RADHARD SYMPOSIUM

10-Year Anniversary Edition

Book of Abstracts

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Chairman‘s Invitation

On behalf of the organizing team, it is our great pleasure to welcome you to the 10th edition of the annual RADHARD Symposium, hosted at Seibersdorf Laboratories near Vienna, Austria.

The RADHARD Symposium continues to serve as a vital platform complementary to the RADECS conference, fostering the exchange of practical insights within the field of radiation hardness assurance (RHA). This event plays an essential role for both industrial applications and academic research, aiming to facilitate dialogue, idea exchange, and the inception of collaborative ventures.

This 10-Year Anniversary Edition, themed „Quo Vadis New Space?“, offers a unique opportunity to reflect on a decade of innovation and to explore the future of New Space. The focus of this year’s RADHARD Symposium includes the following key areas:

- Recap & Reflection: Looking back at major breakthroughs in New Space and how RHA has evolved over the past decade
- Emerging Trends & Future Needs: Presentations on challenges and technological needs shaping the next decade of space missions
- Expert Panels & Discussions: Featuring insights from industry leaders on radiation challenges and future technologies
- Networking & Collaboration: Facilitating discussions and new collaborations within the space technology community
- Laboratory Visits: Including our ISO IEC 17025 accredited TEC-Laboratory for TID testing and the state-of-the-art SEE laser testing facility

We are honored to present a rich program featuring keynote speeches, oral presentations, and expert panels involving leading organizations and figures in the field. As always, a social dinner and guided tours of our laboratory facilities are integral components of the program.

The RADHARD Symposium welcomes participants from across the RHA community, including space system integrators, EEE component manufacturers, industry stakeholders, researchers, and students. We look forward to your contributions and to the vibrant discussions that define this event.

The 10th RADHARD Symposium is proudly organized by Seibersdorf Laboratories and is supported by the Austrian Research Promotion Agency (FFG), the Federal Ministry for Innovation, Mobility and Infrastructure (BMIMI), AUSTROSPACE, and in cooperation with the Graz University of Technology, the University of Applied Sciences Wiener Neustadt, and the RADECS Association.

For the convenience of our participants, the event will be accessible both onsite and via live stream. Recordings will be made available for registered participants for up to one month after the event.

We look forward to welcoming you at the RADHARD Symposium at Seibersdorf Laboratories!

Peter Beck
Christoph Tscherne

On behalf of the organizing team of the RADHARD Symposium

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Aeronautics and Space Agency (ALR/FFG), Head of ALR, Andreas Geisler

ecoplus Wr. Neustadt, Technopol Manager, Rainer Gotsbacher

AUSTROSPACE, President, Dieter Grebner

RADECS Association, President, Robert Ecoffet

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Tuesday, May 6, 2025

Keynote

EEE Space Component Sovereignty for Europe

Christian Poivey on behalf of the EEE Initiative Team

ESA

Abstract

The industrial landscape of Electrical, Electronic and Electro-mechanical (EEE) space components has been changing significantly recently. It is driven now by terrestrial applications. EEE space industry has also been facing some challenges: continuous merger and acquisitions; fabless approach relying on semiconductor manufacturing in far-East; shortages in semiconductors procured outside Europe, leading to increasing lead times; transition from low volume business (institutional missions) to a highly competitive and dynamic business environment (New Space).

ESA member states have recognized these challenges and have initiated the EEE Space component sovereignty for Europe program in 2021 to increase the European EEE Component portfolio for space. This presentation provides the current status of this program and the plans for the near future.

Where Minds Meet and News Move

10 Years of RADHARD Symposium: Advancing Aerospace Radiation Hardness Assurance Through Innovation and Collaboration

Peter Beck, Alexandra Gettler, Lukas Huber, Lukas Höfig, Marcin Latocha, Christian Marchhart, Christoph Tscherne, Valentin Wagner, Michael Wind

Seibersdorf Labor GmbH, Austria

Abstract

For a decade, the RADHARD Symposium organized by Seibersdorf Laboratories has served as an international platform for knowledge exchange and advancement in the field of radiation hardness assurance (RHA) of electronic components for space applications. Building on more than 50 years of expertise in ionizing radiation calibration and more than 30 years in space radiation effects research, the establishment of the TEC-Laboratory marked a major milestone: a specialized aerospace radiation competence center for the testing of Total Ionizing Dose (TID) effects, Enhanced Low Dose Rate Sensitivity (ELDRS) phenomena, and radiation hardness of EEE components according to ESA and military standards under accreditation according to EN ISO/IEC 17025.

