RENESAS

INDUSTRIAL NETWORKS

Enabling IIoT and industry 4.0 Infrastructure

2025.03

Industrial Networks for Factory Automation

Seamless real-time communication is indispensable to Industry 4.0 and Industrial Internet of Things (IIoT) implementations. Renesas offers a variety of solutions for industrial networks to enable advancement and automation of industrial equipment, with support for protocols such as EtherCAT, EtherNet/IP, and PROFINET.

CONTENT

Absolute Integration

Industrial networks are a big part of achieving communication among devices from sensor to cloud. A common base technology serves to standardise and open the plant floor to the advantages of unbridled connectivity. Sensor data can be analyzed in the cloud to offer innovative services like preventative maintenance.

Distributed Intelligence

Manufacturing is being driven towards an increasing trend of individualised products requiring significant flexibility in the plant. This can only be achieved through distributed intelligence. More and more processing power is needed within individual plant components therefore driving the need for higher performance semiconductor products at all levels of the plant hierarchy.

Vertical Transparency

The cost of deployment and maintenance is related to the visibility of automation equipment in the plant. The ability to adjust parameters and configure individual machines, I/O devices, and processes is becoming a firm requirement. The ability to remotely configure the plant in real time is the ultimate goal of vertical transparency.

Industrial Network Solutions from Renesas

Factories and production facilities today are becoming more advanced in order to improve productivity and safety. These advances are based on communication via open industrial networks.

Several technical requirements demanded by equipment used inside factories are ;

1. Support for an open network communication protocol : PROFINET, EtherCAT, and OPC UA
2. High-speed real-time performance to achieve higher productivity from protocols such as EtherCAT, PROFINET IRT, and TSN, as well as low power consumption.
3. Support for functional safety to realize safety operation equipment.

Industrial equipment vendors need to develop equipment that satisfies these requirements, and users will implement and use these equipment. Renesas provides products for industrial networks that make it easy to realize these functions.

Product Lineup

High-end Control	Motor Control				PLC, Gateway	Network Controller, Remote I/O				PROFINET
RZ/T2H, NEW RZ/N2H Arm®Cortex®-A55 Quad (1.2GHz) Arm®Cortex®-R52 x2 (1.0GHz)	**RZ/T2M, NEW RZ/T2ME** Arm®Cortex®-R52 x2 (800MHz)	**RZ/T2L** Arm®Cortex®-R52 x1	**RZ/T1** Arm®Cortex®-R4 Arm®Cortex®-M3	**RX72M** RXv3 Core	**RZ/N1** Arm®Cortex®-A7 x2 Arm®Cortex®-M3	**RZ/N2L** Arm®Cortex®-R52	**R-IN32M3-EC** Arm®Cortex®-M3	**R-IN32M3-CL** Arm®Cortex®-M3	**R-IN32M4-CL3** Arm®Cortex®-M4	**TPS-1** PROFINET CPU
4 port, 3×GMAC w/ TSN switch EtherCAT Slave	3 port GMAC w/ TSN switch EtherCAT Slave	EtherCAT Slave	2 port w/ switch EtherCAT slave	2 port EtherCAT slave	5 port GMAC w/ switch	3 port GMAC w/ switch TSN switch EtherCAT slave	2 port switch w/ PHY EtherCAT slave	2 port GMAC w/ switch CC-Link IE field	2 port w/ switch gigabit PHY CC-Link IE field and CC-Link IE TSN Class B	2 port w/ PHY
										Modbus **RA6Mx** Cortex®-M33 1 port w/ith DMA

Renesas Industrial Network Solution Contribute to Realize Smart Society

There are various protocols for industrial network and there are made the best use of various features. However, coexist of various protocols is the challenge for realizing smart society that require interoperability. Renesas has various product/solution and overcomes challenges with customer.

Various products to solve any industrial protocols

Renesas can provide one protocol communication IC and multi protocols communication IC.
One protocol communication IC give benefits as small footprint and low cost for customer.
Multi protocol communication IC give benefits as unique environment for customer.

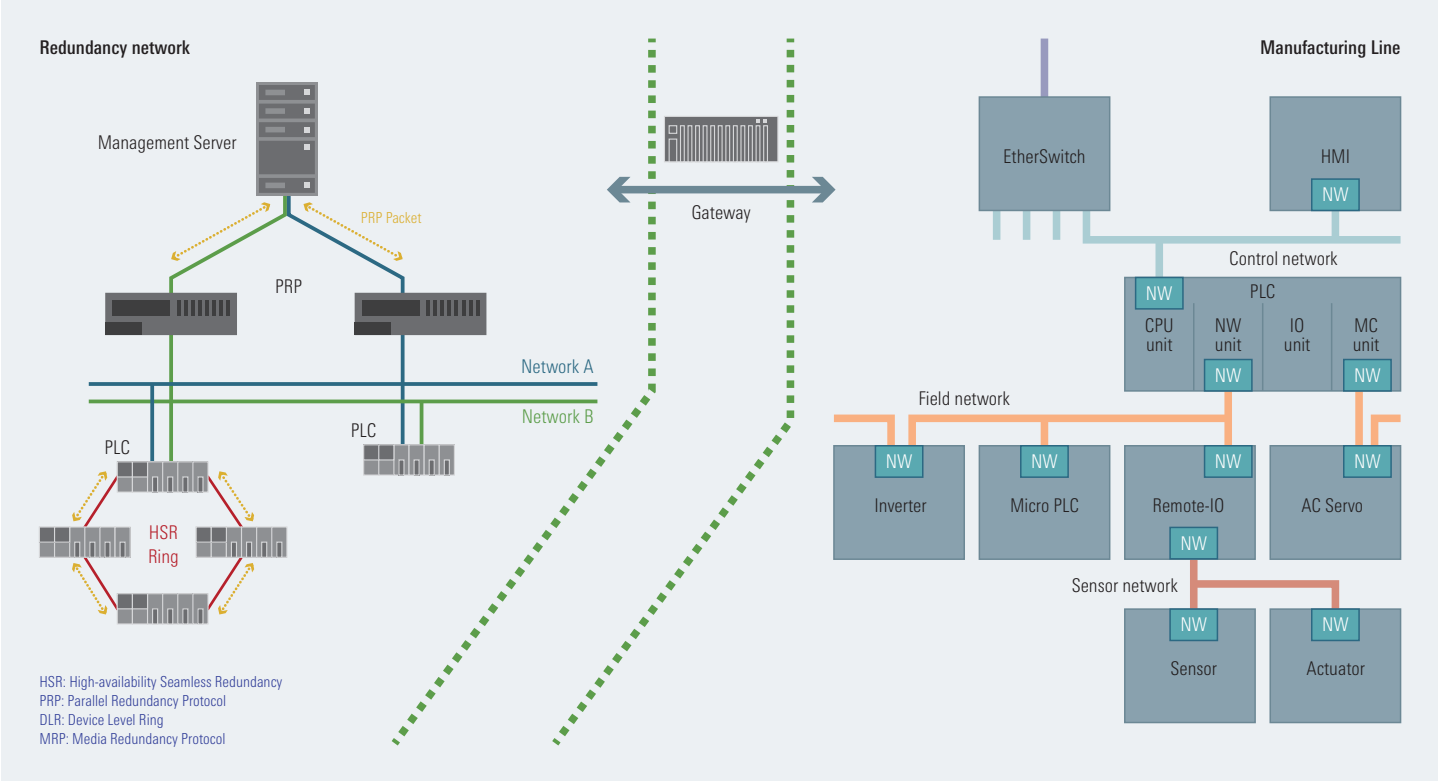
Usable for any layers/use cases in industrial

Renesas industrial ethernet IC can realize standard ethernet products by customer.
Further, Renesas industrial ethernet IC supports redundancy network (HSR, PRP, DSR, MRP and so on). Furthermore, Renesas industrial ethernet IC can use expanded communication IC for MCU/MPU. So, Renesas IC can solve/use any layer communication.

Contribute to realize the interoperability for smart society

Some multi protocols communication IC can realize simultaneous operation for two industrial protocols. So, customer can develop the gateway between industrial ethernet protocols.

Industrial Network



Recommended Devices for Industrial Networks

For Master

Type		RZ/T2H, RZ/N2H	RZ/T2M, RZ/T2ME	RZ/T2L	RZ/T1	RZ/N2L	RZ/N1D	RZ/N1S	RZ/N1L	RA6	RX72M
Industrial Ethernet	OPC UA	✓*	—	—	—	—	✓	—	—	—	—
	PROFINET	—	—	—	—	—	✓	—	—	—	—
	EtherCAT	✓	✓*	✓*	✓	✓*	✓	—	—	—	—
	EtherNet/IP	✓	—	—	—	—	✓	—	—	—	—
	POWERLINK	—	—	—	—	—	—	—	—	—	—
	ModbusTCP	✓	—	—	—	—	✓	—	—	✓	✓
	SercosIII	—	—	—	—	—	—	—	—	—	—
	CC-Link IE TSN	—	—	—	—	—	—	—	—	—	—
	CC-Link IE Field	—	—	—	—	—	—	—	—	—	—
Fieldbus	IO-Link	—	—	—	—	—	✓*	✓*	—	✓*	✓*
	PROFIBUS	—	—	—	—	—	—	—	—	—	✓
	CANopen	—	—	—	—	—	✓	—	—	—	✓
	DeviceNet	—	—	—	—	—	—	—	—	—	—
	Modbus RTU/ASCII	✓*	—	—	—	—	✓	—	—	✓	✓
	CC-Link	—	—	—	—	—	—	—	—	—	—

For Slave

Type		RZ/T2H, RZ/N2H	RZ/T2M, RZ/T2ME	RZ/T2L	RZ/T1	RZ/N2L	RZ/N1D	RZ/N1S	RZ/N1L	R-IN32(CL3)	R-IN32(CL)	R-IN32(EC)	TPS-1	RX72M	RA6	RA2	RX23E-A	RL78
Industrial Ethernet	OPC UA	✓*	✓*	—	✓	✓*	✓	✓	✓	✓*	✓	✓	—	✓	—	—	—	—
	PROFINET	✓* RT/IRT	✓* RT/IRT	—	✓ RT	✓* RT/IRT	✓ RT	✓ RT	✓ RT	✓ RT	✓ RT	✓ RT	✓ RT/IRT	✓ RT	—	—	—	—
	EtherCAT	✓	✓	✓	✓	✓	✓	✓	✓	—	—	✓	—	✓	—	—	—	—
	EtherNet/IP	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	—	—	—	—
	POWERLINK	✓*	✓*	—	—	✓*	✓	✓	✓	—	—	—	—	—	—	—	—	—
	ModbusTCP	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	✓	—	—	—
	SercosIII	—	—	—	—	—	✓	✓	✓	—	—	—	—	—	—	—	—	—
	CC-Link IE TSN A: ClassA B: ClassB	✓* A	✓* A	—	✓* A	✓* A	✓* A	✓* A	✓* A	✓ A, B	✓ A	✓ A	—	✓ A	—	—	—	—
	CC-Link IE F: Field FB: Field Basic	✓* FB	✓* FB	—	✓* FB	✓* FB	✓* FB	✓* FB	✓* FB	✓ ✓* F FB	✓ ✓* F FB	—	—	✓* FB	—	—	—	—
Fieldbus	IO-Link	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	✓	✓
	PROFIBUS	✓*	✓*	—	✓*	✓*	—	—	—	—	—	—	—	✓	—	—	—	—
	CANopen	✓*	✓*	—	✓*	✓*	—	—	—	—	—	—	—	✓	—	—	—	—
	DeviceNet	✓*	✓*	—	✓*	✓*	—	—	—	—	—	✓	—	✓	—	—	—	—
	Modbus RTU/ASCII	✓*	✓*	—	✓	✓*	✓	✓	✓	✓	✓	✓	—	✓	✓	—	—	✓
	CC-Link	—	—	—	—	—	—	—	—	—	✓	✓	—	—	—	—	—	—

* Under consideration. Contact a sales person for details.

