

### Wide Area Network-Based Distribution Automation System for Tohoku Electric Power Co., Inc.

For Tohoku Electric Power Co., Inc., Fuji Electric has delivered a wide area network-based distribution automation system allowing continuous operation even if large disasters occur.

The main features are as follows:

- (1) By installing servers in 2 service offices distant from each other for mutual backup between the servers, one office can continue operating even if the other is struck by a disaster.
- (2) The impact of a switchover on operations has been minimized by completing switchover to the backup server within 1 s.
- (3) The operating terminals are connected to the server via a network and have no application software installed, improving maintenance efficiency and reducing system maintenance costs.



(a) Indoor unit

(b) Outdoor unit

### Line-up Expansion of “F-COOL NEO” Indirect Outside Air Conditioning Energy-Saving Hybrid Air Conditioning Unit

In recent years, the amount of heat generated by servers used in data centers has increased dramatically as a result of the higher performance and higher density of the servers.

To save energy in data centers, Fuji Electric has been offering the “F-COOL NEO” indirect outside air conditioning unit (cooling capacity: 40 kW), which introduces only outside cold energy through a heat exchanger, and has now developed a new type with a cooling capacity of 56 kW.

The main features are as follows:

- (1) Concurrently operating an outside air cooling unit and built-in refrigeration cooling unit can reduce the annual power consumption to approximately one-third of that of usual air conditioning units.
- (2) Indirect use of the outside air makes the product less susceptible to moisture, PM 2.5 and other types of dust and corrosive substances contained in the outside air.
- (3) Power supply is the only necessary utility and no chilled water or cooling water is required. The downward air inlet (air blow) provides compatibility with access flooring.



### “SVE135” Sealed High-Voltage Contactor

There is rapidly increasing demand for contactors for DC circuits as DC power distribution systems and electric vehicles are becoming increasingly popular. Hence, they are strongly demanded to achieve miniaturization, improved safety, and contact reliability. In order to meet these demands, Fuji Electric has developed the “SVE135” sealed high-voltage contactor with a rated voltage of 450 V DC and a rated current of 135 A.

The main features are as follows:

- (1) The contact block is located in a sealed capsule in which insulating gas is enclosed. This has improved breaking performance and realized miniaturization and high contact reliability.
- (2) The unique contact structure provides a high withstand capability, non-polarity of the main circuit and equal breaking performance both in the normal and reverse directions.
- (3) The contactor can be mounted in any direction, and it has a minimum malfunction shock of 490 m/s<sup>2</sup>.



Servo amplifier



Servomotor

(a) “ALPHA7”



(b) “SPH3000D”

### Motion Control Systems

Motion control systems, which combine a servo system and motion controller, are expanding applications in industrial machines in general, including semiconductor, LCD manufacturing and electronic part processing equipment. In this situation, there are increasing needs to improve safety and maintainability in addition to further speeding up the systems, increasing their precision and reducing their set-up time. To meet these needs, Fuji Electric has developed and commercialized the “ALPHA7” servo system and “SPH3000D” motion controller. The ALPHA7 has achieved the industry’s highest level of high-speed, high-precision drive control and is equipped with safety functions to support safer operation as a standard feature. The SPH3000D, which is capable of sequential control and motion control with one CPU unit, can maximize the performance of the ALPHA7. The motion control system combining the ALPHA7 and SPH3000D contributes to productivity improvement, cost reduction and enhanced safety.



“FST” (φ 100 mm)

## Production Line Extension of High-Accuracy Spool Piece Ultrasonic Flowmeter “FST”

High-accuracy spool piece ultrasonic flowmeters are capable of measuring the flow rate of various liquids including oils with a high accuracy of  $\pm 0.2\%$  of rate by using 3 pairs of sensors in a pipe. This allows efficient flow rate control, which helps to save energy and improve the quality of the entire equipment.

