

ANNUAL REPORT 2023

A photograph of a woman with glasses and a white shirt looking at a man in a blue shirt in a laboratory setting. In the foreground, there are several electronic devices, including two digital multimeters displaying 15.01V and 15.00V, and a green circuit board with components. The background shows a window and lab shelving.

SAL



Silicon Austria Labs (SAL) is a top European research center for Electronics and Software Based Systems (ESBS). At three locations, Graz, Villach, and Linz, the application-oriented center offers cooperative research along the value chain of ESBS – from wafer to intelligent system – and develops innovative solutions for industrial production, health, energy, mobility, safety and more.



198
PROJECTS



184
PUBLICATIONS



323
EMPLOYEES



461
MEDIA REPORTS



Leonore Gewessler
Federal Minister
for Climate Action,
Environment, Energy,
Mobility, Innovation
and Technology

Microchips, vital for the digital age, have an environmental impact in two ways – on the one hand in their production and on the other hand with application possibilities in their usage. Austrian research in semiconductor technology is crucial not only for technological innovation but also for sustainable practices. By developing energy-efficient chip designs and exploring eco-friendly manufacturing processes, researchers based in Austria contribute to the twin transition. This dual focus positions Austria at the forefront of sustainable chip development in Europe, aligning with global efforts to address the environmental challenges posed by the rapidly evolving tech industry. The intersection of cutting-edge technology and environmental consciousness in Austrian research exemplifies a holistic approach towards shaping a more sustainable and technologically advanced future for Europe.



Marion Mitsch
CEO Austrian Association
of the Electrical and
Electronics Industry

Austria's competitive advantage on the global market is dependent on accomplishments, results and our profound knowledge in the area of research and innovation. For these reasons, Silicon Austria Labs is an indispensable partner for the local industry. The non-university research center which was co-founded in December 2018 by the Austrian Association of the Electrical and Electronics Industry (FEEL) has a remarkable success story. To continue this success story, the FEEL remains committed to strengthening the business location through targeted and meaningful research funding, as was achieved in 2023 by securing national funds as part of the Chips Act.



Barbara Eibinger-Miedl
Provincial Minister for
Economics, Science and
Research (Styria)

The microelectronics sector is one of the central sectors of the future and it will only gain more importance as a key technology of digitalization. Within this rapidly growing branch, Silicon Austria Labs has risen to be a major player. I am very happy that we were able to open the new headquarters in the Styrian capital Graz, the "SAL Building", where we find optimal conditions for research. On behalf of the Department of Economics and Science, we will continue to support our partners at the location and work together to increase the international visibility of Styria. I would like to express a heartfelt thank you to the new CEO Christina Hirschl and her team for their great commitment. All the best of success for the future!



Gaby Schaunig
Provincial Minister for
Technology (Carinthia)

In October 2023, the inauguration of Austria's biggest research cleanroom at the SAL site in Villach marked a key milestone for the Carinthian research landscape. The area of 1,100 m² is not only used for research and development of innovative technologies, but it can also be used for small series production with industrial partners. SAL is a remarkable example of what is possible when several strong partners – the state, the provinces of Carinthia, Styria and Upper Austria, and the industry – are ready to realize a vision together, as the future can only be unfolded successfully through cooperation and innovation.



Markus Achleitner
Provincial Minister
for Economics and
Research (Upper Austria)

We want to establish Upper Austria, which is already a center of innovation, as a center of 6G research too. We are pursuing this objective through the stake in Silicon Austria Labs, a top-level research center, that we hold through Upper Austrian Research GmbH (UAR), the Upper Austrian government's lead company for research. With the 6G lighthouse at its Linz site, SAL is developing key technologies for the wirelessly connected factories of the future, for industry and with industry. These future technologies give Upper Austria a crucial competitive advantage in the digital and ecological transformation.



Anton Plimon
Chairman of the SAL
Supervisory Board

ESBS innovation in a dynamic global landscape

Electronic systems are pivotal in today’s advanced technological industry. Silicon Austria Labs (SAL) epitomizes a strategic alliance between public stakeholders and the strong local industrial sector, aiming to bolster competitive standing. SAL, as a newly established Research and Technology Organization (RTO), published its first annual report coinciding with the onset of the COVID-19 pandemic. Thanks to considerable financial support from its shareholders, SAL experienced a dynamic initial phase, marked by critical investments in talented, motivated international teams and state-of-the-art laboratory infrastructure. This remarkable support and trust from our shareholders deserves immense gratitude.

Four years on, the landscape for RTOs in Electronics and Software Based Systems (ESBS) has evolved, influenced by a more polarized global situation. Major entities like the EU have formulated strategies focusing on technological sovereignty, sustainability, and decarbonization across various sectors. The substantial investments made to realize these objectives significantly influence competition in the ESBS domain.

2023 was a year of important internal evolution for SAL. 2023 and 2024 are the years when essential parts of SAL’s equipment start operation. Under the leadership of Christina Hirschl as CEO from mid-year, the management team streamlined the organization’s portfolio, concentrating on fewer strategic research areas. There is a heightened focus on managing more and larger projects successfully. The recent financial agreement with our shareholders, covering 2024 to 2026, provides a foundation for future endeavors.

After its successful establishment phase, SAL is now dedicated to fostering innovation with its industry clients, who are actively participating in the competitive race within rapidly evolving markets. SAL’s portfolio is being tailored to anticipate and meet mid-term technological and research needs relevant for industrial applications. Committed to being a leading innovation partner, SAL continually strives for excellence in its chosen fields.



Klaus Bernhardt
Deputy Chairman of the
SAL Supervisory Board

An indispensable part of the European ecosystem

In view of the current geopolitical situation and the challenges of today, strategic autonomy is becoming increasingly important. The past years highlighted the considerable significance of high technologies for Europe, especially the key technologies of Electronics and Software Based Systems. These technologies are essential for economic stability, political resilience, and the digital and green evolution. Politics has recognized this and thus secured national funding to strengthen and develop local high technologies as part of the Chips Act 2023.

SAL has focused on the right topics from the start, successfully establishing itself as a top non-university research center for Electronics and Software Based Systems in Austria. Founded five years ago, SAL’s main goal is to support local companies by carrying out research services quickly and unbureaucratically. Cooperative projects are co-financed by SAL and enable a quick project start. In May 2023, the new headquarters in Graz was inaugurated. It houses labs for power electronics, dependable ESBS and a new Validation & Testing Lab. In the fall of 2023, Austria’s biggest research cleanroom was opened at the SAL site in Villach. The third SAL site in Linz offers great innovation potential as well: research on 6G is conducted there. With these services and research areas, SAL contributes to the visibility of the Austrian ESBS sector and highlights Austria as an attractive future-oriented business location.

As a relatively young R&D organization, SAL was fortunately able to secure funding for the next financing period, which is a great added value for the Austrian research location. Now we must seize the chance to position SAL as an indispensable part of the European ecosystem for key technologies within the framework of the European Chips Act.