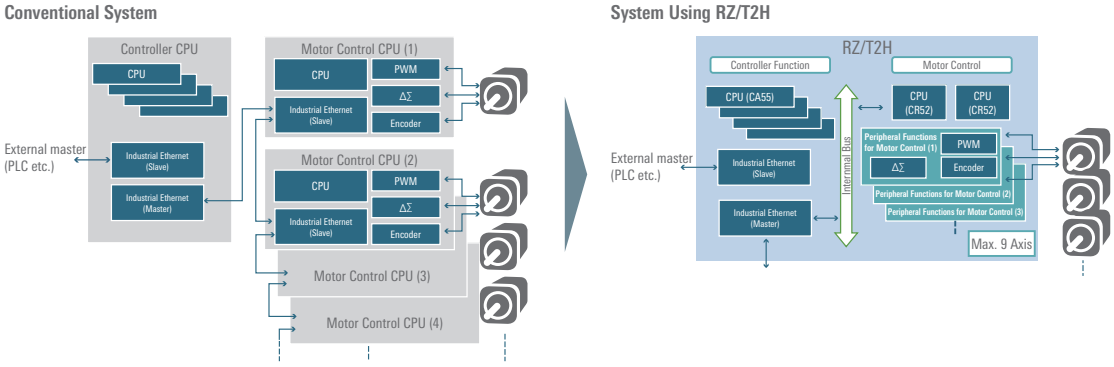
RZ/T2H, RZ/N2H: MPUs That Implement Simultaneous Application Processing and Multi-Axis Real-Time Control

Target Applications

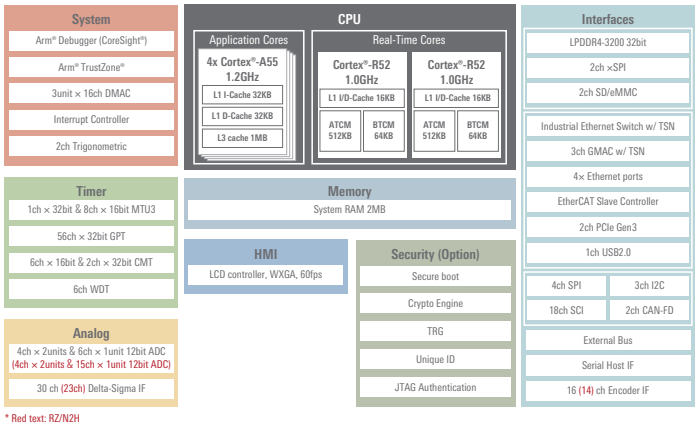
The RZ/T2H and RZ/N2H are products intended as controller devices for applications such as industrial robots requiring multi-axis control and PLCs or motor controllers demanding powerful application processing capabilities or compatibility with Ethernet masters.

Key Features

- Dual Cortex-R52 (1GHz, 576KB TCM*) cores for real-time processing and Cortex-A55 (1.2GHz, quad-, dual-, or single-core) application processor. * TCM: Tightly Coupled Memory
- Peripheral functions (PWM, ΔΣ interface, encoder interface, etc.) enabling control of up to nine* motor axes. * RZ/T2H only
- Four Ethernet ports, Ethernet switch, and 3-channel GMAC allowing flexible implementation of complex network connections.
- Compatible with Civil Infrastructure Platform™ (CIP) Linux backed by long-term support.
- Compatibility with peripheral functions of the RZ/T2M enables reuse of existing real-time processing software resources.



Block Diagram

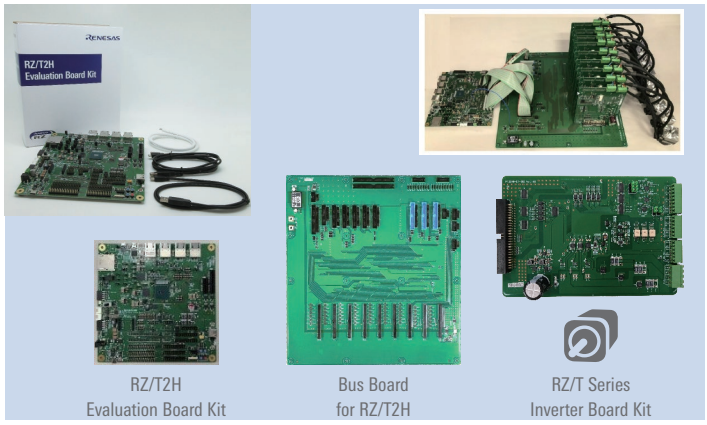


* Red text: RZ/N2H

Solution Kit

The evaluation board kits for the RZ/T2H and RZ/N2H each include an on-board emulator, so you can start evaluation by simply connecting the bundled cable to your PC. Also available are optional boards that enable connection of up to nine motors. Sample programs for applications such as industrial Ethernet and encoder interfaces can be downloaded from the Renesas website.

Multi-Axis Evaluation Kit



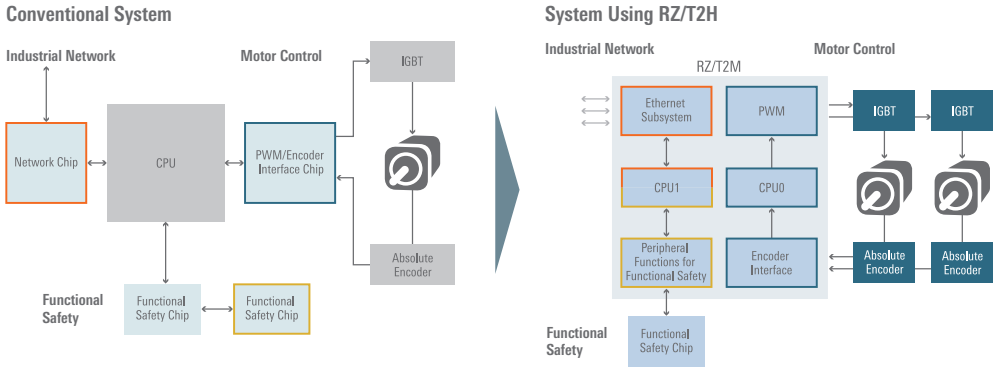
RZ/T2M, RZ/T2ME: MPUs Enabling High-Speed and Highly Precise Servo Motor Control

Target Applications

The RZ/T2M and RZ/T2ME combines fast and highly precise real-time motor control capabilities, together with the latest Industrial Ethernet system architecture on a single chip, while supporting functional safety operation.

Key Features

- Perform high-speed and high-precision real time control by Cortex®-R52 CPU (Max 800MHz), implement large Tightly Coupled Memory (TCM:576KB) and Low Latency Peripheral Port (LLPP) bus.
- Integrates an Ethernet switch compatible with the TSN standard and supports major Industrial Ethernet protocols such as PROFINET IRT.
- Support functional safety processing with one of the dual CPU and dedicated peripheral functions used together with Functional Safety Software.
- On-chip peripheral functions (PWM, delta-sigma interface, encoder interface, etc.) support up to two-axis motor control.
- In addition to the above, the RZ/T2ME provides on-the-fly decryption (OTFD), one-step sync functionality, enhanced security functionality, and more precise time synchronization.



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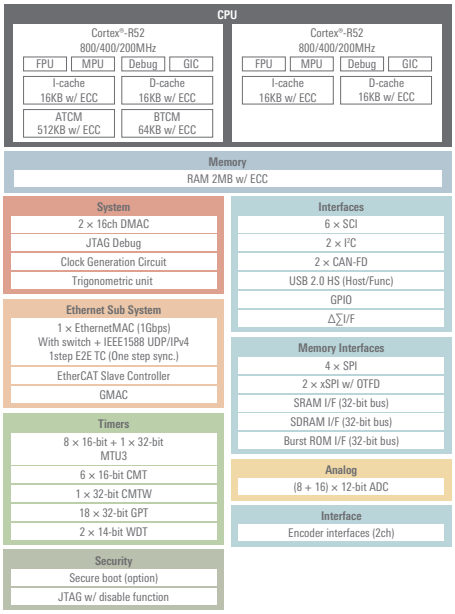


Solution Kit

Renesas Starter Kit+ for RZ/T2M and Renesas Starter Kit+ for RZ/T2ME each include an on-board emulator, so you can start evaluation by simply connecting the bundled cable to your PC. An encoder library and a variety of sample programs for industrial network communication protocols are available on the Renesas website.

Renesas Starter Kit+ for RZ/T2M
(Product No.: RTK9RZT2M0S00000BE)
Renesas Starter Kit+ for RZ/T2ME
(Product No.: RTK9RZT2M1S00000BE)

RZ/T2L: Outstanding Real-Time Performance and EtherCAT Communication Functionality

Target Applications

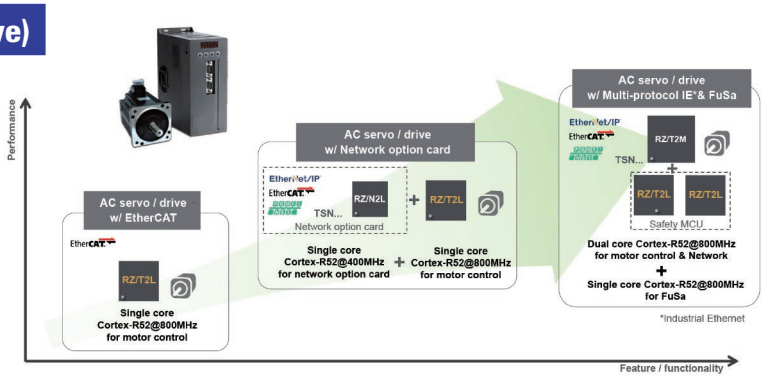
The RZ/T2L is ideal for high-speed, high-precision, real-time control applications and also supports EtherCAT communication.

