RZ FAMILY MICROPROCESSORS

64-Bit & 32-Bit High-performance MPUs

2025.10

RENESAS RZ FAMILY The Next-generation embedded processors enable the smart society that makes people's daily lives more comfortable and affluent.

CONTENTS

In recent years, “intelligence at the edge” has been rapidly advancing across various fields that support our daily lives—such as manufacturing, infrastructure, robotics, home appliances, building management, power grids, and transportation.

This trend is driven by the increasing need for advanced processing directly at the field level, including AI-based image analysis, autonomous control, real-time network communication, and intuitive operation enabled by HMI (Human-Machine Interface).

In addition, processing tasks that were traditionally handled by the cloud are now increasingly expected to be performed by edge devices, such as control and terminal equipment.

In order to meet these evolving market needs, Renesas has developed the next-generation RZ family of embedded processors with performance that can meet the advanced processing requirements of edge devices based on reliable peripheral functions and real-time control technologies cultivated through many years of microcontroller development.

The Zenith of the Renesas micro

The ideal choice to meet the requirements of increasingly diverse and sophisticated edge devices —— That is the RZ family.

Positioning of the RZ

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

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

Analog and Power Devices

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

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

Meeting the Diverse and Evolving Needs of Edge Devices ––– The RZ Family

As application demands become more advanced and varied, the RZ Family delivers a finely tuned blend of processing performance, power efficiency, and peripheral integration, with tailored strengths across each series. This design philosophy enables seamless application across a wide range of edge use cases—Vision AI, industrial networking, real-time control, and human-machine interfaces—providing a best-fit development platform at the edge.

Vision AI

RZ/V Series

AI accelerator
Vision processing
+ Linux

Industrial Network

RZ/N Series

Industrial Ethernet with
Redundancy + Linux/ RTOS

Real-time Control

RZ/T Series

Industrial Ethernet
Motor drive + Linux/RTOS

IoT Edge & HMI

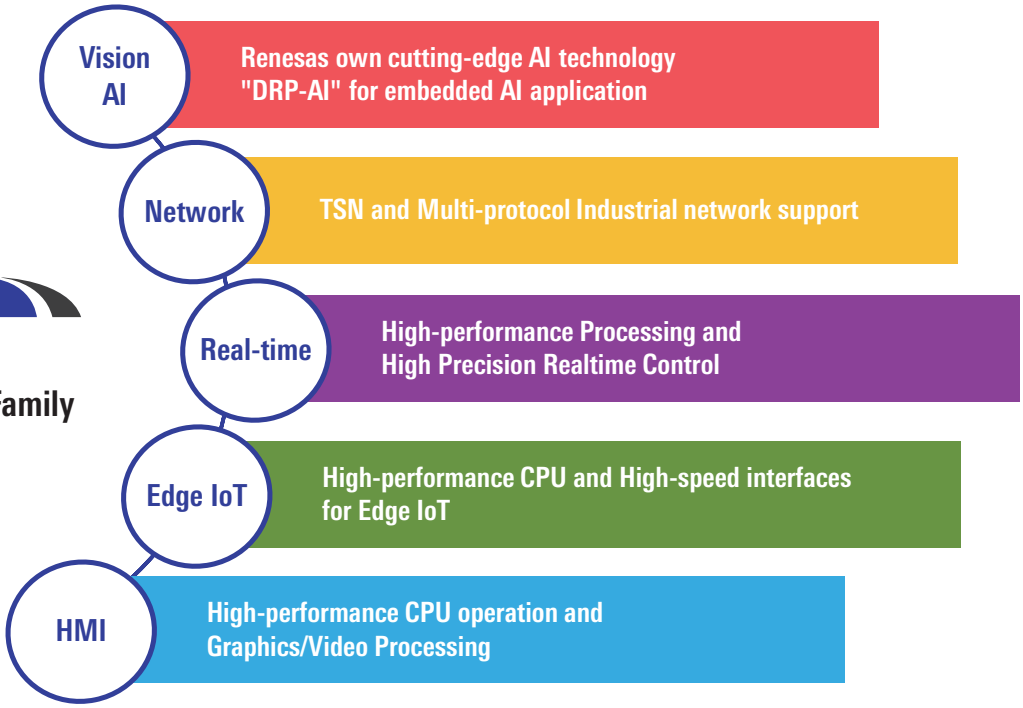
RZ/G Series

Multimedia / 3D Graphics
+ Linux

Human Machine Interfaces

RZ/A Series

Large size RAM
+ RTOS

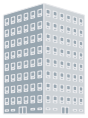


Renesas RZ Family

	Linux / Android™ / Multi-OS with RTOS		RTOS	
Vision AI RZ/V Series	**RZ/V2M** 1.0GHz Dual-core Cortex-A53, DRP-AI(576-MAC), 4K-ISP	**RZ/V2H** 1.8GHz Quad-core Cortex-A55, DRP-AI3(4K-MAC), 4K-ISP, 3D-GPU		
	RZ/V2MA 1.0GHz Dual-core Cortex-A53, DRP-AI(576-MAC), OpenCV Accelerator	**RZ/V2N** 1.8GHz Quad-core Cortex-A55, DRP-AI3(2K-MAC), 4K-ISP,3D-GPU		
		RZ/V2L 1.2GHz Dual-core Cortex-A55, DRP-AI(576-MAC), 3D-GPU		
Industrial Network RZ/N Series	**RZ/N1D** 500MHz Dual-core Cortex-A7, 125MHz Cortex-M3, Industrial Ethernet	**RZ/N2H** 1.2GHz Quad-core Cortex-A55 1.0GHz Dual-core Cortex-R52 Industrial Ethernet, 6-axis Motor Control	**RZ/N1S** 500MHz Cortex-A7,125MHz Cortex-M3, Industrial Ethernet	**RZ/N2L** 400MHz Cortex-R52, Industrial Ethernet
			RZ/N1L 125MHz Cortex-M3, Industrial Ethernet	
Real-time Control RZ/T Series		**RZ/T2H** 1.2GHz Quad-core Cortex-A55, 1.0GHz Dual-core Cortex-R52, 9-axis Motor Control, Industrial Ethernet		**RZ/T2ME** 800MHz Dual-core Cortex-R52, 2-axis Motor Control, Industrial Ethernet, OTFD
			RZ/T1 600MHz Cortex-R4, 150MHz Cortex-M3, 1-axis Motor Control, Industrial Ethernet	**RZ/T2M** 800MHz Dual-core Cortex-R52, 2-axis Motor Control, Industrial Ethernet
				RZ/T2L 800MHz Cortex-R52, 2-axis Motor Control, EtherCAT
IoT Edge RZ/G Series	**RZ/Five** RISC-V, 1.0GHz AX45MP, DDR4/3L, GbEthernet, CAN-FD	**RZ/G3S** 1.1GHz Cortex-A55, 250MHz Dual-core Cortex-M33, LPDDR4/DDR4		
HMI RZ/G Series RZ/A Series	**RZ/G2H** 1.5GHz Quad-core Cortex-A57 + Cortex-A53, LPDDR4, 3DG, H.264/5	**RZ/G3E** 1.8GHz Quad Cortex-A55, LPDDR4/4X, 3DG, NPU	**RZ/A1H** 400MHz Cortex-A9, 10MB RAM, LCDC, JPEG, Ethernet, USB	**RZ/A3M** 1.0GHz Cortex-A55, Built-in DDR3L 128MB
	RZ/G2M 1.5GHz Dual-core Cortex-A57 + Cortex-A53, LPDDR4, 3DG, H.264/5	**RZ/G2L** 1.2GHz Dual-core Cortex-A55, DDR4/3L, 3DG, H.264, CAN-FD	**RZ/A1M** 400MHz Cortex-A9, 5MB RAM, LCDC, JPEG, Ethernet, USB	**RZ/A2M** 528MHz Cortex-A9, 4MB RAM, LCDC, JPEG, MIPI-CSI, Ethernet, USB
	RZ/G2N 1.5GHz Dual-core Cortex-A57, LPDDR4, 3DG, H.264/5	**RZ/G2LC** 1.2GHz Dual-core Cortex-A55, DDR4/3L, 3DG, CAN-FD	**RZ/A1LU** 400MHz Cortex-A9, 3MB RAM, LCDC, JPEG, Ethernet, USB	**RZ/A3UL** 1.0GHz Cortex-A55, DDR4/3L, LCDC, GbEthernet, USB
	RZ/G2E 1.2GHz Dual-core Cortex-A53, DDR3L, 3DG, H.264/5	**RZ/G2UL** 1.0GHz Cortex-A55, DDR4/3L, CAN-FD, ADC	**RZ/A1L** 400MHz Cortex-A9, 3MB RAM, LCDC, Ethernet, USB	
	RZ/G1H 1.4GHz Quad-core Cortex-A15 + Cortex-A7, DDR3, 3DG, H.264	**RZ/G1N** 1.5GHz Dual-core Cortex-A15, DDR3L, 3DG, H.264	**RZ/A1LC** 400MHz Cortex-A9, 2MB RAM, LCDC, Ethernet, USB	
	RZ/G1M 1.5GHz Dual-core Cortex-A15, DDR3L, 3DG, H.264	**RZ/G1E** 1.0GHz Dual-core Cortex-A7, DDR3, 3DG, H.264		

RZ Family Target Applications

The RZ Family brings new value to customer applications with its high-performance CPU core and various accelerators and peripheral functions.

	System control (Main processing, encryption)		Drive (Motor/inverter control)		UI (Camera, Display ,etc)		Communication (Industrial Network, General communication)		Rich Graphics Processing (GPU, Video codec)	
Industrial Automation  Inverter, PLC, Robot machine tools, etc.	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G
	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A
	RZ/T		RZ/T		RZ/T		RZ/T		RZ/T	
Appliances  IH Cooker, Smart Power Tools, Water Pump etc.	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G
	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A
	RZ/T		RZ/T		RZ/T		RZ/T		RZ/T	
Building Automation  HVAC, Elevator, Lighting, Fire Alert Unit, etc.	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G
	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A
	RZ/T		RZ/T		RZ/T		RZ/T		RZ/T	
Medical & Healthcare  Health Monitor Band, Wearable devices, Blood sugar meter, etc.	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G
	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A
	RZ/T		RZ/T		RZ/T		RZ/T		RZ/T	
Consumer Electronics  Home Entertainment, Power Adapters & Chargers, Wearables, etc.	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G
	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A
	RZ/T		RZ/T		RZ/T		RZ/T		RZ/T	
Metering & Energy  Electricity, Gas, Water, Heat Meter	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G
	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A
	RZ/T		RZ/T		RZ/T		RZ/T		RZ/T	
Telematics & Informatics  Driver monitoring system, etc.	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G
	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A
	RZ/T		RZ/T		RZ/T		RZ/T		RZ/T	
Retail, Automation & Payment  POS terminals, etc.	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G	RZ/V	RZ/G
	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A	RZ/N	RZ/A
	RZ/T		RZ/T		RZ/T		RZ/T		RZ/T	

RZ/V Series

Features of the RZ/V Series

The RZ/V series is a microprocessor (MPU) that incorporates Renesas' proprietary AI accelerator, Dynamically Reconfigurable Processor (DRP)-AI, which combines high AI inference performance and low power consumption. With a wide range of scalability from 0.5 to 80TOPS, RZ/V provides high added value for your various AI applications.

Furthermore, it is equipped with advanced image processing capabilities, including a 4K-compatible Image Signal Processor (ISP), an OpenCV accelerator (OpenCVA), and a GPU that supports 3D graphics.

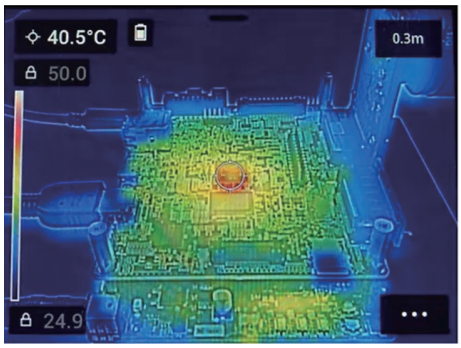
DRP-AI is the world-class low power AI accelerators achieved up to 10 TOPS/W.

By integrating DRP-AI with image processing functionality, it enables the development of compact products that support real-time AI applications at the endpoint—without the need for cooling fans. This makes them ideal for use in retail, robotics, home appliances, and industrial automation.

Building compact products can handle real-time AI applications without cooling fans for retail, robotics, home appliances and industrial automation.

Vision AI

AI accelerator
Vision processing + Linux



Realize high AI performance without Heatsink and FAN
*Depending on conditions

RZ/V Development Environment

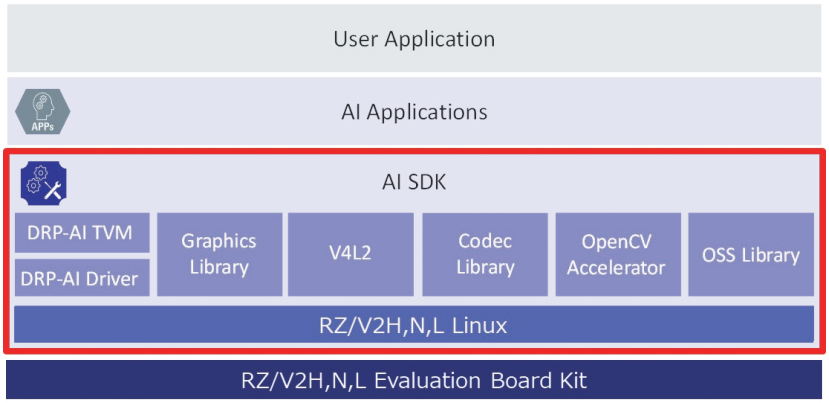
Items	Details
RZ/V AI Applications (AI Apps)	AI Apps are sets of following software that can be used as is for each-case. ■ Pre-trained AI model objects ■ Pre-build application binary ■ Application source code Users can select the category of applications and access the applications provided on GitHub.
RZ/V AI SDK	Binary development environment for AI Applications that is build for specific RZ/V EVK.
RZ/V AI SDK Source Code	Source code of RZ/V AI SDK that user can customize Linux environment.
RZ/V AI Applications Demo	microSD card image that contains the RZ/V AI Applications. Users can try the AI Applications without having AI SDK environment.
RZ/V AI Transfer Learning Tool (TLT)	GUI Tool to re-train the AI models used in RZ/V AI Applications with different datasets.
DRP-AI TVM	Machine Learning Compiler plugin for Apache TVM with AI accelerator DRP-AI, which is a tool to compile your own AI models (including BYOM) to get the executable format on RZ/V series. Note: AI SDK also includes DRP-AI TVM. However it is not the latest version. If you would like to use the latest DRP-AI TVM, please follow the guide in DRP-AI TVM Web to construct the environment.
AI Navigator (e^2 syudio)	A set of plugins for Renesas IDE, e^2 studio, that allows users to use following software on GUI environment. ■ RZ/V AI Applications ■ RZ/V AI SDK ■ RZ/V AI TLT ■ DRP-AI TVM

RZ/V AI SDK

AI Applications and AI SDK are quick and easy solutions for starting AI.

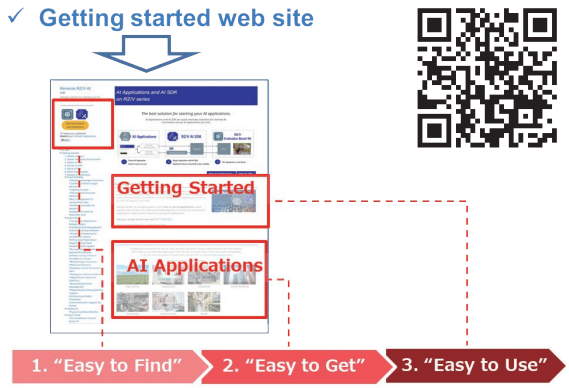
It provides various AI applications for free.

- AI SDK is pre-build S/W environment designed for RZ/V Evaluation Board Kits
- AI SDK source code is also available to support the customization requirements for the boards other than RZ/V Evaluation Board Kit and/or Linux environment
- AI SDK supports RZ/V2L, RZ/V2N and RZ/V2H



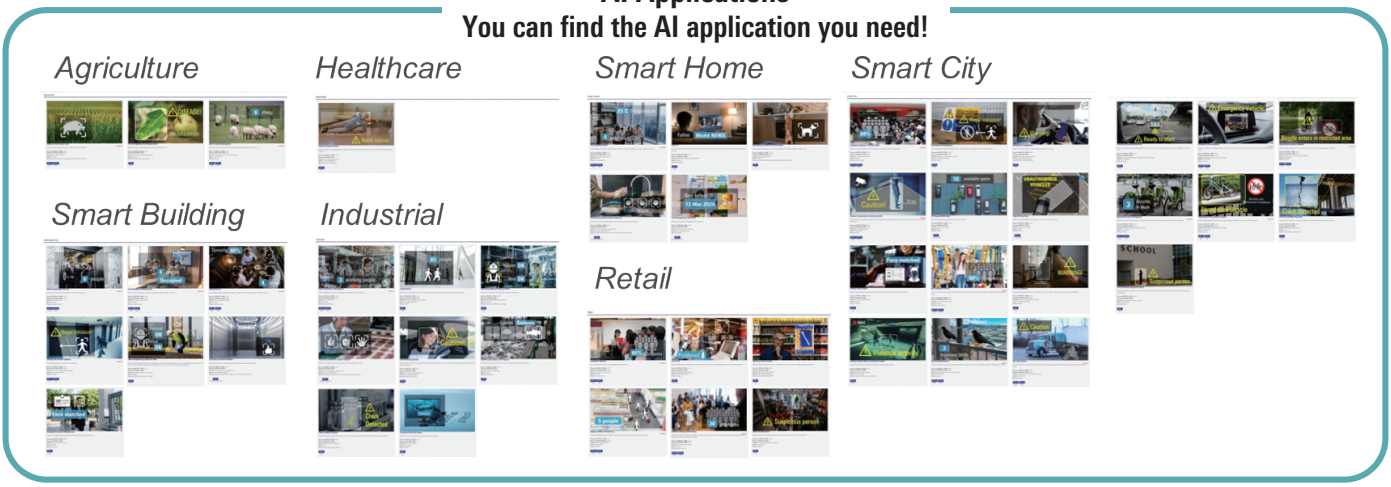
Renesas RZ/V AI Web

https://renesas-rz.github.io/rzv_ai_sdk/latest/

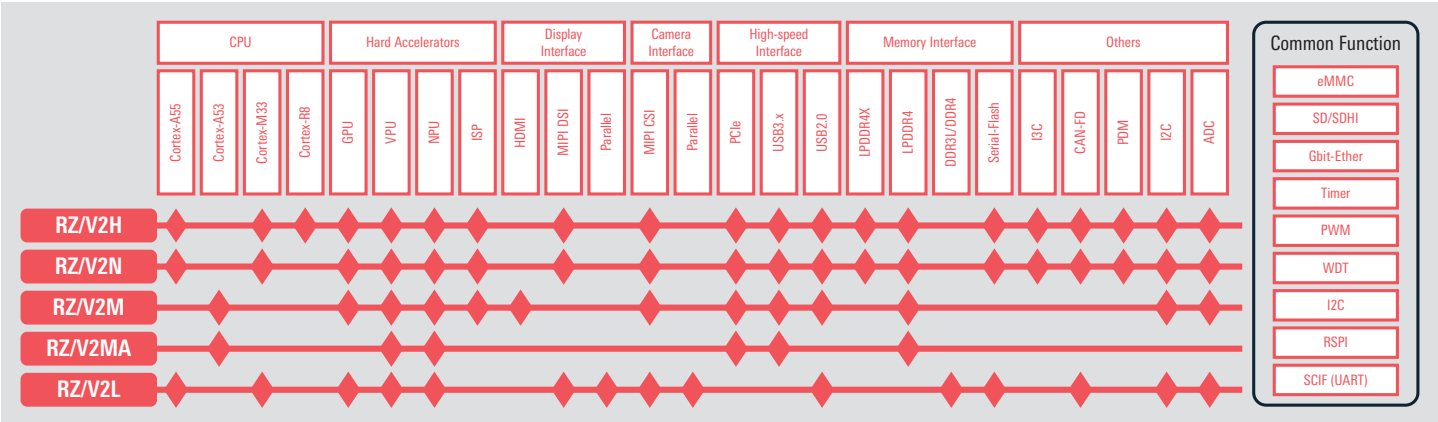


AI Applications

You can find the AI application you need!



RZ/V Series Lineup



RZ/V2M Group: Dual Cortex-A53, DRP-AI 1TOPS, 4K HW ISP

The AI hardware IP, DRP-AI, configured with DRP and AI-MAC, combines both a high-speed AI inference and low power consumption and realizes 1TOPS/W class power performance. In addition, the image signal processor (ISP) is highly robust, producing a stable image independent of the environment, allowing for a high AI recognition accuracy. With these features, the RZ/V2M realizes low power consumption, which is a challenge for embedded devices, making heat dissipation measures easier. Since heat sinks and cooling fans are no longer needed, the equipment can be miniaturized and the BOM cost can be reduced. The result is that it is ideal for vision AI applications in a wide range of embedded markets, including surveillance security, retail, office automation (OA), industrial automation, robotics, and healthcare. In addition, the RZ/V2M also features abundant high-speed communication interfaces such as USB 3.1, PCI-Express, Gigabit Ethernet, and many CPU peripheral functions, so it can also be used in a variety of applications.

CPU core
- Arm® Cortex®-A53, Dual-core
  Max. operating frequency: 1.0GHz

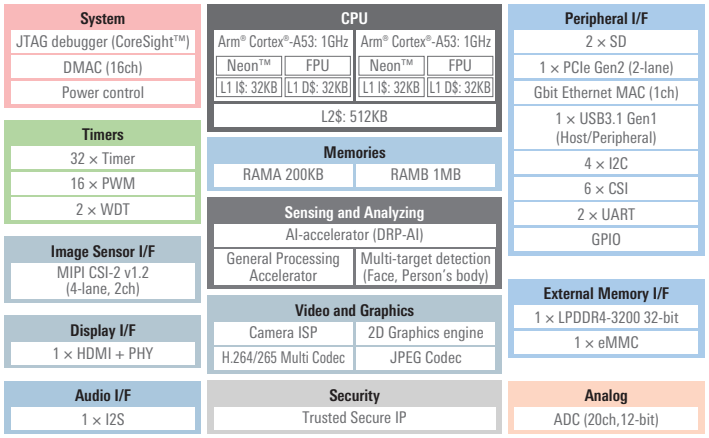
Memory interface
- 32bit LPDDR4 memory interface
- eMMC 4.5.1 × 1 channel
- mSDIO × 2 channel

NPU: DRP-AI: 1TOPS
ISP (Image signal processor): Up to 4K
Camera interface: MIPI-CSI2 × 2 channel
Display interface: HDMI 1.4a

Video codec
- Encoding: H.265 up to 2160p30, H.264 up to 1080p60
- Decoding: H.265 up to 2160p30, H.264 up to 1080p60

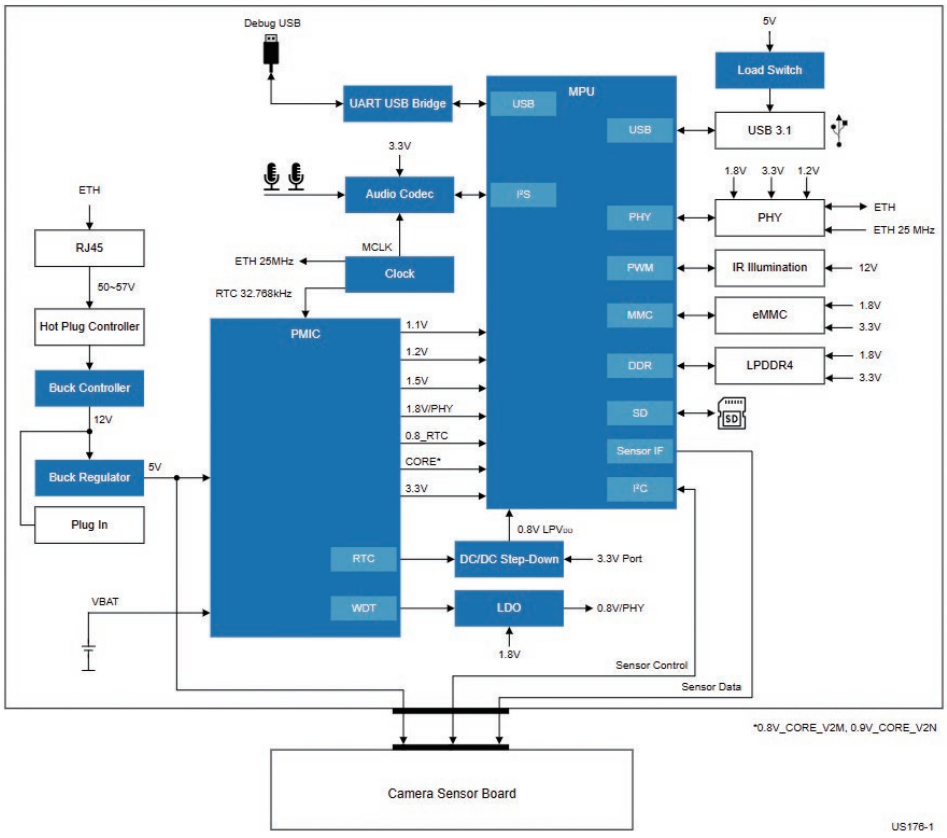
2D Graphics Engine: 200MPixels/s
High Speed interface
- Gigabit Ethernet × 1 channel
- USB3.1 × 1 channel (Host/Function)
- PCIe Gen2 (2-lane)

Package
- FCBGA, 15mm × 15mm, 0.5mm pitch, 841 pins



High-Performance Monitoring Camera

This AI-enabled surveillance camera features a dynamically reconfigurable processor (DRP) engine, boosting Vision AI performance. It boasts a platform for enhanced features such as password-protected connections, voice alarms, and motion detection with support for Ethernet or USB video streaming. With 4K 30fps image processing and advanced digital noise reduction (2D and optional 3D), the system ensures superior clarity, reducing graininess and enhancing visibility in low-light conditions—critical for AI-based surveillance and analysis.



System Benefits:
- High-performance surveillance camera MPU-based design offers AI processing with DRP-AI, enabling high performance with low power consumption and a low-power standby mode.
- Wide dynamic range, custom image settings (saturation, brightness, contrast, sharpness), and black level correction optimize footage for AI detection, ensuring high performance even in challenging lighting conditions.
- Power over Ethernet (PoE) streamlines setup and enables flexible deployment, while Ethernet protocol (100/1000Mbps) ensures high-speed data transmission for reliable and high-resolution streaming.
- Reduced power structure size enables compact camera designs and easy integration into systems without bulky infrastructure.
- AI-based video analytics can monitor crowd movement, congestion patterns, and dwell times for insights.

RZ/V2L Group: Dual Cortex-A55, DRP-AI 0.5TOPS, 5Mp SW ISP

RZ/V2L is equipped with an Arm® Cortex®-A55 (1.2GHz) CPU and built-in AI accelerator "DRP-AI" for vision, which is Renesas' original technology. "DRP-AI" is configured with DRP and AI-MAC. It also has a 16-bit DDR3L/DDR4 interface and a built-in 3D graphics engine with Arm Mali-G31 and video codec (H.264).

DRP-AI's excellent power efficiency eliminates the need for heat dissipation measures such as heat sinks or cooling fans. AI can be implemented cost efficiently not only in consumer electronics and industrial equipment but also in a wide range of applications such as point-of-sale (POS) terminals for retail. Also, the DRP-AI provides both real-time AI inference and image processing functions with the capabilities essential for camera support such as color correction and noise reduction. This enables customers to implement AI-based vision applications without requiring an external image signal processor (ISP).

The RZ/V2L is also package- and pin-compatible with the RZ/G2L. This allows RZ/G2L users to easily upgrade to the RZ/V2L for additional AI functions without needing to modify the system configuration, keeping migration costs low.

CPU core
- Arm® Cortex®-A55, Dual-core/ Single-core
  Max. operating frequency: 1.2GHz
- Arm® Cortex®-M33, Single-core
  Max. operating frequency: 200MHz

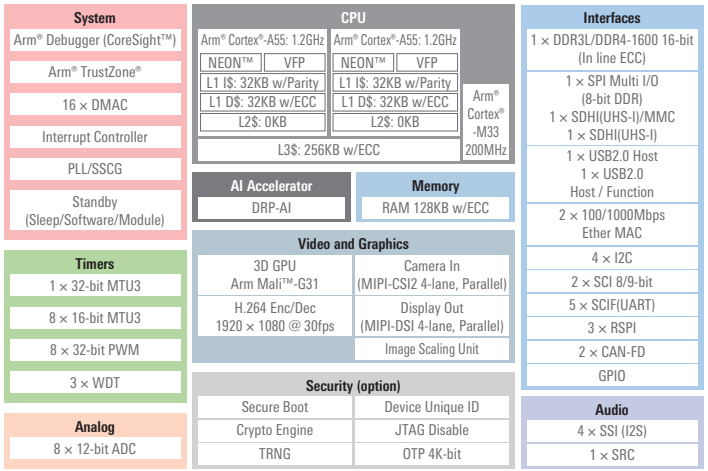
Memory interface
- 16bit DDR3L/DDR4 memory interface
- eMMC 4.5.1 × 1 channel
- SDIO × 1 channel

NPU: DRP-AI: 0.5TOPS
Camera interface: MIPI CSI2 or Parallel I/F × 1 channel
Display interface: MIPI DSI or Parallel I/F × 1 channel

Video codec
- Encoding: H.264 up to 1080p30
- Decoding: H.264 up to 1080p30

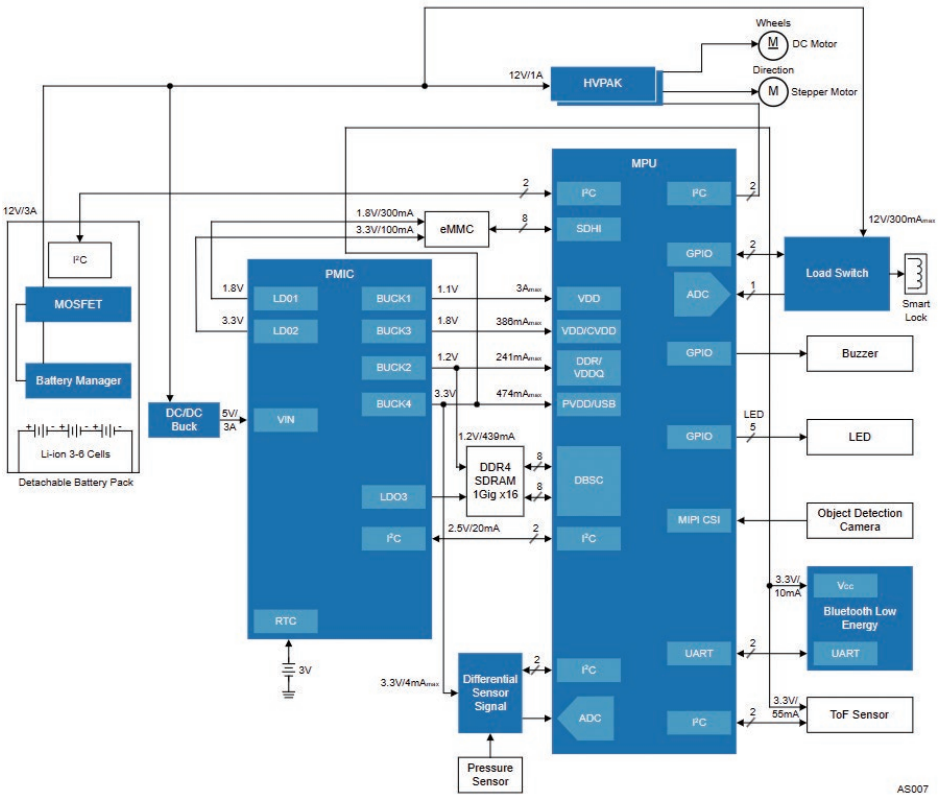
3D Graphics Engine: Arm® Mali™-G31
High Speed interface
- Gigabit Ethernet × 2 channel
- USB2.0 × 2 channel (Host only ×1, Host/Function ×1)

Package
- BGA, 15mm × 15mm, 0.5mm pitch, 456 pins
- BGA, 21mm × 21mm, 0.8mm pitch, 551 pins



Smart Travel Bag

This smart traveling follow-me bag system is revolutionizing the travel industry by offering hands-free convenience, especially beneficial for elderly travelers, children, and pregnant women. The bag's advanced features include an AI accelerator, object detection, and motion detection, allowing it to autonomously follow its owner. Additionally, the design incorporates a detachable battery pack for easy charging, enhancing practicality and user-friendliness.



System Benefits:
- Built-in AI accelerator DRP-AI for vision in the MPU enables intelligent object detection and tracking.
- HVPAK™ programmable mixed-signal matrix for multi-axis motor drive ensures smooth bag movement.
- Accurate object detection for reliable performance.
- Sensor signal conditioner for precise weight detection using pressure sensing.
- SmartBond TINY™ Bluetooth® Low Energy module for smartphone connectivity.
- Alarm and LED fault indications for low battery, tracking loss, and other critical notifications.

