






TEST REPORT IEC/EN 62109-2 Safety of Power Converter for use in Photovoltaic Power Systems Part 2: Particular requirements for inverters	
Report Number: GZES230100125902 Date of issue: 2023-02-01 Total number of pages 30	
Name of Testing Laboratory preparing the Report:	SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch
Applicant's name:	Zhejiang CHISAGE New Energy Technology Co., Ltd
Address:	No. 1828 Fuqing South RD. Panhuo ST. Yinzhou District Ningbo Zhejiang 315000 China
Test specification:	
Standard:	EN 62109-2:2011 IEC 62109-2:2011
Test procedure:	SGS-CSTC
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	Single phase inverter
Trade Mark	 <small>CHISAGE</small>
Manufacturer.....	Zhejiang CHISAGE New Energy Technology Co., Ltd
Address	No. 1828 Fuqing South RD. Panhuo ST. Yinzhou District Ningbo Zhejiang 315000 China
Model/Type reference.....	See model list in page 7 to 8.
Ratings	See model list in Page 7 to 8. Hardware version: Ver2.3 DC Software version: Ver0107 AC Software version: Ver2.5

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):		
<input checked="" type="checkbox"/>	Testing Laboratory:	SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch
	Location/ address.....	198 Kezhu Road, Science City, Economic & Technology Development Area, Guangzhou, Guangdong, China
	Tested by (name, function, signature)	Doris Tao (Project Engineer) 
	Approved by (name, function, signature	Roger Hu (Technical Reviewer) 

<p>List of Attachments (including a total number of pages in each attachment): N/A</p>	
<p>Summary of testing:</p>	
<p>Tests performed (name of test and test equipment): The equipment has been tested according to the standard: EN 62109-2:2010 and IEC 62109-2:2010.</p> <p>All test results are from the original report GZES210602035102, issued by SGS-CTS Standards Technical Services Co., Ltd Guangzhou Branch.</p>	<p>Testing location: See page 2</p>
<p>Summary of compliance with National Differences (List of countries addressed): No National Differences are addressed to this test report</p>	

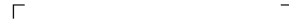
Copy of marking plate(representative):**Utility-Interactive Inverter**

Maximum input Voltage: 60Vdc
 Range of input operating voltage: 25~55Vdc
 Maximum input current: 13A x 4
 Operating voltage range (AC): 230Vac
 Rated output current(AC): 8.7A
 Max output apparent power: 2000VA
 Rated output power: 2000W
 Rated AC Grid Frequency: 50/60Hz
 Ambient Temperature: -40°C~+65°C
 Peak efficiency: 96.5%
 Protective class: Class I
 Ingress protection: IP67
 Max.Units per branch: 3



Type: **CE-1P20001G-230-EU**

Number Serial:



-Both AC and DC voltage sources are terminated inside this equipment
 -Each circuit must be individually disconnected before servicing
 -Photovoltaic array supplied a DC voltage to this equipment when exposed to light
 -Hot surface: To reduce the risk of burn - Do not touch
 -Raintight enclosure: IP67
 -To be connected to a dedicated branch circuit
 -Maximum Branch circuit overcurrent protection: 45A

www.chisagess.com

Note:

1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.
2. Label is attached on the side surface of enclosure and visible after installation
3. Labels of other models are as the same with **CE-1P20001G-230-EU**'s except the parameters of rating.
4. As declared by the applicant, the importer (and manufacturer, if it is different)'s name, registered trade name or registered trademark and the postal address will be marked on the products before being place on the market. The contact details shall be in a language easily understood by end-users and market surveillance authorities.

