Development of the *SANUPS N11B-Li (3 kVA)* Uninterruptible Power Supply

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1. Introduction

Conventionally, SANYO DENKI has offered UPSs for indoor use as backup power for servers and ICT equipment or in combination with industrial devices. However, in recent years, there has been a growing demand for UPSs as backup power for outdoor ICT equipment, such as base stations and remote monitoring devices for disaster prevention.

Equipment for outdoor use is installed in harsh environments with large variation in temperature as well as exposure to water, dust and the like. For this reason, the UPSs for outdoor use need to be capable of operating in a wide temperature range, have water and dust resistance, and require less maintenance.

To date, UPSs have used lead batteries; however, these have a limited operating temperature range, short backup time towards the end of their life cycle, and require replacing.

By adopting lithium-ion batteries (hereinafter "LIB"), UPSs can be used in a wider operating temperature range compared to conventional lead batteries and require less maintenance, as battery replacement is required much less frequently.

SANYO DENKI has already developed the water/dust-resistant *SANUPS N11B-Li* series UPS equipped with LIB in output capacities of 1 kVA and 1.5 kVA. However, we have newly added a 3 kVA output model to the lineup to provide backup power for large capacity applications such as outdoor ICT equipment. This article will introduce the features of this new product.

2. Overview and Features of the Product

2.1 Product overview

Figure 1 shows the appearance of the *SANUPS N11B-Li (3 kVA)*.

Fig. 1: *SANUPS N11B-Li (3 kVA)*

2.2 Features

2.2.1 Wide operating temperature range

The wide operating temperature range of -20 to +50˚C is achieved through the adoption of an LIB. This means this product can be used with confidence in extremely hot or cold environments.

2.2.2 Low maintenance

Lead batteries require replacement approximately every five years, but by adopting LIB, the new model can be used for up to ten years without needing to replace the battery. This reduction in maintenance work means battery replacement costs can also be reduced.

2.2.3 Improved maintainability

Tasks such as battery replacement have been made easy through the modularization of the inverter. Figure 2 shows an image of the *SANUPS N11B-Li (3 kVA)* equipped with an inverter module and battery modules.

This product has a maintenance bypass circuit, therefore modules can be replaced without the need to interrupt power supply from the grid.

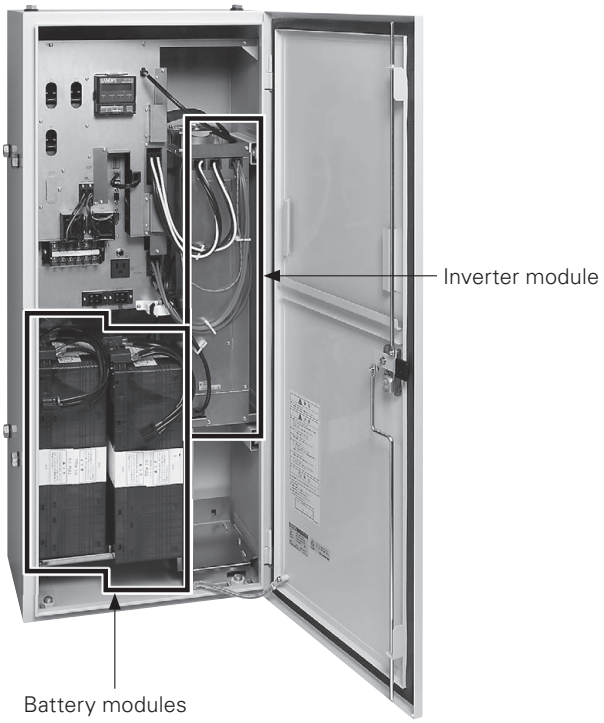

Fig. 2: Inverter module and battery modules (*SANUPS N11B-Li (3 kVA)*)

2.2.4 Enhanced functionality

An LCD panel is used on the operation panel to improve user-friendliness and visibility.

2.2.5 High energy-saving and reduced heat dissipation

With the passive standby topology, the *SANUPS N11B-Li (3 kVA)* suppresses power consumption and achieves a conversion efficiency of 96%. This reduces running costs and contributes to energy-saving.

2.2.6 Outdoor installation

The *SANUPS N11B-Li (3 kVA)* adopts a sealed structure. This makes it possible to use the new model as backup power for ICT equipment installed outdoors.

2.2.7 Water and dustproof performance

This device adopts a sealed structure, therefore has excellent water resistance and protection against dust. As such, it can be used outdoors with confidence.

The new model achieved an IP rating of IP65* in a protection performance test.

* The degree of protection (IP code) is defined by IEC (International Electrotechnical Commission) 60529 "DEGREES OF PROTECTION PROVIDED BY ENCLOSURES (IP Code)." (IEC 60529:2001)
IP65: No ingress of dust. Devices operate stably even when directly exposed to water from many directions.

