Overview

Changes in the E/E architecture of automotives are also driving various changes in vehicle components (ECU). Particularly, BEV (Battery Electric Vehicle) compatible vehicles have increased the coverage of electronic control. The number of electronically controlled components has increased significantly. On the other hand, it is difficult to significantly increase the battery system capacity for vehicle system control from a cost perspective. Therefore, the power consumption allowed for each electronic control component must be reduced.

This white paper introduces a low-power system that utilizes Renesas’ new RH850/F1KM-S2 microprocessor, using the zone system as a theme.

Issue caused by the increase in the number of electronic control units per vehicle

Looking at the time frame from CY2019 to CY2029, the growth rate of gross vehicle production is expected to be 1.1 times, while the growth rate of electronic control components per vehicle is expected to be 2.4 times. One of the main reasons for this gap is the upgrade of power supply and communication networks of the entire vehicle based on zoning. In the upgrade, since it is necessary to update the electronic control of the entire system, the conventional electronic control unit has been revised and sensors have been added, and the number of electronic control units per vehicle has been increasing remarkably. On the other hand, since it is difficult to make a major upgrade of the power supply (battery) for electronic control systems, which is separate from the battery for driving electric motors, it is important to reduce the power consumption of each electronic control unit, which is increasing.

Figure 1: Growth of the automotive market and the increase in automotive electronic control units
Reduced power consumption of Zone ECUs

In the evolution of E/E architecture, systems that match the physical arrangement of electronic control units, called zone systems, is increasing due to the upgrade of the power supply network and communication network of the entire vehicle. Among them, the Zone ECU serves as a relay point for the vehicle system and power control network. Use cases include relaying control information between the central ECU and actuator via communication and controlling actuator operation and power supply systems. Therefore, as a Zone ECU, it is required to operate when performing communication and control operations, and to operate idly by, for example, when not boarding. In all cases, low power consumption is an issue.

The RH850/F1KM-S2 series solves this problem. Like previous RH850/F1Kx products, the RH850/F1KM-S2 series has excellent low power consumption performance during operation and standby, and meets Evita-Medium’s security requirements, solving the issues of Zone ECUs.

As an example, user can achieve power reduction using LPS (Low Power Sampler) installed in the RH850/F1x series. LPS is a hardware sequencer that controls the wake-up signal to return to the RUN state by further offloading the CPU during the low-power mode to compare the A/D conversion result with the expected value to maintain low power consumption.

![Figure 2: Reducing power consumption by LPS at low power consumption](image)

Examples of specific reduction effects are shown. Although it depends on the frequency and time of intermittent operation, in the case of confirming the wake-up request (returning to the RUN state from the low power consumption mode) every 10 msec (conditions such as voltage are the same), when compared with or without LPS utilization,

- Intermittent operation of RUN⇒DeepSTOP only : 560 [mA/sec]
- Intermittent operation with RUN⇒DeepSTOP⇒LPS : 96 [mA/sec]

This has the effect of further reducing power consumption by more than 80% in low-power mode.
RH850/F1Kx series meets diverse market needs

The RH850/F1Kx series, including the RH850/F1KM-S2, is a product group that can meet the various needs of automotive microcontrollers. With a rich combination of Flash/RAM size, CPU performance, various communication interfaces, security, and packaging, customers can choose the most suitable product to build their system.

<table>
<thead>
<tr>
<th>Code Flash</th>
<th>Data Flash</th>
<th>Product</th>
<th>1M</th>
<th>1M</th>
<th>1M</th>
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<td>256K</td>
<td>F1KH-D8</td>
<td>512K</td>
<td>512K</td>
<td>512K</td>
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<tr>
<td>6M</td>
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<td></td>
<td>384K</td>
<td>384K</td>
<td>384K</td>
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<tr>
<td>4M</td>
<td>128K</td>
<td>F1KM-S4</td>
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<td>256K</td>
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<tr>
<td>3M</td>
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<td>192K</td>
<td>192K</td>
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<td></td>
<td>F1KM-S2</td>
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<td>128K</td>
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<tr>
<td>1M</td>
<td>64K</td>
<td>F1KM-S1</td>
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<td>96K</td>
<td>96K</td>
<td>96K</td>
</tr>
<tr>
<td>512K</td>
<td></td>
<td>F1KM-S1</td>
<td>64K</td>
<td>64K</td>
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Figure 3: RH850/F1Kx series lineup

