

# Industry Solutions in Power Electronics Systems

Factory Automation  
Process Automation  
Environmental Solutions  
Instrumentation and Control  
Transportation Systems



## Outlook

Fuji Electric is committed to achieving further efficiency improvement, miniaturization and weight reduction based on power conversion technology in power electronics equipment and has been making contributions by applying them to various fields centering on society and industries.

### Factory Automation

In factory automation, we have commercialized the “FRENIC-HVAC PD Series” inverter that incorporate a commercial power selector switch to meet the rising demand for energy saving in office buildings and factories. This series can significantly save space because it incorporates peripheral circuits, which had been necessary at the time of introducing an inverter, and requires no control panel. We have also commercialized the “FRENIC-eRHR” and “FRENIC-eRHC” compact converters. They significantly save energy and space by returning regenerative energy to the power supply in elevators and other applications.

For motion systems, we have commercialized the “ALPHA7” servo system, various series of servo motors and the “SPH3000D” motion controller to cope with the sophistication of production facilities. In addition, we have commercialized the “ALPHA5 Smart Plus Series” servo system and the “SPF Series” compact controller to launch them on the Asian markets, where production efficiency improvement and labor cost increases have been advancing. For HMIs, we have commercialized the “TECHNOSHOT Series,” which places importance on visibility and external interfaces.

For rotating machines, we have commercialized motors that comply with overseas efficiency regulations including GB2 in China and EISA in the United States as efficiency regulations are increasingly being enforced globally.

### Process Automation

For process automation, we have been providing equipment and systems that can help production facilities to operate stably and reduce specific consumption. We have done this with drive control technology,

instrumentation and control technology, and industrial electric heating technology such as induction furnaces and melting furnaces as the core.

For the metal industry, we have delivered high-speed drive control systems to Indonesia and Turkey, which are expected to become central points of production for automobiles and household electrical appliances. In Japan, we have been expanding our business by providing monitoring control systems and industrial drive equipment with enhanced maintenance support and enhanced coordination with higher level systems while making effective use of existing software assets.

For the chemical and foods industry, as a result of diversification of consumer needs, there has been more construction of new manufacturing plants and greater modification of existing manufacturing plants for consumer market products. In these industries, the improvement of quality and manufacturing efficiency has been demanded more than ever, in addition to needs for high-mix low-volume production and stable operation. Fuji Electric has developed and started offering a system to predict abnormalities in a plant and notify the operators of them, in addition to the control technology it has cultivated until now. We are planning to add a function to notify operators of abnormality avoidance operations.

For the waste disposal industry, in addition to upgrading existing facility systems, there has been greater reconstruction as a result of deterioration of facilities and more construction of new facilities resulting from business integration. For upgrading, we make the maximum use of existing customer assets, such as application software. Meanwhile, for new facilities, we can optimize controllability in a way that applies our control know-how based on our abundant delivery track record. There is also a demand for reducing costs that are incurred for environmental measures such as for exhaust gas, and we provide solutions that combine gas analyzers with shorter response time.

For industrial electric heating industry, we have been expanding the application of induction heating by using the technologies of electromagnetic field analysis

and thermal analysis. From now on, we intend to expand power supply devices in higher frequency regions and apply them to new applications.

### Environmental Solutions

For environmental solutions, we have developed a “sludge-less wastewater treatment system” as a new biological treatment system for wastewater. This combines a magnetic separation device that magnetically separates sludge and *Bacillus* suitable for wastewater treatment and generates little excess sludge. This system does not require a settlement tank or a sludge dehydrator, thus making it possible to both save space while reducing the initial cost of equipment and running costs related to electricity and chemicals.

In the greenhouse horticulture industry, we have developed a high-eave greenhouse construction method that reduces construction materials and improves day-lighting performance and workability inside the facility. We have also developed a “CO<sub>2</sub> and heat supply system” that supplies CO<sub>2</sub> and heat for air conditioning by generating them from a single fuel. This system can reduce the running cost by about 30% compared with conventional equipment. The construction method and system are employed at the greenhouse horticulture of Salad Paprika Co.,Ltd.

### Instrumentation and Control

For instrumentation and control industry, we will provide measuring equipment and sensors that support systems as competitive components by defining their

applications and usage environment. We have launched a temperature controller for the plastic molding machine market in China, a safety standard-certified (SIL) pressure transmitter for petroleum and chemical plants, and an explosion-proof certified high-precision spool-type ultrasonic flowmeter. We have also expanded the functionality of the “FeMIEL2.0” wireless sensor network system for environmental information sensing that connects measuring equipment and sensor signals (temperature, humidity and analog output) to higher-level systems.

