


Prüfbericht - Nr.: Test Report No.:	CN21AQKR 001	Auftrags-Nr.: Order No.:	244367352 (P00458940)	Seite 1 von 89 Page 1 of 89	
Kunden-Referenz-Nr.: Client Reference No.:	2104110	Auftragsdatum: Order date:	2021.07.16		
Auftraggeber: Client:	AISWEI New Energy Technology (Jiangsu) Co., Ltd. No.198, Xiangyang Road, Suzhou 215011, P. R. China				
Prüfgegenstand: Test item:	Grid-connected PV Inverter				
Bezeichnung / Typ-Nr.: Identification / Type No.:	ASW40K-LT-G3, ASW36K-LT-G3, ASW33K-LT-G3, ASW30K-LT-G3, ASW27K-LT-G3, ASW25K-LT-G3				
Auftrags-Inhalt: Order content:	TÜV Rheinland Type Approval				
Prüfgrundlage: Test specification:	IEC 62109-1: 2010, IEC 62109-2: 2011 EN 62109-1: 2010, EN 62109-2: 2011				
Wareneingangsdatum: Date of receipt:	2021.10.12				
Prüfmuster-Nr.: Test sample No.:	Engineering sample				
Prüfzeitraum: Testing period:	2021.10.20 to 2021.11.18				
Ort der Prüfung: Place of testing:	See Summary of testing on page 4.				
Prüflaboratorium: Testing Laboratory:	TÜV Rheinland (Shanghai) Co., Ltd.				
Prüfergebnis*: Test Result*:	Pass				
zusammengestellt von: compiled by:	<i>John Dai</i>		genehmigt von: authorized by:	<i>Yue Yin</i>	
<u>2021.12.14</u> John Dai / Engineer	<u>2021.12.14</u> Yue Yin / Technical Certifier				
Datum Date	Name/Stellung Name/Position	Unterschrift Signature	Datum Date	Name/Stellung Name/Position	Unterschrift Signature
Sonstiges/ Other Aspects:					
The test report includes the following documents: - IEC/EN 62109-2 test report - List of critical components - Photo document					
Zustand des Prüfgegenstandes bei Anlieferung: Condition of test item at delivery:			Prüfmuster vollständig und unbeschädigt Test item complete and undamaged		
* Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet * Legend: P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested					
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.					
V05					

**TEST REPORT
IEC 62109-1
Safety of Power Converter for use in Photovoltaic Power Systems
Part 1: General requirements**

Report

Report Reference No.: CN21AQKR 001
Date of issue: See cover page
Total number of pages: See cover page

Testing Laboratory: **TÜV Rheinland (Shanghai) Co., Ltd.**

Address: No. 177, Lane 777, West Guangzhong Road,
Jing'an District, Shanghai 200072, P. R. China

Applicant's name.....: **AISWEI New Energy Technology (Jiangsu) Co., Ltd.**

Address: No.9 Plant, No.198 Xiangyang Road, Suzhou 215011, P. R. China

Test specification

Standard: IEC 62109-1: 2010 (First Edition)
Test procedure: TÜV Rheinland Type Approval
Non-standard test method.....: N/A

Test Report Form No......: IEC62109_1B

TRF Originator.....: VDE Testing and Certification Institute
Master TRF: Dated 2016-04

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This report is not valid as a CB Test Report unless signed by an approved CB Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.

Test item description: Grid-connected PV Inverter

Trade Mark:



Manufacturer: Same as the applicant

Model/Type reference: ASW40K-LT-G3, ASW36K-LT-G3, ASW33K-LT-G3,
ASW30K-LT-G3, ASW27K-LT-G3, ASW25K-LT-G3

Ratings: See copy of marking label and model list.

