

# CONFERENCE PROGRAM



**BCICTS 2023**  
**IEEE BiCMOS and Compound**  
**Semiconductor Integrated Circuits**  
**and Technology Symposium**

**October 15-18, 2023**  
**Monterey, California USA**

Sponsored by  
**The Electron Devices Society of**  
**The Institute of Electrical and**  
**Electronic Engineers**

In Cooperation with  
**The IEEE Solid - State Circuits**  
**Society The IEEE Microwave Theory &**  
**Techniques Society**



CONFERENCE WEBSITE  
[www.bcicts.org](http://www.bcicts.org)

## **WELCOME FROM THE BCICTS 2023 CHAIRS**

It is with great pleasure that we welcome you to the 2023 IEEE BiCMOS and Compound Semiconductor Integrated Circuits and Technology Symposium (BCICTS)! This is our sixth meeting of the BCICTS – a combined symposium from a 42-year legacy of the Compound Semiconductor IC Symposium (CSICS), and 35 years of the Bipolar/BiCMOS Circuit and Technology Meeting (BCTM).

The planning committee is excited to meet in person again, just like last year, after holding the previous two BCICTS conferences virtually due to the COVID-19 pandemic. This a great opportunity for us in the engineering and technical community to reconnect with each other both professionally and personally, to meet new colleagues and visit with long-time friends, while catching up on the latest trends within microelectronics.

This year, BCICTS will continue the long history, from BCTM and CSICS, of international symposiums where distinguished experts present their latest results in bipolar, SiGe BiCMOS, and compound semiconductor circuits, devices, and technology. There are no other events in the world where you can see leading edge bipolar/BiCMOS devices and technology, 5G ICs, GaN HPAs, InP THz PAs, optical CMOS/SiGe transceivers, GaN HEMT power devices, and advances in compact modeling, all presented together.

This sixth BCICTS includes presentations from worldwide submissions on all aspects of the technologies. Topics span process technology, device advances, TCAD modeling, compact modeling to IC design and testing, high-volume manufacturing, and system applications. BCICTS will also feature the very latest results in RF/microwave, millimeter-wave, THz, analog mixed signal, and optoelectronic integrated circuits.

As we have done in past years, BCICTS will offer a topical short course and a more basic primer course. Both will be taught by leading experts, with the short course intended for professionals seeking comprehensive understanding of the latest industry trends and techniques, and the primer as an introductory tutorial. Specific details on both offerings can be found in the following pages of this program.

We would like to thank the many dedicated volunteers on the BCICTS Committee, and the generous support of the IEEE Electron Devices, Microwave Theory and Techniques, and Solid- State Circuits Societies. Finally, we look forward to interacting with all participants to continue the traditions of technical excellence for BCICTS!

**Breandán Ó hAinle, Symposium Chair  
Analog Devices**

**Robert Howell, Symposium Co-Chair  
Northrop Grumman**

# 2023 BCICTS SCHEDULE AT A GLANCE

<b>SUNDAY – OCTOBER 15</b>	
<b>SHORT COURSE</b>	
Wide Band-Gap Semiconductors for Power Applications: Material, Fabrication, Devices and Reliability <b>San Carlos Ballroom 1</b>	
7:30AM 5:00PM	Registration for Short Course Only <b>San Diego Foyer</b>
8:00AM 8:45AM	Breakfast for Short Course Only <b>San Carlos Ballroom Foyer</b>
8:45AM 8:50AM	Welcome & Speaker Introduction, Doug Weiser, Texas Instruments <b>San Carlos Ballroom 1</b>
8:50AM 10:20AM	GaN Material, Fabrication and Devices, Grace Xing, Cornell University <b>San Carlos Ballroom 1</b>
10:20AM 10:35AM	Coffee Break for Short Course Only <b>San Carlos Ballroom Foyer</b>
10:35AM 12:05PM	SiC Material, Fabrication and Devices, Victor Veliadis, North Carolina State University <b>San Carlos Ballroom 1</b>
12:05PM 1:15PM	Lunch Break for Short Course Only <b>Ferrantes 10<sup>th</sup> Floor</b>
1:15PM 2:45PM	Reliability in Gallium Nitride Power Devices, Enrico Zanoni, University of Padova <b>San Carlos Ballroom 1</b>
2:45PM 3:00PM	Coffee Break for Short Course Only <b>San Carlos Ballroom Foyer</b>
3:00PM 4:30PM	SiC Power Device Reliability, Brett Hull, Wolfspeed <b>San Carlos Ballroom 1</b>
4:30PM 4:45PM	Adjourn and feedback
<b>PRIMER</b>	
Breaking the Barriers of VCO Design in mm-Wave: Overcoming Challenges and Exploring Solutions <b>San Carlos Ballroom 2</b>	
7:30AM 12:50PM	Registration for Primer Only <b>San Carlos Ballroom Foyer</b>
8:00AM 8:45AM	Breakfast for Primer Only <b>San Carlos Ballroom Foyer</b>
8:45AM 8:50AM	Welcome & Speaker Introduction, M Schroter, TU Dresden <b>San Carlos Ballroom 2</b>
8:50AM 11:00AM	Primer Lecture - Part 1, W. Khalil, Ohio State University <b>San Carlos Ballroom 2</b>
11:00AM 11:10AM	Coffee Break for Primer Only <b>San Carlos Ballroom Foyer</b>
11:10AM 12:40PM	Primer Lecture - Part 2, W. Khalil, Ohio State University <b>San Carlos Ballroom 2</b>
12:40PM 12:50PM	Adjourn and feedback

# 2023 BCICTS SCHEDULE AT A GLANCE

<b>MONDAY – OCTOBER 16</b>		
7:30AM 5:00PM	Registration <b>San Diego Foyer</b>	
9:00AM 9:30AM	Welcome and Announcements <b>San Carlos Ballroom 3 &amp; 4</b>	
9:30AM 10:10AM	Plenary Session 1 <b>San Carlos Ballroom 3 &amp; 4</b>	
10:10AM 10:40AM	Coffee Break <b>San Carlos Ballroom Foyer</b>	
10:40AM 11:20AM	Plenary Session 2 <b>San Carlos Ballroom 3 &amp; 4</b>	
11:20AM 12:00PM	Plenary Session 3 <b>San Carlos Ballroom 3 &amp; 4</b>	
12:00PM 2:00PM	Lunch Break <b>Self-Arrangement</b>	
2:00PM 3:40PM	<b>1a. High Performance Compound Semiconductor Device Technologies</b> <b>San Carlos Ballroom 1 &amp; 2</b>	<b>1b. High Frequency Control Circuits</b> <b>San Carlos Ballroom 3 &amp; 4</b>
3:40PM 4:10PM	Coffee Break <b>San Carlos Ballroom Foyer</b>	
4:10PM 5:30PM	<b>2a. Si Process Technology</b> <b>San Carlos Ballroom 1 &amp; 2</b>	<b>2b. Analog Circuits</b> <b>San Carlos Ballroom 3 &amp; 4</b>
5:30PM 7:30PM	Exhibition Reception <b>San Carlos Ballroom Foyer</b>	

<b>TUESDAY – OCTOBER 17</b>		
7:30AM 5:00PM	Registration <b>San Diego Foyer</b>	
7:30AM 8:30AM	Exhibition Breakfast <b>San Carlos Ballroom Foyer</b>	
8:30AM 2:30PM	Exhibition <b>San Carlos Ballroom Foyer</b>	
8:30AM 10:10AM	<b>3a. Advances in GaAs and InP HBT Modeling</b> <b>San Carlos Ballroom 1 &amp; 2</b>	<b>3b. Gan Power Amplifiers</b> <b>San Carlos Ballroom 3 &amp; 4</b>
10:10AM 10:30AM	Coffee Break <b>San Carlos Ballroom Foyer</b>	
10:30AM 11:30AM	<b>4a. Reliability Physics of SiGe HBTs</b> <b>San Carlos Ballroom 1 &amp; 2</b>	<b>4b. High-Performance Circuits for Optical Communications - 1</b> <b>San Carlos Ballroom 3 &amp; 4</b>
11:30AM 12:30PM	<b>5a. Super-cool SiGe HBTs</b> <b>San Carlos Ballroom 1 &amp; 2</b>	<b>5b. High-Performance Circuits for Optical Communications - 2</b> <b>San Carlos Ballroom 3 &amp; 4</b>
12:30PM 2:00PM	Exhibition Lunch <b>San Carlos Ballroom Foyer</b>	
2:00PM 3:40PM	<b>6a. Bipolars Running Hot &amp; Cold</b> <b>San Carlos Ballroom 1 &amp; 2</b>	<b>6b. Millimeter Wave Circuits</b> <b>San Carlos Ballroom 3 &amp; 4</b>
3:40PM 4:00PM	Coffee Break <b>San Carlos Ballroom Foyer</b>	
4:00PM 5:20PM	<b>7a. FETs and Features</b> <b>San Carlos Ballroom 1 &amp; 2</b>	<b>7b. mmW Mixers and Multipliers</b> <b>San Carlos Ballroom 3 &amp; 4</b>

# 2023 BCICTS SCHEDULE AT A GLANCE

WEDNESDAY – OCTOBER 18		
7:30AM 3:30PM	Registration San Diego Foyer	
8:00AM 9:40AM	<b>8a.</b> Wideband-Gap Device Modeling San Carlos Ballroom 1 & 2	<b>8b.</b> Transceiver and Beamforming Techniques San Carlos Ballroom 3 & 4
9:40AM 10:10AM	Coffee Break San Carlos Ballroom Foyer	
10:10AM 11:50AM	<b>9a.</b> High Frequency Technology and Calibration San Carlos Ballroom 1 & 2	<b>9b.</b> HBT Circuits up to 1 THz San Carlos Ballroom 3 & 4
11:50AM 1:30PM	Lunch Ferrante's 10 <sup>th</sup> Floor	
1:30PM 3:10PM	<b>10a.</b> Late News 1 San Carlos Ballroom 1 & 2	<b>10b.</b> Late News 2 San Carlos Ballroom 3 & 4
3:10PM 3:40PM	Coffee Break San Carlos Ballroom Foyer	
3:40PM 4:10PM	Closing Session San Carlos Ballroom 3 & 4	



