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## *Buck Controllers Implement Three-Level Topology For Efficient USB-C Power Solutions*

Renesas Electronics' RAA489300 and RAA489301 are high-performance buck controllers designed with a three-level buck topology used for battery charging and voltage regulation in USB-C systems such as multiple-port USB-PD chargers, portable power stations, PC docking stations, robots, drones, and other applications that need a high-efficiency dc-dc controller.

The three-level buck converter topology enabled by the new ICs delivers exceptional efficiency and significantly reduces the required inductance for regulating the output voltage. Its innovative design minimizes power loss and reduces system size, making it well suited for compact, high-performance applications.

The three-level topology consists of two additional switches and a flying capacitor compared to a conventional two-level buck converter. The flying capacitor reduces voltage stress on the switches, allowing designers to use lower-voltage FETs with better figures of merit. The result is reduced conduction and switching losses. This topology also enables the use of a smaller inductor with peak-to-peak ripple of only about 25% of that of a two-level converter, enabling reduced inductor core and DCR losses (Figs. 1 and 2).

"This three-level buck topology solution is a prime example of Renesas' worldwide leadership in battery charging," said Gaurang Shah, vice president of the Power Division at Renesas. "The innovative technology includes patent-pending breakthroughs that offer our customers clear advantages over competing USB-C power offerings."

The three-level RAA489300/RAA489301 battery charger and voltage regulator offers superior thermal performance which reduces cooling requirements and results in cost and space savings. This innovative approach addresses the growing demand for compact and efficient power management systems.

Key features of the battery charger and voltage regulator include:

- Wide range of input (4.5 V to 57.6 V) and output (3 V to 54.912 V) voltages for use in battery packs and with various PD adapters
- Integrated safety features with built-in protection mechanisms against overcharging, overheating, and voltage anomalies
- Scalability for easily adapting to various power levels and application requirements
- Optimized switching architecture that divides voltage across power switches, improving efficiency
- Minimized power consumption, contributing to greener, more sustainable designs
- Lower thermal stress, which improves system reliability and extends product lifespan.

Complementing these IC products, Renesas offers the RTK-251-SinkCharger-240W and the 240W Dual-Port Daughter Card Winning Combinations that minimize the effort required for customers to design USB-C battery charging into their products. Winning Combinations are technically vetted system architectures from mutually compatible devices that work together seamlessly to bring an optimized, low-risk design for faster time to market.

The RAA489300 and RAA489301 are available now in a 4-mm × 4-mm 32-lead TQFN package. Comprehensive design support and tools, including the RTK-251-SinkCharger-240W Kit and the RTKA489300DE0000BU evaluation board are also available.

For more information, see the RAA489300 product page and the eval board page. Also see the RTK-251-SinkCharger-240W and the 240W Dual-Port Daughter Card pages for more on those system solutions.

