RENESAS

INDUSTRIAL NETWORKS

Enabling IIoT and industry 4.0 Infrastructure

2023.11

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

Motor Control				PLC, Gateway		Network Controller, Remote I/O					PROFINET
RZ/T2M NEW Arm®Cortex®-R52 x2	**RZ/T2L** NEW 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** NEW Arm®Cortex®-R52	**R-IN32M3-EC** Arm®Cortex®-M3	**R-IN32M3-CL** Arm®Cortex®-M3	**R-IN32M4-CL3** Arm®Cortex®-M4	**Module** **R-IN32M3 Module**		**TPS-1** PROFINET CPU
3 port GMAC w/ switch 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	R-IN32M3-EC RJ-45x2 SPI for Application CPU		2 port w/ PHY PROFINET / PROFINET IRT
											EtherCAT **EC-1** Arm®Cortex®-R4 w/ FPU EtherCAT slave
											Modbus **RA6Mx** RA6 Cortex®-M33 1 port w/ with DMA Modbus
TSN					TSN						**ASi-5** **ASI4U-V5** Fully Compliant ASi-5 ASi-5
EtherCAT / EtherNet/IP	EtherCAT	EtherCAT / EtherNet/IP	EtherCAT / EtherNet/IP	EtherCAT / EtherNet/IP	EtherCAT / EtherNet/IP	EtherCAT / EtherNet/IP		CC-Link IE	CC-Link IE / CC-Link IE	EtherCAT / EtherNet/IP	
PROFINET / PROFINET IRT		PROFINET	PROFINET	PROFINET / POWERLINK	PROFINET / PROFINET IRT	PROFINET	PROFINET / EtherNet/IP	PROFINET / EtherNet/IP	PROFINET	
Modbus TCP / POWERLINK		Modbus TCP	Modbus TCP	Modbus TCP / SERCOS	Modbus TCP / POWERLINK	Modbus TCP	Modbus TCP	Modbus TCP	Modbus TCP	

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.
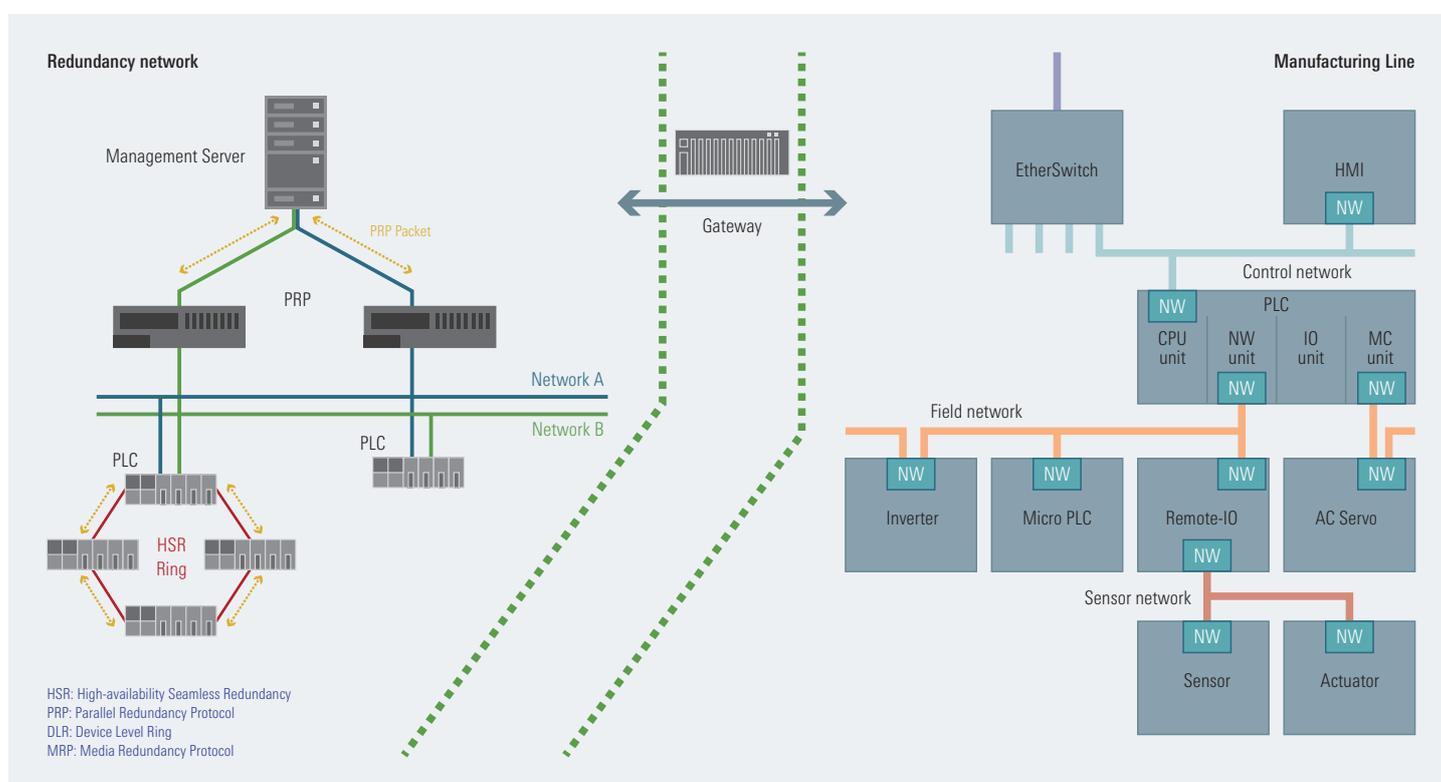
Usable for any layers/use cases in industrial

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

Redundancy network

Management Server

PRP Packet

PRP

Network A
Network B

PLC

PLC

HSR Ring

HSR: High-availability Seamless Redundancy
PRP: Parallel Redundancy Protocol
DLR: Device Level Ring
MRP: Media Redundancy Protocol

Gateway

Manufacturing Line

EtherSwitch

HMI
NW

Control network

NW
PLC
CPU unit | NW unit | IO unit | MC unit
NW | NW

Field network

NW
Inverter

NW
Micro PLC

NW
Remote-IO
NW

NW
AC Servo

Sensor network

NW
Sensor

NW
Actuator

■ Recommended Devices for Industrial Networks

For Master

Type		RZ/T2M	RZ/T2L	RZ/T1	RZ/N2L	RZ/N1D	RZ/N1S	RZ/N1L	RA6	RX72M	ASI4U-V5
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	—	—	—	—	—	—	—	—	—	—
	ASi-5	—	—	—	—	—	—	—	—	—	✓

For Slave

Type		RZ/T2M	RZ/T2L	RZ/T1	RZ/N2L	RZ/N1D	RZ/N1S	RZ/N1L	R-IN32(CL3)	R-IN32(CL)	R-IN32(EC)	EC-1	TPS-1	RX72M	RA6	RA2	RX23E-A	RL78	ASI4U-V5
Industrial Ethernet	OPC UA	✓*	—	✓	✓*	✓	✓	✓	✓*	✓	✓	—	—	✓	—	—	—	—	—
	PROFINET	✓* 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, B	✓ A	✓ A	—	—	✓ A	—	—	—	—	—
	CC-Link IE F: Field FB: Field Basic	✓* FB	—	✓* FB	✓* FB	✓* FB	✓* FB	✓* FB	✓ F ✓* FB	✓ F ✓* FB	—	—	—	✓* FB	—	—	—	—	—
Fieldbus	IO-Link	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓	✓	✓	—
	PROFIBUS	✓*	—	✓*	✓*	—	—	—	—	—	—	—	—	✓	—	—	—	—	—
	CANopen	✓*	—	✓*	✓*	—	—	—	—	—	—	—	—	✓	—	—	—	—	—
	DeviceNet	✓*	—	✓*	✓*	—	—	—	—	—	—	✓	—	✓	—	—	—	—	—
	Modbus RTU/ASCII	✓*	—	✓	✓*	✓	✓	✓	✓	✓	✓	—	—	✓	✓	—	—	✓	—
	CC-Link	—	—	—	—	—	—	—	—	✓	✓	—	—	—	—	—	—	—	—
	ASi-5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	✓

* Under consideration. Contact a sales person for details.

