Plataformas Comerciais

Tricore AURIX TC2xx (Infineon)

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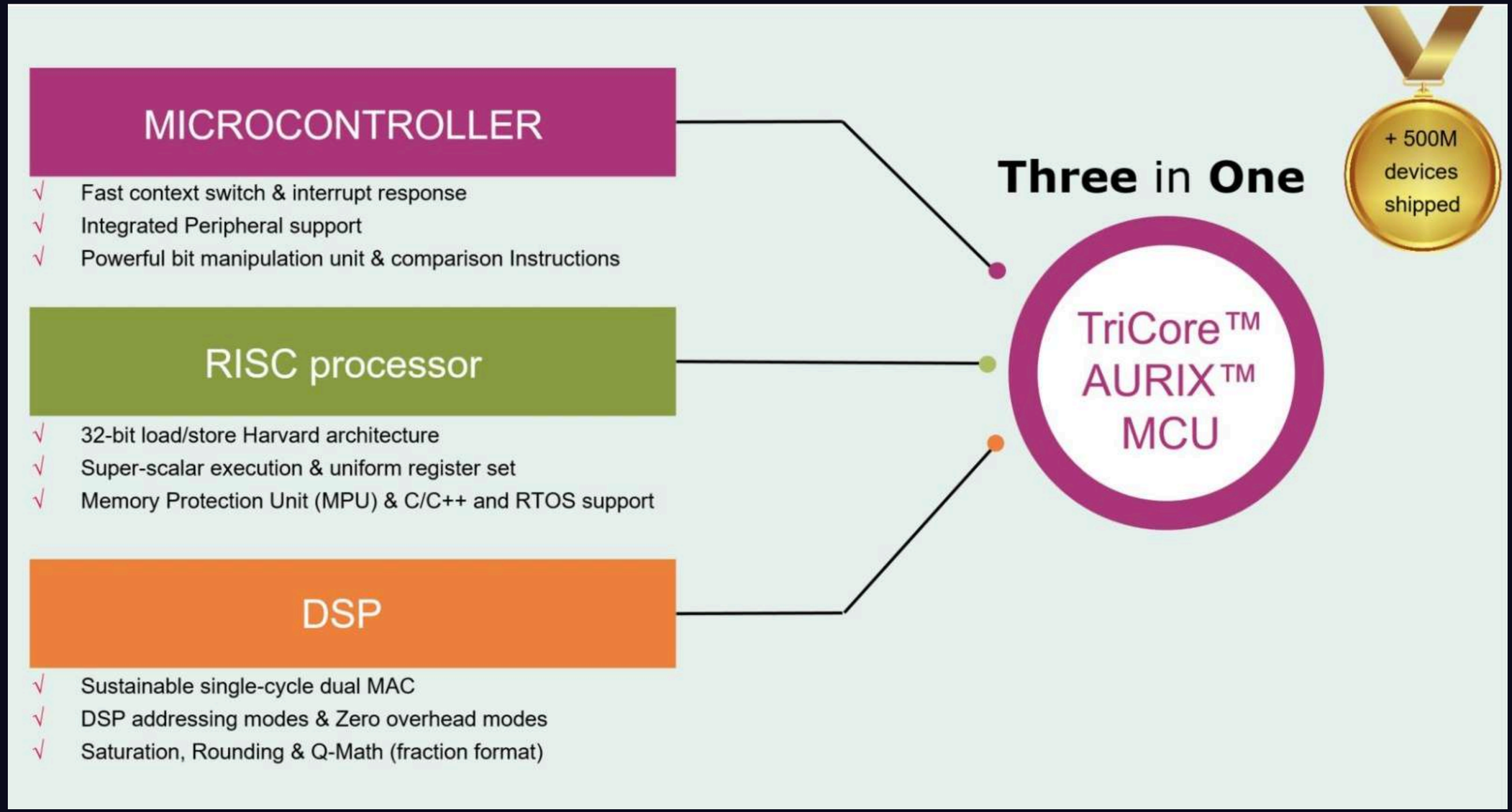