### Transportation Systems

For transportation systems, we have jointly developed with Central Japan Railway Company a main power converter that uses silicon carbide (SiC) power semiconductor modules for Tokaido Shinkansen trains. A prototype has been mounted on the N700-Series Tokaido Shinkansen train, and test running is being carried out. This is the first case in the world in which a SiC power semiconductor module was used for the propulsion system of a high-speed railroad. We have also developed a compact and lightweight auxiliary power unit by applying high-frequency resonance circuit technology. For door drive systems for rolling stock, we have delivered rack-and-pinion-type electrical driven doors with improved reliability and maintainability compared with conventional pneumatic doors. They were delivered to Yamanote Line mass-production trains of East Japan Railway Company (JR-East), and commercial service started in May 2017.

## Factory Automation

### 1 “FRENIC-eRHR” and “FRENIC-eRHC” Compact Converters

We have developed the following 2 series of regenerative converters that are more compact than conventional models: The “FRENIC-eRHR” and the “FRENIC-eRHC” PWM converter. The main features are as follows:

- (1) Using a regenerative converter for an inverter significantly improve energy saving and braking capacity.
- (2) Using a converter in place of a braking resistor or a braking unit make it possible to save space and reduce the generated losses.
- (3) FRENIC-eRHC can significantly reduce the harmonics current by PWM control, thereby allowing conversion coefficient  $K_i$  in the harmonics suppression measure guidelines to be zero by being combined with an inverter. In addition, because it can operate with a power factor of almost one, it can miniaturize power supply transformer capacity and equipment.

Fig.1 “RHR22C-2EJ” and “RHR30C-4EJ”



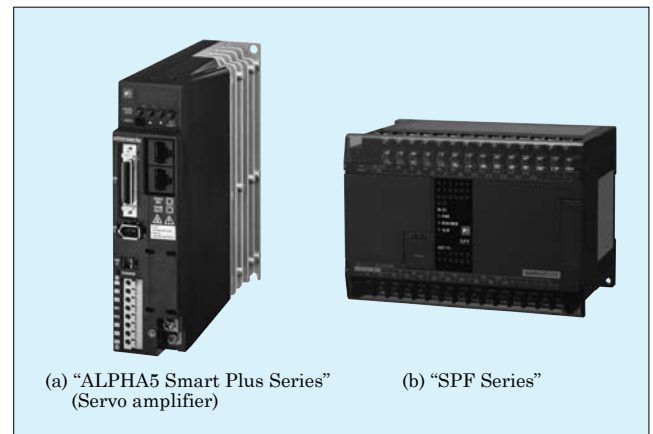
### 2 “ALPHA5 Smart Plus Series,” Servo System for Chinese and Asian Markets

In China and Asia, general-purpose interfaces using pulse train and analog signal are the mainstream in the control of processing machines, removal robots and packaging machines. Fuji Electric has developed the “ALPHA5 Smart Plus Series,” which was made by making additions and improvements to the control functions of the “ALPHA5 Smart Series,” which already has many track records. The main features are as follows:

- (1) Implementation of the dynamic brake function
- (2) Expansion of the single-phase input model (0.75 → 1.5 kW)

We have developed the compact controller “SPF Series,” which becomes suitable for the control of a small-scale system with four axes or less by combining with the ALPHA5 Smart Plus Series and expanded the number of I/Os to 512 words from 360 words.

Fig.2 “ALPHA5 Smart Plus Series” and “SPF Series”



### 3 “TECHNOSHOT Series” Programmable Operator Interface

Fuji Electric has launched the “TS2060” and “TS2060i” of the “TECHNOSHOT Series” programmable operator interface. The main features are as follows:

- (1) Improvement of viewability (number of display colors, luminance, angle of visibility and contrast) by using the 5.7-inch TFT color LCD
- (2) High-speed data communication with USB 2.0
- (3) Improvement of expression and data retention capacity by increasing screen data memory capacity and backup memory capacity\*
- (4) Support for a wide range of communications by Ethernet installed as a standard specification\*
- (5) Improvement of convenience for data utilization with SD card\*
- (6) Reuse of graphics applications of “UG221H” and “V806” reusable with upward compatibility

\*: TS2060i only

Fig.3 “TS2060i”



## Factory Automation

### 4 Motors Certified for Overseas High-Efficiency Regulations

Efficiency regulations for motors (3-phase induction motors) have been increasingly enforced in each country for energy saving and other purposes, and legislation and regulations have been accelerating in each country. Fuji Electric has developed high-efficiency motors that conform to the efficiency regulations of China, the United States and Canada and have acquired the following certifications:

(1) For China [0.75 to 375 kW (2-, 4- and 6-pole machines)]:

Grade GB2 (efficiency class IE3) of GB18613-2012, certification for the new China RoHS and CCC (applicable models only)

(2) For the United States and Canada [0.75 to 30 kW (2-, 4- and 6-pole machines)]:

EISA, EEAct (efficiency class IE3), safety standards UL and cUL

(3) For the United States [0.75 to 55 kW (2- and 4-pole machines)], [0.75 to 45 kW (6-pole machines)]:

EISA (efficiency class IE3)

Fig.4 Motor for China certified for grade GB2



## Process Automation

### 1 Electrical Equipment for Bar and Shape Rolling Mills

Fuji Electric has delivered electrical equipment for bar and shape rolling mills for a certain company in Indonesia. The latest control system achieved a high-performance and high-reliability system and improved added functions for maintainability and visualization of operation. The main features are as follows:

(1) We have developed a new 650-kVA product line of the "FRENIC4400 VM5R" 3-level inverter and used it for steel shearers. This reduced the overall capacity and realized cost savings and compactness.

(2) We have developed an operation monitoring function and a system with high maintainability, enabling stable operation.

- Remote monitoring and maintenance by HMI and loaders

- Utilization of operational data (current, voltage, speed and other data at any given time) of high-speed collection with "f(s)NISDAS 7"

Fig.5 Overall view of rolling mill line



### 2 "FRENIC4800" Drive for Reversing Mill at Nikko Works of Furukawa Electric Co., Ltd.

We have delivered a large-capacity water-cooling drive and synchronous motor for hot reversing mill at Nikko Works of Furukawa Electric Co., Ltd. The main features are as follows:

(1) Reduction of installation space by using a water cooling system (59% reduction compared with conventional products)

(2) Reduction of line harmonics by using a 3-level system (59% reduction compared with conventional products)

(3) Improvement of operability and visibility by using a new monitoring controller

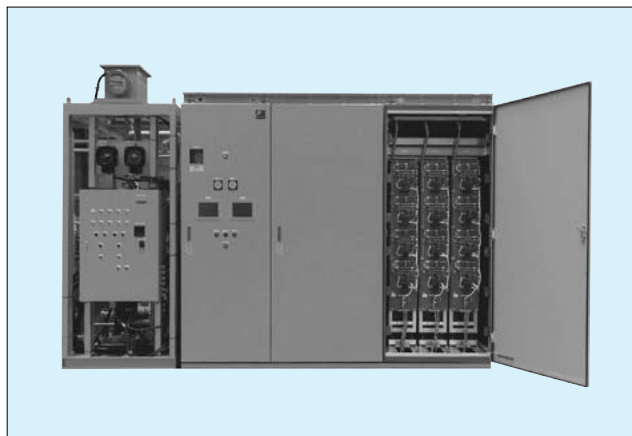
(4) The "FRENIC4800 CM6/VM6" large-capacity water-cooling drive

- Input: 3 $\phi$ , 3,000 V, 5,200 kW
- Output: 3 $\phi$ , 3,100 V, 6,200 kVA
- Overload capability: 150% for 1 min

(5) Synchronous motor

- Output: 2,800 kW, 160/320 min<sup>-1</sup>
- Overload capability: 225% for 1 min

Fig.6 "FRENIC4800 CM6/VM6"





## Process Automation

### 3 Electrical Equipment for Container Crane at Port

Fuji Electric has delivered a lot of electrical equipment to port container cranes all over the world. We completed installation of electrical equipment including the total control system of a container crane recently in Japan. The main sophisticated functions are as follows:

- (1) A stack-type PWM converter and a high-performance vector inverter are used as drive equipment for a port container crane to achieve space saving, for high-performance, higher reliability and improvement of maintenance.
- (2) This crane system is equipped with dedicated monitoring functions, such as observing crane status, managing cargo handling condition, detecting failure condition and trace back function, which achieve quick analysis and recovery of crane system.
- (3) The sophisticated anti-sway control system allows even a non-skilled operator to operate the crane easily and stably like an expert.

Fig.7 Overall view of container crane

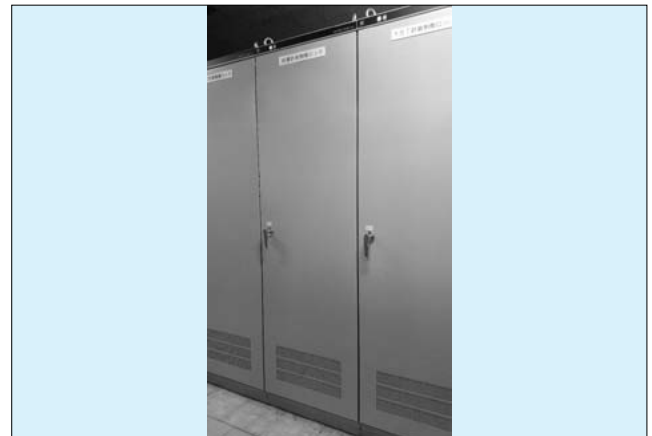


### 4 Replacement of Monitoring Control System for BT-CC Factory of Aichi Steel Corporation

When replacing aging equipment, manufacturers have recently been required to provide new added values while ensuring high quality and shortening the operational downtime. Fuji Electric has replaced the monitoring control system of the BT-CC factory of Aichi Steel Corporation. The main features of the new system are as follows:

- (1) Safe and secure operations on a higher level are achieved. For examples, a multi-window display and the easy-to-understand operation similar to that of general-purpose OSs cause efficient and easy plant operation, and the integration of alarms and operation logs enables speedy failure cause analysis.
- (2) High-quality and a quick start-up of the facility was achieved by conducting parallel run tests, that is, new operator stations and new controllers were connected to both the existing control LAN "DPCS-F" and the new control LAN (FL-net Ver. 3 compliant).

Fig.8 Monitoring control system

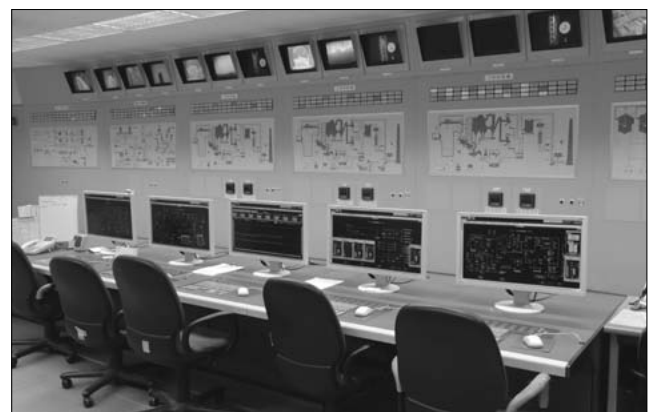


### 5 Replacement of Monitoring Control System for Waste Incineration Plants

Each municipality has been conducting large-scale renovations with the aim of having long-term operation of existing waste treatment facilities. Hence, monitoring control systems have been actively replaced as part of the renovation.

Fuji Electric has replaced the existing "MICREX-IX" system of the West Clean Center of the City of Kobe Environmental Bureau with the "MICREX-VieW XX," a latest monitoring control system. After the replacement, existing I/Os and PLCs are connected to the new system via network adapters. By reusing the existing assets, we ensured quality and shortened the upgrade period. Part of the equipment in the plant needed to perform monitoring control even during the replacement period. Therefore, we operated the new system and the existing system in parallel by leaving the existing "DPCS-F" control network operating until we switched them. Thus, we completed the replacement without affecting the operation of the plant.

Fig.9 Central control room of West Clean Center of City of Kobe Environmental Bureau



## Process Automation

### 6 Remote Monitoring and Cut-Off System for City Gas Utilities

Fuji Electric has been delivering remote monitoring and cut-off systems for medium- and low-pressure governors for city gas utilities in order to reduce damage in the event of an earthquake. We made a proposal based on the past track record and received an order for a remote monitoring and cut-off system for low-pressure governors from a certain gas utility. We newly developed a slave station communication device that uses the LTE lines, as required by the system. Demand for 2,000 units or more can be expected in the future. The main features are as follows:

- (1) Support for the LTE lines (Xi) of NTT Docomo Inc.
- (2) Installation in a wall-mounted panel [W500 × H600 (mm)]
- (3) Capability to back up the power supply for 24 hours or longer during a blackout
- (4) Adoption of firmware that allows the communication protocol to be changed
- (5) 8 analog inputs, 16 digital inputs and 4 digital outputs at the maximum

Fig.10 Example of installation of slave station communication device that supports LTE lines



### 7 Monitoring Control System for New Factory of Dow Corning Toray Co., Ltd.

Fuji Electric has delivered a monitoring control system that consists of the “MICREX-NX” distributed control system and field installed explosion-proof monitors for a new factory to be constructed in the Chiba area of Dow Corning Toray Co., Ltd.

Equipment subject to monitoring control consists of 3 tanks and 2 mixers, process in which require batch control. In the same year, at the customer's another factory, the existing monitoring control system manufactured by another manufacturer was replaced by our system including MICREX-NX. The existing server in the system, however, is continued to use and shared with the new system. Two operator stations were installed for this system. Two explosion-proof monitors were installed to perform monitoring and control in the field of the explosion-proof areas. This has enabled operators facing field equipment and tanks to perform monitoring and control safely using the five senses of people, for examples, grasping changes in the sound and smell.

