Renesas General-Purpose ICs
Power Management Linear ICs / General-Purpose Linear ICs / General-Purpose Logic ICs
General Catalog
Green Stream Solution

These solutions control the flow of power (energy) and contribute to reduced power consumption overall.

The beauty of solutions from Renesas. Achieving reduced power consumption in advanced applications.

Innovation for a beautiful planet...

*Both here and there.*

EVERY WHERE

The new Renesas offers a broad range of product lineups that contribute to an eco-friendly society.
Power Management Linear ICs

Power Management Linear ICs
(Insulated Switching Regulator Controllers)

**Typical Power Supply Circuit**

- **AC Input**
- **Rush Current Protection Circuit**
- **DC/DC Converter**
  - Converts one DC voltage to another DC voltage (step-down, step-up, inversion).
- **Battery Charger**
  - Controls charging of the secondary battery.

**Description of Functions**

1. **Overcurrent Protection Function**
   - Pulse by pulse: The PWM pulse width is limited one pulse at a time to provide protection.
   - Timer Latch: A function that stops pulse output when an overcurrent state has continued for a long period under the assumption that the boost diode has failed.
   - One shot: When an overcurrent state is ongoing, protection operation continues for a fixed period of time, followed by automatic recovery.

2. **Overvoltage Protection Function**
   - When the voltage is excessively large due to a problem such as a multifunction in the load, the overvoltage protection function operates to protect the power supply circuit.

3. **Remote ON/OFF**
   - Enables the power supply to be turned on and off remotely. Output is started and stopped according to a control signal from the system controller.

4. **Soft Start**
   - A system that gradually increases the PWM output pulse width after power-on to prevent overshooting due to a sudden rise in the DC/DC converter output. The function can be enabled by adding a CST to the DB pin.

5. **Adjustable Delay Timer**
   - Enables zero voltage switching (ZVS) by adjusting output time delay TD1 and TD2 by means of external resistors.

**Part No.** | **Application** | **PFC Function** | **DC/DC Function** | **1. Overcurrent Protection Function** | **2. Overvoltage Protection Function** | **3. Remote On/Off** | **4. Soft Start** | **5. Adjustable Delay Timer** | **Fmax (MHz)**
---|---|---|---|---|---|---|---|---|---
R2A20121 | Full bridge control, for high-efficiency applications | — | — | pulse by pulse | yes | yes | yes | yes | yes | 2.0
R2A20124A | Full bridge for high-efficiency applications, support for high load mode | — | — | pulse by pulse | yes | yes | yes | yes | yes | 1.0
MS1995/1/8 | Emergency, for low-power applications | — | — | pulse by pulse/Timer Latch | yes | — | — | — | — | 0.5
MS2213/281 | Local power supply for DC/DC converters, etc. | — | — | Timer Latch | yes | yes | yes | yes | yes | 0.7
MS2235 | Flyback regulator | — | — | — | — | — | — | — | — | —

## Low-Noise, High-Efficiency Interleaved PFC ICs

### Features of Renesas PFC ICs

<table>
<thead>
<tr>
<th>Part No.</th>
<th>1W Mode</th>
<th>Interleave Technology</th>
<th>ZCD Open State</th>
<th>ZCD ZVS State</th>
<th>5 Current Steady State Loss</th>
<th>Constant Power Limit</th>
<th>Multi Feature Loss</th>
<th>3 Dynamic OVP</th>
<th>6 OVP</th>
<th>7 OVP</th>
<th>Light Load Efficiency</th>
<th>Soft Start</th>
<th>OWL</th>
<th>Package</th>
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<tbody>
<tr>
<td>R2A20115</td>
<td>CCM</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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</tbody>
</table>

### Block diagrams & System merits

#### 1 System merits of CRM Interleaved PFC IC

![Block diagram of CRM Interleaved PFC IC](image)

- Low noise, low profile and high efficiency: suitable for FPD-TV power
- Down sizing
- Reduction of radial noise
- Suitable for FPD-TV power

#### 2 Feedback loop open detection

- Built over voltage protection.
- Brownout function

#### 3 Dynamic over voltage protection

- R2A20120 has “Dynamic” and “Static” OVP.
- Dynamic OVP is doing discharge through an external capacitor to the TL pin.

#### 4 Slave ZCD Signal Open/Short Protection Function

- Slave ZCD signal open/short protection function for long time under the assumption that the ZCD line is in an abnormal state.

#### 5 OCP Timer Latch

- OCP level stops OVP1 stop
- OCP waveform is recorded until 30msec

#### 6 Auto Brownout Function

- The AC input voltage is divided and smoothed before being input to the BO pin, preventing switching from occurring.
- The ZCD line is in an abnormal state.
- Halts GD pulses when slave restart mode operation continues for a long time under the assumption that the boost diode is in an abnormal state.

#### 7 OVP2 Function

- OVP2 function stops OVP1 stop
- OVP2 waveform is recorded until 30msec

### Evaluation results

#### 1 Ripple current comparison (CRM single vs. Interleave)

![Ripple current comparison graph](image)

<table>
<thead>
<tr>
<th>Type</th>
<th>Single</th>
<th>Interleave</th>
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</thead>
<tbody>
<tr>
<td>Vin=100V AC</td>
<td>200W</td>
<td>200W</td>
</tr>
<tr>
<td>Vin=100V DC</td>
<td>200W</td>
<td>200W</td>
</tr>
</tbody>
</table>

#### 2 Efficiency comparison (CCM single vs. CRM Interleave)

![Efficiency comparison graph](image)

<table>
<thead>
<tr>
<th>Type</th>
<th>CCM Single</th>
<th>CRM Interleave</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vin=100V AC</td>
<td>95%</td>
<td>92%</td>
</tr>
<tr>
<td>Vin=100V DC</td>
<td>94%</td>
<td>92%</td>
</tr>
</tbody>
</table>

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**Note:**
- CCM: Continuously Controlled Mode
- CRM: Discontinuous Mode
- CML: Complementary Mode

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**Other Features:**
- Functions for protecting systems & ICs
- Low-Noise, High-Efficiency Interleaved PFC ICs
- Power Management Linear ICs
Power Management Linear ICs (POL Converters)

There is a trend in high-performance equipment toward placement of a local power supply close to the load to improve power supply quality and reduce noise emission. Renesas Electronics offers a lineup of devices for such applications, including switching regulator controller ICs for use in combination with switching elements as POL converters and the R2J20702, a SiP with integrated MOS.

