Semiconductor solutions

Semiconductors play an important role in delivering greater energy efficiency and boosting performance for electric vehicles

Semiconductor innovation can offer greater driving range and faster charging times

The next ten years will be decisive for the mass adoption of electric cars, and within this decade the market will reach the tipping point when the majority of all new cars sold worldwide will have a partially or fully electric drivetrain. While CO_2 regulation will continue to play a major role, incentives and a variety of electrification offerings will also drive the mass market adoption of electric mobility.

48V mild-hybrids are the first step, where the electrification is so unobtrusive many drivers are likely unaware the car is driving partially electric. Then comes full hybrids and plug-in hybrids, which offer an electric-powered range long enough for the average daily commute.

More and more fully electric cars with a competitive mileage range are being launched into the market to combat range anxiety. The remaining challenges will be tackled through innovation and technological progress.

"When it comes to costs, range or charging time, aside the battery the semiconductors play a crucial role," states Stephan Zizala head of automotive high power business line at Infineon Technologies, which ten years ago was the first company to develop a dedicated power semiconductor portfolio for electromobility.

In a main inverter, semiconductors transform the direct current from the battery to the alternating current that drives the motor. Less energy lost along this way means a longer range. Just one or two percent more inverter efficiency can quickly offer a five or six percent longer range.

Inverters based on emerging silicon carbide MOSFET technology are more energy efficient

In the battery management system, sensing-chips precisely monitor each battery cell in order to protect the battery from premature ageing and make sure that its capacity is used to the maximum. In terms of chip technology to be used in electric car main inverter systems silicon IGBTs and diodes are the mainstream. However, inverters based on silicon carbide MOSFETs are even more energy efficient and are the most important emerging technology in automotive power semiconductors.

The main challenge for a quick adoption of silicon carbide is cost. Silicon carbide inverters mostly pay off in cars with a very high battery capacity, but for a small city car at the lower end of the price range, classic silicon technology is cheaper. Silicon carbide is the right choice when a high power density and performance is needed. With Infineon's silicon carbide HybridPACK Drive module, for example, the output current more than doubles compared to the silicon-based module, while the footprint stays the same.

"At Infineon, we think it is very important to offer both, silicon and silicon carbide products in all form factors. From bare chips to discretely packaged chips to modules. This way, our customers can choose exactly what they need rather than being limited by one technology," says Zizala.

Infineon drives further innovation with chip embedding – a new technology developed with Schweizer Electronic that enables the integration of power MOSFETs within PCBs rather than soldering them on top. This leads to a performance boost in 48V mild-hybrid systems and reduces their complexity at the same time.

"Rather than looking only at a single chip, we always try to understand the challenges at a system level," explains Zizala. "By offering a scalable chip set for e-mobility including sensors, microcontrollers, gate drivers and power semiconductors we help to reduce system costs in all performance classes," he adds.

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