Development of Small-Capacity UPS "SANUPS A11F"

Yoshitsugu Kashiwagi Hiroshi Sakaba Kenji Ishiguro Kenichi Nakamura
Tetsuya Yamazaki

1. Introduction

In line with the rapid development of information technologies, the demand for greater reliability in servers, routers and other devices involved with network systems has surged. In addition to the reliability of these devices, the reliability of uninterruptible power supplies (hereafter referred to as “UPS”) that supply power to them has become extremely important.

In view of the need to promote environmental conservation, highly efficient products with low power consumption are also in great demand.

With these ideas in mind, Sanyo Denki has developed the "SANUPS A11F", a product whose primary mission is to provide a stable, reliable power supply, together with improving the ease of operation and maintenance, and enhancing cost performance.

This report outlines the development and functionality of this new product.

2. Development Background

Our conventional UPS models in the "SANUPS ASC" Series utilize the continuous inverter power supply model for supplying high-quality power. This product lineup includes units ranging from 1kVA to 5kVA, but the 1kVA to 3kVA class in particular has recently faced fierce cost competition. In view of global warming and other environmental issues, small-capacity UPS systems are also required to offer increased efficiency and eco-friendliness.

Upon its release, the "SANUPS ASE" Series offered 1kVA and 1.5kVA class devices, but the demand for new models with continuous inverter power supplies and superior, highly efficient performance in the 2kVA to 3kVA capacity range has also increased.

3. Features

3.1 Automatic Battery Checking

The "SANUPS A11F" is equipped with a function that automatically performs periodic checks on its batteries to make certain that they can supply sufficient backup power in the event of a power failure. Many cases have been reported in which batteries that had deteriorated failed to supply backup power during a power failure. Our intention is for this battery check function to reduce the likelihood of these problems, by detecting and reporting the age-related deterioration of batteries before it is too late. The frequency of routine checking can be scheduled every one, three, or six months, and disabled according to the user’s preference. (The factory default setting is six months.)

3.2 High Efficiency

The "SANUPS A11F" is able to provide highly efficient performance through the adoption of the 3–arm continuous inverter power supply system for its main circuit, technology that has proven effective in the "SANUPS ASE".

The overall efficiency, from AC input to overall output, has improved to 90% and 91% respectively for the 2kVA A11F202 model and the 3kVA A11F302, in comparison to other conventional models such as the "SANUPS ASC".

3.3 Synchronous Operation

Synchronous operation of up to five units by the use of communication cables is possible with the "SANUPS A11F". Activation and termination with different timings for output from each unit are also a possibility. This means that rush current can be prevented through time-differential activation, and servers and storage can be activated and terminated sequentially.

The "SANUPS A11F" is also equipped with a function for controlling output systems with just one unit, via the optional outlet box.

3.4 Simple Maintenance

The "SANUPS A11F" permits hot swapping since its batteries are organized in units and can be easily replaced from the front of the device. Batteries with a five-year lifespan were chosen to reduce the cost of battery replacement and other routine maintenance.

Furthermore, a maintenance bypass circuit has been included in the

Fig. 1: Battery Replacement

Fig. 3: Screen Shots from Power Supply Management Software

Fig. 2: Sample Installation

system as a standard feature to facilitate maintenance, unit and component replacement, and inspection.

3.5 Various Specifications for I/O Connection

Users can choose from the following two connection methods based on their power supply specifications and load devices. (Addressed at the time the order is placed)

(1) Plug / Outlet Type (NEMA L5-30)

(2) Terminal Stand Type

3.6 Reduced Weight, Rack-mountable

The total number of components in the "SANUPS A11F" system has been reduced, by eliminating some of the components used in the main circuit. The total weight of the unit has also been reduced, by approximately 30% for the "A11F202" (2kVA) and 24% for the "A11F302" (3kVA) over conventional "SANUPS ASC" models (19-inch rack-mount type), mainly by revising the unit's configuration and the number of its batteries

The "SANUPS A11F" Series is compatible with both vertical installation and 19-inch rack mounting (3U for 2kVA; 4U for 3kVA).

3.7 Network Compatibility

In a network environment, various types of communication need to be made with computers for UPS management.

For this purpose, the "SANUPS A11F" is equipped with RS-232C as a standard feature, previously only an option for conventional models ("SANUPS ASC"); additionally, the enclosed standard connection cables allow the use of the UPS services of Windows® NT and other operating systems.

The newly added ring signal transmission function supports personal computers with a "modem wake up" function.

The network environment can be controlled by the use of the optional LAN interface card together with our "SAN GUARD Ⅳ" UPS management software.

3.8 Wide I/O Range

I/O voltage can be selected from 100V, 110V, 115V or 120V to suit the specifications of the user's power source.

The range of input variation has expanded to 20% from the conventional 15%, lowering the frequency for switchover to battery operation.