Key Features

- Integrated Arm® Cortex®-R52 @ Max 800MHz, a tightly coupled memory (576KB) directly connected to CPU and Low Latency Peripheral
- port(LLPP) bus
- Integrated rich peripheral functions such as ∑Δ I/F, A/D converter and multi-protocol encoder I/F
- Seamless H/W architecture with RZ/T2M, and scalable & compatible S/W platform such as FSP with Renesas MPU and MCU
- Integrated EtherCAT slave controller and supports ECC for all internal RAM
- Supports security functions such as secure boot, JTAG authentication and unique ID
- Can be used as safety MCU in the functional safety S/W solution

Scalable System Solution (AC Servo/ AC Drive)

Users can select the MPU suitable for their products from Renesas' MPU lineup that is developed based on similar H/W architecture.
Also, users can use the compatible software platform between Renesas MPU and MCU to utilize existing S/W assets and easily scale their product development.



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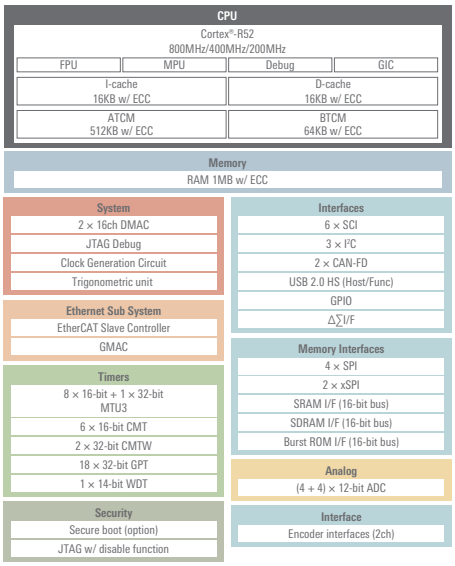


Solution Kit

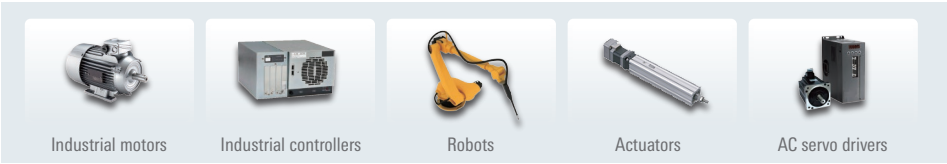
Renesas Starter Kit+ for RZ/T2L includes an on-board emulator, so you can start evaluation by simply connecting the bundled cable to your PC. An encoder library and a variety of sample programs for industrial network communication protocols are available on the Renesas website.

Renesas Starter Kit+ for RZ/T2L
(Product No.: RTK9RZT2L0S00000BJ)

RZ/T1: Industrial Drives with Multi-Protocol Industrial Ethernet Controllers

Target Applications

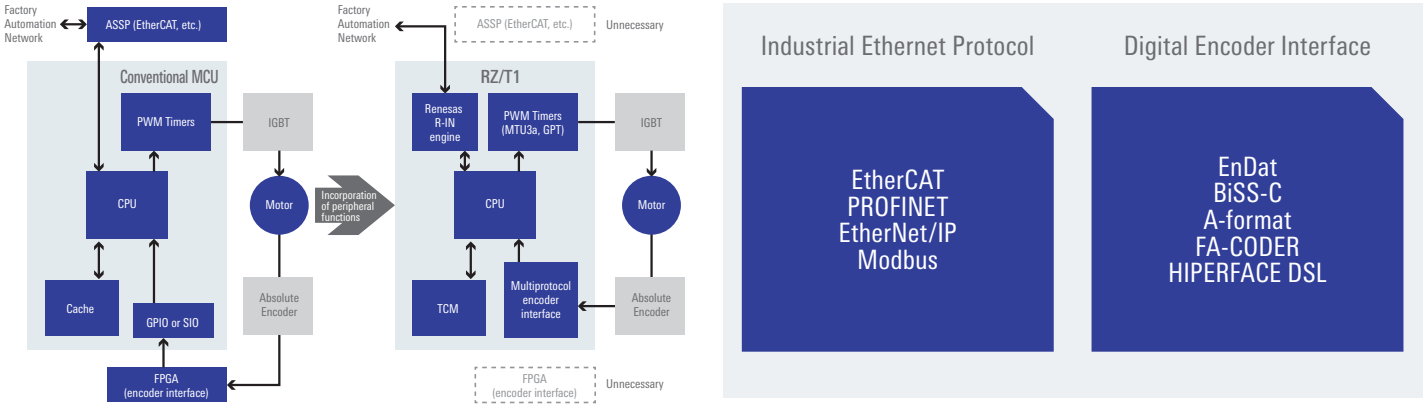
RZ/T1 was specifically developed for Industrial Motors and AC Servos where time is critical, deterministic applications requires minimal latency and jitter, high speed operation providing excellent performance, and improved functionality for industrial equipment.
Some RZ/T1 products also incorporate the Renesas R-IN engine which allows for industrial ethernet communication.



Key Features

The RZ/T1 complements Renesas' industrial smart factory solution portfolio.

- **High Performance and Real-Time Capability**
  The RZ/T1 Group has the Arm® Cortex®-R4 Processor with FPU core, which was designed for real-time processing, and is capable of high-speed operation at up to 600 MHz. Furthermore, tightly-coupled memory capable of definitive real-time response processing allows high-speed access from the CPU without passing through the cache memory.
- **Industrial Ethernet Network**
  RZ/T1 devices that are equipped with a built-in Renesas R-IN engine, which includes accelerator for industrial Ethernet communications, can perform industrial Ethernet processing without loss of real-time performance by Hardware RTOS (HW-RTOS).
- **Digital Encoder Interface**
  RZ/T1 devices that are equipped with a configurable absolute encoder interface are perfectly suited for precision motion control applications. The range of industry standards supported by configurable encoder interface includes EnDat2.2, BiSS®-C, A-format™, FA-CODER®, and HIPERFACE® DSL.



- The encoder interface is external with conventional FPGA or ASIC approaches but is integrated on-chip with the RZ/T1.
- This one-chip AC servo solution helps reduce the component count and saves space.

Solution Kit

The RZ/T1 solution kit provides full access to the single/dual core drive solution with easy access to multiple industrial Ethernet standards and encoder interface protocols. It is the perfect kit for developers who are new to the RZ/T1.

- Renesas Starter Kit : Perfect starter kit to evaluate RZ/T1 performance.

Renesas Starter Kit

RZ/N2L: Industrial Ethernet Communication MPU for Adding Network Functionality to Industrial Equipment and Devices

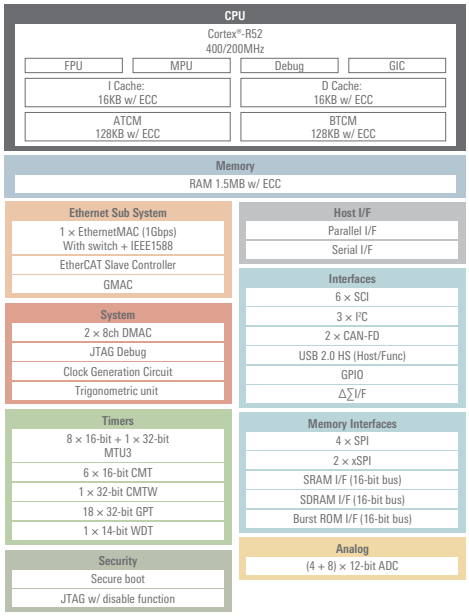
Target Applications

The RZ/N2L is optimized as a dedicated networking companion chip that can easily implement industrial Ethernet communication and TSN in industrial equipment. The RZ/N2L is a single chip solution for both industrial network and application processing.

Key Features

- Arm® Cortex®-R52 operating at a maximum frequency of 400MHz and tightly-coupled memory (256KB).
- 3-port Gigabit Ethernet switch supporting next-generation network standard TSN and EtherCAT® salve controller.
- Host interface allows application CPU to directly connect to RZ/N2L, and access at high speed. Application CPU can directly access to the system RAM of RZ/N2L.
- ELC (Event Link Controller) can be operated without the support of CPU processing.
- Supports functional safety like a safety MCU.

Block Diagram



Solution Kit

Renesas Starter Kit+ for RZ/N2L includes an on-board emulator, so you can start evaluation by simply connecting the bundled cable to your PC. A variety of sample programs for industrial network communication protocols are available on the Renesas website.

Renesas Starter Kit+ for RZ/N2L
(Product No.: RTK9RZN2L0S00000BE)

RZ/N1: Multi-Protocol Industrial Ethernet Controllers meet Performance

Target Applications

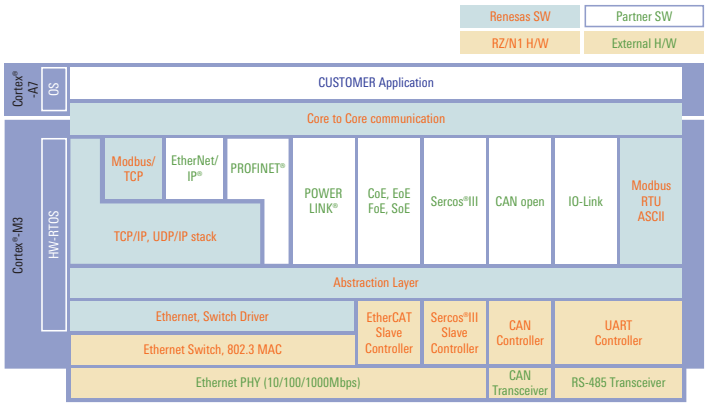
The scalable RZ/N1 family of Arm based communication devices was developed for applications like gateways, PLCs, industrial switches, sensor hubs, and remote I/Os.

