

2014 IEEE Compound Semiconductor Integrated Circuit Symposium

(CSICS 2014)

**La Jolla, California, USA
19-22 October 2014**



**IEEE Catalog Number: CFP14GAA-POD
ISBN: 978-1-4799-3623-6**

List of Papers

SESSION A: Plenary Session

Chairpersons: *Harris Moyer, HRL Laboratories, LLC*
Jim Carroll, NI-AWR Group

- A.1 **Evolution of Multi-Gigabit Wireline Transceivers in CMOS** pg 1
Ichiro Fujimori
- A.2 **FD-SOI Technology Development and Key Devices Characteristics for Fast, Power Efficient, Low Voltage SoCs** pg 5
Joel Hartmann
- A.3 **Materials and Integration Strategies for Modern RF Integrated Circuits** pg 9
Daniel S. Green, Carl L. Dohrman, Avinash S. Kane and Tsu-Hsi Chang
- A.4 **Future of GaN RF Technology in Europe** pg 13
H. Blanck, J. Splettstößer and D. Floriot
- A.5 **GaN for Next Generation Electronics** pg 17
Paul Saunier

SESSION B: Advanced Low Noise and Mixer Technology

Chairpersons: *Gilberto A. De la Rosa, Anadigics*
Tomoya Kaneko, NEC

- B.1 **An InP MMIC Process Optimized for Low Noise at Cryo** pg 21
P. Å. Nilsson, J. Schlee, N. Wade Falk, J. P. Starski, H. Rodilla, G. Alestig, J. Halonen, B. Nilsson, H. Zirath and J. Grahn
- B.2 **Single Chip RF Variable Gain Low Noise Amplifier** pg 25
Bin Hou, Yibing Zhao, Eric Newman and Shuyun Zhang
- B.3 **A 0.05-26 GHz Direct Conversion I/Q Modulator MMIC** pg 29
Eric W. Iverson and Milton Feng
- B.4 **A up to 100 GHz Broadband Mixer with Cascaded Distributed Amplifier** pg 33
Yihu Li, Goh Wang Ling and Yong-Zhong Xiong

SESSION C: Thermal Management of GaN Devices

Chairpersons: *Hooman Kazemi, Nuvotronics*
Avinash Kane, Booz Allen Hamilton

- C.1 **Optimizing GaN-on-Diamond Transistor Geometry for Maximum Output Power** pg 37
J. W. Pomeroy and M. Kuball
- C.2 **Progress on Phase Separation Microfluidics** pg 41
Damena D. Agonafer, James Palko, Yoonjin Won, Ken Lopez, Tom Dusseault, Julie Gires, Mehdi Asheghi, Juan G. Santiago and Kenneth E. Goodson

- C.3 **High Resolution Thermal Characterization and Simulation of Power AlGaIn/GaN HEMTs Using Micro-Raman Thermography and 800 Picosecond Transient Thermoreflectance Imaging** pg 45
Kerry Maize, Georges Pavlidis, Eric Heller, Luke Yates, Dustin Kendig, Samuel Graham and Ali Shakouri
- C.4 **Thermal Interface Resistance Measurements for GaN-on-Diamond Composite Substrates** pg 53
Jungwan Cho, Yoonjin Won, Daniel Francis, Mehdi Asheghi and Kenneth E. Goodson
- C.5 **Microfluidic Heat Exchangers for High Power Density GaN on SiC** pg 57
Yoonjin Won, Farzad Houshmand, Damena Agonafer, Mehdi Asheghi and Kenneth E. Goodson

SESSION D: mm-Wave & THz Amplifiers

Chairpersons: *Arun Natarajan, Oregon State University*
Hooman Kazemi, Nuvotronics LLC

