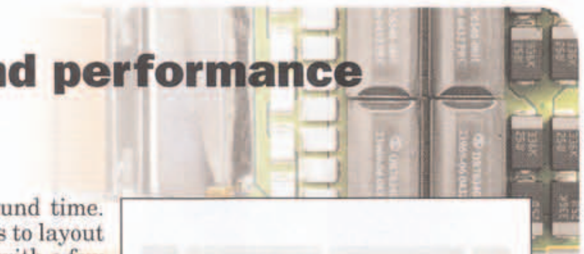

Ac-dc power supply design - Usability, flexibility and performance

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Over the last few years, power system designers have faced increasing pressure to reduce the cost and time to market and increase the flexibility, performance, and reliability of their power systems and accomplish this with fewer resources. As a result, component-based power systems have become the preferred choice in a wide variety of markets and applications.

The traditional approach to power system design usually results in a custom design (done either in-house or by an outside company) made up of discrete components. The development cycle typically requires six to 12 months to design, breadboard, troubleshoot, lay out, prototype, debug and obtain agency approvals.

In contrast to the discrete design, the component approach employs dc-dc converter modules that are highly engineered (see FIG. 1) to produce high power density - a lot of power in a small place - and do it in a very predictable, reliable fashion. A custom discrete power supply has never been built before. A power component most likely has been built millions of times before, resulting in all of the built-in reliability and predictability that such an approach can offer. Modules also can reduce the size of the final power supply because they generally offer much higher power density than a discrete design.

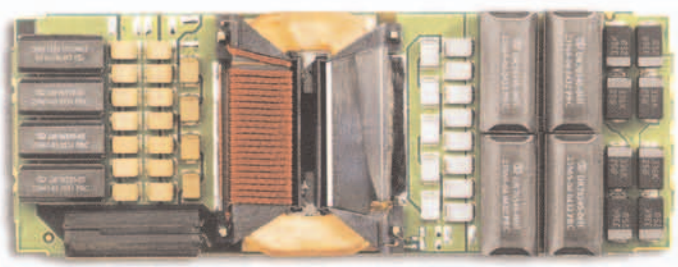

FIG. 1: A mature power component uses sophisticated power processing, control, and packaging technologies to provide high performance, flexibility and cost effectiveness.

But there's more to the picture than the advantage gained by the dc-dc converter modules alone. In any ac-dc power supply, a front end converts the ac source to a rectified dc voltage. Many module manufacturers provide a variety of high-density front-end modules in addition to their dc-dc converters, including power-factor corrected (PFC) or autoranging front ends, both in very small, space-saving modular packages. On the dc-dc side, is the wide selection of high-density dc-dc converters in a variety of sizes and form factors (FIG. 2). That's only part of the story. Modules give the power designer a lot more flexibility around a physical configuration: long, short, narrow or boxy. The flexibility of module designs also simplifies thermal management.

Another advantage is turnaround time. It's true that the designer still has to layout a board, but a module on a board with a few components quickly becomes a working design. Custom power supply suppliers using modular power components, for example, have been able to demonstrate proof of concept - a working supply to demonstrate functional and packaging feasibility - in just a few days. That's where the modular dc-dc converter approach really shines. The designer doesn't have to figure out the turns ratio of transformers, what FETs to buy, what diodes are needed, chase down application notes to figure out how parts go together, or specify control circuits.

Every power supply designer has been faced with last minute specification changes. Such changes can cripple a discrete design, resulting in huge delays while changes are made. With a modular design, changes can be made quickly, often by simply using a higher power module in the same footprint, or just by adding another module.

Design support is available from most power module manufacturers. Power module suppliers have applications engineers readily available who are experienced with many types of power applications. They will evaluate your modular design and make suggestions even before you start building hardware. And they can help throughout the design process.

FIG. 2.: Compact and efficient, converters feature wide input voltage ranges, remote sense, enhanced output programmability and low standby dissipation among their many features. Modules can be paralleled for high power or for redundant operation.

Consider this compelling fact: hundreds of merchant power supply vendors throughout the world design supplies for their customers using modular power components. Why do they do that? Obviously, they can get something that they can't get anywhere else. They can get power density, high performance, and reduced development time. These are all difficult to achieve if you're starting from scratch. Even the most experienced power designer would have difficulty matching the performance and time to market of a module-based design with a discrete one.

In an ac-dc power system, the designer needs to convert the ac to dc and then convert that dc to a usable dc voltage at the load. Modular components function well in all power architectures, and they are especially well suited to distributed architectures that offer benefits such as distributing the heat generated. On the other hand, a system that requires distributed power in some form almost mandates some sort of modular design; otherwise, it becomes an unbearable design problem.

Companies that have a full line of modular products will likely also have input filters and output filters that meet EMI agency requirements. In the case of input filters, for example, recently introduced active EMI filters are a fraction of the size of conventional passive filters. On the output side, ripple-attenuating modules are also active filters that reduce the output ripple and noise of the power supply while taking up a minimum of space.

Input filtering, dc-dc conversion, and output filtering can all be done with much smaller form factors with a modular approach. In fact, the modular approach can provide the same amount of power with five times the power density of a discrete power supply.

Generally, because the dc-dc converter modules are highly engineered and use high switching frequencies and zero-current switching/zero-voltage switching (ZCS/ZVS) topology, they result in power solutions with higher efficiencies than discrete designs. Higher efficiency simplifies thermal management and allows higher power density. In many situations, because of the baseplate design, modular designs can use heat sinks or be mounted on a cold plate rather than resort to the use of fans. The higher power density gives you more flexibility in thermal management.

A designer who has plenty of room and time and who must have the lowest possible cost is probably better off doing what he or she is doing. The designer without a lot of time and space, and who needs top performance, ought to be considering modular component power.