3. Circuit Configuration

Figure 3 shows the circuit diagram for the *SANUPS N11B-Li (3 kVA)*.

The *SANUPS N11B-Li (3 kVA)* integrates an "inverter module" consisting of a main circuit and a control circuit, and an "I/O portion" consisting of a communication interface circuit, input/output circuit, and battery management unit (BMU), and battery modules.

3.1 LIB monitoring circuit configuration

Equipped with a BMU, this product features a data interface between the UPS and LIB. By monitoring detailed LIB data, and having the UPS and LIB perform mutual protection operations and fault detections, the LIB can be used safely.

(1) UPS error detection

When a UPS error occurs, notification is sent from the UPS to the BMU via CAN communication. Once the BMU receives notification, it trips the battery breaker.

(2) LIB error detection

When an LIB error occurs, notification is sent from the BMU to the UPS via CAN communication. In response, the UPS stops the charger's output. Moreover, as soon as the BMU detects an LIB error, it trips the battery breaker.

(3) Monitoring LIB cell voltage and cell temperature

Cell voltage and temperature are measured in the battery module and the BMU is notified of the measurement values through CAN communication. If the cell becomes over-charged, over-discharged, or reaches an abnormal temperature, the BMU determines that an LIB error has occurred and, as mentioned in section (2) above, trips the battery breaker and separates the UPS from the LIB.

Users can check the measured values for battery voltage, cell temperature, and state of charge on the LCD panel.

