28nm process technology achieves increased capacities in on-chip flash memory in microcontrollers

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Renesas Electronics Corporation today announced that it has developed the industry's first 28-nanometer (nm) flash memory intellectual property (IP) for microcontrollers (MCUs) using a 28 nm process technology.

As engines move to even lower fuel consumption, new control mechanisms are now required to deal with the introduction of new combustion methods and further system evolution associated with downsizing. High-speed real-time processing, such as dynamically switching between multiple control algorithms according to the load in response to feedback from various sensors, will become necessary, and a performance level three to five times that will be required in automotive MCUs. Furthermore, while the number of ECUs is increasing, if we consider the limitations on power supply, such as the practice of stopping the engine when the car is temporarily stopped, it is clear that while performance must be improved, it is also necessary to reduce power consumption.

Also, due to issues such as the increasing complexity of integrating multiple MCUs and the control algorithms themselves, flash MCUs will require an increase in on-chip flash memory capacity to about three times that of previous devices. At the same time, since it is now extremely important to increase the safety and security of automotive control and of the requirements on automotive MCUs, high-level

functional safety has become critical. A new many-core architecture is now required for the inclusion of multiple dual processors operating in lock step, and for the integration of a variety of functions. In low fuel consumption engines, the processing accelerators for the injection pulse generation and signal processing required for high-precision combustion control, knock control, and cooperative control with the driving support systems that will lead to autonomous cars are now required and thus a higher integration density, that is, moving to a finer feature size fabrication process, is now indispensable.

Renesas' current 40 nm process technology supports up to 8MB of on-chip flash memory for MCUs. However, on-chip MCU flash memory modules as large as 10 MB will be required to support the increasing sophistication of the control systems implemented with MCUs.

Moving to smaller process geometry is one approach to increasing the integration density of the flash memory and peripheral functions that are integrated on a single chip. Single-chip MCUs developed using Renesas' new 28 nm process technology will be able to support a maximum capacity of over 16MB flash memory on chip.

Renesas has been moving forward with prototypes in the 28 nm process, which features even finer features than the existing 40 nm process. In the latest prototype chip, Renesas was able to achieve a high-speed readout operating clock frequency of 160 MHz, a data retention time of 20 years, and a rewrite cycle count of 250,000 cycles (for data storage). Although it becomes increasingly difficult to maintain flash memory performance and reliability as feature sizes are reduced, Renesas succeeded in creating this prototype by taking advantage of the scalability of the MONOS (Note 1) structure flash memory, which made it possible to increase both the capacity and the performance of the memory integrated in flash MCUs. Renesas' MONOS technology for MCUs has achieved a superb track record through the company's 40 nm

process generation.

The new 28nm flash memory IP for MCUs offers design benefits for automotive and other industries with high-reliability criteria. For example, in the ADAS (advanced driving assistant system) field, the increased memory capacity and performance will make it possible to support complex data processing for 3D radar to increase the safety of automotive. Furthermore, in the power train area, this new technology will enable an even finer-grained control of fuel injection and ignition through increases in the amount of mapping data used for fuel injection and increased data processing capability. This will contribute not only to increased fuel efficiency, but also to reduced environmental and energy challenges. Additionally, by adopting a 28 nm process, it will be possible to reduce current consumption.

Renesas will accelerate their development of 28 nm process automotive flash MCUs for commercial release to support needs for high-speed readout, high reliability, and larger capacities—a maximum capacity of over 16 MB.

Renesas already leads the industry in mass producing flash MCUs and has contributed to the wider adoption of flash MCUs in a wide range of industries, including automotive, consumer, and industrial. Renesas grasped the trend towards higher reliability and increased integration densities early on, and deployed the MONOS structure flash memory, which is comparatively easy to adapt to finer feature size processes, in 150 nm process MCUs in 2004, in 90 nm MCUs in 2007, and in 40 nm MCUs in 2012. In addition, Renesas was the first semiconductor manufacturer to ship flash MCU samples from 90nm generation onward while scaling the process technology.

Key features of the 28 nm on-chip flash memory IP:

(1) Verified high-speed readout

In the prototype chip, Renesas achieved a readout speed of 160 MHz (as compared to 120 MHz in Renesas 40 nm process devices) from program storage flash memory. This will make it possible for MCU products based on the 28 nm technology to implement complex real-time processing, such as engine control.

(2) Verified high reliability

The new IP maintains the 20-year data retention time, which is crucial for automotive MCUs, and achieves a rewrite cycle count of 250,000 times when used as data storage flash memory, which is also the same as that of Renesas 40 nm process devices.

(3) Possible to include large capacity Flash

When 28 nm process flash MCUs are fabricated using this flash memory, it will be possible to include a maximum capacity of over 16 MB on a single chip.

Moving to a finer process also enables about twice as many high-speed/low-power transistors to be included in the logic blocks compared with the earlier Renesas 40 nm process. This makes it possible to develop MCUs that include support for multiple CPU cores, functional safety and security, and multiple interface standards, and enables the integration of the automotive electronic control unit (ECU).

Now, Renesas has completed the development of the industry's first 28 nm process on-chip flash memory IP for MCUs based on the expertise accumulated over many years and its experience in reducing feature sizes to the 40 nm process. This development will make it possible for

Renesas to be the first to create 28 nm flash MCUs for automotive applications, Renesas will be able to deliver increased memory capacities and improved processing performance in conjunction with the finer feature sizes in the logic circuits other than flash memory circuits.

Provided by Renesas Electronics