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# Automotive application guide

We make cars clean, safe and smart.



[www.infineon.com/automotive](http://www.infineon.com/automotive)



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# We make cars clean, safe and smart.

Infineon Technologies is a leading player and pioneer in automotive electronics. Our enduring success in this field is due to a clear strategic focus on automotive applications and standards, along with the understanding and insights that have emerged from over 40 years of dedicated experience and our ability to continually innovate this market with a broad portfolio of outstanding quality. Our sensors, microcontrollers and power semiconductors help automotive manufacturers achieve their increasingly challenging safety, affordability and efficiency targets. Above all, we are helping to create more sustainable mobility choices by lowering emissions and fuel consumption.

## Paving the way for more sustainable mobility choices

In an increasingly mobile society, carbon dioxide emissions are rising and fossil fuel reserves are dwindling. The automotive industry faces the challenge of powering today's mobile lifestyle while simultaneously reducing its carbon footprint. Electronic components play a key role in increasing energy efficiency.

The demand for alternative, more energy-efficient forms of mobility is increasingly geared toward electromobility. Drivetrain electrification, whether in hybrid electric vehicles or – ultimately – fully electric vehicles, has the advantages of higher energy efficiency and zero tailpipe emissions. As the world leader in automotive and advanced power electronics, with over ten years of experience in electromobility, Infineon delivers a broad suite of best-in-class microcontrollers, power semiconductors and sensors that are helping to solve today's electromobility challenges.

As we transition toward greater electromobility, Infineon is also working with leading car manufacturers and system suppliers to improve the energy efficiency of combustion engines and the various subsystems in today's vehicles. We offer a range of dedicated products and solutions targeting hotspots such as demand-driven accessories, energy management and electric power distribution. These solutions embody Infineon's commitment to the exceptional quality and reliability that the world's leading vehicle manufacturers expect.

## Reducing road fatalities

New Car Assessment Programs (NCAP) and governments all over the world have set ambitious road fatality reduction targets. The automotive industry actively contributes to road safety by developing and evolving technologies that reduce the likelihood or impact of accidents, for example by improving of reactive airbag and stability control systems. Similarly, new active safety features include adaptive cruise control and lane departure warning, where the vehicle acts proactively before a crash occurs.

Infineon is continuously optimizing the chipsets that enable the safety features designed to reduce the number of road accidents. With the most rigorous Euro NCAP in mind, we lead the field in many safety innovations for passive, active and preventive safety systems, such as RADAR technologies.

## Complying with functional safety requirements

The increasing number of electronic systems leads to ever more considerations regarding the functional safety of vehicle systems. Infineon has adopted the ISO Standard 26262 for designing the appropriate products but also for setting up the appropriate processes for the development of such products.

## Meeting increased data security demands

As system complexity increases in cars, so too does the volume of data to be processed and distributed. Auto-makers therefore need to ensure that information is processed securely and protected against external access and manipulation (e.g. car tuning or counterfeit spare parts). Furthermore, new payment methods, such as parking fees or road tolls, require a secure flow of transaction data. Infineon can draw on years of expertise in chip card and identification systems to propel automotive data security to the next level.



# Safety applications

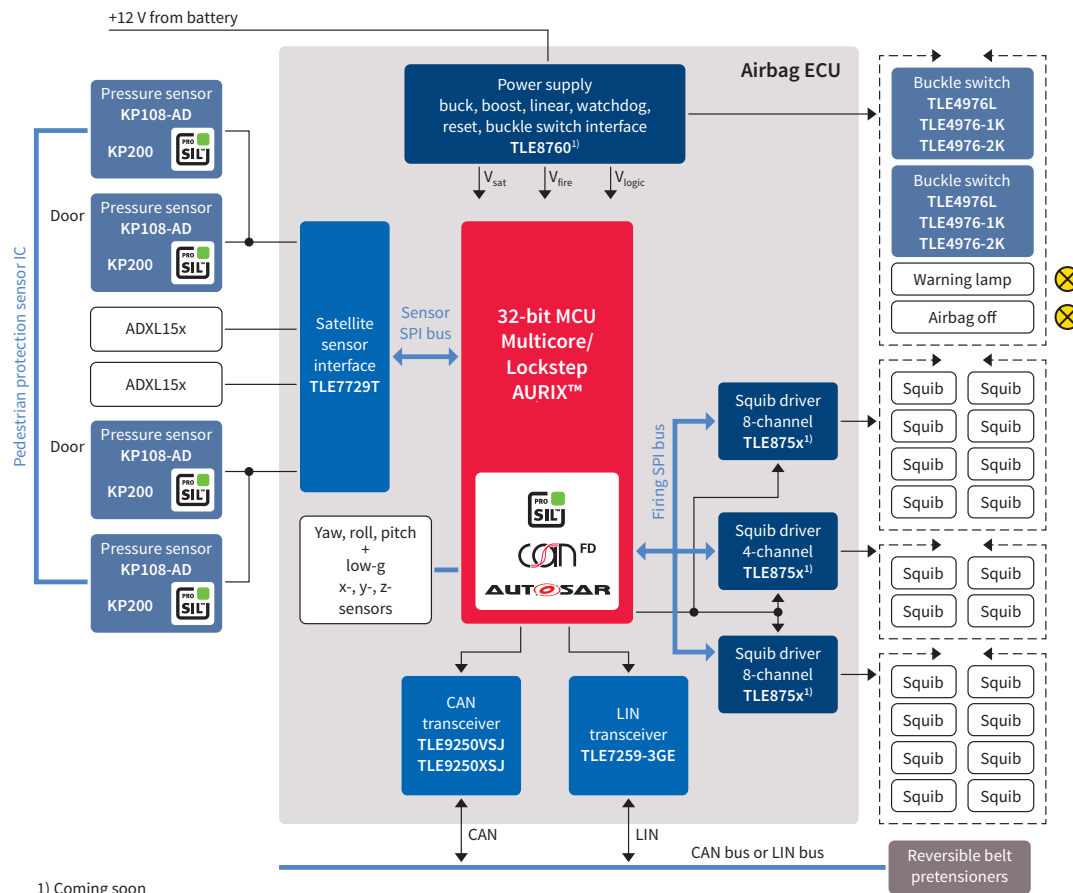
Both customer demands and government legislation continue to improve traffic safety. Electric and electronic safety systems play a key role in this trend. Electric power steering is a good example of how a safety application perfectly combines improved fuel efficiency with enhanced comfort.

Infineon is the broadest supplier with a portfolio extending from intelligent sensors and microcontrollers through automotive power standard products and Application-Specific Standard Products (ASSPs) to highly integrated customized Application-Specific ICs (ASICs). This comprehensive product portfolio – combined with our application expertise gained during four decades of activity in the automotive industry – positions us ideally to help customers overcome their key challenges. These include ongoing application optimization plus the implementation of new features to meet stringent safety requirements. The ISO 26262 safety standard is one example of the exacting standards that apply today.

To help customers to reach the desired Automotive Safety Integrity Level (ASIL) certification, Infineon has already introduced its own PRO-SIL™ concept. This trademark clearly identifies the products which contain “SIL-supporting” features. The Infineon PRO-SIL™ concept includes safety-focused organization and business processes for the generation of hardware and software safety features, including safety documentation.

The functional complexity and levels of integration of real-time safety-critical applications continue to increase exponentially. In addition, the product life cycle of these applications has to meet stringent safety standards. The ISO 26262 mandates more robust and comprehensive product development processes and functional safety concepts in automotive applications.

# Airbag system



## System benefits

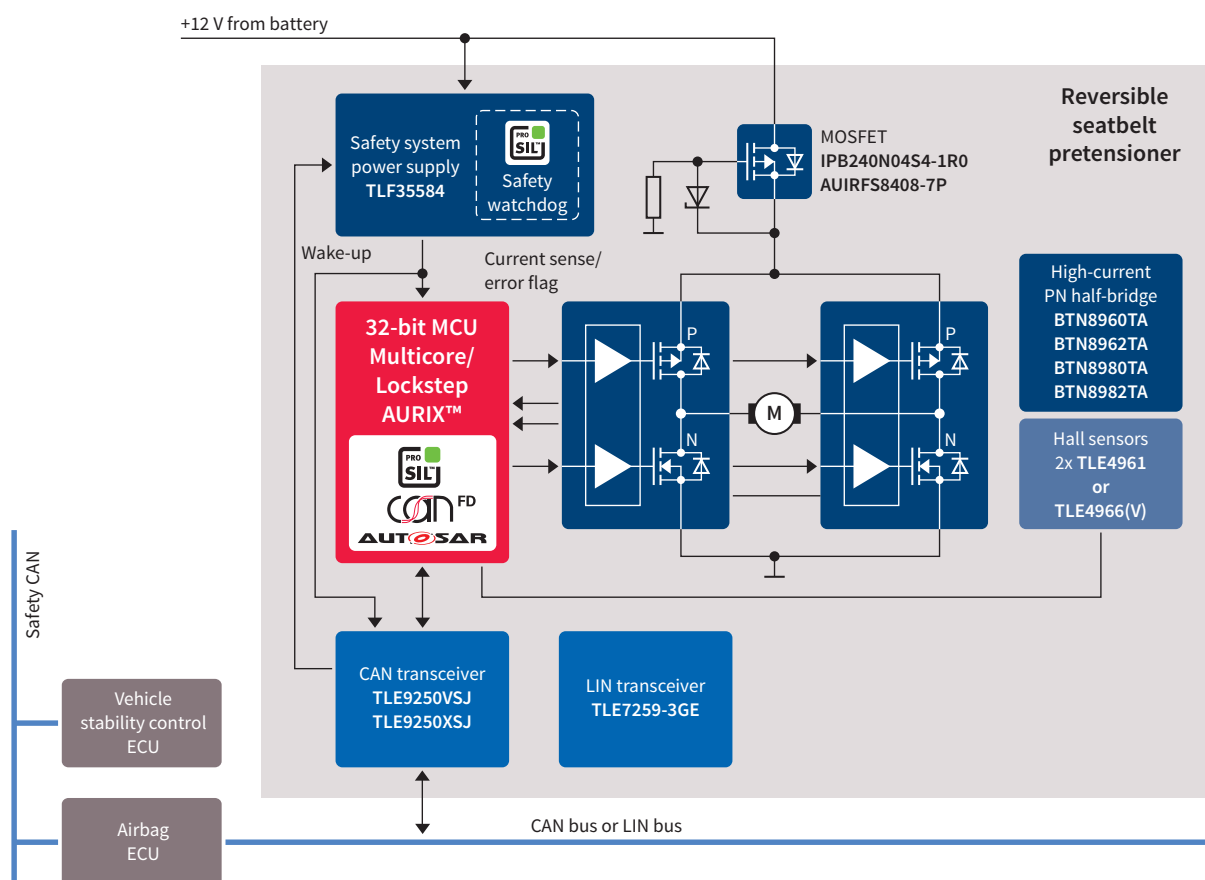
- > Airbag systems are standard in most cars and are mandatory equipment in many countries, saving thousands of lives
- > Infineon’s broad product spectrum supports scalability and flexibility for building systems from 4 to over 20 firing loops
- > Full range of airbag ASSPs ranging from pressure sensors for side crash detection to driver and transceiver ICs
- > High-performance 32-bit AURIX™ MCU family with dedicated safety features enables the integration of multiple functions
- > The parts are optimized in terms of both system interoperability and the best price-performance ratio
- > These systems are mandatory in order to achieve the highest possible scores in the various “New Car Assessment Programs” (NCAP) throughout the world and are even required by law in some countries