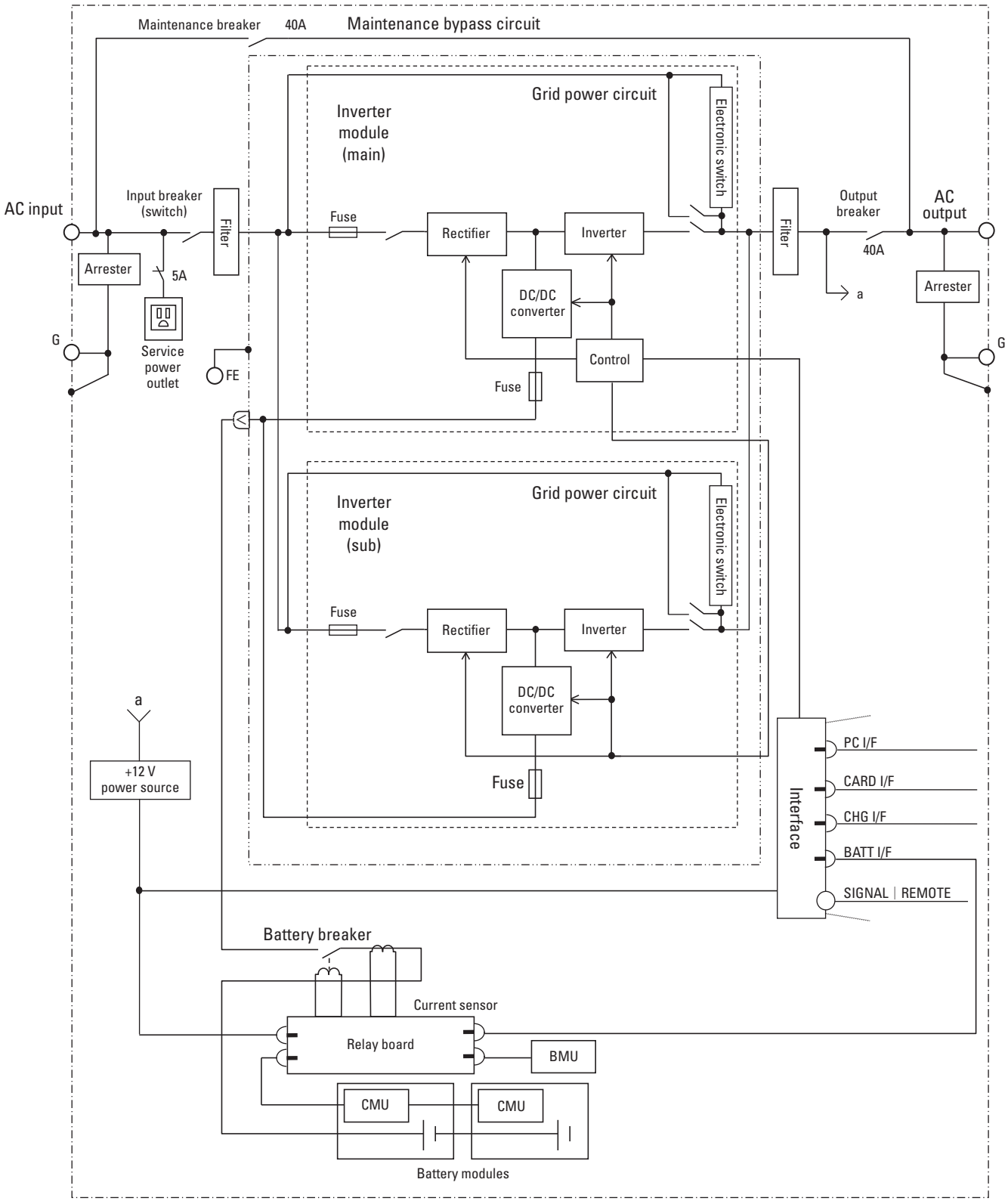

Fig. 3: Circuit diagram for the *SANUPS N11B-Li (3 kVA)*

4. Specifications

Table 1 shows the standard specifications of the *SANUPS N11B-Li (3 kVA)*.

Table 1: Specifications of the *SANUPS N11B-Li (3 kVA)*

Item			Unit	Ratings and characteristics	Remarks
Model			—	N11BL302	
Rated power capacity			**kVA/kW**	3/2.4	Apparent power/Active power
Type	**UPS topology**		—	Passive standby	
	Cooling method		—	Forced air cooling	
	Inverter system		—	High-frequency PWM method (during battery operation)	Commercial synchronous online double conversion
AC input	**No. of phases/wires**		—	Single-phase 2-wire	
	Rated voltage		**V**	100, 110, 120	Same as output voltage
	Voltage range		**%**	Within ±10 of rated voltage	
	Rated frequency		**Hz**	50/60	Frequency is automatically detected
	Frequency range		**%**	Within ±1, 3, 5, or 7 of rated frequency	(The fluctuation range is the same as the selected output frequency regulation)
	Required capacity		**kVA**	4 or less	Max. capacity during battery recovery charging
AC output	**No. of phases/wires**		—	Single-phase 2-wire	
	Rated voltage		**V**	100, 110, 120	Voltage waveform during battery operation: Pure sine wave
	Voltage regulation		**%**	During grid operation: Same as input voltage range	
				During battery operation: Within ±2 of rated voltage	At rated output
	Rated frequency		**Hz**	50/60	Same as input frequency
	Frequency regulation		**%**	During grid operation: Same as input frequency range	
				During battery operation: Within ±0.5	At rated output
	Voltage harmonic distortion		**%**	3 or less / 7 or less	During battery operation, at rated output
	Transient voltage regulation	**Rapid load change**	**%**	Within ±7 of rated voltage	During battery operation, for 0⇔100% load step changes / output switch
		Loss or return of input power	**%**	Within ±5 of rated voltage	During battery operation, at rated output
	Power factor		—	0.8 (lagging)	Variation range: 0.7 (lagging) to 1.0
	Overcurrent protection		**%**	Output breaker trip	
	Overload capability	**During grid operation**	**%**	200/800	30 s / 2 cycles
		During battery operation		105 or greater	200 ms
Battery		**Type**	—	Lithium-ion battery (LIB)	
		Backup time	**Minute**	30	Ambient temperature 25˚C, at rated output, under factory conditions
Noise			**dB**	43 or less	1 m from front of device, A-weighting
IP rating			—	IP65	
Operating environment		**Ambient temperature**	**˚C**	-20 to +50	*
		Relative humidity	**%**	10 to 90	Non-condensing
Storage environment			**˚C**	-20 to +55	**

* Battery charging should be stopped when battery temperature exceeds 55˚C.
** To prolong battery life, avoid use or storage for extended periods of time in environments exceeding +30˚C. If the UPS is stored without being operated for a long period, the batteries may require recharging once a year.

5. Advantage for Customers

Below is a list of customer advantages gained by adopting this device.

(1)Broader selection of applications and installation environments due to a wider operating temperature range

(2)Reduced maintenance costs thanks to low-maintenance batteries

(3)In the unlikely event of a problem, maintenance work can be performed without interrupting power supply to the load equipment.

(4)Able to backup ICT equipment and outdoor equipment even in harsh environments.

(5)Sealed structure enables use in environments exposed to dust and rain.

6. Conclusion

Moving forward, information and communication technologies will undergo even further sophistication and play an even more important role in society. UPSs are used in a variety of applications and environments, and it is believed that the demand for environmental durability will continue to intensify. To satisfy these market requirements, SANYO DENKI will enhance our lineup of UPS equipped with LIB.

It is our goal to develop products that create value for our customers by responding to the diversifying needs of the UPS market.

Reference

Yuhei Shoyama and others: "Development of the Small-Capacity UPS *SANUPS A11K-Li* and *SANUPS N11B-Li* Series" SANYO DENKI Technical Report No. 44

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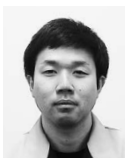

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