INDUSTRIAL POWER MANAGEMENT

Rugged, high-performance power solutions for demanding environments
PROVIDING SOLUTIONS FOR TODAY’S COMPLEX POWER NEEDS

INDUSTRIAL POWER

Contents

Analog Controllers ................................... 04
Switching Regulators .............................. 06
Simple DC/DC Power ICs ....................... 08
Low Dropout Regulators (LDO) ............... 10
Shunt Regulators ................................. 11
Battery Management ............................. 12

Power Modules ...................................... 14
MOSFET Drivers .................................... 16
Wireless Charging ................................. 18
FPGA Power Solutions ......................... 20
PowerCompass™ Tool ............................ 21
A Complete Power Solution

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

Featured in this guide:

**Analog Controllers**
- On-chip MOSFET drivers
- Internal bootstrap diodes
- Best for high voltage/high current

Page 4

**Int. Controller, Driver FETs**
- Integrated HS/LS FETs

Page 6

**LDOs**
- Low dropout power FET
- High-speed control loop
- Low-noise performance

Page 10

**Battery Management System**
- One-package solution with MCU and AFE
- Built-in FET driver

Page 12

**Power Modules**
- Integrated controller, power FETs, output inductor, and compensation circuitry

Page 14

**MOSFET Drivers**
- Integrated LDO to power system circuits
- High current drive stage

Page 16

**Wireless Charging**
- Integrated DC/DC converter
- All functions needed for receiver are integrated on one chip

Page 18
High efficiency ISL81601 controller leverage proprietary buck-boost algorithm for reliable bidirectional operation and smooth mode transitions.

**Key Features**
- Wide input voltage range: 4.5V to 60V
- Wide output voltage range: 0.8V to 60V
- Proprietary algorithm for smoothest mode transition
- MOSFET drivers with adaptive shoot-through protection
- On-the-fly bidirectional operation with independent control of voltage and current on both ends

**Benefits and Key Features**

- **Extensive Protection**
  - OCP, OVP, OTP, SCP

- **Large Selection**
  - Wide input voltage up to 72V
  - Several configurations (single output, multi-output, multi-phase)
  - Wide frequency (100 kHz to 2.5 MHz)
  - Variety of package choices (i.e., DFN, QFN, HTSSOP, QSOP)

- **High Integration**
  - On-chip MOSFET drivers
  - Internal bootstrap diodes
  - Integrated compensation

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**ISL81601** True Bidirectional Synchronous Buck-Boost Controllers for Industrial Battery-Powered Applications

High efficiency ISL81601 controller leverage proprietary buck-boost algorithm for reliable bidirectional operation and smooth mode transitions.

**Key Features**
- Wide input voltage range: 4.5V to 60V
- Wide output voltage range: 0.8V to 60V
- Proprietary algorithm for smoothest mode transition
- MOSFET drivers with adaptive shoot-through protection
- On-the-fly bidirectional operation with independent control of voltage and current on both ends

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**Buck-Boost Applications: Backup Power System**

- Telecommunications and Networking
  - 48V back-up system and discharging
- UPS/Storage Systems
  - Supports different battery voltages
- Redundant Power Supplies
  - Current sharing/phase interleaving
  - Constant current and constant voltage
  - Supports battery charging
- Battery Powered Industrial Applications
- Outdoor Power
- Automotive
### Single-Output Analog Controllers

<table>
<thead>
<tr>
<th>Input</th>
<th>Part No.</th>
<th>VIN Range (V)</th>
<th>VOUT Range (V)</th>
<th>IOUT (max) (A)</th>
<th>Package</th>
<th>Technical Highlights</th>
</tr>
</thead>
<tbody>
<tr>
<td>12V</td>
<td>ISL8104</td>
<td>1.2 to 12</td>
<td>0.6 to Dmax*VIN</td>
<td>30</td>
<td>16 Ld QFN, 14 Ld SOIC</td>
<td>Simple DC/DC conversion, low pin count</td>
</tr>
<tr>
<td></td>
<td>ISL6341/A/B/C</td>
<td>1.5 to 12</td>
<td>0.8 to Dmax*VIN</td>
<td>30</td>
<td>10 Ld DFN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ISL6545A</td>
<td>1 to 12</td>
<td>0.6 to Dmax*VIN</td>
<td>25</td>
<td>10 Ld DFN, 8 Ld SOIC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ISL8105A/B</td>
<td>4.5 to 14</td>
<td>0.6 to Dmax*VIN</td>
<td>25</td>
<td>10 Ld DFN, 8 Ld SOIC</td>
<td></td>
</tr>
<tr>
<td>20V</td>
<td>ISL8118</td>
<td>3.3 to 20</td>
<td>0.6 to Dmax*VIN</td>
<td>30</td>
<td>28 Ld QFN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ISL6540A</td>
<td>3.3 to 20</td>
<td>0.6 to Dmax*VIN</td>
<td>30</td>
<td>28 Ld QFN</td>
<td>Voltage mode with feed forward, feature rich, popular for POL module</td>
</tr>
<tr>
<td></td>
<td>ISL8106</td>
<td>7 to 25</td>
<td>0.6 to Dmax*VIN</td>
<td>12</td>
<td>16 Ld QFN</td>
<td></td>
</tr>
<tr>
<td>28V</td>
<td>ISL8130</td>
<td>4.5 to 28</td>
<td>0.6 to Dmax*VIN</td>
<td>20</td>
<td>20 Ld QFN, 20 Ld QSOP</td>
<td>Universal controller for buck, boost or SEPIC</td>
</tr>
<tr>
<td></td>
<td>ISL6420B</td>
<td>4.5 to 28</td>
<td>0.6 to Dmax*VIN</td>
<td>20</td>
<td>20 Ld QFN, 20 Ld QSOP</td>
<td></td>
</tr>
<tr>
<td>36V</td>
<td>ISL8115</td>
<td>3.0 to 36</td>
<td>0.6 to Dmax*VIN</td>
<td>40</td>
<td>24 Ld TQFN</td>
<td>Voltage mode with non-linear control, current sharing</td>
</tr>
<tr>
<td>60V</td>
<td>ISL8117/A</td>
<td>4.5 to 60</td>
<td>0.6 to Dmax*VIN</td>
<td>20</td>
<td>16 Ld QFN, 16 Ld TSSOP</td>
<td>Current mode, simplified pin-out, low external components</td>
</tr>
<tr>
<td>75V</td>
<td>ISL8107</td>
<td>9 to 75</td>
<td>1.2 to Dmax*VIN</td>
<td>10</td>
<td>16 Ld QFN</td>
<td></td>
</tr>
</tbody>
</table>

