

Power Electronics Industry

Factory Automation
Process Automation
Information Solutions
Social Solutions
Field Services



In the power electronics industry segment, Fuji Electric has combined drive equipment, measurement instruments, and control equipment with artificial intelligence (AI) and the Internet of Things (IoT) to systematize them, providing solutions to support the advancement of digital transformation (DX). We thus contribute to automation, operational stability, and energy saving in the industrial, railway, and marine sectors.

Factory Automation

In the factory automation (FA) business, Fuji Electric has made contributions to automation, optimized operations at facilities, and energy saving by applying AI and IoT to drive equipment, such as inverters, servos, and rotating machines; measuring instrument, such as pressure transmitters and watt-hour meters; and control equipment, such as programmable controllers and programmable operator interfaces.

In the field of drive equipment, we have developed the “FRENIC-Ace (E3) Series” of high-performance, standard inverters equipped with an Ethernet interface, power cycle life diagnosis of insulated gate bipolar transistors (IGBTs), and a traceback function to contribute to the DX of FA systems.

In the field of measuring instruments, we have developed “S-Flow,” a palm-sized, clamp-on compact ultrasonic flowmeter for small-diameter pipes. When mounted, it does not need applying grease, allowing it to be installed even in clean environments such as semiconductor or food plants. We have also developed “HF Series” of flush-mount electronic watt-hour meters with a pulse output function, which contribute to the prevention of erroneous meter readings during electric rate transactions at commercial facilities and elsewhere.

In the field of control equipment, we have expanded our Abnormality Diagnosis Solution, which uses AI to detect and analyze processing abnormalities in the production process. We also developed a CPU module with a diagnostic function of the “SPH5000EC” Series for customers who require highly accurate diagnostic performance. In addition, we have developed the “MONITOUCH V10 Series” programmable operator interface, which delivers stress-free operation with re-

duced start-up time and no waiting time. Its compatibility with existing “MONITOUCH” facilitates equipment replacement.

Process Automation

In the process automation business, we offer reliable control of equipment, remote monitoring control, and anomaly sign detection by utilizing the know-how we have accumulated through a wide range of product line-ups and extensive delivery records.

In the field of drive control systems, we have developed and began application of a plant simulator that promotes DX in system verifications. In addition, in preparation for the replacement of DC motors, which were introduced to many steel rolling mills in Japan in the 1970s, we have added the new model to the existing product line. This is a DC-compatible induction motors with the same cooling system, mounting dimensions, and moment of inertia as the existing motors, which thereby reduces installation periods and costs.

In the field of process control systems, we have developed monitoring and control systems and an engineering support tool that allow customers to adopt new technologies to accelerate globalization and DX while maintaining system inheritability. We have also delivered our monitoring and control systems to small-scale wood biomass power plants and kiln waste heat generation facilities to contribute to the realization of a decarbonized society and to the safe and stable operation of customer plants.

Information Solutions

In the information solutions business, Fuji Electric is working to offer digital solutions and create new products. We are engaged in the information business through DX and carbon neutrality, including factory DX, new-normal offices, and digital transformation of government agencies.

For factory DX, we have developed manufacturing execution systems (MES) compliant with OPC UA, an open international standard designed for safe and reliable data exchange, enabling unitary management of production, inventory, and equipment data in the fac-

tory.

Social Solutions

In the social solutions business, Fuji Electric offers electric systems for railcars, ship and harbor systems, transportation equipment systems, and radiation management systems to contribute to safety, security, and energy saving of social infrastructures.

In the field of railways, New York City Transit's R211 cars started operations in March 2023 where Fuji Electric's door system is installed. As an approach for software development in this project, Fuji Electric, including overseas subsidiaries, received a certification of the Capacity Maturity Model Integration (CMMI) Level-2, the standard to evaluate maturity of organization and management. We are now working to maintain and improve the quality of our software.

In the field of ship and harbor systems, we have developed the onshore power supply system, which supplies the necessary power from land to the ship that docks and stops its engine in consideration of environmental improvement and CO₂ reduction, to contribute to the realization of a decarbonized society.