Fuji Electric released the 50-mm diameter model of the high-accuracy spool piece ultrasonic flowmeter “FST” in 2016 and has now expanded the product line as described below to increase the range of applications.

- (1) For petroleum and chemical plants, explosion-proof models conform to the ATEX, TIIS and NEPSI standards (to be released gradually).
- (2) The size selection has been expanded to include 3 typical diameters in the industry:  $\phi 50$  mm,  $\phi 80$  mm and  $\phi 100$  mm.

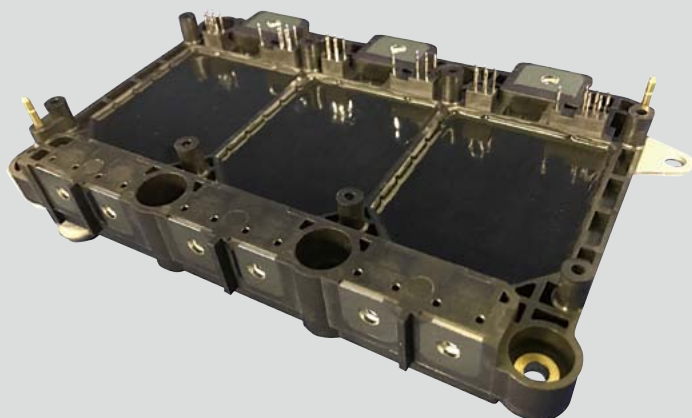


## Electrical Driven Door System for E235 Series of East Japan Railway Company

East Japan Railway Company started operating the mass-produced E235 Series commuter train on Yamanote Line services in May 2017. For this new model of cars, Fuji Electric delivered a rack-and-pinion mechanism type door system. The system for 539 cars (4,312 units in total) will be gradually delivered.

The main features are as follows:

- (1) Improved safety realized by employing a door control sequence combining a high-resolution encoder and servo control to improve obstruction detection accuracy
- (2) Improved maintainability achieved by reducing the size and weight (15% reduction from the conventional product) and integrating devices into a unit
- (3) Improved environmental endurance by employing totally enclosed encoders
- (4) Reduction of environmental burden by decreasing the amount of rare metal used
- (5) Improvement of communication reliability and device condition monitoring function by providing compatibility with the Train Information Management System



## High-Capacity Direct Liquid Cooling Power Modules for Automotive Applications (750 V/1,200 A)

Fuji Electric has developed power modules for electric vehicles and hybrid electric vehicles and launched them onto the markets, which are growing in Japan and overseas.

Automotive power modules are mounted in a limited space in automobiles and downsizing of products is required. Direct liquid cooling power modules for automotive applications have achieved increased power density by employing a lead frame for internal wiring to improve area efficiency. In addition, they employ a water jacket-integrated structure, which offers high heat dissipation performance. Furthermore, we have employed a reverse-conducting insulated gate bipolar transistor (RC-IGBT) integrating an IGBT and FWD into one chip for the power device, which has achieved the world's highest capacity rating for a general-purpose 6-in-1 module of 750 V/1,200 A.



## All-SiC Module with SiC Trench Gate MOSFETs (1,200 V/400 A)

SiC devices are increasingly expected to be launched to meet such demands for power converters as high efficiency, downsizing and high capacity. Previously, Fuji Electric has produced all-SiC modules with a rated capacity of up to 1,200 V/100 A with a new structure package that applies copper pin connection and resin molding technology. This new structure package has low internal inductance and high temperature resistance, allowing SiC devices to operate in high-speed and with high reliability.

We have developed a high-capacity new structure package for the purpose of further increasing the rated capacity. By installing the 1st-generation SiC trench gate MOSFETs, which combine low on-state resistance and high-speed switching characteristics, we have achieved an all-SiC module with a rated capacity of 1,200 V/400 A.





