TEST REPORT
IEC 62109-2
Safety of Power Converter for use in Photovoltaic Power Systems
Part 2: Particular requirements for inverters

Report Number.....:	70.409.21.035.11-00 part 2 of 2
Date of issue .....:	2021-05-17
Total number of pages.....:	30
Testing Laboratory .....:	TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch
Applicant's name .....:	Sungrow Power Supply Co., Ltd.
Address .....:	No. 1699 Xiyou Road, New & High, Technology Industrial Development Zone, 230088 Hefei, Anhui, People's Republic of China
Test specification:	
Standard.....:	IEC 62109-2:2011 (First Edition)
Test procedure.....:	TÜV mark
Non-standard test method.....:	N/A
Test Report Form No. .....:	IEC62109_2B
Test Report Form(s) Originator....:	LCIE - Laboratoire Central des Industries Electriques
Master TRF .....:	Dated 2016-08

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Test item description .....:	Grid-connected PV Inverter
Trade Mark.....:	阳 光 电 源 SUNGROW
Manufacturer .....:	Sungrow Power Supply Co., Ltd. No. 1699 Xiyou Road, New & High, Technology Industrial Development Zone, 230088 Hefei, Anhui, People's Republic of China
Model/Type reference .....:	SH3.0RS, SH3.6RS,SH4.0RS, SH5.0RS, SH6.0RS
Ratings .....:	See rating labels on pages 4 to 6 of part 1 IEC 62019-1 report

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):

☒	**Testing Laboratory .....:**	TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch	
Testing location/ address .....:		5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West, Guangzhou 510656, P. R. China	
☐	**Associated Testing Laboratory:**		
Testing location/ address .....:			
Tested by (name, function, signature) .....:			
Approved by (name, function, signature)..:			
☒	**Testing procedure: CTF Stage 1:**	Test Center of Sungrow Power Supply Co., Ltd. (CNAS L8066)	
Testing location/ address .....:		No. 1699 Xiyou Road, New & High, Technology Industrial Development Zone, 230088 Hefei, Anhui, People's Republic of China	
Tested by (name, function, signature) .....:		Shan Huang, Bin Wu	Shan Huang
Approved by (name, function, signature)..:		Kai Zhao	
☐	**Testing procedure: CTF Stage 2:**		
Testing location/ address .....:			
Tested by (name + signature).....:			
Witnessed by (name, function, signature).:			
Approved by (name, function, signature)..:			
☐	**Testing procedure: CTF Stage 3:**		
☐	**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):

Tests against:

IEC 62109-1(ed.1)/EN 62109-1:2010, IEC 62109-2(ed.1)/EN 62109-2:2011

Total test reports contains 3 parts and 1 attachment listed in below table:

Item	Description	Pages
Part 1	IEC 62109-1(ed.1)/EN 62109-1:2010 test report	77
Part 2	IEC 62109-2(ed.1)/EN 62109-2:2011 test report	30
Part 3	IEC 62477-1:2012+A1:2016, EN 62477-1:2012/A1:2017 test report	67
Attachment 1	Data form for electrical and electronic component(CDF)	13

Summary of testing:

All the tests results are confirmed to the requirements of the standard.

Tests performed (name of test and test clause):

All tests were performed on model SH6.0RS.

Additional were tested on models,

Clause	Requirement	Lab
4.4.4.15.1	Fault-tolerance of residual current monitoring	(1)
4.4.4.15.2	Fault-tolerance of automatic disconnecting means	(1)
4.7.3	Measurement requirements for AC output ports for stand-alone inverters	(1)
4.7.4	Stand-alone Inverter AC output voltage and frequency	(1)
4.7.5	Stand-alone inverter output voltage waveform	(1)
4.4.4.17	Cooling system failure – Blanketing test	(1)
4.8.2.1	Array insulation resistance detection for inverters for ungrounded arrays	(1)
4.8.3.5	Array residual current detection	(1)
9.3.4	Inverter backfeed current onto the array	(1)

Testing location:

Test Center of Sungrow Power Supply Co., Ltd. (CNAS L8066)

No. 1699 Xiyou Road, New & High, Technology Industrial Development Zone, 230088 Hefei, Anhui, People's Republic of China

Summary of compliance with National Differences (List of countries addressed):

All tests were carried out according to IEC 62109-2(ed.1)/EN 62109-2:2011.

The text of IEC 62109-2(ed.1) was approved by CENELEC as a European Standard without any modification. Also compliance with EN 62109-2:2011, Annex ZA of EN 62109-1:2011 is recorded at the end of this report.

☒ **The product fulfils the requirements of IEC 62109-2(ed.1)/EN 62109-2:2011**

Copy of marking plate: Refer to pages 4 to 6 of part 1 IEC 62109-1 report.	
Test item particulars..... :	
Equipment mobility .....:	☐ movable ☐ hand-held ☐ stationary ☒ fixed ☐ transportable ☐ for building-in
Connection to the mains .....:	☐ pluggable equipment ☐ direct plug-in ☒ permanent connection ☐ for building-in
Enviromental category.....:	☒ outdoor ☐ indoor unconditional ☐ indoor conditional
Over voltage category Mains.....:	☐ OVC I ☐ OVC II ☒ OVC III ☐ OVC IV
Over voltage category PV.....:	☐ OVC I ☒ OVC II ☐ OVC III ☐ OVC IV
Mains supply tolerance (%) .....:	±10 %
Tested for power systems .....:	TN system, except corner-earthed system
IT testing, phase-phase voltage (V).....:	N/A
Class of equipment.....:	☒ Class I ☐ Class II ☐ Class III ☐ Not classified
Mass of equipment (kg) .....:	Approx. 18.5kg
Pollution degree.....:	3(external environment), 2(internal environment)
IP protection class .....:	IP65
.....:	
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 does not meet the requirement ..... :	F (Fail)
Testing..... :	
Date of receipt of test item ..... :	2021-03-01
Date (s) of performance of tests..... :	2021-03-02 to 2021-05-14
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 ☐ comma / ☒ point is used as the decimal separator.**	
Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:	
The application for obtaining a CB 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 .....:	☐ **Yes** ☒ **Not applicable**
When differences exist; they shall be identified in the General product information section.	

