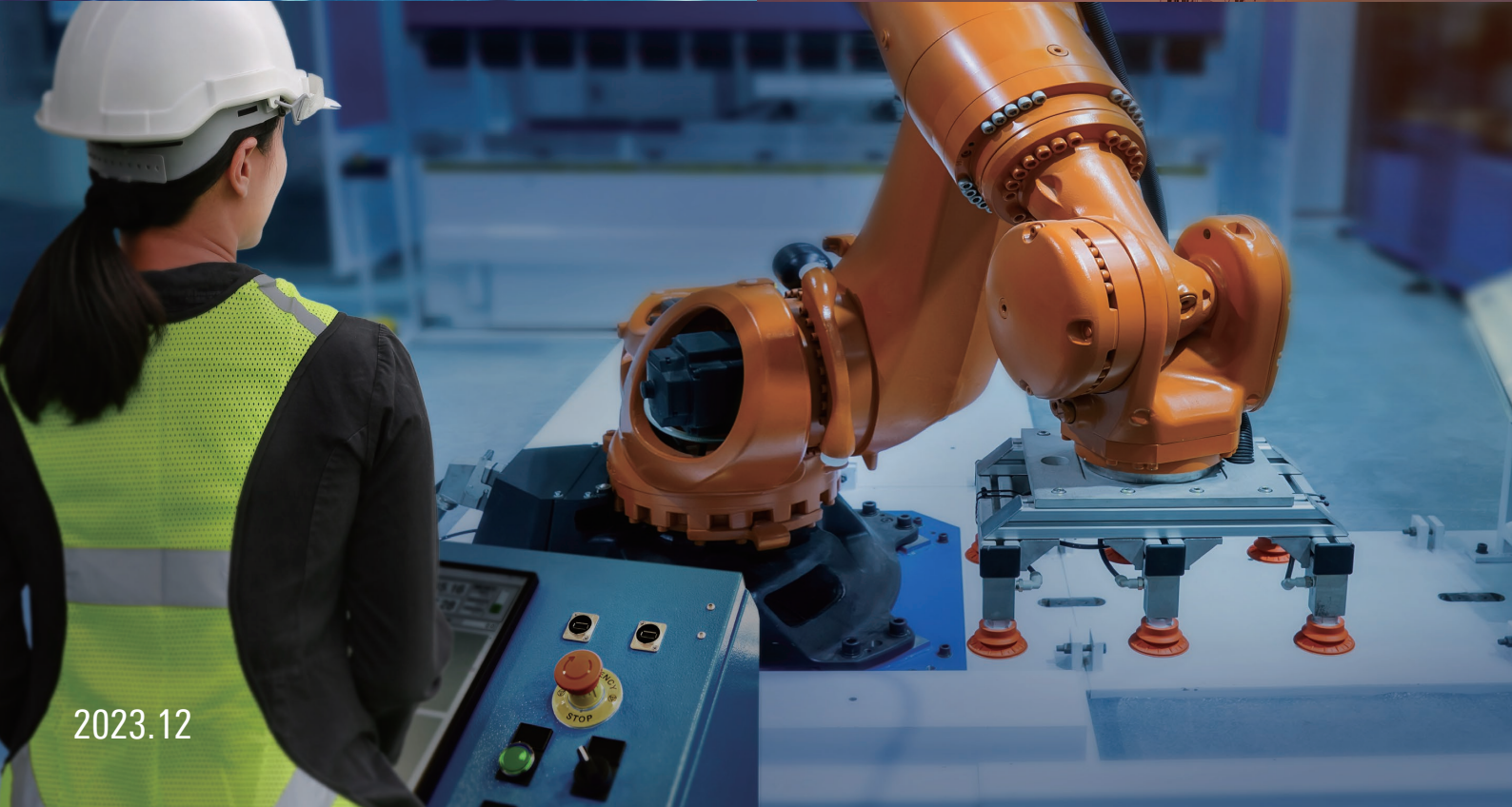


# INDUSTRIAL POWER MANAGEMENT

Rugged, high-performance power solutions for demanding environments



PROVIDING SOLUTIONS FOR TODAY'S  
COMPLEX POWER NEEDS

# INDUSTRIAL POWER



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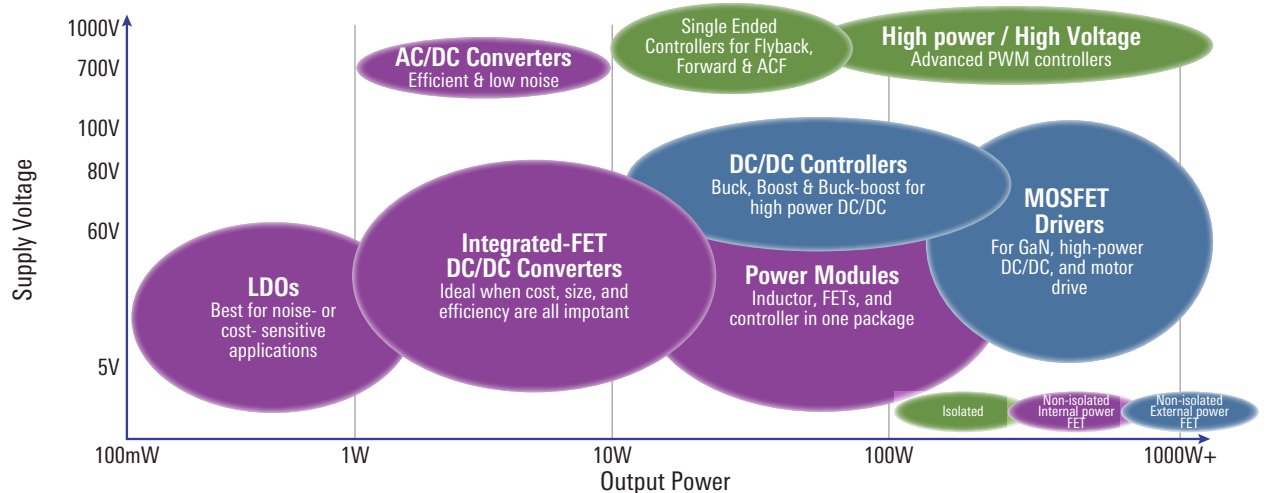
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## Complete Power Solutions

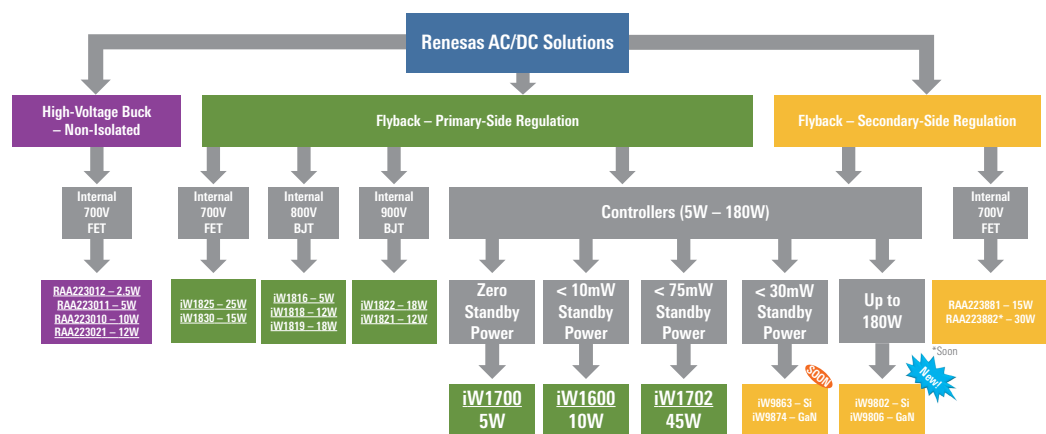
Renesas offers a complete portfolio of high-performance power solutions for processor, controller, DSP, FPGA, CPLD, DDR memory, and other loads in your system. Whether you need standard linear regulators, highly flexible DC/DC converters, or fully integrated power modules, our products are tailored to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

### FROM MILLIWATTS TO KILOWATTS, WE CAN SUPPORT YOUR APPLICATION



# AC/DC POWER CONVERSION

## AC/DC Product Solutions



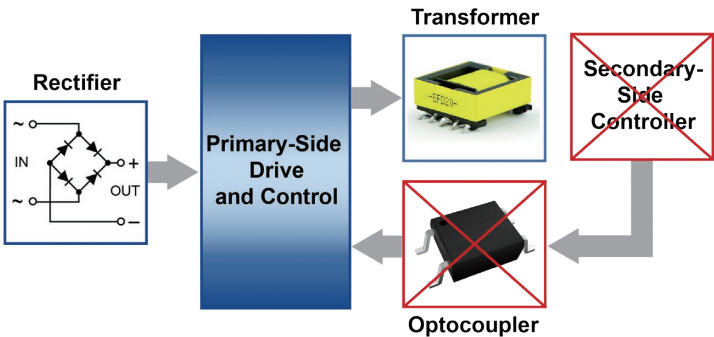
## AC/DC Non-Isolated High-Voltage Buck Converters

| Product   | Typical Output Power (max.) | Power Supply Topology       | No-Load Standby Power | Driver Type            | Key Features                                                                                | Package                   |
|-----------|-----------------------------|-----------------------------|-----------------------|------------------------|---------------------------------------------------------------------------------------------|---------------------------|
| RAA223012 | 2.5W                        | Non-Isolated Buck & Flyback | < 10mW                | Integrated 700V MOSFET | Low EMI, no audible noise, supports 3.3V or 5V output directly - no second-stage LDO needed | TSOT23-5, SOIC-8          |
| RAA223011 | 5W                          | Non-Isolated Buck & Flyback | < 10mW                | Integrated 700V MOSFET | Low EMI, no audible noise, supports 3.3V or 5V output directly - no second-stage LDO needed | TSOT23-5, SOIC8-7, SOIC-8 |
| RAA223010 | 10W                         | Non-Isolated Buck & Flyback | < 15mW                | Integrated 700V MOSFET | Low EMI, no audible noise, supports 3.3V or 5V output directly - no second-stage LDO needed | SOIC8-7                   |
| RAA223021 | 12W                         | Non-Isolated Buck & Flyback | < 20mW                | Integrated 700V MOSFET | Low EMI, no audible noise, supports 3.3V or 5V output directly - no second-stage LDO needed | SOIC8-7                   |

- Non-isolated buck makes AC/DC design easy
    - Eliminates power transformer
  - Also supports isolated flyback topologies
- Renesas' Quiet Light-Load PFM Mode
    - No audible noise, even at light load
  - Low standby power: 5 to 30mW
- Low EMI (conducted and radiated)
  - Supports 3.3V or 5V output directly
    - No second-stage LDO needed

## PrimAccurate™ Digital Primary-Side Regulation Technology

- Patented digital primary-side control technology
  - Provides highly accurate voltage and current control
- Uses digital compensation loop – no external compensation required
- Reduced BOM count enables higher MTBF
  - Eliminates secondary-side feedback and regulation components
  - Lower total BOM count yields higher reliability

