Infeon Technologies - TC233LP32F200FACKXUMA1 Datasheet

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What is "Embedded - Microcontrollers"?

"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "Embedded - Microcontrollers"

Details	
Product Status	Discontinued at Digi-Key
Core Processor	TriCore™
Core Size	32-Bit Single-Core
Speed	200MHz
Connectivity	CANbus, FlexRay, LINbus, QSPI
Peripherals	DMA, WDT
Number of I/O	78
Program Memory Size	2MB (2M x 8)
Program Memory Type	FLASH
EEPROM Size	128K x 8
RAM Size	192K x 8
Voltage - Supply (Vcc/Vdd)	3.3V
Data Converters	A/D 24x12b
Oscillator Type	External
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	100-TQFP Exposed Pad
Supplier Device Package	PG-TQFP-100-23
Purchase URL	https://www.e-xfl.com/product-detail/infineon-technologies/tc233lp32f200fackxuma1

Contents

Family highlights

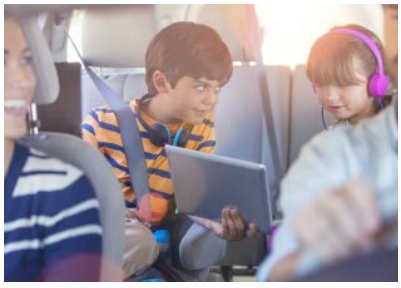
- Compatibility and scalability
- Lowest system cost
- Industry benchmark system performance
- Easy to use
- Broad portfolio
- Certified to automotive standards

Powertrain

Applications

- Gasoline direct injection
- Gasoline multi-port Injection
- Diesel direct injection
- Automatic transmission – hydraulic control
- Dry double clutch transmission – hydraulic control
- Dry double clutch transmission – electrical control
- Integrated (H)EV control
- (H)EV battery management system

Safety



Applications

- Chassis domain control
- Electric Power Steering (EPS)
- Active suspension control system
- Advanced airbag system
- Braking ECU
- Multi-purpose camera configuration
- Short-range radar (24 GHz) system
- Long-range radar (76/77 GHz) system

Connectivity

Applications

- Body domain controller
- Connected gateway
- Advanced body applications
- Telematics including software update over the air
- V2x communication
- eHorizon

Transportation

Applications

- Commercial and Agricultural Vehicle (CAV)
- Fun vehicle
- Transportation
- Trucks

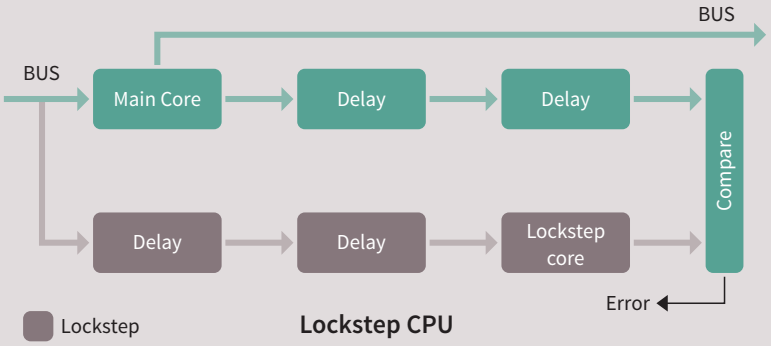
Industrial & Multimarket

Applications

- Mobile controller
- Inverter
- Wind turbine inverter
- Solar panel

Infineon® diverse lockstep concept

- Lockstep architecture designed to control and mitigate common cause factors
  - Physical isolation
  - Instruction-level execution diversity: 2-cycle delay
  - Circuit-level design & timing diversity
- Layout-level diversity
- Diversity controlled and verified by state-of-the-art design methods
- Special design of clock & reset networks
- Careful design of lockstep comparator
- Main core and diverse lockstep core run the same software in parallel to detect computational errors
- Like normal locksteps, both cores are physically separated and have a time delay between their execution
- Diverse lockstep core has been additionally transformed to provide architectural hardware diversity and further reduce common cause failures



AURIX™ security software

Infineon's AURIX™ 32-bit microcontroller family offers a wide portfolio of compatible devices with embedded Hardware Security Module (HSM), which offers cost-efficient solutions for all typical automotive security applications. The SHE+ driver controls the hardware security peripheral in the HSM domain and interacts with the TriCore™ host core. SHE+ comes with the AUTOSAR CRY interface for integrating the HSM security features into an automotive application, including interface to AUTOSAR, communication from TriCore™ to HSM and vice versa, key storage functionality and security peripheral drivers.

	HIS SHE	HSM SHE+ V1	HSM SHE+ envisioned
Key management	10 keys	20 keys	Configurable
Symmetric data encryption / decryption	HW-based AES-128-bit (ECB, CBC)	HW-based AES-128-bit (ECB, CBC, OFB, CFB, CTR, XTC, GCM)	●
MAC generation / verification	●	●	●
Safe MAC verification	–	●	●
Random number management	SHE PRNG	SHE PRNG TRNG	●
Secure boot	●	–	●
Debug access	–	–	Enhanced by HSM debug options
Other SHE services	●	●	●
Asymmetric encryption / decryption	–	–	SW-based RSA1024 SW-based ECC256

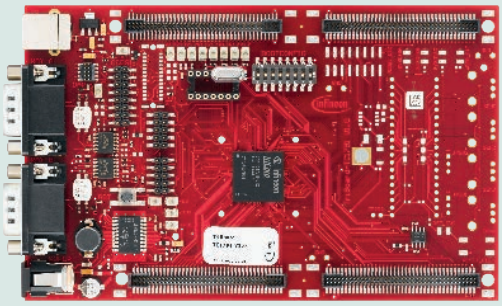
Typical applications	Tuning protection 	Immobilizer  Secure-on-board communication 	Possible extensions, depending on specific tier1 / OEM use case
Key management	●	●	●
Symmetric data encryption / decryption	●	●	●
MAC generation / verification	●	●	●
Safe MAC verification		(optional)	(optional)
Random number management	●	●	●
Secure boot	(optional)	(optional)	(optional)
Debug access	(for development)	(for development)	(for development)
Other SHE services	●	●	●
Asymmetric encryption / decryption	(optional in future)	(optional in future)	(optional in future)

AURIX™ starter and application kits

Infineon Technologies AG starter kits – 32-bit microcontrollers

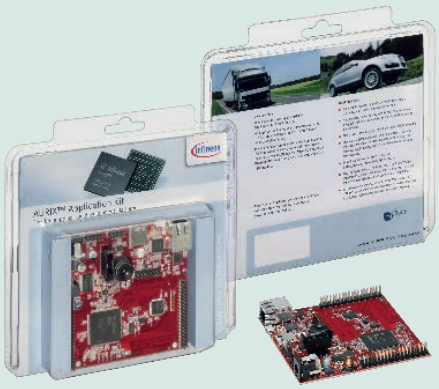
Triboards

Infineon Tricore™ family starter kits are powerful evaluation systems that enable evaluation and development well before the target hardware is available. They offer a solid platform for both hardware and software engineers to evaluate and prototype designs that are closely aligned with their final applications.



Application kits

To simplify the development of your own application, the kit comes with a variety of on-board components, including a highly integrated software development environment that gives you everything you need to compile, debug, and flash your AURIX™ multicore application.



