XENSIV™ gas sensors

For automotive, industrial, and consumer applications

www.infineon.com/sensors

XENSIV™ gas sensors

For automotive, industrial, and consumer applications

“Invisible danger, visible safety.”

Thermal conductivity (TC) sensors are increasingly crucial for gas detection across sectors that demand high performance, speed, and reliability. Their unique properties make them especially well-suited for applications within the hydrogen economy, HVAC refrigerant leak detection, and early identification of thermal runaway in advanced energy systems.

Hydrogen sensing in the hydrogen economy with TCI sensor

As the hydrogen economy expands, ensuring safety through rapid and accurate gas detection is essential. The TCI sensor, based on thermal conductivity principles, can detect hydrogen leaks with astonishing speed, within just 100 ms. This immediate response is critical for early warning systems in hydrogen storage, pipelines, and fuel cell facilities. The TCI sensor exploits hydrogen's significantly higher thermal conductivity compared to air and most industrial gases, enabling high selectivity and sensitivity. Unlike many conventional sensors, TC sensors exhibit very low drift and are inherently robust, maintaining accuracy over time and in harsh environments. Additionally, they are not prone to chemical poisoning, ensuring long operational lifespans and minimal maintenance, a crucial advantage for mission-critical hydrogen applications.

Refrigerant leakage detection in HVAC systems with TCI-R sensor

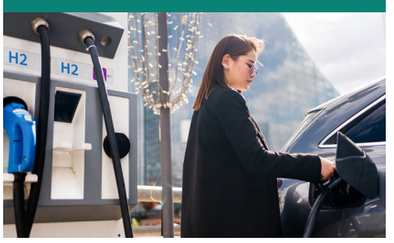
Refrigerant leaks in HVAC systems can harm both equipment and the environment. The TCI-R sensor, optimized for refrigerants, detects leaks quickly and reliably by measuring changes in thermal conductivity specific to common refrigerants like R32, R454A-B-C, R455A, R1234yf and CO_2 (R744). The TCI-R sensor responds instantly to leakage events, helping prevent compressor damage, loss of cooling efficiency, and regulatory noncompliance. Thanks to its low drift and resistance to cross-sensitivity or poisoning, the TCI-R sensor maintains accuracy over years of operation, reducing maintenance costs and environmental impact.

Early thermal runaway in automotive and energy storage systems with TCI-B sensor

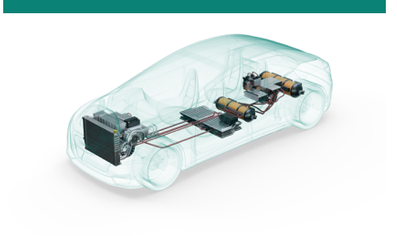
In battery packs for electric vehicles and energy storage, early detection of dangerous fault conditions is vital. The TCI-B sensor detects changes in thermal conductivity caused by early gas emissions, such as hydrogen and hydrocarbons, providing an instant indication of thermal runaway, well before temperatures reach critical levels. Its fast response enables proactive safety interventions, while immunity to poisoning ensures consistent, long-term protection.
Overall, TC sensors, TCI, TCI-R, and TCI-B deliver rapid, robust, and reliable gas detection, making them indispensable tools for safety and operational efficiency in modern, energy-critical industries.

Hydrogen economy

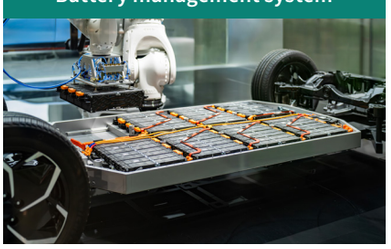
Stationary fuel cell



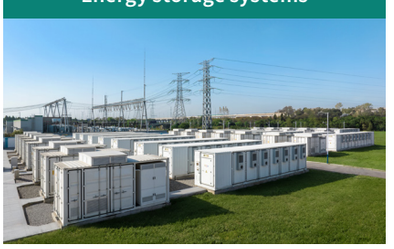
FCEV



Battery management system



Energy storage systems



HVAC systems

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www.infineon.com/gas-sensors

