions.

PANELISTS:

Michelle Kopier, Moderator, *Group Associate Publisher, Design & Engineering Group, Endeavor*

Shirin Montazeri, *Google, Quantum AI Team*

Maddie Frank, *Additive Manufacturing Engineer, Fabric8Labs*

Wendy Shu, *CEO, Eravant*

Sathya Padmanabhan, *General Manager, Maury Microwaves*

Sponsored By: Microwaves&RF

IMS CLOSING SESSION

15:30 – 17:00 | Thursday, 15 June 2023 | SAN DIEGO CONVENTION CENTER Ballroom 20B-D

Inspiring the Next Generation Into STEM/STEAM

KEYNOTE SPEAKER: Saura Naderi, *Outreach and Diversity Director at the Halicioğlu Data Science Institute, UC San Diego*

Saura Naderi, IMS Closing Session Keynote Speaker

ABSTRACT: Want to inspire the next generation into your field? Saura Naderi will talk about her experience engaging youth in engineering activities, including what she is currently working on at the Halicioğlu Data Science Institute at UC San Diego. She'll talk about the value of encouraging more young people into engineering career pathways and how the audience can do their part in helping the next generation succeed in STEM fields.

SPEAKER BIO: Saura Naderi is the outreach and diversity director at the Halicioğlu Data Science Institute at UC San Diego. She earned her engineering degree from UC San Diego Jacobs School just as the recession hit. Not satisfied by the opportunities available to her, she created her own. She volunteered, later becoming an employee, to create a program at UC San Diego where undergraduates and K-12 students could play and explore science and technology with art-themed engineering-based projects. After receiving the exemplary employee award at UC San Diego and the Athena Pinnacle award and invited to do a TEDx talk, she was recruited by Qualcomm to create a similar program named Thinkabit Lab. Upon leaving Qualcomm, Thinkabit Lab engaged 14,000+ middle school students and has been replicated in many different environments from libraries and schools to universities and companies. Saura was also a contestant on SyFy's Robot Combat League, was an "Adventure Person" on Nerdist, and is the color commentator for the world's first giant robot fight held in Japan. One of the creative projects she is most proud of is envisioning, and leading a team of engineers and artists to create, a robotic dress that hugs people. Saura is leading efforts to broaden participation in Data Science by designing creative ways to engage a diverse population.

