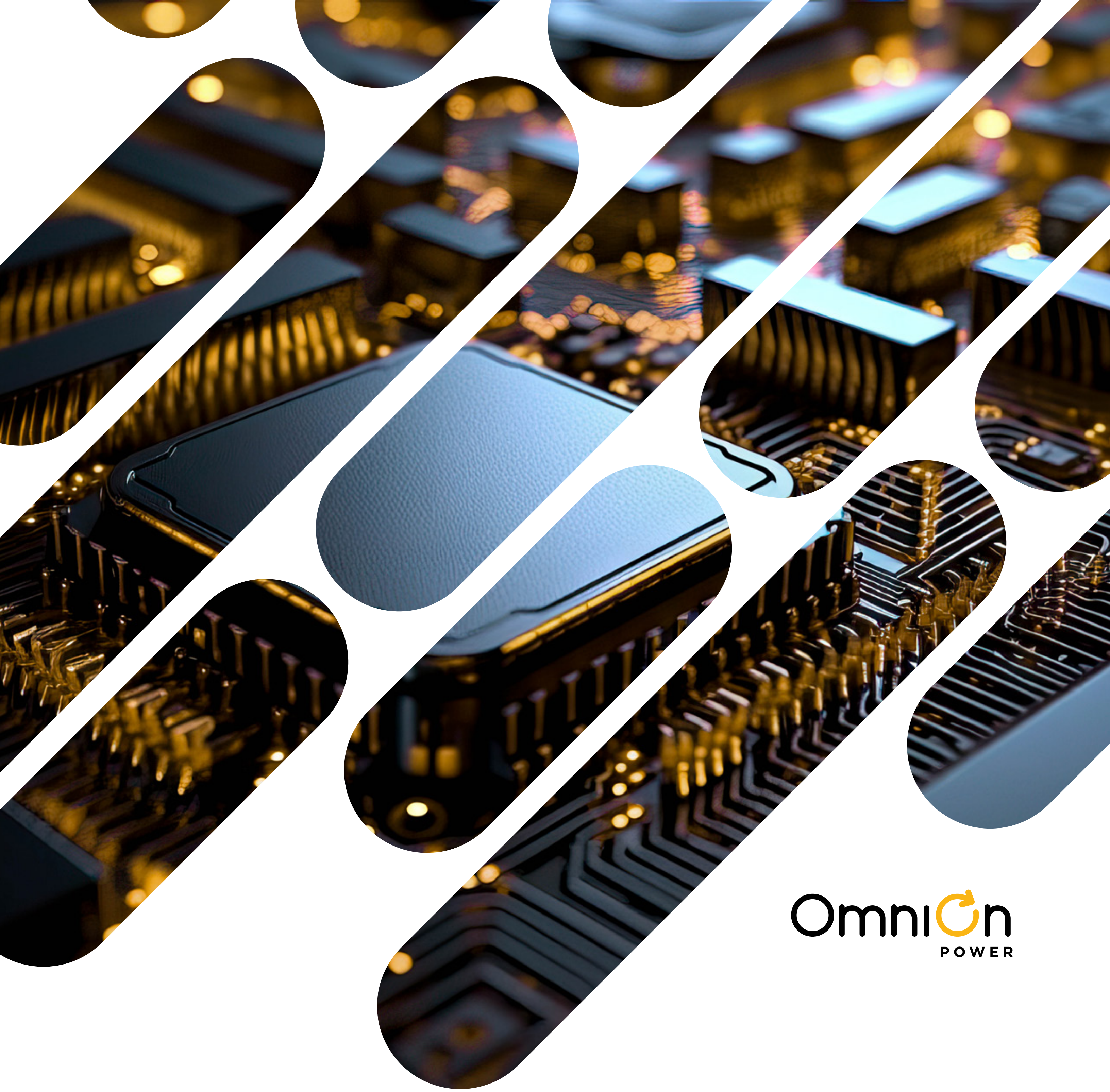

WHITEPAPER

DESIGNING FOR POWER OPTIMIZATION

Mitigating Today's Power Engineering and Printed Circuit Board Density Challenges

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Mitigating Today's Power Engineering and Printed Circuit Board Density Challenges

By: Raj Radjassamy, Ph.D. and Vesa Jokitulppo

POWER CONVERSION SOMETIMES FINDS ITSELF IN A TOUGH PLACE

With the exponential growth of data, new 5G bandwidth, artificial intelligence (AI) applications, and surging digital video content, the corresponding demand for increased processing and networking horse-power is at an all-time high. With that increase comes the requirement for additional power – often in smaller, more compact spaces.

