Overwhelming Effectiveness for positive ulitization of the Shade of PV Panel!

Achieving High Efficiency on PV Systems formed by Nipron String Converter

Nipron Wave

Vol.34 2014 Winter

Nipron

Any Shadows on your Mega Solar?

Great Effect as a Measure against Shadows

Power and failure monitoring systems are in the same junction box

String Tajubu Converter

ST100TBFL series

String Tajubu Converter (ST-CON) is DC-DC step-up converter for PV systems. By boosting the voltage from the dropped voltage of the strings at the power failure or from the shadows on PV panels to make no different voltages between the strings, and ST-CON is utilized the generated PV panels to the full. In addition, ST-CON comes with monitoring functions that make the safe and secure systems established.

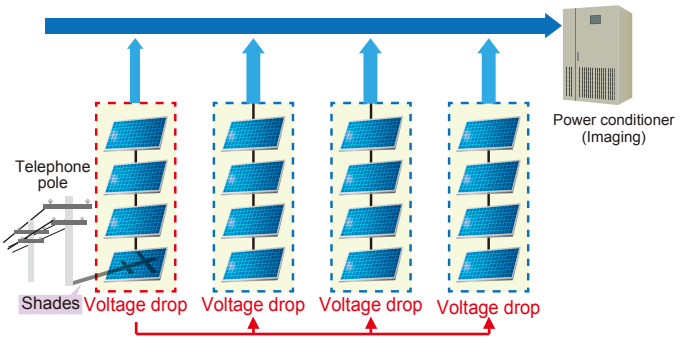
Various factors of blocking power generation

By placing the new mega solar park, broad lands are selected in order to avoid having much shadows and PV fractional number of panels. However, it does not mean that there is no shadows at all and no voltages difference. Any obstructive factors are coming from unexpected directions.

Shades	By changing the seasons and environment, it shows up at different spots and it is happening unexpectedly.	Failure	It is occurred by natural disasters such as typhoon or twister. It causes the problems on the systems for the time of repair.
Characteristics	PV panel aging degradation and temperature difference in the system make changed the characteristics.	Theft	Even it is a rare case but it makes it in recently in the news.

These factors make voltage differences

Without ST-CON

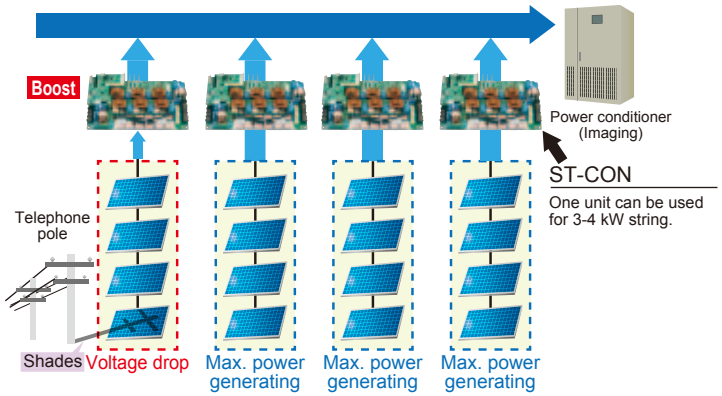


Power conditioner controls the voltage (operating point) so that the total power of all strings is maximized. When the voltages of each string is equal, it works well. However, once the voltages among strings are different because of the factors above, the maximum power points of each string and the operating point of power conditioner develop the gap. It affects to getting the certain amount of power which we expect more to hold and more to sell because it is pulled to the lower voltages point from the higher generated power or it would not be generating at the low voltage string.

If the voltage of a string drops, the MPPT control of power conditioner changes the maximum power point of the other strings. It results to be lower generated power because the point is different from the original point.

"LOSS ≒ the power of shadowed panel × the number of strings (or the number of panels on one string)" It will become big loss.

With ST-CON



By using the ST100TBFL, the dropped voltage of the strings from the shadow and power failure can make it balanced even by boosting the voltages from other strings and get generated the maximum power from the all strings.

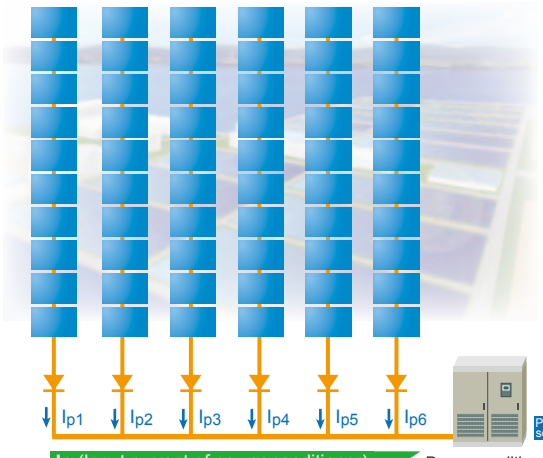
Except for the shadowed panels, ST-CON boosts the voltage of strings. Therefore, only place with the power loss is shadowed places.

ST-CON improves the power generating efficiency by making up the voltage differences between strings.

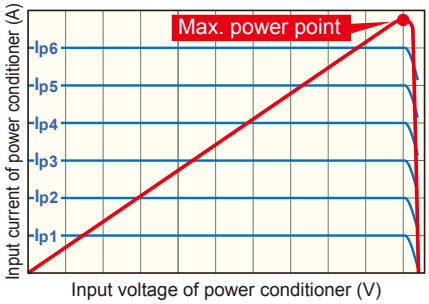
ST-CON totally solves the problems concerned with PV system

If some part of PV panels are shadowed, the total generated power should be reduced significantly even other panels are outputting maximum power.
This is why PV systems need "no shadow" and "large" place. As the market grows in PV, finding the number of perfect places is the issue and gradually decreasing. Here is the solution if the issues you have such as "giving up with some shadows", "setting more fractional panels if we try to avoid the shadow". We are introducing ST-CON how it works against having shadows by using some pictures.

Generating power in normal without ST-CON

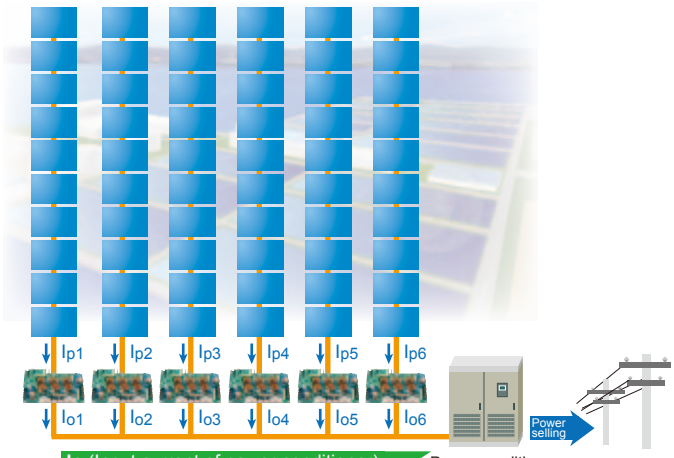


■The power characteristic chart of array

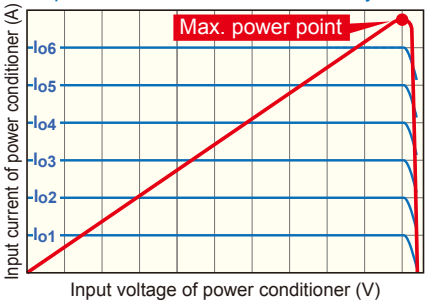


The power characteristic without shadow. Each string generates power by all 10 panels.

