Integrated Sensor Electronics

Mixed Signal Design Service

IoT applications and other electronic solutions with special requirements place demands on the installation space and robustness of the installed sensors. In addition, there is a growing demand for powerful and at the same time energy-efficient electronic systems that are used, for example, in automotive engineering, industrial automation or assistance systems.

At Fraunhofer IIS/EAS we focus our design work on high-performance data converters for various use cases or customize sensor interfaces with regard to their energy efficiency and performance. This is the basis e.g. for high-speed chip-to-chip communication according to new standards. Another focus lies on edge computing concepts and the precalculation of measured high precision data by data reduction in the edge device.

Our Services

- Complete IC design service from specification, layout, testing to prototyping
- Individual IC design with focus on high performance and ultra-low power sensors
- Yield optimization (design for yield)
- Rapid adaptation to change requests/supply of IP variants
- Establishment of in-house, modular, automated component library
- Feasibility analysis at system level
- Inhouse testing and verification
- On request production of small series

Your Benefits

- In-house methodology with several design tools (Cadence and others)
- Software openness and various exchange formats
- Reduction of costs and effort due to our wide range of technologies, manufacturers and process nodes
- Shorter development times with focus on high quality by in-house developed design methodologies
- Circuit optimization at system, circuit layout and post-layout level
- Increased design reliability thanks to automated, flexible IP components
- Technology migration and porting with new automation approaches

More Information

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**Forschungsfabrik
Mikroelektronik**
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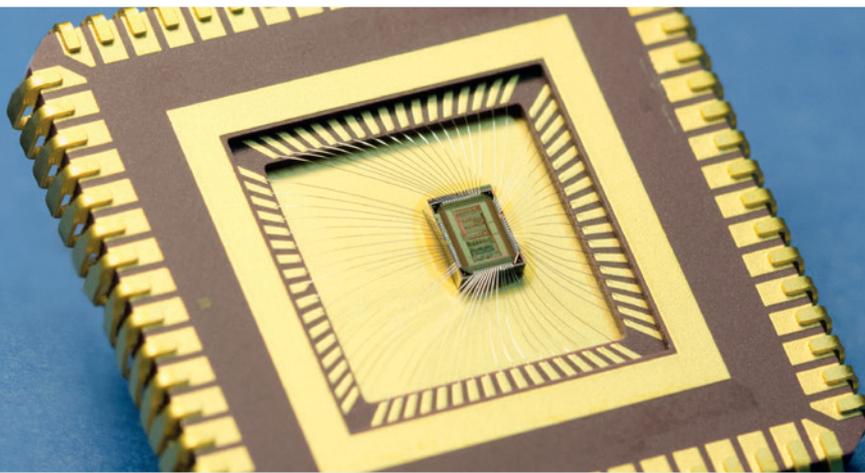
Benefit from the wide range of software and hardware environments we cover with our mixed signal service.

Mixed Signal Design Service

With our analog/mixed-signal design service, we create individual solutions for integrated sensing applications. Benefit from our long-time experience in a wide range of technologies from numerous foundries from 0.6 µm to 5 nm.

Our in-house developed analog design methodology and reliable porting methods for diverse technologies allow for a fast design cycle including layout design, testing, prototyping and small production series on request.

Our detailed knowledge in different design tools, manufacturers and structure widths in combination with direct cooperation with vendors themselves enable us to also develop integrated circuit solutions for small and medium-sized companies and design concepts which can reduce costs and efforts. For that we transfer newest design topologies and architectures from leading-edge research to industrial solutions and offer prototyping and small production series services.

Key Measurement Possibilities

In addition, you can benefit from our measurement capabilities in our laboratories. We are able to perform characterization of ASICs in packages, bare dies or on wafer level. Benefit from our climate chamber with its heating, cooling and humidity capabilities and our fast temperature characterization with thermostream. We also offer automated high-precision measurements of ultra-low voltages and currents. Our wide variety of common, market-standard software and hardware environments allows us to implement diverse, comprehensive design and test requirements.

