

The Core Difference in Your Design

RX600 Microcontrollers



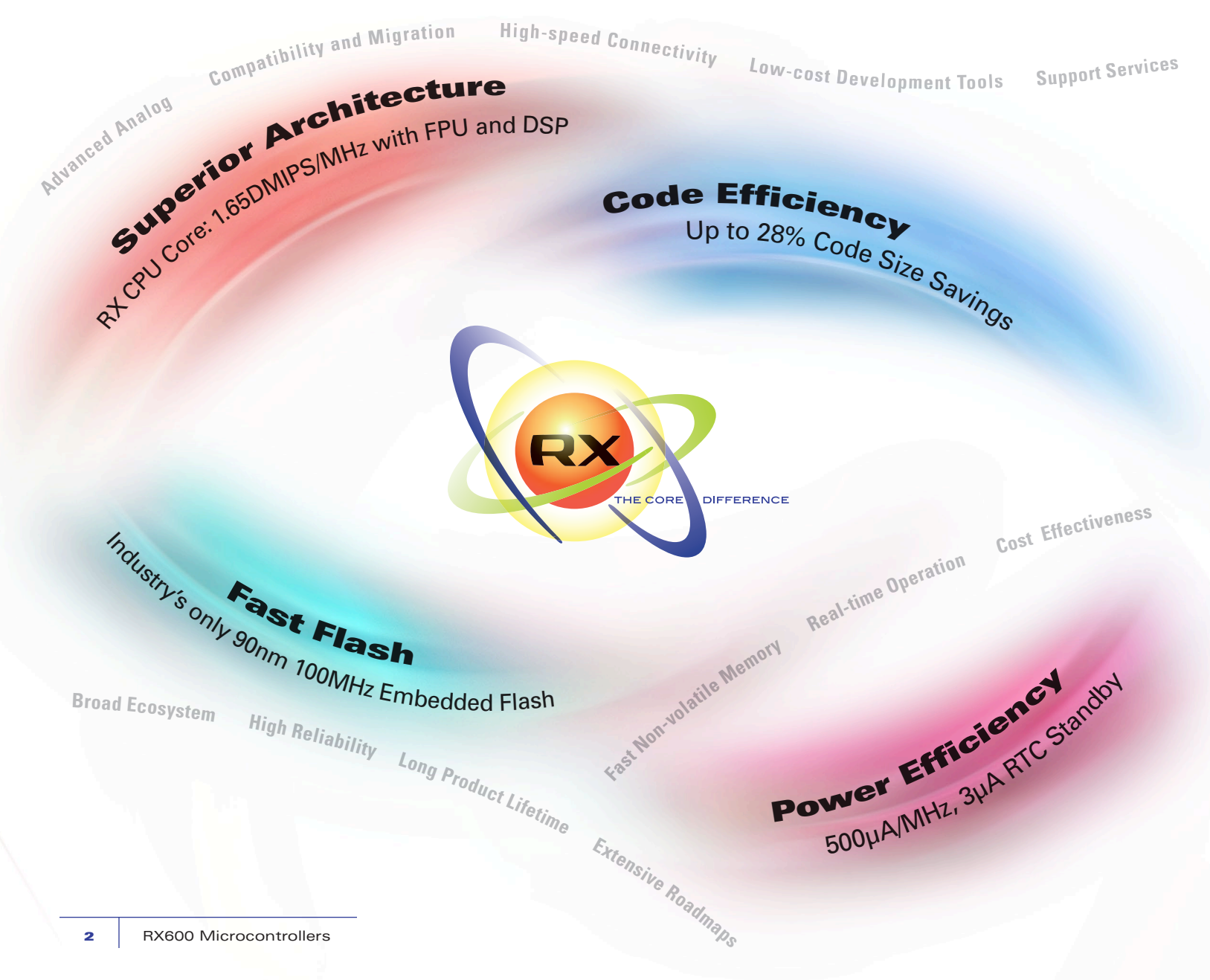
Performance without Sacrifice

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 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 of 165 DMIPS. Memory acceleration isn't required, and the result is just pure, predictable performance.



Today designers are confronted with many critical design and implementation issues. RX MCUs are designed to solve these issues and help them create new innovative end-products faster and more easily than in the past.



Superior Architecture

- RX CPU Core with FPU and DSP: 165 DMIPS at 100MHz, 2.34 CoreMark™/MHz²
- Enhanced Harvard architecture and 5-stage pipeline
- More than six internal busses
- Multiple Direct Memory Access control
- Rapid interrupt response

Fast Flash

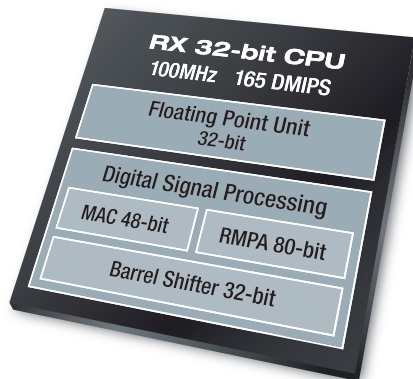
- Industry's only 90nm 100MHz embedded Flash
- CPU receives instructions with no delays
- Mature and reliable silicon process

Power Efficiency

- 500µA/MHz, with all peripherals active
- 3µA RTC Deep Standby (RX631/63N)
- 1mW per DMIPS
- Extends battery life in portable applications

Code Efficiency

- Up to 28% code size savings³ compared to popular 32-bit RISC MCUs on the market
- Variable-length CISC instructions
- FPU, DSP and bit manipulation instructions



Memory

Zero-wait Flash
up to 2MB

SRAM
up to 128KB

Data Flash
up to 32KB

System

DMA & Event System

Fast Interrupt Handler

Clock Generation

POR/LVD

Analog

12-bit ADC
Prog Op Amps
Multi-sample/Hold Comparators

10-bit ADC

10-bit DAC

Temp Sensor

Timers

Motor Control
3-phase PWM
Dead-time Insertion
Shunt Control, PFC, QEI

Timer Pulse Unit

Compare/Match Timer

General Purpose Timer

Multi-function Timer

Prog Pulse Generator

PWM

Watchdog Timer

Real-time Clock

Communication

Ethernet
10/100, MAC with DMA

USB
12Mbps
Host/Device/OTG

CAN

LIN

I²C

SCI/UART

SPI

External Bus
with SDRAM

TFT-LCD ExDMA

GPIO

- RX MCUs leverage Renesas' mature 90nm embedded Flash process, which is currently the fastest in the industry with a 10ns maximum read access time and is designed for optimized power consumption all the way up to full 100MHz operation.
- Design solutions in the RX600 series are scalable. Over 200 products are now available, offering Flash memory from 32KB to 2MB and packages with 48 to 177 pins.
- The companion low-voltage RX200 series operate down to lower voltages (as low as 1.62V), consume less power, and come in smaller packages and memory sizes. The RX200 and RX600 share the same CPU core and integrate many of the same peripherals for easy migration between the two series.
- RX MCUs come with comprehensive system development support, including a vast range of easy-to-use boards, tools, software, middleware, and RTOSs from Renesas and third-party suppliers, comprising a rich ecosystem of products for accelerating progress in design cycles and shrinking time to market.