Generating power in normal with ST-CON

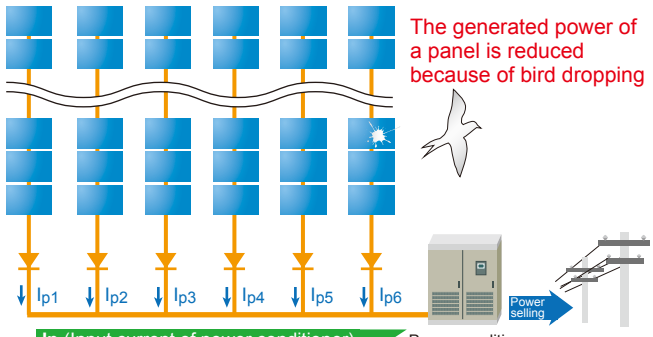


■The power characteristic chart of array

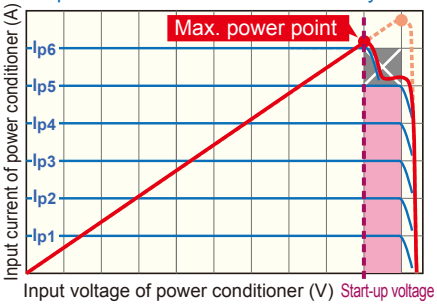


The power characteristic without shadow. As the case without ST-CON, each string generates power by all 10 panels.

Having shadows by bird dropping without ST-CON



■The power characteristic chart of array



The voltage of Ip6 is reduced because of bird dropping. In this case from the left chart, the maximum power point is reduced to the point of the operation voltage point so that 6 panels are not able to generate power even they have remaining power still.

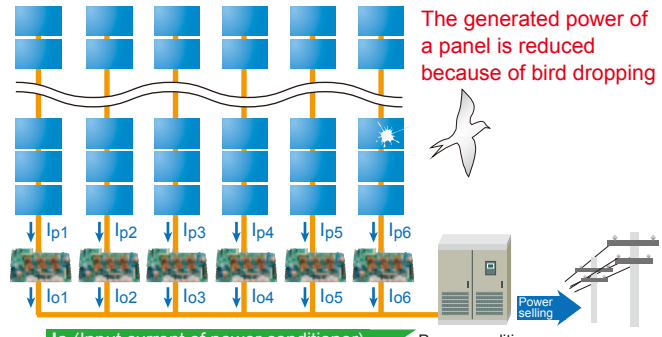
Bird dropping decreases generated power

Though the panels have remaining power, they can not be used effectively

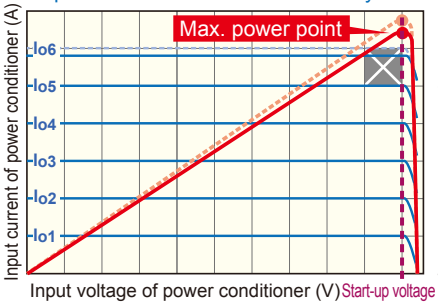
The loss against total generated power (Calculated by 250W per panel)

$$\frac{250W \times 6\ panel}{250W \times 60\ panels} = \frac{1500W}{15000W} = 10\%\ loss$$

Having shadows by bird dropping with ST-CON



■The power characteristic chart of array



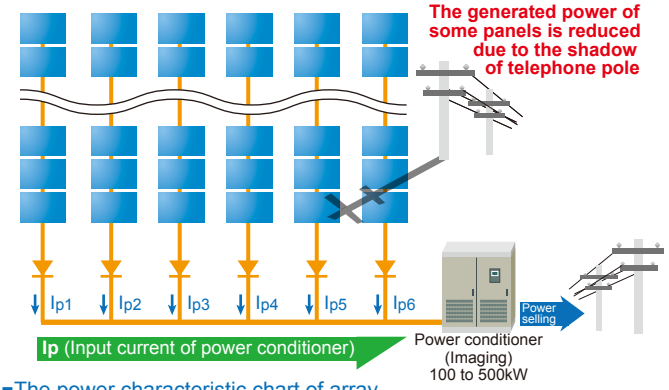
ST-CON fixes the maximum power point of the string which dropped the voltage by MPPT control and it boosts the voltage to output the maximum power. To make the each voltage of strings equaled by ST-CON, the maximum power point shall be hitting to the point to the one at the left chart. Therefore, the other strings can be outputting maximum power and only one panel is having the power loss from the bird dropping.

Bird dropping decreases generated power

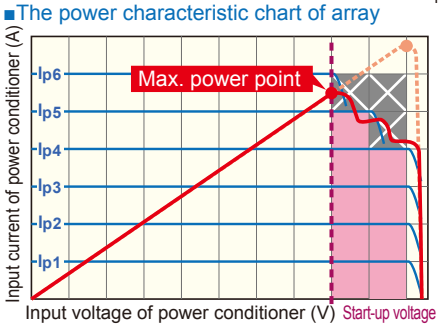
The loss against total generated power (Calculated by 250W per panel)

$$\frac{250W \times 1\ panel}{250W \times 60\ panels} = \frac{250W}{15000W} = Approx.1.7\%\ loss$$

Having the shadows from telephone pole without ST-CON



■The power characteristic chart of array



The voltage of one panel at Ip5 and two panels at Ip6 are reduced because of the shadow from telephone pole. The maximum power point at that time is reduced to the point of left chart. The point is working voltage of the lowest voltage string, and 12 panels are not able to generate power even they have remaining power.

