

# Infineon AURIX™ Microcontrollers

*Intelligent solutions for Automotive Applications*



# AURIX™: Infineon's TriCore Processor

## MICROCONTROLLER

- ✓ Fast context switch & interrupt response
- ✓ Integrated Peripheral support
- ✓ Powerful bit manipulation unit & comparison Instructions

## RISC processor

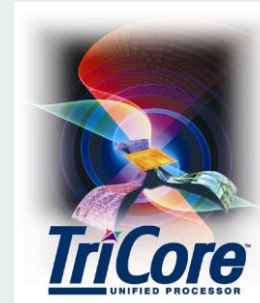
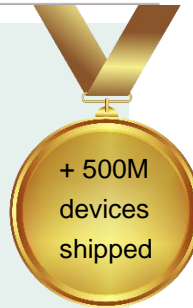
- ✓ 32-bit load/store Harvard architecture
- ✓ Super-scalar execution & uniform register set
- ✓ Memory Protection Unit (MPU) & C/C++ and RTOS support

## DSP

- ✓ Sustainable single-cycle dual MAC
- ✓ DSP addressing modes & Zero overhead modes
- ✓ Saturation, Rounding & Q-Math (fraction format)

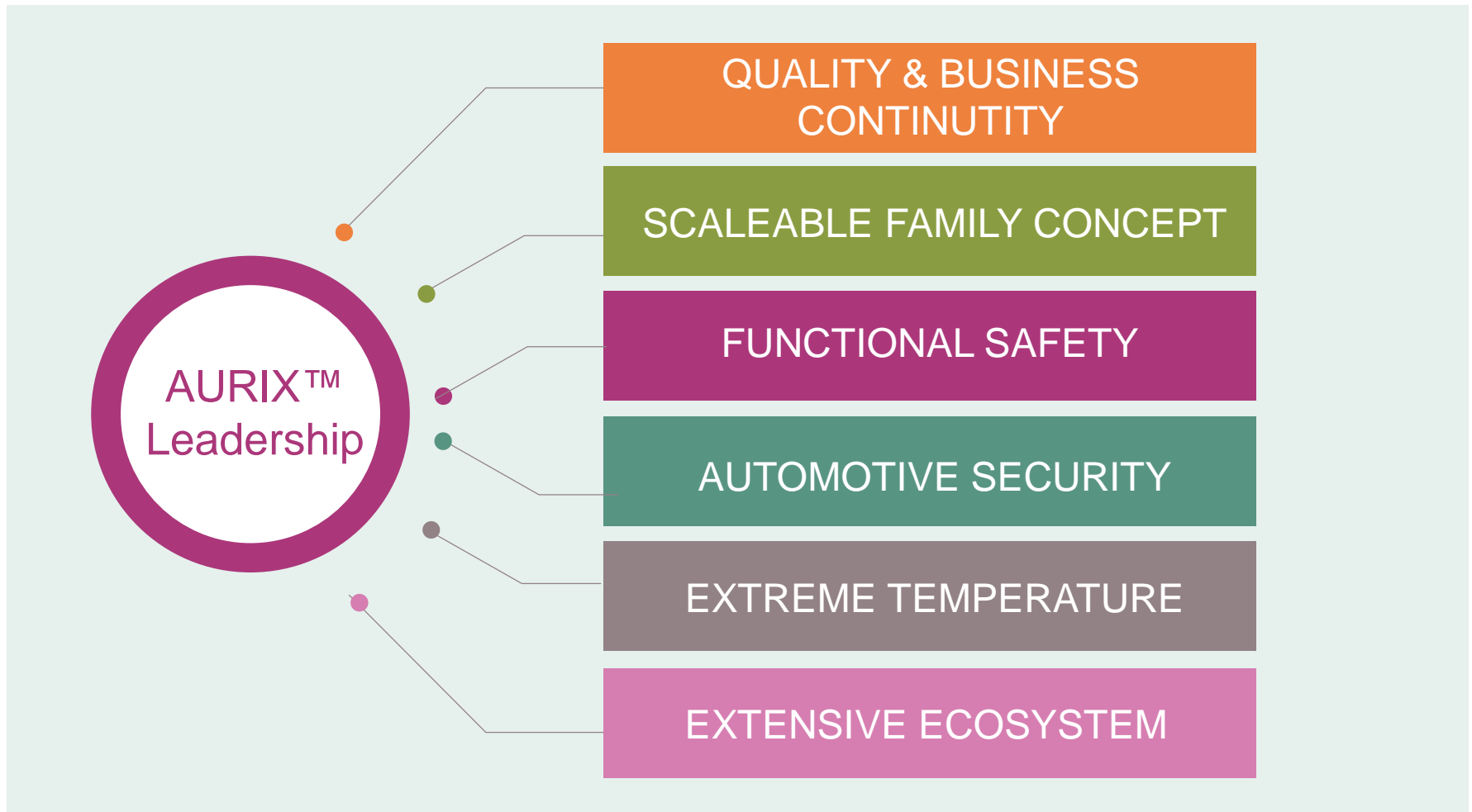
