AURIX™ 32-bit micro-controllers for automotive and industrial applications

Highly integrated and performance optimized

www.infineon.com/aurix

Infineon

Contents

Family Highlights

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

Powertrain – Applications

- Powertrain domain controller
- Gasoline direct injection
- Gasoline multi-port injection
- Diesel direct injection
- Automatic transmission
- Transfer case/torque vectoring

xEV – Applications

- Battery management
- Off-board charging
- On-board charging
- Charging station
- Inverter
- Low-voltage DC-DC
- High-voltage DC-DC

Chassis & 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 (24/60 GHz)system
- Long-range radar (76/77 GHz) system
- LIDAR systems
- LED pixel lighting
- Sensor fusion
- eHorizon

Body & Connectivity – Applications

- Body domain controller
- Connected gateway
- Advanced body applications
- Pixel lighting
- In-vehicle wireless charger
- Telematics
- V2x communication
- Zone Controller

Transportation – Applications

- Commercial and
- Agricultural Vehicle (CAV)
- Railway
- Trucks & Bus
- Trucks
- Drones
- Avionics
- Electric Vertical TakeOff and Landing aircraft

Industrial & Multimarket – Applications

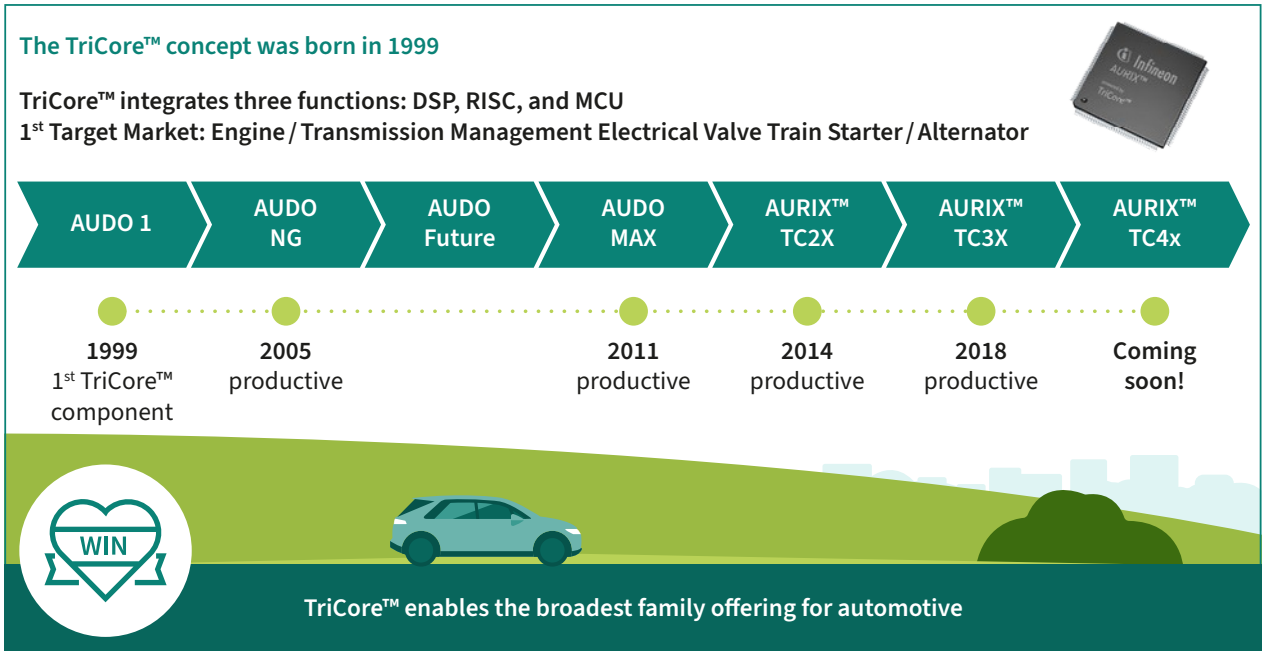
- Safe PLC
- Inverter
- Wind turbine inverter
- Servo drives
- Solar Panel
- Industrial Robotics
- Medical
- Elevator
- EV charger

AURIX™ overview and evolution

Evolution of TriCore™ generations

In 1999, Infineon launched the first generation of the AUDO (AUtomotive unifieD processOr) family. Based on a unified RISC / MCU / DSP processor core, this 32-bit TriCore™ microcontroller was a computational power horse. And the company has evolved and optimized the concept ever since – culminating in what is now the sixth TriCore™ generation.

Thanks to its high real-time performance, embedded safety and security features, the TriCore™ family is the ideal platform for a wide range of automotive applications. These include powertrain engine management and transmission, electric and hybrid vehicles, chassis domains, braking systems, electric power steering systems, airbags, connectivity and advanced driver assistance systems to support the trend toward autonomous and software defined vehicles. TriCore™-based products also deliver the versatility required for the industrial, CAV and transportation sector, excelling in optimized motor control applications and signal processing. Infineon's broad product portfolio allows engineers to choose from a wide range of memories, peripheral sets, frequencies, temperatures and packaging options. And all this with a high degree of compatibility across generations.



The TriCore™ success story continues with the AURIX™ TC2x and TC3x multicore family. AURIX™ combines easy-to-use functional safety support, strong performance and a future-proven security solution in a highly scalable product family. The next natural evolution in terms of performance is the AURIX™ TC4x, which is manufactured in 28 nm technology and designed for ultimate reliability in harsh automotive environments.

As before with AURIX™, the dual frontend concept ensures continuous supply. An extensive ecosystem is available including the AUTOSAR libraries which Infineon has been developing since 2005. Plus the safety software is also available to help manufacturers meet SIL / ASIL safety standards.

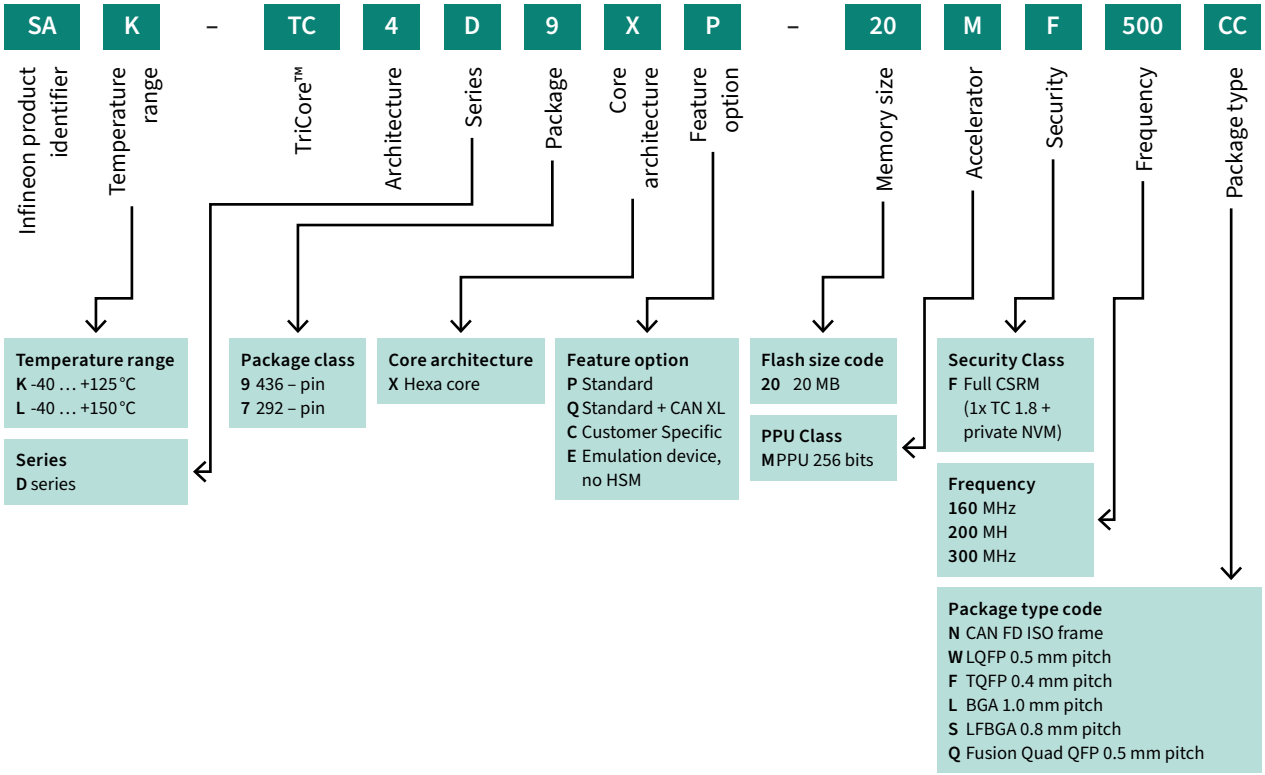
TriCore™ based product roadmap

Segment	Production		
	AURIX™ TC2x	AURIX™ TC3x	AURIX™ TC4x
	65 nm	40 nm	28 nm
High end	TC29xTX 3×300 MHz, 8 MB TC29xTP 3×300 MHz, 8 MB TC27xTP 3×200 MHz, 4 MB	TC39xXA 6×300 MHz, 16 MB TC39xXX 6×300 MHz, 16 MB TC39xXP 6×300 MHz, 16 MB TC3E7Qx 4×300 MHz, 12 MB TC38xQP 4×300 MHz, 10 MB TC37xTX 3×300 MHz, 6 MB TC37xTP 3×300 MHz, 6 MB	TC4x Up to 6×500 MHz Up to 24 MB
Mid range	TC26xD 2×200 MHz, 2.5 MB	TC3AxQA 3×300 MHz, 4 MB TC357TA 3×300 MHz, 4 MB TC36xDP 2×300 MHz, 4 MB	
Low end	TC23xLX 200 MHz, 2 MB TC23xLP 200 MHz, 2 MB TC22xL 133 MHz, 1 MB TC21xL 133 MHz, 0.5 MB	TC33xDA 2×200 MHz, 2 MB TC33xLP 200 MHz, 2 MB TC32x 160 MHz, 2 MB	
Companion chips	TLF35584	TLF35584 TLF30684	

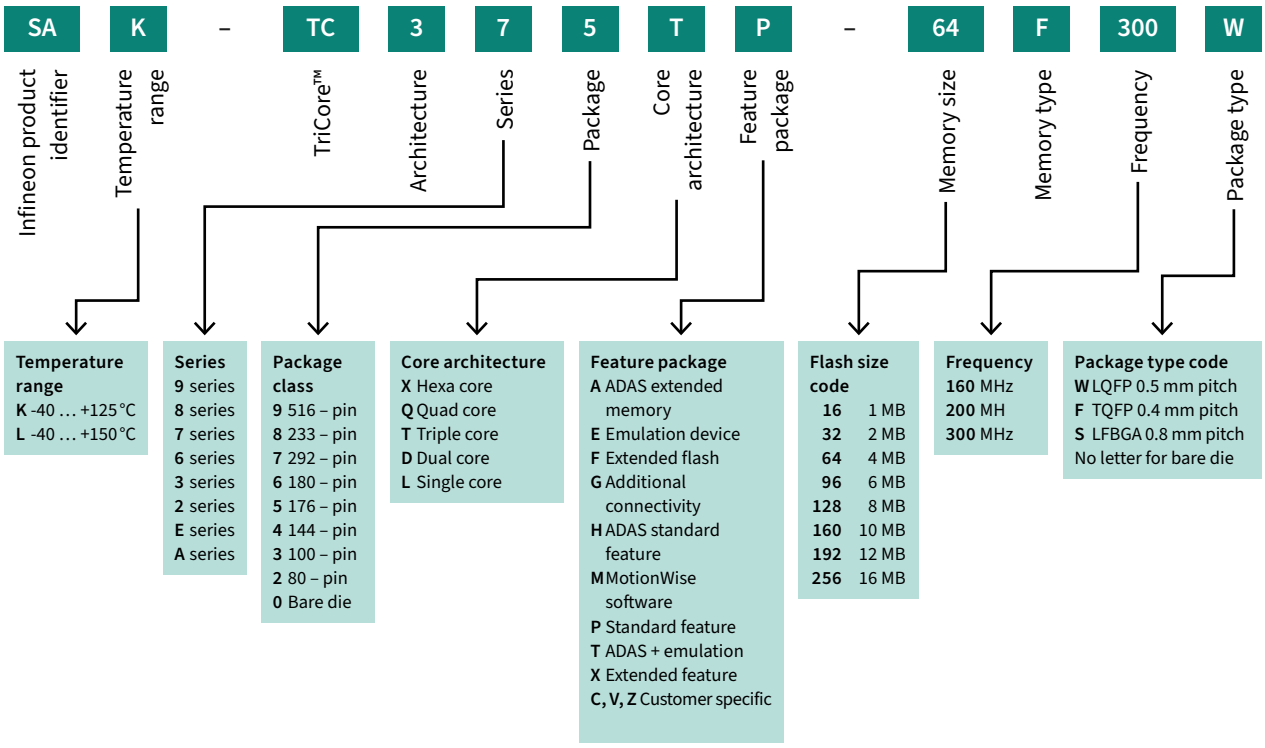
AURIX™ 1st generation AURIX™ 2nd generation AURIX™ 3rd generation

Product Nomenclature Decoder

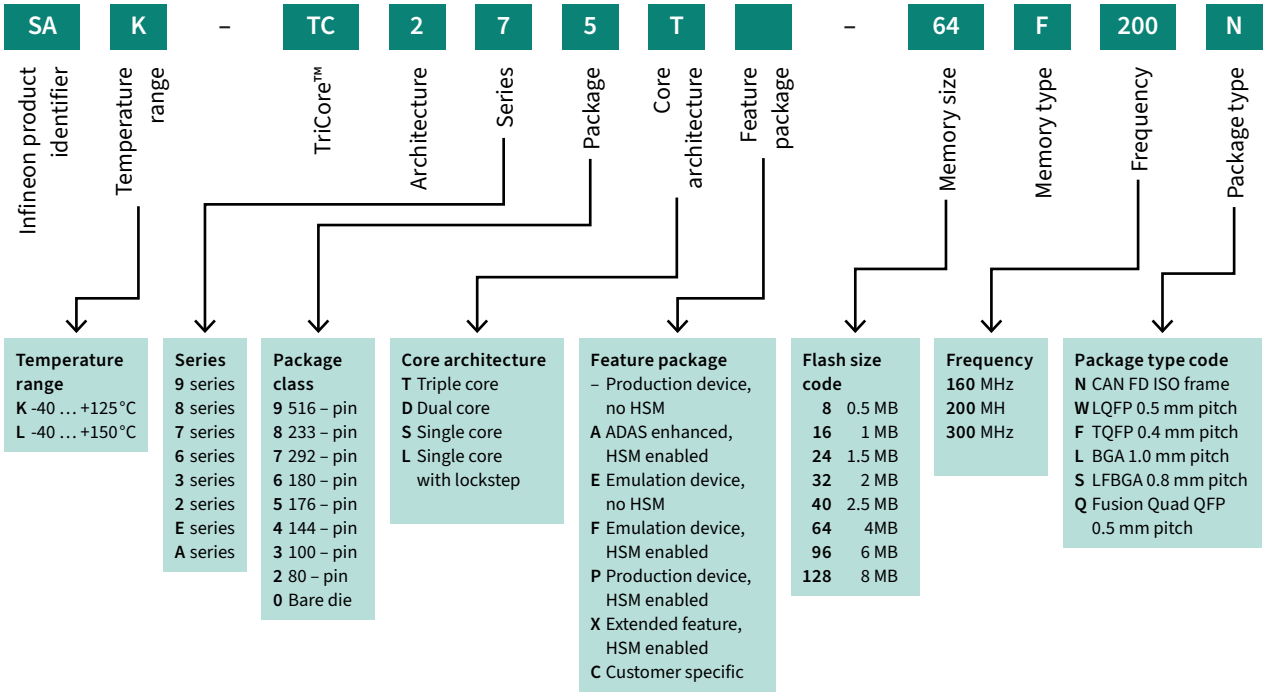
AURIX™ TC4x family product naming system



AURIX™ TC3x family product naming system



AURIX™ TC2x family product naming system



Product Family & System Architecture

AURIX™ TC4x family system architecture

Infineon's AURIX™ TC4x family of microcontrollers – a leader in real-time safety and security performance is coming!

Major disrupters have emerged in the automotive market:

- Innovation in automotive E/E architecture microcontrollers (MCUs) in the areas of domain and zone control
- Accelerated shift from conventional powertrain to xEV
- Increased safety and automated driving

Infineon's AURIX™ TC4x family addresses these challenges, pushing the boundaries in automotive MCU usage for safe and secure processing. These microcontrollers are designed for next generation eMobility, ADAS, Chassis and automotive E/E architectures and affordable artificial intelligence (AI) applications. AURIX™ TC4x has already been chosen by major OEM and Tier 1 for their upcoming platform.

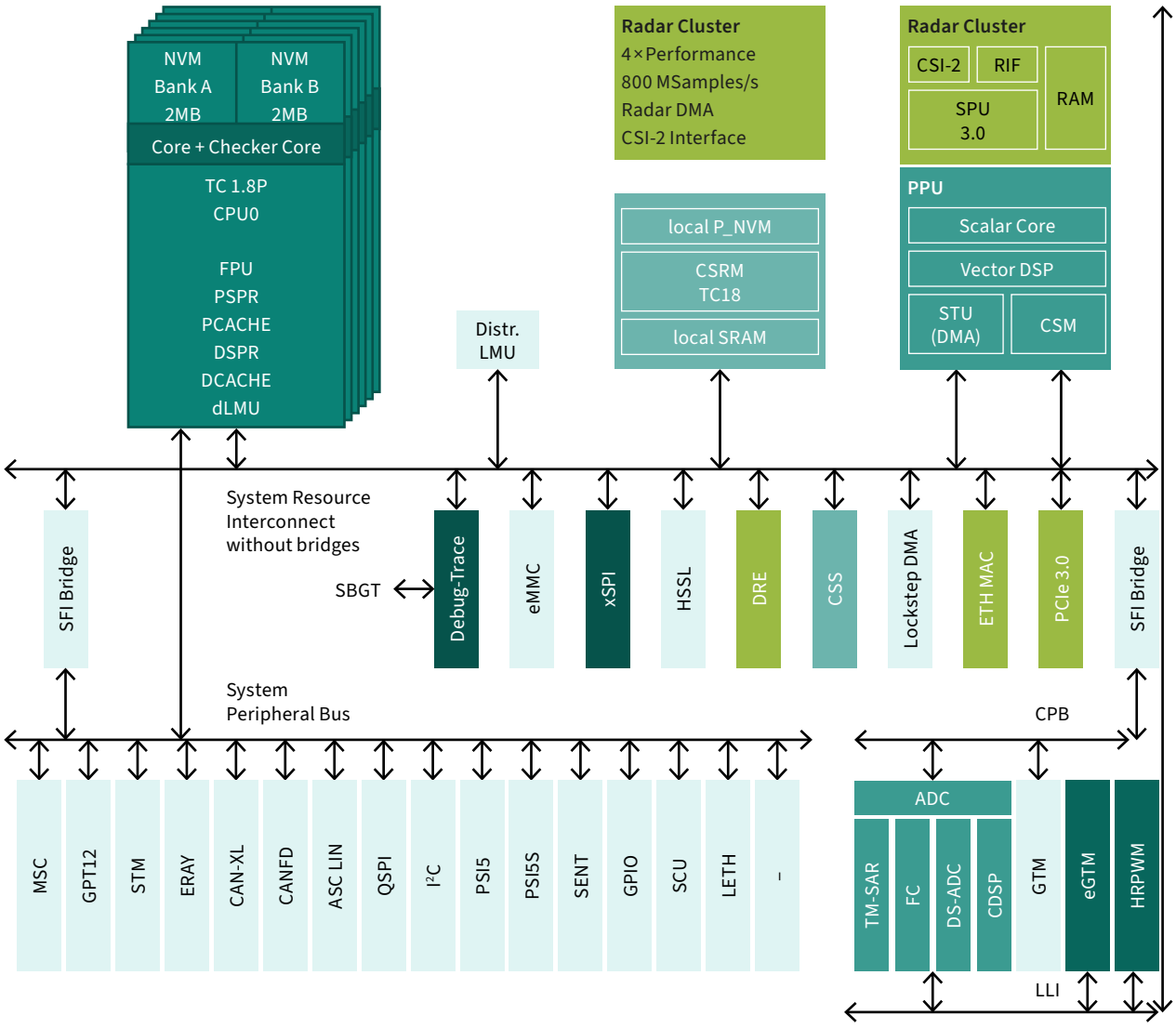
The new scalable microcontroller TC4x family provides an upward migration path from Infineon's leading AURIX™ TC3x family of ASIL-compliant automotive MCUs.

Performance is boosted by the next-generation TriCore™ 1.8 and the scalable AURIX™ accelerator suite, including the new Parallel Processing Unit (PPU) and multiple smart accelerators.

Support for high-speed communication interfaces like 5G-bit Ethernet and PCIe along with new interfaces such as CAN-XL and 10BASE T1S Ethernet gives customers the performance, throughput and flexibility needed to implement new automotive-specific microcontrollers with E/E architectures.

The scalable family concept enables a common software architecture supporting significant platform software savings and the feature-rich concept gives plenty of headroom to grow for both Tier 1's and OEMs.

www.infineon.com/aurix-tc4x



Performance ASIL-D

- **Enhanced TriCore™**
- With up to 6CPUs @ **500 MHz**
- **Bigger Tightly Coupled SRAM** for increased performance
- **Full AB-Swap Support**

Debug and Trace

- Safe and the secure in field

xSPI

- External Memory Interface

ADC

- Dedicated DSPs
- Enhanced ADCs

CSRM

- New high performance Security Modules with QM support

CSS

- Dedicated communication security satellites

New Programmable HW

- **Accelerator – PPU**
- **SIMD Vector DSP + Scalar Core** for Modelling and Precise Control – **ASIL D**

New high-speed comm Interfaces

- PCIe 3.0
- 100Mb- 5 Gbps Ethernet
- **New 10 Mbit Ethernet and CAN-XL**
- **New communication routing accelerator:**
- DRE- Data Routing Engine

New eGTM

- **New eGTM** timers and **High Resolution PWM** with **low latency interconnect (LLI)**

AURIX™ TC4x enhancements

Accelerator Suite

- Each peripheral and shared SRAM has a resource management unit that works as a local access protection mechanism to grant or deny access
- When combined with the memory protection system, this hardware can be used to prevent selected direct access from certain tasks or cores to peripherals or regions of SRAMs and instead redirect the attempted access to a hypervisor function

Memory Upgrade

- Up to 25 MB on-chip Flash
- Zero downtime SOTA support with optimized A / B swap partitioning and external memory interfaces

Broad Connectivity

- Scalable high-speed communication interfaces:
  - 5 Gbps Ethernet
  - PCIe
  - 10BASE T1S Ethernet
  - CAN-XL
- Data Routing Engine (DRE) – communication accelerator

Advanced Timers and ADCs for real-time control

- New eGTM timers and high-resolution PWM with low latency interconnect (LLI). Faster control loops for e-motors & power conversion
- GTM for compatibility with AURIX™ TC3x
- ADC Converters TM / FC / DS /
- CDSP / DSEX accelerator

Safety and security performance boost

- Each security cluster including CSRM and CSS offers enhanced security performance
- ISO 21434 compliant
- Safe DMA
- ASIL-D compliant

Extensive development ecosystem

- Infineon MCAL drivers
- Re-use of existing AURIX™ TC3x algorithms & ecosystem possible
- Rapid prototyping support from Virtual Prototyping using Synopsys – Virtualizer Development Kit for AURIX™ TC4x
- Software Development Kit (SDK)
- Simplify PPU software development using the Synopsys – MetaWare Toolkit for AURIX™ which includes MATLAB and Simulink, DSP and math libraries, Neural Network Software Development Kit, and AUTOSAR Complex Device Driver

AURIX™ TC3x family system architecture

Scalable 2nd generation AURIX™ TC3x system architecture

The latest AURIX™ TC3x microcontrollers are also well-suited for safety-critical applications to support clean, autonomous and connected cars. Ranging from classic airbag, braking and power steering to fail-operational systems supported by sensor-based systems using radar, LIDAR or camera technologies.

The implemented connectivity features, in combination with the highest level of security, enable connected cars with applications such as a telematics unit, connected gateway or in-vehicle wireless charging for portable devices.

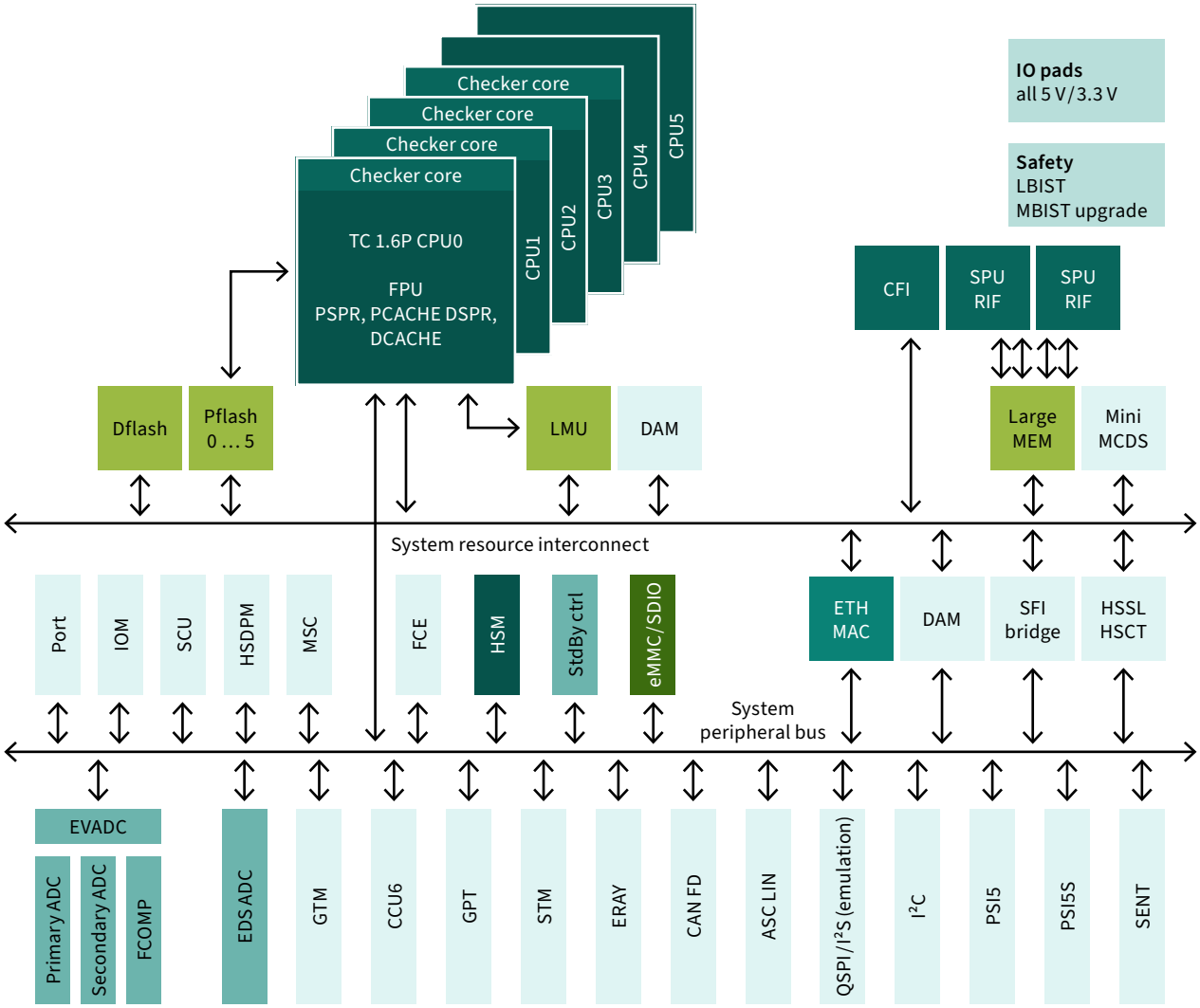
To make the car clean, the new family is well-suited to new systems in electrical and hybrid drives – specifically hybrid domain control, inverter control, battery management, on-board charger and DC-DC converters, in addition to engine management and transmission control systems.

The AURIX™ TC3x combines performance with a powerful safety architecture and offers enhanced security with the second-generation HSM with asymmetric cryptography accelerators and Full EVITA support. This combination makes the family the ideal fit for domain control and data fusion applications supporting the next levels of autonomous driving.

The AURIX™ TC3x family is pin compatible with the AURIX™ TC2x family and offers increased flash memory sizes of up to 16 MByte, over 6 MByte of integrated RAM and up to six TriCore™ 1.62 embedded cores, each with a full clock frequency of 300 MHz. New features include a new radar processing sub-system with up to two dedicated Signal Processing Units (SPU), Gigabit Ethernet, additional CAN FD and LIN interfaces and an eMMC interface for external flash.

www.infineon.com/aurix-tc3x

AURIX™ TC3x – scalable family – from low-cost to high-performance applications



Performance
- New TriCore™ 162 generation
- New instructions
- Up to 6 CPUs at 300 MHz
- New direct flash access path

HSM: Full EVITA compliance
- New accelerators ECC256/SHA256
- Available on all devices

ADAS
- LVDS IF
- Signal processing unit

ADC
- Improvement of existing ADC
- Reduction of capacitive load

Delta-sigma
- Enhanced concept

Memories
- Larger SRAM
- SRAM/flash ratio increased
- Enhanced MPU
- A/B swap support

Stand-by control unit
- Low-power modes

Ethernet
- 1 Gbit/s ETH
- QoS services
- Remote DMA

eMMC/SDIO
- External NAND flash IF

AURIX™ TC3x family package scalability

Cores	Flash	TQFP-80	TQFP-100	LQFP-144 TQFP-144	BGA-180	LQFP-176	BGA-233	LFB-GA-292	LFB-GA-516
		Package							
6×300 MHz	16 MB							TC397XA	
6×300 MHz	16 MB							TC397X	TC399X
4×300 MHz	12 MB							TC3E7Qx	
4×300 MHz	10 MB							TC387Q	TC389Q
3×300 MHz	6 MB							TC377TX	
3×300 MHz	6 MB					TC375T		TC377T	
2×300 MHz	4 MB			TC364D	TC366D	TC365D		TC367D	
4×300 MHz	4 MB						TC3A8Q	TC3A7Q	
3×300 MHz	4 MB				TC356TA			TC357TA	
2×300 MHz	2 MB				TC336DA			TC337DA	
1×300 MHz	2 MB	TC332L	TC333L	TC334L	TC336L			TC337L	
1×160 MHz	1 MB	TC322L	TC323L	TC324L				TC327L	

● Control and actuate ● Sense and compute

– Advanced package technologies deliver the best price / performance ratio
– Customers can choose between different devices in the same pin-compatible package

MCU scalability

- Performance and flash
- Pin compatibility
- Binary-compatible cores

Power consumption

- On-chip SC DC-DC high-efficiency power supply
- Integrated stand-by controller

AURIX™ TC3x

Functional Safety / security concept

- ISO26262 and IEC61508 certified by TÜV
- Performance and flash
- Pin compatibility
- Binary-compatible cores

Connectivity

- Ethernet: up to 2×1 GB
- CAN FD: up to 20 channels
- LIN: up to 24 channels
- eMMC IF

AURIX™ TC2x family system architecture

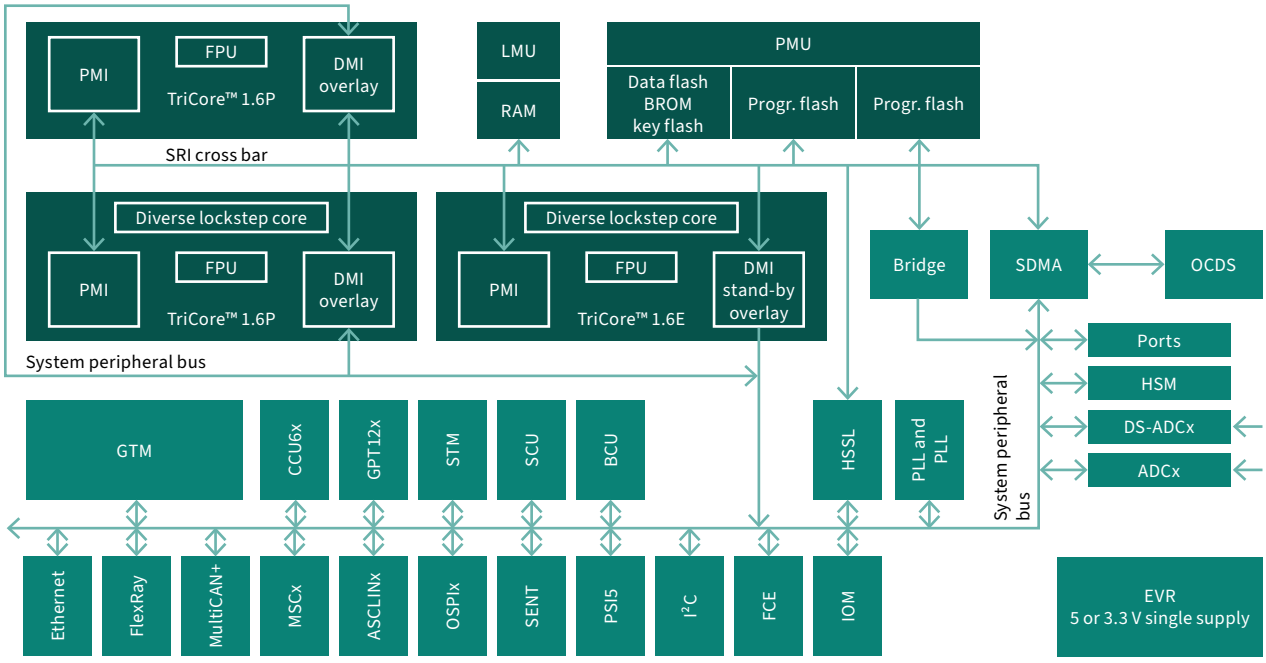
Powerful 1st generation AURIX™ TC2x system architecture

AURIX™ is Infineon's current family of microcontrollers that serve the precise needs of the automotive industry in terms of performance and safety. Its innovative multicore architecture, based on up to three independent 32-bit TriCore™ CPUs, has been designed to meet the highest safety standards, while simultaneously increasing performance significantly.

Using the AURIX™ platform, automotive developers will be able to control powertrain and safety applications with one single MCU platform. Developments using AURIX™ will require less effort to achieve the ASIL-D standard than with a classical lockstep architecture.

Customers wanting to reduce their time-to-market can now cut down their MCU safety development by 30 %. By the same token, a performance surplus of 50 % up to 100 % allows for more functionality and offers a sufficient resource buffer for future requirements, keeping the power consumption on the single-core microcontroller level. While protecting IP, and preventing theft and fraud, AURIX™ provides an already built-in hardware security module.