Fig.11 Explosion-proof monitor

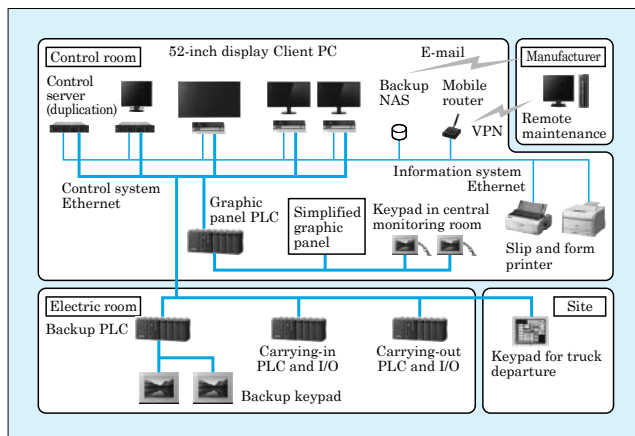


### 8 Monitoring Control System for Grain Silos

Since Japan is heavily dependent on import to meet the demand for grains for food and fertilizers, grain silos play an important role as an intermediate storage place for imported grains. Fuji Electric has developed a high-quality and high-functionality monitoring control system for grain silos with general-purpose SCADA and the “MICREX-SX” programmable controllers. The main features are as follows:

- (1) It can set multiple conveyance routes in advance and automatically select an optimum conveyance routes according to a grain brand and the condition of a grain silo.
- (2) By controlling the last transferred brand and air purge operation history, it prevents grains from being mixed up (contaminated).
- (3) It records the conveyance route up to a silo and the condition of control and generates history data for tracing grains.

Fig.12 System configuration diagram



## Process Automation

### 9 New Functions of “HEART” High-Efficiency Engineering Tool

The “HEART” is an engineering tool that can automatically generate control software from a control function specifications sheet prepared with Excel or Visio. It also allows users to monitor control state through that specifications sheet. Fuji Electric has recently developed the following new functions:

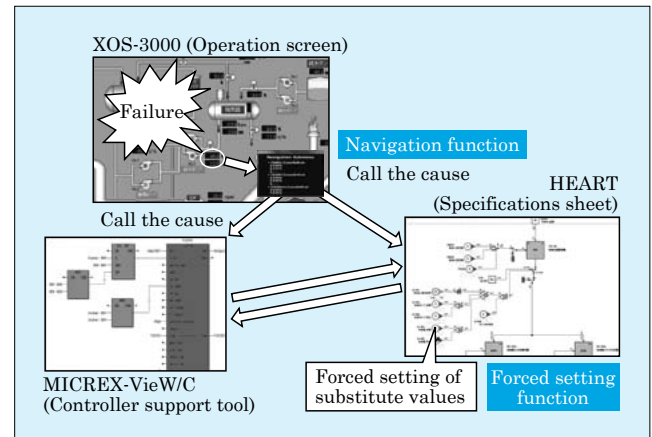
#### (1) Navigation

This makes it easy to trace the cause of a fault or an alarm from the operation screen in the event of trouble at the plant, allowing speedy action.

#### (2) Enforced setting

This is intended to avoid abnormalities temporarily or avoid secondary trouble in the event of a plant abnormality, a sensor failure or partial inspection of equipment. It allows operations to be continued using substitute values set by the user.

Fig.13 Navigation function and forced setting function



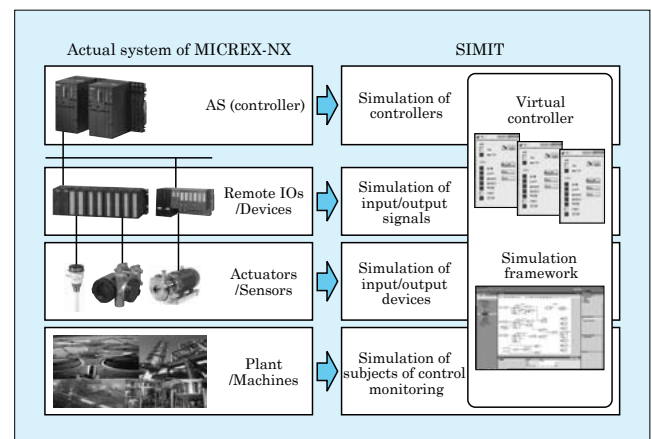
### 10 Integration of Plant Simulator SIMIT and “MICREX-NX”

Fuji Electric has started offering a digital engineering solution that enables integration between the “MICREX-NX” of DCS and SIMIT of plant simulator.

SIMIT is an engineering tool using simulation. It can create models of input and output devices, such as sensors and valves, and whole controlled object that includes plants and machinery and simulate them. In addition, combined with a virtual controller, SIMIT serves as a training system for operators.

Seamless integration of SIMIT and the MICREX-NX can realize improved quality of control programs and optimized plant operations using simulation.

Fig.14 Image of SIMIT system



### 11 Functional Expansion of “MICREX-VieW XX”

Fuji Electric has expanded the functionality of the “MICREX-VieW XX” plant monitoring control system. We have added a new system configuration to resolve the challenges of high-quality product manufacturing and the stabilization and efficiency improvement of operation by customers.