- D.1 **A 23.2dBm at 210GHz to 21.0dBm at 235GHz 16-Way PA-Cell Combined InP HBT SSPA MMIC** pg 62
Zach Griffith, Miguel Urteaga, Petra Rowell and Richard Pierson
- D.2 **Backside Process Free Broadband Amplifier MMICs at D-Band and H-Band in 20 nm mHEMT Technology** pg 66
Thomas Merkle, Arnulf Leuther, Stefan Koch, Ingmar Kallfass, Axel Tessmann, Sandrine Wagner, Hermann Massler, Michael Schlechtweg and Oliver Ambacher
- D.3 **A Broadband 220-320 GHz Medium Power Amplifier Module** pg 70
A. Tessmann, A. Leuther, V. Hurm, H. Massler, S. Wagner, M. Kuri, M. Zink, M. Riessle, H.-P. Stulz, M. Schlechtweg and O. Ambacher
- D.4 **A >200mW SSPA from 76-94GHz, with Peak 28.9% PAE at 86GHz** pg 74
Zach Griffith, Miguel Urteaga, Petra Rowell and Richard Pierson

SESSION E: Advanced Optical Modulators

Chairpersons: *Craig Steinbeiser, TriQuint Semiconductor*
Munehiko Nagatani, NTT Photonics Laboratories

- E.1 **Linear Optical Modulator for DAC-Based Coherent Fiber Communications Systems** pg 78
Hiroshi Yamazaki
- E.2 **A Compact Low-Power 224-Gb/s DP-16QAM Modulator Module with InP-Based Modulator and Linear Driver ICs** pg 82
Naoki Itabashi, Taizo Tatsumi, Tomoko Ikagawa, Naoya Kono, Morihiko Seki, Keiji Tanaka, Kazuhiro Yamaji, Yasushi Fujimura, Katsumi Uesaka, Takashi Nakabayashi, Hajime Shoji and Shoichi Ogita
- E.3 **Silicon Photonic Modulator Based on a MOS-Capacitor and a CMOS Driver** pg 86
M. Webster, C. Appel, P. Gothoskar, S. Sunder, B. Dama and K. Shastri
- E.4 **Gallium Arsenide Electro-Optic Modulators** pg 90
R. G. Walker, M. F. O'Keefe, N. Cameron, H. Ereifej and T. Brast

SESSION F: mm-Wave & THz Arrays

Chairpersons: *Shahriar Shahramian, Bell Laboratories*
Kazuya Yamamoto, Mitsubishi Electric

- F.1 **Wafer-Scale Millimeter-Wave Phased-Array RFICs pg 94**
Gabriel M. Rebeiz, Woorim Shin, Faith Golcuk, Ozgur Inac,
Samet Zehir, Ozan Gurbuz, Jennifer Edwards and Tumay Kanar
- F.2 **245 GHz SiGe Transmitter Array for Gas Spectroscopy pg 98**
Klaus Schmalz, Johannes Borngräber, Wojciech Debski, Mohamed Elkhoully,
Ruoyu Wang, Philipp Neumaier and Heinz-Wilhelm Hübers
- F.3 **A Compact 340 GHz 2x4 Patch Array with Integrated Subharmonic Gilbert Core Mixer as a Building Block for Multi-Pixel Imaging Frontends pg 102**
Yogesh Karandikar, Herbert Zirath, Yu Yan and Vessen Vassilev

SESSION G: Emerging Technologies and Devices

Chairpersons: *Paul Rosenthal, Boeing*
Han Wui Then, Intel Corp

- G.1 **Diverse Accessible Heterogeneous Integration (DAHI) at Northrop Grumman Aerospace Systems (NGAS) pg 106**
Augusto Gutierrez-Aitken, Kelly Hennig, Dennis Scott, Ken Sato, Wesley Chan, Benjamin Poust,
Xiang Zeng, Khanh Thai, Eric Nakamura, Eric Kaneshiro, Nancy Lin, Cedric Monier,
Ioulia Smorchkova, Bert Oyama, Aaron Oki, Reynold Kagiwada and Greg Chao
- G.2 **Enabling Power-Efficient Designs with III-V Tunnel FETs pg 110**
Moon Seok Kim, Huichu Liu, Karthik Swaminathan, Xueqing Li, Suman Datta
and Vijaykrishnan Narayanan
- G.3 **Device Perspective on 2D Materials pg 114**
Peide D. Ye