RZ/T2M: MPU Enabling High-Speed and Highly Precise Servo Motor Control
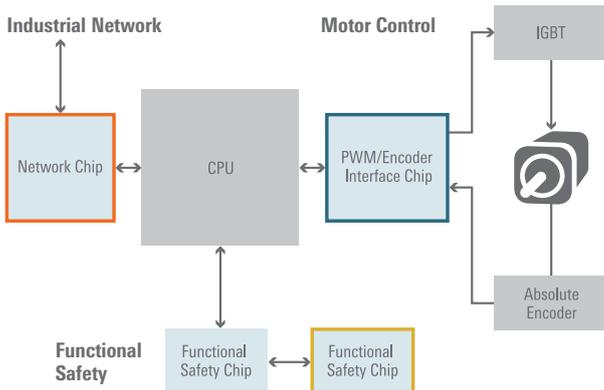
Target Applications

The RZ/T2M 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.
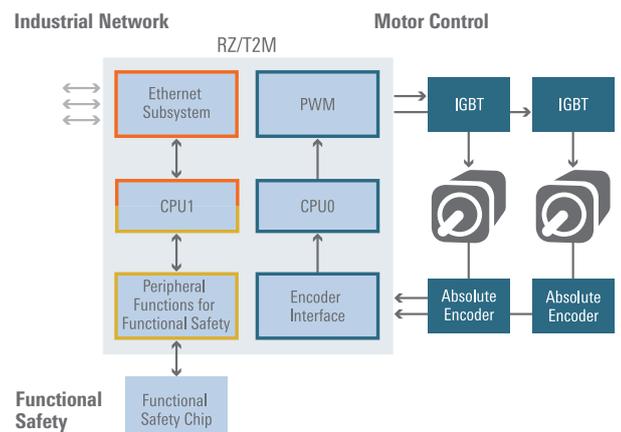

AC servo drivers | Industrial motors | Inverters | Motion controllers | Robots

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.

Conventional System

System Using RZ/T2M

Block Diagram

Solution Kit

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

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.

AC servo drivers | Industrial motors | Inverters | Robots | Medical devices

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 $\sum\Delta$ 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.
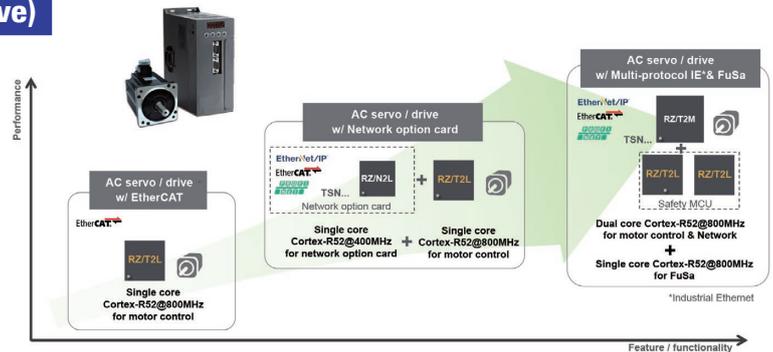
Block Diagram

CPU
Cortex®-R52
800MHz/400MHz/200MHz

FPU	MPU	Debug	GIC

I-cache 16KB w/ ECC	D-cache 16KB w/ ECC
ATCM 512KB w/ ECC	BTCM 64KB w/ ECC

Memory
RAM 1MB w/ ECC

System	Interfaces
2 × 16ch DMAC	6 × SCI
JTAG Debug	3 × I²C
Clock Generation Circuit	2 × CAN-FD
Trigonometric unit	USB 2.0 HS (Host/Func)
	GPIO
Ethernet Sub System	Δ∑I/F
EtherCAT Slave Controller	**Memory Interfaces**
GMAC	4 × SPI
Timers	2 × xSPI
8 × 16-bit + 1 × 32-bit MTU3	SRAM I/F (16-bit bus)
6 × 16-bit CMT	SDRAM I/F (16-bit bus)
2 × 32-bit CMTW	Burst ROM I/F (16-bit bus)
18 × 32-bit GPT	**Analog**
1 × 14-bit WDT	(4 + 4) × 12-bit ADC
Security	**Interface**
Secure boot (option)	Encoder interfaces (2ch)
JTAG w/ disable function	

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.

| Industrial motors | Industrial controllers | Robots | Actuators | AC servo drivers |
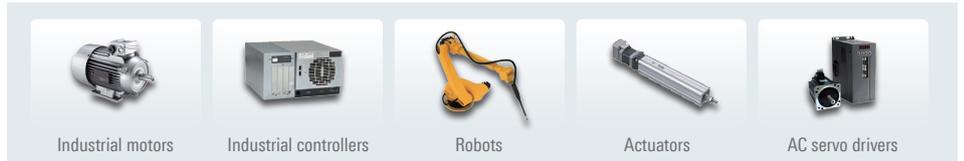
Key Features

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.

Industrial Ethernet Protocol

EtherCAT
PROFINET
EtherNet/IP
Modbus

Digital Encoder Interface

EnDat
BiSS-C
A-format
FA-CODER
HIPERFACE DSL
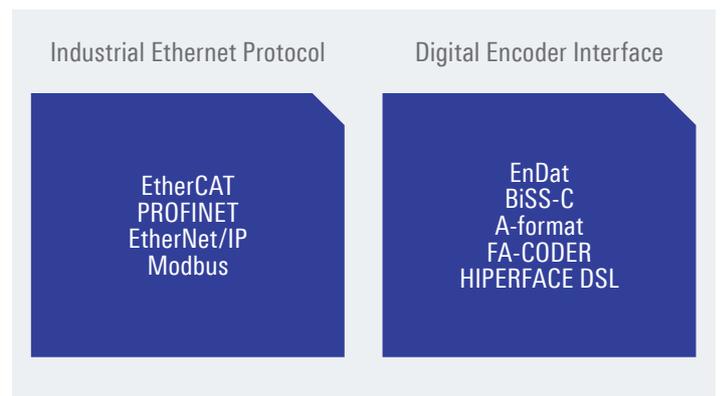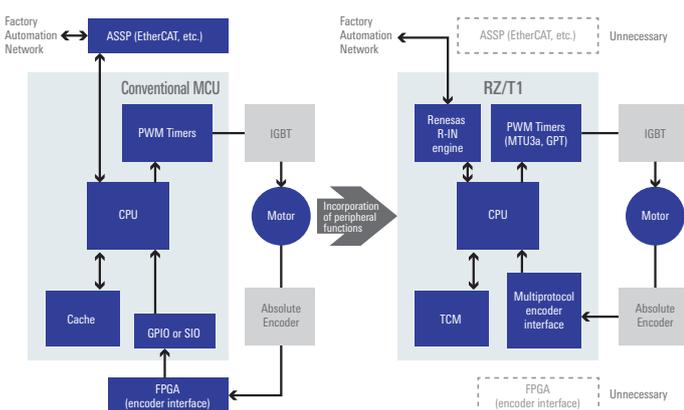
- The encoder interface is external with conventional FPGA or ASIC approaches but is integrated on-chip with the RZ/T1.
- This one-chip AC servo solution helps reduce the component count and saves space.