## Suggested products



Product name	Description
AURIX™	High-performance 32-bit multicore microcontroller family (PRO-SIL™)
TLE8754/8758	Airbag deployment ASSPs
TLE7729	Airbag satellite receiver
TLE9250VSJ/XSJ	CAN transceivers
TLE7259-3GE	LIN transceiver
KP108	Application-specific sensor for side airbag pressure sensing
KP200	Application-specific sensor for side airbag pressure sensing; fully PSIS-compliant (PRO-SIL™)
KP201	Application-specific sensor for pedestrian protection sensing (PRO-SIL™)
TLE4976	Hall switches for buckle switch application

# Reversible seatbelt pretensioner



## System benefits

- › Seatbelts are still the primary safety feature for protecting car passengers from severe harm
- › Correct belt tension before a crash reduces the severity of injuries while also increasing passenger comfort during normal use
- › Safety experts predict that reversible seatbelt pretensioners will become mainstream in the future
- › The illustration shows the partitioning of an Infineon system solution for this application which includes supply, microcontroller, sensor, power and communication ICs

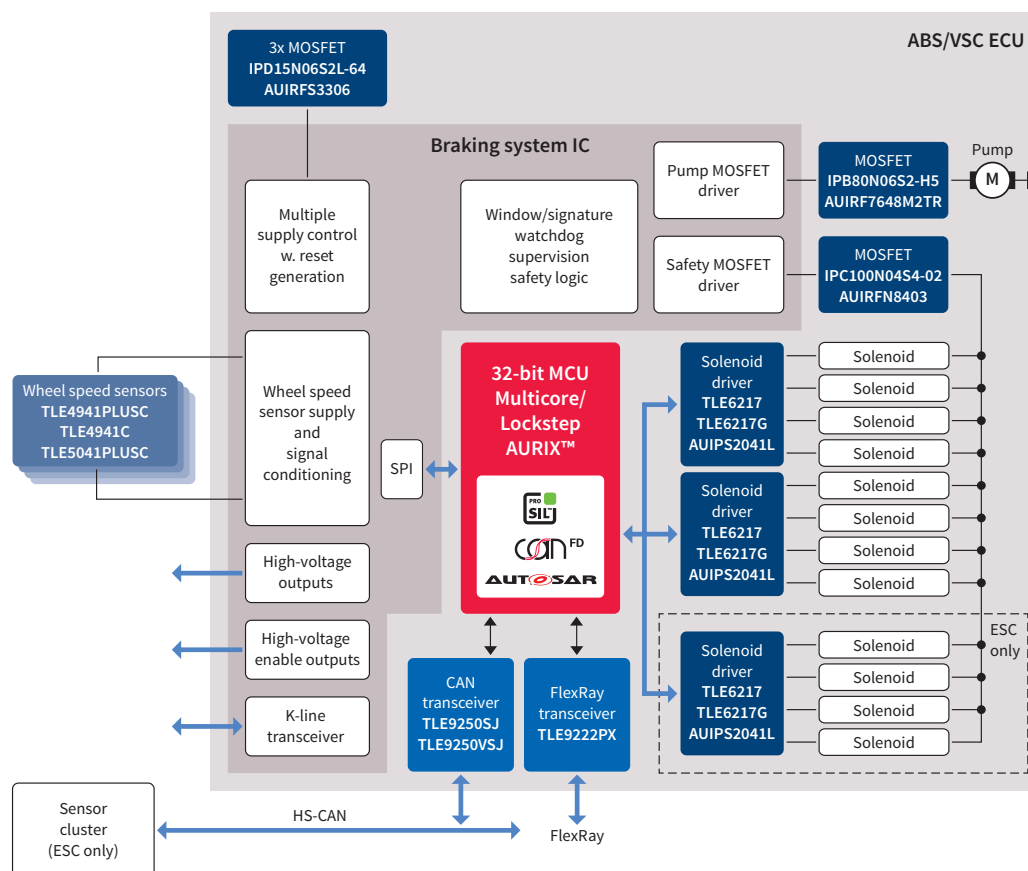
## Suggested products



Product name	Description
AURIX™	High-performance 32-bit multicore microcontroller family (PRO-SIL™)
TLF35584	System power supply with integrated watchdog (PRO-SIL™)
TLE9250VSJ/XSJ	CAN transceivers
TLE7259-3GE	LIN transceiver
TLE4961/TLE4966(V)	Hall switches for position/rotation sensing and rotor index counting
BTN89xx	High-current PN half-bridge ICs



# Brake Vehicle Stability Control (VSC)



## System benefits

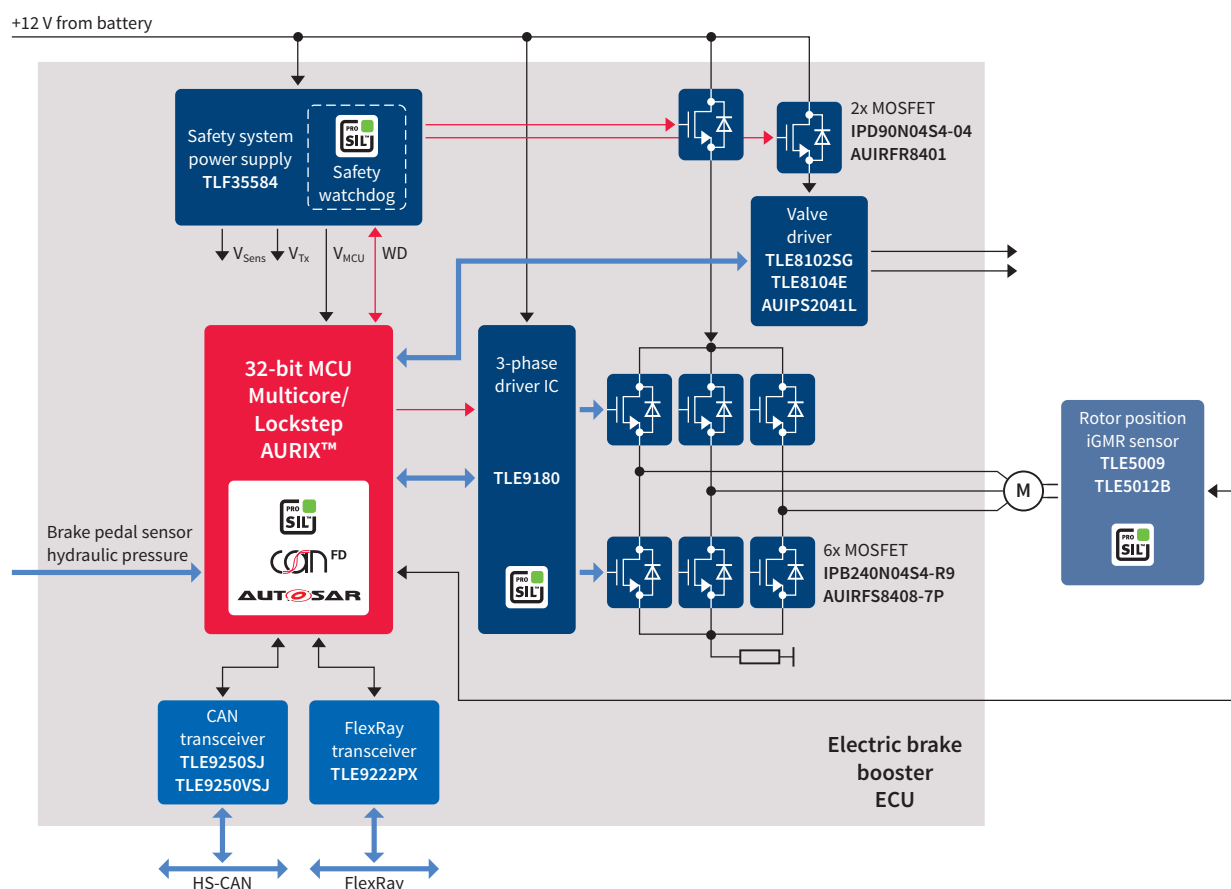
- › Vehicle stability control systems can be found in all car classes on our roads, providing safety while reducing braking distances and keeping the car under control in critical situations
- › These systems are mandatory in order to achieve the highest possible scores in the various “New Car Assessment Programs” (NCAP) throughout the world and are even required by law in some countries
- › Infineon’s range of products for braking systems stretches from scalable microcontrollers, state-of-the-art wheel speed sensors, CAN and FlexRay transceivers to MOSFETs and valve drivers

## Suggested products



Product name	Description
AURIX™	High-performance 32-bit multicore microcontroller family (PRO-SIL™)
TLE9250SJ/VSJ	CAN transceivers
TLE6217	Quad solenoid driver
IPD60Nxxx	OptiMOS™ N-Channel MOSFET family
TLE4941/42, TLE5041	Wheel speed sensors
TLE425x/TLS1xx	Linear voltage trackers for supplying sensors

