RADECS 2020 Technical Program Content

Technical Chair: Nathalie Chatry, TRAD

Session A: BASIC MECHANISMS OF RADIATION EFFECTS

Chair(s): Aleksandr Koziukov (Branch of JSC URSC - ISDE) & Marc Gaillardin (CEA)

A-1 SEU Mechanisms in Spintronic Devices: Critical Parameters and Basic Effects

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1. CNES, SPINTEC Univ. Grenoble Alpes/CNRS/CEA, LIRMM University of Montpellier, France
2. TRAD Test & Radiations, France
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4. LIRMM, University of Montpellier, CNRS, France
5. CNES, France

The paper investigates radiation-induced switching mechanisms, temperature effects, breakdown voltage, sensitive volume and critical charge definitions for Spin-Transfer Torque Magnetic Tunnel Junction.

A-2 Defect-induced phase transition in hafnium oxide thin films by heavy ion irradiation: The role of oxygen defects

T. Vogel[1], N. Kaiser[1], E. Piros[1], S. Petzold[1], N. Guillaume[2], G. Lefèvre[3], C. Charpin-nicolle[2], S. David[3], C. Vallée[3], E. Nowak[2], C. Trautmann[4], L. Alff[1]

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4. Materials Research Department, GSI Helmholtzzentrum für Schwerionenforschung, Germany

In this work, we pinpoint the role of oxygen defects in the phase transition mechanism from the monoclinic to the defect-stabilized tetragonal phase in hafnium oxide films induced by heavy ion irradiation.

A-3 Defect and Impurity-Complex Depassivation During Electron-Beam Irradiation of GaAs

D. Fleetwood[1], T. Mayer[2], M. Melloch[2]

1. Vanderbilt University, USA
2. Purdue University, USA

Significant increases in thermal generation rates in MBE-grown GaAs are attributed to depassivation of hydrogen-defect/impurity complexes during high-intensity, low-energy electron-beam irradiation. Oxygen impurities are likely candidates for the observed degradation.

A-4 Investigation by Thermoluminescence of the Recombination Process in irradiated Ge-doped Silica Preform.

A. Guttilla[1], C. Campanella[2], F. Mady[1], M. Benabdesselam[1], A. Morana[2], A. Boukenter[2], Y. Ouerdane[2], S. Girard[2]

1. Université Côte d'Azur, Institut de Physique de Nice (INPHYNI), CNRS UMR 7010, France
2. Université Jean Monnet de Saint-Etienne, Laboratoire Hubert Curien, CNRS UMR 5516 LTSI, France

We investigated the mechanisms of the creation/annealing of radiation-induced point defects in Ge-doped silica after X-ray irradiation. We show that some thermoluminescence features arise from specific properties of the annealing processes of Ge-related radiation-induced centers.

PA-1 TID Response and Irradiation-enhanced Hot-Carrier Degradation in 65nm MOSFETs: New Concerns on the Layout Dependent Effects

Z. Ren[1], X. An[1], G. Li[1], J. Liu[1], M. Xun[2], Q. Guo[2], X. Zhang[1], R. Huang[1]

1. Peking University, China
2. Xinjiang Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, China

Layout dependence of TID response and irradiation-enhanced hot-carrier degradation in 65nm NMOSFETs is firstly experimentally demonstrated. As SA increases, irradiation-induced Vth shift slightly increases while hot-carrier degradation enhancement significantly increases due to larger tensile stress.

PA-2 Thermal Annealing of Total Ionizing Dose Effect for Partially-Depleted SOI MOSFET

P. Chao[1]

1. CEPREI, China

A radiation hardening process of shallow trench isolation oxide is proposed for 130 nm PDSOI technology. The TID effect and high temperature annealing effect after irradiation are investigated for the PDSOI nMOSFET.

PA-3 Total Ionizing Dose Hardness Enhancement at Room Temperature in CMOS 0.25µm Technology

G. Cussac[1], L. Artola[1], T. Nuns[1], S. Ducret[2]

1. ONERA, France
2. Lynred, France

This work presents electricals characteristics of secondly irradiated MOSFET transistors showing a great TID resistance betterment. This improvement is allowed by interface traps charge build-up during long time annealing.

PA-4 True Dose Rate Effect of the ELDRS Conversional Model

V. Pershenkov[1], A. Zhukov[1], V. Belyakov[1], A. Bakerenkov[1], V. Telets[1], V. Felitsyn[1], A. Rodin[1]

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The possible physical mechanism of true dose rate effect is described using ELDRS conversional model. The effect of the oxide trapped charge on the value of the oxide electric field is taken into account.

Session B: RADIATION EFFECTS ON DEVICES & ICS

Chair(s): Jerome Boch (Univ Montpellier) & Sarah Armstrong (NSWC Crane)

B-1 TID Degradation Mechanisms in 16 nm Bulk FinFETs Irradiated to Ultra-High Doses

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2. INFN-Padova and Department of Physics and Astronomics, University of Padova, Italy, Italy
3. INFN-Milano and Department of Physics, University of Milano Bicocca, Italy, Italy
4. Institute of Microengineering, Ecole Polytechnique Fédérale de Lausanne, Switzerland, Italy

Total-ionizing-dose degradation mechanisms are investigated in 16 nm bulk Si FinFETs up to ultra-high doses. Charge buildup in shallow trench isolation degrade the device responses with worst-case tolerance in long-channel devices.

B-2 Heavy Ions Radiation Effects on 4kb Phase-Change Memory

A. Serra[1], T. Vogel[2], G. Lefevre[3], S. Petzold[4], N. Kaiser[2], G. Bourgeois[1], M. Cyrille[1], L. Alff[2], C. Trautmann[5], C. Vallee[3], S. David[3], C. Charpin[1], G. Navarro[1], E. Nowak[1]

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4. Department Advanced Thin Film Technology, Institute of Materials Science, Technische Universität Darmstadt, Germany
5. 4Materials Research Department, GSI Helmholtzzentrum fuer Schwerionenforschung and Institute of Materials Science, Technische Universität Darmstadt, Germany

In this work we analyze, thanks to both material and 4kb memory arrays characterization, the different effects of heavy ion radiation at high fluences on Ge2Sb2Te5 and Ge rich GeSbTe based Phase¬ Change Memory (PCM).

B-3 Heavy Ion Irradiation Hardening Study on 4kb arrays HfO2-based OxRAM

N. Guillaume[1], G. Lefèvre[2], C. Charpin-nicolle[1], E. Nowak[1], L. Grenouillet[1], T. Vogel[3], N. Kaiser[3], E. Piros[3], S. Petzold[3], L. Alff[3], C. Trautmann[4], S. David[2], C. Vallée[2]

1. CEA-LETI, France
2. CNRS-LTM, France
3. IMS-DATFT, Germany
4. GSI, Germany

HfO2 based OxRAM devices integrated in Back End Of Line (BEOL) of 130nm CMOS have been exposed to extreme irradiation conditions. Single resistive devices and 4kbit arrays have been studied both electrically and morphologically.