Thanks to its special feature set, AURIX™ is the perfect match for powertrain applications (including hybrid and electrical vehicles) as well as safety applications (such as steering, braking, airbag and advanced driver assistance systems).



www.infineon.com/aurix-tc2x

AURIX™ TC2x family package scalability

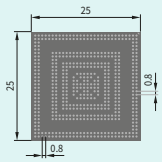
Cores	Flash	TQFP-80	TQFP-100	TQFP-144 LQFP-144	LQFP-176	LFB- GA-292	BGA-416	LFB- GA-516
		Package						
300 MHz	up to 8 MB					TC297	TC298	TC299
200 MHz	up to 4 MB				TC275	TC277		
200 MHz	up to 2.5 MB			TC264	TC265	TC267		
200 MHz	up to 2 MB		TC233	TC234		TC237		
133 MHz	up to 1 MB	TC222	TC223	TC224				
133 MHz	up to 512 KB	TC212	TC213	TC214				

- The LFBGA-516 package is a superset of the LFBGA-292
- Combination PCBs can be designed for I/O and feature upgrades
- Advanced package technologies deliver the best price/performance ratio
- Customers can choose between different devices in the same pin-compatible package

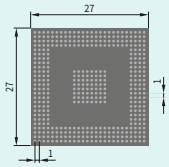
AURIX™ family housing options

Package information for maximum scalability

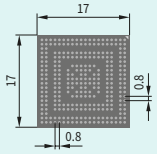
LFBGA-516



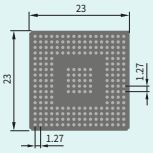
BGA-416



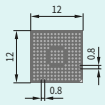
LFBGA-292



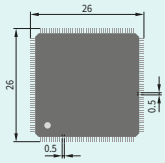
BGA-233



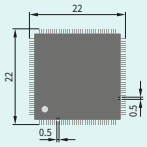
BGA-180



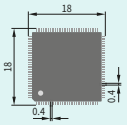
LQFP-176



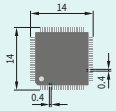
LQFP-144



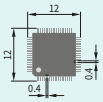
TQFP-144



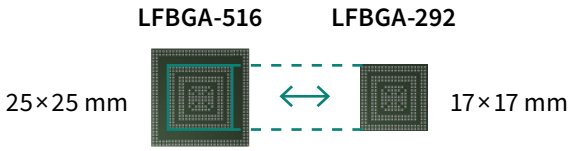
TQFP-100



TQFP-80



TriCore™ upgrade paths



BGA scalability

LFBGA-292 and LFBGA-516 are ball compatible so that customers can build one PCB for both packages

AURIX™ TC4x SW application architecture

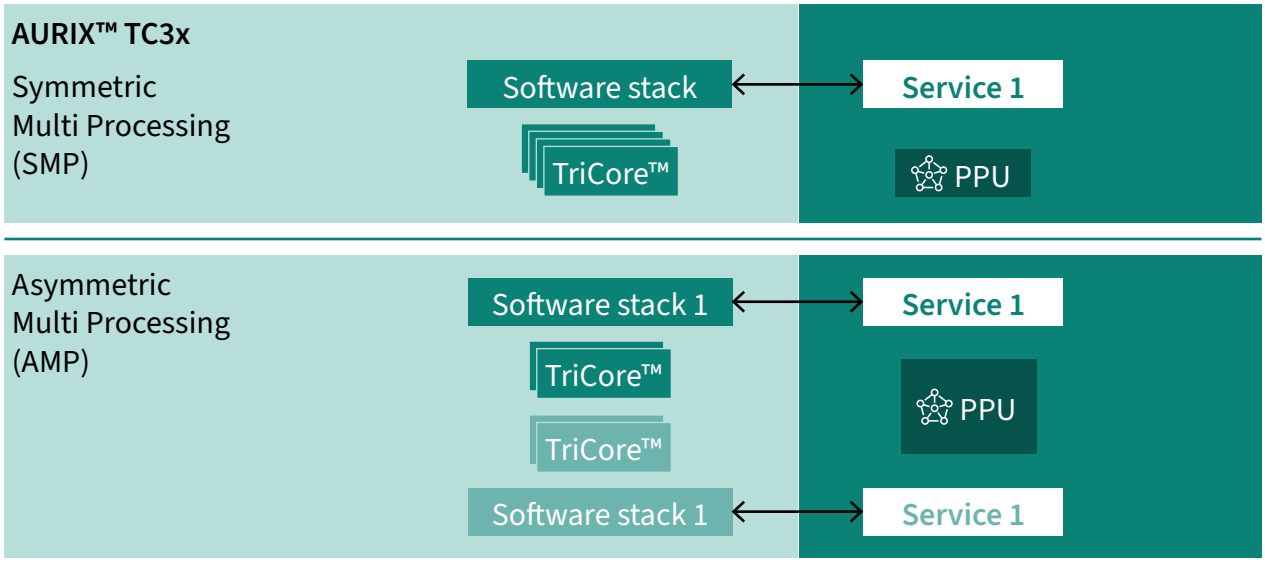
Next generation AURIX™ is a heterogeneous architecture providing new computing abilities for new implementations

AURIX™ TC3x

- Enables SMP and AMP

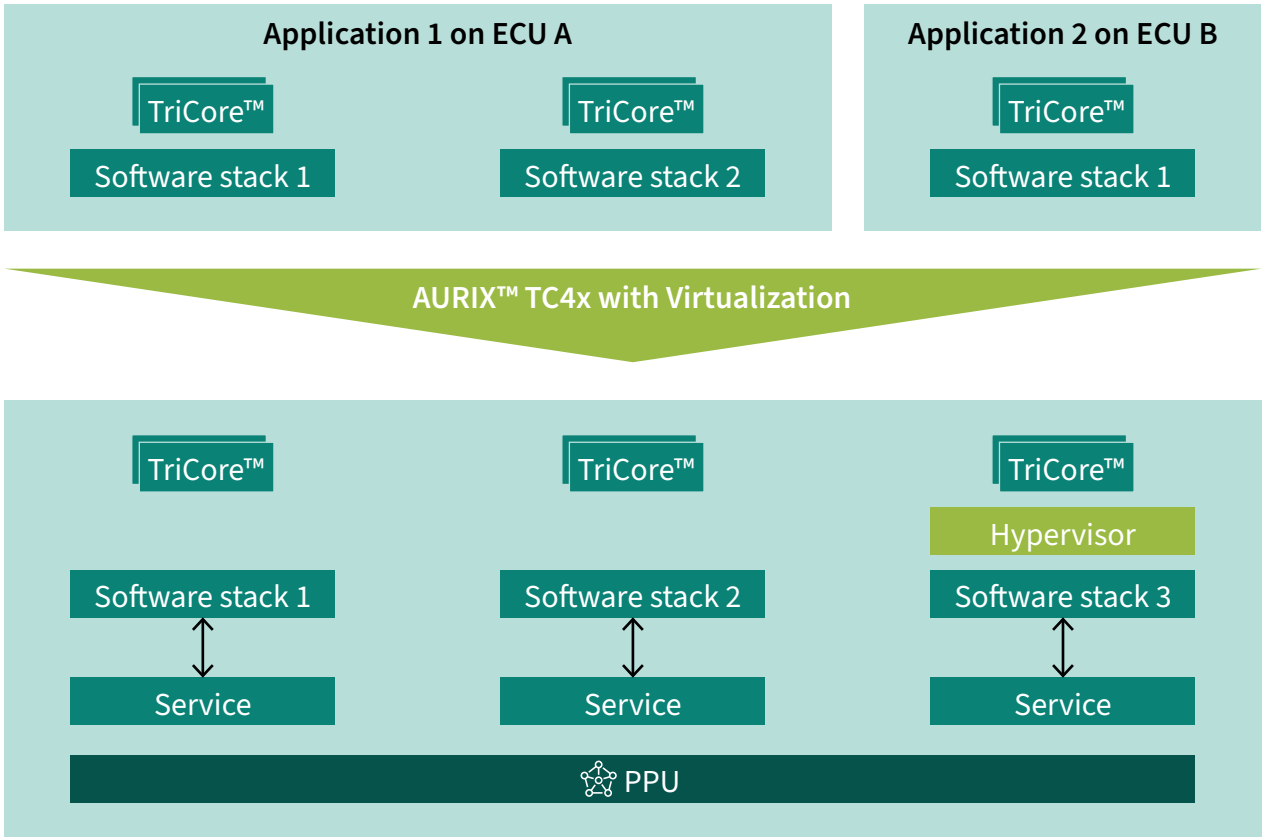
Next-generation AURIX™ TC4x

- Offers heterogeneous variant of SMP and AMP
- PPU can accelerate any functional block stack
- PPU is service provider
- Opens new computational opportunities function



AURIX™ TC4x offers TriCore™ virtualization

- Seamless integration of functions, reducing standalone ECUs
- PPU does not distinguish between virtualized and non-virtualized clients
- Benefits for new and legacy application stacks



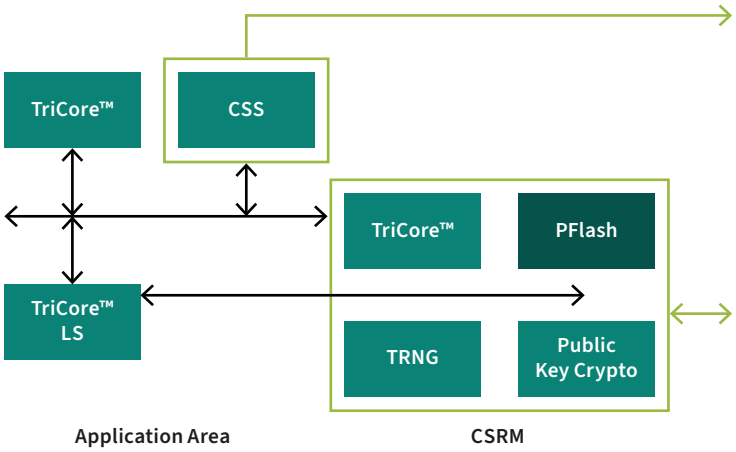
AURIX™ TC4x offers a tremendous computational power boost compared to the previous generation deploying new applications with complex computing needs. The demonstration shows that the PPU:

- Middleware detects requests by dedicated AUTOSAR stacks and handles prioritized execution
- All forms of computations are preserved – traditional AMP and SMP
- They are extended in their topologies by heterogeneous computing
- SW ecosystem will support AUTOSAR and tool-chain enabling high-level programming languages

AURIX™ TC4x innovative cybersecurity architecture

How to secure the future car?

Future cars, with their increasing communication capabilities, will need protection from the ever-changing cyber-security landscape. In order to adapt to these new challenges, we have developed a new concept to address upcoming car-related cybersecurity threats. AURIX™ TC4x comes with a new and innovative cybersecurity cluster, which includes two main modules, the cyber security real time module (CSRM) and the cybersecurity satellite (CSS).



Cyber Security Satellite (CSS)
- Parallelization of HW accelerators is service provider to application area
- Multiple channels to be used by independent applications with different trust levels
- Multiple HW accelerators to increase through put avoid performance bottlenecks
- Providing freedom of interference
- Providing support to ASIL-D use-case

Cyber Security Real-time Module (CSRM)
- CSRM as trusted secure HW environment
- Providing ~ 5–15x more performance vs. previous generation
- Support individual security SW updates independent of application core
- Enable realization of multiple security use cases for wide ranging applications

The CSRM is the root of trust in AURIX™ TC4x for a secure hardware environment. It supports individual security software updates independent from the application core and enables the implementation of multiple security use cases for wide-ranging applications.

CSS is the novel addition to the cluster. It enables the parallelization of hardware accelerators as a service provider to the application area, allowing for multiple channels to be used by independent applications with different trust levels.

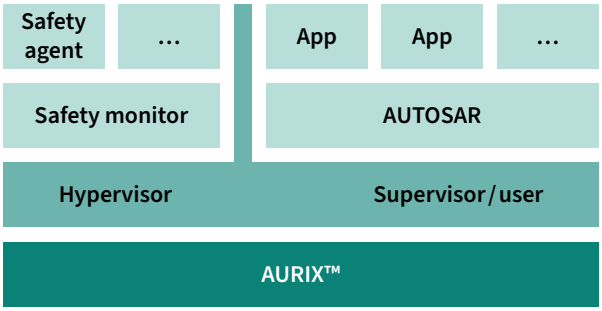
One of the key features of the CSx is that it supports a variety of use cases with a specific focus on communication requirements, as well as vehicle-to-infrastructure (V2X)use cases:
- Intrusion Detection System
- Intrusion Detection Prevention System
- Firewall: feasible with hardware filters in MAC and software
- Authenticated Encryption with Associated Data
- Authentication with Associated Data
- Combined modes

All these allow:
- Minimizing latency and maximizing throughput, as an increasing number of security use cases are expected in the future
- Your system to comply with the newest security standards, namely ISO 21434 and UNECE WP.29
- Enabling software-over-the-air use cases, which require secure and safe distribution of software updates from the cloud or within the vehicle network
- Serving Authenticated Encryption with Associated Data and Authentication with Associated Data solutions, which are expected to gain importance in the future

Peripheral Highlights

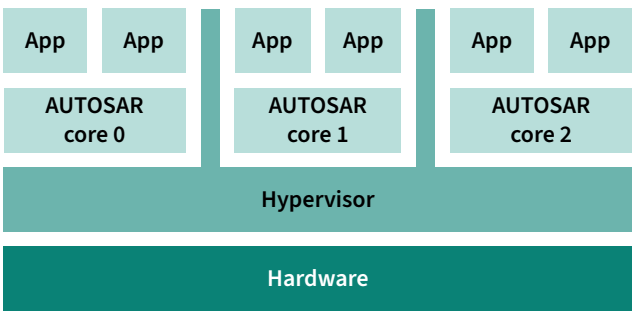
Multi-AUTOSAR OS support on one microcontroller

- AURIX™ provides a memory protection system for each core plus an additional distributed hardware-based resource management system
- Each peripheral and shared SRAM has a resource management unit that works as a local access protection mechanism to grant or deny access
- When combined with the memory protection system, this hardware can be used to prevent selected direct access from certain tasks or cores to peripherals or regions of SRAMs and instead redirect the attempted access to a hypervisor function
- The hypervisor can arbitrate / grant / deny access and therefore provide paravirtualization of mixed-criticality tasks in a unified sub-system architecture with a minimal CPU overhead
- AURIX™ therefore provides the ability to run mixed-criticality software requiring real-time access while still enforcing encapsulation and freedom of interference between cores, even when the cores are not running time and memory-protected operating systems



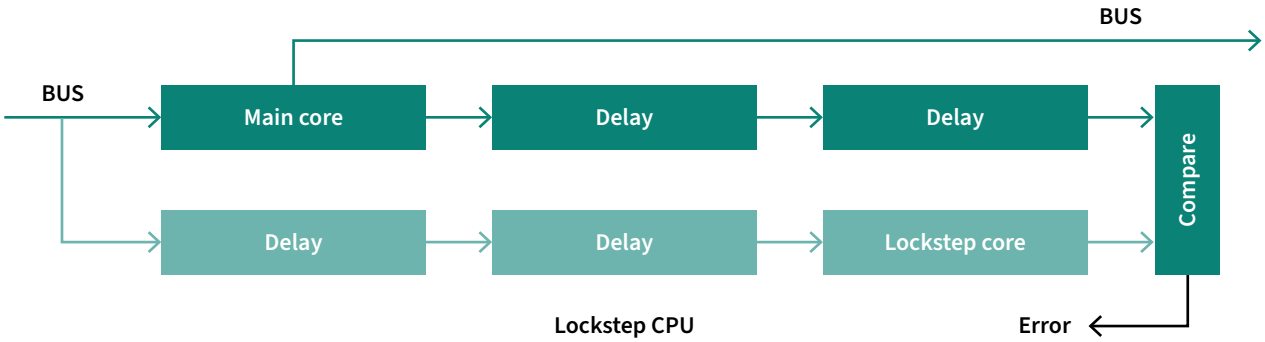
AURIX™ protection system overview

- Hardware support for freedom of interference
  - Between software components
  - Between hardware parts
  - Between hardware parts and software components
- Timing protection



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 and timing diversity
- Layout-level diversity
- Diversity controlled and verified by state-of-the-art design methods
- Special design of clock and 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

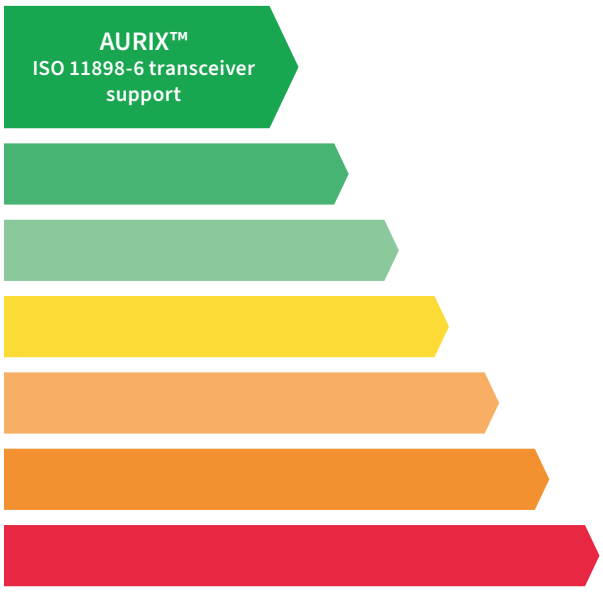


● Lockstep

AURIX™ family communication innovation

AURIX™ Multi-CAN / CAN FD

- Up to 20 CAN nodes with FD support available
- CAN standard V2.0 B active
- AURIX™ family support ISO 11898-1 DIS 2015
- Resonator ready with asynchronous operation and choice of clock source
- Frequency scaling without baud rate change
- Energy saving: pretended networking and partial networking (ISO 11898-6 transceiver support) support (also in CAN FD mode)
- Safety support: countable total amount of bus errors
- Message objects can be freely assigned among the nodes
- Configurable FIFO length, automatic gateway mode support
- Acceptance mask filtering for each message object



AURIX™ Ethernet module

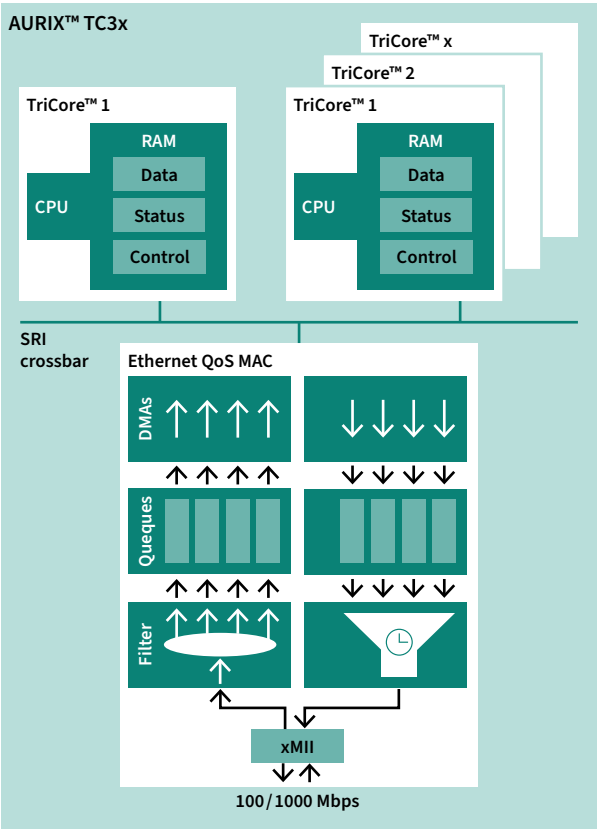
Key highlight features

Ethernet MAC filter

- MAC / VLAN / protocol filter for fast frame processing

QoS

- 8 queues / DMAs for frame separation
- 4 transmit / 4 receive
- IEEE 802.1AS (for IEEE 1588-2008)
- Shapers for bandwidth control
  - 802.1 credit-based shaper
  - Time-aware shaper



Interfaces

- MII / RMII for 100 MBaud
- RGMII for 1 GBaud

Freedom from interference

- DMA operation → separated by hardware
- No impact of queue operation on other queues, DMAs etc.
- Independent control of each queue
- Status / control in RAM → fast direct stack access

"Remote DMA" – fast data copy – RAM to RAM

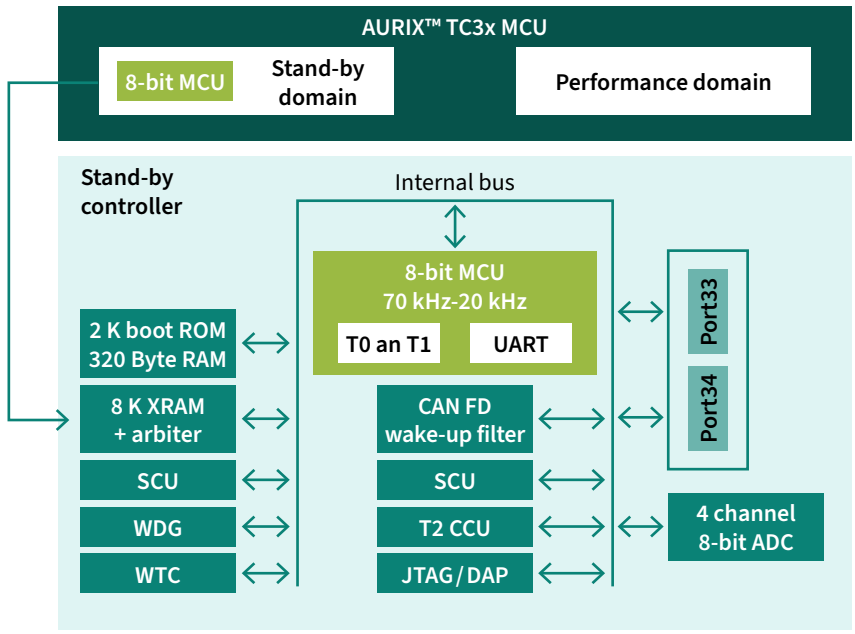
- Data transfer by DMA with no CPU required for transfer
- Transfers triggered by hardware or by software
- Transfers are hardware protected (in AURIX™)
- Full-duplex transfers, low latency mode
- All Ethernet standards and conformance tests are valid

SOME / IP DoIP		"AVB" IEEE 1722	
		IEEE 802.1Q control	
TCP / UDP	IEEE 802.1AS	IEEE 802.1Qav	IEEE 802.1Qbv prelim.
IPv4 / IPv6	Precision Time Protocol (PTP)	Credit-based shaper	Time-based shaper
Clock sync, time stamp Protocol filter VLAN filter MAC filter			

- Software implementation, "Stacks"
- Hardware implementation, available in AURIX™ TC3x

AURIX™ TC3x stand-by controller

Low power consumption, higher energy efficiency, easy implementation



Features and benefits

- Feature available across whole AURIX™ TC3x family
- Integrated 8-bit MCU (ISO 26262 QM module)
- Stand-alone operation
  - Separate power supply at core and IOs
  - Separate clock
  - Separate GPIOs
- Standard tooling support enabling fast design-in
- Real-time clock for periodic wake-up
- Flexible choice of peripherals: LIN / SPI
- Shared I / O with performance domain
- Extremely low current consumption ~ µA range

Application recommendation

- **Enhanced availability:** continue a limited set of functions while the main CPUs are rebooting after a reset (typ. watchdog reset)
- **Steering and braking comfort:** temporary torque supply during main MCU
- **Stand-by operation:** extremely low-power operation while the vehicle is parked
- **(H)EV battery management:** monitor the battery's state-of-heath and charge over a long parking period, e.g. vacation
- **Keyless-go:** trigger main MCU for key communication
- **Fuel leakage supervision:** on-board diagnostics and monitoring of tank pressure, e.g. while parked

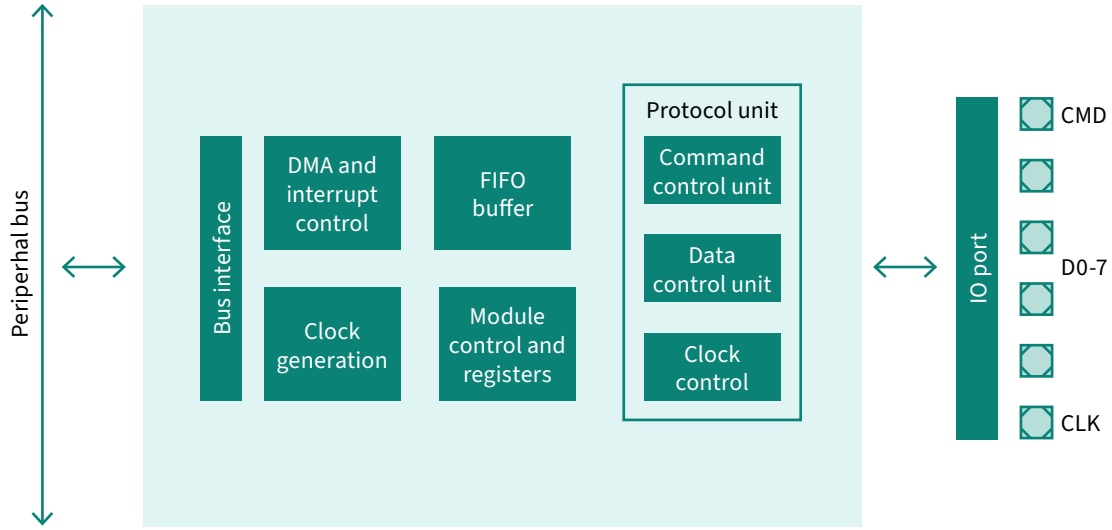
eMMC / SDIO interface on

2 standard protocols supported

- SDIO 2.0
  - 6 pins: 4 data, CLK, CMD
  - 3.3 V, 50 MHz max. clock
- eMMC
  - 10 pins: 8 data, CLK, CMD
  - 3.3 V, 20 MHz

Use cases

- External serial NAND-flash
- Wi-Fi modems
- Camera modules



Safety and Security

AURIX™ Safety features

Infineon PRO-SIL™

The functional complexity and levels of integration of real-time, safety-critical applications continue to increase. Safety standards such as IEC 61508 and ISO 26262, mandate more robust products and functional safety concepts in automotive and industrial applications.

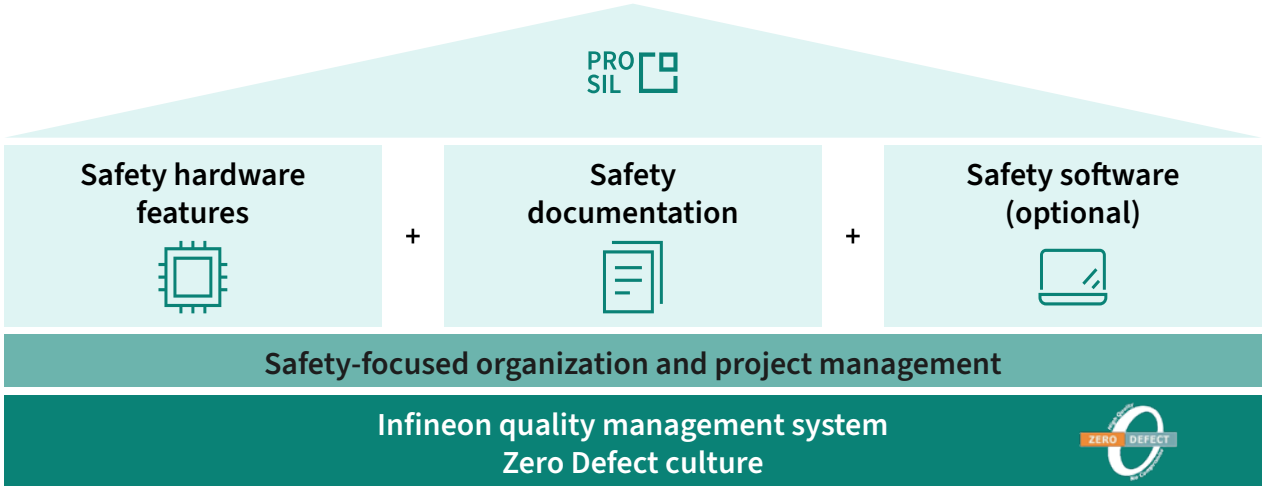
Infineon's PRO-SIL™ trademark designates the Infineon products that contain SIL-supporting (Safety Integrity Level) features.

The purpose of SIL-supporting features involves assisting the overall system design in attaining the desired SIL (according to IEC 61508) or ASIL (according to ISO 26262) level for safety systems with high efficiency. Products with the PRO-SIL™ label will help you to select Infineon products.

ISO 26262 compliant

PRO-SIL™ highlights

- Broad hardware portfolio, including sensors and microcontrollers, along with analog and power management ICs that provide SIL-supporting features
- An independent functional safety management organization supports the ISO 26262 safety lifecycle
- Safety documentation, such as a safety manual and safety analysis summary report, can be made available for dedicated PRO-SIL™ products (NDA may be required)
- Infineon offers expert system integrator support for achieving the required ASIL on system level
- Infineon's PRO-SIL™ logo will guide you to our products (hardware, software, safety documentation) with SIL-supporting fea tures. Infineon's activities result in simplified integration in safety-related applications



www.infineon.com/prosil

AURIX™ security features

AURIX™ security hardware

Infineon's AURIX™ 32-bit microcontroller family, with its embedded Hardware Security Module (HSM), is a perfect fit for automotive applications where secure on-board communication is required. Infineon not only offers a scalable portfolio of compatible AURIX™ devices with integrated HSM, but also the necessary software packages and support services. Furthermore, a best-in-class solution for automotive security can be achieved by combining AURIX™ microcontrollers with an Infineon embedded SIM (eSIM) and Infineon tamper-proof secure elements (TPM).

AURIX™ Hardware Security Module (HSM)

HSM provides a secure computing platform, consisting of a 32-bit CPU, special access-protected memory for storing the cryptographic keys and unique subscriber identifiers and dedicated hardware accelerators for the various automotive security use cases. A firewall separates HSM from the rest of the AURIX™ microcontroller.

The AURIX™ hardware security module offers a highly flexible and programmable solution based on:

- Crypto and algorithm agility via software to support customer-specific solutions powered by a 32-bits CPU
- AIS31-compliant True Random Number Generator (TRNG) with high random entropy over lifetime
- State-of-the-art AES-128 hardware accelerator matching performance for automotive protocols
- State-of-the-art PKC ECC 256 hardware accelerator for asymmetric encryption (only 2nd generation AURIX™ HSM)
- State-of-the-art HASH SHA2-256 hardware accelerator for hashing (only 2nd generation AURIX™ HSM)
- Secured key storage provided by a separated HSM-SFLASH portion. Alternative secure key storage feasible in dedicated HSM-PFLASH sections.

www.infineon.com/aurix-security-solutions

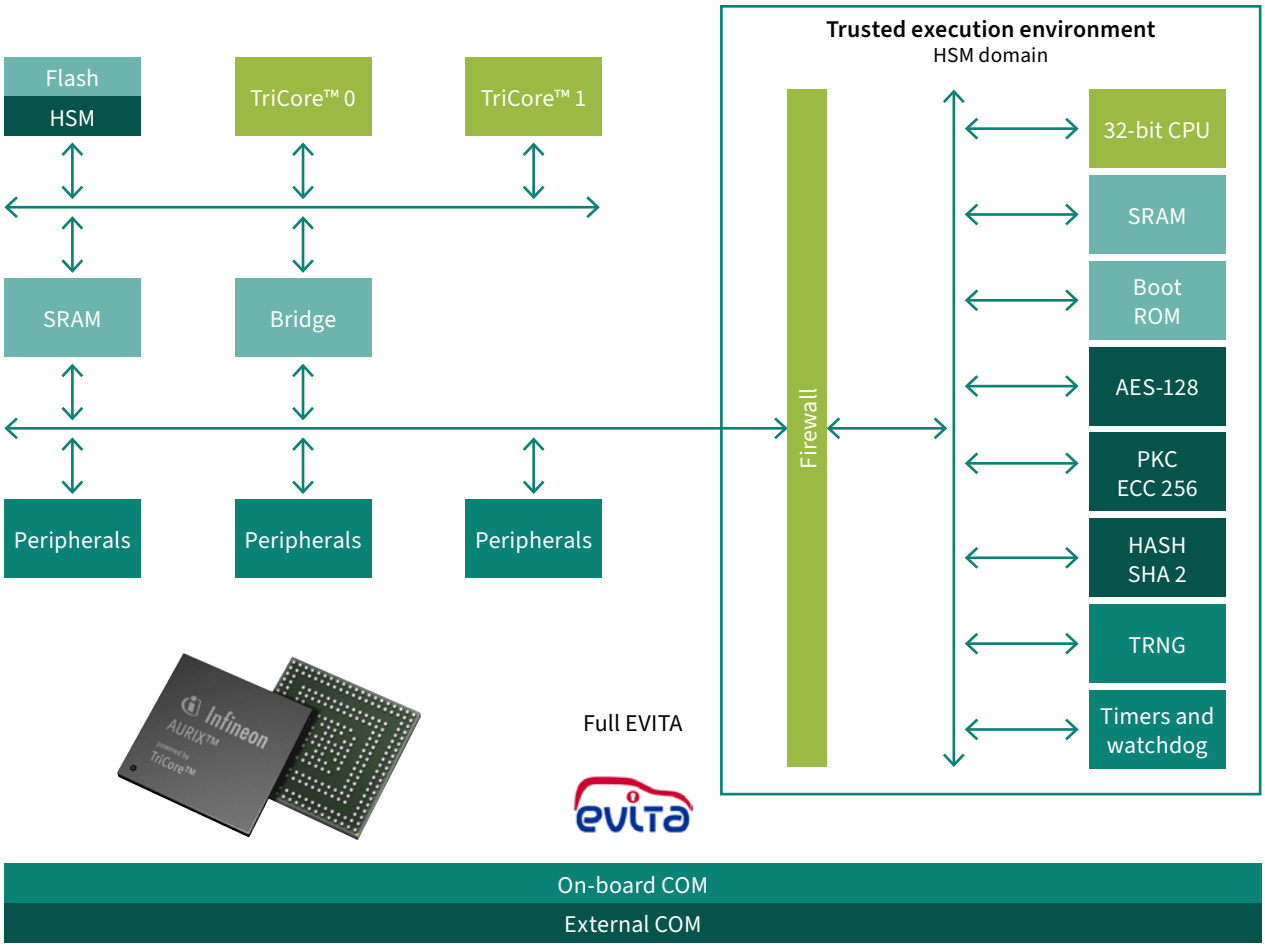
Customer benefits

- **Secured platform** – HSM provides a secured platform, separated from the rest of the microcontroller by a fire-wall, thereby creating a trusted execution environment
- **Security standard compliance** – AURIX™ HSM fulfills SHE HIS and EVITA Medium standards, while the 2nd generation AURIX™ HSM supports up to Full EVITA. In addition to fulfilling the aforementioned standards, HSM generations provide additional functionalities
- **Backward compatibility** – AURIX™ security solutions are backward compatible with the security SHE HIS implementations in previous TriCore™ based microcontroller families. Furthermore, the 2nd generation AURIX™ HSM is backward compati ble with the 1st generation HSM
- **Security differentiation** – customized secure OEM or tier1 crypto apps can be processed within a trusted HSM execution environment, therefore allowing an independent HSM-specific software code review with reference to the huge application host software 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 they are properly integrated and don't conflict with one another
- **Secured failure analysis** – AURIX™ HSM offers a 256-bit password for debugger access protection to prevent unauthorized access to the debugging resources

Typical use cases

- Secured boot
- Secured on-board communication
- Software Over the Air (SOTA) updates
- IP and tuning protection
- Diagnostics via OBD / protected FAR flow / debug protection
- Immobilizer

AURIX™ hardware security module – anchor of trust thanks to separated logical protection domain



HSM domain creates a trusted execution environment

- 32-bit ARM® MCU separated by security firewall
- Background integrity checks of host application

Root of trust functions

Security

- Integrity monitoring
  - Secure boot, on-the-fly checks
- Secure key storage
  - Protected data and program flash
- Strong key generation
  - AIS31-compliant True Random Number Generator (TRNG)
- Crypto accelerators
  - Symmetric: hardware AES-128
  - Asymmetric: hardware ECC-256, SHA-2

Infineon's AURIX™ 32-bit microcontroller family offers a wide portfolio of compatible devices with an 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.

escrypt Embedded Security by ETAS	VECTOR	ETAS		SIEMENS	INTEGRITY SECURITY SERVICES
	SHE HIS	**HSM SHE+ TC2x**	**TC3x crypto driver via partners**
Key management	10 keys	20 keys	Configurable
Symmetric data encryption / decryption	hardware-based AES-128-bit (ECB, CBC)	●	●
MAC generation / verification	Optional	●	●
Safe MAC verification	–	●	●
Random number management	SHE PRNG	●	●
Secure boot	Optional	●	●
Debug access	–	Enhanced by HSM debug options	Enhanced by HSM debug options
Other SHE services	●	●	●
Asymmetric encryption / decryption	–	–	Software-based RSA1024 Software-based ECC256

Typical applications	**Tuning protection**	**Immobilizer Secure-on-board communication**	**Possible extensions, depending on specific tier 1 / 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	●	●	●

Infineon's product development process is certified according to ISO / SAE 21434 by TÜV Nord

The company-wide certification includes:

- Cyber Security Management Continuous Cyber Security Activities (e.g. Monitoring, risk assessment, vulnerability analysis)
- Risk Assessment Methods (e.g. Threat identification)
- Concept Phase (e.g. Cyber security goals)
- Product Development Phase (e.g. Integration and verification)
- Post Development Phase (e.g. Cyber security incident response)

Infineon's position as a trusted partner in automotive security has been proven by an external party

TÜV NORD

ZERTIFIKAT
CERTIFICATE

TÜV NORD
TÜV NORD CERT GmbH
ISO/SAE 21434
Assessed Automotive Cybersecurity

Hiermit wird bescheinigt, dass die Firma / *This certifies that the company*

Infineon Technologies AG
Am Campeon 1-15
85579 Neubiberg
Deutschland

ein Managementsystem konform zu den Anforderungen der ISO/SAE 21434 betreibt und innerhalb der Laufzeit des Zertifikats von 3 Jahren auf Konformität überwacht wird.
operates a management system conforming to the requirements of ISO / SAE 21434 and within the the duration of the certificate of 3 years is monitored for conformity.

