Renesas is working to realize an attractive future for the automobile. At Renesas, as the No. 1 Supplier of vehicle control microcontrollers and SoC products for the vehicle information field, we are focused on the future of the automobile alongside our customers. We aim to be a provider of total solutions in response to trends such as improved fuel economy through the development of the next generation of fuel-efficient engines, efforts to improve ease of maintenance to help reduce the work required for inspection and maintenance tasks, the realization of higher levels of sophistication and safety in driver assist systems, and the increased use of IT and strong security technology. We offer a wide range of solutions that combine control and IT to help our customers build attractive automobiles with plenty of added value.

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Contributing to a Safe and Secure Driving Experience
That is Friendly to People and the Environment

Solutions for fuel-efficient engines and for hybrid and electric vehicles
As CO₂ and NOx emissions standards become more stringent worldwide, Renesas is providing kit solutions composed of microcontrollers matched with analog and power devices optimized for use in inverters for fuel-efficient engines or hybrid and electric vehicles.

The fusion of sophisticated control operations required by the next generation of fuel-efficient engines with high-precision sensing technology and digital assist technology makes possible the realization of low-loss analog technology that benefits from greater precision and integration. In addition, the physical volume of motor control inverters has been reduced by half.

Enhanced safety

The world’s most advanced microcontrollers for automotive safety applications
Renesas produces the world’s most advanced microcontrollers for automotive safety control applications. They combine four technologies indispensable to motoring safety control in a single product.

Renesas microcontrollers for automotive safety applications are based on cutting-edge flash microcontroller technology and support automatic braking, automatic steering, and automatic attitude control functionality essential for driving safety. These microcontroller products provide world-class support for automotive safety by combining security, sensing, networking, and safety technology.

Incorporation of IT in vehicles

Renesas integrated cockpit
Displaying the necessary information when it’s needed in the cockpit.

The integrated cockpit platform from Renesas is intended to bring together the three concepts of flexibility, scalability, and personalization in both the meter display and vehicle information/infotainment fields.
Here are Our Solutions

**Zero and Low Emissions**
Renesas is helping to realize zero and low emissions by offering optimal solutions for applications of all sorts. Our wide-ranging product lineup extends from microcontrollers that combine enhanced performance and reduced power consumption to analog semiconductor devices and power semiconductor devices.

**Safety and Security**
Even as the number of elderly drivers increases, expectations continue to rise for self-driving vehicles. Making self-driving vehicles a reality will require the ability to determine the vehicle’s position and calculate routes, sophisticated cognitive processing to detect hazards such as preceding vehicles and pedestrians, sensor processing and more advanced human-machine interfaces between driver and vehicle, and automotive systems enabling vehicles to achieve a high level of reliability. In addition, in the near future more sophisticated services that utilize links with external data sources to obtain updates on traffic conditions, the weather, and community information are expected to appear. Renesas offers a lineup of high-performance microcontrollers with large-capacity on-chip RAM and SoC products with integrated image recognition engines, making it possible to bring a new level of safety and convenience to the driving experience.

**Connectivity**
Ensuring the reliability and safety of information conveyed via high-speed data transfer and bidirectional communications requires the use of high-speed cloud computing technology utilizing LTE, etc., as well as security technology. Renesas offers a comprehensive product lineup that includes microcontrollers, analog semiconductor devices, power semiconductor devices, and authentication IC devices (secure microcontrollers). We are contributing to the construction of safe and reliable automotive networks with proven security technology.
RH850 40nm Microcontroller: For the New Age of Automobiles

- Excellent Functional Safety and security features, built on a foundation of high performance and low power consumption
- Scalable architecture to cover systems from the low to the high end
- A fusion of the best features of the proven V850 and SuperH microcontrollers

Low Power Consumption

- For more eco-friendly vehicles
- For enhanced peace of mind
- For more advanced Functional Safety
- For basic to luxury models
- For easy software development

Reduced operating power
- 40nm process for ultrafine circuits and lower power consumption during operation
- Reduced leak power
- Low-leak transistors to cut wasteful power leakage
- Reduced standby power
- Cutoff of power during standby to circuit blocks that are not operating for less wasted power

Multi-core technology

- Low power consumption
- Guaranteed operation at high temperatures
- Multi-core technology
- Fully supported control applications
- Scalability and AUTOSAR support

Multi-core technology cuts power consumption while boosting performance.

Multiple Cores

- For more eco-friendly vehicles
- For enhanced peace of mind
- For more advanced Functional Safety
- For basic to luxury models
- For easy software development

RH850 product y
- CPU
- Memory (Flash/DRAM)
- Timer functions
- Analog functions
- Communication interface, etc.
- Peripheral function components
- Selection of necessary components

RH850 product x
- CPU
- Memory (SRAM)
- Timer
- ADC
- FlexRay/CAN/LIN
- PWM
- LVD
- Selection of necessary components

Integration and Scalability of Peripheral Function IP Modules

- Scalable CPU cores, memory, and peripheral functions enable customers to reuse existing software resources.
  - Basic IP modules (serial, counters, etc.)
    - Offering general-use specifications based on refined versions of existing specifications to maintain compatibility moving forward
  - Differentiated IP modules (timers for engine control and motor control, etc.)
    - Offering more advanced specifications to help customers build more competitive products

Restraining the Increasing Software Development Burden

Scalable CPU cores, memory, and peripheral functions enable customers to reuse existing software resources.

Integration and Scalability of Peripheral Function IP Modules

RH850 product y
- CPU
- Memory (Flash/DRAM)
- Timer functions
- Analog functions
- Communication interface, etc.
- Peripheral function components
- Selection of necessary components

RH850 product x
- CPU
- Memory (SRAM)
- Timer
- ADC
- FlexRay/CAN/LIN
- PWM
- LVD
- Selection of necessary components
Focus on cognitive computing for improved safety and HMI computing leading to fuller utilization of IT in vehicles.

Next-Generation Automotive Computing for the Age of Autonomous Vehicles

Utilizing IT to enhance safety and convenience to make the vehicle more “considerate” of the driver.

HMI computing

Providing a safe and attractive driving environment → Value for the driver

Increasing the value of the vehicle and promoting sales → Value for the carmaker

Renesas is working with partners to develop improved solutions to support our customers’ development efforts.

Technology Roadmap and Increasingly Complex Software Development

Systems are growing more complex as technology requirements advance.

Greater software complexity as applications become more sophisticated

R-Car H3 Platform Solutions

As software grows in complexity, Renesas is working with partners to develop improved solutions to support our customers’ development efforts.

Support from partners and OS vendors backed by compatibility with existing R-Car products

Solution for reduced time to market

Stronger OS support

OEM Makers

Tier1 Makers

Customer application

R-Car H3 system evaluation board

OEM A

OEM B

OEM C

Compatibility with existing R-Car products
Analog and Power Device Technology for Eco-Friendly Vehicles

World-Class BiCD Process (for Automotive Analog Devices)

- Superior low-loss characteristics thanks to cutting-edge BiCD process for automotive analog devices — ideal for automotive control systems
- Extensive track record in the automotive field (powertrain, chassis, brakes, EPS, airbags, etc.)
- World leader in cutting-edge BiCD process technology
- Digital assist technology for more ultrafine and high-performance analog circuits

Automotive IGBTs

Renesas offers high-performance IGBT technology to meet demand for electric-powered systems.

Automotive Power MOSFETs

Renesas offers MOSFETs with ultralow on-resistance to accommodate more compact ECUs that must handle higher power levels.

Automotive PMIC (ASSP) Product Roadmap

- MCU: V850
- MH: RH850
- Next Gen. MCU

Multi Power Rails

- RAA21000G5T for Powertrain & Green Car MCU (RH850/E1x & C1x)
- 40QFP (9x9)*
- Programmed Rails
- Improved EMC
- 90 nm BiCD for Automotive Analog Applications

Single Power Rail

- RAA21000G5P for Chassis & Safety MCU (V850/PX4)
- 52QFN (8x8)*
- Peripheral Integration
- Functional Safety support
- Programmable Rails
- Under planning
- Under development (Sample Available)

On-Resistance Index

Nch 100V

UMOS3

ANM2

48V battery system

Process development

ANM1

Nch 40V

ANL2

ANL3

ANL4

12V system

Process development

Competitor A

Competitor B

AE2

FS type*

AE3

Adv. FS type

AE4

Fine cell FS type

Switching loss when on

High Performance

Steady-state loss when on

Development Start

WS Timing

SOP Timing

Process development

Development Start

WS Timing

SOP Timing

Process development

In Production

In mass Production

Under development (Sample Available)

Under planning

Concept level

* Pitch type (pin-to-pin size)
Hybrid electric vehicles (HEVs) and electric vehicles (EVs) are becoming more popular with the introduction of stricter limits on vehicle CO2 emissions as a measure to deal with global warming and help achieve a “sustainable society” that is environmentally friendly, safe, and livable. An HEV uses a drive system that combines a conventional internal-combustion engine (gasoline engine) and an electric motor. The electric motor powers the vehicle when starting from a stopped state, when driving at low speeds, and when accelerating in order to reduce fuel consumption and CO2 emissions. During deceleration or braking the motor functions as an electric generator, converting motive energy into electricity that is used to charge the HEV’s battery (regenerative control). In contrast, an EV does away with the internal-combustion engine altogether and relies solely on an electric motor for motive force and regeneration. This makes possible even lower CO2 emissions than an HEV. Both HEVs and EVs consume a large amount of electricity when the motor is running, so they require large high-voltage (in the several-hundred-volt range) batteries, unlike conventional vehicles powered by gasoline engines. HEV and EV batteries also require functions such as voltage detection and charging control. Renesas provides kit solutions incorporating microcontrollers, ASIC products, power devices (IGBTs and power MOSFETs), etc., for new technologies (such as motor-generator systems and battery charger–DC/DC converter systems) used in HEV and EV systems.