- Characterization of ASICs in package, bare dies or wafer level
- Testing in climate chamber with heating, cooling and humidity possibilities
- Fast temperature characterization with thermostream
- Automated high precision measurement of ultra-low voltages and currents
- Design and test with all common software and hardware environments on the market

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TRANSFER YOUR SENSOR INTO AN INTELLIGENT EDGE DEVICE


© Fraunhofer IIS/EAS, , Foto: Oliver Killig
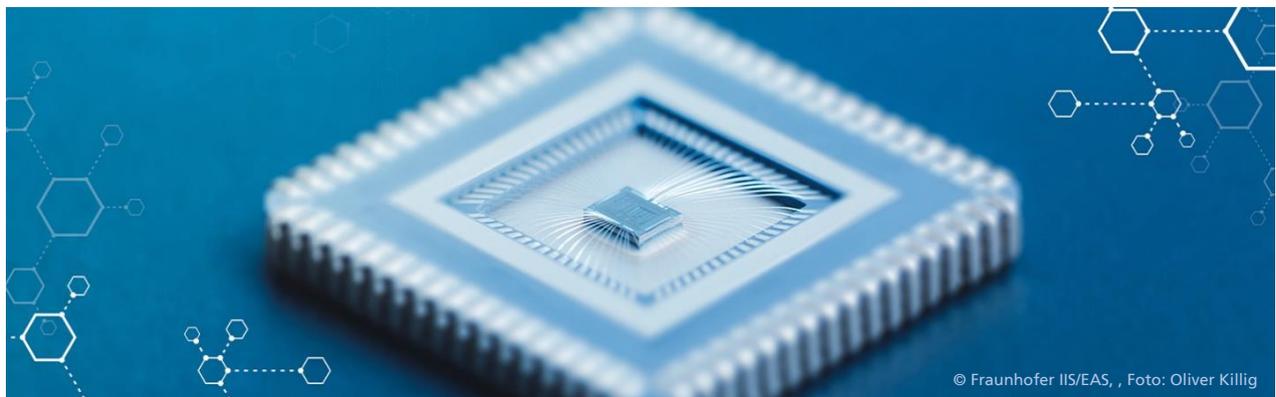
As technology advances, we are increasingly interacting with intelligent systems in our daily lives. Sensors play a crucial role in this interaction by converting analog signals from the physical world into the digital language these systems understand. This includes dealing with large amounts of data, which are often transferred to the cloud for processing. However, cloud computing comes with challenges such as long latency times and concerns about data security.

To ensure fast and reliable processing of large data volumes, we enhance the intelligence of sensors. This involves using application-specific **integrated circuits** for signal conditioning, analog-to-digital and digital-to-analog conversion as well as data preprocessing. Integrated solutions combine all these functionalities with energy efficiency, compact packaging and standard interfaces. In particular, performing **data pre-calculation** at the **edge** significantly reduce the dependency to the cloud.

We specialize in designing integrated sensing solutions for your specific application, seamlessly integrating with your existing **sensor ecosystem**. Our work emphasizes a systemic approach and openness to all possible solutions. Benefit from our extensive experience in a wide range of technologies, spanning **from 180 nm down to 22 nm** and our in-depth knowledge of different design tools. Through direct cooperation with vendors, we are also able to develop integrated circuit solutions for small and medium-sized companies, offering **cost and effort reduction** in design.

Your benefits

- Open up new sensing application fields and markets by integrated electronic design
- Scale down development costs by keeping existing eco system
- Reducing production costs by increasing mass production through improved functionality and application flexibility of smart sensors
- Reduce cloud dependency by enabling data pre-processing in the edge
- Save energy per sensor scaling up in large systems
- Increase design reliability thanks to automated, flexible IP components

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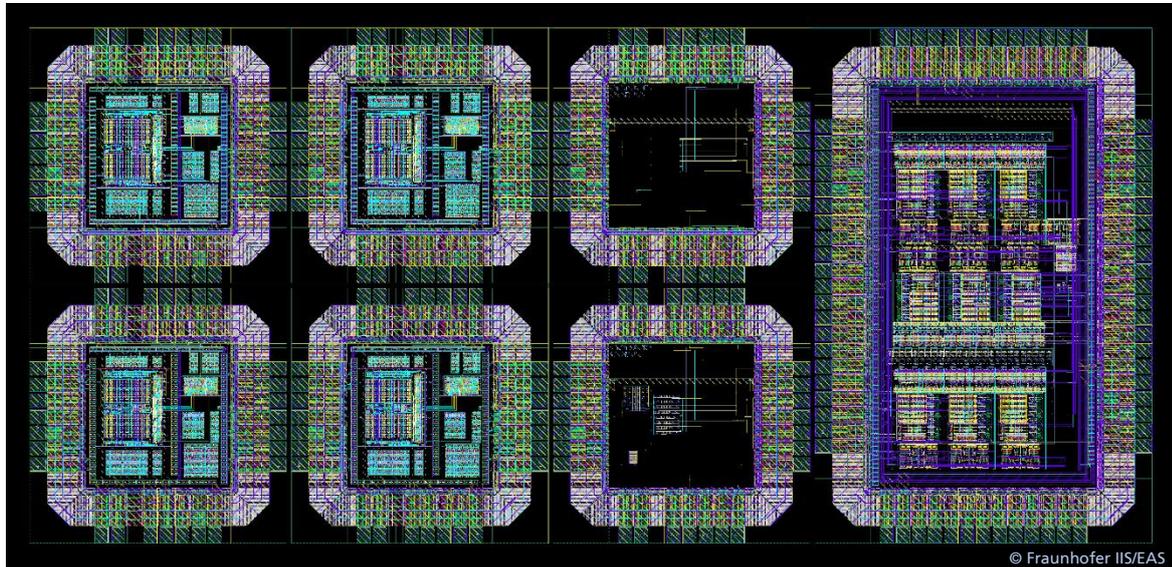
Our services

