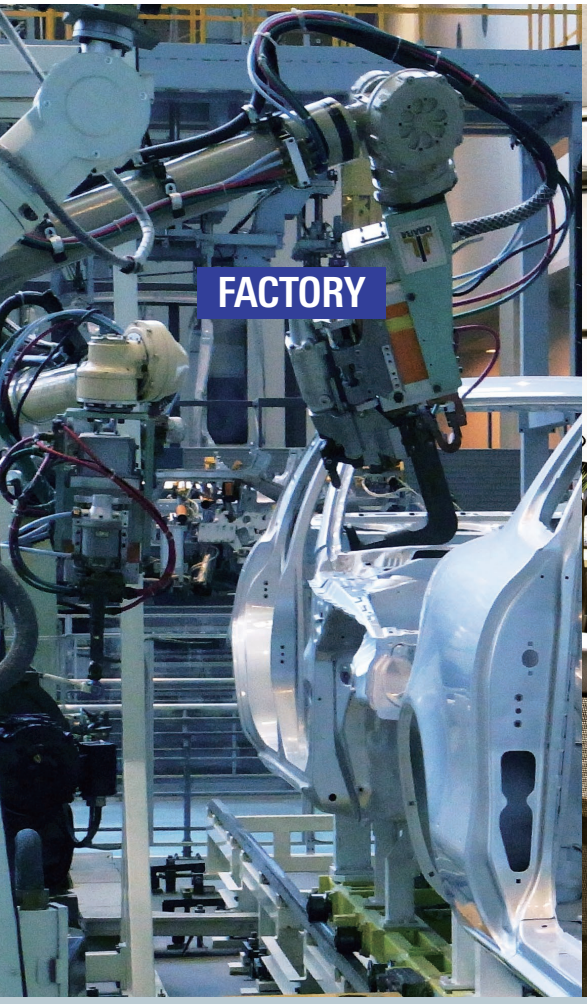
RX FAMILY

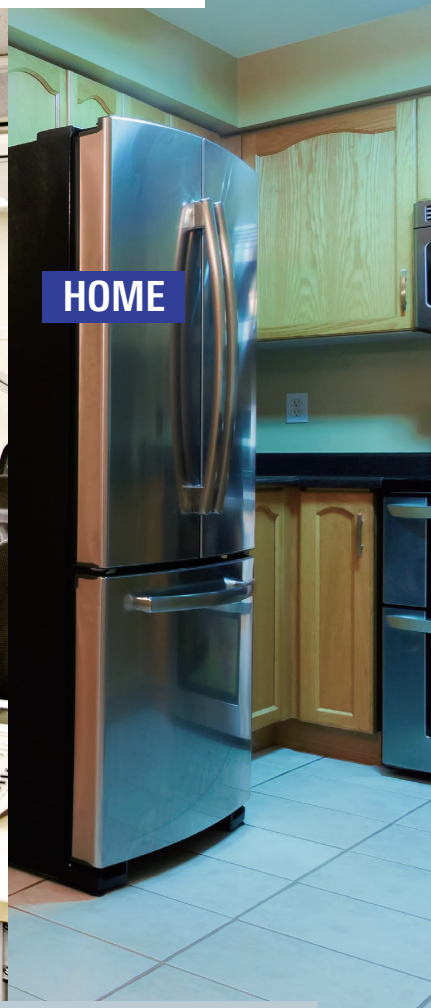
Renesas 32-Bit Microcontrollers

2024.10

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

Maintaining and Advancing the Renesas Tradition

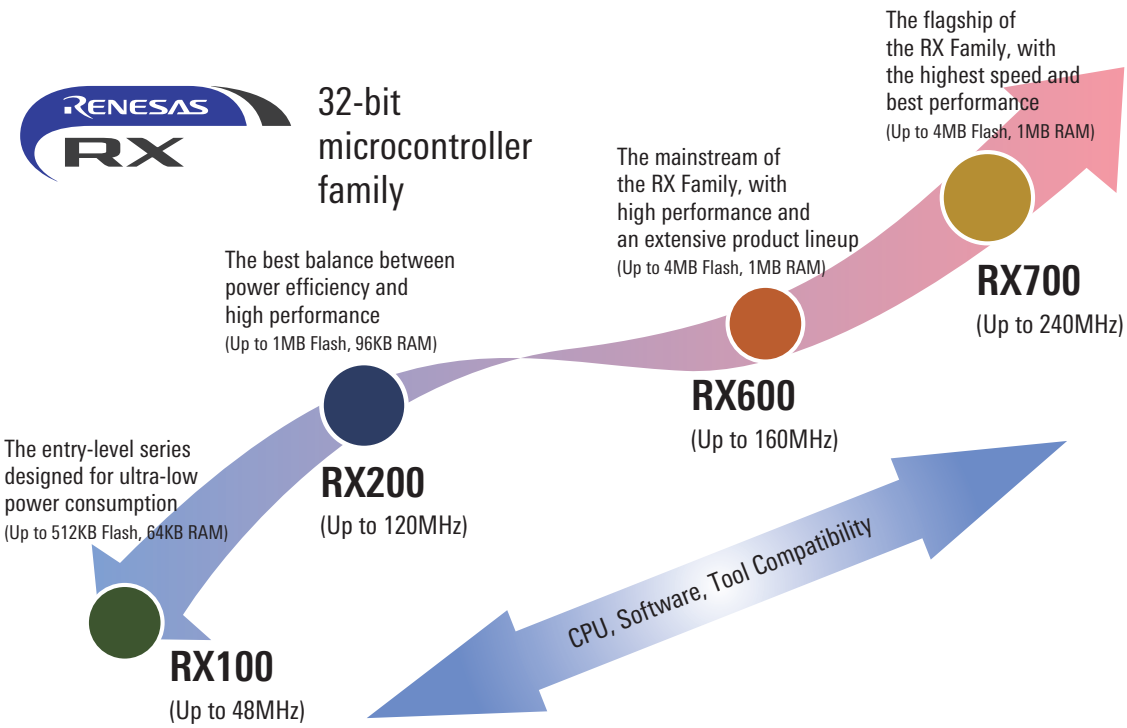




CONTENT

- The following new products have been added:
  RX200 Series: RX261, RX260
- The following pages have been added.
  IEC60730 Functional Safety Solutions

RX Family MCUs are built around advanced CPU cores packed with innovations unique to Renesas. Based on proprietary technology amassed over many years, they are designed to deliver improved responsiveness and power efficiency in all aspects while combining excellent operation performance and low power consumption. The RX Family brings together a variety of technical innovations from Renesas and aims to define the ultimate in 32-bit MCUs with on-chip flash memory for the industrial, home electronics, office automation, and ICT fields.



Power and functionality poised to dominate the market: The four powerful product series that compose the RX Family

The RX Family of 32-bit microcontrollers are built around Renesas' exclusive RX CPU core and combine excellent operation performance with superior power efficiency.
The family consists of four product series: the flagship RX700 Series, with the fastest performance and most advanced functions; the mainstream RX600 Series; the RX200 Series, which delivers an optimal balance of power efficiency and high performance; and the entry-level RX100 Series, with extremely low power consumption. These four series encompass a range of products that provide seamless scalability from small-scale to large-scale applications.

POSITIONING OF THE RX FAMILY

Positioning of the RX Family

With a proven track record and superior reliability, the RX family of 32-bit microcontrollers is suitable for a wide range of applications in the industrial and home electronics fields and supports the full lineup of customer products with a seamless range of operating frequencies from 32MHz to 240MHz.

Renesas Core	**32-bit MCU** RX Power Efficiency **Max operating frequency:** 32MHz~240MHz **Features:** Superior power efficiency High-capacity flash memories Broad lineup	**8/16-bit MCU** RL78 Low Power **Max operating frequency:** 16MHz~48MHz **Features:** Ultra-low energy Low pin count lineup available
Arm® Core	**32/64-bit MPU** RZ High Performance **Max operating frequency:** 125MHz~1.8GHz **Features:** Multi-core up to 8 cores Linux or RTOS available High-capacity on-chip RAM DRP*1 image processing acceleration DRP-AI DNN acceleration *1 DRP: Dynamically Reconfigurable Processor	**32-bit MCU** Renesas Synergy™ Qualified Platform **Max operating frequency:** 32MHz~240MHz **Features:** Qualified software and tools
	32-bit MCU RA Arm® Ecosystem **Max operating frequency:** 48MHz~480MHz **Features:** High efficiency Advanced security Flexible Software Package	

Features of the RX Family

The RX Family mainly comprises four series. The RX700 Series and RX600 Series are designed to deliver high speed and excellent performance. The RX200 Series and RX100 Series are optimized for low power consumption.

RX700 Series Up to 240MHz

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 Up to 160MHz

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 Wi-SUN Motor Capacitive Touch

RX200 Series Up to 120MHz

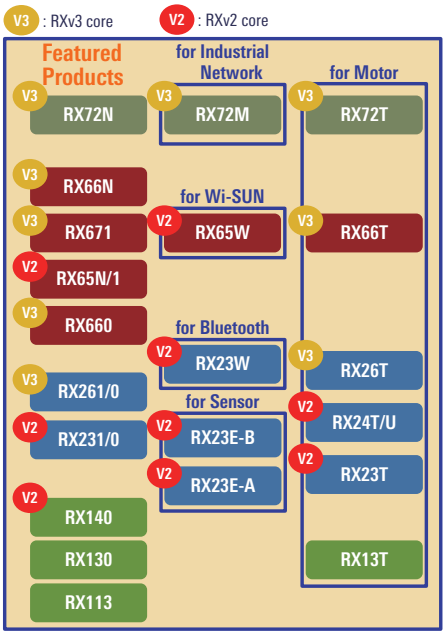
The best balance between power efficiency and high performance

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 Up to 48MHz

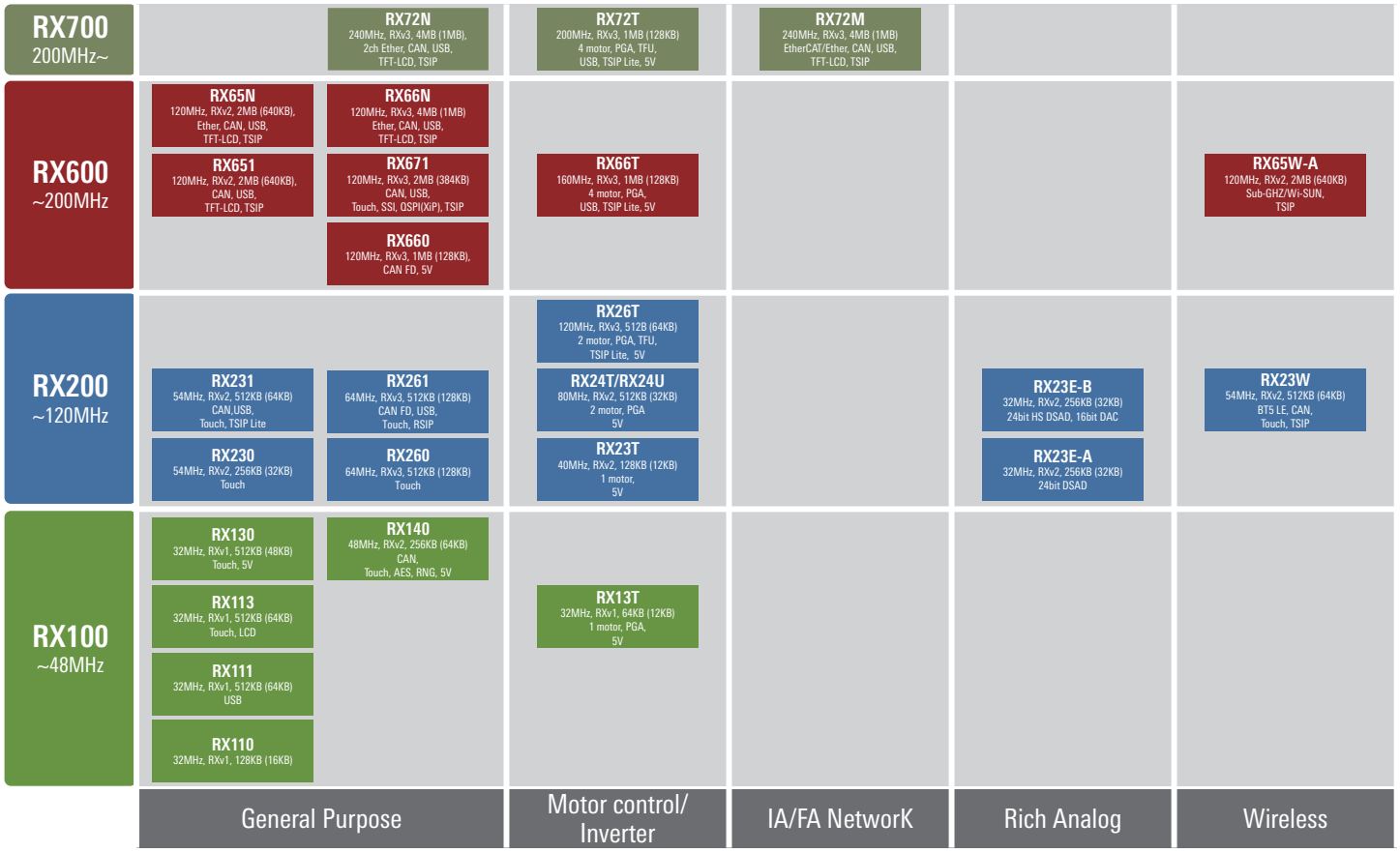
The entry-level series designed for ultra-low power consumption

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

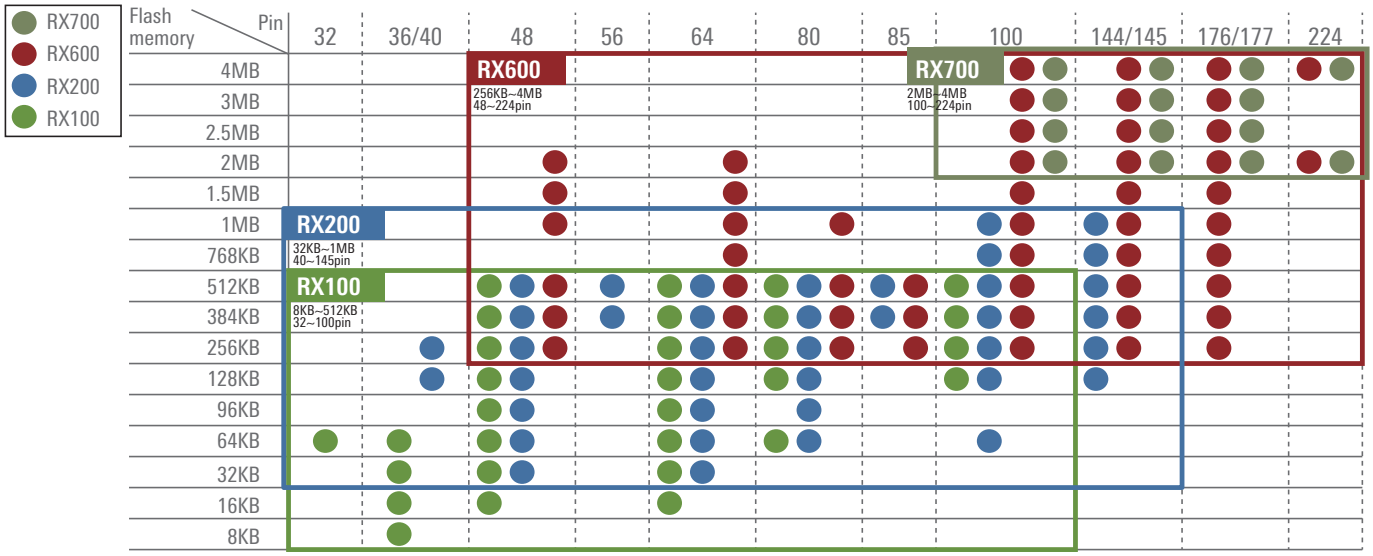
The RX Family has products suitable for a variety of different applications.



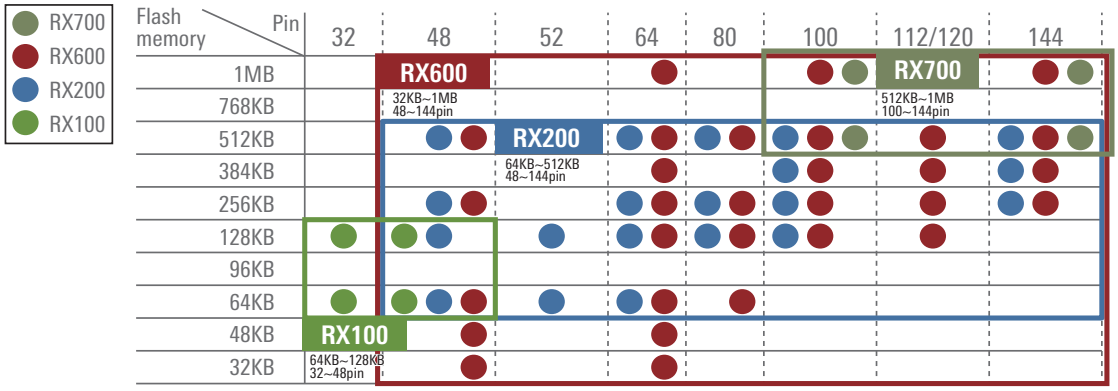
RX Family Memory/Pin Lineup

RX Family MCUs are available in packages with pin counts from 32 to 177 pins and flash memory capacities from 8KB to 4MB. Customers can choose the product that best meets their needs from this extensive lineup.