RZ/V2MA Group: Vision AI Accelerator Dual Cortex-A53, DRP-AI 1TOPS

DRP-AI utilizes an AI accelerator consisting of a Dynamically Reconfigurable Processor (DRP) and AI-MAC that accelerates AI inference to achieve both high-speed AI inference and low power consumption, enabling real-time image AI without heat sinks or cooling fans. In addition, the OpenCV accelerator, which takes advantage of DRP technology featuring high flexibility, enables high-speed image processing outside of AI in addition to image preprocessing for AI inference, all on a single chip.

These features enable smaller devices and lower BOM costs for vision AI applications in a wide range of embedded markets, including surveillance security, industrial automation, and healthcare.

CPU core
- Arm® Cortex®-A53, Dual-core
  Max. operating frequency: 1.0GHz

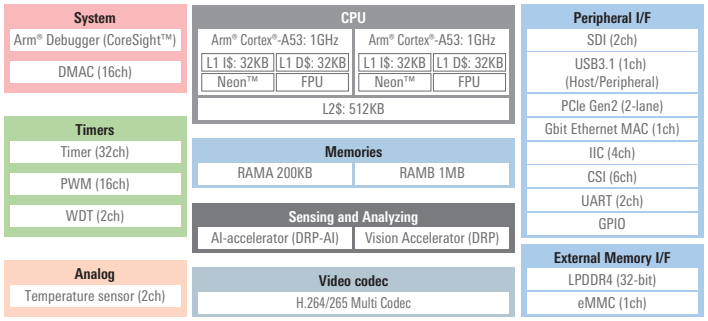
Memory interface
- 32bit LPDDR4 memory interface
- eMMC 4.5.1 × 1 channel
- SDIO × 2 channel

NPU: DRP-AI: 1TOPS
OpenCV accelerator: DRP

Video codec
- Encoding: H.265 up to 2160p, H.264 up to 1080p
- Decoding: H.265 up to 2160p, H.264 up to 1080p

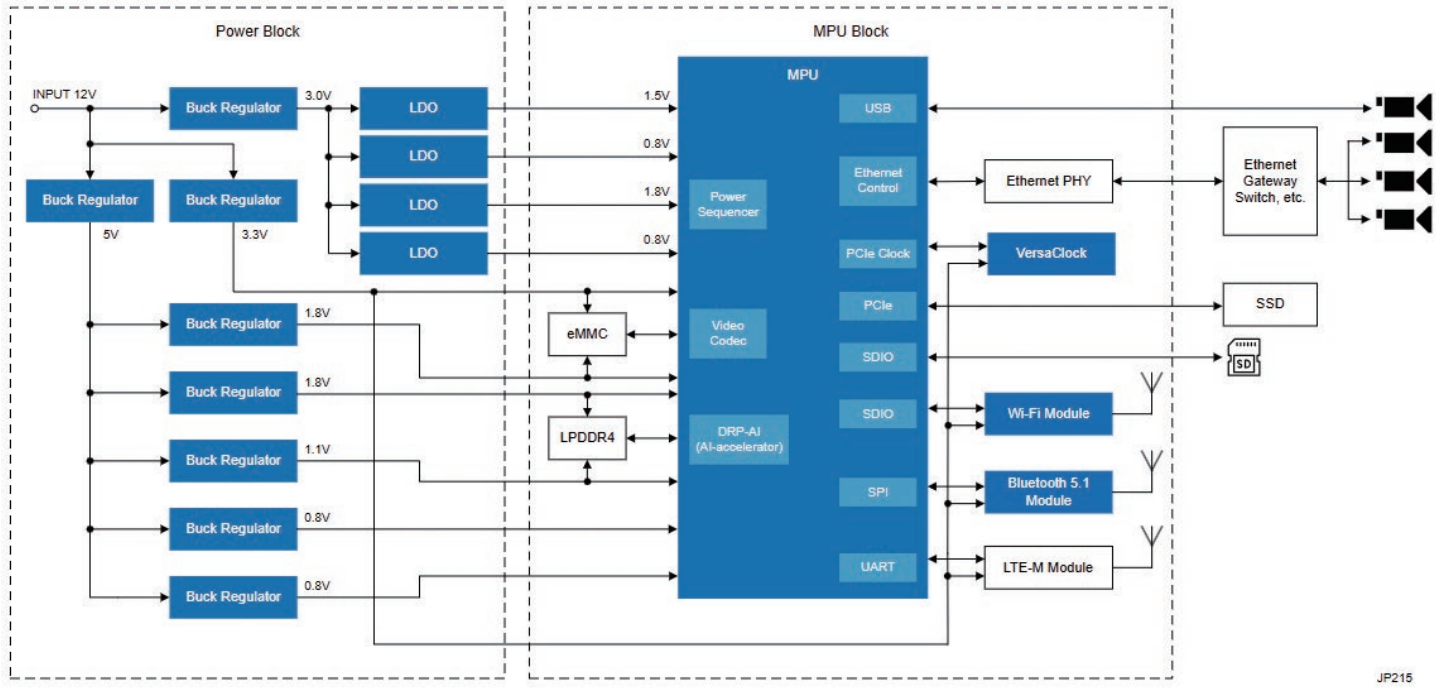
High Speed interface
- Gigabit Ethernet × 1 channel
- USB3.1 × 1 channel (Host/Function)
- PCIe Gen2 (2-lane)

Package
- FCBGA, 15mm × 15mm, 0.5mm pitch, 841 pins



Vision AI Gateway

Renesas' Vision AI Gateway design expertly manages vision data from multiple cameras, performing high-speed AI processing. It features an AI MPU with extensive peripheral functions and an optimized power supply system, achieving high performance and low power consumption and enhancing the value of gateway applications.



System Benefits:
- Fast vision AI processing by decoding video streams (H.264 or H.265) and handling multiple AI inferences with minimal switching overhead.
- Supports high-speed vision gateway functionality with Ethernet protocol at 100/1000Mbps and USB 3.1 Gen1 (5Gbps) for fast connections.
- Offers peripheral extension capabilities with PCI Express® 2.0 (Gen2 / 2 Lane).
- The MPU includes a built-in power sequencing control function, simplifying power supply design and enhancing reliability.
- Integrates various communication devices, including a high-performance Wi-Fi module, a compact Bluetooth® Low Energy (LE) module, and an LTE Cat-M1 cellular IoT module.

RZ/V2H Group: Quad Cortex-A55, Dual Cortex-R8, DRP-AI3 80TOPS

The RZ/V2H high-end AI MPU boasts Renesas' proprietary dynamically reconfigurable processor AI accelerator (DRP-AI3), quad Arm® Cortex®-A55 (1.8GHz) Linux processors, and dual Cortex®-R8 (800MHz) real-time processors. Furthermore, the RZ/V2H also includes another dynamically reconfigurable processor (DRP). This processor can accelerate image processing, such as OpenCV, and dynamics calculations required for robotics applications. It also features high-speed interfaces like PCIe®, USB 3.2, and Gigabit Ethernet, making it an ideal microprocessor for applications such as autonomous robots and machine vision in factory automation, where advanced AI processing must be implemented with low power consumption.

CPU core
- Arm® Cortex®-A55, Quad-core
  Max. operating frequency: 1.8GHz
- Arm® Cortex®-R8, Dual-core
  Max. operating frequency: 800MHz
- Arm® Cortex®-M33, Single-core
  Max. operating frequency: 200MHz

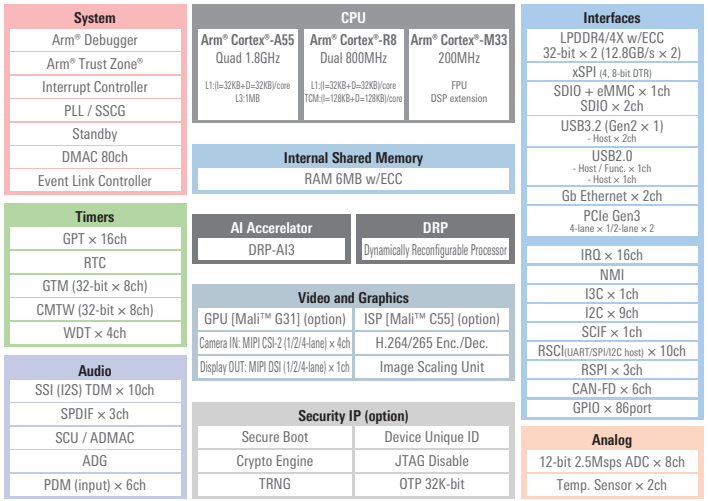
Memory interface
- 32bit × 2 LPDDR4/4X memory interface
- eMMC 4.5.1 × 1 channel
- SDIO × 2 channel

NPU: DRP-AI3: 8TOPS/dense, 80TOPS/sparse
OpenCV accelerator: DRP
ISP (Image signal processor): Up to 4K
Camera interface: MIPI CSI-2 × 4 channel
Display interface: MIPI DSI × 1 channel

Video codec
- Encoding: H.265 up to 2160p30, H.264 up to 1080p60
- Decoding: H.265 up to 2160p30, H.264 up to 1080p60

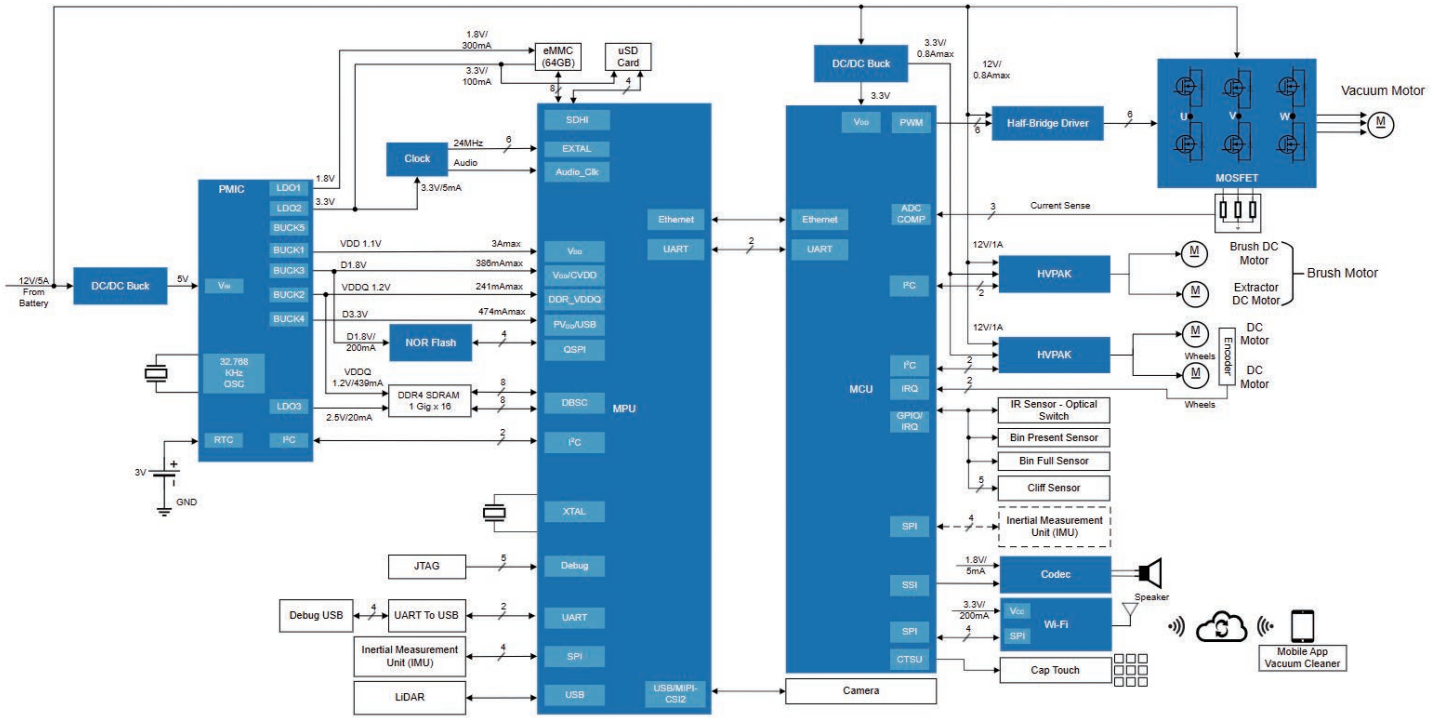
3D Graphics Engine: Arm® Mali™-G31
High Speed interface
- Gigabit Ethernet × 2 channel
- USB3.2 × 2 channel (Host only)
- USB2.0 × 2 channel (Host only ×1, Host/Function ×1)
- PCIe Gen3 (4-lane) × 1 channel

Package
- BGA, 19mm × 19mm, 0.5mm pitch, 1368 pins



Smart Robot Vacuum Cleaner

This robot vacuum cleaner is a smart cleaning device designed to clean floors and carpets without human intervention. It is equipped with autonomous features like environment mapping, anti-drop, obstacle detection, climbing, and auto-recharge. It implements simultaneous localization and mapping (SLAM) using LiDAR positioned on top of its body. Moreover, its infrared sensor assists in detecting and avoiding obstacles in its path. Additional control can be achieved through a mobile app or voice assistant.



System Benefits:
- Powerful Arm® Cortex®-A55 core paired with DRP-AI accelerator builds a virtual map of the room using LiDAR-based SLAM.
- HVPAK reduces BOM count and complexity for brushed motor drive.
- Pre-certified Wi-Fi module enables cloud connectivity with minimal development time and power consumption.

RZ/V2N Group: Quad Cortex-A55, DRP-AI3 15TOPS, 4K HW ISP

The RZ/V2N is a vision AI microprocessor (MPU) with Renesas' proprietary AI accelerator (DRP-AI3) supporting up to 15TOPS AI performance. Its CPUs are quad Arm® Cortex®-A55 (1.8GHz) and Arm Cortex-M33 (200MHz). The RZ/V2N is equipped with an ISP (Image Signal Processor) and dual-channel MIPI® CSI-2® camera interfaces for supporting dual camera signal processing, which is crucial for realizing vision systems. It is also equipped with high-speed interfaces such as PCIe® and USB 3.2, allowing for the expansion of external devices. The RZ/V2N is an ideal microprocessor for applications requiring both low power consumption and advanced AI inference, such as DMS (Driver Monitoring System), monitoring cameras, mobile robots, and more.

CPU core
- Arm® Cortex®-A55, Quad-core
  Max. operating frequency: 1.8GHz
- Arm® Cortex®-M33, Single-core
  Max. operating frequency: 200MHz

Memory interface
- 32bit LPDDR4/4X memory interface
- eMMC 4.5.1 × 1 channel
- SDIO × 2 channel

NPU: DRP-AI3: 4TOPS/dense, 15TOPS/sparse
OpenCV accelerator: DRP-AI3*
ISP (Image signal processor): Up to 4K
Camera interface: MIPI CSI-2 × 2 channel
Display interface: MIPI DSI × 1 channel

Video codec
- Encoding: H.265 up to 2160p30, H.264 up to 1080p60
- Decoding: H.265 up to 2160p30, H.264 up to 1080p60

3D Graphics Engine: Arm® Mali™-G31
High Speed interface
- Gigabit Ethernet × 2 channel
- USB3.2 × 1 channel (Host only)
- USB2.0 × 1 channel (Host/Function ×1)
- PCIe Gen3 (2Lane) × 1 channel

Package
- BGA, 15mm × 15mm, 0.5mm pitch, 840 pins

* Exclusive operation with AI inference

System
Arm® Debugger
Arm® Trust Zone®
Interrupt Controller
PLL / SSCG
Standby
DMAC 80ch
Event Link Controller

Timers
GPT × 16ch
RTC
GTM (32-bit × 8ch)
CMTW (32-bit × 8ch)
WDT × 4ch

Audio
SSI (I2C) TDM × 10ch
SPDIF × 3ch
ASRC / ADMAC
ADG
PDM (input) × 6ch

CPU	
Arm® Cortex®-A55 Quad 1.8GHz L1:(I=32KB+D=32KB)/core L3:1MB	Arm® Cortex®-M33 200MHz FPU DSP extension

Memory
RAM 1.5MB w/ECC

AI Accerelator
DRP-AI3

Video and Graphics	
GPU [Mali™ G31] (option)	ISP [Mali™ C55] (option)
Camera IN: MIPI CSI-2 4-lane × 2ch	H.264/265 Enc./Dec.
Display OUT: MIPI DSI 4-lane × 1ch	Image Scaling Unit

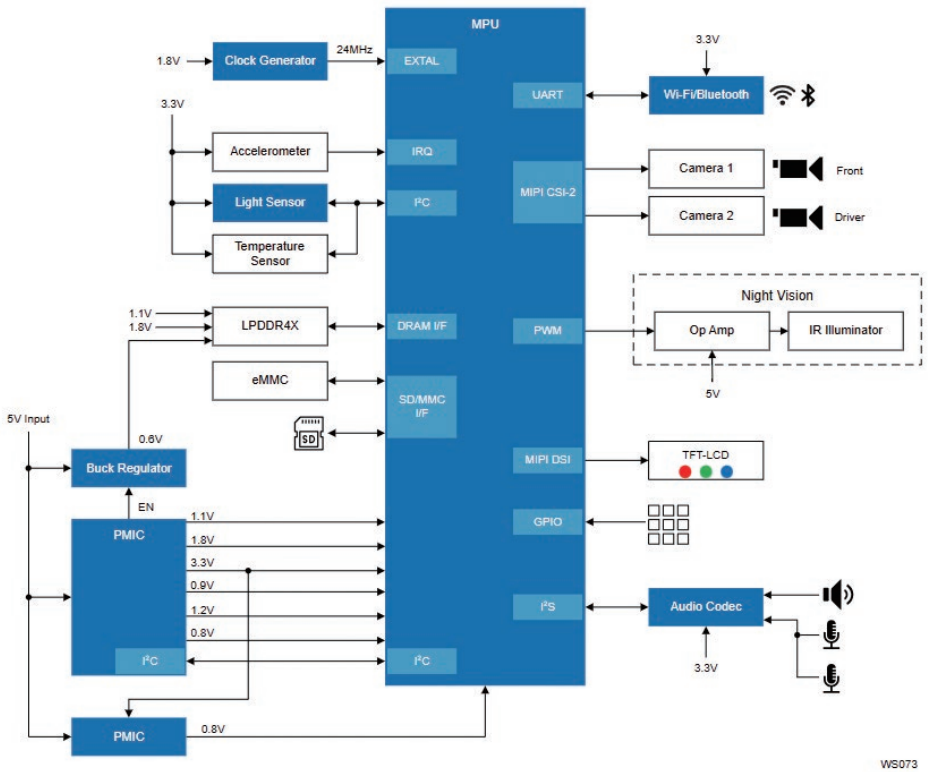
Security IP (option)	
Secure Boot	Device Unique ID
Crypto Engine	JTAG Disable
TRNG	OTP 32K-bit

Interfaces
LPDDR4/4X w/ECC 32-bit × 1 (12.8GB/s × 1)
xSPI (4, 8-bit DTR)
SDIO + eMMC × 1ch SDIO × 2ch - SDIO: x3.0/UHS-I - eMMC: JEDEC 4.5.1
USB3.2 (Gen2 × 1) - Host × 1ch
USB2.0 - Host / Func. × 1ch
Gb Ethernet × 2ch
PCIe Gen3 2-lane × 1
IRQ × 16ch
NMI
I3C × 1ch
I2C × 9ch
SCIF × 1ch
RSCI(UART/SPI/I2C host) × 10ch
RSPI × 3ch
CAN-FD × 6ch
GPIO × 86port

Analog
12-bit 2.5Msps ADC × 24ch
Temp. Sensor × 2ch

AI Dash Camera

The demand for consumer and commercial dash cameras is rising globally, driven by increasing mandates for vehicle safety features. Dash cameras serve various applications, including accident recording for liability protection, rideshare and fleet monitoring, and enhanced driver safety. The integration of AI further expands their capabilities, enabling advanced driver assistance systems (ADAS), higher-resolution video processing, and real-time intelligent analytics. This AI-powered dash camera system utilizes a high-performance vision AI MPU with a power-efficient AI accelerator to deliver superior video quality and advanced AI-driven features, such as license plate recognition, facial detection, and long-range object detection. Its high computational efficiency enables ADAS functionalities, such as collision avoidance alerts, enhancing overall vehicle and driver safety.



System Benefits:
- Great AI performance with exceptional thermal efficiency and low-power AI processing using DRP-AI for real-time vision inference.
- Dual camera support enables a front-facing ADAS camera and cabin-facing driver monitoring system (DMS) for enhanced situational awareness.
- Low power standby mode extends operational time with a connected accelerometer for instant system wakeup and recording upon detecting impacts or motion, ensuring critical events are captured.
- HMI integration supports touch control, LCD, and voice control, offering an intuitive, versatile, and hands-free user experience.

RZ/V Series Specification

Items	RZ/V2H	RZ/V2N	RZ/V2L	RZ/V2M	RZ/V2MA
Main CPU	Cortex-A55 × 4 Cortex-R8 × 2	Cortex-A55 × 4	Cortex-A55 × 2	Cortex-A53 × 2	Cortex-A53 × 2
Sub CPU	Cortex-M33	Cortex-M33	Cortex-M33	–	–
AI Accelerator Performance (DRP-AI)	10 TOPS/W Max. 80 TOPS (Sparse model) Resnet50: 830 Inference/Sec	10 TOPS/W Max. 15 TOPS (Sparse model) Resnet50: 455 Inference/Sec	1 TOPS/W Max. 0.5 TOPS Resnet50: 17 Inference/Sec	1 TOPS/W Max. 1 TOPS Resnet50: 28 Inference/Sec	1 TOPS/W Max. 1 TOPS Resnet50: 28 Inference/Sec
ISP for Camera	4K ISP (option) (hardware)	4K ISP (option) (hardware)	Simple ISP (software)	4K ISP (hardware)	–
MIPI CSI-2 I/F	4-lane × 4ch	4-lane × 2ch	4-lane × 1ch	4-lane × 2ch	–
Computer Vision Accelerator	OpenCV Accelerator	OpenCV Accelerator	OpenCV Accelerator	–	OpenCV Accelerator
Video Codec	H.265, H.264	H.265, H.264	H.264	H.265, H.264	H.265, H.264
Graphics	3D Graphics (option)	3D Graphics (option)	3D Graphics	2D Graphics	–
Package	1368-pin FCBGA, 19mm × 19mm 0.5mm ball pitch	840-pin FCBGA, 15mm × 15mm 0.5mm ball pitch	551-pin PBGA, 21mm × 21mm 0.8mm ball pitch 456-pin PBGA, 15mm × 15mm 0.5mm ball pitch	841-pin FCBGA, 15mm × 15mm 0.5mm ball pitch	841-pin FCBGA, 15mm × 15mm 0.5mm ball pitch

Features of ISP

Supports ISP function to realize Vision System

ISP Comparison Table

Item		RZ/V2H	RZ/V2N	RZ/V2L	RZ/V2M
ISP		H/W ISP Arm Mali™-C55 ISP	H/W ISP Arm Mali™-C55 ISP	S/W ISP Simple ISP by DRP library	H/W ISP 3rd party IP
Maximum Resolution		Up to 4K	Up to 4K	Up to 5M	Up to 4K
Support CMOS Sensor		User's choice	User's choice	User's choice	Select from IMX415, IMX462, IMX568, AR1335
Camera I/F		4× MIPI CSI-2 (4-lane)	2× MIPI CSI-2 (4-lane)	1× MIPI CSI-2 (4-lane), 1× Parallel	2× MIPI CSI-2 (4-lane)
Deliverables	ISP H/W Specifications	✓	✓	✓	–
	Driver/API Specifications	✓	✓	✓	✓
	Software	✓	✓	✓	✓
	Image Tuning Tool	✓	✓	✓	✓

ISP Function

Item	RZ/V2H	RZ/V2N	RZ/V2L	RZ/V2M
Support Image Size	3840 × 2160 p × 30 fps × 2 1920 × 1080 p × 60 fps × 2	3840 × 2160 p × 30 fps 1920 × 1080 p × 30 fps × 2	1920 × 1080 p × 15 fps	3840 × 2160 p × 30 fps 1920 × 1080 p × 30 fps × 2
AE (Auto Exposure), AWB (Auto White Balance)	✓	✓	✓	✓
Black Level Correction	✓	✓	✓	✓
Demosaic	✓	✓	✓	✓
Flicker Correction	✓	✓		✓
Obtain Focus Analysis Results	✓	✓		✓
Tone Mapping Settings	✓	✓		✓
Wide Dynamic Range Correction	✓	✓		✓
Chromatic Aberration Correction	✓	✓	✓	✓
Purple Fringing Correction	✓	✓		✓
Shading Correction	✓	✓		✓
Sharpness Correction	✓	✓	✓	✓
2D Noise Reduction	✓	✓	✓	✓
3D Noise Reduction	✓	✓	✓	
JPEG Conversion				✓
Resize	✓ (Downscale only)	✓ (Downscale only)	✓ (Downscale only)	✓

RZ/N Series

Industrial Network

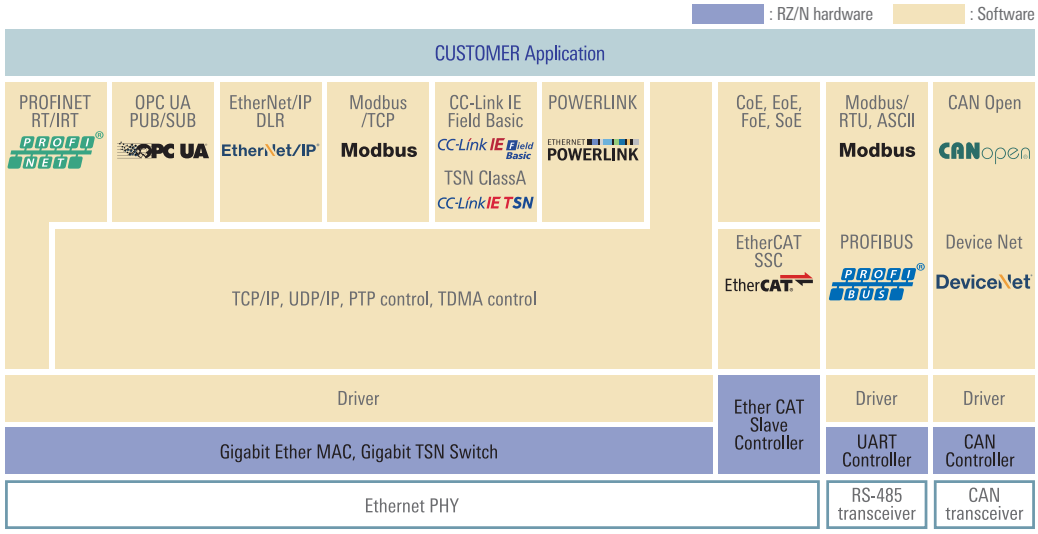
Features of the RZ/N Series

The Arm®-based RZ/N series MPUs offer scalable and high-performance communication features, supporting multiple industrial Ethernet protocols—including TSN—and redundant networking. With a built-in Gigabit switch and rich peripheral interfaces, they simplify integration into industrial Ethernet systems.

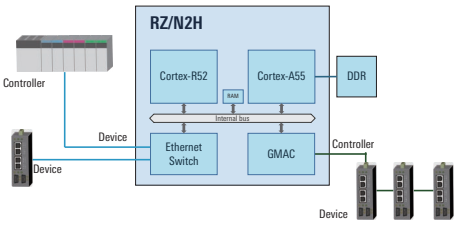
Industrial Ethernet with Redundancy + Linux/ RTOS

1. Provides optimized microprocessors for a variety of industrial network applications
- The RZ/N2H is optimized for industrial controller equipment such as PLC, DCS, CNC and motion controller. It integrates Quad Arm® CortexR-A55 cores (1.2GHz) for application processing and two Arm Cortex-R52 cores (1.0GHz) for real-time control. The flexible Ethernet functionalities supporting TSN execute both industrial Ethernet controller and device. Also, RZ/N2H can support up to 6-axis motor control, suitable for applications requiring multi-axis.
- The RZ/N2L is optimized for the role of dedicated network companion chip, simplifying the task of adding network functionality to industrial equipment. Since it handles network-related processing independently of the external CPU, Industrial Ethernet support can be implemented without the need to make major changes to the existing application software.

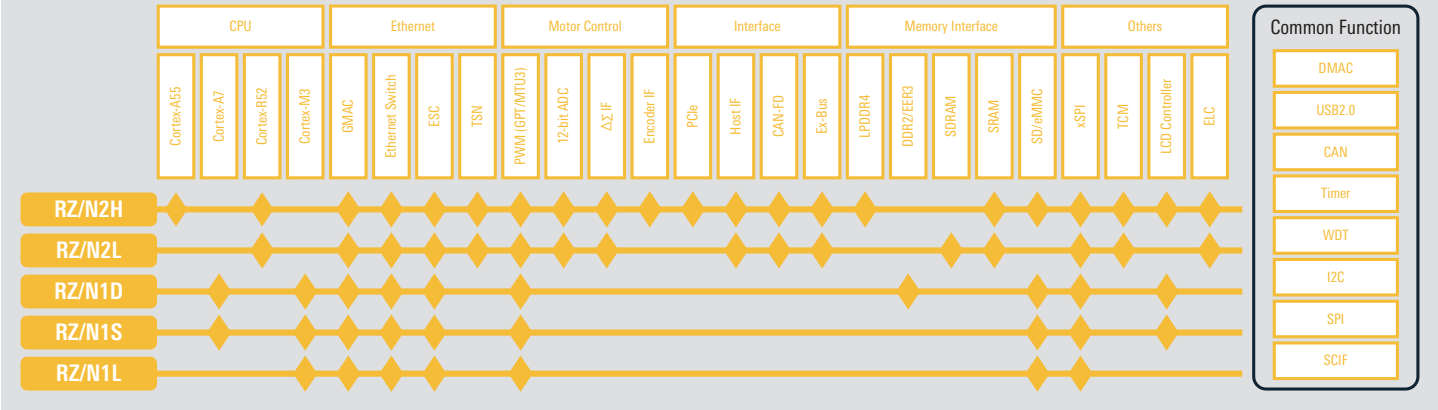
2. Integrated Ethernet switch and EtherCAT slave controller alongside support for major Industrial Ethernet protocols and TSN
- A wide range of Industrial Ethernet protocols are supported. Separating application processing and network processing allows for more efficient application control.



3. Flexible Ethernet Connectivity with RZ/N2H
- RZ/N2H features four Ethernet ports, three GMACs, an Ethernet switch, and an EtherCAT Sub-device Controller (ESC), enabling flexible support not only for industrial Ethernet devices but also for controllers. With a high-performance quad-core Arm Cortex-A55 and LPDDR4 memory, it can run Linux applications, making it an ideal MPU for industrial controller equipment such as PLCs.



RZ/N Series Lineup



RZ/N2H Group: Industrial Ethernet, Linux Application and Real-Time Control in one chip

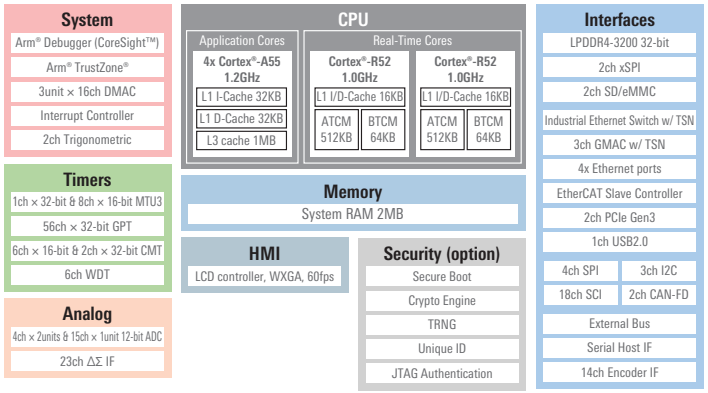
Renesas RZ/N2H group is high-end MPUs for Industrial Automation that offer high performance computing power for Linux application and high-speed real-time processing power with the capability of Industrial Ethernet and up to 6-axis motor control. The N2H group is suitable for industrial controller equipment such as PLC, DCS, CNC and motion controllers, and multi-axis motor control applications, such as industrial robots.