**Three in One**

TriCore™  
AURIX™  
MCU



**AURIX™ TriCore unites the elements of a RISC processor core, a microcontroller and a DSP in one single MCU!**

# AURIX™ - One-stop-shop for Automotive



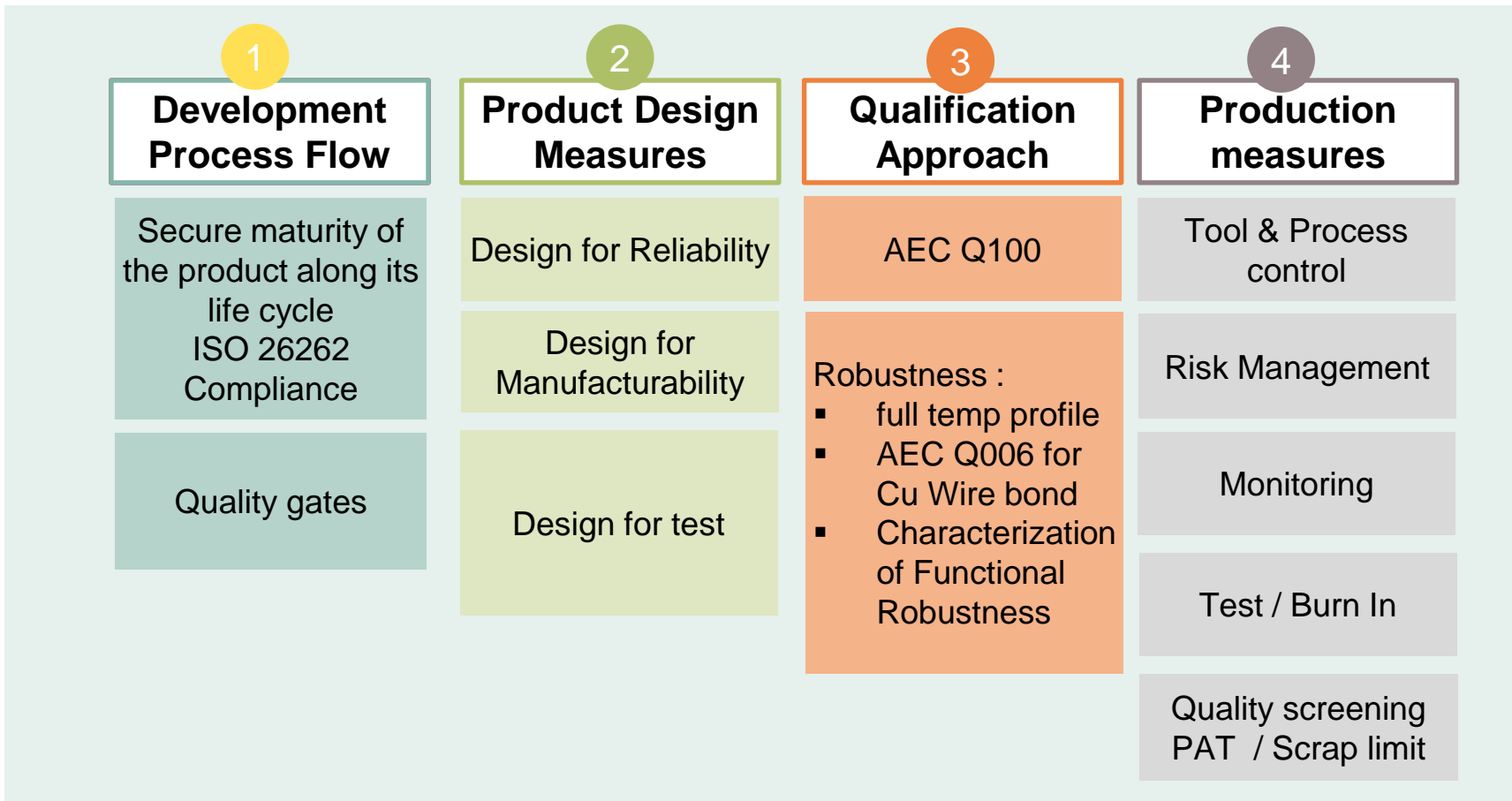
**No other** MCU family can offer this **combination** of functionality across multiple compatible products



# AURIX™: Quality & Business Continuity Leadership

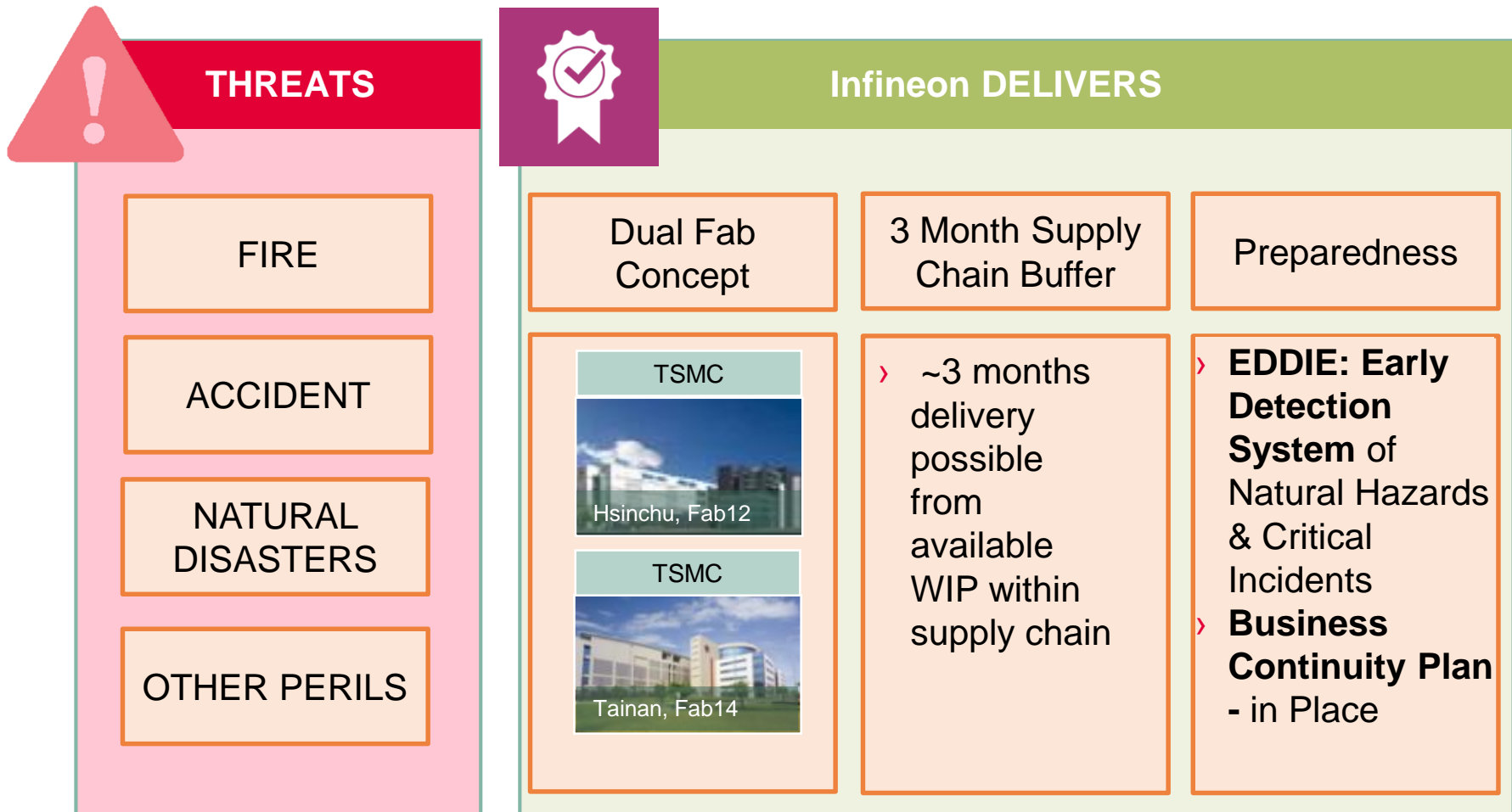


# AURIX™: Quality Leadership by design



The **Next Level of Zero Defect** program ensures **Quality** throughout the Product Life Cycle, with Infineon 32-bit MCUs already reaching **< 1ppm**

# AURIX™: Supply Security Leadership



Continuity of supply is critical for our customers. AURIX™ delivers.

