Renesas Synergy™ MCUs Build Foundation for Groundbreaking Integrated Hardware/ Software Platform

New family of microcontrollers combines scalability, power efficiency with extensive peripheral capabilities

THE KEY TO BUILDING a presence in a new market with an innovative new technology is to construct that technology on a solid foundation. For the Renesas Synergy Platform, that firm foundation is a new family of highly-scalable, compatible and power-efficient microcontrollers (MCUs).

Designers eying new applications in the embedded and rapidly emerging IoT market need a highly-scalable, upwardly compatible family of MCUs that combines high-efficiency with competitive price/performance characteristics.

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The Renesas Synergy MCUs are designed from the ground up to serve that purpose. Based on the ARM® Cortex®-M family CPU cores, these new microcontrollers combine extremely low power consumption with excellent deterministic behavior in a small package.

Rich Connectivity Options

The range of potential embedded applications for these new MCUs runs the gamut from simple tags designed to attach to a cow's ear to monitors in household appliances. Given the wide variety of application requirements, crafting the right MCU feature set is no small task. Some functions, however, clearly essential. One is connectivity.

Most of the MCUs in the embedded market today supply a base set of peripherals including a wide array of connectivity options. Renesas Synergy MCUs take this one step further. The top-of-the-line Renesas Synergy MCU family, for example, offers dual Ethernet with IEEE-1588 synchronization, USB HS, plus many serial interfaces including UART, IIC, SPI, IrDA, QSPI, SSI, SDHI and CAN. As embedded and IoT applications move toward the edge of the network where systems are often measuring the environment, analog interfaces play an increasingly crucial role. To meet this need, Renesas Synergy MCUs add a full array of analog-to-digital and digital-to-analog converters, analog comparators and temperature sensors. In addition, Renesas Synergy MCUs add a variety of timing functions that are typically used in motor and industrial control applications.

Scalability and Compatibility

Time to market is a huge factor in any company's success. The ability to reuse hardware and software helps design teams shorten development time. Renesas Synergy MCUs are architected from the ground-up to provide seamless scalability and peripheral compatibility among products, enabling customers to extend software reuse by using common peripherals based on a consistent memory map. MCU scalability enables customers to easily migrate from one product to another in the same family or between families. And the use of a concentric package design allows customers to easily migrate from one package to another with minimum hardware changes.

In addition, a common CPU architecture based on ARM® Cortex®-M CPU cores enables a seamless code migration across the entire Renesas Synergy MCU family. Taken together, these characteristics make Renesas Synergy MCUs a truly scalable and compatible solution, enabling customers to maximize reuse of software and hardware and, in the process, shortening development time and reducing time to market.

Focus on Security

Given the fundamental role connectivity plays in every IoT design, solutions at every level of the network are vulnerable to malicious attacks. The threats can occur at every stage of the product lifecycle. During manufacturing, a less-than-honest employee could clone firmware or the security configuration of a product. Once the product goes into the field, hackers could replace firmware with malware or exploit a software update session to inject malware into a system. And if system parameters are lost, firmware could be susceptible to an eaves-dropping attack. Clearly product designers must address a wide array of potential security concerns, not only to ensure the integrity of their product, but also to reassure prospective consumers before they invest in this new market.

Unique ID	True Random Number Gen	Crypto HASH Functions	Symmetric Key Crypto	Asymmetric Key Crypto	Secure Key Storage	Read-Out Protection
Security Software Library						

Threat	S7	S5	S3	S1
Product cloning	Best	Best	Better	Good
Product disruption with malware injection during update	Best	Best	Better	Good
Eaves-dropping during update	Best	Best	Better	Good
Privacy threat by firmware/data exposure	Best	Best	Best	Good
Add-on program to damage or steal	Best	Best	Best	Limited

