Renesas and IDT join forces to contribute to the industrial, infrastructure, and automotive markets where high data processing performance is crucial.
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Renesas and IDT are steering the future of innovation together. By joining forces, these leaders in embedded solutions and analog mixed-signal products will help customers succeed in developing fast-growing applications in the industrial, infrastructure, and automotive segments. Their combined portfolios will contribute to markets where high data-processing performance is crucial.

**Renesas Portfolio**
- Microcontrollers (MCUs) & Microprocessors (MPUs)
- Automotive MCUs & MPUs
- Automotive Systems-on-Chip (SoC)
- Automotive Power Management
- Automotive Battery Management
- Automotive Video & Display
- Embedded System Platforms
- Analog ICs
- Power Management ICs
- Space & Harsh Environment ICs

**IDT Portfolio**
- Clocks & Timing
- Memory & Logic
- Interface & Connectivity
- Power Management
- RF Products
- Sensor Products
- Wireless Power
To immediately showcase how Renesas and IDT’s complementary product portfolios work together to deliver comprehensive solutions, Renesas and IDT developed more than a dozen “Winning Combinations,” compelling Renesas-plus-IDT product combinations that capture and highlight the technological advantages Renesas and IDT provide as a combined company.

Examples of Winning Combinations include IDT automotive timing plus Renesas R-Car processor solutions for automotive infotainment applications, an IDT gas sensor plus Renesas MCU for IoT building automation air quality control and other Winning Combinations for base station, wireline and server applications.

To learn more about the Renesas and IDT Winning Combinations, visit www.renesas.com/solutions/idt.html
In response to user requirements that are rapidly expanding in scope, Renesas offers microcontroller (MCU) and microprocessor (MPU) products that provide excellent expandability while allowing customers to make full use of existing resources.

Available in a wide array of memory and package options, Renesas MCUs and MPUs are fast, highly reliable, low in cost, and deliver eco-friendly performance.

Incorporating the latest process technology, which enables integration of large-capacity flash memory, they are used in a wide array of applications, including demanding fields requiring high quality and high reliability such as the automotive industry.

### Family

<table>
<thead>
<tr>
<th>Family</th>
<th>RL78</th>
<th>RX</th>
<th>RZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Features</td>
<td>Ultra-low power, Low-pin</td>
<td>High power efficiency, High capacity ROM</td>
<td>High performance, High capacity RAM</td>
</tr>
<tr>
<td>CPU Core</td>
<td>RL78 core (16-bit)</td>
<td>RX core (32-bit)</td>
<td>Arm® core (32/64-bit)</td>
</tr>
<tr>
<td>Processing Capacity</td>
<td>Max 32MHz</td>
<td>Max 240MHz</td>
<td>Max 1.5GHz/8 cores</td>
</tr>
<tr>
<td>Flash Memory</td>
<td>Built-in</td>
<td>Built-in</td>
<td>External</td>
</tr>
</tbody>
</table>

### Main Function

<table>
<thead>
<tr>
<th>Function</th>
<th>RL78</th>
<th>RX</th>
<th>RZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-AI</td>
<td>-</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>HMI</td>
<td>-</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Capacitive Touch</td>
<td>-</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Motor Control</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>LCD Display Function</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Network</td>
<td>-</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Security</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Bluetooth® Low Energy Sub-GHz Band Wireless Communication</td>
<td>●</td>
<td>●</td>
<td>-</td>
</tr>
</tbody>
</table>
RZ FAMILY ARM®-BASED HIGH-END MPUs

The Renesas RZ Family of high-end 32 and 64-bit Arm-based MPUs enables the solutions required for the smart society of the future. Through a variety of Arm® Cortex®-A7, A9, A15, A53, A57, and R4-based devices, engineers can easily implement high-resolution human machine interfaces (HMI), embedded vision, embedded artificial intelligence (e-AI), real-time control, and industrial ethernet connectivity.

Human Machine Interface (HMI)

RZ/A Series
RZ/A Series MPUs for Display Systems and Human Machine Interface

KEY FEATURES
RZ/A Series MPUs combine the ease-of-use of Renesas microcontrollers (MCUs) with advanced microprocessor features
- 32-bit Arm Cortex processors
- Up to 10 MB of on-chip SRAM
- Buffer up to WXGA resolution without external RAM

The RZ/A2M devices feature Renesas’ proprietary Dynamically Reconfigurable Processor (DRP) technology for up to 10 times faster image processing for computer vision and were winners of Electronic Products’ 2018 Product of the Year Award.

