Development of the Output Control Function "SANUPS PV Monitor Type C"

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1. Introduction

The Agency for Natural Resources and Energy of Japan released the "Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electricity Utilities" in January and March of 2015. This act required power generating equipment utilizing renewable energy to be equipped with an output control system.

To conform to such an output control system, in August 2015, SANYO DENKI developed the "SANUPS PV Monitor E Model" PV power system monitoring device with an output control function[(1)]. At the time of this product's development, the method for obtaining output control schedules from power company servers was yet to be decided. But in September 2016, Kyushu Electric decided on the method and it was decided that their output control implementation would start from April 2017. Responding to this, we developed the "SANUPS PV Monitor Type C." This paper will provide an overview of this new product.

2. Overview of the Output Control System

2.1 New output control rules

The abovementioned act has established the following new output control rules.

(1) Output control will also apply to PV power generation facilities of under 500 kW
(2) Uncompensated output control, formally allowed for up to 30 days in a year in units of 1 day, may be conducted with no limit on the number of days, in units of an hour
(3) To realize output control systems, the installation of PV inverters with an output control function has been made compulsory

2.2 Configuration of a PV inverter system with an output control function

Figure 1 shows the configuration of a PV inverter system with an output control function. This system controls the PV inverter's output power based on an output control schedule obtained from a power company and consists of an output control unit and PV inverter.

(1) Output control unit

We define an "output control unit" as: a control device with a function to control "(2) PV inverter" based on the output control schedule obtained from a power company server. Even if this unit is not capable of communicating externally, it controls "(2) PV inverter" in accordance with a fixed schedule stored within.

The "SANUPS PV Monitor Type C", newly developed by SANYO DENKI, conforms to these requirements.

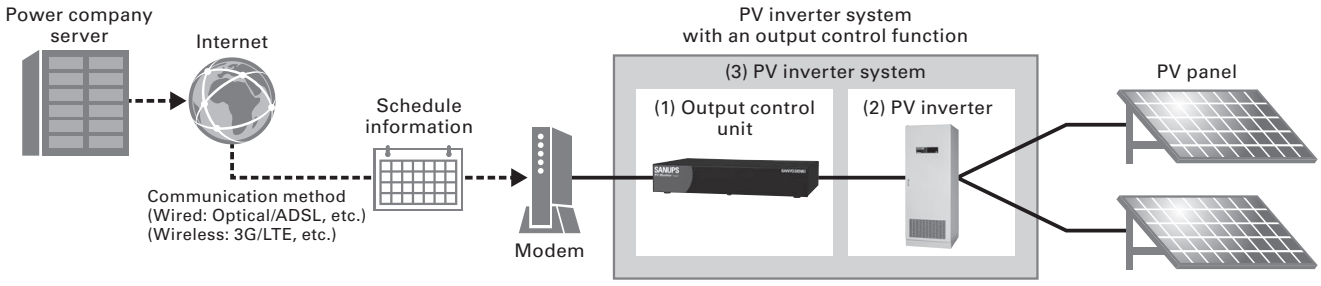


Fig. 1: Configuration of a PV inverter system with an output control function

(2) PV inverter

We define a “PV inverter” as: a PV inverter with an additional function to control the PV power generation output (upper limit value), based on output control information received from the “(1) output control unit”.

Of the SANYO DENKI product lineup, “SANUPS P61B”, “SANUPS P73H”, “SANUPS P73J”, “SANUPS P73K”, and “SANUPS P83E” conform to this requirement.

(3) PV inverter system

We define a “PV inverter system” as: a system consisting of a “(1) output control unit” and “(2) PV inverter” or a system integrating the functions thereof.

2.3 Output control system operation method

(1) Overview of output control operation

An output control unit obtains 1 year’s worth of output control schedules in advance and controls output based on them. However, if an output control unit has an external communication function, it will update the output control schedule as needed by obtaining the latest version from the power company server, which updates the schedule every 30 minutes at the shortest.

