## Advance Program

# BCICTS 2019
# IEEE BiCMOS and Compound Semiconductor Integrated Circuits and Technology Symposium

**Loews Vanderbilt Hotel**
**Nashville, Tennessee, USA**

November 3 - 6, 2019
Short Course - November 3, 2019
Primer - November 4, 2019

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: https://bcicts.org

# 2019 BCICTS Schedule at a Glance

| **Sunday - November 3** | |
|---|---|
| Short Course Only<br>Registration & Breakfast at 8:00 AM<br>**TBD** | |
| 8:45AM<br>5:30PM | Short Course<br>Millimeter-wave radar: systems, circuits, process technologies<br>**Ballroom Symphony #1**<br>Lunch<br>**TBD**<br>**(Short Course attendees only)** |

| **Monday - November 4** | | |
|---|---|---|
| Registration opens at 7:00 AM<br>**TBD** | | |
| 8:00AM<br>12:00PM | Primer<br>Gallium Nitride device technology and circuit design<br>**RoomTBD** | |
| 12:00PM<br>1:00PM | Lunch Break<br>**Self - Arrangement** | |
| 1:00PM<br>1:30PM | Welcome and Announcements<br>**Ballroom Symphony #1** | |
| 1:30PM<br>2:10PM | Plenary Session 1<br>**Ballroom Symphony #1** | |
| 2:10PM<br>2:30PM | Coffee Break | |
| 2:30PM<br>3:10PM | Plenary Session 2<br>**Ballroom Symphony #1** | |
| 3:10PM<br>3:50PM | Plenary Session 3<br>**Ballroom Symphony #1** | |
| 3:50PM<br>4:10PM | Coffee Break | |
| 4:10PM<br>5:30PM | **1a**. Highly-Integrated mm-Wave Transceivers for Wide-Band Radar & Communication Applications<br>**Symphony #1** | **1b**. Advances in GaN HEMT Modeling<br>**RoomTBD** |
| 5:30PM<br>8:00PM | Exhibition Reception<br>**Ballroom Symphony #2&3** | |

## Tuesday - November 5

Registration opens at 7:00 AM

**TBD**

| | | |
|---|---|---|
| 7:00AM<br>8:00AM | Exhibitor Breakfast<br>**Ballroom Symphony #2&3** | |
| 8:00AM<br>9:20AM | **2a.** Electro-Optical Interface Circuits<br>**Symphony #1** | **2b.** High Frequency Characterization<br>**RoomTBD** |
| 9:20AM<br>9:40AM | Coffee Break | |
| 9:40AM<br>11:00AM | **3a.** High Performance SiGe Circuits<br>**Symphony #1** | **3b.** Thermal Characterization<br>**RoomTBD** |
| 11:00AM<br>11:30AM | Coffee Break | |
| 11:30AM<br>12:30PM | **4a.** Ka-Band Amplifiers and Components<br>**Symphony #1** | **4b.** Next Generation Devices for Extreme Power Density and Linearity Performance at mmW<br>**RoomTBD** |
| 12:30AM<br>2:00PM | **Exhibition Lunch**<br>**Ballroom Symphony #2&3** | |
| 2:00PM<br>3:40PM | **5a**. mm-Wave Amplifiers in Silicon & III/V Technologies<br>**Symphony #1** | **5b**. Bipolar Device Physics<br>**RoomTBD** |
| 3:40PM<br>4:10PM | Coffee Break | |
| 4:10PM<br>5:30PM | **6a**. Optical Communications Circuits<br>**Symphony #1** | **6b**. Transistors on the Edge!<br>**RoomTBD** |

| **Wednesday - November 6** | | |
|---|---|---|
| Registration opens at 8:00 AM<br>**TBD** | | |
| 8:30AM<br>10:10AM | **7a.** 5G Systems and Components<br>**(08:50AM)**<br>**Symphony #1** | **7b.** SiGe Technology<br>**RoomTBD** |
| 10:10AM<br>10:40AM | Coffee Break | |
| 10:40AM<br>12:00PM | **8a.** mm-Wave & THz Frequency Generation<br>**Symphony #1** | **8b.** High Speed FETs and HBTs<br>**RoomTBD** |
| 12:00PM<br>1:30PM | **Lunch Break<br>(Self - Arrangement)** | |
| 1:30PM<br>3:10PM | **9a**. Late News 1<br>**Symphony #1** | **9b**. A look at Devices and Models<br>**RoomTBD** |
| 3:10PM<br>3:40PM | Coffee Break | |
| 3:40PM<br>4:40PM | **10a**. Late News 2<br>**Symphony #1** | **10b**. Advanced GaN FET Technologies<br>**RoomTBD** |
| 4:40 PM<br>5:00 PM | Coffee Break | |
| 5:00 PM<br>5:30 PM | Closing Session | |

# Welcome from the BCICTS 2019 Co-Chairs

It is with great pleasure that we welcome you to be a part of the 2019 IEEE BiCMOS and Compound Semiconductor Integrated Circuits and Technology Symposium (BCICTS). After 39 years of the Compound Semiconductor IC Symposium (CSICS), and 32 years of the Bipolar/BiCMOS Circuit and Technology Meeting (BCTM), the second meeting of this combined symposium will be held on Sunday November 3 to Wednesday November 6 in Nashville, Tennessee.

BCICTS continues the long history, from BCTM and CSICS, of international gatherings 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 second BCICTS includes presentations from worldwide submissions on all aspects of the technology. 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.

On Sunday November 3rd, BCICTS offers a topical short course on Millimeter-wave radar: systems, circuits, and process technologies. Taught by leading experts, the short course is intended for technologists, modelers, and IC designers who seek a comprehensive understanding of the latest industry trends and techniques.

On Monday November 4th (prior to the opening of the symposium) we offer a more basic primer course. The primer course is intended to be a tutorial which introduces Gallium Nitride device technology and circuit design.

As a complement to the technical program, the symposium includes numerous social events that allow participants to interact and network in a friendly, relaxed setting. These events include the Monday Evening Exhibition Opening Reception and the Technology Exhibition Luncheon on Tuesday.

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 old and create new traditions with this revitalized conference!

**Sorin Voinigescu**
**Symposium Co-chair**
**University of Toronto**

**Pete Zampardi**
**Symposium Co-chair**
**Qorvo**

# BCICTS 2019 Registration

**Click here to register https://bcicts.org**
**Advance registration deadline is Monday, September 30, 2019.**

**Registration Fees: MAIN MEETING (November 3-6)**
Please contact cs@cshawevents.com for more details.

(1) Conference Registration Cost in US Dollars (includes conference program, electronic proceedings, exhibition opening reception, exhibition lunch, banquet, and all day refreshments)

| | ADVANCE<br>By 9/30/2019 | REGULAR<br>Starting 9/30/2019 |
|---|---|---|
| IEEE Members | $725 | $825 |
| Non-Members | $775 | $875 |
| Students | $400 | $450 |

**Registration Fees: SHORT COURSE (November 3)**
(1) Course Cost (includes breakfast and lunch)

| | | |
|---|---|---|
| Regular | $520 | $520 |
| Students | $270 | $270 |

**Registration Fees: PRIMER (November 4)**
(1) Course Cost (includes breakfast)

| | | |
|---|---|---|
| Regular | $370 | $370 |
| Students | $220 | $220 |

**Notes:**
*All fees are denominated in US$
*Full Registration for the conference Includes: proceedings, all day refreshments, some lunches, and a vendor reception.

*Short Course Registration includes: short course notes, continental breakfast, lunch and light refreshments

*Primer course registration includes: primer course notes, continental breakfast

During the registration process you must enter your hotel confirmation code to avoid **$100 non-conference hotel charge**. Our contract with the hotel includes meeting room fees and other facility charges as part of the room fees paid by our attendees. If you don't stay at the workshop hotel, then your fair share of the meeting room fees, meals, and facilities will be covered by this $100.

