

Solutions for Power Consumption Increase Issues Associated with E/E Architectures Evolution

High Performance Computing, Analog & Power Solutions Group

Renesas Electronics Corporation

Minoru Uemura

Overview

Changes in the E/E architecture of automobiles 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.

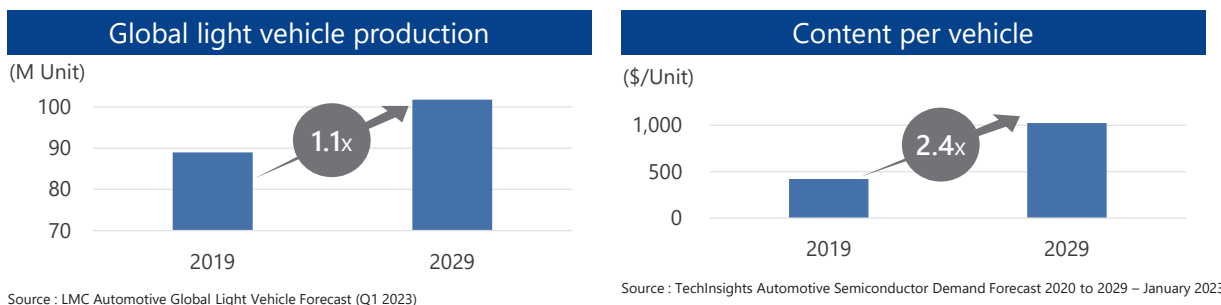


Figure 1: Growth of the automotive market and the increase in automotive electronic control units

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.

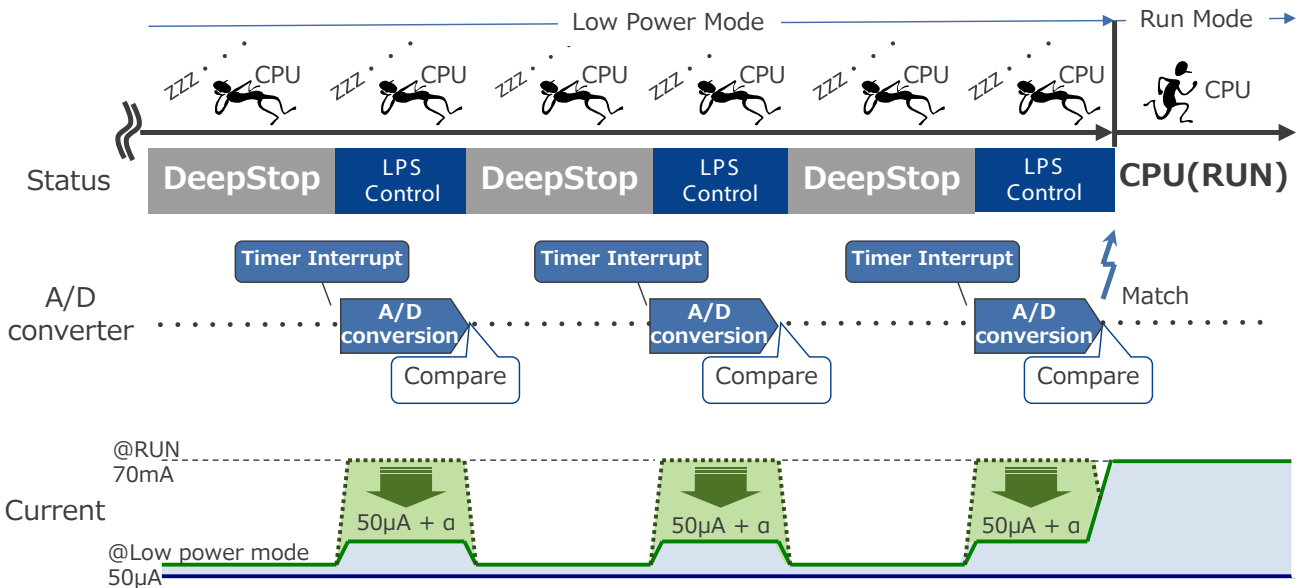


Figure 2: Reducing power consumption by LPS at low power consumption

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.

Code Flash	Data Flash	Product												
8M	256K	F1KH-D8				1M	1M			1M				
6M						896K	896K			896K				
4M	128K	F1KM-S4				512K	512K	512K	512K	512K				
3M		F1KM-S2				384K	384K	384K	384K	384K				
2M		64K	F1K				256K	256K	256K					
1.5M				192K	192K	192K								
1M				160K	160K	160K								
768K	F1KM-S1			128K	128K	128K	128K							
	F1K						96K	96K						
512K	F1KM-S1	96K	96K	96K	96K									
			64K	64K	64K	64K								
			48	64	80	100	144	176	233	272	324			
									Window shows RAM size					
									LQFP			FPBGA		

Figure 3: RH850/F1Kx series lineup

ITEM		F1KH-D8	F1KM-S4	F1KM-S2	F1KM-S1	F1K
Code Flash Size		6/ 8 MB	3/ 4 MB	2 MB	512/ 768 KB 1 MB	768 KB 1/ 1.5/ 2 MB
Data Flash Size		256 KB	128 KB	128 KB	64 KB	64 KB
RAM	Local RAM	320/ 384 KB	192/ 256 KB	128 KB	32/ 64/ 96 KB	32/ 64/ 96 128 KB
	Global RAM	512/ 576 KB	128/ 192 KB	96 KB	—	—
	Retention RAM	64 KB	64 KB	32 KB	32 KB	64 KB
Pin Count		176/ 233/ 324	100/ 144/ 176/ 233/ 272	100/ 144/ 176	48/ 64/ 80/ 100	100/ 144/ 176
CPU Core		G3KH x2		G3KH		
CPU Frequency (Max.)		240MHz x2	240MHz	240MHz	80/ 120MHz	80/ 120MHz
Clocked Serial Interface G (CSIG)		5ch	Max. 4ch	Max. 4ch	1ch	Max. 2ch
Clocked Serial Interface H (CSIH)		5ch	4ch	4ch	Max. 4ch	4ch
CAN Interface	RS CAN	—	—	—	—	Max. 7ch ¹⁾ Max. 1ch ²⁾
	RS CANFD	Max. 12ch	8ch	8ch	Max. 6ch	n/a ¹⁾ 6ch ²⁾
LIN/UART Interface (RLIN3)		8ch	Max. 8ch	Max. 8ch	Max. 4ch	Max. 6ch
LIN Master Interface (RLIN2)		Max. 16ch	Max. 12ch	Max. 10ch	Max. 3ch	Max. 10ch
I2C Interface (RIIC)		2ch	2ch	2ch	2ch	1ch
FlexRay		2ch(Ach,Bch)	2ch(Ach,Bch)	n/a	n/a	n/a
Ethernet AVB (MII)		Max. 2ch	1ch (176pin以上)	n/a	n/a	n/a
Single Edge Nibble Transmission (SENT)		2ch	Max. 2ch	Max. 2ch	2ch	n/a
External memory I/F (MEMC)		Included	Included (176pin and up)	n/a	n/a	n/a
Serial Flash Memory I/F (SFMA)		Included	Included (144pin and up)	Included (144pin and up)	n/a	n/a
Security • ICUS: SHE/EVITA-Light equivalent • ICUM: EVITA-Mid equivalent		ICUM	ICUM	ICUM	ICUS	ICUS

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.](#)

IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES ("RENESAS") PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers skilled in the art designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only for development of an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third-party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising out of your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale, or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu, Koto-ku, Tokyo 135-0061,
Japan
<https://www.renesas.com>

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
<https://www.renesas.com/contact-us>

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.