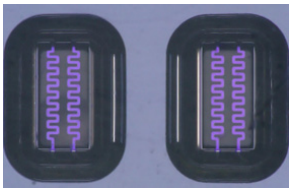
Thermal conductivity-based H2 sensor

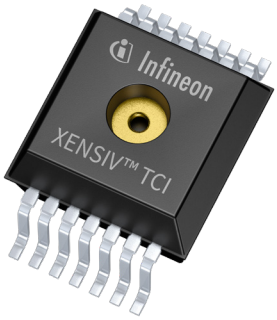
XENSIV™ TCI: H2 sensor with I²C, ultralow power, and 15-year lifetime

Infineon's XENSIV™ TCI gas sensor provides reliable detection of hydrogen (H2) gas in demanding automotive and industrial applications, including FCEVs, H2 combustion engines, H2 refueling stations, battery electric vehicles (BEVs), energy storage systems (ESS), H2 electrolyzers, and stationary fuel cells. Infineon's TCI gas sensor operates on the principle of Thermal Conductivity (TC) and utilizes a full differential MEMS sensor concept. The TC is measured by heating parts of the MEMS structures and measuring the heat transfer through the gas. TC sensing provides the highest robustness and stability for rough automotive applications. Unlike metal oxide-based (MOX) and catalytic combustion (CC) sensors, which rely on chemical reactions, TC gas sensors operate on a physical measurement principle. This makes the TC gas sensor immune to poisoning and immune to the tendency to offset high drift shown by chemical sensors.

Key features

- AEC-Q100 up to 105°C
- Fast response time <100 ms
- Ultralow current consumption
- Robust and proven packages
- Lifetime of 15 years with low drift
- UL 2075 certification



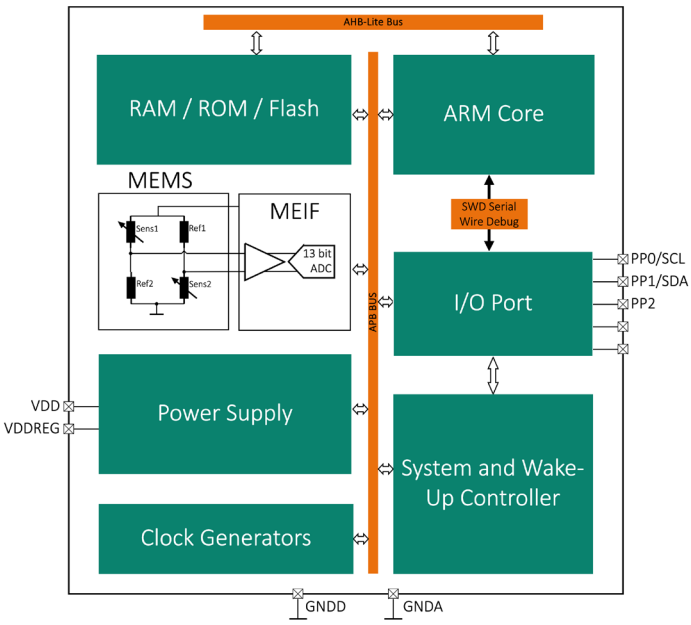


Benefits

- No maintenance or replacement costs
- Robustness and stability compared to catalytic- or metal oxide-sensors
- Low power mode state can be enabled by the customer

Potential applications

- Fuel-cell electric vehicle (FCEV) drivetrain system
- Hydrogen economy (production, storage, and transportation)
- ESS leakage detection



TCI product overview

Product	Accuracy	Interfaces	Supply voltage	Detection range
TCI	±0.12% vol H2	I²C	3.3 V	0-16% vol H2

Click here to learn more:
www.infineon.com/gas-sensors

Thermal conductivity-based H2 sensor for early thermal runaway detection

XENSIV™ TCI-B: ASIL B H2 sensor with I²C, ultralow power, and 15-year lifetime

Battery technology is vital to the fast-growing BEV sector, but lithium-ion batteries pose risks, including thermal runaway. In the early stages of thermal runaway, battery materials decompose chemically, releasing gases, most notably Hydrogen, before a significant temperature rise occurs. Gas sensors, such as hydrogen (H2) sensors, can detect these emissions at very low concentrations, providing an early warning of potential thermal runaway, much sooner than traditional temperature sensors or smoke detectors.