Figure 2 provides an overview of output control operation. In accordance with the output control schedule obtained from the power company server, the output control unit sends an output control value to the PV inverter. The output control schedule for each day is set in 30-minute intervals in increments of 1% and the PV inverter increases or decreases its output in accordance with the output control value.

(2) Contract capacity conversion function

If the PV inverter capacity doesn’t coincide with the panel capacity, this function will convert the output control value from “contract capacity base” to “PV inverter capacity base” and transmits it to the PV inverter. Figure 3 provides an overview of the contract capacity conversion function.

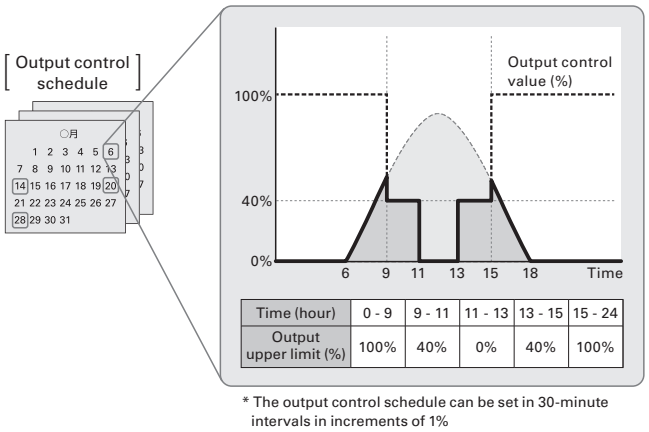


Fig. 2: Overview of output control operation

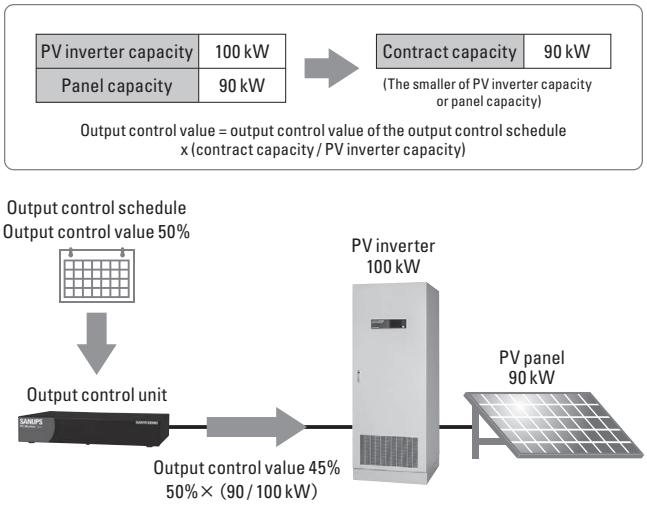


Fig. 3: Overview of the contract capacity conversion function

3. Product Overview

Figure 4 is an external view of the “SANUPS PV Monitor Type C”. This product is connected to SANYO DENKI’s PV inverters via the RS-485 communication interface to configure an output control system. Moreover, using a LAN interface, it enables users to check the amount of power generated by the PV power system as well as monitor remotely, do settings of, and control the connected PV inverters.

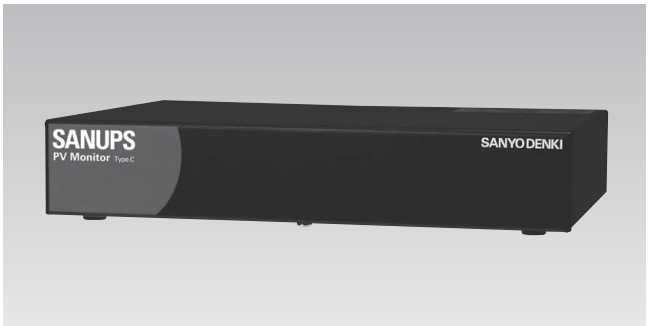


Fig. 4: External view of the “SANUPS PV Monitor Type C”