Test item particulars	Three Phase Inverter
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
Environmental category	<input checked="" type="checkbox"/> outdoor <input type="checkbox"/> indoor unconditional <input type="checkbox"/> indoor conditional
Over voltage category Mains	<input type="checkbox"/> OVC I <input type="checkbox"/> OVC II <input checked="" type="checkbox"/> OVC III <input type="checkbox"/> OVC IV
Over voltage category PV	<input type="checkbox"/> OVC I <input checked="" type="checkbox"/> OVC II <input type="checkbox"/> OVC III <input type="checkbox"/> OVC IV
Mains supply tolerance (%)	-90 / +110 %
Tested for power systems	TN systems
IT testing, phase-phase voltage (V)	N/A
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)	3,5 kg for all model
Pollution degree	Outside PD3; Inside PD2
IP protection class	IP 67
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	CTF Stage 1 procedure
Date of receipt of test item	N/A
Date (s) of performance of tests	2020-09-06 to 2020-09-28

General remarks:

"(See Enclosure #)" refers to additional information appended to the report.
 "(See appended table)" refers to a table appended to the report.

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Throughout this report a comma / point is used as the decimal separator.

Manufacturer's Declaration per sub-clause 4.2.5 of IEC60068-2-2:

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

Yes
 Not applicable

When differences exist; they shall be identified in the General product information section.

Name and address of factory (ies)

NingBo Deye Inverter Technology Co.,Ltd.
 No.26 South YongJiang Road, Daqi, Beilun,
 NingBo, China.

General product information:

Product covered by this report is grid-connected PV inverter for indoor or outdoor installation. The connection to the DC input and AC output are through connectors.

The Solar inverter converts DC voltage into AC voltage.

The input and output are protected by varistors to Earth. The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from input to output (transformerless). The output is switched off redundant by the high-power switching bridge and two relays. This assures that the opening of the output circuit can operate in case of single fault.

Equipment Under Testing:

CE-1P20001G-230-EU.

Variant models:

**CE-1P3001G-230-EU, CE-1P5001G-230-EU, CE-1P6001G-230-EU,
CE-1P8001G-230-EU, CE-1P10001G-230-EU, CE-1P13001G-230-EU,
CE-1P16001G-230-EU, CE-1P18001G-230-EU**

Model Number	CE-1P3001G -230-EU	CE-1P5001G -230-EU	CE-1P6001G -230-EU	CE-1P8001G -230-EU	CE-1P10001G -230-EU
Input (DC)					
Max. input power	400W	600W	800W	1200W	1200W
Max. input voltage	60V				
MPPT voltage range	25~55V				
Max. input current	13A	13A	13A×2	13A×2	13A×2
Output (AC)					
Rated grid voltage	230V				
Rated grid frequency	50Hz				
Rated output power	300W	500W	600W	800W	1000W
Rated output current	1.3A	2.2A	2.6A	3.8A	4.8A
Power factor	> 0.99				
Ambient temperature	-40 °C ~ 65 °C				
Ingress protection	IP67				
Protective class	Class I				

Model Number	CE-1P13001G -230-EU	CE-1P16001G -230-EU	CE-1P18001G -230-EU	CE-1P20001G -230-EU
Input (DC)				
Max. input power	1600W	2400W	2400W	2400W
Max. input voltage	60V			
MPPT voltage range	25~55V			
Max. input current	13A×4	13A×4	13A×4	13A×4
Output (AC)				
Rated grid voltage	230V			
Rated grid frequency	50Hz			
Rated output power	1300W	1600W	1800W	2000W
Rated output current	6.2A	7.7A	8.6A	9.6A
Power factor	>0.99			
Ambient temperature	-40 °C ~65 °C			
Ingress protection	IP67			
Protective class	Class I			

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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	The PCE is isolated type.	N/A
	a). - The inverter ceases to operate		N/A
	- Indicates a fault in accordance with §13.9		N/A
	- Disconnect from the mains		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
	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		P
4.4.4.15.2	Fault-tolerance of automatic disconnecting means	The inverter has 1 pieces of certified relays used for L line and N line as 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	1 pieces of certified 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.	See appended table 4.4.4.15.2 Fault-tolerance of automatic disconnecting.	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.	.	P
4.4.4.15.2.3	For non-isolated inverter, automatic checking of the isolation provided by a disconnect means after single fault.		N/A
	If the check fail: - any still-functional disconnection means shall be		N/A
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Clause	Requirement + Test	Result - Remark	Verdict
	left in the open position		
	at least basic or simple separation shall be maintained between the PV input and the mains		N/A
	the inverter shall not start operation		N/A
	the inverter shall indicate a fault in accordance with 13.9		N/A
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:	The PCE is grid-interactive inverter	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	stabilize without external surface of the inverter exceed 90°C	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		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 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.		N/A
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	Not stand-alone inverter	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