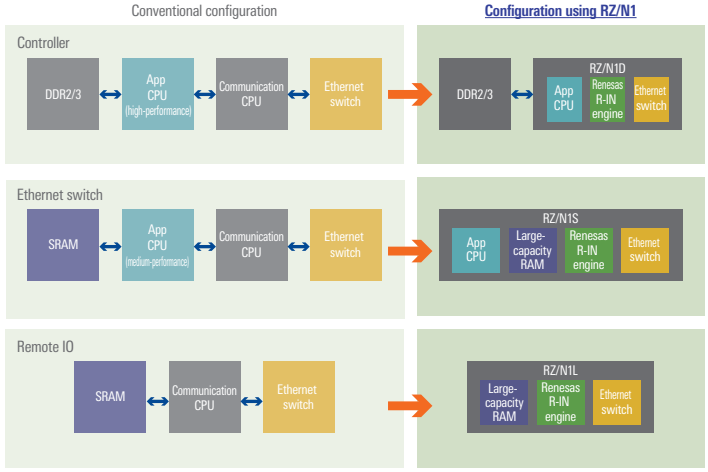
Key Features

The products in the RZ/N1 Group provide single-chip solutions that make it possible to realize simultaneously a field network connected to devices requiring real-time control and a highly reliable control network employing a redundant structure. The group lineup comprises three products that can be utilized in a broad array of applications. The RZ/N1D and RZ/N1S are built around the Arm® Cortex®-A7 in dual- and single-core configurations, respectively, while the RZ/N1L consists of the communication block only. Each of these products features the Renesas R-IN engine, an accelerator that supports a wide variety of protocols and delivers fast processing performance. The major functions are as follows:

1. Renesas R-IN engine, maximum 5-port gigabit Ethernet switch, and independent MAC unit provide support for multiple industrial Ethernet protocols.

2. Lineup of three CPU types to match a range of applications: Dual-core Cortex®-A7 (500MHz × 2), single-core Cortex®- A7 (500MHz), and Renesas R-IN engine only (125MHz).





EtherCAT® SERCOS interface ETHERNET POWERLINK PROFINET

EtherNet/IP IO-Link Modbus TCP

Fast Evaluation and Prototyping

The RZ/N1 Solution Kit is a development package incorporating both hardware and software that implements the main industrial Ethernet protocols such as EtherCAT, EtherNet/IP, and PROFINET. This makes it possible to develop prototypes in less time. By using this kit customers can reduce the time needed to develop a product by up to six months.

In addition to three CPU boards (RZ/N1D, RZ/N1S, and RZ/N1L), expansion boards are available for evaluation of a variety of peripheral functions. Select the evaluation board that best matches your application. This kit is the ideal way to experience the performance and functionality of the RZ/N1.

General Features
- U-boot
- Drivers
- C2C (Core to Core communication), etc.

Operating System
- Linux
- ThreadX

Evaluation version Protocol Stack

Master
- Software PLC
  - PROFINET
  - EtherNet/IP
  - EtherCAT, etc.

Slave
- PROFINET
- EtherNet/IP DLR
- EtherCAT, etc.

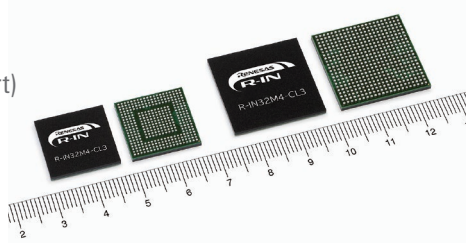
*For full version protocol stack, please contact your nearest stack supplier

R-IN32M4-CL3: Industrial Ethernet Controller with CC-Link IE TSN Support

The R-IN32M4-CL3 is a communication SoC with hardware support for CC-Link IE TSN. In addition to Renesas R-IN engine technology it implements a gigabit Ethernet compatible PHY, making it a one-chip solution for the latest in TSN communication.

Key Features

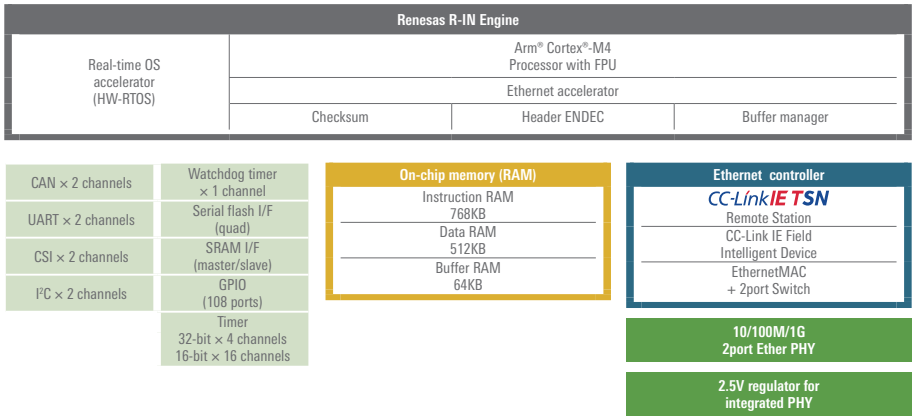
- Time synchronization accuracy between devices of ±1 µs or less (CC-Link IE TSN Class B support)
- 2-port gigabit Ethernet compatible PHY, CPU, and RAM (1.3MB) on an one-chip
- Renesas R-IN engine for same multi-protocol support as preceding product
- Compact package and on-chip PHY regulator for reduced mounting area
- Low power consumption (35% less than R-IN32M3-CL2)



Product Specifications

- CPU Cortex-M4 (100MHz)
- RAM 1.3MB ECC support
- Power supply voltage 3.3V ±5%, 1.15V ±5%
- I/O 106 channels (max.)
- 2 Ethernet ports (integrated 10/100/1000 PHY)
- Numerous peripheral functions
  - 32-bit external MCU interface
  - UART – I^2C
  - CSI – Timer
- Operating temperature range
  - Tj = –40 to +125°C
  - Ta = –40 to +85°C

R-IN32M4-CL3 Block Diagram

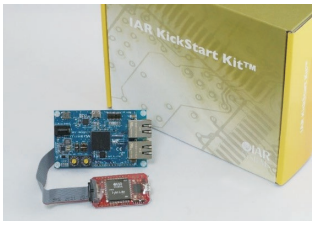


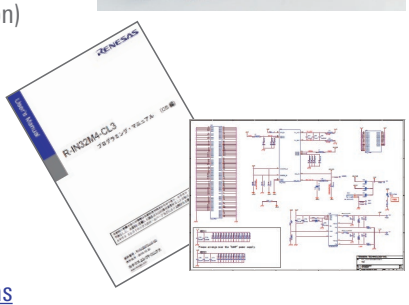
Development Environment

Verify your CC-Link IE TSN communication application within an hour of launching the development environment!

Solution set

- Startup manual
- Evaluation board mounted with R-IN32M4-CL3 (SBEV-RIN32M4CL3, manufactured by Shimafuji Electric Incorporated)
- IAR Embedded Workbench integrated development environment (evaluation version)
- I-jet Lite (JTAG-ICE)
- Sample software*
  - CC-Link IE TSN
  - CC-Link IE Field
  - Peripheral drivers
- Settings file for master station
- User's manuals





Solutions for Renesas R-IN32M4 | IAR Systems

Note: Supplied as IAR Embedded Workbench® for ARM projects.

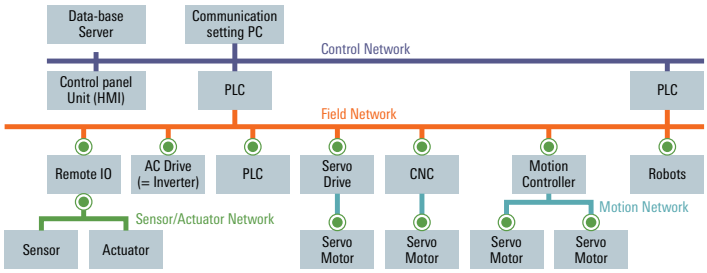
Advantages of CC-link IE TSN

Time synchronization and time sharing among devices makes possible ultrahigh-speed, highly accurate motor control. It is also possible to seamlessly connect information technology (IT) networks and operational technology (OT) networks so they can interoperate with each other, enabling flexible support for multiproduct variable-quantity production in which models and manufacturing volumes can be changed in real time for higher plant productivity overall.

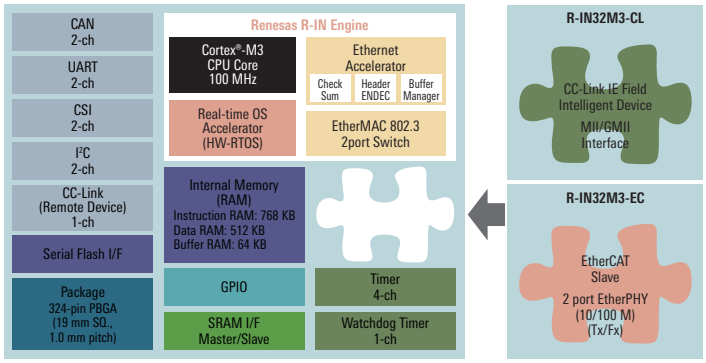
R-IN32M3: Industrial Ethernet Controllers

Target Applications

The R-IN32M3 Series is suitable for use in the communication unit of slave devices in field networks and motion networks indicated by ◉.

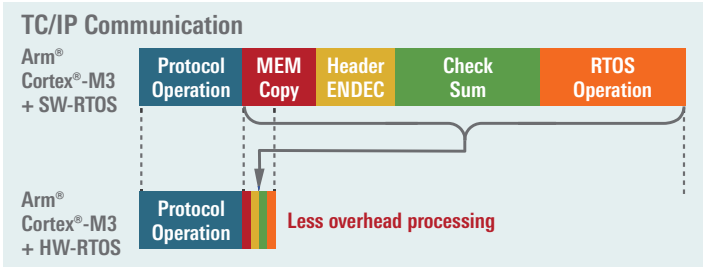


Target products: PLC, remote IO, CNC, AC drive (inverter), robot, servo drive, servo motor



The new Dimension of Real-Time

The Renesas R-IN engine is an integrated processor subsystem that includes hardware Ethernet and RTOS accelerators, developed for high speed and real-time communication under very low power consumption. These mechanisms do not just reduce the number of cycles needed to process one Ethernet frame drastically, but they also provide an unmatched determinism with response times beyond the capabilities of pure CPU based systems. The device supports industrial Ethernet protocols like EtherCAT, PROFINET, EtherNet/IP and CC-Link IE. Some variants also include an integrated Ethernet PHY.



