

# **2020 IEEE Radio Frequency Integrated Circuits Symposium (RFIC 2020)**

**Los Angeles, California, USA  
4-6 August 2020**



**IEEE Catalog Number: CFP20MMW-POD  
ISBN: 978-1-7281-6810-4**

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IEEE Catalog Number:	CFP20MMW-POD
ISBN (Print-On-Demand):	978-1-7281-6810-4
ISBN (Online):	978-1-7281-6809-8
ISSN:	1529-2517

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Chair: Fa Foster Dai, Auburn University, USA — Co-Chair: Joseph D. Cali, BAE Systems, USA

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<sup>1</sup>Fudan University, China ; <sup>2</sup>University of Washington, USA 
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<sup>1</sup>Technische Universiteit Delft, The Netherlands ; <sup>2</sup>EPFL, Switzerland 

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Chair: Ed Balboni, Analog Devices, USA — Co-Chair: Duane Howard, Jet Propulsion Laboratory, USA

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Chair: Pierre Busson, STMicroelectronics, USA — Co-Chair: Kenichi Okada, Tokyo Institute of Technology, Japan








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*<sup>1</sup>Stanford University, USA*  ; *<sup>2</sup>STMicroelectronics, France* 

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<sup>1</sup>Infineon Technologies, Germany  ; <sup>2</sup>eesy-IC, Germany 


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Chair: Hongtao Xu, Fudan University, China — Co-Chair: Shahriar Shahramian, Nokia Bell Labs, USA

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<sup>1</sup>imec, Belgium  ; <sup>2</sup>Pharrowtech, Belgium 










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Chair: Patrick Reynaert, Katholieke Universiteit Leuven, Belgium — Co-Chair: Oleh Krutko, Xilinx, Ireland

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Chair: Renyuan Wang, BAE Systems, USA — Co-Chair: Rocco Tam, NXP Semiconductors, USA









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*Imran Bashir<sup>1</sup>, Dirk Leipold<sup>1</sup>, Mike Asker<sup>1</sup>, Ali Esmailiyan<sup>2</sup>, Hongying Wang<sup>2</sup>, Teerachot Siriburanon<sup>2</sup>, Panagiotis Giounanlis<sup>2</sup>, Anna Koziol<sup>2</sup>, Dennis A. Miceli<sup>2</sup>, Elena Blokhina<sup>2</sup>, R. Bogdan Staszewski<sup>2</sup>*  
<sup>1</sup>Equal1 Labs, USA ; <sup>2</sup>University College Dublin, Ireland 

## RMo4B: Millimeter-Wave and Terahertz Circuits and Systems for Sensing and Communications

Chair: Omeed Momeni, University of California, Davis, USA — Co-Chair: Ruonan Han, MIT, USA





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RMo4B-1 **An Integrated 132–147GHz Power Source with +27dBm EIRP**  
*Akshay Visweswaran<sup>1</sup>, Alexander Haag<sup>2</sup>, Carmine de Martino<sup>3</sup>, Karina Schneider<sup>2</sup>, Tim Maiwald<sup>4</sup>, Bastien Vignon<sup>1</sup>, Klaus Aufinger<sup>5</sup>, Marco Spirito<sup>3</sup>, Thomas Zwick<sup>2</sup>, Piet Wambacq<sup>1</sup>*  
<sup>1</sup>imec, Belgium ; <sup>2</sup>KIT, Germany ; <sup>3</sup>Technische Universiteit Delft, The Netherlands ; <sup>4</sup>FAU Erlangen-Nürnberg, Germany ; <sup>5</sup>Infineon Technologies, Germany 
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RMo4B-2 **A High-Speed 390GHz BPOOK Transmitter in 28nm CMOS**  
*Carl D'heer, Patrick Reynaert, Katholieke Universiteit Leuven, Belgium *
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RMo4B-3 **A SiGe Millimeter-Wave Front-End for Remote Sensing and Imaging**  
*Milad Frounchi, John D. Cressler, Georgia Tech, USA *
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RMo4B-4 **A Fully Integrated Coherent 50–500-GHz Frequency Comb Receiver for Broadband Sensing and Imaging Applications**  
*Sam Razavian, Aydin Babakhani, University of California, Los Angeles, USA *