Christina Hirschl
Chief Executive Officer

Unfolding a better future

In an ever-changing world, we need to bundle all available resources to tackle challenges such as global warming and demographic change. Europe’s economy needs to be positioned globally. This can only be achieved through quality and innovation. The European Chips Act is a major step towards strengthening the development of solutions and technologies for the future – and we want to play our part for a successful Europe.

Not only is the world around us constantly evolving, but SAL also had a year filled with organizational changes and demanding projects. I am proud that we, as a team, mastered all hurdles. We reached important milestones, such as the opening of our new headquarters in Graz or our SAL MicroFab in Villach. We (co-)organized the EPoSS Annual Forum and welcomed EPoSS members and partners to inspiring technical sessions and social gatherings in Villach. We held the first Symposium on 6G in Linz. Owing to the successful first project, the follow-up project Tiny Power Box 2 started in spring 2023. Within the Digneuron project, our colleagues in Linz produced an integrated circuit capable of implementing AI solutions in a miniature size with very low energy consumption. In Villach, we have extended our labs and worked, e.g., on innovative and sustainable solutions for printed electronics.

I would like to express my sincere gratitude for the efforts of our team throughout the year. The contribution of each colleague has been instrumental in SAL’s growth. Our employees have shown passion, commitment and hard work, and have embraced challenges with enthusiasm and resilience. SAL’s growth would also not be possible without our dedicated shareholders and board members. I would also like to thank Ingolf Schädler, former Chairman of the Supervisory Board, for his success and support over the past five years.

I am confident that we will continue to work successfully on research projects that will make our future smarter, greener and more sustainable. Together, we can unfold a better future.

SAL leadership team

We strive for the highest levels of excellence and integrity in everything we do. Our core values are about mutual respect for individuals, recognition of their contributions, and about open communication. They provide the framework for how we work together as one SAL team and implement our strategy. They guide the leadership team and all employees in their day-to-day business.



Christina Hirschl
Chief Executive Officer (CEO)



Christof Wochesländer
Chief Financial Officer (CFO)



Bruno Clerckx
Chief Technology Officer (CTO)



Emily Knes
Head of Human Resources



Alfred Binder
Head of Research Division Power Electronics



Thomas Buchegger
Head of Research Division Intelligent Wireless Systems



Mohssen Moridi
Head of Research Division Microsystems



Jürgen Kosel
Head of Research Division Sensor Systems



Willibald Krenn
Deputy Head of Research Division Embedded Systems



5 Years of SAL

In December 2023, Silicon Austria Labs marked its 5th anniversary, celebrating substantial achievements and growth.

Since its founding during the European Forum Alpbach in 2018, SAL has grown to over 320 employees and 3,281.83 m² of laboratory space, including the largest research cleanroom in Austria, the SAL MicroFab.

Important milestones include the initiation of impactful research projects, such as the “Bulk Current Injection (BCI) Modeling and Test”, the first cooperative SAL project with ams AG. The merger with Carinthian Tech Research (CTR) in June 2019 sealed the streamlined operations, positioning SAL as the connecting hub for all research agendas.

SAL’s commitment to continuous innovation and long-term partnerships is reflected in projects like the Tiny Power Box and the follow-up project Tiny Power Box 2. Financial backing through the Research

Financing Act and significant funding for climate-related research projects further underline SAL’s importance as a key research institution in Austria.

The expansion of the locations with Science Park 4 in Linz, the second building at the High Tech Campus Villach, and the inauguration of the SAL building in Graz contribute to the continued growth of SAL. A notable achievement was the hosting of the first SAL Symposium on 6G in November 2023, emphasizing SAL’s role in shaping the future of wireless communication. In 2023, SAL also co-hosted the EPoSS Annual Forum together with the European Association on Smart Systems Integration in Villach.

As SAL looks back on its journey, it remains dedicated to unfolding a better future through cutting-edge technologies and collaborative research.



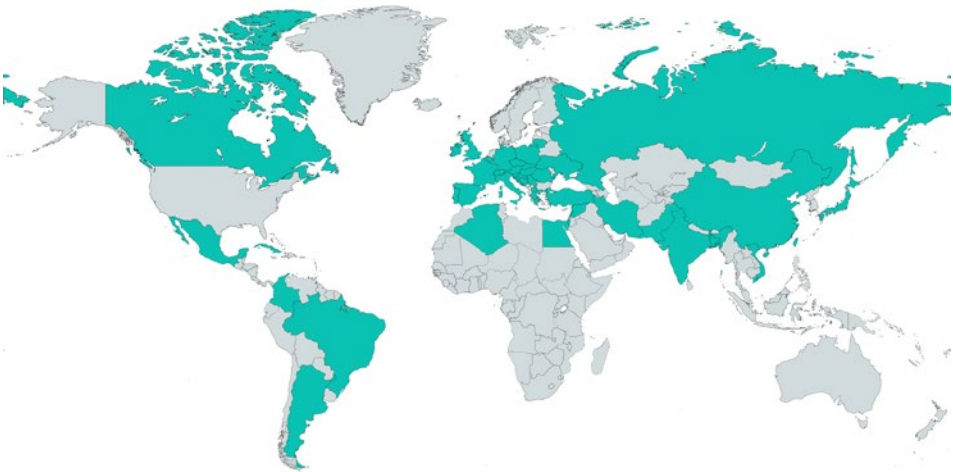
Celebrating internationality at SAL

At SAL, more than half of our employees are not from Austria. Our international colleagues come from all over the world: Europe, the Americas, Asia, Africa – almost every continent is represented in our ranks.

This means not only a multilingual and multicultural workplace, but also a responsibility to introduce our employees to Austrian culture, while at the same time giving them the space and opportunities to practice their own traditions. With our internal “Festivals around the globe” news series, we are presenting festivities

from our employee’s home countries, including Austrian holidays, and thus giving everybody a glimpse into different celebrations around the world. In the summer of 2023, we organized a “Culture Clubbing” get-together for all three sites. Everybody was invited to join us in their traditional clothing and bring specialities from home.

ALL THE COUNTRIES REPRESENTED WITHIN OUR TEAM



GASHI HANUMSHAHE & MONIKA STUBITSCH
Organizers of the Culture Clubbing

We had the idea of a theme party and we thought: What could be a better theme than the over 40 different nationalities represented at our company? We wanted to have a fun get-together with our colleagues and take the opportunity to give each other an insight into our different cultures.



EDI MUSKARDIN

At SAL, a four-person office is a four nationalities office. With different backgrounds but common values, we let each other experience different cultures as authentically as possible, second only to actually living there. We travel without leaving the office, but through people.



SRAVANI CHILUKURI

I am from India and I am a Research Engineer in the Embedded AI team at SAL. The diverse and international team at SAL enables me to learn many new things and work on exciting projects. I am exposed to different cultural aspects and thought processes from across the world.



JAVAD AHMADI-FARSANI

I am originally from Iran and pursued my PhD in Spain. Previously, I worked for CSIC in Spain and collaborated closely with groups from IIT and Politecnico di Milano in Italy, Aarhus University in Denmark, and Tampere University in Finland. At SAL, I am an analog/mixed mode IC designer/scientist, and I thoroughly enjoy the dynamic and international environment fostered by my colleagues.

