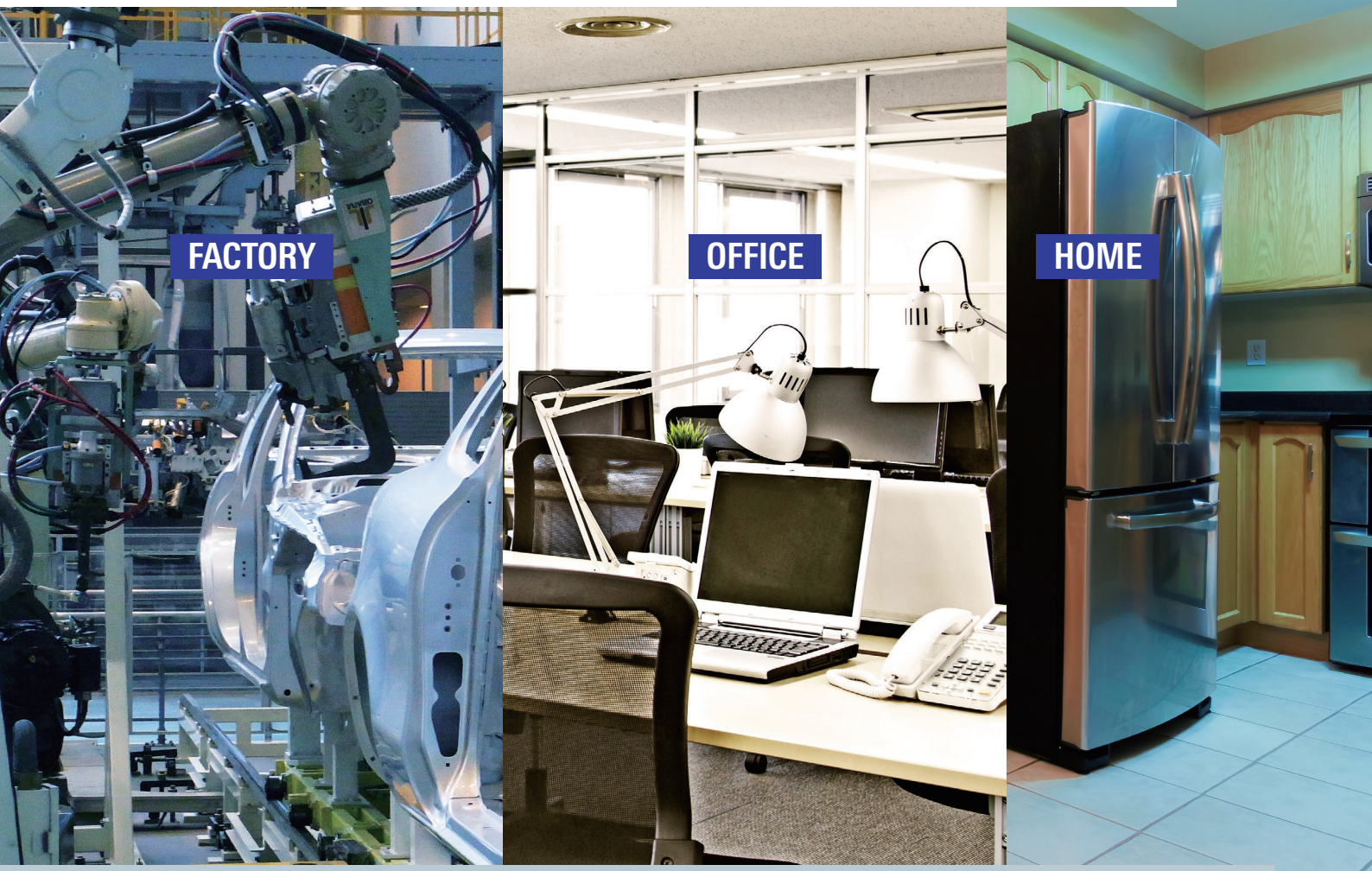
RX FAMILY

Renesas 32-Bit Microcontrollers

2025.09

32-bit microcontrollers built around an exclusive CPU core developed by Renesas

Maintaining and Advancing the Renesas Tradition



CONTENT

With the spread of IoT, the expansion of smart factories, and the increasing demand for energy conservation, modern industrial and consumer devices are required to meet multiple needs, such as more advanced processing capabilities and real-time performance, as well as low power consumption and high reliability.

Furthermore, now that the speed and flexibility of product development are the keys to competitiveness, the importance of a platform that can efficiently reuse development assets is also increasing. Renesas' 32-bit microcontroller family "RX" was born to meet these market demands.

Designed based on a unique CISC architecture, the RX family achieves a good balance of high performance, low power consumption, and high reliability, providing a reliable solution to the diverse challenges faced by development sites.

With reliability backed by a track record around the world, including Europe, the United States, and Asia, flexible scalability, and a product policy that supports long-term supply, the RX family continues to play a central role in all embedded systems, from industrial applications to consumer devices and IoT devices.

Performance, efficiency, and continuity - the RX family does not compromise on any of these, making it the "microcontroller of choice" that supports next-generation manufacturing.

Positioning of the RX

Microcontrollers & Microprocessors, System-on-Chips (SoCs)

- **RZ** — High-end 32/64-bit MPUs
  High-resolution HMI, Industrial network & real-time control
- **RA** — Advanced 32-bit MCUs
  Arm ecosystem, Advanced security, Intelligent IoT
- **RX** — High Power Efficiently 32-bit MCUs
  Motor control, Capacitive touch, Functional safety, GUI
- **RISC-V products** — General-purpose 64-bit MPUs (RZ/Five Group)
  Application-specific 32-bit MCUs
- **RL78** — Ultra-low Energy 8/16-bit MCUs
  Bluetooth® Low Energy, SubGHz, LoRa®-based Solutions
  Automotive actuators & sensors, Low-end ECUs
- **RH850** — Automotive 32-bit MCUs
  Rich functional safety and embedded security features
- **R-Car** — Automotive SoCs
  Next generation of automotive computing

Analog and Power Devices

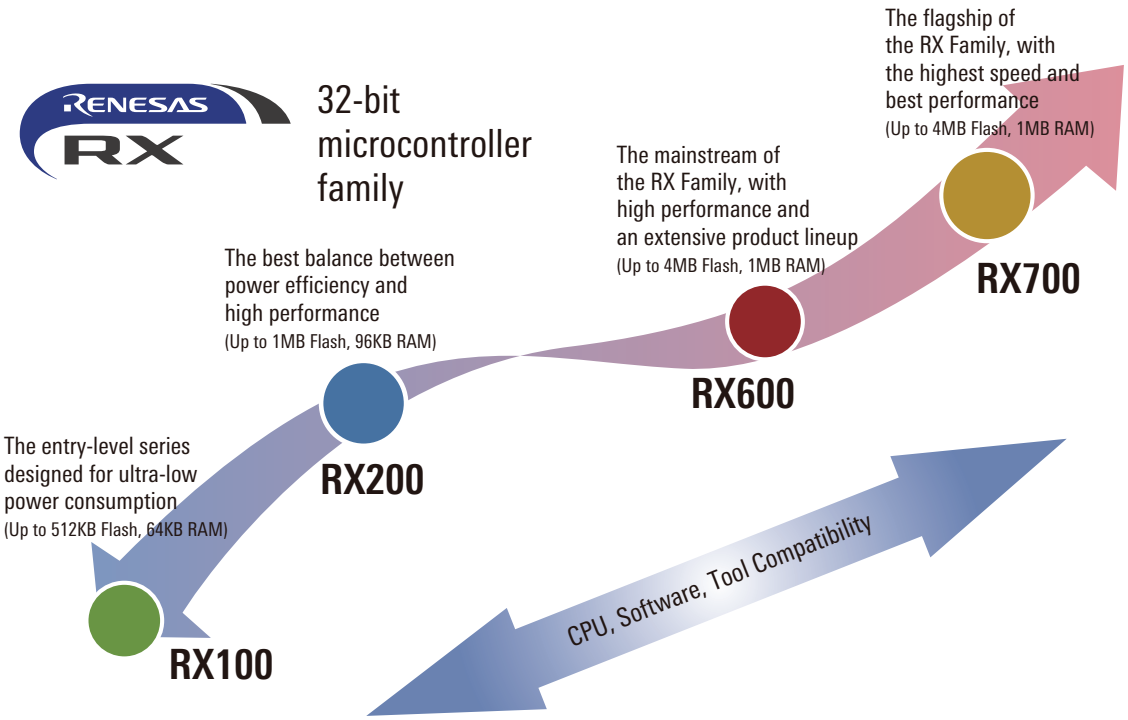
- Analog products
- Clocks & Timing
- Interface & Connectivity
- Memory & Logic
- Power & Power management
- Programmable Mixed-signal, ASIC, & IP products
- RF products
- Sensor products
- Space & Harsh environment

- Timing
- Wireless Power
- Battery Management
- Power Devices
- Power Management
- Sensors
- Video & Display

Positioning of the RX Family

Overwhelming the market with its performance and functions
RX family is available in four powerful series

RX family is a 32-bit microcontroller equipped with Renesas' original RX core, which achieves high computing performance and excellent low power consumption.
RX family is available in four series: flagship RX700 series, which is the fastest and most functional, standard RX600 series, RX200 series, which achieves the best mix of low power consumption and high performance, and RX100 series, which is an ultra-low power consumption entry model.



These four series enable seamless and scalable support for small to large applications.

RX700 Series — The flagship of the RX Family, with the highest speed and best performance

4MB Flash Max Dual Bank	2.7V to 5.5V 1441CoreMark @240MHz	Ethernet USB,CAN SDHI	Security Safety	EtherCAT TFT LCD Motor

RX600 Series — The mainstream of the RX Family, with high performance and an extensive product lineup

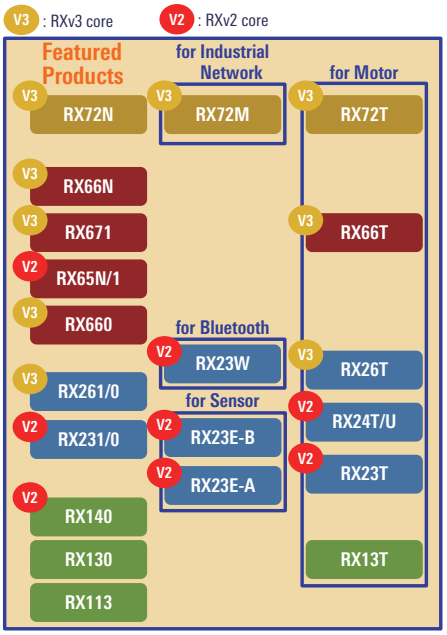
4MB Flash Max Dual Bank	2.7V to 5.5V 721CoreMark @120MHz	Ethernet USB,CAN SDHI	Security Safety	TFT LCD Motor Capacitive Touch

RX200 Series — The best balance between power efficiency and high performance

1MB Flash Max	1.8 to 5.5V 0.12mA/MHz 0.8μA(stby)	USB,CAN SDHI	Security Safety	Bluetooth Motor Capacitive Touch IA Sensor

RX100 Series — The entry-level series designed for ultra-low power consumption

512KB Flash Max	1.8 to 5.5V 0.1mA/MHz 0.25μA(stby)	USB,CAN	Security Safety	Segment LCD Motor Capacitive Touch



RX Family Portfolio

RX Family covers a wide range of applications, from general purpose to motor control and industrial equipment, and its common architecture offers a lineup that enables efficient development on the same platform, such as the RX.

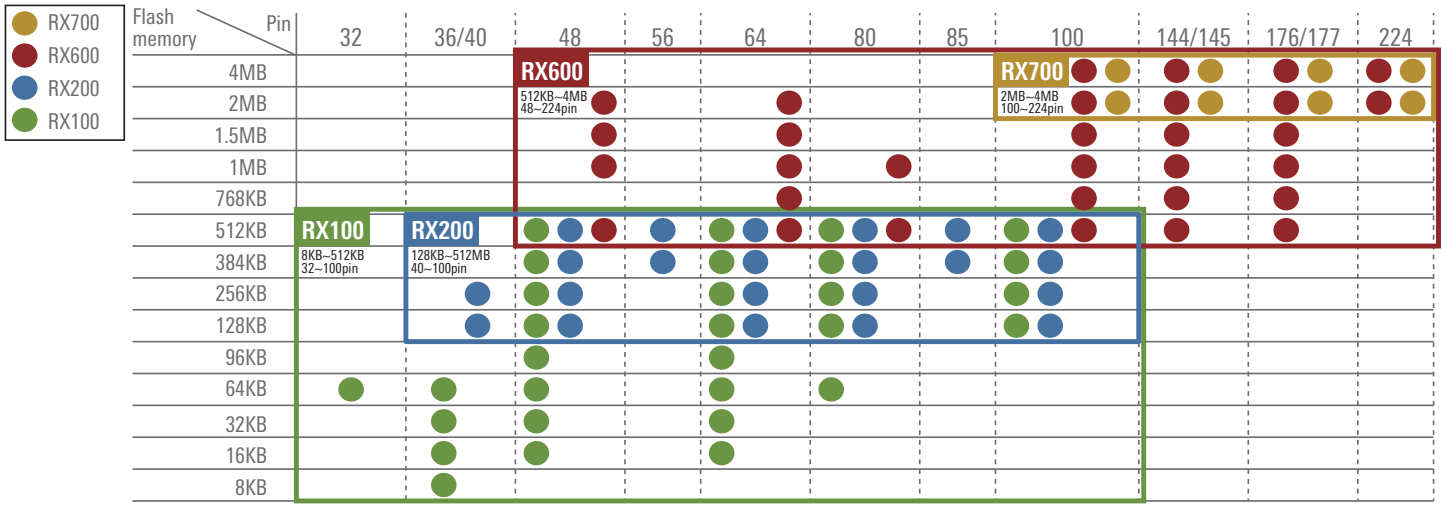
	General Purpose	Motor Control/ Inverter	IA/FA Network	Rich Analog	Wireless
RX700 Series	**RX72N** 240MHz, RXv3, 4MB/1MB, Ether, GLCDC	**RX72T** 200MHz, RXv3, 1MB/128KB, 5V, 4 motor	**RX72M** 240MHz, RXv3, 4MB/1MB, EtherCAT, GLCDC		
RX600 Series	**RX66N** 120MHz, RXv3, 4MB/1MB, Ether, GLCDC **RX671** 120MHz, RXv3, 2MB/384KB, Touch **RX660** 120MHz, RXv3, 1MB/128KB, 5V **RX65N** 120MHz, RXv2, 2MB/640KB, Ether, GLCDC **RX651** 120MHz, RXv2, 2MB/640KB, GLCDC	**RX66T** 160MHz, RXv3, 1MB/128KB, 5V, 4 motor			
RX200 Series	**RX261** 64MHz, RXv3, 512KB/128KB, 5V, Touch **RX260** 64MHz, RXv3, 512KB/128KB, 5V, Touch **RX231** 54MHz, RXv2, 512KB/64KB, 5V, Touch **RX230** 54MHz, RXv2, 256KB/32KB, 5V, Touch	**RX26T** 120MHz, RXv3, 512KB/64KB, 5V, 2 motors **RX24T** 80MHz, RXv2, 512KB/32KB, 5V, 2 motor **RX24U** 80MHz, RXv2, 512KB/32KB, 5V, 2 motor **RX23T** 40MHz, RXv2, 128KB/12KB, 5V, 1 motor		**RX23E-B** 32MHz, RXv2, 256KB/32KB, 24-bit HS DSAD **RX23E-A** 32MHz, RXv2, 256KB/32KB, 24-bit DSAD	**RX23W** 54MHz, RXv2, 512KB/64KB, BT5 LE
RX100 Series	**RX140** 48MHz, RXv2, 256KB/64KB, 5V, Touch **RX130** 32MHz, RXv1, 512KB/48KB, 5V, Touch **RX113** 32MHz, RXv1, 512KB/64KB, Touch, SegLCD **RX111** 32MHz RXv1, 512KB/64KB **RX110** 32MHz, RXv1, 128KB/16KB	**RX13T** 32MHz, RXv1, 64KB/12KB, 5V, 1 motor			

RX Family Memory vs. Pin Lineup

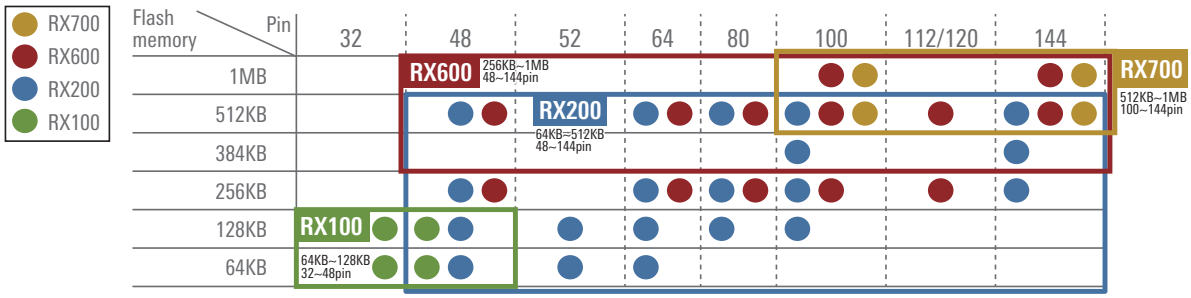
Pin and memory compatibility for smooth product migration

The design prioritizes package and pin layout compatibility, as well as memory capacity scalability, making future expansion and expansion to derivative products smooth, and also enabling the use of the same boards and software assets between microcontrollers with different functions and performance.

Industrial, Home Appliances, and OA/ICT

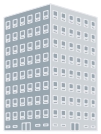


Motor



RX Family Target Applications

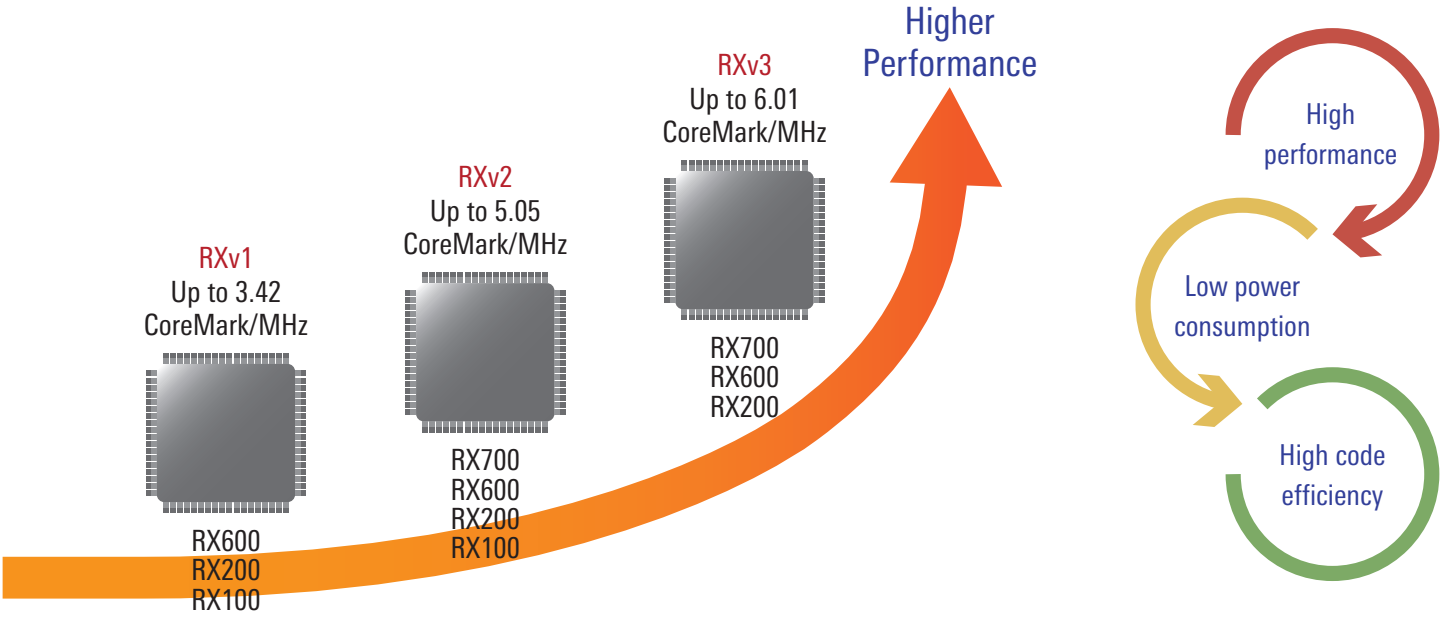
RX Family offers a wide range of performance from 32MHz to 240MHz and is highly compatible with a wide range of peripheral functions tailored to each application.

	System Control		Drive (Motor/inverter control)		UI (Capacitive touch LCD , etc)		Communication & Security		Measurement/ Sensing	
Industrial Automation  Inverter, PLC, Robot machine tools, etc.	RX700	RX-T	RX700	RX-T	RX700	RX-T	RX700	RX-T	RX700	RX-T
	RX600	RX-E	RX600	RX-E	RX600	RX-E	RX600	RX-E	RX600	RX-E
	RX200		RX200		RX200		RX200		RX200	
	RX100		RX100		RX100		RX100		RX100	
Appliances  IH Cooker, Smart Robot Vacuum Cleaner, Power Tools, Water Pump, etc.	RX700	RX-T	RX700	RX-T	RX700	RX-T	RX700	RX-T	RX700	RX-T
	RX600	RX-E	RX600	RX-E	RX600	RX-E	RX600	RX-E	RX600	RX-E
	RX200		RX200		RX200		RX200		RX200	
	RX100		RX100		RX100		RX100		RX100	
Building Automation  HVAC, Elevator, Lighting, Fire Alert Unit, etc.	RX700	RX-T	RX700	RX-T	RX700	RX-T	RX700	RX-T	RX700	RX-T
	RX600	RX-E	RX600	RX-E	RX600	RX-E	RX600	RX-E	RX600	RX-E
	RX200		RX200		RX200		RX200		RX200	
	RX100		RX100		RX100		RX100		RX100	
Medical & Healthcare  Health Monitor Band, Wearable devices, Blood sugar meter, etc.	RX700	RX-T	RX700	RX-T	RX700	RX-T	RX700	RX-T	RX700	RX-T
	RX600	RX-E	RX600	RX-E	RX600	RX-E	RX600	RX-E	RX600	RX-E
	RX200		RX200		RX200		RX200		RX200	
	RX100		RX100		RX100		RX100		RX100	
Consumer Electronics  Home Entertainment, Power Adapters & Chargers, Wearables, etc.	RX700	RX-T	RX700	RX-T	RX700	RX-T	RX700	RX-T	RX700	RX-T
	RX600	RX-E	RX600	RX-E	RX600	RX-E	RX600	RX-E	RX600	RX-E
	RX200		RX200		RX200		RX200		RX200	
	RX100		RX100		RX100		RX100		RX100	
Metering  Electricity, Gas, Water, Heat Meter	RX700	RX-T	RX700	RX-T	RX700	RX-T	RX700	RX-T	RX700	RX-T
	RX600	RX-E	RX600	RX-E	RX600	RX-E	RX600	RX-E	RX600	RX-E
	RX200		RX200		RX200		RX200		RX200	
	RX100		RX100		RX100		RX100		RX100	

RX Family Features

Technological innovations in RX microcontrollers to improve performance and responsiveness

RX microcontrollers have always pursued the processing performance and responsiveness that meet the demands of the times through the evolution of CPU architecture and sophistication of pipeline processing. Furthermore, a design that achieves high code efficiency allows for the implementation of advanced functions with a small program size. This provides a definite competitive edge to our customers' product development in a wide range of applications that require real-time control and high-speed calculations.



RX Core Generation Features

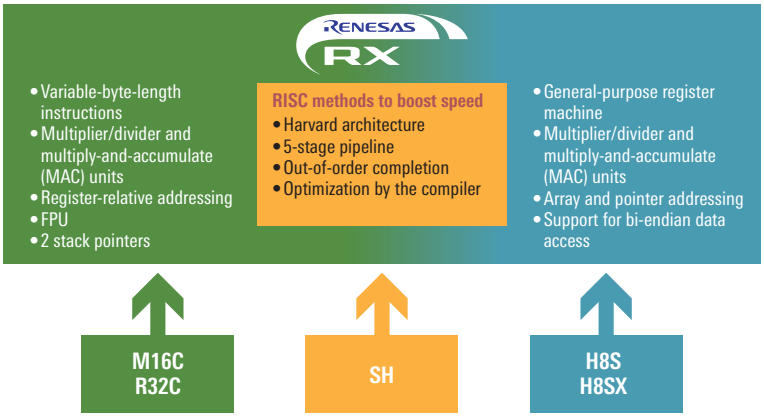
Item	RXv1	RXv2	RXv3
Architecture	32-bit CISC, Harvard architecture		
General purpose registers	32bit × 16ch		
Compatibility	RXv1	Downward compatible with RXv1	Downward compatible with RXv1/RXv2
Instruction set	90 instructions	109 instructions (90 RXv1 instructions + 19 instructions)	113 instructions (109 RXv2 instructions + 4 instructions)
Pipeline	5-stage	Improved 5-stage pipeline Improved IPC through enhanced pipeline (enhanced performance through parallel execution of memory access and operations)	Improved 5-stage pipeline Improved IPC through enhanced pipeline (enhanced performance through improved combination of simultaneously executable instructions)
DSP function instructions	Single-cycle MAC instructions(16-bit), Accumulator × 1	Single-cycle MAC instructions (16-bit, 32-bit), Accumulator × 2	Single-cycle MAC instructions (16-bit, 32-bit), Accumulator × 2
FPU	Single-precision floating-point operation instruction	Single-precision floating-point operation instruction	Single precision / double precision floating-point operation instruction (double precision is optional)
Performance	Up to 3.42 CoreMark/MHz	Up to 5.05 CoreMark/MHz	Up to 6.01 CoreMark/MHz
Others	–	–	Register bank save function (optional) *Availability of optional functions depends on product specifications

RX Core Features

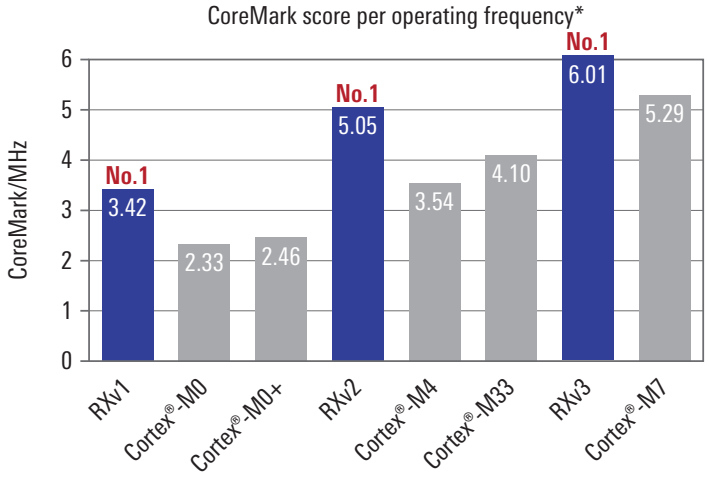
Feature 1: Original CPU That Inherits the Strengths of Its Predecessors

RX core combining advantages of CISC and RISC

- Combines the variable byte-length instructions of CISC with the general-purpose register machine, architecture, and pipelines of RISC. The RX CPU core brings together Renesas technology accumulated over many years.



Feature 2: RX CPU Core with Industry-Top-Class Performance



CoreMark/MHz value = 6.01

Superior embedded performance and power efficiency

RX core features

- CPU developed in-house for high operational efficiency.
- Five-stage superscalar architecture.
- Optimized for power efficiency and high performance.
- Processing capability and code efficiency on par with RISC.
- Improved interrupt responsiveness and FPU/DSP instructions.

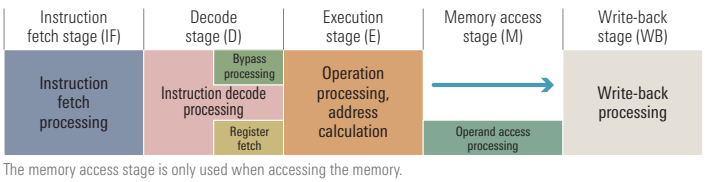
* Cortex®-M is the nominal value of Arm

Feature 3: Pipeline Stage Configuration

- Harvard architecture enabling parallel execution of instruction fetches and data accesses.
- Five-stage pipeline configuration and out-of-order completion for even faster execution. (Allows no-wait execution of later instructions when there is no dependency between later and earlier instructions.)

Pipeline Stage Configuration

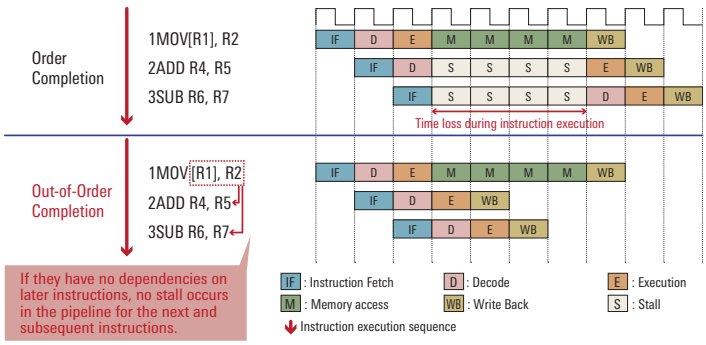
- 5-stage pipeline for faster processing
- Through benchmark testing of various types of application software, processing performance was more than doubled compared with earlier products.



