Online RADHARD SYMPOSIUM

Book of Abstracts

April 26th, 2022

www.radhard.eu

SEIBERSDORF LABORATORIES

FFG Promoting Innovation.

Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

AUSTROSPACE

eco plus
Plattform für Luft- und Raumfahrt
EFRE
Europäische Union Investitionen in Wachstum & Beschäftigung. Österreich.

TU Graz

FACHHOCHSCHULE WIENER NEUSTADT

Association RADECS

Imprint

Editor: Mag. DI Christoph Tscherne, Dr. Peter Beck,
Seibersdorf Labor GmbH, 2444 Seibersdorf, Austria
Layout: Seibersdorf Labor GmbH, Marketing, 2444 Seibersdorf, Austria
Publisher: Seibersdorf Laboratories Publishing, Austria
Print: Seibersdorf Labor GmbH, 2444 Seibersdorf, Austria

ISBN (Print) 978-3-902780-22-5
ISBN (Ebook) 978-3-902780-23-2

Chairman‘s Invitation

On behalf of the organizing team, it is my great pleasure to invite you to the 7th edition of the annual RADHARD Symposium. This year’s edition will be a live online event ensuring the necessary safety for all participants during the Covid pandemic.

The mission of the RADHARD Symposium is to provide you, in addition to the RADECS conference, with a forum for the exchange of practical experience in the field of radiation hardness assurance. This information is important for both industrial applications as well as for research and science. Our vision is that the RADHARD Symposium will provide a place with plenty of room for communication, the exchange of ideas and the possibility to initiate new joint projects.

This year’s RADHARD Symposium focuses on:

- Radiation Testing Facilities
- Current Inventive SmallSat Projects
- Radiation Testing and COTS Components

The RADHARD Symposium is aimed at space system integrators, manufacturers of electrical and electronic equipment, industry, research and science as well as students interested in radiation and its effects on components and systems. International experts present new results and give a comprehensive overview of their current projects. We encourage students to present their early research work on radiation hardness effects and discuss their work and ideas with experts from research and industry.

The first session on radiation testing facilities is opened by a keynote speech given by international expert Gerd Datzmann, founder and CEO of Datzmann interact & innovate. His motto *bridging the gap between science and industry* perfectly suits his keynote on *RADNEXT - Responding to the Emerging Needs of Radiation Testing*. The session on radiation testing facilities is continued with insights into *The Challenges of Testing at European Irradiation Facilities* by ESA expert Anastasia Pesce, followed by a first-hand experience report on accreditation and quality assurance by Seibersdorf Laboratories’ head of business unit and recognized expert Peter Beck in *The Importance of Accredited Procedures for Radiation Testing Laboratories According to ISO/IEC 17025*.

The practical aspect of radiation hardness assurance is of particular importance for New Space applications. In Session II *Current Inventive SmallSat Projects*, we invite international space operators to present their space projects and share their individual experience, knowledge and lessons learnt. Talks show the numerous different applications of SmallSats and cover *Recent, Current and Future CubeSat Activities at FH-Wiener Neustadt* by Carsten Scharlemann (University of Applied Sciences Wiener Neustadt), *PRETTY CubeSat - Prepared for Launch* by Heinrich Fragner (Beyond Gravity Austria GmbH), *IFM Nano Thruster Development: From LEO to Deepspace* by Bernhard Seifert (FOTEC), *Space Debris Detection with ADLER-1* by Gernot Grömer (Austrian Space Forum), and *Detecting and Monitoring Wildfire from Space* by Martin Langer (OroraTech).

The third session on *Radiation Testing and COTS Components* perfectly complements the session on SmallSat projects, as it deals with practical aspects of radiation testing of commercial components, that are regularly used for low-cost space missions. Talks presented are on *Radiation Testing on COTS Components in the Frame of the CORHA ESA Study* by Christoph Tscherne (Seibersdorf Laboratories), *Single Event Effects in Non-volatile Memories for Small Satellites* by Simone Gerardin (University of Padova – Department of Information Engineering), and *Electromagnetic Emissions in Combination with TID Stress – Physical Background, Test Setup and First Results* by Alicja Michalowska-Forsyth and Nikolaus Czepl (Graz University of Technology).

The Symposium concludes with an expert panel discussion on *SmallSats - An attractive business case?* The question is discussed considering the vast increasing number of commercial nanosatellites and constellations, current and future launch and operation costs, business concepts, the increasing competitive pressure, but also reflecting on the increasing criticism regarding the high number of space objects and questions regarding the safety and sustainability in space for future generations.