## RMo4C: High-Performance Frequency-Generation Components

Chair: Mohyee Mikhemar, Broadcom, USA — Co-Chair: Wanghua Wu, Samsung, USA

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RMo4C-1 **A 0.082mm<sup>2</sup> 24.5-to-28.3GHz Multi-LC-Tank Fully-Differential VCO Using Two Separate Single-Turn Inductors and a 1D-Tuning Capacitor Achieving 189.4dBc/Hz FOM and 200±50kHz 1/f<sup>3</sup> PN Corner**  
*Hao Guo, Yong Chen, Pui-In Mak, Rui P. Martins, University of Macau, China *
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RMo4C-2 **A 22.4-to-40.6-GHz Multi-Ratio Injection-Locked Frequency Multiplier with 57.7-dBc Harmonic Rejection**  
*Jingzhi Zhang, Yu Peng, Huihua Liu, Chenxi Zhao, Yunqiu Wu, Kai Kang, UESTC, China *
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RMo4C-3 **A 0.35mW 70GHz Divide-by-4 TSPC Frequency Divider on 22nm FD-SOI CMOS Technology**  
*Zoltán Tibenszky, Corrado Carta, Frank Ellinger, Technische Universität Dresden, Germany *
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RMo4C-4 **A Dual-Core 8–17GHz LC VCO with Enhanced Tuning Switch-Less Tertiary Winding and 208.8dBc/Hz Peak FoM<sub>T</sub> in 22nm FDSOI**  
*Omar El-Aassar, Gabriel M. Rebeiz, University of California, San Diego, USA *

## RTu1A: Millimeter-Wave Signal Generation

Chair: Ehsan Afshari, University of Michigan, USA — Co-Chair: Andrea Cathelin, STMicroelectronics, France

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RTu1A-1      **Frequency Multiplier-by-4 (Quadrupler) with 52dB Spurious-Free Dynamic Range for 152GHz to 220GHz (G-Band) in 130nm SiGe**  
*Paul Stärke, Vincent Riefl, Corrado Carta, Frank Ellinger, Technische Universität Dresden, Germany* **A**
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RTu1A-2      **A D-Band SiGe Frequency Doubler with a Harmonic Reflector Embedded in a Triaxial Balun**  
*Sunil G. Rao, Milad Frounchi, John D. Cressler, Georgia Tech, USA* **A**
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RTu1A-3      **A Multichannel Programmable High Order Frequency Multiplier for Channel Bonding and Full Duplex Transceivers at 60GHz Band**  
*A. Siligaris, J.L. Gonzalez-Jimenez, Clement Jany, B. Blampey, A. Boulmirat, A. Hamani, C. Dehos, CEA-Leti, France* **A**
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RTu1A-4      **A 126GHz, 22.5% Tuning, 191dBc/Hz FOMt 3rd Harmonic Extracted Class-F Oscillator for D-Band Applications in 16nm FinFET**  
*Bart Philippe, Patrick Reynaert, Katholieke Universiteit Leuven, Belgium* **A**
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RTu1A-5      **A 7.4dBm EIRP, 20.2% DC-EIRP Efficiency 148GHz Coupled Loop Oscillator with Multi-Feed Antenna in 22nm FD-SOI**  
*Muhammad Waleed Mansha, Mona Hella, Rensselaer Polytechnic Institute, USA* **A**

## RTu1B: 5G Focus Session on Advances in Mixer-First Receivers

Chair: Harish Krishnaswamy, Columbia University, USA — Co-Chair: Ramesh Harjani, University of Minnesota, USA