The memory access stage is only used when accessing the memory.

Out-of-Order Completion

- Out-of-order completion boots the efficiency and speed of instruction execution.



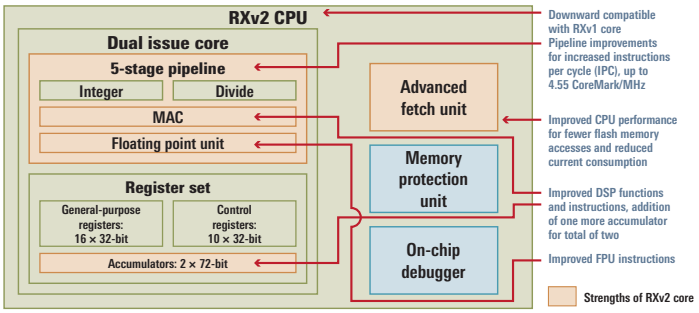
RXv2 Core Features

RXv2 Core: CPU Block Diagram

Further enhancements while maintaining compatibility with the RXv1 core

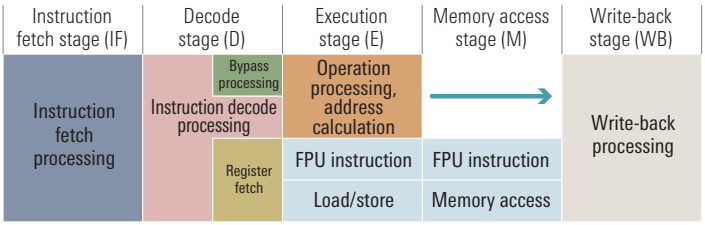
- Improved pipeline for substantial increase in the number of instructions per cycle (IPC)
- Advanced fetch unit with improved interface to on-chip flash memory. Reduces re-fetching of instructions due to penalty imposed by branch instructions and reduces the number of flash memory accesses. Achieves improved CPU performance alongside reduced power consumption.
- Improved instructions for DSP and FPU functions.

RXv2 CPU Block Configuration Diagram



Feature 1: Pipeline Enhancements

RXv2 Pipeline Processing Stage Configuration



The memory access stage is only used when accessing the memory.

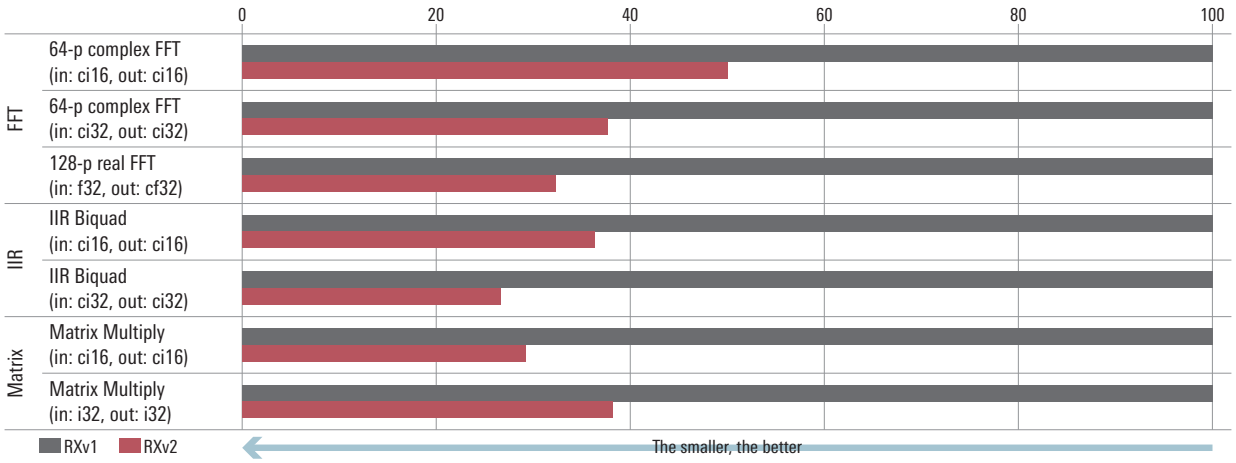
Improved pipeline processing and parallel execution of floating-point operations

- Floating-point operations take place in parallel during execution stages and memory access stages.
- Integer operation instructions and memory access or FPU instructions can execute at the same time.
- Contributes to improved FPU execution speed and CPU performance.

Feature 2: FPU and DSP Enhancements

Enhanced FPU and DSP functions

- Reduced execution cycle count for existing instructions and addition of new instructions.
- The number of accumulators with dedicated buffers has been increased from one to two for more efficient DSP operations.
- Performance in filter operations has been boosted fourfold.



FPU functions (new instructions added, existing instructions speeded up)	
New instructions	FSQRT (√), FTOU, UTOF
	Three-operand format
Speed [cycles]	FADD/FSUB: 4 cycles → 2 cycles FMUL: 3 cycles → 2 cycles
Single-cycle throughput	Pipelined FPU

Improvements are shown in red.

DSP functions (new instructions added, accumulator for operations added)	
32×32=acc, acc ±32×32=acc	EMULA, EMACA, EMSBA
16×16=acc, acc ±16×16=acc	HULLH, MACLH, MSB (LH, HI, LO)
Accumulator rounding instructions (16-/32-bit, round off/down)	RDACW, RDACL, RACL
Accumulator added	1 → 2

RXv3 Core Features

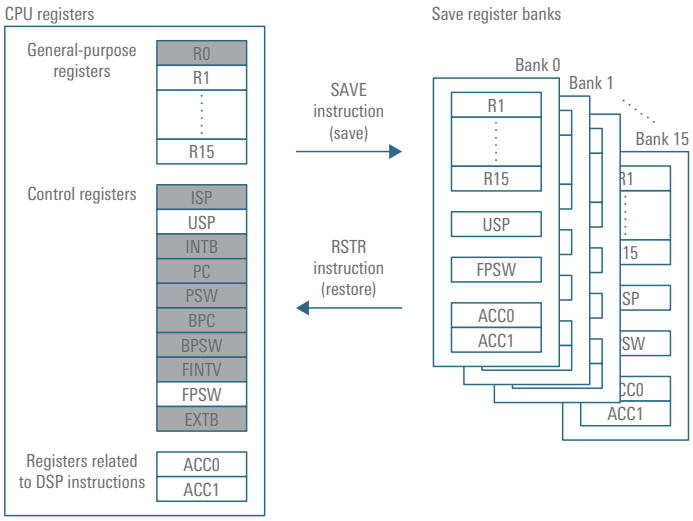
RXv3 core inherits the RXv2 core and implements new features such as improved performance, a double-precision FPU, and a register bank save function. This has resulted in an industry-leading CPU performance of 6.01 CoreMark/MHz in the EEMBC CoreMark® benchmark. Even in many applications that require real-time processing, this enables extremely fast and efficient calculations, contributing to improved responsiveness and processing speed of the entire system and power savings.

Feature 1: Register Bank Save Function

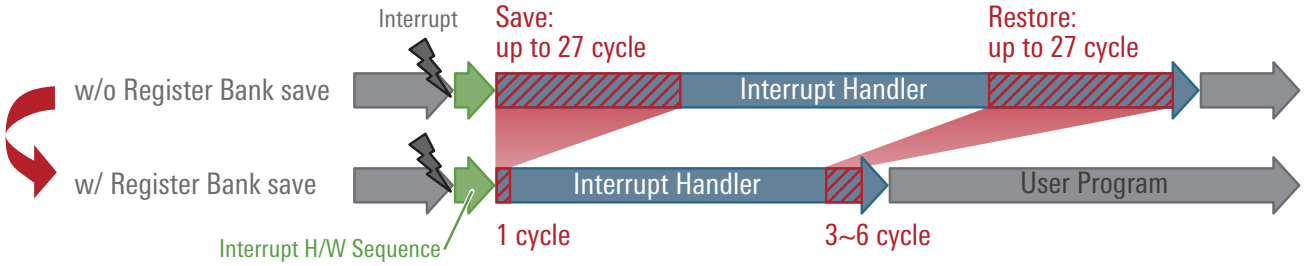
Dedicated memory for improved interrupt responsiveness

- Faster saving/restoring data to/from CPU registers and improved interrupt responsiveness.
- "Register save banks" provided as dedicated memory for register saves.
- Dedicated instructions (SAVE and RSTR) for accessing the register save banks.
- Number of register save bank areas: 16 (RX72T)*1

Note: 1. Number of banks differs among products.

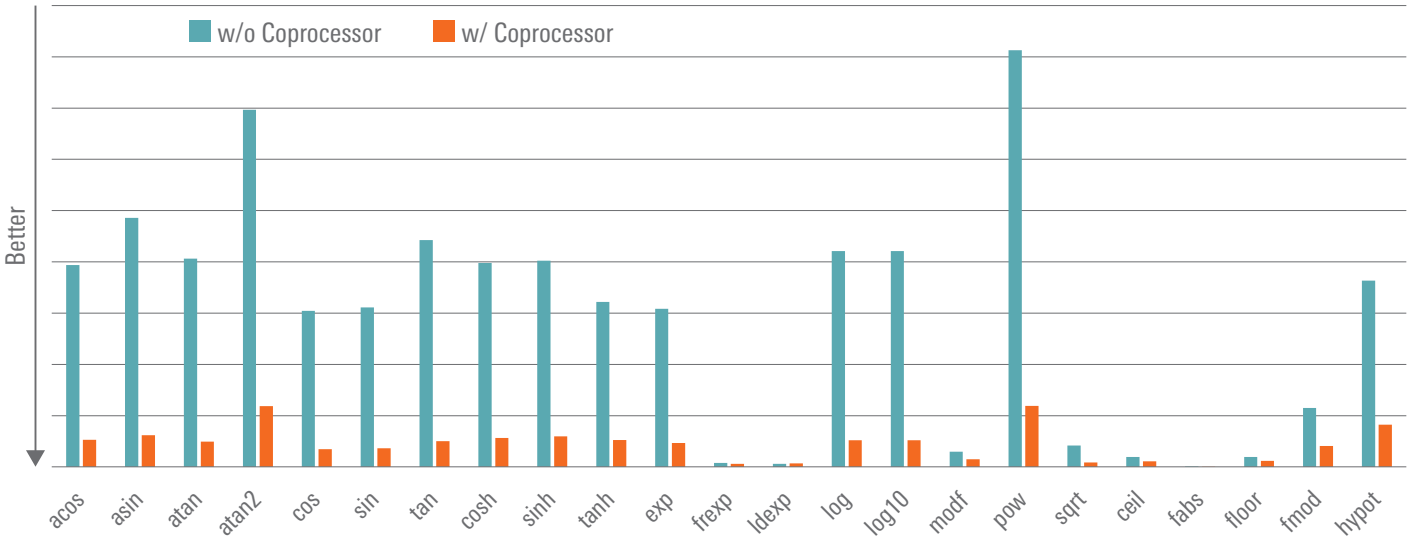


Comparison with conventional product (saving data to all registers)



Feature 2: Double-Precision FPU Support

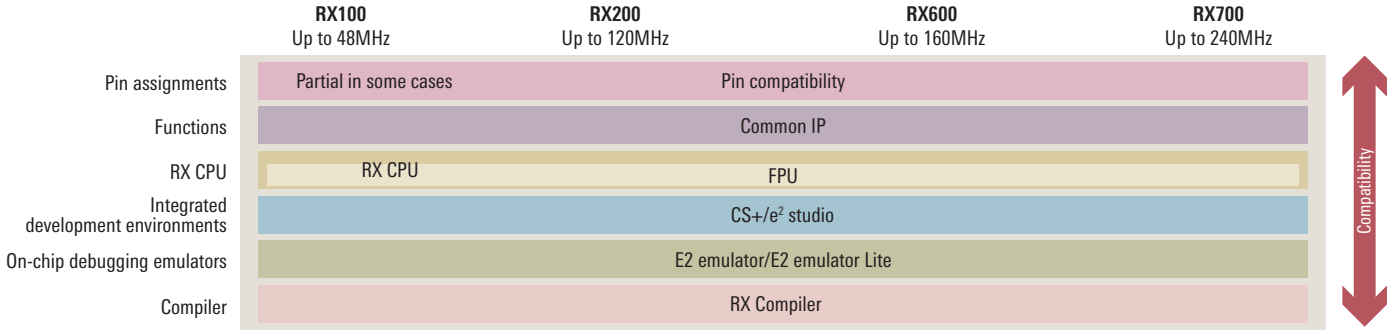
- First RX Family CPU core with a double-precision floating-point processor.
- Greatly improved processing performance in double-precision floating-point operations (up to eight times better).



RX Family Compatibility

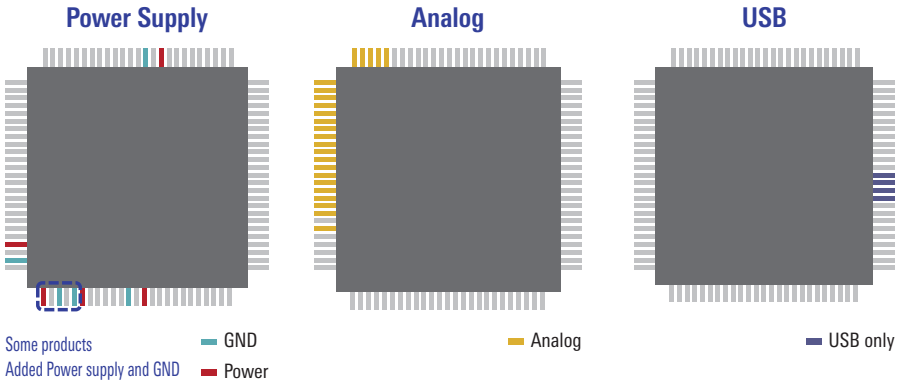
RX microcontrollers maintain compatibility in areas such as instruction sets, pin compatibility, and functional configurations, making it easy to reuse development assets and standardize designs between products. This feature enables new product development, rapid response to market needs, and smooth expansion of the product lineup, contributing to improved development efficiency and flexibility.

- The instruction sets of the RXv1, RXv2, and RXv3 cores are intercompatible.
- The functions of RX Family MCUs are based on common IP cores, allowing for easy migration between RX products.
- The pin assignments of RX Family MCUs are fundamentally consistent with those of earlier Renesas products.
- Pin positions for digital peripheral functions can be selected from among multiple locations, simplifying the development of printed circuit boards.
- Compatibility among development environments has been enhanced, reducing the development burden and cost of tools while simplifying program management.



Pin Compatibility between Series for Power Supply, Analog, and USB

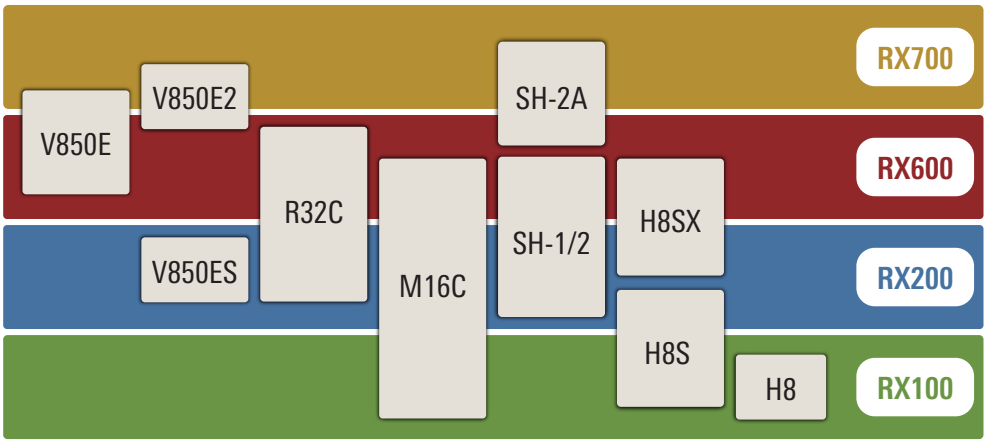
Analog and USB pins are pin compatible. Power supply pins are compatible except in some devices which require additional pins.



*100-pin version terminal layout example

Existing Products and RX Extensibility

The RX Family covers the performance range of a variety of CPU cores utilized in earlier Renesas products.
Improved software reusability and unification of development environments allow the RX Family to provide seamless scalability when developing products over the entire model range from low- to high-end.



RX700 Series

Features of the RX700 Series

High-performance, High-speed response

1416CoreMark @240MHz
Double precision FPU coprocessor
Trigonometric functions arithmetic unit
Register bank save function

Large-capacity

4MB Flash
(Dual bank function)
1MB SRAM

Numerous peripheral functions

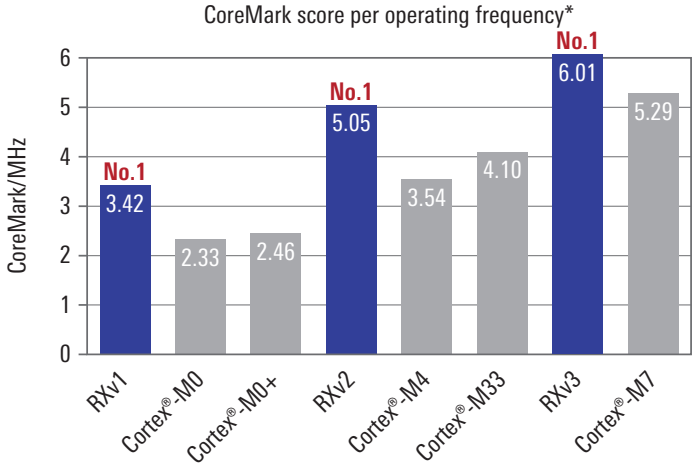
Various communication interfaces
3-phase complementary PWM timer
12-bit A/D converter
TFT LCD controller
2D rendering engine
Trusted Secure IP
Capacitive touch

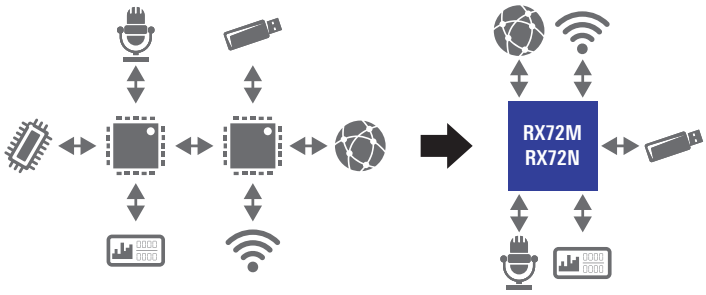
Various solutions

HMI
Cloud
Security
Functional safety

Maximized extreme high efficiency CPU for integrated on one-chip.

- Highest performance CPU as 240MHz RXv3 core in RX family, that has 6.01CoreMark/MHz great cycle performance and up to 1416CoreMark.
- Integrated on one-chip MCU with communication, HMI, system control by large 4MB embedded flash, 1MB SRAM and numerous peripheral functions.





* Cortex®-M is the nominal value of Arm

Support major IA network protocols even multi-protocols

EtherCAT® EtherNet/IP PROFINET®
Modbus OPC UA CC-Link IE TSN
PROFIBUS® CANopen® DeviceNet

Support major protocols makes easy to imprement with multi-protocols

Reducing development terms by using sample project.

EtherCAT slave communication with lower CPU load.

RX700 Series Lineup

RX72M 240MHz,4MB Flash (Dual bank support), 1MB SRAM, 32KB Data Flash
100/144/176/224-pin

RXv3	Double precision FPU	Trigonometric functions arithmetic unit	Ethernet IEEE1588	I^2S	TFT LCD	EtherCAT slave

RX72N 240MHz,4MB Flash (Dual bank support), 1MB SRAM, 32KB Data Flash
100/144/176/224-pin

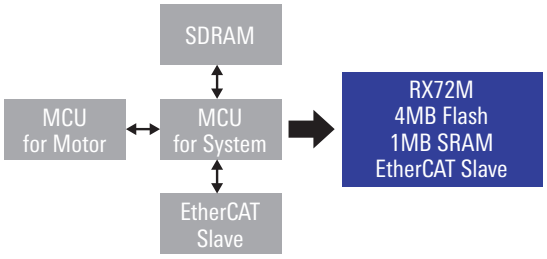
RXv3	Double precision FPU	Trigonometric functions arithmetic unit	Ethernet IEEE1588	I^2S	TFT LCD

Common functions

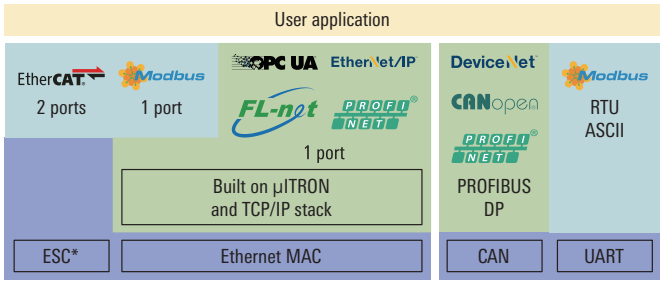
USB	Quad SPI
SD host I/F	CAN
12-bit ADC	12-bit DAC
Security	

RX72M Group: Flagship Models with Support for a Variety of Industrial Network Standards

- EtherCAT slave control* and high-precision time synchronization control for multiple industrial motors implemented on a single chip, enabling more compact product design.
- Full 1MB of on-chip SRAM. Enables high speed execution of middleware for TCP/IP, web server, file system, etc., without need for external memory.
- Supports a variety of industrial network protocol stacks in addition to EtherCAT. Flexible support for diversifying protocol requirements.



4MB flash memory, 1MB SRAM, and EtherCAT slave controller* on-chip.

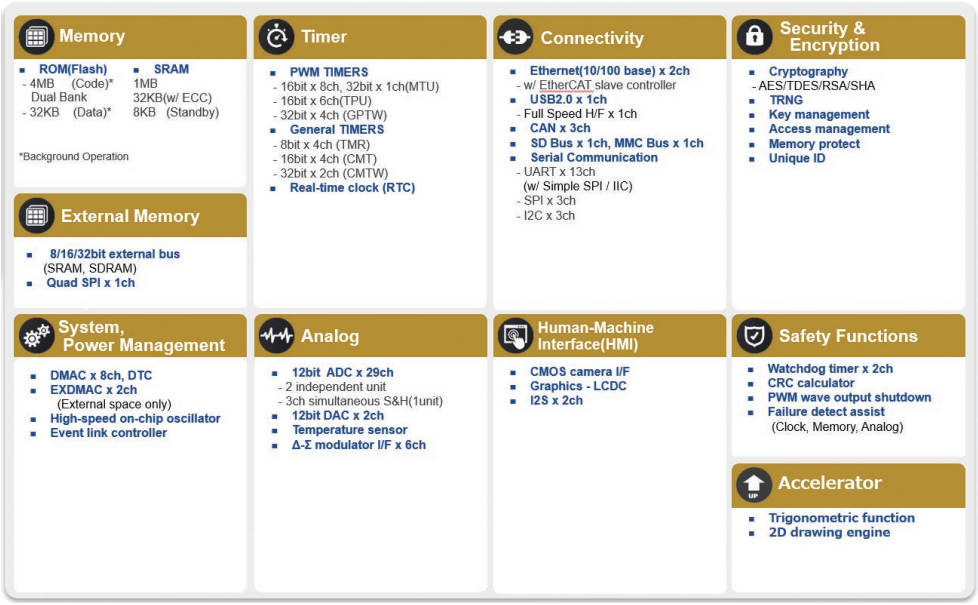


Protocol stacks from Renesas and from partner vendors provide coverage for major industrial network standards.

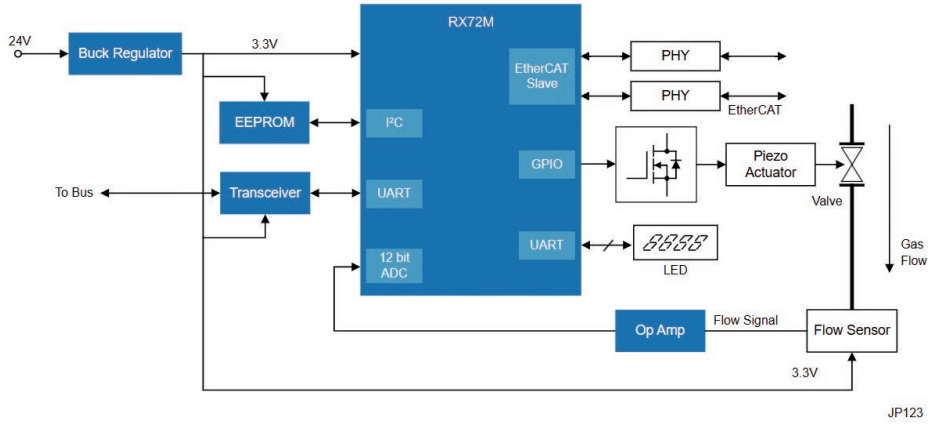
* EtherCAT slave controller (ESC) available on RX72M only.

Block Diagram

RXv3 Core 240MHz (Single / Double - precision FPU), Power Voltage: 2.7 to 3.6V



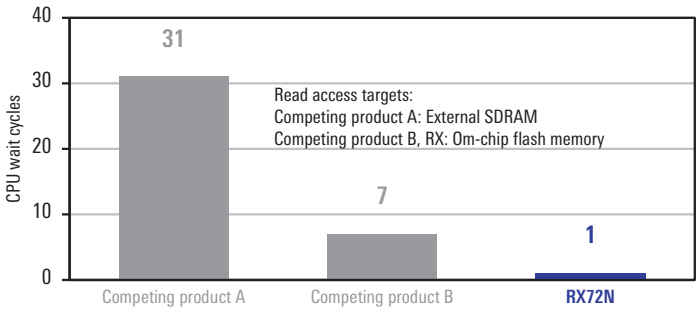
Use Case: Mass Flow Controller with EtherCAT & CAN Connectivity

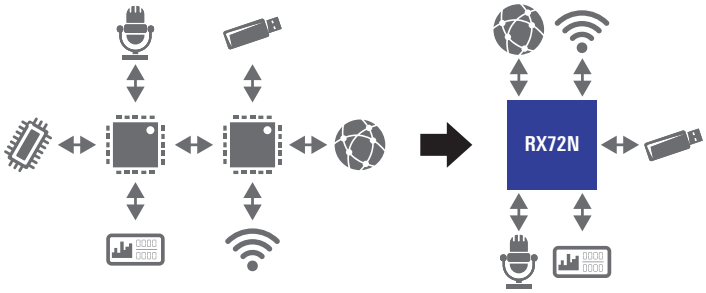


As modern consumer electronics evolve to meet growing consumer expectations for connectivity, convenience, and intuitive operation, human-machine interfaces (HMIs) have become essential for providing clear control and feedback. the RX72M is capable of providing these interfaces with the necessary control, such as LCD displays and voice recognition, on a single chip.

RX72N Group: Device Control and Network Functions on a Single Chip

- The flash memory supports the industry's fastest read times when operating at 120MHz. This permits consistent peak CPU performance and is ideal for applications demanding excellent real-time performance.
- The on-chip memory capacity and number of general-purpose I/O ports are also the highest in the industry. This allows concentration of multiple functions on single chip, enabling more compact finished products and reduced development time.





Outstanding Realtime Performance

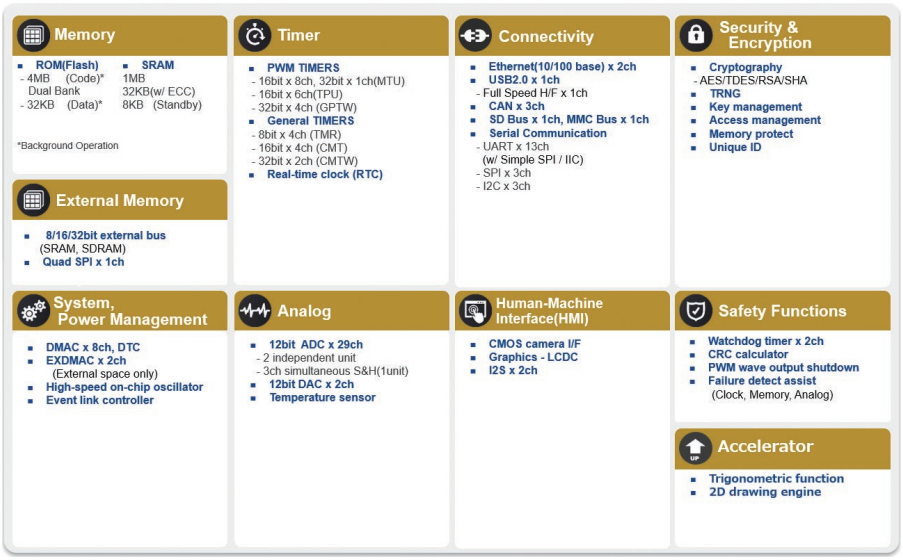
On the RX72N there is only one wait cycle when a cache miss occurs.

