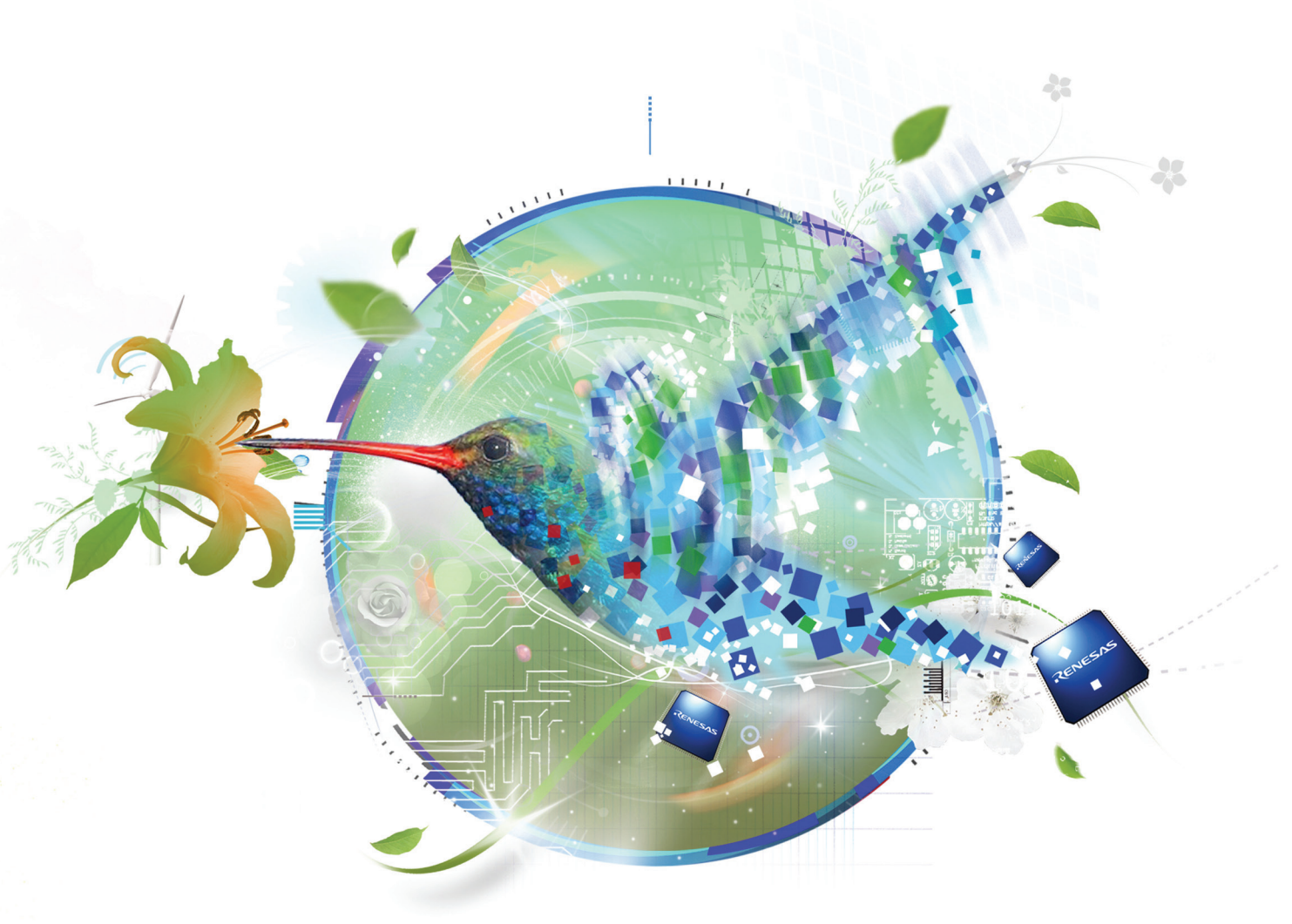


The Core Difference in Your Design

# RX100 Microcontrollers



# RX100 MCUs for True Low Power, Low Cost, High-performance Applications

The RX100 is the RX Family's new entry level 32-bit MCU, extending the RX portfolio to the low end of the spectrum in terms of pin count and flash memory size. This new entrant is a great fit for those who want to benefit from the higher performance RX 32-bit architecture at the lowest possible cost. The RX100 is the market's first 32-bit MCU to feature True Low Power, as well as fast wake-up, zero wait state flash, multiple safety functions and integrated USB 2.0 host, device and OTG support.

