Power Conditioner "SANUPS P83B" for Photovoltaic Power Generation Systems that Contribute to Global Environment

Takeshi Hama

1. Introduction

Currently, most energy for power generation is provided by oil, coal, or other fossil fuels. However, fossil fuels are limited resources and may not be a reliable supply in the future. Furthermore, using these fuels for power generation leads to global warming through the emission of carbon dioxide and other gases, thus contributing to the greenhouse effect that accelerates global warming.

With this in mind, people are turning to solar energy. Photovoltaic power generation systems use this inexhaustible supply of energy to provide power without releasing harmful greenhouse gases. These systems are starting to spread among environmentally conscious businesses today.

This report introduces a newly developed, earth-friendly photovoltaic power generation system for public industry: 100 kW power conditioner "SANUPS P83B".

2. Development Background

The conventional model "SANUPS PMC-TD" can supply electrical power to a special load for disaster prevention in case of a power outage. This allows the product to be used as a disaster prevention system that provides both standalone and recharging operating functions. However, this series was only capable of handling 10 kW to 50 kW, which meant that that maximum output capacity for isolated operation was 50 kW.

Recently, there has been demand for products for disaster prevention systems or load leveling peak-cut systems that can handle massive systems that may even exceed 100 kW.

Therefore, our company has answered the needs of the market by developing a product that can easily meet demands for standalone and recharging operating functions: the 100 kW power conditioner "SANUPS P83B".

3. Product Features

3.1 Flexible system expandability

"SANUPS P83B" can be expanded to include standalone and recharging functions. Implementing the optional standalone automatic switching circuit or the secondary battery connection circuit allows the product to accomplish the following functions:

(1) Isolated operation function (Including disaster prevention abilities)

(2) Recharging operation function

(3) Reverse power output function for snow-melting operations

(4) Rated output operation function for peak-cut operation

The basic lineup includes "P83B104R" for utilities, "P83B104S" for isolated operation, and "P83B104C" for isolated/recharging operation.

Fig. 1 shows the "P83B104R" model, while Fig. 2 shows the system configuration. Figs. 3 and 4 show the system configurations for "P83B104S" and "P83B104C" respectively.

Fig. 1: "P83B104R"

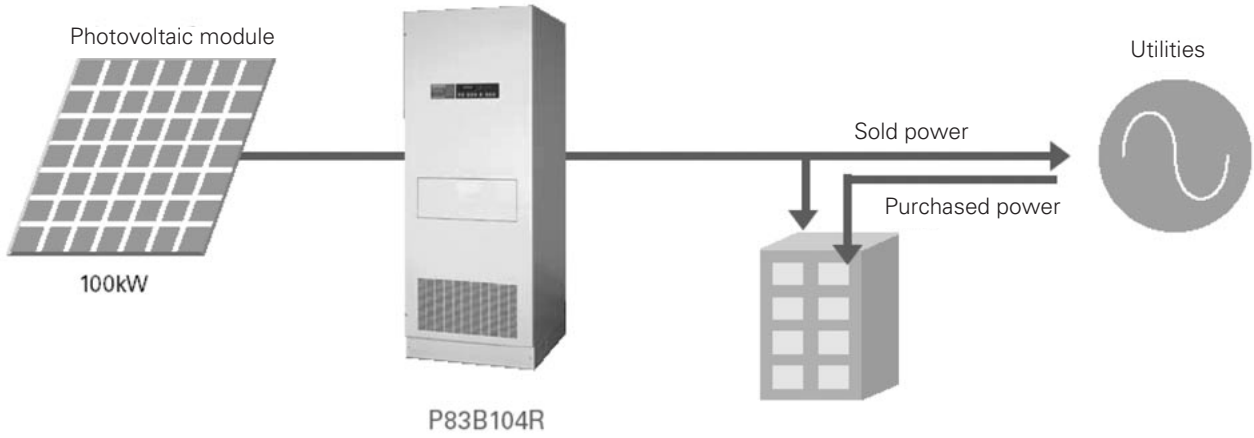

Fig. 2: System configuration for "P83B104R"

