


Test report no.: <i>Prüfbericht-Nr.:</i>	CN23YDIN 001	Order No.: <i>Auftragsnr.:</i>	244495224	Page 1 of 16 <i>Seite 1 von 16</i>
Client reference no.: <i>Kunden-Referenz-Nr.:</i>	2003666	Order date: <i>Auftragsdatum:</i>	2023-02-21	
Client: <i>Auftraggeber:</i>	Sungrow Power Supply Co., Ltd. No. 1699, Xiyou Road, New & High Technology Industrial Development Zone, Hefei, Anhui 230088, P.R. CHINA			
Test item: <i>Prüfgegenstand:</i>	Optimizer			
Identification / Type no.: <i>Bezeichnung / Typ-Nr.:</i>	SP600S			
Order content: <i>Auftrags-Inhalt:</i>	Test report			
Test specification <i>Prüfgrundlage:</i>	See test specification on page 3.			
Date of sample receipt: <i>Wareneingangsdatum:</i>	2023--01-29			
Test sample no.: <i>Prüfmuster-Nr.:</i>	Engineering sample			
Testing period: <i>Prüfzeitraum:</i>	2023-01-29 - 2023-03-01			
Place of testing: <i>Ort der Prüfung:</i>	See summary of testing on page 4.			
Testing laboratory: <i>Prüflaboratorium:</i>	TÜV Rheinland (Shanghai) Co., Ltd.			
Test result*: <i>Prüfergebnis*:</i>	Pass			
tested by: <i>geprüft von:</i>	Xingxin Tian	authorized by: <i>genehmigt von:</i>	Bowen Dong	
Date: 2023-03-22 <i>Datum:</i>		Issue date: 2023-03-22 <i>Ausstellungsdatum:</i>		
Position / Stellung:	Expert/Sachverständige(r)	Position / Stellung:	Expert/Sachverständige(r)	
Other: <i>Sonstiges:</i>	See the following pages for General product information and comment.			
Condition of the test item at delivery: <i>Zustand des Prüfgegenstandes bei Anlieferung:</i>	Test item complete and undamaged Prüfmuster vollständig und unbeschädigt			
* Legend:	P(ass) = passed a.m. test specification(s)	F(ail) = failed a.m. test specification(s)	N/A = not applicable	N/T = not tested
* Legende:	P(ass) = entspricht o.g. Prüfgrundlage(n)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
<p>This test report only relates to the above mentioned test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark. <i>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.</i></p>				

Test report no.: CN23YDIN 001
Prüfbericht-Nr.:

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Remarks
Anmerkungen

1	<p>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</p> <p><i>Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben.</i></p> <p><i>Detaillierte Informationen bezüglich Prüfbedingungen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</i></p>
2	<p>As contractually agreed, this document has been signed digitally only. TUV Rheinland has not verified and unable to verify which legal or other pertaining requirements are applicable for this document. Such verification is within the responsibility of the user of this document. Upon request by its client, TUV Rheinland can confirm the validity of the digital signature by a separate document. Such request shall be addressed to our Sales department. An environmental fee for such additional service will be charged.</p> <p><i>Wie vertraglich vereinbart, wurde dieses Dokument nur digital unterzeichnet. Der TÜV Rheinland hat nicht überprüft, welche rechtlichen oder sonstigen diesbezüglichen Anforderungen für dieses Dokument gelten. Diese Überprüfung liegt in der Verantwortung des Benutzers dieses Dokuments. Auf Verlangen des Kunden kann der TÜV Rheinland die Gültigkeit der digitalen Signatur durch ein gesondertes Dokument bestätigen. Diese Anfrage ist an unseren Vertrieb zu richten. Eine Umweltgebühr für einen solchen zusätzlichen Service wird erhoben.</i></p>
3	<p>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report. Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</p> <p><i>Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt.</i></p>
4	<p>The decision rule for statements of conformity, based on numerical measurement results, in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019.</p> <p><i>Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnissen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird. Zu weiteren Informationen bezüglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019.</i></p>
5	