# Electric brake booster



## System benefits

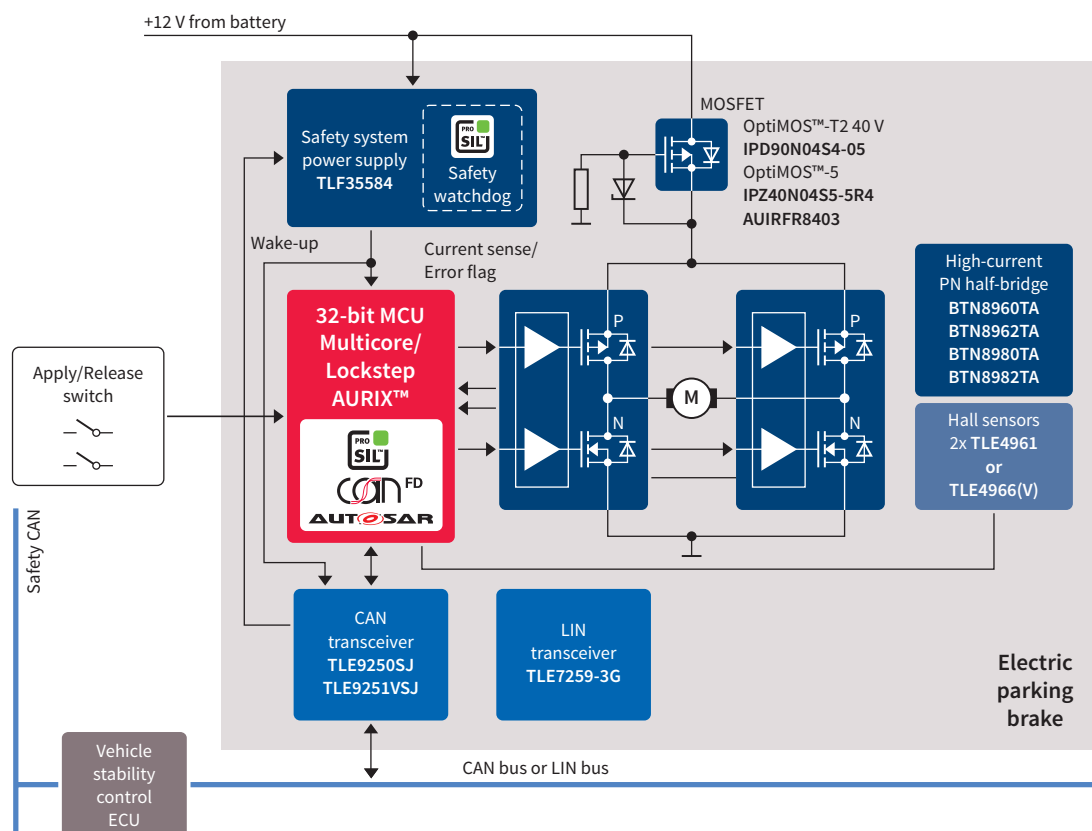
- > Next-generation drivetrains, such as hybrid and electric vehicles and even contemporary highly efficient combustion engines, require a new braking assistance system
- > Current systems are mainly dependent on vacuums generated by the combustion engine or vacuum pumps, which use up electrical energy as well as package space under the hood and are not flexible enough for the driver assistance systems of tomorrow
- > The above illustration shows the new concept of a fully electric brake booster, incorporating vehicle stability control functionality with an efficient and flexible design

## Suggested products



Product name	Description
AURIX™	High-performance 32-bit multicore microcontroller family (PRO-SIL™)
TLF35584	System power supply with integrated watchdog (PRO-SIL™)
TLE9180	3-phase bridge driver IC for automotive safety applications (PRO-SIL™)
TLE9250SJ/VSJ	CAN transceivers
TLE9222PX	FlexRay transceiver
IPB180N04S401 AUIRFR8401	OptiMOS™-T 40 V N-Channel MOSFET family, optimized for EPS applications
TLE499x	Linear Hall sensor family for torque and current sensing
TLE5009/12	iGMR sensors for rotor position sensing
TLE425x/TLS1xx	Linear voltage trackers for supplying sensors

# Electric parking brake



## System benefits

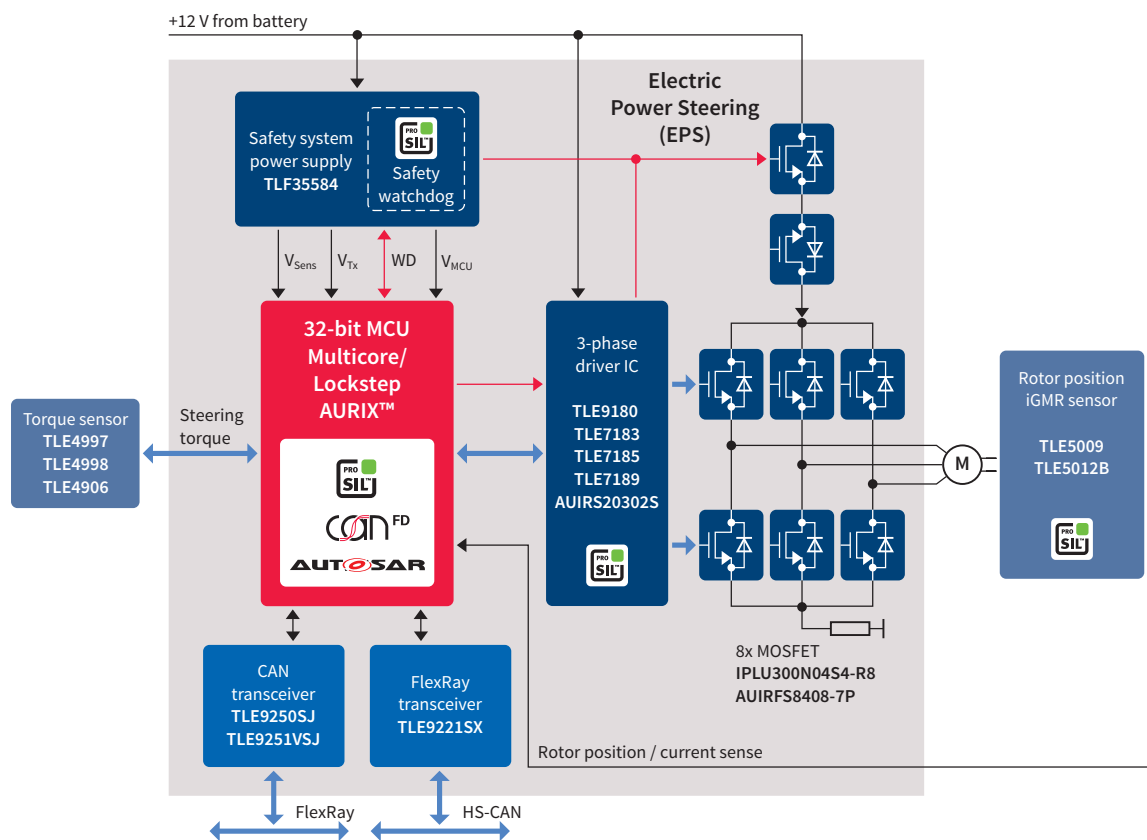
- › The electric parking brake provides drivers with many more comfort and convenience features than the standard mechanical system
- › Hill hold, launch control and roll-away prevention are all possible
- › These convenience features are in many cases safety-relevant and should therefore be implemented using safety-compliant hardware (according ISO 26262)

## Suggested products



Product name	Description
AURIX™	High-performance 32-bit multicore microcontroller family (PRO-SIL™)
TLF35584	System power supply with integrated watchdog (PRO-SIL™)
TLE9250SJ/TLE9251VSJ	CAN transceivers
TLE7259-3G	LIN transceiver
TLE4961/TLE4966(V)	Hall switches for position/rotation sensing and rotor index counting
BTN89xx	High-current PN half-bridge ICs
TLE425x/TLS1xx	Linear voltage trackers for supplying sensors

# Electric Power Steering (EPS)



## System benefits

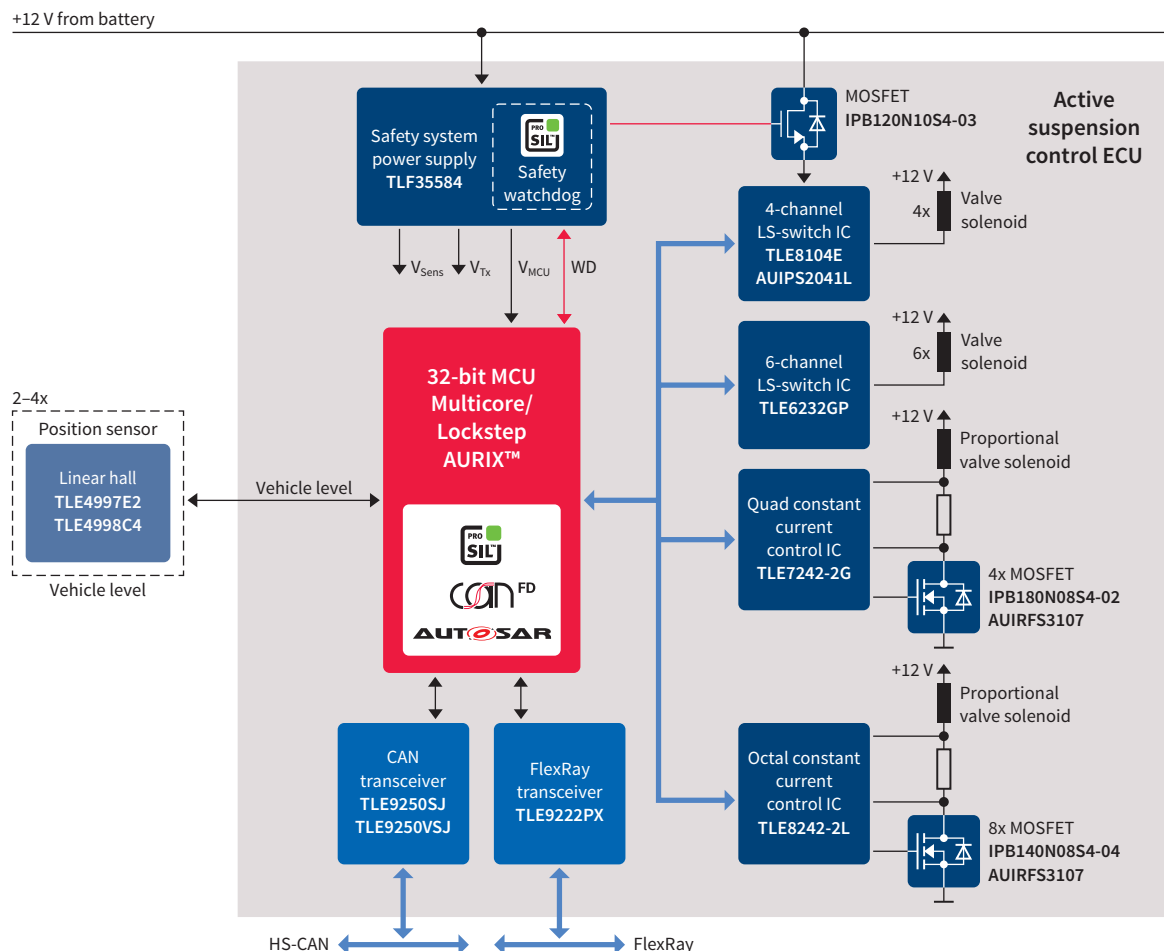
- › Electric Power Steering (EPS) improves fuel efficiency by approximately 3 percent, while also having a positive impact on car handling, the overall driving experience and comfort
- › It combines a compact design with reduced mounting costs
- › EPS can be adapted via software to suit diverse car models as well as dedicated driving modes
- › EPS is the steering technology needed to enable advanced driver assistance systems such as side-wind compensation, lane assist/keeping and parking assistance systems
- › Infineon has over ten years of experience in this exciting application and provides the full range of ICs, from sensors to microcontrollers, and from bridge drivers to world-class MOSFETs