Designed to support a broad range of markets, the new RX111 family delivers a combination of ultra-low-power consumption, on-chip connectivity and superior performance at attractive price points for low-end 32-bit embedded applications, including mobile health care, smart meters, sensors/detectors, and industrial and building automation. It consumes only 350 nA in sleep mode and snaps into full operation in just 4.8  $\mu$ s. Memory size ranges from 8 KB to 512 KB, and compact, low-pin-count packages are available starting at 36 pins.

## Building Automation

- Thermostats
- Home Alarms
- Control Panels

## Home Appliances

- Air Conditioning
- Refrigerators
- Washing Machines

## Environmental Sensors

- Smoke
- Motion
- Humidity
- Light
- Wired & Wireless

## Portable Medical

- Glucose Meters
- Blood-pressure Monitors
- Fitness Monitors
- Wearable Sensors

## Industrial/Commercial

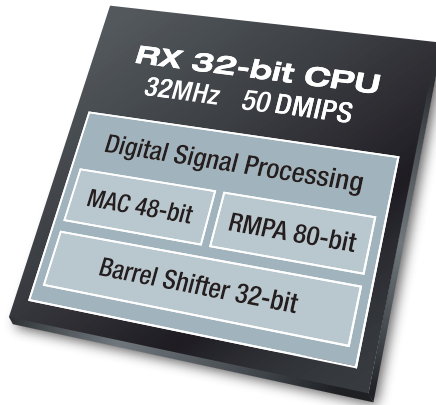
- Keyless Entry Controls
- Irrigation Systems
- Asset-tracking Equipment
- POS Terminals

## Portable Electronics

- Remote Controls
- Meters/Measuring Instruments
- Games and Toys
- MP3 Players



## Block Diagram & Features



Memory
Zero-wait Flash up to 512KB
SRAM up to 64KB
Data Flash 8 KB

System	Communication	Timers
Event Link Controller	I2C 4 ch	MTU2 16-bit 6 ch
Multifunction Pin Controller	SCI/UART 8 ch	CMT 16-bit 4 ch
Data Mgmt. DTC/DMA	SPI 4 ch	I-WDT
Interrupt Cont. 16 levels	USB 2.0 Host/Device/OTG	RTC Calendar
Clocks OSC PLL IRC	GPIO	
POR/LVD	Analog	ADC 12-bit 17ch
Safety CAC DOC CRC	Temp. Sensor	DAC 12-bit 2ch

- **Low Power, Fast Wake-up**
  - 100  $\mu$ A/MHz\*
  - 350 nA standby, 4.8  $\mu$ s wake-up
- **USB Connectivity**
  - Host, device and OTG
- **High Performance**
  - 3.08 CoreMark/MHz
  - 50 DMIPS @ 32 MHz
  - Digital Signal Processing
- **Zero wait-state Flash**
  - 1 KB Block size
  - Erase/Write operation down to 1.8 V
  - BGO Data Flash (Programmable while code is executed)
- **Safety Features**
  - Built in safety features (CAC, DOC, I-WDT, GPIO)
  - Temperature sensor
- **Scalable**
  - Fully compatible with RX600 and RX200
  - Low Pin Count (36 – 100 pins), 8 KB to 512 KB
  - Multifunction Pin Controller (MPC)

\* All peripherals OFF, running NOP.

## Safety Functions

RX100 MCUs provide six modular hardware subsystems that help products meet safety standards. Clock Accuracy Control checks that the clock frequency is within a predefined range. Oscillation Stop Detection switches the chip's main clock to an alternative source if the primary

one fails. Data Operation Circuit continuously performs a SRAM failure test independently of the CPU. The Independent Watchdog Timer (I-WDT) uses a reliable internal clock source.