**R2J20702NP PWM Controller SiP with Integrated MOSSFET (POL-SiP) PWM**

- Integrates mutually optimized synchronous rectification PWM controller and power MOSFETs for high efficiency and reduced size
- Recommended input voltage range: 8V to 14V (supports control circuit operation at 5V)
- Support for large-current output: Max. 40A
- Integrated 0.6V reference voltage generator with 1% accuracy
- Wide operating frequency setting range: 200kHz to 1MHz
- Peak current control for high responsiveness
- Current sharing function (parallel operation of up to 5 devices)
- Support for single operation, 2-phase operation, and multichannel operation (tracking startup function)
- Integrated bootstrap SBD
- Integrated on/off control and overvoltage momentary cutoff function (hiccup circuit)
- Design support tools and evaluation boards available
- Compact package: QFN-56-pin (8mm × 8mm)

**POL Converters/Controllers**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Configuration</th>
<th>Converion Type</th>
<th>Operating Voltage Range</th>
<th>Rectification Type</th>
<th>Output Voltage</th>
<th>Oscillation Frequency</th>
<th>Output MOSFET</th>
<th>Other Functions</th>
<th>Package</th>
<th>T/RIDP</th>
<th>GPN</th>
<th>CSP</th>
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</thead>
<tbody>
<tr>
<td>R2J20702NP</td>
<td>POL SiP</td>
<td>Voltage step-down</td>
<td>7.4 → 18V</td>
<td>Synchronous rectification</td>
<td>40A</td>
<td>1kHz to 1MHz</td>
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<td>1</td>
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<td>–</td>
<td>–</td>
<td>–</td>
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</table>

1. **On/Off Control**

   - On/off control allows stopping IC function and turning off the MOSFETs when in the low-level or open state.

2. **OCP Hiccup Function**

   - When the C5 pin voltage exceeds 1.5V, the OCP hiccup function shuts off the IC and the MOSFETs. Also, the TRK-SS pin is pulled down to SGND by an internal circuit. The RES signal continues for 1,024 times[5] while the ICs off, then switching operation starts from the soft start state.
### Description of Power Management Linear IC (DC/DC) Functions

#### Multi Purpose DC/DC Converters

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Application</th>
<th>Operating Voltage Range</th>
<th>Current Consumption</th>
<th>Output Voltage</th>
<th>Output Current</th>
<th>Oscillation Frequency</th>
<th>Max. On/Duty</th>
<th>Other Functions</th>
<th>Package</th>
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</thead>
<tbody>
<tr>
<td>HA16114</td>
<td>Voltage step-up, polarity reversal</td>
<td>6~15V</td>
<td>9.5mA</td>
<td>3.3V</td>
<td>5mA</td>
<td>~155kHz</td>
<td>90%</td>
<td>Peak current limiter circuit</td>
<td>SOIC (20)</td>
</tr>
<tr>
<td>M62212</td>
<td>Voltage step-up, polarity reversal</td>
<td>6~15V</td>
<td>9.5mA</td>
<td>3.3V</td>
<td>5mA</td>
<td>~155kHz</td>
<td>90%</td>
<td>Peak current limiter circuit</td>
<td>SOIC (20)</td>
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<tr>
<td>M62215</td>
<td>Voltage step-up, polarity reversal</td>
<td>6~15V</td>
<td>9.5mA</td>
<td>3.3V</td>
<td>5mA</td>
<td>~155kHz</td>
<td>90%</td>
<td>Peak current limiter circuit</td>
<td>SOIC (20)</td>
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</tbody>
</table>

#### Fixed-Output-Voltage DC/DC Converters

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Application</th>
<th>Operating Voltage Range</th>
<th>Current Consumption</th>
<th>Output Voltage</th>
<th>Output Current</th>
<th>Oscillation Frequency</th>
<th>Max. On/Duty</th>
<th>Other Functions</th>
<th>Package</th>
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<tbody>
<tr>
<td>HA16120</td>
<td>Voltage step-up, polarity reversal</td>
<td>6~15V</td>
<td>9.5mA</td>
<td>3.3V</td>
<td>5mA</td>
<td>~155kHz</td>
<td>90%</td>
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<td>SOIC (20)</td>
</tr>
<tr>
<td>M62216</td>
<td>Voltage step-up, polarity reversal</td>
<td>6~15V</td>
<td>9.5mA</td>
<td>3.3V</td>
<td>5mA</td>
<td>~155kHz</td>
<td>90%</td>
<td>Peak current limiter circuit</td>
<td>SOIC (20)</td>
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<tr>
<td>M62219</td>
<td>Voltage step-up, polarity reversal</td>
<td>6~15V</td>
<td>9.5mA</td>
<td>3.3V</td>
<td>5mA</td>
<td>~155kHz</td>
<td>90%</td>
<td>Peak current limiter circuit</td>
<td>SOIC (20)</td>
</tr>
</tbody>
</table>

### Description of DC/DC Functions

#### Multi DC/DC Converters

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Conversion Type</th>
<th>Operating Voltage Type</th>
<th>Output Current (Max.)</th>
<th>Rectification Type</th>
<th>MOS FET</th>
<th>Load SW</th>
<th>Pin Sparse</th>
<th>Oscillation Frequency (Max.)</th>
<th>Max. On/Duty</th>
<th>Application</th>
<th>Other Functions</th>
<th>Package</th>
</tr>
</thead>
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<tr>
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<td>5mA</td>
<td>~155kHz</td>
<td>90%</td>
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<td></td>
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</tbody>
</table>

#### 1 Peak Current Limiter Circuit

Peak current detection is accomplished by connecting a resistor (R10) between designated pins. When an overcurrent condition causes the RSC voltage to drop more than 0.7V (standard), the charge current to the oscillation capacitor increases suddenly, minimizing the output switch’s on-period and turning off output.

#### 2 Output Short Protection

The output pin voltage is monitored, and the power supply is shut down when it drops below a specified value.

#### 3 On/Off Control

Enables the power supply to be turned on and off remotely. Output is started and stopped according to a control signal from the system controller.

#### 4 DTC (Dead Time Control)

At startup, a delay circuit prevents the output from turning on until the input power supply stabilizes.

#### 5 Soft Start

A system that gradually increases the PWM output pulse width after power-on to prevent overheating due to a sudden rise in the DC/DC converter output. This function can be enabled by adding a CST to the DB pin.

#### 6 Pulse by pulse CLM

The PWM pulse width is limited one pulse at a time to provide protection.

#### 7 Timer-Controlled Interval Operation Function

When a continuing overcurrent condition exists, the TM and ON/OFF pins are used to make the IC operate intermittently. This makes it possible to configure a power supply with sharp-drop-off characteristics.

#### 8 Quick Shut Function

The quick shut function resets the pin voltages when the IC is turned off, causing PWM pulses output to halt immediately.

#### 9 Vref Overvoltage Protection Function

The Vref input has an on-chip overvoltage protection circuit that prevents excessive voltage from entering via the Vref pin and damaging the device internally.

#### 10 Overvoltage Protection Function

When the voltage is excessively large due to a problem such as a multilayer in the load, the overvoltage protection function operates to protect the power supply circuit.

#### 11 Overcurrent Protection

This function limits the output current to prevent it from becoming excessive. There are two ways: one with a vertical drop-off characteristic and one with “hook-back” drop-off characteristics.

#### Power Good Function

This is a pin that indicates when the converter is supplying the normal output voltage. It is driven low in cases where it is necessary to indicate the possibility that the power supply output is outside the regulation range.
**Power Management Linear ICs**

**Photoflash capacitor charger IC with IGBT driver R2J20071BNS**

**Features**
- Self-oscillation method with fly-back transformer
- The charge completion is detected by indirect detection method with tertiary-winding or direct detection method with secondary-winding.
- Various protect functions
  - Low voltage protection
  - Thermal shutdown
  - Maximum off time limitation for Nch MOSFET
  - Overcharge protection for open winding
- Primary side current is adjustable by inputting the DC voltage to CHGADJ terminal.
- High precision charge completion detection voltage 1.0V +/-1.0%
- Various protect functions
  - Over charge protection for open winding
  - Thermal shutdown
  - Low voltage protection

**Application Circuit Example**

**Shunt Type**

**New Shunt Regulator IC Lineup**

For applications such as output voltage detection in all sorts of electronic devices and as reference voltage sources for A/D input, Renesas Electronics supplies a variety of shunt regulator ICs, including the HA17431 Series and the µPC1093, µPC1943, µPC1944, and µPC1945 Series. The HA17431G Series delivers high-voltage and high-precision characteristics in a compact package, while the µPC1093, µPC1943, µPC1944, and µPC1945 Series include compact-package and low-voltage models.