Industrial, Home Appliances, and OA/ICT

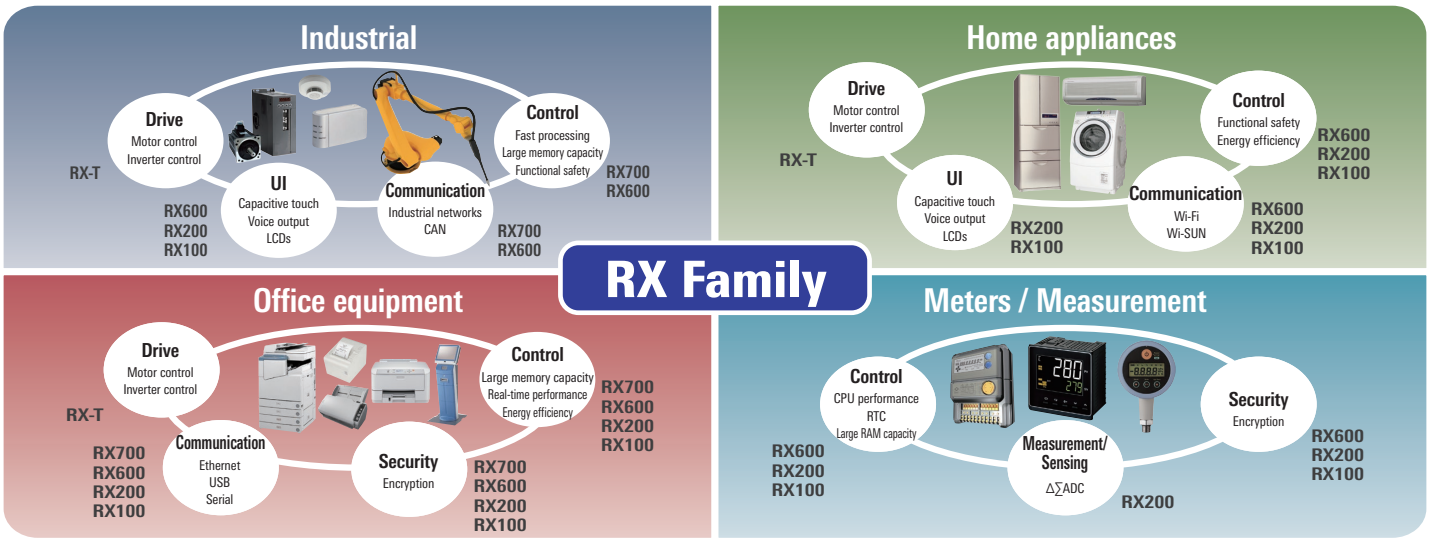


Motor



Contributing to the Development of Platforms in a Variety of Fields

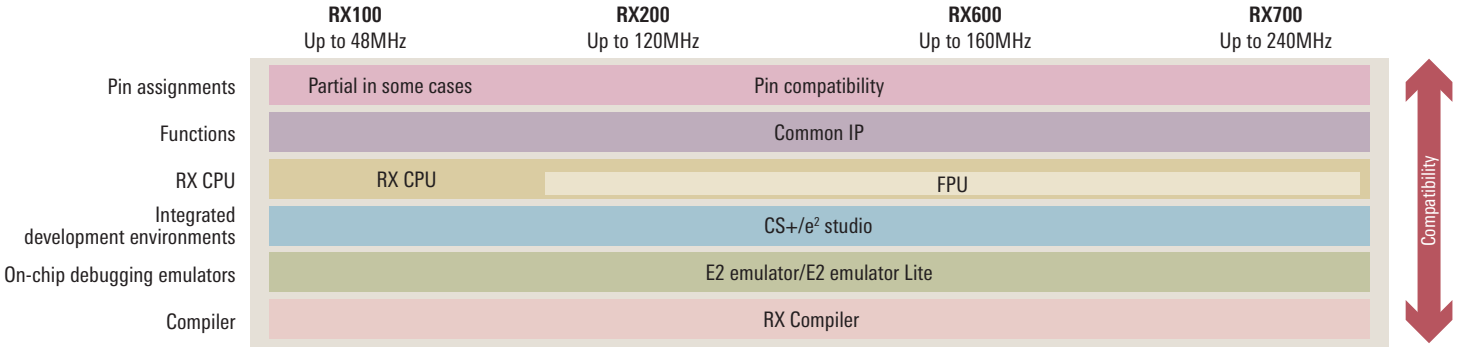
RX Family MCUs cover a wide performance range from 32MHz to 240MHz while providing abundant peripheral functions for many applications and excellent compatibility.



RX Family Compatibility

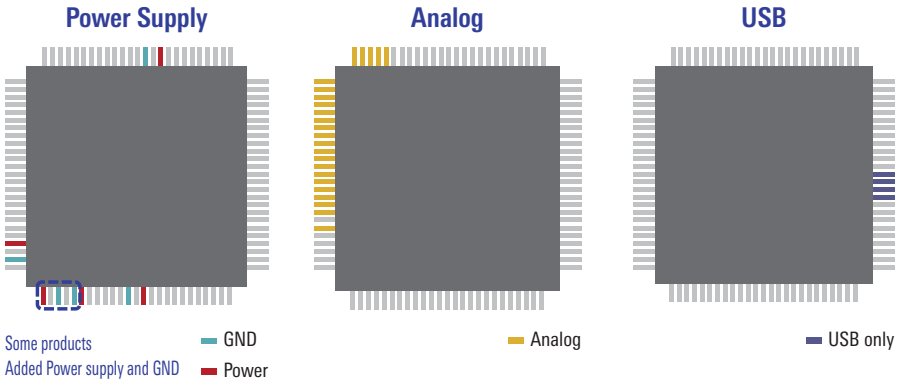
The RX Family is designed for compatibility across products in terms of CPU instructions, pin assignments, and functions.

- 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

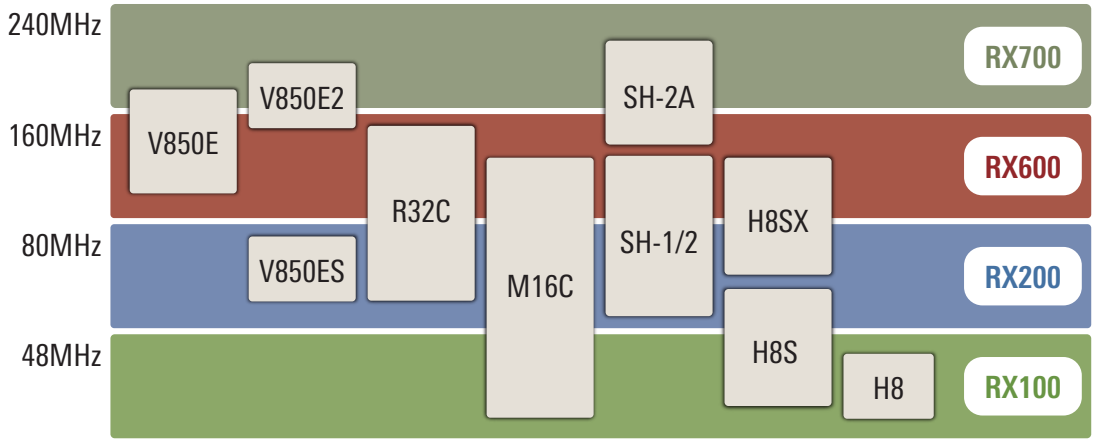
Analog and USB pins are pin compatible. Power supply pins are compatible except in some devices which require additional pins.



*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.



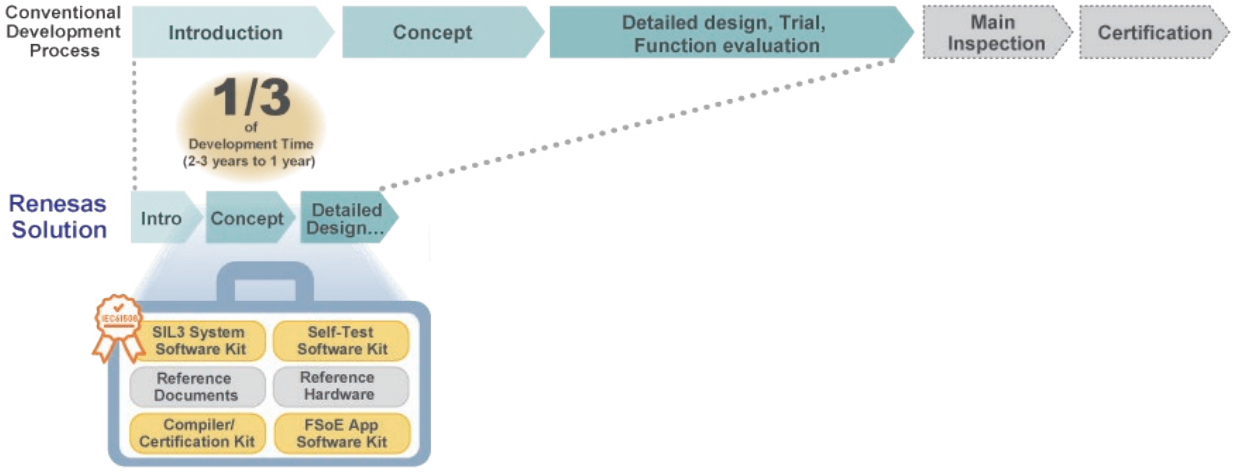
RX FAMILY SOLUTIONS

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.

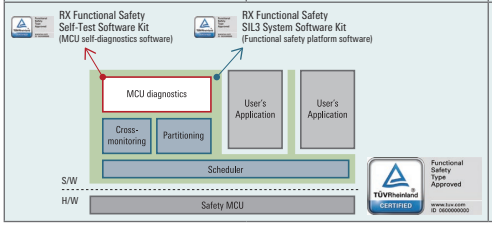
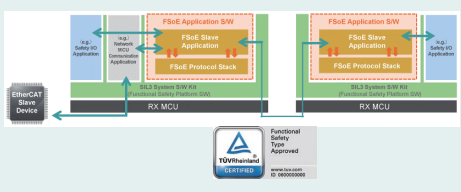
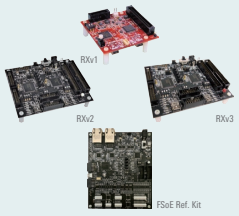


Functional Safety Solution List

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 MCUs: RX671/RX66T/RX660/RX651/RX65N/RX26T(RAM64KB)/RX24T/RX230/RX231/RX23T/RX140/RX130/RX13T

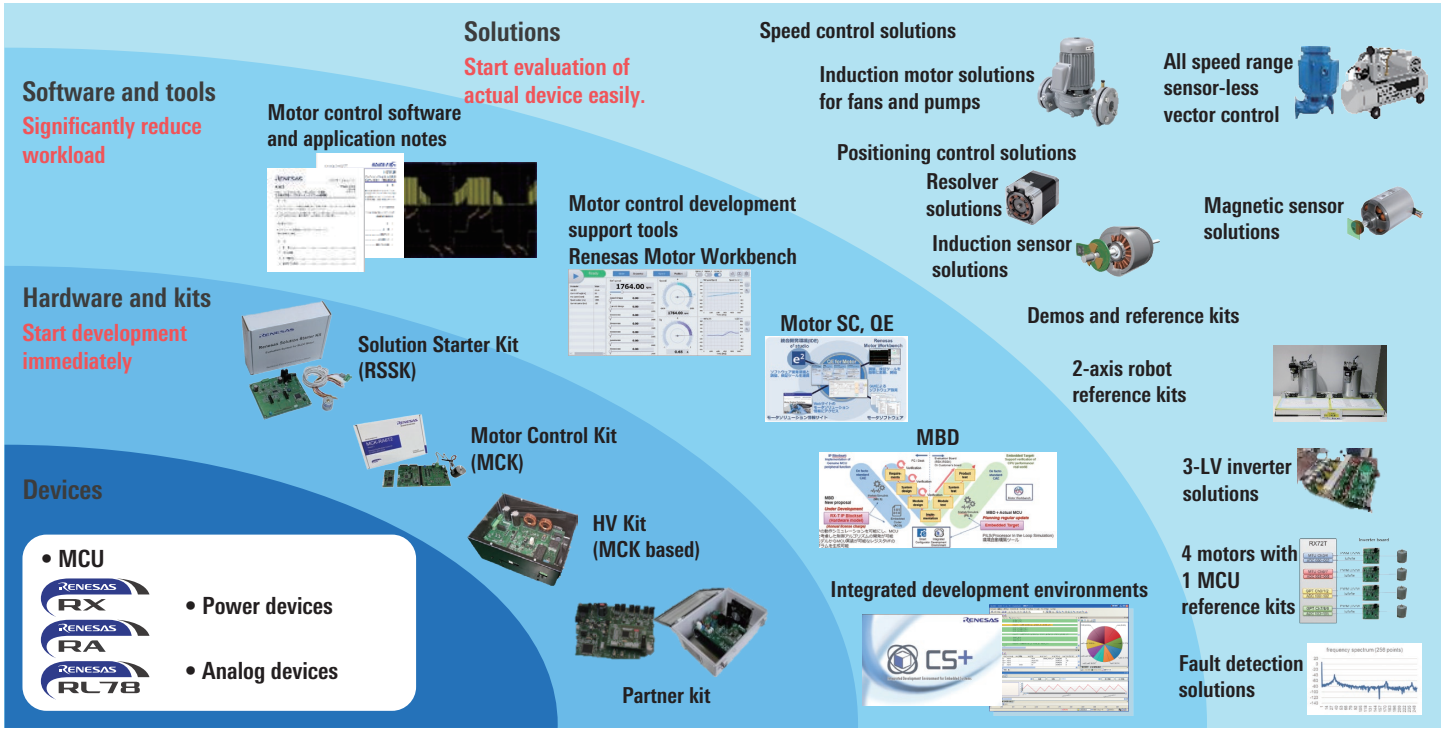
No.	Description	IEC 60730 Class B Compliant Version*2	IEC 60730 Class C Compliant Version*3
1	RRX self-diagnostic software*1 Certified by TÜV Rheinland	✓	✓
2	Safety manual	✓	✓
3	User's guide	✓	✓
4	IEC 60730 certification documentation (approval certificate, test report)	✓	✓

*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 SOLUTIONS

Motor Control Solutions

Renesas offers motor control solutions incorporating microcontrollers and analog products that are designed to enable reduced power consumption and quieter operation when driving brushless DC motors (permanent magnet synchronous motor) and stepping motors. Development tools optimized for each stage in the customer's development workflow are available. They help shorten the time needed for development.



Renesas Solutions for Different Motor Types and Control Methods

Renesas offers kits and motor control software to match various motor types and control MCUs. Each kit comes with different sample software, so refer to the table below to select the appropriate solution to meet your requirements.

Distribution Format	Motor Type	Name of Kit	Vector Control			120-Degree Conducting Control	
			Sensorless	Optical Encoder	Resolver	Sensorless	Hall Effect
			Speed Control	Speed Control/ Positioning Control	Speed Control/ Positioning Control	Speed Control	Speed Control
Supplied as complete kit by Renesas	BLDC	Evaluation system for BLDC Motor + CPU Card (P/N: RTK0EMX270S00020BJ)	✓	–	–	✓	✓
	BLDC	MCK-RX26T (P/N: RTK0EMXE70S00020BJ)	✓	–	–	✓	✓
	Stepping	Evaluation System for Stepping Motor with Resolver (P/N: RTK0EMX270S01020BJ)	–	–	✓	–	–
Renesas kit + motor with encoder*1	BLDC	Evaluation system for BLDC Motor + CPU Card (P/N: RTK0EMX270S00020BJ)	–	✓*1*2	–	–	–
	BLDC	MCK-RX26T (P/N: RTK0EMXE70S00020BJ)	–	✓	–	–	–
Supplied as sample software and application note by Renesas	Induction motor	Evaluation system for ACIM	✓*3	–	–	–	–

*1. The customer must supply a motor with an optical encoder.
*2. Magnetic encoder also supported. (The customer must supply a motor with a magnetic encoder.)
*3. The customer must supply an induction motor and inverter board.

Motor Control Solutions

Motor Control Development Kits

Evaluation System for BLDC Motor

CPU cards, sample software, and development support tools are available separately, allowing you to get started with motor control without delay.

Item	Specification
Kit name	Evaluation System for BLDC Motor
Kit model No.	RTK0EMX270S00020BJ
Structure	48V 5A Inverter board for BLDC motor
	BLDC motor (TG-55L-KA)
Inverter specification	■ Rated voltage: 48V ■ Rated current: 5A (RMS) ■ Protect function: Overcurrent detection, others

Sample Software	Supported MCUs
120-degree conducting control + Speed control (Hall, Sensorless)	RX23T, RX24T
Vector control + Speed control (Encoder, Sensorless)	RX13T*1,RX23T, RX24T, RX24U, RX66T, RX72T, RA6T1
Vector control + Position control (Encoder)	RX23T, RX24T, RX24U, RX66T, RX72T, RA6T1

*1: Sensorless only.

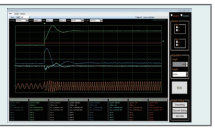
Motor Control Development Support Tool

Renesas Motor Workbench

- Dynamic reading/writing of variables and waveform display while operating the motor.
- Automatic identification of motor parameters and control gains required for vector control.
- Analyzer waveform display data is in csv format. Tuner identification results can be outputted as PDF file or header file.

Analyzer

Extensive functions include trigger, zoom, and commander transmission etc., useful for debugging and evaluation.
Also usable as user I/F.

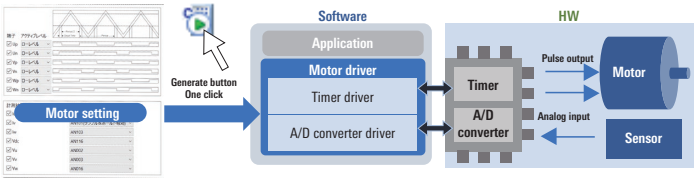


Tuner

Vector control at ease without know-how.
Fine adjustment at ease with manual adjustment function, as well as quick result check.

Motor Driver Generation Function of RX Smart Configurator

This function generates driver code for MCU peripheral functions suitable for motor control. Simply enter motor-related settings via the GUI, click a button, and RX Smart Configurator generates drivers for the timer and A/D converter based on your settings.



Motor driver generation function

MCK-XXXXX

Note: XXXXX designates the group name of the MCU mounted on the CPU board.

This motor solution includes a CPU board, inverter board, and communication board. Sample code and a development support tool are provided so you can get started with motor control immediately after purchase.

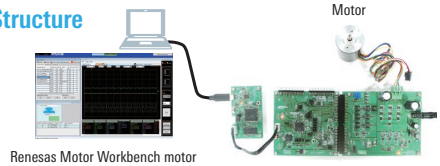
Features

- Equipped with onboard debugger for MCU flash programming.
- Supports 1-shunt and 3-shunt current detection.
- Overcurrent detection function.
- Supports the motor control development support tool “Renesas Motor Workbench” for easy debugging.
- Use of a communication board provides electrical isolation from the PC for safe evaluation and debugging of motor control applications.

Kit specifications

Kit name	MCK-RX26T
Kit model No.	RTK0EMXE70S00020BJ
Structure	48V 10A inverter board for BLDC motor (MCI-LV-1)
	RX26T CPU board (MCB-RX26T Type A)
	Communication board (MC-COM)
	BLDC motor (R42BLD30L3 manufactured by Moons’ Industries)
Inverter specification	■ Rated voltage: 48V ■ Rated current: 10A (continuous) ■ Protect functions: Overcurrent detection, etc.

Overall Structure



Renesas Motor Workbench motor control development support tool

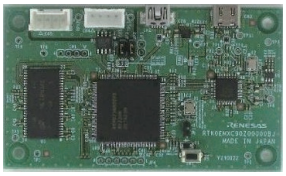
CPU board (replaceable) Inverter board

MC-COM

The communication board for serial communication with a Renesas MCU. It provides an electrically isolated environment to enable safe evaluation and debugging of motor control applications.

Features

- Supports the motor control development support tool “Renesas Motor Workbench”.
- CPU board by manufacturers other than Renesas can be used by embedding code from libraries supported by Renesas Motor Workbench in the user’s motor control software.



Kit specifications

Item	Specification
Kit name	MC-COM
Kit model No.	RTK0EMXC90S00000BJ
Isolation device used	Si8622BC-B-IS (Skyworks Solutions Inc.) or ISO7421FED (Texas Instruments)
Compatible CPU boards	RX13T/23T/24T/24U/66T/72T/72M CPU Card RA6T1 CPU Card MCB-RA6T2/RA6T3/RA4T1 MCB-RX26T Type A/Type B/Type C

RX FAMILY SOLUTIONS

Security Solutions

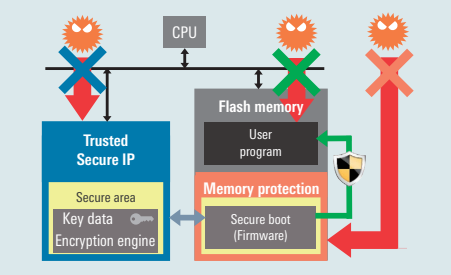
Interest in IoT as a means of creating added value has been steadily growing. Internet connectivity opens the possibility of innovative and differentiating features, but it also exposes devices to risks such as tampering, eavesdropping, and execution of unauthorized software and viruses. This has caused the demand for security solutions to expand to devices that previously did not require security functions.