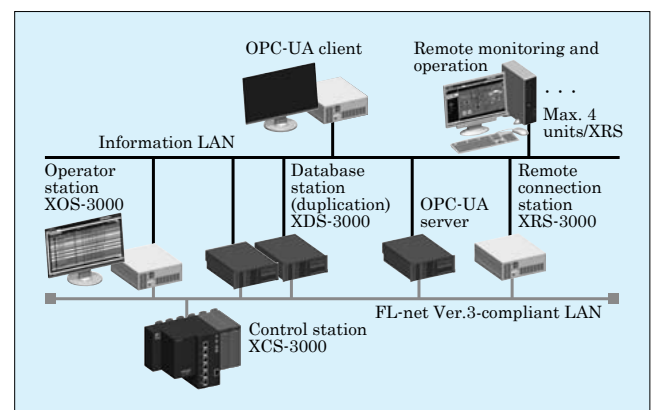
(1) We developed a remote connection station, which enables remote monitoring and operation from an office far from a manufacturing site, with the same screens and operability as those on the site.

(2) We developed an OPC-UA server, thereby ensuring high security that incorporates the latest communication technology and enabling flexible access to plant information.

MICREX-VieW XX has been continuously evolving with enhancing functions, such as with faster data collection and display processing, long-term storage of plant data, and security enhancement.

Reference: FUJI ELECTRIC REVIEW 2016, vol.62, no.3, p.186

Fig.15 Remote monitoring and operation and configuration of OPC-UA server

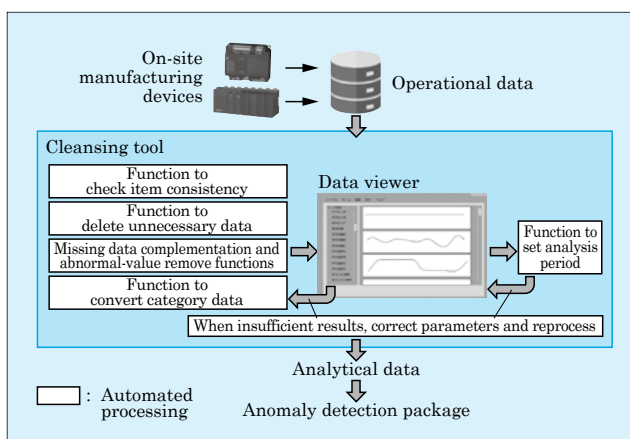


## Process Automation

### 12 Data Cleansing Tool for Anomaly Detection

Fuji Electric has developed a data cleansing tool that creates data for performing anomaly detection using a large amount of operational data obtained from equipment or a plant. In anomaly detection using multivariate statistical process control, it is essential to correct missing data and abnormal value or to remove data of equipment down period (data cleansing) to obtain a correct diagnosis result because they are contained in the data obtained but are not related to the diagnosis. This tool automates data cleansing that had been manually performed by in-house professionals, allowing it to be performed even without expertise. In addition, the graph drawing function that can instantaneously operate a million sets of data has improved the efficiency of the cleansing result check, which in particular used to take many man-hours. We performed an evaluation using actual data and obtained the result that the check can be performed with about one-fifth the man-hours of the previous work.

Fig.16 Automation by data cleansing tool



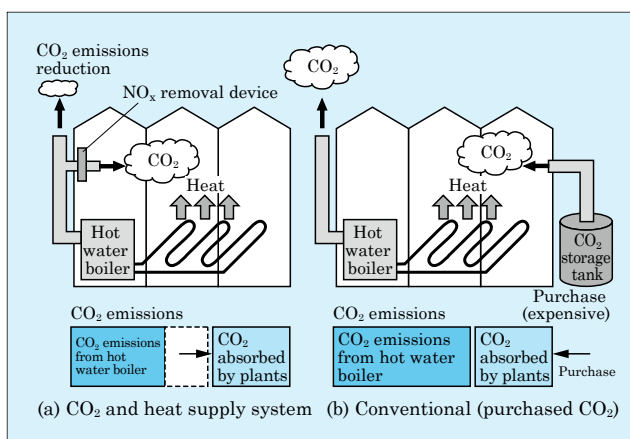
## Environmental Solutions

### 1 High-Eave Greenhouse Construction Method and “CO<sub>2</sub> and Heat Supply System” for Greenhouse Horticulture

Fuji Electric has developed a high-eave greenhouse construction method for greenhouse horticulture that complies with Japanese standards. The method uses technology developed in the Netherlands, which is an advanced country in this field. High height eaves and construction material reduction improved the daylighting performance and workability inside the facility. We have also developed a “CO<sub>2</sub> and heat supply system” that generates and supplies CO<sub>2</sub> and heat, which are indispensable for increasing the yield, from a single fuel. This system supplies both heat and CO<sub>2</sub> that is generated when a heater operates. Its operating cost is lower by 30% than that of the existing system that separately generate them. This also contributes to a reduction in environmental burden.