Multifunctionality and Compact Size

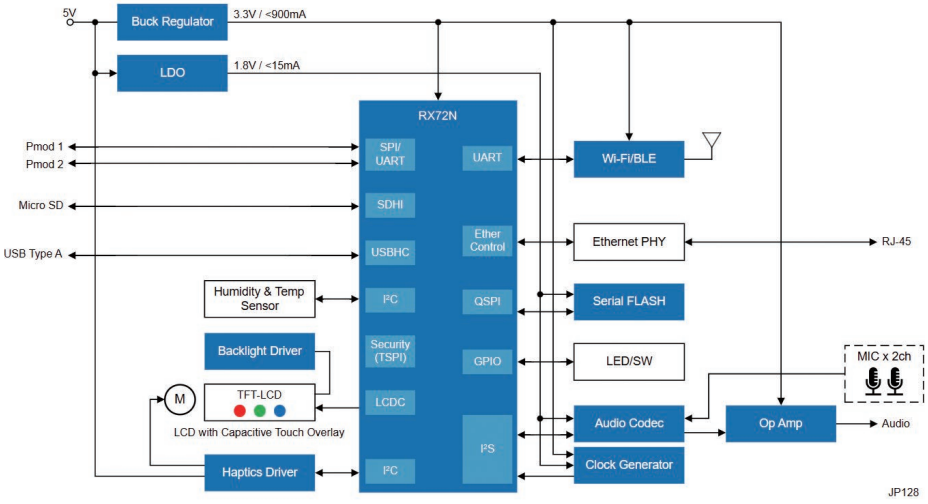
4MB flash memory, 1MB SRAM, and 182 general-purpose I/O ports on a single chip.

Block Diagram

RXv3 Core 240MHz (Single / Double - precision FPU), Power Voltage: 2.7 to 3.6V



Use Case: Smart HMI System with Voice & Display Interfaces



Human machine interfaces (HMIs) are essential components that connect people to machines, systems, or devices, enabling control over various functions and access to data. As technology advances, HMIs need to incorporate features like connectivity (via Wi-Fi, Bluetooth, etc.) and LCD screens to support more complex interactions and commands between humans and machines.

The RX72N is ideal for high-performance smart HMI systems with its high- performance processing at 240 MHz, creation of graphic user interface (GUI) with LCD, audio input/output, and IoT connectivity via Wi-FI, Ethernet, etc.

RX600 Series

Features of the RX600 Series

High-performance, High-speed response

720CoreMark @120MHz
No-wait flash @120MHz
Double precision FPU coprocessor

Large-capacity

4MB Flash
(Dual bank function)
1MB SRAM

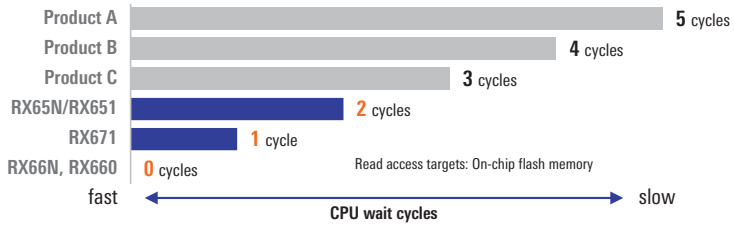
Numerous peripheral functions

Various communication interfaces
3-phase complementary PWM timer
12-bit A/D converter
TFT LCD controller
2D rendering engine
Trusted Secure IP
Capacitive touch

Various solutions

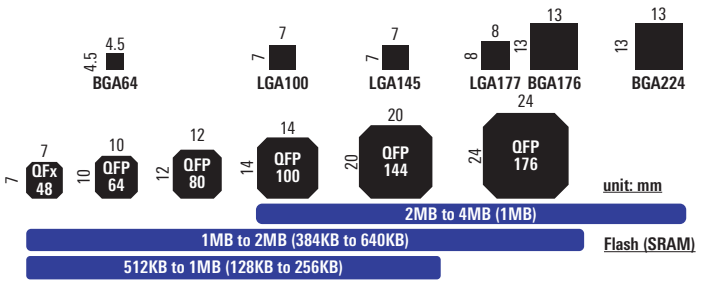
HMI
Cloud
Security
Functional safety

Overwhelming Real-Time Processing Performance



- High-speed built-in flash capable of no-wait operation at up to 120MHz
- Stable CPU performance with no wait time
- Ideal for real-time applications with the high-speed operation

Large-Capacity Memory Expansion and Minimal Package Expansion



- Extensive lineup to suit needs
- Large-capacity memory that does not require external memory
- Small package that can be mounted on a small board

Equipped with Essential Functions for IoT Implementation

Connectivity

- Supports various communication interfaces such as Ethernet, USB, CAN FD, QSPI, I2S, and SD host I/F

HMI

- TFT LCD controller capable of WVGA 8bpp, WQVGA 16bpp display
- Large-capacity working memory that realizes display control with 1 chip
- Touch function with high sensitivity and high noise tolerance

Security

- Trusted Secure IP enables strong and high-speed security processing
- Protect your system from unauthorized usage and tampering

RX600 Series Lineup

RX66N — 120MHz, 4MB Flash (Dual bank support), 1MB SRAM, 32KB Data Flash
100/144/145/176/224-pin

RXv3 | Double precision FPU | Ethernet | CAN | I^2S | TFT LCD

RX671 — 120MHz, 2MB Flash (Dual bank support), 384KB SRAM, 8KB Data Flash
48/64/100/144/145-pin

RXv3 | Double precision FPU | CAN | I^2S | Capacitive touch

RX65N/ RX651 — 120MHz, 2MB Flash (Dual bank support), 640KB SRAM, 32KB Data Flash
64/100/144/145/176/177-pin

RXv2 | Single precision FPU | Ethernet | CAN | TFT LCD

RX660 — 120MHz, 1MB Flash, 128KB SRAM, 32KB Data Flash
48/64/80/100/144-pin

RXv3 | Single precision FPU | CAN-FD | 5V Power supply

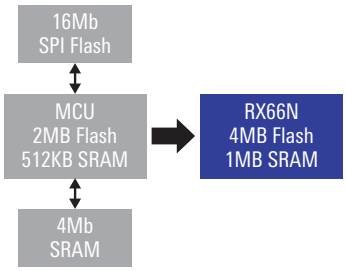
Common functions

- USB*
- Quad SPI*
- SD host I/F*
- 12-bit ADC
- 12-bit DAC
- Security*

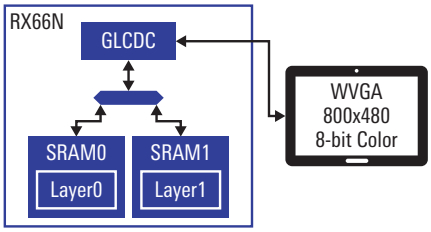
*Not implemented on RX660

RX66N Group: Advanced model of RX65N with Enhanced CPU and On-Chip Memory

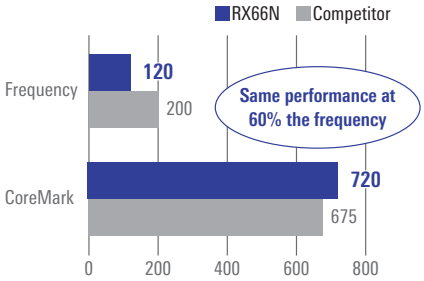
- The industry-leading MCU to combine 4MB of flash memory and 1MB of SRAM. Ability to implement a broad range of functions without external memory.
- Dual-plane SRAM (512KB + 512KB) configuration, allowing smooth display performance on WVGA (800 × 480, 8bpp) displays.
- The RXv3 core delivers excellent performance per unit of operating frequency, achieving performance when operating at 120MHz equivalent to that of competing MCUs operating at 200MHz.



Large-capacity code area and word area on a single chip



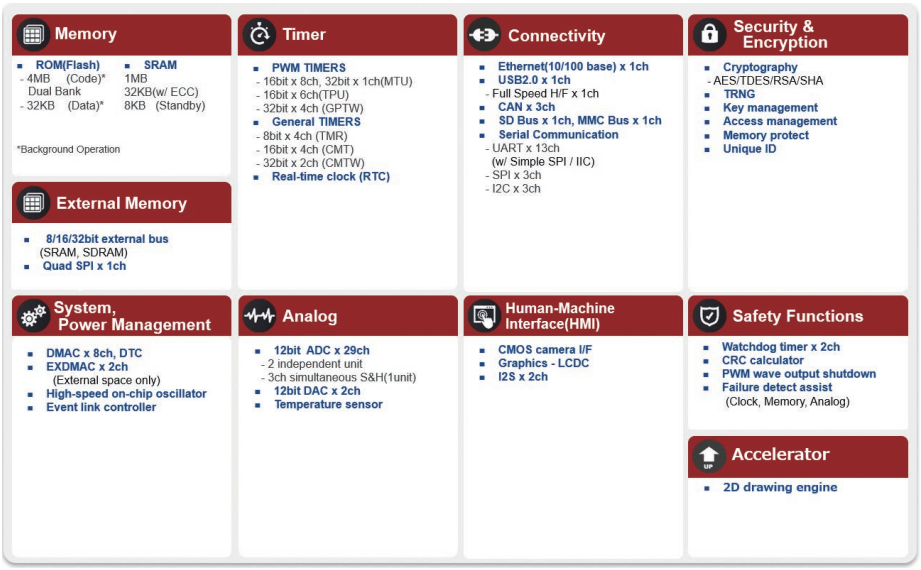
Ability to control a WVGA display without external memory



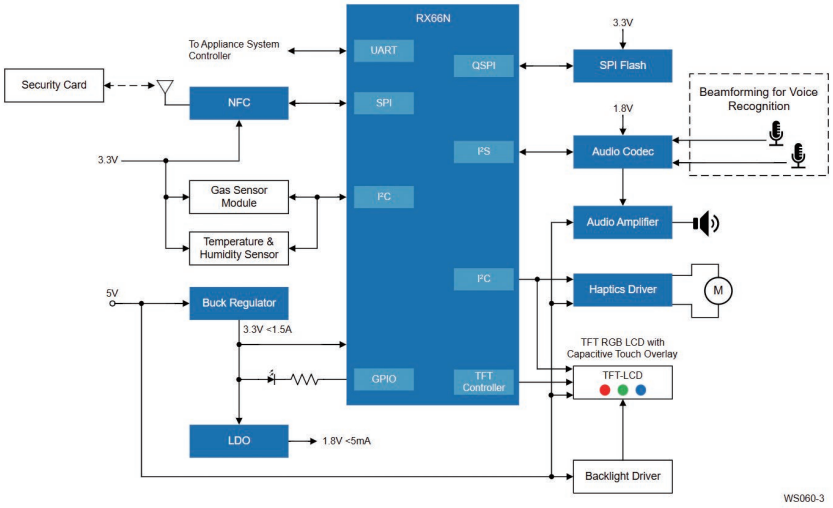
High-performance (6.01 CoreMark/MHz) RXv3 core

Block Diagram

RXv3 Core 240MHz (Single / Double - precision FPU), Power Voltage: 2.7 to 3.6V



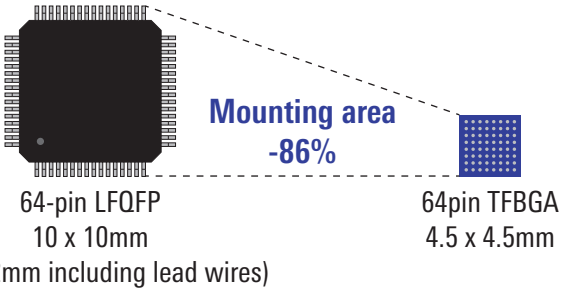
Use Case: Human Machine Interface (HMI) for Appliances



As modern consumer electronics products evolve to meet growing consumer expectations for connectivity, convenience, and intuitive operation, human-machine interfaces (HMIs) have become essential for providing clear control and feedback. RX66N enables control of touchscreens, displays, and voice control on a single chip.

RX671 Group: Support for Superior Power Efficiency, Hygienic User Interface, and Cloud-Connected IoT Appliance

- Functionality for implementing a contactless UI using voice recognition or touch sensing and sophisticated system control on a single chip
- 4.5 × 4.5mm 64-pin BGA standard package enabling compact applications with more advanced functions



Contributing to Simpler System Configurations

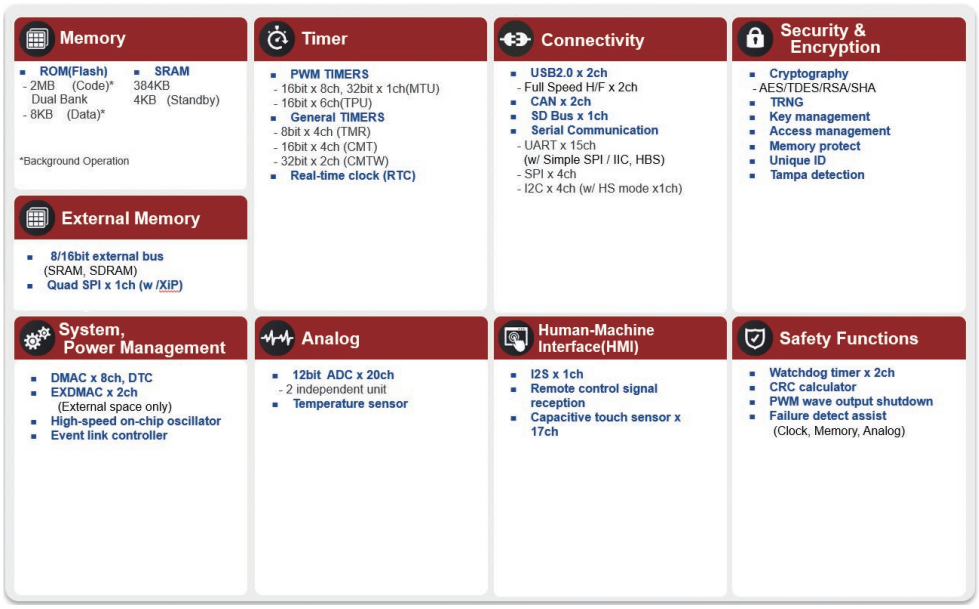
A single-chip solution that supports larger memory requirements of communication protocol stack processing and accommodating an RTOS to enable operation processing on contactless UI devices.

High-Performance CPU and Large Memory Capacity in an Ultracompact 4.5 × 4.5mm Standard Package

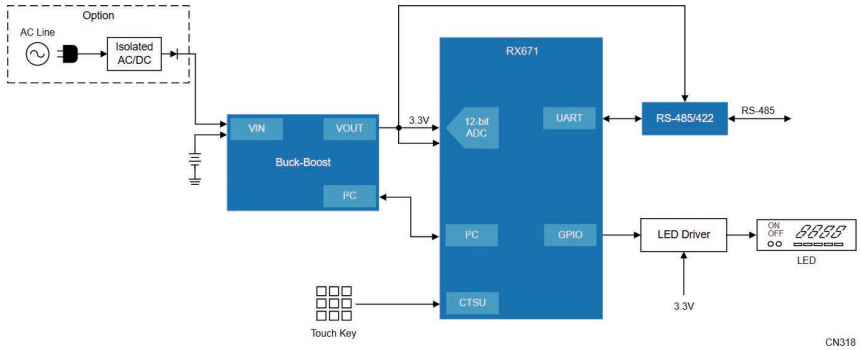
Helps realize more advanced functionality in applications with limited available mounting area.

Block Diagram

RXv3 Core 120MHz (Single / Double - precision FPU), Power Voltage: 2.7 to 3.6V



Use Case: Touchless Button

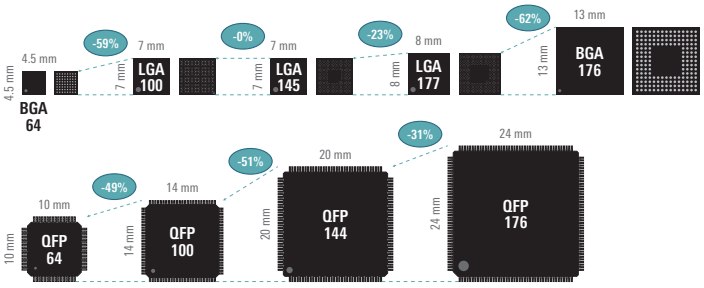


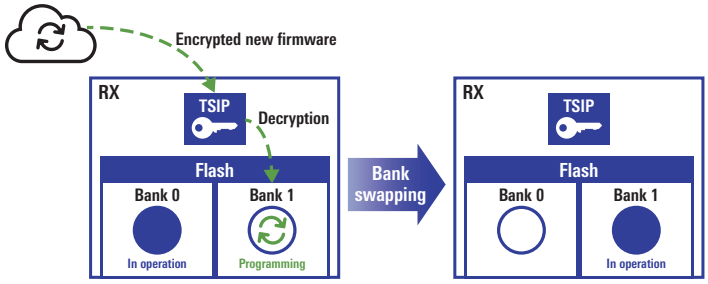
Touchless button solutions are widely used in home lighting switches, bathroom switches, public vending machines, electric door openers, etc. Since button pushing events can be detected without direct touches, bacteria and dirt adhesion to the fingers is reduced. RX671 with capacitive touch sensing unit (CTSU) provides touchless control with high sensitivity and high noise tolerance.

RX65N/RX651 Group: Mainstream MCUs that Integrate Functions Essential for IoT Devices on a Single Chip

RX65N RX651

- Broad lineup ideal for a range of products, with flash memory capacity from 512KB to 2MB and package pin counts from 64 to 177 pins
- Easy implementation of secure firmware over-the-air (FOTA) updates essential for IoT devices





Broad Package Lineup

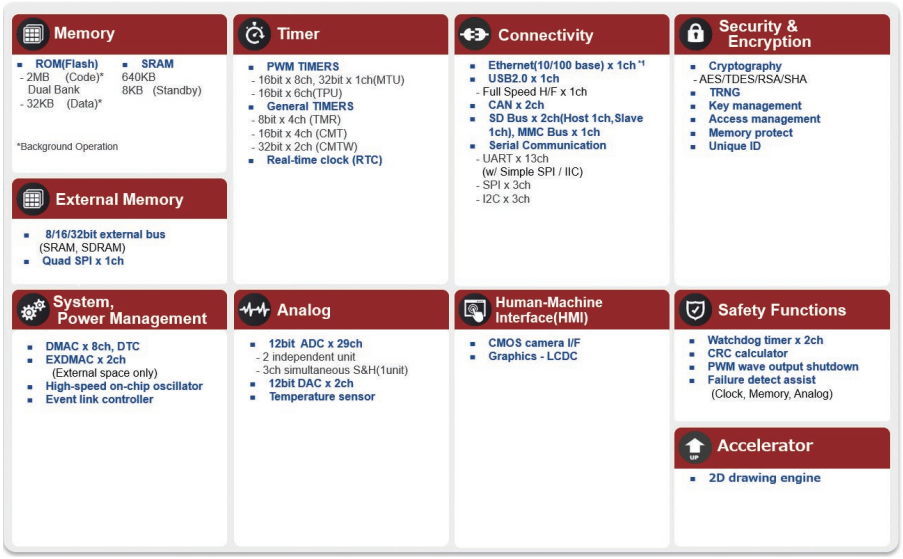
With the exception of 176- and 177-pin products, all packages are available with flash memory capacities from 512KB to 2MB (1.5MB or 2MB only for 176- and 177-pin products).

FOTA Solutions Bringing New Added Value

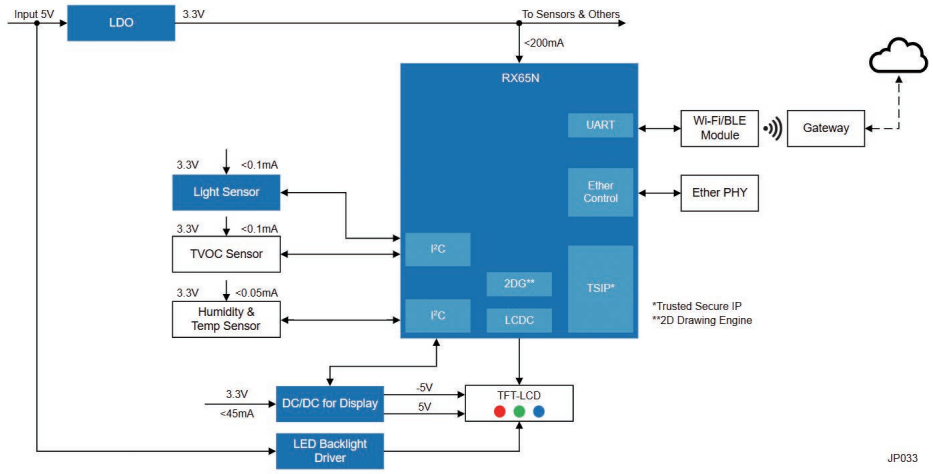
Firmware can be updated while the system continues to operate.
Select wired or wireless connectivity to match the application.
Authentication enables tampering detection and prevents unauthorized updates.

Block Diagram

RXv2 Core 120MHz (Single - precision FPU), Power Voltage: 2.7 to 3.6V



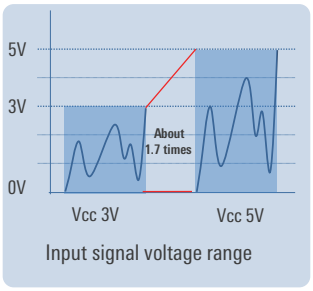
Use Case: Secure Cloud & Sensor Platform

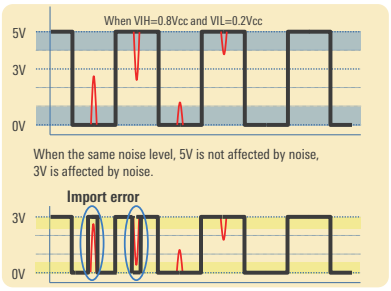


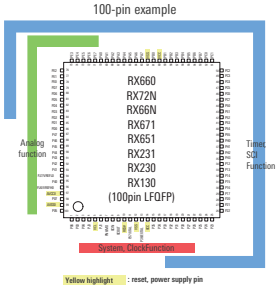
The system supports light, temperature, and total volatile organic compound sensors. All collected data, including sensor readings, can be instantly uploaded to the cloud, making RX65N ideal for IoT edge devices with its human-machine interface and advanced security features. Built-in dual bank capability and Trusted Secure IP enable secure cloud communication and firmware updates.

RX660 Group: 5V Power Supply Compatibility Combined with High-Performance CPU Core

- Support for 5V power supply with noise tolerance superior to that of 3V power supply reduces the need for external components to suppress noise.
- Features the latest RXv3 CPU core while retaining pin compatibility with other 5V products (such as the RX210)







Helping to Improve System Noise Tolerance

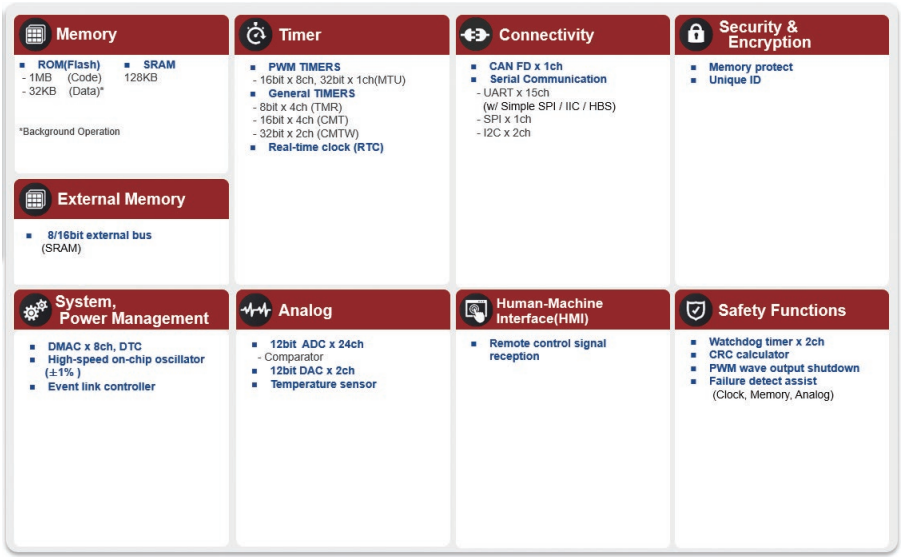
Using a 5V power supply increases the dynamic range to 1.7 times that possible with a 3V power supply, which is valuable in scenarios requiring high-precision sensing. It also makes it possible to reduce the relative noise level.

Easy Migration from Other 5V MCUs

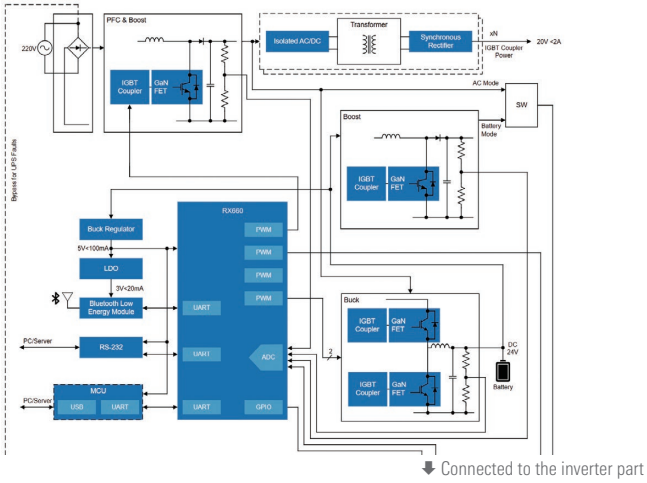
Pin compatibility with previous-generation products such as the RX210 makes it possible to switch to the latest high-performance CPU core while minimizing the system configuration burden.

Block Diagram

RXv3 Core 120MHz (Single - precision FPU), Power Voltage: 2.7 to 5.5V



Use Case: High-Efficiency Online Uninterruptible Power Supply (UPS) with Real-Time Monitoring



Connected to the inverter part

Reliable power is critical for various facilities and applications such as data centers, hospitals, industrial automation, and more. Given the importance and sensitivity of these systems, there is a pressing need for them to remain operational without interruptions.

This online uninterruptible power supply (UPS) system employs advanced power management and real-time monitoring technology to ensure continuous, high-quality power delivery. It outputs AC through an inverter circuit during normal operation and uses battery power to maintain AC output during outages, thereby mitigating power interruptions and protecting sensitive electronic equipment from disturbances.

RX660 for primary power conversion offers a high-performance, streamlined design to boost cost efficiency and reduce time to market.

RX200 Series

Features of the RX200 Series

Both low power consumption and high performance

64MHz
69µA/MHz (operation)
1µA (standby)
SNOOZE mode

5V power supply support Robust security

5V power supply support
RSIP-E11A
Memory protection function

Extensive communication functions

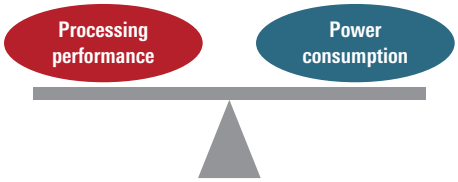
CAN FD
USB full-speed
Bluetooth

Various solutions

Functional safety
Capacitive touch
Security

High performance and low power consumption

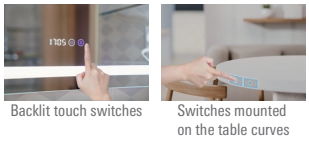
The RX200 series not only delivers high performance of 355Coremark @64MHz, but also combines power-saving drive with an active current of 69µA/MHz and a standby current of 1µA. In addition, snooze mode minimizes power consumption during intermittent operation. It is ideal for high-performance industrial equipment, battery-powered equipment, and energy-saving equipment.



- **355CoreMark (64MHz)**
- **Operating current: 69µA/MHz**
- **RAM hold standby current: 1.0µA**

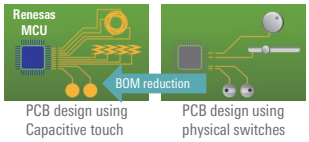
Advanced HMI supporting intuitive and beautiful design

The latest capacitive touch sensor provides intuitive touch operation instead of physical buttons. High sensitivity, high noise immunity, and water resistance ensure excellent operability even in wet or dusty environments.



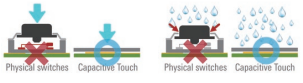
Backlit touch switches | Switches mounted on the table curves

Design & Operability



PCB design using Capacitive touch | PCB design using physical switches

Cost saving



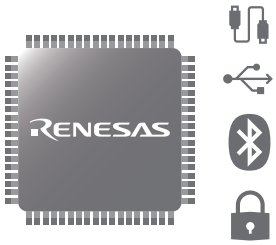
No Abrasion Failure | Dustproof and Splashproof

Superior Durability

Ease of Maintenance

Supporting IoT with Abundant Communication Functions and Advanced Security

It supports a wide variety of communication interfaces such as CAN, USB, and Bluetooth, which are required by various markets, to realize the IoT of devices. In addition, security functions to ensure safety against threats from the network are also included to provide relief and safety.



