RENESAS

Renesas Microcomputer

32-bit All Flash
V850E, V850ES Microcontrollers

Empower your
creativity

V850

ALL FLASH

Flash

Shifting to **All Flash**

All of Renesas Electronics' 32-bit general-purpose microcontrollers are provided with on-chip flash memory.

Shifting to All Flash is bringing
about a manufacturing revolution.

Shifting to All Flash means switching the entire lineup of microcontrollers offered by Renesas Electronics to flash memory products.
All Flash contributes to improved development efficiency, improved quality, and improved system competitiveness due to reduced costs.
The V850 All Flash lineup includes the V850E2/MN4[1] which boasts a world-beating performance of 1024 MIPS when operating at 200 MHz[2].
The lineup also includes the V850ES/Jx3-L, which consumes even less power than a 16-bit microcontroller; the V850ES/Jx3, which features a large-capacity ROM for future peace of mind; the V850ES/Jx3-U with an on-chip USB host controller; the V850E/Ix4 and V850E/Ix4-H, which include an inverter controller; and the V850ES/Jx3-E, which supports Ethernet.
User-friendly development environments that only users of All Flash microcontrollers can experience are also provided.
By offering a lineup of products and environment resources that allow full use of the merits of flash memory products, namely stock reduction, fast delivery, and flexible adaptation to fluctuations in demand, Renesas Electronics is helping to bring about a manufacturing revolution for customers.

Note 1. Figures apply to the μPD70F3514 and 70F3515 with on-chip dual-core CPUs.
2. Dhrystone 2.1

All Flash

H 5 V operation & on-chip multi-channel A/D converter

V850ES/HE3	V850ES/HF3	V850ES/HG3	V850ES/HJ3
64-pin	80-pin	100-pin	144-pin

I 5 V inverter control support & on-chip A/D converter for simultaneous sampling of two circuits

		V850E/IG4-H	V850E/IH4-H
		V850E/IG4	V850E/IH4
V850ES/IE2	V850E/IF3	V850E/IG3	
64-pin	80-pin	100-/161-pin	128-pin

J 3 V operation & on-chip multi-channel serial interfaces: USB, CAN, Ethernet support

		V850ES/JE3-E	V850ES/JF3-E	V850ES/JG3-E	V850ES/JH3-E	V850ES/JJ3-E
				V850ES/JG3-U	V850ES/JH3-U	
V850ES/JC3-H	V850ES/JE3-H			V850ES/JG3-H	V850ES/JH3-H	
				V850ES/JG3		V850ES/JJ3
V850ES/JC3-L	V850ES/JE3-L	V850ES/JF3-L		V850ES/JG3-L		
40-/48-pin	64-pin	80-pin		100-/113-/121-pin	128-pin	144-pin

M High-performance CPU, large-capacity flash memory, USB, CAN and Ethernet Support

V850E2/MN4
304-pin

Application examples

All Flash microcontrollers are suitable for systems that use 16-bit microcontrollers and 32-bit microcontrollers, and add value to these systems.

Cameras
Digital still cameras, digital video cameras, SLR cameras

Industrial equipment
Industrial motors, control equipment, vending machines, power meters

Portable devices
PDAs, IC recorders

Home appliances
Air conditioners, refrigerators, washing machines, microwave ovens

Computer peripherals
LBP, PPC, MFP, inkjet printers, scanners, and fax machines

Audio
Portable audio, component stereo systems, home theater equipment

Video and recording equipment
Blu-ray players, Blu-ray recorders, industrial cameras

Other
Electronic instruments, electric bidets, toys, learning devices, remote controllers, etc.

Providing flash microcontrollers is one way that Renesas Electronics contributes to reforming the consumer supply chain.

ALL FLASH

Flash microcontrollers offer overwhelming advantages.

Compared to mask ROM microcontrollers, flash microcontrollers definitely contribute to speeding up system development. Microcontrollers can be ordered before program completion and programs can be written even after the microcontroller has been mounted on the board. Microcontroller order placement and program development can therefore be done concurrently, allowing TAT to be shortened as a result.

In addition, when flash microcontrollers are used for products with many different versions or that are localized for specific regions, the cost of ordering mask ROM microcontrollers is eliminated and purchase and stock management costs can be slashed.

● For software designers
Software development | Hardware development | Ordering | Production

Software can be changed just before mass production starts and development TAT can also be shortened.

Use of mask ROM microcontrollers: Mask → Software development → Evaluation → Ordering → Fabrication → Evaluation → Mass production

Use of All Flash microcontrollers: All Flash → Software development → Evaluation → Mass production / Ordering — Shortening of TAT
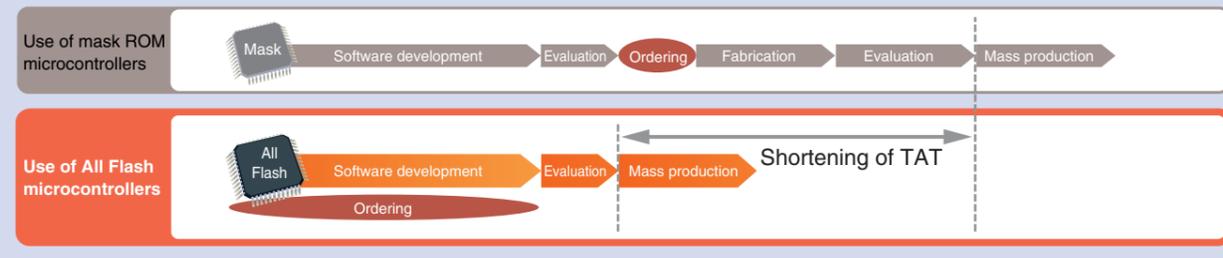
Since mask ROM microcontrollers cannot be ordered until their specifications are finalized, last-minute software changes can be problematic. On the other hand, specifications for flash microcontrollers can be changed just prior to the start of mass production. Thus orders for flash microcontrollers can be placed while the software is still being developed, allowing the development TAT to be shortened.

● For hardware designers
Software development | **Hardware development** | Ordering | Production

Mass-produced flash microcontrollers require evaluation only once, reducing development man-hours.

Use of mask ROM microcontrollers: Development and evaluation of flash microcontrollers → Mass production of flash microcontrollers; Development and evaluation of mask ROM microcontrollers → Mass production of mask ROM microcontrollers

Use of All Flash microcontrollers: Development and evaluation of flash microcontrollers → Mass production of flash microcontrollers — Man-hours required for development reduced by half.

In the case of mass-produced mask ROM microcontrollers, evaluations of both flash microcontrollers and mask ROM microcontrollers are required.
Since evaluated flash microcontrollers can be directly mass-produced, the man-hours required for development are reduced by half, resulting in greatly shortened development TAT.

● For purchasing divisions
Software development | Hardware development | **Ordering** | Production

Flash microcontrollers protect you from fluctuations in demand and can reduce dead stock.

	Predicted demand	Over stock or shortage	Reordering and dead stock

Use of mask ROM microcontrollers: Set A / Set B (Over stock) → Set A / Set B (Shortage) → Software changes → Set B' (Dead stock Set B)

Start of manufacturing — Demand fluctuations — Software changes — Product cycles

Use of All Flash microcontrollers: Set A / Set B → Set A / Set B (No over stock and no shortage) → Software changes → Set B' (No reordering required / No dead stock)

The demand prediction burden is reduced because a blanket order can be placed.

Can be used for other products to compensate for shortages.

No reordering is required even when software is changed, allowing you to start manufacturing immediately without having dead stock.

Mass-produced mask ROM microcontrollers may become dead stock as the result of changes in software or fluctuations in demand. On the other hand, flash microcontrollers can be mass-produced immediately after software changes and used for other products, resulting in fewer lost opportunities, less dead stock, and lower ordering costs.

● For manufacturing divisions
Software development | Hardware development | Ordering | **Production**

Parts sharing makes production planning easier and boosts production efficiency.

Use of mask ROM microcontrollers: Mask, Mask, Mask → Assembly (using several types) → Set A, Set B, Set C

Use of All Flash microcontrollers: All Flash → Assembly (using one type only) → Set A, Set B, Set C
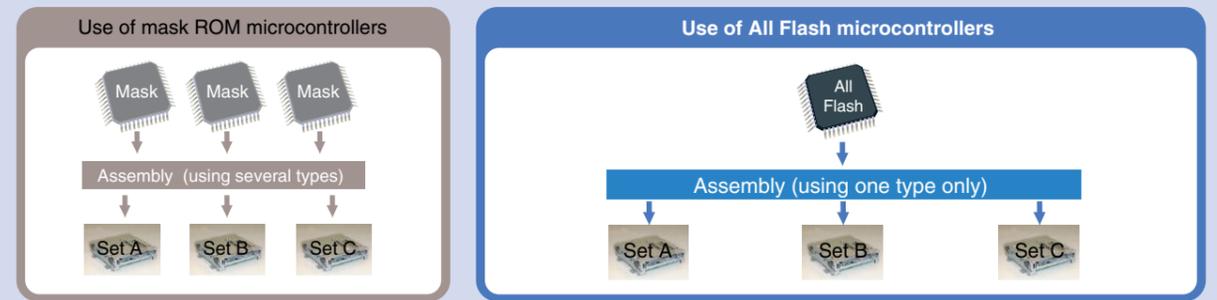
In the case of mass-produced mask ROM microcontrollers, the use of different software for different products necessitates the use of a different microcontroller for each type of product. In contrast, mass-produced flash microcontrollers facilitate the sharing of parts since they can be used for various products by simply rewriting the software.

Worried about taking the first step?
V850 All Flash puts you at ease.

ALL FLASH

Use new products with confidence

For applications with large-scale programming and complicated systems, the development burden is heavy, so anxiety is even greater when it comes to using a new product. V850 All Flash eliminates the anxiety of using a new product, because Renesas Electronics reviews not only products themselves, but all other related aspects, including development, production, and distribution.

Large selection

149 models available

A total of 149 32-bit flash microcontroller models are available to meet all your needs.

With memories of from 16 to 2048 KB, and packages of 40 to 304 pins, the ideal product for your application can be selected from our extensive product lineup, according to the required voltage range or processing performance.

The 40-pin package is a thin and small WQFN just 6 mm x 6 mm in size and 0.75 mm thick. This package is approximately 46% thinner and 82% smaller than our conventional 32-bit microcontroller package (which is a 100-pin LQFP with a size of 14 mm x 14 mm), helping you reduce the size of your set.

ROM size (bytes)

V850ES/Hxx
V850ES/Ixx or V850E/Ixx or V850E/Ixx-x
V850ES/Jxx or V850ES/Jxx-x
V850E2/MN4

RAM size (bytes)
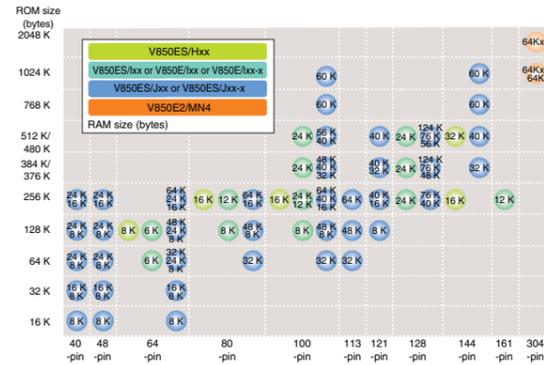
Specialized lineup

Products ideally suited to specific applications

Renesas Electronics provides a range of products ideally suited to developing specific applications. These products include the V850ES/Jx3-H and V850ES/Jx3-U, which feature USB 2.0 communication capability and require only the internal ROM and RAM to develop applications requiring USB connectivity; the V850ES/Jx3-E, which includes an on-chip Ethernet controller enabling remote and monitoring control; and the V850E/Ix4 and V850E/Ix4-H, which feature a faster CPU—100 MHz—and fine-grained inverter control.

V850ES/Jx3-H, V850ES/Jx3-U
(portable POS terminals, printers, scanners)

V850ES/Jx3-E
(factory automation equipment, building management systems)

V850E/Ix4, V850E/Ix4-H, V850E/Ix3
(inverter air conditioners)

High performance

All Flash microcontroller with dual-core 32-bit CPU boasting world-beating performance (V850E2/MN4)

We have now developed the V850E2M, an ultra-fast CPU core based on the high-performance V850E2 (with 2-way parallel superscalar architecture and a 7-stage pipeline) but featuring faster conditional branch instruction execution and a new variable-step division instruction to enable high-speed division calculations. The V850E2M realizes an outstanding performance of 2.56 MIPS/MHz-close to 1.4 times faster than our other cores when operating at the same frequency.

