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A Right-Half-Plane Zero-Free Buck-Boost DC-DC Converter with 97.46% High Efficiency and Low Output Voltage Ripple, Y.-A. Lin*, T.-P. Huang*, Y.-Z. Ou-Yang*, Z.-R. Wu*, K.-H. Chen*, Y.-H. Lin**, M.-H. Lin*** and H.-T. Chou***, *National Chiao Tung Univ., **Realtek Semiconductor Corp. and ***National Chung-Shan Institute of Science and Technology, Taiwan

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Technology / Circuits Joint Focus Session 2**IoT & Sensor [Suzaku III]**

Wednesday, June 12, 16:00-18:05

Chairpersons: M. Hashimoto, Osaka Univ.

D. Markovic, Univ. of California, Los Angeles

JFS2-1 - 16:00

Integrated Power Management and Microcontroller for Ultra-Wide Power Adaptation Down to nW, L. Lin, S. Jain and M. Alioto, National Univ. of Singapore, Singapore

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JFS2-2 - 16:25

A 10mm³ Light-Dose Sensing IoT² System with 35-to-339nW 10-to-300klx Light-Dose-to-Digital Converter, I. Lee*, E. Moon*, Y. Kim**, J. Phillips* and D. Blaauw***, *Univ. of Michigan and **CubeWorks, Inc., USA

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JFS2-3 - 16:50

Low-Power and ppm-Level Detection of Gas Molecules by Integrated Metal Nanosheets, T. Tanaka*, K. Tabuchi*, K. Tatehara*, Y. Shiiki*, S. Nakagawa*, T. Takahashi**, R. Shimizu*, H. Ishikuro*, T. Kuroda*, T. Yanagida** and K. Uchida****, *Keio Univ., **Kyushu Univ. and ***The Univ. of Tokyo, Japan

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JFS2-4 - 17:15

Record-High Performance Trantenna Based on Asymmetric Nano-Ring FET for Polarization-Independent Large-Scale/Real-Time THz Imaging, E.-S. Jang*, M. W. Ryu*, R. Patel*, S. H. Ahn*, H. J. Jeon*, K. Han** and K. R. Kim*, *Ulsan National Institute of Science and Technology and **Dongguk Univ., Korea

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JFS2-5 - 17:40

(Invited)

Custom Silicon and Sensors Developed for a 2nd Generation Augmented Reality User Interface, P. O'Connor, C. Meekhof, C. McBride, C. Mei, C. Bamji, D. Rohn, H. Strande, J. Forrester, M. Fenton, R. Haraden, T. Ozguner and T. Perry, Microsoft, USA.

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J. Proesel, IBM

C16-1 - 16:00

A 50Gb/s Hybrid Integrated Si-Photonic Optical Link in 16nm FinFET, M. Raj*, Y. Frans*, S. L. C. Ambatipudi*, D. Mahashin*, P. De Heyn**, S. Balakrishnan**, J. Van Campenhout**, J. Grayson***, M. Epitoux*** and K. Chang*, *Xilinx, Inc., USA, **imec, Belgium and ***Samtec, Inc., USA

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C16-2 - 16:25

A Laser-forwarded Coherent 10Gb/s BPSK Transceiver Using Monolithic Microring Resonators in 45nm SOI CMOS, N. Mehta, S. Lin, B. Yin, S. Moazeni and V. Stojanovic, Univ. of California, Berkeley, USA

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C16-3 - 16:50

A 4-to-20Gb/s 1.87pJ/b Referenceless Digital CDR with Unlimited Frequency Detection Capability in 65nm CMOS, K. Park, K. Lee, S.-Y. Cho, J. Lee, J. Hwang, M.-S. Choo and D.-K. Jeong, Seoul National Univ., Korea

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C16-4 - 17:15

A 0.87 V 12.5 Gb/s Clock-Path Feedback Equalization Receiver with Unfixed Tap Weighting Property in 65 nm CMOS, D. Lee, D. Lee, Y.-H. Kim and L.-S. Kim, KAIST, Korea

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C16-5 - 17:40

A 0.1pJ/b/dB 1.62-to-10.8Gb/s Video Interface Receiver with Fully Adaptive Equalization Using Un-Even Data Level, J. Lee*, K. Lee*, H. Kim*, B. Kim**, K. Park* and D.-K. Jeong*, *Seoul National Univ. and **Samsung Electronics Co., Ltd., Korea