Field Services

In the field service business, Fuji Electric offers facility optimization solutions that utilize AI and IoT, in addition to conventional maintenance services such as periodic inspections and repairs.

To deliver predictive maintenance of switchboards, we have developed monitoring functions of partial discharge and local overheating in switchboards as part of the "Comprehensive Service for Smart Industrial Safety" we offer for customer equipment.

Factory Automation

1 "HF Series" Flush-Mount Electronic Watt-Hour Meters

Flush-mount mechanical watt-hour meters are typically used in buildings and commercial facilities, but they sometimes cause troubles, including billing issues due to erroneous meter readings and faulty wiring during installation. To address these problems, Fuji Electric has added a flush-mount model to the "HF Series" of electronic watt-hour meters. The main features are as follows:

- (1) Highly visible 6-digit digital display and built-in pulse transmitter to connect to data loggers help prevent erroneous meter readings.
- (2) Faulty wiring check assistance function prevents incorrect wiring.
- (3) Installation and wiring compatible with mechanical flush-mount watt-hour meters simplify replacement work.
- (4) The lineup is available in all four types of phase and wire systems, allowing it to be used for all watt-hour meters across an entire building.
- (5) Built-in battery allows measurement values to be checked even in the event of a power failure

Fig.1 "F7HF-RS23V" (3-phase 3-wire type with a pulse output function)

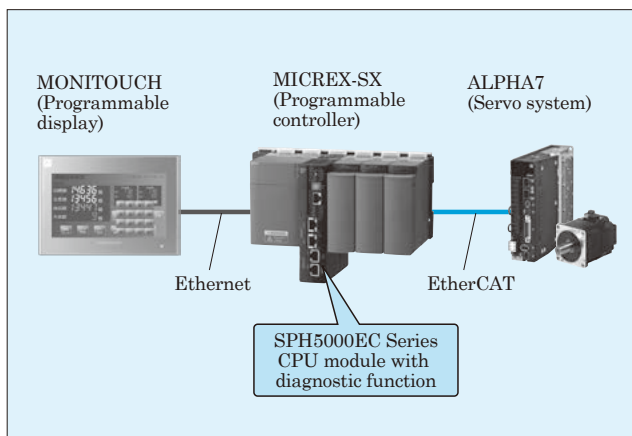


2 CPU Module with Diagnostic Function for the "SPH5000EC" Series

Machinery and equipment used in food packaging and metal processing are required to detect abnormalities in processed products and predict machine failures to stabilize and improve quality and improve operation rates. In response to these requirements, Fuji Electric has provided the "Abnormality Diagnosis Solution," which automatically detects abnormalities by utilizing analytics AI. This time, we have developed a module with a diagnostic function of which a single CPU can perform diagnosis and control designed for customers who require highly accurate diagnostic performance. The main features are as follows:

- (1) Capable of collecting data at a fastest cycle of 500 μs, allowing for very short time data change detection to improve the accuracy of abnormality detection.
- (2) Facilitates sensorless abnormality detection by aligning with the "ALPHA7" servo system and easy diagnosis results visualization by aligning with the "MONITOUCH" programmable display.