**Example Power Supply Circuit**

**Product Lineup**

<table>
<thead>
<tr>
<th>Item</th>
<th>Low voltage type (1.25V)</th>
<th>Standard voltage type (2.5V)</th>
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</thead>
<tbody>
<tr>
<td>Reference voltage</td>
<td>Vref (mV)</td>
<td>1,240</td>
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<tr>
<td>Maximum cathode voltage</td>
<td>Vkl (V)</td>
<td>16</td>
</tr>
<tr>
<td>Continuous cathode current</td>
<td>Ikl (mA)</td>
<td>-30~+50</td>
</tr>
<tr>
<td>Reference voltage accuracy</td>
<td>(%</td>
<td>±1</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>Top (°C)</td>
<td>-20~+85</td>
</tr>
<tr>
<td>Package</td>
<td>DPAK-10pin (2.5 x 2.0 x 0.6mm)</td>
<td></td>
</tr>
</tbody>
</table>

**Efficiency vs Primary side peak current**

![Diagram showing efficiency vs primary side peak current]
Power Management Linear ICs

Shunt Regulator ICs

Series regulator ICs require few external elements and are widely used as simple power supplies. Due to their excellent noise characteristics, series regulator ICs are suitable for supplying power to analog circuits that are sensitive to noise.

Series Regulator Lineup

- In addition to standard type regulators, low-saturation type (LDO) products with minimal input-output voltage difference and low-power CMOS type products are available.
- Wide range of output current specifications, from 0.1A to 2A
- Wide range of output voltage specifications, from 1V to 1.5V

Standard Type Three-Pin Regulators

CMOS regulator

Low-voltage, low-power consumption

Series regulator ICs

- Low-saturation type

Series regulator ICs, etc.

- CMOS regulator

Low-voltage, compact type

- Low-voltage type

Other shunt regulator ICs

Shunt regulator ICs are widely used as feedback circuits in switching power supplies and as reference voltage sources.

Features of µPC1093, µPC1943, µPC1944, and µPC1945 Series

- The product lineup includes the µPC1093 with a standard 2.5V reference voltage (equivalent to 431 from other vendors) and models with a low reference voltage of 1.26V.

Shunt Regulator ICs

Product Name Reference Voltage (V) Accuracy (%) Output Voltage Nominal Range (V) Absolute Maximum Specifications (V) Total Loss (W) Package Remarks

µPC1093 0.15 ±2.66 ±x ±3.0 to 5.0 27 1.05 SC-74A --
µPC1943 0.65 ±1.30 ±x ±1.0 to 2.0 25 1.49 SC-74A For 3V power supplies
µPC1944 0.65 ±1.30 ±x ±1.0 to 2.0 25 1.49 SC-74A For 3V power supplies
µPC1945 0.15 ±1.30 ±x ±1.0 to 2.0 6 0.08 DC-74A For 3.3V power supplies

1) When mounted on 16mm² x 0.7mm ceramic substrate 2) When mounted on 75mm² x 0.7mm ceramic substrate

Other shunt regulator ICs

Shunt regulator ICs are widely used as feedback circuits in switching power supplies and as reference voltage sources.

Features of µPC1093, µPC1943, µPC1944, and µPC1945 Series

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Power Management Linear ICs

3-Pin Type

Low-Saturation Regulators

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Output Current (mA)</th>
<th>IOUT</th>
<th>I2</th>
<th>I3</th>
<th>OT</th>
<th>VTH</th>
<th>Package</th>
<th>Features</th>
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<tbody>
<tr>
<td>µFB2905A</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>µFB2925A</td>
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<td></td>
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<td>2.5</td>
<td>SOT-89</td>
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<tr>
<td>µFB3045A</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.5</td>
<td>TO-92</td>
<td>Low-saturation, 3-pin</td>
</tr>
<tr>
<td>µFB3040A</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.5</td>
<td>TO-92</td>
<td>Low-saturation, 3-pin</td>
</tr>
<tr>
<td>µFB3051A</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.5</td>
<td>TO-92</td>
<td>Low-saturation, 3-pin</td>
</tr>
<tr>
<td>µFB3053A</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.5</td>
<td>TO-92</td>
<td>Low-saturation, 3-pin</td>
</tr>
</tbody>
</table>

*1: Limited by internal circuit characteristics. *2: When mounted on 16 cm² × 0.7 mm ceramic substrate

These 3-Pin Regulators IC Lineup always supply a stable output voltage, unaffected by fluctuations in the input voltage. They are suitable for use in audio equipment power supplies, for stabilization of unstable voltages of multi-output switching regulators, and for power supplies of various kinds of control devices.

Features

- Variety of output voltage grades
- Various built-in protection circuits: current limiting circuit, chip junction temperature limiting circuit, internal power dissipation limiting circuit
- Wide operating temperature range: Ta=−40 to +85°C

Series Regulators

- Suitable for precision, high-stability, low-capacity power supplies (up to 20W)
- Extremely low noise generation
- Facilitate circuit design

Example of Fixed-Output Regulator Circuit

Circuit Lineup

<table>
<thead>
<tr>
<th>Output voltage (V)</th>
<th>Current (mA)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0</td>
<td>100</td>
<td>UPAK(5628)</td>
</tr>
<tr>
<td>4.5</td>
<td>100</td>
<td>UPAK(5628)</td>
</tr>
<tr>
<td>4.0</td>
<td>100</td>
<td>UPAK(5628)</td>
</tr>
<tr>
<td>4.0</td>
<td>150</td>
<td>UPAK(5628)</td>
</tr>
<tr>
<td>3.3</td>
<td>150</td>
<td>UPAK(5628)</td>
</tr>
<tr>
<td>3.0</td>
<td>150</td>
<td>UPAK(5628)</td>
</tr>
<tr>
<td>2.8</td>
<td>150</td>
<td>UPAK(5628)</td>
</tr>
<tr>
<td>2.5</td>
<td>150</td>
<td>UPAK(5628)</td>
</tr>
</tbody>
</table>

Battery

Charge Control IC Roadmap

<table>
<thead>
<tr>
<th>Charge Control IC Roadmap</th>
</tr>
</thead>
<tbody>
<tr>
<td>For integrated charger applications</td>
</tr>
<tr>
<td><strong>R2A20050AN5</strong></td>
</tr>
<tr>
<td><strong>R2J20052NS</strong></td>
</tr>
</tbody>
</table>

Charge Control IC Lineup

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Name</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>R2A20050AN5</td>
<td>Power path control</td>
<td>Suitable for USB chargers</td>
</tr>
<tr>
<td>R2J20052NS</td>
<td>Power path control</td>
<td>Integrated JETAA profile support</td>
</tr>
</tbody>
</table>