Road vehicles – Cybersecurity engineering
gemäß/ *according to* ISO/SAE 21434:2021-08

Geltungsbereich: / *Scope of application:* **CSMS related to CS Policy (Z8F80326733) and cybersecurity aspects of System Development Handbook (SDHB Rev. 6.16.00)**

Geprüft nach: / *Compliant in accordance with:* **ISO/SAE 21434:2021-08**

Registrier-Nr. / *Registration No.* 44 135 222295001
Prüfbericht Nr. / *Test Report No.* TNM_8120136144-D07-R_V1.0
Aktenzeichen / *File reference* 8003046865_8003051377

Gültigkeit / *Validity*
von / *from* 2022-10-25
bis / *until* 2025-10-24

Zertifizierungsstelle
der TÜV NORD CERT GmbH

Essen, 2022-10-25

TÜV NORD CERT GmbH Am TÜV 1 45307 Essen www.tuev-nord-cert.de

Infineon's commitment to the ISO / SAE 21434 gives confidence to OEMs and Tier1s to adopt Infineon solutions

New Products

– Development following ISO 21434 certified process

ISO / SAE 21434
Product certificate

All Products **Available Products**

– Active cyber security monitoring, event evaluation and vulnerability analysis
– Performing of use-case specific risk analysis on request
– Cyber security incident response process

Dedicated support to OEMs and Tier1s to achieve ISO / SAE 21434 compliance with off-the-shelf-components

Established process compliance

– Global cyber security program and management system (CISMS) according to NIST CSF
– ISO 21434-compliant Product Security Incident Response Process: (Ext. Entry Point)
– Threat intelligence according to ISO 21434 recommended practice
– Implementation of product-specific ISO 21434-compliant CSMS

– Infineon-wide ISO / SAE 21434 process certification
– Basis for product evaluations
– Certified by TÜV Mobility (TÜV Nord)

Infineon's latest microcontroller generations will be externally certified according to ISO / SAE 21434

Artificial Intelligence

AURIX™ TC4x enables the use of Embedded AI

Next generation AURIX™ is a heterogeneous architecture providing new computing abilities for new approaches

Embedded AI

- Embedded AI drives the Innovation for Autonomous Driving, eMobility and Connectivity

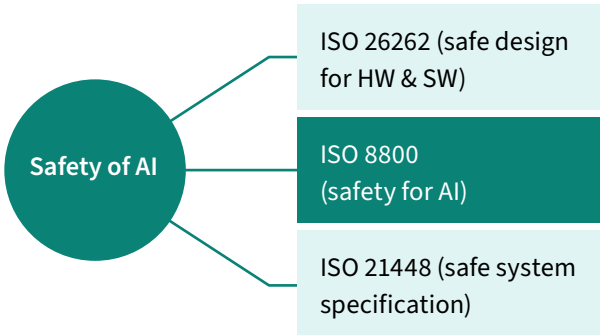
AI-based algorithms require a lot of computing power, which makes it advisable to integrate them into high-performance microcontrollers such as the AURIX™ TC4x. Infineon's AURIX™ TC4x microcontrollers offer high real-time performance and implement the latest trends in AI modelling.

Embedded AI with Next-generation AURIX™ TC4x enables

- Model predictive control (MPC) approaches for more driving comfort and energy efficiency
- model adaptive control (MAC) approaches which lead to higher accuracy and higher energy efficiency in the Electric Drive Train
- Higher dependability using virtual sensors
- Cost reduction of the bill of material for the entire system
- System and software development effort reduction

Our vision of Embedded AI is to enhance and not to replace classical control and signal processing algorithms with data-driven AI approaches

eMobility / xEV	+	Autonomous Driving / ADAS	+	Integration Platforms & Connectivity
On-board Charger and DC-DC Converter		Trajectory Planning & Control (Vehicle Motion)		Energy Consumption Prediction
Traction Inverter		Radar & Audio		Predictive Maintenance
Battery Management System		Sensor Fusion / Processing		HMI & Infotainment



Embedded AI and safety

The concept of AI and safety may seem contradictory at first glance. To address this concern and build customer confidence, Infineon Technologies AG and the Fraunhofer Institute IKS have partnered to develop a safety assurance process for AI-based systems. The developed methodology refers to a set of both well-established and new ISO standards. The methodology enables the assessment of AI trustworthiness in terms of data completeness, operational design domain (ODD), and robustness to perturbations and varying environmental conditions.

www.infineon.com/aurix-tc4x

Application with Embedded AI: benefits

Autonomous Driving

Vehicle Motion
Trajectory Control & Trajectory Planning

- Model Predictive Control (MPC) is required for highest energy efficiency and optimized driving comfort. AI enables MPC for MCU by reducing compute power
- More accurate trajectory tracking leads to better driving comfort and higher energy efficiency.
- Energy efficiency and driving comfort for autonomous vehicles with L2 and higher is improved significantly

Zone control
Audio: Siren Detection & Keyword Recognition

- Autonomous vehicles with L3 and higher shall detect emergency vehicles autonomously, and, thus, react according to driving regulations
- AI enables siren detection on constant quality and robustness level
- It also enables comfort function like “voice-based car opening”. Due to latency requirements, it must be integrated in a zone controller

Radar Pre-Processing
Interference Mitigation & Direction of Arrival

- Interference mitigation is the biggest challenge for automotive radar. It must be solved to increase the accuracy in a cost optimized way
- Radar accuracy is improved with lower cost
- AI enables a scalable and real-time capable solution and a higher accuracy than classical direction of arrival (DOA) algorithms (ESPRIT, MUSIC)

Sensor Fusion
Radar-Radar Fusion

- Due to legislative requirements safety related ADAS functions like Autonomous Emergency Braking become mandatory
- AI enables scalable and cost optimized sensor fusion approaches, in particular low-level fusion for data provided by several radar sensors. This leads to a modality independent logical interface to the Central Car Computer unit

Application with Embedded AI: benefits

eMobility

Traction Inverter
Motor control

- Accuracy increases for control of torque- and speed leading to higher energy efficiency. This results to the increase of driving distance or battery size reduction
- The AI based MPC and MAC approaches provide the capability to use next generation of power semiconductor technologies like SiC and GaN
- AI enables more cost optimized sensor data processing by lower system costs, e.g. resolver can be replaced by a Neural Network

Virtual sensor

- Observers to detect aging and temperature of SiC and GaN based power modules are enabled by AI
- These AI based observers increase WLTP driving cycles and allow cost optimized cooling concepts

On-board Charger
Adaptive Control

- Accuracy increases for charging and in-vehicle power distribution leading to higher energy efficiency. This results to the increase of driving distance or battery size reduction and optimized charging time

Virtual sensor

- Observers to detect aging and temperature of SiC and GaN based power modules are enabled by AI
- These AI based observers increase WLTP driving cycles and allow cost optimized cooling concepts

Battery Management Systems
SOX Prediction

- AI enables higher accuracy battery state calculation during run-time. Accuracy of state of charge and state of power is increased which leads to a higher driving distance or reduced battery size

Fast Charging

- AI enables reliable use of the electrochemical impedance spectroscopy (EIS) for high-voltage batteries. AI-Based post processing of the measured battery impedance leads to a more accurate state of health of the battery. An accurate state of health is needed to reduce the time for fast charging

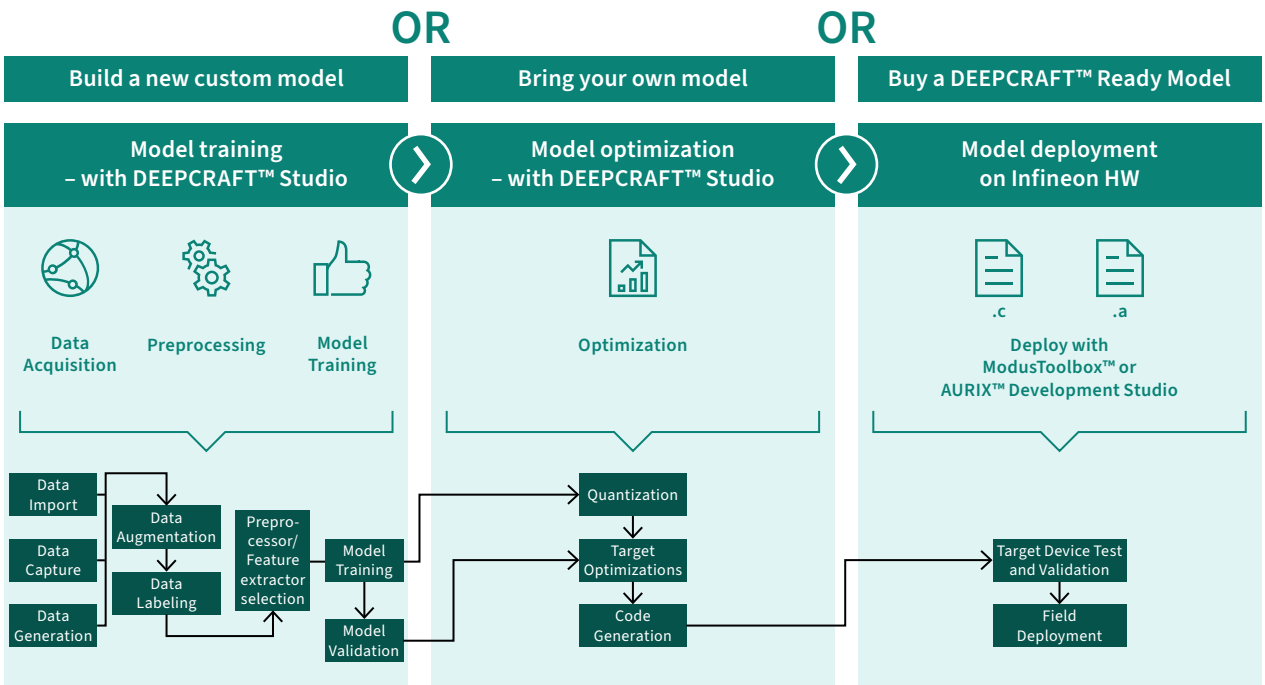
Edge AI with DEEPCRAFT™

With the Edge AI software brand DEEPCRAFT™, Infineon delivers customers end-to-end Edge AI solutions. DEEPCRAFT™ software and the experienced team behind it perfectly complements Infineon's portfolio of powerful microcontrollers.

With DEEPCRAFT™ Ready Models, customers get off-the-shelf AI models that can be deployed right away. By combining with Infineon Technologies' AURIX™ Development Studio, DEEPCRAFT™ Studio is able to provide an end-to-end workflow for building Edge AI models; from real world data collection to labeling, training and optimized deployment for Infineon hardware. It can significantly reduce time to market without spending years of time and millions of dollars on a proprietary in-house solution.

DEEPCRAFT™ Studio offers:

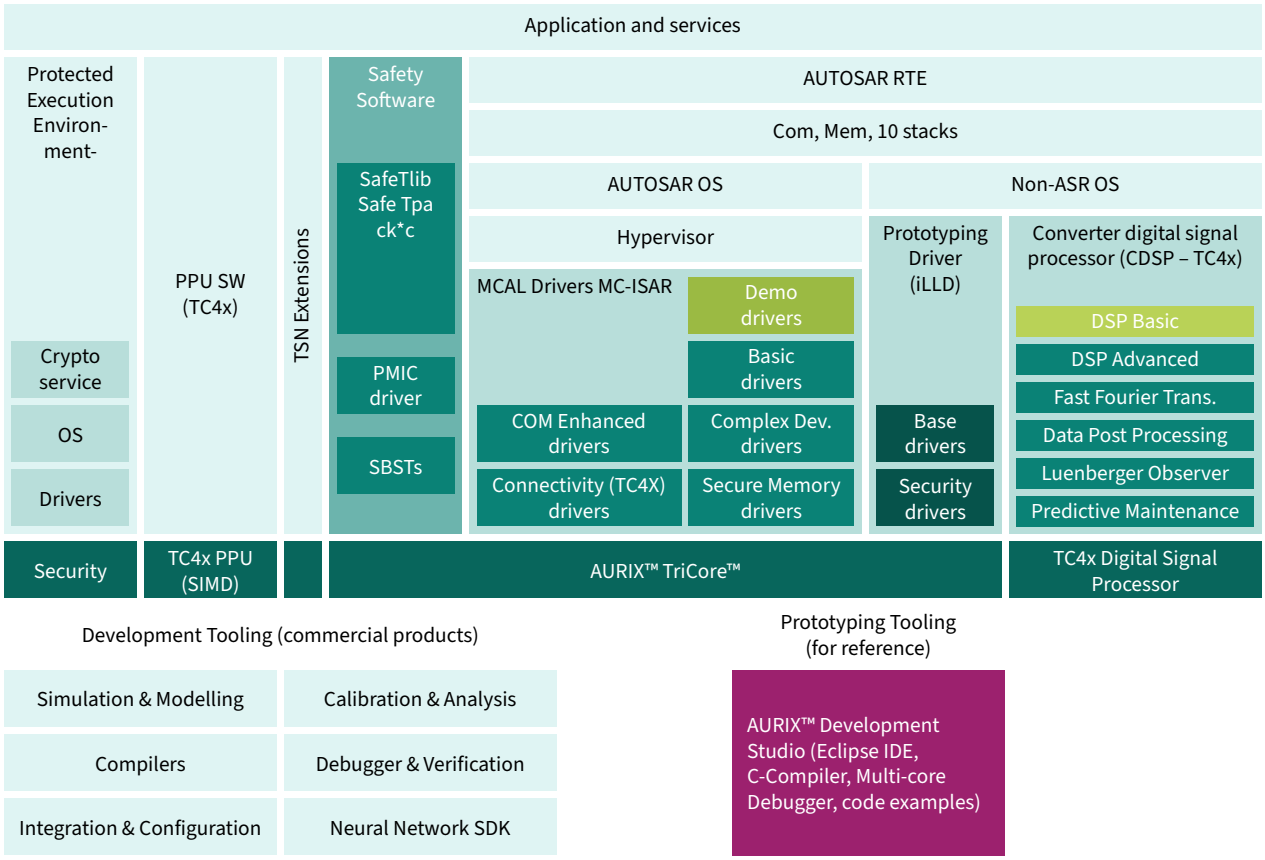
- Improved data collection – get machine learning projects up and running faster and with more flexibility using data collection from different Infineon boards
- Starter projects – new Infineon starter projects provide a solid starting point with pre-collected data and pre-trained models
- Easier deployment of models to Infineon hardware – quickly run and test models on device in the field



AURIX™ Ecosystem and Ease of Use

Embedded software

AURIX™ TC2x / TC3x / TC4x Software Offering



Development Tooling (commercial products)

Simulation & Modelling	Calibration & Analysis
Compilers	Debugger & Verification
Integration & Configuration	Neural Network SDK

Prototyping Tooling (for reference)

AURIX™ Development Studio (Eclipse IDE, C-Compiler, Multi-core Debugger, code examples)

AURIX™ Software Offering

Basic Software (free of charge)?
- Productive code
- Reference code
- Example code

Premium Software (licensed)
- Productive code
- Partner offering
- * From Hitex

Tooling
- Tools for reference use
- Partner offering

- AURIX™ Hardware

Hardware abstraction layer (HAL)

- AUTOSAR MCAL – MC-ISAR MicroController – Infineon Software ARchitecture
- MC-ISAR TC2x: AUTOSAR 3.2.1 / 4.0.3,
  - 29 Drivers including
  - 4 complex drivers
- MC-ISAR TC3x: AUTOSAR 4.2.2 / 4.4.0,
  - 33 Driver
  - ASIL D Freedom From Interference FFI
  - 9 driver with in ASIL D avoidance of systematic faults
  - 5 complex drivers
- MC-ISAR TC4x: AUTOSAR R20-11 + MEM drivers in R21-11;
  - 38 drivers
  - ASIL D Freedom From Interference FFI
  - 17 driver with in ASIL D avoidance of systematic faults
  - 4 complex drivers
- Gate driver
- Multicore support

Safety Software

- SafeTlib TC2x, 26 tests and handling of external watchdog
- Software Based Self Tests SBSTs TC3x + SafeTpack TC3x (Hitex) including handling of external watchdog
- SafeTlib TC4x, tests drivers and handling of external watchdog and power management IC (PMIC)

TC4x CDSP Filter Chain Library

- Fast signal processing filter library
- 12 ready-to-use configurable CDSP filter chains

Infineon tools

- AURIX™ Development Studio for prototyping / reference including low-level peripheral drives (iLLD)

Autosar Bundles MCAL Eval.

- MC-ISAR Basic
- Hightec C / C++ Compiler
- EB Tresos
- IDE Installer incl .simple AURIX™ debugger
- Installer AURIX™ Flasher

www.infineon.com/aurix-embedded-sw/

Embedded software

Infineon AUTOSAR MCAL drivers

MC-ISAR TC2x / TC3x / TC4x product overview

Infineon offers the largest portfolio of AUTOSAR and complex drivers in the industry. The AURIX™ TC3x MCAL is supported based on ASR v4.2.2 and ASR V4.4.0. Even further support for ASIL D applications is provided with major drivers according an ASIL D safety claim and an ASIL D process for freedom from interference. This eases software partitioning and system level safety argumentation and gives more flexibility. Available MC-ISAR TC3x products are:

- MC-ISAR AS422 (ASIL B drivers)
- MC-ISAR AS440 (ASIL B drivers)
- MC-ISAR AS440 EXT (9 ASIL D drivers)

Supporting automotive grade ISO26262 safety, ISO21434 security and ASPICE quality with lifecycle management enables customer to shorten its time to market and save development costs.

The AURIX™ TC4x MCAL is extending the ASIL D safety claim to a broader range of drivers based on AUTOSAR R20-11 with memory drivers according R21-11. New drivers for PCIe, DRE Data Routing Engine etc. enable the communication performance.

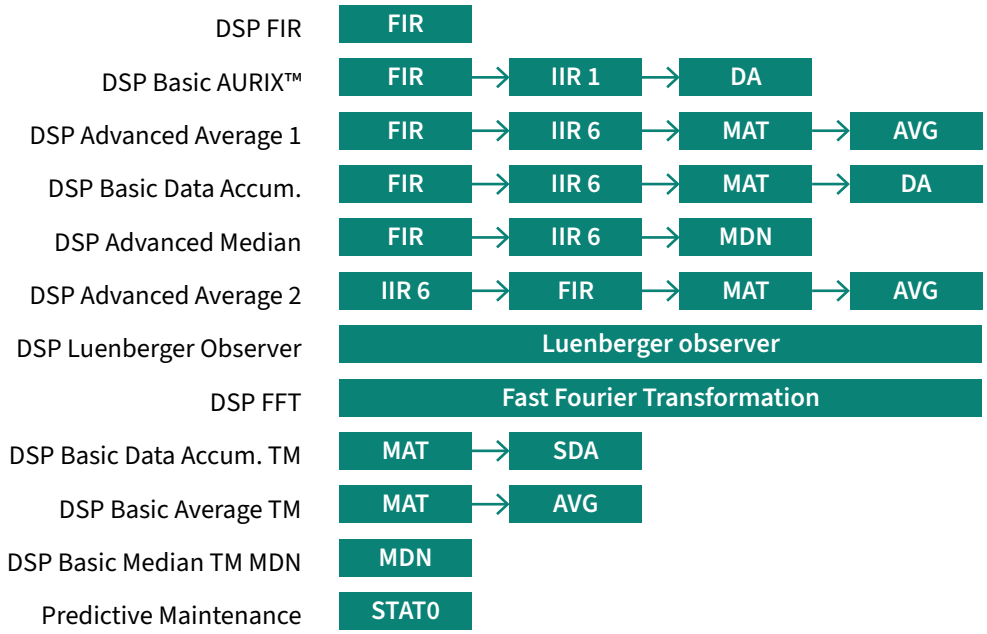
AURIX™ TC2x		AURIX™ TC3x		AURIX™ TC4x	
AUTOSAR versions	– 3.2.1 – 4.0.3	**AUTOSAR versions**	– 4.2.2 – 4.4.0 – 4.4.0 EXT (9 ASIL D drv.)	**AUTOSAR versions**	R20-11 + MEM drivers in R21-11 (17 ASIL D drv.)
MC-ISAR BASE	– MCU – PORT – DIO – ICU – GPT – PWM – SPI – ADC – WDG	**MC-ISAR Basic**	– ADC – BFX – CRC – DIO – FEE – FLS – GPT – ICU – MCALLIB – MCU – OCU – PORT – PWM – SPI – WDG – CAN – CAN Transceiver – LIN	**MC-ISAR Basic**	– MCU – Port – DIO – ICU – TM ADC – WDG – BFX – CRC – GTM – SPI – BMC BSW library – OCU – MEMACC (R21-11) – FEE (R21-11) – MEM (R21-11) – CAN – LIN – GPT – PWM
MC-ISAR COM Basic	– CAN – CAN Transceiver – LIN				
MC-ISAR MEM	– Flash – FEE				
MC-ISAR LIB Library	– CRC – Bit				
MC-ISAR COM Enhanced	– FlexRay – Ethernet	**MC-ISAR COM Enhanced**	– FlexRay – Ethernet	**MC-ISAR COM Enhanced**	– FlexRay – GETH Gigabit Ethernet – LETH Lite Ethernet
		HSM MEM	– FEE – FLS	**MC-ISAR CSRM MEM**	– MEMACC (R21-11) – FEE (R21-11) – MEM (R21-11)
				MC-ISAR Connectivity	– DRE – PCie
MC-ISAR MCD MCAL Complex Drivers	– UART – MSC – DMA – FLSloader	**MC-ISAR MCD MCAL Complex**	– DMA – DS-ADC – SMU – UART – FLSloader	**MC-ISAR MCD MCAL Complex**	– DMA – SMU – DS-ADC – ADC-CDSP – ENCODER – I^2C – UART
MC-ISAR Demo (example code, no qualification / safety claim	– HSSL – SENT – I^2C – STM – DS-ADC – SMU – IOM	**MC-ISAR Demo (example code, no qualification / safety claim)**	– HSSL – I^2C – IOM – SENT – STM – IRQ	**MC-ISAR Demo (example code, no qualification / safety claim)**	– HSSL – SENT – STM – IRQ
Configuration tool	Tresos	**Configuration tool**	Tresos	**Configuration tool**	Tresos
Compiler	– Tasking – Windriver – HighTec	**Compiler**	– Tasking – HighTec – Windriver – Greenhills		– Tasking – HighTec – Windriver – Greenhills
Delivery Package	Source Code, Documentation	**Delivery Package**	Source Code, Documentation		Source Code, Documentation

AURIX™ TC4x CDSP Filter Chain Library

The CDSP Filter Chain Library provides fast signal processing filter functions and efficient usage on a dedicated DSP Core. It includes more than 10 filter functions and 12 ready-to-use configurable CDSP filter chains. This DSP features enable

- Filtering trends in noise from voltage and temperature sensor
- Filtering trends in noise from supply domains used by high compute SoC
- Filtering noise from power distribution lines e.g. MOSFETs
- Calculating min, max, average value over accumulated number of TMADC sample
- Enhancing resolution / Oversampling of TM-ADC

Available filter chain configurations



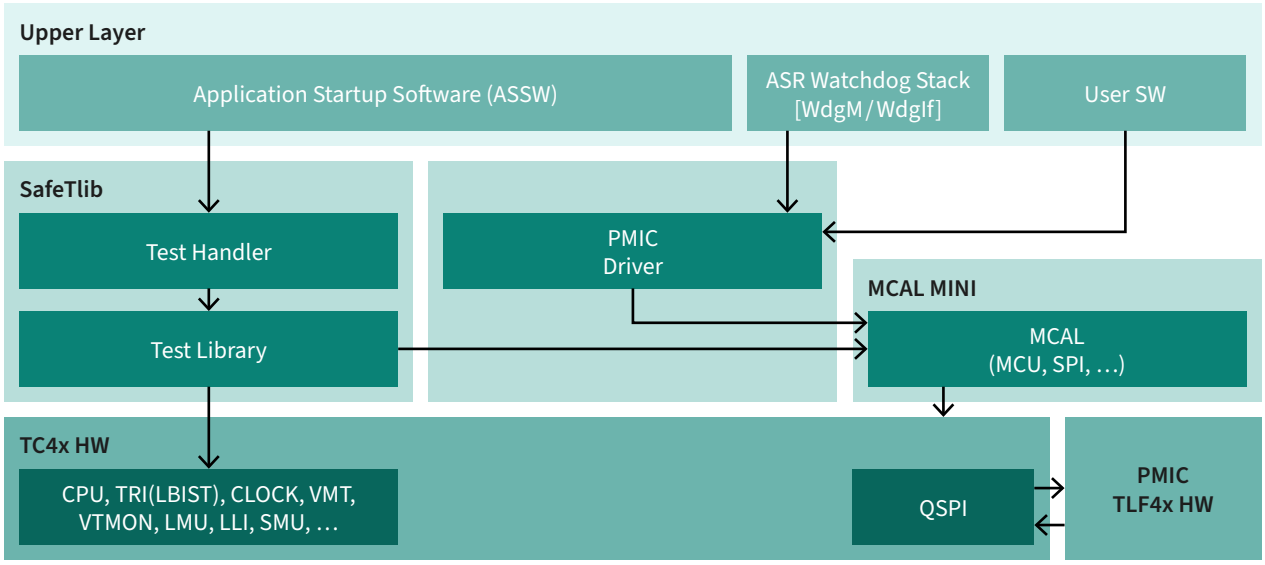
AURIX™ TC4x SafeTlib Product Overview

The AURIX™ TC4x SafeTlib implements 70 % of all mandatory Safety Measures SM and 6 high-effort generic External Safety Measures ESM from the safety manual. This enables fast integration and implementation of the AURIX™ safety concept into applications.

Key features

- Coverage of TC4x Top Level Safety REQs (TLSRs) & External Safety Measures
- Enable safety operation of the chip (startup & runtime)
- Enablement of TLF4x OPTIREG™ PMIC

SW Architecture Overview



Target Applications & HW Products

- Any AURIX™ TC4x application that is addressing safety related use cases

Key facts / Important to know

- SW targeted to be ASIL-D
- ISO26262:2018 compliance
- ISO21434 compliance in evaluation
- ASPICE v3.1 L3 compliant development process

Feature Highlights

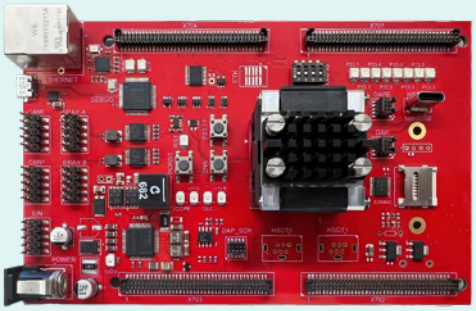
- Safety test library:
  - Safety tests + watchdog handling
- Test handler
  - Mapping tests to different cores, gather test results
- Test library:
  - SMU core alive alarm test, ESM(s) supported
  - Volatile memory test verifies SRAM, ECC, EDC in addition to alarm path test
  - Logic build-in-self-test: configuration, trigger and result handling, alarm path test
  - Voltage Monitoring: test config, result handling, ESM(s) supported
  - Temperature Monitoring: Die temperature test
  - Bus, Clock, NVM, WTU, XSPI monitor: Alarm path test
- WatchDog handling
  - Ready-to-use handling of external watch dog:
  - Enablement and driver of TLF4x OPTIREG™ PMIC: Scalable & flexible power supply solution for TC4x

Device		AURIX™ TC4x
Compatibility		TC4x MC-ISAR based on AUTOSAR vR20-11
SafeTlib features	MC-STL-BASIC	– Test Handler (TstHndlr) – SMU test driver (SmuTst) – Volatile Memory test driver (VMemTst) – Logic test driver (LBistTst)) – Voltage monitor test driver (VoltMonTst) – Clock monitor test driver (ClkMontst) – Bus monitor test driver (BusMonTst) – Temperature monitor test driver (TempMonTst) – NVM test driver (NvmTst) – xSPI test driver (XspiTst) – Watchdog Timer test driver (WTUTst)
	MC-STL- TLF4x to OPTIREG™ PMIC	– TLF4x Power management IC (TLF4x to OPTIREG™ PMIC) CDD – Window Watchdog driver – ASR support
	MC-ISAR ASR20-11 MINI	– MCU – SPI – DIO – PORT – MEM – SMU

AURIX™ TC4x – starter kits

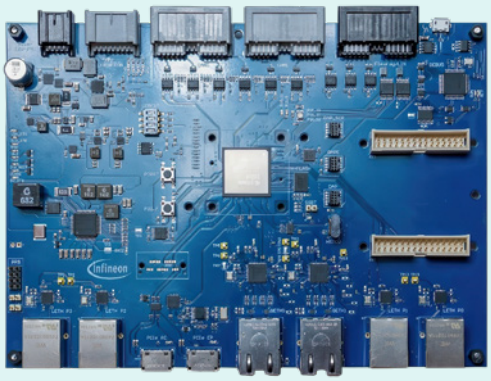
AURIX™ TC4x TriBoards

- Full evaluation board for development to write and debug your 1st programs
- Includes getting started advice, free TriCore™ entry tool chain, technical documentation, compiler and debugger



AURIX™ TC4xD Application Gateway Board

- Includes high-performance AURIX™ TC4D9x Micro-controller
- Rich connectivity: 2x 5GBase-T, 4x 100Base-TX/10Base-T, PCIe Gen3 interface via Ocu-Link (Root Complex/Endpoint), 12x CAN-FD, 4x LIN and 2x FlexRay ↗ interfaces on board
- Add-on board-to-board connector support for the latest communication interfaces like CAN-XL and 10BASE-T1S
- Up to 6x Power distribution channels for local actuation and body domain applications available



AURIX™ TC4x Lite Kit

- AURIX™ TC4x starter kit with TC4Dx in BGA-292 package
- USB-C powered
- FTDI based debugger via micro USB-C
- Arduino compatible connectors
- Support Motor Control Kit via X1, X2 Connectors
- 10/100 Mbit/s Ethernet support

AURIX™ TC3x – starter kits

AURIX™ TC3x TriBoards

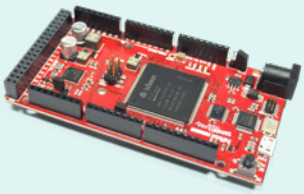
- Full evaluation board for development to write and debug your 1st programs
- Includes getting started advice, free TriCore™ entry tool Chain, technical documentation, compiler and debugger
- TriBoard available for all productive silicon (TC38x, TC39x)
- Learn more

AURIX™ TC3x TFT kits

- Low cost board for early evaluation with limited access to signals
- Additional touchscreen display for convenient handling
- Available for standard and ADAS pinout's for selected devices
- TriBoard available for all productive silicon (TC38x, TC39x)
- Learn more

AURIX™ TC3x Arduino ShieldBuddy kit

- The Hitex TC375 ShieldBuddy follows the Arduino standard
- Compatible with 100's of Arduino application shields
- Evaluation licenses available
- Launched at embedded world
- Learn more



AURIX™ TC3x – starter kits

AURIX™ TC3x lite kit

- AURIX™ TC375 device in LQFP-176 package
- FTDI based debugger with micro USB
- Learn more

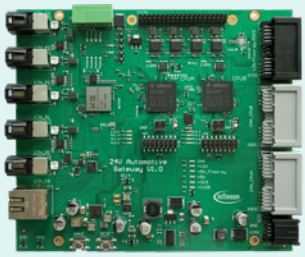
AURIX™ TC3x – application kits

Hybrid kit for inverter applications

- IFX system offering: such as power modules, gate drivers, current and position sensors to develop inverter systems
- Software to start development of inverter for 3-phase motors
- AURIX™ TC3x hardware optimized logic board for testing different hybrid kits for inverter applications
- Learn more

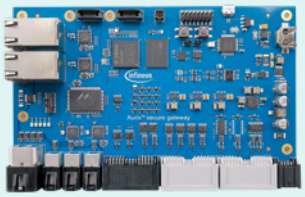
Gateway 24 V board for CAV, bus, truck

- Includes AURIX™ TC397 x2 with & automotive Ethernet switch Realtek RTL9047AA switch available for standard and ADAS pinout's
- Rich connectivity: connect up to: 1000Base-TI, 100Base-T1 x5, CAN-FD x12, LIN x4, and FlexRay devices x4
- Learn more



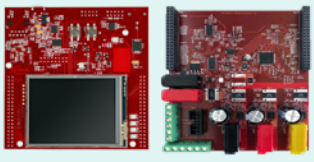
Automotive secure gateway 12 V

- Includes AURIX™ TC377TX with & automotive Ethernet switch Marvell 88Q5050
- Rich connectivity: connect up to: 1000Base-T1 x2, 100Base-T1 x5, CAN-FD x12, LIN x2 , and FlexRay devices x2
- Learn more



Motor control board TC3x

- Based on TC397
- Software FOC (Field Oriented Control) algorithm: encoder as position sensor (GPT12)
- 3-phase current sensing (EVADC), PWM generation (GTM), communication with drive board (QSPI) commands via TFT display (QSPI)
- Learn more



AURIX™ TC3x – application kits

APPKIT_A2G_SAFETY

- Combination of Application Kit AURIX™ TC397 TFT + Evaluation Board AURIX™-TC3x Safety
- Explore the full potential of AURIX™ TC3x ASILB / D's safety
- Features:
  - Suitable to build an ISO26262 complaint application on system level
- Learn more

AURIX™ TC2x – starter kits

AURIX™ TC2x TriBoards

- Full evaluation board for development to write and debug your 1st programs
- Includes getting started advice, free TriCore™ entry tool chain, technical documentation, compiler, and debugger
- TriBoard available for every silicon
- Learn more

AURIX™ TC2x TFT kits

- Low cost board for early evaluation with limited access to signals
- Additional touchscreen display for convenient handling
- TFT board available for every silicon
- Learn more

AURIX™ TC2x Arduino ShieldBuddy kit

- The Hitex TC275 ShieldBuddy follows the Arduino standard
- Compatible with 100's of Arduino application shields
- Evaluation licenses available
- Ideal for getting started on a high-end real time embedded industrial or automotive application as well as students and hobbyists
- Learn more

AURIX™ TC2x lite kit

- AURIX™ TC275 device in LQFP-176 package
- FTDI based debugger with micro USB
- Use of Arduino Uno / compatible platform
- Learn more

AURIX™ TC2x – application kits

Motor control
KIT_AURIX™_TC234_MOTORCTR

- TC234 application kit with TFT display incl. safety supply TLF35584
- Driving of a 3-phase PMSM / BLCD (12 V / max. 50 W)
- BLDC motor from Nanotec integrated
- Software available with flexible configuration
- Learn more

24 GHz radar
KIT_ATV_24GHZ_RADAR

- Range-Doppler radar system with two Rx antennas and one Tx antenna based on AURIX™ TC264DA and BGT24ATR12
- Allows implementation and testing of 24 GHz radar applications as Doppler movement detectors, FSK or FMCW range / position measurement
- Learn more

AURIX™ kits by application

- The AURIX™ Application kits can be used for the following four applications: Gateway, Motor Control, Radar and Wireless Charging.
- Learn more

Development support

Emulation device

- Emulation Devices (ED) are a very powerful solution for calibration, measurement, rapid prototyping, and debugging
- Emulation logic and RAM are added next to the unchanged Production Device (PD) part on the same chip
- Cost-optimized PD, feature-rich ED
- Same package for ED and PD, and a minimum or no additional external circuitry, allow a highly cost-optimized ECU design
- Proven solution with broad tool support from leading automotive and debug tool vendors

AURIX™ highlights

- Up to 4 MByte RAM for calibration with the same access speed as on-chip flash
- Automotive measurement bandwidth (XCP) 15/30 MByte/s via regular 2/3-pin DAP interface

Trace and measurement

Contemporary vehicles are designed to meet rising market demands for engine performance, engine responsiveness, torque, drivability, fuel economy and emissions.
Infineon's proven Multicore Debug Solution (MCDS) enables manufacturers to design and optimize features to support these automotive trends. Unique MCDS features include the fully time-aligned parallel trace of many different on-chip sources, along with its highly powerful trigger capabilities.

Multicore Debug Solution (MCDS)

Key features

- Tracing of CPUs, buses, performance events, and peripheral internal states
- Real time, cycle accurate and in parallel
- Up to 1 MByte on-chip trace RAM (40 Gbit/s bandwidth)
- Very powerful trigger capabilities
- No additional pins needed besides the DAP interface
- New Compact Function Trace (CFT) mode for continuous program trace via DAP
- New fine-grained data trace qualification for automotive measurement

Rust Support

Rust is a multi-paradim systems programming language that emphasizes safety, concurrency, and performance, while improving productivity and reliability. Infineon now officially supports Rust for AURIX™ MCUs. A custom Rust compiler for AURIX™ TC3x was developed by our tool partners, HighTec, with support for TC4x planned as well.

Qualification of the AURIX™ Rust compiler is also in progress. Infineon is also developing Rust Peripheral Access Crates (PACs) and is collaborating with various tool and middleware partners to create an Embedded Rust development ecosystem for AURIX™ MCUs.

www.infineon.com/aurix-tools/

Multicore software development with AURIX™

The right partner for each development stage

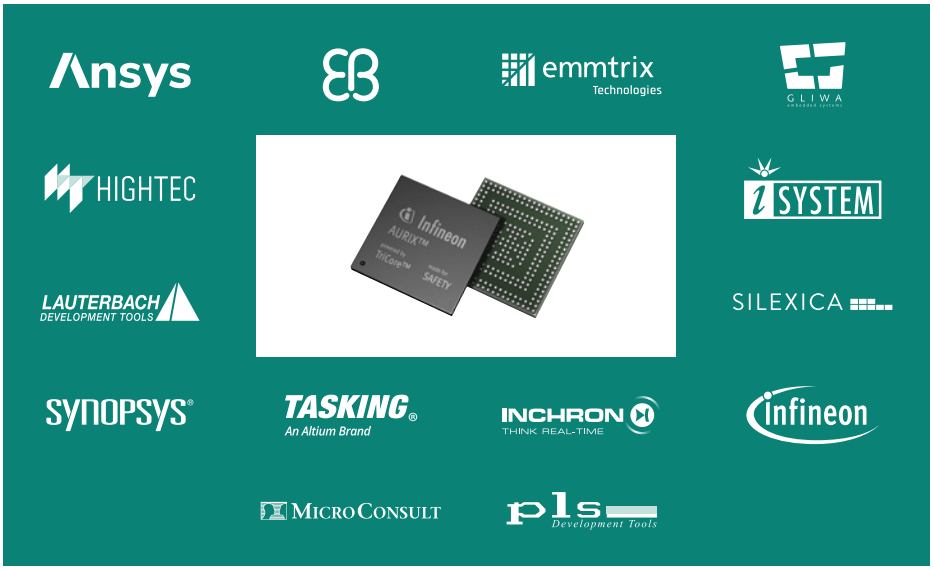
Due to increasing performance demands in the automotive industry, multicore architectures are becoming ever more popular. The AURIX™ microcontroller family offers all the benefits of real-time hardware while supporting a multi-core architecture capable of both asymmetrical and sym-metrical multi-processing, and enabling the creation of ASIL-D systems for automotive applications.