System application kits

The system application kits provide a quick jump-start to typical microcontroller applications such as motor control, radar etc. These reference design kits provide faster design-in support for end applications by providing a reference board, application software, tooling and documentation.

www.infineon.com/AURIX-kits

Hardware Security Module (HSM)

HSM provides a secure computing platform, consisting of a 32-bit CPU, special access-protected memory for storing the cryptographic key and the unique subscriber identifiers, a hardware accelerator for the state-of-the-art AES-128 encryption that can be operated in different modes and specific hardware for generation of random numbers. A firewall separates HSM from the rest of AURIX™ microcontroller.

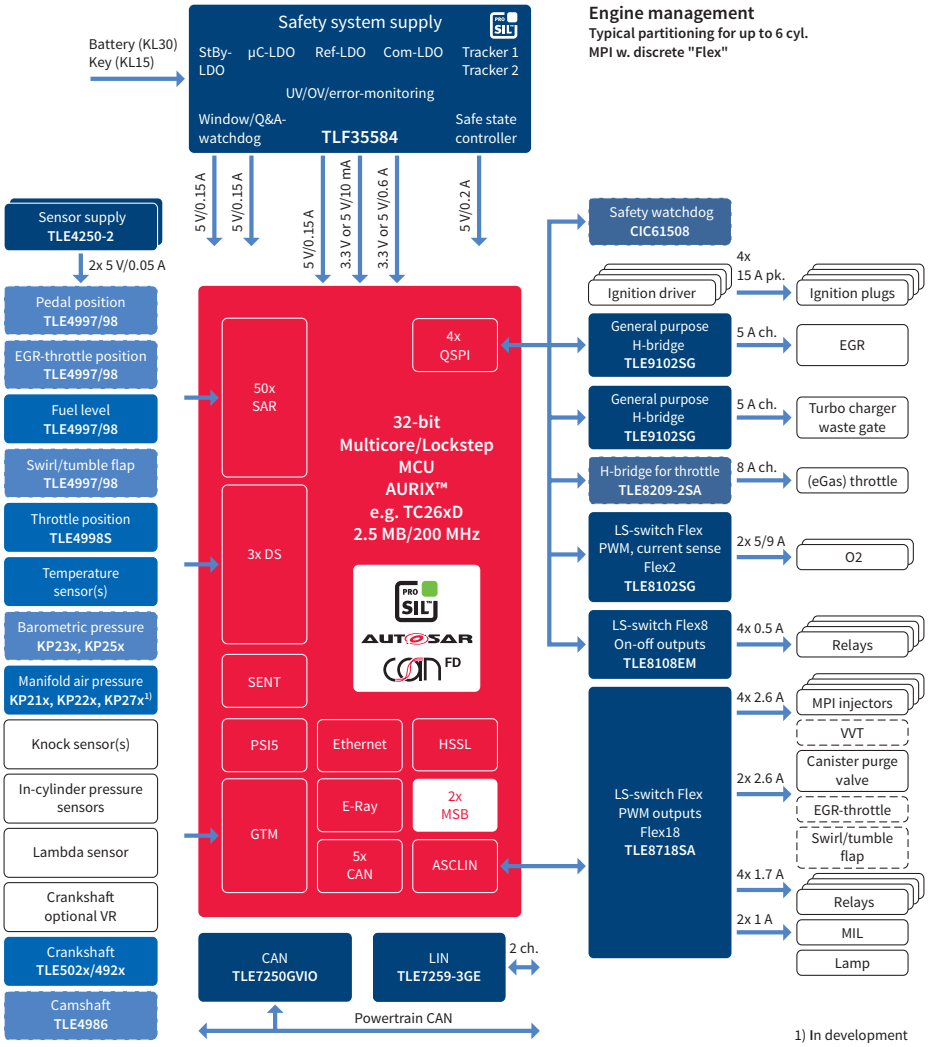
- A highly flexible and programmable solution
- AES-128 HW accelerator matching performance for automotive protocols
- Crypto- and Algorithm Agility by software
- AIS31 compliant True Random Number Generator (TRNG) with high random entropy over lifetime

Customer benefits

- **Secure platform** – HSM provides a secure platform, separated from the rest of the microcontrollers by a firewall, thereby creating a trusted execution environment.
- **Security standard compliance** – AURIX™ HSM fulfills SHE HIS and Evita Medium standards as well as provide some additional functionalities.
- **Backward compatibility** – AURIX™ security solutions are backward compatible to security SHE HIS implementations in previous TriCore™ based microcontroller families.
- **Security differentiation** - customized secure OEM or Tier1 crypto apps can be processed within trusted HSM execution environment and therefore allow independent HSM specific SW code review in reference to the huge application host SW from multiple parties. This helps to harden the security level by reliably avoiding potential security backdoors.
- **Convergence of security and safety** – AURIX™ microcontrollers address both functional safety as well as IT-security requirements, making sure those are properly integrated and not conflicting with one another.
- **Secure process** – Infineon can provide a secure personalization flow. 1st personalization step usually happens at the Tier1, where initial HSM SW and optional transportation key(s) are injected to the ECU. 2nd personalization step happens at the OEM, where a car specific Individual key(s) are injected. AURIX™ HSM offers device specific, individual random read-only key. Read-only key can be used for injected keys and make them invisible for the application SW layer.
- **Secure failure analysis** – for the purpose of preventing unpermitted debug access, AURIX™ HSM offers 256-bit password for debugger access protection. It is possible to create car specific debugger password, which can be stored in OEM/Tier1 data base or generated by secret algorithm. Destructive debugger entry functionality opens debugger access but initiates a persistent destructive action – device gets inoperable in native ECU car environment.

Gasoline multi-port injection – discrete solution

Application example



The new TriCore™ family AURIX™ with state-of-the-art safety features enables systems to achieve the highest safety level up to ASIL-D. The scalable AURIX™ family includes the GTM, the de-facto industry standard timing module that supports highly complex engine management, while meeting the market's most stringent emissions regulations.

Application features

- Gasoline port injection
- Scalable software-based knock detection
- Throttle and EGR control
- Catalyst after treatment
- Start/stop systems
- Cost-optimized for entry segment

