(Photo: provided by The Okinawa Electric Power Company, Incorporated)

The Okinawa Electric Power Company, Incorporated Opens "Abu Mega Solar" Business Service

A photovoltaic power generation plant for the Okinawa Electric Power Company, Incorporated's "Abu Mega Solar," which is the first mega solar (1 MW) plant in Okinawa main land, was completed and started operation in March 2012. This power plant is also a demonstrative site for the following purposes:

(1) To clarify effect of PV's power fluctuation on the grid line

(2) To compare actual outdoor performances of two kinds of solar cells, chemical compound (CIGS) and thin film (amorphous) silicon

Features of this plant are shown below:

(1) It has a supervisory and control function operated from both the site and head office of Okinawa Electric Power Company, Incorporated.

(2) It can control both active and reactive power of PV's output.

(3) A tilt angle of PV modules is adjustable.

Indoor Power Conditioner "PVI750-3/500"

The Feed-in Tariff Scheme for Renewable Energy, which was launched in July 2012, has created a construction boom in Japan for large-scale photovoltaic power generation facilities. The power generation capacity of many of these facilities is less than 2 MW, which capacity allows interconnection with medium-voltage lines. In addition, these facilities are constructed by combining multiple power conditioners from the perspective of maintainability.

Accordingly, Fuji Electric has commercialized the 500 kW PCS (600 V DC) that can be used in parallel by utilizing 3-level-conversion units. It achieves efficiency of 98.1% (exclusive of an internal power supply), which is 0.4 points higher than the products of other manufacturers of the same capacity in the 600 V DC class. Furthermore, the DC input voltage ranges from 310 to 750 V, thereby allowing photovoltaic panels to generate power at the operating point at which the maximum power is produced in JAPAN, where the temperature varies significantly throughout the year, even in both winter, when a photovoltaic panel voltage rises, and summer, when a photovoltaic panel voltage falls.

All-SiC module (1,200 V/100 A)

Inverter unit

Module mounting

Inverter for Photovoltaic Power Generation PCS Equipped with All-SiC Module

Fuji Electric and the National Institute of Advanced Industrial Science and Technology (AIST) have teamed up and have been carrying out research and development of SiC-MOSFET and SiC-SBD. SiC devices have advanced features that are high temperature operation, high frequency switching, etc. Fuji Electric has developed an ultra-small-size All SiC module with AIST's SiC-MOSFET and SBD. We have utilized a high heat-resistant jointing material, molding resin and low inductance wiring structure for the developed module that achieves the development of the module size that is 50% smaller than conventional Si modules.

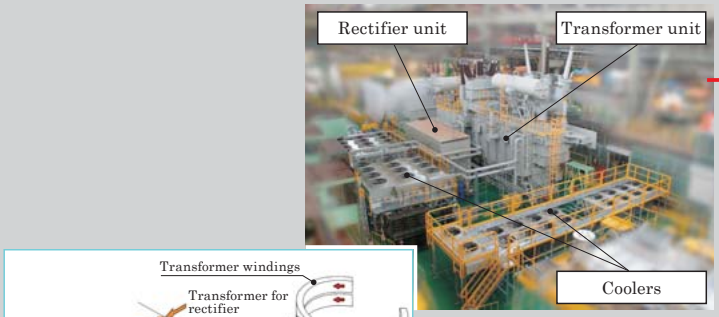
In addition, by adopting the module, we have developed an inverter specialized for power conditioners used with photovoltaic power generation outputting 20 kW. High frequency switching of 20 kHz and advanced t-type neutral-point-clamped (AT-NPC) 3-level circuits have helped us accomplish a capacity that is only 20% of conventional products using the same level of electricity as well as a maximum conversion efficiency of 99.0%. Some of our research efforts were carried out as part of a project of the joint research body "Tsukuba Power-Electronics Constellations (TPEC)."