Fig.2 Example of the system configuration of a motion system



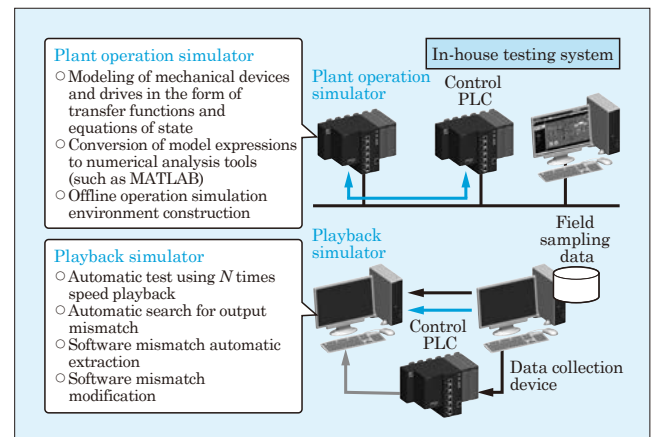
Process Automation

1 Plant Simulator for Industrial Plants with Motor Applications

For steel and non-ferrous metal plants and other industrial plants with motor applications, Fuji Electric has developed a plant simulator to debug control application software, increase on-site testing efficiency, and improve control system quality. The simulator enables even fine tuning of plants in a debugging environment by modeling mechanical plant devices, motors, and drive equipment and by creating a digital virtual plant. The main features are as follows:

- (1) Offline simulation of control conditions through the combination of a plant operation simulator with external numerical analysis tools, thereby improving software quality
- (2) A playback simulator verifies software execution using data from worksites to reduce on-site verification work, saving the software development period and costs.

Fig.3 Plant Simulator Overview

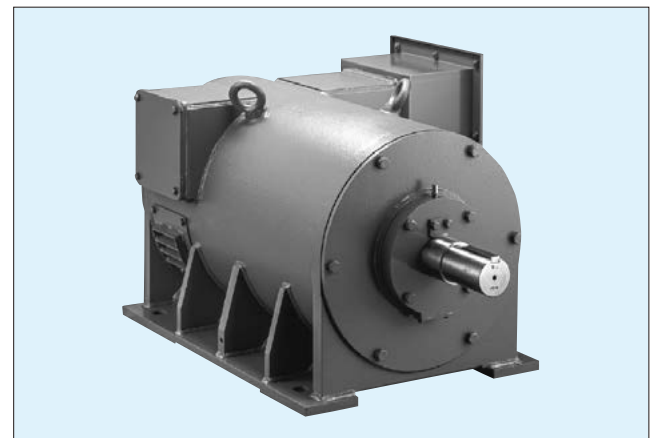


2 DC Commutator Machine Compatible Induction Motor

A number of special DC motors (800 line, 600 line) compliant with JEM 1109 were introduced to steel rolling mills in Japan in the 1970s. They are now due for replacement, but they have special dimensional specifications and unique cooling systems. To meet the demand for replacement, Fuji Electric has developed compatible induction motors and serialized all of them that are equivalent to the existing DC commutator machines with frame sizes of 802A to 818 and 620 to 624 and the "Low Inertia (D) Series." The main features are as follows:

- (1) Use of a cooling system equivalent to that of existing DC commutator machines (separately ventilated type) and matching of the interface dimensions of the motors saves the installation period and costs
- (2) With the same moment of inertia as that of existing DC commutator machines, it can be used for equipment that performs rapid acceleration and deceleration and frequent reversible operations.

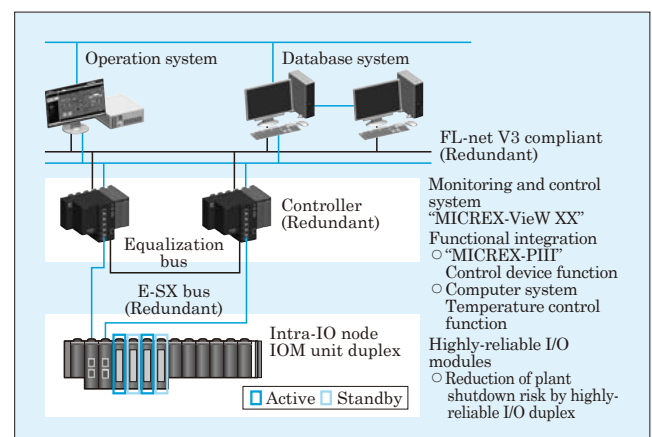
Fig.4 800/600 line-compatible induction motor for steel mill auxiliary



3 Replacement of the Monitoring and Control System for an Oxygen Production Plant

Fuji Electric has conducted replacement work on the monitoring control system of an oxygen production plant. The conventional system consisted of a mix of the "MICREX-AX" and the "MICREX-PIII," which have different architectures. In addition, the temperatures of some pieces of equipment were controlled separately by a computer system. This existing control system was entirely replaced by a new "MICREX-VieW XX" system and reliable I/O modules. The computer system was also integrated into the main control system to achieve a simple system configuration. In addition, the new system adopts a duplex configuration for both the monitoring and control system and the I/O modules to reduce the risk of plant shutdown. In the replacement work, we minimized the downtime of facilities by allowing the existing system to run in parallel with the new system during the changeover.