Renesas is the number one MCU supplier worldwide¹, with a 30% market share.

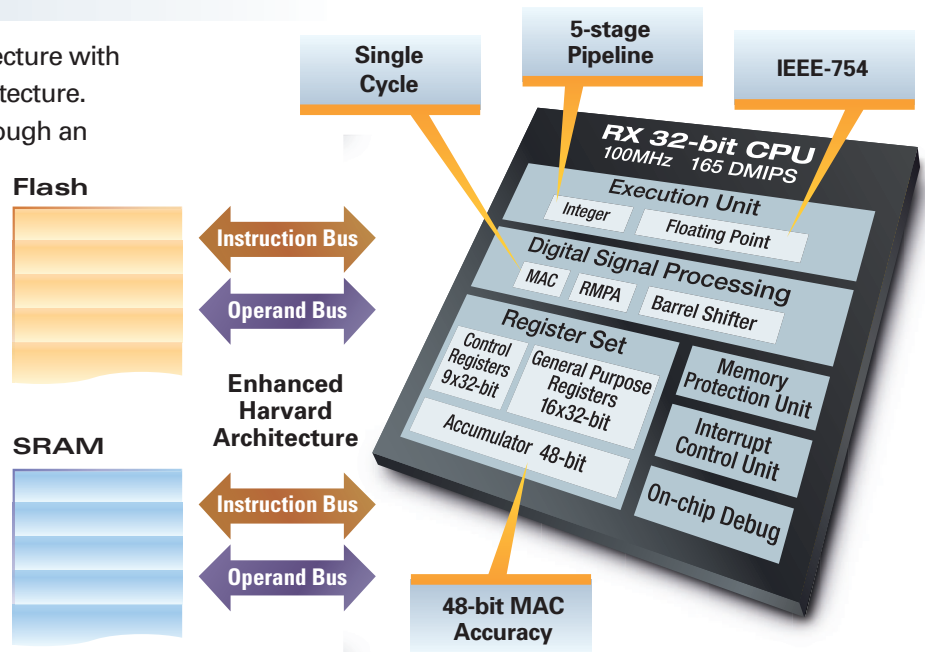
1: Source: Gartner 2010 Worldwide Semiconductor Market Share Database, March 2011 results
2: Source: www.coremark.org as of Jan. 2012
3: Source: Renesas internal testing

Advanced Design and Integration

RX600 Key Benefits

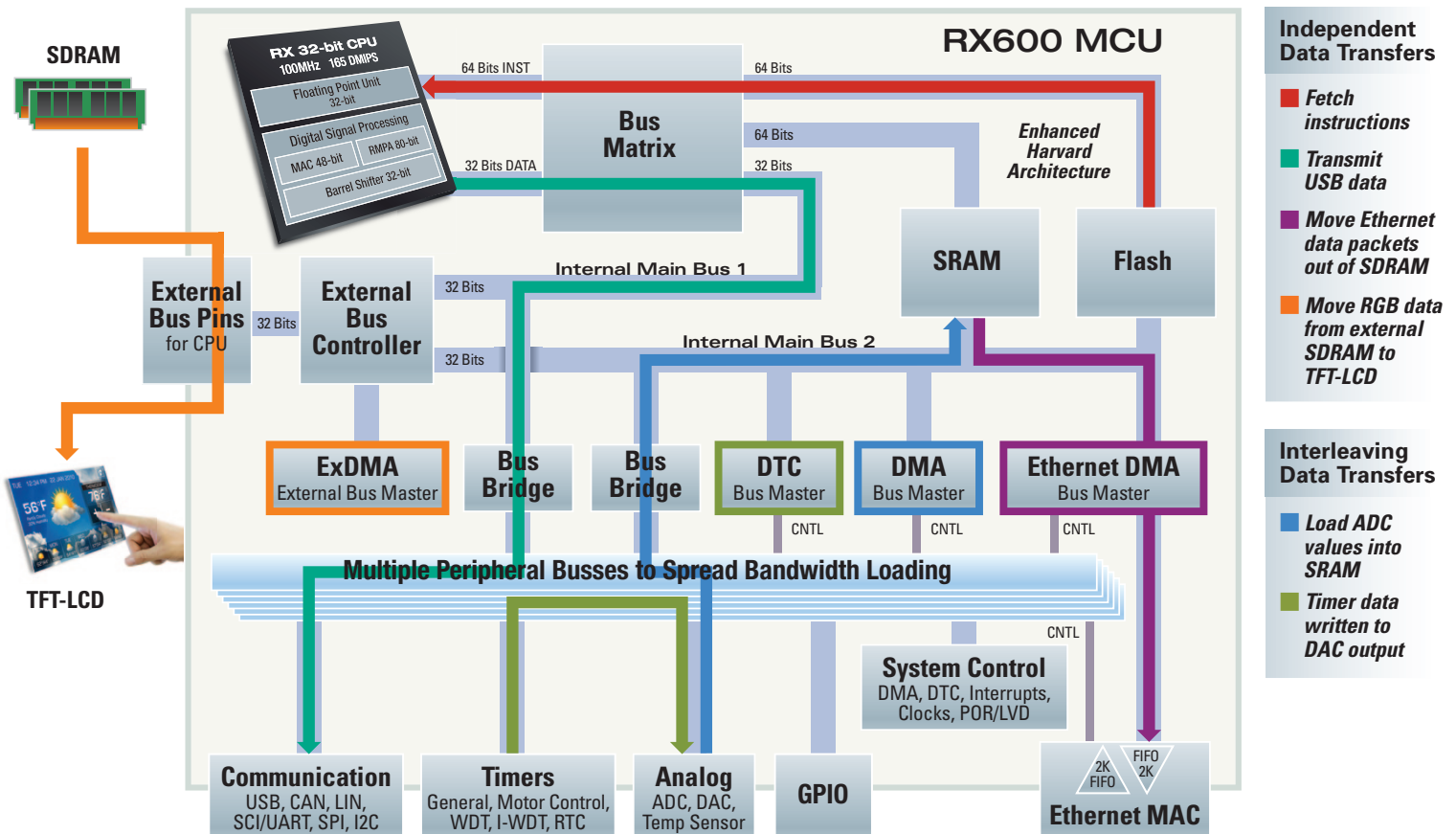
The RX Core marries the speed of a RISC architecture with the flexibility and code efficiency of a CISC architecture. The CPU interacts with the Flash and SRAM through an enhanced Harvard design. The RX Core leverages the industry's fastest Flash memory, delivering 1.65 DMIPS/MHz without wait states.