# AURIX™: Long Term Technology Availability



## 32 Bit (TriCore™) Technology Horizon: AURIX™ 1G

Product	Technology	Wafer Fab	Location	2014	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
TC26x	65nm	TSMC	Taiwan	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
TC27x	65nm	TSMC	Taiwan	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
TC29x	65nm	TSMC	Taiwan	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
TC23x	65nm	TSMC	Taiwan	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
TC22x	65nm	TSMC	Taiwan	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
TC21x	65nm	TSMC	Taiwan	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green

- Qualification successfully completed/mass production
- No new designs recommended
- No prognosis from today's perspective possible, depending on volume

**The Long term availability & Next Level of Zero Defect program ensures Quality & extended product supply life cycle throughout the full AURIX™ MCU products**



# AURIX™: Scalable Family Concept





# AURIX™: TC2xx Scalable Family

## From low cost to high performance applications



TC29x 8 MB					TC297T 300MHz	TC298T 300MHz	TC299T 300MHz
TC27x 4 MB				TC275T 200 MHz	TC277T 200MHz		
TC26x 2.5 MB			TC264D 200 MHz	TC265D 200 MHz	TC267D 200 MHz		
TC23x 2 MB		TC233L 200 MHz	TC234L 200 MHz		TC237L 200 MHz		
TC22x 1 MB	TC222L/S 133 MHz	TC223L/S 133 MHz	TC224L/S 133 MHz				
TC21x 512 kB	TC212L/S 133 MHz	TC213L 133 MHz	TC214L/S 133 MHz				
Flash Package	TQFP 80	TQFP 100	T/LQFP 144	LQFP 176	LFBGA 292	BGA 416	LFBGA 516



Devices with HSM



Upgrade/Downgrade path with pin compatible packages



Single Core (S) Single Lockstep Core (L), Dual Core (D) Triple Core (T)



PRO-SIL™: Safety supporting features

### MCU Scalability

- › Performance & Flash
- › Software compatibility
- › Pin-compatibility
- › Diverse timer architecture

### Power Consumption

- › On-chip DC/DC high-efficiency power supply

### Safety Concept

- › PRO-SIL™ ISO26262/IEC61508 compliance
- › HW redundancy options

### Security Concept

- › Selected devices with Hardware Security Module (HSM)

### Availability

- › All devices are in mass production

### Tools & Boards

- › Multiple options available

# AURIX™: TC29x Series – Performance Device

The AURIX™ family addresses applications, where more performance, connectivity, safety and security are needed.

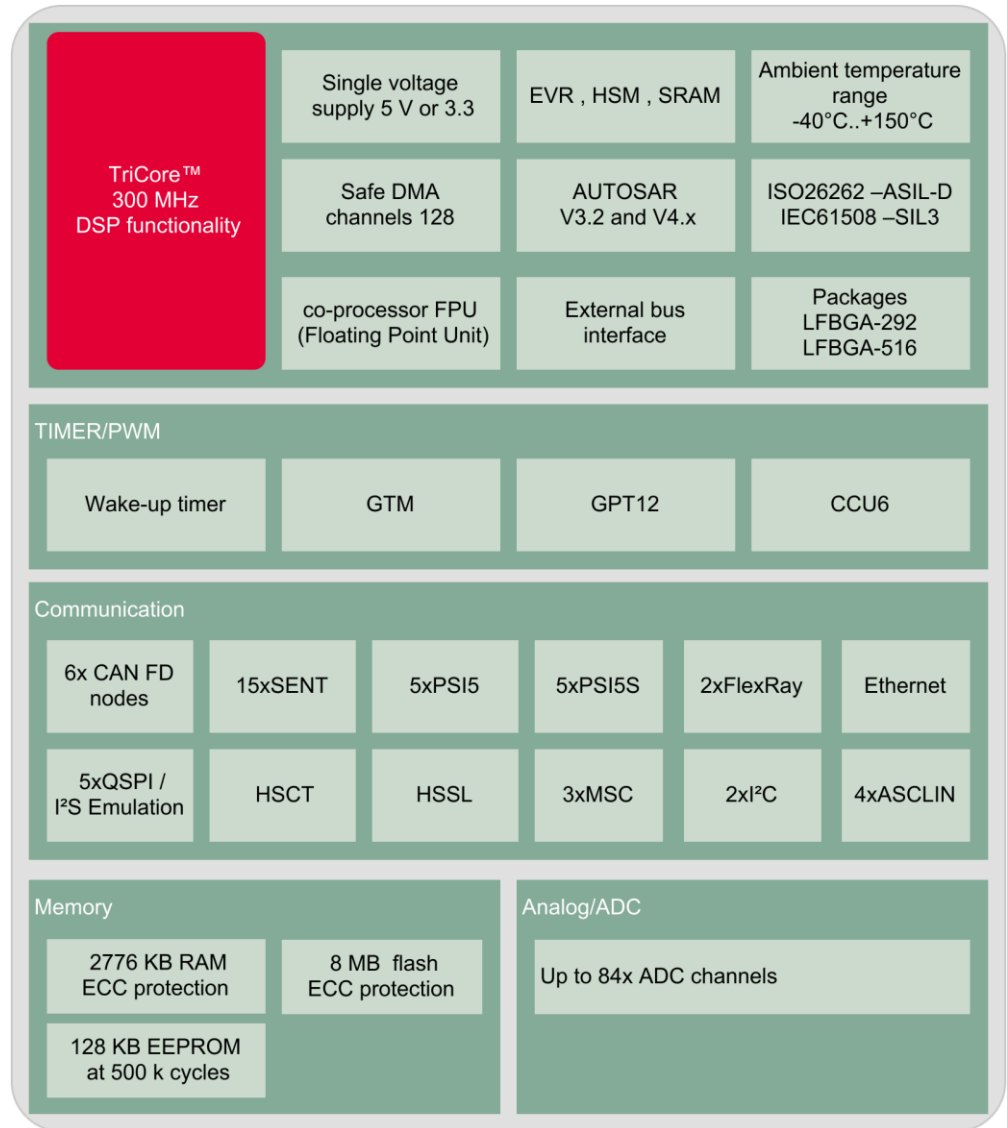
AURIX™ TC2xx microcontrollers serve the precise needs of the automotive and industrial market in terms of performance and safety

