Development of the "SANUPS PV Monitor E Model" with an Output Control Function

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1. Introduction

Following the establishment of the feed-in-tariff law, which aims to popularize and expand renewable energy, there was a rapid increase in power generating equipment which utilize renewable energy, in particular photovoltaic power generation equipment. Consequently, power companies have been unable to balance supply and demand, and publicly announced they have put connection with such power generation equipment on hold due to the risk of hindering the stable supply of power. Therefore, in order to prepare to introduce renewable energy to the maximum extent possible, the Agency for Natural Resources and Energy released ministerial ordinances in January and March of 2015 for the partial amendment of the Act on Special Measures Concerning Procurement of Renewable Electric Energy by Operators of Electric Utilities. In these ordinances, the conventional rules of output control were revised and the introduction of output control systems for power generation equipment utilizing renewable energy was made obligatory.

In order to accommodate such an output control system, we developed the "SANUPS PV Monitor E Model", a photovoltaic power generation system monitoring device with an output control function. This document provides an overview of this product.

2. Overview of the Output Control System

2.1 New output control rules

The new output control rules according to the amended ordinances are as follows:

(1) Photovoltaic power generation equipment less than 500 kW shall also be covered by output control

(2) Uncompensated output control which could be performed for up to 30 days a year in 1-day units shall be possible to be performed unlimited in 1-hour units

(3) The introduction of power conditioners with an output control function (hereinafter "PCS") has been made obligatory in order to realize output control systems

2.2 Configuration of a PCS system with an output control function

Figure 1 shows the configuration of a PCS system with an output control function. This system controls the output power of a PCS based on the output control schedule presented by a power company and is configured from an output control unit and a PCS (narrow sense).

(1) Output control unit

A control system with a function to obtain output control schedules presented by a power company or distribution company, and control a (2) PCS (narrow sense) based on the schedule. Even in the absence of an external communication function, the unit controls the (2) PCS (narrow sense) in accordance with a fixed schedule saved within it.

The "SANUPS PV Monitor E Model" with an output control function developed this time meets the definition of an output control unit.

(2) PCS (narrow sense)

In addition to the conventional functions, a PCS with a function to control the output (maximum) of photovoltaic power generation in accordance with information on output control received from the (1) output control unit.

Our products which meet the definition of a PCS in the narrow sense are the "SANUPS P61B", "SANUPS P73H", "SANUPS P73J", and "SANUPS P83E".

(3) PCS (broad sense)

A system configured from an (1) output control unit and a (2) PCS (narrow sense), or a system which integrates the functions of an (1) output control unit and a (2) PCS (narrow sense).