Tightly coupled to the RX Core are the FPU, MAC, and RMPA (Repeat Multiply Accumulate), which are efficiently driven by DSP and floating point instructions to meet the growing demand of DSC (Digital Signal Controller) type applications.



Simultaneous Data Transfers

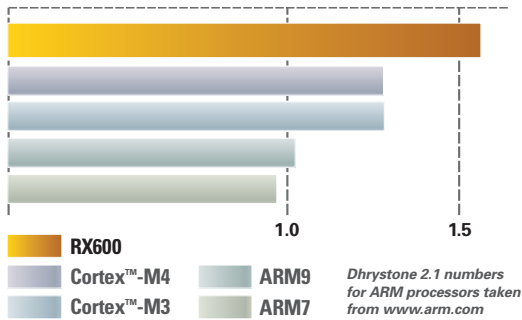
The RX Core uses a large number of parallel busses to handle simultaneous movement of data between the CPU core, Flash, SRAM, and peripherals. Six different peripheral busses enable a flexible distribution of slow and fast peripherals for optimized throughput. An external bus with an independent DMA can move data directly from one external device to another external device, such as a graphic frame buffer to a TFT-LCD panel.



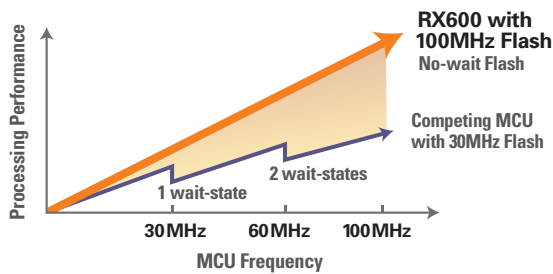
Performance

The RX Core delivers 1.65 DMIPS per MHz, achieving 165 DMIPS when running at 100MHz.

Dhrystone MIPS per MHz
with no wait-state memory access



Industry's only 100MHz On-chip Flash



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.

INT Trigger to CPU Core

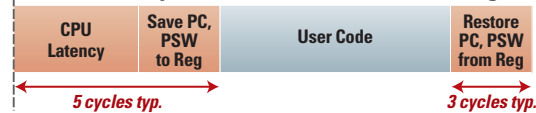
Normal Interrupt



Fast Interrupt



Fast Interrupt with Dedicated General Registers



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.

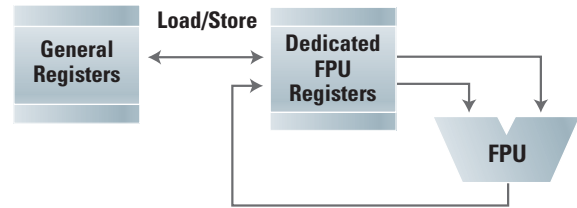
- Many RISC MCUs have only two instruction lengths, 16 bits and 32 bits, so the compiler must make compromises.
- RX CPU supports 10 addressing modes, which optimize manipulation and movement of data.
- Compiled RX code has been measured as much as 28% smaller than the same code compiled on a popular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

Superior FPU Implementation

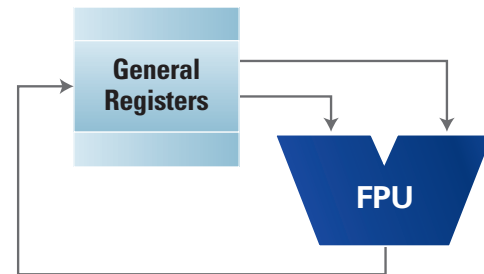
The RX FPU implementation allows direct access to general registers, resulting in faster execution and smaller code size.

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

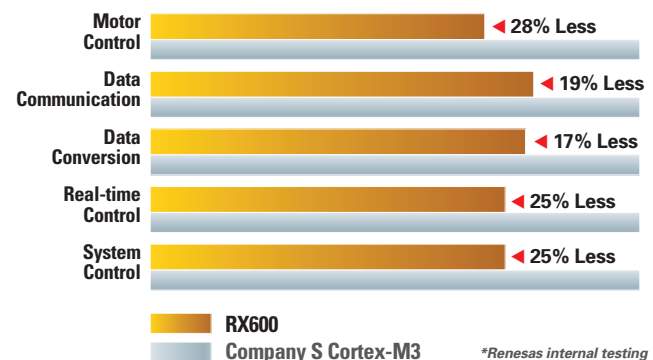
Traditional FPU Implementation



RX FPU Implementation



Code Size (relative)*

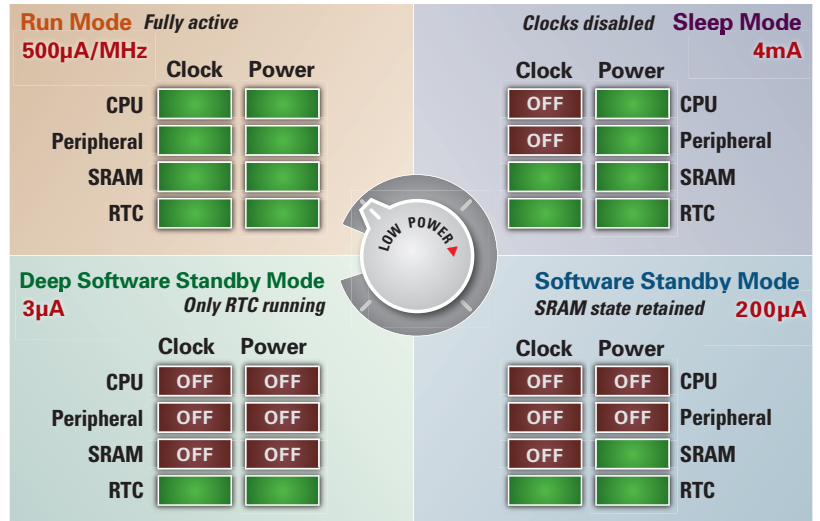
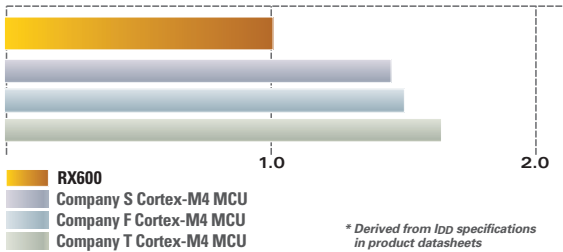


Highly Effective Power Management

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

Milliwatts per DMIPS*



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

EMC Advantages – Built-in to Eliminate Add-Ons

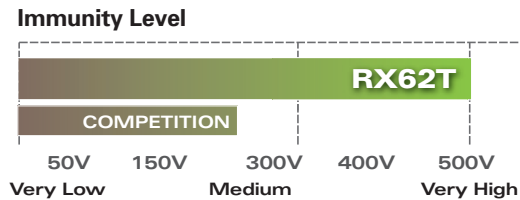
Outstanding EMC performance of RX600 MCUs reduces system-integration problems, lowers development costs, and shortens design cycles. BOM costs drop, too, because external components can be eliminated.