101ST ARFTG MICROWAVE MEASUREMENT CONFERENCE

NVNA USERS' FORUM **To open to all conference attendees.**

Thursday, 15 June 2023 | 15:00 – 16:30 | 32AB, San Diego Convention Center

ORGANIZER: Patrick Roblin, *The Ohio State University*

ON-WAFER USERS' FORUM **To open to all conference attendees.**

Thursday, 15 June 2023 | 16:30 – 18:00 | 32AB, San Diego Convention Center

ORGANIZERS: Gia Ngoc Phung, *PTB* and Andrej Rumiantsev, *MPI*

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IEEE

FRIDAY WORKSHOPS

08:00 – 17:20 | Friday, 16 June 2023

	WORKSHOP TITLE	WORKSHOP ABSTRACT
WFA	**Microwave Challenges and Solutions for Quantum Computing** **Organizers:** Michael Hamilton, *Auburn University*; Alirio Boaventura, *Maybell Quantum* **ROOM: 29C** **08:00 – 11:50**	Quantum computing platforms are actively being scaled-up to a level that can out-perform tomorrow's most powerful classical supercomputers to solve certain impactful complex computations related to materials, energy, and climate. Despite the tremendous progress made over the last decade in the science and engineering of an array of quantum computing systems, many challenges remain. One of the current promising candidate platforms for scaling-up uses superconducting qubits that are controlled and read out using conventional microwave electronics operating at room temperature. Future versions of these systems are envisioned to bring more of the microwave electronics nearer the quantum processor but will require innovation to overcome the associated microwave challenges. The engineering challenges of realizing practical large-scale and densely integrated quantum information processing systems present quantum microwave engineers with new challenges and opportunities. This workshop will address current challenges and solutions being explored to realize scaled superconducting microwave quantum information processing systems.
WFB	**Packaging and Interconnects for Superconducting Applications** **Organizers:** Matthew King, *Raytheon*; Robert Jackson, *University of Massachusetts*; Wolfgang Heinrich, *FBH* **ROOM: 29D** **08:00 – 11:50**	There have been significant advances in the application of quantum technologies with several examples demonstrating the feasibility of what a few decades ago were only theories. However, key challenges still remain as a barrier to fully realizing the advantages brought by quantum technologies. One of the main challenges to overcome is scaling up quantum systems by several orders of magnitude. For instance, as the leading approach in quantum computing relies on superconductors and microwave signal processing, exploring options in packaging and interconnects for superconducting applications in the 4K and mK range is necessary. This workshop offers the opportunity to hear from multiple speakers that are actively working in the areas of microwave packaging and interconnects for superconducting application to face the challenges ahead.
WFC	**Frontiers of mm-Wave Phased Arrays** **Organizers:** Hasan Sharifi, *HRL Laboratories*; Laleh Rabieirad, *Raytheon* **ROOM: 30AB** **08:00 – 11:50**	With the development of high performance semiconductor nodes and emergence of 5G and 6G systems, significant advances have been achieved in electronically scannable mm-wave phased arrays. The continued performance improvements of advanced node CMOS and scaled SiGe HBTs, have enabled the development of highly integrated mm-wave phased arrays for low cost, small size and low dissipation applications. As a result, we have made great advances in RF front-ends, antenna arrays and high-speed analog-to-digital converters. On the other hand, the recent development of THz III-V HEMTs have enabled phased arrays at previously inaccessible frequencies. This workshop will discuss some of the highlights of major advances in mm-wave phased arrays in 4 invited talks by industry and academic leaders. The range of these topics will show how the varying application spaces impose requirements which flow down through the system architecture and component designs to the semiconductor technologies.
WFD	**D-Band and Sub-THz Technologies, Circuits and Systems for High Data-Rate Communication, Sensing and Imaging** **Organizers:** Telesphor Kamgaing, *Intel*; Ali A. Farid, *Intel*; Alberto Valdes-Garcia, *IBM T.J. Watson Research Center* **ROOM: 30DE** **08:00 – 17:20**	The large available spectrum at mm-wave frequencies above 100GHz offers wideband channels with tens of GHz wide bandwidth. This enables the development of wireless and waveguide communication systems with unprecedented data capacity. The small carrier wavelength (λ) permits compact arrays with many antennas. This paves the path for compact radio imaging systems with very high resolution. The goal of this workshop is to review the most recent advances in wireless, waveguide, and radar systems at D-band and beyond. Selected experts from academia and industry will discuss end-to-end components and challenges associated with novel mm-wave massive MIMO arrays, large scale phased arrays, high data-rate waveguide systems for data centers, and radar and sensing systems with very high resolution above 100GHz. Topics addressed will include semiconductor technology, mm-wave wireless transceivers, antenna arrays, waveguide channels and fully packaged modules.
WFE	**Radio-Frequency and mm-Wave Biomedical Radar Technologies** **Organizers:** Changzhan Gu, *SJTU*; Chung-Tse Michael Wu, *Rutgers University*; Fu-Kang Wang, *National Sun Yat-sen University*; Nils Pohl, *Ruhr-Universität Bochum*; Changzhi Li, *Texas Tech University* **ROOM: 30C** **08:00 – 17:20**	In the past few years, the COVID19 pandemic has drawn attention to health. Radio-frequency and mm-wave radar has been regarded as an emerging technique for contactless monitoring of health conditions, particularly the health of the subject's respiratory and cardiovascular systems. Radar has evolved from a complex, high-end technology into a relatively simple, low-cost solution penetrating industrial, automotive and consumer market segments. The adoption of short-range radars for consumer applications requires reliable system performance at small form factor, low-power and low-cost. The advancement of silicon and packaging technology has led to small form factor such that they can be mounted on devices, aesthetically concealed without affecting the system performance. This workshop covers multiple aspects of how to leverage short-range radar sensing for biomedical applications, including the metamaterial bio-radar, the clinic evaluations, gait analysis, monitoring impaired people, system design principles, and MIMO bio-radars.

