RENESAS

The Core Difference in Your Design

RX600 Microcontrollers

RENESAS RX RX600

NEW

RX64M featuring the RXv2 CPU Performance

- 240 DMIPS at 120MHz
- 4.25 CoreMark™/MHz

Renesas Electronics America
www.renesas.com

RX600 Series – Performance

The RX architecture is future oriented and feature rich. It's driven by a Renesas technology roadmap that focuses on the global environment and anticipates the enormous gains in sophistication that microcontroller-based products are expected to achieve in the next 10 to 20 years. Thus, the RX family of microcontrollers (MCUs) delivers superior performance in terms of core processing performance, code efficiency, and power consumption.

An extensive portfolio of on-chip mixed-signal peripherals is available, and fast 90nm and 40nm Flash memory is embedded. The embedded Flash unleashes full CPU performance, feeding instructions to the 32-bit RX CPU with no delays – no waits, no stalls – maintaining the MCU's peak performance. Memory acceleration isn't required, and the result is just pure, predictable performance.

RXv2 CPU Core, 2.00 DMIPS/MHz with FPU and DSP

Superior Architecture

133µA/MHz[2], 1.6µA RTC Standby

Power Efficiency

Code Efficiency

Up to 28%[1] Code Size Savings

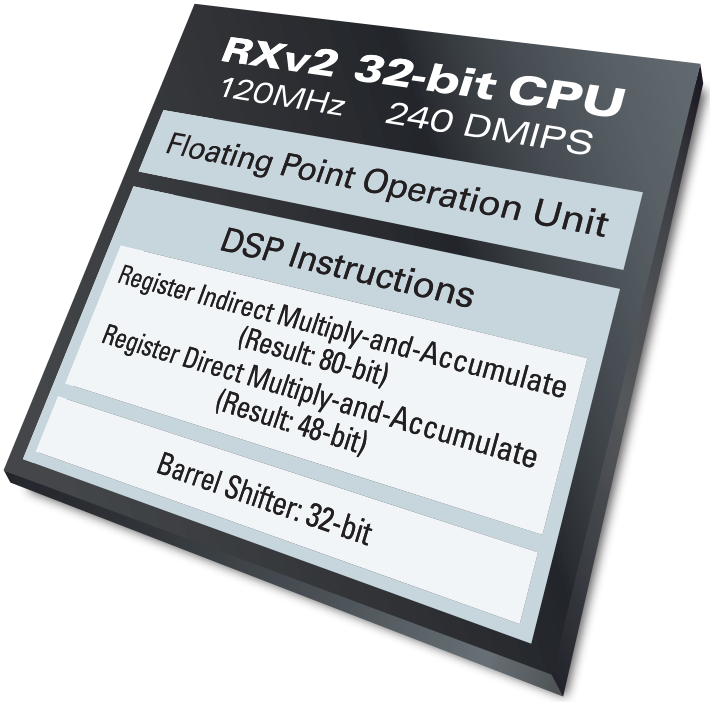
Fast Flash

Industry's Only 40nm 120MHz Embedded Flash

without Sacrifice

NEW

Introducing the RX64M Group – High Performance and Superior Connectivity



Memory
- Flash: up to 4MB
- SRAM: 512KB; ECC RAM: 32KB; Standby RAM: 8KB
- Data Flash: 64KB

System
- Data Transfer Controller: ExDMA Controller x 2 ch; DMA Controller x 8 ch
- Interrupt Controller: 16 levels, 16 pins
- Clock Generation Circuit: PLL; High-speed On-chip Oscillator
- Power-on Reset Voltage Detection Circuit
- Event Link Controller

Analog
- 12-bit ADC: 29 ch
- 12-bit DAC: 2 ch
- Temp Sensor

Timers
- Multifunction Timer Pulse Unit (MTU3): 16-bit 8 ch; 32-bit 1 ch
- General PWM Timer (GPT): 16-bit 4 ch
- Timer Pulse Unit (TPU): 16-bit 6 ch
- Programmable Pulse Generator (PPG)
- 8-bit Timer (TMR): 8-bit 4 ch
- 16-bit Timer (CMT): x 4 ch; 32-bit Timer (CMTW): x 2 ch
- Real-time Clock Calendar Function

Image Capture
- Parallel Data Capture Unit

Communication
- Ethernet Controller: 2 ch
- IEEE 1588: Clock Synchronization Control
- USB Full-speed: 2 ch
- I²C Bus Interface: x 2 ch
- Serial Communications Interface x 13 ch (incl. 4 ch with FIFO)
- Serial Peripheral Interface
- Quad Serial Peripheral Interface
- SD Host Interface
- MMC Host Interface
- Serial Sound Interface: 2 ch
- CAN: 2 ch
- External Bus: 8, 16, or 32-bit

Encryption/Safety
- Encryption Modules: AES/DES/SHA/RNG
- Memory Protection Unit
- Register Write Protection Unit
- Clock Frequency Accuracy Measurment Circuit
- CRC Calculator
- Data Operation Circuit
- Watchdog Timer: 14-bit 1 ch
- Independent Watchdog Timer: 14-bit 1 ch
- Trusted Memory Function

High Performance

- New RXv2 CPU Core offering 2.00 DMIPS per MHz and 4.25 CoreMark™ per MHz with enhancements for floating point and digital signal processing operations
- Industry's only 40nm embedded flash process with zero wait states up to 120MHz, integrating up to 4MB Flash and 512KB SRAM
- With RXv2 CPU Core and 40nm, RX64M consumes only 133µA per MHz with all peripherals off

Superior Connectivity

- Dual Ethernet with IEEE 1588 Version 2 support
- Dual USB with full speed support
- Three CAN channels
- SD Host Interface transfer speed up to 15Mbytes/sec
- MMC Interface transfer speed up to 30Mbytes/sec
- QSPI transfer speed up to 120Mbits/sec
- SPI transfer speed up to 30Mbits/sec
- SCI with FIFO transfer speed up to 15Mbits/sec
- Camera Interface with 8-bit parallel data interface
- Two channels I²S compliant Serial Sound Interface

Note 1: Renesas internal testing.

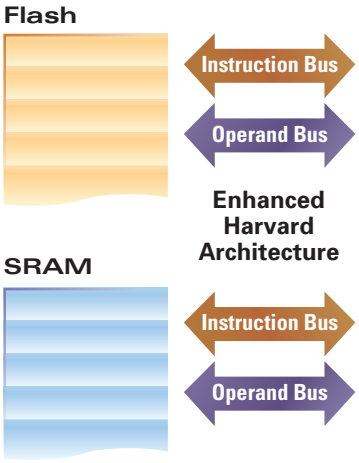
Note 2: Run mode, peripherals off.

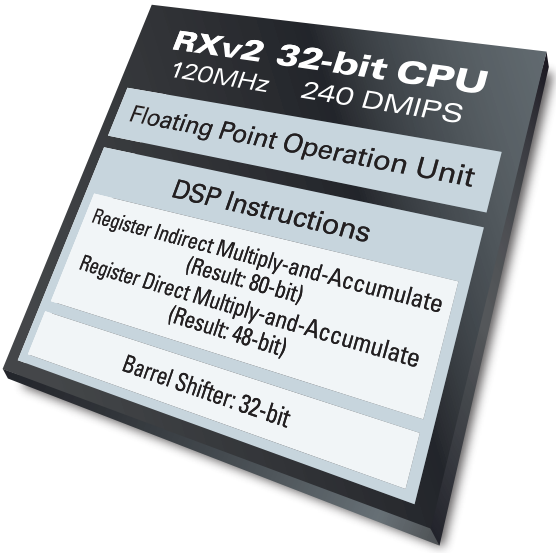
Advanced Design and Integration

RX600 Key Benefits

CPU cores in the RX family (RXv1 and RXv2) marry the speed of a RISC architecture with the flexibility and code efficiency of a CISC architecture. They interact with the flash and SRAM through an enhanced Harvard design. Both cores leverage the industry's fastest Flash memory, delivering performance as high as 2.0 DMIPS/MHz without wait states.