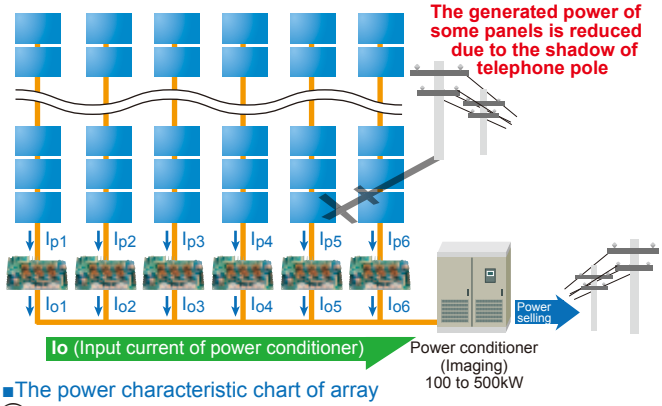
The generated power isreduced due to the shadow of telephone pole

Though the panels have remaining power, they can not be used effectively

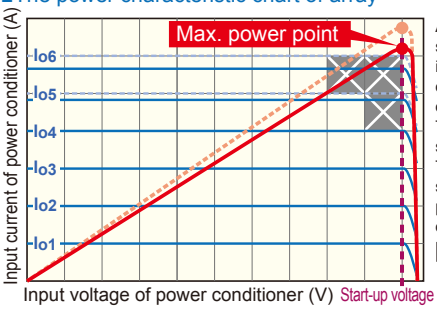
The loss against total generated power (Calculated by 250W per panel)

$$\frac{250W \times 12 \text{ panel}}{250W \times 60 \text{ panels}} = \frac{3000W}{15000W} = 20\% \text{ loss}$$

Having the shadows from telephone pole with ST-CON



■The power characteristic chart of array



As the same case of the shadow with the bird dropping, it boosts the dropped voltage of string so that each voltage of strings become equal. The maximum power point shall be the point of left chart. There are only 3 panels with shadowed that are having a power loss but others can output maximum power.

The generated power is reduced due to the shadow of telephone pole

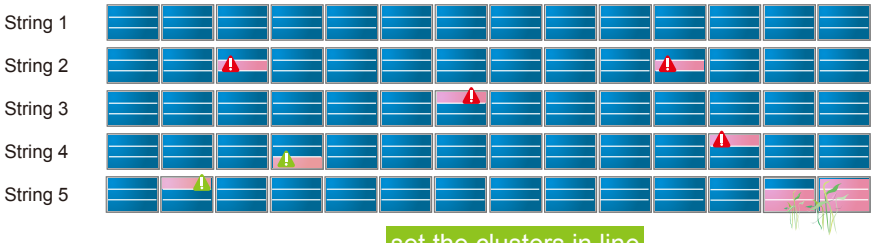
The loss against total generated power (Calculated by 250W per panel)

$$\frac{250W \times 3 \text{ panel}}{250W \times 60 \text{ panels}} = \frac{750W}{15000W} = 3\% \text{ loss}$$

Simulation at the improvement effect of ST-CON

We simulated the following mega solar configuration in order to confirm how the generated power is improved by installing ST-CON.

[PV array example]

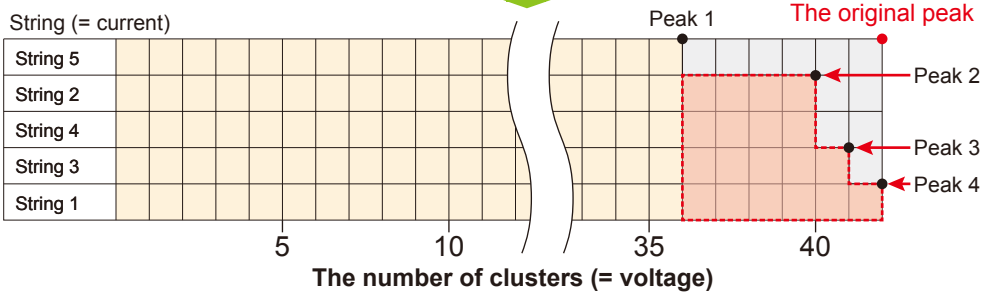


[Mega solar construction example]

- ■The capacity: 1MW
- ■Annual generated power: 1MkWh
- ■Max. start-up voltage: 420V
- ■Open circuit voltage: 530V (25°C)
- ■The spec. of panels: 30V 260W
- ■The number of panels: 3850
- ■The number of strings: 275 (1 string: 14 panels)
- ■The number of arrays: 55 (1 array: 5 strings)

Degradations Bird droppings, Fallen leaves Weeds

set the clusters in line



What is cluster?

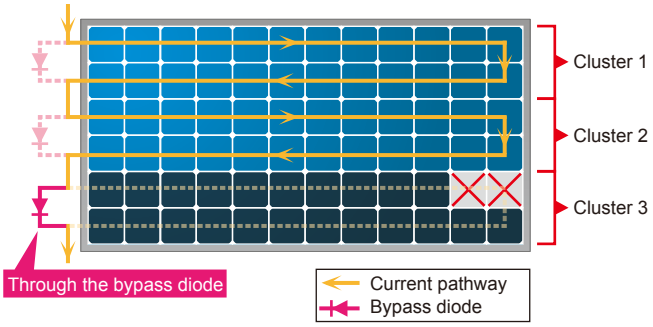
We call the group of cells in between the bypass diodes "cluster" in PV panels.

What is bypass diode?

PV panel consists of the series of multiple cells, and if a cell is shadowed, it becomes resistance that blocks power generation and it becomes worse to get damaged the PV panel. Therefore, using the bypass diodes can avoid having such problems.

Since the bypass diode is used for several cells group, not for each one cell, if a cell is shadowed, the group (cluster) of the cell is bypassed. It results in the large drop of generated power.

The function of bypass diode at failure



When shadows come with various reasons on an array such as "PV array example" of left page.

Max. number of effective clusters is… Peak 1: 180　Peak 2: 160　Peak 3: 82　Peak 4: 42

Peak 1 is max. point and the output voltage of this array shall be around peak 1.
The part that is enclosed by the broken line is not available even it can generate power.

How much do we lose in this case?

Ideal number is 210 but current one is 180
(180 - 210) / 210 = -0.142…Approx. 14% power loss

The annual power loss from one array is 2,545kWh

By setting the ST-CON,

The loss will be reduced by getting each string to work at max. power point.
(199 - 210) / 210 = -0.05…Reduce the loss to approx. 5%

The annual power loss from one array is 909kWh

If these losses would have been occurred at multiple panels, it must be a big loss.
According to this simulation, setting ST-CON could be making the power loss much reduced about the one-third possible.

* These amount of the loss or reduction rate is subject to change the power generating environment.

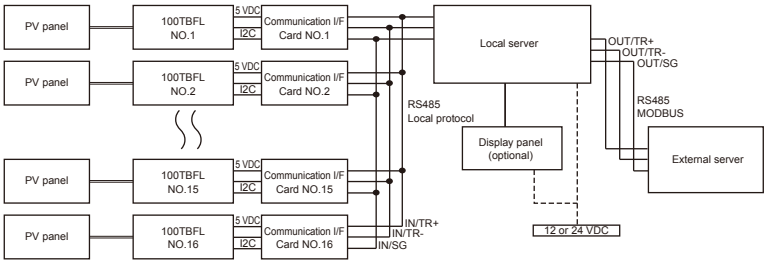
Immediate detection with abnormal issues possible by setting the monitoring function

It is not only the generating power support by ST-CON. It achieves a quick response for reporting the malfunctions so that it reduces the loss time and improves power generation efficiently.