## Most innovative safety:

- Diverse Lockstep Core with clock delay
- Redundant and diverse timer modules (GTM, CCU6, GPT12)
- Access permission system
- Safety management unit
- DMA
- I/O, clock, voltage monitor
- Developed and documented following ISO 26262 to support safety requirements up to ASIL-D
- AUTOSAR V3.2 and V4.x

## System benefits :

- Diverse Lockstep architecture to reduce development effort for ASIL-D systems .
- High integration for reduced complexity and significant cost savings .
- Delta-sigma analog-to-digital converters for fast and accurate measurements .
- Innovative single supply concept for best-in-class power consumption and cost savings in external supply .
- Scalability in terms of performance, packages, memory and peripherals for flexibility across platform concepts .
- Available as single and lockstep core .
- Latest connectivity CAN FD (flexible data rate) .
- Scalable safety from QM to ASIL D for Industrial and Automotive Applications .
- Dedicated emulation device chip (ED) for multicore debugging, tracing and calibration .
- Hot package options for extended temperature range



# AURIX™: TC21x Series – Value Efficient Device

The AURIX™ family addresses applications, where more performance, connectivity, safety and security are needed.

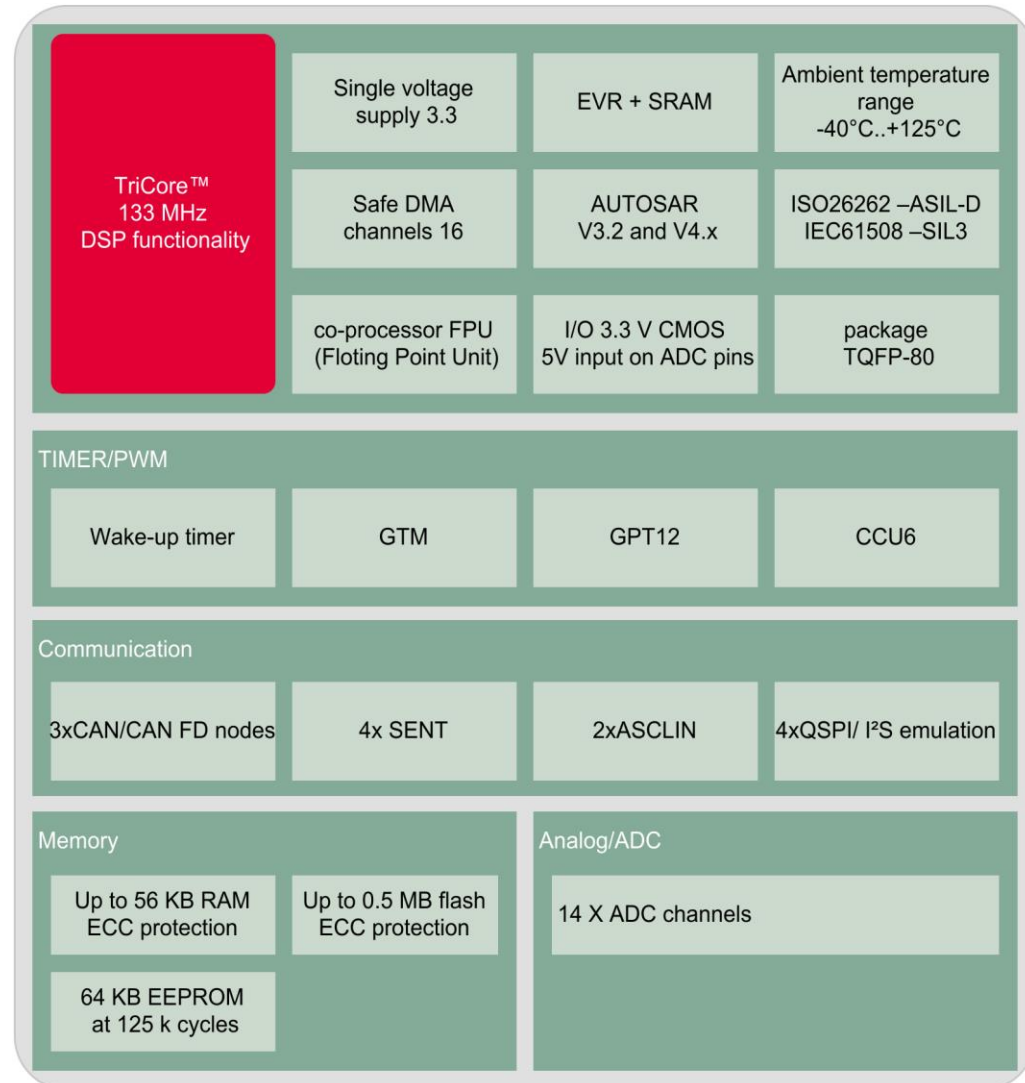
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- Available as single and lockstep core .
- Latest connectivity CAN FD (flexible data rate) .
- Scalable safety from QM to ASIL D for Industrial and Automotive Applications .
- Dedicated emulation device chip (ED) for multicore debugging, tracing and calibration .
- Hot package options for extended temperature range



