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Get The Right Power Supply To Tackle Peaks And Valleys

A power supply with high peak-current capability can support loads that are higher than the nominal continuous power for short periods of time, without the unit shutting down or damage occurring. Typical constraints on this capability include time (duration of the current peak) and the percentage of time the supply must support the higher load (duty cycle).

Products often requiring high peak current include print heads, pumps, motors, and disk drives, found in abundance in factory automation, medical pumping systems, fluid and material handling, robotics, power tools, machining, packaging, test, dispensing systems, and printers.

Anticipated growth in these sectors indicates a growing need for power supplies that can support short-duration high-peak loads. Such units must also be environmentally friendly and efficient. There are significant benefits to utilizing power supplies capable of supporting high peak loads.

First, designers may use a smaller supply, reducing overall system size and weight. In a system needing 800 W for a short duration, a 400-W unit with an 800-W peak will generally mean a smaller footprint.

Second, the lower-power, high-peak unit will cost less. Again, if you need 400 W continuous but there is a short 800-W peak, rather than using a more expensive 800-W supply, a 400-W unit with an 800-W peak may be more cost-effective. To realize these benefits, it is important to define your system with respect to some variables: peak current, duration of peak current, frequency of peak current events (duty cycle), and anticipated power requirements during non-peak current demand *(Fig. 1)*.

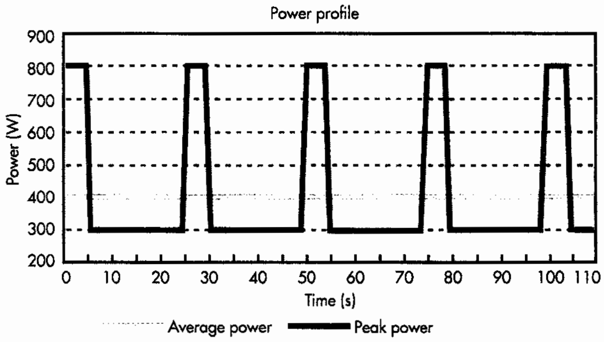
There are ways of estimating some of these values and deriving them based on the characteristics of the supply. For applications with peak current requirements, a simple evaluation of the proposed systems' power budget can help minimize both the size and cost of the system. Properly profiling the power requirement will lead to an optimal solution.

However, there are potential pitfalls. Some supplies described as supporting high peak loads may not actually provide the anticipated benefits. Digging deeper into a manufacturer's data sheet may be necessary to understand how the performance characteristics relate to the specific application.

PEAK LOAD CAPABILITY

Typically, there are three methods for characterizing peak load capability. One common characterization entails testing a supply for a short duration (up to 30 seconds is not unusual) at a duty cycle of 10% to 15% and at a peak load just below the overcurrent protection (OCP) cutoff, usually 12% to 20% above the continuous current rating.

Essentially, this is an off-the-shelf supply, characterized to infer a safety margin



1. In many applications, the average power requirement will be much lower than the peak demand. Careful consideration to system requirements helps prevent the specification of an unnecessarily large and expensive power supply.

or headroom over and above the nominal continuous rating. In practice, this may provide a false feeling of security. Although some applications may require an additional 12% to 20% of power for short durations, most motors, pumps, and print heads, for example, demand much higher current for a shorter duration.

A second practice characterizes the supply with a very high peak, up to 200% of nominal, but for such a short duration that the OCP circuit cannot detect or react to the overcurrent condition. Some data sheets specify peak-current handling based on what the power supply can withstand for 500 μs via this characterization scheme.

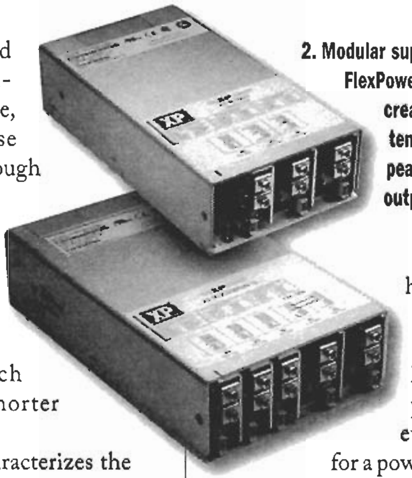
Based on this, a 300-W supply can operate at 600 W for 500 μs, but must operate at less than 300 W through a non-peak period. While this is a common way to characterize power supplies, very few applications require 200% nominal power for such short durations.

The third characterization method specifies the peak rating at high-line, meaning with a greater than 180-V ac input. In this example, a 400-W supply may be able to provide 600 W of continuous power with an input voltage greater than 180 V ac—a real benefit when high-line ac input is available.

Globally, there is such an array of potential input voltages that this benefit is nice to have. But it may restrict the sale of a system to countries where low-line ac input is predominant, or at least encountered on a regular basis.

Power supplies specifically groomed with high peak capabilities in mind use an overall design and architecture, OCP circuitry, energy storage characteristics, efficiency, and thermal robustness that will support high peak loads. Such units may be able to deliver up to twice their nominal power for 10 s, which is a realistic application requirement. Furthermore, this capability may extend to duty cycles that range from 35% to 50%.

One approach along these lines is to use a power supply that provides dc-output modularity. A modular design enables the user to specify several standard outputs alongside one that provides the necessary high peak current capability. In other words, you aren't likely to need a high peak capability on every output, so look for a power system that avoids the need to pay for that *(Fig. 2)*.



2. Modular supplies like XP Power's FlexPower system can help to create an optimal power system by only specifying high peak capability on those outputs requiring it.

WORKING OUT THE NUMBERS

Important factors to determine when selecting a power supply for a high peak application include how much power can be drawn during the non-peak duration, how much peak power can be provided, and how long the peak power can be drawn. The answers to these questions are constrained by the rated specification of the power supply.

For example, the specification of a 400-W power supply that can provide 800 W of peak power for up to 10 s at a 35% duty cycle defines the operating envelope within which your requirements must fall. Using these specifications, you can determine that the available power during the non-peak duration will be approximately 180 W. If you know your application won't require more than 720 W at peak and for 5 s or less and the duty cycle is 25%, then you can draw about 290 W during the non-peak duration.

Once you're satisfied that your design requirement does not exceed the power supply's rated specification, the system-level questions arise. For instance, you may need to establish how much power can be drawn during the non-peak duration if the peak is less than the power supply's peak rating or what duty cycle can be achieved if the peak power is drawn for less than the power supply's rated duration. The math is not complex, but you do need to account for all these system level issues to ensure trouble-free power-supply operation.

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