Development of the Power Conditioner for Photovoltaic Power Generation Systems “SANUPS P73H”

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1. Introduction

In recent years, anticipation towards renewable energy has risen as a way of achieving both the goals of economic growth and combating global warming. Among these, photovoltaic power generation has a large potential available supply and is expected to be effective in creating jobs for all industries. As a result, it is expanding through governmental supportive measures and there is great anticipation that diffusion will spread.

In 2009, Japan revived the subsidiary system for household photovoltaic power generation after three years and newly established a system by which the power company would buy surplus power at a fixed rate for the first 10 years after installation.

Industrial (non-household) photovoltaic power generation has not spread as much as for households, but since the price for buying surplus power was greatly increased in 2011, it is expected that introduction of photovoltaic power generation will accelerate in the future.

With these conditions, the market demands a high-efficiency, easy-to-use, and highly reliable power conditioner for photovoltaic power generation systems.

This document introduces an overview and features of the developed the “SANUPS P73H” .

2. Background of the Development

In order to obtain more power, photovoltaic power generation systems must obviously improve the efficiency of the photovoltaic battery modules (cells), but they also must improve the conversion efficiency of the power conditioner.

Furthermore, in recent years, photovoltaic battery modules have diversified, leading to an increasing demand for a wider DC input voltage range for power conditioners.

To meet these market demands, we developed the 10 kW power conditioner the “SANUPS P73H” with high conversion efficiency and a wide DC input voltage range.

3. Features

3.1 High conversion efficiency

The main circuit for the “SANUPS P73H” uses a non-insulating method that does not use an insulation transformer. Furthermore, in order to realize high conversion efficiency, the conversion circuit is composed of a soft-switch type chopper circuit and a 3-level type inverter circuit.

As a result, the “SANUPS P73H” has achieved top class conversion efficiency in the industry at 94.5%[*1].

3.2 Wide DC input voltage range

In order to address the diverse selection of photovoltaic battery modules of recent years, the “SANUPS P73H” can handle an input voltage of DC 600 V.

Furthermore, by increasing the input operating voltage range from the conventional model, “SANUPS P73D” , the new model can address specifications for diverse types of photovoltaic battery modules.

Fig. 1 shows the input operating voltage ranges for the “SANUPS P73H” and “SANUPS P73D” .

Since the “SANUPS P73H” covers the input operating voltage range for “SANUPS P73D” , the new model can also be effective as a replacement for the conventional model.

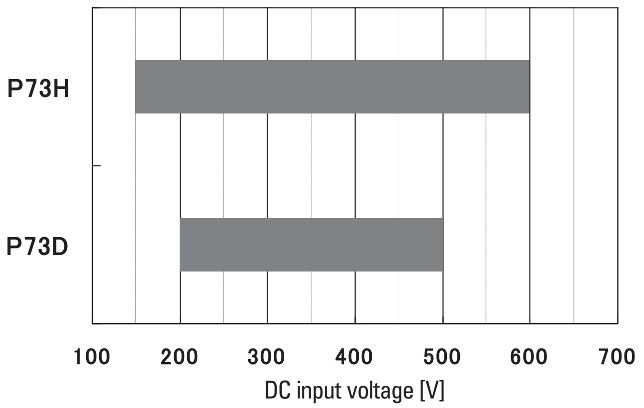


Fig. 1: Comparison of input operating voltage range

3.3 Superior environment resistance characteristics

3.3.1 Dustproof and waterproof performance

The “SANUPS P73H” has an airtight housing with superior dustproof and waterproof performance for use as an outdoor power conditioner. This structure protects the device from ingression of rain, dust, or small bugs to make a highly reliable product that customers can use with even greater security.

The “SANUPS P73H” has achieved protection class IP65*2 in the enclosure protection test from the Research Institute of Marine Engineering.

3.3.2 Ambient temperature range

The “SANUPS P73H” reworked the circuit parts from the conventional model and expanded the operating ambient temperature to range -25 to 60˚C*3.

With this, we have created a product that is almost entirely unrestricted by temperature in operating environments within Japan.

3.4 Built-in transducer function

The “SANUPS P73H” includes a built-in transducer (signal converter) circuit that can connect directly to the radiometer and thermometer, so an external transducer does not need to be obtained separately. Furthermore, as with the conventional model, it can also be connected to a 4 to 20 mA signal from an external transducer.

3.5 Acquisition of JET*4 authentication

The “SANUPS P73H” has achieved JET authentication as an outdoor type, wall-mounted 10 kW power conditioner, and therefore the time and cost associated with electric power consultations can be reduced.

4. Circuit Architecture

4.1. Circuit block diagram

Fig. 2 shows the circuit block diagram for the “SANUPS P73H” .

The “SANUPS P73H” consists of a main circuit unit (including a chopper circuit, inverter circuit, and filter circuit) and a control circuit unit (including a control circuit that controls the main circuits, interactive protection circuit, and external communication circuit).