**Refund/Cancellation Policy:**
All refund/cancellation requests must be provided in writing via email to BCICTSReg@ieee.org and received by **September 21, 2019**. There will be an administrative fee of **US $100** deducted from each refund. There will be no refunds offered after **September 21, 2019**.

# 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. To be eligible for consideration for the Best Student Paper Award, the following criteria have to be met: 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; and 4) the paper identified as a student paper in submission, but not presented by the student will be disqualified for Best Student Paper Award competition. In this scenario, the paper will be moved to non - student category for Best Paper Award competition automatically.

Eligible papers are evaluated by the Best Paper Award Committee and the notifications will be sent out after the conference. The winners of the awards will be recognized with a $500 check and a plaque at next year's BCICTS conference.

**FURTHER INFORMATION** 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).

**ADMISSION** All interested persons are welcome to register and attend the BCICTS; you do not have to be an IEEE member. Admission to sessions requires a BCICTS name badge. Please wear your badge at all times.

**REGISTRATION** Complete registration information is contained in the conference's web page (https://bcicts.org) Please use the website to register. All conference activities are included in the registration fees (technical sessions, food breaks) as well as an electronic copy of BCICTS 2019 Proceedings.

**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.

# Hotel Reservations

A block of rooms has been reserved at special discounted rates for BCICTS conference participants at our host hotel below. While there are alternatives, we would like to remind attendees to please support the conference and fully enjoy all the activities by staying at the official host hotel. The symposium relies on attendees staying at the conference hotel. Room reservations should be made as soon as possible before the hotel cut-off date below, as there are a limited number available at the group rate.

During the registration process you must enter your hotel confirmation code to avoid **$100 non-conference hotel charge**. Our contract with the hotel includes meeting room fees and other facility charges as part of the room fees paid by our attendees. If you don't stay at the workshop hotel, then your fair share of the meeting room fees, meals, and facilities will be covered by this $100.

Loews Vanderbilt
210 West End Avenue
Nashville TN 37203

Check-in Time: 4:00 PM Check-out Time: 12:00 PM
Group Hotel Rates $244.00 plus tax (12.695%)
Book your room at the group rate
https://www.loewshotels.com/vanderbilt-hotel/ieee-compund-and-bipolarbicoms-conference

**Hotel Accommodations**

**Room Reservation:** You are responsible for booking your hotel room at the host hotel.

- The Discounted Group Guest Room Rate: Single / Double $244.00 plus tax. Group Rate will be provided 3 days before and after meeting dates (based on availability). **Reservation Cut-Off Date**: Reservations must be made by the cut-off date, **Friday, September 27** in order to receive the group rate and guarantee availability. After this date, rooms will be on a space available basis and at possibly higher rates. We recommend you book early.
- To reserve your room or call reservations at 1-800-336-3335 and mention the IEEE conference in November and please be sure to reference our group block code which is IEEN03. The Loew’s reservations office is open 7 days a week, 7AM-11PM Central Time.
- Discounted Guest Room Rate: Single / Double $244.00 plus tax.
- Changes or Cancellations: Contact the hotel directly

**Internet**: Internet access is available in all guest rooms. Complimentary Wi-Fi is also available in the lobby and public areas.

**Parking**

- Parking is available on property.
- Discounted Self-Parking: $35 USD per night
- Discounted Valet Parking Fee: $39 USD per night

# Travel

You are responsible for booking your own air travel.

Special Airfares: Travel arrangements using the IEEE negotiated air carriers or the carriers of your choice can be made through World Travel, Inc.

Call in: Between 8:00 AM and 5:30 PM EST, Monday through Friday. Within the US and Canada, call (800) TRY-IEEE, (+1 800 879-4333); and outside of the US and Canada, call +1 717 556-1100.

- Online: Visit their website at http://www.ieee.org/travel
- Email: Email your request to ieee@worldtravelinc.com

**Ground Transportation**: Airport Option: The hotel is located 15 minutes away from Nashville Airport. Ground transportation pick-ups take place on Level 1 of the new Parking and Transportation Center.

**Finding the New Ground Transportation Center**:

- Exit the terminal on Level 1 and turn right.
- Follow the sidewalk and pedestrian canopy to the Parking and Transportation Center. Overhead signs will direct you.
- The Ground Transportation Center is on Level 1.Taxi 2. Uber/Lyft

**Rates**:
From the airport, the meter starts at $7 and the rate is $2.10 per mile. There is a flat rate of $25 to the downtown hotel area, plus an additional passenger charge of $1 when accompanying original passenger and proceeding to same destination.

For additional information visit: https://www.flynashville.com/ground-transportation/Pages/taxis.aspx Companies listed alphabetically.

**Complimentary Car Service**
Our complimentary courtesy vehicle-a shiny new Luxury SUV-is at the ready with dedicated staff from 8 AM–10 PM to take you within a three-mile radius of our hotel. See our concierge for availability.

**Discounted Car Rentals**: IEEE corporate car rental discounts are available to all attendees. Use discount codes here when calling your preferred car rental company to receive special rates: Avis A606000, Budget X520000, Hertz 61368, and Enterprise NA24IE1.

# BCICTS 2019 Short Course
## *Ballroom Symphony #1*

**Date:** Sunday, November 3, 2019
**Time:** 8:00 AM - 5:30 PM
**Topic:** Millimeter-wave radar: systems, circuits, process technologies
**Speakers:**

- Vadim Issakov (Infineon)
- Mohamed Elkhouly (Nokia Bell Labs)
- Alvin Joseph (GLOBALFOUNDRIES)

**8:00 - 8:45 AM Registration and breakfast**
**8:45 - 9:00 AM Welcome**
*Michael Schröter and Leonardo Vera*

**Course Overview**
Renowned experts from academia and industry will share their views on systems, circuits and technology for radar applications.

**9:00 - 10:00 AM**
**Millimeter-wave radar: systems, circuits, process technologies - Systems**
*Instructor: Vadim Issakov (Infineon)*
Recent advances of silicon-based semiconductor processes and packaging technologies have accelerated the implementation of radar sensors for numerous mass-volume applications at mm-wave frequencies. This talk will start with the basic introduction of continuous-wave (CW) and pulsed radar systems. We discuss briefly the frequency regulations for automotive and consumer radar applications. Then we focus only on CW and FMCW systems and consider range, velocity and angular resolution. We discuss how to derive a specification of the radar system based on the specific radar application scenario, as e.g. link budget calculation, frequency chirp, dimensioning of filters and VGA in the analog baseband, choosing sampling rate and resolution of the ADC. Next, we discuss the impact of phase noise on radar systems, as e.g. range correlation effect. Further, we discuss the radar signal processing, range-Doppler map and detection of multiple targets. Finally, we discuss advanced topics as noise floor degradation by non-ideal mixing and TX to RX spillover cancellation and show integrated radar system examples.

**Vadim Issakov** received the M.Sc. degree in microwave engineering from the TU Munich in 2006 and the Ph.D. degree (summa cum laude) from the University of Paderborn, Germany, in 2010. In March 2010 he joined Infineon in Neubiberg, Germany. Afterwards he worked at IMEC and Intel Corporation, before he came back to Infineon in August 2015 as mm-wave Design Lead and Principal Engineer leading a research group working on predevelopment of mm-wave radar and communication products. His work has been recognized by the IEEE MTT Outstanding Young Engineer Award. In September 2019 he joins the University of Magdeburg, Germany, as a full professor holding the Chair for Electronics.