Despite the fact that multicore architectures provide performance benefits, they also result in challenges with regard to software (SW) development. At Infineon, we fully understand the increasing performance demands across multiple applications, as well as the challenges that customers face when designing multicore software. To enable customers to achieve optimal performance when using the powerful AURIX™ architecture, Infineon has built up a network of strong partnerships with companies highly specialized in multicore software development.

Infineon's multicore partners can offer the best multicore expertise and tools on the market for each stage of the software design process, covering everything from the initial multicore knowledge acquisition phase right up to final optimization of the multicore software.

Infineon proactively addresses the challenges of multi core software development by offering special AURIX™ – dedicated literature and training for multi-core software devel opment. Furthermore, Infineon also participates in the organization of dedicated conferences, such as the EMCC (Embedded Multi-Core Conference) www.multicore-conference.com where various car manufacturers and suppliers share their experiences, challenges, and latest findings from the field of multicore architecture.

- Multicore know-how
- Multicore SW design
- Multicore SW development
- MCAL Multicore support
- Multicore performance evaluation
- Multicore SW optimization



AURIX™ Development Studio

The AURIX™ Development Studio is a free of charge Integrated Development Environment (IDE) for the TriCore™-based AURIX™ microcontroller family. It is a comprehensive development environment, including **Eclipse IDE, C-compiler and multicore debugger, Infineon Low-Level Driver (iLLD**), with no time and code-size limitations that enables editing, compiling, and debugging of application code.

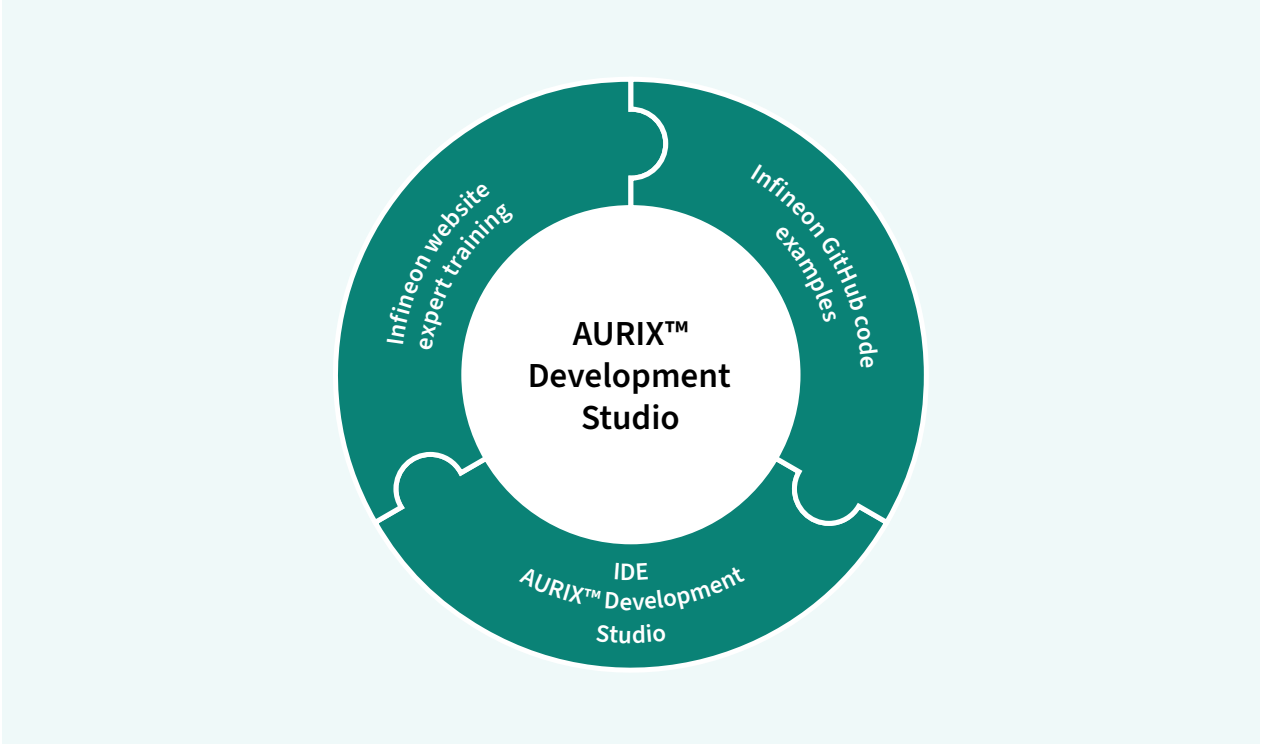
The AURIX™ Development Studio is supported by **expert trainings.** Code examples, trainings and all the technical documentation you may need are readily available at your fingertips:

Find more information at:
www.infineon.com/cms/en/product/promopages/aurix-development-studio/

The AURIX™ Development Studio three parts, which are linked to each other in a connected system

AURIX™ Development Studio can be used with the following AURIX™ kits:
- AURIX™ lite Kits
- AURIX™ ShieldBuddy
- AURIX™ TC3x TFT Kits
- AURIX™ TC2x TFT Kits

Find more information about AURIX™ kits at:
www.infineon.com/cms/en/product/promopages/AURIX-microcontroller-boards/AURIX-kits-supported-by-ADS/#cE



AURIX™ partners

Experience the Future of Automotive with AURIX™ Partners

Compiler

Green Hills Software, HIGHTEC, synopsys, TASKING, WNDRVR

AI and ML

EKXIONO, imagimob, synopsys, TASKING, TERAKI

Debugger Test Tools

DTS INSIGHT, Green Hills Software, iSYSTEM, LAUTERBACH, pls, TASKING

Calibration / Measurement tool

ATI, ETAS, VECTOR

AUTOSAR RTOS

Elektrobit, Embedded Office, ETAS, RTOS, HIGHTEC, KRONO-SAFE, SIEMENS, SYSGO, TTTech, VECTOR

Flash Tools

ACROVIEW, Algocraft, BPM, Data I/O, DTS INSIGHT, ELNEC, ertec, GAIO, Green Hills Software, HIGHTEC, LAUTERBACH, MINATO, OpteeQ, Phyton, pls, ProMik, SEGGER, SMH Technologies, TASKING, WNDRVR

Timing Analysis und Simulation

AbsInt, Ansys, aste, dSPACE, emmtrix, ETAS, INCHRON, MathWorks, RapiTime, synopsys, TASKING

OS

Elektrobit, ETAS, Green Hills Software, VECTOR, HIGHTEC

Security

ARGUS, ETAS, G-PULSE, ISS, SIEMENS, VECTOR

Preferred Design Houses – PDH

Empower your innovations with MCU experts

Our Microcontroller™ preferred design houses is a trusted partners' ecosystem that extends the support force by tailoring their know-how to meet your specific needs.
By partnering with one of our qualified preferred design houses, you can be assured that you'll receive expert advice and customized support to help you achieve your goals. Our team of professionals brings added value to customer service, working together to optimize your design and help you succeed in your business objectives.
We understand that every customer is unique, which is why we offer tailored solutions to meet y

our specific needs. From product-specific support to application-specific advice, our preferred design house is fully trained to use AURIX™, TRAVEO™ T2G and automotive PSOC™ and provides a wealth of knowledge and expertise to help you succeed.
Together with our partners, we offer optimized customer support for systems using our products. Our preferred design houses are committed to delivering exceptional service and support to ensure your success. So why wait? Contact us today to learn more about how our Preferred design house can help you achieve your goals and take your business to the next level.

Classic – Free of charge	– To be agreed between customers and PDH – First level customer support covering Infineon products and solutions – Technical interface and support to the customer – Driving design at customer – Basic training for design teams at customer – 24 h response time to the customer
Premium – Consultancy mode	– Project management and project-specific application support – Specification of general software architecture, defining required layers, control, – Safety, security, Multicore and Arm support – Specification and implementation of custom device drivers and project-specific – Optimization of software components with regards to speed / code size – Software testing – Functional safety engineering and project-specific support for security solution

Preferred Design Houses rating

Your opinion matters! At Infineon, we believe in the power of feedback. By sharing your experiences with our partners, you play a crucial role in shaping the future of business collaborations

– To proceed with the rating, please make sure that you're to My Infineon registered
– To know more about Infineon privacy policy, please click here

Click here and rate your PDH

www.infineon.com/aurix-preferred-design-houses/

	Product Family						Supported Region(s)					
	AURIX™	TRAVEO™ T2G Body	TRAVEO™ T2G Cluster	PSOC™ Automotive	PSOC™ High Voltage	PSOC™ Multitouch & Fingerprint	Global	EMEA	AMR	JP	GC	AP
Altia			●				●					
Amarakosha Technologies	●										●	●
Avin Systems	●						●					●
AVL	●				●		●					
Bluewind	●							●				
Candera			●				●					
CATARC	●										●	
Clicktouch				●		●		●				
Colorado Engineering / CEI Colorado Engineering	●								●			
Crevavi	●	●					●					
D3 Engineering	●								●			
Digital Edge Solutions	●											●
DriveXpert / Drive Expert	●	●						●				
Eagle Wings Design	●	●	●	●	●				●			
Eboata											●	
eInfochip	●	●	●	●	●		●					
Embedded Office	●	●	●	●				●				
Embien Technologies			●									●
Elektrobit Automotive GmbH	●	●	●				●					
FESCARO	●											●
Frobas	●						●					
Galaxi Engineering Technology Services	●											●
G-Pulse	●	●	●	●	●						●	
GRINN	●							●				
Hamso				●			●					
Hightec	●	●	●	●	●		●					
Hitachi Industry & Control Solutions, Ltd.										●		
Hitex	●	●	●	●	●		●					
IAV	●							●				
IMST	●							●				
Intecs Solutions	●							●				
Integra Sources	●							●				
Jingwei HiRain	●	●		●							●	
KPIT Technologies Ltd.	●						●					
L4B software			●					●				
Leadmove	●										●	
Macnica	●	●	●	●						●		
MecTronic	●							●				
Microfuzzy	●	●		●				●				
Mixed Mode	●							●				
Neutron Controls	●	●	●	●	●				●			
NEXTY Electronics Corporation	●	●	●	●						●		
Olvia	●							●				
PiNTeam	●							●				
Precise Biometric						●		●				
QianQin	●										●	
QT			●				●					
Revotech	●	●	●									●
RDM Group / RDM Automotive	●							●				
Samsotec				●	●	●		●				
Seasidetech	●							●				
Sigma Connectivity						●	●					
Siili Auto			●					●				
T & S Engineering	●							●				
Tbench Solutions	●							●				
Techrein	●	●	●									●
Tokyo Electron Device	●	●	●	●	●	●				●		
Tongji	●										●	
Tresa Energy	●											●
ULMA Embedded Solutions	●							●				
Vitalcore Technologies	●	●										●
VECENTEK	●										●	
Witekio			●				●					

TASKING Pin Mapper

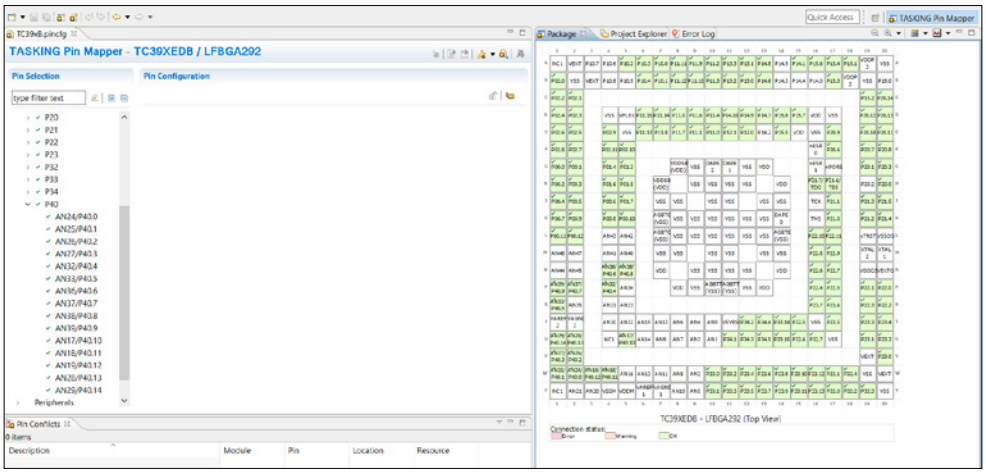
The Pin Mapper can save a substantial amount of time for developers and provides assurance that no pin conflicts exist. In addition, the pin mapper generates a data file for PCB design, eliminating the chance for errors when passing data manually.

Benefits of the TASKING Pin Mapper for AURIX™

- The Pin Mapper tool reduces developer time and costs, while improving the quality of results.
- Configuration takes place via an intuitive eclipse based GUI with built-in knowledge about AURIX™ devices and packages. This saves the developer from the tedious task of consulting piles of device manuals and maintaining configuration settings in spreadsheets.
- Configuration errors/conflicts are detected at entry time and can be either automatically resolved by the built-in conflicts solver or solved manually. Whereas traditionally such errors remain hidden until code has been generated and is tested
- The Pin Mapper reduces miscommunication between individuals and teams by creating all project files from one source. The Pin Mapper creates:
  - Device initialization code in ISO-C format
  - A spreadsheet (CVS) file for project documentation
  - A schematic symbol block that can be imported by PCB design tools such as Altium Designer

Supported TriCore™ devices

- AURIX™ TC2x family
- AURIX™ TC3x family



Free TriCore™ entry tool chain

This free-of-charge entry tool chain provides all the features required to develop and test software for TriCore™ and AURIX™. The tool can be used with all available TriCore™ and AURIX™ starter kits and application boards.

Key features

- Eclipse-based IDE
- Project wizard to easily define the project properties for device and board support
- High-performance GNU C compiler
- Integrated source-level debugger
- On-chip flash programming support

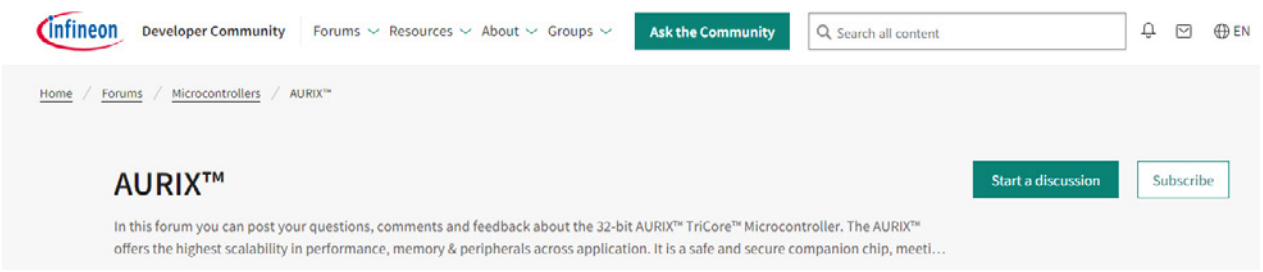
For further information on TriCore™ tools, please visit www.infineon.com/aurix-tools

Online Support

The answers you need, right at your fingertips
AURIX™ Community

Introducing the enhanced AURIX™ experience! Our strategic shift towards the wider mass market has led to the development of the AURIX™ Forum, a dedicated platform designed to support both our mass market and core account customers. We've revolutionized the forum's maintenance to empower our customers to swiftly find the answers they need, right at their fingertips.

To ensure seamless support, we've curated a comprehensive FAQ section covering the most critical topics, resulting in a significant surge in traffic to our AURIX™ forum. With these improvements, our customers can now easily access the support they require, making the forum the go-to destination for all AURIX™ Automotive needs.



Join our thriving community at Infineon Community and experience the difference!

AURIX™ MyICP

By registering for myInfineon Collaboration Platform you can get access to additional add-on technical documentation, trainings, tools, and much more. Please follow these steps in order to get started:

1. Register for myInfineon
2. For AURIX™ documentation please email to aurix@infineon.com
3. You will receive a confirmation which explains how to use your new access

Application Pages

AURIX™ for powertrain applications

The new powertrain

Emission free mobility will be the driving force in the automotive industry for the next decades. The transition from burning natural resources to sustainable electrified mobility is inevitable. Certainly, this is a disruptive and challenging undertaking to the well-established automotive industry, but it also provides opportunities – we call it the era of “the new powertrain”.

Energy efficiency for conventional powertrain

Electronic automotive components are key to raising fuel efficiency levels and cutting emissions. The latest environment protection agency standards – Euro 6 and the upcoming Euro 7 for passenger cars and Euro 3 and Euro 4 for motorcycles – are driving developments in advanced engine management.

Now with up to six embedded TriCore™ cores and 300 MHz operation, the AURIX™ TC3x family members have the real-time performance needed for improved combustion technologies such as Homogeneous Charge Compression Ignition (HCCI) as well as for direct injection, smart turbocharger and valve actuation applications AURIX™ is also ideal for a range of innovative transmission technologies such as Double Clutch Transmission (DCT) and modern Continuous Variable Transmission (CVT). The AURIX™ family offers high temperature operation of up to 150°C junction enabling operation in the harsh transmission environment. This is also of benefit in transfer case (4WD) applications, where AURIX™ is a leader in systems requiring the challenging combination of high temperature, safety and security.

A key benefit of AURIX™ in powertrain is it’s scalability between generations, which enables customers to follow a platform approach with tooling and software costs being shared across multiple applications. This approach can help customers to venture into the opportunities presented by the new xEV applications as part of “the new powertrain”.

www.infineon.com/powertrain

The new powertrain: motion control and energy management

The new powertrain refers to the change of mind, from enhancing a combustion engine with electrification towards a pure electric driven vehicle. Motion control and energy management describes well what "the new powertrain" is about: motion control is self-explanatory, referring to the acceleration as well as deceleration of a vehicle. Energy management describes the management, conversion and distribution of energy using various sources.

While they excel in fuel economy, driving experience and reducing CO_2 emissions, Hybrid Electric Vehicles (HEV) and Electric Vehicles (EV) have the drawbacks of a higher cost, limited drive-range and safety concerns (e.g. risk of battery over-charging). Thanks to their high performance, functional integration and application-based software support, TriCore™ products are the ideal solution for (H)EV motor drives and are perfectly positioned to support lithium ion batteries which will likely be the energy storage system of choice in the near future.

No other MCU family can offer this **combination** of functionality across multiple compatible products for **powertrain and xEV**.

Flexible inverter implementation for motion control

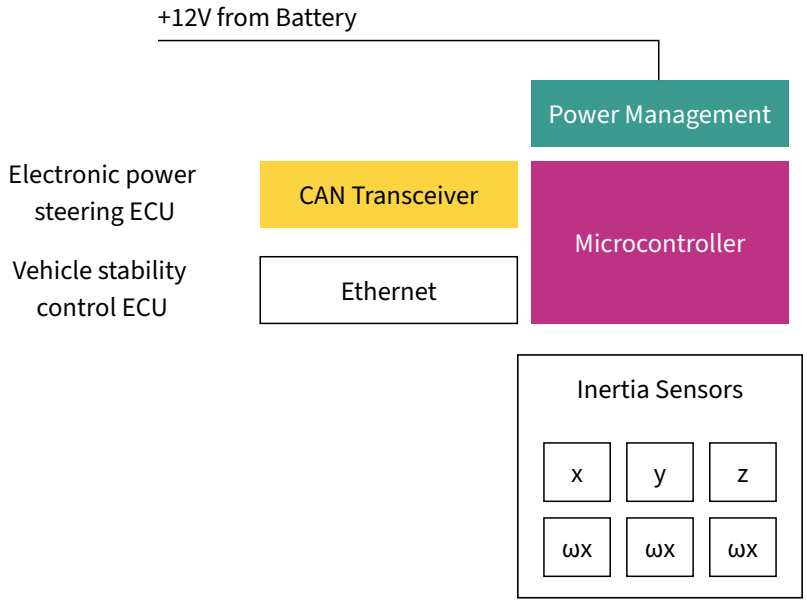
TriCore™ offers a CPU load of less than 3% at 300 MHz frequency for the complete Field-Oriented Control (FOC) algorithm. The TriCore™ AURIX™ family offers multicore architecture, allowing inverter control, hybrid torque management and DC-DC conversion to be executed within one single microcontroller. Nevertheless, the TriCore™ AURIX™ family has built-in resolver functionality, helping customers to save the cost of implementing an external resolver IC.

Energy management for battery and new technology to come

Often seen as the master micro in battery balancing topology, the TriCore™ AURIX™ family proposes a 32-bit stand-by domain combined with an integrated 8-bit standby controller, essential for battery balancing under low-power mode (e.g. vacation parking). As cross-border charging becomes popular, AURIX™ has increased its SRAM to flash ratio to enable various charging protocols. Infineon is the market leader in providing Hardware Security Module (HSM), a feature that prevents the main CPU from illegal manipulation, making the billing for battery charging more trustworthy.

Powertrain Domain Controller (PDC)

Application diagram



www.infineon.com/pdc

Features and benefits

Key features

- Human-machine interface
- Torque coordination
- Driving strategy control
- Cruise control
- Charging coordination
- Thermal management & environment models
- Predictive functions
- Safety and fail-operational
- Firewall and security

Key benefits

- Microcontroller with best-in-class real-time performance
- Scalable platform – performance, memory size and I/Os
- Support A/B swap for SOTA
- Rich legacy peripherals (CAN FD, LIN, …) for integrated gateway application
- Enhanced communication (Ethernet) for fast connection to network & SoC
- External memory interface for data logging
- HSSL connectivity for direct coupling with SoC
- Availability of AUTOSAR 4.x
- Supports safety levels up to ASIL-D

Suggested products

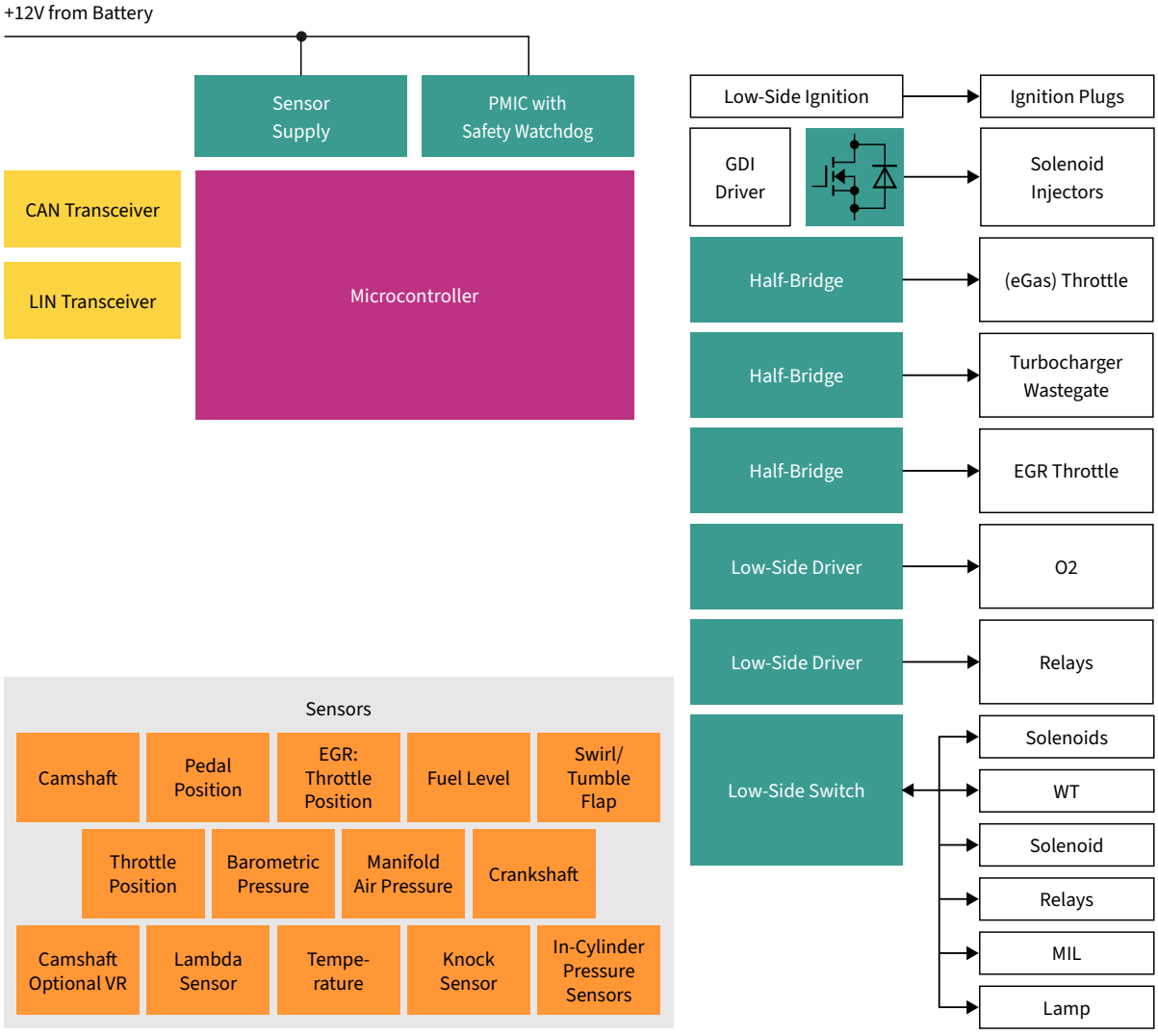
- TC29x
- TC39x
- TC3E7
- TC387

www.infineon.com/pdc

Gasoline direct injection

Thanks to its state-of-the-art safety features, the TriCore™ AURIX™ family 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 diagram



Features and benefits

Key features

- Direct injection
- Scalable software-based knock detection
- Variable valve control
- Throttle and EGR control
- Turbocharging
- Advanced after-treatment: Three Way Catalyst
- Start/stop system

Key benefits

- Microcontroller with best-in-class real-time performance
- Scalable platform – performance, memory size and I/Os
- Committed to continued and tailpipe CO_2 and pollutant emissions reduction
- Anti-theft protection and tuning protection
- Increased knock detection accuracy via DS-ADC
- Enhanced communication (Ethernet)
- Dedicated peripherals for powertrain
- Supports safety levels up to ASIL-D

Suggested products

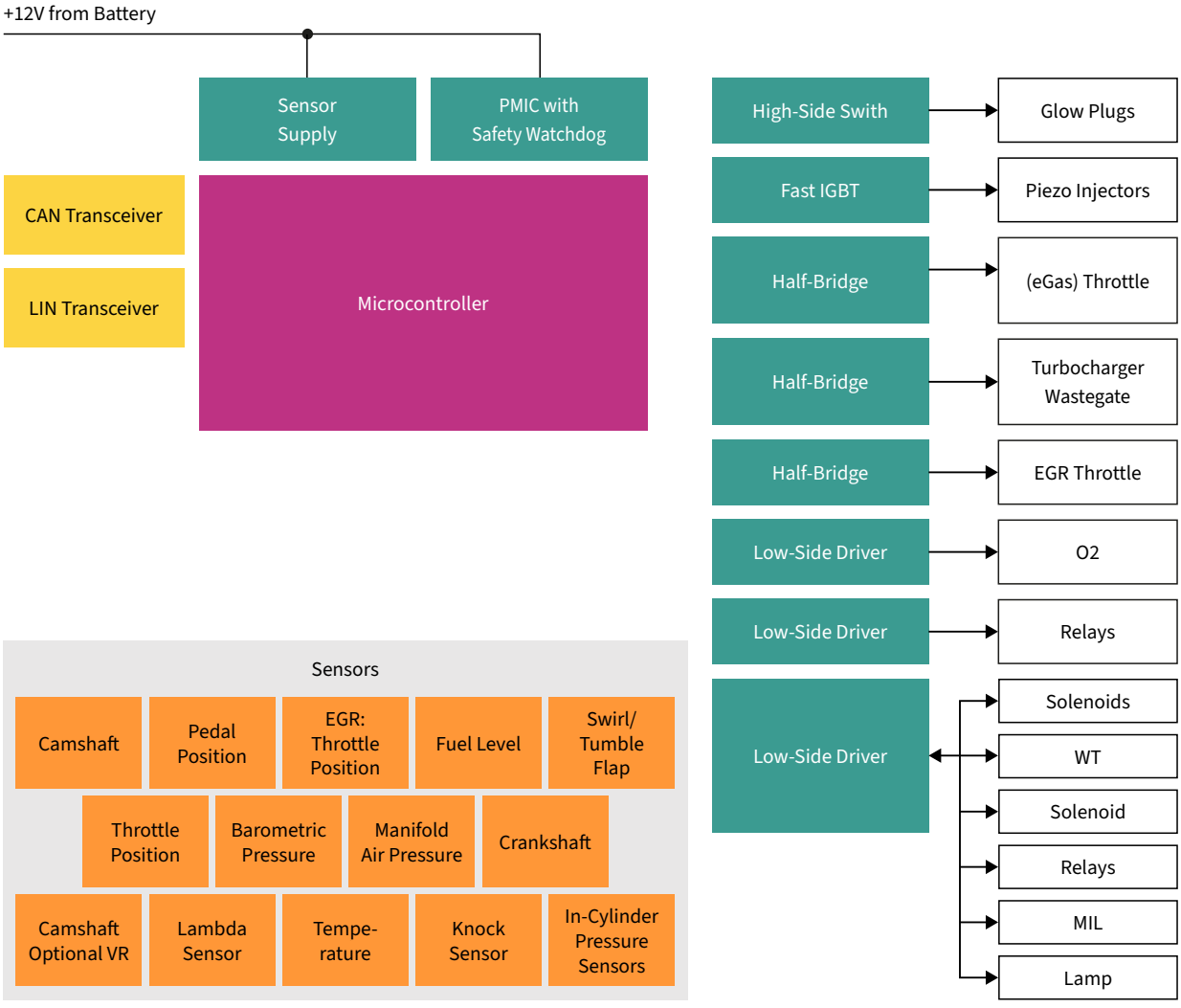
- TC38x
- TC3Ex

www.infineon.com/gasolineengine

Diesel direct injection

Thanks to its state-of-the-art safety features, the TriCore™ AURIX™ family 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 diagram



Features and benefits

Key features

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

Key benefits

- Microcontroller with best-in-class real-time performance
- Scalable platform – performance, memory size and I / Os
- Committed to continued and tailpipe CO_2 and pollutant emissions reduction
- 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
- Supports safety levels up to ASIL-D

Suggested products

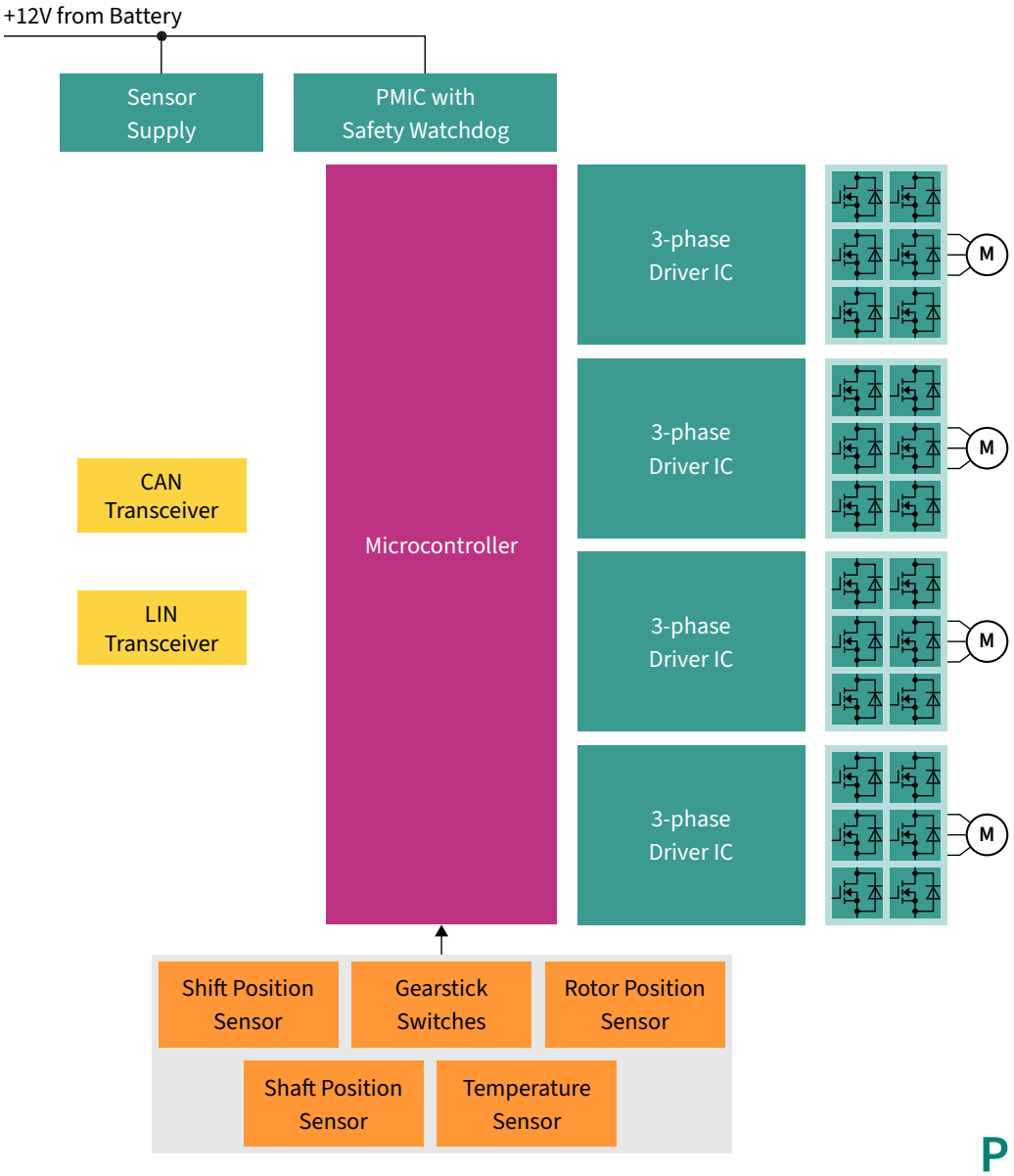
- TC38x
- TC3Ex and TC39x

www.infineon.com/dieselengine

Double-clutch transmission – electrical control

Thanks to its state-of-the-art safety features, the new TriCore™ AURIX™ family 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 systems. Furthermore, the hot temperature package and bare die solutions enable AURIX™ to be used in both attached and integrated control units.

Application diagram



Features and benefits

Key features

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

Key benefits

- Improved fast clutch control
- Feature set optimized for wet and dry DCT designs
- Continuous torque on wheels ensures a dynamic driving experience
- Infineon e-motor driver
- Supports safety levels up to ASIL-D
- Hot bare die capabilities enable microcontrollers to be placed directly where they are needed in the system

Suggested products

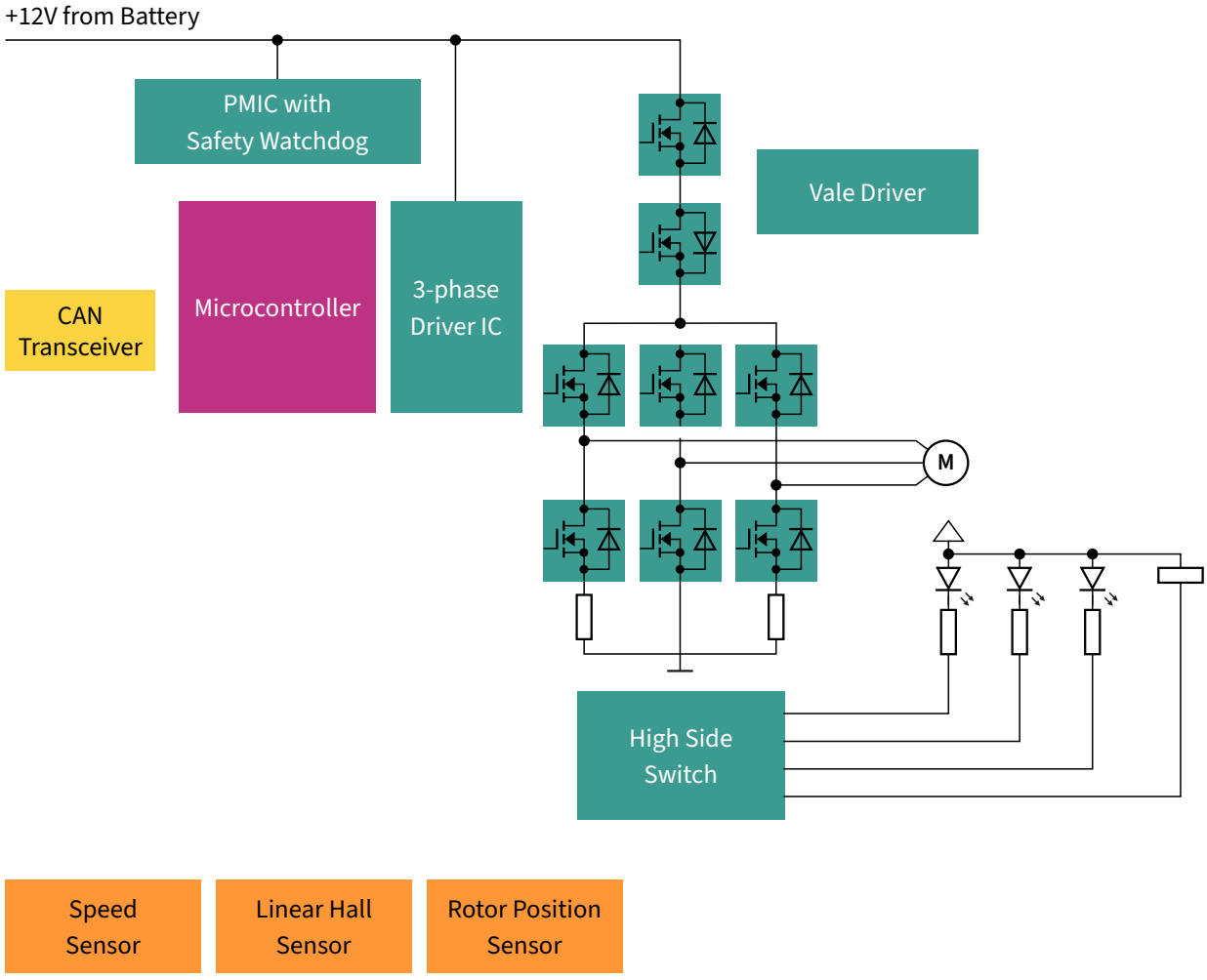
- TC37x
- TC38x

www.infineon.com/electriccontrol-dct

Transfer case

In Four-Wheel Drive (4WD) and All-Wheel Drive (AWD) vehicles, the transfer case is the part of the drivetrain responsible for the transfer of torque from the transmission to the front and rear wheels. The market now demands increased performance to drive BLDC motors and ever-greater functional safety requirements. AURIX™ has the state-of-the-art safety features required to enable systems to achieve ASIL-D, the highest safety level.

