

# Power system selection and design: Expert systems play growing role

*Online design and product selection tools help designers produce timely, cost-effective solutions*

BY JEFFREY HORD and  
ROBERT MARCHETTI  
Vicor, Andover, MA  
<http://www.vicr.com>

Power designers are assailed by time-to-market pressures and bombarded by an abundance of choices when designing a power system. Further, with companies outsourcing their power supplies, they may not have in-house power expertise to help these designers anymore. What's more, designers are constrained by manufacturers to a limited range of standard products from which to choose or they have to accept the additional cost and longer schedules associated with custom products.

Online design and product selection tools are proliferating to help designers produce timely cost-effective power solutions. These range from product selectors and configurators to simple design calculators to performance simulators to complete systems that actually create a custom design in real time. The combination of these interactive tools offers designers the resources

to overcome most of the typical design issues involved in producing a power solution.

## Product selectors and configurators

Product selection tools are relatively common and respond to basic parameters entered by the designer by delineating the standard products

that most nearly satisfy the designer's criteria. The parameters may include the following:

- Commercial or defense environment.
- Input/output (ac/dc or dc/dc).
- Product group (power supplies, converter modules, input modules, or output filter modules).
- Input voltage (which covers a wide range of available inputs).

When the designer has selected each parameter, the tool identifies the product families that meet the identified requirements. From there, a product configurator helps the designer determine the best-fit off-the-shelf product.

To use the configurator, the designer selects the required input voltage, output voltage, output power/current, and operating temperature from pull-down menus. The configurator then returns the most appropriate package size along with a part number. When it is applicable, an alternative solution will be recom-

Fig. 1. A calculator program determines trim resistance values for fixed-output-voltage trimming.

mended as well.

### Design calculators

Design calculators are the simplest of the design tools, but not all suppliers have them. Once a product is selected, an interactive design calculator can assist the designer with the associated design issues.

Calculators, for example, can provide resistor values for fixed- or variable-output-voltage trimming. These calculators determine the trim resistor values based on dc/dc product family, nominal output voltage, and desired output voltage (see Fig. 1). Another calculator allows the designer to select an optimal heat sink configuration (see Fig. 2) by calculating necessary parameters such as the maximum allowable thermal impedance, °C/W, between the baseplate and the environment.

Additional calculators are available that are product specific, such as determining trim resistor values for setting float voltage and charge current in battery chargers, and determining holdup capacitor values for use with front-end modules, such as an autoranging rectifier front end.

### Simulators and online aids

Simulators, which usually include Spice modeling capability, give designers the ability to analyze specific designs and predict performance without building a prototype. The designer selects a module; adds interface, control, and/or filtering circuit elements; and then does a Spice simulation to verify the stability and performance of the design.

Spice modeling can also help the designer run simulations on a number of different power system designs, quickly and efficiently. Many engineers, of course, already have Spice capability on their own system.

In addition, the Web sites of many power component manufacturers offer some combination of online tutorials, application notes, and articles. These tools address many common design issues (such as creating high-voltage outputs, designing a power supply with multiple input options, meeting conducted noise standards,

<a href="#">back to main window</a> <b>Thermal Calculations</b>		Calculate	Calculate	Calculate	Calculate
		Maximum Output Power	Maximum Thermal Impedance	Maximum Ambient Temperature	Temperature Rise
Output power	<input type="text"/> <input type="button" value="Clear"/>		<input type="text"/> W	<input type="text"/> W	<input type="text"/> W
Module efficiency	<input type="text"/> % <input type="button" value="Clear"/>	<input type="text"/> %	<input type="text"/> %	<input type="text"/> %	<input type="text"/> %
Dissipation			<input type="text"/> W	<input type="text"/> W	<input type="text"/> W
Input power			<input type="text"/> W	<input type="text"/> W	<input type="text"/> W
Thermal impedance	<input type="text"/> °C/W <input type="button" value="Clear"/>			<input type="text"/> °C/W	<input type="text"/> °C/W
Max. baseplate temp.	<input type="text"/> °C <input type="button" value="Clear"/>	<input type="text"/> °C	<input type="text"/> °C	<input type="text"/> °C	
Max. ambient temp.	<input type="text"/> °C <input type="button" value="Clear"/>	<input type="text"/> °C	<input type="text"/> °C		
<input type="button" value="Reset"/>		<input type="button" value="Calculate"/>	<input type="button" value="Calculate"/>	<input type="button" value="Calculate"/>	<input type="button" value="Calculate"/>
		<input type="text"/> W	<input type="text"/> °C/W	<input type="text"/> °C	<input type="text"/> °C

Fig. 2. A program calculates thermal issues for heat sink selection.

and powering dynamic loads). They are usually tailored to the needs of the supplier's particular products.

Notwithstanding the value that these online tools offer to power design engineers, each design can encounter unique issues that require the experience and insights of a power specialist. Most companies—certainly more than in the past—have applications engineers that can be accessed online, in addition to by phone and face to face.

### Custom systems

Many, probably most, designers can get along quite nicely with standard converters, but some really do need a custom product that is specific to their requirements. Unfortunately, the custom area has not been well served up to now. At least one such system is available today that creates a custom dc/dc converter design from scratch using an expert software system; the module is then built and qualified in a matter of a few weeks.

Designers enter their design parameters (such as input voltage range, output voltage set point, output power, and operating temperature) and mechanical variations (including package size, baseplate style, and pin/interconnect options). Once all parameters are selected, the design's feasibility is checked.

For a design to be determined feasible, at least three designs must be possible; if the design is determined

not to be feasible, an alternative solution is recommended. At this point a unique part number, price, and delivery can be returned to the designer and stored in a password-protected account so that the product can be ordered at any time.

When the designer places an order, the expert system determines all possible designs, which in some cases can exceed 2,000 potential designs. Although each of these designs is feasible and incorporates available parts, the system then rates each design based on performance characteristics (such as efficiency, component stress, and temperature rise) and selects the optimum design. The bill of materials, test parameters, and work instructions are electronically fed to the computer-integrated manufacturing system for production of the product.

The design undergoes qualification test (by an experienced engineer using specialized ATE), and the product is shipped to the customer. At this time, the designer has received a custom product without the long lead times or high cost normally required by custom products.

Finally, a second online expert system is now available. It uses the custom dc/dc converter described above, a number of preassembled and tested front ends, and a choice of output connections and mechanical platforms to produce a wide range of custom configured modular power solutions for diverse applications. 