Power Electronics Equipment

Drive Systems
Power Supply Systems
Transportation Systems
Electric Distribution, Switching and Control Devices

Outlook

Power electronics products form the basis of daily life and production activities in a wide range of fields from lifeline services to industrial/social infrastructures. In terms of energy saving, there are strong expectations for high-efficiency conversion technology. There are calls for the proliferation of products featuring silicon carbide (SiC) power devices as well as products conforming to regulations regarding efficiency and safety.

In the field of drive systems, we have developed a high-performance compact IP65-rated inverter. We reduced power dissipation in the main circuit by 44% through using an SiC power device and achieved compactness and a totally enclosed self-cooled structure for the inverter. This is a dustproof and waterproof inverter that can be installed without a panel even in an environment with dust or water/oil splashes, and that does not need an external cooling fan. As for the "RHC Series" of PWM converters with an SiC hybrid module (stack type), we added a new 690-V model to the line-up intended for cranes and iron/steel applications for which demand is increasing overseas. We employed SiC power devices to products with a capacity of 355 kW or higher to achieve miniaturization through reducing the generated loss.

In the field of power supply systems, we delivered uninterruptible power systems (UPSs) for data centers. The amount of equipment investment made in data centers is increasing year by year due to the proliferation of cloud services and the utilization of big data. Amid an acceleration in efficiency improvement and systematization, we have commercialized high-efficiency large-capacity UPSs intended for North America and Asia that conform to the standards in the respective countries. We have also commercialized a rack-mounted direct current UPS that integrates a UPS and a server's internal power supply in order to reduce the conversion loss during power distribution. We will increase the variety of high-efficiency products to which SiC power devices are used.

In the field of transportation systems, we have developed jointly with Central Japan Railway Company a traction converter that uses SiC power devices, for Tokaido Shinkansen trains. We mounted a prototype on Series N700 train cars and are conducting the first running test in the world using a drive system of a high-speed railway in which an SiC power devices are employed. We are also working to commercialize a compact and lightweight auxiliary power unit that does not use a commercial frequency transformer by applying insulation technology through high-frequency switching. Drive systems for train car doors were delivered for new cars of the Nippori-Toneri Liner of the Bureau of Transportation, Tokyo Metropolitan Government and New Shuttle of Saitama New Urban Transit Co., Ltd. Instead of conventional products using a pneumatic door drive system, they are equipped with rack-and-pinion type electrical operated door drive system that offers high reliability and improved maintainability. These cars are currently being used for commercial operations. For rotating machines, we have developed motors that conform to overseas efficiency regulations, one for GB2 in China and the other for EISA in the United States (both classified as efficiency class IE3). The motor conforming to EISA in the United States also conforms to UL standards. Furthermore, we have developed low-inertia, high-speed motors that are required due to the proliferation of electric vehicles and faster rotation of mounted motors.

In the field of electric distribution, switching and control devices, there is growing demand for space-saving and highly reliable distribution equipment and control systems for production equipment, office buildings and commercial facilities in addition to the renewable energy-related businesses. In line with the proliferation of Top Runner motors (IE3) following the revision of the "Act on the Rational Use of Energy" (Energy Conservation Act), we have developed the "G-TWIN Series" of circuit breakers supporting 100 to 250 AF and "SW-N03" to "SW-N5-1" of compact magnetic switches combined with new thermal overload relays. The low-voltage distribution equipment market is demanding improved added value of lighting distribution panels.

In response, we have developed a breaker providing single-phase 3-wire neutral line phase loss protection and earth leakage alarm by adding an earth leakage alarm function to a neutral line phase loss protection breaker. As for high-voltage vacuum circuit breakers, we have developed a 24-kV vacuum circuit breaker (VCB) for the Southeast Asian market that conforms to IEC 62271-200 by itself. With it, we have achieved significant compactness through the use of a solid-insulated vacuum valve. As an energy monitoring system, we have developed "F-MPC Web Unit" (UM12-10) featuring enhanced support functions for energy-saving measures and a simplified user interface. With regard to switchgears, we started producing switchgears at Fuji Electric Manufacturing (Thailand) Co., Ltd. and are planning to transfer MV switchgears to Fuji SMBE Pte. Ltd. (Singapore) as a move toward globalization. We have completed the development of 24-kV/25-kA IEC-compliant switchgear following the development and commercialization of the 7.2-kV/31.5-kA model. Compared with JEM-compliant products designed for the Japanese market, human safety has been improved through measures against internal arc accident and such like.

We will continue to working to develop new technologies and products, pursue customer satisfaction and contribute to the achievement of a sustainable society.