## Suggested products

Product name	Description
AURIX™	High-performance 32-bit multicore microcontroller family (PRO-SIL™)
TLF35584	System power supply with integrated watchdog (PRO-SIL™)
TLE9180	3-phase bridge driver IC for automotive safety applications (PRO-SIL™)
TLE9250SJ/TLE9251VSJ	CAN transceivers
TLE9221SX	FlexRay transceiver
IPB180N04S4-01	OptiMOS™-T 40 V N-Channel MOSFET family in a TOLL package, optimized for EPS applications
TLE499x	Linear Hall sensor family for torque and current sensing
TLE5009/12	iGMR sensors for rotor position sensing
TLE425x/TLS1xx	Linear voltage trackers for supplying sensors



# Active suspension control system



## System benefits

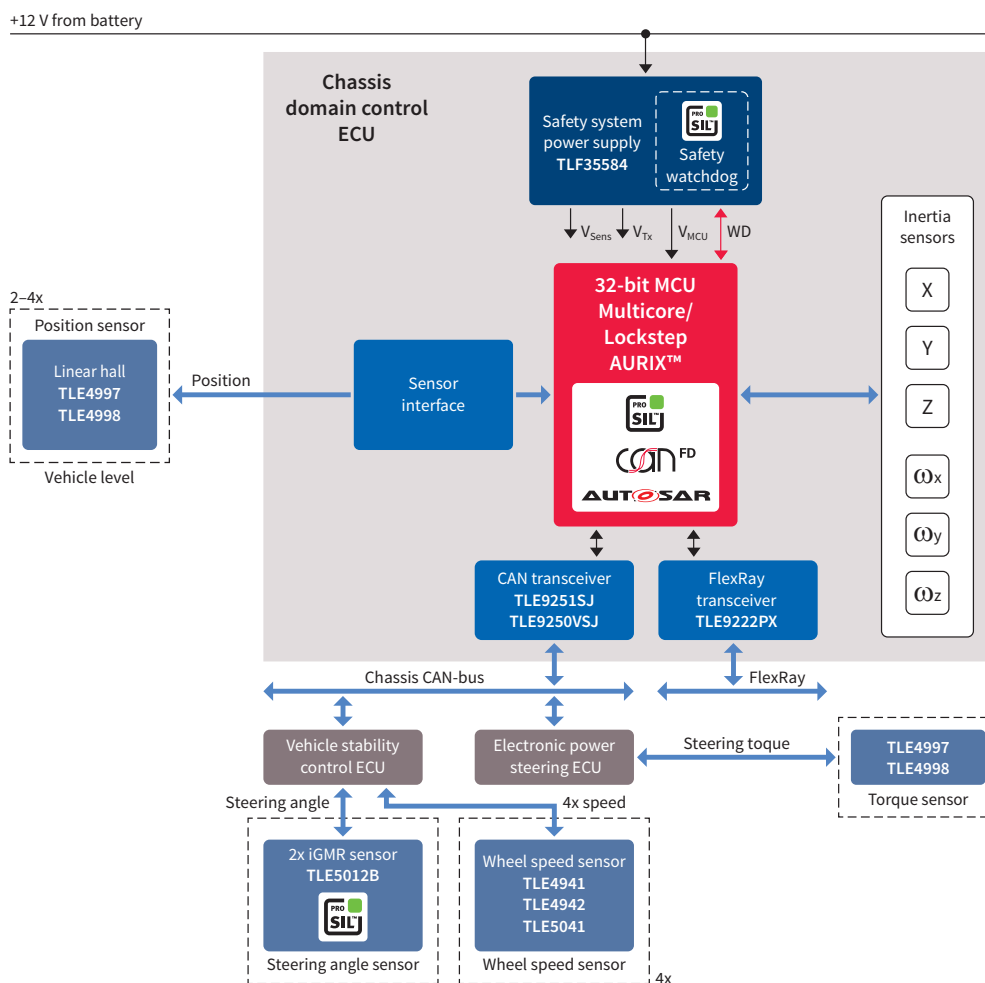
- Advanced suspension systems originally used in high-end sports and luxury cars are now prevalent in the mid-market car segment
- By adapting both the vehicle's leveling and damping characteristics, these systems significantly improve car comfort, handling performance and driving safety
- Infineon's broad product spectrum – including high-end 32-bit microcontrollers as well as multi-channel drivers for bistable and analog valves – covers the full range of suspension systems, ranging from car/load leveling, semi-active to active suspension and air-suspension systems

## Suggested products

Product name	Description
AURIX™	High-performance 32-bit multicore microcontroller family (PRO-SIL™)
TLF35584	System power supply with integrated watchdog (PRO-SIL™)
TLE6232GP	6-channel low-side switch IC
TLE8104E	4-channel low-side switch IC
TLE7242G	Quad constant current pre-driver IC
TLE9250SJ/VSJ	CAN transceivers
TLE9222PX	FlexRay transceiver
TLE8242-2L	Octal constant current pre-driver IC
TLE4997/98	Linear Hall sensors for vehicle level sensing
TLS202B1MEV50	Post regulator to supply CAN transceiver
TLE425x/TLS1xx	Linear-voltage trackers for supplying sensors



# Chassis domain control



## System benefits

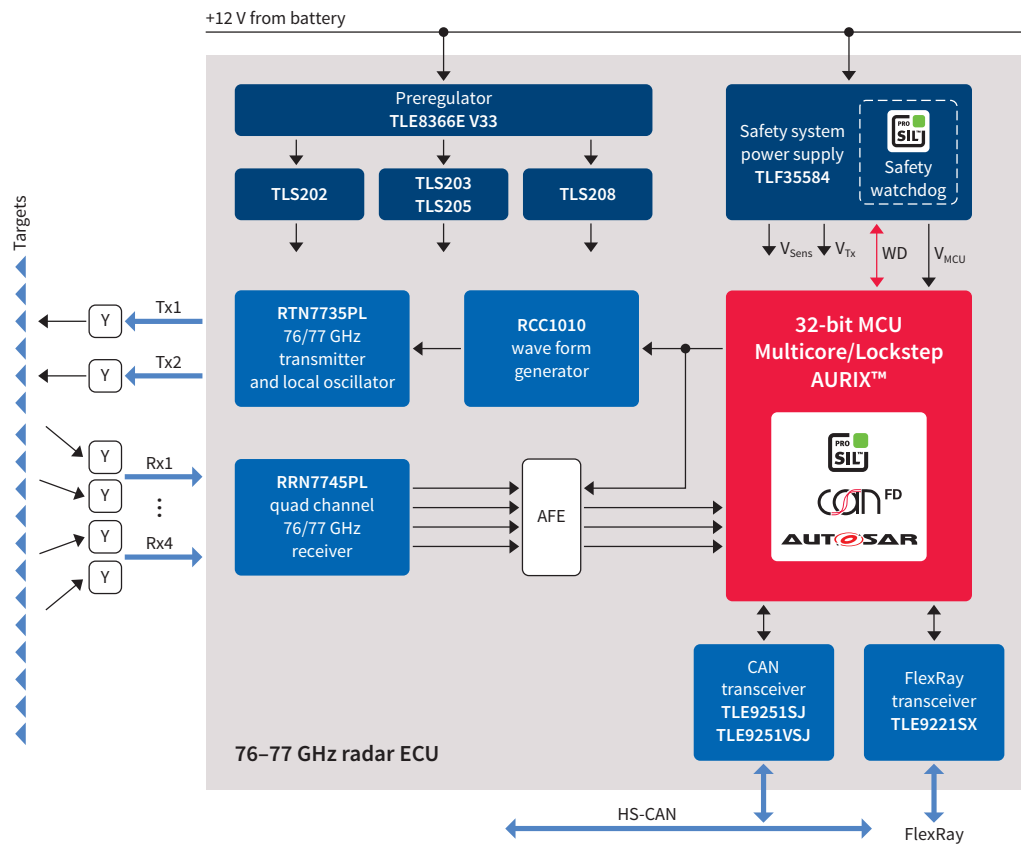
- > The chassis domain control approach provides a high-performance, scalable and safe computing platform which already includes the sensor cluster with all its multi-axle inertia sensors
- > Domain controllers allow a cost-efficient x-check and fusion of the inertia sensor signals, as well as highly efficient and safe computing of the vehicle dynamic model
- > Consequently, the chassis domain control unit represents a promising approach to perfectly coordinating functions such as VSC, semi-active suspension and drivetrain, especially when a four-wheel drive with torque vectoring is required

## Suggested products

Product name	Description
AURIX™	High-performance 32-bit multicore microcontroller family (PRO-SIL™)
TLF35584	System power supply with integrated watchdog (PRO-SIL™)
TLE9251SJ/VSJ	CAN transceivers
TLE9222PX	FlexRay transceiver
TLE5012	iGMR sensor with integrated 8-bit microcontroller
TLE4997/98	Linear Hall sensors
TLS202B1MEV50	DC-DC converter
TLE425x/TLS1xx	Linear-voltage trackers for supplying sensors