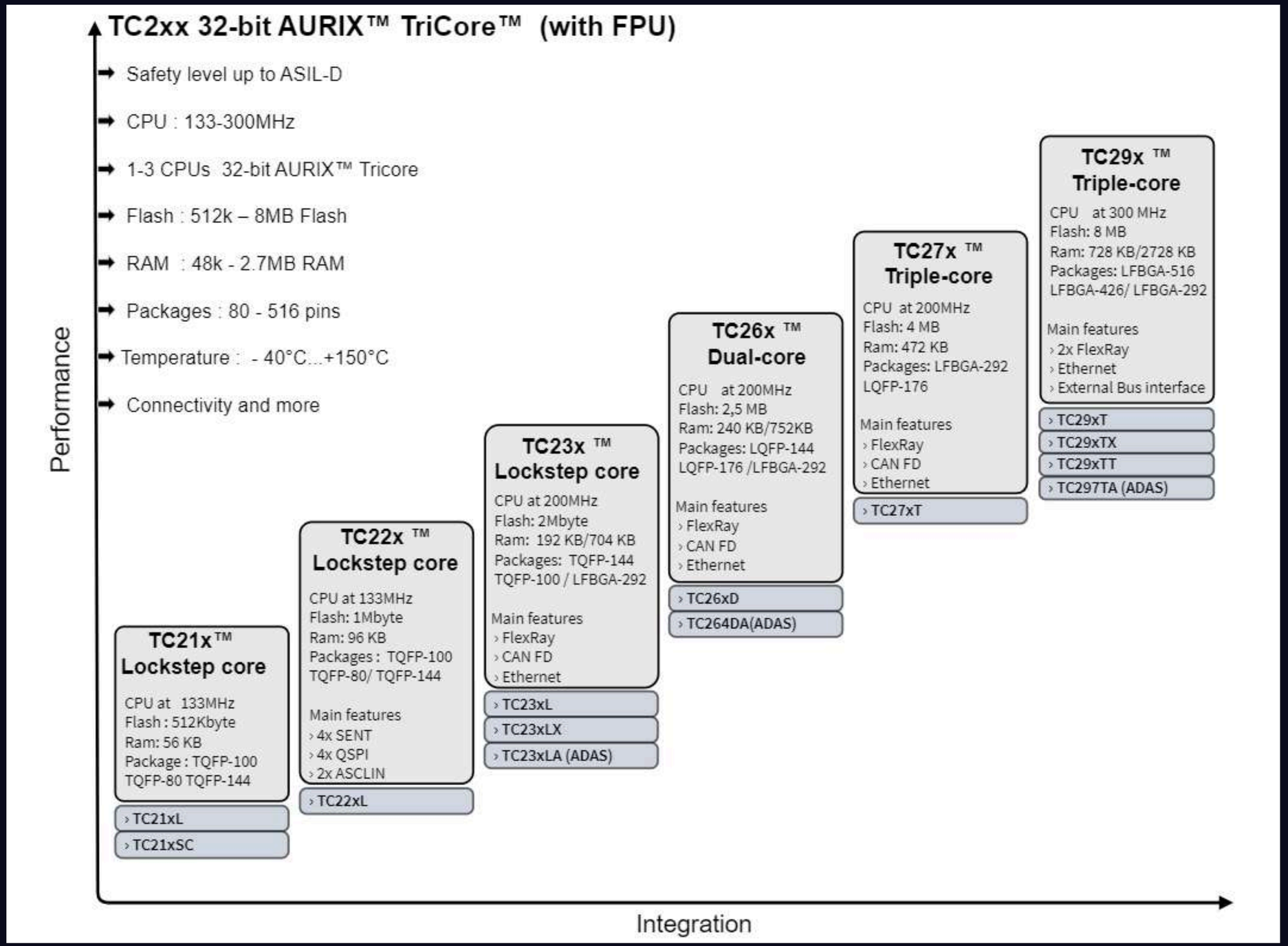
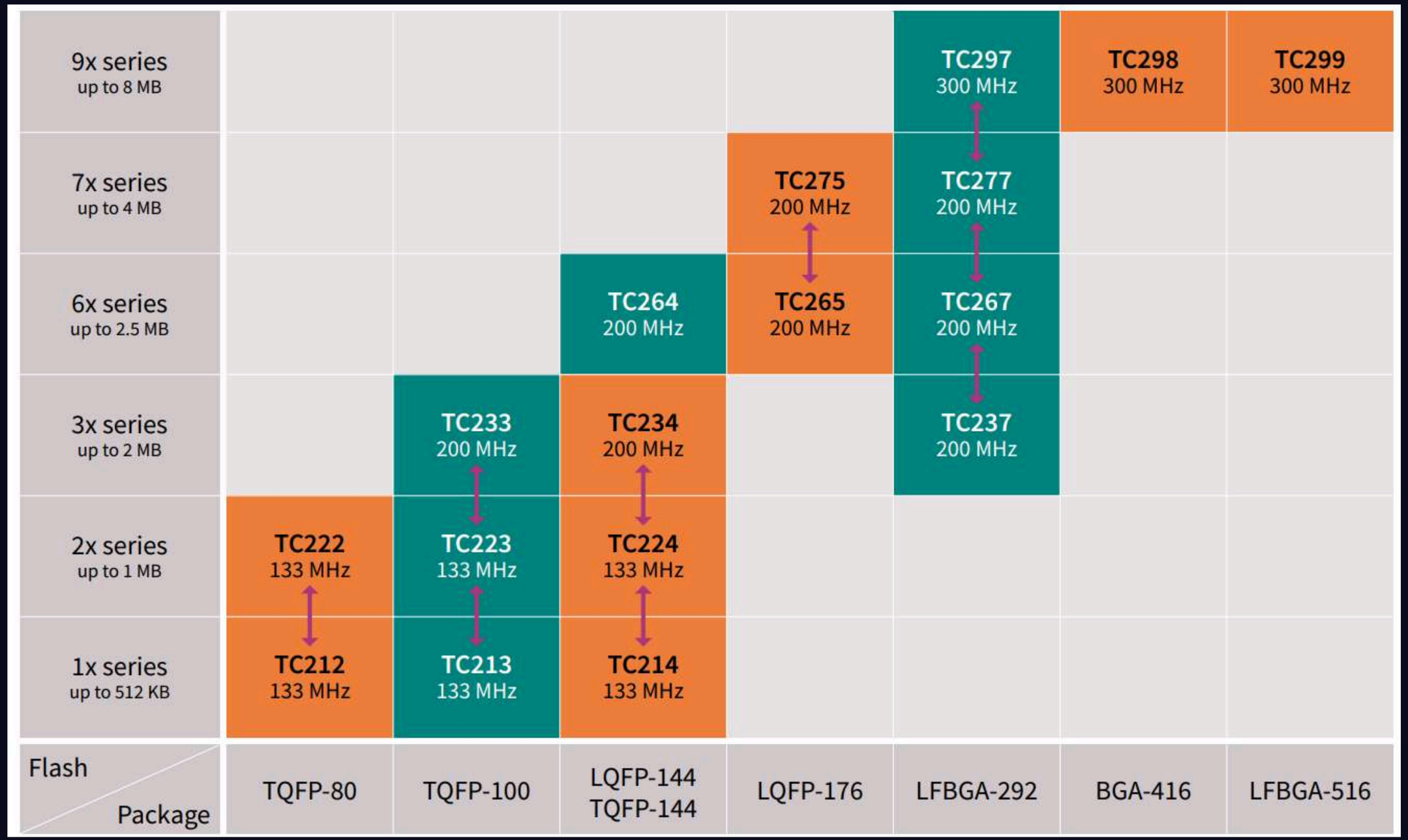
Davi Coelho Maciel

O que é o TC2xx ?



