

2016 IEEE Radiation Effects Data Workshop (REDW 2016)

**Portland, Oregon, USA
11-15 July 2016**



**IEEE Catalog Number: CFP16NSR-POD
ISBN: 978-1-5090-5115-1**

**Copyright © 2016 by the Institute of Electrical and Electronics Engineers, Inc
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP16NSR-POD
ISBN (Print-On-Demand):	978-1-5090-5115-1
ISBN (Online):	978-1-5090-5114-4

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

Table of Contents

Guide to the 2015 IEEE Radiation Effects Data Workshop Record.....	1
<i>David M. Hiemstra, MDA Corporation, Canada</i>	
Collation of the Electronic Components Intended to Spacecraft	
Equipment Critical to SEE	7
<i>Vasily S. Anashin, Aleksandr E. Koziukov, Konstantin Zh. Faradian, Sergey A. Yakovlev, Aleksey V. Perebeynos, Artur V. Vlasov, Branch of Joint - Stock Company "United Rocket and Space Corporation"- "Institute of SpaceDevice Engineering" (Branch of JSC URSC - ISDE), Moscow, Russia; Pavel A. Chubunov, Branch of Joint - Stock Company "United Rocket and Space Corporation"- "Institute of SpaceDevice Engineering" (Branch of JSC URSC - ISDE), Moscow, Russia, National Research Nuclear University MEPhI (NRNU MEPhI), Moscow, Russia; Alexey S. Borisov, and Alexey A. Kryukov, Scientific production Center "ElTest", S. Petersburg, Russia</i>	
Compendium of Total Ionizing Dose and Displacement Damage Results from NASA Goddard Spaceflight Center.....	10
<i>Michael J. Campola, Shannon Alt, Dakai Chen, Alvin J. Boutte, Kenneth A. LaBel, Jonathan A. Pellish, Raymond L. Ladbury, Megan C. Casey, Jean-Marie Lauenstein, Michael A. Xapsos, NASA LaRC, USA; Donna J. Cochran, Robert A. Gigliuto, Edward P. Wilcox, Martha V. O'Bryan, ASRC Federal Space and Defense, Inc. (AS&D, Inc.), USA</i>	
Compendium of Single Event Effect Results from NASA Goddard Space Flight Center	19
<i>Martha V. O'Bryan, Carl M. Szabo, Edward P. Wilcox, Melanie D. Berg, ASRC Federal Space and Defense, Inc. (AS&D, Inc.), USA; Kenneth A. LaBel, Dakai Chen, Michael J. Campola, Megan C. Casey, Jean-Marie Lauenstein, Raymond L. Ladbury, Jonathan A. Pellish, NASA/GSFC, USA; Stanley A. Ikpe, NASA LaRC, USA</i>	
Compendium of Ball Aerospace TID and SEE Test Results.....	31
<i>T.R. Oldham and J.H. Lee, Ball Aerospace, USA</i>	
Recent Gallium Nitride Power HEMT Single-Event Testing Results.....	36
<i>Leif Z. Scheick, Jet Propulsion Laboratory, California Institute of Technology, USA</i>	
SEE and TID Effects in Transistors and Voltage Reference Devices.....	42
<i>J. S. George, J. R. Srour, M. Tockstein, B. Kwan, A. Wright, J. Bonsall, R. Koga, and S. C. Davis, The Aerospace Corporation, USA</i>	
Displacement Damage Testing of Intersil Analog and Power Management Parts	50
<i>N. W. van Vonno, L. G. Pearce, J. S. Gill, and F. Ballou, Intersil Corporation, Precision Products, USA; K. A. Scott, Boeing Satellite Systems, USA</i>	
Measurements of Proton Displacement Damage in Several Commercial Optocouplers.....	58
<i>Farokh Irom, Gregory R. Allen, and Bernard G. Rax, Jet Propulsion Laboratory, California Institute of Technology, USA</i>	
Heavy Ion Induced Single-Event Latchup Screening of Integrated Circuits Using Commercial Off-the-Shelf Evaluation Boards	63
<i>Gregory R. Allen, Farokh Irom, Leif Scheick, Sergeh Vartanian, and Michael O'Connor, Jet Propulsion Laboratory, California Institute of Technology, USA</i>	