Drive Systems

1 Servo System "ALPHA5 Smart Series" (Multi-Axis Integrated Type)

For the "ALPHA5 Smart Series," a product that mainly targets China and other Asian markets, we developed a new, multi-axis integrated type (Max. connectable axis: 5). The main features are as follows:

(1) By employing a common converter section, we have managed to reduce the amount of power supply wiring and lower the price.
(2) By using common direct-current intermediate capacitors and supplying DC power to each inverter, we have saved power by making effective use of regeneration power.
(3) The line-up of three types of inverters, 0.2 kW, 0.4 kW and 0.75 kW, offers higher flexibility in the combination of capacities.
(4) The configuration allows a single axis to be replaced, which improves maintainability.

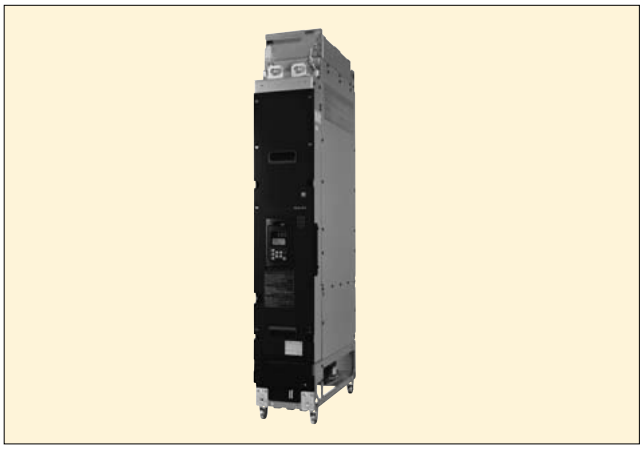
Fig.1 "ALPHA5 Smart Series" (multi-axis integrated type)

2 SiC Hybrid Module-Mounted PWM Converter "RHC Series"

PWM converters have been used to save energy, improve the power factor and suppress harmonics through regenerative operation of a power supply. In recent years, they have also come to require a larger capacity due to their increasing applications in large-scale systems. Fuji Electric has developed the "RHC Series" of PWM converters designed to provide larger capacity. The main features are as follows:

(1) SiC hybrid module using SiC for FWD and Si for IGBT is employed to increase capacity by about 43% compared with products using a conventional Si module of the same appearance (stack type).
(2) A direct parallel connection method allows an output of 450 kW and parallel connection of up to four units (1,700-kW/690-V line).
(3) It can use spare parts of the "FRENIC-VG" inverter that are in common when only the software, terminal block board and touch panel are changed.

Fig.2 "RHC Series" (stack type)



Drive Systems

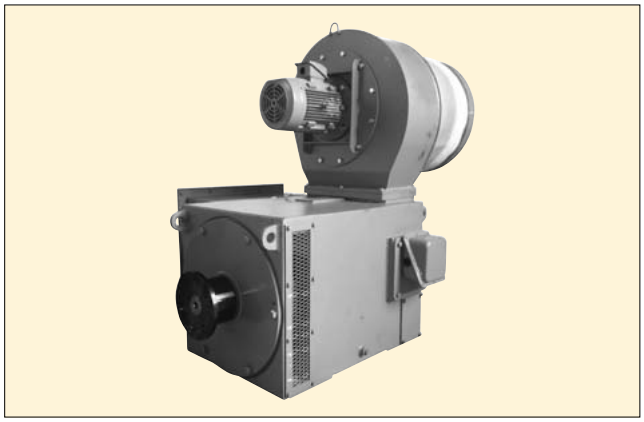
3 Low-Inertia, High-Speed Motor for Automotive Testing Machines

Fuji Electric has developed a low-inertia, high-speed motor with 500-kW rated output. It is to be used as driving power or a load of testing machines for such automotive components as engines, transmissions, differential gears. The main features are as follows:

(1) Since this is an induction motor, it rotates smoothly especially when no current is applied, without generating torque ripples or core loss.
(2) The design of the rotor has been innovated as driving power for testing machines, resulting in lower inertia, faster rotation and higher torque compared with conventional motors.
(3) Use of an air-cooling system eliminates the need for water-cooling equipment and piping work.
(4) The adoption of grease-lubricated sealed bearings eliminates the need for forced lubricating equipment.

We plan to continue the development of 220-kW and 370-kW models to expand model variations.

Fig.3 Low-inertia, high-speed motor for automotive testing machines



Power Supply Systems

1 High-Efficiency UPS for North America "UPS7000HX-T3U"

Products for data centers, which are expected to increase in particular in the UPS market, have been requiring high-quality and high-efficiency UPSs and it has become important to obtain various certifications to prove such ability.