Female Power at SAL

Teamwork is the name of the game – but it is equally important to recognize and celebrate the individual milestones of our people within the big picture! Enjoy some research highlights from four of our colleagues in 2023.

ALL GOOD THINGS COME IN THREES: TRIPLE RESEARCH POWER FOR VARIMED

Junior Scientists Pooja Thakkar, Sara Guerreiro and Madeleine Petschnigg not only won the Early Career Call for their project proposal VARIMED, but they also got nominated for the Spirit of Styria Award for Women in Science. Their project focuses on the development of a micromirror for compact endoscopes. This micromirror is controlled by a piezoelectric thin film, which will make it possible to easily turn, bend and focus the endoscope without having to use additional components like lenses.

It is a joint project between three Research Units at SAL and therefore benefits from the expertise of three different fields. Not only that, but the three scientists are positioned internationally, opening up a lot of cross-border opportunities for the VARIMED project: Madeleine is currently completing her PhD degree off-site at Penn State University (USA), while Sara is preparing to go on a research stay at the University of Tokyo.



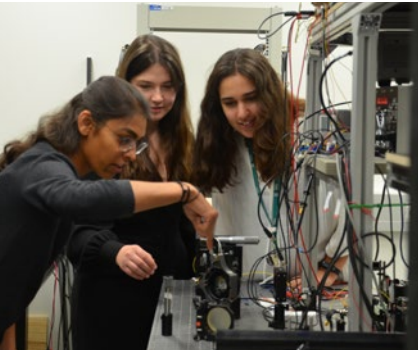
Pooja Thakkar
Photonic Systems

I’m focusing on defining the requirements of micro mirrors of the application, verifying the concept from optical simulation and developing an optical testbench for two photon/multi-photon microscopy.



Sara Guerreiro
Piezoelectric Microsystem Technologies

I’m overseeing the complete development process of a micro mirror for the specific application of VARIMED. I’m sure this project will push me even further, challenge me to be creative and make me completely understand the physics behind the device!



Madeleine Petschnigg
Thin Film Technologies

My goal is to achieve a deeper grasp of the factors that control the long-term stability, which facilitates the advancement of new devices with enhanced performance. My focus lies in understanding and overcoming material related issues during fabrication and utilization of the piezoelectric micro device to ensure a reliable performance over its entire lifetime.



Diana Mori
Electronic Sensors

I started working for SAL in July 2021 for my bachelor thesis where I investigated the resonant frequency behavior of MEMS micro mirrors. Since August 2022 I have been working as a laboratory assistant in the Electronic Sensors Research Unit alongside my master’s degree at TU Graz. I was lucky to be assigned directly to a project with some wonderful colleagues, allowing me to get better insights into a field of research beyond my studies. I am looking forward to starting my master’s thesis with SAL in February 2024 where I will be further investigating MEMS.



Unfold your career

Our research and enterprise team consists of over 300 people – each with their own unique background and experience before joining SAL. This year, we launched our SAL Career Blog to give our employees the space and opportunity to tell their own career stories, from their first steps in the research world to when they joined SAL. We have discussed projects, milestones, highlights, job advice ... and thus gave a voice to our employees that didn't only reach internal cycles, but also partners, job candidates and other interested parties.



[www.silicon-austria-labs.com/
karriere/karriere-blog](https://www.silicon-austria-labs.com/karriere/karriere-blog)



CHRISTIAN MENTIN
Packaging & Multiphysics

My highlight at SAL? After having already won several awards in Austria, our Tiny Power Box was nominated for the German SEMIKRON Innovation Award in March 2023. The prize is just the tip of the iceberg of long and hard work, but the fact that we are now being noticed beyond the borders of Austria is unique and great feedback for us.



KATRIN UNGER
Electronic Sensors

I am happy that my potential was recognized through the thorough recruiting and that my talents were also considered for positions other than the one I applied for. The interface between industry, fundamental research and prototype production in which SAL is located is perfect for me!



JÜRGEN KOSEL
Advanced Sensors and Electronics Technologies

One of my reasons for applying at SAL was the proximity of the research to industry, which I really appreciate. We are attractive partners for companies and we link our research directly to end users. Thus, our research has a direct impact on people.





INGO PILL
Trustworthy Adaptive Computing

At SAL, the research is very versatile, depending on the project. In some cases, we conduct fundamental research, while in other projects we are already close to the development of prototypes or products. In our unique SAL Doctoral College, we have a relatively low TRL, for example, which is very interesting from a scientific perspective, and which fulfills my research drive!



EMILY BEZERRA
Advanced Sensors and Electronics Technologies

My journey at SAL has been challenging and rewarding at the same time – and I wouldn't have had it any other way! I joined SAL in August 2022 after I finished my MSc in Saudi Arabia. My primary focus at SAL is integrating electronics efficiently into various substrates and onto various surfaces. The end goal is to print anything on everything, and I work with one of our newer pieces of equipment, the Aerosol Jet Printer, to achieve this.



HERBERT HACKL
Coexistence and Electromagnetic Compatibility

In research we are always pushing the boundaries of what is possible and doable. At SAL, we start working where others stop. Typical research questions here include finding solutions to (other people's) problems that are so complex that they don't have the resources to deal with them. As a researcher my job is to try things that no one has done before and to answer those questions that no one has an answer to.



RAHEEB MUZZAFAR
Wireless Communications

At SAL my first responsibility was to establish the 5G research and experimentation testbed in Linz. The goal of this testbed is to provide experimental support for industrial automation use cases and research for future developments. As SAL works as a bridge between research and industry, I started to exchange ideas with industrial and scientific experts to develop and optimize 5G technology for innovative 6G use cases.



FJOLLA ADEMAJ-BERISHA
Wireless Communications

I joined SAL in autumn 2019, right after my PhD graduation. At that time, our Wireless Communications team was still small and in the process of being built up. I was the third member of a team that now counts fourteen people. But not only did my team grow, so did I: Less than a year after my start at SAL, I was leading two projects in the field of security and safety.



MATTEO MONTAGNESE
Photonic Systems

I enjoy the challenge of putting what I have learned and my passion for physics to service to solve problems. The research at SAL is application-oriented, and it is very rewarding to work towards a bigger, tangible objective.



Highlights 2023

01/2023
Kick-Off EU
projects CoRaLi-DAR
and DETERMINISTIC6G

03/2023
Opening of the SAL
Headquarters in Graz

03/2023
Tiny Power Box
wins Semikron
Innovation Award

06/2023
Christina Hirschl
becomes new
CEO of SAL

06/2023
Transducers
2023 conference
in Tokyo

07/2023
SAL co-hosts
EPoSS Annual
Forum in Villach

07/2023
SAL receives funding
for FOWLPL (fan-out
wafer level packaging)
pilot line

10/2023
Opening of the
new SAL MicroFab
research cleanroom
in Villach

11/2023
First SAL
Symposium on
6G in Linz

12/2023
Madeleine Petschnigg,
Sara Guerreiro &
Pooja Thakkar nominated
for the first Spirit Award
for Women in Science

Collabo- rations with SAL



Investments in key technologies are the basis for developing competitive products, processes and services.