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Clause	Requirement + Test	Result - Remark	Verdict
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/μs 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 in the load equipment and inverter, or cause the load equipment to fail to comply with the applicable product safety standards.		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	The PCE is intended to be used with grounded array or ungrounded array.	P
	Type of Array grounding supported		N/A
	Inverter isolation	The PCE is isolated inverter.	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 required insulation resistance before connection to the MAINS: 60V/30mA=2 k Ω	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	P
	Measured DC insulation resistance:	P
	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	First with one pole grounded fault occurred, following an insulation resistance below limit simulated, then allow	P

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Clause	Requirement + Test	Result - Remark	Verdict
		the inverter to start, the inverter shall not connect to the mains. Also tested with blind spot of PV+ and PV- with low insulation resistance together.	
	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	Not for functionally grounded arrays	N/A
4.8.2.2	Array insulation resistance detection for inverters 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) must not be lower than $R = (V_{MAX} PV/30 \text{ mA})$ ohms.		N/A
	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	The max. Measured touch current is 0,12mA which is below the limit 30mA. See appended table 4.8.3.2	P
4.8.3.3	Fire hazard residual current type test for isolated inverters	The max. Measured residual current is 2,3 mA which is below the limit 300mA. See appended table 4.8.3.3	P
4.8.3.4	Protection by application of RCD's	The unit was insulated type	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

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Clause	Requirement + Test	Result - Remark	Verdict
	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 RCD 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	The unit was insulated type	N/A
4.8.3.5.1	General		N/A
	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.		N/A
	The residual current monitoring means shall measure the total (both a.c. and d.c. components) RMS current.		N/A
	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:		N/A
	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:		N/A
	maximum 300 mA for inverters with continuous output power rating ≤ 30 kV;		N/A
	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.		N/A
	b) Sudden changes in residual current: The inverter shall disconnect from the mains within the time specified in Table 31		N/A
	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.		N/A
	- 30mA@0,3s		N/A
	- 60mA@0,15s		N/A
	150mA@0,04s		N/A
	The inverter may attempt to re-connect if the array insulation resistance meets the limit in 4.8.2.		N/A
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.		N/A
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.		N/A
4.8.3.6	Systems located in closed electrical operating areas	Outdoor use, not limited to be located in closed electrical operating areas.	N/A
	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

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Clause	Requirement + Test	Result - Remark	Verdict
5	Marking and documentation		P
5.1	Marking		P
5.1.4	Equipment ratings		P
	PV input ratings:	See rating label	P
	Vmax PV (absolute maximum) (d.c. V)		P
	Isc PV (absolute maximum) (d.c. A)		P
	a.c. output ratings:	See rating label	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	IP67	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		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.	The unit is allowed to be installed in operator access area.	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 Table 33 below. Only those ratings that are applicable based on the type of inverter are required.		P
	PV input quantities :	See user manual	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		P
	a.c. output quantities:	See user manual	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

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Clause	Requirement + Test	Result - Remark	Verdict
	- Maximum output fault current (a.c. A, peak and		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)	Class I	P
	Ingress protection (IP) rating per part 1	IP67	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:	No adjustable setting available. Only the factory default values, however the adjustment shall be performed by service personnel.	N/A
	The setting of field adjustable setpoints shall be accessible from the PCE		N/A
5.3.2.3	Transformers and isolation		P
	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.		P
	An inverter shall be provided with information to the installer regarding:		P
	- providing of internal isolation transformer		P
	- the level of insulation (functional, basic, reinforced, or double)		P
	The instructions shall also indicate what the resulting installation requirements are regarding:		P
	- earthing or not earthing the array		P
	- providing external residual current detection	follow national regulations	P
	- requiring an external isolation transformer,		N/A
5.3.2.4	Transformers required but not provided	Not required	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		N/A