Sobre o TC2xx

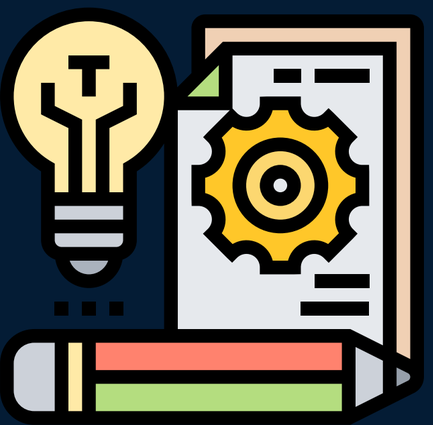

TC2xx 32-bit AURIX™ TriCore™ (with FPU)
Safety level up to ASIL-D
CPU : 133-300MHz
1-3 CPUs 32-bit AURIX™ Tricore
Flash : 512k – 8MB Flash
RAM : 48k - 2.7MB RAM
Packages : 80 - 516 pins
Temperature : - 40°C...+150°C
Connectivity and more
Performance
Integration
TC21x™ Lockstep core
CPU at 133MHz
Flash : 512Kbyte
Ram: 56 KB
Package : TQFP-100
TQFP-80 TQFP-144
› TC21xL
› TC21xSC
TC22x ™ Lockstep core
CPU at 133MHz
Flash: 1Mbyte
Ram: 96 KB
Packages : TQFP-100
TQFP-80/ TQFP-144
Main features
› 4x SENT
› 4x QSPI
› 2x ASCLIN
› TC22xL
TC23x ™ Lockstep core
CPU at 200MHz
Flash: 2Mbyte
Ram: 192 KB/704 KB
Packages: TQFP-144
TQFP-100 / LFBGA-292
Main features
› FlexRay
› CAN FD
› Ethernet
› TC23xL
› TC23xLX
› TC23xLA (ADAS)
TC26x ™ Dual-core
CPU at 200MHz
Flash: 2,5 MB
Ram: 240 KB/752KB
Packages: LQFP-144
LQFP-176 /LFBGA-292
Main features
› FlexRay
› CAN FD
› Ethernet
› TC26xD
› TC264DA(ADAS)
TC27x ™ Triple-core
CPU at 200MHz
Flash: 4 MB
Ram: 472 KB
Packages: LFBGA-292
LQFP-176
Main features
› FlexRay
› CAN FD
› Ethernet
› TC27xT
TC29x ™ Triple-core
CPU at 300 MHz
Flash: 8 MB
Ram: 728 KB/2728 KB
Packages: LFBGA-516
LFBGA-426/ LFBGA-292
Main features
› 2x FlexRay
› Ethernet
› External Bus interface
› TC29xT
› TC29xTX
› TC29xTT
› TC297TA (ADAS)


9x series
up to 8 MB
7x series
up to 4 MB
6x series
up to 2.5 MB
3x series
up to 2 MB
2x series
up to 1 MB
1x series
up to 512 KB
TC297
300 MHz
TC298
300 MHz
TC299
300 MHz
TC275
200 MHz
TC277
200 MHz
TC264
200 MHz
TC265
200 MHz
TC267
200 MHz
TC233
200 MHz
TC234
200 MHz
TC237
200 MHz
TC222
133 MHz
TC223
133 MHz
TC224
133 MHz
TC212
133 MHz
TC213
133 MHz
TC214
133 MHz
Flash
Package
TQFP-80
TQFP-100
LQFP-144
TQFP-144
LQFP-176
LFBGA-292
BGA-416
LFBGA-516

Características Principais

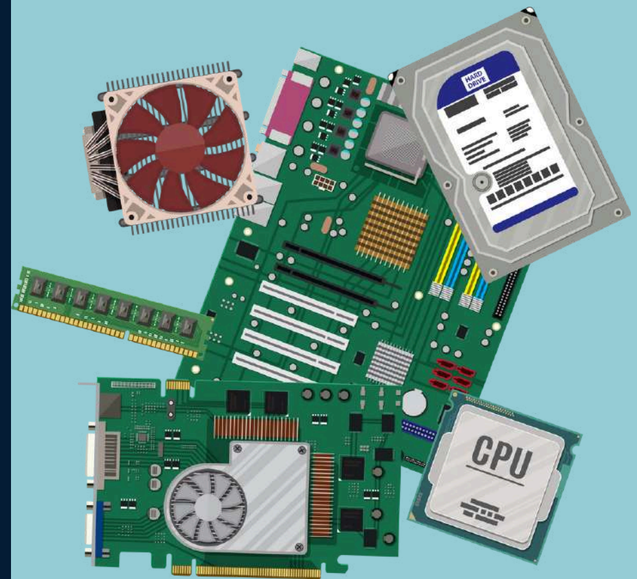
ISA

- 4 GBytes de espaço de endereçamento
- Instruções de 16 e 32 bits para redução do tamanho do código
- Instruções de desvio (com previsão de desvio)
- Unidade de Ponto Flutuante (FPU) e Unidade de Gerenciamento de Memória (MMU)
- Operações SIMD (Single Instruction Multiple Data)
- Esquema flexível de priorização de interrupções
- Proteção de memória e suporte a depuração