2024 IEEE MTT-S INTERNATIONAL MICROWAVE SYMPOSIUM

16–21 JUNE 2024

THE WALTER E. WASHINGTON CONVENTION CENTER

Washington, D.C.

IMS2024 is the centerpiece of Microwave Week 2024, which includes the RFIC Symposium (www.rfic-ieee.org) and the ARFTG Microwave Measurement Conference (www.arftg.org).

IMS2024 will feature a far-reaching Technical Program focused on **Capitalizing Across the Spectrum** — the electromagnetic spectrum from RF-to-optical, the application spectrum from commercial wireless to scientific sensing, and the human spectrum encompassing diversity, equity, and inclusion.

The location of IMS2024 is our nation's capital, Washington D.C. The Walter E. Washington Convention Center is located in downtown Washington D.C., near Chinatown and the city's hip Shaw neighborhood which is known for its lively social and restaurant scene. Washington D.C. is home to many famous landmarks and historical sites such as the White House, the National Mall with its famous monuments and memorials, the Smithsonian Institution — the world's largest museum complex, the National Zoo, and the Kennedy Center for the Performing Arts.

Washington D.C. is also home to many agencies and institutions that oversee use of the electromagnetic spectrum. One of our conference themes is to highlight advances in spectrum access and use, including coexistence, sustainability and emerging Future-G systems. Other themes will feature the critical role of the RF-to-THz spectrum for aerospace and transportation, national security, and radar. The central role that equity, inclusion and diversity play across the spectrum of our community will be highlighted throughout the week.

For more information: ims-ieee.org

Automatic RF Techniques Group 08:00 – 17:00 Friday, 16 June 2023 Sapphire Ballroom, Hilton San Diego Bayfront Hotel

101ST ARFTG MICROWAVE MEASUREMENT CONFERENCE

Challenges in Complex Measurement Environments

07:55-08:00 | Welcome to the 101st ARFTG Conference – Introduction

Conference Co-Chairs: Marco Spirito and Jeffrey Jargon
TPC Co-Chairs: Jon Martens and Dennis Lewis

08:00-08:40

Keynote: Measurement Challenges and Novel Approaches to Modern Antenna Measurements in Complex Environments Using UAVs and Multi-Axis Robots
Stuart Gregson, Next Phase Measurements*

Session A: Over-the-air Measurement Topics

Session Chair: Dennis Lewis, *Boeing*

A-1 **08:40-09:00**	**Practical Verification of Over-the-Air Measurements and Correlation across Measurement Setups** Thomas Deckert, *NI**; Okay Schierhorn, *NI*; Harsh Nitharwal, *NI*; Jan Fromme, *NI*
A-2 **09:00-09:20**	**Robot-Based Multi-Purpose Measurement Platform for 6G Communications** Woohyun Chung, *Korea Research Institute of Standards and Science**; Chihyun Cho, *KRISS*; Jae-Yong Kwon, *KRISS*
A-3 **09:20-09:40**	**Dynamic Range by Design in OTA EVM Measurements** Paritosh Manurkar, *CU Boulder**; Dan Kuester, *NIST*; Joshua M Kast, *Colorado School of Mines*; Rob Horansky, *NIST*