Name and address of factory (ies)……..:	1. Sungrow Power Supply Co., Ltd. No. 1699 Xiyou Road, New & High Technology Industrial Development Zone, 230088 Hefei, Anhui, People's Republic of China 2. Sungrow Power Supply Co., Ltd. No. 608, Changning Avenue, New & High Technology Industrial, Development Zone 230088 Hefei City, Anhui Province PEOPLE'S REPUBLIC OF CHINA 3. Sungrow Developers (India) Private Limited No.85, kanmike village, Kengeri hobli Bangalore South Taluk, 560074 Bangalore, INDIA
General product information: Refer to pages 8 to 11 of part 1 IEC 62109-1 report.	

IEC 62109-2			
Clause	Requirement + Test	Result - Remark	Verdict
4	**GENERAL TESTING REQUIREMENTS**		P
4.4.4	Single fault conditions to be applied		P
4.4.4.15	Fault-tolerance of protection for grid-interactive inverters		P
4.4.4.15.1	Fault-tolerance of residual current monitoring according to 4.8.3.5: the residual current monitoring system operates properly	Residual current monitoring is met by provision of RCMU integrated in inverter, the protective system including a self-diagnostic test to check if RCMU is Ok (within the specified accuracy) before the next attempted re-start because it is considered highly unlikely that a fault in the monitoring system would happen on the same day a person coming into contact with normally enclosed hazardous live parts of the PV system.	P
	a).. - The inverter ceases to operate		P
	- Indicates a fault in accordance with §13.9		P
	- Disconnect from the mains		P
	- not re-connect after any sequence of removing and reconnecting PV power		P
	- not re-connect after any sequence of removing and reconnecting AC power		P
	- not re-connect after any sequence of removing and reconnecting both PV and AC power		P
	b) . - The inverter continues to operate		N/A
	- the residual current monitoring system operates properly under single fault condition		N/A
	- Indicates a fault in accordance with §13.9		N/A
	c).. - The inverter continues to operate regardless of loss of residual current monitoring functionality		N/A
	- not re-connect after any sequence of removing and reconnecting PV power		N/A
	- not re-connect after any sequence of removing and reconnecting AC power		N/A
	- not re-connect after any sequence of removing and reconnecting both PV and AC power		N/A
	- Indicates a fault in accordance with §13.9		N/A
4.4.4.15.2	Fault-tolerance of automatic disconnecting means		P

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Clause	Requirement + Test	Result - Remark	Verdict
4.4.4.15.2 .1	The means provided for automatic disconnection of a grid-interactive inverter from the mains shall:		P
	- disconnect all grounded current-carrying conductors from the mains	Not allowed to be used in grounded current-carrying system.	N/A
	- disconnect all ungrounded current-carrying conductors from the mains	2 pieces TUV/UL approved series relays used for all active conductors.	P
	- be such that with a single fault applied to the disconnection means or to any other location in the inverter, at least basic insulation or simple separation is maintained between the PV array and the mains when the disconnecting means is intended to be in the open state.	Inverter does not have internal isolated transformer between the mains and PV circuit, 2 pieces TUV/UL approved solar AC relays with two pairs of contacts used in series for all ungrounded current-carrying conductors. When the contacts fault applied to one relay, alarm an error code in display panel when first initial start-up or reconnection, also refer to functional safety technical report.	P
4.4.4.15.2 .2	Design of insulation or separation complies with requirements of 7.3.7 of Part 1: report here Part 1 comment and verdict.	Consider the Vmax of AC mains, overvoltage category, pollution degree, impulse withstand voltage of 4000V, the minimum required cl.1.95mm, of single relay for altitude<4000m, the detail sees report of Part 1, clause cl. and cr.	P
4.4.4.15.2 .3	For non-isolated inverter, automatic checking of the isolation provided by a disconnect means after single fault.	Consider the Vmax of AC mains, overvoltage category, pollution degree, impulse withstand voltage of 4000V, the minimum required cl.1.95mm, of single relay for altitude<4000m, the detail sees report of Part 1, clause cl. and cr.	P
	If the check fail: - any still-functional disconnection means shall be left in the open position		P
	- at least basic or simple separation shall be maintained between the PV input and the mains		P
	- the inverter shall not start operation		P
	- the inverter shall indicate a fault in accordance with 13.9		P
4.4.4.16	A stand-alone inverter with a transfer switch to transfer AC loads from the mains or other AC bypass source to the inverter output:	Without such transfer switch	N/A
	- shall continue to operate normally		N/A
	- shall not present a risk of fire as the result of an out-of-phase transfer		N/A
	- shall not present a risk of shock as the result of an out-of-phase transfer		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	- And having control preventing switching: components for malfunctioning ……..:		N/A
4.4.4.17	Cooling system failure – Blanketing test No hazards according to the criteria of sub-clause 4.4.3 of Part 1 shall result from blanketing the inverter This test is not required for inverters restricted to use only in closed electrical operating areas.	See appended test table Cooling system failure – Blanketing test.	P
	Test stop condition: time duration value or stabilized temperature ……..:	stabilize without external surface of the inverter exceed 90˚C	P
4.7	ELECTRICAL RATINGS TESTS		P
4.7.4	Stand-alone Inverter AC output voltage and frequency		P
4.7.4.1	General		P
4.7.4.2	Steady state output voltage at nominal DC input The steady-state AC output voltage shall not be less than 90 % or more than 110 % of the rated nominal voltage with the inverter supplied with its nominal value of DC input voltage.	See appended test table 4.7.4 Steady state Inverter AC output voltage and frequency	P
4.7.4.3	Steady state output voltage across the DC input range The steady-state AC output voltage shall not be less than 85 % or more than 110 % of the rated nominal voltage with the inverter supplied with any value within the rated range of DC input voltage.	See appended test table 4.7.4 Steady state Inverter AC output voltage and frequency	P
4.7.4.4	Load step response of the output voltage at nominal DC input The AC output voltage shall not be less than 85 % or more than 110 % of the rated nominal voltage for more than 1,5 s after application or removal of a resistive load.	See appended test table 4.7.4 Steady state Inverter AC output voltage and frequency	P
4.7.4.5	Steady state output frequency The steady-state AC output frequency shall not vary from the nominal value by more than +4 % or –6 %.	See appended test table 4.7.4 Steady state Inverter AC output voltage and frequency	P
4.7.5	Stand-alone inverter output voltage waveform		P
4.7.5.1	General		P
4.7.5.2	The AC output voltage waveform of a sinusoidal output stand-alone inverter shall have a total harmonic distortion (THD) not exceeding of 10 % and no individual harmonic at a level exceeding 6 %.		P
4.7.5.3	Non-sinusoidal output waveform requirements	Sinusoidal output waveform	N/A
4.7.5.3.1	General		N/A
4.7.5.3.2	The total harmonic distortion (THD) of the voltage waveform shall not exceed 40 %.		N/A
4.7.5.3.3	The slope of the rising and falling edges of the positive and negative half-cycles of the voltage waveform shall not exceed 10 V/µs measured		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	between the points at which the waveform has a voltage of 10 % and 90 % of the peak voltage for that half-cycle.		
4.7.5.3.4	The absolute value of the peak voltage of the positive and negative half-cycles of the waveform shall not exceed 1,414 times 110 % of the RMS value of the rated nominal AC output voltage.		M/A
4.7.5.4	Information requirements for non-sinusoidal waveforms The instructions provided with a stand-alone inverter not complying with 4.7.5.2 shall include the information in 5.3.2.6.		N/A
4.7.5.5	Output voltage waveform requirements for inverters for dedicated loads. For an inverter that is intended only for use with a known dedicated load, the following requirements may be used as an alternative to the waveform requirements in 4.7.5.2 to 4.7.5.3.		N/A
	The combination of the inverter and dedicated load shall be evaluated to ensure that the output waveform does not cause any hazards in the load equipment and inverter, or cause the load equipment to fail to comply with the applicable product safety standards.	See attached document: 4.7.5.5 Evaluation of inverter for dedicated load	N/A
	The inverter shall be marked with symbols 9 and 15 of Table C.1 of Part 1.		N/A
	The installation instructions provided with the inverter shall include the information in 5.3.2.13.		N/A
4.8	ADDITIONAL TESTS FOR GRID-INTERACTIVE INVERTERS		P
4.8.1	General requirements regarding inverter isolation and array grounding	Inverter isolation: transformer-less solar inverter, without galvanic isolation from the MAINS and PV array. PV Array grounding: Ungrounded with warning substance in manufacturer's manual. Array ground insulation resistance measurement: Before starting operation, per 4.201.2.1 for ungrounded arrays; Action on fault: signal the fault and do not connect to the MAINS; Array residual current detection: monitoring for both continuous excessive residual current per 4.201.3.1.4 a) and excessive sudden changes per 4.201.3.1.4 b) by RCMU integrated in inverter; Action on fault: shut down the inverter, disconnect from the MAINS, indicate the fault on LCD	P
	- Type of Array grounding supported ……:	Ungrounded array	P