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RTu1B-1      **mm-Wave Mixer-First Receiver with Passive Elliptic Low-Pass Filter**  
*Pingyue Song, Hossein Hashemi, University of Southern California, USA* **A**
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RTu1B-2      **10–35GHz Passive Mixer-First Receiver Achieving +14dBm In-Band IIP3 for Digital Beam-Forming Arrays**  
*Sashank Krishnamurthy, Ali M. Niknejad, University of California, Berkeley, USA* **A**
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RTu1B-3      **A 9–31GHz 65nm CMOS Down-Converter with >4dBm OOB B1dB**  
*Zachariah G. Boynton, Alyosha Molnar, Cornell University, USA* **A**
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RTu1B-4      **A 2.5-to-4.5-GHz Switched-LC-Mixer-First Acoustic-Filtering RF Front-End Achieving <6dB NF, +30dBm IIP3 at 1×Bandwidth Offset**  
*Hyungjoo Seo, Jin Zhou, University of Illinois at Urbana-Champaign, USA* **A**

## RTu1C: Linearization and Efficiency Enhancement Techniques

Chair: Sungwon Chung, Neuralink, USA — Co-Chair: Margaret Szymanowski, NXP Semiconductors, USA

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*Yiyu Shen, Rob Bootsman, Morteza S. Alavi, Leo C.N. de Vreede, Technische Universiteit Delft, The Netherlands* **A**
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*Heechai Kang, Venkata S. Rayudu, Ki Yong Kim, Ranjit Gharpurey, University of Texas at Austin, USA* **A**
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RTu1C-3      **Preserving Polar Modulated Class-E Power Amplifier Linearity Under Load Mismatch**  
*Awani Khodkumbhe<sup>1</sup>, Maikel Huiskamp<sup>2</sup>, Ali Ghahremani<sup>2</sup>, Bram Nauta<sup>2</sup>, Anne-Johan Annema<sup>2</sup>*  
*<sup>1</sup>BITS Pilani, India* **A**; *<sup>2</sup>University of Twente, The Netherlands* **A**
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RTu1C-4      **A 28GHz Voltage-Combined Doherty Power Amplifier with a Compact Transformer-Based Output Combiner in 22nm FD-SOI**  
*Zhiwei Zong<sup>1</sup>, Xinyan Tang<sup>1</sup>, Khaled Khalaf<sup>2</sup>, Dongyang Yan<sup>1</sup>, Giovanni Mangraviti<sup>1</sup>, Johan Nguyen<sup>1</sup>, Yao Liu<sup>1</sup>, Piet Wambacq<sup>1</sup>*  
*<sup>1</sup>imec, Belgium* **A**; *<sup>2</sup>Pharrowtech, Belgium* **A**
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RTu1C-5      **A 6GHz 160MHz Bandwidth MU-MIMO Eight-Element Direct Digital Beamforming TX Utilizing FIR H-Bridge DAC**  
*Boyi Zheng, Lu Jie, Runyu Wang, Michael P. Flynn, University of Michigan, USA* **A**

## RTu1D: Mixed-Signal and Power Management Techniques for RF Transceivers

Chair: Antoine Frappé, IEMN (UMR 8520), France — Co-Chair: Bahar Jalali Farahani, Acacia Communications, USA

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RTu1D-1      **Fourier-Domain DAC-Based Transmitter: New Concepts Towards the Realisation of Multigigabit Wireless Transmitters**  
*Oner Hanay, Erkan Bayram, Stefan Müller, Mohamed Elsayed, Renato Negra, RWTH Aachen University, Germany* **A**
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RTu1D-2      **A 10MHz 40V  $V_{IN}$  Slope-Reconfigurable Gaussian Gate Driven GaN DC-DC Converter with 49.1dB Conducted EMI Noise Reduction at 100MHz**  
*Chang Yang<sup>1</sup>, Weizhong Chen<sup>1</sup>, Wei Da<sup>2</sup>, Yanli Fan<sup>2</sup>, Ping Gui<sup>1</sup>*  
*<sup>1</sup>Southern Methodist University, USA* **A**; *<sup>2</sup>Texas Instruments, USA* **A**
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RTu1D-3      **A Sub-10fs FOM, 5000× Load Driving Capacity and 5mV Output Ripple Digital LDO with Dual-Mode Nonlinear Voltage Detector and Dead-Zone Charge Pump Loop**  
*Bowen Wang, Woogeun Rhee, Zhihua Wang, Tsinghua University, China* **A**
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RTu1D-4      **A 32-40GHz 7-Bit CMOS Phase Shifter with 0.38dB/1.6° RMS Magnitude/Phase Errors for Phased Array Systems**  
*Yongjie Li<sup>1</sup>, Zongming Duan<sup>2</sup>, Wei Lv<sup>2</sup>, Dongfang Pan<sup>1</sup>, Zipeng Xie<sup>1</sup>, Yuefei Dai<sup>2</sup>, Ligu Sun<sup>1</sup>*  
*<sup>1</sup>USTC, China* **A**; *<sup>2</sup>ECRIEE, China* **A**