Motor Control Solutions for Hybrid and Electric Vehicles

To make hybrid and electric vehicles more efficient it is essential to make motor control ECUs more compact and lightweight. Renesas kits combining motor control microcontrollers, micro-isolators, and IGBTs help to substantially reduce the volume of ECUs.

**MCU Roadmap for HEV/EV Systems**

<table>
<thead>
<tr>
<th>CPU Core</th>
<th>2009</th>
<th>2011</th>
<th>2013</th>
<th>2015</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>RH850/C1H</td>
<td>2 Resolver/Digital Converters</td>
<td>200kHz</td>
<td>240MHz</td>
<td>Single Core</td>
<td></td>
</tr>
<tr>
<td>RH850/C1M</td>
<td>1 Resolver/Digital Converter</td>
<td>200kHz</td>
<td>240MHz</td>
<td>Single Core</td>
<td></td>
</tr>
<tr>
<td>V850E2/P4</td>
<td>Max. 1MB Flash</td>
<td>Max. 160MHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SH72A0/SH72A2</td>
<td>32-bit CPU</td>
<td>Max. 100MHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V850E2/P4A-S</td>
<td>16-bit CPU</td>
<td>Max. 32-bit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V850E2/P4A-D</td>
<td>Resolver/Digital Converter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V850E2/P4A-L</td>
<td>Resolver/Digital Converter</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

**Applications**

- HEV/EV
- Powertrain
- Body
- Instrument Cluster
- Car Audio
- Car Information System
- In-Vehicle Networking

**Green Vehicles, Better Fuel Efficiency**

Hybrid electric vehicles (HEVs) and electric vehicles (EVs) are becoming more popular with the introduction of stricter limits on vehicle CO2 emissions as a measure to deal with global warming and help achieve a “sustainable society” that is environmentally friendly, safe, and livable. An HEV uses a drive system that combines a conventional internal-combustion engine (gasoline engine) and an electric motor. The electric motor powers the vehicle when starting from a stopped state, when driving at low speeds, and when accelerating in order to reduce fuel consumption and CO2 emissions. During deceleration or braking the motor functions as an electric generator, converting motive energy into electricity that is used to charge the HEV’s battery (regenerative control). In contrast, an EV does away with the internal-combustion engine altogether and relies solely on an electric motor for motive force and regeneration. This makes possible even lower CO2 emissions than an HEV. Both HEVs and EVs consume a large amount of electricity when the motor is running, so they require large high-voltage (in the several-hundred-volt range) batteries, unlike conventional vehicles powered by gasoline engines. HEV and EV batteries also require functions such as voltage detection and charging control. Renesas provides kit solutions incorporating microcontrollers, ASIC products, power devices (IGBTs and power MOSFETs), etc., for new technologies (such as motor-generator systems and battery charger–DC/DC converter systems) used in HEV and EV systems.

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<td>240MHz</td>
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<td></td>
</tr>
<tr>
<td>RH850/C1M</td>
<td>1 Resolver/Digital Converter</td>
<td>200kHz</td>
<td>240MHz</td>
<td>Single Core</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>V850E2/P4A-D</td>
<td>Resolver/Digital Converter</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>V850E2/P4A-L</td>
<td>Resolver/Digital Converter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

**Applications**

- HEV/EV
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Motor-Generator Control System

The main tasks of a motor-generator system are motor control during driving and regenerative control during braking, when the motor functions as an electric generator. Advances in motor control and regenerative control aimed at reducing fuel consumption and CO2 emissions are being made constantly, creating demand for microcontrollers delivering high performance and advanced functionality. In response, Renesas offers an extensive lineup of microcontrollers incorporating high-performance CPUs, timers and ADCs optimized for motor control and regenerative control, and on-chip RDCs for reduced system cost. Renesas also has a wide selection of analog and power devices.

Battery Charger and DC/DC Control System

A charger and DC/DC voltage-boost system uses AC input control and DC/DC circuits to increase the voltage of a home power supply to that required by the battery in order to charge the battery cells. The control microcontroller performs PFC* control and controls the DC/DC voltage-boost circuit. In addition to microcontrollers for monitoring battery cells, Renesas offers analog and power devices suitable for such systems.

Recommended Products for HEV/EV Systems

<table>
<thead>
<tr>
<th>MCU</th>
<th>Recommended Product</th>
<th>ROM</th>
<th>RAM</th>
<th>Operating Frequency</th>
<th>Package</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor-generator control system main MCU</td>
<td>RH850/F1x</td>
<td>256K-2M</td>
<td>64K-128K</td>
<td>80-96</td>
<td>48-176</td>
<td>ECC, CAN, 12-bit A/D, CAN-S</td>
</tr>
<tr>
<td></td>
<td>RH850/F2L</td>
<td>256K-2M</td>
<td>32K-192K</td>
<td>32</td>
<td>20-80</td>
<td>16-bit Flash, PWM output, 12-bit CAN, LIN</td>
</tr>
<tr>
<td></td>
<td>RL78/F13</td>
<td>16K-128K</td>
<td>1K-8K</td>
<td>32</td>
<td>30-100</td>
<td>10-bit ADC, CAN, LIN</td>
</tr>
<tr>
<td></td>
<td>RL78/F14</td>
<td>48K-256K</td>
<td>4K-20K</td>
<td>32</td>
<td>48-144</td>
<td>16-bit Flash, PWM output, 12-bit CAN, LIN, I2C</td>
</tr>
<tr>
<td></td>
<td>SH72A0/A2</td>
<td>256K-512K</td>
<td>32K-64K</td>
<td>80-100</td>
<td>64-100</td>
<td>32KB data flash, PWM output, 12-bit CAN, CAN, LIN</td>
</tr>
</tbody>
</table>

Recommended Products for HEV/EV Systems

<table>
<thead>
<tr>
<th>Analog or Power Device</th>
<th>Recommended Product</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGBT</td>
<td>RBZ41A/K3**</td>
<td>Insulation function (inch-cord), dielectric strength: 2.5M/Vcm, overcurrent protection function, Miller clamp, anti-turn-off, etc.</td>
</tr>
<tr>
<td>CAN transceiver</td>
<td>R2A25416SP</td>
<td>High-speed CAN, 8-pin SOP</td>
</tr>
</tbody>
</table>

Notes:
1. PFC: Power Factor Correction
2. DCLS: Dual Core Lock Step
3. Planned
To meet emissions requirements, which are becoming stricter year by year, and improve fuel efficiency, powertrain systems must provide highly precise control. With the trend toward standardization in the industry, efforts at cooperative control, and the need to accommodate polarization between the needs of environmental technology and of emerging economies, demand continues to grow for improved microcontroller performance. In addition to the SH725x series of microcontrollers for powertrain systems, which have an established reputation in the market, Renesas will be releasing new products built around the high-performance RH850 core moving forward. These products will provide even better performance and power efficiency. Renesas also offers total solutions based on its lineup of power IC devices, peripheral IC devices, power MOSFETs, and CAN transceivers.

The development of the next generation of fuel-efficient engines will require high-performance microcontrollers capable of fast control operation and high-precision, low-loss analog devices.
Gasoline Direct Injection Engine System

In a direct injection engine a high-pressure fuel pump is used to pressurize the fuel, which is sprayed directly into the cylinders by a series of injectors. This approach allows greater freedom to adjust the fuel injection timing and volume than MPI systems and can deliver improved fuel efficiency. As solutions for these increasingly complex control applications, Renesas offers microcontrollers for use as direct injection engine ECUs that combine high-performance CPUs and low power consumption, as well as an extensive lineup of analog and power devices.

Diesel Engine System

Among internal-combustion engines, diesel engines provide excellent thermal efficiency and allow use of less refined fuel. They use a compression ignition system in which the intake air is pressurized within the cylinder and fuel is injected, causing it to self-ignite. They are not generally subject to knocking, even when supercharging is used, so most diesel engines include superchargers. As solutions for these increasingly complex control applications, Renesas offers microcontrollers for use as diesel engine ECUs that combine high-performance CPUs and low power consumption, as well as an extensive lineup of analog and power devices.

