SUNGROW

SP600S Optimizer

Design Guide

Version：V1.2

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Clean power for all

I. Introduction to SP600S Optimizer

● Functions

The SP600S intelligent optimizer system has the following main functions:

1) Module-level Power Optimization

Increase system energy yield by 4%-30%.

- ✓ Reduce the energy yield loss of PV modules due to dust, hotspot effect, etc.
- ✓ Reduce the energy yield loss due to inconsistent attenuation of PV modules in long-term operation.
- ✓ Increase energy yield by increasing installation capacity of multiple orientations of rooftop.

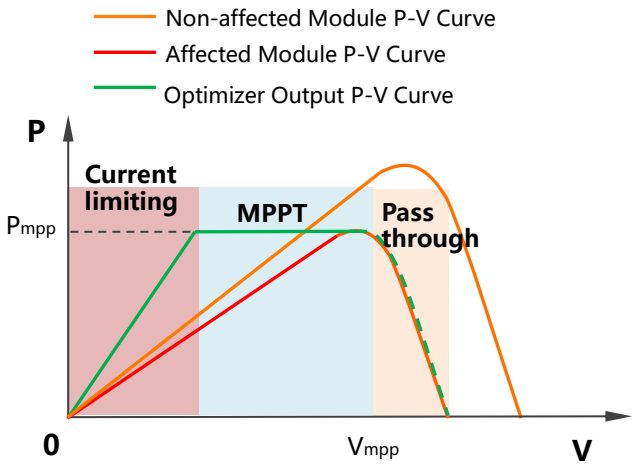

Figure 1. P-V Curve of SP600S Optimizer Eliminating Cask Effect of String

2) Safety Mode

Support module-level rapid shutdown. 20s module-level rapid shutdown for residential applications and 30s module-level rapid shutdown for C&I applications.

- ✓ Provide module-level shutdown needed in the installation scenarios as required by the policies in the place where the projects are located. Meets safety requirements for rapid shutdown at PV module level: Compliant with the worldwide standards NEC 2017 & 2020.

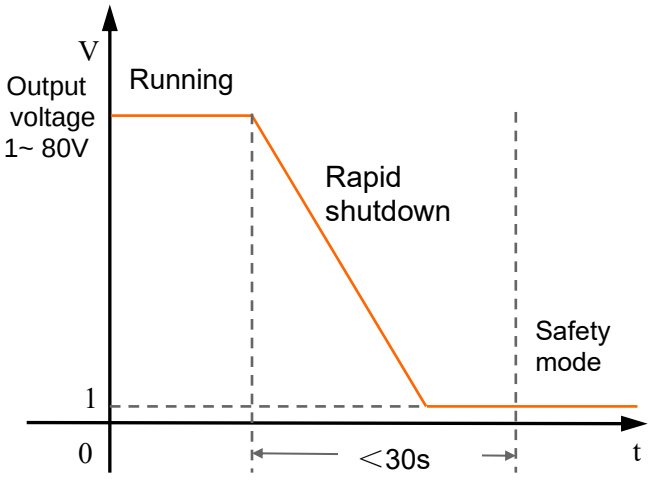

Figure 2. Rapid Shutdown Voltage Curve of SP600S Optimizer

3) Efficient O&M

Monitor the working status at the modules level in the iSolarCloud web or APP at any time. Operations staff can easily locate anomalous modules.

