RENESAS

Embedded System Solutions for

Medical Electronics

Renesas Electronics America
www.renesas.com

Delivering Proven Prescriptions for

Renesas Electronics is the recognized world leader in microcontrollers and embedded system solutions. Our innovative semiconductor technology supports requirements for advanced connectivity, low power operation, data security and more. The 11 wafer fabrication plants and 17 test and assembly plants owned and operated worldwide by Renesas ensure predictability in supply management and product life cycle. Additionally, tight quality assurance is enforced during design, manufacturing and testing so that you receive exceptionally reliable products.

- Renesas is the top supplier of 8-bit, 16-bit and 32-bit MCUs, worldwide
- Products are supported from 10 to 15 Years
- Manufacturing has achieved the exceptional quality desired for supporting the medical industry

Member of Industry Alliances

Renesas Electronics is an active member in key organizations that support the medical electronics industry, including the Continua Health Alliance and the ANT+ Alliance.

Continua HEALTH ALLIANCE

ANT+

A Complete Portfolio of Components, Tools and Solutions

Microcontrollers

A large portfolio of low-power, high-performance MCUs with DSP capability, safety features, and scalable memory

MCU Family		Unique Attributes
32-bit	SH-2A	VGA Video support, FPU
	RX600	High-Performance, Direct-Drive TFT, FPU
	RX200	Low Power with 50MHz operating speed
	V850ES/Jx3-L	Low Power with up to 1MB Flash
8/16-bit	RL78	Low Power, Snooze Mode for wearable sensors
	78K0R/Lx3	12-bit ADC, 12-bit DAC, LCD MCU
	R8C/3xT	Special hardware supporting Capacitive Touch

System Components

EEPROM, protection diodes and power MOSFETs

Memory and Power	Unique Attributes
Serial EEPROMs	2Kbit to 1Mbit density, I2C or SPI interface
Zener Diodes	Single-device-package, multiple-device package, small package size
Power MOSFETs	Low RDS_{on} for fast control

Solutions

Wired and wireless connectivity, cost-effective displays, and enhanced user interfaces

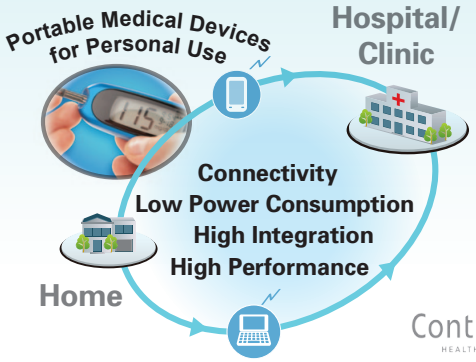
Vast Ecosystem and Third-Party Tools

Compiler, debugger and complete development tools are complemented with industry-leading FDA compliance solution, RTOS and other third party tools

Innovation, Quality and Longevity

Connected medical devices

Personal medical devices increasingly automate the transfer of information to medical professionals. Renesas MCUs have proven on-chip connectivity features that simplify system designs.



- USB
- WiFi
- Ethernet
- Bluetooth LE[1]
- Continua Standard
- ANT+

Medical safety issues

The combination of safety regulation and standards demands a high level of fail detection mechanism. Renesas MCUs integrate a number of features to simplify compliance.

- Specialized RAM and Flash check to ensure data and code integrity
- Memory Protection Unit to detect illegal memory access
- Clock monitor for detecting clock anomalies

Battery-powered portable devices and wearable sensors

Mobile medical devices and wearable sensors require greater computing performance within limited power budgets. Renesas has many MCUs with suitable features and capabilities.

- MCUs with low µA/DMIPS do more work with less current
- Low supply voltage extends battery life
- Small packages for wearable sensors

Protection from cloning and hacking

Complicated medical supply chains and device hacking have become important security concerns. Tampered and cloned devices with degraded capabilities can damage a brand's reputation. Renesas' proven authentication solutions provide flexibility for ensuring product authenticity and proper operation.

- Anti-tamper mechanism
- Authentication of genuine equipment
- Enforcement of expiration dates and other usage controls

Signal processing to support improved sensing for better diagnostics

The increased signal acquisition accuracy requires sophisticated digital signal processing (DSP) to improve diagnostics. Renesas MCUs have DSP functions such as a double precision floating point unit. They can accelerate algorithm computation.