The V850E2/MN4 lineup features products that incorporate two of these ultra-fast CPU cores to enable a world-beating performance of 1024 MIPS when operating at 200 MHz. Our dual-core microcontrollers also consume only 0.88 mW/MIPS-60% of the power of single-core products-and provide a wide range of on-chip peripherals, letting you build smaller systems with fewer components.

MIPS performance Dhrystone 2.1
(Comparing single-chip microcontrollers)

MIPS		
Company A 120MHz	Company B 264MHz	Renesas Electronics V850E2/MN4 200MHz
150	600	1024

High reliability

Software protection based on experience, technology and strong security features

All our products reflect the experience we have gained in supplying more than 2 billion microcontroller units (as of May, 2010) for more than 1,000 types of applications, and the technology we have developed for flash microcontrollers for the automotive field. Our products also provide features that disable reading and malicious software rewriting and erasing, thus offering maximum protection of your valuable software.

Cumulative shipment total: More than 2,000,000,000 units

Supportive environment for development

We make development easier

Renesas Electronics has released the Cube-Suite® integrated development platform, an easy-to-use and convenient development environment. CubeSuite can be used to compile and debug programs, manage pin layouts, generate code for microcontroller peripherals, and execute high-speed building.

Use CubeSuite in combination with MINI-CUBE2—an on-chip debug emulator with programming capability—to create a powerful environment that enables fast and accurate system development.

■ **Top screen**

■ **Code generated easily**

CubeSuite automatically generates source code (a device driver program) to control the microcontroller peripherals (such as the timers, UART, and A/D converter).

Mass production support

In addition to a full range of writing tools, writing services are also provided.

Numerous writing tools are provided not only by Renesas Electronics, but also by our partner companies, so programs can be easily written in nearly any situation, such as at development locations and on production lines. Furthermore, our partners, both overseas and in Japan, offer writing services for post-shipment mass-quantity writing and a wide variety of other needs.

Flash memory programmers manufactured by Renesas Electronics

PG-FP5

MINICUBE2

Flash micro-controllers

Flash memory programmers made by our partner companies

Naito Densei Machida Mfg. Co., Ltd. | Yokogawa Digital Computer Corporation | Wave Technology Co., Ltd.

FL-PR5 | NET IMPRESS series | Y3000-8

TESSERA Technology Inc. | Interface Co., Ltd.

Stick GANG Writer | StickWriter | ITF2000

Programming houses

Matsubara.KK | ROHTEC | AVNET Logistics | Synchroworks Corporation

LIBERTY | HING | ertec | TAKUMI SHOJI CO.,LTD

We offer flash microcontrollers in various packages and ROM and RAM sizes, allowing you to select the best flash microcontroller for your product or application.

Generic Name	V850ES/HE3	V850ES/HF3	V850ES/HG3	V850ES/HJ3	V850ES/IE2	V850E/IF3	V850E/IG3	V850E/IG4	V850E/IH4	V850E/IG4-H	V850E/IH4-H
Pin Count / ROM (Bytes)	64-pin	80-pin	100-pin	144-pin	64-pin	80-pin	100/161-pin	100-pin	128-pin	100-pin	128-pin
2048 K	Part Number (RAM: Bytes)										
1024 K											
768 K											
512 K/ 480 K				μPD70F3757 (32 K)				μPD70F3915 (24 K)	μPD70F3918 (24 K)	μPD70F3921 (24 K)	μPD70F3924 (24 K)
384 K/ 376 K								μPD70F3914 (24 K)	μPD70F3917 (24 K)	μPD70F3920 (24 K)	μPD70F3923 (24 K)
256 K		μPD70F3750 (16 K)	μPD70F3752 (16 K)	μPD70F3755 (16 K)		μPD70F3452 (12 K)	μPD70F3454 (12 K)	μPD70F3913 (24 K)	μPD70F3916 (24 K)	μPD70F3919 (24 K)	μPD70F3922 (24 K)
128 K	μPD70F3747 (8 K)				μPD70F3714 (6 K)	μPD70F3451 (8 K)	μPD70F3453 (8 K)				
64 K					μPD70F3713 (6 K)						
32 K											
16 K											

V850ES/Hx3 Microcontrollers

V850ES/Ix2 and V850E/Ixx Microcontrollers for inverter control

Package

64-pin LQFP GB Thickness: 1.4 mm 10 x 10 mm Pitch: 0.5 mm	80-pin LQFP GK Thickness: 1.4 mm 12 x 12 mm Pitch: 0.5 mm	100-pin LQFP GC Thickness: 1.4 mm 14 x 14 mm Pitch: 0.5 mm	144-pin LQFP GJ Thickness: 1.4 mm 20 x 20 mm Pitch: 0.5 mm	64-pin LQFP GC Thickness: 1.4 mm 14 x 14 mm Pitch: 0.8 mm	80-pin LQFP GC Thickness: 1.4 mm 14 x 14 mm Pitch: 0.65 mm	100-pin LQFP GC Thickness: 1.4 mm 14 x 14 mm Pitch: 0.5 mm	100-pin LQFP GC Thickness: 1.4 mm 14 x 14 mm Pitch: 0.5 mm	128-pin LQFP GF Thickness: 1.4 mm 14 x 20 mm Pitch: 0.5 mm	100-pin LQFP GC Thickness: 1.4 mm 14 x 14 mm Pitch: 0.5 mm	128-pin LQFP GF Thickness: 1.4 mm 14 x 20 mm Pitch: 0.5 mm

100-pin LQFP GF Thickness: 1.4 mm 14 x 20 mm Pitch: 0.65 mm
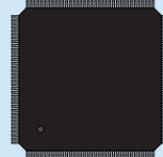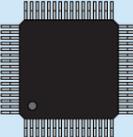
100-pin LQFP GF Thickness: 1.4 mm 14 x 20 mm Pitch: 0.65 mm
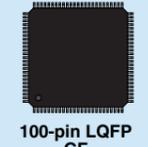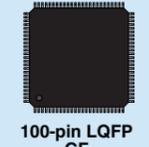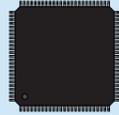
161-pin FBGA[Note] F1 Thickness: 1.13 mm 10 x 10 mm Pitch: 0.65 mm

Note μPD70F3454 only
Remark The packages shown are the actual size.

**We offer flash microcontrollers in various packages and ROM and RAM sizes, allowing you to select the best flash microcontroller for your product or application.**

Generic Name	V850ES/JC3-L		V850ES/JE3-L	V850ES/JF3-L	V850ES/JG3-L	V850ES/JG3	V850ES/JJ3
Pin Count / ROM (Bytes)	40-pin	48-pin	64-pin	80-pin	100/121-pin	100-pin	144-pin
2048 K	**Part Number (RAM: Bytes)**						
1024 K						µPD70F3742 (60 K)	µPD70F3746 (60 K)
768 K						µPD70F3741 (60 K)	µPD70F3745 (60 K)
512 K/ 480 K					µPD70F3793, µPD70F3796[Note 1] (40 K)	µPD70F3740 (40 K)	µPD70F3744 (40 K)
384 K/ 376 K					µPD70F3792 (32 K), µPD70F3795[Note 1] (40 K)	µPD70F3739 (32 K)	µPD70F3743 (32 K)
256 K	µPD70F3838[Note 1] (16 K)	µPD70F3839[Note 1] (16 K)	µPD70F3840[Note 1] (16 K)	µPD70F3736 (16 K)	µPD70F3738 (16 K), µPD70F3794[Note 1] (40 K)		
128 K	µPD70F3800[Note 1] (8 K)	µPD70F3804[Note 1] (8 K)	µPD70F3808[Note 1] (8 K)	µPD70F3735 (8 K)	µPD70F3737 (8 K)		
64 K	µPD70F3799[Note 1] (8 K)	µPD70F3803[Note 1] (8 K)	µPD70F3807[Note 1] (8 K)				
32 K	µPD70F3798[Note 1] (8 K)	µPD70F3802[Note 1] (8 K)	µPD70F3806[Note 1] (8 K)				
16 K	µPD70F3797[Note 1] (8 K)	µPD70F3801[Note 1] (8 K)	µPD70F3805[Note 1] (8 K)				

V850ES/Jx3-L Microcontrollers

V850ES/Jx3 Microcontrollers

Package

40-pin	48-pin	64-pin	80-pin	100/121-pin	100-pin	144-pin
40-pin WQFN K8 Thickness: 0.75 mm 6 x 6 mm Pitch: 0.5 mm	48-pin LQFP GA Thickness: 1.4 mm 7 x 7 mm Pitch: 0.5 mm	64-pin LQFP GB Thickness: 1.4 mm 10 x 10 mm Pitch: 0.5 mm	80-pin LQFP GK Thickness:1.4 mm 12 x 12 mm Pitch: 0.5 mm	100-pin LQFP GC Thickness:1.4 mm 14 x 14 mm Pitch: 0.5 mm	100-pin LQFP GC Thickness: 1.4 mm 14 x 14 mm Pitch: 0.5 mm	144-pin LQFP GJ Thickness: 1.4 mm 20 x 20 mm Pitch: 0.5 mm
	48-pin WQFN K8 Thickness: 0.75 mm 7 x 7 mm Pitch: 0.5 mm	64-pin FBGA F1 Thickness: 0.91 mm 5 x 5 mm Pitch: 0.5 mm	80-pin LQFP GC Thickness: 1.4 mm 14 x 14 mm Pitch: 0.65 mm	100-pin LQFP[Note 2] GF Thickness: 1.4 mm 14 x 20 mm Pitch: 0.65 mm / 121-pin FBGA F1 Thickness: 1.21 mm 8 x 8 mm Pitch: 0.65 mm		

Notes 1. Under development
2. µPD70F3737 and 70F3738 only
Remark The packages shown are the actual size.

We offer flash microcontrollers in various packages and ROM and RAM sizes,
allowing you to select the best flash microcontroller for your product or application.