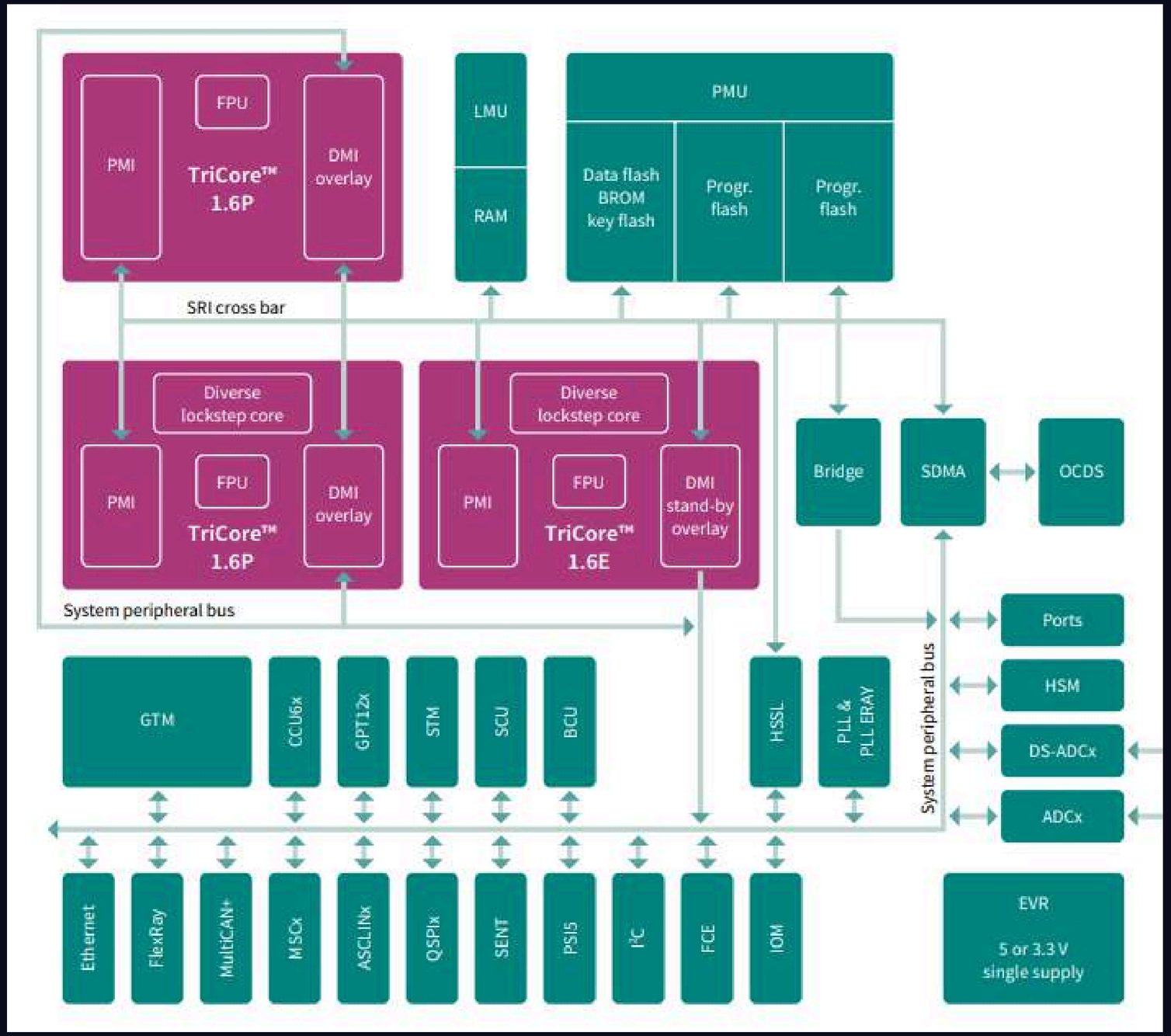


Hardware

- 1-3 CPUs de 32 bits AURIX™ TriCore™
- CPUs: 133-300 MHz
- Nível de segurança até ASIL-D
- Flash: 512 KB – 8 MB de memória flash
- RAM: 48 KB - 2,7 MB de RAM
- Temperatura: -40°C a +150°C