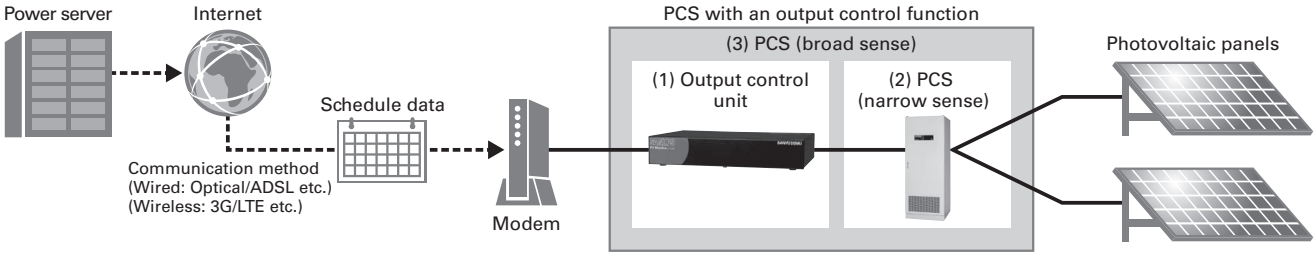


Fig. 1: Configuration of a PCS system with an output control function

2.3 Operation method of the output control system

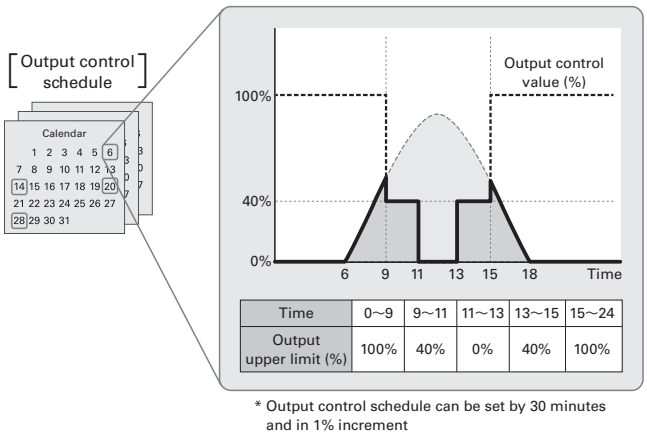
(1) Overview of output control operations

Figure 2 provides an overview of output control operations. The output control unit sends an output control value to the PCS (narrow sense) in accordance with the output control schedule obtained from the power server. The daily output control schedule is set in units of 1% for every 30 minutes and the PCS (narrow sense) increases or decreases output in accordance with the output control value.

Moreover, the output control unit controls output by obtaining one years' worth of output control schedules in advance. However, if the output control unit has an external communication function, it can obtain an output control schedule updated at least every 30 minutes from the power server and constantly rewrite the schedule.

(2) Function for conversion to contract capacity

When PCS capacity and panel capacity do not match, the output control value is converted from contract-capacity base to PCS-capacity base and sent to the PCS (narrow sense). Figure 3 provides an overview of the function for conversion to contract capacity.



Time	0~9	9~11	11~13	13~15	15~24
Output upper limit (%)	100%	40%	0%	40%	100%

* Output control schedule can be set by 30 minutes and in 1% increment

Fig. 2: Overview of output control operations

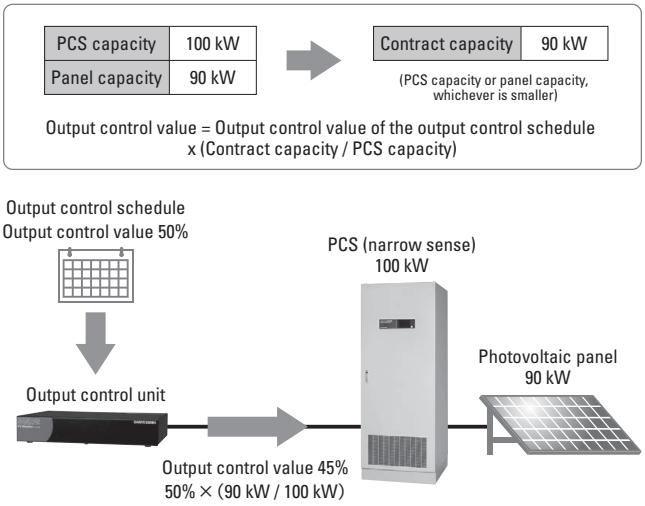


Fig. 3: Overview of the function for conversion to contract capacity

3. Product Overview

Figure 4 is a photograph of the "PV Monitor E Model" with an output control function. This product forms an output control system when connected with a Sanyo Denki PCS for photovoltaic power generation via RS-485 communication. Moreover, through the LAN interface, the user can check the amount of power generated by the photovoltaic power generation system, as well as remotely monitor, configure and control the PCS connected to this product.

Fig. 4: Photograph of the "SANUPS PV Monitor E Model" with an output control function