Security Features Provided by RX Security Solutions

- Key protection: Hardware security IP prevents leakage of key data.
- Simple implementation: One-stop solutions for building robust protection mechanisms for IoT devices.
- Operation management: Support for life-cycle management from product shipment, market operation, and firmware updates to EOL.
- The world's first microcontroller to obtain NIST FIPS CMVP Level 3 certification, this encryption technology is CAVP conformant as a guarantee of correctness.*[2]

Notes: 1. National Institute of Standards and Technology
2. Certification obtained for RX231, RX65N, and RX651.

Root of Trust implementation in security hardware



RX Security Solutions

RX Hardware-Based Security Functions

The Root of Trust is implemented by a hardware security IP module and memory protection functionality. The memory protection functionality protects authentication programs against tampering.

* Trusted Secure IP (TSIP) or Renesas Secure IP (RSIP)

Function / MCU Group	Encryption							Memory Protection				
	Key Management Function	Access Management Circuit*	AES	RSA	ECC	SHA	TRNG	Code Protect ID	Code Protect ROM	Trusted memory	Area Protection	Memory Protection Unit
RX231/RX23W	✓	✓	✓	–	–	–	✓	✓	✓	–	✓	✓
RX261	✓	✓	✓	–	✓	✓	✓	✓	✓	–	✓	✓
RX26T	✓	✓	✓	–	–	–	✓	✓	✓	✓	✓	✓
RX66T/RX72T	✓	✓	✓	–	–	–	✓	✓	✓	✓	–	✓
RX651/RX65N/RX66N/ RX671/RX72M/RX72N	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

* Provides functionality that shuts down the encryption engine when unauthorized access is detected.

Driver Software: Security IP Custom Driver (TSIP, RSIP*)

- Simple API reduces barriers to implementation.
- Optimized driver for high-speed encryption processing.
- No nondisclosure agreement (NDA) required, free of charge.
- Sample programs for applications such as such as secure boot and secure firmware update simplify development.

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

RX Family Security Evaluation Kits

Start evaluating robust security applications using the Security IP right away.

Board Type	Board Name	Lineup	Supported MCU Group
Standard	Renesas Starter Kit	RSK-RX*	*: RX231, RX23W, RX66T, RX72T, RX65N, RX72M, RX72N, RX671
	Evaluation kit	EK-RX671,EK-RX261	RX671, RX261
LCD	Envision Kit	RX72N Envision Kit	RX72N
IoT	Cloud Kit	CK-RX65N	RX65N
Motor	MCB	MCB-RX26T Type B	RX26T

Tool Service: Security Key Management Tool

This support tool is used to implement key management systems or secure functions that utilize Renesas' security IP module.

- Supports key use (key generation, key injection, key updating) over the life cycle of the product.
- PGP* is used for transfer of keys to ensure security. * PGP (Pretty Good Privacy) is public key encryption–based software that is widely used to encrypt data such as files and emails.
- The Key Wrap Service provides support for secure key injection.
- The Key Wrap Service is automated, so wrapped keys can be generated and supplied immediately.

Renesas Starter Kit


MCB-RX26T Type B


CK-RX65N


RX72N Envision Kit


Evaluation Kit

Ecosystem Partners

Renesas works with partners to deliver simple and robust security solutions.

Company	Products Supplied	Summary	Availability
wolfSSL https://www.wolfssl.com/	Security Layer Library SSL/TLS library with TSIP support Secure bootloader	■ TLS, MQTT, and crypto libraries and middleware ■ SSL/TLS library with TSIP support ■ Secure bootloader with RX72N support	Worldwide
IAR Systems https://www.iar.com/	IAR Embedded Workbench for Renesas RX Embedded Trust, C-Trust, Secure Desktop Provisioner	■ Security development tools ■ Support for integration with IAR Embedded Workbench for Renesas RX	Worldwide
EPS Global https://www.epsprogramming.com/	Secure Provisioning & IC Programming	■ Secure provisioning services at a very competitive price point ■ Supports Renesas Synergy, RA, RL78 and RX families ■ Seamless transition from prototype to high volume	Worldwide
Ubiquitous AI Corporation https://www.ubiquitous-ai.com/en/	Edge Trust Secure IoT device development kits SSL/TLS library with TSIP support	■ Solutions for implementing secure IoT services ■ TLS, HTTP, MQTT, and TCP/IP middleware ■ SSL/TLS library with TSIP support ■ Implementation of device lifecycle management	Worldwide
Veridify https://www.veridify.com/	Veridify Security	■ Security solutions for implementing software ■ Usable with products such as the RX100 that lack TSIP functionality	Worldwide
Trusted Objects https://www.trusted-objects.com/	Tops Plug&Go	■ Secure and automated programming solution for production facilities. ■ Simplify the OEM process for secure programming on RX MCUs ■ Improve the security level of the programming operations	Worldwide

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

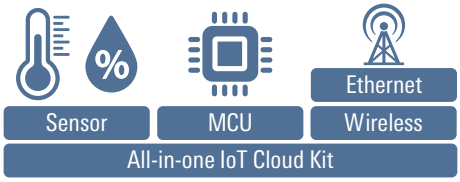
Software and security updates

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

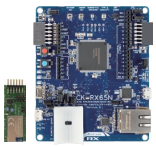
Development Platforms for Cloud (IoT) Devices

Expedite solution development with quick evaluation and proof of concept development.

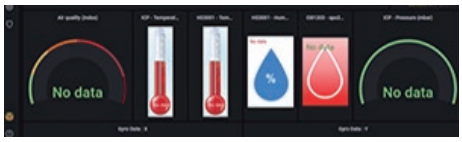
AWS Certified Hardware Environment



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
- Firmware update design guidelines
- AWS FreeRTOS OTA implementation procedure
- IoT device provisioning procedure
- TLS communication using TSIP*

... and many more * Trusted Secure IP

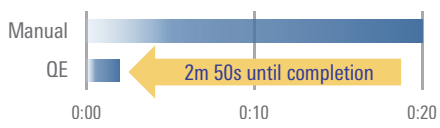
Development Environment that Simplifies and Facilitates IoT Development

e² studio integrated development environment from Renesas
- Smart Configurator
  - Setting configuration for Free RTOS
  - Setting configuration for peripheral functions and pins
- IoT new project generation feature
- QE for OTA development support tool

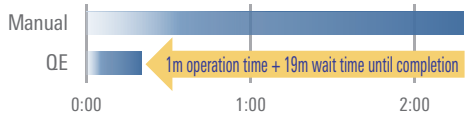
QE for OTA Development Support Tool

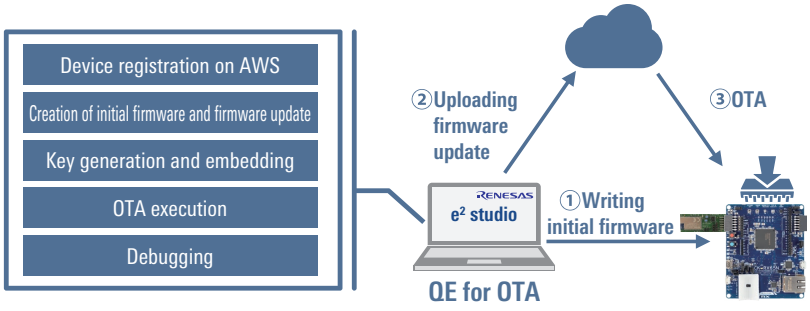
QE for OTA is a development support tool that is available free of charge for developers to implement over-the-air (OTA) firmware updates with a simple and easy graphical user interface. It allows you to reduce the time required until OTA execution by **around 90%**, compared with configuring settings manually.

Time Required to Implement OTA on One Unit



Time Required to Create Initial Firmware for 10 Units





RX FAMILY SOLUTIONS

Capacitive Touch Solutions

RX Capacitive Touch Functionality

- Support for two capacitive touch technologies on a single chip:
  Self-capacitance, which provides high sensitivity and proximity sensing, and mutual-capacitance, which provides superior water resistance.
- Accurate touch input even in harsh environments and excellent design flexibility.
- QE for Capacitive Touch program simplifies development by letting you easily adjust the sensitivity of touch sensors, previously a complex task, and control system operation.

Features	Advantages for the User
High sensitivity/improved noise immunity	Support for thick overlay panels or wood panels, operation when wearing gloves, and air gaps.
Improved water resistance	Enables capacitive touch operation in wet environments or outdoors.
Simple development	The development tool can generate detection programs automatically, provides self-calibration functions to shorten development time, and reduces resource requirements.

	Self-capacitance	Mutual-capacitance
Noise immunity	✓	✓
High sensitivity	✓	–
Water resistance	–/✓*	✓

*: When using active shield

RX Capacitive Touch MCU Lineup

Capacitive touch sensor IP	2nd generation					3rd generation		
MCU	RX113	RX130	RX231/0	RX23W	RX671	RX140	RX261	RX260
	RXv1 32MHz		RXv2 54MHz		RXv3 120MHz	RXv2 48Mz	RXv3 64MHz	
Touch key ch	Max 12ch	Max 36ch	Max 24ch	Max 12ch	Max 17ch	Max 36ch	Max 34ch	Max 36ch
Features	5V, Segment LCDC	5V	5V, Security	5V, Security Bluetooth	Cloud, Connectivity, Security	5V, Security	5V, High power efficiency, CAN FD, USB	5V, High power efficiency
Application	Electric home appliances, measurement, healthcare, OA, portable device, industrial equipment							

Numerals indicate number of touch control channels.

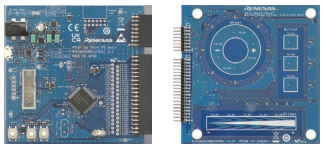
RX113
RX130
RX140
RX230
RX231
RX23W
RX261
RX260
RX671

Flash memory \ Pin	32	48	56	64	80	83	85	100	144	145
2MB		6		8				17	17	17
1.5MB		6		8				17	17	17
1MB		6		8				17	17	17
512KB		24 / 6 / 22 24	8	32 / 10 / 30 32	36 / 34 36	12	12	12 36 / 24 / 34 36		
384KB		24 / 6 / 22 24	8	32 / 10 / 30 32	36 / 34 36	12	12	12 36 / 24 / 34 36		
256KB		24 36 / 6 / 22 24		32 36 / 10 / 30 32	36 / 34 36			12 36 / 24 / 34 36		
128KB		24 36 / 6		32 36 / 10	36			12 36 / 24		
64KB	12	24 12		32 12	36					

Capacitive Touch Evaluation System

Using the board and software that come with the kit, you can get started with evaluation right away.

- Version for RX130 (RTK0EG0003S02001BJ)
- Version for RX140 (RTK0EG0039S01001BJ)
- Version for RX261 (RTK0EG0055S01001BJ)
- Version for RX671 (RTK0EG0044S01001BJ)



Version for RX140 (RTK0EG0039S01001BJ)

[Product Contents]

- CPU board populated with RX130, RX140, RX261 or RX671
- Touch application board
  - Self-capacitance evaluation board
    Supports basic capacitive touch controls, such as switches, sliders, and wheels.
  - Mutual-capacitance evaluation board*1
    Mutual-capacitance matrix keys and self-capacitance proximity sensor
    *1. Version for RX130 only

[Related Information]

- The following items are available on the websites linked to above.
  User's manuals, application notes, sample code, circuit diagrams, pattern diagrams

LCD 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.

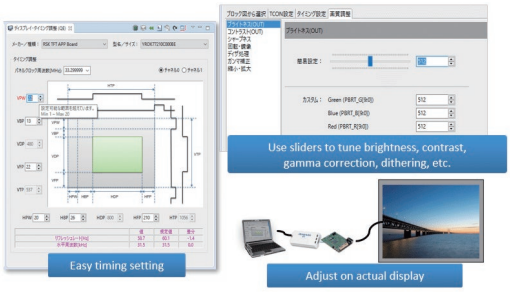
RX72N Envision Kit

Display sample using SPI

QE for Display (e² studio Plugin)

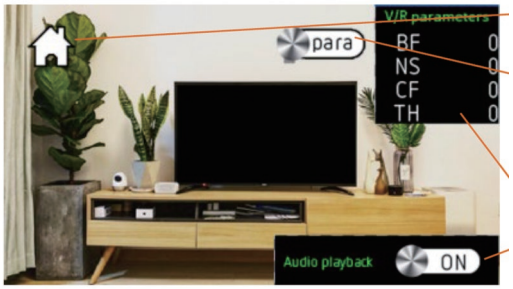
This tool assists in GUI development by simplifying configuration of LCD panel settings and enabling links with GUI tools from Renesas partner vendors.

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.



Voice Recognition Solutions

By making use of voice recognition middleware from Renesas partner vendors developers can facilitate operation triggered by voice commands. With fast response not requiring access to a network and small memory requirements, these solutions make it possible to implement voice recognition even on MCUs with comparatively little on-chip memory, such as the RX200 Series. Support for directional sound collection functionality using a stereo microphone makes possible use even in noisy environments.



RX72N Envision Kit/Renesas Starter Kit+ for RX671 Voice Recognition Demo

- This demo lets the user experience screen transitions triggered by voice commands, noise tolerance, CPU load factors, and more.
- Perform evaluation while making changes to parameters such as threshold and directional strength.
- Demo firmware available on the web can be installed on the kit.
- An (optional) cloud connection function is available that enables synchronizing the operation results of voice commands with a cloud service (RX671 only).

Middleware	Vendor	Type	Applicable Demo
AMI Voice	Advanced Media, Inc.	Voice recognition library	RX72N Envision Kit, RSK+ for RX671
RECAIUS	Toshiba	Voice recognition library	RSK+ for RX671
DSpotter	Cyberon	Voice recognition library	EK-RX671
Zoom Voice	Techno Mathematical Co., Ltd.	Noise suppressor and beam focusing functions	RX72N Envision Kit, RSK+ for RX671

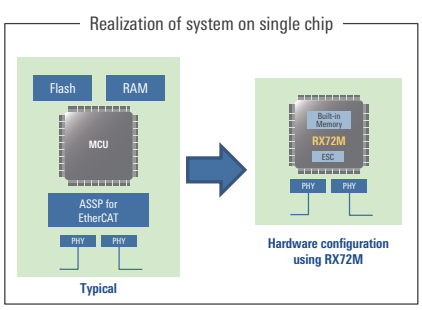
RX FAMILY SOLUTIONS

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.

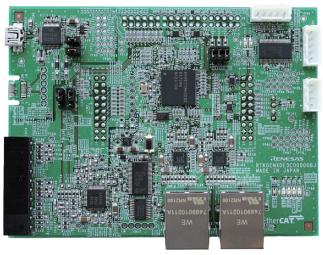
RX72M Network Solutions

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.



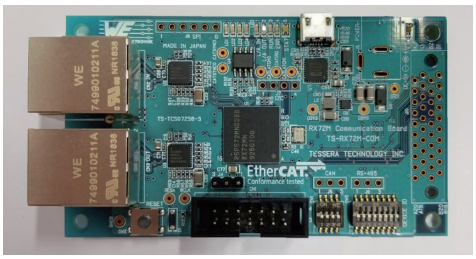
RX72M Network Solution Boards

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.

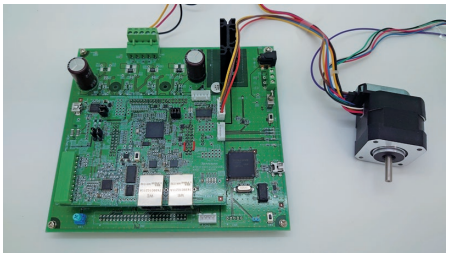


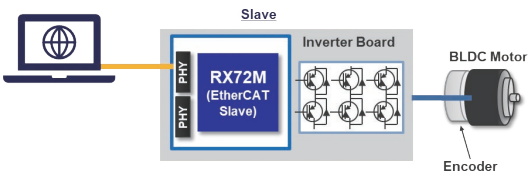
EtherCAT Conformance tested | PI CERTIFIED PROFIBUS • PROFINET | ODVA CONFORMANT

TS-RX72M-COM*

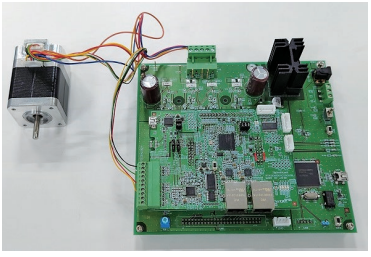
- EtherCAT and 2-channel Ethernet ports (MII)
- RS-485 and CAN transceiver (field network support)
- Conformance tested on three major protocols (EtherCAT®, PROFINET RT, and EtherNet/IP).

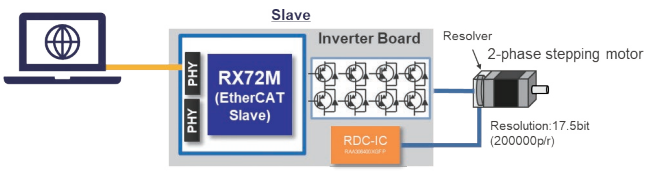
* The TS-RX72M-COM board is available for purchase from Tessera Technology, Inc. For details, please contact your Renesas sales agent.





- 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.

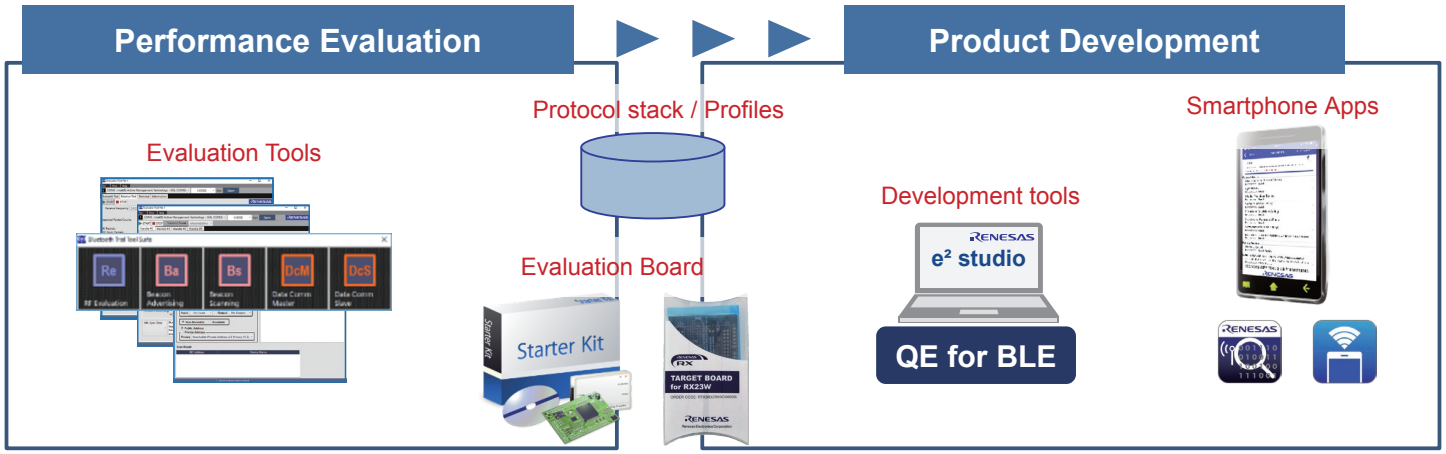




- Vector control for resolver-equipped stepping motors
  By installing resolver vector control software on an RX72M MCU, EtherCAT® communication and resolver-equipped stepping motor control and can be implemented on a single chip.