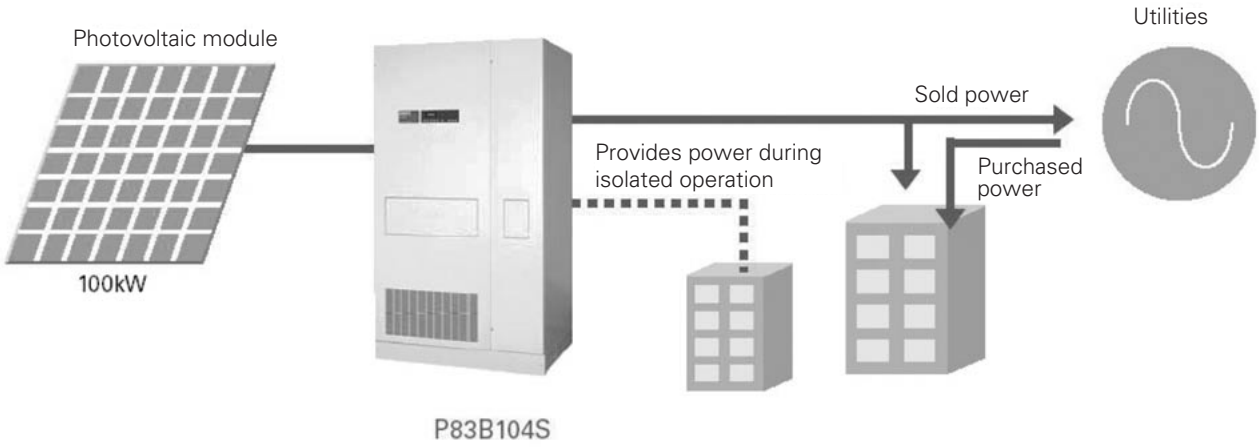

Fig. 3: System configuration for "P83B104S"

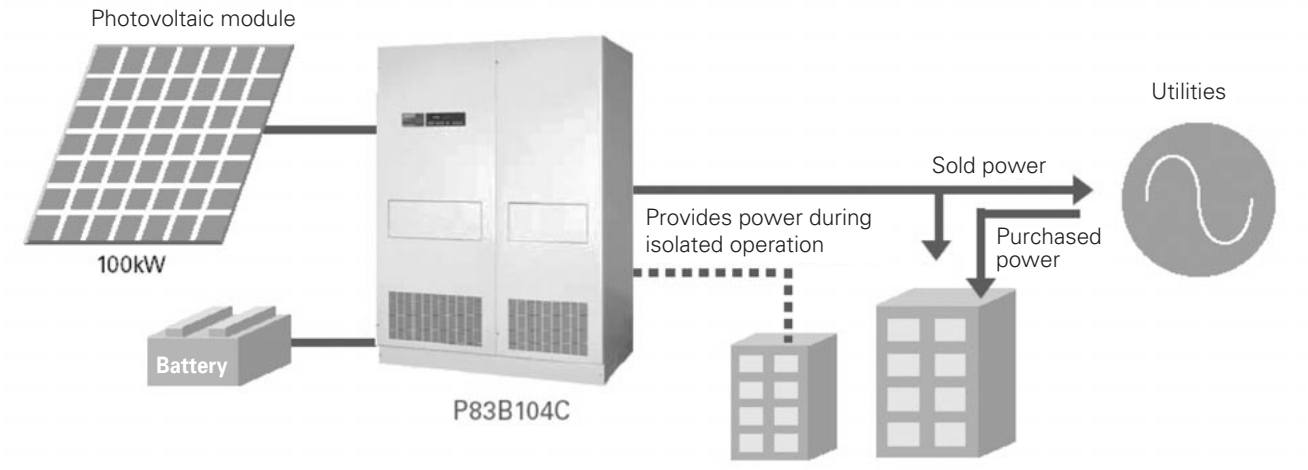

Fig. 4: System configuration for "P83B104C"

3.2 100 kW output capacity

"SANUPS P83B" is power conditioner with an output capacity of 100 kW. It comes equipped with a power switching device, controlled power source, operation switches, displays, and utility protective device.

