

# Development of the *SANUPS W75A* Rectifier Unit for Wind Power and Hydro Power Generation Systems

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## 1. Introduction

In recent years, renewable energy sources such as photovoltaic, wind, hydro, and biomass have been attracting worldwide attention as potential candidates to help achieve decarbonization. At the end of 2015, the Paris Agreement was decided as a common goal for the world. Moreover, in 2018, Japan established its 5th Strategic Energy Plan.<sup>(1)</sup> The plan aims to make renewable energy “an economically self-supporting, decarbonized main source of electricity” by 2050. Moving forward, it is expected that the introduction of renewable energy will be promoted further.

In addition to widespread photovoltaic power generation, wind and hydro power generation are two other renewable energy sources that are attracting increasing attention in Japan. Compared to other renewable energy sources, the introduction of wind power generation is expected to expand due to its relatively low cost and applicability under the feed-in tariff scheme. As for hydro power generation, it has a higher energy conversion efficiency than other sources, and

also facilitates long-term operation and stable supply. As a result, micro hydro power generation is attracting attention for its use in agricultural water and waterworks applications.

We have newly developed the *SANUPS W75A* rectifier unit that can be used in wind power and hydro power generation systems with output capacities of 10 kW or less. This article introduces the features of this new product.

## 2. Development Background

Figure 1 illustrates a simplified power generation system. Wind and hydro power generation systems require the use of a rectifier to convert the AC power generated by the generation system into DC power for use with its power conditioners (i.e., renewable energy inverters).

However, there had been no standard rectifiers on the market for generation systems with an output capacity of 10 kW or less. Therefore, we have developed the *SANUPS W75A* as a rectifier that can be used in such power generation systems.

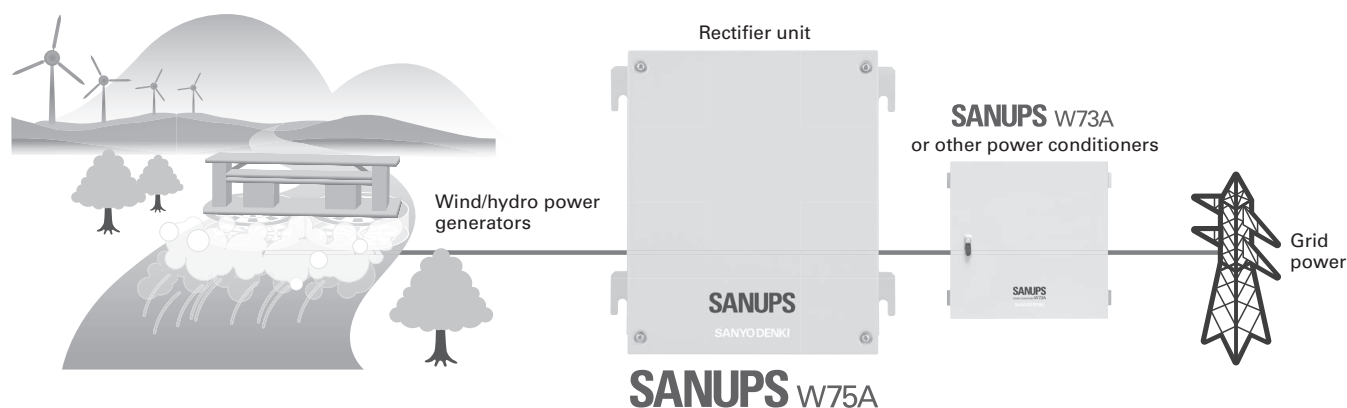


Fig. 1 Power generation system overview

### 3. Outline and Specifications of the SANUPS W75A

The SANUPS W75A has a rated output capacity of 11 kW. Table 1 shows its specifications and Figure 2 its appearance.

The main circuit uses a full-wave rectification method. It converts the AC power generated by the system's generators into DC power for use with the power conditioners. Its conversion efficiency is 99%<sup>(1)</sup>, the highest level in the industry.