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SESSION 17 - Non-Volatile Memories [Suzaku I]

Wednesday, June 12, 16:00-18:05

Chairpersons: Y. Takai, Micron Japan

V. Agrawal, Cypress Semiconductor Corp.

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A 65nm Silicon-on-Thin-Box (SOTB) Embedded 2T-MONOS Flash Achieving 0.22 pJ/bit Read Energy with 64 MHz Access for IoT Applications, K. Matsubara, T. Nagasawa, Y. Kaneda, H. Mitani, H. Sato, T. Iwase, Y. Aoki, K. Maekawa, H. Yamakoshi, T. Ito, H. Kondo and T. Kono, Renesas Electronics Corp., Japan

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Embedded PCM Macrocell for Automotive-Grade Microcontroller in 28nm FD-SOI Technology, F. E. C. Disegni*, R. Annunziata*, A. Molgora*, G. Campardo*, P. Cappelletti*, P. Zuliani*, P. Ferreira**, A. Ventre*, G. Castagna*, A. Cathelin**, A. Gandolfo*, F. Goller*, S. Malhi***, D. Manfrè*, A. Maurelli*, C. Torti*, F. Arnaud**, M. Carfi*, M. Perroni*, M. Caruso*, S. Pezzini*, G. Piazza*, O. Weber**** and M. Peri*, *STMicroelectronics N.V., Italy, **STMicroelectronics N.V., France, ***STMicroelectronics N.V., India and ****CEA-LETI, France

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C17-3 - 16:50

Liquid Silicon: A Nonvolatile Fully Programmable Processing-In-Memory Processor with Monolithically Integrated ReRAM for Big Data/Machine Learning Applications, Y. Zha*, E. Nowak** and J. Li*, *Univ. of Wisconsin-Madison, USA and **CEA-LETI, France

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C17-4 - 17:15

The Demonstration of Gate Dielectric-Fuse 4kb OTP Memory Feasible for Embedded Applications in High-K Metal-gate CMOS Generations and Beyond, E. R. Hsieh***, C. W. Chang*, C. C. Chuang*, H. W. Chen**** and S. Chung*, *National Chiao Tung Univ., Taiwan, **Stanford Univ., USA and ***United Microelectronics Corp., Taiwan

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C17-5 - 17:40

A 24MB Embedded Flash System Based on 28nm SG-MONOS Featuring 240MHz Read Operations and Robust Over-The-Air Software Update for Automotive, A. Kanda, T. Kurafuji, K. Takeda, T. Ogawa, Y. Taito, K. Yoshihara, M. Nakano, T. Ito, H. Kondo and T. Kono, Renesas Electronics Corp., Japan

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SESSION 18 - Sensors for Object Detection and Recognition [Suzaku III]

Thursday, June 13, 8:30-10:10

Chairpersons: Y. Oike, Sony Semiconductor Solutions Corp.

L. Sibeud, CEA-LETI

C18-1 - 8:30

A 640x640 Fully Dynamic CMOS Image Sensor for Always-On Object Recognition, I. Park*, W. Jo*, C. Park*, B. Park*, J. Cheon** and Y. Chae*, *Yonsei Univ. and **Kumoh National Institute of Technology, Korea