# Automotive 77 GHz radar system



## System benefits

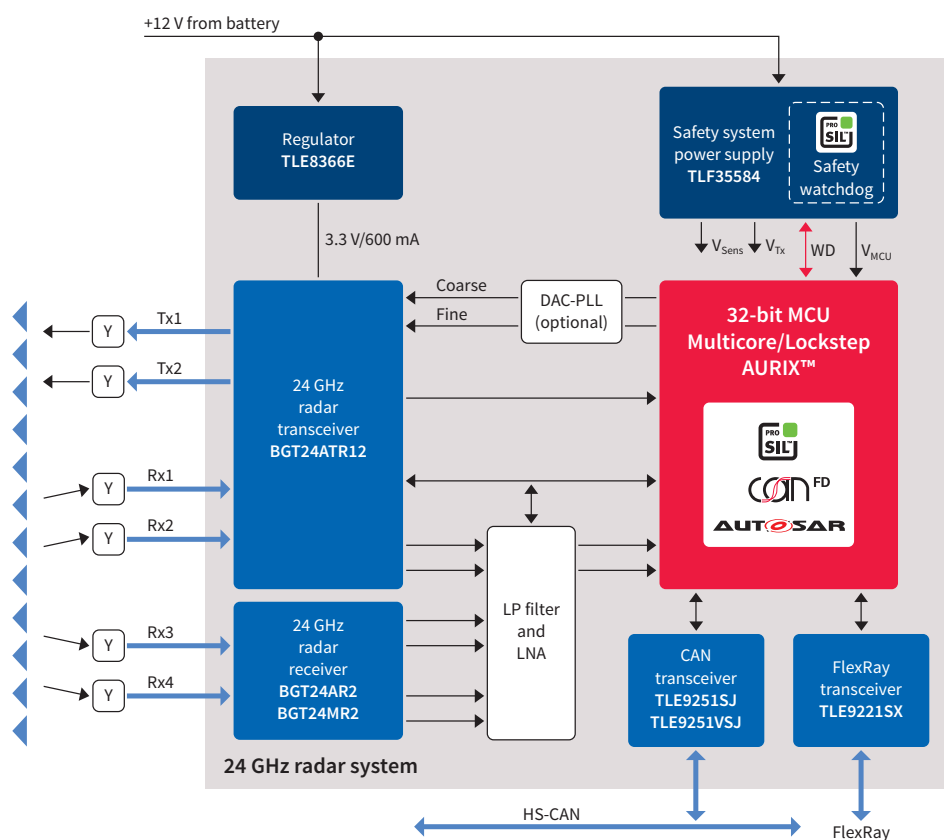
- › Automotive radar sensors are a key technology for enabling future driver assistance functions and securing high ratings in New Car Assessment Programs (NCAP) throughout the world
- › The Radar System IC (RASIC™) series consists of a group of highly integrated functions for the 76–77 GHz range for automotive radar
- › The ICs offer a high level of integration and need only a few – if any – external components
- › Infineon’s SiGe process benefits from its origins in the volume bipolar segment. Its unique features include its high-frequency capability and robustness, making it suitable for automotive environments over the full temperature range up to full automotive qualification according to AEC-Q100
- › Infineon’s AURIX™ 32-bit multicore ADAS derivative offers a dedicated feature set for radar applications which, in many cases, renders additional DSP, external SRAM and external ADC ICs obsolete. This results in cost-efficient short-range radar implementation.

## Suggested products

Product name	Description
AURIX™	Powerful 32-bit multicore microcontroller family with dedicated ADAS features (PRO-SIL™)
TLF35584	System power supply with integrated watchdog (PRO-SIL™)
TLE9251SJ/TLE9251VSJ	CAN transceivers
TLE9221SX	FlexRay transceiver
RTN7730	76/77 GHz radar 2-channel transmitter IC
RRN7740	76/77 GHz radar 4-channel receiver IC
RCC1010	Wave form generator IC
TLS20x	Low noise linear post regulators



# Automotive 24 GHz radar system



## System benefits

- > Infineon's 24 GHz radar technology offers a cost-efficient solution for driver assistance systems such as blind spot detection
- > The Infineon 24 GHz transceiver is a highly integrated, SPI-controlled solution consisting of a VCO, medium-power amplifier, power amplifier, frequency dividers, several sensors and two complete IQ receivers
- > The signal generation unit is a standalone transmitter MMIC with the fully integrated IQ twin-receiver MMIC, in which two complex homodyne down-conversion mixers are combined; a lot of different system architectures can be served by combining the individual components
- > With its SiGe-based technology, Infineon is the first big market player to offer a competitive solution with a long-term roadmap approach for any kind of short-range radar ADAS applications
- > Infineon's AURIX™ 32-bit multicore ADAS derivative offers a dedicated feature set for radar applications which, in many cases, renders additional DSP, external SRAM and external ADC ICs obsolete. This results in cost-efficient short-range radar implementation

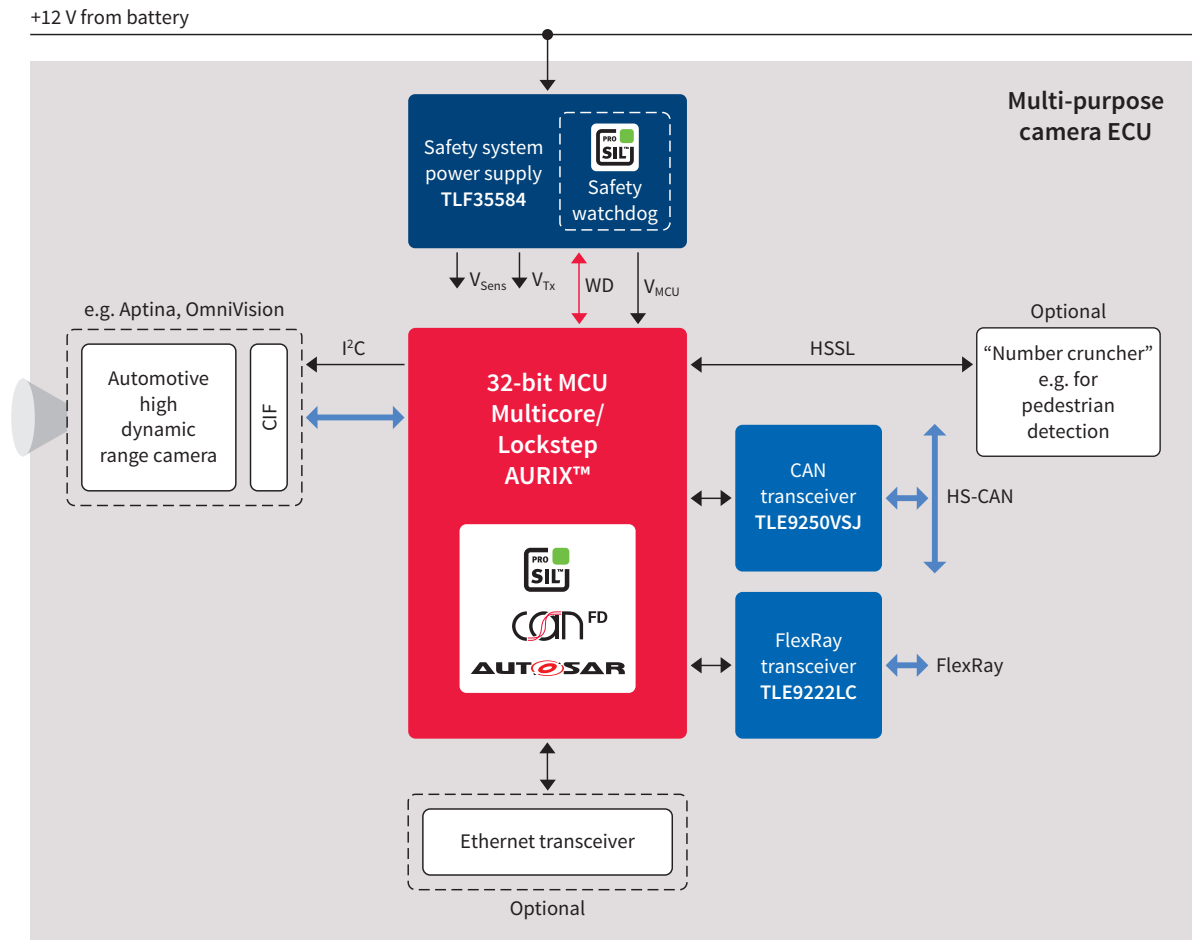
## Suggested products

Product name	Description
AURIX™	Powerful 32-bit multicore microcontroller family with dedicated ADAS features (PRO-SIL™)
TLF35584	System power supply with integrated watchdog (PRO-SIL™)
TLE9251SJ/TLE9251VSJ	CAN transceivers
TLE9221SX	FlexRay transceiver
BTG24AR2	24 GHz radar 2-channel receiver IC
BGT24ATR12	24 GHz radar 1-channel transmitter, 2-channel receiver IC
TLS20x	Low noise linear post regulators