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	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	N/A
	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 equipment before operating that load with the inverter		N/A
	The inverter manufacturer shall provide information regarding:		N/A
	- what types of loads may experience increased		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,		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	Refer to user manual	P

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Clause	Requirement + Test	Result - Remark	Verdict
	of how to properly make connections to (where applicable), and use, the electrical or electronic fault indication required by 13.9.		
5.3.2.11	External array insulation resistance measurement and response		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	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 $R = V_{MAX} PV/30 \text{ mA}$ 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 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
	An inverter utilizing firmware for any protective functions shall provide means to identify the firmware version.		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.....		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		N/A

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	protective earth provided within the inverter or 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
	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 from 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	Red blinks LED indicate a failure during Micro-Inverter start-up.	P
	b) a electrical or electronic indication that can be remotely accessed and used.	Red blinks LED indicate a failure during Micro-Inverter start-up.	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.	Red blinks LED indicate a failure during Micro-Inverter start-up.	P

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Clause	Requirement + Test	Result - Remark	Verdict

4.4.4	TABLE: Single fault condition to be applied		N/A
	Ambient temperature (°C)	at the prevailing ambient temperature	
	Power source for EUT: Manufacturer, model/type, output rating	--	

4.4.4.15.1 Fault-tolerance of residual current monitoring						
Component No.	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation

Supplementary information:
 The unit was insulated type.

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Clause	Requirement + Test	Result - Remark	Verdict

4.4.4	TABLE: Single fault condition to be applied					P
	Ambient temperature (°C)	at the prevailing ambient temperature				
	Power source for EUT: Manufacturer, model/type, output rating	--				
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 K1	Short before start-up	230V/0A	10min	F300	-	Unit can't start up, no damage, no hazard, no fire
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)						
Supplementary information:						

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Clause	Requirement + Test	Result - Remark	Verdict

4.4.4.17	Cooling system failure – Blanketing test						P
	Test voltage (Vdc)	40V	--	--	--	--	--
	Test current (Idc)	2*12,5A	--	--	--	--	--
	Test voltage (Vac)	230V	--	--	--	--	--
	Test current (Iac)	8,69A	--	--	--	--	--
	tamb1 (°C)	45,0	--	--	--	--	--
	tamb2 (°C)	45,0	--	--	--	--	--
maximum temperature T of part/at::		T (°C)					Tmax (°C)
	Front side of enclosure	74,88	--	--	--	--	90*
	Back side of enclosure	83,36	--	--	--	--	90*
	Left side of enclosure	74,89	--	--	--	--	90*
	Right side of enclosure	72,97	--	--	--	--	90*
	Top side of enclosure	72,79	--	--	--	--	90*
	Bottom side of enclosure	67,21	--	--	--	--	90*
Supplementary information:							
*The heatsinks are marked with the hot surface marking of symbol 14 of Annex C,							

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Clause	Requirement + Test	Result - Remark	Verdict

4.7.4	TABLE: Steady state Inverter AC output voltage and frequency		N/A
	Nominal DC input (V) Nominal output AC voltage (V) :		
AC output U (V)	Frequency (Hz)	Condition/status	Comments
		Without load	
		Resistive load application	
		Resistive load removal	
Supplementary information:			
The unit was grid-connected type			

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Clause	Requirement + Test	Result - Remark	Verdict

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 $R = (V_{MAX PV} / 30mA)$ (kΩ)	Result
PVA DC+				
24V	25V	94,6	2	P
24V	40V	98,7	2	P
24V	45V	99,1	2	P
24V	55V	100,7	2	P
24V	60V	99,4	2	P
PVA DC-				
24V	25V	101,0	2	P
24V	40V	100,6	2	P
24V	45V	99,9	2	P
24V	55V	100,5	2	P
24V	60V	99,8	2	P
PVB DC+				
24V	25V	98,1	2	P
24V	40V	98,8	2	P
24V	45V	99,4	2	P
24V	55V	99,3	2	P
24V	60V	99,8	2	P
PVB DC-				
24V	25V	99,1	2	P
24V	40V	99,1	2	P
24V	45V	94,7	2	P
24V	55V	94,4	2	P
24V	60V	97,5	2	P
PVC DC+				
24V	25V	97,6	2	P
24V	40V	100,5	2	P
24V	45V	97,5	2	P
24V	55V	101,5	2	P
24V	60V	99,3	2	P
PVC DC-				
24V	25V	100,5	2	P
24V	40V	99,0	2	P
24V	45V	100,0	2	P
24V	55V	98,9	2	P
24V	60V	94,1	2	P

