

# Development of the Small-Capacity UPS “SANUPS A11K” Series

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## 1. Introduction

In recent years advances of information and communications technology, the reliability of devices relating to network systems such as servers and routers and the maintenance management of stable operation are becoming extremely important. Also, as network systems increase in significance, the impact of the network system stop on society is increased. That is why there is a demand for the highly reliable uninterruptible power supplies (hereinafter “UPS”) that supply network systems with power.

Furthermore, the power supplies are expected to have even higher efficiency because more people are concerned with natural protection, especially with CO<sub>2</sub> reduction for the prevention of global warming.

This document introduces the small-capacity UPS “SANUPS A11K” that was developed to meet these demands.

## 2. Background of the Development

Sanyo Denki’s conventional model, the “SANUPS A11F” adopts an online UPS system to supply high quality power and has models of 1 kVA to 3 kVA in lineup, however the competition is extremely intense in this market and there is a need to enhance performance even further.

Moreover, due to issues such as global warming, highly efficient products which are thoughtful of the environment are sought.

In the 5 kVA output capacity class, our conventional model “SANUPS ASC” is available, however the design is outdated and there was an urgent need to develop a successor model.

This is the background of developing “SANUPS A11K”.

## 3. Product Features

For the “SANUPS A11K” we have prepared models with output capacities of 1 kVA, 1.5 kVA, 2 kVA, 3 kVA and 5 kVA.

Figures 1, 2 and 3 show the “SANUPS A11K” 1 kVA, 3 kVA and 5 kVA, respectively. (1.5 kVA and 2 kVA differ to 1 kVA only in depth.)



Fig. 1: “SANUPS A11K” 1 kVA



Fig. 2: “SANUPS A11K” 3 kVA



Fig. 3: “SANUPS A11K” 5 kVA

### 3.1 High efficiency

In the same way as the conventional models, these models adopt a 3-arm continuous inverter power supply system on their main circuits and achieve a maximum capacity of 92% or higher due to optimization of circuit components, artificial resonance of control power circuits and so on. This efficiency enables the device to reduce running costs and contribute to energy conservation.

Figure 4 shows the comparison data with conventional models.

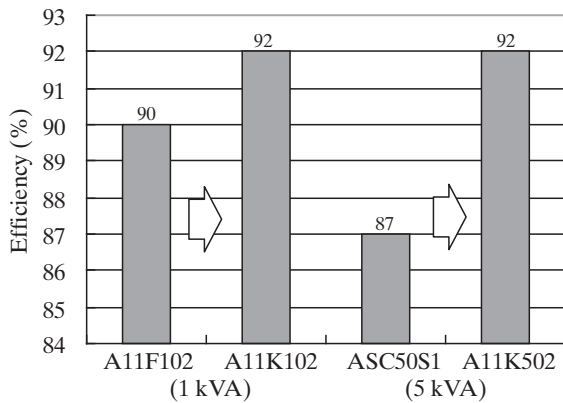


Fig. 4: Comparison of efficiency with conventional models

### 3.2 Wide range input

The allowable input voltage has a wide range of -20% to +20% rated voltage if the load factor exceeds 70% and -40% to +20% if the load factor is 70% or less.

The wide-range input reduces the frequency of changing to battery power feeding as well as minimizes battery wear and deterioration even in unstable power environments.

### 3.3 Improved environment resistance characteristics

The operating temperature range of -10°C to +55°C is wider than conventional models. (Operating temperature

range of conventional models is 0°C to 40°C)

This makes it possible to use the device in a wide range of temperature environments.

### 3.4 Improved maintainability

Through modularization of the inverter and battery sections, maintenance work such as the replacement of the inverter module has been simplified. Figure 5 shows a state with an inverter module and battery module installed.

Maintenance bypass circuits are equipped on all models and it makes possible to supply power from utility power even during module replacement.