An outstanding achievement during this journey was the development of the SATDOS reference dosimetry platform, a compact and highly precise system designed for operation aboard nanosatellites in orbit. SATDOS provides real-time, high-fidelity measurements of space radiation environments, supporting both mission assurance and scientific research. With this innovation, Seibersdorf Laboratories have successfully bridged the gap between ground-based calibration excellence and in-orbit radiation monitoring, reinforcing their leading position in applied space dosimetry.

The RADHARD Symposium has significantly fostered the creation of a strong international network, connecting stakeholders from research, industry, and space agencies. This network has not only enabled new collaborations but has also been instrumental in harmonizing testing methods across Europe and advancing the understanding of space radiation effects.

In its 10th edition, the Symposium reflects on the crucial question: „Quo Vadis New Space?" — in the context of rapidly growing private space initiatives and disruptive technologies. Seibersdorf Laboratories actively embrace this challenge by expanding their capabilities: the new Laser Testing Laboratory for Single Event Effects (SEE) testing marks a significant leap forward. It strengthens the capability to test components under conditions closely resembling space environments, and it positions Seibersdorf Laboratories at the forefront of supporting both traditional and New Space missions.

Motivated by the achievements of the past decade and inspired by the dynamic opportunities ahead, Seibersdorf Laboratories invite the community to jointly shape the next era of space exploration and technology development.

Acknowledgments

The authors gratefully acknowledge the support of R&D projects by the Aeronautics and Space Agency (ALR) of the Austrian Research Promotion Agency (FFG), the Department for Space and Aviation Technologies of the Federal Ministry for Innovation, Mobility and Infrastructure (BMIMI) and the European Space Agency (ESA).

ESA Phi-Lab Net Austria – The competence center for industrialisation of space upstream technology

Carlos Fernandez de Retana

Head of ESA Phi Lab AT/ accent Inkubator GmbH

Abstract

ESA Phi Lab Austria focus on ideas related to the industrialization of innovative upstream hardware and software. We combine the opportunity of growing new space with the local strength of "industrialization" to address the problem of serial production. we support the projects through tailored, hands-on assistance in the areas of business development, technology, intellectual property (IP), and sustainability. Our team works closely with each project to develop customized strategies that support the industrialization focus. This holistic approach ensures that innovative concepts are not only technically feasible but also commercially viable and future-proof.

Together with other companies, we are setting up a space hub at Vienna Airport and, as the first of many Phi Labs in Europe, we can draw on a broad network with different competencies in the ESA Phi-LabNET.

Austria‘s first ESA Lab - A Cooperation Scheme to Intensify Education, Research and Development, Dissemination and Public Outreach to Foster the Growth of the Space Sector

Bernhard Seifert[1], Carsten Scharlemann[2], Helmut Loibl[1], **Laura Bettiol**[1], Johanna Fries[1] and Silvo Korez[2]

[1] FOTEC Forschungs- und Technologietransfer GmbH
[2] University of Applied Sciences Wiener Neustadt

Abstract

“ESA_Lab@ – Partnering to Innovate” is an initiative launched by the European Space Agency (ESA) in 2016 as part of its Basic Activities. In Austria, the Austrian Research Promotion Agency (FFG) selected the University of Applied Sciences Wiener Neustadt (UAS WN / FHWN), together with its research subsidiary FOTEC Forschungs- und Technologietransfer GmbH (FOTEC), as the first ESA_Lab@ in the country.

The objectives of ESA_Lab@UAS WN & FOTEC are rooted in the core strengths of both institutions - development of small satellites and dedicated propulsion and diagnostics solutions [1]. FHWN administers a Master’s program in Aerospace Engineering [2], with a strong emphasis on hands-on skills through a dedicated nanosatellite program and related activities. FOTEC’s Aerospace Engineering department focuses primarily on advancing electric and chemical propulsion systems for small satellites, alongside the development of diagnostic tools for performance evaluation [3]. FOTEC is also offering their facilities for environmental testing of third party’s hardware [4]. Accordingly, the three pillars of ESA_Lab@UAS WN & FOTEC are: (1) education; (2) research and development and (3) dissemination and public outreach. FOTEC and FHWN recognize that integrating these three aspects in an interdisciplinary way is essential for driving scientific progress. This initiative aims to catalyze innovative aerospace research and mobilize talent in a sustainable manner, under a unified label and strategic development framework.