CPU core
- Arm® Cortex®-A55, Quad/Dual/Single-core
  Max operating frequency: 1.2GHz
  L1 I/D-cache 32KB per core, L3 cache 1MB
- Arm® Cortex®-R52, Dual-core
  Max operating frequency: 1.0GHz
  L1 I/D-cache 16KB,
  Tightly Coupled Memory (TCM):
  512KB (w/ ECC) + 64KB (w/ ECC) per core

Features
- On-chip system SRAM 2.0MB (w/ ECC)
- LPDDR4-3200 32-bit
- SD/eMMC
- Motor Control Peripherals (Support up to 6-axis)
  – PWM Timer: MTU3 9ch
  – PWM Timer: GPT 56ch
  – ΔΣ interface: 23ch
  – 12-bit ADC: 3units
  – Encoder IF: 14ch
  – Trigonometric function unit
- Industrial Ethernet
  – Ethernet Switch w/ TSN
  – 3ch Gigabit Ethernet MAC w/ TSN
  – 4× Ethernet ports
  – EtherCAT Slave Controller (ESC)
- PCI Express Gen3
- Serial host interface
- LCD Controller
- CAN-FD
- USB2.0
- SPI, SCI, I²C
- xSPI

Safety functions
- Register write protection, input clock oscillation stop detection, and CRC
- Isolated peripheral function access via MPU

Package
- 576-pin FCBGA (21mm × 21mm, 0.8mm pitch)
- Tj = −40°C to +125°C

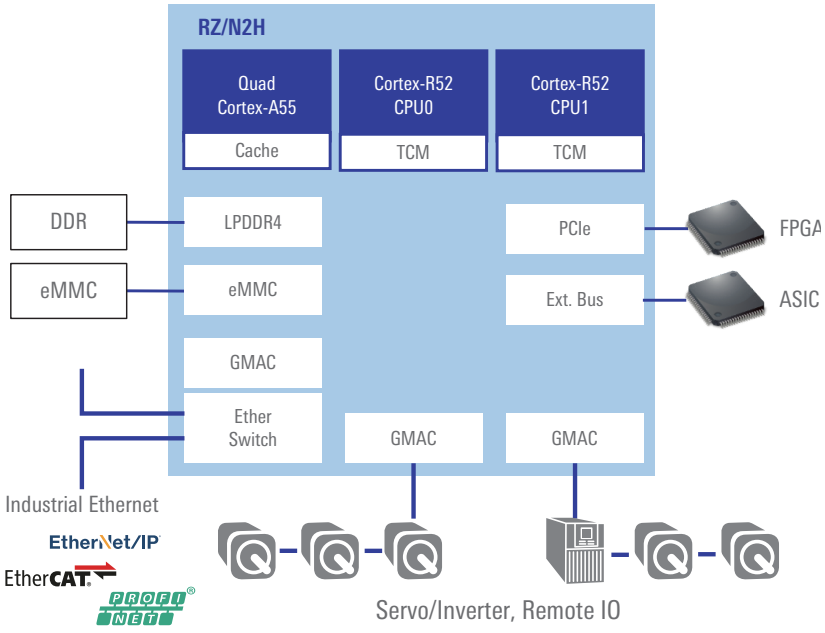


PLC (Programable Logic Controller) and Motion Controller

RZ/N2H is suitable for PLC and Motion Controller, which require multi-network support including Industrial Ethernet controller and device, such as EtherCAT®, Ethernet/IP™, PROFINET®.

The Cortex®-A55 Quad core have High Application Processing Power to execute Linux applications such as user-defined sequence processing and Industrial Ethernet controller.

Dual Cortex-R52 have High Real-time Performance to support Industrial Ethernet device required for standalone PLC and motion controller. High-Speed Connectivity such as PCIe or External Bus to FPGA or custom ASIC which often used for backplane bus or proprietary network.



RZ/N2L Group: Easily Implement Industrial Ethernet and TSN on Industrial Systems

RZ/N2L is an Ethernet communication microprocessor (MPU) that enables customers to easily implement industrial Ethernet and TSN in various IoT and industrial applications like drives, gateways, remote IO and more.

RZ/N2L has functions such as an advanced 3-port Gigabit Ethernet switch with TSN, EtherCAT® slave controller, and supports major industrial Ethernet protocols such as EtherCAT, PROFINET RT/IRT, EtherNet/IP™, and OPC UA.

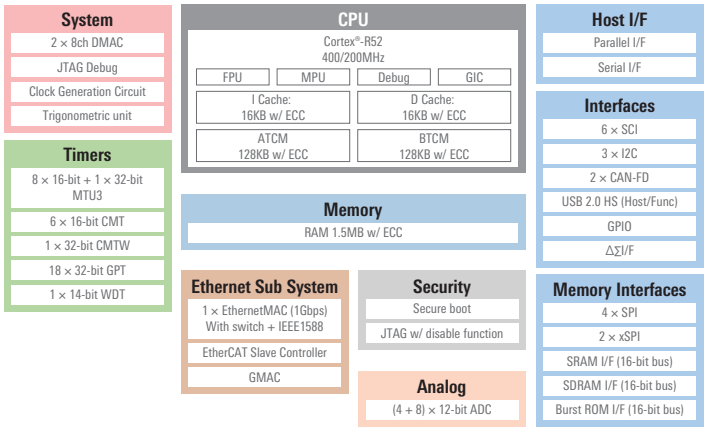
RZ/N2L is optimized for network companion chip use-cases. It easily connects to existing systems through its parallel or serial host interface without requirement of major changes.

CPU core
- Arm® Cortex®-R52
  Max operating frequency: 400MHz
  L1 I/D-cache 16KB
  Tightly Coupled Memory (TCM):
  128KB (w/ ECC) + 128KB (w/ ECC)

Features
- On-chip system SRAM 1.5MB (w/ ECC)
- TSN support
- 3-port Gigabit Ethernet switch
- EtherCAT Slave controller
- Parallel host/serial host interface
- PWM timer
- ΔΣ interface
- ADC
- Trigonometric function unit
- CAN-FD
- USB2.0
- SPI, SCI, I²C
- xSPI

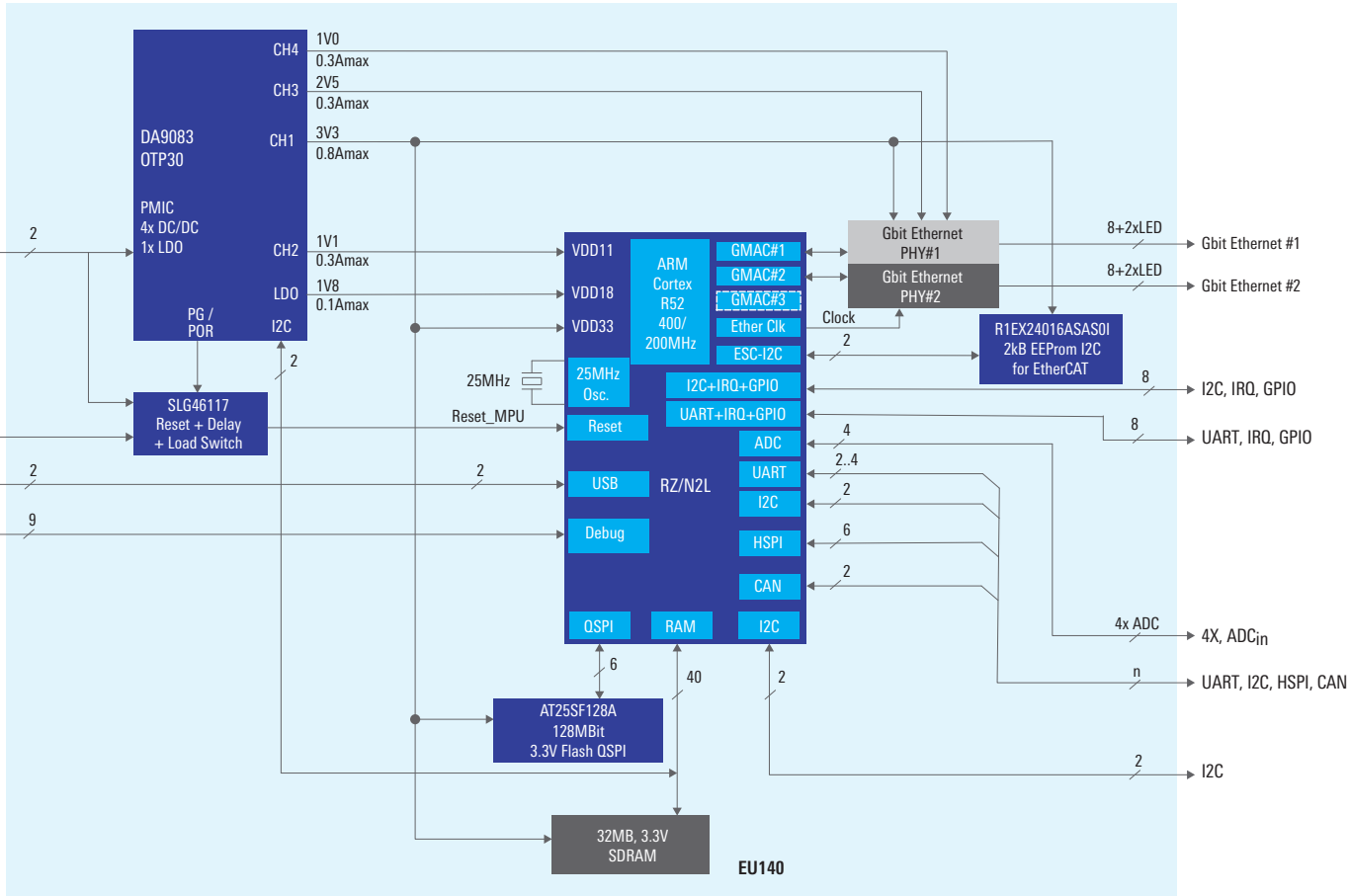
Safety functions
- Register write protection, input clock oscillation stop detection, and CRC
- Isolated peripheral function access via MPU

Package
- 225-pin FBGA (13mm × 13mm, 0.8mm pitch)
- 128-pin FBGA (10mm × 10mm, 0.8mm pitch)
- Tj = −40°C to +125°C



Industrial Gigabit Ethernet System-on-Module

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.



RZ/N2 Specification

Item	RZ/N2H	RZ/N2L
Application Core	Cortex-A55 1.2GHz ×4	–
Realtime Core	Cortex-R52 1.0GHz ×2	Cortex-R52 400MHz
DDR	LPDDR4-3200 32-bit	–
Industrial Ethernet	4 Ether ports 3 GMAC Ethernet Switch ESC, TSN	3 Ether ports 1 GMAC Ethernet Switch ESC, TSN
Motor Control	Up to 6-axis	–
PCIe	PCIe (Gen3) ×2	–
HMI	Parallel RGB	–
Host IF	Serial	Serial / Parallel
Package	FCBGA 576-pin (23mm × 23mm)	FBGA 225-pin (23mm × 23mm) FBGA 121-pin (10mm × 10mm)

RZ/T Series

Real-time Control

Features of the RZ/T Series

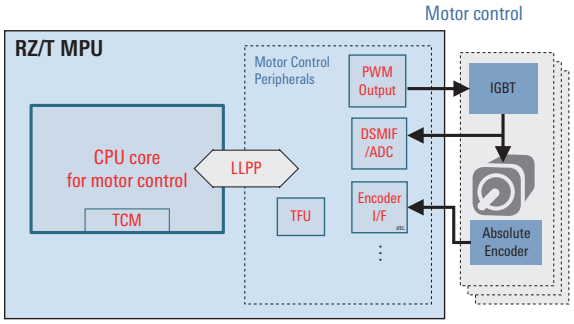
The Arm®-based RZ/T series MPUs deliver fast real-time control and high-performance application processing with industrial Ethernet communication to build high-performance systems for a wide range of industrial motor control equipment from servos to multi-axis robots. Equipped with encoder interfaces, RZ/T MPUs can support various encoder protocols.

- RZ/T2H is a high-end MPU equipped with a high-performance quad-core Cortex-A55 @1.2GHz for application processing, two high-speed real-time Cortex-R52 cores @1GHz, and peripherals capable of controlling up to 9-axis motors. It also supports both Industrial Ethernet controller and device functions.
- RZ/T2M and RZ/T2ME are equipped with two Cortex-R52 cores @800MHz and support motor control of up to 2 axes as well as various Industrial Ethernet devices. RZ/T2ME supports OTFD for security enhancement.
- RZ/T2L is equipped with a single Cortex-R52 core @800MHz and supports motor control of up to 2 axes as well as EtherCAT communication.

Industrial Ethernet
Motor drive + Linux/RTOS

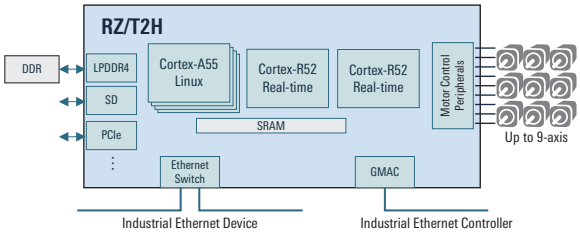
High-Performance, High-Speed Real-Time Control

- The Real-time core Cortex-R52 equipped with large Tightly Coupled Memory (TCM) minimizes execution time variation by avoiding cache-related fluctuations.
- Motor control peripherals are placed on the LLPP (low latency peripheral port) bus for faster CPU access.
- TFU accelerates trigonometric functions processing.
- Supports multi-protocol absolute encoders such as A-format™, EnDat 2.2, and BiSS-C®, HIPERFACE DSL and FA-Coder, enabling faster and more precise position control.
- Motor control peripheral scalability: RZ/T2H supports up to 9 axes, whereas RZ/T2M, RZ/T2ME, and RZ/T2L support up to 2 axes.

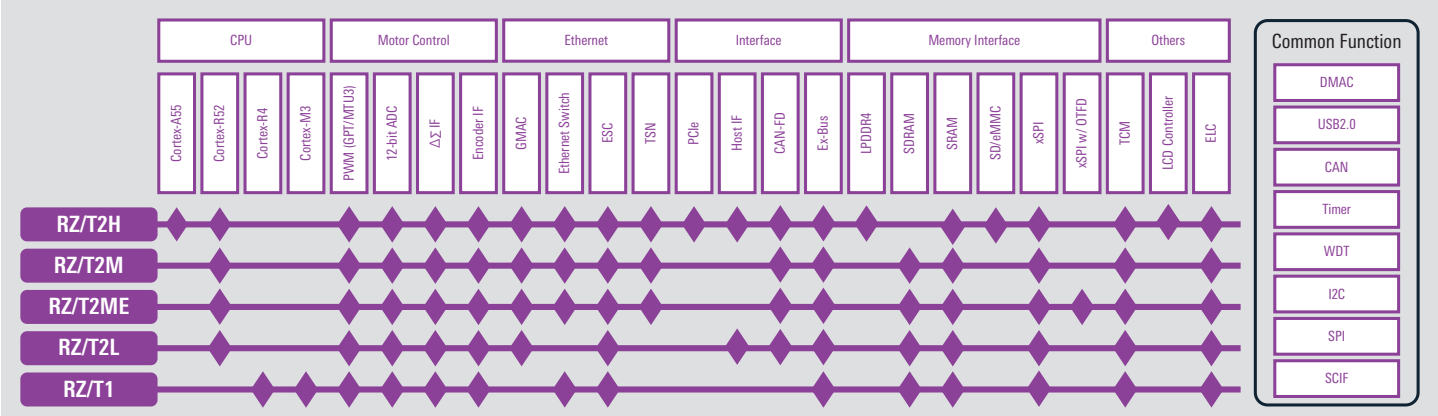


High Application-Processing Power and Real-Time Performance

- RZ/T2H is an advanced high-end microprocessor (MPU) equipped with Quad Arm® Cortex®-A55 cores (1.2GHz) for application processing and two Arm Cortex-R52 cores (1.0GHz) for real-time control.
- LPDDR4-3200 (32-bit) support provides high-speed and large-capacity memory, allowing flexible implementation of Linux, RTOS, or BareMetal software.
- Enables control of up to 9 motor axes while flexibly supporting industrial Ethernet devices and controllers, with compatibility for next-generation TSN.
- Rich Peripheral Set Including PCIe Gen3 (2ch), SD/eMMC, CAN-FD, and LCD Controller.



RZ/T Series Lineup



RZ/T2H Group: Up to 9 axes control, Industrial Ethernet and Linux Application in one chip

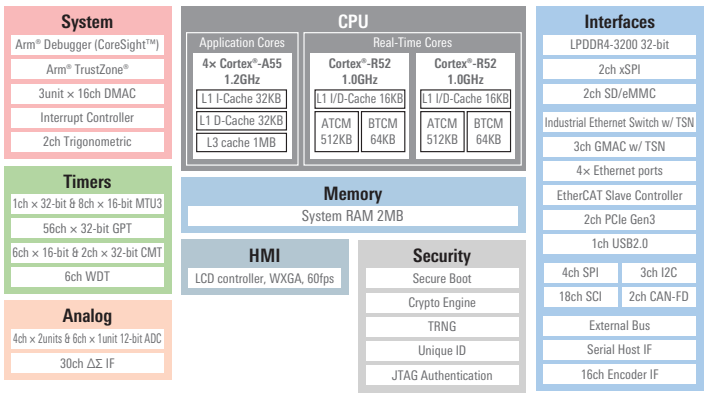
Renesas RZ/T2H group is high-end MPUs for Industrial Automation that offer high performance computing power for Linux application and high-speed real-time processing power with capability of up-to 9 axes motor control and multiple Industrial Ethernet. The T2H group is suitable for industrial robots with multi-axis control and controller applications such as PLC, DCS, CNC and motion controllers.

CPU core
- Arm® Cortex®-A55, Quad/Dual/Single-core
  Max operating frequency: 1.2GHz
  L1 I/D-cache 32KB per core, L3 cache 1MB
- Arm® Cortex®-R52, Dual-core
  Max operating frequency: 1.0GHz
  L1 I/D-cache 16KB,
  Tightly Coupled Memory (TCM):
  512KB (w/ ECC) + 64KB (w/ ECC) per core

Features
- On-chip system SRAM 2.0MB (w/ ECC)
- LPDDR4-3200 32-bit
- SD/eMMC
- Motor Control Peripherals (Support up to 9-axis)
  – PWM Timer: MTU3 9ch
  – PWM Timer: GPT 56ch
  – ΔΣ interface: 30ch
  – 12-bit ADC: 3units
  – Encoder IF: 16ch
  – Trigonometric function unit
- Industrial Ethernet
  – Ethernet Switch w/ TSN
  – 3ch Gigabit Ethernet MAC w/ TSN
  – 4× Ethernet ports
  – EtherCAT Slave Controller (ESC)
- PCI Express Gen3
- Serial host interface
- LCD Controller
- CAN-FDz
- USB2.0
- SPI, SCI, I²C
- xSPI

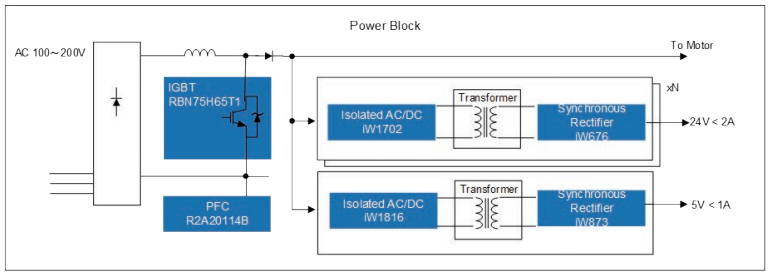
Safety functions
- Register write protection, input clock oscillation stop detection, and CRC
- Isolated peripheral function access via MPU

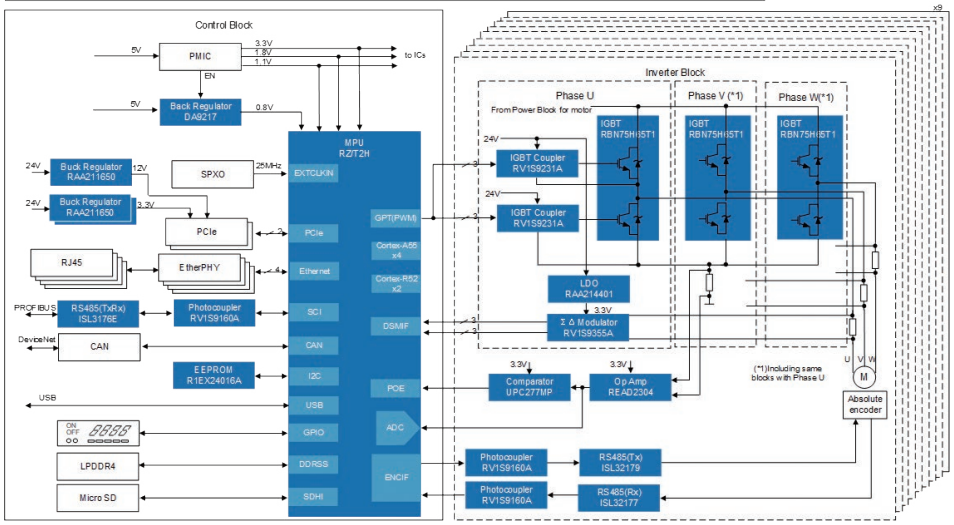
Package
- 729-pin FCBGA (23mm × 23mm, 0.8mm pitch)
- Tj = −40°C to +125°C



9-Axis Industrial Motor Control with Ethernet

The system integrates the MPU with peripheral devices, minimizing the need for external components. The MPU's dual Arm® Cortex®-R52 cores enable high-precision motor control and facilitate industrial Ethernet communication.
It provides high-precision current sensing through the MPU's delta-sigma (ΔΣ) interface and ΔΣ modulator and supports various encoder types with an MPU encoder interface and RS-485 connectivity. The MPU's quad Arm Cortex-A55 cores perform advanced arithmetic processing, including trajectory formation for 9-axis motor control. The system supports major industrial Ethernet protocols, such as EtherCAT®, Ethernet/IP™, PROFINET®, and OPC Unified Architecture (OPC UA), with a simple configuration requiring minimal external components. A functional safety system can be easily built using the MPU and one MCU for mutual monitoring. Renesas provides reference circuits and a variety of sample programs to assist in implementation.





RZ/T2M & RZ/T2ME Group:

High-performance MPU Realizing High-speed High Precision Control for real time control

RZ/T2M&T2ME is an industry-leading high-performance multi-function MPU that realizes high-speed processing, high precision control, and functional safety required for industrial equipment such as AC servos and industrial motors.

Powered by dual Arm® Cortex®-R52 cores with a maximum frequency of 800MHz for real-time control and embedded with a large tightly coupled memory (576KB) directly connected to the CPU to realize high-performance real-time processing, enables low latency access by arranging the peripherals for motor control to the LLPP (Low Latency Peripheral Port) that is directly connected to the CPU.

RZ/T2M&T2ME realizes high speed and highly precise motor control and industrial Ethernet communication such as EtherCAT, PROFINET RT/IRT and EtherNet/IP on a single chip.

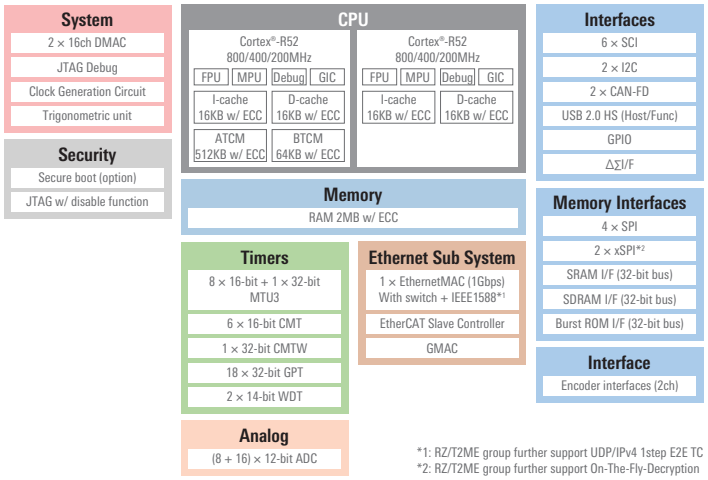
CPU core
- Arm® Cortex®-R52 × 2
  Max operating frequency: 800MHz
  L1 I/D-cache 16KB
  Tightly Coupled Memory (TCM):
  512KB (w/ ECC) + 64KB (w/ ECC)

Features
- On-chip system SRAM 2MB (w/ ECC)
- Low latency peripheral port (LLPP) bus
- TSN support
- 3-port Gigabit Ethernet switch
- EtherCAT Slave controller
- IEEE1588 UDP/IPv4 1-step E2E TC*
- Encoder interface
- PWM timer
- ΔΣ interface
- ADC
- Trigonometric function unit
- CAN-FD
- USB2.0
- SPI, SCI, I²C
- xSPI (Octa/Quad)
- xSPI (Octa/Quad) w/ On-The-Fly-Decryption (OTFD)*
- Functional safety support up to SIL3

Safety functions
- Register write protection, input clock oscillation stop detection, and CRC
- Isolated peripheral function access via MPU

Package
- 320-pin FBGA (17mm × 17mm, 0.8mm pitch)
- 225-pin FBGA (13mm × 13mm, 0.8mm pitch)
- 176-pin LQFP (24mm × 24mm, 0.5mm pitch)
- 128-LQFP (20mm × 14mm, 0.5mm pitch)
- Tj = −40°C to +125°C

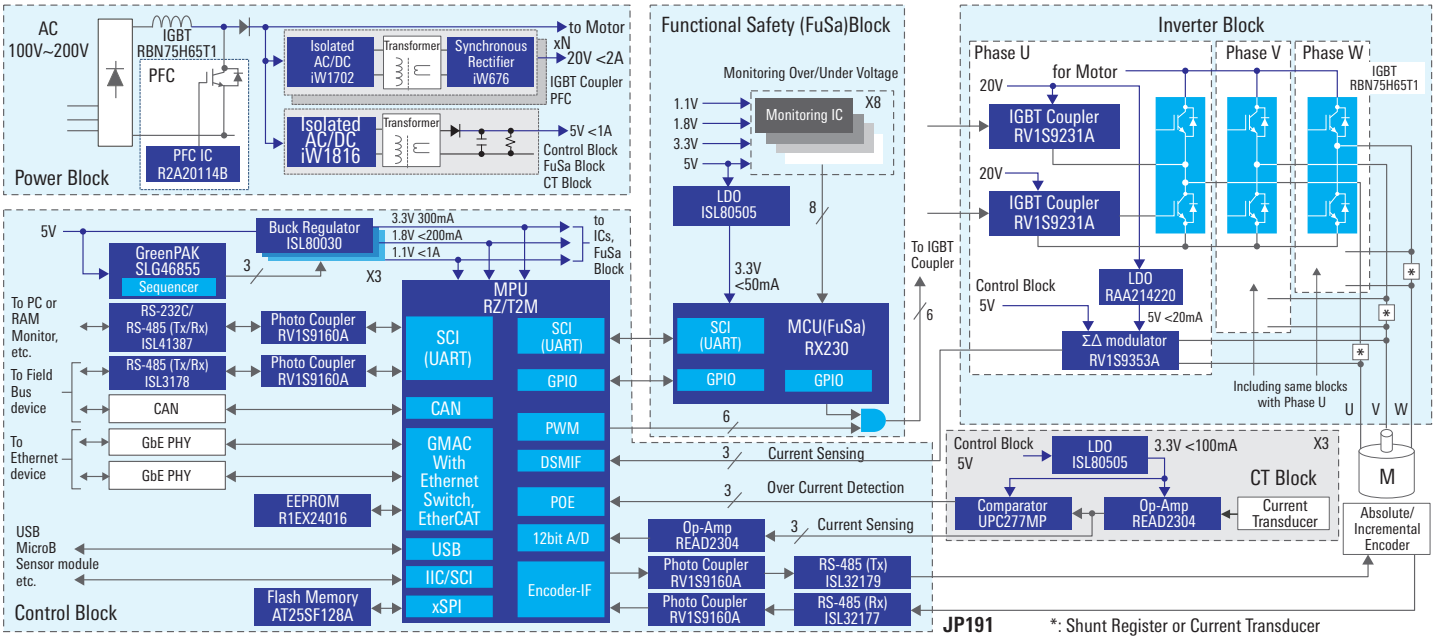
* Supported only by RZ/T2ME



*1: RZ/T2ME group further support UDP/IPv4 1step E2E TC
*2: RZ/T2ME group further support On-The-Fly-Decryption

Motor Control System with Industrial Network and Functional Safety

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.



RZ/T2L Group: High-Performance MPU for Real-Time Control with EtherCAT

RZ/T2L is high-performance MPU that realizes high-speed and high-precision real-time control with EtherCAT. RZ/T2L has Arm® Cortex®-R52 @Max Frequency 800MHz and the large tightly coupled memory size (576 KB) is directly connected to the CPU, reducing the fluctuation in execution time that can occur when cache memory is used, and delivering deterministic and fast-response processing.

RZ/T2L has seamless hardware architecture with RZ/T2M such as CPU core, peripheral functions and LLPP (Low Latency Peripheral Port) bus, and can be proposed for higher performance control systems such as AC servo.

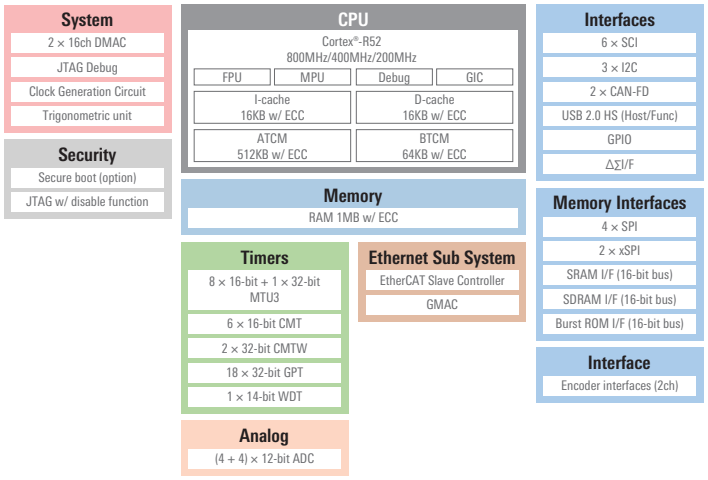
Also, RZ/T2L offers a scalable and compatible software platform with Renesas MPUs and MCUs. It enables customer utilizing their software assets for new model development.

CPU core
- Arm® Cortex®-R52
  Max operating frequency: 800MHz
  L1 I/D-cache 16KB
  Tightly Coupled Memory (TCM):
  512KB (w/ ECC) + 64KB (w/ ECC)

Features
- On-chip system SRAM 1MB (w/ ECC)
- Low latency peripheral port (LLPP) bus
- EtherCAT Slave controller
- Gigabit Ether MAC
- Encoder interface
- PWM timer
- ΔΣ interface
- ADC
- Trigonometric function unit
- Serial host interface
- xSPI (Octa/Quad)
- CAN-FD
- USB 2.0
- SPI, SCI, I²C
- Offering functional safety software up to SIL3

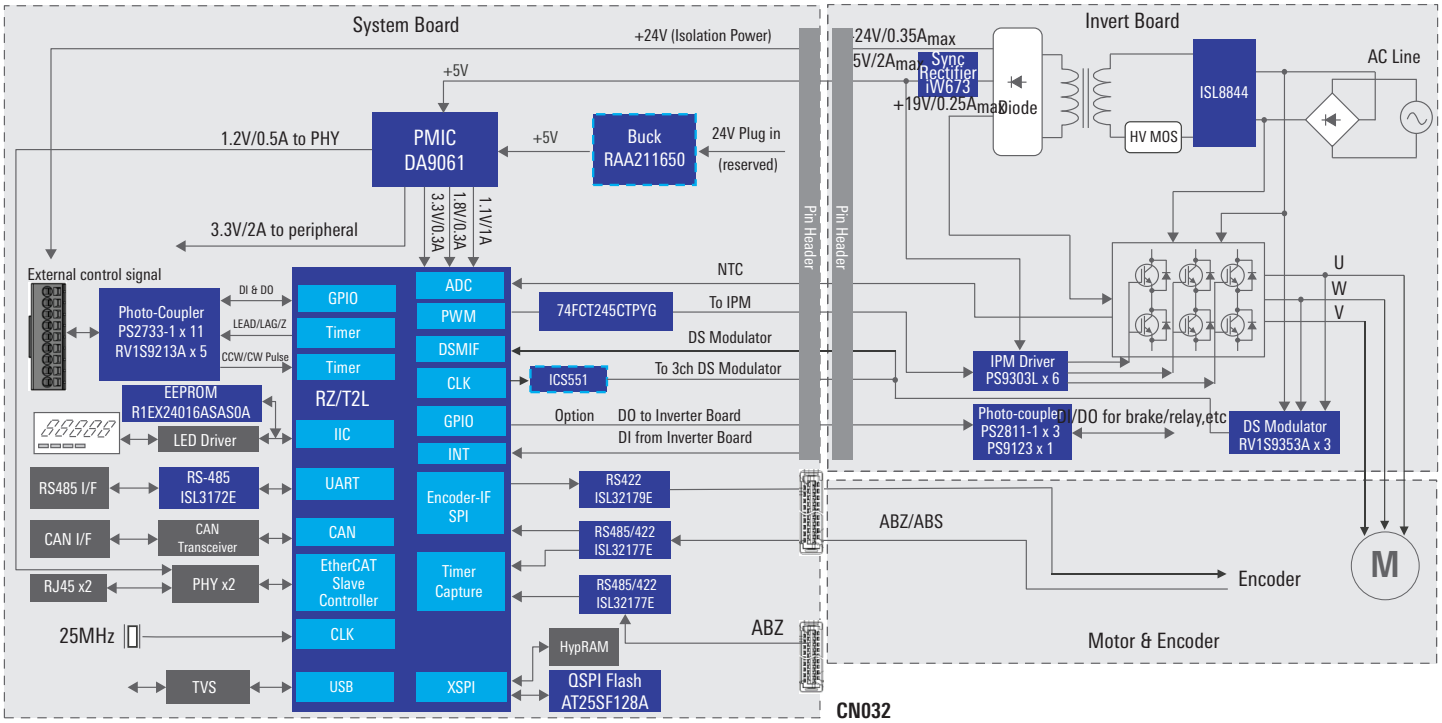
Safety functions
- Register write protection, input clock oscillation stop detection, and CRC
- Isolated peripheral function access via MPU

Package
- 196-pin FBGA (12mm × 12mm, 0.8mm pitch)
- Tj = −40°C to +125°C



AC Servo

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 or RZ/T2L microprocessor, this monolithic solution design outperforms traditional two-chip platforms on performance and cost.