Table 1 Specifications of the SANUPS W75A

Items		Model no.	W75A113	Remarks
<b>Main circuit type</b>			Full-wave rectification	
<b>Cooling system</b>			Passive air cooling	
<b>Rated Output</b>			11 kW	The generator output should be 11 kW or less. If exceeding this, contact us.
<b>AC input</b>	<b>No. of phases/wires</b>		3-phase 3-wire	
	<b>Rated voltage</b>		300 VAC	
	<b>Maximum allowable voltage</b>		420 VAC	Take necessary measures at the generator side to ensure that a voltage higher than the maximum allowable input voltage will not be applied.
	<b>Input operating voltage range</b>		106 to 420 VAC	Rated output range is 176 to 420 VAC.
	<b>Input frequency range</b>		0 to 400 Hz	
	<b>Rated input current</b>		30 AAC	At a power factor of 0.7
	<b>Number of circuits</b>		1 circuit	
<b>DC output</b>	<b>Current type</b>		Direct current	
	<b>Rated voltage</b>		420 VDC	
	<b>Maximum current</b>		45 ADC	
	<b>Rated current</b>		26 ADC	
	<b>Voltage range</b>		0 to 600 VDC	
<b>Brake</b>	<b>Operating voltage</b>		530 VDC	Release voltage: 400 VDC
	<b>Current</b>		Mean: 25 A max.	
<b>Efficiency</b>			99%	Efficiency measurement method in accordance with JIS C 8961: 2008
<b>Acoustic noise</b>			25 dBA or less	At 1 m height, 1 m from the front of the unit
<b>Operating environment</b>	<b>Operating temperature range</b>		-25 to +60°C	When using in combination with a SANUPS W73A power conditioner in the same environment
	<b>Relative humidity</b>		90% or less (non-condensing)	
	<b>Altitude</b>		2000 m max.	
<b>Protection rating</b>			IP65	
<b>Housing material</b>			SUS430	Thickness 1.2 mm

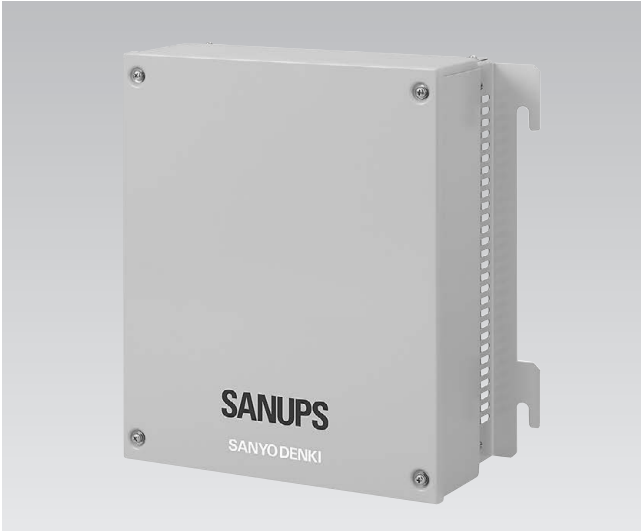


Fig. 2 SANUPS W75A

The SANUPS W75A was designed to be used in combination with our SANUPS W73A series power conditioners for three-phase 10 kW wind power and hydro power generation systems. This rectifier unit can be combined with power conditioners other than the SANUPS W73A series products if their ratings such as DC output voltage range are within the specifications shown in Table 1.

(1) Efficiency measurement is according to JIS C 8961. Our SANUPS W73A power conditioner was used as the load.

## 4. Features of the SANUPS W75A

### 4.1 DC voltage rise control function (Brake function)

The SANUPS W75A is equipped with a DC voltage rise control function (brake function) to prevent damage to the power conditioner in the event that the generator generates power in excess of the power conditioner's input voltage range. This function can be enabled by connecting an external shunt resistor. Figure 3 shows the circuit block diagram of the SANUPS W75A.

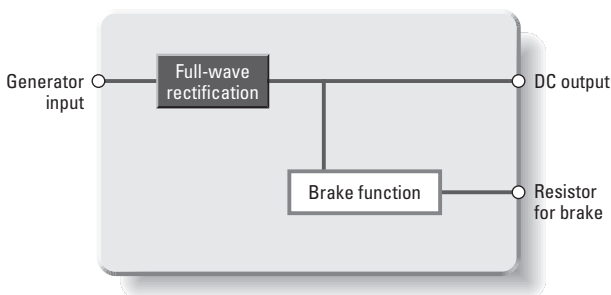


Fig. 3 Circuit block diagram of the SANUPS W75A

This function constantly monitors the DC output voltage. When the output voltage exceeds the specified value, the brake function is activated to send current to the resistor for brake. This prevents the input voltage of the power conditioner from rising too high. In addition, the product has a potential difference between the brake activation and release voltages to ensure that the control function is not activated too often.