- 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”

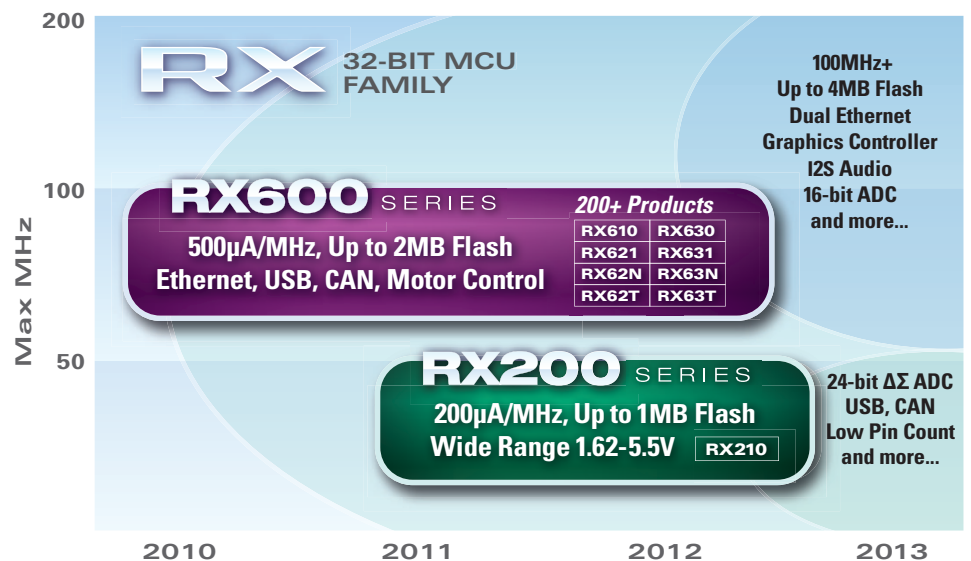
Renesas press release, October 21, 2010



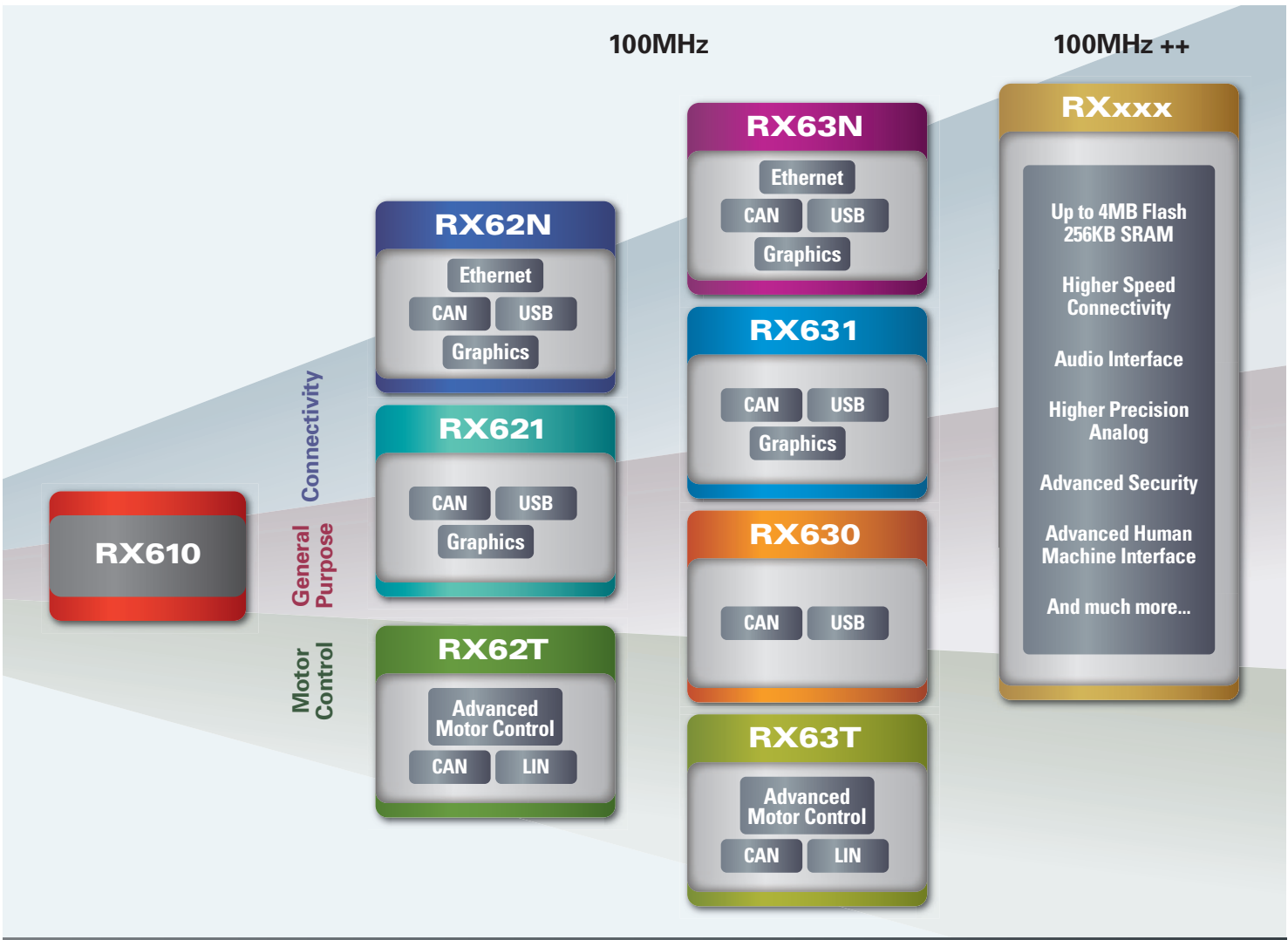
RX Family Product Portfolio

The RX family currently consists of two extensive product series. MCUs in the RX600 series are optimized for applications requiring high-performance, high-efficiency processors. Devices in the RX200 series expand the range of compatible system-design choices, adding smaller, lower power devices with fewer pins.