The use of the latest technologies affects not only a company's potential for economic growth, but also its long-term positioning in the market. We work together with partners and companies of different sizes and branches and offer industry-oriented research as well as services at the highest level. Our offer is complemented by a well-equipped research infrastructure and customized opportunities for cooperation. These opportunities include contract research, R&D services and our SAL cooperation model.

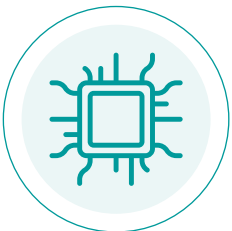


[https://silicon-austria-labs.com/
zusammenarbeit](https://silicon-austria-labs.com/zusammenarbeit)



SEBASTIAN REISS
Bosch Sensortec GmbH

During our collaboration with SAL, our objective was to identify and enhance tools to reliably perform physical optics propagation in micro-optical systems, aligning with existing experimental data. We successfully reached and even exceeded our primary goal. We highly appreciated the team's readiness and flexibility in adjusting the activities based on intermediate results to meet the overall targets.



MARKUS PUFF
TDK Electronics GmbH & Co OG

2023 was a very intense year in our collaboration with SAL. I would like to highlight the launch and first phase of the Tiny Power Box 2 project. Despite some initial difficulties and challenges, these phases went extremely well thanks to a dedicated and focused team.



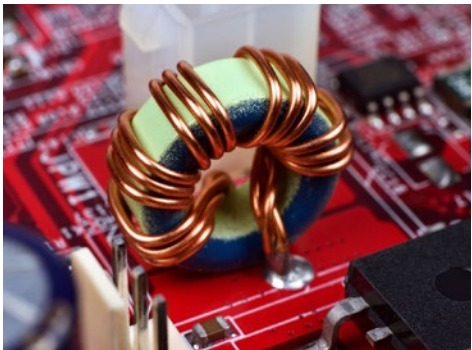
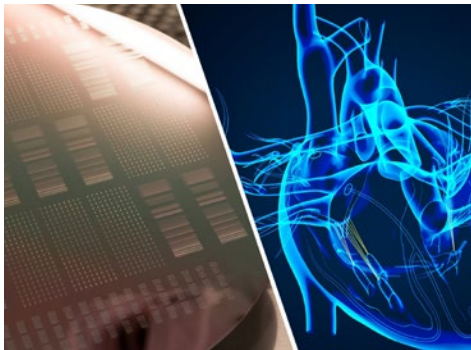
MARTIN HEINISCH
BMW Motoren GmbH Steyr

Thanks to the close and professional cooperation with the Power Electronics Division at Silicon Austria Labs, especially with the Research Units 'Co-Existence & Electromagnetic Compatibility' and 'Architectures & Topologies', we have a reliable and competent partner at our side who strengthens and enriches us in the development of next-generation electric drives.

Microsystems

The Microsystems research division is specialized in spearheading the development of cutting-edge devices, covering the entire spectrum from conceptualization to prototyping, with a dedicated focus on micro- and nanoelectromechanical systems (MEMS/NEMS).

SAL offers extensive expertise across diverse disciplines such as design, system-level development, testing, and the seamless integration of optical, RF filters (acoustic wave resonators), and magnetic components with high-performance thin films.



CoRaLi-Dar

The CoRaLi-Dar project aims at developing an advanced detection and ranging system for the automotive industry based on radio and light sensing. The system's functionalities play a crucial role in improving driving safety and advancing towards fully autonomous driving. The key innovation is integrating lidar and radar chips on the same printed circuit board. The full integration of photonics and electronics will reduce power consumption, packaging size, and manufacturing costs compared to current technology.

PLATEAU

The project aims at developing next-generation piezoelectric micromachined ultrasonic transducers (pMUTs). These pMUTs should leverage advanced piezoelectric thin film and microsystems technologies for medical imaging applications. PMUTs are anticipated to offer significant advantages over traditional ultrasonic transducers in terms of product quality and cost-effectiveness. Nonetheless, inherent limitations such as constrained bandwidth characterize pMUTs. We focus on addressing typical limitations of pMUTs and meeting the specific requirements of medical imaging applications.

EMRD

State-of-the-art fault current limiters are based on active components or inductors and are large and expensive devices. This project investigates a new passive and compact current limiter device concept based on the EMR (electromagnetic resonance) effect. With proper mobility and good interfaces, an EMR ratio as high as 2000 % can be achieved in a 2-terminal system, which could make this technology suitable to replace state-of-the-art fault current limiter components.

Sensor Systems

The Sensor Systems research division develops sensors and systems that can be used in almost all areas of commerce and industry.

In addition to developing novel sensor solutions, SAL also integrates market-available sensor technologies into a wide variety of applications. Furthermore, the division's teams work in various labs to design, build, test and characterize components or systems. The research topics are covered by the respective areas of the 4 Units: Photonic Systems, Electronic Sensors, Advanced Sensors & Electronics Technologies and R&D Services Electronics.



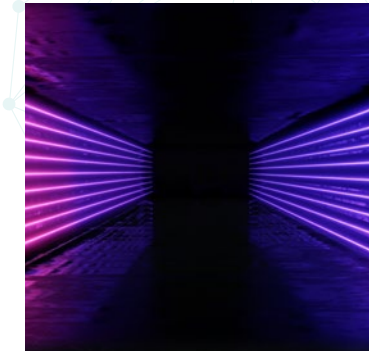
GIRAFFE

The project focuses on the development of quantum gyroscopes that rely on measuring nuclear spins of point defects in diamonds. Quantum gyroscopes are sensors used for measuring rotation and orientation with unprecedented accuracy. They are thus key instruments for precise navigation for all types of planes and automobiles, especially for next-generation autonomous driving. The project is financed within the framework of Quantum Austria.



KERMIT

In Europe, more than 100 million people live with chronic kidney disease (CKD), but a vast majority are unaware of their condition. Together with our partners Infineon Technologies, Graz University of Technology, Consiglio Nazionale delle Ricerche, University of Pisa, University of Ioannina, and Fundacja My Pacjenci, we are developing a smart skin patch that can detect kidney diseases at an early stage. This technology aims at easier and more affordable health monitoring for everyone.



WOMBAT

The project aims at developing novel, state-of-the-art algorithms to study wave-optical effects, present in micro-optical assemblies. Currently, most proprietary tools for optical system design are based on ray tracing, which does not consider wave properties of light giving rise to diffraction, interference and polarization. The developed methods address the challenge of fast and accurate wave propagation through curved interfaces, allowing a calculation of wave optical phenomena present in real optical systems.