B-4 Supply Voltage Dependence of RO Frequencies for Total Ionizing Dose Exposures for 7nm Bulk FinFET Technology

Y. Xiong[1], A. Feeley[1], P. Wang[1], X. Li[1], E. Zhang[1], L. Massengill[1], B. Bhuva[1]

1. Vanderbilt University, USA

TID effects at the 7nm bulk FinFET node are characterized through changes in ring oscillator (RO) frequencies and current as a function of VDD to model delay and power degradations in digital circuits.

B-5 Analysis of Bipolar Integrated Circuit Degradation Mechanisms Against Combined TID-DD Effects

R. Ferraro[1], R. Garcia[1], S. Danzeca[1], M. Alessandro[1]

1. CERN, Switzerland

This work presents circuit simulations based on experimental data to explain degradation mechanisms induced by combined Total Ionizing Dose and Displacement Damage effects on a bipolar integrated circuit current source.

PB-1 Impact of Gamma irradiation on advanced Si/SiGe:C BiCMOS technology: comparison versus X-ray

J. El beyrouthy[1], F. Pascal[1], B. Sagnes[1], J. Boch[1], T. Maraine[1], M. El sherif[1], S. Haendler[2], P. Chevalier[3], D. Gloria[2]

1. IES Institut d'Electronique et des Systèmes, France
2. STMicroelectronics, France
3. STMicroelectronics, France

Gamma irradiation effects are investigated on Si/SiGe:C HBTs developed with the latest BiCMOS technologies. A degradation comparison induced by the Gamma source with an earlier study using an X-ray source is held.

PB-2 Total Ionizing Dose Effects on HfO2-based Memristors

P. Martín-holgado[1], M. Maestro-izquierdo[2], M. B. González[2], Y. Morilla[1], F. Campabadal[2]

1. Centro Nacional de Aceleradores, Spain
2. Institut de Microelectronica de Barcelona (IMB-CNM, CSIC), Spain

The effect of gamma-ray irradiation on HfO2-based memristors is investigated. Extensive electrical characterization of their resistive switching performance and assessment of data retention under irradiation indicate that the devices are resilient to radiation damage.

PB-3 A two-dimensional electrostatic potential model for total dose ionization effects in FOI FinFETs

X. Zhang[1], F. Liu[2], B. Li[2], B. Li[2], F. Zhang[1], Y. Huang[1], C. Yang[2], J. Luo[1], Z. Han[1], X. Liu[2], K. Petrosyants[3]

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2. Institute of Microelectronics, Chinese Academy of Sciences; Key Laboratory of Silicon Device Technology, Chinese Academy of Sciences, China
3. Institute for Design Problems in Microelectronics of Russian Academy of Sciences (IPPM RAS), Russian Federation

TID electrostatic potential model of FOI FinFETs is proposed. The model includes the effects of Not and Nit in both gate oxide and BOX respectively and can predict threshold voltage and its shift ΔVTH.

PB-4 Study on the saturation effect of threshold voltage shift in SOI MOSFETs at high total ionizing dose

X. Li[1], C. Zeng[2], D. Li[2], L. Gao[2], W. Yan[2], Y. Zhang[3], B. Li[4], Z. Han[2], J. Luo[2]

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4. Institute of Microelectronics, Chinese Academy of Sciences, China

The saturation effect of back-gate threshold-voltage shift in SOI NMOSFET at high TID is analyzed by experiments and simulation. It's attributed to the electric-field modulation generated by oxide-charge and the compensation of radiation-induced interface-trap charge.

~~**PB-5 Investigation on Origin of Characteristic Degradation of AlGaN/GaN High Electron Mobility Transistors by Proton Irradiation**~~

~~D. Kim[1]~~

~~*1. Korea Atomic Energy Research Institute, Kor*~~

~~We investigated origin of characteristic degradation of AlGaN/GaN high electron mobility transistors by proton irradiation. The created defects attributed from pre-existing defects and caused by secondary particles are expected as origin of characteristic degradation.~~

Session C: SINGLE EVENT EFFECTS: MECHANISMS & MODELLING

Chair(s): Cecile Weulersse (Airbus Defense and Space) & Ani Khachatrian (Naval Research Laboratory)

C-1 Electron induced SEU and MBU sensitivity of 20-nm planar and 16-nm FinFET SRAM-based FPGA

G. Augustin[1], M. Mauguet[1], N. Andrianjohany[1], N. Sukhaseum[1], N. Chatry[1], F. Bezerra[2]

1. TRAD, France
2. CNES, France

This work investigates the electron-induced SEU sensitivity of recent CMOS technologies (FPGA) from tests and simulations. The related question of the risk of MBU due to electrons in the space environment is also studied.

C-2 Characteristic Charge Collection Mechanism Observed in FinFET SRAM cells

K. Takeuchi[1], T. Kato[2], K. Sakamoto[1], K. Yukumatsu[1], K. Watanabe[1], Y. Tsuchiya[1], H. Matsuyama[2], A. Takeyama[3], T. Ohshima[3], S. Kuboyama[1], H. Shindou[1]

1. Japan Aerospace Exploration Agency, Japan
2. Socionext Inc., Japan
3. National Institutes for Quantum and Radiological Science and Technology, Japan

The single event effects (SEEs) characteristics on 14/16-nm bulk FinFETs were investigated in terms of single bit upsets (SBUs) and multiple cell upsets (MCUs). The sensitive area estimation based on the cross-section are also discussed.

C-3 Contribution of the proton direct ionization to the SEU rate for low-scale devices

J. Guillermin[1], G. Augustin[1], N. Sukhaseum[1], N. Chatry[1], F. Bezerra[2], R. Ecoffet[2]

1. TRAD, France
2. CNES, France

Low Energy Protons can induce SEU, for technologies lower than 90nm. This study assesses the in-orbit impact of the direct ionization phenomenon for low-scale devices, considering the importance of the environment and the straggling effect.

C-4 Enhancing Fault Injection for SRAM FPGAs

J. Perez-celis[1], C. Thurlow[1], M. Wirthlin[1]

1. Brigham Young University, USA

This paper describes an enhanced fault injection method for SRAM-based FPGAs that uses multiple-cell upset information from radiation tests to uncover failures that single-bit fault injection cannot cause.

PC-1 Analysis of Single Event Transients (SETs) using Machine Learning and Ionizing Radiation Effects Spectroscopy (IRES)

J. Cancelleri[1], D. Loveless[1], D. Reising[1]

1. University of Tennessee Chattanooga, USA

SETs are analyzed and characterized through ionizing radiation effects spectroscopy (IRES) and machine learning. Leveraging machine learning algorithms with IRES data, the identification of transients is facilitated and makes an on-chip implementation feasible.

PC-2 Role of Electron-induced Coulomb Interactions to the Total SEU Rate during Earth and JUICE Missions

P. Caron[1], C. Inguimbert[1], L. Artola[1], R. Ecoffet[2], F. Bezerra[2]

1. ONERA, France
2. CNES, France

The contribution of electron-induced Coulomb processes in SEU sensitivity is investigated. The case of an integrated memory is studied. The relative importance to the total SEU rate of electron, proton and gamma environments is compared.