Bluetooth® Low Energy Solutions

RX Bluetooth solutions deliver industry-top-class power efficiency and smart connections, making them ideal for applications such as healthcare and fitness devices, consumer electronics, and RFID tags. Tools suitable for evaluating functions and performance as well as application development support are available.



Evaluation Boards

Item	Renesas Solution Starter Kit	Target Board for RX23W	Target Board for RX23W module
Device	85-pin RX23W (R5F523W8ADBL: without encryption functions)/ (R5F523W8BDBL: with encryption functions)	56-pin RX23W (R5F523W8ADNG: without encryption functions)	RX23W module (R5F523W8CDLN: without encryption functions) [certified under Radio Law]
Accessories	LCD panel, E2 Emulator Lite	None (However, an emulator is mounted on the board.)	
URL	https://www.renesas.com/RX23W-Starter-Kit/	https://www.renesas.com/RTK5RX23W0C00000BJ/	https://www.renesas.com/RTK5RX23W0C01000BJ/

Protocol Stacks

Bluetooth Low Energy Protocol Stack (FIT)

This FIT module consists of a Bluetooth LE–conformant protocol stack and application development support software. It can be combined with Bluetooth profiles generated by QE for BLE to reduce the development time required for a wide range of applications. Additional support for application development is available in the form of sample programs using the protocol stack and a development guide.

Bluetooth Mesh Stack for RX Family

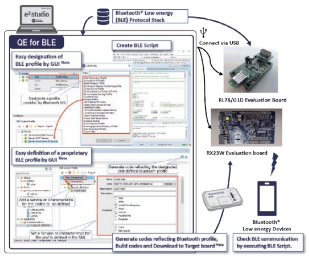
The Bluetooth Mesh Stack can be used to create a secure mesh network conforming to the Bluetooth Mesh networking standard. All mesh models are supported, so a variety of applications can be accommodated. In addition to sample programs compatible with the evaluation board for RX23W, there is also a sample smartphone application for network configuration.

Development Support Tools

Bluetooth Low Energy Development Support Tool: QE for BLE

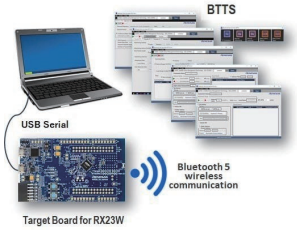
This tool runs on the e2 studio integrated development environment and provides support for system development using the Bluetooth Low Energy protocol stack.

- Create custom profiles.
- Check Bluetooth LE communication.



Bluetooth Test Tool Suite (BTTS)

This Windows application provides a GUI for controlling the RX23W. It can help users evaluate Bluetooth functions and better understand the APIs provided with the protocol stack. BTTS also can be used as a tool for controlling devices undergoing certification testing under the Radio Law.

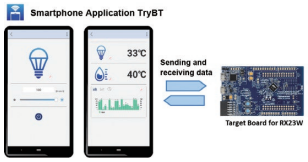


iOS/Android Application: GATTBrowser

GATTBrowser is a smartphone app for verifying the operation of Bluetooth LE applications developed using the RX23W. It can also connect to and transfer data with commercially available products that support Bluetooth LE.

Smartphone Sample Application: TryBT

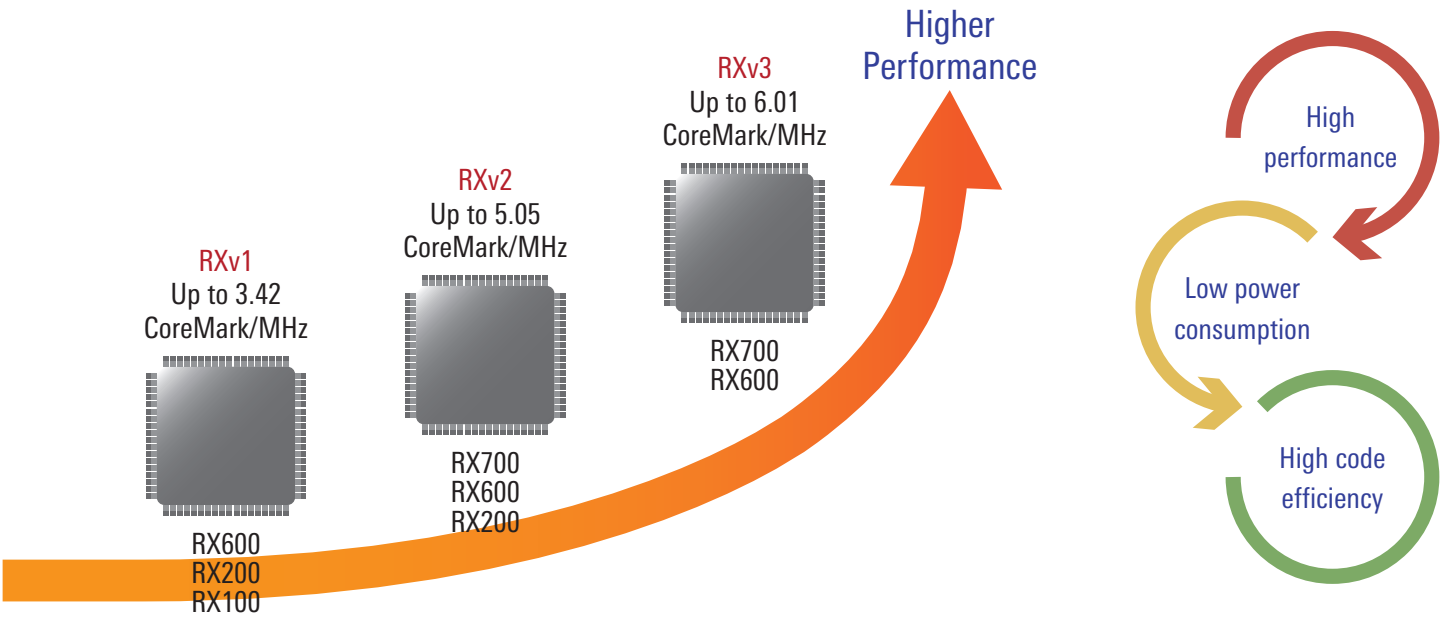
TryBT is supplied as a project that can be used as a basis for developing smartphone applications by modifying its operation and design elements. In its initial form TryBT can be used to test communication with the software preinstalled on the target board.



RX CORE FEATURES

RX Core Roadmap

The need for increasing added value and system complexity demands higher microcontroller performance. At the same time, energy saving and longer battery life is also needed, so lower power consumption is also demanded. The RX core continues to evolve even further to meet these demands.



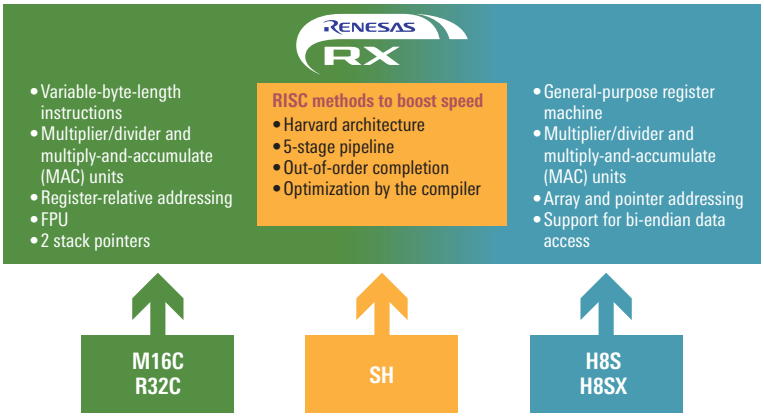
Comparison of RX Cores

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

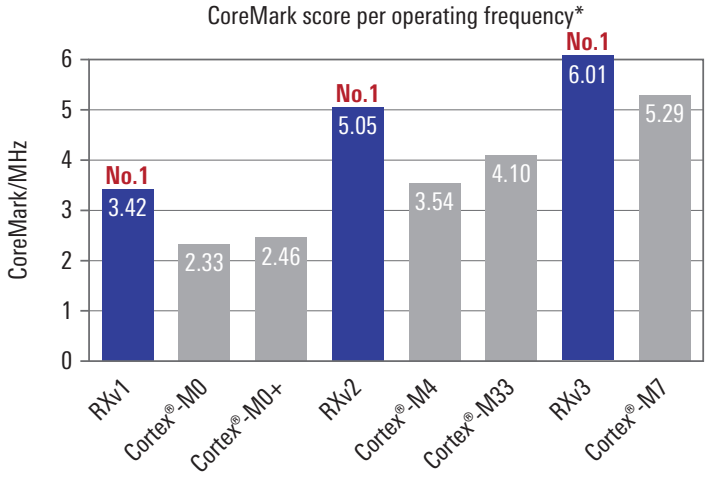
Feature 1: Original CPU That Inherits the Strengths of Its Predecessors

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.

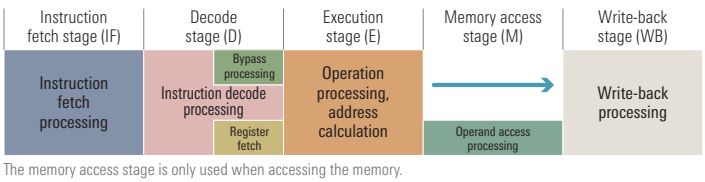
* Cortex®-M is the nominal value of Arm

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

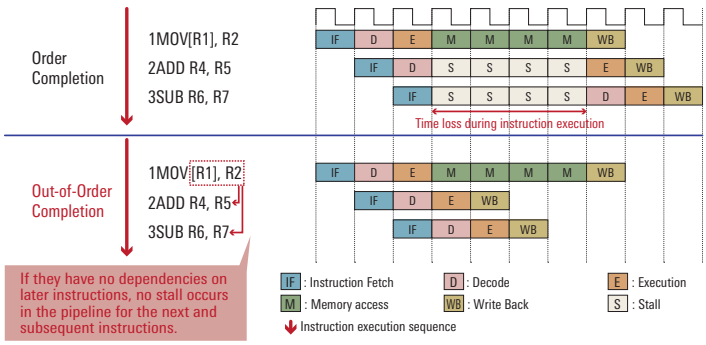
- 5-stage pipeline for faster processing
- Through benchmark testing of various types of application software, processing performance was more than doubled compared with earlier products.



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.



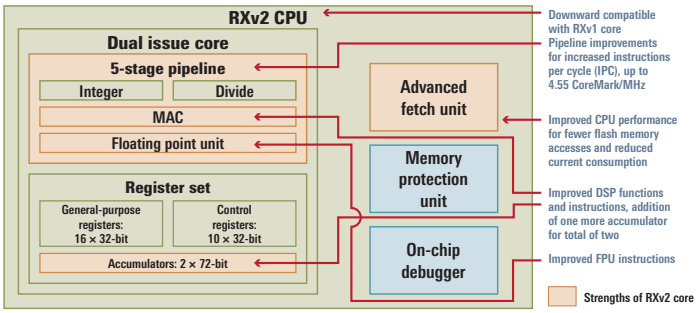
RXv2 CORE FEATURES

RXv2 Core: CPU Block Diagram

Further enhancements while maintaining compatibility with the RXv1 core

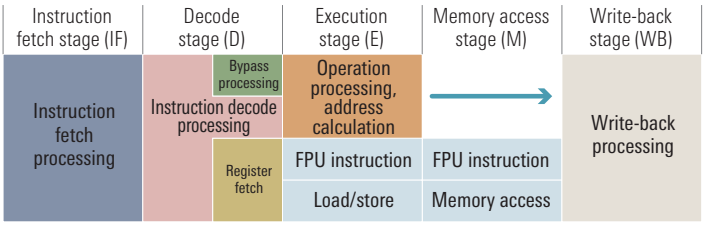
- Improved pipeline for substantial increase in the number of instructions per cycle (IPC)
- Advanced fetch unit with improved interface to on-chip flash memory. Reduces re-fetching of instructions due to penalty imposed by branch instructions and reduces the number of flash memory accesses. Achieves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

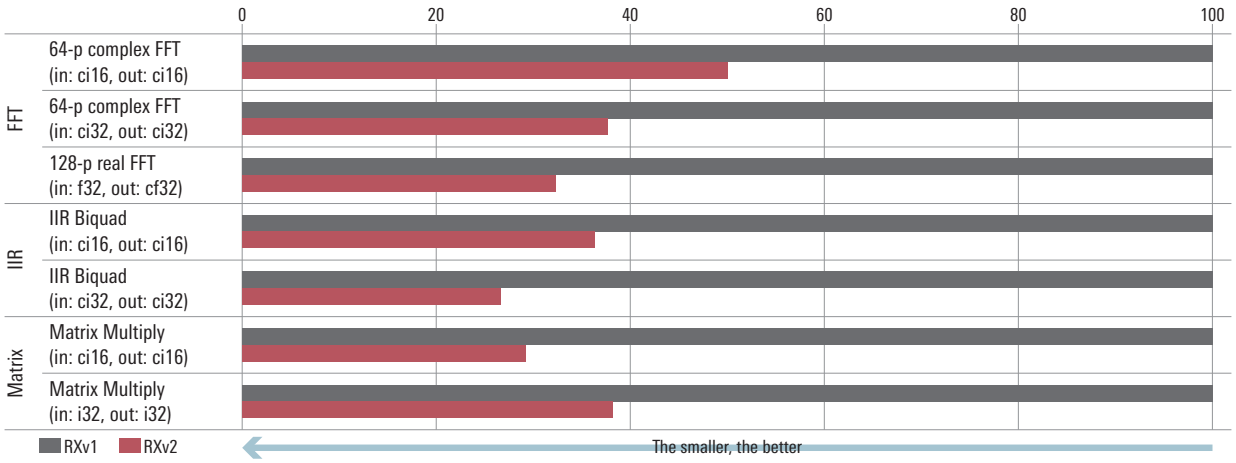
Improved pipeline processing and parallel execution of floating-point operations

- 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

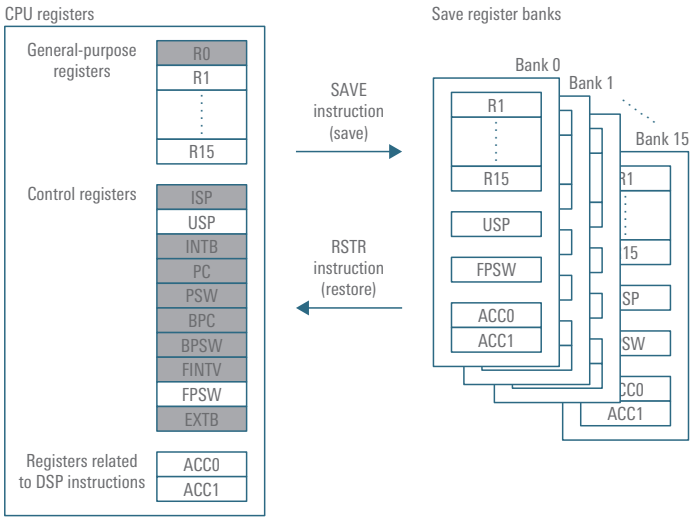
The successor to the RXv2 core, the RXv3 core boosts performance with new functions while adding a double-precision FPU and a register bank save function. These improvements enable it to achieve a score of 5.82 CoreMark/MHz on the EEMBC CoreMark® benchmark test, among the best CPU performance levels in the industry. The RXv3 core contributes to extremely fast and efficient operations in a wide array of applications requiring realtime processing.

Feature 1: Register Bank Save Function

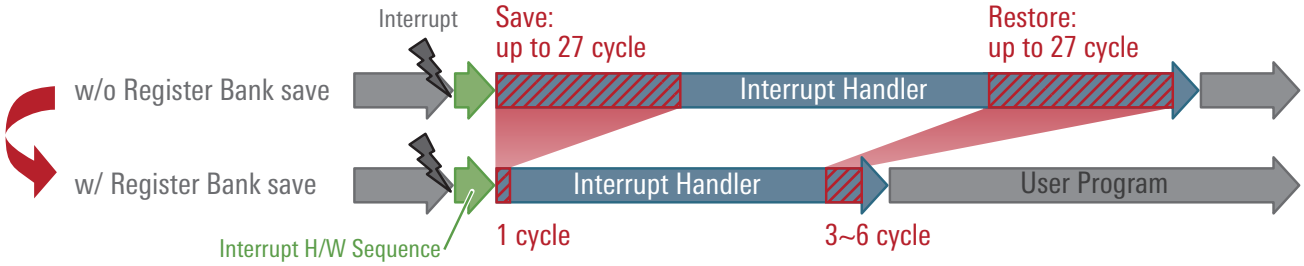
Dedicated memory for improved interrupt responsiveness

- 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.

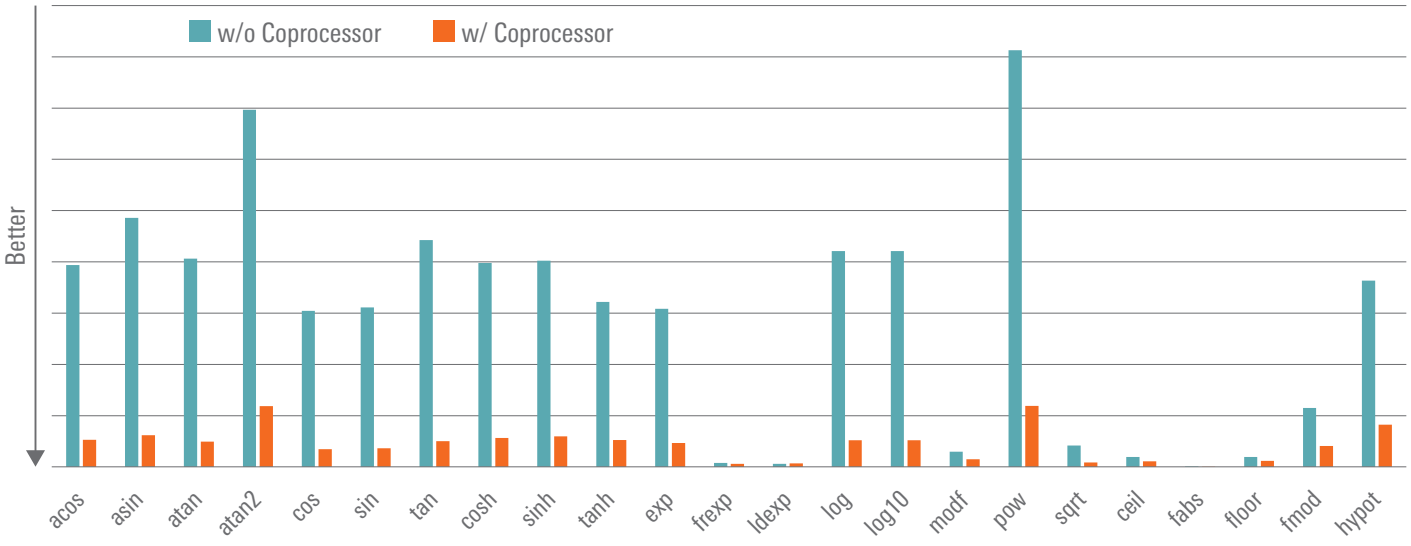


Comparison with conventional product (saving data to all registers)



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).