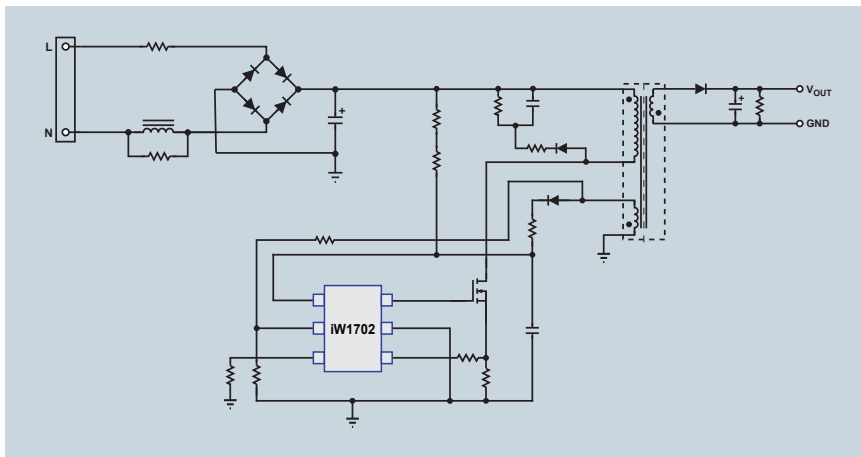


## AC/DC PrimAccurate™ Primary-Side Isolated Flyback Controllers

| Product | Typical Output Power (max.) | Power Supply Topology | No-Load Standby Power | Driver Type | Key Features                                  | Package |
|---------|-----------------------------|-----------------------|-----------------------|-------------|-----------------------------------------------|---------|
| iW1700  | 5W                          | Primary-side flyback  | < 5mW                 | BJT         | Zero Power standby (<5mW)                     | SOT23-6 |
| iW1600  | 10W                         | Primary-side flyback  | < 10mW                | BJT         | Ultra-low standby (<10mW)                     | SOT23-6 |
| iW1702  | 45W                         | Primary-side flyback  | < 75mW                | MOSFET      | Cost effective solution; option for input OVP | SOT23-6 |

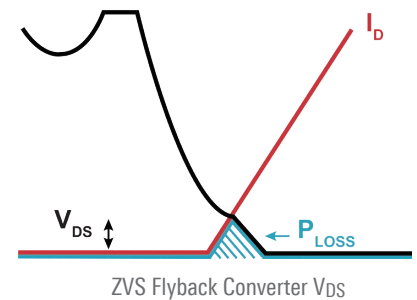
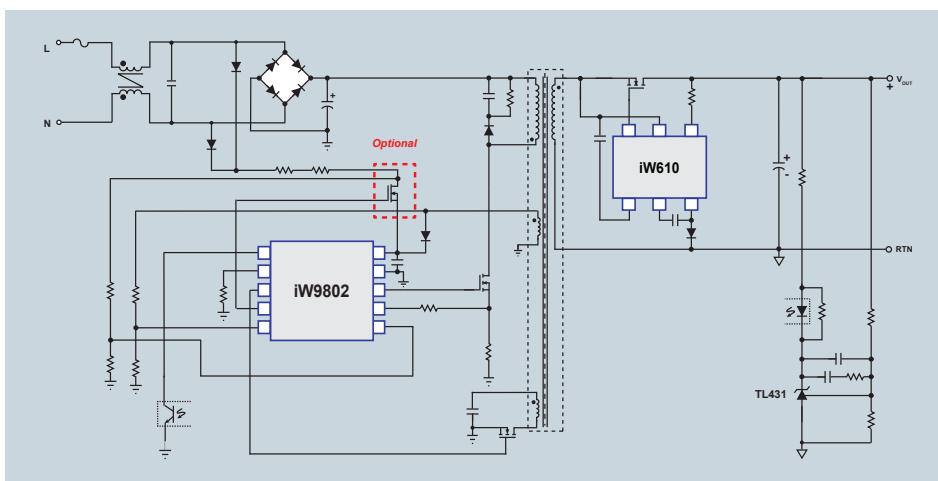
## iW1702 – 45W *PrimAccurate™* Primary-Side Isolated Flyback Controller

- Quasi-resonant DCM flyback controller
  - 79kHz switching frequency
  - Adjustable light-load mode optimizes for fast transient response and low standby power
    - < 75mW no-load standby power with fast DLR
  - Adaptive multi-mode control
    - High efficiency across all load steps
- Optimized to start into large capacitive loads - 330 $\mu$ F to 6,000 $\mu$ F
- *PrimAccurate™* technology – primary-side regulation
- Optimized for low BOM cost isolated power supplies for appliances, smart meters, smart home applications



## High Performance Secondary-Side Regulation Flyback Controllers

| Product | Typical Output Power (max.) | Power Supply Topology | No-Load Standby Power | Driver Type | Key Features                                   | Package |
|---------|-----------------------------|-----------------------|-----------------------|-------------|------------------------------------------------|---------|
| iW9802  | 135W                        | ZVS Flyback           | < 20mW                | Silicon FET | High power density ZVS technology              | SOIC-10 |
| iW9806  | 180W                        | ZVS Flyback           | < 20mW                | GaN HEMT    | High power density ZVS technology; GaN driver  | SOIC-10 |
| iW9863  | 100W                        | QR Flyback            | < 20mW                | Silicon FET | Dual-polarity aux winding; adaptive gate drive | SOT23-6 |
| iW9874  | 100W                        | QR Flyback            | < 75mW                | GaN HEMT    | Dual-polarity aux winding; GaN driver          | SOT23-6 |

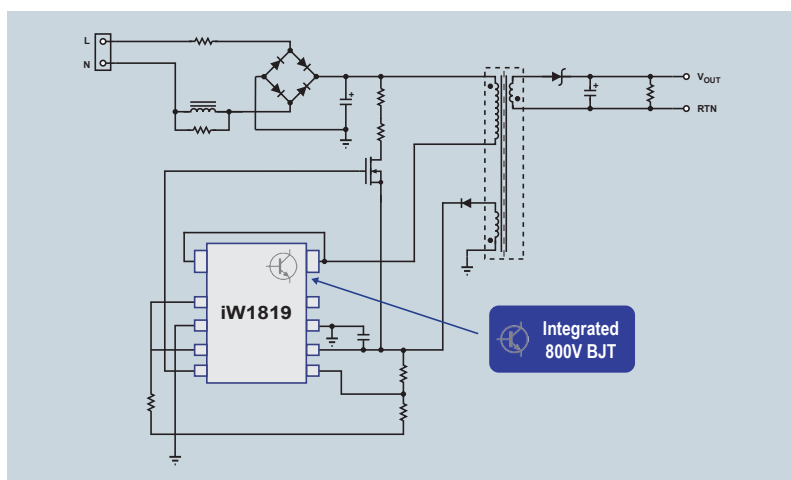


## AC/DC *AccuSwitch™* Isolated Flyback Converters

| Product                             | Typical Output Power (max.) | Power Supply Topology  | No-Load Standby Power | Integrated Power                   | Features                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Package       |
|-------------------------------------|-----------------------------|------------------------|-----------------------|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| iW1816                              | 5W                          | Primary-side flyback   | < 30mW                | 800V BJT                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | SO-7          |
| iW1818                              | 12W                         | Primary-side flyback   | < 50mW                | 800V BJT                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | PDIP-7        |
| iW1821                              | 12W                         | Primary-side flyback   | < 50mW                | 1200V BJT                          | Optimized for high-voltage 3-phase systems                                                                                                                                                                                                                                                                                                                                                                                                                            | SO-10 Batwing |
| RAA223181<br>RAA223182<br>RAA223183 | 12W                         | Secondary-side flyback | < 150mW               | 900V FET<br>1000V FET<br>1000V FET | <ul style="list-style-type: none"> <li>Frequency doubling for heavy load operation, up to 12W within 100ms</li> <li>Valley switching for best efficiency and EMI across full load range</li> <li><i>CapSaver™</i> input OVP – saves input cap cost, shuts off output voltage (RAA223181/2)</li> <li><i>CapSaver™</i> input OVP – saves input cap cost, maintains output regulation (RAA223183)</li> <li>Single 400V input capacitor for input up to 450VAC</li> </ul> | SOIC16-13     |
| iW1820                              | 15W                         | Primary-side flyback   | < 30mW                | 800V BJT                           | Optimized for 5V output                                                                                                                                                                                                                                                                                                                                                                                                                                               | SO-10 Batwing |
| iW1830                              | 15W                         | Primary-side flyback   | < 50mW                | 700V FET                           | Optimized for 12V output                                                                                                                                                                                                                                                                                                                                                                                                                                              | PDIP-7        |
| RAA223881                           | 15W                         | Secondary-side flyback |                       | 700V FET                           | Quasi-resonant switching at full load and PFM at light load for best efficiency and EMI across full load range                                                                                                                                                                                                                                                                                                                                                        | PDIP8-7       |
| iW1819                              | 18W                         | Primary-side flyback   | < 30mW                | 800V BJT                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | SO-10 Batwing |
| iW1822                              | 18W                         | Primary-side flyback   | < 30mW                | 900V BJT                           | 900V high breakdown voltage                                                                                                                                                                                                                                                                                                                                                                                                                                           | SO-10 Batwing |
| iW1825                              | 25W                         | Primary-side flyback   | < 75mW                | 700V FET                           | Configurable light load mode                                                                                                                                                                                                                                                                                                                                                                                                                                          | SO-10 Batwing |
| RAA223882                           | 30W                         | Secondary-side flyback |                       | 700V FET                           | Quasi-resonant switching at full load and PFM at light load for best efficiency and EMI across full load range                                                                                                                                                                                                                                                                                                                                                        | PDIP8-7       |

### iW1816, iW1819: *AccuSwitch™* AC/DC PWM ICs with Integrated High-Voltage Switch

- PWM controller and 800V BJT in one package
  - iW1816 – 5W output; iW1819 – 18W output
- *PrimAccurate™* primary-side regulation eliminates optocoupler
- Isolated flyback power supply topology without adding components
- Optimized to start into high capacitance loads up to 6,000µF
- Meets stringent energy regulations:
  - High light-load and active-mode efficiency
  - < 30mW no-load with fast dynamic load response
- *EZ-EMI™* valley mode switching lowers EMI, reduces filtering components size/cost
- Low-cost SOIC-7 package (iW1816)
- Innovative 10-lead SOIC batwing package (iW1819)
  - Provides high-voltage isolation
  - Small footprint, enhanced thermal performance

