ROHM Products for Electric Vehicles

EV Solutions
SiC devices hold the key in the electric vehicle performance

SiC devices are being increasingly adopted – primarily in DC/DC converters and onboard chargers for electric vehicles. This is due to their superior voltage resistance and loss characteristics which make them ideal for next-generation applications.

SiC Device Performance

Perhaps the biggest challenge for electric vehicles is maximizing cruising distance given the limited battery power. To this end, it is important to increase electricity costs in lieu of fuel economy. SiC devices are considered key in achieving this goal. Their superior physical characteristics as a semiconductor material make it possible to exceed the limits of Si devices and provide greater performance in electric vehicles.

Advantages of SiC devices

- Reduced conduction loss
- Lower switching loss
- Supports higher voltages and frequencies

SiC MOSFET

Switching Loss Comparison

<table>
<thead>
<tr>
<th>Technology</th>
<th>Loss (%)</th>
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<tbody>
<tr>
<td>IGBT + FRD</td>
<td>74%</td>
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<tr>
<td>IGBT + SiC SB</td>
<td>40%</td>
</tr>
<tr>
<td>Full SiC</td>
<td>74%</td>
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Dedicated EV units require higher reliability and lower power consumption in a smaller form factor.

ROHM supplies power devices such as SiC and IGBTs together with gate driver ICs designed to drive them. ROHM also offers a broad lineup of general-purpose products, from power supply ICs optimized for peripheral circuitry and discretes (transistors/diodes) to current detection shunt resistors.

ROHM Solutions

<table>
<thead>
<tr>
<th>High Voltage</th>
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<tr>
<td>SiC, IGBT</td>
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<tr>
<th>Isolation Technology</th>
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<td>Gate Driver ICs</td>
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<tr>
<th>General-Purpose</th>
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<tr>
<td>Power Supply ICs/Motor Driver/Transistor/Diode/Shunt Resistor, etc.</td>
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Topics

New SiC MOSFET Evaluation Board

ROHM’s solution board includes a control power supply, multiple protection functions, and gate drive circuit optimized for the latest SiC MOSFETs.

Isolated Gate Driver IC (BM6101FV-C)

Flyback Power Supply IC (BD7F200EFR-LB)

SIC MOSFET (TO-247N) Insertion points

SIC MOSFET (TO-247-4L)* Insertion points (*4-terminal type with driver source pin)

P02SCT3040KR-EVK-001
ROHM is focused on a variety of applications for electric vehicles, including the main inverter, onboard charger, and DC/DC converter. And going forward, in response to emerging trends such as greater miniaturization due to higher frequency drive, larger battery voltages, and improved set efficiency, the adoption of SiC devices is expected to only increase. ROHM achieves superior quality and stable supply through a vertically integrated production system, from raw materials to finished products.

**Advantages of SiC devices**

- Improved inverter efficiency
- Smaller, lighter cooling system

**SiC Reduces Battery Size**

SiC improves power consumption by 3 to 8%

Reduces battery capacity while maintaining cruising range

**Dedicated EV Blocks**

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On-board chargers consist of AC/DC converters that convert an AC voltage (100V to 240V) to a DC voltage in order to charge the high voltage battery. To ensure worldwide compatibility, the permissible input voltage for many on-board chargers ranges from 85V to 265V. And to meet market needs for shorter charge times, the voltage specified under fast charging standards is increased, along with battery voltage. As a result, on-board chargers tend to have higher permissible input voltage, promoting the use of SiC not only for the internal diodes, but MOSFETs as well.

Gate Drivers 2,500Vrms Isolated Gate Drivers

ROHM gate drivers integrate an isolated gate driver element that leverages the latest BIC-DMOS processes along with original on-chip transformer technology. This makes it possible to achieve the smallest package size in the industry, contributing to system miniaturization. In addition, our gate drivers incorporate protection elements and meet automotive quality requirements while providing higher noise immunity, lower current consumption, shorter delay time, and superior temperature characteristics compared to conventional photocoupler types to improve system reliability and reduce design load.
DC/DC CONVERTER

In EVs the engine is replaced by a high voltage battery and motor. The DC/DC converter switches power elements and utilizes a transformer to convert the high battery voltage to a lower voltage. To protect low voltage electronic circuits, it is necessary to electrically isolate both the signal and ground from the low and high voltage boards. ROHM DC/DC converters with built-in SiC MOSFET enable high-speed switching, making it possible to achieve greater miniaturization and higher performance while improving safety.
The main inverter converts DC voltage supplied by the battery into 3-phase AC voltage for driving the motor. Conventional power devices for inverters typically utilize a combination of IGBTs and diodes, but SiC MOSFETs that reduce conduction and switching losses are attracting increased attention.

**LDOs** Single Output Low Saturation Regulators

Along with greater functionality and accuracy in automotive blocks, ICs that can supply stable power to MCUs and sensors are being increasingly demanded. In response, ROHM offers linear regulators strong against external noise and battery fluctuations. We also offer a broad lineup of class-leading automotive-grade quiescent current regulators that contributes to greater energy savings and enables users to select the ideal product based on application requirements.
In EVs, the AC compressor is electric. High voltage is used to increase motor efficiency, and for inverters that control rotation as well, high voltage, along with high reliability and high efficiency, are important factors. ROHM IGBTs for electric compressors are low-loss devices that achieve superior short-circuit tolerance.

**RESISTORs**

Features such as high power handling capability and ultra-low resistance are ideal for current detection in high power automotive blocks. High precision welding technology utilized between the resistive element and electrodes allows ROHM’s PSR series to deliver excellent temperature coefficient of resistance (TCR) - even in the low-ohmic region.

**SCHOTTKY BARRIER DIODEs**

High power achieved by combining precision welding technology with a high-performance alloy

- High Performance Resistive Alloy (Ni-Cr/Cu-Mn)
- Electrode (Cu)
- Precision welds
- Electrode (Cu)

The broad lineup consists of both low Vf and low IR types that allow users to select the ideal product based on set requirements.

**MOSFETs**

ROHM offers a wide range of MOSFETs that support a variety of motor and drive applications, including low ON resistance models developed utilizing the latest processes.
Acquired development process certification under automotive functional safety standard ISO26262 ~Supports device development with the highest level of safety (ASIL-D)~

ROHM has built a dedicated line for automotive products and performs development that complies with quality management system (IATF 16949) and electronic product reliability (AEC-Q100/101/102) standards. And in 2018 ROHM obtained ISO26262 development process certification (a functional safety standard for automotive applications) from 3rd party certification organization TUV Rheinland (Germany). This allows ROHM's automotive device development process to support the highest safety requirements (ASIL-D). Going forward, ROHM will contribute to greater safety and security in the automotive industry by continuing to apply its ISO 26262 certified development process to products such as power supply and timing controller ICs that require functional safety.

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