PC-3 SEB sensitivity prediction based on MOSFET electrical characteristics analysis

L. Kessarinskiy[1]

1. NRNU MEPhI / SPELS, Russian Federation

This article presents a practical method of SEB sensitivity prediction based on MOSFET electrical characteristics analysis. A correlation between the softness coefficient of the parasitic diode and the relative breakdown voltage of SEB is shown

PC-4 Experimental and Simulation Study of Secondary Ion-Induced Multiple Cell Upsets under Heavy Ion Irradiation

A. Galimov[1], A. Gukov[1], A. Klyayn[2], A. Koziukov[2]

1. JSC NIIMA Progress, Russian Federation
2. Branch of JSC URSC - ISDE, Russian Federation

Multiple cell upsets potentially caused by secondary ion impact were observed in the heavy ion backside irradiation experiment of 40 nm SRAM. Geant4 simulation was carried out to evaluate the occurrence probability of such events.

PC-5 The Pion SEL Cross Section Enhancement Mechanisms and Consequences for Accelerator RHA

A. Coronetti[1], R. Garciaalia[1], W. Hajdas[2], D. Soderstrom[3], A. Javanainen[4], F. Saigné[5]

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2. Pau Sherrer Institute, Switzerland
3. University of Jyväskylä, Finland
4. RADEF, Finland
5. University of Montpellier, France

The pion SEL cross-section is experimentally found to be higher than that of protons for an energy range wider than the pion inelastic reaction resonance. The underlying mechanisms and RHA impact are analyzed.

PC-6 A Novel Propagation Model for Heavy-Ions Induced Single Event Transients on 65nm Flash-based FPGAs

B. Du[1], M. Colucci[2], S. Francola[2], L. Aranci[2], E. Artina[2], N. Ratti[2], E. Picardi[2], R. Mancini[3], V. Piloni[2], S. Azimi[1], L. Sterpone[1]

1. Politecnico di Torino, Italy
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3. Thales Alenia Space Italy, Italy

We present a SET generation and propagation model based on Hann-smoothing function for 65nm Flash-based FPGAs. The model has been characterized with heavy ions radiation campaigns demonstrating its viable usage for circuit analysis and mitigation purposes.

PC-7 Single Event Burnout dependence on reverse gate voltage for SiC Power MOSFETs in atmospheric environment

K. Niskanen[1], A. Touboul[2], R. Germanicus[3], A. Michez[4], F. Wrobel[5], J. Boch[5], V. Pouget[6], F. Saigné[5]

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6. IES-CNRS, France

Neutron-induced SEB in commercial Silicon Carbide power MOSFETs under atmospheric-like neutron spectrum was studied. The effect of gate voltage on the failure behavior was evaluated. Enhanced failure sensitivity for drain voltage values close to safe operating area was observed.

PC-8 A Track-Structure Based Approach to Upset-Rate Calculations

D. Hansen[1]

1. DDC, USA

This paper presents an approach to calculating single-event upset-rates that accounts for ion-track structure. It accurately predicts upset rates for device level effects where with an unknown number of sensitive volumes.

Session D: SINGLE EVENT EFFECTS: DEVICES & ICS

Chair(s): Christian Poivey (ESA) & Dmitry Boychenko (NRNU MEPhI / SPELS)

D-1 Backside Laser Testing of Single-Event Effects in GaN-on-Si Power HEMTs

C. Ngom[1], V. Pouget[2], M. Zerarka[3], F. Coccetti[3], A. Touboul[4], M. Matmat[3], O. Crepel[5], S. Jonathas[6], G. Bascoul[7]

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4. IES - university of Montpellier, France
5. Airbus, France
6. PULSCAN, France
7. CNES, France

We present backside laser testing of GaN power devices on Si substrate using parameters compatible with three-photon absorption in GaN and single-photon absorption in the substrate. The technique allows identifying the sensitive regions of the devices.

D-2 Microprocessor Error Diagnosis by Trace Monitoring under Laser Testing

M. Peña-fernandez[1], A. Lindoso[2], L. Entrena[2], I. Lopes[3], V. Pouget[3]

1. Arquimea S.L.U., Spain
2. University Carlos III Madrid, Spain
3. Université de Montpellier, France

This work explores the diagnosis capabilities of the enriched information provided by microprocessors trace subsystem combined with laser fault injection. Injection campaigns in delimited architectural regions have been accomplished on an ARM Cortex-A9 device.

D-3 Impact of Cores Integration and Operating System on ARM Processors Reliability: Micro-Architectural Fault-Injection vs Beam Experiments

P. Bodnmann[1], A. Chatzidimitriou[2], G. Papadimitriou[2], D. Gizopoulos[2], P. Rech[1]

1. UFRGS, Brazil
2. University of Athens, Greece

We compare and correlate neutron beam and micro-architectural fault-injection data on ARM Cortex-A5 and Cortex-A9 running codes bare-metal and on top of Linux. Cores integration exacerbates crashes while Linux does not significantly impact SDCs rate.

D-4 Novel FPGA Radiation Benchmarking Structures

G. Bricas[1], G. Tsiligiannis[1], A. Touboul[1], J. Boch[1], M. Kastriotou[2], C. Cazzaniga[2]

1. IES, France
2. STFC, Rutherford Appleton Laboratory, United Kingdom

This paper introduces novel benchmarking structures for the evaluation of the radiation sensitivity of FPGAs, based on arithmetic operations. Atmospheric neutron beam test results are presented comparing their radiation sensitivity over different implementation.

D-5 High Current Events Triggered by Heavy Ion Microbeam and Pulsed Laser on a MRAM

M. Mauguet[1], J. Guillermin[1], B. Vandevelde[1], N. Chatry[1], J. Carron[2], F. Bezerra[2]

1. TRAD, France
2. CNES, France

We investigate events on power consumption in a magnetic RAM using heavy ion microbeam and pulsed laser. The spatiotemporal resolution was useful to locate the sensitive areas and to study the current behavior.

PD-1 Heavy ion testing method and results of Normally Off GaN-Based High Electron Mobility Transistor

J. Sauveplane[1], A. Dufour[1], E. Marcault[2], M. Orsatelli[2], M. Gavelle[2], G. Duran[3], J. Burky[3], B. Forgerit[3], F. Tilhac[3], F. Guerre[3]

1. CNES, France
2. CEA, France
3. Alter Technology France, France

Three GaN HEMT were tested under heavy ion. This paper presents testing methodology, device preparation and observations from the irradiation run. At last dynamic RON issue with respect to SOA of one reference is highlighted.

PD-2 The Upset Imbalance of the SEU Susceptibility in 40nm Bulk DICE DFFs

Q. Sun[1], B. Liang[1], Y. Chi[1], J. Liu[1], J. Chen[1], H. Yuan[1]

1. National University of Defense Technology, China

This paper reports the imbalanced cross-sections in 40nm bulk DICE-RDFF, which is caused by the cascaded three transistors in the master latch. The relationship between threshold voltage and radiation tolerance of DICE-RDFF has been discussed.