RZ/G Series
RZ/G Series MPUs for 3D Graphics and Full-HD Video Display

KEY FEATURES
RZ/G Series MPUs extends the capabilities of RZ/A MPUs to deliver high-end performance for graphics, multi-stream video, and embedded vision
- 32-bit and 64-bit Arm Cortex A-Series cores
- MIPI camera input
- 3D graphics accelerators
- Up to 4K UHD video codecs
- High-Reliability internal and external ECC memory
- Full suite of memory and I/O interfaces
- Free RZ/G Linux Platform tools reduce design cost
- Super-Long Term Support Linux kernel from CIP

Industrial Network & Real-time Control

RZ/T Series
RZ/T Series MPUs for Real-Time Control

KEY FEATURES
- High-performance, high-speed real-time control
- R-IN engine industrial Ethernet communications accelerator
- Integrated peripheral functions

RZ/N Series
RZ/N Series MPUs for Industrial Networking

KEY FEATURES
- Optimized MCUs for a variety of industrial networking applications
- R-IN engine enables implementation of major industrial Ethernet protocols (slave)
- Redundant network configuration reduces network downtime to zero

To learn more, visit: www.renesas.com/RZ
32-BIT HIGH POWER EFFICIENCY MCUs (RX)

The RX Family is the new generation of MCUs built around the revolutionary RX core, which combines the strengths of RISC and CISC architectures. Products in the RX Family feature integrated digital signal processor (DSP) and floating point arithmetic processor modules. The RX700 and RX600 Series are optimized for high speed and superior performance. The ultra-low-power RX200 and RX100 Series are designed to deliver excellent power efficiency.

To learn more, visit: www.renesas.com/RX

16-BIT ULTRA-LOW ENERGY MCUs (RL78)

Ultra Low Power Microcontroller Family

The RL78 Family of MCUs combines advanced low-power technology, outstanding performance, and the broadest lineup in its class for the most demanding 8- and 16-bit embedded applications.

The RL78 MCUs’ innovative “Snooze” mode achieves ultra-low power by allowing ADC operation and serial communication while the CPU is turned off. This makes the RL78 MCUs best-in-class for low-power applications.

To learn more, visit: www.renesas.com/RL78
The Renesas Synergy™ Platform integrates a scalable family of microcontrollers with a commercial-grade real-time operating system and middleware, and provides application frameworks that expose scalable Application Programming Interfaces (APIs). All the elements of the Synergy Platform are designed from the ground up as a single platform to provide unprecedented scalability and compatibility, not just across hardware, but also across software, allowing unparalleled design reuse.

**Standardized API**
- Abstracts dependencies, ensures portability, and accelerates product development
- Provides easy access to the SSP and Software Add-ons

**Powerful Software**
- Consists of widely-deployed, commercial-grade ThreadX® RTOS, extensive Middleware, Application Frameworks, Functional Libraries, and Hardware Abstraction Layer (HAL) Drivers

**Versatile Microcontrollers**
- Comprised of low-power Cortex® M0+ MCUs to high-performance Cortex M4-based chips
- Up to 4 MB of flash and cryptographic algorithms in hardware

**Rich Tools & Kits**
- Includes industry-leading IDE, debug and design tools: IAR Embedded Workbench® for Renesas Synergy™, C-RUN®, C-STAT®, GUIX™ Studio and TraceX®
- Development Kits to jump-start evaluation

**Software Add-Ons**
- Verified Software Add-ons (VSAs) add specialty functions from third-party experts; certified by Renesas to be SSP compatible
- Partner projects, application projects & module guides

**Full Solution**
- Application Examples (AEs) to highlight key technologies enabled by the Synergy Platform
- Product Examples (PEs) provide design instances of actual end products for a great start

**Single-Source Delivery**
- Implements the online destination for everything related to Synergy Software
- Go to production with simple click-through licensing
- Unlimited production licenses for SSP and tools available for no additional cost

**ACCELERATE DEVELOPMENT**
Let us take care of everything below the API so you can focus on differentiating your product.

**REDUCE TOTAL COST OF OWNERSHIP**
Lower your costs from start to finish – technology, development, and maintenance are all included.