**10:00 - 10:15 AM Break**

**10:15 - 11:15 PM**
**Millimeter-wave radar: systems, circuits, process technologies - Systems (continued)**
*Instructor: Vadim Issakov (Infineon)*

**11:15 - 11:30 AM Break**

**11:30 AM - 12:30 PM**
**Millimeter-wave radar: systems, circuits, process technologies - Circuits**
*Instructor: Mohammed Elkhouly (Nokia Bell Labs)*
In this workshop we will address the design and implementation of several radar transceiver building blocks from the device layout to the full circuit implementation using both SiGe HBT and 22nm FDSOI silicon technologies. The effect of transistor interconnects will be discussed which is important for PA design in the advanced CMOS nodes. Then, advanced radar front-ends will be discussed and presented..

**Mohammed Elkhouly**, PhD, received the B.Sc and M.Sc. degrees in electronics and communication engineering from Ain Shams University, Cairo, Egypt, in 2003 and 2008 respectively, and the Ph.D. degree from Technical University of Dresden, Dresden, Germany, in 2015. In 2008, he joined the Microwave and Millimeter-Wave Group, IHP, Frankfurt (Oder), Germany, as a Researcher, where he participated in the design of 60-240 GHz transceivers. In 2015, he joined Robert Bosch GmbH, Reutlingen, Germany. He participated in the design of several automotive radar chips both in SiGe and CMOS technologies. He also participated in the design of the IQ transceivers for next generation OFDM radars in 45 nm CMOS SOI. Currently, he is a member of technical staff at Nokia Bell-Labs, where he is working on the next generation highly integrated millimeter-wave phased arrays for radar and communications.

**12:30 - 1:30 PM Lunch**

**1:30 - 2:30 PM**

**Millimeter-wave radar: systems, circuits, process technologies - Circuits (continued)**

*Instructor: Mohammed Elkhouly (Nokia Bell Labs)*

**2:30 - 2:45 PM Break**

**2:45 - 3:45 PM**

**Millimeter-wave radar: systems, circuits, process technologies - Process Technologies**

*Instructor: Alvin Joseph (GLOBALFOUNDRIES)*

With the growing demand for millimeter wave radar applications, such as automotive radar (77 GHz), gesture sensing (60 GHz), and security/imaging (94 GHz), there is a sizeable market which can be addressed by silicon technologies. With the introduction of phased array technology for improving sensor range / detection, system cost has become a concern and Si-based technologies are sought to address this performance-cost challenge. In this short course segment, we will discuss two technologies in detail, both of which can easily address this market: SiGe9HP, a 300 / 365 GHz (fT / fmax) BiCMOS process and 22FDx, a 22nm 350 / 400 GHz fully-depleted CMOS process. 9HP SiGe HBT offers superior performance on phase noise and gain stability over temperature, whereas, 22FDX offers a pathway for SoC. The lecture will be subdivided into process technology, PDK tools, model and hardware correlation, and future roadmap opportunities.

**Alvin Joseph** received his Ph.D. degree in EE from Auburn University, Auburn, AL, in 1997 and soon after joined IBM Microelectronics Division, Essex Junction, Vermont. In 2001, under his leadership, an industry leading 180nm / 120 GHz (7HP) SiGe BiCMOS technology was installed for production. Between 2007-2010, he led the development of 350nm SiGe PAs with TSV and 180nm RFSOI switch/LNA processes, both of which resulted in transforming the market for silicon adoption in RF front-ends. He is currently a GLOBALFOUNDRIES fellow. He has over 100 technical journal papers and conference publications and over 100 patents issued. Dr. Joseph was the general chair for the 2011 IEEE BCTM. In 2015, he was appointed an IEEE Fellow for contributions to silicon-germanium bipolar-CMOS and RF silicon-on-insulator technology.

**3:45 - 4:00 PM Break**

**4:00 - 5:00 PM**

**Millimeter-wave radar: systems, circuits, process technologies - Process Technologies (continued)**

*Instructor: Alvin Joseph (GLOBALFOUNDRIES)*

**5:00 – 5:30 PM Course Evaluation**

# BCICTS 2019 Primer Course
## *RoomTBD*

**Date:** Monday, November 4, 2019
**Time:** 7:00 AM - 12:00 PM
**Discussion Topic:** Gallium Nitride device technology and circuit design
**Speakers:**

- Michael Roberg
- Dan Denninghoff

**7:00 - 7:50 AM Registration and breakfast**
**7:50 - 8:00 AM Welcome**
*Pete Zampardi and Breandán Ó hAnnaidh*

**Course Overview**
Renowned experts from industry teach present more tutorial and fundamental instruction for those new to the field or wanting a refresher. This will include III/V technology and mm-wave layout tips and tricks components.

**8:00 - 9:40 AM**
**Introduction to MMIC High Power Amplifier Design**
*Instructor: Michael Roberg (Qorvo)*

This primer course was developed to serve as an introductory level course on high power microwave monolithic integrated circuit (MMIC) amplifier design. Covered material will start with reactively matched power amplifiers and conclude with wideband power amplifier design. Circuit topologies will be presented, analyzed and transformed into a monolithically compatible form. Various aspects and limitations of transistor and MMIC technology are highlighted as the circuit functions are developed. Where available fabricated examples of Gallium Nitride (GaN) power amplifier MMICs will be presented.

Reactively Matched Power Amplifier Design
  - Power Amplifier Specifications
  - Transistor Cell Selection
  - Matching Network Synthesis
  - Stability Analysis

Wideband Power Amplifier Design
  - Bandwidth Limitations
  - Wideband Topologies
  - Circuit Design
  - Biasing and Transformers
  - MMIC Examples

**Michael Roberg** received the Ph.D. degree from the University of Colorado at Boulder in 2012. From 2003 to 2009, he was an engineer at Lockheed Martin-MS2 in Moorestown, NJ working on advanced phased array radar systems. He currently works for Qorvo in the Infrastructure and Defense Products business unit as a MMIC design engineer, senior member technical staff. His current research interests include microwave power amplifier theory and design, and high efficiency radar, electronic warfare and communication system transmitters.

**9:40 - 10:10 AM Break**

**10:10 - 11:50 AM**
**TBD**
*Instructor:Dan Denninghoff (HRL)*

This primer course was developed to serve as an introductory level course on

**Dan Denninghoff** received his

**11:50 - 12:00 PM Course Evaluation**

# Introductory Remarks and Plenary

## Welcome and Announcements

1:00 - 1:30 PM – **Ballroom Symphony #1**

**Bruce Green, Chair**

## Plenary

Monday 1:30 PM – Ballroom Symphony #1
Session Chair: Sorin Voinigescu, *University of Toronto*
Co-chair: Pete Zampardi, *Qorvo*

### 1:30 PM - 2:10 PM - Coherent Transceiver for High Speed Optical Communications: Opportunities and Challenges (Invited)

Sebastien Blais, Yuriy Greshishchev, Peter Schvan, Ian Betty, and Douglas McGhan
*Ciena Corporation, Ottawa, Canada*

### 2:10 PM - 2:30 PM Break

### 2:30 PM - 3:10 PM - Advanced mm-Wave Power Electronics (Invited)

Young-Kai Chen[1], Tsu-Hsi Chang[2], Abirami Sivananthan[3]
[1] *Defense Advanced Research Projects Agency, 675 N Randolph Street, Arlington, VA 22203*
[2] *HetInTec Corp., Rockville, MD 20850*
[3] *Booz Allen Hamilton, 3811 N Fairfax Drive, Arlington, VA 22203*

### 3:10 PM - 3:50 PM - Design Considerations for Behavioral Modeling and Pre-Distortion of Wide Bandwidth Wireless Systems (Invited)