While system designers can package more computing and data capacity into smaller devices, the power conversion technology needed to accommodate this increased capacity traditionally required larger power modules and more space on a printed circuit board (PCB). That was the case until power-component engineers asked themselves, "What if new power density strategies could reclaim previously unusable space on a PCB?"

The embedded power engineers at OmniOn Power call this concept "Designing for Power Optimization." It's a design concept that turns persistent power-design challenges or barriers – such as making use of limited PCB space for power, accommodating separate power measurement and control components, or keeping power components thermally efficient – up-side down. In some cases, literally.

Let's examine some of the power and computing density challenges facing power engineers and board designers today.

CHALLENGE – PLACING POWER OFF CRITICAL PCB SPACE

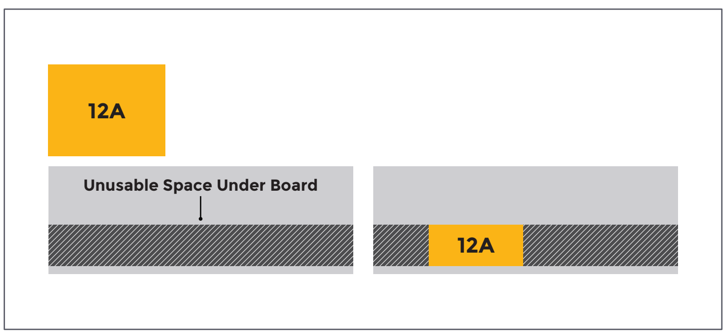
Putting Power Around, Underneath and On Top

One plus one always equals two, right? In traditional PCB design, if you required two separate power outputs with separate voltage controls, you needed two DC-to-DC power modules at, for example, 12 amperes (amps) each. And that second module would require an additional approximate 4 millimeters (mm) of space around three of its sides.

"Designing for Power Optimization" gives back critical PCB space for computing capacity.

With “Designing for Power Optimization” in mind, OmniOn engineered a single 24-amp power module with dual 12-amp outputs and dual control – its Dual DLynx™. The DC-to-DC module helps eliminate some of the extra 4 mm of space around the sides of the previous second module. Add to that the space savings of a single, smaller 24-amp module (compared with the combined area required for two 12-amp modules) and the power footprint can be reduced to 550 mm^2 versus 735 mm^2 — resulting in board real estate gains of up to 25 percent.

Now, let’s look under the hood for additional space. Or, in this case, under the PCB. When board real estate on top of a PCB is limited, OmniOn is able to place its 2.8-to-2.9-mm SlimLynx™ power module under the board where the clearance is usually a mere 3 mm. Moving the power supply to the bottom of the board opens up valuable space on the top of the PCB for additional components, capacity, and functionality. Moving the power conversion module under the board also creates thermal management benefits, via conductive cooling approaches including placing the module near or on the chasisis, or employing conductive materials such as a thermal pad or thermal paste.



This low-profile power solution also comes into play when placing a separate open-frame power module on a secondary PCB “daughter” board. Again, SlimLynx can be placed below the PCB or on the “mezzanine” between the main and secondary board, freeing up valuable space and height for additional components.

Compact, low-height solutions also allow for top-board mounting near, or even under, traditional heat sinks — further conserving space and addressing additional thermal challenges.

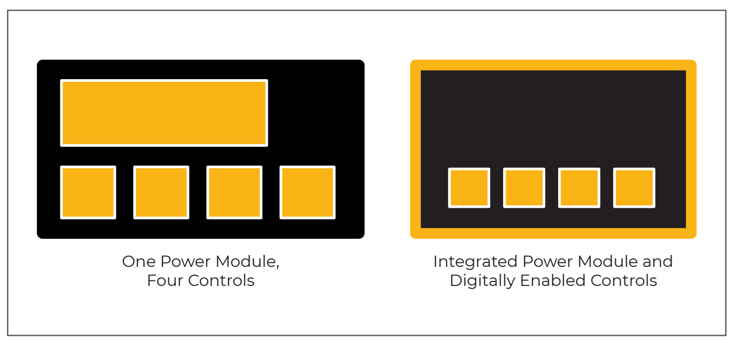
CHALLENGE – MORE FEATURES IN LESS SPACE

Getting to Less by Adding More

Remember when your desktop really was a “desk,” with a phone, computer, clock and a pad of note paper? Today, that’s all consolidated into your smart phone or tablet. Power design has also gone this route. A PCB power conversion module typically also requires discrete components for functions such as current accuracy, voltage levels, temperature measurement, and tight set-point controls.

