World's First Motor Drive by a SiC Power Module with Built-in SiC CMOS Gate Driver

— Achieves low energy loss by reducing noise during high-speed switching operation —

Researchers

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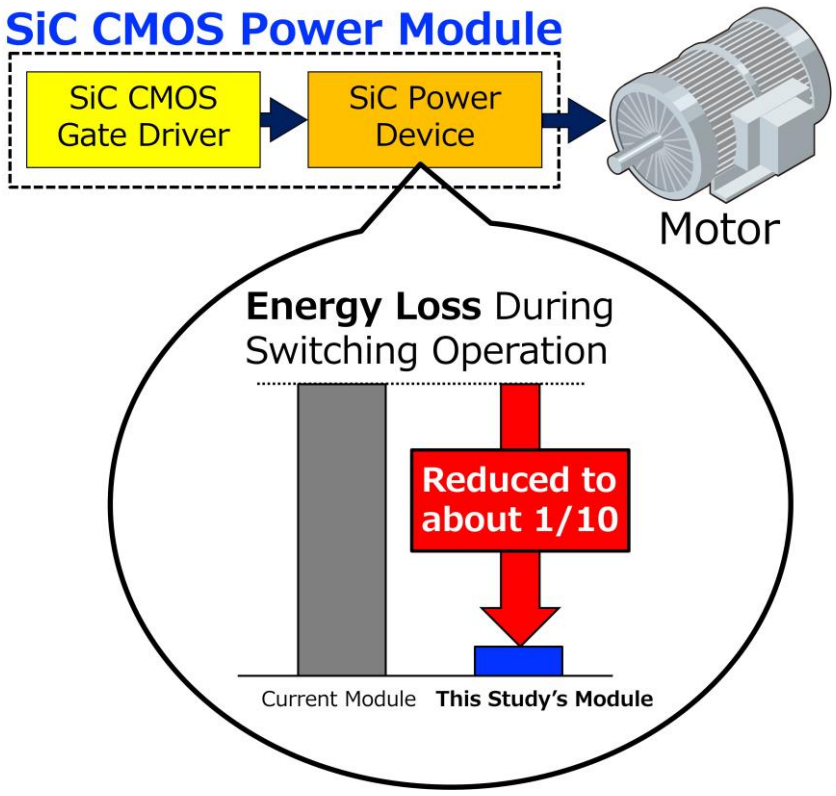
Points

- **Realized motor drive by power module with built-in SiC CMOS gate driver**
- **The unique gate drive method reduces noise and contributes to improved reliability of the motor system.**
- **Energy loss during switching operation is reduced to approximately one-tenth by simply replacing the current power module.**



Motor system with power module incorporating SiC CMOS gate driver

*Figures from the original paper have been cited and modified.

Summary

AIST researchers, in collaboration with MEIDENSHA CORPORATION (Meidensha), have realized the world's first motor drive by a SiC power module with a built-in SiC CMOS gate driver (hereinafter referred to as "SiC

CMOS power module" — a power module that combines silicon carbide (SiC) devices with a complementary metal-oxide-semiconductor (CMOS) circuit for precise and efficient switching control).

Due to their high energy-saving performance, SiC (silicon carbide) power devices are being applied in fields where high efficiency is important, such as motor drive control for electric and hybrid vehicles. However, current SiC power devices are used only in extremely low-speed switching operations, without fully exploiting their inherent energy-saving performance.

AIST has been working on the development of high-speed switching operation technology for SiC power devices using SiC CMOS gate driver. This time, AIST and Meidensha have succeeded in driving a motor using SiC CMOS power modules for the first time in the world by conducting integrated joint research from basic device technology to motor system applications. By reducing noise through the unique gate drive method, the energy loss (switching loss) during switching operation can be reduced to about one-tenth by simply replacing the current SiC power module with a SiC CMOS power module, while improving the reliability of the motor system. The SiC CMOS power module is a new power module that is designed to be used in the future.

The results of this research were presented in detail at the 2025 IEEJ National Convention on March 20, 2025.

Social Background

SiC power devices are expected to find applications in many fields where improved energy efficiency is required. These power devices perform power conversion by repeatedly switching on and off. The energy loss generated during this switching operation is called switching loss, which can be reduced by increasing the switching speed of the power device (i.e. by achieving high-speed switching operation). SiC power devices are capable of high-speed switching operation and offer higher energy-saving performance. However, current SiC power devices are only used in extremely low speed switching operations, restricting them from reaching their full potential. A major reason for this is the risk that SiC power devices malfunction with current gate drive methods due to noise from high-speed switching operations. Therefore, there is a strong need to develop a novel gate drive method that can reduce noise during high-speed switching operation and apply it to motor systems.