Test Report issued under the responsibility of:



TEST REPORT Electric Power Generation Comparison Test for PV systems with/without Optimizers	
Report Number..... :	CN23YDIN 001
Date of issue..... :	See cover page
Total number of pages	See cover page
Name of Testing Laboratory preparing the Report	TÜV Rheinland (Shanghai) Co., Ltd.
Applicant's name	Sungrow Power Supply Co., Ltd.
Address..... :	No. 1699, Xiyou Road, New & High Technology Industrial Development Zone, Hefei, Anhui 230088, P.R. CHINA
Test specification:	
Standard	Technical specification provided by client
Test procedure	Test report
Non-standard test method	N/A
Test Report Form No. :	N/A
Test Report Form(s) Originator :	TÜV Rheinland (Shanghai) Co., Ltd.
Master TRF	N/A
General disclaimer:	
The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing Testing Laboratory. The authenticity of this Test Report and its contents can be verified by contacting the testing laboratory which is responsible for this Test Report.	

Test item description :	Optimizer	
Trade Mark :	SUNGROW	
Manufacturer	Same as the applicant	
Model/Type reference	Optimizer: SP600S, Inverter: SG6.0RS	
Ratings	See copy of marking label and model list.	
Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):		
<input type="checkbox"/>	CB Testing Laboratory:	
Testing location/ address		
<input type="checkbox"/>	Associated CB Testing Laboratory:	
Testing location/ address		
Tested by (name, function, signature) :		
Approved by (name, function, signature) ... :		
<input type="checkbox"/>	Testing procedure: CTF Stage 1:	
Testing location/ address		
Tested by (name, function, signature) :		
Approved by (name, function, signature) ... :		
<input type="checkbox"/>	Testing procedure: CTF Stage 2:	
Testing location/ address		
Tested by (name + signature)		
Witnessed by (name, function, signature) .:		
Approved by (name, function, signature) ... :		
<input type="checkbox"/>	Testing procedure: CTF Stage 3:	
<input type="checkbox"/>	Testing procedure: CTF Stage 4:	
Testing location/ address		
Tested by (name, function, signature) :		
Witnessed by (name, function, signature) .:		
Approved by (name, function, signature) ... :		
Supervised by (name, function, signature) :		


List of Attachments (including a total number of pages in each attachment): - None	
Summary of testing:	
Tests performed (name of test and test clause): Electric power generation comparison test Tests conducted on experimental group and control group at the same time with the same weather condition.	Testing location: Hengjun Testing Technology Co., LTD No. 88 Wutong Road, Hefei City, Anhui Province, P.R. CHINA.


Copy of marking plate:
The artwork below may be only a draft.

SG6.0RS:

49.99

SUNGROW		GRID-CONNECTED PV INVERTER
Type	SG6.0RS	
S/N	A*****	
DC -----	V _{DC max}	600V
	V _{DC MPP}	40V...560V
	I _{DC max}	32A(16A / 16A)
	I _{SC PV}	40A(20A / 20A)
AC-Grid ~ 50Hz / 60Hz	V _{AC,r}	220V / 230V / 240V
	I _{AC max}	27.3A
	P _{AC,r}	6000W
	S _{AC,r}	6000VA
	cos(φ)	-0.8...1...+0.8
Overvoltage Category		III[AC],II[PV]
Safety Class I	IP65	-25°C...+60°C