This unit is also capable of receiving signals (after conversion by a transducer) sent from meteorological measurement devices such as pyanometer and thermometers, a feature that is critical to field tests of photovoltaic technology projects such as those conducted by Japan's New Energy and Industrial Technology Development Organization (NEDO).

3.3 Insulation transformer method

When a large-scale photovoltaic system is configured, the required number of photovoltaic modules increases; as a result, the stray capacitance between the solar cells and the ground is increased, causing a larger leakage current. To prevent this leakage current from spilling into the commercial utilities, an insulation transformer with a commercial frequency has been installed between the photovoltaic module and the utility system.

3.4 Reduction in required installation space

The external dimensions of the "P83B104C" are 1350 mm wide by 800 mm deep by 1950 mm high, and its weight is 1150 kg. The area needed for installation is 1.1 m2, which is only 78% of the space needed for installing two units of 50 kW "SANUPS PMC-TD".

3.5 High conversion efficiency

The conversion efficiency (the rated load efficiency according to JIS C8961 during utility system operation or isolated operation) of the "SANUPS P83B" is 93%, which is among the highest in the industry for 100 kW systems. As noted above, the unit incorporates a utility frequency insulation transformer and optimizes the switching frequency.

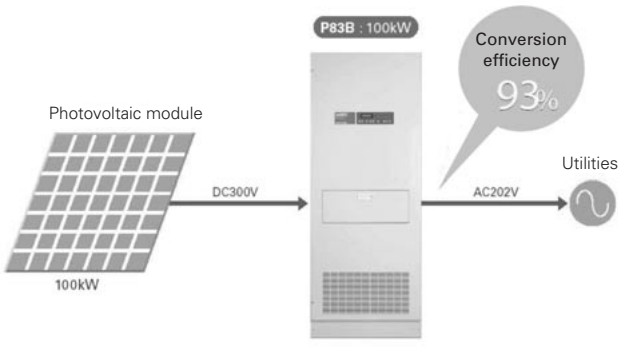

Fig. 5: Conversion efficiency for "SANUPS P83B"

3.6 Compatible with large-scale photovoltaic systems

The "SANUPS P83B" is equipped with the following functions to accommodate large-scale photovoltaic systems:

(1) Detection of islanding operation

When several power conditioners are used with the same utility system, synchronous signals need to be connected between each of the power conditioners in order to prevent a decline in sensitivity in the active method resulting from islanding operation.

Since the "SANUPS P83B" is capable of managing synchronous signals for up to 27 units, it is compatible with photovoltaic systems of up to 2700 kW.

(2) Communication port

Use of the RS-485 interface for communication port has enabled up to 27 power conditioner units to be connected to the same line.

(3) Measurement data

When several power conditioners are installed, output power and output energy can be monitored on the power conditioner that has been designated as the master unit, without the need for a dedicated display unit.

3.7 Failure history data

The "SANUPS P83B" can store up to 10 sets of failure data in the failure history log, in addition to real-time failure data. In the event that a failure occurs, the failure history data can be reviewed, thus improving the ease of maintenance work.

3.8 Cross-platform sharing of communication protocol

By making both the interface for communication port (RS-485) and the communication protocol the same as that of other models, the "SANUPS P83B" power conditioner can be connected with other Sanyo Denki models such as the "SANUPS PMCTD", "SANUPS P73D", "SANUPS P73E", and "SANUPS P83A". In this way, existing systems can be expanded and photovoltaic systems can be accommodated in a flexible manner.