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<thead>
<tr>
<th>ITEM</th>
<th>F1KH-D8</th>
<th>F1KM-S4</th>
<th>F1KM-S2</th>
<th>F1KM-S1</th>
<th>F1K</th>
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<tbody>
<tr>
<td>Code Flash Size</td>
<td>6/ 8 MB</td>
<td>3/ 4 MB</td>
<td>2 MB</td>
<td>512/ 768 KB</td>
<td>768 KB</td>
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<tr>
<td>Data Flash Size</td>
<td>256 KB</td>
<td>128 KB</td>
<td>128 KB</td>
<td>64 KB</td>
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<tr>
<td>RAM</td>
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</tr>
<tr>
<td>Local RAM</td>
<td>320/ 384 KB</td>
<td>192/ 256 KB</td>
<td>128 KB</td>
<td>32/ 64/ 96 KB</td>
<td>32/ 64/ 96 KB</td>
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<tr>
<td>Global RAM</td>
<td>512/ 576 KB</td>
<td>128/ 192 KB</td>
<td>96 KB</td>
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<tr>
<td>Retention RAM</td>
<td>64 KB</td>
<td>64 KB</td>
<td>32 KB</td>
<td>32 KB</td>
<td>64 KB</td>
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<tr>
<td>Pin Count</td>
<td>176/ 233/ 324</td>
<td>100/ 144/ 176/ 233/ 272</td>
<td>100/ 144/ 176/ 233/ 272</td>
<td>48/ 80/ 100/ 144/ 176/ 233/ 272</td>
<td>100/ 144/ 176/ 233/ 272</td>
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<td>G3KH x2</td>
<td>G3KH x2</td>
<td>G3KH x2</td>
<td>G3KH x2</td>
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<tr>
<td>CPU Frequency (Max.)</td>
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<td>2400MHz x2</td>
<td>2400MHz x2</td>
<td>80/ 120MHz x2</td>
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<td>Clocked Serial Interface G</td>
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<td>Max. 4ch</td>
<td>Max. 4ch</td>
<td>1ch</td>
<td>Max. 2ch</td>
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<tr>
<td>Clocked Serial Interface H</td>
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<td>4ch</td>
<td>4ch</td>
<td>Max. 4ch</td>
<td>4ch</td>
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<tr>
<td>CAN Interface</td>
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<tr>
<td>RS CAN</td>
<td>—</td>
<td>—</td>
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<tr>
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<td>8ch</td>
<td>Max. 6ch</td>
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<td>LIN/UART Interface (RLIN3)</td>
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<td>Max. 8ch</td>
<td>Max. 8ch</td>
<td>Max. 4ch</td>
<td>Max. 6ch 2)</td>
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<td>LIN Master Interface (RLIN2)</td>
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<td>Max. 12ch</td>
<td>Max. 10ch</td>
<td>Max. 3ch</td>
<td>Max. 10ch</td>
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<td>I2C Interface (RIIC)</td>
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<td>2ch</td>
<td>2ch</td>
<td>2ch</td>
<td>1ch</td>
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<td>FlexRay</td>
<td>2ch(Ach,Bch)</td>
<td>2ch(Ach,Bch)</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
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<td>Ethernet AVB (MII)</td>
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<td>1ch</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>Single Edge Nibble Transmission (SENT)</td>
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<td>Max. 2ch</td>
<td>Max. 2ch</td>
<td>2ch</td>
<td>n/a</td>
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<tr>
<td>External memory I/F (MEMC)</td>
<td>Included (176pin and up)</td>
<td>Included (144pin and up)</td>
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<tr>
<td>Serial Flash Memory I/F (SFMA)</td>
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<tr>
<td>Security</td>
<td>ICUS: SHE/EVITA-Light equivalent</td>
<td>ICUM</td>
<td>ICUM</td>
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</tr>
</tbody>
</table>

1) n/a: Not applicable
2) 1ch: One channel

Figure 3: RH850/F1Kx series lineup
Solutions for Power Consumption Increase Issues Associated with E/E Architectures Evolution.

Summary
In this white paper, we introduced the RH850/F1KM-S2 power consumption reduction and the RH850/F1Kx series for Zone ECUs.

Renesas’ extensive lineup of automotive microcontrollers contributes to the construction of optimal systems for customers.

References
Renesas’ RH850 Automotive MCUs: Unleashing Next-Gen Performance, Safety, and Reliability | Renesas – RH850 family Introduction.

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