CAN/CAN FD	For FA applications. Highly reliable maximum 1Mbps communication
USB	Connection with PC, F / W update with USB memory
BLE	Realize new functions by communicating with smartphones, etc.(RX23W)
Security	Equipped with various cryptographic engines such as AES, ECC, SHA, etc. RSIP-E11A prevents key data leakage and cipher misuse Area protection feature prevents tampering with authentication programs

RX200 Series Lineup

RX261 64MHz, 512KB Flash, 128KB SRAM, 8KB Data Flash
48/64/80/100-pin

RXv3 | CAN FD | USB | Security | 5V Power supply

RX260 64MHz, 512KB Flash, 128KB SRAM, 8KB Data Flash
48/64/80/100-pin

RXv3 | 5V Power supply

RX23W 54MHz, 512KB Flash, 64KB SRAM, 8KB Data Flash
56/83/85-pin

RXv2 | CAN | USB | Security | Bluetooth

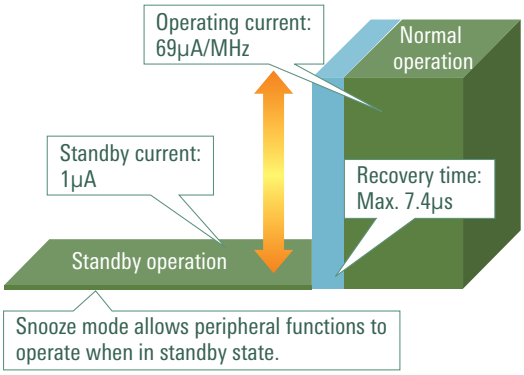
Common functions
- Single precision FPU
- Capacitive touch
- 12-bit ADC
- 8 or 12-bit DAC

RX261/RX260 Group: Equipped with 3rd generation touch IP for further low power consumption

RX261 RX260

Outstanding Power Efficiency

Ideal for battery-powered applications



Advanced Capacitive Touch

The latest capacitive touch functionality with improved noise immunity and reduced power consumption

Capacitive Touch IP	RX261/RX260
	CTSU2SL
Radiated noise immunity (IEC/EN61000-4-3)*1	Level 4
Conductive noise immunity (IEC/EN61000-4-6)*1	Level 3
Pins for shielded electrode drive	Supported
Smart wakeup (auto-sensing and multi-scan)	Supported

*1: Uses capacitive touch evaluation system.

Powerful Security Functions

- Hardware Security IP:
  Key management function, Access management circuit, Various Cryptographic functions (AES,ECC,SHA,TRMG)
- Memory protection functions

Block Diagram

RXv3 Core 64MHz (Single - precision FPU), Power Voltage: 1.6 to 5.5V

*1: RX261 only *2: RX260 has 36-ch

Memory
- ROM(Flash)
  - 512KB (Code)
  - 8KB (Data)*
- SRAM
  - 128KB

* Background operation

Timer
- PWM timers
  - 32-bit x 2ch(GPTW)
  - 16-bit x 6ch(GPTW)
- General timers
  - 16-bit x 4ch (CMT)
  - 8-bit x 4ch (TMR)
- Low Power Timer (LPT)
- Real-time clock (RTC)

Connectivity
- USB2.0 x 1ch *1
  - Full speed host/function
- CAN FD x 1ch*1
- Remote control signal receiver x 1ch
- Serial communication
  - UART x 7ch (w/ Simple SPI / I2C / HBS)
  - SPI x 1ch
  - I2C x 1ch

Security & Encryption
- RSIP-E11A
  - AES/ECC/SHA engines
  - TRNG
  - Key management
  - Access management
- Memory protect
- Unique ID

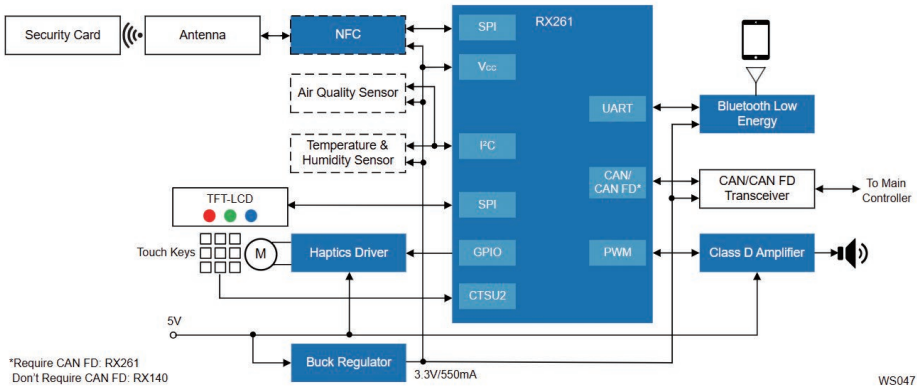
System, Power Management
- DMAC x 4ch, DTC
- High-speed on-chip oscillator (±1%)
- Low-speed on-chip oscillator
- Event link controller

Analog
- 12-bit ADC x 25ch
  - Comparator
- 8-bit DAC x 2ch
- Temperature sensor

Human-Machine Interface(HMI)
- Capacitive touch sensor x 34ch*2

Safety Functions
- Watchdog timer x 2ch
- CRC calculator
- PWM wave output shutdown
- Failure detect assist (Clock, Memory, Analog)

Use Case: Robust Operational Touch Panel with CAN FD



As technology advances, consumers expect intuitive, interactive interfaces that enhance the user experience in modern applications like e-bikes and elevators. Touch panels with high responsiveness and error-free communication, such as CAN FD, are crucial for safe operation, minimizing the risk of system failure or accidents.

The latest generation of capacitive touch IP provides a reliable human-machine interface (HMI) that responds even in wet environments.

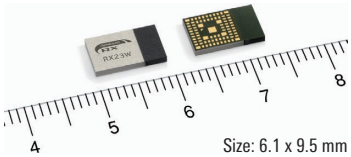
The RX261 provides the highest level of safety in life-critical systems by ensuring reliability and safety through flawless communication between the operation panel and the system controller.

RX23W Group: High Performance CPU, Security, and Wireless Communications on a Single Chip

High performance RXv2 core capable of controlling multiple systems, Trusted Secure IP implementing robust security functions, and Bluetooth 5.0 Low Energy with enhanced connectivity functions, all on a single chip.

RENESAS RX + Strong Security (Trasted secure IP) + Bluetooth® = 

The lineup includes modular products with integrated antenna and oscillator. The module size is among the world's smallest, and the design enables use of a large number of MCU peripheral function pins. These modules are certified under the Radio Laws of Japan (technical standards compliance), North America (FCC/ISED), and Europe (CE), making it possible to bring products to market quickly.



Size: 6.1 x 9.5 mm

Block Diagram

RXv2 Core 54MHz (Single - precision FPU), Power Voltage: 1.8 to 3.6V

Memory
- ROM(Flash) - 512KB (Code) - 8KB (Data)*
- SRAM 64KB

*Background Operation

Timer
- PWM TIMERS - 16bit x 5ch(MTU)
- General TIMERS - 8bit x 4ch (TMR) - 16bit x 4ch (CMT)
- Low Power Timer (LPC)
- Real-time clock (RTC)

Connectivity
- USB2.0 x 1ch - Full Speed H/F x 1ch
- CAN x 1ch
- SD Bus 1ch
- Serial Communication - UART x 4ch (w/ Simple SPI / IIC) - SPI x 1ch - I2C x 1ch - IrDA
- Bluetooth 5.0

Security & Encryption
- Cryptography - AES
- TRNG
- Access management
- Memory protect
- Unique ID

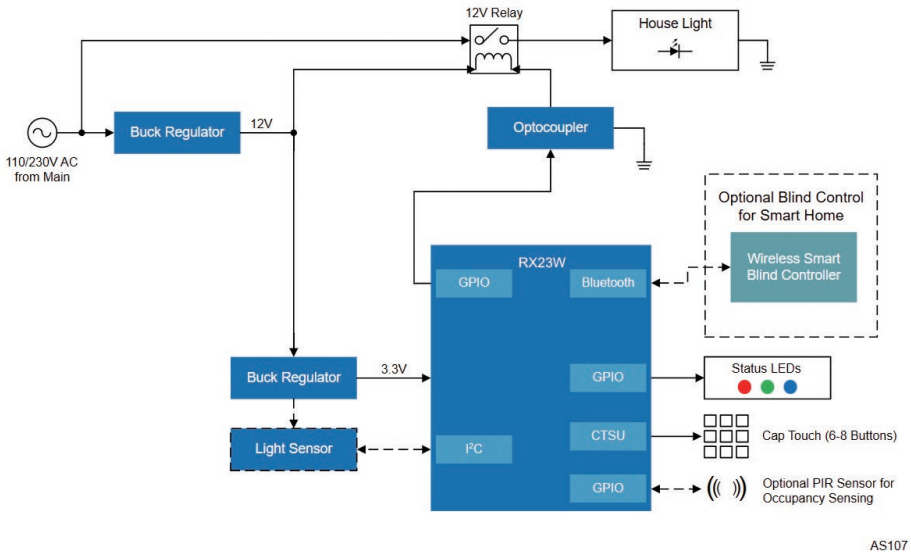
System, Power Management
- DMAC x 4ch, DTC
- High-speed on-chip oscillator
- Event link controller

Analog
- 12bit ADC x 14ch - Comparator
- 12bit DAC x 2ch
- Temperature sensor

Human-Machine Interface(HMI)
- I2S x 1ch
- Capacitive touch sensor x 12ch

Safety Functions
- Watchdog timer x 2ch
- CRC calculator
- PWM wave output shutdown
- Failure detect assist (Clock, Memory, Analog)

Use Case: Capacitive Touch Wall Switch



Capacitive touch switches are increasingly being adopted in commercial buildings, hotels, and other hospitality environments, addressing the growing demand for stylish, functional, and smart home-compatible solutions. The RX23W with Bluetooth Low Energy (LE) enables smart features and connected home system controls.

RX100 Series

Features of the RX100 Series

Power consumption among the lowest in the industry

48MHz
0.25µA standby

5V power supply support Segment LCD support

5V power supply support
Segment LCD support

Superior cost/performance ratio

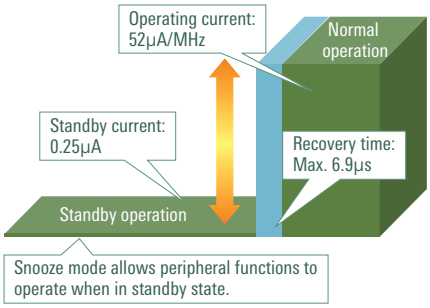
Low-pin-count/
small-ROM-capacity versions
Integration of peripheral ICs

Various solutions

Functional safety
Capacitive touch

Ultra-low-power, cost-effective 32-bit microcontroller

Ideal for battery-powered applications



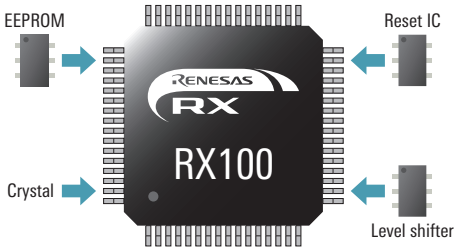
- Ultra-low power consumption in both standby and operating modes
- Ultra-fast return from standby to normal operation
- Snooze mode reduces overall system power consumption (Touch measurement, serial communication reception, AD conversion)

Functions suitable for measuring instruments and home appliances

RX100 Features and Specifications	Healthcare	Industrial Equipment	Instrumentation	Home appliances	Portable equipment
HMI (Touch key, Seg-LCD)	✓	–	–	✓	–
5V Operation	–	✓	–	✓	–
Communication (USB/SSI/CAN)	✓	✓	✓	–	✓
4mmEach small PKG	✓	–	✓	–	✓
Safety standards IEC/UL60730 compliant	✓	✓	✓	✓	✓

Excellent cost performance

– Small-pin/small-ROM lineup
– BOM reduction by incorporating peripheral ICs
– High compatibility between RX families reduces development costs



RX100 Series Lineup

RX140 48MHz, 256KB Flash, 64KB SRAM, 8KB Data Flash
32/48/64/80-pin

RXv2 | Single precision FPU | CAN | 5V Power supply | Security*

*AES/TRNG

RX130 32MHz, 512KB Flash, 48KB SRAM, 8KB Data Flash
48/64/80/100-pin

RXv1 | Remote control signal receiver | 5V Power supply

RX113 32MHz, 512KB Flash, 64KB SRAM, 8KB Data Flash
64/100-pin

RXv1 | USB | Segment LCD

Common functions
- Capacitive touch
- 12-bit ADC
- 8 or 12-bit DAC

RX140 Group: Achieving Lowest power consumption and the highest performance of the RX100 series

CPU operation: 52µA/MHz
Standby mode: 0.25µA

Ultra-low power consumption

5V operation, 12-bit A/D, RTC
Capacitive touch key

Optimal Peripheral features

Common Pin configuration
Common development tools

High Compatibility

inheritance

RENESAS RX

RX140

evolve

Highest Performance In the series

Equipped with the RXv2 CPU, the first in the RX100 series
Max operating frequency increased to 48 MHz

Through Low power consumption

30% less power usage than traditional products.
Added a snooze mode for peripheral functions to work without activating the CPU

Improved operability Security Enhancements

A new generation of capacitive touch sensing unit (CTSU2) enhanced sensitivity and noise resistance
Hardware security (AES and a True Random Number Generator)

Block Diagram

RXv2 Core 48MHz (Single - precision FPU), Power Voltage: 1.8 to 5.5V

Memory
- ROM(Flash) - 256KB (Code) - 8KB (Data)*
- SRAM 64KB

*Background Operation

Timer
- PWM TIMERS - 16bit x 6ch(MTU)
- General TIMERS - 8bit x 4ch (TMR) - 16bit x 2ch (CMT)
- Low Power Timer (LPC)
- Real-time clock (RTC)

Connectivity
- CAN x 1ch
- Serial Communication - UART x 6ch (w/ Simple SPI / IIC) - SPI x 1ch - I2C x 1ch

Security & Encryption
- Cryptography - AES
- TRNG
- Memory protect
- Unique ID

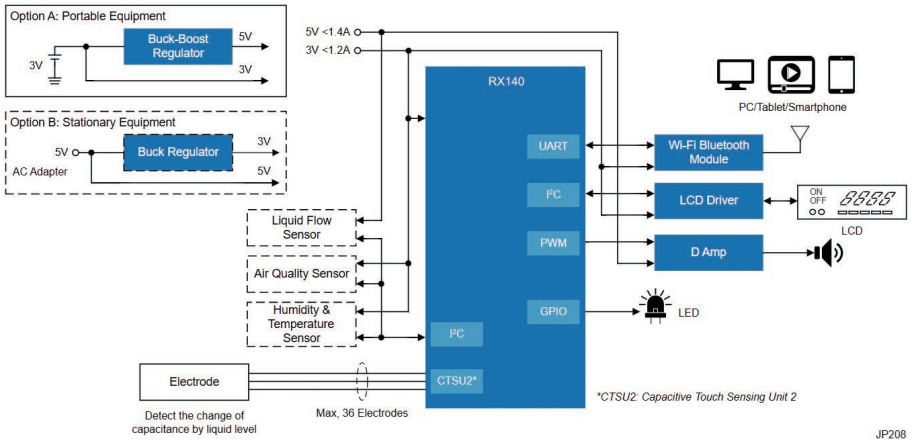
System, Power Management
- DTC
- High-speed on-chip oscillator
- Event link controller

Analog
- 12bit ADC x 18ch - Comparator
- 8bit DAC x 2ch
- Temperature sensor

Human-Machine Interface(HMI)
- Capacitive touch sensor x 48ch

Safety Functions
- Watchdog timer x 1ch
- CRC calculator
- PWM wave output shutdown
- Failure detect assist (Clock, Memory, Analog)

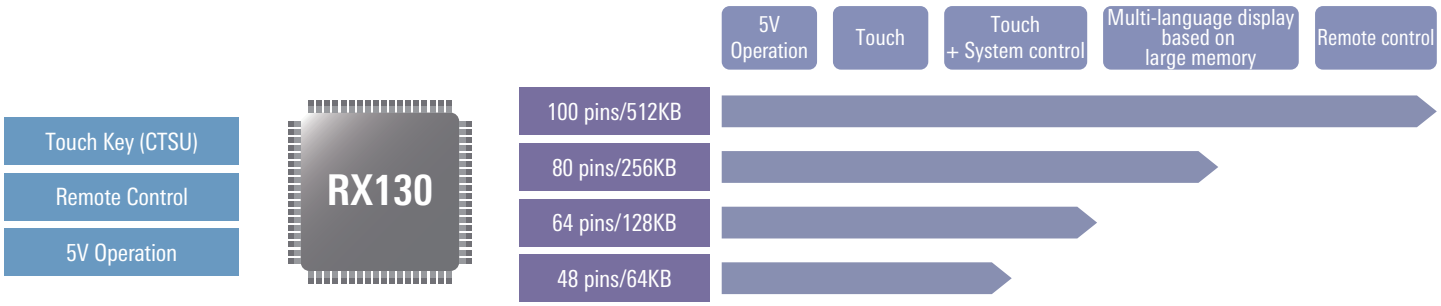
Use Case: Infusion Level Monitor Using Capacitive Touch Sensing



The RX140 controls both system and capacitive touch sensors to provide accurate, non-intrusive, and reliable fluid level measurement. Furthermore, the combination of RX140's low-power operation and Bluetooth/Wi-Fi combo module ensures long operation times. This allows the user to remotely monitor the remaining liquid and can be used at locations such as a nurse's station.

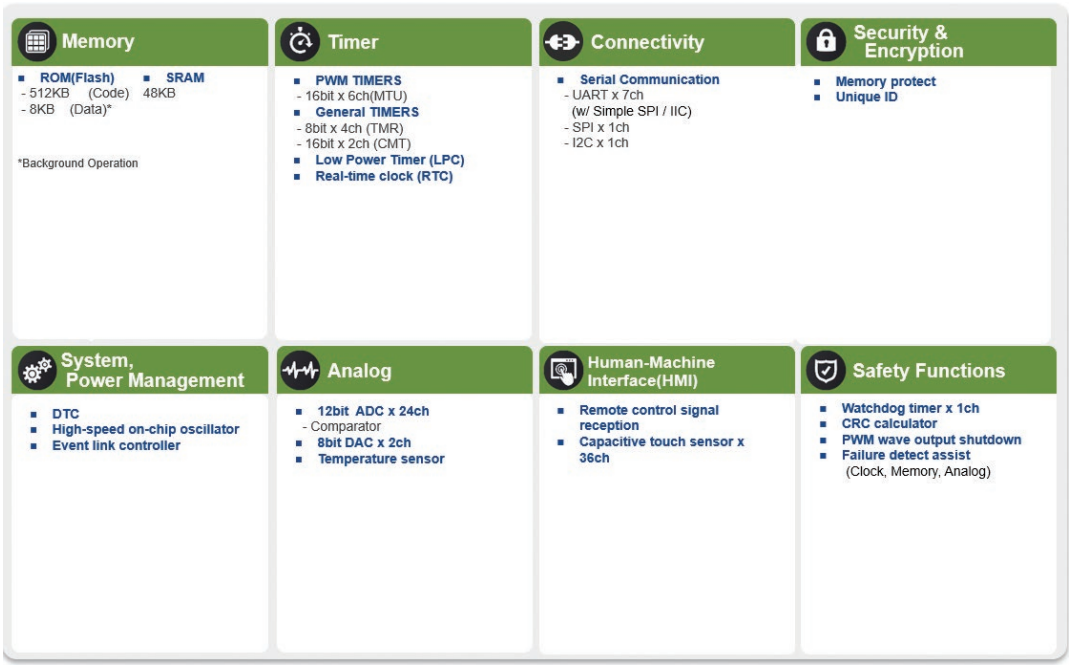
RX130 Group: High cost performance with touch key function and 5V support

Large Flash memory of up to 512 KB and a lineup of up to 100-pin LQFP packages support the development of a wide variety of devices.

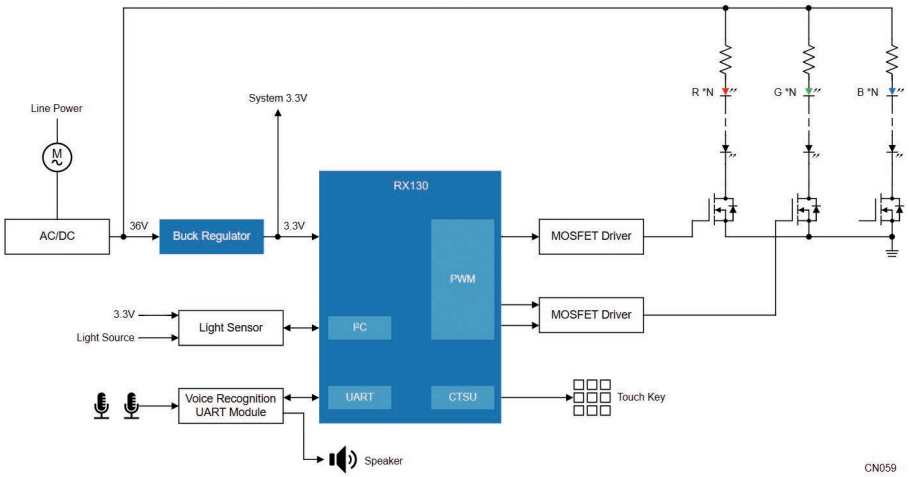


Block Diagram

RXv1 Core 32MHz , Power Voltage: 1.8 to 5.5V



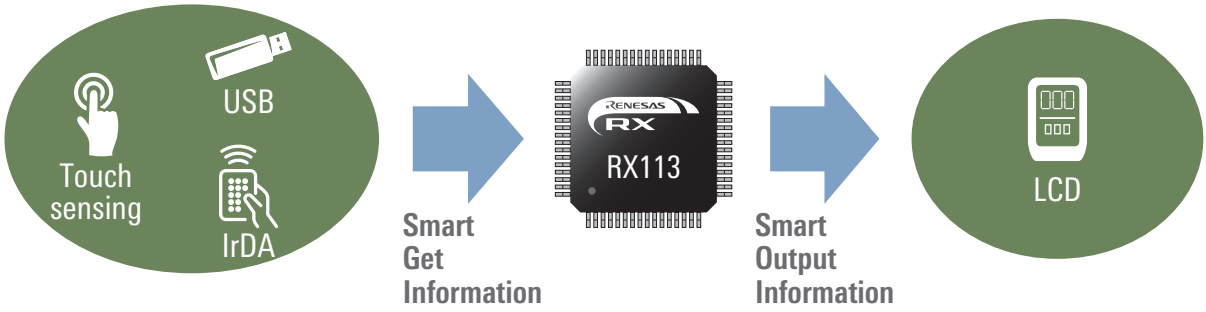
Use Case: Smart Lighting Control with RGB Light Sensor



Lighting control is rapidly emerging as a high-growth market, offering advanced functionalities that enhance quality of life and drive innovation in critical areas. These applications span personalized healthcare, emergency response, traffic management, smart manufacturing, home security, and smart energy distribution. The RX130 provides capacitive sensing for touch control for adding further value.

RX113 Group: System control + user IF control on a single chip

The high-performance RX CPU is equipped with communication functions such as USB and IrDA, and user IF such as Touch and LCD, making this microcontroller ideal for smart devices such as data loggers, home appliances, and healthcare.



Block Diagram

RXv1 Core 32MHz , Power Voltage: 1.8 to 3.6V

Memory
- ROM(Flash) - SRAM
- 512KB (Code) 64KB
- 8KB (Data)*

*Background Operation

Timer
- PWM TIMERS
- 16bit x 6ch(MTU)
- General TIMERS
- 8bit x 4ch (TMR)
- 16bit x 4ch (CMT)
- Low Power Timer (LPC)
- Real-time clock (RTC)

Connectivity
- USB2.0 x 1ch
- Full Speed H/F x 1ch
- Serial Communication
- UART x 8ch (w/ Simple SPI / IIC)
- SPI x 1ch
- I2C x 1ch
- IrDA

Security & Encryption
- Memory protect
- Unique ID

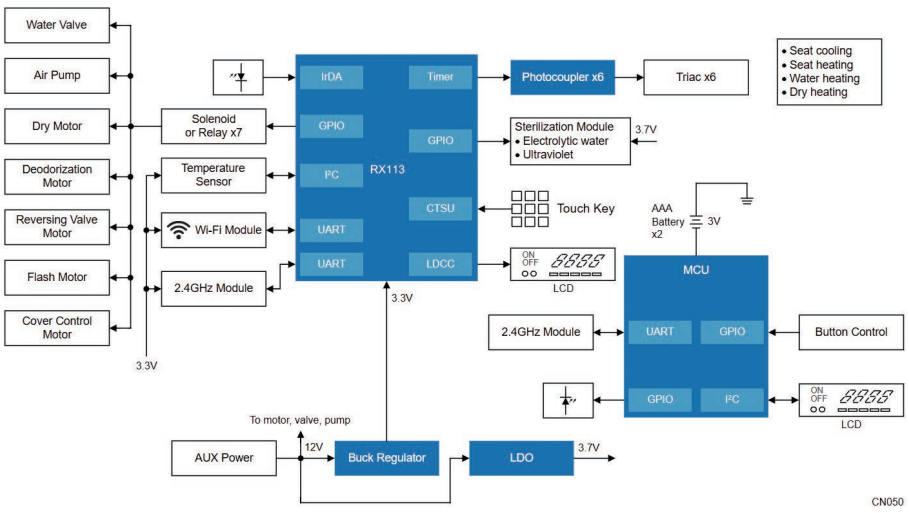
System, Power Management
- DTC
- High-speed on-chip oscillator
- Event link controller

Analog
- 12bit ADC x 17ch
- Comparator
- 12bit DAC x 2ch
- Temperature sensor

Human-Machine Interface(HMI)
- Segment - LCDC
- 36seg x 8common(100pin)
- 40seg x 4common(100pin)
- 20seg x 4common(64pin)
- 16seg x 8common(64pin)
- I2S x 1ch
- Capacitive touch sensor x 12ch

Safety Functions
- Watchdog timer x 1ch
- CRC calculator
- PWM wave output shutdown
- Failure detect assist (Clock, Memory, Analog)

Use Case: Smart Toilet



Smart toilets continue to be a rapidly emerging market, with market share increasing worldwide. This design demonstrates a high-end product with key features such as seat, water, and dry cooling and heating systems, along with a sterilization function, all controlled via a remote. At its core, the RX113 serves as a single-chip solution for bi-directional human machine interface (HMI) and peripheral device management.

RX-T Products

Features of the RX-T Products

The RX-T products is MCU for motor and inverter control equipped with Renesas' CPU core "RXv1/RXv2/RXv3". They incorporate High-performance timer that realizes advanced PWM control and other built-in functions for motor/inverter control and support the 5V power supply that is required by many industrial/ consumer applications, and are also equipped with a comprehensive set of analog functions such as 12-bit analog-to-digital (A/D), 3-channel simultaneous Sample-and-Hold circuit, programmable gain amplifier (PGA), and a comparator.

Broad lineup

32MHz to 200MHz
1 motor to 4 motors
Highly compatible pin assignments

Specialized motor control functions

Three-phase complementary PWM output
Timer output emergency stop
Trigonometric function unit

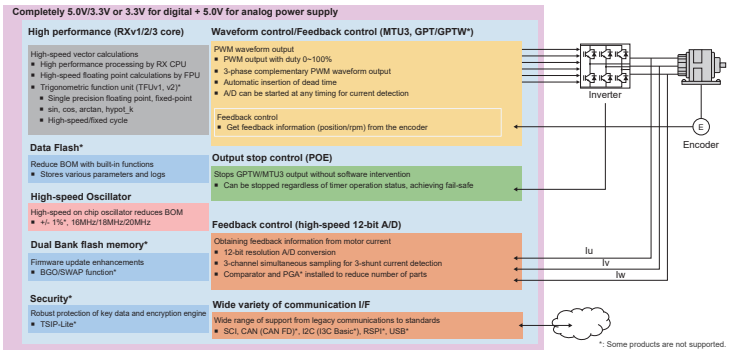
Analog circuit to extract full performance potential

Three-channel simultaneous sample-and-hold circuit
PGA
Comparator

Various solutions

Motor/Power control
Functional Safety
Security/OTA

Best Fit Resources Specially for Motor and Inverter Control



RX-T Lineup

RX72T 200MHz, 1MB Flash, 128KB SRAM, 32KB Data Flash
100/144-pin

RXv3 | Motors 3 to 4 | Pseudo-Differential PGA | Register bank save | Trigonometric Functions Arithmetic unit | CAN | USB | Security

RX66T 160MHz, 1MB Flash, 128KB SRAM, 32KB Data Flash
48/64/80/100/112/144-pin

RXv3 | Motors 3 to 4 | Pseudo-Differential PGA | CAN | USB | Security

RX26T 120MHz, 512KB Flash (Dual Bank support), 64KB SRAM, 16KB Data Flash
48/64/80/100-pin

RXv3 | Motors 2 | PGA | Register bank save | Trigonometric Functions Arithmetic unit | CAN FD | Security

RX24U 80MHz, 512KB Flash, 32KB SRAM, 8KB Data Flash
100/144-pin

RXv2 | Motors 2 to 3 | Pseudo-Differential PGA | CAN

RX24T 80MHz, 512KB Flash, 32KB SRAM, 8KB Data Flash
64/80/100-pin

RXv2 | Motors 2 to 3 | PGA | CAN

RX23T 40MHz, 128KB Flash, 12KB SRAM
48/52/64-pin

RXv2 | Motors 1

RX13T 32MHz, 128KB Flash, 12KB SRAM, 4KB Data Flash
32/48-pin

RXv1 | Motors 1 | PGA

Common functions
- Single precision FPU
- 5V Power Supply
- 12-bit ADC
- 8 or 12-bit DAC
- Comparator

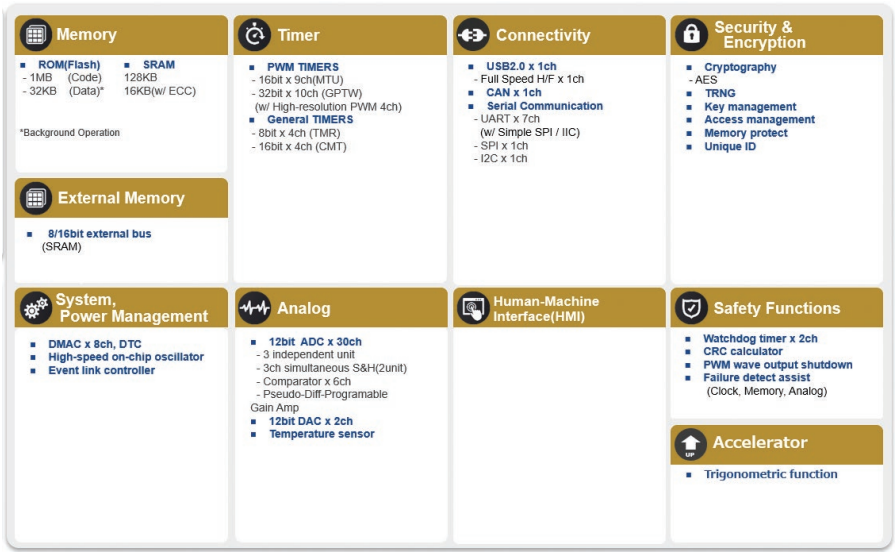
RX72T Group: Optimized for Motor Control in Industrial, Home Appliance, and Robotics Devices

RX72T Group microcontrollers are equipped with the RXv3 third-generation RX CPU core and are optimized for motor control applications. The RX72T Group offers high performance required for motor control in robots and other equipment by max. 200 MHz operating frequency CPU core and dedicated accelerators. Built-in security and safety features also offer new added value for inverter control applications.