Kevin Chuang
*NanoSemi, Inc., Waltham, Massachusetts, USA*

### 3:50 PM - 4:10 PM Break

# Conference Program

## 1a. Highly-Integrated mm-Wave Transceivers for Wide-Band Radar & Communication Applications

Monday 4:10 AM - ***Ballroom Symphony #1***
Session Chair: Kazuya Yamamoto, *Sumitomo Electric Industries, Ltd*
Co-Chair: Wooram Lee, *IBM T.J Watson Research Center*

**1a.1**
**4:10-4:30 PM – D-band Full-Duplex Transceiver Utilizing 70-nm GaAs-mHEMT Open Foundry Service**
Masaharu Ito, Takashi Okawa, Tsunehisa Marumoto
*NEC Corp., Kawasaki, Japan*

**1a.2**
**4:30-4:50 PM – A Highly Integrated D-Band Multi-Channel Transceiver Chip for Radar Applications**
Andrea Bilato[1], Vadim Issakov[2], Vera Kurz[3], Daniel Englisch[2]
[1]*Univ. of Padova, Italy*
[2]*Infineon Technologies AG*
[3]*Tech. Univ. of Munich, Germany*

**1a.3 (Invited)**
**4:50-5:30 AM – Millimeter-Wave CMOS Phased-Array Transceiver Toward 1Tbps Wireless Communication**
Kenichi Okada
*Tokyo Institute of Technology, Tokyo, Japan*

## 1b. Advances in GaN HEMT Modeling

Monday 4:10 AM - ***RoomTBD***
Session Chair: Yueying Liu, Wolfspeed
Co-Chair: Mikael Garcia, *Analog Devices*

**1b.1 (Invited)**
**4:10-4:50 PM – Modeling layout, distribution and breakdown effects in GaN HEMTs in the MVSG approach**
Khandker Akif Abrar[1], Lan Wei[2], Ujwal Radhakrishna[3]
[1]*University of Notre Dame, SouthBend, IN, USA,*
[2]*University of Waterloo, Waterloo, ON, Canada,*
[3]*Massachusetts Institute of Technology, Cambridge, MA, USA*

**1b.2 (Student)**
**4:50-5:10 PM – A Computationally efficient modelling methodology for field-plates in GaN HEMTs**
Jason Hodges, Sayed Ali Albahrani, Sourabh Khandelwal,
*School of Engineering, Macquarie University, Sydney, Australia,*

**1b.3 (Student)**
**5:10-5:30 AM – Scalable small signal modeling of AlGaN/GaN HEMT based on distributed gate resistance**
Bilal Hassan[1], Adrien Cutivet[2], Christophe Rodriguez[1], Flavien Cozette[1], Ali Soltani[1], François Boone[1], Hassan Maher[1]
[1]*Laboratoire Nanotechnologies Nanosystèmes (LN2), CNRS UMI-3463 - Université de Sherbrooke, 3000 boul. de Université, J1K0A5, Québec, Canada*
[2]*OMMIC- 2, Rue du Moulin B.P. 11, 94453 Limeil-Brévannes Cedex France, France*

## 2a. Electro-Optical Interface Circuits

Tuesday 8:00 AM - ***Ballroom Symphony #1***
Session Chair: Yuriy Greshishchev, *Ciena*
Co-Chair: Koichi Murata, *IDT*

**2a.1 (invited)**
**8:00-8:40 AM – Integrated CMOS-Compatible Mode-Locked Lasers and Their Optoelectronic Applications**

Franz X. Kärtner, Neetesh Singh
*Center for Free-Electron Laser Science, Deutsches Electronen Synchrotron-DESY and Physics Department, University of Hamburg, Hamburg, Germany*

**2a.2 (Student)**
**8:40-9:00 AM – A DC-51.5 GHz Electro-Absorption Modulator Driver with Tunable Differential DC Coupling for 3D Wafer Scale Packaging**
Xi Zhang[1], Xiao Liu[1], Mark Spiegelberg[2], A. Rainier van Dommele[1], Marion K. Matters-Kammerer[1]
[1]*Integrated Circuits- Eindhoven University of Technology, Eindhoven, The Netherlands*
[2]*Photonic Integration- Eindhoven University of Technology, Eindhoven, The Netherlands*

**2a.3 (Student)**
**9:00-9:20 AM – Over 70-GHz 4.9-$V_{ppdiff}$ InP Linear Driver for Next Generation Coherent Optical Communications**
Romain Hersent[1,2], Jean-Yves Dupuy[1], Agnieszka Konczykowska[1], Filipe Jorge[1], Fabrice Blache[1], Muriel Riet[1], Virginie Nodjiadjim[1], Colin Mismer[1], Abed-Elhak Kasbari[2], Achour Ouslimani[1]
[1]*III-V Lab, GEI Nokia Bell Labs-Thales-CEA Leti, Palaiseau, France*
[2]*Laboratoire Quartz, ENSEA, Cergy, France*

## 2b. High Frequency Characterisation

Tuesday 8:00 AM - ***RoomTBD***
Session Chair: Breandán Ó hAnnaidh, *Analog Devices*
Co-Chair: Sadayuki Yoshitomo, *Toshiba*

**2b.1**
**8:00-8:20 AM - Distortion analysis of the CE and CB SiGe HBT power cells with fmax beyond 220 GHz for millimeter-wave applications**
Paulius Sakalas[1,2,3], Anindya Mukherjee[1], Michael Schröter[1]
[1]*CEDIC, Technische Universität Dresden, Germany,*
[2]*FRL, Semiconductor Physics Institute of Center for Physical Sciences and Technology, Vilnius, Lithuania,*
[3]*BPTI, Baltic Advanced Technology Institute, Saulėtekio, Vilnius, Lithuania*

**2b.2 (Student)**
**8:20-8:40 AM - TCAD simulation and assessment of anomalous deflection in measured S-parameters of SiGe HBTs in THz range**
Soumya Ranjan Panda[1], Sebastien Fregonese[2], Anjan Chakravorty[1], Thomas Zimmer[2]
[1]*IMS Laboratory, University of Bordeaux, France,*
[2]*Indian Institute of Technology, Madras, India*

**2b.3 (Invited)**
**8:40-9:20 AM - Load pull measurement techniques: architecture, accuracy, and applications**
Mauro Marchetti, Gustavo Avolio, Michele Squillante, Ajay K. Doggalli
*Anteverta-mw B.V. High Tech Campus 41, 5656AE, Eindhoven, The Netherlands*

## 3a. High Performance SiGe Circuits

Tuesday 9:40 AM - ***Ballroom Symphony #1***
Session Chair: Tony Quach, *Air Force Research Laboratory*
Co-Chair: Nabil El-Hinnawy, *TowerJazz*

**3a.1**
**9:40-10:00 AM - A Scalable Multimode 24GHz Radar Transceiver for Industrial and Consumer Applications in a 0.13um SiGe BiCMOS Technology**

Abhiram Chakraborty[1], Mohamed Hamouda[1], Yijue Chen[1], Claus Lautenschlager[2], Daniel Englisch[1],
Muhammad Qureshi[1], Ngoc-Hoa Huynh[1], Klaus Hoenninger[1], and Hans-Peter Forstner[1]
*[1]Infineon Technologies AG, Germany*
*[2]eesy-IC GmbH, Germany*

**3a.2**
**10:00-10:20 AM - A Broadband Logarithmic Power Detector Using 130 nm SiGe BiCMOS Technology**
Yunyi Gong[1], Seokchul Lee[1], Edward Gebara[2], Huifang Gu[3], Charles Nicholls[3] and John D. Cressler[1]
*[1]School of ECE, 777 Atlantic Drive, N.W., Georgia Tech, Atlanta, GA 30332-0250*
*[2]$I^2R$ Nanowave, Inc., 85 5th St N.W., Atlanta, GA 30308 USA*
*[3]NANOWAVE Technologies, Inc., 433 Horner Ave, Etobicoke, ON. M8W 4W3*