RX700/RX600 SERIES (Industrial/Appliances/Office Equipment/ICT)

Features of RX700/RX600 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

Main Applications of RX700 and RX600 Series

Industrial

Robots, Machine tools
General-purpose inverters
PLC
Smart meter
Power conditioner
HVAC controller
Security controller

Office Automation

Copiers
Printers
Projector

Consumer

Camera body
Lens
Air conditioner (outdoor unit, indoor unit)
Audiovisual equipment

Lineup of RX700 and RX600 Series

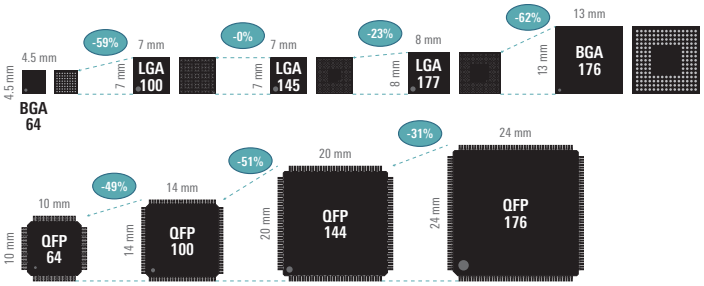
RX72M	240MHz, 4MB Flash, 1MB SRAM 100/144/176/224-pin	RXv3	Double precision FPU	Trigonometric functions arithmetic unit	Ethernet IEEE1588	I^2S	TFT LCD	EtherCAT slave
RX72N	240MHz, 4MB Flash, 1MB SRAM 100/144/145/176/224-pin	RXv3	Double precision FPU	Trigonometric functions arithmetic unit	Ethernet IEEE1588	I^2S	TFT LCD	
RX66N	120MHz, 4MB Flash, 1MB SRAM 100/144/145/176/224-pin	RXv3	Double precision FPU		Ethernet	I^2S	TFT LCD	
RX671	120MHz, 2MB Flash, 384KB SRAM 48/64/100/144/145-pin	RXv3	Double precision FPU			I^2S	Capacitive touch	
RX65N/ RX651	120MHz, 2MB Flash, 640KB SRAM 64/100/144/145/176/177-pin	RXv2	Single precision FPU		Ethernet		TFT LCD	
RX65W-A	120MHz, 2MB Flash, 640KB SRAM 145-pin	RXv2	Single precision FPU		Ethernet			Wi-SUN
RX660	120MHz, 1MB Flash, 128KB SRAM 48/64/100/144-pin	RXv3	Single precision FPU					CAN-FD, 5V

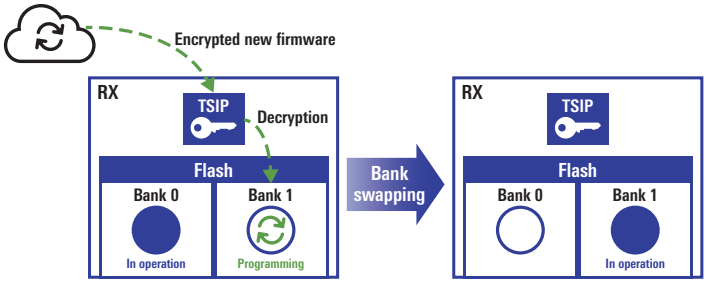
Common functions
- Dual bank*1
- USB*1
- CAN*2
- SD host I/F*1
- Quad SPI*1
- Security*1
- 12-bit ADC

*1: Not implemented on RX660.
*2: Not implemented on RX65W.

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

- 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

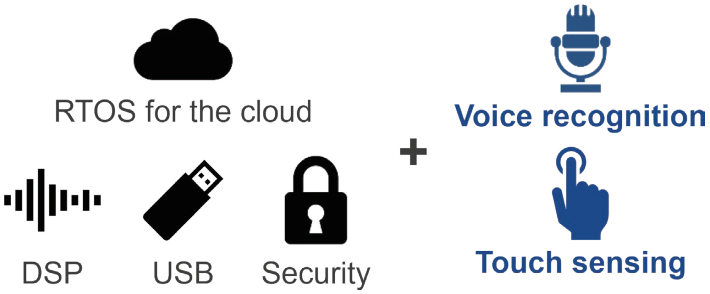
With the exception of 176- and 177-pin products, all packages are available with flash memory capacities from 512KB to 2MB (1.5MB or 2MB only for 176- and 177-pin products).

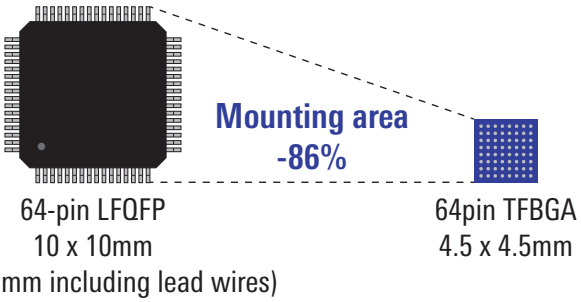
FOTA Solutions Bringing New Added Value

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.

RX671: Support for Superior Power Efficiency, Hygienic User Interfaces, and Cloud-Connected IoT Applications

- 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

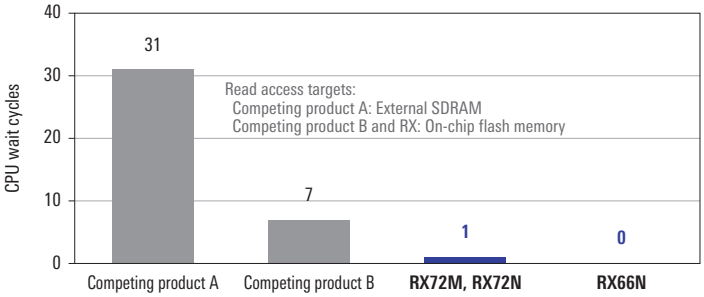
A single-chip solution that supports larger memory requirements of communication protocol stack processing and accommodating an RTOS to enable operation processing on contactless UI devices.

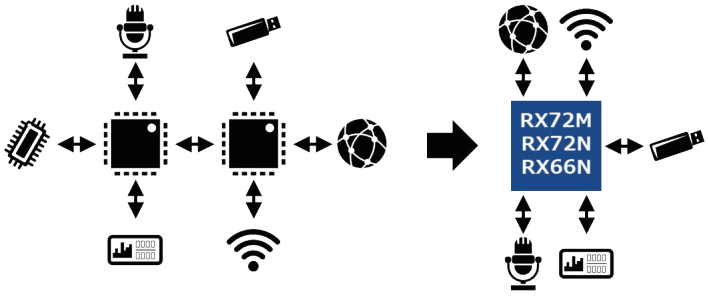
High-Performance CPU and Large Memory Capacity in an Ultracompact 4.5 × 4.5mm Standard Package

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

RX72M, RX72N, and RX66N: 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 RX72M and RX72N there is only one wait cycle when a cache miss occurs.
On the RX66N there generally are no wait cycles.

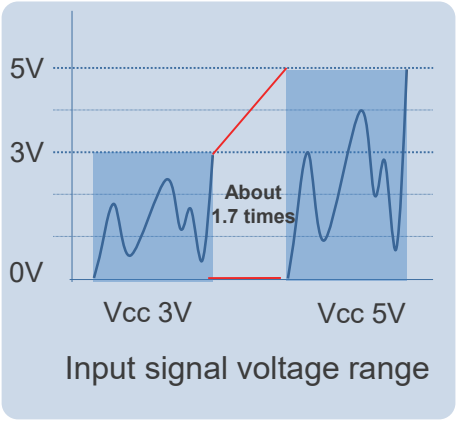
Multifunctionality and Compact Size

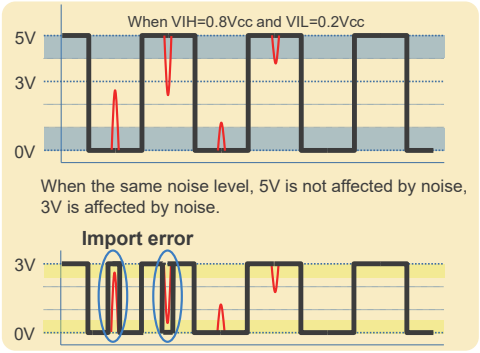
4MB flash memory, 1MB SRAM, and 182 general-purpose I/O ports on a single chip.

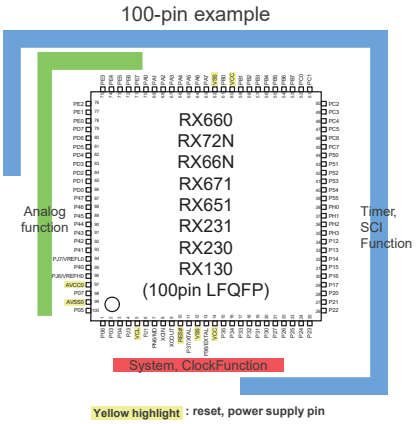
RX700/RX600 SERIES (Industrial/Appliances/Office Equipment/ICT)

RX660: 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

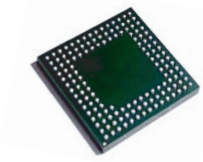
Pin compatibility with previous-generation products such as the RX210 makes it possible to switch to the latest high-performance CPU core while minimizing the system configuration burden.

RX65W-A: Wi-SUN FAN 1.1 Conformant Sub-GHz Communication MCU

- Conforms to the latest Wi-SUN FAN Profile: Wi-SUN FAN 1.1
- Support for two modulation methods: OFDM and FSK (max. 2.4Mbps)
- Support for main sub-GHz bands: US, EU, JP, and BR bands*
- Industry-top-class RF reception sensitivity: -109dBm in 50kbps SUN FSK
  -119dBm in 12.5kbps SUN OFDM

* Supported frequency bands
European band: 863-876MHz
American band: 902-928MHz
Japanese band: 920-928MHz
Brazilian band: 902.0-907.5, 915.0-928.0MHz

RENESAS RX + Wi SUN + compact package =



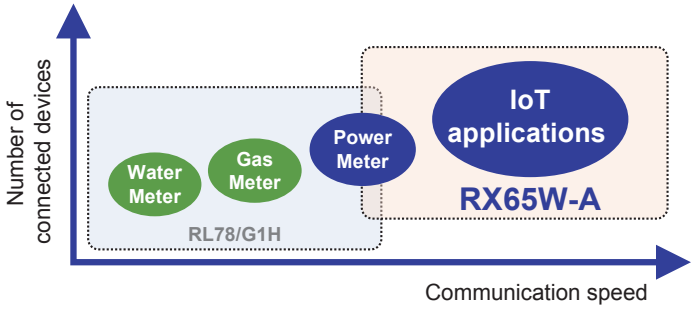
Large Memory:
ROM 2MB, RAM 640KB

Renesas is a board member of the Wi-SUN Alliance.

145pin TFBGA
8 x 8mm

The Wi-SUN FAN sub-GHz wireless communication standard provides *high signal reachability, long-distance communication over a multi-hop mesh network*, and a *network automatic rebuild function yielding stable communications*. Its use is growing in smart meters for electricity, gas, and water systems. Wi-SUN FAN is expected to be adopted and its market to expand as a means of linking IoT devices of all kinds as our smart society develops.
The RF firmware and Wi-SUN FAN 1.1 protocol software stack for the RX65W-A, as well as development tools and reference designs, provide support for customers developing IoT systems and making the smart society a reality.

Visualization of Target Applications



MEMO

RX200 SERIES (Industrial/Appliances/Office Equipment/ICT)

Features of 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

Main Applications of RX200 Series

Consumer (battery drive)

Digital cameras
Gadgets

Healthcare

Wearable devices
Blood glucose meter

Industrial

Power meters
Pressure, temperature,
and flow volume meters, Inverters

Home appliances

Air conditioners
Refrigerators
Washing machines

Lineup of RX200 Series

RX261 64MHz, 512KB Flash, 128KB SRAM

RXv3	Single precision FPU	CAN FD	USB	Capacitive touch	Security

RX260 64MHz, 512KB Flash, 128KB SRAM

RXv3	Single precision FPU			Capacitive touch	Security

RX231 54MHz, 512KB Flash, 64KB SRAM

RXv2	Single precision FPU	CAN	USB	Capacitive touch	Security

RX230 54MHz, 256KB Flash, 64KB SRAM

RXv2	Single precision FPU			Capacitive touch	

RX23W 54MHz, 512KB Flash, 64KB SRAM

RXv2	Single precision FPU	CAN	USB	Capacitive touch	Security	Bluetooth

RX200 Series Memory/Pin Lineup

	RX23W			RX231 / RX230			RX261/RX260			
Flash size	56-pin	83-pin	85-pin	48-pin	64-pin	100-pin	48-pin	64-pin	80-pin	100-pin
512KB	●	●	●	●	●	●	●	●	●	●
384KB	●	●	●	●	●	●	●	●	●	●
256KB				● ●	● ●	● ●	●	●	●	●
128KB				● ●	● ●	● ●				

Pin

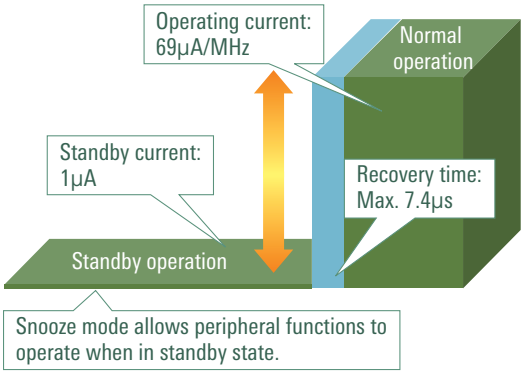
● RX261/RX260
● RX23W
● RX231
● RX230

RX261/RX260 Concept

Power efficiency and performance	69µA/MHz during CPU operation, 1.0µA in standby mode Snooze mode that allows peripheral functions to operate during standby without activating the CPU First RX200 Series product with RXv3 CPU core (max. operating frequency: 64MHz) 355 CoreMark score, 1.4 times that of preceding product
Advanced capacitive touch	New-generation capacitive touch IP (CTSU2SL) combining high sensitivity with superior noise immunity
Highly reliable high-speed communication and security	Support for CAN FD, USB full-speed, and RSIP-E11A (AES, ECC, and SHA)
Excellent compatibility	5V operation, 12-bit A/D converter, RTC, etc., with functional- and pin-compatibility with conventional products

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	RX231	RX261/RX260
	CTSU	CTSU2SL
Radiated noise immunity (IEC/EN61000-4-3)*1	Level 3	Level 4
Conductive noise immunity (IEC/EN61000-4-6)*1	Level 3	Level 3
Pins for shielded electrode drive	Not supported	Supported
Smart wakeup (auto-sensing and multi-scan)	Not supported	Supported

*1: Uses capacitive touch evaluation system.

Powerful Security Functions

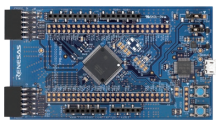
An array of security functions help protect user assets.

			RX231 (TSIP-Lite)	RX261 (RSIP-E11A)
Hardware Security IP	Key management function		✓	✓
	Access management circuit		✓	✓
	Cryptographic functions	AES	✓	✓
		ECC	–	✓
		SHA	–	✓
	TRNG		✓	✓
Memory protection functions	Area protection		✓	✓
	Area protection unit		✓	✓
	Code protect		✓	✓

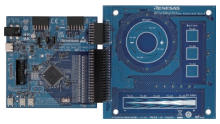
Evaluation Boards

Select the evaluation board that best meets your requirements.

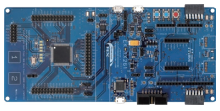
FPB-RX261
Ideal for initial prototyping.
Pmod × 2
Arduino Uno × 1



RSSK-RX261
Ideal for evaluation of capacitive touch applications.
Touch interface × 34 channels
Pmod ×2



EK-RX261
Ideal for evaluation of a full range of functions.
Touch interface × 2 channels
Pmod × 2
Arduino Uno × 1
CAN FD
Grove × 2
Qwiic × 1
mikroBUS × 1
USB FS host/function



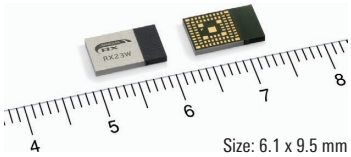
RX23W Concept and Platform

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® = RX23W

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

RX100 SERIES (Industrial/Appliances/Office Equipment/ICT)

Features of 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

Main Applications of RX100 Series

Consumer (battery drive)

Sensor hubs
(smartphones, game consoles, PCs, tablets),
digital cameras, digital camcorders

Healthcare

Healthcare devices,
wearable devices

Home appliances

Cooking appliances,
water heaters

Industrial

Power meters,
detectors (smoke detectors, etc.),
pressure gauges, thermostats

Lineup of RX100 Series

RX140 48MHz, 256KB Flash, 64KB SRAM

RXv1 | 12-bit A/D | CAN | Capacitive touch | 5V | Security*

*AES/TRNG

RX130 32MHz, 512KB Flash, 48KB SRAM

RXv1 | 12-bit A/D | Remote control receiver circuit | Capacitive touch | 5V

RX113 32MHz, 512KB Flash, 64KB SRAM

RXv1 | 12-bit A/D | USB | Segment LCD | Capacitive touch

RX111 32MHz, 512KB Flash, 64KB SRAM

RXv1 | 12-bit A/D | USB

RX110 32MHz, 128KB Flash, 16KB SRAM

RXv1 | 12-bit A/D

RX100 Series Memory/Pin Lineup

	3.3V + USB				RX113		5V + Touch					
Flash size	36	40	48	64	64	100	32	48	64	80	100	Pin
512KB			●	●	●	●		●	●	●	●	
384KB			●	●	●	●		●	●	●	●	
256KB			●	●	●	●		● ●	● ●	● ●	●	
128KB			● ●	● ●	●	●		● ●	● ●	● ●	●	
96KB			● ●	● ●								
64KB	● ●	● ●	● ●	● ●			●	● ●	● ●	●		
32KB	● ●	● ●	● ●	● ●								
16KB	● ●	● ●	● ●	● ●								
8KB	●	●										

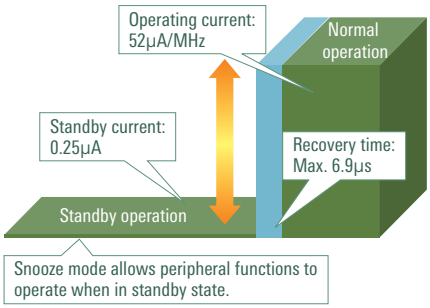
● RX140
● RX130
● RX113
● RX111
● RX110

RX140 Concept

Advanced ultralow power consumption	52µA MHz when CPU operating, 0.25µA in standby mode More than 30% lower power consumption than preceding product (RX130) Addition of snooze mode, allowing peripheral functions to operate in standby mode while CPU is idle
Highest performance in the series	First RX100 Series MCU with RXv2 CPU core (max. operating frequency: 48MHz) 204 CoreMark score, double that of preceding product
Advanced capacitive touch	New-generation capacitive touch IP (CTSU2SL) combining high sensitivity with superior noise immunity
Stronger security	Hardware security functions (AES and true random number generator)
High compatibility	5V operation, 12-bit A/D converter, RTC, etc., with functional- and pin-compatibility with conventional products

Advanced Ultralow Power Consumption

- Ideal for battery-powered applications



- Ultralow current consumption during both standby and normal operation
- Fast recovery from standby to normal operation
- Snooze mode contributes to improved power efficiency for the entire system (touch measurement, reception of serial data, A/D conversion).