Description of Functions

1 Battery Connection Detection Function

2 AC Adaptor Connection Detection Function

3 Temperature Detection Function

4 Forced Charge Stop

Power Management Linear ICs

For Battery Chargers
Smart Battery System for Notebook PC “R2J24020F/50F**”

High-precision battery charge remaining management and battery protection functions in a single package

Features

• 16-bit RBC CPU core—a low power consumption
• High precision A/D converter for more exact battery remaining detection and reduction of power consumption
• Smaller and thinner package—TS SOP48 (R2J24050F**)
• 16-bit R8C CPU core → Low power consumption
• High precision A/D converter for more exact battery remaining detection and reduction of power consumption
• Smaller and thinner package—TSSOP48 (R2J24050F**)

Battery Solution Roadmap

Example PC Battery Implementation Using SiP (R2J24010F)

Power Management Linear ICs

Peripheral ICs for MCUs

Power Supply Monitoring

Renesas Electronics produces a variety of peripheral ICs in response to a range of customer requirements, including single-function CMOS type devices with a voltage detection accuracy of ±1% and low current consumption, single-function bipolar type devices supporting high power supply voltages, and multifunction type devices such as sequencers for controlling the power-on sequence of multiple power supplies.

Reset ICs

• Single-Function Devices Supporting High Power Supply Voltages

<table>
<thead>
<tr>
<th>Category</th>
<th>Part No.</th>
<th>Package</th>
<th>Detection Voltage (Vs in V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply voltage detection</td>
<td>RNA51957BFP</td>
<td>FP</td>
<td>5.0V</td>
</tr>
<tr>
<td>Input voltage detection (Vs high)</td>
<td>RNA51957AFP</td>
<td>FP</td>
<td>4.6V</td>
</tr>
<tr>
<td>Power supply sequence controller</td>
<td>RNA52A10</td>
<td>FP</td>
<td>4.5V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A46FLP</td>
<td>FP</td>
<td>4.4V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A45FLP</td>
<td>FP</td>
<td>3.1V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A44FLP</td>
<td>FP</td>
<td>3.0V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A31FLP</td>
<td>FP</td>
<td>2.9V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A30FLP</td>
<td>FP</td>
<td>2.8V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A29FLP</td>
<td>FP</td>
<td>2.7V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A28FLP</td>
<td>FP</td>
<td>2.6V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A27FLP</td>
<td>FP</td>
<td>1.4V</td>
</tr>
</tbody>
</table>

**: Under Development

• Single-Function Devices with ±1% Voltage Detection Accuracy and Low Current Consumption

<table>
<thead>
<tr>
<th>Category</th>
<th>Part No.</th>
<th>Package</th>
<th>Detection Voltage (Vs in V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply voltage detection</td>
<td>RNA51953A FP</td>
<td>FP</td>
<td>5.0V</td>
</tr>
<tr>
<td>Input voltage detection (Vs high)</td>
<td>RNA51953B FP</td>
<td>FP</td>
<td>4.6V</td>
</tr>
<tr>
<td>Power supply sequence controller</td>
<td>RNA51957AFP</td>
<td>FP</td>
<td>4.5V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A10</td>
<td>FP</td>
<td>4.4V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A46FLP</td>
<td>FP</td>
<td>3.1V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A45FLP</td>
<td>FP</td>
<td>3.0V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A44FLP</td>
<td>FP</td>
<td>2.9V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A31FLP</td>
<td>FP</td>
<td>2.8V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A30FLP</td>
<td>FP</td>
<td>2.7V</td>
</tr>
<tr>
<td>Power good signal</td>
<td>RNA52A29FLP</td>
<td>FP</td>
<td>2.6V</td>
</tr>
</tbody>
</table>

**: Under Development

• Multifunction Devices Such as Sequencers for Multiple Power Supplies

<table>
<thead>
<tr>
<th>Category</th>
<th>Part No.</th>
<th>Function</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-channel CMOS reset</td>
<td>RNA51957B</td>
<td>Reset output: 1.5V PIT voltage detection voltage</td>
<td>FP</td>
</tr>
<tr>
<td>Power supply sequence controller</td>
<td>RNA51957B</td>
<td>Power supply sequence</td>
<td>FP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Part No.</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory controller</td>
<td>RNA51957B</td>
<td>Power-on delay</td>
</tr>
</tbody>
</table>

**: Under Development

• ASSPs for Memory Backup

<table>
<thead>
<tr>
<th>Category</th>
<th>Part No.</th>
<th>Function</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC/DC unit</td>
<td>RNA51957B</td>
<td>Monitoring: 12V</td>
<td>US</td>
</tr>
</tbody>
</table>

**: Under Development

http://japan.renesas.com/spesply_assp
Peripheral ICs for MCUs

Data Converters

Mixed digital/analog capability: the decisive factor in automatic adjustment and high-speed, high-precision control

These are D/A converters for trimming applications with 2 to 36 channels incorporated in one package, operating at low/medium speeds of 100kHz to 1MHz. The use of CMOS analog circuitry and pattern design employing patented technologies enables high precision to be achieved without using special processes, trimming, etc.

Features

- World’s top runner in trimming D/A converter market
- Wide selection of variations (DAC)
  - Number of channels: 2 to 36
  - Resolution: 8 to 12 bits
  - Bus type: Three-wire, PC
  - Power supply voltage: 3V, 5V systems available
- Fewer channel D/A converter lineup available

Applicable Market Areas

- Mobile phone, DVCs, DSCs, monitors, TVs, printers, CD-R, etc.

List of D/A Converters

<table>
<thead>
<tr>
<th>Channel count</th>
<th>Part No.</th>
<th>I/O : 4 to 12 channels selectable</th>
<th>D/A : 4 to 12 channels selectable</th>
</tr>
</thead>
<tbody>
<tr>
<td>36ch</td>
<td>M62370/371</td>
<td>Normal 3-wire D/A + I/O expander</td>
<td>M62376</td>
</tr>
<tr>
<td>12ch</td>
<td>M62352/352A/368/352B/369/352F</td>
<td>Multiplying type</td>
<td>M62392</td>
</tr>
<tr>
<td>8ch</td>
<td>M62354/354A/366/354B/367/354F</td>
<td>Trimming D/A converter</td>
<td>M62393/4/5/6</td>
</tr>
<tr>
<td>6ch</td>
<td>M62364/364A/364B/364F</td>
<td>Double-integral A/D</td>
<td>M62303 (AD18ch)</td>
</tr>
<tr>
<td>4ch</td>
<td>M62343</td>
<td>Multiplying type</td>
<td>M62301 (AD4ch)</td>
</tr>
<tr>
<td>3ch</td>
<td>M62343/344/345/346/347/348</td>
<td>Multiplying type</td>
<td>M62362</td>
</tr>
<tr>
<td>2ch</td>
<td>M62343/344/345/346/347/348</td>
<td>Multiplying type</td>
<td>M62333/334/335/336/337/338</td>
</tr>
</tbody>
</table>

Peripheral ICs for MCUs (D/A Converters)

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Voltage (V)</th>
<th>Channels</th>
<th>I/O : Selectable (I/O)</th>
<th>D/A : Selectable (D/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M62352/352A/368/352B/369/352F</td>
<td>2.7-5.5</td>
<td>36</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>M62354/354A/366/354B/367/354F</td>
<td>2.7-5.5</td>
<td>36</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>M62364/364A/364B/364F</td>
<td>2.7-5.5</td>
<td>36</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>M62333/334/335/336/337/338</td>
<td>2.7-5.5</td>
<td>36</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>

1. I/O bus type D/A converters have no I/O signal (a signal transferred from the serial interface of the serial IC to the D/A converter). no setting time is stipulated.
2. I/O is specified such that the duration from the falling edge of the 8th clock pulse of the clock data transfer to the establishment of the analog output voltage is 30µs (as a reference value).
3. Items with a product No. ending in A (7LSOP) are available in an LLSSOP package only.
Peripheral ICs for MCUs

**General-Purpose CMOS, Op-Amp. and Comparator ICs Series**

### Products Concept
We offer a lineup of products combining low-voltage operation, low power consumption, and compact size.

