AC-DC Power Supplies for Control Panels

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ABSTRACT

Control panels for social and industrial infrastructure are being required to use smaller power supplies to accommodate increasingly sophisticated and large-scale systems. Using industrial platform power supply technology, Fuji Electric has developed compact power supplies for control panels that incorporate redundancy functions to reduce wiring. This product makes it possible to mount a larger number of devices, thereby further contributing to sophistication and scalability of control panels. The unit comes with dedicated output terminals to ensure compatibility with existing control panels to facilitate replacement. We also provide a model that can operate maintenance-free for 10 years for users in various industries.

1. Introduction

Some social and industrial infrastructure systems require a high level of reliability to ensure they do not fail or accidentally shut down during operation. In such systems, power supplies, controllers and networks are configured in redundant. Moreover, control panels and their internal devices are required to be smaller, lighter and lower cost.

Fuji Electric has been working on size reduction and performance enhancement of the controllers and network devices used in control panels. With regard to power supply, however, we have conventionally used commercially available power supply units, circuit protectors (CPs) and redundant units and individually mounted them on DIN rails, occupying a large amount of space in the control panel. Moreover, many wires were used to connect the power supply units with the CPs and the redundant units, and therefore, there was room for improvement in terms of cost, quality and assembly time.

This paper describes AC-DC power supplies for control panels developed by Fuji Electric to solve this problem. The power supply integrates the functions of redundant units, which were external attachments in previous models.

2. Overview of AC-DC Power Supplies for Control Panels

Fuji Electric's control panels have been used in important industrial facilities such as steelworks, water treatment facilities and various types of plants in Japan and abroad for over 30 years.

The new power supplies for control panels developed for these facilities have achieved a reduction of volume by up to 50% by minimizing wiring with connector wiring and by adopting a rack mount structure, thereby enabling more devices to be mounted on the panel.

A line-up of three 24-V DC output models of 10 A, 20 A and 40 A is offered to meet the needs of increasingly sophisticated and larger-scale control panels.

Table 1 shows the general specifications of the power supplies for control panels, and Fig. 1 shows their external appearance. These power supplies receive a single-phase 100 to 120 V AC or 200 to 240 V AC and outputs 24 V DC used in the control panel. To meet the needs of the connected devices and their capacities, users can select from a line-up of 10-A, 20-A and 40-A models, all of which can be mounted on a 19-inch rack. These power supplies are compliant with the UL standard and CE marking, thereby enabling use in North America and Europe as well.

Figure 2 shows a block diagram of the 40-A model as an example of power supplies for control panels.

All models consist of a main circuit board for a platform power supply intended for industrial devices, as well as a DC/DC converter circuit board rated at 10 A. These power supplies can be equipped with a maximum of four 12-V or 24-V DC/DC converter circuit boards and have capacities of 600 W in output power. Any custom combination of DC/DC converter circuit boards can be mounted to match the power capacity of the device. One of these DC/DC converter circuit boards is used for the 10-A model, two are used for the 20-A model, and four are used for the 40-A model.

Furthermore, there is a built-in function for redundant power supply. This enables the transmission of alarm signals for power output errors and fan errors.

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Table 1 General specifications of power supplies for control panels

Item		Specification		
		10-A model	20-A model	40-A model
Input	Rating	100 to 120 V AC / 200 to 240 V AC, 50/60 Hz		
	Range	85 to 264 V AC, 47 to 63 Hz		
Output	Rated voltage	24.0 V DC*1		
	Rated current	10 A	20 A	40 A
	Peak current	13 A	26 A	52 A
Output hold time		20 ms		
Voltage sag Immunity		SEMI-F47 (200-V system input)		
Operating temperature range		−10°C to +55°C*2		
EMI		Class A (FCC, VCCI, CISPR, EN55022) compliant		
Protective function		Input overcurrent / Output overvoltage and overcurrent / Temperature		
External dimensions (mm)		W440.0 × H79.0 (2U) × D200.0		W440.0 × H132.5 (3U) × D200.0
Interface	Input	3 pins		
	Output 1	4 pins		
	Output 2	2 pins	None	
	Signal 1	2 pins		
	Signal 2	10 pins		
Noise (Reference value)*3		40 dB		46 dB
MTBF*4		200,000 hours or more		
Safety standard	Applied standard	CE marking, UL		
	Overvoltage Category*5	III		

*1 The 10-A model is equipped with an output voltage adjustment function.
*2 For the 40-A model, the current is derated at 50°C or higher.
*3 25°C, input voltage of 200 V AC, rated current
*4 Mean time between failures (MTBF)
*5 IEC 60664 (see *1 on p.32)