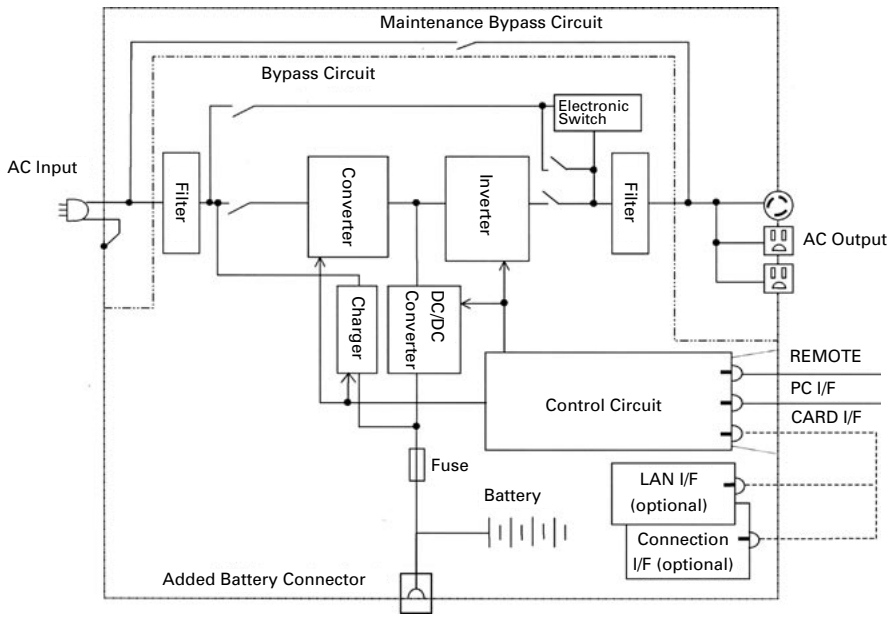

Fig. 4: Circuit Block Diagram

4. Circuit Structure

Fig. 4 shows the circuit block diagram for the "SANUPS A11F".

4.1 Main Circuit Structure

The "SANUPS A11F" is comprised of a high power factor converter, inverter, charger, output select switch, bypass circuit, and batteries.

(1) A three-arm continuous inverter power supply system has been adopted to enhance efficiency and to reduce the number of components.

(2) The size of the battery voltage has been reduced by the use of a high-frequency transformer.

4.2 Control Circuit Structure

The UPS is controlled by the DSP; the CPU manages sequence control.

(1) UPS control

Converter control, inverter control, battery voltage control and various monitoring and protective actions are performed by a single DSP, enabling the number of components in the control circuit to be reduced by about 60%.

(2) Sequence control

A status transition sequence has replaced the logic sequence that was previously used in conventional models for sequence control, reducing the required memory capacity by roughly 30% compared to conventional models, and enabling the incorporation of a more economical CPU to be.

4.3 Electric Properties

Table 1 shows the standard specifications for the UPS.

Table 1: "SANUPS A11F"Standard Specifications

Item			A11F202	A11F302	Notes
Output Capacity			**2kVA／1.4kW**	**3kVA／2.1kW**	
Cooling Method			Forced Air Cooling		
AC Input	Number of Phases		Single-phase, Two Lines		
	Voltage		Within +15% to -20% of 100, 110, 115 and 120V		Same as the output voltage The load ratio needs to be reduced to 80% when -20%
	Frequency		50Hz or 60Hz +/-1%, +/-3%, or +/-5%		The fluctuation range depends on the setting for output frequency accuracy.
	Required Capacity		1.8kVA	2.7kVA	
AC Output	Number of Phases		Single-phase, Two Lines		
	Voltage		100, 110, 115 and 120V		Settings are changeable
	Voltage Accuracy		Within +/-2% of rated voltage		
	Frequency		50Hz or 60Hz		Same as the input frequency
	Frequency Accuracy		Within +/-1%, 3%, or 5% of rated frequency (+/-3% at the time of shipment)		Settings are changeable.
	Voltage Waveform		Sine Wave		
	Distortion Ratio in Voltage Waveform		For linear load: 3% or less For wave rectifier load: 7% or less		
	Transient Voltage Fluctuation	During a sudden change in loads	Within +/-5% of rated voltage		
		During a power failure and resumption			
		During a sudden change in input voltage			
	Load Power Factor		0.7 (delay)		Fluctuation range: 0.7 to 1.0
	Over-current Protection Action		Automatic Switching to Bypass Circuit (auto-return)		
	Overload Capacity	Inverter	105%		200ms
		Bypass	200%		30 seconds
			800%		Two cycles
Battery	System		Sealed Lead Battery (Small)		Life expectancy: 5 years
	Rated Capacity		12Ah	17Ah	20-hour rate
	Number of Batteries		Five (@12V each)		
	Backup Time		10 minutes		25°C (default value)
Environmental Conditions	Ambient Temperatures: 0 to 40°C		Relative Humidity: 20 to 90%		Non-condensing
Noise			45dB or less		At 1m from the front of the device, A characteristics

5. Conclusion

Information technology (IT) is certain to play an increasingly important role in our everyday lives in the future, and at the same time increasing in overall social importance. In line with these trends, demands on UPS systems for higher reliability and more advanced functions at lower costs are likely to grow, along with the demand for small-capacity UPS systems.

The authors pledge to continue their efforts in the rapid development of products that respond to the needs of the market and satisfy our customers.

Finally, the authors are grateful for the cooperation and advice received from many supporters throughout the course of the development and commercial release of the SANUPS A11F.

Reference

(1) Wada, et al.: "Development of the Small-Capacity UPS SANUPS ASE"; SANYO DENKI Technical Report No.12

Yoshitsugu Kashiwagi
Joined Sanyo Denki in 1989
Power Systems Division, 2nd Design Department
Area of Expertise: Development and design of UPS systems

Hiroshi Sakaba
Joined Sanyo Denki in 1990
Power Systems Division, 2nd Design Department
Area of Expertise: Development and design of UPS systems

Kenji Ishiguro
Joined Sanyo Denki in 1996.
Power Systems Division, 2nd Design Department
Area of Expertise: Development and design of UPS systems

Kenichi Nakamura
Joined Sanyo Denki in 2002.
Power Systems Division, 2nd Design Department
Area of Expertise: Development and design of UPS systems

Tetsuya Yamazaki
Joined Sanyo Denki in 1983.
Power Systems Division, 2nd Design Department
Area of Expertise: Design of UPS systems