RZ/A1 Embedded ARM® Microprocessors
The Right Choice for HMI Designs
The RZ Family of ARM-based High-Performance MPUs
Innovative Architecture & Advanced Integration

Renesas RZ/A1 series microprocessors (MPUs) offer an innovative architecture based on the ARM Cortex®-A9 processor and up to an industry-leading 10MB of on-chip memory. RZ/A1 MPUs can execute code at 1000 DMIPS from the abundant on-chip memory or in-place from inexpensive QSPI memory, while using on-chip memory for graphics buffering up to WXGA (1280x800) resolution. The 128-bit wide internal memory bus with x4 parallel access enables higher-throughput memory access as compared to systems with external DDR memory. The RZ/A1 series offers enormous advantages in terms of BOM cost, performance, power consumption, and system design time, making it the right choice for HMI (Human Machine Interface) and other system-on-chip applications.

- Remove the need for external DRAM
- Execute code from on-chip RAM or in-place from inexpensive serial flash memory
- Choose from three sizes of on-chip RAM: 3MB (RZ/A1L), 5MB (RZ/A1M), and 10MB (RZ/A1H)
- Match system peripheral requirements to three device variants to reduce BOM cost
- Implement up to two independent LCD displays with WXGA (1280x800) resolution for impressive graphical user interfaces

Renesas RZ/A1 solution streamlines board design and reduces BOM cost

<table>
<thead>
<tr>
<th>BOM Component</th>
<th>Conventional Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash</td>
<td>$$$ (NOR Flash)</td>
</tr>
<tr>
<td>RAM</td>
<td>$$$ (DDR2)</td>
</tr>
<tr>
<td>Regulators</td>
<td>$$$ (5-7 PMIC channels)</td>
</tr>
<tr>
<td>PCB layers</td>
<td>$$$ (DDR2 supplies, routing)</td>
</tr>
<tr>
<td>Total BOM cost</td>
<td>$$$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BOM Component</th>
<th>RZ/A1 Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash</td>
<td>$ (SPI Flash)</td>
</tr>
<tr>
<td>RAM</td>
<td>n/a (internal)</td>
</tr>
<tr>
<td>Regulators</td>
<td>$ (3.3V, 1.2V regulator)</td>
</tr>
<tr>
<td>PCB layers</td>
<td>$ (as few as two)</td>
</tr>
<tr>
<td>Total BOM cost</td>
<td>$</td>
</tr>
</tbody>
</table>
Create Superior HMI Designs with Fewer Components

On-chip functions provided by RZ/A1 MPUs reduce BOM cost, save board space and minimize integration tasks. Typical applications like the one shown below take advantage of a rich portfolio of intellectual property from Renesas and can utilize a range of built-in peripherals, including: CMOS camera interface, JPEG Codec Unit, 12-bit ADC, and OpenVG 2D graphics engine, among others.

**Features**

- Up to 10MB on-chip RAM
  - For code execution/data buffering
- 128-bit memory bus
  - With parallel (x4) access to deliver superior memory throughput
- Execute-In-Place (XIP) from inexpensive QSPI memory
  - With three layers of cache
- LCD controller to drive up to two independent WXGA displays
  - For vivid displays

**Benefits**

- Lower BOM Cost
  - No external SDRAM or LCD controller
  - Simpler voltage regulators
  - Reduced PCB layers
- Increased Performance
  - 1000 DMIPS at 400MHz
  - 6x throughput of 333MHz 16-bit DDR2
- Decreased Power Consumption
  - Fewer board components
  - No copying of code from flash to RAM
- Accelerate Time to Market
  - Simpler PCB design
  - Decreased EMI via reduced switching
  - No DDR procurement issues

One RZ/A1 MPU can accommodate entire software stack (libraries, operating system and application code) plus graphics frame buffer.

**RZ/A1 Series System Diagram**

Build full-featured HMI solutions with digital audio and WXGA (1280x800) resolution using a single RZ/A1 MPU and SPI Flash.
RZ/A1L MPUs

Ideal Solutions for Cost-Sensitive Designs (up to WSVGA Resolution)

- Buffer up to WSVGA (1024x600) images in internal memory
- Accelerate multimedia processing with ARM NEON™ SIMD (Single Instruction, Multiple Data) engine
- Connect to single LCD display

Highly Efficient 32-bit CPU Core (ARM Cortex-A9)

- 1000 DMIPS performance at 400MHz
- ARM NEON multimedia engine
- Boots from parallel or serial flash

3MB Internal RAM

- Use as large data buffer or to run system from internal memory
- Employs parallel bus structure dedicated to SRAM to speed processing

Execute-In-Place Operation from QSPI Flash

- Take full advantage of cost-effective external serial flash
- Simplifies program execution

Single- and Double-Precision Floating Point Unit, IEEE754 Compliant

- Accelerates trigonometric operations such as scaling and rotation

LCD Controller with 24-bit RGB Interface

- Handles 3-layer overlays
- Provides 1-ch video input, 1-ch display output
- Implements alpha blending
- Supports chroma keying

