Next Generation High Performance Solutions
RZ Embedded Microprocessors
The RZ Family

**Embedded Microprocessors**

The RZ is a new family of embedded microprocessors that retains the ease-of-use of Renesas microprocessors (MPUs) while combining Renesas’ proprietary technologies with the ARM® ecosystem, fusing control and information technology (IT) to provide the solutions necessary for the smart society of the future.

**RZ Family Roadmap**

All aspects of everyday life, such as home appliances, industrial equipment, building management, power grid, and transportation, are becoming more technologically advanced, and the emergence of a smart society interconnected through the cloud is nigh. To meet the demands of this smart society, microprocessors are required to have IT networking capability, human machine interface display capability, faster data processing capability, and so on in addition to providing high performance and power saving control for devices. It was in this environment that the RZ Family was developed as a new lineup of high-end embedded microprocessors that employ an ARM® core.
The RZ/A family extends the SuperH (SH726x) based family including the peripheral functions for driving a display and providing a scalable solution from the lowest performance SH2A based devices up to the 400 MHz ARM® Cortex-A9 solutions.

Key Features of the RZ/A Family

- **Up to 10 MB on-chip large-capacity RAM for low system cost and higher performance**
  - The 10 MB on-chip RAM enables image data for two screens of WXGA size image display to be saved as a frame buffer. It also makes this the device with the largest SRAM in the world.
  - The 10 MB of SRAM allows designers to build a system without any external RAM, and offers a significantly decreased system cost.

- **400 MHz MCU core with advanced bus structure to increase performance**
  - RAM block is split into 5 separate blocks with a multilayer bus to ensure the CPU can fetch code and write data as well as the LCD controller accessing the RAM concurrently.
  - This removes the significant bottleneck of current day HMI systems.

- **Up to WXGA screen size supported with OpenVG hardware acceleration**
  - The device features a dedicated LCD controller able to support 4 layer overlay and drive up to two WXGA screens concurrently.
  - An OpenVG 2D graphics engine is also included in order to support vector graphics operations.

- **Boot and Execute from QSPI**
  - No need for NOR flash, which can be replaced by cheaper QSPI flash.
  - Execute in place supports running code directly from the external serial flash.
## RZ/A System Diagram

### Interfaces
- **USB 2.0**
- **HDD**
- **SD/MMC I/F**
- **External Bus**
- **SPI-Multi I/O**
- **Camera**

### RZ/A Product Table

<table>
<thead>
<tr>
<th>Device</th>
<th>Memory</th>
<th>Interfaces</th>
<th>Timers &amp; Other Peripherals</th>
<th>Miscellaneous Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>Nickname</td>
<td>Part Number</td>
<td>RAM (B [fC])</td>
<td>SPI/SPIUARTs/FIC</td>
</tr>
<tr>
<td>RZ/A-H</td>
<td>RZ721000VLFP</td>
<td>GFF256</td>
<td>10 MB SRAM</td>
<td>5ch/8ch/4ch</td>
</tr>
<tr>
<td>RZ721000VFPP</td>
<td>GFF256</td>
<td>10 MB SRAM</td>
<td>5ch/8ch/4ch</td>
<td>2ch</td>
</tr>
<tr>
<td>RZ721001VLBP</td>
<td>GBA324</td>
<td>4ch/5ch/4ch</td>
<td>2ch</td>
<td>5ch</td>
</tr>
<tr>
<td>RZ721001VBP</td>
<td>GBA324</td>
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<td>2ch</td>
<td>5ch</td>
</tr>
<tr>
<td>RZ721000VCBG</td>
<td>GBA326</td>
<td>4ch/5ch/4ch</td>
<td>2ch</td>
<td>5ch</td>
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<tr>
<td>RZ721000VCBG</td>
<td>GBA326</td>
<td>4ch/5ch/4ch</td>
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<td>5ch</td>
</tr>
<tr>
<td>RZ721000VLFP</td>
<td>GFF256</td>
<td>5 MB SRAM</td>
<td>5ch/8ch/4ch</td>
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</tr>
<tr>
<td>RZ721000VFPP</td>
<td>GFF256</td>
<td>5 MB SRAM</td>
<td>5ch/8ch/4ch</td>
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<td>5ch/8ch/4ch</td>
<td>2ch</td>
<td>5ch</td>
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<tr>
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<td>GBA324</td>
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<td>5ch</td>
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<td>RZ721000VCBG</td>
<td>GBA326</td>
<td>5ch/8ch/4ch</td>
<td>2ch</td>
<td>5ch</td>
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<tr>
<td>RZ721000VCBG</td>
<td>GBA326</td>
<td>5ch/8ch/4ch</td>
<td>2ch</td>
<td>5ch</td>
</tr>
</tbody>
</table>

