

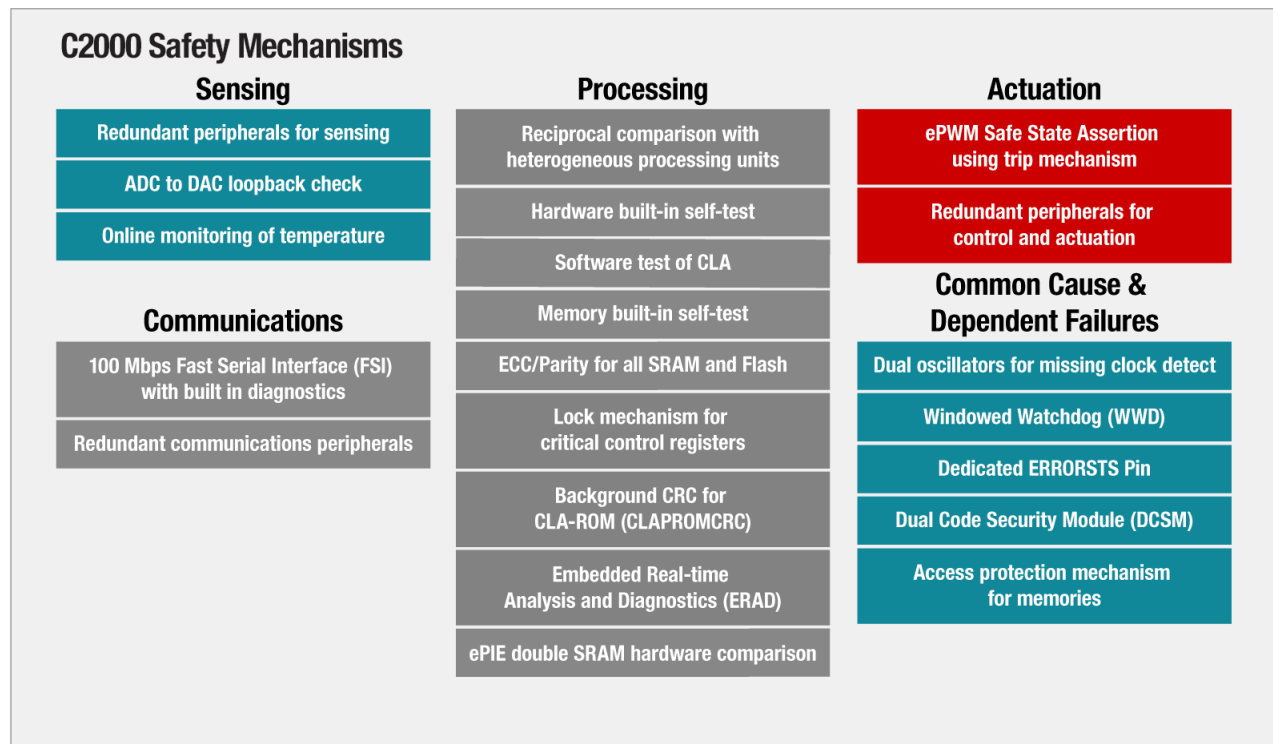
Industrial Functional Safety for C2000™ Real-Time Microcontrollers



Streamline and speed-up IEC 61508 (SIL) and ISO13849 (PL) certification process with our Functional Safety-Compliant products, documentation, software and support from our knowledgeable experts. Our C2000™ real-time MCUs are independently assessed and certified by TUV SUD to meet a systematic capability up to SIL 3 and help you create industrial applications requiring functional safety. C2000 real-time MCUs also address [Automotive Functional Safety](#).

Highlights of the C2000 functional safety offering are

- Device architecture for functional safety
- Documentation to support to ease customer's safety assessment at system level
- Software library to implement the safety mechanisms



Safety mechanisms play a key role in the overall safety of a system by detecting potentially dangerous failures and consequently helping place the system in a safe state. With over 300 safety mechanisms defined and independently assessed by TUV SUD for its effectiveness, C2000 MCUs provide the required diagnostic coverage to meet a random hardware capability of SIL 2 at a component level. Functional safety manuals provide detailed information on the safety mechanisms, techniques for achieving non-interference between elements and avoiding dependent failures, to aid customers in the development of compliant systems up to SIL 3. The tunable FMEDA provides increased flexibility to customize and calculate HW metrics with features such as package FIT estimation, product function tailoring, safety mechanism tailoring and custom diagnostics allowing customers to [tune the FMEDA](#) to their own application specific needs.

Learn More about Safety Mechanisms

Key safety features	F2838x	F2837x F2807x	F28003x	F28002x	F280015x
SIL-3 Compliant Development Process	✓	✓	✓	✓	✓
Random Hardware Capability	SIL-2	SIL-2	SIL-2	QM	SIL-2
Systematic Capability	SIL-3	SIL-3	SIL-3	SIL-3	SIL-3
Redundant and diverse processing units (C28x and CLA) for implementing safety functions	✓	✓	✓	X	Lockstep C28x
Memory parity	✓	✓	X	X	✓
Memory ECC	✓	✓	✓	✓	✓
Memory BIST (MPOST)	✓	X	✓	✓	✓
Dual Core Security Module (DCSM) to achieve non-interference between software elements	✓	✓	✓	✓	✓
Windowed watch-dog timer with independent clock	✓	✓	✓	✓	✓
Hardware CRC acceleration	✓	✓	✓	✓	✓
Hardware BIST (HWBIST): Permanent fault coverage of 90%+ for C28x CPU	✓	✓	✓	✓	X C28x-STL (60% coverage)
CLA-Self Test Library (STL)	✓	✓	✓	N/A	N/A
Redundant and independent ADC / PWM Modules	✓	✓	✓	✓	✓
Redundant Configurable Logic Block (CLB) option	✓	✓	✓	✓	N/A
Safety Manual: detailed product overview, capabilities and constraints, TI development process, safety elements, and safety diagnostics.	SFFS022	SPRUI78	Beta available - contact TI	SPRUI5	Beta available - contact TI
Device Certification	SSZQM2	SWAQ009	Coming soon	Not planned	Coming soon