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Clause	Requirement + Test	Result - Remark	Verdict
	- Inverter isolation ……..:	Inverter does not have internal isolated transformer between the mains and PV circuit.	P
4.8.2	Array insulation resistance detection for inverters for ungrounded and functionally grounded arrays	(See attached table)	P
4.8.2.1	Array insulation resistance detection for inverters for ungrounded arrays	Minimum Insulation Resistance before connection to the MAINS: 600V/30mA=20 kΩ	P
	Inverter shall have means to measure DC insulation resistance from PV input (array) to ground before starting operation		P
	Or Inverter shall be provided with instruction in accordance with 5.3.2.11.	The expected insulation resistance of the array to ground shall be calculated based on an array insulation resistance of 40 MΩ per m^2 either known according to 61730, calculate the practice PV system resistance with the surface area of the parallel and series panels and the set value maybe adjusted with agreement of authority agency.	P
	Measured DC insulation resistance: ……..:	20kΩ x 0.9=18 kΩ	P
	Inverter measurement circuit shall be capable of detecting insulation resistance below the limit value R= Vmax/30mA under normal conditions		P
	Inverter measurement circuit shall be capable of detecting insulation resistance below the limit value R= Vmax/30mA with ground fault in the PV array	First with one pole grounded fault occurred, following an insulation resistance below limit simulated, then allow the inverter to start, the inverter shall not connect to the mains.	P
	Isolated inverters shall indicate a fault if the insulation resistance is less than the limit value		P
	Isolated inverter fault indication maintained until insulation resistance has recovered to a value higher than the limit value		P
	Non-isolated inverters, or inverters with isolation not complying with the leakage current limits in the minimum inverter isolation requirements in Table 30:		N/A
	- shall indicate a fault in accordance with 13.9		N/A
	- shall not connect to the mains		N/A
4.8.2.2	Array insulation resistance detection for inverters for functionally grounded arrays	Not for functionally grounded arrays	N/A
	a-1)The value of the total resistance, including the intentional resistance for array functional grounding, the expected insulation resistance of the array to ground, and the resistance of any other networks connected to ground (for example measurement networks)		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	must not be lower than R = (VMAX PV/30 mA) ohms.		
	a-2) The installation instructions shall include the information required in 5.3.2.12.		N/A
	b-1) As an alternative to a), or if a resistor value lower than in a) is used, the inverter shall incorporate means to detect, during operation, if the total current through the resistor and any networks (for example measurement networks) in parallel with it, exceeds the residual current values and times in Table 31		N/A
	b-2) Inverter shall either disconnect the resistor or limit the current by other means ……:		N/A
	b-3) If the inverter is a non-isolated inverter, or has isolation not complying with the leakage current limits in the minimum inverter isolation requirements in Table 30, it shall also disconnect from the mains.		N/A
	c) The inverter shall have means to measure the DC insulation resistance from the PV input to ground before starting operation, in accordance with 4.8.2.1.		N/A
4.8.3	Array residual current detection		P
4.8.3.1	General		P
4.8.3.2	30 mA touch current type test for isolated inverters	Protected by residual current monitoring unit integrated in inverter	P
4.8.3.3	Fire hazard residual current type test for isolated inverters	Not isolated inverters	P
4.8.3.4	Protection by application of RCD's	Not isolated inverters	N/A
	- The requirement for additional protection in 4.8.3.1 can be met by provision of an RCD with a residual current setting of 30 mA, located between the inverter and the mains..	Type B RCMU integrated in inverter for monitoring the residual current, an additional RCD, type B according to IEC 60755, amendment 2 which is located between the inverter and the mains, may be provided for fault protection by automatic disconnection of supply in the end-use application with the agreement of local network operator.	N/A
	- The selection of the RCD type to ensure compatibility with the inverter must be made according to rules for RCD selection in Part 1.		N/A
	- The RCD provided integral to the inverter, or		N/A
	- The RDC provided by the installer if details of the rating, type, and location for the RCD are given in the installation instructions per 5.3.2.9.		N/A
4.8.3.5	Protection by residual current monitoring		P