*Others Features: OpenVG, PAL/NTSC, RTC, SDHC, optional security module

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**Notes:**
- RZ/A-H: High-performance variant
- RZ/A-M: Medium-performance variant
- RZ/A-L: Low-performance variant
- RAM: Memory available in different capacities
- USB: USB 2.0 support
- SPI: Serial Peripheral Interface
- CAN: Controller Area Network
- USB: Universal Serial Bus
- Ethernet: Ethernet support
- HDMI: High-Definition Multimedia Interface
- SD/MMC: Secure Digital/Multimedia Card
- I/F: Interface compatibility
- Camera: Camera support
- Display: Display support
- Memory: Memory types supported
- SPI-Multi: SPI multi-channel support
- IO: I/O expansion options
- External: External hardware peripherals
- Reduce: Reduction in external components
- Reduce display controller: Reduction in display controller usage

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**Sources:**
- www.renesas.eu
The RZ/A1-H Series

RZ/A1-H in Detail

High Efficient 32-bit CPU Core (Cortex A9®)
• 400 MHz CPU Clock Frequency

Single and Double Floating Point Unit Compliant with IEEE754
• Accelerates e.g. trigonometric operations like rotation

High-Density up to 10 MByte Internal RAM
• Parallel bus structure dedicated to SRAM

2D-Graphics Engine OpenVG 1.1
• Full support for Khronos OpenVG 1.1 API
• Rendering, Animation and Acceleration
  OpenVG w/o CPU

Support for Booting from QSPI Flash Memory and NAND Flash Memory
• New Approach lot of SRAM instead of FLASH
• External SPI serial flash is extremely cheap compared to on-chip flash
• Execute in place

LCD Controller WXGA (1024 x 768) with 24-bit interface
• 4 layer overlay
• 2ch video input, 2ch display out with 1ch LVDS
• Dot and window Alpha Blending
• Chroma Keying

Bus Interface Controller for glueless Connection of
• SRAM, SDRAM, NOR, NAND, eMMC, Flash Memory
• 128 KB L2 cache

10/100 EtherMAC 1ch

2ch USB 2.0 Host and Function Controller with integrated USB Transceiver

Up to 5 CAN Channels

Package
• 256-pin BGA (0.5 mm)/256-pin QFP (0.4mm)/324-pin BGA (0.8 mm)
The RZ/A1-M Series

RZ/A1-M in Detail

High Efficient 32-Bit CPU Core (Cortex A9®)
- 400 MHz CPU Clock Frequency

Single and Double Floating Point Unit Compliant with IEEE754
- Accelerates e.g. trigonometric operations like rotation

High-Density up to 5 MByte Internal RAM
Parallel bus structure dedicated to SRAM

2D-Graphics Engine OpenVG 1.1
- Full support for Khronos OpenVG 1.1 API
- Rendering, Animation and Acceleration
OpenVG w/o CPU

Support for Booting from QSPI Flash Memory and NAND Flash Memory
- New Approach lot of SRAM instead of FLASH
- External SPI serial flash is extremely cheap compared to on-chip flash
- Execute in place