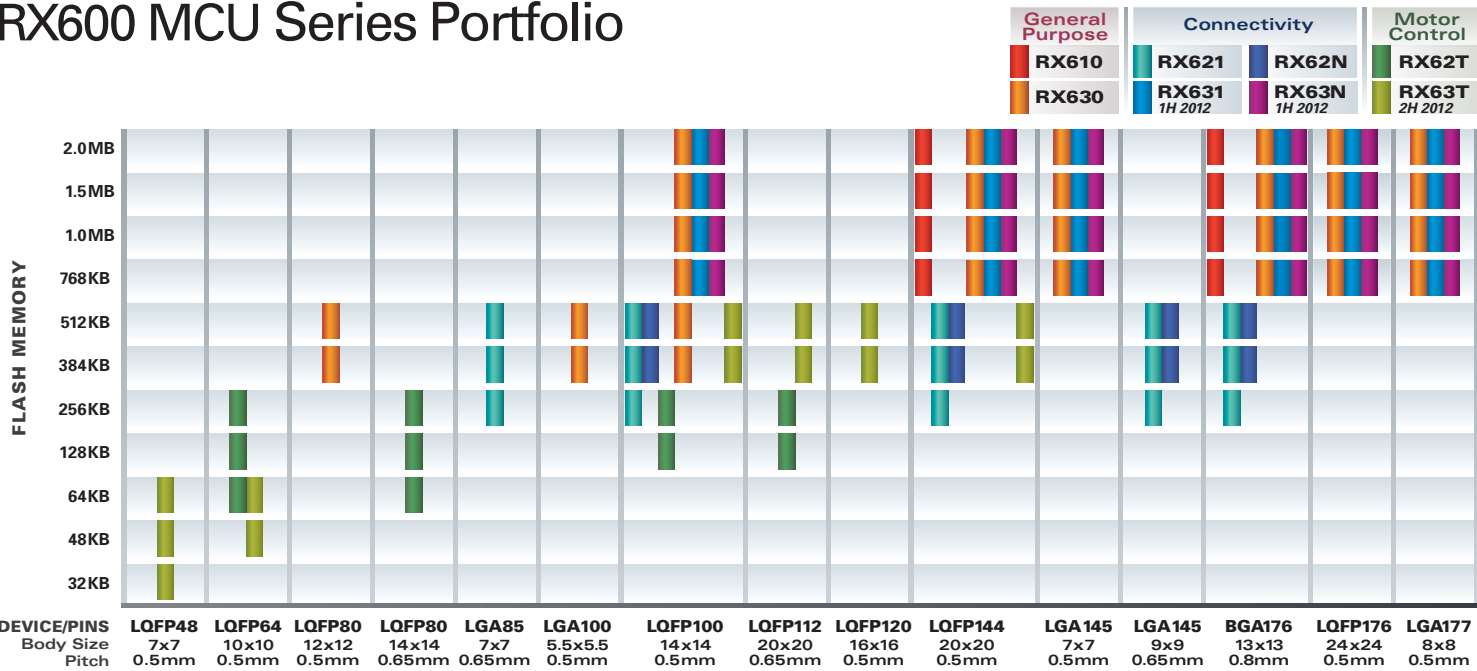
Migration from existing Renesas architectures to RX solutions is easy. And, of course, moving designs among RX family members is very easy, since RX600 and RX200 MCUs share the same CPU architecture and peripherals. This gives system engineers valuable design flexibility and provides substantial head starts on reusing software assets. New products for niche markets can be created quickly and efficiently, as can upgraded or simplified versions of existing products for addressing changes in customer preferences.