Testing procedure and testing location:
<input checked="" type="checkbox"/> Testing Laboratory: Testing location/ address : See cover page <input type="checkbox"/> Associated Laboratory: Testing location/ address : Tested by (name + signature) : Approved by (+ signature)..... :
<input type="checkbox"/> Testing procedure: TMP Testing location/ address : Tested by (name + signature) : Approved by (+ signature)..... :
<input type="checkbox"/> Testing procedure: WMT Testing location/ address : Tested by (name + signature) : Witnessed by (+ signature) : Approved by (+ signature)..... :
<input type="checkbox"/> Testing procedure: SMT Testing location/ address : Tested by (name + signature) : Approved by (+ signature)..... : Supervised by (+ signature) :
<input type="checkbox"/> Testing procedure: RMT Testing location/ address : Tested by (name + signature) : Approved by (+ signature)..... : Supervised by (+ signature) :

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

- ATTACHMENT 1 – Test report of IEC 62109-2: 2011 (1st Edition) (15 pages)
- ATTACHMENT 2 – Photo documentation (8 pages)
- ATTACHMENT 3 – List of critical components (18 pages)

Summary of compliance with National Differences:

List of countries addressed: None.

The product fulfils the requirements of

IEC 62109-1: 2010, EN 62109-1: 2010,
IEC 62109-2: 2011, EN 62109-2: 2011

Copy of marking plate:

Model: ASW40K-LT-G3

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 180-1000V
Max. input current	d.c. 32/32/40A
Isc PV(absolute maximum)	d.c. 48/48/60A
Rated grid voltage	3/N/PE ~ 400V
Rated grid frequency	50/60Hz
Rated AC output active power	40kW
Max. AC output apparent power	44kVA
Max. continuous output current	a.c. 63.8A
Adjustable cos(φ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	non-isolated
Ingress protection	IP 66
Protective class	I
Overvoltage category	II(PV) III(MAINS)



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Made in China


Model: ASW36K-LT-G3

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 180-1000V
Max. input current	d.c. 32/32/40A
Isc PV(absolute maximum)	d.c. 48/48/60A
Rated grid voltage	3/N/PE ~ 400V
Rated grid frequency	50/60Hz
Rated AC output active power	36kW
Max. AC output apparent power	39.6kVA
Max. continuous output current	a.c. 57.4A
Adjustable cos(φ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	non-isolated
Ingress protection	IP 66
Protective class	I
Overvoltage category	II(PV) III(MAINS)



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Model: ASW33K-LT-G3

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 180-1000V
Max. input current	d.c. 32/32/40A
Isc PV (absolute maximum)	d.c. 48/48/60A
Rated grid voltage	3/N/PE - 400V
Rated grid frequency	50/60Hz
Rated AC output active power	33kW
Max. AC output apparent power	36.3kVA
Max. continuous output current	a.c. 52.6A
Adjustable cos(φ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	non-isolated
Ingress protection	IP 66
Protective class	I
Overvoltage category	II(PV) III(MAINS)



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Model: ASW30K-LT-G3

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 180-1000V
Max. input current	d.c. 3x32A
Isc PV (absolute maximum)	d.c. 3x48A
Rated grid voltage	3/N/PE - 400V
Rated grid frequency	50/60Hz
Rated AC output active power	30kW
Max. AC output apparent power	33kVA
Max. continuous output current	a.c. 47.8A
Adjustable cos(φ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	non-isolated
Ingress protection	IP 66
Protective class	I
Overvoltage category	II(PV) III(MAINS)



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Model: ASW27K-LT-G3

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 180-1000V
Max. input current	d.c. 3×32A
Isc PV(absolute maximum)	d.c. 3×48A
Rated grid voltage	3/N/PE - 400V
Rated grid frequency	50/60Hz
Rated AC output active power	27kW
Max. AC output apparent power	29.7kVA
Max. continuous output current	a.c. 43A
Adjustable cos(φ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	non-isolated
Ingress protection	IP 66
Protective class	I
Overtoltage category	II(PV) III(MAINS)