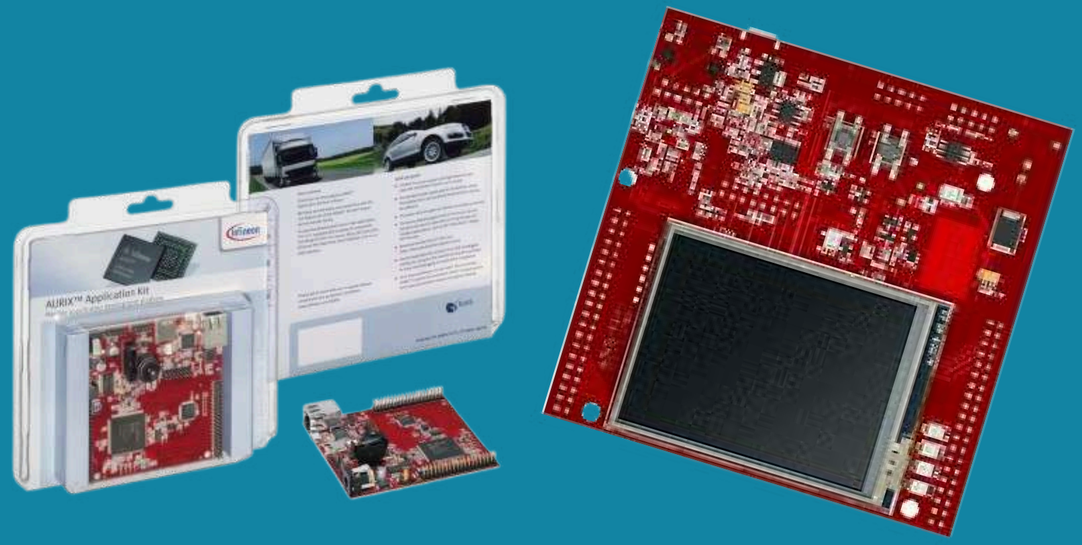
Organização


PMI
FPU
TriCore™ 1.6P
DMI overlay
LMU
RAM
PMU
Data flash BROM key flash
Progr. flash
Progr. flash
SRI cross bar
Diverse lockstep core
PMI
FPU
TriCore™ 1.6P
DMI overlay
Diverse lockstep core
PMI
FPU
TriCore™ 1.6E
DMI stand-by overlay
Bridge
SDMA
OCDS
System peripheral bus
Ports
HSM
DS-ADCx
ADCx
GTM
CCU6x
GPT12x
STM
SCU
BCU
HSSL
PLL & PLL ERAY
System peripheral bus
Ethernet
FlexRay
MultiCAN+
MSCx
ASCLINx
QSPIx
SENT
PSI5
I²C
FCE
IOM
EVR
5 or 3.3 V single supply