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Clause	Requirement + Test	Result - Remark	Verdict
4.8.3.5.1	General		P
	Where required by Table 30, the inverter shall provide residual current monitoring that functions whenever the inverter is connected to the mains with the automatic disconnection means closed.		P
	The residual current monitoring means shall measure the total (both a.c. and d.c. components) RMS current.		P
	As indicated in Table 30 for different inverter types, array types, and inverter isolation levels, detection may be required for excessive continuous residual current, excessive sudden changes in residual current, or both, according to the following limits:		P
	a) Continuous residual current: The inverter shall disconnect within 0,3 s and indicate a fault in accordance with 13.9 if the continuous residual current exceeds:		P
	- maximum 300 mA for inverters with continuous ouput power rating ≤30kV;	Inverter rating≤30kVA	P
	- maximum 10 mA per kVA of rated continuous output power for inverters with continuous output power rating > 30 kVA.		N/A
	The inverter may attempt to re-connect if the array insulation resistance meets the limit in 4.8.2.		P
	b) Sudden changes in residual current: The inverter shall disconnect from the mains within the time specified in Table 31		P
	The inverter indicates a fault in accordance with 13.9, if a sudden increase in the RMS residual current is detected exceeding the value in the table.		P
	- 30mA@0.3s	20mA@120ms	P
	- 60mA@0.15s	50mA@60ms	P
	- 150mA@0.04s	70mA@32ms	P
	The inverter may attempt to re-connect if the array insulation resistance meets the limit in 4.8.2.		P
4.8.3.5.2	Test for detection of excessive continuous residual current: test repeated 5 times and time to disconnect shall not exceed 0,3 s.	See appended test table 4.8.3.5.2 Test for detection of excessive continuous residual current	P
4.8.3.5.3	Test for detection of sudden changes in residual current repeated 5 times and each of the 5 results shall not exceed the time limit indicated in for each row (30mA, 60mA and150mA) of Table 31.	See appended test table 4.8.3.5.3 Test for detection of sudden changes in residual current	P
4.8.3.6	Systems located in closed electrical operating areas	Based on risk analysis, area between inverter side of that isolation transformer and mains shall be protected as systems located in closed electrical operating areas, indicating which	P

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Clause	Requirement + Test	Result - Remark	Verdict
		forms of shock hazard protection are and are not provided integral to the inverter in installation instructions. All operation, installation and maintenance shall be followed with Sungrow instruction strictly.	
	The protection against shock hazard is not required if the installation information provided with the inverter indicates the restriction for use in a closed electrical operating area, and		P
	Installation information indicates what forms of shock hazard protection are and are not provided integral to the inverter, in accordance with 5.3.2.7.		P
	The inverter shall be marked as in 5.2.2.6.		P
5	**MARKING AND DOCUMENTATION**		P
5.1	Marking		P
5.1.4	Equipment ratings		P
	PV input ratings:		P
	- Vmax PV (absolute maximum) (d.c. V)	600	P
	- Isc PV (absolute maximum) (d.c. A)	See user manual	P
	a.c. output ratings:		P
	- Voltage (nominal or range) (a.c. V)	See user manual	P
	- Current (maximum continuous) (a.c. A)	See user manual	P
	- Frequency (nominal or range) (Hz)	50/60	P
	- Power (maximum continuous) (W or VA)	See user manual	P
	- Power factor range	0.8leading…0.8lagging	P
	a.c input ratings:		N/A
	- Voltage (nominal or range) (a.c. V)		N/A
	- Current (maximum continuous) (a.c. A)		N/A
	- Frequency (nominal or range) (Hz)		N/A
	d.c. output ratings:		N/A
	- Voltage (nominal or range) (d.c. V)		N/A
	- Current (maximum continuous) (d.c. A)		N/A
	Protective class (I or II or III)	Class I	P
	Ingress protection (IP) rating per part 1	IP65	P
	An inverter that is adjustable for more than one nominal output voltage shall be marked to indicate the particular voltage for which it is set when shipped from the factory.		N/A
5.2	Warning markings		P
5.2.2	Content for warning markings		P
5.2.2.6	Inverters for closed electrical operating areas		P
	Where required by 4.8.3.6, an inverter not provided with full protection against shock hazard on the PV array shall be marked with a warning that the inverter is only for use in a closed electrical operating area, and referring to the installation instructions.		P
5.3	Documentation		P

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Clause	Requirement + Test	Result - Remark	Verdict
5.3.2	Information related to installation		P
5.3.2.1	Ratings. Subclause 5.3.2 of Part 1 requires the documentation to include ratings information for each input and output. For inverters this information shall be as in Table 33 below. Only those ratings that are applicable based on the type of inverter are required.		P
	PV input quantities :		P
	- Vmax PV (absolute maximum) (d.c. V)	600	P
	- PV input operating voltage range (d.c. V)	See user manual	P
	- Maximum operating PV input current (d.c. A)	See user manual	P
	- Isc PV (absolute maximum) (d.c. A)	See user manual	P
	- Max. inverter backfeed current to the array (a.c. or d.c. A)	Maximum inverter backfeed current form grid to the array is 0A based on test/circuit topology analysis.	P
	a.c. output quantities:		P
	- Voltage (nominal or range) (a.c. V)	See user manual	P
	- Current (maximum continuous) (a.c. A)	See user manual	P
	- Current (inrush) (a.c. A, peak and duration)	See report part1	P
	- Frequency (nominal or range) (Hz)	50/60	P
	- Power (maximum continuous) (W or VA)	See user manual	P
	- Power factor range	-0.8…+0.8	P
	- Maximum output fault current (a.c. A, peak and duration or RMS)	See user manual	P
	- Maximum output overcurrent protection (a.c. A)	See user manual	P
	a.c. input quantities:		N/A
	- Voltage (nominal or range) (a.c. V)		N/A
	- Current (maximum continuous) (a.c. A)		N/A
	- Current (inrush) (a.c. A, peak and duration)		N/A
	- Frequency (nominal or range) (Hz)		N/A
	d.c input (other than PV) quantities:		N/A
	- Voltage (nominal or range) (d.c. V)		N/A
	- Nominal battery voltage (d.c. V)		N/A
	- Current (maximum continuous) (d.c. A)		N/A
	d.c. output quantities:		N/A
	- Voltage (nominal or range) (d.c. V)		N/A
	- Nominal battery voltage (d.c. V)		N/A
	- Current (maximum continuous) (d.c. A)		N/A
	Protective class (I or II or III)	Class I	P
	Ingress protection (IP) rating per part 1	IP65	P
5.3.2.2	Grid-interactive inverter setpoints		P
	For a grid-interactive unit with field adjustable trip points, trip times, or reconnect times, the presence of such controls, the means for adjustment, the factory default values, and the limits of the ranges of adjustability shall be provided in the documentation for the PCE or in other format such as on a website. Provided solution: ……..	refer to user manual	P