4. Features

4.1 Output control system configuration

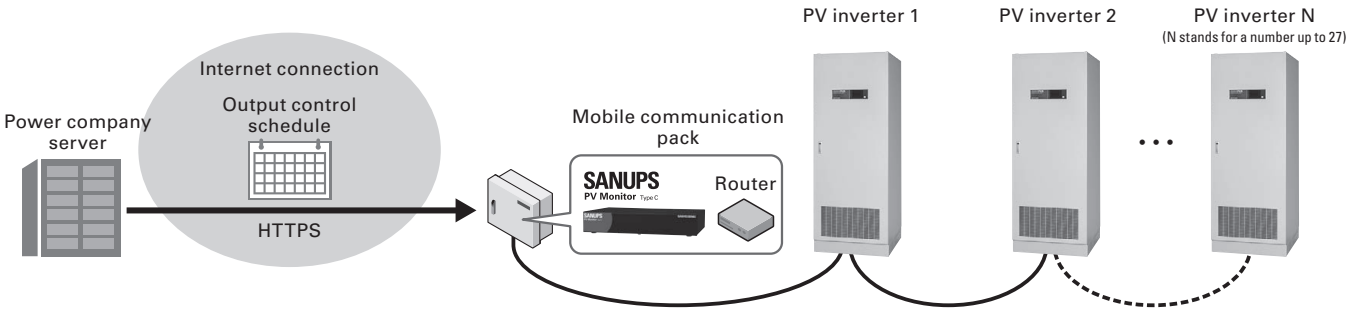
As an output control unit, the "SANUPS PV Monitor Type C" can be connected to up to 27 units of our PV inverter. Figure 5 shows the configuration of an output control system using this product. In one system configuration, the output control schedule is updated as needed via an internet connection (an output control system based on rewriting of the output control schedule). The other system configuration doesn't require an internet connection and the individual operators themselves update the output control schedule periodically (an output control system based on a fixed schedule).

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

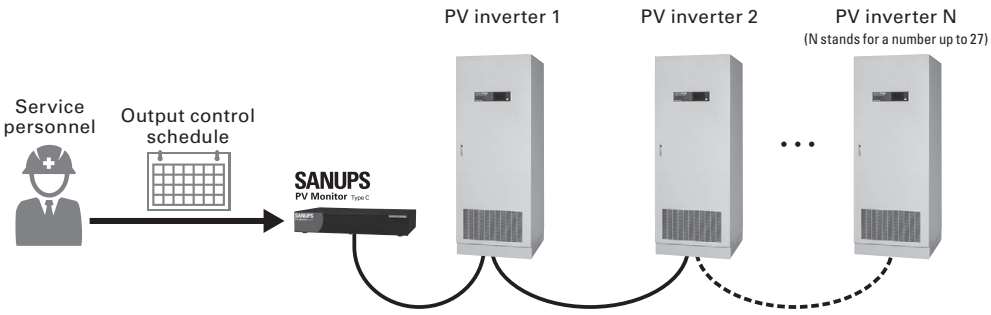
In this system, the output control schedule that "SANUPS PV Monitor Type C" has is updated as needed by obtaining the latest schedules from the power company server via an internet connection. This system can be built even in environments without internet connections by using the "Mobile Communication Pack", which stores the "SANUPS PV Monitor Type C" and a router for mobile communication in a case suited to outdoor use. The "Mobile Communication Pack" can be used in any area with FOMA or Xi communication coverage.

(2) Output control system based on a fixed schedule

In this system, individual power generation operators themselves manually obtain output control schedules from the power company server at least once a year then update the output control schedule of the "SANUPS PV Monitor Type C" accordingly.



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



(2) Output control system based on a fixed schedule

Fig. 5: Configuration of an output control system using the "SANUPS PV Monitor Type C"

4.2 Function for communicating with power company server

Figure 6 shows the screen for setting the schedule transmission conditions. On this screen, you can set the information necessary to communicate with power company servers.

An output control unit can obtain output control schedules by communicating with power company server via secure communication based on Transport Layer Security (TLS) protocol, using Hypertext Transfer Protocol Secure (HTTPS).