Kits de Desenvolvimento

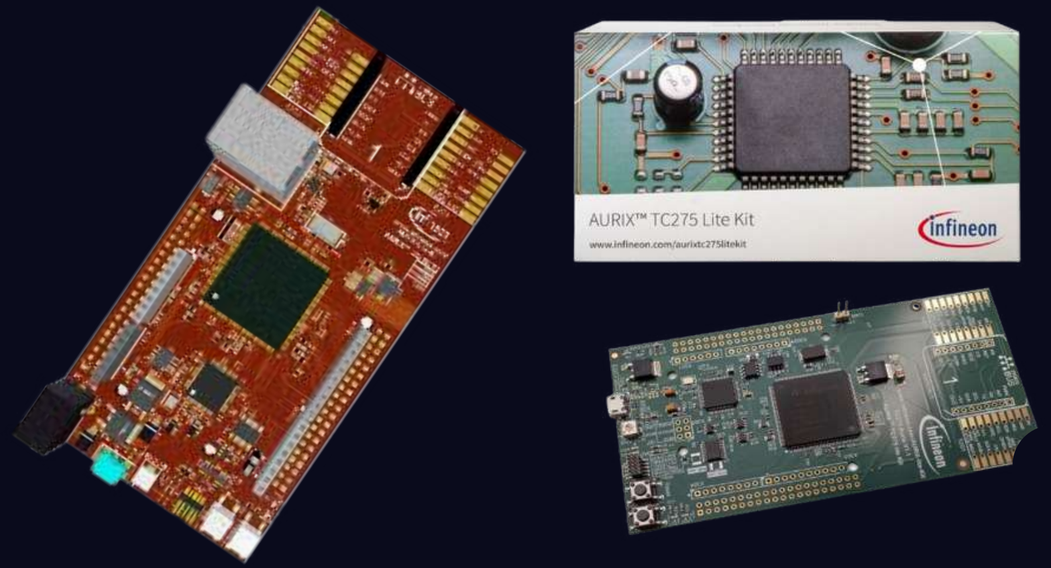
AURIX™ TC2x TriBoards

AURIX™ TC2x TFT kits



AURIX™ TC2x Arduino ShieldBuddy kit

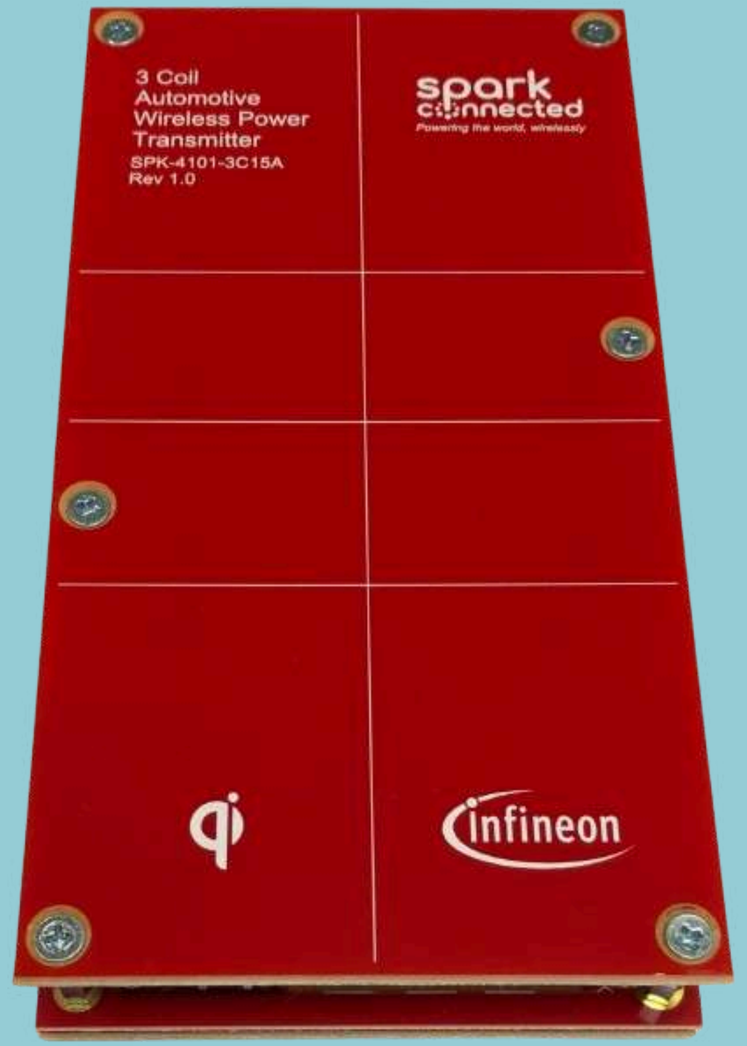
AURIX™ TC2x lite kit



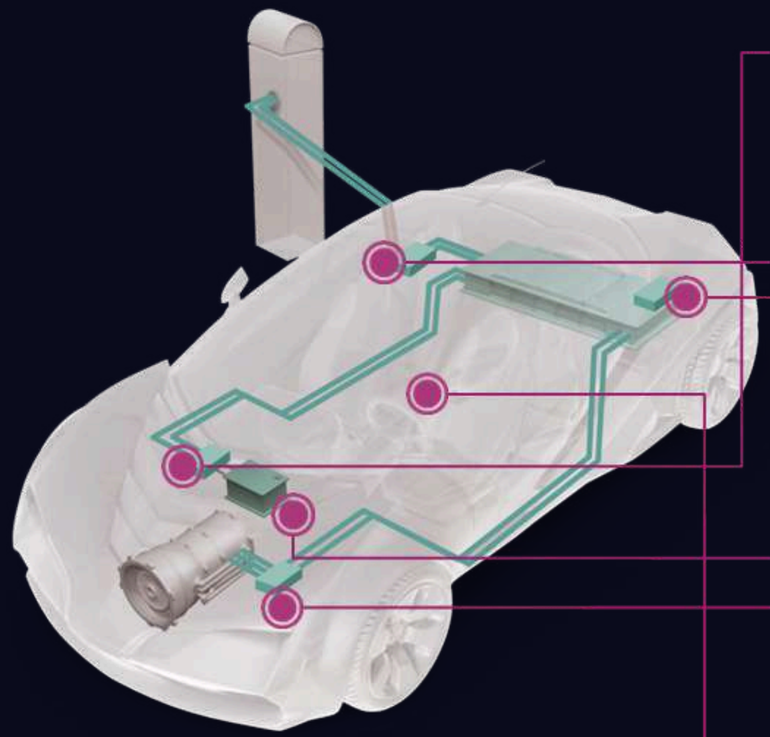
Kits de Aplicação

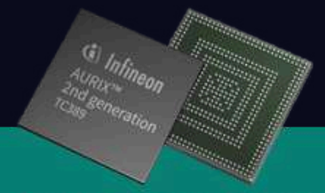
KIT_ATV_24GHZ_RADAR

KIT_AURIX_TC21_SC



Mobilidade Elétrica





AURIX™ for Main Inverter
Realiza o gerenciamento de torque e o posicionamento do rotor para um controle eficiente do motor.

AURIX™ for DC/DC Converter
Gerencia a comunicação com a pilha AUTOSAR, bem como executa loops de controle para múltiplas fases (até 8).

AURIX™ for Auxiliary Inverters/Converters
Aciona a bomba d'água, o compressor de HVAC, o aquecedor PTC, além de gerenciar o sistema térmico para um uso mais eficiente de energia.

AURIX™ for Battery Management
Monitora e reage ao Estado de Saúde (SoH), Estado de Carga (SoC) e Profundidade de Descarga (DoD) com o auxílio de ASICs de balanceamento; previne manipulações ilegais tanto no sistema quanto nos pacotes de bateria por meio de fluxo de dados criptografado; monitora a segurança do sistema através de topologia em anel habilitada por SPI.

AURIX™ for On-board Charger
Garante isolamento galvânico entre a rede elétrica e a bateria de alta tensão (HV-battery), além de fornecer cobrança segura de carga e habilitar várias classes de potência para tempos de carregamento flexíveis.

AURIX™ for HCU & Domain Control
Gerencia a comunicação entre os submódulos, como o motor e os motores híbridos dentro de um veículo elétrico híbrido (Hybrid EV). Garante comunicação segura e suporte a Software Over the Air (SOTA) como gateway central para o domínio do powertrain na arquitetura E/E.

	Inverter/HCU	DC-DC/OBC	BMS
AURIX	VW MEB platform TC275	Hyundai 48V Tucson TC264	Daimler S Class 48V TC277
AURIX	Ford C-Max & F150 TC298	Mazda Atenza TC264	Kia Soul TC264
AURIX	Mercedes E Class TC277	London Taxi Company TC265 & TC233	Hyundai Sonata TC264
AURIX	Suzuki Ertiga TC233	AUDI E-Tron TC277	BMW 530 TC277
AURIX	AUDI Q5 HEV TC277	SAIC Baojun730 TC275	Next EV Nio TC275
AUDO	Renault Twizy & Zoe TC1782	Hyundai Avante XC164	BJEV EU260 TC1782
AUDO	Volvo XC90 TC1798	VW Blue e-Motion TC1797	AUDI A3 TC1797
AUDO	BMW i3 & i8 TC1797	Mercedes S500 TC1797	Mercedes SLS TC1797