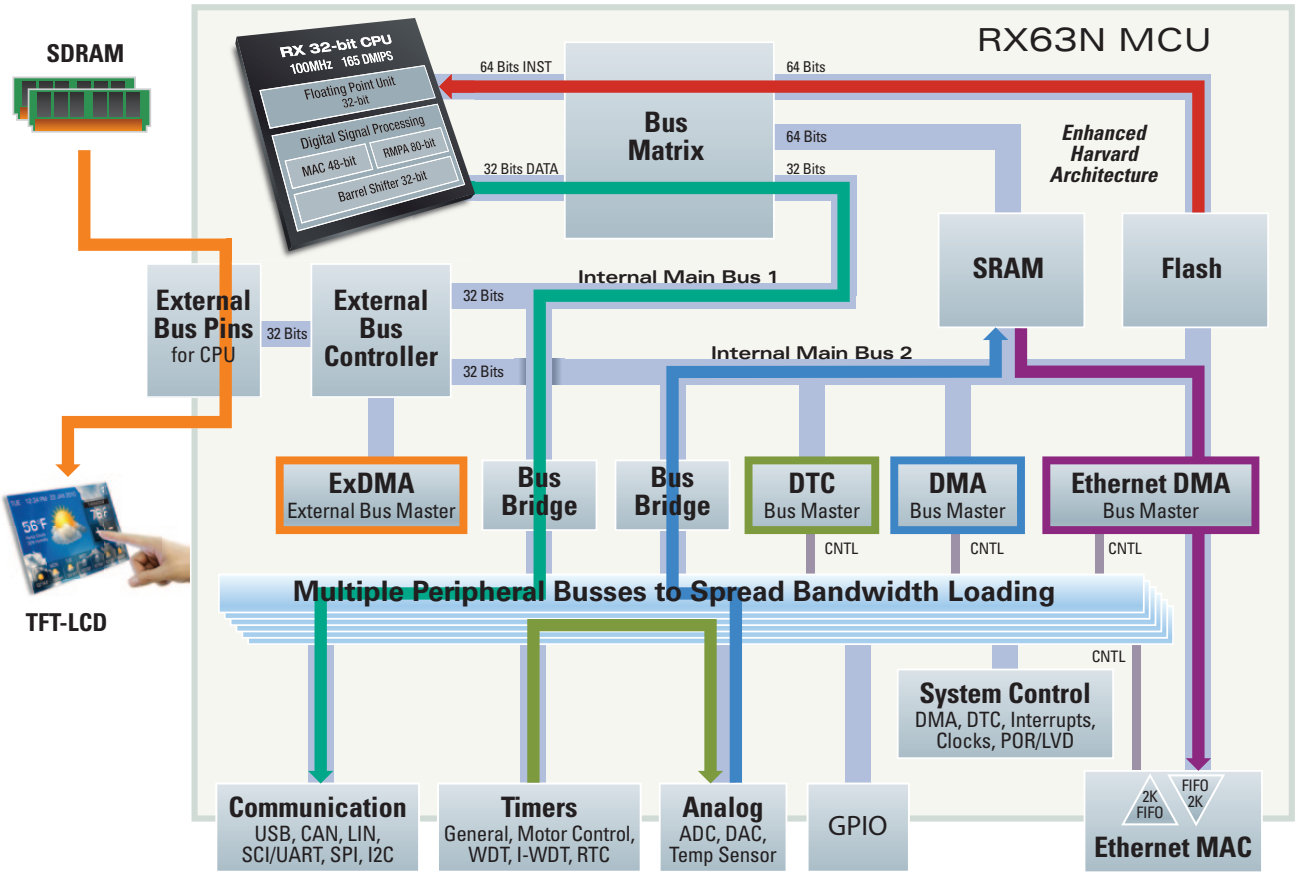
The cores are tightly coupled to FPU, MAC, and RMPA (Repeat Multiply Accumulate) functions driven by DSP and floating-point instructions to meet the processing requirements of DSC (Digital Signal Controller) type applications.





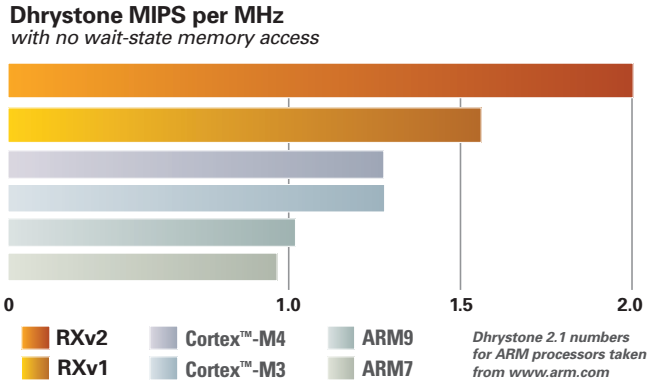
Simultaneous Data Transfers

RX MCUs use parallel busses that allow simultaneous movements of data between the CPU core, flash, SRAM, and peripherals, thereby spreading the bandwidth loading. Six peripheral busses enable a flexible distribution of slow and fast peripherals for optimized throughput. An external bus with an independent DMA moves data directly from one external device to another, such as from a graphic frame buffer to a TFT-LCD panel.

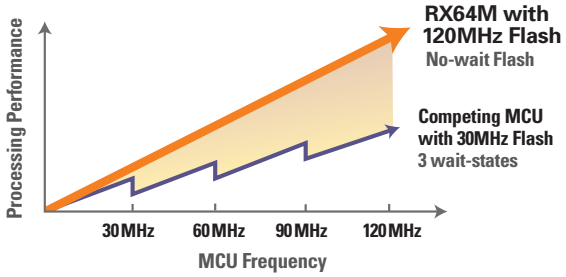


Performance

The RX Core delivers 2.00 DMIPS per MHz, achieving 240 DMIPS when running at 120MHz.



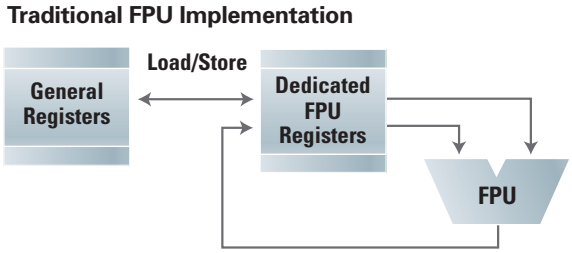
Industry's only 120MHz On-chip Flash

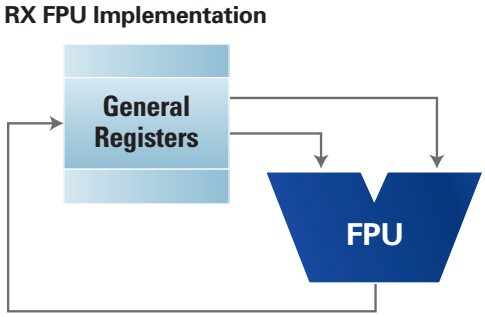


Superior FPU Implementation

The RX FPU implementation allows direct access to general registers, resulting in faster execution and smaller code size.

