ISSUE: August 2024

Field Programmable Controller Replaces Up To Six MCUs For EV Power Train Control And Energy Management

From Silicon Mobility, an Intel company, the OLEA U310 Field Programmable Control Unit (FPCU) is part of its next generation of OLEA FPCU series and consolidates the functionalities of multiple traditional microcontrollers into a single system on chip (SoC), leading to substantial benefits for electric vehicle (EV) manufacturers and consumers. A first for the industry, according to the vendor, it replaces up to six separate microcontrollers while simultaneously delivering real-time control of multiple and diverse power and energy functions and guaranteeing maximum safety integrity and future-proofed cybersecurity.

The unique design allows OEMs to break free from the conventions of EV domain controls and move to a highly integrated X-in-1 powertrain that delivers unmatched system performance, according to the company. It will help to make EVs more energy efficient, lighter and ultimately more cost-effective, to accelerate their adoption on a global scale, says the vendor.

The rise of electric vehicles is triggering a profound shift in the automotive industry. The traditional embedded electric architecture is being reinvented to support a software-driven approach. This "software defined vehicle" concept promises a more sustainable model for car development and a constantly updatable and evolving user experience. However, it requires powerful computational and control solutions that seamlessly integrate hardware and software.

The OLEA U310 is specifically engineered to match the need for powertrain domain control in electrical architectures with distributed software. Built with a unique hybrid and heterogenous architecture it surpasses the capabilities of traditional microcontrollers (Fig. 1).

The SoC embeds multiple software and hardware programmable processing and control units while seamlessly integrating functional safety and cybersecurity into its core design (Fig. 2). This allows OEMs to run multiple time-based applications while simultaneously executing multiple event-based control functions.

OEMs and automotive tier 1s can design several variants of system integration with the OLEA U310 including a combination of the following functions: traction inverter and electric motor control with gearbox, dc-dc converter control, power factor converter control, on-board charger, air compressor for fuel cell, battery management system, thermal management system with high-voltage e-compressor control, and more.

Silicon Mobility says it is the only provider to offer a complete solution combining hardware and software. Leveraging the company’s strength in control software, its future roadmap will include advanced algorithms to address model predictive control with optimized pulse pattern modulation, combined with real-time and local neuronal network acceleration or variable voltage inverter/motor control.

The OLEA U310 delivers unparalleled real-time processing, according to the vendor, enabling the implementation of the most demanding and time-constrained control algorithms for maximum efficiency in energy saving. It can control up to four traction inverters and their motor in parallel at an impressive speed of 1000-kHz field-oriented control loop with high PWM precision of hundreds of picoseconds.

The beneficial impacts on the system are multiple. In addition to the BoM reduction, early figures show up to 5% energy efficiency improvement, 25% motor downsizing for the same power, 35% less cooling need and up to 30 times passive component downsizing, according to Silicon Mobility.

Key features of this second-generation FPCU include

- 3x Cortex-R52 at 350 MHz – 2196 DMIPS
- AxEC 2.0: 2x FLUs at 175 Mhz – 400 GOPS + 9.1 GMAC
- SILant 2.0: Safe and Determinist Multi-Core/FLU
- Flexible HSM: HW & SW EVITA Full
- 8 MB of P-Flash, 256 kB of D-Flash and 1 MB of RAM

- CAN FD, CAN XL, and Ethernet
- ISO 26262 ASIL-D design ready
- ISO/SAE 21434
- AEC-Q100 Grade 1
- 292-ball BGA package

The OLEA U310 is equipped with a complete software suite from Silicon Mobility to enable the development of concurrent control algorithms for automotive power and energy application control.

OLEA COMPOSER is a design framework that seamlessly integrates with leading development tools throughout the V-Model design cycle, significantly accelerating the development process for OLEA FPCUs. It supports various simulation environments from MiL to HiL and leverages the hardware/software split within the OLEA U310 to dramatically reduce development, validation, and calibration times while achieving superior performance.