SESSION H: High-Speed Optical Communication Components

Chairpersons: *The' Linh Nguyen, Finisar*
Yuriy Greshishchev, Ciena Corporation

- H.1 **Advances on III-V on Silicon DBR and DFB Lasers for WDM Optical Interconnects and Associated Heterogeneous Integration 200mm-Wafer-Scale Technology pg 118**
S. Menezo, H. Duprez, A. Descos, D. Bordel, L. Sanchez, P. Brianceau, L. Fulbert,
V. Carron and B. Ben Bakir
- H.2 **Optical Phase-Locking and Wavelength Synthesis pg 124**
M. J. W. Rodwell, H. C. Park, M. Piels, M. Lu, A. Sivananthan, E. Bloch, Z. Griffith,
M. Uteaga, L. Johansson, J. E. Bowers and L. A. Coldren
- H.3 **InP DHBT Mux-Drivers for Very High Symbol Rate Optical Communications pg 128**
J. Godin, J.-Y. Dupuy, F. Jorge, F. Blache, M. Riet, V. Nodjiadjim, P. Berdaguer
B. Duval and A. Konczykowska
- H.4 **A 25Gb/S Common-Cathode VCSEL Driver pg 132**
Kwan Ting Ng, Yeung Bun Choi and Keh Chung Wang

SESSION I: High Efficiency Power Amplifier Architectures

Chairpersons: *David W. Runton, M/A-COM Tech. Solutions Inc.*
Rik Jos, NXP Semiconductors

- I.1 **Power Amplifier Design Optimized for Envelope Tracking** pg 136
Gayle Fran Collins, Jeremy Fisher, Fabian Radulescu, Jeff Barner, Scott Sheppard, Rick Worley and Don Kimball
- I.2 **GaN Technology in Base Stations - Why and When?** pg 140
Eric Higham
- I.3 **Development of High-Efficiency X-Band Outphasing Transmitter** pg 145
Chenggang Xie, David Cripe, John Reyland, Don Landt and Anders Walker
- I.4 **Broadband Doherty Alternative with Filter Design Considerations** pg 149
Jeff Jones, Basim Noori, Jeff Frei and Enver Krvavac

SESSION J: GaN Modeling

Chairpersons: *Faramarz Kharabi, RFMD*
Kenneth K. Chu, BAE Systems

- J.1 **Status of the GaN HEMT Standardization Effort at the Compact Model Coalition** pg 153
Samuel D. Mertens
- J.2 **Symmetrical Modeling of GaN HEMTS** pg 157
Ankur Prasad, Christian Fager, Mattias Thorsell, Christer M. Andersson and Klas Yhland
- J.3 **First Pass Multi Cell Modeling Strategy for GaN Package Devices** pg 161
Subrata Halder, John McMacken and Joseph Gering
- J.4 **Model Development for Monolithically-Integrated E/D-Mode Millimeter-Wave InAlN/AlN/GaN HEMTs** pg 165
Jun Ren, Bo Song, Huili Grace Xing, Shuoqi Chen, Andrew Ketterson, Edward Beam, Tso-Min Chou, Manyam Pilla, Hua-Quen Tserng, Xiang Gao, Paul Saunier and Patrick Fay