**ELIMINATE BARRIERS TO ENTRY**
Innovate without facing obstacles of upfront costs, complicated licensing, or starting from square one.

To learn more, visit: renesas.com/synergy
As the number one supplier of vehicle control microcontrollers and SoC products for the automotive industry, we are focused on helping our customers realize their vision for the future of the automobile. With billions of SoCs and MCUs supplied to our global customers, Renesas is also a proven partner, true to our policy of “Quality First.” Our technologies address the latest trends in fuel economy, engine efficiency, driver-assist systems, body control, infotainment, connectivity, security, and reliability.

To learn more, visit: www.renesas.com/automotive

**MARKET SHARE IN AUTOMOTIVE MCU/SoC (CY17)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Supplier Rank</th>
<th>Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powertrain</td>
<td>No.1</td>
<td>39%</td>
</tr>
<tr>
<td>xEV</td>
<td>No.1</td>
<td>37%</td>
</tr>
<tr>
<td>ADAS + Infotainment &amp; Instruments</td>
<td>No.1</td>
<td>25%</td>
</tr>
<tr>
<td>Chassis &amp; Safety</td>
<td>No.1</td>
<td>23%</td>
</tr>
<tr>
<td>Body</td>
<td>No.1</td>
<td>37%</td>
</tr>
<tr>
<td>xEV</td>
<td>No.1</td>
<td>37%</td>
</tr>
</tbody>
</table>

*1: Renesas’ revenue estimate in each segment is based on the market analyses by Strategy Analytics 2018. / *2: Including infotainment and instrument according to the definition of Strategy Analytics. / *3: Excluding ADAS / MCU. Microcontrollers / SoC: System-on-a-chip

**AUTOMOTIVE 28nm MCUs (RH850)**

The RH850 is Renesas Electronics’ latest automotive MCU family that offers high performance balanced with very low power consumption over a wide and scalable range of products. This family offers rich functional safety and embedded security features needed for new and advanced automotive applications.

To learn more, visit: www.renesas.com/RH850

**AUTOMOTIVE SoC “R-CAR”**

Renesas’ system-on-chip (SoC) family, R-Car, designed for car information systems, ADAS and AD (autonomous drive).

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

To learn more, visit: www.renesas.com/r-car
In today’s fast-paced technology environment, designers need to be innovative without compromising time to market. Thinking at the system level is crucial to being able to address design challenges upfront. By offering quality solutions for the two most critical parts of your design, processors and power, Renesas accelerates your development and enables differentiation, while bringing predictability to your application. Whatever your product field – automotive, industrial, home electronics, office automation, or information communication technology – Renesas is the partner you can rely on from design to production.

A top-to-bottom, front-to-back product offering will help speed design and bring quality, compatibility, and predictability to your applications.

### POWER MANAGEMENT AND PRECISION ANALOG PRODUCTS

<table>
<thead>
<tr>
<th>Power Management</th>
<th>Amplifiers &amp; Buffers</th>
<th>Audio &amp; Video</th>
<th>Data Converters</th>
<th>Switches &amp; Multiplexers</th>
<th>Optoelectronics</th>
<th>Timing &amp; Digital</th>
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</thead>
<tbody>
<tr>
<td>Discrete DC/DC Converters</td>
<td>Buffers</td>
<td>Switches</td>
<td>D/A Converters</td>
<td>High Voltage</td>
<td>Ambient Light Sensors</td>
<td>Clock Generators</td>
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<tr>
<td>Battery Management Systems (BMS)</td>
<td>Comparators</td>
<td>Automotive Infotainment &amp; Security</td>
<td>Digital Potentiometers (DCPs)</td>
<td>Low Voltage</td>
<td>Ambient Light and Proximity Sensors</td>
<td>Counters/Time Base ICs</td>
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<tr>
<td>Computing Power VRM/IMVP</td>
<td>Current Sense</td>
<td>High-Speed</td>
<td>High-Speed A/D Converters</td>
<td>Medium Voltage</td>
<td>Laser Diode Drivers (LDD)</td>
<td>DSP</td>
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<tr>
<td>Digital Power</td>
<td>Differential Amplifiers</td>
<td>A/D Converters</td>
<td>Precision A/D Converters</td>
<td>USB</td>
<td>Proximity Sensors</td>
<td>Memory</td>
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<td>Display Power and Backlighting</td>
<td>Display Amplifiers and Buffers</td>
<td>Voltage References</td>
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<td>– High-Speed</td>
<td>Microprocessors and Peripherals</td>
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<tr>
<td>Hot Swap &amp; ORing</td>
<td>Gain Blocks</td>
<td></td>
<td>References</td>
<td>High-Speed plus 2ch Stereo Audio</td>
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<td>Isolated Power Supply</td>
<td>High-Speed Op Amps</td>
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<td>High-Speed UART</td>
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<td>Real Time Clocks</td>
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<td>LED Drivers</td>
<td>Instrumentation Amplifiers</td>
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<td>Dual 3-1 MUX</td>
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<td>LNB Regulators</td>
<td>Line Drivers</td>
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<td>Low Dropout Regulator ICs</td>
<td>Precision Op Amps</td>
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<td>MOSFET Drivers</td>
<td>Sample and Hold Amplifiers</td>
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<tr>
<td>PMIC</td>
<td>Transistor Arrays</td>
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<tr>
<td>Power Modules</td>
<td></td>
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</tr>
</tbody>
</table>