The presentation will provide an overview of the ESA_Lab@UAS WN & FOTEC initiative and its stakeholders, outline the current focus, describe opportunities for collaboration with other institutions, and present the roadmap for the near future.

References

[1] FHWN, “ESA Lab @Austria.” Accessed: Apr. 14, 2025. [Online]. Available: www.fhwn.ac.at/en/research/esa-lab

[2] FHWN, “Master - Aerospace Engineering.” Accessed: May 22, 2024. [Online]. Available: www.fhwn.ac.at/en/studyprogramme/master-aerospace-engineering

[3] FOTEC, “Aerospace Engineering.” Accessed: May 22, 2024. [Online]. Available: www.fotec.at/Home/AerospaceEngineering

[4] L. Bettiol et al., “FOTEC’s Testing and Qualification Capabilities for Small Satellites,” presented at the H-Space, 2024.

Small Satellite Research Network (SSRN)

Ingo Gulyas

University of Applied Sciences Wiener Neustadt, 2700 Wiener Neustadt, Austria

Abstract

The development and validation of CubeSats, presents an interdisciplinary challenge demanding for a broad spectrum of expertise and experience, including mechanics, electronics, physics and effects of radiation, which can only be addressed due to efficient networking. For this purpose, the FTI-partnership 'Small Satellite Research Network' (SSRN) was founded by the University of Applied Sciences Wiener Neustadt (UAS WN), Forschungs- und Technologietransfer GmbH (FOTEC), Seibersdorf Laboratories and R-Space GmbH. Within SSRN, the national expertise in space technology with respect to small satellites is collected to establish a comprehensive database in order to build a dedicated network of key players. This initiative intends to prepare Austria's industry, research, and academic sectors for the future challenges and opportunities in the field of nano satellites. Based on the established network, an ESA-Lab proposal was submitted, accepted and implemented at the end of 2024.The ESA-Lab@UAS WN & FOTEC aims to establish a network for initiating new research proposals and projects in small satellite development. This includes design, manufacturing, testing, launch readiness, and mission operation and therefore extends SSRN activities to an international context. Recently, a steering board has been established to obtain input from key players in industry and academia. Irradiation tests of small satellite key components at Seibersdorf Laboratories and MedAustron are under preparation, as well as the organization of the SSRN workshop in June 2025. Based on results of previous irradiation tests, SSRN intends to develop a modular test setup capable of monitoring the performance of a wide range of potential devices during irradiation test campaigns. Associated activities include the preparation of beam irradiation tests of a novel FPGA system in 7 nm technology. Related devices have a high potential to address upcoming trends like machine learning and neural networks for future small satellite missions [1].

References

[1] A. Cratere, L. Gagliardi, G. A. Sanca, F. Golmar and F. Dell'Olio, „On-Board Computer for CubeSats: State-of-the-Art and Future Trends," in IEEE Access, vol. 12, pp. 99537-99569, 2024, doi: 10.1109/ACCESS.2024.3428388.

2nd Day:
Wednesday, May 7, 2025

Keynote

Upcoming Space Weather Missions with Austrian Contributions

W. Magnes, D. Fischer, M. Agú, I. Jernej, R. Steinhöfler and A. Valavanoglou

Space Research Institute, Austrian Academy of Sciences

Abstract

Severe space weather has the potential to cause significant socio-economic impacts. It is widely recognized that mitigating this risk requires more comprehensive observations of the Sun and heliosphere, allowing more accurate and timely prediction of significant events.

In this context, observations from the two Sun-Earth Lagrange points L1 and L5 (both remote and in situ) offer considerable benefits in our ability to monitor and forecast space weather. L1 is located between the Earth and the Sun, making it ideal for real-time solar wind monitoring. It provides short-term warnings (about 30–60 minutes) of incoming solar storms heading directly towards Earth. L5, trailing Earth in its orbit by about 60°, offers a side view of the Sun, allowing the observation of active regions before they rotate into Earth's view. This gives advance warning of potential solar storms several days in advance, although it is less effective at predicting immediate effects. Placing space weather missions at these two points at the same time can therefore be seen as ideal.