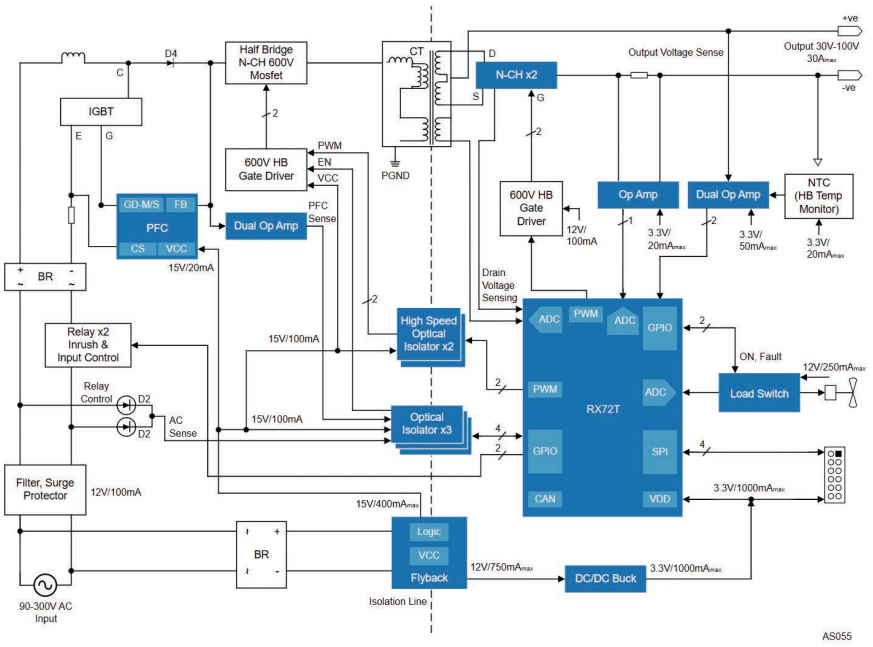
- RXv3 Core 200 MHz operation (6.01 CoreMark/MHz), Supports 2.7V~5.5V operation
- Program Flash up to 1 MB, High-speed flash memory with 120 MHz maximum read operation
- RXv3 Register save bank improves interrupt response
- Arithmetic unit for trigonometric functions improves coordinate transformation/position control/phase control
- Enhanced Analog12-bit A/D Converter x 3 units, 6-channel Comparators, 6-channel Pseudo-Differential PGA
- Generating three-phase complementary pulse width modulation (PWM) output for up to 3~4 motors
- Renesas' Trusted Secure IP (TSIP) provides secure firmware updates and encrypted communication with a track record of CAVP certification

Block Diagram

RXv3 Core 200MHz (Single - precision FPU), Power Voltage: 2.7 to 5.5V



Use Case: 3KW Off-Board Electric Vehicle Charger



As the e-Mobility segment expands, there is a growing need for more efficient charging solutions. This high-power off-board charger works on a universal input voltage range and uses a high-end MCU to control power factor correction (PFC) and manage the zero voltage switching (ZVS) – the half-bridge switching converter sitting on the secondary side of the system. The MCU offers secure control of the output parameters, and its CAN interface targets a wide range of applications.

System Benefits:

- Digital controller provides protections and features like UVLO, OVP, OCP, OTP, and inrush current control.
- Upgradable design supports higher current systems with an option to add synchronous rectification on the secondary side.
- CAN/SPI implementation enables connection to smart network cards for telematics.

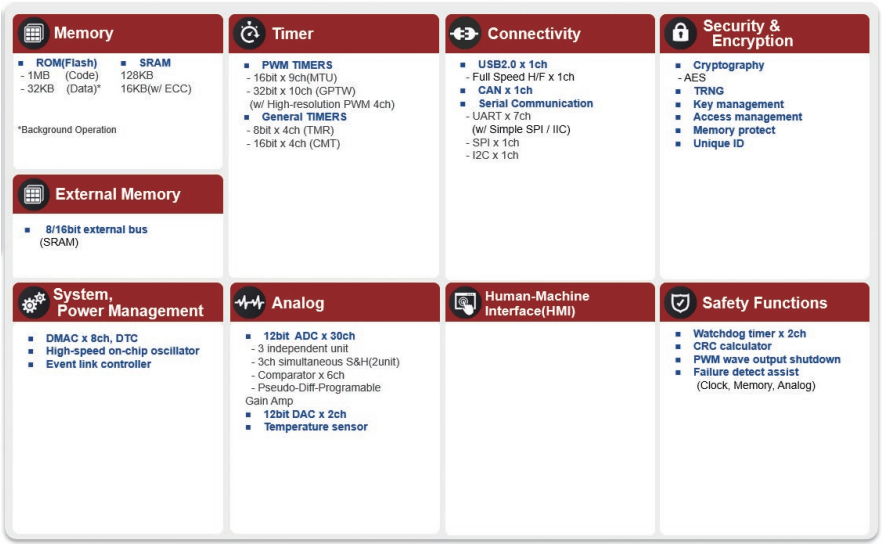
RX66T Group: Optimized for Motor Control in Industrial, Home Appliance, and Robotics Devices

RX66T Group microcontrollers are the first products equipped with the RXv3 third-generation RX CPU core and are optimal for motor control applications. The RX66T Group enables simultaneous control of up to four motors by max 160 MHz (961 CoreMark) operating frequency CPU core and motor control peripherals. Built-in security and safety features also offer new added value for inverter control applications.

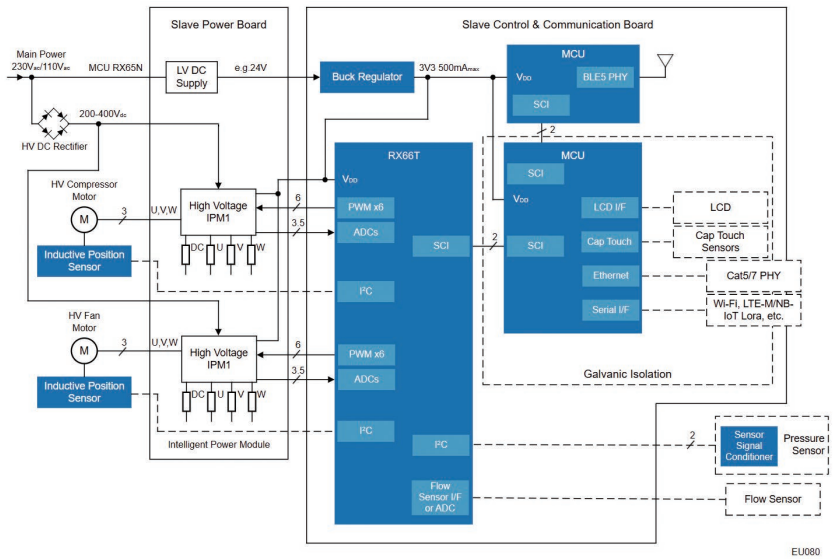
- RXv3 Core 160 MHz operation (6.01 CoreMark/MHz), Supports 2.7V~5.5V operation
- Program Flash up to 1 MB, High-speed flash memory with 120 MHz maximum read operation
- Enhanced Analog12-bit A/D Converter x 3 units, 6-channel Comparators, 6-channel Pseudo-Differential PGA
- Generating three-phase complementary pulse width modulation (PWM) output for up to 3~4 motors
- Renesas' Trusted Secure IP (TSIP) provides secure firmware updates and encrypted communication with a track record of CAVP certification

Block Diagram

RXv3 Core 160MHz (Single - precision FPU), Power Voltage: 2.7 to 5.5V



Use Case: Smart HVAC Control with Integrated Slave Actuator

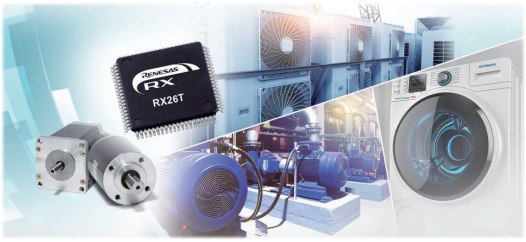


The slave actuator unit controls a fan or HVAC system in a specific room or section of a home or building by executing commands from the master actuator. It manages various fan controls, including the RPM of a brushless DC (BLDC) fan motor, airflow direction, flow sensor measurements, and electrical heater settings from 0% to 100%. When controlling an HVAC system, the actuator may incorporate additional sensors and outputs for enhanced control, such as the RPM of a BLDC compressor motor and a compressor pressure sensor. A user interface, through capacitive touch, push buttons, or an LCD, displays local values and allows data entry.

System Benefits:

- Operates with low power consumption, achieving microampere-level averages while maintaining connectivity.
- Eliminates the need for additional wiring, simplifying installation and reducing costs.
- Features automatic routing without the need for setup, enhancing ease of use.
- Offers scalable speed versus range, providing flexibility for extended range or increased speed depending on location.
- Supports power supply options from building control systems, including 230VAC, 110VAC, or 24VDC.

RX26T Group: 32-bit Microcontroller Optimized for Dual-Motor and PFC Control



RX26T Group microcontrollers are 5V-compatible products which provide dual-motor control using Field Oriented Control (FOC) and Power Factor Correction (PFC) control on a single chip.

- Industry-leading real-time performance: RXv3 core operating at 120 MHz, 120 MHz with no-wait flash memory access
- 5V power supply support: High noise immunity and dynamic range of analog inputs
- Dual motor support with FOC and PFC control on a single chip: 120 MHz PWM (2 channels of three-phase complementary + 2 channels of single-phase complementary), three 12-bit ADCs
- Board miniaturization/BOM reduction: built-in high-speed on-chip oscillator, small QFN packages (48-HWQFN: 7x7mm, 64-HWQFN: 9x9mm)
- Highly secure: dual-bank flash memory enables rewriting without halting the system; Trusted Secure IP-Lite reduces risk of information leakage
- High-speed communication: next generation CAN FD and I3C basic support

Block Diagram

RXv3 Core 120MHz (Single - precision FPU), Power Voltage: 2.7 to 5.5V

Memory
- ROM(Flash) - 512KB (Code)* Dual Bank - 16KB (Data)*
- SRAM 64KB

*Background Operation

Timer
- PWM TIMERS - 16bit x 9ch(MTU) - 32bit x 8ch (GPTW) (w/ High-resolution PWM 4ch)
- General TIMERS - 8bit x 8ch (TMR) - 16bit x 4ch (CMT) - 32bit x 2ch (CMTW)

Connectivity
- CAN FD x 1ch
- Serial Communication - UART x 7ch (w/ Simple SPI / IIC / HBS) - SPI x 1ch - I2C x 1ch - I3C Basic x 1ch

Security & Encryption
- Cryptography - AES
- TRNG
- Key management
- Access management
- Memory protect
- Unique ID

System, Power Management
- DMAC x 8ch, DTC
- High-speed on-chip oscillator (±1%)
- Event link controller

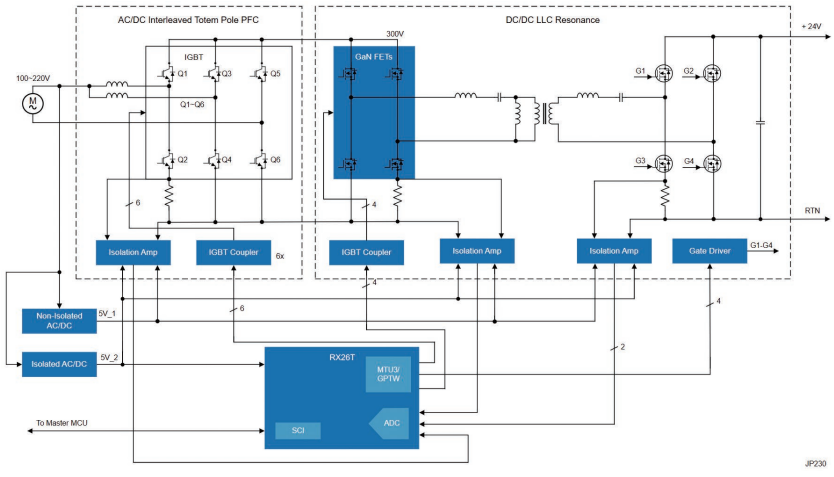
Analog
- 12bit ADC x 22ch - 3 independent unit - 3ch simultaneous S&H(2unit) - Comparator x 6ch - Programable Gain Amp
- 12bit DAC x 2ch
- Temperature sensor

Human-Machine Interface(HMI)

Safety Functions
- Watchdog timer x 2ch
- CRC calculator
- PWM wave output shutdown
- Failure detect assist (Clock, Memory, Analog)

Accelerator
- Trigonometric function

Use Case: Digital Power Conversion with Totem Pole Interleaved PFC

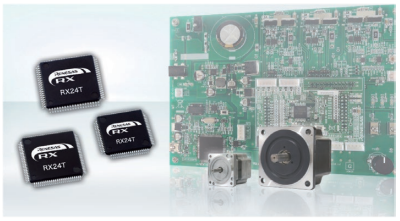


This platform provides a highly efficient AC/DC power supply essential for most industrial and telecom equipment. The totem pole PFC eliminates the typical diode bridge used to rectify the AC input, reducing energy loss. Interleaving improves efficiency further and produces a low-ripple DC output. Combining totem pole PFC with an LLC resonant DC/DC converter enables versatile AC/DC power supply applications.

System Benefits:

- Totem pole interleaved PFC provides high efficiency and low ripple.
- High-efficiency LLC resonant DC/DC converter can support a wide range of output voltages.
- High-performance MCU with dedicated peripherals ensures advanced power control and protection with high-end algorithms.

RX24T/RX24U Group: 32-Bit Microcontroller with On-Chip FPU Enable to Drive Two Motors Simultaneously



The RX24T/RX24U Group is a 32-bit microcontroller suited for dual inverter control that has a built-in Floating-Point Unit (FPU) which enables it to easily program complex inverter control algorithms.

- RXv2 CPU core with operating frequency of 80 MHz and performance of 5.05 CoreMark/MHz
- On-chip FPU eliminates need for overflow processing when performing fixed-point arithmetic operations and contributes to more readable software code
- Support for a wide range of power supply voltages from 2.7V to 5.5V. Offering 5V support provides a high level of noise tolerance
- Incorporates MTU3/GPT timer module for inverter control. The timer counter clock operates on a high-speed clock frequency equal to the CPU's operating frequency, making it easy to generate complementary PWM output with dead time that is required for inverter control
- Channel-dedicated sample and hold function enables simultaneous sampling of three phase current values, eliminating the need for error correction and lightening the software load
- On-chip peripheral functions such as 8KB on-chip data flash, PGA(Pseudo-Diff type in RX24U) and comparator reduce the need for peripheral components

Block Diagram

RXv2 Core 80MHz (Single - precision FPU), Power Voltage: 2.7 to 5.5V

*1: RX24U only *2: RX24T only *3: RX24T has 3 ch

Memory
- ROM(Flash) - 512KB (Code) - 8KB (Data)*
- SRAM 32KB

*Background Operation

Timer
- PWM TIMERS
  - 16bit x 9ch(MTU)
  - 16bit x 4ch (GPTW)
- General TIMERS
  - 8bit x 4ch (TMR)
  - 16bit x 4ch (CMT)

Connectivity
- CAN x 1ch
- Serial Communication
  - UART x 6ch*3 (w/ Simple SPI / IIC)
  - SPI x 1ch
  - I2C x 1ch

Security & Encryption
- Memory protect
- Unique ID

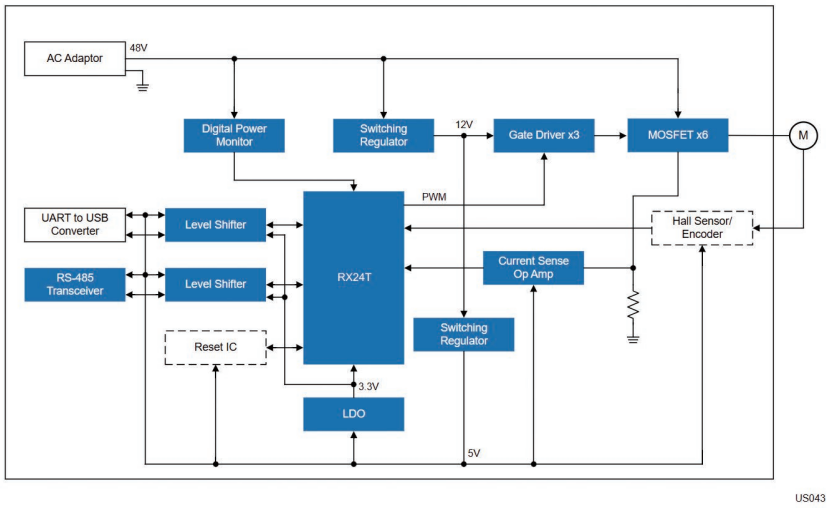
System, Power Management
- DTC
- High-speed on-chip oscillator

Analog
- 12bit ADC x 22ch
  - 3 independent unit
  - 3ch simultaneous S&H(1unit)
  - Comparator x 4ch
  - Pseudo-Diff-Programable Gain Amp*1
  - Programable Gain Amp*2
- 8bit DAC x 2ch

Human-Machine Interface(HMI)

Safety Functions
- Watchdog timer x 1ch
- CRC calculator
- PWM wave output shutdown
- Failure detect assist (Clock, Memory, Analog)

Use Case: 48V BLDC Motor Position Control



US043

BLDC motor applications have been increasing rapidly due to the demand for smaller, high-efficiency products. The core of a BLDC motor design is a robust and reliable motor control circuit paired with a versatile MCU for a safe control algorithm. Key components of a motor control circuit include a MOSFET driver, versatile MCU, voltage regulators, cell balancer, and battery charger. This 48V position control system integrates these components to deliver precise and efficient motor control for various industrial applications.

System Benefits:

- Utilizes an ultra-low power MCU for energy efficiency.
- Offers a fast wake-up time of 4µs for responsive control.
- Features an integrated 12-bit ADC with an op amp and comparator.
- Provides accurate cell balancing and monitoring with customer-programmable EEPROM for customization.

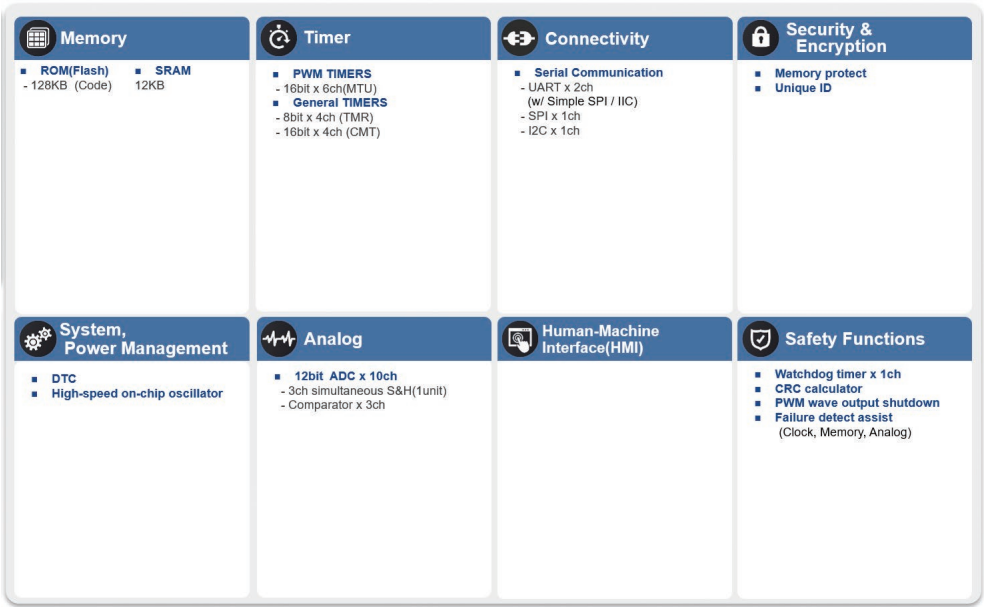
RX23T Group: 32-bit Microcontroller with Floating Point Unit (FPU) Ideal for Controlling a Single Inverter

The RX23T Group is a 32-bit microcontroller suited for single motor/inverter control and operate in a broad voltage range from 2.7V to 5.5V, which is useful for inverter control.

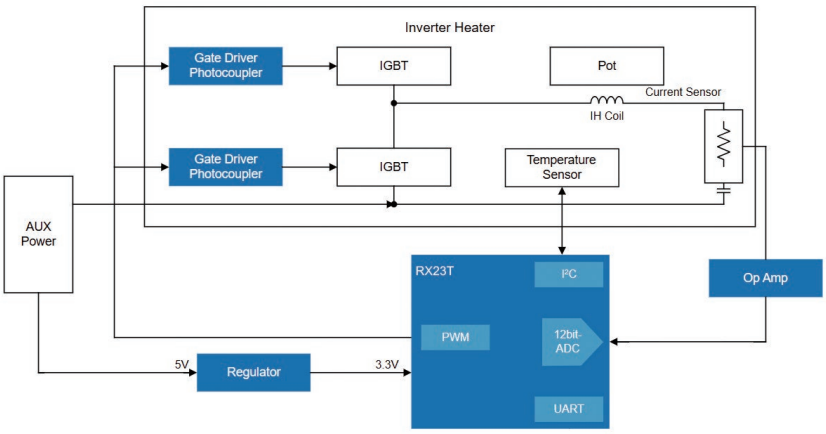
- RXv2 CPU core with operating frequency of 40 MHz and performance of 5.05 CoreMark/MHz
- On-chip FPU eliminates need for overflow processing when performing fixed-point arithmetic operations and contributes to more readable software code
- Support for a wide range of power supply voltages from 2.7V to 5.5V. Offering 5V support provides a high level of noise tolerance
- Incorporates MTU3 timer module for inverter control. The timer counter clock operates on a high-speed clock frequency equal to the CPU's operating frequency, making it easy to generate complementary PWM output with dead time that is required for inverter control
- Channel-dedicated sample and hold function enables simultaneous sampling of three phase current values, eliminating the need for error correction and lightening the software load

Block Diagram

RXv2 Core 40MHz (Single - precision FPU), Power Voltage: 2.7 to 5.5V



Use Case: Induction Heating Cooker



Induction Heat (IH) cooking is gaining popularity due to its low power requirements and safety advantages. IH cooking models capable of accommodating all types of metallics are now available and ideal for the "all-electric" home. These appliances require high-performance MCUs to control the heating process and need advanced controls such as touch displays which are now rapidly becoming the standard, as they are easy to use and easy to clean.

System Benefits:

- The RX23T is designed for complex inverter control algorithms for IH control and inverter heaters

RX13T Group: 32-bit Microcontrollers for Single Motor control; Reduces Footprint and BOM

The RX13T Group of microcontrollers is equipped with the proven RX Family RXv1 core operating at 32MHz, a floating point unit (FPU), an inverter control timer, and a 12-bit A/D converter, allowing high-efficiency inverter control of brushless DC motors with one device.

- RXv1 CPU core with operating frequency of 32 MHz and performance of 3.42 CoreMark/MHz
- On-chip FPU eliminates need for overflow processing when performing fixed-point arithmetic operations and contributes to more readable software code
- Support for a wide range of power supply voltages from 2.7V to 5.5V. Offering 5V support provides a high level of noise tolerance
- Incorporates MTU3 timer module for inverter control. The timer counter clock operates on a high-speed clock frequency equal to the CPU's operating frequency, making it easy to generate complementary PWM output with dead time that is required for inverter control
- Channel-dedicated sample and hold function enables simultaneous sampling of three phase current values, eliminating the need for error correction and lightening the software load
- On-chip peripheral functions such as 4KB on-chip data flash, three-channel PGA, three-channel comparator, and high-speed on-chip oscillator (HOCO, accuracy of ±1.0%) reduce the need for peripheral components

Block Diagram

RXv1 Core 32MHz (Single - precision FPU), Power Voltage: 2.7 to 5.5V

Memory
- **ROM(Flash)** - 128KB (Code) - 4KB (Data)*
- **SRAM** 12KB

*Background Operation

Timer
- **PWM TIMERS** - 16bit x 6ch(MTU)
- **General TIMERS** - 16bit x 2ch (CMT)

Connectivity
- **Serial Communication** - UART x 3ch (w/ Simple SPI / IIC) - I2C x 1ch

Security & Encryption
- **Memory protect**
- **Unique ID**

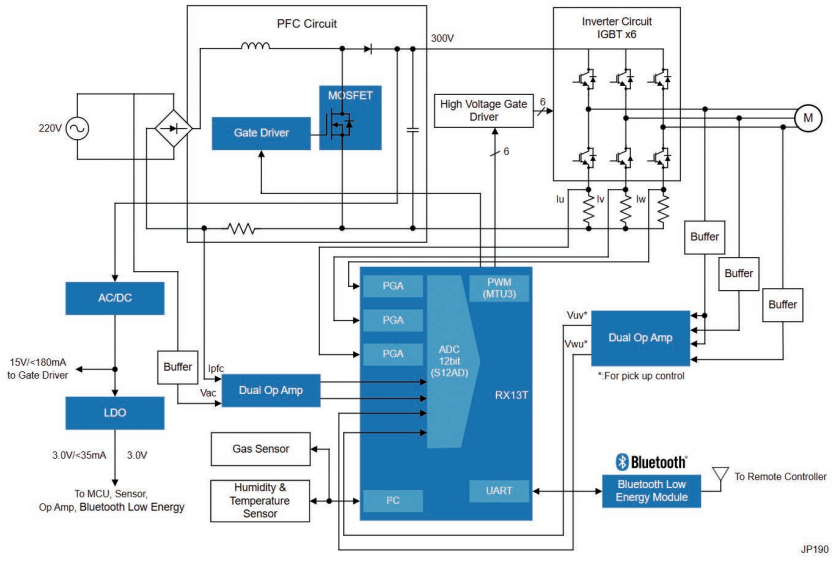
System, Power Management
- **DTC**
- **High-speed on-chip oscillator**

Analog
- **12bit ADC x 8ch** - 3ch simultaneous S&H(1unit) - Comparator x 1ch - Programable Gain Amp

Human-Machine Interface(HMI)

Safety Functions
- **Watchdog timer x 1ch**
- **CRC calculator**
- **PWM wave output shutdown**
- **Failure detect assist** (Clock, Memory, Analog)

Use Case: Smart BLDC Ceiling Fan with PFC



This compact, high-performance ceiling fan system is designed for next-generation home appliances, integrating advanced motor control and power factor correction (PFC) within a simplified architecture. Built around a high-efficiency 32-bit MCU, it supports sensorless vector control for BLDC motors and delivers robust PFC performance, ensuring reliable operation under variable load conditions.

System Benefits:

- Features a compact and high-performance motor control and PFC block powered by MCU.
- Utilizes efficient BLDC motor drive with sensorless vector control.
- With support for sensorless vector control for BLDC motors and robust PFC performance, the system enables reliable operation from low to high-speed rotation.