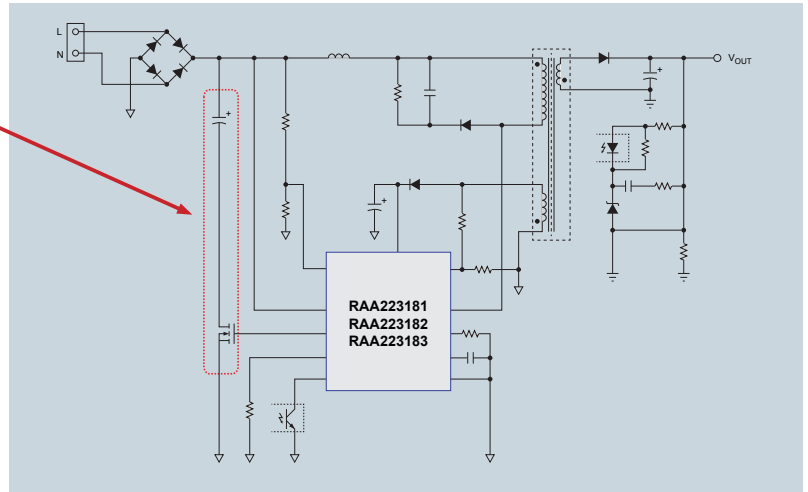


## RAA223181/2/3 12W *AccuSwitch™* Isolated Secondary-Side Flyback Converters

- 12W output power, integrated 900V MOSFET (RAA223181)
- 12W output power, integrated 1000V MOSFET (RAA223182/3)
- Very high accuracy secondary-side regulation
- *CapSaver™* – single 400V input capacitor for input up to 450V<sub>AC</sub>
- Frequency doubling for heavy load operation up to 12W, < 100ms
- Programmable fixed switching frequency, friendly with PLC communication
- Valley switching for best efficiency and EMI across full load range
- Low standby power < 150mW
- Ideal for metering, appliances, smart home power supplies

### Renesas' Patent-Pending *CapSaver™* Reduces Cost and Standby Power

- Built-in inrush current limiter
- Eliminates 450V input capacitor to reduce BOM cost
- Eliminates cap balancing resistors
- Always-on output during CapSaver mode - RAA223183



## Isolated AC/DC or DC/DC Controllers

### Value Proposition:

- High Immunity for transformer signal coupling
- Diode emulation mode for better light load efficiency
- Brick wall OCP protection
- Soft start and soft stop ( Supports pre-bias)
- Optimized/adjustable dead time control

| Topology Characteristic              | Flyback                 | Forward (two switch)             | Active clamp forward | Push-pull           | Half-Bridge     | Full-Bridge ZVS     | Full Bridge (Telecom) Hard SW |
|--------------------------------------|-------------------------|----------------------------------|----------------------|---------------------|-----------------|---------------------|-------------------------------|
| Recommended power level              | <150W                   | 120W~200W                        | 120- 400W            | 100W~500W           | 150W~500W       | >400W               | >400W                         |
| Efficiency                           | Least ~70-80%           | Moderate ~80-90%                 | High 85~92%          | Moderate ~85-93%    | High ~95%+      | High ~95%+          | High ~95%+                    |
| Recommended Devices                  | ISL884X<br>ISL672X      | ISL672X                          | ISL6726              | ISL6741             | ISL674X         | ISL675X             | ISL674X                       |
| Cost                                 | Least                   | Low                              | Low                  | Low                 | Medium          | High                | High                          |
| Transfer Function = $V_{out}/V_{in}$ | $(N_s/N_p) * D / (1-D)$ | $(N_s/N_p) * D$                  | $(N_s/N_p) * D$      | $2 * (N_s/N_p) * D$ | $(N_s/N_p) * D$ | $2 * (N_s/N_p) * D$ | $2 * (N_s/N_p) * D$           |
| High Input Voltage                   | Good for bias supply    | Good for 2-switch forward        | Good                 | Not recommended     | Good            | Good                | Good                          |
| Max. Duty Cycle                      | < 100%                  | < 50%<br>(70% with active clamp) | 70%                  | < 50% each          | < 50% each      | < 50% each          | < 50% each                    |
| Reference Designs                    | ISL884X<br>ISL672X      | ISL672X                          | ISL6726              | ISL6741             | ISL674X         | ISL675X             | ISL674X                       |

# ANALOG CONTROLLERS

High Voltage/High Current for Today's Power Demands  
Single-Output Analog Controllers

| Part No.   | V <sub>IN</sub> Range (V) | V <sub>OUT</sub> Range (V)               | Package                     | Topology           | Technical Highlights                                      |
|------------|---------------------------|------------------------------------------|-----------------------------|--------------------|-----------------------------------------------------------|
| ISL8130    | 4.5 to 28                 | 0.6 to D <sub>max</sub> *V <sub>IN</sub> | 20 Ld 4x4 QFN, 20 Ld QSOP   | Buck, Boost, SEPIC | Universal controller                                      |
| ISL8117/A  | 4.5 to 60                 | 0.6 to D <sub>max</sub> *V <sub>IN</sub> | 16 Ld 4x4 QFN, 16 Ld TSSOP  | Buck               | Current mode, simplified pin-out, low external components |
| ISL81401/A | 4.5 to 40                 | 0.8 to 40                                | 32 Ld 5x5 QFN               | Buck-Boost         | Bi-Directional, CV/CC for both input and output           |
| ISL81601   | 4.5 to 60                 | 0.8 to 60                                | 32 Ld 5x5 QFN, 38 Ld HTSSOP | Buck-Boost         | Bi-Directional, CV/CC for both input and output           |
| ISL81801   | 4.5 to 80                 | 0.8 to 80                                | 32 Ld 5x5 QFN, 38 Ld HTSSOP | Buck-Boost         | Bi-Directional, CV/CC for both input and output           |
| ISL81100   | 4.5 to 100                | 0.8 to 96                                | 25 Ld 5x5 TQFN              | Buck               | Current mode, support current sharing operation           |

SOON

## 80V Dual Phase Buck Controllers for Si and GaN FETs ISL81802 /ISL81806

### Key Features

- Integrated CC/CV controller+ driver
- Supports single or dual outputs
- Supports multi-chip paralleling and phase interleaving
- Wide switching frequency: 100kHz to 1MHz
- Selectable mode between PWM/DE/Burst
- Shoot-thru protection, OCP, OVP, OTP, UVP
- ISL81806 with optimized gate drive for GaN FETs

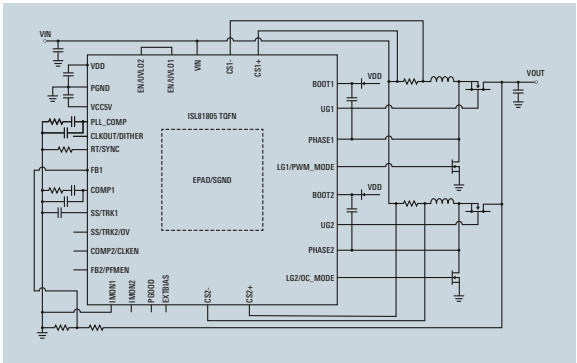


ISL81806 Demo Board  
300W, 1/16 Brick

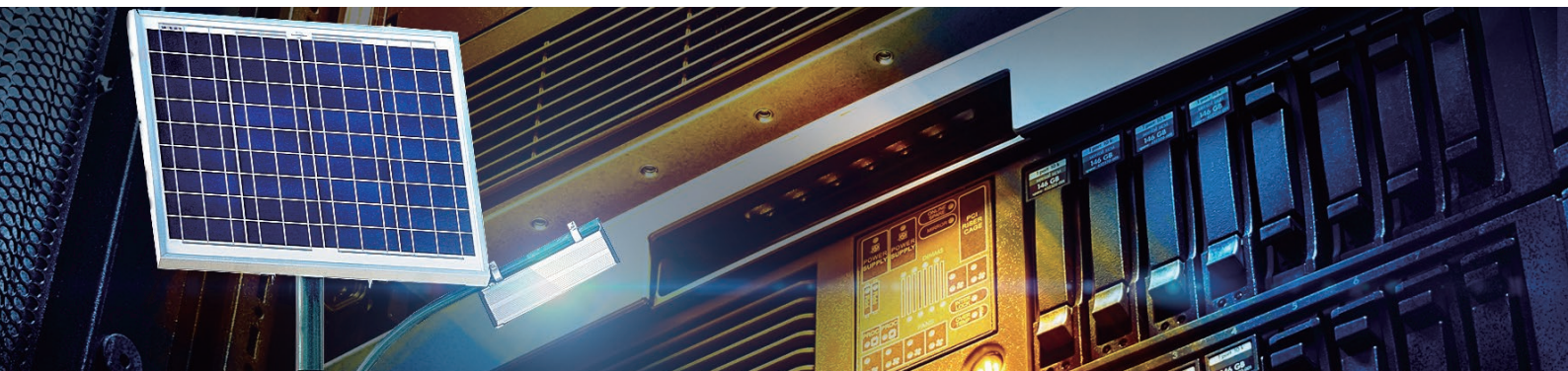
## 80V Dual Output/Two Phase Boost Controller ISL81805 /ISL81807

### Key Features

- Integrated CC/CV controller+ driver
- Supports single or dual outputs
- Supports multi-chip paralleling and phase interleaving
- Wide switching frequency: 100kHz to 1MHz
- Selectable mode between PWM/DE/Burst
- Shoot-thru protection, OCP, OVP, OTP, UVP
- ISL81807 with optimized gate drive for GaN FETs



Typical Application Diagram



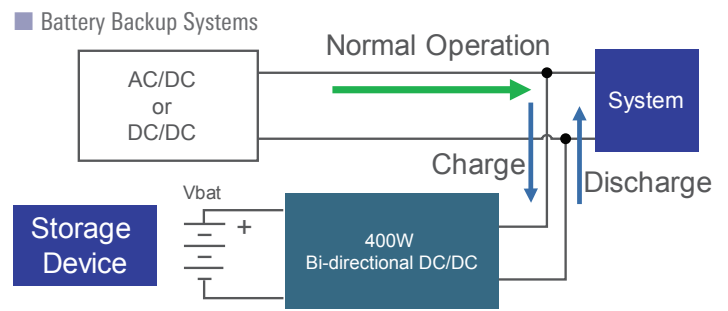
## Multi-Outputs and Multiphase Analog Controllers

| Output         | Part No. | Status   | V <sub>IN</sub> Range (V) | V <sub>OUT</sub> Range (V)               | Package                        | Topology | Technical Highlights           |
|----------------|----------|----------|---------------------------|------------------------------------------|--------------------------------|----------|--------------------------------|
| Dual           | ISL81802 | Released | 4.5 to 80                 | 0.8 to 76                                | 32 Ld 5x5 TQFN<br>38 Ld HTSSOP | Buck     | MOSFET controller              |
|                | ISL81806 | Released | 4.5 to 80                 | 0.8 to 76                                | 32 Ld 5x5 TQFN                 | Buck     | GaN controller                 |
|                | ISL81805 | Released | 4.5 to 80                 | 5 to 80                                  | 32 Ld 5x5 TQFN                 | Boost    | MOSFET controller              |
|                | ISL81807 | Released | 4.5 to 80                 | 5 to 80                                  | 32 Ld 5x5 TQFN                 | Boost    | GaN controller                 |
| Up to 12-phase | ISL8126  | Released | 3.0 to 26.5               | 0.6 to D <sub>max</sub> *V <sub>IN</sub> | 32 Ld 5x5 QFN                  | Buck     | Current sharing up to 12 phase |

### ISL81801 80V BI-DIRECTIONAL BUCK-BOOST Controller

#### Industry's FIRST bi-directional 80V buck-boost controller

- CV/CC for both input and output
- Wide programmable frequency: 100KHz to 600KHz (SYNC to 2MHz)
- Current sharing for parallel operation
- Supports on-the-fly settings change including the current flow
- High reliability with OVP, OCP, OTP, UVLO protection
- Sense both positive and negative inductor peak current



## Bidirectional Buck-Boost Controllers

| Outputs | Part No.   | V <sub>IN</sub> Range (V) | V <sub>OUT</sub> Range (V) | Output Current Max (A) | I <sub>Q</sub> | POR | SYNCH Capability | External Bias | Control Type | Package Type                   |
|---------|------------|---------------------------|----------------------------|------------------------|----------------|-----|------------------|---------------|--------------|--------------------------------|
| Single  | ISL81401/A | 4.5 to 40                 | 0.8 to 40                  | Current sharing        | 3 μA           | Yes | Yes              | Yes           | Current Mode | 32 Ld 5x5 QFN                  |
|         | ISL81601   | 4.5 to 60                 | 0.8 to 60                  | Current sharing        | 3 μA           | Yes | Yes              | Yes           | Current Mode | 32 Ld 5x5 QFN,<br>38 Ld HTSSOP |
|         | ISL81801   | 4.5 to 80                 | 0.8 to 80                  | Current sharing        | 2.7 μA         | Yes | Yes              | Yes           | Current Mode | 32 Ld 5x5 QFN,<br>38 Ld HTSSOP |

\*Current sharing means current sharing with phase interleaving.