On this screen, users can set the information needed to communicate with power company servers such as power station ID, transmission server URL, etc.

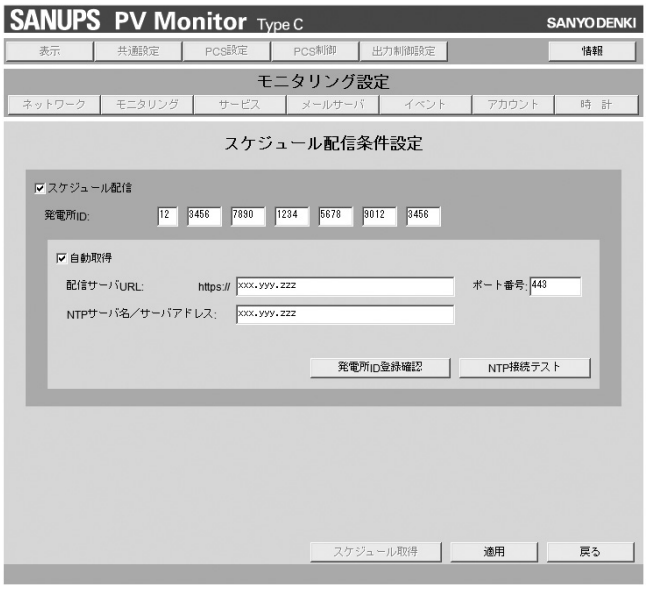


Fig. 6: Screen for setting the schedule transmission conditions

4.3 Time synchronization function with power company server

To obtain output control schedules from power company servers and control PV inverter output power based on these, time synchronization with power company servers has been made compulsory.

Current products are also equipped with a time synchronization function based on Network Time Protocol (NTP), however, in the case of obtaining output control schedules from power company servers, synchronization with power company server time need to be performed at the time of periodical update predesignated by the power company.

4.4 Output control function

Figure 7 shows the output control browsing screen. On this screen, users can check control schedules for 30-minute intervals in increments of 1% obtained from power company servers and check up to 1000 days' worth of output control schedules.

Also, if the PV inverter capacity and panel capacity are inconsistent, the output control value will be converted from "contract capacity base" to "PV inverter capacity base" then transmitted to the PV inverter.

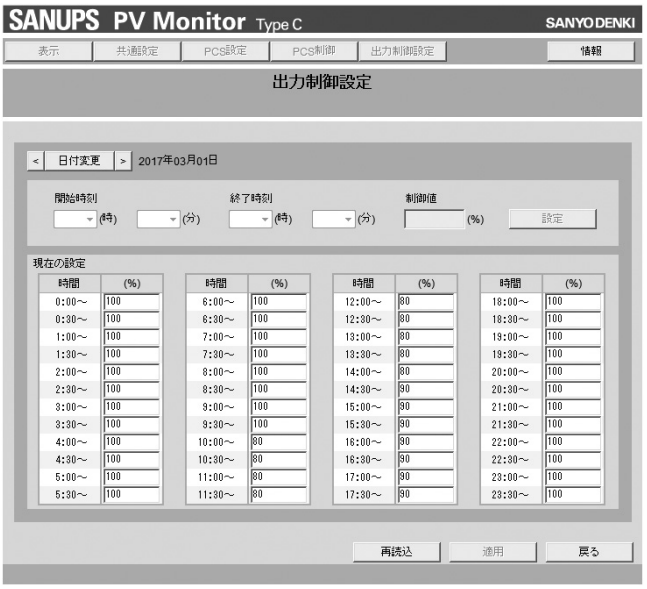


Fig. 7: Output control browsing screen

4.5 PV power system monitoring function

This is a function for monitoring the PV power system overall by displaying measurement values, such as power generation amount collected from the PV inverters, monitoring PV inverter status via email, etc.

Moreover, the PV inverter status display screen enables users to monitor the status of connected PV inverters. Figure 8 shows the PV inverter status display screen. This screen displays a list of PV inverter operating status, output control status, and the output control values transmitted to PV inverters for the number of units registered.