The 7th RADHARD Symposium is organized by Seibersdorf Laboratories and supported by the Austrian Research Promotion Agency (FFG), the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology, AUSTROSPACE, ecoplus Aerospace Platform and in cooperation with the Graz University of Technology (TUG), the University of Applied Sciences Wiener Neustadt (FHWN) and the RADECS Association.

Our special thanks go to our supporters, AUSTROSPACE, ecoplus Aerospace Platform and the Austrian Research Promotion Agency (FFG), who once again enabled us to provide the RADHARD Symposium without participation fee.

The 7th RADHARD Symposium will take place as live online event for all participants via an interactive live stream on 26th April 2022. Additionally, the stream will be available for rewatching for up to one month after the event.

Even if no come-together dinner can take place this year among the participants, the event will be organized for you with many innovative ideas, with new presentation possibilities, very integrative and as a joint event with lots of fun and heart.

We wish you all an interesting 7th RADHARD Symposium!

Christoph Tscherne

On behalf of the entire organizing team of the RADHARD Symposium

Table of Content

Program Tuesday, April 26th, 2022

09:15 **Welcome Notes by the General Manager**
Martina Schwaiger, Seibersdorf Laboratories, Austria

Welcome Notes by the Head of Austrian Aeronautics and Space Agency
Andreas Geisler, Austrian Aeronautics and Space Agency, Austria

Welcome Notes by the Technopol Manager Wiener Neustadt
Rainer Gotsbacher, ecoplus, Austria

Welcome Notes by the Platform Manager Aerospace
Robert Geiger, ecoplus, Austria

Welcome Notes by the Executive Committee President from Austrospace
Dieter Grebner, Austrospace, Austria

Introduction and Program Overview
Peter Beck, Seibersdorf Laboratories, Austria
Christoph Tscherne, Seibersdorf Laboratories, Austria

10:00 **Keynote: RADNEXT - Responding to the Emerging Needs of Radiation Testing**
Gerd Datzmann, Datzmann interact & innovate GmbH, Germany

Q&A Keynote Talk
Moderated by Christoph Tscherne

10:45 Session I: Radiation Testing Facilities

The Challenges of Testing at European Irradiation Facilities
Anastasia Pesce, European Space Agency, The Netherlands

Characterization and Accreditation of Testing Laboratories According to EN ISO/IEC 17025
Peter Beck, Seibersdorf Laboratories, Austria

Q&A - Radiation Testing Facilities
Moderated by Christoph Tscherne

11:45 **Lunch Break**

Program status at the editorial deadline.

12:45 Session II: Current Inventive SmallSat Projects

Recent, Current and Future CubeSat Activities at FH-Wiener Neustadt
Carsten Scharlemann, University of Applied Sciences Wiener Neustadt, Austria

PRETTY CubeSat - Prepared for Launch
Heinrich Fragner, Beyond Gravity Austria GmbH, Austria

IFM Nano Thruster Development: From LEO to Deepspace
Bernhard Seifert, FOTEC Forschungs- und Technologietransfer GmbH, Austria

Space Debris Detection with ADLER-1
Gernot Grömer, Austrian Space Forum, Austria

Detecting and Monitoring Wildfire from Space
Martin Langer, OroraTech GmbH, Germany

Q&A - Current Inventive SmallSat Projects
Moderated by Christoph Tscherne

14:15 Session III: Radiation Testing and COTS Components

Radiation Testing on COTS Components in the Frame of the CORHA ESA Study
Christoph Tscherne, Seibersdorf Laboratories, Austria

Single Event Effects in Non-volatile Memories for Small Satellites
Simone Gerardin, University of Padova - Department of Information Engineering, Italy

Electromagnetic Emissions in Combination with TID Stress – Physical Background, Test Setup and First Results
Alicja Michalowska-Forsyth, Nikolaus Czepl, Graz University of Technology, Austria

Q&A - Radiation Testing and COTS Components
Moderated by Christoph Tscherne

15:00 Panel Discussion - SmallSats - An attractive business case?
Including the Speakers and Experts of Session II
Moderated by Peter Beck and Christoph Tscherne

16:00 Closing

Program status at the editorial deadline.