### Interface Space & Harsh Environment

- RS-485 & RS-422
- RS-232
- 2-Wire Bus Buffers
- Signal Integrity
- Radiation Hardened
- Defense & Hi-Reliability
INDUSTRIAL POWER MANAGEMENT SOLUTIONS

Renesas offers a complete portfolio of high-performance power solutions for processor, controller, DSP, FPGA, CPLD, DDR memory, or other load in your system. Whether you need standard linear regulators, highly flexible PWM controllers, or fully integrated plug-and-play power modules, these products are tailored to meet your design challenges.

### LDOs
- Fast transient response
- Best-in-class ±0.5% initial accuracy and ±1.8% total DC accuracy over full temp range
- Very low dropout (81mV @ 2A typ)
- Best-in-class package power density (Up to 3A per 9mm²)

### Switching Regulators
- Complete portfolio
- Robust and reliable
- High integration

### Analog Controllers
- Remote sense, Power-Good, Enable, adjustable soft-start
- Extensive protection (OCP, OVP, OTP, SCP)
- Reference tracking, voltage margining
- Pre-biased startup, external compensation
- External frequency synchronization

### FPGA Power Solutions
- Xilinx
- Intel (formerly Altera)
- Microsemi
- Lattice

Learn more about Renesas power management ICs, visit: renesas.com/products/power-management

INTERSIL SPACE PRODUCTS

Highly reliable, efficient and accurate radiation-hardened power and analog ICs for space applications and other radiation environments.

### SEVEN DECADES OF FLIGHT EXPERIENCE

Intersil’s (now Renesas) history and experience in the space and defense industries spans almost seven decades beginning with the founding of Radiation, Inc. in 1950. Today, we continue to support and release new SMD-based, Class-V/Q radiation hardened (rad hard) products for the Hi-Reliability and Space marketplaces.

The low dose rate total ionizing dose response of semiconductors has become a key issue in space applications. We are addressing this changed market through wafer-by-wafer low dose rate acceptance testing as a complement to current high dose rate acceptance testing.

All of our SMD products are MIL-PRF-38535/QML compliant and are 100% burned in.

Learn more about Intersil Space ICs, visit: renesas.com/products/space-harsh-environment
IDT’s RF products are best-in-class in dealing with unwanted interference from an increasingly crowded radio spectrum. Today’s higher data rates drive the need for better radio signal-to-noise ratios, which translates to the need for IDT’s higher linearity RF components. IDT’s unique patented RF solutions enable green networks with minimal power consumption and will serve as a company growth driver for years to come.

RF solutions from IDT address the evolving needs of a wide range of applications, including cellular 4G and 5G base stations, Active Antenna Systems for both sub-6 GHz and mmWave frequencies, and SATCOM phased array antennas.

IDT’s innovative silicon-based products utilize CMOS, SOI, and SiGe processes. To continue advancing our portfolio, IDT adds in III-V technologies to enable further improvements in device performance, as needed, for next-generation designs.

With a combination of technologies and advanced IP, IDT delivers unique solutions to the design challenges faced by designers.

