RX is Online – www.rxmcu.com

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 our development tools, use time-saving MCU selection aids, participate in discussion forums, find out about upcoming events, take advantage of special promotions, and more.

Online purchase: www.cn.renesas.com/easygo

http://www.cn.renesas.com

The Core Difference in Your Design
RX600 Microcontrollers

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 QVGA 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: YLCDRS8RX62N/S

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/CE certified
- Throughput of up to 8Mbps
- Standby current as low as 0.5mA
- IEEE WiFi module API library
- Connects to MCU using SPI or UART interfaces
- Integrated encryption support for Open, WEP, WPA/WPA2-PSK (TKIP and AES) mode of operation
- WiFi modules with or without integrated TCP/IP stack

Part number: YRMCXRTX62T

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, >25kHz
- Demo code and library
- Compact and small board USB powered
- E1, E2W, Renesas compiler unlimited for 60 days, 12MB code size limit after

Part number: YRMCXRTX62T

Connectivity Solutions Using the RX62N
Explore connectivity through many possible layouts utilizing an integrated kit with CAN, USB and Ethernet
- Two RX-based boards connected to each other through different connectivity options
- Cable, Internet hub, debuggers included
- Free software with ready-to-run devices
- Integrated firmware
- RX62N, 512KB Flash, 96KB RAM

Part number: RS-RX62N-029T
www.renesas.com

RX600 Microcontrollers

RX600 is the latest generation of microcontrollers from Renesas, offering high-performance, low-power, and cost-effective solutions for a wide range of applications.

RX600 devices feature the latest ARM Cortex-M0 processor, with enhanced peripherals and connectivity options.

The RX600 series includes various devices with different memory configurations and I/O options, making it suitable for different applications.

For more information, visit www.renesas.com(rx600)
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. That 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: 1.65DMIPS/MHz with FPU and DSP
- Fast Non-volatile Memory
- Mixed Signal Integration
- Cost Effectiveness
- High Reliability
- Compatibility and Migration
- High-speed Connectivity
- Low-cost Developmen Tools
- Broad Ecosystem
- Support Services

Fast Flash

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

Power Efficiency

- 500µA/MHz, 1.4µA RTC Standby
- 500µA/MHz, with all peripherals active
- 1.4µA RTC Deep Standby (RX661/66N)
- 1mW per DMIPS
- Extends battery life in portable applications

Code Efficiency

- Up to 28% Code Size Savings compared to popular 32-bit RISC MCUs on the market
- Variable-length CISC instructions
- FPU, DSP and bit manipulation instructions
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 and 2.25 CoreMark/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.

**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: Can be assigned dynamically to any interrupt source, responding in just five CPU clock cycles, 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.

**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

**Industry’s only 100MHz On-chip Flash**

RX600 with 100MHz Flash

No-wait-states

Competing MCU with 8MHz Flash

**Code Size (relative)**

- Motion Control: < 28% Loss
- Communication: < 15% Loss
- Data Conversion: < 17% Loss
- USB/RS485 Control: < 25% Loss
- System: < 25% Loss

RX600

Company 5 Cortex-M3
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**

- 2.0
- 1.0
- 7.5
- 15.0

* Calculated from chip operating characteristics

**Compared to a Cortex-M4 based MCU, an RX600 chip enables up to a 45% power reduction – consuming only 10mW per DMIPS**

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. SOM 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

**Immuinity Level**

**RX62T**

- Very Low
- Medium
- Very High

**RX610**

- General Purpose
- Motor Control

**RX621**

- Advanced Motor Control
- CAN
- USB
- Graphics

**RX63N**

- Ethernet
- CAN
- USB
- Graphics

**RX631**

- Ethernet
- CAN
- USB
- Graphics

**RX630**

- CAN
- USB
- Graphics

**RX63T**

- Advanced Motor Control
- CAN
- LIN

**RX600 MCU Series Roadmap**

100MHz, 90nm Technology

**RX64x**

- 100MHz ++, 40nm Technology

**RX63N**

- Ethernet
- CAN
- USB
- Graphics

**RX631**

- Ethernet
- CAN
- USB
- Graphics

**RX630**

- CAN
- USB
- Graphics

**RX63T**

- Advanced Motor Control
- CAN
- LIN

**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 being introduced in 2011 will 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 Portfolio**

- Max MHz
- Flash Memory
- 32-bit, 80mm. Up to 2MB Flash, Ethernet, USB, CAN, Motor Control
- 32-bit, 120mm. Up to 1MB Flash, Low Power & Low Voltage – 200mA/MHz, 10µA STBY, 1.2V Min VDD

- LQFP44: 7x7, 9.5mm
- LQFP64: 10x10, 9.5mm
- LQFP80: 12x12, 9.5mm
- LQFP100: 14x14, 9.5mm
- LQFP128: 20x20, 9.5mm
- LGA100: 8x8, 9.5mm
- LQFP100: 14x14, 7.6mm
- LGA104: 8x8, 9.5mm

Comprehensive On-chip Peripherals

To save cost, 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 PC serial channels. Among their other peripherals are analog interfaces; timers, RTC and UART; and many 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.