**3a.3 (Student)**
**10:20-10:40 AM - A 17 GHz All-npn Push-Pull Class-C VCO**
Simone Veni[1], Michele Caruso[2], Marc Tiebout[2], Andrea Bevilacqua[1]
*[1]DEI, University of Padova, Italy*
*[2]Infineon Technologies, Villach, Austria*

**3a.4**
**10:40-11:00 AM - A 2-20 GHz SiGe Amplitude Control Circuit with Differential Signal Selectivity for Wideband Reconfigurable Electronics**
Moon-Kyu Cho[1], Ickhyun Song[2], Nelson E. Lourenco[3], Adilson S. Cardoso[4], Christopher T. Coen[3],
Douglas R. Denison[3], and John D. Cressler[1]
*[1]School of Electrical and Computer Engineering, Georgia Tech, Atlanta, GA, 30332-0250*
*[2]School of Electrical and Computer Engineering, Oklahoma State University, Stillwater, OK, USA*
*[3]Advanced Concepts Laboratory and [4]Sensors and Electromagnetic Applications Laboratory*
*Georgia Tech Research Institute, Atlanta, GA 30332*

## 3b. Thermal Characterisation

Tuesday 9:40 AM - ***RoomTBD***
Session Chair: Michael Schröter, *TU Dresden*
Co-Chair: Breandán Ó hAnnaidh, *Analog Devices*

**3b.1 (Invited)**
**9:40-10:20 AM - Thermal analysis of semiconductor devices and materials - Why should I not trust a thermal simulation?**
Martin Kuball
*Center for Device Thermography and Reliability, University of Bristol, England*

**3b.2**
**10:20-10:40 AM - Study of self-heating effect of GaN HEMTs with buffer traps by low frequency S-parameters measurements and TCAD simulation**
Tomohiro Otsuka[1], Yutaro Yamaguchi[1], Shintaro Shinjo[1], Toshiyuki Oishi[2]
*[1]Information Technology R&D Center, Mitsubishi Electric Corporation, 5-1-1 Ofuna, Kamakura, Kanagawa, 247-8501, Japan,*
*[2]Saga University, 1 Honjo-machi, Saga, Saga, 840-8502, Japan*

**3b.3 (Student)**
**10:40-11:00 AM - DC and RF variability of SiGe HBTs operating down to deep cryogenic temperatures**
Hanbin Ying, Jeffrey W. Teng, George N. Tzintzarov, Anup P. Omprakash, Sunil G. Rao, Uppili Raghunathan,
Adrian Ildefonso, Martin S. Fernandez, and John D. Cressler

*School of Electrical and Computer Engineering, Georgia Tech*
*777 Atlantic Drive N.W. Atlanta, GA 30332-0250 USA*

## 4a. Ka-Band Amplifiers and Components

Tuesday 11:30 AM - ***Ballroom Symphony #1***
Session Chair: Jim Carroll, *Akash Systems*
Co-Chair: Taylor Barton, *University of Colorado Boulder*

### 4a.1
### 11:30-11:50 AM - A High Efficiency, Ka-Band, GaN-on-SiC MMIC with Low Compression

Bruce Schmukler, Kyle M. Bothe, Satyaki Ganguly, Terry Alcorn, Jennifer Gao, Chris Hardiman, Evan Jones, Dan Namishia, Fabian Radulescu, Jeffrey Barner, Jeremy Fisher, Don A. Gajewski, Scott T. Sheppard, and Jim W. Milligan
*Wolfspeed | A Cree Company, Durham, NC*

### 4a.2
### 11:50-12:10 PM - A Ka-Band CW 15.5W 15.6% Fractional Bandwidth GaN Power Amplifier MMIC Using Wideband BPF Inter-stage Matching Network

Keigo Nakatani, Yutaro Yamaguchi, Masatake Hangai, Shintaro Shinjo
*Mitsubishi Electric Corporation, Information Technology R&D Center, Kamakura, Japan*

### 4a.3 (Student)
### 12:10-12:30 PM - A Broadband Reflection-Type Phase Shifter Achieving Uniform Phase and Amplitude Response across 27 to 31 GHz

Yuan Chang and Brian A. Floyd
*North Carolina State University, Raleigh, NC, USA*

## 4b. Next Generation Devices for Extreme Power Density and Linearity Performance at mmW

Tuesday 11:30 AM - ***RoomTBD***
Session Chair: Robert Howell, *Northrop Grumman Mission Systems*
Co-Chair: Hiroshi Yamamoto, *Sumitomo Electric Industries*

### 4b.1
### 11:30-11:50 AM - Toward Diamond-Collector Heterojunction Bipolar Transistors via grafted GaAs-Diamond n-p junction

Doug Liu[1], Sang Jung Cho[1], Aaron Hardy[2], Jisoo Kim[1], Cristian J. Herrera-Rodriguez[3], Edward Swinnich[4], Mohadeseh A. Baboli[5], Jiarui Gong[6], Xenofon Konstantinou[3], John Papapolymerou[3], Parsian K. Mohseni[5], Michael Becker[2], Jung-Hun Seo[4], John D. Albrecht[3], Timothy Grotjohn[3], Zhenqiang Ma[1]
*[1]Department of Electrical and Computer Engineering*
*University of Wisconsin-Madison, Madison, WI, USA,*
*[2]Fraunhofer USA Center for Coatings and Diamond Technologies, East Lansing, MI, USA*
*[3]Department of Electrical and Computer Engineering*
*Michigan State University, East Lansing, MI, USA*
*[4]Department of Materials Design and Innovation, The State University of New York, Buffalo, Buffalo, NY, USA*
*[5]Microsystems Engineering and NanoPower Research Laboratories, Rochester Institute of Technology, Rochester, NY, USA*
*[6]Department of Physics, University of Wisconsin-Madison, Madison, WI, USA*

### 4b.2 (Student)
### 11:50-12:10 PM - Graded-Channel GaN-Based HEMTs for High Linearity Amplifiers at Millimeter-Wave

Nivedhita Venkatesan, Gerardo Silva Oelker, Patrick Fay
*Department of Electrical Engineering, Notre Dame, South Bend, Indiana, USA*

### 4b.3

**12:10-12:30 PM - Diamond Superjunction (SJ) Process Development: Super-Lattice Power Amplifier with Diamond Enhanced Superjunction (SPADES)**
S. Afroz[1], B. Novak, K. Nagamatsu[1], K. Frey[1], P. Shea[1], R. Howell[1], J. Chang[1], A Koehler[2], T. Feyelson[2], V. Wheeler[2], M. Tadjer[2], J. Gallagher[2], G. Foster[2], K. Hobart[2]
[1]*Northrop Grumman Corporation, Linthicum, MD, USA*
[2]*U.S. Naval Research Laboratory, Washington, D.C., USA*

## 5a. mm-Wave Amplifiers in silicon and III/V

Tuesday 2:00 PM - ***Ballroom Symphony #1***
Session Chair: Marc Rocchi, *OMMIC*
Co-Chair: Eric Bryerton, *Virginia Diodes*

**5a.1 ( Invited)**
**2:00 -2:40 PM – 50-250 GHz High-Gain Power Amplifier MMICs in 250-nm InP HBT**
Zach Griffith, Miguel Urteaga, Petra Rowell, Lan Tran, Bobby Brar
*Teledyne Scientific Company, Thousand Oaks, CA, USA*