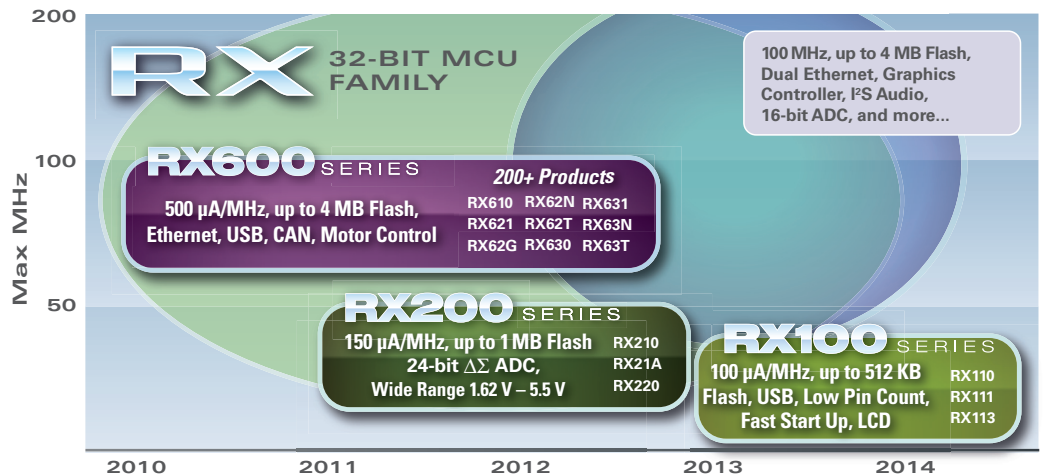
Clock	RAM	Serial Communication	OCO Dedicated for WDT
<b>CAC</b> Detects abnormal frequency	<b>Data Operation Circuit</b> Assists RAM failure check test	<b>Cyclic Redundancy Check</b> Detects serial communication data error	<b>I-WDT</b> Independent watchdog timer clock source from system clock
<b>Oscillation Stop Detection</b> Detects OSC stop Switch clock source to OCO			
			<b>GPIO</b> With read back ability

CAC: Clock frequency accuracy measurement circuit    OCO: On-chip oscillator

# RX Family Performance/Power Consumption Comparison

The RX family now contains three series of 32-bit MCUs that are optimized for a vast range of application requirements. The RX100, RX200 and RX600 series are CPU and peripheral compatible and share the same software tools and ecosystem.

MCUs in the top-level RX600 series are ideal for systems that require high-performance, excellent connectivity, LCD drive and motor control capability. By contrast, devices in the RX200 and RX100 series are optimized for ultra-low-power, portable applications, safety functionality and integrated analog interfaces.



RX100	RX200	RX600
<ul style="list-style-type: none"> <li>The entry level RX100 series is the lowest cost product line in the RX Family. The RX100 family offers ultra-low-power operation, a fast wake-up time, USB connectivity, 8 KB data Flash, a DAC, and communication channels. Pin counts in the RX100 series are as low as 36 pins. The RX100 is available with flash memory sizes from 8 KB to 512 KB.</li> </ul>	<ul style="list-style-type: none"> <li>RX210 MCUs feature memory sizes from 32 KB to 1 MB and provide an integrated 12-bit ADC, analog comparator and temperature sensor. RX220 MCUs aim at price-sensitive designs; they come in smaller packages with as few as 48 pins and offer additional options for smaller memory footprint applications. The RX21A group features advanced analog and security functions such as a 24-bit Delta-Sigma data converter and a Memory Protection Unit.</li> </ul>	<ul style="list-style-type: none"> <li>RX62N and RX63N product groups are characterized by advanced connectivity with Ethernet, USB host function, and multiple CAN interfaces; those in the RX62T, RX63T and RX62G groups have features specifically intended for controlling motors and power inverters.</li> </ul>

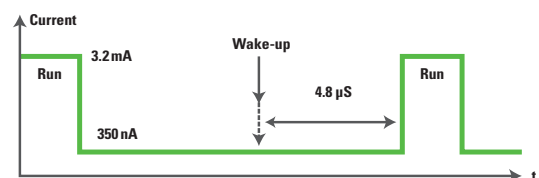
## True Low Power without Compromising Performance

