**News Release**

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**Renesas Electronics' Extreme Low-Power SOTB™ Process Technology Eliminates the Need for Batteries to Power IoT Devices**

*Ground-Breaking Energy Harvesting Embedded Controller Operates on Current Levels Not Possible with Conventional Technology*

Düsseldorf, November 14, 2018 – Renesas Electronics Corporation (TSE:6723), a premier supplier of advanced semiconductor solutions, today unveiled an innovative energy-harvesting embedded controller that can eliminate the need to use or replace batteries in IoT devices. Developed based on Renesas' breakthrough [SOTB](https://www.renesas.com/jp/en/about/press-center/news/2017/news20170608.html)™ (silicon-on-thin-buried-oxide) process technology, the new embedded controller achieves extreme reduction in both active and standby current consumption, a combination that was not previously possible to achieve in conventional microcontrollers (MCUs). These extreme low current levels of the SOTB-based embedded controller enables system manufacturers to take a step further and completely eliminate the need for batteries in some of their products through harvesting ambient energy sources such as light, vibration, and flow. The use of extreme low-power and energy harvesting gives rise to a new market of maintenance-free connected IoT sensing devices with endpoint intelligence for applications in industrial, business, residential, agricultural, healthcare, and public infrastructure, as well as health and fitness apparel, shoes, wearables, smart watches, and drones. Renesas has already begun supplying the new embedded controller to beta customers.

Renesas’ first commercial product using SOTB technology, the R7F0E embedded controller, is a 32-bit, Arm® Cortex®-based embedded controller capable of operating up to 64 MHz for rapid local processing of sensor data and execution of complex analysis and control functions. Consuming just 20 μA/MHz active current, and only 150 nA deep standby current, approximately one-tenth that of conventional low-power MCUs, these industry-leading characteristics make the R7F0E perfectly suited for extreme low-power and energy harvesting applications.

The R7F0E eliminates many challenges faced by system designers who want to build cost-effective products with efficient energy harvesting capabilities. There is a unique and configurable Energy Harvest Controller (EHC) function that increases robustness and minimizes costly external components. The EHC enables direct connection to many different types of ambient energy sources, such as solar, vibration, or piezoelectric, while protecting against harmful inrush current at start-up. The EHC also manages the charging of external power storage devices such as supercapacitors or optional rechargeable batteries. Many other system considerations for extreme low power are addressed by the R7F0E. Three such examples include the ability: (1) to sense and capture external analog signals at all times because the 14-bit Analog-to-Digital Converter (ADC) consumes only 3 uA current, (2) to retain up to 256 KB of SRAM data content while consuming just one nA per each KB of SRAM, and (3) to provide graphics data conversion including rotation, scroll, and colorization by incorporating sophisticated low-power hardware techniques for driving an external display using Memory-In-Pixel1 LCD technology that consumes virtually no power to retain an image. These few examples represent the attention to detail that designers of the R7F0E had in mind to accommodate the needs of engineers who must consider overall system requirements for extreme low power designs.

“I am very pleased that Renesas achieved this milestone to productize our SOTB technology into a first-of-its-kind solution in the energy harvesting market,” said Yoshikazu Yokota, Executive Vice President and General Manager of Industrial Solution Business Unit of Renesas. “By removing the need for batteries, or the need to replace batteries, new markets will open for us and our customers. Energy harvesting will become a mandatory technology for a smart society and Renesas is poised to lead and expand this technology, and this market. Renesas continues to push forward with e-AI to realize AI at the endpoint, in embedded devices. Looking forward, our SOTB technology will expand our reach into use cases where combining e-AI and energy harvesting will make a very large positive impact to our day-to-day lives.

**Key Features of the R7F0E Embedded Controller**

* CPU: Arm Cortex-M0+
* Operating frequency: Up to 32 MHz, and up to 64 MHz in boost mode
* Memory: Up to 1.5 MB flash, 256 KB SRAM
* Current consumption while operating at 3.0V:
  + Active: 20 µA/MHz
  + Deep Standby: 150 nA with real-time clock source and reset manager
  + Software Standby: 400 nA with retention of core logic and 32 kB SRAM data, real-time clock source, reset manager
  + SRAM data retention consumes 1nA per KB of SRAM, optionally up to 256KB
* Energy Harvesting Controller (EHC): Interface for direct robust connection to energy generating devices, and for charge management of energy storage devices
* Analog-to-Digital Converter (ADC): 14-bit, 32KHz operation frequency, 3uA consumption
* Graphics: 2D graphics data conversion and MIP display interface
* Security and Encryption: True random number generator, a unique ID for each R7F0E device, AES encryption acceleration

Originating with the new R7F0E embedded controller, Renesas will expand the line of energy harvesting solutions with varied features and functions to address many extreme low-power applications. Renesas is committed to promoting endpoint intelligence with its energy harvesting technology to realize an eco-friendly, smart society in which even higher levels of performance and functionality can be created without power supply or battery replacement issues.

**About Renesas’ SOTB process technology**

The unique SOTB process technology originated by Renesas realizes extreme reduction of both active and standby current, which has typically been a trade-off and is not possible to achieve in conventional MCU process technologies. On the silicon substrate, an oxide film (BOX: buried oxide) is buried under a thin silicon layer on the wafer substrate. No impurities are doped to the thin silicon layer which makes it possible to maintain stable operation at low voltages. The devices can therefore deliver high computing performance with excellent power efficiency. At the same time, the potential of the silicon substrate below the BOX layer is controlled with a back bias circuit to reduce leakage currents to further suppress standby power consumption.

Note 1: MIP (memory-in-pixel) LCDs are display devices that do not require power to retain a displayed image during standby, making them very well suited for extreme low power applications.

**Availability**

Samples of the new R7F0E embedded controller are available now for beta customers, and samples are scheduled to be available for general customers from July 2019. Mass production is scheduled to start from October 2019.

**Demonstration at electronica 2018**

Renesas will showcase several energy harvesting technology demonstrations featuring the new R7F0E embedded controller from November 13 to 16, at [electronica](https://electronica.de/) 2018 (Hall B4 at booth #556). Visitors can experience the new market of endpoint intelligence using energy harvesting.

For more information on the new R7F0E embedded controller, please visit <http://www.renesas.com/us/en/solutions/key-technology/sotb.html>

**Learn more about Renesas’ e-AI solutions**

Check out the new e-AI webpage: [https://www.renesas.com/en/solutions/key-technology/e-ai.html](https://www.renesas.com/jp/en/solutions/key-technology/e-ai.html).

Watch the brand-new e-AI concept video: [https://www.renesas.com/en/support/videos/e-ai-overview-video.html](https://www.renesas.com/jp/en/support/videos/e-ai-overview-video.html).

**About Renesas Electronics Corporation**

Renesas Electronics Corporation ([TSE: 6723](https://www.jpx.co.jp/english/)) delivers trusted embedded design innovation with complete semiconductor solutions that enable billions of connected, intelligent devices to enhance the way people work and live—securely and safely. A [global](https://www.renesas.com/about/company/profile/global.html) leader in microcontrollers, analog, power, SoC products and integrated platforms, Renesas provides the expertise, quality, and comprehensive solutions for a broad range of Automotive, Industrial, Home Electronics, Office Automation and Information Communication Technology applications to help shape a limitless future. Learn more at [renesas.com](https://www.renesas.com).

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