Development of Power Conditioner for Photovoltaic Power Generation, "SANUPS" P73D103

Norio Tazawa Akinori Matsuzaki Takeshi Hama Yuuji Wada
Hiroshi Yamada Tomohiro Nishibori Katsutoshi Yamanaka

1. Introduction

Recently, public concern about global warming has led to the increased concern for solar energy as environmentally-friendly, no pollution energy. In this situation, as for the industrial photovoltaic generation system, the spread is a little late compared with the photovoltaic generation system for the house, and further cost reduction of the system, etc. are demanded in the market.

Therefore, our conventional model "SANUPS" PMC-TD has to meet the requirements of miniaturization, lightweight, and cost reduction of the exclusive machine for 10kW interactive system.

To satisfy these market trends, we developed the power conditioner "SANUPS" P73D103, which is able to contribute to the cost reduction of the entire photovoltaic generation system as well as being miniaturized and light weighted by integrating the function of the connection box and the I/O box that were the peripheral devices in the conventional models with the power conditioner.

This text is going to explain about the power conditioner "SANUPS" P73D103 developed at this time.

2. Background of the Development

We adopted the build-up method for our conventional "SANUPS" PMC-TD, which is easy to construct the system from 10k-50kW by piling the 10kW standard machine up on the I/O box.

There were extra structures or functions when thinking about the exclusive machine for the 10kW interactive system because functionally, the extendibility of stand-alone, recharged running function besides the utility interactive operating function had been given to the standard machine of 10kW.

Moreover, the connection box and the I/O box had to be miniaturized and light weighted as well as the power conditioner since they were mandatory to construct the system.

In addition, to reduce the cost of the entire system, we thought that it was important to decrease the cost of introduction of the system, containing an installation construction of a power conditioner.

For the above reasons, the "SANUPS" P73D103 was developed as an exclusive machine for the 10kW interactive system, which integrated the conventional peripherals with the power conditioner.

3. Features

3.1 All-In-One Structure

The "SANUPS" P73D103 has an all-in-one structure to store all of a power conditioner of the output capacity of 10kW, a connecting box, and an I/O box function, which had been peripheral devices.

This includes an I/O switch, a connecting circuit, and 2 transducers that entrap the weather measurements such as a solar radiation meter and a temperature meter other than the necessary devices as a power conditioner such as a power converter, a control power supply, a system utility protective device and a display function.

Fig. 1 shows the external view and Fig. 2 shows the circuit block chart of "SANUPS"P73D103.

Fig. 1 "SANUPS" P73D103

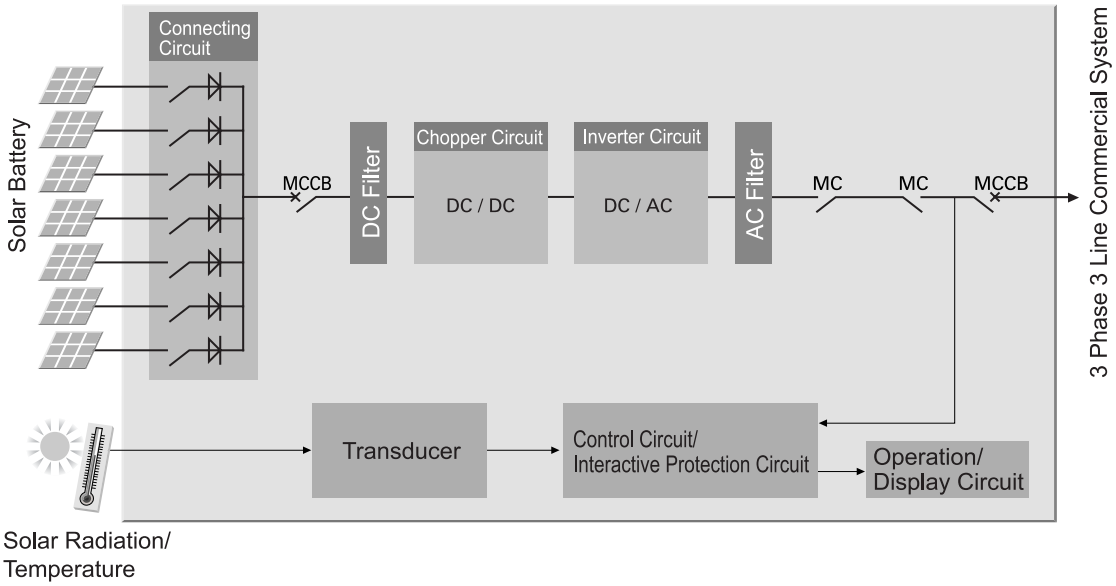

Fig. 2 Circuit System Block "SANUPS"P73D103

Installation and wiring work of a connecting box becomes unnecessary by having adopted this all-in-one structure, and a great reduction of system construction expense can be expected.