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**RTu2A: Ultra-Low Power Transceivers**

*Chair: Chun Huat Heng, NUS, Singapore — Co-Chair: Gernot Hueber, Silicon Austria Labs, Austria*

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RTu2A-1      **A 66.97pJ/Bit, 0.0413mm<sup>2</sup> Self-Aligned PLL-Calibrated Harmonic-Injection-Locked TX with >62dBc Spur Suppression for IoT Applications**  
*Chung-Ching Lin, Huan Hu, Subhanshu Gupta, Washington State University, USA *
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RTu2A-2      **A 67-μW Ultra-Low Power PVT-Robust MedRadio Transmitter**  
*Somok Mondal, Drew A. Hall, University of California, San Diego, USA *
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RTu2A-3      **A 400MHz/900MHz Dual-Band Ultra-Low-Power Digital Transmitter for Biomedical Applications**  
*Zhaoyang Weng<sup>1</sup>, Hanjun Jiang<sup>1</sup>, Yanshu Guo<sup>1</sup>, Zhihua Wang<sup>2</sup>*  
*<sup>1</sup>Tsinghua University, China  ; <sup>2</sup>RITS, China *
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*Zhen Feng, Li-Xuan Chuo, Yao Shi, Yejoong Kim, HunSeok Kim, David Blaauw, University of Michigan, USA *
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RTu2A-5      **A Fully Integrated 0.2V 802.11ba Wake-Up Receiver with -91.5dBm Sensitivity**  
*Jaeho Im<sup>1</sup>, Jacob Breiholz<sup>2</sup>, Shuo Li<sup>2</sup>, Benton Calhoun<sup>2</sup>, David D. Wenzloff<sup>1</sup>*  
*<sup>1</sup>University of Michigan, USA  ; <sup>2</sup>University of Virginia, USA *

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**RTu2B: 5G Focus Session on Millimeter-Wave Components and Systems**

*Chair: Tim Larocca, Northrop Grumman, USA — Co-Chair: Jane Gu, University of California, Davis, USA*