### Features
- Ultra-small package saves you space (CMPAK-5, MPAK-5, MMPAK-8, TSSOP-14)
- Low-voltage operation and low current dissipation most suitable for battery-use device (VDD=1.8 to 5.5V, IDD: 15 to 800mA). The high output type supports 2.7 to 5.5V.
- Output full-swing (operational amplifier) VOH:2.9Vmin
- Output low input offset voltage (operational amplifier) VIO=4mVmax
- Low input current bias current 150/30nA typ.
- Operating temperature range 

### Series Evolution
- **Op-Amps**
- **Comparators**

### Lineup
- **Op-Amps**
- **Comparators**

### General-Purpose Bipolar Op-Amp and Comparator ICs

#### μPC Series Product Lineup

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Spin</th>
<th>Input offset</th>
<th>Input bias</th>
<th>Operating voltage (V)</th>
<th>Current (mA typ.)</th>
<th>Response Time (μs)</th>
<th>Power Supply Voltage (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single power supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single power supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single power supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single power supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single power supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single power supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes
- When multiple values are listed, the figure on the left applies to products with fewer channels and that on the right to products with more channels.
- “SR” indicates the slow rate of an op-amp, and “response time” refers to the pulse response time of a comparator.
Peripheral ICs for MCUs

HA17 Series General-Purpose Bipolar Op-Amp and Comparator ICs

Features
- Lineup of world standard compatible products
- Variety of packages (DIP-8/14, SOP-8/14, TSSOP-8/14)

Specifications
- Op-Amps
  - HA17003A: +15V, –14V
  - HA17004A: +15V, –15V

- Comparators
  - HA17901A: +15V, –15V
  - HA17902A: +15V, –15V

Product Lineup

<table>
<thead>
<tr>
<th>Op-Amps</th>
<th>Comparator</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA17003A</td>
<td>HA17901A</td>
</tr>
<tr>
<td>HA17004A</td>
<td>HA17902A</td>
</tr>
</tbody>
</table>

Peripheral ICs for MCUs (LED Drivers)

In addition to scan-type displays such as LCD panels, LEDs and other light emitting elements are important means for indicating output from control systems such as MCUs. Two types of devices are used to drive LEDs: constant-voltage drivers (simple switches) and constant-current drivers. Output varies with the power supply voltage when constant-voltage drive is used, but this method is widely used in low-cost applications due to its simplicity. In contrast, constant-current drive has the advantage of unvarying brightness regardless of fluctuations in the power supply voltage, making it suitable for applications (such as game machines) where subtle color changes would cause problems.

Either series or parallel connection can be used to drive multiple LEDs. Since white LEDs have a voltage drop of 3V to nearly 3.6V, high voltage is necessary when they are connected in series, and the driver used must have a high voltage tolerance. When the LEDs are connected in parallel, a drive capacity of 10mA to 20mA per LED is necessary.

Renesas Electronics offers a wide-ranging lineup of LED driver ICs, including high-output devices that can also accommodate parallel connection of many LEDs, devices with latch input, devices with a serial-parallel function using a shift register, and newly developed SpAS* devices.

Note: With an SpAS type LED driver, an SCI interface is used to illuminate multiple LEDs. Each LED is assigned an address, allowing for fine-grained control focusing on specific points. (SpAS stands for “SCI protocol with address selected.”)

Development Roadmap

In game machines a large number of LEDs are typically mounted on a board with a large area. Using conventional serial-parallel conversion employing shift registers requires a large number of control lines and is very susceptible to noise. An SpAS type LED driver, which provides stable drive by means of SCI-based address selection, is ideal in such cases.
Peripheral ICs for MCUs

LED Drivers

Main High-Functionality ICs

- **Part No.**: RD40LD003FP 8, RD30LDT595 8, RD15LD74A 8, RD30LDT3595 24, RD30LD06A 8
- **Function**: Data protection, Shift register
- **Input/Output**: Serial-parallel conversion
- **Characteristics**: Enables simplified LED data transfer and efficient power management.

1. **Shift Register Serial-Parallel Function**
2. **SpAS/SCI protocol with Address System**
3. **DMAC**
4. **Power Up/Down Protection**
5. **Gradation Control**

Level Converters

A wide range of products are available, including high-speed level shifters, clock generators that reduce emission noise, and world standard interface ICs.

**Level Shifting Use in Personal Computer, etc.**

3V
- **3V**
- **FDD**, **HDD**, **LCD**, **I/O port**

5V
- **FDD**, **HDD**, **LCD**, **I/O port**

**Level Shifting Use in Personal Computer, etc.**

- **3V**
- **5V**

**Ex. Memory**

<table>
<thead>
<tr>
<th>Vcc</th>
<th>Level Shifters (for Level Transfer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2-2.7V</td>
<td>HD74ALVC165245A (Vout:2.5-3.6V)</td>
</tr>
<tr>
<td>1.4-3.6V</td>
<td>HD74ALVC16105245A (Vout:3-3.6V)</td>
</tr>
<tr>
<td>1.2V</td>
<td>HD74ALVC4245A (Vout:2.5-3.6V)</td>
</tr>
<tr>
<td>2.3-3.6V</td>
<td>HD74ALVC4245A (Vout:3-3.6V)</td>
</tr>
</tbody>
</table>

**Ex. CPU**

<table>
<thead>
<tr>
<th>Vcc</th>
<th>Level Shifters (for Level Transfer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4-3.6V</td>
<td>HD74ALVC165245A (Vout:2.5-3.6V)</td>
</tr>
<tr>
<td>2.5V</td>
<td>HD74ALVC4245A (Vout:2.5-3.6V)</td>
</tr>
</tbody>
</table>

**High-Speed Level Shifter Lineup**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Bits</th>
<th>High/Level Transfer</th>
<th>VccA</th>
<th>VccB</th>
<th>Tj (max)</th>
<th>Drive Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD74ALVC168245A</td>
<td>16</td>
<td>○</td>
<td>2.5V</td>
<td>2.5V</td>
<td>4.0mA</td>
<td>25mA</td>
</tr>
<tr>
<td>HD74ALVC165245A</td>
<td>16</td>
<td>○</td>
<td>2.5V</td>
<td>2.5V</td>
<td>6.0mA</td>
<td>50mA</td>
</tr>
<tr>
<td>HD74ALVC4245A</td>
<td>6</td>
<td>○</td>
<td>5V</td>
<td>5V</td>
<td>2.7 to 3.6V</td>
<td>7mA</td>
</tr>
<tr>
<td>HD74ALVC4245A</td>
<td>6</td>
<td>○</td>
<td>5V</td>
<td>5V</td>
<td>2.7 to 3.6V</td>
<td>7mA</td>
</tr>
<tr>
<td>HD74ALVC3245A</td>
<td>8</td>
<td>○</td>
<td>2.7 to 3.6V</td>
<td>3.3V</td>
<td>9mA</td>
<td>25mA</td>
</tr>
<tr>
<td>HD151015</td>
<td>9</td>
<td>○</td>
<td>2.7V</td>
<td>4.5V</td>
<td>13mA</td>
<td>25mA</td>
</tr>
</tbody>
</table>