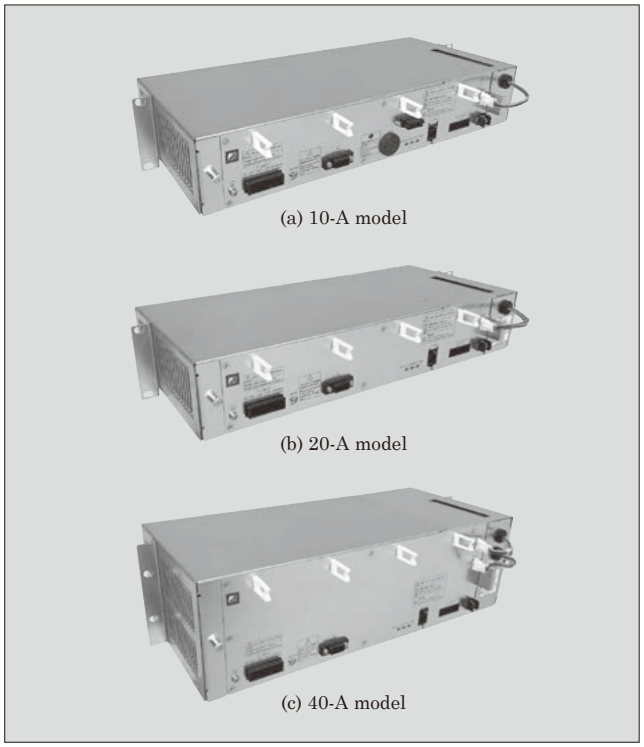

Fig.1 Power supplies for control panels

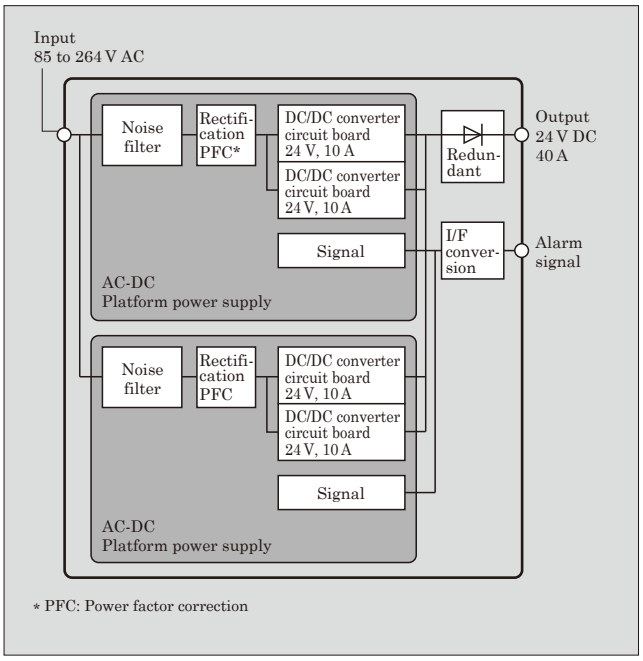

Fig.2 Block diagram for the 40-A model

3. Features

As recent control systems have become more complex and control panels are required to contain many control devices, Fuji Electric has significantly reduced the size of power supplies, which previously occupied a large amount of space, without sacrificing performance.

3.1 Size reduction with the use of a built-in redundancy function

As conventional power supplies contain a commercially available power supply unit, a CP and a redundant unit as shown in Fig. 3, they require a large installation area and many wires to connect the components.

The newly developed power supplies for control panels (the Power Supplies) contain every component, from the power supply unit to the redundant unit, shown in Fig. 3(b), all housed inside a single enclosure, as shown in Fig. 3(a). In addition to the reduction of the installation area as a result of this structure, the CP and wires have been reduced by integrating the CP functions into the overcurrent protection device or the breaker installed in the front stage of the Power Supply. Moreover, by employing a rack mount structure, the man-hours required for installation at the work site can also be reduced significantly.

3.2 Compliance with the overvoltage category suitable for control panel devices

This newly developed Power Supply unit, which is compliant with the Overvoltage Category III*1, can be directly connected to an input system to which high impulse voltages may be applied.