IEC 62109-2			
Clause	Requirement + Test	Result - Remark	Verdict
	The setting of field adjustable setpoints shall be accessible from the PCE	Special software via communication with password protected	P
5.3.2.3	Transformers and isolation		N/A
	whether an internal isolation transformer is provided, and if so, what level of insulation (functional, basic, reinforced, or double) is provided by that transformer. The instructions shall also indicate what the resulting installation requirements are regarding such things as earthing or not earthing the array, providing external residual current detection devices, etc.	No internal isolation transformer	N/A
	An inverter shall be provided with information to the installer regarding:		N/A
	- providing of internal isolation transformer		N/A
	- the level of insulation (functional, basic, reinforced, or double)		N/A
	The instructions shall also indicate what the resulting installation requirements are regarding:		N/A
	- earthing or not earthing the array	Unearthed array	P
	- providing external residual current detection devices	Pls. follow national regulations	P
	- requiring an external isolation transformer,		P
5.3.2.4	Transformers required but not provided		N/A
	An inverter that requires an external isolation transformer not provided with the unit, shall be provided with instructions that specify, and for the external isolation transformer with which it is intended to be used:		N/A
	- the configuration type		N/A
	- electrical ratings		N/A
	- environmental ratings		N/A
5.3.2.5	PV modules for non-isolated inverters		P
	Non-isolated inverters shall be provided with installation instructions that require PV modules that have an IEC 61730 Class A rating	IEC 61730 Class A rating required	P
	If the maximum AC mains operating voltage is higher than the PV array maximum system voltage then the instructions shall require PV modules that have a maximum system voltage rating based upon the AC mains voltage.		P
5.3.2.6	Non-sinusoidal output waveform information		N/A
	The instruction manual for a stand-alone inverter not complying with 4.7.5.2 shall include a warning that:		N/A
	- the waveform is not sinusoidal,		N/A
	- some loads may experience increased heating,		N/A
	- the user should consult the manufacturers of the intended load equipment before operating that load with the inverter		N/A

IEC 62109-2			
Clause	Requirement + Test	Result - Remark	Verdict
	The inverter manufacturer shall provide information regarding:		N/A
	- what types of loads may experience increased heating		N/A
	- recommendations for maximum operating times with such loads		N/A
	The inverter manufacturer shall specify for the waveforms as determined by the testing in 4.7.5.3.2 through 4.7.5.3.4.:		N/A
	- THD		N/A
	- slope		N/A
	- peak voltage		N/A
5.3.2.7	Systems located in closed electrical operating areas		N/A
	Where required by 4.8.3.6, an inverter not provided with full protection against shock hazard on the PV array shall be provided with installation instructions:		N/A
	- requiring that the inverter and the array must be installed in closed electrical operating areas		N/A
	- indicating which forms of shock hazard protection are and are not provided integral to the inverter (for example the RCD, isolation transformer complying with the 30 mA touch current limit, or residual current monitoring for sudden changes)		N/A
5.3.2.8	Stand-alone inverter output circuit bonding		N/A
	Where required by 7.3.10, the documentation for an inverter shall include the following:		N/A
	- if output circuit bonding is required but is not provided integral to the inverter, the required means shall be described in the installation instructions, including which conductor is to be bonded and the required current carrying capability or cross-section of the bonding means;		N/A
	- if the output circuit is intended to be floating, the documentation for the inverter shall indicate that the output is floating.		N/A
5.3.2.9	Protection by application of RCD's		N/A
	Where the requirement for additional protection in 4.8.3.1 is met by requiring an RCD that is not provided integral to the inverter, as allowed by 4.8.3.4, the installation instructions shall state the need for the RCD,.	If required strictly, should be type B	N/A
	and shall specify its rating, type, and required circuit location		N/A
5.3.2.10	Remote indication of faults		P
	The installation instructions shall include an explanation of how to properly make connections to (where applicable), and use, the electrical or electronic fault indication required by 13.9.	Refer to user manual	P

IEC 62109-2			
Clause	Requirement + Test	Result - Remark	Verdict
5.3.2.11	External array insulation resistance measurement and response	IRM function integrated in inverter	P
	The installation instructions for an inverter for use with ungrounded arrays that does not incorporate all the aspects of the insulation resistance measurement and response requirements in 4.8.2.1, must include:		N/A
	- for isolated inverters: an explanation of what aspects of array insulation resistance measurement and response are not provided, and		N/A
	- an instruction to consult local regulations to determine if any additional functions are required or not;		N/A
	- for non-isolated inverters: an explanation of what external equipment must be provided in the system, and		N/A
	- what the setpoints and response implemented by that equipment must be, and:		N/A
	- how that equipment is to be interfaced with the rest of the system.		N/A
5.3.2.12	Array functional grounding information	Not functional ground array used	N/A
	Where approach a) of 4.8.2.2 is used, the installation instructions for the inverter shall include all of the following:		N/A
	a) the value of the total resistance between the PV circuit and ground integral to the inverter ……		N/A
	b) the minimum array insulation resistance to ground that system designer or installer must meet when selecting the PV panel and system design, based on the minimum value that the design of the PV functional grounding in the inverter was based on ……;		N/A
	c) the minimum value of the total resistance R = VMAX PV/30 mA that the system must meet, with an explanation of how to calculate the total ……;		N/A
	d) a warning that there is a risk of shock hazard if the total minimum resistance requirement is not met.		N/A
5.3.2.13	Stand-alone inverters for dedicated loads		N/A
	Where the approach of 4.7.5.5 is used, the installation instructions for the inverter shall include a warning that the inverter is only to be used with the dedicated load for which it was evaluated, and		N/A
	shall specify the dedicated load.		N/A
5.3.2.14	Identification of firmware version(s)		P