Note: *Control pins (DR, DO) are VccA on the LVC Series and HD74145, and VccB on the ALVC Series. **: VccA = 3.3V, VccB = 5.0V.
Peripheral ICs for MCUs
Uni-Logic

One to Three Gates in Ultra-Small, Lightweight Packages.
As portable electronic products become ever more compact, there is a constant demand for smaller and lighter logic ICs. The solution to this demand is provided by Uni-Logic ICs, containing from one to three logic gates in a package with a mounting area approximately 1/20 that of an SOP. As well as making efficient use of on-board space, these devices facilitate wiring design. And board modifications can be achieved simply by adding logic.

Configurable Multiple Function Gate
One product realizes various logic functions by changing connection of input pins.

Unidirectional Level Shifting Using Uni-Logic IC
Eliminates wasted space by reducing the mounting area.

Package Comparison

Uni-Logic Family

Uni-Logic

http://documentation.renesas.com/jpn/products/logic/tq7a0013_uni_tokusei.pdf
Overview of Low-Voltage Logic ICs

Low-Voltage Products Offering a Variety of System Benefits.

These low-voltage standard logic ICs meet the demands of portable systems for small size and low power dissipation together with high performance. These devices offer such user-friendly features as performance equivalent to or exceeding that of 5V standard logic ICs on a drive voltage of only 3V, good noise characteristics, and usability in mixed 5V/3V systems.

High-Speed Type LVC Series

RD74LVC-B Series / HD74LVC Series

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-speed operation</td>
<td>Vcc: 1.65V to 5.5V</td>
</tr>
<tr>
<td>Low leakage and low current consumption</td>
<td>ILO=5mA (max)</td>
</tr>
</tbody>
</table>

LVCZxxxA Products CMOS Logic ICs Supporting Hot Swapping

These ICs support hot swapping, with output being driven to the high-impedance state when IC power is turned ON or OFF. HD74LVCZxxxA products employ a Power Up/Down protection function that prevents erroneous system operation by driving output to the Hi-Z state in a power supply voltage range of 0V to 2V. In addition to hot swapping, this is also useful for systems whose operation is to be guaranteed when power is turned ON or OFF.

Schematic Drawing of Boards

Main system (power only)

High-Voltage Logic IC RD74HV1G Series/RD74HV8T Series

<table>
<thead>
<tr>
<th>Function</th>
<th>Part No.</th>
<th>Package</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-bit Products</td>
<td>RD74HV1G34VS</td>
<td>SOP-20</td>
<td>16</td>
</tr>
<tr>
<td>4-bit Products</td>
<td>RD74HV1G08VS</td>
<td>SOP-20</td>
<td>10</td>
</tr>
<tr>
<td>2-bit Products</td>
<td>RD74HV1G04VS</td>
<td>SOP-20</td>
<td>8</td>
</tr>
<tr>
<td>1-bit Products</td>
<td>RD74HV1G02VS</td>
<td>SOP-20</td>
<td>4</td>
</tr>
</tbody>
</table>

Example Illustration of Level Conversion (Conversion from 5V to 30V)

- RD74HV1G02VS
- RD74HV1G04VS
- RD74HV1G08VS
- RD74HV1G34VS

Example Illustration of Level Conversion (Conversion from 3.3V to 30V)

- RD74HV8T02
- RD74HV8T04
- RD74HV8T06
- RD74HV8T07
EMI Noise Solutions are Urgently Needed.

- EMI noise is becoming an increasingly severe problem due to the higher system operating frequencies used in the latest equipment.
- EMI noise is generally thought to adversely affect other electronic equipment, and recently, the regulations limiting EMI emissions have become increasingly strict in many countries around the world. (USA: FCC, Europe: CE, Japan: VCCI)
- Renesas is releasing the SSCG Series that adopts spread spectrum technology to reduce EMI noise.

**Actual EMI Test Results**

- Significant reductions in the system development period.
- Stable EMI performance that does not depend on the skill and experience of system engineers.
- No circuit board design changes, and no new components are required.
- Tuning the resistor and capacitor component values to improve the EMI characteristics.

**Effects of SSCG**

- The high-frequency peaks have been reduced and the EMI characteristics improved significantly by using Renesas SSCG Series devices.

**RD151TS33XXXA Series Lineup**

Output frequency: Covering a wide range of frequencies from 10MHz to 160MHz, and providing respective center/down spread modulation. Most suitable products for application can be selected.

**Serial Interface**

- Also the power-saving CMOS edition that is compatible with the high-function RS-485, and the interface IC based on the RS-422A, which is suitable for high-speed, long-distance interfaces between PCs are lined up. (HD26/29 series)
I/O Expanders, High-Speed Bus Switches

I/O Expanders

I/O expanders are a convenient way to extend the ports of an MCU. Our lineup includes products with FC bus and parallel bus support.

High-Speed Bus Switches

250 ps Switching Speed. Ultra-High 8-Fold Speed at a Stroke.

Bus Switch

- 250 ps delay time enabling the construction of high-speed bus systems
- Almost no power is consumed within the circuit, for low power dissipation
- Structure providing on/off linkage between input and output eliminates the need for direction switching in input/output switching
- 5V => 3.3V level transfer, partial power-down support

Input/Output Characteristics Supporting Partial Power-Down

The HD74CBT Series supports partial power-down operation (partial power supply stoppage). As there is no leakage current at the time of NMOS switch-off, the Vcc = OFF and Vcc = ON systems are totally isolated in partial power-down mode. Functions remain unchanged when HD74CBT power is turned off.

Bus Switch Series (HD74CBT1G125/126CM)

Signal on/off
(Low on-resistance: 5W (typ), ultra-high speed: 250ps)
Partial power-down support SW:
High impedance at off or power-off
Small CMPAK-5 package

Applications

PWM Power Supply with PFC Function, Low-Voltage DC/DC Converter, Uninsulated On-Board DC/DC Converter

Isolated DC/DC converter
(full-bridge, phase shift)

Low-Voltage DC/DC Converter

Uninsulated On-Board DC/DC Converter

Application Circuit Example

http://japan.renesas.com/power_supply
### Generating the reference voltage for the secondary side error amplification circuit of a switching power supply.

![Reference Voltage Circuit Diagram](image)

### Interface between 3.3V LOGIC system to 12V LOGIC system.

![Interface Circuit Diagram](image)

### Controlling the hardware standby mode of an MCU.

**Circuit Example Using a Multifunction Reset IC for Memory Write Prevent Processing Before Hardware Standby.**

The hardware standby function of the H8S/SX can be used to maintain data in on-chip memory. Using a standby controller (RD3ST24) in combination enables a simpler circuit design. When the RNA52A10 is used, data can be maintained in memory with a higher degree of safety because the transition to standby mode can be made after write prohibit processing.