# SWITCHING REGULATORS

## Wide $V_{IN}$ Coverage

### Benefits and Key Features

#### Robust & Reliable Performance

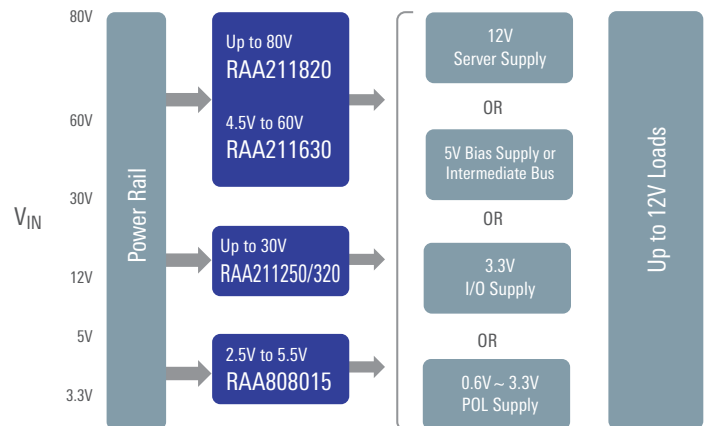
- PGOOD, Enable, adjustable soft-start
- Extensive protection (OCP, OVP, OTP, SCP)
- External frequency synchronization

#### High Integration

- Integrated HS/LS FETs
- Internal compensation

#### Target Applications

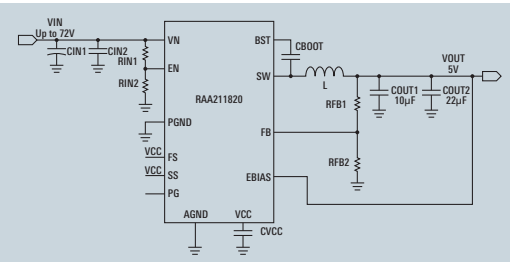
- High Voltage single board system
- Industrial power system
- Battery powered devices
- Telecommunication base station
- POLs for high performance DSPs, FPGAs, ASICs, and microprocessor



## RAA211xxx New 24V to 75V Sync Buck Regulator Family – Wide $V_{IN}$ Range

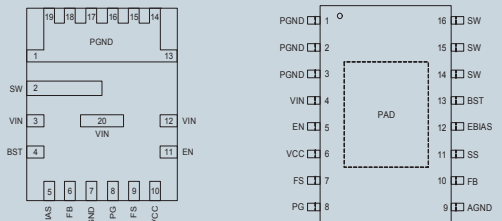
### Common Feature

- Integrated high-performance MOSFETs
- Programmable, fixed switching frequency up to 800kHz
- High efficiency light-load operation
- IC can be biased from its own output to improve efficiency
- Power Good, Soft Start, and Enable functions



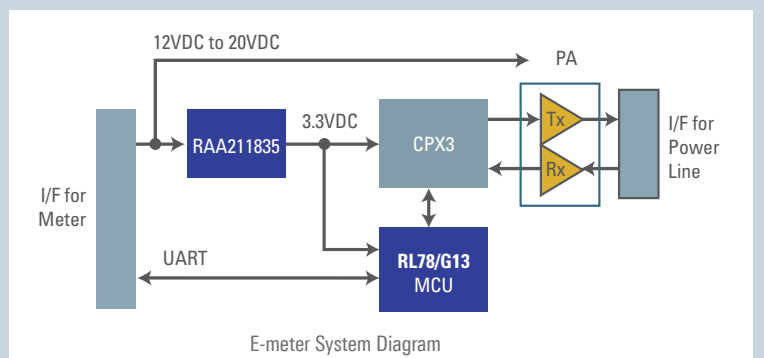
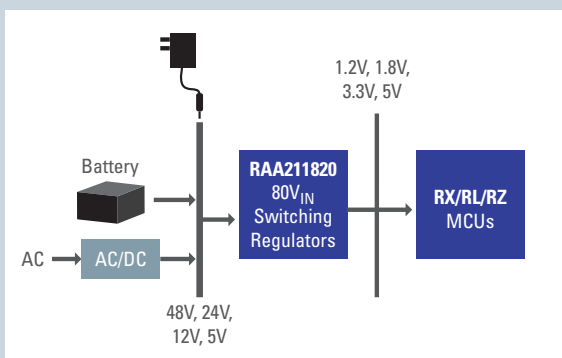
Typical Application Diagram

| Part No.  | $V_{IN}$ Range | $R_{dson}$ (High/Low) QFN | $R_{dson}$ (High/Low) HTSSOP | IOUT | Package                         |
|-----------|----------------|---------------------------|------------------------------|------|---------------------------------|
| RAA211250 | 4.5V to 30V    | 70mΩ/25mΩ                 | 115mΩ/40mΩ                   | 5A   | 20 Ld 3.5x4 QFN<br>16 Ld HTSSOP |
| RAA211450 | 4.5V to 42V    | 75mΩ/25mΩ                 | 115mΩ/40mΩ                   | 5A   |                                 |
| RAA211630 | 4.5V to 60V    | 110mΩ/40mΩ                | 155mΩ/55mΩ                   | 3A   |                                 |
| RAA211820 | 4.5V to 75V    | 155mΩ/80mΩ                | 200mΩ/95mΩ                   | 2A   |                                 |
| RAA211835 | 4.5V to 75V    | 155mΩ/NA                  | 200mΩ/NA                     | 3A   |                                 |



QFN3.5 x 4 & HTSSOP-16 Package Options

### Using 80V Sync Buck Regulator Family to Power MCUs



**RAA211230 24V, 3A Synchronous Buck Regulator**
**Key Features**

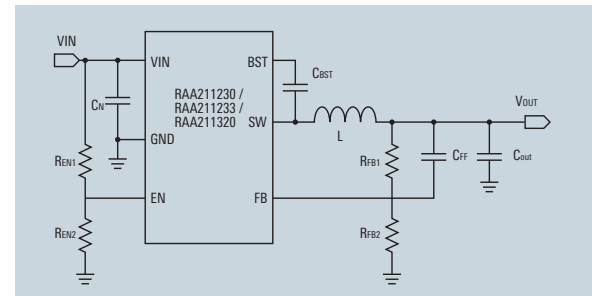
- 24V operating max rating is designed for up to 19V nominal input with 20% derating headroom
- Current-mode CoT modulator for excellent transient response
- Small TSOT23-6 package minimizes BOM & cost
- Common footprint to minimize supply chain risk

**RAA211233 24V, 3A Synchronous Buck Regulator**
**Key Features**

- High switching frequency up to 1.4MHz
- PFM for light load operation
- Comprehensive protection: UVLO, OCP, OUV, OTP

**RAA211320 30V, 2A Synchronous Buck Regulator**
**Key Features**

- 4.5V to 30V input, 2A sync buck regulator, 400μA typ Iq
- Frequency 450kHz
- PFM for light load operation
- Comprehensive protection: UVLO, OCP, OUV, OTP



| Part No.  | VIN Range   | IOUT | FB & Acc      | Rdson (High/Low) | Fsw (Hz) | Control Mode | Package  |
|-----------|-------------|------|---------------|------------------|----------|--------------|----------|
| RAA211230 | 4.5V to 24V | 3A   | 0.765V±0.015V | 85mΩ/45mΩ        | 500K     | CoT          | TSOT23-6 |
| RAA211233 | 4.5V to 24V | 3A   | 0.6V±0.012V   | 85mΩ/45mΩ        | 1.4M     |              |          |
| RAA211320 | 4.5V to 30V | 2A   | 0.765V±0.015V | 150mΩ/75mΩ       | 450K     |              |          |



## 2.5V-6V Synchronous Buck Regulators

| Part No.     | Status   | IOUT (max) (A) | # of Outputs | VIN Range (V) | VOUT Range (V) | PFM | Ext Comp | Sync | Fsw (Hz)         | FB & accuracy | Package        |
|--------------|----------|----------------|--------------|---------------|----------------|-----|----------|------|------------------|---------------|----------------|
| ISL8088      | Released | 0.8            | Dual         | 2.75 to 5.5   | 0.6 to VIN     | Y   | N        | Y    | 2.25M, Sync 4M   | 0.6±0.01V     | 10 Ld 3x3 DFN  |
| RAA808013    | Released | 3              | Single       | 2.7 to 5.5    | 0.6 to VIN     | Y   | N        | N    | 1.5M             | 0.6±0.012V    | 6 Ld TSOT23    |
| RAA808015A/B | Released | 5              | Single       | 2.7 to 5.5    | 0.6 to VIN     | Y/N | N        | N    | 1.8M             | 0.6±0.012V    | 8 Ld QFN 2x2.5 |
| ISL80019/A   | Released | 1.5            | Single       | 2.7 to 5.5    | 0.6 to VIN     | Y   | Y        | N    | 1M/2M            | 0.6±0.005V    | 8 Ld 2x2 TDFN  |
| ISL80015/A   | Released | 1.5            | Single       | 2.7 to 5.5    | 0.6 to VIN     | N   | N        | N    | 1M/2M            | 0.6±0.006V    | 8 Ld 2x2 TDFN  |
| ISL8022      | Released | 2/1.7          | Dual         | 2.7 to 5.5    | 0.6 to VIN     | Y   | N        | Y    | 2.25M, Sync 8M   | 0.6±0.01V     | 12 Ld 4x3 DFN  |
| ISL8002/A    | Released | 2              | Single       | 2.8 to 5.5    | 0.6 to VIN     | Y   | Y        | N    | 1M/2M            | 0.6±0.005V    | 8 Ld 2x2 TDFN  |
| ISL8002B     | Released | 2              | Single       | 2.7 to 5.5    | 0.6 to 4       | Y   | N        | N    | 2M               | 0.6±0.005V    | 8 Ld 2x2 TDFN  |
| ISL80020/A   | Released | 2              | Single       | 2.7 to 5.5    | 0.6 to VIN     | N   | N        | N    | 1M/2M            | 0.6±0.006V    | 8 Ld 2x2 TDFN  |
| ISL8033/A    | Released | 3/3            | Dual         | 2.85 to 6     | 0.8 to VIN     | N   | N        | Y    | 1M/2.5M, Sync 6M | 0.8±0.01V     | 24 Ld 4x4 QFN  |
| ISL8036/A    | Released | 3/3            | Dual         | 2.85 to 6     | 0.8 to VIN     | N   | N        | Y    | 1M/2.5M, Sync 6M | 0.8±0.01V     | 24 Ld 4x4 QFN  |
| ISL80030/A   | Released | 3              | Single       | 2.7 to 5.5    | 0.6 to VIN     | N   | N        | N    | 1M/2M            | 0.6±0.006V    | 8 Ld 2x2 DFN   |
| ISL80031/A   | Released | 3              | Single       | 2.7 to 5.5    | 0.6 to VIN     | Y   | N        | N    | 1M/2M            | 0.6±0.006V    | 8 Ld 2x2 DFN   |
| ISL8023/A    | Released | 3              | Single       | 2.7 to 5.5    | 0.6 to VIN     | Y   | Y        | Y    | 1M/2M            | 0.6±0.005V    | 16 Ld 3x3 TQFN |
| ISL8024/A    | Released | 4              | Single       | 2.7 to 5.5    | 0.6 to VIN     | Y   | Y        | Y    | 1M/2M            | 0.6±0.005V    | 16 Ld 3x3 TQFN |
| ISL8025/A    | Released | 5              | Single       | 2.7 to 5.5    | 0.6 to VIN     | Y   | Y        | Y    | 500K~4M/1M~4M    | 0.6±0.005V    | 16 Ld 3x3 TQFN |
| ISL8026/A    | Released | 6              | Single       | 2.5 to 5.5    | 0.6 to VIN     | Y   | Y        | Y    | 500K~4M/1M~4M    | 0.6±0.006V    | 16 Ld 3x3 TQFN |
| ISL8016      | Released | 6              | Single       | 2.7 to 5.5    | 0.6 to VIN     | Y   | Y        | Y    | 500K~4M, Sync 4M | 0.6±0.006V    | 20 Ld 3x4 QFN  |
| ISL8018      | Released | 8              | Single       | 2.7 to 5.5    | 0.6 to VIN     | Y   | Y        | Y    | 500K~4M, Sync 4M | 0.6±0.006V    | 20 Ld 3x4 QFN  |