09:40–10:40 | BREAK – EXHIBITS AND INTERACTIVE FORUM

Session B: Modulated and Spectral Analysis

Session Chair: Dominique Schreurs, *KU Leuven*

B-1 **10:40-11:00**	**A Measurement-Referenced Error Vector Magnitude for Counterfeit Cellular Device Detection** Améya S Ramadurgakar, *NIST**; Kate Remley, *NIST*; Dylan Williams, *NIST*; Jacob Rezac, *NIST*; Melinda Piket-May, *University of Colorado Boulder*; Rob Horansky, *NIST*
B-2 **11:00-11:20**	**Spectral Purity Evaluation of VNA Frequency Extenders to Enable Electronic Software-Based Power Control** Carmine De Martino, *Delft University of Technology**; Juan Bueno Lopez, *Delft University of Technology*; Marco Spirito, *TU Delft*
B-3 **11:20-11:40**	**Pulsed Sub-THz Wideband Vector Component Analysis** Jean-Pierre Teyssier, *Keysight Technologies**; Joel Dunsmore, *Keysight Technologies*; Johan Ericsson, *Keysight Technologies*; Sam Kusano, *Keysight Technologies, Inc.*; Nizar Messaoudi, *Keysight Technologies, University of Waterloo*
B-4 **11:40-12:00**	**Accurately Applying Wideband Modulated Signals to a DUT Using an Extended VSG-VSA Setup** Frans Verbeyst, *NI**; Pawel Barmuta, *NI*; Marc Vanden Bossche, *NI*; Markus Rullmann, *NI*

12:00–13:20 | AWARDS LUNCHEON

Session C: Doug Rytting Memorial Session: Advanced Linear Network Analysis

Session Chair: Rusty Myers, *Keysight Technologies*

C-1 **13:20-13:40**	**Memorial for Doug Rytting** Marc Vanden Boscche, *NI*
C-2 **13:40-14:00**	**D-Band Characterization of a Commercial High-Resistivity Silicon Calibration Substrate** Gia Ngoc Phung, *Physikalische Technische Bundesanstalt**; Hyunji Koo, *KRISS*; Chihyun Cho, *KRISS*; JAE-YONG KWON, *KRISS*; Uwe Arz, *Physikalisch-Technische Bundesanstalt, PTB*
C-3 **14:00-14:20**	**Dielectric Spectroscopy of Liquids by De-embedding Two-Port Measurements** Seyede Maede Chavoshi, *KU Leuven**; Matko Martinic, *KU Leuven*; Helene Ponsaerts, *KU Leuven*; Maya Van Dijck, *KU Leuven*; Bart Nauwelaers, *KU Leuven*; Tomislav Markovic, *KU Leuven*; Dominique Schreurs, *University of Leuven*
C-4 **14:20-14:40**	**Verification of Reference Impedance from Common On-Wafer Calibrations on Commercial Calibration Substrates** Lucas Nyssens, *Université catholique de Louvain**; Martin Rack, *Université catholique de Louvain*; Romain Tuytaerts, *Université catholique de Louvain*; Dimitri Lederer, *Université catholique de Louvain*; Jean-Pierre Raskin, *Université catholique de Louvain*