System benefits

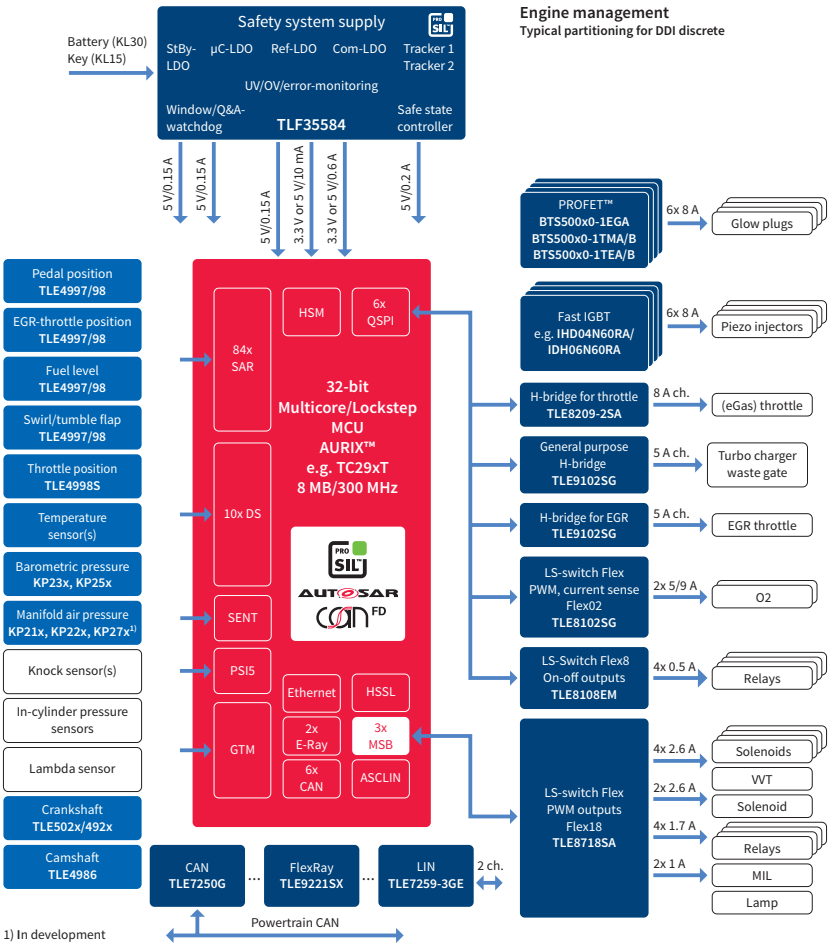
- Scalable platform – performance, memory size and I/Os
- Single voltage supply (EVR)
- Focus on reducing CO_2
- Easy migration from ultra low-end to mid-range applications
- Best tool/partner support for all development phases within V-cycle

Suggested products

- TC265 – TriCore™ 32-bit microcontroller
- TC264 – TriCore™ 32-bit microcontroller

Diesel direct injection

Application example



The new TriCore™ family AURIX™ with state-of-the-art safety features enables systems to achieve the highest safety level up to ASIL-D. The scalable AURIX™ family includes the GTM, the de-facto industry standard timing module that supports highly complex engine management, while meeting the market's most stringent emissions regulations.

Application features

- Direct injection (piezo/magnetic)
- In-cylinder pressure measurement
- Hardware-supported security enhancements
- Throttle and EGR control
- Turbo charging
- Diesel particulate filter
- 'Blue' after-treatment support (e.g. urea-based SCR)

Suggested products

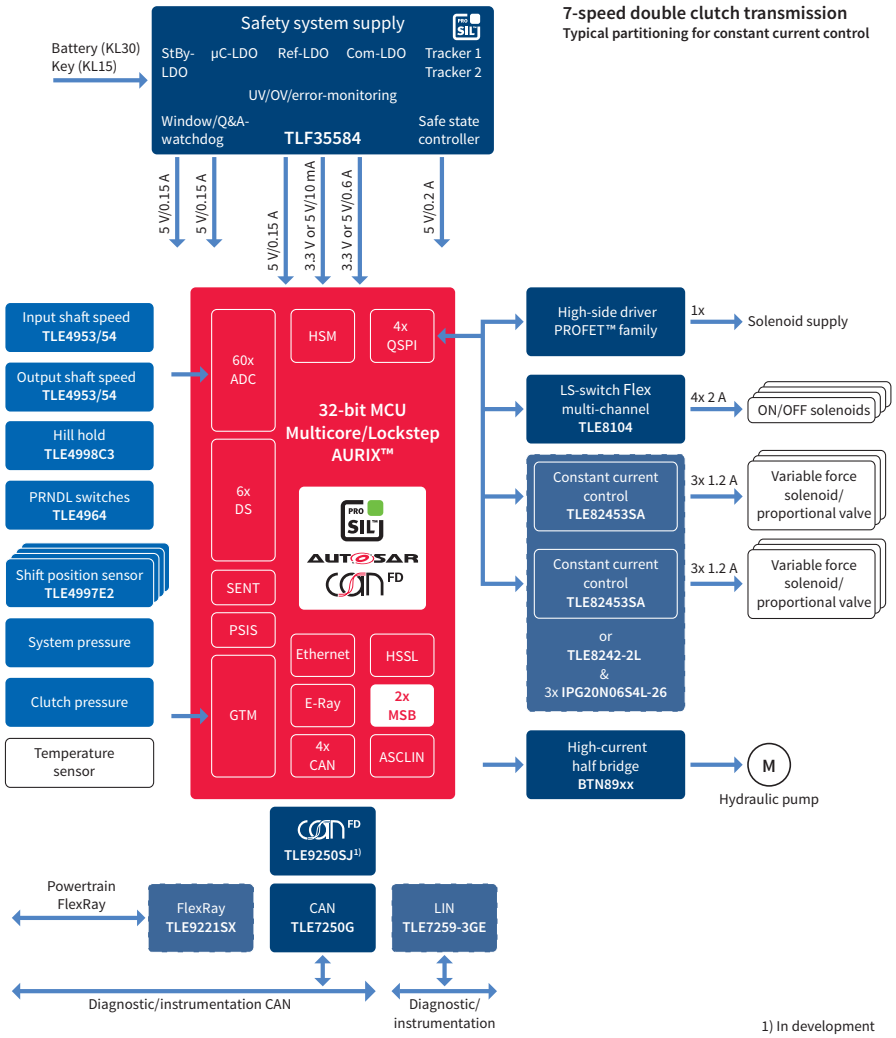
- TC29x – TriCore™ 32-bit microcontroller
- TC27x – TriCore™ 32-bit microcontroller

System benefits

- Microcontroller with best-in-class real-time performance
- Scalable platform – performance, memory size and I/Os
- Committed to reduce NOx and particulate matter in line with Euro 6 standard
- Hardware-supported IP/anti-theft protection and tuning protection
- Increased accuracy with in-cylinder pressure sensing via DS-ADC
- Enhanced communication (Ethernet)
- Dedicated peripherals for powertrain

Dry double clutch transmission – hydraulic control

Application example



The new TriCore™ family AURIX™ with state-of-the-art safety features enables systems to achieve the highest safety level up to ASIL-D. The rich scalability of the AURIX™ family permits a platform approach that meets the needs of a range of transmission system demands. Furthermore, the hot temperature package and bare die solutions enable AURIX™ to be used in both attached and integrated control units.

Application features

- Ultra-fast gear switching
- Closely coupled with engine control via high-speed CAN/CAN-FD/FlexRay link
- Support of four 3-phase DC-brushless E-drives (dry-DCT)
- High microcontroller junction bare die temperature

Suggested products

- TC275 – TriCore™ 32-bit microcontroller
- TC270 – Bare die TriCore™ 32-bit microcontroller

System benefits

- Improved fast clutch control
- Supports safety level up to ASIL-D
- Feature set optimized for wet and dry DCT designs
- Continuous torque on wheels ensures a sportive driving experience
- Hot bare die capabilities enable microcontrollers to be placed directly where they are needed in the system
- Hot bare die supports modular temperature-optimized TCU designs

AURIX™ for safety applications

AURIX™ made for safety

The AURIX™ architecture ISO 26262 compliant process is designed to efficiently meet ASIL-D on an application level. The platform uses up to 2 cores in TriCore™ diverse lockstep core technology, a diverse lockstep architecture combined with cutting-edge safety technology, such as safe internal communication buses or distributed memory protection system. Innovative encapsulation techniques allow the integration of software with various safety levels (QM to ASIL-D) from different sources, thereby significantly reducing system complexity. Thanks to this optimized approach, multiple applications and operating systems (such as steering, braking, airbag and advanced driver assistance systems) are seamlessly hosted on an unified platform. This leads to productivity gains of up to 30%, resulting in a smaller development outlay and reduced time-to-market for our customers.