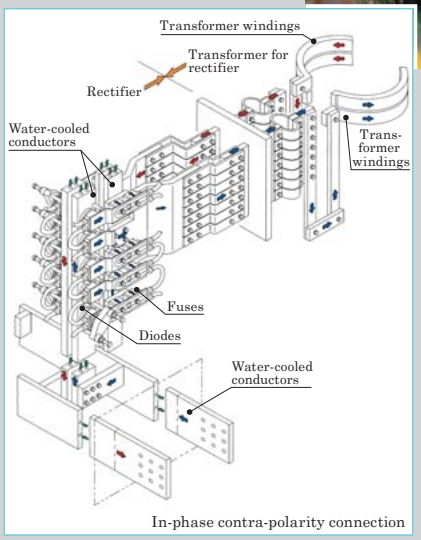
Direct Drive Permanent Magnet Generator of 3,000 kW Class for Wind Power Generation

Development has been made of a direct drive permanent magnet generator of the 3,000 kW class for wind power generation. With rotation speed of 15 min^{-1} at a voltage of 690 V, this generator is the largest permanent magnet generator for wind power in Japan.

Making full use of analysis technology at the time of the development has allowed us to incorporate many innovative design technologies and production enhancements to achieve weight savings and high performance. Some of the implementations include reducing total length by utilizing a concentrated winding coil, improving cooling capability through a new cooling system, and the achievement of a strong structure that can endure heavy loads. During factory testing, we were able to obtain good results, which satisfy our predetermined performance standards, such as a temperature rise of 115K or less and an acoustic noise of 80 dB or less under no-load.

Systems that make use of direct drive permanent magnet generators are superior to other types of systems concerning maintainability and operating efficiency. Sales of mass-produced generators are scheduled to start in FY2013.





World's Largest Single-Unit Capacity Transformer Rectifier Unit "S-Former" for Aluminum Smelting Facility

Fuji Electric completed manufacturing of transformer-rectifier units which are called S-Former and the units were successfully shipped in August 2012. The DC output rating of the units is 92 kA at 2,000 V DC and it is the world's largest single-unit capacity ever manufactured.

The transformers have been designed to be small footprint in size and to effectively deal with harmonics through the use of a hybrid insulation technology which appropriately arranges insulation materials corresponding to high temperature in the windings.

The rectifier stack has been developed as the world's first unit to be 2,000 V DC output.

The unit configuration uses Fuji Electric's unique in-phase contra-polarity connection technology to achieve the design which simultaneously eliminates magnetic fields and facilitates a high withstand voltage.

Stack-Type "FRENIC-VG Series" Inverter

In recent years, there has been increasing demand at large-scale facilities such as iron and steel plants for systemization that optimizes capacity and responsiveness, while at the same time, requiring easier installation and replacement procedures as well as less space usage. These customer demands can be met with the addition of a stack-type, which inherits the basic performance of the "FRENIC-VG Series," high-performance vector control inverters.

The main features are as follows:

(1) Improved storage efficiency with a slim structure, a width of 220 mm, allows to downsize cabinets (34% reduction over our previous products).

(2) Users can select either diode rectifiers or PWM converters to meet their applications.

(3) There are product lineups for various capacities up to 3,000 kW, and they employ a direct parallel connection method that makes them possible to operate with reducing operating capacity if one of the inverters breaks down.

(4) Easy stack replacement improves maintainability.

Standard-Type Inverter "FRENIC-Ace Series"

The Standard-Type Inverter "FRENIC-Ace Series" has been developed for driving motors of plant facilities, processing machinery, etc.