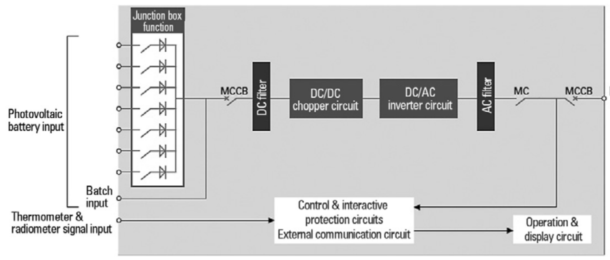
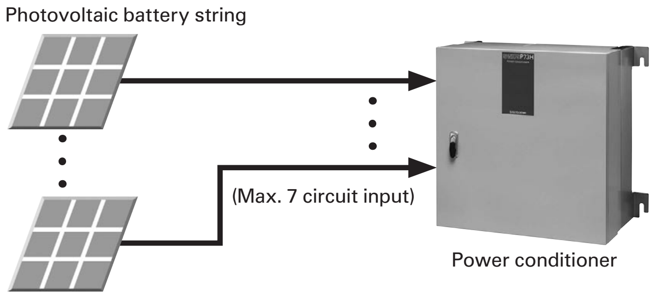


Fig. 2: Circuit block diagram of the “SANUPS P73H”

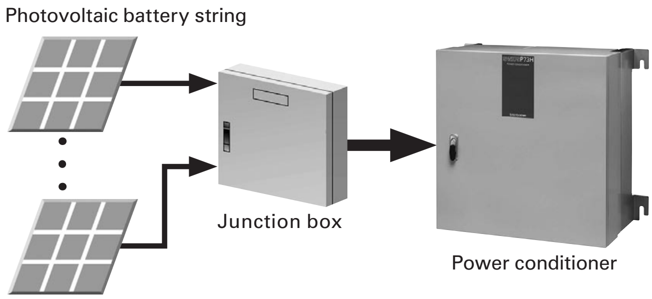
4.2 Flexible DC input circuit

The “SANUPS P73H” has both a junction box circuit (max. 7 circuit input) and a DC batch input circuit as standard specifications, and therefore it can flexibly address a variety of DC input specifications.

Fig. 3 shows the DC input method for the “SANUPS P73H” .



a. When using the junction box circuit



b. When using the DC batch input circuit

Fig. 3: DC input circuits for the “SANUPS P73H”

4.3 External communication circuit

External communications use RS-485, which is the same communication method as the conventional “SANUPS P73D” model.

When connected to the “SANUPS PV Monitor” from Sanyo Denki, this allows remote monitoring, plus data acquisition and analysis from radiometers and thermometers for the “SANUPS P73H”.

Fig. 4 shows an image of the connections when using “SANUPS PV Monitor” for remote monitoring.

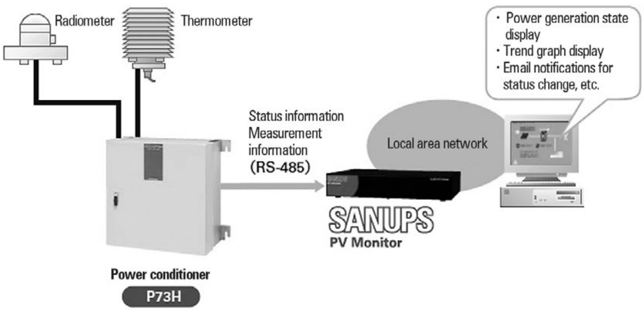


Fig. 4: Image of connection to PV Monitor

5. Specifications

Table 1 shows the specifications for the “SANUPS P73H”, while Fig. 5 shows the appearance.

Fig. 5: Appearance of the “SANUPS P73H”

6. Conclusion

This document described the overview of the “SANUPS P73H”.

The development of this product adds a model that can flexibly address the specifications of various photovoltaic battery modules to our lineup of power conditioners.

With the expected future growth of photovoltaic power generation, we believe that the demand will increase for power conditioners that have high efficiency, high performance, high reliability and low cost.

We will continue to quickly develop products that can address the requirements from the market, supply products that satisfy customers, and contribute to the realization of the low carbon society.

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

*1: Rated load efficiency based on “JIS C 8961 Measuring procedure of power conditioner efficiency for photovoltaic systems”. Excluding junction box circuit.

*2: Classification defined in “JIS C 0920 Degrees of protection provided by enclosures (IP Code)”.

*3: In a location that does not receive direct sunlight. If the ambient temperature exceeds 40°C, rising temperature is suppressed through limited output.

*4: JET = Japan Electrical Safety & Environment Technology Laboratories.

Table 1: Main specifications of the “SANUPS P73H”

Item		**SANUPS P73H**	**Remarks**
Rated output		10kW	
Method	**Main circuit method**	Self-commutation voltage type	
	Switching method	High-frequency PWM method	
	Insulation method	Transformer-less system	
DC input	**Rated voltage**	DC 400 V	
	Maximum allowable input voltage	DC 600 V	
	Input operation voltage range	DC 150 to 600 V	Rated output range DC 280 to 550 V
	Maximum power point tracking control range	DC 150 to 550 V	
	No. of input circuits	7 circuits(Max. 10 A per circuit) 1 circuit(Batch input)	In the case of batch input, an external junction box is required
AC output	**No. of phases/wires**	Three phase, three wire	S phase ground
	Rated voltage	AC 202 V	
	Rated frequency	50 Hz or 60 Hz	
	Rated output current	AC 28.6 A	
	AC output current distortion factor	Total: 5% or less 3% or less for each harmonics	Rated output current ratio
	Output power factor	0.95 or higher	During rated output
Efficiency		94.5%(Excluding junction box circuit)	Rated load factor based on JIS C 8961
Grid connected protection function		Over-voltage (OV) Under-voltage (UV) Over-frequency (OF) Under-frequency (UF)	Over-voltage ground relay (OVGR) is installed externally.
Islanding operation detection	**Passive method**	Voltage phase jump method	
	Active method	Reactive power fluctuation method	
Environment	**Ambient temperature**	-25 to + 60°C	When ambient temperatures are above +40°C , the output power is limited
	Relative humidity	90% or less	Non-condensing
	Altitude	2,000 m or less	
Coating color		Munsell 5Y 7/1(Semi-glossy)	
Transducer function		Yes	For radiometer For thermometer

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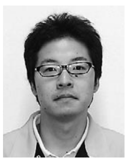

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