- RX eliminates the overhead of load/store operations
- Results in higher performance and smaller code size

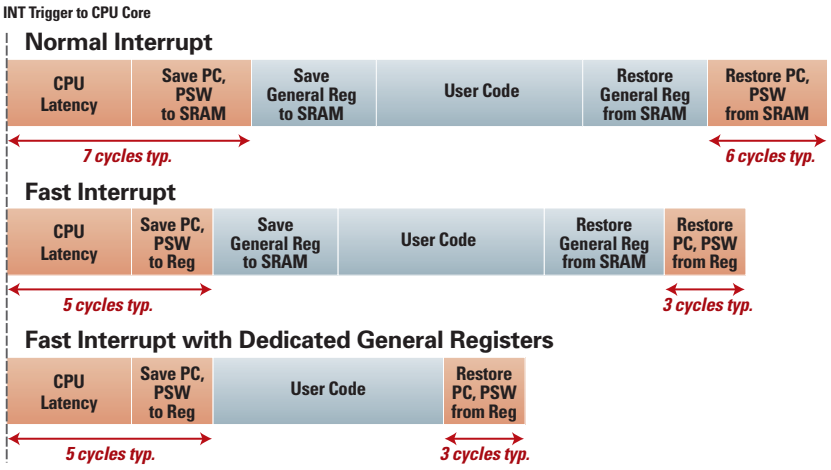




Efficient Interrupt Handling

There are flexible options to achieve minimum latency for various scenarios:

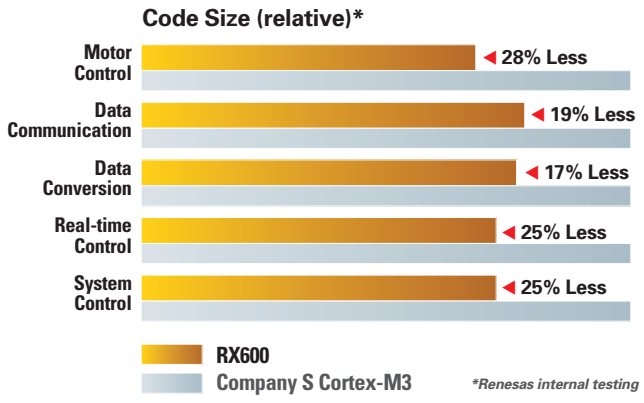
- Normal interrupt responds in as few as seven CPU clock cycles from the event until the firmware serves the interrupt.
- Fast interrupt mode can be assigned dynamically to any interrupt source, responding in just five CPU clocks using dedicated registers to save and restore the CPU state.
- All interrupt service routines can be shortened by dedicating up to four RX CPU general registers for use only by interrupts, eliminating the need to push and pop the registers to and from the stack.



Substantial Code Size Reduction

The RX CISC CPU architecture has inherent advantages over RISC CPUs in terms of code size, with RX's variable length instructions ranging from 8 bits to 64 bits, allowing the compiler to select just the right instruction to do the job.

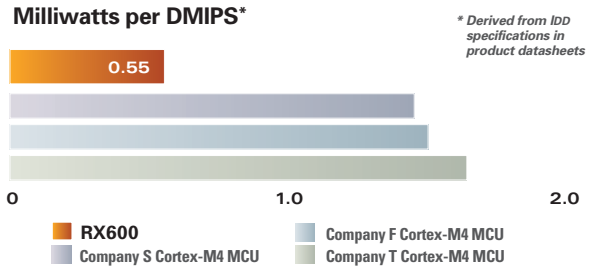
- Many RISC MCUs have only two instruction lengths, 16 bits and 32 bits, so the compiler must make compromises.
- RX CPU supports 10 addressing modes, which optimize manipulation and movement of data.
- Compiled RX code has been measured as much as 28% smaller than the same code compiled on a popular RISC MCU.

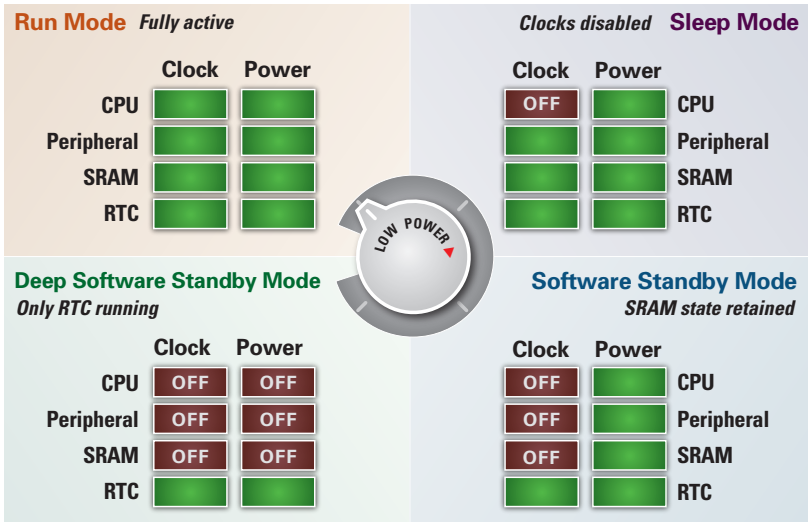


Highly Effective Power Management

Strike an optimized balance of performance and power consumption with many low-power modes of operation enabled by these design techniques:

- Flexible system clocking and gating for each peripheral
- Selective power domain gating for unused sections of the device
- Low-power, high-voltage threshold transistors minimize leakage



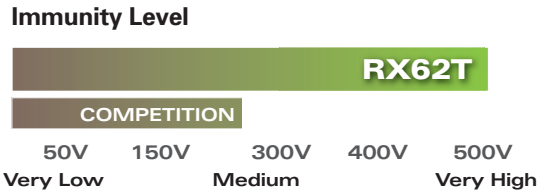


> *The RX Series has four power modes to manage precious battery energy consumption without compromising performance*

EMC Advantages – Built-in to Eliminate Add-Ons

Outstanding EMC performance of RX600 MCUs reduces system-integration problems, lowers development costs, and shortens design cycles. BOM costs drop, too, because external components can be eliminated.

- Strong electromagnetic immunity boosts system reliability
- Careful VCC and VSS layout
- Noise filters on input signals
- Advanced chip layout techniques



LANGER EMV-Technik

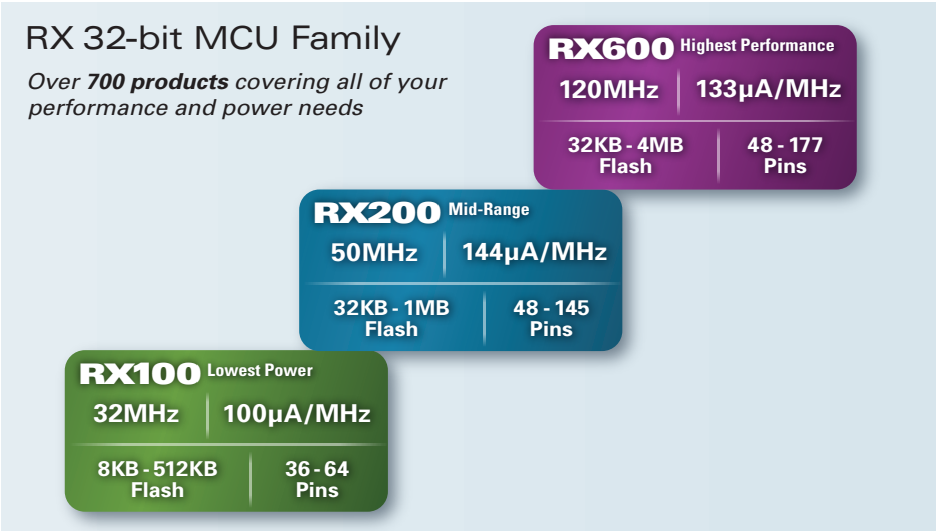
"Langer EMV and Renesas Electronics today announced that the RX600 microcontroller (MCU) family is the most robust MCU Langer EMV has ever tested against environmental noise"