**5a.2**
**2:40-3:00 PM – Highly Efficient Ka-band (33 GHz-36 GHz) GaN MMIC Power Amplifier with>58.5% PAE**
M.Micovic, D.Regan, J.Wong, J.Tai,H. Sharifi
*HRL Laboratories LLC, Malibu, CA,USA*

**5a.3**
**3:00-3:20 PM – A 48-79 GHz Low-Noise Amplifier with Broadband Phase-Invariant Gain Control in 45nm SOI CMOS**
Wooram Lee
*IBM T.J Watson Research Center, Yorktown Heights, NY, USA*

**5a.4**
**3:20-3:40 PM – 140 GHz SiGe HBT and 100GHz InP DHBT Broadband Triple-Stacked Distributed Amplifiers with active Bias Terminations**
Kevin W,Kobayashi, Ying McClearyi
*IDP Research QORVO, Torrance, CA, USA*

## 5b. Bipolar Device Physics

Tuesday 2:00 PM - ***RoomTBD***
Session Chair: Jonggook Kim, *Texas Instruments*
Co-Chair: Vibhor Jain, *GLOBALFOUNDRIES*

**5b.1 (Student)**
**2:00-2:20 AM - Reliability Differences Between SiGe HBTs Optimized for High-Performance and Medium-Breakdown**
Rafael Perez Martinez, Uppili S. Raghunathan, Brian R. Wier, Harrison P. Lee, and John D. Cressler
*School of Electrical and Computer Engineering, Georgia Tech*

**5b.2 (Student)**
**2:20-2:40 AM - Analysis of Horizontal Current Bipolar Transistor (HCBT) Characteristics for RF Power Amplifiers**
Željko Osrečki, Josip Žilak, Marko Koričić, Tomislav Suligoj
*Micro and Nano Electronics Laboratory, Department of Electronics, University of Zagreb, Croatia*

**5b.3 (Student)**
**2:40-3:00 AM - Monte Carlo Investigation of Travelling Accumulation Layers in InP Heterojunction Bipolar Transistor Power Amplifiers**
Jonathan P. Sculley[1], Brian Markman[2], Utku Soylu[2], Yihao Fang[2], Miguel E. Urteaga[3], Andy D. Carter[3], Mark J. W. Rodwell[2], Paul D. Yoder[1]

*[1]Georgia Institute of Technology,*
*[2]University of California, Santa Barbara,*
*[3]Teledyne Scientific and Imaging*

**5b.4 (Invited)**
**3:00-3:40 AM - Probabilistic Computing with p-bits**
Kerem Y. Camsari, Supriyo Datta
*School of Electrical and Computer Engineering, Purdue University*

## 6a. Optical Communications Circuits

Tuesday 4:10 PM - ***Ballroom Symphony #1***
Session Chair: Munehiko Nagatani, *NTT*
Co-Chair: Craig Steinbeiser, *Qorvo*

**6a.1**
**4:10-4:30 PM – 25.78-Gbit/s Burst Mode TIA for 50G-EPON OLT**
Keiji Tanaka, Naruto Tanaka, Shoich Ogita
*Transmission Devices Laboratories, Sumitomo Electric Industries, Ltd., Yokohama, Japan*

**6a.2 (Student)**
**4:30-4:50 PM – A 4.6V, 6-bit, 64GS/s Transmitter in 22nm FDSOI CMOS**
Jashva Rafique[1], The'Linh Nguyen[2], Sorin P. Voinigescu[1]
*[1]ECE Department, University of Toronto, Toronto, Canada*
*[2]Finisar Corporation, Sunnyvale, United States*

**6a.3**
**4:50-5:10 PM - A 60GS/s 8-b DAC with > 29.5dB SINAD up to Nyquist frequency in 7nm FinFET CMOS**
Yuriy Greshishchev, Jorge Aguirre, Sadok Aouini, Marinette Besson, Robert Gibbins, Cho Young Gouk, Jerry Lam, Douglass McPherson, Mahdi Parvizi, Tingjun Wen, Naim Ben-Hamida
*Ciena Corporation, Ottawa, Canada*

## 6b. Transistors on the Edge!

Tuesday 4:10 PM - ***RoomTBD***
Session Chair: Masaya Iwamoto, *Keysight Technologies*
Co-Chair: Paul Tasker, *Cardiff University*

**6b.1 (Invited)**
**4:10-4:50 PM - Characterization of the Self-enhanced Class J PA Operating Mode in LDMOS Transistors**
Frederik Vanaverbeke, Michael Satinu, Kevin Kim
*NXP Semiconductors, Chandler, Arizona, 85295, USA*

**6b.2**
**4:50-5:10 PM – Measurement-based Accurate Definition of the SOA Edges for SiGe HBTs**
Mathieu Jaoul[1,2], Didier Céli[1], Cristell Maneux[2], Thomas Zimmer[2]
*[1]STMicroelectronics, 850 Rue Jean Monnet, 38926 Crolles, France,*
*[2]IMS, Université Bordeaux I, 33405 Talence, France*

**6b.3**
**5:10-5:30 PM - Quiescent Drain Voltage Dependence of Pulsed I-V Characteristics of GaN HEMTs: Analysis and Modeling**
Sourabh Khandelwal[1], Kevin Kellogg[2], Cole Hill[2], Hugo Morales[2], Larry Dunleavy[1,2], Gergana Drandova[3], Anita Pacheco[3], Jose Jimenez[3]
*[1]Department of Electrical Engineering, University of South Florida, Tampa, Florida, USA,*
*[2]Modelithics, Tampa, Florida, USA,*
*[3]Qorvo, Richardson, Texas, USA*

## 7a. 5G Systems and Components

Wednesday 8:50 AM - ***Ballroom Symphony #1***

Session Chair: Tomoya Kaneko, *NEC Corporation*
Co-Chair: Michael Roberg, *Qorvo*

**7a.1 (Invited)**
**8:50-9:30 AM - RF Front End Module Architectures for 5G**
Florinel Balteanu
*Skyworks Solutions Inc., California, USA*

**7a.2**
**9:30-9:50 AM - 8-Watt Linear Three-Stage GaN Doherty Power Amplifier for 28 GHz 5G Applications**
David Wohlert[1], Bror Peterson[1], Thi Ri Mya Kywe[1], Luis Ledezma[2], and Jeff Gengler[1]
[1]*Qorvo, Inc. Richardson, USA*
[2]*Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA*

**7a.3 (Student)**
**9:50-10:10 AM - A Compact Ka-Band Transformer-Coupled Power Amplifier for 5G**
Valdrin Qunaj, Patrick Reynaert
*KU Leuven-MICAS, Leuven, Belgium*

## 7b. SiGe Technology

Wednesday 8:30 AM - ***RoomTBD***
Session Chair: Pascal Chevalier, *STMicroelectronics*
Co-Chair: Jack Pekarik, *GLOBALFOUNDRIES*

**7b.1**
**8:30-8:50 AM - Ballast Resistor Temperature Effect and Ruggedness**
Yves Ngu, Ephrem Gebreselasie, Rajendran Krishnasamy, Rick Rassel
*GLOBALFOUNDRIES, Essex Junction, USA*

**7b.2 (Invited)**
**8:50-9:30 AM - Development of SiGeSn Technique towards Integrated Mid-Infrared Photonics Applications**
Wei Du[1], Yiyin Zhou[2,6], Huong Tran[2,6], Shui-Qing Yu[2], Seyed Ghetmiri[3], Aboozar Mosleh[3], Mansour Mortazavi[3], Greg Sun[4], Richard Soref[4], Joe Margetis[5], John Tolle[5], Baohua Li[6]
[1]*Wilkes University, Wilkes-Barre, USA*
[2]*University of Arkansas, USA*
[3]*University of Arkansas at Pine Bluff, USA*
[4]*University of Massachusetts at Boston, USA*
[5]*ASM, Phoenix, USA*
[6]*Arktonics LLC, Fayetteville, USA*