Generic Name	V850ES/JC3-H		V850ES/JE3-H	V850ES/JG3-H	V850ES/JH3-H	V850ES/JG3-U	V850ES/JH3-U	V850ES/JE3-E	V850ES/JF3-E	V850ES/JG3-E	V850ES/JH3-E	V850ES/JJ3-E	V850E2/MN4
Pin Count ROM (Bytes)	40-pin	48-pin	64-pin	100-pin	128-pin	100-pin	128-pin	64-pin	80-pin	100/113-pin	128-pin	144-pin	304-pin
2048 K	Part Number (RAM: Bytes)												μPD70F3515[Note 1] (64 K×2)
1024 K			**USB**					**Ethernet**					μPD70F3510[Note 1](64 K), μPD70F3512[Note 1](64 K), μPD70F3514[Note 1](64 K×2)
768 K			**V850ES/Jx3-H and Jx3-U Microcontrollers**					**V850ES/Jx3-E Microcontrollers**					**V850E2/ MN4 Micro- controllers**
512 K/ 480 K				μPD70F3762 (56 K[Note 2])	μPD70F3767 (56 K[Note 2])	μPD70F3764 (56 K[Note 2])	μPD70F3769 (56 K[Note 2])			μPD70F3780 (76 K[Note 3]), μPD70F3782, 70F3783 (124 K[Note 4])	μPD70F3784 (76 K[Note 3]), μPD70F3785, 70F3786 (124 K[Note 4])		
384 K/ 376 K				μPD70F3761 (48 K[Note 2])	μPD70F3766 (48 K[Note 2])	μPD70F3763 (48 K[Note 2])	μPD70F3768 (48 K[Note 2])			μPD70F3779 (76 K[Note 3]), μPD70F3781 (124 K[Note 4])			
256 K	μPD70F3813[Note 1] (24 K)	μPD70F3818[Note 1] μPD70F3819[Note 1] (24 K)	μPD70F3824[Note 1], μPD70F3825[Note 1] (24 K)	μPD70F3760, μPD70F3770, (40 K[Note 2])	μPD70F3765, μPD70F3771, (40 K[Note 2])			μPD70F3828[Note 1], μPD70F3829[Note 1] (64 K[Note 3])	μPD70F3832[Note 1], μPD70F3833[Note 1] (64 K[Note 3])	μPD70F3836[Note 1], μPD70F3837[Note 1] (64 K[Note 3])	μPD70F3778 (76 K[Note 3])		
128 K	μPD70F3812[Note 1] (24 K)	μPD70F3817[Note 1] (24 K)	μPD70F3823[Note 1] (24 K)					μPD70F3827[Note 1] (48 K[Note 3])	μPD70F3831[Note 1] (48 K[Note 3])	μPD70F3835[Note 1] (48 K[Note 3])			
64 K	μPD70F3811[Note 1] (24 K)	μPD70F3816[Note 1] (24 K)	μPD70F3822[Note 1] (24 K)					μPD70F3826[Note 1] (32 K[Note 3])	μPD70F3830[Note 1] (32 K[Note 3])	μPD70F3834[Note 1] (32 K[Note 3])			
32 K	μPD70F3810[Note 1] (16 K)	μPD70F3815[Note 1] (16 K)	μPD70F3821[Note 1] (16 K)										
16 K	μPD70F3809[Note 1] (8 K)	μPD70F3814[Note 1] (8 K)	μPD70F3820[Note 1] (8 K)										
Package	40-pin WQFN K8 Thickness: 0.75 mm 6 x 6 mm Pitch: 0.5 mm	48-pin LQFP GA Thickness: 1.4 mm 7 x 7 mm Pitch: 0.5 mm 48-pin WQFN K8 Thickness: 0.75 mm 7 x 7 mm Pitch: 0.5 mm	64-pin LQFP GB Thickness: 1.4 mm 10 x 10 mm Pitch: 0.5 mm 64-pin FBGA[Note 5] F1 Thickness: 1.11 mm 6 x 6 mm Pitch: 0.65 mm 64-pin WQFN K8 Thickness: 0.75 mm 9 x 9 mm Pitch: 0.5 mm	100-pin LQFP GC Thickness: 1.4 mm 14 x 14 mm Pitch: 0.5 mm	128-pin LQFP GF Thickness: 1.4 mm 14 x 20 mm Pitch: 0.5 mm	100-pin LQFP GC Thickness: 1.4 mm 14 x 14 mm Pitch: 0.5 mm	128-pin LQFP GF Thickness: 1.4 mm 14 x 20 mm Pitch: 0.5 mm	64-pin LQFP GB Thickness: 1.4 mm 10 x 10 mm Pitch: 0.5 mm 64-pin WQFN K8 Thickness: 0.75 mm 9 x 9 mm Pitch: 0.5 mm	80-pin LQFP GK Thickness: 1.4 mm 12 x 12 mm Pitch: 0.5 mm	100-pin LQFP GC Thickness: 1.4 mm 14 x 14 mm Pitch: 0.5 mm 113-pin FBGA F1 Thickness: 0.91 mm 8 x 8 mm Pitch: 0.65 mm	128-pin LQFP GF Thickness: 1.4 mm 14 x 20 mm Pitch: 0.5 mm	144-pin LQFP GJ Thickness: 1.4 mm 20 x 20 mm Pitch: 0.5 mm	304-pin FBGA F1 Thickness: 1.11 mm 19 x 19 mm Pitch: 0.8 mm

Notes 1. Under development
2. Contains an 8 KB area for data use only.
3. Contains a 16 KB area for data use only.
Remark The packages shown are the actual size.
4. Contains a 64 KB area for data use only.
5. μPD70F3824 only

Specialized lineup

We provide products ideally suited to specific applications.
With our extensive specialized lineup, you can choose the product that is perfect for your system.

Connectvity

Our All Flash V850 microcontrollers help you realize systems that are friendly both to people and the environment by providing organic inter-device connectivity, allowing data to be transferred between systems and effectively controlled, whatever the application.
In addition to standard serial interfaces, we can offer V850 microcontrollers with interfaces that enable data transfer types and speeds suited to each application, letting you easily build the system you need.

Connectivity of V850 products

Function Device	USB2.0 Full-spead		CAN	Ethernet 10/100 Mbs
	Function	Host		
V850ES/JG3-L	O*			
V850ES/Jx3-H	O		O*	
V850ES/Jx3-U	O	O		
V850ES/Jx3-E	O		O*	O
V850E/Ix4-H	O			
V850E2/MN4	O	O	O*	O*

* In some Products only.

USB microcontrollers (V850ES/Jx3-H, V850ES/Jx3-U)

1. Complete USB 2.0 functionality on a single chip

Applications that require USB connectivity can be developed quickly and easily because a USB 2.0 host[Note] and/or USB 2.0 function interface is integrated on the microcontroller chip, eliminating the need to connect an external USB chip.

■ **USB specifications**
- On-chip USB 2.0 host (full-speed) interface x 1 ch[Note]/
  USB 2.0 function (full-speed) interface x 1 ch
- USB host transfer modes[Note]
  : Control, Bulk, Interrupt, and Isochronous
- USB host interface connectivity[Note]
  : PPON (USB power supply output) pin
  OCI (overcurrent detection input) pin
- USB function interface endpoint configuration:
  Two endpoints for Control transfers, four endpoints for Bulk transfers,
  and one endpoint for Interrupt transfers
  Note V850ES/Jx3-U only.

■ **All our USB microcontrollers are USB certified.**

CERTIFIED **USB**

2. Extensive USB driver support

■ **USB drivers**
- USB function driver
  Renesas Electronics provides free sample code.
  Driver software is available from one of our partner companies.
- USB host driver
  Driver software is available from one of our partner companies.
  Partner companies   : Interface Co., Ltd.
                 Tepco Uquest, Ltd.
                 Grape Systems Inc.
                 Ubiquitous Corporation
  Remark MSC: Mass storage class
         CDC: Communication device class

USB host and function driver configuration

User application

File system[Note 1]

Class driver
MSC or[Note 2] CDC or[Note 3] Other

USB host driver/
USB function driver

Hardware

☐ Sample code for these sections is supplied by Renesas Electronics or a partner company.[Note 2]

Notes 1. Can only be used with USB host.
     2. Can only be used with USB function.
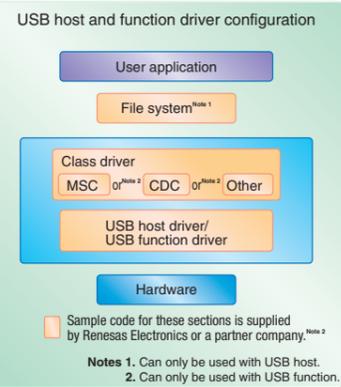
3. Supportive development environment

Renesas Electronics offers two starter kits: one for USB host system development, and one for USB function system development. These starter kits help you develop and evaluate your application at the system level.

TK-850/JH3U-SP
Made by TESSERA Technology Inc.

TK-850/JG3H
Made by TESSERA Technology Inc.

Ethernet microcontrollers (V850ES/Jx3-E)

1. Control your networks and systems using only the internal memory.

Renesas Electronics' Ethernet microcontrollers incorporate up to 512 KB of flash memory and 124 KB of RAM.
They also include a 10/100 base Ethernet MAC and feature a high CPU performance of 103MIPS (Dhrystone 1.1) when operating at 50 MHz. This enables network and system control using only the internal memory.

2. On-chip Ethernet controller lets you build a low-cost system

- MAC
  Enables IEEE802.3-compliant 10/100 Mbps full-duplex and half-duplex communication as well as flow control.
  Uses MII as the physical layer device (PHY) interface.
  Includes an on-chip VLAN detector.
- FIFO size: Transmission = 2 KB, Reception = 2 KB
- Dedicated Ethernet controller DMAC
- On-chip reception checksum calculator compliant with RFC1071

Internal bus — Dedicated Ethernet controller DMAC — FIFO controller (Transmission FIFO (2 KB), Reception FIFO (2 KB)) — MAC (Reception checksum unit) — MII I/O buffer — PHY — TPO+, TPO−, TPI+, TPI−
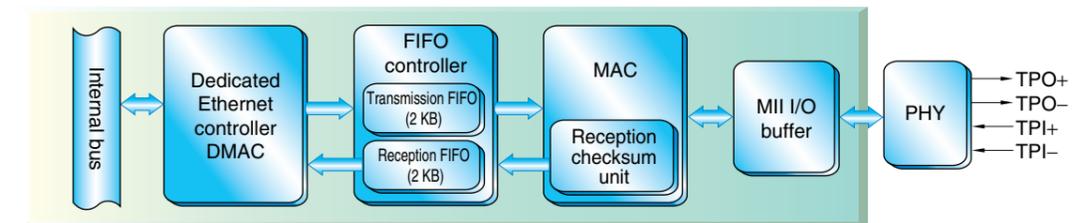
3. Enhanced development environment and network software

Renesas Electronics provides a starter kit that can be used for evaluation and development at the system level and network software. Network software is also available from our partner companies. See the Application Examples page for more details.

Inverter control microcontrollers (V850E/Ix4, V850E/Ix4-H)

The V850E/Ix4 and V850E/Ix4-H feature a CPU with a ramped up operating speed of 100 MHz—1.5 times faster than our previous model—enabling much finer inverter control.
Add this to the large-capacity internal flash memory (256 KB to up to 480 KB), and you have a microcontroller that is ideal for systems that need to run large-capacity programs, such as factory automation equipment. Our inverter control microcontrollers also have a wealth of built-in analog peripherals, including a 12-bit A/D converter, six operational amplifiers, and 12 comparators. This helps greatly to reduce the number of components in the system and reduce costs.

DC/AC fan motor — MOS FET — Photocoupler
Louver stepper motor — Driver
Power supply — Photocoupler
PFC
Power module
Power module — Photocoupler — PWM
BLDC compressor motor
BLDC fan motor
Current sensor input
8-bit or 16-bit microcontroller for controlling indoor air conditioner unit — UART — V850E/Ix4 or V850E/Ix4-H inverter control microcontroller for controlling outdoor air conditioner unit
Operational amplifier
LCD LED — Remote controller — Sensor

High performance

On-chip high-performance CPU core V850E2M corresponding to the multi-core

All Flash microcontroller with dual-core 32-bit CPU boasting world-beating performance (V850E2/MN4)We have now developed the V850E2M, an ultra-fast CPU core based on the high-performance V850E2 (with 2-way parallel superscalar architecture and a 7-stage pipeline) but featuring faster conditional branch instruction execution and a new variable-step division instruction to enable high-speed division calculations. The V850E2M realizes an outstanding performance of 2.56 MIPS/MHz-close to 1.4 times faster than our other cores when operating at the same frequency.

The V850E2/MN4 lineup features products that incorporate two of these ultra-fast CPU cores to enable a world-beating performance of 1024 MIPS when operating at 200 MHz. Our dual-core microcontrollers also consume only 0.88 mW/MIPS-60% of the power of single-core products-and provide a wide range of on-chip peripherals, letting you build smaller systems with fewer components.

MIPS performance Dhrystone 2.1
(Comparing single-chip microcontrollers)

	MIPS
Company A 120MHz	150
Company B 264MHz	600
Renesas Electronics V850E2/MN4 200MHz	1024

V850E2/MN4 Dual-Core CPUs Block Diagram

| INTC1 | RAM1 |

V850E2M CPU1

Flash cache 1

Flash memnory

Flash interface

| INTC2 | RAM2 |

V850E2M CPU2

Flash cache 2

Interface

・PMEMC (SRAM/SDRAM) For high-speed access

Interface

<On-chip peripheral A>
•CSI   •I²C
•UART •CAN
•A/D, etc.

Interface

<On-chip peripheral B>
•EX-RAM
•USB
•Ethernet, etc.