TEXHYPE

Textile integrated electronics have emerged as a promising solution for the development of innovative biosensors for vital function monitoring. TexHype explores the integration of electronics and sensors into textiles through additive manufacturing, specifically inkjet printing. Three sensor modules – one for the heart rate, one for the breath rate, and an accelerometer – were developed and tested for washability in a conventional washing machine. This integration of cutting-edge components not only enhances computational capabilities but also ensures real-time data processing, thus opening new possibilities for wearable healthcare applications. This project is funded by the FFG.

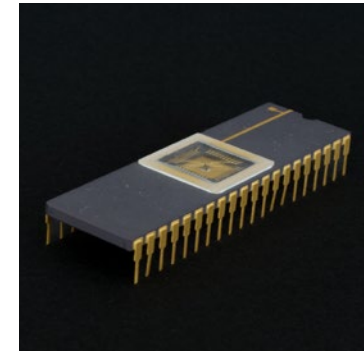
Intelligent Wireless Systems

The Intelligent Wireless Systems research division aims to develop innovations in relation to wireless communication and radar technologies in the radio-frequency spectrum from MHz through to the very high GHz range.



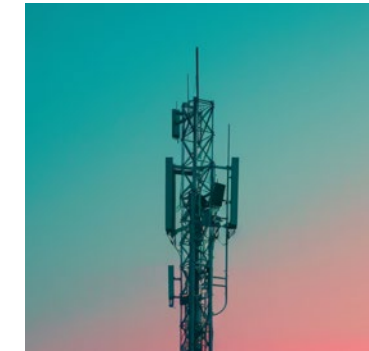
6G SYMPOSIUM

On November 22-23, the first SAL Symposium on 6G took place in Linz. Over 120 international participants and speakers came together to discuss technologies that will be shaping the next generation of wireless communications. Sir John Pendry offered profound insights into the fundamental physics of Metamaterials and shared his insights into invisibility research. Emphasis was put on the convergence of communications and sensing modalities. One such topic was Reconfigurable Intelligent Surfaces (RIS), programmable devices that manipulate and control wireless signals to enhance communication performance in various environments.



DIGINEURON

The Digineuron project was launched in 2021 with the goal of producing an integrated circuit (chip) capable of implementing AI solutions in a miniature size with very low energy consumption. The chip's neural network blocks mimic the way the human brain works, with neurons arranged in layers and communicating only with other neurons in their vicinity to minimize energy consumption. This system can be used in portable electronic systems, from watches to smartphones, for example.



PRINTEDRADAR

PrintedRadar develops innovative 3D radar antennas using additive manufacturing. In contrast to conventional antennas, these enable better performance and a smaller size. The challenge lies in metallizing the antennas correctly. The consortium is working together to build expertise in radar technology and manufacturing. SAL translates the antenna definition provided by Infineon into a hardware implementation based on the requirements of the 3D printing process provided by ProFactor and the material properties derived from Tiger Coatings. The goal is to quickly adopt radar hardware to application-specific requirements with optimum usage of human resources.



InSecTT

Within InSecTT, we have been developing solutions for intelligent, secure, trustable things. In this big project with 55 partners, SAL has developed a trustworthiness framework for Wireless Sensor Networks considering lower network layer aspects such as Received Signal Strength Indicator (RSSI) and wireless channel behavior. With this framework it is possible to do passive RSSI sniffing with very low-cost sensor nodes, estimate interference and predict potential upcoming problems.

Power Electronics

In Power Electronics, we develop more efficient and powerful solutions for all types of electric energy converters in all power classes, from the system and control design to switching structures, integration methods and construction elements in new technologies.

Our projects range from the areas of e-mobility, electromagnetic compatibility, renewable energy, power device packaging, to the aerospace sector and various industrial applications.



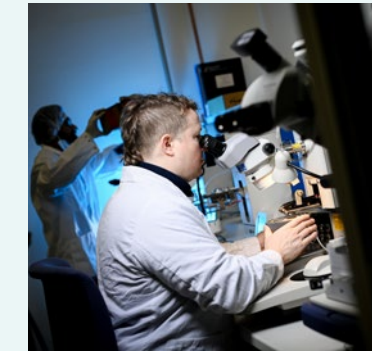
TINY POWER BOX 2

After the huge success of SAL's cooperative project Tiny Power Box, our team is back with a follow-up project that aims to develop an even smaller and more efficient onboard charger for electric vehicles. Using novel semiconductor technologies, optimized topologies and targeted thermo-mechanical optimization, the second Tiny Power Box shall take us one step closer to an industrial prototype and become the world's most compact next-generation onboard charger.



REWINDT

ReWindT, Retrofit of Wind Turbines, aims to optimize power electronics implementation and the associated control systems for renewable energy applications. A particular focus lies on the development of a modular control platform for power converters used in wind turbines and grid-connected energy systems in general.



HETEROGENEOUS INTEGRATION TECHNOLOGIES (HIT)

Just like heterogeneous integration is the linking element between single components and electronic systems, our HIT Research Unit acts as a linking element between different research areas at SAL. Within HIT, we use our cross-divisional competencies to work on wafer level integration, power device integration, hybrid flexible integration and photonic assembly across our cleanrooms and different SAL labs. This year, we received the national FFG infrastructure funding to build up a FOWLP pilot line (fan-out wafer level packaging) in Villach. FOWLP is one of the most advanced microelectronic packaging technologies, offering numerous advantages over traditional packaging technologies such as better electrical and thermal performance, lower inductance, thermal resistance, power consumption and costs.



SURFBOND

Surfbond is a line for surface preparation for fusion bonding and hybrid bonding for substrates. Within this project we are working on wafer processing and preparation for fusion bonding (project phase 1) and hybrid bonding (project phase 2). The main objective is to develop an advanced surface preparation of 8" Si wafers with different specifications and requirements for direct bonding.

Embedded Systems

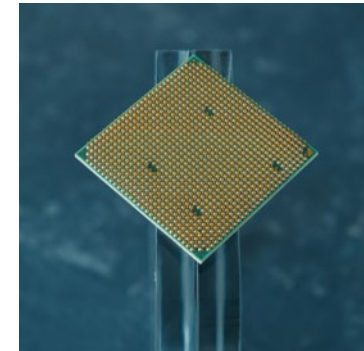
Embedded Systems focuses on dependable software and adaptive computation covering conventional designs up to privacy-preserving distributed AI-solutions.

Our research is driven by topics of trustworthy AI for, e.g., advanced virtual sensing or adaptive & secure computation or RISC-V. We aim to build the trustworthy, intelligent, and green cyber-physical systems of the future.



ARCHIMEDES

Archimedes aims at developing techniques for increasing the lifetime of key ESBS from 8,000 to 120,000 hours, while also reducing the necessary time for design and qualification. SAL leads Supply Chain 3 “Long-life, efficient and dependable systems for emergency response, mobility and industry” and coordinates the aircraft battery demonstrator of Supply Chain 3, integrating own results and the research of nine partners from all over Europe.



ISOLDE

Isolde aims to speed up the transition towards a green, climate neutral and digital Europe. The project consortium consists of 39 companies from all over Europe. SAL’s primary research focus in this project is to develop innovative concepts for hardware-based accelerators in post-quantum cryptography and event-based convolutional operations. By the end of the project, the aim is to have high-performance RISC-V processing systems at prototypical stage.