The Space Research Institute (IWF) of the Austrian Academy of Sciences is involved with magnetometer hardware on both, an L1 and an L5 satellite. The Space Weather Follow-On mission to L1, which will be launched in September 2025, is a joint undertaking by NASA and the National Oceanic and Atmospheric Administration. The IWF is responsible for the front-end electronics of the two magnetic field sensors which have been developed under the lead of the Southwest Research Institute in Texas. As part of ESA's Vigil mission to L5, IWF is partnering with Imperial College London to provide the magnetometer (Eastwood et al. 2024). Development of this instrument, for which IWF is providing the fully redundant power supply electronics, has just started. Vigil is scheduled for launch in 2031.

References

[1] Eastwood, J.P., P. Brown, W. Magnes, C.M. Carr, M. Agú, R. Baughen, G. Berghofer, J. Hodgkins, I. Jernej, C. Möstl, T. Oddy, A. Strickland, A. Vitkova: The Vigil magnetometer for operational space weather services from the Sun-Earth L5 point, Space Weather, 22, doi:10.1029/2024SW003867, 2024.

Start-Ups and Space Missions

In orbit-demonstration with R-Space

W. Treberspurg, C. Obertscheider, C. Scharlemann

R-Space GmbH, Office park 2/5 Wien Flughafen, Austria

Abstract

The GreenBox service of R-Space provides in-orbit-demonstration IOD opportunities and is designed for an increased speed and ease of access to space. This is enabled by decoupling the payload completely from the satellite bus with the stand-alone payload accommodation unit (PAU). The customer can integrate the IOD technology in the PAU without the need to deal with the complexity of the satellite bus or the final integration into the satellite. This service targets small companies with little or no experience with space missions or spacecrafts, beside the traditional space industry involved in upstream technology.

After introducing the general GreenBox service elements (spacecraft bus, qualification testing, launch and in-orbit operation), some exemplary payloads will be used to showcase the procedure from initial customer contact to a successful in orbit demonstration including among others the accommodation analysis, mock-up integration. Presently, R-Space prepares two flight missions to be launched in Q4/2025 or Q1/2026. The two missions and possible opportunities to participate will be presented.

GATE Space - A Startup‘s Journey to First Flight

Daniel Frank

GATE Space Innovation GmbH

Abstract

As satellite constellations grow and orbital environments become increasingly congested, the demand for precise and responsive spacecraft maneuvering continues to rise. Applications such as collision avoidance, orbit adaptation, rendezvous and proximity operations and post-mission disposal require propulsion systems that are both capable and adaptable.

GATE Space [1] is developing modular chemical propulsion systems to address these challenges across a wide range of spacecraft. By combining advanced bipropellant thruster technology with integrated avionics, the systems support straightforward integration and enable maneuvers ranging from fine attitude adjustments to large-scale orbit changes.

Founded in 2022, the company has evolved rapidly, expanding its team, facilities, and product portfolio to meet rising demand. It is engaged in multiple commercial and institutional programs across Europe and the US, and its first in-orbit demonstration mission is scheduled for 2026.

This talk presents the growth of the company from humble beginnings to now developing flight hardware for its first few in-space missions, as well as the accompanying evolution of the electronics and avionics development approach.

References

[1] https://gate.space

CLIMB: An educational CubeSat mission at the University of Applied Sciences Wiener Neustadt

C. Scharlemann, W. Treberspurg, A. Stren

University of Applied Sciences Wiener Neustadt

Abstract

After the successful CubeSat mission, PEGASUS, the University of Applied Sciences Wiener Neustadt (FHWN) will launch its next CubeSat CLIMB in 2025/6 as part of the Aerospace Engineering educational program. The satellite will be released into a sun synchronous orbit with 500 km altitude. Using a Field Emission Electric Propulsion (FEEP) system, provided by the company ENPULSION, the satellite's orbit will be raised to an elliptical orbit with its apogee around 1000 km – well inside the inner Van Allen belt.