## Up to 18V Synchronous Buck Regulators

| Part No.   | Status   | I <sub>OUT</sub> (max) | # of Outputs | V <sub>IN</sub> Range | V <sub>OUT</sub> Range                    | F <sub>sw</sub> (Hz)  | I <sub>Q</sub> (typ) | Package            |
|------------|----------|------------------------|--------------|-----------------------|-------------------------------------------|-----------------------|----------------------|--------------------|
| ISL85003/A | Released | 3A                     | Single       | 4.5V to 18V           | 0.8V to D <sub>max</sub> *V <sub>IN</sub> | 500K, Sync 2M         | 3.2 mA               | 12 Ld 3x4 DFN      |
| ISL85005/A | Released | 5A                     | Single       | 4.5V to 18V           | 0.8V to D <sub>max</sub> *V <sub>IN</sub> | 500K, Sync 2M         | 3.2 mA               | 12 Ld 4x3 DFN      |
| ISL85009   | Released | 9A                     | Single       | 3.8V to 18V           | 0.6V to D <sub>max</sub> *V <sub>IN</sub> | 300K or 600K, Sync 1M | 3 mA                 | 15 Ld 3.5x3.5 TQFN |
| ISL85012   | Released | 12A                    | Single       | 3.8V to 18V           | 0.6V to D <sub>max</sub> *V <sub>IN</sub> | 300K or 600K, Sync 1M | 3 mA                 | 15 Ld 3.5x3.5 TQFN |
| ISL85014   | Released | 14A                    | Single       | 3.8V to 18V           | 0.6V to D <sub>max</sub> *V <sub>IN</sub> | 300K or 600K, Sync 1M | 3 mA                 | 15 Ld 3.5x3.5 TQFN |

## Up to 30V Synchronous Buck Regulators

| Part No.  | Status   | I <sub>OUT</sub> (max) | # of Outputs | V <sub>IN</sub> Range | V <sub>OUT</sub> Range                      | F <sub>sw</sub> (Hz) | I <sub>Q</sub> (typ) | Package                       |
|-----------|----------|------------------------|--------------|-----------------------|---------------------------------------------|----------------------|----------------------|-------------------------------|
| RAA211230 | Released | 3A                     | Single       | 4.5V to 24V           | 0.765V to D <sub>max</sub> *V <sub>IN</sub> | 500K                 | 400 μA               | TSOT23-6                      |
| RAA211233 | Released | 3A                     | Single       | 4.5V to 24V           | 0.6V to D <sub>max</sub> *V <sub>IN</sub>   | 1.4M                 | 400 μA               | TSOT23-6                      |
| RAA211320 | Released | 2A                     | Single       | 4.5V to 30V           | 0.765V to D <sub>max</sub> *V <sub>IN</sub> | 500K                 | 400 μA               | TSOT23-6                      |
| RAA211250 | Released | 5A                     | Single       | 4.5V to 30V           | 0.8V to 90%*V <sub>IN</sub>                 | 200K~800K            | 90 μA                | 20 Ld 3.5x4 QFN, 16 Ld HTSSOP |
| ISL85033  | Released | 3A                     | Dual         | 4.5V to 28V           | 0.8V to D <sub>max</sub> *V <sub>IN</sub>   | 300K~2M              | 1.2 mA               | 28 Ld 4x4 TQFN                |

## Up to 40V Synchronous Buck Regulators

| Part No.                         | Status   | I <sub>OUT</sub> (max) | # of Outputs | V <sub>IN</sub> Range | V <sub>OUT</sub> Range                    | F <sub>sw</sub> (Hz) | I <sub>Q</sub> (typ) | Package                       |
|----------------------------------|----------|------------------------|--------------|-----------------------|-------------------------------------------|----------------------|----------------------|-------------------------------|
| ISL85412                         | Released | 150 mA                 | Single       | 3.5V to 40V           | 0.6V to D <sub>max</sub> *V <sub>IN</sub> | 700K                 | 50 μA                | 8 Ld 3x3 TDFN                 |
| ISL85413                         | Released | 300 mA                 | Single       | 3.5V to 40V           | 0.6V to D <sub>max</sub> *V <sub>IN</sub> | 700K                 | 50 μA                | 8 Ld 3x3 DFN                  |
| ISL85415                         | Released | 500 mA                 | Single       | 3V to 36V             | 0.6V to D <sub>max</sub> *V <sub>IN</sub> | 300K~2M              | 80 μA                | 12 Ld 4x3 DFN                 |
| ISL85418                         | Released | 800 mA                 | Single       | 3V to 40V             | 0.6V to D <sub>max</sub> *V <sub>IN</sub> | 300K~2M              | 80 μA                | 12 Ld 4x3 DFN                 |
| ISL85410                         | Released | 1A                     | Single       | 3V to 40V             | 0.6V to D <sub>max</sub> *V <sub>IN</sub> | 300K~2M              | 80 μA                | 12 Ld 4x3 DFN                 |
| ISL854102                        | Released | 1.2A                   | Single       | 3V to 40V             | 0.6V to D <sub>max</sub> *V <sub>IN</sub> | 300K~2M              | 80 μA                | 12 Ld 4x3 DFN                 |
| ISL85403<br>(Buck or Buck-Boost) | Released | 2.5A                   | Single       | 3V to 40V             | 0.8V to D <sub>max</sub> *V <sub>IN</sub> | 200K~2.2M            | 300 μA               | 20 Ld 4x4 QFN                 |
| RAA211450                        | Released | 5A                     | Single       | 4.5V to 42V           | 0.8V to 90%*V <sub>IN</sub>               | 200K~800K            | 90 μA                | 20 Ld 3.5x4 QFN, 16 Ld HTSSOP |

## Up to 80V Synchronous Buck Regulators

| Part No.  | Status   | I <sub>OUT</sub> (max) | # of Outputs | V <sub>IN</sub> Range | V <sub>OUT</sub> Range      | F <sub>sw</sub> (Hz) | I <sub>Q</sub> (typ) | Package                       |
|-----------|----------|------------------------|--------------|-----------------------|-----------------------------|----------------------|----------------------|-------------------------------|
| RAA211630 | Released | 3A                     | Single       | 4.5V to 60V           | 0.8V to 90%*V <sub>IN</sub> | 200K~800K            | 90 μA                | 20 Ld 3.5x4 QFN, 16 Ld HTSSOP |
| RAA211650 | Released | 5A                     | Single       | 4.5V to 60V           | 0.8V to 90%*V <sub>IN</sub> | 200K~2.5M            | 16.5 mA              | 28 Ld 4x5 QFN                 |
| RAA211651 | Released | 5A                     | Single       | 4.5V to 60V           | 0.8V to 90%*V <sub>IN</sub> | 565K                 | 19 μA                | 28 Ld 4x5 QFN                 |
| RAA211820 | Released | 2A                     | Single       | 4.5V to 75V           | 0.8V to 90%*V <sub>IN</sub> | 200K~800K            | 90 μA                | 20 Ld 3.5x4 QFN, 16 Ld HTSSOP |

## Up to 80V Non-Synchronous Buck Regulators

| Part No.    | Status   | I <sub>OUT</sub> (max) | # of Outputs    | V <sub>IN</sub> Range | V <sub>OUT</sub> Range                    | F <sub>sw</sub> (Hz) | I <sub>Q</sub> (typ) | Package                       |
|-------------|----------|------------------------|-----------------|-----------------------|-------------------------------------------|----------------------|----------------------|-------------------------------|
| RAA211605   | Released | 500 mA                 | Single          | 4.5V to 60V           | 0.6V to D <sub>max</sub> *V <sub>IN</sub> | 450K                 | 300 μA               | TSOT23-6                      |
| RAA212831   | Released | 500mA                  | 1 buck + 2 LDOs | 4.5V to 72V           | 1.25V to 24V                              | 350K                 | 325 μA               | SOIC-8                        |
| RAA212832   | Released | 500mA                  | 1 buck + 2 LDOs | 4.5V to 72V           | 12V                                       | 350K                 | 325 μA               | SOIC-8                        |
| RAA211835   | Released | 3A                     | Single          | 4.5V to 75V           | 0.8V to 90%*V <sub>IN</sub>               | 200K~800K            | 90 μA                | 20 Ld 3.5x4 QFN, 16 Ld HTSSOP |
| RAA211412   | Released | 1A                     | Single          | 5.8V to 45V           | 0.8V to Vin-3                             | 630K                 | 300 μA               | 6 Ld SOT23                    |
| RAA211403/5 | Released | 300mA                  | Single          | 7V to 40V             | 3.3V/5V                                   | 500K                 | 3.5 μA               | 5 Ld SOT23                    |
| RAA211803/5 | Released | 300mA                  | Single          | 7V to 80V             | 3.3V/5V                                   | 500K                 | 5.5 μA               | 5 Ld SOT23                    |

# MEMO

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# LOW DROPOUT REGULATORS (LDO)