# Multi-purpose camera



## System benefits

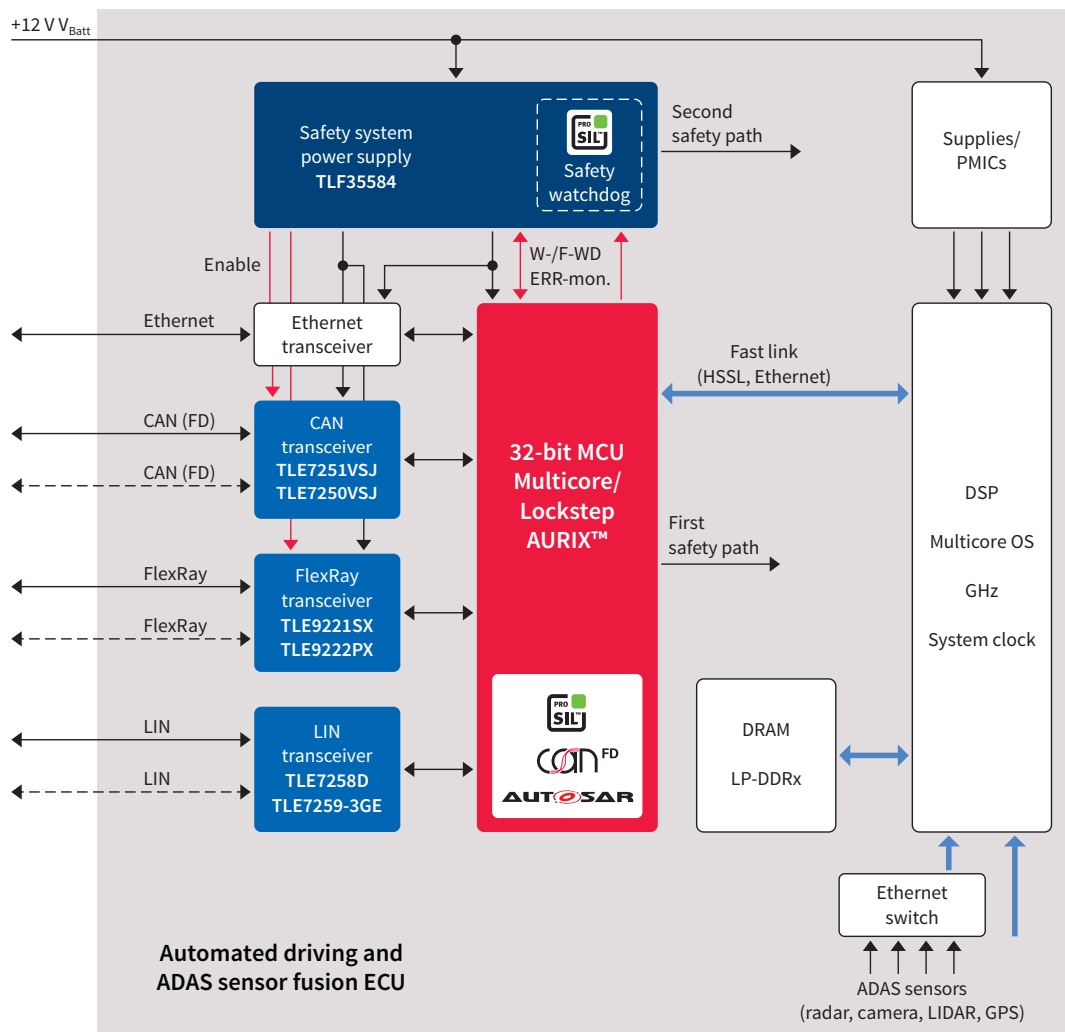
- › The market for automotive cameras is quickly growing, enabling advanced driver assistance functions such as lane departure warning, forward collision warning, along with traffic sign and pedestrian recognition
- › Infineon offers a highly integrated solution to enable compact and efficient camera systems for the next generation of assistance functions
- › This includes ISO 26262 support, innovative supply concepts and best-in-class power consumption
- › AURIX™ multicore architecture includes encapsulation features to support freedom from interference between multiple applications

## Suggested products

Product name	Description
AURIX™	High-performance 32-bit multicore microcontroller family (PRO-SIL™)
TLF35584	System power supply with integrated watchdog (PRO-SIL™)
TLE9250VSJ	CAN transceivers
TLE9222LC	FlexRay transceiver
TLS20x	Low noise linear post regulators



# Sensor fusion



## System benefits

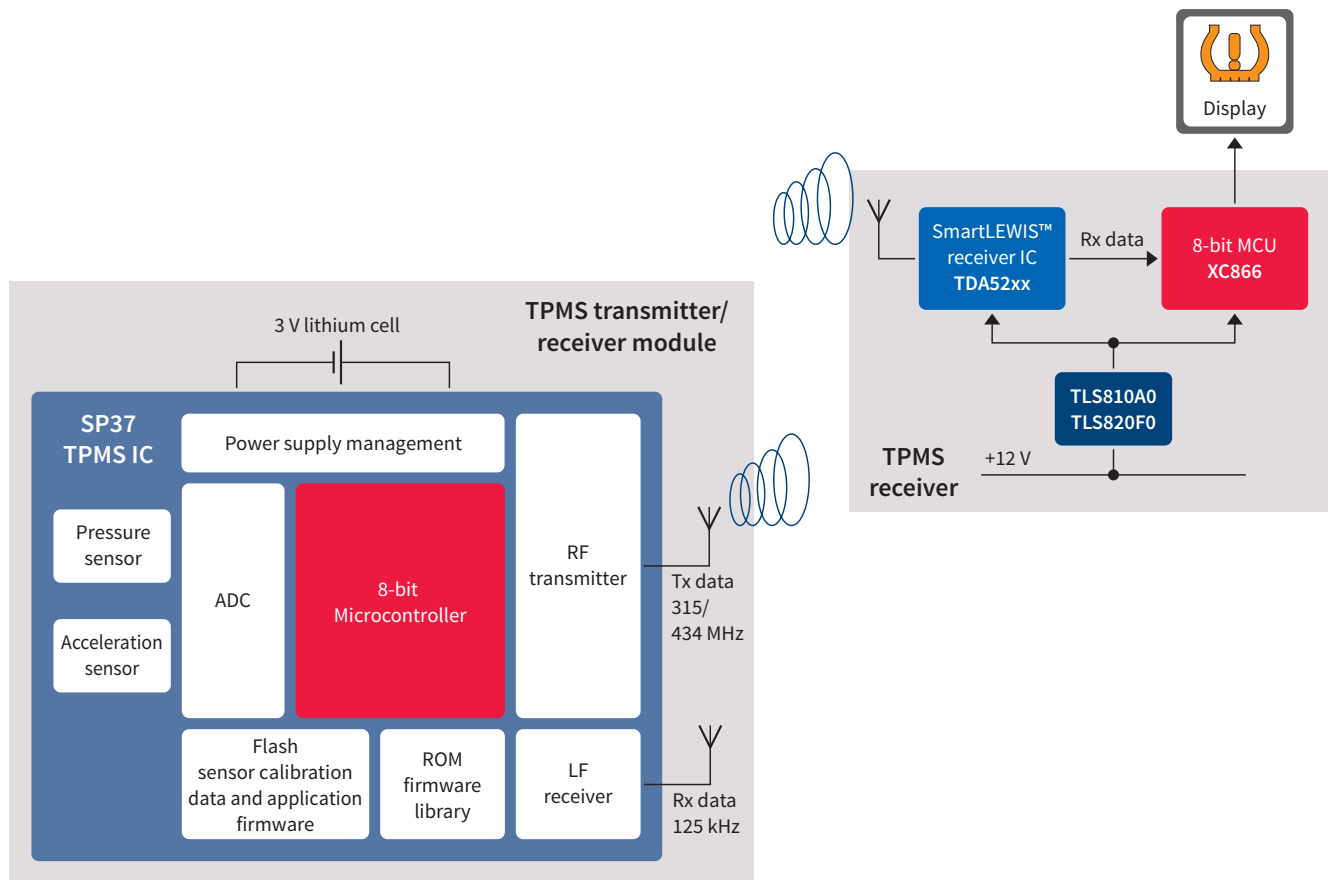
- > Enables the sensor data fusion of several environmental sensors such as radar, camera, ultrasonic and lidar
- > Enhanced ADAS functions, such as cross traffic assist and autonomous obstacle avoidance, require the data from more than one sensor and the corresponding sensor fusion
- > Since the system can make critical, autonomous decisions, safety and security implementation is a must and is supported by Infineon’s high-performance AURIX™ micro-controller
- > AURIX™ combined with the TLF35584 safety power supply and a dedicated processor enables new and enhanced ADAS features

## Suggested products

Product name	Description
AURIX™	High-performance 32-bit multicore microcontroller family (PRO-SIL™)
TLF35584	System power supply with integrated watchdog (PRO-SIL™)
TLE7251	CAN transceiver
TLE9221	FlexRay transceiver
TLE7259	Lin transceiver



# Tire Pressure Monitoring System (TPMS)



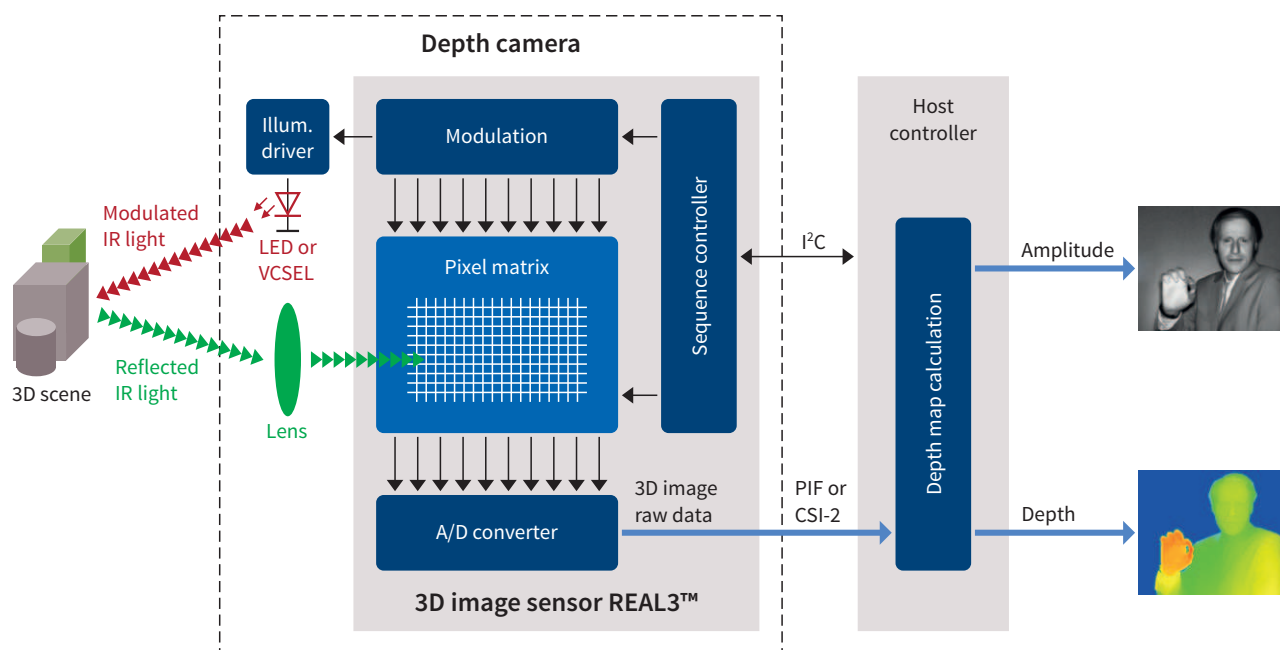
## System benefits

- › TPMS ensures correct tire pressure which is essential for car safety, handling, comfortable driving and tire lifetime
- › Furthermore, accurate tire pressure prevents increased fuel consumption/CO<sub>2</sub> emissions
- › TPMS is already mandatory in the USA, EU and South Korea
- › Infineon’s TPMS IC SP37 provides
  - various surveillance functions ensuring reliable measurements
  - a per-calibrated pressure sensor system for instant use
  - a fully packaged sensor system proven to withstand harsh automotive environments
  - a microcontroller-based architecture that enables flexible system design
  - a high level of integration for reducing the overall system component count
  - an increased tire lifetime by up to 30 percent