Its main features are as follows:

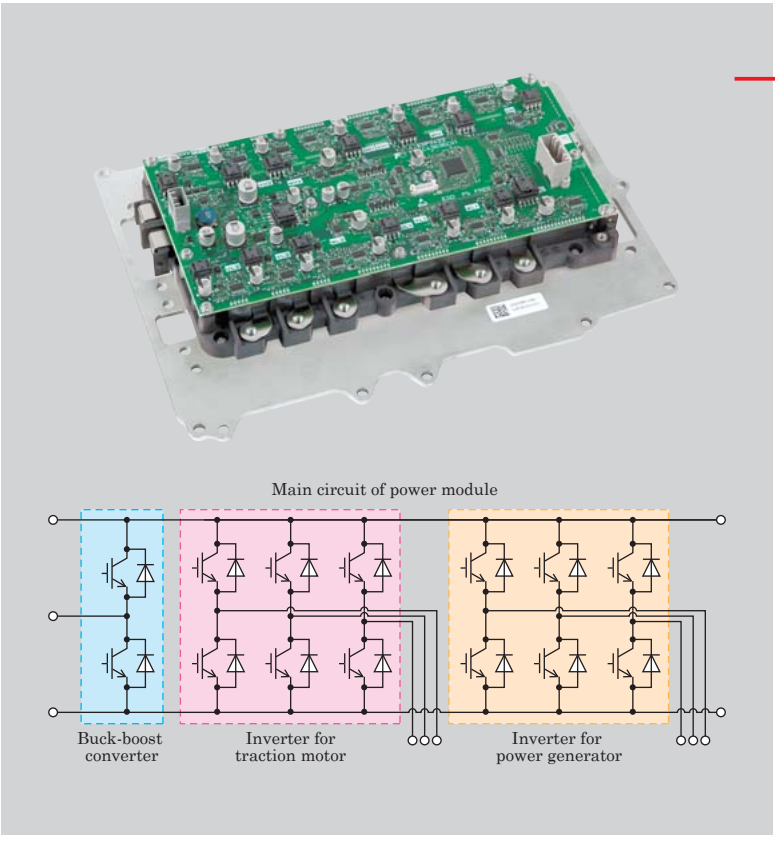
(1) Capacity series: 3-phase 200 V class 0.1 to 90 kW, 3-phase 400 V class 0.4 to 630 kW

(2) A size and cost of an inverter can be optimized by selecting up to four overload current ratings as well as selecting a current ratings or capacity which is suitable for a purpose.

(3) A feature rich customizable logic function makes it possible for customers to simplify surrounding circuits as well as construct an inverter designed for dedicated applications.

(4) This series contributes to energy-saving through featuring a sensorless driving method for synchronous motors as standard.

(5) Machine safety functions comply with functional safety standard IEC61800-5-2/61508.