Transmission Control System

Transmission ECUs must operate under high-temperature conditions. Renesas offers microcontrollers for use as transmission ECUs that achieve low power consumption even at high temperatures. An extensive lineup of analog and power devices is also available.
### Recommended Products for Powertrain Systems

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Main MCU</td>
<td>RH850/E1A-52</td>
<td>4M</td>
<td>320K</td>
<td>240-320</td>
<td>252-304</td>
<td>DS ADC<em>1, SAR ADC</em>2, DFE<em>3, ATU-IV</em>4, APA<em>5, CAN, RHSB</em>6, FlexRay<em>7, CAN FD</em>8, SENT<em>8, ICU-S</em>8</td>
</tr>
<tr>
<td></td>
<td>RH850/E1A-5</td>
<td>4M</td>
<td>320K</td>
<td>240-320</td>
<td>252-304</td>
<td>DS ADC<em>1, SAR ADC</em>2, DFE<em>3, ATU-IV</em>4, APA<em>5, CAN, RHSB</em>6, FlexRay<em>7, CAN FD</em>8, SENT<em>8, ICU-S</em>8</td>
</tr>
<tr>
<td></td>
<td>RH850/E1L</td>
<td>2M</td>
<td>180K</td>
<td>180-240</td>
<td>252</td>
<td>DS ADC<em>1, SAR ADC</em>2, DFE<em>3, ATU-IV</em>4, APA<em>5, CAN, RHSB</em>6, FlexRay*7</td>
</tr>
<tr>
<td></td>
<td>SK125k</td>
<td>1.020x-444</td>
<td>180-280</td>
<td>176-272</td>
<td></td>
<td>FPU, ATU-IV*7, A-DMAC, RSPI, AUD-II, CAN</td>
</tr>
<tr>
<td>S1k MCU</td>
<td>BL378F13</td>
<td>16K-128K</td>
<td>16.4K</td>
<td>24-32</td>
<td>20-80</td>
<td>10-bit ADC × 31 channels, 8-bit DAC, comparator, LVD*9, 150°C</td>
</tr>
<tr>
<td></td>
<td>BL378F14</td>
<td>40K-256K</td>
<td>46.2K</td>
<td>24-32</td>
<td>16-180</td>
<td>10-bit ADC × 20 channels, LVD*9, 150°C</td>
</tr>
<tr>
<td></td>
<td>BL378F15</td>
<td>128K-512K</td>
<td>32</td>
<td>48-144</td>
<td></td>
<td>10-bit ADC × 31 channels, 8-bit DAC, comparator, LVD*9, 150°C</td>
</tr>
</tbody>
</table>


### Recommended Products for Engine Systems

- **Step-up MOSFET**
- **High-side MOSFET**
- **Low-side MOSFET**
- **O2 sensor driver**
- **Micro-hybrid (start/stop)**
- **Motor drive MOSFET**
- **Direct injection injector driver**
- **EGR motor drive MOSFET**
- **Transmission linear solenoid driver**
- **Fuel injector driver**
- **CAN transceiver**

### Recommended MCUs

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SH725x</td>
<td>1.25M-4M</td>
<td>64K-256K</td>
<td>160-200</td>
<td>176-272</td>
<td>FPU, ATU-III *4, A-DMAC, RSPI, AUD-II, CAN</td>
<td></td>
</tr>
<tr>
<td>RH850/E1L</td>
<td>2M</td>
<td>160K</td>
<td>160-240</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RH850/E1M-S</td>
<td>4M</td>
<td>320K</td>
<td>240-320</td>
<td>252-304</td>
<td>DS ADC<em>1, SAR ADC</em>2, DFE<em>3, ATU-IV</em>4, APA<em>5, CAN, RHSB</em>6, FlexRay*7</td>
<td></td>
</tr>
<tr>
<td>RH850/E1M-S2</td>
<td>4M</td>
<td>320K</td>
<td>240-320</td>
<td>252-304</td>
<td>DS ADC<em>1, SAR ADC</em>2, DFE<em>3, ATU-IV</em>4, APA<em>5, CAN, RHSB</em>6, FlexRay*7</td>
<td></td>
</tr>
<tr>
<td>RL78/F13</td>
<td>16K-128K</td>
<td>1K-8K</td>
<td>24-32</td>
<td>20-80</td>
<td>4KB data flash, Motor Control Timer, CAN, LIN, Ultra Low Power, 8-bit DAC, 150°C</td>
<td></td>
</tr>
<tr>
<td>RL78/F14</td>
<td>4K-256K</td>
<td>4K-20K</td>
<td>24-32</td>
<td>30-100</td>
<td>8KB data flash, Motor Control Timer, CAN, LIN, Ultra Low Power, 8-bit DAC, 150°C</td>
<td></td>
</tr>
</tbody>
</table>

### Analog or Power Device

<table>
<thead>
<tr>
<th>Analog or Power Device</th>
<th>Recommended Product</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injection driver</td>
<td>µPU1068U</td>
<td>Dual-line side-P/E, 132-175V, 50mA, 20-pin S0P</td>
</tr>
<tr>
<td>Direct injection driver</td>
<td>M35109M20Q</td>
<td>60V, 20mA, 22Ω, 256, 4-pin S0P</td>
</tr>
<tr>
<td>Low-side WSINT</td>
<td>M35109M50Q</td>
<td>60V, 20mA, 52Ω, 4-pin S0P</td>
</tr>
<tr>
<td>EGR motor drive MOSFET</td>
<td>M35109M50G</td>
<td>60V, 20mA, 52Ω, 4-pin S0P</td>
</tr>
<tr>
<td>EGR pre-driver and power IC</td>
<td>R2A25107KFP</td>
<td>7V to 36V (14-pin S0P)</td>
</tr>
<tr>
<td>Micro hybrid (start/stop)</td>
<td>M35109M00T</td>
<td>40V, 1.5A, 1.05Ω, 4-pin S0P</td>
</tr>
<tr>
<td>O2 sensor driver</td>
<td>µPU1068U</td>
<td>High-side P/E, 40V, 40mA, 7-pin T0-222</td>
</tr>
<tr>
<td>Transmission linear actuator</td>
<td>µPU1064U</td>
<td>Dual-side P/E, 20mA, 8-pin S0P</td>
</tr>
<tr>
<td>Transmission linear actuator</td>
<td>M35109M50U</td>
<td>60V, 20mA, 22Ω, 256, 4-pin S0P</td>
</tr>
<tr>
<td>Transmission linear actuator</td>
<td>M35109M50V</td>
<td>60V, 20mA, 52Ω, 4-pin S0P</td>
</tr>
<tr>
<td>Transmission linear actuator</td>
<td>M35109M50G</td>
<td>60V, 20mA, 52Ω, 4-pin S0P</td>
</tr>
</tbody>
</table>

### Recommended MCUs

- **RSBs: Renesas High-Speed Bus**
- **FlexRay: RH850/E1M-S and RH850/E1M-S2 only**
- **LVD: Low Voltage Detection**
- **H8R: Renesas High-Speed Bus**
- **ATU-IV: Advanced Timer Unit**
- **APA: Autonomous Pulse-Adaptor**

### Recommended Products

- **Step-up MOSFET**
- **High-side MOSFET**
- **Low-side MOSFET**
- **O2 sensor driver**
- **Micro-hybrid (start/stop)**
- **Motor drive MOSFET**
- **Direct injection injector driver**
- **EGR motor drive MOSFET**
- **Transmission linear solenoid driver**
- **Fuel injector driver**
- **CAN transceiver**

### Recommended MCUs

- **RH850/P1x-C**
- **RH850P1x-C**
- **RH850/P1x-C**
- **RH850/P1x-C**
- **RH850/P1x-C**
- **RH850/P1x-C**

---

**Renesas** offers an extensive lineup of microcontrollers and analog and power devices, ranging from the low end to the high end, to meet the requirements of vehicle systems and enable customers to build safer automobiles.

Renesas produces the world’s most advanced microcontrollers for automotive safety control applications. They combine four technologies indispensable to motoring safety control in a single product.

---

**Chassis & Safety**

**Improved Safety and Ease of Maintenance**

As the use of electronics and electric motors in automobiles continues to advance, chassis and safety systems’ involved in tasks such as steering and braking must meet higher standards of safety and environmental friendliness. Vehicle systems are expected to comply with the ISO 26262 Functional Safety standard for automobiles. This means that microcontrollers must meet a variety of functional and performance requirements, including safety mechanisms such as redundant cores, high processing power, capabilities for communicating with peripheral devices, high-precision A/D converters, and low power consumption.

---

**The world’s most advanced microcontrollers for automotive safety applications**

Renesas produces the world’s most advanced microcontrollers for automotive safety control applications. They combine four technologies indispensable to motoring safety control in a single product.

---

**Technical issues for safe vehicle control**

- **Security**: Hardware security, remote support, robust data security, network connectivity
- **Coordinated control for safe driving**: Coordinated safety control, CAN FD, Ethernet, vehicle safety control with 8 or more channels
- **Sensing**: Field Logic BIST, performance, linked sensing, multi-sensor fusion
- **Networking**: High-speed real-time performance, linked sensing, multi-sensor fusion
- **All-in-one implementation of vehicle safety control**: RH850/P1x-C
- **Industry-standard platform for vehicle safety control**
There is a growing trend toward the use of electric power steering (EPS) as a step toward building environmentally friendly automobiles. Such systems use electric motors instead of conventional hydraulic steering assist mechanisms to reduce the weight of the vehicle and improve fuel efficiency. In recent years EPS systems have gained additional functionality to assist the driver in operating the vehicle, moving beyond simple power shifting to provide stepless variation of the steering gear ratio according to the vehicle speed and steering angle. Microcontrollers, in order to provide the sophisticated motor control required in such applications, need to offer a high-performance CPU, large-capacity on-chip memory, dedicated timer units, high-speed and high-precision ADC, and interfaces for communicating with other control units. In addition, as the use of electronics and electric motors in automobiles continues to advance, chassis systems involved in tasks such as steering and braking must meet stricter safety standards. Many such systems are required to support ASIL D*, the highest safety level of the ISO 26262 Functional Safety standard for automobiles. The need for greener vehicles also means that these systems are expected to be power efficient. Renesas offers optimal solutions based on high-performance CPU cores, etc., to support more advanced EPS systems.