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## LOCATION INFORMATION

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### ON-SITE CONFERENCE REGISTRATION DESK HOURS

Registration will be open in the San Diego Foyer

- Sunday, October 15 7:30 AM - 5:00 PM
- Monday, October 16 7:30 AM - 5:00 PM
- Tuesday, October 17 7:30 AM - 5:00 PM
- Wednesday, October 18 7:30 AM - 3:30 PM

### CONFERENCE NETWORKING & SOCIAL EVENTS

Several networking events have been arranged to promote informal social interactions among conference participants. Event details are listed below for your reference:

#### **Monday, October 16:**

5:30 PM to 7:30 PM

Exhibitor Reception - San Carlos Ballroom Foyer

#### **Tuesday, October 17:**

7:30 AM to 8:30 AM

Exhibitor Breakfast - San Carlos Ballroom Foyer

#### **Tuesday, October 17:**

12:30 PM to 2:00 PM

Conference Exhibitor luncheon - San Carlos Ballroom Foyer

#### **Wednesday, October 18:**

11:50 AM – 1:30 PM

Conference Luncheon – Ferrante’s 10<sup>th</sup> Floor

**Attendee Lounge & Speaker Ready Room:** The Attendee Lounge/Speaker Ready Room “**Santa Barbara Room**” will be available from 7:00 AM - 5:00 PM daily.

### VISITING MONTEREY

Monterey County, with its charming small-town atmosphere, offers stunning natural beauty and wildlife. Discover iconic landmarks, a storied history, sustainable and diverse culinary offerings, top-notch vineyards and wineries, varied landscapes from scenic coastal views to rugged terrain, world-class art, and more.

Visit [www.seemonterey.com/things-to-do](http://www.seemonterey.com/things-to-do) to find activities, landmarks, and attractions.

### GETTING AROUND

Aside from Uber and Lyft, there are multiple taxicab companies\* that serve Monterey.

\*There are only two taxicab companies that serve the Monterey airport; the Salinas Yellow Cab and the Marina Taxi Company. The Monterey County Regional Taxi Authority regulates these taxis and they are permitted by the Monterey Peninsula Airport District, which monitors taxi activity at the airport. A \$3 Airport Surcharge will be assessed to the overall meter rate to and from the airport. No reservations are needed.

**Salinas Yellow Cab** 831.333.1234

**Marina Taxi Company** 831.384.3894

If you should have questions or need assistance, please send a message to:

Catherine Shaw  
BCICTS Conference Director  
[cs@cshawevents.com](mailto:cs@cshawevents.com)

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## ADDITIONAL INFORMATION

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**REGISTRATION** Complete registration information is contained in the centerfold of this booklet as well as on the conference's web page (<https://bcicts.org>) Please use the website to register. The advanced registration deadline is **September 15**. All conference activities are included in the registration fees (technical sessions, coffee breaks, Monday exhibition reception, Tuesday exhibition breakfast and Wednesday lunch

**CONFERENCE SOCIAL EVENTS** Several events have been arranged to promote informal social interactions among conference participants.

**TUTORIAL / SURVEY TALKS** Tutorial talks given by invited experts are intended to give a broad overview of a given subject with a critical review of technology and applications. They are twice the length of the usual contributed talk with longer abstracts in the Proceedings.

**MEMBERS OF THE PRESS:** You are welcome to attend BCICTS. Admission is free. Just present your business card at the registration desk.

**RECRUITING:** intensive recruiting undermines the purposes for which the BCICTS was established and is contrary to IEEE policy.

**BEST STUDENT PAPER AND BEST PAPER AWARDS** BCICTS offers a Best Paper Award. The BCICTS Best Paper Award recognizes and promotes high quality contributions to scholarly research among professionals who author and present papers at the conference. All papers submitted in non-student category are eligible for consideration for the Best Paper Award.

The BCICTS Best Student Paper Award recognizes and promotes outstanding research led by students. The Best Student Paper Award the following criteria: 1) the student must have carried out a substantial part of the research reported in the paper, 2) the student must be the first author and must present the paper at the conference, 3) the paper must be identified as a student paper during submission of the paper.

Eligible papers have been evaluated by the Best Paper Award Committee and the notifications will be sent out after the conference.

### OUR SPONSORS

BCICTS is sponsored by the IEEE Electron Devices Society (EDS) in co - operation with the IEEE Solid - State Circuits Society (SSCS) and the IEEE Microwave Theory & Techniques Society (MTT).

# MEETINGS & SESSIONS SCHEDULE DETAILS

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## SUNDAY

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### BCICTS 2023 SHORT COURSE *San Carlos Ballroom 1*

**Date:** Sunday, October 15, 2023

**Time:** 8:00 AM – 4:45 PM

**Topic:** Wide Band-Gap Semiconductors for Power Applications: Material, Fabrication, Devices and Reliability

**Speakers:**

- Huili Grace Xing (Cornell University)
- Victor Veliadis (North Carolina State University)
- Enrico Zanoni (University of Padova)
- Brett Hull (Wolfspeed)

**8:00– 8:45 AM – Breakfast (Primer/Short Course Only)**

**8:45 – 8:50 AM - Welcome & Speaker Introduction**

*Doug Weiser, Texas Instruments*

**8:50 – 10:20 AM – GaN Material, Fabrication and Devices**

*Instructor: Dr. Huili Grace Xing, Cornell University*

**Abstract:** A material with a bandgap higher than 2 eV were often categorized as an insulator. The relentless pursuit of light-emitting diodes (LEDs) in the past 7 decades, especially the high-efficiency visible LEDs, leads to development of the extremely pure semiconductor with a bandgap ranging from 2 eV to 6 eV to date. GaN is the hero semiconductor along with its sibling materials. To fully unleash the potential of a semiconductor, it is critical to 1) control its defect levels below the limits that the targeted applications can tolerate, 2) control its doping in both n-type and p-type, and 3) engineer the most effective carrier injection into the conduction and valence bands, i.e. excellent ohmic contacts. In this talk, I will discuss the brief history of GaN development, the realization of both unipolar and bipolar devices, and the unique features of GaN in comparison to other semiconductors. Among the binary nitride semiconductors (InN, GaN, AlN, BN, ScN etc) there is often a sizable lattice mismatch and/or crystalline phase mismatch. The most studied interface to date between two binary nitride semiconductors is that between GaN and AlN. On the metal-polar platform, a 2DEG is often found in GaN immediately below AlN while a 2DHG is found in GaN immediately above AlN. On the N-polar platform, the scenario is reversed. In this talk, I will also reflect on our development of structures based on GaN and AlN thin layers: epitaxy, properties and devices. This collected body of work has been funded over the years by the National Science Foundation, the Department of Energy, the Office of Naval Research, the Air Force Office of Scientific Research, the DARPA, Semiconductor Research Corporation, Intel and Asahi Kasei. The author is particularly grateful for her students and postdocs and their close collaborators in the Jena group and other collaborating groups in the past 2+ decades.



**Huili Grace Xing** (IEEE S'03, F'22) is currently the William L. Quackenbush Professor of Electrical and Computer Engineering, Materials Science and Engineering at Cornell University, the Director of SUPREME - a SRC JUMP2.0 research center. She received B.S. in physics from Peking University (1996), M.S. in Material Science from Lehigh University (1998) and Ph.D. in Electrical Engineering from University of California, Santa Barbara (2003), respectively. She was a faculty with the University of Notre Dame from 2004 to 2014. Her research focuses on development of III-V nitrides, 2-D crystals, oxide semiconductors, exploration of strongly correlated materials such as multiferroics & superconducting materials on their growth, electronic and optoelectronic devices, especially the interplay between material properties and device development for high performance devices. She is a recipient of the AFOSR Young Investigator Award, NSF CAREER Award, ISCS Young Scientist Award, and the Intel Outstanding Researcher Award. She is a fellow of APS, IEEE & AAAS.

**10:20 – 10:35 AM – Coffee - Break**

**10:35 – 12:05 PM – SiC Material, Fabrication and Devices**

*Instructor: Victor Veliadis, PowerAmerica*

**Abstract:** SiC chips are displacing their incumbent Si counterparts in several high-volume power applications. As SiC market share continues to grow, the industry is lifting the last barriers to mass commercialization that include the higher than silicon chip cost that increases disproportionately with area, defects that limit chip yield and area, reliability and ruggedness concerns, and the need for a trained workforce to skillfully insert SiC into power electronics circuits. To enable cost effective manufacturing, high-yielding SiC fabrication in conventional Si fabs is desirable. In this short course, I will summarize key aspects of SiC fabrication technology and outline non-CMOS compatible processes that have been streamlined to allow for mass SiC chip fabrication in conventional Si mature fabs. The SiC industry is successfully leveraging the Si fab infrastructure, and is making the relatively small financial investments that allow existing Si fabs to process SiC. Consequently, SiC chip fabrication in volume fabs, alongside Si, has emerged as a cost-reduction model that exploits the silicon manufacturing economies of scale. Indeed, today's SiC fab infrastructure mirrors that of silicon and is rapidly expanding.