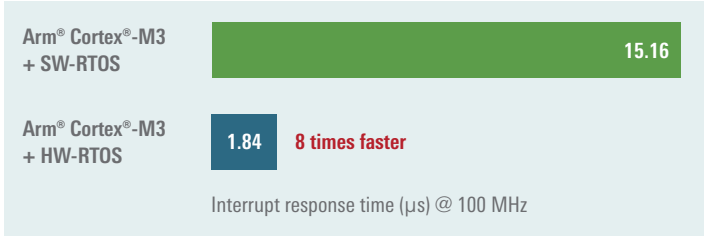
Effects on Ethernet Frame Processing: Drastic Reduction of Overhead Processing

Characterized by Innovation

R-IN32M3 is an Industrial Network Controller with multiprotocol support for industrial applications like Remote IOs, Sensors, Actuators, PLCs, Drives, Motion Controllers or robots. The design philosophy is characterized by three design rules:

- Low power dissipation despite the highest level of integration
- Perform time sensitive and process intensive tasks in hardware
- Support all major industrial Ethernet standards

The Renesas R-IN engine also features a Hardware Accelerator for both the real-time operating system and higher layer network frame processing.



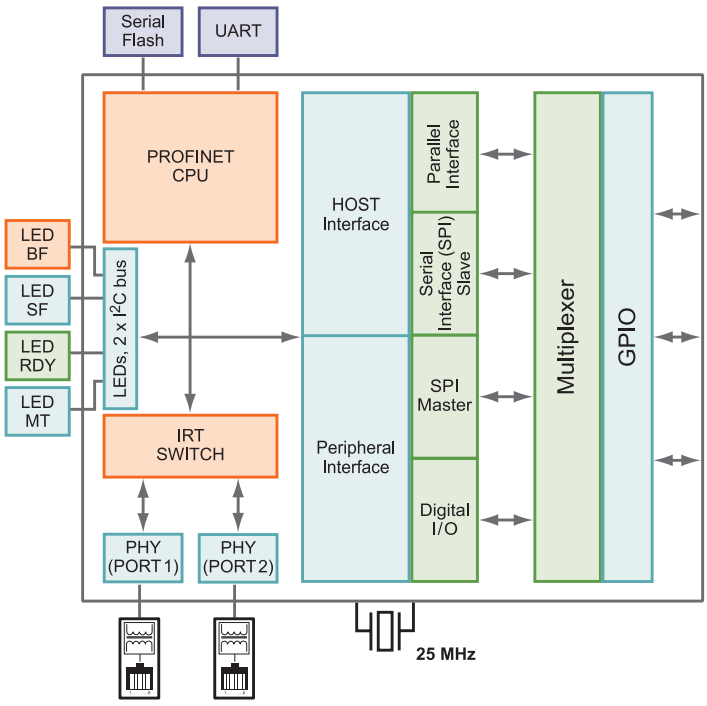
TPS-1: Single Chip for PROFINET RT and IRT

Certified RT/IRT Functionality for PROFINET V2.3

The PROFINET Device Chip TPS-1 is designed for easy and cost-efficient implementation of PROFINET interfaces for automation devices. It is a highly integrated single chip solution that complies with the PROFINET Conformance Class C.

The internal structure is designed to fulfill the requirements of the IRT protocol and the time-critical PROFINET protocols are supported by hardware.

The configurable interfaces facilitate the flexible realization of different use cases like direct connection of an external host CPU or digital I/Os without additional circuitry. Special synchronization signals allow to lock the host application program to the PROFINET I/O cycle. To support line topologies in PROFINET networks, the TPS-1 is equipped with two integrated PHYs and an integrated IRT switch.



TPS-1 Block Diagram

Efficiency - Sustainable Low Cost

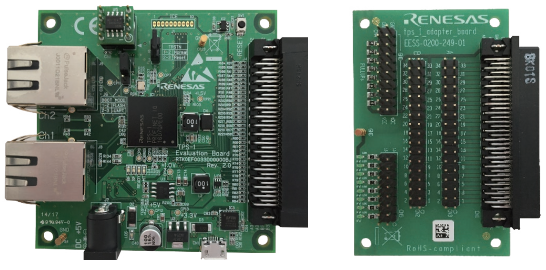
For the complete implementation of a PROFINET device interface, only the TPS-1, a serial Flash device, an oscillator, and the physical adaptations for the Ethernet interface (transformers and connectors) are needed. The serial flash component contains the individual chip configuration and the PROFINET stack firmware.

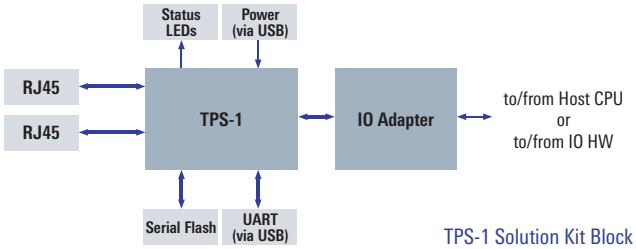
Due to the low space requirement (just 260 mm²) and low power dissipation (0.8 W) of the TPS-1, a PROFINET interface can also be integrated into automation devices with special requirements regarding housing size and protection classes. Conductor routing between the balls is still possible in order to keep down PCB cost.

Low-cost Solution Kit for TPS-1 "Y-CONNECT-IT-TPS-1L"

The new TPS-1 low-cost Solution Kit allows a simple and efficient PROFINET IRT design with the TPS-1 PROFINET IRT device chip. Beside the TPS-1 board, the kit features a passive adapter board that allows a simple connectivity to almost any MCU, a DVD with software and several cables.

The TPS-1 board runs the latest PROFINET IRT software and features only the basic circuitry needed for a PROFINET IRT network. Due to the optimized hardware there is a significantly lower entry cost to the PROFINET world and not at the expense of the usability. All the GPIOs and additional control signals are available on the connector and can be easily accessed.





TPS-1 Solution Kit Block Diagram

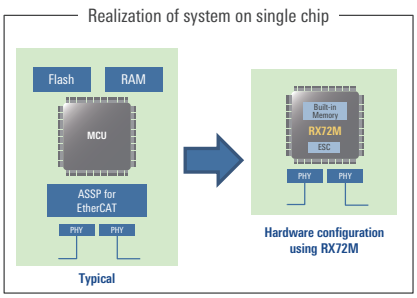
Solutions page
(renesas.com)

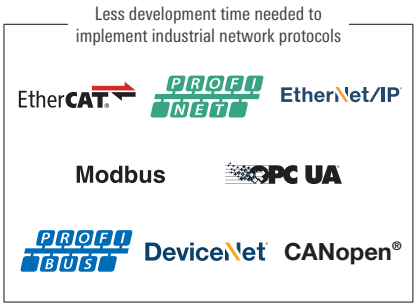
RX72M Industrial Network Solutions

Industrial networks often involve multiple protocols operating side-by-side and coexisting with each other, with each being utilized for the specific features it provides. Renesas offers solutions incorporating the RX72M that support multiple protocols to assist customers with their development work.

RX72M Network Solutions

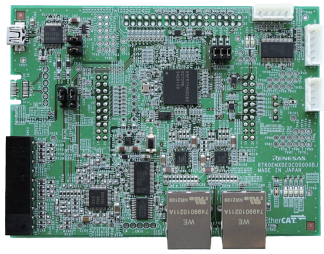
Sample software is available that supports EtherCAT® and other major industrial network communication protocols covering 70% of the market. In collaboration with partner vendors, Renesas enables customers to reduce the development time required for protocol implementation. By utilizing the excellent performance and large memory capacity of the RX72M operating at 240MHz (CoreMark score: 1461), these solutions concentrate system functions on a single chip, reducing the development BOM cost and contributing to more compact products.





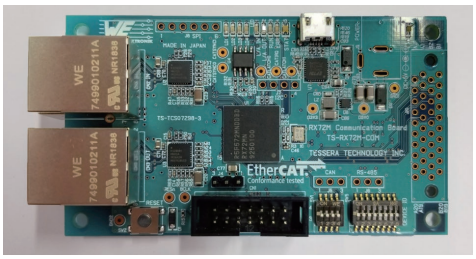
RX72M Network Solution Boards

Renesas offers RX72M evaluation boards ideal for initial evaluation of network devices, along with OSes, middleware, and sample software.



RX72M CPU Card with RDC-IC (RTK0EMXDE0C00000BJ)

- Can be used to control BLDC motors and stepping motors when used in combination with a compatible inverter board.
- A variety of sample code is available.



EtherCAT Conformance tested

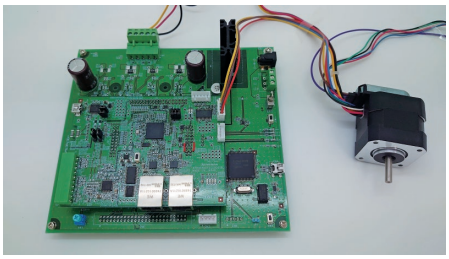
PI CERTIFIED PROFIBUS • PROFINET

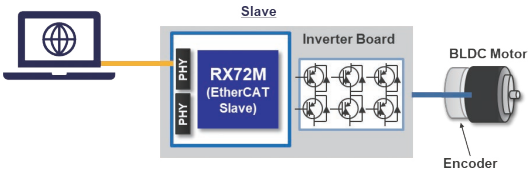
ODVA CONFORMANT

TS-RX72M-COM*

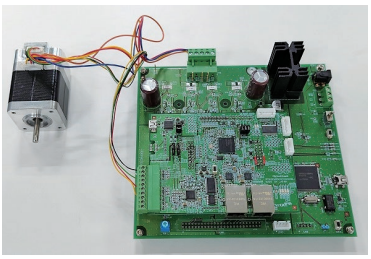
- EtherCAT and 2-channel Ethernet port (MII)
- RS485 and CAN transceiver (field network support)
- Conformance tested on three major protocols (EtherCAT®, PROFINET RT, and EtherNet/IP).

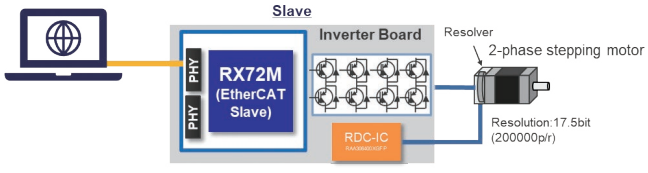
* The TS-RX72M-COM board is available from Tessera Technology Inc. For details, contact a Renesas sales agent.





- Encoder vector control for permanent magnet synchronous motors
  Encoder vector control software is programmed onto the RX72M, enabling implementation of EtherCAT® communication and encoder brush motor control using a single chip.





- Vector control of stepping motors with resolvers
  Resolver vector control software is programmed onto the RX72M, enabling implementation of EtherCAT® communication and control of stepping motors with resolvers using a single chip.