4. Features

4.1 Configuration of an output control system

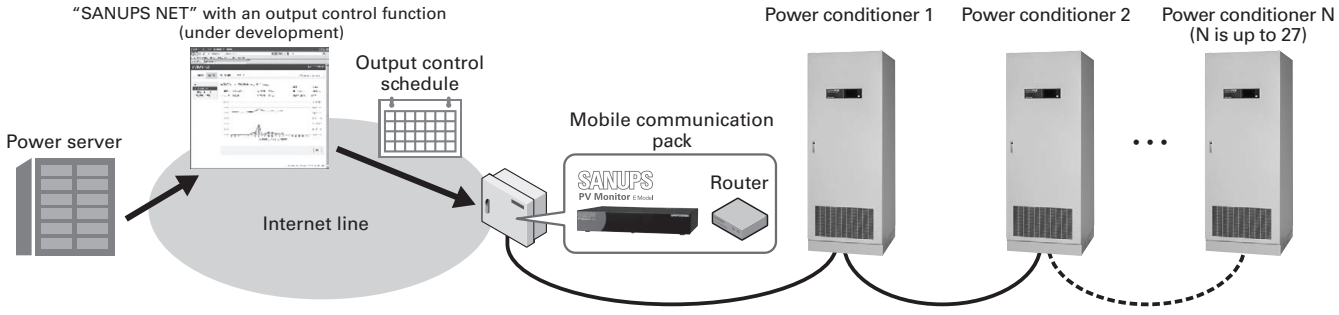
As an output control unit, the "SANUPS PV Monitor E Model" with an output control function can be connected with up to 27 Sanyo Denki-made PCS for photovoltaic power generation systems. Figure 5 shows the configuration of an output control system using this product. It is possible to configure a system which updates the output control schedule as needed via an Internet connection (output control system based on rewriting the output control schedule), or a system whereby the power producer updates the output control schedule regularly (output control system based on a fixed schedule).

(1) Output control system based on rewriting the output control schedule

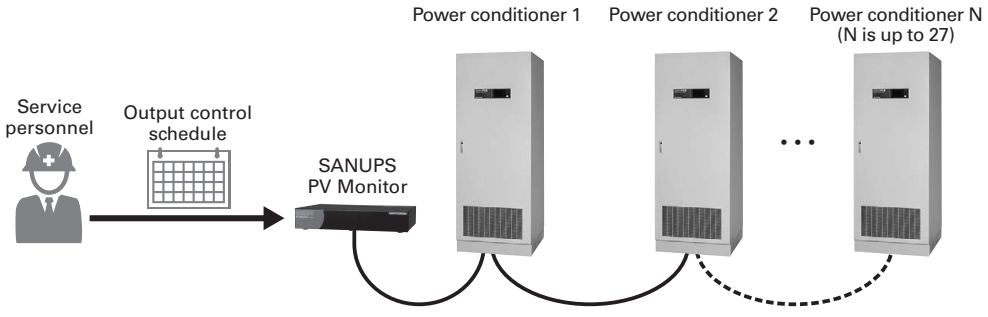
In this system, the "SANUPS NET" with an output control function (in development), which is a service for monitoring the status of photovoltaic power generation systems, obtains the output control schedule from power servers and uses an Internet connection to update the output control schedule of the "SANUPS PV Monitor E Model" with an output control function on an as needed basis. Even if there is no Internet connection available in the installation location, this system can be realized by using a "Mobile Communication Pack". It consists of a "PV Monitor E Model" with an output control function and a router for mobile communication, and they are contained in an enclosure for outdoor use. The "Mobile Communication Pack" can be used in FOMA 3G communication area.

(2) Output control system based on a fixed schedule

In the case of this system, the power producer manually updates the output control schedule of the "SANUPS PV Monitor E Model" with an output control function at least once a year from the power server.



(1) Output control system based on rewriting the output control schedule



(2) Output control system based on a fixed schedule

Fig. 5: Configuration of an output control system using a "SANUPS PV Monitor E Model" with an output control function

4.2 Output control function

Figure 6 shows the output control confirmation screen. On this screen the user can check the control schedule obtained from the power server every 30 minutes in units of 1% for up to 1000 days' worth of output control schedules.

Moreover, when PCS capacity and panel capacity do not match, output control value is converted from contract-capacity base to PCS-capacity base and sent to the PCS using the method described in 2.3 (2).