Advanced peripherals include:
- 10/100 MAC
- MIU or RMU connection to PHY
- 2KB xmit and 2KB recv buffers
- 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 peripherals

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

Flexible programmable system clock tree
PLI generates system clock frequencies
Internal high and low speed oscillators

Flexible hardware DMA controllers
Flexible software DTC controllers
Insulates CPU from data movement burden

5-clock response for Fast mode
Up to 256 internal sources
16 programmable external sources

Capable hardware DMA controllers
Flexible software DTC controllers
Insulates CPU from data movement burden

Full calendar w/ alarm, 3 x tamper detect
Binary Coded Decimal format
32kHz crystal and battery backup

6 x 16-bit General purpose timer
2 x 16-bit Compare Match Timer
2 x 8-bit General purpose timer
2 x Watchdog timers to detect fault
1 with independent internal clock
1 with windowed reset time band

4 x 16-bit timer channels
100 MHz operation
Motor control and general purpose
Programmable Pulse Generator
16-bit, expandable to 32-bit width

12-bit resolution
32 psec conversion
12- and 10-bit converters, 1 psec
3 x independent sample-held Programmable Gain Amps

10-bit resolution
2 psec conversion
9 x 16-bit timer channels
Drive (2) BLDC motors
Quadrature encoder inputs

Connectivity

<table>
<thead>
<tr>
<th>Group</th>
<th>Connectivity</th>
<th>Advanced Motor</th>
<th>Memory</th>
<th>Analog</th>
<th>Timer</th>
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* USB device only
## RX600 MCU Series Devices

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### Analog

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### Serial Interface

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### Digital Interface

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### Memory

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### Port Configuration

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### Device Group

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### Notes

- [RX600 Microcontrollers](#)
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-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 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
- 100 MHz, 16-bit Multifunction Timer unit (MTUJ)
- 100 MHz, 16-bit General Purpose Timer unit (GPT1)
- Complementary 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
- 1 Gbps
- 1000BASE-T
- Wake on LAN

USB
- Host/Device/OTG
- Up to 2 ports
- 5 V support
- 5 Mbps

CAN
- CAN
- SPI
- SCI
- TS4186-1
- 1 Mbps
- 32 Mbit/s

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 RX62N Demo Kit (RDH) aids familiarization with and evaluations of RX solutions.

**Renesas RX 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.

**Renesas Demonstration Kit (RDH)**

- This board plugs into a PC’s USB port to showcase the features and capabilities of RX600 MCUs.
- 36MHz RX62N 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 128K evaluation version, full GNU version.
  - Quick-start guide, RX62N sample projects.
- Shared firmware projects at www.renesas.com/RX62N

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 KITP 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 GNU RX compiler. HEW and the GNU RX compiler are both free. The free Renesas C++ compiler allows unlimited binary output size for 60 days; thereafter, restricting compile size to 128 KB.

**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.

**Support Software**

- **Reneses 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.

- **Reneses Peripheral Driver Library (RPDL)**
  - Low-level firmware drivers for all basic RX peripherals are free, source code included. RPDL eliminates the need for creating your drivers, saving time and reducing errors. RPDL functions are easily integrated into HEW projects, and PDG can be used to generate initialization code and calls to RPDL functions based on your own specified configuration.

- **Reneses Peripheral Driver Generator (PDG)**
  - A Windows user interface for configuring RX peripherals and pins.
  - Menus to select/initialize peripherals.
  - Generates C code calls to RPDL driver functions.
  - Select and manage pin assignments.

**Third-party RTOS and Middleware**

RX600 devices are well suited for embedded real-time tasks, 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.

<table>
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<th>CMX Systems</th>
<th>Crank Software Inc.</th>
<th>Micrium</th>
<th>Redpine Signals</th>
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**Additional Renesas MCU Support**

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

  www.cn.renesas.com/alliance

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

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- Gain the technical knowledge you need. Research and learn at your own pace, where you want, when you want, for free.

  www.renesasinteractive.com
Solution Kits for RX

RX Direct-drive Solutions for TFT-LCD
A quick and easy solution to add color to your system
- Low cost 32-bit MCU solution to drive color TFT-LCD panels up to WVQGA 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

Partnumber: YLC0R58RX62JNS

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

Partnumber: YRMCX01TRX62T

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
- 512KB Flash, 96KB RAM

Partnumber: YLMCNX01TRX62T

Connectivity Solutions Using the RX62N
Explore connectivity through many possible layouts utilizing an integrated kit with CAN, USB and Ethernet
- Two RX-based boards connected to each other through different connectivity options
- Cables, Internet hub, debuggers included
- Free software with ready-to-run demos
- Integrated firmware
- RX62N, 512KB Flash, 96KB RAM

Partnumber: RS-RX62N-2291

RX is Online – www.rxmcu.com
Renesas makes product data, design and application information, and much more available 24/7 in the RX area of our website.
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http://www.cn.renesas.com