The construction method and system are employed at the greenhouse horticulture of Salad paprika Co., Ltd. and will be applied more widely.

Fig.17 Conceptual diagram of “CO<sub>2</sub> and heat supply system”



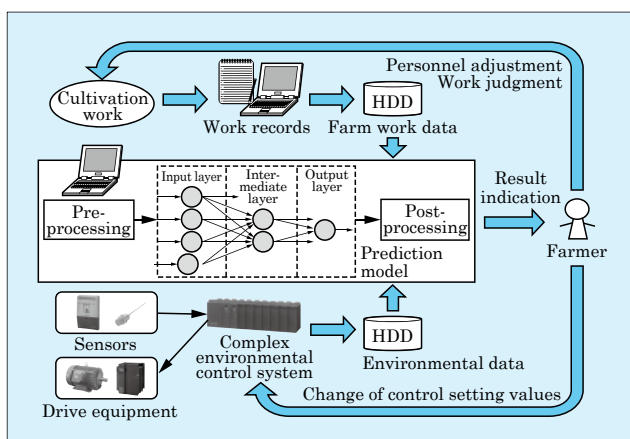
### 2 System for Predicting Production Process Data

Fuji Electric has developed a technology for predicting the yield of strawberries as one method to resolve issues in plant factories. It has achieved high prediction accuracy by performing machine learning based on the past environmental data and farm work data. In addition, this method eliminated the complex parameter setting that had been necessary for the conventional prediction method using mathematical formulas. As a result, man-hours are significantly reduced needed for adjusting the prediction model. By performing accurate daily yield prediction, this method makes it possible to predict both the amount to be shipped and the workload. Using the system allows a reduction in sales losses and improvement of profit by improving work efficiency.

The results of the demonstration experiment to predict short-term yield at “Tomato Farm,” a plant factory in Hokkaido, showed that the system achieved a prediction accuracy of 15% on average. We will try to improve the mid- and long-term prediction accuracy and aim to apply the system to other crops.

Reference: FUJI ELECTRIC REVIEW 2016, vol.62, no.3, p.160

Fig.18 Configuration of system for predicting production process data



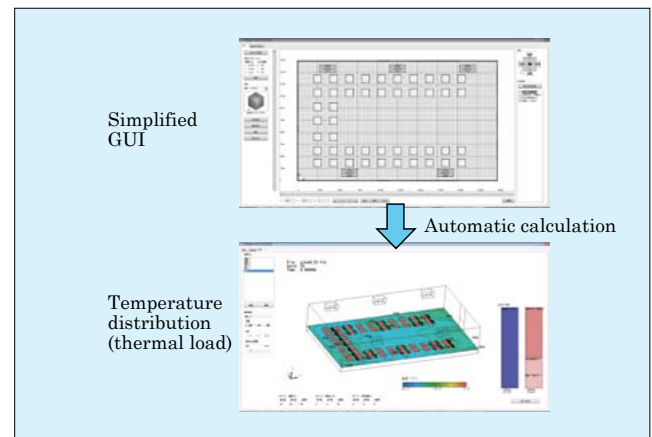


## Environmental Solutions

### 3 Design Simulation for Refrigerated Warehouse

Fuji Electric has developed an engineering tool that allows the arrangement and selection of indoor air-conditioning equipment, such as unit coolers and air curtains, to be designed in a short time and with high precision. It is intended for large-scale frozen and refrigerated facilities, such as refrigerated warehouses. This tool features an intuitive arrangement operation function using a simplified GUI for indoor air-conditioning equipment and the 3D analysis function of thermal load and temperature distribution in refrigerated warehouses by thermo-fluid analysis. In thermo-fluid analysis in particular, we developed new "pseudo-non-stationary calculation" that combines stationary calculation and non-stationary calculation. It can predict non-stationary events specific to refrigerated warehouses, such as door opening and closing, and realizes quick and high-precision analysis. This reduced the time for arranging and selecting indoor air-conditioning equipment by 20% and enabled designing with 15% better thermal load prediction accuracy.