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RTu2B-1      **A 16-Element Fully Integrated 28GHz Digital Beamformer with In-Package 4×4 Patch Antenna Array and 64 Continuous-Time Band-Pass Delta-Sigma Sub-ADCs**  
*Rundao Lu, Christine Weston, Daniel Weyer, Fred Buhler, Michael P. Flynn, University of Michigan, USA *
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RTu2B-2      **A 28GHz Front-End Module with T/R Switch Achieving 17.2dBm P<sub>sat</sub>, 21.5% PAE<sub>max</sub> and 3.2dB NF in 22nm FD-SOI for 5G Communication**  
*Yao Liu<sup>1</sup>, Xinyan Tang<sup>1</sup>, Giovanni Mangraviti<sup>1</sup>, Khaled Khalaf<sup>2</sup>, Yang Zhang<sup>1</sup>, Wei-Min Wu<sup>1</sup>, Shih-Hung Chen<sup>1</sup>, Björn Debaille<sup>1</sup>, Piet Wambacq<sup>1</sup>*  
*<sup>1</sup>imec, Belgium  ; <sup>2</sup>Pharrowtech, Belgium *
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RTu2B-3      **A 24–28GHz Power and Area Efficient 4-Element Phased-Array Transceiver Front-End with 21.1%/16.6% Transmitter Peak/OP1dB PAE Supporting 2.4Gb/s in 256-QAM for 5-G Communications**  
*Wei Zhu<sup>1</sup>, Jiawen Wang<sup>1</sup>, Wei Lv<sup>2</sup>, Xiaohan Zhang<sup>3</sup>, Bingbing Liao<sup>2</sup>, Yanping Zhu<sup>2</sup>, Yan Wang<sup>1</sup>*  
*<sup>1</sup>Tsinghua University, China  ; <sup>2</sup>ECRIE, China  ; <sup>3</sup>Rice University, USA *
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RTu2B-4      **A CMOS Ka-Band SATCOM Transceiver with ACI-Cancellation Enhanced Dual-Channel Low-NF Wide-Dynamic-Range RX and High-Linearity TX**  
*Yun Wang<sup>1</sup>, Dongwon You<sup>1</sup>, Xi Fu<sup>1</sup>, Takeshi Nakamura<sup>1</sup>, Ashbir Aviat Fadila<sup>1</sup>, Teruki Someya<sup>1</sup>, Atsuhiko Kawaguchi<sup>1</sup>, Jian Pang<sup>1</sup>, Kiyoshi Yanagisawa<sup>1</sup>, Bangan Liu<sup>1</sup>, Yuncheng Zhang<sup>1</sup>, Haosheng Zhang<sup>1</sup>, Rui Wu<sup>1</sup>, Atsushi Shirane<sup>1</sup>, Shunichiro Masaki<sup>2</sup>, Daisuke Yamazaki<sup>2</sup>, Kenichi Okada<sup>1</sup>*  
*<sup>1</sup>Tokyo Institute of Technology, Japan  ; <sup>2</sup>Socionext, Japan *

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**Inter-Stream Loopback Calibration for 5G Phased-Array Systems**  
*Yuuichi Aoki, Yonghoon Kim, Yongan Hwang, Sunryoul Kim, Manh Tuan Dao, Daehyun Kang, Donggyu Minn, Heedo Kang, Hyun-Chul Park, An-Sang Ryu, Sehyug Jeon, Sung-Gi Yang, Samsung, Korea* 

## RTu2C : Sub-6 GHz Receiver Front-End Circuits


*Chair: Kamran Entesari, Texas A&M University, USA — Co-Chair: Gary Hau, Qualcomm, USA*

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**A Wide-Band RF Front-End Module for 5G mMIMO Applications**  
*Mike Fraser, Venkata N.K. Malladi, Joseph Staudinger, Chun-Wei Chang, NXP Semiconductors, USA* 


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**A 1.2V, 5.5GHz Low-Noise Amplifier with 60dB On-Chip Selectivity for Uplink Carrier Aggregation and 1.3dB NF**  
*Daniel Schrögendorfer, Thomas Leitner, Infineon Technologies, Austria* 


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**A 5-6GHz Low-Noise Amplifier with >65-dB Variable-Gain Control in 22nm FinFET CMOS Technology**  
*Yi-Shin Yeh, Hyung-Jin Lee, Intel, USA* 

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**A Wideband Variable-Gain Amplifier with a Negative Exponential Generation in 40-nm CMOS Technology**  
*Yangtao Dong, Lingshan Kong, Chirn Chye Boon, Zhe Liu, Chenyang Li, Kaituo Yang, Ao Zhou, NTU, Singapore* 

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**A 0.08mm<sup>2</sup> 1-6.2GHz Receiver Front-End with Inverter-Based Shunt-Feedback Balun-LNA**  
*Benqing Guo<sup>1</sup>, Dario Prevedelli<sup>2</sup>, Rinaldo Castello<sup>2</sup>, Danilo Manstretta<sup>2</sup>*  
*<sup>1</sup>Chengdu University, China* ; *<sup>2</sup>Università di Pavia, Italy* 