

Trends in online tools key to smart bill-of-material strategies

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Over the past several years, the growing sophistication in power-converter modules and the loads they're targeted at has led to significant growth in module-makers' product lines. So, although application schematics may appear far simpler, selecting the right power-converter module is, in fact, a more complex task than ever.

Part of this complexity derives from the applications themselves. Demands for greater power density, wider input-voltage and temperature range, higher efficiency, and fast transient response complicate power-converter selection and power-train implementation.

Additionally, although opportunities for design reuse abound, subsequent designs within a given product line are often architected for different power or voltage levels. So system designers are challenged to identify power components that meet the power and form factor targets of their current designs, but also offer the flexibility to support the power requirements of next-generation designs within the same form factor. Miscalculating power component scalability in early design stages can result in a larger-than-expected reinvestment in engineering and missed opportunities for streamlined supply-chain and component-inventory management.

Fortunately, the trend in online design-support tools is to address these challenges, speed the design cycle, and reduce design risk early in the project. The result is that you can identify candidate power modules and quickly gain substantial insight into a prospective design even before acquiring power-converter samples. Three types of online design tools make this possible.

Smart selectors

The oldest and most common of these online tools –the selector—has undergone a significant capability expansion. Once, a simple tabular depiction of a product line that, at best, allowed single-parameter sorting, the current-day smart selector is an interactive tool that automatically identifies models that meet your design's electrical, mechanical, and thermal criteria.

Smart selectors can operate across product lines within a manufacturer's portfolio—an increasingly attractive capability as product lines often overlap in electrical capability and differentiate themselves on performance, cost, feature sets, footprint, and mounting method. The selector must narrow the list of candidate parts from a large product range based on multiple parametric inputs. These usually comprise minimum and maximum input voltages, output voltage setpoint and trim range, load current or power, operating temperature, and primary features.

The selection process's complexity can greatly increase in cases where two or more

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products operate in tandem as is sometimes the case, for example, with devices like Vicor's PRM and VTM products. The PRM provides regulation and the VTM provides current multiplication and isolation. The two combine to form an efficient power train that can serve a wide range of applications by mixing and matching among the two product's models. The selector in this case must identify correct pairings from each family derived from a single set of user-provided specifications.

Another example includes designs in which load current can exceed a particular power module's capability but paralleling multiple modules is desirable. This architecture is beneficial in applications that exhibit wide-ranging load currents and for which turning modules on and off to match load demand provides high conversion efficiency across the load-current range.

