Wolfspeed WolfPACK™ Modules Deliver Higher Ampacity for Power-Hungry High-Voltage Applications

Recent years have seen technological advancements in key areas including solar photovoltaics and battery energy storage systems (BESS) and the associated emergence of new technologies like Solid State Transformers (SST), Energy Storage Systems (ESS) and Megawatt Charging Systems (MCS). For power electronics, these advancements have put more focus on improving system efficiency and increasing power density while also reducing system costs.

The Wolfspeed WolfPACKTM modules are easy to scale and provide higher ampacity as compared to the same topology with multiple discreet devices. These modules are available in half-bridge, T-type, full-bridge, and six-pack (three-phase) configurations, all with the option of pre-applied thermal interface material (TIM).

The Wolfspeed WolfPACK power module line supports a diverse range of applications. Let's explore a few in more detail.

Car charging stations

The demand for electric vehicles (EVs) has increased considerably in recent years, but one key area that will lead to tangible, rapid growth is the ability to provide fast chargers. One of the biggest advantages of fossil fuel vehicles over electric vehicles is the former's ability to be refueled in minutes. EVs, on the other hand, can take much longer to be ready to return to the road; different charging designs can take as little as 30 minutes to charge or as much as twelve hours1. Fast charging technology can shorten the recharging time by transferring large amounts of energy quickly using higher voltages, higher currents, or a combination of both.

Wolfspeed WolfPACK power modules' SiC technology and their high ampacity capabilities make them a great fit for fast-charging environments. The small profile of these modules allows for use in many different locations, whether it's large gas stations or space-constrained urban recharging locations. Furthermore, the modules' scalability allows manufacturers to develop scalable charging systems, a consideration that will become increasingly important as the energy capacities of EVs increase.

Renewable energy

To support a more sustainable energy future, reduced reliance on fossil fuels is also required in the energy sector — which requires a rise in renewable energy solutions, such as wind and solar. While these power sources are environmentally friendly, both produce electricity that cannot be directly fed into the grid — thus they require additional power conversion steps to be viable.

The power generated by wind turbines may require an AC/DC converter, which is used to convert AC power (which will not be synced to the grid's frequency or phase) into DC power. When that's complete, the power is then converted back into AC for use with the grid. Solar panels, meanwhile, produce DC power only, and so require an inverter if they are to be connected to the grid.

Depending on the deployment, power distribution systems for renewable energy may be size-constrained, which is the case for residential-based solar installations that are often mounted to utility poles. The SiC MOSFET technology featured in the Wolfspeed WolfPACK modules allows for overall reduced size of power conversion systems through an increase in power density. When reviewing the system level savings associated with a shift to silicon carbide, photovoltaic (PV) inverters have been demonstrated to reduce size, weight, and cost from 20 to 50% when compared to Si-based technology, while maintaining or even increasing efficiency2. This is due to the optimal material properties of silicon carbide; the wider bandgap enables higher breakdown voltage and higher junction temperature operation, resulting in higher power density than Si with higher efficiency. Any increase in efficiency is critical to supporting a better power distribution network, as it results in less lost energy — just a 1% increase in efficiency would equate to an additional 600 megawatts of solar power annually from the 60 gigawatts of solar installed in the United States3. This desire to increase efficiency has also led to the trend of utilizing a 1500 V DC link to decrease the residual losses of the power conversion and delivery system. The 2300 V baseplate-less power modules, built with Gen 4 MOSFET technology, enable the shift to a simplified 2-level topologies to interface with the grid, which significantly reduces driver count, control and system complexity.

Energy storage

An increase in renewable energy not only requires power conversion for viability but also requires that power is available to meet consumer and industrial demand at all hours, every day of the year. In some cases, renewable energy sources under-produce due to sub-optimal ambient conditions, while other times they can create excessive energy above immediate demand. To resolve this discrepancy between stable energy supply and demand, large-scale energy storage systems, such as batteries, are implemented. These systems charge during high renewable energy generation periods and discharge back to the grid when renewable energies cannot meet peak energy demands.

As with the power conversion requirements of renewable energy, Wolfspeed WolfPACK SiC modules are a great choice for renewable energy storage solutions due to the inherent increases in system density and efficiency associated with silicon carbide technology. This module's ability to create easily scalable solutions, coupled with its reduced size footprint, makes the technology ideal for developing renewable energy infrastructure supporting grid-supply to meet demand. A great example of it is the partnership between Wolfspeed and EPC Power, a premier utility-scale inverter manufacturer. EPC Power used the 2300 V silicon carbide Wolfspeed WolfPACK to create their "M", the industry's first utility-scale string-style inverter that makes grid-tied energy storage more efficient, reliable, and scalable.

Industrial Power Systems

Industrial power systems apply across several types of industrial sectors: from data centers to airports, manufacturing to automotive, and more. While many industrial power systems are built with a focus on expandability, automation, and adaptability, these systems also demand durability — as downtime of any piece of equipment can become costly. In such industrial applications, durability is the most crucial element of decision making because downtime means huge.

The low inductance and low switching losses of Wolfspeed Wolfpack modules make them ideal for high-frequency operation in applications including motor control systems, power converters, and welders. Furthermore, the modules feature baseplate-less packaging which, when coupled with the company's leading SiC technology solutions, affords system designers flexible thermal management implementation.

Conclusion

Wolfspeed WolfPACK modules offer tremendous potential across a range of industries and applications, including EV charging, renewable energy, energy storage, and industrial power systems, among others. Its ease of implementation, coupled with the high efficiency and superior performance of silicon carbide package for medium power range solutions.