## Suggested products

Product name	Description
XC8xx	8-bit microcontroller family with dual-cycle 8051 core
Supply ICs	Linear voltage regulators, DC-DC converters
TDA52xx	SmartLEWIS™ RX autonomous receiver
TDK51xx	Wireless control transmitter
SP37	Highly integrated TPMS with integrated microcontroller and RF transmitter for pressure ranges 450 kPa, 900 kPa, 1300 kPa (trucks)

# In-cabin sensing applications



## System benefits

- > Highly robust 3D data based on the Time-of-Flight principle with an outstanding depth performance and lowest power consumption
- > Reliable in all ambient light conditions – in sunlight, darkness and changing light levels
- > Smallest footprint thanks to single-chip design and monocular 3D camera architecture
  - no baseline between active parts
  - no risk of misalignment, for example through temperature fluctuations or vibrations
  - minimum calibration work
- > Reduced computing time, regardless of the color, pattern and structure of objects

## Suggested products

Product name	Description
IRS1125A <sup>1)</sup>	3D image sensor REAL3™ with 100 k pixel resolution (352 x 288 pixel), automotive-qualified BGA package

1) IRS1125A is in development and for selective customer projects only; SOP planned for Q4/2018



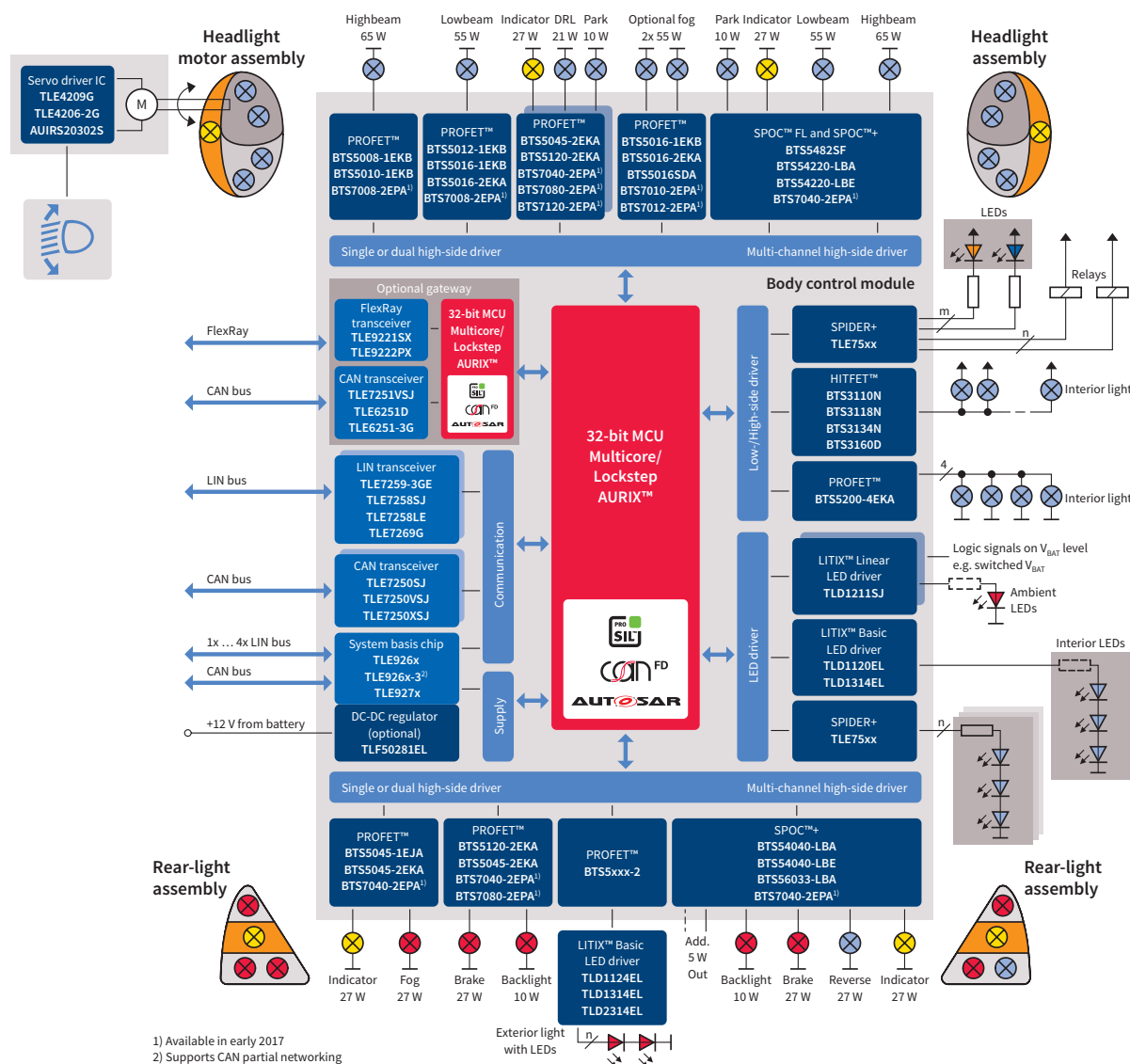
# Body and convenience applications

Infinion offers a wide variety of products dedicated to body and interior electronics. These include protected power switches for bulb and motor control, dedicated system basis chips and easy-to-use Hall sensor solutions. The new TriCore™-based AURIX™ family provides sufficient performance, as well as dedicated safety and security features, to meet the needs of upcoming domain electronics modules. As one example, a **high-feature body control module with integrated gateway** functionality is shown on page 23.

The following pages present well-known electronic modules for car body interior and comfort systems, such as the **body control modules** including a dedicated low-cost version, the Seat Electronics Module and the **HVAC control module**. Further modules reveal the growing trend toward decentralized modules at the point of load, such as a **front light module** or a **smart window lift module**.

Some new electronic module designs reflect the latest functional and architectural advances. One prominent example is a **power distribution system** for high-current applications supporting the move toward more advanced and efficient wiring harness systems in start/stop-capable vehicles. Another example is an **interior light module with touch-sensitive control** based on a similar human-machine interface to that featured in the latest consumer electronics devices. Finally, the growing family of system-on-chip devices supports space- and cost-optimized single-chip solutions for various motor control applications, such as window lift, fuel pump and HVAC blower.

# Central body control module



## System benefits

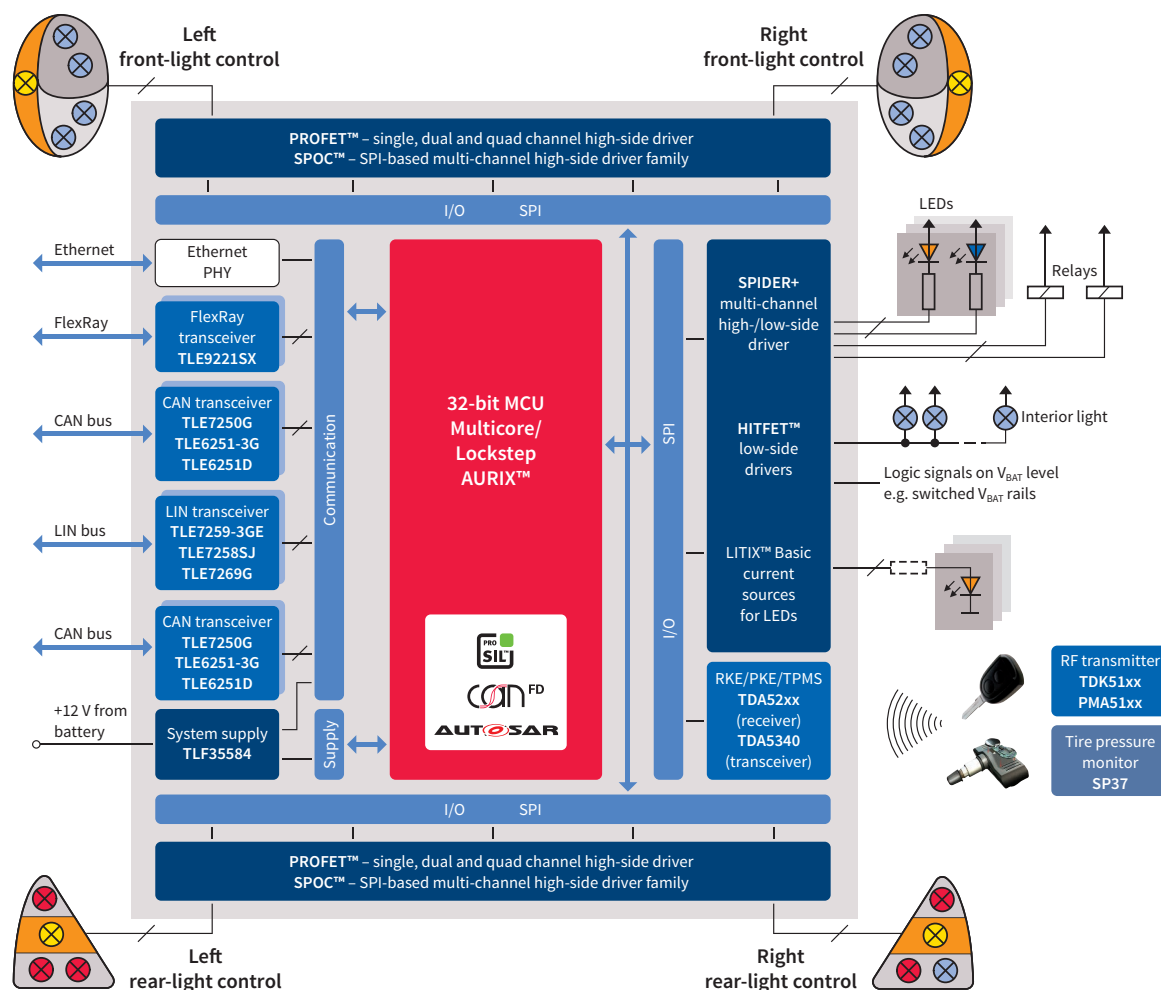
- > Reduced board space due to integrated functionality
- > Protected load control with sophisticated diagnostic features
- > Supports the “Limp Home” functional safety concept
- > High scalability and benchmark short-circuit robustness of power semiconductors (PROFET™)
- > Supports a smooth transition to LEDs for interior and exterior lighting