Early detection is essential to prevent failures and ensure safety. The TCI-B sensor addresses this by enabling real-time monitoring and rapid detection of thermal events in battery packs. It supports timely interventions, such as driver alerts or automatic safety system activation, before temperatures become critical. This proactive response not only enhances safety but also helps automakers meet regulatory standards such as GTR20. Beyond its use in BEVs, the TCI-B sensor provides early, precise detection of thermal event precursors in energy storage systems (ESS), enabling rapid response and mitigation. Continuous monitoring increases reliability, lowers the risk of catastrophic failures, and helps protect both assets and personnel.

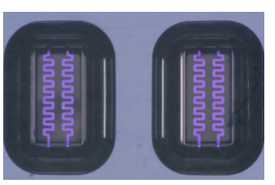
Infineon's XENSIV™ TCI-B hydrogen sensor operates using thermal conductivity (TC) and a differential MEMS sensor design. By measuring the heat transfer through gases after heating parts of the MEMS structure, TC sensing ensures robust, stable performance in tough automotive conditions. Unlike metal oxide (MOX) or catalytic combustion (CC) chemical sensors, TC sensors rely on a physical principle, making them immune to poisoning and high offset drift, thereby improving reliability.

Features

- FuSa QM/ASIL B capable
- AEC-Q100 up to 105°C
- Fast response time <100 ms
- Ultralow current consumption
- Robust and proven packages
- Lifetime of 15 years with low drift
- Autonomous operating mode for system level power saving UL-2075 certification

Benefits

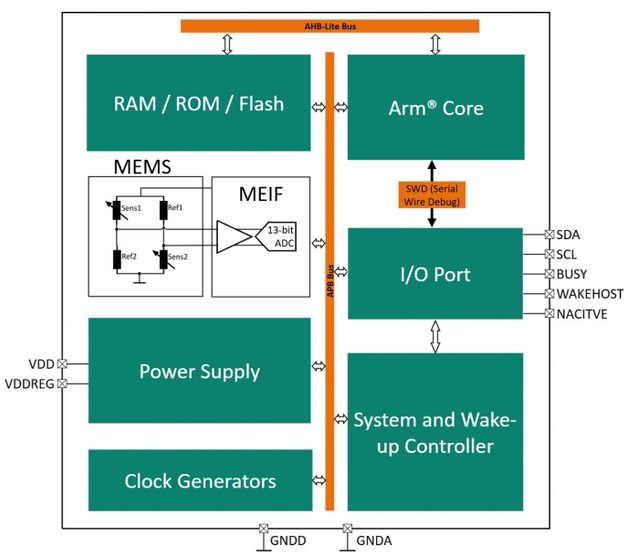
- Automotive grade sensor reliability
- ISO 26262 compliance capabilities up to ASIL B
- No maintenance or replacement costs
- Robustness and stability compared to catalytic- or metal-oxide-sensors
- Low power mode can be enabled by customer



Potential applications

- Early thermal runaway detection in BEVs
- Automotive battery management system (BMS)
- Early thermal runaway detection in ESS

Block diagram



TCI-B product overview

Product	Accuracy	Interfaces	Supply voltage	Detection range
TCI-B	±0.12% vol H2	I²C	3.3 V	0-16% vol H2

Click here to learn more:
www.infineon.com/gas-sensors

Thermal conductivity-based sensor for refrigerant leakage detection in HVAC systems

XENSIV™ TCI-R: Refrigerant leakage sensor with I²C, ultralow power, and 15-years lifetime

Automotive and industrial HVAC manufacturers are increasingly using alternative refrigerants that are classified as mildly flammable (A2L) or flammable (A3). This shift introduces new safety risks from refrigerant leakage, prompting standards such as UL 60335-2-40 and IEC 60335-2-40 to require Refrigerant Detection Systems (RDS) for specific refrigerant loads and room sizes.