- Feasibility analysis at system level by balance of costs and performance
- Development of an application specific integrated solution
- Technology consulting based on various nodes (e.g. 22nm, 55nm, 180nm) and vendors
- Prototyping and Integration support

About us

The Fraunhofer Institute for Integrated Circuits IIS is one of the world's leading research institutions for microelectronic and information technology systems and services. At the division Engineering of Adaptive Systems EAS, researchers are working on the efficient realization of intelligent systems. The goal is to ensure the swift, resource-efficient, error-free and safe development of electronic systems and to come up with new design concepts to meet the challenge of the constant miniaturization of semiconductor components and the growing complexity of integrated circuits. Tailored to the current and future requirements of the economy, adaptive and robust technological solutions, especially in the areas mobility and industrial automation, are developed.

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REALIZE SHIFT LEFT AND REDUCE RISK WITH CUSTOM A/MS IC DESIGN AUTOMATION

Automation of A/MS IC Design using IIP Generators
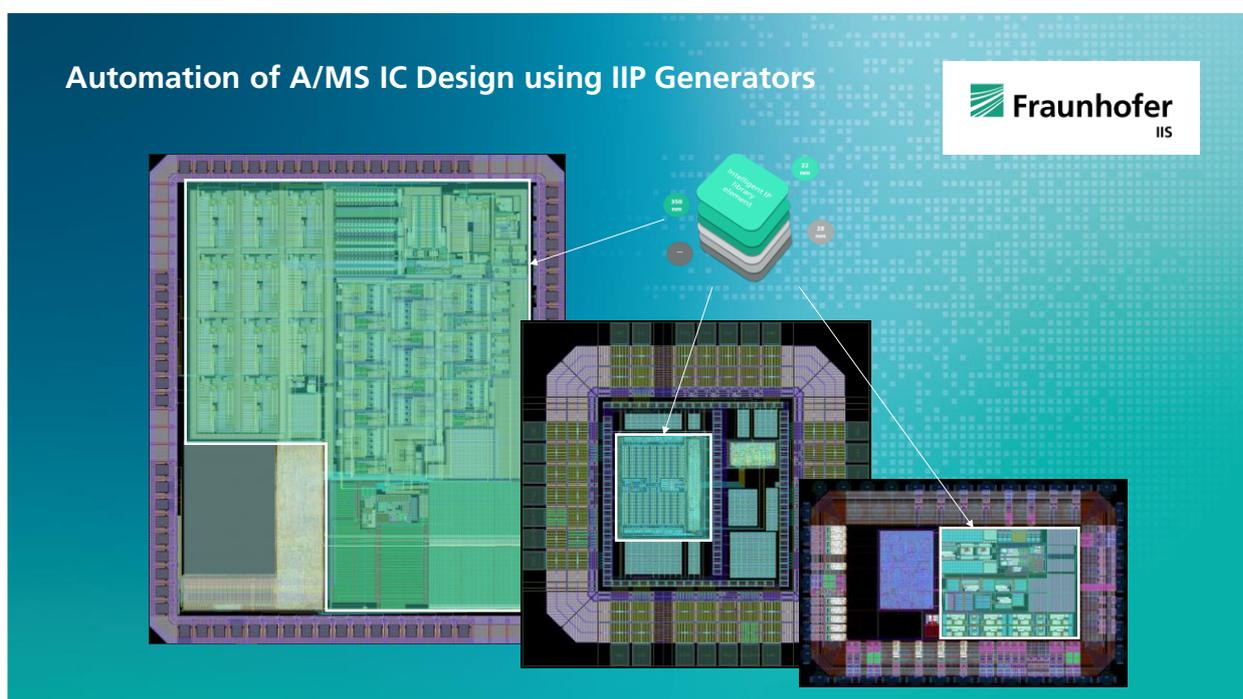
Analog/mixed-signal IC design is a critical challenge for ASIC development with tight specifications and ambitious tapeout schedules that are not easy to meet. The manual analog design approach from architecture through layout verification limits the amount of early insights and results in time-consuming design iterations. Therefore, approaches arose that ease A/MS design by means of increased levels of automation that are applied to just the right sweet spots in the complex design flow.

