
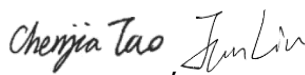




TEST REPORT IEC 62109-2 Safety of Power Converter for use in Photovoltaic Power Systems Part 2: Particular requirements for inverters	
Report Number.....	704092455803-00
Date of issue.....	2024-05-31
Total number of pages.....	27
Name of testing laboratory preparing the report.....	TÜV SÜD New Energy Vehicle Testing (Jiangsu) Co., Ltd.
Applicant's name	HYOSUNG HEAVY INDUSTRIES Co., Ltd.
Address.....	119, Marpo-daero, Mapo-gu 04144 Seoul, South Korea
Test specification:	
Standard.....	IEC 62109-2:2011
Test procedure	N/A
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 2016-11
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Test item description :	Grid Connected Photovoltaic Inverter	
Trade Mark :	 HYOSUNG	
Manufacturer	HYOSUNG HEAVY INDUSTRIES Co., Ltd. 119, Marpo-daero, Mapo-gu 04144 Seoul, South Korea	
Model/Type reference :	HS-P300GLO (인버터)	
Ratings :	See rating labels on page 4 to 5.	
Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):		
<input checked="" type="checkbox"/>	Name of Testing Laboratory preparing the report:	TÜV SÜD New Energy Vehicle Testing (Jiangsu) Co., Ltd.
	Location/ address	TÜV SÜD Testing Center, D1 building, No. 63 Chuangqi Road, Shilou Town, Panyu District, Guangzhou 511447, China
	Tested by (name, function, signature) :	Chenjia Tao, Jun Liu <i>Project handler</i> 
	Approved by (name, function, signature) .. :	Shan Huang <i>Designated reviewer</i>

List of Attachments (including a total number of pages in each attachment):

N/A

Summary of testing:

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

All the tests are extracted from test report 64.290.22.31522.01 directly except visual inspection and clause 4.8.3.5.2, because the model SUN2000-330KTL-H1 which has been approved in that test report is same as HS-P300GLO (인버터) except with different type names and different ratings according to Korea local regulation which will not affect test results.

Tests performed (name of test and test clause):

- ☒ Fault-tolerance of residual current monitoring –clause 4.4.4.15.1;
- ☒ Fault-tolerance of automatic disconnecting means - clause 4.4.4.15.2;
- ☒ Cooling system failure – Blanketing test –clause 4.4.4.17;
- ☒ Array insulation resistance detection for inverters for ungrounded and functionally grounded arrays - 4.8.2;
- ☒ Array residual current detection - clause 4.8.3;

Testing location:

TÜV SÜD Certification & Testing (China)
Co., Ltd. Guangzhou Branch
TÜV SÜD Testing Center, D1 building, No.
63 Chuangqi Road, Shilou Town, Panyu
District, Guangzhou 511447, China

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

N/A

Copy of marking plate:

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.



Additional warning labels:



**CAUTION**

Before replacing the fan,
disconnect the FAN-POWER
cable and then the fan cable.
更换风扇前，必须先拔除风扇电源线，
再拔除风扇线。

Notes: Marking plate material: pressure-sensitive unprinted label stocks stamped into aluminum surface;
Suitable for outdoor use with respect to exposure to Ultraviolet Light, Water Exposure and thermal
transfer printed label stock applications, -60°C to 95°C, An additional PET film provided to cover label



Test item particulars..... :			
Equipment mobility	<input type="checkbox"/> movable	<input type="checkbox"/> hand-held	<input type="checkbox"/> stationary
	<input checked="" type="checkbox"/> fixed	<input type="checkbox"/> transportable	<input type="checkbox"/> for building-in
Connection to the mains.....	<input type="checkbox"/> pluggable equipment	<input type="checkbox"/> direct plug-in	
	<input checked="" type="checkbox"/> permanent connection	<input type="checkbox"/> for building-in	
Enviromental 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 (%)	±10 %		
Tested for power systems	IT		
IT testing, phase-phase voltage (V)	800V		
Class of equipment	<input checked="" type="checkbox"/> Class I	<input type="checkbox"/> Class II	<input type="checkbox"/> Class III
	<input type="checkbox"/> Not classified		
Mass of equipment (kg)	Approx. 112kg		
Pollution degree	3(external environment), 2(internal environment)		
IP protection class.....	IP66		
..... :			
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	2024-04-29		
Date (s) of performance of tests	2024-05-08		