- RX100 MCUs are great design choices for embedded systems that must minimize power consumption by running in sleep mode whenever possible, yet must wake-up quickly whenever there is a need to perform computing or control tasks. Renesas' True Low Power capability offers designers the lowest possible power consumption across the entire temperature and voltage range, including all peripherals and Flash memory, while also providing maximum flexibility with multiple operational and sleep modes. Four different power-saving modes are available: Run, Sleep, Deep Sleep, and Software Standby. Wake-up time in low-power mode ranges from less than 1  $\mu$ s to 4.8  $\mu$ s.
- Peripherals that aren't required can be completely shut down in every mode. A flexible clock system allows peripherals to use a clock frequency from the one driving the CPU to achieve the lowest possible level of power consumption.
- In run modes, the RX100 MCUs' three different operating modes can be applied according to the demands of the application at any point in time: high speed, middle speed and low speed.

Run Mode	ICLK Frequency	Internal Voltage Regulator Mode
High Speed	8 MHz – 32 MHz	High Power
Middle Speed	1 MHz – 12 MHz	Middle Power
Low Speed	32 kHz – 1 MHz	Low Power

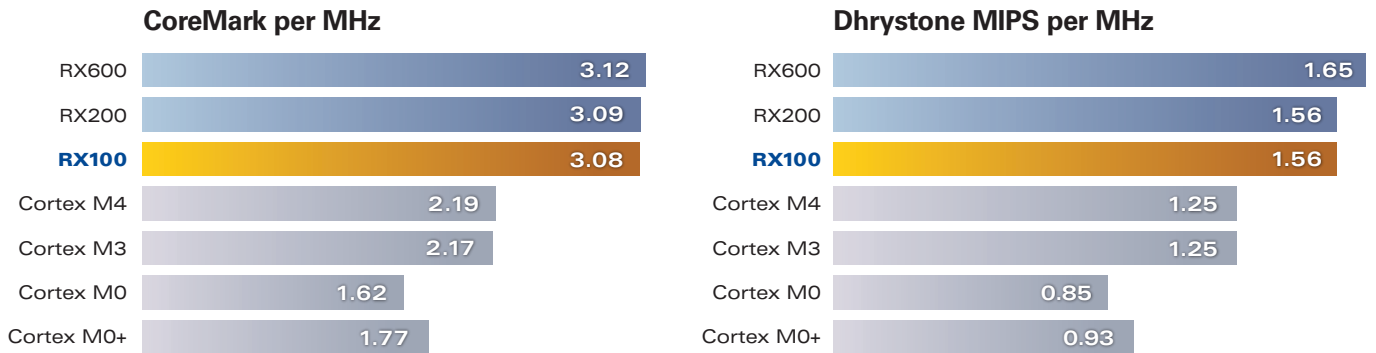
## Low Power Consumption, Fast Wake-up

- Software standby achieves a power consumption of only 350 nA, with a 4.8  $\mu$ s wake-up time. Applications requiring a shorter wake-up can utilize the Sleep and Deep-Sleep modes that reduce the delay to just 1  $\mu$ s.