In this field, Fraunhofer IIS/EAS develops user-friendly automation that supports design teams. The method works intuitively, supports various foundries and technology nodes by principle, and generates DRC clean and LVS clean results in a matter of seconds to minutes. This way, parasitic effects are seen early, risk is reduced, and iterations are significantly accelerated by automating repetitive design tasks.

Your Benefits

- Rapid design iterations
- Rapid design reuse across process nodes and vendors
- Minimization of design risks and fast knowledge of parasitic effects
- Accelerated design flow from specification over schematic through layout
- Benefit from our experiences when you plan your own A/MS design or CAD automation project

Features

- Intuitive and user-friendly automation: if you know pCells, IIP will be fast adopted by your team
- PDK-agnostic automation with experience from 350…5nm across eight foundries
- Highly-automated porting across various foundries' PDKs
- Interface-API to ease custom flow development (Python)
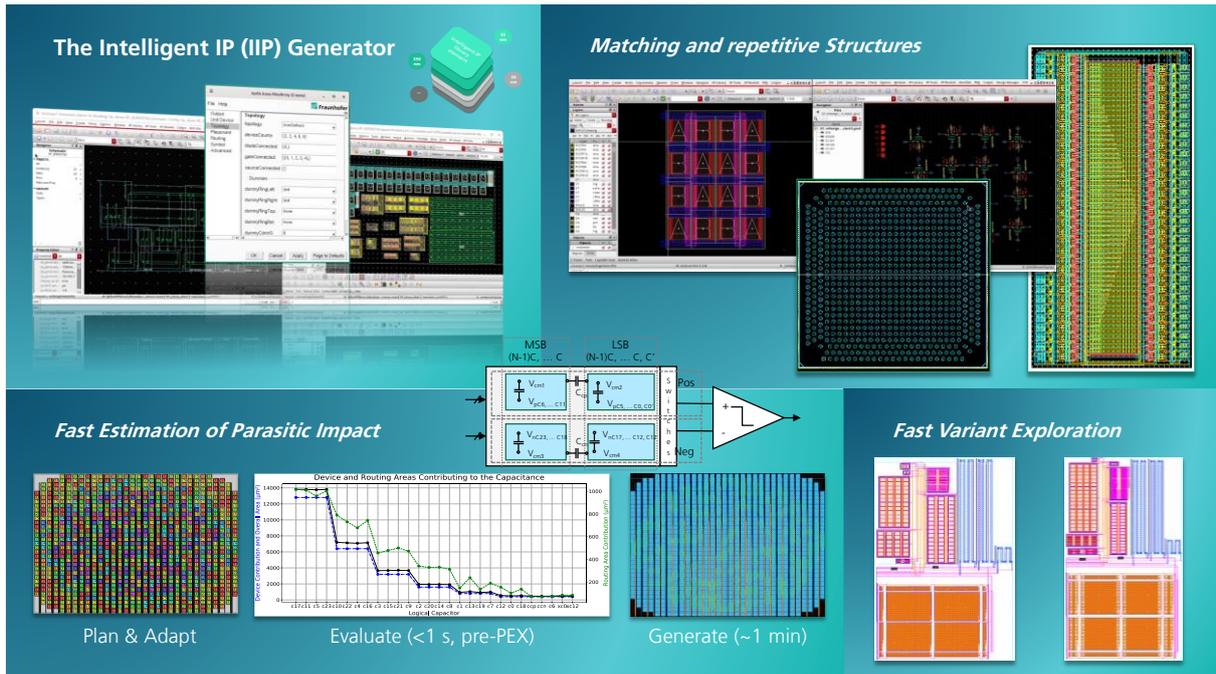
Use Case Examples of the Fraunhofer A/MS IC Design Automation Method Intelligent IP

About us

The Fraunhofer Institute for Integrated Circuits IIS is a world leader in research on microelectronic and IT system solutions and services. Scientists at the institute's EAS division in Dresden are working on key technologies for cutting-edge adaptive systems that can independently detect, analyze and evaluate changes in their environment or in their internal structure. To this end, the researchers are developing innovative algorithms and powerful sensor components. Other key areas include the automatic analysis of large data volumes, artificial intelligence, IoT and the development of technologies for connected automation in production processes.