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
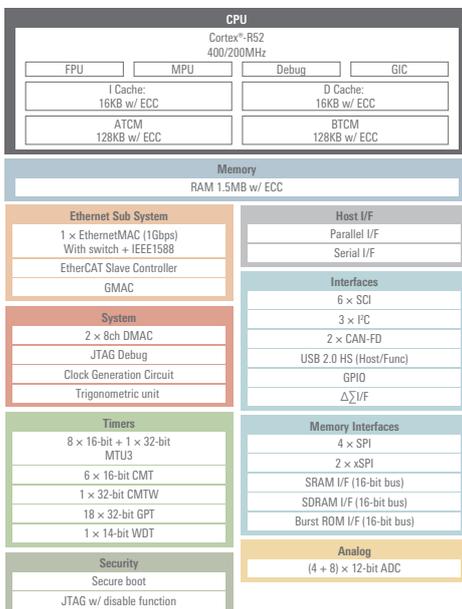
Target Applications

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.

Communication units	Remote I/O	Sensor hubs	Gateways	Motor drive

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

CPU
Cortex®-R52 400/200MHz

FPU	MPU	Debug	GIC

I Cache: 16KB w/ ECC	D Cache: 16KB w/ ECC
ATCM 128KB w/ ECC	BTCM 128KB w/ ECC

Memory
RAM 1.5MB w/ ECC

Ethernet Sub System
1 × EthernetMAC (1Gbps) With switch + IEEE1588
EtherCAT Slave Controller
GMAC

Host I/F
Parallel I/F
Serial I/F

System
2 × 8ch DMAC
JTAG Debug
Clock Generation Circuit
Trigonometric unit

Interfaces
6 × SCI
3 × I²C
2 × CAN-FD
USB 2.0 HS (Host/Func)
GPIO
Δ∑I/F

Timers
8 × 16-bit + 1 × 32-bit MTU3
6 × 16-bit CMT
1 × 32-bit CMTW
18 × 32-bit GPT
1 × 14-bit WDT

Memory Interfaces
4 × SPI
2 × xSPI
SRAM I/F (16-bit bus)
SDRAM I/F (16-bit bus)
Burst ROM I/F (16-bit bus)

Security
Secure boot
JTAG w/ disable function

Analog
(4 + 8) × 12-bit ADC

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
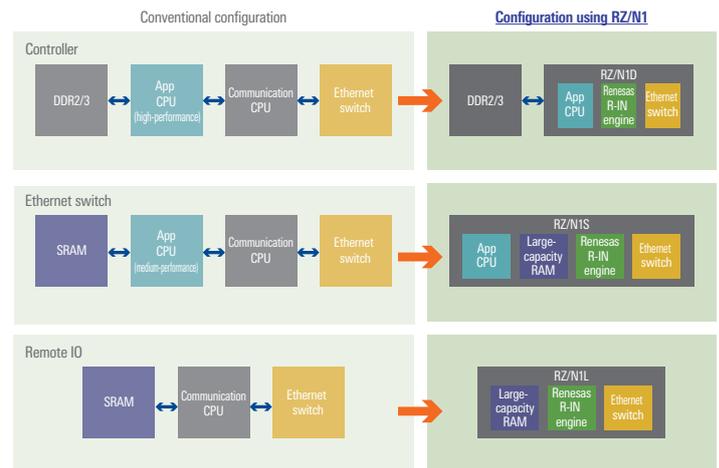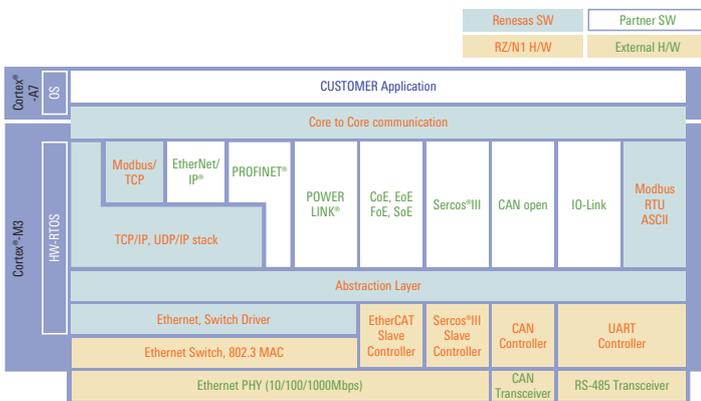
Target Applications

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.

PLC industrial controllers	Industrial switches	Sensor hubs	Gateways	Communication modules	Remote I/O

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).

Conventional configuration — Configuration using RZ/N1

Controller: DDR2/3 ↔ App CPU (high-performance) ↔ Communication CPU ↔ Ethernet switch → RZ/N1D: DDR2/3 ↔ App CPU · Renesas R-IN engine · Ethernet switch

Ethernet switch: SRAM ↔ App CPU (medium-performance) ↔ Communication CPU ↔ Ethernet switch → RZ/N1S: App CPU · Large-capacity RAM · Renesas R-IN engine · Ethernet switch

Remote IO: SRAM ↔ Communication CPU ↔ Ethernet switch → RZ/N1L: Large-capacity RAM · Renesas R-IN engine · Ethernet switch

Renesas SW / Partner SW / RZ/N1 H/W / External H/W

CUSTOMER Application
Core to Core communication
Modbus/TCP · EtherNet/IP® · PROFINET® · POWER LINK® · CoE, EoE FoE, SoE · Sercos®III · CAN open · IO-Link · Modbus RTU ASCII
TCP/IP, UDP/IP stack
Abstraction Layer
Ethernet, Switch Driver · EtherCAT Slave Controller · Sercos®III Slave Controller · CAN Controller · UART Controller
Ethernet Switch, 802.3 MAC
Ethernet PHY (10/100/1000Mbps) · CAN Transceiver · RS-485 Transceiver

Cortex®-A7 · OS · Cortex®-M3 · HW-RTOS

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

Industrial Ethernet Embedded Module
R-IN32M3 Module

The R-IN32M3 is a compact industrial Ethernet embedded module that supports the PROFINET, EtherNet/IP™, and EtherCAT® protocols. By using it in combination with a host MCU to control the user application, it enables users easily to develop supported products without worrying about the details of industrial Ethernet communication. It is also possible to deploy support for Modbus TCP by using the host MCU for control.