# Computing Capabilities for Application Performance

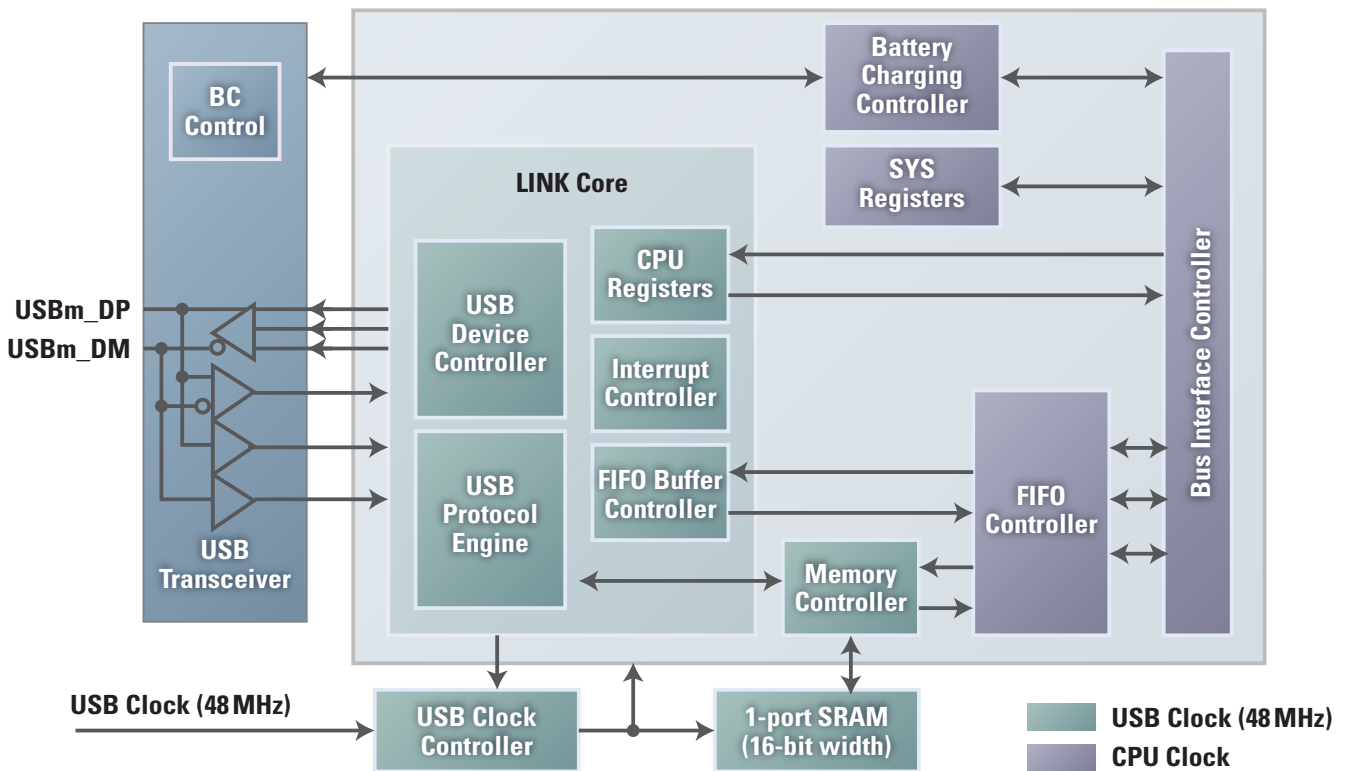
- The RX100 core features 1.56 DMIPS/MHz and 3.08 CoreMark/MHz performance and achieves 50 DMIPS at 32 MHz.



Sources: Cortex M Series CoreMark and DMIPS available on [www.arm.com](http://www.arm.com). RX200 and RX100 CoreMark estimates are from Renesas with IAR compiler. RL78 and RX600 CoreMark are published on [www.coremark.org](http://www.coremark.org). DMIPS/MHz are published on all Renesas brochures for RX and RL families.

## USB Connectivity of RX100 MCUs

- Devices in the RX111 and RX113 groups incorporate a USB2.0 Host/Function controller and an OTG communication peripheral. Operating as a host, the controller provides full-speed and low-speed data transfers. It also supports battery charging and complies with the battery charging application specification, rev 1.2.



# Comprehensive On-chip Peripherals

Many different combinations of on-chip analog, timer, communication, system and other functions are built into RX100 MCUs to save cost, simplify systems and reduce total power consumption.