14:40–15:30 | BREAK – EXHIBITS AND INTERACTIVE FORUM

Session D: Non-Linear, Large-Signal VNA Techniques

Session Chair: Patrick Roblin, *The Ohio State University*

D-1 **15:30-15:50**	**VNA-Based Characterization of Frequency Multipliers Phase-Distortions Under Continuous-Wave and Modulated Signal Excitation** Mahitab Eladwy, *University of Waterloo**; Ahmed Ben Ayed, *University of Waterloo*; Slim Boumaiza, *University of Waterloo, Canada*
D-2 **15:50-16:10**	**Modulated-Input Control and Linearization of a Multi-Port Millimeter-Wave PA by VNA-based Calibrated Wideband Measurements** Mattia Mengozzi, *University of Bologna**; Gian Piero Gibiino, *University di Bologna*; Alberto Maria Angelotti, *University of Bologna*; Christoph Schulze, *Ferdinand-Braun-Institut*; Olof Bengtsson, *Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik*; Corrado Florian, *University of Bologna*; Alberto Santarelli, *University of Bologna**
D-3 **16:10-16:30**	**A Rigorous Analysis of the Random Noise in Reflection Coefficients Synthesized via Mixed-Signal Active Tuners** Faisal Mubarak, *VSL**; Marco Spirito, *TU Delft*; Fabio Munoz, *VSL*
D-4 **16:30-16:50**	**First Comparison of Active and Passive Load Pull at W-Band** Christopher Clymore, *University of California, Santa Barbara**; Matthew Guidry, *UCSB*; Emre Akso, *UCSB*; Henry Collins, *UCSB*; Wenjian Liu, *UCSB*; Christian Wurm, *UCSB*; Nirupam Hatui, *UCSB*; Umesh Mishra, *UCSB*
D-5 **16:50-17:10**	**Mini Rump Session—High Frequency Measurements in 2030** Moderator: Leonard Hayden, *Qorvo*

Interactive Forum

Session Chair: Jeffrey Jargon, *NIST*

P-1 **09:40-15:30**	**A 3D FW-EM Simulation-Based PSOD Method for Characterizing On-Wafer Devices Compensating for Short Pattern Error** Yunsang Shin, *Seoul National University**; Sangwook Nam, *Seoul National University*
P-2 **09:40-15:30**	**Design of Optimal Length for Waveguide Offset Shorts in D-band based on Uncertainty Analysis** Chihyun Cho, *KRISS**; Jae-Yong Kwon, *KRISS*
P-3 **09:40-15:30**	**Implementing Direct RF Sampling at Sub-Nyquist Rate for Error Vector Magnitude Measurements** Xifeng Lu, *NIST**; Paritosh Manurkar, *NIST*; Dazhen Gu, *NIST*; Dan Kuester, *NIST*; Rob Horansky, *NIST*
P-4 **09:40-15:30**	**Evaluating Correlation Between Measurement Samples in Reverberation Chambers Using Clustering** Carnot L Nogueira, *NIST**; Kate Remley, *NIST*; Rob Horansky, *NIST*
P-5 **09:40-15:30**	**VNA-Based Large-Signal Drain-Modulated Power Amplifier Measurement Setup With Digital Pre-Distortion** Rob Vissers, *Chalmers University of Technology**; Christian Fager, *Chalmers University of Technology*; Gregor Lasser, *Chalmers University of Technology*
P-6 **09:40-15:30**	**Over-the-Air Characterization of mmW Near-Field Channels** Yagmur Ozturk, *The Ohio State University**; Niru Nahar, *Ohio State University*; Kubilay Sertel, *Ohio State University*
P-7 **09:40-15:30**	**NPR Assessment Without Multi-Tone Phase Randomization** Ricardo Figueiredo, *University of Aveiro**; Nuno Borges Carvalho, *Instituto de Telecomunicacoes*
P-8 **09:40-15:30**	**Validity of Room-temperature Calibration for On-wafer Measurements up to 220 GHz, 125 °C, and 48 h** Tianze Li, *Cornell University**; Lei Li, *Cornell University*; James C. M. Hwang, *Cornell University*
P-9 **09:40-15:30**	**Characterization of a Compact Wideband Microwave Metasurface Lens for Cryogenic Applications** Ali Al-Moathin, *U. Glasgow*; Mingyan Zhong, *U. Glasgow*; Qusay Al-Taai, *U. Glasgow*; Yunan Jiang, *U. Glasgow*; Michael Farage, *U. Glasgow*; Jalil ur Rehman Kazim, *U. Glasgow*; Muhammad Zulfiqar Ali, *Oxford Instr.*; Fatemeh Nikbakhtnasrabadi, *U. Glasgow*; Megan Powell, *U. Strathclyde*; Prince Khatri, *U. Strathclyde*; Manoj Stanley, *NPL*; Alessandro Rossi, *U. Strathclyde*, *NPL*; Hadi Heidari, *U. Glasgow*; Muhammad Ali Imran, *U. Glasgow*; Qammer H. Abbasi, *U. Glasgow*; Nick M. Ridler, *NPL*; Martin Weides, *U. Glasgow*; Chong Li, *U. Glasgow**
P-10 **09:40-15:30**	**In-Situ Measurement of Transmitter Antenna Input Current Using a Software-Defined Radio** Austin S. Egbert, *Baylor University*; Adam C. Goad, *Baylor University*; Samuel M. Haug, *Baylor University*; Charles Baylis, *Baylor University**; Benjamin Kirk, *Army Research Laboratory*; Anthony Martone, *Army Research Laboratory*; Robert J. Marks II, *Baylor University*