PD-3 Dependency of Temperature and Back-gate Bias on Single Event Upset Induced by Heavy Ion in a 0.2 μm DSOI CMOS Technology

Y. Wang[1], F. Liu[1], B. Li[1], B. Li[1], Y. Huang[1], C. Yang[1], J. Zhang[2], G. Wang[2], J. Luo[2], Z. Han[2], X. Liu[2], K. Petrosyants[3]

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3. Institute for Design Problems in Microelectronics of Russian Academy of Sciences (IPPM RAS), Russian Federation

The dependency of temperature and back-gate bias on SEU sensitivity is investigated based on a 0.2 μm DSOI technology. Increased temperature will enhance the parasitic bipolar effect, but negative back-gate bias can effectively suppress it.

PD-4 Intermittent Stuck-Bit study in a 512Mb SDRAM Induced by Proton

S. Bounasser[1], C. Boatella polo[1], T. Borel[1], C. Poivey[1]

1. ESA, Netherlands

Proton and γ-ray tests have been made in order to evaluate the VRT and ISB phenomena in a 512Mb SDRAM. The VRT phenomenon is studied and a special attention is given to quantify ISB parameters.

PD-5 Analyzing DUE Errors with Neutron Irradiation Test and Fault Injection to Control Flow

K. Ito[1], Y. Zhang[1], H. Itsuji[2], T. Uezono[2], T. Toba[2], M. Hashimoto[1]

1. Osaka University, Japan
2. Hitachi, Ltd., Japan

This work analyzes DUEs reported by the GPU driver under fault injection and neutron irradiation tests. Results point out the necessity of investigating the fault modes originating from faults in components invisible to programmers.

PD-6 On The Reliability of Xilinx's Deep Processing Unit and Systolic Arrays for Matrix Multiplication

F. Libano[1], P. Rech[2], J. Brunhaver[1]

1. Arizona State University, USA
2. Federal University of Rio Grande do Sul, Brazil

Through neutron beam experiments, we measure the radiation sensitivity of Xilinx's DPU, and discuss the trade-offs between performance, area, and reliability. Furthermore, we provide insights on the fault model of systolic arrays for matrix multiplication.

PD-7 Supply Voltage and Temperature Dependence of Micro-Latchups at the 7nm Technology Node

C. Sheets[1], S. Ball[1], S. Wen[2], R. Fung[2], C. Cazzaniga[3], B. Bhuva[1], L. Massengill[1]

1. Vanderbilt University, USA
2. Cisco Systems, Inc., USA
3. Rutherford Appleton Laboratory, United Kingdom

Micro-latchup at the 7nm bulk FinFET node are characterized as a function of circuit design, supply voltage, and temperature for neutron exposures.

PD-8 Alpha, Heavy Ion and Neutron Test Results On 90nm ST BCD-CMOS technology

A. Jain[1], A. Veggetti[2], D. Crippa[3], S. Gerardin[4], M. Begatin[5], A. Benfante[6], C. Cazzaniga[7]

1. ST Microelectronics, India
2. ST Microelectronics, Italy
3. ST Mircoelectronics, Italy
4. DEI - Padova University, Italy
5. University of Padova, Italy
6. STMicroelectronics, Italy
7. Rutherford Appleton Laboratory, Didcot, UK, United Kingdom

This paper presents design, implementation, test methodology and results for radiation qualification on 90nm ST BCD CMOS technology platform. The radiation test is performed with alpha particles, heavy ions and neutron. The results obtained are analyzed and correlated with CAD data. Further the effectiveness of prominent radiation hardening techniques is also studied which can make the technology usable for very low error rate applications such as automotive, medical and space.

PD-9 Impact of High Particle Flux in Radiation Ground Tests with Protons

M. Rezaei[1], P. Martinholgado[2], Y. Morilla[2], F. Franco[1], J. Fabero[3], H. Mecha[4], H. Puchner[5], G. Hubert[6], J. Clemente[1]

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2. CNA, Spain
3. Complutense University of Madrid, Spain
4. UCM, Spain
5. Cypress, USA
6. ONERA, France

An experimental study of the impact of using a high flux in radiation ground tests on the measured cross-section of SRAMs. Results show that using high particle flux can increase the cross-section 1 order of magnitude.

Session E: PHOTONICS, OPTOELECTRONICS & SENSORS

Chair(s): Julien Mekki (CNES) & Jochen Kuhnhenn (Fraunhofer INT)

E-1 Distributed temperature and strain measurement for radiation environment

M. Aubry[1], C. Sabatier[2], L. Mescia[3], A. Morana[4], G. Melin[5], T. Robin[5], E. Marin[6], S. Girard[7], Y. Ouerdane[6], A. Boukenter[6]

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2. LabHC / iXBlue / Politecnico di Bari, France
3. Politecnico di Bari, Italy
4. Laboratory Hubert Curien, France
5. iXblue, France
6. Laboratoire Hubert Curien, France
7. Université de Saint Etienne, France

We investigate the radiation effects on a temperature and strain sensor exploiting the multipeak Brillouin signature of one optical fiber and discuss about the fiber architectures that could allow better sensing performances in harsh environment.

E-2 Regeneration of Fiber Bragg Gratings and their Responses under X-rays

T. Blanchet[1], A. Morana[1], E. Marin[1], Y. Ouerdane[1], A. Boukenter[1], S. Girard[1]

1. Laboratory Hubert Curien, France

We regenerated type I fiber Bragg Grating inscribed in H2- or D2-loaded Ge-doped fiber at temperatures above 820°C. Under X-rays at room temperature, their Bragg wavelengths shift of less than 40 pm after 72 kGy(SiO2).

E-3 Degradation study of InGaAsN PIN solar cell under 1 MeV electron irradiation

M. Levillayer[1], S. Duzellier[1], T. Nuns[1], C. Inguimbert[1], T. Le cocq[1], C. Pons[1], R. Rey[1], I. Massiot[2], A. Arnoult[2], S. Parola[3], C. Aicardi[4], G. Almuneau[2], L. Artola[1]

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3. IES, Université de Montpellier, CNRS, France
4. CNES, France

Degradation of InGaAsN pin subcell under 1 MeV electron irradiation was studied by characterizing cells before and after irradiation. Cells are measured to retain more than 94% of their original photocurrent after 1e15 cm-2 electron-irradiation.

E-4 On the Improvement of VCO Based Matrix Particle Detector for High Resolution Particles Recognition and Tracking

K. Coulié[1], W. Rahajandraibe[1], L. Ottaviani[1]

1. IM2NP - Aix-Marseille University, France

A particle detection chain based on a CMOS-SOI VCO circuit associated to a matrix of detection is presented. The solution is used for the recognition and tracking of an alpha particle.

PE-1 Radiation Responses of Fiber Random Gratings

T. Blanchet[1], A. Morana[1], E. Marin[1], Y. Ouerdane[1], A. Boukenter[1], C. Hnatovsky[2], P. Lu[2], S. Mihailov[2], S. Girard[1]

1. Laboratory Hubert Curien, France
2. National Research Council Canada, Canada

A type I fiber random grating was written with a femtosecond laser in a germanium-doped fiber and irradiated up to 225kGy(SiO2) at a dose-rate of 1Gy/s. A spectrum shift of less than 15pm was observed.