**Victor Veliadis** is Executive Director & CTO of PowerAmerica, a member-driven consortium of industry, universities, and national labs accelerating the commercialization of energy efficient SiC and GaN power semiconductor technologies. At PowerAmerica, he has managed a budget of \$152 million that he strategically allocated to over 210 industrial and University projects to catalyze SiC/GaN semiconductor and power electronics manufacturing, workforce development, and job creation. His PowerAmerica educational activities have trained 420 full-time students in collaborative industry/University WBG projects, and engaged over 4600 attendees in tutorials, short courses, and webinars. Dr. Veliadis is an ECE Professor at NCSU, and an IEEE Fellow and EDS Distinguished Lecturer. He has 27 issued U.S. patents, 6 book chapters, and over 150 peer-reviewed publications to his credit. Prior to entering academia

and taking an executive position at Power America in 2016, Dr. Veliadis spent 21 years in the semiconductor industry where his work included design, fabrication, and testing of SiC devices, GaN devices for military radar amplifiers, and financial and operations management of a commercial semiconductor fab. He has a Ph.D. degree in Electrical Engineering from John Hopkins University (1995).

**12:05 – 1:15 PM - Lunch**

**1:15 – 2:45 PM – Reliability in Gallium Nitride Power Devices**

*Instructor: Enrico Zanoni, University of Padova*

**Abstract:** This tutorial will review potential issues affecting the dynamic performance and reliability of GaN power devices. Trap-related effects, leading to dynamic on-resistance increase and threshold voltage instabilities will be extensively discussed, as well as hot-electron effects resulting from soft- and hard-switching. Failure modes and mechanisms of p-GaN gate AlGaIn/GaN HEMTs will be discussed in detail, including time-dependent breakdown effects in dielectrics and within GaN. Models of trapping and detrapping kinetics will be described, followed by a short survey of GaN more advanced structures.

**Enrico Zanoni** is professor of Microelectronics at the Department of Information Engineering of the University of Padova and an IEEE Life Fellow. He graduated in Physics at the University of Modena and Reggio Emilia in 1982. Since 1993 he has been a full professor in Microelectronics at the University of Padova. Together with his group he has been involved in research on the characterization, modeling and reliability of Gallium Nitride electronic and optoelectronic devices since 1999. At the University of Padova he contributed to establish the "Microelectronics" research group, involved in CMOS analog and rf integrated circuit design, CMOS reliability and radiation hardness, compound semiconductor electronic and optoelectronic devices characterization, modeling and reliability. The facilities of the associated laboratory include several systems for the DC, rf and pulsed characterization of GaN HEMTs, current Deep Level Transient Spectroscopy beyond 600 V, accelerated testing in a wide range of environmental conditions, failure analysis using electroluminescence spectroscopy and microscopy techniques, AFM and electron microscopy. Various European research projects at University of Padova deal with the study of reliability and failure physics of RF and power GaN HEMTs, GaN-based photodetectors, LEDs and lasers. Enrico Zanoni published his first paper at the IEEE International Reliability Symposium (on the reliability of multilayer metallizations for bipolar digital integrated circuits) in 1981, and is coauthor of approximately one thousand publications on the modeling and reliability physics of silicon and compound semiconductor devices, and of 4 patents.

**2:45 – 3:00 PM – Coffee Break**

### **3:00 – 4:30 PM – SiC Power Device Reliability**

*Instructor: Brett Hull, Wolfspeed*

**Abstract:** Power devices fabricated from 4H-SiC are quickly supplanting Si-based incumbent technologies in many electrical power conversion technologies. The critical breakdown electric field of SiC is about 10 times that of Si, which creates a variety of opportunities for significant improvement in electrical power conversion systems by implementing SiC power devices. There are a variety of fundamental material properties that influence the functional design of 4H-SiC power devices. In this tutorial, we will walk through a few of the design differences between 4H-SiC Power devices and their Si counterparts for the design space of 600V to 1700V applications and discuss how the unique properties of SiC devices change how we study intrinsic reliability of these devices. We will begin with a discussion of the fundamental properties that provide the performance benefits observed, and we'll discuss how those properties impact standard Power Device Qualification tests such as High Temperature Reverse Bias (HTRB) and High Temperature Gate Bias. We'll also discuss more fundamental reliability aspects, such as accelerated life testing under both drain bias (ALT-HTRB) and under gate bias conditions (time dependent dielectric breakdown, TDDB). Beyond reliability, device ruggedness, in which a device is subjected to common electrical circuit fault conditions, such as a forced device avalanche condition, achieved by unclamped inductive switching (UIS), or a condition in which the device is forced into a high bias/high current condition (a short circuit condition), are also importance considerations, and we will discuss how these ruggedness tests are implemented on SiC Power MOSFETs. Finally, we will discuss constant failure rate failure-in-time (FIT) statistics that derive from the constant bombardment of devices from neutrons that are produced in Earth atmosphere from the constant bombardment of space-derived cosmic rays.

**Brett Hull** received the Bachelor of Science (B.S.) degree in Materials Science and Engineering from the Virginia Polytechnic Institute and State University in 1998, followed by the Doctor of Philosophy (Ph.D.) in Materials from the Pennsylvania State University in 2004. His work in wide bandgap semiconductor materials started during his days in graduate school at Penn State, working on contact metallurgy to p-type Aluminum Gallium Nitride, investigating interfacial reactions and reaction kinetics between various metal thin films and p-type GaN and AlGaN. He joined Wolfspeed (formerly Cree) in 2003 as a research scientist in the Power Device Technology Development Team. In the years since, he has been involved with many facets of technology development, focusing primarily on device fabrication, and determining the links between device design and processing with yield, reliability and ruggedness for unipolar and bipolar diodes and switches that range in voltage blocking class from 600V to beyond 20 kV. He is currently the Director of Technology Development for SiC Power Devices at Wolfspeed.

### **4:30 – 4:45 PM - Adjourn and Feedback**

# BCICTS 2023 PRIMER

## *San Carlos Ballroom 2*

**Date:** Sunday, October 15, 2023

**Time:** 8:00 AM – 12:50 PM

**Topic:** Breaking the Barriers of VCO Design in mm-Wave:  
Overcoming Challenges and Exploring Solutions

**Instructor:** Dr. Waleed Khalil, Ohio State Univ., Columbus,  
USA

**8:00 – 8:45 AM**      **Breakfast**

**8:45 – 8:50 AM**      **Welcome - *Michael Schröter***

**8:50 – 11:00 AM**      **Primer Lecture – P1 - *Waleed Khalil***

**11:00 – 11:10 AM**      **Coffee Break**

**11:10 – 12:40 PM**      **Primer Lecture – P2 - *Waleed Khalil***

**12:40 – 12:50 PM**      **Adjourn and Feedback**

The primer course is an introductory-level course on a selected topic relevant to BCICTS attendees.

### **Abstract:**

The field of mm-Wave VCO design and analysis has seen significant growth with over 18,000 IEEE Xplore published articles describing new architectures, circuits, and analysis techniques, with more than 1500 dedicated to mm-Wave VCOs. However, this abundance of research presents a challenge to designers who must navigate practical limitations and potential trade-offs. This IEEE tutorial aims to provide fundamental knowledge of mm-Wave VCOs on silicon technologies, enumerate key design challenges, and discuss current and emerging techniques for building robust VCOs with enhanced tuning range, phase noise, and power efficiency. The tutorial encourages analytical thinking on various design techniques and challenges while providing new perspectives for addressing them.

**Waleed Khalil** received his BS and MS degrees from the University of Minnesota, and his PhD degree from Arizona State University. He is currently serving as a Professor at the ECE department and the ElectroScience Lab, The Ohio State University. He also serves as Co-Director of the Air Force Center of Excellence for Enabling Cyber Defense in Analog and Mixed Signal Domain (CYAN) and The National MicroElectronics Security Training Center (MEST). Prior to joining OSU in 2009, he spent 16 years at Intel Corporation where he held various positions in wireless and wireline communication groups. His group's research is focused on integrated circuits and systems, with applications in the areas of wireless and wireline communications, hardware security, heterogeneous chip integration, and image sensors. He is the recipient of OSU's College of Engineering Lumley Research Award and IEEE-Eta Kappa Nu/Fred H. Pumphrey's Distinguished Teacher Award. His research group has received several best paper awards in several conferences. He authored 19 issued and several other pending patents, over 120 journal and conference papers and three books/book chapters. He served as the general chair for the 2020 RFIC Symposium and as an Associate Editor for the Journal of Solid State Circuits. He is currently serving as the Editor-in-Chief for the IEEE RFIC Virtual Journal and Associate VP for Publications at the IEEE Solid State Circuits Society.

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# MONDAY

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## INTRODUCTORY REMARKS AND PLENARY

### WELCOME AND ANNOUNCEMENTS

Monday, 9:00 - 9:30 AM

**San Carlos Ballroom 3 & 4**

**Breandán Ó hAinmí, Chair**

### PLENARY 1

Monday 9:30 AM – 10:10 AM

**San Carlos Ballroom 3 & 4**

Session Chair: Breandán Ó hAinmí, *Analog Devices*

Co-chair: Tomislav Suligoj, *University of Zagreb*

### **3D Heterogeneous Integration (3DHI): An Enabler For Next Generation RF Systems**

Thomas Kazior<sup>1</sup>, Sharon Woodruff<sup>2</sup>, Gregory Jones<sup>3</sup>, and  
Iskren Abdomerovic<sup>2</sup>

<sup>1</sup> *DARPA Microsystems Technology Office*

<sup>2</sup> *Booz Allen Hamilton*

<sup>3</sup> *Advanced Research Consultants*

### PLENARY 2

Monday 10:40 AM – 11:20 AM

**San Carlos Ballroom 3 & 4**

Session Chair: Breandán Ó hAinmí, *Analog Devices*

Co-chair: Tomislav Suligoj, *University of Zagreb*

### **Practical Approaches to Industrializing Near-THz Communication Systems**

Shahriar Shahramian, Mustafa Sayginer, Michael Holyoak,  
Mohamed Elkhoully, Mike Zierdt, Jaegeun Ha, Joe Weiner  
and Yves Baeyens