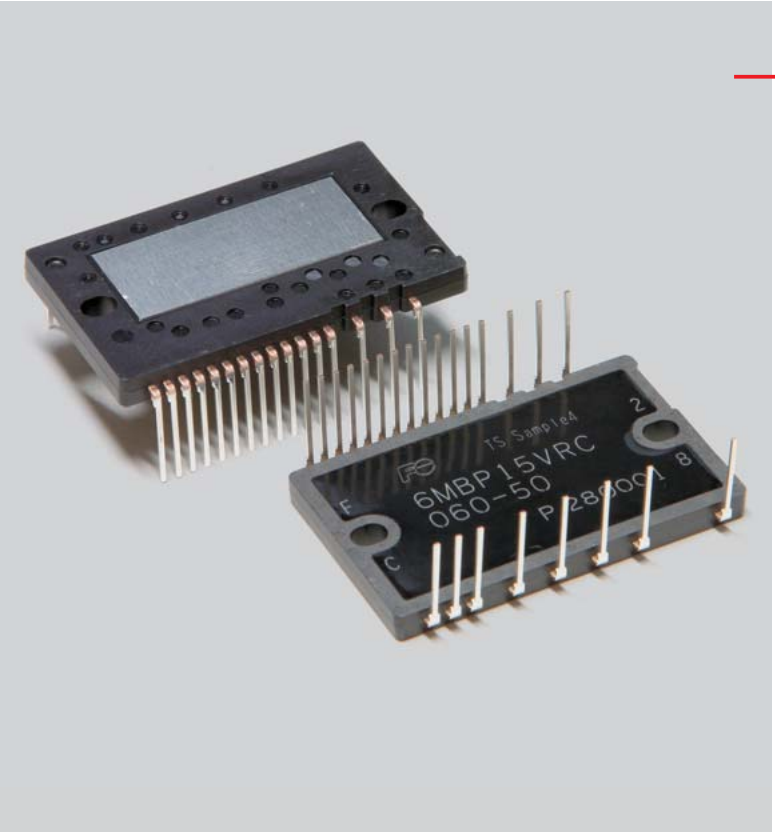


Intelligent Power Modules for Plug-In Hybrid Electric Vehicles

Mass production of intelligent power modules (IPM) for plug-in hybrid electric vehicles has started.

This module consists of separate inverters of a traction motor and power generator as well as a buck-boost converter. In order to achieve a compact and lightweight to realize the high output needed for plug-in hybrid electric vehicles, this IPM has been commercialized to combine a low-loss 1,200 V sixth-generation IGBT and FWD with a heat dissipation aluminum direct-water-cooling heat sink.

The mounted drive board incorporates several built-in protection functions, a fault detection function and a power supply circuit, which make it possible to use the CPU to have serial communication with the master ECU. Thermal fluid analysis was utilized to optimize the fin detail and coolant channel design in the aluminum direct-water-cooling heat sink in order to facilitate the effectiveness of heat dissipation. Furthermore, high durability of the insulating substrate soldering has been ensured by using high strength solder.



Compact Type IPMs for Inverter Air Conditioners

Among home appliances, air conditioners have the highest energy consumption ratio. In order to improve on energy saving performance, Fuji Electric has started mass-producing compact type intelligent power modules (IPMs) that have a built-in 3-phase inverter bridge circuit and control circuit.

By utilizing an optimized low-loss device, this IPM reduces loss during light load conditions, which occupy about 80% of yearly air conditioning usage, by about 25% in comparison with conventional devices.

In addition, thermal resistance has been reduced through the adoption of an insulated metal substrate with high thermal conductivity. Combining this with low-loss devices that facilitate effective loss reduction, temperature rises in the IPM can be suppressed, leading to an inverter that is smaller in size.

By utilizing this technology, Fuji Electric plans to start production in FY2013 to establish a product line-up of IPMs with a rated current of up to 30 A.

MCCB ELCB

"G-TWIN Λ (Lambda) Series" of Compact Low-Voltage Circuit Breakers and Earth Leakage Circuit Breakers

"The G-TWIN Λ Series" of compact molded case circuit breaker (MCCB) and earth leakage circuit breakers (ELCB) (32 to 63 AF) have been developed to provide comparatively low-current circuit protection for most machinery installations and control boards. This series reduce its installation area by narrowing the external width to 70% of that of previous products and comply with standards of many countries in the world as with existing "G-Twin Series," allowing to improve its adaptivity to miniaturization and global needs.

Silver and copper savings have also been realized through the adoption of a thermal over current detection mechanism and arc commutation breaking method. Furthermore, by adopting miniaturization technology for each component structure, we have secured enough mounting space for internal accessories which are necessary to configure control sequence. Thus all types of this series can be equipped with auxiliary and alarm contacts.

Fuji Electric is also currently developing models which serve downsizing needs of electrical facilities by employing a plug-in connection capability, leakage alarm function and correspondence to high voltage direct current.

Start of Commercial Operation of Ulubelu Geothermal Power Station in Indonesia

In February 2010, Fuji Electric contracted a full turnkey project of the geothermal power plant (55 MW×2 units), as a subcontractor of Sumitomo Corporation, with an Indonesian state-owned power company. This geothermal power plant is located at the Ulubelu region in the southern Sumatra.

The scope of Fuji Electric includes engineering work, supplying main equipment such as geothermal steam turbine, generator and control units and commissioning of the power plant.

The power plant commences commercial operation of the Unit1 in September 2012 and the Unit2 in October 2012.