PE-2 Infrared Radiation-Induced Attenuation of Germanosilicate Optical Fibers at MGy dose levels

C. Campanella[1], A. Guttilla[2], A. Morana[1], C. Muller[1], F. Mady[2], E. Marin[1], Y. Ouerdane[1], A. Boukenter[1], M. Benabdesselam[2], S. Girard[1]

1. Université Jean Monnet de Saint-Etienne, Laboratoire Hubert Curien, CNRS UMR 5516 LTSI, France
2. Université Côte d'Azur, Institut de Physique de Nice (INPHYNI), CNRS UMR 7010, France

The Radiation Induced Attenuation at 1550 nm was investigated under X-rays in the two germanosilicate optical fibers using different injected power levels at 1550 nm to study the photobleaching phenomenon at high doses.

PE-3 Generated Quantum Emitters in Hexagonal Boron Nitride via High Energy Ion Irradiation

R. Gu[1], X. Zhang[1], L. Cai[2], J. Liu[3], B. Li[1], L. Wang[1], G. Guo[2], J. Qiao[4], X. Shan[1], G. Xiong[1], J. Gao[1], F. Zhao[1], H. Zhu[1], J. Luo[1], Z. Han[5], X. Liu[5]

1. Institute of Microelectronics of the Chinese Academy of Sciences, China
2. China Institute of Atomic Energy, China
3. Institute of Modern Physics, Chinese Academy of Sciences, China
4. NAURA Technology Group Co., Ltd, China
5. Institute of Microelectronics of the Chinese Academy of Sciences and University of Chinese Academy of Sciences, China

Ta and Ge ions irradiation were used for photon emitters generation in hBN. Emitters production efficiency and location were evaluated with fluence and hBN thickness. High purity photon emitters in middle of hBN could be obtained by irradiation.

PE-4 A Kinetic Monte Carlo Algorithm to Model the Annealing Process to Compute the Dark Current Non Uniformity

K. Lemiere[1], C. Inguimbert[1], T. Nuns[1]

1. ONERA, France

A simulation chain, composed of GEANT4 and a Kinetic Monte Carlo algorithm, dedicated to study the annealing process of defects produced after irradiation is presented. Results will be used to compute Dark Current Non Uniformity.

PE-5 Comparison of Displacement Damage Effects in Two CMOS SPAD Layouts Under Electron and Proton Irradiations

M. Campajola[1], F. Di capua[1], D. Fiore[2], L. Gasparini[3]

1. University of Naples "Federico II" and INFN, Italy
2. CNES, France
3. Fondazione Bruno Kessler (FBK), Italy

The damage effects induced by electrons and protons on CMOS SPADs have been studied. The Dark Count Rate increase with dose, its distribution and the dependence on the structural parameters of the SPADs are shown

Session F: HARDENING TECHNIQUES

Chair(s): Eric Leduc (Microchip A & D) & Luca Sterpone (Politecnico di Torino)

F-1 On the Mitigation of Single Event Transient in 3D LUT by In-Cell Layout Resizing

S. Azimi[1], C. De Sio[1], L. Sterpone[1]

1. Politecnico di Torino, Italy

We propose a workflow for the analysis and mitigation of 3D-ICs versus SET by upsizing the sensitive transistors. The workflow is applied to a 45-nm 3D-LUT and the results show a 37% reduction in failure rate.

F-2 On the Use of Redundant Resources in COTS Mixed-Precision GPUs for Efficient DWC

P. Martins basso[1], F. Santos[1], M. Brandalero[2], P. Rech[1]

1. UFRGS, Brazil
2. Brandenburg University of Technology Cottbus- Senftenberg, Germany

COTS GPUs include redundant resources as tensor-cores and approximate functional-units that can be leveraged for DWC. Using redundant hardware we detect an average of 74% errors with 0.1% time and 24% energy consumption overhead.

F-3 A Radiation-Hardened Phase-Locked Loop for Phase Interpolator Clock and Data Recovery

H. Yuan[1], B. Liang[1], J. Chen[1], Y. Chi[1], W. Xu[1], Y. Guo[1]

1. National University of Defense Technology, China

A radiation-hardened PLL is proposed for CDR. A sensitive node-compressed charge pump and multi-node cross-coupling VCO are proposed. The PLL RMS jitter achieves 2.58ps@2GHz and will not lose locked state under LET of 37.3MeV•cm2/mg.

F-4 Design-Stage Hardening of 65 nm CMOS Standard Cells Against Multiple Events

A. Balbekov[1], M. Gorbunov[1], A. Galimov[2]

1. SRISA, Russian Federation
2. JSC NIIMA Progress, Russian Federation

We proved the efficiency of the layout recommendations by means of the layout-aware simulation technique. The proposed strategy decreasing the multiplicity of upsets was experimentally verified.

F-5 A Mixed Method to Mitigate the TID Effects on 28nm FDSOI Transistors

A. Urena Acuna[1], J. Armani[2], M. Slimani[2], M. Casse[3], P. Dollfus[4]

1. CEA-Université Paris-Saclay, France
2. CEA, Université Paris-Saclay, France
3. CEA, Université Grenoble-Alpes, France
4. CNRS, Université Paris-Saclay, France

In this work we propose a mixed method to mitigate the effects of TID on 28nm FDSOI MOSFETS exposed to gamma radiation. This new methodology reduces the impact on the transistor reliability.

PF-1 Evaluating and Mitigating Neutrons Effects on COTS EdgeAI Accelerators

S. Blower[1], P. Rech[2], C. Cazzaniga[1], M. Kastriotou[3], C. Frost[4]

1. STFC, United Kingdom
2. LANL / UFRGS, USA
3. STFC, United States minor outlying islands
4. ISIS Neutron and Muon Facility, United Kingdom

Through neutron beam experiments and fault-injection we investigate the reliability of a COTS accelerator for AI applications. By redistributing the classification representations we are able to correct 96% of the misclassifications with nearly-zero overhead.

PF-2 Intrinsic Vulnerability to Soft Errors and Mitigation Technique by Layout Optimization on DICE Flip Flops in a 65 nm Bulk Process

F. Mori[1], M. Ebara[1], Y. Tsukita[1], J. Furuta[1], K. Kobayashi[1]

1. Kyoto Institute of Technology, Japan

Our experimental results showed that DICEFF in a 65 nm bulk process exhibits lower soft error tolerance by Kr irradiation. We found specific pairs of transistors that become sensitive to soft errors by device simulations.

PF-3 DFF Architecture Impact on SEU Response in Different Semiconductor Technologies

J. Black[1], D. Ball[2], D. Black[3], M. Mclain[4], M. Marinella[1], M. Esposito[5], D. Hughart[5], C. Bennett[1], J. Salas[1], R. Reed[2], R. Weller[2], M. Breeding[2], A. Tonigan[2], R. Schrimpf[2]

1. Sandia National Labs, USA
2. Vanderbilt University, USA
3. Sandia, USA
4. SANDIA National Laboratories, USA
5. Sandia National Laboratories, USA

DFF architecture and logic input are shown to impact DFF cross-section in different semiconductor technologies. The logic input can be made with no impact on the DFF size, speed, or power performance.