- Integrated FPU with high operating frequency to maintain precision
- Fast multiplication operation to speed up algorithm
- Optimized architecture for high throughput

Enhanced user interfaces

Medical equipment that incorporates video, audio and touch technology is simpler to operate and more intuitive to control. Renesas has a line of solutions, including support for VGA video, OpenVG 2D animation, cost-optimized WVGA TFT, and capacitive touch key with tactile haptic feedback capability[2].

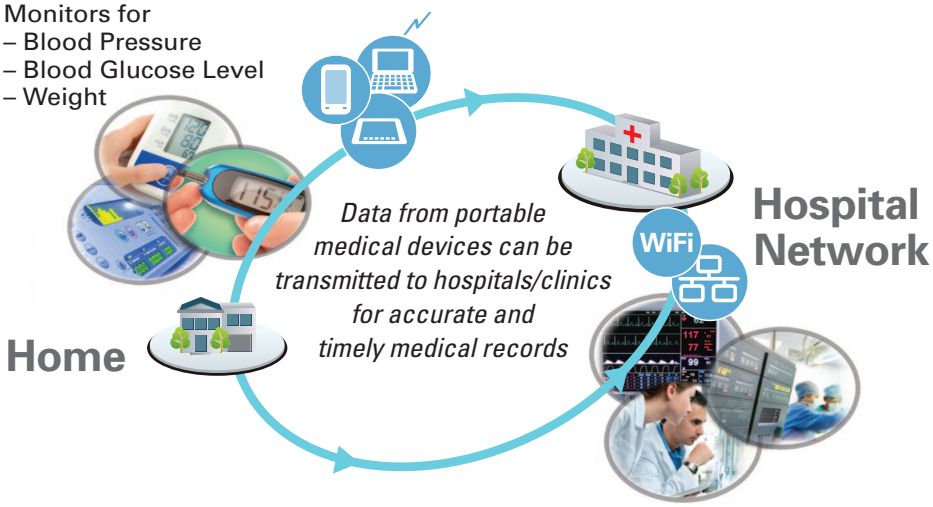
- VGA support with Video In/Video Out
- Hardware assisted OpenVG for 2D animation
- Cost optimized WVGA TFT solution
- Capacitive touch with haptic feed-back for improved control capability[2]

1. Available in 2012. 2. Offered through Immersion Corporation.

Connectivity

Continua and ANT+ Demonstration Support for Connected Medical and Fitness Devices

Monitors for
– Blood Pressure
– Blood Glucose Level
– Weight

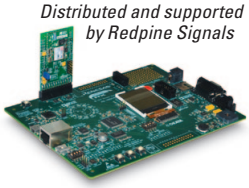


Continua Demonstration Platform*

ANT+ Demonstration Platform*

WiFi Evaluation Kits
PN: RS-RL78G13-220X
PN: RS-RX62N-2201

Distributed and supported by Redpine Signals



Ethernet Evaluation Kits
PN: YRDKRX62N

Connected medical and fitness devices apply diverse technologies to form networks.

The Continua Health Alliance has proposed an end-to-end architecture that deploys multiple connectivity technologies, from USB, Bluetooth® and ZigBee® in medical devices, to other industrial standards that govern exchange protocols in the Medical IT infrastructure.

Inside hospitals today, the predominant networking technologies are WiFi and Ethernet. And for health and fitness equipment, the ANT+ low-power radio technology is a popular choice for simple data exchanges, such as between a heart-rate monitor and a sports watch.

Renesas MCUs support a wide variety of connectivity solutions and industry standards.

