Introducing the Renesas Synergy™ Platform
Introducing Renesas Synergy™

A complete and qualified platform that accelerates embedded development, inspiring innovation and enabling differentiation.
What can Renesas Synergy™ do for you?

Time to Market

Cost of Ownership

Barriers to Entry
Time to Market

Easier development leads to faster time to market and better products. Let’s see how.
Time to Market

Traditional Development

Development Using Renesas Synergy

- Hardware Design
- Driver Software Design
- Middleware Design
- Integration w/ RTOS
- Cloud Connect
- Application Code
- System Test

- H/W Design
- Application Code
- Additional Innovation
- System Test

- Essential System Code
- Differentiated Code
- Product Differentiation

Development Using Renesas Synergy introduces additional innovation in the product differentiation phase compared to traditional development.
Accelerating Time of Entry to Market

Start Application Development Earlier
Focus software development at the API layer freeing up resources to enable product differentiation.

Tuned for Efficiency
Software, MCUs and tools optimized for scalability, performance and ease of development.

Do Business in One Stop
Renesas stands behind the Synergy platform providing one source for all support & quality assurance.
Cost of Ownership

Finding the bottom line. It’s not always just in the numbers. Let’s take a look at how Synergy can save you money.
What is Total Cost of Ownership?

- Purchase
- Acquisition
- Training
- Development
- Integration & Optimization
- Verification & Qualification
- Upgrades & Updates
- Support & Maintenance

MCU

Visible upfront costs

Often underestimated costs
Reducing Total Cost of Ownership

Save Cost the Smart Way
Simple business and risk justification for your “Build or Buy” embedded platform decision.

Minimize Your Risk
A reliable platform with qualified software and low upfront investment reduces unanticipated risks.

Stay on the Cutting Edge
A complete embedded system platform that will continue to grow and support the latest industrial technologies.
Barriers to Entry

Getting started. That can be a pretty daunting task. Synergy breaks through some common obstacles to make it easier and less costly than you might think.
Lowering Barriers to Entry

**Development with No Upfront Cost**
A simple sign up gains unrestricted access to all platform components and support.

**Accelerated Development**
Programming application code is easier - e² studio ISDE guides every step of project development.

**Kits to Start & Expand**
Wide range of kits to explore technology, begin developing and learn how to implement solutions.
## Renesas Synergy™ Platform Elements Summary

<table>
<thead>
<tr>
<th>Software</th>
<th>Microcontrollers</th>
<th>Tools &amp; Kits</th>
<th>Solutions</th>
<th>Gallery</th>
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</thead>
<tbody>
<tr>
<td>- Qualified Renesas Synergy Software Package (SSP) for guaranteed operation</td>
<td>- Wide MCU spectrum based on 32bit ARM® Cortex®-M CPU cores</td>
<td>- Integrated Solution Development Environment (ISDE) with context-aware documentation</td>
<td>- Product Example (PE) kits: Complete design journeys representative of end-product designs</td>
<td>- Web access to Renesas Synergy specific software, tools, licensing plus 3rd pty software &amp; services</td>
</tr>
<tr>
<td>- Complete package fully integrated and maintained</td>
<td>- Completely scalable and pin compatible</td>
<td>- Starter Kits (SK) and Development Kits (DK) for immediate access to entire software package</td>
<td>- Application Example (AE) kits: Technology building-block examples to build upon</td>
<td>- Future growth to complete secure cloud access infrastructure for end-products to use</td>
</tr>
<tr>
<td>- Applications can be written at the package API level</td>
<td>- On-chip Flash memory up to 4 MB</td>
<td>- Security &amp; encryption acceleration</td>
<td>- Ultra low power</td>
<td></td>
</tr>
</tbody>
</table>

Click any icon to see more information on each Platform element

Subject to Change
Renesas Synergy™ Software
Renesas Synergy™ Software Package (SSP)
The heart of the platform … and it’s qualified

ThreadX® RTOS
Premium commercial multitasking real time kernel with preemptive scheduling and small memory footprint. Stable heartbeat of the system

Stacks & Middleware
X-Ware™ and Renesas-originated specialized software for TCP/IP, USB, color graphics, file sys, DSP, touch, security, safety and more. Completely optimized and integrated

Software API
Standardized ‘C’ language APIs for X-Ware™, Appl Framework, Middleware, Libraries, DSP, HAL, BSP, and MCU regs. Abstract the dependencies, ensure portability and accelerate product development.