Keynote

Keynote
RADNEXT - Responding to the Emerging Needs of Radiation Testing

Gerd Datzmann[1], Ennio Capria[2], Rubén García Alía[3]

[1] Datzmann interact & innovate GmbH, München, Deutschland
[2] ESRF, Grenoble, France
[3] CERN, Geneva, Switzerland

Abstract

Radiation hardness qualification procedures for electronic components and systems require testing at facilities providing high-energetic protons, heavy ions, neutrons, electrons as well as gamma-rays, X-rays and to some extent pulsed X-rays. These irradiation facilities ensure the emulation of the radiation environment that the electronic devices will face in real operation. Especially high-energetic protons, heavy ions and neutrons are generated at particle accelerator or research reactors located at universities or publicly funded institutions. Thus, industry is dependent on a service provision by large-scale research infrastructures and scientific laboratories.

The collaboration of radiation effects experts from industry with nuclear physics scientists from the facilities can be challenging, in particular in a business setting of selling a fee-based service to industry customers. Topics such as visibility of the service offering, availability and accessibility of the irradiation facilities will be discussed. However, a number of research facilities have established a professionally operated service that is regularly used for routine qualifications tests of microelectronic devices. Results of an in-depth study [1] will be presented, highlighting the facilitators and the barriers in the relationship between irradiation facility and its industrial users in Europe. Recently, the growing demand for testing – triggered to a large extent by new space projects – versus a static offering from the facilities is perceived as a great challenge in the field for the upcoming years.

The EU project RADNEXT [2] is a network of European irradiation facilities as well as academic, research and industrial partners from the radiation effects domain. Its main purpose is easing access to accelerator infrastructure for radiation effects users (mainly SEE) for space, atmospheric and high-energy accelerator applications. Since the launch of RADNEXT in June 2021 the program is continuously offering beamtime for external users via transnational access at more than 20 irradiation facilities in Europe including one facility in Canada. This keynote will describe the status and prospects of the RADNEXT project and will highlight a set of measures and initiatives that aim to solve current challenges in the field of radiation hardness assurance.

References

[1] G. Datzmann (2019). “Success factors and barriers in university-industry cooperation: Case study of radiation hardness testing services for microelectronic devices”, Master thesis, TUM School of Management, Technische Universität München

[2] https://radnext.web.cern.ch

Session I:
Radiation Testing Facilities

The Challenges of Testing at European Irradiation Facilities

Anastasia Pesce[1], Alessandra Costantino[1]

[1] European Space Agency

Abstract

In this paper the challenges faced when testing complex electronic components according to ESCC 25100 [1] will be presented. The European Irradiation Facilities are an asset for all the space community when assuring the radiation hardness of a component in a given space mission environment.

Limitations such as the number of available beam hours, the test set up cost and the difficulties encountered in the sample preparation of modern technologies are a hinder in the overall RHA process. European irradiation testing facilities are an important part of the European space electronics supply chain infrastructure and can strongly impact the time-to-market of parts for space customers.

Relying on the access to European irradiation testing capabilities is fundamental to maintain a European non dependence on RHA for space.

References

[1] European Space Components Coordination, ESCC Basic Specification No. 25100, Single Event Effects Test Method and Guidelines, Issue 2, Oct. 2014

The Importance of Accredited Procedures for Radiation Testing Laboratories According to ISO/IEC 17025

Peter Beck[1]

[1] Seibersdorf Laboratories, Austria

Abstract

ISO/IEC 17025 accreditation is aimed at laboratories with the incentive to develop, maintain and continuously improve their quality through a quality management system [1]. The focus of the ISO/IEC 17025 accreditation is on the reliability and quality of test methods. Accreditation according to ISO/IEC 17025 demonstrates the integrity and the professionalism of a contract laboratory. It further proofs the laboratories' ability to consistently produce reliable and trustworthy results; the key to customer satisfaction and acceptance of the contract laboratory as an independent testing body.

Seibersdorf Laboratories holds and maintains numerous ISO/IEC 17025 accredited procedures for its various test facilities. One facility that is of particular interest for the radiation hardness assurance community is the TEC-Laboratory, one of Seibersdorf Laboratories' Co-60 facilities dedicated entirely to total ionizing dose (TID) testing of electronic components and systems.

The abbreviation TEC stands for Testing of Electronic Components. The testing procedures of the TEC-Laboratory are fully compliant with the ISO/IEC 17025 standard of test laboratories. Further, the procedures of the TEC-Laboratory comply with ESCC Basic Specification No. 22900 [2] and Steady-State Total Dose Irradiation Procedure of MIL-STD-750 [3]. For maintaining its accreditation, the TEC-Laboratory is regularly audited by an independent governmental body certified for accreditation of test laboratories – the Accreditation Austria. The Accreditation Austria is a full member of the International Laboratory Accreditation Cooperation ILAC and a signatory of the MRA for "Testing, Calibration and Inspection", guaranteeing the acceptance of accreditation worldwide. As part of its accreditation, the TEC-Laboratory must also participate in relevant comparative qualification tests, e.g. interlaboratory comparisons, to demonstrate its technical competence. As a results of its accreditation, the TEC-Laboratory is allowed to issue test reports showing the accreditation body's and the ILAC symbol – a sign of excellent quality assurance.