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Clause	Requirement + Test	Result - Remark	Verdict

PVD DC+				
24V	25V	97,5	2	P
24V	40V	94,2	2	P
24V	45V	98,8	2	P
24V	55V	98,1	2	P
24V	60V	99,4	2	P
PVD DC+				
24V	25V	99,7	2	P
24V	40V	99,1	2	P
24V	45V	99,8	2	P
24V	55V	99,1	2	P
24V	60V	99,6	2	P

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:

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Clause	Requirement + Test	Result - Remark	Verdict

4.8.3.2	TABLE: 30mA touch current type test for isolated inverters		P
Condition	Current (mA)	Limit (30mA)	
Model: CE-1P20001G-230-EU			
PVA DC+ to PE	0,196	30	
PVA DC- to PE	0,203	30	
PVB DC+ to PE	0,198	30	
PVB DC- to PE	0,196	30	
PVC DC+ to PE	0,205	30	
PVC DC- to PE	0,211	30	
PVD DC+ to PE	0,187	30	
PVD DC- to PE	0,175	30	
Supplementary information: The touch current measurement circuit of IEC 60990, Figure 4 is connected from each terminal of the array to ground, one at a time.			

4.8.3.3	TABLE: Fire hazard residual current type test for isolated inverters		P
Condition	Current (mA)	Limit (300mA or 10mA per kVA)	
Model: CE-1P20001G-230-EU			
PVA DC+ to PE	45.2	300	
PVA DC- to PE	45.7	300	
PVB DC+ to PE	45.8	300	
PVB DC- to PE	48.2	300	
PVC DC+ to PE	47.7	300	
PVC DC- to PE	49.2	300	
PVD DC+ to PE	44.5	300	
PVD DC- to PE	44.8	300	
Supplementary information:			

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Clause	Requirement + Test	Result - Remark	Verdict

4.8.3.5	TABLE: Protection by residual current monitoring		N/A
Test conditions:		Output power (kVA) : Input voltage (VDC): Frequency (Hz): Output AC Voltage (VAC):	
4.8.3.5.2	Test for detection of excessive continuous residual current		N/A
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
+ PV to N:			
			300
			300
			300
			300
			300
- PV to N:			
			300
			300
			300
			300
			300
Note: – maximum 300mA for inverters with continuous output power rating ≤30kVA; – 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.			
Supplementary information: The unit was isolated type			

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Clause	Requirement + Test	Result - Remark	Verdict
4.8.3.5.3	TABLE: Test for detection of sudden changes in residual current		N/A
+PV to N			
Limit (mA)	U_N		Limit (ms)
	Disconnection time (ms)		
30			300
30			300
30			300
30			300
30			300
60			150
60			150
60			150
60			150
60			150
150			40
150			40
150			40
150			40
150			40
-PV to N			
Limit (mA)	U_N		Limit (ms)
	Disconnection time (ms)		
30			300
30			300
30			300
30			300
30			300
60			150
60			150
60			150
60			150
60			150
150			40
150			40
150			40
150			40
150			40
Note:			
The capacitive current is raised until disconnection.			
Test condition: $I_c + 30/60/150\text{mA} \leq I_{c\text{max}}$. R1 is set that 30/60/150mA Flow and switch S is closed.			
Supplementary information:			
The unit was insulated type.			

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Clause	Requirement + Test	Result - Remark	Verdict

List of measurement units used for investigation

Supplementary information:

The measurement units used please see IEC/EN 62109-1:2010 report: GZES210602035102 for reference.