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Made in China


Model: ASW25K-LT-G3

Max. input voltage	d.c. 1100V
MPP voltage range	d.c. 180-1000V
Max. input current	d.c. 3×32A
Isc PV(absolute maximum)	d.c. 3×48A
Rated grid voltage	3/N/PE - 400V
Rated grid frequency	50/60Hz
Rated AC output active power	25kW
Max. AC output apparent power	27.5kVA
Max. continuous output current	a.c. 39.9A
Adjustable cos(φ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Topology	non-isolated
Ingress protection	IP 66
Protective class	I
Overtoltage category	II(PV) III(MAINS)



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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
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 (%).....	According to the specified supply range.
Tested for power systems	TN
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).....	30
Pollution degree	<input type="checkbox"/> PD 1 <input checked="" type="checkbox"/> PD 2 (Inside) <input checked="" type="checkbox"/> PD 3 (outside)
IP protection class	IP66

Testing

Date of receipt of test item(s): See cover page
 Dates tests performed

Possible test case verdicts:

- test case does not apply to the test object: N/A
- test object does meet the requirement.....: Pass (P)
- test object was not evaluated for the requirement ..: N/E
- test object does not meet the requirement.....: Fail (F)

General remarks:

"(see Attachment #)" refers to additional information appended to the report.

"(see appended table)" refers to a table appended to the report.

The tests results presented in this report relate only to the object tested.

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List of test equipment must be kept on file and available for review.

Additional test data and/or information provided in the attachments to this report.

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

Determination of the test results includes consideration of measurement uncertainty from the test equipment and methods.

Manufacturer's Declaration per sub-clause 6.2.5 of IEC60068-2-1:

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):

AISWEI New Energy Technology (Yangzhong) Co., Ltd.

No.588, Gangxing Road, Economic Development Zone, Yangzhong, P. R. China.

General product information:
Brief description:

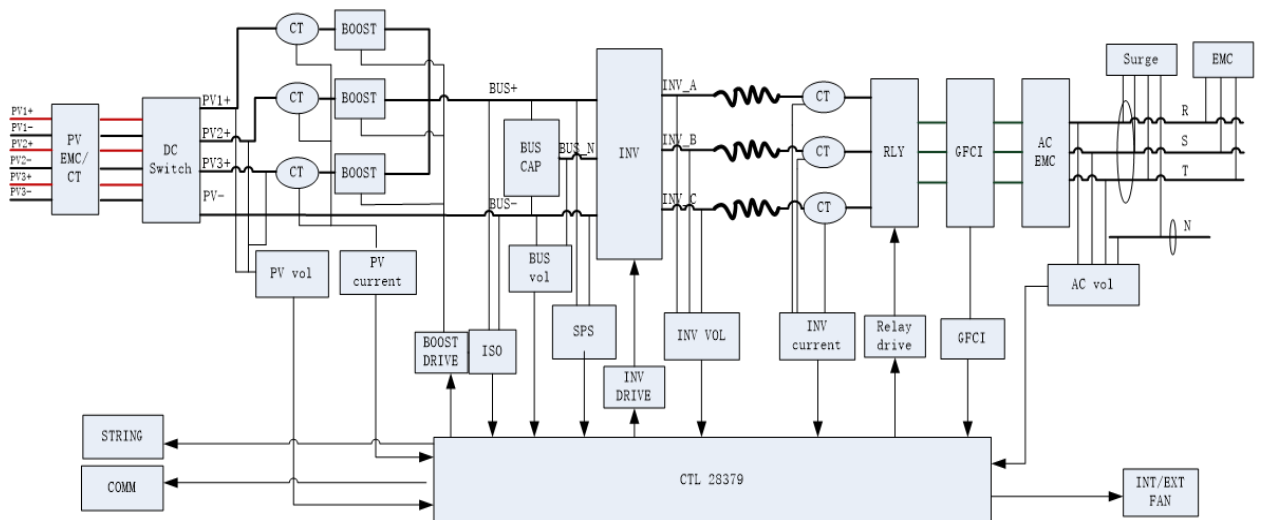
The PCE under test (EUT) is Grid-connected PV inverter, which utilizes the advanced power electronics conversion components such as MOSFET, IGBT, IPM to convert the variable DC power generated from the photovoltaic (PV) arrays to the stable utility AC power, which can be fed into the commercial electrical grid.