SESSION K: mm-Wave & THz Subsystems

Chairpersons: *Frank E. van Vliet, TNO*
Marc Rocchi, OMMIC

- K.1 **SiGe Transmitter and Receiver Circuits for Emerging Terahertz Applications** pg 169
U. R. Pfeiffer, J. Grzyb, R. Al Hadi, N. Sarmah, K. Statnikov, S. Malz and B. Heinemann
- K.2 **Silicon Wireless Systems for 60-GHz Consumer and Infrastructure Applications** pg 173
Alex Tomkins, Alan Poon, Eric Juntunen, Ahmed El-Gabaly, Grigori Temkine, Yat-Loong To, Craig Farnsworth, Arash Tabibiazar, Mohammad Fakharzadeh, Saman Jafarlou, Hatem Tawfik, Brad Lynch, Mihai Tazlauanu and Ronald Glibbery
- K.3 **An Active Double-Balanced Down-Conversion Mixer in InP/Si BICMOS Operating from 70-110 GHz** pg 177
Jamin J. McCue, Matthew Casto, James C. Li, Paul Watson and Waleed Khalil

- K.4 GaN Technology for E, W and G-Band Applications pg 181**
*A. Margomenos, A. Kurdoghlian, M. Micovic, K. Shinohara, D. F. Brown, A. L. Corrion,
H. P. Moyer, S. Burnham, D. C. Regan, R. M. Grabar, C. McGuire, M. D. Wetzel,
R. Bowen, P. S. Chen, H. Y. Tai, A. Schmitz, H. Fung, A. Fung and D. H. Chow*

SESSION L: Evaluation and Modeling of High-Power and High-Speed Devices

Chairpersons: *Michael Schroter, UCSD/TUD
Rob Jones, Raytheon*

- L.1 An Evaluation of Extraction Methods for the Emitter Resistance for InP DHBTs pg 185**
T. Nardmann, J. Krause and M. Schroter
- L.2 The Impact of Electro-Thermal Coupling on HBT Power Amplifiers pg 189**
Matthew T. Ozalas
- L.3 Analysis of the Influence of Layout and Technology Parameters on the Thermal Impedance of GaAs HBT/BiFET Using a Highly-Efficient Tool pg 193**
A. Magnani, V. d'Alessandro, L. Codecasa, P. J. Zampardi, B. Moser and N. Rinaldi
- L.4 Evaluation and Modeling of Voltage Stress-Induced Hot Carrier Effects in High-Speed SiGe HBTs pg 197**
*Grazia Sasso, Cristell Maneux, Josef Boeck, Vincenzo d'Alessandro, Klaus Aufinger,
Thomas Zimmer and Niccolò Rinaldi*

SESSION M: High Frequency Power Amplifiers

Chairpersons: *Simon Wood, Cree
Frank van Vliet, TNO*

- M.1 Miniaturization of Ka-Band High Power Amplifier by 0.15 μm GaN MMIC Technology pg 201**
Kris Kong, Ming-Yih Kao and Sabyasachi Nayak
- M.2 X-Ku Wide-Bandwidth GaN HEMT MMIC Amplifier with Small Deviation of Output Power and PAE pg 205**
*Yoshitaka Niida, Yoichi Kamada, Toshihiro Ohki, Shiro Ozaki, Kozo Makiyama,
Naoya Okamoto, Masaru Sato, Satoshi Masuda and Keiji Watanabe*
- M.3 A 6-12 GHz Push-Pull GaN Amplifier for Low Harmonic Drive Applications pg 209**
Michael Roberg and Bumjin Kim
- M.4 Investigation of Various Envelope Complexity Linearity under Modulated Stimulus Using a New Envelope Formulation Approach pg 213**
*F. L. Ogbai, P. J. Tasker, M. Akmal, J. Lees, J. Benedikt, S. Bensmida, K. Morris,
M. Beach and J. McGeehan*