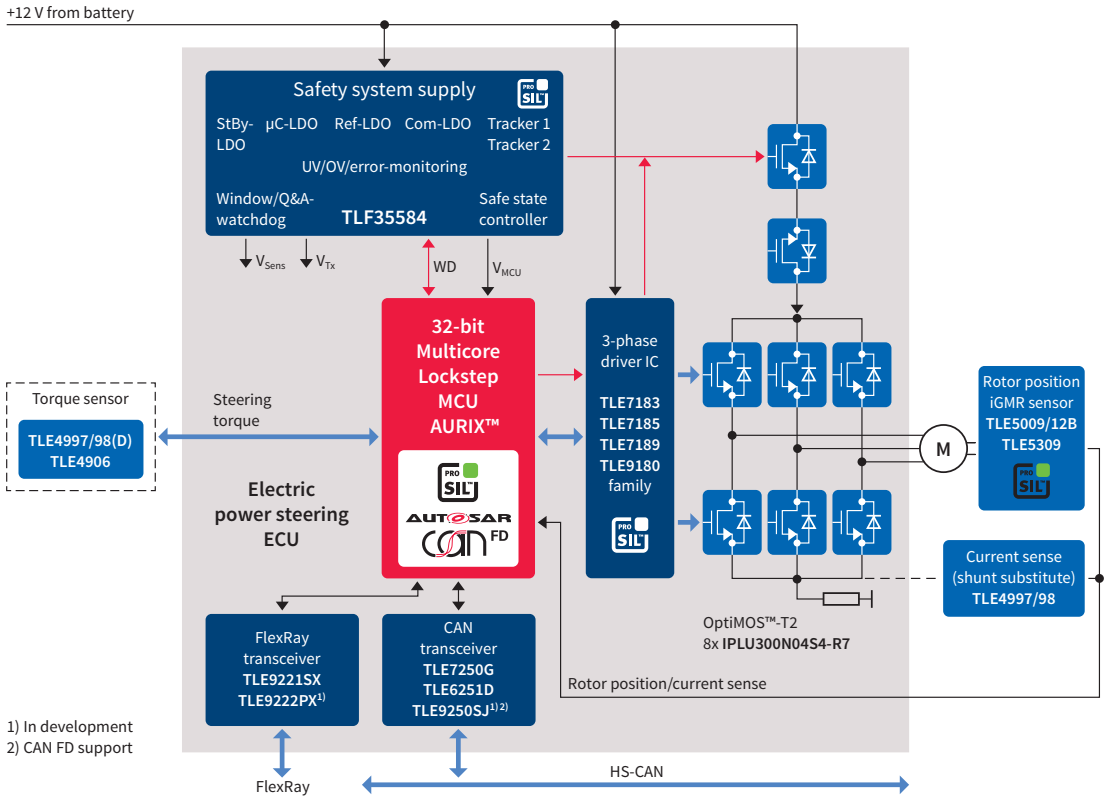
Furthermore, Infineon extends the microcontroller safety roadmap with devices dedicated to the Advanced Driver Assistance System (ADAS) segment, such as radar or camera applications. Innovation has been focused on system partitioning in order to further integrate system functionality and consequently reduce the complexity and area, providing our customers with highly optimized solutions. The new devices include high- speed interfaces, integrated hardware acceleration and enhanced ECU validation and instrumentation tools. All ADAS devices support ISO 26262 safety methodology, meaning that they can be involved in automatic decisions to assist drivers, such as emergency braking.

AURIX™ made for scalability

Thanks to its market-leading expertise, Infineon has translated customer demands for individual scalability into a universal product roadmap. Designed to optimize its customers' investment, the AURIX™ family comes with a comprehensive range of fully modular components, thereby ensuring long-term design flexibility. The devices range in the ultra high-end from a 300 MHz triple-core device with 8 MB of embedded Flash to a 200 MHz triple core with 4 MB of embedded Flash to a 200 MHz dual-core device with 2.5 MB of embedded Flash right down to 130 MHz and 80 MHz single-core and single-core lockstep devices with 1.5 MB, 1 MB and 0.5 MB of embedded Flash. The package portfolio includes a BGA-516 package with a ball-compatible BGA-292 package (I/O subset), and compatible QFP-176, QFP-144, QFP-100 to QFP-80 packages.

Electric Power Steering (EPS)

Application example



The new TriCore™ family AURIX™ with state-of-the-art safety features enables systems to achieve the highest safety level ASIL-D, which is already required in contemporary steering systems.
The latest diverse lockstep technology with clock delay (diverse lockstep core) reduces the software overhead significantly and enables fast time-to-market.
Its rich scalability meets a variety of different electric power steering system demands.

Application features

- Flash 512 KB–8 MB
- Performance from 133 MHz–3x 300 MHz
- T_a = -40 °C … 145 °C
- Dedicated peripheral set: LIN, CAN, SPI, FlexRay , Ethernet
- Advanced timer unit for totally flexible PWM generation and hardware input capture
- Redundant flexible 12-bit ADC
- Hardware SENT interface for low CPU load
- Hardware-focused safety concept for reduced SW overhead
- Safety software: Infineon SafeTcore library
- ISO 26262 conformance to support safety requirements up to ASIL-D
- Availability of AUTOSAR 4.x