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FRAUNHOFER IIS

Division Engineering of Adaptive
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Mixed-Signal Automation

Automated Analog Design

Modern business models in the world of integrated circuit (IC) design offer excellent scalability with a high degree of automation and reusability, as impressively demonstrated in the area of digital design. Analog design, by contrast, still suffers from a very low level of automation, resulting in long development times and relatively low reusability, coupled with high design risk and development costs. Such challenges are increasingly aggravated by growing system complexity and ever-smaller technology nodes.

Fraunhofer IIS/EAS therefore supports you with solutions to enable greater automation in analog design. Among other things, we've developed an approach using Intelligent IP (IIP) that automates typical analog basic circuits in a user-friendly manner, thereby speeding up the design process. We also automate design steps on an individual basis in line with customer requests.

Our Services

- Advisory service on design and automation tools in analog and mixed analog/digital IC design
- Evaluations and feasibility analyses of automation solutions, including rapid prototype development
- Licensing and development of PDK-agnostic generators for automated circuit and layout generation
- Provision of our Intelligent IP methodology for your in-house generator development
- Integration of customer-specific automation tools into your design environment

Added Value for you

- Increased design efficiency
- Minimization of design risks
- Overarching design flows and advice on everything from specification to layout
- IIP as a tried-and-tested automation solution
  - User-friendly and flow-compatible approach
  - Automation of typical analog basic circuits and customer-specific tasks
  - Reuse of circuits across different PDKs and projects
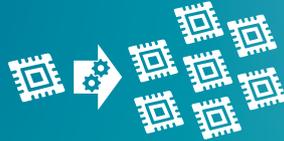 - Automation of hierarchical circuits

More Information

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Deutschland

Standardized Automation
For Common Building Blocks

Reusable Analog IP
By Our Reuse Flow

Custom Analog Automation
According to Your Specification

Your Challenge is Automated by Us
or
You Automate Yourself by Using Our Technology

IIP Framework and Flow Integration as Basis
(With Support for CAD and PDK Setups)

Our analog automation offerings that reduce your development risks and help save time and money.

What we offer you

Our portfolio of services for automated analog design includes the development of software and scripts for recurring and/or error-prone design steps, in particular for the Cadence Virtuoso® design environment. In addition, we develop application-oriented and automated design flows, from schematic entry to simulation and layout automation. Our services are applicable to technologies ranging from 350 nm to 22 nm, as well as FinFET technologies from various foundries. We also offer cross-project automation, design porting, and design migration. When it comes to selecting suitable automation methods and design tools, our focus is on cost, benefit, and usability for our customers.

The IIP Approach

Intelligent IP provides a completely flow-compatible approach to analog automation. This method speeds up the design process, boosts design safety, and facilitates the reuse of circuits across projects and technologies. It can even be used to automate entire hierarchical circuits if this proves to be economically viable – e.g., in test structures or frequently used circuit components from product families.

IP Reuse with Intelligent IP

IIntelligent IP allows you to reuse IP. Create your own PDK-agnostic generators from your circuits at the touch of a button and use them in other projects for other dimensioning variants, PDK flavors, or target technologies.

You can do so using IIP generators right from the schematic entry stage – and will receive your parameterized circuit automatically. Our layout methods also result in an initial LVS-clean layout for rapid initial inspection.

At the same time, our approach is fully compatible with the customary design flow – and you can adapt or expand the resulting design data as usual without having to prepare any program code, although you can also do so if you wish. Intelligent IP allows you to boost design efficiency at the push of a button thanks to user-friendly and technology-independent automation.

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IC Reliability

Design support for robust and reliable ICs

Rapid technological progress in the development of electronic components also requires new strategies for the design process. Nowadays, developers are confronted with major challenges from constraints such as reliability, durability and cost efficiency as well as miniaturization.