# AURIX™ device list: Endless applications

Feature Set		9x Series	7x Series	6x Series	3x Series	2x Series	1x Series
TriCore 1.6P	# Cores / Checker	3 / 1	2 / 1	1 / 1	- / -	- / -	- / -
	Frequency	2x300 / 1x200 MHz	200 MHz	200 MHz	-	-	-
TriCore 1.6E	# Cores / Checker	- / -	1 / 1	1 / -	1 / 1	1 / 1 (1 / 0)	1 / 1 (1 / 0)
	Frequency	-	200 MHz	200 MHz	200 MHz	133 MHz	133 MHz
Flash	Program Flash	8 MB	4 MB	2.5 MB	2 MB	1 MB	512 KB
	EEProm @ w/e cycles	128 KB @ 500k	64 KB @ 500k	16 KB @ 500k	128k @ 125 k cycles	96k @ 125k cycles	64k @ 125k cycles
SRAM	Total (DMI , PMI, LMU)	728 KB	472 KB	240 KB	192 KB	96 KB	56 KB
DMA	Channels	128	64	48	16	16	16
ADC	Modules 12bit / DS	11 / 10	8 / 6	4 / 3	2 / -	2 / -	2 / -
	Channels 12bit / DS	84 / 10 diff	60 / 6 diff	50 / 3 diff	24 / -	/ -	24 / -
Timer	GTM Input / Output	48 / 152 channels	32 / 88 channels	24 / 64 channels	8 / 32	8 / 32	8 / 32
	CCU / GPT modules	2 / 1	2 / 1	2 / 1	2 / 1	2 / 1	2 / 1
Interfaces	FlexRay (#/ch.)	2 / 4	1 / 2	1 / 2	1 / 2	-	-
	CAN FD <sup>3</sup> (nodes/obj)	6 / 384	4 / 256	5 / 256	6 / 256	3 / 128	3 / 128
	QSPI / ASCLIN / I2C	6 / 4 / 2	4 / 4 / 1	4 / 4 / 1	4 / 2 / -	4 / 2 / -	4 / 2 / -
	SENT / PSI5 / PSI5S	15 / 5 / 1	10 / 3 / 1	6 / 2 / 1	4 / -	4 / -	4 / -
	HSCT / MSC / EBU	1 / 3 diff LVDS / 1	1 / 2 diff LVDS / -	1 / 2 diff LVDS / -	- / - / -	- / - / -	- / - / -
	Other	Ethernet	Ethernet	Ethernet	-	-	-
Safety	SIL Level	ASIL-D	ASIL-D	ASIL-D	ASIL-D	ASIL-D	ASIL-D
Security	HSM	Yes	Optional	No	Optional	No	No
Power	EVR	Yes	Yes	Yes	Yes	Yes	Yes

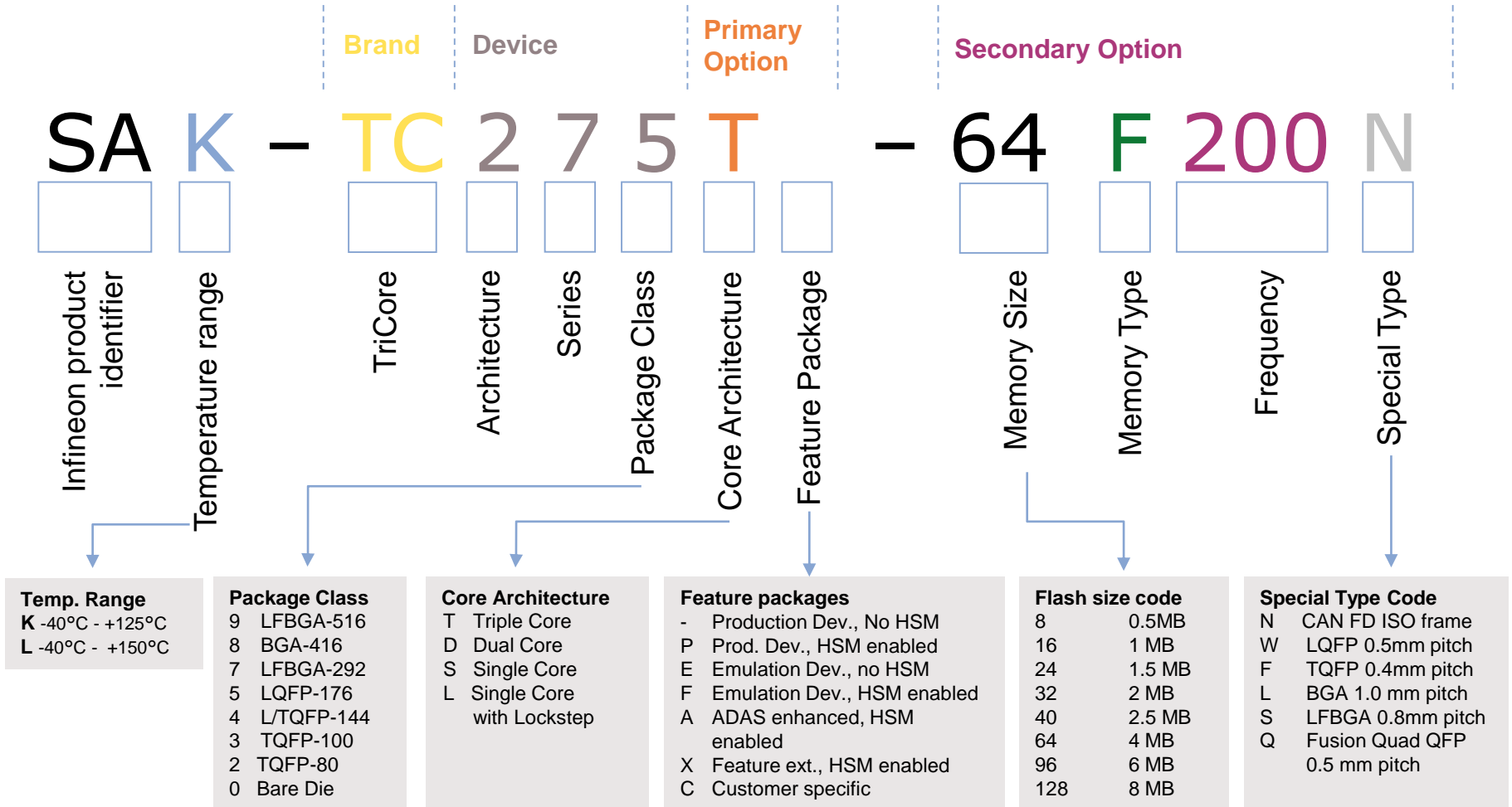
AURIX™ family concept offers both scalable feature-sets and pin-outs for optimal flexibility

