Build Secured and Cost Effective Next-Generation Actuator and Sensor Applications based on the Latest E/E Architectures

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Overview

Automotive E/E architectures have undergone remarkable changes in recent years influencing actuator and sensor applications such as body control (lights, windows, and mirrors, etc.), motor control such as engine pumps and fans, and sensor control. Traditionally, these applications have used small and low-cost 16-bit microcontrollers (MCUs) but now they need more advanced 16-bit MCUs. In this white paper, we will introduce the latest 16-bit RL78/F2x3 MCUs that can respond to the changes from E/E architecture.

Challenges to E/E Architecture Change ~ Change to Brushless DC Motor

The changes in E/E architecture are driving an acceleration in the adoption of electrified vehicles (xEVs). The shift to xEVs has changed existing small motors to brushless DC motors due to low noise and the need to reduce power consumption. In general, brushless DC motor control requires high-performance processing, and 32-bit microcontrollers were the mainstream products in the past. However, the newly released 16-bit RL78/F2x MCUs are equipped with dedicated arithmetic assist hardware (Application Accelerator Unit) to reduce the software load of FOC (field-oriented control) algorithm processing used for brushless DC motor control making it possible for 16-bit microcontrollers to drive brushless DC motor control as well. The following diagram shows the improved motor control efficiency of RL78/F24 MCU compared to its previous generation.

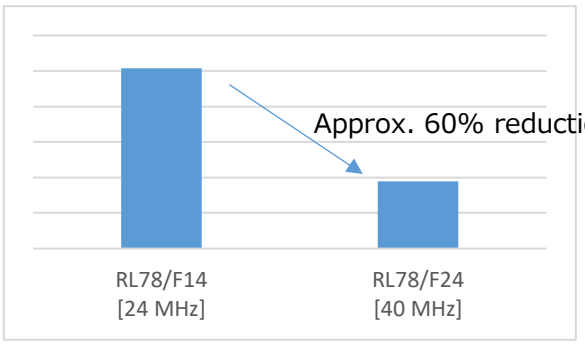

Figure 1: Brushless DC Motor Control Efficiency with RL78/F24

In addition, this Application Accelerator Unit has the functions shown in Figure 2 and can be applied to DC/DC converter control.

1. Sine operation
2. Cosine operation
3. Clarke & Park transformation
4. Inverse Park (I-Park) transformation
5. Inverse Clarke (I-Clarke) transformation
6. PI control for motor operation
7. Clarke & Park transformation and PI control for motor operation
8. I-Park & I-Clarke transformation
9. PI control for DC/DC converter control operation (1 to 3 channels)
10. Multiply 32-bit × 32-bit = 64-bit operation

Figure 2: Corresponding Computational Algorithm of Application Accelerator Unit

Challenges to E/E Architecture Changes ~ Responding to Security

As E/E architectures change, security is essential. Actuator and sensor applications that are connected to Zone and Domain systems via secured network communication are required to provide security and need to be prepared for control takeovers and software tampering by network spoofing. RL78/F2x MCUs are equipped with secure boot, encryption engine (AES-128, 192, 256), and random number generator (TRNG) functions, enabling security functions equivalent to those of Evita-Light.

Inheritance of Ultra-low Power Consumption and High Temperature Support

Regardless of the changes in E/E architectures, actuator and sensor applications must follow the same requirements. For example, low power consumption is required due to the need for control when the engine is not running on a battery, and high temperature support is required because it is mounted in the engine compartment in some applications. RL78/F2x MCUs will continue to support ultra-low power consumption and high-temperature operation that enables Ta=150°C, which have been well established since the RL78/F1x generation.

Reuse of Existing Software and Hardware Resources

In addition to ultra-low power consumption and high temperature support, RL78/F2x MCUs are the successors to RL78/F1x, allowing the reuse of RL78/F1x software and hardware resources. With brushless DC control and security support, you can efficiently and cost-effectively support next-generation development of the actuator and sensor applications.

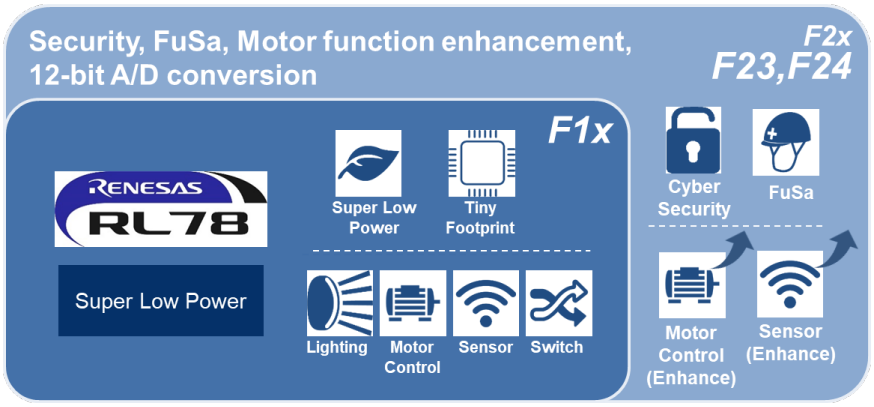

Figure 3: Scaling from RL78/F1x to F2x MCUs

Summary

The RL78/F2x 16-bit MCUs can support the next-generation development of actuator and sensor applications resulted from the changes in E/E architecture.

Renesas' extensive lineup of automotive microcontrollers enables customers to scale development with optimized systems.

References

- RL78/F24 – Ultra-low Power 16-bit MCU for Next Generation Actuator and Sensor with CAN Communication
- RL78/F24 Target Board – Easily Evaluate RL78/F2x MCUs by Connecting to On-chip Debugging Emulators
- RL78/F23 – Ultra-low Power 16-bit MCU for Next Generation Actuator and Sensor with LIN Communication

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