CN032

RZ/T2 Specification

Item		RZ/T2H	RZ/T2ME	RZ/T2M	RZ/T2L
Application Core		Cortex-A55 1.2GHz ×4	–	–	–
Realtime Core		Cortex-R52 1.0GHz ×2	Cortex-R52 800MHz ×2	Cortex-R52 800MHz ×2	Cortex-R52 800MHz
DDR		LPDDR4-3200 32-bit	–	–	–
Industrial Ethernet		4 Ether ports 3 GMAC Ethernet Switch ESC, TSN	3 Ether ports 1 GMAC Ethernet Switch ESC, TSN	3 Ether ports 1 GMAC Ethernet Switch ESC, TSN	ESC
Motor Control	GPT/MTU (for motor control)	56ch/9ch (Up to 9-axis)	7ch/9ch (2-axis)	7ch/9ch (2-axis)	7ch/9ch (2-axis)
	Sigma Delta I/F	30ch	6ch	6ch	6ch
	Absolute Encoder I/F	16ch	2ch	2ch	2ch
PCIe		PCIe (Gen3) ×2	–	–	–
HMI		Parallel RGB	–	–	–
On-The-Fly-Decryption		–	Supported	–	–
Host IF		Serial	–	–	Serial
Package		FCBGA 729-pin (23mm × 23mm)	FBGA 320-pin (17mm × 17mm) FBGA 225-pin (13mm × 13mm)	FBGA 320-pin (17mm × 17mm) FBGA 225-pin (13mm × 13mm) LQFP 176-pin (24mm × 24mm) LQFP 126-pin (14mm × 20mm)	FBGA 196-pin (12mm × 12mm)

RZ/G Series

IoT Edge & HMI

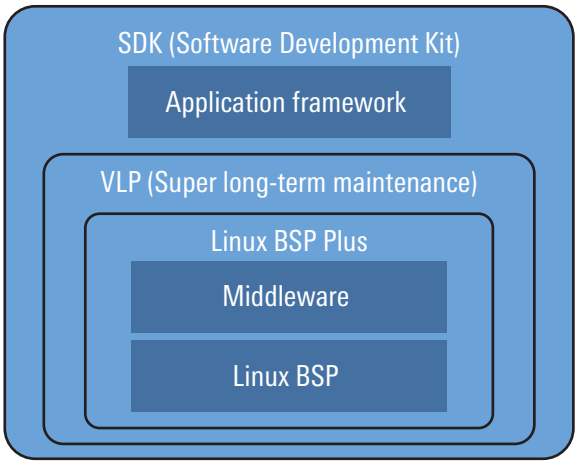
Multimedia / 3D Graphics
+ Linux

Features of the RZ/G Series

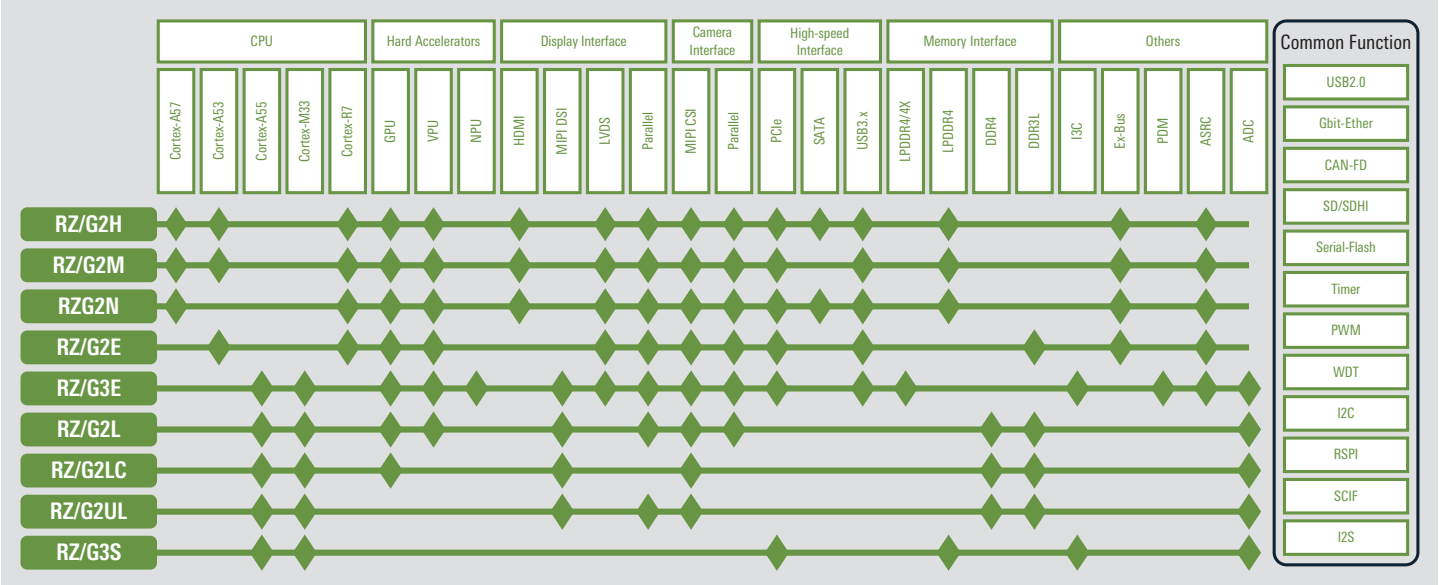
The RZ/G series is a scalable MPU platform based on the Arm® Cortex® architecture and RISC-V architecture with advanced graphics, video engine and high-speed interface. The scalable and efficient performance of the RZ/G series is ideal for industrial automation, building automation HMI, industrial cameras, and IoT Edge applications.

Yocto Based Linux Solution Overview

- Linux BSP Plus
  Support LTS Kernel: Long Term Support Kernel
  For experts who want to start development with the latest Kernel
- Verified Linux Package (VLP)
  Support SLTS Kernel: Super Long Term Support Kernel
  For users who requires super long-term Linux Kernel maintenance
- Software Development Kit (SDK)
  All-in-one package including application frameworks and VLP
  For Linux beginners who want to start Application software development early



RZ/G Series Lineup



RZ/G3E Group: 1.8GHz Quad Cortex-A55, LPDDR4/4X, 3DG, NPU

RZ/G3E is a microprocessor (MPU) integrated with quad CPU and NPU in one chip, improving power efficiency, reliability, and security for human machine interface (HMI) applications. The RZ/G3E offers rich HMI functions including graphics engine (GPU), video codec, multi-screen full HD output, and Neural Processing Unit (NPU) for edge computing functions. In addition to the Cortex-A55 quad core delivering a powerful 1.8GHz to run both HMI and edge computing functions, RZ/G3E also features a Cortex-M33 core to enable low power operation. The combination of two different cores enables users to build products with both high performance and low power consumption.

CPU core
- Arm® Cortex®-A55, Quad-core or dual-core
  Max. operating frequency: 1.8GHz
- Arm® Cortex®-M33, single-core
  Max. operating frequency: 200MHz
  Cache memory (Cortex®-A55)
  – L1 instruction cache: 32KB
  – L1 data cache: 32KB
  – L3 cache: 1MB

External memory
- Ability to connect LPDDR4-SDRAM / LPDDR4X-SDRAM via DDR dedicated bus
- Data bus width: 32 bits × 1 channel

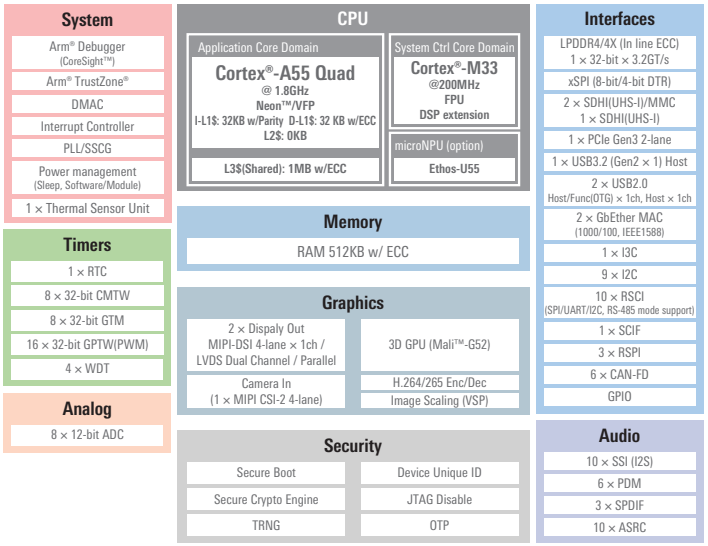
3D graphics
- Arm Mali™-G52 GPU

Video functions
- Video display interface: MIPI DSI × 1 channel or LVDS Dual channel or Digital parallel output × 1 channel
- Video input interface: MIPI CSI-2 × 1 channel
- Video codec module: VCD × 1 channel
- Video Signal processing VSP 1channel

Audio functions
- Serial sound interface × 10 channels
- Asynchronous sampling rate converter unit
- SPDIF × 3 channels
- Pulse density modulation x 6 channels

Storage interfaces
- USB 3.2 Gen2 × 1 channel (Host only)
- USB 2.0 × 2 channels (Host only 1 channel/Host-Function 1 channel)
- SD host interface × 1 channel
- SD host interface/Multimedia card interface × 2 channels (Shared with SDHI)

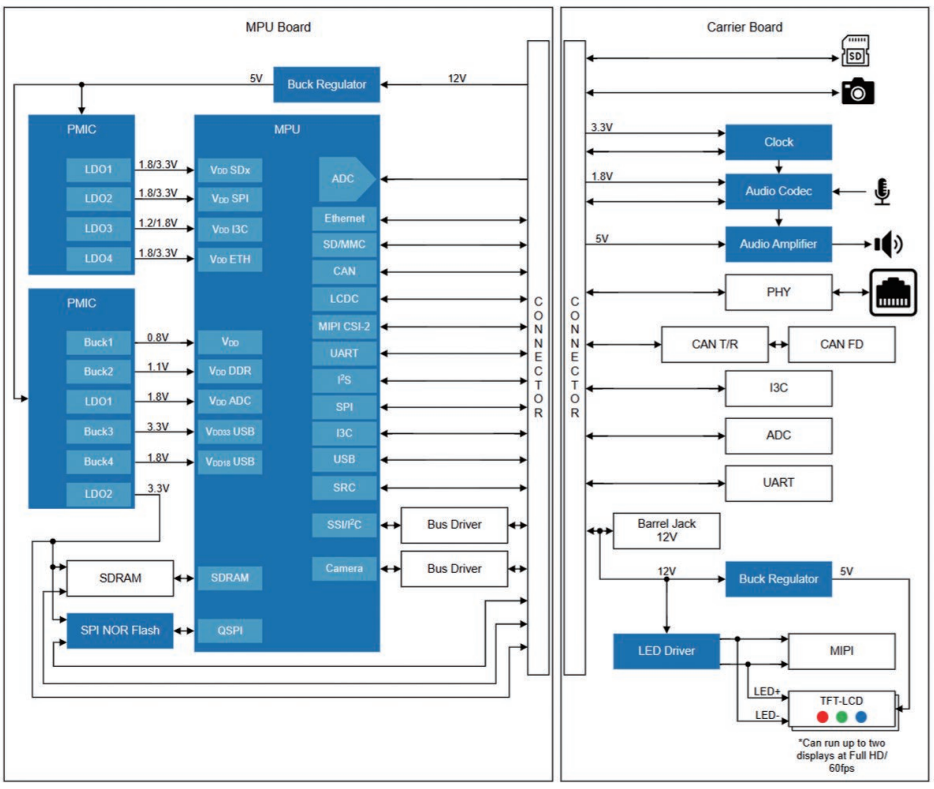
Other peripheral functions
- 32-bit general-purpose timer × 16 channel
- 32-bit CMTW timer × 8 channels
- I3C bus interface × 1 channels
- I2C bus interface × 9 channels
- Serial communication interface with FIFO (SCIF) × 1 channel
- Serial communication interface (RSCI) ×10 channels
- SPI Multi I/O Bus Controller× 1 channel(8bit Double data rate)
- Serial Peripheral Interface (RSPI) ×3 channels
- Gigabit Ethernet controller × 2 channels
- Controller area network (CAN) interface × 6 channels (support CAN FD)
- 12-bit A/D converter × 8 channels
- Interrupt controller
- Clock generator (CPG): on-chip PLL
- On-chip debug function



High-End Feature-Rich HMI Platform

The demand for sophisticated human machine interfaces (HMIs) continues to grow, necessitating support for multiple display outputs like RGB and MIPI, flexibility in display resolutions, along with peripherals such as microphones, speakers, Ethernet, and CAN FD across various industries.

This feature-rich HMI platform integrates multiple peripherals, including microphones, Ethernet, and CAN FD, and is scalable to meet diverse application needs. It offers both an MCU-based system for single displays up to WXGA resolution and an MPU-based system for dual displays up to Full HD, providing flexibility for various end applications.



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RZ/G3S Group: 1.1GHz Cortex-A55, Dual Cortex-M33, LPDDR4

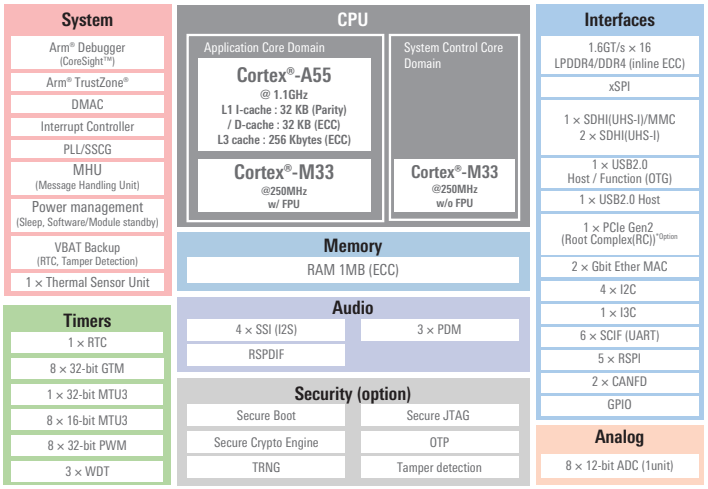
The RZ/G3S microprocessor includes an Arm® Cortex®-A55 (1.1GHz) CPU, 16-bit LPDDR4 or DDR4 interface and low-power mode. It also has many interfaces such as PCIe, CAN FD, and 12-bit ADC, making it ideal for applications such as IoT edge applications.

CPU core
- Arm® Cortex®-A55 single-core
  Max. operating frequency: 1.1GHz
- Arm® Cortex®-M33 core x2
  Max. operating frequency: 250MHz
  Cache memory (Cortex®-A55)
- L1 instruction cache: 32KB
- L1 data cache: 32KB
- L3 cache: 256KB

External memory
- Ability to connect LDDR4-SDRAM / DDR4-SDRAM via DDR dedicated bus
- Data bus width: 16 bits × 1 channel

Storage interfaces
- USB 2.0 × 2 channels (Host only 1 channel/Host-Function 1 channel)
- SD host interface × 2 channels
- Multimedia card interface × 1 channel (Shared with SDHI)

Other peripheral functions
- 16-bit timer × 8 channels
- I^2C bus interface × 4 channels
- Serial communication interface with FIFO (SCIF) × 6 channels
- SPI Multi I/O Bus Controller × 1 channel (4bit Double data rate)
- Serial Peripheral Interface (RSPI) × 5 channels
- Gigabit Ethernet controller × 2 channels
- Controller area network (CAN) interface× 2 channels (support CAN FD)
- 12-bit A/D converter × 8 channels
- Interrupt controller
- Clock generator (CPG): on-chip PLL
- On-chip debug function

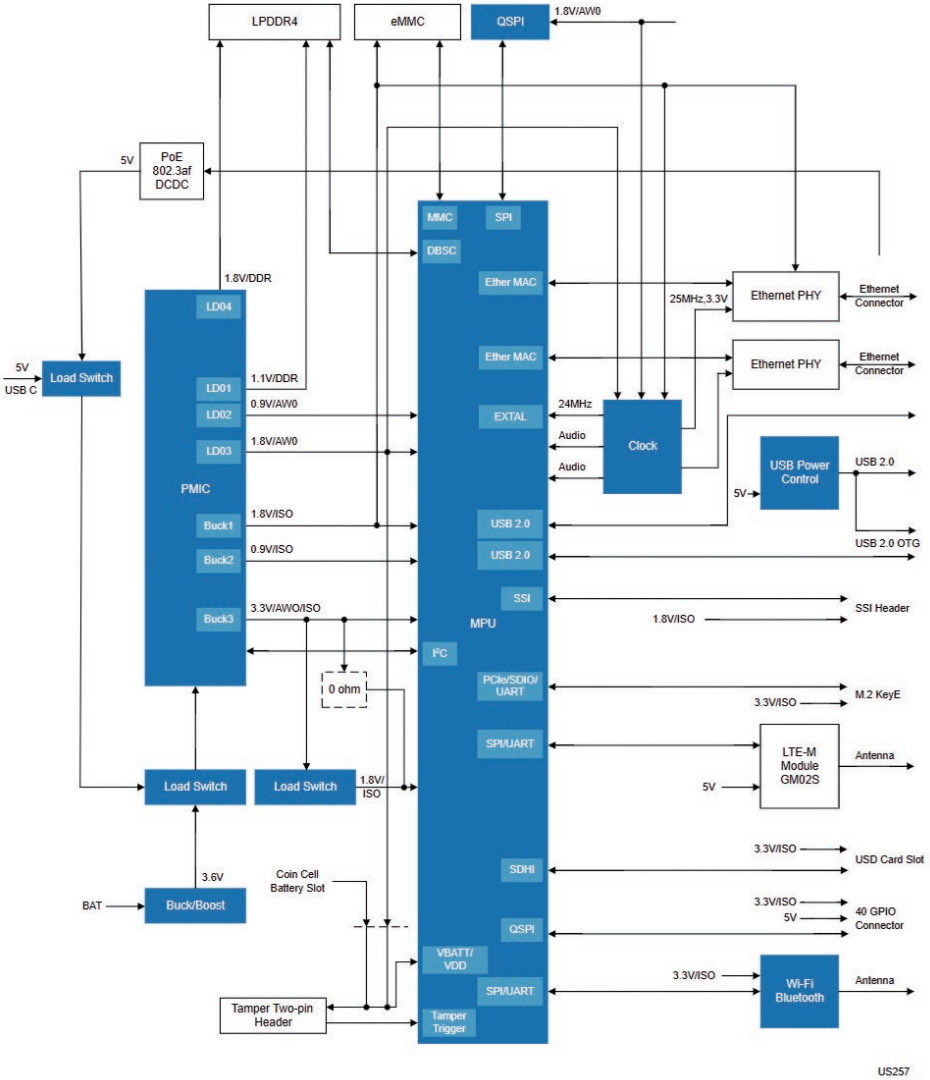


Single Board Computer Gateway

SBC gateway with Arm Cortex-A55 and Arm Cortex-M33 cores offers efficient processing, flexibility, and connectivity.

With the increasing number of IoT devices in smart buildings and industrial settings, there is a strong need for gateways that can manage and control connected devices. A single board computer (SBC) gateway facilitates communication between different IoT devices and protocols, ensuring smooth data transfer and real-time control across devices, which is essential for automation systems.

This SBC gateway system is assembled with a power-efficient MPU that incorporates an Arm® Cortex®-A55 and two Arm Cortex-M33 cores for real-time processing. A broad set of interfaces provides sensor connectivity and network communication options, making this design suitable for environments where energy efficiency, fast processing, and flexible integration with existing infrastructure are important.



RZ/G2L Group: 1.2GHz Dual Cortex-A55, DDR4/DDR3L, 3DG, Video codec

The RZ/G2L microprocessor includes a Cortex®-A55 (1.2GHz) CPU, 16-bit DDR3L/DDR4 interface, 3D graphics engine with Arm® Mali-G31 and video codec (H.264). It also has many interfaces such as camera input, display output, USB 2.0, and Gbit-Ether, making it ideal for applications such as entry-class industrial human-machine interfaces (HMIs) and embedded devices with video capabilities.

The RZ/G2L is also package-compatible and pin-compatible with the RZ/V2L embedded with AI accelerator. This allows RZ/G2L users to easily upgrade to the RZ/V2L for additional AI functions without needing to modify the PCB, keeping migration costs low.

CPU core
- Arm® Cortex®-A55, dual-core or single-core
  Max. operating frequency: 1.2GHz
- Arm® Cortex®-M33, single-core
  Max. operating frequency: 200MHz

Cache memory (Cortex®-A55)
- L1 instruction cache: 32KB
- L1 data cache: 32KB
- L3 cache: 256KB

External memory
- Ability to connect DDR4-SDRAM / DDR3L-SDRAM via DDR dedicated bus
- Data bus width: 16 bits × 1 channel

3D graphics
- Arm Mali™-G31 GPU

Video functions
- Video display interface:
  MIPI DSI × 1 channel or Digital parallel output × 1 channel
- Video input interface:
  MIPI CSI-2 × 1 channel or Digital parallel input × 1 channel
- Video codec module: VCPL4 × 1 channel
- Video image processing functions (Resizer and Color Space / Color Format Conversion)

Audio functions
- Serial sound interface × 4 channels

Storage interfaces
- USB 2.0 × 2 channels (Host only 1 channel/Host-Function 1 channel)
- SD host interface × 2 channels
- Multimedia card interface × 1 channel (Shared with SDHI)

Other peripheral functions
- 32-bit timer × 1 channel
- 16-bit timer × 8 channels
- PWM timer × 8 channels
- I^2C bus interface × 4 channels
- Serial communication interface with FIFO (SCIF) × 5 channels
- Serial communication interface (SCI) × 2 channels
- SPI Multi I/O Bus Controller× 1 channel (8bit Double data rate)
- Serial Peripheral Interface (RSPI) × 3channels
- Gigabit Ethernet controller × 2 channels
- Controller area network (CAN) interface × 2 channels (support CAN FD)
- 12-bit A/D converter × 8 channels
- Interrupt controller
- Clock generator (CPG): on-chip PLL
- On-chip debug function

System
Arm® Debugger (CoreSight™)
Arm® TrustZone®
16ch DMAC
Interrupt Controller
PLL/SSCG

Timers
1 × 32-bit MTU3
8 × 16-bit MTU3
8 × 32-bit PWM
3 × WDT

Analog
8 × 12-bit ADC

CPU		
Cortex®-A55 1.2GHz Neon™/VFP I-L1$: 32KB (Parity) D-L1$: 32KB (ECC) L2$: 0KB	Cortex®-A55(#) 1.2GHz Neon™/VFP I-L1$: 32KB (Parity) D-L1$: 32KB (ECC) L2$: 0KB	Cortex®-M33 @200MHz
L3$(Shared) : 256KB (ECC)		

Memory
RAM 128KB (ECC)

Video & Graphics	
3D GPU Arm® Mali™-G31	Camera In (MIPI CSI-2 4-lane, Parallel)
	Display Out (MIPI DSI 4-lane, Parallel)
H.264 Enc/Dec 1920 × 1080 @30fps	Image Scaling Unit

Security (option)	
Secure Boot	Device Unique ID
Crypto Engine	JTAG Disable
TRNG	OTP 4Kbit

Interfaces
1.6/1.3GT/s × 16 DDR4/DDR3L (inline ECC)
1 × SPI Multi I/O (8-bit DDR)
1 × SDHI (UHS-I)/MMC 1 × SDHI (UHS-I)
1 × USB2.0 Host
1 × USB2.0 Host / Function
2 × 100/1000Mbps Ether MAC
2 × I2C, 2 × I2C
2 × SCI 8/9-bit
5 × SCIF (UART)
3 × RSPI
2 × CAN-FD
GPIO

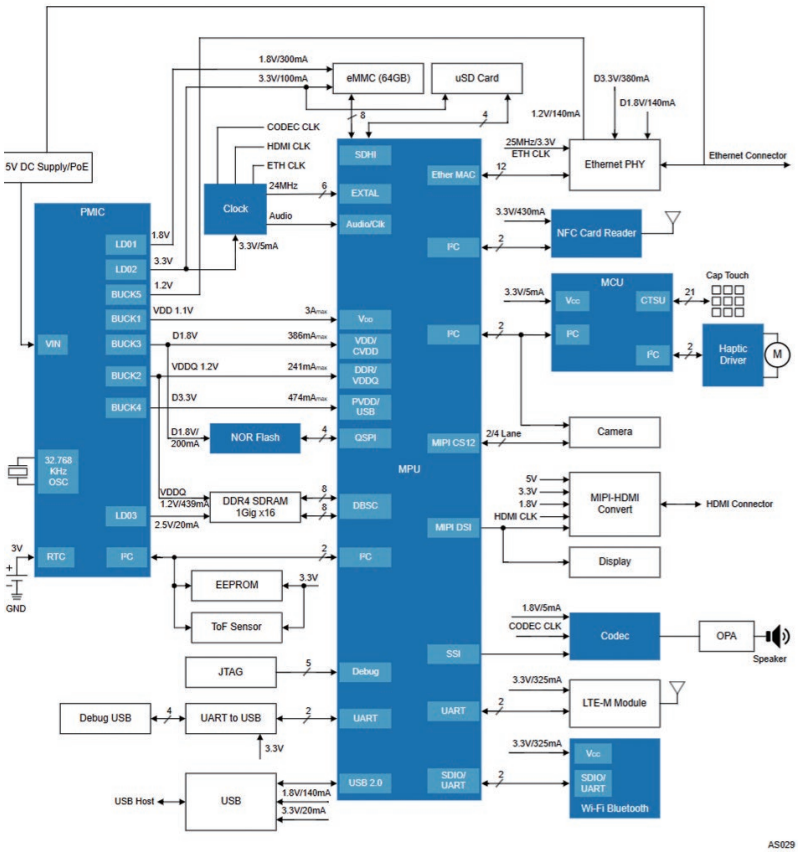
Audio
4 × SSI (I2S)

Access Control System with NFC, Camera, and Capacitive Touch Authentication

The access control system ensures security with NFC, Wi-Fi, PoE, local storage, and flexible OS support.

With increasing concerns over unauthorized access to buildings and sensitive locations within facilities, there is a growing demand for advanced, multi-layered security solutions in residential, commercial, and industrial settings.

This access control system offers authenticated access and user information storage via NFC card, camera, or manual entry. Capacitive buttons prevent mechanical key failures over extended use, while haptics provide active user feedback. The system supports a proximity sensor to enable auto wake-up functionality to conserve energy, and the option to use either a Linux or Android operating system, offering flexibility in UI experiences.



RZ/G2LC Group: 1.2GHz Dual Cortex-A55, DDR4/DDR3L, 3DG

The RZ/G2LC microprocessor includes a Cortex®-A55 (1.2GHz) CPU, 16-bit DDR3L/DDR4 interface, and 3D graphics engine with Arm® Mali-G31. It also has many interfaces such as camera input, display output, USB 2.0, and Gbit-Ether, making it ideal for applications such as entry-class industrial human-machine interfaces (HMIs) and embedded devices with GUI capabilities.

CPU core
- Arm® Cortex®-A55, dual-core or single-core
  Max. operating frequency: 1.2GHz
- Arm® Cortex®-M33, single-core
  Max. operating frequency: 200MHz

Cache memory (Cortex®-A55)
- L1 instruction cache: 32KB
- L1 data cache: 32KB
- L3 cache: 256KB

External memory
- Ability to connect DDR4-SDRAM / DDR3L-SDRAM via DDR dedicated bus
- Data bus width: 16 bits × 1 channel

3D graphics
- Arm Mali™-G31 GPU

Video functions
- Video display interface: MIPI DSI × 1 channel
- Video input interface: MIPI CSI-2 × 1 channel
- Video image processing functions (Resizer and Color Space / Color Format Conversion)

Audio functions
- Serial sound interface × 2 channels

Storage interfaces
- USB 2.0 × 2 channels (Host only 1 channel/Host-Function 1 channel)
- SD host interface × 2 channels
- Multimedia card interface × 1 channel (Shared with SDHI)

Other peripheral functions
- 32-bit timer × 1 channel
- 16-bit timer × 5 channels
- PWM timer × 4 channels
- I^2C bus interface × 4 channels
- Serial communication interface with FIFO (SCIF) × 3 channels
- Serial communication interface (SCI) × 2 channels
- SPI Multi I/O Bus Controller× 1 channel (4bit Double data rate)
- Serial Peripheral Interface (RSPI) × 3channels
- Gigabit Ethernet controller × 1 channel
- Controller area network (CAN) interface × 2 channels (support CAN FD)
- Interrupt controller
- Clock generator (CPG): on-chip PLL
- On-chip debug function

System
Arm® Debugger (CoreSight™)
Arm® TrustZone®
16ch DMAC
Interrupt Controller
PLL/SSCG

Timers
1 × 32-bit MTU3
5 × 16-bit MTU3
6 × 32-bit PWM
3 × WDT

CPU		
Cortex®-A55 1.2GHz Neon™/VFP I-L1$: 32KB (Parity) D-L1$: 32KB (ECC) L2$: 0KB	Cortex®-A55(#) 1.2GHz Neon™/VFP I-L1$: 32KB (Parity) D-L1$: 32KB (ECC) L2$: 0KB	Cortex®-M33 @200MHz
L3$(Shared) : 256KB (ECC)		

Memory
RAM 128KB (ECC)

Graphics	
3D GPU Arm® Mali™-G31	Camera In (MIPI CSI-2 4-lane)
Image Scaling Unit	Display Out (MIPI DSI 4-lane)

Security (option)	
Secure Boot	Device Unique ID
Crypto Engine	JTAG Disable
TRNG	OTP 4Kbit

Interfaces
1.6/1.3GT/s × 16 DDR4/DDR3L (inline ECC)
1 × SPI Multi I/O (4-bit DDR)
1 × SDHI (UHS-I)/MMC 1 × SDHI (UHS-I)
1 × USB2.0 Host
1 × USB2.0 Host / Function
1 × 100/1000Mbps Ether MAC
2 × I2C, 2 × I2C
2 × SCI 8/9-bit
4 × SCIF (UART)
3 × RSPI
2 × CAN-FD
GPIO

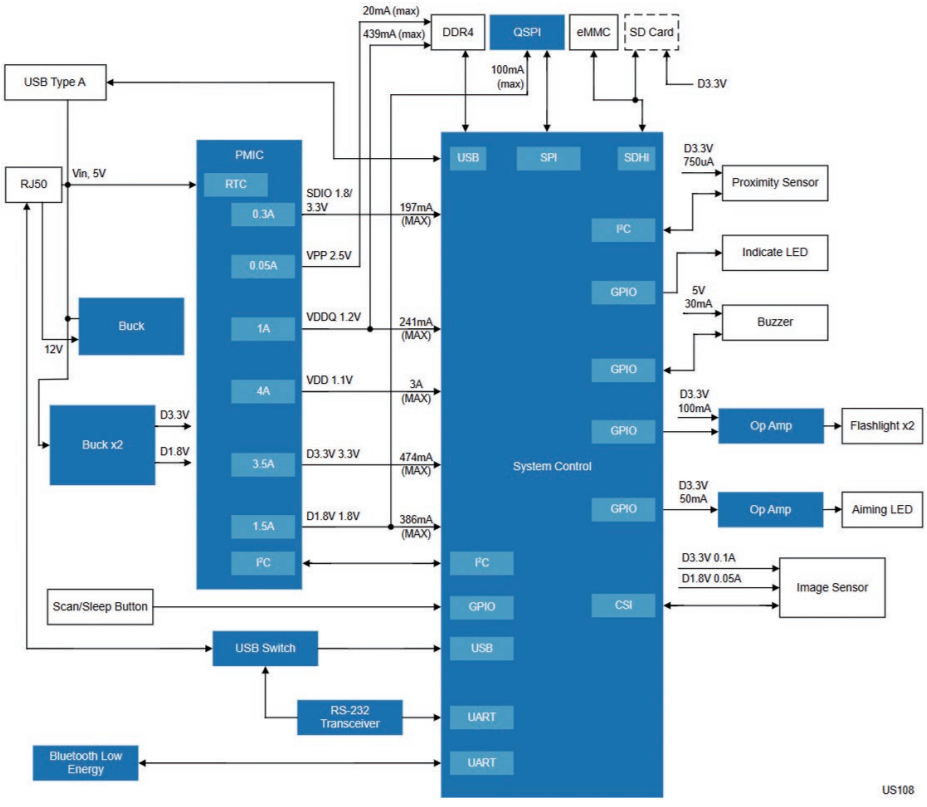
Audio
3 × SSI (I2S)

Barcode Scanner System

Dual-core Cortex-A55-based barcode scanner with object detection, safe operation, and flexible connectivity.