# AURIX™ device list: Endless applications

Feature Set Special Devices		29x Xtended	29x ADAS	26x ADAS	23x Xtended	23x ADAS
<b>TriCore</b> <b>1.6P</b>	# Cores / Checker	3 / 1	3 / 1	- / -	- / -	- / -
	Frequency	2x300 / 1x200 MHz	2x300 / 1x200 MHz	-	-	-
<b>TriCore</b> <b>1.6E</b>	# Cores / Checker	- / -	- / -	1 / -	1 / 1	1 / 1
	Frequency	-	-	200 MHz	200 MHz	200 MHz
<b>Flash</b>	Program Flash	8 MB	8 MB	2.5 MB	2 MB	2 MB
	EEProm @ w/e cycles	128 KB @ 500k	128 KB @ 500k	16 KB @ 500k	128k , 125 k cycles	128k , 125 k cycles
<b>SRAM</b>	Total (DMI , PMI, LMU)	728 KB + <b>2MB</b>	728 KB + 2MB	240 KB + 512 KB	192 KB + <b>512KB</b>	192 KB + 512KB
<b>DMA</b>	Channels	128	128	48 + ADAS DMA	16	16
<b>ADC</b>	Modules 12bit / DS	11 / 10	11 / 10	4 / 3	4 / -	4 / -
	Channels 12bit / DS	84 / 10 diff	84 / 10 diff	40 / 3 diff	24 / -	24 / -
<b>Timer</b>	GTM Input / Output	48 / 152 channels	48 / 152 channels	24 / 64 channels	8 / 32	8 / 32
	CCU / GPT modules	2 / 1	2 / 1	2 / 1	2 / 1	2 / 1
<b>Interfaces</b>	FlexRay (#/ch.)	2 / 4	2 / 4	1 / 2	1 / 2	1 / 2
	CAN FD <sup>1)</sup> (nodes/obj)	6 / 384	6 / 384	5 / 256	6 / 256	6 / 256
	QSPI / ASCLIN / I2C	6 / 4 / 2	6 / 4 / 2	4 / 4 / 1	4 / 2 / -	4 / 2 / -
	SENT / PSI5 / PSI5S	15 / 5 / 1	15 / 5 / 1	6 / 2 / 1	4 / -	4 / -
	HSCT / MSC / EBU	1 / 3 diff LVDS / 1	1 / 3 diff LVDS / 1	1 / 2 diff LVDS / -	- / - / -	- / - / -
	Other	Ethernet	Ethernet, <b>CIF, FFT accelerator</b>	Ethernet, <b>CIF, FFT accelerator</b>	Ethernet	Ethernet, <b>FFT accelerator</b>
<b>Safety</b>	SIL Level	ASIL-D	ASIL-D	ASIL-D	ASIL-D	ASIL-D
<b>Security</b>	HSM	Yes	Optional	No	Option	Option
<b>Power</b>	EVR	Yes	Yes	Yes	Yes	Yes

AURIX™ family concept offers both scalable feature-sets and pin-outs for optimal flexibility

# AURIX™ Getting Started with A1G: Product Selector



Consult the [AURIX™ product selector](#) to order samples today!



# AURIX™: Functional Safety Leadership



# AURIX™: Functional Safety Leadership

IEC 61508

Automotive	→	ISO 26262
Machinery	→	IEC 62061
Railway	→	EN 50129
Nuclear Power	→	IEC 61513
Process Industry	→	IEC 61511
Household Appliances	→	IEC 60335
Furnaces	→	IEC 50156
Agriculture	→	ISO 25119
Aviation	→	DO-178

Full support  
AURIX™

The AURIX™ architecture is developed to allow compliance with multiple IEC 61508 across several applications



# AURIX™: Functional Safety Leadership as specified by PRO-SIL

## What is PRO-SIL™?

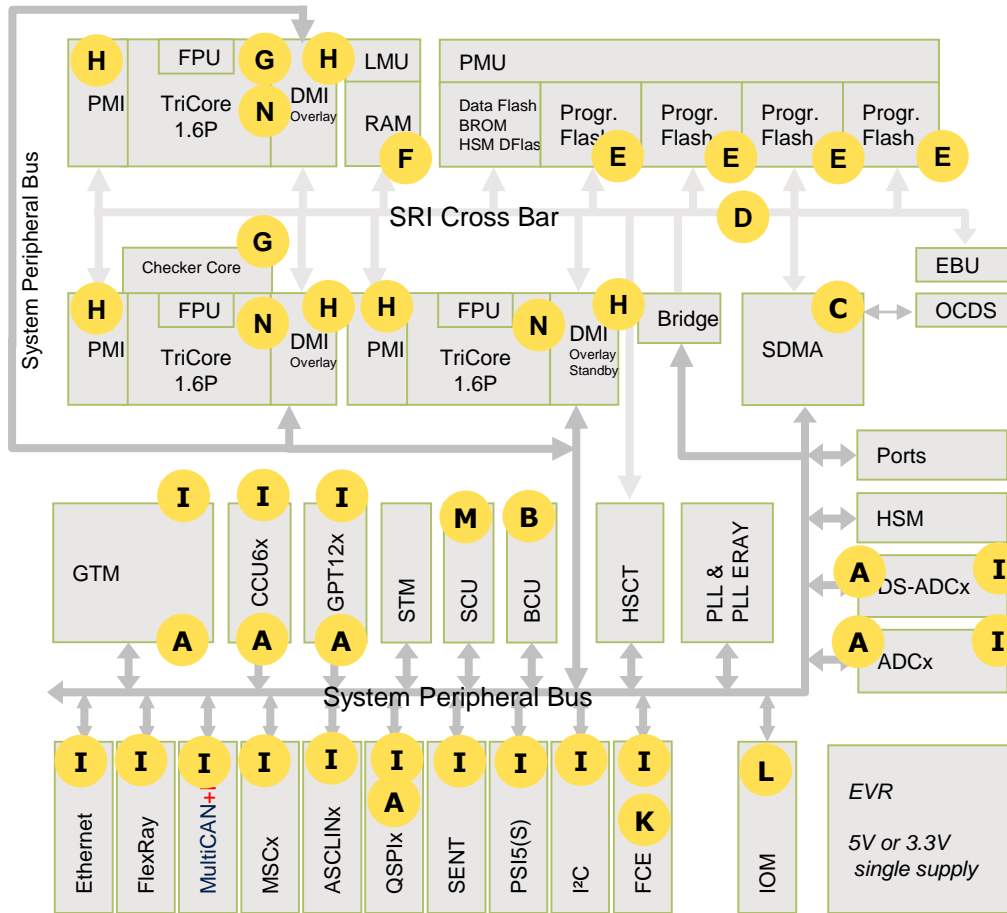


- > PRO-SIL™ shows where an Infineon product has SIL (Safety Integrity Level) features
- > Allows Infineon products to attain SIL (IEC 61508) and ASIL ISO 26262) level for safety systems



The AURIX™ is PRO-SIL™ compliant with safety hardware features throughout. Documentation may require an NDA. PRO-SIL™ SafeTlib Safety Software is available.