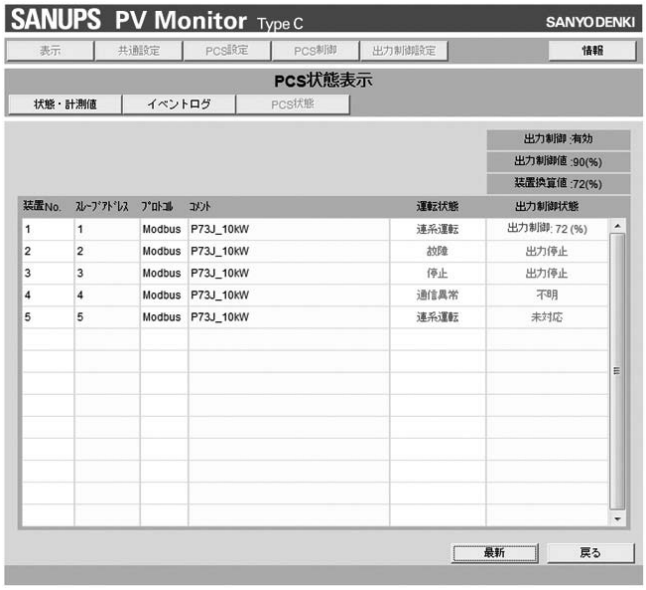


Fig. 8: PV inverter status display screen

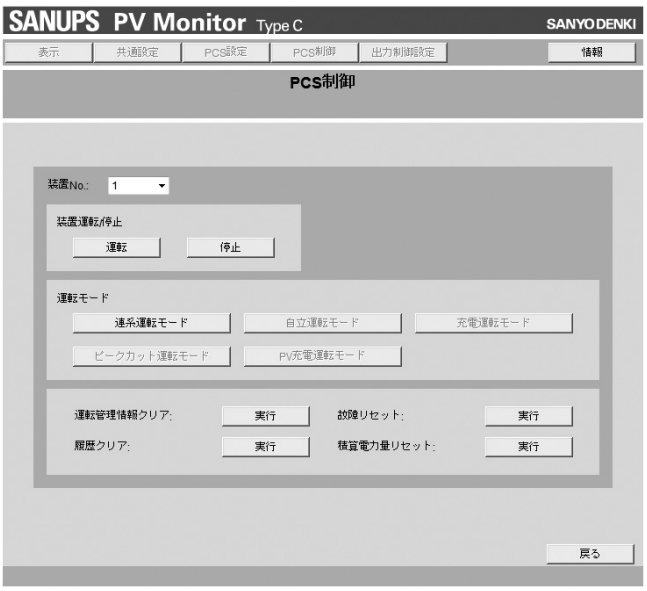


Fig. 10: PV inverter control screen

4.6 PV inverter setting/control function

This product enables the user to set and control connected PV inverters. Figure 9 shows the PV inverter settings screen. On this screen, users can confirm and change settings of the PV inverter main unit including the PV inverter interconnection protection function, output power factor and settings related to isolated operation.

Figure 10 shows the PV inverter control screen. This screen is for controlling the PV inverter, including operating, stopping and switching operation mode.

The PV inverters that support this function are the “SANUPS P73H”, “SANUPS P73J”, “SANUPS P73K” and the “SANUPS P83E”.