Features

- **An all-in-one solution that shortens time-to-market**
  - This embedded module implements the functionality required by industrial networks.
  - Reduces the burden of software development and component procurement.
- **Multi-protocol**
  - The protocol can be changed without overwriting the firmware.
  - No need to purchase a separate module for each protocol stack.

- **Ample selection of development tools**
  - Sample software is available for Renesas RA, RX, and RL MCUs.
  - Get started with evaluation right away using a simple master tool.
- **Easy-to-implement host interface**
  - SPI connection via pin header connector.
  - No need to mount additional connectors.

Solution Kits

Users can choose between two environments when selecting a solution kit to support development. Sample packages are available for download on the web, so you can get started right away with the development environment that best matches your application.

- **Adapter Board Mounted with R-IN32M3 Module [YCONNECT-IT-I-RJ4501]**
  - Connects to an Arduino™ MCU development board for development work.
  - Ideal for customers who have already decided on the host MCU they plan to use.

- **CPU Card Mounted with R-IN32M3 Module [SEMB1320: Shimafuji Electric Incorporated]**
  - Evaluation board with integrated module and mounted with RX66T host MCU.
  - Ideal for customers just getting started with evaluation of Industrial Ethernet applications.

RENESAS RA
w/EK-RA6M4
w/EK-RA6M3

RENESAS RL78
w/RL78/G14

YCONNECT-IT-I-RJ4501

RENESAS RX

SEMB1320

Specifications

Product No.	RY9012A0000GZ00 #001 (30 pcs.)/#002 (1 pc.)
CPU	R-IN32M3-EC
Protocol	PROFINET EtherNet/IP EtherCAT®
Size	50×34×12mm
Power supply voltage	3.3 ± 0.15 VDC
Power consumption	Typ. 1.3W/max. 2.0W
Operating temperature range	−40 to 70°C
Certification/authorization	Network certification* CE UKCA c UL us RoHS REACH

Product page (renesas.com)

Product introduction video (youtube.com)

* Each protocol is network certified, but the customer's system still needs to be certified as a finished product.

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)
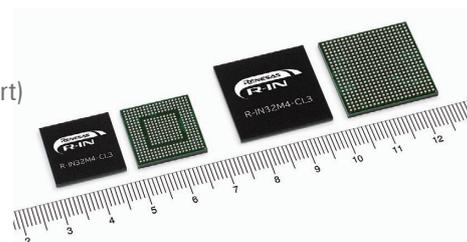
Product Specifications

- 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   – I²C
  – CSI   – Timer
- Operating temperature range
  – Tj = −40 to +125°C
  – Ta = −40 to +85°C

R-IN32M4-CL3 Block Diagram

Renesas R-IN Engine		
Real-time OS accelerator (HW-RTOS)	Arm® Cortex®-M4 Processor with FPU	
	Ethernet accelerator	
	Checksum	Header ENDEC	Buffer manager

| CAN × 2 channels |
| UART × 2 channels |
| CSI × 2 channels |
| I²C × 2 channels |

| Watchdog timer × 1 channel |
| Serial flash I/F (quad) |
| SRAM I/F (master/slave) |
| GPIO (108 ports) |
| Timer 32-bit × 4 channels 16-bit × 16 channels |

On-chip memory (RAM)
Instruction RAM 768KB
Data RAM 512KB
Buffer RAM 64KB

Ethernet controller
CC-Link IE TSN
Remote Station
CC-Link IE Field
Intelligent Device
EthernetMAC
+ 2port Switch

10/100M/1G 2port Ether PHY

2.5V regulator for integrated PHY

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
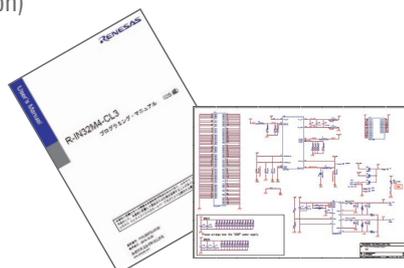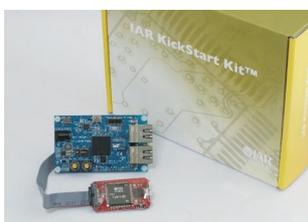
Solutions for Renesas R-IN32M4 | IAR Systems

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 ◉.
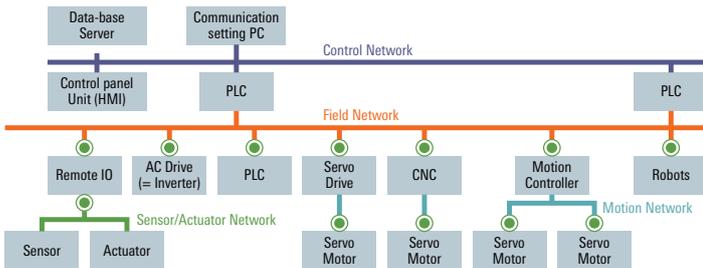
Target products: PLC, remote IO, CNC, AC drive (inverter), robot, servo drive, servo motor
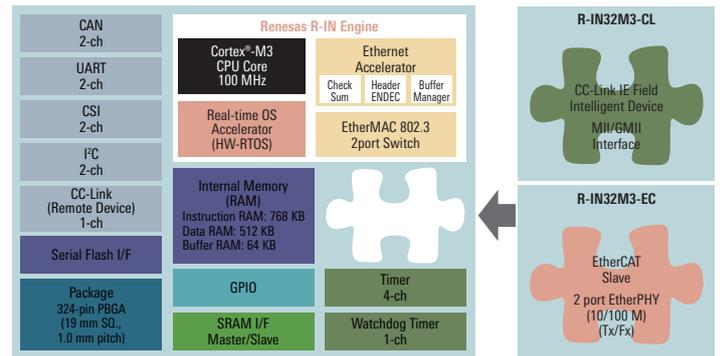
The new Dimension of Real-Time

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.

Interrupt response time (μs) @ 100 MHz

EC-1: High Performance EtherCAT® Controller

Target Applications

EC-1 is a dedicated device with a built-in EtherCAT slave controller. This is an optimal solution to design high performance EtherCAT protocol in Industrial automation and manufacturing.

1. Remote IO

    EC-1 handle both EtherCAT communication and I/O control at the same time thus, eliminating the need for additional external CPU for I/O control. Get started quickly using provided application software for EtherCAT and I/O Control.

2. Communication Module

    Can easily upgrade to EtherCAT communication from existing serial interfaces.
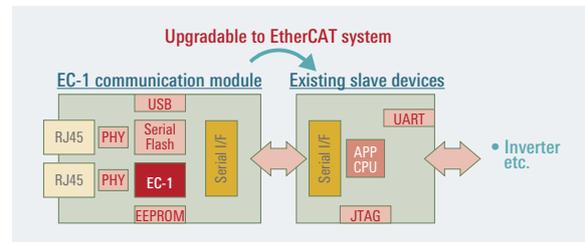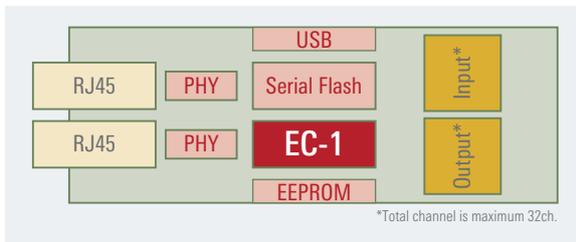
Key Features

Solution certified by EtherCAT Test Center (ETC) conformance testing

• Software environment and evaluation board are certified by official conformance test based on BECKHOFF's EtherCAT slave stack code.