Continua HEALTH ALLIANCE

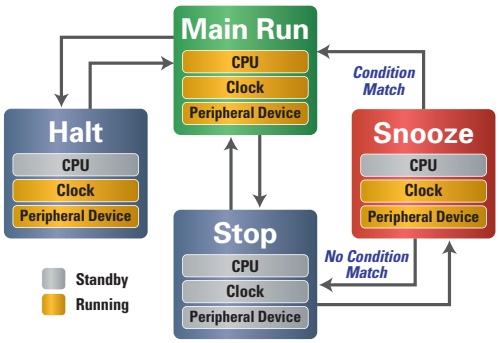
ANT+

*Contact sales for demonstrations

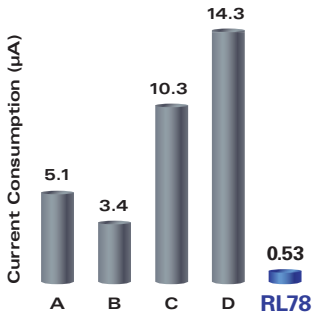
Portable Devices

Low Power 16-bit RL78 MCU for Wearable Sensors

– Multiple modes for activating specific functions only when needed
– Snooze mode that enables serial interfaces and/or ADC when CPU is off
– Power-saving capability for radio networking and vital-sign monitoring



The innovative Snooze Mode featured on RL78 MCUs can reduce average power by as much as 30%



Stop Mode current consumption comparison – RL78 versus competing MCUs; Stop Mode with Low Voltage Detect (LVD) and Watchdog Timer (WDT)

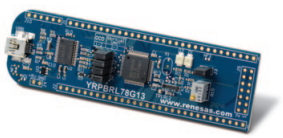
Low Power 32-bit MCUs for handheld portable devices

Family	Application	Special Features
RX200 – 130µA/DMIPS (512KB)	Low power with high processing requirements	– 50MHz CPU and Flash means no wasted energy in pre-fetch logic compared to other architecture – Memory Protection Unit for OS – Single cycle MAC to support DSP algorithm – Up to 512KB Flash with a roadmap to 1MB
V850ES/Jx3-L – 330µA/DMIPS (512KB)	Low power with large code size and USB requirements	– 20MHz CPU and Flash – 1MB Flash is available today – Integrated USB connectivity

Portability makes medical devices much more useful, eliminating the need to handle and move bulky equipment. Increasingly, new products are handheld or wearable, so system designers demand low power consumption and greater energy efficiency from the MCUs.

The RL78 is suitable for wearable sensors and coin-cell operated devices because of its snooze mode and a low operating voltage. For portable devices, where processing level is higher, the RX200 is a great option. And for portable applications that require USB connectivity, V850ES/Jx3-L is an excellent choice.