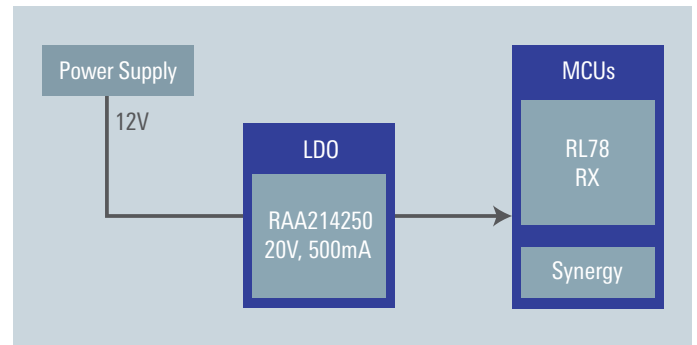
## High Performance LDOs

### RAA214250 20V Wide Input Voltage Range, 500mA Linear Regulator

The RAA214250 is a Cost-effective power for Renesas RA, RL78, Synergy, and RX MCUs

#### Key Features

- Efficient
- Low 50 $\mu$ A supply current for high light-load efficiency
- ENABLE pin shuts down output to save power
- Reliable
- Approved for use with all modern Renesas MCUs
- Stable with no load, so it can power an MCU in HALT or SLEEP mode

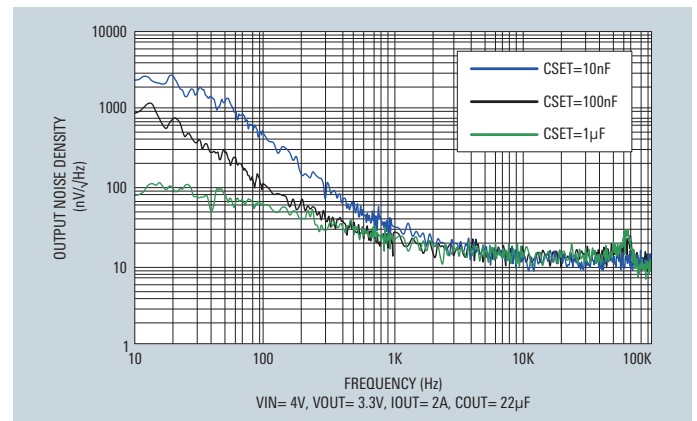


### RAA214020 LOW NOISE LDO FOR SENSITIVE CIRCUITRY

New ultra-low noise LDOs minimize phase noise & jitter in high-performance applications

#### Excellent Noise Performance

- Low Spot Noise Spectral Density: 82nV/Sqrt Hz @ 10Hz
- Low Integrated Noise: 4.54 $\mu$ V RMS from 10Hz-100kHz
- Very high PSRR @ 2A load current: Freq=10kHz=80dB
- $V_{in}$  = 2.7V to 5.5V,  $V_{out}$ =0.9V to  $V_{in}$ -dropout
- Low dropout of 500mV max @ 2A, over temperature



High-Performance LDOs

|      | Part No.          | Status   | I <sub>OUT</sub><br>max (A) | V <sub>IN</sub> (V) | V <sub>OUT</sub> (V)    | PSRR @1<br>kHz (dB) | Fixed V <sub>OUT</sub><br>Option | Dropout (mV)                     | Acc.<br>(%) | I <sub>Q</sub> (typ) | Package                                        |
|------|-------------------|----------|-----------------------------|---------------------|-------------------------|---------------------|----------------------------------|----------------------------------|-------------|----------------------|------------------------------------------------|
| SOON | RAA214035         | Sampling | 3                           | 2.7 to 5.5          | 0.9 to 5.5<br>– dropout | >80                 | No                               | 500                              | ±2.0        | 100 µA               | 5mm x 5mm 20 Ld QFN<br>3.5mm x 3.5mm 20 Ld QFN |
|      | RAA214401         | Released | 0.15                        | 5.4 to 40           | 3.3                     | 47                  | Yes                              | 1550 @ 150mA                     | ±1.0        | <3 µA                | SOT23                                          |
|      | RAA214220         | Released | 0.15                        | 2.5 to 20           | 1.23 to 18              | >63                 | No                               | 145 @ 100mA                      | ±2.0        | 6 µA                 | SOT23                                          |
|      | RAA214250         | Released | 0.5                         | 2.5 to 20           | 1.23 to 18              | >63                 | No                               | 350 @ 500mA                      | ±2.0        | NA                   | 8Ld DFN3x3/ SOIC                               |
|      | RAA214020         | Released | 2                           | 2.7 to 5.5          | 0.9 to 5.5<br>- dropout | >80                 | No                               | 500                              | ±2.0        | 100 µA               | 10 Ld DFN                                      |
|      | RAA214023         | Released | 2                           | 2.7 to 5.5          | 0.9 to 5.5<br>- dropout | >80                 | No                               | 500                              | ±2.0        | 100 µA               | 5mm x 5mm 20 Ld QFN<br>3.5mm x 3.5mm 20 Ld QFN |
|      | ISL80505          | Released | 0.5                         | 1.8 to 6            | 0.8 to 5.5              | 50                  | No                               | 45 @ 500mA                       | 1.8         | 2.2 mA               | 8 Ld 3x3 DFN                                   |
|      | ISL80510          | Released | 1                           | 2.2 to 6            | 0.8 to 5.5              | 48                  | No                               | 130 @ 1A                         | 1.8         | 2.2 mA               | 8 Ld 3x3 DFN                                   |
|      | ISL80101A         | Released | 1                           | 2.2 to 6            | 0.8 to 5                | 48                  | Yes                              | 90 @ 1A                          | 1.8         | 3.0 mA               | 10 Ld 3x3 DFN                                  |
|      | ISL80101-<br>Adj. | Released | 1                           | 2.2 to 6            | 0.8 to 5                | 58                  | Yes                              | 130 @ 1A                         | 1.8         | 3.0 mA               | 10 Ld 3x3 DFN                                  |
|      | ISL80102          | Released | 2                           | 2.2 to 6            | 0.8 to 5                | 55                  | Yes                              | 81 (@2A,V <sub>out</sub> =2.5V)  | 1.8         | 7.5 mA               | 10 Ld 3x3 DFN                                  |
|      | ISL80103          | Released | 3                           | 2.2 to 6            | 0.8 to 5                | 55                  | Yes                              | 120 (@3A,V <sub>out</sub> =2.5V) | 1.8         | 7.5 mA               | 10 Ld 3x3 DFN                                  |
|      | ISL80111          | Released | 1                           | 1 to 3.6            | 0.8 to 3.3              | 80                  | No                               | 27 @ 1A                          | 1.6         | 3.5 mA               | 10 Ld 3x3 DFN                                  |
|      | ISL80112          | Released | 2                           | 1 to 3.6            | 0.8 to 3.3              | 80                  | No                               | 53 @ 2A                          | 1.6         | 3.5 mA               | 10 Ld 3x3 DFN                                  |
|      | ISL80113          | Released | 3                           | 1 to 3.6            | 0.8 to 3.3              | 80                  | No                               | 75 @ 3A                          | 1.6         | 3.5 mA               | 10 Ld 3x3 DFN                                  |

Wide Input Voltage Generic LDOs (Focus on Low Quiescent Current)

|      | Part No.  | Status       | I <sub>OUT</sub><br>max (A) | V <sub>IN</sub> (V) | V <sub>OUT</sub> (V) | PSRR @1<br>kHz (dB) | Fixed V <sub>OUT</sub><br>Option | Dropout (mV) | Acc.<br>(%) | I <sub>Q</sub> (typ) | Package            |
|------|-----------|--------------|-----------------------------|---------------------|----------------------|---------------------|----------------------------------|--------------|-------------|----------------------|--------------------|
|      | ISL80410  | Released     | 0.15                        | 6 to 40             | 2.5 to 12            | 66                  | No + EN                          | 295 @ 150mA  | ±1.0        | 18 µA                | 8 Ld EPSOIC        |
|      | RAA214401 | Released     | 0.15                        | 5.4 to 40           | 3.3                  | 47                  | Yes                              | 1550 @ 150mA | ±1.0        | <3 µA                | SOT23-3            |
|      | RAA214220 | Released     | 0.15                        | 2.5 to 20           | 1.23 to 18           | >63                 | No + EN                          | 145 @ 100mA  | ±2.0        | 38 µA                | SOT23-5            |
| SOON | RAA214223 | Sampling     | 0.15                        | 2.5 to 20           | 3.3                  | >65                 | Yes + EN                         | 240 @ 150mA  | ±2.0        | 96 µA                | SOT23-5            |
|      | RAA214250 | Released     | 0.5                         | 2.5 to 20           | 1.23 to 18           | >63                 | No + EN                          | 350 @ 500mA  | ±2.0        | 68 µA                | 8Ld DFN3x3/ EPSOIC |
| SOON | RAA214290 | Sampling     | 1                           | 2.5 to 20           | 1.23 to 18           | >62                 | No + EN                          | 270@ 500mA   | ±2.0        | 80 µA                | 8Ld DFN3x3/EPSOIC  |
| SOON | RAA214403 | Pre-Released | 0.15                        | 3.6 to 40           | 3.3                  | 47                  | Yes + EN                         | <100 @ 10mA  | ±3.0        | <4 µA                | SOT23-5 & SOT89-3  |
| SOON | RAA214404 | Pre-Released | 0.15                        | 3.9 to 40           | 3.6                  | 47                  | Yes + EN                         | <100 @ 10mA  | ±3.0        | <4 µA                | SOT23-5            |
| SOON | RAA214405 | Pre-Released | 0.15                        | 5.3 to 40           | 5                    | 47                  | Yes + EN                         | <100 @ 10mA  | ±3.0        | <4 µA                | SOT23-5 & SOT89-3  |
| SOON | RAA214409 | Pre-Released | 0.15                        | 9.3 to 40           | 9                    | 47                  | Yes                              | <120 @ 10mA  | ±3.0        | <4 µA                | SOT89-3            |

# SHUNT REGULATORS

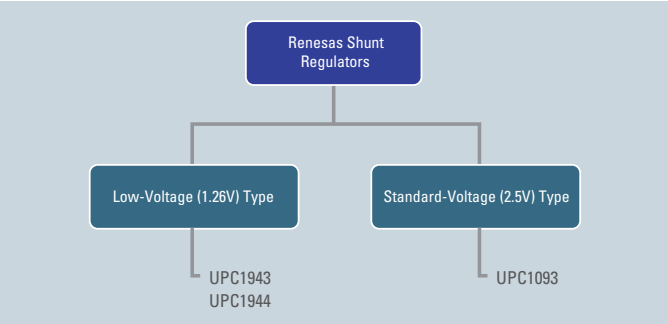
## Reference Power Supply ICs

### Benefits and Key Features

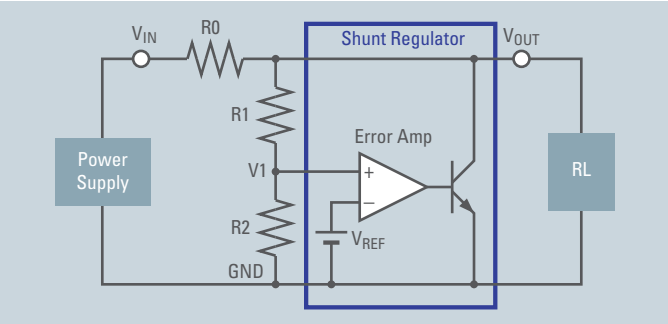
Shunt regulators are the standard reference voltage source widely used by the feedback circuits of switching power supplies and so on. Compared to the Zener diode, which is a discrete product, a shunt regulator has much better voltage precision because voltage control is carried out as an IC.

