"UPS7500WX" Large-Capacity Uninterruptible Power System

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The spread of cloud computing based information systems and e-commerce has led to an increasing number of data centers (DCs) around the world. In addition to providing Internet access, DCs are responsible for maintaining and operating servers that store critical information. Therefore, the power supply in DCs must be stable and continuous.

Fuji Electric provides comprehensive engineering services from design to operational support for all electrical equipment in DCs, contributing to stable power supply, energy saving, and space savings. One of the core pieces of equipment in DCs is an uninterruptible power system (UPS), which continues to supply power in the event of a power failure or other power supply problem.

In recent years, hyperscale DCs, which are increasingly being constructed mainly in North America and Asia, uses enormous amounts of electricity. This means that UPSs need to have a high capacity and save their energy consumption. Fuji Electric released the 1,000-kVA "UPS7400WX" in FY2018, which meets the safety standards of the North American market.

In this paper, we will describe the next generation model of the "UPS7400WX." That is the "UPS7500WX" large-capacity uninterruptible power system, which is developed based on platform technologies, such as power conversion circuits and parallel control of UPS modules.

1. Features

Our new UPS achieves the industry's highest level of power conversion efficiency by using a normal inverter feeding system. At the same time, it also uses a continuous commercial power feeding system, which Fuji Electric calls high efficiency (HE) mode. HE mode prioritizes power supply efficiency. It feeds power directly from the commercial power supply to the load when the commercial power supply is operating normally.

1.1 Improved single-unit capacity and space savings

Our newly developed UPS can expand from 600 kVA to 2,400 kVA per single unit by using up to four 600-kVA power conversion modules (W1,000 mm, D900 mm) in combination.

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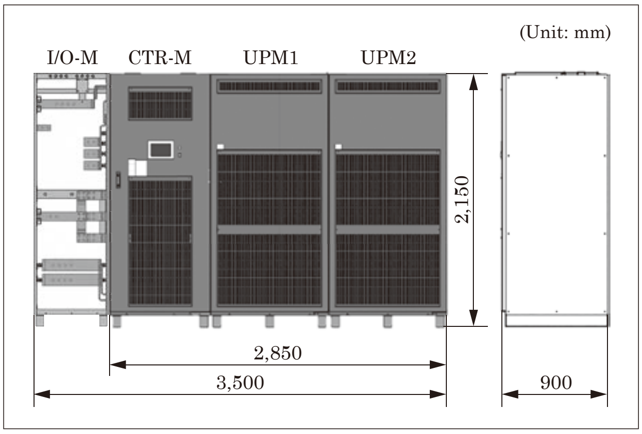

Fig.1 "UPS7500 WX" (400-V, 1,200-kVA model)

Figure 1 shows a 1,200-kVA system as an example. The basic configuration of the UPS consists of an input and output module (I/O-M) that connects the main circuit cables and control signal lines, a control module (CTR-M) that includes control units and internal bypass circuits, and a power conversion module (UPM) that integrates a rectifier and inverter.

The 1,200-kVA unit consists of one I/O-M, one CTR-M, and two UPMs. When installed side-by-side in the panel, it has a width of 3,500 mm and a depth of 900 mm, the smallest footprint in the industry.

The installation space can be saved further due to the elimination of the need for maintenance space on the left, right, and rear sides of the panel. Comprehensive design including peripheral panels can incorporate I/O-M functions into the peripheral panels, eliminating the use of the I/O-M. This allows the 1,200-kVA system to be configured with one CTR-M and two UPMs, reducing the width from 3,500 mm to 2,850 mm. Space-saving of UPS systems can expand the installation space for servers and other IT equipment.

1.2 Power supply system

Figure 2 shows the available internal bypass circuit of the UPS: the HE mode type [see Fig. 2(a)] and the hybrid mode type [see Fig. 2(b)]. The circuit configuration of the HE mode type consists of a series circuit of mechanical switches and thyristors through which a rated output current of the UPS continually flows. On the other hand, hybrid mode type, which was the mode available for conventional products, consists of a parallel circuit of mechanical switches and thyristors de-