This barcode scanner system can read 1D and 2D barcodes via an integrated image-based scanner with optional object detection using a fast image processor based on a dual Arm® Cortex®-A55 core. The barcode information can be shared through RS-232, USB, or wireless communication.

The system can be based on a variety of processors from the RZ MPU family, depending on the end application.



RZ/G2UL Group: 1.0GHz Cortex-A55, DDR4/DDR3L

The RZ/G2UL microprocessor includes a Cortex®-A55 (1.0GHz) CPU, a 16-bit DDR3L/DDR4 interface, and a simple LCD controller. It also has many interfaces such as camera input, display output, USB 2.0, and Gbit-Ether, making it ideal for applications such as entry-level industrial gateway control and embedded devices with simple GUI capabilities.

CPU core
- Arm® Cortex®-A55, single-core
  Max. operating frequency: 1.0GHz
- Arm® Cortex®-M33, single-core
  Max. operating frequency: 200MHz

Cache memory (Cortex®-A55)
- L1 instruction cache: 32KB
- L1 data cache: 32KB
- L3 cache: 256KB

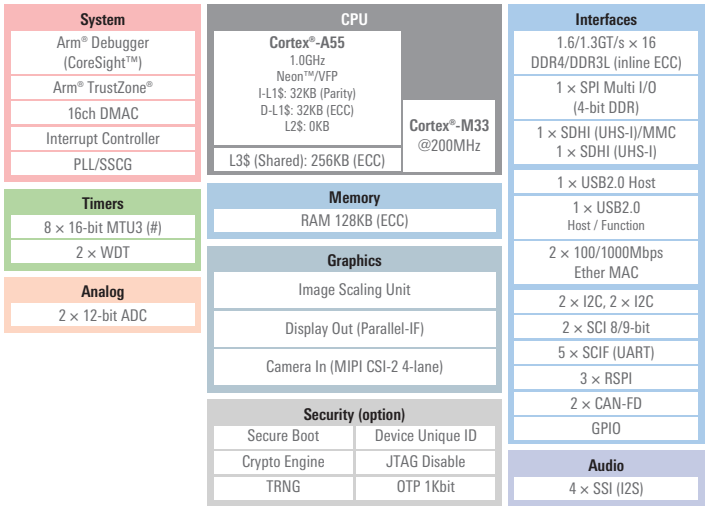
External memory
- Ability to connect DDR4-SDRAM / DDR3L-SDRAM via DDR dedicated bus
- Data bus width: 16 bits × 1 channel

Video functions
- Video display interface:
  Digital parallel output × 1 channel
- Video input interface:
  MIPI CSI-2 × 1 channel
- Video image processing functions (Resizer and Color Space / Color Format Conversion)

Audio functions
- Serial sound interface × 4 channels

Storage interfaces
- USB 2.0 × 2 channels (Host only 1 channel/Host-Function 1 channel)
- SD host interface × 2 channels
- Multimedia card interface × 1 channel (Shared with SDHI)

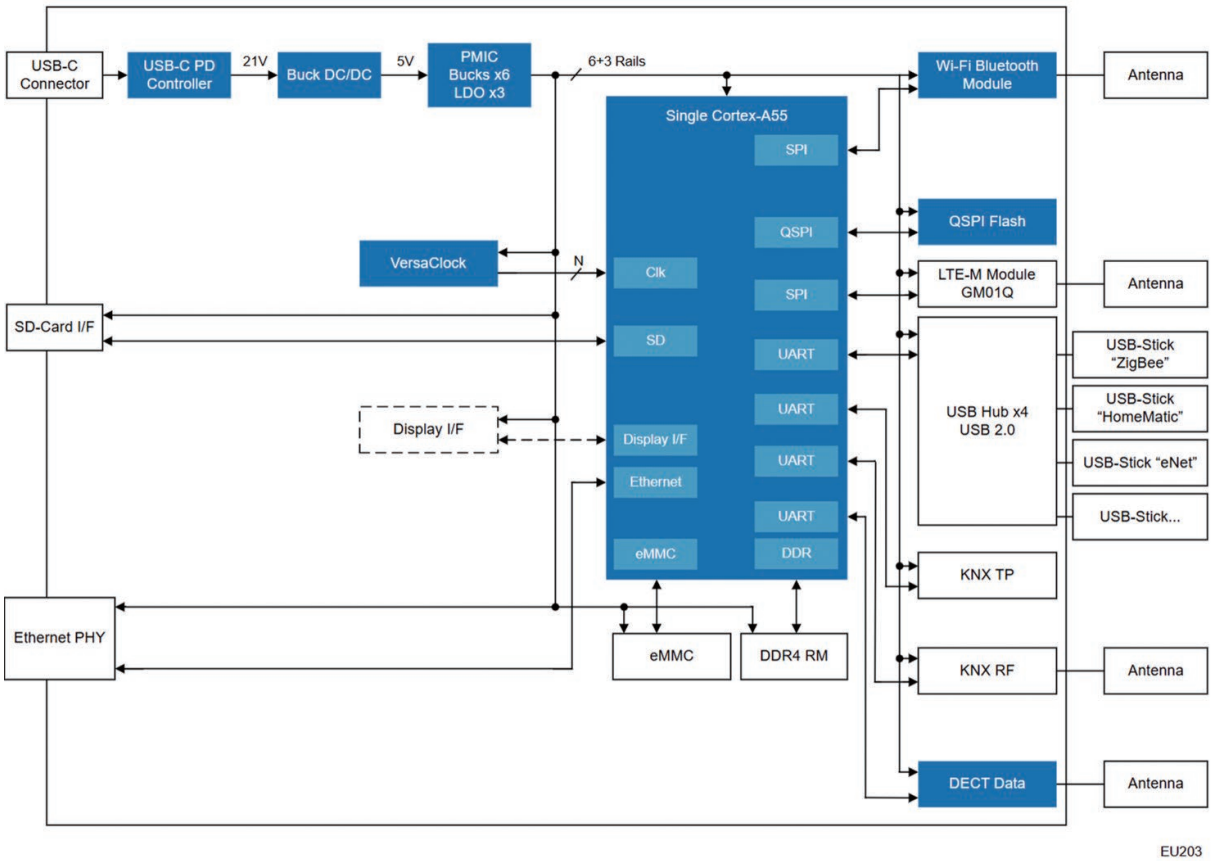
Other peripheral functions
- 16-bit timer × 8 channels
- I^2C bus interface × 4 channels
- Serial communication interface with FIFO (SCIF) × 5 channels
- Serial communication interface (SCI) × 2 channels
- SPI Multi I/O Bus Controller× 1 channel (4bit Double data rate)
- Serial Peripheral Interface (RSPI) × 3channels
- Gigabit Ethernet controller × 2 channels
- Controller area network (CAN) interface × 2 channels (support CAN FD)
- 12-bit A/D converter × 2 channels
- Interrupt controller
- Clock generator (CPG): on-chip PLL
- On-chip debug function



Smart Home Controller with Multiple PHY

All-in-one smart home gateway with multi-standard support, USB-C power, and upgradeable design.

Smart home systems have multiple standards. This design combines all of them in one, allowing for control and visualization of all of your smart home devices from different vendors.



RZ/G2H Group: 1.5GHz Quad Cortex-A57,Quad Cortex-A53, LPDDR4, 3DG

Ultra-high processing performance with quad-core Arm® Cortex®-A57 (1.5GHz) and quad-core Arm Cortex-A53 (1.2GHz) CPUs, with 3D graphics and 4K video encoder/decoder.

CPU core
- Arm® Cortex®-A57, quad-core
  Max. operating frequency: 1.5GHz
- Arm® Cortex®-A53, quad-core
  Max. operating frequency: 1.2GHz
- Arm® Cortex®-R7, single-core
  Max. operating frequency: 800MHz

Cache memory (Cortex®-A57)
- L1 instruction cache: 48KB
- L1 data cache: 32KB
- L2 cache: 2MB

Cache memory (Cortex®-A53)
- L1 instruction cache: 32KB
- L1 data cache: 32KB
- L2 cache: 512KB

Cache memory (Cortex®-R7)
- L1 instruction cache: 32KB
- L1 data cache: 32KB
- I-TCM: 32KB
- D-TCM: 32KB

External memory
- Ability to connect LPDDR4-SDRAM via DDR dedicated bus
- Data bus width: 32 bits × 2 channels

External expansion
- Ability to connect flash ROM or SRAM directly
- Data bus width: 8/16 bits
- PCI Express 2.0 : 1 Lane × 2 channels (one of PHY is shared with Serial ATA)

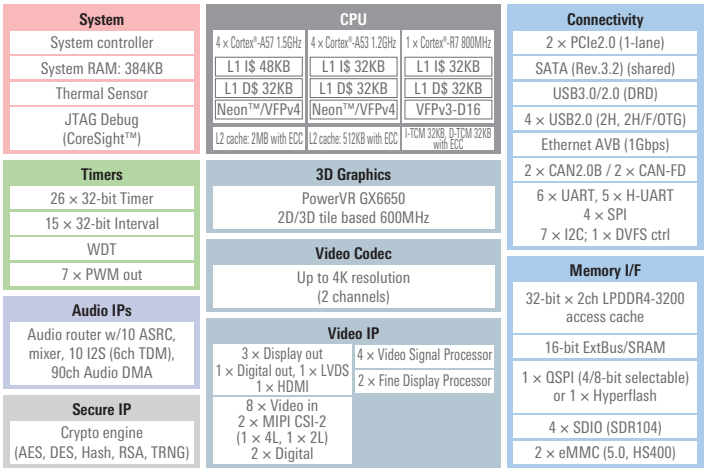
3D graphics
- PowerVR™ GX6650

Video functions
- Video display interface × 3 channels (1 channel: HDMI(option), 1 channel: LVDS, 1 channel: RGB888)
- Video input interface × 4 channels (2 channels: MIPI CSI-2, 2 channels: Digital(RGB/YCbCr))
- Video codec module: VCP4 × 1 channel
- IP converter module
- Video image processing functions (color conversion, image enlargement/reduction, filtering)

Audio functions
- Sampling rate converter × 10 channels
- Serial sound interface × 10 channels

Storage interfaces
- USB 3.0 DRD × 1 channel
- USB 2.0 × 2 channels (Host only 1 channel/Host-Function 1 channel)
- SD host interface × 4 channels
- Multimedia card interface × 2 channels
- Serial ATA interface × 1 channel

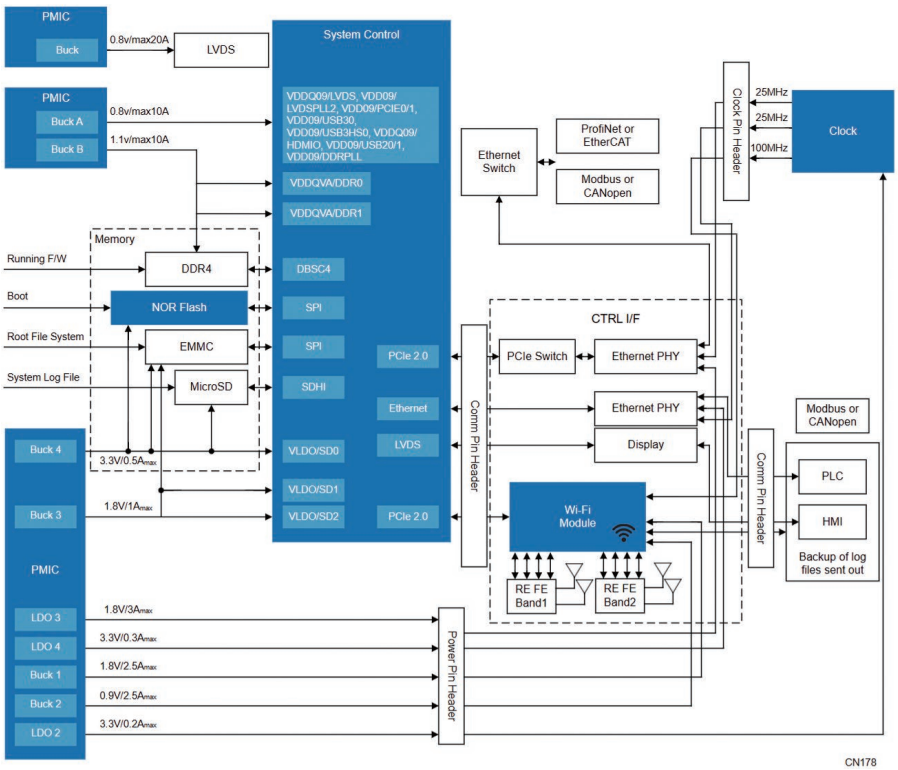
Other peripheral functions
- 32-bit timer × 15 channels
- PWM timer × 7 channels
- I²C bus interface × 7 channels
- Serial communication interface (SCIF) × 6 channels
- Quad serial peripheral interface (QSPI) × 2 channels (boot support)
- Clock-synchronous serial interface (MSIOF) × 4 channels (SPI/IIS support)
- Ethernet controller with AVB support (support for IEEE 802.1BA, IEEE 802.1AS, IEEE 802.1Qav, and IEEE 1722)
- Controller area network (CAN) interface × 2 channels
- Interrupt controller (INTC)
- Clock generator (CPG): on-chip PLL
- On-chip debug function



FC-BGA: 29 × 29mm² 1022-pins, 0.8mm pitch

Industrial Gateway with Wi-Fi 6

This solution shows the capability and features of an ultra-high performance MPU with quad-core Arm® Cortex®-A57 and quad-core Arm® Cortex®-A53 CPUs, rich peripheral supports LVDS, PCIe, and memory I/F like Gigabit Ethernet, DDR, USB 3.0, SD, etc. Power and clock design is simple and saves on PCB size. High-performance, highly integrated Wi-Fi 6 (802.11ax) R2 single PCIe chip delivers the best Wi-Fi network with flexibility and reliability.



RZ/G2M Group: 1.5GHz Dual Cortex-A57,Quad Cortex-A53, LPDDR4, 3DG

Get a higher specification of processing performance with dual-core Arm® Cortex®-A57 (1.5GHz) and quad-core Arm Cortex-A53 (1.2GHz) CPUs, with 3D graphics and 4K video encoder/decoder.

CPU core
- Arm® Cortex®-A57, dual-core
  Max. operating frequency: 1.5GHz
- Arm® Cortex®-A53, quad-core
  Max. operating frequency: 1.2GHz
- Arm® Cortex®-R7, single-core
  Max. operating frequency: 800MHz

Cache memory (Cortex®-A57)
- L1 instruction cache: 48KB
- L1 data cache: 32KB
- L2 cache: 2MB

Cache memory (Cortex®-A53)
- L1 instruction cache: 32KB
- L1 data cache: 32KB
- L2 cache: 512KB

Cache memory (Cortex®-R7)
- L1 instruction cache: 32KB
- L1 data cache: 32KB
- I-TCM: 32KB
- D-TCM: 32KB

External memory
- Ability to connect LPDDR4-SDRAM via DDR dedicated bus
- Data bus width: 32 bits × 2 channels

External expansion
- Ability to connect flash ROM or SRAM directly
- Data bus width: 8/16 bits
- PCI Express 2.0 : 1 Lane × 2 channels (one of PHY is shared with Serial ATA)

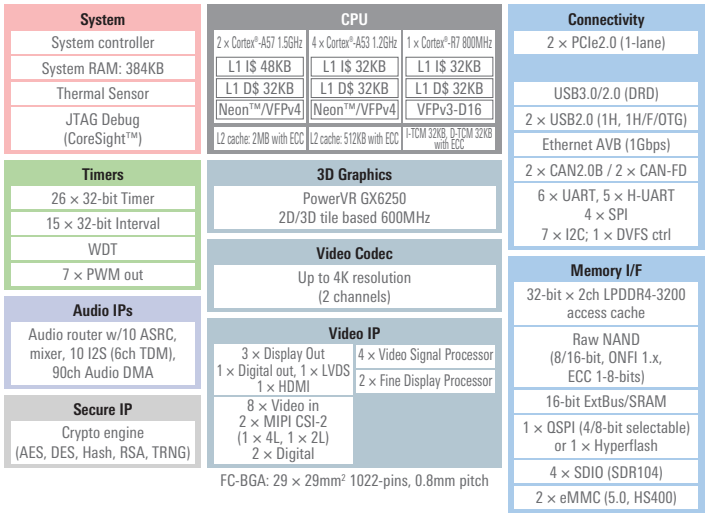
3D graphics
- PowerVR™ GX6250

Video functions
- Video display interface × 3 channels (1 channel: HDMI(option), 1 channel: LVDS, 1 channel: RGB888)
- Video input interface × 4 channels (2 channels: MIPI CSI-2, 2 channels: Digital(RGB/YCbCr))
- Video codec module: VCP4 × 1 channel
- IP converter module
- Video image processing functions (color conversion, image enlargement/reduction, filtering)

Audio functions
- Sampling rate converter × 10 channels
- Serial sound interface × 10 channels

Storage interfaces
- USB 3.0 DRD × 1 channel
- USB 2.0 × 2 channels (Host only 1 channel/Host-Function 1 channel)
- SD host interface × 4 channels
- Multimedia card interface × 2 channels

Other peripheral functions
- 32-bit timer × 15 channels
- PWM timer × 7 channels
- I^2C bus interface × 7 channels
- Serial communication interface (SCIF) × 6 channels
- Quad serial peripheral interface (QSPI) × 2 channels (boot support)
- Clock-synchronous serial interface (MSIOF) × 4 channels (SPI/IIS support)
- Ethernet controller with AVB support (support for IEEE 802.1BA, IEEE 802.1AS, IEEE 802.1Qav, and IEEE 1722, GMII/MII interface, PHY device connection support)
- Ethernet controller with AVB support (support for IEEE 802.1BA, IEEE 802.1AS, IEEE 802.1Qav, and IEEE 1722)
- Controller area network (CAN) interface × 2 channels
- Interrupt controller (INTC)
- Clock generator (CPG): on-chip PLL
- On-chip debug function

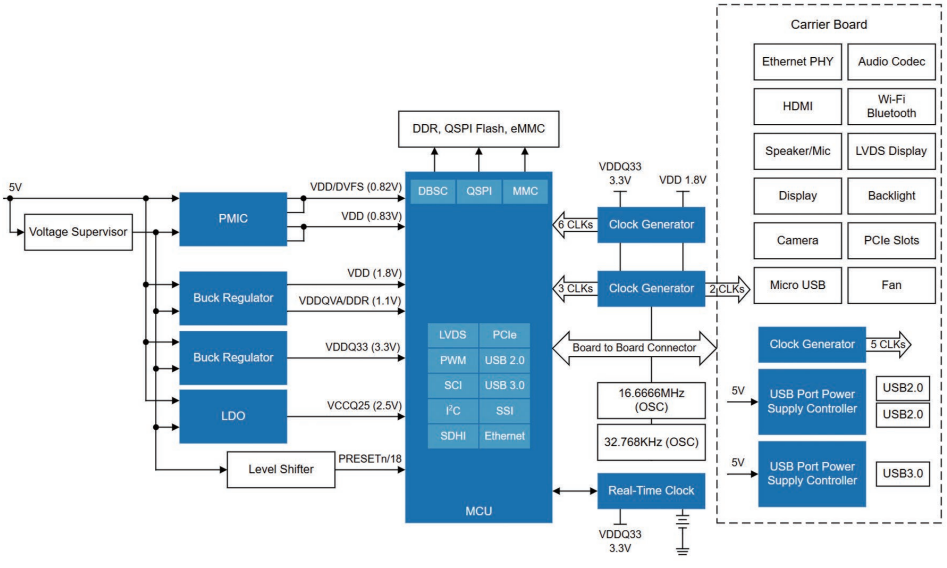


FC-BGA: 29 × 29mm² 1022-pins, 0.8mm pitch

Multi-Display HMI SoM

SOM with optimized power and timing supports multi-display embedded applications.

System-on-modules (SoMs) are compact, ready-to-use processor modules that help customers accelerate time to market and shorten project schedules for embedded products. This SoM provides an optimized power and timing tree for the MPU, supporting three displays: HDMI, LVDS, and RGB. It helps SoM system designers avoid risk by leveraging a proven, reliable design.



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RZ/G2N Group: 1.5GHz Dual Cortex-A57, LPDDR4, 3DG

Higher specification of processing performance with dual-core Arm® Cortex®-A57 (1.5GHz) and with 3D graphics and 4K video encoder/decoder.

CPU core
- Arm® Cortex®-A57, quad-core
  Max. operating frequency: 1.5GHz
- Arm® Cortex®-R7, single-core
  Max. operating frequency: 800MHz

Cache memory (Cortex®-A57)
- L1 instruction cache: 48KB
- L1 data cache: 32KB
- L2 cache: 2MB

Cache memory (Cortex®-R7)
- L1 instruction cache: 32KB
- L1 data cache: 32KB
- I-TCM: 32KB
- D-TCM: 32KB

External memory
- Ability to connect LPDDR4-SDRAM via DDR dedicated bus
- Data bus width: 32 bits × 1 channel

External expansion
- Ability to connect flash ROM or SRAM directly
- Data bus width: 8/16 bits
- PCI Express 2.0 : 1 Lane × 2 channels (one of PHY is shared with Serial ATA)

3D graphics
- PowerVR™ GE7800

Video functions
- Video display interface × 3 channels (1 channel: HDMI(option), 1 channel: LVDS, 1 channel: RGB888)
- Video input interface × 4 channels (2 channels: MIPI CSI-2, 2 channels: Digital(RGB/YCbCr))
- Video codec module: VCP4 × 1 channel
- IP converter module
- Video image processing functions (color conversion, image enlargement/reduction, filtering)

Audio functions
- Sampling rate converter × 10 channels
- Serial sound interface × 10 channels

Storage interfaces
- USB 3.0 DRD × 1 channel
- USB 2.0 × 2 channels (Host only 1 channel/Host-Function 1 channel)
- SD host interface × 4 channels
- Multimedia card interface × 2 channels
- Serial ATA interface × 1 channel

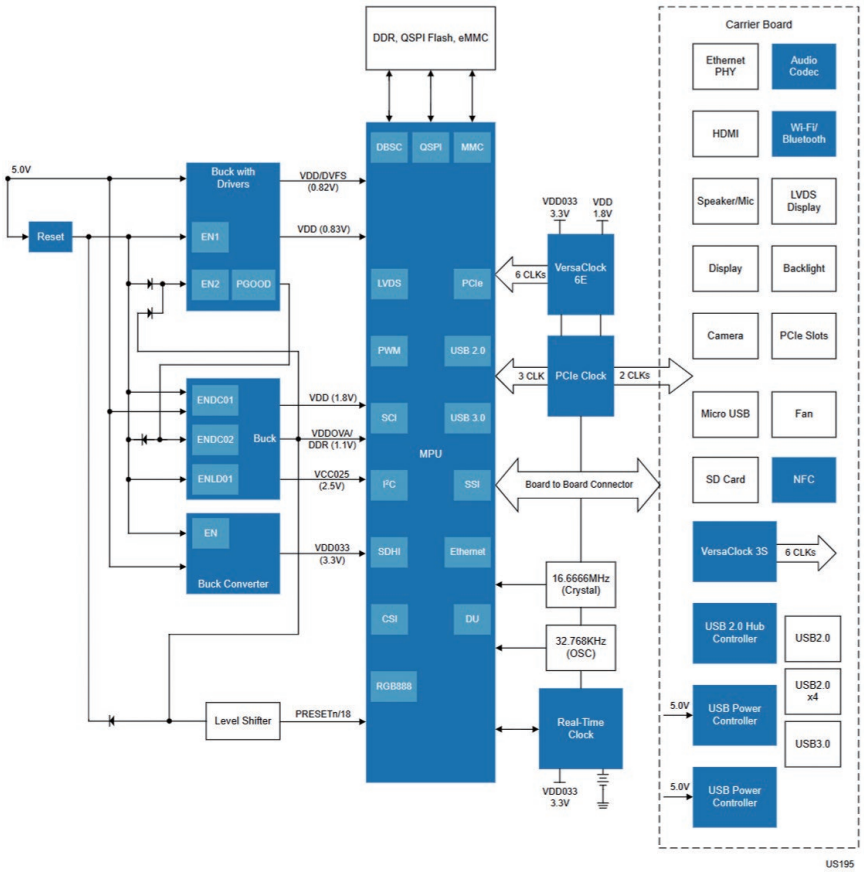
Other peripheral functions
- 32-bit timer × 15 channels
- PWM timer × 7 channels
- I^2C bus interface × 7 channels
- Serial communication interface (SCIF) × 6 channels
- Quad serial peripheral interface (QSPI) × 2 channels (boot support)
- Clock-synchronous serial interface (MSIOF) × 4 channels (SPI/IIS support)
- Ethernet controller with AVB support (support for IEEE 802.1BA, IEEE 802.1AS, IEEE 802.1Qav, and IEEE 1722)
- Controller area network (CAN) interface × 2 channels
- Interrupt controller (INTC)
- Clock generator (CPG): on-chip PLL
- On-chip debug function

System	CPU		Connectivity
System controller	2 × Cortex®-A57 1.5GHz	1 × Cortex®-R7 800MHz	2 × PCIe2.0 (1-lane)
System RAM: 384KB	L1 I$ 48KB	L1 I$ 32KB	SATA (Rev.3.2) (shared)
Thermal Sensor	L1 D$ 32KB	L1 D$ 32KB	USB3.0/2.0 (DRD)
JTAG Debug (CoreSight™)	Neon™/VFPv4	VFPv3-D16	2 × USB2.0 (1H, 1H/F/OTG)
Timers	L2 cache: 1MB with ECC	I-TCM 32KB, D-TCM 32KB with ECC	Ethernet AVB (1Gbps)
26 × 32-bit Timer	**3D Graphics**		2 × CAN2.0B / 2 × CAN-FD
15 × 32-bit Interval	PowerVR GE7800 2D/3D tile based 600MHz		6 × UART, 5 × H-UART 4 × SPI 7 × I2C; 1 × DVFS ctrl
WDT	**Video Codec**		**Memory I/F**
7 × PWM out	Up to 4K resolution (2 channels)		32-bit × 1ch LPDDR4-3200 access cache
Audio IPs	**Video IP**		Raw NAND (8/16-bit, ONFI 1.x, ECC 1-8-bits)
Audio router w/10 ASRC, mixer, 10 I2S (6ch TDM), 90ch Audio DMA	3 × Display out 1 × Digital out, 1 × LVDS 1 × HDMI	2 × Video Signal Processor 1 × Fine Display Processor	16-bit ExtBus/SRAM
Secure IP	8 × Video in 2 × MIPI CSI-2 (1 × 4L, 1 × 2L) 2 × Digital		1 × QSPI (4/8-bit selectable) or 1 × Hyperflash
Crypto engine (AES, DES, Hash, RSA, TRNG)			4 × SDIO (SDR104)
			2 × eMMC (5.0, HS400)

FC-BGA: 29 × 29mm² 1022-pins, 0.8mm pitch

High-Performance Human Machine Interface (HMI) System

This solution features a system-on-module (SoM) design to reduce overall complexity and cost. The integrated and tested SoM features a high-performance RZ MPU that enables the creation of graphical human machine interfaces (HMI), capable of driving multiple displays at up to 4K resolutions. Wireless connectivity is provided via Wi-Fi, Bluetooth® Low Energy or near-field communication (NFC).



RZ/G2E Group: 1.2GHz Dual Cortex-A53, DDR3L, 3DG

High processing performance with dual-core Arm® Cortex®-A53 (1.2GHz) CPUs, with 3D graphics and video codec engine.

CPU core
- Arm® Cortex®-A53, quad-core
  Max. operating frequency: 1.2GHz
- Arm® Cortex®-R7, single-core
  Max. operating frequency: 800MHz

Cache memory (Cortex®-A53)
- L1 instruction cache: 32KB
- L1 data cache: 32KB
- L2 cache: 256KB

Cache memory (Cortex®-R7)
- L1 instruction cache: 32KB
- L1 data cache: 32KB
- I-TCM: 32KB
- D-TCM: 32KB

External memory
- Ability to connect DDR3L-SDRAM via DDR dedicated bus
- Data bus width: 32 bits × 1 channel

External expansion
- Ability to connect flash ROM or SRAM directly
- Data bus width: 8/16 bits
- PCI Express 2.0 : 1 Lane × 1 channel

3D graphics
- PowerVR™ GE8300

Video functions
- Video display interface × 2 channels (2 channels: LVDS, 1 channel: RGB888)
- Video input interface × 3 channels (1 channels: MIPI CSI-2, 2 channels: Digital(RGB/YCbCr))
- Video codec module: VCP4 × 1 channel
- IP converter module
- Video image processing functions (color conversion, image enlargement/reduction, filtering)

Audio functions
- Sampling rate converter × 10 channels
- Serial sound interface × 10 channels

Storage interfaces
- USB 3.0 DRD × 1 channel
- USB 2.0 × 1 channel (Host-Function 1 channel)
- SD host interface × 3 channels
- Multimedia card interface × 1 channel

Other peripheral functions
- 32-bit timer × 15 channels
- PWM timer × 7 channels
- I^2C bus interface × 8 channels
- Serial communication interface (SCIF) × 6 channels
- Quad serial peripheral interface (QSPI) × 2 channels (boot support)
- Clock-synchronous serial interface (MSIOF) × 4 channels (SPI/IIS support)
- Ethernet controller with AVB support (support for IEEE 802.1BA, IEEE 802.1AS, IEEE 802.1Qav, and IEEE 1722)
- Controller area network (CAN) interface × 2 channels
- Interrupt controller (INTC)
- Clock generator (CPG): on-chip PLL
- On-chip debug function

System	CPU		Connectivity
System controller	2 × Cortex®-A53 1.2GHz	1 × Cortex®-R7 800MHz	1 × PCIe2.0 (1-lane)
System RAM: 128KB	L1 I$ 32KB	L1 I$ 32KB	
Thermal Sensor	L1 D$ 32KB	L1 D$ 32KB	USB3.0/2.0 (DRD)
JTAG Debug (CoreSight™)	Neon™/VFPv4	VFPv3-D16	USB2.0 (1H/F)
	L2 cache: 256KB with ECC	I-TCM 32KB, D-TCM 32KB with ECC	Ethernet AVB (1Gbps)
			2 × CAN2.0B / 2 × CAN-FD
			6 × UART, 5 × H-UART 4 × SPI 8 × I2C; 1 × DVFS ctrl

Timers	3D Graphics	Memory I/F
26 × 32-bit Timer	PowerVR GE8300 2D/3D tile based 600MHz	32-bit DDR3L-1856 access cache
15 × 32-bit Interval		Raw NAND (8-bit, ONFI 1.x, ECC 1-8-bits)
WDT	Video Codec	16-bit ExtBus/SRAM
7 × PWM out	Up to FHD resolution	1 × QSPI (4/8-bit selectable) or 1 × Hyperflash
Audio IPs	**Video IP**	3 × SDIO (SDR104)
Audio router w/10 ASRC, mixer, 10 I2S (6ch TDM), 45ch Audio DMA	2 × Display out: (2 × LVDS or 1 × LVDS + 1 × DRGB) 2 × Video Signal Processor 1 × Fine Display Processor 2 × Video in 1 × MIPI CSI-2 (1 × 2L) 1 × Digital	eMMC (5.0, HS400)
Secure IP		
Crypto engine (AES, DES, Hash, RSA, TRNG)		

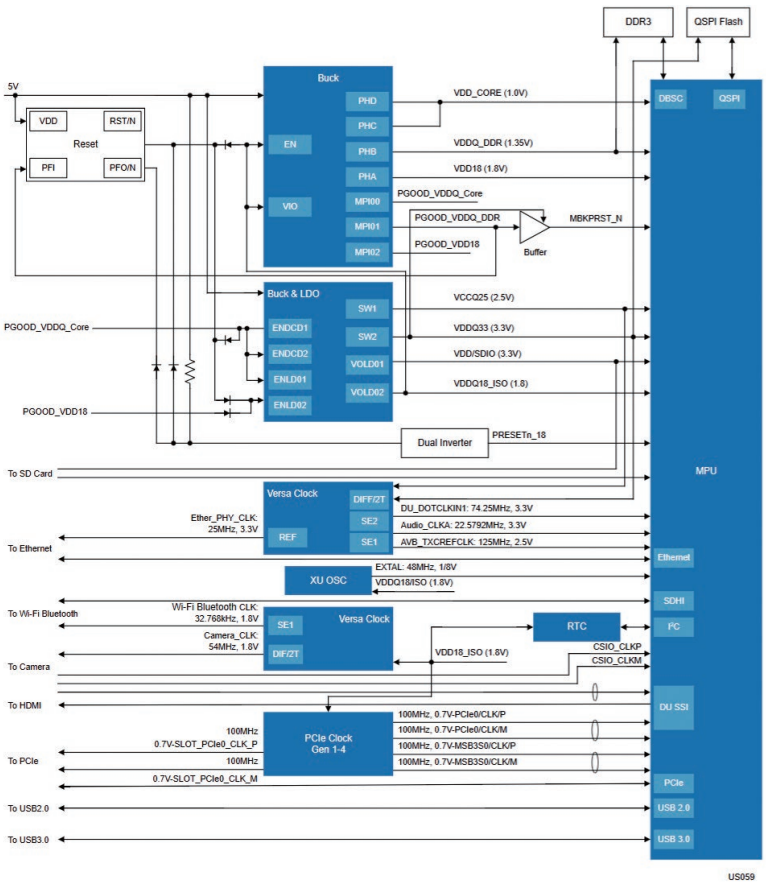
FC-BGA: 21 × 21mm² 552-pins, 0.8mm pitch

Power & Timing SoM for RZ/G2E

Power and timing SoM ensures precise timing and efficient power distribution.