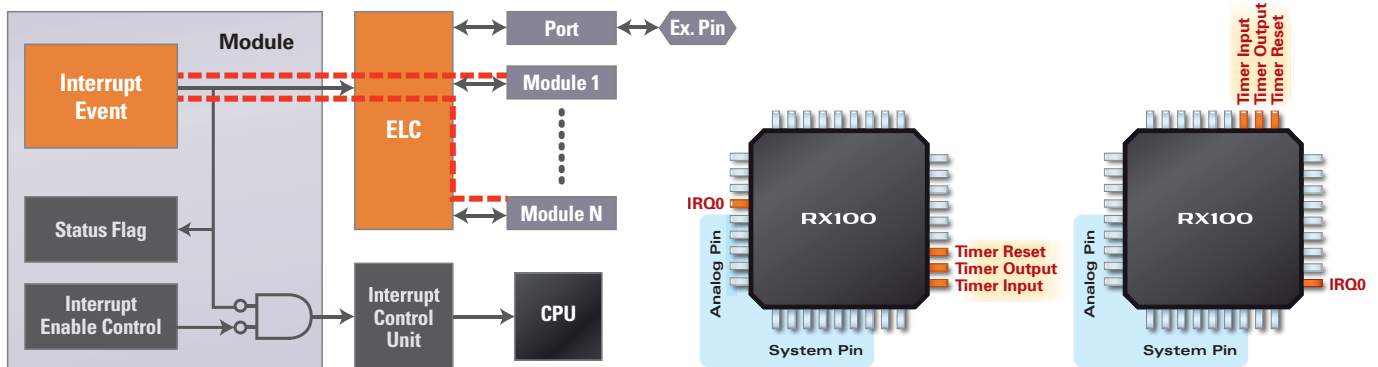
	Flash (min)	Flash (max)	SRAM (max)	Data Flash	Safety	MPC	ADC 12-bit	DAC	Temp. Sensor	MTU2	CMT	TMR	IWDT	RTC	I <sup>2</sup> C	I <sup>2</sup> S	SCI/UART	SPI	USB 2.0	LCD
<b>RX113</b>	128 KB	512 KB	64 KB	8 KB	✓	✓	17	2 x 12-bit	✓	✓	4	4	✓	✓	9	✓	8	9	✓	✓
<b>RX111</b>	16 KB	512 KB	64 KB	8 KB	✓	✓	14	2 x 8-bit	✓	✓	2	-	✓	✓	4	-	3	4	✓	-
<b>RX110</b>	8 KB	128 KB	16 KB	-	✓	✓	14	-	✓	✓	2	-	✓	✓	4	-	3	4	-	-



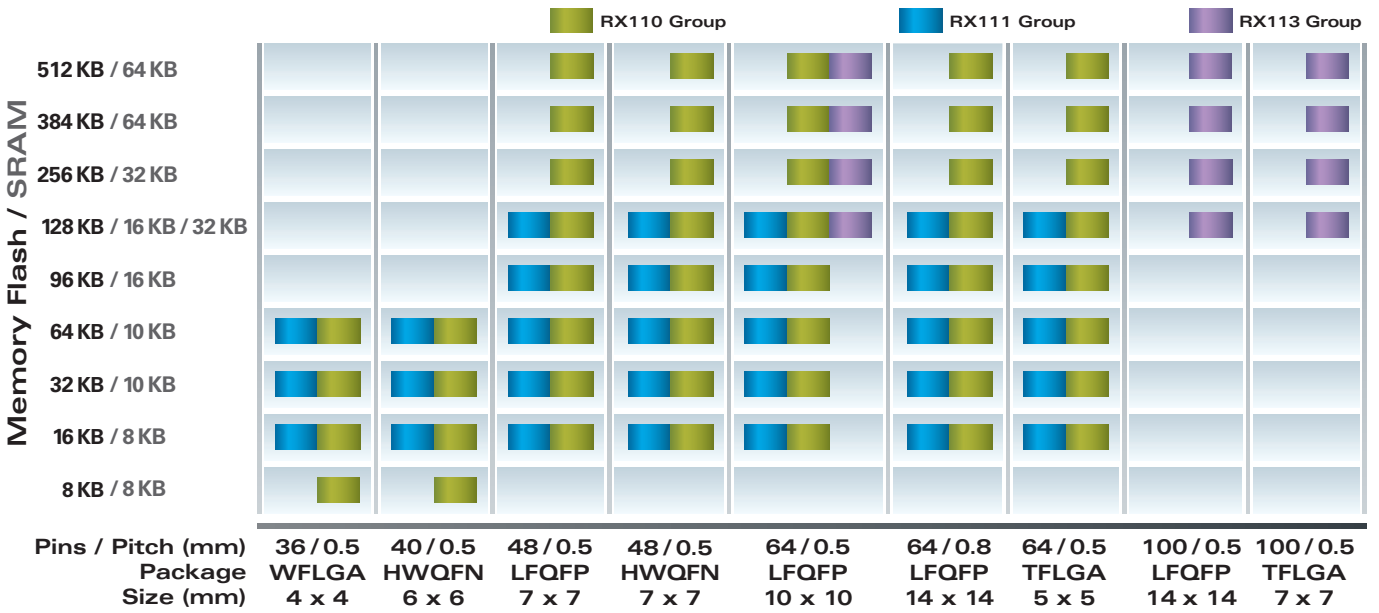
## Innovative Peripherals

The **Event Link Controller (ELC)** is an innovative way to reduce CPU load by directly routing interrupt event signals from one peripheral or module to the other; as a result, power consumption, interrupt latency and program size are minimized.