Online simulators

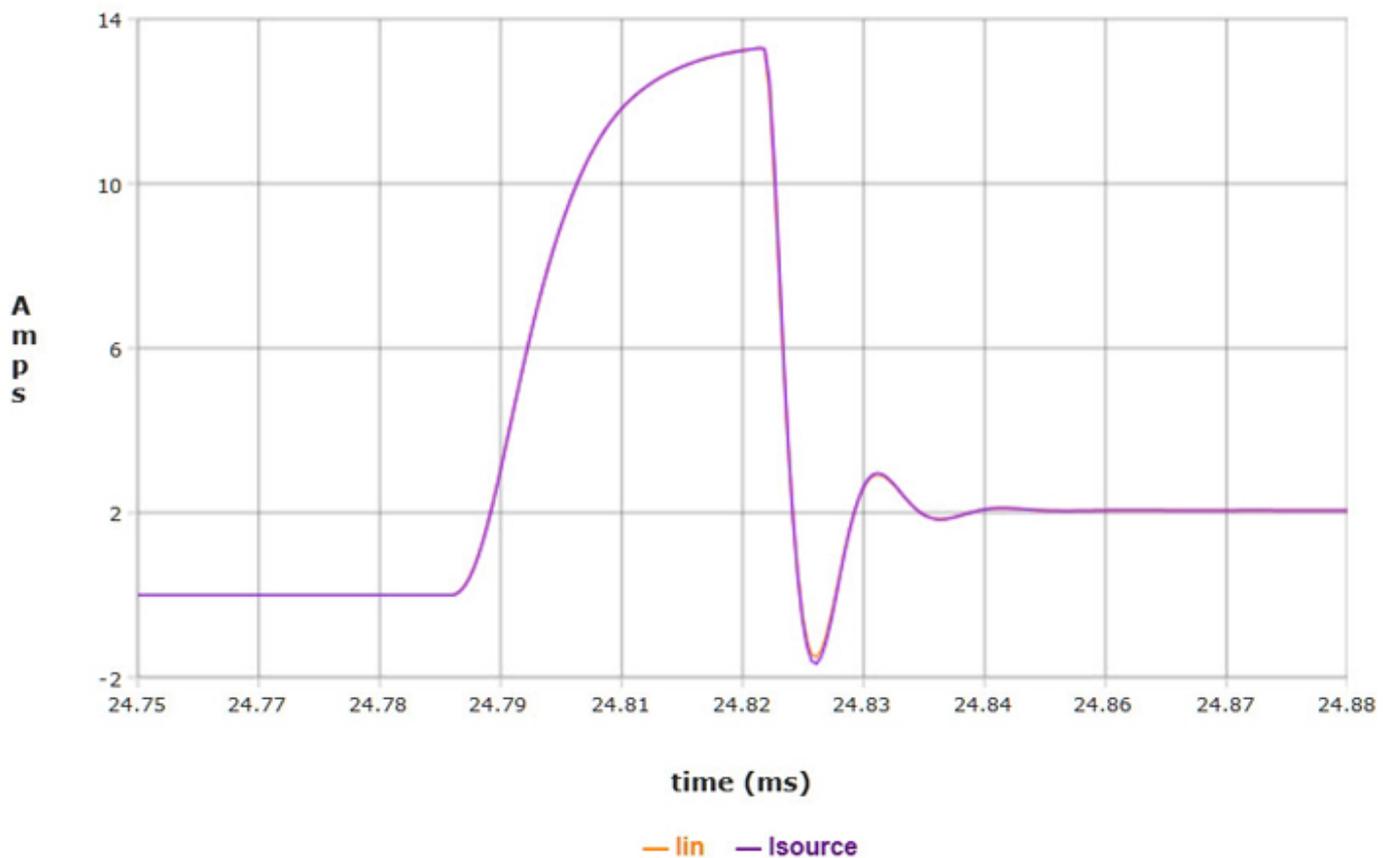
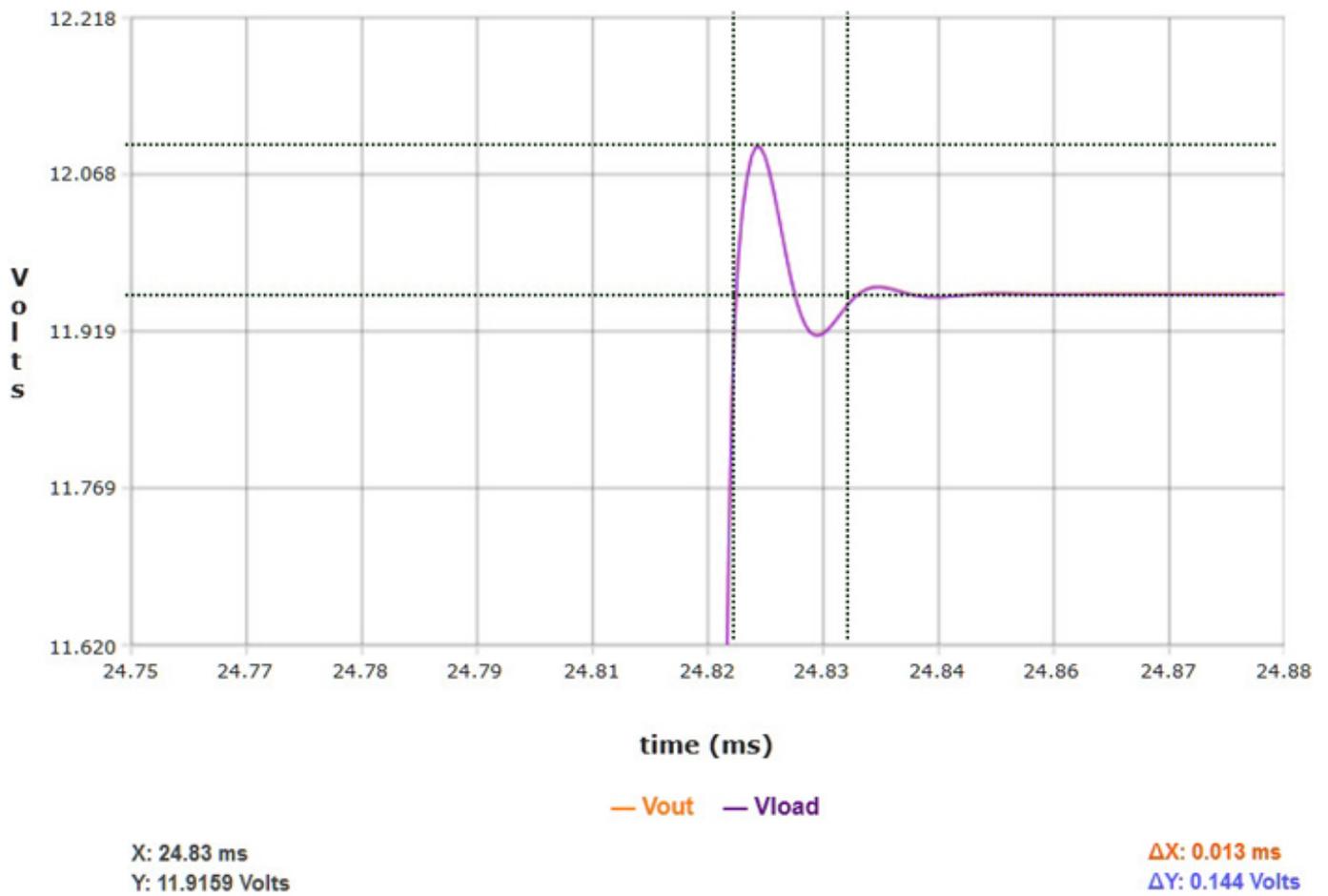
It's common for engineers using smart selectors to reduce the list of candidates quickly to just a few parts. A benefit of interactive tools is that you can load each part's simulation model, reference design, and nominal operating conditions into an online simulator with a single mouse click from within the smart selector.