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



### Shunt Regulator Application



## Shunt Regulators

| Item                        |                              | Low-Voltage (1.26V) Type                  |          | Standard-Voltage (2.5V) Type                 |          |          |
|-----------------------------|------------------------------|-------------------------------------------|----------|----------------------------------------------|----------|----------|
|                             |                              | UPC1943T                                  | UPC1944T | UPC1093TA                                    | UPC1093T | UPC1093G |
| Reference voltage           | VREF (V)                     | 1.23 (min.) to 1.26 (typ.) to 1.29 (max.) |          | 2.440 (min.) to 2.495 (typ.) to 2.550 (max.) |          |          |
| Cathode voltage             | VKA (V)                      | 24 (max.)                                 |          | 36 (max.)                                    |          |          |
| Cathode current             | IK (mA)                      | 30 (max.)                                 |          | 100 (max.)                                   |          |          |
| Operating temperature range | TA (°C)                      | -30 to +85                                |          | -20 to +85                                   |          |          |
| Package                     | 5-pin mini mold(SC-74A)      |                                           |          |                                              |          |          |
|                             | 3-pin power mini mold(SC-62) |                                           |          |                                              |          |          |
|                             | 8-pin SOP                    |                                           |          |                                              |          |          |

# MEMO

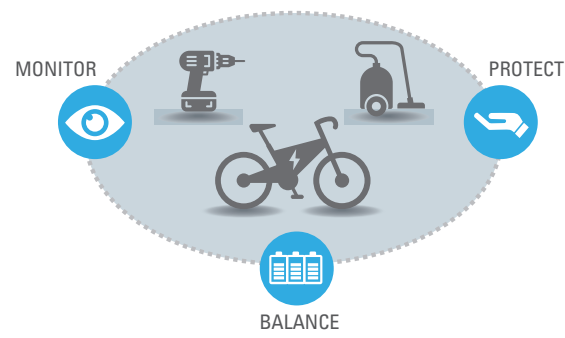
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# BATTERY MANAGEMENT

## 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

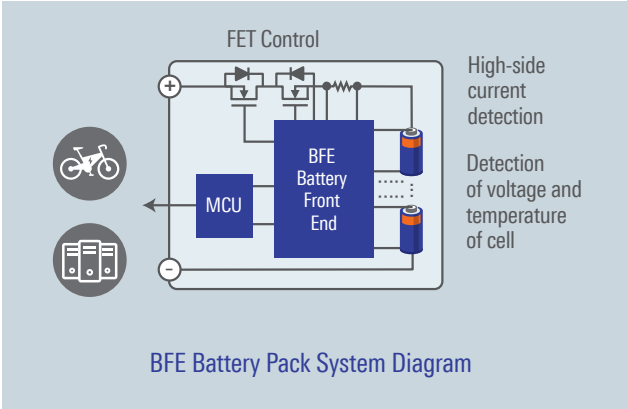
### Benefits and Key Features

#### 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



### RAA489206 Industrial Battery Front End Protects, Monitors, and Balances High Voltage Battery Packs

- Up to 16 cell inputs
- Highly integrated, includes charge pump, high side FET drivers, current measurement, LDO, wake-up logic, internal and external balancing circuits, and LED drivers
- Hot plug tested and proven via random connection trials
- Reference circuit, sample code, and high degree of integration accelerates battery pack design, test and verification

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

| Cells                     | Pack Voltage                      | Part Number | Cell Balance               | Current Sense | Charge/Discharge FET              | Internal ADC | Features                                    | Package |
|---------------------------|-----------------------------------|-------------|----------------------------|---------------|-----------------------------------|--------------|---------------------------------------------|---------|
| 4 to 16                   | 12 to 60V (60V available Q4'2021) | RAA489206   | Both Internal and External | Low Side      | N-channel, High side and Low side | Yes          | LDO, LED Drivers                            | 64QFN   |
| 4 to 6                    | 4 to 26.4                         | ISL94208    | Both Internal and External | Low Side      | N-channel, Low Side               | No           | Simplicity, internal cell balancing         | 32QFN   |
| 6 to 14 (and Daisy Chain) | 10 to 65                          | RAA489204   | Both Internal and External | No            | N/A                               | Yes          | Daisy chain                                 | 64TQFP  |
| 3 to 8                    | 4 to 36                           | ISL94202    | External                   | High Side     | N-channel, High Side              | Yes          | High-side current sense, standalone capable | 48TQFN  |

## Battery Fuel Gauge ICs (FGIC)

Dedicated one-package solution with MCU and AFE provides an intelligent, programmable system for battery management that constantly monitors and protects the battery.

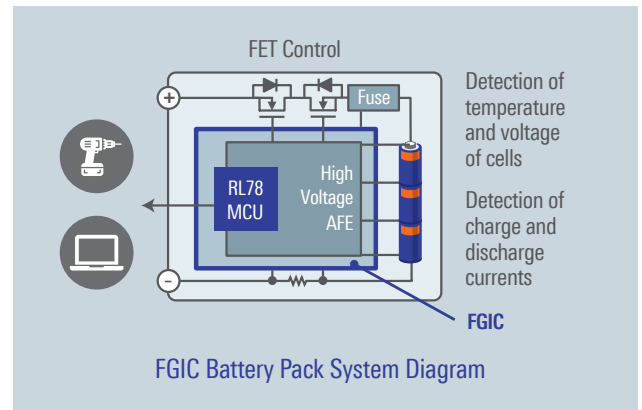
### Benefits and Key Features

#### 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



### FGIC Block Diagram

#### Voltage and Current Measurement by Independent A/D Converters

- Current detection: 153  $\mu\text{A}/\text{LSB}$  resolution (18-bit  $\Delta\sum 5 \text{ m}\Omega$  shunt resistor) support for simultaneous measurement with virtually no temperature drift
- Voltage/temperature measurement: 15-bit  $\Delta\sum \text{ADC}$

#### High Reliability & High Integration

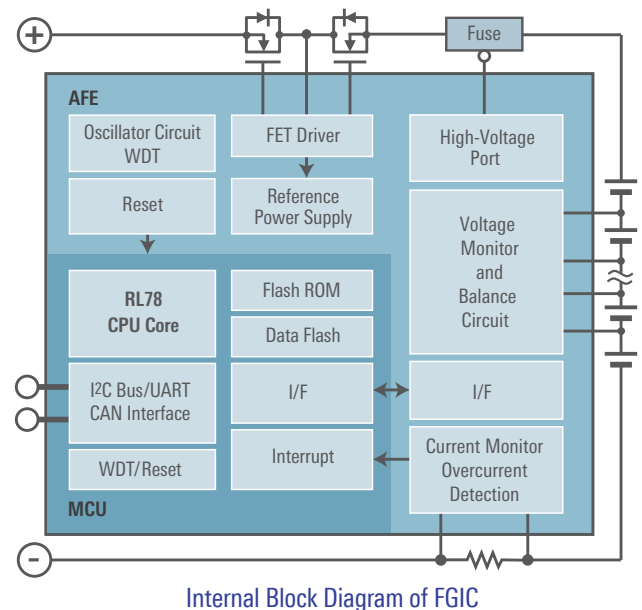
- Built-in FET protection for overcurrent or short circuit conditions
- Redundant fault detection by both MCU and AFE
- Ability to set lifecycle related limits and maintain battery parameter and operation history using data flash guaranteed for 100,000 erase/write cycles
- Integrated CAN interface and 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  $\mu\text{A}$  or less and cell balance circuit to maximize battery capacity (RAJ240090 and RAJ240100)



## Battery Fuel Gauge ICs

|     | Cells   | Pack Voltage (V) | Part No.  | Flash ROM | RAM    | Charge/Discharge FET Control | Serial I/F                  | I/O | Features                                                                                   | Package |
|-----|---------|------------------|-----------|-----------|--------|------------------------------|-----------------------------|-----|--------------------------------------------------------------------------------------------|---------|
| NEW | 1       | 2 to 5.5         | RAA241200 | 64 KB     | 4.0 KB | Low side                     | I <sup>2</sup> C, UART      | 7   | Very compact package (1.871mm x 2.478mm)<br>Very low power consumption (10 $\mu\text{A}$ ) | 16WLPGA |
| NEW | 2 to 4  | 2.2 to 25        | RAJ240055 | 64 KB     | 4.0 KB | High side                    | I <sup>2</sup> C, UART      | 12  | Compact package (4mm x 4mm)                                                                | 32QFN   |
|     |         |                  | RAJ240057 | 128 KB    | 7.0 KB |                              |                             |     |                                                                                            |         |
|     | 2 to 5  | 4 to 25          | RAJ240071 | 32 KB     | 1.5 KB | High side                    | I <sup>2</sup> C, UART      | 11  | Compact package (4mm x 4mm)<br>5 cell support                                              | 32QFN   |
|     |         |                  | RAJ240075 | 64 KB     | 4.0 KB |                              |                             |     |                                                                                            |         |
|     | 3 to 8  | 4 to 50          | RAJ240090 | 128 KB    | 7.0 KB | High / Low side              | I <sup>2</sup> C, UART, CAN | 31  | High voltage tolerance, On-chip CAN,<br>Low power consumption (25 $\mu\text{A}$ )          | 64LQFP  |
|     | 3 to 10 |                  | RAJ240100 |           |        |                              |                             |     |                                                                                            |         |
| NEW | 3 to 7  | 4 to 40          | RAJ240301 | 64 KB     | 5.5 KB | Low side                     | I <sup>2</sup> C, UART      | 21  | GPIO: I/O x 15, Input x 2, NOD x 2, HVNOD x 2                                              | 48QFP   |
|     | 3 to 10 | 8 to 50          | RAJ240310 | 64 KB     | 4.0 KB | Low side                     | I <sup>2</sup> C, UART      | 15  | Compact package (5mm x 5mm)<br>10 cell support                                             | 40QFN   |

\* Specifications are subject to change without notice.

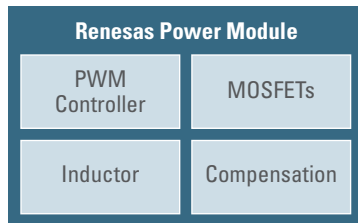
# POWER MODULES

## Complete Power System

### Benefits and Key Features

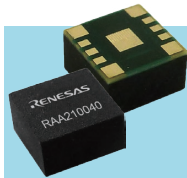
#### Easy to Use

- Full integration means less complexity and easier design
- First pass success



#### Featured Product

- RAA210040 5V, 4A Step-Down DC/DC Mini Module with Integrated Inductor



**5V, 4A Low-profile Mini Module**  
for industrial, telecom and medical applications

- RAA210130 12V, 30A Step-Down DC/DC Digital Power Module. 12V, 30A Small Footprint, Digital Power Module for general purpose power for ASIC, FPGA, DSP and memory



#### Highest Power Density

- Power output up to **100W** POL in a single package

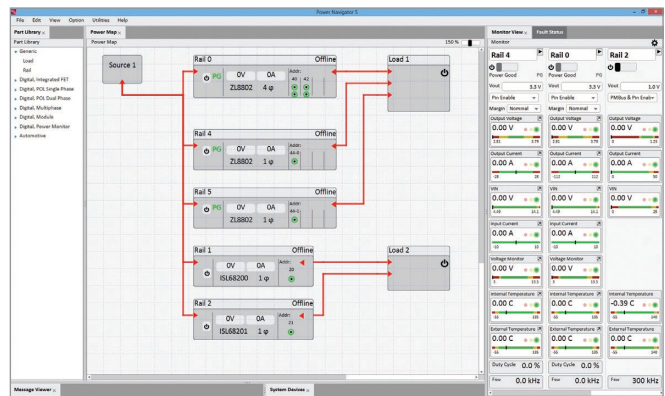
#### Thermally Enhanced Package Technology

- 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)



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.