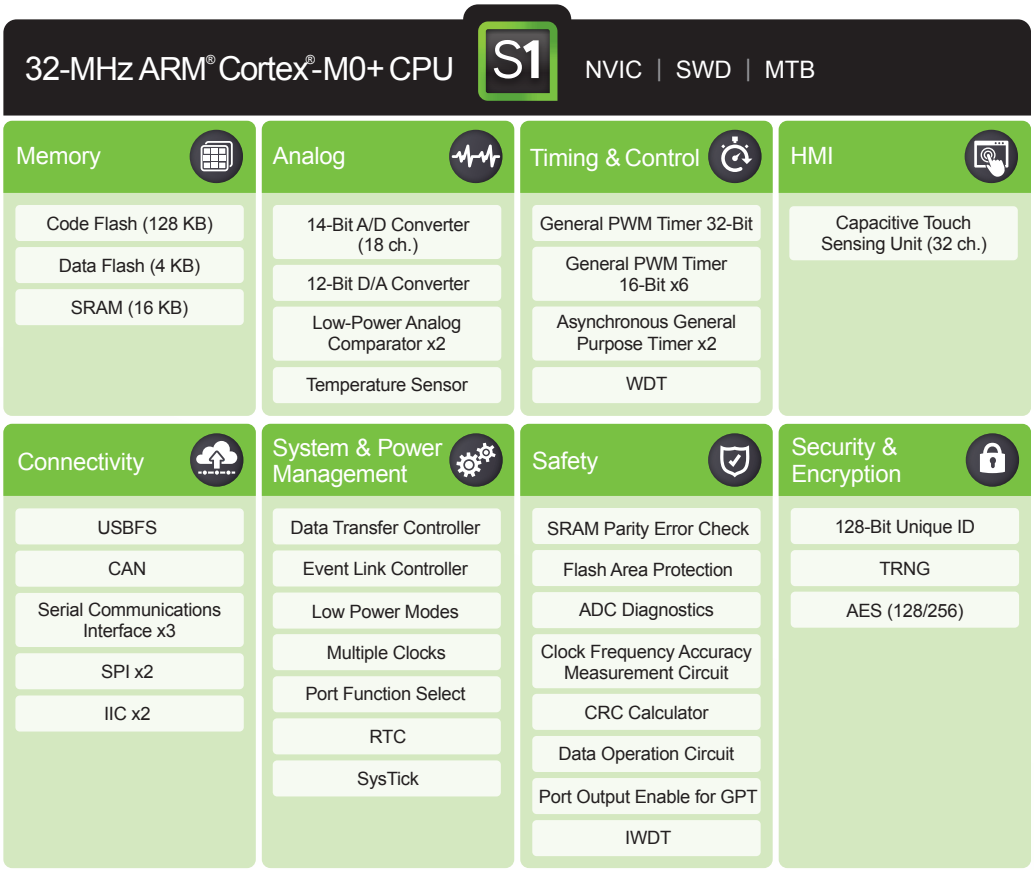
Renesas Synergy Security Protection

To protect embedded systems from these threats, Renesas Synergy MCUs add significant security capabilities in hardware where they are less susceptible to attack. As an example, when each MCU in the Renesas Synergy product line is manufactured, it is assigned a 128-bit unique ID which can be used to generate keys to protect applications and assist provisioning. Renesas Synergy includes true random number generator on a chip for use with industry standard specifications such as NIST SP800-90 recommended deterministic random bit generators (DRBGs). Many of the MCU members also feature Memory Protection Units (MPUs) that can be used to read- and write-protect an area across the entire addressable memory map. Developers can use this feature to create a secure region that is protected from access by a rogue program. They also feature hardware accelerators for symmetric cryptography, asymmetric cryptography, and HASH.

Ultra-low Power S1 Series

For the low power end of the market where many embedded and IoT solutions are expected to emerge, Renesas has selected the ARM® Cortex®-M0+ CPU core. Optimized for battery-powered applications, the ARM® Cortex®-M0+ core combines a state of the art low-power architecture with optimized low-power modes, faster wake-up time and low-power peripherals.

Utilizing these capabilities, Renesas engineers have developed the S1 Series MCUs for very low power, cost-sensitive embedded and IoT applications where developers may be considering migrating from an 8- or 16-bit solution. With these new devices, they now have access to the processing resources of a 32-bit MCU. Fabricated using a 130-nm low-power process, the S1 Series MCUs dissipate exceptionally low power in both standby and operating mode. On-chip memory for initial devices ranges up to 128 KB of Code Flash, 4 KB of Data Flash and 16 KB of SRAM.