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C18-2 - 8:55 A 132 by 104 10µm-Pixel 250µW 1kefps Dynamic Vision Sensor with Pixel-Parallel Noise and Spatial Redundancy Suppression , C. Li*, L. Longinotti*, F. Corradi** and T. Delbruck***, *iniVation AG, **iniLabs GmbH and ***Univ. of Zurich, Switzerland	157	C20-3 - 9:20 A 1.4GHz 20.5Gbps GZIP Decompression Accelerator in 14nm CMOS Featuring Dual-Path Out-of-Order Speculative Huffman Decoder and Multi-Write Enabled Register File Array , S. Satpathy, V. Suresh, R. Kumar, M. Anders, H. Kaul, A. Agarwal, S. Hsu, R. Krishnamurthy, V. De, S. Mathew, V. Gopal and J. Guilford, Intel Corp., USA	175
C18-3 - 9:20 An Automatic Ear Detection Technique in Capacitive Sensing Readout IC Using Cascaded Classifiers and Hovering function , S.-H. Ko, Samsung Electronics Co., Ltd., Korea	159	C20-4 - 9:45 A 3.25Gb/s, 13.2pJ/b, 0.64mm² Configurable Successive-Cancellation List Polar Decoder Using Split-Tree Architecture in 40nm CMOS , Y. Tao, S.-G. Cho and Z. Zhang, Univ. of Michigan, USA	177
C18-4 - 9:45 A 1.54mW per Element 150µm-Pitch-Matched Receiver ASIC with Element-Level SAR-Shared-Single-Slope Hybrid ADCs for Miniature 3D Ultrasound Probes , J. Li***, Z. Chen**, M. Tan**, D. van Willigen**, C. Chen**, Z.-Y. Chang**, E. Noothout**, N. de Jong****, M. Verweij***** and M. Pertijs**, *Univ. of Electronic Science and Technology of China, China, **Delft Univ. of Technology and ***Erasmus MC, The Netherlands	161	Technology / Circuits Joint Focus Session 3 Technology and System for AI [Shunju II, III] Thursday, June 13, 8:30-10:10 Chairpersons: H. Wu, Tsinghua Univ. G. Yeric, ARM Ltd.	
SESSION 19 - Continuous-Time ADCs [Suzaku II] Thursday, June 13, 8:30-10:10 Chairpersons: M. Fukazawa, Renesas Electronics Corp. S. Ho, MediaTek Inc.		JFS3-1 - 8:30 (Invited) Considerations of Integrating Computing-In-Memory and Processing-In-Sensor into Convolutional Neural Network Accelerators for Low-Power Edge Devices , K.-T. Tang*, W.-C. Wei*, Z.-W. Yeh*, T.-H. Hsu*, Y.-C. Chiu*, C.-X. Xue*, Y.-C. Kuo*, T.-H. Wen*, M.-S. Ho**, C.-C. Lo*, R.-S. Liu*, C.-C. Hsieh* and M.-F. Chang*, *National Tsing Hua Univ. and **National Chung Hsin Univ., Taiwan	179
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C22-3 - 11:20 A 56Gb/s Long Reach Fully Adaptive Wireline PAM-4 Transceiver in 7nm FinFET , D. Pfaff*, S. Moazzeni*, L. Gao*, M.-C. Chuang**, X.-J. Wang*, C. Palusa***, R. Abbott*, R. Ramirez*, A. Maher*, M.-C. Huang***, C.-C. Lin***, F. Kuo**, W.-L. Chen**, T. Y. Goh* and K. Hsieh**, *TSMC, Canada, **TSMC, Taiwan and ***TSMC, USA	201
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Technology / Circuits Joint Focus Session 4 The Future of Memory [Shunju II, III] Thursday, June 13, 10:30-12:35 Chairpersons: H.-T. Lue, Macronix International Co., Ltd. G. Hemink, Western Digital Corp.	
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JFS4-3 - 11:20 Recent Progress and Next Directions for Embedded MRAM Technology , W. J. Gallagher, E. Chien, T.-W. Chiang, J.-C. Huang, M.-C. Shih, C. Y. Wang, C. Bair, G. Lee, Y.-C. Shih, C.-F. Lee, R. Wang, K.-H. Shen, J. J. Wu, W. Wang and H. Chuang, TSMC, Taiwan	211
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Developing Visual Systems for Entertainment and Art , Y. Hanai, Rhizomatiks, Japan	
SESSION 23 - Biomedical Circuits and Systems [Suzaku III] Thursday, June 13, 14:00-15:40 Chairpersons: Y. P. Xu, National Univ. of Singapore A. Arbabian, Stanford Univ.	
C23-1 - 14:00 A Multimodal Multichannel Neural Activity Readout IC with 0.7μW/Channel Ca²⁺-Probe-Based Fluorescence Recording and Electrical Recording , T. Lee*, J.-H. Park**, J.-H. Cha**, N. Chou***, D. Jang*, J.-H. Kim****, I.-J. Cho***, S.-J. Kim** and M. Je*, *KAIST, **Ulsan National Institute of Science and Technology, ***Korea Institute of Science and Technology (KIST) and ****Ewha Womans Univ., Korea	217
C23-2 - 14:25 A 100Mb/s Galvanically-Coupled Body-Channel-Communication Transceiver with 4.75pJ/b TX and 26.8 pJ/b RX for Bionic Arms , Y. Jeon, C. Jung, S.-I. Cheon, H. Cho, J.-H. Suh, H. Jeon, S.-T. Koh and M. Je, KAIST, Korea	219
C23-3 - 14:50 A 143nW Glucose-Monitoring Smart Contact Lens IC with a Dual-Mode Transmitter for Wireless-Powered Backscattering and RF-Radiated Transmission Using a Single Loop Antenna , C. Jeon, J. Koo, K. Lee, S.-K. Kim, S. K. Hahn, B. Kim, H.-J. Park and J.-Y. Sim, POSTECH, Korea	221
C23-4 - 15:15 A 108dB DR Hybrid-CTDT Direct-Digitalization $\Delta\Sigma$-$\Sigma\Delta$ Front-End with 720mV_{pp} Input Range and >300mV Offset Removal for Wearable Bio-Signal Recording , X. Yang****, J. Xu**, H. Chun***, M. Ballini***, M. Zhao*, X. Wu*, C. van Hoof***** and N. van Helleputte***, *Zhejiang Univ., China, **Holst Centre, The Netherlands, ***imec and ****KU Leuven, Belgium	223