IEC 62109-2			
Clause	Requirement + Test	Result - Remark	Verdict
	An inverter utilizing firmware for any protective functions shall provide means to identify the firmware version.	ARM_SUNSTONE-H_V11_V01_A, MDSP_SUNSTONE-H_V11_V01_A	P
	This can be a marking, but the information can also be provided by a display panel, communications port or any other type of user interface……	Provided by a display panel	P
7	**PROTECTION AGAINST ELECTRIC SHOCK AND ENERGY HAZARDS**		N/A
7.3	Protection against electric shock		N/A
7.3.10	Additional requirements for stand-alone inverters		N/A
	One circuit conductor bonded to earth to create a grounded conductor and an earthed system.		N/A
	The means used to bond the grounded conductor to protective earth provided within the inverter or		N/A
	as part of the installation		N/A
	If not provided integral to the inverter, the required means shall be described in the installation instructions as per 5.3.2.8.		N/A
	The means used to bond the grounded conductor to protective earth shall comply with the requirements for protective bonding in Part 1,		N/A
	If the bond can only ever carry fault currents in stand-alone mode, the maximum current for the bond is determined by the inverter maximum output fault current.		N/A
	Output circuit bonding arrangements shall ensure that in any mode of operation, the system only has the grounded circuit conductor bonded to earth in one place at a time..		N/A
	Switching arrangements may be used, in which case the switching device used is to be subjected to the bond impedance test along with the rest of the bonding path		N/A
	Inverters intended to have a circuit conductor bonded to earth shall not impose any normal current on the bond except for leakage current.		N/A
	Outputs that are intentionally floating with no circuit conductor bonded to ground, must not have any voltages with respect to ground that are a shock hazard in accordance with Clause 7 of Parts 1 and 2.		N/A
	The documentation for the inverter shall indicate that the output is floating as per 5.3.2.8.		N/A
7.3.11	Functionally grounded arrays		N/A

IEC 62109-2			
Clause	Requirement + Test	Result - Remark	Verdict
	All PV conductors in a functionally grounded array shall be treated as being live parts with respect to protection against electric shock.		N/A
9	**PROTECTION AGAINST FIRE HAZARDS**		P
9.3	Short-circuit and overcurrent protection		P
9.3.4	Inverter backfeed current onto the array		P
	The backfeed current testing and documentation requirements in Part 1 apply, including but not limited to the following.		P
	Inverter backfeed current onto the PV array maximum value……..	Maximum inverter backfeed current form grid to the array is 0A based on test/circuit topology analysis.	P
	This inverter backfeed current value shall be provided in the installation instructions regardless of the value of the current, in accordance with Table 33.	Refer to user manual	P
13	**PHYSICAL REQUIREMENTS**		P
13.9	Fault indication		P
	Where this Part 2 requires the inverter to indicate a fault, both of the following shall be provided:		P
	a) a visible or audible indication, integral to the inverter, and detectable from outside the inverter, and		P
	b) an electrical or electronic indication that can be remotely accessed and used.	PMU Pro, RS485 communication port.	P
	The installation instructions shall include information regarding how to properly make connections (where applicable) and use the electrical or electronic means in b) above, in accordance with 5.3.2.10.	Provided by a display panel	P

	EN 62109-2:2010		P
Annex ZA	Normative references to international publications with their corresponding European publications	Considered	P

4.4.4	TABLE: Single fault condition to be applied						P
	Ambient temperature (°C) .....:				N/A(at the prevailing ambient temperature)		¾
	Power source for EUT: Manufacturer, model/type, output rating .....:				DC source: 1500V, 30A AC source: California		¾
4.4.4.15.1	Fault-tolerance of residual current monitoring						
Component No.	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation	
R14	Short circuit before start-up	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter can't start, LCD showed Leakage current circuit self-checking error. No hazard.	
R17	Open circuit before start-up	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter can't start, LCD showed Leakage current circuit self-checking error. No hazard.	
Check that the residual current monitoring operates properly						Inverter ceases to operate, indicates a fault in accordance with 13.9, disconnects from the mains, and does not re-connect after any sequence of removing and reconnecting PV power, AC power, or both.	
Supplementary information: Also see IEC 62109-1(ed.1), EN 62109-1:2010 test report.							

4.4.4	TABLE: Single fault condition to be applied						P
	Ambient temperature (°C) .....:				N/A(at the prevailing ambient temperature)		¾
	Power source for EUT: Manufacturer, model/type, output rating .....:				DC source: 1500V, 30A AC source: California		¾
4.4.4.15.2	Fault-tolerance of automatic disconnecting means						
No.	component No.	fault	test voltage (V)	test time	fuse No.	fuse current (A)	Result
1	Relay1, open contact(EPS)	open circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
2	Relay1, short contact(EPS)	Short circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 60s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
3	Relay2, open contact(EPS)	open circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	LCD showed Relay-Pro, inverter can't connect to grid. No hazard.

4	Relay2, short contact(EPS)	Short circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 60s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
5	Relay3, open contact(EPS)	open circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
6	Relay3, short contact(EPS)	Short circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 60s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
7	Relay4, open contact(EPS)	open circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
8	Relay4, short contact(EPS)	Short circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 60s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
9	Relay5, open contact(Ground)	open circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	LCD showed Ground fault, inverter can't connect to grid. No hazard.
10	Relay5, short contact(Ground)	Short circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 60s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
11	Relay6, open contact(Grid)	open circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
12	Relay6, short contact(Grid)	Short circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 60s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
13	Relay7, open contact(Grid)	open circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
14	Relay7, short contact(Grid)	Short circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 60s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
15	Relay8, open contact(Grid)	open circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	LCD showed Relay-Pro, inverter can't connect to grid. No hazard.

16	Relay8, short contact(Grid)	Short circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 60s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
17	Relay9, open contact(Grid)	open circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
18	Relay9, short contact(Grid)	Short circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 60s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
19	Relay10, open contact(Bypass)	open circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
20	Relay10, short contact(Bypass)	Short circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 60s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
21	Relay11, open contact(Bypass)	open circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 600s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
22	Relay11, short contact(Bypass)	Short circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 60s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
23	Relay12, open contact(Bypass)	open circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 600s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
24	Relay12, short contact(Bypass)	Short circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 60s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
25	Relay13, open contact(Bypass)	open circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 600s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
26	Relay13, short contact(Bypass)	Short circuit	PV: 550Vdc, BAT: 450V; AC: 230Vac	5 mins	-	-	Inverter worked normally when short circuit. Restart inverter, after 60s, LCD showed Relay-Pro, inverter can't connect to grid. No hazard.
Check that the relays fulfil the basic insulation or simple separation based on the PV circuit working voltage.							Yes

Each active phase can be switched. (L and N)	Yes (2 pieces TUV/UL approved series relays used for all active conductors, only for grid voltage measurement and isolated from PV circuit by basic insulation as well.)
Supplementary information: Also see IEC 62109-1(ed.1), EN 62109-1:2010 test report.	