OLEA LIB is a companion software library providing engineers with a modular set of pre-built, pre-tested functional blocks (reference and target models for MATLAB and Simulink) tailored to common powertrain control tasks. These building blocks offer increasing levels of performance and content based on specific customer and application needs. Models from OLEA LIB can be directly used within OLEA COMPOSER for MiL simulations and automatic code generation, further streamlining the development process.

The OLEA U310 is available today to selective customers. For information see the OLEA U310 page or contact David Fresneau.

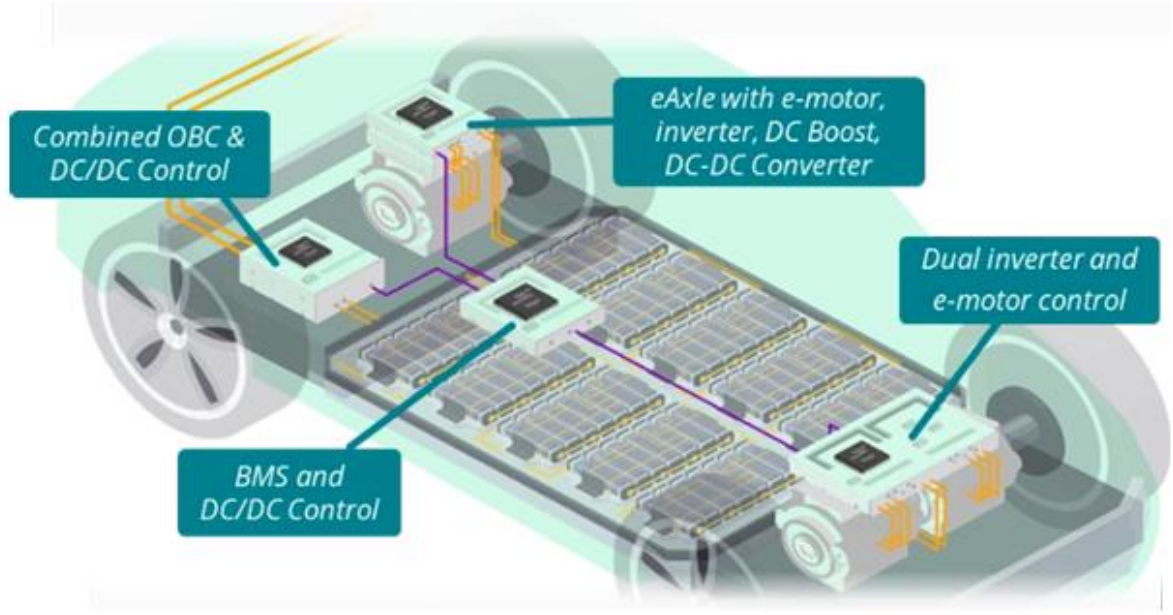

Fig. 1. Up to six standard microcontrollers can be replaced by a single OLEA U310 in a system combination where the FPCU is controlling in parallel an inverter, a motor, a gearbox, a dc-dc converter and an on-board-charger.