The TCI-R sensor, which detects refrigerants using the thermal conductivity principle, is a vital component of RDS. Compared to other detection technologies, the TCI-R sensor provides low power consumption and fast response time, making it ideal for continuous monitoring. Its versatility is demonstrated by the ability to detect a broad range of refrigerants, including R32, R454A, R454B, R454C, R455A, R1234yf, and R744 (CO_2), all common in modern HVAC systems. When a leak is detected, the system can automatically trigger safety measures, such as activating fans to dilute refrigerant, improving occupant safety and ensuring regulatory compliance. As manufacturers shift toward low-GWP refrigerants, TCI-R sensors play an essential role in safe, reliable HVAC operation.

Infineon's XENSIV™ TCI-R sensor operates using thermal conductivity (TC) and a differential MEMS sensor design. By measuring the heat transfer through gases after heating parts of the MEMS structure, TC sensing ensures robust, stable performance in tough automotive and industrial conditions. Unlike metal oxide (MOX) or catalytic combustion (CC) chemical sensors, TC sensors rely on a physical principle, making them immune to sensor poisoning and high offset drift, resulting in greater reliability.

Features

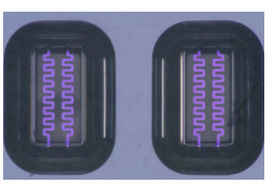
- AEC-Q100 up to 105°C
- Fast response time < 5 s
- Ultralow current consumption
- Robust and proven packages
- Lifetime of 15 years with low drift
- Autonomous operating mode for system level power saving UL-60335-2-40/89 recognition (construction review)

Benefits

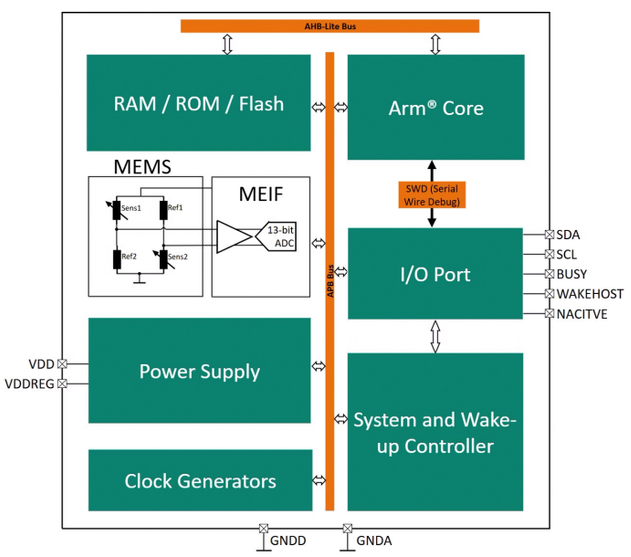
- No maintenance or replacement costs
- Robustness and stability compared to catalytic- or metal-oxide-sensors
- Low power mode can be enabled by customer

Potential applications

- Refrigerant leakage detection in automotive HVACs
- Refrigerant leakage detection in commercial, residential HVACs and heat pumps



Block diagram



TCI-R product overview

Product	Accuracy	Interfaces	Supply voltage	Detection range
TCI-R	±2.5% LFL (nominal) ±5% LFL (extreme)	I²C	3.3 V	0-25% LFL

Click here to learn more:
www.infineon.com/gas-sensors

ISO 26262 – Functional Safety (FuSa)

Dependable electronics based on Functional Safety

Automotive Functional Safety – we simplify the process of integrating safety features with our safety guidelines and services.

Infineon provides dependable electronics to support today's safety-relevant systems and future fail-operational solutions, serving as essential components that allow customers to meet their safety requirements at the application level. Highly integrated systems equipped with reliable electronic semiconductors play a crucial role in key application areas like connectivity, electromobility, and advanced levels of automated driving. The ISO 26262 standard establishes requirements and provides guidance for integrating products into automotive safety applications.