Easy transition from low-speed serial communication to EtherCAT

• Customer can easily change communication protocol to legacy serial interfaces, allowing user to focus on their end application.

• Sample software is provided that targets various devices with different profiles :

    √ CiA402 drive profile for motor driving devices.

    √ ETG.5003 profile for semiconductor manufacturing equipment.

Optimized for EtherCAT applications. Best suited for designing slave devices with High-Speed connectivity.

• Integrated Arm® Cortex®-R4F Core @ 150MHz with double and single precision floating point unit. The Tightly Coupled Memory (TCM), EtherCAT slave controller is ideal for deterministic high-speed connectivity.

• Compatibility has been verified with master devices from more than ten manufacturers. This is a proven solution and significantly reduces the development time for EtherCAT slave applications.

Fast Evaluation

Remote I/O Solution for EC-1 (Tessera Products: TS-EC-1)
Solution kits packaging the hardware, software and integrated development environment necessary for enabling many users to start evaluation and development safely, quickly and easily.
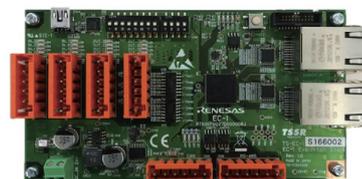
TPS-1: Single Chip for PROFINET RT and IRT

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.
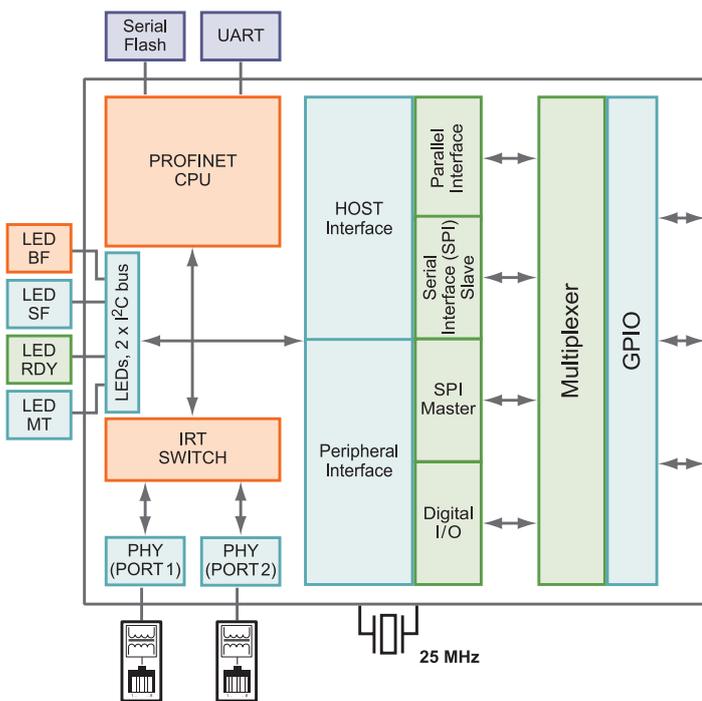
Efficiency - Sustainable Low Cost

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.
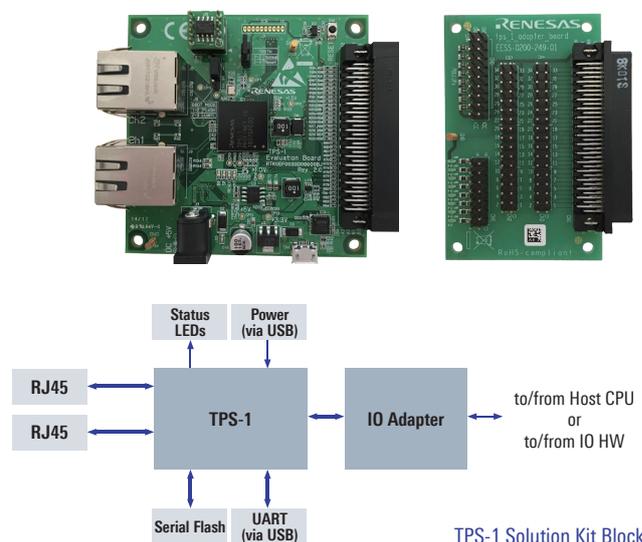
TPS-1 Block Diagram

TPS-1 Solution Kit Block Diagram

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.

Realization of system on single chip

Less development time needed to
implement industrial network protocols
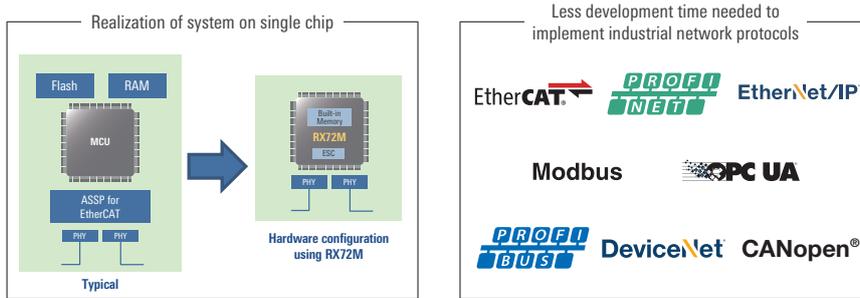
RX72M Network Solution Boards

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

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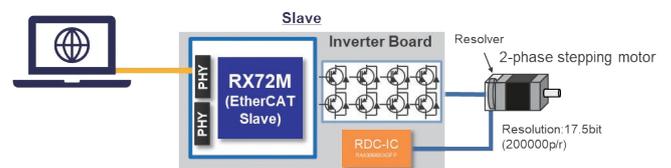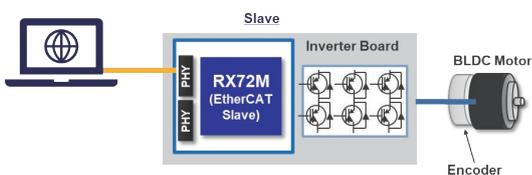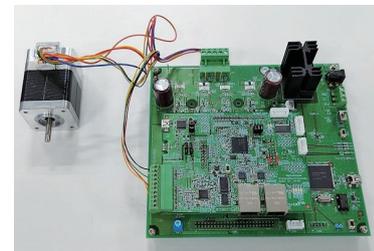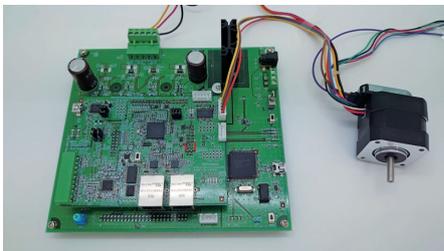
- Encoder vector control for permanent magnet synchronous motors
  Encoder vector control software is programmed onto the RX72M, enabling implementation of EtherCAT® communication and encoder brush motor control using a single chip.