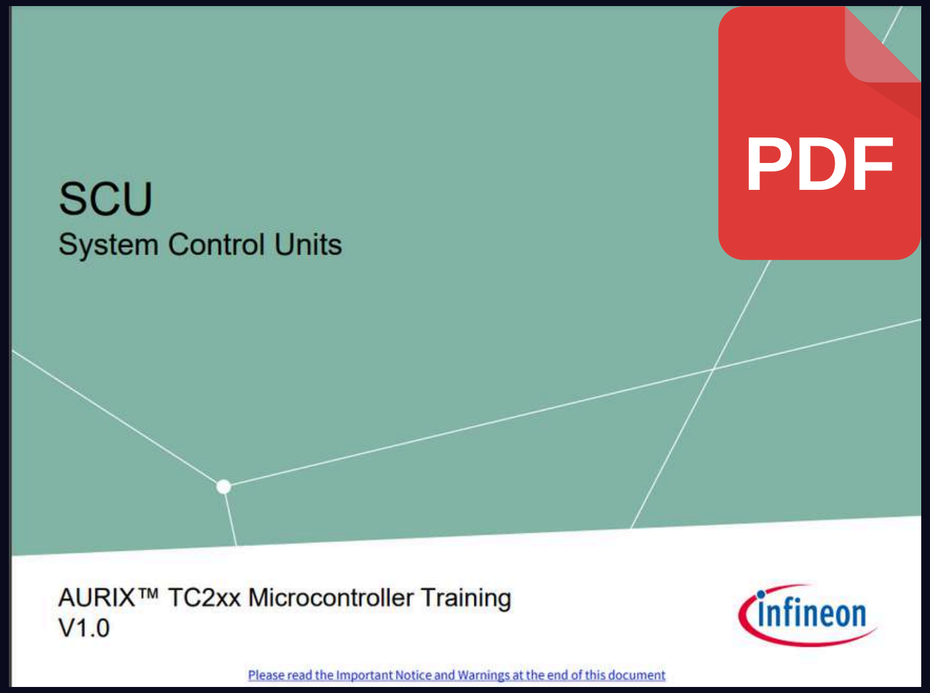
Ambiente de Desenvolvimento

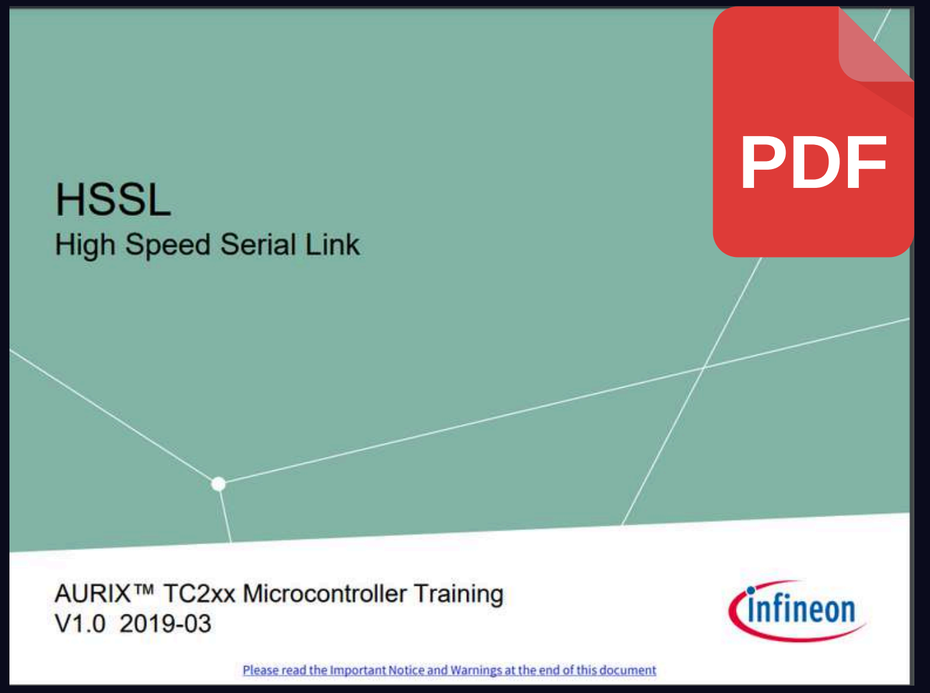
Treinamentos Básicos e Expert no Website

IDE AURIX Development Studio

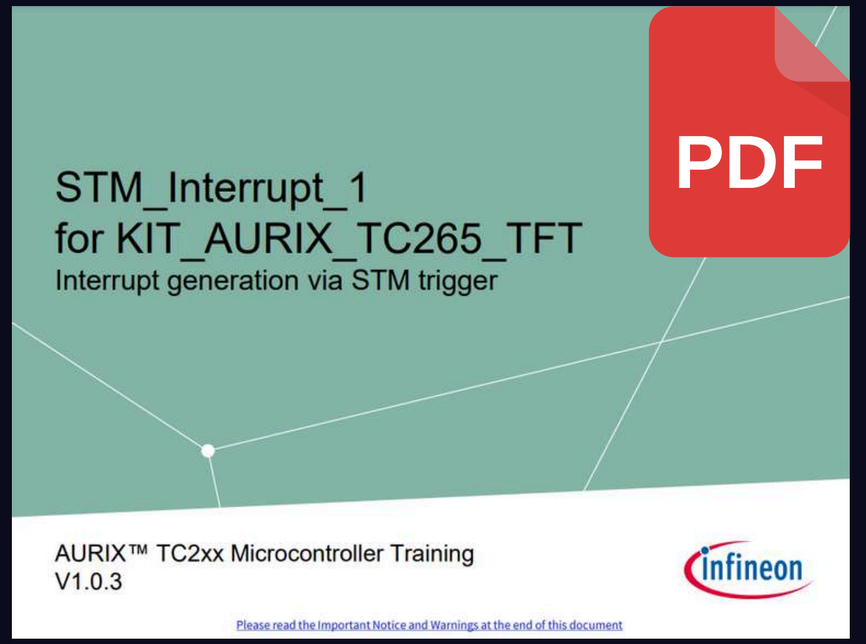
Exemplos de código do github

Treinamentos “Rápidos”





Treinamentos “Experts”



Exemplos de código no Github

Communication Protocols	Data Handling	Timers	Analog/Digital Signals	CPU Management	Alarms, Interrupts and Resets
ASCLIN module handling for LIN, UART and SPI	Flexible CRC Engine control	Capture and Compare Unit control	Versatile Analog-to-Digital converter control	Assembly code execution	Device Reset type trigger and detection
Ethernet communication	Input-Output Monitor control	Clock System	Delta-Sigma Analog-to-Digital converter control	Code execution from SRAM	Interrupt handling
I2C communication	BUS register protection	General Purpose Timer control	GPIO port control	Performance registers usage	Safety Management Unit control
CAN communication	Memory Protection control	Generic Timer Module control		Power Management System control	
SPI communication	Data and Program Flash programming	System Timer Module control		Multicore	
	DMA control			Trap recognition	
	Memory test			Watchdog handling	