Advanced Capacitive Touch

Capacitive Touch IP	Advantages	RX130	RX140	
		CTSU	CTSU2L*1	CTSU2SL*2
Radiated noise immunity (IEC/EN61000-4-3 equivalent)*3	Reduction in malfunctions due to radiated noise	Level 3	Level 4	Level 4
Conductive noise immunity (IEC/EN61000-4-6 equivalent)*3	Reduction in malfunctions due to conductive noise	Level 3	Level 3	Level 3
Pins for shielded electrode drive	Improved water resistance	Not supported	Supported	Supported
Smart wakeup (auto-sensing and multi-scan)	Reduced power consumption	Not supported	Not supported	Supported

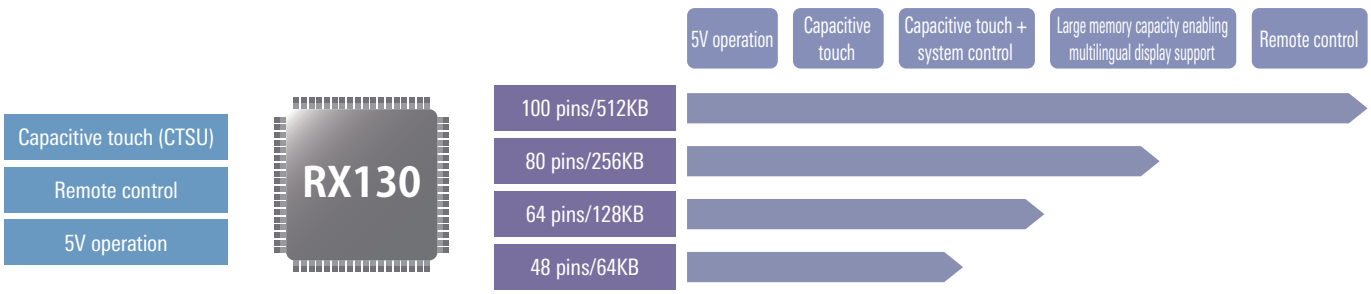
*1. Versions with 64KB of flash memory only
*2. Versions with at least 128KB of flash memory only
*3. Using capacitive touch evaluation system

Excellent Compatibility

- Low-pin-count/small ROM included in lineup of products
- Reduced BOM cost due to integration of peripheral IC functions
- Excellent compatibility across RX Family for reduced development cost with other RX products

RX130 Concept

Support for Development of Diverse Devices with Product Lineup Extending up to 512KB of Flash Memory and 100-pin LQFP Package



RX-T (for Motor Control)

Features of RX-T (for Motor Control)

Broad lineup

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

5V power supply support External bus

5V power supply support
External bus

Analog circuit to extract full performance potential

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

Specialized motor control functions

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

Main Applications of RX-T (for Motor Control)

Industrial

Robots, Machine tools

General-purpose inverters

Meters

Building automation

Office Automation

Copiers
Printers

Home appliances

Air conditioners
Refrigerators
Washing machines

Product Lineup of RX-T (for Motor Control)

RX72T

200MHz, 1MB Flash

RXv3	Single precision FPU	Motors 3 to 4	Pseudo-differential PGA	Register bank save	Trigonometric functions arithmetic unit	CAN	USB	Security

RX66T

160MHz, 1MB Flash

RXv3	Single precision FPU	Motors 3 to 4	Pseudo-differential PGA			CAN	USB	Security

RX26T

120MHz, 512KB Flash

RXv3	Single precision FPU	Motors 2	PGA	Register bank save	Trigonometric functions arithmetic unit	CAN FD	Security	Dual bank

RX24U

80MHz, 512KB Flash

RXv2	Single precision FPU	Motors 2 to 3	Pseudo-differential PGA			CAN		

RX24T

80MHz, 512KB Flash

RXv2	Single precision FPU	Motors 2 to 3	PGA			CAN		

RX23T

40MHz, 128KB Flash

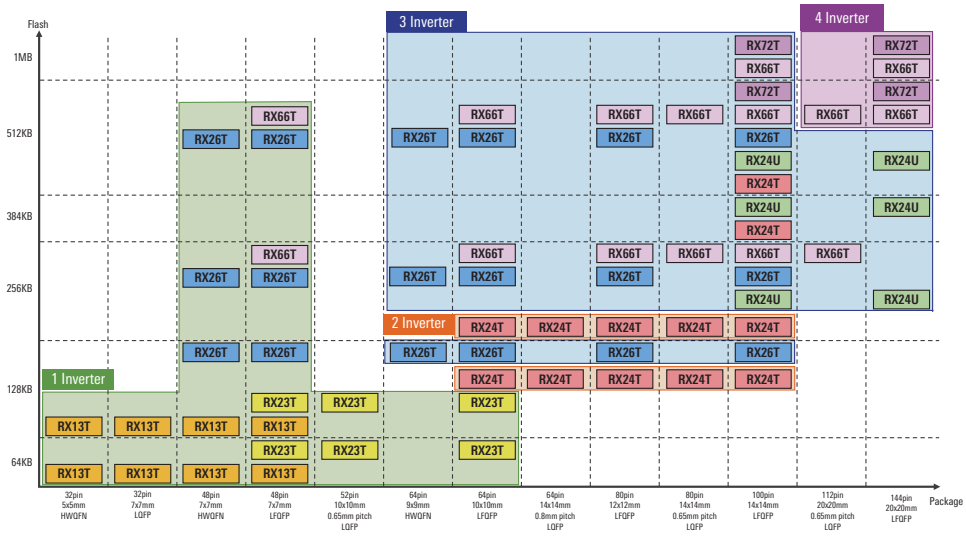
RXv2	Single precision FPU	Motors 1						

RX13T

32MHz, 128KB Flash

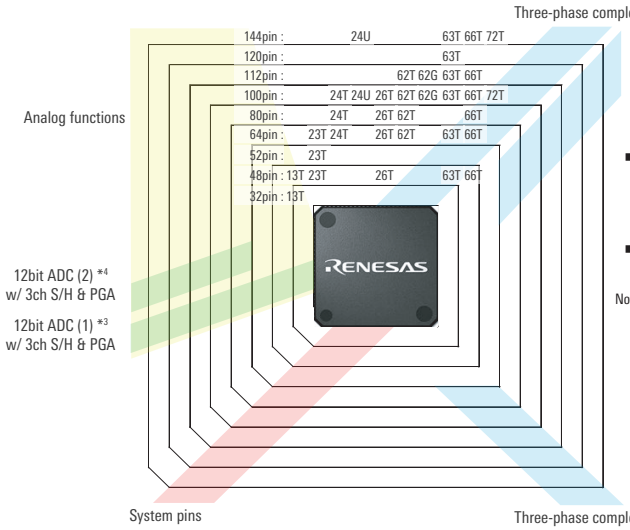
RXv1	Single precision FPU	Motors 1	PGA					

Product Lineup of RX-T (for Motor Control)



Note: The x in "x Inverter" represents the maximum number of units to which 3-phase complementary PWM output can be supplied.

Allocation of Resources Specially for Motor Control

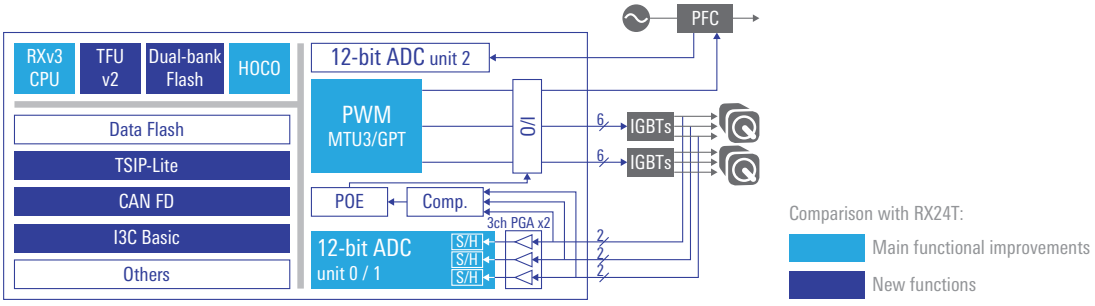


- Pin assignments that simplify design and layout
  - Six pins for three-phase complementary PWM output arranged side-by-side.
  - A/D converter input pins (with simultaneous three-channel sample-and-hold support) arranged side-by-side by unit.
- Consistent approach to motor control–related pin assignments across all RX devices designed for motor control

Notes: 1. Pin assignments provided on RX24T/U, RX26T, RX62T/G, RX63T (some product versions), RX66T, and RX72T.
2. Pin assignments provided on products with GPT, except RX62T 64-pin products.
3. PGA function provided on all products, except RX23T and RX63T (some product versions).
4. Pin assignments provided on RX26T, RX62T/G, RX63T (some product versions), RX66T, and RX72T.

RX26T: Ideal for 2-Motor Control and PFC Control

- RXv3 CPU core operating at 120MHz (721 CoreMark score), flash memory with 120MHz read operation, and Arithmetic Unit for Trigonometric Functions (TFU) for excellent computing performance and realtime performance enabling highly efficient motor or inverter control
- Retains the 5V power supply in high demand for motor applications for its high noise tolerance and ample analog input dynamic range.



Single-Chip Implementation of 2-Motor + PFC Control

120MHz PWM (2 channels for 3-phase complementary output + 2 channels for single-phase complementary output) timer, 12-bit ADC × 3 units, 3-channel simultaneous sample and hold circuit × 2 units

Latest Communication Standards and Improved Functions for IoT Technology

Latest Communication functions I3C BASIC and CAN FD, dual-bank flash memory, and security functions (TSIP-Lite)

RX-E (for Sensor Measurement)

Features of RX-E (for Sensor Measurement)

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
I^2C

Main Applications of RX-E (for Sensor Measurement)

Temperature

Resistance temperature detectors
Thermocouples
Temperature controllers
Peltier coolers

Strain

Load cells
Weight scales
Force sensors
Torque sensors

Pressure and flow

Pressure gauges
Pressure calibrators
Electropneumatic regulators
Flow meters
Mass flow controllers

Data acquisition

Data loggers
Recorders
Analog input modules
Digital multimeters

Product Lineup of RX-E (for Sensor Measurement)

RX23E-A 32MHz, 256KB Flash

RXv2	Single precision FPU	24 bit delta-sigma × 2 units	Fully-differential PGA	Excitation current source × 4 channels	Integrated voltage reference source	BIAS voltage generator circuit	On-chip temperature sensor

RX23E-B 32MHz, 256KB Flash

RXv2	Single precision FPU	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

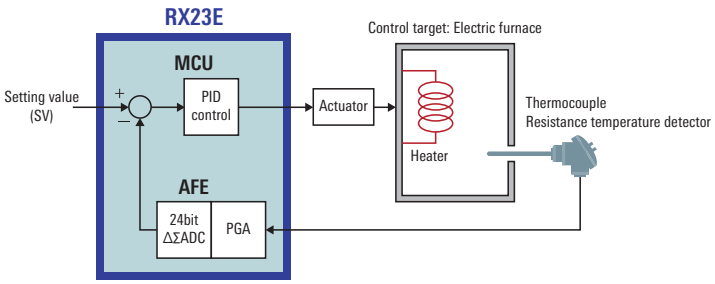
Product Lineup of RX-E (for Sensor Measurement)

			RX23E-A		RX23E-B					
24bit Δ-Σ A/D converter			40-pin	48-pin	40-pin	48-pin	64-pin	80-pin	100-pin	Pin
Max. Date rate	Analog input voltage range	Unit								
125ksps	+/-10V & 5V	1			●		●		●	
	5V				●	●	●	●		
31.25ksps	5V				●	●	●	●	●	
15.6ksps	5V	2	●	●						
		1	●	●						

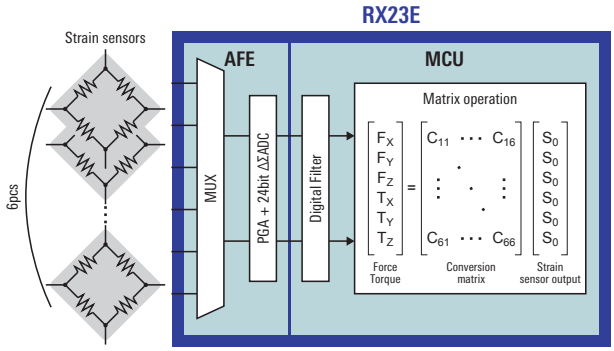
● RX23E-A
● RX23E-B

High-Precision AFE and MCU on a Single Chip

- High-precision AFE optimized for temperature and strain measurement in the industrial field
- High-performance MCU suitable for implementation of correction processing and digital signal processing
- Variety of communication interfaces enabling flexibility in system and board design



Application example: Temperature control

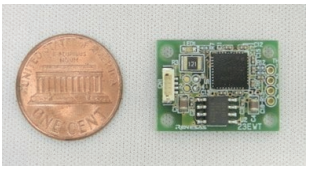


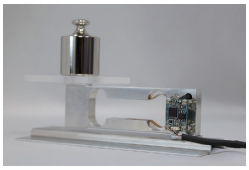
Application example: 6-axis force sensor

Sensor Measurement Reference Designs Using RX-E

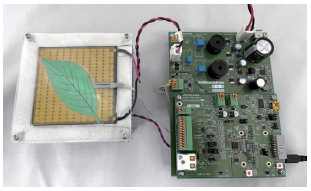
Tiny Board for Digital Load Cell

This reference design employs the RX23E-A or RX23E-B MCU with on-chip high-precision AFE to implement a digital load cell. Using the RX23E-A or RX23E-B eliminates the need for a dedicated AFE, allowing use of a smaller board. The reference design uses a compact board (22mm × 16mm) small enough to allow integration into the load cell.



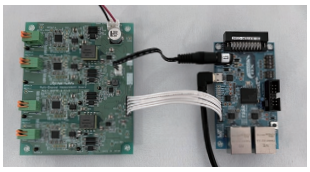


Peltier Cooler



This reference design employs the RX23E-A MCU with on-chip high-precision AFE to implement a Peltier cooler. Peltier coolers utilizes a phenomenon known as the Peltier effect to implement temperature controllers capable of both heating and cooling, and they are used in a wide range of temperature control applications. Using the RX23E-A makes it possible to use a single chip to implement the measurement, calculation, and control functions necessary for Peltier cooler temperature control.

CH-to-CH Isolated Analog Measurement System



This is a reference design of a system employing four RX23E-A MCUs on mutually isolated channels to simultaneously measure temperature and voltage. The reference design makes use of the RX23E-A MCUs with on-chip high-precision AFE to implement distributed processing. It is ideal for applications with multiple analog inputs such as analog input modules, temperature controllers, recorders, and data acquisition.

Force Sensor

This reference design employs the RX23E-B to implement a 6-axis force sensor. Such a 6-axis force sensor would typically be installed in a location such as the tip of a robotic arm. It is composed of six strain sensors that measure load and torque on the x-, y-, and z-axes, a total of six values. Using the RX23E-B makes it possible to use a single chip to implement the A/D conversion and matrix processing necessary for 6-axis force sensor measurement.

RX-E Evaluation Board (Renesas Solution Starter Kit)

This Renesas Solution Starter Kit (RSSK) is an evaluation kit that supports deployment of RX-E Series MCUs. The RSSK comprises an evaluation board populated with the RX-E and peripheral circuits for sensor measurement, a GUI tool, and related application notes. It enables evaluation of an AFE, including the sensors needed for deployment, without the need to develop software.

Item	Renesas Solution Starter Kit for RX23E-A	Renesas Solution Starter Kit for RX23E-B
Device	RX23E-A 40pinQFP (R5F523E6ADFL)	RX23E-B 100pinQFP (R5F523E6LDFP)
Related application notes	■ Temperature Measurement Example Using a Thermocouple (R01AN4747) ■ Temperature Measurement Examples Using Resistance Temperature Detectors (R01AN4788) ■ Weight Measurement Example Using a Load Cell (R01AN4789) ■ Force Sensor Measurement Example (R01AN5447)	■ Example of 4-20mA transmitter using built-in D/A converter (R01AN6518) ■ Example of weight measurement using AC excited load cell (R01AN6517)

RX FAMILY MOTOR CONTROL

Motor Types and Recommended Microcontrollers

	Consumer/office equipment				Industrial					
	 Air conditioners	 Washing machines	 Refrigerators	 Printers/ multifunction units	 Pumps	 Fans	 Surveillance cameras	 General-purpose inverters	 Robots/ machine tools/ industrial motors	 AC servos
Motors	BLDC IM	BLDC IM	BLDC IM	BLDC STM	BLDC IM	BLDC IM	BLDC STM	BLDC IM	BLDC STM	BLDC
Recommended microcontrollers	RX200 RX600	RX100 RX200 RX600	RX100 RX200	RX100 RX200 RX600	RX100 RX200	RX100 RX200	RX100 RX200 RX600	RX200 RX600 RX700	RX100 RX200 RX600 RX700	RX600 RX700

BLDC: Brushless DC motor, IM: AC induction motor, STM: Stepping motor

Motor Types, Control Methods, and Recommended RX Series

Motor type	Control method	Necessary functions	Performance required by application and recommended RX microcontroller			
			Up to 20MHz	Up to 50MHz	Up to 100MHz	Over 100MHz
			RX100	RX200	RX600	RX700 RX600 RX200 (RX26T)
Brushless DC motor	Vector control (180-degree conducting control)	PWM × 6, dead time generation, POE, A/D converter (PWM link)	Compact industrial motors	Compact robots, surveillance cameras, general-purpose inverters, printers/multifunction units		General-purpose inverters, machine tools, industrial robots, AC servos
				Washing machines (1-motor), refrigerators (1-motor), pumps, compressors	Air conditioner outdoor units (2-motor), washing machines (2-motor)	
			Fans, drone			
	Square wave control (120-degree conducting control)	PWM × 6, A/D converter	Refrigerators, fans, compact robots	Refrigerators, pumps, compressors		
AC induction motor	Vector control	PWM × 6, dead time generation, POE, A/D converter (PWM link)		Industrial pumps	General-purpose inverters (fans, pumps)	
	V/f control		Fans, refrigerators, washing machines pumps	Air conditioner outdoor units, pumps	General-purpose inverters (fans, pumps)	
Stepping motor	Pulse output	Port control or PWM control	Printers/multifunction units, surveillance cameras		Industrial motors	
	Vector control (resolver)	PWM × 4, dead time generation, POE, A/D converter		Compact robots, carrier machine, textile machine, printers/multifunction units		Industrial robots and AC servos for low-end

Motor Control by RX

RX delivers high-speed arithmetic performance alongside MTU2 or MTU3, GPT timer, 12-bit A/D converter, and POE functions to simplify the process of implementing motor control.