LCD Controller WXGA (1024 x 768) with 24-bit Interface
- 4 layer overlay
- 2ch video input, 2ch display out with 1ch LVDS
- Dot and window Alpha Blending
- Chroma Keying

Bus Interface Controller for glueless Connection of
- SRAM, SDRAM, NOR, NAND, eMMC, Flash Memory
- 128 KB L2 cache

10/100 EtherMAC 1ch

2ch USB 2.0 Host and Function Controller with integrated USB Transceiver

Up to 5 CAN Channels

Package
- 256-pin BGA (0.5 mm)/256-pin QFP (0.4 mm)/324-pin BGA (0.8 mm)

Block Diagram RZ/A1-M
The RZ/A1-L Series

RZ/A1-L in Detail

High Efficient 32-bit CPU Core (Cortex A9®)
• 400 MHz CPU Clock Frequency

Single and Double Floating Point Unit Compliant with IEEE754
• Accelerates e.g. trigonometric operations like rotation

High-Density up to 3 MByte Internal RAM
• Parallel bus structure dedicated to SRAM

Support for Booting from QSPI Flash Memory
• New Approach lot of SRAM instead of FLASH
• External SPI serial flash is extremely cheap compared to on-chip flash
• Execute in place

LCD Controller WXGA (1024 x 768) with 24-bit Interface
• 3 layer overlay
• 1ch video input, 1ch display out
• Dot and window Alpha Blending
• Chroma Keying

Bus Interface Controller for glueless Connection of
• SRAM, SDRAM, NOR, eMMC, Flash Memory
• 128 KB L2 cache

10/100 EtherMAC 1ch

2ch USB 2.0 Host and Function Controller with integrated USB Transceiver

Up to 2 CAN Channels

Package
• 176-pin QFP (0.5 mm)/176-pin BGA (0.5 mm)/208-pin QFP (0.5 mm)

RZ/A1-H/-M/-L Package Selection

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>176-pin BGA</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>0.5 mm pitch</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>8 mm x 8 mm (Non Auto Grade)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
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</table>

Block Diagram RZ/A1-L
Renesas Starter Kit (RSK)

Speed your time to market with the Renesas Starter Kit. The kit includes everything you will need to start your development.

The kit includes:
- WVGA touch panel for HMI development
- Segger JTAG-lite debugger
- Embedded IDE and compiler with evaluation licence
- Sample code peripheral drivers

<table>
<thead>
<tr>
<th>Part Number</th>
<th>TFT Display</th>
<th>Debugger</th>
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<tbody>
<tr>
<td>YR0K77210S001BE</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>YR0K77210S002BE</td>
<td>Yes</td>
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<tr>
<td>YR0K77210S003BE</td>
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</table>

RZ Eco-System

A wide range of operating systems, tools, IDEs and software are available for the RZ/A from both Renesas and partners.

Tools & IDE

- Renesas
- IAR Systems
- ARM

HMI-GUI Partners

- altia
- expresslogic
- TES Electronic Solutions
- SEgger
- Micrium
- IS2T

RTOS Partners

- Micrium
- SEgger
- SCIOPTA
- ThreadX
The RZ/T Family complements the already strong portfolio aimed at the factory automation market. The family includes a peripheral set taken from the SH and RX family of products to provide a migration path for motor control solutions from the low end up to a 600 MHz ARM Cortex-R4® solution.