Bus Interface Controller

- Directly connects to SRAM, SDRAM, and flash (NOR, NAND, eMMC), as well as 128KB L2 cache

Multiple Network Connectivity Interfaces

- Integrates 10/100 EtherMAC controller (1 ch.)
- Includes USB 2.0 host and function controller with integrated USB transceiver (2 ch.)
- Offers up to 2 CAN channels

Three Package Options

- 208-pin QFP (0.5mm)
- 176-pin QFP (0.5mm)
- 176-pin BGA (0.5mm)
RZ/A1H and RZ/A1M MPUs

Best Choices for Higher-End HMI Designs (up to WXGA Resolution)

- Buffer up to two independent WXGA (1280x800) images with a single RZ/A1H MPU chip
- Buffer up to two WSVGA (1024x600) images or a single WXGA (1280x800) image with one RZ/A1M chip
- Utilize the on-chip OpenVG graphics engine for impressive 2D graphics acceleration
- Connect to one or two independent LCD displays
- Exploit additional peripherals, including: NAND Flash interface, JPEG Codec Unit, IMR engine, sound generator, NTSC/PAL decoder for video, and PWM timer

Highly Efficient 32-bit CPU Core (ARM Cortex-A9)
- 1000 DMIPS performance at 400MHz
- ARM NEON multimedia engine
- Boots from parallel or serial flash

10MB (RZ/A1H) and 5MB (RZ/A1M) Internal RAM
- Use as large data buffer or to run system from internal memory
- Employs parallel bus structure dedicated to SRAM to speed processing

Execute-In-Place Operation from QSPI Flash
- Take full advantage of cost-effective external serial flash
- Simplifies program execution

Single- and Double-Precision Floating Point Unit, IEEE754 Compliant
- Accelerates trigonometric operations such as scaling and rotation

2D-Graphics Engine with OpenVG 1.1 Capability
- Fully supports the Khronos™ OpenVG 1.1 API
- Offloads CPU for rendering, animation and video acceleration operations

LCD Controller with 24-bit RGB and 16-bit LVDS Interfaces
- Handles 4-layer overlays
- Provides 2-ch video input, 2-ch display output with 1-ch of LVDS
- Implements alpha blending
- Supports chroma keying

Bus Interface Controller
- Directly connects to SRAM, SDRAM, and flash (NOR, NAND, eMMC), as well as 128KB L2 cache

Multiple Network Connectivity Interfaces
- Integrates 10/100 EtherMAC controller (1 ch.)
- Includes USB 2.0 host and function controller with integrated USB transceiver (2 ch.)
- Offers up to 5 CAN channels

Three Package Options
- 324-pin BGA (0.8mm)
- 256-pin QFP (0.4mm)
- 256-pin BGA (0.5mm)
## Renesas RZ/A1 Device Selector

<table>
<thead>
<tr>
<th>Core Group</th>
<th>Part Number</th>
<th>Clock Speed</th>
<th>RAM</th>
<th>SPI / UARTs / I2C</th>
<th>CAN</th>
<th>USB</th>
<th>Ethernet</th>
<th>Timer Channels</th>
<th>PWM Outputs</th>
<th>A/D / D/A Converter</th>
<th>DMA</th>
<th>Supply Voltage</th>
<th>Packages / Pins</th>
<th>Other Features</th>
</tr>
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<tbody>
<tr>
<td>RZ/A1H</td>
<td>R7S721000VLFP</td>
<td>400 MHz</td>
<td>10MB SRAM</td>
<td>5 ch / 8 ch / 4 ch</td>
<td>5 ch</td>
<td>2 ch</td>
<td>1 ch</td>
<td>1 ch / 5 ch / 2 ch</td>
<td>Yes</td>
<td>up to 2 ch WXGA (1280 x 800)</td>
<td>8 ch x 12-bit / –</td>
<td>16 ch</td>
<td>3.3V + 1.18V</td>
<td>QFP256</td>
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<td>5MB SRAM</td>
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<td>5 ch</td>
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<td>1 ch</td>
<td>1 ch / 5 ch / 2 ch</td>
<td>Yes</td>
<td>up to 2 ch WXGA (1280 x 800)</td>
<td>8 ch x 12-bit / –</td>
<td>16 ch</td>
<td>3.3V + 1.18V</td>
<td>QFP256</td>
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### Renesas RZ/A1 Packaging Options

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<tr>
<th>Model</th>
<th>176-pin BGA 0.5 mm pitch 8 mm x 8 mm</th>
<th>176-pin QFP 0.5 mm pitch 24 mm x 24 mm</th>
<th>208-pin QFP 0.5 mm pitch 28 mm x 28 mm</th>
<th>256-pin BGA 0.5 mm pitch 11 mm x 11 mm</th>
<th>256-pin QFP 0.4 mm pitch 28 mm x 28 mm</th>
<th>324-pin BGA 0.8 mm pitch 19 mm x 19 mm</th>
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<tbody>
<tr>
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<td>✔</td>
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<tr>
<td>RZ/A1M</td>
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<td>✔</td>
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<td>✔</td>
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### Renesas RZ/A1 Series Starter Kits

Shorten product development cycles with the Renesas Starter Kit (RSK). The RZ/A1 kit includes everything you need to jump-start your system development and ease the design and debug process.