Fig.5 Monitoring and control system configuration



Process Automation

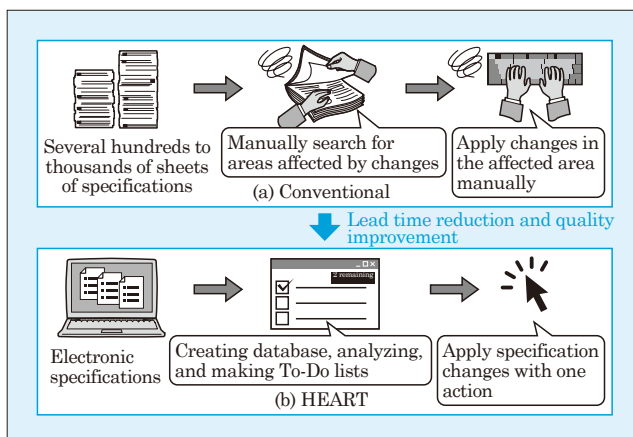
4 “HEART” High-Efficiency Engineering Support Tool to Accelerate DX

Specification changes in plant monitoring and control systems need manual work to search for changes to be made and reflect them, leading to challenges such as the prevention of quality degradation due to oversights and the reduction of work hours. To address these challenges, Fuji Electric has added following new functions to its “HEART” engineering support tool, which automatically generates controller software from control function specifications.

- (1) Creates a database of the software elements included in the specifications of the control function, analyzes areas affected by the changes in real time, and makes a To-Do list that indicates the areas to be changed
- (2) Jumping to the target specification page by clicking on a To-Do list item and checking the details before reflecting changes

These functions improve quality and shorten the work hours required when changes are made to specifications.

Fig.6 Using “HEART” to automate the reflection of changes in specifications

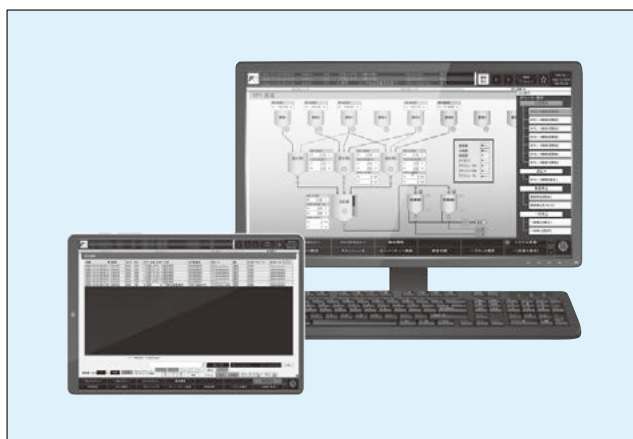


5 “MICREX-View FOCUS Evolution” Global Monitoring and Control System

In 1994, Fuji Electric launched the “MICREX-View FOCUS,” which is a monitoring and control system for small- and medium-scale plants. We have since delivered this product to many small- and medium-scale industrial plants in Japan. In December 2022, we developed and launched the “MICREX-View FOCUS Evolution,” which facilitates system construction, and to enhance its application in small- and medium-scale plants, including those outside Japan, we adopted the OPC UA international standard as a communication standard. The main features are as follows:

- (1) Easy engineering with drag and drop operations from catalogs in its tools.
- (2) Systems can be configured inexpensively through the use of general-purpose PCs and network equipment without using highly functional products such as SQL Server.
- (3) Duplex configuration is adopted for critical points such as controllers, system networks, and I/O buses to stable plant operation.