Application diagram



Features and benefits

Key features

- More accurate torque distribution, enabling new features such as higher comfort and flexible settings
- Fuel economy improvements due to advanced slip control
- Safety requirements up to ASIL-D
- Secure CAN communication
- Extended ambient temperature range to meet stringent environment requirements

Key benefits

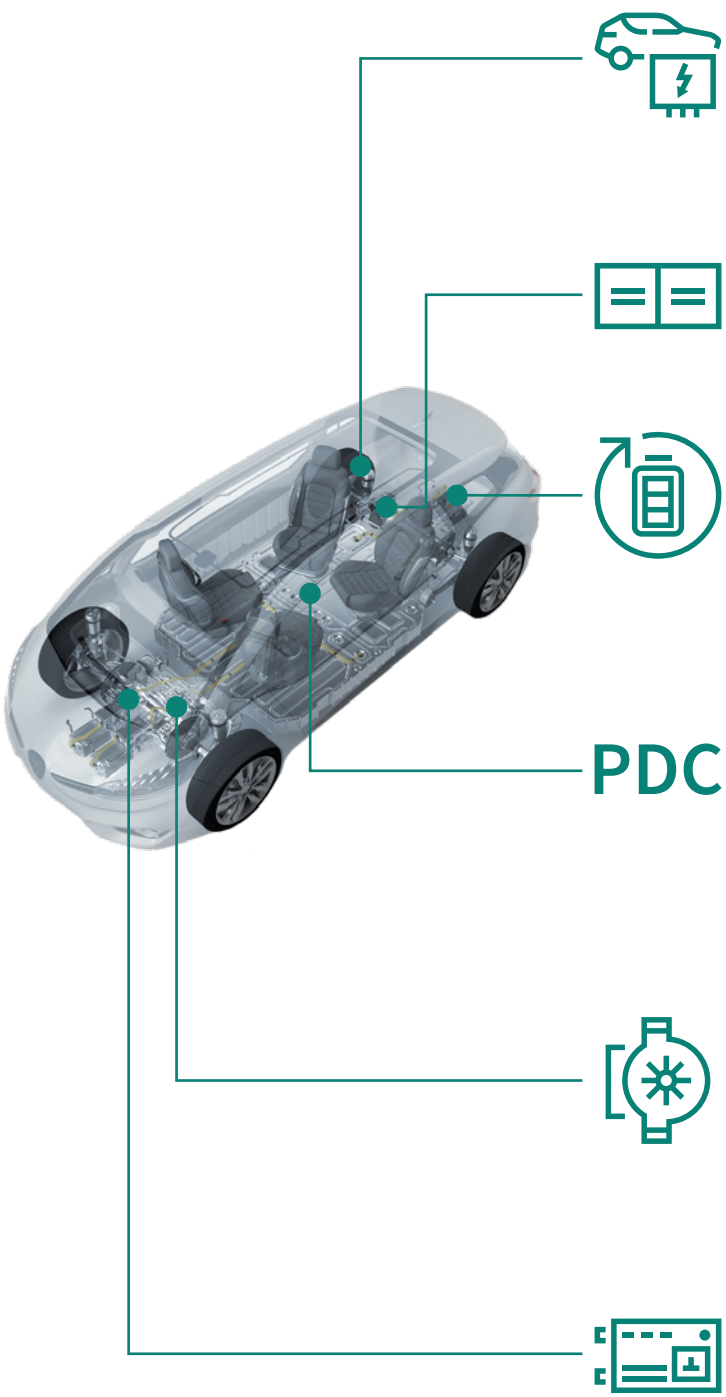
- Advanced timer unit for totally flexible PWM generationand hardware input capture
- Redundant flexible 12-bit ADC
- Scalability over flash, RAM and peripherals, offering the best cost-performance ratio
- High microcontroller junction bare die temperature
- Supports the safety level ASIL-D
- Safety software: Infineon SafeTcore library
- Availability of AUTOSAR 4.x
- HSM security module to prevent tampering

Suggested products

- TC33x

www.infineon.com/transfercase

AURIX™ for xEV applications



On-board charger
Controls the charging of the battery with AC-DC converter module (off-board and inductive charging solutions are also possible).

HV-LV DC-DC converter
Charges conventional 12 V power supply net from the high-voltage battery and replaces belt driven alternator.

Battery management system
Controls battery state during charging and discharging and implements intelligent features to reduce system cost and extend battery life (e.g. state of health, state of charge).

Powertrain domain controller
Controls inter-communication between xEV pow-ertrain ECUs (e.g. inverter, battery management, transmission, engine) and includes centralized power-train functions (e.g. torque control, gear selection).

Auxiliaries
Trend from belt-driven auxiliaries (e.g. water-pump, HVAC compressor, PTC heater) to electric solutions. These are inverters and converters or high-side / low-side switches.

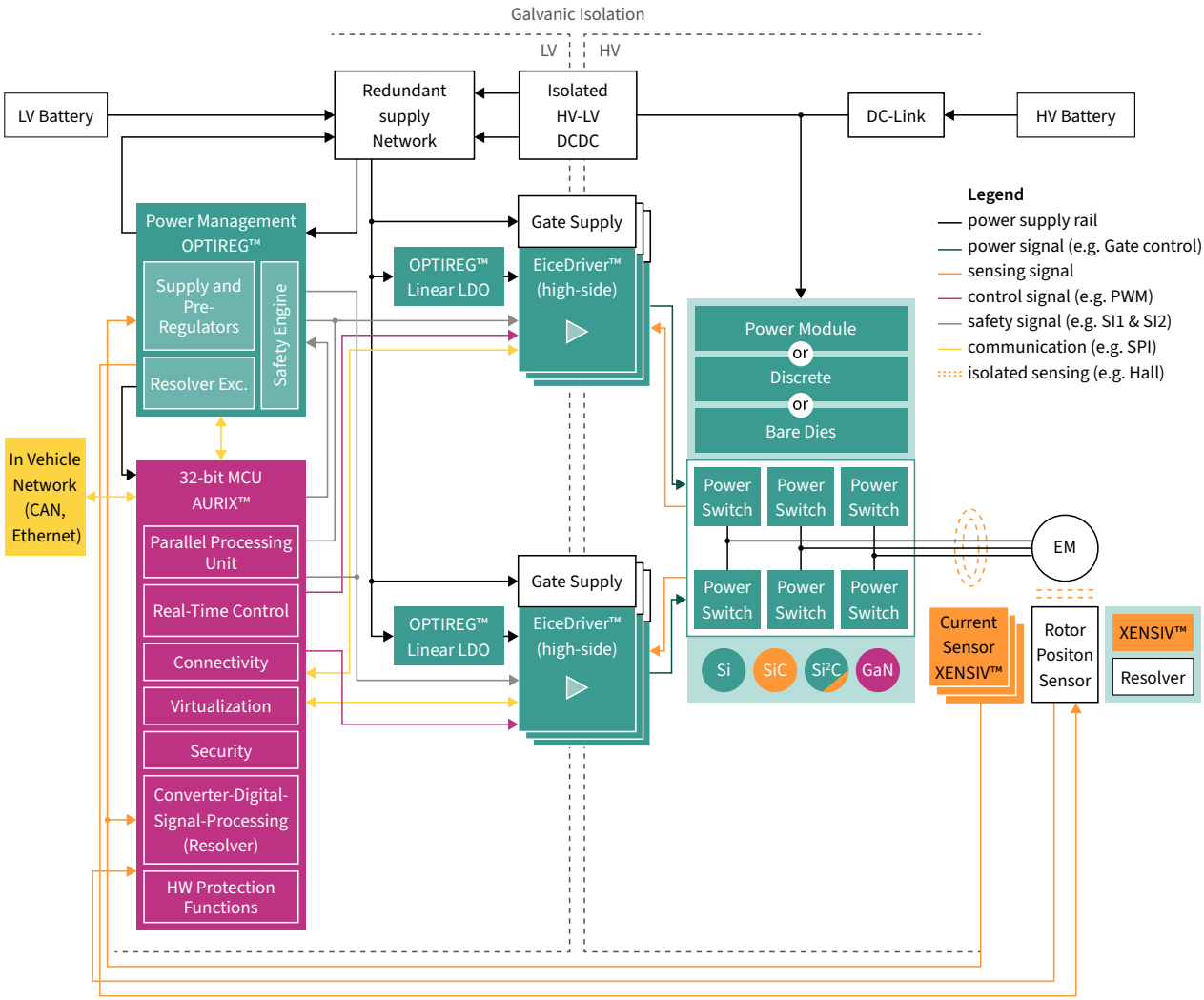
Inverter
Controls the electric motor for optimal efficiency whilst driving and controls regenerative braking.

www.infineon.com/HEV

xEV main inverter

The inverter controls the electric motor in an electric or hybrid drivetrain. Its function is equivalent to an Engine Management System (EMS) in vehicles with an internal combustion engine. Therefore, the inverter is a key component for achieving optimal vehicle dynamics in an electric or hybrid vehicle. In addition to driving the electric motor, it converts the regenerated braking energy and feeds it into the battery. Consequently, a vehicle's range is significantly impacted by the efficiency of the control strategy of an inverter. In addition to efficiency, functional safety and security are key requirements for an inverter system in order to control a vehicle's dynamics.

Application diagram



Features and benefits

Key features

- Multicore concept enables task split and several control strategies for best in class efficiency
- Lockstep architecture
- TC3x offers 50 % performance increase compared to AURIX™ TC2x
- Optimized PWM pattern generation in GT

Key benefits

- Resolver IC replacement with DS-ADC (cost saving)
- Facilitates integration with other xEV applications
- Supports safety levels up to ASIL-D

Suggested products

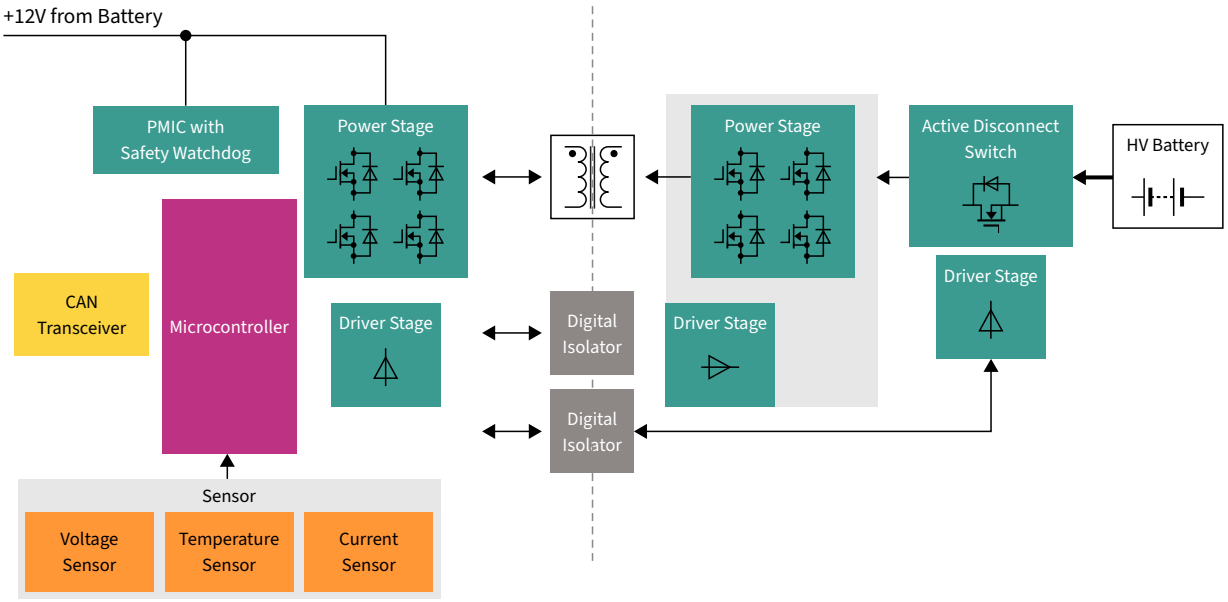
- TC27x
- TC29x
- TC37x
- TC38x

www.infineon.com/HEV-inverter

DC-DC converter (low voltage to 12 V)

The DC-DC converter ECU is responsible for the conversion of voltage between the low voltage domain (typically 48 V to 60 V) and the 12 V domain in mild hybrid cars. The 48 V domain powers stop-start motors, hybrid motors, and turbochargers, enabling engine downsizing and better fuel economy and performance.

Application diagram



Features and benefits

Key features

- Supports current control-specific features
- Fast compare ADCs with support for up to 5 Msps
- Supports flexible PWM generation via a scalable timer across the family
- Supports DC-DC converter for 48 V systems and for high-voltage systems
- CAN FD support
- Ethernet support

Key benefits

- Scalability across the family supporting seamless migration in different DC-DC power and efficiency classes
- Enables sub-system integration (communication handling + DC-DC control) thanks to the AURIX™ multicore performance
- Supports safety levels up to ASIL-D
- Supports bi-directional DC-DC converter functionality

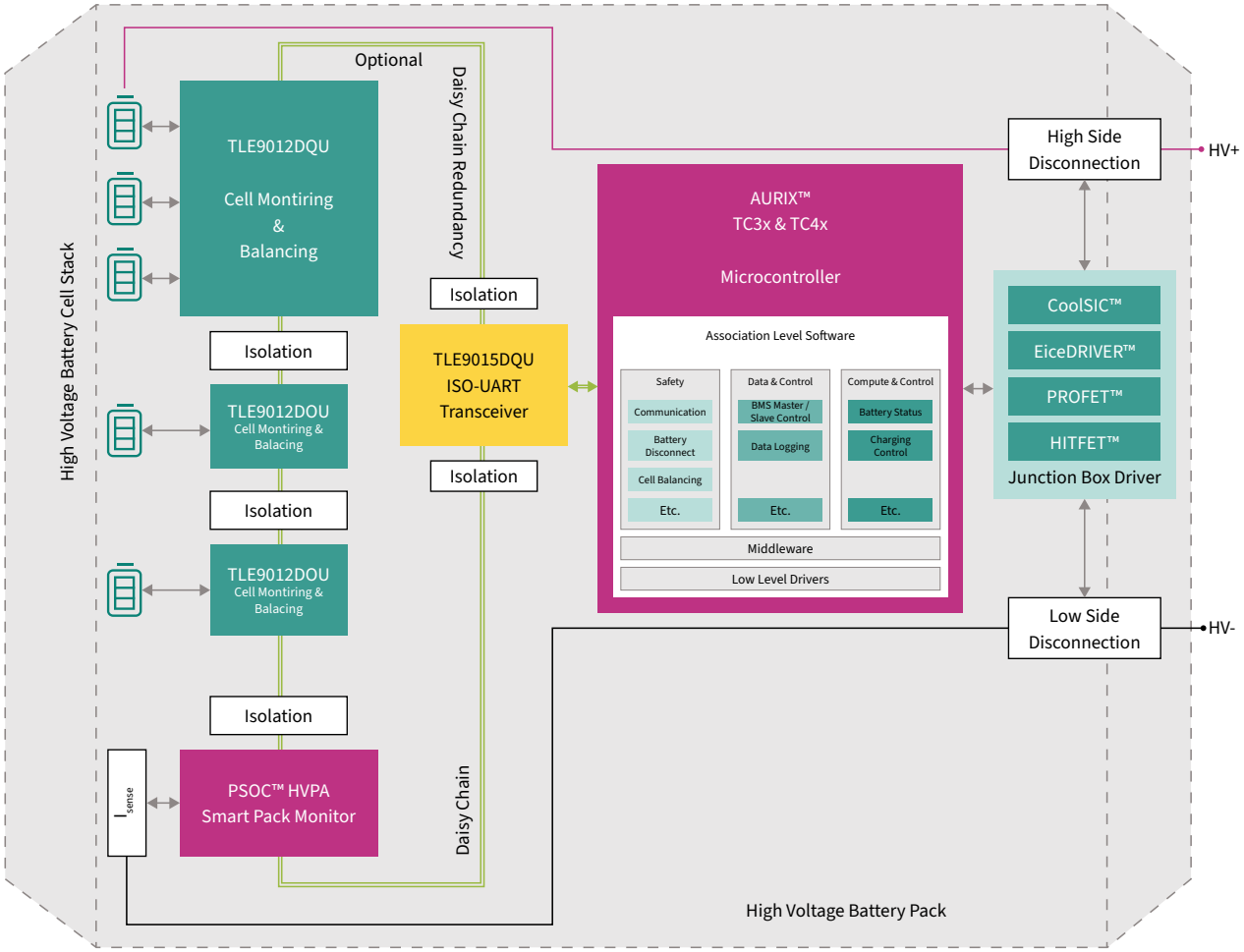
Suggested products

- TC27
- TC26
- TC37
- TC36
- TC33

xEV battery management system

The battery management system controls the battery state during charging and discharging. Intelligent functionality is needed to extend the battery lifetime, which has a considerable impact on the total cost of ownership. The State of Health (SoH), State of Charge (SoC) and Depth of Discharge (DoD) of the battery is permanently monitored.

Application diagram



Features and benefits

Key features

- Multicore and lockstep core architecture
- Fast communication interface
- Integrated low-power 8-bit stand-by controller
- Hardware Security Module (HSM)

Key benefits

- Standard UART interface (available MCAL driver) supporting robust and cost optimized (capacitive coupling) communication
- Optional fault wake-up function from cell monitoring IC (TLE9012AQU) via TLE9015QU to TLF35584
- Synchronized accurate voltage measurement throughout all cells in the battery
- Battery security enabled through Hardware Security Module (HSM)

Suggested products

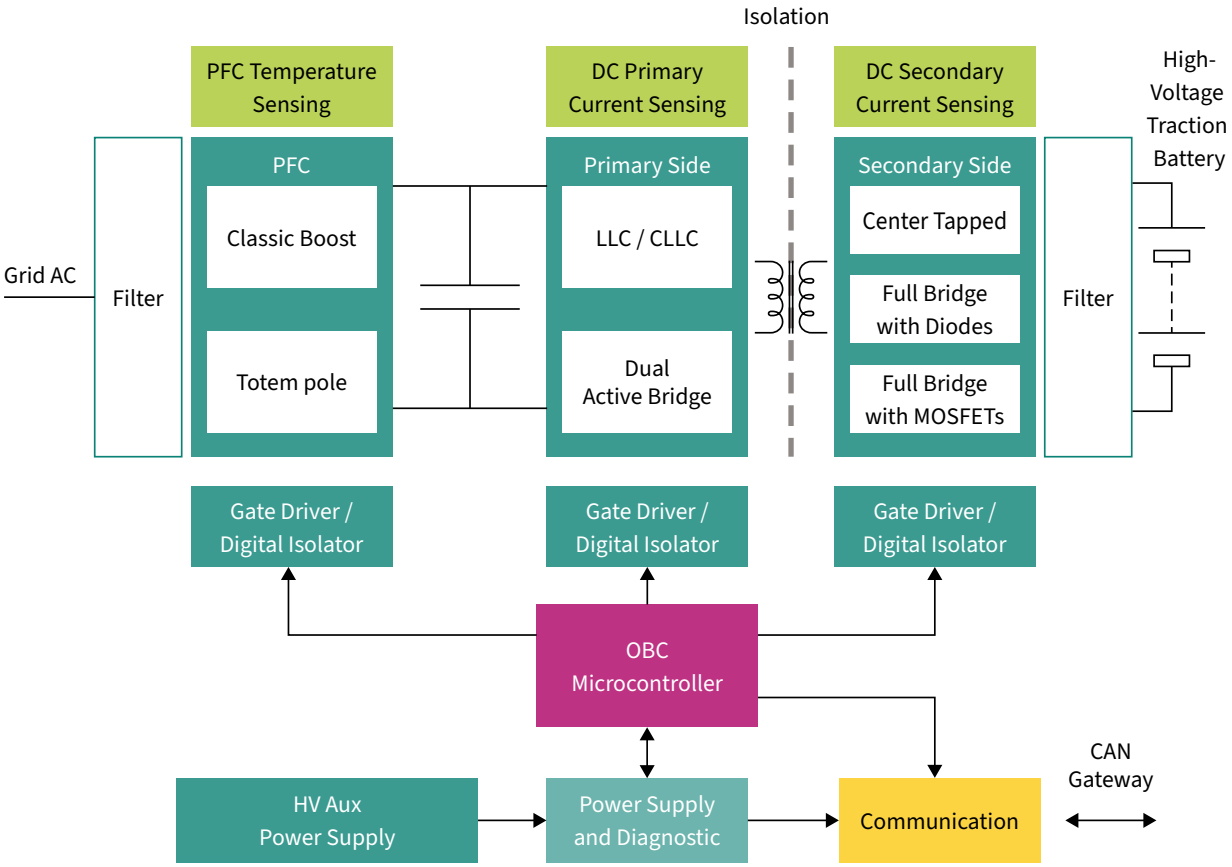
- TC23x
- TC26x
- TC27x
- TC33x
- TC36x
- TC37x

www.infineon.com/atvbms

xEV on-board charger

The EV on-board charger (OBC) recharges the high-voltage (HV) main battery from AC grids while the car is parked. Longer driving ranges of plug-in hybrid electric vehicles (PHEV) and battery electric vehicles (BEV) are achieved by increasing the battery capacities and energy efficiencies of electric components. Typical development targets are efficient power conversion for 400 V and 800 V systems, power density, reliability, and bi-directional (instead of unidirectional) power flow to enable future use cases (V2L, V2H, and V2G).

Application diagram



Features and benefits

Key features

- Supports current control-specific features
- Fast compare ADCs with support for up to 5 Msps
- Optimized PWM pattern generation in GTM
- Lockstep architecture
- CAN-FD / Ethernet support

Key benefits

- Microcontroller with best-in-class real-time performance
- Enable system integration (communication + FuSa + control) thanks to AURIX™ multicore architecture
- Scalable platform – performance, memory size and I / Os
- Highest Automotive standards – Safety up to ASIL-D, Security EVITA Full
- Availability of AUTOSAR 4.x

Suggested products

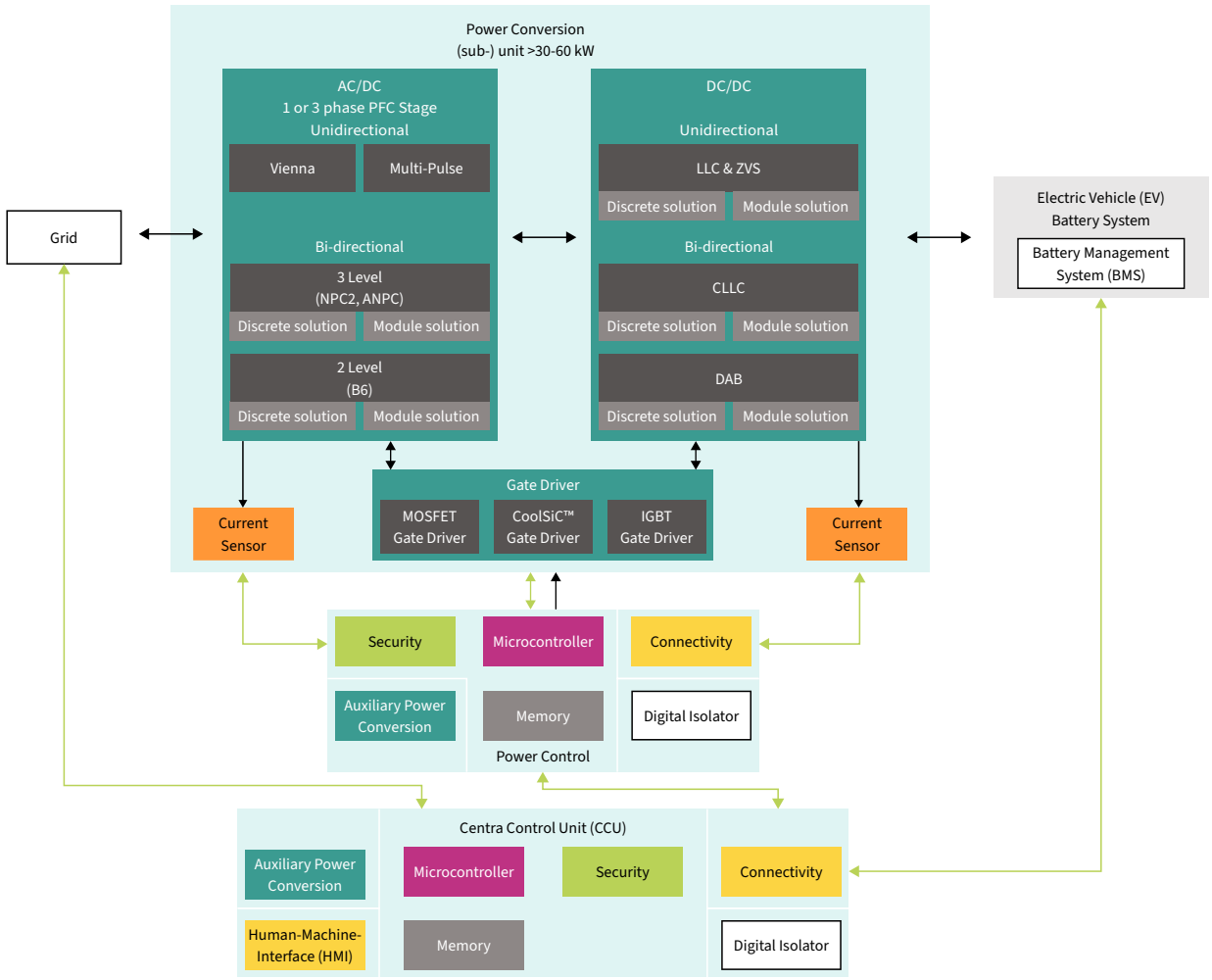
- TC38
- TC37
- TC36

www.infineon.com/ev_acdc

EV off-board charging station

Off-board charging, where users can charge plug-in hybrids and pure EVs in private garages and open parking lots, demands an optimized solution with high MCU switching frequency to stay efficient and cost competitive. The Infineon XMC™ family is the answer! If you have security or safety requirements, you can scale from XMC™ family to AURIX™ to support your solution.

Application diagram



Features and benefits

Key features

- Platform concept to allow extensive customization
- RAM: 8 kB up to 352 kB
- Flash: 16 kB up to 2 MB
- Accurate analog-mixed signal peripherals
- Fast timer / PMW peripherals
- Rich communication interfaces
- 16–196 pin-count packages
- Long-term availability

Key benefits

- Scalable family with compatibility: software, pin-out
- Performance, efficiency and cost competitiveness
- Great scalability and software re-use across the whole family
- Rich ecosystem and tooling environment for a shorter time-to-market

Suggested products

- XMC4xxx – 32-bit ARM® Cortex®-M4 MCU

AURIX™ for chassis & safety applications

AURIX™ made for safety

The AURIX™ architecture is designed in accordance with an ISO 26262-compliant process to efficiently meet ASIL-D requirements.

The platform uses up to four cores in a diverse lock-step architecture combined with cutting-edge safety technology, such as safe internal communication buses or a 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 a 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.

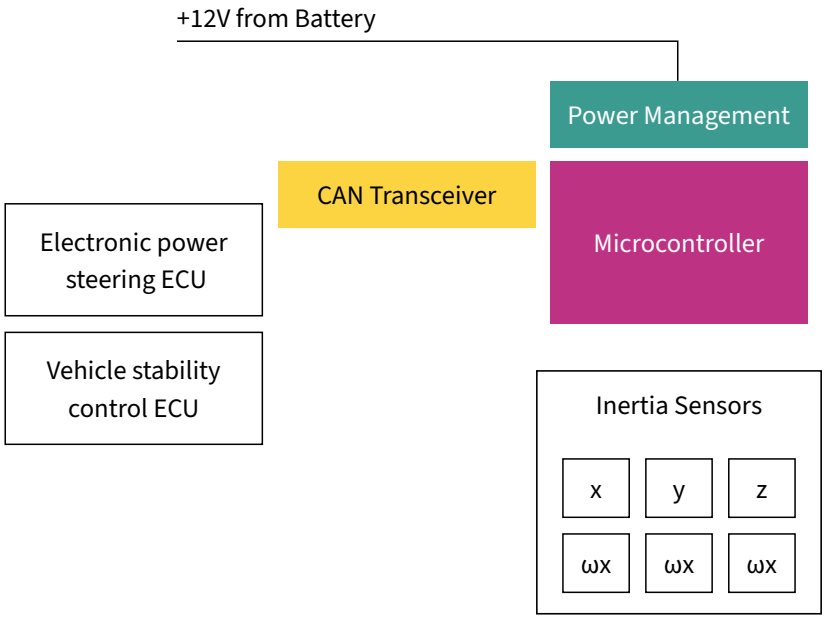
AURIX™ made for scalability

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 from an ultra high-end, 300 MHz six-core device with 16 MB of embedded flash, down to 160 MHz and 1 MB 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 BGA-196 and QFP-80 packages.

Chassis domain control

Thanks to its state-of-the-art safety features, the new TriCore™ AURIX™ family enables systems to achieve the highest ASIL-D safety level, which is already required in contemporary domain control systems. The latest diverse lockstep technology with clock delay (diverse lockstep core) significantly reduces the software overhead and enables fast time-to-market. Thanks to a scalable multicore system and innovative encapsulation techniques, this supports the integration of software with mixed-criticality levels from different sources, thereby allowing multiple applications and operating systems to be seamlessly hosted on a unified platform.

Application diagram



Features and benefits

Key features

- TriCore™ DSP functionality
- Best-in-class performance with up to six-core 300MHz
- Supports the floating point and fix point with all cores
- Up to 6.9MB of internal RAM
- ISO 26262 conformance to support safety requirement up to ASIL-D

Key benefits

- Advanced communication with FlexRay and Ethernet
- Highest available performance with integrated FPU
- Flexible DMA unit
- Scalability over flash, RAM and peripherals
- Innovative supply concept leads to best-in-class power consumption

Suggested products

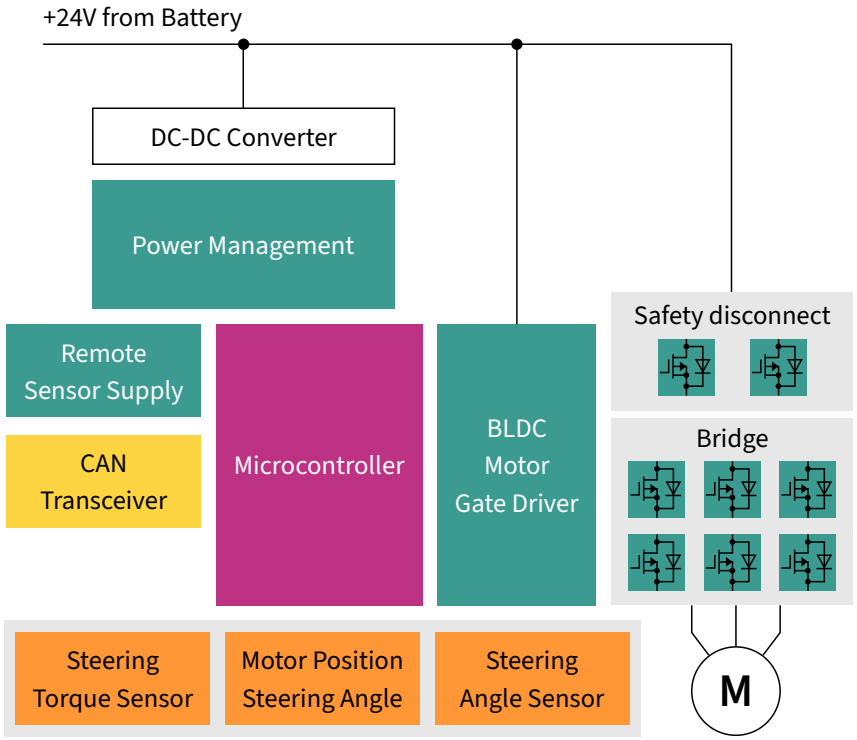
- TC37x
- TC38x
- TC39x
- TC3E7
- TC4x

www.infineon.com/chassis_domain_controller

Scalable EPS solution

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

Application diagram



Features and benefits

Key features

- Flash 512 KB – 8 MB
- Scalable flash from 1 – 16 MB
- Advanced timer unit for totally flexible PWM generation
- Redundant flexible 12-bit ADC
- Hardware SENT interface for a low CPU load
- Hardware built-in self-test

Key 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

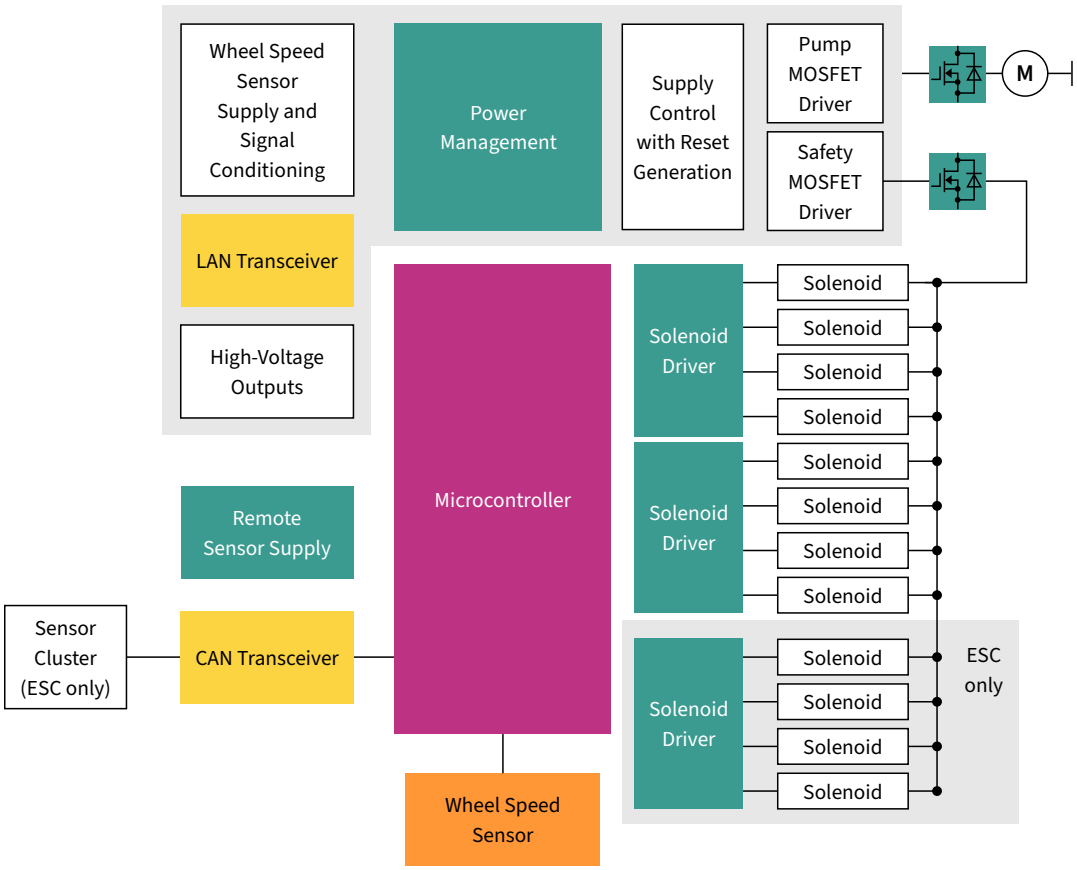
- TC32x
- TC33x
- TC36x
- TC4x

www.infineon.com/eps

Brake Vehicle Stability Control (VSC)

Thanks to its state-of-the-art safety features, the new TriCore™ AURIX™ family enables systems to achieve the highest ASIL-D safety level, which is already required in contemporary braking systems. The latest diverse lockstep technology with clock delay (diverse lockstep core) significantly reduces the software overhead 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 diagram



Features and benefits

Key features

- Scalable flash 1 – 16 MB
- Performance 160 MHz – 6x 300 MHz
- Dedicated peripheral set: LIN, CAN, SPI, FlexRay, Ethernet
- Advanced timer unit for totally flexible PWM generation
- Redundant flexible 12-bit ADC
- Hardware SENT interface for a low CPU load

Key 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

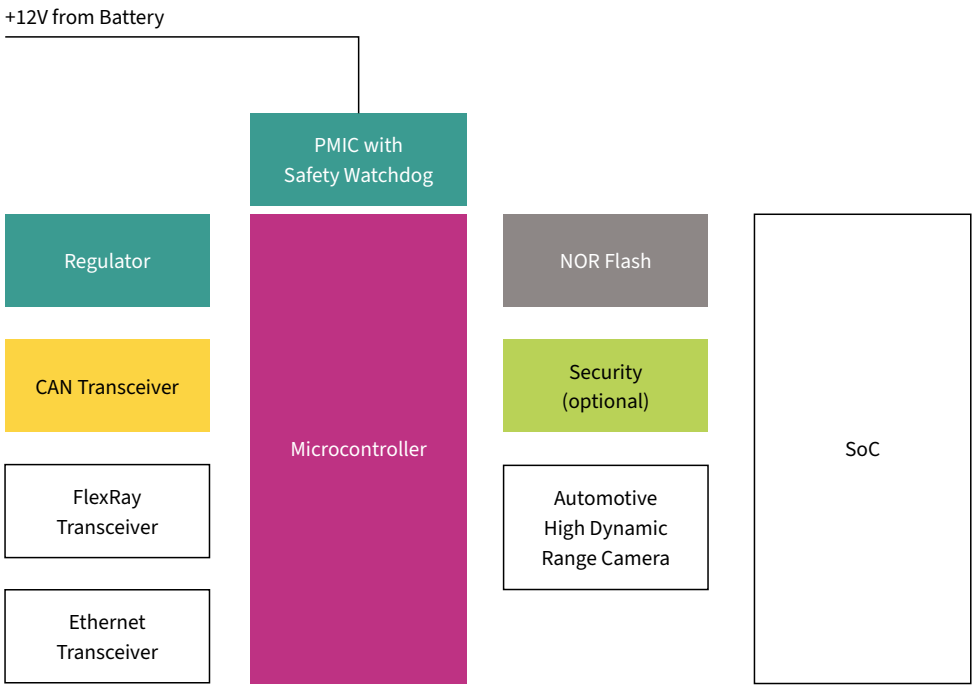
- TC36x
- TC37x
- TC38x
- TC39x
- TC3E7
- TC4x

www.infineon.com/esc

Multi-purpose camera

The AURIX™ family will enhance classic safety features with dedicated features to cater for multi-purpose camera systems. Thanks to its rich connectivity, scalable portfolio of performance, eRAM and eFlash, AURIX™ is the ideal companion for the high-performance vision SoC.