DMA

CPU1 bus   CPU2 bus   DMA bus

→ <1> <2> <3> Data flow
→ <4> <5> Instruction flow
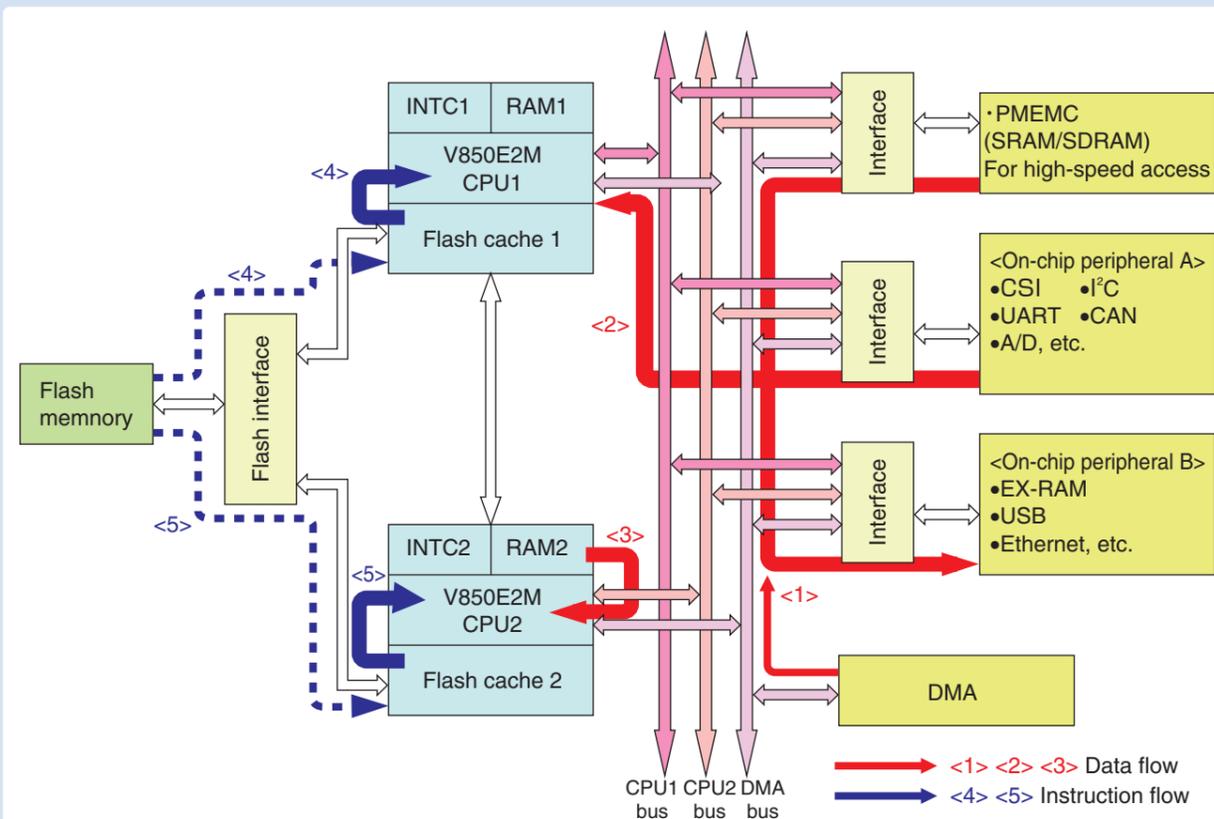
The V850E2/MN4 includes three high-speed internal buses to maximize the dual-core performance.
These buses allow various types of processing to be performed in parallel.
By maximizing the performance of each unit in this way, the overall performance can be dramatically improved.
Example of processing that can be performed in parallel:
<1> Data is transferred at high speed from an external memory to an Ethernet peripheral by using DMA.
<2> CPU1 executes CAN communication protocol processing while processing other data at the same time.
<3> CPU2 processes the data from internal RAM2 while its high-performance CPU core executes high-speed calculations.
<4>, <5> CPU1 and CPU2 execute no-wait instruction fetches from the microcontroller's large-capacity flash memory using the flash cache in each core.

Rich development environment
Introducing Prism[Note], a dynamic analysis tool for multi-core microcontrollers (V850E2/MN4)

Prism is an analysis and verification environment that provides software optimized for implementing multi-core architecture.

Prism provides virtual task division, core assignment, and data-dependent display features that allow software engineers to easily develop and realize the full potential of multi-core processors without the need to change the source code.

Note Made by CriticalBlue, Inc
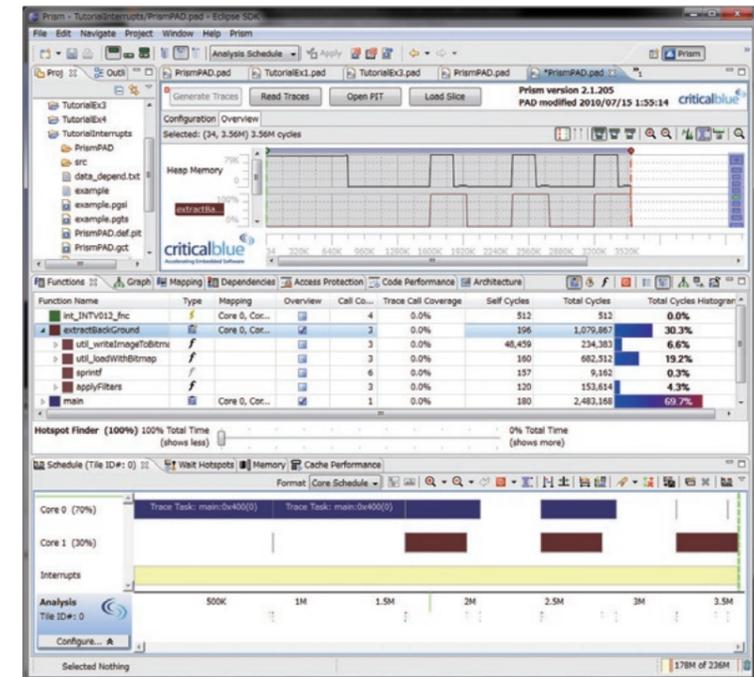
High-performance RTC (real-time counter)[Note]
Alleviates the software load and further reduces power consumption.

• No need for updating using a program because the RTC has a calendar feature for automatic updating until 2099.
• Sustained clock operation without wakeup to reduce power consumption.
• Built-in alarm starts the microcontroller at the set time (day, hour, minute).

Conventional watch timer — Current Active Standby — Watch update — 0.5 s max. — Watch update — Watch update

V850 RTC — Current Active Standby — **Automatic RTC updating until 2099 without need for updating with CPU** — Interrupt: 1 month max.
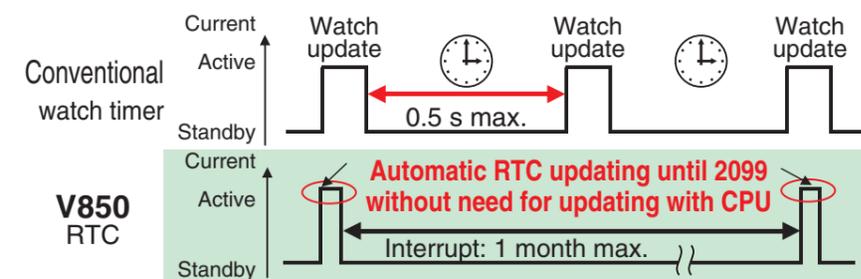
Note Available in some V850ES/Jx3-L products as well as V850ES/Jx3-U and V850ES/Jx3-H products.

High reliability

The reliability technologies developed for automotive flash microcontrollers can be found in all our flash microcontrollers, making them a safe choice.

Cumulative shipment total: More than 2,000,000,000 units[Note]

Used for more than 1,000 types of applications

Note As of May, 2010

A flash security setting is provided to protect your software from malicious rewriting and reading.

Flash memory programmer
PG-FP5

Writing → Writing → You can disable writing.

Erasing → Erasing → You can disable erasing.

Reading[Note 1] → Reading → You can disable reading.[Note 2]

Notes 1. No commands for reading are provided for the V850ES/Ix2.
2. Reading is disabled by default in the PG-FP5.
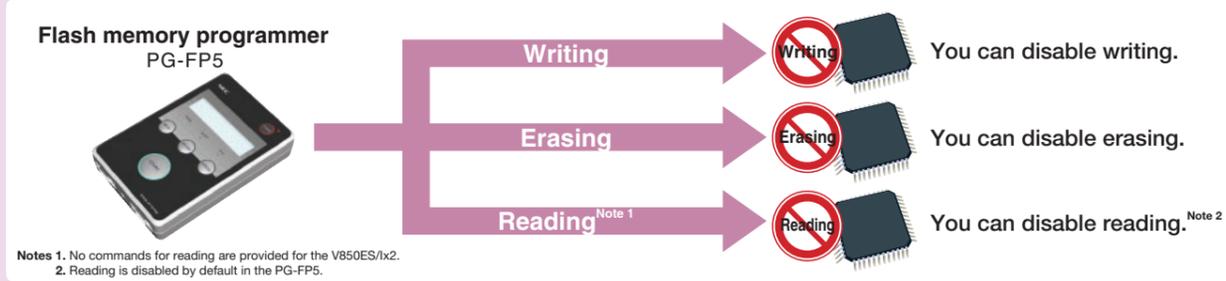
A boot swap feature is provided to protect important programs even when power shuts down during self-programming.

Problems during self-programming

Momentary power shutdown

?????

Self-programming in progress

Operation is disabled.

Power shutdown during self-programming may disable microcontroller recovery.

Boot swapping[Note]

Writing to boot 1   Erasing boot 0   Boot swap

Boot 1

New Boot Program

New Boot Program

New Boot Program → Boot

xxxxH

Momentary power shutdown

0000H → Program starts

Boot 0   Boot Program   Boot   Boot Program   Boot   Boot Program   Boot   Boot Program

0000H

xxxxH

The microcontroller can start normally even when momentary power shutdown occurs during boot rewriting.

Note Supported by the µPD70F3713 in the V850ES/IE2 series.

Supportive environment for development (1/2)

Renesas Electronics provides a range of development environments for each development phase.

Lineup of development environment

Test board

Target board for MINICUBE2

QB-V850ESJG3L-TB   QB-V850ESIE2-TB   QB-V850EIG3-TB
QB-V850EIH4H-TB   QB-V850ESHG3-TB   QB-V850ESJG3U-TB
QB-V850ESJJ3-TB

(Image shows QB-V850ESJG3L-TB.)

Starter kit
Made by TESSERA Technology Inc.

TK-850/HG3   TK-850/JG3L   TK-850/JG3   TK-850/JG3H
TK-850/JH3U-SP
Remark Evaluation boards for Ethernet® and ZigBee® are available.

(Image shows TK-850/JG3H.)

| Software development | Debugging/verification | Writing |

Development environment

Microcontroller integrated development platform (CubeSuite)

On-chip debug emulator (MINICUBE®)

On-chip debug emulator with programming capability (MINICUBE2)

Full-function in-circuit emulator (IECUBE)

Device driver configurator (Applilet3)

Simulator (SM+)

MINICUBE2 wireless option (QB-MINI2-RF)

Flash memory programmer (PG-FP5)

Compiler/ project manager/ real-time OS (CA850/PM+/RX850/RX850 Pro/RX850V4)

Flash memory programmer (FL-PR5)

Note Products of Naito Densei Machida Mfg. Co., Ltd.

Significant man-hours are required to develop and modify software from existing chips. We have development environments to help reduce these man-hours.

Product-specific peripheral function settings automatically easily generated with Applilet®.

On-chip debug emulator MINICUBE

Software resources

V850

C source code can be transported almost as is.

C compiler CA850 with limited functions

Transported

| Coding | Compiling | Debug evaluation |
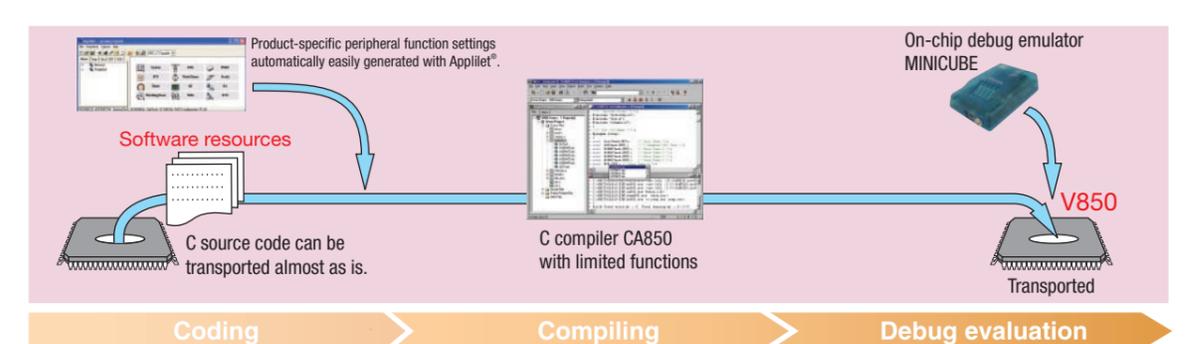
Supportive environment for development (2/2)

Software

- Rich lineup of tools for each development phase
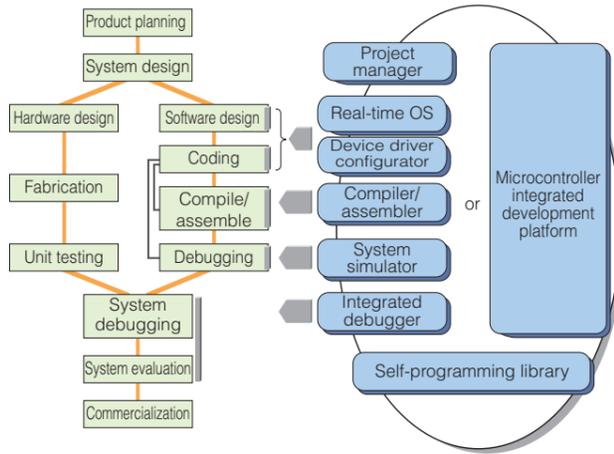
Type	Name
Microcontroller integrated development platform	CubeSuite
Software package	SP850
Project manager	PM+
C compiler	CA850
System simulator	SM+ for V850
Integrated debugger	ID850QB
Real-time OS	RX850, RX850 Pro, RX850V4[Note]
Self-programming library	FSL
Device driver configurator	Applilet3 for V850ES/Jx3 Applilet3 for V850ES/Jx3-L (under development)

■ **Microcontroller integrated development platform**
Can be used to compile and debug programs, manage pin layouts, generate code for microcontroller peripherals, and execute high-speed building.