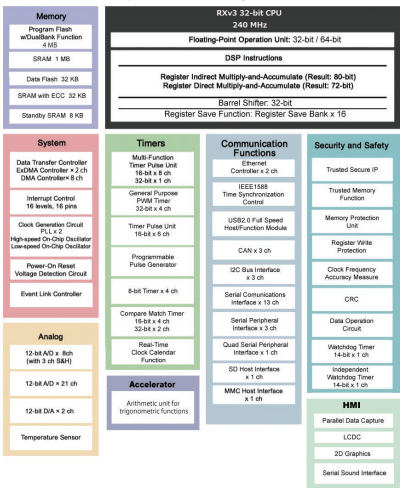
RX72N, RX66N, RX65N
Expands Equipment Control and Networking Portfolio with 32-Bit MCUs

Outstanding real-time performance and one-chip solutions

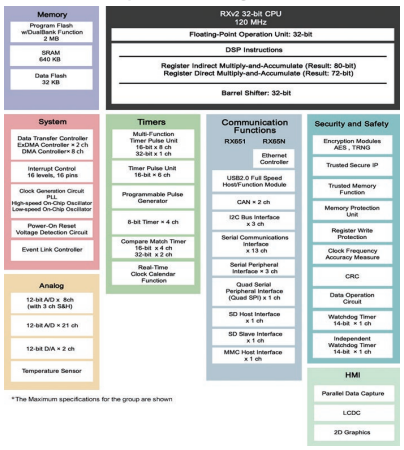
Overview

Delivered more than one billion microcontrollers from the RX Family of 32-bit MCUs, and enable to pick up the the Ethernet supported MCU that best suits the application from a large selection of line-up. In addition to CPU performance from 120MHz to 240MHz, a wide range of memory options is available such as on-chip flash memory is from 512KB to 4MB and on-chip SRAM is from 256KB to 1MB. Other features include multiple communication interfaces, cloud connections, security, and HMI functions.

RX72N Group Block Diagram



RX65N Group Block Diagram



Key Features

RX72N, RX66N

- Outstanding Real-Time performance: With the fastest flash memory operation in the industry, even if the cache miss occured, program instructions execute promptly no wait cycles for the RX66N and with only one wait cycle for the RX72N.
- Multiple Functions and Small Footprint: The largest memory of industry's and general-purpose I/O interface enable to implement many functions, it contributes space saving and shorter development time.
- Robust Security: Perfect application from various threats by Trusted Secure IP (TSIP), as TSIP outputs key generation related unique ID, this avoids to use in other devices, even if the key generation is eavesdropped.
- Advanced HMI function: LCD controller, 2D drawing engine, serial sound I/F, and 1MB SRAM realize HMI functions without external RAM.

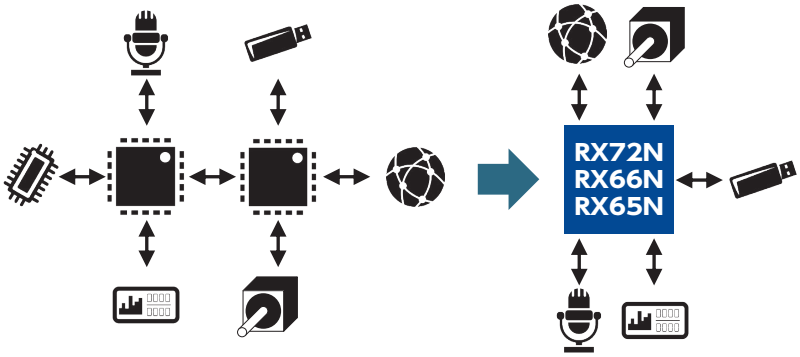
RX65N

- A variety of communication interfaces are implemented on-chip, including Ethernet (1 channel), USB, CAN, SD host/slave, and quad SPI.
- 2MB flash memory and 640KB SRAM relaze to downsizing and large-capacity memory, suitable for a variety of applications.

New RX Portfolio

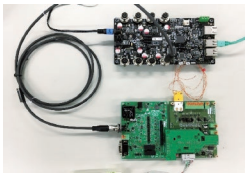
	Industrial network protocol support	Flagship product offering highest performance	No-wait state real-time performance	Mainstream Device with Excellent Power Efficiency
Group	RX72M	RX72N	RX66N	RX65N
CPU	240MHz RXv3 core Double-precision FPU Register bank save function	240MHz RXv3 core Double-precision FPU Register bank save function	120MHz RXv3 core Double-precision FPU Register bank save function	120MHz RXv2 core Single-precision FPU
Memory	4MB flash memory (120MHz read access) 1 MB SRAM	4MB flash memory (120MHz read access) 1 MB SRAM	4MB flash memory (120MHz read access) 1 MB SRAM	2MB flash memory (50MHz read access) Max. 640KB of SRAM
Network	Ethernet: 2 channels EtherCAT: 2 channels + support for major protocols	Ethernet max. 2 channels	Ethernet: 1 channel	Ethernet: 1 channel

System Configuration



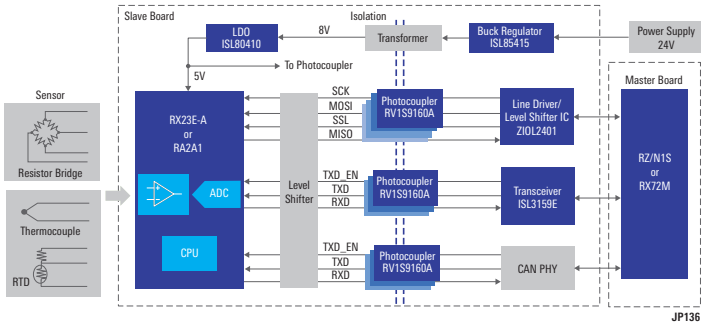
IO-Link Solution

Toward realization the the smart factory that is at the core of Industry 4.0., the market trend shifted from general Ether to Industrial Ether. The challenge is to "Connect" all product devices from upper layers such as PLCs to lower layers such as sensors and actuators and common network communication is required in the market. IO-Link supports bidirectional communication and gather attention as a key technology to realize the goal of bringing IoT to the factory.



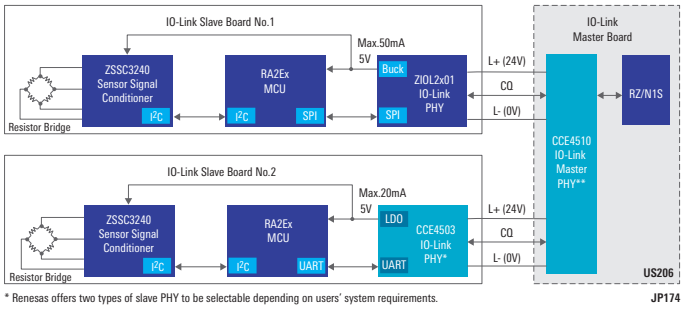
RX23E-A Temperature Sensor Solution

- This solution uses 32-bit MCU RX23E-A built-in a high-precision analog front-end (AFE) to measure temperature, process sensing and signals, and realizes IO-Link communications via ZIOL2401 IO-Link PHY chip.
- IO-Link tool on user's PC enables to provide data check, monitor the value of temperature measurement, and set parameter.
  With IO-Link Teach In, enables to control LED on/off based on the temperature measurement.



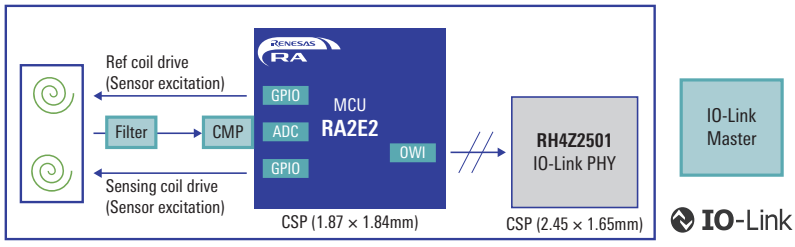
RA2E1 Pressure Sensor Solution

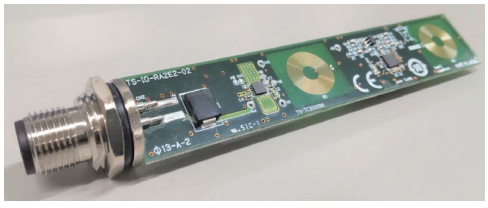
- The combination of RA2E1 ultra-compact (CSP package) with low-power and ZSSC3240 kit (sensor + sensor signal conditioner) realize pressure measurement, signal processing, and IO-Link communication, suitable for space-constrained applications.
- IO-Link tool on user's PC enables to provide data check, monitor the value of pressure measurement, and set parameter.
  With IO-Link Teach In, enables to control LED on/off based on the pressure measurement.



RA2E2 Proximity Sensor Solution

- Ultracompact, power-efficient RA2E2 32-bit MCU with Arm Cortex-M23 core running at 48MHz and available in a variety of wafer chip scale package (WCSP) versions contributes to reduced BOM cost.
- We recommend using the one-wire interface (OWI) of the RH4Z2501 IO-Link PHY from Renesas to eliminate the need to use pins to connect to the MCU.
- Metal is detected by sensing the electrical resistance between two coils on the partner vendor board (IO-Link Inductive Sensor Solution Board), causing an LED on the board to illuminate. This can also be controlled and monitored using a GUI software tool that runs on a PC.





TS-IO-RA2E2-02* (IO-Link Inductive Sensor Solution Board)

- RA2E2 MCU
- Inductive proximity sensor functionality
- IO-Link device communication functionality
- Ability to connect to E2 emulator or E2 Lite emulator

* The TS-IO-RA2E202 is available from Tessera Technology Inc. For details, contact a Renesas sales agent.

IEC16508 Certified Functional Safety Solutions for Industrial Applications

Renesas' functional safety solutions provide the core technologies needed to obtain IEC 61508 SIL* certification. Certified software, kits, and reference boards, backed by reference documentation, ensure that the process of building a functional safety system is a smooth one. These solutions can dramatically shorten the time required for development and help you realize functional safety systems that perform appropriate processing when malfunctions occur.

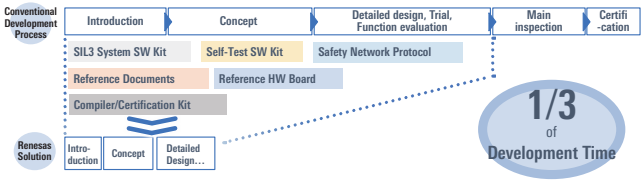
* SIL: Safety Integrity Level. Designates the safety level under functional safety standards.

TÜV Certified Solution

Safety system development is very complexed process. Therefore it is very important to build up an application piece by piece considering functional safety standards in both hard and software modules. Ideally the parts should come with certification. While every application is different per usage for safety components, hard as well as software, Renesas provides less extensive workload for safety system developers.