The **Multifunction Pin Controller (MPC)** allows peripheral input and output signals to be remapped to alternate ports, offering more design layout flexibility. In this example, the ports of the IRQ0 and timer have been moved to a different location of the MCU.



# RX100 MCU Series Portfolio



All devices available in -40 – 85 °C version, please check with Renesas for versions supporting 105 °C operation

## RX100 Series Devices

Device	Flash (Kbytes)	SRAM (Kbytes)	Data Flash (Kbytes)	16-bit Timers	8-bit Timers	Watchdog Timer	RTC	ADC 12-bit	DAC	I <sup>2</sup> C	I <sup>2</sup> S	SCI	SPI	USB 2.0	LCD	Package Type	Pin Pitch	Package Size
R5F5110xADFM	16 – 128	8 – 16	–	6	–	1	1	14	–	4	–	3	4	–	–	LQFP-64	0.5	10 x 10
R5F5110xADFK	16 – 128	8 – 16	–	6	–	1	1	14	–	4	–	3	4	–	–	LQFP-64	0.8	14 x 14
R5F5110xADLF	16 – 128	8 – 16	–	6	–	1	1	14	–	4	–	3	4	–	–	WFLGA-64	0.5	5 x 5
R5F5110xADFL	16 – 128	8 – 16	–	6	–	1	1	10	–	4	–	3	4	–	–	LQFP-64	0.5	7 x 7
R5F5110xADNE	16 – 128	8 – 16	–	6	–	1	1	10	–	4	–	3	4	–	–	HWQFN-40	0.5	7 x 7
R5F5110xADNF	8 – 64	8 – 10	–	6	–	1	–	8	–	4	–	3	4	–	–	HWQFN-48	0.5	6 x 6
R5F5110xADLM	8 – 64	8 – 10	–	6	–	1	–	7	–	4	–	3	4	–	–	WFLGA-36	0.5	4 x 4
R5F5111xADFM	16 – 512	8 – 64	8	8	–	1	1	14	2 x 8-bit	4	–	3	4	–	–	LQFP-64	0.5	10 x 10
R5F5111xADFK	16 – 512	8 – 64	8	8	–	1	1	14	2 x 8-bit	4	–	3	4	1	–	LQFP-64	0.8	14 x 14
R5F5111xADLF	16 – 512	8 – 64	8	8	–	1	1	14	2 x 8-bit	4	–	3	4	1	–	WFLGA-64	0.5	5 x 5
R5F5111xADFL	16 – 512	8 – 64	8	8	–	1	1	10	–	4	–	3	4	1	–	LQFP-64	0.5	7 x 7
R5F5111xADNE	16 – 512	8 – 64	8	8	–	1	1	10	–	4	–	3	4	1	–	HWQFN-40	0.5	7 x 7
R5F5111xADLM	8 – 64	8 – 10	8	8	–	1	–	8	–	4	–	3	4	1	–	HWQFN-48	0.5	6 x 6
R5F5111xADNF	8 – 64	8 – 10	8	8	–	1	–	7	–	4	–	3	4	1	–	WFLGA-36	0.5	4 x 4
R5F5113xADFP	128 – 512	32 – 64	8	10	4	1	1	17	2 x 12-bit	9	1	9	9	1	36 x 8	LQFP-100	0.5	14 x 14
R5F5113xADFM	128 – 512	32 – 64	8	10	4	1	1	17	2 x 12-bit	9	1	8	9	1	36 x 8	TFLGA-100	0.65	7 x 7
R5F5113xADFM	128 – 512	32 – 64	8	10	4	1	1	11	2 x 12-bit	7	1	6	7	1	16 x 8	LQFP-64	0.5	10 x 10

Selected examples shown here. Please check [www.renesas.eu/RX100](http://www.renesas.eu/RX100) for complete list of available devices. Note: Support for 105 °C available

# Get up and Running with the RX Ecosystem

Renesas makes it easy to launch new system designs. Our comprehensive hardware and software tools – including very low cost and free products – help swiftly advance the product development process from concept stage to final RX-based design.