Renesas press release, October 21, 2010

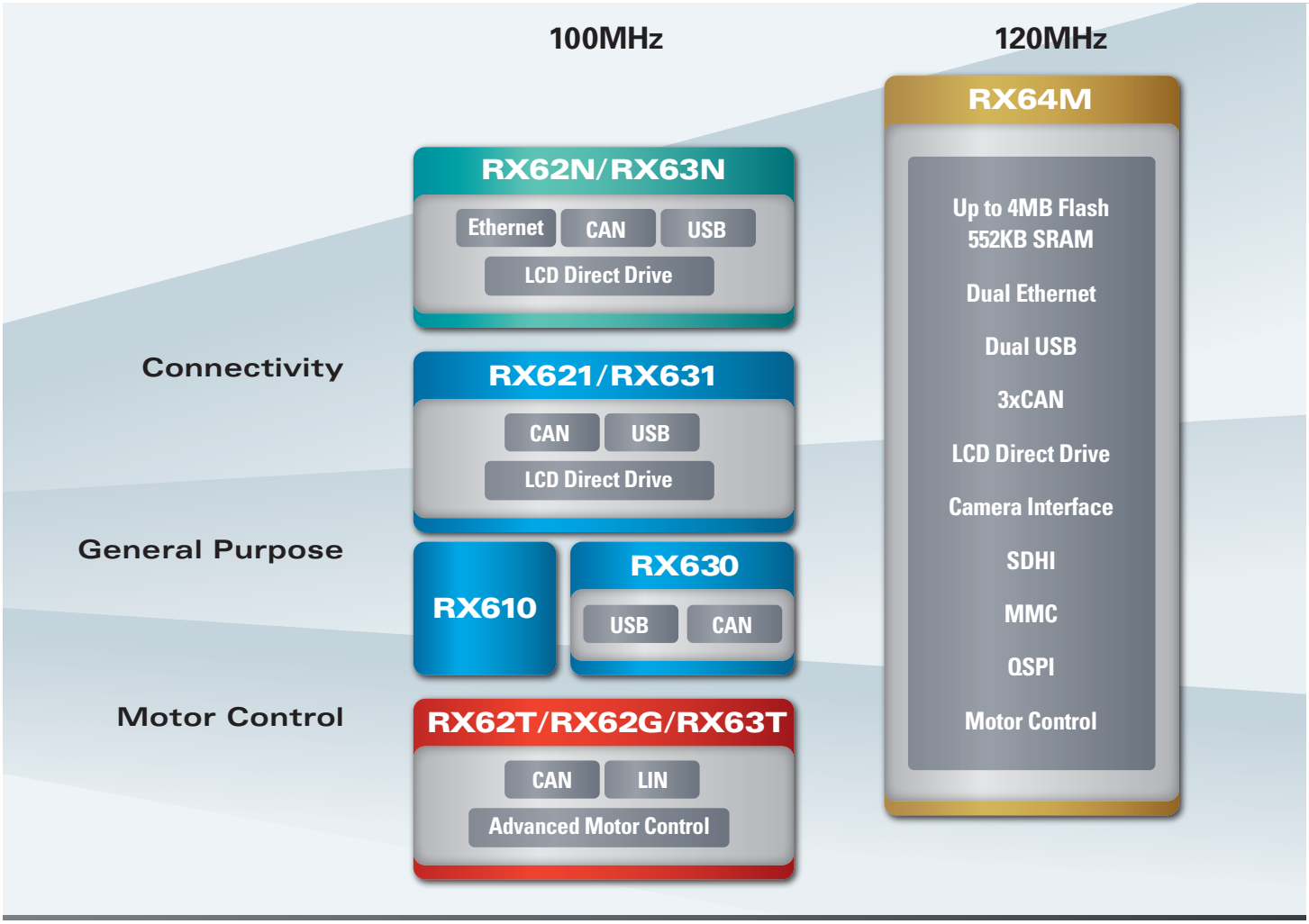
RX Family Product Portfolio

The RX family now consists of three product series containing over 700 different devices. MCUs in the RX600 series and RX64M group are ideal for applications requiring high-performance, high-efficiency processors. Devices in the RX200 and RX100 series expand the range of compatible system-design choices, adding smaller, lower power devices with fewer pins.

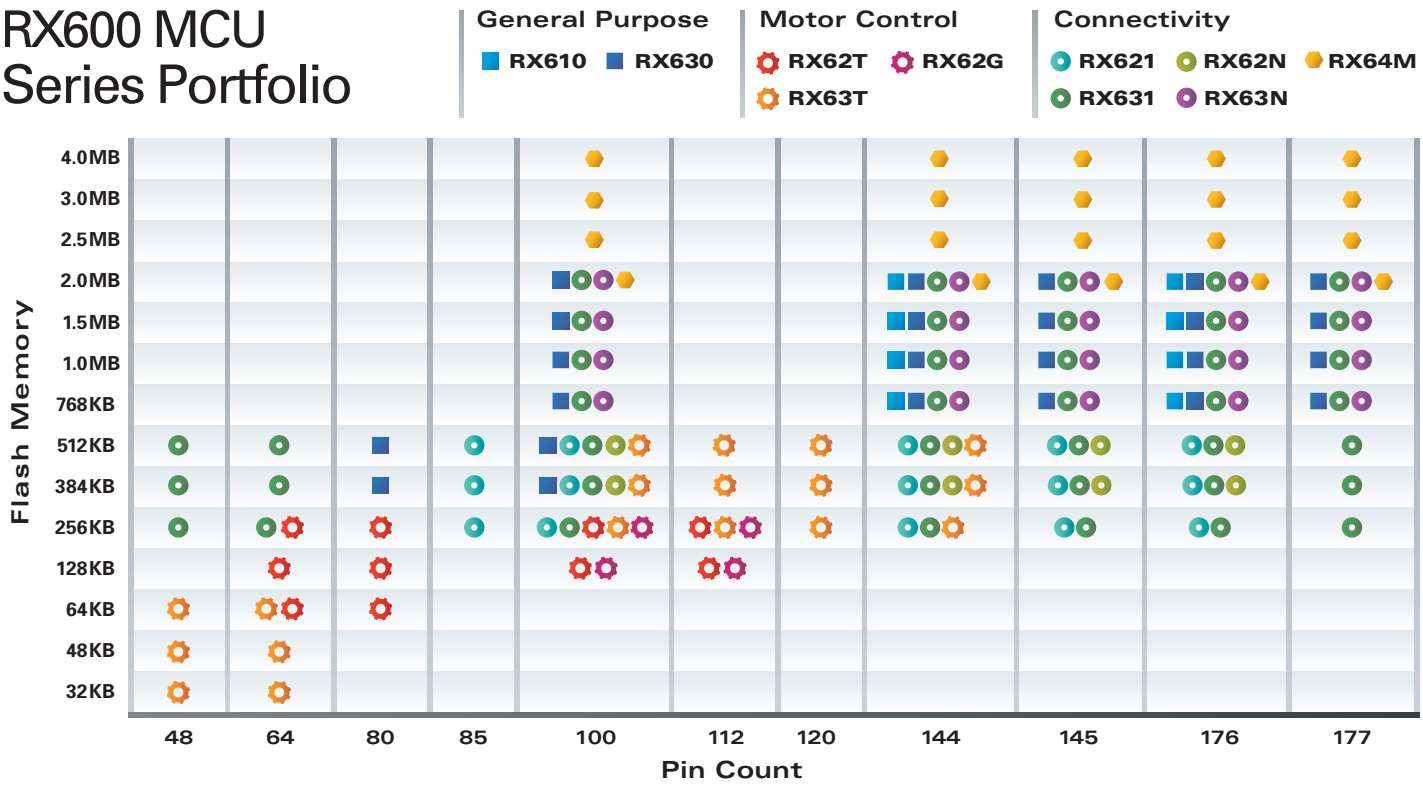
Migration from existing Renesas architectures to RX solutions is easy. And, of course, moving designs among RX family members is very easy, since RX600, RX64M, RX200 and RX100 MCUs share the same basic CPU architecture and peripherals and provide upward code compatibility. This maximizes design flexibility and facilitates software reuse.