Radiation Evaluation of the TPS7H3301-SP Linear Regulator for Double Data Rate (DDR) Applications	70
<i>J. Cruz-Colon, Thang Trinh, Texas Instruments, USA; M. Hamlyn, V. Zhu, B. A. Dahl, and R. C. Baumann</i>	
Radiation Tolerance of Commercial-Off-The-Shelf Components Deployed in an Underground Nuclear Decommissioning Embedded System	75
<i>M. Nancekievill, S. Watson, P. R. Green, and B. Lennox, Department of Electrical and Electronic Engineering, UK</i>	
Proton and Heavy Ion Sensitivity of Commercial Instrumentation and Precision Operational Amplifiers.....	80
<i>S. Davis, R. Koga, and J. George, The Aerospace Corporation, USA</i>	
Multifunctional Equipment and Test Results for Total Ionizing Dose Testing of Analog Integrated Circuits	88
<i>Alexander S. Bakerenkov, Alexander S. Rodin, Vladislav A. Felitsyn, National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Moscow; Russia; Pavel A. Chubunov, National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Moscow, Russia, Branch of Joint Stock Company United Rocket and Space Corporation – Institute of Space Device Engineering (Branch of JSC URSC – ISDE), Moscow, Russia; Vasily S. Anashin, Branch of Joint Stock Company United Rocket and Space Corporation – Institute of Space Device Engineering (Branch of JSC URSC – ISDE), Moscow, Russia</i>	
ELDRS Characterization to 300 krad of Texas Instruments High Speed Amplifier LMH6702.....	92
<i>Kirby Kruckmeyer and Thang Trinh, Texas Instruments, USA</i>	
Heavy-Ion Testing Results for Several Commercial and Military Grade Parts	96
<i>Benjamin Buck, Kyle Bojanowski, and Andrew Cunningham, MIT Lincoln Laboratory, USA</i>	
Heavy Ion and Proton Induced Radiation Effects on Commercial Analog Switch Microcircuits	103
<i>R. Koga, J. George, S. Davis, The Aerospace Corporation, USA; B. Buck, K. Bojanowski, A. Cunningham, MIT Lincoln Laboratory, USA</i>	
Single Event Effects Testing of a Commercial-Off-The-Shelf Analog-to-Digital Converter in a Camera Application.....	110
<i>Michael Campola, NASA GSFC, USA; Carolyn Thayer, MKI, USA; John Doty, Noqsi Aerospace Ltd, USA; Edward Wilcox, AS&D, Inc., NASA GSFC, USA</i>	
Single Event Effects Characterization of TI ADS1282-SP High Resolution ADC.....	113
<i>Sriram Narayanan, Wade VonBergen, Joel Cruz-Colon, and Veera Narayanan, Texas Instruments, USA</i>	
The Use of 14-Mev Monoenergetic Neutrons to Improve the Single Event Latch-Up Response of the Texas Instruments VSP1221	118
<i>Adalin Benedetto, Colorado State University, USA; James Salzman, Texas Instruments, USA; Michael Tostanoski, Radiation Test Solutions, USA; Joseph Benedetto, Cobham RAD Solutions, USA</i>	

