Basic Knowledge Regarding Uninterruptible Power Supply (UPS)

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1. Introduction

UPS is the abbreviation for Uninterruptible Power Supply, and is a device which supplies power to devices for a fixed amount of time without stopping even when there are problems occurring with utility power and other power sources.

In this present-day highly information-orientated society, the work tasks of many industries, including manufacturing, service and medical, operate on networks. For this reason, network system stoppages have an enormous impact on society and as such, the importance of UPS to provide these systems with a stable power supply is increasing.

This report provides basic knowledge such as the necessity, applications and systems of UPS, which is the flagship product of the Power Systems Division, including an introduction of Sanyo Denki's products, the "SANUPS" series.

2. Necessity

Japan's power situation is extremely stable and there are virtually no power outages or voltage abnormalities, however, regardless of the status of power supply and power transmission, power outages, voltage fluctuations, and the like can occur due to natural phenomena such as lightning or snow affecting power cables and the breakdown of power generation or power distribution equipment, therefore it is necessary for users to take appropriate measures or appropriate measures should be taken to load devices.

In particular, the impact of system stoppages and malfunctions on systems which utilize computers and networks is immeasurable. UPS is essential to avoid this kind of power trouble and enable the stable operation of systems.

Moreover, UPS enables power source management, such as the starting and stopping of network systems and the building of automated solutions.

Without UPS…
The system would stop on a fault. In the worst case, the system would be damaged and an enormous amount of money and time would be required for its restoration.

With UPS…
The power stored in the UPS's battery would be supplied, securing enough time to stop the system safely.

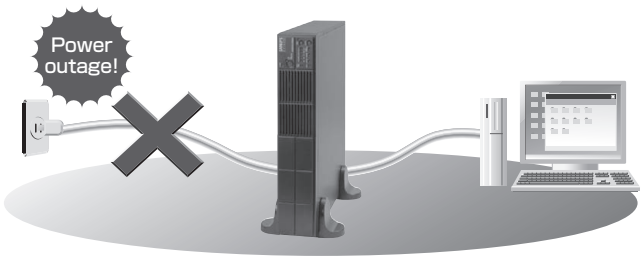

Fig. 1: Necessity of UPS

3. Applications and Role

When power failures such as power outages occur, computer devices such as servers and workstations may break down, leading to various problems such as the loss of important data and program malfunction.

Moreover, even a momentary voltage drop on factory production lines, can result in system stoppages, defective products, and in the worst-case scenario, damage to equipment.

These issues can be avoided by installing UPS in computers, network systems, production lines, and the like and it is also possible to operate systems with stability and efficiency using the various functions of the UPS. The following are the main applications.

3.1 Backup in the case of power outages/ momentary voltage drops

By connecting utility power to devices such as computers via a UPS, rather than directly, it is possible to supply stable power without fluctuation even if power outages or momentary voltage drops occur in utility power.

3.2 Power source management

(1) Automatic start-up/shutdown of computers

By combining UPS with power source management software, it is possible to properly shutdown computers and other devices connected to UPS in the event of a power outage.

Moreover, when the power has been restored, the computers which were automatically stopped when the power outage occurred can be automatically started up again.

(2) Scheduled operation

Scheduled operation of turning UPS output on and off is possible once a day.

(When UPS is off, computers will be automatically shut down).

Figure 2 gives an example of UPS system connection.

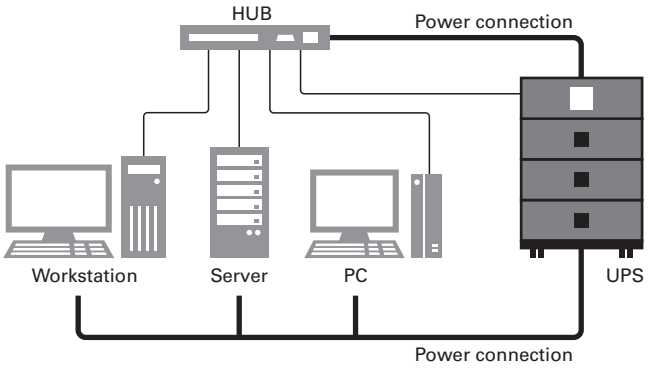

Fig. 2: An example of UPS system connection

4. Basic structure

UPS consists of the following circuits and the battery. In the event of a power outage or failure occurring in the AC input, the UPS continues supplying power from the batteries to the AC output.