*Nokia – Bell Labs, New Providence, NJ, USA*

### PLENARY 3

Monday 11:20 AM – 12:00 PM

**San Carlos Ballroom 3 & 4**

Session Chair: Breandán Ó hAinmí, *Analog Devices*

Co-chair: Tomislav Suligoj, *University of Zagreb*

### **N-polar GaN: A resurgence of Gallium Nitride**

Umesh Mishra

*University of California - Santa Barbara,*

*Santa Barbara, CA, USA*

## CONFERENCE PROGRAM

### **1a. High Performance Compound Semiconductor Device Technologies**

Monday 2:00 PM – *San Carlos Ballroom 1 & 2*

Session Chair: Ken Chu, *BAE Systems*

Co-Chair: Tim Vasen, *Northrop Grumman*

#### **1a.1 (Invited)**

#### **2:00-2:40 PM – AIscN High Electron Mobility Transistors: Integrating High Piezoelectric, High K Dielectric, and Ferroelectric Functionality**

J. Casamento<sup>1</sup>, K. Nomoto<sup>2</sup>, T. S. Nguyen<sup>1</sup>, H. Lee<sup>2</sup>, C. Savant<sup>1</sup>, L. Li<sup>2</sup>, A. Hickman<sup>2</sup>, T. Maeda<sup>3</sup>, Y. T. Shao<sup>4</sup>, J. Encomendero<sup>2</sup>, V. Gund<sup>2</sup>, H. Xing<sup>1,2,3,4</sup>, and D. Jena<sup>1,2,3</sup>

<sup>1</sup>*Department of Materials Science and Engineering, Cornell University, Ithaca, NY 14853, USA*

<sup>2</sup>*School of Electrical and Computer Engineering, Cornell University, Ithaca, NY 14853, USA*

<sup>3</sup>*Kavli Institute at Cornell for Nanoscale Science, Cornell University, Ithaca, NY 14853, USA*

<sup>2</sup>*School of Applied and Engineering Physics, Cornell University, Ithaca, New York 14853, USA*

#### **1a.2**

#### **2:40-3:00 PM – Millimeter-wave gallium nitride maturation of 40nm T3 gallium nitride monolithic microwave integrated circuit process**

D. Fanning, A. Corrion, G. Siddiqi, S. Nadri, D. Denninghoff, E. Arkun, I. Ramos, H. Moyer, A. Fu, J. Carlson, and S. Bharadwaj

*HRL Laboratories, LLC, Malibu, CA, USA*

#### **1a.3**

#### **3:00-3:20 PM – High Performance 0.25 $\mu\text{m}$ GaN Technology with Low Memory Effects**

B. Grote, B. Green, C. Gaw, Y. Wei, D. Hill, P. Renaud, J. Wan, C. Rampley, D. Burdeaux, K. Foxx, M. Vadipour, D. Currier, C. Zhu, H. Kabir, T. Arnold, H. Stewart, D. Ferguson, J. Higginbottom, and P. Hu

*NXP Semiconductors, Chandler, AZ, USA*

#### **1a.4 (Student)**

#### **3:20-3:40 PM – Multi-Finger 250-nm InP/GaAsSb DHBTs with Record 37.3% Class-A PAE at 94 GHz**

S. Hamzeloui<sup>1</sup>, A. M. Arabhavi<sup>1</sup>, F. Ciabattini<sup>1</sup>, M. Ebrahimi<sup>1</sup>, M. Müller<sup>2</sup>, O. Ostinelli<sup>1</sup>, M. Schröter<sup>2</sup>, and C. R. Bolognesi<sup>1</sup>

<sup>1</sup>*Millimeter-Wave Electronics (MWE) Group, ETH Zürich, Switzerland*

<sup>2</sup>*Chair for Electron Devices and Integrated Circuits (CEDIC), TU Dresden, Germany*

### **1b. High Frequency Control Circuits**

Monday 2:00 PM - *San Carlos Ballroom 3 & 4*

Session Chair: Kazuya Yamamoto, *Mitsubishi Electric Corp.*

Co-Chair: Frank van Vliet, *TNO*

#### **1b.1 (Student)**

#### **2:00-2:20 PM – Wideband Switched-Capacitor and Switched-Transmission-line Circulators in 40nm GaN Technology: Design and Device Modeling**

Hari Vemuri, Armagan Dascurcu, Kexin Li, Harish Krishnaswamy

*Department of Electrical Engineering Columbia University, NY, NY USA*

## **1b.2**

### **2:20-2:40 PM – Gen1 Active Tunable SiGe Integrated Parallel Synthesis Filters (PSF) without Q-enhancement**

Farooq Amin<sup>1</sup>, Shuai Zhou<sup>2</sup>, Long Huang<sup>2</sup>, Christopher Latorre<sup>2</sup>, Folu Popoola<sup>2</sup>, and Parrish Ralston<sup>2</sup>

<sup>1</sup> Northrop Grumman Mission Systems, Morrisville, NC, USA

<sup>2</sup> Northrop Grumman Mission Systems, Baltimore, MD, USA

## **1b.3 (Student)**

### **2:40-3:00 PM – Demonstration of a Ku-Band N-Path Downconverter in GaN-on-SiC**

Damla Dimlioglu, Alyosha C. Molnar  
Cornell University, Ithaca, NY, USA

## **1b.4 (Student)**

### **3:00-3:20 PM – A Ka-Band VCO Chip with Integrated Dividers Using 1.5 V Supply in 130-nm SiGe BiCMOS Technology for Low-Power Radar Sensors**

Batuhan Sutbas<sup>1,2</sup>, Mohamed H. Eissa<sup>1</sup>, Gerhard Kahmen<sup>2</sup>

<sup>1</sup> IHP – Leibniz-Institut für innovative Mikroelektronik, Frankfurt (Oder), Germany

<sup>2</sup> Brandenburg University of Technology, Cottbus, Germany

## **1b.5 (Student)**

### **3:20-3:40 PM – A High Linearity SiGe D-Band Diode Ring Mixer**

Olga Krylova<sup>1</sup>, Jan Schopf<sup>1</sup>, Klaus Aufinger<sup>2</sup>, Nils Pohl<sup>1,3</sup>

<sup>1</sup> Ruhr-University Bochum, Universitätsstr. 150, D-44801 Bochum, Germany

<sup>2</sup> Infineon Technologies AG, Am Campeon 1-15, D-85579 Neubiberg, Germany

<sup>3</sup> Fraunhofer FHR, Fraunhoferstr. 20, D-53343 Wachtberg, Germany

## **2a. Si Process Technology**

Monday 4:10 PM - **San Carlos Ballroom 1 & 2**

Session Chair: Jay John, *NXP Semiconductors*

Co-Chair: Stan Phillips, *Tower Semiconductor*

## **2a.1 (Invited)**

### **4:10 - 4:50 PM – Monolithic Silicon Photonics**

T. Letavic, Massimo Sorbara, Ken Geiwont, Yusheng Bian, Vihbor Jain, Sameer Jain, Koushik Ramachandran, Zhuo-Jie Wu, Brittany Hedrick, Kevin K. Dezfulian, Thomas Houghton, Daniel Fisher, Takako Hirokawa, Monica Esopi, Vaishnavi Karra, Won Suk Lee, Jorge Lubguban, Jae Kyu Cho, Rongtao Cao, Hanyi Ding, Sujith Chandran, Michal Rakowski, Abdelsalam Aboketaf, Subramanian

Krishnamurthy, Scott Mills, Norman Robson, Ian Melville, Robert Fox, Vikas Gupta and Anthony Yu

*GlobalFoundries, Malta, NY, USA*

## **2a.2 (Invited)**

### **4:50 - 5:30 PM – High Volume Wafer Fab Equipment for RF Technologies**

Michael Peters, David A. Britz, Miao-Chun Chen, Manish Hemkar and Andy Lo

*Applied Materials, Santa Clara, CA*

## **2b. Analog Circuits**

Monday 4:10 PM - **San Carlos Ballroom 3 & 4**

Session Chair: Sri Navaneeth Easwaran, *Texas Instruments*

Co-Chair: Hanh-Phuc Le, *University of California San Diego*

### **2b.1 (Invited)**

#### **4:10 - 4:50 PM – Vertical Power Delivery and Heterogeneous Integration for High-Performance Computing**

Hanh-Phuc Le<sup>1</sup>, Casey Hardy<sup>1</sup>, Hieu Pham<sup>1</sup>, Mohamed Mehdi Jatlaoui<sup>2</sup>, Frederic Voiron<sup>2</sup>, Patrick Mercier<sup>1</sup>, Po-Han Chen<sup>1</sup>, and Saket Jha<sup>1</sup>

<sup>1</sup> *University of California, San Diego, CA, USA*

<sup>2</sup> *Murata, Caen, France*

### **2b.2 (Student)**

#### **4:50 - 5:10 PM A 12 Bit R-2R Digital-to-Analog Converter for Shuttling Operation in a Trapped-Ion Quantum Computer**

Alexander Meyer<sup>1</sup>, Peter Toth<sup>1</sup>, Axel Engelhardt<sup>1</sup>, Jens Repp<sup>2</sup>, Matthias Brandl<sup>2</sup>, and Vadim Issakov<sup>1</sup>

<sup>1</sup> *Institute for CMOS Design, TU Braunschweig, Braunschweig, Germany*

<sup>2</sup> *Infineon Technologies AG, Neubiberg, Germany*

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## **TUESDAY**

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## **3a. Advances in GaAs and InP HBT Modeling**

Tuesday 8:30 AM - **San Carlos Ballroom 1 & 2**

Session Chair: Masaya Iwamoto, *Keysight Technologies*

Co-Chair: Kaiman Chan, *Texas Instruments*

### **3a.1 (Invited)**

#### **8:30-9:10 AM – Practical and Efficient Approaches to Device Modeling and Power Amplifier Module Design**

Hans Rohdin, Bart Jansen, William Snodgrass, J. Stephen Kofol, Sonja Nedeljkovic, Ziad El Chami, Will Sutton and Tom Dungan