### Multi-Output Analog Controllers

<table>
<thead>
<tr>
<th>Output</th>
<th>Part No.</th>
<th>VIN Range (V)</th>
<th>VOUT Range (V)</th>
<th>IOUT (max) (A)</th>
<th>Package</th>
<th>Technical Highlights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual</td>
<td>ISL6446A</td>
<td>5.6 to 24</td>
<td>0.6 to Dmax*VIN</td>
<td>25/ch</td>
<td>24 Ld QSOP</td>
<td>2 outputs, voltage mode</td>
</tr>
<tr>
<td>Triple</td>
<td>ISL9444</td>
<td>4.5 to 28</td>
<td>0.6 to Dmax*VIN</td>
<td>25/ch</td>
<td>40 Ld QFN</td>
<td>3 outputs, current mode, internal compensation</td>
</tr>
<tr>
<td></td>
<td>ISL9440B</td>
<td>4.5 to 24</td>
<td>0.8 to Dmax*VIN</td>
<td>0.8/ch</td>
<td>32 Ld QFN</td>
<td>3 outputs with programmable soft-start</td>
</tr>
</tbody>
</table>

### Multiphase Analog Controllers

<table>
<thead>
<tr>
<th>Phase</th>
<th>Part No.</th>
<th>VIN Range (V)</th>
<th>VOUT Range (V)</th>
<th>IOUT (max) (A)</th>
<th>Package</th>
<th>Technical Highlights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 12-phase</td>
<td>ISL8126</td>
<td>3.0 to 26.5</td>
<td>0.6 to Dmax*VIN</td>
<td>60</td>
<td>32 Ld QFN</td>
<td>Current sharing up to 12 phase</td>
</tr>
<tr>
<td>2-phase</td>
<td>ISL8121</td>
<td>3.0 to 20</td>
<td>0.6 to Dmax*VIN</td>
<td>60</td>
<td>24 Ld QFN</td>
<td>2-phase, popular for 5V/3.3V module</td>
</tr>
<tr>
<td>4-phase</td>
<td>ISL6558</td>
<td>5 ±10%</td>
<td>0.8 to Dmax*VIN</td>
<td>120</td>
<td>20 Ld QFN, 16 Ld SOIC</td>
<td>4-phase controller, 5VIN bias</td>
</tr>
</tbody>
</table>

### Bidirectional Buck-Boost Controllers

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Part No.</th>
<th>VIN Range (V)</th>
<th>VOUT Range (V)</th>
<th>Output Current Max (A)</th>
<th>IQ</th>
<th>POR</th>
<th>SYNCH Capability</th>
<th>External Bias</th>
<th>Control Type</th>
<th>Package Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>ISL81401/A</td>
<td>4.5 to 40</td>
<td>0.8 to 40</td>
<td>20 / phase*</td>
<td>3 µA</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Current Mode</td>
<td>32pin-QFN</td>
</tr>
<tr>
<td></td>
<td>ISL81601</td>
<td>4.5 to 60</td>
<td>0.8 to 60</td>
<td>20 / phase*</td>
<td>3 µA</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Current Mode</td>
<td>32pin-QFN, 38pin-TSSOP-EP</td>
</tr>
</tbody>
</table>

*Current sharing with phase interleaving
# SWITCHING REGULATORS

## Wide Vin Coverage

### Benefits and Key Features

**Robust & Reliable Performance**
- PGOOD, Enable, adjustable soft-start
- Extensive protection (OCP, OVP, OTP, SCP)
- External frequency synchronization

**High Integration**
- Integrated HS/LS FETs
- Internal compensation

**Target Applications**
- Servers and infrastructure POLs
- Industrial PCs, factory automation, PLCs
- General purpose POLs
- Telecom and networking systems

### 40V Sync Buck Regulator Family – Wide Vin Range with Rich Feature Set

#### Adjustable Output Voltage
- 0.6V to 95% of input voltage
- Wide conversion range

#### Fully Integrated
- Internal compensation
- Integrated HS/LS FETs and bootstrap diode

#### Selectable PWM or PFM Mode
- PFM for high efficiency at light loads

#### Full Protection
- OC (Pos and Neg), OV, UV, OT protections and UVLO

### Using 40V Sync Buck Regulator Family to Power MCUs

**Part No.** | **Vin Range** | **IOUT** | **Package**
---|---|---|---
ISL85412 | 3.5V to 40V | 150 mA | 3x3 TDFN
ISL85413 | 3.5V to 40V | 300 mA | 3x3 TDFN
ISL85415 | 3V to 36V | 500 mA | 4x3 DFN
ISL85418 | 3V to 40V | 800 mA | 4x3 DFN
ISL85410 | 3V to 40V | 1 A | 4x3 DFN
ISL854102 | 3V to 40V | 1.2 A | 4x3 DFN

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**E-meter System Diagram**
### 2.5V-6V Synchronous Buck Regulators