DIVERGENT

In Divergent we explore decentralized decision-making methods and algorithms to support smart bidirectional charging of electric vehicles. Our approach encompasses traditional decision-making algorithms as well as those based on reinforcement learning and machine learning. A significant aspect of our project is the development of a lab demonstrator, combining an onboard charger with automated AC power supply equipment to simulate the two-way energy and data flow between electric vehicle batteries, onboard chargers, and the power grid.



SUNRISE

Traditionally, rocket carrier systems have been designed as single-use items. Transitioning to reusable carrier systems not only provides a more sustainable solution for the environment but is also less costly. The Sunrise project, a collaboration between SAL and the German Aerospace Center (DLR), is dedicated to researching technologies for the intelligent regulation of liquid propulsion rocket engines both in-use and on the test bench via AI. These AI technologies will enable the development of an intelligent and reliable sensing concept, a crucial step towards the ultimate objective of reusable rocket carrier systems.

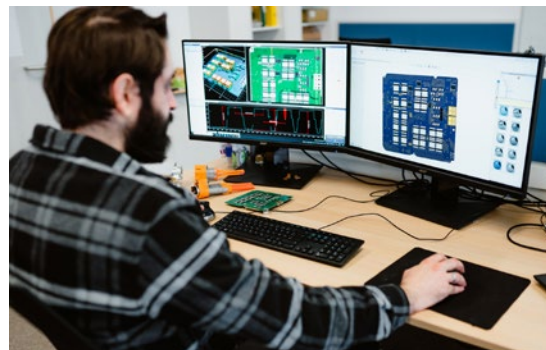


Infra-structure & Labs

Excellent research requires excellent infrastructure and tools.

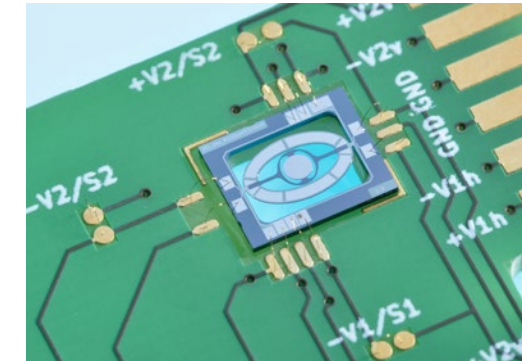
Across our three sites, we operate several laboratories with a wide range of high-tech equipment used by our SAL employees, partner organizations and customers to achieve the best research results.

Graz



POWER LAB

- Evaluation and optimization for power dense converters
- Developing high efficiency power electronics for renewable energy



ELECTRONIC SENSORS LAB

- Electronic read out circuits for custom made sensors
- Optimization of ultra-low-signal level and ultra-high-resolution signal processing with respect to wireless energy & data transfer
- Electrical analysis from DC to the GHz level
- Development of the whole sensor read out-, data processing- and data displaying system



VALIDATION LAB

- Prototyping and testing of Electronics and Software Based Systems
- Programming & testing of novel, AI-based, signal analysis algorithms
- Functional, lifetime, aging and reliability testing



DEPENDABLE CPS LAB

- Signal processing & advanced perception
- Resilient & robust AI (learning & model-based)
- Customized, secure & safe edge devices
- Distributed, collaborative computing
- Verification of (AI-based) embedded software

Linz



IWS LAB

SAL offers measurements and characterization of devices operating in spectra of 100's GHz, enabling:

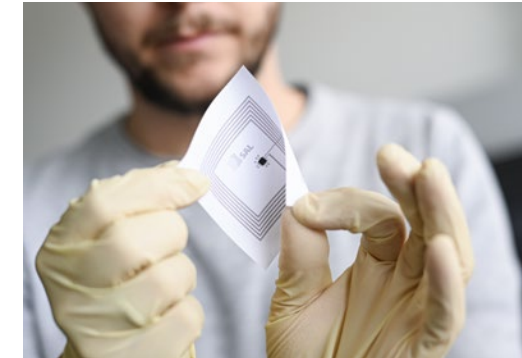
- Spectral analysis including measurement reports
- Package analysis and feasibility studies up to PCB design rule recommendations
- Device verification testing according to customers' standard requirements
- Platform architecture and feasibility up to application integration aspects

5G/6G TESTBED

- Infrastructure for experimental performance evaluation and configuration optimization (under real life conditions)
- Research and development of application protocols, TSN integration and positioning
- Training and support from theoretical aspects to roll-out and deployment challenges

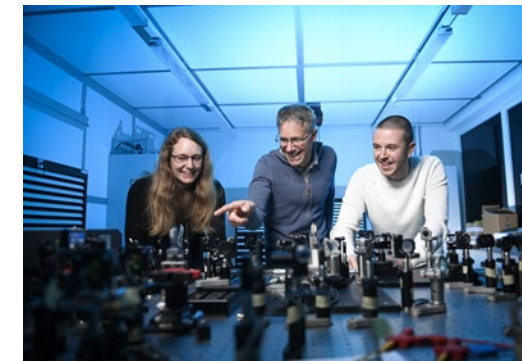


Villach



PRINTED & FLEXIBLE ELECTRONICS LAB

- Printed electronic solutions through a wide range of technologies
- Printed sensors, photovoltaic, displays, antennas, actuators, ...
- Sustainable sensorics (biosourced, biodegradable, ...)
- Electronics on a variety of flexible substrates
- Non-contact readout solutions



PHOTONICS LAB

- Laser class-4 laboratories
- General-purpose optics lab, laser development lab
- Raman(micro)spectroscopy lab, ultra-fast/quantum sensing lab
- Application lab for dedicated test stands and out-of-lab functional demonstrators and prototypes
- Comprehensive competence in component, system design and simulation software



ENVIRONMENTAL & HIT LAB

- Test & qualification setups for sensors
- Project-oriented custom setups
- Backend assembly & characterization
- 2 Areas: standard lab and C8



SAL MICROFAB: INAUGURATION AND NEW LEADERSHIP

Over the years, SAL has established a 300 m² ISO-5 **R&D cleanroom facility** at the High Tech Campus in Villach: a contamination-free environment with controlled temperature, humidity and pressure, furnished with state-of-the-art equipment to carry out microfabrication and prototyping of micro(opto)electromechanical systems (M(O)EMS), and advanced wafer level packaging.

In October 2023, we opened our additional 1,100 m² of cleanroom space, making the SAL MicroFab **the largest research cleanroom complex in Austria** with a total area of 1,400 m².

The new facility will be equipped with batch processing tools that will enable industrial R&D and small series prototyping, thus positioning the SAL MicroFab at the junction between research development and high-volume manufacturing.



AYA COHEN
Head of SAL MicroFab

From 2024, the MicroFab will be headed by **Aya Cohen**, a specialist in process engineering with over a decade of experience from both industry and academy. Aya has worked in a leading semiconductor manufacturing company in Israel for seven years, before she took on the management of a semiconductor fabrication research facility in Israel's technical university, where she has been employed for five years.

