Infineon AURIX™ Microcontrollers

*Intelligent solutions for Automotive Applications*
AURIX™: Infineon’s TriCore Processor

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

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

+ 500M devices shipped

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Infineon Proprietary
No other MCU family can offer this combination of functionality across multiple compatible products.
AURIX™: Quality & Business Continuity Leadership
## AURIX™: Quality Leadership by design

### Development Process Flow
- Secure maturity of the product along its life cycle
  - ISO 26262 Compliance
- Quality gates

### Product Design Measures
- Design for Reliability
- Design for Manufacturability
- Design for test

### Qualification Approach
- Robustness:
  - full temp profile
  - AEC Q006 for Cu Wire bond
  - Characterization of Functional Robustness
- AEC Q100

### Production measures
- Tool & Process control
- Risk Management
- Monitoring
- Test / Burn In
- Quality screening PAT / Scrap limit

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

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Continuity of supply is critical for our customers. AURIX™ delivers.
AURIX™: Long Term Technology Availability

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

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

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 compliance

Security Concept
- Selected devices with Hardware Security Module (HSM)

Availability
- All devices are in mass production

Tools & Boards
- Multiple options available

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
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.
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- Hot package options for extended temperature range.
<table>
<thead>
<tr>
<th>Feature Set</th>
<th>9x Series</th>
<th>7x Series</th>
<th>6x Series</th>
<th>3x Series</th>
<th>2x Series</th>
<th>1x Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>TriCore # Cores / Checker</td>
<td>3 / 1</td>
<td>2 / 1</td>
<td>1 / 1</td>
<td>- / -</td>
<td>- / -</td>
<td>- / -</td>
</tr>
<tr>
<td>TriCore Frequency</td>
<td>2x300 / 1x200 MHz</td>
<td>200 MHz</td>
<td>200 MHz</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TriCore # Cores / Checker</td>
<td>- / -</td>
<td>1 / 1</td>
<td>1 / -</td>
<td>1 / 1</td>
<td>1 / 1 (1 / 0)</td>
<td>1 / 1 (1 / 0)</td>
</tr>
<tr>
<td>TriCore Frequency</td>
<td>-</td>
<td>200 MHz</td>
<td>200 MHz</td>
<td>200 MHz</td>
<td>133 MHz</td>
<td>133 MHz</td>
</tr>
<tr>
<td>Flash Program Flash</td>
<td>8 MB</td>
<td>4 MB</td>
<td>2.5 MB</td>
<td>2 MB</td>
<td>1 MB</td>
<td>512 KB</td>
</tr>
<tr>
<td>Flash EEPROM @ w/e cycles</td>
<td>128 KB @ 500k</td>
<td>64 KB @ 500k</td>
<td>16 KB @ 500k</td>
<td>128k @ 125 k cycles</td>
<td>96k @ 125k cycles</td>
<td>64k @ 125k cycles</td>
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<tr>
<td>SRAM Total (DMI, PMI, LMU)</td>
<td>728 KB</td>
<td>472 KB</td>
<td>240 KB</td>
<td>192 KB</td>
<td>96 KB</td>
<td>56 KB</td>
</tr>
<tr>
<td>DMA Channels</td>
<td>128</td>
<td>64</td>
<td>48</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>ADC Modules 12bit / DS</td>
<td>11 / 10</td>
<td>8 / 6</td>
<td>4 / 3</td>
<td>2 / -</td>
<td>2 / -</td>
<td>2 / -</td>
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<tr>
<td>ADC Channels 12bit / DS</td>
<td>84 / 10 diff</td>
<td>60 / 6 diff</td>
<td>50 / 3 diff</td>
<td>24 / -</td>
<td>/ -</td>
<td>24 / -</td>
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<tr>
<td>Timer GTM Input / Output</td>
<td>48 / 152 channels</td>
<td>32 / 88 channels</td>
<td>24 / 64 channels</td>
<td>8 / 32</td>
<td>8 / 32</td>
<td>8 / 32</td>
</tr>
<tr>
<td>Timer CCU / GPT modules</td>
<td>2 / 1</td>
<td>2 / 1</td>
<td>2 / 1</td>
<td>2 / 1</td>
<td>2 / 1</td>
<td>2 / 1</td>
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<tr>
<td>Interfaces FlexRay (#/ch.)</td>
<td>2 / 4</td>
<td>1 / 2</td>
<td>1 / 2</td>
<td>1 / 2</td>
<td>-</td>
<td>-</td>
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<td>6 / 4 / 2</td>
<td>4 / 4 / 1</td>
<td>4 / 4 / 1</td>
<td>4 / 2 / -</td>
<td>4 / 2 / -</td>
<td>4 / 2 / -</td>
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<tr>
<td>Interfaces SENT / PS15 / PS15S</td>
<td>15 / 5 / 1</td>
<td>10 / 3 / 1</td>
<td>6 / 2 / 1</td>
<td>4 / -</td>
<td>4 / -</td>
<td>4 / -</td>
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<tr>
<td>Interfaces HSCT / MSC / EBU</td>
<td>1 / 3 diff LVDS / 1</td>
<td>1 / 2 diff LVDS / -</td>
<td>1 / 2 diff LVDS / -</td>
<td>- / - / -</td>
<td>- / - / -</td>
<td>- / - / -</td>
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<tr>
<td>Interfaces Other Ethernet</td>
<td>Ethernet</td>
<td>Ethernet</td>
<td>Ethernet</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Safety SIL Level</td>
<td>ASIL-D</td>
<td>ASIL-D</td>
<td>ASIL-D</td>
<td>ASIL-D</td>
<td>ASIL-D</td>
<td>ASIL-D</td>
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<tr>
<td>Security HSM</td>
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<td>No</td>
<td>Optional</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Power EVR</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