Application Framework
System level services linking RTOS to HAL for inter-process messaging, security services, audio playback, serial comm, power mgmt, JPEG conversion, cap touch, console, more. Saves time

Board Support Package
Customized for every Synergy hardware kit and MCU, easily tailored for end-product

Hardware Abstraction Layer
Efficient low-level drivers for all peripherals and system services. Eliminates need for deep study

Subject to Change
Renesas Synergy™ Multi-Layer API Access

Main Program | USB thread | Network thread | Security thread | Audio thread | Waveform thread | Comms thread | Sensor thread | Display thread | Control thread | Motor thread

Defined API for Use at Many Layers

ThreadX® RTOS

USBX™ Apps

NETX™

Middleware & Function Libraries

Application Framework

More Functions | PWM | UART | ADC

HAL Drivers

More Peripheral Drivers

GPT driver | SCI driver | ADC driver | RSPI driver

Custom driver

BSP

MCU

Subject to Change

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Renesas Synergy™ Microcontrollers
Renesas Synergy™ Microcontrollers

Initial Lineup...

### Technology

- 40-nm and 130-nm processes
- Operating temperature range: -40°C to 105°C
- Flash: 64 KB - 4 MB
- SRAM: 16 KB - 640 KB
- Pin count: 36 - 224
- GPIO pins: Up to 172

### Four Microcontroller Series

<table>
<thead>
<tr>
<th>Series</th>
<th>Core Frequency</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>S7</td>
<td>200 MHz to 300 MHz</td>
<td>ARM® Cortex® M0+ 32 MHz</td>
</tr>
<tr>
<td>S5</td>
<td>100 MHz to 200 MHz</td>
<td>ARM® Cortex® M4 48 MHz</td>
</tr>
<tr>
<td>S3</td>
<td>32 MHz to 100 MHz</td>
<td>ARM® Cortex® M4 100 MHz</td>
</tr>
<tr>
<td>S1</td>
<td>Up to 32 MHz</td>
<td>ARM® Cortex® M4 240 MHz</td>
</tr>
</tbody>
</table>

Subject to Change
## Renesas Synergy™ MCU – Application Coverage

<table>
<thead>
<tr>
<th>Initial Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Purpose and Analog Acquisition</td>
</tr>
</tbody>
</table>

### High Performance
- **S7**
  - 200 MHz to 300 MHz

### High Integration
- **S5**
  - 100 MHz to 200 MHz

### High Efficiency
- **S3**
  - 32 MHz to 100 MHz

### Ultra-Low Power
- **S1**
  - Up to 32 MHz

- **Flash**
  - 64 KB - 4 MB
- **SRAM**
  - 16 KB - 640 KB
- **Pin Count**
  - 36 - 224

Subject to Change
# Renesas Synergy™ MCU S1 Series

## Ultra-Low Power

### Technology

- **Performance**
  - 800 nA (Software Standby Mode)
  - 77 μA/MHz (Bus 7 state)
- **Flash Density**
  - 130-nm low-power process
  - Operating temperature range: -40°C to 105°C
  - GPIO pins: up to 51
  - QFN: 40, 48, 64
  - LQFP: 48, 64
  - LGA: 36

### 32-MHz ARM® Cortex®-M0+ CPU

<table>
<thead>
<tr>
<th>Memory</th>
<th>Analog</th>
<th>Timing &amp; Control</th>
<th>HMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code Flash (128 KB)</td>
<td>14-Bit A/D Converter (18 ch.)</td>
<td>General PWM Timer 32-bit</td>
<td>Capacitive Touch Sensing Unit (32 ch.)</td>
</tr>
<tr>
<td>Data Flash (4 KB)</td>
<td>12-Bit D/A Converter</td>
<td>General PWM Timer 16-bit</td>
<td></td>
</tr>
<tr>
<td>SRAM (16 KB)</td>
<td>Low-Power Analog Comparator x2</td>
<td>Asynchronous General Purpose Timer x2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Temperature Sensor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Connectivity

- **USBFS**
- **CAN**
- **Serial Communications Interface x3**
- **SPI x2**
- **IIC x2**

### System & Power Management

- **Data Transfer Controller**
- **Event Link Controller**
- **Low Power Modes**
- **Multiple Clocks**
- **Port Function Select**
- **RTC**
- **SysTick**

### Safety

- **SRAM Parity Error Check**
- **Flash Area Protection**
- **ADC Diagnostics**
- **Clock Frequency Accuracy Measurement Circuit**
- **Data Operation Circuit**
- **CRC Calculator**
- **Port Output Enable for GPT**
- **IWDT**

### Security & Encryption

- **128-bit Unique ID**
- **TRNG**
- **AES (128/256)**

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Subject to Change
### Renesas Synergy™ MCU S3 Series

**High Efficiency**

#### Technology

**Performance**
- 1.7 μA (Software Standby Mode)
- 329 μA/MHz (Normal mode)

**Flash Density**
- ARM® Cortex® M4
  - 48 MHz
  - 1.6 V-5.5 V

#### 48-MHz ARM® Cortex®-M4 CPU

**Memory**
- Code Flash (1 MB)
- Data Flash (16 KB)
- SRAM (192 KB)
- Flash Cache
- Security MPU
- Memory Mirror Function