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 checked="" type="checkbox"/> point is used as the decimal separator.	
Manufacturer's Declaration per sub-clause 4.2.5 of IEC62109-2:	
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	<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)	1) Huawei Machine Co., Ltd. No. 2, New City Avenue, Songshan Lake Sci. & Tech. Industry Park, 523808 Dongguan, Guangdong, PEOPLE'S REPUBLIC OF CHINA 2) Dongguan Yangtian Electronic Technology Co., Ltd. No.152, Luyuan Rd., Keyuancheng, Tangxia Town, 523710 Dongguan City, Guangdong Province PEOPLE'S REPUBLIC OF CHINA 3) Jiancheng Hengrui (Huizhou) Electronic Co., Ltd No.558, Yuanzhou Avenue, Baimawei Village, Yuanzhou Town, Boluo County, 516123 Huizhou City, Guangdong Province, PEOPLE'S REPUBLIC OF CHINA.
General product information:	
1. The unit is non-isolated (transformerless) inverter for connection with public low voltage grid, for outdoor use. 2. The unit shall be used at specified ambient range. Temperature: -30°C to +60°C, Auto-derating at 40°C; Humidity: 0% to 100%; Altitude: <4000m; Overvoltage category: II (PV side), III (AC side). 3. The unit provides two relays in series on each phase between inverter output and grid terminal (L). The internal control is redundantly built. 4. The decisive voltage class of all communication ports is defined less than DVC A. 5. Low voltage electrical installations shall comply with national and local regulation. Only qualified electricians are allowed to install and maintain the inverter. 6. Manufacture's installation manual states that the overcurrent protection shelled in all source port (PV side, AC grid) at the end -used application. 7. The unit has an internal residual current monitoring unit (RCMU). Its external AC switch should be a three-phase circuit breaker or ant other AC load circuit breaker to safety disconnect the unit from the power grid.	
For model technical specifications, pls. see as in table below (exact from user manual directly for reference): PV input	
Maximum input voltage	1500 V

Maximum input current (per MPPT)	65 A
Maximum short-circuit current (per MPPT)	115 A
Minimum operating voltage/startup voltage	500 V/550 V
MPP voltage range	500 to 1500 V
Rated input voltage	1080 V
Number of inputs	28
Number of MPPTs	6

AC output

Rated output power	300 kW
Maximum apparent power	300 kVA
Maximum active power ($\cos\phi = 1$)	300 kW
Rated output voltage	800 V AC, 3W+PE
Rated output current	216.6 A
Adapted power grid frequency	50 Hz/60 Hz
Maximum output current	238.2 A
Power factor	0.8 leading and 0.8 lagging
Maximum total harmonic distortion (rated power)	< 1%

Note [1]: The ambient temperature is 50°C.

Protection

Input DC switch	Supported
Anti-islanding protection	Supported
Output overcurrent protection	Supported
Input reverse connection protection	Supported
PV string fault detection	Supported
DC surge protection	Type II
AC surge protection	Type II
Insulation resistance detection	Supported
Residual current monitoring unit (RCMU)	Supported

General Specifications

Dimensions (W x H x D)	1048 mm x 732 mm x 395 mm
Net weight	112 kg
Operating temperature	-25°C to +60°C
Cooling mode	Smart air cooling
Maximum operating altitude	5000 m (derated when the altitude is greater than 4000 m)
Relative humidity	0%–100% RH
Input terminal	HH4SFD4TMS/HH4SMD 4TMS
Output terminal	Waterproof terminal+OT/DT terminal
IP rating	IP66
Self power consumption at night (sleep mode)	4.8 W

The function of array insulation resistance detection for inverters for ungrounded arrays are integrated into the inverter.

The following safety parameters are factory set and fixed per IEC 62109-2:2011.

Default protection settings

Parameters	Normative requirements		Internal threshold setting	
	Maximum clearance time	Trip limit	Maximum clearance time (factory setting)	Factory set trip value
PV array Insulation resistance measurement before starting operation	-	50kΩ	-	50kΩ
Continuous residual current	300ms	300mA for output power ≤ 30 kVA 10mA per kVA for output power > 30 kVA	300ms	3300mA
Sudden changes in residual current	300ms	30mA	300ms	30mA
	150ms	60mA	150ms	60mA
	40ms	150mA	40ms	150mA



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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	See appended table 4.4.4.15.1	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
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		P
	- disconnect all ungrounded current-carrying conductors from the mains		P
	- be such that with a single fault applied to the disconnection means or to any other location in the inverter, at least basic	See appended table 4.4.4.15.2 Fault-tolerance of automatic disconnecting.	P