RL78 Demonstrator Board
PN: YRPBRL78G13

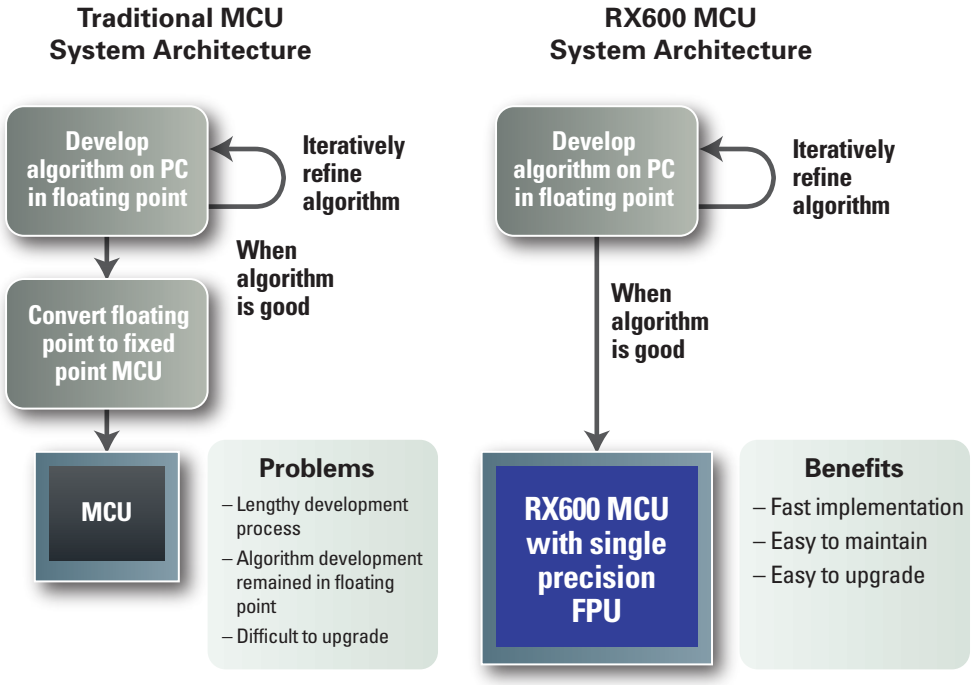


Renesas RX200 Starter Kit
PN: R0K505210S000BE

V850ES/Jx3-L
Low Power Demonstrator
PN: V850ES-JX3L-LPD

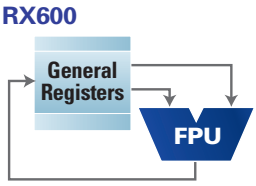
Signal Processing

Integrated FPU in RX600 Simplifies Algorithm Design, Implementation and Support

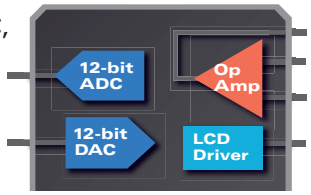


Signal acquisition has improved dramatically in recent years. Today a capable signal-processing engine is needed to handle and analyze the data to improve diagnostic results.

One Renesas solution is the single-precision floating-point unit (FPU) built into our 32-bit RX600 MCUs. It allows an algorithm to be implemented in floating point, a method that's easy to implement, maintain and upgrade.



For applications where analog functions integrated in the MCU are important, we offer the 16-bit 78K0R/Lx3 MCUs that provide a 12-bit ADC, 12-bit DAC, and op-amp.



User Interface

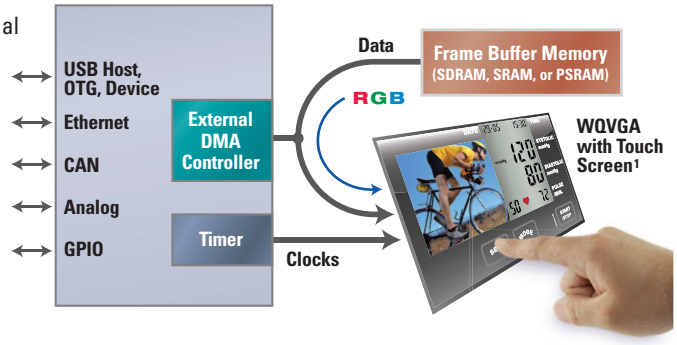
SH-2A MPU Supports OpenVG for Enhanced 2D Graphics

– Enables scrolling, zoom in/out and other 2D graphic manipulation
– On-chip hardware to accelerate OpenVG library

OpenVG

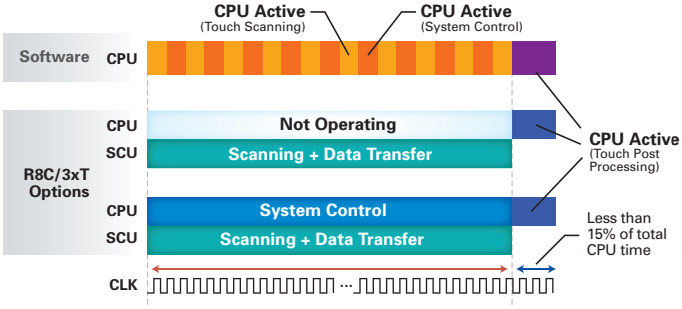
RX600 MCU TFT-LCD Direct-Drive Capability

– On-chip circuit eliminates external TFT driver
– MCU supports up to WQVGA displays



Capacitive Touch Key with Haptic Feedback

– Hardware-assisted to give CPU more cycles for algorithm processing
– Haptic feedback to improve operator control of sensing activity



Video, display and sound technology enhancements have enabled improvements in medical equipment control and operating procedures, saving time and reducing user errors. To simplify the implementation, Renesas offers a wide range of solutions that take advantage of the specialized hardware in the microcontrollers.

– VGA video support with video in/out
– OpenVG support for manipulation of 2D graphics
– Cost-optimized direct-drive WVGA TFT solution
– Integrated LCD segment display driver
– Capacitive Touch Key and Haptic solution[2]
– Audio playback support

TFT-LCD Direct-Drive Solution Kit for RX600 MCUs
PN: YLCDRSKRX62NS

Capacitive Touch Evaluation System
PN: YR8C36TAKIT01

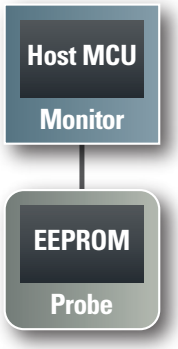
1. Resistive 2. Haptic solutions supported by Immersion Corp.