<table>
<thead>
<tr>
<th>Part No.</th>
<th># of Outputs</th>
<th>(V_{\text{IN}}) Range (V)</th>
<th>(I_{\text{OUT}}) (max) (A)</th>
<th>(V_{\text{OUT}}) Range (V)</th>
<th>(I_{Q}) (typ) (mA)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISL8088</td>
<td>Dual</td>
<td>2.7 to 5.5</td>
<td>0.8</td>
<td>0.6 to (V_{\text{IN}})</td>
<td>Y</td>
<td>N/N</td>
</tr>
<tr>
<td>ISL80019/A</td>
<td>Single</td>
<td>2.7 to 5.5</td>
<td>1.5</td>
<td>0.6 to (V_{\text{IN}})</td>
<td>Y</td>
<td>N/N</td>
</tr>
<tr>
<td>ISL80015/A</td>
<td>Single</td>
<td>2.7 to 5.5</td>
<td>1.5</td>
<td>0.6 to (V_{\text{IN}})</td>
<td>N</td>
<td>N/N</td>
</tr>
<tr>
<td>ISL8022</td>
<td>Dual</td>
<td>2.7 to 5.5</td>
<td>2/1.7</td>
<td>0.6 to (V_{\text{IN}})</td>
<td>Y</td>
<td>N/N</td>
</tr>
<tr>
<td>ISL8002/A</td>
<td>Single</td>
<td>2.8 to 5.5</td>
<td>2</td>
<td>0.6 to (V_{\text{IN}})</td>
<td>Y</td>
<td>N/N</td>
</tr>
<tr>
<td>ISL8002B</td>
<td>Single</td>
<td>2.7 to 5.5</td>
<td>2</td>
<td>0.6 to 4</td>
<td>Y</td>
<td>Y/Y</td>
</tr>
<tr>
<td>ISL80020/A</td>
<td>Single</td>
<td>2.7 to 5.5</td>
<td>2</td>
<td>0.6 to (V_{\text{IN}})</td>
<td>N</td>
<td>N/N</td>
</tr>
<tr>
<td>ISL80033/A</td>
<td>Dual</td>
<td>2.85 to 6</td>
<td>3/3</td>
<td>0.8 to (V_{\text{IN}})</td>
<td>N</td>
<td>N/N</td>
</tr>
<tr>
<td>ISL8036/A</td>
<td>Dual</td>
<td>2.85 to 6</td>
<td>3/3</td>
<td>0.8 to (V_{\text{IN}})</td>
<td>N</td>
<td>Y/N</td>
</tr>
<tr>
<td>ISL80030/A</td>
<td>Single</td>
<td>2.7 to 5.5</td>
<td>3</td>
<td>0.6 to (V_{\text{IN}})</td>
<td>N</td>
<td>N/N</td>
</tr>
<tr>
<td>ISL80031/A</td>
<td>Single</td>
<td>2.7 to 5.5</td>
<td>3</td>
<td>0.6 to (V_{\text{IN}})</td>
<td>N</td>
<td>N/N</td>
</tr>
<tr>
<td>ISL8023/A</td>
<td>Single</td>
<td>2.7 to 5.5</td>
<td>3</td>
<td>0.6 to (V_{\text{IN}})</td>
<td>Y</td>
<td>Y/N</td>
</tr>
<tr>
<td>ISL8024/A</td>
<td>Single</td>
<td>2.7 to 5.5</td>
<td>4</td>
<td>0.6 to (V_{\text{IN}})</td>
<td>Y</td>
<td>Y/N</td>
</tr>
<tr>
<td>ISL8025/A</td>
<td>Single</td>
<td>2.7 to 5.5</td>
<td>5</td>
<td>0.6 to (V_{\text{IN}})</td>
<td>Y</td>
<td>Y/N</td>
</tr>
<tr>
<td>ISL8026/A</td>
<td>Single</td>
<td>2.5 to 5.5</td>
<td>6</td>
<td>0.6 to (V_{\text{IN}})</td>
<td>Y</td>
<td>Y/N</td>
</tr>
<tr>
<td>ISL8016</td>
<td>Single</td>
<td>2.7 to 5.5</td>
<td>6</td>
<td>0.6 to (V_{\text{IN}})</td>
<td>Y</td>
<td>Y/N</td>
</tr>
<tr>
<td>ISL8018</td>
<td>Single</td>
<td>2.7 to 5.5</td>
<td>8</td>
<td>0.6 to (V_{\text{IN}})</td>
<td>Y</td>
<td>Y/N</td>
</tr>
</tbody>
</table>

### 18V Synchronous Buck Regulators

<table>
<thead>
<tr>
<th>Part No.</th>
<th># of Outputs</th>
<th>(V_{\text{IN}}) Range (V)</th>
<th>(I_{\text{OUT}}) (max) (A)</th>
<th>(V_{\text{OUT}}) Range (V)</th>
<th>(I_{Q}) (typ) (mA)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISL85003/A</td>
<td>Single</td>
<td>4.5V to 18V</td>
<td>3A</td>
<td>0.8V to D\text{max}V_{\text{IN}}</td>
<td>3.2 mA</td>
<td>12 Ld 3x4 DFN</td>
</tr>
<tr>
<td>ISL85005/A</td>
<td>Single</td>
<td>4.5V to 18V</td>
<td>5A</td>
<td>0.8V to D\text{max}V_{\text{IN}}</td>
<td>3.2 mA</td>
<td>12 Ld 4x3 DFN</td>
</tr>
<tr>
<td>ISL85009</td>
<td>Single</td>
<td>3.8V to 18V</td>
<td>9A</td>
<td>0.6V to D\text{max}V_{\text{IN}}</td>
<td>3 mA</td>
<td>15 Ld 3.5x3.5 TQFN</td>
</tr>
<tr>
<td>ISL85012</td>
<td>Single</td>
<td>3.8V to 18V</td>
<td>12A</td>
<td>0.6V to D\text{max}V_{\text{IN}}</td>
<td>3 mA</td>
<td>15 Ld 3.5x3.5 TQFN</td>
</tr>
<tr>
<td>ISL85014</td>
<td>Single</td>
<td>3.8V to 18V</td>
<td>14A</td>
<td>0.6V to D\text{max}V_{\text{IN}}</td>
<td>3 mA</td>
<td>15 Ld 3.5x3.5 TQFN</td>
</tr>
</tbody>
</table>

### 28V Synchronous Buck Regulators

<table>
<thead>
<tr>
<th>Part No.</th>
<th># of Outputs</th>
<th>(V_{\text{IN}}) Range (V)</th>
<th>(I_{\text{OUT}}) (max) (A)</th>
<th>(V_{\text{OUT}}) Range (V)</th>
<th>(I_{Q}) (typ) (mA)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISL85033</td>
<td>Dual</td>
<td>4.5V to 28V</td>
<td>3A</td>
<td>0.8V to D\text{max}V_{\text{IN}}</td>
<td>1.2 mA</td>
<td>28 Ld 4x4 TDFN</td>
</tr>
</tbody>
</table>