System benefits

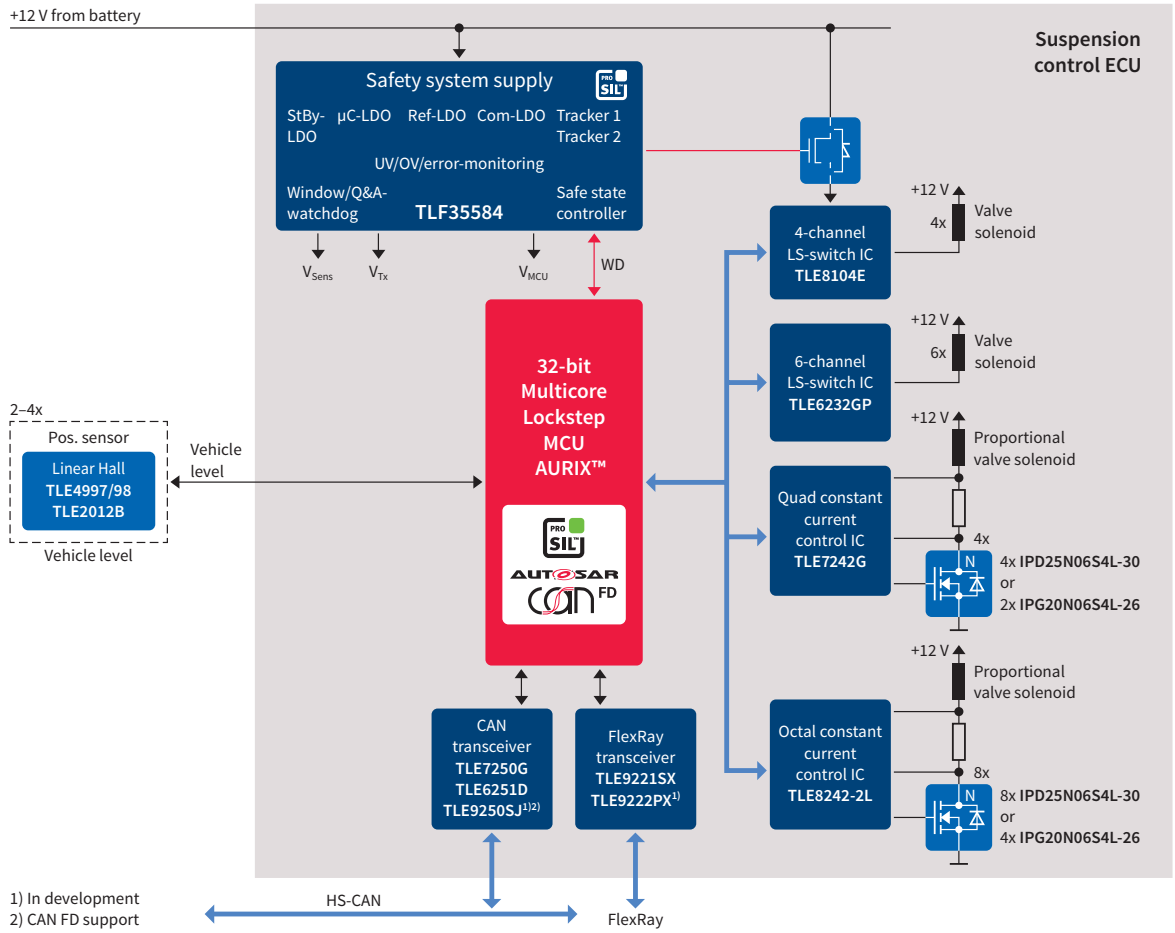
- Scalability over Flash, RAM and peripherals offering the best cost-performance ratio
- Serves all kinds of EPS systems, such as column or belt drive
- Proven safety concept to support ISO 26262
- Innovative supply concept leads to best-in-class power consumption

Suggested products

- TC26x
- TC23x
- TC22x

Active suspension control system

Application example



The new TriCore™ family AURIX™ with state-of-the-art safety features enables systems to achieve the highest safety level ASIL-D, which is already required in contemporary suspension systems.
The latest diverse lockstep technology with clock delay (diverse lockstep core) reduces the software overhead significantly and enables fast time-to-market.
The scalability supports an optimized fit in order to meet different OEM specifications.

Application features

- TriCore™ DSP functionality
- Best-in-class performance: triple TriCore™ with up to 300 MHz per core
- Supporting floating point and fix point with all cores
- Communication peripherals: CAN, LIN, FlexRay, Ethernet
- Innovative single supply 5 V or 3.3V
- Wide range of packages from 80-pin – 516-pin
- ISO 26262 conformance to support safety requirements up to ASIL-D
- Availability of AUTOSAR 4.x

System benefits

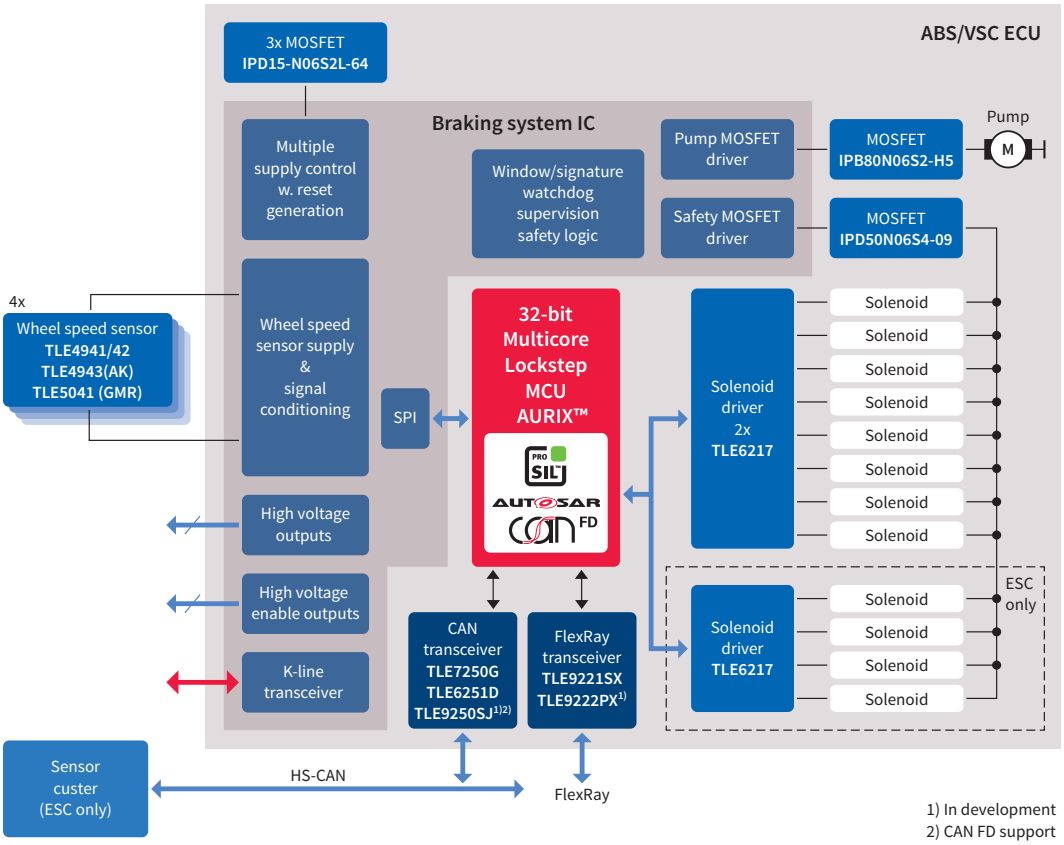
- Scalability over Flash, RAM and peripherals offering the best cost-performance ratio
- Proven safety concept to support ISO 26262
- Innovative supply concept leads to best-in-class power consumption and saves external component costs

Suggested products

- TC27x
- TC26x
- TC23x
- TC22x

Braking

Application example



The new TriCore™ family AURIX™ with state-of-the-art safety features enables systems to achieve the highest safety level ASIL-D, which is already required in contemporary braking systems. The latest diverse lockstep technology with clock delay (diverse lockstep core) reduces the software overhead significantly and enables fast time-to-market. The scalability supports an optimized cost-performance fit for basic ABS systems up to highly-integrated ESC systems.