RX600 MCU Series Roadmap



RX600 MCU Series Portfolio



Comprehensive On-chip Peripherals

To lower costs, simplify system designs, reduce total system power consumption, and enable the implementation of value-added features, a wide range of on-chip peripheral functions is clustered around the powerful CPU cores of RX MCUs. Broadly categorized into analog, timer, communication and system functions, these numerous peripherals are proven designs delivering impressive performance. The many different types of RX MCUs offer diverse sets of functions, so chip capabilities and cost can be matched to application needs.

- **RX631/63N MCUs** (100MHz RXv1 core) offer up to 2MB Flash and 256KB RAM and provide extensive connectivity features: Ethernet, CAN, and up to two USB-FS 2.0 channels, each operating in Host, Device, or OTG (On the Go) modes. They also provide up to 13 SCI, 3 SPI, and 4 I²C serial channels, analog interfaces, timers, RTC and POR/LVD functions, and more.

	Advanced Peripherals											
	Connectivity								Motor			
Group	Ethernet 10/100 MAC	USB 2.0 Host/ Device/OTG	CAN 2.0B	Graphics ExDMA	PDC (Camera I/F)	SDHI	MMC	QSPI	ADC 12-bit	MTU3	GPT	Hardware Security
RX621	–	1	1	1	–	–	–	–	–	–	–	–
RX631	–	2	3	1	1	–	–	–	–	–	–	Yes
RX62N	1	2	1	1	–	–	–	–	–	–	–	–
RX63N	1	2	3	1	1	–	–	–	–	–	–	Yes
RX610	–	–	–	–	–	–	–	–	–	–	–	–
RX630	–	1*	3	–	–	–	–	–	–	–	–	–
RX62T	–	–	1	–	–	–	–	–	8	8	4	–
RX62G	–	–	1	–	–	–	–	–	8	8	4**	–
RX63T	–	1*	1	–	–	–	–	–	8	8	8	–
RX64M	2	2	3	1	1	1	1	1	–	9	4	Yes

Connectivity
General Purpose
Motor Control
RXv2

- **RX63T MCUs** (100MHz RXv1 core) have improved motor/inverter control timers, enhanced analog peripherals and up to 512KB flash for designing precision motor control and positioning equipment. MTU3 and GPT timers enable one chip to control three motors simultaneously. The FPU and improved analog functions handle three-shunt or single-shunt vector-type motor control methods.

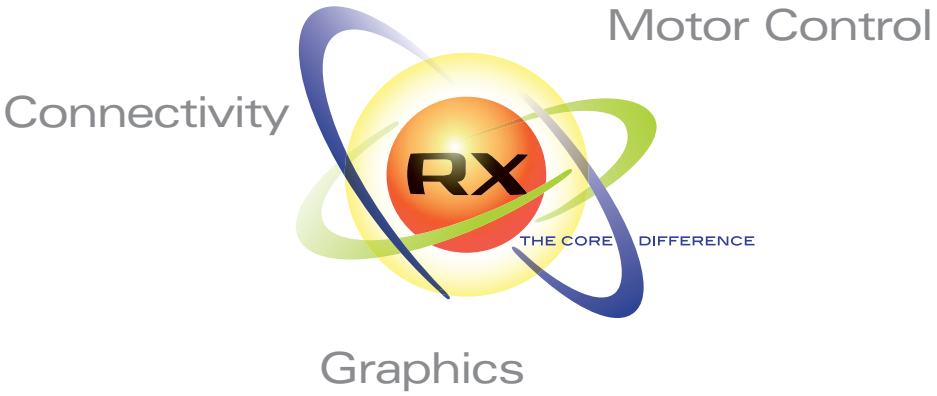
- **RX64M MCUs** (120MHz RXv2 core) have more memory (up to 4MB flash/552KB RAM) and deliver greater functionality, especially in connectivity features. Noteworthy peripheral additions include IEEE1588 Ethernet; SD card, MMC and QSPI interfaces; DES/SHA/RNG + AES encryption; improved 12-bit A/D; faster DSP, sophisticated timers; and a parallel data-capture unit (PDC) for connecting to image sensors.

Basic Peripheral Set																							
Memory			Analog					Timers									Communication						
Flash (max)	SRAM (max)	Data Flash	ADC 10-bit	DAC 10-bit	ADC 12-bit	DAC 12-bit	Temp Sensor	MTU2	TPU	PPG	TMR	CMT	WDT	I-WDT	RTC	CMTW	I²C	SSI (I²S)	SCI	ExBus	SPI	LIN
512KB	96KB	32KB	–	2	8	–	–	12	–	8	4	4	1	1	1	–	2	–	6	8/16/32	2	–
2MB	256KB	32KB	8	2	21	–	1	6	12	8	4	4	1	1	1	–	4	–	13	8/16/32	3	–
512KB	96KB	32KB	–	2	8	–	–	12	–	8	4	4	1	1	1	–	2	–	6	8/16/32	2	–
2MB	256KB	32KB	8	2	21	–	1	6	12	8	4	4	1	1	1	–	4	–	13	8/16/32	3	–
2MB	128KB	32KB	16	2	–	–	–	–	12	8	4	4	1	–	–	–	2	–	7	8/16	–	–
2MB	128KB	32KB	8	2	21	–	1	6	12	8	4	4	1	1	1	–	4	–	13	8/16/32	3	–
256KB	16KB	32KB	12	–	–	–	–	–	–	–	–	4	1	1	–	–	1	–	3	–	1	1
256KB	16KB	32KB	12	–	–	–	–	–	–	–	–	4	1	1	–	–	1	–	3	–	1	1
512KB	48KB	32KB	20	2	–	–	–	–	–	–	–	4	1	1	–	–	2	–	5	8/16	2	–
4MB	512KB	64KB	–	–	29	2	1	–	6	8	4	4	1	1	1	2	2	2	13	8/16/32	1	–

** USB device only*
*** High Resolution*

Design Versatility of the RX

System design versatility, application capability, and economic sensibility are built into the many microcontrollers in the RX family. Driven by a technology roadmap that anticipates more sophisticated applications in the next decade that demand cost effectiveness, RX devices offer abundant core performance and extensive peripheral functions enabling a variety of solutions.