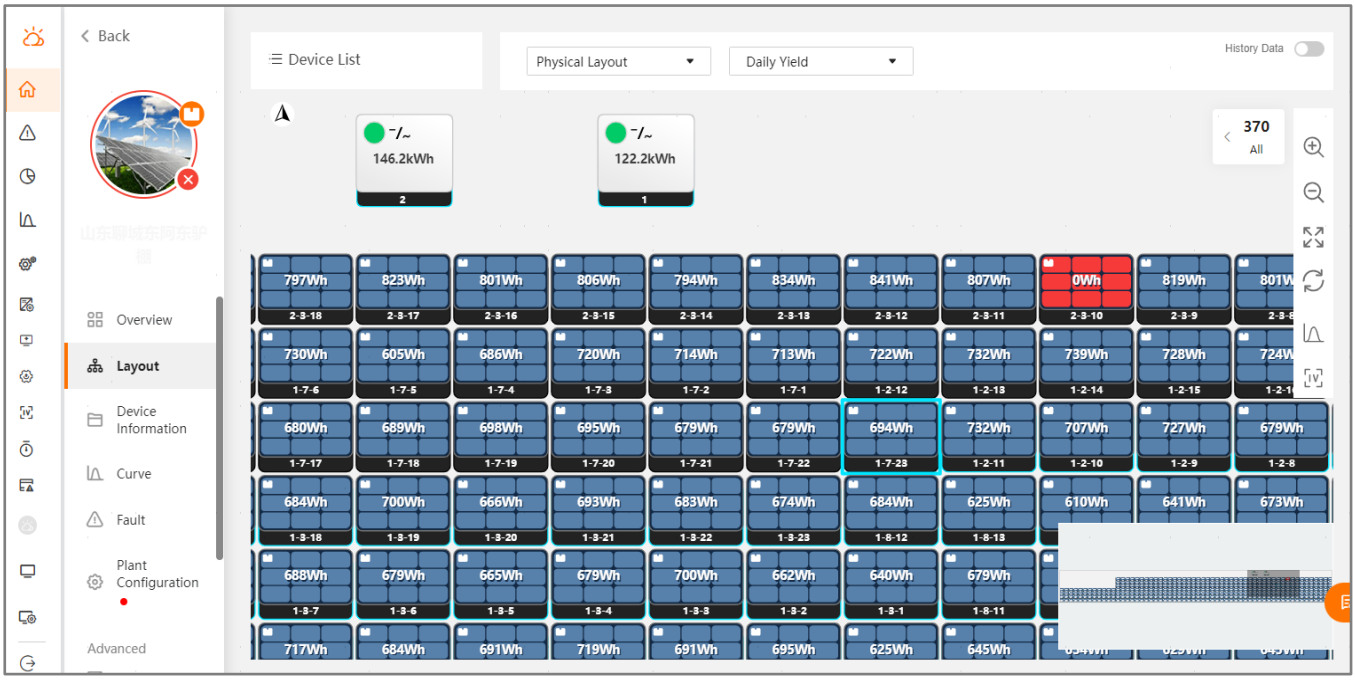

Figure 3. Interface of Module-level System Monitoring and Fault Localization

4) Intelligent Module Diagnosis

Perform IV scanning of the PV plant through iSolarCloud, which supports the diagnosis of four common PV module faults: current mismatch, low open-circuit voltage, low operating current and low MPP fault.

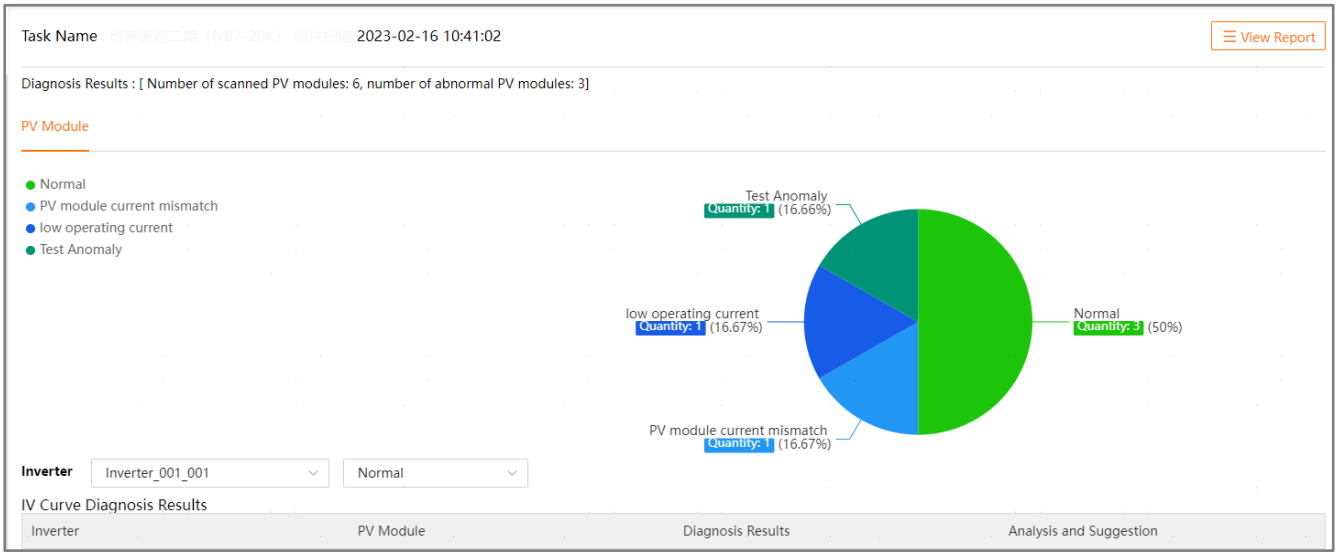

Figure 4. Module-level IV Scanning

● Technical parameters

Please refer to the datasheet of SP600S for details.

● Product features

1) Temperature Derating

The operating ambient temperature range of the SP600S optimizer is -40~85°C. The optimizer operates at full power below 65℃ and derating operation may occur above 65℃.

2) PV Module Adaptation

Recommend input power of SP600S is 450W - 695W. If the rated power of modules under standard test

conditions (STC) is higher than 630 W, the DC/AC ratio should be higher than 1.2. For detailed information, please refer to page 11 “String design”. If the rated power of modules under standard test conditions (STC) is higher than 695 W, please consult Sungrow before placing the order.

II. System Design

● Optimizer Compatibility Models and Communication Devices

The optimizer communicates with the PV inverter / hybrid inverter using PLC communication, which does not require additional communication cables. The inverter is equipped with Sungrow WiNet-S2 and Logger1000 communication devices. Please refer to the table below.

Inverter	System
SGRS series	SP600S+Winet-S2+iSolarCloud
SHRS series	SP600S+Winet-S2+ iSolarCloud
SGRT-P2 series	SP600S+Winet-S2+ iSolarCloud
SGCX-P2	SP600S+Winet-S2+ iSolarCloud
	SP600S+Logger1000/COM100+ iSolarCloud

Table 1: Compatibility Table for Optimizers, Inverters and Communication Devices

For a single inverter scenario in a residential PV and energy storage system, recommend using WiNet-S2, while for multiple inverters in parallel, recommend using Logger1000.