RX600 MCU Series Roadmap



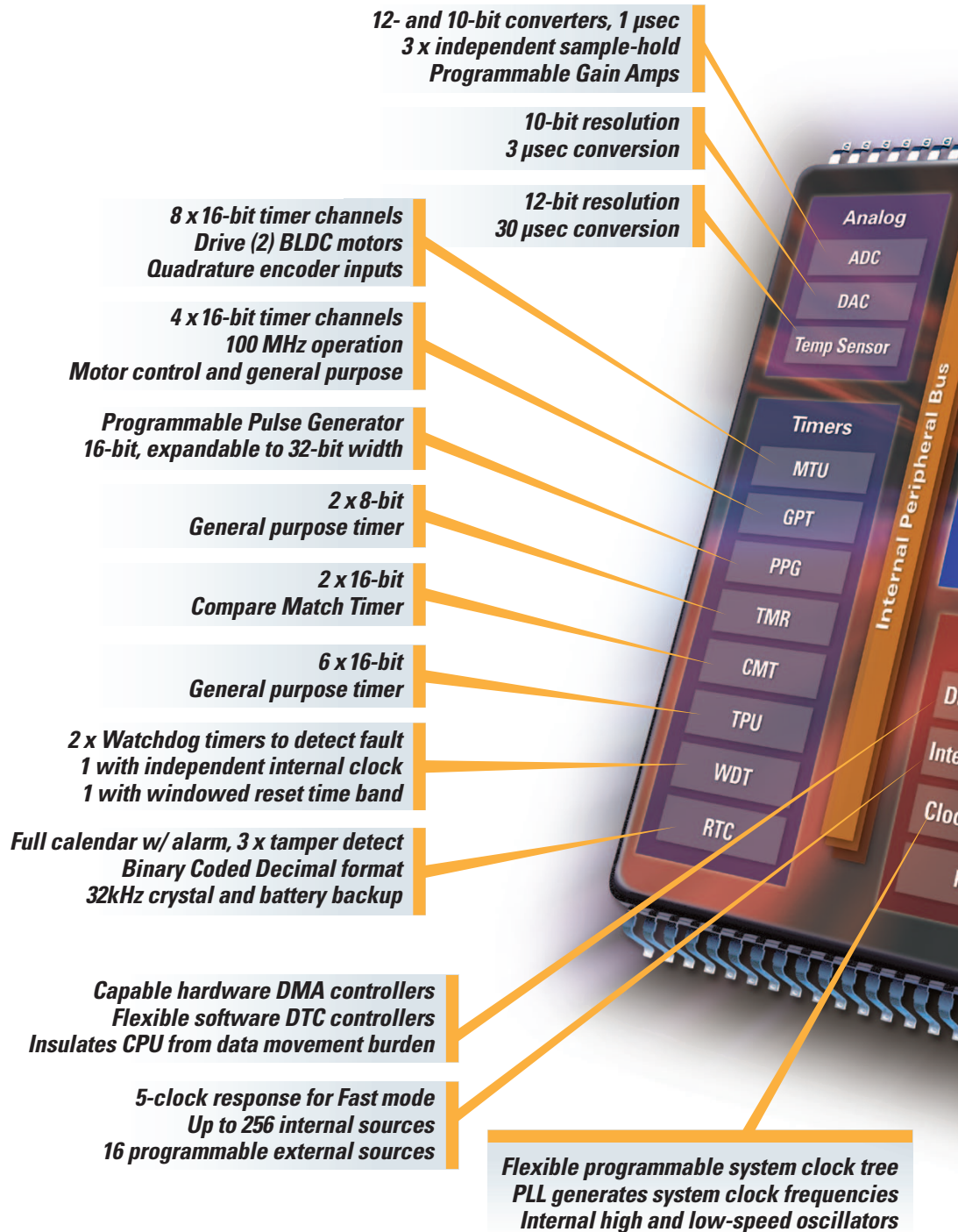
RX600 MCU Series Portfolio



Comprehensive On-chip Peripherals

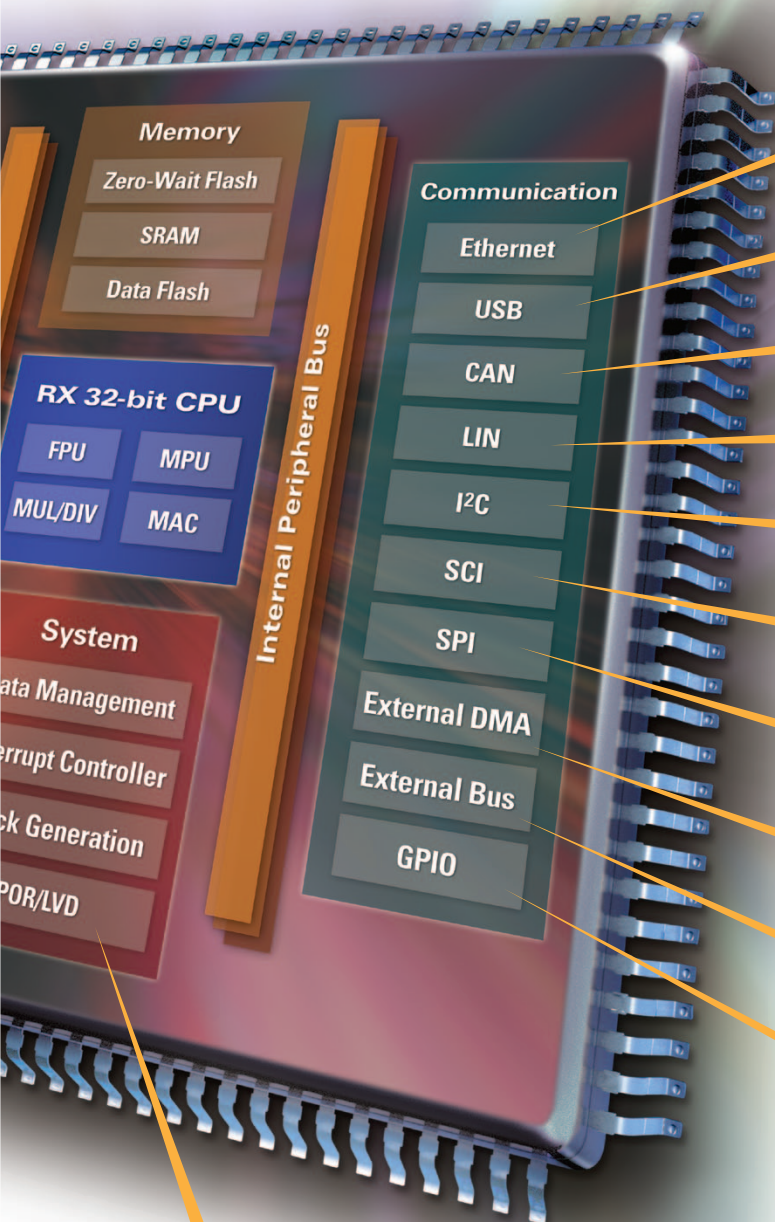
To lower costs, simplify system designs, reduce total system power consumption, and enable the implementation of value-added features, a wide range of on-chip peripheral functions is clustered around the powerful CPU core of RX MCUs. Broadly categorized into analog, timer, communication and system functions, 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. The devices in the RX621/62N and RX62T product groups exemplify this diversity and optimization.

- RX621/62N MCUs provide extensive communication peripherals with options for Ethernet, CAN, and up to two USB-FS 2.0 channels, each operating as USB Host, USB Device, or USB OTG (On the Go). Additionally, they offer up to six SCI, two SPI, and two I²C serial channels. Among their other peripherals are analog interfaces; timers; RTC and POR/LVD functions; and more.
- RX62T MCUs provide improved motor/inverter control timers and enhanced analog peripherals for implementing very precise motor control and positioning applications. The MTU3 and GPT timer peripherals enable one MCU to control three motors simultaneously. An FPU and improved analog functions make these MCUs ideal for use with three-shunt or single-shunt vector-type motor control methods.
- RX630 MCUs offer up to 2MB flash and come packed with communication peripherals such as a USB device, 13 SCI, three SPI, and four I²C serial channels. There is also an integrated temperature sensor and 29 ADC channels available.



Group		Advanced Peripherals							Basic Peripheral Set																			
		Connectivity				Advanced Motor			Memory			Analog				Timers							Communication					
		Ethernet 10/100 MAC	USB 2.0 Host/Device/OTG	CAN 2.0B	Graphics ExDMA	Advanced ADC 12-bit	MTU3	GPT	Flash (max)	SRAM (max)	Data Flash	ADC 10-bit	DAC 10-bit	ADC 12-bit	Temp Sensor	MTU2	TPU	PPG	TMR	CMT	WGT	I-WDT	RTC	I2C	SCI	ExBus	SPI	LIN
Connectivity	RX621	–	1	1	1	–	–	–	512KB	96KB	32KB	–	2	8	–	12	–	8	4	4	1	1	1	2	6	8/16/32	2	–
	RX631	–	2	3	1	–	–	–	1MB	128KB	32KB	8	2	21	1	6	12	8	4	4	1	1	1	4	13	8/16/32	3	–
	RX62N	1	2	1	1	–	–	–	512KB	96KB	32KB	–	2	8	–	12	–	8	4	4	1	1	1	2	6	8/16/32	2	–
	RX63N	1	2	3	1	–	–	–	1MB	128KB	32KB	8	2	21	1	6	12	8	4	4	1	1	1	4	13	8/16/32	3	–
General Purpose	RX610	–	–	–	–	–	–	–	2MB	128KB	32KB	16	2	–	–	–	12	8	4	4	1	–	–	2	7	8/16	–	–
	RX630	–	1*	3	–	–	–	–	2MB	128KB	32KB	8	2	21	1	6	12	8	4	4	1	1	1	4	13	8/16	3	–
Motor Control	RX62T	–	–	1	–	8	8	4	256KB	16KB	8KB	12	–	–	–	–	–	–	4	1	1	–	1	3	–	1	1	