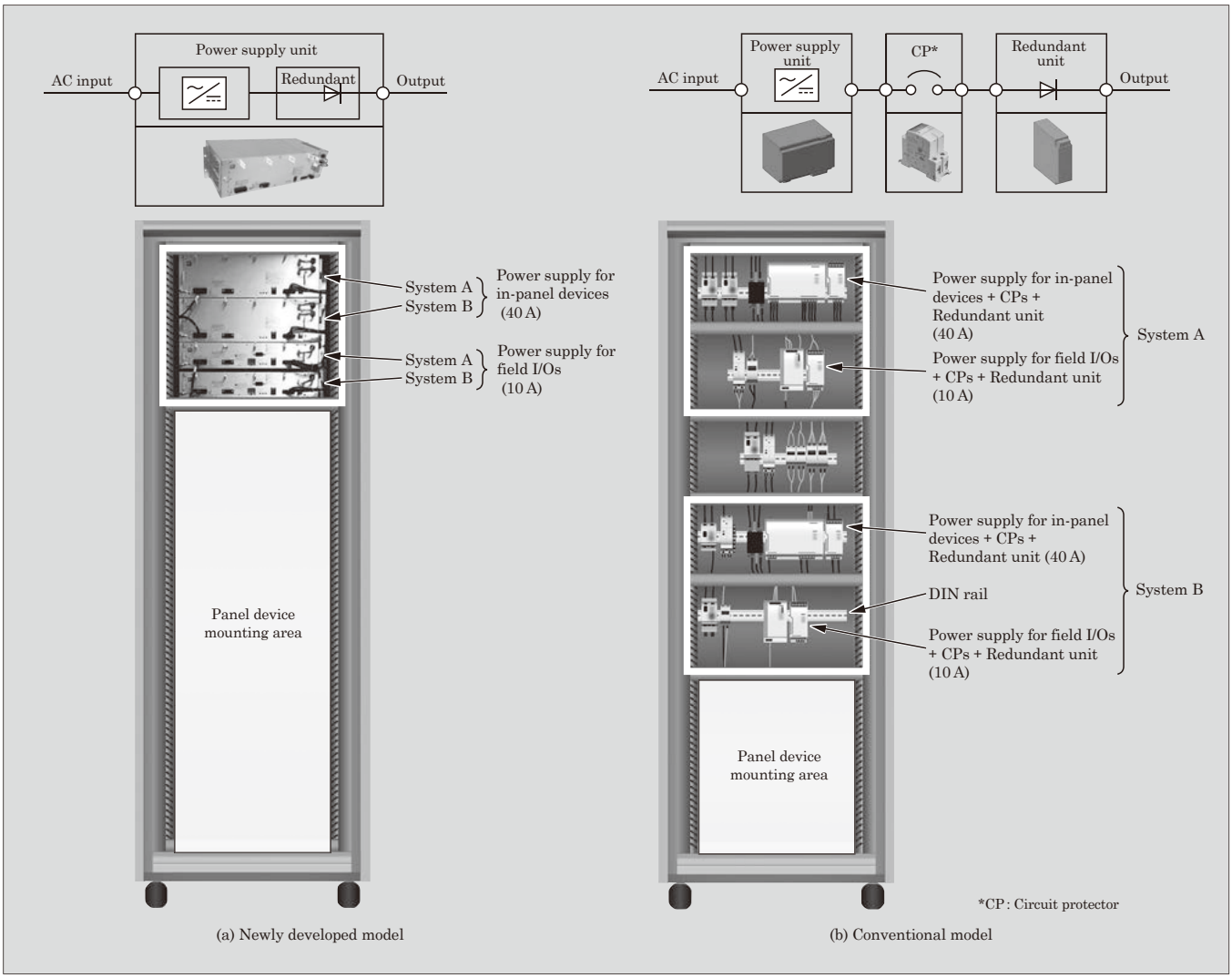

Fig.3 Power supplies for control panels and the spaces occupied by it (in bold outlines)

3.3 Maintenance-free support and audible noise suppression

In response to requests for a maintenance-free design, a model that eliminates the need for maintenance for 10 years by using long-life fans for forced air cooling has been included in the line-up. Moreover, the air filter and fan located at the air intake port are included as separate units to enable the user to perform cleaning and replacement with ease.

The Power Supplies have an MTBF*2 greater than or equal to that of a conventional power supply (power supply unit, CP and redundant unit).

In addition, the Power Supplies suppress excessive audible noise from the control panel during operation by monitoring the temperatures of the internal elements and controlling the rotational speed of the fan according to the surrounding air temperature and load factor.

3.4 Support for varied voltage and output before redundancy*3

The 10-A model serves as the field power supply for I/O units, which are field devices installed outside the control panel. As the wiring to the I/O units becomes longer, the voltage drop becomes larger. To

*1 Overvoltage Category: The impulse withstand voltage of devices is classified into four levels by the International Electrotechnical Commission (IEC). The devices applicable to Category III support an impulse withstand voltage of 4,000 V and are suitable for use on the load side of fixed-type equipment, including main electrical distribution switchboards.