Note: for the European region, Sungrow supports EyeS4-EU and logger1000A-EU communication devices.

● Typical System Scheme

The SP600S optimizer is suitable for Solar systems and ESS systems. The typical system schemes for residential and commercial PV projects are shown in the figure below.

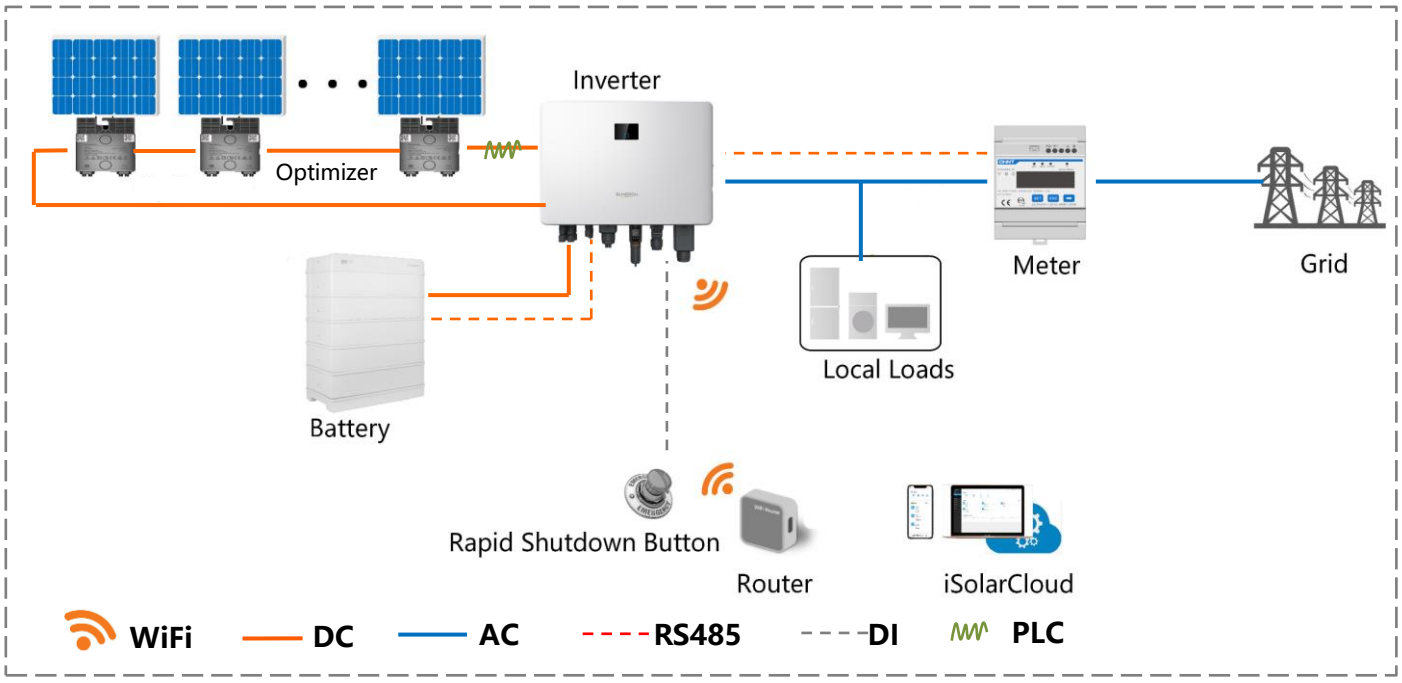

Figure 5. Typical Residential Scenario with SP600S Optimizers

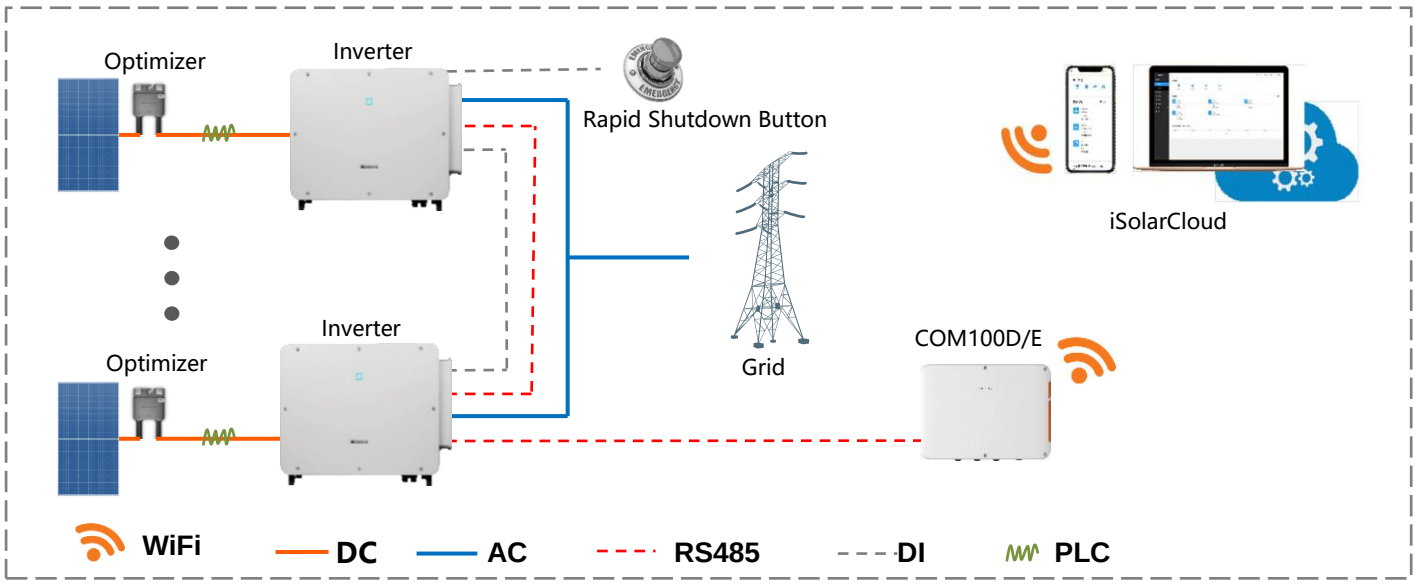

Figure 6. Typical C&I Scenario with SP600S Optimizers

Note: DI terminal (emergency stop dry contact): The dry contact can be set as an emergency stop port and supports cascading of dry contacts of multiple inverters to achieve emergency shutdown through an external switch (refer to the SGCX-P2 series inverter user manual for details).