## Commercial Operation Started at Takigami Binary Power Plant of Idemitsu Oita Geothermal Co., Ltd.

The Takigami Binary Power Plant, for which Fuji Electric received an order for a power generation facility from Idemitsu Oita Geothermal Co., Ltd. as an engineering, procurement and construction (EPC) project, started commercial operation in March 2017. Binary power generation is a system in which a heat source is used to evaporate a medium with a low boiling point and the resulting steam is used to rotate a turbine. It can make effective use of low-temperature steam or hot water, which could not be conventionally used, as a heat source, and is a promising power generation system.

This is the Fuji Electric's first commercial binary power plant, and the turbine was manufactured at Kawasaki Factory. The generating end output is 5,050 kW at the maximum, which is among Japan's highest.

While there were many factors that hindered outdoor work such as the Kumamoto earthquakes, a long spell of rainy weather and a cold wave, we completed the delivery as originally scheduled, thanks to the cooperation of the customer and related companies.



## "PVI1000BJ-3/1000" Power Conditioning System for Large-Scale Photovoltaic Power Generation

Fuji Electric has developed the "PVI1000BJ-3/1000," a new power conditioning system (PCS) for large-scale photovoltaic power generation (mega solar) in Japan and overseas, as the mega solar market is continuously growing. With the features of the conventional product including high efficiency, outdoor compatibility and elimination of the need for air conditioning maintained, a significant size and weight reduction has been achieved. This makes the product applicable to mega solar power plants in mountainous areas.

The main features are as follows:

- (1) Equipment capacity: 1,000 kVA
- (2) DC input voltage: 1,000 V DC
- (3) AC input voltage: 380 V AC
- (4) Maximum efficiency: 98.5%
- (5) External dimensions: W2,000 × D950 × H1,940 (mm)
- (6) Mass: 2,000 kg (approximately 75% reduction from 7,500 kg of the conventional product)
- (7) Various options: Cold weather model, salt-tolerant model, fuse branch and others

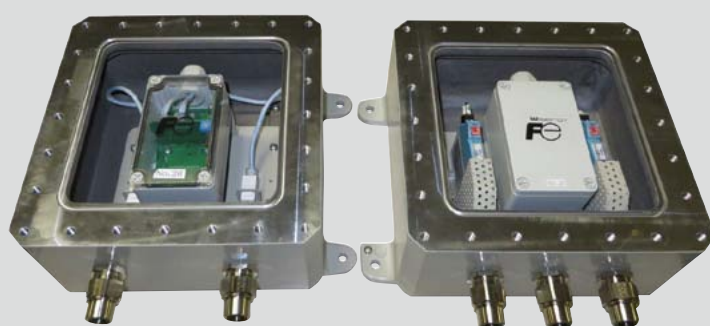


## Latte Machine for Seven-Eleven Japan Co., Ltd.

Seven-Eleven Japan Co., Ltd. decided to add new drinks with fresh milk to the SEVEN CAFÉ menu. Fuji Electric worked on developing a system in which milk is being handled in a simple operation in hygienic conditions and environment.

The main features are as follows:

- (1) Aseptic packaged milk has been employed for the first time in the world, and an innovative piping system is used to prevent milk from remaining inside the piping at normal temperature.
- (2) Maintenance of hygiene of the dispensing module has been simplified by using newly developed special detergent and self-cleaning functions.
- (3) An in-line milk frothing mechanism that does not require disassembly for cleaning, which was conventionally needed, has allowed a fine froth to be produced.
- (4) A structure has been adopted that prevents milk from being mixed in unintentionally, which is an allergen, by separating the latte dispensing stage from that for coffee.