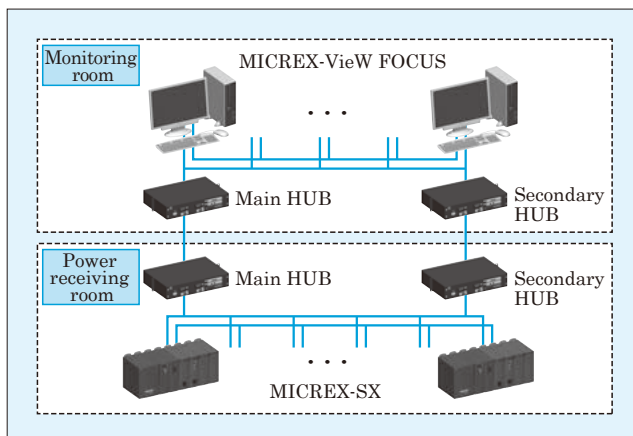
Fig.7 Graphic, alarm history screens examples



6 Replacement of the Supply Monitoring System for a City Gas Provider

Fuji Electric delivers remote monitoring and control systems to a number of gas suppliers who use them to provide a stable supply of city gas to factories and homes. In this project, we replaced an existing LNG satellite monitoring and control system including the “MICREX-View FOCUS” system delivered in 2005 with the new version system for a city gas provider. As it was necessary to monitor and control the plant equipment during the replacement period, we continued operating the existing system and started changing over the secondary system while keeping the main system active. As a result, we completed the replacement work without affecting plant operation. While both the shape and size of the symbols on the control screen remain the same as they were in the old system, the visibility of the screen and the processing speed have been improved in line with client PC updates, thereby improving operability for the customer.

Fig.8 Supply monitoring system configuration



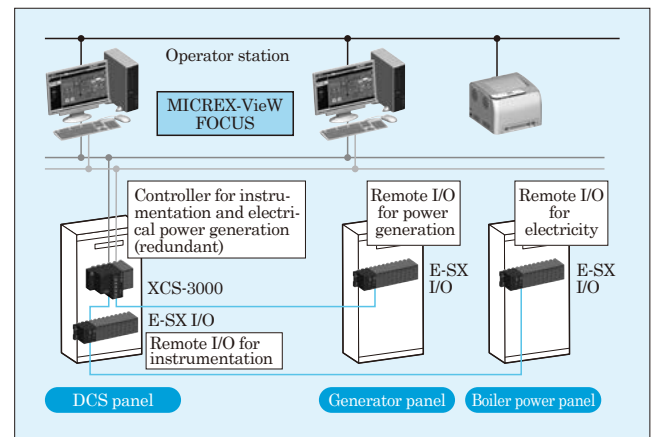
Process Automation

7 Monitoring and Control System for Small-Scale Wood Biomass Power Generation

The introduction of biomass power generation is progressing as part of efforts to realize a decarbonized society. Fuji Electric has developed a compact and highly functional monitoring and control system (DCS) for small wood biomass power plants of 2-MW class, which are expected to become more popular due to the low fuel security constraints. We have delivered this system to seven locations in Japan through plant manufacturers. The main features are as follows:

- (1) The integration of electrical, instrumentation, and power generation control into the monitoring and control system centralizes operations and reduces operator load.
- (2) A remote I/O system has downsized the control panels and saved wiring work.
- (3) Standard packaging of software through methods such as the integrated generation of operation screens and control logic reduces the price.