■ **Software package**
Project manager, C compiler, assembler, integrated debugger, etc., provided on a single CD-ROM disk

■ **Project manager**
- Various development tools integrated on Windows™
- A series of operations, such as editor, builder, and debugger startup, is possible.

■ **C compiler**
- ANSI-C standard compliant
- Powerful optimization
- Optimum features for embedded system development
- Multiple utilities

■ **System simulator**
- GUI design similar to that of integrated debugger
- Evaluation possible without target prior to target completion

■ **Integrated debugger**
- Operates on Windows
- Easy to understand GUI
- Buttons provided for frequently used commands
- Can be started up with a simple mouse click

■ **Real-time OS**
- μITRON specification compliant
- Compact size
- Easy program reuse and maintenance

■ **Self-programming library**
- The flash memory can be programmed with the microcontroller itself, without using a programmer.
- Built-in boot swap function for protecting the boot area at power down

■ **Device driver configurator**
The setting sources of the built-in peripheral functions can be automatically generated through GUI operation without referring to the device's user's manual.

Note Conforms to μITRON 4.0 specifications.

Hardware (1/2)

■ Full-function in-circuit emulator (IECUBE)

- Enables detailed debugging through equivalent emulation of microcontrollers, using trace, time measurement, and other functions.

IECUBE system configuration
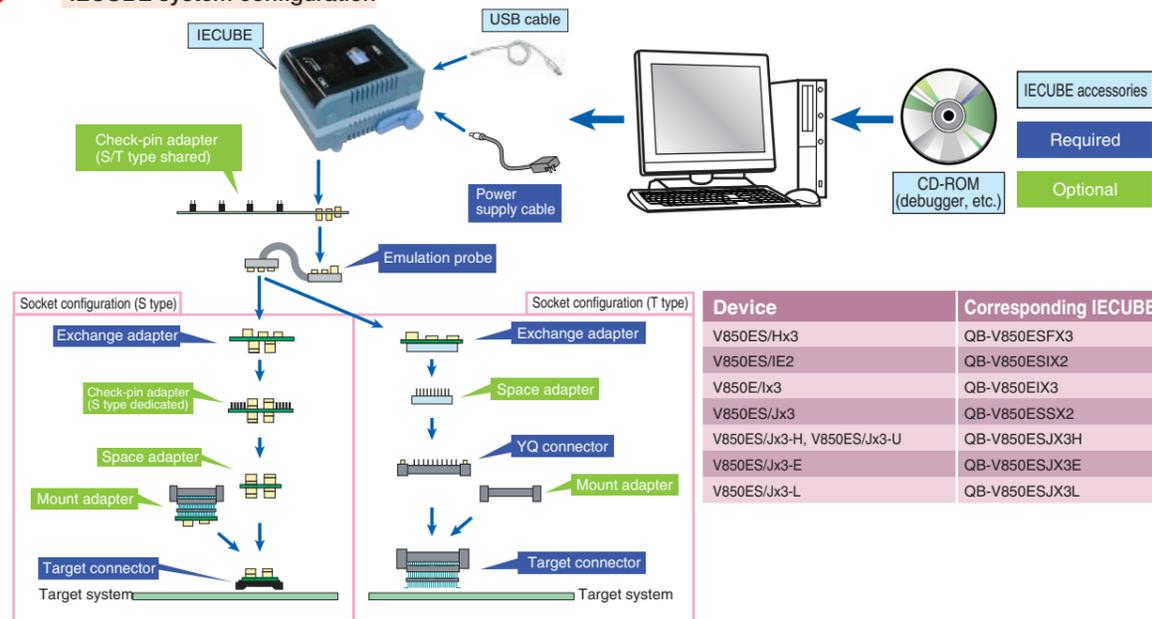
Device	Corresponding IECUBE
V850ES/Hx3	QB-V850ESFX3
V850ES/IE2	QB-V850ESIX2
V850E/Ix3	QB-V850EIX3
V850ES/Jx3	QB-V850ESSX2
V850ES/Jx3-H, V850ES/Jx3-U	QB-V850ESJX3H
V850ES/Jx3-E	QB-V850ESJX3E
V850ES/Jx3-L	QB-V850ESJX3L

To order development tools, contact a Renesas Electronics sales representative or an authorized Renesas Electronics distributor.

Hardware (2/2)

■ On-chip debug emulator (MINICUBE)

- Debugging with the microcontroller mounted on the target system is possible.
- Basic debugging functions such as run, break, and download are provided.

MINICUBE system configuration
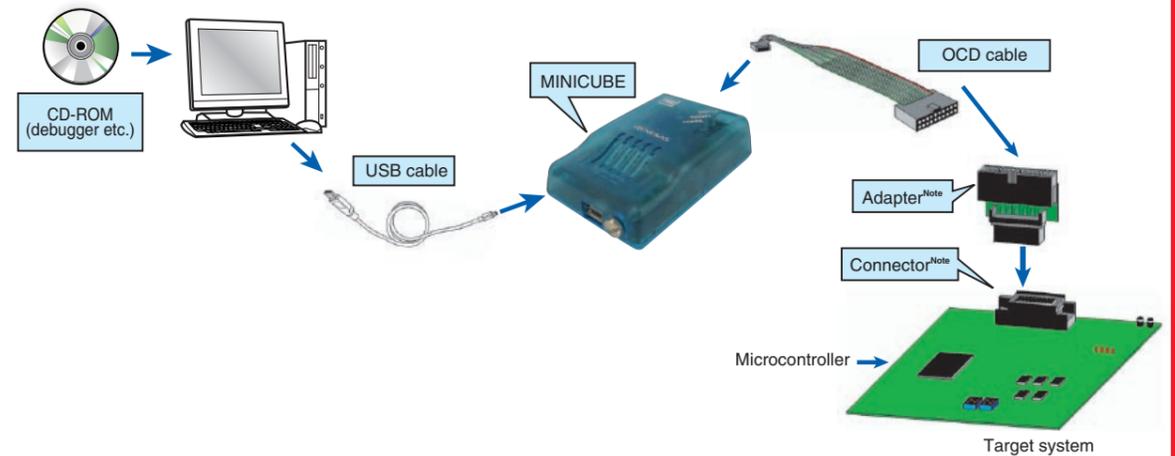
Note The adapter and connector can be selected and purchased from various partners' products according to the mounting area of the target system.
Remark For more information on MINICUBE: http://www2.renesas.com/micro/en/development/asia/v850/minicube.html

MINICUBE supported devices
V850ES/Hx3, V850E/IG3, V850ES/Jx3, V850ES/Jx3-L, V850ES/Jx3-H, V850ES/Jx3-U, V850ES/Jx3-E, V850E/Ix4, V850E/Ix4-H, V850E2/MN4

■ On-chip debug emulator with flash programming capability (MINICUBE2)

- Debugging with the microcontroller mounted on the target system is possible.
- In addition to simple debugging with a foreground monitor, use as a programmer is also possible.

MINICUBE2 system configuration

Recommended connectors
- HIF3FC-16PA-2.54DS (made by Hirose Electric Co., Ltd., right-angle product)
- HIF3FC-16PA-2.54DSA (made by Hirose Electric Co., Ltd., straight product)
- 7616-5002PL (made by Sumitomo 3M Ltd., right-angle product)
- 7616-6002PL (made by Sumitomo 3M Ltd., straight product)
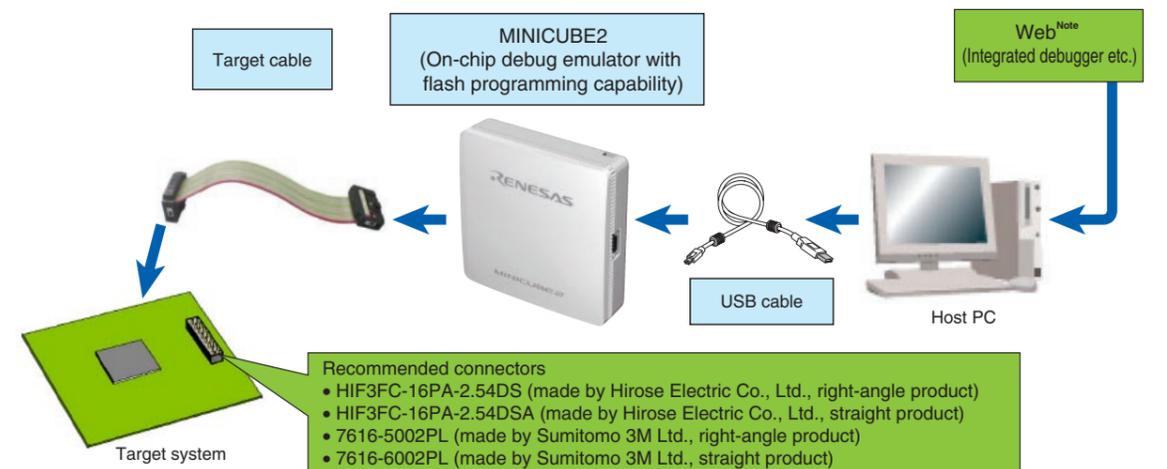
Note For more information on MINICUBE2:
http://www2.renesas.com/micro/en/development/asia/minicube2/minicube2.html

MINICUBE2 supported devices
All devices without V850E2/MN4

To order development tools, contact a Renesas Electronics sales representative or an authorized Renesas Electronics distributor.

Support for mass production

We provide a mass production environment that meets your needs.
You can select the best mass production method for you, based on delivery time or mass production quantity.

Programming by the customer

Delivery time[Note 1]: Practically **none**, highly flexible

Support for introducing in-line programming

Support for introducing programming processes to production line

Naito Densei Machida Mfg. Co., Ltd.
Yokogawa Digital Computer Corporation

Customizing programmer GUIs

Unprogrammed products received → All Flash → Mount → Test and program → Completion

Plant line

Consultation for introduction of programming processes
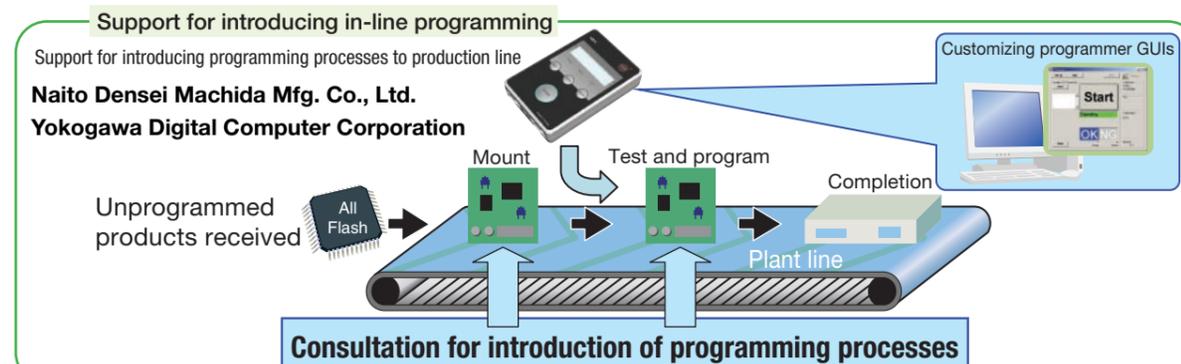
Flash memory programmers

Various products selectable for your purpose and price range

PG-FP5	FL-PR5	NET IMPRESS series[Note]	Y3000-8[Note]	ITF-2000[Note]	Stick GANG Writer[Note]	StickWriter[Note]
Renesas Electronics	Naito Densei Machida Mfg. Co., Ltd.	Yokogawa Digital Computer Corporation	Wave Technology Co., Ltd.	Interface Co., Ltd.	TESSERA Technology Inc.	TESSERA Technology Inc.