Note: This circuit diagram is intended for reference only. Careful verification should be performed before actually using this design in a system.

### Monitoring the power supply voltage.

**Multiple Power Supply Application Example of Multifunction Reset IC.**

The power supply to the RNA52A10MM enables monitoring of a separate voltage. For example, it is possible to monitor a motor drive power supply and have a warning lamp light when a voltage drop occurs.

Note: This circuit diagram is intended for reference only. Careful verification should be performed before actually using this design in a system.
Applications

Power Supply Reference Voltage, Standby Control, Reset

Controlling the power-on sequence of power supplies.
Example of power supply sequence control using a multifunction reset IC and an MCU with two power supplies.

For Dual Power Supplies MPU/MCU

For Triple Power Supplies MPU/MCU

Note: This circuit diagram is intended for reference only. Careful verification should be performed before actually using this design in a system.

Controlling an LCD backlight.
Sample Backlight Control Application Circuit Using MS2115FP Dual-Input Type DC/DC Converter

Converting between different logical levels.
Easy implementation of 5V → 3.3V Level Conversion Using External Diode

Extending the output ports of an MCU.

Note: Simultaneous startup of SH7785 MCUs, etc.
In this case an external power supply unit must be used due to the large current requirements.
Simultaneous power supply startup can be difficult under these circumstances.
This configuration example is designed to deal with this problem.
Applications

Port Extension, Weak Signal Handling, Battery Monitoring, Camera Flash

Handling weak signals, Driving an actuator.

Monitoring the charge current of a battery charger.

Driving a camera flash unit.

Illuminating LEDs using an SpAS system.

Illuminating LEDs using serial-parallel conversion.

Illuminating 7-segment LEDs.
Applications

LED Illumination

Lowering the voltage for LED illumination.

Application Circuit Example (Voltage Step-Down Mode)

Raising the voltage for LED illumination.

Application Circuit Example (Voltage Step-Up Mode)

Package Dimensions

Package Dimensions 1
### Package Dimensions 6

<table>
<thead>
<tr>
<th>Package Name</th>
<th>Package Code</th>
<th>(Units: mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSOP</td>
<td>MPRF008JC-A</td>
<td></td>
</tr>
<tr>
<td>SSOP</td>
<td>8P2L-A</td>
<td></td>
</tr>
<tr>
<td>SSOP</td>
<td>8P2K-A</td>
<td></td>
</tr>
<tr>
<td>SSOP</td>
<td>16P2E-A</td>
<td></td>
</tr>
<tr>
<td>SSOP</td>
<td>20P2E-A</td>
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</tr>
<tr>
<td>SSOP</td>
<td>2P2P-A</td>
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<tr>
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</tr>
<tr>
<td>TSSOP</td>
<td>PTSP0024JB-A</td>
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</table>

### Package Dimensions 7

<table>
<thead>
<tr>
<th>Package Name</th>
<th>Package Code</th>
<th>(Units: mm)</th>
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</thead>
<tbody>
<tr>
<td>SSOP</td>
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<tr>
<td>SSOP</td>
<td>PTSP0016JA-A</td>
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<tr>
<td>TSSOP</td>
<td>PTSP0008JC-B</td>
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<tr>
<td>QFP</td>
<td>48PFD-28</td>
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</tr>
</tbody>
</table>

*Dimension including the plating thickness
Base material dimension
*Dimension including the plating thickness
Base material dimension
*Dimension including the plating thickness
Base material dimension
*Dimension including the plating thickness
Base material dimension
*Dimension including the plating thickness
Base material dimension
Package Dimensions

Package Dimensions 8

Package Dimensions 9
### Renesas New Package Code Destination

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Composition</th>
<th>Destination</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRDP 0008</td>
<td>A - F - A</td>
<td></td>
</tr>
</tbody>
</table>

- **Package structure code (1 alphanumeric character)**
  - Code: Description
  - M: Ceramic (Laminated ceramic)
  - S: Package using wafer process

- **Taping and packing specification**
  - Code: Description
  - R: Lead plating specification
  - V: Package using wafer process
  - X: Package consisting of metal
  - 0.50: Light transmissive package
  - 0.80: X
  - 1.00: V
  - 1.70: R

- **Package mounting height code (1 alphanumeric character)**
  - Code: Description
  - 1: Package appearance code (2 alphanumeric characters)
  - 8: Package type

### Part No. Composition

- **Package type**
  - ZIP: Asymmetric DTP
  - SIP: SOJ
  - SOJ: TSOP(1)
  - QFP: QFF
  - QF: LGA
  - DIP: Card with connector
  - BGA: BGA

- **Pin pitch code (1 alphanumeric character)**
  - 1.20: L
  - 1.70: Z

- **Appearance identification code**
  - Contact-less: No. Pins
  - No. Pins

- **Display**
  - GD: 0208
  - W: 0000

- **Number of pins (4-digit number)**
  - 0208

### Standard Logic Part No. Composition

**Base Series**
- HD74HC
- HD74AC
- HD74LV-A
- HD74ALVC
- HD74CBT
- HD26
- HD29
- HD151
- RD74LV-B
- RD3CYD
- RD5CYD
- RD74HV

**Taping Abbreviation**
- E: Embossed
- EL: Embossed, left-reel
- ELL: Embossed, left-reel, large

**Package Abbreviation**
- P: DIP
- FP: JEITA SOP
- RP: JEDEC SOP (Overseas sales only)
- T: TSSOP
- SS: SSOP (Without 8 pins)
- CM: CMPAK
- VS: VSON
- US: SSOP-8

**Product Name Number (Function)**
- 1G: 5-pin / 6-pin device
- 1GW: 6-pin device
- 2G: 6-pin / 8-pin device
- No code: Other

**TTL Input Level Product**
- Note: TTL input versions of the HD74L V1G/2G are the L V1GT/2GT.
### Product Numbers 3

#### Part No. Destination of Series Regulators

<table>
<thead>
<tr>
<th>µPC</th>
<th>29</th>
<th>M</th>
<th>33</th>
<th>A</th>
<th>T</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

1. **Product category**
   - C: Bipolar integrated circuits
   - D: CMOS integrated circuits

2. **Series**
   - Bipolar type:
     - D: CMOS integrated circuits
     - C: Bipolar integrated circuits
   - CMOS type:
     - N: No representation
     - A: 2A
     - W: 1.5A

3. **Additional functions**
   - 0: None
   - 1: ON/OFF

4. **Output voltage**
   - 00: Variable
   - 10: 1.0V or 10V
   - 11: 1.5V or 15V
   - 18: 1.8V or 18V

5. **Output Current**
   - L: 100mA
   - N: 300mA
   - T: 400mA
   - M: 500mA
   - D: 500mA
   - W: 5.0V

6. **Version**
   - T: SC-63 or SOT-89
   - H: SC-64
   - T1: TO-252 (Pin 3)
   - T1B: SOT-89
   - T1F: TO-252 (Pin 5)

7. **Package**
   - GR-9LG: TSSOP
   - DP-14/16
   - FP-14DN
   - FP-8DC
   - FP-20DA
   - FP-8DGV
   - FP-14DNV
   - FP-16DA
   - FP-20DA

8. **Version**
   - D: CMOS integrated circuits
   - C: Bipolar integrated circuits