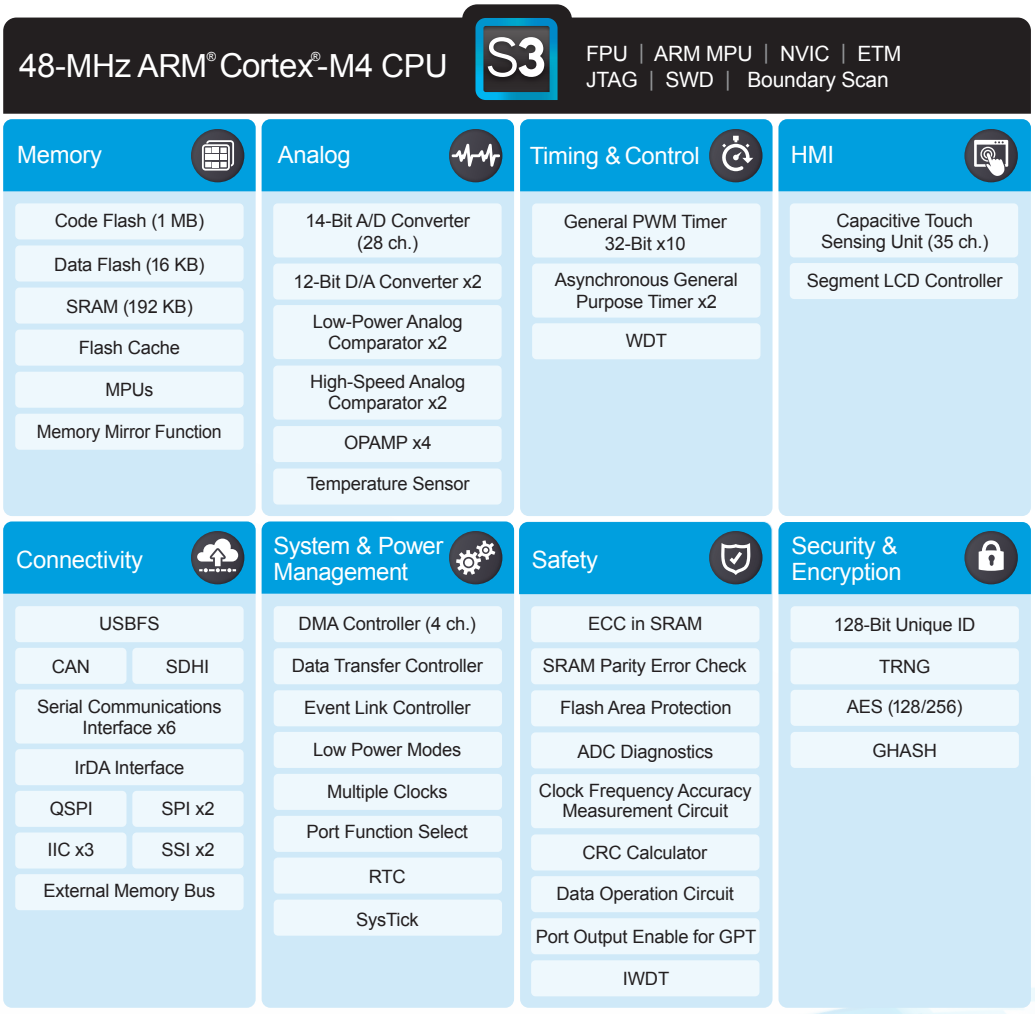


Based on the ARM® Cortex®-M0+ CPU core, Renesas Synergy S1 Series MCUs, represented here by the superset S124 device, offer an ideal solution for low power, cost-sensitive embedded and IoT applications.

High Efficiency S3 Series

S3 Series initial devices are based on a 48 MHz ARM® Cortex®-M4 CPU core and serve applications that demand higher levels of integration than the ARM® Cortex®-M0+ CPU core-based S1 Series. Fabricated using the same 130 nm low-power process used for the S1 Series, the S3 Series adds up to 124 GPIOs and larger memory resources with up to 1 MB of Code Flash, 16 KB of Data Flash and up to 192 KB of SRAM.

Emerging IoT applications require a high level of security. The S3 Series offers essential security and encryption building blocks such as GHASH, AES and True RNG. In addition, the S3 Series features a flexible Segment LCD controller and high accuracy analog peripherals such as a 14-bit A/D Converter. Finally, on-chip Operational Amplifiers and High-Speed Analog Comparators make the S3 Series MCUs an ideal solution for IoT building automation applications.