4.4.4.16	**Stand-alone inverters – Load transfer test(**SH6.0RS**)**					P			
Battery			**Back up load**			**Grid**			Remark
P (W)	I(A)	U (V)	P (W)	I(A)	U (V)	P (W)	I(A)	U (V)	
Voltage range - low	N/A	N/A	N/A	N/A	N/A	-6101.14	26.57	229.93	
6538.61	29.58	221.04	6019.93	26.24	229.47	N/A	N/A	N/A	
Voltage range - rated	N/A	N/A	N/A	N/A	N/A	-6073.46	26.43	230.09	
6420.23	18.82	341.07	5999.35	26.13	229.59	N/A	N/A	N/A	
Voltage range – high	N/A	N/A	N/A	N/A	N/A	-6049.79	26.32	229.92	
6435.87	13.96	461.13	6021.19	26.22	229.64	N/A	N/A	N/A	
Supplementary information:									

4.4.4.17	**TABLE: heating temperature rise measurements of cooling system failure-fan disconnected, blanketing test**		P
Model	SH6.0RS		
	test voltage (V) .....:	Supplementary information	¾
	t1 (°C).....:	Supplementary information	¾
	t2 (°C) .....:	Supplementary information	¾

Thermocouple Locations	Max. temperature measured (°C)				Max. temperature limit, (°C)
--	(1)	(2)			
PV connector	66.52	61.22			90
Battery connector	67.58	62.01			90
Grid terminal enclosure	58.80	59.39			90
DC switch	69.80	61.37			90
Mounting surface	74.12	65.85			90
Front surface	76.64	67.11			90
Ambient	60.56	59.69			Ref.

Supplementary information:

test condition 1: PV 350V@13kW charge the battery 220V@6kW and to the GRID 6kW (with 2cm blanket covered, power with derating, 60°C).

test condition 2: PV 350V@13kW charge the battery 220V@6kW and to the GRID 6kW (with fan fault, power with derating, 60°C).

Blanketing test:

The entire inverter including any external heatsink provided shall be covered in surgical cotton with an uncompressed thickness of minimum 2 cm, covering all heatsink fins and air channels. This surgical cotton replaces the cheesecloth required by subclause 4.4.3.2 of Part 1.

Run the device at full load condition until minimum of 7 hours except the test may be stopped when temperatures stabilize if no external surface of the inverter is at a temperature exceeding 90°C.

4.7.4.2 & 4.7.4.3 & 4.7.4.4 & 4.7.4.5	**Steady state output voltage at nominal DC input & Steady state output voltage across the DC input range & Load step response of the output voltage at nominal DC input & Steady state output frequency**						P
AC output U (V)			Frequency (Hz)			Condition/status	Comments
L1	L2	L3	L1	L2	L3		
230.24	-	-	49.98	-	-	Without load	PV supply the AC load, at PV voltage: *PV MPPT low voltage.* (Note 2,3)285V
229.54	-	-	49.98	-	-	Resistive load application	
230.27	-	-	49.98	-	-	Resistive load removal	
230.33	-	-	49.98	-	-	Without load	PV supply the AC load, at PV voltage: *PV rated voltage.* (Note 1,3)365V
229.04	-	-	49.98	-	-	Resistive load application	
230.36	-	-	49.98	-	-	Resistive load removal	
230.34	-	-	49.98	-	-	Without load	PV supply the AC load, at PV voltage: *PV MPPT high voltage.*. (Note 2,3)480V
229.60	-	-	49.98	-	-	Resistive load application	
230.37	-	-	49.98	-	-	Resistive load removal	
230.30	-	-	49.98	-	-	Without load	Battery supply the AC load, at battery supply: *BAT low range voltage* (Note 2,3)
226.84	-	-	49.98	-	-	Resistive load application	
230.30	-	-	49.98	-	-	Resistive load removal	
230.31	-	-	49.98	-	-	Without load	Battery supply the AC load, at battery supply: *BAT rated voltage* (Note 1,3)
229.60	-	-	49.98	-	-	Resistive load application	
230.31	-	-	49.98	-	-	Resistive load removal	
230.29	-	-	49.98	-	-	Without load	Battery supply the AC load, at battery supply: *BAT high range voltage* (Note 2,3)
229.61	-	-	49.98	-	-	Resistive load application	
230.30	-	-	49.98	-	-	Resistive load removal	

Note 1: 4.7.4.2 & 4.7.4.4, with nominal DC input voltage, the measure AC output voltage should be $90\%AC_{normal} \leqslant AC_{Measure} \leqslant 110\% AC_{normal}$. And the measure time is at the time t=1.5s after the load step change.

Note 2: 4.7.4.3, with minimum & maximum value within the rated range of DC input voltage, the measure AC output voltage should be $85\%AC_{normal} \leqslant AC_{Measure} \leqslant 110\% AC_{normal}$ at each load step change.

Note 3: 4.7.4.5, with minimum & maximum value within the rated range of DC input voltage, the measure AC output voltage should be $-6\%Hz_{normal} \leqslant Hz_{Measure} \leqslant +4\%Hz_{normal}$ at each load step change.