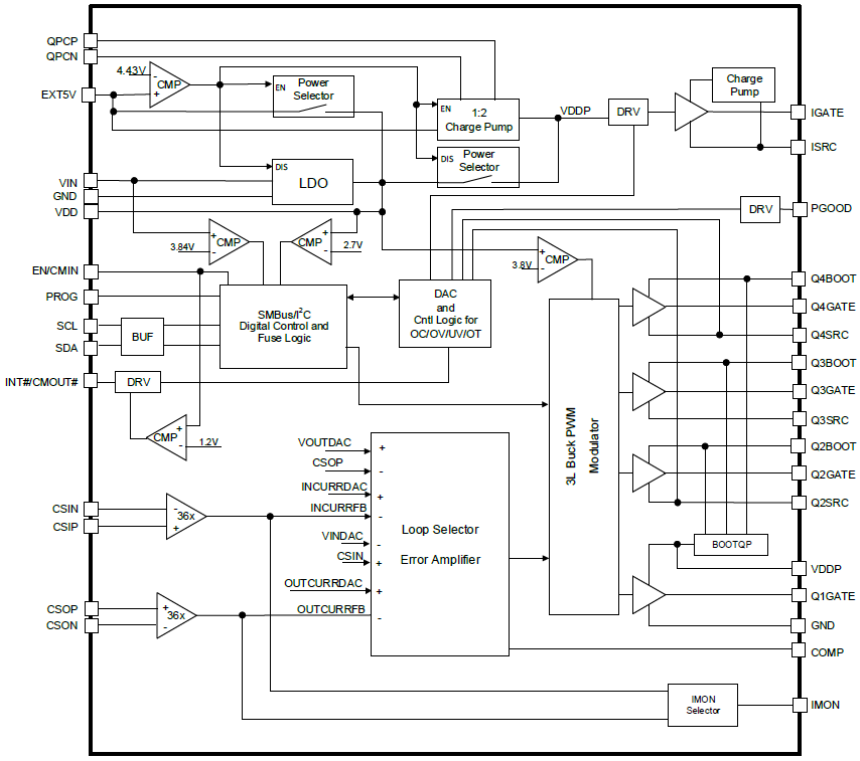
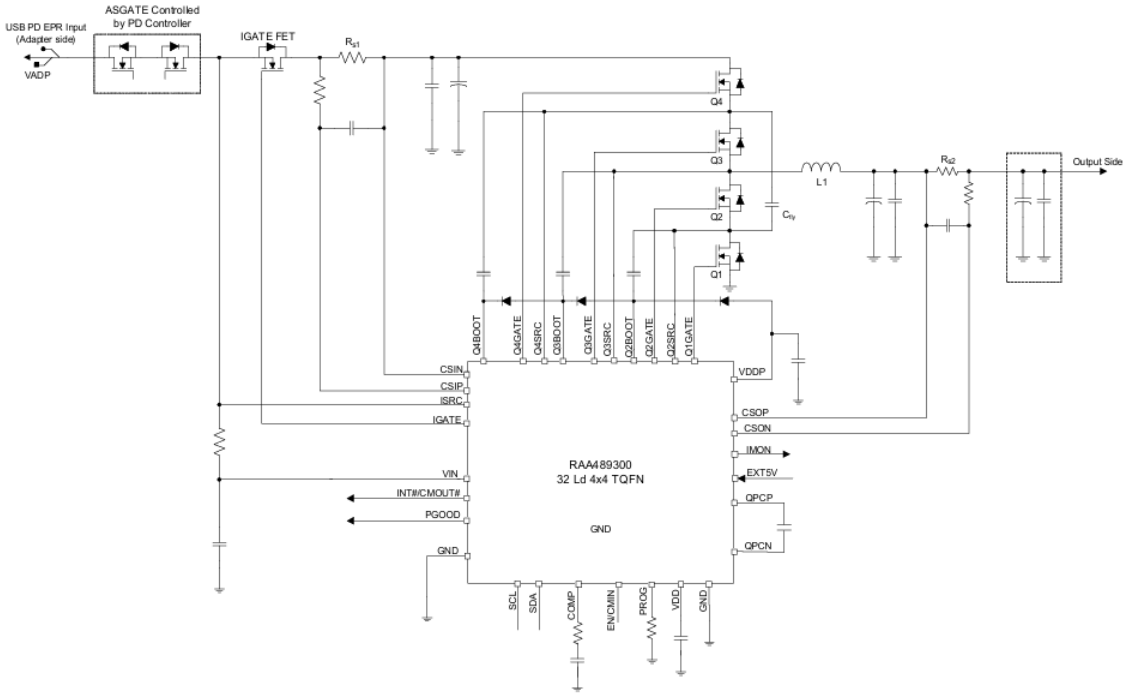



*Fig. 1. RAA489300 block diagram. The chip is a high-performance buck controller designed for a three-level buck topology. This topology delivers exceptional efficiency and significantly reduces the required inductance for output voltage regulation. Additionally, the controller ensures a seamless switching mode transition across the entire output voltage range.*




*(a)*


*(b)*

*Fig. 2. Typical three-level application circuit with isolation FET at input (a). The controller, which is housed in a 4-mm × 4-mm 32-lead TQFN, is well suited for use in multi-port USB-PD chargers and portable power stations (b).*