The mission payload consists of a SATDOS, a radiation monitor, developed by Seibersdorf Laboratories, and a magnetometer developed by the FHWN. The radiation monitor will continuously monitor the space radiation environment in terms of total ionizing dose (TID) and single event effects (SEE) and its impact on CLIMB's subsystems during its yearlong ascent to, and operation in the Van Allen belt. Those in-space radiation measurements will allow a comparison with results from ground-based testing (TID, SEE). This again will allow to evaluate the quality of ground-test-based predictions of space radiation effects. Such investigations will ultimately contribute to mission safety and success for future missions. The results of several on-ground test campaigns, both TID and SEE, are presented for selected systems and components.

The second major payload of CLIMB is a magnetometer with a sensitivity of down to 10 nT. Measurements with such accuracies require the investigation of the magnetic properties of the satellite itself. For this purpose, the German company IABG provided the CLIMB team the opportunity and support to conduct measurements of the magnetic properties of an electrical model of the spacecraft at their magnetic field simulation facility (MFSA). The results of those tests indicated a magnetic dipole moment of the satellite in the range of 20 mA.m^2.

Utilizing an electric propulsion system on a CubeSat has many impacts on the satellites subsystems, in particular on the thermal control system. In order to verify the numerical analysis (ESATAN) a new concept of a thermal vacuum chamber (TVC) was developed. This chamber allows the operation of the propulsion system integrated in the CubeSat during a thermal vacuum test. The paper presents initial results of this advanced TVC obtained with a thermal model of the CLIMB satellite.

Ready for Launch - SpaceTeamSat1 CubeSat

David Wagner

TU Wien Space Team

Abstract

With “SpaceTeamSat1”, the TU Wien Space Team develops a 1U CubeSat platform from scratch and operates it in low earth orbit at an approximate altitude of 500 km in SSO. The launch will happen later this year from Andøya, Norway, with the second Spectrum rocket from ISAR Aerospace. STS1 will allow pupils of secondary schools, aged between 15 and 19, to run their code on a Raspberry Pi payload in space. The mentioned payload offers a variety of sensors, including but not limited to a radiation dosimeter from Seibersdorf Laboratories, two cameras, and internal satellite health information. This allows the execution of a broad range of experiments. Participating pupils and those who form teams will be supervised by their teachers. In order to teach common industry practices and to maximize the chances of a successful mission, the TU Wien Space Team offers additional guidance in the form of documentation, reviews, and get-togethers. The experiments can be divided into different levels, beginning at entry-level tasks, such as calculating the rotation rate or investigating the thermal behavior of the CubeSat. More advanced tasks may include taking pictures of the earth from a specific location or the moon. At the current stage, ten schools are participating in this project as well as a museum, which will hold workshops that could generate additional experiments that will be executed on the satellite. It is expected that the number of participating schools will increase once the satellite is in orbit and produces the first results.

Acknowledgments

This project receives financial support from many supporters. The TU Wien Space Team especially thanks the Austrian Forschungsförderungsgesellschaft (FFG) and TU Wien for their support.

Facing Radiation in Space: Projects & Progress

CORHA-2: Advancing Radiation Testing and AI-driven Reliability for COTS Components

Christoph Tscherne[1], Peter Beck[1], Lukas Huber[1], Marcin Latocha[1], Christian Marchhart[1], Valentin Wagner[1], Michael Wind[1], Marta Bagatin[2], Simone Gerardin[2], Marc Poizat[3]

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

Abstract

The CORHA-2 project, initiated in October 2024, is a three-year European Space Agency (ESA) endeavor led by Seibersdorf Laboratories in partnership with the University of Padova. Building upon the achievements of its predecessor, CORHA-1, this project aims to advance radiation hardness assurance (RHA) methodologies for commercial off-the-shelf (COTS) components vital to the European space industry.

This presentation will delve into the project‘s initial phases, encompassing the selection of critical electronic components—including III-V semiconductors, data converters, memory devices, and oscillators—and the development of comprehensive radiation testing strategies. These strategies incorporate Total Ionizing Dose (TID) assessments and Single Event Effects (SEE) evaluations using heavy ions and pulsed laser techniques.

Key innovations of CORHA-2 include the establishment of a publicly accessible database to enhance transparency in radiation testing data, the formulation of updated COTS guidelines tailored for low-cost space missions, and the integration of artificial intelligence (AI) and machine learning (ML) models to refine predictive accuracy in RHA processes. These efforts collectively aim to set new benchmarks for reliability, cost-efficiency, and sustainability in space technology.