- 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
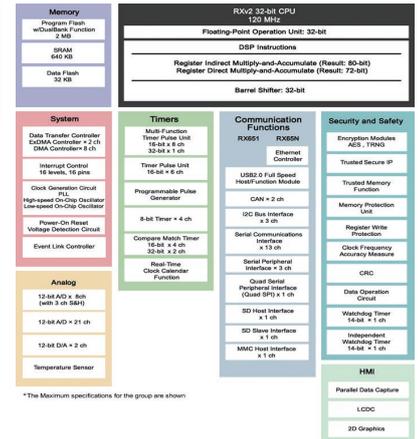
Outstanding real-time performance and one-chip solutions

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

*The Maximum specifications for the group are shown
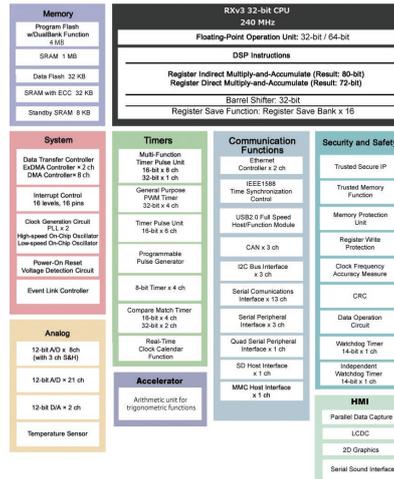
Key Features

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
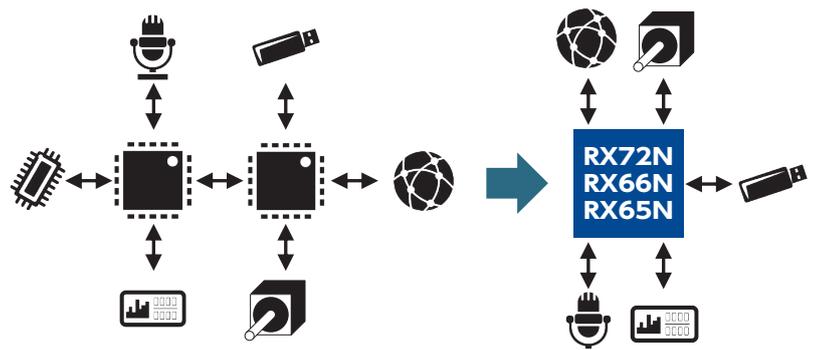
IO-Link

IO-Link

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.
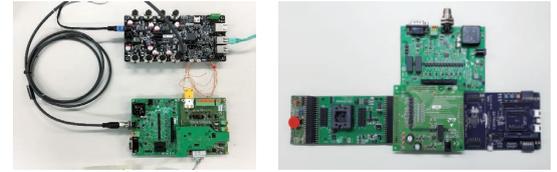

RX23E-A Temperature Sensor Solution

- 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.
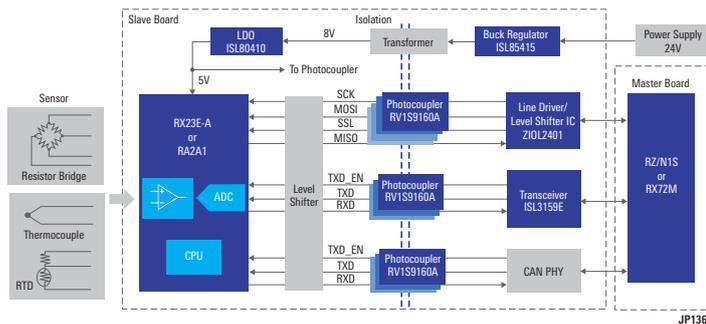
RA2E1 Pressure Sensor Solution

- 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.
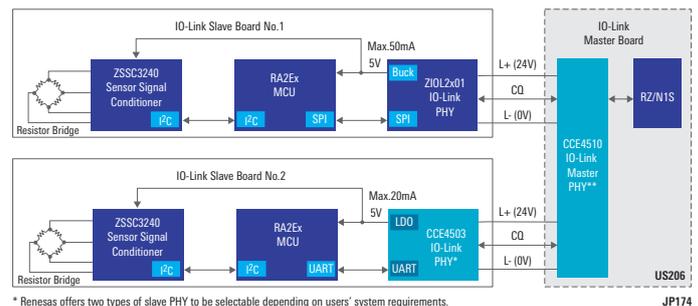
RA2E2 Proximity Sensor Solution

- 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.

ASI4U-V5: Fully Compliant ASi-5 Transceiver ASSP

The ASI4U-V5 is the industry's first silicon solution to fulfill the ASi-5 (Actuator-Sensor-Interface version 5) standard for industrial network equipment that enables comprehensive Industry 4.0 applications. The ASI4U-V5 ASSP comes with a completely verified and field-proven firmware that fully implements ASi-5. Hence, integration of ASi-5 into any application is very easy, as the complexity of the fieldbus is hidden by the chip and the firmware.

Key Features

- Fully compliant to the AS-i version 5 standard
- Fully compatible to the AS-i version 3 standard
- The solution consists of the ASSP and a self contained ASi-5 firmware
- 64-pin QFN package
- Support for simple slave applications (digital-IO connection)

- Support for complex slave applications (SPI/IF to the application)
- Operating temperature -40°C to +85°C
- Supply voltages: 5V and 3.3V
- Package dimensions: 9 × 9 mm, 0.5 mm pitch
- Part Number: R9J06G039UGNP

ASi-5 Key Technology Advantages

Faster and more efficient for Industry 4.0 applications
- ASi-5 supports 1.2ms cycle time with a jitter of less than 10ns vs 5ms of ASi-3
- ASi-5 allows for 96 devices being attached to the same cable vs 62 in ASi-3
- ASi-5 can run up to 200m cable vs 100m in ASi-3
- ASi-5 supports diagnostics and event handling needed for industry 4.0 applications

Robustness
- ASi-5 is the most robust field bus due to its 3D redundancy concept, which ensures that all data reaches the destination in time without any errors. Robustness is a key asset in industrial communication.

Ease of integration
- ASI4U-V5 is an ASi-5 silicon solution, which consists of the ASi-5 ASSP and a fully self-contained firmware image that handles all ASi-5 specific items. Hence, it is the easiest fieldbus integration option.
- ASI4U-V5 is fully backwards compatible to ASi-3
- ASI4U-V5 supports all bus topologies (line, star, tree)
- ASI4U-V5 supports and easy integration with IO-Link

Application Examples

Supports simple slave and complex slave applications

- Up to **22 digital I/Os** for cyclic communication
- **No software interface**

- **SPI I/F** for up to **32 bytes** for cyclic communication
- **Software interface** for diagnostic, parameter setting, local firmware update, time synchronization

Simple Slave

Complex Slave

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.