* ASIL: Automotive Safety Integrity Level (a safety standard for automobiles)
  ASIL D: The highest-level safety standard for automobiles

There are many types of brake systems, including ABS*, functions such as electronic stability control that help maintain vehicle stability, brake pedal assist functions, regenerative braking and booster control systems for hybrid and electric vehicles, and electric parking brakes. These systems may also interoperate with steering and engine systems to provide integrated control of the vehicle. As a result, they place a wide array of functional and performance requirements on microcontrollers. Also, since brake systems must meet the highest-level safety standard for automobiles, the microcontrollers they employ must integrate safety mechanisms such as redundant cores. Renesas offers a wide-ranging lineup of microcontrollers for brake systems ranging from the low end to the high end, as well as a variety of optimized solutions incorporating analog and power devices.

* ABS: Antilock Brake System
There is a trend in airbag systems toward the use of more satellite sensors as a way to help ensure the safety of the driver and passengers when a collision occurs. Microcontrollers must provide a high level of processing performance in order to rapidly process the large amount of data input by these sensors. Also needed are a high-speed SPI*-compatible interface for communication with peripheral devices and flexible peripheral interfaces for cooperative control with other ECUs. Renesas offers a wide-ranging product lineup ranging from the low end to the high end. Safety system solutions are available for applications of all sorts, from passenger detection devices and flexible peripheral interfaces for cooperative control with other ECUs. Renesas offers a wide-ranging product lineup.

Airbags

Motorized Seatbelt

Radar

Canbus

Passenger

Rear

Sensors

Front

Rear

Driver

Valeo

Rear

Driver

Sensors

Satellite

Sensors

Side

Impact Airbag

Airbag

Pretension

System

Automatic Transmission

Engine / Automatic Transmission

Electric Power Steering

CAN Transceiver

Fail Safe Switch

Note: 1. DCLS: Dual Core Lock Step  
* Under development  
** Option

Recommended Products for Chassis and Safety Systems

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EPS main MCU</td>
<td>RH850/P1M*</td>
<td>512K-2M</td>
<td>64K-128K</td>
<td>160</td>
<td>108-144</td>
<td>DCLS*, Safety, 12-bit ADC, advanced-functionality motor control timers, general-purpose timers, FlexRay, security**</td>
</tr>
<tr>
<td></td>
<td>V850E2/f4+</td>
<td>512K-1M</td>
<td>48K-80K</td>
<td>80-180</td>
<td>144</td>
<td>DCLS*, Safety, 12-bit ADC, advanced-functionality motor control timers, general-purpose timers, FlexRay</td>
</tr>
<tr>
<td></td>
<td>V850E2/f4+L</td>
<td>384K</td>
<td>24K</td>
<td>80</td>
<td>100</td>
<td>DCLS*, Safety, 12-bit ADC, advanced-functionality motor control timers, general-purpose timers</td>
</tr>
<tr>
<td>Brake system main MCU</td>
<td>RH850/P1M*</td>
<td>512K-2M</td>
<td>64K-128K</td>
<td>160</td>
<td>108-144</td>
<td>DCLS*, Safety, 12-bit ADC, advanced-functionality motor control timers, general-purpose timers, FlexRay, security**</td>
</tr>
<tr>
<td></td>
<td>V850E2/f4+</td>
<td>512K-1M</td>
<td>48K-80K</td>
<td>80-180</td>
<td>144</td>
<td>DCLS*, Safety, 12-bit ADC, advanced-functionality motor control timers, general-purpose timers, FlexRay</td>
</tr>
<tr>
<td></td>
<td>V850E2/f4+L</td>
<td>384K</td>
<td>24K</td>
<td>80</td>
<td>100</td>
<td>DCLS*, Safety, 12-bit ADC, advanced-functionality motor control timers, general-purpose timers</td>
</tr>
<tr>
<td>Airbag main MCU</td>
<td>RH850/P1M*</td>
<td>512K-2M</td>
<td>64K-128K</td>
<td>160</td>
<td>108-144</td>
<td>DCLS*, Safety, 12-bit ADC, advanced-functionality motor control timers, general-purpose timers, FlexRay, security**</td>
</tr>
<tr>
<td></td>
<td>V850E2/f4+L</td>
<td>384K-2M</td>
<td>32K-64K</td>
<td>80-180</td>
<td>100</td>
<td>12-bit ADC, advanced-functionality motor control timers, general-purpose timers</td>
</tr>
<tr>
<td>Airbag sub MCU</td>
<td>RL78/F13</td>
<td>16K-128K</td>
<td>1K-8K</td>
<td>32-200</td>
<td>4KB data flash, PWM output, 10-bit ADC, CAN, LIN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RL78/F14</td>
<td>48K-256K</td>
<td>4K-20K</td>
<td>32-100</td>
<td>8KB data flash, PWM output, 10-bit ADC, CAN, LIN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SH72A0/A2</td>
<td>256K-512K</td>
<td>32K-64K</td>
<td>80-100</td>
<td>64-100</td>
<td>12-bit ADC, advanced-functionality motor control timer</td>
</tr>
<tr>
<td></td>
<td>V850E2/Fx4-L</td>
<td>256K-1M</td>
<td>24K-64K</td>
<td>48-64</td>
<td>84-144</td>
<td>PREM output, 10-bit ADC, CAN, LIN</td>
</tr>
<tr>
<td></td>
<td>SH72A0/A2</td>
<td>256K-512K</td>
<td>32K-64K</td>
<td>80-100</td>
<td>64-100</td>
<td>12-bit ADC, advanced-functionality motor control timer</td>
</tr>
<tr>
<td></td>
<td>V850E2/Fx4-L</td>
<td>256K-1M</td>
<td>24K-64K</td>
<td>48-64</td>
<td>84-144</td>
<td>CAN, 10-bit ADC, FDC, Data Flash, LIN</td>
</tr>
<tr>
<td></td>
<td>RL78/F14</td>
<td>48K-256K</td>
<td>48-256K</td>
<td>32</td>
<td>28-98</td>
<td>40K data flash, PWM output, 10-bit ADC, CAN, LIN</td>
</tr>
<tr>
<td></td>
<td>RL78/F15</td>
<td>128K-512</td>
<td>100-32K</td>
<td>32</td>
<td>48-144</td>
<td>16KB data flash, PWM output, 10-bit ADC, CAN, LIN, LINbus</td>
</tr>
</tbody>
</table>

Recommended Products for Chassis and Safety Systems

<table>
<thead>
<tr>
<th>Analog or Power Device</th>
<th>Recommended Product</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPS 3-phase brushless motor drive</td>
<td>NIP28H40G4U</td>
<td>3-phase driven, capacity (Cin) = 1330kWp, 240V, 141mp, 3000rpm, 3-pin CAN</td>
</tr>
<tr>
<td>EPS Motor drive MOSFET for 3-phase brushless motors</td>
<td>NIP15H40G4U</td>
<td>400, 100A, 144mp, 3000rpm, 3-pin CAN</td>
</tr>
<tr>
<td>EPS Motor drive MOSFET for 3-phase brushless motors</td>
<td>NIP12H40G4U</td>
<td>400, 100A, 125mp, 3000rpm, 3-pin CAN</td>
</tr>
<tr>
<td>EPS Motor drive MOSFET for 3-phase brushless motors</td>
<td>NIP9H40G4U</td>
<td>400, 100A, 100mp, 3000rpm, 3-pin CAN</td>
</tr>
<tr>
<td>EPS Motor drive MOSFET for 3-phase brushless motors</td>
<td>NIP8H40G4U</td>
<td>400, 100A, 80mp, 3000rpm, 3-pin CAN</td>
</tr>
<tr>
<td>EPS Motor drive MOSFET for H-bridge motors</td>
<td>NIP18H60F4P</td>
<td>400A, 100A, 2.45Ω, 5V, 10-pin TO-263</td>
</tr>
<tr>
<td>EPS Motor drive MOSFET for H-bridge motors</td>
<td>NIP18H40G4P</td>
<td>400A, 100A, 2.05Ω, 5V, 10-pin TO-263</td>
</tr>
<tr>
<td>EPS Motor drive MOSFET for H-bridge motors</td>
<td>NIP18H40G4U</td>
<td>400A, 100A, 2.05Ω, 5V, 10-pin TO-263</td>
</tr>
<tr>
<td>Brake system Motor drive MOSFET</td>
<td>NIP10H40G4P</td>
<td>400A, 100A, 2.05Ω, 5V, 10-pin TO-263</td>
</tr>
<tr>
<td>Brake system Hydraulic solenoid drive MOSFET</td>
<td>NIP90H40G4P</td>
<td>400A, 100A, 2.05Ω, 5V, 10-pin TO-263</td>
</tr>
<tr>
<td>Brake system MOSFET and IPS for fail-safe switches</td>
<td>NIP100H40G4T, etc.</td>
<td>400A, 240V, high-side MOSFET</td>
</tr>
<tr>
<td>Airbag MOSFET for fail-safe switches</td>
<td>NIP100H40G4P</td>
<td>400A, 240V, high-side MOSFET</td>
</tr>
<tr>
<td>CAN transceiver</td>
<td>NUXA5410H3</td>
<td>High-speed CAN, 8-pin SOP</td>
</tr>
</tbody>
</table>
It is said that more than 90% of automobile accidents are caused by the driver. The goal of an ADAS* is to help prevent and reduce accidents by, for example, providing advance warning to help prevent mishaps in situations where accidents may occur, such as if the driver’s eyes stray from the road or if visibility is poor. ADAS technology is expected to play an important role in helping to realize a safer and more convenient driving experience in the automobiles of the future.