In many applications, power and timing are crucial. Applications involving multiple sensors and systems, such as real-time data processing, require precise timing synchronization to ensure all components work in unison, reducing latency and improving performance. Additionally, power distribution is essential for system peripherals to maintain stable performance and energy efficiency.

System-on-Modules (SoMs) are compact, ready-to-use processor modules that help engineers and developers accelerate time to market for embedded products and shorten overall project schedules. This SoM offers an optimized power and timing tree for the RZ/G2E MPU, ensuring precise timing and power distribution for various system peripherals.



RZ/Five [RISC-V] Group: 1.0GHz RISC-V CPU, DDR4/DDR3L

The RZ/Five microprocessor includes a RISC-V CPU Core (AX45MP Single) 1.0 GHz, 16-bit DDR3L/DDR4 interface. And it also has many interfaces such as Gbit-Ether, CAN, and USB 2.0, making it ideal for applications such as entry-class social infrastructure gateway control and industrial gateway control.

CPU core
- 64bit RISC-V CPU Core AndesCore™ AX45MP Single core 1.0GHz

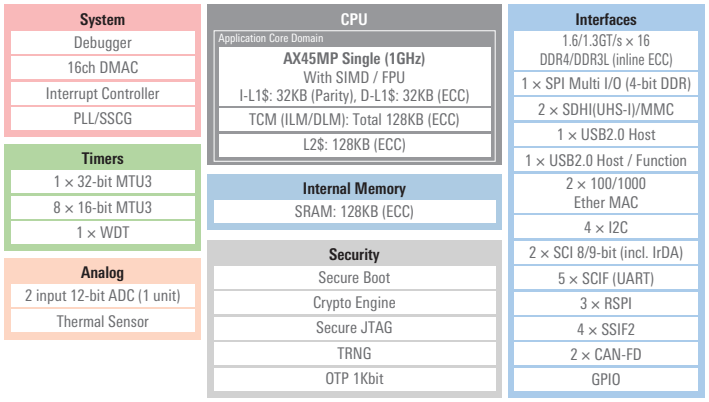
Cache memory
- L1 instruction Cache: 32KB
- L1 data cache: 32KB
- L2 cache: 256KB

External memory
- Ability to connect DDR4-SDRAM / DDR3L-SDRAM via DDR dedicated bus
- Data bus width: 16 bits × 1 channel

Audio functions
- Serial sound interface × 4 channels

Storage interfaces
- USB 2.0 × 2 channels (Host only 1 channel/Host-Function 1 channel)
- SD host interface × 2 channels
- Multimedia card interface × 1 channel (Shared with SDHI)

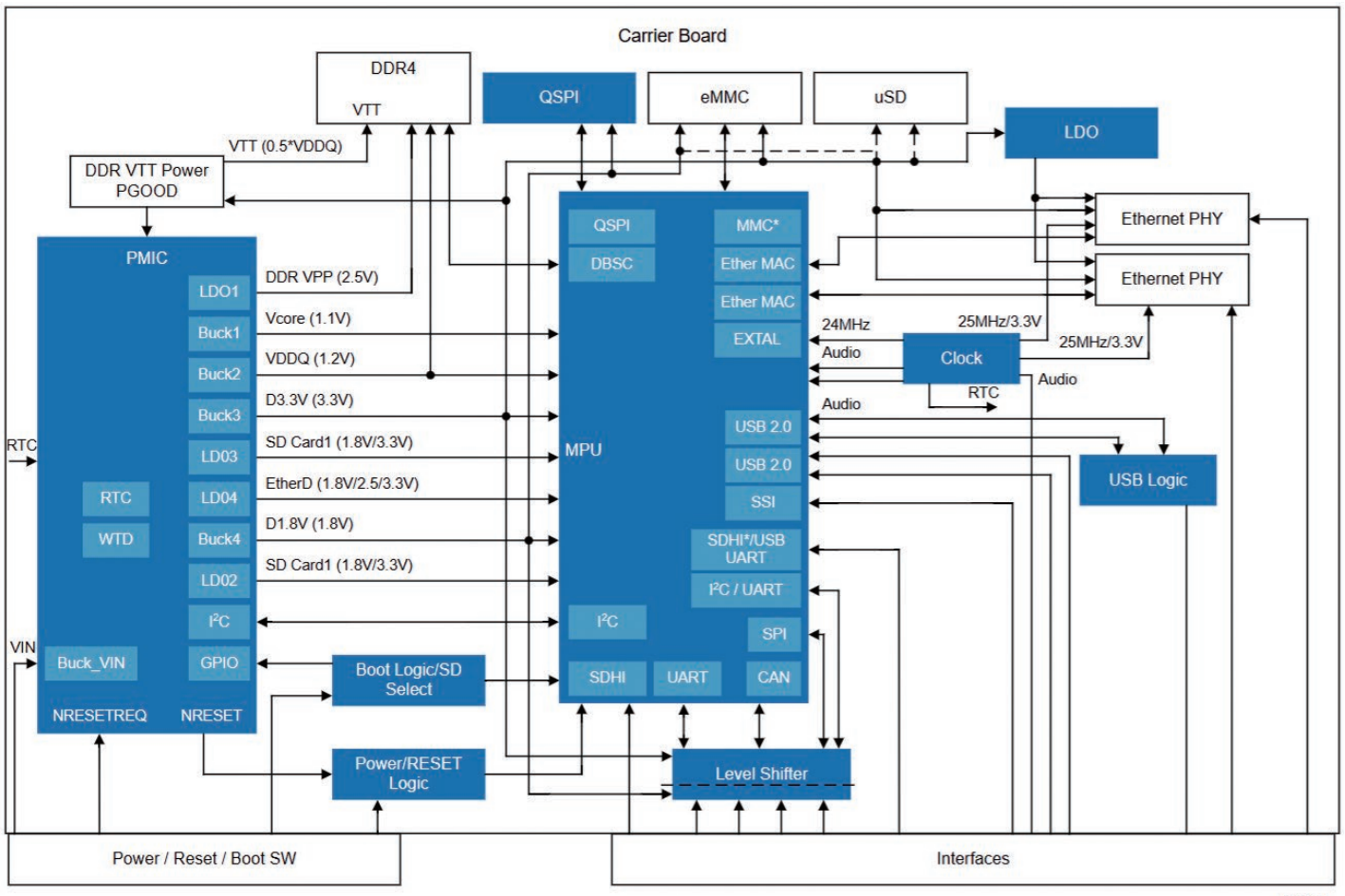
Other peripheral functions
- 16-bit timer × 8 channels
- I^2C bus interface × 4 channels
- Serial communication interface with FIFO (SCIF) × 5 channels
- Serial communication interface (SCI) × 2 channels
- SPI Multi I/O Bus Controller × 1 channel (4bit Double data rate)
- Serial Peripheral Interface (RSPI) × 3 channels
- Gigabit Ethernet controller × 2 channels
- Controller area network (CAN) interface × 2 channels (support CAN FD)
- 12-bit A/D converter × 2 channels
- Interrupt controller
- Clock generator (CPG): on-chip PLL
- On-chip debug function



Scalable SMARC 2.1 Gateway SoM with RISC-V MPU

The scalable SMARC 2.1 SoM design for IIoT gateways with low power consumption, strong connectivity, and flexibility.

As Industrial Internet of Things (IIoT) systems expand, there's a growing demand for compact, modular gateway designs that support high-performance processing while maintaining low power consumption. The Smart Mobility Architecture (SMARC) 2.1 standard is increasingly preferred for IoT gateway designs due to its flexibility and ability to integrate key features like communication interfaces, display support, and optimized power management into a small form factor. It offers a modular approach to system design, enabling accelerated time to market.



US244

RZ/G3 Specification

Items	RZ/G3E	RZ/G3S
CPU (Arm® Cortex®-A)	2× or 4× Cortex®-A55@1.8GHz L1, L3 Parity/ECC	1× Cortex®-A55@1.1GHz L1, L3 Parity/ECC
CPU (Arm® Cortex®-M)	1× Cortex®-M33@200MHz	1× or 2× Cortex®-M33@250MHz
NPU	1 × Ethos™-U55	–
DRAM I/F	32-bit × 1ch LPDDR4/4X-3200 w/ECC	16-bit × 1ch LPDDR4/DDR4-1600 w/ECC
Video in	1 × MIPI CSI-2	–
Video Codec	Support up to 4K @30fps resolutions	–
3D GFX	Arm Mali™-G52 GPU	–
Display out	1 × MIPI DSI or 1 × Digital Parallel output	–
USB	USB3.2 (Gen2) Host × 1ch USB2.0 × 2ch (1Host, 1Host/Function/OTG)	USB2.0 × 2ch (1Host, 1Host/Function/OTG)
Gbit Ether	2ch	2ch
CAN	6ch (support CAN-FD)	2ch (support CAN-FD)
12-bit ADC	8ch	8ch
Package	625-pin FCBGA, 21mm × 21mm, 0.8mm ball pitch 529-pin FCBGA, 15mm × 15mm, 0.5mm ball pitch	359-pin LFBGA, 14mm × 14mm, 0.5mm ball pitch 361-pin LFBGA, 13mm × 13mm, 0.5mm ball pitch

RZ/G2 Specification 1

Items	RZ/G2L	RZ/G2LC	RZ/G2UL
CPU (Arm® Cortex®-A)	1× or 2× Cortex®-A55@1.2GHz L1, L3 Parity/ECC	1× or 2× Cortex®-A55@1.2GHz L1, L3 Parity/ECC	1× Cortex®-A55@1.0GHz L1, L3 Parity/ECC
CPU (Arm® Cortex®-M)	1× Cortex®-M33@200MHz	1× Cortex®-M33@200MHz	1× Cortex®-M33@200MHz
DRAM I/F	16-bit ×1ch DDR4-1600/DDR3L-1333 w/ECC	16-bit ×1ch DDR4-1600/DDR3L-1333 w/ECC	16-bit ×1ch DDR4-1600/DDR3L-1333 w/ECC
Video in	1×MIPI CSI-2 or 1×Digital Parallel input	1×MIPI CSI-2	1×MIPI CSI-2
Video Codec	Support up to Full HD @30fps resolutions Encoding and Decoding: H.264	–	–
3D GFX	Arm Mali-G31 GPU @500MHz	Arm Mali-G31 GPU @500MHz	–
Display out	1×MIPI DSI or 1×Digital Parallel output	1×MIPI DSI	1×Digital Parallel output
USB	USB2.0×2ch (1Host, 1Host/Function/OTG)	USB2.0×2ch (1Host, 1Host/Function/OTG)	USB2.0×2ch (1Host, 1Host/Function/OTG)
Gbit Ether	2ch	1ch	2ch
CAN	2ch (support CAN-FD)	2ch (support CAN-FD)	2ch (support CAN-FD)
12-bit ADC	8ch	–	2ch
Package	551-pin LFBGA, 21mm×21mm, 0.8mm ball pitch 456-pin LFBGA, 15mm×15mm, 0.5mm ball pitch	361-pin LFBGA, 13mm×13mm, 0.5mm ball pitch	361-pin LFBGA, 13mm×13mm, 0.5mm ball pitch

RZ/G2 Specification 2

Items	RZ/G2H	RZ/G2M	RZ/G2N	RZ/G2E
CPU (Arm® Cortex®-A)	4× Cortex®-A57@1.5GHz 4× Cortex®-A53@1.2GHz L1, L2 Parity/ECC	2× Cortex®-A57@1.5GHz 4× Cortex®-A53@1.2GHz L1, L2 Parity/ECC	2× Cortex®-A57@1.5GHz L1, L2 Parity/ECC	2× Cortex®-A53@1.2GHz L1, L2 Parity/ECC
CPU (Arm® Cortex®-R)	1× Cortex®-R7@800MHz L1, TCM w/ECC	1× Cortex®-R7@800MHz L1, TCM w/ECC	1× Cortex®-R7@800MHz L1,TCM w/ECC	1× Cortex®-R7@800MHz L1,TCM w/ECC
DRAM I/F	32-bit ×2ch LPDDR4(3200)	32-bit ×2ch LPDDR4(3200)	32-bit ×1ch LPDDR4(3200)	32-bit ×1ch DDR3L(1856)
Video in	2×MIPI CSI-2, 2×Digital (RGB/YCbCr) up to 8 input image can be captured	2×MIPI CSI-2, 2×Digital (RGB/YCbCr) up to 8 input image can be captured	2×MIPI CSI-2, 2×Digital (RGB/YCbCr) up to 8 input image can be captured	1×MIPI CSI-2, 1×Digital(RGB/YCbCr) up to 2 input image can be captured
Video Codec	Support up to 4k resolutions Decoding: H.265, Encoding and Decoding: H.264	Support up to 4k resolutions Decoding: H.265, Encoding and Decoding: H.264	Support up to 4k resolutions Decoding: H.265, Encoding and Decoding: H.264	Support up to FHD resolutions Decoding: H.265, Encoding and Decoding: H.264
3D GFX	PowerVR GX6650@600MHz	PowerVR GX6250@600MHz	PowerVR GE7800@600MHz	PowerVR GE8300@600MHz
Display out	1×HDMI, 1×LVDS, 1×Digital RGB	1×HDMI, 1×LVDS, 1×Digital RGB	1×HDMI, 1×LVDS, 1×Digital RGB	2×LVDS or 1×LVDS, 1×Digital RGB
USB	USB2.0×2ch (1H, 1H/F/OTG) USB3.0/2.0×1ch (DRD)	USB2.0×2ch (1H, 1H/F/OTG) USB3.0/2.0×1ch (DRD)	USB2.0×2ch (1H, 1H/F/OTG) USB3.0/2.0×1ch (DRD)	USB2.0×1ch (H/F) USB3.0/2.0×1ch (DRD)
Gbit Ether	1ch	1ch	1ch	1ch
CAN	2ch (support CAN-FD)	2ch (support CAN-FD)	2ch (support CAN-FD)	2ch (support CAN-FD)
PCIe	2ch (Rev2.0 1Lane) one of the 2ch is shared with SATA	2ch (Rev2.0 1Lane)	2ch (Rev2.0 1Lane) one of the 2ch is shared with SATA	1ch (Rev2.0 1Lane)
SATA	1ch (Pin Shared)	No	1ch (Pin Shared)	No
Package	1022-pin FCBGA, 29mm×29mm 0.8mm ball pitch	1022-pin FCBGA, 29mm×29mm 0.8mm ball pitch	1022-pin FCBGA, 29mm×29mm 0.8mm ball pitch	552-pin FCBGA, 21mm×21mm 0.8mm ball pitch

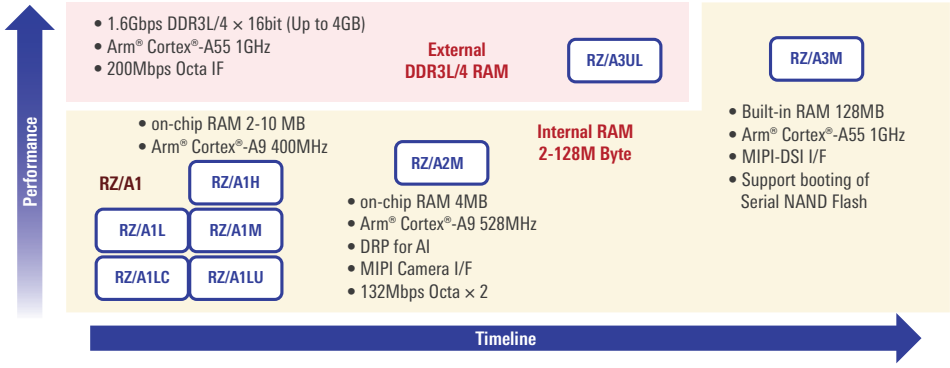
Pin Compatible

RZ/A Series

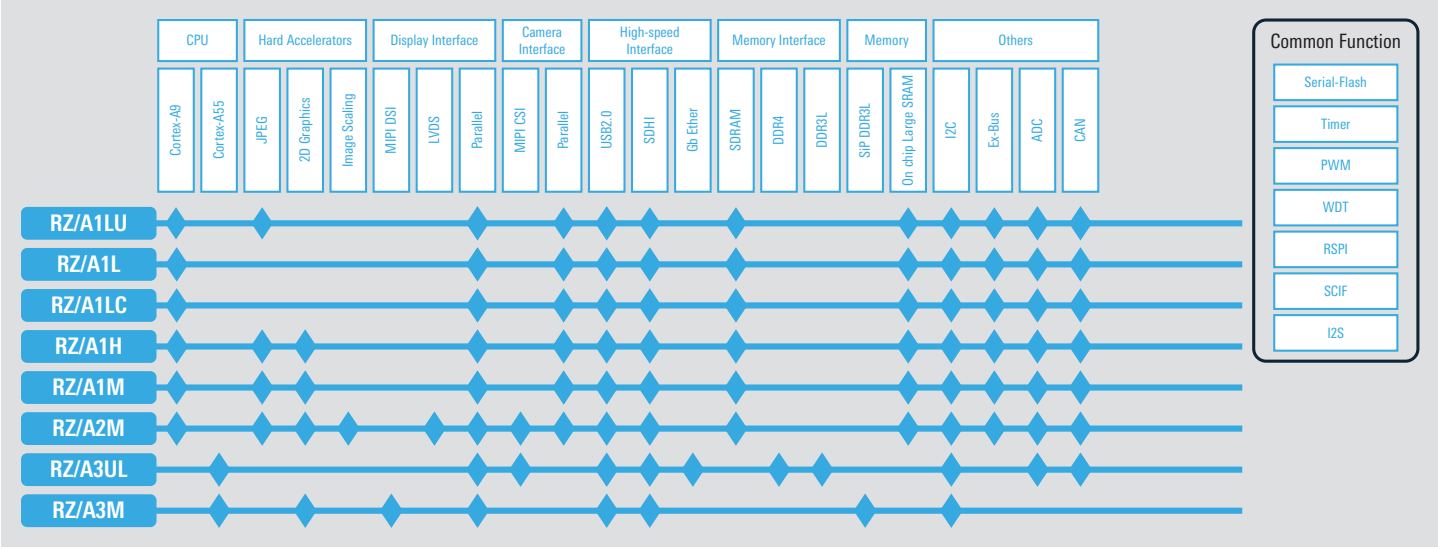
Features of the RZ/A Series

The RZ/A series is an RTOS-based microprocessor (MPU) combining excellent real-time performance and fast boot time based on Renesas' proprietary technology and Arm® ecosystem, and is as user-friendly as Renesas MCUs with integrated large size RAM. RZ/A series are specialized devices with a feature set optimized to address diverse HMI, Consumer, Smart Home and Building Automation, Healthcare, Industrial Applications, and Office Automation market segments.

RZ/A Series Product Positioning



RZ/A Series Lineup



Human Machine Interfaces

Large size RAM
+ RTOS

RZ/A3M Group: RTOS MPU with built-in DDR3L SDRAM

RZ/A3M microprocessor includes a Cortex®-A55 core with NEON™ extension and built-in large capacity 128MB DDR3L memory. It integrates features such as high-resolution Graphics LCD controller with parallel RGB and 4-lane MIPI-DSI interfaces to display panels, 2D graphics drawing engine, support QSPI NOR/NAND Flash and 244 pin LFBGA package which is ideal for 2-layers board design.

CPU core
- Arm® Cortex®-A55, single-core
  Max. operating frequency: 1.0GHz
  Neon™ extension

Cache memory (Cortex®-A55)
- L1 instruction cache: 32KB
- L1 data cache: 32KB
- L3 data cache: 256KB

Memory
- Internal 128KB SRAM
- SiP 128MB DDR3L SDRAM

2D Graphics
- 2D Graphics Drawing Engine

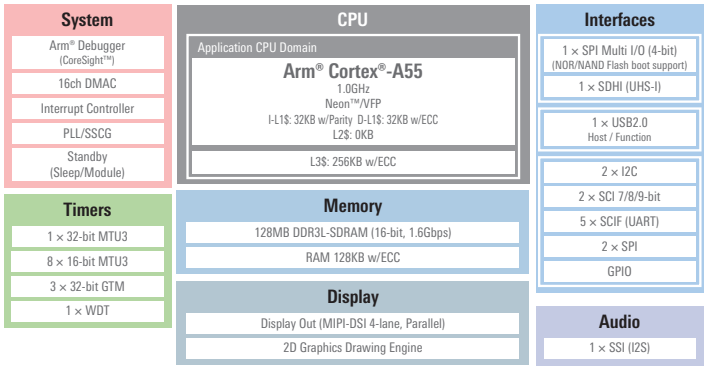
Video functions
- Video display interface
  MIPI-DSI 4-lane × 1 channel
  Parallel interface × 1 channel

Audio functions
- Serial sound interface × 1 channel

Storage interfaces
- USB2.0 × 1 channel (Host-Function)
- SD host interface × 1channel

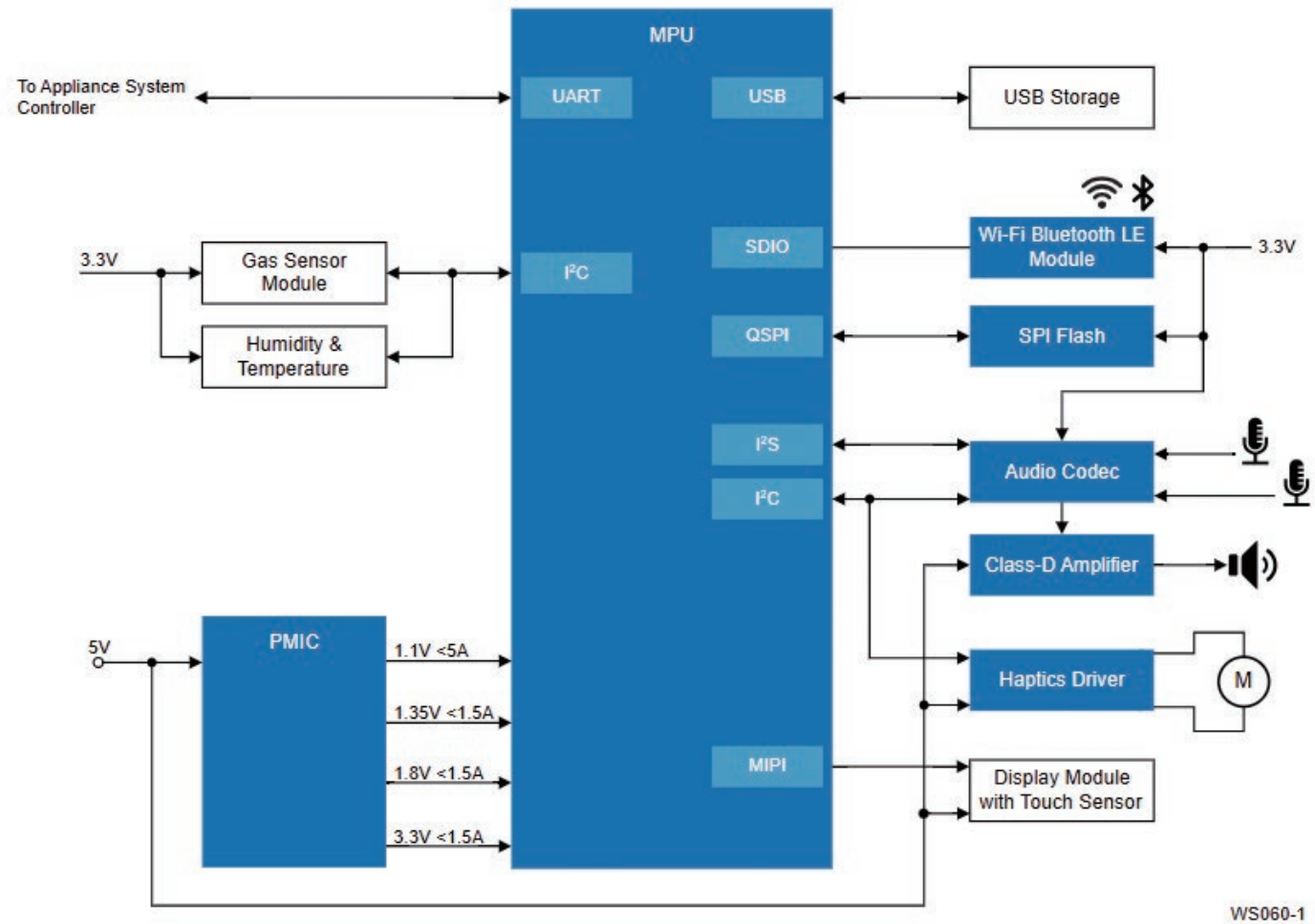
Other peripheral functions
- 16-bit Multi-function Timer × 8 channels
- 32-bit Multi-function Timer × 1 channel
- 32-bit General Timer × 3 channels
- I²C bus interface × 2 channels
- Serial communication interface with FIFO (SCIF) × 5 channels
- Serial communication interface (SCI) × 2 channels
- SPI Multi I/O Bus controller with NOR/NAND support × 1 channel (4bit Double data rate)
- Serial Peripheral Interface (RSPI) × 2 channels
- Interrupt controller
- Clock generator (CPG): on-chip PLL
- On-chip debug function

Package
- 244-LFBGA (17mm × 17mm, 0.8mm pitch)



Human Machine Interface (HMI) for Appliances

Renesas will provide a reference system solution for the RZ/A3M with DA9080-62 power management IC. These devices work together seamlessly in Winning Combinations, such as Multi HMI Solutions for Appliance, that can be used as reference designs to reduce product development time.



RZ/A3UL Group: RTOS MPU for High-Definition HMI

RZ/A3UL microprocessor includes a Cortex®-A55 core with NEON™ extension, the ability to connect to high-speed DDR3L/DDR4 RAM and an Octal-SPI memory interface that facilitates simpler and more compact board designs. Using an RTOS allows systems to start up instantly, in less than a second after boot-up. RZ/A3UL provides a cost-effective solution for HMI, IoT Gateway, and audio equipment.

CPU core
- Arm® Cortex®-A55, single-core
  Max. operating frequency: 1.0GHz
  Neon™ extension

Cache memory (Cortex®-A55)
- L1 instruction cache: 32KB
- L1 data cache: 32KB
- L3 data cache: 256KB

Memory
- Internal 128KB SRAM
- DDR4/3L SDRAM 16-bit interface

Video functions
- Video display interface
  Parallel interface × 1 channel
- Video input interface
  MIPI CSP-2 × 1 channel
- Video image processing functions (Resize and Color Space/Color format Conversion)

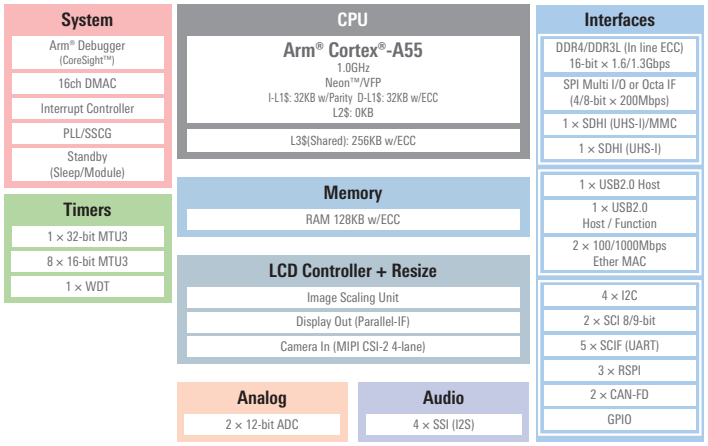
Audio functions
- Serial sound interface × 4 channel

Storage interfaces
- USB2.0 × 2 channels (Host 1channel, Host-Function 1 channel)
- SD host interface × 2 channels
- Multimedia card interface × 1 channel (Shared with SDHI)

Analog functions
- 12-bit ADC ×2 input channels

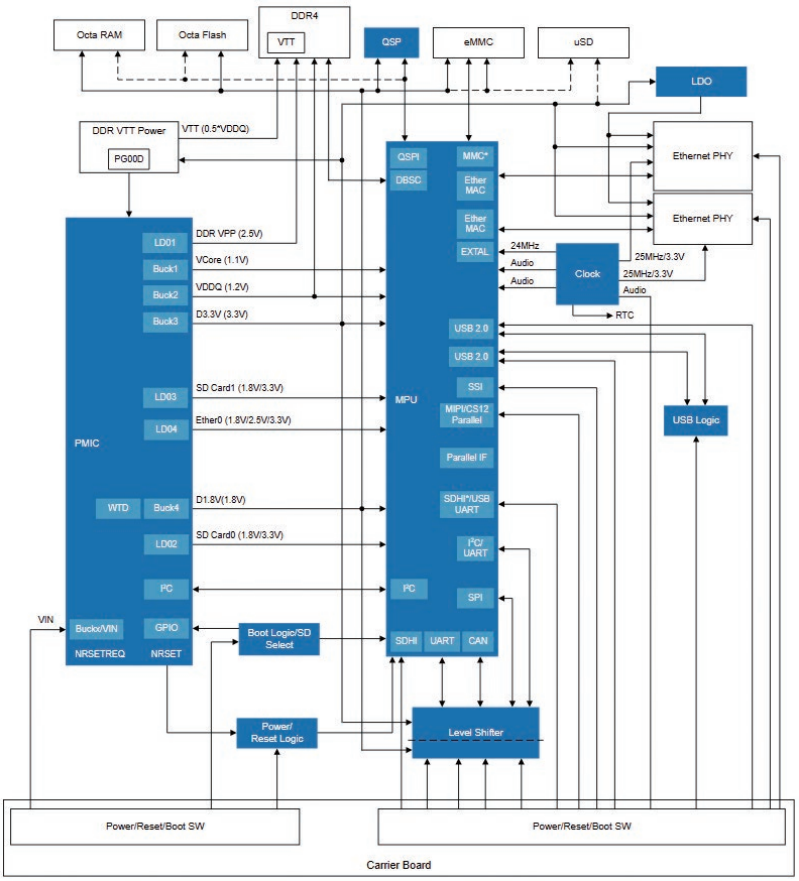
Other peripheral functions
- 16-bit Multi-function Timer × 8 channels
- 32-bit Multi-function Timer × 1 channel
- I²C bus interface × 4 channels
- Serial communication interface with FIFO (SCIF) × 5 channels
- Serial communication interface (SCI) × 2 channels
- SPI Multi I/O Bus controller x 1 channel (4/8-bit Double data rate)
- Serial Peripheral Interface (RSPI) x 3 channels
- Gigabit Ethernet controller × 2 channel
- Controller area network (CAN) interface × 2 channels (support CAN-FD)
- Interrupt controller
- Clock generator (CPG): on-chip PLL
- On-chip debug function

Package
- 361-LFBGA (13mm × 13mm, 0.5mm pitch)



RTOS-Based RZ/A3UL HMI SMARC SoM

This compact SMARC 2.1 system-on-module (SoM) incorporates a Renesas RZ/A3UL MPU for RTOS applications. This system design architecture provides a complete power and timing tree. It is targeted for real-time human machine interface (HMI) applications, such as smart homes/buildings or industrial terminals.



US221

System Benefits:
- RTOS operating system
- Single Arm® Cortex®–A55 configurations for low power consumption
- Support for multiple memories: Octal Flash and RAM, DDR, QSPI, eMMC
- Single programmable clock generator
- Multiple communication interface support: USB, Ethernet, CAN, Wi-Fi/Bluetooth® Low Energy (LE)

RZ/A2M Group: RTOS MPU with DRP and 4MB of On-chip RAM

RZ/A2M supports the MIPI camera interface, widely used in mobile devices, and is equipped with a DRP for high-speed image processing. Renesas has also boosted network functionality with the addition of two-channel Ethernet support. These features enable network connectivity, making the new RZ/A2M best suited for a wide range of systems employing image recognition, from home appliances to industrial machinery.

