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Nidec Corporation

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Nidec Develops the World's First Drive System Using a Magnet-Less Motor Driven by SiC Based Inverter

Nidec Corporation (NYSE:NJ) today announced that the Nidec Research and Development Center has developed a motor-drive system based on a SiC (Silicon Carbide; next generation semiconductor) inverter. The Nidec Research and Development Center has succeeded in making the world's first concept model of a drive system using a magnet-less motor with a SiC based inverter, by applying the above drive technology to an SR motor (switched reluctance motor) which is free of permanent magnets, but requires a special control.

1. Need for motor drive system using a SiC based inverter

The future drive system should be compact, lightweight and of low power consumption. Above all, low power consumption is the most important challenge to achieve a society full of green innovation, because the power consumption of motor-driven equipment accounts for 57.3% of the total power consumption in Japan^(*).

*Source: "The investigation report on present and future trend of power consumption of electrical instruments" by Research & Development Association for Future Electron Devices issued on March 23, 2009

In response to the above social situation, power semiconductors such as SiC and GaN (Gallium Nitride) - which are superior to present silicon devices - have been developed. The Nidec Research and Development Center has succeeded in applying these to a compact and lightweight motor drive system, focusing on SiC semiconductors which offer reduced power losses, improved heat resistance and higher current capacity. The volume and weight of the above concept model are 32% and 69% of the conventional motor drive system, including motor and inverter, respectively. It is expected that the characteristics of lower power losses will contribute to reducing power consumption.

2. Technology of motor drive system using a SiC based inverter

Design of the motor drive system by the Nidec Research and Development Center required electrical circuit technology in order to fully realize the performance of the SiC power semiconductors, and thermal analysis technology to facilitate thermal management of the inverter circuit components.

R&D of SiC power semiconductor devices has been conducted for many decades in Kyoto University. The SiC power semiconductors which were used by the Nidec Research and Development Center were developed through Nidec's participation in the Kyoto super-cluster program of the Japan Science and Technology Agency. This was promoted by many universities, above all Kyoto, working in unison with corporations and public research organizations. A core institution of the Kyoto super-cluster program is the Advanced Scientific Technology & Management Research Institute of Kyoto. Specifically, the Nidec Research and Development Center has made open innovation by joint collaboration with ROHM whose head office is located in Ukyo-ku, Kyoto city; with Nichicon, whose head office is located in Nakagyo-ku, Kyoto city; and with Kyoto University, Osaka University and Ritsumeikan University. The Nidec Research and Development Center has also made joint research with Yokohama National University in the technology of thermal analysis for motor drive systems, including circuit simulation of the SiC based inverter.

3. Activity plan of motor drive system incorporating a SiC based inverter

The Nidec Research and Development Center of Nidec Corporation has already successfully developed a motor-drive system using a SiC based inverter. An integrated motor-drive system (in which the inverter is built inside the motor housing) will be developed in 2015.

Specification of the concept model

Max. of output (motor)	44kW
Cooling method	Liquid cooling



Figure: Future motor-drive system (motor and inverter integrated)

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