Renesas offers a lineup of products for ADAS applications that offer support for essential functionality such as surround detection systems, front detection systems, millimeter-wave radar, and sensor fusion systems. The ADAS lineup also includes solutions with support for vehicle-to-vehicle communication functions.

* ADAS: Advanced Driver Assistance System

**RENESAS ADAS Open Platform**

**MCU/SoC Roadmap for ADAS**

<table>
<thead>
<tr>
<th>Year</th>
<th>R-Car H1</th>
<th>R-Car H2</th>
<th>R-Car Gen3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2011</td>
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<td></td>
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<td>2013</td>
<td></td>
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<td></td>
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<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2018</td>
<td></td>
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</tbody>
</table>

**Target Application**
- Front Detection Systems
- Millimeter-wave Radar
- Surround Detection Systems
- Vision
- Sensor fusion
- ADAS Control ECU
- V2X Systems

**SW Platform**
- Radar toolbox
- Computer vision platform

**Silicon**
- RH850/V1x
- R-CarV2H
- R-CarGen3

**Doct. Solution**
- Radar SDK
- Vision SDK
- S VIEW SDK

**RTOS**
- Autosar
- Linux

**Complex OS**
- RTOS
- Linux

**COM**
- HAD solution kit
- V2X Starter kit
These systems assist the driver by using millimeter-wave radar to detect obstacles while the vehicle is in motion. Renesas microcontrollers for ADAS applications provide features required by millimeter-wave radar systems, including high-speed reception of millimeter-wave signals, fast operation performance, large-capacity RAM, and compact package sizes.

### Recommended Products for ADAS

<table>
<thead>
<tr>
<th>MCU</th>
<th>Recommended Product</th>
<th>ROM (Bytes)</th>
<th>RAM (Bytes)</th>
<th>Operating Frequency (MHz)</th>
<th>Package (Pin, Count)</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main MCU</td>
<td>SH745x</td>
<td>1M-2M</td>
<td>280K-536K</td>
<td>160-240</td>
<td>176-292</td>
<td>DRI, PDAC, ATU-IIIS multifunction timer, FlexRay, FBGA</td>
</tr>
<tr>
<td>Main SoC</td>
<td>R-Car V2H</td>
<td>—</td>
<td>1000</td>
<td>647</td>
<td>IMP-X4, IMP-LSX3, IMP, DRC, DDR-SDRAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SH7766</td>
<td>32K</td>
<td>533</td>
<td>440</td>
<td>DDR3-SDRAM, IMP, IMR, DRC, 2DG</td>
<td></td>
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</tbody>
</table>

### V2X Device Recommended Product

<table>
<thead>
<tr>
<th>V2X Device</th>
<th>Recommended Product</th>
<th>ROM (Bytes)</th>
<th>RAM (Bytes)</th>
<th>Operating Frequency (MHz)</th>
<th>Package (Pin, Count)</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>V2X Radio</td>
<td>R-Car W1R</td>
<td>32KB</td>
<td>128KB</td>
<td>180</td>
<td>176</td>
<td>150MHz/S, 8-pin J107</td>
</tr>
<tr>
<td>V2X Radio</td>
<td>R-Car W2R</td>
<td>32KB</td>
<td>128KB</td>
<td>175</td>
<td>176</td>
<td>5.5GHz/S, 8-pin J107</td>
</tr>
<tr>
<td>V2X Host</td>
<td>R-Car M2R</td>
<td>—</td>
<td>512KB</td>
<td>800</td>
<td>501</td>
<td>High performance security FP</td>
</tr>
</tbody>
</table>

### Analog or Power Device Recommended Product

<table>
<thead>
<tr>
<th>Analog or Power Device</th>
<th>Recommended Product</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAN transceiver</td>
<td>R2A2531D3P</td>
<td>High-speed CAN, 8-pin SOIC</td>
</tr>
</tbody>
</table>

### Sensor Fusion and ADAS Control ECU

Sensor fusion and ADAS control systems link sensing results from radar and cameras with the vehicle’s accelerator, brake, and steering systems. Renesas SoC/MCU products for ADAS applications deliver high performance and Functional Safety support for a wide range of vehicles classes, from the high-end to the low-end.
Body

Ease of Maintenance, Enhanced Safety, Automotive IT

Body systems help make automobiles more comfortable and convenient by controlling functions such as power windows, automatic air conditioning, interior LED lighting control, and seat position control tailored to the individual driver. They also contribute to enhanced safety through antitheft control and headlight direction control linked to the steering angle. In all of these areas the use of electronic control is becoming more widespread, and there is demand for more integration and reuse of resources among systems. With the popularization of HEVs and EVs in recent years, there is a growing need for body systems that are more lightweight and power efficient (through reduction of dark current), both of which are directly linked to battery performance. In response to these requirements, Renesas offers a broad lineup of microcontrollers combining high performance and low power consumption, as well as compatibility with Functional Safety and security support programs, which if produced independently can reduce development efficiency. Renesas also provides kit solutions comprising analog and power devices optimized for each type of system. This makes it possible for customers to build high-quality body control systems at low cost.
A body control module (BCM) integrates the functions of various lights, door locks, etc., into a single unit and implements CAN and LIN gateway functionality. Microprocessors for use in these units need to have CAN and LIN network support, to be available in package and memory configurations that support a variety of system scales, to have low EMI characteristics to prevent radio noise interference from the vehicle’s internal wiring, and to provide low current consumption to reduce battery drain when in the standby state. Renesas offers kit solutions consisting of microcontrollers, analog devices, and power devices optimized for body control applications. For LED headlight units, which have become widespread in recent years, Renesas supplies power devices specifically designed for use in LED headlight controllers. They provide overcurrent detection and diagnostic functions together with low power consumption.

Wiper control demands smooth motor control. Renesas offers a broad lineup of compact microcontrollers built around a 16-bit CPU core and suitable for high-performance motor control.

A power door unit that automatically opens and closes a door using an electric motor requires network functionality as well as three-phase motor control. Renesas offers a broad lineup of CAN/LIN microcontrollers with three-phase motor control functions.

The main (driver’s-seat) microcontroller of a power window or door unit must be CAN and LIN network compatible, and the sub (passenger/rear-seat) microcontroller must be LIN network compatible. The function for preventing pinched fingers demands high-speed operation performance. Renesas offers a broad lineup of compact, high-performance microcontrollers that meet these requirements. Also available are custom ASIC products that integrate power supply or communication driver functions in a single package, and microcontrollers with on-chip regulator or LIN transceiver modules.

High-intensity discharge lighting systems (HID) that have become more widespread in recent years require microcontrollers for electronic control. The LED headlight unit is located in the engine compartment, so the microcontroller used must be very compact and able to withstand a wide range of temperatures. It has also become common recently for such units to be linked to an AFS*, which requires network support. Renesas offers CAN/LIN microcontrollers that are ideal for such applications, with compact packages and a wide guaranteed operating temperature range of –40°C to 125°C.

* AFS: Adaptive Front-Lighting System
Recommended Products for Body Heating, Ventilation and Air Conditioning (HVAC)

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>LH52/53L</td>
<td>RAJ280002 4H11HPF*2 40V/1.6mΩ, protection function, self-diagnostic function, high-precision load current sensing, low power supply voltage off hold</td>
<td>512K-2M</td>
<td>32KB-192KB</td>
<td>2.5-12</td>
<td>48-pin SOIC</td>
<td>LIN, MCU, LIN, VSI-S</td>
</tr>
<tr>
<td>LH52/53L</td>
<td>RAJ280004 4H11HPF*2 40V/3.8mΩ, protection function, self-diagnostic function, high-precision load current sensing, low power supply voltage off hold</td>
<td>512K-2M</td>
<td>32KB-192KB</td>
<td>2.5-12</td>
<td>48-pin SOIC</td>
<td>LIN, MCU, LIN, VSI-S</td>
</tr>
<tr>
<td>LH52/53L</td>
<td>RAJ280003 4H11HPF*2 40V/2.5mΩ, protection function, self-diagnostic function, high-precision load current sensing, low power supply voltage off hold</td>
<td>512K-2M</td>
<td>32KB-192KB</td>
<td>2.5-12</td>
<td>48-pin SOIC</td>
<td>LIN, MCU, LIN, VSI-S</td>
</tr>
<tr>
<td>LH52/53L</td>
<td>RAJ280002 4H11HPF*2 40V/1.6mΩ, protection function, self-diagnostic function, high-precision load current sensing, low power supply voltage off hold</td>
<td>512K-2M</td>
<td>32KB-192KB</td>
<td>2.5-12</td>
<td>48-pin SOIC</td>
<td>LIN, MCU, LIN, VSI-S</td>
</tr>
<tr>
<td>LH52/53L</td>
<td>RAJ280004 4H11HPF*2 40V/3.8mΩ, protection function, self-diagnostic function, high-precision load current sensing, low power supply voltage off hold</td>
<td>512K-2M</td>
<td>32KB-192KB</td>
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</tr>
<tr>
<td>LH52/53L</td>
<td>RAJ280003 4H11HPF*2 40V/2.5mΩ, protection function, self-diagnostic function, high-precision load current sensing, low power supply voltage off hold</td>
<td>512K-2M</td>
<td>32KB-192KB</td>
<td>2.5-12</td>
<td>48-pin SOIC</td>
<td>LIN, MCU, LIN, VSI-S</td>
</tr>
</tbody>
</table>

