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power electronics

POL Voltage Regulators Allow Single-Input-Rail Operation

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Modern POL voltage regulators allow single-input-rail operation in a wide voltage range. As a result, a single-phase application can easily be implemented with single-stage power conversion. The elimination of this first stage allows for better efficiency while freeing up board space.

The proliferation of point-of-load (POL) solutions with unique power specifications creates input-rail-routing issues: this is today's system-design challenge as far as distributed POL applications are concerned. In a traditional server architecture, two-stage power conversion is generally used. The first stage converts the 12V input voltage to the rail voltage - 3.3 or 5V - required for the second stage. The second stage generates the required output voltage. This solution requires a significant amount of board space and results in high power losses. However, conventional POL solutions cannot directly operate with 12V input voltage. To help designers implement a flexible, highly efficient and space-saving solution in a low-risk environment, International Rectifier's SupIRBuck family of POL voltage regulators allows single-input-rail operation from 5V to 14V. This new solution shrinks the silicon footprint by 70% compared to discrete solutions while maintaining the same design flexibility offered by discrete solutions thanks to the common footprint with the 4, 7 and 12A SupIRBuck family.

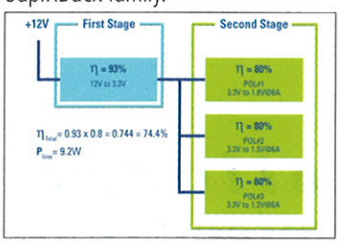

Figure 1: Example for the architecture for two-stage power conversion.

Increasing efficiency

Single-stage power conversion allows better efficiency than a two-stage power conversion. The examples in Figures 1 and 2 help compare the efficiency of both systems. Power losses for the two-stage power conversion are about 9.2W, and efficiency around 74.4%. In the case of single-stage power conversion, power losses are 4.76W, and efficiency is 85%. Generally, single-stage power conversion enables a more efficient solution, with 4.44W less power loss. In addition, the elimination of one power stage frees board space and reduces cost. The final solution is more reliable, due to a reduced component count and lower thermal stress.

Reduced board size

The SupIRBuck family of point-of-load voltage regulators integrates high-performance synchronous-buck-converter ICs and benchmark trench technology MOSFETs in a compact 5x6mm Power QFN package, shrinking the silicon footprint by 70% compared to discrete solutions (Figure 3) and offering 8 to 10% higher full-load efficiency than competing monolithic ICs. The thermally enhanced package, with a slim 0.9mm profile, allows mounting on the backside of the motherboard for additional space saving. The ability to use single-stage power conversion for a smaller footprint integrated solution, together with the possibility of mounting the device on the backside of the motherboard, make the devices well-suited for space-constrained, high-density server applications. Common features include pre-bias start-up, fixed 600kHz switching frequency, hiccup current limit, thermal shutdown, and precise output-voltage regulation. Optional features include tracking, programmable power-good, and 300kHz switching frequency to provide an additional 2A of output-current capability.

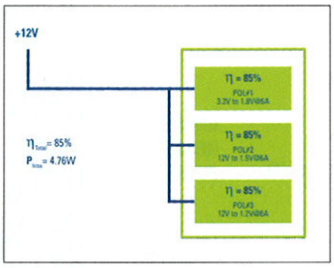

Figure 2: Architecture for single-stage power conversion.

Simplifying system design

The family is designed for 4, 7 and 12A of output load current at 600 kHz switching frequency, or 6, 9 and 14A current at 300 kHz switching frequency. Because these devices have a unique, scalable common footprint, designers can simply "cut and paste" their design to significantly reduce risk and enable faster time-to-market. The current requirements are generally unknown at the beginning of a design and can change during the design process. A common footprint enables system designers to migrate from one current-rating to another without changing the PCB layout. Traditional monolithic or co-pack solutions feature different footprints for every current level. Increasing or decreasing the current (for a cost reduction) requires changing the layout, thereby increasing risk. Discrete solutions allow the flexibility to change only the MOSFETs' current rating. However, a discrete solution typically requires second and third passes before a design is successful. The discrete solution also introduces EMI issues due to parasitic components such as board-trace inductance. SupIRBuck reduces the board space, minimises the EMI problem and ensures "first pass" success while providing the same design flexibility as a discrete solution.

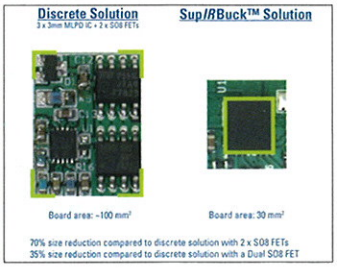

Figure 3: Board-size comparison of two-stage and one-stage power conversion.

Conclusion

This family of integrated voltage regulators makes it easy to power any POL rail of the motherboard below 15A with a single footprint. Designers can simply place the common footprint on the board, with the option, at a later stage, to optimise the exact current level. This saves time and risk upfront, and overall system cost later on. These devices save space and cost by eliminating the two-stage conversion and by replacing discrete on-board solutions. They reduce the size and quantity of external components, leaving more room for value-added functions. In server systems, one-stage conversion allows 10.6% higher efficiency than the existing two-stage solution, simplifying embedded power design and well serving applications that require efficiency, lower cost, smaller footprint and standardisation.

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