<Available monitoring functions in ST-CON>
■Monitoring input/output voltage and current
■Generated power monitoring
■Malfunction detection

- Bird droppings
- Hot-spot
- Breaking of wire
- Bypass diode failure
- Wrong wiring

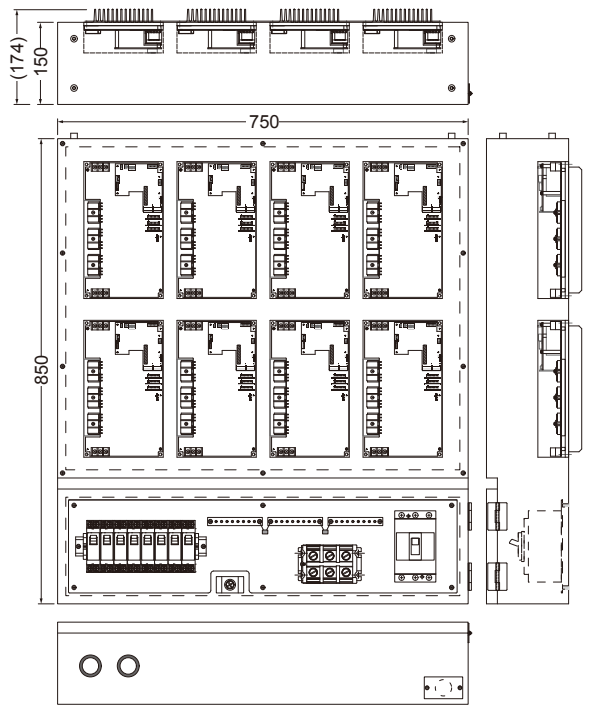
etc.



ST100TBFL line-up

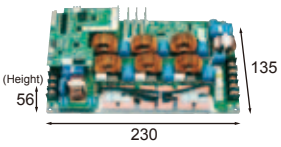
[String converters embedded in the junction box]
<4/6/8/10/12/16 strings types are feasible>

8 strings type (Imaging)　<Power monitoring / Malfunction monitoring functions are installed>



Embedded "the 100-year Converter" output specification (dedicated to PV)

100TBFL 400V type



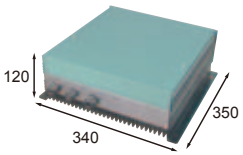
High voltage output type will be joining in our line-up!!
Output range: **200-600 VDC**[*1]

100TBFL-1000-	SFV/FV	SF48V/F600V
Input voltage range	20 - 400 VDC	30 - 600 VDC
Boosting start voltage	24±2 VDC or higher	48±2 VDC or higher
Boosting stop voltage	18±4 VDC or lower	25±4 VDC or lower
Output voltage adjusting range	100 - 400 VDC	200 - 600 VDC[*1]
Output power	Max. 4000W[*2]	Max. 4000W[*2]
MPPT control circuit	○	○

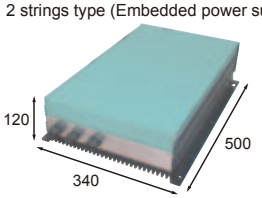
*1 If input voltage is 500V or higher, it outputs the input voltage as it is.
*2 Varies by the input-output voltage difference. Please refer to the product specification for details.

One or two units build-in type goes as a fractional converter.
If it goes for the shadowed string, the following box types are useful to be installed.

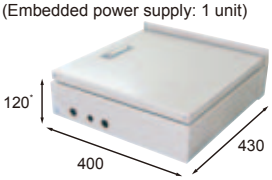
Aluminum-fin type
1 string type
(Embedded power supply: 1 unit)



Aluminum-fin type
2 strings type (Embedded power supply: 2 units)

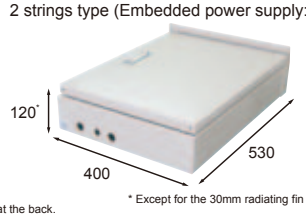


Box type
1 string type
(Embedded power supply: 1 unit)



* Except for the 30mm radiating fin at the back.

Box type
2 strings type (Embedded power supply: 2 units)



* Except for the 30mm radiating fin at the back.

The ST-CON data from our measurement Part.2

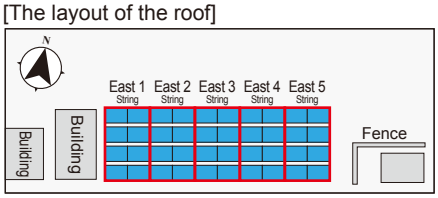
In this special feature, we continue to examine the effect of ST-CON with our PV system. We collected the data during the period from Sep. 1st to Oct. 31st in order to confirm the effectiveness of ST-CON.

[System constitution]

Panel spec.:
- Nominal open voltage -> 43.0V
- Nominal operating voltage -> 33.8V
- Nominal max. output -> 108.2W

The number of panels: 40
The number of panels in one string: 8
The number of strings: 5
Total amount of generated power: 4.33kW

[The layout of the roof]



<The measuring method>

The PV system was alternately measured with ST-CON and without ST-CON.

<The varification for the effectiveness method>

In the PV system, East 5 string was shadowed by the fence in the morning. Also, in the evening, the shadow of building was occurred from East 1 to East 3 as time advances. We compared the generated power of shadowed strings of each time with ST-CON and without ST-CON. During the two months measurement, the hours of sunshine of samplings shall be longer than 0.8 hour*.

* Reference: Japan Meteorological Agency
"Weather, Climate & Earthquake Information" (observation point: Osaka)

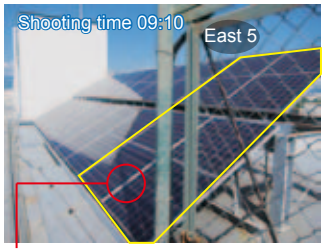
The actual measurement data of generated power from 01-Sep-2013 to 31-Nov-2013