Application features

- Scalable MCU family with diverse lockstep
- Flash 512 KB–8 MB
- Performance from 133 MHz–3x 300 MHz
- Hardware-focused safety concept for reduced SW overhead
- SENT interface for low CPU load
- Safety software: Infineon SafeTcore library
- ISO 26262 conformance to support safety requirements up to ASIL-D
- Availability of AUTOSAR 4.x

System benefits

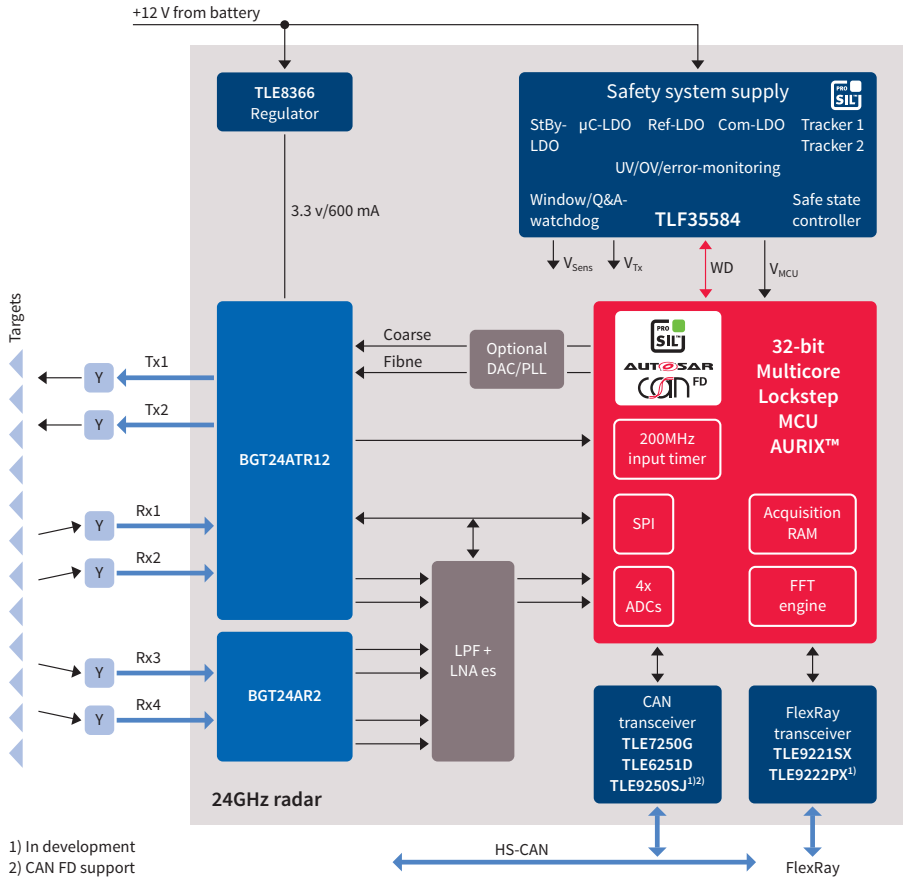
- Scalability over Flash, RAM, performance and peripherals leads to an optimized cost-performance fit
- Proven safety concept to support ISO 26262 validated by 3rd party
- Innovative supply concept leads to best-in-class power consumption and saves external component costs

Suggested products

- TC29x
- TC27x
- TC26x
- TC23x
- TC22x

Short-range radar (24 GHz) system

Application example



The new TriCore™ family AURIX™ will enhance classic safety features with dedicated features to serve the needs of 24 GHz radar systems.
The combination of new features and increased SRAM, in conjunction with outstanding safety features, enables a high level of integration and reduction of complexity.

Application features

- Up to 752 KB RAM for radar image storage
- Radar signal processing with windowing functionality
- Flexibility in radar signal acquisition with 4x internal ADCs
- Possibility to connect external ADCs (interface to connect up to 16-bit ADCs)
- High-precision input timers
- High-precision output timers for DAC
- Innovative single supply 5 V or 3.3 V
- ISO 26262 compliance to support safety requirements up to ASIL-D
- Availability of AUTOSAR 4.x

System benefits

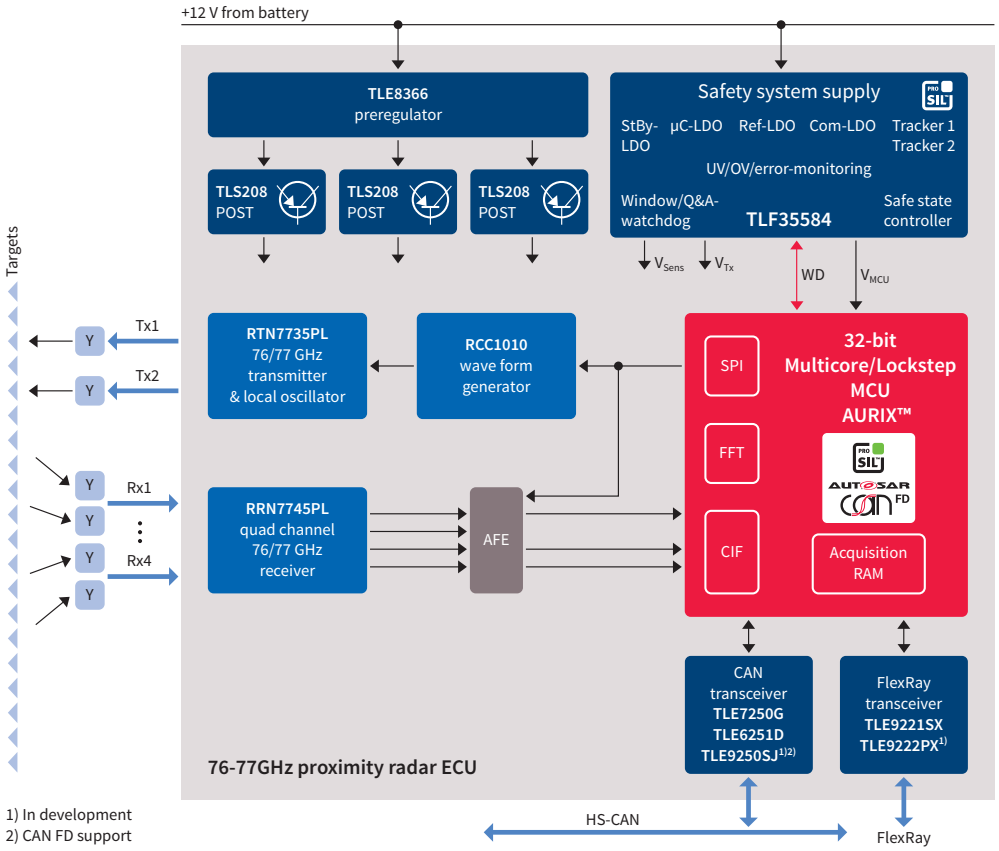
- High integration leads to significant cost savings
- High integration leads to reduced complexity
- ISO 26262 compliance supports safe input for functions such as emergency braking
- Innovative supply concept

Suggested products

- TC23xLA
- TC26xDA
- TC29xTA

Long-range radar (76/77 GHz) system

Application example



The new TriCore™ family AURIX™ will enhance classic safety features with dedicated features to serve the needs of 77 GHz radar systems.
The combination of new features and increased SRAM, in conjunction with outstanding safety features, enables a high level of integration and reduction of complexity.