Radiation Hardness of the CLARO8 ASIC: A Fast Single-Photon Counting Chip for the LHCb Experiment at CERN	122
<i>Mirco Andreotti, Wander Baldini, Roberto Calabrese, Angelo Cotta Ramusino, Massimiliano Fiorini, Eleonora Luppi, Roberto Malaguti, Luca Minzoni, Luciano Libero Pappalardo, Luca Tomassetti, Universita degli Studi di Ferrara and INFN Sezione di Ferrara, Italy; Mateusz Baszczyk, Piotr Dorosz, Wojciech Kucewicz, AGH University of Science and Technology and INP, Poland; Andrea Candelori, Serena Mattiazzo, Luca Silvestrin, Universita degli Studi di Padova, INFN Sezione di Padova, Italy; Paolo Carniti, Lorenzo Cassina, Andrea Giachero, Claudio Gotti, Matteo Maino, Gianluigi Pessina, Universita degli Studi di Milano Bicocca and INFN Sezione di Milano Bicocca, Italy</i>	
Total Ionizing Dose Characterization of an 8-bit 200-MSps Switched-Capacitor Pipeline A-to-D Converter in 32nm SOI CMOS	126
<i>Alfio Zanchi, Mark Yao, Solid-State Electronics Development, The Boeing Company, USA; Manuel Cabanas-Holmen, Barry Meaker, Anthony Amort, Solid-State Electronics Development, The Boeing Company, USA</i>	
Single Event Effects in 14-nm Intel Microprocessors	132
<i>Adam R. Duncan, Matthew J. Gadlage, Austin H. Roach, Aaron M. Williams, Matthew J. Kay, James D. Ingalls, Casey H. Hedge, Dobrin P. Bossev, NAVSEA Crane, USA; Carl M. Szabo, AS&D, Inc., supporting NASA/GSFC, USA; Kenneth A. LaBel, NASA GSFC, USA</i>	
Single Event Effects Testing of the Hardened Texas Instruments MSP430FR5739 Microcontroller on with Embedded Ferroelectric Memory	141
<i>James Aarestad, David Alexander, COSMIAC R&D Center of the University of New Mexico, USA; Paul Eaton, Will Burke, Microelectronics Research & Development Corp, USA; James Salzman, Texas Instruments, Inc., USA; Keith Avery, Air Force Research Laboratory, USA</i>	
Input Size Effects on the Radiation-Sensitivity of Modern Parallel Processors	147
<i>Daniel Oliveira, Caio Lunardi, Philippe Navaux, Luigi Carro, Paolo Rech, Instituto de Informatica, Federal University of Rio Grande do Sul (UFRGS), Brazil; Laercio Pilla, Departamento de Informatica e Estatistica, Federal University of Santa Catarina (UFSC), Brazil; Israel Koren, Department of Electrical & Computer Engineering, University of Massachusetts, USA; Fernando Fernandes</i>	
Single-Event Effects and Total Dose Testing of the Intersil ISL72027SEH CAN Bus Transceiver	153
<i>N. W. van Vonno, A. G. Robinson, L. G. Pearce, and E. J. Thomson, Intersil Corporation, Precision Products, USA</i>	
SEL and TID Test Results on a Radiation Hardened Bus Switch Family	161
<i>Matt Von Thun, Scott Sapp, Dale Walz, Rex Anderson, and Teresa Farris, Cobham Semiconductor Solutions Colorado Springs, USA</i>	
SEL and TID Test Results of a Hardened CAN Transceiver	166
<i>Matt Von Thun, Derek Bass, Dale Walz, Rex Anderson, and Teresa Farris, Cobham Semiconductor Solutions Colorado Springs, USA</i>	
Single Event Upset Characterization of the Kintex UltraScale Field Programmable Gate Array Using Proton Irradiation	170
<i>David M. Hiemstra, Valeri Kirischian, and Jakub Brelski, MDA Corporation, Canada</i>	

An Analysis of High-Current Events Observed on Xilinx 7-Series and UltraScale Field-Programmable Gate Arrays.....	175
<i>David S. Lee, Sandia National Laboratories, USA; Gary Swift, Swift Engineering & Radiation Services, LLC, USA; Michael Wirthlin, Center for High Performance Reconfigurable Computing, Brigham Young University, Department of Electrical and Computer Engineering, USA</i>	
Design and Test of Xilinx Embedded ECC for MicroBlaze Processors.....	180
<i>Zachary K. Baker, Los Alamos National Laboratory, CCS-7 Advanced Co-Design Laboratory, USA; Heather M. Quinn, Los Alamos National Laboratory, ISR-3 Space Data Systems, USA</i>	
Single Event Effects Testing on the SERDES, Fabric Flip-Flops and PLL in a Radiation-Hardened Flash-Based FPGA—RT4G150.....	187
<i>Jih-Jong Wang, Nadia Rezzak, Stephen Varela, Microsemi-SoC, USA; Durwyn Dsilva, Microsemi-SoC, Susquehanna International Group, USA; Sean Cui, Microsemi-SoC, University of Toronto, USA, Canada</i>	
SEL Site Localization Using Masking and PEM Imaging Techniques: A Case Study on Xilinx 28nm 7-Series FPGAs	193
<i>William Rudge, Cody Dinkins, William Boesch, Dave Vail, Josh Bruckmeyer, Space and Intelligence Segment of Harris Corporation, USA; Gary Swift, Swift Radiation and Engineering Services, LLC, USA</i>	
Total Ionizing Dose Response of SDRAM, DDR2 and DDR3 Memories.....	199
<i>Mehran Amrbar and Steven M. Guertin, Jet Propulsion Laboratory, California Institute of Technology, USA</i>	
Single Event Testing of SDRAM, DDR2 and DDR3 Memories.....	205
<i>Steven M. Guertin and Mehran Amrbar, Jet Propulsion Laboratory, California Institute of Technology, USA</i>	
TID/SEE Tests of the Radiation Hardened DDR2 SDRAM Memory Solution	212
<i>Pierre-Xiao Wang, Charles Sellier, 3D PLUS SAS, France; Pierre Southiratn, SODETEST, France; Duc Nguyen, ManTech International Corp, USA; Kai Grurmann, DSI GmbH, Germany</i>	
Radiation Hardness Performance of 2 Gbit LPDDR SDRAM Fabricated on Epitaxial Wafer for Space Applications	216
<i>Mi Young Park, Jang-Soo Chae, Chol Lee, Jungsu Lee, Im Hyu Shin, and Sinae Ji, Satellite Technology Research Center, Korea Advanced Institute of Science and Technology, South Korea</i>	
SEE Testing of the 4 Gb Samsung and Spansion Flash NAND	220
<i>D. L. Hansen, R. Hillman, F. Meraz, J. Montoya, and G. Williamson, Data Device Corporation, USA</i>	
Heavy Ion and Proton Test Results for Micron 4 Gb NAND Flash Memory.....	224
<i>James S. Hack, Kodie Altvater, Deas Brown, Paul Dudek, Douglas Jaeger, Ellwood Lane, John Lindley, Brinton Song, and Thomas Tittel, Northrop Grumman Mission Systems, USA</i>	
Heavy Ion, Proton and Electron Single-Event Effect Measurements of a Commercial Samsung NAND Flash Memory	231
<i>Farokh Irom, Gregory R. Allen, and Douglas J. Sheldon, Jet Propulsion Laboratory, California Institute of Technology, USA</i>	
3MeV Proton Irradiation of Commercial State of the Art Photonic Mixer Devices.....	237
<i>Martin Grimm, Burkart Vob, Department of Electrical Engineering, University of Applied Sciences Jena, Germany; Elke Wendler, Institute of Solid State Physics, University of Jena, Germany</i>	