RX-E Products

Features of the RX-E Products

High-precision AFE and MCU on a single chip

24-bit delta-sigma ADC
Fully differential PGA
32MHz RXv2 CPU core

Ample peripheral functions

DAC
Excitation current source
Integrated voltage reference source
BIAS voltage generator circuit
On-chip temperature sensor

Variety of communication interfaces

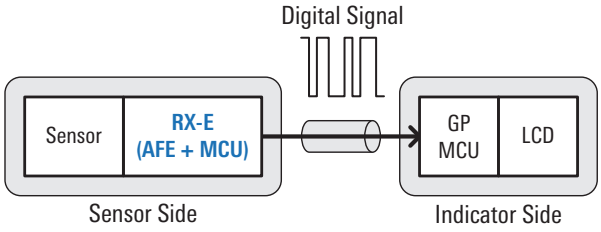
CAN
SPI
UART
I²C

Various solutions

Thermocouple
Resistance temperature detector
Load cell
Force sensor
Analog input module

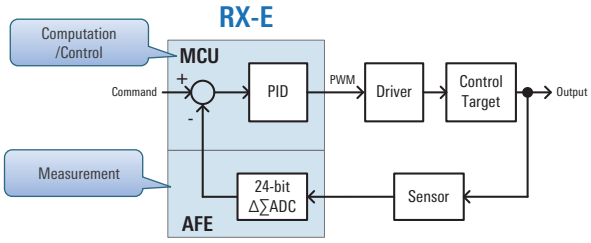
Digitalizing Sensor Modules By Compact Circuit

The RX-E products, integrating a high-precision AFE and a high-performance RX CPU onto a single chip, can realize intelligent digital sensors that balance digitalization and miniaturization.



Measurement, Computation/ Control Into A Single Chip

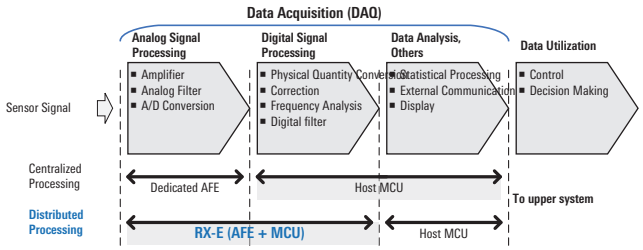
The roles of dedicated AFE and general-purpose MCU combine into one chip RX-E products. No need to handle communication between the AFE-MCU and easy to synchronize measurement and control cycles.



Data Acquisition (DAQ*) and Distributed Processing

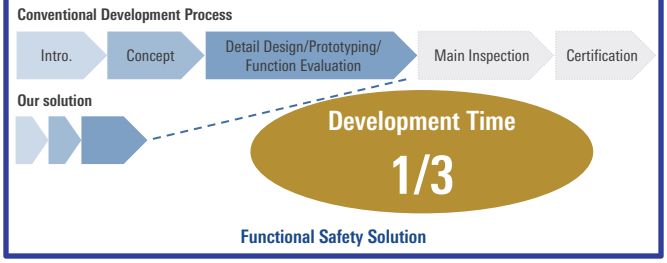
Distribute analog/digital signal processing on the sensor side and reduce the processing load on the host MCU.

*DAQ: A function that collects, analyzes, and displays data from various sensors



Connectivity and Industrial Functional Safety Support

Support connectivity such as IO-Link and wireless (Wi-Fi, Bluetooth) aligning with the advancement of sensor intelligence.
Also compile with functional safety requirements such as the European standard (IEC61508)



RX-E Lineup

RX23E-A 32KHz, 256KB Flash, 32KB SRAM, 8KB Data Flash
40/48-pin

RXv2 | 24 bit delta-sigma × 2units | Fully-differential PGA | Excitation current Source × 4 channels | Integrated voltage Reference source | BIAS voltage Generator circuit | On-chip Temperature sensor

Up to 15.6ksps

RX23E-B 32KHz, 256KB Flash, 32KB SRAM, 8KB Data Flash
40/48/64/80/100-pin

RXv2 | 24 bit delta-sigma | Fully-differential PGA | 16 bit DAC | Excitation current Source × 2 channels | Integrated voltage Reference source | BIAS voltage Generator circuit | On-chip Temperature sensor

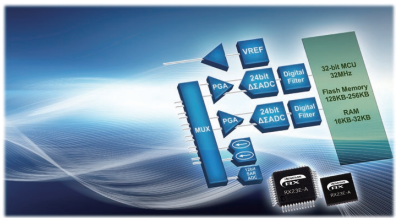
Up to 125ksps

Common functions
- Single precision FPU
- 5V Power Supply
- 12-bit ADC
- CAN

RX23E-A Group: Built-in Analog Front End Ideal for Advances Sensing and Measurement

RX23E-A group MCUs are equipped with an analog front-end that can measure temperature, pressure, flow, and weight with high accuracy, making it ideal for high-precision sensing, test and measurement equipment. The CPU is equipped with an RXv2 core that excels in DSP/FPU operations, enabling high-accuracy measurement, control and communication with a single chip.

- 2units of 24-bit delta-sigma A/D converter: Up to 23-bit effective resolution, programmable data rate 7.6sps to 15.6ksps
- PGA: Rail-to-rail analog input, Gain 1 to 128, offset drift 10nV/˚C, gain drift 1ppm/˚C
- Voltage reference: low drift 10ppm/˚C with good temperature stability
- Excitation current source: Matched programmable current source
- CPU: 32-bit RXv2 (32MHz), DSP/FPU for digital signal processing
- Interface: SPI × 1ch, UART × 4ch, I^2C × 1 ch, CAN × 1ch



Block Diagram

RXv2 Core 32MHz (Single - precision FPU), Power Voltage: 1.8 to 5.5V, AVCC0 = 2.7 to 5.5V

Memory
- ROM(Flash) 256KB (Code) 32KB
- SRAM 8KB (Data)*

*Background Operation

Timer
- PWM TIMERS
  - 16bit x 6ch(MTU)
- General TIMERS
  - 8bit x 4ch (TMR)
  - 16bit x 2ch (CMT)
- Low Power Timer (LPC)

Connectivity
- CAN x 1ch
- Serial Communication
  - UART x 4ch (w/ Simple SPI / IIC)
  - SPI x 1ch
  - I2C x 1ch

Security & Encryption
- Memory protect
- Unique ID

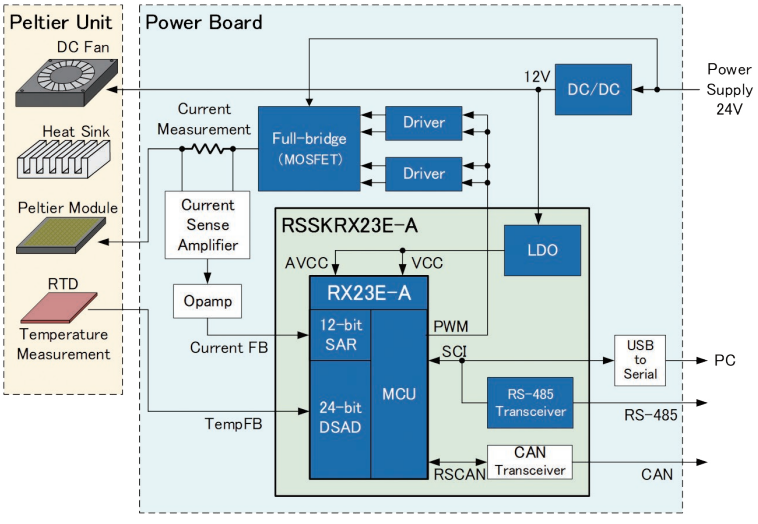
System, Power Management
- DMAC x 4ch, DTC
- High-speed on-chip oscillator
- Event link controller

Analog
- 24bit ΔΣADC x 2unit
  - Differential 6ch
  - Single- end 11ch
  - Programable Gain Amp(x1~x128)
  - Up to 15.6kSPS
- AFE(Analog Front End)
  - Voltage reference (VREF)
  - Bias voltage generator (VBIAS)
  - Excitation current sources (IEXC)
  - Temperature sensor (TEMPS)
  - Low-side switch (LSW)
  - Voltage detector (VDET)
- 12bit ADC x 6ch

Human-Machine Interface(HMI)

Safety Functions
- Watchdog timer x 1ch
- CRC calculator
- PWM wave output shutdown
- Failure detect assist (Clock, Memory, Analog)

Use Case: Peltier Cooler System



The Peltier cooler is a device for heating and cooling that utilizes a phenomenon called the Peltier effect, in which heat is transferred by the flow of current between two different metals. The Peltier cooler has features such as easy switching between heating and cooling depending on the direction of current, no mechanical drive, no vibration and noise, and high-precision and quick-response temperature control. It is used in various fields such as food, chemistry, optics, and medical use. The built-in high-precision 24-bit delta-sigma AD converter in RX23E-A MCU is capable of highly accurately measuring and controlling temperature with a single chip.

System Benefits:

- Combining MCU and high-precision analog front end (AFE) on a single chip makes an external dedicated AFE unnecessary, thereby reducing the BOM cost and the board mounting area.
- The RX v2 core enables to speed up filter operation and PID control operation using FPU.

RX23E-B Group: Integrated 24-Bit Delta-Sigma A/D Converter up to 125kSPS

RX23E-B group MCUs are equipped with a high-speed and low-noise 24-bit delta-sigma A/D converter that can measure strain, temperature, pressure, flow, current, voltage, etc. at high-speed and with accuracy. RX23E-B's 24-bit delta-sigma A/D converter has been improved compared to RX23E-A. The maximum data rate is 125kSPS, which is 8 times faster than RX23E-A. The RMS noise has been reduced to about 1/3 of that of RX23E-A.
RX23E-B also has an integrated 16-bit D/A converter and +/-10V high-voltage analog input circuit, reducing the overall BOM and footprint. The CPU is equipped with an RXv2 core that excels in DSP/FPU operations, enabling high-precision measurement, control, and communication on a single chip.

- 24-bit delta-sigma A/D converter: Up to 24-bit effective resolution, programmable data rate 3.8sps to 125ksps
- PGA: Rail-to-rail analog input, Gain 1 to 128, offset drift 4nV/˚C, gain drift 1ppm/˚C
- 16-bit D/A converter: DNL=+-1LSB, INL=+/-5LSB
- CPU: 32-bit RXv2 (32MHz), DSP/FPU for digital signal processing
- Interface: SPI × 1ch, UART × 4ch, I^2C × 1 ch, CAN × 1ch

Block Diagram

RXv2 Core 32MHz (Single - precision FPU), Power Voltage: VCC = 1.8 to 5.5V, AVCC0 = 4.5 to 5.5V

Memory
- ROM(Flash) ■ SRAM
- 256KB (Code) 32KB
- 8KB (Data)*

*Background Operation

Timer
- PWM TIMERS
- 16bit x 6ch(MTU)
- General TIMERS
- 8bit x 4ch (TMR)
- 16bit x 2ch (CMT)
- Low Power Timer (LPC)
- Real-time clock (RTC)

Connectivity
- CAN x 1ch
- Serial Communication
- UART x 7ch (w/ Simple SPI / IIC)
- SPI x 1ch
- I2C x 1ch

Security & Encryption
- TRNG
- Memory protect
- Unique ID

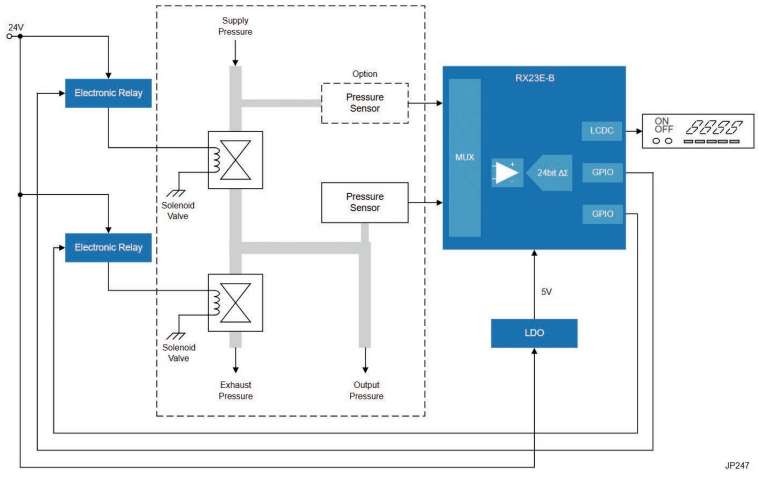
System, Power Management
- DMAC x 4ch, DTC
- High-speed on-chip oscillator
- Event link controller

Analog
- 24bit ΔΣADC x 1unit
- Differential 8ch
- Single- end 16ch
- Programable Gain Amp(x1~x128)
- Up to 125kSPS
- AFE(Analog Front End)
- Voltage reference (VREF)
- Bias voltage generator (VBIAS)
- Excitation current sources (IEXC)
- Temperature sensor (TEMPS)
- Low-side switch (LSW)
- Voltage detector (VDET)
- 16bit DAC
- 12bit ADC x 8ch

Human-Machine Interface(HMI)
- Segment LCDC
- 40seg x 4common

Safety Functions
- Watchdog timer x 1ch
- CRC calculator
- PWM wave output shutdown
- Failure detect assist (Clock, Memory, Analog)

Use Case: Industrial Pressure Control System



Pressure control systems are essential in various industrial applications, such as pressure calibrators, electro-pneumatic regulators, and flow control systems. These systems consist of solenoid valves, pressure sensors, and a controller, the pressure is controlled by opening and closing the solenoid valves according to the set pressure. RX23E-B with a high-precision analog front end provides precise pressure control with a minimum of components.

System Benefits:

- Integrating the MCU and high-precision analog front end (AFE) into one chip eliminates the need for an external dedicated AFE, reducing BOM costs and board mounting area.
- Achieves high accuracy and fast response by speeding up filter calculations and PID control calculations using the FPU of the RX v2 core.

Development Environment

Renesas supports customers through all stages of the development of their applications by supplying integrated development environments, RTOS, middleware, and programming tools that dramatically enhance the development process. These development tools, combined with evaluation kits and assistance tools specifically for the RX Family, enable you to accomplish coding, building, and debugging tasks quickly and easily, while helping to reduce system development time.

Evaluation

Evaluation versions of tools, sample software, application notes

FPB
(Fast Prototyping Board)

Recommended for users getting started developing MCU applications

CK-RX65N for IoT application development

Renesas Starter Kit

A growing selection of starter kits you can start using immediately

Envision Kit for LCD application development

Evaluation Kit (EK)

Development

Integrated Development Environment and Source Code Editor

e² studio

IAR Embedded Workbench® for RX

Visual Studio Code
(Source Code Editor)

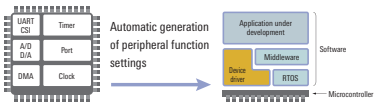
CS+

Compilers

Renesas C/C++ Compiler Package for RX Family (CC-RX) (node locked and floating license versions)

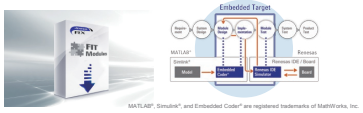
Original compilers from IAR Systems generate code that leads the industry in speed and compactness.

GNU compilers are available for RX Family MCUs.



Smart configurator

QE (Quick and Effective tool)



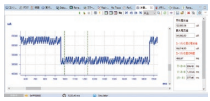
Middleware

Embedded Target for RX Family
(Model-Based Development Environment)

E2 Emulator Lite

E2 Emulator

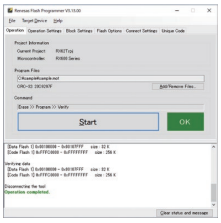
Debug and Parameter Settings



QE for Current Consumption

QE for Capacitive Touch

Mass production



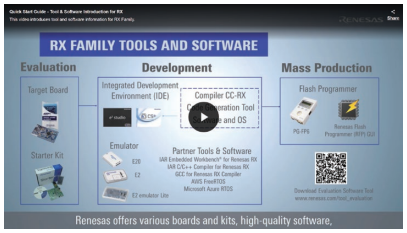
Renesas Flash Programmer

PG-FP6

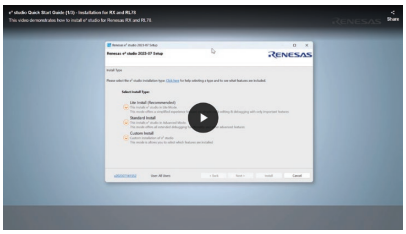
Also supported by debuggers and programmers from **Segger**.

RX has prepared videos explaining each development environment.
Click here for details
Link: [RX Family Software & Tool]

In these videos, you will learn about solutions, software, and tools for the Renesas RX family of MCUs. these videos introduce the Renesas development environment in an easy-to-understand manner to start your development.

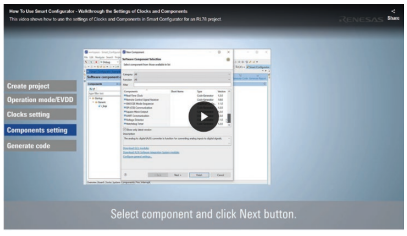


Quick Start Guide - Tool & Software Introduction for RX | Renesas

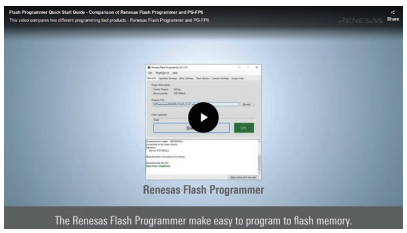


e² studio Quick Start Guide (1/3) - Installation for RX and RL78 | Renesas

Renesas Emulator Selection Guide for RX | Renesas



How To Use Smart Configurator - Walkthrough the Settings of Clocks and Components | Renesas



Flash Programmer Quick Start Guide - Comparison of Renesas Flash Programmer and PG-FP6 | Renesas

QE Solution for Reducing Effort and Cost in Application Development | Renesas

RX Family General-Purpose Kits

The RX Family general-purpose kits enable users to effortlessly evaluate the features of different RX MCU Groups and quickly develop sophisticated IoT & embedded systems prototyping. A wide range of line-up from entry, basic kit to full-evaluation offer numerous options suitable for various needs. All are supported by RX Driver Package, Renesas IDE e² studio and 3rd IDE like IAR Embedded Workbench.

- Allow quick evaluation with built-in features and customization options with full I/Os access and connectors to seamless integration with expansion boards.
- Include on/off-board debuggers and programmers.
- Offer numerous sample projects and demos to kick-start the evaluation and development.
- Provide comprehensive application note and supplement document, in both English and Japanese. Design data is available to reference for customization.

Product Lineup

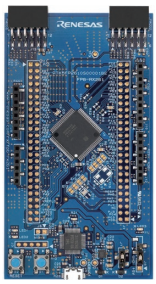
RX Kit Portfolio	RX700 Series	RX600 Series	RX200 Series	RX100 Series
Target Board (TB) **Fast Prototyping Board (FPB)** ■ Low-Cost kit for first-time customers ■ All MCU pin access ■ On-board debugger ■ 2 Pmods/Arduino Uno R3 *1		TB-RX65N TB-RX660 TB-RX66N TB-RX671	TB-RX231 TB-RX23W TB-RX23W Module FPB-RX261	TB-RX130 TB-RX140 FPB-RX140
Evaluation Kit (EK) ■ Rich-Featured evaluation kit ■ Specific function for try out MCU features ■ Both On-board/external debugger supported		EK-RX671	EK-RX261	
Renesas Starter Kit (RSK) ■ All-in-One evaluation kit ■ Rich connectors for evaluating all MCU features ■ Standalone emulator E2/E2-Lite ■ Pmod-type TFT-LCD	RSK-RX72M RSK-RX72N RSK-RX72T	RSK-RX65N RSK-RX660 RSK-RX66T RSK-RX671	RSK-RX231 RSK-RX23T RSK-RX24T RSK-RX24U	RSK-RX111 RSK-RX113 RSK-RX130 RSK-RX140

*1: Target Board has one Pmod

Board Image


TB-RX140


FPB-RX140


FPB-RX261

Target Board

Fast Prototyping Board


EK-RX261


EK-RX671

Evaluation Kit


RSK-RX72N

Renesas Starter Kit

A lineup of all kits including solution kits is available.
Click here for details.
Link: renesas.com/rx/kits

Integrated Development Environment

Renesas have prepared an integrated development environment that strongly supports the entire embedded system development. You can choose from an open source-based environment with various expansion functions, an original Renesas development environment, or a partner-made environment according to your usage scenario.

e² studio

This development environment based on Eclipse provides a large number of functions and is a popular choice among users developing for RX the world over. A variety of compilers are supported, and you can create projects using simple operations.

IAR Embedded Workbench® for RX

This is the C/C++ integrated development environment most broadly used internationally as a high-performance and highly reliable commercial tool for embedded software development. All functions are integrated seamlessly to maximize development efficiency. The static response analysis and dynamic response analysis add-ons provide a low-cost way for developers to dramatically increase the quality of their code.

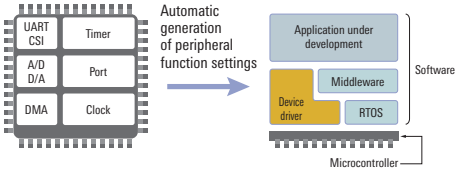
Visual Studio Code (Source Code Editor)

Visual Studio Code from Microsoft, available on Microsoft Visual Marketplace, provides build and debug functions (extensions) for developing applications using Renesas MCUs.

CS+

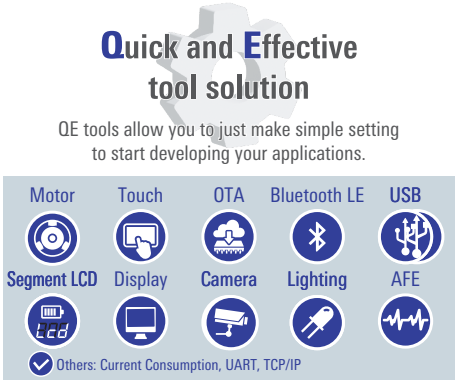
This package provides access to basic software tools with a single install. Recommended for users looking for a convenient way to make use of basic functions. For new products, we will focus on e² studio for RX, but will continue to support existing products.

Renesas offers Solution Toolkits to provide for more efficient development. Each Solution Toolkit includes a variety of plug-ins that will assist in coding and the development of applications.

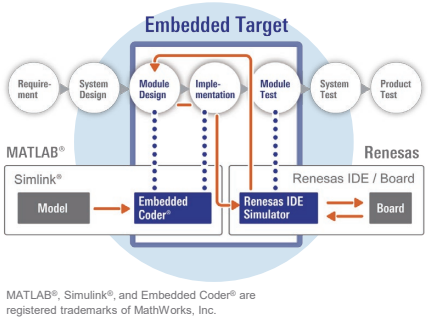


Smart configurator

Tool that automatically generates device drivers



QE (Quick and Effective tool)



MATLAB®, Simulink®, and Embedded Coder® are registered trademarks of MathWorks, Inc.

Embedded Target for RX Family (Model-Based Development Environment)

Links e² studio or CS+ with MATLAB® or Simulink® to assist customers with model-based development.

Compiler

Renesas is preparing a range of compilers to maximize the performance of RX, from its own compilers to open source compilers from its partners.

Renesas C/C++ Compiler Package for RX Family (CC-RX) (node locked and floating license versions)

Provides powerful optimized features that help you realize the full performance potential of Renesas' proprietary RX CPU cores and boost development efficiency. A selection of compiler license formats are available.

Original compilers from IAR Systems generate code that leads the industry in speed and compactness.

GNU compilers are available for RX Family MCUs.

Emulator

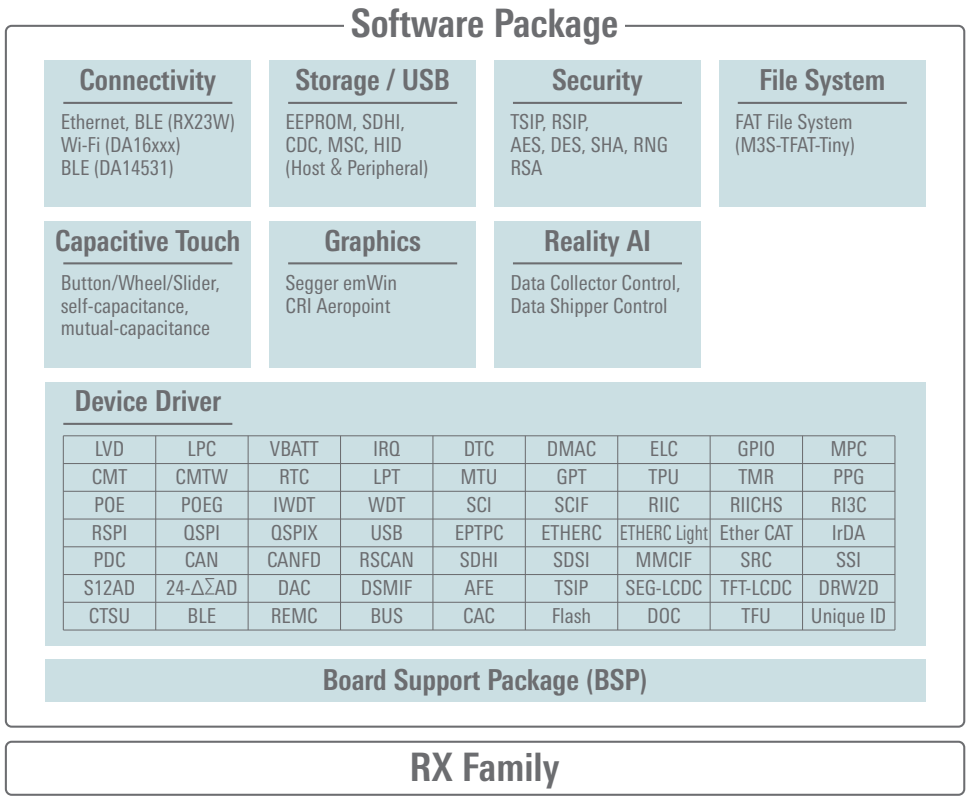
These on-chip debugging emulators can be also used as flash programmers. Execution address and data access break functions and on-chip trace function are supported.

E2 Emulator Lite
Entry-level model recommended for new users.

E2 Emulator
This model provides high functionality for enhanced development efficiency, with support for fast downloads and external trigger I/O.

RX Driver Package

The RX Driver Package is a software package that enables use of peripheral function drivers, middleware, etc. Using this package contribute to reduced system development time for customers. Firmware Integration Technology (FIT) can be used on MCUs across the RX Family. By using e² studio or Smart Configurator, you can configure OS, drivers, middleware, and board-dependent code as user code templates. You can focus on the development of your applications.



Benefits

- Two types of software packages that include peripheral drivers and middleware are available for the RX Family: the Code Generator and FIT software modules.
- The Code Generator automatically generates drivers from simple parameter settings made through its GUI. FIT software modules, on the other hand, are part of a set of modules compliant with the Firmware Integration Technology (FIT) specifications and provided in the Renesas Driver Package. Integrating these FIT software modules is also easy.
- The e² studio or CS+ IDE automatically downloads the RTOS, peripheral drivers, middleware, and board-dependent code from the repository on GitHub, which is used in handling the appropriate version control of the individual software modules.
- Provides flexibility in using bare-metal programming, included Azure RTOS, FreeRTOS and RI600V4(PX), your preferred RTOS, legacy code, and third-party ecosystem solutions

QE (Quick and Effective) Tools Tailored for Many Application Types

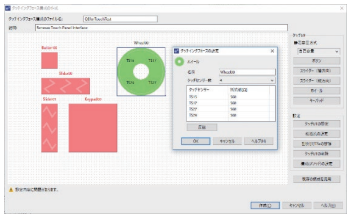
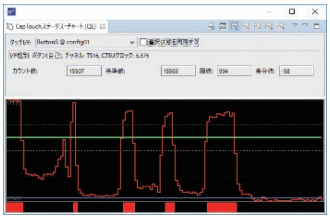
Renesas Solutions and Tools that Lighten the Application Development Workload

QE (Quick and Effective tool)

QE development support tools add development knowhow (functionality) to applications within the integrated development environment, helping to minimize the application development workload.

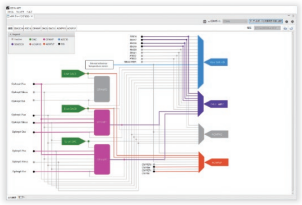
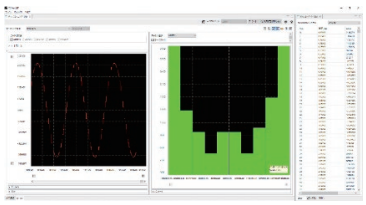
QE for Capacitive Touch Development Support Tool for Capacitive Touch Sensor Applications

This tool simplifies making initial touch interface settings and tuning sensitivity, reducing the time required for development.

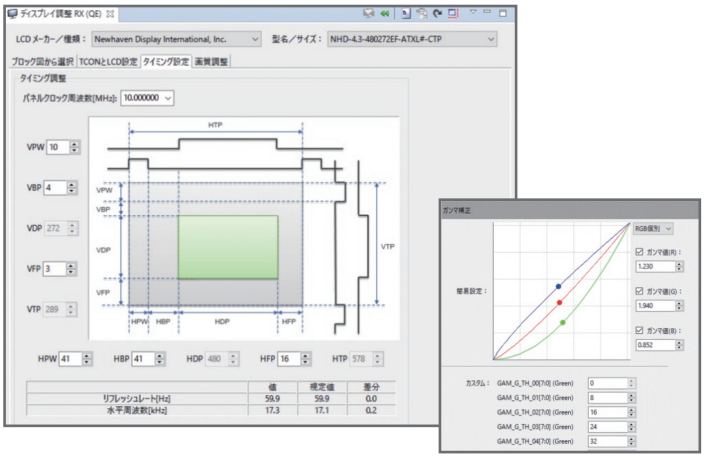
QE for AFE Development Support Tool with Analog Frontend Support

This tool lets you perform high-precision sensing adjustment while viewing circuit diagrams of the AFE configuration and make adjustments to analog signals without the need for an oscilloscope.