Protection from Cloning

Tamper-proof Authentication Solutions

Traditional Unsecure Authentication

- MCU reads a serial number from EEPROM
- MCU checks the serial number against a pre-defined list

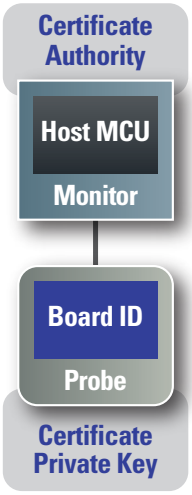


Problems

- EEPROM is not tamper-proof
- Communication is "clear text"
- Another MCU can read the number and reprogram EEPROM

Board ID Secure Authentication

- MCU and Board ID are initialized at factory
- Certificate Authority (CA) checks validity of certificate
- Host MCU sends a challenge that can be solved by Board ID's private key
- Board ID solves challenge, then sends the response required for authentication



BOARD ID
M2M AUTHENTICATION

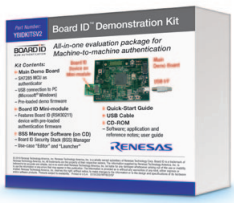
Benefits

- Board ID is tamper-proof from physical attacks
- Support different cryptography
- Solution is certified by industry standard such as Visa, Mastercard, FIPS and Common Criteria

Complex medical supply chains make it difficult to prevent the introduction of fake and refurbished equipment that doesn't perform to OEM specifications, thus creating medical risks and potentially damaging corporate reputations.

The robust, sophisticated Renesas Board ID solution uses a modern public/private key algorithm that mandates proper authentication and ensures the application of only genuine, authorized equipment. Additionally, this security scheme supports important usage controls such as duration of operation.

Board ID Demonstration Kit
PN: YBIDKITSV2



Safety Considerations

Renesas MCU Safety Features[1]

CPU

- Illegal memory access generates internal reset
- Trap instruction "FF" generates internal reset

Clock

- Stop detection made possible by Watchdog Timer (WDT)
- Frequency check enabled by a timer function

CRC Hardware

- Error detection for Flash memory
- Error detection for serial communication interface

RAM

- Parity check for internal reset when error detected on Read or Write
- Write Protection for safeguarding critical code or data

System Registers

- Write protection for setting ports, interrupts, clock, and Low Voltage Detection
- Prevents unintended updates to system critical registers

ADC

- Specialized features to facilitate self-test with Internal Vref (1.4V typ) and temperature sensor

Safety has always been a major focus in the design of medical electronic devices, and it necessitates special system design features and thorough product testing.

Renesas MCUs are ideal for medical applications because they provide dedicated hardware features for detecting operational anomalies that might cause erroneous equipment operation. The rapid detection of such problems can be used to activate functions to gracefully shut down a device and, if possible, recover the system so the medical device can deliver its full, uncorrupted capabilities.

Additionally, to simplify medical device testing, Renesas has assembled a strong ecosystem of third-party support tools.

Highlights of the Medical Ecosystem and Third-Party Support

coverity®

- Development Testing tools with out-of-the-box FDA compliance solutions

www.coverity.com

Micriμm

- Real Time Operating Systems serving the medical device community for over a decade

www.micrium.com

LDRA

- Embedded systems lifecycle management to meet safety-critical compliance needs

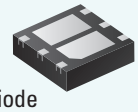
www.ldra.com

1. Implementation and support vary between MCU Families

Application/Solution Reference

Listed here is a small sample selection of applications and suggested MCUs and components that Renesas offers to support them. Please visit our Medical Solutions web page for a more complete overview of our products and solutions.