Application features

- TriCore™ DSP functionality
- Best-in-class performance: triple TriCore™ with up to 300 MHz per core
- Up to 2.7 MB RAM for radar image storage
- Radar signal processing with windowing functionality
- Flexibility in radar signal acquisition with 4x internal ADCs
- Possibility to connect external ADCs (interface to connect up to 16-bit ADCs)
- High-precision input timers
- High-precision output timers for DAC
- Innovative single supply 5 V or 3.3 V
- External memory interface
- ISO 26262 compliance to support safety requirements up to ASIL-D
- Availability of AUTOSAR 4.x

System benefits

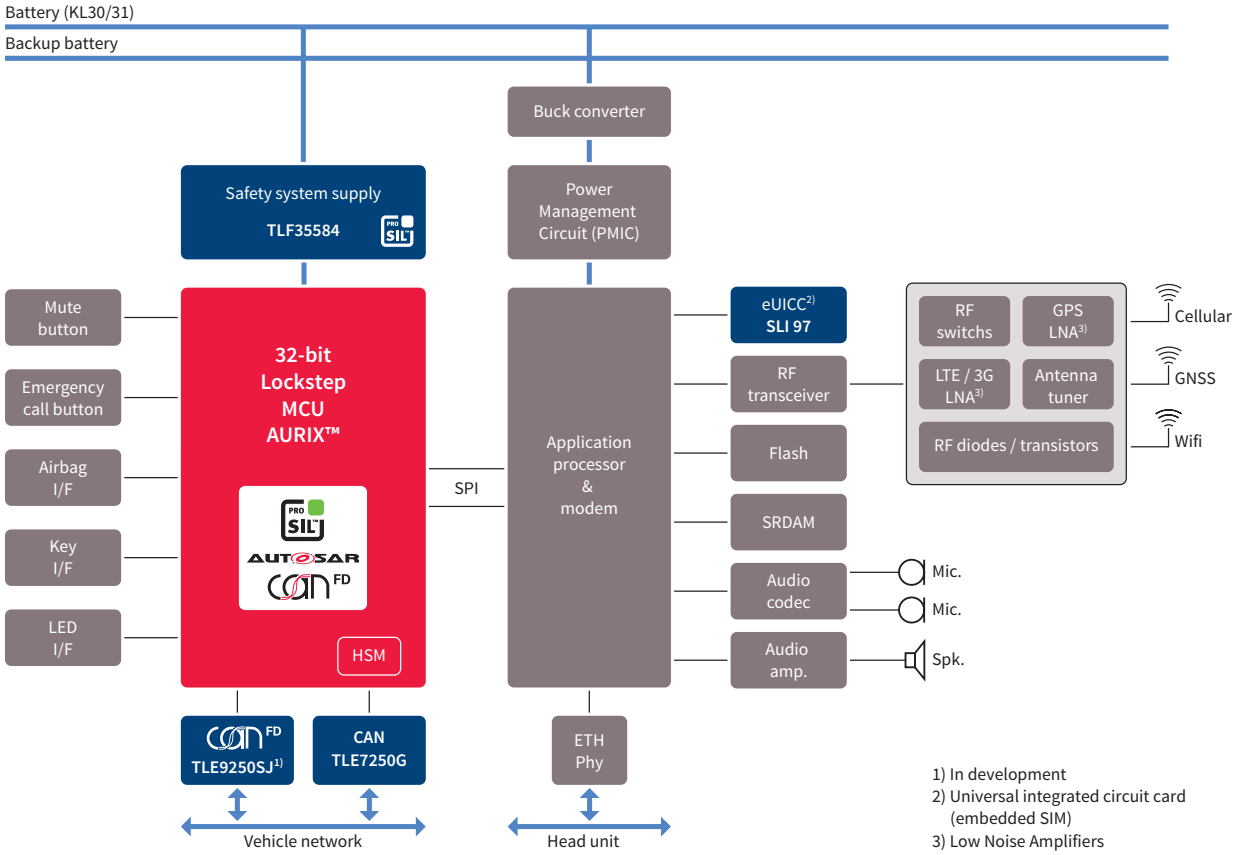
- High integration leads to significant cost savings
- High integration leads to reduced complexity
- ISO 26262 compliance supports safe input for functions such as emergency braking
- Innovative supply concept leads to best-in-class power consumption

Suggested products

- TC26xDA
- TC29xTA

Telematics control unit for over-the-air updates

Application example



The telematics control unit connects the car to the outside world and thereby enables numerous new applications and functionalities. Software in different ECUs can be updated remotely, to either add new features or remove any software bugs that might be found during operation. This reduces the number of recalls and related costs and increases customer satisfaction. The possibility of adding new features opens up the door for new business models and revenue streams.

Application features

- eCall
- Remote diagnostics
- Payment systems
- Software update
- Feature upgrades
- Internet services
- etc.

Application features

- TC23x – TriCore™ 32-bit microcontroller
  - Superior Hardware Security Solution (HSM) + functional safety up to ASIL-D (e.g. eCall, V2x communication, software update of safety-critical ECUs)
  - Automotive & consumer interfaces (incl. CAN/-FD, FlexRay, Ethernet etc.)
  - Highly scalable product portfolio (starting with 2 MB & QFP-100 at the lowest end)

System benefits

- System supplies, bock converter, active antenna supplies etc.
- Secure elements (eUICC, OPTIGA™ TPM 2.0, SLI 97 V2X etc.)
- RF switches, RF diodes/transistors, low-noise amplifiers (GPS, LTE etc.)
- Silicon microphone

AURIX™ for industrial applications

High-performance, multicore and safety-demanding applications

The AURIX™ 32-bit microcontroller family is based on the Infineon TriCore™ high-performance core concept and provides a very high scalability family from single core to multi core.

The AURIX™ family enabling highest integrated safe memory sizes (SRAM up to 2.7 MB and flash memory up to 8 MB) and all memory is protected by hardware Error Correction Code (ECC). The devices reach more than 600 DMIPS at clock rates of up to 300 MHz and combine MCU & DSP instructions with an integrated FPU.

The integrated peripheral set is primarily targeted toward motor control and power conversion providing up to 11 ADCs, DS ADCs and a full set of diverse high-performance timers – namely the General Timer Module (GTM), CapCom 6, GPT12. This is one of the very few in the industry that is able to drive the upcoming three-level inverter topologies.

Furthermore the AURIX™ family supports the latest connectivity like Ethernet, CAN FD, Flexray and multiple other high speed interfaces.

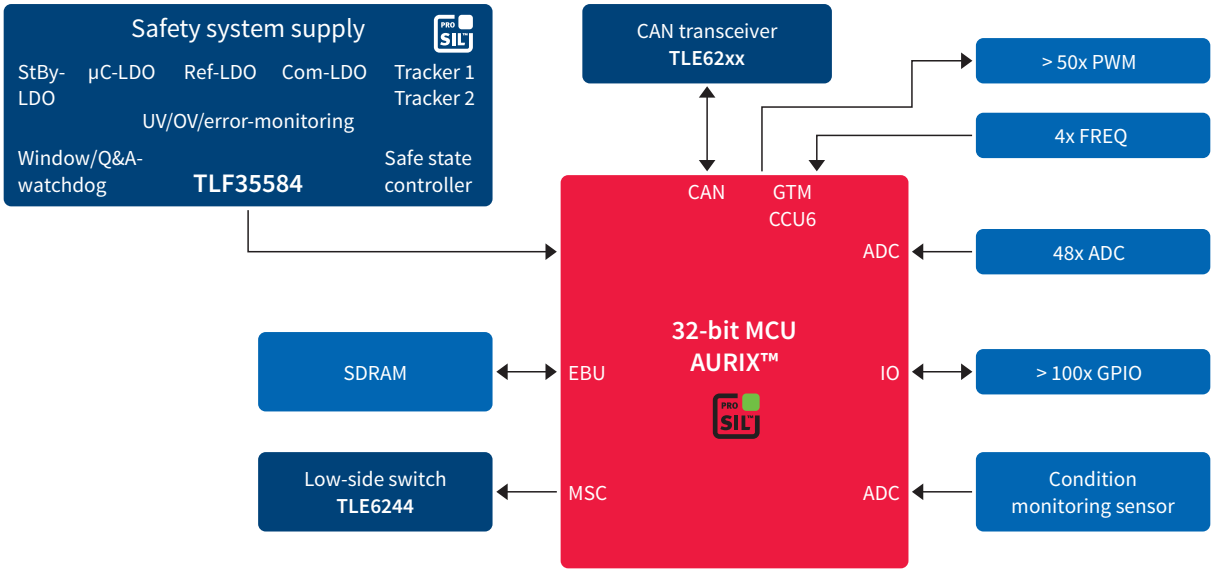
Providing security and functional safety