Application diagram



Features and benefits

Key features

- TriCore™ DSP functionality
- Best-in-class performance: up to six TriCore™ with 300 MHz per core
- Innovative single supply of 5 V or 3.3 V
- Rich peripherals including Ethernet 100 Mbit/s and 1 Gbit/s, multiple CAN FD, multiple SPIs
- Portfolio offering up to 6.9 MB embedded RAM

Key benefits

- High scalability option with pin-to-pin compatibility and an identical safety and security concept across the whole family, for easy development and fast go-to-market
- High integration leads to reduced complexity
- Innovative supply concept leads to best-in-class power consumption

Suggested products

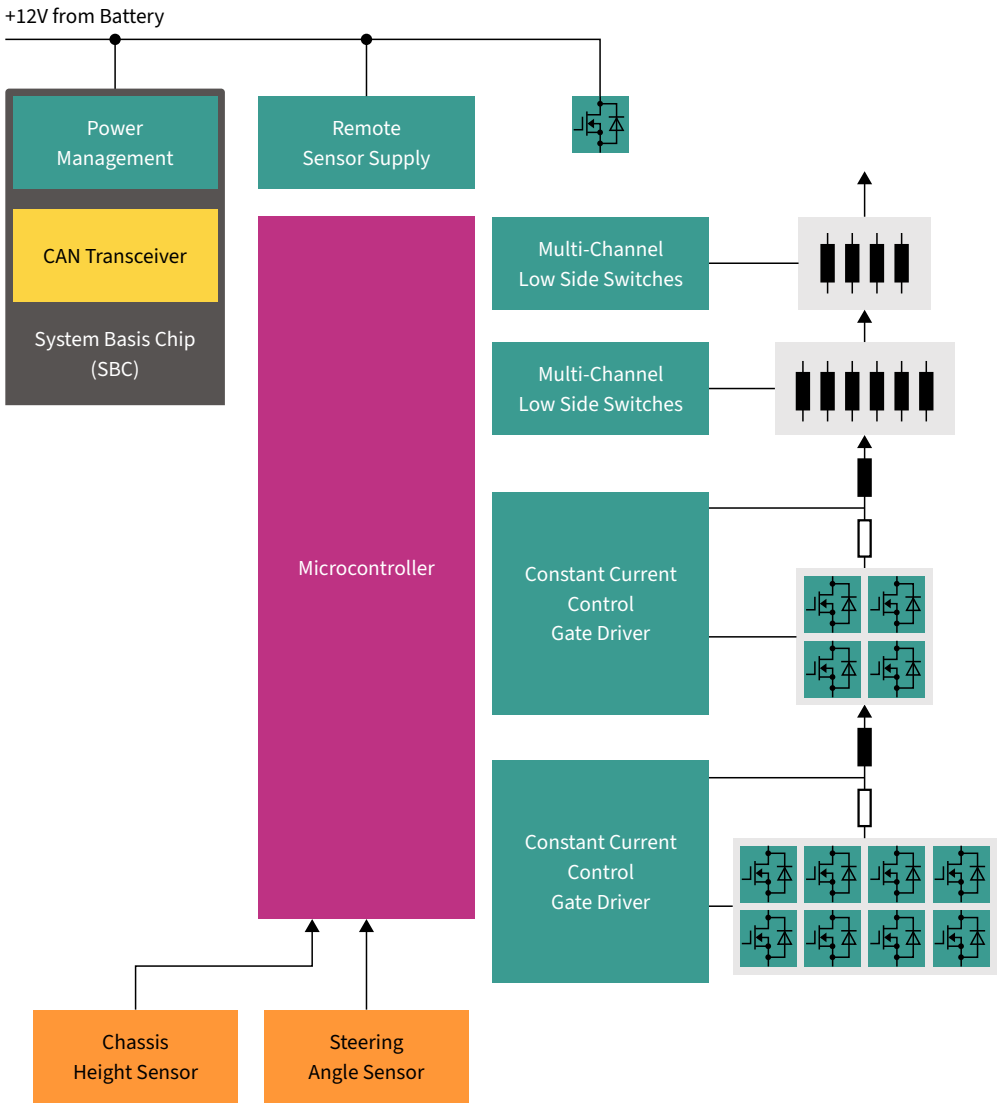
- TC333LP
- TC367DP
- TC377TP
- TC4x

www.infineon.com/multi-purpose-camera-configuration

Active suspension control system

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

Application diagram



Features and benefits

Key features

- TriCore™ DSP functionality
- Best-in-class performance: up to six TriCore™ with 300 MHz per core
- Supports the floating point and fix point with all cores
- Up to 6.9 MB
- Communication peripherals: CAN, LIN, FlexRay, Ethernet
- Innovative single supply of 5 V or 3.3 V

Key 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

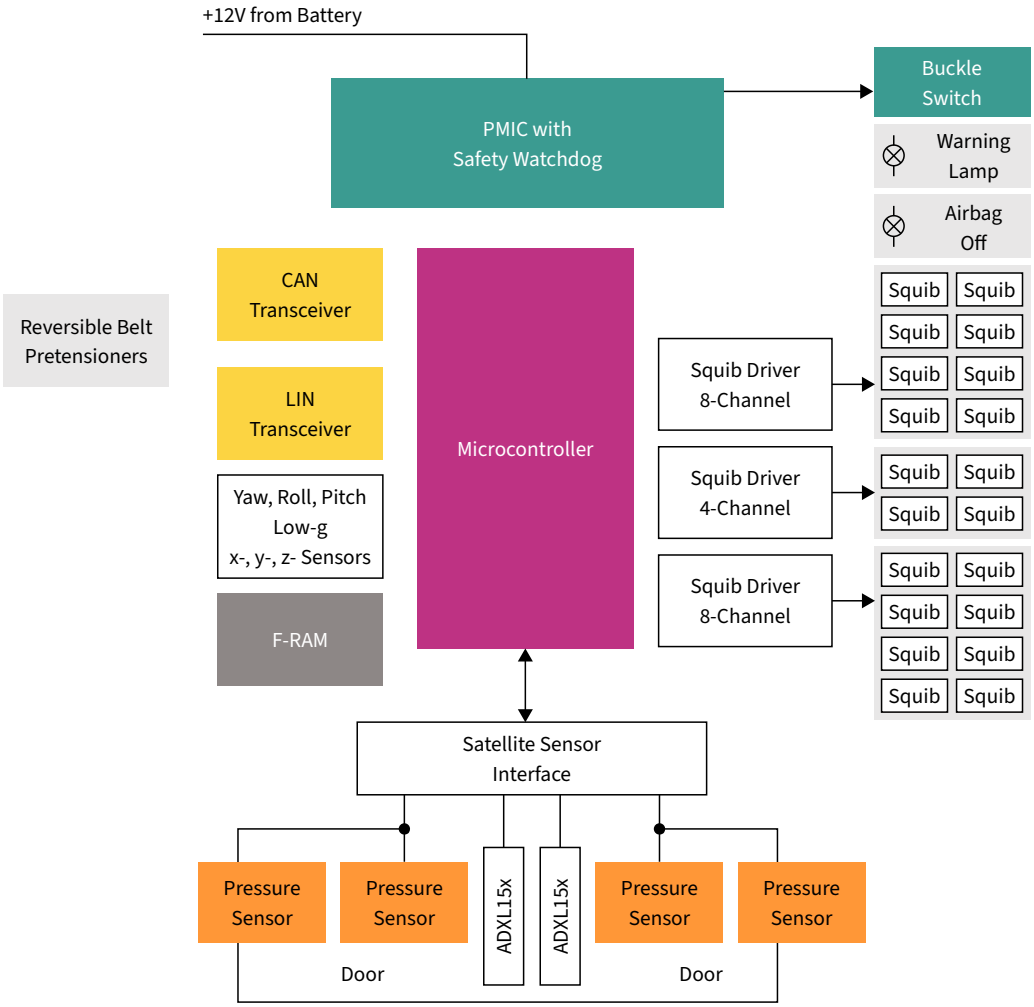
- TC33x
- TC36x
- TC37x
- TC4x

www.infineon.com/suspension

Airbag system

Thanks to its state-of-the-art safety features, the new TriCore™ AURIX™ family enables systems to achieve the highest safety level up to ASIL-D. Its scalability allows the selection of a single-core solution for basic airbag systems and multicore solutions for airbag systems with an integrated sensor cluster. The best cost-performance fit is offered by the wide range of flash, performance and peripheral options available within the AURIX™ family.

Application diagram



Features and benefits

Key features

- Scalable flash 1 – 16 MB
- Performance 160 MHz – 6x 300 MHz
- Dedicated peripheral set: CAN, LIN, SPI, FlexRay, Ethernet
- Advanced timer unit, totally flexible PWM generation and hardware input capture
- Redundant flexible 12-bit ADC

Key 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

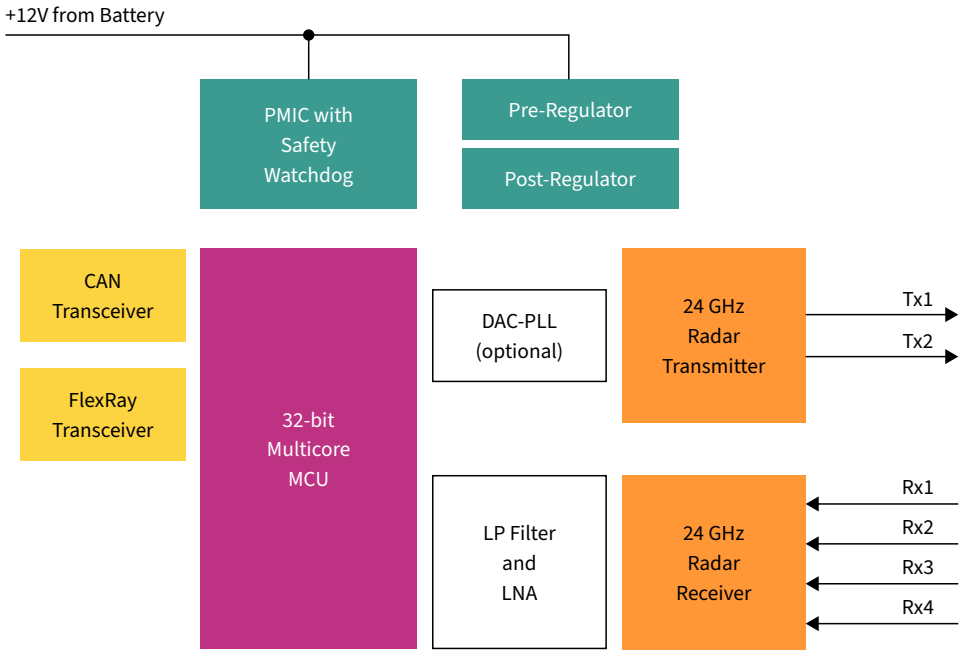
- TC32x
- TC33x
- TC36x
- TC4x

www.infineon.com/airbag

Automotive 24 GHz radar system

The new TriCore™ AURIX™ family will enhance classic safety features with dedicated features to meet 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 diagram



Features and benefits

Key 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)
- Continuous, precise and flexible bit-streaming machine (HSPDM) in AURIX™ TC3x, to replace the external DAC controlling the ramp generator

Key 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
- Cost savings on the DAC component by using the AURIX™ TC3x, which integrates the HSPDM IP

Suggested products

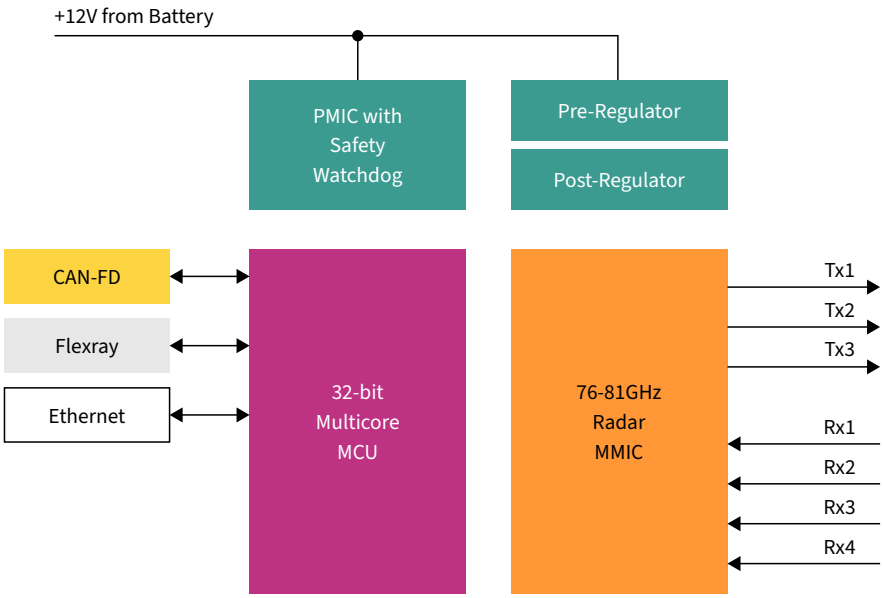
- TC33xDA
- TC4x

www.infineon.com/radar-sensors

Highly integrated automotive 77 GHz radar chipset

Thanks to its proprietary radar accelerator IP, the new TriCore™ AURIX™ TC3x family will bring another level of performance to radar applications, as well as fulfilling the ever-growing requirements regarding safety and security in the ADAS market.

Application diagram



Features and benefits

Key features

- TriCore™ DSP functionality
- Dedicated radar cluster with its own radar interface (RIF, LVDS-based) and accelerators (SPU), offering not only FFT but also filtering (CFAR), along with windowing and signal power measures capabilities
- Up to 4 MB RAM for radar image storage
- High-precision input timers

Key benefits

- Family concept with three products for fast go-to-market and scalable radar portfolio
- Rich features implemented in hardware to attain an optimal performance / consumption ratio and reduce the amount of components, leading to cost savings

Suggested products

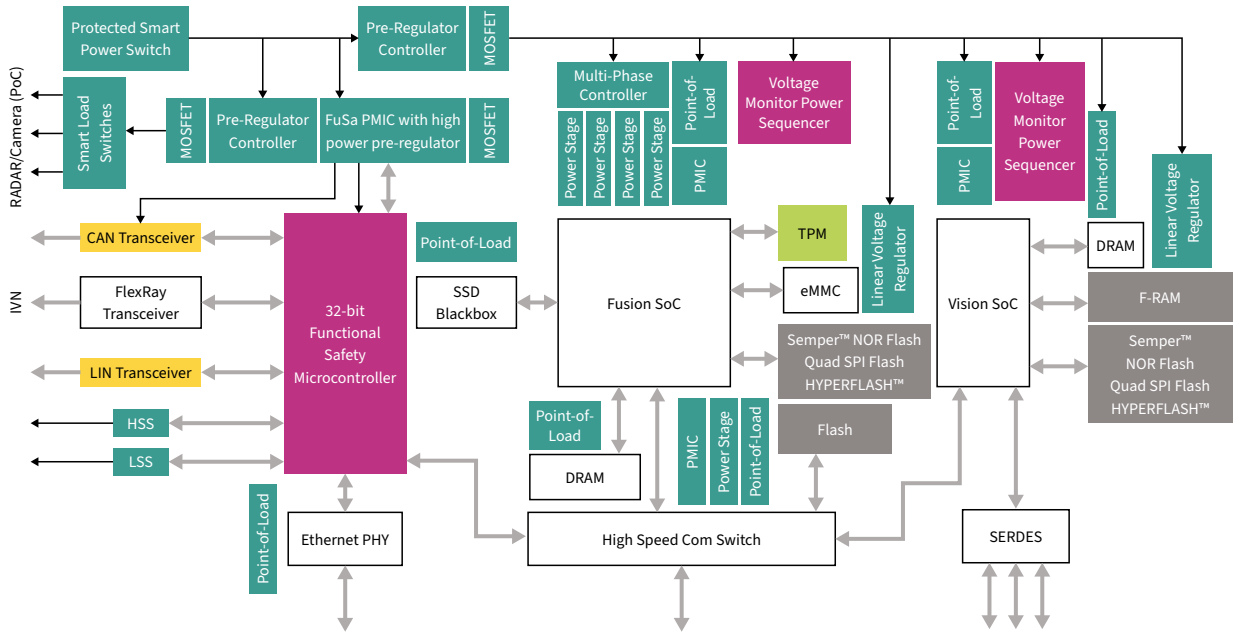
- TC33xDA
- TC35xTA
- TC39xxA
- TC39XA
- TC3AxQA

www.infineon.com/radar-sensors

Sensor fusion

The new TriCore™ AURIX™ TC3x family offers a scalable product portfolio to address the needs of sensor fusion applications, from stand-alone object fusion to companionship for a high-end AD ECU.

Application diagram



Features and benefits

Key features

- TriCore™ DSP functionality
- Best-in-class performance: up to six TriCore™ with up to 300 MHz per core, up to 3200 DMIP ASIL-D capable per MCU
- Up to 4 MB RAM for grid information treatment
- Up to 16 MB eFlash to support A/B swap SOTA
- Ethernet up to 1 Gbit/s for fast connection to network and SoC

Key benefits

- Family concept with PIN and software compatibility, for maximum re-use and fast go-to-market
- Rich legacy peripherals (CAN FD, LIN, …) for integrated gateway application

Suggested products

- TC35xTA
- TC37xTX
- TC38xQP
- TC39xXX
- TC3E7Qx
- TC4x

www.infineon.com/sensorfusion

AURIX™ for body & connectivity applications

AURIX™ made for connectivity

Connectivity electronics systems embrace a broad variety of applications inside the car, covering comfort, safety and security as well as high-performance computing and in-vehicle networking. This leads to the key strengths of the AURIX™ family:

Power consumption – An innovative supply concept automatically adapts the power consumption to the actual performance requirements. Furthermore, the new trend of pretended networking and ECU degradation is actively supported.

Enhanced communication – As cars incorporate an in-creasing amount of electronics, the body electronics module's responsibilities increase to handle the additional components and message traffic. Due to the gateway functionality of the BDC, AURIX™ has enhanced communication capabilities to support communication between CAN FD, LIN, FlexRay and Ethernet buses.

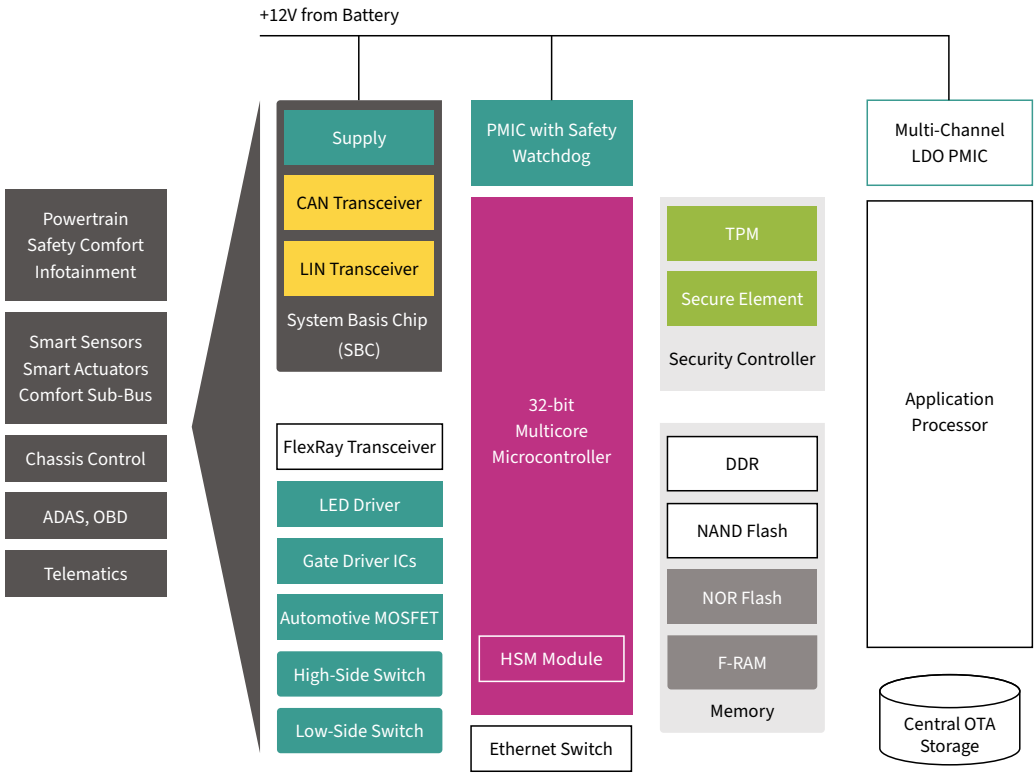
Safety – The trend is toward the integration of safety targets in the requirements of advanced body systems, such as lighting, BDC etc. To achieve the required ASIL level according to ISO 26262, AURIX™ has the capability to cover targets up to the highest ASIL-D safety integrity level.

Security – In the future, the need for a high level of security will also expand into body applications. Cars are expected to hold even more information as they become smart cards on wheels for simplifying financial transactions at gas pumps, charging stations, parking lots, toll booths, drive-through shops and more. The vehicle will act as a smart card and pay your fee/fare – sometimes automatically. Hardware-based security is more robust than software-only security. AURIX™ provides a dedicated module, the HSM (Hardware Secure Module), to cover the highest level of security.

Advanced gateway architecture

In gateway applications, AURIX™ TC3x microcontrollers support the latest communications interfaces and feature a Gigabit Ethernet interface, up to 12 ISO 11898-1-compliant CAN FD channels and up to 24 LIN channels. An additional eMMC interface for external flash interfacing enables local data storage, supporting software-over-the-air update concepts.

Application diagram



Features and benefits

Key features

- High-performance processing: up to six-core 300 MHz
- Automotive up to 2xGB Ethernet
- Up to 20 CAN FD
- eMMC for external flash
- Hardware security module

Key benefits

- Integrated, cost-efficient solution for a connected gateway with SOTA, secure on-board communication …
- Fast secure boot
- Gateway board to reduce the development outlay

Suggested products

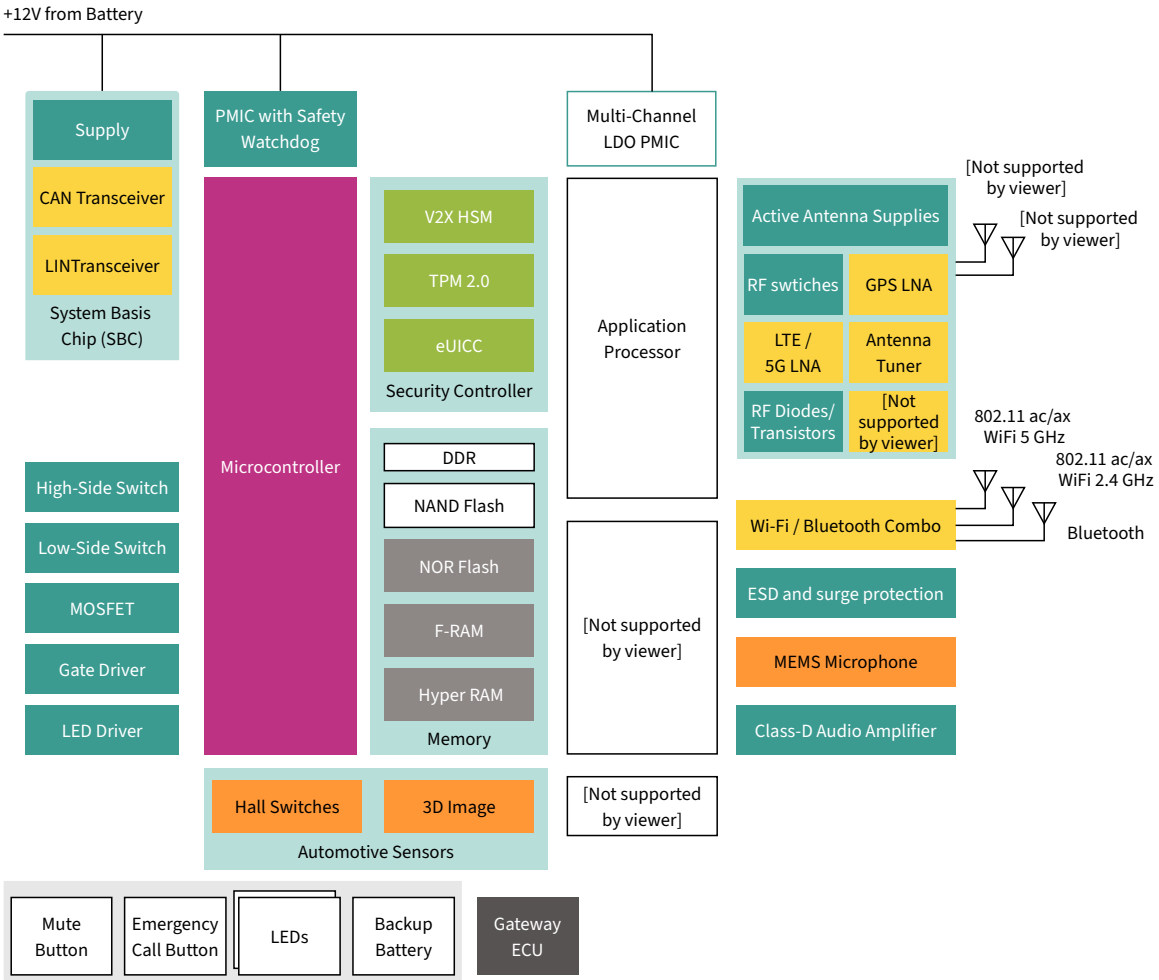
- TC36x
- TC37x
- TC3E7
- TC38x
- TC39x
- TC4x

www.infineon.com/gateway

Telematics control unit and V2X

The telematics control unit connects the car to the outside world, thereby enabling 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, while increasing customer satisfaction. The opportunity to add new features opens up the door to new business models and revenue streams.

Application diagram



Features and benefits

Key features

- Remote diagnostics
- Superior Hardware Security Solution (HSM) + functional safety up to ASIL-D
- Rich automotive and consumer interfaces

Key benefits

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

Suggested products

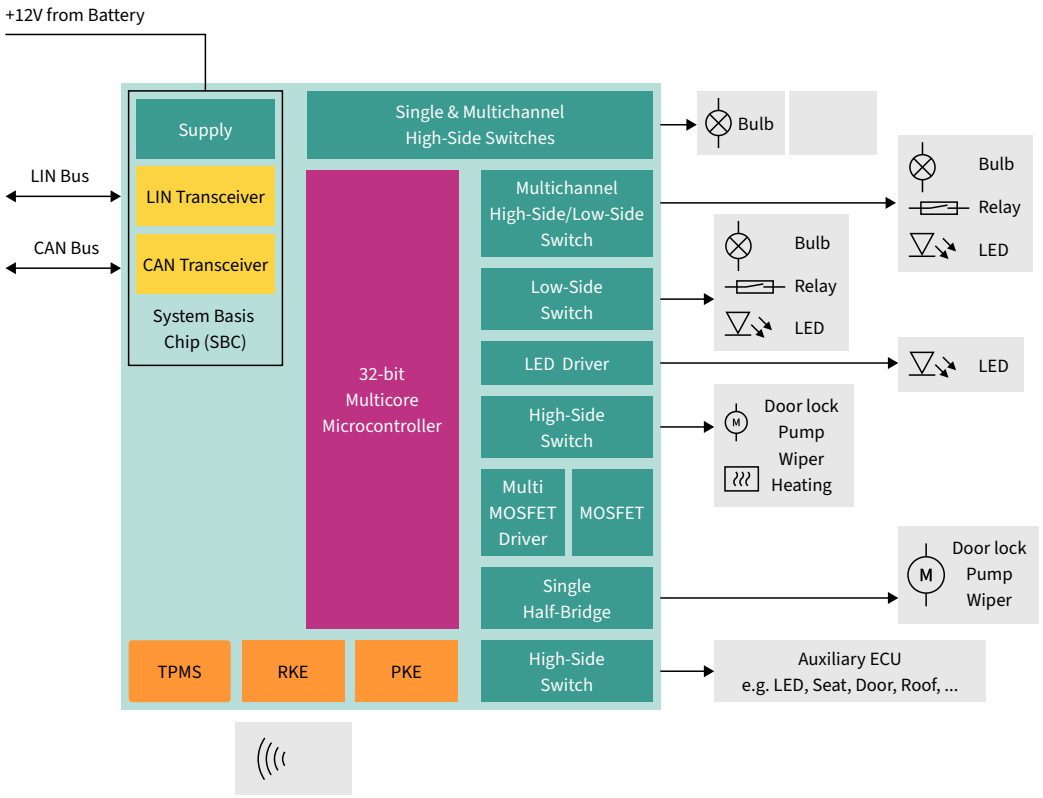
- TC33x
- TC3Ex
- TC36x
- TC37x
- TC4x

www.infineon.com/tcu

High-feature body domain control unit

Body Domain Control unit (BDC) application comprising internal and external lighting systems, as well as control of relays and voltage rails and further comfort functions such as door and wiper control. The central gateway manages all internal interfaces (i.e. motor management, in-car entertainment, dashboard or convenience control) and communication with external interfaces for after-sales software updates. The AURIX™ multicore concept enables the integration of two applications in one device, e.g. BDC and gateway.

Application diagram



Features and benefits

Key features

- Scalable MCU family from single to multicore
- Encapsulation feature allows interference-free software development for multiple applications
- Advanced communication peripherals: CAN, LIN, SPI, FlexRay, Ethernet
- ISO 26262 conformance to support safety requirements up to ASIL-D

Key benefits

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

Suggested products

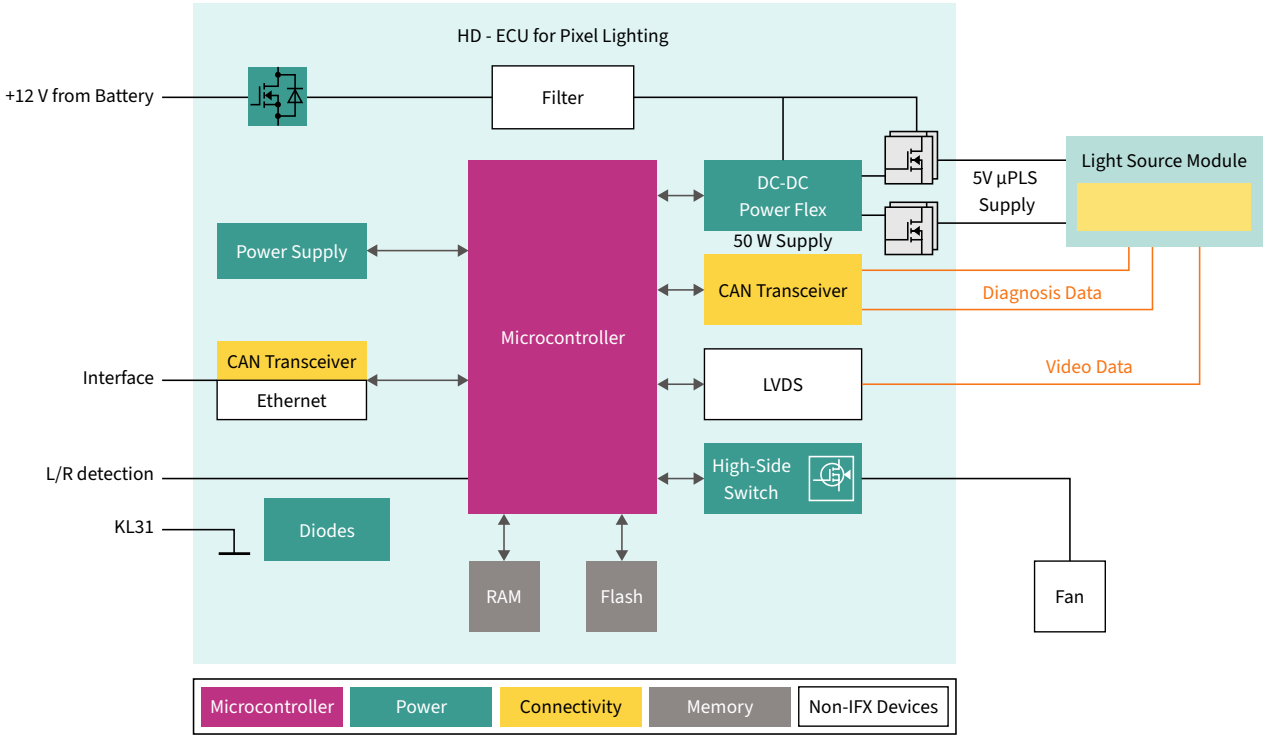
- TC36x
- TC37x
- TC38x
- TC39x
- TC3E7
- TC4x

www.infineon.com/bdc_advanced

Pixel lighting

The new TriCore™ AURIX™ TC3x family offers a scalable product portfolio to address low to high-definition safe headlight systems.