High-speed arithmetic operations (RX core)

High-speed vector calculations
- High-speed processing at 240MHz
- FPU for high-speed floating point operations
- TFU for high-speed trigonometric functions
  - single-precision floating point
  - sin, cos, arctan, sqrt (x2+y2)
  - Fast/fixed cycle operation

*Only RX26T/RX72T/RX72M/RX72N supports TFU

Waveform control/feedback control (MTU2 and MTU3, GPT, etc.)

PWM waveform output
- PWM output with 0 to 100% duty
- 3-phase complementary PWM waveform output
- Automatic insertion of dead time
- A/D activation at user-defined timing for 1-shunt current detection

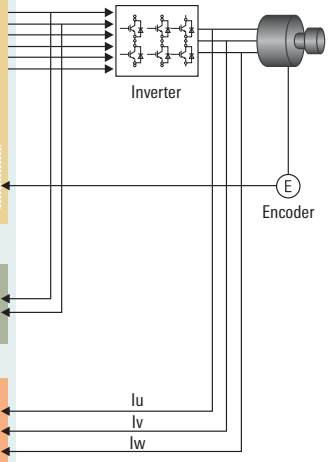
Feedback control
- Acquisition of feedback information (position/rotation rate) from encoder

Disable control output signals (POE)

Disable output signals for the MTU and the GPT without using software.
- Forcibly disable complementary PWM output and realize fail-safe

Feedback control (high-speed 12-bit A/D converter)

Acquisition of feedback information using motor current
- High-speed (1.0µs) 12-bit A/D converter
- Simultaneous sampling of three tracks for 3-shunt current detection
- Reduce BOM by using built-in comparator and PGA (some products)



Examples of Motor Control Functions Provided by RX

Description		For motor control				For General-Purpose, Sensor, and Network Applications								
		RX13T/RX23T	RX24T/RX24U	RX66T	RX72T/RX26T	RX111/RX113	RX130	RX140	RX230/RX231	RX651/RX65N	RX660	RX671	RX66N	RX72N/RX72M
Waveform output control	PWM output with 0 to 100% duty	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Synchronous output on multiple channels	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Chopping or level waveform output in AC synchronous motor drive mode	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	3-phase complementary PWM output with dead time (left-right symmetric dead time amplitude)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	3-phase complementary PWM output with dead time (left-right asymmetric dead time amplitude)	–	✓	✓	✓	–	–	–	–	–	–	✓	✓	✓
	High-resolution PWM output	–	–	✓	✓	–	–	–	–	–	–	–	–	–
Feedback detection	Phase counting mode	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	High-speed 12-bit A/D converter using sequential conversion	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	A/D converter activation requests at user-defined timing (for 1-shunt current detection)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	12-bit A/D converter double-trigger function (storage of data from two conversions in separate registers)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	12-bit A/D converter with simultaneous sampling of three tracks	✓	✓	✓	✓	–	–	–	–	✓	–	–	✓	✓
Acceleration	Compare match and A/D conversion start request skipping function	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	FPU for high-speed arithmetic operations	✓	✓	✓	✓	–	–	✓	✓	✓	✓	✓	✓	✓
	Double buffering function (provision of two register buffer stages for compare match operation)	✓	✓	✓	✓	–	–	–	–	✓	✓	✓	✓	✓
Safety functions	Error detection and PWM output auto-cutoff using port output enable	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Other	Compare match/input capture	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	5V power supply	✓	✓	✓	✓	–	✓	✓	✓	–	✓	–	–	–
	32-bit counter support	✓	✓	✓	✓	–	–	–	–	✓	✓	✓	✓	✓
	Trigonometric functions arithmetic unit	–	–	–	✓	–	–	–	–	–	✓	–	–	✓

RX FAMILY DEVELOPMENT TOOLS

Development Tools Designed to Maximize the Attractions of the RX Family

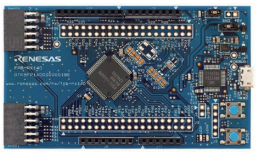
Renesas supports customers through all stages of the development of their applications by supplying integrated development environments, real-time OSes, middleware, and programming tools that dramatically enhance the development process. These development tools, combined with evaluation kits and assistance 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

Evaluation versions of tools, sample software, application notes

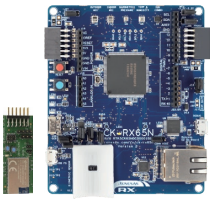
Recommended for users getting started developing MCU applications



FPB (Fast Prototyping Board)

Solution kits for specific solutions

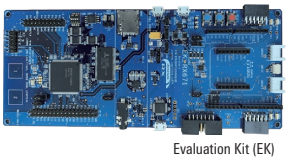
Envision Kit for LCD application development



CK-RX65N for IoT application development

A growing selection of starter kits you can start using immediately

Renesas Starter Kit



Evaluation Kit (EK)

Development

Choose among Renesas' proprietary development environments, enabling use of a variety of extended functions, and development tools from our partner vendors to meet your specific requirements.

Integrated Development Environment and Source Code Editor

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.

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.

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.

Compilers

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.

OSes

Embedded OS with the best established track record in Japan and conformant with µITORN standard (RI600V4 and RI600PX)

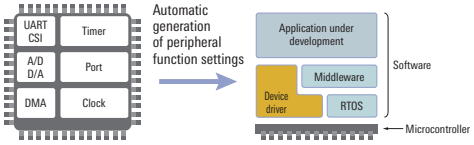
FreeRTOS, which supports connecting to AWS

Azure RTOS, which supports connecting to Azure

Support planned from 2025.

Development

Software and tools that speed up system development



Smart configurator
Tool that automatically generates device drivers

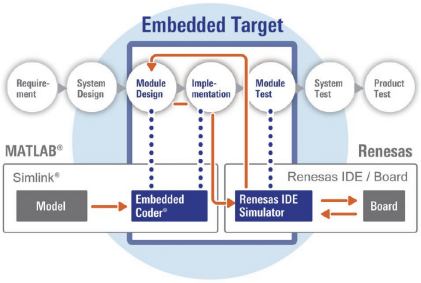
Quick and Effective tool solution

QE tools allow you to just make simple setting to start developing your applications.

AFE BLE Touch OTA Display
Motor Lighting Other
Camera USB
TCP/IP UART
Current Consumption

QE (Quick and Effective tool)

Middleware
Support for communication environments, security, image processing, and signal processing



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.

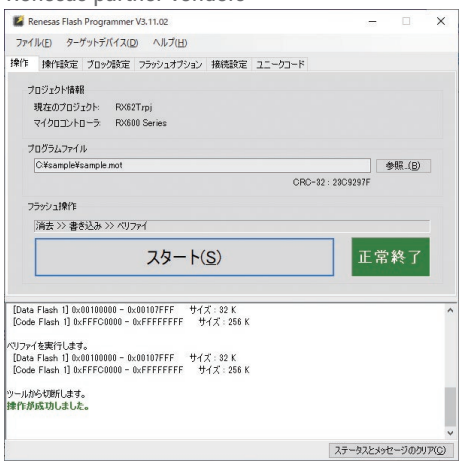
E2 Emulator Lite
Entry-level model recommended for new users.

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

E20 Emulator
This model enables even faster debugging. It provides high-capacity trace functionality and RAM monitoring functionality suitable for use with the RX600 and RX700.

Mass production

Programming tools, including products from Renesas partner vendors



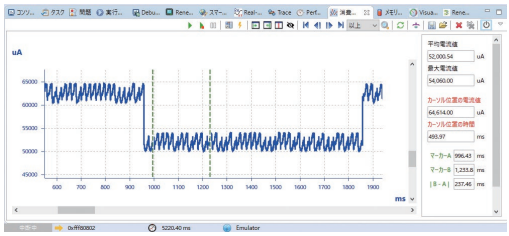
Renesas Flash Programmer
flash memory programming software

PG-FP6
standalone flash programmer

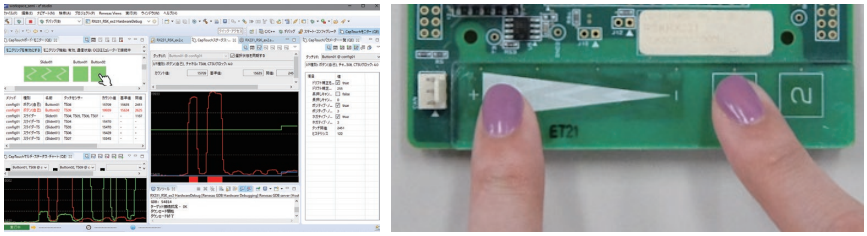
SEGGER

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

Debug



[QE for Current Consumption]
Using just the E2 Emulator you can measure current consumption and detect abnormal current flows.



[QE for Capacitive Touch]
Supports embedded systems employing capacitive touch sensors. Easily implement touch and slider operations in applications.

RX FAMILY DEVELOPMENT TOOLS

Software and Support Tools You Can Use Immediately with the RX Family

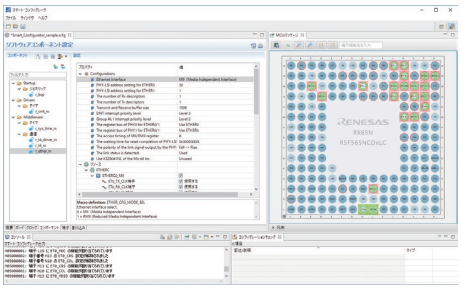
Software packages available from Renesas include documentation and application examples for peripheral function drivers, middleware, and more. The GUI-based Smart Configurator substantially boosts development efficiency by facilitating integration of these packages and generating I/O drivers automatically.

Searching for Information in Sample Code or Manuals

From within the integrated development environment, you can search for resources such as sample code and Renesas product information on the web, and then display, download, and install specific items.

Making Complex Pin Settings and Embedding Drivers

The integrated development environment lets you add drivers and configure pin settings from the built-in GUI, and when conflicts are detected you can resolve them with a single click.



Smart Configurator

RX Family Middleware Driver Package (RX Driver Package)

The RX Driver Package is a software package that enables use of peripheral function drivers, middleware, etc. Using this package can contribute to reduced system development time for customers. Firmware Integration Technology (FIT) can be used on MCUs across the RX Family. This significantly reduces the software development cost burden for customers extending their product lines.

Software Package

Connectivity
Ethernet, BLE (RX23W)
Wi-Fi (DA16xxx)
BLE (DA14531)

Sensor
HS300x, HS400x,
FS2012, FS3000,
FS1015, ZMOD4xxx,
RRH46410

Storage / USB
EEPROM, SDHI,
CDC, MSC, HID
(Host & Peripheral)

Security
TSIP, RSIP,
AES, DES, SHA, RNG
RSA

File System
FAT File System
(M3S-TFAT-Tiny)

Capacitive Touch
Button/Wheel/Slider,
self-capacitance,
mutual-capacitance

Graphics
Segger emWin
CRI Aeropoint

Reality AI
Data Collector Control,
Data Shipper Control

Device Driver

LVD	LPC	VBATT	IRQ	DTC	DMAC	ELC	GPIO	MPC
CMT	CMTW	RTC	LPT	MTU	GPT	TPU	TMR	PPG
POE	POEG	IWDT	WDT	SCI	SCIF	RIIC	RIICHS	RI3C
RSPI	QSPI	QSPIX	USB	EPTPC	ETHERC	ETHERC Light	Ether CAT	IrDA
PDC	CAN	CANFD	RSCAN	SDHI	SDSI	MMCIF	SRC	SSI
S12AD	24-ΔΣAD	DAC	DSMIF	AFE	TSIP	SEG-LCDC	TFT-LCDC	DRW2D
CTSU	BLE	REMC	BUS	CAC	Flash	DOC	TFU	Unique ID

Board Support Package (BSP)

RX Family

Renesas Middleware and Driver Usage Examples

Building Automation
TCP/IP | F/W Update
Ether | USB
LCD | Security

Remote Operation of Home Electronics/Appliances
TCP/IP | F/W Update
Ether | ADPCM
Wi-Fi | Touch

Factory Automation/Robots
TCP/IP | F/W Update
CAN | ADC
Timer (Motor) | AFE

Medical and Healthcare Devices
USB | F/W Update
SDIO | Sensor
LCD | Security

Smart Meters
TCP/IP | F/W Update
Ether | Sensor
ADC | Security

Office Automation
Storage | F/W Update
Graphics | ADPCM
File System | Touch

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

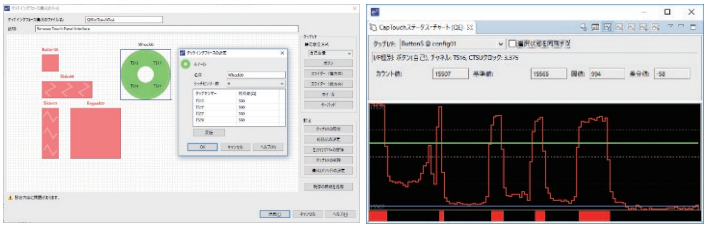
Renesas Solutions and Tools that Lighten the Application Development Workload

QE (Quick and Effective tool)

"I've imported this application but it doesn't work! What should I do?" Has this ever happened to you? QE development support tools add development knowhow (functionality) to applications within the integrated development environment, helping to minimize the application development workload.

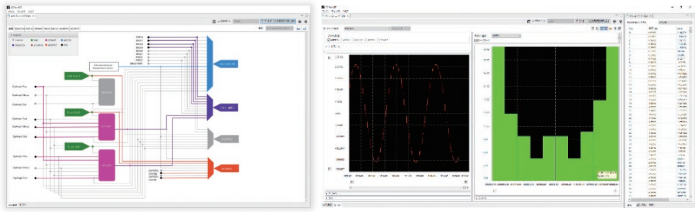
QE for Capacitive Touch Development Support Tool for Capacitive Touch Sensor Applications

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



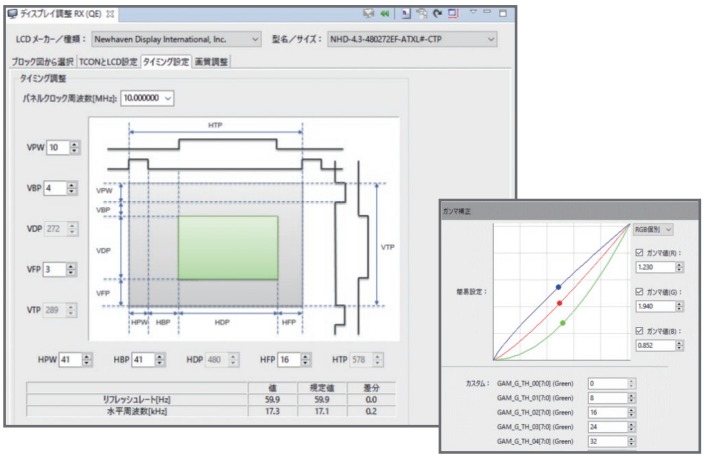
QE for AFE Development Support Tool with Analog Frontend Support

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.



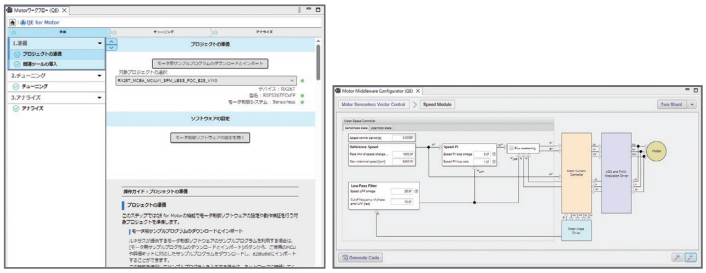
QE for Display Development Support Tool for Display Applications

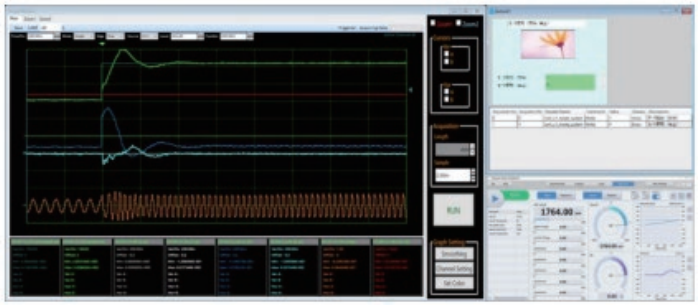
This tool simplifies initial screen calibration of the display when using the MCU's on-chip LCD controller, reducing the time required for development. It also supports the use of an external LCD controller via a serial connection.



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.

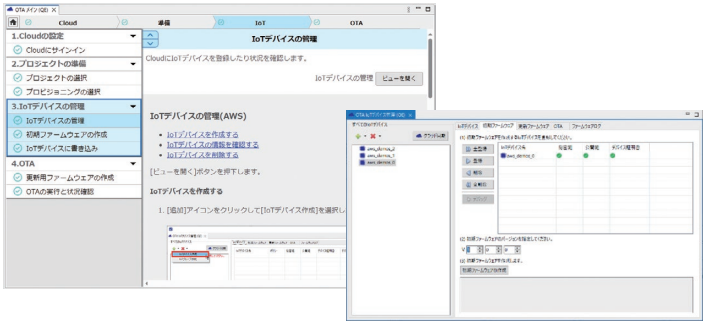




Renesas Motor Workbench

QE for OTA Development Support Tool for Cloud Applications

This tool lets you easily try out the over the air (OTA) functions of leading cloud services such as AWS and Azure. 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.



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.

Winning Combinations (Reference Designs)

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. By making use of these combinations you can speed up product development cycles and reduce the overall risk associated with bringing a new product to market. Renesas continues to make available new Winning Combinations, including many featuring RX Family MCUs, one after another.