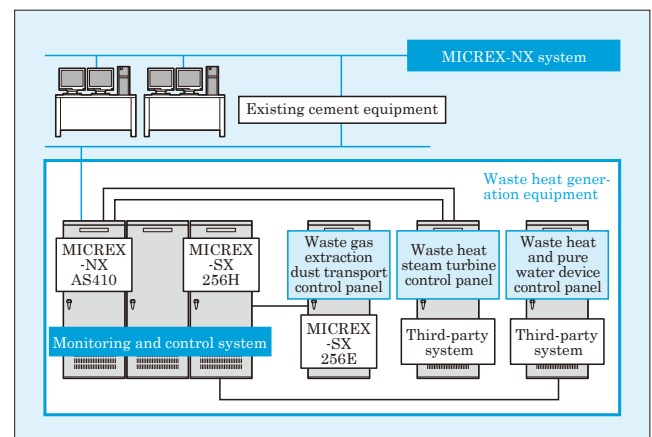
Fig.9 Monitoring and control system configuration



8 Delivery of a Monitoring and Control System for a Waste Heat Power Generation System

To reduce CO₂ emissions from cement facilities, Fuji Electric delivered a monitoring and control system for a kiln waste heat generation plant (rated output at generator terminal: 8 MW), which began operation in November 2022. In the kiln waste heat power generation plant, the heat of the gas discharged from the kiln combustion process of the existing cement facilities is recovered by the waste heat boiler equipment, and the steam generated by the heat is used in the turbine generator equipment to generate power. To reduce the burden on the operator accompanying the expansion, we added a waste heat monitoring and control function to the existing Fuji Electric “MICREX-NX System,” a cement equipment monitoring and control system, thereby maintaining the same monitoring and operability as the existing system. The operation of this equipment can reduce CO₂ emissions by approximately 23,000 tons per year. We will use this delivery of a waste heat generation system as a case study to continue contributing to the realization of a decarbonized society.

Fig.10 System configuration diagram

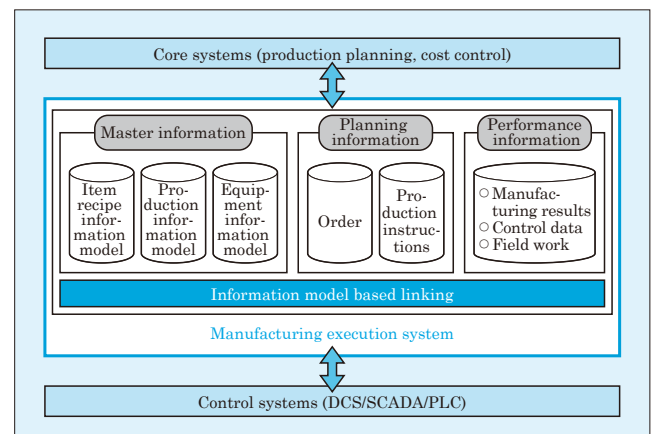


Information Solutions

1 Information Model-Based Manufacturing Execution System

To achieve factory DX, various types of field data must be collected, managed, and analyzed, then utilized for productivity improvement and quality control. For the integrated management of factory data, Fuji Electric has developed a manufacturing execution system based on an information model. The information model is a framework proposed by OPC UA to transfer information between systems. Based on this framework, we achieved unitary management of all factory data by linking together the master information (item recipes, production, and equipment), planning information, and performance information necessary for production. The adoption of an open architecture has made it easier to link information with external analysis tools and core systems, enabling the use of data to improve plant productivity and optimize production planning. We will continue to expand our capabilities and contribute to the realization of factory DX for our customers.