Functional Safety Type Approved
TÜVRheinland® CERTIFIED
www.tuv.com
ID 0600000000

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.
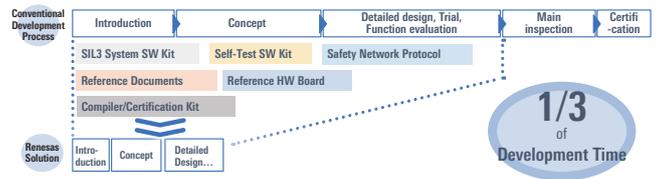
Target Application

- 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.)
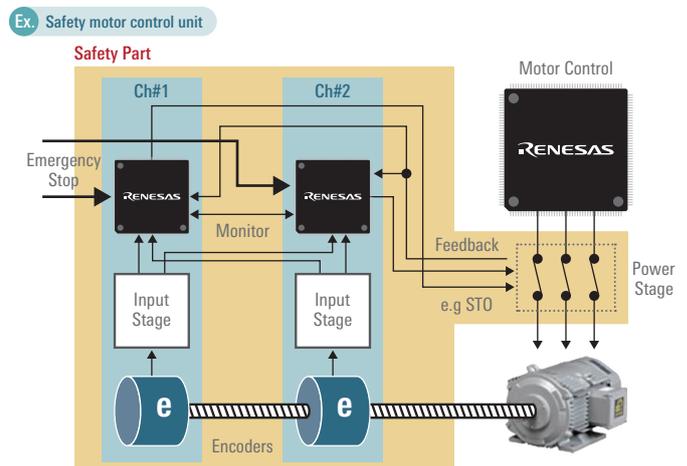
Renesas Solution Overview

SOFTWARE KIT

IEC61508 CERTIFIED COMPILERS

Functional Safety Ready MCU/MPU

REFERENCE DOCUMENT

REFERENCE HARDWARE
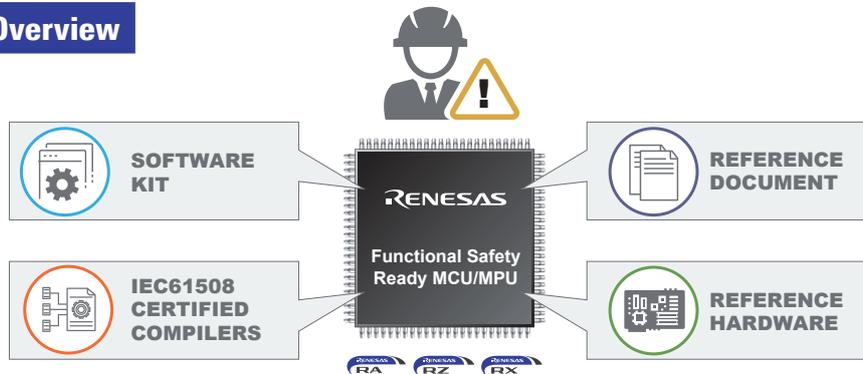
Software

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	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.

Winning Combinations
Analog + Power + Embedded Processing + Connectivity

Application	Title	ID
Network	Gigabit Industrial Ethernet System-on-Module (SoM) Solution	EU140
	Multi-Protocol Industrial Ethernet Switch	EU012
	CC-Link IE TSN Solution	JP135
	Real-Time Industrial Ethernet Switch (Low Cost) with RZ/N1S	EU013
	Industrial Automation Solution with Industrial Ethernet Module	JP205
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
	Industrial Ethernet Connected Sensor	EU113

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

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

The easy way to discover Winning Combinations:

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) ⬈

System Board

+24V (Isolation Power)
+5V

1.2V/0.5A to PHY
PMIC DA9061 | +5V | Buck RAA211650 | 24V Plug in (reserved)

3.3V/2A to peripheral

3.3V/0.3A | 1.8V/0.3A | 1.1V/1A

External control signal

Photo-Coupler PS2733-1 x 11 RV1S9213A x 5 — DI & DO — GPIO / Timer / Timer

LEAD/LAG/Z
CCW/CW Pulse

RZ/T2M

ADC | PWM | DSMIF | CLK | GPIO | INT — NTC — To IPM — 74FCT245CTPYG — DS Modulator — To 3ch DS Modulator — ICS551 — Option DO to Inverter Board — DI from Inverter Board

EEPROM R1EX24016ASAS0A
LED Driver

IIC

RS485 I/F — RS-485 ISL3172E — UART

CAN I/F — CAN Transceiver — CAN

RJ45 x2 — PHY x2 — EtherCAT Slave Controller

Encoder-IF SPI — RS422 ISL32179E — RS485/422 ISL32177E — RS485/422 ISL32177E

Timer Capture

25MHz — CLK

TVS — USB | XSPI — HypRAM — QSPI Flash AT25SF128A

Pin Header | Pin Header

ABZ/ABS — ABZ

CN032

Invert Board

24V/0.35A max
5V/2A max — Sync Rectifier iW673
+19V/0.25A max — Diode — HV MOS — ISL8844 — AC Line

IPM Driver PS9303L x 6

Photo-coupler PS2811-1 x 3 PS9123 x 1 — DO for brake/relay,etc

DS Modulator RV1S9353A x 3

U W V

M

Encoder

Motor & Encoder

<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.

• Industrial Automation Solution with Industrial Ethernet Module (JP205) ⬈

Master Device (e.g. PLC)

Industrial Ethernet:
"PROFINET", "EtherNet/IP" and "EtherCAT"
with various topologies ie. Ring(shown), Star, Line,··

Ethernet

Node Device (1)

GPIO — MCU RA6M4 /RX66T /RL78G14

Sensor (Others)

Humidity Sensor HS3001

Air Quality Sensor ZMOD4410

I2C

5V — LDO ISL80101

3.3V < 600mA

INT | INT | SPI

PHY | PHY
GMAC | GMAC
R-IN32M3 Module RY9012
INT | INT | SPI

Node Device (2) .... Node Device (n)

R-IN32M3 Module RY9012

JP205

<Overview>
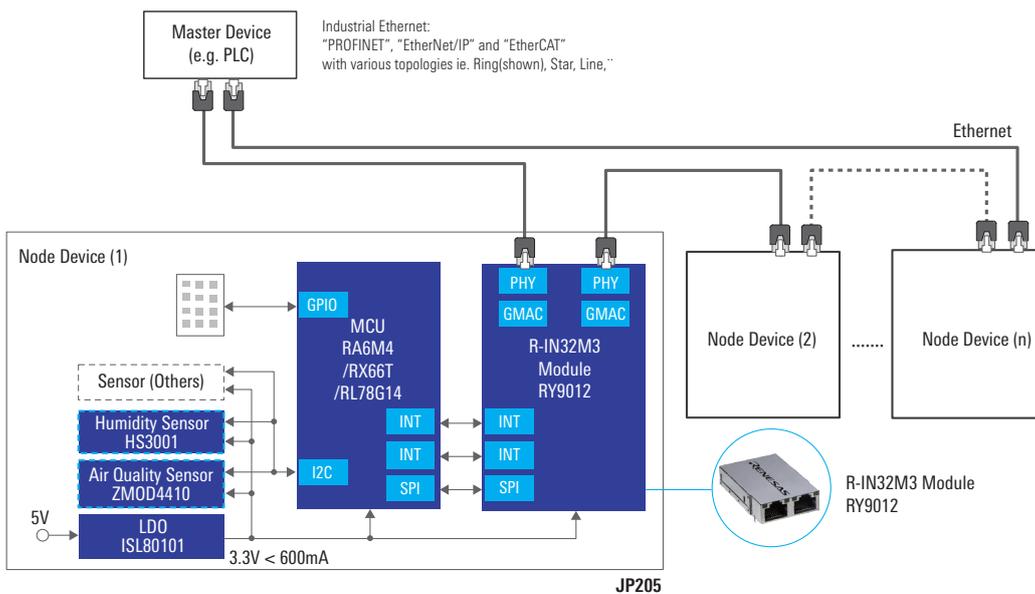
Previous industrial automation solutions used conventional bus connections such as RS-485 between master and node devices. This solution using the Renesas R-IN32M3 module allows ease of migration from an industrial field bus system to an industrial Ethernet system. It supports three major industry standard protocol stacks: PROFINET, EtherNet/IP and EtherCAT. This enables customers to develop industrial Ethernet systems easily.