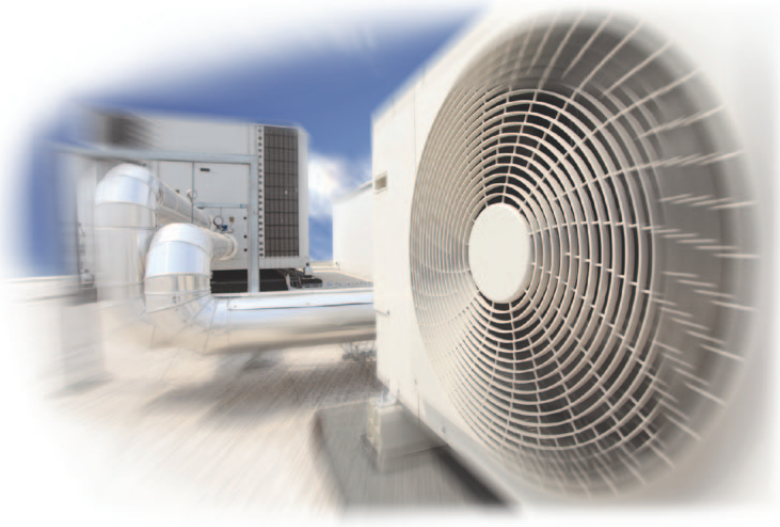


RX for Motor Control

High-performance CPU and FPU capability, and advanced analog and timer peripherals, make the RX62T/62G and RX63T ideal solutions for inverter and motor control applications. Renesas can help you develop your motor control solution with kits and firmware that support many kinds of motor control, including ultra-quiet, energy-efficient, and high-precision three-phase sensorless vector control.

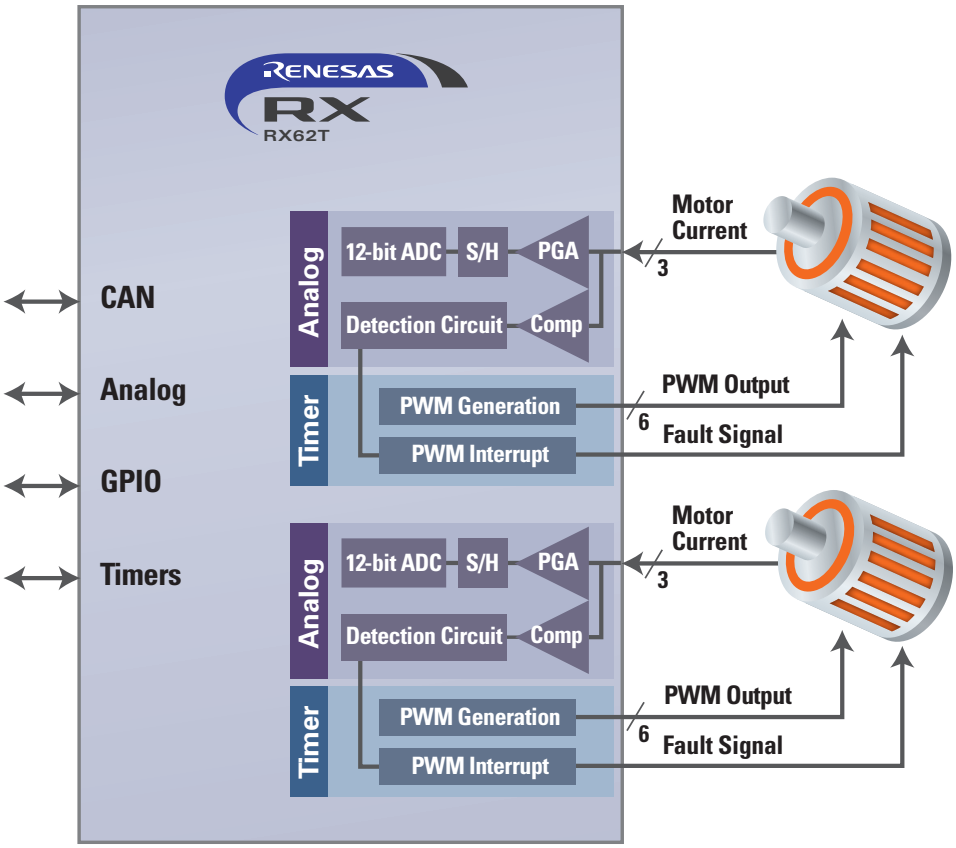
In the home appliance example shown here, the RX62T is driving two three-phase motors simultaneously using its advanced PWM timers. These timers are well suited for Brushless DC three-phase motors by having complimentary PWM outputs with automatic dead-time insertion, an emergency "Shut-down" (stop) input, and quadrature encoder inputs for speed and direction feedback.

The RX62T's advanced analog subsystem with multiple sample-hold circuits enables sampling of three simultaneous current measurements. It also offers programmable operational amplifiers and



integrated window comparators to eliminate external components. The 12-bit ADCs have a fast 1µsec conversion time, can be triggered by the PWM timers, and provide self-diagnostic capability.

The RX62G has a high-resolution (312.5ps) timer, making it ideal for motor control with power factor correction (PFC).



Advanced Analog

- Two 12-bit ADC units, each with 4 input channels, 1 µsec conversion time and self-diagnostic capability
- Each 12-bit ADC unit has:
  - 3 x independent sample-hold circuits
  - 3 x programmable op amps
  - 3 x analog window comparators
  - 3 trigger sources (PWM timers, external and software)

Advanced Timers

- 100MHz, 16-bit Multifunction Timer unit (MTU3)
- 100MHz, 16-bit General Purpose Timer unit (GPT)
- Complimentary PWM and Reset-Synchronous outputs
- Dead-time insertion
- Quadrature encoder inputs
- Emergency motor "Shut-down" (stop) input

Motor Control Solutions Using the RX MCU

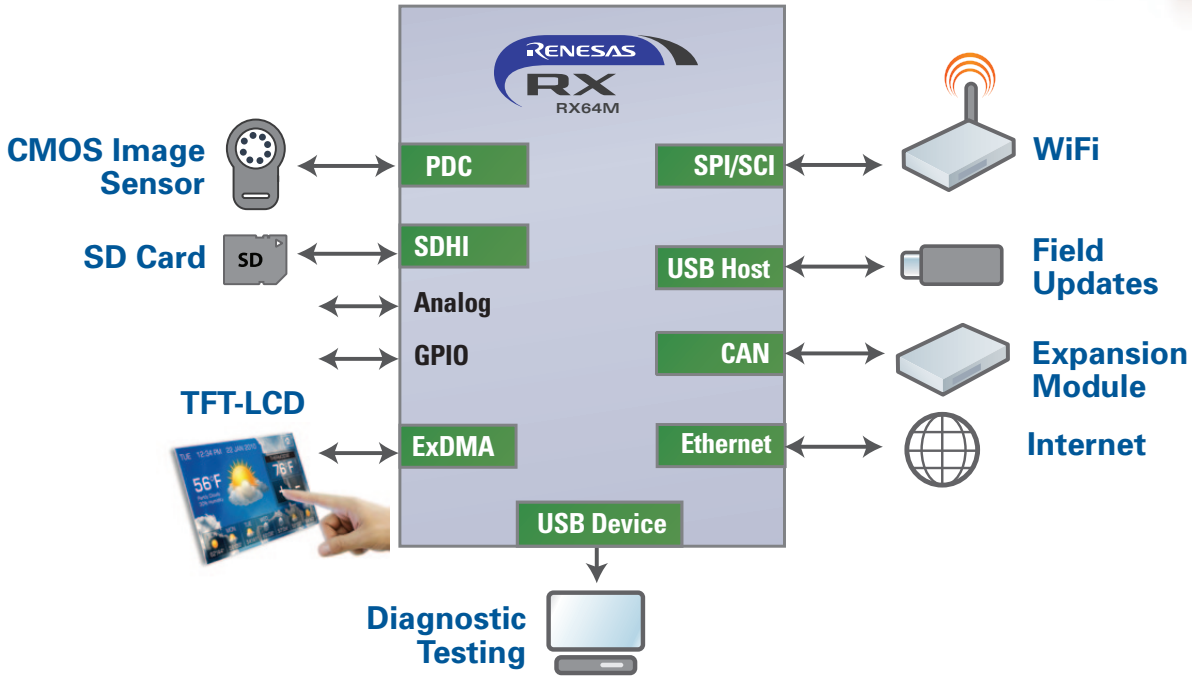
A solid evaluation and development platform for motor control