Fig.11 Manufacturing execution system configuration

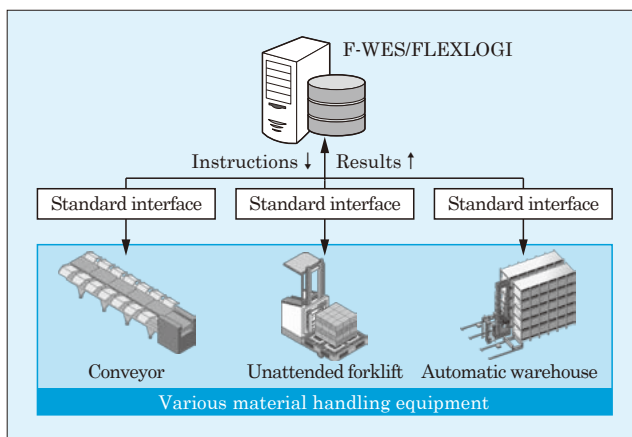


Information Solutions

2 “F-WES/FLEXLOGI” Standard Interface for Distribution Automation Equipment

Due to the labor shortage in recent years, the adoption of a diverse range of distribution automation (material handling) equipment has been increasing in the distribution industry to improve the efficiency of various operations. Fuji Electric has delivered the “F-WES/FLEXLOGI” warehouse management system to distribution centers and warehouses. However, the problem is that developing an interface for each piece of material handling equipment adopted increases the development period and cost, and also complicates the system. To address this problem, we have developed a standard interface that defines standard data linkage methods for each piece of material handling equipment, including conveyors and automatic warehouses. This interface makes it possible to link various types of material handling equipment to the warehouse operation management system without relying on the vendor of the material handling equipment. It also minimizes the development period and costs required for the adoption of systems. Furthermore, it unifies the data formats and operations associated with instructions to the material handling equipment, thereby supporting efficiency improvement through the adoption of material handling equipment.

Fig.12 Conceptual diagram of collaboration with various types of material handling



Social Solutions

1 Onshore Power Supply System

As a means of improving the environment and reducing CO₂ emissions in the ship and harbor system fields, onshore power supply systems have been attracting attention, which supply necessary power from land to ships that berth with the engine stopped. Fuji Electric has developed an onshore power supply system based on the “FRENIC-RHC-E Series” pulse width modulation converters. The main features are as follows:

- (1) Applicable to even a vulnerable power system of ports and ships because of the optimized design of harmonic filters to reduce the total harmonic current distortion THDi of the onshore system to 2.5% or less and the total harmonic voltage distortion THDv of the ship side system to 1% or less
- (2) Multiplex control to enable up to 4 parallel operations and accommodate a wide range of capacities up to 3 MVA. In the event of a converter failure, the system can disconnect only the corresponding converter to continue operation.

Fig.13 Pulse width modulation converter for onshore power supply systems



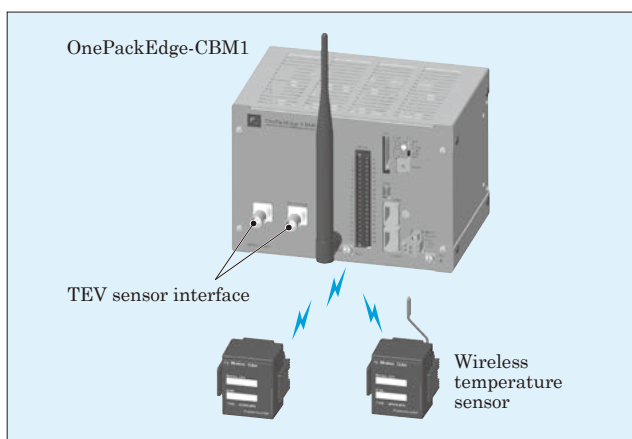
Field Services

1 Switchboard Deterioration Information Collection System for “Comprehensive Service for Smart Industrial Safety”

Maintenance including predictive maintenance is required to be more efficient by monitoring the deterioration trend of electrical equipment such as high-voltage switchboards. To address this demand, Fuji Electric offers the “Comprehensive Service for Smart Industrial Safety” to improve the efficiency of maintenance management through data collection, analysis, and diagnosis using IoT. As one of the functions to monitor switchboard deterioration, we have developed the “OnePackEdge-CBM1” information collection system, which monitors trends in partial discharge and local overheating. The main features are as follows:

- (1) Trends in partial discharge and deterioration can be monitored by connecting two TEV sensors for either indoor or outdoor use.
- (2) Up to 32 wireless temperature sensors can be installed on switchboard components, such as busbars and cables, to detect local overheating caused by looseness of conductor connections and other factors.

Fig.14 Switchboard deterioration information collection system for switchboards





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