*Wireless Semiconductor Division, Broadcom Inc.*

### **3a.2**

#### **9:10-9:30 AM – A Novel Base Resistance Model Incorporating Base Distributive Effects along with Emitter Length**

Bin Li, Andre G. Metzger, Cristian Cismaru

*ATG Group, Skyworks Solutions*

### **3a.3 (Student)**

#### **9:30-9:50 AM – Physics-Based Compact Modeling of the Transfer Current in III-V DHBTs with the Generalized Integral Charge Control Relation**

Markus Müller<sup>1</sup>, Mario Krattenmacher<sup>1</sup>, Hendrik Leenders<sup>2</sup>, Sara Hamzeloui<sup>3</sup>, Colombo Bolognesi<sup>3</sup>, Christoph Jungemann<sup>2</sup> and Michael Schröter<sup>1</sup>

<sup>1</sup> *Chair for Electron Devices and Integrated Circuits (CEDIC), TU Dresden, 01062 Germany*

<sup>2</sup> *Chair of Electromagnetic Theory, RWTH Aachen University, 52072 Aachen, Germany*

<sup>3</sup> *Laboratory for Millimeter-Wave Electronics, ETH Zürich, 8092 Zürich, Switzerland*



### **3a.4 (Student)**

#### **9:50-10:10 AM – Thermal Characterization of InP / GaAsSb DHBTs: Effect of Emitter and Collector Layers**

F. Ciabattini, A. M. Arabhavi, S. Hamzeloui, M. Ebrahimi, O. Ostinelli and C. R. Bolognesi  
*Millimeter-Wave Electronics (MWE) Group, ETH-Zürich, Gloriastrasse 35, 8092 Zürich, Switzerland*

## **3b. GaN Power Amplifiers**

Tuesday 8:30 AM **San Carlos Ballroom 3 & 4**

Session Chair: Jim Carroll, *AmpliTech*

Co-Chair: Shuoqi Chen, *Qorvo*

### **3b.1**

#### **8:30-8:50 AM – A 4-18 GHz, 35W GaN MMIC Power Amplifier with Improved Thermal Performance**

Michael Litchfield, Andrew Kingswood

*BAE Systems – Microelectronics, Nashua, NH, USA*

### **3b.2 (Invited, Student)**

#### **8:50-9:30 AM – Transient Field-Plate Thermometry in Cascode FET Power Amplifiers**

David J. Niven, Simon J. Mahon, Andrew J. Jones, Melissa C. Gorman

*Macquarie University, NSW 2109, Australia*

### **3b.3 (Student)**

#### **9:30-9:50 AM – A 33 dBm, >30% PAE GaN Power Amplifier Based on a Sub-Quarter-Wavelength Balun for 5G Applications**

Dongyang Yan<sup>1,2</sup>, Yang Zhang<sup>1</sup>, Dries Peumans<sup>1,3</sup>, Mark Ingels<sup>1</sup>, Piet Wambacq<sup>1,2</sup>

<sup>1</sup> *IMEC, Belgium*

<sup>2</sup> *Dept. of Electronics and Informatics, Vrije Universiteit Brussel, Brussels, Belgium*

<sup>3</sup> *Dept. ELEC, Vrije Universiteit Brussel, Brussels, Belgium*

### **3b.4**

#### **9:50-10:10 AM – Fully Qualified Gallium Nitride Power Amplifier For Use In Ka-Band Commercial Satellite Applications**

Simon Mok, Norman Chiang, Vivian Law, James J. Sowers  
*Maxar Space Infrastructure, 3825 Fabian Way, Palo Alto, CA.*

## **4a. Reliability Physics of SiGe HBTs**

Tuesday 10:30 AM - **San Carlos Ballroom 1 & 2**

Session Chair: Jonggook Kim, *Texas Instruments*

Co-Chair: Martin Claus, *Infineon Technologies*

### **4a.1 (Student)**

#### **10:30-10:50 AM – Numerical Device Simulation Aided Study of RF-Stress-Caused Degradation in SiGe HBTs**

Christoph Weimer, Viktor Kazantsev, Markus Müller, and Michael Schröter

*Chair for Electron Devices and Integrated Circuits,*

*Technische Universität Dresden, 01062 Dresden, Germany*

#### **4a.2 (Student)**

### **10:50-11:10 AM – The Effects of Carbon Doping on the Performance and Electrical Reliability of SiGe HBTs**

Harrison P. Lee<sup>1</sup>, Nelson E. Sepulveda-Ramos<sup>1</sup>, Jeffrey W. Teng<sup>1</sup>, Jackson P. Moody<sup>1</sup>, Delgermaa Nergui<sup>1</sup>, Brett L. Ringel<sup>1</sup>, Zachary R. Brumbach<sup>1</sup>, Alizeh Premani<sup>1</sup>, Uppili S. Raghunathan<sup>2</sup>, Vibhor Jain<sup>3</sup>, and John D. Cressler<sup>1</sup>

<sup>1</sup> School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, GA 30332-0250 USA

<sup>2</sup> GlobalFoundries, Essex Junction, VT 05452 USA

<sup>3</sup> GlobalFoundries, Malta, NY 12020 USA

#### **4a.3**

### **11:10-11:30 AM – Electrostatic Discharge Stress effects on the Performance and Reliability of High Performance NPN SiGe HBTs**

Dimitris P. Ioannou, Ephrem Gebreselasie, Vinh Pham, Uppili S. Raghunathan

GlobalFoundries, USA

## **4b. High-Performance Circuits for Optical Communications - 1**

Tuesday 10:30 AM - **San Carlos Ballroom 3 & 4**

Session Chair: Mahdi Parvizi, Cisco Systems

Co-Chair: Munehiko Nagatani, NTT Corporation

#### **4b.1 (Invited)**

### **10:30-11:10 PM – High-Speed SiGe BiCMOS Circuits for Optical Communication**

Guy Torfs, Bart Moeneclaey, Joris Lambrecht, Cedric, Bruynsteen, Jakob Declercq, Shengpu Niu, Nishant Singh, Marijn Verbeke, Xin Yin, Peter Ossieur, Johan Bauwelinck  
IDLab, Dept. of Information Technology,  
Ghent University – Imec, Belgium

#### **4b.2**

### **11:10-11:30 AM – 100 GBaud DSP-free PAM-4 optical signal generation using an InP-DHBT AMUX-driver and a Thin-Film Lithium Niobate Modulator Assembly**

R. Hersent<sup>1,2</sup>, F. Jorge<sup>1,2</sup>, F. Blache<sup>1,2</sup>, B. Duval<sup>1,2</sup>, M. Goix<sup>1,2</sup>, H. Mardoyan<sup>1</sup>, S. Almonacil<sup>1</sup>, M. Xu<sup>3</sup>, Y. Zhu<sup>3</sup>, L. Chen<sup>3</sup>, Z. Hu<sup>3</sup>, J. Renaudier<sup>1</sup>, M. Riet<sup>1,2</sup>, A. Konczykowska<sup>1,4</sup>, B. Ardouin<sup>1,2</sup>

<sup>1</sup> III-V Lab, a joint laboratory between Nokia Bell Labs, Thales Research and Technology and CEA Leti, Palaiseau, France

<sup>2</sup> Nokia Bell Labs France, Massy, 91300, France,

<sup>3</sup> Liobate Semiconductor Technology, Guangzhou, China,

<sup>4</sup> ADesign, l'Hay les Roses, France

## **5a. Super-cool SiGe HBTs**

Tuesday 11:30 AM - **San Carlos Ballroom 1 & 2**

Session Chair: Guanghai Ding, Analog Devices

Co-Chair: Kai Kwok, Skyworks

#### **5a.1 (Invited)**

### **11:30-12:10 PM – The SiGe HBT at Cryogenic Temperatures**

John D Cressler

School of Electrical and Computer Engineering, Georgia Tech, Atlanta, GA 30308 USA

#### **5a.2 (Student)**

### **12:10-12:30 PM – The Impact of BEOL Stress on SiGe HBTs at Cryogenic Temperatures**

Jackson P. Moody, Jeffrey W. Teng, and John D. Cressler  
School of Electrical and Computer Engineering, Georgia Tech  
777 Atlantic Drive N.W., Atlanta, GA 30332-0250 USA

## **5b. High-Performance Circuits for Optical Communications - 2**

Tuesday 11:30 AM - **San Carlos Ballroom 3 & 4**

Session Chair: Koichi Murata, *Renesas Electronics America*

Co-Chair: Yuri Greshishchev, *Ciena Corporation*

### **5b.1**

#### **11:30-11:50 AM – A 19-dB Peaking at 72-GHz and 4.1-Vppd Output Swing SiGe BiCMOS Linear Driver with Dynamic Cascode Output Buffer**

Hiroshi Uemura, Taichi Misawa, Naoki Itabashi, Munetaka Kurokawa, Yoshiyuki Sugimoto, Seiji Kumagai, Masaru Takechi, and Keiji Tanaka

*Transmission Devices Laboratories, Sumitomo Electric Industries, Ltd., Yokohama, Japan*

### **5b.2**

#### **11:50-12:10 PM Design Trade-offs between Series-Peaking Inductor and High $f_T$ SiGe HBTs in Transimpedance Amplifiers**

Prateek Kumar Sharma<sup>1</sup>, Vaibhav Ruparelia<sup>1</sup>, Saurabh Sirohi<sup>2</sup>, Uppili S. Raghunathan<sup>2</sup>, Venkata Vanukuru<sup>1</sup>, Vibhor Jain<sup>2</sup>

<sup>1</sup> *GlobalFoundries, India*

<sup>2</sup> *GlobalFoundries, USA*

### **5b.3**

#### **12:10-12:30 PM A Shunt-Feedback TIA with Common-Base Variable Gain Input Stage for 128-GBaud Coherent Communication**

Seiji Kumagai, Yoshiyuki Sugimoto, Hiroshi Uemura, Munetaka Kurokawa, Naoki Itabashi, Masaru Takechi, Takuya Okimoto, and Keiji Tanaka