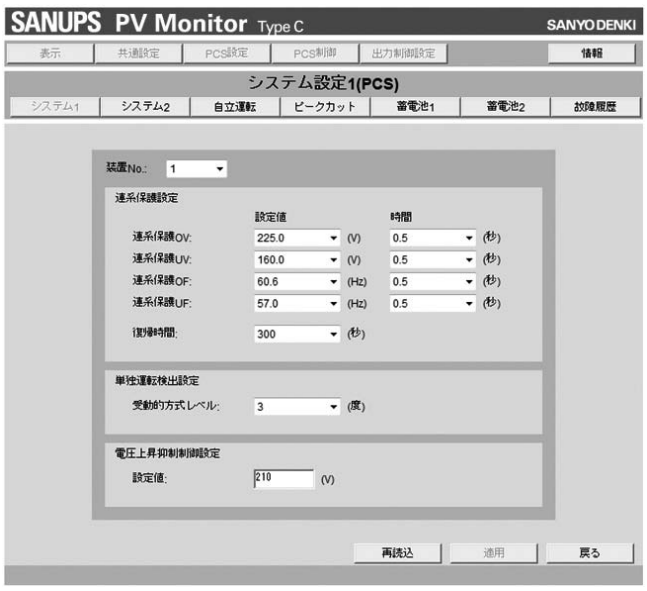


Fig. 9: PV inverter settings screen

4.7 Data collection/tallying function

This product is able to tally and store the data collected from PV inverters.

The current model had the capacity to store 42 days of 10-min tallying data and 1-hr tallying data (daily report), as well as 25 months of 1-day tallying data (monthly report).

In accordance with the recommended specifications for output control systems, this product has an expanded capacity for 10-min tallying data as a power generation track record of up to 100 days, and the ability to store approximately 3 months of output control results.

5. Specifications

Table 1 lists the specifications of the “SANUPS PV Monitor Type C” PV power system monitoring device with output control function, while Table 2 shows its functions.

Table 1: “SANUPS PV Monitor Type C” specifications

Item		Specifications	Remarks
Input voltage		100 to 115 VAC	
Allowable input voltage range		85 to 264 VAC	
Input frequency		50 / 60 Hz	
Max. power consumption		5 W	
External interface	**For PV inverter Interface**	RS-485	Plug-in terminal block 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% or less	Non-condensing
External dimensions		220 x 150 x 40 mm (width x depth x height)	Not including protrusions
Mass		1.0 kg	
PV inverter supporting output control		SANUPS P73H SANUPS P73J SANUPS P73K SANUPS P83E SANUPS P61B	

Table 2: “SANUPS PV Monitor Type C” functions

Item	Description	Remarks
Output control function	Stores up to 1000 days of output control settings (30-min cycle)	
PV inverter setting function	System settings, isolated operation settings, peak-cut settings, Storage battery settings, malfunction history display	3-phase PV inverter only
PV inverter control function	Operate, stop, operation mode change	3-phase PV inverter only
E-mail monitoring function	Event notifications, request email response, report emails PV inverter settings, control	
SNMP support	Standard MIB (RFC1213), expansion MIB	
WEB support	Power generation status chart, trend graph (daily reports/monthly reports)	
Measurement data collection	10-sec information sampling interval, up to 27 devices connectable	
Measured data tallying	Stores up to 100 days of 10-min tallying data (system total value)	
	Stores up to 42 days of 1-hr tallying data (individual device value x 27 units)	
	Stores up to 25 months of 1-day tallying data (individual device value x 27 units)	
DHCP support	Available	
NTP support	Available	
FTP-based data downloads	Information relating to measurements, events, settings, tallying and output control schedules	
Non-communication monitoring (Alive monitoring)	E-mail monitoring, SNMP monitoring	
Remote parameter setting	SSH, Telnet, WEB	
Remote program update	Available	
Combined usage with data-gathering devices	Available	

6. Conclusion

This paper has provided an overview of the “SANUPS PV Monitor Type C” PV power system monitoring device with output control function. The “SANUPS PV Monitor Type C” has made it possible to combine a function to communicate with power company servers and formally build output control systems for PV power generation.

The introduction of output control systems by power companies will continue in the future, increasing the need for this product and, in accordance with this, it is predicted that requirements relating to PV power system maintenance and monitoring will also increase. SANYO DENKI wishes to continue offering products which meet such requirements and win customer satisfaction by further enhancing its maintenance and monitoring services.

References

(1) Naoki Takemoto and others:
“Development of the “SANUPS PV Monitor E Model” with an Output Control Function”:
SANYODENKI Technical Report No. 41 (2016)

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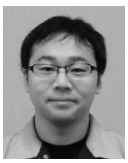

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