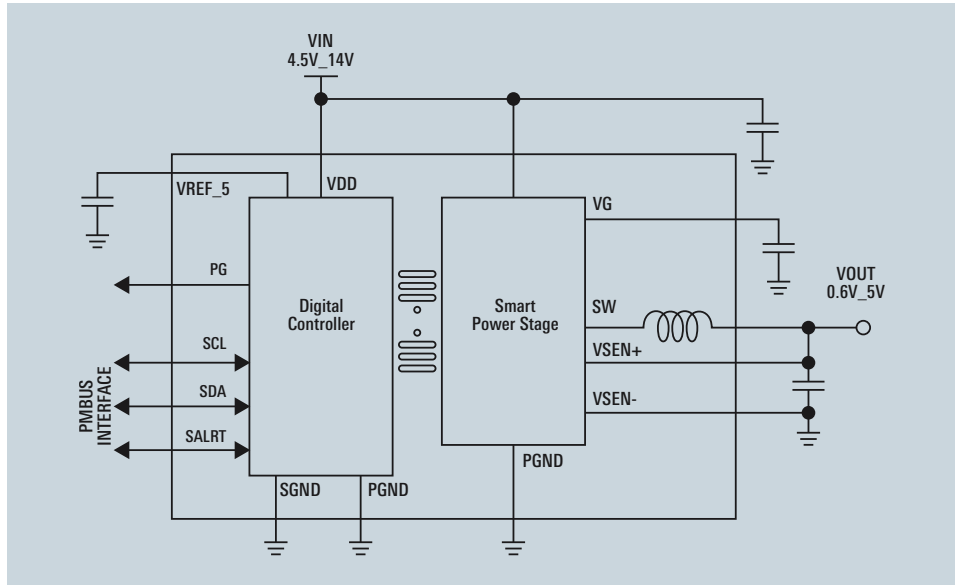
# DC/DC POWER MODULES

## RAA210130 PMBUS-enabled 15V, 30A Module

High power density supports demanding loads in BGA-POP module

### Key Features

- PMBus™ Compliant Controller + Smart Power Stage
- Vin range: 4.75V to 15V, Vout range: 0.45V to 3.3V
- ±0.7% Output Voltage Accuracy over Temperature
- Pin-selectable pre-programmed output voltage options
- "Black box" fault capture & recording
- User-accessible one-time-programmable memory slots



## DC/DC Power modules integrated inductor

| Part No.  | I <sub>OUT</sub> MAX (A) | Ch | Circuit           | V <sub>IN</sub> (V) | V <sub>OUT</sub> (V) | Package                                               | PMBus | Molded |
|-----------|--------------------------|----|-------------------|---------------------|----------------------|-------------------------------------------------------|-------|--------|
| RAA210130 | 30A                      | 1  | DC/DC (Step-down) | 4.75 to 15          | 0.45 to 3.3          | 10mm x 13mm x 7.8mm BGA package                       | Yes   | NO     |
| RRM12120  | 20A                      | 1  | DC/DC (Step-down) | 4.75 to 15          | 0.45 to 3.3          | 10mm x 13mm x 5.9mm BGA package                       | Yes   | NO     |
| RRM20030  | 3A                       | 1  | DC/DC (Step-down) | 4.5 to 20           | 0.6 to 5             | 3mm x 2.8mm x 1.7mm dual flat no-lead package         | No    | YES    |
| RAA210040 | 4A                       | 1  | DC/DC (Step-down) | 2.7 to 5.5          | 0.6 to 5             | 3mm x 3mm x 1.7mm dual flat embedded laminate package | No    | YES    |
| RAA210030 | 3A                       | 1  | DC/DC (Step-down) | 2.7 to 5.5          | 0.6 to 5             | 3mm x 3mm x 1.1mm dual flat embedded laminate package | No    | YES    |

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  $I_Q$  ( $<10 \mu A$ ) eliminates the need for a disconnect switch to maintain idle battery life

### Integrated Linear Regulators (HIP2104) for External Loads

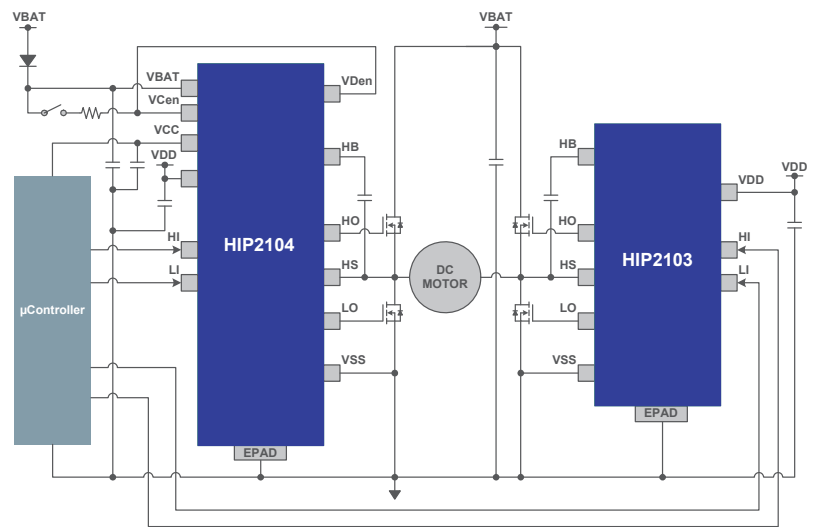
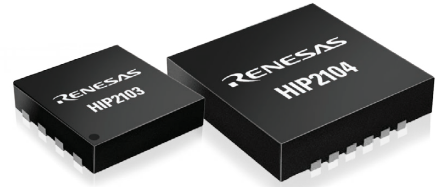
- Reduces external components for lower BOM cost and smaller solution footprint
- 12V output provides gate drive bias
- 3.3V output provides digital controller bias

### 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



Typical Full-Bridge Application

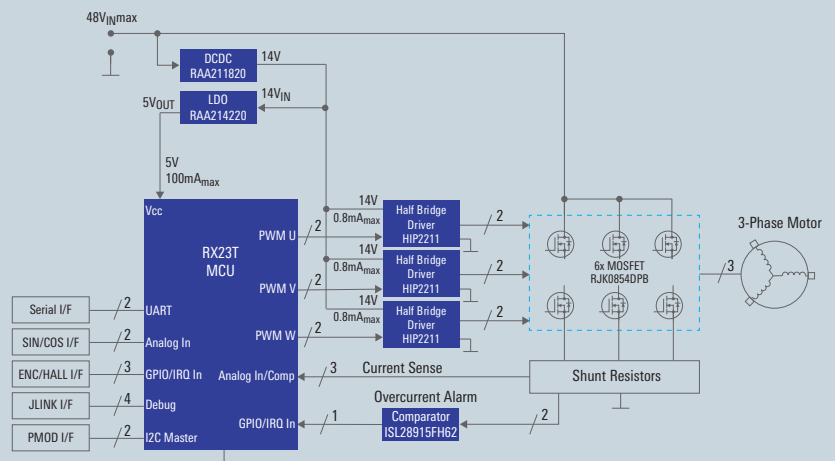
## 48V BLDC Motor Control – Using 120V HB drivers + DC/DC + LDO + RX23T

### Benefits

- Smaller solution size
- Better system efficiency through higher driver current and lower  $I_Q$
- 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

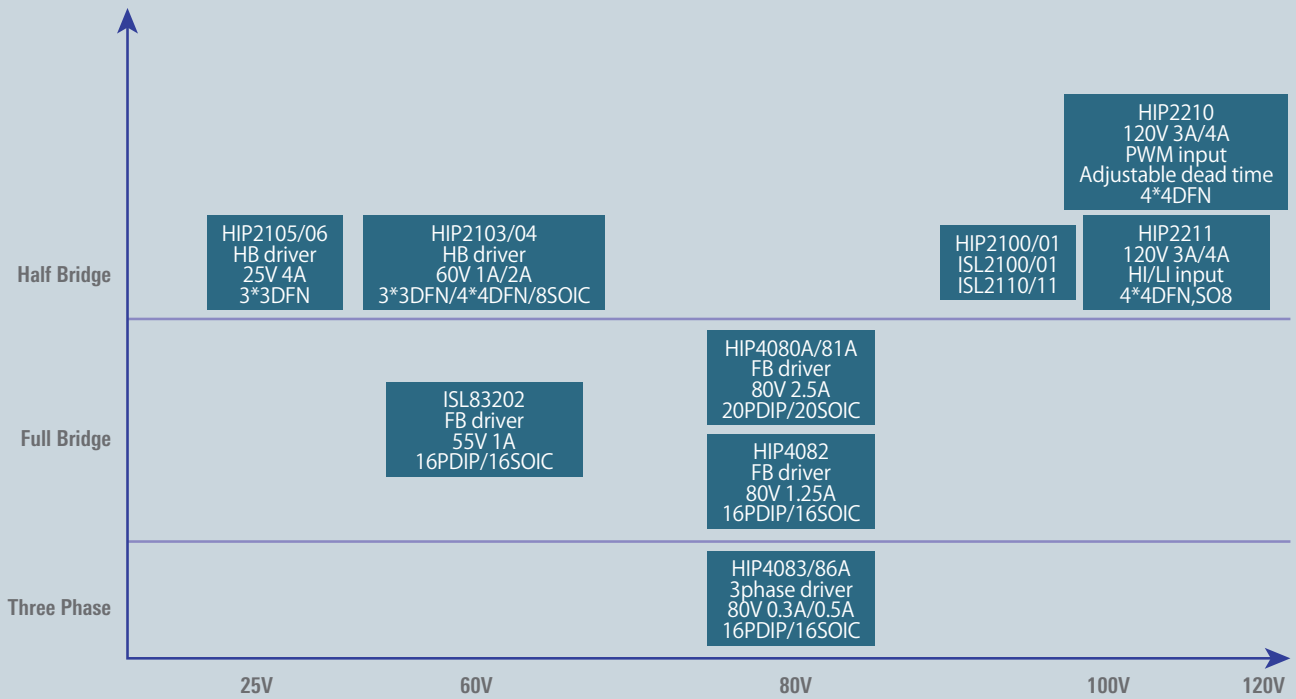
### Applications

- Telecom bricks and power supplies
- High power motor control
- Robotics



## Full Menu of MOSFET Gate Drivers

### BRIDGE FET DRIVERS



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