This is the first large-scale geothermal power plant in Sumatra. The power plant is expected to provide stable supply of electrical power to southern Sumatra.

(Photo: provided by The Okinawa Electric Power Company, Incorporated)

Start of Commercial Operations of Unit 1 Yoshinoura Thermal Power Station for The Okinawa Electric Power Company, Incorporated

Fuji Electric, in partnership with Siemens AG, has delivered power generation facilities, consisting of a single-shaft combined-cycle-power-plant, to the Yoshinoura Thermal Power Station. This is the first time that this type of system has been employed, meeting the special environmental needs of The Okinawa Electric Power Company, Incorporated. The power station uses LNG as fuel, and with both Units 1 and 2 producing a respective 251 MW at generator terminal, Yoshinoura has become Okinawa's largest capacity power station.

Utilization is made of Siemens' 1,400 °C class gas turbine SGT6-4000F to create a shaft configuration that consists of the gas turbine, generator, clutch and steam turbine. This plant adopts a static frequency converter, which uses the power generator as a start-up motor, while dis-engagement is made of the steam turbine at gas turbine start up time via the clutch. This type of design minimizes energy loss during start up. Unit 1 started commercial operations in November 27, 2012, while Unit 2 is scheduled to begin commercial operations in May 2013.

Module-Type Data Centers

Developments in our IT-based society have created an accelerated need to integrate IT devices into a data center. Fuji Electric has developed the module-type data centers through employing "built in block system," which offers physical infrastructure such as housing-units, air-conditioning systems and power supplies as well as needed components for building and operating monitoring control functions etc. in the form of blocks. The result of this development has been the achievement of a stepwise architecture that minimizes investment burdens. In addition, we have been able to realize quick construction completion dates (three months) through the standardization of the housing-unit, air-conditioning system, power supply, etc.

The air-conditioning system used in the data center is a highly efficient indirect outdoor air-conditioning unit that combines indirect outdoor cooling with compression refrigeration cooling. The system's average yearly coefficient of performance for the Tokyo area has yielded a result of 10 or better, helping this system contribute to energy conservation.

"ECOMAX S Series" Display Cases for Supermarkets

Fuji Electric has developed the "ECOMAX S Series" refrigeration display case as a freezer unit with enhanced energy-savings capability.

We have improved cooling capability by utilizing blower speed distribution and internal temperature distribution of a front air-curtain as well as LED lighting, thus reducing 30% of power consumption per store (a hypothetical store with 24 display cases).

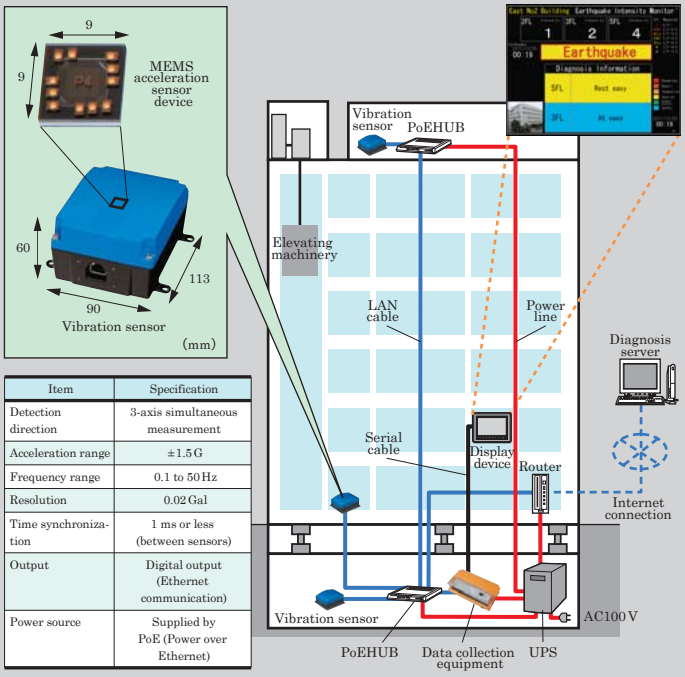
The design has been optimized to achieve cold airflow balance according to the unique technology employed in the air-curtain airflow guide configuration of the edge of shelves. By suppressing front air-curtain disturbances, increased isolation from outside air is achieved. Furthermore, cooling capability is also increased by decreasing the amount of frost formation on the heat exchanger by sucking outside air.