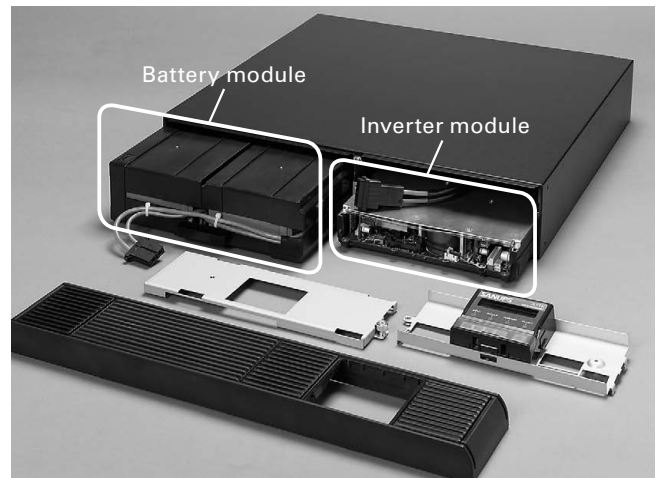


Fig. 5: Inverter module and battery module (1 kVA)

### 3.5 Battery management function

The new model features self-diagnosis functions such as an automatic battery operation test and battery life management in order to be capable of performing reliable backup of load devices during power outages. Furthermore, functions such as battery life warning, estimated battery operation time, battery charge percentage, and estimated backup time are included in order to improve reliability.

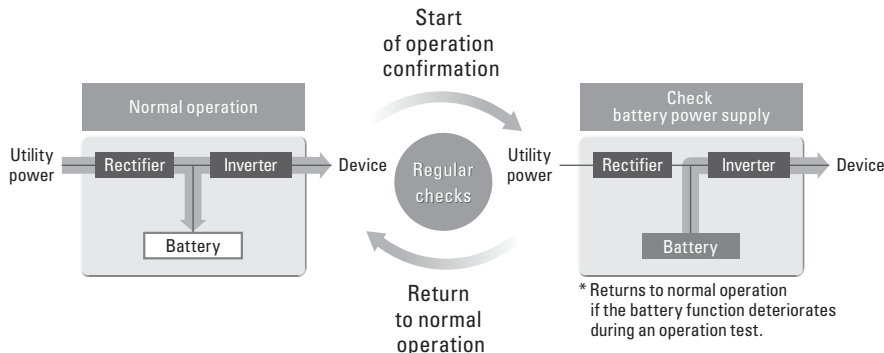


Fig. 6: Battery operation test

### 3.6 Downsizing

Compared with conventional models, the new model is downsized by up to 30% as a result of efforts such as making the battery charging/discharging circuit common and using surface-mounted devices. In addition, output power and battery backup time have been increased.

Table 1 shows a comparison with conventional models.

Table 1: Comparison with conventional models

Output capacity	Device model no.	Output power	Backup time	Volume comparison
1 kVA	A11K102 (New model)	800 W	13 min (when 700 W)	-1.1%
	A11F102 (Conventional model)	700 W	9 min (when 700 W)	-
1.5 kVA	A11K152 (New model)	1,200 W	12 min (when 1,050 W)	-12.3%
	A11F152 (Conventional model)	1,050 W	7 min (when 1,050 W)	-
2 kVA	A11K202 (New model)	1,600 W	10 min (when 1,400 W)	-30.0%
	A11F202 (Conventional model)	1,400 W	10 min (when 1,400 W)	-
3 kVA	A11K302 (New model)	2,400 W	10 min (when 2,100 W)	-26.4%
	A11F302 (Conventional model)	2,100 W	10 min (when 2,100 W)	-
5 kVA	A11K502 (New model)	4,000 W	10 min (when 3,500 W)	-28.4%
	ASC50S1 (Conventional model)	3,500 W	10 min (when 3,500 W)	-

### 3.7 Improvement of functionality

User operability and visibility have been improved by implementing an LCD panel on the operation area. By modularization of the operation area, it is possible to change the direction to one which enables easy operations depending on whether the device is stored vertically or horizontally.

Moreover, in addition to the conventional RS-232C communication interface, the model is standard equipped with a USB connector and can be connected with a PC via a commercially-sold USB, making it possible to use UPS management software.

## 4. Circuit Configuration

Figure 7 shows the UPS circuit block diagram.

### 4.1 Main circuit configuration

This UPS is configured from a rectifier, inverter, DC/DC convertor, bypass circuit, battery and so on.

- (1) Improved motor efficiency through the adoption of a 3-arm continuous inverter power supply system.
- (2) Reduced number of components and achieved downsizing through the adoption of a DC/DC convertor which makes the battery charging/discharging circuit common.

### 4.2 Control circuit configuration

This UPS has successfully reduced the mounting surface by designing the control circuit components to be surface-mounted. Moreover, the hardware of this model is slimmed down by integrating the sequence control, converter control, inverter control and battery charging/discharging control on one CPU.