Session G: RADIATION HARDNESS ASSURANCE

Chair(s): Lee Pater (Airbus Defense and Space UK) & Francoise Bezerra (CNES)

G-1 Bridging RHA methodology from component to system level applied to System-on-Modules

I. Da costa lopes[1], V. Pouget[1], F. Wrobel[1], A. Touboul[1], F. Saigné[1], K. Roed[2]

1. IES, University of Montpellier, CNRS, France., France
2. University of Oslo, Norway

this works presents an RHA methodology that combines both component and system level data to predict system-level reliability. The methodology is illustrated by its application to two system-on-module embedding an avionic application irradiated with protons.

G-2 Neutron sensitivity of high voltage SiC devices for avionics applications

C. Weulersse[1], M. Mazurek[2], S. Morand[1], C. Binois[3], O. Crepel[4]

1. Airbus Defense and Space, France
2. Airbus Operations SAS, France
3. AIRBUS D&S, France
4. Airbus SAS, France

The SEE radiation tolerance of power SiC devices from several manufacturers has been studied. SOA and failure rates at aircraft altitudes have been characterized in order to validate the common used derating value of 50%.

~~G-3 SEU-Related Survivability Analysis for Critical Missions using Xilinx FPGA Devices~~

~~M. Berg[1], M. Campola[2], H. Kim[3], A. Phan[3], P. Maillard[4], M. Sawant[4]~~

~~*1. SSAI, USA*~~
~~*2. NASA/GSFC, USA*~~
~~*3. SSAI in support of NASA/GSFC, USA*~~
~~*4. Xilinx Inc., USA*~~

~~We propose a methodology for survivability analysis of critical applications using Xilinx SRAM-based FPGA devices. The approach takes advantage of generic data when possible to potentially avoid exorbitant costs of single event upset (SEU) testing.~~

PG-1 Single event rate estimation based on limited experimental data

A. Sogoyan[1], A. Smolin[1], A. Chumakov[1]

1. NRNU MEPhI, Russian Federation

The paper presents an approach to single event rate calculation based on experimental data for a single LET value. This approach minimizes irradiation time while providing a conservative estimation of device’s compliance with mission requirements

PG-2 Development of TID Hardness Assurance Methodologies to Capitalize on Statistical Radiation Environment Models

R. Ladbury[1], T. Carstns[2]

1. NASA GSFC, USA
2. NASA Goddard Space Flight Center, USA

We develop methods for bounding part-to-part variation in TID data, allowing use of statistical radiation environment models to estimate piece part reliability. Two methods are developed, and their results compared for realistic data.

Session H: RADIATION ENVIRONMENTS

Chair(s): Angelica Sicard (ONERA) & Henning Wulf (OHB System AG)

H-1 A new technique based on convolutional neural networks to measure simultaneously the energy of protons and electrons with Timepix detector

M. Ruffenach[1], S. Bourdarie[2], B. Bergmann[3], S. Gohl[3], J. Mekki[4], J. Vaille[5]

1. ONERA - The French Aerospace Lab, France
2. ONERA, France
3. Institute of Experimental and Applied Physics, Czech Republic
4. CNES, France
5. IES – Université de Montpellier, France

A new technique to measure simultaneously protons and electrons with Timepix detector is presented. This new method based on neural networks trained with Geant4 data is described and applied to SATRAM data.

H-2 Surface ionizing dose for space application estimated with low energy spectra going down to some hundreds of eV

C. Inguimbert[1], P. Caron[1], Q. Gibaru[1], A. Sicard[1], N. Balcon[2], R. Ecoffet[2]

1. ONERA, France
2. CNES, France

The importance of low energy particles down to ~200 eV, on the dose deposited to the very near surface of materials subject to space environment, is investigated by means of Monte Carlo simulations with GEANT4.

H-3 On-orbit pile-up detection and digital pulse-shape measurement results in the radiation telescope

H. Ueno[1], K. Kamiya[1], H. Matsumoto[1], T. Takashima[1], M. Tomitaka[1]

1. Japan Aerospace Exploration Agency, Japan

A radiation detector equipped with a cosmic radiation pile-up detection function has been developed. The results of the on-orbit data analysis are presented.

Session I: FACILITIES AND DOSIMETRY

Chair(s): Yolanda Morilla (CNA) & Michael Trinczek (TRIUMF)

I-1 Proton Beam Profile Monitoring with Silica-based Optical Materials

J. Vidalot[1], A. Morana[2], O. Duhamel[3], C. Hoehr[4], H. El hamzaoui[5], A. Boukenter[2], G. Bouwmans[5], B. Capoen[5], M. Trinczek[4], Y. Ouerdane[6], P. Paillet[3], M. Gaillardin[3], M. Bouazaoui[5], S. Girard[6]

1. CEA / université Jean Monnet St Etienne, France
2. Laboratory Hubert Curien, France
3. CEA, France
4. Triumf, Canada
5. Laboratoire PhLam - Physique des Lasers, Atomes et Molécules, France
6. Université de Saint Etienne, France

We demonstrate the potential of two differently doped materials to perform real-time proton beam profile characterization through radioluminescence monitoring. Various test configurations have been characterized to assess the sensor performances at the TRIUMF facility.

I-2 Monitoring of Particle Flux and LET Variations with Pulse Stretching Inverters

M. Andjelkovic[1], J. Chen[1], A. Simevski[1], O. Schrape[1], M. Krstic[1], R. Kraemer[1]

1. IHP, Germany

This work investigates the use of pulse stretching inverters for monitoring the variation of particle flux and LET. The solution can be used to dynamically trigger the fault tolerance mechanisms within a self-adaptive system.

I-3 Angular dependency of SRAM cross sections with Ultra-High Energy Pb beams

J. Wang[1], J. Prinzie[1], S. Thys[1], P. Leroux[1]

1. KU Leuven, Belgium

This paper presents an analysis of the Single-Event Upset cross section of an SRAM based radiation monitor under tilted irradiation angles with ultra-high energy beams, the result is compared to a standard heavyion beam.

PI-1 First Chamber in Spain to Irradiate at Low and High Temperatures with Gamma, Neutrons and Low-Energy Protons

P. Martinholgado[1], [1], J. Labrador[1], [2], J. Herranz[2], Y. Morilla[1]

1. Centro Nacional de Aceleradores, Spain
2. Proactive Research and Development, S.L., Spain

In this work it is presented the commissioning of the first system, implemented in Spain, to perform irradiation testing at Low and High Temperature with Gamma, Neutrons and Low-Energy Protons.

PI-2 Temperature Effect on the Radioluminescence of Cu, Ce and CuCe Doped Silica-based Fiber Materials

N. Kerboub[1], D. Difrancesca[1], S. Girard[2], H. El hamzaoui[3], Y. Ouerdane[2], G. Bouwmans[3], R. Habert[3], A. Boukenter[2], B. Capoen[3], E. Marin[2], M. Bouazaoui[3], Y. Kadi[4], R. Garciaalia[1], J. Mekki[5], M. Brugger[4]

1. CERN, Switzerland
2. Université de Saint Etienne, France
3. Univ-Lille, CNRS, UMR8523 - PhLAM – Physique des Lasers, Atomes et Molécules, France
4. CERN, France
5. CNES, France

We evaluate the temperature effect on the X-ray Radiation Induced Luminescence (RIL) response of Cu or Ce- single-doped, and CuCe co-doped silica glass rods between -120 °C and 80 °C.