In this talk I will present and discuss the key aspects of accreditation of testing laboratories to ISO/IEC 17025. As an example, I will show the process of gaining and maintaining accreditation of the TEC Laboratory, Seibersdorf Laboratories' Co-60 test facility of TID testing of electronic components and system. Important aspects such as Co-60 photon field characterization and the effect of backscattering, e.g. from the concrete walls by means of measurements and Monte Carlo methods will be investigated [4][5]. Further, preliminary results from the latest interlaboratory measurements will be provided. All these examples will highlight the importance of accreditation to ISO/IEC 17025 of test facilities to the end user, to receive accurate, reliable and traceable test results.

References

[1] EN ISO/IEC 17025:2017, General requirements for the competence of testing and calibration laboratories, 2018

[2] European Space Component Coordination, Total Dose Steady-State Irradiation Test Method, ESCC Basic Specification No.22900, escies.org, 2016

[3] MIL-STD-750-F Test Method Standard, Method 1019.5, Steady-State Total Dose Irradiation Procedure, Department of Defense, 2016

[4] T.T. Bohlen, et. Al., The FLUKA Code: Developments and Challenges for High Energy and Medical Applications, Nuclear Data Sheets 120, 211-214, 2014

[5] A. Ferrari, et. Al., FLUKA: a multi-particle transport code, CERN-2005-10 (2005), INFN/TC_05/11, SLAC-R-773

Session II:

Current Inventive SmallSat Projects

Recent, Current and Future CubeSat Activities at FH-Wiener Neustadt

C. Scharlemann[1], W. Treberspurg[1], C. Obertscheider[1]

[1] University of Applied Sciences Wiener Neustadt

Abstract

In 2013, long before CubeSat have become a ubiquitous tool for education and research, the university of Applied Sciences Wiener Neustadt (FHWN) has initiated a nanosatellite program as part of the education in Aerospace Engineering. The most visible output of this program is the 2U CubeSat PEGASUS, which was launched in 2017 and is successfully operating up to this date. As part of the educational program, the department of Aerospace Engineering is frequently conducting conceptional studies to explore the potential of CubeSats for future missions including:

CLIMB: Exploration of the Van Allen Belt and conducting radiation and magnetic field measurements

Solar Sentinel S3: CubeSats as an early detection and warning system against solar flares and corona mass ejections

Magneto: A distributed CubeSat swarm to investigate the magnetopause of Earth

Moonraker: A CubeSat constellation around the Moon, providing GNSS services to support ground explorations

In 2018, CLIMB was selected as the next flight mission of the FHWN (see cubesat.fhwn.ac.at). Funded by Lower Austria and the FHWN, the 3U CubeSat is currently under development. CLIMB will be launched into a low, circular orbit of about 500 km altitude. Using a Field Emission Electric Propulsion (FEEP) system, developed by FOTEC and commercialized by the company ENPULSION, the satellite will be lifted to a slightly elliptical orbit with its apogee around 1000 km – well inside the inner Van Allen belt. Using a radiation monitor developed by Seibersdorf Laboratories, the satellite will continuously monitor the space radiation dose and its impact on CLIMB's subsystems during its yearlong ascent to and operation in the Van Allen belt. The simulation of the expected radiation exposure in combination with radiation testing of the subsystems on ground, will allow to mitigate or consider specific radiation effects in the mission planning. In addition, this comparison allows an evaluation of how well such ground tests can predict effects of space radiation on CubeSat subsystems. Such comparisons are an important contribution for future mission since they can help to increase mission safety and with that mission success. The second major payload of CLIMB is a magnetometer with a sensitivity of about 10 nT. Measurements with such accuracies require the investigation of the magnetic properties of the satellite itself. For this purpose, IABG provided the CLIMB team the opportunity and support to conduct measurements of the magnetic properties of an electrical model of the space craft at the MFSA facility. . The preliminary results of those tests indicated a magnetic dipole moment of the satellite in the in the range of 20 mA.m^2.