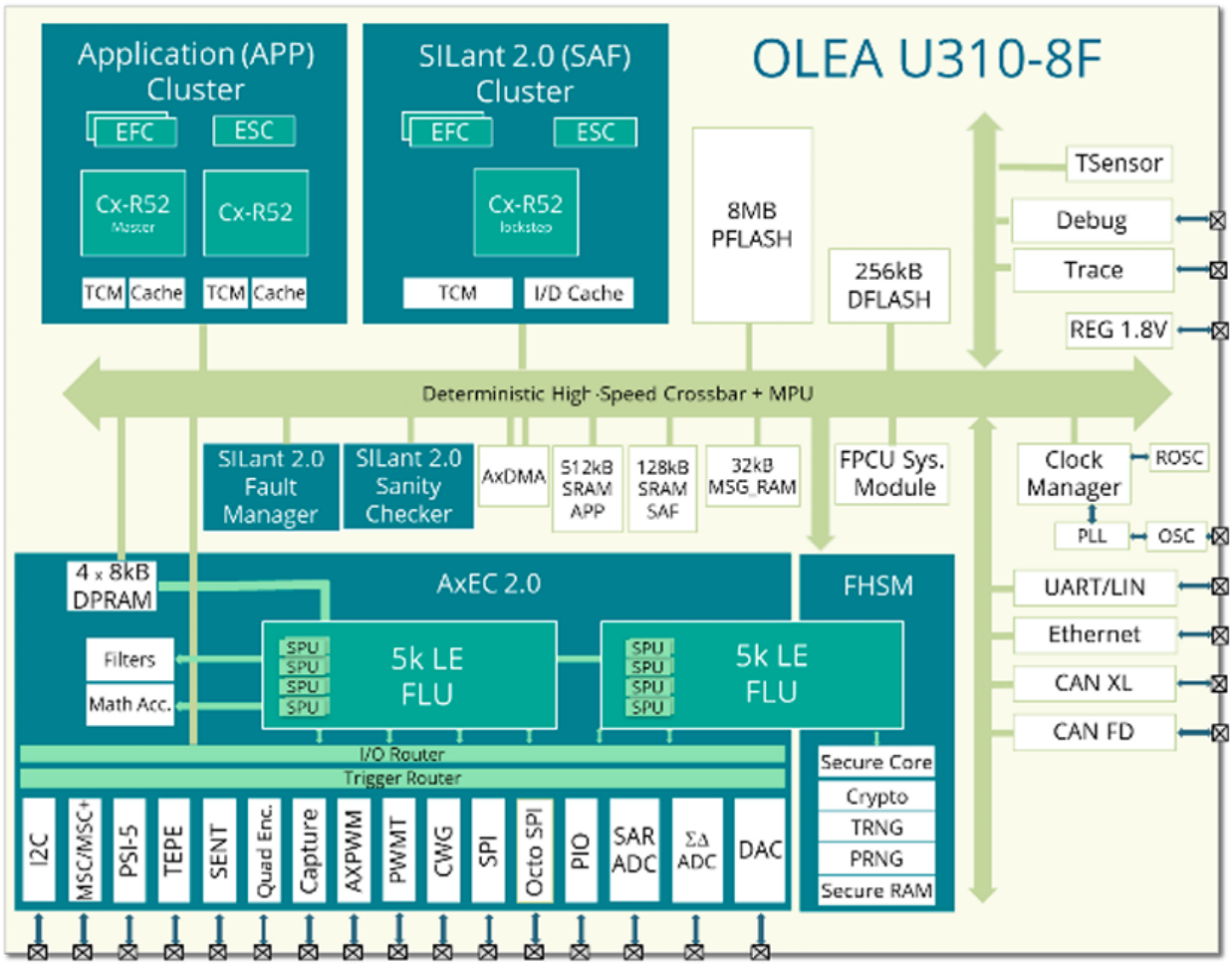

Fig. 2. The OLEA U310 is a three Cortex-R52-core controller chip which leverages its strength from three unique technologies: AxEC 2.0, SILant 2.0 and FHSM. AxEC 2.0, the Advanced execution and Events Control, is a data processing and real-time control unit based on programmable hardware and configurable peripherals supporting multiple parallel applications thanks to multi-Flexible Logic Units (FLU) clusters. SILant 2.0, the Safety Integrity Level agent, is a set of units and functionalities dedicated to the FPCU and the system functional safety ensuring ISO 26262 ASIL-D compliancy. This new generation has a deterministic multi-core and multi-FLU cluster which guarantees worst-case execution timing. FHSM, the Flexible Hardware Security Module, is a subsystem dedicated to the cybersecurity of the FPCU integrating encryption/decryption accelerators and is compliant to EVITA Full and ISO 21434. It is combined with a hardware programmable cluster to support unidentified threats and strengthen security.