With ST-CON				Without ST-CON			
Date	Weather	The amount of generated power (kWh)	The total amount of generated power (kWh)	Date	Weather	The amount of generated power (kWh)	The total amount of generated power (kWh)
9/1	Cloudy, Occasional Rain	3.27	3.27	9/2	Rain	1.94	1.94
9/3	Mostly Cloudy	8.86	12.18	9/4	Rain, Partly Cloudy	4.21	6.15
9/5	Mostly Cloudy	11.56	23.76	9/6	Mostly Cloudy	15.34	21.49
9/7	Cloudy	4.63	28.41	9/8	Cloudy	6.73	28.31
9/9	Clear	19.84	48.26	9/10	Partly Cloudy	18.02	46.33
9/11	Clear	21.22	69.48	9/12	Partly Cloudy	17.47	63.8
9/13	Clear	21.07	90.55	9/14	Mostly Cloudy	13.61	77.41
9/15	Cloudy, Rain Later	4.22	94.77	9/16	Rain, Clear Later	11.56	88.97
9/17	Clear	24.77	119.54	9/18	Clear	22.21	111.18
9/19	Clear	23.48	143.02	9/20	Clear	22.18	133.36
9/21	Clear	22.27	165.29	9/22	Clear	19.80	153.16
9/23	Clear	20.31	185.60	9/24	Partly Cloudy	17.16	170.32
9/25	Clear	21.67	207.27	9/27	Clear	22.33	192.65
9/28	Clear	23.11	230.38	9/30	Partly Cloudy	17.63	210.28
10/1	Partly Cloudy	19.69	250.07	10/2	Mostly Cloudy	7.93	218.21
10/3	Partly Cloudy	16.49	266.56	10/4	Mostly Cloudy	14.56	232.77
10/5	Cloudy	8.88	275.44	10/6	Clear	20.03	252.8
10/7	Partly Cloudy	19.83	295.27	10/8	Cloudy	7.08	259.88
10/9	Rain, Clear Later	12.49	307.76	10/10	Partly Cloudy	18.05	277.93
10/11	Partly Cloudy	17.40	325.16	10/12	Clear	19.19	297.12
10/13	Clear	21.55	346.71	10/14	Clear	21.06	318.18
10/15	Rain	0.79	347.50	10/16	Cloudy	8.22	326.4
10/17	Partly Cloudy	19.89	367.39	10/18	Cloudy	6.58	332.98
10/19	Cloudy, Occasional Rain	5.99	373.38	10/20	Rain	1.89	334.87
10/21	Mostly Cloudy	13.40	386.78	10/22	Mostly Cloudy	9.82	344.69
10/25	Rain	1.44	388.22	10/24	Cloudy, Occasional Rain	7.41	352.1
10/27	Partly Cloudy	15.51	403.73	10/26	Cloudy	7.41	359.51
10/29	Cloudy	3.04	406.77	10/28	Clear	20.92	380.43
10/31	Mostly Cloudy	14.54	421.31	10/30	Partly Cloudy	16.63	397.06

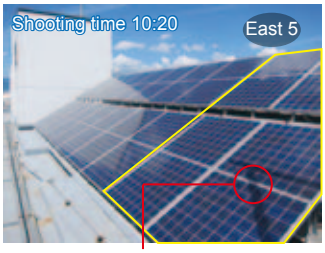
The total amount of generated power during the two months

With ST-CON...421.21kWh Without ST-CON...396.97kWh

Validation 1 9:00~11:00

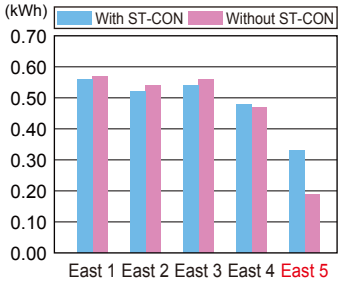


The shadow of fence on the part of East 5 string

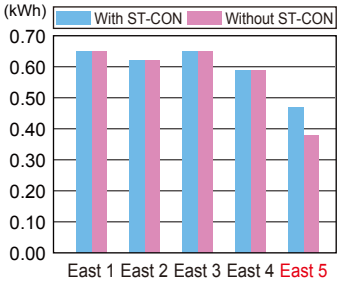


The shadow of fence on the part of East 5 string

[9:00~10:00]



[10:00~11:00]



<The average generated power of East 5 string>

With ST-CON...0.32kWh <9:00~10:00> 0.47kWh <10:00~11:00>
Without ST-CON...0.19kWh <9:00~10:00> 0.38kWh <10:00~11:00>

<Result>

The improvement effect of ST-CON in the shadow of fence was 38.6% including both time zones.

[The data of actual measurement with ST-CON]

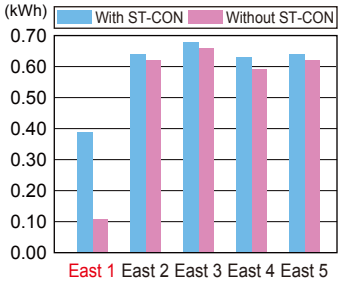
Date	The amount of generated power(kWh) 9:00~10:00					10:00~11:00				
	East 1	East 2	East 3	East 4	East 5	East 1	East 2	East 3	East 4	East 5
9/9	0.54	0.50	0.53	0.47	0.37	0.71	0.68	0.72	0.65	0.53
9/11	0.53	0.50	0.52	0.46	0.35	0.66	0.63	0.67	0.60	0.49
9/13	0.48	0.45	0.47	0.42	0.31	0.56	0.54	0.57	0.52	0.42
9/17	0.62	0.58	0.60	0.53	0.38	0.73	0.69	0.72	0.66	0.55
9/19	0.60	0.56	0.58	0.51	0.35	0.69	0.66	0.69	0.63	0.52
9/21	0.59	0.55	0.57	0.50	0.36	0.67	0.64	0.68	0.62	0.51
9/23	0.57	0.53	0.55	0.48	0.35	0.67	0.63	0.67	0.61	0.49
9/25	0.58	0.54	0.56	0.49	0.36	0.67	0.63	0.67	0.61	0.48
9/28	0.61	0.57	0.59	0.52	0.38	0.65	0.62	0.66	0.60	0.46
10/1	0.58	0.54	0.56	0.49	0.32	0.65	0.62	0.65	0.59	0.46
10/7	0.60	0.56	0.58	0.51	0.32	0.70	0.66	0.70	0.64	0.51
10/11	0.42	0.40	0.42	0.37	0.23	0.41	0.41	0.44	0.40	0.32
10/13	0.60	0.56	0.58	0.51	0.30	0.71	0.67	0.70	0.64	0.51
10/17	0.47	0.45	0.47	0.42	0.24	0.45	0.44	0.46	0.42	0.34
10/27	0.58	0.55	0.57	0.51	0.30	0.72	0.68	0.71	0.65	0.45
10/31	0.54	0.52	0.54	0.47	0.25	0.69	0.65	0.68	0.62	0.45
Average	0.56	0.52	0.54	0.48	0.32	0.65	0.62	0.65	0.59	0.47
	Average amount of insolation(MJ/m²)				2.16	Average amount of insolation(MJ/m²)				2.50

[The data of actual measurement without ST-CON]