Product Categories
- Integrated Receive RF Front-ends
- Transmit Chains
- mmWave Beamformers
- Digital step attenuators (DSA)
- Variable voltage attenuators (VVA)
- RF switches
- Broadband mixers
- Variable gain amplifiers (VGA)
- Amplifiers
- Broadband modulators
- DPD Demodulators with integrated DSA, RF switch and LO switch

Features
- Highly differentiated RF products
- Smart Silicon enables unique technical innovations
  - Low noise
  - High linearity
  - Low power
  - Small form factors
- Scalable RF Solutions for increased integration

Applications
Wireless Infrastructure
- 4G / 5G macro base stations
- Active antenna systems (AAS)
- 5G mmWave
- Distributed antenna systems (DAS)
- Repeaters
- Microwave (RF/IF) point to point

SATCOM
- Phased Array Antenna

Industrial
- Military/tactical communication systems
- FMCW Radar
- Public Safety
- Test and Measurement

Broadband CATV
- Headend (CMTS)
- Distribution nodes
- Fiber repeaters
- Cable modem, set-top box
- Satellite receivers and modems

To request samples, download documentation, or learn more, visit: idt.com/rf
With more than 20 years of industry experience, IDT is an expert in providing sensor technologies that enable our customers to design and build best-in-class sensor solutions. As we expand the breadth of our sensor technologies, IDT will create unique and differentiated sensor solutions.

**SENSORSHARE™ TECHNOLOGY**
Connects IDT’s array of environmental sensor solutions designed to measure, monitor, and sense smart devices and industrial end applications

**BREADTH OF EXPERIENCE**
Bringing decades of knowledge, know-how, and data from our technologies today into our solutions of the future

**TRUSTED, RELIABLE PARTNER**
A proven supplier who has shipped millions of parts into major consumer and automotive manufacturers

**BEST-IN-CLASS PERFORMANCE**
Featuring low-power, high-accuracy solutions meeting ISO 26262, Automotive EMC, and reliability requirements

To request samples, download documentation, or learn more, visit: idt.com/sensors
WIRELESS POWER

Leverage IDT’s leading-edge technology in your wireless power design with a portfolio that delivers the industry’s best flexible SoC architecture, efficiency, and hardware/algorithm implementation.

IDT’s highly integrated transmitter ICs are designed for use in fixed and portable charging bases, while the ultra-compact, low-power receiver ICs are targeted at portable devices and accessories. With variations in input voltages, wireless power standards support, and coil types/numbers, IDT’s wireless power solutions are suitable for a wide range of applications spanning virtually all markets and industries. In addition, some wireless charger ICs can provide additional benefits for increased wattage and control when paired together.

Because implementing wireless charging technology is complex, IDT complements its solutions with reference designs, support tools, and design-in documentation — streamlining the design-in process as much as possible.

IDT is a member of the Wireless Power Consortium (WPC) and develops wireless power ICs and reference design certified to the Qi standard.

IDT Advantages

- Industry first, flexible ARM® Cortex®-M0-based SoC architecture
- Industry-leading efficiency
- Unique and proven hardware / algorithm implementation
- Widest portfolio of wireless power Tx and Rx ICs provides distinct advantages in:
  - Integration
  - Ease-of-use
  - Power efficiency
  - Flexibility
- Qi-compatible wireless charging ICs
- Design support
  - Reference design kits enable fast prototyping and time to market
  - Extensive documentation library
    - Application notes
    - Design guides
    - User manuals
    - Online support tools

To request samples, download documentation, or learn more, visit: idt.com/wirelesspower
IDT offers the broadest and deepest silicon timing portfolio in the industry. In addition to our wide selection of buffers and clock synthesizer products, we deliver leading-edge system timing solutions to resolve timing challenges in virtually any applications. With proven expertise spanning more than twenty years in both analog and digital timing, our portfolio features the lowest phase noise and highest performance advanced timing technology.

**IDT TIMING FEATURES**
- Lowest phase noise and highest performance
- Industry’s broadest and deepest portfolio
- Proven expertise in both analog and digital timing
- Advanced timing technology

**IDT TIMING BENEFITS**
- Extensive online tools library
- Deep knowledge base / FAQ
- Complimentary clock tree design and review services
- Expert engineering support

**APPLICATIONS**
- Wireless infrastructure
- Networking
- Datacenters
- Consumer electronics
- Industrial systems
- Automotive infotainment and navigation

To request samples, download documentation, or learn more, visit: [idt.com/timing](http://idt.com/timing)