am.renesas.com/medical

Applications and Trends	Renesas Microcontroller Solution	
Blood Glucose Meter – Continua standard support – Low power – Chip-on-glass or LCD display – Multi-language support	RENESAS V850 **V850ES/JG3-L** – Up to 1MB Flash – 32-bit performance with 330µA/DMIPS (512KB) – USB Connectivity	RENESAS 78K **78K0R/Lx3** – Up to 128KB Flash – LCD with booster – 12-bit ADC, 12-bit DAC
Continuous Blood Glucose **Wireless Patch Unit** – Low power – Small package	RENESAS RL78 **RL78/G13** – Low power: 110µA/DMIPS – Snooze mode to reduce power for wireless connectivity	RENESAS 78K **78K0R/Kx3-A** – 12-bit ADC, 12-bit DAC – BGA package
Display Unit – Continua standard support – Chip-on-glass or LCD display – Advanced graphic support	RENESAS R8C **78K0R/Lx3** – Up to 60KB of Flash – Integrated LCD driver – RTC	RENESAS V850 **V850ES/JG3-L** – Low power with 330µA/DMIPS – Up to 1MB of Flash – USB connectivity
Blood Pressure Monitor – Chip-on-glass or LCD display – Voice playback – Support for Continua – Advanced ADC/DAC for more accurate sensing	RENESAS 78K **78K0R/Lx3** – Up to 128KB Flash – LCD with booster – 12-bit ADC, 12-bit DAC	RENESAS RX **RX200** – Energy efficient at 130µA/DMIPS – 12-bit ADC – 32-bit processing for multiple sensing algorithm
Oximeter & Heart Rate Monitor – Wireless operation to eliminate wiring such as in hospital beds and in ambulances – Faster and more accurate signal processing from higher quality analog front end – Reliable storage for calibration, operation statistics	RENESAS RL78 **RL78/G13** – Low power: 110µA/DMIPS – Hardware MAC – Snooze mode for low power wireless connectivity	RENESAS 78K **78K0R/Lx3** – Up to 128KB Flash – LCD with booster – 12-bit ADC, 12-bit DAC – Op-Amp
ECG/AED – Advanced signal processing – Active analysis and data logging – TFT display for instruction	RENESAS RX **RX600** – FPU to support floating algorithm – Large RAM to support data analysis	– Direct-Drive TFT; eliminates need for external TFT driver
Patient Monitor – Video and audio for better presentation – Graphic support – Increase the amount of patient data – Data processing	RENESAS SuperH – 200MHz with 400 DMIPS – UP to 1.5MB SRAM for frame buffer for video – BT656 Video In/16-bit RGB Video out	– Double precision FPU eliminates external DSP – OpenVG support
CPAP Machine – Quiet, variable speed motor control – Active analysis and data logging – Monitor pressure and moisture	RENESAS RX **RX600** – FPU to support advanced motor control – Large RAM to support data acquisition – 12-bit ADC for data acquisition	**2mm x 2mm N, P, Dual MOSFETs** – For small load switches – Built-in gate protection diode – Halogen free 

A Sample of Renesas Microcontrollers for Medical Devices

The table only lists a few memory configurations and package sizes of the highlighted microcontrollers. For more options, please refer to the product brochure and our web site.