PRETTY CubeSat - Prepared for Launch

Heinrich Fragner[1], Andreas Dielacher[1], Michael Moser-Moritsch[1], P. Beck[2], C. Tscherne[2], M. Wind[2], L. Huber[2], M. Wenger[3], A. Hörmer[3]

[1] Beyond Gravity Austria GmbH, Stachegasse 13, 1120 Vienna
[2] Seibersdorf Laboratories, 2444 Seibersdorf, Austria
[3] Graz University of Technology, Inffeldgasse 12, 8010 Graz, Austria

Abstract

The ESA In-Orbit Demonstration (IOD) mission PRETTY is a 3U CubeSat mission planned and implemented by a consortium of Beyond Gravity Austria GmbH, Graz University of Technology and Seibersdorf Laboratories. It hosts two payloads: The primary payload is a passive reflectometer receiving the reflected GNSS signals from the Earth's surface. This instrument evaluates the signal waveform and measures the path delay of the reflected signals in order to obtain altimetry and surface condition data. The secondary payload is a dosimeter for electronics featuring two different sensor types for total ionizing dose (TID) assessment with high durability and with high resolution.

Both instruments have recently been improved by the payload responsibles with significant effort to increase the scientific value of the PRETTY mission. Seibersdorf Laboratories is responsible for the dosimeter and has added the capability to measure single event upset (SEU) rates within their instrument.

Beyond Gravity Austria GmbH has modified the observation frequency from L1 to L5 band. According to newest findings the L5 band allows to implement significantly increased coherent integration times. Furthermore, the passive reflectometer now also supports Galileo signals.

Graz University of Technology is currently performing the integration of the complete spacecraft and ground segment. The task to host two complex payloads, one with high data rate demands, the need for high accuracy pointing and agile platform pointing into a complete working system is often challenged by technical, administrative and financial limitations. Thanks to an experienced team with excellent know-how and endless motivation, all challenges that occurred up to now have been resolved together with the prime contractor.

Within this presentation we will focus on the latest introduced modifications of the two instruments as well as on some of the challenges during the overall mission design and implementation.

References

[1] Fragner, H.; Dielacher, A.; Moritsch, M.; Zangerl, F.; Beck, P.; Koudelka, O.; Hoeg, P.; Wickert, J.; Cardellach, E.; Wenger, M.; Hormer, A.; Zeif, R.; Teschl, F.; Martin-Neira, M.; Semmlinge, M.; Walker, R; Recycling GPS signals and radiation monitoring: The two payloads on board of PRETTY Proceedings of SPIE Vol. 11131, 111310J; DOI: 10.1117/12.2530806

Acknowledgments

The authors want to thank the European Space Agency (ESA) as well as the Austrian Research Promotion Agency (FFG).

IFM Nano Thruster Development: From LEO to Deepspace

Bernhard Seifert[1], Thomas Hörbe[2], Emre Ceribas[3], Jakob Kirschner[4]

FOTEC Forschungs- und Technologietransfer GmbH
[1] Head of Aerospace Engineering Department, seifert@fotec.at
[2] Scientist, hoerbe@fotec.at
[3] Scientist, ceribas@fotec.at
[4] Scientist, kirschner@fotec.at

Abstract

Building on the long-term experience of ion emitters and ion thrusters based on FEEP (Field Emission Electric Propulsion) technology, FOTEC started the development of the integrated propulsion system IFM Nano Thruster for CubeSats and Nanosatellites in 2015. In parallel to the miniaturization of the thruster and periphery, also the PPU (Power Processing Unit) was developed to operate the thruster. It controls the heater to liquefy the solid propellant indium, generates negative and positive high voltage to ionize and accelerate the propellant and operates the thermionic neutralizers to compensate the positive expelled ions by emitting electrons. In 2018, the first IOD (in-orbit demonstration) of the IFM Nano Thruster showed the functionality of the micro-propulsion system integrated into a 3U CubeSat.

While the TID (Total Ionizing Dose) rate in lower LEO (Low Earth Orbit) is comparatively low, it strongly increases to significant levels at altitudes of 800 km and higher. Here, the proper selection of EEE (Electrical, Electronic and Electromechanical) components is crucial to guarantee proper functionality of the PPU after a certain accumulated dose. FOTEC has performed various TID test campaigns at Seibersdorf Laboratories to verify the functionality and stability of the components resulting in a PPU that can be exposed to 30 krad TID without loss of performance.