### 4.2 Generator speed contact output

In wind power and hydro power generation systems, it is necessary at times to collect generator speed data.

The SANUPS W75A comes with a contact output terminal that outputs the generator's output voltage frequency. Generator speed can be measured using the output voltage frequency. Moreover, generator speed can be monitored by connecting a signal transducer to the contact output terminal.

In addition, by using the SANUPS W73A series and the SANUPS PV Monitor remote monitoring device in combination, remote monitoring and data collection of generator speed can be done via a network, helping build smart grid systems.

### 4.3 Temperature rise alarm contact output

The SANUPS W75A continuously monitors the temperature of its full-wave rectification circuit. The rectifier unit comes with a contact output terminal that turns off the full-wave rectification circuit by opening the circuit when the temperature of the circuit exceeds its specified value. Furthermore, the safety of the system can be enhanced by using the contact output to incorporate controls such as safe shutdown of the generator and power conditioner.

### 4.4 Quiet operation

The SANUPS W75A uses a fanless passive air cooling system to improve its quietness. The rectifier uses large cooling fins that take into account the temperature rise of the diodes used in the full-wave rectification circuit. By making the cooling fins a part of the housing, this product satisfied the required cooling performance even with a sealed structure and also achieved quiet operation.

Figure 4 shows the rear surface of the SANUPS W75A.

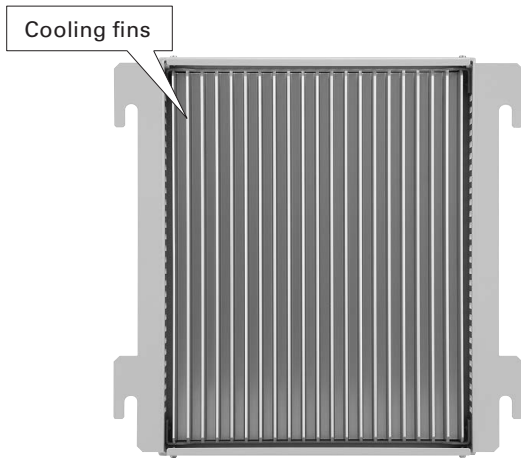


Fig. 4 Rear structure of the *SANUPS W75A*

#### 4.5 Waterproof and dustproof

With a sealed structure and fanless passive air cooling system, the *SANUPS W75A* achieves an IP65<sup>(2)</sup> water and dust protection rating. The structure completely protects the unit from dust and water sprayed from all directions.

This means that the unit is protected from rainwater, dust, small insects, and animals. This enables the construction of an environmentally durable system that can be safely used outdoors for long periods of time.

#### 4.6 Use in other power generation systems

The *SANUPS W75A* has a wide range of voltages. Specifically, it covers an AC input voltage range of 106 to 420 VAC and DC output voltage range of 0 to 600 VDC. Use of this rectifier is not limited to wind and hydro power generation systems. It can be used in a variety of renewable energy generation systems that use 3-phase generators, including biomass and geothermal power generation systems.

### 5. Conclusion

This article introduced the *SANUPS W75A* rectifier unit for wind and hydro power generation systems. In addition to the rectifier's basic functions for converting the AC power generated by generators into DC power, it also comes with contact output and environmental durability.

We believe that this product will contribute to the promotion of renewable energy generation systems such as those for wind and hydro power generation.

We will continue to develop products in related fields in a timely manner so that we can meet the needs of our customers. By doing this, we expect that our products will contribute to the spread of renewable energy and the realization of a low-carbon society.

- (2) Classifications defined in "JIS C 0920: Degrees of Protection Provided by Enclosures (IP Code)"  
IP65: Complete protection from dust and against water spray from all directions. (Based on the protection performance test defined by Japan Ship Machinery Quality Control Association Research Institute of Marine Engineering)

#### References

- (1) "The 5th Strategic Energy Plan," Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry  
[https://www.enecho.meti.go.jp/category/others/basic\\_plan/pdf/180703.pdf](https://www.enecho.meti.go.jp/category/others/basic_plan/pdf/180703.pdf) (2019.9.17)

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