● DC Wiring Requirements for Solar System with SP600S Optimizer

1) To ensure communication quality, the system design needs to ensure that the farthest optimizer in the string is no more than 350m away from the inverter and the total string loop length is no more than 700m. DC positive and negative cables should be routed together and the distance between DC positive and negative cables of the same string should be as close as possible. Cable coiling is not allowed. All requirements are shown in the picture below.

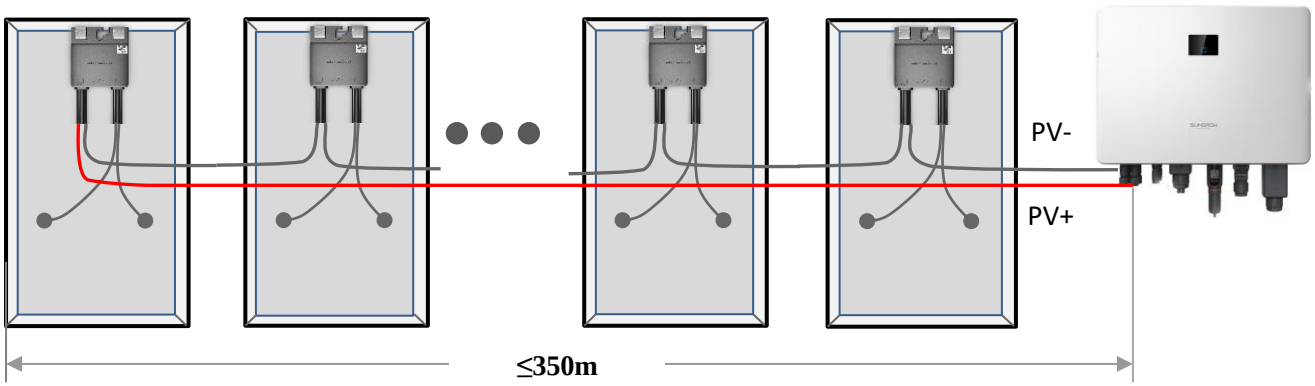

Figure 7. Distance Limitation for DC Cable of Single String

2) DC wiring requirements: The positive and negative DC cables of the same string should be routed side by side. The correct wiring is as shown below.