In 2021, FOTEC started to test the PPU sensitivity to SEE (Single Event Effects) with high-energy protons (up to 250 MeV) at MedAustron, a synchrotron based medical facility. The first tests were done at system level and rasterizing the PCB allows detailed conclusions to be drawn about the individual components and their performance by correlating the spatial information of the beam with the timely logged telemetry. A full qualification campaign of the next generation FEEP propulsion systems consisting of TID and SEE tests is planned for 2022.

Space Debris Detection with ADLER-1

Gernot Grömer[1], Willibald Stumptner[1], Marvin Schumacher[1]

[1] Austrian Space Forum

Abstract

ADLER-1, a 3U CubeSat, launched in January 2022 to measure small space debris particles at ca. 500 km altitude. Two instruments are implemented: Firstly, APID (Austrian Particle Impact Detector), able to measure particles in the range of down to ca. 10 µm. Given ESA's MASTER model and the instrument properties, we expect more than 100 impact events over the projected lifetime of at least one year. The detector provides impact energy data derived from a deployable piezoelectric detector array.

Secondly, a continuous-wave radar measures both radar cross section and Doppler-derived velocity vectors for larger mm-sized particles. Both payloads are intended as in-orbit validation of the detection technique and shall contribute to complement the ESA MASTER-model with in-situ data sets.

We report on the sensor technology and the first two months of operation of ADLER-1 and its automated data processing pipeline.

Acknowledgments

The ADLER-1 mission is a joint project of the Austrian Space Forum, Findus Venture and SPIRE Global.

Detecting and Monitoring Wildfire from Space

Martin Langer[1], Sebastian Wuerl[1], Rupert Amann[1], Lucas Krempel[1] Florian Mauracher[1], Thomas Gruebler[1]

[1] OroraTech GmbH, St.-Martin-Str. 112, 81669 Munich

Abstract

Wildfires heavily contribute to global warming as they emit tonnes of CO2 into the atmosphere, up to 20% of global greenhouse gas emissions yearly. Estimates by the UN project a global increase of extreme fires of up to 14 per cent by 2030, and 30 per cent by the end of 2050 [1]. Climate change and land-use change accelerates this development, making wildfires more frequent and intense in the future. This could dangerously affect the delicate global balance between CO2 emissions and sinks and become part of a vicious cycle that is no longer local, but global. Emissions by wildfires will increase climate change and extreme weather conditions and vice versa. OroraTech is developing an end-to-end solution that strongly addresses this problem on a global scale. Our current wildfire service aggregates 21 satellite data sources in thermal-infrared on a global scale, standing out in comparison to existing publicly available downstream service solutions. Data fusion with local sensors and overlays for weather and terrain data further enhance the value added for the users. As a result, detection times are lower, and monitoring capabilities are higher than in other options. The wildfire product is currently used by different customer groups (fire services, commercial forestry sector, insurer) around the globe. One of the most critical improvements requested is to provide satellite data at local afternoon times, where a gap in current data exists and the wildfire intensity peaks. We intend to close this gap with a so-called minimum viable constellation of nanosatellites, placed in a sun-synchronous orbit at local afternoon time. Complementing existing satellite data sources by our nanosatellites will increase the quality of detection, the revisit rate, and the monitoring capabilities and broaden our portfolio use-cases in more detail. The insights produced by the data, provided either through our proprietary platform or through an API, could also revolutionize areas like insurance, disaster management (wildfires, volcanoes), water management & urban heat mapping, agriculture, disease mapping and monitoring of industrial risks, like air pollution and oil spills.

References

[1] United Nations Environment Programme (2022). Spreading like Wildfire – The Rising Threat of Extraordinary Landscape Fires. A UNEP Rapid Response Assessment. Nairobi

Session III:
Radiation Testing and COTS Components

Radiation Testing on COTS Components in the Frame of the CORHA ESA Study

Peter Beck[1], Marta Bagatin[2], Simone Gerardin[2], Lukas Huber[1], Marcin Latocha[1], Alessandro Paccagnella[2], **Christoph Tscherne**[1], Michael Wind[1], Marc Poizat[3]

[1] Seibersdorf Laboratories, Austria
[2] University of Padova, Italy
[3] European Space Agency, ESA

Abstract

Nanosatellites such as CubeSats have become a popular and cost-effective way to access space [1]. The increased interest in flying small-satellite missions and projects of the European Space Agency, ESA, to improve the reliability of SmallSats have resulted in an increased utilization of commercial off-the-shelf (COTS) components for space. COTS components are not only used for SmallSat applications, but also on mainstream missions that rely on the use of latest technology such as high-performance applications. In order to account for this development, ESA initiated a study on radiation screening of COTS components and verification of COTS radiation hardness assurance (RHA) approach (CORHA).