IEC 62109-2			
Clause	Requirement + Test	Result - Remark	Verdict
	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.		
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.	See appended table 4.4.4.15.2 Fault-tolerance of automatic disconnecting.	P
4.4.4.15.2 .3	For non-isolated inverter, automatic checking of the isolation provided by a disconnect means after single fault.		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:		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
	- 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		P
4.7	ELECTRICAL RATINGS TESTS		N/A
4.7.4	Stand-alone Inverter AC output voltage and frequency		N/A
4.7.4.1	General	Not Stand-alone Inverter	N/A
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.		N/A
4.7.4.3	Steady state output voltage across the DC		N/A



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Clause	Requirement + Test	Result - Remark	Verdict
	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.		
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.		N/A
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 %.		N/A
4.7.5	Stand-alone inverter output voltage waveform		N/A
4.7.5.1	General		N/A
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 %.		N/A
4.7.5.3	Non-sinusoidal output waveform requirements		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/ μ s measured between the points at which the waveform has a voltage of 10 % and 90 % of the peak voltage for that half-cycle.		N/A
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.		N/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		N/A



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Clause	Requirement + Test	Result - Remark	Verdict
	in the load equipment and inverter, or cause the load equipment to fail to comply with the applicable product safety standards.		
	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		P
	- Type of Array grounding supported	Ungrounded array	P
	- Inverter isolation	Transformer less type	P
4.8.2	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		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.		N/A
	Measured DC insulation resistance:		N/A
	Inverter measurement circuit shall be capable of detecting insulation resistance below the limit value $R = V_{max}/30mA$ under normal conditions		P
	Inverter measurement circuit shall be capable of detecting insulation resistance below the limit value $R = V_{max}/30mA$ with ground fault in the PV array		P
	Isolated inverters shall indicate a fault if the insulation resistance is less than the limit value		N/A
	Isolated inverter fault indication maintained until insulation resistance has recovered to a value higher than the limit value		N/A
	Non-isolated inverters, or inverters with isolation not complying with the leakage current limits in the minimum inverter isolation requirements in Table 30:		P
	- shall indicate a fault in accordance with 13.9		P
	- shall not connect to the mains		P
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		N/A



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Clause	Requirement + Test	Result - Remark	Verdict
	resistance of the array to ground, and the resistance of any other networks connected to ground (for example measurement networks) must not be lower than $R = (V_{MAX} PV/30 \text{ mA})$ 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	Transformer less type	N/A
4.8.3.3	Fire hazard residual current type test for isolated inverters	Transformer less type	N/A
4.8.3.4	Protection by application of RCD's		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..		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

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Clause	Requirement + Test	Result - Remark	Verdict
4.8.3.5	Protection by residual current monitoring	RCM is provided integrated in inverter	P
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 output power rating ≤ 30 kW;		N/A
	- maximum 10 mA per kVA of rated continuous output power for inverters with continuous output power rating > 30 kVA.		P
	The inverter may attempt to re-connect if the array insulation resistance meets the limit in 4.8.2.		N/A
	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		P
	- 60mA@0,15s		P
	- 150mA@0,04s		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 and 150mA) of Table 31.		P
4.8.3.6	Systems located in closed electrical operating		N/A



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Clause	Requirement + Test	Result - Remark	Verdict
	areas		
	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		N/A
	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.		N/A
	The inverter shall be marked as in 5.2.2.6.		N/A
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)		P
	- Isc PV (absolute maximum) (d.c. A)		P
	a.c. output ratings:		P
	- Voltage (nominal or range) (a.c. V)		P
	- Current (maximum continuous) (a.c. A)		P
	- Frequency (nominal or range) (Hz)		P
	- Power (maximum continuous) (W or VA)		P
	- Power factor range		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	IP66	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.		P
5.2	Warning markings		N/A
5.2.2	Content for warning markings		N/A
5.2.2.6	Inverters for 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 marked with a warning that the inverter is only for use in a closed electrical operating area, and referring to the installation instructions.		N/A
5.3	Documentation		P
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		P



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Clause	Requirement + Test	Result - Remark	Verdict
	Table 33 below. Only those ratings that are applicable based on the type of inverter are required.		
	PV input quantities:		P
	- Vmax PV (absolute maximum) (d.c. V)		P
	- PV input operating voltage range (d.c. V)		P
	- Maximum operating PV input current (d.c. A)		P
	- Isc PV (absolute maximum) (d.c. A)		P
	- Max. inverter backfeed current to the array (a.c. or d.c. A)		P
	a.c. output quantities:		P
	- Voltage (nominal or range) (a.c. V)		P
	- Current (maximum continuous) (a.c. A)		P
	- Current (inrush) (a.c. A, peak and duration)		P
	- Frequency (nominal or range) (Hz)		P
	- Power (maximum continuous) (W or VA)		P
	- Power factor range		P
	- Maximum output fault current (a.c. A, peak and duration or RMS)		P
	- Maximum output overcurrent protection (a.c. A)		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)		P
	Ingress protection (IP) rating per part 1		P
5.3.2.2	Grid-interactive inverter setpoints	Non-adjustable to operator, settled by manufacture.	N/A
	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:		N/A