Closing Notes – End of 101st ARFTG Conference

Exhibit Hall Happenings

HOURS:

Tuesday, 13 June	**09:30 – 17:00**
Wednesday, 14 June	**09:30 – 18:00**
Industry Hosted Reception, Wednesday, 14 June	**17:00 – 18:00**
Thursday, 15 June:	**09:30 – 15:00**

TUESDAY:

Professional Headshots (Booth 1700)	**09:30 – 17:00**
IMS Game Zone (Booth 214)	**09:30 – 17:00**
AM— Coffee Break	**09:40 – 10:10**
MicroApps Seminars (Booth 2447)	**10:00 – 15:30**
Sweet Treat Tuesday	**12:30**
PM—Coffee Break	**15:10 – 15:40**
IMS Executive Forum (Booth 2447)	**15:30 – 16:30**

WEDNESDAY:

Professional Headshots (Booth 1700)	**09:30 – 18:00**
IMS Game Zone (Booth 214)	**09:30 – 18:00**
Build a "Foxhole" Radio Receiver, Systems Demo Zone (Booth 2155)	**09:30 – 17:00**
AM—Coffee Break	**09:40 – 10:10**
MicroApps Seminars (Booth 2447)	**09:30 – 17:00**
PM—Coffee Break	**15:10 – 15:40**
Industry Hosted Reception	**17:00 – 18:00**

THURSDAY:

IMS2024 Selfie Station (Booth 1700)	**09:30 – 15:00**
IMS Game Zone (Booth 214)	**09:30 – 15:00**
AM—Coffee Break	**09:40 – 10:10**
MicroApps Seminars (Booth 2447)	**09:30 – 15:00**

Visit the Societies Pavilion (Booth 1913) to learn more about the IEEE Microwave Theory & Technology Society (MTT-S) as well as other IEEE Societies!

Learn more about the MTT-Sat Challenge and view demonstrations from the finalists in the Systems Pavilion (Booth 2141)!

IMS2023

First-time exhibitors are highlighted in green.

IMS2023 EXHIBITOR LIST AS OF 11 MAY 2023 | *For the most up-to-date information, please visit: ims-ieee.org*