**The kit includes:**
- 1024x800 touch panel for HMI development (optional)
- Segger JTAG-lite debugger
- Embedded IDE and compiler with evaluation license
- Sample code and peripheral drivers

<table>
<thead>
<tr>
<th>Part Number</th>
<th>TFT Display</th>
<th>Debugger</th>
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</thead>
<tbody>
<tr>
<td>YR0K77210S001BE</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>YR0K77210S003BE</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### IAR Embedded Workbench®
- Integrated development environment and optimized C++ compiler for RZ MPUs
- Project management tools and editor
- Configuration files for all RZ devices
- Emulator debugger support
- Run-time libraries

### ARM
- The ARM DS-5® Development Studio, Renesas RZ Edition, is a complete software development environment for systems that use RZ/A1 MPUs.
- This IDE provides the DS-5’s code editor, compiler, debugger and performance analyzer. These tools seamlessly generate, debug and optimize code for the powerful ARM Cortex-A9 CPU built into RZ/A1 series chips.

### Renesas e² studio
- Based on the popular Eclipse open-source environment
- Complete IDE supports IAR and free GNU compilers
- Powerful project management
- Download free at: am.renesas.com/e2studio

### Green Hills Software
- Green Hills Software supports Renesas RZ/A1 MPUs with its MULTI® IDE, C/C++ optimizing compilers, Probe debugger, and many other development tools. These products let system engineers generate fast, compact code, quickly find and fix bugs, and make sense of complex systems.

### RTOS

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<thead>
<tr>
<th>expresslogic</th>
<th>Micrium</th>
<th>FreeRTOS</th>
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<tbody>
<tr>
<td>ThreadX®</td>
<td>μC/OS-III®</td>
<td>FreeRTOS</td>
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<table>
<thead>
<tr>
<th>KEIL</th>
<th>Linux</th>
<th>embOS®</th>
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<tbody>
<tr>
<td>RTX</td>
<td>Linux BSP</td>
<td>embOS®</td>
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<tr>
<td><a href="http://www.keil.com">www.keil.com</a></td>
<td>oss.renesas.com</td>
<td><a href="http://www.segger.com">www.segger.com</a></td>
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</table>

### Graphics Packages

<table>
<thead>
<tr>
<th>expresslogic</th>
<th>Serious</th>
<th>Segger</th>
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<tbody>
<tr>
<td>GUIX™</td>
<td>SHIPTide</td>
<td>emWin™</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Crank software inc.</th>
<th>IS2T</th>
<th>Segger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crank Storyboard™ Suite</td>
<td>MicroEJ®</td>
<td>DeepScreen®</td>
</tr>
<tr>
<td><a href="http://www.cranksoftware.com">www.cranksoftware.com</a></td>
<td><a href="http://www.is2t.com">www.is2t.com</a></td>
<td><a href="http://www.altia.com">www.altia.com</a></td>
</tr>
</tbody>
</table>
Get on the RZ Express!

Fast track your next Renesas RZ/A1 design with Express Logic ThreadX® RTOS, middleware stack and more at no cost to you!

Renesas and Express Logic have teamed up to bring you the RZ Express promotion! This is a chance for qualified production customers of the Renesas RZ/A1 microprocessor (MPU) to apply to receive a single-product license of Express Logic ThreadX® real-time operating system (RTOS) and middleware stack at no cost. Customers who are chosen to receive this valuable single-product license free of charge will also enjoy free software support from Express Logic for 90 days. The RZ Express promotion is available for a limited time, so apply today!

See website for more details on this offer: renesas.com/rzexpress

RZ Express Benefits

- No royalties! No licensing fees!
- Speed your time to revenue with ThreadX by Express Logic
- Differentiate your product with RZ/A1 ARM® Cortex-A9 MPUs by Renesas
- Using the Express Logic RTOS and middleware, including GUIX™, enables designers to quickly and effectively build differentiated HMI solutions on top of the Renesas RZ/A1 hardware platform

Renesas Ecosystem

- The Alliance Partner Program allows you to connect instantly with hundreds of qualified design consulting and contracting professionals. am.renesas.com/Alliance
- A forum and community site to share technical information, questions and opinions with others who use Renesas MCUs and MPUs. www.RenesasRulz.com
- Gain the technical knowledge you need. Evaluate, research and learn at your own pace, where you want, when you want, for free. www.RenesasInteractive.com
- For educators and students. Teach with professional grade tools. Learn MCUs with a modern architecture. www.RenesasUniversity.com
- Customize your data retrieval needs on the Renesas web site. You’ll receive updates on the products you’re interested in. am.renesas.com/MyRenesas
- Software Library – Free SW am.renesas.com/softwarelibrary
- Free Samples am.renesas.com/samples
- Technical Support am.renesas.com/tech_support

For additional information, please visit am.renesas.com/RZA

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