An example of the system configuration of the conventional "SANUPS" PMC-TD is shown in Fig. 3 and an example of the system configuration of the "SANUPS" P73D103 is shown in Fig. 4.

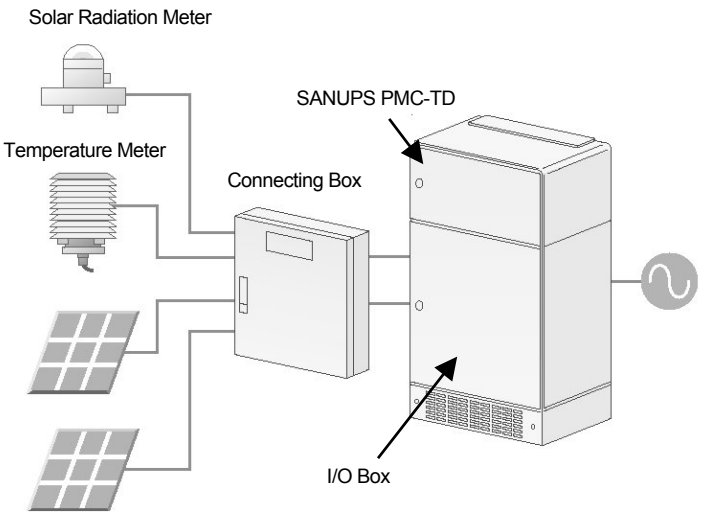

Fig. 3 Example of System Configuration "SANUPS" PMC-TD

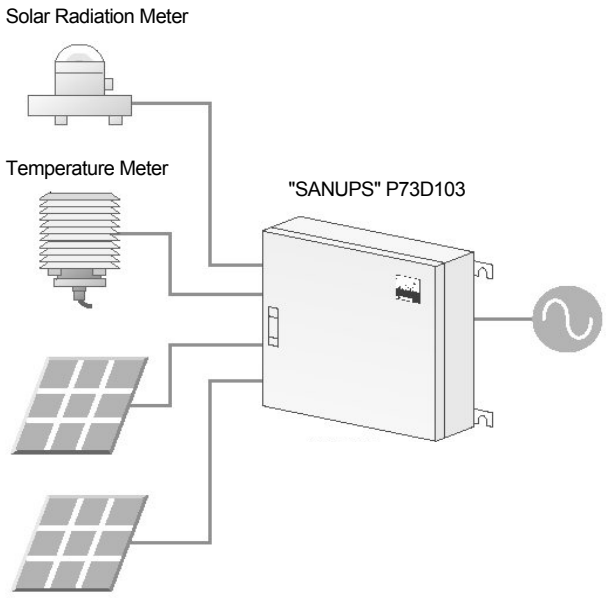

Fig. 4 Example of System Configuration "SANUPS"P73D103

3.2 Reduction in Number of Parts

A great number of parts were reduced in the "SANUPS" P73D103 by narrowing the function and the usage of the main circuit, the control circuit, and the structure.

(1) Main Circuit
We reexamined the methods of the chopper circuit and the inverter circuit, and adopted a new circuit method that has a fewer number of parts but satisfies the performance of the conventional models.
Reviewing the parts one by one also has reduced the number of parts by about 17% compared with the conventional model.

(2) Control Circuit
The number of the surrounding parts of the CPU was reduced by newly adopting a low-priced, high performance CPU compared with the conventional CPU.
Parts were also removed by taking the function that had been structured in hardware in software.
In addition, putting the circuits together in one high board as much as possible to remove the connection parts, such as connectors, reduced the number of parts by approximately 36% compared with the conventional model.

(3) Structure
The number of parts was reduced by approximately 20% compared with the conventional models by reexamining a sheet metal structure and connecting parts. The number of print boards used also was reduced from seven in conventional models to five.

We succeeded, as a power conditioner, to reduce the number of parts by about 35%, compared with the conventional model by performing the above-mentioned steps (1) - (3).

3.3 Small・Lightweight

The "SANUPS"P73D103 has achieved a great miniaturization and lightweight of 1/4 in size (77% reduction from the conventional model) and 1/3 in mass (65% reduction from the conventional model) compared with the conventional structure (10kW standard machine + I/O box + connecting box). The reduction of the number of parts and reexamination of the parts and structure reduced the size down to 0.101m3 and the mass to 60kg.

3.4 Expansion of Installation Variation

Although the installation method of the conventional machine has been only a fixed type, the "SANUPS" P73D103 adopts a wall-hanging type for both indoor and outdoor as a standard, and can be fixed by using an optional, stand-type metal fitting.
In addition, the installation variation was expanded by preparing a weather shelter as an option to block off direct sunshine.
Moreover, as for being waterproof and dustproof, performance was improved from the conventional IP33[note1)] standard to IP34[note 2)] standard by adding an easy structure to an air outlet.