Key Technologies

HMI
Artificial Intelligence (AI)
Security
Functional Safety

Industrial

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

Consumer Electronics

Power Adapters & Chargers
Computing
Wearables
Home Theater & Entertainment

Communications Infrastructure

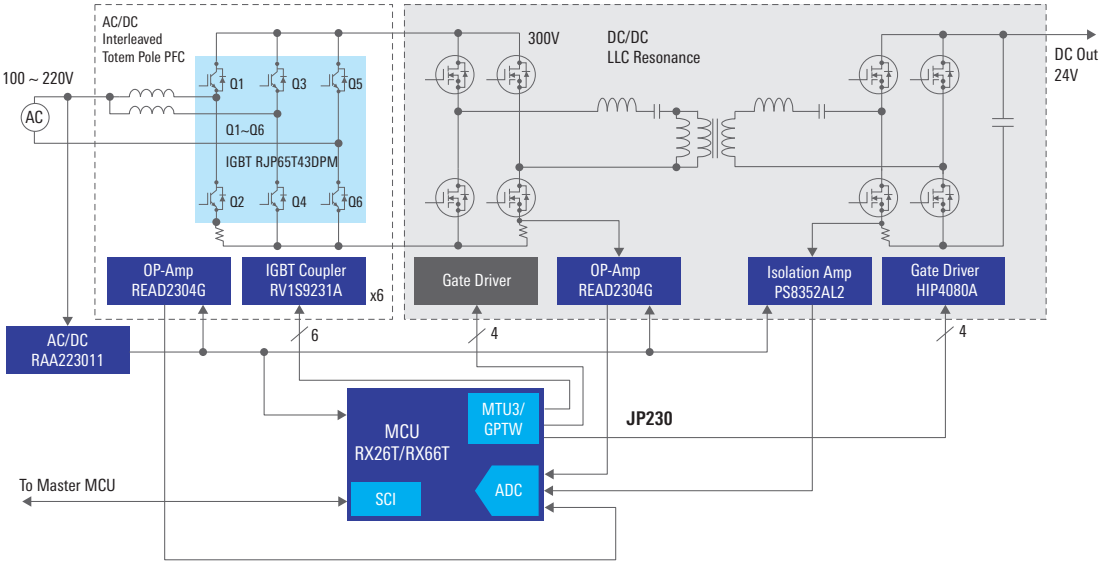
Memory
Networking & Fixed Access
Cloud & Enterprise
Wireless Infrastructure

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

Easy-to-understand explanation of benefits

Easy-to-read block diagram

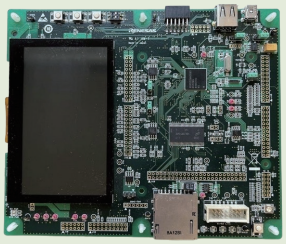
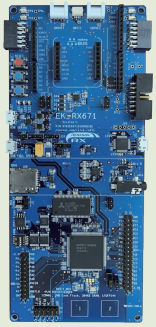
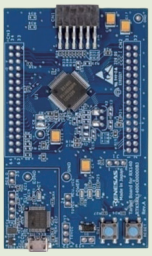
Easy access to related Renesas product pages



MEMO

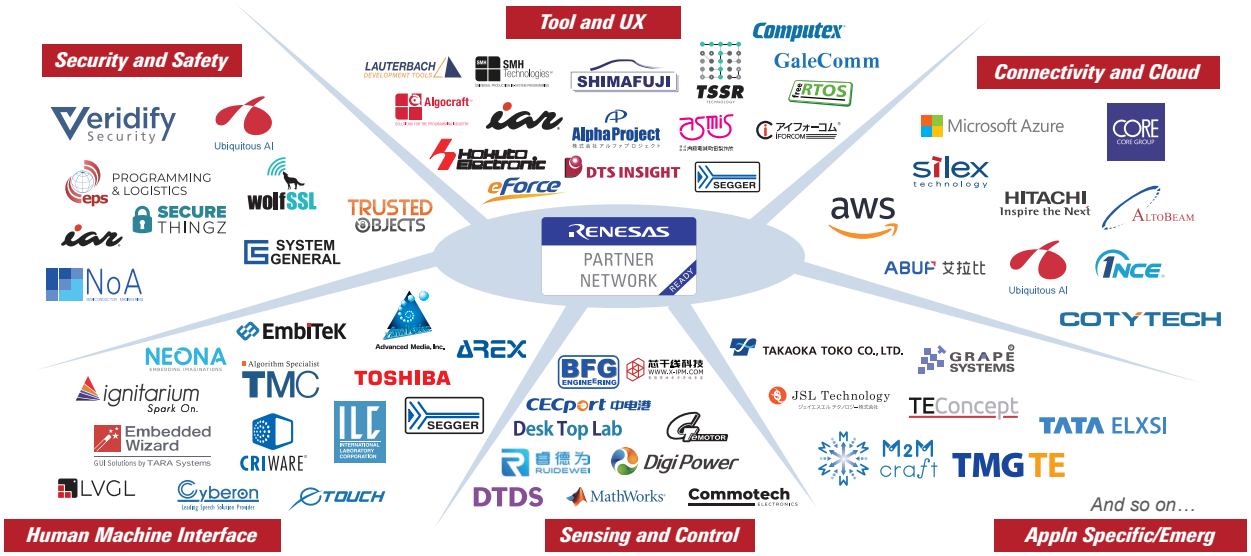
RX Evaluation Boards

The RX evaluation boards include three types designed to meet diverse user needs: the Renesas Starter Kit, Evaluation Kit, and Fast Prototyping Board or Target Board, in addition to RSSK and MCK boards for various specific solutions.
Fast Prototyping Boards and Target Boards are entry-level products designed for users new to RX MCUs. They feature Arduino Uno, Pmod connectors, and onboard debugging circuits. (Arduino Uno is available only on Fast Prototyping Boards)
Evaluation Kits come equipped with a range of standard onboard connectors, including mikroBUS, Arduino, and Pmod. This allows for seamless integration with separately purchased expansion boards, adding functionality such as sensing, motor control, wireless communication, LCD display. Additionally, the kits support features specific to various RX MCU Groups, such as touch interfaces and CAN FD, enabling rapid and versatile prototyping across numerous applications.

Name of Kit	Renesas Stater Kit	RX Family EK Kit	Fast Prototyping Board (FPB) Target Board (TB)	
Target MCUs	All RX MCU Groups	RX261 / RX671	FPB	RX140/RX261
			TB	RX130 / RX140 / RX231/ RX23W RX23W module / RX65N / RX66N RX671 / RX660
Photo			 FPB-RX140	 TB-RX140
Features	Comprehensive evaluation environment of all MCU features • Provides peripheral circuits for all MCU feature evaluation. • Includes additional hardware such as external emulator (E2 or E2 Lite) or Pmod LCD panel.	Flexible boards to quickly expand functionality • Features specific MCU functions. • Equips on-board debugging circuit. • Provides a variety of ecosystem interfaces for quickly prototyping various applications.	Easy to use, try and buy • Affordable price. • Provides on-board debugging circuit. • Equips one Arduino and two Pmod connectors.* * TB board has one Pmod connector.	

Renesas Ready Partner Network

Renesas' extensive network of ecosystem of partner vendors offer software and hardware building blocks that you can start using with Renesas MCUs right away. The Renesas RX ecosystem makes it possible to accelerate development of IoT applications integrating core technologies related to security, safety, connectivity, HMI, and more. The network of partner vendors is growing constantly. Visit the Renesas website for detailed, up-to-date information.

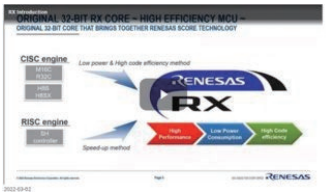


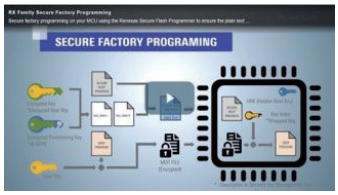
RX Family Web Page

Links to reach the ecosystem such as development support information, video libraries, solutions, etc. are posted on the RX TOP page.

Video library (Promotion videos and demos)

Introducing new product information and solution information of RX





Handbook for Engineers

Information and materials required at the time of product development summarized and listed for each development phase. Simplifies searching for the information you need.

Products › Microcontrollers & Microprocessors › RX 32-Bit Performance / Efficiency MCUs › RX72N

RX72N ● Active
Samples Available

RX Family Flagship 32-bit Microcontroller with Highest Performance

RX72N Group Datasheet
RX72N Group U
RX Family RXv3 Instruction Set Architecture Use
RX72N Handbook for Engineers Rev.2.00

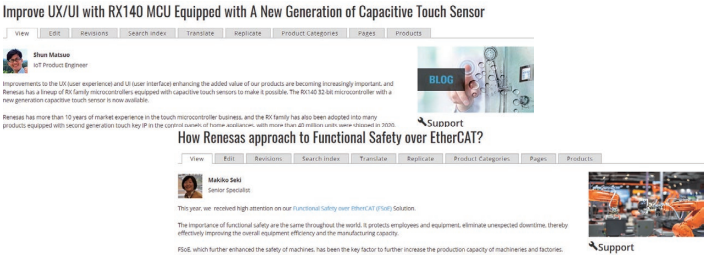
Appears on the product page on the website.

Step1: MCU selection

	Item	Content	Link
1	Hardware information	Datasheet	Doc
2	Products & Solutions	Video	Web site
3		Blog	Web site
4		Reference designs (Winning combination)	Web site
5	Product longevity program (PLP)	Overview of product longevity program (PLP)	Web site
6		Product selection (product selector) Note: Refer to PLP column in the chart.	Web site

Blog

RX latest information Blog



Getting Started with the RX Family Development Environment

Full of information for those who are new to the RX family(Tools required for development / Recommended kits / Ready-to-use download information)

Ease of Using the Environment

Purchase the Renesas Starter Kit, a set which includes an IDE, debugger, evaluation board, and cables. Once you have the kit, you can quickly start evaluation including all the facilities of the given RX-family MCU.
We recommend this method for users who want ease of preparing the environment and a quick start of evaluation.

Configuration

- Integrated Development Environment *1
- On-chip debugging emulator
- Evaluation board
- Cables

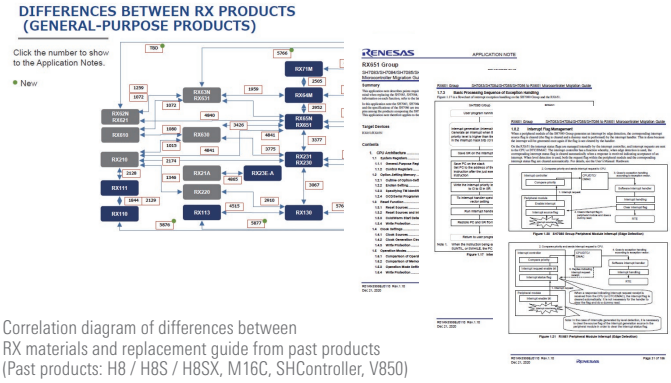
Search for products to buy on the product list

Software & tool course (how to videos)

Posted videos on how to install development tools, how to debug, how to use solution kits, etc.

RX replacement support information

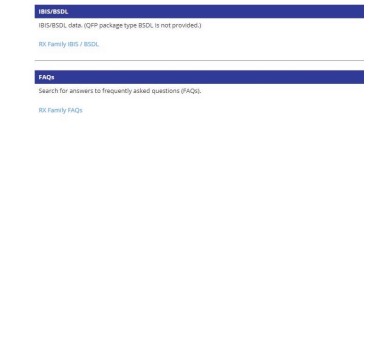
Differences between the RX series, or specification comparisons between past products such as SH and H8 and RX are posted together. Please use it when considering the replacement of the microcomputer.



Correlation diagram of differences between RX materials and replacement guide from past products (Past products: H8 / H8S / H8SX, M16C, SHController, V850)

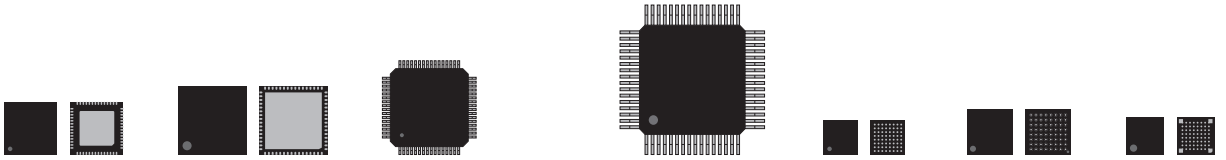
RX useful information

Full of useful information for development (hardware design guide, precautions for high temperature operation, IBIS / BSDL information, etc.)



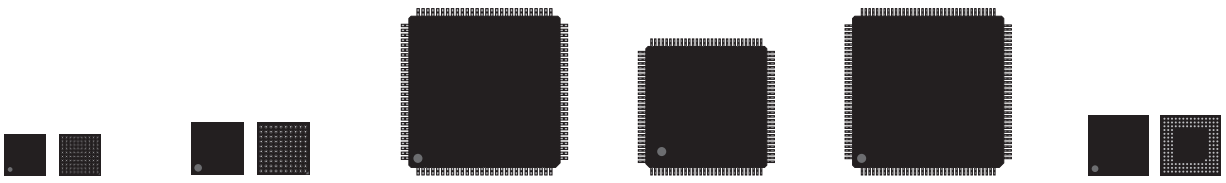
RX FAMILY PACKAGE LINEUP

Pin-type:	32-HWQFN	32-LQFP	36-WFLGA	40-HWQFN	48-HWQFN	48-LFQFP	52-LQFP
Size:	5 x 5 mm	7 x 7 mm	4 x 4 mm	6 x 6 mm	7 x 7 mm	7 x 7 mm	10 x 10 mm
Pitch:	0.50 mm	0.80 mm	0.50 mm	0.50 mm	0.50mm	0.50 mm	0.65 mm
Thickness:	0.80 mm	1.70 mm	0.76 mm	0.80 mm	0.80mm	1.70 mm	1.70 mm
Group:	RX140, 13T	RX140, 13T	RX111, 110	RX23E-A, 23E-B, 111, 110	RX671, 26T, 231, 230, 140, 13T, 130, 111, 110	RX660, 63T, 631, 26T, 261, 260, 23T, 23E-A, 23E-B, 231, 230, 220, 210, 140, 13T, 130, 111, 110	RX23T

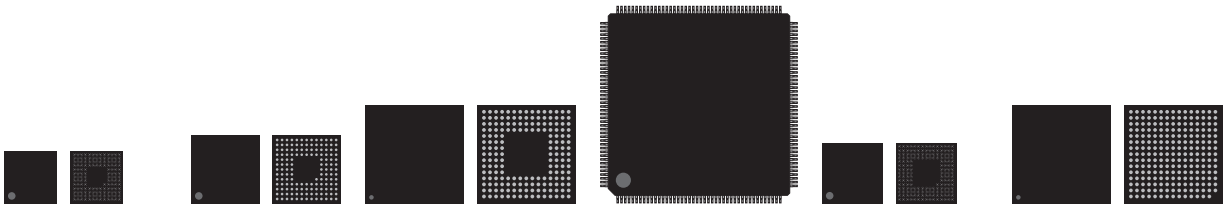


Pin-type:	56-HVQFN	64-HWQFN	64-LFQFP	64-LQFP	64-TFBGA	64-TFLGA	64-WFLGA
Size:	7 x 7 mm	9 x 9 mm	10 x 10 mm	14 x 14 mm	4.5 x 4.5 mm	6 x 6 mm	5 x 5 mm
Pitch:	0.40 mm	0.50 mm	0.50 mm	0.80 mm	0.50 mm	0.65 mm	0.50 mm
Thickness:	0.90 mm	0.80 mm	1.70 mm	1.70 mm	1.20 mm	1.05 mm	0.76 mm
Group:	RX23W	RX26T, 231, 230	RX671, 660, 66T, 651, 63T, 631, 62T, 26T, 261, 260, 24T, 23T, 23E-B, 231, 230, 220, 21A, 210, 140, 130, 113, 111, 110	RX62T, 24T, 220, 210, 140, 130, 111, 110	RX671, 651	RX631	RX231, 230, 111, 110

Pin-type:	80-LFQFP	80-LQFP	83-TFLGA	85-TFBGA	85-TFLGA	100-LFQFP	100-TFBGA
Size:	12 x 12 mm	14 x 14 mm	6.1 x 9.5 mm	5.5 x 5.5 mm	7 x 7 mm	14 x 14 mm	5.5 x 5.5 mm
Pitch:	0.50 mm	0.65 mm	0.50 mm	0.50 mm	0.65 mm	0.50 mm	0.50 mm
Thickness:	1.70 mm	1.70 mm	1.00 mm	1.20 mm	1.20 mm	1.70 mm	1.20 mm
Group:	RX660, 66T, 630, 26T, 261, 260, 24T, 23E-B, 21A, 210, 140, 130	RX66T, 62T, 24T, 210	RX23W	RX23W	RX621	RX72T, 72M, 72N, 71M, 671, 660, 66T, 66N, 65N, 651, 64M, 63T, 63N, 631, 630, 62T, 62N, 62G, 621, 26T, 261, 260, 24U, 24T, 23E-B, 231, 230, 220, 21A, 210, 130, 113	RX23E-B



Pin-type:	100-TFLGA	100-TFLGA	112-LQFP	120-LFQFP	144-LFQFP	145-TFBGA
Size:	5.5 x 5.5 mm	7 x 7 mm	20 x 20 mm	16 x 16 mm	20 x 20 mm	8 x 8 mm
Pitch:	0.50 mm	0.65 mm	0.65 mm	0.50 mm	0.50 mm	0.50 mm
Thickness:	1.05 mm	1.05 mm	1.70 mm	1.70 mm	1.70 mm	1.19 mm
Group:	RX630, 231, 230, 210	RX71M, 671, 65N, 651, 64M, 63N, 631, 21A, 210, 113	RX66T, 63T, 62T, 62G	RX63T	RX72T, 72M, 72N, 71M, 671, 660, 66T, 66N, 65N, 651, 64M, 63T, 63N, 634, 631, 630, 62N, 621, 610, 24U, 210	RX65W-A



Pin-type:	145-TFLGA	145-TFLGA	176-LFBGA	176-LFQFP	177-TFLGA	224-LFBGA
Size:	7 x 7 mm	9 x 9 mm	13 x 13 mm	24 x 24 mm	8 x 8 mm	13 x 13 mm
Pitch:	0.50 mm	0.65 mm	0.80 mm	0.50 mm	0.50 mm	0.80 mm
Thickness:	1.05 mm	1.20 mm	1.40 mm	1.70 mm	1.05 mm	1.40 mm
Group:	RX72N, 71M, 671, 66N, 65N, 651, 64M, 63N, 631, 630, 210	RX671, 62N, 621	RX72M, 72N, 71M, 66N, 65N, 651, 64M, 63N, 631, 630, 62N, 621, 610	RX72M, 72N, 71M, 66N, 65N, 651, 64M, 63N, 631, 630	RX71M, 65N, 651, 64M, 63N, 631, 630	RX72M, 72N, 66N

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	62G	RX62G
72N	RX72N	26T	RX26T
71M	RX71M	261	RX261
66N	RX66N	260	RX260
660	RX660	24T	RX24T
671	RX671	24U	RX24U
65N	RX65N	23T	RX23T
65W	RX65W-A	23W	RX23W
651	RX651	231	RX231
64M	RX64M	230	RX230
63N	RX63N	23E	RX23E
631	RX631	220	RX220
62N	RX62N	210	RX210
621	RX621	21A	RX21A
634	RX634	13T	RX13T
630	RX630	140	RX140
610	RX610	130	RX130
72T	RX72T	113	RX113
66T	RX66T	111	RX111
63T	RX63T	110	RX110
62T	RX62T		

Operating ambient temperature

N	-20°C to 85°C
D	-40°C to 85°C
G	-40°C to 105°C

Package type/pin count/pin pitch

BD	LFBGA	224	0.8	LA	TFLGA	100	0.5
BG	LFBGA	176	0.8	LC	TFLGA	177	0.5
BL	TFBGA	85	0.65	LD	TFLGA	85	0.65
BP	TFBGA	64	0.5	LE	TFLGA	145	0.65
FA	LFQFP	120	0.5	LF	WFLGA	64	0.5
FB	LFQFP	144	0.5	LH	TFLGA	64	0.65
FC	LFQFP	176	0.5	LJ	TFLGA	100	0.65
FD	LQFP	52	0.65	LK	TFLGA	145	0.5
FF	LQFP	80	0.65	LM	WFLGA	36	0.5
FH	LQFP	112	0.65	LN	TFLGA	83	0.5
FJ	LQFP	32	0.8	ND	HWQFN	64	0.5
FK	LQFP	64	0.8	NE	HWQFN	48	0.5
FL	LFQFP	48	0.5	NF	HWQFN	40	0.5
FM	LFQFP	64	0.5	NG	HVQFN	56	0.4
FN	LFQFP	80	0.5	NH	HWQFN	32	0.5
FP	LFQFP	100	0.5				

Packing specification

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

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.

Renesas Electronics Corporation TOYOSU FORESIA, 3-2-24 Toyosu, Koto-ku, Tokyo 135-0061, Japan

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