## Renesas Customizable Software Library

Application Leading Tool is a support tool that makes it easy to generate code optimized for an RX100 MCU. It functions through a simple GUI windows application or via an e2studio plug-in. This tool generates customizable device drivers that compiles code and works out of the box.



[www.renesas.eu/Application Leading Tool](http://www.renesas.eu/Application%20Leading%20Tool)

## e2studio – Integrated Development Environment (IDE)

Complete development and debug environment based on the popular Eclipse platform and the associated C/C++ Development Tooling (CDT) project. Available with Renesas Compiler or the free of charge, installable GNU compiler with automatic integration into e2studio IDE and debugger. Includes free of charge email technical support.

Basic Features		Advanced Debug Features	
– Connect/Disconnect	– Variable and Expression views	– Renesas Debug view with Call Stack	– Real-time Expression view
– Run/Stop (Resume/Suspend)	– Register view	– I/O Registers view	– Real-time Memory view
– Software breakpoints	– Basic Memory view	– Trace view	– Real-time Chart view
– Source step/disassembly step	– Endian selection	– Eventpoints view	

[www.renesas.eu/e2studio](http://www.renesas.eu/e2studio)

## RX100 Renesas Promotion Board (RPB)

The board was designed to showcase RX111 low power modes, featuring Pmod and energy harvesting connectors, and comes loaded with software and tools.

- Integrated J-Link debugger
- Power measurement built in
- Applilet
- e2studio toolchain
- USB Demo



RPB Part Number: YRPBRX111  
[www.renesas.eu/RPBRX111](http://www.renesas.eu/RPBRX111)

## RX100 Renesas Starter Kits (RSK)

These complete RX111 and RX113 based hardware and software platforms provide a complete development environment for the RX100, including the E1 Debugger, a trial version of the e2studio and the RX compiler and demonstration firmware



RX111 RSK Part Number: YR0K505111S000BE  
[www.renesas.eu/RSKRX111](http://www.renesas.eu/RSKRX111)  
RX113 RSK Part Number: YR0K505113S000BE  
[www.renesas.eu/RSKRX113](http://www.renesas.eu/RSKRX113)

## Complete Debugging, Emulation, and Programming

On-chip debugging of an RX-based application is performed via a debug connection to the target and USB connection to the Windows-based IDE. The Renesas E1 and E20 debuggers offer thorough CPU control and visibility.



Renesas E1  
R0E000010KCE00  
[www.renesas.eu/tools](http://www.renesas.eu/tools)  
Renesas E20  
R0E000200KCT00  
[www.renesas.eu/tools](http://www.renesas.eu/tools)

## Third-party Solutions

Compilers	 <a href="http://www.iar.com/ewrx">www.iar.com/ewrx</a>	The IAR Embedded Workbench for RX is now available in two editions – the EWRX Standard edition and the new EWRX-8L Baseline edition, which is targeted at developers working with Renesas RX MCUs with smaller memory like the RX100 series. The Baseline edition is limited to a code size of 256 KB, but otherwise provides a fully functional IDE, including project manager, editor, compiler, assembler, linker librarian and debugger tools.	 <a href="http://www.kpitgntools.com">www.kpitgntools.com</a> KPIT GNURX Compiler
		<b>NEW:</b> Free 64 KB size-limited Kickstart version now also available!	

	 <a href="http://www.freertos.org">www.freertos.org</a>	 <a href="http://www.segger.com">www.segger.com</a>	 <a href="http://www.micrium.com">www.micrium.com</a>	 <a href="http://www.cmx.com">www.cmx.com</a>	 <a href="http://www.rowebots.com">www.rowebots.com</a>	 <a href="http://www.expresslogic.com">www.expresslogic.com</a>
RTOS	FreeRTOS	embOS	µC/OS-III	CMX-RTX	Unison	ThreadX
USB		✓	✓	✓	✓	✓

Before purchasing or using any Renesas Electronics products listed herein, please refer to the latest product manual and/or data sheet in advance.