Fig.19 Design simulation with engineering tool



## Instrumentation and Control

### 1 Temperature Controller "PXE5"

The temperature controllers of Fuji Electric, such as the high-quality and reasonably priced "PXF Series," have a track record of cumulative sales of 3 million units in the world. We launched the new "PXE5" for the plastic molding machine market in China in September 2016. The main features are as follows:

- (1) Two-degree-of-freedom PID control in addition to PID auto tuning and fuzzy control
- (2) Dual control with a single unit (for heating and cooling)
- (3) Shallow design with a depth of 62 mm and a thickness of the front indicator section of 1.6 mm
- (4) Front waterproof specification (NEMA4X)
- (5) Loader interface

Fig.20 "PXE5"



### 2 Zoning Air Curtain for Refrigerated Warehouses

In refrigerated warehouses, the amount of load fluctuates significantly, and if it is small, the warehouse generates an energy loss by cooling wasted space. Fuji Electric has developed a zoning air curtain that can save energy by changing the cooling area in accordance with the amount of load. The main features are as follows:

- (1) It allows temperature zoning that separates the temperature zone in a large space into two different zones by using only air flow.
- (2) It achieves energy saving by raising the set temperature for areas with no products.
- (3) The ceiling-mounted structure significantly reduces the risk of collision with forklifts.
- (4) By introducing the moving mechanism (optional), the area of the temperature zoning can be changed.

Fig.21 Zoning air curtain with moving mechanism



## Instrumentation and Control

### 3 Functional Safety Certified Pressure Transmitter

At petroleum and chemical plants, there has recently been increased demand for reliable safety systems that are operated in emergency, such as emergency shutdown systems and firefighting equipment; also, for system components, conformity to the functional safety standard IEC 61508 has been increasingly required. To comply with this standard, Fuji Electric has developed a pressure transmitter with a significantly enhanced self-diagnosis function and has obtained the certification. In addition, we improved performance and functions such as the world's top-class response time. The specifications are as follows:

(1) Functional safety standard certification (IEC 61508)

Hardware: SIL2; Software: SIL3

(2) High-speed response

Dead time: 40 ms; Output update period: 40 ms

(3) HART communication

Latest version 7

Fig.22 Functional safety certified pressure transmitter

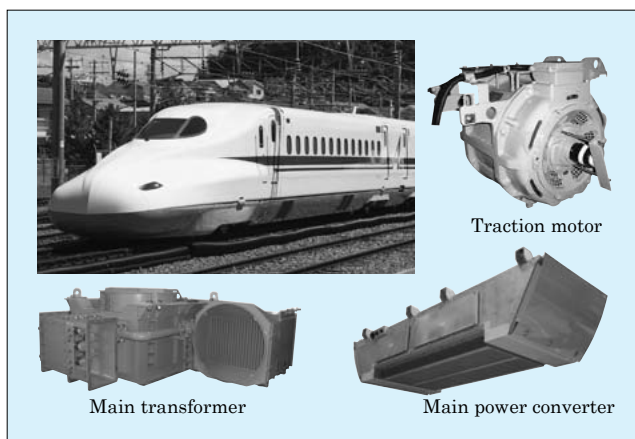


## Transportation Systems

### 1 Electrical Equipment for N700A Shinkansen Trains of Central Japan Railway Company

Since March 2017, Central Japan Railway Company has been introducing N700A Shinkansen trains (third train) that reflect the latest results of technology development. Fuji Electric has manufactured propulsion systems (main transformers, main power converters and traction motors) as electrical equipment for N700-Series and N700A Shinkansen trains. The systems are based on power electronics technology and system control technology, and we have been delivering them since April 2007. For the main converter, we have achieved low noise and high efficiency by adopting a running wind cooling system that does not use blowers. For N700A (third train), we have adopted an electric gate signal system and used stainless steel as the box material to achieve further compactness and light weight. This has helps to improve environmental performance and save energy. The main parts are shared with the N700 Series and N700A (first and second trains) to maintain product quality.

Fig.23 Electrical machinery product for N700A Shinkansen trains



### 2 High-Temperature-Resistant and Dust-Proof Auxiliary Power Unit for Rolling Stock

Fuji Electric has been distributing auxiliary power units for rolling stock in Japanese and overseas markets. We have recently developed an auxiliary power unit for electrical rolling stock that has high-temperature resistance and improved dust-proof performance.

The input voltage of the auxiliary power unit is 750 V DC (3rd rail). The output voltage and capacity of that are 400 V AC and 146.4 kVA for three-phase units, and 240 V AC and 3.6 kVA for single-phase units. The main features are as follows:

(1) By applying high-frequency resonance circuit technology and miniaturizing the insulation transformer, we have miniaturized and reduced the weight of the unit.

(2) By installing a heat exchanger in the equipment room and adopting a heat sink in which heat pipes are inserted to cool the elements, we have improved the cooling efficiency, so that the auxiliary power unit can cope with an outside air temperature of 65°C.

(3) By increasing the tightening force of the inspection cover to improve the air-tightness of the packing around the cover, the unit complies with the dust-proof and waterproof standard IP65.

Fig.24 High-temperature-compatible dust-proof auxiliary power unit for electrical rolling stock





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