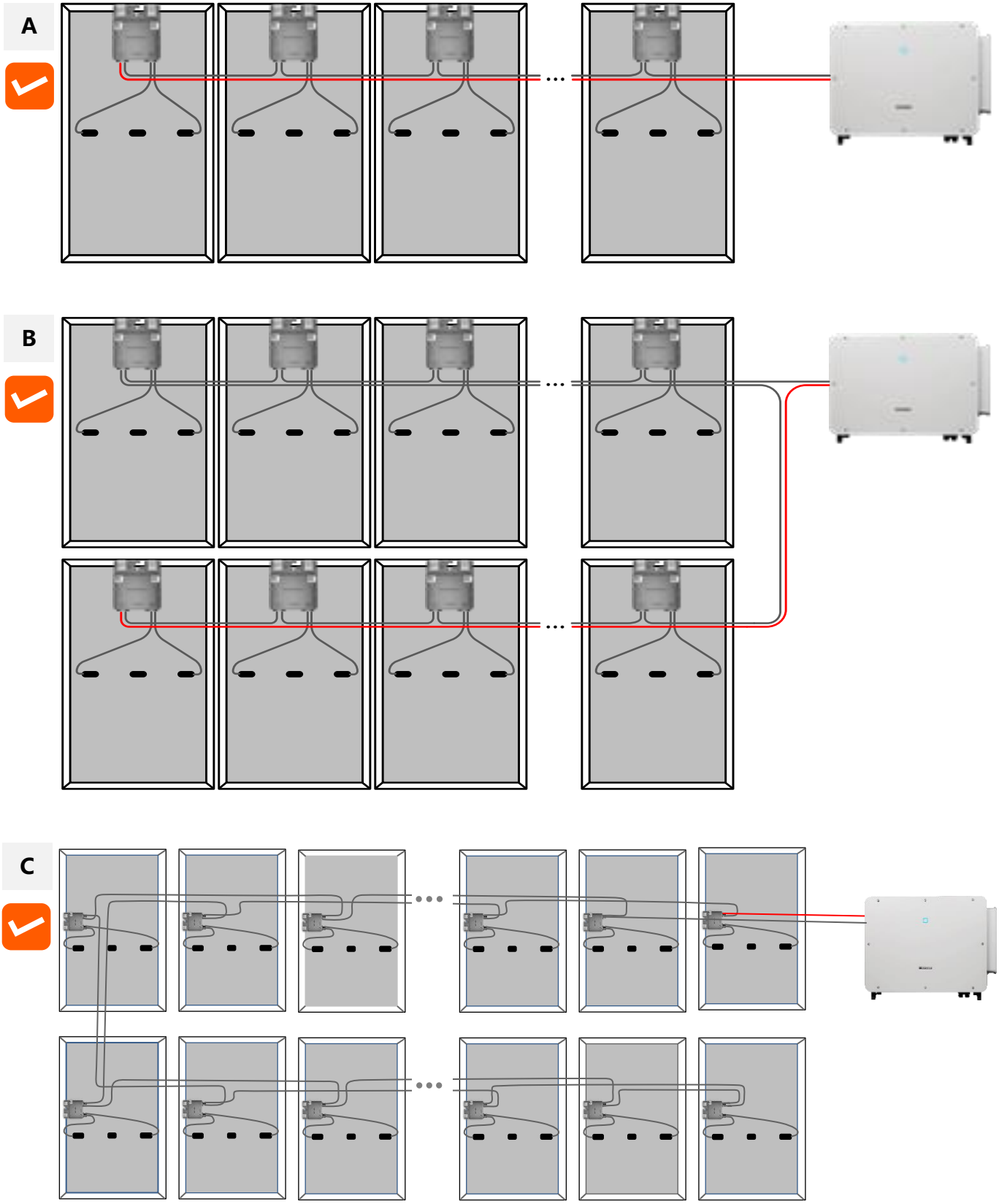

Figure 8. DC Cabling Requirement

3) DC wiring not allowed: The positive and negative DC cables of the same string are not allowed to be routed separately as figure shown below.

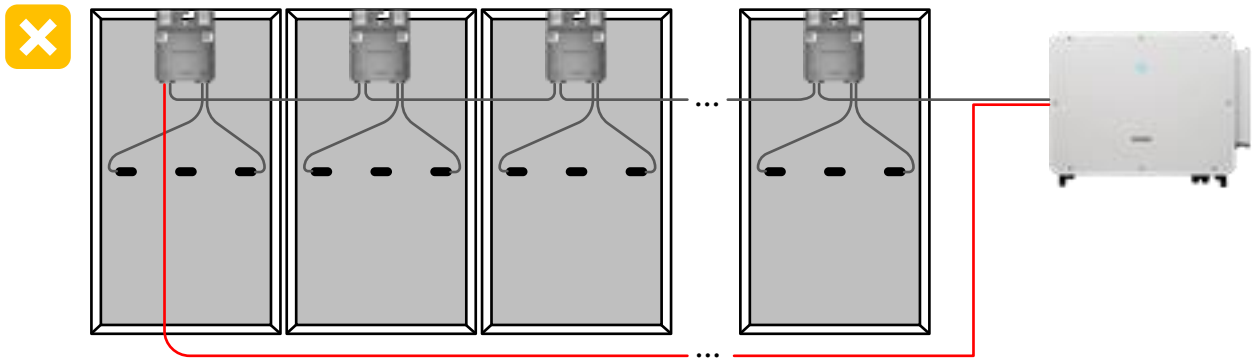

Figure 9. Prohibited DC Wiring

III. Detailed Design

The SP600S optimizer is a product in one-on-one correspondence with PV modules. The relationship between the PV module, the SP600S optimizer and the string wiring is as shown below.