3.5 High Efficiency ・ Low Stand-by Loss

The "SANUPS" P73D103 achieved the equivalent efficiency 92% (rated load efficiency based on JIS C 8961) with the conventional model by reexamining a main circuit part and career frequency though it has the function of a connecting box built in.
The power consumption (stand-by loss) at the time of power conditioner stand by was reduced to approximately 60% of the conventional product to be an even more energy-saving product.

3.6 Input Increase of Measurement Signal

The measurement data, which had not been able to be taken into the power conditioner, can now be taken in by increasing the points of the measurement signal input from the outside from the conventional two to four.

3.7 Acquisition of JET[note3)] Certificate

We usually have to have a conference in close cooperation with the local power company to request permission when we set up a photovoltaic generation system, and we have been spending a lot of time preparing documents for the conference and processing permission.
However, the time or expense spent for the conference can be cut if the power conditioner that is going to be installed has a JET Certificate because we can simplify the procedure of obtaining permission.
The "SANUPS" P73D103 acquired this JET certificate for the first time as our power conditioner. [note4)]
Therefore, we are sure that it will be possible to greatly contribute to the cost reduction at the introduction of this system in the future.

4. Specifications

Table 1 shows the main specifications of the "SANUPS" P73D103.

Table 1 Main Specifications of "SANUPS"P73D103

Item		SANUPS P73D103	Note
Output Capacity		10kW	
Method	Main Circuit Method	Self-urge Method Voltage Type	
	Switching Method	High Frequency PWM	
	Insulation Method	Transless	
DC Input	Rated Voltage	DC300V	
	Maximum Allowance Input Voltage	DC500V	
	Input Operation Voltage Range	DC200～500V	Rated Output Range DC280～450V
	Maximum Output Follow-up Control Range	DC200～450V	
AC Output	Number of Phases/ Lines	3 Phase 3 Line	S Phase Earth
	Rated Voltage	AC202V	
	Rated Frequency	50/60Hz Auto-identification	Fixed installation also available
	AC Output Currency Distortion Rate	Total of 5%, less than 3% each	Output Current Ratio
	Output Power Factor	0.95≦	At rated output
	Linkage Classification	Low Pressure/ High Pressure	
Efficiency		92%	Rated load efficiency based on JIS C8961
Interactive Protection		Over Voltage (OV) Under Voltage (UV) Over Frequency (OF) Under Frequency (UF) Ground Fault Over Voltage (OVGR)	OVGR installed externally
Independent Operation Detection	Passive Method	Voltage Phase Jump Method	
	Active Method	Non-effective Power Fluctuation Method	
Environment of Use	Ambient Temperature	-10～40℃(50℃)	Can be operated with output control between 40～50℃
	Relative Humidity	30～90%	Should be no condensation
	Altitude	2000m≦	

5. Conclusion

The main features of the "SANUPS"P73D103 were introduced above.

A drastic miniaturization and light weight were achieved in this product development compared with the conventional model by positively examining and adopting new ideas to realize the concrete target we put in our minds, specifically to reduce the number of parts.

In addition, the new product can greatly contribute to the cost saving of the entire system because we have paid much attention to not only the power conditioner itself but also the system.

We will continuously make efforts to achieve further high performance and low-cost of the power conditioner, and work on the development and design of products that consider the environment.

We would like to express our appreciation to those who cooperated and gave advice on this development and commercialization.

Note 1,2) Classifications provided in "JIS C 0920 Degrees of Protection Provided by Enclosures (IP Code). "

Note 3) JET:Japan Electrical Safety & Environment Technology Laboratories.

Note 4) Model name for JET Certificated Product is "P73D103KJ."

Norio Tazawa

Joined company in 1984.
Power Systems Division, 1st Design Dept.
Worked on the development and design of the Photovoltaic Power System.

Akinori Matsuzaki

Joined company in 1981.
Power Systems Division, 1st Design Dept.
Worked on the development and design of the Photovoltaic Power System.

Takeshi Hama

Joined company in 1986.
Power Systems Division, 1st Design Dept.
Worked on the development and design of the Photovoltaic Power System.

Yuuji Wada

Joined company in 1988.
Power Systems Division, 1st Design Dept.
Worked on the development and design of the Photovoltaic Power System.

Hiroshi Yamada

Joined company in 1994.
Power Systems Division, 1st Design Dept.
Worked on the development and design of the Photovoltaic Power System.

Tomohiro Nishibori

Joined company in 2001.
Power Systems Division, 1st Design Dept.
Worked on the development and design of the Photovoltaic Power System.

Katsutoshi Yamanaka

Joined company in 1996.
Power Systems Division, 1st Design Dept.
Worked on the development and design of the Photovoltaic Power System.