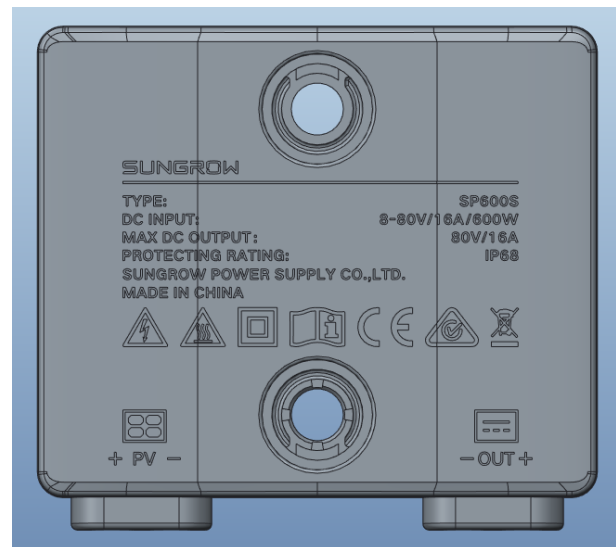




SUNGROW POWER SUPPLY CO., LTD.
www.sungrowpower.com Made in china

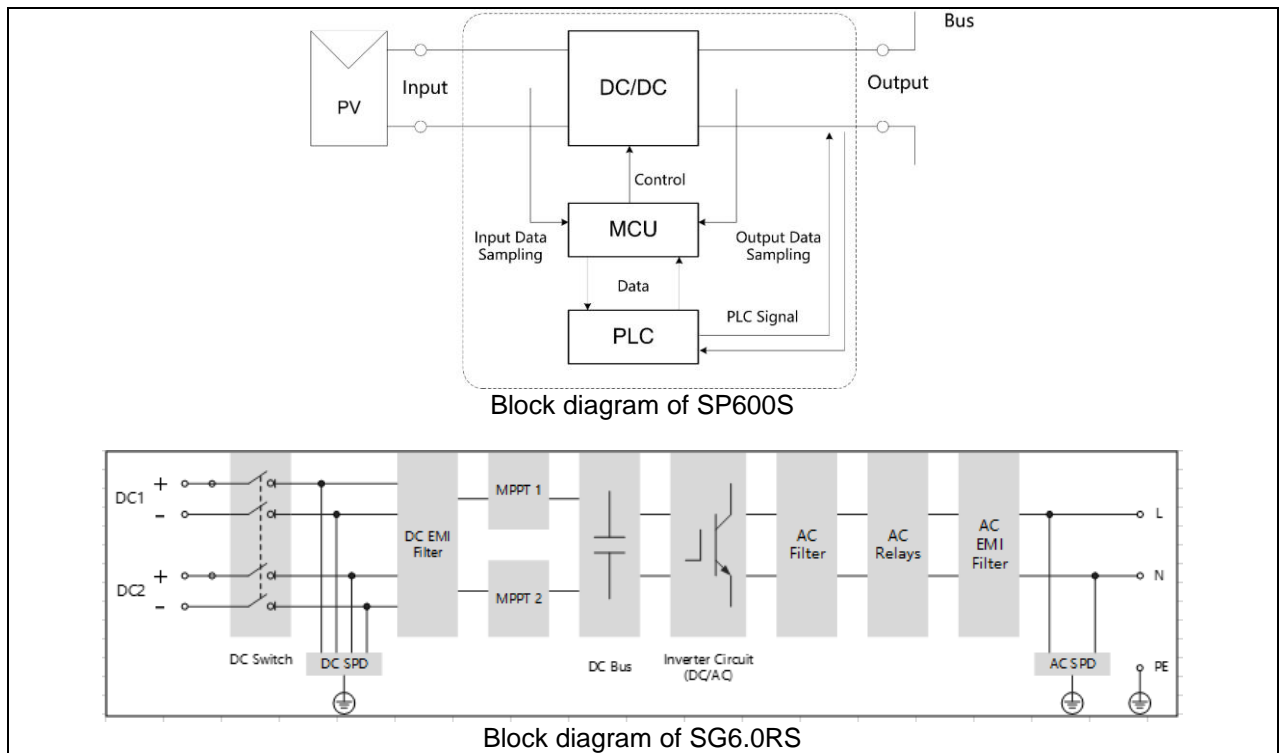
78.00

SP600S:



Test item particulars:	
Equipment mobility	<input type="checkbox"/> movable <input type="checkbox"/> hand-held <input checked="" type="checkbox"/> stationary <input checked="" type="checkbox"/> fixed <input type="checkbox"/> transportable <input type="checkbox"/> for building-in
Connection to the mains	<input checked="" type="checkbox"/> pluggable equipment <input type="checkbox"/> direct plug-in <input type="checkbox"/> permanent connection <input type="checkbox"/> for building-in
Environmental category	<input checked="" type="checkbox"/> outdoor <input type="checkbox"/> indoor unconditional <input type="checkbox"/> indoor conditional
Over voltage category Mains	<input type="checkbox"/> OVC I <input type="checkbox"/> OVC II <input checked="" type="checkbox"/> OVC III <input type="checkbox"/> OVC IV
Over voltage category PV	<input type="checkbox"/> OVC I <input checked="" type="checkbox"/> OVC II <input type="checkbox"/> OVC III <input type="checkbox"/> OVC IV
Mains supply tolerance (%)	-90 / +110 %
Tested for power systems	TN
IT testing, phase-phase voltage (V)	- - -
Class of equipment	<input type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input type="checkbox"/> Not classified
Mass of equipment (kg)	See model list on the following pages.
Pollution degree	PD 3
IP protection class	See nameplates.
.....:	
Possible test case verdicts:	
- test case does not apply to the test object	N/A
- test object does meet the requirement	P (Pass)
- test object was not evaluated for the requirement	N/E
- test object does not meet the requirement	F (Fail)
Testing	
Date of receipt of test item	See cover page
Date (s) of performance of tests	See cover page

General remarks:	
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report.	
Throughout this report a <input type="checkbox"/> comma / <input type="checkbox"/> point is used as the decimal separator.	
Manufacturer's Declaration per sub-clause 4.2.5 of IEC 60384-14:	
The application for obtaining a Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided :	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> Not applicable
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (ies) : N/A	
General product information:	
<u>Brief description:</u>	
<p>The optimizer model type SP600S is a module level power electronic which utilizes power electronic technology to control and adjust the voltage and current of each PV module, to realize module-level most power point tracing and increase electric power production of PV system. Besides, it has the function of module-level shut-up, module-level IV scanning and auto physical positioning.</p> <p>The inverter model type SG6.0RS is single-phase grid connected inverter for solar power generation. The Grid-connected PV Inverters utilize the advanced power conversion technology IGBT to convert the DC power normally from the photovoltaic array to stable AC power and then feed the power to the utility grid.</p>	
<u>Block Diagram:</u>	


Model List:

MODELS LIST		SP600S
INPUT	Rated Input DC Power [W]	600
	Max. Input Voltage [Vdc]	80
	MPP voltage range [Vdc]	8-80
	Max. allowed system voltage [Vdc]	1100
	Max. DC input current [A]	16
	Max. DC short-circuit current [A]	20
OUTPUT	Max. output voltage [Vdc]	80
	Max. Output Current I _{max} [A]	16
	Protective Class	II
SYSTEM	Enclosure Protection (IP)	IP68
	Overvoltage Category	II
	Operating Temperature Range [°C]	-40 to 85 (>80 derating)
	Pollution degree (PD)	PD3 (outside), PD2 (inside)
	Altitude [m]	4000
	Weight [kg]	0.53
	Dimensions (W*H*D) [mm]	86*107.5*25
Firmware version	MLPE_KUROYOROCK_V01_V01_A	