Renesas Solutions vs Certification Process

Renesas solutions covers certification process and will shortens customer's actual development TAT.
Renesas' certified SW will complete the functional safety diagnosis on MCU so customer will be able to focus more on their own application development.



Target Application

- AC servos/drives
- Remote I/O
- Programmable logic controllers
- Sensors/actuators


Industrial Robot Arm


PLC

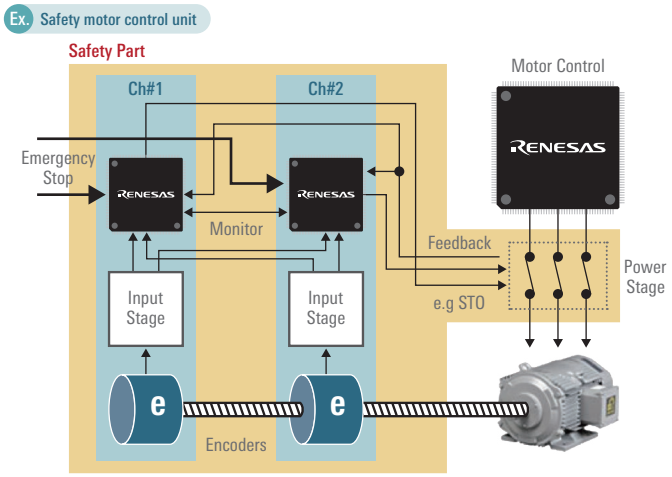

AC Drive, Inverter


Light Curtain, Sensor

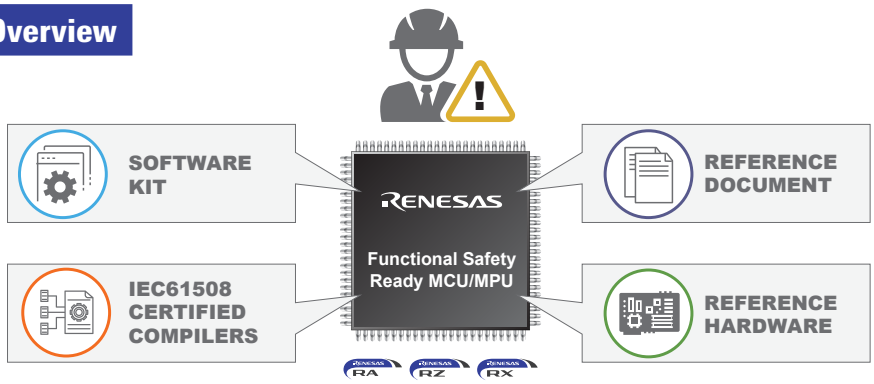
Usage Example : Safe Motor Control

Application and Safety Functionality separated
Two channel concept (1oo2 architecture)
Cross Monitoring
Standard Compliant
- IEC 61508 SIL3
- ISO 13849 Ple Cat4
- IEC 62061 SILCL3

Safety functions according to IEC61800-5-2 (e.g. STO, SLS, etc.)



Renesas Solution Overview



Software

Self-Test Software Kit*

Diagnostic software for permanent failure of CPU, ROM, RAM inside the MCU/MPU.

Available for web download with certificate

SIL3 System Software Kit*

Functional Safety Platform software for dual MCU/MPU system equipped with MCU/MPU diagnosis, scheduler, and partitioning function.

Free evaluation version available via web download

Safety Protocol Application Software Kit*

FSoE and PROFIsafe for slave devices.

Free evaluation version available via web download

Safety Kit for Compiler

IEC61508 Certification Kit for RX Compilers*

Document set certifying functional safety compliance of Renesas compiler "CC-RX".

Document

Reference Document*

Guideline document to obtain IEC61508 certification, including:

- Sample documents to submit to certification body
- Preparation guide
- Technical documents, necessary for safety part development such as input/output circuit diagnosis—, and power-supply monitoring

Free digest version available via web download

Evaluation

Reference Hardware

- Reference board (dual MCU configuration eval board)
  - RX111-RX111 (RXv1 core version)
  - RX71M-RX651 (RXv2 core version)
  - RX72N-RX72N (RXv3 core version)
- FSoE reference kit with RX MCU*
  - RX72M – RX23T dual MCU configuration eval board comes with sample software to realize safety Remote I/O

*Acceptance beforehand of a license agreement, or payment of a license fee when using the free evaluation version, is required.

Solution Portfolio

Product	Family	RX			RA				RZ
	Core	RXv1 (RX111, 113, 130)	RXv2	RXv3	CM4	CM23	CM33	CM85	CR52 (RZ/T2M, T2L, N2L)
Self-Test Software Kit		✓	✓	✓	✓	✓	✓	✓	✓
SIL3 System Software Kit			✓	✓					✓
FSoE Application Software Kit			✓	✓					✓
PROFIsafe Application Software Kit			✓	✓					✓
Reference Document		✓	✓	✓	✓*	✓*	✓*	✓*	✓*
Reference Hardware		✓	✓	✓					
IEC 61508 Certified Compilers		✓	✓	✓	**	**	**	**	**

*: Although the example describes using RX MCUs, it can be used for other MCUs as it is a technical document for the functional safety standard itself and not dedicated to a specific MCU/MPU Family.
**: EWARM from IAR Systems ready

Winning Combinations

What are Winning Combinations?

Winning combinations are comprehensive solutions that combine complementary Renesas products from our portfolio, such as analog + power + embedded processing devices. These winning combinations bring together products that work together optimally, enabling customers to speed up the design process and bring their finished products to market more quickly. With the focus on the industrial, infrastructure, and automotive fields, Renesas is working to provide an optimal portfolio of products to customers and partners worldwide.

Application	Title	ID
Network	Gigabit Industrial Ethernet System-on-Module (SoM) Solution	EU140
	Remote I/O Solution	CN032-7
	Multi-Protocol Industrial Ethernet Switch	EU012
	CC-Link IE TSN Solution	JP135
	Real-Time Industrial Ethernet Switch (Low Cost) with RZ/N1S	EU013
Motor	Motor Control System with Industrial Network and Functional Safety	JP191
	AC Servo Solution	CN032
	Functional Safety Network with Safety Drive System	JP148
Sensor	Industrial Ether Connectable IoT Sensor Hub	JP129
	Time of Flight (ToF) Sensor Module	JP084
	Industrial Sensor Network Solution	JP136
	IO-Link Master Solution	US206
	IO-Link Slave Sensor Solution	JP174
	IO-Link Enabled Sensor System	US020
	Multi-Sensor Module for Industrial Ethernet	EU025

Visit the website below to see examples of a variety of solutions for industrial equipment.

https://www.renesas.com/winning-combinations

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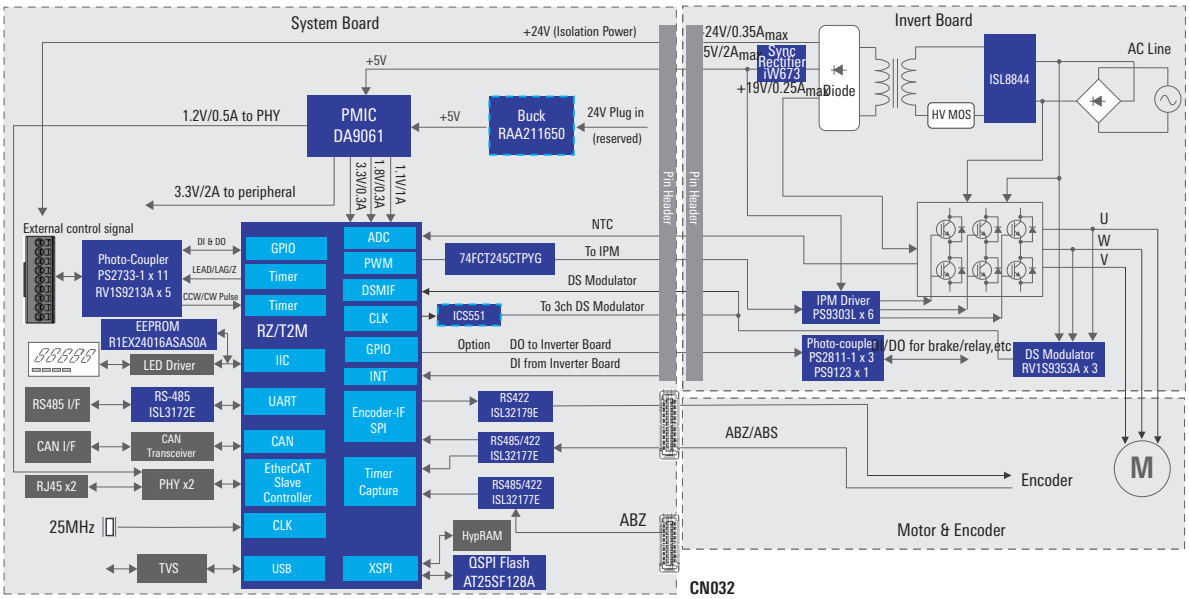
Type the ID number into the search bar on the Renesas website (www.renesas.com) to view the corresponding page.

Notable Winning Combinations

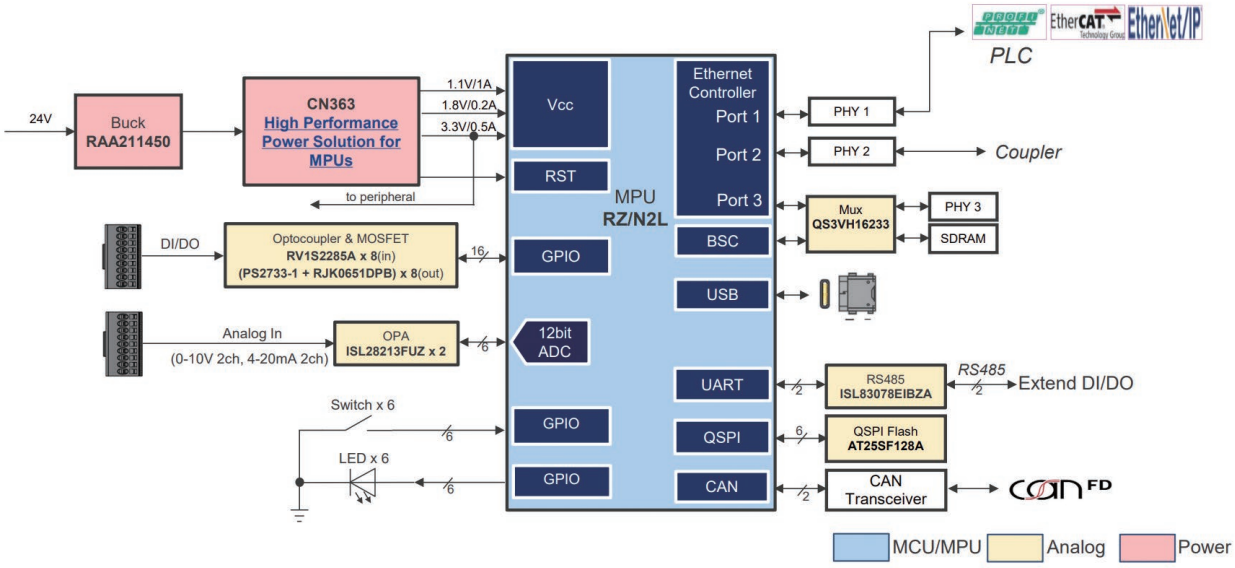
• AC Servo Solution (CN032)



<Overview>

This Renesas AC servo solution integrates motor control and EtherCAT design to support high-speed and high-precision motor control through synchronizing time-sensitive industrial Ethernet communications. This solution is composed of three blocks: system control, power drive and motor encoder, which are physically isolated while maintaining a high degree of interconnect. By utilizing the high-performance RZ/T2M or RZ/N2L microprocessor, this monolithic solution design outperforms traditional two-chip platforms on performance and cost.