Discover Infineon's products with ISO 26262 classification

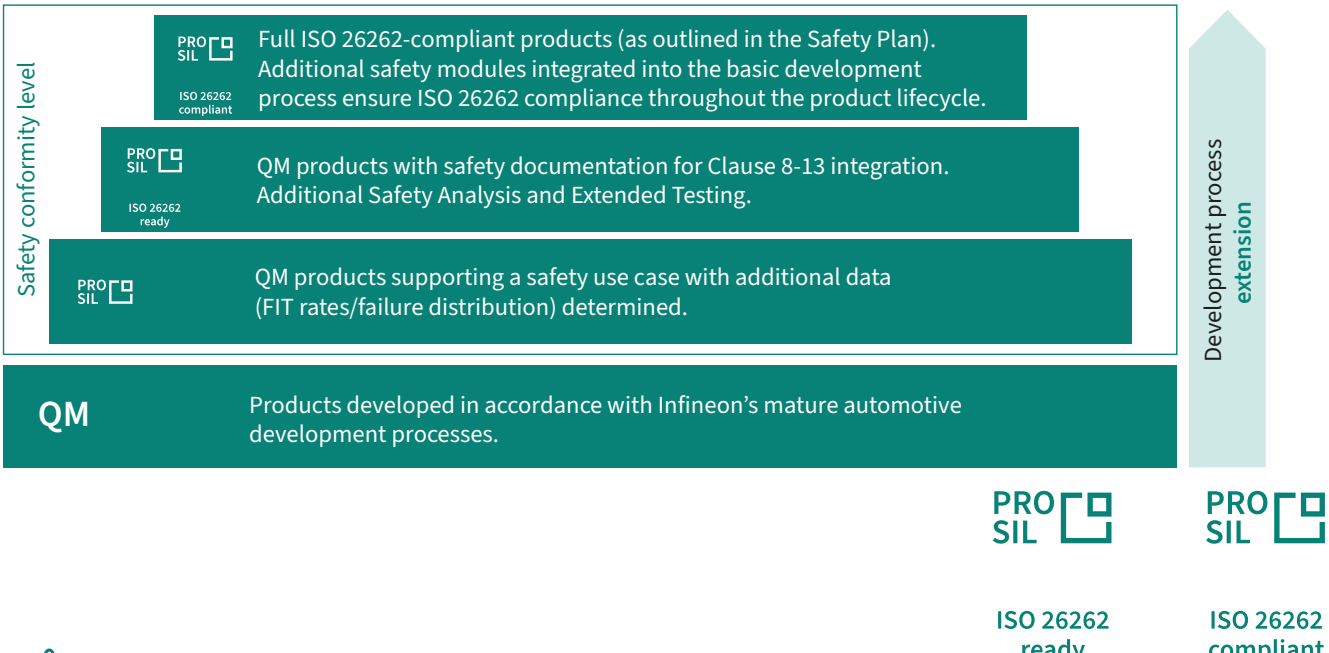
With our holistic approach to functional safety, Infineon is addressing the increased complexity and stringent requirements that make functional safety projects costly and time-consuming. We provide the necessary products, including documentation and supporting information, to ease integration and reduce efforts for system integrators.

Benefit from:

- Innovative solutions for automotive safety-related applications
- Improved time-to-market through comprehensive safety documentation for ISO 26262-compliant products
- Reduced integrators' efforts with ISO 26262-compliant and ready-to-use products
- A broad portfolio of ISO 26262-compliant products already available
- Newly developed automotive parts that will primarily follow an ISO 26262-compliant development flow

Safety conformity levels:

- PRO-SIL™ ISO 26262-compliant devices meet all relevant requirements for semiconductors as defined in the ISO 26262 series of standards for automotive functional safety
- The PRO-SIL™ ISO 26262-ready marking designates QM devices that can be integrated into a safety-related application by utilizing the ISO 26262:2018 Clause 8-13, Class II hardware evaluation framework
- The Infineon Automotive Ensured Compliance process framework was certified by SGS-TÜV Saar for compliance with ISO 26262:2018 as of April 2022. This certification reinforces our commitment to automotive functional safety



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Dependability is the key driver for the megatrend towards autonomous driving

The future car will be fully connected and always online. It will be all-electric and autonomous. At Infineon, we believe that realizing this vision requires both technology and trust.

The growing demand for safe electronic systems in vehicles that drivers and passengers can rely on lays the foundation for trust and drives progress toward higher levels of automated driving.

Earning the trust of tomorrow's passengers begins with dependable electronics that enable highly available, reliable, robust, safe, and secure systems, capable of operating in all conditions.