The CORHA project is coordinated by Seibersdorf Laboratories, Austria, and is performed in collaboration with the University of Padova, Italy. The objectives of the CORHA study are to (1) screen and procure COTS components, (2) prepare and execute TID and SEE radiation test campaigns, and (3) propose an ad-hoc RHA approach for COTS components.

The CORHA team evaluated COTS technologies available on the market with respect to their TID and SEE response. As the CORHA project is in its finishing months, the presentation will summarize the project and conclude on the project outcome and lessons learnt. This includes TID and SEE testing results and the presentation of the formulated ad-hoc RHA approach for COTS components.

References

[1] M. Poizat, A. Zadeh, C. Poivey, R. Walker, Radiation Hardness Assurance for Commercial-Off-The-Shelf (COTS) components for Small Satellites, RADHARD Symposium 2018, https://www.seibersdorf-laboratories.at/en/radhard/archive/2018-radhard-symposium, ISBN (Print) 978-3-902780-12-6, ISBN (Ebook) 978-3-902780-13-3, Editor: Peter Beck, Seibersdorf Labor GmbH, 2444 Seibersdorf, Austria, Publisher: Seibersdorf Laboratories Publishing, Austria, April 2018.

Acknowledgments

We acknowledge the support by the European Space Agency, ESA under the ESA contract No. 4000126049/18/NL/KML.

Single Event Effects in Non-volatile Memories for Small Satellites

Simone Gerardin[1], Marta Bagatin[1], Alessandro Paccagnella[1], Peter Beck[2], Christoph Tscherne[2], Michael Wind[2], Marc Poizat[3]

[1] University of Padova – Department of Information Engineering, Italy
[2] Seibersdorf Laboratories, Austria
[3] European Space Agency, ESA

Abstract

Microcontrollers and FPGAs used in small satellites require low-footprint non-volatile memories (NVM) for configuration, code, and data storage purposes. The Serial Peripheral Interface (SPI) is a standard low-pin count interface that allows for simplified routing and small board area occupation and it is therefore well suited for this kind of application. On the other side, the Flash NOR interface has a larger pin-count and footprint, but provides faster random access.

In this talk we will show the results of Single Event Effects (SEE) tests performed on NVMs, in the frame of the project CORHA (COTS Radiation Hardness Assurance), funded by the European Space Agency. We will present SEE data on three SPI memories and one NOR Flash memory, to address the needs of small satellites. The SPI NVMs are manufactured with two different technologies, charge trap and ferroelectric RAM. The NOR Flash memory employs the floating gate technology.

References

[1] M. Poizat, A. Zadeh, C. Poivey, R. Walker, "Radiation Hardness Assurance for Commercial-Off-The-Shelf (COTS) components for Small Satellites", RADHARD Symposium 2018, https://www.seibersdorf-laboratories.at/en/radhard/archive/2018-radhard-symposium, ISBN (Print) 978-3-902780-12-6, ISBN (Ebook) 978-3-902780-13-3, Editor: Peter Beck, Seibersdorf Labor GmbH, 2444 Seibersdorf, Austria, Publisher: Seibersdorf Laboratories Publishing, Austria, April 2018.

[2] P. Beck, M. Bagatin, S. Gerardin, M. Latocha, Alessandro Paccagnella, C. Tscherne, M. Wind, M. Poizat, "CORHA - Radiation Screening of COTS Components and Verification of COTS RHA Approach", RADHARD Symposium 2019

Electromagnetic Emissions in Combination with TID Stress – Physical Background, Test Setup and First Results

Alicja Michalowska-Forsyth[1], Nikolaus Czepl[1], Bernd Deutschmann[1]

[1] Graz University of Technology, Institute of Electronics

Abstract

Circuits with large switching currents and fast switching edges are often sources of electromagnetic emissions (EME). At the system level these emissions can interfere with electromagnetically susceptible components by radiation, coupling or conductive paths. At the system design-level the overall electromagnetic compatibility (EMC) is ensured by designing integrated circuits (IC) in compliance to EMC standards and in many cases, by dedicated system-level tests. In space, medical or industrial applications the ICs are exposed to different stresses, in particular of concern here – the total ionizing dose (TID) due to ionizing radiation. We present a methodology and first results of screening ICs for TID-induced drifts in their electromagnetic emission. Thereby, the electromagnetic emission of a CMOS output driver test IC is characterized by the so-called 150 Ohm direct coupling method. This method is described in the IEC 61967-4 standard and enables the measurement of the conducted emission of one of the ICs outputs in the frequency range from 150 kHz to 1 GHz. For these investigations, custom ICs of known topology and circuit-level simulation techniques are used in order to deepen the understanding of the effects of underlying combined effect mechanisms. The main motivation for such studies is to determine if TID stress will change the electromagnetic emission of ICs, since certain MOSFET parameters that influence the electromagnetic emission behavior of switched IC topologies drift with TID stress.