PI-3 New Single Event Effect Heavy Ion Test Facility Design Project

D. Bobrovsky[1], A. Pechenkin[2], A. Sogoyan[2], A. Chumakov[2], S. Soloviev[2], E. Syresin[3], G. Filatov[3], A. Slivin[3], T. Kulevoy[4], Y. Titarenko[4], A. Titarenko[4]

1. NRNU MEPHI/SPELS, Russian Federation
2. NRNU MEPhI/SPELS, Russian Federation
3. JINR, Russian Federation
4. ITEP, Russian Federation

Two sets of experimental equipment for IC's SEE test are under development based on NICA accelerator complex. The first facility has 3.2 MeV/n energy and the second one has energy range 150-500 MeV/n.

PI-4 Diagnostics of Low-Flux Proton Beams for Radiation Effect Testing at KOMAC

Y. Kim[1], S. Yun[2], E. Oh[2], G. Jung[2], H. Kim[2], H. Kwon[2]

1. KAERI (Korea Atomic Energy Research Institute), Korea, Republic of
2. KAERI, Korea, Republic of

The low-flux proton irradiation facility at KOMAC can provide a very low flux of 105 #/cm2/pulse with good uniformity. We report the components of the present diagnostic installed at KOMAC for a low-flux beam in detail.

PI-5 Estimation of errors of RADFET-based dosimeters

B. Podlepetsky[1], V. Pershenkov[2], A. Bakerenkov[2], V. Felitsyn[2]

1. MEPhI, Russian Federation
2. NRNU MEPhI, Russian Federation

Estimation of various types errors of RADFET-dosimeters of total ionizing dose have been done based on experimental investigations of RADFETs radiation sensitivity. The electro-physical models were proposed to interpret obtained results.

Session DW: DATA WORKSHOP

Chair(s): Robert Baumann (Radiosity Solutions LLC) & Alexandre Rousset (TRAD)

DW-1 Total Ionizing Dose Effects on 28GHz CMOS Bi-Directional Transceiver for 5G Non-Terrestrial Networks

K. Atsuhiro[1], P. Jian[1], L. Zheng[1], Y. Kiyoshi[1], S. Atsushi[1], O. Kenichi[1]

1. Tokyo Institute of Technology, Japan

This paper presents TID effects on 28GHz 5G bi-directional transceiver fabricated in 65nm CMOS. The transceiver employs a phased-array for beam steering. TID experiments show 2.5dB gain drop and 6degree phase variation at 1000krad doses.

DW-2 Experimental Study on Single Event Effect of a ReRAM Memory

H. Lyu[1], H. Zhang[1], Q. Yu[1], Y. Sun[1], B. Mei[1], P. Li[1]

1. China Aerospace Components Engineering Center, China Academy of Space Technology, China

This paper analyzed the working principle of ReRAM, selected MB85AS4MT type ReRAM memory produced by Fujitsu company as the research object, carries out the sensitivity test of heavy ion and proton single event effect.

DW-3 Compendium of Single Event Effects Test Results for Selected Integrated Circuits

S. Witczak[1], J. Horner[1], J. Hack[1], N. Goldstein[1], P. Dudek[1], B. Song[1], R. Horner[1], G. Macejik[1], T. Knight[1]

1. Northrop Grumman, USA

Test results for single event effects due to heavy-ion irradiation are reported for more than 30 part types. Event characterization includes LET thresholds, cross-sections and oscilloscope captures for both destructive and non-destructive events.

DW-4 CTTB Memory Test Board Single Event Effect Geostationary In-flight Data Analysis

M. Pinto[1], P. Gonçalves[1], J. Sampaio[1], T. Sousa[2], C. Poivey[3]

1. LIP, Portugal
2. EFACEC, Portugal
3. ESA, Netherlands

The CTTB aboard the Alphasat in geostationary orbit carried a SEU monitor, a SEL monitor and a NAND-Flash memory for technology demonstration. Here we present the in-flight data analysis of all memories.

DW-5 Testing of COTS Operational Amplifier in the Framework of the ESA CORHA Study

C. Tscherne[1], M. Wind[2], M. Bagatin[3], S. Gerardin[4], M. Latocha[1], A. Paccagnella[3], M. Poizat[5], P. Beck[2]

1. Seibersdorf Labor GmbH, Austria
2. Seibersdorf Laboratories, Austria
3. University of Padova, Italy
4. DEI - Padova University, Italy
5. ESA, Netherlands

We present TID radiation response test data of commercial operational amplifiers as part of the ESA CORHA study. The aim of the CORHA study is to investigate COTS components relevant for space and nanosatellite applications.

~~DW-6 Single Event Effects Radiation Characterization of 55-65nm NOR flash for Space Applications~~

~~B. Tanios[1], M. Kaddour[1], B. Forgerit[1], F. Guerre[1], C. Poivey[2]~~

~~*1. Alter Technology TÜV Nord France, France*~~
~~*2. European Space Agency (ESA), Netherlands*~~

WITHDRAWN

~~This work presents a comparative study of Single Event Effects (SEE) radiation sensitivity of two COTS (commercial off-the-shelf) 55-65nm NOR flash memories for space applications.~~

DW-7 SEE Testing on commercial power MOSFETs

P. Fernandezmartinez[1], A. Papadopoulou[1], S. Danzeca[1], G. Foucard[1], R. Garciaalia[1], M. Kastriotou[2], G. Tsiligiannis[1], R. Gaillard[3]

1. CERN, Switzerland
2. CERN, France
3. Consultant, France

This paper compiles the results obtained in several irradiation campaigns carried out in different European facilities to study and characterize the SEE susceptibility of a series of medium voltage power MOSFETs under varied irradiation conditions.

DW-8 Single Event Effect Characterization of the GR716A Rad-Hard LEON3FT Microcontroller

L. Tambara[1], F. Hernandez[2], [1], F. Sturesson[1], N. Wessman[1], J. Andersson[1], S. Habinc[1], C. Monteleone[3]

1. Cobham Gaisler, Sweden
2. Gaisler, Sweden
3. European Space Agency, Netherlands

This work presents the Single Event Effect (SEE) characterization of the GR716A, a mixed-signal radiation-hardened Microcontroller based on a LEON3FT fault-tolerant processor. Results show an SEE error rate below 7.0x10-6 events/device/day for typical space orbits.

DW-9 Total Ionizing Dose Response of Commercial Off-The-Shelf Microcontrollers and Operational Amplifiers

J. Armani[1], S. Blairon[2], A. Urenaacuna[3]

1. CEA LIST, France
2. EDF, France
3. CEA, France

The response to total ionizing dose of several microcontrollers and operational amplifiers was evaluated under 60Co irradiation. The MSP430FR5994 microcontroller and the ADA4622-1 operational amplifier were fully functional after a cumulated dose of 5 kGy.