Infineon is your trusted partner, offering all the essential components for your dependable systems – automotive quality, functional safety, cybersecurity, innovative products, system expertise, and operational excellence.

Dependable electronics for safer, smarter vehicles

As vehicles become increasingly reliant on electronic components, demand for safe, reliable systems continues to grow. Rising levels of automated driving especially depend on drivers' and passengers' trust in the quality and reliability of each component. The complexity and requirements in the automotive industry are expected to increase further, particularly in terms of quality and dependability, to ensure vehicles operate safely and smoothly throughout their 15-year lifespan.

Infineon's commitment to delivering high-quality, dependable products has resulted in a portfolio that offers superior performance and unmatched durability, driven by our zero-defect mentality. We go beyond industry standards to meet the real-world requirements of applications.

Enhance your automotive systems and applications with our high-quality semiconductor components designed for your needs.

Dependable electronics based on quality
Automotive quality beyond the standards with a zero-defect mindset.
Vehicle complexity and functionality will continue to grow, driving the need for dependable electronics, with quality being one of its key ingredients. Our passion for quality creates a product portfolio that meets high standards and delivers highly reliable, robust products.

How Infineon differentiates as a quality leader:

1. Our goal is to go beyond standards to better meet real application requirements: from intensive screening methods to detect production defects, to advanced AEC Q100/101 tests (where required), to sub-1 dpm validation aimed at achieving ultralow defect rates.
2. Our track record of achievements, including multiple quality awards from customers such as Toyota (Honor Quality Award in 2020) and Continental (Supplier of the Year in 2019), demonstrates that we consistently meet and exceed outstanding quality targets in the automotive industry.
3. Infineon offers best-in-class customer service, supported by a regional network of failure analysis labs, strong localized expertise, technical training programs, and state-of-the-art regional quality analysis labs equipped for advanced failure analysis.
4. We meet customer needs through industry-leading product requirements, design, manufacturing, and testing practices. Quality is integrated into our development processes (e.g., RDDF), design rules (e.g., ADeGo), materials, manufacturing processes, process controls, proprietary testing, and screening methods.

Infineon's Zero Defect mentality is built upon:

- Producing 24/7/365 at sub-dpm levels: Translated into a year's timeline, this means we deliver zero defects for all but the last three seconds of the year.
- Delivering sub-ppm quality levels.
- Achieving Zero Defect status for 90 percent of our products.

We go beyond the standards to better meet real application requirements.

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Infineon support for sensors

Useful links and helpful information

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Infineon customized solutions

Your specific needs, realized

A customized solution (commonly known in the industry as an ASIC — Application Specific IC, or CSP — Customer Specific Product) is designed, planned, developed, and used for a specific purpose. Its mission is to be optimized and efficient, with all the required functionalities and features for a specific application for a single customer.

Infineon as your one-stop-shop from design to delivery

Infineon, as a market leader in customized solutions, believes innovation comes through collaboration and exploring new paths. Working closely with our customers, understanding their needs, and combining their needs with our cutting-edge solutions, we know there is always a benefit for every customer and application. Whether the challenge is related to IP or BOM constraints or requires higher integration, an ASIC can be the solution. Furthermore, customers benefit from Infineon's trusted quality, supply guarantee, and experience, combined with additional advantages such as IP protection and a well-established partner network.