4.7.5	Stand-alone inverter output voltage waveform								P	
Harmonic. Nr.(U)	Harmonic voltage measurement:Load / Prated									Limit
	5%			50%			100%			
	L1	L2	L3	L1	L2	L3	L1	L2	L3	
2	0.020	-	-	0.029	-	-	0.044	-	-	6%
3	0.210	-	-	0.891	-	-	1.462	-	-	6%
4	0.010	-	-	0.019	-	-	0.017	-	-	6%
5	0.817	-	-	0.740	-	-	0.686	-	-	6%
6	0.006	-	-	0.019	-	-	0.010	-	-	6%
7	0.608	-	-	0.589	-	-	0.699	-	-	6%
8	0.006	-	-	0.017	-	-	0.009	-	-	6%
9	0.282	-	-	0.556	-	-	0.413	-	-	6%
10	0.004	-	-	0.015	-	-	0.006	-	-	6%
11	0.379	-	-	0.333	-	-	0.384	-	-	6%
12	0.006	-	-	0.016	-	-	0.006	-	-	6%
13	0.234	-	-	0.312	-	-	0.385	-	-	6%
14	0.005	-	-	0.017	-	-	0.006	-	-	6%
15	0.136	-	-	0.333	-	-	0.264	-	-	6%
16	0.003	-	-	0.015	-	-	0.007	-	-	6%
17	0.148	-	-	0.202	-	-	0.231	-	-	6%
18	0.004	-	-	0.017	-	-	0.005	-	-	6%
19	0.062	-	-	0.209	-	-	0.223	-	-	6%
20	0.004	-	-	0.018	-	-	0.006	-	-	6%
21	0.042	-	-	0.228	-	-	0.254	-	-	6%
22	0.005	-	-	0.019	-	-	0.007	-	-	6%
23	0.114	-	-	0.138	-	-	0.119	-	-	6%
24	0.004	-	-	0.020	-	-	0.006	-	-	6%
25	0.060	-	-	0.167	-	-	0.195	-	-	6%
26	0.005	-	-	0.022	-	-	0.007	-	-	6%
27	0.075	-	-	0.175	-	-	0.153	-	-	6%
28	0.006	-	-	0.023	-	-	0.008	-	-	6%
29	0.126	-	-	0.088	-	-	0.104	-	-	6%
30	0.007	-	-	0.025	-	-	0.009	-	-	6%
31	0.045	-	-	0.128	-	-	0.170	-	-	6%

32	0.008	-	-	0.028	-	-	0.010	-	-	6%
33	0.064	-	-	0.113	-	-	0.051	-	-	6%
34	0.008	-	-	0.029	-	-	0.010	-	-	6%
35	0.080	-	-	0.036	-	-	0.124	-	-	6%
36	0.007	-	-	0.028	-	-	0.009	-	-	6%
37	0.051	-	-	0.075	-	-	0.106	-	-	6%
38	0.006	-	-	0.027	-	-	0.007	-	-	6%
39	0.064	-	-	0.051	-	-	0.033	-	-	6%
40	0.005	-	-	0.024	-	-	0.007	-	-	6%
THD (2-40)	1.202	-	-	1.595	-	-	1.972	-	-	10%
Supplementary information:										

4.8.2	TABLE: Array insulation resistance detection for inverters for ungrounded and functionally grounded arrays	P
4.8.2.1	Array insulation resistance detection for inverters for ungrounded arrays	

DC Voltage below minimum operating voltage (V)	DC Voltage for inverter begin operation (V)	Resistance between ground and PV input terminal (kΩ)	Required Insulation resistance R = (V_{MAX} PV / 30mA) (kΩ)	Result
ISO setting=40kΩ				
		DC1+ to earth		
40	50	18	20	P
40	50	18	20	P
40	50	18	20	P
40	50	18	20	P
40	50	18	20	P
		DC1- to earth		
40	50	18	20	P
40	50	18	20	P
40	50	18	20	P
40	50	18	20	P
40	50	18	20	P
		DC1+ earthed to DC-		
40	50	18	20	P
40	50	18	20	P
40	50	18	20	P

40	50	18	20	P
40	50	18	20	P
DC1- earthed to DC+				
40	50	18	20	P
40	50	18	20	P
40	50	18	20	P
40	50	18	20	P
40	50	18	20	P
Supplementary information: It is not required to test all PV input terminals because analysis of the design indicates that other terminals can be expected to have the same result. Test repeated with a ground fault directly in the PV array in each pole, and then attempted to start inverter, the inverter indicated a fault in accordance with 13.9 and did not connect to the mains				

4.8.3.2	TABLE: 30mA touch current type test for isolated inverters	N/A
Condition	Current (mA)	Limit
DC+ to PE		30mA
DC- to PE		30mA
Supplementary information: not isolated inverter.		

4.8.3.3	TABLE: Fire hazard residual current type test for isolated inverters	N/A
Condition	Current (mA)	Limit (300mA or 10mA per kVA)
DC+ to PE		300 mA
DC- to PE		300 mA
Supplementary information: not isolated inverter.		

4.8.3.5	**TABLE: Protection by residual current monitoring**			P
Test conditions:	Output power (kVA): 6 Input voltage (VDC): 500 Frequency (Hz): 50 Output AC Voltage (VAC):230			
4.8.3.5.2	Test for detection of excessive continuous residual current			P
Fault Current (mA)		Disconnection time (ms)		
Measured Fault Current	Limit 300mA for output power ≤ 30 kVA 10mA per kVA for output power > 30 kVA	Measured Disconnection time		Limit
Default setting: 1250mA@240ms PV1+ to earth:				
1268	300	249		300
1272	300	239		300
1267	300	256		300

1280	300	257	300
1276	300	239	300
PV1- to earth:			
1287	300	243	300
1271	300	261	300
1284	300	238	300
1275	300	244	300
1286	300	250	300

Note:
– maximum 300mA for inverters with continuous output power rating ≤30 kVA;
– maximum 10mA per kVA of rated continuous output power for inverters with continuous output power rating > 30 kVA.
This test shall be repeated 5 times, and same design on other MPP trackers, the test is repeated for other PV MPP input terminals once for verification.

4.8.3.5.3	**TABLE: Test for detection of sudden changes in residual current**	P
PV1+ to earth:		
Limit (mA)	UN Disconnection time (ms)	Limit (ms)
Default setting: 20mA@120ms		
30	136.6	300
30	146.6	300
30	140.2	300
30	136.2	300
30	134.2	300
Default setting: 50mA@60ms		
60	85.0	150
60	75.8	150
60	62.6	150
60	59.4	150
60	73.8	150
Default setting: 70mA@20ms		
150	36.0	40
150	24.4	40
150	38.4	40
150	22.0	40
150	20.8	40
PV1- to earth		
Limit (mA)	UN Disconnection time (ms)	Limit (ms)
Default setting: 20mA@120ms		
30	148.2	300
30	148.6	300
30	163.8	300
30	167.8	300
30	148.2	300
Default setting: 50mA@60ms		
60	61.2	150
60	67.2	150

60	76.4	150
60	67.2	150
60	70.8	150
Default setting: 70mA@20ms		
150	29.2	40
150	33.2	40
150	38.8	40
150	22.4	40
150	20.0	40
Note: The capacitive current is risen until disconnection. Test condition: Ic + 30/60/150mA <= Icmax. R1 is set that 30/60/150mA Flow and switch S is closed.		
Supplementary information: This test shall be repeated 5 times, and same design on other MPP trackers, the test is repeated for other PV MPP input terminals once for verification.		

……End of test report……