**Notes:**
1. MCP: Multi Chip Package.
2. Component recommended for power door and power window applications.
3. Under development

**Motor drive MOSFET for power window:**
- **MCP:** Multi Chip Package
- **R2A25108KFP**
  - 3-phase pre-driver: drive capacity (Ciss) = 10,000pF; on-chip current sense amplifier, motor position detection, dead time function, etc.; 48-pin LQFP

**Motor drive MOSFET for blower motor:**
- **NP80N06MLG**
  - 60V, 80A, 10mΩ, TO-220

**Motor drive MOSFET for mirror, wiper, power door:**
- **Flyback converter drive MOSFET**
  - **NP82N10PUF**
    - 82V/15mΩ, TO263

**MOSFET:**
- **Battery reverse connection protection**
  - **NP22N055SLE**
    - 55V/37mΩ, Ciss = 1100pF, TO-252

**LED headlight power switch:**
- **R2A25416SP**
  - High-speed CAN, 8-pin SOP

**Analog ICs for Power Device:**
- **RAJ280002 4H11HPF*2 40V/1.6mΩ, protection function, self-diagnostic function, high-precision load current sensing, low power supply voltage off hold**
- **RAJ280004 4H11HPF*2 40V/3.8mΩ, protection function, self-diagnostic function, high-precision load current sensing, low power supply voltage off hold**
- **RAJ280003 4H11HPF*2 40V/2.5mΩ, protection function, self-diagnostic function, high-precision load current sensing, low power supply voltage off hold**

**Notes:**
1. MCP: Multi Chip Package
2. Component recommended for power door and power window applications
3. Under development
RL78 Low-power Automotive Microcontrollers
RL78/F13, RL78/F14, and RL78/F15

The RL78/F1x microcontrollers are the successors to the 78K0R and R8C. They combine high performance and low power consumption. The integrated CAN/LIN communication functions, advanced functionality timers, safety functions, etc., make them ideal for both automotive and industrial applications.

RL78/F13, RL78/F14, and RL78/F15 Lineup

<table>
<thead>
<tr>
<th>Pinout</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>60</th>
<th>80</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>RL78/F13</td>
<td>1K</td>
<td>1K</td>
<td>1K</td>
<td>1K</td>
<td>1K</td>
<td>1K</td>
</tr>
<tr>
<td>RL78/F14</td>
<td>1K</td>
<td>1K</td>
<td>1K</td>
<td>1K</td>
<td>1K</td>
<td>1K</td>
</tr>
<tr>
<td>RL78/F15</td>
<td>1K</td>
<td>1K</td>
<td>1K</td>
<td>1K</td>
<td>1K</td>
<td>1K</td>
</tr>
</tbody>
</table>

Wire numbers indicate RAM size (KB):

Features of RL78/F13
- Lineup extending from 20 to 80 pins and 16KB to 128KB of ROM. Product versions with and without CAN functionality are pin compatible.
- Common core, peripheral functions, and pin layout throughout the lineup simplifies migration between product versions. Excellent software compatibility.

Features of RL78/F14
- AUTOSAR support (R3.2 and R4.0 planned), MCAL and CAN/LIN software driver support planned.
- Contributed to improved software quality.
- Expanded motor functions
  - On-chip comparator and D/A converter can be combined with Timer RD to implement brushless DC motor control.
  - Backward compatibility with RL78/F13 simplifies migration.

Features of RL78/F15
- Backward compatibility with the RL78/F13 and RL78/F14 simplifies migration between product versions.
- Expanded CAN and LIN channels, and on-chip iBus controller. Enhanced functionality makes the RL78/F15 suitable as an automotive gateway support product.

Features of RL78/F14

- Advanced functionality
  - 32MHz operation (2.7V to 5.5V at 105°C)
  - 3-phase waveform output function (Timer RD)
  - 4KB BGO data flash (RL78/F13)
  - 8KB BGO data flash (RL78/F14)
  - 16KB BGO data flash (RL78/F15)
  - High-speed on-chip oscillator (±2% at –40 to +105°C)
  - CPU: 32MHz, peripheral: 64MHz (Timer RD)
  - Advanced-functionality-on-chip debugging
  - RAM monitor/live debug
  - Functional Safety support
  - Compact package
  - QFN Package lineup
    - Example: 32-pin SSOP → QFN
  - High-temperature support
    - Ta = 150°C operation (RL78/F13, F14)

The high reliability required by automotive applications also makes the RL78/F1x group suitable for industrial applications.
Renesas offers a lineup of products for implementing a wide range of solutions ranging from the low end to the high end. The broad array of available on-chip peripheral functions includes 2D and 3D graphics, audio and video processing, and image recognition, making it possible to build vehicle information terminals with superior flexibility and ease of use. The product roadmap encompasses products for high-end systems employing vehicle-coordinated processing, as well as products with specialized functions for entry-level and mid-level systems. These can be combined with system power IC devices to achieve environmentally friendly power efficiency.

**SoC Roadmap for Cockpit System**

The scalable R-Car hardware platform and flexible software platform cover the full product range, from the premium class to the entry level. Plug-ins are available for multiple open OSes.

**R-Car Platform**

The scalable R-Car hardware platform and flexible software platform cover the full product range, from the premium class to the entry level. Plug-ins are available for multiple open OSes.
R-Car SoC Devices Expressly for Cockpit Systems

Utilizing open platforms to realize rich solutions

- Support for general-purpose OSes and standard APIs to promote software collaboration
- Offering rich software solutions to system manufacturers

Rich solutions available from Renesas

What is R-Car Consortium?
Renesas Electronics’ R-Car Series is built on reliability and a proven track record. Renesas will continue to introduce new R-Car Series products that are optimized for the needs of the market in a timely manner. The R-Car Consortium site is a membership site (registration required) where you can pursue and create integrated cockpit solutions through collaboration with a wide variety of partners who position the R-Car as a core technology.

Why the Consortium was Established:
The R-Car Consortium aims to lead the integrated cockpit market through:
- Collaboration with partners
- Mutual cooperation to shorten the development period (accelerate development)
- Enhancement of a support system
- Implementation of next-generation integrated cockpit solutions
With an eye toward increasing sales of automobiles in emerging economies, carmakers are seeking ways to reduce system costs and software development costs. Renesas offers a lineup of products featuring on-chip integration of external components that are common to many types of systems, a variety of integrated motor driver counts, and other options to meet the needs of a range of customers.

**Low-End Instrument Cluster**

With the trend toward the integrated cockpit, instrument clusters are increasingly using high-resolution display screens with faster display capabilities. Renesas offers a lineup of single-chip products with 2D graphics functions that are effective in cutting system costs overall, as well as two-chip product configurations with more sophisticated graphics capabilities.

**MCU/SoC Roadmap for Instrument Cluster Systems**

<table>
<thead>
<tr>
<th>SOP</th>
<th>2011</th>
<th>2013</th>
<th>2015</th>
<th>2017</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premium Nav / HU Driver Assist</td>
<td>SOC Platform</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Premium Cluster Mid Nav / HU</td>
<td>R-CAR Gen1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High 2D/3D Cluster Display Audio</td>
<td>R-CAR Gen2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid 2D Cluster</td>
<td>R-CAR D1 CA7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic Cluster and Companion Chips</td>
<td>V850/D1D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Cluster</td>
<td>V850/D1A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**D1x Lineup by Instrumentation Segments**

- **Low**
  - Segment LCD
  - Fixed Pattern (CPU Control)
  - 2D (CPU Drawing)

- **Basic**
  - 2.3” Dot-Matrix, QVGA Monochrome
  - 2D (Sprite)

- **Low-2D**
  - 2.5” QVGA Monochrome
  - CAN/LIN
  - ETH

- **Mid-2D**
  - 4.2” to 8” WVGA
  - CAN/LIN
  - ETH

- **High-2D**
  - Dual 4.2” to 12.2” WVGA
  - CAN/LIN
  - ETH

- **High/Ultra-3D**
  - Triple 8” to 12.2” WVGA
  - CAN/LIN
  - ETH, MOST, USB

**Low-End Instrument Cluster**

With an eye toward increasing sales of automobiles in emerging economies, carmakers are seeking ways to reduce system costs and software development costs. Renesas offers a lineup of products featuring on-chip integration of external components that are common to many types of systems, a variety of integrated motor driver counts, and other options to meet the needs of a range of customers.
2D Graphics Instrument Cluster with Gauges

The use of color graphics in displays is increasing as a way to convey various types of information to the driver in an easy-to-understand manner. To meet the needs of a variety of customers, Renesas offers a lineup of products with features such as graphics engines with vector drawing support and large-capacity RAM for use as frame buffers, in addition to functions required by conventional systems, such as stepping motor drivers for gauges.

3D Graphics Instrument Cluster with Gauges

While using features such as graphics and head-up displays to differentiate models and grades of automobiles, it is possible at the same time to create systems that supply the driver with appropriate information in a timely manner and in a format that is safe and easy to understand. Renesas offers a lineup of scalable solutions to match every vehicle grade.