Fraunhofer IIS/EAS offers a wide spectrum of products and services for supporting the design of robust and reliable ICs as well as systems. Master effects such as process variations, aging or electro-thermal interactions owing to technology and design quickly and reliably to reduce your costs in the production process and improve your product quality.

Our Services

- Measurements on reliability and robustness at the wafer and system levels
- Development of degradation models for transistors, including implementation in different EDA environments
- Modeling of effects caused by process variations and the behavior of ESD structures
- Multi-physical simulation including creation of reduced-complexity models
- Development of stress monitoring solutions and forecasts for the remaining lifetime of electronic systems
- Development of algorithms and software

Your Benefits

- Secure use of technological capabilities without overdimensioning
- Compliance with quality standards
- Equivalent support for different design environments based on customer requirements
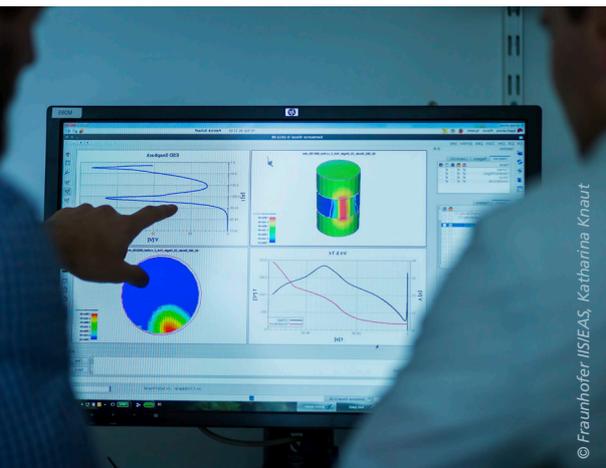- Meaningful reliability analyses as well as safeguarding of the lifespan of transistors and ICs
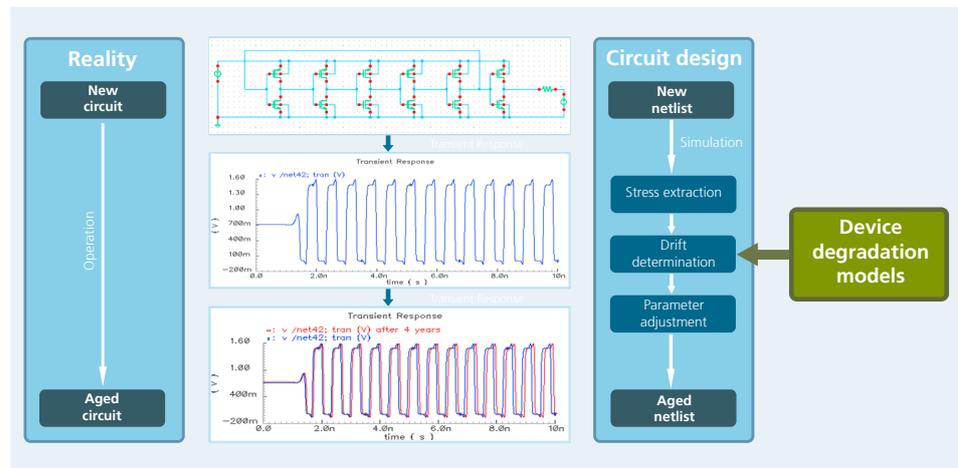
More information

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left:
Investigating the
behavior of ESD structures

right:
Principles of aging
simulation

Our Solutions for Your Designs

Particularly in safety-critical areas where durability and cost efficiency are a must, the aspects of reliability and robustness have to be taken into consideration in IC design.
We supply methods and solutions to help our partners meet their individual requirements with their designs. Generally, our offers extend existing EDA solutions to include specific models or software with additional functionalities.

- Degradation models for aging simulations with precision and tool support according to customer requirements
- Concepts for analyzing system reliability based on physical and data-driven models

Our solutions can verify the functioning of an electronic system under various operating conditions. Considering coupled behavior in particular helps derive concrete constraints and tips for designing integrated circuits and their layouts. As a result, users can efficiently verify and safeguard the reliability and robustness of their systems during the design process. Our solutions also enable users to monitor functionality and reliability after production right in the specific application.

Users

Our services and software tools are aimed at semiconductor manufacturers as well as IC and system designers.
They are the ideal choice for the following industries:

- Automotive electronics
- Aerospace
- Medical technology
- Industrial automation

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