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6-A Buck Converter Achieves Tiny Size, High Efficiency Using Novel Architecture

Murata Manufacturing's MYMGA1R86RELC2RA dc-dc converter is billed as the world's smallest, most efficient, fully integrated 6-A buck regulator. According to the company, with its dimensions of 12 mm x 9 mm x 2 mm (L × W × T) the module has a footprint that is 25% less than the nearest competitive solution and a 30% lower profile (Fig .1)

The MYMGA series leverages a unique two-stage power converter architecture that was originally developed by Arctic Sands, a startup that was ultimately acquired by Murata. This architecture combines a "pipeline" stage switched-capacitor network (charge pump) with either a buck or boost stage—a buck in the case of the MYMGA series (Fig. 2).

In the MYMGA1R86RELC2RA, using a charge pump to stepdown the 12-V input to 4 V, allows use of low-voltage MOSFETs in the buck, which improves efficiency while also supporting the use of higher switching frequencies (which in turn allows use of smaller passives). The buck converter also operates with a higher duty cycle, which allows use of a smaller inductor and smaller output capacitor while achieving faster transient response. On the input side, the charge pump is a two-phase design that achieves lower input ripple and EMI, reducing the space required for external EMI filter components (Fig. 3).

According to the company, designing this type of architecture posed challenges in start-up and shutdown of the charge pump and in matching capacitors. To that end, Murata's expertise as a capacitor manufacturer was helpful. In addition, timing of circuit operation is very important in this architecture and the MYMGA1R86RELC2RA synchronizes operation of both the charge pump and buck converter.

Featuring an input voltage range of 5.5 V to 14.4 V and a programmable output of 0.7 V to 1.8 V at up to 6 A, the MYMGA1R86RELC2RA is designed for two-cell, three-cell and 12-V point-of-load applications where high efficiency, low profile and small solution size are essential. The module integrates all passive components, including bulk output capacitance, to meet exacting transient load requirements. As such, no additional external components are required for most applications, according to the vendor.

Furthermore, this buck regulator does not need any additional external components to meet stringent transient requirements, and so the typical solution footprint is said to be approximately 50% of any alternative product. In addition, peak efficiency exceeds 90% for 12-V input to 1.8-V output, which is more than 5% higher than competing products, according to Murata.

Other benefits resulting from this power architecture include an approximate 5X reduction in input ripple, lower conducted and radiated EMI emissions and a wide temperature range of -40°C to +105°C with derating.

In addition to the MYMGA series module, the company also offers similar 6-A buck converter functionality in a two-chip solution (the PE24101 and PE24102), which can be used to achieve an even lower profile of 1.2 mm when the converter is operated at a 3-MHz switching frequency. Murata is also offering a fully integrated charge pump, the MY0268, which accepts a 6-V to 16-V input and delivers an output of ½ or 1/3 V_{IN} at power levels up to 45 W. The MY0268 measures just 11.8 mm x 10.8 mm x 1.4 mm.

Target markets and applications for the module include telecom equipment, base stations, networking switches, routers and microservers, SSDs, PCIE add-in cards and high-performance mobile computing platforms. The product will be sampling in August and mass production is scheduled for later in 2019. Sample pricing will be $10.

"Murata is bringing to market a new family of highly integrated dc-dc converters that set new standards for efficiency, size and performance," says Jim Cable, CEO at pSemi and global R&D director at Murata. "This development is a collaborative effort fueled by Murata's long-standing and acquired strengths in power conversion architecture, power module development, advanced 3D integrated packaging and passive components."

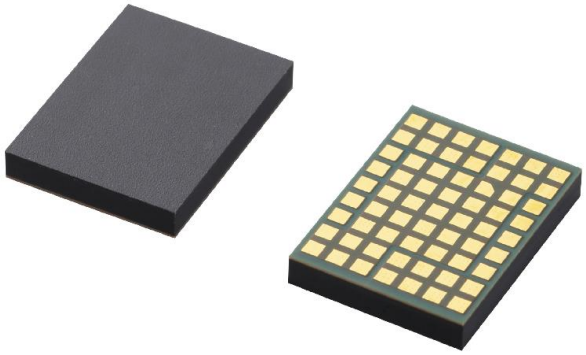

Fig. 1. Operating from an input voltage range of 5.5 V to 14.4 V, the MYMGA1R86RELC2RA dc-dc converter produces a programmable output of 0.7 V to 1.8 V at up to 6 A in a package measuring 12 mm x 9 mm x 2 mm. This footprint is said to be 25% less than that of the nearest competitor.