www.renesas.com

				Memory			Perf.			System				Timers			Analog							Communication							User Interface			Package	
Family	Series	Group	Part Number	Flash	RAM	Data Flash	Max Freq.	FPU	Vcc	External Data Bus	Power On Reset	Low Voltage Detect	8-bit & 16-bit Timers	Watchdog Timers	Real Time Clock	A/D 10-bit	A/D 12-bit	A/D 16-bit	D/A 8-bit	D/A 10-bit	D/A 12-bit	Op-Amps	USART	SSU (SPI Compatible)	I2C	USB 2.0 Function	USB 2.0 OTG	USB 2.0 Host	10/100 Ethernet	LCD	Direct-drive TFT-LCD	Cap Touch	Package Pin Count	Starter Kit
78K0	78K0/Lx3	LF3	UPD78F0495GK-GAK-AX	60	2	–	10	–	1.8-5.5	–	Y	Y	7	1	Y	8	–	3	–	–	–	–	2	2	–	–	–	–	–	Y	–	–	LQFP 80	QB-MINI2-K0/LF3
78K0R	78K0R/Lx3	LF3	UPD78F1500AGC-GAD-AX	64	4	–	20	–	1.8-5.5	–	Y	Y	12	1	Y	–	8	–	–	–	2	2	3	2	2	–	–	–	–	Y	–	–	LQFP 80	QB-MINI2-K0R/LH3
		LF3	UPD78F1501AGC-GAD-AX	96	6												8					2	3	2	2								LQFP 80	QB-MINI2-K0R/LH3
		LG3	UPD78F1505AGC-UEU-AX	128	7												12					3	4	3	3								LQFP 100	QB-MINI2-K0R/LH3
R8C	R8C/3xT	33T	R5F21334TDFP#V2	16	1.5	4	20	–	1.8-5.5	–	Y	Y	3	1	–	12	–	–	–	–	–	–	3	–	1	–	–	–	–	–	–	Y	LQFP 32	YR8C33TKIT02
		3JT	R5F213J6TNNP#W4	32	2.5								3											1									HXQFN 40	YR8C33TKIT02
	R8C/LAxA	LA6	R5F2LA64ADFP#U0	16	2	2	20	–	1.8-5.5	–	Y	Y	6	1	–	8	–	–	–	–	–	–	1	1	1	–	–	–	–	Y	–	–	LQFP 64	R0K502LA8S000BE
		LA8	R5F2LA88ANFP#U0	64	3.5											12							2		2								LQFP 80	R0K502LA8S000BE
RL78	RL78/G12	G12	R5F1036AASP#V0	16	1.5	–	24	–	1.8-5.5	–	Y	Y	4	1	–	11	–	–	–	–	–	–	1	1	1	–	–	–	–	–	–	–	LSSOP 20	YR0K50100LS000BE
			R5F1027AANA#U0	16	1.5	2																		2	3								WQFN 24	YR0K50100LS000BE
	RL78/G13	G13	R5F100BFANA#U0	96	8	8	32	–	1.6-5.5	–	Y	Y	8	1	Y	8	–	–	–	–	–	–	3	3	4	–	–	–	–	–	–	–	WQFN 32	YR0K50100LS000BE
			R5F100BGANA#U0	128	12																												WQFN 32	YR0K50100LS000BE
			R5F100PJAFB#V0	256	20	8	32	–	1.6-5.5	–	Y	Y	12	1	Y	20	–	–	–	–	–	–	4	8	9	–	–	–	–	–	–	–	LQFP 100	YR0K50100LS000BE
			R5F100PLAFB#V0	512	32																												LQFP 100	YR0K50100LS000BE
RX	RX21x	RX210	R5F52105ADFM	128	20	8	50	–	1.62-5.5	–	Y	Y	14	2	Y	–	12	–	–	2	–	–	6	1	1	–	–	–	–	–	–	–	LQFP 64	R0K505210S000BE
			R5F52106ADFN	256	32												14						7										LQFP 80	R0K505210S000BE
			R5F52107ADFP	384	64					Y	Y	Y	14	2	Y	–	16	–	–	2	–	–	7	1	1	–	–	–	–	–	–	–	LQFP 100	R0K505210S000BE
			R5F52108ADFP	512																													LQFP 100	R0K505210S000BE
	RX61x	RX610	R5F56104VDFP#V0	768	128	32	100	Y	3.0-3.6	Y	–	–	26	1	–	16	–	–	–	–	–	–	7	–	2	–	–	–	–	–	–	–	LQFP 144	R0K556100S000BE
			R5F56108VDFP#V0	2048																				–									LQFP 144	R0K556100S000BE
	RX62x	RX621	R5F56216BDLD#U0	256	64	32	100	Y	2.7-3.6	Y	Y	Y	20	2	–	8	8	–	–	–	–	–	6	2	2	1	1	1	–	–	Y	–	TFLGA 85	R0K5562N0S000BE
			R5F56218BDFB#V0	512	96																												LQFP 144	R0K5562N0S000BE
		RX62N	R5F562N7ADFP#V0	384	64	32	100	Y	2.7-3.6	Y	Y	Y	20	2	–	8	8	–	–	–	–	–	6	2	1	1	1	1	–	–	Y	–	LQFP 100	R0K5562N0S000BE
			R5F562N8BDFB#V0	512	96																				2				1				LQFP 144	R0K5562N0S000BE
		RX62T	R5F562T6EDFM#V0	64	8	8	100	Y	2.7-3.6	–	Y	Y	10	2	–	–	8	–	–	–	–	–	3	1	1	–	–	–	–	–	–	–	LQFP 64	R0K5562T0S000BE
			R5F562TAADFF#V0	256	16	32			4.0-5.5	–			16			4																	LQFP 80	R0K5562T0S000BE
	RX63x	RX630	R5F56308DDFP#V0	512	64	32	100	–	3.0-3.6	Y	Y	Y	10	2	Y	8	14	–	–	1	–	–	9	2	2	1	–	–	–	–	–	–	LQFP 100	R0K50563NS000BE[1]
			R5F5630EDDFB#V0	2048	128								16				21			2			13	3	4								LQFP 144	R0K505630S000BE[1]
		RX631	R5F5631BDDFP#V0	1028	128	32	100	–	3.0-3.6	Y	Y	Y	10	2	Y	8	14	–	–	1	–	–	9	2	2	1	–	–	–	–	Y	–	LQFP 100	R0K50563NS000BE[2]
			R5F5631BDDFC#V0	1028									16				21			2			13	3	4	2	1	1					LQFP 176	R0K50563NS000BE[2]
		RX63N	R5F563NADDFP#V0	768	128	32	100	–	3.0-3.6	Y	Y	Y	10	2	Y	8	14	–	–	1	–	–	9	2	2	1	–	–	1	–	Y	–	LQFP 100	R0K50563NS000BE[2]
			R5F563NBDDFP#V0	1028																													LQFP 100	R0K50563NS000BE[2]
SH	SH-2A	7266	R5S72660W144FP#V0	–	1692	–	144	Y	1.15-1.35	Y	Y	–	7	1	Y	6	–	–	–	–	–	–	5	2	3	1	–	1	–	–	–	–	LQFP 144	YR0K572643S000BE-L
		7267	R5S72670W144FP#V0																				8	3									LQFP 176	YR0K572643S000BE-L
V850	V850ES/Jx3-L	JG3-L (USB)	UPD70F3843GC-UEU-AX	768	80	–	20	–	2.0-3.6	Y	–	Y	8	1	Y	12	–	–	2	–	–	–	7	5	3	1	–	–	–	–	–	–	LQFP 100	QB-MINI2-V850/JG3L+USB
			UPD70F3844F1-CAH-A	1024	80	–	20	–	2.0-3.6	Y	–	Y	8	1	Y	12	–	–	2	–	–	–	7	5	3	1	–	–	–	–	–	–	FBGA 121	QB-MINI2-V850/JG3L+USB