References

[1] Benfica, J., Poehls, L. B., Vargas, F., Lipovetzky, J., Lutenberg, A., & Garcia, S. E. (2012, May). Configurable platform for SoC combined tests of TID radiation, aging and EMI. In 2012 Asia-Pacific Symposium on Electromagnetic Compatibility (pp. 393-396). IEEE.

[2] Czepl, N., Deutschmann, B., & Michalowska-Forsyth, A. (2021). Influence of ionizing radiation on the conducted electromagnetic emission of integrated circuits. Microelectronics Reliability, 126, 114335.

[3] Islam, M., Imran, R., & Mahjabeen, B. (2013). On-chip techniques for electromagnetic interference (EMI) reduction. Journal of VLSI and Signal Processing, 2(4), 47-52.

[4] Lara, E. L., Constante, A. A., Benfica, J., Vargas, F., Boyer, A., Dhia, S. B., Gleinser, A., Winkler, G., & Deutschmann, B. (2021). Impact of place and route strategy on FPGA electromagnetic emission. Microelectronics Reliability, 126, 114333

[5] Schwank, J. R., Shaneyfelt, M. R., Fleetwood, D. M., Felix, J. A., Dodd, P. E., Paillet, P., & Ferlet-Cavrois, V. (2008). Radiation effects in MOS oxides. IEEE Transactions on Nuclear Science, 55(4), 1833-1853.

Expert Panel Discussion
SmallSats - An attractive business case?

With the era of Space 2.0, we see a vastly increasing number of satellite launches, especially for commercial SmallSats. As more and more missions are realized, the question arises: Are SmallSats only a temporary passing trend, a playing field for institutions and industry, or are SmallSats meant to stay? Are SmallSats an attractive business case?

Experts discussing this topic are:

Heinrich Fragner, Beyond Gravity Austria GmbH

Dieter Grebner, Austrospace, Peak Technology

Gernot Grömer, Austrian Space Forum

Martin Langer, OroraTech GmbH

Carsten Scharlemann, University of Applied Sciences Wiener Neustadt

Bernhard Seifert, FOTEC Forschungs- und Technologietransfer GmbH

Moderated by

Peter Beck, Seibersdorf Laboratories

Christoph Tscherne, Seibersdorf Laboratories

List of Lecturers

BECK Peter, Seibersdorf Laboratories
The Importance of Accredited Procedures for Radiation Testing Laboratories According to ISO/IEC 17025

DATZMANN Gerd, Datzmann interact & innovate GmbH
RADNEXT - Responding to the Emerging Needs of Radiation Testing

FRAGNER Heinrich, Beyond Gravity Austria GmbH
PRETTY CubeSat - Prepared for Launch

GERARDIN Simone, University of Padova
Single Event Effects in Non-volatile Memories for Small Satellites

GRÖMER Gernot, Austrian Space Forum
Space Debris Detection with ADLER-1

LANGER Martin, OroraTech GmbH
Detecting and Monitoring Wildfire from Space

MICHALOWSKA-FORSYTH Alicja, CZEPL Nikolaus, Graz University of Technology
Electromagnetic Emissions in Combination with TID Stress - Physical Background Test Setup and First Results

PESCE Anastasia, European Space Agency
The Challenges of Testing at European Irradiation Facilities

SCHARLEMANN Carsten, University of Applied Sciences Wiener Neustadt
Recent, Current and Future CubeSat Activities at FH-Wiener Neustadt

SEIFERT Bernhard, FOTEC Forschungs- und Technologietransfer GmbH
IFM Nano Thruster Development: From LEO to Deepspace

TSCHERNE Christoph, Seibersdorf Laboratories
Radiation Testing on COTS Components in the Frame of the CORHA ESA Study

Notes

Notes

CONTACT

Seibersdorf Labor GmbH
2444 Seibersdorf, Austria

www.seibersdorf-laboratories.at
Fax: +43 50550 - 2502

Secretary
+43 50550 - 2500
office@seibersdorf-laboratories.at