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

Power Block
AC 100V~200V
IGBT RBN75H65T1
PFC
PFC IC R2A20114B
Isolated AC/DC iW1702 — Transformer — Synchronous Rectifier iW676
Isolated AC/DC iW1816 — Transformer
to Motor xN 20V <2A
IGBT Coupler PFC
5V <1A Control Block FuSa Block CT Block

Control Block
5V
GreenPAK SLG46855 — Sequencer
Buck Regulator ISL80030 — 3.3V 300mA / 1.8V <200mA / 1.1V <1A — to ICs, FuSa Block
X3
To PC or RAM Monitor, etc. — RS-232C/RS-485 (Tx/Rx) ISL41387 — Photo Coupler RV1S9160A
To Field Bus device — RS-485 (Tx/Rx) ISL3178 — Photo Coupler RV1S9160A
CAN
To Ethernet device — GbE PHY / GbE PHY
EEPROM R1EX24016
USB MicroB Sensor module etc.
Flash Memory AT25SF128A

MPU RZ/T2M
SCI (UART) / SCI (UART) / GPIO / CAN / PWM / GMAC With Ethernet Switch, EtherCAT / DSMIF / POE / USB / 12bit A/D / IIC/SCI / Encoder-IF / xSPI

Functional Safety (FuSa) Block
Monitoring Over/Under Voltage
1.1V / 1.8V / 3.3V / 5V — Monitoring IC X8
LDO ISL80505
3.3V <50mA
MCU(FuSa) RX230 — SCI (UART) / GPIO / GPIO
6

Current Sensing 3
Over Current Detection 3
Op-Amp READ2304
Photo Coupler RV1S9160A — RS-485 (Tx) ISL32179
Photo Coupler RV1S9160A — RS-485 (Rx) ISL32177

To IGBT Coupler 6

Inverter Block
Phase U / Phase V / Phase W
for Motor
IGBT RBN75H65T1
20V
IGBT Coupler RV1S9231A
20V
IGBT Coupler RV1S9231A
Control Block 5V
LDO RAA214220 — 5V <20mA
ΣΔ modulator RV1S9353A
Including same blocks with Phase U
U V W
*
M
Absolute/Incremental Encoder

CT Block
Control Block 5V
LDO ISL80505 — 3.3V <100mA — X3
Comparator UPC277MP — Op-Amp READ2304 — Current Transducer
Current Sensing 3

JP191   *: Shunt Register or Current Transducer

<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) ↗

DA9083 OTP30
PMIC 4x DC/DC 1x LDO
CH4 1V0 0.3Amax
CH3 2V5 0.3Amax
CH1 3V3 0.8Amax
CH2 1V1 0.3Amax
LDO 1V8 0.1Amax
PG / POR
I2C
3V3 2

SLG46117 Reset + Delay + Load Switch
Reset
USB 2
Debug 9

ARM Cortex R52 400/200MHz
RZ/N2L
VDD11 / VDD18 / VDD33
GMAC#1 / GMAC#2 / GMAC#3 / Ether Clk / ESC-I2C
I2C+IRQ+GPIO / UART+IRQ+GPIO / ADC / UART / I2C / HSPI / CAN
QSPI / RAM / I2C
25MHz Osc.
25MHz
Reset_MPU
Reset / USB / Debug

Gbit Ethernet PHY#1 — 8+2xLED — Gbit Ethernet #1
Gbit Ethernet PHY#2 — 8+2xLED — Gbit Ethernet #2
Clock 2
R1EX24016ASAS0I 2kB EEProm I2C for EtherCAT

8 — I2C, IRQ, GPIO
8 — UART, IRQ, GPIO
4 / 2.4 / 2
6
2
4x ADC — 4X, ADC$_{in}$
n — UART, I2C, HSPI, CAN
2 — I2C

AT25SF128A 128MBit 3.3V Flash QSPI
6 / 40 / 2
32MB, 3.3V SDRAM
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-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)
R-IN32M3 Module	Evaluation Kit	YCONNECT-IT-I-RJ4501
EtherCAT EC-1	Solution Kit	YCONNECT-IT-EC1
RX72M	CPU card with RDC/IC	RTK0EMXDE0C00000BJ
TPS-1	Low Cost Solution Kit	YCONNECT-IT-TPS-1L
CCE4503	Evaluation Board	CCE4503-EVAL-V3
CCE4502	Evaluation Board	CCE4510-EVAL-V2
RH4Z2501	Evaluation Board	RH4Z2501-KIT
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
RZ/T2M	Renesas Starter Kit	RTK9RZT2M0S00000BE
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/T1	Solution Kit	YDRIVE-IT-RZT1
RZ/N1D	Solution Kit	YCONNECT-IT-RZN1D
RZ/N1D or RZ/N1S	Expansion Board	YCONNECT-IT-RZN1-EB
RZ/N1S	Solution Kit	YCONNECT-IT-RZN1S
RZ/N1L	Solution Kit	YCONNECT-IT-RZN1L
RA2E1	Evaluation Board	RTK7EKA2A1S00001BU
RA2E2	Evaluation Board	RTK7EKA2E2S00001BE
RA6M3	Evaluation Board	RTK7EKA6M3S00001BU

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

Renesas Electronics America Inc. Milpitas Campus
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.
Tel: +1-408-432-8888, Fax: +1-408-434-5351

Renesas Electronics America Inc. San Jose Campus
6024 Silver Creek Valley Road, San Jose, CA 95138, USA
Tel: +1-408-284-8200, Fax: +1-408-284-2775

Renesas Electronics Canada Limited
603 March Road, Ottawa, ON K2K 2M5, Canada
Tel: +1-613-595-6300, Fax: +1-613-595-6329

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 101-T01, Floor 1, Building 7, Yard No. 7, 8th Street, Shangdi, Haidian District, Beijing 100085, China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai 200333, China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 3501-03, 35/F, One Kowloon, 1 Wang Yuen Street, Kowloon Bay, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, #06-02 Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit No 3A-1 Level 3A Tower 8 UOA Business Park, No 1 Jalan Pengaturcara U1/51A, Seksyen U1, 40150 Shah Alam, Selangor, Malaysia
Tel: +60-3-5022-1288, Fax: +60-3-5022-1290

Renesas Electronics India Pvt. Ltd.
Bagmane Tech Park, Municipal No. 66/1-4, Lakeview Block, Block B, Ground Floor, Krishnappa Garden, C V Raman Nagar, Bengaluru, Karnataka 560 093, India
Tel: +91-80-67208700

Renesas Electronics Korea Co., Ltd.
7F, Hae-seong 2nd building, 508, Teheran-ro, Gangnam-gu, Seoul, Korea 06178
Tel: +82-2-558-3737, Fax: +82-2-558-5338

Renesas Electronics Corporation

www.renesas.com