In a global economy, IP protection and secure communication plays an increasingly important role. This demand is accounted for by the integration of special security modules providing the required means of safe key storage, along with secure boot and encryption on the hardware level. As one of the leaders in functional safety, Infineon has designed the TriCore™ MCUs to meet the growing demand for functional safety in the industrial market as specified in IEC 61508. Via our cooperation partner Hitex, Infineon offers a complete package comprising a microcontroller, safety supply with integrated watchdog TLF35584, software and documentation, achieving safety integrity levels up to SIL3.

The next generation of TriCore™-based microcontrollers – AURIX™ – will provide another significant performance milestone by integrating up to three cores in one device. The multicore concept is targeted at running concurrent applications in parallel. Some of the integrated cores integrate lockstep functionality and the peripherals can be allocated to individual cores. This allows running a combination of safety-critical tasks, such as controlling an inverter, with non-critical tasks, such as network communication, on a single MCU.

Mobile controller

Application example



Application features

- Closed-loop control of solenoid currents
- Multitasking to drive hydraulic and electric actuators
- IEC 61131-3 support
- Tasking/Green Hills/GNU(Hightec)/windriver toolchain
- Ready for harsh environments
- IEC 61508 support - Integrity Level (SIL) 1 to 3

Suggested products

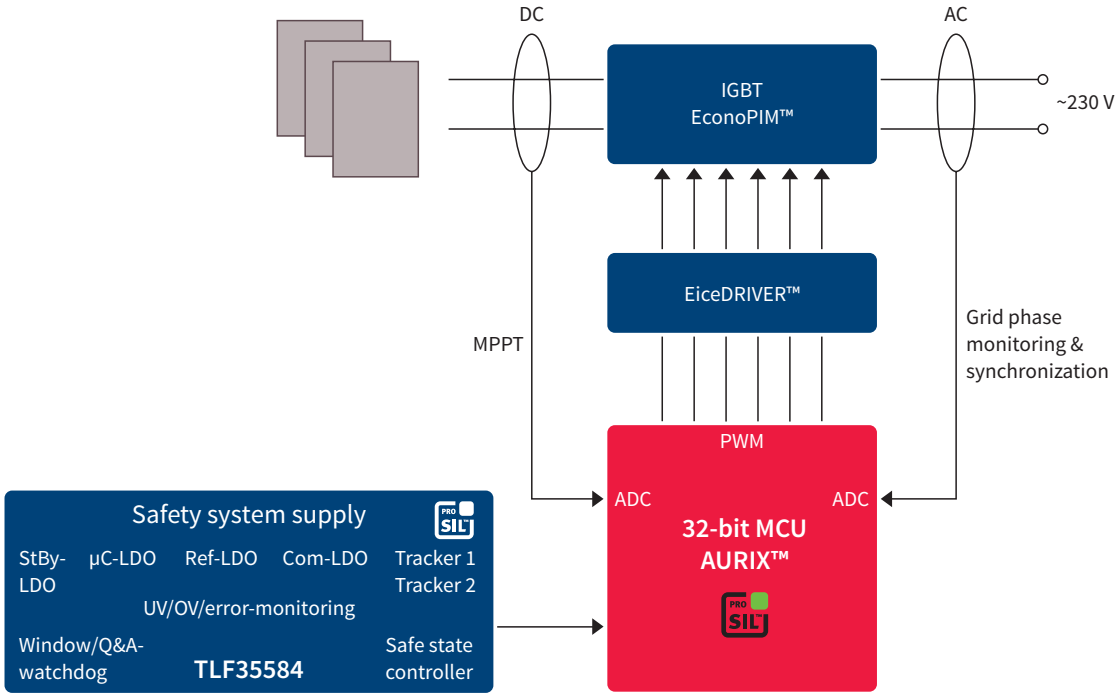
- TC26xD – TriCore™ 32-bit microcontroller
- TC27xT – TriCore™ 32-bit microcontroller

System benefits

- Scalable family with compatibility: SW, pin-out
- High-speed 200 MHz asymmetric single/dual/triple core
- Up to 50 Pulse-Width-Modulated (PWM) outputs
- Four 12-bit Analog to Digital Converters (SAR-ADC)
- 12-bit, up to 60 channels
- DS-ADC converter
- Temperature range up to T_a = 150 °C, T_j = 175 °C
- SAE J1939 supported for up to 6 CAN nodes incl. CAN FD
- 64 KB EEPROM
- Innovative single power supply concept

Solar panel

Application example



Application features

- Multi-phase PWM controller for single or multiple strings
- Runs multiple modulation strategies (SVPWM, DPWM, soft-PWM, direct torque control) to support requirements for reduced noise emissions and increased efficiency
- Maximum Power Point Tracking (MPPT) to extract maximum power from solar panels
- Grid phase monitoring and synchronization to ensure power factor unity
- Current control to avoid disharmonics and to determine the feed-in refund
- Support for 3-level inverter topologies

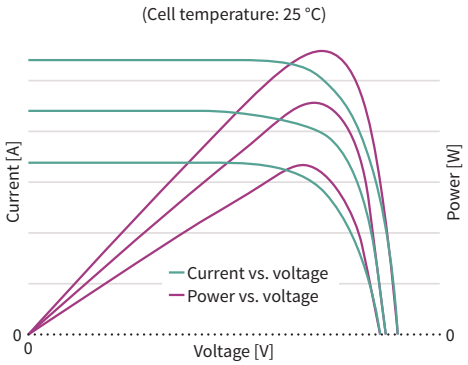
Suggested products

- TC26xD – TriCore™ 32-bit microcontroller
- TC27xT – TriCore™ 32-bit microcontroller

System benefits

- Diverse timer architecture: generic timer module (GTM), CCU6, GPT12
- 8 SAR-ADCs 12-bit resolution, 1 MSPS
- DS-ADC
- Resolver I/F
- Encoder I/F with digital noise filter
- IEC 61508 support - Integrity Level (SIL) 1 to 3
- Innovative single power supply concept
- DSP library available

Maximum Power Point Tracking (MPPT)



TriCore™ tool partners

Embedded software solutions AUTOSAR suites

Simulation/virtual prototyping

Integrated compiler environments

Auto code generation tools

Timing/scheduling analysis

Operating systems

Debugger and test tools

Data measurement/calibration/rapid prototyping

Programmer/flash tools

Software verification

Training/services

Free tooling

Free TriCore™ Entry Toolchain, MemTool, ACT