Note Compatibilities differ according to the product.

Programming by partner companies

Flexible support for small-volume programming and short delivery time

Programming houses

Ask us about the programming houses in your region.

Synchro-work Corporation — TAKUMI SHOJI CO.,LTD
Matsubara.KK — AVNET Logistics — REMTEC — LIBERTY
ertec

Programmed products

Shipment form same as that of mask ROM microcontrollers

Renesas Electronics

The same way as mask ROM microcontrollers, programmed products can be delivered with a short TAT.

RENESAS Renesas Electronics

All Flash

Submitting software → **Programming** → **Shipment**
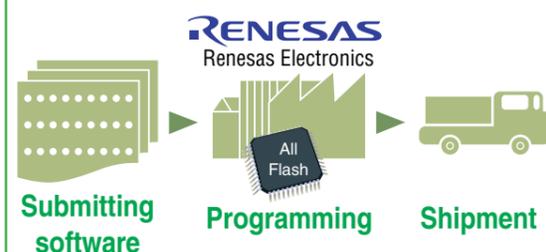
Programming houses

Delivery time[Note 1]: **Several days**

Renesas Electronics

Delivery time[Note 1]: **About 1/2 that of mask ROM[Note 2]**

Order → All Flash → All Flash microcontrollers

Order → All Flash → All Flash microcontrollers

Delivery → **Mass production**

Order → Conventional mask ROM microcontrollers

From ordering to delivery time for mass production start schedule

Notes 1. Period from completion of software until start of mass production
2. Delivery time may vary depending on purchase conditions, such as order quantity.

Application examples

You can achieve the functionality you need by combining V850 All Flash features and libraries.
New features can be easily constructed. One example is introduced below.

Speaking (ADPCM: Adaptive Differential Pulse Code Modulation)

System control and voice feature now on one chip, contributing to reduced costs.

Conventional: Micro controller + Voice synthesis IC

Compact V850

ADPCM library[Note 1] + Voice data[Note 2] → Internal flash / Internal RAM / D/A or PWM → •Filter •Amp → Speaker

Application example: The bath is ready. — Water heater controller
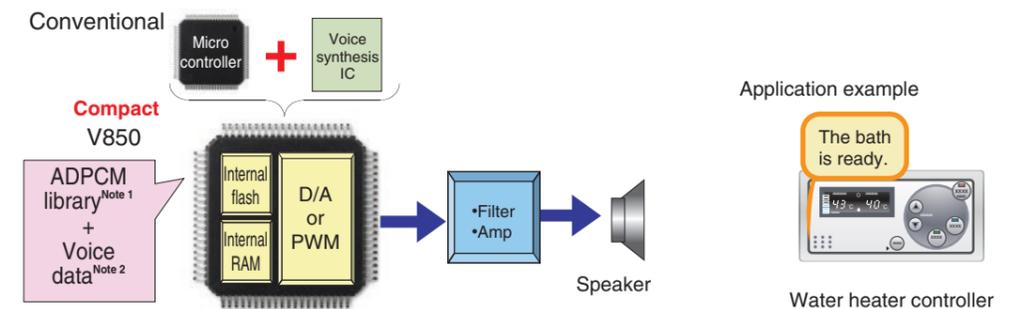
Note 1. ADPCM library (ADPCM-SP) features

Library size		Processing performance (at 20 MHz)	
ROM	RAM	Compression	Decompression
3 KB	32 bytes	15 µs, max.	12 µs, max.

Cautions 1. The above processing times are processing times for individual libraries. When mounted in a system, extra processing time is required for output processing.
2. Processing is necessary every 125 µs in the case of 8 kHz sampling voice.

Note 2. Voice data compression can be chosen from 3 patterns.

Compression rate	High audio quality ←		→ High compression
	4 KBps	3 KBps	2 KBps

Evaluation environment to support "speaking"

Voice conversion tool (WAVE→ADPCM)
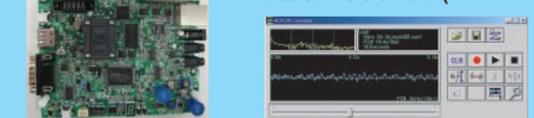
TK-850/JH3U-SP
Made by TESSERA Technology Inc.

CvADPCM
Made by Renesas Electronics
Obtained from our website

Connecting (TCP/IP)

The high-performance V850ES/Jx3-E has a large-capacity internal memory, enabling single-chip control of networks and systems.

"Connecting" achieved with a simple structure not requiring external memory

Ethernet PHY — MII — V850ES /Jx3-E — TCP/IP stack

Memory — Unnecessary
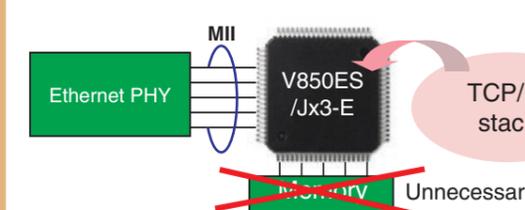
Middleware to support "connecting"

The TCP-IP protocol stacks available from our experienced partner companies provide powerful support.
- **USNetPlus** (Nissin Systems Co., Ltd.)
- **Qlism** (NEC Communication Systems)
- **kasago** (Zuken Elmic, Inc.)
- **Cente** (Data Technology Inc.)
- **Ubiquitous TCP-IP** (Ubiquitous Corporation)

Renesas Electronics also provides a library for evaluation.
- **Compact TCP-IP stack**

"Connecting" system example

Renesas Electronics microcontrollers can be used for "connecting" in factory automation networks, building management systems, and many other applications.

Evaluation kit to support "connecting"

TK-850/JH3E+NET
(Incorporated in the V850ES/JH3-E)

Manufactured by TESSERA Technology Inc.[Note]

Note Please check when sales will begin.

Generic Name		V850ES/HE3	V850ES/HF3	V850ES/HG3	V850ES/HJ3		V850ES/IE2		V850E/IF3		V850E/IG3		V850E/IG4			V850E/IH4			V850E/IG4-H			V850E/IH4-H		
Pin Count		64-pin	80-pin	100-pin	144-pin		64-pin		80-pin		100-pin	100-/161-pin	100-pin			128-pin			100-pin			128-pin		
Part Number		μPD70F3747	μPD70F3750	μPD70F3752	μPD70F3755	μPD70F3757	μPD70F3713	μPD70F3714	μPD70F3451	μPD70F3452	μPD70F3453	μPD70F3454	μPD70F3913	μPD70F3914	μPD70F3915	μPD70F3916	μPD70F3917	μPD70F3918	μPD70F3919	μPD70F3920	μPD70F3921	μPD70F3922	μPD70F3923	μPD70F3924
CPU core		V850ES core	V850ES core	V850ES core	V850ES core		V850ES core		V850E core		V850E core		V850E core			V850E core			V850E core			V850E core		
CPU performance (Dhrystone)		69MIPS (@ 32 MHz)				66MIPS (@ 32 MHz)	39MIPS (@ 20 MHz)		131MIPS (@ 64 MHz)		131MIPS (@ 64 MHz)		197MIPS (@ 100 MHz)			197MIPS (@ 100 MHz)			197MIPS (@ 100 MHz)			197MIPS (@ 100 MHz)		
Flash memory (bytes)		128 K	256 K	256 K	256 K	512 K	64 K	128 K	128 K	256 K	128 K	256 K	256K	384 K	480 K	256K	384 K	480 K	256K	384 K	480 K	256K	384 K	480 K
RAM (bytes)		8 K	16 K	16 K	16 K	32 K	6 K	6 K	8 K	12 K	8 K	12 K	24 K	24 K	24 K	24 K	24 K	24 K	24 K	24 K	24 K	24 K	24 K	24 K
External bus interface	Bus type	–	–	–	Multiplexed		–		–		Notes 1, 2		–			–			Multiplexed Note 3			Separate/Multiplexed		
	Address bus	–	–	–	16		–		–		8/16 Note 2		–			–			Multiplexed:16 bits, Separate:8 bits					
	Data bus	–	–	–	8/16		–		–		8/16 Note 2		–			–			8/16			8/16		
	Chip select signal	–	–	–	4		–		–		2 Note 2		–			–			2			2		
Power supply voltage		3.7 to 5.5 V (A/D converter: 4.0 to 5.5 V)					3.5 to 5.5 V (A/D converter: 4.5 to 5.5 V)		3.5 to 5.5 V (A/D converter: 4.0 to 5.5 V)				1.5 V/5.0 V			1.5 V/5.0 V			1.5 V/5.0 V/3.3 V			1.5 V/5.0 V/3.3 V		
Clock	Main clock	4 to 32 MHz					20 MHz		4 to 64 MHz		4 to 64 MHz		10 to 12.5 MHz			10 to 12.5 MHz			10 to 12.5 MHz			10 to 12.5 MHz		
	Subclock (crystal resonator)	32.768 kHz					–		–		–		–			–			–			–		
	Internal oscillation clock	240 kHz/8 MHz (TYP.)					–		–		–		–			–			–			–		
Port	I/O	51	67	84	128		39		44		56		55			68			51			68		
	Input	–	–	–	–		–		4		8		12			12			12			12		
Timer/counter	16-bit timer (TMQ/TAB) Number of channels	1	1	2	3		2		2		2		2			2			2			2		
	16-bit timer (TMQ/TAB) Function						Interval timer/external event counter/PWM output (3 channels max.)/pulse width measurement/square-wave output/one-shot pulse output																	
	16-bit timer (TMP/TAA) Number of channels	5	5	5	5		4		5		5		3			3			3			3		
	16-bit timer (TMP/TAA) Function						Interval timer/external event counter/PWM output/pulse width measurement/square-wave output/one-shot pulse output																	
	16-bit timer (TMT) Number of channels	–	–	–	–		–		2		2		4			4			4			4		
	16-bit timer (TMT) Function												Interval timer/external event counter/PWM output/pulse width measurement/square-wave output/one-shot pulse output/encoder counter											
	16-bit timer (TMM) Number of channels	1	1	1	1		1		4		4		4			4			4			4		
	16-bit timer (TMM) Function												Interval timer											
	Watch timer	1	1	1	1		–		–		–		–			–			–			–		
	Real-time counter (RTC)	–	–	–	–		–		–		–		–			–			–			–		
	Watchdog timer (WDT)	1	1	1	1		1		1		1		1			1			1			1		
Serial interface	CSI	2	2	2	3	1	1		–		–		–			–			–			–		
	CSI with automatic transmit/receive functions (32-byte buffer)	–	–	–	–		–		–		–		–			–			–			–		
	UART	2 Note 4	2 Note 4	3 Note 4	3 Note 4	4 Notes 4, 5	2		–		–		–			–			–			–		
	I²C	1	1	1	1	–	–		–		–		–			–			–			–		
	UART/CSI	–	–	–	–	2 Notes 4, 5	–		3 Note 6		3 Note 6		3 Note 6			3 Note 6			3 Note 6			3 Note 6		
	UART/I²C	–	–	–	–	1 Note 4	–		1		1		1			1			1			1		
	CSI/I²C	–	–	–	–		–		–		–		–			–			–			–		
	UART/CSI/I²C	–	–	–	–		–		–		–		–			–			–			1		
	UART/I²C/CAN	–	–	–	–		–		–		–		–			–			–			–		
USB controller	USB2.0 function	–	–	–	–		–		–		–		–			–			1 (full-speed)			1 (full-speed)		
	USB2.0 host	–	–	–	–		–		–		–		–			–			–			–		
Ethernet controller		–	–	–	–		–		–		–		–			–			–			–		
A/D converter	12-bit	–	–	–	–		–		5 × 2 units		5 × 2 units		(4, 3) × 1 units			4 × 2 units			(4, 3) × 1 units			4 × 2 units		
	10-bit	10	12	16	24		4 × 2 units		4		8		12			12			12			12		
D/A converter (8-bit)		–	–	–	–		–		–		–		–			–			–			–		
DMA controller		4 Note 7	4 Note 7	4 Note 7	4 Note 8		–		4 Note 7		4 Note 7		7			7			7			7		
Interrupt source	External	9	9	12	16		7		15		21		22			22			22			22		
	Internal	43	43	51	58	64	36		74		75		82			82			84			84		
On-chip debug function	MINICUBE	Provided	Provided	Provided	Provided		–		–		Provided		Provided			Provided			Provided			Provided		
	MINICUBE2	Provided	Provided	Provided	Provided		Provided		Provided		Provided		Provided			Provided			Provided			Provided		
Other peripheral I/O functions		Motor control (1 ch), Hi-Z output control, on-chip POC/LVI, clock monitor, RAM hold flag, SSCG					Motor control (1 ch), Hi-Z output control, on-chip POC/LVI, RAM hold flag, clock monitor		Motor control Hi-Z output on-chip operational amplifier, clock		(2 ch), control, POC/LVI, comparator, monitor		Motor control (2 ch), Hi-Z output control, operational amplifier (6 ch), comparator, on-chip POC/LVI, clock monitor						Motor control (2 ch), Hi-Z output control, operational amplifier (6 ch), comparator, on-chip POC/LVI, clock monitor					
Operating ambient temperature		–40 to +85°C					–40 to +85°C		–40 to +85°C		–40 to +85°C		–40 to +85°C			–40 to +85°C			–40 to +85°C			–40 to +85°C		