MODELS LIST		SG6.0RS
INPUT	V _{MAX} PV [Vdc]	600
	I _{SC} PV [A]	20/20
	MPP Voltage Range V _{MPP} [Vdc]	40-560
	Max. Input Current I _{max} [A]	16/16
	MPP Voltage Range for rated power [Vdc]	285-480
	Start PV Voltage [Vdc]	50
	Backfeed Current [A]	0
	Overvoltage Category (OVC)	II
OUTPUT	Rated Output Voltage U _r [Vac]	220/230/240
	Normal Operating Voltage Range U _n [Vac]	154~276 V
	Rated Output Frequency F _{NETZ} [Hz]	50/60Hz
	Normal Operating Frequency Range F _n [Hz]	50 Hz / 45~55 Hz, 60 Hz / 55~65 Hz
	Rated Output Power P _E [kW]	6.0
	Max. Apparent Power P _{E_{max}} [kVA]	6.0
	Max. Output Current I _{max} [A]	27.3
	Power Factor cosφ [λ]	0.8leading- 0,8lagging
	Overvoltage Category (OVC)	III
SYSTEM	Protective Class	I
	Enclosure Protection (IP)	IP65
	Operating Temperature Range [°C]	-25 to 60°C
	Altitude [m]	4000
	Weight [kg]	10
	Dimensions (W*H*D) [mm]	410* 270* 150
	Firmware version	ARM_SUNSTONE-S_V11_V01_A; MDSP_SUNSTONE-S_V11_V01_A

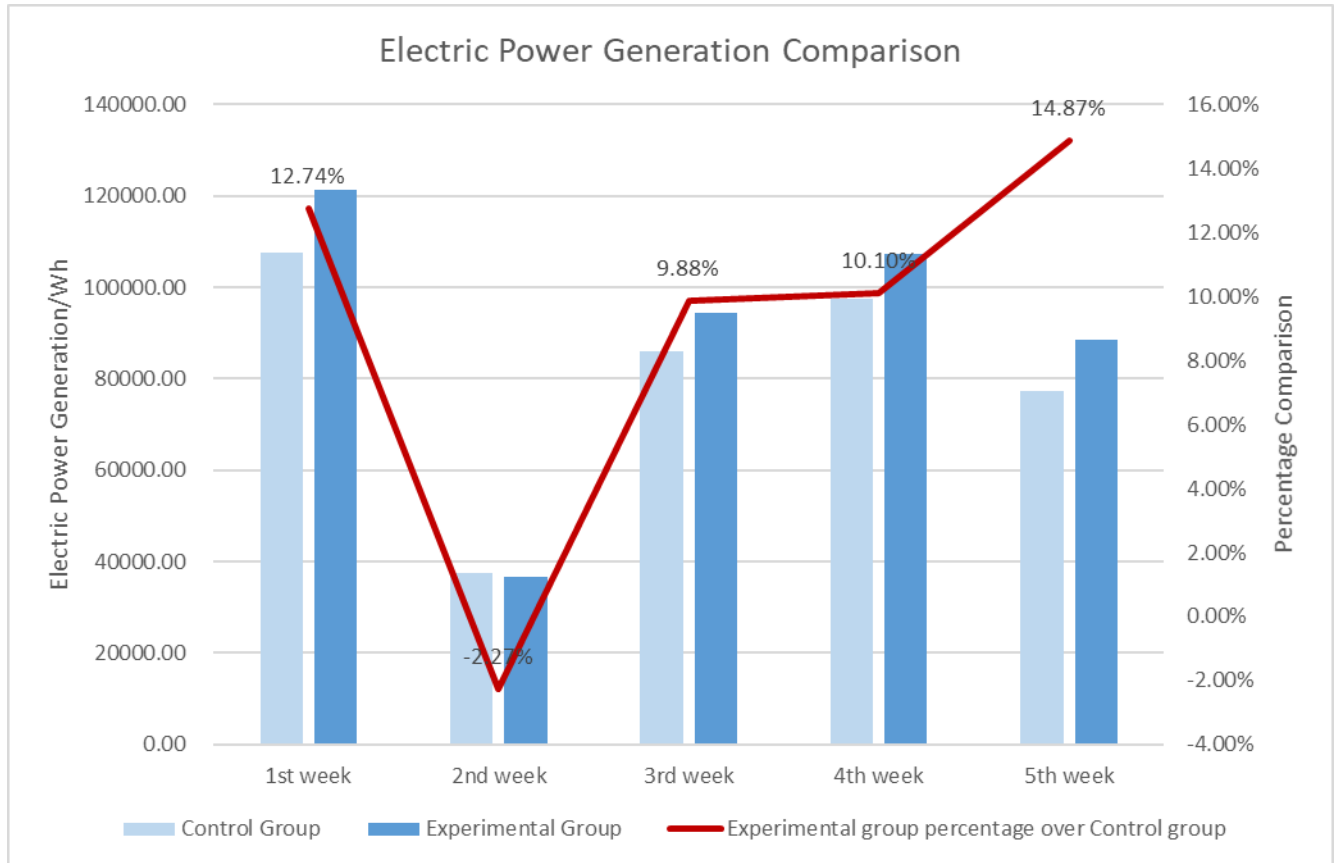
ELECTRIC POWER GENERATION COMPARISON TEST FOR PV SYSTEMS WITH/WITHOUT OPTIMIZERS			
Clause	Requirement – Test	Result – Remark	Verdict