The high-efficiency UPS for North America "UPS7000HX-T3U" provides an input/output voltage of 480 V AC and equipment capacity of 500 kVA. It has achieved equipment efficiency of 97.5% which is the industry's highest level for a UPS double conversion. To sell it in the market in North America, we have obtained the following third-party certifications for the product:

(1) U.S. safety standard UL 1778 and Canada's safety standard CSA C22.2 No. 107.3-14
(2) Energy Star
(3) California's seismic standards (OSHPD)

Fig.4 "UPS7000HX-T3U"

2 Expanding Product Line of 3-Phase 400-V Large-Capacity UPS "UPS7000HX Series"

In order to increase the variety of products outside Japan, Fuji Electric has developed "UPS7000HX-T4C" (300/400/500 kVA) as models to be added to the "UPS7000HX Series" product line of large-capacity UPS products that have been released in advance. To provide safety and security, these products have been evaluated by a third-party certification body and approved for their conformance to the following safety standards of the respective regions:

(1) The products have obtained conformance certifications for European safety standard EN 62040-1 and EMC standard EN 62040-2 and declared the conformance to CE Marking.
(2) The products have satisfied the requirements of the international standard IEC 62040-3 regarding the performance and test requirements of UPS.
(3) We have had a safety test conducted by the TLC Certification Center, which is a Chinese official certification body, and acquired TLC certification.

Fig.5 "UPS7000HX-T4C"

Transportation Systems

1 Rack-and-Pinion Door Drive System for Nippori-Toneri Liner of Bureau of Transportation, Tokyo Metropolitan Government

Model 330 cars of Nippori-Toneri Liner, which started being operated on October 10, 2015 by Bureau of Transportation, Tokyo Metropolitan Government, have adopted an electrical operated door drive system instead of a conventional pneumatic door drive system. Fuji Electric has delivered a rack-and-pinion door drive system. The main features are as follows:

(1) It achieves high reliability and safety by adopting the latest power electronics technology while inheriting the mechanism of Fuji Electric's conventional products.
(2) The standardized adjusting method of the locking mechanism facilitates the door installation and lock adjustment work during the manufacturing and maintenance of rolling stock.
(3) A failure diagnosis function reduces maintenance time.
(4) Adoption of the latest sensing technology has improved the detection performance in the case of a passenger or belongings being caught between doors.

Fig.6 Model 330 cars and rack-and-pinion door drive system

2 Rack-and-Pinion Door Drive System for New Shuttle of Saitama New Urban Transit Co., Ltd.

Series 2020 cars of New Shuttle, which started being operated on November 4, 2015 by Saitama New Urban Transit Co., Ltd., have adopted an electrical operated door drive system instead of a conventional pneumatic door drive system. Fuji Electric has delivered a rack-and-pinion door drive system. The main features are as follows:

(1) In order to install the door system to the train car at a slant due to the limited mounting space, we improved the methods of hanging the system equipment and of connecting it to the door panel for higher flexibility.
(2) The standardized adjusting method of the locking mechanism facilitates the door installation and lock adjustment work during the manufacturing and maintenance of rolling stock.
(3) A failure diagnosis function reduces maintenance time.
(4) Adoption of the latest sensing technology has improved the detection performance in the case of a passenger or belongings being caught between doors.

Fig.7 Series 2020 cars and rack-and-pinion door drive system

Electric Distribution, Switching and Control Devices

1 24-kV Vacuum Circuit Breaker (VCB) for Southeast Asian Market

Fuji Electric has developed a vacuum circuit breaker (VCB) to be mounted on IEC standard-compliant switchgears intended mainly for the electric distribution market in Southeast Asia.

The specifications include a rated voltage of 24 kV, rated breaking current of 25 kA, and rated current of 1,250 A. The main features are as follows:

(1) Safety mechanism conforming to IEC 62271-200
  ○ The external operation mechanism unit allows the VCB to be inserted into or drawn out from the outside of the panel with the door closed.
  ○ The interlock mechanism prohibits the insertion/drawing out operation when the power is on and opens the front door only at the test position.
(2) Compactness through the adoption of a solid-insulated valve to the main circuit
  Pitch between phases: Shortened from 230 to 210 mm
  Pitch between poles: Shortened from 470 to 310 mm
  External height: Lowered from 1,125 to 788 mm

Fig.8 "HS2520F-12Mf-A"

Fuji Electric

Innovating Energy Technology

* All brand names and product names in this journal might be trademarks or registered trademarks of their respective companies.