### 40V Synchronous Buck Regulators

<table>
<thead>
<tr>
<th>Part No.</th>
<th># of Outputs</th>
<th>(V_{\text{IN}}) Range (V)</th>
<th>(I_{\text{OUT}}) (max) (mA)</th>
<th>(V_{\text{OUT}}) Range (V)</th>
<th>(I_{Q}) (typ) (mA)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISL85412</td>
<td>Single</td>
<td>3.5V to 40V</td>
<td>150 mA</td>
<td>0.6V to D\text{max}V_{\text{IN}}</td>
<td>50 (\mu)A</td>
<td>8 Ld 3x3 TDFN</td>
</tr>
<tr>
<td>ISL85413</td>
<td>Single</td>
<td>3.5V to 40V</td>
<td>300 mA</td>
<td>0.6V to D\text{max}V_{\text{IN}}</td>
<td>50 (\mu)A</td>
<td>8 Ld 3x3 DFN</td>
</tr>
<tr>
<td>ISL85415</td>
<td>Single</td>
<td>3V to 36V</td>
<td>500 mA</td>
<td>0.6V to D\text{max}V_{\text{IN}}</td>
<td>80 (\mu)A</td>
<td>12 Ld 4x3 DFN</td>
</tr>
<tr>
<td>ISL85418</td>
<td>Single</td>
<td>3V to 40V</td>
<td>800 mA</td>
<td>0.6V to D\text{max}V_{\text{IN}}</td>
<td>80 (\mu)A</td>
<td>12 Ld 4x3 DFN</td>
</tr>
<tr>
<td>ISL85410</td>
<td>Single</td>
<td>3V to 40V</td>
<td>1A</td>
<td>0.6V to D\text{max}V_{\text{IN}}</td>
<td>80 (\mu)A</td>
<td>12 Ld 4x3 DFN</td>
</tr>
<tr>
<td>ISL854102</td>
<td>Single</td>
<td>3V to 40V</td>
<td>1.2A</td>
<td>0.6V to D\text{max}V_{\text{IN}}</td>
<td>80 (\mu)A</td>
<td>12 Ld 4x3 DFN</td>
</tr>
<tr>
<td>ISL85403 (Buck or Buck-Boost)</td>
<td>Single</td>
<td>3V to 40V</td>
<td>2.5A</td>
<td>0.8V to D\text{max}V _{\text{IN}}</td>
<td>300 (\mu)A</td>
<td>20 Ld 4x4 QFN</td>
</tr>
</tbody>
</table>

---

(Adj SS/TRK, Ext Comp, Sync, Adj Freq, Adj OCP)

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(Buck or Buck-Boost)
**SIMPLE DC/DC POWER ICS**

*ICs for Microcontroller Power Supply System*

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**Benefits and Key Features**

**Compact Design**

The main power supply circuit elements are integrated. This reduces the number of components and mounting area of the power supply block.

**Reduced System Power Consumption**

Integrated Auto Pulse Frequency Modulation (PFM) mode. Matches the system’s operating current, making it easy to reduce the overall power consumption.

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**Easy Power Supply Design for Renesas RZ Family MPUs and R-IN Series Multi-Protocol LSI Products**

- RZ and R-IN reference boards populated with Simple DC/DC devices are available. Simplify the design process and reduce development turnaround time by utilizing the provided circuit diagrams and recommended parts.

- Board schematics with Renesas MCU, SoC, and other suggested devices are available.

- The integrated discharge circuit simplifies R-IN cutoff sequence design.

- There is no need for an external discharge circuit, reducing the total number of parts.
### Simple DC/DC Products

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Ch</th>
<th>Circuit</th>
<th>Vin (V)</th>
<th>Vout (V)</th>
<th>Iout Max (A)</th>
<th>Package</th>
<th>Sequence</th>
<th>Auto PFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAA230231</td>
<td>2</td>
<td>DC/DC x2 (Step-down)</td>
<td>4.5 to 16</td>
<td>ch 1 = 3.3V, ch 2 = Adj. Adj: 0.8V to 6.0V</td>
<td>3A</td>
<td>20-pin HTSSOP</td>
<td>Controlled by P-Good</td>
<td>✓</td>
</tr>
<tr>
<td>RAA230232</td>
<td>2</td>
<td>DC/DC x2 (Step-down)</td>
<td>4.5 to 16</td>
<td>ch 1 = 3.3V, ch 2 = 5.0V</td>
<td>3A</td>
<td>20-pin HTSSOP</td>
<td>Controlled by P-Good</td>
<td>✓</td>
</tr>
<tr>
<td>RAA230233</td>
<td>2</td>
<td>DC/DC x2 (Step-down)</td>
<td>4.5 to 16</td>
<td>ch 1 = Adj., ch 2 = Adj. Adj: 0.8V to 6.0V</td>
<td>3A</td>
<td>20-pin HTSSOP</td>
<td>Controlled by P-Good</td>
<td>✓</td>
</tr>
<tr>
<td>RAA230131</td>
<td>1</td>
<td>DC/DC (Step-down)</td>
<td>4.5 to 16</td>
<td>3.3V</td>
<td>3A</td>
<td>8-pin HLSOP</td>
<td>–</td>
<td>✓</td>
</tr>
<tr>
<td>RAA230132</td>
<td>1</td>
<td>DC/DC (Step-down)</td>
<td>4.5 to 16</td>
<td>5.0V</td>
<td>3A</td>
<td>8-pin HLSOP</td>
<td>–</td>
<td>✓</td>
</tr>
<tr>
<td>RAA230133</td>
<td>1</td>
<td>DC/DC (Step-down)</td>
<td>4.5 to 16</td>
<td>Adj: 0.8V to 6.0V</td>
<td>3A</td>
<td>8-pin HLSOP</td>
<td>–</td>
<td>✓</td>
</tr>
<tr>
<td>RAA230151</td>
<td>1</td>
<td>DC/DC (Step-down)</td>
<td>7.0 to 28</td>
<td>3.3V</td>
<td>3A</td>
<td>8-pin HLSOP</td>
<td>–</td>
<td>✓</td>
</tr>
<tr>
<td>RAA230152</td>
<td>1</td>
<td>DC/DC (Step-down)</td>
<td>7.0 to 28</td>
<td>5.0V</td>
<td>3A</td>
<td>8-pin HLSOP</td>
<td>–</td>
<td>✓</td>
</tr>
<tr>
<td>RAA230153</td>
<td>1</td>
<td>DC/DC (Step-down)</td>
<td>7.0 to 28</td>
<td>Adj: 0.8V to 6.0V</td>
<td>3A</td>
<td>8-pin HLSOP</td>
<td>–</td>
<td>✓</td>
</tr>
</tbody>
</table>

* 1: Adjustable: Voltage can be set using an external resistor.

### Simple DC/DC Applications

#### Industrial Equipment (PLCs, etc.)

![Industrial Equipment Diagram](image)

**Power Supply**

- 24V
- 5V 1.2A

**RAA230231**

- DC/DC
- R-IN
- Core
- I/O

- Other Devices
  - e.g., Sub-MCU, Sensor, Amplifier, USB, etc.

**RAA230152**

- DC/DC
- Core
- I/O

- Other Devices
  - e.g., Sub-MCU, SRAM, EEPROM, Logic IC, etc.

**Battery**

- 6V~8.4V

**RAA230231**

- DC/DC
- 3.3V
- 0.2A
- 1.8V
- 0.5A

- Other Devices
  - e.g., Sub-MCU, SRAM, EEPROM, Logic IC, etc.

#### Handheld Terminals

![Handheld Terminals Diagram](image)

**Power Supply**

- 12V

**RAA230231**

- DC/DC
- 3.3V
- 0.1A
- 1.2V
- 0.3A

- Other Devices
  - e.g., Sub-MCU, SRAM, EEPROM, Logic IC, etc.