Footnotes: 1. Available Q4/2011 2. Available Q1/2012

Direct Third-party Support for your Applications

The Renesas ecosystem includes many products and services from third-party vendors, complementing the system development tools Renesas provides. This ecosystem also encompasses long-term support programs.

RTOS and Middleware

Micriμm

μC/OS-II

www.micrium.com

SEGGER

embOS RTOS

www.segger.com

freeRTOS

freeRTOS is available at

www.freertos.org

CMX SYSTEMS

RTX RTOS support

www.cmx.com

Integrated Development Environment

IAR SYSTEMS

IDE with optimizing C/C++ compiler and C-Spy debugging from IAR Systems

www.iar.com/ewV850

Renesas MCU Ecosystem

ALLIANCE PARTNER RENESAS

> Consultant and tool vendor network

am.renesas.com/Alliance

RENESAS UNIVERSITY PROGRAM

> University program

www.RenesasUniversity.com

Renesas INTERACTIVE

> Online training

www.RenesasInteractive.com

RenesasRulz.com

Think it. Build it. Post it.

MyRenesas

> Customized updates

am.renesas.com/MyRenesas

Software Library – *Free SW*

am.renesas.com/softwarelibrary

Free Samples

am.renesas.com/samples

Technical Support

am.renesas.com/tech_support

RENESAS

Renesas Electronics America Inc. | www.renesas.com
2880 Scott Boulevard, Santa Clara, CA 95050-2554 | Phone: 1 (408) 588-6000

Printed on Recycled Paper. 0212/1K/CPR/BCD/SP Document No.: R00SG0003EU0000_Healthcare