* USB device only



10/100 MAC
MII or RMI connection to PHY
2KB xmit and 2KB rcv buffers

Up to 2 x FS Host, Device, or OTG
10 x endpoints, 2KB FIFO
Self or bus-powered, on-chip PHY

Compliant with CAN 2.0B specification
32 x transmit/receive mailboxes
8 x individual acceptance masks

1 x master channel
Baud rate generator

Standard, Fast, and High Speed (1MHz)
Master, slave, multi-master support
Digital noise filtering

Serial Communications Interface
Synchronous and Asynchronous
UART and 9-bit mode, Smart Card

Master, slave, multi-master support
3-wire or 4-wire operation
Double-buffered 8-bit to 32-bit data length

Transfers data from external to external device
Data movement has minimal load on CPU
Drive color TFT-LCD with external frame SDRAM

8-, 16-, 32-bit CPU data width, 24-bit address
8 x programmable chip select regions
SDRAM support

Programmable configuration at each pin
Options for built-in pull-up and 5V tolerance
Multiplexed with internal peripheral functions

Built-in Power-on Reset generation
Precision Low-voltage Detect early warning
Source of reset can be read by firmware

Selected examples shown here.
Please check www.renesas.com/rx
for complete list of available devices.

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				RX630				100	2.7-3.6	2048	128	32	-	1*	13	3	4	4	-	Y	4	24	1	2	21	8	2	-	Y	117																																															
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*USB device only

Design Potential and Versatility of the RX

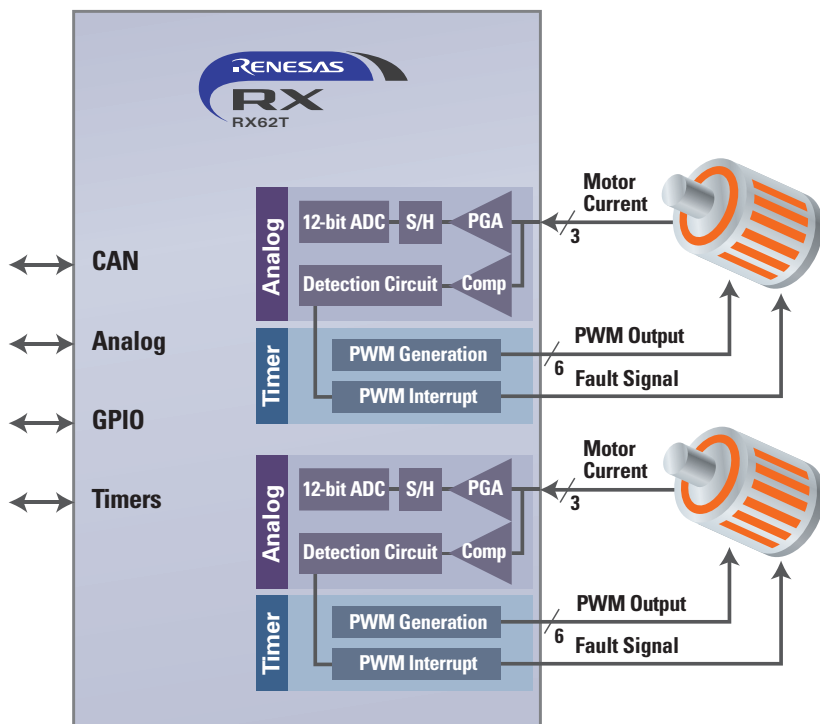
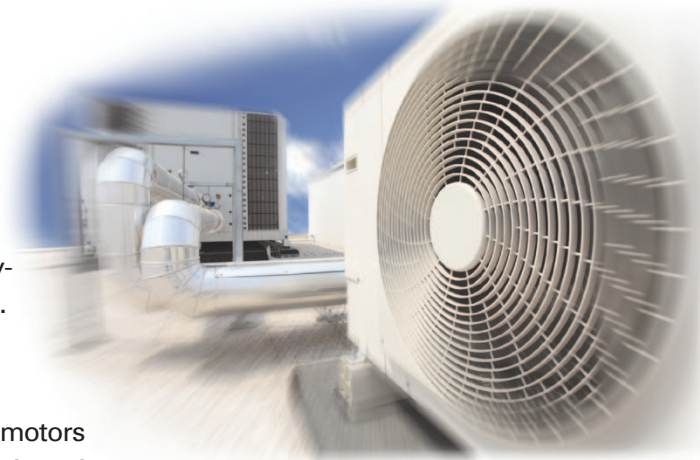
System design versatility, application capability, and economic sensibility are built into the many microcontrollers in the RX family. Driven by a technology roadmap that anticipates more sophisticated applications in the next decade that demand cost effectiveness, RX devices offer abundant core performance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

RX62T for Motor Control

High-performance CPU and FPU capability, and advanced analog and timer peripherals, make the RX62T an ideal solution 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-and-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.



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-and-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

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. The Ethernet, USB and CAN connectivity modules are well-proven, reliable designs.

Ethernet MAC

- 10/100 Mbps
- 2KB TX FIFO
- 2KB RX FIFO
- MII, RMII connection to PHY
- Wake on LAN

USB

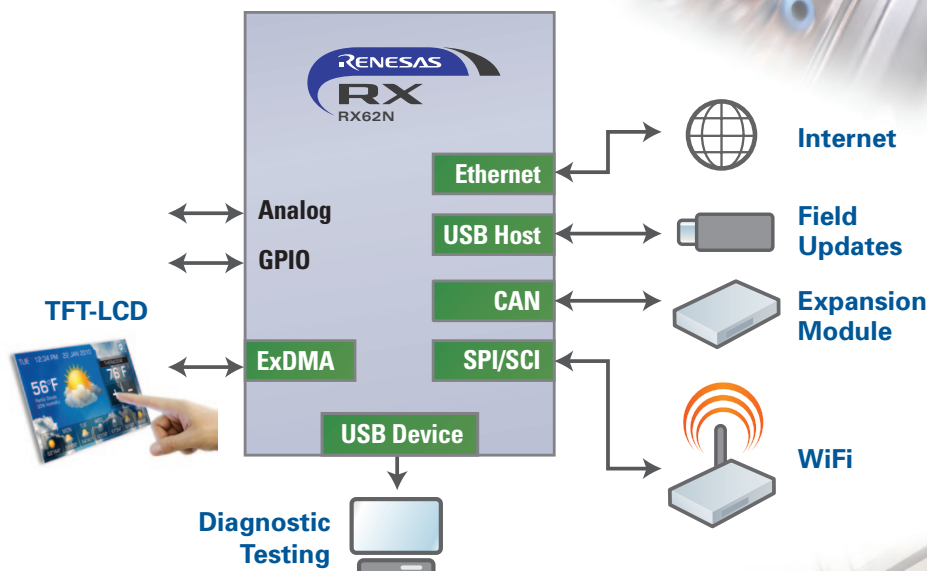
- Host/Device/OTG
- 12 Mbps
- Up to 2 ports
- 10 Endpoints
- 2KB FIFO