**RX631**

- Core
- I/O

**Battery**

- 6V~8.4V

**RAA230231**

- DC/DC
- 3.3V
- 0.2A
- 1.8V
- 0.5A

- Other Devices
  - e.g., Sub-MCU, SRAM, EEPROM, Logic IC, etc.

**RZ/A1**

- Core
- I/O

- Other Devices
  - e.g., Sub-MCU, SRAM, EEPROM, Logic IC, etc.

#### Smart Grid

![Smart Grid Diagram](image)

**Power Supply**

- 12V

**RAA230231**

- DC/DC
- 3.3V
- 0.1A
- 1.2V
- 0.3A

- Other Devices
  - e.g., Sub-MCU, SRAM, EEPROM, Logic IC, etc.

**RX631**

- Core
- I/O

**Battery**

- 6V~8.4V

**RAA230231**

- DC/DC
- 3.3V
- 0.2A
- 1.8V
- 0.5A

- Other Devices
  - e.g., Sub-MCU, SRAM, EEPROM, Logic IC, etc.

**RZ/A1**

- Core
- I/O

- Other Devices
  - e.g., Sub-MCU, SRAM, EEPROM, Logic IC, etc.
LOW DROPOUT REGULATORS (LDO)

High Performance LDOs

**ISL80410**

40V, Low Quiescent Current, 150mA Linear Regulator

The ISL80410 is a high voltage, adjustable \( V_{\text{OUT}} \), low quiescent current linear regulator ideally suited for “always-on” and “keep alive” applications. The ISL80410 consumes only 18μA of quiescent current at no load.

**Key Features**

- ±1% accurate voltage reference
- 6V to 40V (45V max) input
- 150 mA load current rating
- 18 μA ultra-low quiescent current
- 8 Ld exposed pad EPSOIC package

**18 μA Ultra-low Quiescent Current**

**Quiescent Current vs Temperature (at Unity Gain), \( V_{\text{IN}} = 14V \)**

### High-Performance LDOs

<table>
<thead>
<tr>
<th>Part No.</th>
<th>( V_{\text{IN}} ) (V)</th>
<th>( V_{\text{OUT}} ) (V)</th>
<th>( I_{\text{OUT}} ) max (A)</th>
<th>PSRR @1 kHz (dB)</th>
<th>Fixed ( V_{\text{OUT}} ) Option</th>
<th>Dropout (mV)</th>
<th>Acc. (%)</th>
<th>( I_{q} )</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISL80410</td>
<td>6 to 40</td>
<td>2.5 to 12</td>
<td>0.15</td>
<td>66</td>
<td>No</td>
<td>295 @ 150mA</td>
<td>±1.0</td>
<td>18 μA</td>
<td>8 Ld EPSOIC</td>
</tr>
<tr>
<td>ISL80136</td>
<td>6 to 40</td>
<td>2.5 to 12</td>
<td>0.05</td>
<td>45</td>
<td>No</td>
<td>120 @ 50mA</td>
<td>1.0</td>
<td>18 μA</td>
<td>8 Ld EPSOIC</td>
</tr>
<tr>
<td>ISL80138</td>
<td>6 to 40</td>
<td>2.5 to 12</td>
<td>0.15</td>
<td>47</td>
<td>No</td>
<td>295</td>
<td>1.0</td>
<td>18 μA</td>
<td>14 Ld HTSSOP</td>
</tr>
<tr>
<td>ISL80505</td>
<td>1.8 to 6</td>
<td>0.8 to 5.5</td>
<td>0.5</td>
<td>50</td>
<td>No</td>
<td>45 @ 500mA</td>
<td>1.8</td>
<td>2.2 mA</td>
<td>8 Ld 3x3 DFN</td>
</tr>
<tr>
<td>ISL80510</td>
<td>2.2 to 6</td>
<td>0.8 to 5.5</td>
<td>1</td>
<td>48</td>
<td>No</td>
<td>130 @ 1A</td>
<td>1.8</td>
<td>2.2 mA</td>
<td>8 Ld 3x3 DFN</td>
</tr>
<tr>
<td>ISL80101A</td>
<td>2.2 to 6</td>
<td>0.8 to 5</td>
<td>1</td>
<td>48</td>
<td>Yes</td>
<td>90 @ 1A</td>
<td>1.8</td>
<td>3.0 mA</td>
<td>10 Ld 3x3 DFN</td>
</tr>
<tr>
<td>ISL80101-Adj</td>
<td>2.2 to 6</td>
<td>0.8 to 5</td>
<td>1</td>
<td>58</td>
<td>Yes</td>
<td>130 @ 1A</td>
<td>1.8</td>
<td>3.0 mA</td>
<td>10 Ld 3x3 DFN</td>
</tr>
<tr>
<td>ISL80102</td>
<td>2.2 to 6</td>
<td>0.8 to 5</td>
<td>2</td>
<td>55</td>
<td>Yes</td>
<td>81 (I@2A, Vout=2.5V)</td>
<td>1.8</td>
<td>7.5 mA</td>
<td>10 Ld 3x3 DFN</td>
</tr>
<tr>
<td>ISL80103</td>
<td>2.2 to 6</td>
<td>0.8 to 5</td>
<td>3</td>
<td>55</td>
<td>Yes</td>
<td>120 (I@3A, Vout=2.5V)</td>
<td>1.8</td>
<td>7.5 mA</td>
<td>10 Ld 3x3 DFN</td>
</tr>
<tr>
<td>ISL80111</td>
<td>1 to 3.6</td>
<td>0.8 to 3.3</td>
<td>1</td>
<td>80</td>
<td>No</td>
<td>27 @ 1A</td>
<td>1.6</td>
<td>3.5 mA</td>
<td>10 Ld 3x3 DFN</td>
</tr>
<tr>
<td>ISL80112</td>
<td>1 to 3.6</td>
<td>0.8 to 3.3</td>
<td>2</td>
<td>80</td>
<td>No</td>
<td>53 @ 2A</td>
<td>1.6</td>
<td>3.5 mA</td>
<td>10 Ld 3x3 DFN</td>
</tr>
<tr>
<td>ISL80113</td>
<td>1 to 3.6</td>
<td>0.8 to 3.3</td>
<td>3</td>
<td>80</td>
<td>No</td>
<td>75 @ 3A</td>
<td>1.6</td>
<td>3.5 mA</td>
<td>10 Ld 3x3 DFN</td>
</tr>
</tbody>
</table>
SHUNT REGULATORS
Reference Power Supply ICs

Benefits and Key Features

Shunt regulators are the standard reference voltage source widely used by the feedback circuits of switching power supplies and so on. Compared to the Zener diode, which is a discrete product, a shunt regulator has much better voltage precision because voltage control is carried out as an IC.