2pi-Labs GmbH	2649
3D Glass Solutions Inc.	1027
3G Shielding Specialties	2734
3H Communication Systems	1714
3Rwave	1450
A-Alpha Waveguide Inc.	2424
Accu-Tech Laser Processing Inc.	1907
ACE-Accurate Circuit Engineering	1650
ACEWAVETECH	824
Admotech Co. Ltd.	2152
Adsantec Inc.	2308
AdTech Ceramics	225
Advanced Circuitry International	2637
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Aerospace & Defense Technology	327
Aerowave, a Plymouth Rock Technologies Co.	319
Aeterlink Corp.	2655
Aethertek Technology	1716
AFT Microwave Inc.	2111
AGC Multi Material America Inc.	1425
Agile Microwave	1553
AI Technology Inc.	1117
A-INFO Inc.	1322
AJ Tuck Co.	2123
Akoustis Inc.	553
Alifecom Technology Corp.	2005
ALMT/Sumitomo Electric USA	516
Altum RF	1648
AMCAD Engineering	1523
AMCOM Communications Inc.	2448
American Standard Circuits	1548
Ampleon Netherlands BV	1835
AmpliTech Inc.	443
Analog Devices Inc.	1335
AnaPico Inc.	1514
Anoison Electronics LLC	626
Anokiwave Inc.	2148
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AntenneX BV	2154
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AR Modular RF	947
AR RF/Microwave Instrumentation	947
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ASI CoaxDepot	535
Association of Old Crows	854
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Axiom Test Equipment	2008
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Benchmark Electronics	1351
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Centerline Technologies	2205
Cernex / Cernexwave	1015
Chengdu KeyLink Wireless Technology Co. Ltd.	2608
Chengdu Lingyi Communication Technology CoLtd	2607
Chengdu Wattsine Electronic Technology Co. Ltd.	2306
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CX Thin Films	617

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UTE Microwave Inc.	1647
Vacuum Engineering & Materials	1815
Valence Surface Technologies	2504
Vanteon Corporation	1847
Varioprint AG	1844
Vaunix Technology Corp.	1119
Ventec International Group	2343
Verifide Technologies Inc.	1806
VIAS3D	2142
Viking Tech America	1610
Viper RF	223
Virginia Diodes Inc.	948
Virtual Industries	418
Vishay Intertechnology Inc.	2025
WAFIOS Machinery Corp.	1705
Waka Manufacturing Co. Ltd.	1222
Wakefield Thermal	1849
Wave Mechanics Pvt. Ltd.	1321
Wavepia Co. Ltd.	1846
WavePro	1701
Wavetek Microelectronics Corporation	417
Wavice Inc.	2727
WayvGear	2614
Weasic Microelectronics S.A.	2150
Weinschel Associates	615
Werlatone Inc.	1922
West Bond Inc.	1347
Wevercomm Co. Ltd.	1324
Wilkes University	2201
WIN Semiconductors Corp.	235
Win Source Electronics	2214
Winchester Interconnect	2327
WIPL-D	1148
Wireless Telecom Group	1619
Withwave Co. Ltd.	2144
WL Gore & Associates Inc.	724
Wolfspeed Inc.	1735
Wupatec	2117
XMA Corporation	520
Xpeedic Technology Inc.	1121
XYZTEC Inc.	1706
Y.TECH	2113
YTTEK Technology Corp.	2348
Yuetsu Seiki Co. Ltd.	2501
Z-Communications Inc.	757

AMPLITECH GROUP

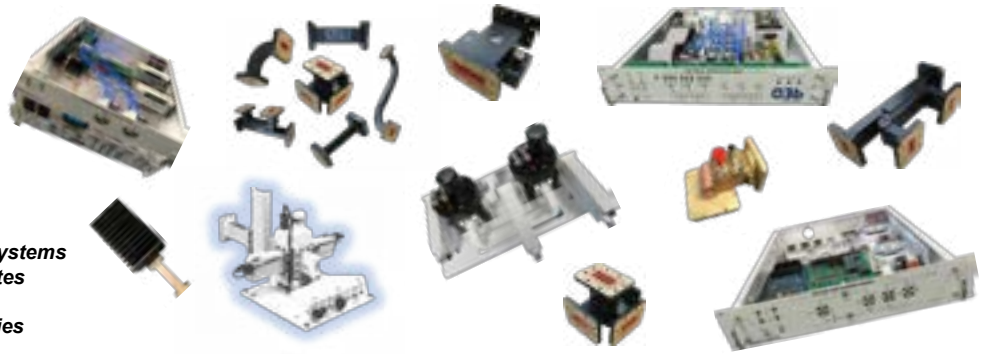
AmpliTech

- *DC to 40 GHz Low Noise Coaxial Amplifiers*
- *Ultra Low Noise Cryogenic Amplifiers*
- *Space Qualified Low Noise Amplifiers*
- *S, C, X, Ku, Ka Band Waveguide Amplifiers*
- *SATCOM Amplifiers*
- *Wideband Amplifiers*
- *Medium Power Amplifiers*
- *Multioctave Amplifiers*
- *Surface Mount Amplifiers*
- *Desktop Amplifiers*
- *Custom Amplifiers*