By applying the “Designing for Power Optimization” concept, OmniOn engineered these previously separate functions into a single, consolidated power module, while also reducing the overall power footprint. The 20-amp OmniOn PicoDLynx II™ power module, for example, takes all the features and functions of an integrated power conversion design that previously totaled 232 mm^2 and consolidates them into a package that’s just 149 mm^2. This footprint reduction lets board designers recapture almost 36 percent of critical PCB space previously used for power conversion.

Other previously separate power control functions – such as controllers; components that provide bias voltage for optimum efficiency; or supplemental output capacitance – are now part of more standard, consolidated power modules that help further optimize board real estate.



Another power conversion challenge facing engineers centers on controlling transient-response performance during sensitive load changes for devices such as digital signal processors and field-programmable gate arrays. Typically, transient response can be controlled with external capacitance, but that comes at a cost, both in dollars and board space.

OmniOn addresses this challenge with its Tunable Loop technology, which adds a small tuning capacitor and a resistor to voltage regulator, or point-of- load (POL), power modules. The result is desired target transient performance with fewer external capacitors. This “Designing for Power Optimization” approach can provide up to a 75 percent smaller power footprint as well as savings with less external capacitance.

> “Rather than make the fan more efficient, we eliminated it altogether by putting power conversion on more thermally efficient, unused board space.”

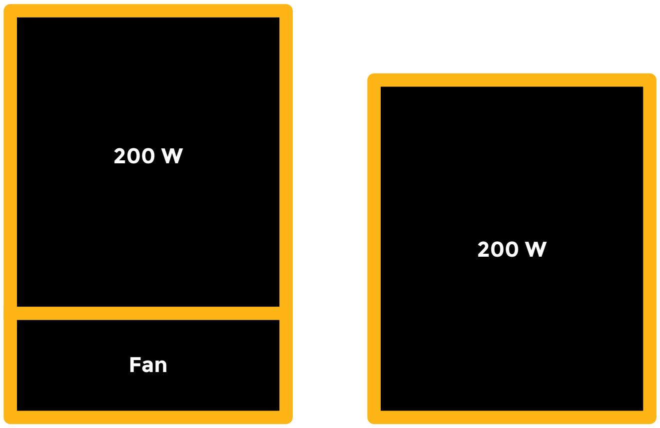
CHALLENGE – MORE POWER WITH LESS HEAT

Taking the Heat to Make More Space

It’s conventional wisdom — physics really — that AC-to-DC power conversion generates heat. And for many power systems, that heat is dissipated with a small, on-the-board fan. But that’s one more component taking up space, using energy and impacting reliability.

One way to regain this space is to rethink cooling requirements, like OmniOn did with its family of CLP open-frame power supplies. Rather than asking how to make the cooling fan more effective and efficient, “Power Optimization”-driven design thinking posed the question of, “How do we eliminate the fan altogether?” With its CLP family, OmniOn placed heat-intensive integrated circuits on the bottom of the PCB – which was previously unused space. This allowed the use of conductive cooling through the system chassis, eliminating the need for a separate fan. In addition, further power density was achieved with its zero-voltage switching, quasiresonant topology operating at a high switching frequency that makes use of smaller transformers and components.

By “Designing for Power Optimization,” OmniOn was able to approximately double the power density of similar components to 17.85 watts-per-cubic-inch — achieving a similar output in just about half the space.



Enclosed Power Module Cooled With External Fan

“Fanless” Conductive Cooling

BIG IDEAS FOR GETTING SMALLER

Challenge always drives innovation. New challenges for DC-power conversion suppliers are being set every day by communications, data center and industrial system designers who need precious real estate on PCBs and devices for more computing horsepower.

Approaches and ideas that “Design for Power Optimization” can create power density solutions that minimize or even remove some power elements to create smaller, more feature-rich and higher processing-powered devices and systems.

VISIT US

To learn more about Designing for Power Optimization and to see how OmniOn is helping to address today’s power engineering and board design challenges, visit: omnionpower.com

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Vesa Jokitulppo is a senior product manager for OmniOn’s line of non-isolated DC-DC converters. Prior to joining the company in 2014, he held various business development, program management, marketing planning, and product management positions at Microsoft and in the mobile phone division of Nokia. Vesa holds a master’s degree in industrial engineering from the University of Lappeenranta in Finland and a master’s degree in operations management from the University of Nottingham in the U.K.