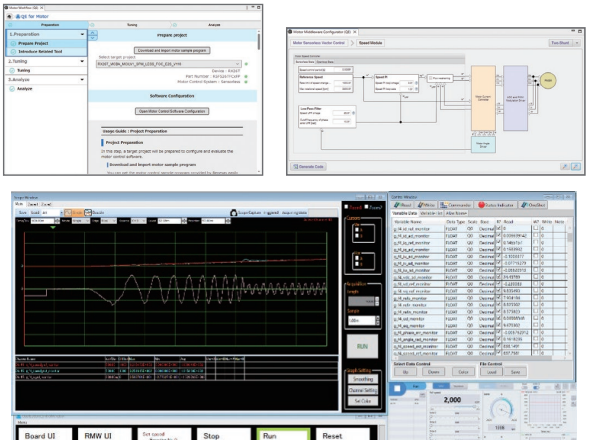
QE for Display Development Support Tool for Display Applications

This tool simplifies initial screen calibration of the display when using the MCU's on-chip LCD controller, reducing the time required for development.
It also supports the use of an external LCD controller via a serial connection.



QE for Motor Development Support Tool for Motor Applications

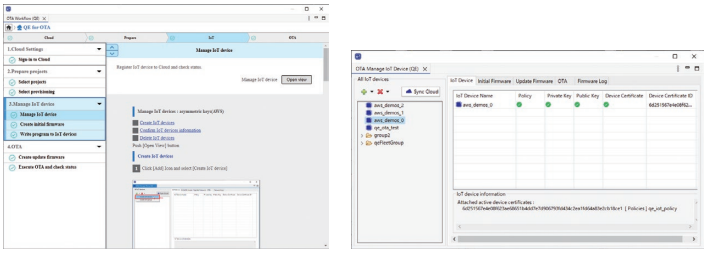
This tool makes it easy to configure motor-related middleware and driver settings and to perform motor tuning and analysis. It lets you efficiently configure motor-related middleware and driver settings while checking block diagrams representing hardware configurations. Also, Renesas Motor Workbench automates the process of configuring settings, letting you get started with motor tuning and analysis right away.



Renesas Motor Workbench

QE for OTA: Development Assistance Tool for Firmware Update

This tool lets you easily try out the over the air (OTA) functions of leading cloud services such as AWS. You can use it to evaluate everything from creating firmware updates, uploading them to the cloud, and executing OTA updates. It is also compatible with AWS fleet provisioning. It is now possible to update the firmware of a Secondary MCU connected to the Primary MCU via UART, and to update the firmware without using the cloud.



QE for BLE Bluetooth® Low Energy Development Support Tool

This tool provides support for system development using the Bluetooth® Low Energy protocol stack, allowing you to try out its communication functions immediately and shortening the development time until deployment.

Embedded Target for RX family (Model-Based Development Environment)

Implementation from model to Renesas MCU is automated to streamline software development

Embedded Target (evaluation version) verifies algorithms to aid customers' model-based development by linking a Renesas integrated development environment (CS+ or e² studio) with MATLAB® or Simulink® from MathWorks.

Software development can be streamlined by automatically porting code for an embedded MCU and ensuring the state in which buildand debug is performed in order to perform Processor-In-the-Loop simulation. The advanced analysis function of the Renesas integrated development environment is also useful for improving a model.

Seamless development, from building an environment to verifying a model's performance

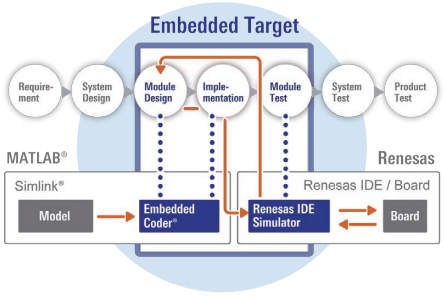
Automatically building a PILS* environment

*Processor In the Loop Simulation

Generate models for PILS from Simulink®models with one click.
A channel for communication between MATLAB®and the Renesas integrated development environment is built automatically.

Automatically generating a projectfor the Renesas integrated development environment

Embedded Coder®incorporates code generated from a verification model and automatically generates buildable/debuggableprojects for CS+/e² studio.



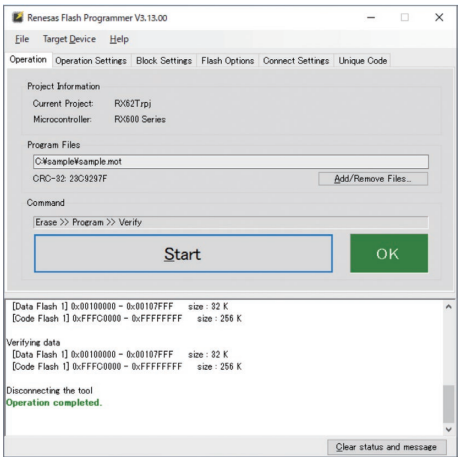
Verifying a model's performance using a Renesas MCU or simulator

The actual equipment debugger or simulator function of CS+ or e² studio can be used for PIL simulation, and the analysis functions of CS+ or e² studio (including the execution time measurement function) can be used for model performance verification.

Programming Tools

You can choose the model that best suits your needs, from development, prototyping, and small-scale programming to mass production.

Programming tools, including products from Renesas partner vendors



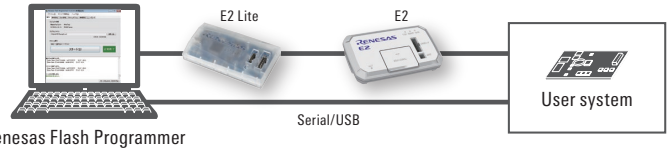
Renesas Flash Programmer
flash memory programming software

PG-FP6
standalone flash programmer

Also supported by debuggers and programmers from **Segger**.

Programming controlled by a PC [Renesas Flash Programmer flash programming software]

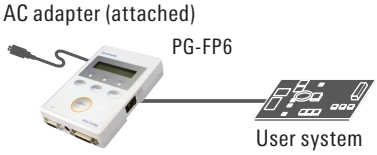
- Simple GUI specialized for programming
- Batch processing efficiently for programming large quantities at mass production
- PC-controlled programming using E2 emulator, E2 emulator Lite or serial/USB
- Ability to embed unique code



Renesas Flash Programmer
flash programming software

Programming controlled by a PC or stand-alone programming [PG-FP6 flash programmer]

- Stand-alone programming
- Programming controlled by a PC using a dedicated GUI
- Ability to store settings for up to eight environments
- Ideal for use on the production line (command control, remote control)
- Ability to embed unique code



Winning Combinations

Speeding Up Application Design for Customers

More Than 400 Winning Combinations for a Variety of Applications

Renesas offers comprehensive full-system solutions, featuring Winning Combinations of devices across our embedded processing, power, analog, and connectivity portfolios, to meet your application needs. With these engineering-vetted designs, you can take advantage of an elevated platform for your design ideas, accelerate your product development cycle, and lower overall risk to bring your designs to market.
Renesas continues to make available new Winning Combinations, including many featuring RX Family MCUs, one after another.

Key Technologies

Artificial Intelligence (AI)
Functional Safety
Gallium Nitride (GaN) Power
Human Machine Interface (HMI)
Motor Control
Security
Tracking & Locationing
USB

Industrial

Appliances
Building Automation
Industrial Automation
Medical & Healthcare
Metering
Motor Drives & Robotics
Renewable Energy & Grid
Retail, Automation & Payment

Consumer Electronics

Cameras
Computing
Home Entertainment
Power Adapters & Chargers
Wearables

Communications Infrastructure

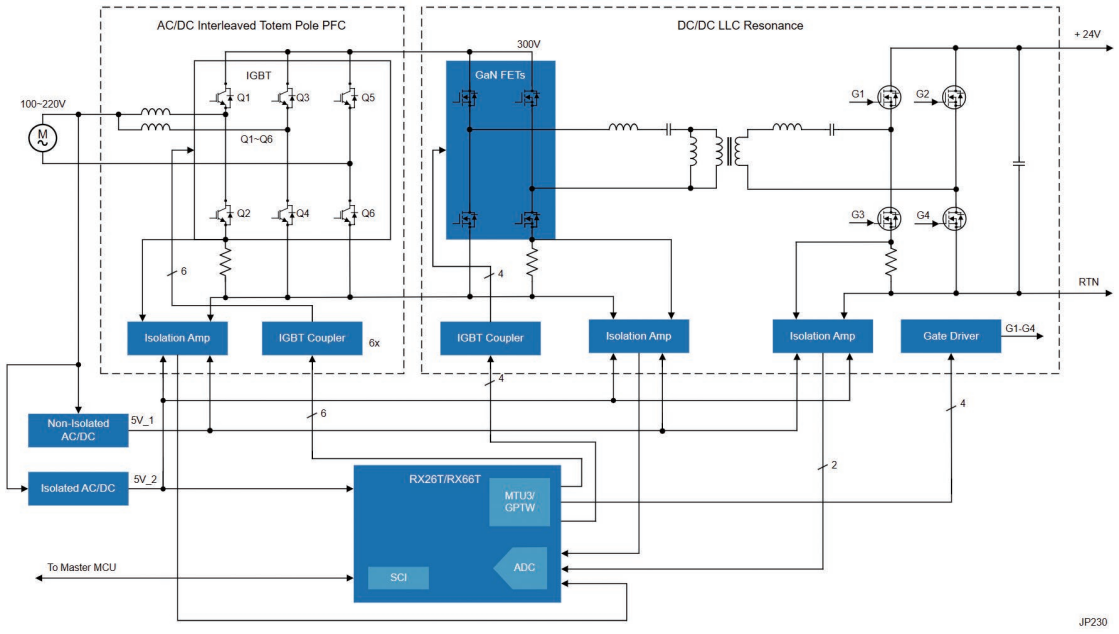
Cloud & Enterprise
Memory
Networking & Fixed Access
Wireless Infrastructure

Example Winning Combination: Digital Power Conversion with Totem Pole Interleaved PFC

Easy-to-understand explanation of benefits

Easy-to-read block diagram

Easy access to related Renesas product pages



Renesas Enabling Intelligence from the Cloud to the Edge and Endpoint Sustainably

Our comprehensive AI/ML developer stack transforms Vision, Voice, and Real-time Analytics applications. The extensive portfolios in sensing, connectivity, computing, and actuation, we cover all IoT layers. Our rich software, tools, solution offerings, and partner ecosystem provide the essential elements to accelerate your AIoT designs.

Why Choose Renesas?

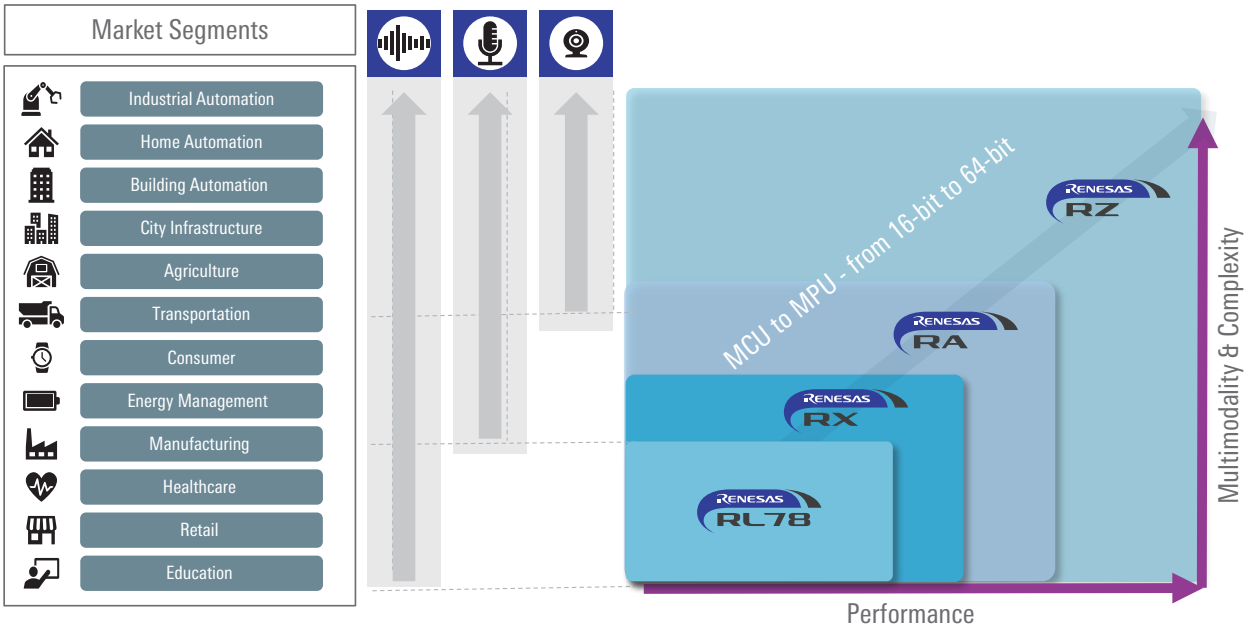
Comprehensive AI/ML developer stack for vision, voice, and real-time analytics use cases. Tools and workflows for multiple developer journeys (bring-your-own-model, transfer learning, bespoke consulting and more). Rich library of easy-to-find solutions (application examples, toolboxes, solution suites, hardware reference kits). Broad ecosystem of trusted partners offering commercial-grade building blocks.

SIDE NOTE: Why Decentralize Intelligence?

Traditionally, the IoT has been built on a cloud-centric intelligence architecture. To truly scale and enable intelligence at all levels of the network, a decentralized intelligence architecture is needed. This means running cloud-independent inference engines on power-efficient or tiny computers within the edge and endpoints.

Comprehensive AIoT Developer Stack

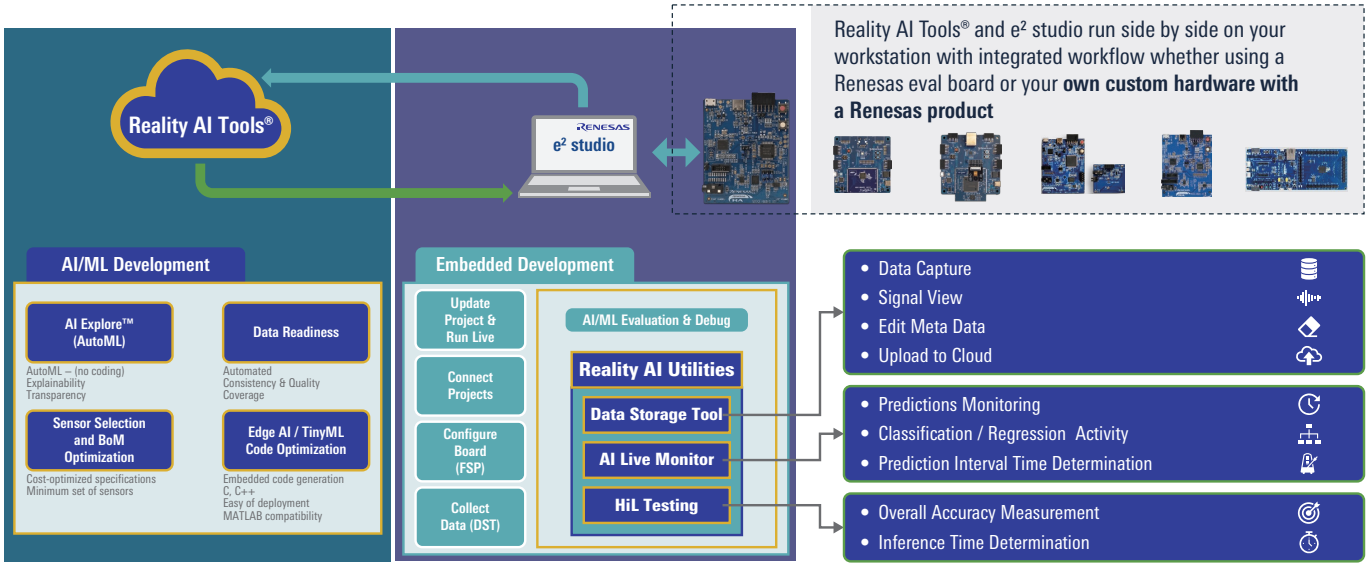
Software Partner Ecosystem	**RA Ready** RA Arm® Cortex® M - MCUs	**RX Ready** RX 32-bit Performance Efficiency MCUs	**RL78 Ready** RL78 Low Power 8 & 16-bit MCUs	**RZ Ready** RZ 32 & 64-bit MPUs
AI/ML Application Zoo	**Solution Suites**	**Toolboxes**	**Application Examples**	**Reference Designs**
AI/ML Tools & SDKs	**Real-Time Analytics** Reality AI Tools® Reality AI Toolboxes	**Vision** RZ/V AI SDK e-AI Development Environment	**Voice** Cyberon Dspotter Cyberon Cspotter	
Embedded Software / SDKs	**Packages** Flexible Software Package (MCU) Firmware Integration Technology (MCU) Software Integration System (MCU) CIP Linux (MPU)	**Tools** e² studio		
Hardware Portfolio	**AI at The Edge** MPU Timing Power Memory Inteface RF	**AI at The Core** Timing Power Memory Inteface	**AI at The Endpoint** MCU / MPU Power Connectivity AMS & CMIC Sensors	



Application Zoo

Real-life application examples supported across the wide range of Renesas MCU/MPU and reference/demonstration kits. Pretrained models for vision, voice and realtime analytics.

Reality AI Tools



Reference Kits & Develpoment Boards

Technology

RTA, Vision, Audio	Voice	Motor Control	Cloud	HMI
AIK-RA8D1	VK-RA8M1	MCK-RA8T1	CK-RA6M5	CAP-TOUCH RX671
AIK-RA6M3	Voice-RA6E1	MCK-RA6T2	CK-RX65N	
AIK-RA4E1	Voice-RA4E1	MCK-RX26T		
	Voice-RA2L1	RSSK-RX72T		
		RSSK-RX66T		
		RSSK-RX23T		
		RSSK-RX13T		

Product

Evaluation

EK-RA8M1	FPB-RL78
EK-RA8D1	
FPB-RA0	

Security Solutions

In the rapidly growing area of IoT and highly-connected devices, increasing consumer awareness and government legislation is forcing embedded device manufacturers to take the topic of security seriously. Already under the constraints of needing to create cost- and energy-efficient solutions, developers nowadays are required to design and implement security with limited additional time and budget.
Let Renesas simplify your path to product security and regulatory compliance.

Integrated Hardware-based Security Features

The RX Family was designed with security in mind, with scalable hardware-based security features including:

Functions		RX72M, RX72N	RX72T	RX671, RX66N, RX651, RX65N	RX66T	RX261	RX26T	RX231, RX23W	RX140
Identity	Chip Unique ID	✓	✓	✓	✓	✓	✓	✓	✓
Isolation	Security Engine	TSIP	TSIP-Lite	TSIP	TSIP-Lite	RSIP-E11A	TSIP-Lite	TSIP-Lite	–
Cryptography and Key Handling	AES	✓	✓	✓	✓	✓	✓	✓	✓
	SHA	✓	–	✓	–	✓	–	–	–
	RSA and ECC	✓	–	✓	–	ECC	–	–	–
	TRNG	✓	✓	✓	✓	✓	✓	✓	✓
	Secure Key Handling	✓	✓	✓	✓	✓	✓	✓	–
Memory Protection	Trusted Memory	✓	✓	✓	✓	–	✓	–	–
	Area Protection	✓	–	✓	–	✓	✓	✓	✓
	Memory Protection Unit	✓	✓	✓	✓	✓	✓	✓	–
	ID Code Protect	✓	✓	✓	✓	✓	✓	✓	✓
	ROM Code Protect	✓	✓	✓	✓	✓	✓	✓	✓
Physical Protection	Passive Tamper Pins	–	–	✓ (RX671 Only)	–	–	–	–	–
	SPA/DPA Resistance	✓	–	✓	–	✓	–	–	–

Software and Tools

The RX Family **Firmware Integration Technology** (FIT) contains APIs for using the powerful cryptographic features of the Renesas Security Engines (TSIP, RSIP *):

- No nondisclosure agreement (NDA) required, free of charge.
- The RX MCUboot FIT module includes integrated support for the Renesas Security Engines (TSIP, RSIP).

*: Trusted Secure IP (TSIP), Renesas Secure IP (RSIP)

The easy-to-use Security Key Management Tool, combined with the Renesas Key Wrap Service, provides support for secure key injection and update for prototype development and over the lifetime of the product.

Clear, full-featured Application Notes and Sample Programs provide customizable demonstrations of the RX Family Security Features and Solutions. (www.renesas.com/iot-security)

Valuable Certifications

The RX family has obtained the following certifications that demonstrate the security compliance of its cryptographic algorithms and modules:

- NIST Cryptographic Algorithm Verification Program (CAVP) for assurance of cryptographic correctness
- NIST FIPS 140-2 Level 3

Ecosystem Partners

Renesas works with partners to deliver simple and robust security solutions.
(Renesas RX Partner Ecosystem Solutions | Renesas)

Company	Security Offerings	URL
wolfSSL	Security library for embedded systems (wolfSSL, wolfCrypt, wolfSSH, wolfBoot, wolfMQTT)	https://www.wolfssl.com/
IAR Systems	Tools & Environments for Security Development and Programming	https://www.iar.com/
EPS Global	Secure Provisioning & IC Programming Service	https://www.epsprogramming.com/
Ubiquitous AI Corporation	Solution for Secure Management & Operation of IoT Devices (Edge Trust)	https://www.ubiquitous-ai.com/en/
Veridify	Lightweight and Low-power Security Features (Veridify Security)	https://www.veridify.com/
Trusted Objects	Secure Programming & Provisioning (Tops Plug&Go for RX MCUs)	https://www.trusted-objects.com/

IoT Cloud Over-the-Air (OTA) Solutions

Issues and Requirements Related to IoT Devices

- ✓ Utilize **AI/ML on AWS cloud services**
- ✓ Develop **S/W with minimum costs**
- ✓ Expand **Network (Wired, Wireless)**

- ✓ Realize **Remote monitoring and remote control**
- ✓ Realize **OTA (Over the Air), FW update**
- ✓ Strengthen **Security feature**

Enhancing product's value proposition
Creating a comprehensive solution suite

Data collection
Remote operation
Remote monitoring

Monitoring health status and health management

Cost Optimization
Reducing work load and time to market

Connected Cities

Process optimization
Inventory tracking

Strengthening security
Security alerts and over-the-air updates

Anomaly and fault detection
Predictive Maintenance

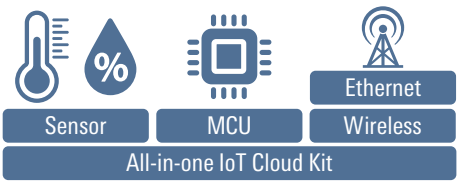
Software and security updates

IoT Cloud Over-the-Air (OTA) Solutions to Support IoT Development

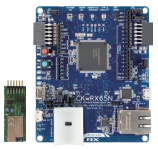
Development Platforms for Cloud (IoT) Devices

Expedite solution development with quick evaluation and proof of concept development

AWS Certified Hardware Environment



AWS device certified
evaluation kit for IoT development
CK-RX65N



Sample software ideal for use with IoT devices

Application notes to support development

- Sensor data visualization demo program
- AWS FreeRTOS OTA implementation procedure
- IoT device provisioning procedure
- TLS communication using TSIP*

.... and many more

* TSIP: Trusted Secure IP

Development Environment that Simplifies and Facilitates IoT Development

Quick and Effective tool solution

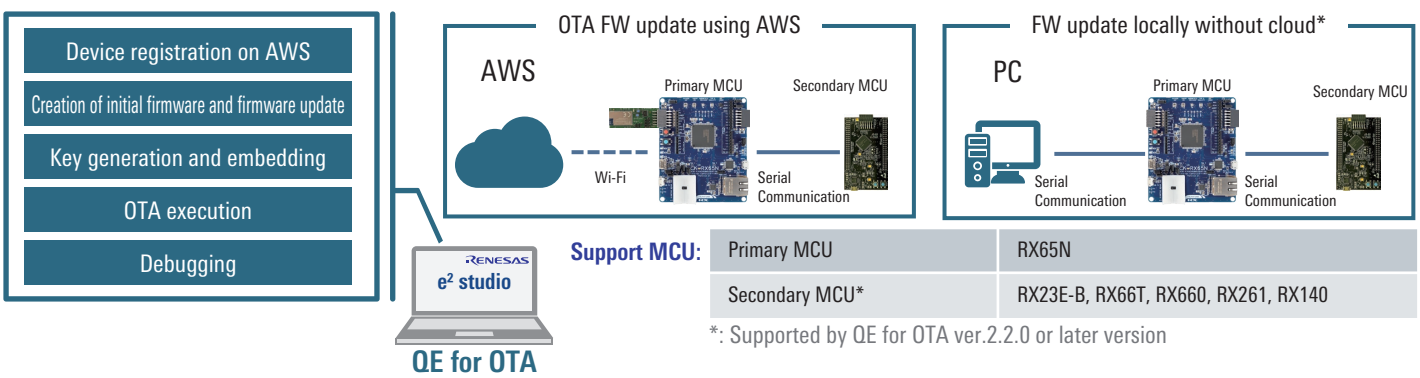
QE for OTA

e² studio integrated development environment from Renesas

- Smart configuration for FreeRTOS
  - Setting configuration for FreeRTOS
  - Setting configuration for peripheral functions and pins
- IoT new project generation feature
- QE for OTA development support tool

"QE for OTA" Development Assistance Tool for Firmware update

QE for OTA is development assistance tool that is available free of charge for developers to implement over-the-air (OTA) firmware updates with a simple and easy graphical user interface. It allows you to reduce the time required until OTA execution by 90% compared with configuring setting manually.
QE for OTA also supports firmware update of secondary MCU via primary MCU as well as firmware updates for MCUs that are not connected to the cloud.



Support MCU:		
	Primary MCU	RX65N
	Secondary MCU*	RX23E-B, RX66T, RX660, RX261, RX140

*: Supported by QE for OTA ver.2.2.0 or later version

Graphical Solutions

These LCD solutions feature a graphic LCD controller (GLCDC) and large on-chip memory capacity (maximum 4MB ROM and 1MB RAM). Display resolutions up to WVGA (8-bit) are supported without requiring external memory. An integrated 2D rendering engine (DRW2D) ensures smooth graphics rendering with a reduced CPU processing load.
What's more, new LCD display solutions are now available with an RX device as the standard MCU and employing an SPI interface. They are ideal for applications where cost efficiency is a priority or cases where a small, high-resolution display is required.

GUI Evaluation Kit

The Envision Kit (RX72N/RX65N) for GLCDC or DRW2D evaluation includes a WQVGA LCD and makes it easy to get started with GUI development.

- A debugger is included. Simply connect the board to a PC with a USB cable to start debugging.
- A preinstalled demo lets you experience the rendering performance of the 2D rendering engine.
- Compatible with the emWin for RX GUI tool from Segger. (Available free of charge to RX users.)
- Ample sample code and demos are available for download on the web.

The available sample LCD display applications using the SPI interface are quite similar to actual applications. Alongside QVGA LCD display applications, capacitive touch sensor operations can be evaluated at the same time.

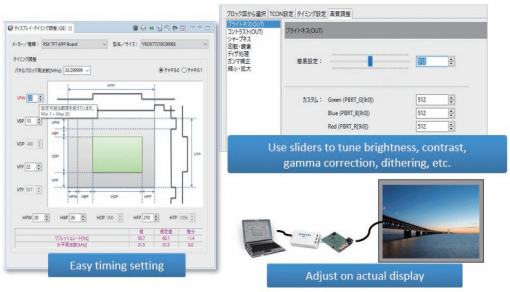
RX72N Envision Kit

Display sample using SPI

QE for Display (e^2 studio Plugin)

This tool assists in GUI development by simplifying configuration of LCD panel settings and enabling links with GUI tools from Renesas partner vendors.

1. Simple LCD adjustment
   - Simplifies timing adjustments and picture quality adjustments.
   - Just click a button to update parameter values in registers. You can see the results on the LCD as you make adjustments.
2. Linkage with GUI tools from partner vendors
   - Download, install, and call tools from partner vendors.
   - Update projects with image data edited in tools.
   - Supports emWin for RX from Segger and Aeropoint GUI from CRI middleware.