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Clause	Requirement + Test	Result - Remark	Verdict
	The setting of field adjustable setpoints shall be accessible from the PCE		N/A
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.	Non-isolation	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		N/A
	- providing external residual current detection devices		N/A
	- requiring an external isolation transformer,		N/A
5.3.2.4	Transformers required but not provided	Required, pls. refer to technical information about transformer	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		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.		N/A
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		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	equipment before operating that load with the inverter		
	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



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Clause	Requirement + Test	Result - Remark	Verdict
	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 of APP	P
5.3.2.11	External array insulation resistance measurement and response	IRM function integrated in inverter	N/A
	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		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 $R = V_{MAX} PV/30 \text{ mA}$ 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		N/A



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Clause	Requirement + Test	Result - Remark	Verdict
	include a warning that the inverter is only to be used with the dedicated load for which it was evaluated, and		
	shall specify the dedicated load.		N/A
5.3.2.14	Identification of firmware version(s)		P
	An inverter utilizing firmware for any protective functions shall provide means to identify the firmware version.	V001R001	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.....	Refer to user manual of APP	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		N/A



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Clause	Requirement + Test	Result - Remark	Verdict
	are a shock hazard in accordance with Clause 7 of Parts 1 and 2.		
	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
	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.....		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.		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.		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.		P

4.4.4	TABLE: Single fault condition to be applied					P
	Ambient temperature (°C) :			N/A(at the prevailing ambient temperature)		—
4.4.4.15.1	Fault-tolerance of residual current monitoring					
Component No.	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation
RCD control (output board R2408/R2409/R2410/R2411)	Open-circuit	PV: 1080Vd.c. Mains: 800Va.c.	10mins	-	-	PV inverter cannot start up, indicate RCD sensor fault. No components damage, no hazard.
RCD control (output board U21 pin 8 to GND)	Open-circuit	PV: 1080Vd.c. Mains: 800Va.c.	10mins	-	-	PV inverter disconnected from grid immediately, indicate RCD sensor fault. No components damage, no hazard.
Check that the residual current monitoring operates properly					Yes	
Supplementary information: also see IEC 62109-1 report						

4.4.4	TABLE: Single fault condition to be applied					P
	Ambient temperature (°C) : N/A(at the prevailing ambient temperature)					—
4.4.4.15.2	Fault-tolerance of automatic disconnecting means					
Component No.	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation
Relay control (control board R18)	Open-circuit	PV: 1080Vd.c. Mains: 800Va.c.	10mins	-	-	PV inverter cannot start up, indicate Grid Relay fault. No components damage, no hazard.
Relay control (control board R17)	Open-circuit	PV: 1080Vd.c. Mains: 800Va.c.	10mins	-	-	PV inverter cannot start up, indicate Grid Relay fault. No components damage, no hazard.
Relay K401	Short-circuit	PV: 1080Vd.c. Mains: 800Va.c.	10mins	-	-	PV inverter cannot start up, indicate Grid Relay fault. No components damage, no hazard.
Relay K402	Short-circuit	PV: 1080Vd.c. Mains: 800Va.c.	10mins	-	-	PV inverter cannot start up, indicate Grid Relay fault. No components damage, no hazard.
Relay K403	Short-circuit	PV: 1080Vd.c. Mains: 800Va.c.	10mins	-	-	PV inverter cannot start up, indicate Grid Relay fault. No components damage, no hazard.
Relay K404	Short-circuit	PV: 1080Vd.c. Mains: 800Va.c.	10mins	-	-	PV inverter cannot start up, indicate Grid Relay fault. No components damage, no hazard.