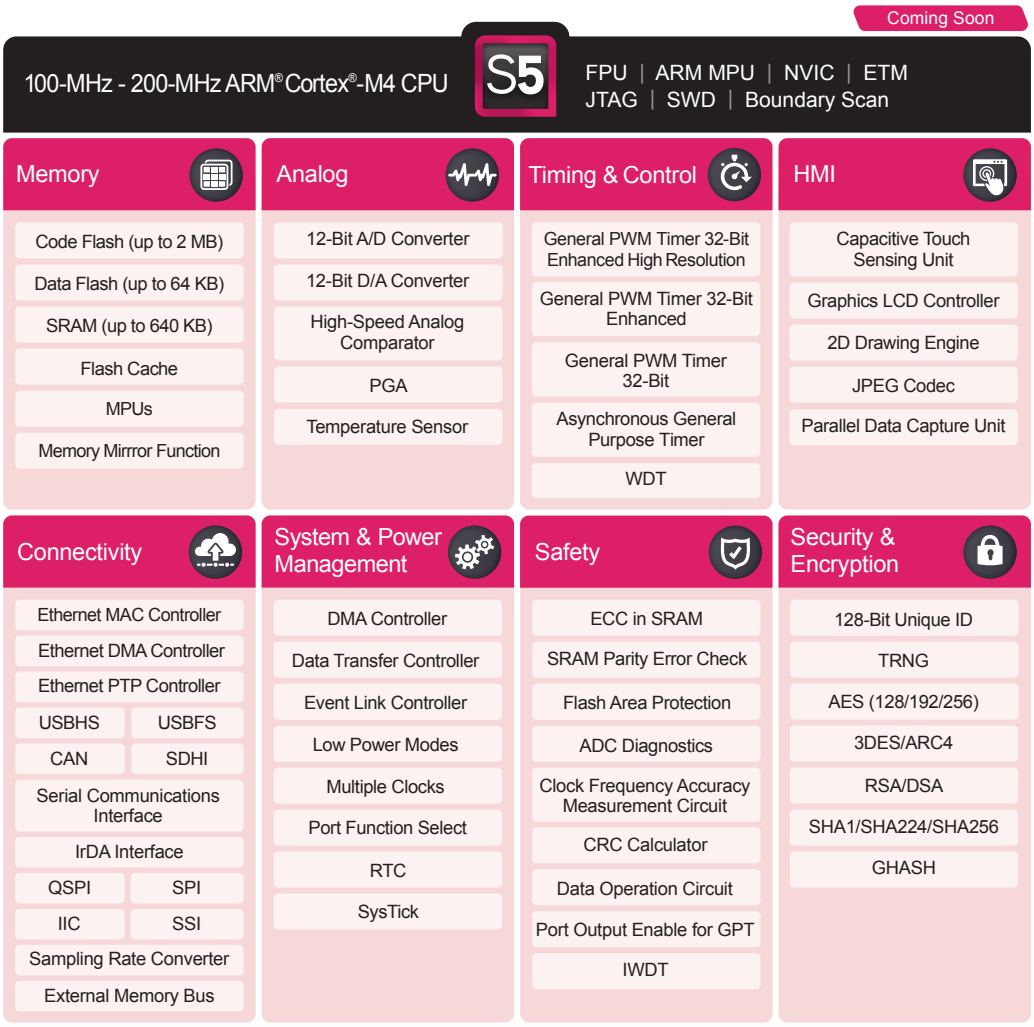


For higher levels of integration, Renesas Synergy S3 Series MCUs, represented here by the S3A7 device, offer more memory and a wider array of peripherals than the S1 Series.

High Integration S5 Series

For higher performance applications, the S5 Series MCUs use an ARM® Cortex®-M4 CPU core running at between 100 and 200 MHz. Targeted at more complex embedded applications, the S5 Series offers more memory on chip, including up to 2 MB of Code Flash, 64 KB of Data Flash and 640 KB of SRAM. These MCUs are fabricated using the same high-performance 40-nm process used for the S7 Series.

The S5 series also offers a higher level of encryption for IoT applications. These devices feature True RNG, AES, DES/ARC, RSA/DSA and Hashing functions. In addition, rich connectivity such as Ethernet Controller, USB HS and QSPI make the S5 devices ideal for economical HMI applications in the appliance market that require a Graphics LCD controller with 2D Drawing Engine and JPEG Codec.