(1) Rectifier: Circuit which converts AC power to DC power
(2) Inverter: Circuit which converts DC power to AC power
(3) Bypass: Circuit which directly outputs AC power
(4) Switch: Circuit which switches between inverter output and bypass output

Figure 3 shows the basic structure of UPS.

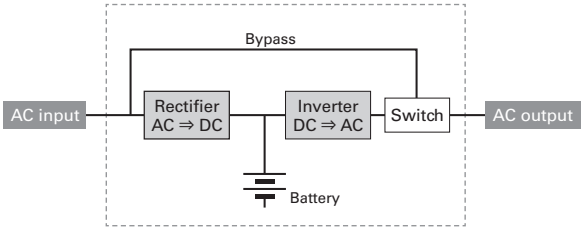

Fig. 3: Basic structure of UPS

5. Systems

5.1 UPS systems

This section gives an overview of the main UPS systems.

5.1.1 Online UPS

A system of supplying power by converting AC input (utility power) to DC and reconverting it to stable AC by the inverter while constantly charging the batteries.

Supplies power without momentary power breaks in the event of a power outage.

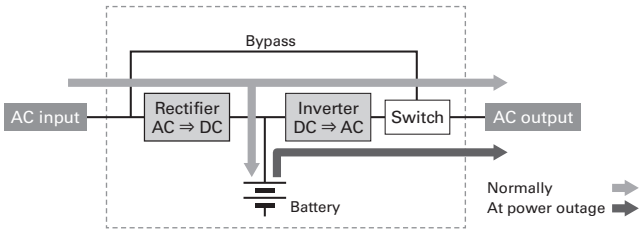

Fig. 4: Online UPS

5.1.2 Standby UPS

A system where, normally AC input (utility power) is output as is to connected devices and when a power outage or abnormal voltage is detected, inverter starts feeding using power from the batteries.

In the event of a power outage, a few milliseconds of momentary break occurs in AC output.

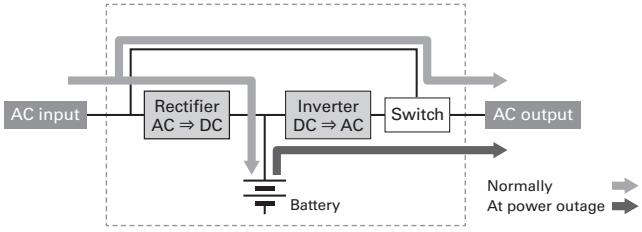

Fig. 5: Standby UPS

5.1.3 Parallel processing UPS

While power from AC input (utility power) is supplied, the bidirectional inverter connected in parallel corrects voltage and absorbs noise. Because this is the online inverter (parallel) system, it has both high efficiency and high reliability.

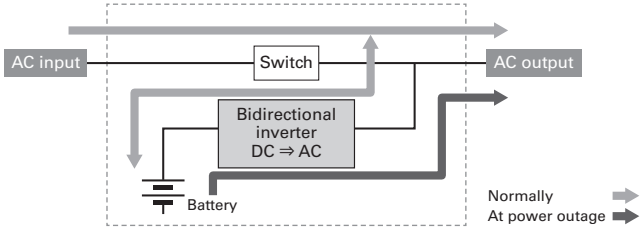

Fig. 6: Parallel processing UPS

5.1.4 Hybrid UPS

This system consists of three modes: double conversion mode, economy mode, and active filter mode. The UPS automatically selects the power feeding mode to best suit the power situation and load conditions. It is possible to shift between the respective modes with no momentary break in output voltage. Double conversion mode is selected when the power situation is poor and economy mode is selected when the power situation is good.