SESSION 24 - AI Accelerators [Suzaku I]

Thursday, June 13, 14:00-15:40

Chairpersons: M. Natsui, Tohoku Univ.
C. Tokunaga, Intel Corp.**C24-1 - 14:00****A 0.11 pJ/Op, 0.32-128 TOPS, Scalable, Multi-Chip-Module-Based Deep Neural Network Accelerator with Ground-Reference Signaling in 16nm**, B. Zimmer*, R. Venkatesan*, Y. S. Shao*, J. Clemons*, M. Fojtik*, N. Jiang*, B. Keller*, A. Klinefelter*, N. Pinckney*, P. Raina*, S. G. Tell*, Y. Zhang*, W. J. Dally***, J. S. Emer****, C. T. Gray*, S. W. Keckler* and B. Khailany*, NVIDIA Corp., **Stanford Univ. and ***Massachusetts Institute of Technology, USA

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C24-2 - 14:25**A Full HD 60 fps CNN Super Resolution Processor with Selective Caching based Layer Fusion for Mobile Devices**, J. Lee, D. Shin, J. Lee, J. Lee, S. Kang and H.-J. Yoo, KAIST, Korea

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C24-3 - 14:50**A 1.32 TOPS/W Energy Efficient Deep Neural Network Learning Processor with Direct Feedback Alignment based Heterogeneous Core Architecture**, D. Han, J. Lee, J. Lee and H.-J. Yoo, KAIST, Korea

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C24-4 - 15:15**SNAP: A 1.67 – 21.55TOPS/W Sparse Neural Acceleration Processor for Unstructured Sparse Deep Neural Network Inference in 16nm CMOS**, J.-F. Zhang*, C.-E. Lee*, C. Liu*, Y. S. Shao**, S. W. Keckler** and Z. Zhang*, *Univ. of Michigan and **NVIDIA Corp., USA

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SESSION 25 - Biosensors [Suzaku III]

Thursday, June 13, 16:00-17:40

Chairpersons: M. Je, KAIST
C. Lopez, imec**C25-1 - 16:00****A 1.7x4.1x2 mm³ Fully Integrated pH Sensor for Implantable Applications using Differential Sensing and Drift-Compensation**, T. Kang*, I. Lee*, S. Oh*, T. Jang**, Y. Kim*, H. Ahn*, G. Kim*, S.-U. Shin*, S. Jeong*, D. Sylvester* and D. Blaauw*, *Univ. of Michigan, USA and **ETH Zürich (Eidgenössische Technische Hochschule Zürich), Switzerland

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C25-2 - 16:25**An Aptamer-based Electrochemical-Sensing Implant for Continuous Therapeutic-Drug Monitoring *in vivo***, J.-C. Chien*, P. L. Mage**, H. T. Soh* and A. Arbabian*, *Stanford Univ. and **BD Bioscience, USA

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C25-3 - 16:50**A 114GHz Biosensor with Integrated Dielectrophoresis for Single Cell Characterization**, A. Ameri*, L. Zhang*, A. Gharia*, A. M. Niknejad* and M. Anwar**, *Univ. of California, Berkeley and **Univ. of California, San Francisco, USA