- Vector control of BLDC motors
- 4 sensorless vector speed-control algorithms
- 1 position-control algorithm
- Easy parameter tracking using GUI
- 24V/4-pole BLDC motor
- Connector for user-supplied boards
- E1, HEW, Renesas compiler unlimited for 60 days, 128KB code size limit after

Part number:
YMCRPRX62T

RX for Connectivity

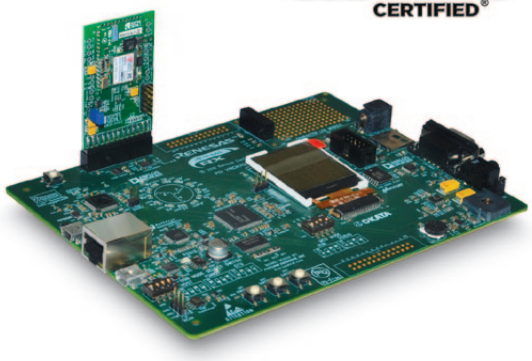
RX MCUs provide built-in hardware for implementing efficient communications with external peripherals, systems, test equipment and networks such as the Internet. In particular, devices in two product groups excel for such applications: RX63N MCUs (100-MHz RXv1 core) and RX64M MCUs (120-MHz RXv2 core). RX63N chips serve mainstream systems, while RX64M MCUs provide the additional connectivity features, more memory and extra functions essential for top-end products.



Wi-Fi Starter Kit Featuring the RX62N

For designs that require 802.11n connectivity, ultra-low power and high performance

- Self-contained, compact size
- Wi-Fi modules for 802.11b/g/n or 802.11a/b/g/n
- FCC/IC/CE certified
- Throughput of up to 8Mbps
- Standby current as low as 0.5mA
- Free Wi-Fi module API library
- Connects to MCU using SPI or UART interfaces
- Integrated encryption support for Open, WEP, WPA/WPA2-PSK (TKIP and AES) modes of operation
- Wi-Fi modules with or without integrated TCP/IP stack



REDPINE SIGNALS®

Kit sold thru Redpine Signals
Part number: **RS-RX62N-2201**
www.redpinesignals.com

GainSpan®

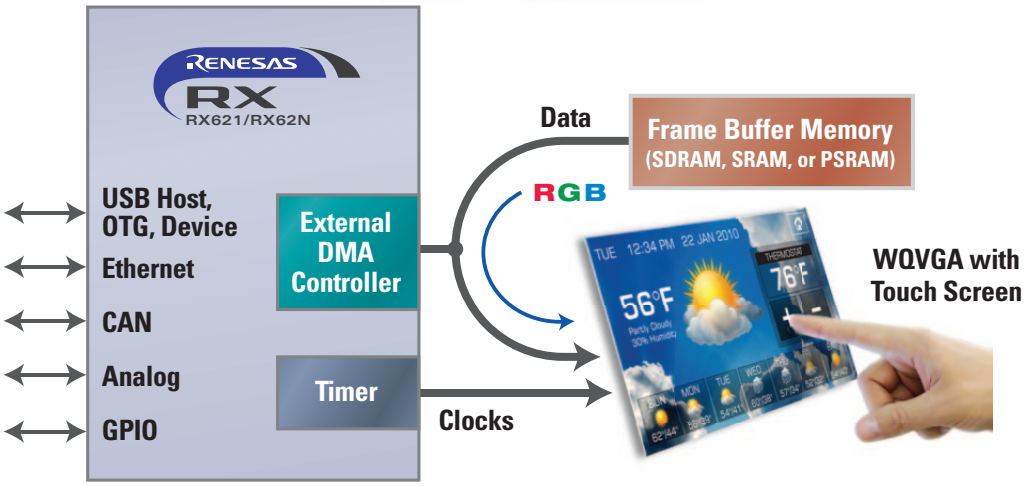
Wi-Fi adaptor board also available thru Gainspan
Part number: **WAB-GW-1500M**
www.gainspan.com

RX for Graphics

The external DMA controller integrated into RX devices can drive a TFT-LCD panel directly, greatly reducing the load on the MCU's CPU; thus, maximizing the performance of application software.

External DMA Controller

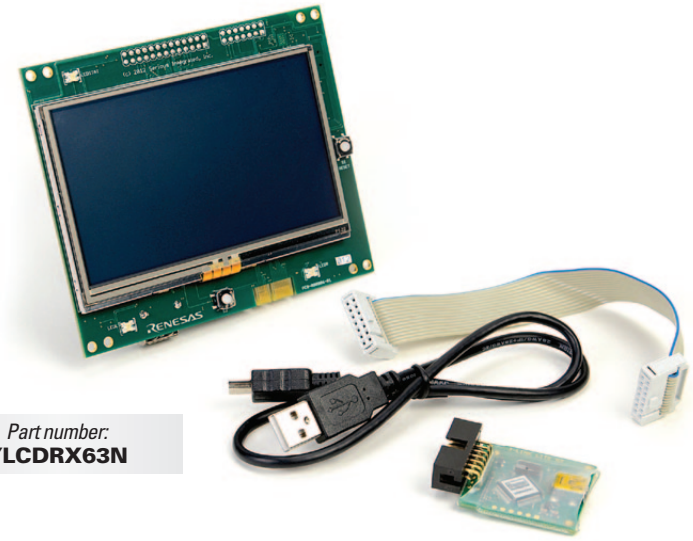
- Directly drive a TFT-LCD panel
- RGB pixel data moves directly from frame buffer to the TFT-LCD and never enters the RX MCU
- RX CPU is loaded only 5%, while refreshing at 60Hz
- Plenty of CPU bandwidth remains to run the application, communication channels, and create moderate animation on the TFT-LCD



RX Embedded GUI Kit

A quick and easy solution to add color TFT-LCD to your design

- RX63N with DDLCD technology
- Color TFT LCD with touchscreen
  – 4.3" WQVGA (480x272)
- Supports multiple GUI software platforms
  – Micrium µC/GUI
  – Serious Integrated SHIPtide
  – Renesas GAPI
- J-Link Lite RX debugger included
- Pre-loaded demo software



Part number:
YLCDRX63N

Get up and running with the RX Ecosystem

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

System Development Kits

- The Renesas Starter Kit (RSK) facilitates in-depth MCU experimentation and allows system design development
- Renesas Demonstration Kit (RDK) aids familiarization with and evaluations of RX solutions

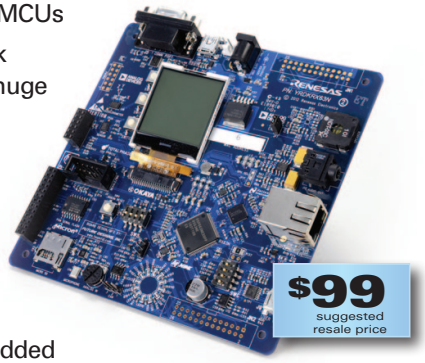
Renesas Starter Kit (RSK)

- This complete RX600-based hardware/software platform for in-depth application design includes the E1 Debugger, a trial version of the HEW IDE, and demonstration firmware.