For more information, visit the CORHA-2 website: https://www.seibersdorf-laboratories.at/corha2
And follow CORHA-2 on LinkedIn: http://linkedin.com/showcase/corha-seibersdorf-laboratories

Acknowledgments

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Development of a Rad-Hard FPGA with ultra-deep sub-micron Technology for New Space Applications

Sarah Azimi[1], Giorgio Cora[1], Aobo Cui[1], Corrado De Sio[1], **Luca Sterpone**[1], Eleonora Vacca[1], Alp Kilic[2]

[1] Politecnico di Torino
[2] Nanoxplore

Abstract

Field-programmable gate arrays (FPGAs) are crucial in space applications, enabling advanced communications, instruments, and systems that are essential for the next generation of space missions. Their versatility and reconfigurability make FPGAs invaluable for tackling the demanding and ever-evolving challenges of the space industry. In the last decade, the semiconductor industry has contributed drastically to the performance improvement of radiation-hardened FPGAs thanks to the continuous scaling in the transistor size [1]. The device scaling continued to 14nm toward 7nm, thanks to the FinFET multi-gate devices that have been introduced into the manufacturing processes. In this work, we present the development status of a radiation-hardened FPGA using 7nm FinFET ultra-deep submicron technology [2]. The new radiation-hardened FPGA architecture will target future requirements for high-performance computation in space, it will support the future application demands [3]. The design of the new FPGA architecture involves the design of a new 7nm LUT structure, a new interconnection switch-matrix, and the internal computational building blocks focused on computing acceleration. The presentation will provide an overview of test and validation methodologies relevant to establishing the radiation-hardened capabilities in different space environments, ranging from Low Earth Orbit to the deep-space.

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[2] S. Azimi, C. De Sio, L. Sterpone, “Analysis of radiation-induced transient errors on 7 nm FinFET technology”, Microelectronics Reliability, Volume 126, 2021, ISSN 0026-2714, doi: 10.1016/j.microrel.2021.114319.

[1] A. Portaluri, S. Azimi and L. Sterpone, „Design Techniques for Multi-Core Neural Network Accelerators on Radiation-Hardened FPGAs,“ 2023 22nd International Symposium on Parallel and Distributed Computing (ISPDC), Bucharest, Romania, 2023, pp. 16-22, doi: 10.1109/ISPDC59212.2023.00023.

Acknowledgments

This work is related to the PUMA project funded by the European Commission via the EU Space R&I Programme under grant N° 101189992

Effects of Ionizing Radiation on the EMI-Induced Offset Voltage of Operational Amplifiers

Nikolaus Czepl, Dominik Zupan, Alicja Michalowska-Forsyth, Bernd Deutschmann

Institute of Electronics, Graz University of Technology, Austria

Abstract

In this work, we investigate the impact of ionizing radiation on the robustness towards electromagnetic interference (EMI) of operational amplifiers (OpAmps). Therefore we irradiate two OpAmps, one including a standard differential input stage structure, the other OpAmp featuring a second cross-coupled double differential input pair added to the standard input stage structure. We perform measurements on the manufactured test chip structures to determine general characteristics (gain, offset, gain-bandwidth product (GBWP) and phase margin), as well as EMI-related characteristics like EMI-induced offset and electromagnetic interference rejection ratio (EMIRR). Based on these characteristics, we compare both structures with regard to their performance prior to, during and after irradiation with X-rays. We observe a change in the EMIRR performance with increasing ionising dose. Finally, we explain our observations by taking into account transistor-level effects.

References

[1] N. Czepl, D. Zupan, A. Michalowska-Forsyth and B. Deutschmann, „Effects of Ionizing Radiation on the EMI-Induced Offset Voltage of Operational Amplifiers," 2024 14th International Workshop on the Electromagnetic Compatibility of Integrated Circuits (EMC Compo), Torino, Italy, 2024, pp. 111-115, doi: 10.1109/EMCCompo61192.2024.10742062

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We would like to sincerely thank Mr. Reinhard Spinotti and ams OSRAM for their support during layout and fabrication of the test chips.

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CONTACT

Seibersdorf Labor GmbH
2444 Seibersdorf, Austria

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

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

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