Application diagram



Features and benefits

Key features

- Best-in-class performance: up to six TriCore™ with up to 300 MHz per core
- Up to 6.9 MB RAM for light distribution processing
- Up to 16 MB eFlash to support A/B swap SOTA
- Ethernet up to 1 Gbit/s for fast connection to network

Key benefits

- Enables smart headlight solutions , to save connectivity costs
- Family concept with PIN and software compatibility, for maximum portfolio scalability, re-use and fast go-to-market
- Compatibility with all major headlight driver solutions
- Rich legacy peripherals (CAN FD, LIN, …)

Suggested products

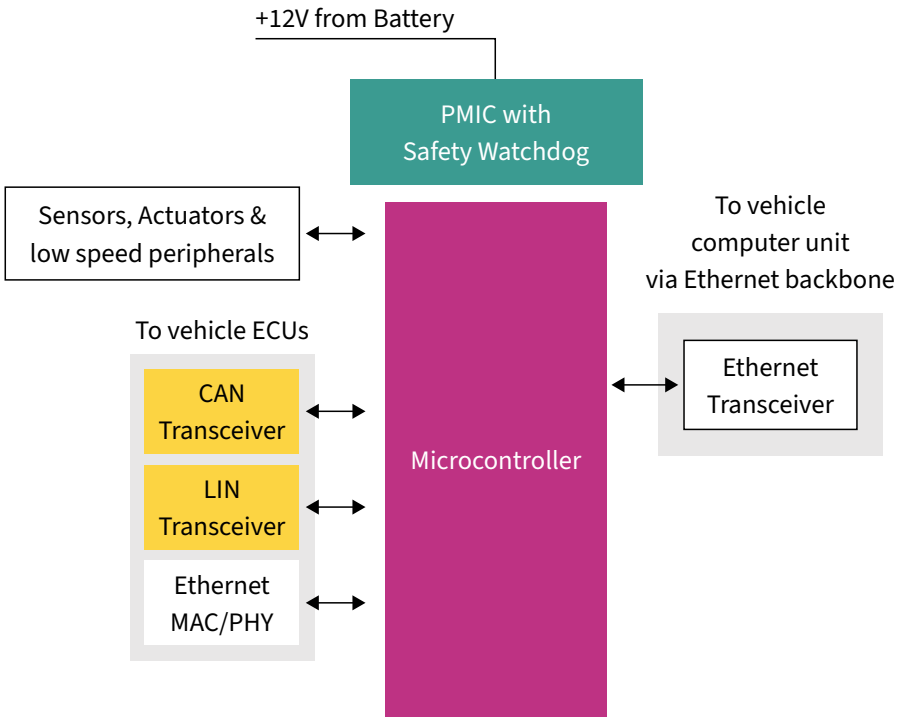
- TC367DP
- TC377TP/X
- TC387QP
- TC397XP/X
- TC4x

www.infineon.com/pixel-lighting

Zone Controller

For cars in zonal architecture the overall number of ECUs will be reduced due to further consolidation of functions which leads to increased performance as well as interface requirements for MCUs in the zones. Beyond that, connectivity inside the car and to the outside is getting more important leading to significantly increased connectivity requirements up to multiple multi-gigabit interfaces. While the hardware architecture is becoming more homogenous and simpler overall, the complexity on software side is increasing in order to cope with the ever-greater number of functions in a vehicle with even fewer computing units. Infineon AURIX™ microcontrollers are designed for high performance, dependability, safety and security making them ideal for the demanding requirements of modern automotive E/E architectures incl.

Application diagram



Features and benefits

Key features

- High performance & versality with up to 6 cores operating at 300MHz up to 16 MB non-volatile memory and A/B swap capability for SOTA support
- Rich connectivity features including CAN, LIN, FlexRay, 1 Gbit Ethernet, etc …
- ASIL D safety standard according to ISO26262
- Full EVITA HSM security module with secured RAM
- Symmetric and asymmetric HW Crypto Engine

Key benefits

- Cores with closely coupled memories for high compute performance
- Memory with A/B swap functionality for SOTA support
- Multiple Gbit Ethernet channels to support fast in-vehicle Ethernet backbone
- Best-in-class SW ecosystem for fast and comprehensive system bring-up
- ISO 26262 & Full EVITA compliance ensuring highest levels of functional safety & cyber security

Suggested products

- TC37x
- TC38x
- TC39x
- TC4x

www.infineon.com/zone-controller

AURIX™ for Commercial and Agricultural Vehicles (CAV) applications

AURIX™ is Infineon's brand-new family of microcontrollers, designed to precisely meet the needs of the 24-60 V industry in terms of performance, memory, scalability, safety, and security.

Its innovative multicore architecture supports the latest trends in connectivity, such as Ethernet and CAN FD, as well as safety (IEC 61508 / ISO 25119 / ISO 26262) and security.

While supporting a high performance, the innovative supply concept with integrated DC-DC converter leads to best-in-class power consumption.

The scalable AURIX™ family leads to the most optimized cost-performance application fit.

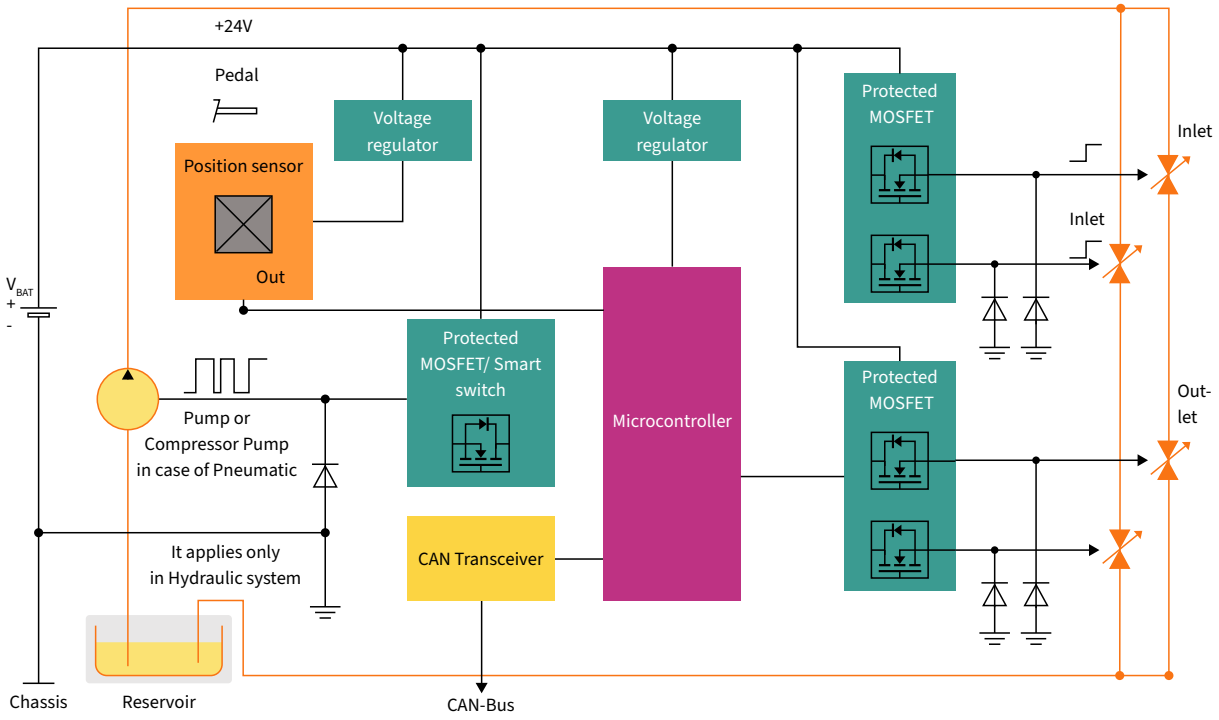
AURIX™ addresses CAV requirements and challenges

External memory extension	Lots of IOs	Safety
– Expensive external RAMs – Short life cycles – Design complexity – No memory integrity support	– Hundreds of valves, actuators, and LEDs – Many analog signals to be measured – Communication interfaces	– Increasingly rigorous safety standards – Expensive dual-channel approach – Tedious work until certification
– Special devices with extended SRAM – Up to 2.7 MB SRAM	– Different packages up to 516 pins – Multiple ADCs, communication interfaces	– IEC 61508 family safety concept – Lockstep – Safety support

Hydraulic / pneumatic management system

CAVs are under mounting pressure to provide highest possible availability and lowest-possible operating costs as operators strive to maximize profits. Hydraulic or pneumatic system are key applications toward such targets, providing great reliability and low operational cost. The new TriCore™ AURIX™ TC3x family offers a scalable product portfolio to address all the demands for valve control management and carry out a variety of protective and diagnostic functions. Hydraulic management system has to be precise and robust enough to withstand harsh environments and engineered to carry out a variety of protective and diagnostic functions.

Application diagram



Features and benefits

Key features

- Valves and pumps can be driven via linear activation or demand-controlled via PWM signals
- Integrated solution reduces the design outlay
- Integrated solution reduces the design outlay
- Pin-to-pin and software compatibility

Key benefits

- AURIX™ advanced timer unit for dynamic PWM generation and hardware input capture
- Scalability over flash, RAM and peripherals, offering the best cost-performance ratio
- High microcontroller junction bare die temperature to withstand high temperature environments

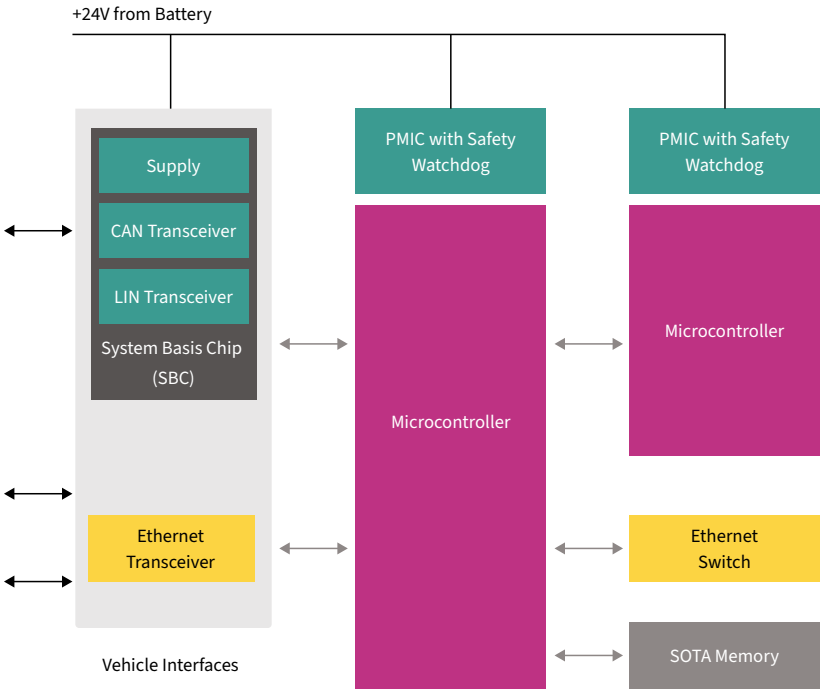
Suggested products

- TC32x
- TC33x
- TC36x
- TC37x
- TC4x

Gateway 24 V

Not different from a passenger cars, in order to comply with Megatrends like CO_2 emissions, ADAS and Connectivity, CAVs need sophisticated systems which can offer cost efficient and high performant computational power. Such requirements demand high complexity E/E architectures with respect to in-vehicle communication networks, power networks, connectivity, safety and security. In order to reliably and securely transfer different types of data through different network protocols, CAVs make use of a Gateway controller, which perform as a hub among all the functional domains that share data. The high computing performance and multiple connectivity interfaces of the new TriCore™ AURIX™ family makes it the ideal microcontroller for gateway applications.

Application diagram



Features and benefits

Key features

- 24 V compliant gateway
- Enable high complexity E/E architectures
- Data transfer across different functional domains working in different network protocols
- Gateway board to reduce the development outlay

Key benefits

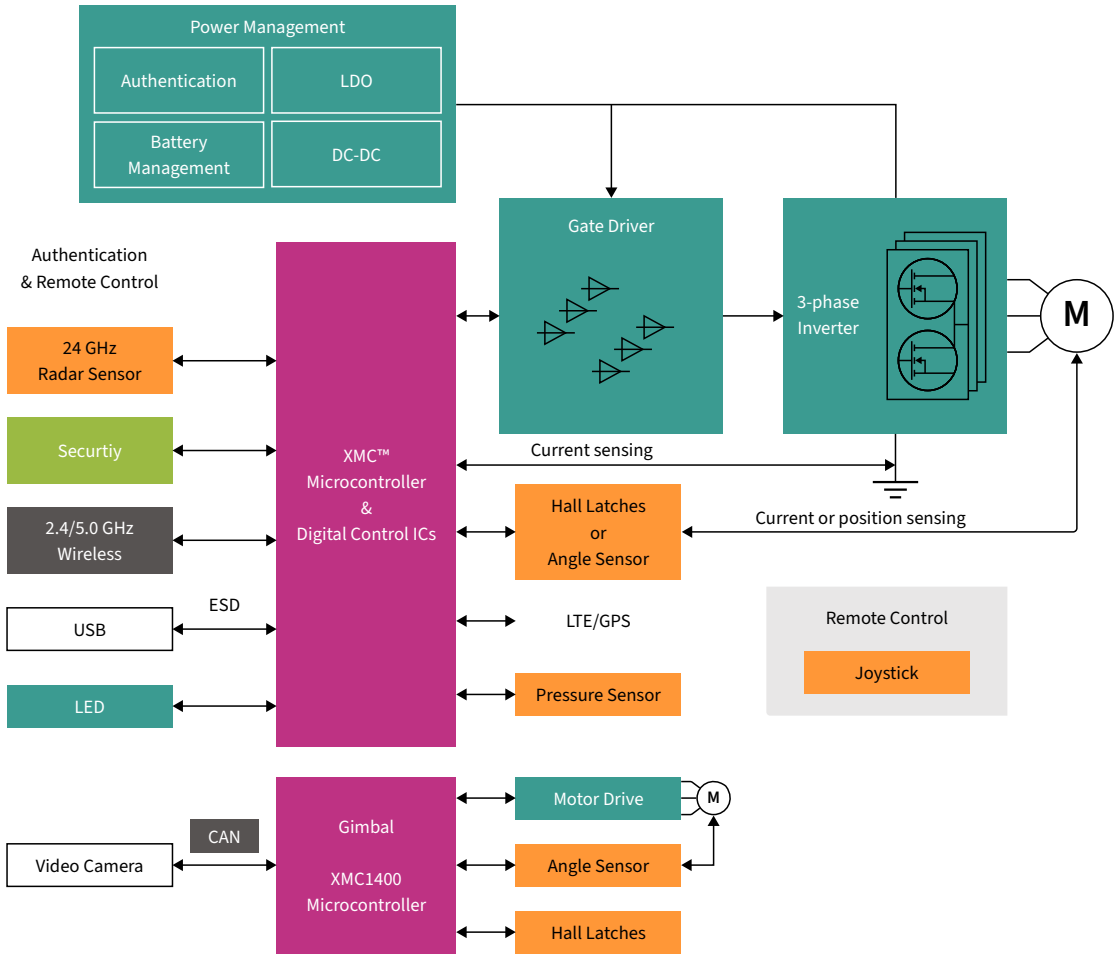
- AURIX™ computing performance, flexibility, scalability, integrated safety and security support
- AURIX™ multiple connectivity capabilities, including up to 2 Gigabit Ethernet interfaces
- High integration leads to significant cost savings and reduced complexity
- AURIX™ Hardware Security Solution (HSM) provides the highest level of security
- Hardware compliance with ISO 26262 up to ASIL-D

Suggested products

- TC37x
- TC39x
- TC4x

eVTOL / Multicopter / Drones

Application diagram



Features and benefits

Key features

- Commercial drone solution based on AURIX™ family
- Decentralized architecture
- Single chip solution – AURIX™ for flight control, motor control, radar sensors,
- BMS and power conversion providing optimum balance between BOM cost and performance

Key benefits

- Dedicated motor control unit using AURIX™ CCU6 & GTM for fine motor tuning, as well as multicore architecture to drive several motor per device
- Redundant sensors input for safety and sensor fusion enabling a smooth and precise flight control
- AURIX™ Hardware Security Module (HSM) provides secure authentication for original parts, protection against ma-nipulation and secure SOTA software updates

Suggested products

- TC37x
- TC39x
- TC4x

AURIX™ for industrial applications

AURIX™ addresses CAV requirements and challenges

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

AURIX™ was developed as a Safety Element out of Context (SEooC) fulfilling the applicable objectives of ISO 26262:2018 up to ASIL-D and IEC61508 up to SIL-3. The customer benefits of AURIX™ for safety and security microcontrollers include: 'Supporting the development of applications with ISO 26262:2018 and IEC61508 certification' Supporting protection against random faults as described in the safety manual ' Accelerating the development of safety critical applications via SW libraries

The AURIX™ family enables the highest integrated safe memory sizes (SRAM up to 6.9 MB and flash memory up to 16 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 6x 300 MHz and combine MCU and DSP instructions with an integrated FPU.

The integrated peripheral set is primarily targeted toward motor control and power conversion, providing high-performance ADCs, DS ADCs and a full set of diverse high-performance timers. 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, such as Ethernet, CAN FD, FlexRay and multiple other high-speed interfaces.

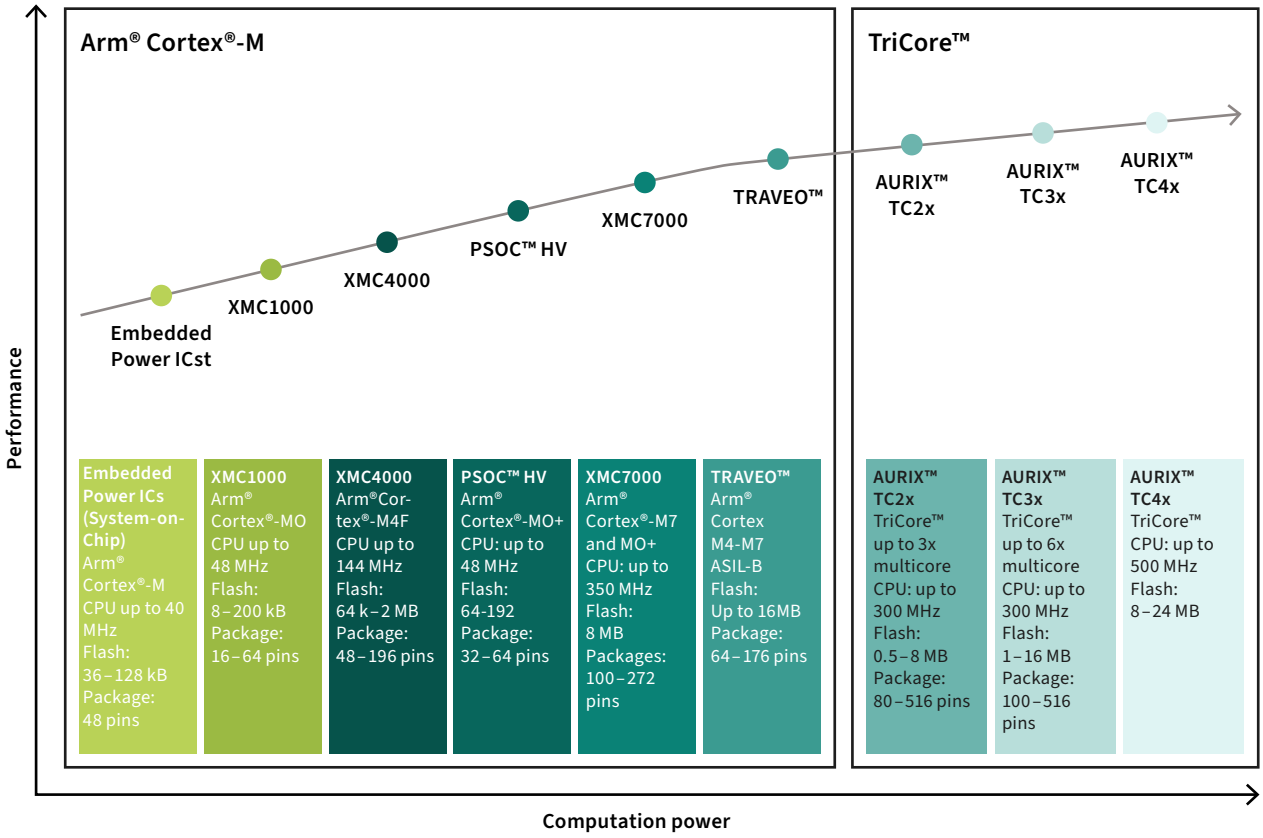
Providing security and functional safety

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 new generation of TriCore™-based microcontrollers – AURIX™ – provides another significant performance milestone by integrating up to six 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 facilitates running a combination of safety-critical tasks, such as controlling an inverter, with non-critical tasks, such as network communication, on a single MCU.

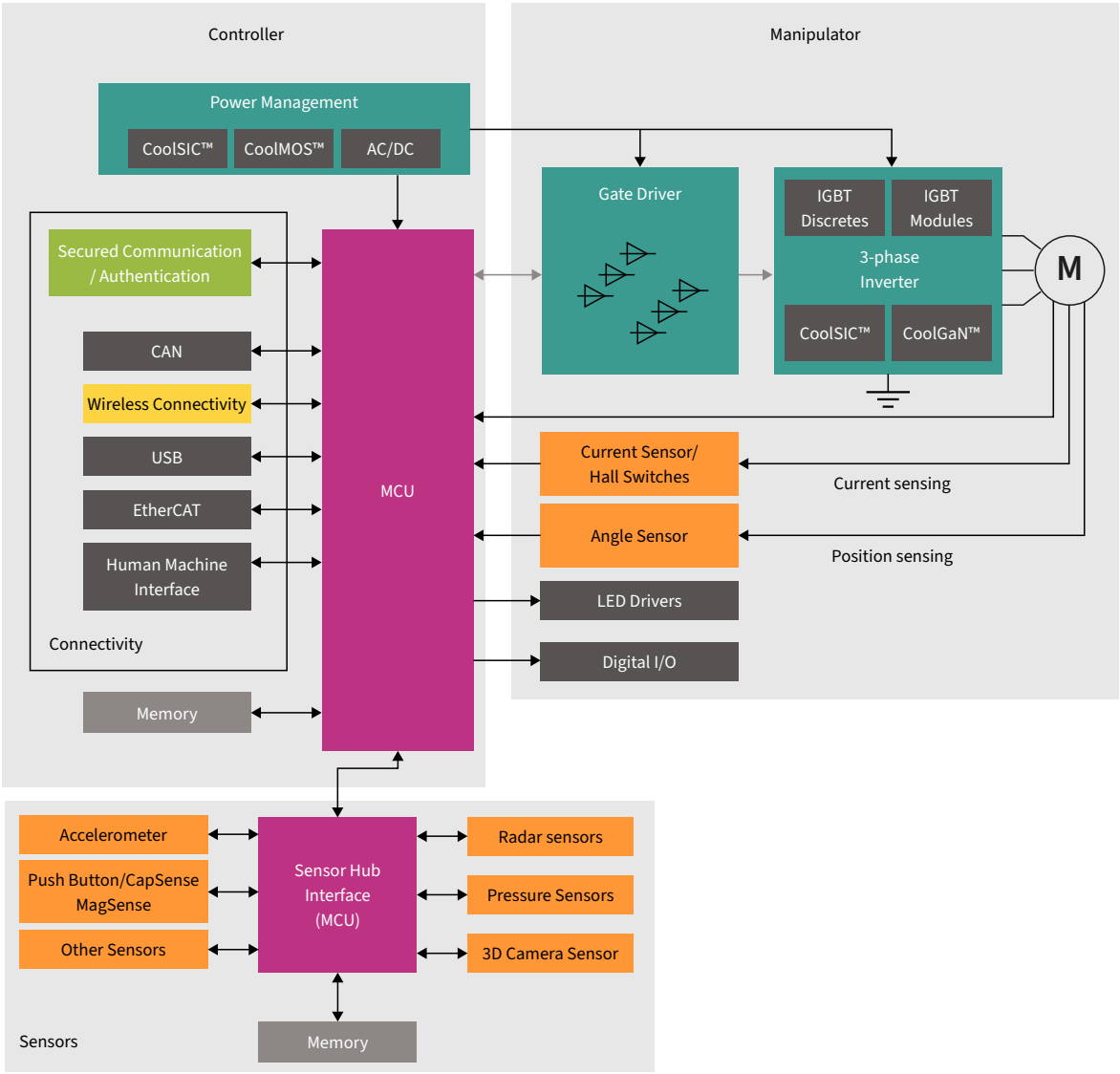
Infineon Microcontrollers for industrial applications

Industrial motor drives have become more and more sophisticated over the years as they have to drive different motors, a large amount of sensors and communication requirements. But beyond those, Safety becomes key to protect the humans interacting with the machines. Therefore are various redundancy mechanisms required. This is what AURIX™ portfolio offers combined with high reliability and long lifetime management.



Industrial robotics

Application diagram



Features and benefits

Key features

- High computing performances
- High level of accuracy, integration and efficiency
- Safety management in line with current norms
- Various topologies for axes, joints and motors
- Security features that protect intellectual property from counterfeiting

Key benefits

- High computing performance: up to 6x 300 MHz
- High flexibility thanks to tailored peripherals
- Integrated safety support (EN ISO 10218 and ISO/TS15066)
- Integrated security with hardware security module
- Robust 3 V-, 5 V-, LVDS – PortPins
- Large portfolio with long-term availability

Suggested products

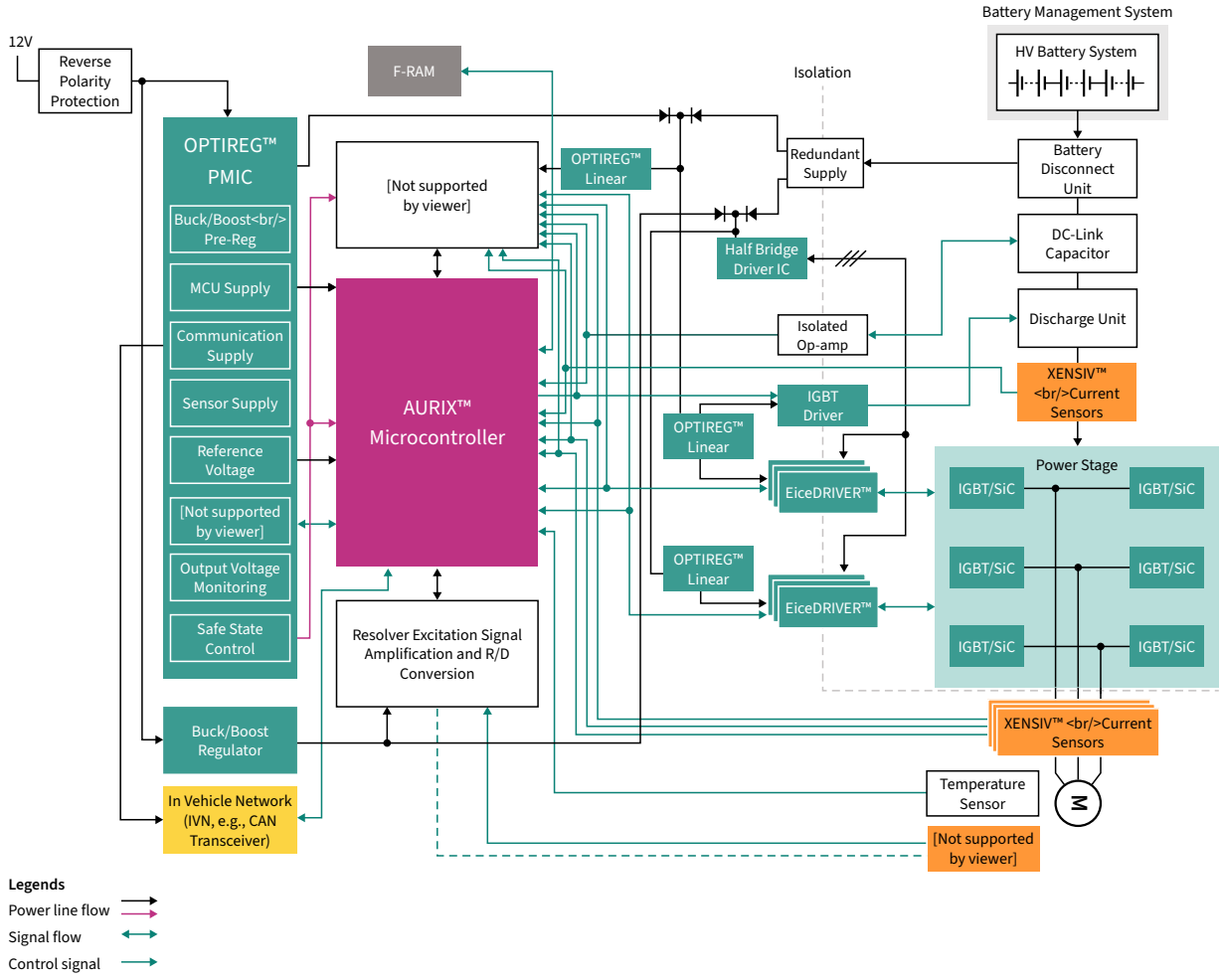
- TC33x
- TC36x
- TC37x
- TC38x
- TC39x
- TC4x

www.infineon.com/industrial-robots/

Industrial motor drives

Industrial motor drives have become more and more sophisticated over the years as they have to drive different motors, a large amount of sensors and communication requirements. But beyond those, Safety becomes key to protect the humans interacting with the machines. Therefore are various redundancy mechanisms required. This is what AURIX™ portfolio offers combined with high reliability and long lifetime management.

Application diagram



PROSIL

Features and benefits

Key features

- Multi-axis controller for two 3-phase complementary PWMs
- Multiple modulation strategies (SVPWM, DPWM, soft-PWM, direct torque control) to support requirements aimed at reducing noise emissions and increasing efficiency
- Field-oriented control with less than 10 % CPU load
- Multiprocessor support for reliability and safety
- Support for 3-level inverter topologies

Key benefits

- Diverse high-performance timer architectures
- Up to 12 SAR-ADCs 12-bit resolution and up to 14 DS-ADC
- Resolver I/F and encoder I/F with digital noise filter
- Very fast control loop
- IEC 61508 support – Safety Integrity Level (SIL) 1 to 3
- Innovative single power supply concept

Suggested products

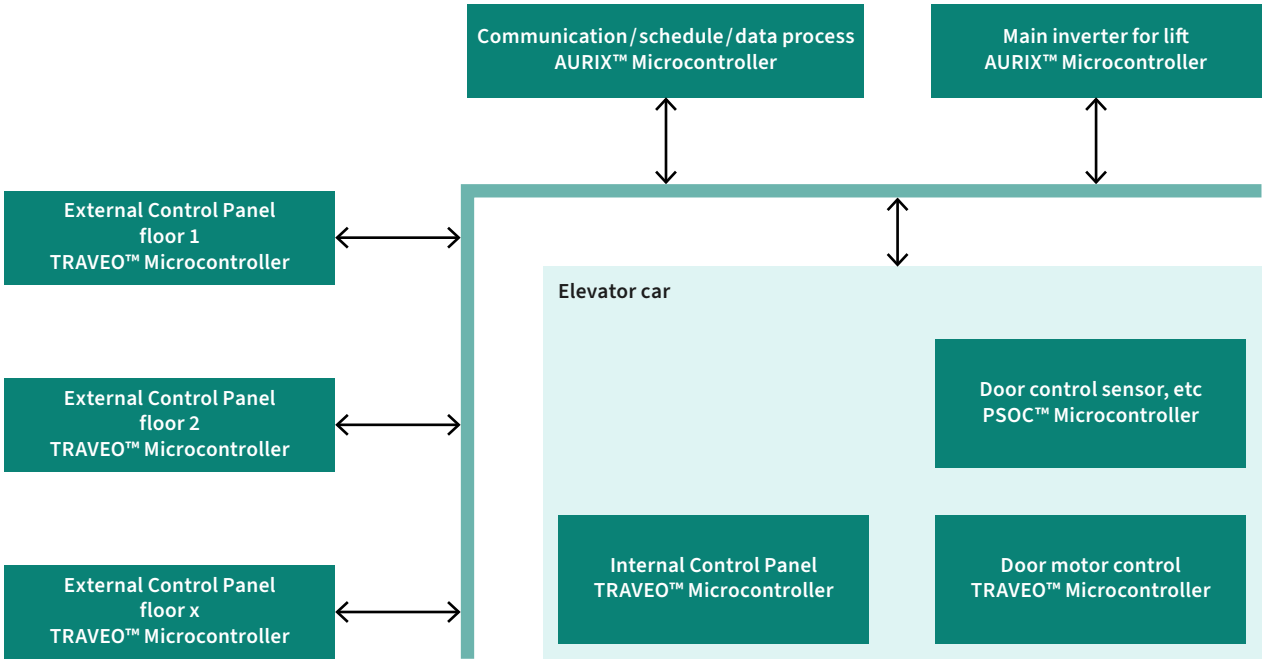
- TC33x
- TC36x
- TC37x
- TC38x
- TC39x
- TC4x

www.infineon.com/motor-control

Elevators

Modern elevators have strong safety requirements. The new TriCore™ family AURIX™ with state-of-the-art safety features enables your system to meet the highest safety levels that are required in your system.
Combining AURIX™ and TRAVEO™ families from Infineon is enabling you a powerful solution that will reduce your software overhead significantly and help your fast time-to-market.

Application diagram



Features and benefits

Key features

- Multiprocessor support for reliability and safety
- Platform concept to allow extensive customization
- Up to 12 CAN for communication in system
- External bus interface (32-bit) with cache
- SRAM up to 6.9 MB
- Flash up to 16 MB

Key benefits

- High computing performance: up to 6x 300 MHz
- Scalable family with compatibility: SW, pin-out
- High-speed asymmetric single / dual / triple core
- Resolver I / F and encoder I / F with digital noise filter
- Safety requirements supported up to IEC 61508 / SIL-3

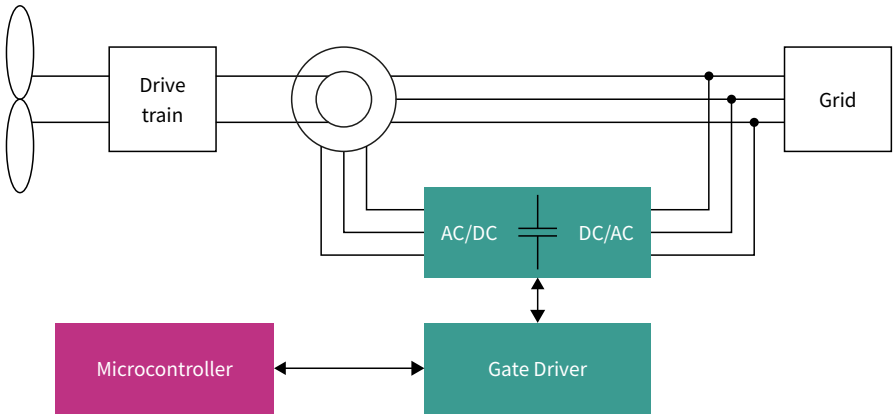
Suggested products

- AURIX™: TC33x, TC36x, TC37x, TC38x, TC39x, TC4x
- TRAVEO™
- PSOC™

Wind turbines

New sources of renewable energy, such as wind, are increasing to meet growing demand while helping reduce CO_2 emissions. In parallel, generation and distribution are driven by strong innovation requirements that can be fulfilled with our strong portfolio. Our microcontrollers can support the high level of connectivity and dataflow required as well as efficiently manage the high power energy generated with the best cost – performance ratio.

Application diagram



Features and benefits

Key features

- Reliable blade pitch control
- Increased wind turbine efficiency
- Multiple modulation strategies (SVPWM, DPWM, soft-PWM, direct torque control) to support requirements aimed at reducing noise emissions and increasing efficiency
- Multiprocessor support for reliability and safety
- Support for 3-level inverter topologies

Key benefits

- Scalable and compatible portfolio
- Diverse high-performance timer architectures
- Up to 12 SAR-ADCs 12-bit resolution
- Up to 14 DS-ADC
- Resolver I/F and Encoder I/F with digital noise filter
- IEC 61508 support – Safety Integrity Level (SIL) 1 to 3

Suggested products

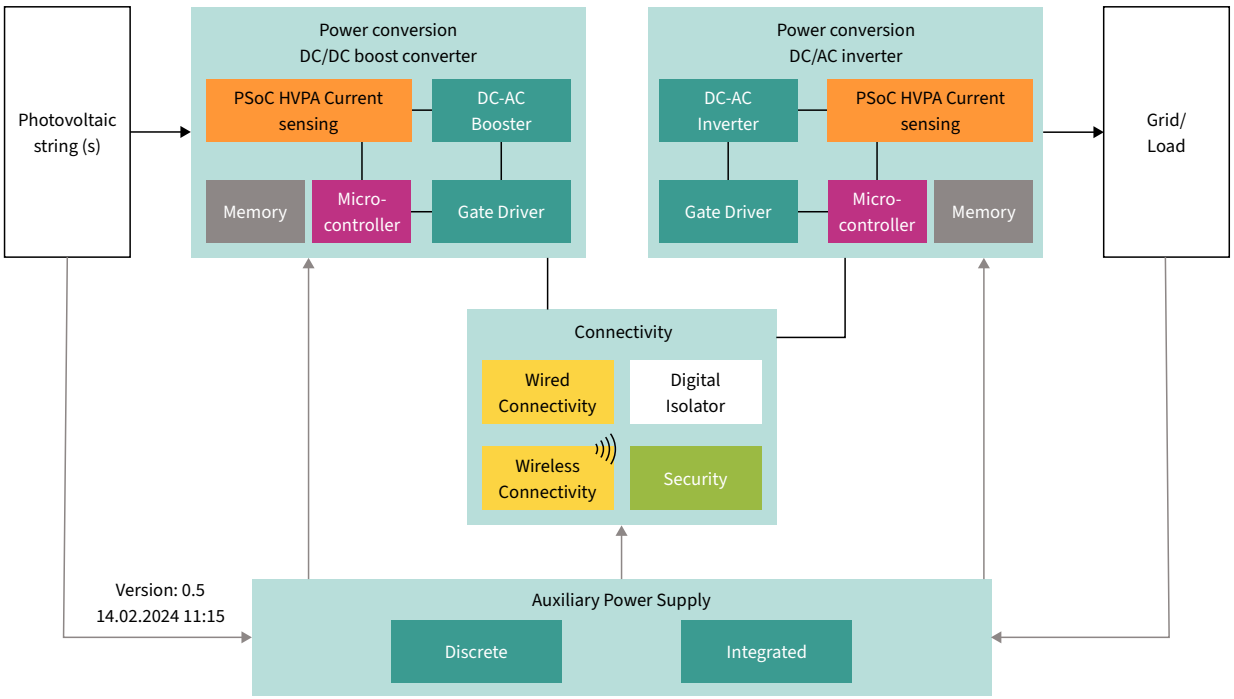
- TC33x
- TC36x
- TC37x
- TC38x
- TC39x
- TC4x

www.infineon.com/wind

Solar panels

Renewable energy standards require a certain amount of the energy produced to be generated from renewable sources such as wind and solar. Some countries include some more specific requirements which further incentivize the deployment of particular energy technologies. In this contest, there is an increasing demand for solar power generation systems.