Notes 1. Separate/Multiplexed (interface voltage: 5 V) 2. Provided only in the GC package products. 3. Interface voltage: 5 V 4. UART supports LIN. 5. This UART is shared by a port or both CSI and a port. Six UART channels are provided in the μPD70F3757. 6. FIFO buffer provided for UART in one of these channels. 7. Transfer to/from on-chip peripherals and internal RAM.
8. Transfer to/from on-chip peripherals, internal RAM, and external memory.

Part numbers by group:
- **V850ES/JC3-L[1] — 40-pin:** μPD70F3797, μPD70F3798, μPD70F3799, μPD70F3800, μPD70F3838
- **V850ES/JC3-L[1] — 48-pin:** μPD70F3801, μPD70F3802, μPD70F3803, μPD70F3804, μPD70F3839
- **V850ES/JE3-L[1] — 64-pin:** μPD70F3805, μPD70F3806, μPD70F3807, μPD70F3808, μPD70F3840
- **V850ES/JF3-L — 80-pin:** μPD70F3735, μPD70F3736
- **V850ES/JG3-L — 100/121-pin:** μPD70F3737, μPD70F3738, μPD70F3792, μPD70F3793, μPD70F3794[1], μPD70F3795[1], μPD70F3796[1]
- **V850ES/JG3 — 100-pin:** μPD70F3739, μPD70F3740, μPD70F3741, μPD70F3742
- **V850ES/JJ3 — 144-pin:** μPD70F3743, μPD70F3744, μPD70F3745, μPD70F3746

Item		JC3-L 40-pin	JC3-L 48-pin	JE3-L 64-pin	JF3-L 80-pin	JG3-L 100/121-pin	JG3 100-pin	JJ3 144-pin
CPU core		V850ES core	V850ES core	V850ES core	V850ES core	V850ES core	V850ES core	V850ES core
CPU performance (Dhrystone)		43MIPS (@ 20 MHz)	43MIPS (@ 20 MHz)	43MIPS (@ 20 MHz)	43MIPS (@ 20 MHz)	43MIPS (@ 20 MHz)	69MIPS (@ 32 MHz)	69MIPS (@ 32 MHz)
Flash memory (bytes)		16 K / 32 K / 64 K / 128 K / 256 K	16 K / 32 K / 64 K / 128 K / 256 K	16 K / 32 K / 64 K / 128 K / 256 K	128 K / 256 K	128 K / 256 K / 384 K / 512 K / 256 K / 384 K / 512 K	384 K / 512 K / 768 K / 1024 K	384 K / 512 K / 768 K / 1024 K
RAM (bytes)		8 K / 8 K / 8 K / 8 K / 16 K	8 K / 8 K / 8 K / 8 K / 16 K	8 K / 8 K / 8 K / 8 K / 16 K	8 K / 16 K	8 K / 16 K / 32 K / 40 K / 40 K / 40 K / 40 K	32 K / 40 K / 60 K / 60 K	32 K / 40 K / 60 K / 60 K
External bus interface	Bus type	–	–	–	Multiplexed	Separate/Multiplexed	Separate/Multiplexed	Separate/Multiplexed
	Address bus	–	–	–	18	22	22	24
	Data bus	–	–	–	8/16	8/16	8/16	8/16
	Chip select signal	–	–	–	–	–	–	4
Power supply voltage		2.2 to 3.6 V (A/D converter: 2.7 to 3.6 V)	2.2 to 3.6 V (A/D converter: 2.7 to 3.6 V)	2.2 to 3.6 V (A/D converter: 2.7 to 3.6 V)	2.2 to 3.6 V (A/D converter: 2.7 to 3.6 V)	2.0 to 3.6 V (A/D converter: 2.7 to 3.6 V) / 2.0 to 3.6 V (USB operation: 3.0 to 3.6 V, A/D converter: 2.7 to 3.6 V)	2.85 to 3.6 V (A/D converter: 3.0 to 3.6 V)	2.85 to 3.6 V (A/D converter: 3.0 to 3.6 V)
Clock	Main clock	2.5 to 20 MHz	2.5 to 20 MHz	2.5 to 20 MHz	2.5 to 20 MHz	2.5 to 20 MHz, 2.5 to 16 MHz (USB operation)	2.5 to 32 MHz	2.5 to 32 MHz
	Subclock (crystal resonator)	32.768 kHz	32.768 kHz	32.768 kHz	32.768 kHz	32.768 kHz	32.768 kHz	32.768 kHz
	Internal oscillation clock	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)
Port	I/O	27 (of which 5 V tolerance: 17)	34 (of which 5 V tolerance: 20)	50 (of which 5 V tolerance: 28)	66 (of which 5 V tolerance: 25)	84 (of which 5 V tolerance: 31) / 83 (of which 5 V tolerance: 31) / 80 (of which 5 V tolerance: 28)	84 (of which 5 V tolerance: 40)	128 (of which 5 V tolerance: 60)
	Input	–	–	–	–	–	–	–
Timer/counter	16-bit timer (TMQ/TAB) Number of channels	1	1	1	1	1	1	1
	Function	Interval timer/external event counter/PWM output (3 channels max.)/pulse width measurement/square-wave output/one-shot pulse output						
	16-bit timer (TMP/TAA) Number of channels	6	6	6	4	6	6	9
	Function	Interval timer/external event counter/PWM output/pulse width measurement/square-wave output/one-shot pulse output						
	16-bit timer (TMT) Number of channels	–	–	–	–	–	–	–
	Function	–	–	–	–	–	–	–
	16-bit timer (TMM) Number of channels	1	1	1	1	1	1	1
	Function	Interval timer						
	Watch timer	1	1	1	1	1	1	1
	Real-time counter (RTC)	–	–	–	–	1	–	–
	Watchdog timer (WDT)	1	1	1	1	1	1	1
Serial interface	CSI	1	2	3	2	3	3	4
	CSI with automatic transmit/receive functions (32-byte buffer)	–	–	–	–	–	–	–
	UART	1[2]	–	–	2[2]	4[2]	–	1[2]
	I²C	–	–	–	–	–	–	–
	UART/CSI	–	1[2]	1[2]	–	1[2]	1[2]	1[2]
	UART/I²C	1[2]	2[2]	2[2]	1[2]	2[2]	2[2]	2[2]
	CSI/I²C	1	1	1	1	1	1	1
	UART/CSI/I²C	–	–	–	–	–	–	–
	UART/I²C/CAN	–	–	–	–	–	–	–
USB controller	USB2.0 function	–	–	–	–	1 (full-speed)	–	–
	USB2.0 host	–	–	–	–	–	–	–
Ethernet controller		–	–	–	–	–	–	–
A/D converter	12-bit	–	–	–	–	–	–	–
	10-bit	5	6	10	8	12	12	16
D/A converter (8-bit)		–	1	1	1	2	2	2
DMA controller		4[3]	4[3]	4[3]	4[3]	4[3]	4[3]	4[3]
Interrupt source	External	6	6	9	9	9	9	10
	Internal	43	47	49	40	48 / 55	48	61
On-chip debug function	MINICUBE	Provided	Provided	Provided	Provided	Provided	Provided	Provided
	MINICUBE2	Provided	Provided	Provided	Provided	Provided	Provided	Provided
Other peripheral I/O functions		On-chip LVI, clock monitor, real-time output, CRC					On-chip LVI, clock monitor, real-time output, CRC	
Operating ambient temperature		−40 to +85°C					−40 to +85°C	

Notes 1. Under development. **2.** UART supports LIN. **3.** Transfer to/from on-chip peripherals, internal RAM, and external memory.

