Development of "SANUPS P83A" Power Conditioner for Photovoltaic Systems

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1. Introduction

Since the Kyoto Protocol went in to effect in February of 2005, we have witnessed increased interest in solar energy as a source of pollution-free energy that does not contribute to global warming. Until now, wide need of photovoltaic systems with output of 100kW or more for industrial purposes has lated behind residential use due to the space constraints involved in installing photovoltaic panels, as well as the high operating costs of these systems. However, certain industrial fields have undergone a recent increase in demand for over 100kW photovoltaic systems, such as photovoltaic solar mega-projects led by Japan's Ministry of the Environment, along with water purification facilities and other places where a large surface area is available for the installation of solar panels.

In the past, Sanyo Denki's conventional "SANUPS PMC-TD" model was often used in photovoltaic systems with capacities over 50kW by simply combining several units together in a single installation. In light of current demands for power conditioners exceeding 100kW that require less space for installation, use fewer cables, and permit easier maintenance, however, such a solution is beginning to appear less viable.

To respond to the needs of the market, Sanyo Denki has developed the "SANUPS P83A" power conditioner, capable of handling large-scale photovoltaic systems, and contributing to an overall improvement in their quality.

Details on the development of the new "SANUPS P83A" power conditioner are outlined below.

2. Development Background

Our conventional "SANUPS PMC-TD" model has serial capacities ranging from 10kW to 50kW. This product has accommodated large-scale systems of 50kW or greater by combining several units in a single installation, such as using four 50kW units in a photovoltaic system with a 200kW capacity, for example.

Since the "SANUPS PMC-TD" offered expandable functions, such as isolated operation and charged operation functions, as well as a utility-connected operation function found in a large percentage of photovoltaic systems, it required redundant structures, and relatively high costs.

In addition, the power conditioner also required measures to prevent current leakage due to stray capacitance, a phenomenon peculiar to photovoltaic cells, when it was configured into large-scale systems.

This situation is in contrast to initiatives to reduce the cost of adopting the system, including the expense of installing the power conditioner, in order to make the overall system more economical.

Taking the limitations of the "SANUPS PMC-TD" into consideration, we developed the new "SANUPS P83A" power conditioner, capable of 100kW output and designed for exclusive use of utility system, the mainstream of photovoltaic systems.

3. Features

3.1 100kW Output Capacity

The "SANUPS P83A" has a 100kW output capacity, and is 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).

Fig. 1 shows the external appearance of "SANUPS P83A", and Fig. 2 shows a circuit diagram of the unit.

Fig. 1: "SANUPS P83A"

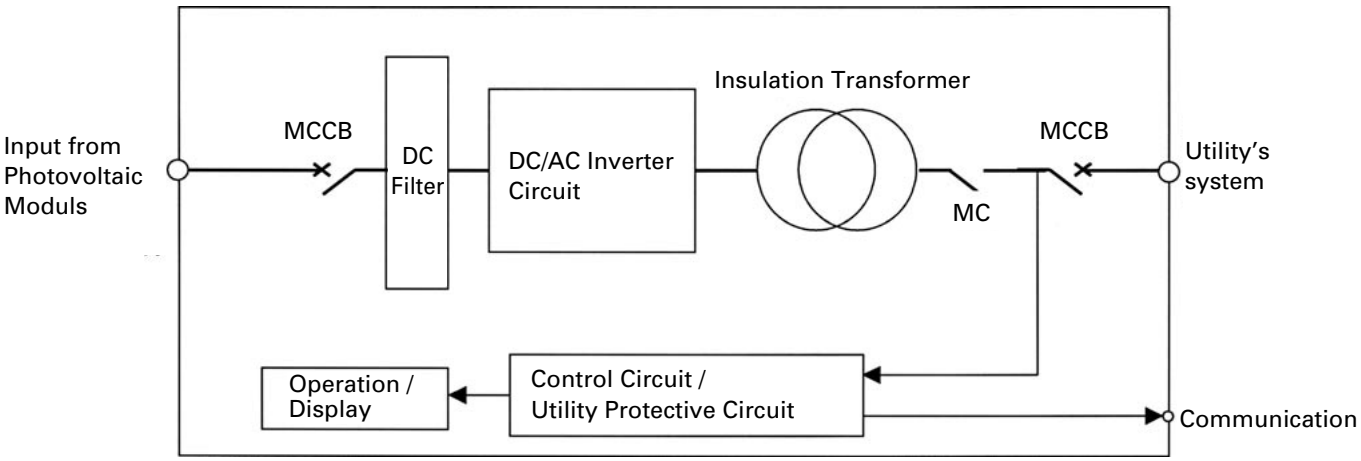

Fig. 2: Block Diagram of the "SANUPS P83A"

3.2 Insulation Transformer Type

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, an insulation transformer with a commercial frequency has been installed on both the photovoltaic module side and the utility system side. The use of a utility frequency insulation transformer has also eliminated a circuit of DC current detection.

3.3 Less Space Required for Installation

The external dimensions of the "SANUPS P83A" are 750mm wide by 800mm deep by 1950mm high, and its weight is 800kg. The area needed for installation is 0.6m^2, which is only 43% of the space needed for installing two units of 50kW "SANUPS PMC-TD". Fig. 3 compares the space requirements for installation of the new and old models.