Test Description			
1	Test Purpose		
	By means of comparing the electric power generation of PV systems with or without optimizer, to verify the improvement performance of electric power generation of the optimizer.	See below.	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
2	Test Condition		
2.1	Test Period	29-01-2023 to 01-03-2023	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
2.2	Test Location	Hengjun Testing Technology Co., LTD No. 88 Wutong Road, Hefei City, Anhui Province, P.R. CHINA.	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
2.3	Weather Condition during test	See weather record photograph below.	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
3	Test Method		
3.1	Experimental Group	See below.	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
	Experimental group is equipped with an inverter and appropriate quantity of PV modules, each module integrated with an optimizer.	Inverter: SG6.0RS Optimizer: S600S Quantity of PV modules: 30 pieces. Rated power of one module: 235W	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
3.2	Control Group	See below.	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
	Control group is equipped with the same inverter model and same quantity of PV modules, modules not integrated with optimizers.	Inverter: SG6.0RS Quantity of modules: 30 pieces. Rated power of one	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>

ELECTRIC POWER GENERATION COMPARISON TEST FOR PV SYSTEMS WITH/WITHOUT OPTIMIZERS			
Clause	Requirement – Test	Result – Remark	Verdict
		module: 235W. No optimizer.	
3.3	Location selection requirement for PV array	See below.	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
	Location of PV array for experimental and control group shall be on one building roof and with same orientation and similar lighting condition, avoidance of fixed shade such as parapets, stair wells or tall buildings.	The PV arrays selected for experimental and control group are in same orientation, and no visible fixed shade. See the test photograph below for details.	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
3.4	Experimental procedure	See below.	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
	Test shall be performed on experimental group and control group at the same time, output electric power and energy shall be recorded each day respectively for experimental group and control group, the test shall be lasted for more than 30 days. At the end of the test, total electric power energy shall be recorded and analysed.	The tests stated and ended at the same time. The output power and energy were recorded by one power analyser.	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
4	Test result		
	Total electric power energy of experimental group and control group shall be recorded, analysed and compared. Increase rate of electric energy production of experimental group compared with control group = (electric energy production of experimental group - electric energy production of control group) ÷ electric energy production of control group × 100%	Electric energy production of experimental group = 448003 Wh Electric energy production of control group = 405358 Wh Increase rate = (448003-405358) ÷ 405358 × 100%= 10.52%	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
5	Conclusion	In this test, the electric energy production of PV system with optimizer is 10.52% higher than that of PV system without optimizer.	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>

Test Result:

Electric Power Generation Comparison Test Result								
Electric Power Generation (Wh)	Date	29-Jan	30-Jan	31-Jan	01-Feb	02-Feb	03-Feb	04-Feb
	Weather	Sunny	Sunny	Sunny	Cloudy	Cloudy	Cloudy	Cloudy
	Control Group	12088	22365	30638	10939	10066	10294	11086
	Experimental Group	14212	25793	35839	11887	11065	10562	11812
	Date	05-Feb	06-Feb	07-Feb	08-Feb	09-Feb	10-Feb	11-Feb
	Weather	Overcast	Overcast	Overcast	Rainy	Rainy	Cloudy	Cloudy
	Control Group	2462	2326	2321	2462	5708	11087	11051
	Experimental Group	2111	1883	1883	2107	4903	11805	11874
	Date	12-Feb	13-Feb	14-Feb	15-Feb	16-Feb	17-Feb	18-Feb
	Weather	Rainy	Cloudy	Sunny	Sunny	Cloudy	Cloudy	Overcast
	Control Group	2322	11110	26345	22392	10305	11143	2321
	Experimental Group	1881	11781	30565	25978	10560	11781	1883
	Date	19-Feb	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb
	Weather	Sunny	Sunny	Cloudy	Rainy	Overcast	Cloudy	Sunny
	Control Group	22397	26350	10086	5697	2464	11049	19315
	Experimental Group	25049	30413	11032	4903	2107	11875	21810
	Date	26-Feb	27-Feb	28-Feb	01-Mar	Total		
	Weather	Sunny	Sunny	Sunny	Sunny			
	Control Group	30675	31083	13726	1685	405358		
	Experimental Group	35345	35861	15756	1685	448003		
Result Analysis	Increase rate of power generation during test period (%)			10.52				



Test Photographs:

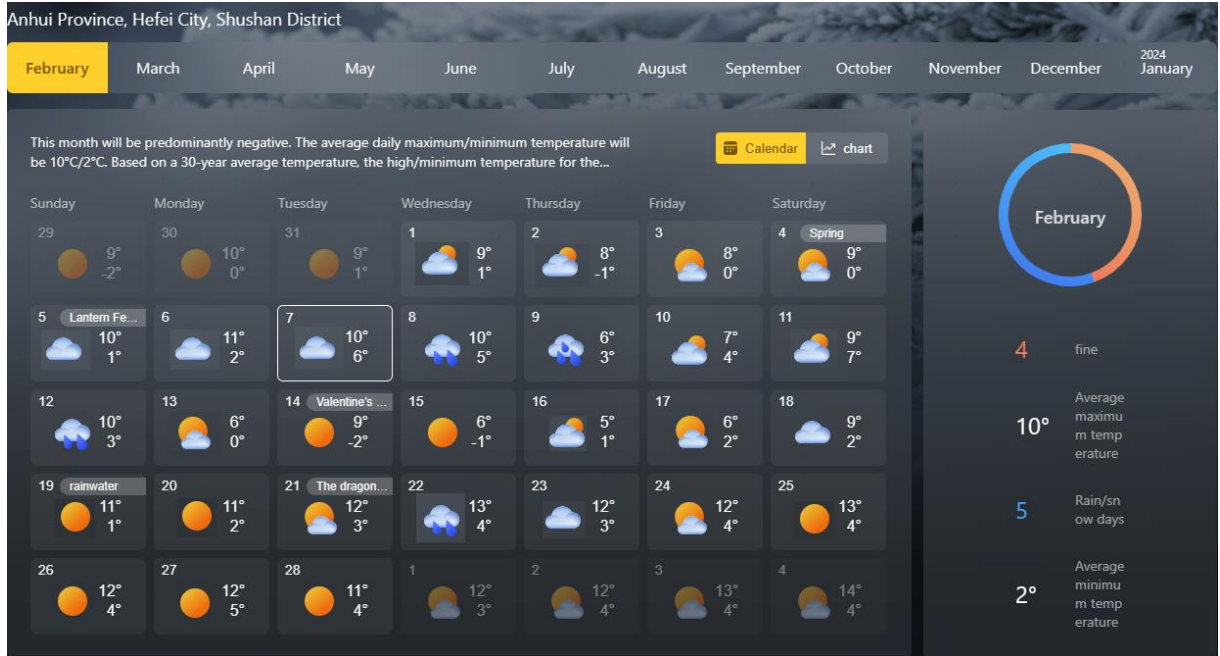


Figure. 1 Weather in test period

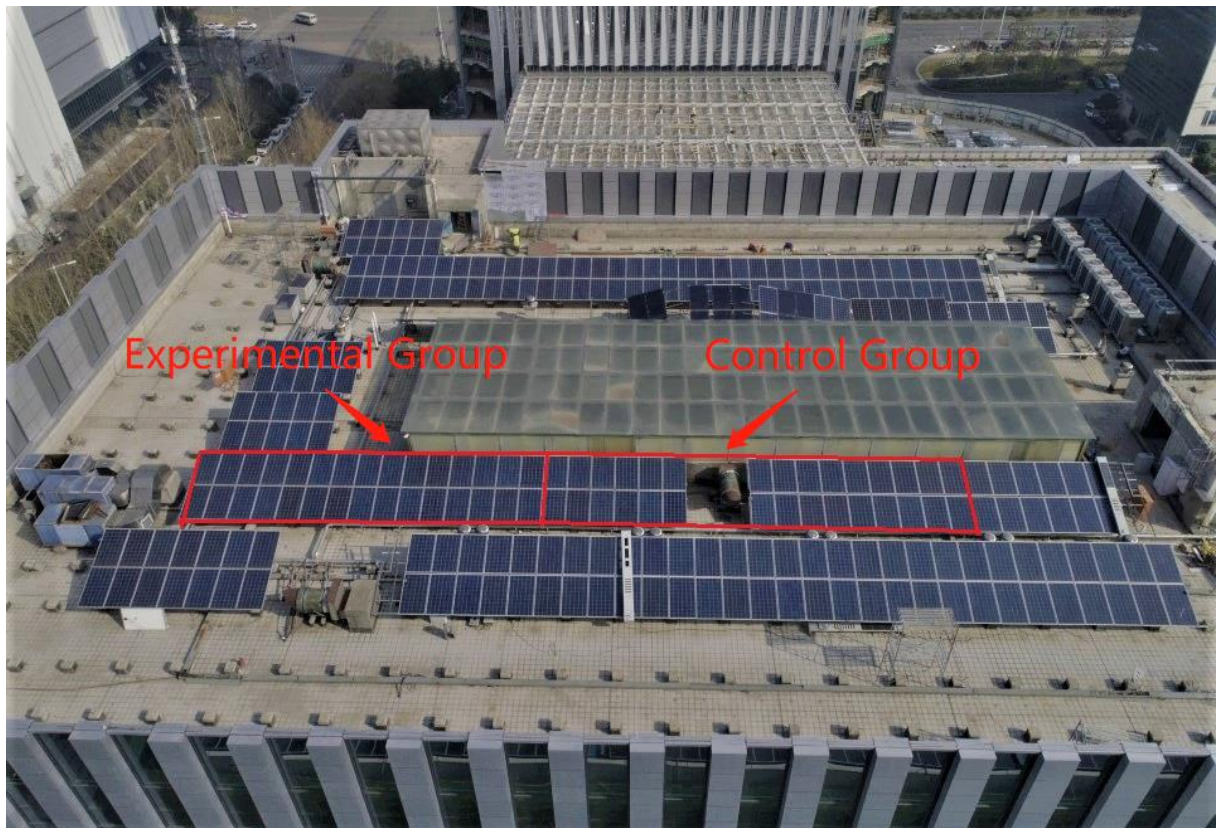


Figure. 2 Test location

Equipment List:

No.	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Due Date
1	Precision Power Analyser	YOKOGAWA	WT1800	C3SA15008E	2022/04/06 to 2023/04/05
2	Current sensor	TEKTRONIX	A621	01RR10751DV	2022/12/14 to 2023/12/13
3	Current sensor	TEKTRONIX	A621	01RR10758DV	2022/11/09 to 2023/11/08

-----End of report-----