In addition to its use as a reference power source for amplifier circuits, A/D converters, etc., it is also widely used for feedback circuits of switching regulators.

Shunt Regulators Lineup

<table>
<thead>
<tr>
<th>Item</th>
<th>Low-Voltage (1.26V) Type</th>
<th>Standard-Voltage (2.5V) Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPC1943T</td>
<td>UPC1944T</td>
<td>UPC1944GR</td>
</tr>
<tr>
<td>Reference voltage</td>
<td>VREF (V)</td>
<td>1.23 (min.) to 1.26 (typ.) to 1.29 (max.)</td>
</tr>
<tr>
<td>Cathode voltage</td>
<td>VKA (V)</td>
<td>24 (max.)</td>
</tr>
<tr>
<td>Cathode current</td>
<td>IK (mA)</td>
<td>30 (max.)</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>TA (˚C)</td>
<td>-30 to +85</td>
</tr>
</tbody>
</table>

Shunt Regulator Application

Shunt Regulators

In addition to its use as a reference power source for amplifier circuits, A/D converters, etc., it is also widely used for feedback circuits of switching regulators.

In addition to its use as a reference power source for amplifier circuits, A/D converters, etc., it is also widely used for feedback circuits of switching regulators.

Shunt Regulators

In addition to its use as a reference power source for amplifier circuits, A/D converters, etc., it is also widely used for feedback circuits of switching regulators.
BATTERY MANAGEMENT

Management and Protection of Lithium-ion Batteries

Protect, Monitor & Balance Rechargeable Battery Packs

Renesas’ Li-ion battery pack monitoring, protection, and balancing ICs are specifically designed to meet the stringent safety, reliability, and performance requirements of portable and battery powered applications such as consumer, industrial, and medical products.

Battery Front End (BFE), Battery Management ICs

**Benefits and Key Features**

**Protection and Cell Balancing**
- Hot plug tolerant
- Over/under voltage
- Charge/discharge current
- FET control when error detected
- Open-wire detection
- Auto-cell balancing

**Host Controlled Features**
- Current measurement
- Cell voltage measurement
- Pack voltage measurement
- Temperature measurement
- LED indication by GPIO
- Power supply for MCU

**ISL94202**

**Standalone Battery Protection System Accurately Monitors & Balances Rechargeable Battery Packs**

- 8-cell voltage monitors support Li-ion CoO2, Li-ion Mn2O4, and Li-ion FePO4 battery chemistries
- Highest level of integration: cell voltage level shift, automatic cell balance, 14-bit ADC, current sense monitor, power FET control, and temperature sensor interface
- Multiple cell voltage protection options up to 4.8V
- Integrated charge/discharge FET drive circuitry with built-in charge pump supports high-side N-channel FETs

**Battery Front End, Multi-Cell Li-Ion Battery Management ICs**

<table>
<thead>
<tr>
<th>Cells</th>
<th>Pack Voltage (V)</th>
<th>Part No.</th>
<th>Interface</th>
<th>Cell Balance</th>
<th>Current Sense</th>
<th>Charge/Discharge FET</th>
<th>Stand-alone capable</th>
<th>Internal ADC</th>
<th>Features</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min.</td>
<td>Max.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>ISL94202</td>
<td>I2C</td>
<td>External</td>
<td>High Side</td>
<td>N-channel, High Side</td>
<td>Yes</td>
<td>Yes</td>
<td>High-side current sense, standalone capable</td>
<td>48TQFN</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>ISL94208</td>
<td>I2C</td>
<td>Both</td>
<td>Low Side</td>
<td>N-channel, Low Side</td>
<td>No</td>
<td>No</td>
<td>Low-side current sense, internal cell balance</td>
<td>32QFN</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
<td>ISL94212</td>
<td>SPI</td>
<td>External</td>
<td>No</td>
<td>N/A</td>
<td>No</td>
<td>Yes</td>
<td>60V pack voltage, daisy-chain</td>
<td>64TQFP</td>
</tr>
</tbody>
</table>
 Battery Fuel Gauge ICs (FGIC)

Dedicated one-package solution with MCU and AFE for Battery Management System provides intelligent battery system by constantly monitoring the battery state.

**Benefits and Key Features**

**Safety and Protection Control**
- Over/under voltage
- Charge/discharge current
- FET control when error detected
- Chemical fuse control
- Cell balancing

**Remaining Capacity Management**
- Current/voltage detection
- Precise coulomb counter
- Deterioration detection
- Calculation and learning of battery capacity
- Current/voltage calibration
- Fault detection/history management

**Voltage and Current Measurement by Independent A/D Converters**
- Current detection: 153 µA/LSB resolution (18-bit ΔΣ, 5 mΩ shunt resistor) support for simultaneous measurement with virtually no temperature drift
- Voltage/temperature measurement: 15-bit ΔΣ ADC

**High Reliability & High Integration**
- Built-in FET protection for overcurrent or short circuit conditions
- Redundant fault detection by both MCU and AFE
- Ability to set lifecycle related limits and maintain battery parameter and operation history using data flash guaranteed for 100,000 erase/write cycles
- Integrated CAN interface and RTC (Real Time Clock) circuit for industrial apps; ICs can manage date and time in a single device (RAJ240090 and RAJ240100)

**Few Parts, Low System Cost**
- Supports large-current discharge with N-channel FET drivers
- Integrated pull-up resistors for thermistor

**Extended Battery Life**
- Low power mode with consumption of 25 µA or less and cell balance circuit to maximize battery capacity (RAJ240090 and RAJ240100)