Generic Name		V850ES/JC3-H [Note 1]		V850ES/JE3-H [Note 1]	V850ES/ JG3-H	V850ES/JH3-H	V850ES/JG3-U	V850ES/JH3-U	V850ES/JE3-E [Note 1]	V850ES/JF3-E [Note 1]	V850ES/JG3-E [Note 1]	V850ES/JH3-E	V850ES/JJ3-E
Pin Count		40-pin	48-pin	64-pin	100-pin	128-pin	100-pin	128-pin	64-pin	80-pin	100/113-pin	128-pin	144-pin
Part Number		µPD70F3809 / µPD70F3810 / µPD70F3811 / µPD70F3812 / µPD70F3813	µPD70F3814 / µPD70F3815 / µPD70F3816 / µPD70F3817 / µPD70F3818 / µPD70F3819	µPD70F3820 / µPD70F3821 / µPD70F3822 / µPD70F3823 / µPD70F3824 / µPD70F3825	µPD70F3760 / µPD70F3761 / µPD70F3762 / µPD70F3770	µPD70F3765 / µPD70F3766 / µPD70F3767 / µPD70F3771	µPD70F3763 / µPD70F3764	µPD70F3768 / µPD70F3769	µPD70F3826 / µPD70F3827 / µPD70F3828 / µPD70F3829	µPD70F3830 / µPD70F3831 / µPD70F3832 / µPD70F3833	µPD70F3834 / µPD70F3835 / µPD70F3836 / µPD70F3837	µPD70F3778 / µPD70F3779 / µPD70F3780 / µPD70F3781 / µPD70F3782 / µPD70F3783	µPD70F3784 / µPD70F3785 / µPD70F3786
CPU core		V850ES core		V850ES core	V850ES core	V850ES core	V850ES core		V850ES core	V850ES core	V850ES core	V850ES core	V850ES core
CPU performance (Dhrystone)		98MIPS (@ 48 MHz)		98MIPS (@ 48 MHz)	98MIPS (@ 48 MHz)	98MIPS (@ 48 MHz)	98MIPS (@ 48 MHz)	98MIPS (@ 48 MHz)	103MIPS (@ 50 MHz)	103MIPS (@ 50 MHz)	103MIPS (@ 50 MHz)	103MIPS (@ 50 MHz)	103MIPS (@ 48 MHz)
Flash memory (bytes)		16 K 32 K 64 K 128 K 256 K	16 K 32 K 64 K 128 K 256 K 256 K	16 K 32 K 64 K 128 K 256 K 256 K	256 K 384 K 512 K	256 K 384 K 512 K 256 K	384 K 512 K	384 K 512 K	64 K 128 K 256 K 256 K	64 K 128 K 256 K 256 K	64 K 128 K 256 K 256 K	256 K 384 K 512 K 384 K 512 K 512 K	512 K 512 K 512 K
RAM (bytes)		8 K 16 K 24 K 24 K 24 K	8 K 16 K 24 K 24 K 24 K 24 K	8 K 16 K 24 K 24 K 24 K 24 K	40 K[Note 1] 48 K[Note 2] 56 K[Note 3]	40 K[Note 1] 48 K[Note 2] 56 K[Note 3] 40 K[Note 1]	48 K[Note 2] 56 K[Note 3]	48 K[Note 2] 56 K[Note 3]	32 K[Note 1] 48 K[Note 2] 64 K[Note 3] 64 K[Note 3]	32 K[Note 1] 48 K[Note 2] 64 K[Note 3] 64 K[Note 3]	32 K[Note 1] 48 K[Note 2] 64 K[Note 3] 64 K[Note 3]	76 K[Note 3] 76 K[Note 3] 76 K[Note 3] 124 K[Note 4] 124 K[Note 4] 124 K[Note 4]	76 K[Note 3] 124 K[Note 4] 124 K[Note 4]
External bus interface	Bus type	–	–	–	Multiplexed	Separate/Multiplexed	Multiplexed	Separate/Multiplexed	–	–	–	Separate/Multiplexed	Separate/Multiplexed
	Address bus	–	–	–	16	24	16	24	–	–	–	22	24
	Data bus	–	–	–	8/16	8/16	8/16	8/16	–	–	–	8/16	8/16
	Chip select signal	–	–	–	3	3	3	3	–	–	–	2	3
Power supply voltage		2.85 to 3.6 V (A/D converter, USB controller: 3.0 to 3.6 V)					2.85 to 3.6 V (A/D converter, USB controller: 3.0 to 3.6 V)		2.85 to 3.6 V (A/ D converter, USB controller: 3.0 to 3.6 V)				
Clock	Main clock	24 to 48 MHz	24 to 48 MHz	24 to 48 MHz	24 to 48 MHz	24 to 48 MHz	24 to 48 MHz	24 to 48 MHz	24 to 50 MHz	24 to 50 MHz	24 to 50 MHz	24 to 50 MHz	24 to 50 MHz
	Subclock (crystal resonator)	32.768 kHz	32.768 kHz	32.768 kHz	32.768 kHz	32.768 kHz	32.768 kHz	32.768 kHz	32.768 kHz	32.768 kHz	32.768 kHz	32.768 kHz	32.768 kHz
	Internal oscillation clock	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)	220 kHz (TYP.)
Port	I/O	25 (of which 5 V tolerance: 13)	32 (of which 5 V tolerance: 15)	45 (of which 5 V tolerance: 18)	77 (of which 5 V tolerance: 24)	96 (of which 5 V tolerance: 27)	75 (of which 5 V tolerance: 22)	96 (of which 5 V tolerance: 27)	29 (of which 5 V tolerance: 14)	41 (of which 5 V tolerance: 19)	64 (of which 5 V tolerance: 28)	84 (of which 5 V tolerance: 48)	100 (of which 5 V tolerance: 59)
	Input	–	–	–	–	–	–	–	–	–	–	–	–
Timer/counter	16-bit timer (TMQ/TAB) Number of channels	1	1	1	2	2	2	2	1	1	1	2	2
	Function	Interval timer/external event counter/ PWM output (3 channels max.)/pulse width measurement/square-wave output/one-shot pulse output											
	16-bit timer (TMP/TAA) Number of channels	4	4	4	6	6	6	6	4	4	4	6	6
	Function	Interval timer/external event counter/PWM output/pulse width measurement/square-wave output/one-shot pulse output											
	16-bit timer (TMT) Number of channels	1	1	1	1	1	1	1	1	1	1	1	1
	Function	Interval timer, external event counter/ PWM output/pulse width measurement/square-wave output/ one-shot pulse output/encoder counter											
	16-bit timer (TMM) Number of channels	4	4	4	4	4	4	4	4	4	4	4	4
	Function	Interval timer											
	Watch timer	–	–	–	–	–	–	–	–	–	–	–	–
	Real-time counter (RTC)	1	1	1	1	1	1	1	1	1	1	1	1
	Watchdog timer (WDT)	1	1	1	1	1	1	1	1	1	1	1	1
Serial interface	CSI	1	1	1	2	2	2	2	1	2	2	1 [Notes 5, 6]	1 [Notes 5, 6]
	CSI with automatic transmit/receive functions (32-byte buffer)	–	–	–	–	–	–	–	–	–	–	–	–
	UART	–	–	–	–	–	–	–	–	–	–	–	–
	I²C	–	–	–	–	–	–	–	–	–	–	–	1
	UART/CSI	2 [Note 7]	2 [Note 7]	2 [Note 7]	2 [Note 7]	2 [Note 7]	2 [Note 7]	2 [Note 7]	1 [Note 7]	1 [Note 7]	1 [Note 7]	4 [Notes 6, 7, 8, 9]	6 [Notes 7, 8, 9]
	UART/I²C	–	1 [Note 7]	–	1 [Note 7]	–	2 [Note 7]	1 [Note 7]	2 [Note 7]	1 [Note 7]	2 [Note 7]	1 [Note 7]	–	1 [Note 7]	–	1 [Note 7]	–
	CSI/I²C	–	–	–	–	–	–	–	–	–	–	–	–
	UART/CSI/I²C	1 [Note 7]	1 [Note 7]	1 [Note 7]	1 [Note 7]	1 [Note 7]	1 [Note 7]	1 [Note 7]	1 [Note 7]	2 [Note 7]	2 [Note 7]	3 [Notes 5, 6, 7]	3 [Notes 5, 6, 7]
	UART/I²C/CAN	–	–	1 [Note 7]	–	1 [Note 7]	–	1 [Note 7]	1 [Note 7]	–	–	1 [Note 7]	–	1 [Note 7]	–	1 [Note 7]	–	1 [Note 7]	–	1 [Note 7]
USB controller	USB2.0 function	1 (full-speed)	1 (full-speed)	1 (full-speed)	1 (full-speed)	1 (full-speed)	1 (full-speed)	1 (full-speed)	1 (full-speed)	1 (full-speed)	1 (full-speed)	1 (full-speed)	1 (full-speed)
	USB2.0 host	–	–	–	–	–	1 (full-speed)	1 (full-speed)	–	–	–	–	–
Ethernet controller		–	–	–	–	–	–	–	1	1	1	1	1
A/D converter	12-bit	–	–	–	–	–	–	–	–	–	–	–	–
	10-bit	5	6	10	12	12	12	12	8	8	10	10	12
D/A converter (8-bit)		–	1	1	2	2	2	2	–	–	–	–	–
DMA controller		4 [Note 10]	4 [Note 10]	4 [Note 10]	4 [Note 10]	4 [Note 10]	4 [Note 10]	4 [Note 10]	4 [Note 10]	4 [Note 10]	4 [Note 10]	4 [Note 10]	4 [Note 10]
Interrupt source	External	10	10	11	17	20	15	20	11	20	22	22	27
	Internal	52	54	58	54	58	69	73	69	73	72	72	62	66	66	67	66	70	78	82	84	88
On-chip debug function	MINICUBE	Provided	Provided	Provided	Provided	Provided	Provided	Provided	Provided	Provided	Provided	Provided	Provided
	MINICUBE2	Provided	Provided	Provided	Provided	Provided	Provided	Provided	Provided	Provided	Provided	Provided	Provided
Other peripheral I/O functions		On-chip LVI, clock monitor, RAM hold flag, real-time output, CRC		On-chip LVI, clock monitor, RAM hold flag, Hi-Z output control, real-time output, CRC		motor control (1 ch), CRC	On-chip LVI, clock monitor, RAM hold flag, motor control (1 ch), Hi-Z output control, real-time output, CRC		On-chip LVI, clock monitor, RAM hold flag, CRC	On-chip LVI, clock monitor, RAM hold flag, motor control (1 ch), CRC		On-chip LVI, clock monitor, RAM hold flag, motor control (1 ch), Hi-Z output control, real-time output, CRC	
Operating ambient temperature		−40 to +85°C					−40 to +85°C		−40 to +85°C				

Notes 1. Under development. **2.** Contains an 8 KB area for data use only. **3.** Contains a 16 KB area for data use only. **4.** Contains a 64 KB area for data use only. **5.** One CSI channel is assigned to two different pins. **6.** One CSI channel includes a FIFO buffer. **7.** UART supports LIN. **8.** One UART/CSI channel is assigned to two different pins. **9.** Two UART channels include a FIFO buffer. **10.** Transfer to/from on-chip peripherals, internal RAM, and external memory.

Product specifications (4/4)

Generic Name		V850E2/MN4 Note 1			
Pin Count		304-pin			
Part Number		μPD70F3510	μPD70F3512	μPD70F3514	μPD70F3515
CPU core		V850E2M		V850E2M × 2	
CPU performance (Dhrystone)		512MIPS (@200MHz)			
Flash memory (bytes)		1 M	1 M	1 M	2 M
RAM (bytes)		64 K	64 K	64 K × 2	64 K × 2
External bus interface	Bus type	Separate			
	Address bus	26			
	Data bus	8/16/32, 16/32			
	Chip select signal	4, 5			
Power supply voltage		1.1 to 1.3 V (internal)/3.0 to 3.6 V (external)/analog system: 3.0 to 3.6 V or 4.5 to 5.5 V Note 2			
Clock		144 to 200 MHz			
Port	I/O	181			
	Input	7			
Timer/counter	32-bit timer	Number of channels	4 channels × 1 unit		
		Function	Timer array unit		
	16-bit timer	Number of channels	16 channels × 4 unit		
		Function	Timer array unit		
	16-bit encoder timer	2			
	OS timer	1		2	
	Watchdog timer (WDT)	1		2	
Serial interface	UART/CSI	4			
	UART/CSI/I²C	6 Note 3		4 Note 4	
	UART/CSI/I²C/CAN	–		2 Note 5	
USB controller	USB2.0 function	1 (full-speed)			
	USB2.0 host	1 (full-speed)			
Ethernet controller		–		1	
A/D converter	12-bit	12 (using 5 V analog power supply)			
	10-bit	12 (using 3.3 V analog power supply)			
DMA controller		16			
Interrupt source	External	29	29	29	29
	Internal	180	190	196	
On-chip debug function	MINICUBE	Provided			
	MINICUBE2	–			
Other peripheral I/O functions		H-bus shared memory: 64 KB H-bus memory side cache: 16 KB Dedicated DMA for secondary memory controller Inverter timer support possible Boundary scan			
Operating ambient temperature		−40 to +100℃			

Notes 1. Under development
2. 10-bit resolution when using 3.3 V analog power supply and 12-bit resolution when using 5 V analog power supply.
3. Of which 4 UART/CSI channels include a FIFO buffer.
4. Of which 3 UART/CSI channels include a FIFO buffer.
5. Of which 1 UART/CSI channel includes a FIFO buffer.

The Microcontrollers page on the Renesas Electronics website provides a range of information, including All Flash documentation and other contents.

http://www2.renesas.com/micro/en/promotion/allflash/
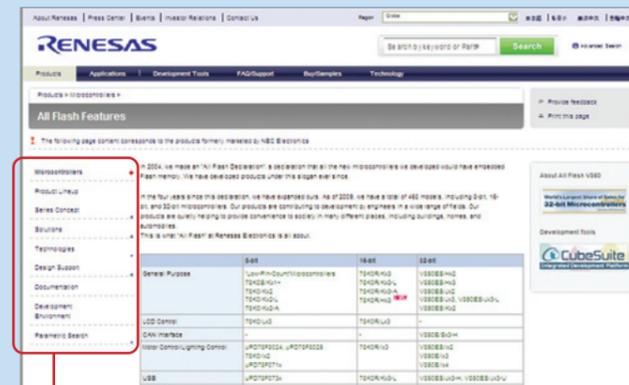
■ Design Support
Characteristic data and sample programs can be downloaded from this area.
■ Documentation
Pamphlets and documents can be searched for and downloaded from this area.
■ Development Environment
Information about development tools can be found in this area.
■ Parametric Search
Click here to select a product based on functional or characteristics parameters.

See our website for a comprehensive list of partner companies providing products for Renesas Electronics All Flash microcontrollers.

http://www.renesas.com/products/tools/partner_information/partners_landing.jsp
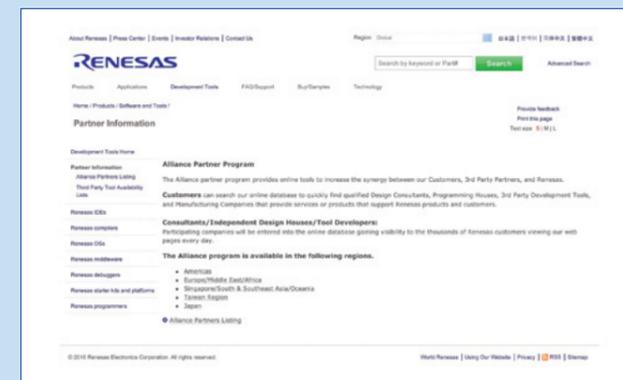
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Renesas Microcomputer 32-bit All Flash

Renesas Electronics Corporation

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http://www.renesas.com

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