Date	The amount of generated power(kWh) 9:00~10:00					10:00~11:00				
	East 1	East 2	East 3	East 4	East 5	East 1	East 2	East 3	East 4	East 5
9/10	0.56	0.52	0.55	0.47	0.26	0.67	0.64	0.67	0.61	0.41
9/18	0.60	0.56	0.59	0.50	0.19	0.70	0.66	0.70	0.64	0.45
9/20	0.60	0.56	0.58	0.48	0.18	0.70	0.66	0.69	0.63	0.43
9/22	0.54	0.51	0.53	0.44	0.21	0.58	0.56	0.59	0.53	0.38
9/24	0.59	0.55	0.57	0.48	0.18	0.69	0.65	0.68	0.61	0.38
9/27	0.53	0.50	0.52	0.43	0.16	0.73	0.69	0.72	0.66	0.38
9/30	0.59	0.55	0.57	0.49	0.19	0.68	0.65	0.68	0.62	0.38
10/4	0.50	0.47	0.49	0.41	0.22	0.47	0.46	0.49	0.43	0.35
10/6	0.62	0.57	0.60	0.47	0.16	0.71	0.67	0.70	0.65	0.40
10/10	0.56	0.53	0.55	0.45	0.21	0.52	0.50	0.53	0.47	0.39
10/12	0.58	0.54	0.57	0.47	0.22	0.55	0.53	0.56	0.50	0.33
10/14	0.61	0.57	0.59	0.49	0.17	0.70	0.67	0.70	0.64	0.40
10/28	0.59	0.56	0.58	0.51	0.17	0.70	0.67	0.70	0.64	0.33
Average	0.57	0.54	0.56	0.47	0.19	0.65	0.62	0.65	0.59	0.38
	Average amount of insolation(MJ/m²)				2.17	Average amount of insolation(MJ/m²)				2.52

Validation 2 13:00~14:00

The shadow of building on the part of East 1 string



<The average generated power of East 1 string>
With ST-CON...0.39kWh
Without ST-CON...0.11kWh

<Result>
The improvement effect of ST-CON in the shadow of building was 255%.

[The data of actual measurement with ST-CON]

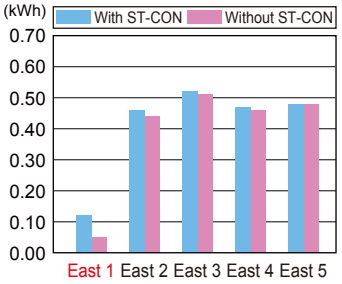
Date	The amount of generated power(kWh)				
	East 1	East 2	East 3	East 4	East 5
9/9	0.33	0.54	0.58	0.53	0.54
9/11	0.39	0.66	0.71	0.65	0.66
9/13	0.37	0.63	0.68	0.62	0.64
9/17	0.43	0.70	0.75	0.68	0.70
9/19	0.40	0.67	0.71	0.64	0.67
9/21	0.40	0.65	0.69	0.63	0.65
9/23	0.35	0.58	0.63	0.58	0.59
9/25	0.39	0.65	0.69	0.63	0.65
9/28	0.37	0.62	0.66	0.61	0.63
10/3	0.42	0.69	0.73	0.67	0.68
10/7	0.32	0.52	0.56	0.51	0.53
10/9	0.42	0.64	0.69	0.64	0.65
10/11	0.44	0.68	0.73	0.67	0.69
10/17	0.47	0.73	0.77	0.70	0.72
Average	0.39	0.64	0.68	0.63	0.64
Average amount of insolation(MJ/m²)					2.50

[The data of actual measurement without ST-CON]

Date	The amount of generated power(kWh)				
	East 1	East 2	East 3	East 4	East 5
9/12	0.16	0.63	0.68	0.60	0.63
9/16	0.14	0.63	0.68	0.60	0.63
9/18	0.07	0.67	0.71	0.64	0.67
9/20	0.07	0.68	0.73	0.64	0.68
9/22	0.12	0.60	0.64	0.57	0.60
9/24	0.13	0.51	0.55	0.49	0.52
9/27	0.04	0.69	0.74	0.66	0.69
10/6	0.10	0.59	0.63	0.56	0.60
10/10	0.18	0.53	0.57	0.51	0.53
10/12	0.16	0.65	0.69	0.61	0.64
10/14	0.10	0.64	0.68	0.61	0.64
Average	0.11	0.62	0.66	0.59	0.62
Average amount of insolation(MJ/m²)					2.49

Validation 3 14:00~15:00

The shadow of building on the large part of East 1 string



<The average generated power of East 1 string>
With ST-CON...0.12kWh
Without ST-CON...0.05kWh

<Result>
The effect was not much because the generated power itself was low. However, a little improvement was shown.

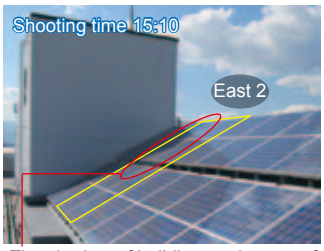
[The data of actual measurement with ST-CON]

Date	The amount of generated power(kWh)				
	East 1	East 2	East 3	East 4	East 5
9/9	0.10	0.33	0.37	0.34	0.35
9/11	0.14	0.40	0.47	0.43	0.44
9/13	0.10	0.52	0.60	0.55	0.56
9/17	0.12	0.58	0.66	0.60	0.62
9/19	0.12	0.55	0.63	0.58	0.60
9/21	0.11	0.49	0.57	0.52	0.53
9/23	0.09	0.37	0.42	0.39	0.40
9/25	0.12	0.43	0.48	0.43	0.44
9/28	0.14	0.55	0.63	0.58	0.60
10/7	0.09	0.27	0.31	0.28	0.29
10/11	0.14	0.48	0.54	0.50	0.51
10/13	0.08	0.35	0.39	0.35	0.36
10/17	0.19	0.60	0.66	0.60	0.61
Average	0.12	0.46	0.52	0.47	0.48
Average amount of insolation(MJ/m²)					2.02

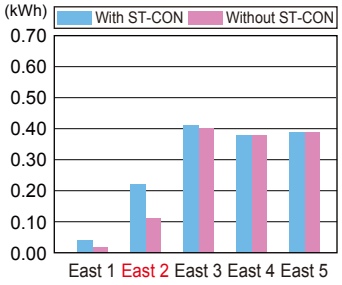
[The data of actual measurement without ST-CON]

Date	The amount of generated power(kWh)				
	East 1	East 2	East 3	East 4	East 5
9/12	0.10	0.40	0.48	0.43	0.45
9/18	0.03	0.52	0.60	0.55	0.57
9/20	0.03	0.54	0.62	0.56	0.59
9/22	0.06	0.53	0.61	0.55	0.57
9/27	0.01	0.55	0.63	0.57	0.59
10/2	0.07	0.29	0.36	0.32	0.33
10/6	0.06	0.27	0.32	0.29	0.29
10/10	0.07	0.48	0.55	0.50	0.52
10/14	0.04	0.49	0.56	0.50	0.53
10/16	0.05	0.33	0.37	0.33	0.35
Average	0.05	0.44	0.51	0.46	0.48
Average amount of insolation(MJ/m²)					2.01

Validation 4 15:00~16:00



The shadow of building on the part of East 2 string



<The average generated power of East 2 string>
With ST-CON...0.22kWh
Without ST-CON...0.11kWh

<Result>
Even the generated power itself was low, approx. 100% improvement effect was confirmed.