(a) Transceiver

(b) Wireless vibration sensor

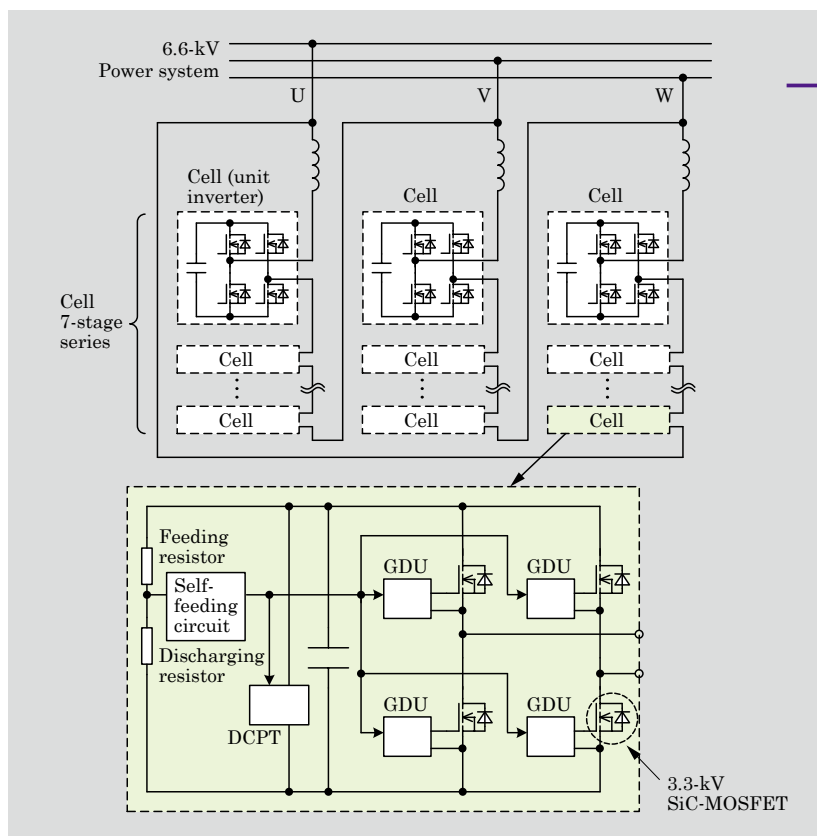
## Explosion Proof Certification of “Wiserot” Wireless Diagnostic System for Rotating Machine Vibration

The “Wiserot” wireless diagnostic system for rotating machine vibration is intended to promptly detect abnormalities by measuring the vibration of machinery and equipment, such as rotating machines, fans and pumps. Such equipment is employed in large numbers in automobile, steel, chemical (non-explosion-proof areas) and other manufacturing plants.

Fuji Electric has acquired explosion proof certification in Japan and overseas and offered an explosion-proof wireless vibration sensor as an addition to the line-up. The product can be used for explosion-proof areas in petrochemical and other plants in Japan and overseas. The explosion proof structure is Ex db IIB + H<sub>2</sub>T4 Gb. While the main unit is made of aluminum casting, the top cover uses polycarbonate in consideration of wireless communication.

The explosion proof certifications acquired are as follows:

- (1) IEC 60079-0/1/11
- (2) EN 60079-0/1/11
- (3) JNIOHS-TR-46-1, 2, 6: 2015



## MMC-Based Static Synchronous Compensator (STATCOM) with Direct Interconnection with 6.6-kV Power System

Fuji Electric participates in the Strategic Innovation Promotion Program (SIP) of the Cabinet Office to work on the development of a modular multilevel converter (MMC)-based static synchronous compensator (STATCOM) capable of direct interconnection with 6.6-kV power systems without using an interconnection transformer.

The main features are as follows:

- (1) Efficiency can be improved by using 3.3-kV high withstand voltage SiC-MOSFETs as power devices.
- (2) Peripheral circuits can be miniaturized with self-feeding technology, which provides a non-isolated power supply from the main circuit potential to the SiC device gate drive units (GDU) and DC potential transformer (DCPT).
- (3) Fuji Electric's proprietary cell (unit inverter) DC voltage equalization control allows negative-sequence power compensation as well as reactive power compensation.





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