The PCE series under test is three-phase grid-connected PV inverter for solar power generation with the rating of 40kW, 36kW, 33kW, 30kW, 27kW and 25kW.

Model difference:

The models of ASW40K-LT-G3 series are identical on topological schematic circuit diagram and control solution codes except for the type designation, the input/output rating.

Unless otherwise specified, all the tests were conducted on the basic model of ASW40K-LT-G3 to represent the others.

Block diagram:


Model list:				
Model		ASW40K-LT-G3	ASW36K-LT-G3	ASW33K-LT-G3
INPUT	V _{MAXPV} [Vdc]	1100		
	I _{SCPV} [A]	48 / 48 / 60		
	MPP Voltage Range [Vdc]	180 - 1000		
	Full power MPP Voltage Range [Vdc]	450 - 850		
	Max. Input Current [A]	32 / 32 / 40		
	Start PV Voltage [Vdc]	160		
	Back feed Current [A]	0		
	Overvoltage Category (OVC)	II		
OUTPUT	Rated Output Voltage [Vac]	3N~ 400		
	Rated Output Frequency [Hz]	50/60		
	Rated Output Power [kW]	40.0	36.0	33.0
	Max. Apparent Power [kVA]	44.0	39.6	36.3
	Rated Output Current [A]	58.0	52.2	47.8
	Max. Output Current [A]	63.8	57.4	52.6
	Power Factor (cosφ)	1.0 (default), 0.80 lead, 0.80 lag		
	Overvoltage Category (OVC)	III		
SYSTEM	Protective Class	I		
	Enclosure Protection (IP)	IP66		
	Operating Temperature Range [°C]	-25 to +60 (45°C derating)		
	Pollution Degree (PD)	PD 3		
	Altitude [m]	≤ 3000		
	Acoustic Noise [dB]	60		
	Weight [kg]	30		
	Size (W x H x D) [mm]	543 x 463 x 225		
	Firmware Version	V1.00		

Model list:				
Model		ASW30K-LT-G3	ASW27K-LT-G3	ASW25K-LT-G3
INPUT	V _{MAXPV} [Vdc]	1100		
	I _{SCPV} [A]	3 x 48		
	MPP Voltage Range [Vdc]	180 - 1000		
	Full power MPP Voltage Range [Vdc]	450 - 850		
	Max. Input Current [A]	3 x 32		
	Start PV Voltage [Vdc]	160		
	Back feed Current [A]	0		
	Overvoltage Category (OVC)	II		
OUTPUT	Rated Output Voltage [Vac]	3N~ 400		
	Rated Output Frequency [Hz]	50/60		
	Rated Output Power [kW]	30.0	27.0	25.0
	Max. Apparent Power [kVA]	33.0	29.7	27.5
	Rated Output Current [A]	43.5	39.1	36.2
	Max. Output Current [A]	47.8	43.0	39.9
	Power Factor (cosφ)	1.0 (default), 0.80 lead, 0.80 lag		
	Overvoltage Category (OVC)	III		
SYSTEM	Protective Class	I		
	Enclosure Protection (IP)	IP66		
	Operating Temperature Range [°C]	-25 to +60 (45°C derating)		
	Pollution Degree (PD)	PD 3		
	Altitude [m]	≤ 3000		
	Acoustic Noise [dB]	60		
	Weight [kg]	30		
	Size (W x H x D) [mm]	543 x 463 x 225		
	Firmware Version	V1.00		

Throughout the test report following abbreviations may be used:

