



# Power electronics at a crossroads

Designing high-performance power systems continues to increase in complexity year after year, to the extent where the industry has reached a milestone moment, which presents challenges and opportunities in equal measure. Electronic Specifier Editor Joe Bush caught up with Phil Davies, Corporate Vice President, Global Sales and Marketing at power module manufacturer Vicor to find out more.

Industries such as data centres, automotive, solid-state lighting, and robotics, have undergone a significant level of technological advancement over the last few years and, as such, power electronics have struggled to keep up with demand. And, as Davies explained, every power system is a necessary evil and the only good power system is one that is 100% efficient, takes up no space, and costs nothing.

As a result, the demands on power delivery networks (PDNs) are focussed around the need for smaller footprints with higher

efficiencies and integrated power with cost advantages. This is no easy task and, as such, moving PDNs to higher voltages such as 48V, from typical 12V systems, have the potential to ease the delivery and distribution of higher power. Currently, 48V architectures provide the optimal trade-off of meeting regulations, performance, weight and cost.

## AN INDUSTRY AT A CROSSROADS

Davies commented: “Around two years ago artificial intelligence (AI) started to move into data centres, which drove power requirements within the rack through the

roof. In the automotive world the use of a 48V mild-hybrid architecture of the power system is gaining a lot of traction as a means of meeting the requirements of new CO2 emission standards. Solid-state lighting is moving towards 48V as a means of distributing the voltage within large lighting systems. We've also seen 48V being rolled-out in UAVs (manned and unmanned) and within robotics."

Over that same time period Vicor has invested over \$400m in its power module technology and the industry is at a point in time where engineers are starting to look for 48V solutions. Whether that's powering from high voltage DC such as 400V and 800V.

"Vicor has been around for 40 plus years and we've invested heavily in a power module approach to power systems design rather than our competition, who typically sell controllers, which engineers then buy with discretes to build their own custom power systems," Davies continued.

"If you look at where power electronics has to go, it's going to be very difficult for our competition, within a number of these market segments and applications, to apply their discrete approach or their power module technology that relies on low frequency switching topologies. Their magnetics technology has also not kept up with what is needed to make a dense, efficient power module."

Davies added that while Vicor's competitors are starting to consider GaN or Silicon Carbide devices, because of its higher frequency switching capability, Vicor doesn't need to. "I'm forever being asked when are we going to use GaN," he added. "The simple answer is that we don't need it because a low voltage MOSFET is lower cost, has a higher

figure of merit and we can use it for 800V input solutions due to the topologies that we have. So, we don't need to use expensive and as yet, unproven GaN."

## PDNs

We are seeing new performance demands and PDNs are moving to higher voltages. Engineers require density and low weight, which is very important for automotive, UAV and robotic applications.

"We're finding that Vicor is the power module company with the highest performance and density," Davies added. "We're getting tremendous design wins in what is a who's who list of AI companies. Right now, we have around an 85% market share of all new 48V AI system designs. Pretty much any AI company you could name around the world is designing in Vicor power modules. We're also getting significant design wins in the automotive market with our advanced power modules that we're bringing forward at 48V.

"We are setting ourselves apart by not just having the most efficient and dense power modules, but we have front end to point of load (PoL) modules so we can give you the complete solution - whatever your input is, right to the PoL. We are seeing many of our customers working with us in this form of power delivery.

"Density, efficiency, size and weight are all important and we are miles ahead of the competition in this regard. It really comes down to the switching topologies that we have. Our Sine amplitude converter topology (SAC) for example is unique to Vicor - it's heavily patented, we've improved on the engine year-on-year in terms of taking it to a higher frequency, which has enabled us to shrink magnetics, passives and use smaller power discretes.

“This topology, new control systems and advanced packaging, coupled with constant innovations in planar magnetics is at the heart of everything that we do, and all of our investments are really paying off. Constant innovation really is the cornerstone of the advantage that we have.”

## GROWTH AND EXPANSION

As a result, Vicor are experiencing more customer interaction than the company has seen before, and to keep up, are investing heavily in its factory - moving from high mix, low volume to low mix, high volume. Vicor ships millions of chips a year to Google for example, for its data centres, and are adding more customers of that ilk to its portfolio.

Vicor will be expanding its factory in Andover, Massachusetts this year, and will be online in the second half of 2020. Vicor is around a \$300m company today, but Davies estimates that the new factory upgrade will mean the company will be capable of putting out around \$750m worth of revenue by the end of 2021.

Beyond that Vicor are aiming to build a new facility that will come online in 2022, taking the company over \$1bn. This will allow

Vicor to service the automotive customers that expected to come onboard in 2022 and 2023. In terms of location Vicor are currently looking at a facility in Asia or to keep manufacturing solely in the US. The final decision will be made in 2020.

## COMPETITION

This recent company evolution is moving Vicor into a world of different competitors. “We used to compete with all the traditional power supply companies,” Davies added. “Now we’re taking on the semiconductor guys. Things are changing and this is very important as we start to move the brand away from niche high cost military defence aerospace and into this exciting automotive and data centre AI world where these competitors reside, so we’re definitely moving our brand.

“Fundamentally we solve the toughest power delivery problems and the industries are really moving towards our power module solutions because of their density, the advantages that they bring in new high-performance PDNs, and the higher power loads that we’re seeing within many different end markets – so the crossroads in the industry has been reached at a perfect time for us.”

Right: The power electronics industry faces a tremendous opportunity in sectors such as the data centre market