**Introduction**

**Key Features of the RZ/T Family**

**High-Speed Realtime Performance**
- Cortex R4F®@ 450 MHz or 600 MHz
- Single/Double precision FPU
- Tightly Coupled Memory (TMC) : 512 K + 32 K allowing for fast single-cycle operation
- Scalable options
  - Single Core
  - R-IN32 engine

**Highly Integrated Peripherals**
- Compatible peripherals with SuperH and RX MCUs
- Supports SPI flash for reduced board area
- External SDRAM interface
- CAN 2ch, I2C 2ch
- USB2.0 (HS) Host/Peripheral 1ch
- 100 Mbps EtherMAC with 2-port switch

**Industrial Standard Support**
- Several Industrial Ethernet standards including EtherCAT
- Safety Control (ECC RAM, CRC, Clock Monitor, etc)

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**RZ/T Roadmap**

**Industrial Network ASSP**

**General Purpose MCU**

**Standard Ethernet Support**
**RZ/T System Diagram**

- Ethernet
- CAN
- USB
- ARM Cortex-R4™

**RZ/T Product Table**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Main CPU</th>
<th>Sub CPU / R-IN Engine</th>
<th>TCM for Cortex-R4™</th>
<th>Extended Internal RAM</th>
<th>EtherCAT Slave</th>
<th>Encoder I/F</th>
<th>Security Module</th>
<th>Package</th>
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<tbody>
<tr>
<td>RZS910001</td>
<td>450 MHz</td>
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<td>512 KB (ATCM) + 32 KB (BTCM)</td>
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<td>512 KB (ATCM) + 32 KB (BTCM)</td>
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<td>RZS910007</td>
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<td>512 KB (ATCM) + 32 KB (BTCM)</td>
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<td>512 KB (ATCM) + 32 KB (BTCM)</td>
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<td>–</td>
<td>–</td>
<td>Yes 320BGA</td>
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</table>
RZ/T1-R Features & Block Diagram

**High Performance CPU (ARM Cortex-R4F®)**
- Max. operating frequency: 600 MHz
- High-speed real-time response
- Single/Double precision FPU

**Network Controller (R-IN Engine)**
- HW-RTOS: High-speed operation with the basic function of the RTOS (ITRON) in hardware
- Ethernet based communication accelerator

**Power Supply Voltage**
- 1.2 V, 3.3 V

**On-chip Memory**
- Tightly Coupled RAM 512 KB + 32KB /w/ECC (Cortex-R4F®)
- Optional additional RAM 1 MB w/ECC

**Features**
- EtherCAT slave controller
- Ethernet Accelerator
- Encoder I/F (Endat2.2/BiSS-B/BiSS-C)
- PWM timer: MTU3a, GPT
- High-speed USB
- Secure boot

**Features**
- Safety Control
  - ECC RAM supported
  - CRC (32-bit)
  - Independent WDT with dedicated on-chip oscillator
- \( \Delta \Sigma \) Interface

**Package**
- FBGA 320-pin (17 x 17 mm, 0.8 mm pitch)

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RZ/T1 Single Core Features & Block Diagram

**High Performance CPU (ARM Cortex-R4F®)**
- Max. operating freq: 450/600 MHz
- High-speed real-time response
- Single/Double precision FPU

**Power Supply Voltage**
- 1.2 V, 3.3 V

**On-chip Memory**
- Tightly Coupled RAM 512 KB + 32KB /w/ECC (Cortex-R4F®)
- Optional additional RAM 1 MB w/ECC

**Features**
- Ethernet Accelerator
- PWM timer: MTU3a, GPT
- High-speed USB
- Secure boot
- Safety Control
  - ECC RAM supported
  - CRC (32-bit)
  - Independent WDT with dedicated on-chip oscillator
- \( \Delta \Sigma \) Interface

**Package**
- FBGA 320-pin (17 x 17 mm, 0.8 mm pitch)
- QFP 176-pin (20 x 20 mm, 0.4 mm pitch)
Renesas Starter Kit (RSK)

The RZ/T Family will be supported by the industry leading tool chain our RSK (Renesas Starter Kit) giving access to all pins, peripherals and including:

- RSK board
- Segger JTAG-lite debugger
- Embedded IDE and compiler with evaluation licence
- Sample code peripheral drivers

This is the ideal starting point for any development for your motor control.

Order Code: RTK7910017S00000BE