*Transmission Devices Laboratory, Sumitomo Electric Industries, LTD.*

## **6a. Bipolars Running Hot & Cold**

Tuesday 2:00 PM - **San Carlos Ballroom 1 & 2**

Session Chair: Michael Schröter, *TU Dresden*

Co-Chair: Nicolas Derrier, *ST Microelectronics*

### **6a.1 (Invited)**

#### **2:00 - 2:40 PM – A Circuit Designer's Perspective on Transistor Modelling Challenges for 6G, Fiberoptics, and Quantum Computing ICs.**

S. P. Voinigescu, S. Bonen, S. Pati Tripathi, G. Cooke, T. Jager, and A. Bharadwaj

*ECE Department, University of Toronto*

### **6a.2**

#### **2:40 - 3:00 PM – Simulation of DC Safe Operating Area and RF Breakdown in SiGe PA HBT**

Beng Woon Lim<sup>1</sup>, Ajay Raman<sup>2</sup> and Saurabh Sirohi<sup>2</sup>

<sup>1</sup> *GLOBALFOUNDRIES, Malta, NY 12020 USA*

<sup>2</sup> *GLOBALFOUNDRIES, Essex Junction, VT 05452 USA*

### **6a.3 (Invited)**

#### **3:00 - 3:40 PM – Electro-Thermal Investigation of SiGe HBTs: A Review**

Thomas Zimmer<sup>1</sup>, Sébastien Fregonese<sup>1</sup>, Anjan Chakravorty<sup>2</sup>

<sup>1</sup> *IMS Laboratory, CNRS, University of Bordeaux, 33400 Talence Cedex, France*

<sup>2</sup> *IIT Madras, Chennai 600036, India*

## **6b. Millimeter Wave Circuits**

Tuesday 2:00 PM - **San Carlos Ballroom 3 & 4**

Session Chair: Greg Flewelling, *BAE Systems*

Co-Chair: Kevin Kobayashi, *Qorvo*

### **6b.1 (Invited)**

#### **2:00-2:30 PM – Advanced mHEMT Technologies for Use in Radar, Communication and Meteorological Applications**

Axel Tessmann<sup>1</sup>, Arnulf Leuther<sup>1</sup>, Fabian Thome<sup>1</sup>, Laurenz John<sup>1</sup>, Bersant Gashi<sup>1</sup>, Hermann Massler<sup>1</sup>, Alexander Saam<sup>2</sup>, and Sebastien Chartier<sup>1</sup>

<sup>1</sup> *Fraunhofer Institute for Applied Solid State Physics IAF, Tullastr. 72, 79108 Freiburg, Germany*

<sup>2</sup> *Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR, 53343 Wachtberg, Germany*

### **6b.2 (Student)**

#### **2:30-2:50 PM – A Wideband Ultra-Low Noise 15-55 GHz Dual-Beam Receive Phased-Array Beamformer with 2.9-4.2 dB NF**

Omar Hassan, Mir Mahmud, Abdulrahman Alhamed, Gabriel M. Rebeiz

*University of California San Diego, La Jolla, CA, USA*

### **6b.3 (Student)**

#### **2:50-3:10 PM – 46-102 GHz GaN Balanced Cascode Amplifier-Isolator**

Anthony Romano, Timothy Sonnenberg, Zoya Popovic  
*Department of Electrical Engineering, University of Colorado Boulder, Boulder, CO, USA*

### **6b.4**

#### **3:10-3:30 PM – GaN/Si 37-40 GHz T/R Chip MMIC for 5G Communications**

M. El Kaamouchi, A. Gasmi, J. Poulin, P. Altuntas, B. Wroblewsky, R. Leblanc

*MACOM Technology Solutions France, 2 rue du Moulin, 94453 Limeil-Brévannes, France*

## **7a. FETs and Features**

Tuesday 4:00 PM - **San Carlos Ballroom 1 & 2**

Session Chair: Pete Zampardi, *Qorvo*

Co-Chair: Saurabh Sirohi, *GlobalFoundries*

### **7a.1 (Invited)**

#### **4:00-4:40 PM – Cryogenic Modeling for Open-Source Process Design Kit Technology**

Akin Akturk<sup>1</sup>, Ayushman Tripathi<sup>2</sup>, Mehdi Saligane<sup>2</sup>

<sup>1</sup> *CoolCAD Electronics, LLC, 5000 College Ave., Ste. 2105, College Park, MD, 20740 USA*

<sup>2</sup> *University of Michigan, 1301 Beal Ave., Ann Arbor, MI, 48109 USA*

### **7a.2**

#### **4:40-5:00 PM – A Physically-Based Matching Model for HiSIM\_HV**

Rachid Hamani, J. R. O. R. Martins, Hagen Wald, Joerg Gessner and Michaelina Ong Ing Ing

*X-FAB Semiconductor Foundries*

### **7a.3**

#### **5:00-5:20 PM – Flipchip Characterization for RF SOI Switch Model Improvement**

Kathleen Muhonen, Jayashree Jayabalan and Scott Parker  
*Qorvo, Inc, Modeling and Characterization, 8220 Piedmont Triad Parkway, Greensboro, NC, 27409 USA*

## **7b. mmW Mixers and Multipliers**

Tuesday 4:00 PM - *San Carlos Ballroom 3 & 4*

Session Chair: Harris Moyer, *HRL Laboratories*

Co-Chair: Kazuya Yamamoto, *Mitsubishi Electric Corporation*

### **7b.1**

#### **4:00-4:20 PM – A D-band Sub-harmonically pumped Mixer with High LO Suppression using 250-nm InP DHBT P-N Junction**

Shinji Hachiyama, Koki Tanji, Toshihide Kuwabara, Naoki Oshima, Kazuaki Kunihiro and Tomoya Kaneko  
*NEC Corporation, Kawasaki 211-8666, Japan*

### **7b.2 (Student)**

#### **4:20-4:40 PM – 120 GHz GaAs Single Balanced Mixer**

Nethini Weerathunge, Simon J. Mahon, Gerry McCulloch and Sudipta Chakraborty

*School of Engineering, Macquarie University, Australia*

### **7b.3 (Student)**

#### **4:40-5:00 PM – A 377-416 GHz Push-Push Frequency Doubler with Driving Stage and Transformer-Based Mode Separation in SiGe BiCMOS**

Justin Romstadt<sup>1</sup>, Tobias Welling<sup>1</sup>, Florian Vogelsang<sup>1</sup>, Muhammed Ali Yildirim<sup>1</sup>, Klaus Aufinger<sup>2</sup>, Nils Pohl<sup>1,3</sup>

<sup>1</sup> *Ruhr-University Bochum, Universitätsstr. 150, D-44801 Bochum, Germany*

<sup>2</sup> *Infineon Technologies AG, Am Campeon 1-15, D-85579 Neubiberg, Germany*

<sup>3</sup> *Fraunhofer FHR, Fraunhofer Str. 20, D-5334 Wachtberg, Germany*

### **7b.4 (Student)**

#### **5:00-5:20 PM – A 61-187.2-GHz Traveling Wave Push-Push Frequency Doubler With 101.7% Relative Bandwidth**

Melika Dedovic<sup>1</sup>, Florian Vogelsang<sup>1</sup>, Hakan Papurcu<sup>1</sup>, Klaus Aufinger<sup>2</sup>, Nils Pohl<sup>1,3</sup>

<sup>1</sup> *Ruhr-University Bochum, Universitätsstr. 150 D-44801 Bochum, Germany*

<sup>2</sup> *Infineon Technologies AG, Am Campeon 1-12, D-85579 Neubiberg, Germany*

<sup>3</sup> *Fraunhofer FHR, Fraunhofer Str. 20, D-53343 Wachtberg, Germany*

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## **WEDNESDAY**

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## **8a. Wide-bandgap Device Modeling**

Wednesday 8:00 AM - *San Carlos Ballroom 1 & 2*

Session Chair: Subrata Halder, *Qorvo*

Co-Chair: Masaya Iwamoto, *Keysight Technologies*

### **8a.1**

#### **8:00-8:20 AM - GaN and GaAs HEMT Channel Charge Model for Nonlinear Microwave and RF Applications**

Anthony E. Parker and Simon J. Mahon  
*Macquarie–Analog Devices Research Laboratory, Macquarie University Sydney, Australia*

### 8a.2

#### **8:20-8:40 AM - Optimization of GaN HEMTs with ScAlN Barrier for High 2DEG Density and Low On-Resistance**

Ivan Berdalovic, Mirko Poljak and Tomislav Suligoj  
*Faculty of Electrical Engineering and Computing,  
University of Zagreb, 10000 Zagreb, Croatia*

### 8a.3

#### **8:40-9:00 AM - Modeling of Snappy, and Soft Reverse Recovery of SiC MOSFET's Body Diode**

Arman Ur Rashid, Britt Brooks, Steven Manz and Daniel J. Litchenwalner  
*Power Research and Development, Wolfspeed Inc.*

### 8a.4 (Invited)

#### **9:00-9:40 AM – Modeling and Simulation of Discrete Silicon Carbide Integrated Passive Devices in High-Power RF Amplifiers**

Marvin Marbell, Yueying Liu, Michelle Tran, Haedong Jang, Mehdi Hasan, Dan Etter, Dan Namishia, Dan Stasiw, Jeremy Fisher, Scott Sheppard and Basim Noori  
*RF Design Technology, Wolfspeed*

## **8b. Transceiver and Beamforming Techniques**

Wednesday 8:00 AM - **San Carlos Ballroom 3 & 4**

Session Chair: Frank van Vliet, *TNO*

Co-Chair: Mustafa Sayginer, *Nokia*

### 8b.1 (Invited)

#### **8:00-8:40 AM – Comparative Performance of 100-200 GHz Wideband Transceivers: CMOS vs Compound Semiconductors**

Ethan Chou<sup>1</sup>, Hesham Beshary<sup>1</sup>, Meng Wei<sup>1</sup>, Rami Hijab<sup>1</sup>, Farhana Sheikh<sup>2</sup>, Steven Callender<sup>2</sup> and Ali M. Niknejad<sup>2</sup>  
<sup>1</sup> *Department of Electrical Engineering and Computer Sciences (EECS), University of California at Berkeley, USA*  
<sup>2</sup> *Intel Corporation, Hillsboro, Oregon, USA*