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C25-4 - 17:15**A Sub-pA Current Sensing Front-End for Transient Induced Molecular Spectroscopy**, D. Ying, P.-W. Chen, C. Tseng, Y.-H. Lo and D. A. Hall, Univ. of California, San Diego, USA

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SESSION 26 - Power Management & Energy Harvester [Suzaku II]

Thursday, June 13, 16:00-17:40

Chairpersons: K. Kanda, Fujitsu Laboratories Ltd.
P. Mercier, Univ. of California, San Diego**C26-1 - 16:00****A 6.78MHz 92.3%-Peak-Efficiency Single-Stage Wireless Charger with CC-CV Charging and On-Chip Bootstrapping Techniques**, L. Cheng*, X. Ge**, W. C. Ng**, W.-H. Ki**, J. Zheng**, T. F. Kwok**, C.-Y. Tsui** and M. Liu***, *Univ. of Science and Technology of China, **Hong Kong Univ. of Science and Technology and ***Chinese Academy of Sciences, China

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C26-2 - 16:25**A High Current efficiency Stacked Digital Low Dropout Array with True-Random-Noise Injection and Ultralow Output Ripple for Power-Side Channel Attack Protection**, C.-Y. Lee*, T.-P. Huang*, K.-H. Chen*, Y.-H. Lin**, S.-R. Lin** and T.-Y. Tsai**, *National Chiao Tung Univ. and **Realtek Semiconductor Corp., Taiwan

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C26-3 - 16:50**A Piezoelectric Energy-Harvesting System with Parallel-SSHI Rectifier and Integrated MPPT Achieving 417% Energy-Extraction Improvement and 97% Tracking Efficiency**, S. Li*, A. Roy** and B. H. Calhoun*, *Univ. of Virginia and **Marvell Semiconductor, Inc., USA

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C26-4 - 17:15**A Bidirectional High-Voltage Dual-Input Buck Converter for Triboelectric Energy-Harvesting Interface Achieving 70.72% End-to-End Efficiency**, I. Park, J. Maeng, M. Shim, J. Jeong and C. Kim, Korea Univ., Korea

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Technology SESSION 2 - Highlight [Shunju I, II, III]

Tuesday, June 11, 10:30-12:35

Chairpersons: K. Miyashita, Toshiba Electronic Devices & Storage Corp.
G. Jurczak, Lam Research**T2-1 - 10:30****Enhanced Reliability of 7nm Process Technology Featuring EUV**, K. Choi, H. C. Sagong, W. Kang, H. Kim, J. Hai, M. Lee, B. Kim, S. Lee, H. Shim, J. Park, Y. Cho, H. Rhee and S. Pae, Samsung Electronics Co., Ltd., Korea

N/A

T2-2 - 10:55**Technology Challenges and Enablers to Extend Cu Metallization to Beyond 7 nm Node**, T. Nogami*, H. Huang*, H. Shobha*, R. Patlolla*, J. Kelly*, C. Penny*, C.-K. Hu*, D. Sil*, S. DeVries*, J. Lee*, S. Nguyen*, S. Lian**, D. Edelstein*, B. Haran*, L. Jiang*, J. Demarest*, J. Li*, G. Lian*, M. Ali*, P. Bhosale*, N. Lanzillo*, K. Motoyama*, T. Standaert* and G. Bonilla*, *IBM Research and **Samsung Electronics Co., Ltd., USA

N/A

T2-3 - 11:20**3D Multi-Chip Integration with System on Integrated Chips (SoIC™)**, M.-F. Chen, C.-C. Hu, W.-C. Chiou and D. C. H. Yu, TSMC, Taiwan

N/A

T2-4 - 11:45**In-Memory Reinforcement Learning with Moderately-Stochastic Conductance Switching of Ferroelectric Tunnel Junctions**, R. Berdan*, T. Marukame*, S. Kabuyanagi**, K. Ota**, M. Saitoh**, S. Fujii**, J. Deguchi** and Y. Nishi*, *Toshiba Corp. and **Toshiba Memory Corp., Japan

N/A

T2-5 - 12:10**Monolithic Three-Dimensional Imaging System: Carbon Nanotube Computing Circuitry Integrated Directly Over Silicon Imager**, T. Srimani, G. Hills, C. Lau and M. Shulaker, Massachusetts Institute of Technology, USA

N/A