Choosing the Best Board-Mounted DC-DC Power Converter for Your High-Performance System

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As the demand for high-performance, cost-effective systems continues to increase, power system design has become more challenging and complex than ever before. In addition to being responsible for the critical selection of the most cost-effective board mounted power solutions from discrete to modular dc-dc solutions and other board-level components, designers are now also tasked with developing solutions that can quickly adapt to a variety of operating environments without being affected by rapid design-to-manufacture cycles. To address these challenges, many designers are now considering modular, non-isolated dc-dc converters to deliver the performance and manufacturing efficiencies customers demand without dramatically increasing system-level costs.

This article will explain factors that should be considered when choosing a dc-dc power solution and explore the trends driving the adoption of low-profile, non-isolated dc-dc converter modules over other discrete motherboard-based solutions. It will also explore the benefits that new modular converter packaging styles provide today’s designers.

When comparing power solutions, designers should consider a number of factors in order to identify the lowest-cost solution that adequately meets performance requirements. In addition to the project's bill-of-materials (BOM), additional direct and indirect costs as they apply to each specific application should also be carefully weighed before selecting an integrated dc-dc power solution. When all costs are considered, it becomes apparent that modular power solutions are emerging as strong “first-choice” candidates for a variety of design applications, particularly in the computing and telecommunications industries.

From a direct cost perspective, it is important to note that while the BOM cost is arguably the most basic criterion to meet, it is often the most overly simplified as well. At this most basic level, discrete power solutions may seem like the most cost-effective choice. However, BOM costs can be very misleading when taken at face value – particularly in newer high-end systems with increased power demands. For

example, there are a variety of costs often omitted from standard BOM figures that could dramatically affect the final cost of the solution. These include supplemental standard features, integrated protection circuitry and – often most importantly – motherboard footprint area.

Real estate carries a high premium when it comes to motherboard space, sometimes costing upward of several dollars per square inch. Discrete solutions tend to occupy a significantly larger footprint compared to their modular counterparts, particularly as power capabilities increase. In addition to having an impact from a direct cost perspective, the power solution's footprint also significantly impacts indirect costs. Ultimately, larger, discrete power solutions have a greater opportunity cost than low-profile modular converters. Generally speaking, a modular form factor means a smaller footprint, which in turn enables alternative uses of available board space that may ultimately add value to the end-solution.

Scalability is another factor that should be taken into account when selecting a dc-dc power solution. In most cases, uniformly-sized modules are available in a variety of power ratings, maintaining the same footprint. Similar to the way a customer can add or swap processors in some multi-processor systems, these modules enable designers to optimize the appropriate output current rating required by the final application and provide a clear power migration path without the need for a PCB layout change. Generally speaking, most discrete motherboard solutions do not have this flexibility. When installing the solution in a system that requires frequent adaptation, this can result in greater inefficiency and increased costs as supplemental components are installed.

From a research and development (R&D) standpoint, significant costs also correspond with the use of available resources and time in the development of these solutions. The development of a high-performance, low-cost system can take many months in the hands of even the most experienced designer. From a design-to-manufacture standpoint, modular converters can be designed and qualified once and used with confidence in many different applications. Considering the high cost

of extended design timelines, a modular solution enables the designer to utilize design time efficiently to maximize the return on investment (ROI).

Finally, from a technical standpoint, there are a number of factors driving the adoption of modular, board-mounted converters over conventional discrete power solutions. In addition to considering necessary design compromises, system integration issues and safety approvals, the ability to consistently perform with a high level of reliability is frequently a top concern when selecting an integrated power solution. The reliability of any power converter is heavily influenced by thermal management practices and techniques. If these techniques are compromised, the reliability of the power conversion circuitry will be negatively impacted.

The integration of the power converter into the motherboard design poses unique challenges to cooling both the devices and the motherboard itself. In many of these reference designs, heat is first channeled to the motherboard and must then be removed. This process is complicated when high current must also be distributed. By design, low profile dc-dc modules lend themselves well to this method of thermal management – particularly those using packaging once found primarily in ICs and other board-mount devices.

Many non-isolated converter modules – including the LGA C Series from Emerson Network Power – now come in a compact, low-profile Land Grid Array (LGA) package. In addition to being packaged similarly to other IC’s and FPGA devices already used in the system board, their flat top and bottom facilitate bilateral thermal management that is not easily achieved in discrete power solutions. The use of LGA packaging also offers designers the opportunity to employ a variety of conductive cooling techniques (heatsinks, coldplates, etc.) via either surface.

The use of similar IC-style packaging represents a significant paradigm shift from the traditional open-frame converters, which have a larger inductor and connecting pins. By overcoming the awkward and often inconsistent mechanical variations of

traditional discrete solutions, this new, uniform packaging style facilitates a more efficient manufacturing process. This trend is drawing renewed attention to the benefits of modular converter technologies and is sure to be a driving force behind innovative power system design in many next-generation applications.

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