---

### Packing

#### Packing 1

<table>
<thead>
<tr>
<th>Package</th>
<th>Packing Unit (packs/box)</th>
<th>Symbol</th>
<th>Appearances</th>
<th>Magazine</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1F</td>
<td>2,500</td>
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</tr>
<tr>
<td>5F</td>
<td>2,500</td>
<td>4L</td>
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<td></td>
</tr>
</tbody>
</table>

- **Part No.** + (EL) or (ELL)
- **Part No.** + (-EL)

*Products with "EL" and "-EL" (UPAKV) are the counter-clockwise rolled emboss tape type. Please order the products in packing units for shipment in reel.*

---

### Part No. Destination of Switching Regulators

<table>
<thead>
<tr>
<th>µPC</th>
<th>1933</th>
<th>GR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

1. **Product category**
   - C: Bipolar integrated circuits
   - D: CMOS integrated circuits

2. **Product serial number**
   - C: CX
   - G: GR, GS: SOP
   - W: wafer

---

### Part No. Destination of Op Amp & Comparators

<table>
<thead>
<tr>
<th>µPC</th>
<th>358</th>
<th>GR - 9LG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

1. **Product category**
   - Bipolar integrated circuits

2. **Product serial number**
   - MN-KAA: TSSOP
   - MP-KAA: TSSOP(2.8x2.9)
   - G2: SOP(25mili)
   - C: DIP(300mili)

3. **Package**
   - GR-9LG: TSSOP
   - MN-60A: TSSOP
   - MP-KAA: TSSOP(2.8x2.9)
   - G2: SOP(25mili)
   - C: DIP(300mili)
### General-Purpose Logic Taping Specifications

<table>
<thead>
<tr>
<th>Package</th>
<th>Packing Configurations</th>
<th>Packing Unit (pcs/reel)</th>
<th>Symbol</th>
<th>Appearance</th>
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<tbody>
<tr>
<td>SOP (JEITA)</td>
<td>SOP-8&quot; (FP)</td>
<td>Magazines (Multiples of 1000) Taping</td>
<td>2500</td>
<td>EL</td>
</tr>
<tr>
<td></td>
<td>SOP-14&quot; (FP)</td>
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<td>SOP-16&quot; (FP)</td>
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<td>SOP-20&quot; (FP)</td>
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<tr>
<td></td>
<td>SOP-8&quot; (RP)</td>
<td>Magazines (Multiples of 1000) Taping</td>
<td>2500</td>
<td>EL</td>
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<td>SOP-14&quot; (RP)</td>
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<td>CMPAK</td>
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</tr>
<tr>
<td>SSOP</td>
<td>SSOP-8 (US)</td>
<td>Taping</td>
<td>3000</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>SSOP-36 (FP)</td>
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</tr>
</tbody>
</table>

EL/ELL is the counter-clockwise-reeled emboss-tape type.
*Please order the products in multiples of 1000 for shipment in magazines (applicable only to “*” and DIP).*

### Environmental Considerations for Renesas Electronics Products

Renesas Electronics is working actively to improve product environmental quality in all aspects of its business operations, including product design, materials procurement, manufacturing, and shipping.

#### Design
- Development of environmentally compliant products through product environmental assessment
- Making products more resource and energy efficient (more compact, higher integration, reduced power consumption, extended service life)
- Reducing environmental load due to chemicals (management of chemical content of products)
- Compliance with domestic and international product environmental regulations
  - EU RoHS Directive, China RoHS, EU Directive, REACH Regulation

#### Procurement
- Thoroughgreen procurement activities
- Investigation and confirmation of chemical content of procured parts and materials
- Prevention of inclusion or contamination by prohibited chemicals in products (process management)
- Reduction of CO₂ emissions (reduction of PFC output and energy usage), reduction of environmental load from chemicals used in manufacturing, reduction of waste materials

#### Manufacturing
- Reduction of energy consumption in transport (improving overall efficiency of distribution)
- Reducing environmental load due to chemicals (management of chemical content of products)
- Reduced power consumption, extended service life

#### Shipping
- Customers
  - Requirement to eliminate hazardous substances, requirements for use of chemical substances
- Development, design
  - Original environmental management (development and design operations)
- Procurement
  - Green procurement (procurement of environmentally compliant products)
- Green procurement (procurement of environmentally compliant products)
- Assurance of chemical content of products
- Assurance of chemical content of products

#### Renesas Green Device Accreditation System

Renesas green device definitions:
Renesas Electronics defines green devices as products that reduce environmental impact by more than a specified amount over their life cycle, which includes procurement, production, distribution, use, and disposal, as determined at the R&D and design stage according to the company’s internal environmental standards. Renesas Electronics recognizes three green device ranks for each fiscal year.

- a) Green devices:
  - Products having a “FactorX” score of 1 or higher after completion of a product environmental assessment (at completion of development), and an improvement ratio of 10% or greater.
- b) Supergreen devices:
  - Products that have been assigned a “FactorX!” score after completion of a product environmental assessment (at completion of development) and an improvement ratio that place them among the top 20 products.
- c) Ultragreen devices:
  - Products selected from among the supergreen devices as having environmental performance that is No. 1 in the industry or extremely high, or products that combine high environmental performance with excellence in another aspect such that they are considered to contribute substantially to boosting the presence of Renesas Electronics.

### Environmental Management

- Compliance with customer requirements
- Transmission of information such as chemical content of products
- Part 1: Reduction of the use of hazardous substances, environmental quality management
- Part 2: Overview of environmental quality management system
Visit www.renesas.com for comprehensive support for your development work.

**Searching by Product Name**
By using the search function on the top page you can go directly to the content that interests you.

- **Keyword/Part No. Search**
  You can search the contents of the website by entering keywords or enter a part number to view a listing of product specifications. On the results page you can switch to the information you need by clicking the corresponding tab. (Click on the tabs in the back to display the product pages from which datasheets, etc., can be obtained.)

- **Parametric Search**
  You can display custom listings of product specs by narrowing the range of functions or specifications to search for. The search results can then be downloaded as a CSV file.

- **Document Search**
  You can search for documents by document type or document number.

- **Obsolete/Discontinued Product Search**
  You can search for information on products that have been discontinued or are no longer being actively promoted.

**Searching by Application**
The selection of application examples on the Renesas Electronics website has been further enhanced. You can search for product examples among the following categories.
- Mobile/networking
- PCs and PC peripherals
- Consumer electronics
- Healthcare
- Automotive
- Industrial/building management
- Elemental technologies

**Searching by Category**
From the standard IC top page you can search for content arranged by product series from among categories such as power ICs, op-amps and comparators for use with MCUs, converter ICs, and logic ICs. In addition, you can use the navigation panel on the left to locate documentation related to standard ICs.

**Support Information**
We aim to offer a total support package to meet customers’ needs through the provision of simulation data, FAQ, seminars, inquiries via the Web, and so on.

**Renesas VP**
The Buck Designer section of Renesas VP enables you to enter your usage conditions to obtain a listing of the optimal power MOSFETs for your buck converter and a graphical display of its simulated characteristics.

**User Registration**
MyRenesas Registration provide rich information about Renesas by mail-magazine and various premium supports.

**http://www.renesas.com**

Renesas Electronics Corporation

Renesas General-Purpose ICs

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