Safety collateral	
Development Process Certificate Hardware Software	TUV-SUD certificate for QRAS-AP00210. Functional safety development process for IEC 61508-2 and ISO 26262-5 Compliant Components
C2000 Safety package*	By request and NDA required. Package includes below elements: <ul style="list-style-type: none"> • Technical Report on Random HW Capability • Technical Report on Systematic Capability • FMEDA: A failure mode, effects and diagnostic analysis (FMEDA) is used in the development stage to provide a detailed analysis of different failure modes, the associated effects of failure modes, diagnostics and the impact of any implemented diagnostics/ safety mechanisms in terms of diagnostic coverage. 5 part FMEDA training video series. • Device Concept Assessment • SAR (Safety Analysis Report): Contains results of safety analysis according to the targeted functional safety standards.
Software diagnostic library	A library of modules and examples demonstrating safety features and mechanisms. Examples include CPU, memory, clocks/ watchdogs, HWBIST, etc. F2837x/07x supported through this library . All other F28x series supported by libraries released in C2000Ware .
CLA co-processor self-test library*	Library to perform start-up and periodic tests for CLA logic integrity
Compiler qualification kit	Compare compiler coverage for customer use cases against coverage of TI compiler release validations
Safety certified RTOS (SafeRTOS)	Pre-certified safety Real Time Operating System (RTOS)
MathWorks simulation & code generation	IEC certification kit helps you qualify MathWorks code generation and verification tools to streamline certification of your embedded systems

*Not publicly available collateral. Contact your local TI representative to request.

Industrial Safety Architectures common in machinery applications typically require a dual channel safety approach (hardware fault tolerance = 1). C2000 devices offer unique capability and scalability to implement two different architectures for SIL-2 (or cat 3 PL d) and SIL-3 (or cat 3 or cat 4 PL e) systems; a C2000 MCU for each of two safety channels or a C2000 MCU for one safety channel and a C2000 MCU for the second safety channel and the controller combined in single device. Further, compared to general purpose MCUs being used for safety functions C2000 devices offer superior compute performance and device features for implementing complex safe motion functions beyond just Safe Torque Off (STO) that requires real-time monitoring of parameters such as SLS (Safe Limiting Speed), Safe Brake Control (SBC), Safe Direction (SDI), Safe Speed Monitor (SSM) and fast actuation of the safe state.

Further details are available under safety NDA in a TUV report on this concept and architectures.

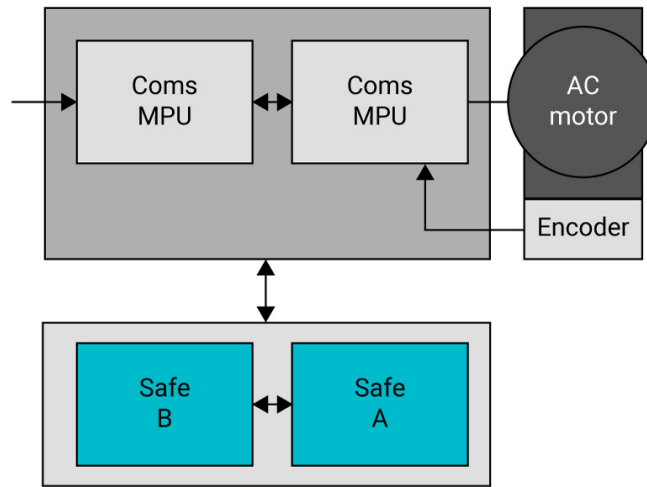


Figure 1. Architecture 1 with dual safety MCUs.

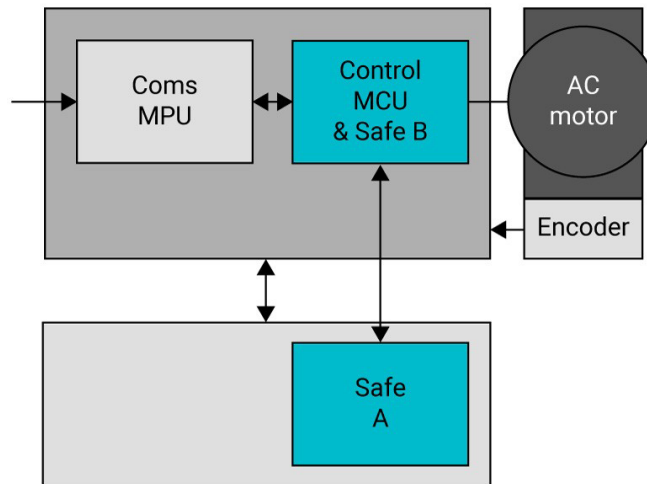


Figure 2. Architecture 2 with single safety MCU and safety integrated functions into the Drive MCU.

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