### 8b.2

#### **8:40-9:00 AM – Multi-Channel PA, LNA, and Switch MMICs for Beam-Switching Applications at 160 GHz, Based on an InGaAs mHEMT Technology**

Laurenz John<sup>1</sup>, Thomas Merkle<sup>1</sup>, Arnulf Leuther<sup>1</sup>, and Jaehoon Chung<sup>2</sup>  
<sup>1</sup> *Fraunhofer Institute for Applied Solid State Physics IAF, Germany*  
<sup>2</sup> *Communication & Media Standard Lab., CTO Division, LG Electronics, Inc., South Korea*

### 8b.3 (Student)

#### **9:00-9:20 AM – A 202 GHz Link Using Planar Transceiver Modules**

Utku Soylu<sup>1</sup>, Amirreza Alizadeh<sup>1</sup>, Munkyo Seo<sup>2</sup>, Ahmed S. H. Ahmed<sup>1</sup> and Mark J. W. Rodwell<sup>1</sup>  
<sup>1</sup> *Department of Electrical and Computer Engineering, University of California, Santa Barbara, USA*  
<sup>2</sup> *Department of Electrical and Computer Engineering, Sungkyunkwan University, South Korea*

### **8b.4 (Student)**

#### **9:20-9:40 AM – Single-Ended Resistive Down-Converter MMICs in InGaAs mHEMT and GaN-HEMT Technologies for D-Band (110-170 GHz) Applications**

Cristina Maurette-Blasini<sup>1</sup>, Rainer Weber<sup>2</sup>, Sandrine Wagner<sup>2</sup>, Dirk Schwantuschke<sup>2</sup>, Sébastien Chartier<sup>2</sup>

<sup>1</sup> *Institute for Sustainable Systems Engineering, University of Freiburg, Germany*

<sup>2</sup> *Fraunhofer Institute of Applied-Solid-State Physics, Germany*

## **9a. High Frequency Technology and Calibration**

Wednesday 10:10 AM – **San Carlos Ballroom 1 & 2**

Session Chair: Marcus Pan, SRC

Co-Chair: Alex Margomenos, *Infineon Technologies*

### **9a.1 (Invited)**

#### **10:10-10:50 AM – Adaptable 40 nm GaN T-gate MMIC Processes for Millimeter-wave Applications**

D. Denninghoff<sup>1</sup>, E. Arkun<sup>1</sup>, J.-S. Moon<sup>1</sup>, J. Tai<sup>1</sup>, H. Tran<sup>1</sup>, A. Corrion<sup>1</sup>, G. Siddiqi<sup>1</sup>, D. Fanning<sup>1</sup>, M. Fireman<sup>1</sup>, J. Wong<sup>1</sup>, B. Grabar<sup>1</sup>, C. Dao<sup>1</sup>, I. Milosavljevic<sup>1</sup>, R. Tran<sup>1</sup>, A. Getter<sup>1</sup>, A. Clapper<sup>1</sup>, S. Dadafshar<sup>1</sup>, J. Georgieva<sup>1</sup>, H. Moyer<sup>1</sup>, N. Miller<sup>2</sup>, M. Elliott<sup>2</sup>, R. Gilbert<sup>2</sup>

<sup>1</sup> *HRL Laboratories, LLC, 3011 Malibu Canyon Road, Malibu, CA, USA*

<sup>2</sup> *Air Force Research Laboratory*

*Sensors Directorate, Wright-Patterson AFB, OH, USA*

### **9a.2 (Invited)**

#### **10:50-11:30 AM – On Extracting the Maximum Power Density at High Frequencies from Gallium Nitride and Related Materials**

Mohamadali Malakoutian<sup>1</sup>, and Srabanti Chowdhury<sup>1,2</sup>

<sup>1</sup> *Department of Electrical Engineering, Stanford University, Stanford, CA, USA*

<sup>2</sup> *Department of Materials Science and Engineering, Stanford University, Stanford, CA*

### **9a.3 (Student)**

#### **11:30-11:50 AM – Microstrip and Grounded CPW Calibration Kit Comparison for On-Wafer Transistor Characterization from 220 GHz to 325 GHz**

Rob D. Jones<sup>1,2</sup>, Jerome Cheron<sup>1,3</sup>, Bryan T. Bosworth<sup>1</sup>, Benjamin F. Jamroz<sup>1</sup>, Dylan F. Williams<sup>1</sup>, Miguel E.

Urteaga<sup>4</sup>, Ari D. Feldman<sup>1</sup>, and Peter H. Aaen<sup>2</sup>

<sup>1</sup> *Institute of Standards and Technology (NIST), Boulder, CO, USA*

<sup>2</sup> *Colorado School of Mines, Golden, CO, USA*

<sup>3</sup> *Department of Physics, University of Colorado, Boulder CO, USA*

<sup>4</sup> *Teledyne Scientific Company, Thousand Oaks, CA, USA*

## **9b. HBT Circuits up to 1 THz**

Wednesday 10:10 AM - **San Carlos Ballroom 3 & 4**

Session Chair: Nils Pohl, *Ruhr-University Bochum*

Co-Chair: Vadim Issakov, *TU Braunschweig*

### **9b.1 (Invited)**

#### **10:10 - 10:50 AM – Analog/mmWave Circuit Demonstrations in State-of-the-art SiGe BiCMOS Process for 5G and Optical Transceivers**

Venkata Vanukuru, Hari Kakara, Santosh Gedela, Vaibhav Ruparelia, and Prateek Kumar Sharma

*GlobalFoundries, Bangalore, India*

## 9b.2

### **10:50 - 11:10 AM – D-Band Power Amplifier with 27dBm Peak Output Power and 14.9% PAE in 250-nm InP HBT Technology**

Amirreza Alizadeh<sup>1</sup>, Utku Soylu<sup>1</sup>, Navneet Sharma<sup>2</sup>, Gary Xu<sup>2</sup>, and Mark J. W. Rodwell<sup>1</sup>

<sup>1</sup> *University of California, Santa Barbara, USA*

<sup>2</sup> *Samsung Research America, Plano, TX, USA*

## 9b.3 (Student)

### **11:10 - 11:30 AM – A Compact 0.98 THz Source With On-Chip Antenna in 250-nm InP DHBT**

Senne Gielen<sup>1,2</sup>, Yang Zhang<sup>1</sup>, Mark Ingels<sup>1</sup> and Patrick Reynaert<sup>2</sup>

<sup>1</sup> *IMEC, Belgium*

<sup>2</sup> *MICAS, DU Leuven, Belgium*

## **10a. Late News 1**

Wednesday 1:30 PM – 3:10 PM **San Carlos Ballroom 1 & 2**

Session Chair: Breandán Ó hAinle, *Analog Devices*

Co-chair: Robert Howell, *Northrop Grumman*

## 10a.1

### **1:30-1:50 PM – A 15-24 GHz, 15W Reactively Matched GaN MMIC Power Amplifier**

Michael Litchfield

*BAE Systems – ES Microelectronics, Nashua, NH, USA*

## 10a.2 (Student)

### **1:50-2:10 PM – An 18.6-dBm, 8-way-combined D-band Power Amplifier with 21.6% PAE in 22-nm FD-SOI CMOS**

Jeff Shih-Chieh Chien, Eythan Lam and James Buckwalter

*University of California, Santa Barbara, CA, USA*

## 10a.3 (Student)

### **2:10-2:30 PM – A 12-162 GHz Distributed Amplifier in a 45-nm BiCMOS SOI Process Achieving 2.67 THz Gain-Bandwidth Using an Active Bias Termination**

Justin Kim<sup>1</sup>, Wonho Lee<sup>2</sup> and James Buckwalter<sup>1</sup>

<sup>1</sup> *University of California, Santa Barbara, CA, USA*

<sup>2</sup> *PRL PCR, Intel Labs, Hillsboro, OR, USA*

## 10a.4

### **2:30-2:50 PM – Low-noise Si/SiGe HBT for LEO satellite user terminals in Ku-Ka bands**

A. Gauthier<sup>1</sup>, E. Brezza<sup>1</sup>, A. Montagné<sup>1</sup>, N. Guitard<sup>1</sup>, J. Azevedo Goncalves<sup>1</sup>, M. Buczek<sup>1</sup>, S. Jan<sup>1</sup>, N. Derrier<sup>1</sup>, D. Céli<sup>1</sup>, C. Deglise-Favre<sup>1</sup>, J. Ma<sup>1</sup>, H. Audouin<sup>1</sup>, F. Deprat<sup>1</sup>, D. Ristoiu<sup>1</sup>, L. Berthier<sup>1</sup>, L. Clément<sup>1</sup>, B. Grelaud<sup>1</sup>, C. Rougier<sup>2</sup> and P. Chevalier<sup>1</sup>

<sup>1</sup> *STMicroelectronics, 850 rue Jean Monnet, 38926 Crolles Cedex, France*

<sup>2</sup> *STMicroelectronics, iXcampus, 34 rue de la Croix de Fer, 78100 Saint-Germain-en-Laye, France*

## 10a.5

### **2:50-3:10 PM – D-band 4-ch Antenna-on-Chip Phased-Array TX Front-End**

Toshihide Kuwabara, Naoki Oshima, Koki Tanji, Noriaki Tawa, Shinji Hachiyama and Tomoya Kaneko