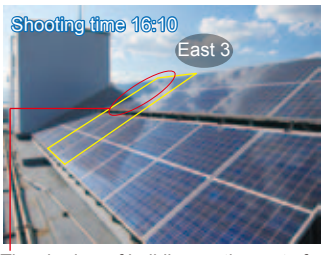
[The data of actual measurement with ST-CON]

Date	The amount of generated power(kWh)				
	East 1	East 2	East 3	East 4	East 5
9/9	0.03	0.15	0.46	0.43	0.44
9/13	0.05	0.22	0.42	0.40	0.41
9/17	0.02	0.26	0.48	0.46	0.46
9/19	0.02	0.25	0.45	0.43	0.44
9/21	0.02	0.26	0.46	0.44	0.44
9/25	0.05	0.13	0.32	0.31	0.31
9/28	0.03	0.25	0.42	0.41	0.41
10/7	0.05	0.17	0.28	0.26	0.26
10/13	0.04	0.22	0.34	0.31	0.32
10/17	0.05	0.30	0.43	0.40	0.40
Average	0.04	0.22	0.41	0.38	0.39
Average amount of insolation(MJ/m²)					1.37

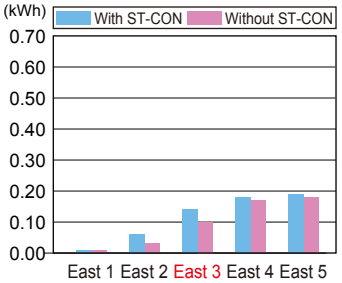
[The data of actual measurement without ST-CON]

Date	The amount of generated power(kWh)				
	East 1	East 2	East 3	East 4	East 5
9/12	0.05	0.13	0.36	0.34	0.35
9/16	0.02	0.10	0.45	0.44	0.45
9/18	0.02	0.06	0.44	0.42	0.43
9/20	0.01	0.07	0.46	0.44	0.45
9/22	0.04	0.12	0.39	0.37	0.38
9/27	0.01	0.09	0.45	0.43	0.44
10/6	0.01	0.11	0.30	0.29	0.29
10/10	0.02	0.12	0.39	0.36	0.37
10/14	0.02	0.15	0.37	0.34	0.34
10/16	0.01	0.17	0.43	0.40	0.41
Average	0.02	0.11	0.40	0.38	0.39
Average amount of insolation(MJ/m²)					1.39

Validation 5 16:00~17:00



The shadow of building on the part of East 3 string



<The average generated power of East 3 string>
With ST-CON...0.14kWh
Without ST-CON...0.10kWh

<Result>
The effect was not much because the generated power itself was low. However, a little improvement was shown.

[The data of actual measurement with ST-CON]

Date	The amount of generated power(kWh)				
	East 1	East 2	East 3	East 4	East 5
9/9	0.02	0.07	0.16	0.24	0.28
9/13	0.03	0.06	0.13	0.18	0.19
9/17	0.01	0.08	0.17	0.24	0.27
9/19	0.01	0.07	0.15	0.20	0.22
9/21	0.01	0.07	0.15	0.21	0.22
9/23	0.02	0.05	0.09	0.11	0.12
9/25	0.01	0.08	0.16	0.20	0.21
9/28	0.01	0.08	0.15	0.20	0.20
10/9	0.01	0.06	0.15	0.16	0.16
10/13	0.01	0.05	0.12	0.11	0.12
10/21	0.01	0.02	0.14	0.13	0.14
Average	0.01	0.06	0.14	0.18	0.19
Average amount of insolation(MJ/m²)					0.71

[The data of actual measurement without ST-CON]

Date	The amount of generated power(kWh)				
	East 1	East 2	East 3	East 4	East 5
9/12	0.02	0.07	0.10	0.13	0.13
9/16	0.00	0.03	0.08	0.22	0.27
9/18	0.01	0.03	0.07	0.19	0.22
9/20	0.01	0.03	0.06	0.20	0.23
9/22	0.02	0.06	0.10	0.16	0.19
9/24	0.01	0.04	0.07	0.15	0.18
9/27	0.00	0.02	0.09	0.21	0.22
10/2	0.02	0.05	0.11	0.15	0.15
10/6	0.00	0.02	0.13	0.19	0.18
10/10	0.00	0.02	0.12	0.14	0.14
10/12	0.00	0.02	0.14	0.16	0.15
10/14	0.00	0.03	0.11	0.12	0.11
Average	0.01	0.03	0.10	0.17	0.18
Average amount of insolation(MJ/m²)					0.70

Conclusion

Throughout the result of this measurement, this is such an outstanding effect with ST-CON we confirmed. Even it hits the certain time getting the most highest generated power, a shadowed string reduces its generated power. However, by setting ST-CON, it can be suppressed the reduction rate and raise the efficiency for generating power substantially.

Furthermore, in terms of the whole day generated power, more than 23kWh is generated for several days with ST-CON, but there was not the day when more than 23kWh is generated without ST-CON. It could be considered as the effect of ST-CON.

There were some typhoons and the weather was unstable from September to October. Even though the data is not enough for validation, we will continue to collect precise data in order to verify the capability of ST-CON.

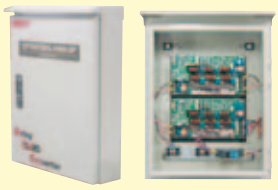
Time	The amount of generated power(kWh)	
	With ST-CON	Without ST-CON
9:00~10:00	2.42	2.33
10:00~11:00	2.97	2.88
13:00~14:00	2.99	2.61
14:00~15:00	2.05	1.94
15:00~16:00	1.44	1.31
16:00~17:00	0.59	0.49
Total	12.46	11.56

The improvement of ST-CON ...approx. 7.8%

ST-CON Q&A

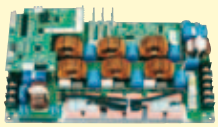
Answer the questions about ST-CON!

Is ST-CON dedicated to mega-solar?



ST-CON can be used not only for mega solar but also for various other applications such as the middle solars with several dozens to hundreds of kilowatt to be supplied for the plant and facilities, and also for the general households which need to be supplied several kilowatts as well. It can be installed in the shadowed string, too.
ST-CON is structured by DC-DC step-up converter "100-year" converter. It also can be utilized for PV systems and industrial machines such as robots or carrier machines.

What is the "100-year" converter?



It is a DC-DC step-up converter structured by ST-CON. The design concept of this power supply is to exclude short lifetime components: electrolytic capacitors and cooling fans so that it achieves ultra long lifetime.

Max. **99%**
Industry-leading level ultrahigh efficiency

Long lifetime
No electrolytic capacitors
No fans

When there are no shadows, does ST-CON increase the power loss?

In the case that there are no shadows (when ST-CON does not boost), the loss of ST-CON is some dozen W per string. However, if ST-CON is connected, the blocking diodes of + sides are not needed, hence there is little difference loss compared with the case without ST-CON.
Also, even if any shadows are not expected, the effect of ST-CON is expected because there would be occasional shadows such as bird droppings, fallen leaves or snows. In addition, ST-CON can suppress the reduction of generated power caused by the degradation or characteristic change of PV panels.

