UPS technologies enhance efficiency

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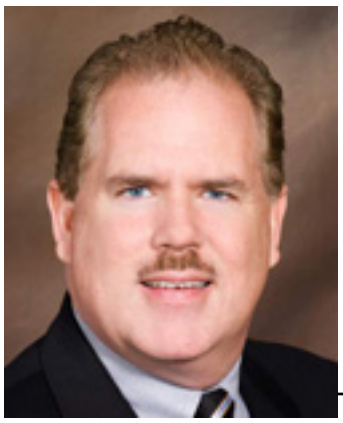

Today’s data centers are expected to deliver more computing capacity while operating more efficiently, eliminating downtime and adapting to constant change. Infrastructure technologies are rising to the challenge by evolving to support higher density equipment and the need for greater efficiency, scalability and control.

For data center power systems, high-efficiency UPS technologies work within proven system configurations to enhance efficiency while maintaining availability. When looking to invest in a UPS, data center managers should select a power system to fit their availability and capacity needs while taking advantage of today’s more energy efficient technologies and configurations.

There are many options to consider in the area of power system design that affect the energy efficiency and scalability of the UPS and the availability of the IT network. In most cases, availability and scalability are primary considerations. The data center is directly dependent on the critical power system, and electrical disturbances can have disastrous consequences in the form of increased downtime. In addition, a poorly designed system can limit expansion. Relative to other infrastructure systems such as cooling and the IT systems themselves, the power system consumes significantly less energy, and efficiency can be enhanced through new control options.

IT professionals have long recognized that while every data center aspires to 100 percent availability, not every business is positioned to make the investments required to achieve that goal. The Uptime Institute defined four tiers of data center availability to help guide decisions in this area (Figure 1). Factors to consider related specifically to AC power include UPS design, module-level redundancy and power distribution design.

Data Center Infrastructure Tier	Description	Availability Supported
I: Basic Data Center	Single path for power and cooling distribution without redundant components. May or may not have a UPS, raised floor or generator.	99.671%
II: Redundant Components	Single path for power and cooling distribution with redundant components. Will have a raised floor, UPS and generator but the capacity deign is N+1 with a single-wired distribution path throughout	99.741%
III: Concurrently Maintainable	Multiple active power and cooling distribution paths, but only path is active. Has redundant components and is concurrently maintainable. Sufficient capacity and distribution must be present to simultaneously carry the load on one path while performing maintenance on the other path.	99.982%
IV: Fault Tolerant	Provides infrastructure capacity and capability to permit any planned activity without disruption to the critical load. Infrastructure design can sustain at least one worst case, unplanned failure or event with no critical load impact.	99.995%

Figure 1. The Uptime Institute defines four tiers of data center infrastructure availability to help organizations determine the level of investment required to achieve desired availability levels.

UPS Design

There is growing interest in using transformer-free UPS modules in three-phase critical power applications. In large, transformer-free UPS systems greater than 300 kVA in capacity, they are typically are constructed of smaller, modular building blocks that deliver higher power in a lighter weight with a smaller footprint and higher full-load efficiency. In addition, some transformer-free UPS modules may also offer new scalability options that allow UPS modules to grow in capacity without adding additional external enclosure and systems to be paralleled to enable the power system to grow in a more flexible manner with simple paralleling methods or internally modular designs.

Professionals who value full load efficiency and scalability above all other attributes may consider a power system design based on a transformer-free UPS. However, as noted earlier, the larger transformer-free UPS designs utilize high component counts as a result , may result in lower Mean Time Between Failure, higher service rates, and lower overall system availability when compared to large transformer based UPS systems.

For those critical applications where maximizing availability is more important than achieving efficiency improvements in the power system, a state-of-the-art transformer-based UPS ensures the highest availability and robustness for mission critical facilities. Transformers within the UPS provide fault and DC isolation as well as useful options for power distribution.

Characteristic	Transformer-Free	Transformer-Based
Fault Management		+
Low Component Count		+
Robustness		+
Input / DC / Output Isolation		+
Scalability	+	
In the Room / Row	+	
Double Conversion Efficiency	Up to 96%	Up to 94%
VFD (Eco-Mode) Efficiency	Up to 99%	Up to 98%

Figure 2. Comparison of transformer-based and transformer-free UPS systems. For more on VFD mode and other UPS operating modes, see the Emerson white paper, UPS Operating Modes – A Global Standard.

Transformers also help to isolate faults to prevent them from propagating throughout the electrical distribution system. Selecting the best UPS topology for a data center is dependent on multiple factors such as location, voltage, power quality, efficiency needs, availability demands, fault management, as well as other factors (Figure 2). A critical power infrastructure supplier who specializes in both designs is ideally suited to propose the optimal choice based on your unique needs.

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