SESSION N: Application of Next Generation Technologies

Chairpersons: *Steve Huettner, Nuvotronics LLC
Jim Carroll, NI-AWR Group*

- N.1 W-Band GaN Receiver Components Utilizing Highly Scaled, Next Generation GaN Device Technology pg 217**
*A. Margomenos, A. Kurdoghlian, M. Micovic, K. Shinohara, H. Moyer, D. C. Regan,
R. M. Grabar, C. McGuire, M. D. Wetzel and D. H. Chow*
- N.2 Ka Band Chip-Set for Electronically Steerable Antennas pg 221**
Rémy Leblanc, Noelia Santos Ibeas, Ahmed Gasmî and Joël Moron

- N.3 **12.5 THz Fco GeTe Inline Phase-Change Switch Technology for Reconfigurable RF and Switching Applications** pg 225
Nabil El-Hinnawy, Pavel Borodulin, Evan B. Jones, Brian P. Wagner, Matthew R. King, John S. Mason Jr., James Bain, Jeyanandh Paramesh, T. E. Schlesinger, Robert S. Howell, Michael J. Lee and Robert M. Young
- N.4 **Low Loss, High Performance 1-18 GHz SPDT Based on the Novel Super-Lattice Castellated Field Effect Transistor (SLCFET)** pg 228
Robert S. Howell, Eric J. Stewart, Ron Freitag, Justin Parke, Bettina Nechay, Harlan Cramer, Matthew King, Shalini Gupta, Jeff Hartman, Pavel Borodulin, Megan Snook, Ishan Wathuthanthri, Parrish Ralston, Karen Renaldo and H. George Henry

SESSION O: Mixed Signal Circuits

Chairpersons: *James Buckwalter, UC San Diego*
Hui Pan, Broadcom, Irvine

- O.1 **1700 Pixels Per Inch (PPI) Passive-Matrix Micro-LED Display Powered by ASIC** pg 232
Wing Cheung Chong, Wai Keung Cho, Zhao Jun Liu, Chu Hong Wang and Kei May Lau
- O.2 **Programmable Active Clock Spine for 100Gb/200Gb Coherent Optical Receiver Chip in 32nm CMOS** pg 236
Naim Ben-Hamida, Christopher Kurowski, Robert Gibbins, Junxian Weng, Ted Wong, John Lindsay, Harvey Mah, Sadok Aouini and Andrew McCarthy
- O.3 **A 7-8 GHz Serrodyne Modulator in SiGe for MIMO Signal Generation** pg 240
Johan C. J. G. Withagen, A. J. Annema, B. Nauta and F. E. van Vliet

SESSION P: Breaking News Papers

Chairpersons: *Douglas S. McPherson, Ciena*
Charles F. Campbell, TriQuint Semiconductor

- P.1 **A Highly Integrated Chipset for 40 Gbps Wireless D-Band Communication Based on a 250 nm InP DHBT Technology** pg 244
Sona Carpenter, Zhongxia He, Mingquan Bao and Herbert Zirath
- P.2 **Characterization of the High Frequency Performance of 28-nm UTBB FDSOI MOSFETs as a Function of Backgate Bias** pg 248
Stefan Shopov and Sorin P. Voinigescu
- P.3 **An 8-Bit 140-GHz Power-DAC Cell for IQ Transmitter Arrays with Antenna Segmentation** pg 252
Stefan Shopov and Sorin P. Voinigescu
- P.4 **Advanced Process and Modeling on 600+ GHz Emitter Ledge Type-II GaAsSb/InP DHBT** pg 256
Huiming Xu, Barry Wu, Ardy Winoto and Milton Feng
- P.5 **170 GHz SiGe-BiCMOS Loss-Compensated Distributed Amplifier** pg 261
Paolo Valerio Testa, Guido Belfiore, David Fritsche, Corrado Carta and Frank Ellinger
- P.6 **Direct Down-Conversion 38 GHz GaAs and SiGe Receivers** pg 265
Ryan M. Clement, Leigh E. Milner, Emmanuelle R. Convert, Leonard Hall, Michael Parker, MacCrae G. McCulloch, Anna Dadello, Benny Wu, James T. Harvey, Anthony E. Parker and Simon J. Mahon