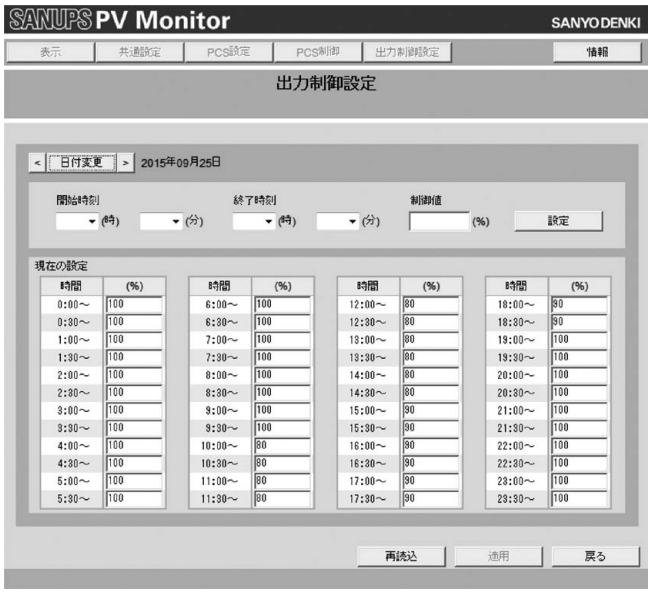


Fig. 6: Output control confirmation screen

4.3 Monitoring function for photovoltaic power generation systems

As per the conventional approach, this is a function to monitor photovoltaic power generation systems. It displays the measurements of amount of power generated by the photovoltaic power generation system, etc. collected from a PCS and monitors the PCS's status via email, etc.

This time, the function has been enhanced to include a PCS status display screen, which displays the status of the connected PCS. Figure 7 shows the PCS status display screen. On this screen it is possible to display the PCS operational status, output control status and the output control values sent to the PCS for the number of registered units, all in a list format.

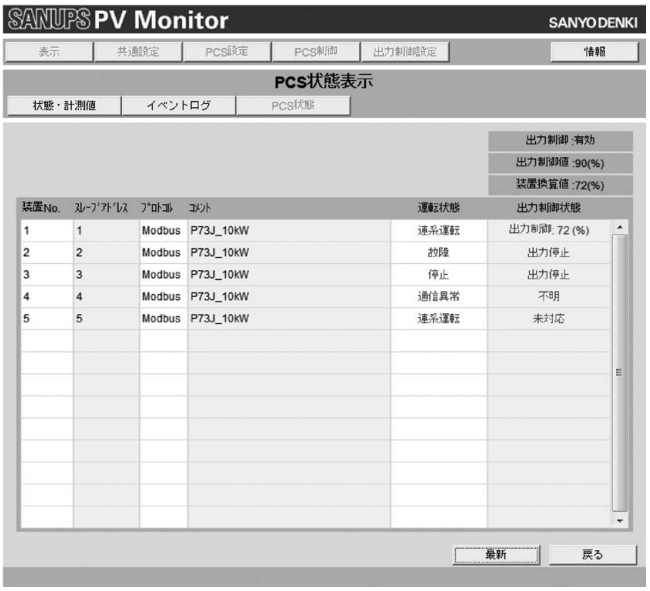


Fig. 7: PCS status display screen

4.4 PCS settings/control function

This product can set and control the connected PCS. Figure 8 shows the PCS settings screen. On this screen, the user can check or change settings of the PCS main unit such as the PCS grid-connection protection function setting, output power factor setting, and settings related to isolated operation.

Figure 9 shows the PCS control screen. On this screen, the user can perform various controls, such as start and stop of PCS and change of operation modes.

PCS which support this function are the "SANUPS P73H", "SANUPS P73J", and "SANUPS P83E".