**Battery Fuel Gauge ICs**

<table>
<thead>
<tr>
<th>Cells</th>
<th>Pack Voltage (V)</th>
<th>Part No.</th>
<th>Flash ROM</th>
<th>RAM</th>
<th>AFE ADC Port</th>
<th>Serial I/F</th>
<th>I/O</th>
<th>Features</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min.</td>
<td>Max.</td>
<td>4 to 25</td>
<td>RAJ240045</td>
<td>64 KB</td>
<td>4.0 KB</td>
<td>2-ch</td>
<td>FC, UART</td>
<td>12</td>
<td>Compact package (4mm×4mm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 to 25</td>
<td>RAJ240047</td>
<td>128 KB</td>
<td>5.5 KB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>4 to 25</td>
<td>RAJ240071</td>
<td>32 KB</td>
<td>1.5 KB</td>
<td>3-ch</td>
<td>FC, UART</td>
<td>11</td>
<td>Compact package (4mm×4mm)</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>4 to 28</td>
<td>RAJ240075</td>
<td>64 KB</td>
<td>4.0 KB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>4 to 50</td>
<td>RAJ240080</td>
<td>64 KB</td>
<td>5.5 KB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>4 to 50</td>
<td>RAJ240090</td>
<td>128 KB</td>
<td>7 KB</td>
<td>4-ch</td>
<td>FC, UART, CAN</td>
<td>31</td>
<td>High voltage tolerance, on-chip CAN, low power consumption (25 µA)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 to 50</td>
<td>RAJ240100</td>
<td>128 KB</td>
<td>7 KB</td>
<td>4-ch</td>
<td>FC, UART, CAN</td>
<td>31</td>
<td>High voltage tolerance, on-chip CAN, low power consumption (25 µA)</td>
</tr>
</tbody>
</table>

* Specifications are subject to change without notice
POWER MODULES
Complete Power System in an Encapsulated Module

Benefits and Key Features

Easy to Use
- Full integration means less complexity and easier design

Renesas Power Module

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWM Controller</td>
<td></td>
</tr>
<tr>
<td>MOSFETs</td>
<td></td>
</tr>
<tr>
<td>Inductor</td>
<td></td>
</tr>
<tr>
<td>Compensation</td>
<td></td>
</tr>
</tbody>
</table>

Highest Power Density
- Power output up to 250W POL in a single package

Thermally Enhanced Package Technology
- Thermal molding compound allows for even heat distribution
- Large copper pads transfer heat efficiently
- Operates at full load across wide temperature range
- Leaded package allows pin access

Real-Time Telemetry — Dynamic Configuration (Available in Digital Power Modules)

PowerNavigator™ GUI

Allows simple configuration and monitoring of multiple Digital-DC devices using a PC with a USB interface.

Analog Modules
A simple, effective DC/DC power supply solution that integrates necessary power elements in a single package.

Digital Modules
A high-performance DC/DC power supply solution that integrates all power elements in a single package and supports digital communication and configurability for advanced power management techniques. Digitally design with PowerNavigator™ GUI software.
## Featured Analog & Digital Power Module

<table>
<thead>
<tr>
<th>Output Current</th>
<th>Channel</th>
<th>Input Voltage</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>80A</td>
<td></td>
<td>3.3VIN - 6VIN</td>
<td>ISL8273M</td>
</tr>
<tr>
<td>70A</td>
<td></td>
<td>4.5VIN - 14VIN</td>
<td>RAA210870</td>
</tr>
<tr>
<td>50A</td>
<td></td>
<td>4.5VIN - 14VIN</td>
<td>ISL8272M</td>
</tr>
<tr>
<td>50A</td>
<td></td>
<td>4.5VIN - 14VIN</td>
<td>RAA210850</td>
</tr>
<tr>
<td>33A</td>
<td></td>
<td>4.5VIN - 14VIN</td>
<td>RAA210833</td>
</tr>
<tr>
<td>33A</td>
<td></td>
<td>4.5VIN - 14VIN</td>
<td>ISL8278M</td>
</tr>
<tr>
<td>25A</td>
<td></td>
<td>4.5VIN - 14VIN</td>
<td>RAA210825</td>
</tr>
<tr>
<td>25A</td>
<td></td>
<td>4.5VIN - 14VIN</td>
<td>ISL8277M</td>
</tr>
<tr>
<td>10A</td>
<td></td>
<td>4.5VIN - 13.2VIN</td>
<td>ISL9010M</td>
</tr>
<tr>
<td>6A</td>
<td></td>
<td>4.5VIN - 13.2VIN</td>
<td>ZL9006M</td>
</tr>
<tr>
<td>6A</td>
<td></td>
<td>4.5VIN - 14VIN</td>
<td>ISL8203M</td>
</tr>
<tr>
<td>5A</td>
<td></td>
<td>2.85VIN - 6VIN</td>
<td>ISL8205M</td>
</tr>
<tr>
<td>3A/3A</td>
<td></td>
<td>2.85VIN - 6VIN</td>
<td>ISL8203M</td>
</tr>
<tr>
<td>3A</td>
<td></td>
<td>2.6VIN - 5.5VIN</td>
<td>ISL8202M</td>
</tr>
<tr>
<td>3.3VIN - 6VIN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5VIN - 16.5VIN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80VIN +</td>
<td></td>
<td></td>
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</tbody>
</table>

More power modules are available. To see a complete product list, visit: [www.renesas.com](http://www.renesas.com)
MOSFET DRIVERS

Industry-Leading Bridge Drivers

HIP2103/04 Family of 60V Bridge Drivers for BLDC and Similar Loads

Optimized for Battery Powered Applications from 5V to 36V
- 60V max rating is suitable for 36V battery applications
- 4.5 UVLO allows operation as low as 5V
- Proprietary sleep mode activation eliminates the need for additional I/O control pins
- Very low IQ (<10 µA) eliminates the need for a disconnect switch to maintain idle battery life

Integrated Linear Regulators (HIP2104) for External Loads
- Reduces external components for lower BOM cost and smaller solution footprint
- 12V output provides gate drive bias
- 3.3V output provides digital controller bias

1A Sourcing, 2A Sinking MOSFET Drivers
- Enough drive strength for high speed switching applications
- Enough drive strength for very high MOSFET gate charge

Easy to Configure Half-Bridge, Full-Bridge, and 3-phase
- Small packages allow drivers to be placed next to the bridge FETs

100V BLD Motor Control — Using High Voltage MOSFET Drivers with Renesas MCUs

Benefits
- Smaller solution size
- Better system efficiency through higher driver current and lower IQ
- Adaptive dead time eliminates the need for leading-edge delays for shoot-thru prevention, reducing the programming complexity for the controller
- BOM cost saving with integrated current monitor

Applications
- Telecom bricks and power supplies
- High power motor control
- Robotics
Bridge Drivers Lineup

Renesas Bridge Drivers

Half-Bridge
- 100V
  - 2A: HIP2100, HIP2101
  - 3A/4A: ISL2110, ISL2111
  - 1.4A: ISL6700
  - 1A/2A: HIP2103, HIP2104
- 80V
  - 1A/2A: HIP4080A, HIP4081A
  - 1.4A: HIP4082
- 50V
  - 2.6A: HIP4083
  - 1.4A: HIP4086
  - 0.5A: HIP4086A
  - 0.5A: HIP4020

Full-Bridge
- 80V
  - 2.6A: HIP4080A, HIP4081A
  - 1.4A: HIP4082

3-Phase
- 80V
- 0.5A

Integrated FET Full-Bridge
- 15V
- 0.5A
Ultra-small One-chip Solution for Receiver Integration

Fully functional receiver in a single chip — Wireless Power Transmission (WPT) control, Li-ion/polymer battery charger, protection, and DC/DC.