CPU (Arm® Cortex®-A9)
- Operating frequency: 528MHz
- Single-precision/double-precision FPU
- Arm® Neon™

On-chip memory
- 4MB

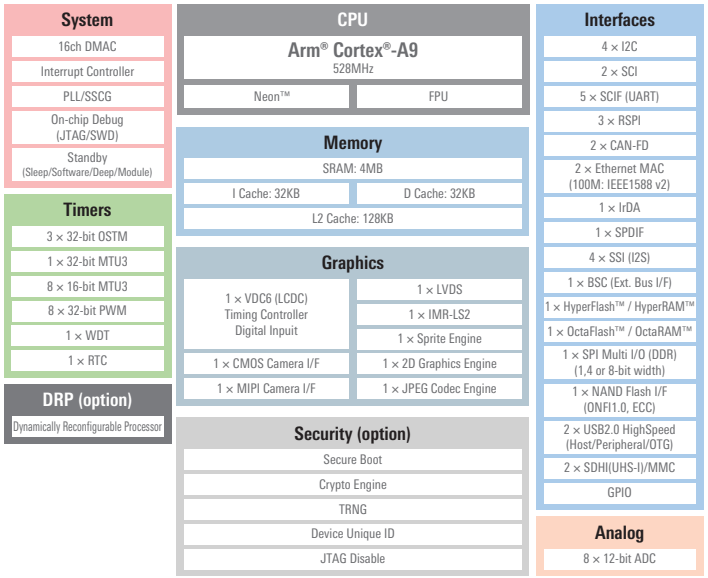
Main graphics and camera input functions
- Video display controller (VDC6): 1 channel
  LCD output: Max. WXGA
  Screen superimposition: 3 layers
  Video input: Max. XGA
- CMOS camera input (CEU): 1 channel
- MIPI CSI-2 interface: 1 channel
- Distortion compensation unit (IMR): 1 channel
- 2D graphics engine: 1 channel
- Sprite engine: 1 channel
- JPEG coding engine: 1 channel

Main memory interface functions
- NOR flash, SDRAM, NAND flash
- Serial flash: 1-bit/4-bit/8-bit: 1 channel, 8-bit: 1 channel (ability to run stored programs directly)
- SD/MMC host interface: 2 channels

Main communication functions
- USB 2.0 High Speed: 2 channels (Host/Function switchable)
- 10M/100M EtherMAC: 2 channels
- SCIF: 5 channels
- I²C: 4 channels
- SSI: 4 channels
- RSPI: 3 channels
- CAN-FD: 2 channels

Optional functions
- DRP (Dynamically Reconfigurable Processor)

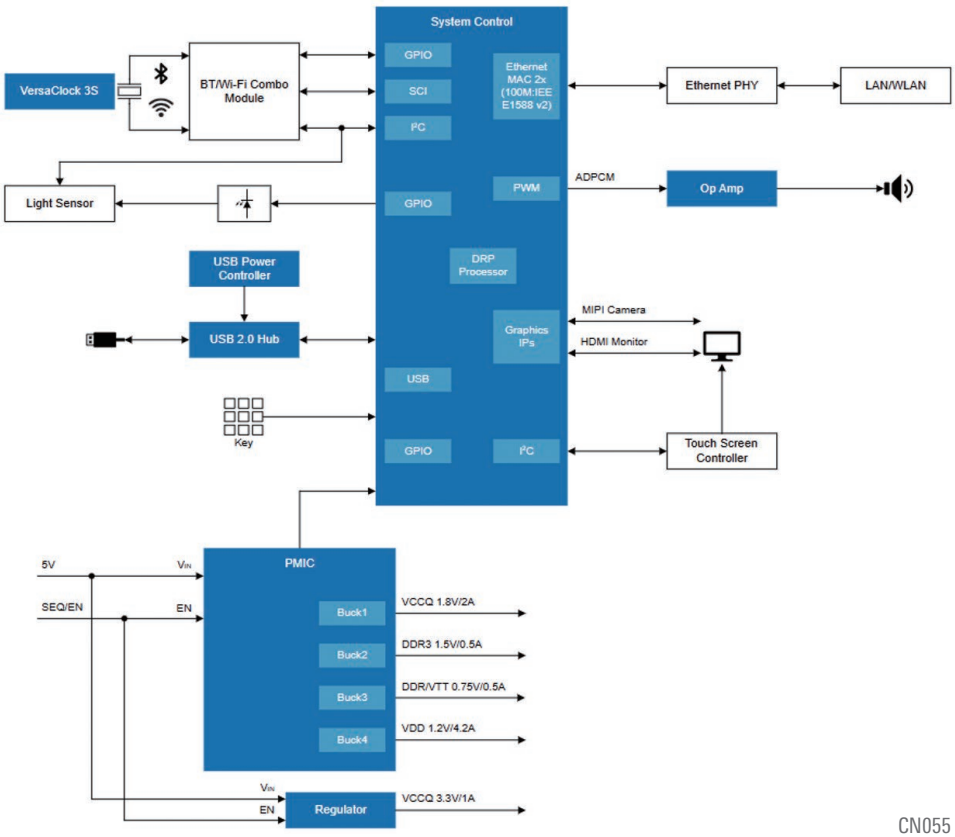
Package
- 176-LFBGA (13mm × 13mm, 0.8mm pitch)
- 256-LFBGA (11mm × 11mm, 0.5mm pitch)
- 272-FBGA (17mm × 17mm, 0.8mm pitch)
- 324-FBGA (19mm × 19mm, 0.8mm pitch)



Industrial Barcode Scanner

Barcode scanners are widely used in industrial applications such as automatic tracking and quality control. Barcode scanners have advantages over other tracking methods, as they offer faster input speed, higher reliability, and the ability to scan a large amount of information while being flexible.

Renesas has a range of MCU/MPUs, power and analog devices that can be used for any barcode scanner solution, optimizing the solution to the specific need.



RZ/A1H & RZ/A1M Group: RTOS MPU with 10MB/5MB of On-chip RAM

RZ/A1H can display WXGA (1280 x 800) and RZ/A1M can display XGA (1024 x 768) without requiring external memory. In addition, with two LCD outputs, up to two LCD displays are possible. It enables very compact embedded designs without the need to worry about memory procurement and memory EOL. You can design your embedded system like an MCU and get the performance of a 400MHz Arm® Cortex®-A9 MPU.

CPU (Arm® Cortex®-A9)
- Operating frequency: 400MHz
- Single-precision/double-precision FPU
- Arm® Neon™

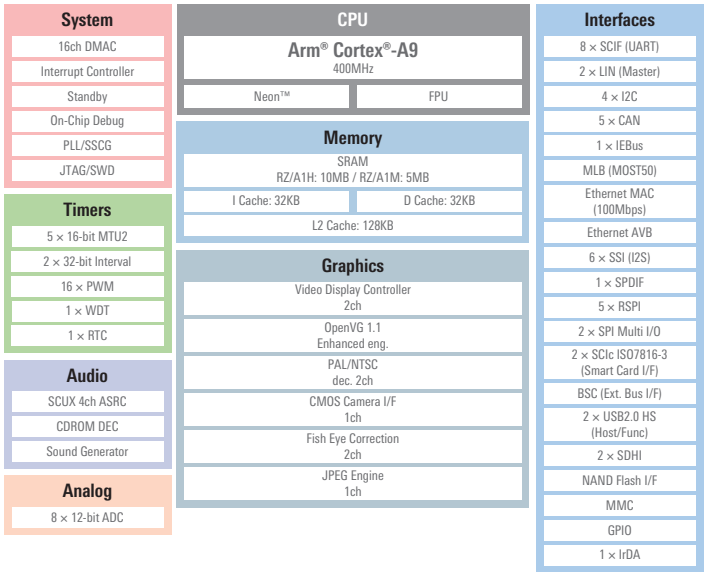
On-chip memory
- RZ/A1H: 10MB
- RZ/A1M: 5MB

Main graphics and camera input functions
- Video display controller (VDC5): 2 channels
  LCD output: Max. WXGA
  Screen superimposition: 4 layers
  Video input: Max. XGA (CVBS analog input supported)
- CMOS camera input (CEU): 1 channel
- PAL/NTSC decoder (DVDEC): 2 channels
- Distortion compensation unit (IMR): 1 channel
- Open VG accelerator: 1 channel
- JPEG coding engine: 1 channel

Main memory interface functions
- NOR flash, SDRAM, NAND flash
- QSPI serial flash: 2 channels (ability to run stored programs directly)
- SD host interface: 2 channels
- MMC host interface: 1 channel

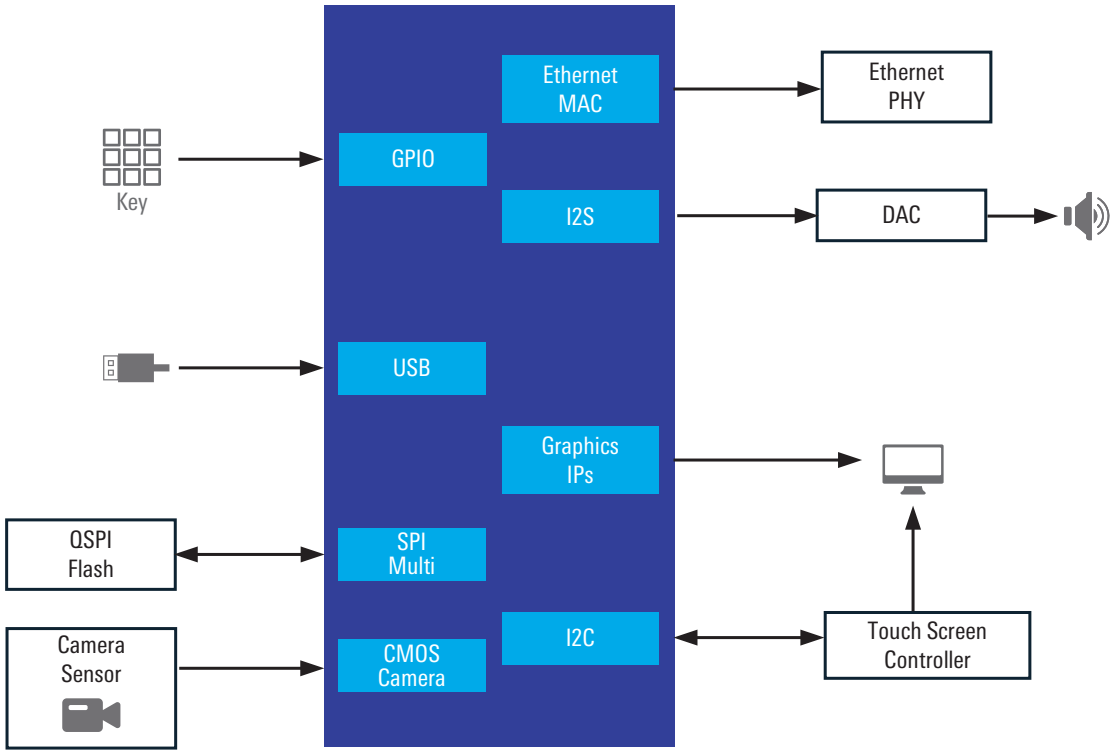
Main communication functions
- USB 2.0 High Speed: 2 channels (Host/Function switchable)
- 10M/100M EtherMAC: 1channel
- SCIF: 8 channels
- I^2C: 4 channels
- SSI: 6 channels
- RSPI: 5 channels
- Ethernet AVB: 1 channel
- CAN: 5 channels

Package
- 256-LFBGA (11mm × 11mm,0.5mm pitch)
- 256-LFQFP (28mm × 28mm,0.4mm pitch)
- 324-FBGA (19mm × 19mm,0.8mm pitch)



Industrial HMI Systems

With the advancement of industrial HMI systems, there is a growing need for embedded platforms that compactly integrate high-performance graphical interfaces and a variety of peripheral functions.RZ/A1H,RZ/A1M are equipped with a Cortex-A9 processor and large-capacity internal memory, integrating smooth display performance and a variety of interfaces. It utilizes Ethernet, USB, and other technologies to powerfully support the construction of operation screens for industrial and medical equipment.



RZ/A1LU Group: RTOS MPU with JPEG codec and 3MB of On-chip RAM

RZ/A1LU is capable of displaying WVGA (800x480) images without external SDRAM thanks to its 3MB internal SRAM. In addition, the built-in JPEG codec unit improves image processing capabilities. Using the RZ/A1LU, you can design embedded systems like MCUs and obtain the performance of a 400MHz Arm® Cortex®-A9 MPU.

CPU (Arm® Cortex®-A9)
- Operating frequency: 400MHz
- Single-precision/double-precision FPU
- Arm® Neon™

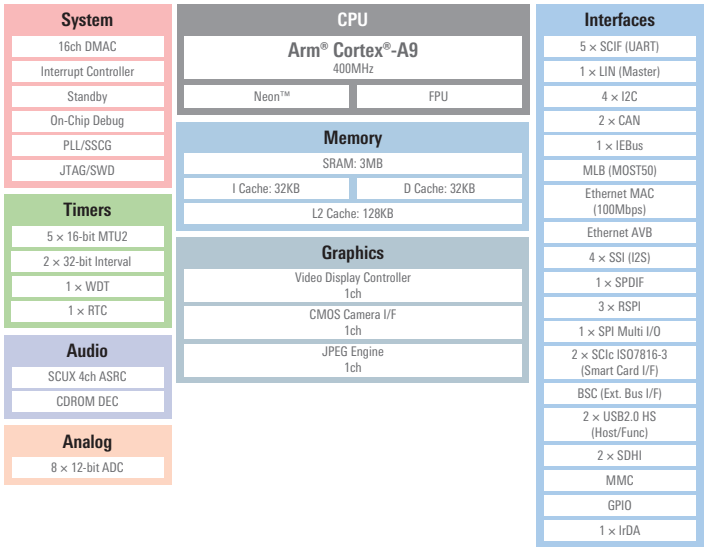
On-chip memory
- 3MB

Main graphics and camera input functions
- LCD controller (VDC5): 1 channel
  LCD output: Max. WXGA
  Screen superimposition: 3 layers
  Video input: Max. XGA
- CMOS camera input (CEU): 1 channel
- JPEG coding engine: 1 channel

Main memory interface functions
- NOR flash, SDRAM
- QSPI serial flash: 1 channel (ability to run stored programs directly)
- SD host interface: 2 channels
- MMC host interface: 1 channel

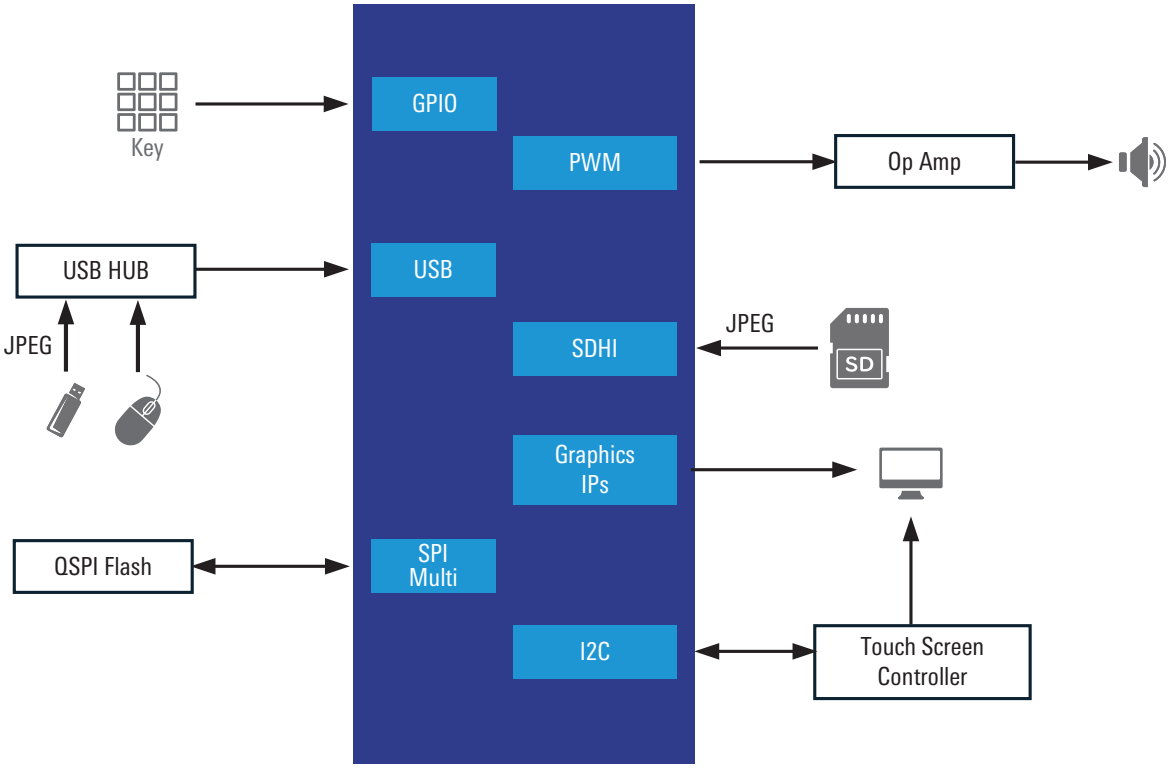
Main communication functions
- USB 2.0 High Speed: 2 channels (Host/Function switchable)
- 10M/100M EtherMAC: 1channel
- SCIF: 5 channels
- I^2C: 4 channels
- SSI: 4 channels
- RSPI: 3 channels
- Ethernet AVB: 1 channel
- CAN: 2 channels

Package
- 176-LFBGA (8mm × 8mm,0.5mm pitch)
- 176-LFQFP (24mm × 24mm,0.5mm pitch)
- 208-LFQFP (28mm × 28mm,0.5mm pitch)



Digital photo frame

JPEG files stored on a microSD card or USB memory stick are loaded and processed by the built-in JPEG codec unit, and it smoothly displayed on the LCD. Images are scaled according to the LCD resolution to ensure optimal display quality. It also supports intuitive user operations via touch panels and USB mouse, making it easy to implement interactive UI features such as page turning and image enlargement/reduction. The large capacity of 3MB of built-in RAM eliminates the need for external memory, simplifying board design and reducing costs, while providing powerful support for the development of compact, high-performance image viewer devices.



RZ/A1L & RZ/A1LC Group: RTOS MPU with 3MB/2MB of On-chip RAM

RZ/A1L can display WVGA (800x480) images without external SDRAM thanks to its built-in 3MB SRAM, while the RZ/A1LC can display VGA (640x480) images. It also has an SDRAM interface that can expand external memory up to 128 MB.

CPU (Arm® Cortex®-A9)
- Operating frequency: 400MHz
- Single-precision/double-precision FPU
- Arm® NEON™

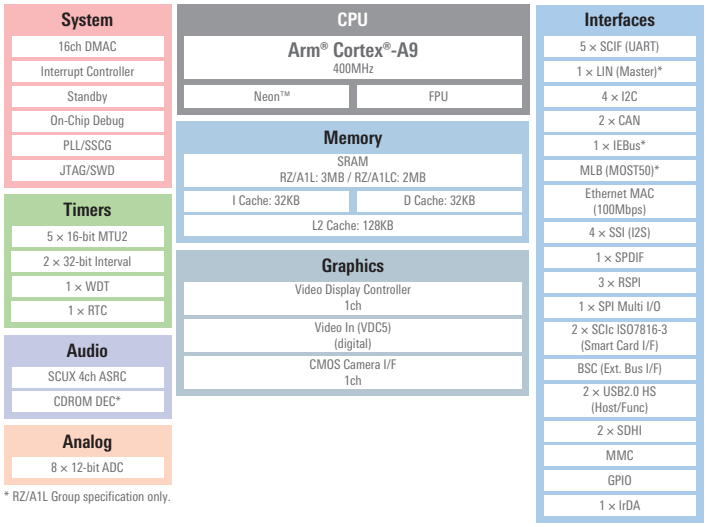
On-chip memory
- RZ/A1L: 3MB
- RZ/A1LC: 2MB

Main graphics and camera input functions
- LCD controller (VDC5): 1 channel
  LCD output: Max. WXGA
  Screen superimposition: 3 layers
  Video input: Max. XGA
- CMOS camera input (CEU): 1 channel

Main memory interface functions
- NOR flash, SDRAM, NAND flash
- QSPI serial flash: 1 channel (ability to run stored programs directly)
- SD host interface: 2 channels
- MMC host interface: 1 channel

Main communication functions
- USB 2.0 High Speed: 2 channels (Host/Function switchable)
- 10M/100M EtherMAC: 1 channel
- SCIF: 5 channels
- I^2C: 4 channels
- SSI: 4 channels
- RSPI: 3 channels
- CAN: 2 channels

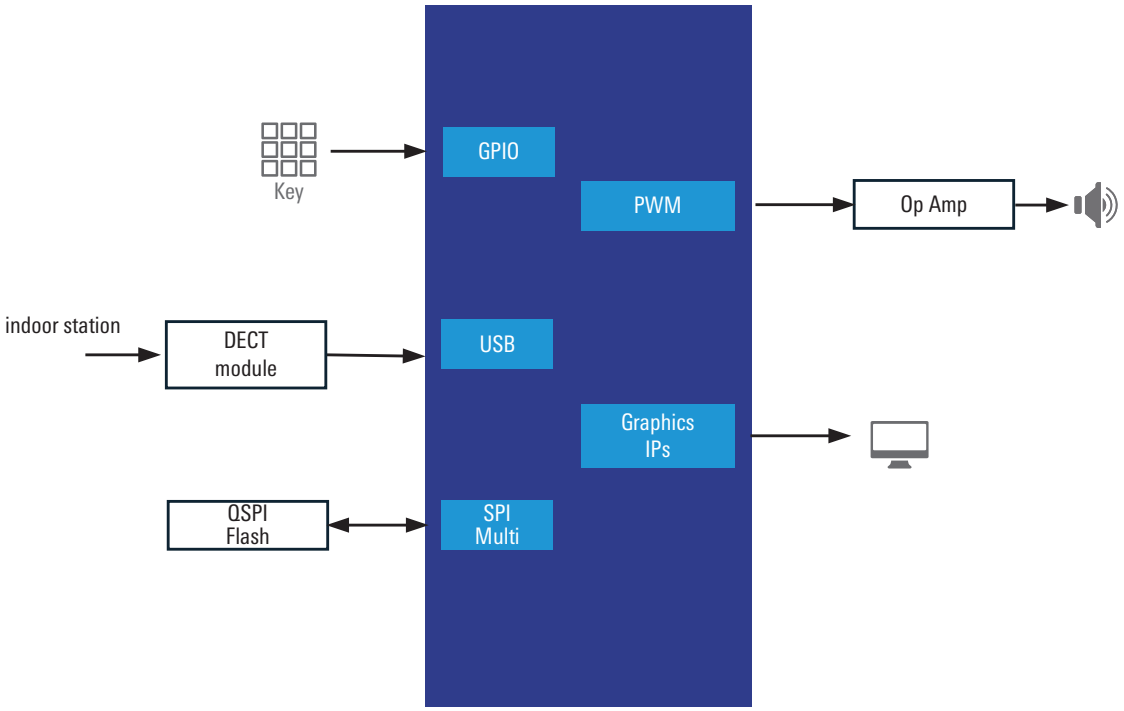
Package
- 176-LFBGA (8mm × 8mm,0.5mm pitch)
- 176-LFQFP (24mm × 24mm,0.5mm pitch)
- 208-LFQFP (28mm × 28mm,0.5mm pitch)
- 233-FBGA (15mm × 15mm, 0.8mm pitch)



* RZ/A1L Group specification only.

Indoor Unit System for Video Door Phone

This system receives and processes image and audio data transmitted via DECT signals from the indoor master unit, displaying video on the LCD while outputting audio in real time.It is equipped with a built-in LCD controller, serial audio IF, and a wide range of communication interfaces (SCI, SPI, I2C, etc.), enabling a compact design with a minimum of external components.The built-in RAM can store RTOS, lightweight frame buffers, audio buffers, etc., providing a real-time, responsive user operating environment.



Development Environment for the RZ Family

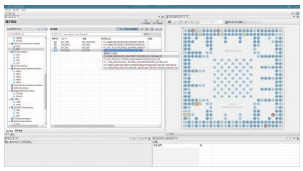
The RZ Family is a lineup of high-performance processors designed to support a wide range of applications, offering a variety of product groups. These products are structured to meet diverse needs—ranging from those optimized for graphics and AI processing to those specialized for real-time control and industrial networks.A key feature of the RZ Family is that each product group is supported by a development environment optimized for its specific use case. The development environment for the RZ Family can be broadly categorized into the following two styles.

Linux-based development

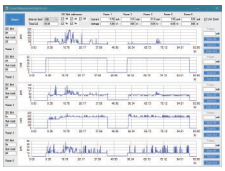
The RZ/V, RZ/N, RZ/T, and RZ/G series support development based on the Linux operating system. These series are optimized for applications requiring high computational performance and flexible software configurations, such as AI inference processing, multimedia handling, and GUI rendering.

Evaluation → **Development / Mass production**

	Target Users	Kernel Update
Linux BSP Plus	Linux Expert	Every year (LTS)
Verified Linux Package Super Long-Term Support: 10years maintenance	Linux Expert	Every 2 years (SLTS)
SDK (Only RZ/V and RZ/G Series)	Linux Beginner	Every 2 years (SLTS)



Smart Configurator



Current Measurement Program

*For Cortex-M cores, please refer to the IDE-based development.

IDE based development

The RZ/V, RZ/N, RZ/T, RZ/G, and RZ/A series offer support for real-time OS-based development environments. Through the use of integrated development environments, real-time operating systems, compilers, and debuggers provided by Renesas Electronics and its partners, customers can achieve substantial improvements in development efficiency.

Introduction/initial development | **Development** | **Mass production**

Development Kit

Evaluation Borad

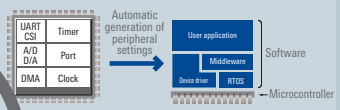
free evaluation version

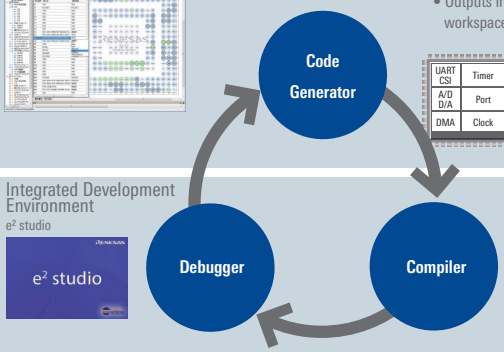
Software tool free evaluation version

Starter Kit

FSP SC

- Automatically generates microcontroller peripheral function control programs (device driver programs).
- Outputs integrated development environment workspace files and program files.





Note: Compatible source code can be generated for IAR Embedded Workbench® for Arm® from IAR Systems and e² studio (GNU Tools).

- J-Link LITE from Segger
- J-Link series from Segger

- I-jet™/I-jet Trace™
- JTAGjet-Trace

Evaluation Board

The Renesas RZ Family of 32-bit and 64-bit Arm microprocessors (MPUs) enables the solutions required for the smart societies of the future. Through high-performance CPU cores and a variety of accelerators and peripheral functions, engineers can easily implement high-resolution human machine interfaces (HMI), embedded vision, embedded artificial intelligence (e-AI), and real-time control and industrial ethernet connectivity

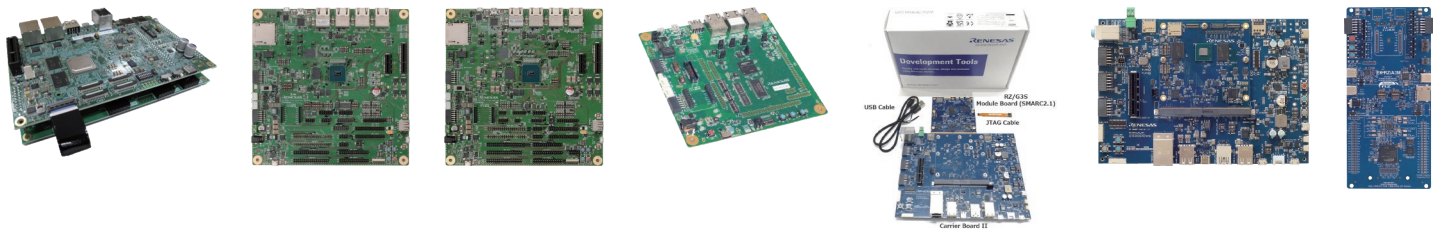
Evaluation Board is used to evaluate our RZ Family MPUs. Renesas provide environment where customers can evaluate functionalities of the MPUs using the software environment and various technical documents provided by us.

- **Vision AI (RZ/V series)**
  The evaluation board kits are used to evaluate our RZ/V vision AI MPUs. We provide the Verified Linux Package and DRP-AI Support Package for these kits. It allows users to boot Linux and run the AI application easily and quickly.
- **Industrial Network (RZ/N Series)**
  The evaluation board kits are used to evaluate our RZ/N Industrial Network MPUs. With an on-board emulator, allowing users to start development simply by connecting the included cable to a PC. Industrial Ethernet communication can be easily evaluated using the provided solution.
- **Real-time Control (RZ/T Series)**
  The evaluation board kits are used to evaluate our RZ/T Real-time Control MPUs. With an on-board emulator, allowing users to start development simply by connecting the included cable to a PC. With the RZ/T2H-EVKIT, motor control of up to 9 axes can be evaluated by connecting to the RZ/T Series Inverter Board and Bus Board.
- **IoT Edge (RZ/G Series)**
  The evaluation board kits MPUs are used to evaluate our RZ/G IoT Edge MPUs (RZ/G3S and RZ/Five). We provide the Verified Linux Package for these kits. It allows users to boot Linux and reduce the burden of software development in embedded system development.
- **HMI (RZ/G and RZ/A series)**
  The evaluation board kits are used to evaluate our RZ/G HMI MPUs and RZ/A MPUs. For the RZ/G Evaluation Board kits, we provide the Linux BSP Plus, Verified Linux Package (VLP), and RZ/G HMI Software Development Kit (HMI SDK). It allows users to boot Linux and run HMI demos easily and quickly. For RZ/A Evaluation Board Kits, we provide RZ/A Flexible Software Package (FSP) to help users quickly develop embedded systems.

Board Lineup

	Vision AI RZ/V Series	**Industrial Network** RZ/N Series	**Real-time Control** RZ/T Series	**IoT Edge** RZ/G Series	**HMI** RZ/G Series RZ/A Series
Linux / Android™ / Multi-OS with RTOS	RZ/V2H-EVK RZ/V2N-EVK RZ/V2L-EVKIT RZ/V2M-EVKIT RZ/V2MA-EVKIT	RZ/N2H-EVKIT	RZ/T2H-EVKIT	RZ/G3S-EVKIT RZ/Five-EVKIT	RZ/G3E-EVKIT RZ/G2L-EVKIT RZ/G2LC-EVKIT RZ/G2UL-EVKIT RZ/A3UL-EVKIT RZ/G2H-HiHOPE RZ/G2M-HiHOPE RZ/G2N-HiHOPE EK874 (RZ/G2E)
RTOS		RZ/N2L-RSK	RZ/T2ME-RSK RZ/T2M-RSK RZ/T2L-RSK		EK-RZ/A3M RZ/A3UL-EVKIT RZ/A2M-EVKIT

RZ/V2H-EVK RZ/N2H-EVKIT RZ/T2H-EVKIT RZ/T2ME-RSK RZ/G3S-EVKIT RZ/G3E-EVKIT EK-RZ/A3M

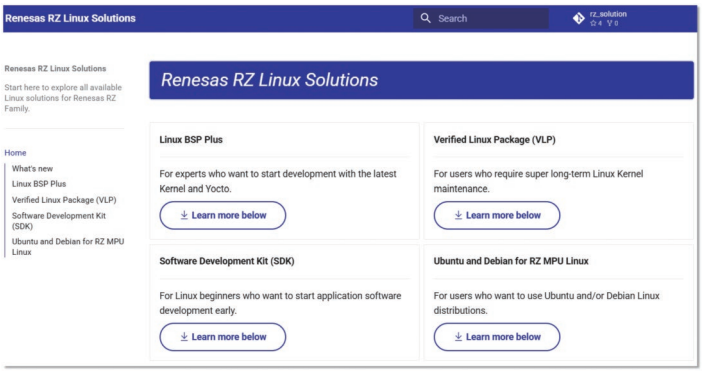


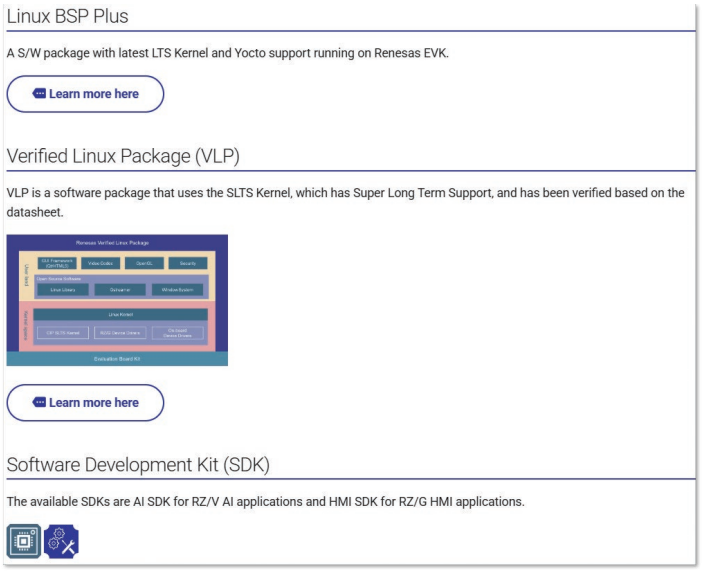
Examples of Boards and Kits for RZ MPUs family

Development Environment for Linux

A development environment is available through a Yocto Project-based Linux BSP, which can be customized to meet specific system requirements. Various development environments are available to accommodate different development needs, enabling flexible development of Linux device drivers and applications. Please visit the following website for further information.

https://renesas-rz.github.io/rz_solution/

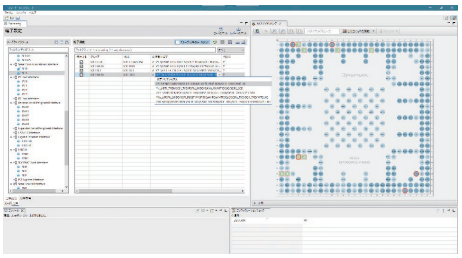




Furthermore, user-friendly development tools, including “Smart Configurator” and “Current Measurement Program”, are available to support efficient design.

