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MCUs Enable More Accurate Fault Detection In Solar, Energy Storage And Motor Applications

Texas Instruments' TMS320F28P55x and F29H85x series real-time microcontrollers deliver advancements to help engineers achieve more intelligent and secure processing in automotive and industrial applications. The TMS320F28P55x series of C2000 MCUs is being introduced as the industry's first portfolio of real-time microcontrollers with an integrated neural processing unit (NPU), enabling fault detections with high accuracy and low latency. Meanwhile, the F29H85x series is built on TI's new 64-bit C29 digital signal processor core and offers an advanced architecture with integrated safety and security features.

Engineers today are challenged to design systems that can make accurate, intelligent decisions in real time to perform functions such as arc fault detection in solar and energy storage systems and motor-bearing fault detection for predictive maintenance. As the industry's first real-time MCUs with an integrated neural processing unit, TI's C2000 TMS320F28P55x series meets both of these challenges by ensuring consistent performance with real-time processing, says the vendor (see Figs. 1 and 2).

The NPU in the TMS320F28P55x series offloads the execution of the neural network model from the main CPU, achieving five to 10 times lower latency than software implementations to enable faster, more accurate decision-making. Further, the model that runs on the integrated NPU learns and adapts to different environments through training, helping systems achieve greater than 99% fault detection accuracy to enable more informed decision-making at the edge. TI's complete AI toolchain, which includes models that are optimized and tested for specific applications, helps engineers with any level of experience easily complete the AI model development process, according to the vendor.

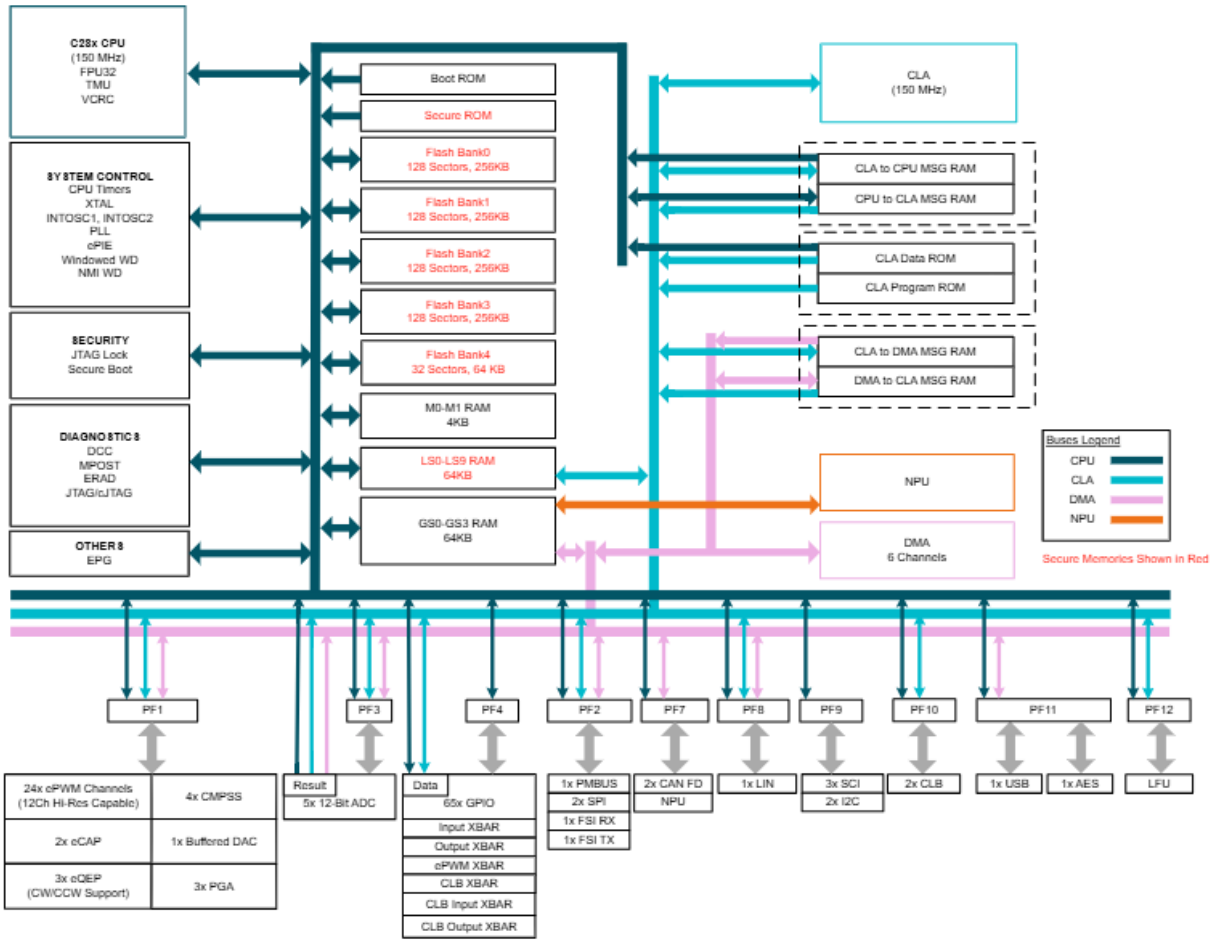
Designers are increasingly looking for a single MCU with more flash memory, larger computational capabilities and more integrated functionality. This need is particularly evident as vehicles shift from discrete solutions to integrated solutions, where a single chip is capable of handling various computational and housekeeping functions within the powertrain. TI's new C29 core, with its 64-bit architecture, delivers more than double the real-time signal-chain performance of the C28 core.