Comparing simulation results of candidate parts can reduce both the costs and delays for sampling and bench-evaluation. To be effective, however, the simulations cannot be canned runs but must allow you to modify operating conditions and external component values to meet your design requirements.

Vicor's PowerBench online simulator, for example, provides seven simulation types: VIN startup, EN startup, EN shutdown, VIN step, load step, steady state, and thermal. A 30 ms startup simulation, for example typically takes just seconds to complete. The results allow you to zoom in and measure waveform details such as the startup voltage overshoot and startup current inrush using oscilloscope-like cursors (Figure 1).

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The simulation schematic comprises a reference design including recommended initial values for external components and nominal operating conditions. The schematic is flexible, allowing you to set the input voltage source, PCB-trace resistances and inductances, input filter (one or two stage), output filter, output distribution model, and load (constant current or resistance). Reference designs for regulated devices give access to control pins. The simulator offers access to probe any node within the simulation circuit so you can check performance throughout the design. For example, probing filter nodes allows you to confirm filter-damping behavior resulting from source or load steps while probing the source current reveals the magnitude of the startup-current transient.

You can adjust component values to tailor the power subsystem's performance to your application's needs. You can also adjust operating parameters to investigate a converter's behavior under non-nominal conditions. For example, raising the operating temperature allows you to simulate the converter's behavior at elevated temperatures.

Thermal simulation allows you to select heat sink or cold plate options; PCB, and ambient temperatures; and airflow then simulate and observe the device's operating temperature. Even simulations as conceptually simple as steady state allow you to glean important insight into a converter's performance: Set the operating conditions and you can read back from the simulation parameters including operating temperature, conversion efficiency, and output ripple.

Online configurator

A third tool, the online configurator, allows you to customize certain types of power converters, simulate the customized part, and refine your specifications as necessary prior to ordering samples. The manufacturer can build standard units to inventory then quickly configure to order by programming user-defined settings into the modules' non-volatile memory. This manufacturing flow can deliver customized modules at a cost only somewhat higher than off-the-shelf standard parts.

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