Effect of Gamma Exposure on Chalcogenide Glass Films for Microphotonic Devices	241
<i>Spencer Novak, Kathleen Richardson, Department of Materials Science and Engineering, Clemson University, USA, CREOL, College of Optics and Photonics, USA; Vivek Singh, Corentin Monmeyran, Zhaohong Han, Hongtao Lin, Neil Patel, Qingyang Du, Juejun Hu, Department of Materials Science and Engineering, Massachusetts Institute of Technology, USA; Adam Ingram, Institute of Mathematics and Physics, Opole University of Technology, Poland; Nikolay Borodinov, Igor Luzinov, Department of Materials Science and Engineering, Clemson University, USA; Roman Golovchak, Department of Physics and Astronomy, Austin Peay State University, USA; Anuradha Agarwal, Department of Materials Science and Engineering and Material Processing Center, Massachusetts Institute of Technology, USA</i>	
On-Orbit measurements of TID and Dose Rate from Two RADFETs on Board NANOSAT-1B Satellite	245
<i>Maite Alvarez, P. Manzano, D. Escribano, C. Hernando, J.J. Jimenez, S. Sampedro, and I. Arruego, National Institute for Aerospace Technology (INTA), Spain</i>	
Laser Single Event Effects Response of Optek and Infineon Hall Effect Sensors	249
<i>Michael Newton, Haibin Wang, Li Chen, Department of Electrical and Computer Engineering, University of Saskatchewan, Canada; David M. Hiemstra, Valeri Kirischian, MDA Corporation, Canada</i>	
Two Photon Absorption Laser Facility for Single Event Effect Testing.....	254
<i>Michael Newton, , Haibin Wang, Li Chen, Department of Electrical and Computer Engineering, University of Saskatchewan, Canada; Brook Danger, Structural Sciences Centre, University of Saskatchewan, Canada; David M. Hiemstra, Valeri Kirischian, MDA Corporation, Canada</i>	
TID Irradiation Facility Utilizing Novel Alanine Dosimetry	259
<i>Aridio M. Sanchez, Victor Brisan and Anthony Difonzo, VPT Rad, Inc, USA</i>	
IC SEE Comparative Studies at UCL and JINR Heavy Ion Accelerators	264
<i>Alexey O. Akhmetov, Dmitry V. Bobrovsky, Alexander S. Tararaksin, Andrey G. Petrov, Leonid N. Kessarinskiy, Dmitry V. Boychenko, Alexander I. Chumakov, National Research Nuclear University (NRNU MEPhI), Russia; Alexandre Rousset, Christian Chatry, TRAD Test&Radiation Company, France</i>	
COTS Components Radiation Test Activity and Results at MSSL	268
<i>Daohua Hu, Mullard Space Science Laboratory, University College London, UK</i>	
Single-event Upsets Characterization & Evaluation of Xilinx UltraScale™ Soft Error Mitigation (SEM IP) Tool	275
<i>Pierre Maillard, Michael Hart, Jeff Barton, Paula Chang, Michael Welter, Robert Le, Restu Ismail, and Eric Crabill</i>	
Design Baseline Considerations for a High Dose Rate Irradiator for Total Dose Effects Testing.....	279
<i>Michael Shannon, Hopewell Designs Inc., USA, Georgia Tech Research Institute, USA; Spencer Mickum, Hopewell Designs Inc., USA; Zachary Hope, Hopewell Designs Inc, USA</i>	
Cumulative Index	285
Author Index.....	315