# AURIX™: Hardware Functional Safety Leadership



- A** Redundant, spatially separated peripherals
- B** Bus Monitoring Unit
- C** Safe DMA
- D** Safe SRI
- E** FLASH ECC (detects multi bit failures)
- F** SRAM ECC (detects multi bit failures)
- G** Lockstep core
- H** Memory protection core
- I** Memory protection peripherals
- J** Safe Interrupt Processing
- K** Flexible CRC Engine (FCE)
- L** IO Monitor
- M** Clock Monitoring
- N** CPU self tests (90% Latent Fault Metric)

**SAFETY is more than just a lockstep core. AURIX™ is designed with Pro-SIL™ (Safety Integrity Level) features throughout**



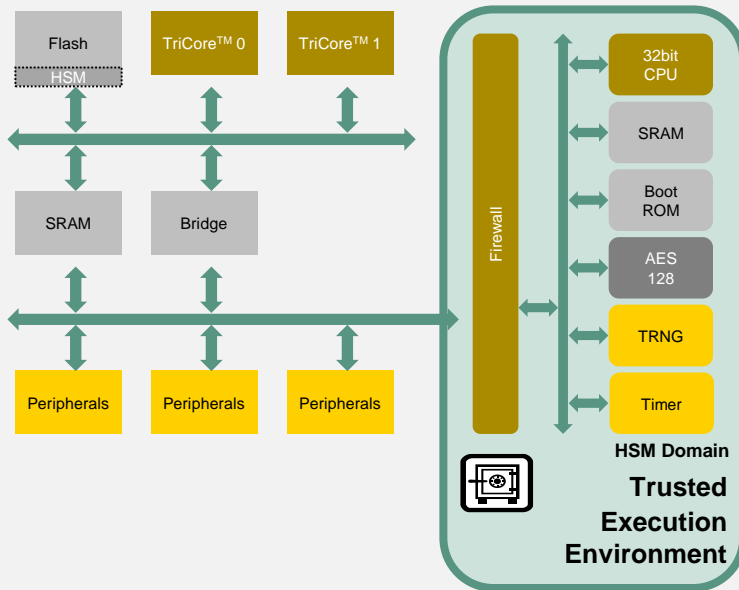
# AURIX™: Security Leadership



# AURIX™ HSM: Automotive Security Leadership



## What is the AURIX™ Hardware Security Module (HSM)?



- Trusted Execution Environment
- 32-bit ARM MCU separated by firewall
- Reserved access to shared NVM to host OEM application SW



## AURIX™ HSM Use Cases

- Key Distribution and Generation
- Secure Boot
- Secure on board communication



## AURIX™ HSM Crypto Accelerators

- **On-chip Symmetric:** HW AES-128
- **Asymmetric:** implemented in SHE + SW



## AURIX™ HSM Security Level

- **EVITA Medium:** The standard for Secure on-board communications



AURIX™ provides security leadership by enabling secure on-board communications. HSM is available now on selected devices.



# AURIX™: Extreme Temperature Leadership



# AURIX™: Extreme Temperature Leadership



## Standard Automotive Temp (SAK)

- › Standard Auto Temp range
  - › -40 to + 125°C

## Infineon HOT Package (SAL)

- › Upgraded to
  - › -40 to + 150°C

## Potential Application

- Anywhere where extreme temperatures are required
- Examples include, transmissions, All wheel drive, starter generator....

No other scalable Automotive MCU family can offer HOT package, SAFETY and SECURITY across the entire product range



# AURIX™: Extensive Ecosystem



# AURIX™ Getting Started: Kits

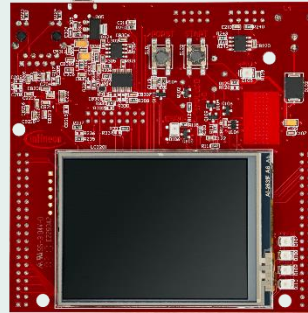
€99



## Arduino Shield Buddy

- > 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.
- > [KIT\\_AURIX\\_TC275\\_ARD\\_SB](#)

€149



## AURIX™ TFT

- > Low cost board for early evaluation with limited access to signals
- > Additional touchscreen display for convenient handling
- > TFT board available for every silicon
- > [KIT\\_AURIX\\_TC2xx\\_TFT](#)

€350+



## AURIX™ TriBoard

- > Full evaluation board for development to write and debug your 1<sup>st</sup> programs
- > Includes Getting Started advice, free TriCore Entry Tool Chain , technical documentation, compiler and debugger.
- > TriBoard available for every silicon
- > [KIT\\_AURIX\\_TC2xx\\_TRB](#)

For more applications please check: [www.infineon.com/AURIX](http://www.infineon.com/AURIX)



# AURIX™ Application Kits

To accelerate your Time to Market



€449

## Motor Control

- › TC234 Application Kit with TFT Display incl. safety supply TLF35584
- › Driving of a 3 Phase PMSM/BLCD (12Volt/max. 50Watt)
- › BLDC Motor from Nanotec integrated
- › Software available with flexible configuration
- › [KIT AURIX TC234 MOTORCTR](#)



€1499

## 24GHz Radar

- › Range-Doppler radar system with two Rx antennas and one Tx antenna based on AURIX™ TC264DA and BGT24ATR12
- › allow implementation and testing of 24GHz radar applications as Doppler movement detectors, FSK or FMCW range/position measurement
- › [KIT ATV 24GHZ RADAR](#)