CAN

- ISO11898-1
- 1 Mbps
- 32 Mailboxes

SPI/SCI

- Up to 18MHz (SPI Master)
- Flexible configurations

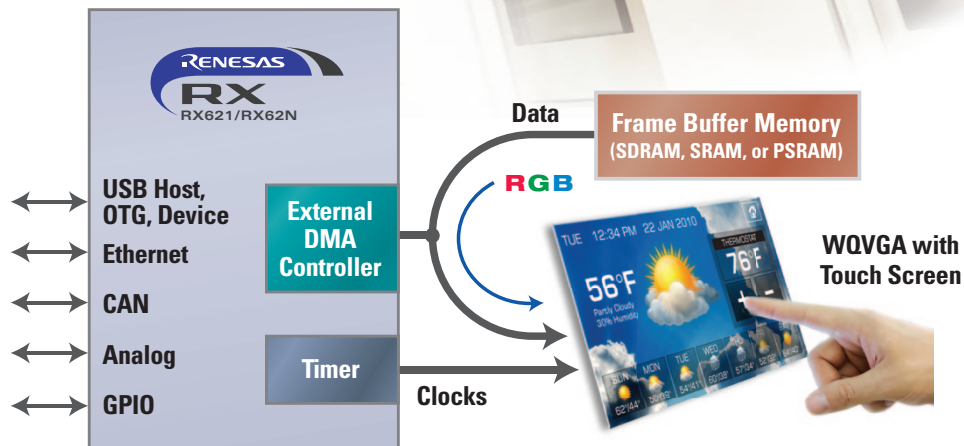


RX for TFT-LCD Applications

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



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.

Processor	RSK Part Number
RX610	R0K556100S000BE
RX62N	R0K5562N0S000BE
RX62T	R0K5562T0S000BE
RX630	R0K505630S000BE



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 development environments and optimized compilers from KPIT Cummins (GNURX) and IAR.



HEW: A Complete Integrated Development Environment (IDE)

HEW accelerates progress on the full range of system design tasks, from editing, to peripheral driver generation, to compilation, to debugging, and to Flash programming. HEW works with the Renesas compiler or Open Source GNURX compiler. HEW and the GNURX compiler are both free. The free Renesas C++ compiler allows unlimited binary output size for 60 days; thereafter, restricting compile size to 128 KB.

HEW Part Number: YRTA-HEWRX-1U

- Project Manager
- Output Window
- Built-in Editor
- Full Bus Trace
- Peripheral Driver Generator
- Virtual Desktop
- Local Variable Watch
- C/C++ Variable Watch
- Stack Trace
- Memory Views
- Debug Control (E1, E20, J-Link)

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

Support Software








Renesas Software Library

Renesas offers a wide variety of free sample code and libraries supporting applications using Ethernet, USB, CAN, DSP, Motor Control, PCM Audio and Graphics. Renesas also provides the Renesas Peripheral Driver Library (RPDL) and the Peripheral Driver Generator (PDG) free of charge.

Connectivity <ul style="list-style-type: none"> TCP/IP USB CAN API 	Graphics <ul style="list-style-type: none"> Graphics and GUI Libraries JPEG 	File System <ul style="list-style-type: none"> TFS FAT12 FAT16 MMS SD Simplified 	Numerical <ul style="list-style-type: none"> Digital Filter, FFT Math Libraries IEEE 754 Standard 	Sound / Audio <ul style="list-style-type: none"> ADPCM 
Motor Control <ul style="list-style-type: none"> SPWM 	Security <ul style="list-style-type: none"> DES AES 128/256 	Safety <ul style="list-style-type: none"> IEC 607030 Library 	Peripherals <ul style="list-style-type: none"> Peripheral Driver Generator Peripheral Driver Library 	Programming <ul style="list-style-type: none"> Flash API Flash over CAN Flash via UART Data Flash Drivers 

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

■ Available Now ▲ Under Development

Additional Renesas MCU Support



- > 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



- > 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



- > 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

Solution Kits for RX

RX Direct-drive Solutions for TFT-LCD

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

- Low-cost 32-bit MCU solution to drive color TFT-LCD panels up to WQVGA resolution
- Only 5% loading on CPU when refreshing the TFT-LCD panel at 60Hz, with ample bandwidth left for running the rest of the application
- Free graphics API library and examples for evaluating graphics
- Third-party support for additional graphics requirements

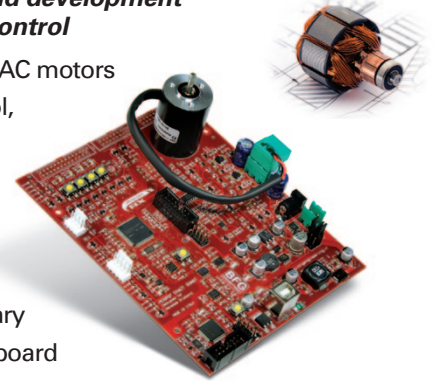


Part number:
YLCDRSKRX62NS

Motor Control Solutions Using the RX MCU

A solid evaluation and development platform for motor control

- Drive sensorless PMAC motors
- Field oriented control, 3-phases
- Single PCB: inverter + MCU
- High-frequency modulation >20kHz
- Demo code and library
- Compact and small board USB powered
- E1, HEW, Renesas compiler unlimited for 60 days, 128KB code size limit after

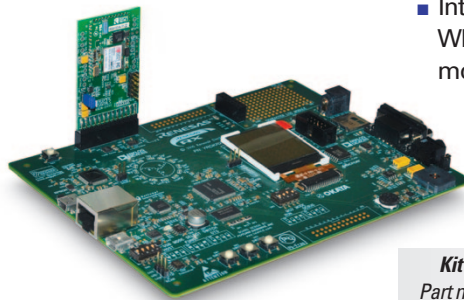


Part number:
YMCRPRX62T

WiFi Starter Kit Featuring the RX62N

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

- Self-contained, compact size
- WiFi 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 WiFi 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
- WiFi modules with or without integrated TCP/IP stack

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

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



RX is Online www.renesas.com/rx

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.



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