High efficiency of the control power circuit is achieved by adopting the artificial resonance RCC system.

Moreover, by featuring an auxiliary control power circuit it has become possible to continue supplying power from utility power circuit by using the bypass circuit even if an error occurs in the control power.

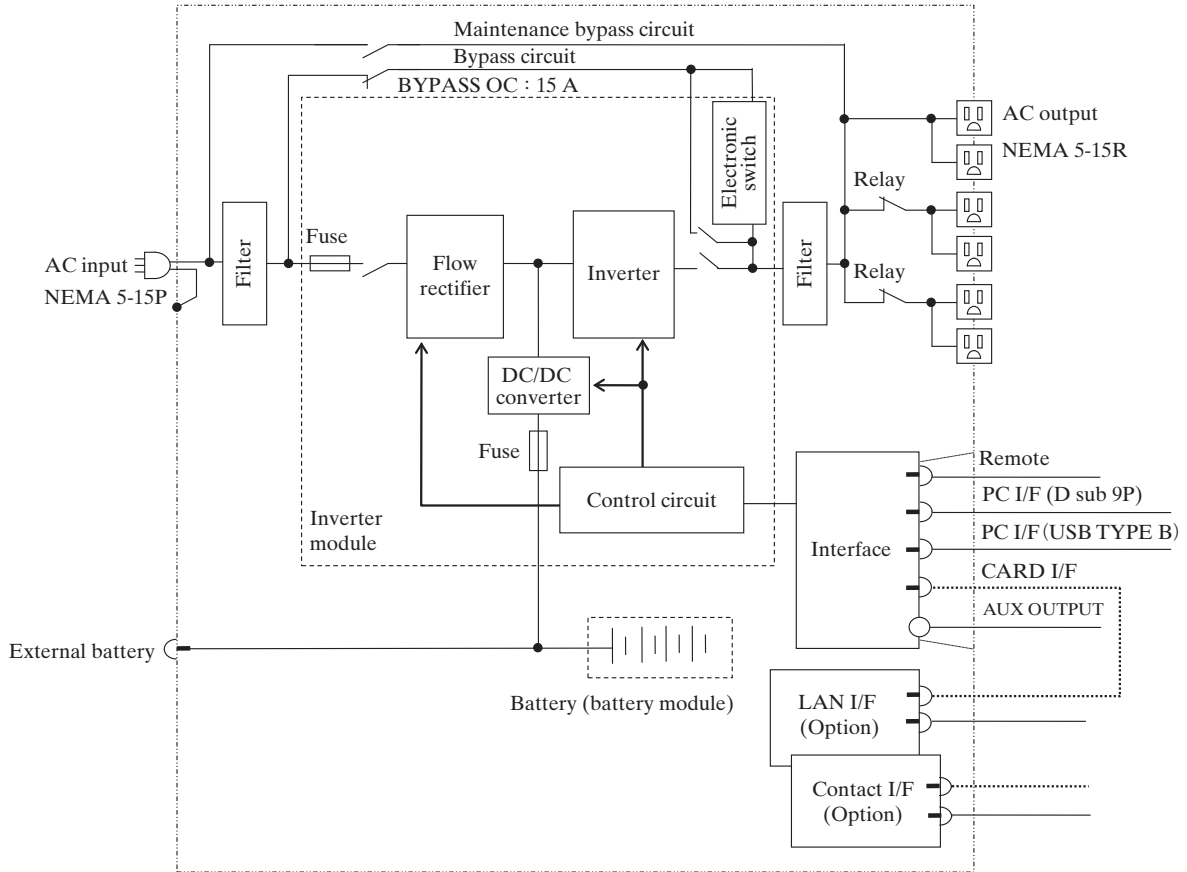


Fig. 7: Circuit block diagram (1 kVA)

### 4.3 Electrical characteristics

Table 2 shows the general specifications for the UPS.