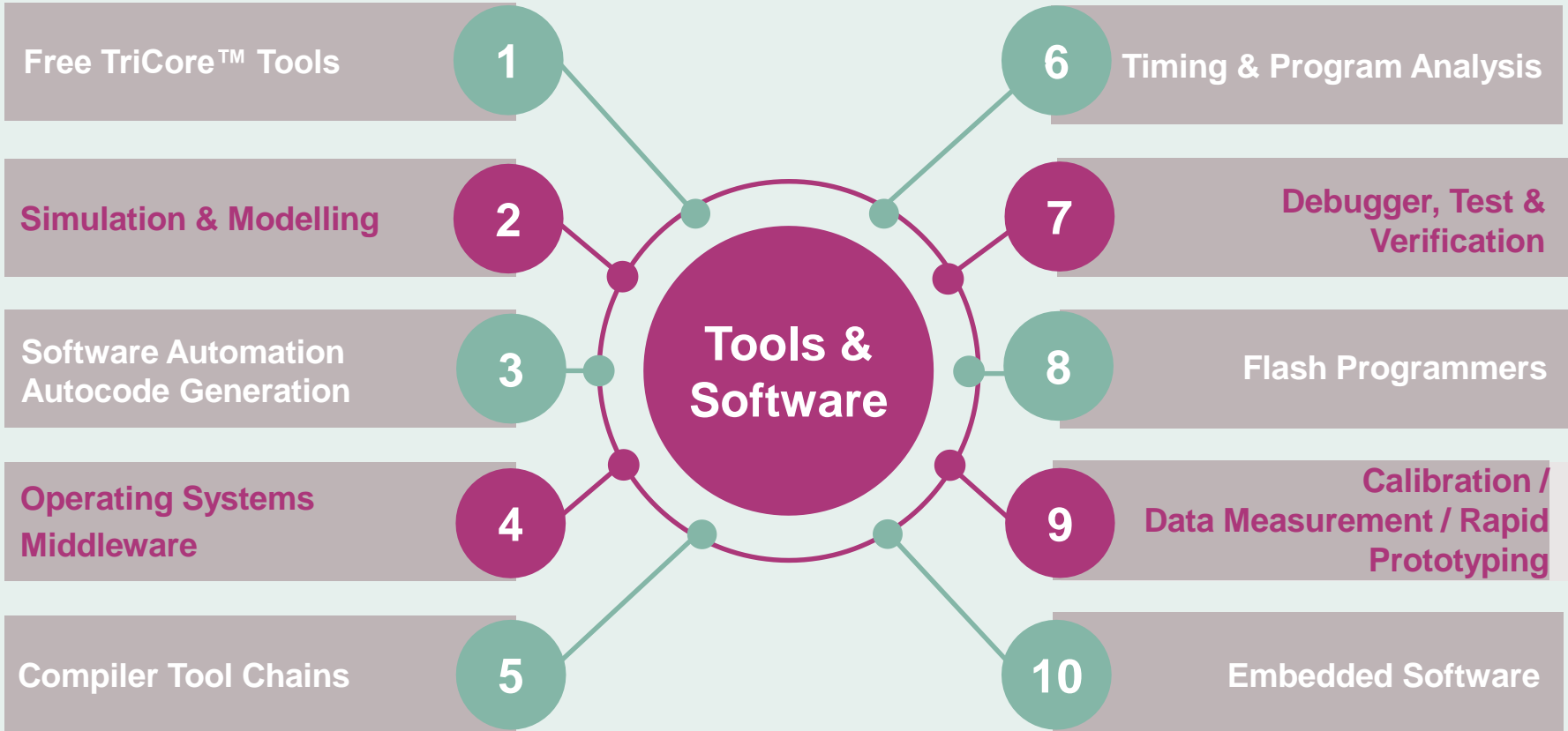


€599

## Wireless Charging

- › Supports all fast charge smartphones
- › Unique power drive architecture minimizes EMI
- › Improved accuracy Foreign Object Detection (FOD)
- › [KIT AURIX TC21 SC](#)

# AURIX™ Tools & Software Ecosystem



Infineon together with our partners has created an extensive AURIX™ Tools and software Ecosystem. [Find the solution that works for you](#)

# AURIX™ Getting Started: Free Tools

## AURIX™ Free Tool Chain

- › **Provider:** HighTec
- › Eclipse based IDE
- › GNU C compiler
- › On-chip flash programming

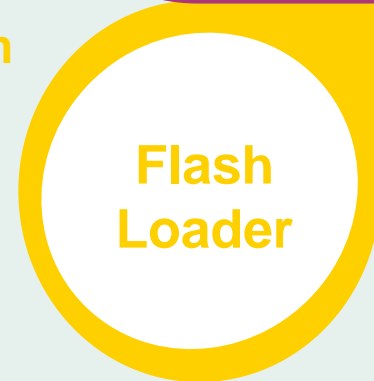


## AURIX™ Configuration

- › **Provider:** Altium
- › AURIX™ pin mapping
- › Drivers files + OS
- › Compiler and debugger

## AURIX™ Free Flash Loader

- › **Provider:** Infineon
- › Flash Loader SW
- › Data Communication



## Software

- › **Provider:** Infineon
- › Mem Tool – on chip flash programming
- › DAS (Device Access Server) tool interface

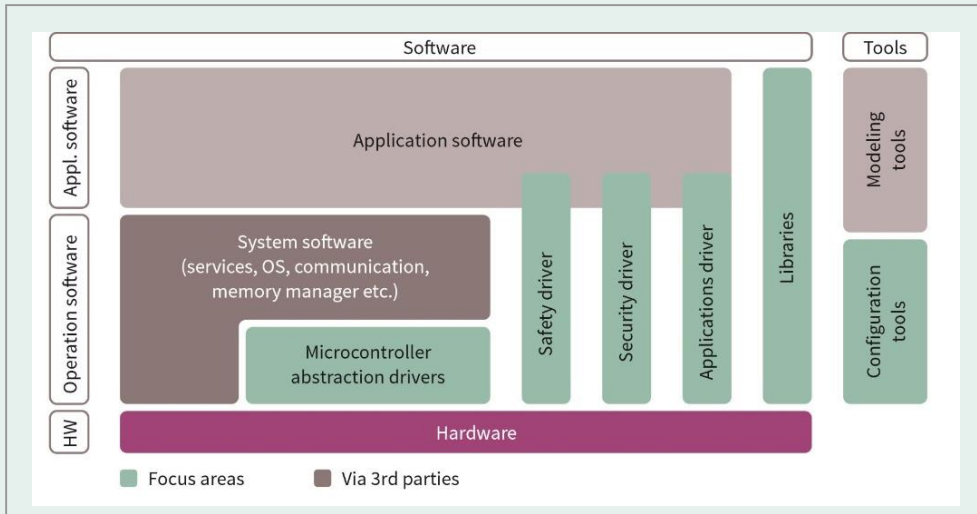
It's easier than ever to get [started with AURIX™ free Tools](#)

# AURIX™: Embedded Software Solution MC-ISAR



## Why Infineon MC-ISAR Software?

1. Customer gets optimized software based on IFX hardware expertise.
2. Infineon saves the opportunity cost of SW developers
3. Leaves more time to differentiate with systems level software



## MC-ISAR low-level drivers based on the AUTOSAR MCAL layer

- › Set of standardized basic software drivers packages:
  - › Basic
  - › COM (Communications)
  - › MEM (Memory)
  - › CD (Complex Drivers)

To find out how to license MC-ISAR software, please contact [tac@infineon.com](mailto:tac@infineon.com)

# AURIX™: More Information

Product home page AURIX™:  
[www.infineon.com/AURIX](http://www.infineon.com/AURIX)

AURIX™ forum for technical information exchange:  
[www.infineon.com/tricore-forum](http://www.infineon.com/tricore-forum)

AURIX™ special documentation access - register at:  
[www.myinfineon.com](http://www.myinfineon.com)

Free tool chain AURIX™:  
<http://free-entry-toolchain.hightec-rt.com/>  
<http://forms.tasking.com/tricore.html>





Part of your life. Part of tomorrow.