Benefits and Key Features

Eliminates the need to Change Batteries or Connect a Power Cable

Wireless charging enables device design with no need for connection ports
- Waterproof / dustproof
- Washable
- Smaller and thinner

Single-chip Rx IC Enables Smaller Applications
- All functions needed for receiver integrated on one chip. The ultra-small size (3.22mm x 2.77mm) helps make smaller applications

High-Efficiency DC/DC — Longer Battery Life
- Integrating DC/DC converter for a system power supply. High-efficiency of 85% (at 1 mA load) extends battery life

Minimizing Heat Generation
- Proper power control between Tx IC and Rx IC (at ATPC mode) enables minimized heat generation; a Li-ion/polymer battery is protected from heat

Wireless Charging System Diagram

Transmitter System

<table>
<thead>
<tr>
<th>Power Supply</th>
<th>4.4~5.25V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate Driver for Bridge Circuit</td>
<td></td>
</tr>
<tr>
<td>Monitor &amp; Protection</td>
<td></td>
</tr>
<tr>
<td>Modulation Demodulation</td>
<td></td>
</tr>
</tbody>
</table>

Receiver System

<table>
<thead>
<tr>
<th>RAA458100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power MOS</td>
</tr>
<tr>
<td>Charger</td>
</tr>
<tr>
<td>Protection</td>
</tr>
<tr>
<td>DC/DC</td>
</tr>
<tr>
<td>Rectifier Circuits</td>
</tr>
<tr>
<td>Modulation Demodulation</td>
</tr>
</tbody>
</table>

No Connectors Needed

Charging Pad

Health Monitor

Wearable

Health Monitor

Wearable

No Connectors Needed

Charging Pad

Health Monitor
Selectable Operation Modes

<table>
<thead>
<tr>
<th>Operation Mode</th>
<th>System Configuration (M = Master, S = Slave)</th>
<th>Features</th>
</tr>
</thead>
</table>
| **ATPC Mode** (automatic power control) | ![Diagram](image1) | - Transmitting power: Automatically controlled based on load  
- Battery charging: Automatically controlled  
- WPT communication: Active (between Tx and Rx)  
- Other features  
  - Stable and safe operation by precise power control of transmitting IC, which monitors receiving IC’s condition  
  - Minimizing heat generation by proper power control |
| **Standalone Mode** (fixed-power transfer) | ![Diagram](image2) | - Transmitting power: Fixed power is set by terminals  
- Battery charging: Automatically controlled  
- WPT communication: Not in use  
- Usable even at weak coupling between Tx coil and Rx coil |
| **MCU Control Mode** (controlled by MCU) | ![Diagram](image3) | - Transmitting power: Controlled by external MCU  
- Battery charging: Automatically controlled  
- WPT communication: Active (between Tx and Rx)  
- Useable for system debugging  
  - Use PC software instead of MCU |

Wireless Charging System ICs

<table>
<thead>
<tr>
<th>Type</th>
<th>Part. No</th>
<th>Advantage</th>
<th>Functions</th>
<th>Operating Ambient Temperature</th>
<th>Package</th>
</tr>
</thead>
</table>
| Power Transmitter IC      | RAA458100 | • 5V single power source (usable power bank)  
• Safety (built-in bridge circuit over current protection and two systems of external overheat protection)  
• Integrated functions such as gate driver, monitor and protection, and I2C interface | • Selectable half bridge/full bridge  
• Transmission power control  
• Two-wire serial interface  
• Bridge circuit over current protection  
• Two systems of external overheat protection  
• Input voltage: 4.4V to 5.25V | -20 to +60°C | 40-pin UQFN (5.0mm x 5.0mm x 0.65mm thin, 0.4mm pitch) |
| Power Receiver IC         | RAA457100 | • All functions in a small package (rectifier, modulation, demodulation, battery protection, and li-Ion battery charger)  
• Top level of power-efficiency DC/DC converter for long-life battery | • Synchronous rectification  
• Lithium-ion second battery charge control (selectable charge termination voltage from 4.05V, 4.2V, and 4.35V; rapid-charge current setting: Max. 70 mA)  
• Power supply control to application  
• Battery protection  
• 12-bit A/D converter for monitor  
• DC/DC converter (selectable from 1.2V, 1.5V, 1.8V, and 3.6V)  
• Two-wire serial interface | -20 to +50°C | 41-pin WLPGA (3.22mm x 2.77mm x 0.70mm thin, 0.4mm pitch) |
Renesas offers a complete portfolio of high-performance power solutions for FPGAs and other loads in your system. These products, which range from standard linear regulators to highly flexible PWM controller and driver options to plug-in fully integrated power modules, are tailored to meet your design challenges.

For more information, visit: renesas.com/solutions/key-technology/fpga-power-solutions.html

Use PowerCompass™ to find your FPGA Power Solution

- Over 250 templates covering popular FPGA platforms
- Xilinx and Intel (Altera) FPGA power estimator import function to jump start your design

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Renesas Power Management ICs offer Solutions for Industry-Leading FPGA Products

**Xilinx**
- Spartan Series
- Virtex Series
- Kintex Series
- Artix Series
- Zynq Series

**Intel (Altera)**
- Stratix Series
- Arria Series
- Cyclone Series
- MAX 10 Series

**Lattice**
- ECP Family
- iCE Family
- CrossLink Family
- Mach Family

**Microsemi**
- PolarFire FPGA Family
- IGLD02 Low-Density FPGAs
- RTG4 Radiation-Tolerant FPGAs
- SmartFusion2 SoC FPGA
POWERCOMPASS™ TOOL

Simplify Your Power Design with the PowerCompass Multi-load Configurator

The PowerCompass™ tool makes product selection easy — quickly find Renesas parts that match your requirements, set up multiple rails if needed, perform high-level system analysis, and generate reference design files.

- Upfront design time reduced by 92%
- Multiple solution options highlight design tradeoffs for BOM count, design size, and price
- Pre-loaded design templates for popular FPGAs and microprocessors

1 Define Your Power Requirements
2 Select Parts
3 Summary Analysis
4 Generate Reference Designs

Start Your Project Now
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