Click here to learn more:
www.infineon.com/asic

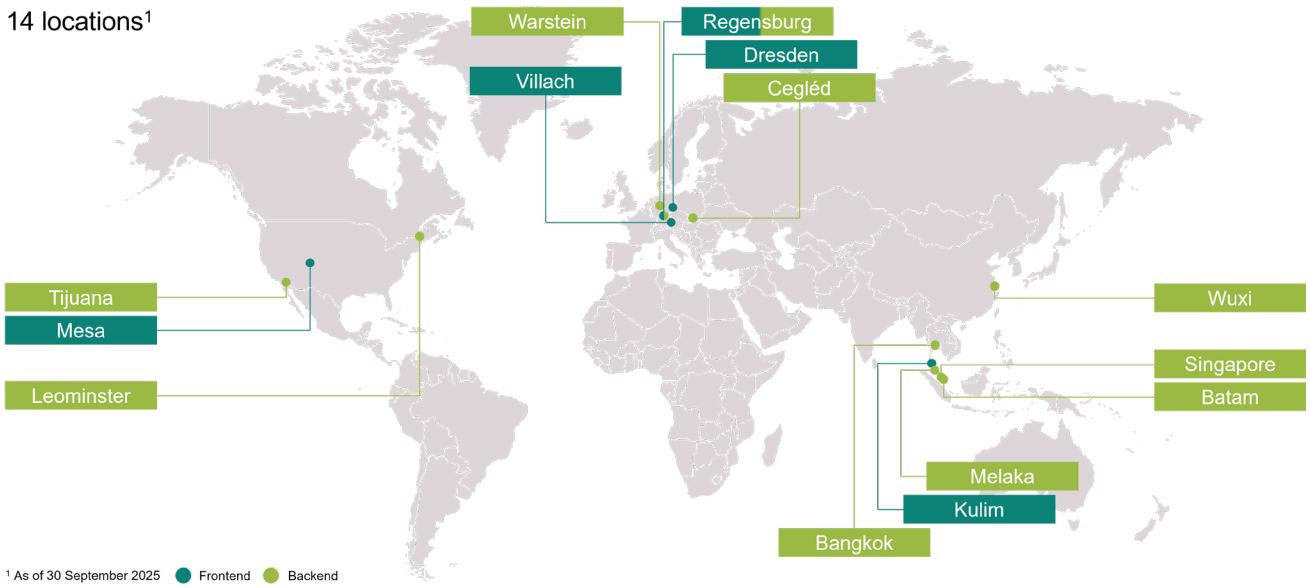
A process streamlined through efficiency, expertise, and experience

The journey starts with you and a focus on feasibility – we match your needs early on with our 40 years of expertise in building world-class, industry-leading semiconductors and ensure the successful implementation of your requirements.

From technology advantage to supply stability

Whether it is digital, analog, or mixed-signal devices, an embedded processor, or integrated sensors, we have the experience and product know-how. Being one of the largest semiconductor companies, we also have a vast array of IPs. We can integrate almost anything into your chip from our wide variety of sensors, discrete devices, drivers, and many more, including support for higher voltage levels. Our in-house fabrication facilities and design centers around the globe are known for the highest quality standards. We also have well-established partnerships with all major silicon foundries and assembly test fabs to complement our in-house technologies. At every step along the way, we take pride in the highest quality Infineon is known for.

If you are interested and would like to find out further information, visit **www.infineon.com/asic**



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The Infineon Partner Program

Together we create and innovate for our customers' success

Find solutions from our partners to accelerate your next business opportunity. Infineon's global network of partners is an expert in designing products, solutions, and services leveraging Infineon components in 5 key domains: software, hardware, services, tools, and end applications.

The Infineon Partner Program is a global ecosystem of qualified companies, offering knowledge and experience to enable and implement Infineon products. Our associated, preferred, and premium partners help design your device and application based on our components. They have been carefully selected by us on the basis of their competence and ability to design and deliver strong and trustworthy solutions, especially for new technologies and use cases.

Hardware	Software	Tools	Services	End applications
Partners manufacturing electronic components, demo boards, and turnkey modules	Partners programming various types of software, algorithms, and operating systems	Partners designing computer programs for the development of embedded systems	Partners providing cloud and engineering services, application support or trainings	Partners creating end products and related applications
... jointly we create and commercialize value-added solutions, while reaching new buyers	... jointly we enhance our portfolio with complementary components and expand technology know-how	... jointly we enable a complete and immersive development experience for customers	... jointly we build up engineering capabilities and offer them to a world class customer network	... jointly we provide customers with state-of-the-art solutions and innovative use cases

Find out more about the Infineon Partner Program, the latest news and solutions from our partners, and much more on our Partner ecosystems webpage.

Looking for a specific partner solution in your region? Our partner finder provides an overview of our partners and their offerings. Simply specify your search in the dropdown menu and browse through the companies and their solutions to navigate directly to the respective website for further information.

Additionally, use the "Partner solutions" tab on our product and application pages to find out more about Infineon's partner solutions.

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