3.4 High Conversion Efficiency

The conversion efficiency (the rated load efficiency pursuant to JIS C 8961) of the "SANUPS P83A" is 93%, which is among the highest in the industry for 100kW systems. As noted above, the unit incorporates a utility frequency insulation transformer and optimizes the switching frequency.

3.5 Compatible with Large-Scale Photovoltaic Systems

The "SANUPS P83A" 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 P83A" is capable of managing synchronous signals for up to 27 units,

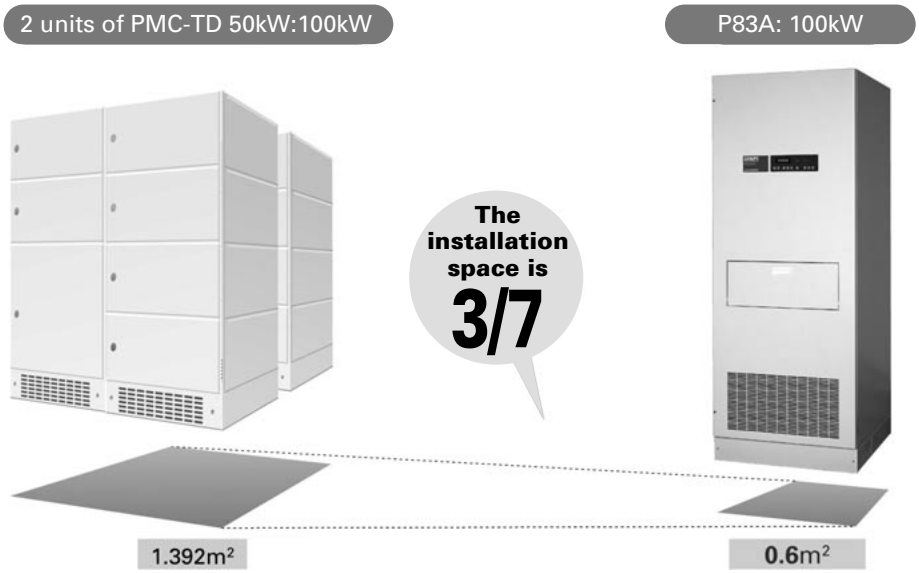

Fig. 3: Comparison of the Space Needed for Installation

it is compatible with photovoltaic systems of up to 2700kW.
(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.

3.6 Failure History Data

The "SANUPS P83A" can store up to 10 sets of failure data in the failure history log, in addition to real-time failure data. Maintenance work is facilitated the ability to review failure history data, in the event that a failure occurs.

3.7 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 old models, the "SANUPS P83A" power conditioner can be connected with models such as the "SANUPS PMC-TD", "SANUPS P73D" and "SANUPS P73E". In this way, existing systems can be expanded and photovoltaic systems can be accommodated in a flexible manner.

3.8 Options

The following options allow for flexibility, to meet a variety of needs:
(1) Transducer (DC voltage, DC current, AC output power)
(2) DC grounding detection function
(3) Outdoor enclosure

4. Specifications

Table 1 shows the general specifications of the "SANUPS P83A".

5. Conclusion

To conclude, this report has outlined the major features of the "SANUPS P83A".

Table 1: General Specifications of the "SANUPS P83A"

Item		P83A104	Notes
Output Capacity		**100kW**	
Method	Main Circuit Method	Self communication voltage stiff	
	Switching Method	High Frequency PWM	
	Insulation Method	Utility Frequency Link Type	
DC Input	Rated Voltage	DC300V	
	Maximum Allowable Input Voltage	DC500V	
	Input Operation Voltage Range	DC250～450V	
	Range of Rated Output Voltage	DC270～420V	
	Maximum Power Point Tracking	DC250～450V	
AC Output	Number of Phases / Wires	3-Phase 3-Wire	S-Phase Earth
	Rated Voltage	AC202V	
	Rated Frequency	50 / 60Hz Auto-identification	Fixed installation also available
	AC Output Current Distortion Ratio	(Total) 5%≧ (Each) 3%≧	Rated Output Current Ratio
	Output Power Factor	0.95%≦	At rated output
	Linkage Classification	Low Voltage / High Voltage	
	Efficiency	93%※	
Interactive Protection		Over-voltage (OV)	OVGR installed externally
		Under-voltage (UV)	
		Over-frequency (OF)	
		Under-frequency (UF)	
Independent Operation Detection	Passive Method	VoltNage Phase Jump Method	
	Active Method	Non-effective Power Fluctuation Method	
Usage Environment	Ambient Temperature	-5～40°C	
	Relative Humidity	30～90%	Non-condensing
	Altitude	2000m≧	

※Rated load efficiency based on JIS C8961

Our experience in developing power conditioners for 100kW capacity systems has shown us that common components shared between UPS units with identical output capacities must be utilized whenever possible. To illustrate this point, we dramatically shortened the development period of the "SANUPS P83A" by making maximum use of the software resources developed for the previous conventional model, "SANUPS PMC-TD".

By developing a power conditioner specifically for photovoltaic systems connected to utilities, we believe that great improvements in installation space requirements and overall system costs can be achieved.

We intend to continue our efforts to enhance the functionality and economy of power conditioners, and to move ahead in the development of products offering compatibility with isolated operation and charged operation functions, a feature in demand for disaster prevention systems.

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

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