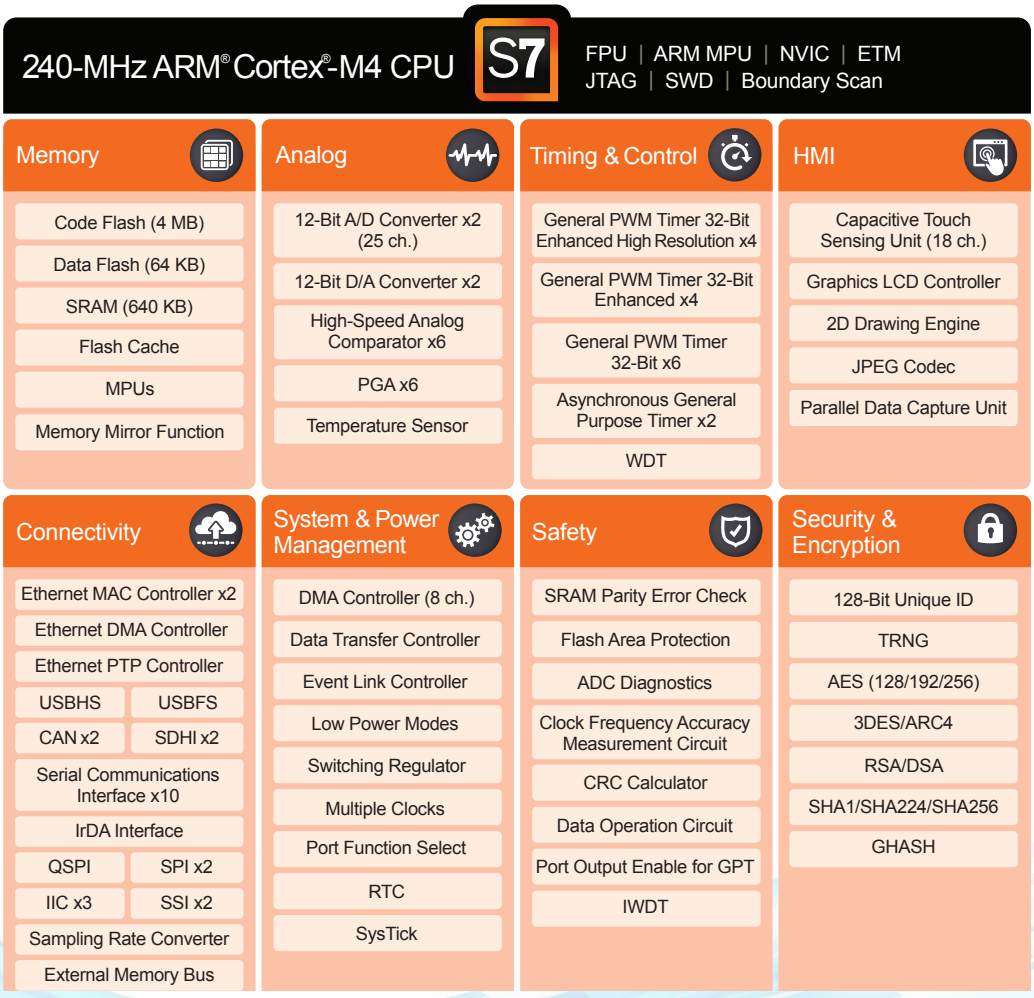


With up to 2 MB of Code Flash and an extensive array of security and connectivity capabilities, Renesas Synergy S5 Series MCUs offer an ideal platform for higher performance embedded applications. The initial S5 products are still in the planning phase at the time of this article; therefore, the individual S5 products features will be disclosed at a later date.

High Performance S7 Series

At the top end of the performance spectrum, the initial devices in the S7 Series deliver high performance using a 240 MHz ARM® Cortex®-M4 CPU core. This MCU series features a wide array of peripherals and significantly more memory on-chip including an industry-leading 4 MB of Code Flash and 640 KB of SRAM fabricated using a high-performance 40-nm process. These additional resources give embedded developers substantial new design options, particularly when their solutions require memory resources to buffer large high-speed messages, perform calculations in background, or run multiple software applications concurrently.

The S7 Series devices are ideal for applications that require a higher level of encryption and security. The MCUs feature True RNG, AES, DES/ARC, RSA/DSA and Hashing functions. In addition to superior performance, the S7 Series offer high-speed, high-precision analog interfaces such as High-Speed Analog Comparators and 12-bit A/D converters with an outstanding sampling rate of 2.5Msps. The S7 Series also feature multiple high-speed connectivity options including USB HS, Dual Ethernet Controller and QSPI. When combined with an integrated Graphics LCD Controller with a 2D Drawing Engine and a JPEG Codec, this feature set makes the S7 Series ideal for HMI, factory automation and building applications.



Based on a 240 MHz ARM® Cortex®-M4 core and featuring up to 4 MB of Code Flash, Renesas Synergy S7 Series MCUs, represented here by the superset S7G2 device, are ideal for applications that demand the highest levels of performance and security.

Conclusion

The Renesas Synergy platform promises to transform the embedded design process by eliminating many of the traditional hardware/software integration functions and freeing the designer to spend more time delivering innovation. To achieve that goal, however, embedded designers need an extensive line of compatible and scalable MCUs to maximize software and hardware re-use. By building upon the low-power advances in the ARM® Cortex®-M CPU cores and developing an extensive portfolio of connectivity, safety and security functions, the Renesas Synergy MCU family offers a comprehensive platform for building next-generation embedded and IoT solutions.