~~DW-10 Single Event Effects Radiation Characterization of 24-36nm COTS NAND flash for Space Applications~~

~~B. Tanios[1], M. Rousselet[1], F. Lochon[1], B. For[illegible]Guerre[1], C. Poivey[2]~~

~~*1. Alter Technology TÜV Nord France, France*~~
~~*2. European Space Agency (ESA), Netherlands*~~

WITHDRAWN

~~This work presents a comparative study of Single Event Effects (SEE) radiation sensitivity of two COTS (commercial off-the-shelf) 24-36nm NAND flash memories for space applications.~~

DW-11 Single-Event Transient Test Results for the Intersil ISL73141SEH Precision SAR ADC

J. Harris[1], L. Pearce[2], N. Van vonno[1], E. Thomson[1]

1. Renesas Electronics America, USA
2. Renesas Electronics America, USA

We report the results of nondestructive single-event transient (SET) testing of the Intersil ISL73141SEH 14-bit 750/1000ksps precision SAR ADC.

DW-12 Total Dose Testing of the Renesas ISL70005SEH Hardened Dual Output Point of Load Regulator

N. Van vonno[1], J. Gill[1], F. Ballou[1], B. Satterfield[2], L. Pearce[1], C. Newman[1]

1. Renesas Electronics America, USA
2. Retired, USA

We report results of low and high dose rate total dose testing of the ISL70005SEH dual output point of load converter, which combines a synchronous buck regulator and a low dropout voltage linear regulator.

DW-13 Total Dose and Single-Event Effects Test Results of the Intersil ISL7x100SEH Current Sense Amplifier

W. Newman[1], N. Van Vonno[1]

1. Renesas Electronics America, USA

We report the results of total ionizing dose (TID) and destructive and nondestructive single-event effects (SEE) testing of the Intersil ISL70100SEH and ISL70300SEH radiation hardened, current sense amplifier circuits.

DW-14 Cosmic ray immunity of COTS Normally-Off Power GaN FETs for space, aeronautic and automotive applications

M. Zerarka[1], O. Crepel[2], C. Weulersse[3], S. Morand[3], C. Binois[3], M. Mazurek[2], F. Coccetti[1]

1. IRT Saint Exupery, France
2. Airbus SAS, France
3. Airbus Defense and Space, France

The objective of this work is to characterize the SEE failure induced by heavy ion and neutron irradiations on commercial Normally-Off GaN technologies used in switching power conversion. TID sensitivity is also explored.

~~DW-15 Compendium of Current Proton-Induced Radiation Effects Results on Integrated Power Supervisors~~

~~J. Budroweit[1], N. Aksteiner[1], T. Firchau[1], J. L~~

~~*1. DLR, Germany*~~

WITHDRAWN

~~This paper presents the latest test results of power supervisor devices under proton irradiation. Single event effects (SEE) and the accumulated dose effects are investigated, analyzed and discussed~~

DW-16 Radiation Effects on the Transmission of Non-Radiation-Hardened Glass Elements

C. Stone[1], J. Johnson[2], A. Carlton[2]

1. University of Rochester, USA
2. MIT Lincoln Laboratory, USA

The radiation effects on the transmission of nine non-radiation-hardened glass types are quantified. The elements are irradiated up to 22 krad(Si) and transmission measurements are made to assess darkening and annealing.

DW-17 Compendium of Current Proton-Induced Radiation Effect Results on Power Regulators

N. Aksteiner[1], J. Budroweit[2], T. Firchau[2], J. Häseker[2]

1. DLR e.V., Germany
2. DLR, Germany

This paper presents the latest test results of power regulator devices under proton irradiation. Single event effects (SEE) and accumulated total ionizing dose (TID) effects are investigated, analyzed and discussed.

~~DW-18 SAMRH71F20C RHBD 32-bits Flash Microcontroller Preliminary Radiation Test Report - Single Event Effects & TID evaluation~~

~~J. Vrignaud[1], G. Bourg-cazan[1], S. Furic[1], J. Bernard[1], Leduc[2]~~

~~*1. Microchip A & D, France*~~
~~*2. Microchip A & D, France*~~

WITHDRAWN

~~The SAMRH71F20C is a high-performance microcontroller based on the 32-bit ARM® Cortex®-M7 RISC (5.04 CoreMark/MHz) processor with Floating Point Unit (FPU). This report summarizes the SAMRH71F20C SEL, SEU as well as TID radiation test results in digital~~

DW-19 Fault Mode Analysis of Neural Network-based Object Detection on GPUs with Neutron Irradiation Test

Y. Zhang[1], K. Ito[1], H. Itsuji[2], T. Uezono[2], T. Toba[2], M. Hashimoto[1]

1. Osaka University, Japan
2. Hitachi Ltd., Japan

This work analyzes the fault modes of NN-based object detection on GPUs using a neutron beam. Results show that there are burst fault modes that repeat the same SDC errors and induce variant SDC errors.

~~**DW-20 VSC8541RT Single Port Gigabit Ethernet PHY Radiation Test Report - Single Event Effects and Total Ionizing Dose**~~

~~B. Treuillard[1], S. Furic[2], P. Fournier[2], E. Leduc[3], G. Bourg-cazan[2], J. Vrignaud[2], F. Malou[4]~~

~~*1. Microchip A & D, France*~~
~~*2. Microchip A & D, France*~~
~~*3. Microchip A & D, France*~~
~~*4. CNES, France*~~

~~The VSC8541RT product is a copper ethernet PHY designed for space-constrained 10/100/1000BASE-T applications and a SEL immune version qualified using Microchip's proprietary hardening techniques. This reports gives a summary of TID and SEE results.~~

DW-21 Proton irradiation of GaN transistor based power supply operating in the linear region

J. Devine[1], E. Cano gonzalez[1]

1. CERN, Switzerland

This paper describes board level testing of linear power supply based on SiC JBS diodes and GaN gate injection transistors in a 186 MeV proton beam to evaluate the potential sensitivity to SEEs.

DW-22 Heavy Ion and Proton Induced Single Event Effects on Microchip RT PolarFire FPGA

N. Rezzak[1], J. Wang[1], R. Chipana[1], L. Chio[1], B. Gregory[1], F. Hawley[1], E. Hamdy[1]

1. Microchip, USA

Single-Event response of Microchip RT PolarFire SONOS-based FPGA is characterized using heavy ion and proton. SONOS configuration cell is SEU immune due to SONOS technology and the design of the configuration cell of RT PolarFire

~~**DW-23 MCP37D31-RT200 200 Msps, 16 bit, Pipeline Analog-to-Digital Converter Radiation Test Report - Single Event Effects evaluation & TID Evaluation**~~

~~J. Vrignaud[1], F. Colbert[2], S. Gopalakrishnan[2], E. Leduc[3]~~

~~*1. Microchip A & D, France*~~
~~*2. Microchip A & D, USA*~~
~~*3. Microchip A & D, France*~~

~~The MCP37D31-RT200 is Microchip's baseline 16-bit 200 Msps pipelined ADC Rad Tolerant product. An SEL immune version qualified using proprietary hardening techniques. This report presents the radiation results obtained during the different TID and SEE sessions.~~