3.9 Options

The following options allow for flexibility, to meet a variety of needs:

(1) Transducer (DC voltage, DC current, AC output power)

(2) Outdoor enclosure

(3) Single phase output transformer board (converts 3-phase isolated operation output into a single phase)

4. Specifications

Table 1 shows the general specifications of the "SANUPS P83B".

Table 1: General specifications of “SANUPS P83B”

Item			Utilities operation P83B104R	Isolated operation P83B104S	Isolated/Recharging operation P83B104C	Notes
	Output capacity		100kW			
	Method	Main circuit method	Self communication voltage stiff			
		Switching method	High frequency PWM			
		Insulation method	Utility frequency link type			
Utility operation	DC output	Rated voltage	300 VDC			
		Max. allowable input voltage	500 VDC			
		Input operation voltage range	250 to 450 VDC			
		Range of rated output voltage	270 to 420 VDC			
		Max. power point tracking	250 to 420 VDC			
	AC output	No. of phases/wires	3-phase, 3-wire			S-phase earth
		Rated voltage	202 VAC			
		Rated frequency	50/60 Hz Auto-identification			Fixed installation also available
		AC output current distortion ratio	(Total) 5% max/(Each) 3% max.			Rated output current ratio
		Output power factor	0.95 min.			At rated output
	Efficiency		93%*			
Isolated	DC output	Rated voltage	—	300 VDC		
		Max. allowable input voltage	—	500 VDC		
		Input operation voltage range	—	270 to 420 VDC		For “P83B104C”: Dependent on the battery setting
	AC output	Rated output	—	100 kW		Load power ratio 1.0
		No. of phases/wires	—	3-phase, 3-wire		
		Rated voltage	—	202 VAC		
		Voltage accuracy	—	Within ±8% of the rated voltage		
		Rated frequency	—	50/60 Hz		
		Frequency accuracy	—	Within ±0.1 Hz of the rated frequency		
		Voltage waveform distortion rate	—	Linear load: Within 5%		
		Overload resistance	—	100% continuous		
	Efficiency		—	93%		
Recharging	DC output	Rated output	—		80 kW	Max. 100 kW
		Rated charging voltage	—		375 VDC	Adjustable range: 270 to 415 VDC (1 V increments)
		Rated charging current	—		213 ADC	Adjustable range: 10 to 310 DC (10 A increments)
	AC input	No. of phases/wires	—		3-phase, 3-wire	
		Rated voltage	—		202 VAC	
		Operating voltage range	—		Within ±10% of the rated value	
		Rated frequency	—		50/60 Hz Auto-identification	
		Operating frequency range	—		Within ±1% of the rated value	
	Efficiency		—		90%	
	Interactive protection		Over-voltage (OV), Under-voltage (UV), Over-frequency (OF), Under-frequency (UF)			OVGR installed externally
	Islanding operation detection	Passive method	Voltage phase jump method			
		Active method	Non-effective power fluctuation method			
	Usage environment	Ambient temperature	-10 to 40℃			
		Relative humidity	30 to 90%			Non-condensing
		Altitude	2000 m max.			

* Rated load efficiency based on JIS C8961

5. Conclusion

To conclude, this report has outlined the major features of the public industry 100 kW power conditioner “SANUPS P83B”.

Our company aims to meet our customers’ needs for a flexible system configuration with the development of this product that has options for both isolated operation function and recharging operation function. We support increasing the introduction of photovoltaic power generation systems in the public industry. By replacing the current power generation with fossil fuels, we can contribute to the global environment.

We intend to continue our efforts to enhance the functionality and economy of power conditioners, and continue developing and designing power conditioners while giving consideration to the environment.

Finally, the author of this report wishes to thank the many individuals who provided cooperation and advice over the course of development and product release.

Takeshi Hama
Joined Sanyo Denki in 1986.
Power Systems Division, 1st Design Dept.
Worked on the development and design of photovoltaic power generation systems.