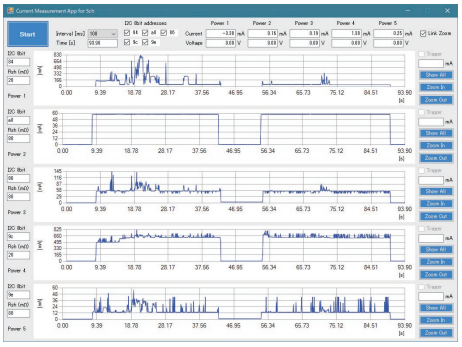
Smart Configurator for RZ

The Smart Configurator is a GUI tool that helps you easily assign shared pins to their specific functions. This tool can generate a device tree file (.dtsi) for Linux. By using this device tree file, users can apply new pin settings.



Current Measurement Program

The Current Measurement Program is a GUI tool that measures current on the EVK of RZ/G3S and RZ/G3E. This tool provides real-time plotting and automatically saves the data as a CSV file. Customers can develop software while checking in real time how much current the EVK is consuming.



Development Environment for RTOS

The RZ family development environment offers flexibility in terms of different supported on-chip debuggers, IDEs, and compilers. Customers can use the Renesas e² studio, IAR Embedded Workbench*. All tools can use the RZ configurators for FSP driver and middleware selection and configuration, in addition to pin mapping and clock tree configuration.

* Supported only on some RZ product series.

Overview

	Renesas e² studio	IAR Systems Embedded Workbench for Arm	Arm Development Studio
Integrated Development Environment	This development environment based on Eclipse provides a large number of functions.	This is the C/C++ integrated development environment most broadly used internationally.	Embedded C/C++ software development toolchain specifically for Arm-based SoCs.
Compilers	■ GNU Arm Embedded Toolchain	■ IAR Arm Compiler*	■ Arm Compiler
Debugger probes	■ J-Link LITE from Segger ■ J-Link series from Segger*	■ I-jet™/I-jet Trace™ for Arm® Cortex®-A/R/M ■ JTAGjet-Trace	■ DSTREAM™ ■ ULINKpro™ ■ ULINKproD™ ■ ULINK2™
Supported products	■ RZ/N2H, N2L ■ RZ/T Series ■ RZ/A1 Group, RZ/A2M, RZ/A3UL	■ RZ/N2H, N2L ■ RZ/T Series ■ RZ/A1 Group, RZ/A2M	■ RZ/A2M

* Compiler must be purchased and licensed directly from 3rd-party.

Integrated Development Environment

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

e² studio

The eclipse-based e² studio along with a GCC compiler and SEGGER J-Link debugger is the primary development solution for RZ MPUs and Flexible Software Package (FSP). e² studio offers a complete development flow from initial project generators, graphical FSP configuration and comprehensive debugger options.

IAR Embedded Workbench® for Arm®

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

Arm Development Studio

Arm Development Studio is an embedded C/C++ development toolchain designed specifically for Arm-based SoCs, from tiny microcontrollers to custom multicore processors. Designed alongside Arm processor IP, it accelerates system design and software development for Cortex-M, Cortex-R and Cortex-A, Cortex-X and Neoverse processors. Only the RZ/A2M model is supported among RZ products.

Compiler

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

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

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

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

Arm Development Studio is an embedded C/C++ development toolchain designed specifically for Arm-based SoCs, from tiny microcontrollers to custom multicore processors.

Debuggers, ICEs

Debugger/ICE is a tool that supports the development and debugging of embedded systems. It emulates the operation of the CPU and memory on the target board, providing features such as setting breakpoints, stepping through p-rogram execution, accessing registers and memory, and real-time tracing.

	KMC Kyoto Microcomputer Co., Ltd.	DTS INSIGHT Our insight, your value	LAUTERBACH DEVELOPMENT TOOLS	Computex	SEGGER
Debuggers	■ PARTNER-Jet2	■ microVIEW-Xross	■ TRACE32 PowerView	■ CSIDE version 7	■ Ozone ■ e² studio
ICEs		■ adviceXross	■ TRACE32 PowerDebug & PowerTrace	■ PALMiCE4	■ J-Link Series
Supported compilers	■ exeGCC from Kyoto Microcomputer ■ GNU tool*1 ■ Arm CC*2 ■ IAR C/C++ compiler,*3 etc.	■ Arm CC*2 ■ GNU tool,*1 etc.	■ Arm CC*2 ■ GNU tool*1 ■ IAR C/C++ compiler*3 etc.	■ Arm CC*2 ■ IAR C/C++ compiler*3 ■ GNU tool,*1 etc.	■ GNU Arm Embedded Toolchain ■ Arm compiler ■ IAR C/C++ compiler, etc.
Supported products	■ RZ/T2H, RZ/T2ME, RZ/T2M, RZ/T1 ■ RZ/N2H, RZ/N2L ■ RZ/A1 Group, RZ/A2M, RZ/A3UL	■ RZ/T2H, RZ/T2ME, RZ/T2M, RZ/T1 ■ RZ/N2H, RZ/N2L	■ RZ/T2H, RZ/T2ME, RZ/T2M, RZ/T2L ■ RZ/T1 ■ RZ/N2H, RZ/N2L ■ RZ/A1 Group, RZ/A2M, RZ/A3UL	■ RZ/T1	■ RZ/A1 Group, RZ/A2M, RZ/A3UL

Real-time operating systems (RTOS)

Main RTOS supported by the RZ family are FreeRTOS and Zephyr RTOS. Other RTOSs (such as AzureRTOS) are supported by the Renesas RZ ecosystem, which consists of a wide range of partners.

FreeRTOS is supporting a small memory footprint, fast execution times, and cutting-edge RTOS features and libraries including Symmetric Multiprocessing (SMP), a thread-safe TCP stack with IPv6 support, and seamless integration with cloud services. It's open-source and actively supported and maintained.

The Zephyr Project is a Linux Foundation hosted Collaboration Project. It's an open-source collaborative effort uniting developers and users in building a best-in-class small, scalable, RTOS optimized for resource-constrained devices, across multiple architectures.

Winning Combinations

Speeding Up Application Design for Customers

■ More Than 400 Winning Combinations for a Variety of Applications

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

Renesas continues to make available new Winning Combinations, including many featuring RZ Family MPUs, one after another.

Key Technologies

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

Industrial

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

Consumer Electronics

Cameras
Computing
Home Entertainment
Power Adapters & Chargers
Wearables

Communications Infrastructure

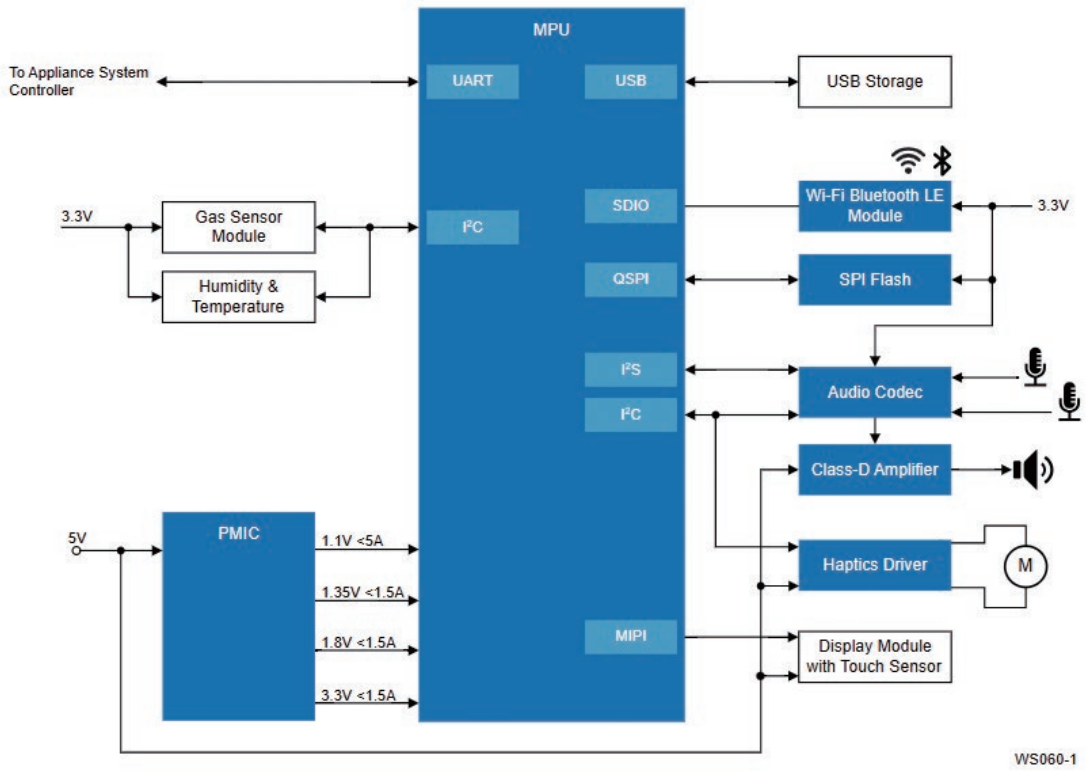
Cloud & Enterprise
Memory
Networking & Fixed Access
Wireless Infrastructure

■ Example Winning Combinations: Human Machine Interface (HMI) for Appliances

Easy-to-understand explanation of benefits

Easy-to-read block diagram

Easy access to related Renesas product pages



Motor Control Solution

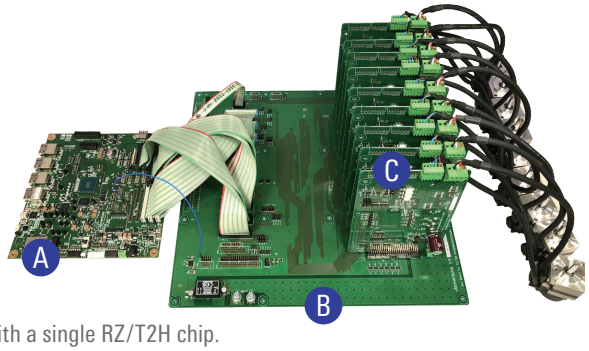
Renesas provides kits and motor control sample code for different types of motors and MPUs.

Motor Type	Kit Name	RZ/T2H	RZ/T2M	RZ/T2L	RZ/N2L
BLDC Motor	RZ/T2H 9-Axis Motor Control Reference Design	✓	–	–	–
	RZ/T Series Inverter Board	✓	–	–	–
	RZ/T Series Inverter Board Kit	✓	–	–	–
	Bus Board for RZ/T2H	✓	–	–	–
	RZ/T2M Motor Solution Kit	–	✓	–	–
AC Synchronous Motor	RZ/T2M, RZ/T2L, and RZ/N2L Motor Solution Kit (AC 220V Version)	–	✓	✓	✓

RZ/T2H 9-Axis Motor Control Reference Design

The RZ/T2H 9-Axis Motor Control Reference Design enables 9-axis motor control using the RZ/T2H advanced high-end microprocessor (MPU). This design consists of the following three boards.

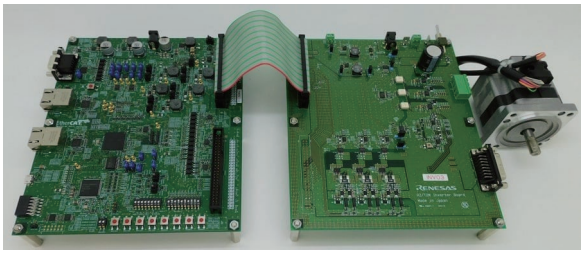
A) Evaluation board kit for RZ/T2H (P/N:RTK9RZT2H0S00000BJ)
B) Bus board for RZ/T2H (P/N:RTK0EM0000Z03000BJ)
C) RZ/T series inverter board kit (P/N:RTK0EM0000S05010BJ) x 9



By connecting these boards, it is possible to evaluate the control of a BLDC motor for 9 axes with a single RZ/T2H chip.

RZ/T2M Motor Solution Kit

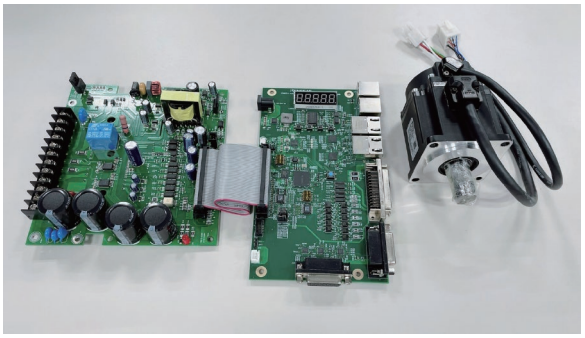
The RZ/T2M Motor Solution Kit is a development kit that enables easy initial evaluation and advanced development of a customer's motor control system development using the RZ/T2M MPU with a low voltage 24V BLDC motor.



RZ/T2M, RZ/T2L, and RZ/N2L Motor Solution Kit (AC 220V Version)

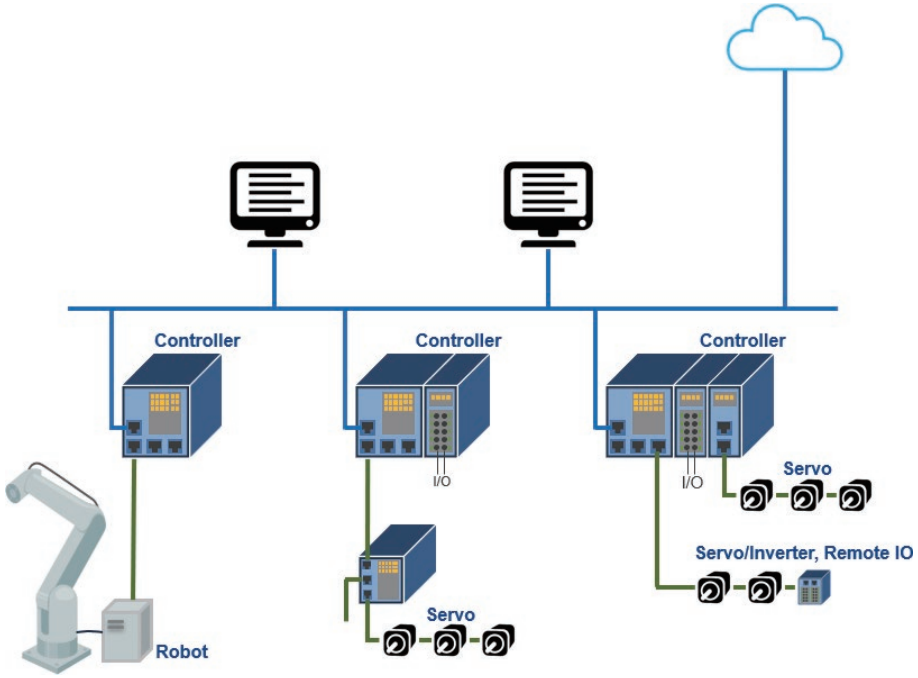
This motor solution kit is a reference kit that enables easy initial evaluation and advanced development of motor control systems using an RZ/T2M (or RZ/T2L or RZ/N2L) MPU with a high voltage 220V AC servo motor.

- RZ/T2M version (P/N: CN032-ACSERVOT2MPOCZ)
- RZ/T2L version (P/N: CN032-ACSERVOT2LPOCZ)
- RZ/N2L version (Loaned products)



Industrial Ethernet Solution

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.



Lineup

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.

	RZ/T2H Arm® Cortex®-A55 Quad Arm® Cortex®-R52 ×2	RZ/N2H Arm® Cortex®-A55 Quad Arm® Cortex®-R52 ×2	RZ/T2M RZ/T2ME Arm® Cortex®-R52 ×2	RZ/T2L Arm® Cortex®-R52 ×1	RZ/N2L Arm® Cortex®-R52 ×1
Controller	OPC UA, PROFINET *, EtherCAT *, EtherNet/IP *	OPC UA, PROFINET *, EtherCAT *, EtherNet/IP *	EtherCAT *	–	EtherCAT *
Device	OPC UA, PROFINET *, EtherCAT, EtherNet/IP, Modbus TCP	OPC UA, PROFINET *, EtherCAT, EtherNet/IP, Modbus TCP	OPC UA, PROFINET, EtherCAT, EtherNet/IP, Modbus TCP	EtherCAT	OPC UA, PROFINET, EtherCAT, EtherNet/IP, Modbus TCP

*: Partner solution. Please contact your sales representative for details.

Reliable Development

Conformance tested on major protocols.

EtherCAT® Conformance tested

PI CERTIFIED PROFIBUS • PROFINET

ODVA CONFORMANT

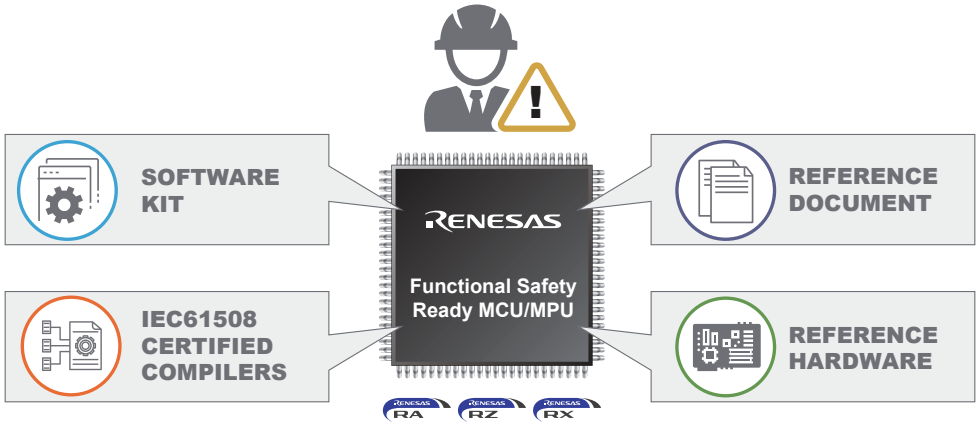
Functional Safety

The Renesas Functional Safety solution provides core technology needed for IEC61508 SIL* certification. The certified software kits and related reference board and documents help to construct a certified functional safety system.

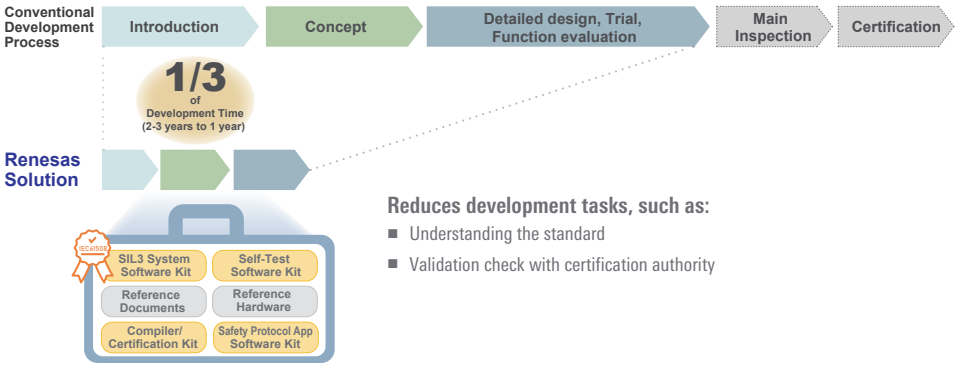
This solution significantly reduces development time and contributes to the implementation of a safe working environment in factories with the ability to handle hazards—even when the system functions fail.

* SIL: Safety Integrity Level which is defined in the functional safety standard

Renesas Solution Overview



Fast, Easy, and Reliable Development



Note: The software kits in yellow boxes are certified by TÜV Rheinland

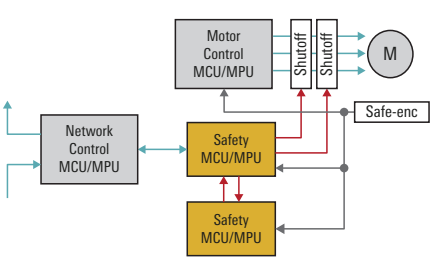
RZ/T2L Safety Network Reference Kit

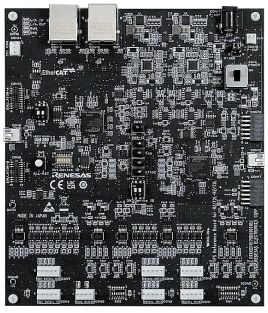
Hardware and software package for realizing safety network function.

- Easily conduct evaluation and development of safety network function on a board equipped with two RZ/T2L chips
- Reference software is available for three types of safety protocols (FSoE, PROFIsafe, and CIPSafety™)

What is inside:

- RZ/T2L functional safety reference board
- RZ/T2L safety network reference software (scan QR code inside the kit)
  - RZ/T2L FSoE reference software
  - RZ/T2L PROFIsafe reference software
  - RZ/T2L CIP Safety™ reference software





For more detail, please visit RZ/T2L Safety Network Reference Kit.

RZ Family Ecosystem Partners

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

Expansive Third Party Solutions Portfolio

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

Commercial Grade Building Block Solutions

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

Problem Solving at Heart

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

Partner Overview

The partner overview shown might not be complete since the partner network is extending almost daily. For best reference and latest data, we recommend checking our webpage at: RZ Partner Ecosystem Solutions

Explanation of Orderable Part Numbers

RZ/V Series

(1)	Option	Quality Grade	Package	Qualification level
R9AxxGxxxx	xx	G	BG	#xxn

(1)	
R9A09G057H	RZ/V2H Group
R9A09G011	RZ/V2M Group
R9A09G055M	RZ/V2MA Group
R9A09G056N	RZ/V2N Group
R9A07G054L	RZ/V2L Group

Option (RZ/V2H Group)	
Quad Core + Realtime CPU	
41	No ISP/GPU, non-Secure
42	GPU only, non-Secure
44	ISP and GPU, non-Secure
45	No ISP/GPU, Secure
46	GPU only, Secure
48	ISP and GPU, Secure

Option (RZ/V2N Group)	
Quad Core + Realtime CPU	
41	No ISP/GPU, non-Secure
42	Non-Secure, GPU
43	Non-Secure, ISP
44	Non-Secure, ISP, GPU
45	Secure
46	Secure, GPU
47	Secure, ISP
48	Secure, ISP, GPU

Quality Grade	
G	Standard

Package	
BG	BGA

Qualification level	
#ACn	Bulk (Tray)
#BCn	Full Carton (Tray)

Option (RZ/V2M Group)
–

Option (RZ/V2MAv Group)	
Quad Core + Realtime CPU	
A3	Full-spec, non-Secure

Option (RZ/V2N Group)	
Dual Core + sub-CPU	
13	Reduced-pin, non-Secure
14	Full-pin pkg, non-Secure
17	Reduced-pin, Secure
18	Full-pin pkg, Secure
23	Reduced-pin, non-Secure
24	Full-pin pkg, non-Secure
27	Reduced-pin, Secure
28	Full-pin pkg, Secure

Explanation of Orderable Part Numbers

RZ/N Series

Note: For the RZ/N1 group, please refer to the RZ Family Product Part Number Guide.

(1)	Option	Quality Grade	Package	Qualification level
R9AxxGxxxx	xx	G	BG	#xxn

(1)	
R9A07G084M	RZ/N2L Group
R9A09G087M	RZ/N2H Group

Option (RZ/N2H Group)	
04	Cortex-A55 Single-core, non-Secure
08	Cortex-A55 Single-core, Secure
24	Cortex-A55 Dual-core, non-Secure
28	Cortex-A55 Dual-core, Secure
44	Cortex-A55 Quad-core, non-Secure
48	Cortex-A55 Quad-core, Secure

Option (RZ/N2L Group)	
04	Non-Secure
08	Secure

Quality Grade	
G	Standard

Package (RZ/N2L Group)	
BG	225pin BGA
BA	121pin BGA

Package (RZ/N2H Group)	
BG	576pin BGA

Qualification level	
#ACn	Bulk (Tray)
#BCn	Full Carton (Tray)

Explanation of Orderable Part Numbers

RZ/T Series

Note: For the RZ/T1 group, please refer to the RZ Family Product Part Number Guide.

(1)	Option	Quality Grade	Package	Qualification level
R9A0xG07xM	xx	G	xx	#xxn

(1)	
R9A07G074M	RZ/T2L Group
R9A07G075M	RZ/T2M, RZ/T2ME Group *
R9A09G077M	RZ/T2H Group

*: If the option (RZ/T2M, RZ/T2ME group) is 29, the group name will be RZ/T2ME. Otherwise, it will be RZ/T2M.

Quality Grade	
G	Standard

Package (RZ/T2H Group)	
BG	729pin BGA

Package (RZ/T2L Group)	
BG	196pin BGA

Package (RZ/T2M, RZ/T2ME Group)	
BA	225pin BGA
BG	320pin BGA
FA	128pin QFP
FP	176pin QFP

Qualification level	
#ACn	Bulk (Tray)
#BCn	Full Carton (Tray)

Option (RZ/T2H Group)	
04	Cortex-A55 Single-core, non-Secure
08	Cortex-A55 Single-core, Secure
24	Cortex-A55 Dual-core, non-Secure
28	Cortex-A55 Dual-core, Secure
44	Cortex-A55 Quad-core, non-Secure
48	Cortex-A55 Quad-core, Secure

Option (RZ/T2L Group)	
01	Classical CAN, non-EtherCAT, non-Secure
04	CAN-FD, EtherCAT, non-Secure
05	Classical CAN, non-EtherCAT, Secure
08	CAN-FD, EtherCAT, Secure

Option (RZ/T2M,RZ/T2ME Group)			
Single Core		Dual Core	
01	Classical CAN, non-Ether, non-Secure	21	Classical CAN, non-Ether, non-Secure
02	Classical CAN, non-Secure	22	Classical CAN, non-Secure
04	CAN-FD, non-Secure	24	CAN-FD, non-Secure
05	Classical CAN, non-Ether, Secure	26	Classical CAN, Secure
06	Classical CAN, Secure	27	CAN-FD, non-Ether, Secure
08	CAN-FD, Secure	28	CAN-FD, Secure
–	–	29	CAN-FD, Secure, OTFD

Explanation of Orderable Part Numbers

RZ/G Series

(1)	HDMI Support	Quality Grade	Option	Package	Qualification level
R8A774x	x	HA	xx	Bx	#xxn

(2)	Option	Quality Grade	Package	Qualification level
R9A0xG04xx	xx	G	BG	#xxn

(1)	
R8A774A	RZ/G2M Group
R8A774B	RZ/G2N Group
R8A774C	RZ/G2E Group
R8A774E	RZ/G2H Group

HDMI Support	
0	HDMI OFF
1	HDMI ON
2	HDMI OFF
3	HDMI ON

Quality Grade	
G,HA	Standard

(2)	
R9A07G044L	RZ/G2L Group
R9A07G044C	RZ/G2LC Group
R9A07G044U	RZ/G2UL Group
R9A08G045S	RZ/G3S Group
R9A09G047E	RZ/G3E Group
R9A07G043F	RZ/Five Group

Qualification level	
#ACn	Bulk (Tray)
#BCn	Full Carton (Tray)

Option (RZ/G2H, RZ/G2M, RZ/G2N, RZ/G2E Group)	
01	Standard

Package	
BG	BGA

Option (RZ/Five Group)	
00	Non-Secure, 266pins
01	Non-Secure, 361pins
04	Secure, 266pins
05	Secure, 361pins

Option (RZ/G2L, RZ/G2LC, RZ/G2UL Group)			
Single Core		Dual Core +subCPU	
01	Smaller pkg, non-Secure	22	Small pkg, non-Secure
05	Smaller pkg, Secure	23	Reduced-pin, non-Secure
Single Core +subCPU		24	Full-pin pkg, non-Secure
11	Smaller pkg, non-Secure	26	Small pkg, Secure
15	Smaller pkg, Secure	27	Reduced-pin, Secure
–	–	28	Full-pin pkg, Secure

Option (RZ/G3E Group)			
Dual Core +subCPU		Quad Core +subCPU	
27	15×15mm package, Secure	47	15×15mm package, Secure
28	21×21mm package, Secure	48	21×21mm package, Secure
37	15×15mm package, NPU, Secure	57	15×15mm package, NPU, Secure
38	21×21mm package, NPU, Secure	58	21×21mm package, NPU, Secure

Option (RZ/G3S Group)			
Dual Core +subCPU		Quad Core +subCPU	
11	Non-Secure,1× Cortex-M33,13mm BGA	31	Non-Secure,1× Cortex-M33,13mm BGA
13	Non-Secure, PCIe,1× Cortex-M33,14mm BGA	33	Non-Secure,PCIe,1× Cortex-M33,14mm BGA
15	Secure,1× Cortex-M33,13mm BGA	35	Secure,1× Cortex-M33,13mm BGA
17	Secure, PCIe,1× Cortex-M33,14mm BGA	37	Secure,PCIe,1× Cortex-M33,14mm BGA

Explanation of Orderable Part Numbers

RZ/A Series

(1)	Pin count	Temperature	Quality Grade	Package	Qualification level
R7S7210x	x	V	x	xx	#xxn

(2)	Pin count, Secure	Temperature	Quality Grade	Package	Qualification level
R7S9210x	x	V	x	BG	#xxn

(3)	Option	Quality Grade	Package	Qualification level
R9A07G06xx	xx	G	BG	#xxn

(1)	
R7S72100	RZ/A1H Group (10MB)
R7S72101	RZ/A1M Group (5MB)
R7S72102	RZ/A1L Group (3MB)
R7S72103	RZ/A1LU Group (3MB), RZ/A1LC Group (2MB)

(2)	
R7S92104	RZ/A2M Group: (4MB), without DRP
R7S92105	RZ/A2M Group: (4MB), with DRP

(3)	
R9A07G063U	RZ/A3UL Group
R9A07G066M	RZ/A3M Group

Option (RZ/A3M Group)	
04	Built-in DDR 128MB

Option (RZ/A3UL Group)	
02	DDR I/F

Package, Pin count, Pin pitch (RZ/A2M Group)			
BG	BGA	176pin	0.8mm
BG	BGA	256pin	0.5mm
BG	BGA	272pin	0.8mm
BG	BGA	324pin	0.8mm

Package, Pin count, Pin pitch (RZ/A1M,RZ/A1H Group)			
FP	QFP	256pin	0.4mm
BG	BGA	324pin	0.8mm
BG	BGA	256pin	0.5mm

Quality Grade	
L	High quality
G	Standard
C	Standard

Temperature	
V	-40°C to 85°C

Qualification level (RZ/A2M, RZ/A3M,RZ/A3UL Group)	
#ACn	Bulk (Tray)
#BCn	Full Carton (Tray)

Qualification level, Material (RZ/A1H, RZ/A1M, RZ/A1L, RZ/A1LU, RZ/A1LC Group)		
#Aan	Bulk (Tray)	Sn (Tin) only
#ACn	Bulk (Tray)	SnCu and others

Package (RZ/A3M,RZ/Z3UL Group)	
BG	BGA

Package, Pin count, Pin pitch (RZ/A1LU RZ/A1LC Group)			
FP	QFP	176pin	0.5mm
FP	QFP	208pin	0.5mm
BG	BGA	176pin	0.5mm
BG	BGA	233pin	0.8mm

Package, Pin count, Pin pitch (RZ/A1L Group)			
FP	QFP	176pin	0.5mm
FP	QFP	208pin	0.5mm
BG	BGA	176pin	0.5mm

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