*2 MTBF: Initialism for mean time between failures. MTBF is an indicator of system reliability and represents the mean time for continuous operation.

*3 Output before redundancy: Output of voltage from the DC/DC converter circuit board to the external redundancy function [see “Output 2” in Fig. 4(a)]

meet reliability requirements, this model is equipped with a voltage adjustment function to compensate for these voltage drops.

Some existing systems have a redundant unit installed outside the control panel. To allow this type of redundant unit to continue to be used after the renewal of the existing system, the Power Supplies provide two types of output, output 1 and output 2, as shown in Fig. 4, (a).

(1) When an internal redundant function is used: Output 1
(2) When an external redundant unit is used: Output 2

Figure 4, (b) shows a connection example for the use of a redundant unit installed outside the Power Supply when an existing panel is renewed.

3.5 Overload support

The DC/DC converter circuit board uses a current resonant circuit with high conversion efficiency, and a single board alone supplies a rated power of 240 W. It can withstand peak loads of 312 W (130%) for 3 seconds or 432 W (180%) for 0.1 seconds, allowing the Power Supplies not to only be used for controllers and other control devices, but also for applications that require instantaneous high power, such as solenoids and motors.

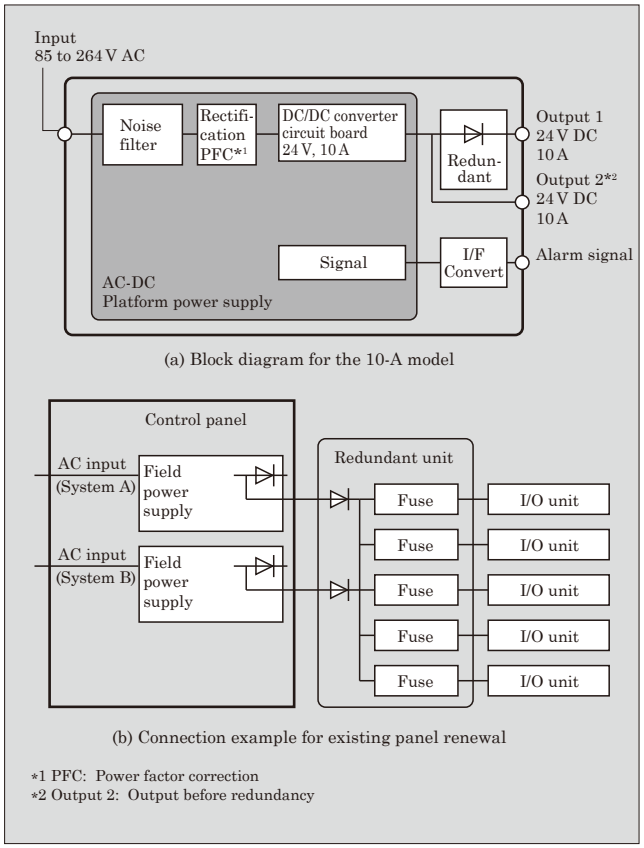

Fig.4 Block diagram and connection example for existing panel renewal

Table 2 Fields and control facilities

Field	Control facility
Steel making	○ Energy centers ○ Steelworks
Cement	○ Raw material mining plants ○ Cement plants
Energy	○ Thermal power plants ○ Geothermal power plants
Waste treatment	○ Garbage incinerator plants
Petroleum	○ Airport fueling facilities ○ Pipeline oil/gas transport facilities

4. Examples of Applications

Control panels equipped with the Power Supply can be used for various types of control facilities in a wide range of fields, as shown in Table 2.

(1) Application example 1: Major steel manufacturer

In steel mills, the Power Supplies are installed in the control panels of the converter equipment and the control systems for secondary refining and energy. While the number of control panels varies according to system scale, the reliability of the system is enhanced through redundancy configurations for the CPUs and power supplies. By using the Power Supplies, power supply redundancy can be established with ease.

(2) Application example 2: Aircraft fueling system

When renewing an existing DCS*4, the power supplies of the five control panels were replaced with the Power Supplies.

Since the Power Supplies are smaller than conventional ones, the DCS could be renewed without increasing the number of control panels, and the lead time from design to delivery was shortened as a result of reduced wiring.

5. Postscript

This document described a new type of AC-DC power supplies for control panels. The use of the AC-DC power supplies for control panels in industrial control equipment enables the building of highly reliable control systems easily, as well as the renewal of existing systems. Using this technology, Fuji Electric will continue to contribute to energy saving and stable operations in our society.

*4 DCS: Initialism for distributed control system. A DCS is a type of control system in which a control device is placed for each component that makes up the system, and the controlling devices are linked through a network.

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