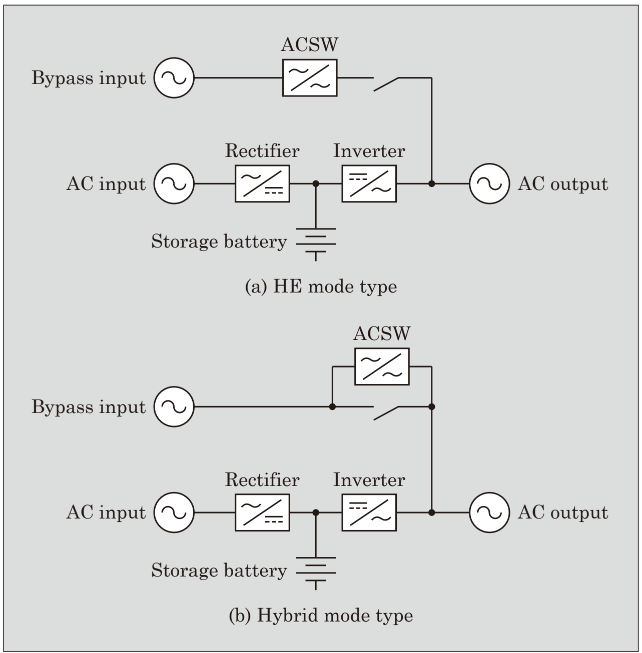

Fig.2 Power supply system

signed in the short-term current overload capacity area for uninterruptible switching.

HE mode uses a continuous commercial power feeding to prioritize the efficiency of normal power supply operations and achieve equipment efficiency of 98.4%. During this mode, the converters are in the following states:

(a) Deactivation of rectifier
(b) Active filter operation to improve inverter power factor and suppress harmonics
(c) Floating charge of storage batteries through inverse conversion from the inverter output side*

In the event that a bypass power failure or thyristor misfire is detected during HE mode, the system switches to inverter power supply within 2 ms.

Selecting the internal bypass circuit according to application enables the equipment to operate efficiently.

1.3 Optimal load operation function

A redundant system for high DC reliability causes the load factor of a UPS during normal operation to be in the range of 20% to 40%. Within that load factor range, compared with higher load factor range, the operation efficiency is too low. As shown in Fig. 3, the UPS has an optimal load operation function to improve the efficiency of the entire UPS system. When in low load operation, this function determines the load factor of each UPM and automatically stops unnecessary UPMs to reduce the number of units in operation.

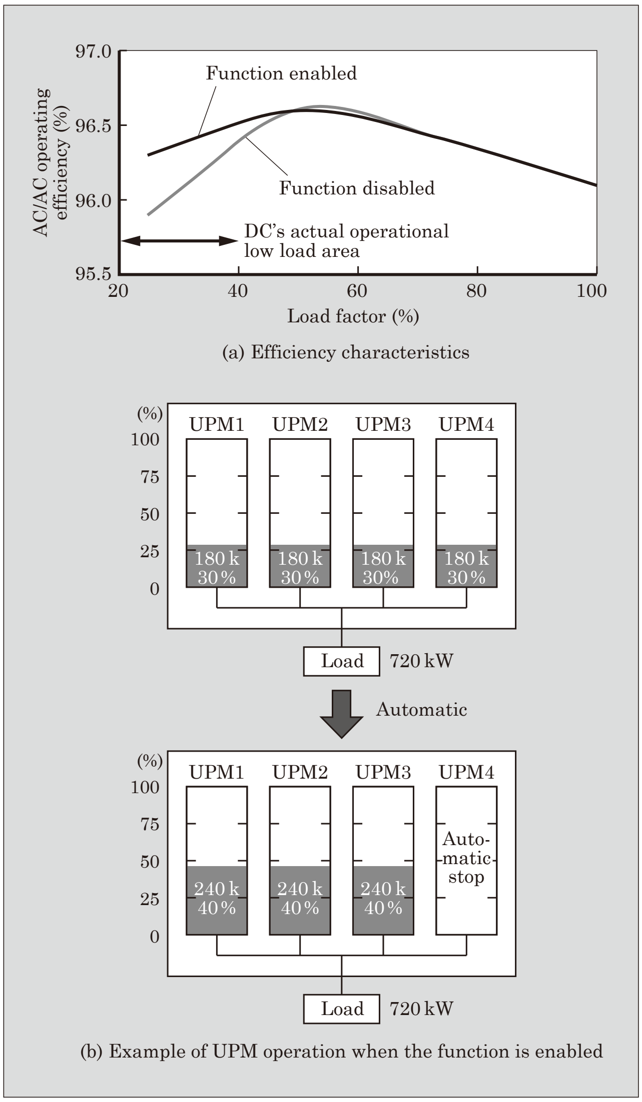

Fig.3 Improved UPS efficiency through optimal load operation function

1.4 Power regeneration function

UPSs delivered to a DC undergo certification tests performed by a consulting firm, including 8 hours of continuous operation at rated load and 30 minutes at overloaded operation. Conventionally, dummy loads necessary for such tests have to be prepared. In contrast, our newly developed UPS eliminates the need for dummy loads by using its power regeneration function. This makes field tests more efficient and energy-saving. The UPS's main features are as follows:

(1) As shown in Fig. 4, the test can be completed between UPSs connected in parallel. This eliminates the need for dummy loads and temporary cables.
(2) Conventionally, the power flowing through the dummy load is released as thermal energy. The UPS regenerates power during the test, allowing it to reduce the power consumption to the amount

* Floating charge: This refers to a method in which a load and a storage battery are connected in parallel to a power converter. It enables the storage battery to be charged while supplying power to the load by continuously applying a constant voltage.

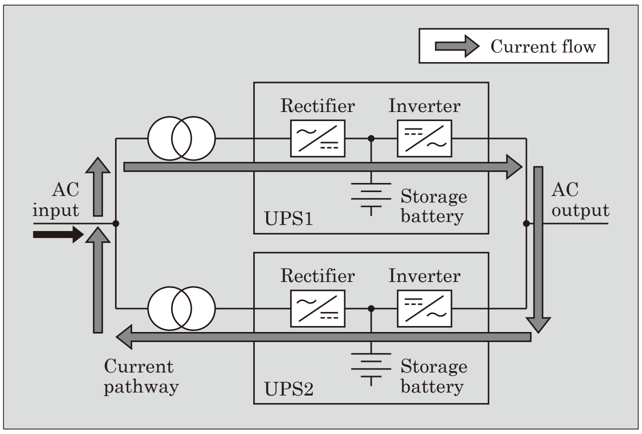

Fig.4 Example of using the power regeneration function

equivalent to the power loss of the UPS, which is 10% the power consumption of conventional systems.

1.5 High-reliability systemization

UPSs are often used as a redundant system combining multiple units to improve availability, which represent the percentage of utilization of systems and services. This ensures a stable power supply 24 hours a day, 365 days a year as a UPS system, not only during DC maintenance and operation, but also in the event of a failure of any single UPS.

1.6 Meeting global specifications

Conventionally, three-phase, three-wire UPSs have been dominant in Japan. In recent years, major overseas DC operators require vendors to adopt internationally standardized three-phase, four-wire systems when building DCs in Japan. To meet such requirement, our UPSs are also available in rated voltages of 380 to 420 V and three-phase, four-wire systems.

2. Specifications

Table 1 shows the basic specifications of the UPS7500WX (1,200-kVA model).

Table 1 "UPS7500WX" (1,200-kVA model) basic specifications

Item		Specifications
System		Normal inverter feeding system (VFI) HE mode or hybrid mode (VFD)
Rated capacity		1,200 kVA/1,200 kW
External dimensions		W3,500 × D900 × H2,050 (mm) (including I/O-M) W2,850 × D900 × H2,050 (mm) (not including I/O-M)
Highest equipment efficiency		96.6% (VFI), 98.4% (VFD)
Switchover time		Uninterruptible (VFI), <2 ms (VFD)
Mass		3,450 kg
AC input	No. of phases	Three-phase four-wire
	Voltage	380 V, 400 V, 415 V, 420 V
	Frequency	50/60 Hz
	Input power factor	0.99 (lag) or higher, 1.0 or below
	Input harmonic current	Less than 3% overall
Bypass input	No. of phases	Three-phase three-wire or three-phase four-wire
	Voltage	380 V, 400 V, 415 V, 420 V
DC input	Rated voltage	480 V
	Type	Lithium-ion batteries, lead-acid batteries
AC output	No. of phases	Three-phase three-wire or three-phase four-wire
	Voltage	380 V, 400 V, 415 V, 420 V
	Frequency	50/60 Hz
	Output load power factor	0.7 (lag) to 1.0
	Voltage accuracy	±1% or less (load balanced)
	Transient voltage regulation	±3% or less (sudden load change)
	Voltage distortion rate	2% or less (linear load) 2.5% or less (IEC 62040-3)
	Overload capability	125%: 10 minutes, 150%: 1 minute (At recommended temperature)
Environment	Ambient temperature	0°C to 40°C (recommended 25°C)
	Ambient humidity	5% to 95% (no condensation)
Communication protocol		Web/SNMP, MODBUS* RTU, MODBUS TCP/IP

* MODBUS is a trademark or registered trademark of Schneider Automation, Inc.

Launch Date

June 2021 (1,200-kVA model)
To be released sequentially (600-kVA, 1,800-kVA, 2,400-kVA models)

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