**Analog**
- 14-Bit A/D Converter (28 ch.)
- 12-Bit D/A Converter x2
- Low-Power Analog Comparator x2
- High-Speed Analog Comparator x2
- OPAMP x4
- Temperature Sensor

**Timing & Control**
- General PWM Timer 32-bit x10
- Asynchronous General Purpose Timer x2
- WDT

**Connectivity**
- USBFS
- CAN
- SDHI/MMC
- Serial Communications Interface x6
- IrDA Interface
- SPI x2
- IIC x3
- SSI x2
- External Memory Bus

**System & Power Management**
- DMA Controller (4 ch.)
- Data Transfer Controller
- Event Link Controller
- Low Power Modes
- Multiple Clocks
- Port Function Select
- RTC
- SysTick

**Safety**
- ECC in SRAM
- SRAM Parity Error Check
- Flash Area Protection
- ADC Diagnostics
- Clock Frequency Accuracy Measurement Circuit
- CRC Calculator
- Data Operation Circuit
- Port Output Enable for GPT
- IWDT

**Security & Encryption**
- 128-bit Unique ID
- TRNG
- AES (128/256)
- GHASH

#### Connectivity Details
- USBFS
- CAN
- SDHI/MMC
- Serial Communications Interface x6
- IrDA Interface
- SPI x2
- IIC x3
- SSI x2
- External Memory Bus

#### System & Power Management Details
- DMA Controller (4 ch.)
- Data Transfer Controller
- Event Link Controller
- Low Power Modes
- Multiple Clocks
- Port Function Select
- RTC
- SysTick

#### Safety Details
- ECC in SRAM
- SRAM Parity Error Check
- Flash Area Protection
- ADC Diagnostics
- Clock Frequency Accuracy Measurement Circuit
- CRC Calculator
- Data Operation Circuit
- Port Output Enable for GPT
- IWDT

#### Security & Encryption Details
- 128-bit Unique ID
- TRNG
- AES (128/256)
- GHASH

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**Subject to Change**
## Renesas Synergy™ MCU S5 Series

### High Integration

### Technology

<table>
<thead>
<tr>
<th>Performance</th>
<th>Flash Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARM® Cortex® M4 100 MHz - 200 MHz</td>
<td>ARM® Cortex®</td>
</tr>
</tbody>
</table>

### Memory
- Code Flash (up to 2 MB)
- Data Flash (up to 64 KB)
- SRAM (up to 640 KB)
- Flash Cache
- MPUs
- Memory Mirror Function

### Analog
- 12-Bit A/D Converter
- 12-Bit D/A Converter
- High-Speed Analog Comparator
- PGA
- Temperature Sensor

### Connectivity
- Ethernet MAC Controller
- Ethernet DMA Controller
- Ethernet PTP Controller
- USBHS
- USBFS
- CAN
- SDHI
- Serial Communications Interface
- IrDA Interface
- QSPI
- SPI
- IIC
- SSI
- Sampling Rate Converter
- External Memory Bus

### System & Power Management
- DMA Controller
- Data Transfer Controller
- Event Link Controller
- Low Power Modes
- Multiple Clocks
- Port Function Select
- RTC
- SysTick

### Timing & Control
- General PWM Timer 32-Bit
- Enhanced High Resolution
- General PWM Timer 32-Bit
- Asynchronous General Purpose Timer
- WDT

### HMI
- Capacitive Touch Sensing Unit
- Graphics LCD Controller
- 2D Drawing Engine
- JPEG Codec
- Parallel Data Capture Unit

### Safety
- ECC in SRAM
- SRAM Parity Error Check
- Flash Area Protection
- ADC Diagnostics
- Clock Frequency Accuracy Measurement Circuit
- CRC Calculator
- Data Operation Circuit
- Port Output Enable for GPT
- IWDT

### Security & Encryption
- 128-Bit Unique ID
- TRNG
- AES (128/192/256)
- 3DES/ARC4
- RSA/DSA
- SHA1/SHA224/SHA256
- GHASH

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Subject to Change

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Renesas Synergy™ MCU S7 Series

High Performance

Technology

- 4.5 µA (Deep Software Standby Mode)
- 170 µA/MHz (Normal mode)
- 40-nm high-performance process
- Operating temperature range: -40°C to 105°C
- GPIO pins: up to 172
- LOFP: 100, 144, 176
- BGA: 176, 224
- LGA: 145