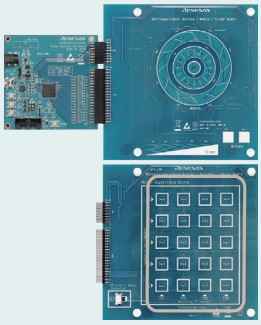
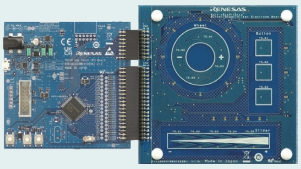
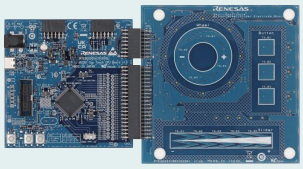
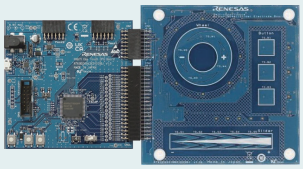
Renesas Ready Partner Network for Display Applications

Partner	Solution	Description	RA Arm Cortex-M	RX 32-Bit Performance / Efficiency MCUs	RZ 32 & 64-Bit MPUs
Candera	CGI Studio	A powerful design tool for your embedded human machine interfaces (HMI). It enables the creation of HMIs and UIs of all kinds for automotive, white goods, medical, or industrial customers.			✓
Crank | AMETEK	Storyboard	An embedded graphical user interface (GUI) development framework for creating engaging HMI applications with exceptional user experiences.	✓		✓
Envox	EEZ Studio	A powerful solution for rapid development of embedded and desktop GUIs, offering seamless remote control of multiple devices and test & measurement (T&M) automation.	✓	✓	✓
LVGL	LVGL Embedded UI Library	A free and open-source embedded graphics library to create beautiful User Interfaces (UIs) for any MCU, MPU and display type. It makes UI development easier with 30+ built-in widgets, anti-aliasing, and more.	✓	✓	✓
Qt	Qt for MCU	Qt for MCUs is a complete graphics framework and toolkit with everything you need to design, develop, and deploy GUIs on RA 32-bit MCUs.	✓		
	Qt Device Creation	Develop a single cross-platform code base using one integrated toolset and target embedded, desktop, and mobile platforms.			✓
	Qt Design Studio	An easy-to-use 3D-capable design tool that bridges the gap between design and development. It allows prototyping within minutes and converts the design into production-grade code.			✓
SEGGER	emWin	A flexible, professional GUI platform, enabling the creation of highly efficient, high-quality, interactive GUI for the Renesas RA and RX Family MCUs on any display.	✓	✓	
SquareLine Ltd	SquareLine Studio	A visual drag-and-drop UI editor that enables individuals and businesses to design and create stunning GUIs quickly and effortlessly.	✓	✓	✓
Tara Systems	Embedded Wizard	A GUI technology that enables the customer to create platform-independent and high-performance GUI, even on resource-constrained microcontrollers.	✓	✓	✓
TES Electronic Solutions	Guiliani - Graphic Solutions	A powerful, yet easy-to-use, modern, object-orientated, and customizable software for creating stylish GUI quickly.	✓		
	Guiliani - Graphical UI Framework	A modern and powerful C++ software for creating stylish GUI on a wide range of embedded hardware such as the RZ/A MPU family.			✓

Capacitive Touch Sensing Solution

Renesas offers a capacitive touch solution that supports manufacturing processes and creates a user-friendly environment to lower hurdles in capacitive touch sensor development, proposing revolutionary designs for switching devices and equipment.
The capacitive touch evaluation system includes a CPU board and a self-capacitance evaluation board for use as a touch application board. It has everything you'll need to get started evaluating applications incorporating buttons, sliders, and wheels

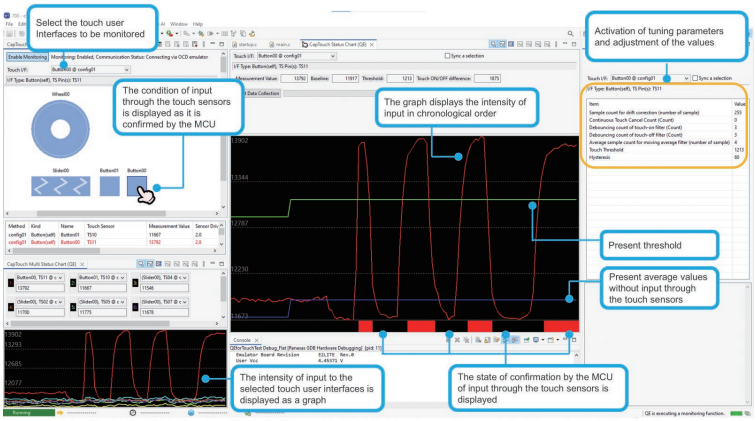
Capacitive Touch Evaluation Systems

MCU	RX130	RX140	RX261	RX671
Product ID	RSSK-RX130	RSSK-RX140	RSSK-RX261	RSSK-RX671
Kit name	Capacitive Touch Evaluation System for RX130	Capacitive Touch Evaluation System for RX140	Capacitive Touch Evaluation System for RX261	Capacitive Touch Evaluation System for RX671
Part No.	RTK0EG0003S02001BJ	RTK0EG0039S01001BJ	RTK0EG0055S01001BJ	RTK0EG0044S01001BJ
Board Image				
MCU	R5F5130ADFN	R5F51406ADFN	R5F52618BGFP	R5F5671EHDFP
Package	80-pin LFQFP	80-pin LFQFP	100-pin LFQFP	100-pin LFQFP
ROM/RAM	128KB/16KB	256KB/64KB	512KB/128KB	2MB/384KB
Number of Touch pins	36	36	34	17
Bundled items	• Evaluation board – RX130 CPU board – Self-capacitance electrode board (buttons, sliders, wheels) – Mutual-capacitance electrode board (buttons, proximity sensors) • USB cable • First Step Guide	• Evaluation board – RX140 CPU board – Self-capacitance electrode board (buttons, sliders, wheels) • First Step Guide	• Evaluation board – RX261 CPU board – Self-capacitance electrode board (buttons, sliders, wheels) • First Step Guide	• Evaluation board – RX671 CPU board – Self-capacitance electrode board (buttons, sliders, wheels) • First Step Guide

QE for Capacitive Touch: Development Assistance Tool for Capacitive Touch Sensors

QE for Capacitive Touch is a solution toolkit that runs on the integrated development environment. It speeds up the development of integrated systems utilizing capacitive touch sensors by simplifying tasks such as configuring initial settings or tuning the sensitivity of the touch interface.

Monitoring and parameter adjustment functions

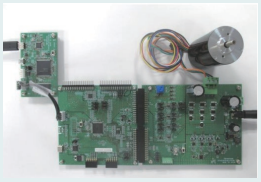
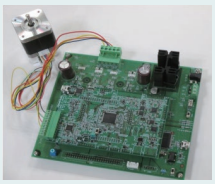


Motor Control Solution

Motor Control Development Kits for RX Family enable easy evaluation of motor control with permanent magnet synchronous motors(brushless DC motors) and stepper motors. These kits are configured to run sample code, which are downloaded from webpage. In addition, development support tools such as Renesas Motor Workbench and QE for Motor encourage easy analyzing and tuning for motor control, so you can immediately start evaluation using RX Family MCU.

Features

- Include inverter board for 3-phase BLDC motor or Stepping motor
- Supports 1-/3-shunt current sensing for BLDC motor
- Overcurrent detection function
- Supports Motor Control Development Support Tool Renesas Motor Workbench and QE for Motor
- MCB-RX26T-TYPE-A version 2(RTK0EMXE70C00001BJ) is a supported CPU board for separately sold High Voltage Inverter Board (MCI-HV-1)

MCU		RX26T		RX13T, RX23T, RX24T, RX24U, RX66T, RX72T, RX72M	RX24T, RX72M
Product ID		MCK-RX26T (version 1)	MCK-RX26T (version 2)	MOTOR-RSSK-BLDC	MOTOR-RSSK-STEPPER
Kit name		Renesas Flexible Motor Control Kit for RX26T MCU Group		Evaluation System for BLDC Motor	Evaluation System for Stepping Motor with Resolver
Part No.		RTK0EMXE70S00020BJ	RTK0EMXE70S00021BJ	RTK0EMX270S00020BJ	RTK0EMX270S01020BJ
Image					
Bundled items	Inverter Board	MCI-LV-1 (RTK0EM0000S04020BJ)		48V 5A Inverter board for BLDC motor	48V 2A Inverter board for stepping motor
	CPU Board	MCB-RX26T-TYPE-A version 1 (RTK0EMXE70C00000BJ)	MCB-RX26T-TYPE-A version 2 (RTK0EMXE70C00001BJ)	— Not included*	RX24T CPU Card with RDC
	Communication Board	MC-COM (RTK0EMXC90S00000BJ)		— On board communication circuit	— On board communication circuit
	Motor	R42BLD30L3 (MOONS' Industries)		TG-55L-KA (TSUKASA Electric Co.,Ltd)	R17PMK440CNVA4438 (MinebeaMitsumi Inc.)
Inverter specification		■ Rated voltage: 48V ■ Rated current: 10A (continuous) ■ Protect functions: Overcurrent detection, PWM overlap protection		■ Rated voltage: 48V ■ Rated current: 5A (continuous) ■ Protect function: Overcurrent protection	■ Rated voltage: 48V ■ Rated current: 2A (continuous) ■ Protect function: Overcurrent protection
Sample Code		• Hall sensor vector control of PM motors • Sensorless Vector Control for IPMSM over the Whole Speed Range • Sensorless Vector Control of a Permanent Magnet Synchronous Motor (1motor, 2motors) • Vector Control for Permanent Magnet Synchronous Motor with Encoder		• 120-deg conducting control with hall sensor • Sensorless 120-deg conducting control • Sensorless vector control (1motor, 2motors, 4motors) • Encoder vector control (1motor, 3motors) • Magnetic sensor vector control • Inductive sensor vector control	• Vector control for 2-phase stepping motor with resolver
Resources		MCK-RX26T User's Manual Design Package MCK-RX26T Quick Start Guide		Evaluation System for BLDC Motor User's Manual Schematic, BOM List	Evaluation System for Stepping Motor with Resolver User's Manual rtk0emx270s01020bj-design-package

Note: Evaluation System for BLDC Motor does not include CPU card and requires purchase separately sold CPU card for evaluation.

Compatible CPU Card

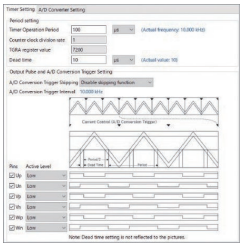
		Part No.	MOTOR-RSSK-BLDC	MOTOR-RSSK-STEPPER
Motor CPU Card	RX13T	RTK0EMXA10C00000BJ	✓	
	RX23T	RTK0EM0003C01202BJ	✓	
	RX24T	RTK0EM0009C03402BJ	✓	
	RX24U	RTK0EMX590C02000BJ	✓	
	RX66T	RTK0EMX870C00000BJ	✓	
	RX72T	RTK0EMX990C00000BJ	✓	
With RDC-IC	RX24T+RDC-IC	RTK0EMX270C02000BJ*		✓
	RX72M+RDC-IC	RTK0EMXDE0C00000BJ	✓	✓

*RX24T+RDC-IC CPU card is included in MOTOR-RSSK-STEPPER. Not purchasable by CPU card only.

Motor Driver Generator Function of Smart Configurator for RX

The Motor component of Smart Configurator for the RX Family can generate drivers suitable for motor control for peripheral functions such as the multi-function timer pulse unit and A/D converter module, and you can use it without needing to be aware of the minute details of peripheral settings. This function is available in the e^2 studio integrated development environment and in RX Smart Configurator (standalone version).

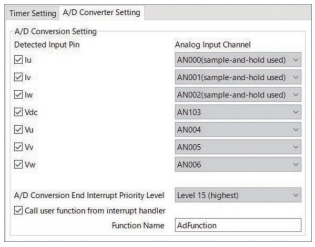
Timer (MTU/GPT) Settings



Configurable Settings

- Complementary PWM mode (MTU3 or GPT) or triangle-wave PWM mode (GPT)
- Switching frequency
- Dead time duration
- A/D conversion start trigger settings
- PWM signal output polarity
- Motor connection pin selection

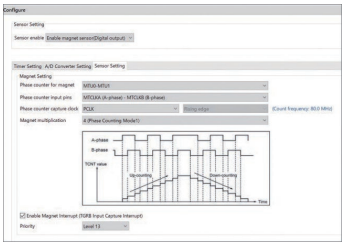
12-Bit A/D Converter (S12AD) Settings



Configurable Settings

- A/D converter pin selection for motor control
- Interrupt priority level selection

Sensor Settings



Configurable Settings

- Motor component setting support Encoder and Hall sensor
- Motor component setting support Magnetic sensor (digital output) for RX24T

Features

- By configuring settings in a simple GUI, you can generate driver source code for the timer (multi-function timer pulse unit (MTU) or general PWM timer (GPT)) and 12-bit A/D converter (S12AD) peripheral modules that perform pulse output and current measurement essential for motor control. Complex settings such as timer pulse output settings (complementary PWM mode settings) and settings to trigger A/D conversion by timer events are configured automatically by the generated drivers.
- It is easy to change settings for the peripheral function channels or pins used for motor control from within Smart Configurator.

Supported MCUs: RX13T, RX23T, RX24T, RX24U, RX26T, RX66T, RX72T, and RX72M
Supported motors: 3-phase brushless DC motors and 2-phase stepping motors

Renesas Motor Workbench

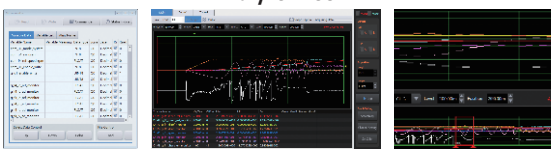
Renesas Motor Workbench is a development support tool for debugging, analyzing and tuning motor control programs. With user friendly GUI, visually engaging experience while providing variable monitoring as real time waveform.

Features

- With use of motor included to Motor Control Kit, testing and confirming the operation of motor
- Motor Specific parameter measurement for various motor as well as debugging and adjusting the parameters.
- With motor embedded to final application, RMW can confirm the motor operation.

Supported MCUs: RX13T, RX23T, RX24T, RX24U, RX26T, RX66T, RX72T, and RX72M

Analyzer Tool

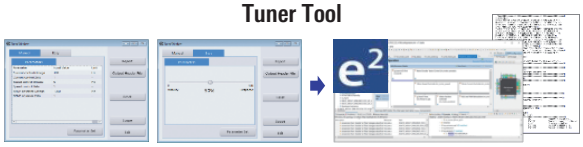


- Dynamic access to variables in the MCU
- Displays changes in variables as waveforms in real-time
- Trigger settings and zoom analysis

Easy GUI Tool

- Intuitive operations enable you to control speed and position of the motor easily
- You can check the drive status at a glance with meters and graphs

Tuner Tool



- Automatically obtains and tunes the parameters necessary for vector control
- Enables fine tuning by means of the manual tuning function
- Outputs the tuning results (header file, PDF)

Servo Tool

Inertia Estimation | Servo Tuning | Return to Origin | Point to Point

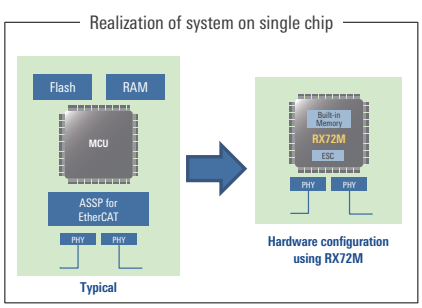
- Inertia Estimation: Estimates the load inertia and the inertia of the rotor and the shaft connected with the motor-axis while driving the motor
- Servo Tuning: Configures the settings for servo operation such as position control method and control parameters
- Return to Origin: Sets the method for return to origin and the return speed, etc.
- Point to Point: Performs PTP (Point to Point) operation for one axis

Industrial Network Solutions

Industrial networks are characterized by a variety of protocols coexisting side by side, each utilized for its own particular strongpoints. Renesas offers solutions that are compatible with multiple protocols to provide support for customers' development efforts.

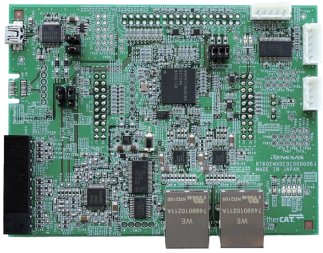
RX72M Network Solutions

The sample software supports EtherCAT® and other leading industrial network communication protocols that cover 70% of the market. Benefiting from collaboration with Renesas partner vendors, these sample program packages help reduce the development time required for implementation of protocols. The RX72M delivers superior performance with a 1461 CoreMark® score when operating at 240MHz together with large memory capacity, making it possible to realize a system on a single chip, reducing the BOM cost associated with development, and contributing to reduced device size.



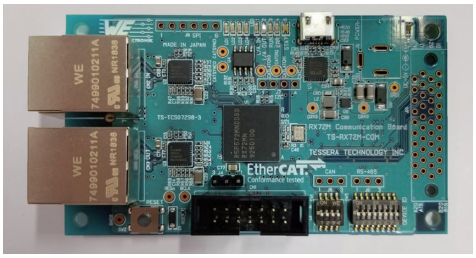
RX72M Network Solution Boards

These solutions consist of an evaluation board mounted with an RX72M MCU ideal for initial evaluation of networked devices, OS, middleware, and sample code.



RX72M CPU Card with RDC-IC (RTK0EMXDE0C00000BJ)

- Supports BLDC motor and stepping motor control when combined with a compatible inverter board.
- A variety of sample code is provided.

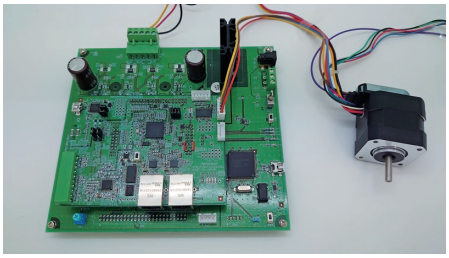


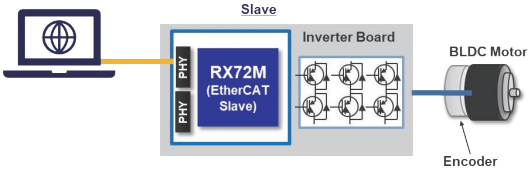
EtherCAT Conformance tested | PI CERTIFIED PROFIBUS • PROFINET | ODVA CONFORMANT

TS-RX72M-COM*

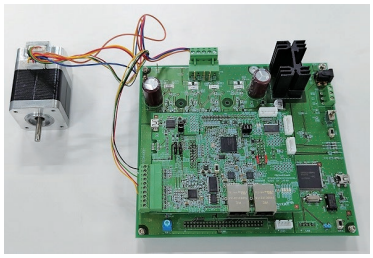
- EtherCAT and 2-channel Ethernet ports (MII)
- RS-485 and CAN transceiver (field network support)
- Conformance tested on three major protocols (EtherCAT®, PROFINET RT, and EtherNet/IP).

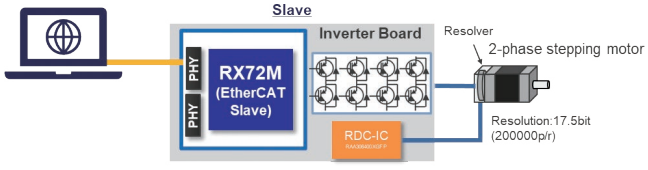
* The TS-RX72M-COM board is available for purchase from Tessera Technology, Inc. For details, please contact your Renesas sales agent.





- Encoder vector control for permanent magnet synchronous motors
  By installing encoder vector control software on an RX72M MCU, EtherCAT® communication and encoder brushless motor control can be implemented on a single chip.





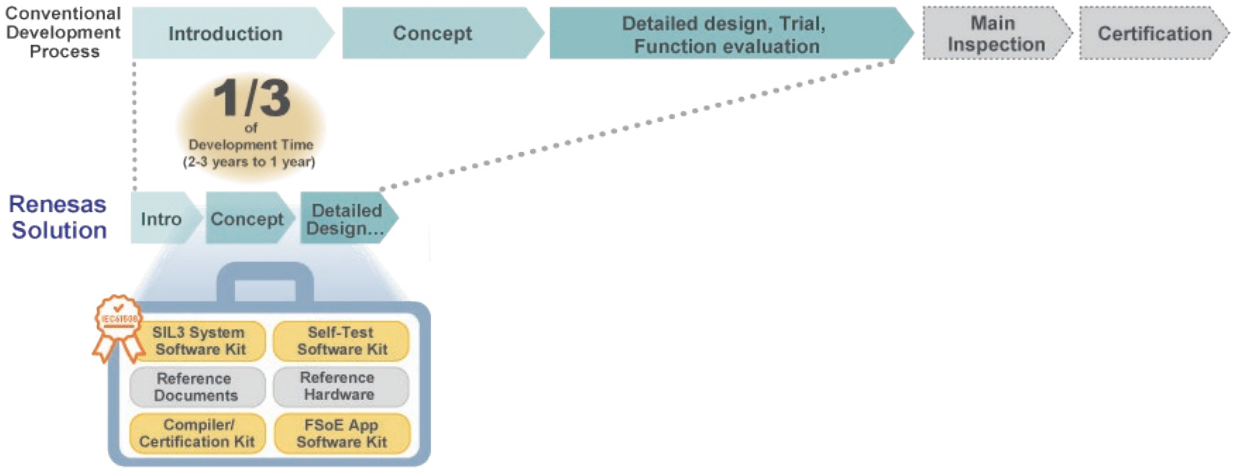
- Vector control for resolver-equipped stepping motors
  By installing resolver vector control software on an RX72M MCU, EtherCAT® communication and resolver-equipped stepping motor control and can be implemented on a single chip.

IEC61508 Functional Safety Solutions

The crucial importance of functional safety is rising in the industrial field, aiming to maintain safety when malfunctions occur in order to prevent breakdowns and accidents during planned operation, adverse impacts from operator injuries, and associated economic losses. However, while equipment is required to meet functional safety standards and the scope of application to apply functional safety standard is expanding in many industrial fields, the development burden on customers is also increasing.
As a solution towards this problem, Renesas released a functional safety solution certified by the certification body.

Functional Safety Solution Overview

As Renesas been the 1st MCU supplier to complete the verification of the core self test, Renesas provides functional safety solutions that reduce the development burden on customer and contributes to realize safe and reliable factories.
IEC61508 SIL3 certified products provide MCU self-test software, platform software to build dual MCU systems, safety network software, and safety compilers. In addition, we also provide evaluation boards of dual MCU configuration and technical document for acquiring IEC61508 certification and development, as a reference solution.

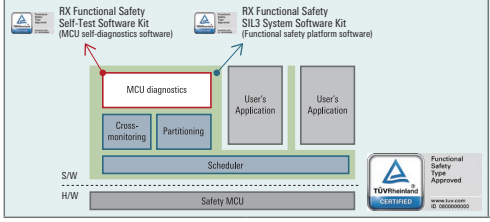
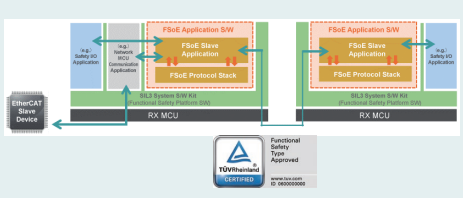
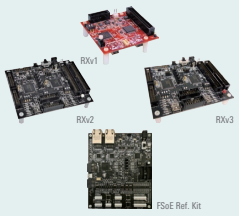


Functional Safety Solution List

The key features and our aim of our solution are;

- One-stop functional safety solution for general purpose MCU
- Reduces time for constructing functional safety systems
- Easy implementation of safety system for various safety applications such as motor, safety controllers, programmable logic controls, and sensors.

Free evaluation version available for download via our web.

Self-test Software Kit	SIL3 System Software Kit	Safety Network Application Software Kit	Reference Documents	Reference Hardware Boards
Free package of MCU Self-diagnostics SW for diagnosing CPU, ROM, and RAM in MCU.	Package of Functional Safety Platform SW for cross-monitoring dual MCU and controlling user's application behavior.	Renesas offers this safety network protocol solution that can be used with the SIL3 System Software Kit. (Both FSoE slave and PROFIsafe slave functions are supported.)	Technical document explaining the method to comply with IEC61508 standard. The document consists with documents and excel data with easy explanation of the requirements to meet the IEC61508 standard.	These kits combine software and hardware, including evaluation boards for dual configurations and software for implementing the FSoE slave function. They can be used to evaluate Renesas safety software.
				

Also, because to prove that compiler generates a valid code when constructing SW, Renesas original certified compiler and certification kit is available. Certified IAR compiler also available from IAR.

IEC60730 Functional Safety Solutions

In recent years, the use of automated electronic control systems has expanded to a wide variety of applications, and the need for reliability and safety has become an important element in system design. The IEC 60730 standard stipulates control requirements intended to guarantee that products, especially home appliances such as air conditioners, washing machines, dishwashers, clothes dryers, and refrigerators, operate with a high degree of safety and reliability. Recently, IEC 60730 has been extended to cover not only home appliances, but also industrial machinery such as collaborative robots, broadening the importance of the standard.
Renesas offers a package including self-diagnostic software and safety manuals for the RX Family that meets IEC 60730 class B and C requirements.* These items have been approved by a certification authority and a copy of the approval certificate is included in the package. Making use of the package enables customers to reduce the time and effort involved in obtaining IEC 60730 certification for their applications.

* Certification under the IEC 60335 standard is also included.

Examples of Products Covered by IEC 60730 Class B

- Air conditioner outdoor units (fan/compressor)
- Ventilation fans
- Washing machines
- IH heaters and ranges

Examples of Products Covered by IEC 60730 Class C

- Automatic guided vehicles (AGVs)
- Water heaters, boilers
- Service robots
- Physical assistant robots
- Collaborative robots

IEC60730 Functional Safety Solutions Overview

Renesas offers two types of solutions to meet the class B and C requirements, respectively, of the IEC 60730 standard. These solutions are functional safety certified, and can be used as is in devices requiring functional safety support.

Supported MCU Series: RX100/RX200/RX600

No.	Description	IEC 60730 Class B Compliant Version*2	IEC 60730 Class C Compliant Version*3
1	RRX self-diagnostic software*1 (Certified by TÜV Rheinland)	✓	✓
2	Safety manual	✓	✓
3	User's guide	✓	✓
4	IEC 60730 certification documentation (approval certificate, test report)	✓	✓

*1: Certified compiler Renesas CC-RX v3.05.00 may be embedded into products at no charge and is provided with no warrantee or support.
*2: Compliant with the following standards: IEC 60730-1 Annex H Class B, IEC 60335-1 Annex R Table R.1, EN 60730-1 Annex H Class B, EN 60335-1 Annex R Table R.1.
*3: Compliant with the following standards: IEC 60730-1 Annex H Class C, IEC 60335-1 Annex R Table R.2, EN 60730-1 Annex H Class C, EN 60335-1 Annex R Table R.2.

RX Family Ecosystem Partners

Renesas is enabling a comprehensive partner ecosystem to deliver an array of software and hardware building blocks that will work out-of-the-box with Renesas RX Family MCUs. The Renesas RX ecosystem will help accelerate the development of IoT applications, including core technologies such as security, safety, connectivity, and HMI among others.

Expansive Third Party Solutions Portfolio

- 200+ partners, 300+ solutions and growing
- Coverage across all key IoT technologies
- Robust GTM and strong digital drumbeat

Commercial Grade Building Block Solutions

- Commercial grade software
- Work out-of-box with Renesas products
- Bundling options for select solutions

Problem Solving at Heart

- Address specific design problems
- Address specific skill-set gaps
- Customer-centric approach

Partner Overview

The partner overview shown might not be complete since the partner network is extending almost daily. For best reference and latest data, we recommend checking our webpage at: www.renesas.com/rx-partners

Explanation of Orderable Part Numbers

R5	F	5	72M	N	H	G	FC	#V	0
Renesas MCU	ROM Type F: Flash S: ROM LESS	RX Family	Product Group	ROM/RAM/ data flash capacity (KB)*1	Chip Original info*1	Operating ambient temperature	Package type/pin count/pin pitch	Packing specification	Product identification code

Product Group

72M	RX72M	24U	RX24U
72N	RX72N	23T	RX23T
72T	RX72T	23W	RX23W
66N	RX66N	231	RX231
660	RX660	230	RX230
671	RX671	23E	RX23E
65N	RX65N	13T	RX13T
651	RX651	140	RX140
66T	RX66T	130	RX130
26T	RX26T	113	RX113
261	RX261	111	RX111
260	RX260	110	RX110
24T	RX24T		

Operating ambient temperature

D	-40°C to 85°C
G	-40°C to 105°C

Packing specification

U, V, 2, 3	Tray
0, 1	Tray (Full carton)
5	Tape and reel

Package type/pin count/pin pitch

BD	LFBGA	224	0.8
BG	LFBGA	176	0.8
BL	TFBGA	85	0.65
BP	TFBGA	64	0.5
FB	LFQFP	144	0.5
FC	LFQFP	176	0.5
FD	LQFP	52	0.65
FF	LQFP	80	0.65
FH	LQFP	112	0.65
FJ	LQFP	32	0.8
FK	LQFP	64	0.8
FL	LFQFP	48	0.5
FM	LFQFP	64	0.5
FN	LFQFP	80	0.5
FP	LFQFP	100	0.5
LA	TFLGA	100	0.5
LC	TFLGA	177	0.5
LE	TFLGA	145	0.65
LF	WFLGA	64	0.5
LJ	TFLGA	100	0.65
LK	TFLGA	145	0.5
LM	WFLGA	36	0.5
LN	TFLGA	83	0.5
ND	HWQFN	64	0.5
NE	HWQFN	48	0.5
NF	HWQFN	40	0.5
NG	HVQFN	56	0.4
NH	HWQFN	32	0.5

Example of product information for RX72M (176-pin), product No. R5F572MNHGFC#V0

This guide lists the values for individual product numbers. For information on the actual product lineup, refer to the relevant user's manual.

Note: 1. This information is different for each RX group. Refer to the relevant user's manual for details.

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