• Remote I/O Solution (CN032-7)

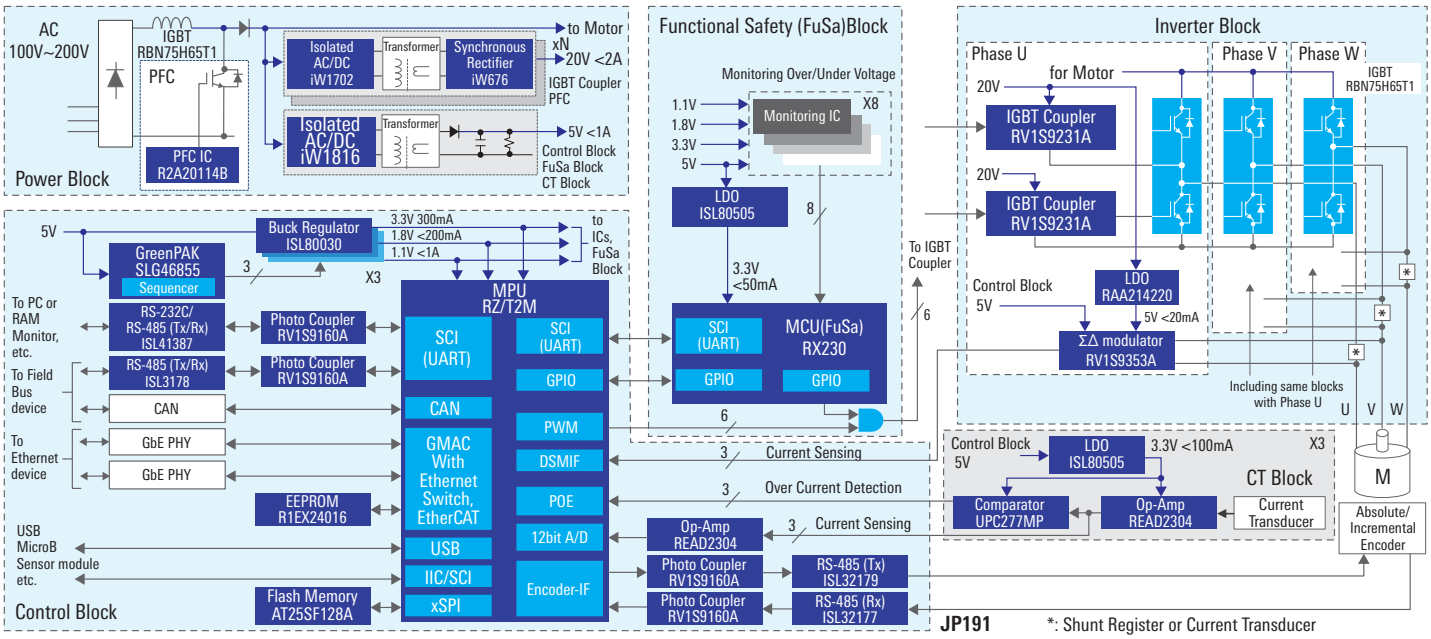


<Overview>

The Renesas Remote I/O Solution is a development kit for evaluating remote I/O applications using the RZ/N2L Gateway Solution Board which is equipped with digital IO interface with photocoupler isolation and analog input and supports industrial network communications such as EtherCAT and EtherNet/IP. In addition, we provide sample programs for industrial network communication and DI/DO.

There is equipped with necessary components such as a power module that supports the RZ/N2L power sequence, transceivers for RS485 and CAN, and Ethernet PHY, and can be used as a reference design.

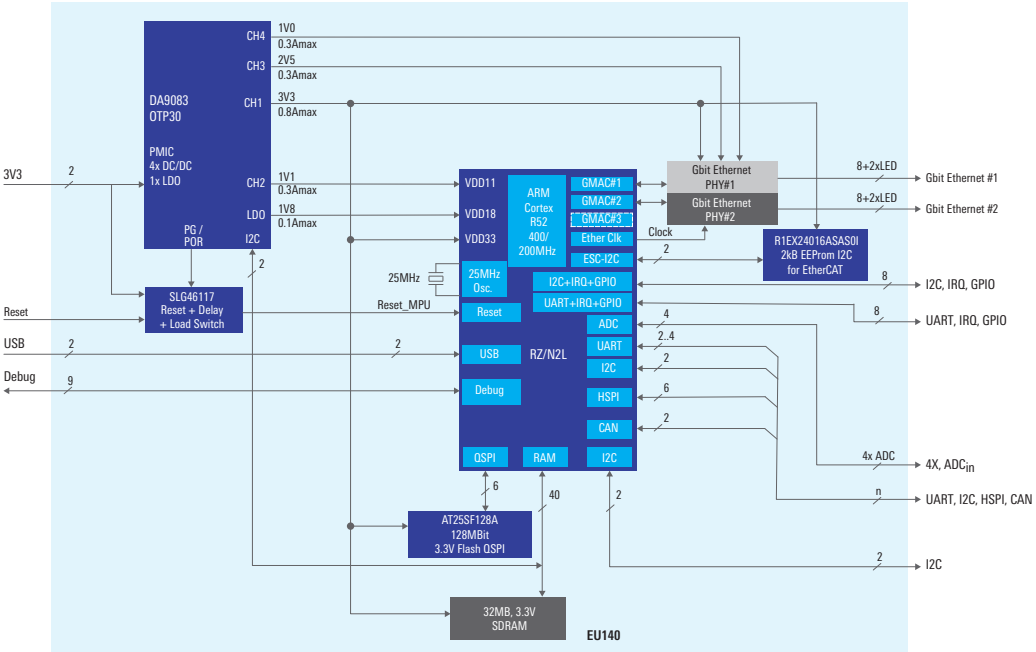
• Motor Control System Supporting Industrial Networks and Functional Safety (JP191)



<Overview>

This is a total solution for an industrial motor control system composed of a variety of devices such as MPUs, MCUs for cross monitoring, power ICs, and delta-sigma modulators. Combining these devices makes it possible to implement a variety of functions required for motor control, industrial networks, and functional safety (FuSa) in a manner that delivers both high performance and simplicity.

• Gigabit Industrial Ethernet SoM (EU140)



<Overview>

There is increasing demand in the industrial equipment market for MPU-based system on module (SoM) products that offer advanced functionality and compact size, enabling customers to build their own peripheral devices. This solution, which includes an SoM and carrier board, is designed to substantially reduce the time, development cost, and risk for customers bringing products to market.

Tool Kits

TABLE OF AVAILABLE TOOL KITS			
	Related Product	Available Kit	Order Number
R-IN	R-IN32M3-EC	Solution Kit	YCONNECT-IT-RIN
	R-IN32M3-EC	Evaluation Kit	Y-SK-RIN32M3-EC (EtherCAT)
	R-IN32M3-CL	Evaluation Kit	Y-SK-RIN32M3-CL (CC-Link IE)
EtherCAT	RX72M	CPU card with RDC/IC	RTK0EMXDE0C00000BJ
TPS-1	TPS-1	Low Cost Solution Kit	YCONNECT-IT-TPS-1L
IO-Link	CCE4503	Evaluation Board	CCE4503-EVAL-V3
	CCE4502	Evaluation Board	CCE4510-EVAL-V2
	RH4Z2501	Evaluation Board	RH4Z2501-KIT
RENESAS RX	RX23E-A	Solution Kit	RTK0ESXB10C00001BJ
	RX65N	Renesas Starter Kit	RTK50565N2S80000BE
	RX65N	Cloud Kit	RTK5CK65N0S04000BE
	RX66N	Target Board	RTK5RX66N0C00000BJ
	RX72N	Envision Kit	RTK5RX72N0C00000BJ
	RX72M	Renesas Starter Kit	RTK5572MNDS10000BE
	RX72M	RX72M CPU Card with RDC-IC	RTK0EMXDE0C00000BJ
	RX71M, RX651	Functional Safety, Reference Board for RX71M-RX651	RTK0EF0058D01001BJ
	RX72N	Functional Safety, Reference Board for RX72N-RX72N	RTK0EF0058D02001BJ
RENESAS RZ	RZ/T2H	Evaluation Board	RTK9RZT2H0S00000BJ
	RZ/N2H	Evaluation Board	RTK9RZN2H0S00000BJ
	RZ/T2M	Renesas Starter Kit	RTK9RZT2M0S00000BE
	RZ/T2ME	Renesas Starter Kit	RTK9RZT2M1S00000BE
	RZ/T2L	Renesas Starter Kit	RTK9RZT2L0S00000BJ
	RZ/N2L	Renesas Starter Kit	RTK9RZN2L0S00000BE
	RZ/N2L	Evaluation Kit	YCONNECT-IT-RZN2L
	RZ/T1	Renesas Starter Kit	RTK7910018S00000BE
	RZ/T1	Renesas Starter Kit (without debugger)	RTK7910018S90000BE
	RZ/N1D	Solution Kit	YCONNECT-IT-RZN1D
	RZ/N1S	Solution Kit	YCONNECT-IT-RZN1S
	RZ/N1L	Solution Kit	YCONNECT-IT-RZN1L
	RZ/N1D or RZ/N1S	Expansion Board	YCONNECT-IT-RZN1-EB
RENESAS RA	RA2E1	Evaluation Board	RTK7EKA2A1S00001BU
	RA2E2	Evaluation Board	RTK7EKA2E2S00001BE
	RA6M3	Evaluation Board	RTK7EKA6M3S00001BU

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