"I believe the SAL MicroFab will become a leading member of the European semiconductor world. SAL's mission 'From Idea to Innovation' sets the path for the SAL MicroFab, steering us towards sophisticated fabrication, in order to enable state-of-the-art research and to bridge the gap for higher TRLs," says Aya Cohen.



Research Network

Together with our partner universities, we have formed a strong research network for ESBS with the aim of fostering young research talents and delivering excellent research results of high relevance to the academic and industrial ESBS ecosystem.



ESPML LAB

SAL & JKU Linz

Christian Huber (SAL) won the “**Hojjat Adeli Award for Outstanding Contributions in Neural Systems**”, together with Mario Huemer (JKU), Péter Kovács and Gergő Bognár (both Eötvös Loránd University Budapest). The team received the award for their paper on “VPNET: Variable Projection Networks”, which was a successful cross-border effort in which a novel model-driven neural network architecture based on variable projection was introduced. The approach was evaluated in the context of signal-processing and successfully used in a real-life application to classify electrocardiogram signals.

DES Lab

SAL & TU Graz

As a collaboration in the DES Lab, **Edi Muskardin** (SAL), Martin Tappler and Bernhard Aichernig (both TU Graz) won the **TAYSIR competition** with their model of recurrent neural networks and transformers, presented at the International Conference on Grammar Inference in Morocco. The research is a step forward towards understanding the inner workings of language models such as ChatGPT.

USE LAB

SAL & University of Klagenfurt

In 2023, the USE Lab team got approval for several new projects, among them PATTERN-Skin, CloudFridge and AdapTex. These new projects are a great win for the USE Lab and will ensure continuous cooperation in the future.

MMW LAB

SAL & JKU Linz

The SAL-LIT mmW Lab team achieved a power efficiency world record for DC-to-THz conversion and headed further to demonstrate a radar system integration on a single chip at 960 GHz.

GEMC LAB

SAL & TU Graz

The GEMC Lab got two best paper nominations in 2023: together with his colleagues from Graz University of Technology and SAL, Christian Riener was nominated for a best paper award and a best student paper award for his papers “Broadband 3D Modeling and Simulation of DC-Biased SMT Ferrite Beads for EMI Filters” and “Modeling a GaN Transistor and its Impact on Conducted Emission up to 300 MHz” respectively.

RFFE LAB

SAL & FH Kärnten

This year, the team developed a CMOS test chip (system on chip) as well as a photonic chip and started production with tape outs. These two tape outs mark important milestones and make it possible to prototype the planned novel implementation of Photonic RF DAC with heterogenous integration.

SAL Doctoral College

The Silicon Austria Labs Doctoral College (SAL-DC) offers young researchers in the field of ESBS a secure future in an excellent research network for ESBS with regional, national, and international collaborations.

As part of the SAL-DC training program and in addition to their studies in the field of ESBS, students will have the opportunity to establish international connections and become future research leaders in an interdisciplinary and intersectoral environment.



**ARASH
SAHBAFARD**

The SAL DC environment has been instrumental in my research on URLLC networks. The 5G Testbed provides a unique space for hands-on exploration, and the collaborative atmosphere enhances learning. The support from fellow doctoral colleagues and experts has been invaluable, making SAL DC an exceptional place for research and growth.



**KHALED
IBRAHIM**

Following two years of research at SAL, I took the opportunity to start my doctoral studies in collaboration with Graz University of Technology, working on the state estimation research of lithium-ion batteries for electric aircraft. This not only presents an outstanding chance to broaden my knowledge but also allows me to conduct valuable research and establish positive connections. Furthermore, I am pleased with the collaborative environment and the state-of-the-art laboratory facilities.



**JASMIN
SPETTEL**

At SAL, I work on MEMS and photonic integrated circuits (PIC) on an aluminum nitride platform. I am also enrolled as a PhD student at École Polytechnique Fédérale de Lausanne (EPFL). While I spend most of my time at SAL, I occasionally travel to Switzerland to attend courses or take advantage of the cleanroom facilities to perform fabrication steps for my devices. It is a great experience to spend time abroad, get to know other students, and see how other cleanroom facilities are handled.

CRYSTALLINE PROGRAM AWARDED WITH THE MSCA COFUND

SAL's Doctoral College (SAL-DC) was awarded the co-funding of its CRYSTALLINE program under the Marie Skłodowska-Curie Actions COFUND call. In CRYSTALLINE, which stands for electronics and software based systems research excellence in Europe, we will enable 18 up-and-coming talents in science to move to Austria and pursue their PhD studies in ESBS research.



HANS-PETER BERNHARD

Receiving the MSCA COFUND is a remarkable achievement for the SAL-DC and for SAL as a research center and RTO! The Marie Skłodowska-Curie Actions COFUND represents a pinnacle of excellence in research and innovation. It is a great honor to receive this funding, and great evidence of our commitment and dedication to top research.

THE SAL-DC SUMMIT 2023

In November, the SAL-DC summit brought PhD students, supervisors and management together in small interactive groups, plenaries, keynotes, and poster sessions. Students from all sites and associated students from universities met in Klagenfurt for 3 days to share their successful work on their PhD studies and to network with peers.



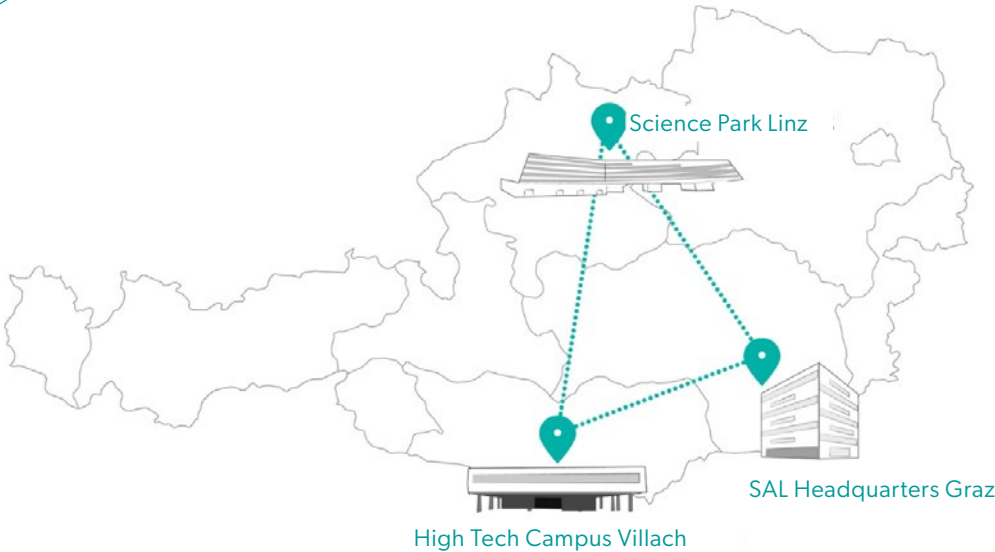
Locations

By the end of 2023, SAL employed **323 people**. Not only has our workforce grown, but our locations have also increased in size or moved to new places.