Application diagram



Features and benefits

Key features

- Multi-phase PWM controller for single or multiple strings
- Multiple modulation strategies (SVPWM, DPWM, soft-PWM, direct torque control) to support requirements aimed at reducing noise emissions and increasing efficiency
- Maximum Power Point Tracking (MPPT) to extract maximum power from solar panels
- Grid phase monitoring and synchronization to ensure power factor unity

Key benefits

- Diverse high-performance timer architectures
- Up to 12 SAR-ADCs 12-bit resolution
- Up to 14 DS-ADC
- Resolver I/F
- Encoder I/F with digital noise filter
- IEC 61508 support – Safety Integrity Level (SIL) 1 to 3

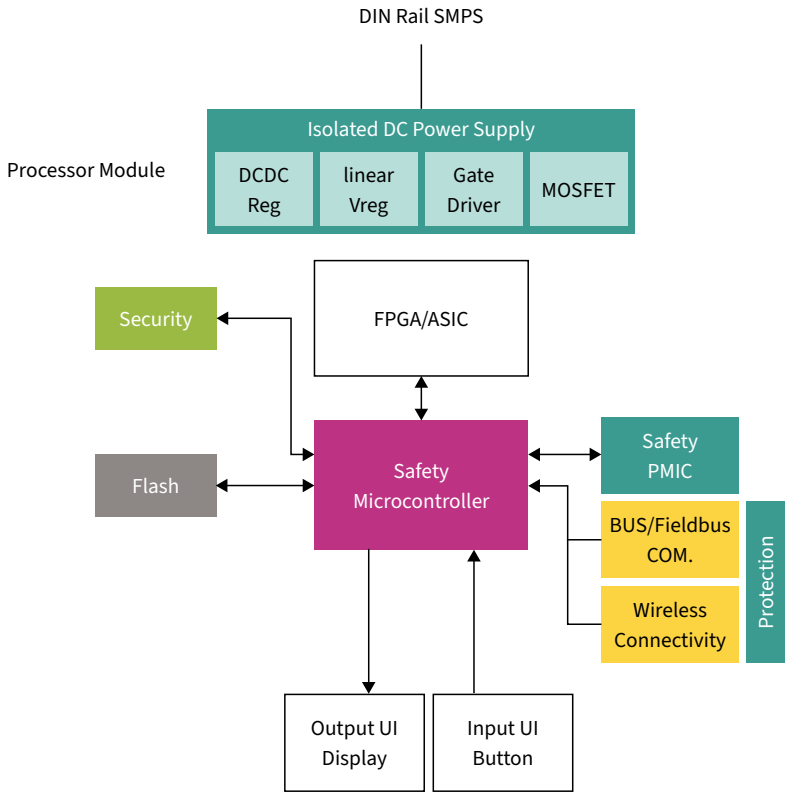
Suggested products

- TC33x
- TC36x
- TC37x
- TC38x
- TC39x
- TC4x

Safe PLC

At the heart of most industrial control and factory automation systems is a programmable logic controller (PLC). Commonly referred to as the “brain” of a factory, a PLC controls a wide range of functions by receiving and processing data from sensors and machines. It then uses this data to control and actuate external devices. Because it’s used in industrial applications, a PLC must be robust. Moreover, a successful design must offer reliability, system stability and 100 % interoperability with connected automation systems.

Application diagram



Features and benefits

Key features

- Multiprocessor support for reliability and safety
- SRAM up to 6.9 MB
- Flash up to 16 MB

Key benefits

- AURIX™ as EtherCAT® master
- SW development via PDH RT labs
- Safety IEC 61508 (SIL3) high performance
- Scalability and SW reusability across family

Suggested products

- AURIX™ TC3x, TC4x

AURIX™ Microcontroller – TC4x family

Product type	Markets			Package		Tri Core™		Program flash		Data flash			SRAM	DMA	Timer	Interfaces																			Safety	Security	Power	
	Automotive	Industrial	Consumer	Temperature T_A [°C]	Package (Pitch)	# Cores/checker	Max frequency [MHz]	Size [MB]	Data retention	Physical size [kb]	Erase cycles	Data retention	Total (DMI, PMI) [KB]	Channels	GTM/CCU/GPT modules	FlexRay (#/ch.)	CAN-FD	Queued Synchronous Peripheral Interface (QSPI)	Asynchronous/Synchronous Interface (ASCLIN)	Inter-Integrated Circuit Bus Interface (I^2C)	Single Edge Nibble Transmission (SENT)	Peripheral Sensor Interface (PSI5)	PSI with Serial PHY Connection (PSI5S)	High-Speed Communication Tunnel (HSCT)	Micro Second Channel (MSC)	External bus interface e.g. ext. memory	Signal Processing Unit (SPU)	"Camera (incl. pixel preprocessing), and ext. ADC 16-bit interface (CIF)"	Ethernet MAC 100 Mbit/s	Gigabit Ethernet	SIL level	Hardware Security Module (HSM)	"Embedded Voltage Regulator (EVR) (5 V/3.3 V)"	Standby control unit Standby control unit
AURIX™ TC3x – family																																				
TC4D9XP-20MF500	●	●	–	125	BGA-436 (0.8 mm)	6/6	500	20	20 years	1024	250k	10 years	10016	128	eGTM/no/no	4	20	8	28	3	30	2	Yes	2	1	Yes	–	–	4	2 5 Gbit)	ASIl-D	ISO-21434	Yes	Yes (8 bit)

ASC = Asynchronous Serial Channel
EVR = Embedded Voltage Regulator
MSC = Micro Second Channel
SENT = Single Edge Nibble Transmission
Ambient temperature range:
K = -40 … 125°C, L = -40 … 150°C

AURIX™ Microcontroller – TC3x family

Product type	Markets			Package		Tri Core™		Program flash		Data flash			SRAM	DMA	Timer	Interfaces																Safety	Security	Power	
	Automotive	Industrial	Consumer	Temperature T_A [°C]	Package (Pitch)	# Cores/checker	Max frequency [MHz]	Size [MB]	Data retention	Physical size [kb]	Erase cycles	Data retention	Total (DMI, PMI) [KB]	Channels	GTM/CCU/GPT modules	FlexRay (#/ch.)	CAN-FD	Queued Synchronous Peripheral Interface (QSPI)	Asynchronous/Synchronous Interface (ASCLIN)	Inter-Integrated Circuit Bus Interface (I^2C)	Single Edge Nibble Transmission (SENT)	Peripheral Sensor Interface (PSI5)	PSI with Serial PHY Connection (PSI5S)	High-Speed Communication Tunnel (HSCT)	Micro Second Channel (MSC)	External bus interface e.g. ext. memory	Signal Processing Unit (SPU)	"Camera (incl. pixel preprocessing),and ext. ADC 16-bit interface (CIF)"	Ethernet MAC 100 Mbit/s	SIL level	Hardware Security Module (HSM)	"Embedded Voltage Regulator (EVR)(5 V/3.3 V)"	Standby control unit Standby control unit
AURIX™ TC3x – family																																		
TC397XA-256F300S	●	●	–	125	lFBGA-292 (0.8 mm)	6/4	300	16	20 years	1024	125 k	10 years	6912	128	● / ● / ●	4	12	6	12	2	17	4	●	2	1	–	2	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC399XX-256F300S	●	●	–	125–150	lFBGA-516 (0.8 mm)	6/4	300	16	20 years	1024	125 k	10 years	6912	128	● / ● / ●	4	12	6	12	2	25	4	●	2	4	●	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC399XP-256F300S	●	●	–	125–150	lFBGA-516 (0.8 mm)	6/4	300	16	20 years	1024	125 k	10 years	2816	128	● / ● / ●	4	12	6	12	2	25	4	●	2	4	●	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC397XX-256F300S	●	●	–	125–150	lFBGA-292 (0.8 mm)	6/4	300	16	20 years	1024	125 k	10 years	6912	128	● / ● / ●	4	12	6	12	2	20	4	●	2	2	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC397XP-256F300S	●	●	–	125–150	lFBGA-292 (0.8 mm)	6/4	300	16	20 years	1024	125 k	10 years	2816	128	● / ● / ●	4	12	6	12	2	20	4	●	2	2	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC397QA-160F300S	●	●	–	125	lFBGA-292 (0.8 mm)	4/4	300	16	20 years	1024	125 k	10 years	6368	128	● / ● / ●	4	12	6	12	2	20	4	●	2	1	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC397XM-256F300S	●	●	–	125	lFBGA-292 (0.8 mm)	6/4	300	16	20 years	1024	125 k	10 years	2816	128	● / ● / ●	4	12	6	12	2	20	4	●	2	2	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC389QP-160F300S	●	●	–	125–150	lFBGA-516 (0.8 mm)	4/2	300	10	20 years	512	125 k	10 years	1568	128	● / ● / ●	4	12	5	24	2	25	4	●	1	3	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC387QP-160F300S	●	●	–	125–150	lFBGA-292 (0.8 mm)	4/2	300	10	20 years	512	125 k	10 years	1568	128	● / ● / ●	4	12	5	24	2	20	4	●	1	2	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC3E7QG-160F300S	●	●	–	125	lFBGA-292 (0.8 mm)	4/2	300	10	20 years	512	125 k	10 years	1696	128	● / ● / ●	4	20	5	24	2	20	4	●	1	2	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC3E7QF-192F300S	●	●	–	125–150	lFBGA-292 (0.8 mm)	4/2	300	12	20 years	512	125 k	10 years	1696	128	● / ● / ●	4	16	5	24	2	20	4	●	1	2	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC3E7QX-192F300S	●	●	–	125–150	lFBGA-292 (0.8 mm)	4/2	300	12	20 years	512	125 k	10 years	1696	128	● / ● / ●	4	20	5	24	2	20	4	●	1	2	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC377TX-96F300S	●	●	–	125	lFBGA-292 (0.8 mm)	3/3	300	6	20 years	256	125 k	10 years	4208	128	● / ● / ●	2	12	5	12	1	15	2	●	1	2	–	–	1	2/2	ASIL-D	Full eVita	●	● (8 bit)
TC377TP-96F300S	●	●	–	125–150	lFBGA-292 (0.8 mm)	3/2	300	6	20 years	256	125 k	10 years	1136	128	● / ● / ●	2	8	5	12	1	15	2	●	1	2	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC375TP-96F300W	●	●	–	125–150	lQFP-176 (0.5 mm)	3/2	300	6	20 years	256	125 k	10 years	1136	128	● / ● / ●	2	8	5	12	1	15	2	●	1	2	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC367DP-64F300S	●	●	–	125–150	lFBGA-292 (0.8 mm)	2/2	300	4	20 years	128	125 k	10 years	672	64	● / ● / ●	2	8	4	12	1	10	2	●	1	1	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC364DP-64F300W	●	●	–	125–150	lQFP-176 (0.5 mm)	2/2	300	4	20 years	128	125 k	10 years	672	64	● / ● / ●	2	8	4	12	1	10	2	●	1	1	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC364DP-64F300F	●	●	–	125–150	TQFP-144 (0.4 mm)	2/2	300	4	20 years	128	125 k	10 years	672	64	● / ● / ●	2	8	4	12	1	10	2	●	1	1	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC366DP-64F300S	●	●	–	125–150	BGA-180 (0.8 mm)	2/2	300	4	20 years	128	125 k	10 years	672	64	● / ● / ●	2	8	4	12	1	10	2	●	1	1	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC365DP-64F300W	●	●	–	125–150	lQFP-176 (0.5 mm)	2/2	300	4	20 years	128	125 k	10 years	672	64	● / ● / ●	2	8	4	12	1	10	2	●	1	1	–	–	–	1/1	ASIL-D	Full eVita	●	● (8 bit)

AURIX™ Microcontroller – TC3x family

Product type	Markets			Package		Tri Core™		Program flash		Data flash			SRAM	DMA	Timer	Interfaces														Safety	Security	Power	
	Automotive	Industrial	Consumer	Temperature T_A [°C]	Package (Pitch)	# Cores/checker	Max frequency [MHz]	Size [MB]	Data retention	Physical size [kb]	Erase cycles	Data retention	Total (DMI, PMI) [KB]	Channels	GTM/CCU/GPT modules	FlexRay (#/ch.)	CAN-FD	Queued Synchronous Peripheral Interface (QSPI)	Asynchronous/Synchronous Interface (ASCLIN)	Inter-Integrated Circuit Bus Interface (I^2C)	Single Edge Nibble Transmission (SENT)	Peripheral Sensor Interface (PSI5)	PSI with Serial PHY Connection (PSI5S)	High-Speed Communication Tunnel (HSCT)	Micro Second Channel (MSC)	External bus interface e.g. ext. memory	Signal Processing Unit (SPU)	"Camera (incl. pixel preprocessing),and ext. ADC 16-bit interface (CIF)"	Ethernet MAC 100 Mbit/s	SIL level	Hardware Security Module (HSM)	"Embedded Voltage Regulator (EVR)(5 V/3.3 V)"	Standby control unit Standby control unit
AURIX™ TC3x – family																																
TC357TA-64F300S	●	●	–	125	lFBGA-292 (0.8 mm)	3/2	300	4	20 years	128	125 k	10 years	3664	64	● / ● / ●	2	8	4	4	1	–	–	–	–	–	–	2	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC357TH-64F300S	●	●	–	125	lFBGA-292 (0.8 mm)	3/2	300	4	20 years	128	125 k	10 years	3152	64	● / ● / ●	2	8	4	4	1	–	–	–	–	–	–	2	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC356TH-64F300S	●	●	–	125	BGA-180 (0.8 mm)	3/2	300	4	20 years	128	125 k	10 years	3152	64	● / ● / ●	2	8	4	4	1	–	–	–	–	–	–	2	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC356TA-64F300S	●	●	–	125	BGA-180 (0.8 mm)	3/2	300	4	20 years	128	125 k	10 years	3664	64	● / ● / ●	2	8	4	4	1	–	–	–	–	–	–	2	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC337DA-32F200S	●	●	–	125	lFBGA-292 (0.8 mm)	2/1	200	2	20 years	128	125 k	10 years	1576	16	● / ● / ●	2	4	4	6	–	6	–	–	–	–	–	1	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC337LP-32F200S	●	●	–	125–150	lFBGA-292 (0.8 mm)	1/1	200	2	20 years	128	125 k	10 years	248	16	● / ● / ●	2	8	4	12	–	6	–	–	–	–	–	–	–	-/-	ASIL-D	Full eVita	●	● (8 bit)
TC334LP-32F200F	●	●	–	125–150	TQFP-144 (0.4 mm)	1/1	200	2	20 years	128	125 k	10 years	248	16	● / ● / ●	2	8	4	12	–	6	–	–	–	–	–	–	–	-/-	ASIL-D	Full eVita	●	● (8 bit)
TC333LP-32F200F	●	●	–	125–150	TQFP-100 (0.4 mm)	1/1	200	2	20 years	128	125 k	10 years	248	16	● / ● / ●	2	6	4	5	–	6	–	–	–	–	–	–	–	-/-	ASIL-D	Full eVita	●	● (8 bit)
TC337LP-32F300S	●	●	–	125–150	lFBGA-292 (0.8 mm)	1/1	300	2	20 years	128	125 k	10 years	248	16	● / ● / ●	2	8	4	12	–	6	–	–	–	–	–	–	–	-/-	ASIL-D	Full eVita	●	● (8 bit)
TC337DA-32F300S	●	●	–	125	lFBGA-292 (0.8 mm)	2/1	300	2	20 years	128	125 k	10 years	1576	16	● / ● / ●	2	4	4	6	–	6	–	–	–	–	–	1	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC336LP-32F300S	●	●	–	125–150	BGA-180 (0.8 mm)	1/1	300	2	20 years	128	125 k	10 years	248	16	● / ● / ●	2	8	4	12	–	6	–	–	–	–	–	–	–	-/-	ASIL-D	Full eVita	●	● (8 bit)
TC336LP-32F200S	●	●	–	125–150	BGA-180 (0.8 mm)	1/1	200	2	20 years	128	125 k	10 years	248	16	● / ● / ●	2	8	4	12	–	6	–	–	–	–	–	–	–	-/-	ASIL-D	Full eVita	●	● (8 bit)
TC336DA-32F300S	●	●	–	125	BGA-180 (0.8 mm)	2/1	300	2	20 years	128	125 k	10 years	1576	16	● / ● / ●	2	4	4	5	–	6	–	–	–	–	–	1	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC336DA-32F200S	●	●	–	125	BGA-180 (0.8 mm)	2/1	200	2	20 years	128	125 k	10 years	1576	16	● / ● / ●	2	4	4	5	–	6	–	–	–	–	–	1	–	1/1	ASIL-D	Full eVita	●	● (8 bit)
TC334LP-32F300F	●	●	–	125–150	TQFP-144 (0.4 mm)	1/1	300	2	20 years	128	125 k	10 years	248	16	● / ● / ●	2	8	4	12	–	6	–	–	–	–	–	–	–	-/-	ASIL-D	Full eVita	●	● (8 bit)
TC333LP-32F300F	●	●	–	125–150	TQFP-100 (0.4 mm)	1/1	300	2	20 years	128	125 k	10 years	248	16	● / ● / ●	2	6	4	5	–	6	–	–	–	–	–	–	–	-/-	ASIL-D	Full eVita	●	● (8 bit)
TC332LP-32F300F	●	●	–	125–150	TQFP-80 (0.4 mm)	1/1	300	2	20 years	128	125 k	10 years	248	16	● / ● / ●	2	6	4	5	–	6	–	–	–	–	–	–	–	-/-	ASIL-D	Full eVita	●	● (8 bit)
TC332LP-32F200F	●	●	–	125–150	TQFP-80 (0.4 mm)	1/1	200	2	20 years	128	125 k	10 years	248	16	● / ● / ●	2	6	4	5	–	6	–	–	–	–	–	–	–	-/-	ASIL-D	Full eVita	●	● (8 bit)
TC327LP-16F160S	●	●	–	125–150	lFBGA-292 (0.8 mm)	1/1	160	1	20 years	96	125 k	10 years	152	16	● / ● / ●	2	8	4	4	–	6	–	–	–	–	–	–	–	-/-	ASIL-D	Full eVita	●	● (8 bit)

AURIX™ Microcontroller – TC3x family

Product type	Markets			Package		Tri Core™		Program flash		Data flash			SRAM	DMA	Timer	Interfaces															Safety	Security	Power	
	Automotive	Industrial	Consumer	Temperature T_A [°C]	Package (Pitch)	# Cores/checker	Max frequency [MHz]	Size [MB]	Data retention	Physical size [kb]	Erase cycles	Data retention	Total (DMI, PMI) [KB]	Channels	GTM/CCU/GPT modules	FlexRay (#/ch.)	CAN-FD	Queued Synchronous Peripheral Interface (QSPI)	Asynchronous/Synchronous Interface (ASCLIN)	Inter-Integrated Circuit Bus Interface (I^2C)	Single Edge Nibble Transmission (SENT)	Peripheral Sensor Interface (PSI5)	PSI with Serial PHY Connection (PSI5S)	High-Speed Communication Tunnel (HSCT)	Micro Second Channel (MSC)	External bus interface e.g. ext. memory	Signal Processing Unit (SPU)	"Camera (incl. pixel preprocessing),and ext. ADC 16-bit interface (CIF)"	Ethernet MAC 100 Mbit/s	SIL level	Hardware Security Module (HSM)	"Embedded Voltage Regulator (EVR)(5 V/3.3 V)"	Standby control unit Standby control unit
AURIX™ TC3x – family																																	
TC324LP-16F160F	●	●	–	125–150	TQFP-144 (0.4 mm)	1/1	160	1	20 years	96	125 k	10 years	152	16	● / ● / ●	2	8	4	4	–	6	–	–	–	–	–	–	–	-/-	ASIL-D	Full eVita	●	● (8 bit)
TC323LP-16F160F	●	●	–	125–150	TQFP-100 (0.4 mm)	1/1	160	1	20 years	96	125 k	10 years	152	16	● / ● / ●	2	6	4	4	–	6	–	–	–	–	–	–	–	-/-	ASIL-D	Full eVita	●	● (8 bit)
TC322LP-16F160F	●	●	–	125–150	TQFP-80 (0.4 mm)	1/1	160	1	20 years	96	125 k	10 years	152	16	● / ● / ●	2	6	4	4	–	6	–	–	–	–	–	–	–	-/-	ASIL-D	Full eVita	●	● (8 bit)

ASC = Asynchronous Serial Channel
EVR = Embedded Voltage Regulator
MSC = Micro Second Channel
SENT = Single Edge Nibble Transmission

Ambient temperature range:
K = -40 … 125°C, L = -40 … 150°C

AURIX™ Microcontroller – TC2x family

Product type	Markets			Package		Tri Core™		Program flash		Data flash			SRAM	DMA	ADC		Timer-GTM				Timer	Interfaces																Safety	Security	Power	
	Automotive	Industrial	Consumer	Temperature T_A [°C]	Package (Pitch)	# Cores/checker	Max frequency [MHz]	Size [MB]	Data retention	Physical size [kb]	Erase cycles	Data retention	Total (DMI, PMI) [KB]	Channels	Modules 12-bit (SAR) / 16-bit (DS)	Channels VADC/DSADC	GTM input/output channels	TOM – standard 16-bit PWM ch.	ATOM – complex 24-bit PWM ch.	DTM – 2x 4 ch	CCU/GPT modules	FlexRay (#/ch.)	CAN-FD (nodes/obj)(DIS 2014)	CAN-FD (nodes/obj)(DIS 2015)	Queued Synchronous Peripheral Interface (QSPI)	Asynchronous/Synchronous Interface (ASCLIN)	Inter-Integrated Circuit Bus Interface (I^2C)	Single Edge Nibble Transmission (SENT)	Peripheral Sensor Interface (PSI5)	PSI with Serial PHY Connection (PSI5S)	High-Speed Communication Tunnel (HSCT)	Micro Second Channel (MSC)	External bus interface e.g. ext. memory	FFT accelerator engine	"Camera (incl. pixel preprocessing), and ext. ADC 16-bit interface (CIF)"	Ethernet MAC 100 Mbit/s	SIL Level	Hardware Security Module (HSM)	Embedded Voltage Regulator (EVR)	Standby control unit
AURIX™ TC2x – family																																							
SAK-TC299TX-128F300	●	●	–	125	lFBGA-516 (0.8 mm)	3/1	300	8	20 years	768	125 k	10 years	2776	128	11/10	84/10 diff	48/152	80	72	–	2/1	2/4	6/384	4	6	4	2	15	5	1	1	3 diff lVDS	1	–	–	1	ASIL-D	●	●	SRAM
SAK-TC299TY-128F300	●	●	–	125	lFBGA-516 (0.8 mm)	3/1	300	8	20 years	768	125 k	10 years	2776	128	11/10	84/10 diff	48/152	80	72	–	2/1	2/4	6/384	4	6	4	2	15	5	1	1	3 diff lVDS	1	–	–	1	ASIL-D	–	●	SRAM
SAK-TC299TP-128F300	●	●	–	125, 150	lFBGA-516 (0.8 mm)	3/1	300	8	20 years	768	125 k	10 years	728	128	11/10	84/10 diff	48/152	80	72	–	2/1	2/4	6/384	4	6	4	2	15	5	1	1	3 diff lVDS	1	–	–	1	ASIL-D	●	●	SRAM
SAK-TC298TP-128F300	●	●	–	125, 150	lFBGA-416 (1.0 mm)	3/1	300	8	20 years	768	125 k	10 years	728	128	11/10	62/10 diff	48/152	80	72	–	2/1	2/4	6/384	4	4	4	2	15	5	1	1	3 diff lVDS	1	–	–	1	ASIL-D	●	●	SRAM
SAK-TC297TA-128F300	●	●	–	125	lFBGA-292 (0.8 mm)	3/1	300	8	20 years	768	125 k	10 years	2776	128	11/10	60/6 diff	48/152	80	72	–	2/1	2/4	6/384	4	5	4	2	15	5	1	1	3 diff lVDS	–	1	1	1	ASIL-D	●	●	SRAM
SAK-TC297TB-128F300	●	●	–	125	lFBGA-292 (0.8 mm)	3/1	300	8	20 years	768	125 k	10 years	2776	128	11/10	60/6 diff	48/152	80	72	–	2/1	2/4	6/384	4	5	4	2	15	5	1	1	3 diff lVDS	–	1	1	1	ASIL-D	–	●	SRAM
SAK-TC297TX-128F300	●	●	–	125	lFBGA-292 (0.8 mm)	3/1	300	8	20 years	768	125 k	10 years	2776	128	11/10	60/6 diff	48/152	80	72	–	2/1	2/4	6/384	4	5	4	2	15	5	1	1	3 diff lVDS	–	–	–	1	ASIL-D	●	●	SRAM
SAK-TC297TY-128F300	●	●	–	125	lFBGA-292 (0.8 mm)	3/1	300	8	20 years	768	125 k	10 years	2776	128	11/10	60/6 diff	48/152	80	72	-	2/1	2/4	6/384	4	5	4	2	15	5	1	1	3 diff lVDS	–	–	–	1	ASIL-D	–	●	SRAM
SAK-TC297TP-128F300	●	●	–	125, 150	lFBGA-292 (0.8 mm)	3/1	300	8	20 years	768	125 k	10 years	728	128	11/10	60/6 diff	48/152	80	72	–	2/1	2/4	6/384	4	5	4	2	15	5	1	1	3 diff lVDS	–	–	–	1	ASIL-D	●	●	SRAM
SAK-TC297T-128F300	●	●	–	125, 150	lFBGA-292 (0.8 mm)	3/1	300	8	20 years	768	125 k	10 years	728	128	11/10	60/6 diff	48/	80	72	–	2/1	2/4	6/384	4	5	4	2	15	5	1	1	3 diff lVDS	–	–	–	1	ASIL-D	–	●	SRAM
SAK-TC277TP-64F200	●	●	–	125, 150	lFBGA-292 (0.8 mm)	3/2	200	4	20 years	384	125 k	10 years	472	64	8/6	60/6 diff	32/88	48	40	–	2/1	1/2	4/256	4	4	4	1	10	3	1	1	2 diff lVDS	–	–	–	1	ASIL-D	●	●	SRAM
SAK-TC277T-64F200	●	●	–	125, 150	lFBGA-292 (0.8 mm)	3/2	200	4	20 years	384	125 k	10 years	472	64	8/6	60/6 diff	32/88	48	40	–	2/1	1/2	4/256	4	4	4	1	10	3	1	1	2 diff lVDS	–	–	–	1	ASIL-D	–	●	SRAM
SAK-TC275TP-64F200	●	●	–	125, 150	lQFP-176 (0.5 mm)	3/2	200	4	20 years	384	125 k	10 years	472	64	8/6	48/6 diff	32/88	48	40	–	2/1	1/2	4/256	4	4	4	1	10	3	1	1	2 diff lVDS	–	–	–	1	ASIL-D	●	●	SRAM
SAK-TC275T-64F200	●	●	–	125, 150	lQFP-176 (0.5 mm)	3/2	200	4	20 years	384	125 k	10 years	472	64	8/6	48/6 diff	32/88	48	40	–	2/1	1/2	4/256	4	4	4	1	10	3	1	1	2 diff lVDS	–	–	–	1	ASIL-D	–	●	SRAM
SAK-TC267D-40F200	●	●	–	125, 150	lFBGA-292 (0.8 mm)	2/1	200	2.5	20 years	96	125 k	10 years	240	48	4/3	56/3 diff	24/64	32	32	–	2/1	1/2	5/256	No	4	4	1	6	2	1	1	2 diff lVDS	–	–	–	1	ASIL-D	–	●	Yes
SAK-TC265D-40F200	●	●	–	125, 150	lQFP-176 (0.5 mm)	2/1	200	2.5	20 years	96	125 k	10 years	240	48	4/3	50/3 diff	24/64	32	32	–	2/1	1/2	5/256	4	4	4	1	6	2	1	1	2 diff lVDS	–	–	–	1	ASIL-D	–	●	Yes
SAK-TC264DA-40F200	●	●	–	125	lQFP-144 (0.5 mm)	2/1	200	2.5	20 years	96	125 k	10 years	752	48	4/3	40/3 diff	24/64	32	32	–	2/1	1/2	5/256	4	4	4	1	6	2	1	1	2 diff lVDS	–	1	1	1	ASIL-D	–	●	Yes
SAK-TC264D-40F200	●	●	–	125, 150	lQFP-144 (0.5 mm)	2/1	200	2.5	20 years	96	125 k	10 years	240	48	4/3	40/3 diff	24/64	32	32	–	2/1	1/2	5/256	4	4	4	1	6	2	1	1	2 diff lVDS	–	–	–	1	ASIL-D	–	●	Yes
SAK-TC234LA-32F200	●	●	–	125	TQFP-144 (0.4 mm)	1/1	200	2	20 years	128	125 k	10 years	704	16	4/–	24/–	8/32	32	–	2	2/1	1/2	6/256	No	4	2	–	4	–	–	–	–	–	1	–	1	ASIL-D	●	●	WUT + SRAM
SAK-TC234LX-32F200	●	●	–	125	TQFP-144 (0.4 mm)	1/1	200	2	20 years	128	125 k	10 years	704	16	2/–	24/–	8/32	32	–	2	2/1	1/2	6/256	No	4	2	–	4	–	–	–	–	–	–	–	1	ASIL-D	●	●	WUT + SRAM
SAK-TC237LP-32F200	●	●	–	125, 150	lFBGA-292 (0.8 mm)	1/1	200	2	20 years	128	125 k	10 years	192	16	2/–	24/–	8/32	32	–	2	2/1	1/2	6/256	4	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-D	●	●	WUT + SRAM
SAK-TC234LP-32F200	●	●	–	125, 150	TQFP-144 (0.4 mm)	1/1	200	2	20 years	128	125 k	10 years	192	16	2/–	24/–	8/32	32	–	2	2/1	1/2	6/256	4	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-D	●	●	WUT + SRAM
SAK-TC234L-32F200	●	●	–	125, 150	TQFP-144 (0.4 mm)	1/1	200	2	20 years	128	125 k	10 years	192	16	2/–	24/–	8/32	32	–	2	2/1	1/2	6/256	4	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-D	–	●	WUT + SRAM
SAK-TC233L-32F200	●	●	–	125, 150	TQFP-100 (0.4 mm)	1/1	200	2	20 years	128	125 k	10 years	192	16	2/–	24/–	8/32	32	–	2	2/1	1/2	6/256	4	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-D	–	●	WUT + SRAM
SAK-TC233LP-32F200	●	●	–	125, 150	TQFP-100 (0.4 mm)	1/1	200	2	20 years	128	125 k	10 years	192	16	2/–	24/–	8/32	32	–	2	2/1	1/2	6/256	4	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-D	●	●	WUT + SRAM
SAK-TC224L-16F133	●	●	–	125, 150	TQFP-144 (0.4 mm)	1/1	133	1	20 years	96	125 k	10 years	96	16	2/–	24/–	8/32	32	–	2	2/1	–	3/128	3	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-D	–	●	WUT + SRAM

AURIX™ Microcontroller – TC2x family

Product type	Markets			Package		Tri Core™		Program flash		Data flash			SRAM	DMA	ADC		Timer-GTM				Timer	Interfaces																Safety	Security	Power	
	Automotive	Industrial	Consumer	Temperature T_A [°C]	Package (Pitch)	# Cores/checker	Max frequency [MHz]	Size [MB]	Data retention	Physical size [kb]	Erase cycles	Data retention	Total (DMI, PMI) [KB]	Channels	Modules 12-bit (SAR) / 16-bit (DS)	Channels VADC/DSADC	GTM input/output channels	TOM – standard 16-bit PWM ch.	ATOM – complex 24-bit PWM ch.	DTM – 2x 4 ch	CCU/GPT modules	FlexRay (#/ch.)	CAN-FD (nodes/obj)(DIS 2014)	CAN-FD (nodes/obj)(DIS 2015)	Queued Synchronous Peripheral Interface (QSPI)	Asynchronous/Synchronous Interface (ASCLIN)	Inter-Integrated Circuit Bus Interface (I^2C)	Single Edge Nibble Transmission (SENT)	Peripheral Sensor Interface (PSI5)	PSI with Serial PHY Connection (PSI5S)	High-Speed Communication Tunnel (HSCT)	Micro Second Channel (MSC)	External bus interface e.g. ext. memory	FFT accelerator engine	"Camera (incl. pixel preprocessing), and ext. ADC 16-bit interface (CIF)"	Ethernet MAC 100 Mbit/s	SIL Level	Hardware Security Module (HSM)	Embedded Voltage Regulator (EVR)	Standby control unit
AURIX™ TC2x – family																																							
SAK-TC224S-16F133	●	●	–	125, 150	TQFP-144 (0.4 mm)	1/0	133	1	20 years	96	125 k	10 years	96	16	2/–	24/–	8/32	32	–	2	2/1	–	3/128	3	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-B	–	●	WUT + SRAM
SAK-TC223L-16F133	●	●	–	125, 150	TQFP-100 (0.4 mm)	1/1	133	1	20 years	96	125 k	10 years	96	16	2/–	24/–	8/32	32	–	2	2/1	–	3/128	3	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-D	–	●	WUT + SRAM
SAK-TC223S-16F133	●	●	–	125, 150	TQFP-100 (0.4 mm)	1/0	133	1	20 years	96	125 k	10 years	96	16	2/–	24/–	8/32	32	–	2	2/1	–	3/128	3	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-B	–	●	WUT + SRAM
SAK-TC222L-16F133	●	●	–	125, 150	TQFP-80 (0.4 mm)	1/1	133	1	20 years	96	125 k	10 years	96	16	2/–	24/–	8/32	32	–	2	2/1	–	3/128	3	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-D	–	●	WUT + SRAM
SAK-TC222S-16F133	●	●	–	125, 150	TQFP-80 (0.4 mm)	1/0	133	1	20 years	96	125 k	10 years	96	16	2/–	24/–	8/32	32	–	2	2/1	–	3/128	3	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-B	–	●	WUT + SRAM
SAK-TC214L-8F133	●	●	–	125, 150	TQFP-144 (0.4 mm)	1/1	133	0.5	20 years	64	125 k	10 years	56	16	2/–	24/–	8/32	32	–	2	2/1	–	3/128	3	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-D	–	●	WUT + SRAM
SAK-TC214S-8F133	●	●	–	125, 150	TQFP-144 (0.4 mm)	1/0	133	0.5	20 years	64	125 k	10 years	56	16	2/–	24/–	8/32	32	–	2	2/1	–	3/128	3	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-B	–	●	WUT + SRAM
SAK-TC213L-8F133	●	●	–	125, 150	TQFP-100 (0.4 mm)	1/1	133	0.5	20 years	64	125 k	10 years	56	16	2/–	24/–	8/32	32	–	2	2/1	–	3/128	3	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-D	–	●	WUT + SRAM
SAK-TC213S-8F133	●	●	–	125, 150	TQFP-100 (0.4 mm)	1/0	133	0.5	20 years	64	125 k	10 years	56	16	2/–	24/–	8/32	32	–	2	2/1	–	3/128	3	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-B	–	●	WUT + SRAM
SAK-TC212L-8F133	●	●	–	125, 150	TQFP-80 (0.4 mm)	1/1	133	0.5	20 years	64	125 k	10 years	56	16	2/–	24/–	8/32	32	–	2	2/1	–	3/128	3	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-D	–	●	WUT + SRAM
SAK-TC212S-8F133	●	●	–	125, 150	TQFP-80 (0.4 mm)	1/0	133	0.5	20 years	64	125 k	10 years	56	16	2/–	24/–	8/32	32	–	2	2/1	–	3/128	3	4	2	–	4	–	–	–	–	–	–	–	–	ASIL-B	–	●	WUT + SRAM

ASC = Asynchronous Serial Channel
EVR = Embedded Voltage Regulator
MSC = Micro Second Channel
SENT = Single Edge Nibble Transmission
Ambient temperature range:
K = -40 … 125°C, L = -40 … 150°C

Published by
Infineon Technologies AG
Am Campeon 1-15, 85579 Neubiberg
Germany

© 2024 Infineon Technologies AG.
All rights reserved.

Public

Date: 11/2024

Stay connected!

Scan QR code and explore offering
www.infineon.com