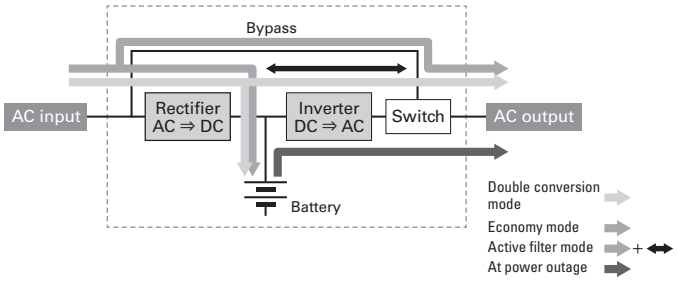

Fig. 7: Hybrid UPS

5.2 Parallel redundant operation system

Normally one unit operates in isolation, however by connecting two of the same units in parallel, it is possible to continue supplying power from one unit in the unlikely event that an error occurs on the other unit. This is referred to as the parallel redundant operation system. There will be a greater number of components than if only one UPS was used in isolation however reliability is notably improved based on the theory of a parallel system.

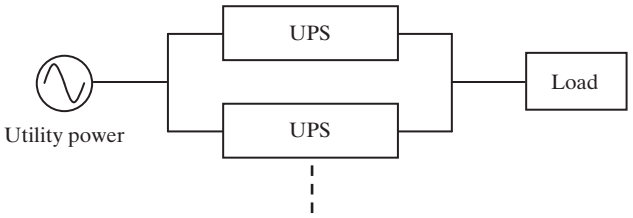

Fig. 8: Parallel redundant operation system

Table 1 gives a comparison of the various UPS systems.

Table 1: Comparison of UPS systems

System	Switchover time	Output voltage stability	Efficiency	Dimensions	Weight	Price	Main connected devices
Online	◎	◎	△	○	○	○	Server Workstation
Standby	△	○	◎	◎	○	◎	PC PC periphery devices
Parallel processing	◎	◎	◎	○	○	○	FA/industrial devices
Hybrid	◎	◎	◎	○	○	○	Server Workstation

6. Sanyo Denki's Lineup

Sanyo Denki offers a UPS lineup ranging from output capacities of 350 VA to 600 kVA with a focus on the online UPS.

Table 2 is a list of the products in this lineup.

The main markets are information, communication and industrial and there is a large supply among OEM products (customer brand products).

In order to increase power feeding reliability, we have many units which are standardly equipped with automatic battery testing and are able to be configured in parallel redundancy.

Options include an extra battery to extend battery retention time, as well as the power source management software, "SANUPS SOFTWARE" and "LAN Interface Card", which manage power source and monitor UPS status.

Figure 9 and Figure 10 show the "SANUPS A11K" 1kVA and "SANUPS E33A" 300 kVA, respectively.

Fig. 9: "SANUPS A11K" 1 kVA

Fig. 10: "SANUPS E33A" 300 kVA

Table 2: "SANUPS" series lineup

System	Series name	Output capacity (kVA)	Remarks
Online	A11K	1, 1.5, 2, 3, 5	Single phase
	A11J	5, 10, 15, 20,	Single phase, parallel redundancy
		15, 30, 45	Three phase, parallel redundancy
	ASE-H	1, 2, 3, 4, 5	Single phase, parallel redundancy
	A11G-Ni	1, 1.5	Single phase, nickel hydrogen battery
	A23C	30, 50, 75, 100, 150, 200, 300	Three phase
	RMA	50, 100	Three phase
	AMB	10, 15, 20	Three phase
	AMA W	20, 30	Three phase
Parallel processing	E23A	20, 50, 100, 200	Three phase
	E33A	100,200,300,400,500,600	Three phase, parallel redundancy
Hybrid	E11A	0.35, 0.75, 1, 1.5, 2, 3	Single phase

7. Conclusion

Moving forward, networks will undergo even further sophistication and play an even more important role in society. Moreover, with increased applications in a variety of environments, it is likely that the requirements for UPS will diversify.

By changing the backup battery from a lead battery to a lithium ion battery, which will grow in popularity, it will become possible to also apply UPS to peak-cut and peak shift.

We will continue to quickly develop products to meet these market demands and provide devices that fulfill our customers' needs.

Reference

Naohiko Shiokawa and Others: "Technologies Supporting Reliability of Power System Products" SANYO DENKI Technical Report No.36

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Joined Sanyo Denki in 1984.
Power Systems Division, 1st Design Dept.
Worked on the development and design of power supplies.