Table 2: "SANUPS A11K" Series specifications

Item		Units	Rating or characteristic					Remarks
Model		-	A11K102	A11K152	A11K202	A11K302	A11K502	
Rated output capacity		kVA/kW	1/0.8	1.5/1.2	2/1.6	3/2.4	5/4	Apparent power/effective power
System	Charging system	-	Online UPS					
	Cooling system	-	Forced air cooling					
	INV system	-	High frequency PWM					Utility-synchronous online UPS system
AC input	Number of phases	-	Single-phase, two-wire					
	Rated voltage	V	100, 110, 120					Same as output voltage
	Voltage range	%	Rated voltage within $\pm 20$					With a load factor of 70% or more
			Rated voltage within -40, +20					With a load factor of less than 70% Return voltage of -20% or more
	Rated frequency	Hz	50 or 60					Automatic frequency discrimination (Note 1)
	Frequency range	%	Rated frequency $\pm 1, 3, 5, 7$					(Fluctuation range is identical to the output frequency accuracy selection)
	Required capacity	kVA	1.1 or less	1.5 or less	2.0 or less	3.0 or less	5.3 or less	Max. capacity during battery recovery
Power factor	-	0.95 or higher			0.97 or higher		When input voltage distortion is within 1%	

Item		Units	Rating or characteristic		Remarks	
AC output	Number of phases	-	Single-phase, two-wire			
	Rated voltage	V	100,110,120		Default, voltage waveform: Sine wave	
	Voltage setting precision	%	Rated voltage within $\pm 2$		During rated operations	
	Rated frequency	Hz	50 or 60		Same as input frequency	
	Frequency precision	%	Rated frequency within $\pm 1, 3, 5, 7$ (Default $\pm 3$ )		Frequency accuracy settings are adjustable ( $\pm 1, 3, 5, 7\%$ ) $\pm 0.5\%$ or less during battery operation <sup>(Note 1)</sup>	
	Voltage wave form distortion factor	%	3 or less / 7 or less		Linear load/wave rectifier load during rated operations	
	Transient voltage fluctuation	Sudden variation of load	%	Rated voltage within $\pm 5$		0 $\Rightarrow$ 100% change, during output changeover
		Power outage/recovery	%			During rated operations
		Sudden variation of input voltage	%			Change $\pm 10\%$
		Response time	Max.			5 cycles
	Load power factor	-	0.8 (slow)		Fluctuation range 0.7 (delay) to 1.0	
	Overcurrent protection	%	105 or higher		Automatic switching to bypass circuit <sup>(Note 1)</sup>	
	Overload endurance	Inverter	%	105 or higher		200 ms
Bypass		200 / 800		30 seconds / 2 cycles		
Battery	Type	-	Small-sized valve regulated lead-acid battery			
	Backup Time	Minute	10	10 <sup>(Note 2)</sup>	Ambient temperature 25°C, during rated output, default	
Acoustic noise	dB		40 or less	45 or less	1 m from device front, A characteristic (when ambient temperature is 40°C or less)	
			50 or less	55 or less	1 m from device front, A characteristic (when ambient temperature exceeds 40°C)	
Operating environment	Ambient temperature	°C	-10 to +55		<sup>(Note 3)</sup>	
	Relative humidity	%	10 to 90		No condensation	

Note 1: When the AC input frequency has a range of  $\pm 3\%$  (selectable between 1%, 3%, 5%, or 7%) the rated frequency and the AC input voltage has a range of  $\pm 20\%$  the rated voltage (when load factor is 70% or less, the range is -40% to +20%), the inverter operated synchronous with the AC input and no-break transfers to the bypass circuit are possible. If the AC input frequency exceeds the setting range, operation switches to battery operations.

Note 2: When the load power factor is 0.7 (2 kVA: 1.4 kW, 3 kVA: 2.1 kW, 5 kVA: 3.5 kW). 8 min when the load power factor is 0.8.

Note 3: Battery charging stops when ambient temperature exceeds 40°C.

## 5. Benefits for Our Customers

By achieving a high conversion efficiency of 92% or more, this UPS can help to reduce our customers' running costs and conserve energy.

Moreover, by a wide-ranging of input voltage, battery replacement costs have been reduced by minimizing battery wear and deterioration even in unstable power environments.

## 6. Conclusion

As information communication technology becomes more sophisticated, its social importance will continue to grow. Moreover, the UPS demand will be more diversified to use in a variety environments.

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

We sincerely thank the many people involved in the development and realization of this UPS product for their advice and support.

### Reference

Yoshitsugu Kashiwagi and Others: Development of Small-Capacity UPS "SANUPS A11F"  
SANYO DENKI Technical Report No.19



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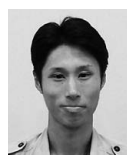
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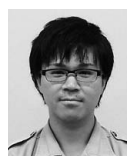
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