Relay K405	Short-circuit	PV: 1080Vd.c. Mains: 800Va.c.	10mins	-	-	PV inverter cannot start up, indicate Grid Relay fault. No components damage, no hazard.
Relay K406	Short-circuit	PV: 1080Vd.c. Mains: 800Va.c.	10mins	-	-	PV inverter cannot start up, indicate Grid Relay fault. No components damage, no hazard.
Check that the relays fulfil the basic insulation or simple separation based on the PV circuit working voltage.						Yes L distance: 4mm*2=8mm
Each active phase can be switched. (L1/L2/L3)						Yes
Supplementary information: also see IEC 62109-1 report						

4.4.4.17	TABLE: Cooling system failure – Blanketing test			P
	Test voltage (V)	930.1VDC/800.1VAC/50Hz		—
Max. temperature T of part/at:		T (°C)	Permitted T (°C)	
Ambient Temperature		26.1	-	
Front of surface		41.3	90	
Left surface		46.2	90	
Right surface		45.3	90	
Bottom surface		51.4	90	
Rear of enclosure		41.2	90	
Mounting surface		56.7	90	

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			P
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 $R = (V_{MAX} \text{ PV} / 30\text{mA})$ (kΩ)	Result
ISO setting=50kΩ				
PV+ to earth				
490	550	48	50	Insulation fault
490	550	48	50	Insulation fault
490	550	48	50	Insulation fault
490	550	48	50	Insulation fault
490	550	48	50	Insulation fault
490	550	52	50	Normal Operation
490	550	52	50	Normal Operation
490	550	52	50	Normal Operation
490	550	52	50	Normal Operation
490	550	52	50	Normal Operation
PV- to earth				

490	550	48	50	Insulation fault
490	550	48	50	Insulation fault
490	550	48	50	Insulation fault
490	550	48	50	Insulation fault
490	550	48	50	Insulation fault
490	550	52	50	Normal Operation
490	550	52	50	Normal Operation
490	550	52	50	Normal Operation
490	550	52	50	Normal Operation
490	550	52	50	Normal Operation

Note:

For isolated inverters, shall indicate a fault in accordance with 13.9 (operation is allowed); the fault indication shall be maintained until the array insulation resistance has recovered to a value higher than the limit above

For non-isolated inverters, or inverters with isolation not complying with the leakage current limits in the minimum inverter isolation requirements in Table 30, shall indicate a fault in accordance with 13.9, and shall not connect to the mains; the inverter may continue to make the measurement, may stop indicating a fault and may connect to the mains if the array insulation resistance has recovered to a value higher than the limit above.

It is not required to test all PV input terminals if analysis of the design indicates that one or more terminals can be expected to have the same result, for example where multiple PV string inputs are in parallel.

Supplementary information:

Additional test with first one pole ground fault, following an insulation resistance below limit simulated, then allow the inverter to start, the inverter shall not connect to the mains.

4.8.3.5	TABLE: Protection by residual current monitoring (only for RCM function)			P
Test conditions:		Output power (kVA): 330 Input voltage (VDC): 1080 Frequency (Hz): 50 Output AC Voltage (VAC): 800		
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: 3300mA@300ms PV1+ to earth:				
2427	3300	268.0	300	
2427	3300	288.0	300	
2427	3300	292.0	300	
2427	3300	270.0	300	
2427	3300	288.0	300	
PV1- to earth:				
2268	3300	280.0	300	

2268	3300	251.5	300
2268	3300	270.0	300
2268	3300	255.0	300
2268	3300	264.0	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 for all 5 tests the time to disconnect shall not exceed 0,3s.

The test is repeated for each PV input terminal. It is not required to test all PV input terminals if analysis of the design indicates that one or more terminals can be expected to have the same result, for example where multiple PV string inputs are in parallel.

4.8.3.5.3	TABLE: Test for detection of sudden changes in residual current(only for RCM function)		P
PV1+ to earth:			
Limit (mA)	UN		Limit (ms)
	Disconnection time (ms)		
Default: 30mA@300ms			
30	265.5		300
30	268.0		300
30	268.0		300
30	272.0		300
30	270.0		300
Default: 60mA@150ms			
60	132.5		150
60	129.0		150
60	132.0		150
60	135.0		150
60	132.5		150
Default: 150mA@40ms			
150	27.0		40
150	28.5		40
150	27.5		40
150	23.5		40
150	28.9		40
PV1- to earth			
Limit (mA)	UN		Limit (ms)
	Disconnection time (ms)		
Default: 30mA@300ms			
30	268.5		300
30	271.0		300
30	274.0		300
30	271.0		300
30	269.0		300
Default: 60mA@150ms			
60	130.0		150
60	135.0		150
60	135.0		150



60	131.3	150
60	130.0	150
Default: 150mA@40ms		
150	26.3	40
150	29.3	40
150	28.0	40
150	29.3	40
150	23.8	40
<p>Note: The capacitive current is risen until disconnection. Test condition: $I_c + 30/60/150\text{mA} \leq I_{cmax}$. R1 is set that 30/60/150mA Flow and switch S is closed.</p> <p>Supplementary information: Same design on other MPP trackers, it is not required to test on other MPP trackers because analysis of the design indicates that other MPP trackers expected to have the same result.</p>		

--- End of test report---