AURIX™ family concept offers both scalable feature-sets and pin-outs for optimal flexibility.
# AURIX™ device list: Endless applications

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

<table>
<thead>
<tr>
<th>Feature Set Special Devices</th>
<th>29x Xtended</th>
<th>29x ADAS</th>
<th>26x ADAS</th>
<th>23x Xtended</th>
<th>23x ADAS</th>
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<tbody>
<tr>
<td>TriCore 1.6P</td>
<td></td>
<td></td>
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<tr>
<td># Cores / Checker</td>
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<td>- / -</td>
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<tr>
<td>Frequency</td>
<td>2x300 / 1x200 MHz</td>
<td>2x300 / 1x200 MHz</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>TriCore 1.6E</td>
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<td></td>
<td></td>
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<tr>
<td># Cores / Checker</td>
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<td>- / -</td>
<td>1 / -</td>
<td>1 / 1</td>
<td>1 / 1</td>
</tr>
<tr>
<td>Frequency</td>
<td>-</td>
<td>-</td>
<td>200 MHz</td>
<td>200 MHz</td>
<td>200 MHz</td>
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<tr>
<td>Flash</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Program Flash</td>
<td>8 MB</td>
<td>8 MB</td>
<td>2.5 MB</td>
<td>2 MB</td>
<td>2 MB</td>
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<tr>
<td>EEPROM @ w/e cycles</td>
<td>128 KB @ 500k</td>
<td>128 KB @ 500k</td>
<td>16 KB @ 500k</td>
<td>128k, 125 k cycles</td>
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<tr>
<td>SRAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (DMI, PMI, LMU)</td>
<td>728 KB + 2MB</td>
<td>728 KB + 2MB</td>
<td>240 KB + 512 KB</td>
<td>192 KB + 512KB</td>
<td>192 KB + 512KB</td>
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<tr>
<td>DMA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Channels</td>
<td>128</td>
<td>128</td>
<td>48 + ADAS DMA</td>
<td>16</td>
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<td>ADC</td>
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<td>Modules 12bit / DS</td>
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<td>Channels 12bit / DS</td>
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<td>84 / 10 diff</td>
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<tr>
<td>Timer</td>
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<td>GTM Input / Output</td>
<td>48 / 152 channels</td>
<td>48 / 152 channels</td>
<td>24 / 64 channels</td>
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<td>8 / 32</td>
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<td>CCU / GPT modules</td>
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<td>2 / 1</td>
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<td>Interfaces</td>
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<td>FlexRay (#/ch.)</td>
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<td>CAN FD(^3) (nodes/obj)</td>
<td>6 / 384</td>
<td>6 / 384</td>
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<td>SENT / PSIS / PSIS5</td>
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<td>15 / 5 / 1</td>
<td>6 / 2 / 1</td>
<td>4 / -</td>
<td>4 / -</td>
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<tr>
<td>HSCT / MSC / EBU</td>
<td>1 / 3 diff LVDS / 1</td>
<td>1 / 3 diff LVDS / 1</td>
<td>1 / 2 diff LVDS / -</td>
<td>- / - / -</td>
<td>- / - / -</td>
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<tr>
<td>Other</td>
<td>Ethernet, CIF, FFT accelerator</td>
<td>Ethernet, CIF, FFT accelerator</td>
<td>Ethernet, CIF, FFT accelerator</td>
<td>Ethernet, FFT accelerator</td>
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<tr>
<td>Safety</td>
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<tr>
<td>SIL Level</td>
<td>ASIL-D</td>
<td>ASIL-D</td>
<td>ASIL-D</td>
<td>ASIL-D</td>
<td>ASIL-D</td>
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<tr>
<td>Security</td>
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<td>Option</td>
<td>Option</td>
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<td>Power</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>EVR</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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Infineon Proprietary
Consult the AURIX™ product selector to order samples today!
AURIX™:
Functional Safety Leadership
The AURIX™ architecture is developed to allow compliance with multiple IEC 61508 across several applications.
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 ASI 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.
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
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

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

AURIX™ TriBoard

- 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
- KIT_AURIX_TC2xx_TRB

For more applications please check: www.Infineon.com/AURIX
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

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

Wireless Charging

- Supports all fast charge smartphones
- Unique power drive architecture minimizes EMI
- Improved accuracy Foreign Object Detection (FOD)
- KIT_AURIX_TC21_SC

KIT_AURIX_TC234_MOTORCTR

KIT_ATV_24GHZ_RADAR
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™ Free Flash Loader
- **Provider:** Infineon
- Flash Loader SW
- Data Communication

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

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 our how to license MC-ISAR software, please contact tac@infineon.com
AURIX™: More Information

Product home page AURIX™:
www.Infineon.com/AURIX

AURIX™ forum for technical information exchange:
www.infineon.com/tricore-forum

AURIX™ special documentation access - register at:
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.