Recommended Products for Instrument Cluster

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-end main MCU</td>
<td>RL78/G1A</td>
<td>24K-128K</td>
<td>2K-16K</td>
<td>32</td>
<td>40-100</td>
<td>Stepping motor controller/driver, LCD controller/driver, ROM Data flash</td>
</tr>
<tr>
<td>Main MCU for 2D graphics instrument cluster with gauges</td>
<td>RH850/D1Mx</td>
<td>3.75M-5M</td>
<td>512K-1M</td>
<td>160-240</td>
<td>176-484</td>
<td>Stepping motor controller/driver, LCD controller/driver, 2D graphics engine, SWAP, video I/O, FlexRay</td>
</tr>
<tr>
<td>High-end main MCU for non/2D/3D graphics instrument cluster</td>
<td>RH850/D1Lx</td>
<td>2M-4M</td>
<td>256K-512K</td>
<td>120</td>
<td>144-176</td>
<td>Stepping motor controller/driver, LCD bus interface</td>
</tr>
<tr>
<td>SoC for graphics of 3D graphics instrument cluster with gauges</td>
<td>R-CarD1</td>
<td>—</td>
<td>—</td>
<td>660-780</td>
<td>543</td>
<td>3D and 2D graphics engines, DRAM, LVDS, and RGB outputs (up to 3 outputs); MIPICSI and digital inputs (2 inputs); MMC and Raw NAND interfaces; H.264, Ethereal AVB, 1 x 32-bit DDR3L-1066/1333, 1 mm pitch, Full</td>
</tr>
</tbody>
</table>

Analog or Power Device

<table>
<thead>
<tr>
<th>Recommended Product</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAN transceiver</td>
<td>RA9254100P</td>
</tr>
</tbody>
</table>
Car audio systems are no longer limited to playing content from the radio or music CDs. Now they require multifunctional capabilities, such as the ability to play portable music players and hands-free mobile phone calling via Bluetooth. In addition, increasingly such products are equipped with TFT displays to provide back monitor display capabilities and improve usability. At the same time, there is a demand in emerging economies for affordable audio systems with no CD and only radio and portable music player playback via a USB connection. For the car audio market Renesas offers the V850 series, which is ideal for system control and vehicle network applications, and the SH7260 series, which supports USB and Bluetooth connectivity. The range of available solutions extends from the low end to the high end.
Control by electronic systems such as ECUs is attaining greater sophistication and higher performance as part of efforts to make automobiles more safe, reliable, comfortable, and eco-friendly. In particular, electronic systems handle the main vehicle control functions of driver assistance systems such as collision mitigation by braking systems and automatic tracking systems; therefore the safety risks associated with control malfunctions in electronic systems are substantial. Complex control by electronic systems is essential to the realization of self-driving vehicles, a focus of research and development efforts in recent years, and this will require an even higher level of safety. This is why Functional Safety technology that can cope safely with any faults that may occur, and security technology to protect the operation of such systems from external attacks, are becoming ever more essential. ISO 26262, an international Functional Safety standard for electrical and electronic systems in automobiles, was established in 2011. It requires strict attention to Functional Safety throughout the development process. Since then concerns regarding cybersecurity in automobiles have increased. It is anticipated that a development process for design elements related to automobile security will be put in place, and the relation between Functional Safety and Security plans to be mentioned in ISO26262 2nd edition.

### Recommended Products for Car Audio

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Control MCU for car audio</td>
<td>V850ES/Sx3</td>
<td>256K-1M</td>
<td>24-64K</td>
<td>32</td>
<td>100/144</td>
<td>PWM output, 10-bit ADC, CAN, LIN, IEBus</td>
</tr>
<tr>
<td></td>
<td>V850ES/SxH</td>
<td>512K-1.5M</td>
<td>64-256K</td>
<td>44</td>
<td>140-270</td>
<td>PWM output, 10-bit ADC, CAN, LIN, IEBus</td>
</tr>
<tr>
<td></td>
<td>RH850/F1L</td>
<td>256K-3M</td>
<td>336-180K</td>
<td>66/96</td>
<td>48-176</td>
<td>PWM output, 12-bit ADC, CAN, LIN, IEC 6.1</td>
</tr>
<tr>
<td></td>
<td>RH850/F1M</td>
<td>320-4M</td>
<td>256K-320K</td>
<td>120</td>
<td>144-233</td>
<td>PWM output, 12-bit ADC, CAN, LIN, FlexRay, ECU-5</td>
</tr>
<tr>
<td></td>
<td>RH850/F1Y</td>
<td>320-4M/5M</td>
<td>320K-512K</td>
<td>2x 120</td>
<td>175-272</td>
<td>PWM output, 12-bit ADC, CAN, LIN, FlexRay, Ethernet, IEC M</td>
</tr>
<tr>
<td></td>
<td>RH850/F1K</td>
<td>652K-7M</td>
<td>584-78K</td>
<td>80/130</td>
<td>190-276</td>
<td>PWM output, 12-bit ADC, CAN/AVB, CAN, LIN, IEC 6.1</td>
</tr>
<tr>
<td></td>
<td>RL16F13</td>
<td>192-128K</td>
<td>16-48K</td>
<td>32</td>
<td>20-80</td>
<td>408 data flash, PWM output, 10-bit ADC, CAN, LIN</td>
</tr>
<tr>
<td></td>
<td>RL16F14</td>
<td>468-256K</td>
<td>48-200</td>
<td>32</td>
<td>38-180</td>
<td>808 data flash, PWM output, 10-bit ADC, CAN, LIN</td>
</tr>
<tr>
<td></td>
<td>RL16F15</td>
<td>128K-512K</td>
<td>100-320K</td>
<td>32</td>
<td>48-144</td>
<td>108B data flash, PWM output, 10-bit ADC, CAN, LIN, Eibus</td>
</tr>
<tr>
<td>Central MCU for display audio and connectivity audio</td>
<td>SKY206, SH7207</td>
<td>—</td>
<td>1.5M</td>
<td>144</td>
<td>146-176</td>
<td>USB2.0, video display controller, CAN, IEBus</td>
</tr>
<tr>
<td></td>
<td>SH7208, SH7209</td>
<td>—</td>
<td>2.5M</td>
<td>256</td>
<td>230-272</td>
<td>USB2.0, video display controller, CAN, IEBus</td>
</tr>
<tr>
<td></td>
<td>SH7230, SH7268</td>
<td>—</td>
<td>1.5-2.5M</td>
<td>216</td>
<td>120-194</td>
<td>USB2.0, SPI, multi I/O bus controller, CAN, IEBus</td>
</tr>
<tr>
<td></td>
<td>RZ/L1Y3</td>
<td>2M</td>
<td>408</td>
<td>176-pin QFP, 28-pin QFP</td>
<td>512-pin QFP</td>
<td>USB2.0 x 2 channels, video display controller, CAN, IEBus, Ethernet AVB</td>
</tr>
<tr>
<td>Analogue or Power Device Recommended Products</td>
<td>Features</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog or Power Device Recommended Product</td>
<td>Features</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

### Recommended Products for Car Information System

<table>
<thead>
<tr>
<th>MCU</th>
<th>Recommended Product</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-Car E2</td>
<td></td>
<td>400FP Cortex-A7 x 2 + SH-4A zone, 2D support, multi-codec video processing IP, dedicated audio DSP, distortion correction module, SD host interface, NISSI interface, Ethernet support, RS485 support</td>
</tr>
</tbody>
</table>

### Underlying Technologies

#### Renesas Functional Safety and Security Solutions

A world leader in Functional Safety and security technology

ISO 26262 Functional Safety and security trends

Control by electronic systems such as ECUs is attaining greater sophistication and higher performance as part of efforts to make automobiles more safe, reliable, comfortable, and eco-friendly. In particular, electronic systems handle the main vehicle control functions of driver assistance systems such as collision mitigation by braking systems and automatic tracking systems; therefore the safety risks associated with control malfunctions in electronic systems are substantial. Complex control by electronic systems is essential to the realization of self-driving vehicles, a focus of research and development efforts in recent years, and this will require an even higher level of safety. This is why Functional Safety technology that can cope safely with any faults that may occur, and security technology to protect the operation of such systems from external attacks, are becoming ever more essential. ISO 26262, an international Functional Safety standard for electrical and electronic systems in automobiles, was established in 2011. It requires strict attention to Functional Safety throughout the development process. Since then concerns regarding cybersecurity in automobiles have increased. It is anticipated that a development process for design elements related to automobile security will be put in place, and the relation between Functional Safety and Security plans to be mentioned in ISO26262 2nd edition.
About ISO 26262 Functional Safety

ISO 26262 is an international standard covering the Functional Safety of electrical and electronic systems in automobiles weighing up to 3.5 tons. It comprises ten parts, which define matters such as the management of Functional Safety, Automotive Safety Integrity Level (ASIL)-oriented and safety-oriented analysis, system development, hardware and software development, production and operation, and supporting processes.

Technology Trends in Recent Years

- Increased system complexity and sale
  - Cooperative system control
  - Higher performance, more advanced functionality, etc.
- Introduction of new technology
  - Increased use of electric motors, etc.
  - HEVs and HEVs, X-by-wire technology, etc.

Requirements of ISO 26262

- Requirements related to the development process
  - Appropriate development procedure
  - Analysis procedure
  - Review by organization
  - Documentation, etc.
- Requirements related to product specifications
  - Sufficient preparation for fault occurrence, etc.