Will ST-CON affect on the price of electric power selling?

Selling price of electric power is fixed at the time of installation of power conditioner (JPY38/kWh as of now).
For example, if ST-CON is installed to the system with the selling price of JPY42/kWh, the price remains the same but if the power conditioner is changed out, the price will be changed to the selling price at JPY38/kWh.

Are there any shadows on mega-solar?

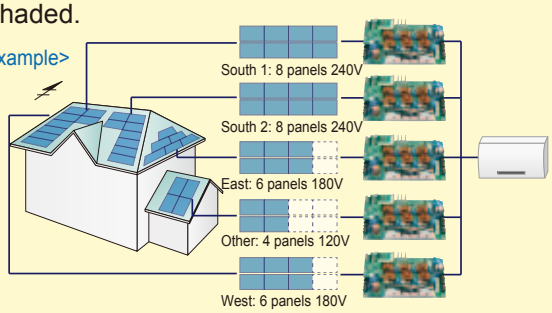
Generally, mega solar is set up in the areas where no shadows or no unequal panel numbers are necessary. However, to fulfill all such these conditions with a large place is barely available. It is would be the only problem in "enlarging the land", it must be easy to solve for being Landfill-on-sea or reclamation of mountain but we will be facing the problems of nature destruction and the cost for making place against the profit of generating power.

Even there was no shaded place in the beginning of the setting up the solar part, it must be having some shades and some bird droppings on the panels later along with the environmental changes.

There are no spaces that are preferable for PV system.

ST-CON boosts the voltage so that each voltage of strings becomes equal with its ultra wide range input and compact size. It can utilize the space where the number of panels is unequal or the space where can be shaded.

<An example>



String output with 2 to 2.5kW model is under development for the usage of the households with the requirement of small capacity. Scheduled to be developed in the spring of 2014.

How long is the warranty of ST-CON?

10 years (The expected lifetime is longer than 25 years)

QUESTION Is ST-CON usable for wind-power generation?

ST-CON is dedicated to PV system, but the embedded power supply, the "100-year" converter, and it is used for wind-power generation as well.
The reason why it is used for wind-power generation is that the "100-year" converter has been equipped MPPT control circuit. MPPT control shall be optimized for each power generation methods in wind power, hydraulic power or fuel cell. It is all adjusted the appropriate MPPT controls.
Please contact us if you consider an usage of others than PV system.

QUESTION Is there interference with the MPPT of power conditioner?

The interference does not occur. The MPPT of power conditioner refers to the input current and voltage of the power conditioner. Since ST-CON is installed in front of the power conditioner, the generated power shall be controlled by the MPPT of ST-CON and it inputs to power conditioner as the maximum power.

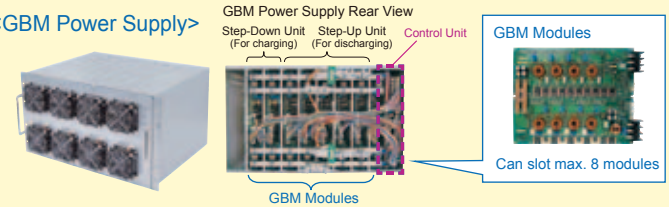
QUESTION Is the monitoring function necessary?

No, it is not if you just need to focus on the generating power. Monitoring function does not affect the power generating directly.
However, if any malfunction occurs in PV panel, sometimes users do not recognize the malfunction and they are losing the generated power which they are supposed to receive. The reason why they do not recognize the malfunction is that the generated power of PV is always varies and, therefore, they can not judge if the variation is from natural phenomenon or from the malfunction of panels by visual check or the data.
Monitoring function helps and prevents the reduction of generating efficiency by detecting malfunctions for taking measures.

QUESTION Can ST-CON charge batteries?

Since ST-CON is a step-up DC-DC converter, it can not charge the battery because the battery voltage is lower than the input voltage of ST-CON. However, we have "GBM power supply" and "the charging converter" available to construct a backup system possible.

<GBM Power Supply>



Perfect for large capacity battery (lithium-ion, lead-acid etc.) charging / discharging systems!
GBM power supply is a configuration of voltage step-up / -down modular so that it can flexibly fit into various systems including battery capacity and input / output SPEC. Also, with an external interface you can control battery charging / discharging, and check battery charged capacity from outside.

<Charging converter>

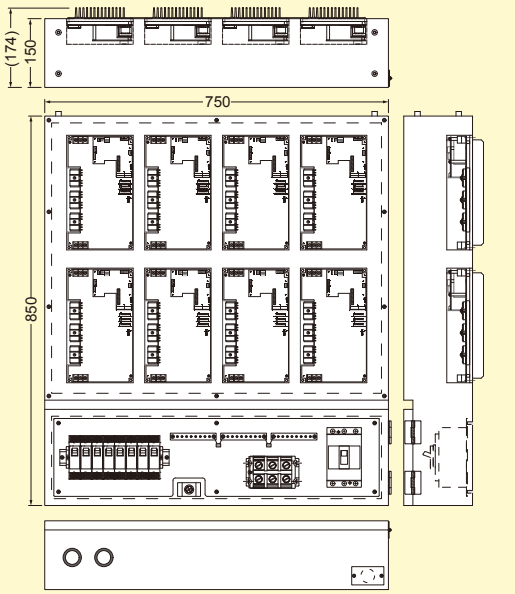
2-way converter for charging / discharging. It steps-down the excess generated power for charging and it steps-up the voltage for discharging when the generated power is not enough.

	At step-down charging Battery (48V type)	At step-up discharging
	Efficiency: 91-93% typ.	Efficiency: 96% typ.
	Charger (insulated step-down part)	Booster (non-insulated step-up part)
Input voltage	100-370 VDC	24-75 VDC
Output voltage	58 VDC (with +12VSB)	100-400 VDC
Output power	2-3 kW	6 kW nominal

QUESTION How many ST-CONs are needed?

It depends on the scale of systems. Basically one unit is installed for one string, but we also carry a junction box for multi-string use. The figure below shows the 8-string type but other string types are also arrangeable as your requested. Please feel free to contact us and discuss for further.

8-string type (Imaging) <Power monitoring / Malfunction monitoring functions are installed>



QUESTION Is it available outside?

ST-CON can be installed outside (IP44). Also, it has the long lifetime design which aims longer than 26 years operating performance. Even though the inside of the box would be high temperature when it is set outside in summer, ST-CON can work without problems*. Furthermore, the lifetime is not affected by the high temperature because it is not composed of short lifetime components.

*Although temperature specification is 60°C, it has a margin for the sake of safety. The actual performance achieves higher than 60°C environment operation.

Nipron Co.,Ltd.

●Sales department and R&D department
1-3-30, Nishinagasu-cho, Amagasaki-city, Hyogo, 660-0805, Japan.
TEL: +81-6-6487-0605 FAX: +81-6-6487-2212
URL: http://www.nipron.com/

www.nipron.com

●Contact us