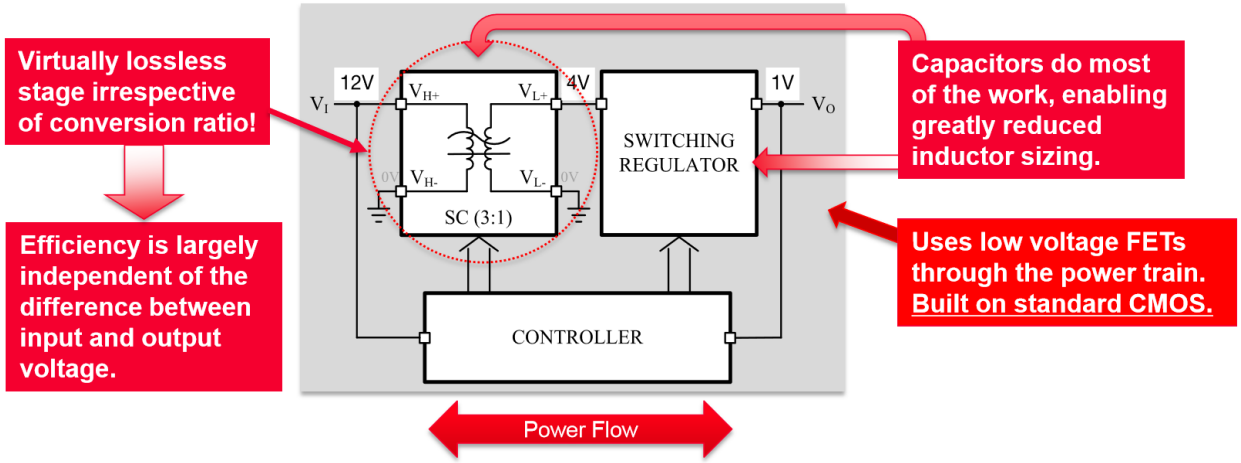

Fig. 2. This point-of-load converter uses a two-stage architecture that combines a "pipeline" stage switched-capacitor network (charge pump) with either a buck or boost stage. (A buck stage is used in the case of this MYMGA series part.)

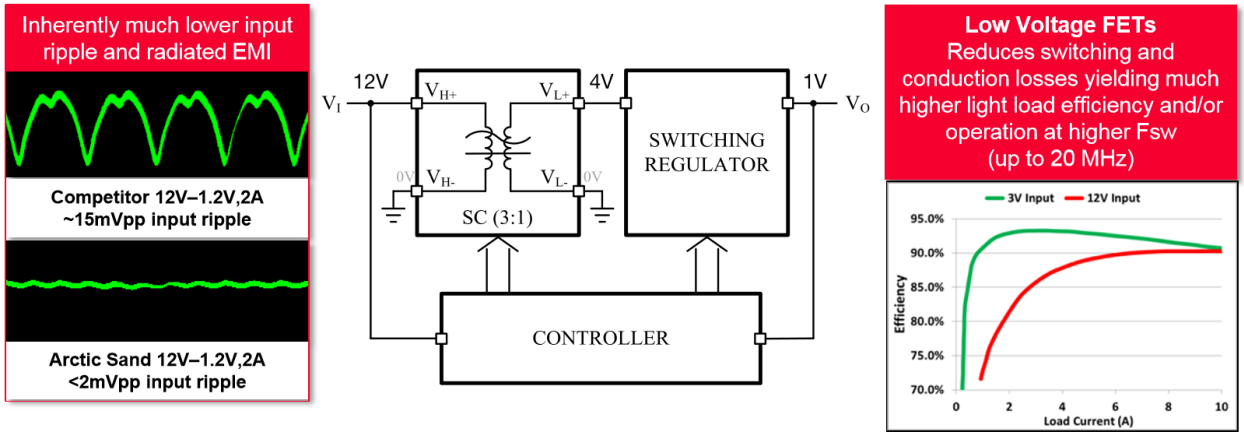

Fig. 3. Benefits of the two-stage architecture. Using a charge pump to stepdown the 12-V input to 4 V, allows use of low-voltage MOSFETs in the buck, which improves efficiency while also supporting the use of higher switching frequencies (which in turn allows use of smaller passives). The buck converter also operates with a higher duty cycle, which in turn allows use of a smaller inductor and smaller output capacitor while achieving faster transient response. On the input side, the charge pump is a two-phase design that achieves lower input ripple and EMI, reducing space requirements for external EMI filter components.