Deficiencies and omissions in safety design

- Previously, each carmaker had its own independent safety design standards.
  - How is safety design put into practice?
  - Is quantitative evaluation of conformance possible?
  - Is the management of safety design effective and efficient?

There is a need for universal tools for certifying the adequacy of safety design.

ASIL-Compliant Microcontroller Development Sequence

Example of Quantitative Analysis for Airbags

- Safety target: Front airbags do not deploy unintentionally when the vehicle is in motion (ASIL D).
  - Single-point fault metric (SPFM) > 89%
  - Latent fault metric (LFM) > 90%

Safety and Security Collaboration

Standardization Trends in Functional Safety and Security

As a leader in Functional Safety and security technology, Renesas is actively involved in efforts to promote the establishment and adoption of standards.

- ISO/TC 22/SC 32/WG 08 (ISO 26262)
- ISO/PAS 19451
- SAE, Society of Automotive Engineers
- JSAE
- JasPar
- AUTOSAR
- etc.

Solutions Integrating Functional Safety and Security

Renesas makes it easier for customers to develop the next generation of automotive systems by providing solutions that consider both Functional Safety and security requirements.

Introducing the Functional Safety and Security Support Program

Comprehensive support for four aspects of Functional Safety and security.

- Four aspects:Hardware, Software, Functional Safety work products, Consulting
- Simple implementation using tools backed by a proven track record and extensive expertise in safety analysis and security threat analysis
- Simple system building with support for software that is tightly linked to the hardware
- Simple implementation using standards-compliant work product sets

Automotive Functional Safety and Security Support Program

Products with Functional Safety and Security Support

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Introducing the Functional Safety and Security Support Program

Comprehensive support for four aspects of Functional Safety and security.

- Four aspects: Hardware, Software, Functional Safety work products, Consulting
- Simple implementation using tools backed by a proven track record and extensive expertise in safety analysis and security threat analysis
- Simple system building with support for software that is tightly linked to the hardware
- Simple implementation using standards-compliant work product sets

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The Three Strengths of Renesas and AUTOSAR

Renesas is helping spur widespread AUTOSAR adoption.

## Powerful Solutions

AUTOSAR solutions from Renesas provide answers to the problems faced by developers of software and ECU software as ever more advanced automotive functionality brings increases in onboard data transfer volumes and a larger scale of software development.

### AUTOSAR Layered Architecture

- **Services layer** independent of the microcontroller and ECU hardware
- **ECU abstraction layer and complex device drivers** independent of the microcontroller and dependent on the ECU hardware
- **Microcontroller abstraction layer** dependent on the microcontroller

Together with the microcontroller, Renesas supplies a MCAL that all customers can use to optimize the entire software development process.

### Renesas MCAL Block Diagram

- **Microcontroller Drivers**
- **Memory Drivers**
- **Communication Drivers**
- **I/O Drivers**
- **MCAL software modules**

*The configuration and names of the software modules differ depending on the target microcontroller.*

## Powerful Lineup

With an extensive track record in the mass production of ECUs, the range of Renesas AUTOSAR solutions continues to expand.

### RENESAS MCAL LINEUP

<table>
<thead>
<tr>
<th>AUTOSAR Release</th>
<th>Series</th>
<th>Computing Body</th>
<th>Powertrain</th>
<th>HEV/EV</th>
<th>Chassis &amp; Safety</th>
<th>Instrument Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>R2</td>
<td>RH850</td>
<td>—</td>
<td>RH850/F1K*</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>R4.2</td>
<td>RH850</td>
<td>—</td>
<td>RH850/F1K*</td>
<td>RH850/F1M</td>
<td>RH850/C1M</td>
<td>RH850/C1H</td>
</tr>
<tr>
<td>R4.0</td>
<td>RH850</td>
<td>—</td>
<td>RH850/E1x</td>
<td>RH850/P1H-L</td>
<td>RH850/P1M-L</td>
<td>RH850/D1M</td>
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<tr>
<td>R3.x</td>
<td>RH850</td>
<td>—</td>
<td>RH850/E1x</td>
<td>RH850/P1H-L</td>
<td>RH850/P1M-L</td>
<td>RH850/D1M</td>
</tr>
</tbody>
</table>

* Under development

## Powerful Innovation

Renesas delivers AUTOSAR solutions in collaboration with partners, using an innovative and more efficient method of ECU software development in which code is generated automatically based on models.

### AUTOSAR Ecosystem Based on Renesas Microcontrollers
RH850 Family Development Tools

Renesas offers total solutions for optimized development environments in collaboration with partner vendors.

**Basic Software**

- **RV90 AUTOSAR Specification OS**
  - Optimized for the RH90 family.
  - Compliant with the AUTOSAR 4.0 specification.
  - Supports scalability classes 1 and 3.
  - Supports two OS configurations: XML format (AUTOSAR-compliant) and OIL format (Deki/VDK-compliant).
  - Development environment: MULTI integrated development environment from Green Hills Software.

- **RV850/V2 µITRON Specification OS**
  - Compliant with the µITRON 0 specification, the industry standard.
  - Supports the RH850 Family (Automotive only).
  - Enables high level of portability.
  - Compact design suitable for ROM storage.
  - Automatically selects only necessary modules at link time for a lighter system footprint.
  - Interoperates with the CS+ integrated development environment from Renesas and supports automatic setting of necessary options when building the OS.
  - Function to display the status of objects managed by the OS, such as tasks and semaphores (resource information panel); and function to display graphically task operation logs and service call issuance logs (task analyzer).

**Model-Based Development Tools**

- **C Compiler Package for RH850 Family (Bundled with CS+ Integrated Development Environment)**
  - Compliant with ANSI standard C99 and C11 (not all functions supported).
  - MISRA-C: Automatic checking of C source code based on 2004 rules supported as a compiler option.
  - Newly enhanced optimization functionality with more extensive optimization than earlier versions.

- **Additional Compilers from Renesas Partners***
  - Optimized for the RH850 family.
  - *Compatible compilers are available from Green Hills Software and IAR Systems.

**Flash Programming Tools**

- **Renesas Flash Programmer Software**
  - PC-controlled programming via the E1 or a serial connection.
  - Easier creation of projects.
  - Ability to cooperate with other software by Batch processing.
  - Programming a unique code to a designated area of flash memory.

**Development Support Services**

**Compiler Qualification (Service to Support Functionality Safety)**

This five-based service for customers using our compiler products provides assistance with the "development tool certification" required by the ISO 26262 Functional Safety standard.

- Details: http://www.renesas.com/compiler-qualification.html

**Compiler Maintenance Service (Agreement for Maintenance Service for a Specified Compiler Version)**

This five-based service is designed to provide “peace of mind” to customers using a specific compiler version for an extended period of time.

- Details: http://www.renesas.com/compiler-maintenance
### Renesas Development Tools

**Development tools from Renesas partner vendors**

#### Partner Solutions

Renesas collaborates with partner vendors to provide solutions to meet the needs of customers worldwide.

#### Functional Design Tools

<table>
<thead>
<tr>
<th>Tool Name</th>
<th>Vendor</th>
</tr>
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<tbody>
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</tr>
<tr>
<td>TargetLink®</td>
<td>dSPACE GmbH</td>
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<td>EB Inva® Studio/AutoCore</td>
<td>Electrombit Corporation</td>
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<tr>
<td>EB Inva® SafetyOSS</td>
<td>KPS Technologies Ltd.</td>
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<td>ECU Spectrum</td>
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<td>CANified mCAN</td>
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<td>CANbedded</td>
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<tr>
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<td>Vector Informatik GmbH</td>
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<tr>
<td>FRstress</td>
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<tr>
<td>VX1000</td>
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<td>VR Embedded Workbench (VWR)</td>
<td>VR Systems AB</td>
</tr>
<tr>
<td>IDE Developer</td>
<td>Abadon AB</td>
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</table>
| Automated Embedded Software Unit Testing Tool CoverageMaster w/AMS 
MC-Checker: Model and Code Comparator | GAID TECHNOLOGY CO., LTD |
| WinIDEA | SYSTEM AG |
| TRACE32® IDE PowerTools | Lecroy GmbH |
| En vigent: | Trebogawa Digital Computer Corporation |
| activities: | |
| - adv. LIN | |
| - adv. LIN | |
| - adv. CAN | |
| - adv. CAN | |
| - adv. A2P | |
| - UDS | |
| - NIVIPRESS | |
| - NETIAPRESS | |
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<tr>
<td>CANtoo</td>
<td>Vector Informatik GmbH</td>
</tr>
<tr>
<td>RAMScope EX-GE100 Series</td>
<td>Trebogawa Digital Computer Corporation</td>
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#### Renesas Website

**Announcement of New Website Design**

The structure and design of the Renesas Website have been completely revamped with the aim of making it easier and more convenient for customers to find and use the information they need.

1. **Private Portal Function**
   - This function allows you to save selected information for your own use later on. You can view the saved information whenever you like. Log in to MyRenesas to get started.

2. **Keyword Searches**
   - Now you can search for items that were previously organized into different categories all at once using related keywords. Now information on development tools, documentation, and product specifications can be located using a single search.

3. **Information on Solutions**
   - This section contains single-page descriptions of solutions from Renesas. Check here for information on related products, documentation, development tools, and more.

[https://www.renesas.com/en-us/]
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