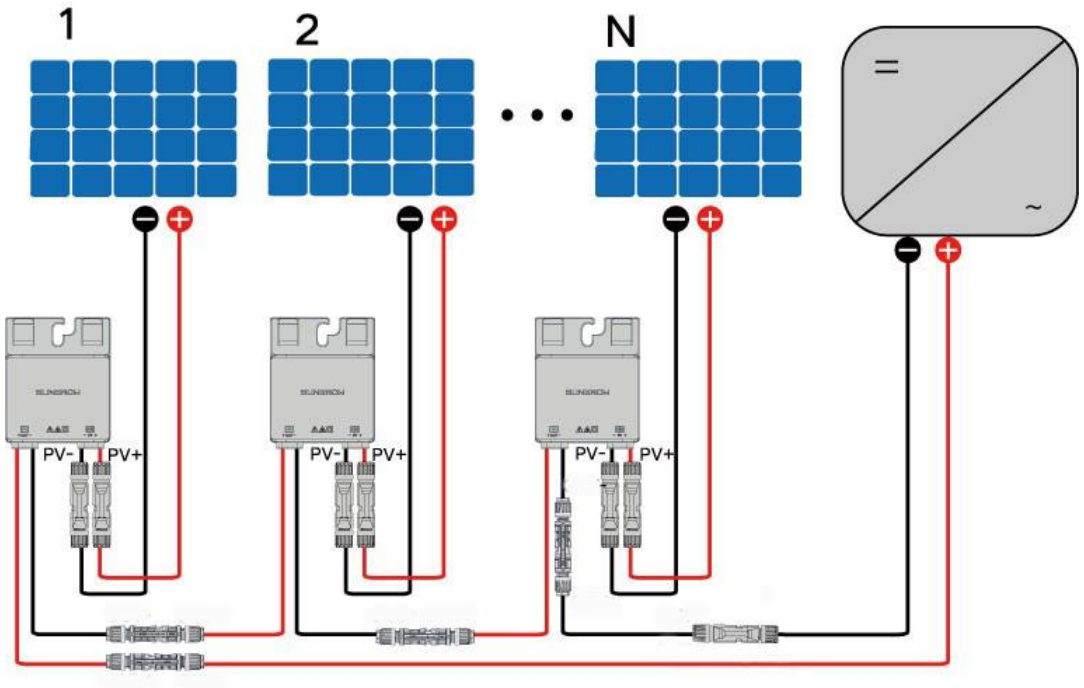

Figure 10. Schematic Diagram of PV module, Optimizer, and Inverter Wiring

String Design

When SP600S is applied with the inverter, the MPPT voltage range and maximum current of the optimizer will affect the maximum power of the photovoltaic string and MPPT. It is recommended to configure C&I solar systems with SP600S according to the table below.

Note:

a) **When the string contains more than 28 optimizers, the system voltage after rapid shutdown may be over 30V, please check carefully if this complies with the local policy.**

b) **The number of modules in different strings within the same MPPT must be consistent.**

c) **Different PV modules mixed installation is not allowed in principle, please consult Sungrow if the mixed installation cannot be avoided.**

d) **The specified PV module power is the STC power of the module. Please convert the power based on module arrangement, irradiation, temperature, etc. during design.**

Residential Scenario

Series	Model	Number of string units difference optimizers between different MPPTs	Recommended number of strings (DC/AC ratio >0.9)	Maximum Continuous Power per String (W)	Maximum Continuous Power per MPPT (W)	Number of optimizers supported by string	Recommended number of string optimizers for typical module power level		
							400W	450W	500W
SHRS	SH3.0RS-V13	≤6PCS（240V）	1~2	3300	3300	6~13	10~13	9~11	8~10
	SH3.6RS-V13		1~2	3960	3960	6~15	10~15	9~14	8~12
	SH4.0RS-V13		1~2	4400	4400	6~17	11~17	10~15	9~14
	SH5.0RS		1~2	5500	5500	6~21	13~21	11~19	10~17
	SH6.0RS		1~2	6600	6600	8~25	13~25	11~22	10~20
SGRS	SG2.0RS-S-V13	/	1	2200	2200	7~8	-	-	-
	SG2.5RS-S-V13		1	2750	2750	7~10	-	-	-
	SG3.0RS-S-V13		1	3300	3300	7~12	10~12	9~10	8~9
	SG3.0RS-V13	≤6PCS（240V）	1~2	3300	3300	4~12	10~12	9~10	8~9
	SG3.6RS-V13		1~2	3960	3960	8~12	10~12	9~11	8~10
	SG4.0RS-V13		1~2	4400	4400	8~14	11~14	10~12	9~11
	SG5.0RS-V13		1~2	5500	5500	8~17	13~17	11~15	10~14
	SG6.0RS-V13		1~2	6600	6600	8~20	13~20	11~18	10~16
	SG8.0RS-V13		1~3	7680	7680	7~24	7~24	10~19	10~19
	SG9.0RS-V13		2~3	7680	7680	8~25	13~19	11~17	10~15
	SG10RS-V13		2~3	7680	7680	8~25	11~23	11~23	10~20

SGRT-P2	SG5RT-P2	/	1~2	5500	5500	6~18	14~17	13~18	11~16
	SG6RT-P2		1~2	6600	6600	6~21	17~20	15~21	14~19
	SG7RT-P2	≤4 PCS（160V）	1~3	7700	7700	6~24	20~24	18~24	16~22
	SG8RT-P2		1~3	8800	8800	6~28	22~27	20~28	18~25
	SG10RT-P2		1~3	11000	11000	6~33	22~33	20~30	18~27
	SG12RT-P2		1~3	12500	13200	7~35	22~35	20~34	18~30
	SG15RT-P2		2~4	12500	15500	7~35	22~35	22~35	18~30
	SG17RT-P2		2~4	12500	15500	8~35	22~35	20~34	18~30
	SG20RT-P2		2~4	12500	15500	9~35	22~35	20~34	18~30

Table 2. Boundary for Configuring SP600S Optimizer String Design in Residential Scenario