## Suggested products

Product family	Description
AURIX™	Scalable 32-bit TriCore™ microcontroller family from single to multicore (PRO-SIL™)
Supply ICs	Linear voltage regulators, DC-DC converters
SPIDER, HITFET™	Single- and multi-channel protected high- and low-side switches
LITIX™ Basic LED driver	Linear current sources for LED applications
SBCs, network transceiver	System basis chips, CAN, LIN and FlexRay transceiver
PROFET™, SPOC™+	Single- and multi-channel protected high-side switches



# High-feature body control module



## System benefits

- › AURIX™ multicore concept enables the integration of two applications into one device.
- › AURIX™ supports safety requirements up to ASIL-D (ISO 26262)
- › AURIX™ hardware encryption (HSM) enables advanced security features
- › Encapsulation feature allows software development without interference between multiple applications
- › Very high integrated functionality enables reduced board space
- › All features of a classic body control module are available, including protected load control with sophisticated diagnostics

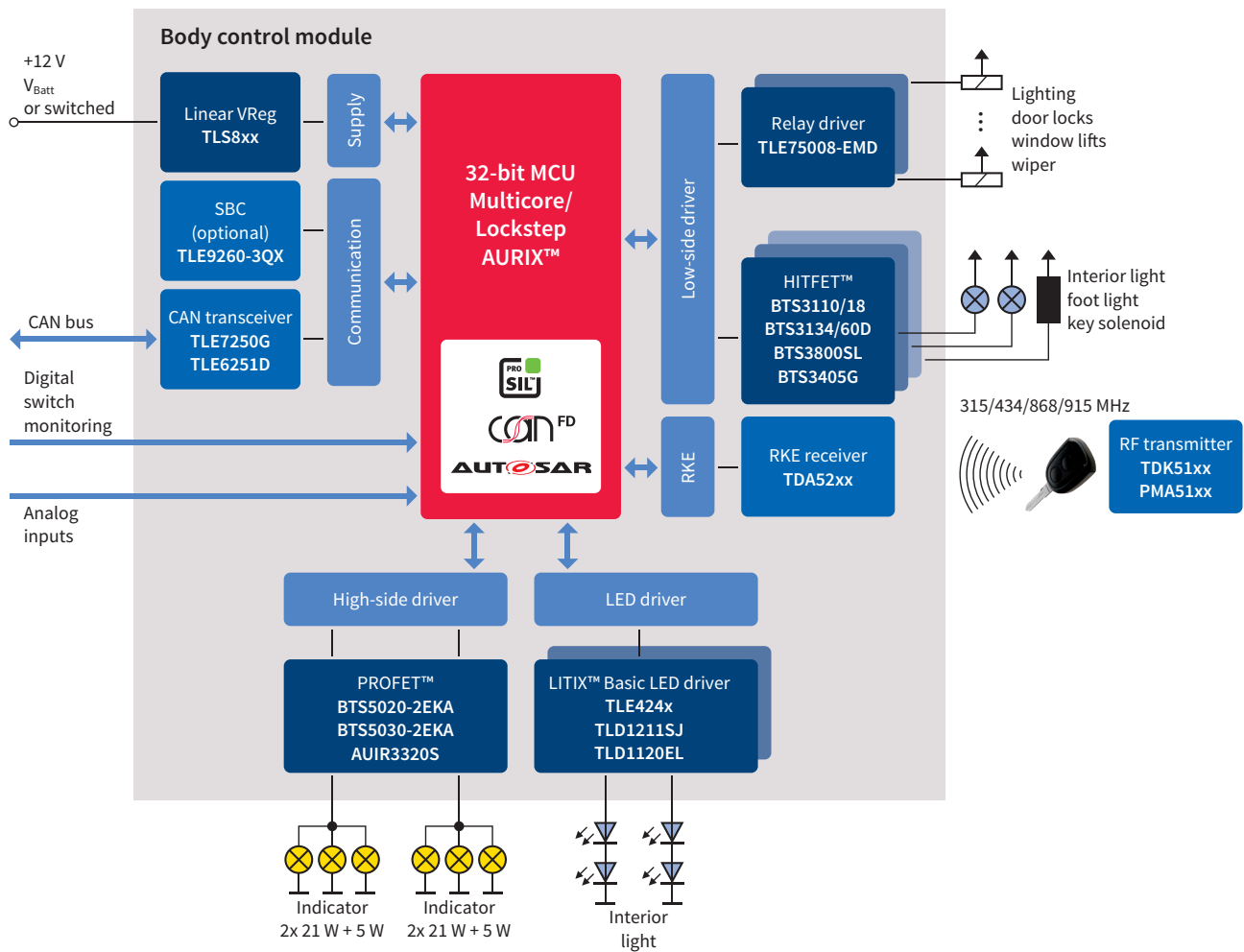
## Suggested products

Product family	Description
AURIX™	Scalable 32-bit TriCore™ microcontroller family from single to multicore (PRO-SIL™)
Supply ICs	Linear voltage regulators, DC-DC converters
SPIDER, HITFET™	Single- and multi-channel protected high- and low-side switches
LITIX™ Basic LED driver	Linear current sources for LED applications
Network transceiver	CAN, LIN, FlexRay transceiver
PROFET™, SPOC™	Single- and multi-channel protected high- and low-side switches
TDA52xx, TDK51xx, PMA51xx	Chipset for remote keyless entry and tire pressure monitoring applications





# Low-cost body control module



## System benefits

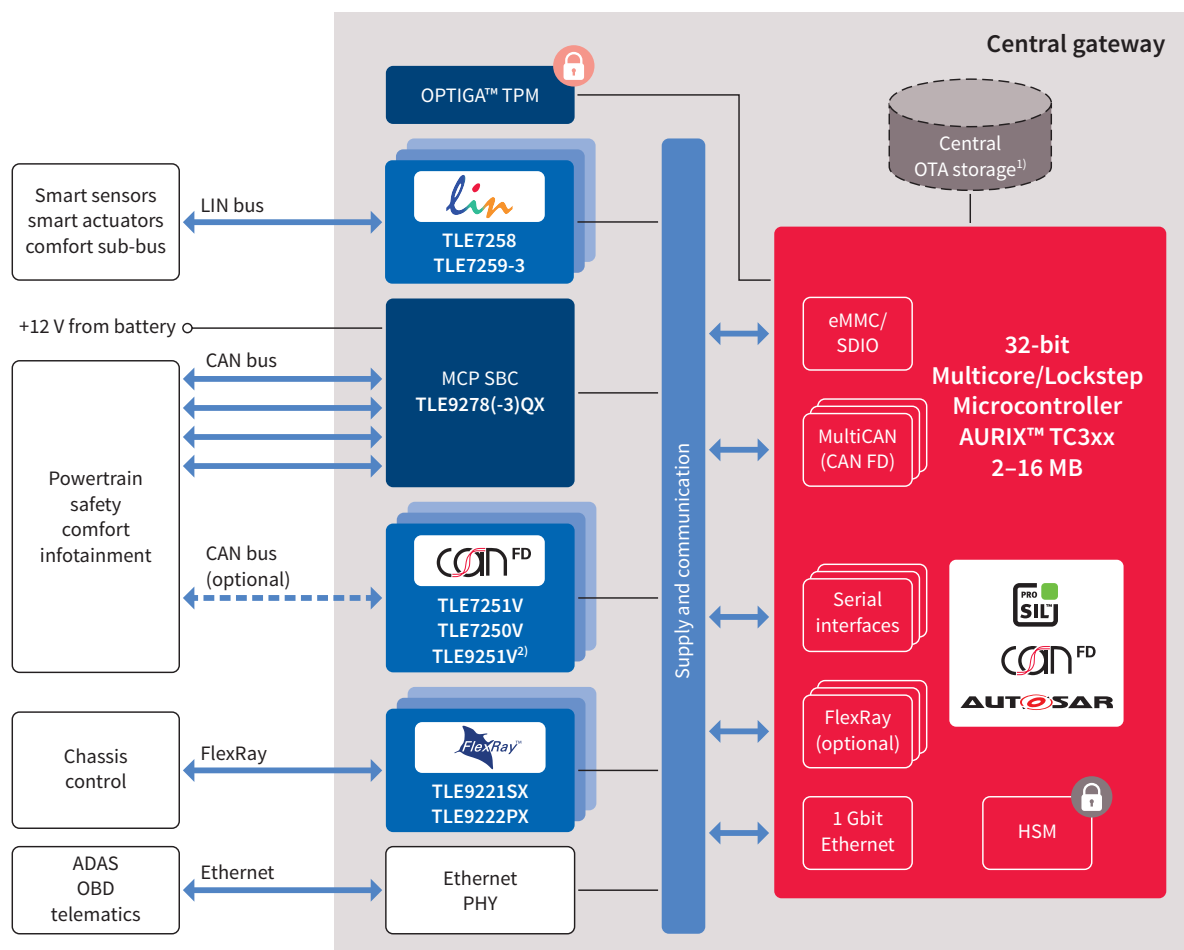
- › Single low-cost module solution for the car body electronics
- › Scalability of the devices increases the reuse grade and design flexibility
- › Benchmark short-circuit robustness of power semiconductors improves system reliability (PROFET™)
- › Full integration of load protection and diagnostics reduces PCB area and improves the design quality

## Suggested products

Product family	Description
AURIX™	Scalable 32-bit TriCore™ microcontroller family from single to multicore (PRO-SIL™)
Supply ICs	Linear voltage regulators, DC-DC converters
SPIDER, HITFET™	Single- and multi-channel protected high- and low-side switches
LITIX™ Basic LED driver	Linear current sources for LED applications
Network transceiver	CAN and LIN transceiver
PROFET™	Protected high-side switches
TDA52xx, TDK51xx	Chipset for remote keyless entry applications



# Gateway



1) Depending of customer architecture, part of gateway, telematics etc.  
 2) In development, samples available

## System benefits

- > Enables pretended networking and ECU degradation
- > High integration leads to significant cost savings
- > High integration results in reduced complexity
- > ISO 26262 compliance supports ASIL requirements
- > Innovative supply concept leads to best-in-class power consumption

## Suggested products

Product family	Description
AURIX™	Scalable 32-bit TriCore™ microcontroller family from single to multicore (PRO-SIL™)
Supply ICs	Linear voltage regulators, DC-DC converters
Network transceiver	CAN, LIN and FlexRay transceiver