All showcases come standard with energy-saving LED lighting, which is an industry first. This results in a power consumption savings of 48% over conventional fluorescent lighting.

Peak-Shift Vending Machines for Coca-Cola (Japan) Company, Limited

In the aftermath of the Great East Japan Earthquake, the need to save electricity has increased with power shortages. Accordingly, Fuji Electric has developed a new peak-shift vending machine, in collaboration with Coca-Cola (Japan) Company, Limited. This new peak-shift vending machine uses electricity for intensive refrigeration during the nighttime when demand for electricity is comparatively low, thereby enabling the machine to provide cold drinks throughout the day for up to 16 hours without the need for extra cooling. Furthermore, since peak-shifts are possible, the machine also contributes to saving electricity during winter. Its main features are as follows: (1) a thermal storage technology makes full use of the thermal capacity of the drinks contained in the machine, allowing to maintain the optimum temperature of the next drink to be sold for a long time; (2) a highly advanced insulation technology that employs vacuum insulation materials allows the outside appearance and storage inside dimensions of the machine to remain unchanged while reducing heat intrusion to the inside of the machine by approximately 50% when compared with existing vending machines; and (3) the contents of drinks stored in the machine can be quickly cooled at a uniform temperature with a new structural airflow control technology.

Configuration of structural health monitoring system



Item	Specification
Detection direction	3-axis simultaneous measurement
Acceleration range	±1.5 G
Frequency range	0.1 to 50 Hz
Resolution	0.02 Gal
Time synchronization	1 ms or less (between sensors)
Output	Digital output (Ethernet communication)
Power source	Supplied by PoE (Power over Ethernet)

Vibration Sensors

Fuji Electric has created a vibration sensor that applies MEMS technology as a means to apply structural health monitoring to carry out soundness and safety tests for buildings, bridges, and other structures. The vibration sensor is capable of continuous micro-vibration measurements of around 0.1 Gal (1 Gal = 0.01 m/s^2) for unfelt earthquakes, structural diagnostics, etc. The sensor can be used to detect various abnormalities such as earthquake damage to buildings and deterioration of a structure due to aging. This newly developed vibration sensor also comes equipped with an acceleration sensor device that employs original MEMS technology. The adoption of this type of technology provides the ability to replace previously used servos as well as take advantage of a compact size and low-cost (about a 20% decrease), while performing multi-point measurements for various applications. The vibration sensor provides a wide range of applicable uses that include performing micro-vibration measurements for structural vibration and seismic motion of buildings and bridges, and even the ability to use the sensor to detect human motion, etc.

Demonstration System Created for Kitakyushu Smart Community

Since FY2010, the Kitakyushu Smart Community Creation Project has been making advancements in its efforts to realize a low carbon society. Fuji Electric has provided various energy management systems (EMSs), smart meters and electric power storage systems. Smart communities started attracting attention following the Great East Japan Earthquake as a countermeasure against the tightness of electricity supply and demand. In addition, since FY2012, demonstration testing of Japan's first dynamic electricity pricing has begun, which varies electricity rates based on supply and demand conditions.

Demonstration results verified a 10 to 13% peak-cut performance while important data was acquired to analyze demand fluctuations caused by rate changes. In addition, demonstration tests have begun with verification to ensure power quality, supply and demand balance, etc. by using a regional EMS system to handle the challenges of power systems that rely on introduction of high penetrating renewable energy.

Fuji Electric will continue the tests until FY2014 to confirm the effectiveness of regional EMS while accumulating operational know-how and developing the business throughout Japan and overseas.