**7b.3 (Invited)**
**9:30-10:10 AM - Device Architectures for High-speed SiGe HBTs**
Holger Rücker and Bernd Heinemann
*IHP, Frankfurt (Oder), Germany*

## 8a. mm-Wave & THz Frequency Generation

Tuesday 10:40 AM - ***Ballroom Symphony #1***
Session Chair: Shahriar Shahramian, *Bell Labs, New Providence, NJ*
Co-Chair: Wibo van Noort, *Texas Instruments*

**8a.1 (Student)**
**10:40-11:00 AM – A 114-126 GHz Frequency Quintupler with >36 dBc Harmonic Rejection in0.13 um SiGe BiCMOS**
Andrea Bilato[1], Vadim Issakov[2], Andrea Bevilacqua[1]
[1]*Univ. of Padova, Italy*
[2]*Infineon Technologies AG*

**8a.2**
**11:00-11:20 Comparison of 10/20/40 GHz Quadrature VCOs for W-band FMCW Radar Systems in 90nm SiGe BiCMOS Technology**
Weihu Wang, Brian A. Floyd
*North Carolina State Univ., Raleigh, NC*

**8a.3 (Student)**
**11:20-11:40 PM – A THz Pulse Radiator Based on PIN Diode Reverse Recovery**
Sam Razavian, Aydin Babakhani
*Univ. of California, Los Angeles, CA*

**8a.4**
**11:40-12:00 PM – Active Single-Ended to Differential Converter (Balun) for DC up to 70 GHz in 130nm SiGe**
Paul Stärke[1], Vincent Riess[1], Corrado Carta[2], Frank Ellinger[1]
*[1]Technische Univ. Dresden, Dresden, Germany*
*[2]Dresden Univ. of Technology, Dresden, Germany*

## 8b. High Speed FETs and HBTs

Tuesday 10:40 AM - ***RoomTBD***
Session Chair: Patrick Fay, *Univ. of Notre Dame*
Co-Chair: Carl Dohrman, *Northrop Grumman*

**8b.1 (Invited)**
**10:40-11:20 AM – High-Performance InGaAs-on-Silicon Technology Platform for Logic and RF Applications**
Cezar B. Zota, Clarissa Convertino, Marilyne Souza, Daniele Caimi, Kirsten Moselund, Lukas Czornomaz
*IBM Research – Zurich, Ruschlikon, Switzerland*

**8b.2 (Student)**
**11:20-11:40 AM – InP/GaAsSb DHBT Power Performance with 30% Class-A PAE at 94 GHz**
W. Quan, A. M. Arabhavi, D. Marti, S. Hamzeloui, O. Ostinelli, C. R. Bolognesi
*Millimeter-Wave Electronics, ETH Zurich, Zurich, Switzerland*

**8b.3 (Student)**
**11:40-12:00 PM – New GaInAs/InAs/InP Composite Channels for mm-Wave Low-Noise InP HEMTs**
Diego C. Ruiz, Tamara Saranovac, Daxin Han, Olivier Ostinelli, Colombo R. Bolognesi
*Millimeter-Wave Electronics, ETH Zurich, Zurich, Switzerland*

## 9a. Late News 1

Wednesday 1:10 PM - ***Ballroom Symphony #1***
Session Chair: Peter Zampardi, *Qorvo*
Co-Chair: Doug Weiser, *Texas Instruments*

**9a.1**
**1:30-1:50 PM - 300-GHz 120-Gb/s Wireless Transceiver with High-Output-Power and High-Gain Power Amplifier Based on 80-nm InP-HEMT Technology**
Hiroshi Hamada[1], Takuya Tsutsumi[1], Go Itami[1], Hiroki Sugiyama[1], Hideaki Matsuzaki[1], Kenichi Okada[2], and Hideyuki Nosaka[1]
*[1]NTT Device Technology Labs, NTT Corporation, 3-1 Morinosato-Wakamiya, Atsugi-shi, Kanagawa, 243–0198, Japan*
*[2]Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro-ku, Tokyo, 152-8550, Japan*

**9a.2**
**1:50-2:10 PM - A 110-GHz-Bandwidth 2:1 AMUX-Driver IC using 250-nm InP DHBTs for Beyond-1-Tb/s/carrier Optical Transmission Systems**
Munehiko Nagatani[1,2], Hitoshi Wakita[1], Yoshihiro Ogiso[3], Hiroshi Yamazaki[1,2], Miwa Mutoh[1], Minoru Ida[1], Fukutaro Hamaoka[2],

Masanori Nakamura[2], Takayuki Kobayashi[2], Yutaka Miyamoto[2], and Hideyuki Nosaka[1,2]
*[1]NTT Device Technology Laboratories, NTT Corporation, 3-1 Morinosato-Wakamiya, Atsugi, Kanagawa, 243–0198, Japan*
*[2]NTT Network Innovation Laboratories, NTT Corporation, 1-1 Hikari-no-oka, Yokosuka, Kanagawa, 239-0847, Japan*
*[3]NTT Device Innovation Center, NTT Corporation, 3-1 Morinosato-Wakamiya, Atsugi, Kanagawa, 243–0198, Japan*

**9a.3**

### 2:10-2:30 PM - A 19.5 dBm Power Amplifier with Highly Accurate 8-bit Power Controlling for Automotive Radar Applications in a 28 nm CMOS Technology

Daniel Reiter[1,2], Hao Li[1], Herbert Knapp[1], Jonas Kammerer[1], Jonas Fritzin[1], Soran Majied[1], Badou Sene[1,2] and Nils Pohl[2]
*[1]Infineon Technologies, Am Campeon 1-15, 85579 Neubiberg, Germany*
*[2]Ruhr-University Bochum, 44780 Bochum, Germany*

**9a.4**

### 2:30-3:10 PM - A 16-dBm D-Band Power Amplifier with a Cascaded CE and CB Output Power Stage Using a Stub Matching Topology

Badou Sene[1,2], Herbert Knapp[1], Hao Li[1], Jonas Kammerer[1], Soran Majied[1], Klaus Aufinger[1], Jonas Fritzin[1], Daniel Reiter[1,2] and Nils Pohl[2]
*[1]Infineon Technologies AG, Am Campeon 1-15, D-85579 Neubiberg, Germany*
*[2]Ruhr-University Bochum, Universit¨atsstr. 150, D-44780 Bochum, Germany*

**9a.5**

### 2:30-3:10 PM - 82 GHz direct up-converter mixer using double-balanced Gilbert cell with sensitivity analysis at mm-wave frequency

[1]Ahmed Omar, [1]A. Mukherjee, [1,3]P. Sakalas, [1]Y. Zhang, [2]W. Liang and [1]Michael Schröter
*[1]CEDIC, TUD, 01062 Dresden, Germany,*
*[2]Infineon Technologies AG, 85579 Neubiberg, Germany*
*[3]FRL, Center for Physical Sciences and Tech., 10257 Vilnius, Lithuania*

## 9b. A look at Devices and Models

Wednesday 1:30 PM - ***RoomTBD***
Session Chair: Jin Tang, *Texas Instruments*
Co-Chair: Breandán Ó hAnnaidh, *Analog Devices*

**9b.1**

### 1:30-1:50 PM - Application of the Kull epilayer formulation to a compact model for junction diodes

Adam W. DiVergilio
*GLOBALFOUNDRIES, Essex Junction, VT 05452, USA*

**9b.2 (Student)**

### 1:50-2:10 PM - Collector-substrate modeling of SiGe HBTs up to THz range

Bishwadeep Saha[1,2], Sebastien Frégonese[1], Soumya Ranjan Panda[1], Anjan Chakravorty[2], Didier Céli[3], Thomas Zimmer[1]
*[1]Laboratoire de l'Integration du Material au Systeme, University of Bordeaux, 33405 Talence Cedex, France*
*[2]Department of Electrical Engineering, Indian Institute of Technology, Madras, India*
*[3]STMicroelectronics, 850 rue Jean Monnet, 38926 Crolles, France*