Featuring comprehensive diagnostics and error-checking mechanisms, the F29H85x series was engineered for compliance with ISO-26262 and IEC-61508 automotive and industrial safety standards, with levels up to ASIL D and SIL 3. These MCUs also provide cybersecurity capabilities, with a fully isolated hardware security module that protects systems from unauthorized access and cyberthreats. Additionally, TI's proprietary safety and security unit provides runtime safety and security without a performance penalty using an advanced, context-aware memory protection unit for hardware isolation of CPU tasks, with freedom from interference and self-test processes.

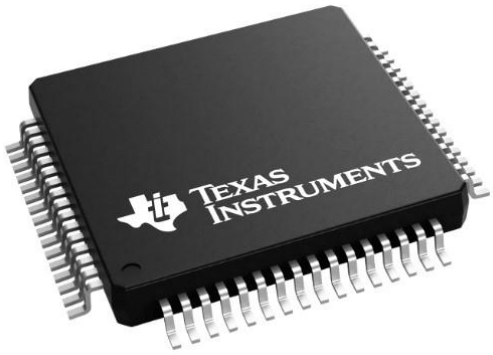
As noted in an application brief cited at the end of this article, real-time control MCUs like the F29H859TU-Q1 and F29H850TU and their C29 cores help engineers deliver increased processing capabilities, power efficiency, and fast switching frequencies in subsystems for electric vehicles (such as on-board chargers and high- and low-voltage dc-dc converters) and energy infrastructure (such as solar inverters and UPSs).

The TMS320F28P550SJ and TMS320F28P559SJ-Q1 are available now via the C2000 real-time microcontrollers page in preproduction quantities, with the F29H850TU and F29H859TU-Q1 available by year-end 2024. For more information, see the TMS320F28P550SJ page, the TMS320F28P559SJ-Q1 page, the F29H850TU page, and the F29H859TU-Q1 page.

To learn more about AI-enabled real-time control applications, see "Optimizing system fault detection in real-time control systems with edge AI-enabled MCUs." To learn more about how TI helps engineers solve processing and safety design challenges, see the application brief, "How MCUs Built With Innovative C29 Cores Increase Real-Time Performance in High-Voltage Systems."



(a)



(b)

Fig. 1. Functional block diagram (a) and package photo (b) for the TMS320F28P550SJ. The TMS320F28P55x (F28P55x) is a member of the C2000 real-time microcontroller family of scalable, ultra-low latency devices designed for efficiency in power electronics, including but not limited to high power density, high switching frequencies, and supporting the use of GaN and SiC technologies. The neural-network processing unit (NPU) can support machine-learning inferencing using pre-trained models. Capable of 600 to 1200 MOPS (mega operations per second) with model support for arc fault detection or motor fault detection, the NPU provides up to 10x NN inferencing cycle improvement versus a SW-only-based implementation.

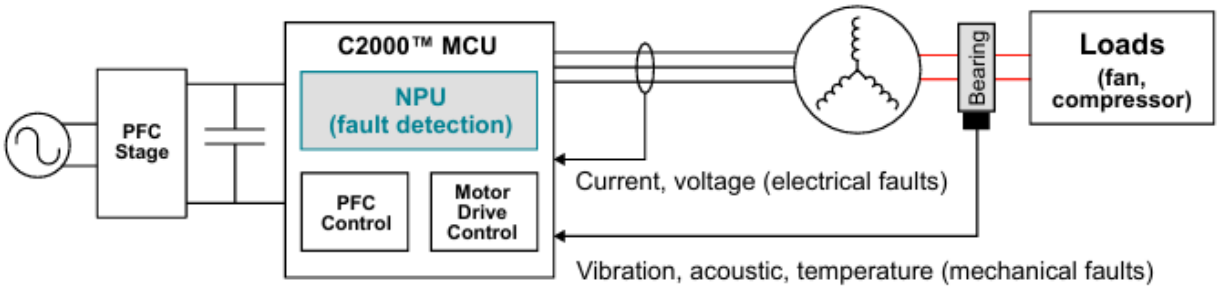


Fig. 2. The TMS320F28P55x series of C2000 MCUs with an integrated edge AI hardware accelerator enables smarter real-time control, with up to 99% fault detection accuracy. Shown here is an edge AI-enabled fault monitoring solution in a real-time control system.