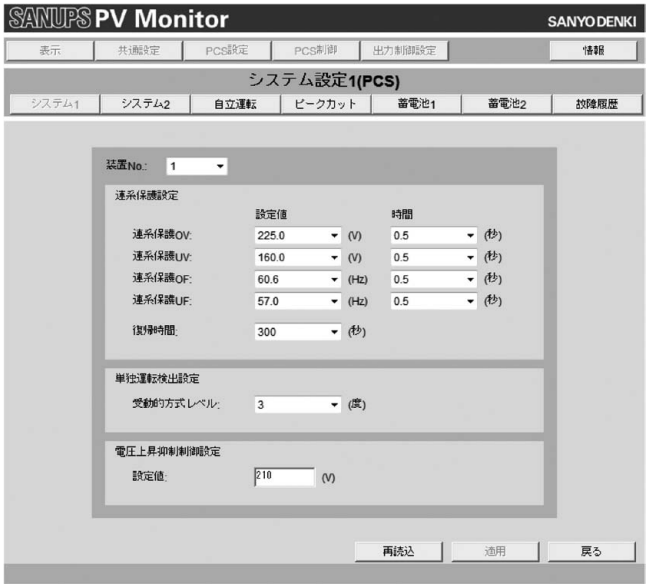


Fig. 8: PCS settings screen

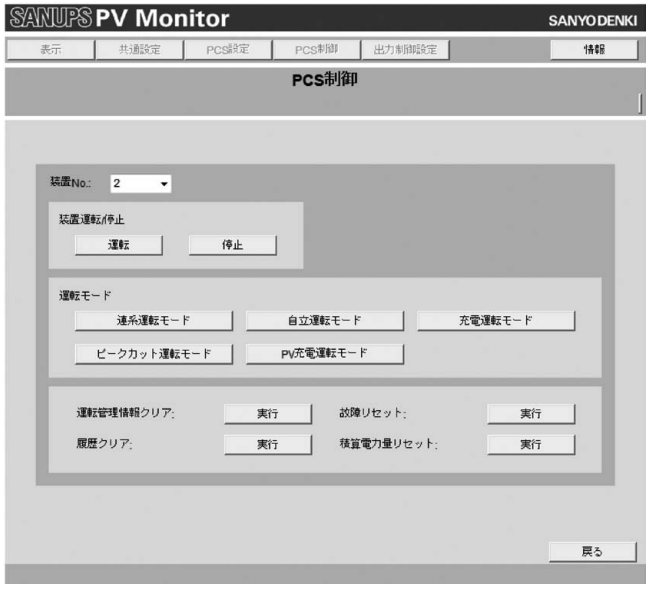


Fig. 9: PCS control screen

5. Specifications

Table 1 shows the specifications of the "SANUPS PV Monitor E Model" with an output control function, while Table 2 shows its functions.

Table 1: Specifications of the "SANUPS PV Monitor E Model" with an output control function

Item		Specifications	Remarks
Input voltage		100 to 240 V AC	
Allowable input voltage range		85 to 264 V AC	
Input frequency		50/60 Hz	
Maximum power consumption		5 W	
External interface	**Power conditioner interface**	RS-485	Attachable terminal strip 3-pin
	LAN interface	100BASE-Tx / 10BASE-T	RJ-45
	Settings port	RS-232C USB	RS-232C D-Sub 9 Pin (male) MiniUSB
Operating environment	**Ambient temperature**	-25 to +60˚C	
	Relative humidity	90% max.	Non-condensing
Dimensions		220 x 150 x 40 mm (W x D x H)	Protruding parts not included
Mass		1.0 kg	

Table 2: Functions of the "SANUPS PV Monitor E Model" with an output control function

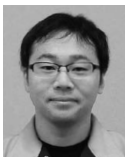
Item	Content	Remarks
Output control function	Output control value setting (every 30 minutes), Holds up to 1000 days' worth	
PCS setting function	System setting, isolated operation setting, peak-cut setting, storage battery setting, error history display	Only supports 3-phase PCS
PCS control function	Start/stop operations or change operation modes	Only supports 3-phase PCS
E-mail monitoring function	Event notification emails, request email response, report emails	
SNMP support	Standard MIB (RFC1213), Expansion MIB	
WEB support	Power generation status diagram, trend graph (daily/monthly reports)	
Measurement data collection	Information sampling interval: 10 sec, Connected devices: Max. 27 units	
Measurement data tally	Holds 42-days' worth of 10-min aggregation data (system total value)	
	Holds 42-days' worth of 1-hr aggregation data (individual machine x 27 units)	
	Holds 25-months' worth of 1-day aggregation data (individual machine x 27 units)	
DHCP	Compatible	
NTP	Compatible	
Data download using FTP	Measurement information, event information, settings information, aggregation information, output control schedule	
Non-communication monitoring (alive monitoring)	Email monitoring, SNMP monitoring	
Remote parameter settings	SSH, Telnet, WEB	
Remote program updates	Possible	
Coexistence with data collection devices	Possible	

6. Conclusion

This document has provided an overview of the “SANUPS PV Monitor E Model”, a photovoltaic power generation system monitoring device with an output control function. The development of this product has made the configuration of a photovoltaic power generation output control system possible.

It is predicted that more requirements will emerge relating to the maintenance and monitoring of photovoltaic power systems. We intend to develop more sophisticated products to meet these requirements and continue to provide products which earn customer satisfaction.

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



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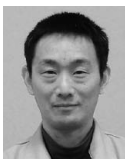

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