240-MHz ARM® Cortex®-M4 CPU

<table>
<thead>
<tr>
<th>Memory</th>
<th>Analog</th>
<th>Timing &amp; Control</th>
<th>HMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code Flash (4 MB)</td>
<td>12-Bit A/D Converter x2 (25 ch.)</td>
<td>General PWM Timer 32-bit Enhanced High Resolution x4</td>
<td>Capacitive Touch Sensing Unit (18 ch.)</td>
</tr>
<tr>
<td>Data Flash (64 KB)</td>
<td>12-Bit D/A Converter x2</td>
<td>General PWM Timer 32-bit Enhanced x4</td>
<td>Graphics LCD Controller</td>
</tr>
<tr>
<td>SRAM (640 KB)</td>
<td>High-Speed Analog Comparator x6</td>
<td>General PWM Timer 32-bit x6 Asynchronous General Purpose Timer x2</td>
<td>2D Drawing Engine</td>
</tr>
<tr>
<td>Flash Cache</td>
<td>PGA x6</td>
<td>WDT</td>
<td>JPEG Codec</td>
</tr>
<tr>
<td>Security MPU</td>
<td>Temperature Sensor</td>
<td></td>
<td>Parallel Data Capture</td>
</tr>
<tr>
<td>Memory Mirror Function</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Connectivity

- Ethernet MAC Controller x2
- Ethernet DMA Controller
- Ethernet PTP Controller
- USBHS
- USBFS
- CAN x2
- SDHI/MMC x2
- Serial Communications Interface x10
- IrDA Interface
- QSPI
- SPI x2
- IIC x3
- SSI x2
- Sampling Rate Converter
- External Memory Bus

System & Power Management

- DMA Controller (8 ch.)
- Data Transfer Controller
- Event Link Controller
- Low Power Modes
- Switching Regulator
- Multiple Clocks
- Port Function Select
- RTC
- SysTick

Safety

- ECC in SRAM
- SRAM Parity Error Check
- Flash Area Protection
- ADC Diagnostics
- Clock Frequency Accuracy Measurement Circuit
- CRC Calculator
- Data Operation Circuit
- Port Output Enable for GPT
- IWDT

Security & Encryption

- 128-bit Unique ID
- TRNG
- AES (128/192/256)
- 3DES/ARC4
- RSA/DSA
- SHA1/SHA224/SHA256
- GHASH

Subject to Change
Renesas Synergy™ Tools & Kits
Renesas Synergy™ Software Development Tool - e² studio

IDE
Integrated Development Environment

Renesas Synergy
Solution-oriented components

Renesas Synergy Tools

- Smart Manual
- Config Tools
- SW Pack Manager
- ThreadX® Debug
- Plug-Ins
- Eclipse Framework
- Codan
- Debug
- Compile

ISDE
Integrated Solution Development Environment

Windows PC
Renesas Synergy™ Kits - Initial Lineup

<table>
<thead>
<tr>
<th></th>
<th>Development Kit</th>
<th>Starter Kit</th>
<th>Promotion Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td>Full Synergy Project Prototyping</td>
<td>Synergy Introduction and First Steps</td>
<td>Experience Synergy Platform</td>
</tr>
<tr>
<td><strong>MCU Pin Access</strong></td>
<td>All Pins</td>
<td>Most Pins</td>
<td>Some Pins</td>
</tr>
<tr>
<td><strong>Expandability</strong></td>
<td>Expansion &amp; Pmod Connectors</td>
<td>Arduino &amp; Pmod Connectors</td>
<td>Typically USB</td>
</tr>
<tr>
<td><strong>SSP Qualification Basis</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>BLE Connectivity</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>On-board J-Link Debugger</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Part Number</strong></td>
<td>DK-S7G2, DK-S3A7, DK-S124</td>
<td>SK-S7G3</td>
<td>PK-S124</td>
</tr>
<tr>
<td><strong>Suggested Resale Price</strong></td>
<td>$149 - $299</td>
<td>$29 - $69</td>
<td>Typically No Charge</td>
</tr>
</tbody>
</table>

Subject to Change
Renesas Synergy™ Gallery
Renesas Synergy™ Gallery – A Cloud Based Infrastructure

- User & Company account based access
- Download all Synergy Software and tools
- Distribute Software Add-ons
  - Evaluation version of Verified Software Add-ons
  - Licensed Qualified Software Add-ons
- Manage / Modify SSP Licenses
  - Development and Production License
  - Source License
- Portal for making SSP warranty claims
- Registration is required for content downloads
Conclusion
A Complete Platform

- Professional Software
- Scalable Microcontrollers
- Effortless Tools and Kits
- Showcase Solutions
- Cloud Connection

Software API

**Synergy Software Package (SSP)**

- ThreadX® RTOS
- Stacks Middleware Libraries
- Application Framework
- HAL Drivers
- BSP

**Synergy Microcontrollers**

**Tools & Kits**

**Solutions**

**Synergy Gallery**

Renesas Synergy™ Platform