Cpu0_Main.c
Cpu1_Main.c
Cpu2_Main.c

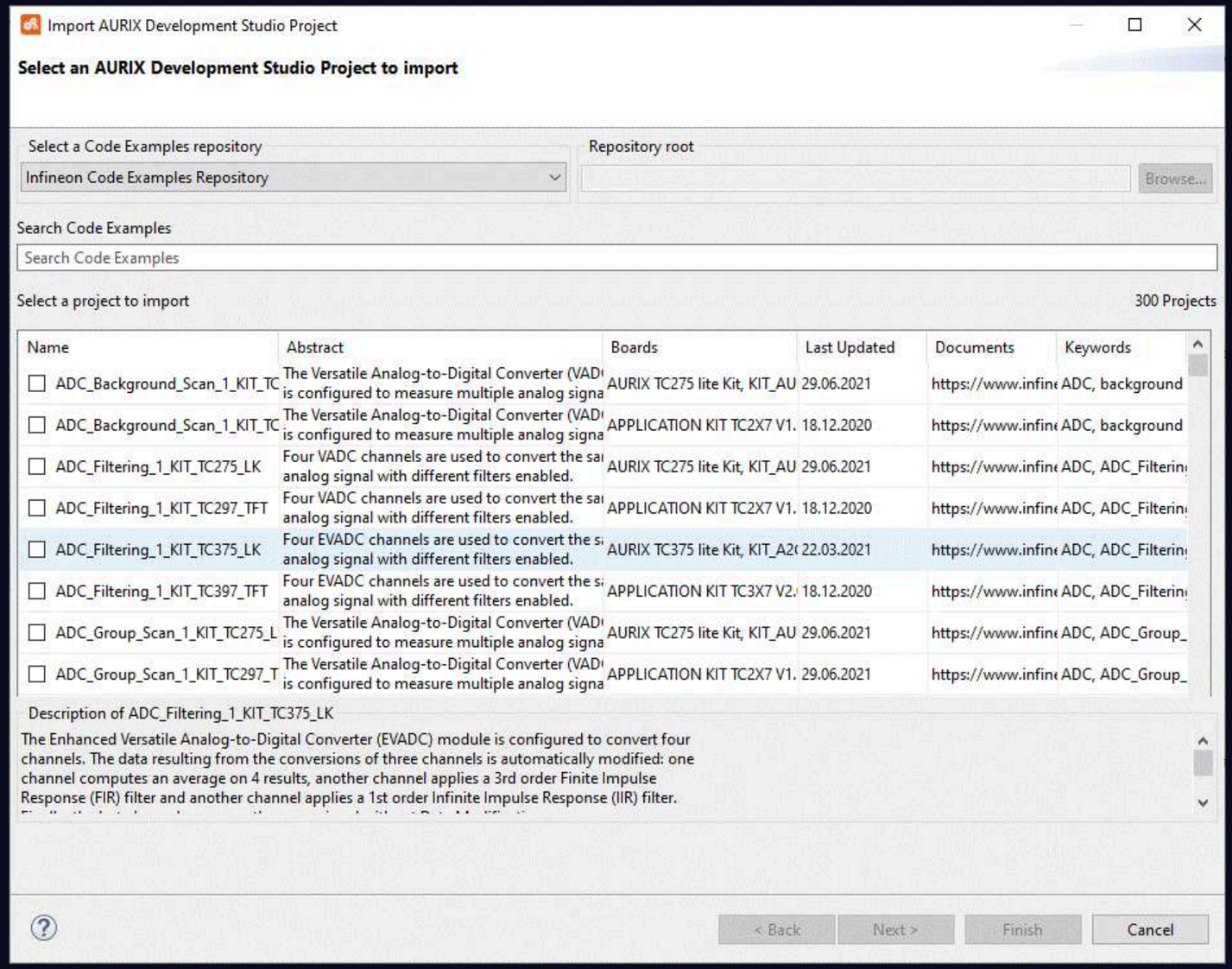
```c
int core0_main(void)
{
    IfxCpu_enableInterrupts();
    /* Wait for CPU sync event */
    IfxCpu_emitEvent(&g_cpuSyncEvent);
    IfxCpu_waitEvent(&g_cpuSyncEvent, 1);

    /* Initialize the VADC module and start the background scan */
    initADC();
```

```c
int core1_main(void)
{
    IfxCpu_enableInterrupts();
    /* Wait for CPU sync event */
    IfxCpu_emitEvent(&g_cpuSyncEvent);
    IfxCpu_waitEvent(&g_cpuSyncEvent, 1);
```

```c
int core2_main(void)
{
    IfxCpu_enableInterrupts();
    /* Wait for CPU sync event */
    IfxCpu_emitEvent(&g_cpuSyncEvent);
    IfxCpu_waitEvent(&g_cpuSyncEvent, 1);
```

IDE AURIX Development Studio



Infineon
AURIX™ TC2xx

Bibliografia

- Site Oficial
  - https://www.infineon.com/cms/en/product/microcontroller/32-bit-tricore-microcontroller/32-bit-tricore-aurix-tc2xx/
- Software
  - https://www.infineon.com/cms/en/tools/aurix-embedded-sw/
  - https://github.com/Infineon/AURIX_code_examples
- Hardware
  - https://www.infineon.com/dgdl/Infineon-Power_and_Sensing-ProductSelectionGuide-v04_00-EN.pdf?fileId=8ac78c8c90530b3a0190e3b892a95f09&da=t
  - https://www.infineon.com/dgdl/Infineon-TriCore_Family_BR-ProductBrochure-v01_00-EN.pdf?fileId=5546d4625d5945ed015dc81f47b436c7

Perguntas?

Obrigado!