Series	Model	DC String Design in the standard condition				
SHRS		Configuration of Inverter DC input string and MPPT (annotation example: "1+0" means MPPT 1 is connected to 1 string, and MPPT 2 to 0 string)				
		1+0	1+1			
	SH3.0RS-V13	√	√			
	SH3.6RS-V13	√	√			
	SH4.0RS-V13	√	√			
	SH5.0RS	√	√			
	SH6.0RS	√	√			
SGRS		Configuration of Inverter DC input string and MPPT (annotation example: "1+0+0" means MPPT 1 is connected to 1 string, while MPPT 2 and MPPT3 to 0 string)				
		1+0+0	1+1+0	1+1+1		
	SG2.0RS-S-V13	√	/	/		
	SG2.5RS-S-V13	√	/	/		
	SG3.0RS-S-V13	√	/	/		
	SG3.0RS-V13	√	√	/		
	SG3.6RS-V13	√	√	/		
	SG4.0RS-V13	√	√	/		
	SG5.0RS-V13	√	√	/		

	SG6.0RS-V13	√	√	/		
	SG8.0RS-V13	/	√	√		
	SG9.0RS-V13	/	√	√		
	SG10RS-V13	/	√	√		
SGRT-P2		Configuration of inverter DC input String and MPPT (annotation example: "1+0" means MPPT 1 is connected to 1 string, and MPPT 2 to 0 string)				
		1+0	1+1	2+0	2+1	2+2
	SG5RT-P2	√	/	√	/	/
	SG6RT-P2	√	/	√	/	/
	SG7RT-P2	√	√	√	√	/
	SG8RT-P2	√	√	√	√	/
	SG10RT-P2	√	√	√	√	/
	SG12RT-P2	√	√	√	√	/
	SG15RT-P2	/	√	√	√	√
	SG17RT-P2	/	√	/	√	√
	SG20RT-P2	/	√	/	√	√

Table 3. Recommended DC Unlimited-power String Design in Residential Scenarios

Distributed Industrial and Commercial Scenarios

Series	Model	Number of string units difference optimizers between different MPPTs	Recommended number of strings (DC/AC ratio >0.9)	Maximum Continuous Power per String (W)	Maximum Continuous Power per MPPT (W)	Number of optimizers supported by string	Recommended number of string optimizers for typical module power level		
							550W	630W	695W*
SGCX-P2	SG25CX-P2	≤2PCS（80V）	2~6	12500	24000	12~35	16~28	14~24	22~27
	SG30CX-P2		3~6	12500	24000		16~28	14~24	18~22
	SG33CX-P2		3~6	12500	24000		16~28	14~24	19~24
	SG36CX-P2		3~8	12500	24000		16~28	14~24	21~26
	SG40CX-P2		4~8	12500	24000		16~28	14~24	18~22
	SG50CX-P2		4~8	12500	24000		16~28	14~24	22~27
	SG125CX-P2		10~24	12500	24000	13~35	16~25	14~22	22~27

*DC/AC ration should be more than 1.2, the detail calculation is shown in table 6 & table 7.

Table 4. Boundary for Configuring SP600S Optimizer String Design in C&I Scenarios

Series	Model	DC Unlimited-power String Design													
SGCX-P2		Configuration of Inverter DC input string and MPPT (annotation example: "2+1+1+1" means MPPT 1 is connected to 2 strings, while MPPT 2, MPPT 3 and MPPT 4 to 1 string)													
		1+1	1+1+1+0	2+1+1+0	2+2+1+0	2+2+2+0	1+1+1+1	2+1+1+1	2+2+1+1	2+2+2+1	2+2+2+2					
	SG25CX-P2	√	√	√	√	√	/	/	/	/	/					
	SG30CX-P2	/	√	√	√	√	/	/	/	/	/					
	SG33CX-P2	/	√	√	√	√	/	/	/	/	/					
	SG36CX-P2	/	√	/	/	/	√	√	√	√	√					
	SG40CX-P2	/	/	/	/	/	√	√	√	√	√					
	SG50CX-P2	/	/	/	/	/	√	√	√	√	√					
		Configuration of Inverter DC input string and MPPT (annotation example: "1*9+2*3" means 9 MPPTs are connected to 1 string, while 3 MPPTs are connected to **2** strings)													
		1*10	1*11	1*12	1*11+2	1*10+2*2	1*9+2*3	1*8+2*4	1*7+2*5	1*6+2*6	1*5+2*7	1*4+2*8	1*3+2*9	1*2+2*10	1+2*11	2*12
	SG125CX-P2	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Table 5. Recommended DC Unlimited-power String Design in Residential Scenarios

Input condition			Output	
PV module	PV module power（W）	695	Rated power（W）	50000
	PV module Vmpp（V）	40.3	Output voltage from Optimizer（V）	36.4
	PV module Imp（A）	17.25	Output current from Optimizer（A））	16
Inverter	Model	SG50CX-P2	Max. output power from Optimizer（W）	**581.8**
	Max. efficiency	98.5%	Input power required by inverter（W）	**576.8**
	Max-Power voltage（V）	800	**Max. loss of power（W）**	**0** (582W＞577W)
SP600S Optimizer	Rated output power (W)	600		
	Rated output current (A)	16		
System adaptation	DC strings	4		
	Number of PV modules in a string	22		
	Number of PV modules	88		
	Limit of DC / AC ratio	1.21		