**9b.3**

### 2:10-2:30 PM - Mathematical foundation for constructing accurate dynamic bipolar transistor compact models

Michael Schröter and Mario Krattenmacher

*CEDIC, Technische Universität Dresden, Germany*

### 9b.4 (Invited)
### 2:30-3:10 PM - Ultra-fast Thermoreflectance Imaging for Electronic, Optoelectronic, and Thermal Devices
Je-Hyeong Bahk[1] and Ali Shakouri[2]
*[1]Dept. of Mechanical and Materials Engineering, University of Cincinnati, Cincinnati, OH 45221, USA*
*[2]Microsanj LLC, San Jose CA; and Birck Nanotechnology Center, Purdue University, West Lafayette IN 47907, USA*

## 10a. Late News 2
Wednesday 2:50 PM - ***Ballroom Symphony #1***
Session Chair: Bruce Green, *NXP*
Co-Chair: Brian Moser, *Qorvo*

### 10a.1
### 3:40-4:00 PM – Virtual-Source Modeling of N-polar GaN MISHEMTS
Rohit R. Karnaty, Matthew Guidry, Pawana Shrestha, Brian Romanczyk, Nirupam Hatui, Xun Zheng, Christian Wurm, Haoran Li, Stacia Keller, Umesh K. Mishra, James F. Buckwalter
*Department of Electrical and Computer Engineering, University of California, Santa Barbara,California 93106,USA*

### 10a.2
### 4:00-4:20 PM – Implementation of InGaAs-OI Passive Devices and Its Application to 5G Millimeter-Wave Phase Shifter
Pilsoon Choi[1], Annie Kumar[2], Sachin Yadav[2], Xiao Gong[2], Dimitri A. Antoniadis[1], and Eugene A. Fitzgerald[1]
*[1]Massachusetts Institute of Technology, Cambridge, MA 02139, USA*
*[2]National University of Singapore, Singapore, 119077*

### 10a.3
### 4:20-4:40 PM – A 6–12 GHz Reconfigurable Transformer-Based Outphasing Combiner in 250-nm GaAs
Daniel Martin[1], Michael Roberg[2], Zoya Popovic[1], Taylor Barton[1]
*[1] Dept. of Electrical, Computer and Energy Engineering, University of Colorado Boulder, Boulder, CO 80309 USA*
*[2] Qorvo, Inc. Infrastructure and Defense Products, Richardson, TX 75080 USA*

## 10b. Advanced GaN FET Technologies
Wednesday 3:40 PM - ***RoomTBD***
Session Chair: Ken Chu, *BAE Systems*
Co-Chair: Sansaptak Dasgupta, *Intel*

### 10b.1
### 3:40-4:00 PM – Second Generation SLCFET Amplifier: Improved $F_T/F_{MAX}$ and Noise Performance
Ken A. Nagamatsu, Brian Novak, Annaliese Drechsler, Josephine Chang, Dale Dawson, Ron Freitag, Kevin Frey, Monique Farrell, Georges Siddiqi, Shamima Afroz, Shalini Gupta, Sam Wanis, Jeffrey Hartman, Eric J. Stewart, Patrick Shea, Karen Renaldo, Robert S. Howell
*Northrop Grumman Corporation (Mission Systems), Linthicum, Maryland, 21090, USA*

### 10b.2
### 4:00-4:20 PM – Remarkable Current Collapse Suppression in GaN HEMTs on Free-standing GaN Substrates
Yusuke Kumazaki[1,2], Toshihiro Ohki[1,2], Junji Kotani[1,2], Shiro Ozaki[1,2], Yoshitaka Niida[2], Kozo Makiyama[1,2], Yuichi Minoura[1,2], Naoya Okamoto[1,2], Norikazu Nakamura[1,2], Keiji Watanabe[1,2]
*[1]Fujitsu Limited, Atsugi, Kanagawa, 243-0197, Japan,*
*[2]Fujitsu Laboratories Ltd., Atsugi, Kanagawa, 243-0197, Japan*

### 10b.3

## 4:20-4:40 PM – Feasibility Study of InAlN/GaN HEMT for sub-6 GHz Band Applications

Kazutaka Inoue, Kenta Sugawara, Ken Kikuchi, Isao Makabe, Hiroshi Yamamoto

*Transmission Devices Laboratory, Sumitomo Electric Industries, Ltd., Sakae-ku, Yokohama, Kanagawa, 244-8588, Japan*

# Executive Committee

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| Todd Thibeault | TowerJazz |

## Symposium Event Management

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| Candi Wooldridge | MP Associates, Inc. |
| Jessica Lotito | IEEE Electron Devices Society |
| Jim Skowrenski | IEEE Electron Devices Society |
| Sherry Russ Sills | IEEE Meetings, Conferences and Events |

# Meeting Diagram & Local Information

## Loews Vanderbilt Hotel

★Short Course, Primer, Technical Sessions

♦Registration Desk

⭘Exhibitor Space

Map Coming Soon

**Local Directory**:
Click here to view some fun things to do during your stay in Nashville

**About Music City aka Nashville**
https://www.visitmusiccity.com/visitors/aboutmusiccity

**Dining:**
Lowes Vanderbilt Nashville Brochure

Dining and Entertainment **Mason’s** soulfully inspired fare from Executive Chef Brandon Fortune in a warm and inviting gathering place to share a drink, grab a bite and escape the hustle and bustle of Music City. Mason’s Bar A modern interpretation of the beloved, traditional “Southern Public House”—a place where folks dropped in for laughter, tall tales, good company and some of the finest beverages known to mankind.

**Ruth’s Chris Steak House®POD Organic Market**
Features fresh pastries, salads, flatbreads and a multitude of pre-packaged organic snacks and drinks. Some local favorites such as Frothy Monkey Coffee and Yazoo Beer are also available.

**Food around Nashville**
https://www.visitmusiccity.com/visitors/food

## Registration

Registration will be open

- Sunday, November 3 7:30 AM - 5:00 PM
- Monday, November 4 7:00 AM - 5:00 PM
- Tuesday, November 5 7:00 AM - 5:00 PM
- Wednesday, November 6 8:00 AM - 4:00 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, November 4, 2019**
Exhibitor Reception
5:30 PM to 8:00 PM
Symphony Ballroom #2&3

**Tuesday, November 5, 2019**
Exhibitor Breakfast
7:00 AM to 8:00 AM
Symphony Ballroom #2&3

Exhibitor Luncheon
11:30 AM to 1:00 PM
Symphony Ballroom #2&3

**Tuesday, November 5, 2019**
*Special Networking Event
5:00 to 6:00 PM
*Additional details will follow at a later date.

**Attendee Lounge & Speaker Ready Room:**
The Attendee Lounge/Speaker Ready Room will be available locations – TBD

We look forward to seeing you in Nashville. If you should have questions or need assistance during the planning process, please send a message to the specific contact below.

**Web Registration**
**Rachael Estabrook**
Event Associate, Event Management Services
**IEEE Meetings, Conferences & Events (MCE)** | 445 Hoes Lane, Piscataway, NJ 08854 USA
t:+1 844 816 1739 | f: +1 609 689 0069 | r.estabrook@ieee.org

**Hotel & General Meeting Information:**
Catherine Shaw
BCICTS Conference Manager
cs@cshawevents.com

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**November 8-11, 2020**
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