All AmpliTech amplifiers are MADE IN USA with:

Reverse Voltage Protection - Internal Regulation - State-of-the-Art PHEMT Technology - MIL-883, MIL-45208 Assembly Standards

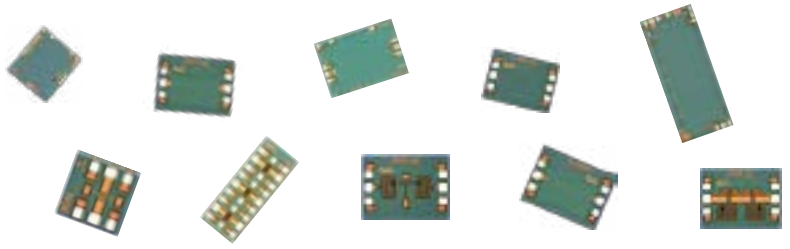
Specialty MICROWAVE



- *Waveguide Assemblies*
- *Waveguide to Coax Adapters*
- *Crossguide Couplers*
- *High Power Dummy Loads*
- *Integrated Systems*
- *Block Downconverters*
- *1:1 & 1:2 Low Noise Amplifier Systems*
- *Redundant LNA Controllers/Plates*
- *Subsystems*
- *Specialized Electronic Assemblies*

AGMDC

An AmpliTech Group Company



- *Low Noise Amplifiers*
  - Freq: 2-4 GHz, Gain: 26 dB, NF: 0.8 dB
  - Freq: 4-8 GHz, Gain: 26 dB, NF: 0.9 dB
- *Low Pass Filters*
  - Freq: DC-8 GHz Passband Loss: 0.88 dB, REJ: 20 dB
- *Bandpass Filters*
  - Freq: 8-12 GHz, Passband Loss: 1.05 dB, REJ: 20 dB
  - Freq: 17.7-21.2 GHz, Passband Loss: 1.45 dB, REJ: 20 dB
- *3dB Fixed Attenuator*
  - Freq: DC-50 GHz, IL: 2.96 dB

SPECTRUM SEMICONDUCTOR MATERIALS

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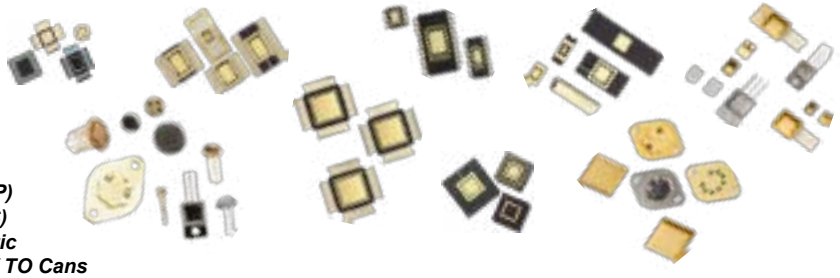

- *Ceramic Quad Flat Package - Cerquad*
- *Leadless LCC / Leaded LDCC Chip Carriers*
- *Hybrid Package – Multi-Chip Module (MCM)*
- *Side-Brazed Dual In-Line Ceramic Package (DIP)*
- *Small Outline Integrated Circuit Package (SOIC)*
- *Ceramic Pin Grid Array (CPGA) Ceramic / Plastic*
- *Transistor Outlines – TO Headers / TO Power / TO Cans*

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