Table 6. Optimizer system of 695W PV Module and SG50CX-P2

Input condition			Output	
PV module	PV module power（W）	695	Rated power（W）	125000
	PV module Vmpp（V）	40.3	Output voltage from Optimizer（V）	34.8
	PV module Imp（A）	17.25	Output current from Optimizer（A））	16
Inverter	Model	SG125CX-P2	Max. output power from Optimizer（W）	**581.8**
	Max. efficiency	98%	Input power required by inverter（W）	**579.8**
	Max-Power voltage（V）	800	**Max. loss of power（W）**	**0** (582W＞580W)
SP600S Optimizer	Rated output power (W)	600		
	Rated output current (A)	16		
System adaptation	DC strings	10		
	Number of PV modules in a string	22		
	Number of PV modules	220		
	Limit of DC / AC ratio	1.21		

Table 7. Optimizer system of 695W PV Module and SG125CX-P2

IV. Design for Special Scenarios

● Long String Installation

The SP600S optimizer supports long string installation. For SGRS and SHRS series single-phase inverters, it supports up to 25 optimizers connection, and for SGRT-P2 and SGCX-P2 series, it supports up to 35 optimizers connection. Please refer to Tables 4 and 6 for specific designs.

The shutdown voltage of each SP600S optimizer is (1 ± 0.1) V. If there are more than 28 series optimizers in one series, the voltage of the PV string after shutdown may exceed 30V, which may not meet the local regulatory requirements for rapid shutdown.

● Partial Installation

The SP600S supports partial installation at the MPPT level for SGRT-P2 and SGRS series inverters. SP600S optimizer can be installed in one or more MPPT strings of the inverter. Installing optimizers on some PV modules in one PV string is not allowed. If there are 2 or more strings under one MPPT, all PV strings under that MPPT should be equipped with an SP600S optimizer, and it is not allowed to install optimizers only on one of the strings. In partial installation scenario, strings without the SP600S optimizer installed do not have functions such as module-level rapid shutdown, fault location, and intelligent component diagnosis.

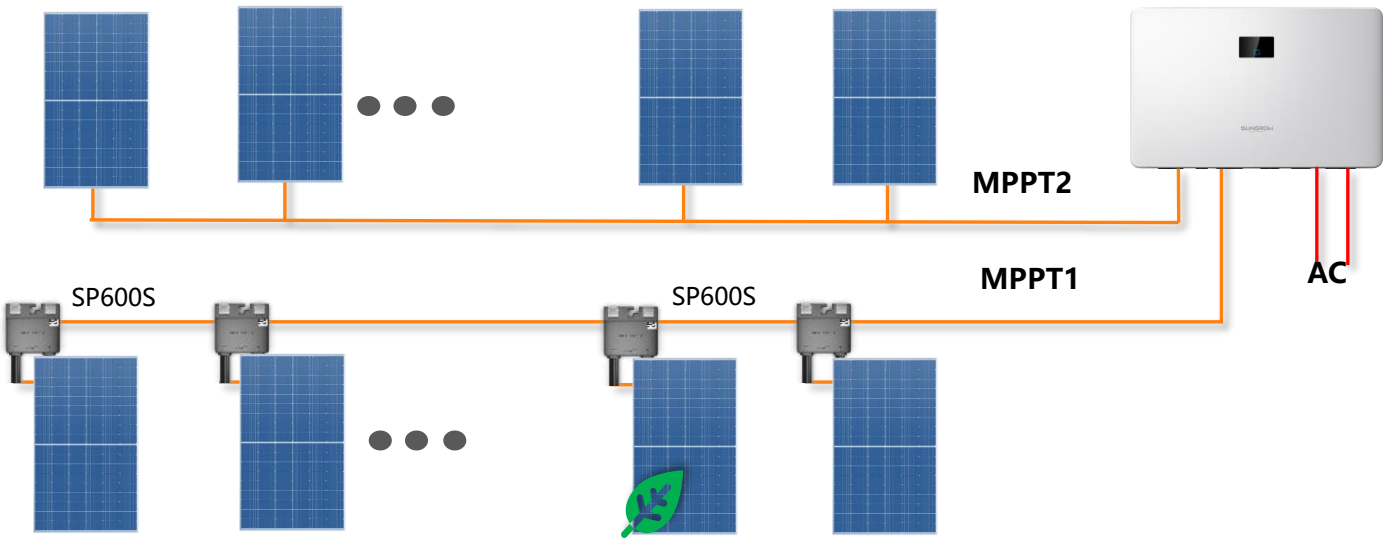

Figure 11. Schematic Diagram of Partial Installation of SP600S Optimizer

● Installation in Different Orientations

The SP600S optimizer allows more flexible PV plant design and higher installed capacity. With the SP600S optimizer deployed, the limitations of traditional design solutions are removed. PV modules with different orientations can be connected to the same PV string, and PV modules can also be installed in shadowed areas, the installed capacity can increase 10% - 50%.

Figure 12. Deploying SP600S Optimizers on Rooftops in Different Orientations to Maximize Installed Capacity

Note: In one MPPT, it is allowed for PV modules to have max. two different orientations, and the number of PV modules connected in the two strings within the same MPPT must be identical.

SUNGROW

SUNGROW POWER SUPPLY CO., LTD
No.1699 Xiyou Rd.,
High-tech Industrial Development Zone,
Hefei, P.R. China

+86-551-6532 7834
www.sungrowpower.com