*NEC Corporation, Japan*



## **10b. Late News 2**

Wednesday 1:30 PM – 3:10 PM **San Carlos Ballroom 3 & 4**

Session Chair: Jay John, *NXP Semiconductors*

Co-Chair: Doug Weiser, *Texas Instruments*

### **10b.1**

#### **1:30-1:50 PM – A DC-to-150-GHz InP-DHBT Active Combiner Module for Ultra-Broadband Signal Generation**

Teruo Jyo, Munehiko Nagatani, Miwa Mutoh, Yuta Shiratori, Hitoshi Wakita and Hiroyuki Takahashi

*NTT Device Technology Labs, NTT Corporation*

### **10b.2**

#### **1:50-2:10 PM – Quad-channel 100-GHz-bandwidth InP-HBT-based Linear Amplifier Module for High Symbol Rate Communications**

Hitoshi Wakita, Teruo Jyo, Munehiko Nagatani and Hiroyuki Takahashi

*NTT Device Technology Labs, NTT Corporation*

### **10b.3 (Student)**

#### **2:10-2:30 PM – An 80-GBaud PAM-4 Gm-Boosted Variable-Gain TIA in 22-nm FDSOI**

Jianan Zhao and Sorin P. Voinigescu

*Edward S. Rogers Sr. Department of Electrical and Computer Engineering, University of Toronto*

### **10b.4**

#### **2:30-2:50 PM – Low Phase Noise and Low Power Consumption Magnetic Cross-Coupled Push-Push VCO in SiGe BiCMOS Technology**

Shuvadip Ghosh<sup>1</sup>, Hao Li<sup>1</sup> and Nils Pohl<sup>2</sup>

<sup>1</sup> *Infineon Technologies AG, Neubiberg, Germany*

<sup>2</sup> *Ruhr-University Bochum, Germany*

### **10b.5**

#### **2:50-3:10 PM – A 28-Gb/s 27.2 mW NRZ Full-Rate Bang-Bang Clock and Data Recovery in 22 nm FD-SOI CMOS Technology**

Mohammed Iftekhar, Harshan Nagaraju, Pascal Kneuper, Babak Sadiye, Wolfgang Muller and J. Christoph Scheytt

*Department of System and Circuit Technology, Heinz Nixdorf Institute, Paderborn University, Paderborn, Germany*

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## The 2024 IEEE BiCMOS and Compound Semiconductor Integrated Circuits and Technology Symposium (BCICTS)

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## CALL FOR PAPERS

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The 2024 BCICTS will be held in Ft. Lauderdale, Florida, USA from October 27-30, 2024. Subject area groupings for paper submissions are as follows:

**HIGH-SPEED DIGITAL, MIXED-SIGNAL, AND OPTOELECTRONIC ICs** Mixed analog/digital ICs - Digital ICs - (high-speed) DACs and ADCs - Networking ICs, MUX/DEMUX, Clock and data recovery, Decision circuits, Equalizers - Optical data links, Laser and modulator drivers, optoelectronics and photonics ICs

### ANALOG, RF, AND MICROWAVE ICs

Op amps - Voltage references and regulators - Integrated filters - Sensors and actuators - RF circuits and systems - Radio and transceiver subsystems - LNAs - AGCs - Mixers - Voltage controlled oscillators - Frequency synthesizers - Power amplifiers - RF switches - Noise and distortion suppression - RF Packaging - Integrated RF passives. Analog, RF, power conversion, High-voltage ICs - Biomedical electronics - Power Management ICs - Energy harvesting ICs - Motor controls - Analog subsystems within a VLSI chip - Packaging of high-performance ICs.

### mm-WAVE AND THZ ICs

Millimeter - wave circuits and systems - THz circuits and systems. MM-Wave switches and amplifiers. Phased-array antenna circuits

### DEVICE PHYSICS:

New device physics phenomena in Si, SiGe, SiC, GaN, MOS, and III-V HBTs and FETs - Device design issues and scaling limits - Hot electron effects and reliability physics - Transport and high field phenomena - Noise - Linearity/Distortion - Novel measurement techniques - Operation in extreme environments (low/high temperatures, radiation effects), and ESD phenomena.

### MODELING AND SIMULATION

Improved silicon-based BJT and HBT models and physics-based modelling techniques - Improved III-V HBT and FET models and physics-based modelling techniques - Parameter extraction methods and test structures - High-frequency measurement, calibration and de-embedding techniques - RF and thermal simulation techniques - Modelling of passives, interconnect and packages - Statistical modelling - Device, process and circuit simulation - CAD/modelling of power devices - Packaging of power devices.

### PROCESS AND DEVICE TECHNOLOGY

Device and IC manufacturing processes, testing methodologies, & reliability - Integration of III-V devices on Si - High performance devices such as GaN power conversion devices - near-THz SiGe HBTs & InP HEMTs - Novel devices such as tunnel FETs (TFETs) - carbon nanotubes, MEMS, graphene & diamond transistors. Optoelectronic and photonic devices such as optical modulators, lasers, photodetectors, and Silicon Photonics - Thermal management

technologies, thermal simulation - Advanced packaging of high-power devices and ICs. Advances in processes and device structures demonstrating high speed, low power, low noise, high current, high voltage, etc. BiCMOS processes - Advanced process techniques - Si and SiC homojunction bipolar/BiCMOS devices and SiGe heterojunction bipolar/BiCMOS devices - Manufacturing solutions related to Bipolar and BiCMOS yield improvements - Fabrication of high-performance passive components, sensors, and MEMs - Process technology related to discrete and integrated bipolar/BiCMOS power devices - IGBT, RF power devices. Wide bandgap bipolar devices (e.g., SiC) and related process technology - 3D Integration - Reliability and testing for IC manufacturing

### **IMPORTANT DATES**

**Friday May 10, 2024 – Abstracts Due**

**Friday, July 19, 2024 – Decision E-mail Sent**

**Friday, September 6, 2024 – Final Manuscript Due**

Authors must submit an abstract (not more than 4 pages including figures and other supporting material) of results not previously published or not already accepted by another conference. Papers will be selected on the basis of the abstract.

The abstract must concisely and clearly state:

- a) The purpose of the work
- b) What specific new results have been obtained
- c) How it advances the state-of-the-art or the industry
- d) References to prior state-of-the-art
- e) Sub-committee preference:
  - Analog, RF, and Microwave ICs
  - Device Physics
  - High-Speed Digital, Mixed-Signal, & Optoelectronic ICs
  - Modeling & Simulation
  - mm-Wave and THz ICs
  - Process & Device Technology

Abstracts must include: title, author(s) name(s) and affiliation(s), corresponding authors' postal and e-mail addresses, and telephone numbers. The committee will honor the authors' committee preference but reserves the right to review the paper in other categories.

Company and governmental clearances must be obtained prior to submission of the abstract.

Accepted work may be used for publicity purposes. Portions of the abstracts may be quoted in articles publicizing the Symposium. Please note on the abstract if this is not acceptable.

Abstracts (PDF only) must be submitted electronically.

Authors will be informed of a decision by July 8, 2024. Authors of accepted papers are required to submit a 4-page camera-ready PDF by August 29, 2024 for inclusion in the Symposium Digest.

Further questions on abstract submission may be addressed to the Symposium Technical Chair:

Tomislav Suligoj

Head of Micro and Nano Electronics Laboratory (MiNEL)

University of Zagreb, Faculty of Electrical Engineering and Computing

Email: [tomislav.suligoj@fer.hr](mailto:tomislav.suligoj@fer.hr)

Symposium information, including abstract submission instructions and a link to the abstract submission system will be available on the BCICTS website at: <http://www.bcicts.org> in the near future.

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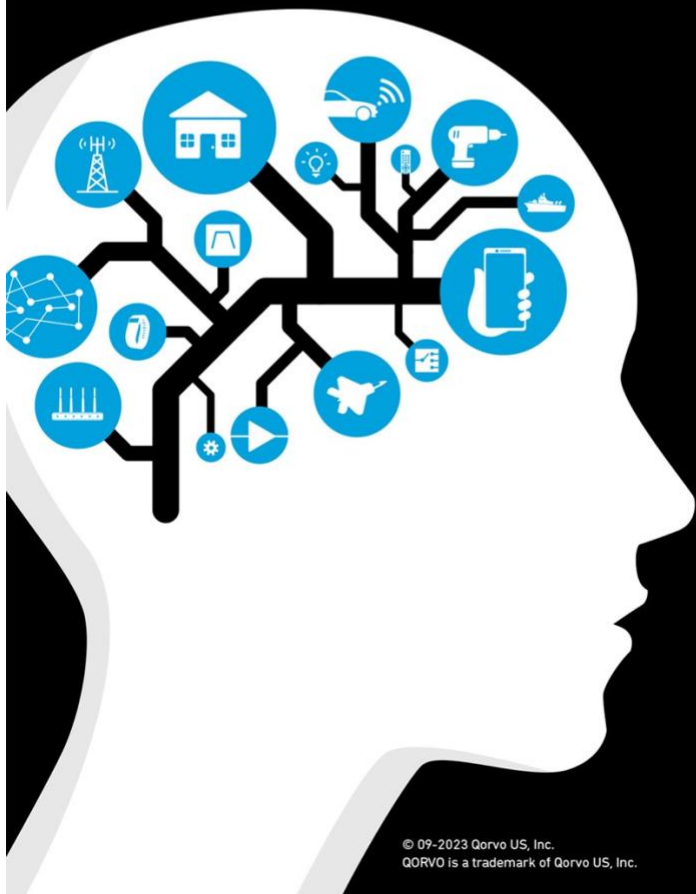
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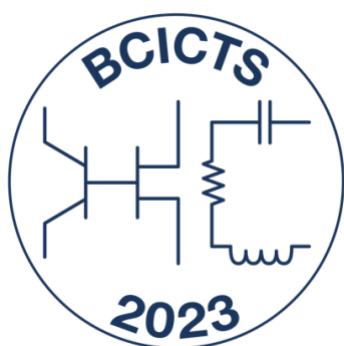
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