MCU	*RSK Part Number*
RX610	R0K556100S000BE
RX62N	R0K5562N0S000BE
RX62T	R0K5562T0S000BE
RX630	R0K505630S000BE
RX63N	R0K50563NS000BE
RX64M	YR0K50564MS000BE

Renesas Demonstration Kit (RDK)

- This board plugs into a PC's USB port to showcase the features and capabilities of RX600 MCUs
- RX MCU board with J-Link integrated debugger and huge peripheral set, including Ethernet, CAN and USB
- Graphic display
- 3-axis accelerometer
- Audio in/out
- Installation CD containing:
  - High-performance Embedded Workshop (HEW)
  - RX Family C/C++ toolchains (Renesas 128KB evaluation version, full GNU version)
  - Quick-start guide, sample projects



Processor	*RDK Part Number*
RX62N	YRDKRX62N
RX63N	YRDKRX63N

Application Development Tools

RX MCUs are supported by a comprehensive set of popular Renesas hardware and software tools that have been widely praised for their capabilities and ease of use. Additional support is provided by a dedicated community of third-party experts offering many helpful, time-saving products and services, including the IAR EWRX development environment and the optimized compilers from KPIT Cummins (GNURX) and IAR.

IAR SYSTEMS
www.iar.com/ewrx

KPIT Cummins Infosystems Limited
www.kpitgnutools.com

Complete Debugging, Emulation, and Programming

On-chip debugging of an RX-based application is performed via JTAG connection to the target and USB connection to the Windows-based IDE. E1 and J-Link offer thorough CPU control and visibility. E20 adds high-speed tracing.

Renesas E1
R0E000010KCE00

Renesas E20
R0E000200KCT00

SEGGER
J-Link

e² studio: A Complete Integrated Development Environment (IDE)

e² studio is a new development and debug environment from Renesas based on the popular Eclipse platform. It can be combined with either the free KPIT GNURX toolchain or the RX toolchains from Renesas and IAR, which require a commercial license. Evaluation versions of the Renesas and IAR toolchains are available. Full versions can be purchased from Renesas and IAR, respectively. The e² studio IDE itself is free of charge and includes free technical support from Renesas.

- Free Eclipse-based IDE with free support from Renesas
- Powerful code editing and code navigation features
- Project generation wizard
- Supports Renesas, IAR, and GNU compilers
- Advanced debug features like real-time memory view, IO Register view, complex breakpoints, and trace
- Complete installer or separate plug-ins

Renesas RX toolchain single-user license bundled with e² studio IDE:
YRX2-E2STUDIO-1U

am.renesas.com/e2studio

Support Software

Renesas Software Solutions

Renesas offers a wide variety of free sample code and libraries supporting applications such as Ethernet, USB, CAN, DSP, Motor Control, Audio and Graphics. Renesas also provides the Renesas Peripheral Driver Library (RPDL) and the Peripheral Driver Generator (PDG) free of charge. Here is a sampling of our software solutions.
For a complete list, visit: **am.renesas.com/softwarelibrary**.

Connectivity
- TCP/IP
- USB
- CAN API

Graphics
- Graphics and GUI Libraries
- JPEG Decoder
- Direct Drive LCD

File System
- TFS
- FAT12/16/32
- SD Simplified
- MMC

DSP
- DSP Library
- Image Filters
- Color Space Conversion

Drivers
- Peripheral Driver Generator
- Peripheral Driver Library

Motor Control
- Sensorless Vector Control
- Position Control
- Sinusoidal
- Trapezoidal

Security
- DES
- AES 128/256*
- SHA-1 Hash
- RSA*

Safety
- IEC 607030 Library

Sound / Audio
- ADPCM
- DTMF
- MP3*
- OGG Vorbis*
- Speaker Compensation*

Programming
- Flash API
- Virtual EEPROM

* Contact Sales

Third-party RTOS and Middleware

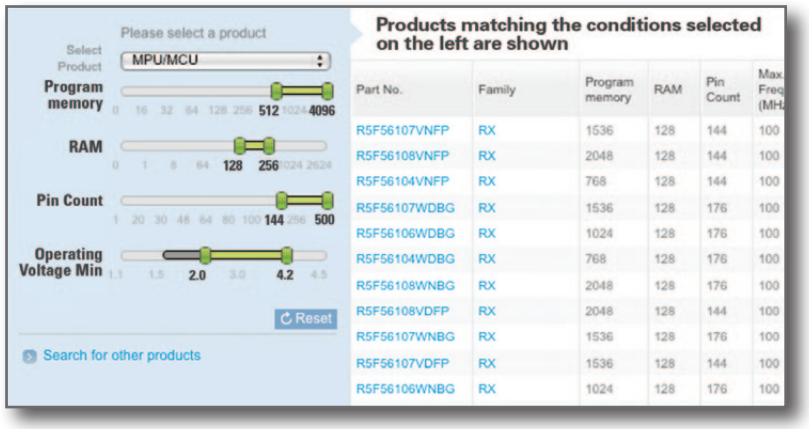
RX600 devices are well suited for embedded real time tasks and high computation, as well as simultaneous data transfers on many high-speed communication channels. Because of this, communication middleware and Real Time Operating Systems (RTOS) are commonly needed. Renesas has established technology partnerships with many leading independent suppliers to provide high-quality, cost-effective solutions.

Middleware	CMX-RTX	ThreadX	FreeRTOS	µEZ (based on FreeRTOS)	µC/OS-III (MPU support available)	Unison	embOS
TCP/IP	■	■	■	■	■	■	■
USB	■	■			■	■	■
CAN					■		
Graphics					■		■
File System	■	■		■	■	■	■
RTOS							

RX is Online

Renesas makes product data, design and application information, and much more, available 24/7 in the RX area of our website. Bookmark it and visit it often to get the latest data on the newest and previously released devices, learn details about (and download free versions of) system development tools, use time-saving MCU-selection aids, participate in discussion forums, find out about upcoming events, take advantage of special promotions, and more.

> ***The handy Quick Device Selector will find just the right MCU for you according to your connectivity, flash, RAM and pin requirements.***



www.renesas.com/rx

Renesas Ecosystem

ALLIANCE PARTNER RENESAS

> The Alliance Partner Program allows you to connect instantly with hundreds of qualified design consulting and contracting professionals.

am.renesas.com/Alliance

RenesasRulz.com

Think it. Build it. Post it.

> A forum and community site to share technical information, questions and opinions with others who use Renesas MCUs and MPUs.

www.RenesasRulz.com

Renesas INTERACTIVE

> Gain the technical knowledge you need. Evaluate, research and learn at your own pace, where you want, when you want, for free.

www.RenesasInteractive.com

RENESAS UNIVERSITY PROGRAM

> For educators and students. Teach with professional grade tools. Learn MCUs with a modern architecture.

www.RenesasUniversity.com

MyRenesas

> Customize your data retrieval needs on the Renesas web site. You'll receive updates on the products you're interested in.

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

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