GRAZ
SAL Building, Sandgasse 34, 8010 Graz

In March 2023, our team in Graz moved into our new headquarters at Sandgasse 34 on the TU Graz Inffeldgasse Campus. The official inauguration took place on May 3rd. In addition to new office space, we now have over **820 m²** of laboratory space. The new laboratory infrastructure offers the employees an optimal research environment. In the future, comprehensive tests in the field of Power Electronics and Dependable ESBS can be carried out. In the newly created Validation Lab, sensors can be tested for environmental influences such as temperature, mechanical vibration, or humidity.



VILLACH
High Tech Campus Villach, Europastraße 12, 9524 Villach

After moving into the offices in the new building some time earlier, the official opening of the SAL MicroFab laboratories and clean-room took place in October 2023. The lab area of over **770 m²** in the HTC 1 was expanded by a further **1,580 m²** in the new HTC 2. The newly built cleanroom alone covers over **1,100 m²**. This space serves as a sterile environment for microfabrication and prototyping of micro(opto)-electromechanical systems (M(O)EMS) and advanced wafer level packaging. SAL also makes the premises available to industrial partners who do not have their own cleanroom for small series production.



LINZ
Science Park 4, Altenberger Straße 66c, 4040 Linz

There have also been many developments in the Science Park 4, which our colleagues in Linz have already moved to in the year 2021. Currently, the building occupies **110 m²** of lab area. The focus in Linz lies on research in the area of intelligent wireless systems, especially the next generation of mobile communications – 6G. In 2024, a further expansion of the lab space is planned. Nearly **210 m²** should follow.



Last year, we began implementing a workplace health promotion project. This initiative is aimed at preventing illness in the workplace, strengthening health, and improving and maintaining people's well-being in the long term.

SAL's philosophy is that only those who feel good at their workplace can also make a significant contribution to the company's productivity. This initiative is another benefit for our employees, which SAL provides in addition to all other perks.

With this in mind, SAL has implemented several measures during this first year. Besides interesting workshops and seminars about healthy nutrition, healthy breaks or ergonomics at the workplace, we also organized sports events and courses on mental health.

Here are some impressions of the activities we have set:

HEALTHY BACK IN VILLACH

Back pain is a widespread problem, especially among those who have a sedentary job. To counter this issue, we have initiated a training program which addresses back health in Villach.



REFRESHING BODY AND MIND IN GRAZ

In these sessions, the participants were able to gain a kind of "instruction manual" for their body and mind, through which they learned to make full use of their potential in everyday life. The exercises should increase concentration and flexibility of the spine without overloading the organism.



BADMINTON IN LINZ

In 2023, a group in Linz met regularly to play badminton. Badminton promotes fitness, dexterity and responsiveness, and strengthens the leg and arm muscles in particular. However, the main focus was on having fun!



COACHING

In the last quarter of 2023, we offered a coaching pool to all employees. This offer is meant to give employees the possibility to discuss personal and professional developments and challenges with trained coaches. Additionally, SAL provided seminars on different topics related to mental health, e.g., stress management, conflict management and leadership topics.

Work & Family

We are proud to announce that SAL was recertified with the certificate “Beruf und Familie” (“work and family”) in the year 2023, which is valid until 2026.



With this recertification, we are anchoring and sharpening awareness of compatibility issues among our management circle and all employees, fostering a culture that prioritizes both work and family commitments.

Through the implementation of part-time leadership opportunities and the optimization of substitution arrangements, we are ensuring flexibility and support for our employees’ family needs. With the introduction of SAL Family Information and formalized parental leave management, we are striving to create an inclusive and supportive environment for all members of our company.

Together, we are deepening our understanding and commitment to a work and family-friendly culture, where success is measured not only by professional achievements but also by the well-being and fulfillment of our employees and their families.



ISO 9001:2015

In the course of the annual surveillance audit by TÜV AUSTRIA CERT, we were able to confirm our ISO 9001:2015 certificate once again.

The high-quality standard was particularly underlined by the existing systems and the measurements we have implemented in the last two years.

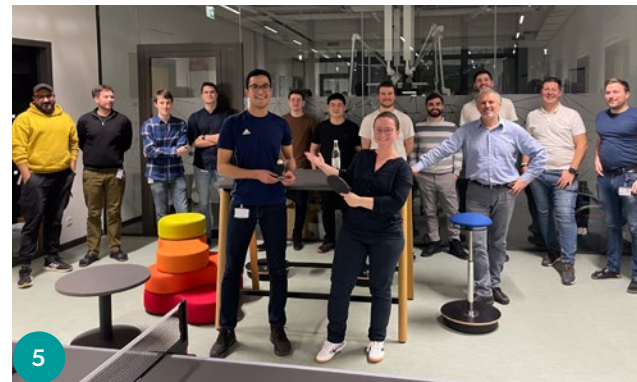
Many thanks to everyone who took part in the audit and in the continuous improvement of our processes.



Behind the scenes at

SAL

- 1 Crux Lauf Villach
- 2 LOPEC Group
- 3 EBSCON 2023
- 4 Breakfast in Linz
- 5 Table Tennis Tournament Graz
- 6 MEMS 2023

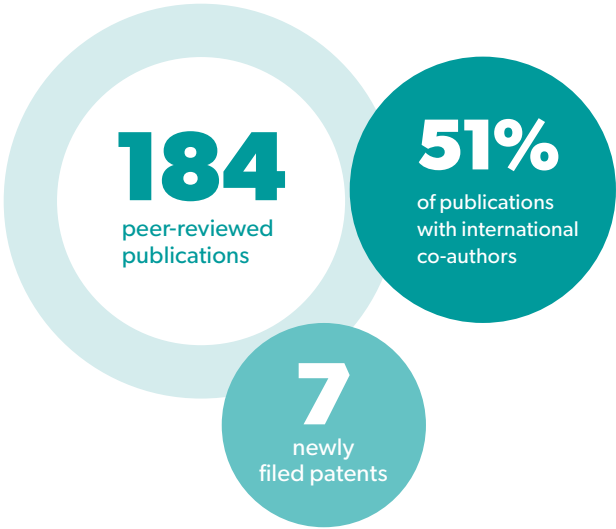




- 1 Culture Clubbing
- 2 Tauern Circle 2023 in Schladming
- 3 TPV Kirchtag
- 4 Kärnten läuft
- 5 Business Run Graz

SAL in Numbers

Publications & Patents



Human Resources



Project Volume



Finance



Shareholders

50,1 %
Republic of Austria



24,95 %
Austrian Association
of the Electrical and
Electronics Industry (FEEI)



10 %
Styrian Business
Promotion Agency (SFG)



10 %
Federal State of Carinthia



4,95 %
Upper Austrian
Research GmbH (UAR)



At a glance

COMPANY TYPE

Public-Private-Partnership
Limited Liability Company (GmbH/Ltd.)

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Information as of December 2023.



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