- input	i/p	- Test repeated, similar result(3 times)	TRSR
- output	o/p	- No indication of dielectric breakdown	NB
- short-circuited	s-c	- Cheesecloth remained intact	NC
- overloaded	o-l	- Tissue paper remained intact	NT
- open-circuited	o-c	- No hazards	NH
- normal conditions	N.C.	- The PCE can recover to operate automatically after removing the abnormal condition	RO
- single fault conditions	SFC	- functional insulation	FI
- between parts of opposite polarity	BOP	- basic insulation	BI
- internal protection operated	IPO	- supplementary insulation	SI
- Component damage (list damaged component)	CD	- double insulation	DI
- No component damaged	NCD	- reinforced insulation	RI
Indicate used abbreviations (if any)			

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
4	GENERAL REQUIREMENTS		P
4.1	General General Testing is required by this standard to demonstrate that the EUT is fully in accordance with the applicable requirements of this standard.		P
4.2	General conditions for testing		P
4.2.1	Sequence of tests		P
4.2.2	Reference test conditions		P
4.2.2.1	Unless otherwise specified in this standard, for example with regard to environmental category as defined in 6.1, the following ambient environmental conditions shall exist in the test location: a) temperature of 15 °C to 40 °C; b) a relative humidity of not more than 75 % and not less than 5 %; c) an air pressure of 75 kPa to 106 kPa; d) no frost, dew, percolating water, rain, solar radiation, etc.	Ambient environmental condition compliance.	P
4.2.2.2	State of equipment	Test carried on a complete EUT.	P
4.2.2.3	Position of equipment	The equipment was installed in accordance with the manufacturer's instructions.	P
4.2.2.4	Accessories	Accessories and operator-interchangeable parts available from or recommended by the manufacturer according to the installation manual required.	P
4.2.2.5	Covers and removable parts	No covers or parts, which can be removed without using a TOOL.	N/A
4.2.2.6	Mains supply	See below.	P
	a) Voltage:	A wider range is given in the specification of the EUT. DC Input: V_{MAXPV} : 1000Vd.c. AC Output: Tolerance is considered.	P
	b) Frequency:	DC Input: N/A AC Output: 50/60Hz.	P
	c) Polarity:	Permanently connected equipment.	N/A

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
	d) Earthing:	Equipment was supplied from either an earthed supply system under tests.	P
	e) Over-current Protection:	Input over current protection that will be present in the installation was provided during testing.	P
4.2.2.7	Supply ports other than the mains	See below.	P
4.2.2.7.1	Photovoltaic supply sources	DC power supply source was used with sufficient capability.	P
4.2.2.7.2	Battery inputs	Not used.	N/A
4.2.2.8	Conditions of loading for output ports	The least favorable loading conditions were considered.	P
	- for continuous operation.	Until steady condition was established.	P
	- for intermittent operation.		N/A
	- for short-time operation.		N/A
4.2.2.9	Earthing terminals	Connection to the earth	P
4.2.2.10	Controls	Any position was set.	P
4.2.2.11	Available short circuit current	Considered.	P
4.3	Thermal Testing	See below.	P
4.3.1	General		P
4.3.2	Maximum temperatures Materials and components shall be selected so that under the most severe rated operating conditions, the temperatures do not exceed the temperature limits.	See appended table 4.3.	P
4.3.2.1	General		P
4.3.2.2	Touch temperatures		P
4.3.2.3	Temperature limits for mounting surfaces		P
4.4	Testing in single fault condition	See appended table 4.4.	P
4.4.1	General		P
4.4.2	Test conditions and duration for testing under fault conditions		P
4.4.2.1	General		P
4.4.2.2	Duration of tests		P
	- automatic reset devices or circuits		N/A
	- manual reset devices or circuits		N/A

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
	- non-resettable devices or circuits	One cycle and until temperatures stabilize.	P
4.4.3	Compliance after application of fault conditions		P
4.4.3.1	Protection against shock hazard		P
4.4.3.2	Protection against the spread of fire		P
4.4.3.3	Protection against other HAZARDS		P
4.4.3.4	Protection against parts expulsion hazards		P
4.4.4	SINGLE FAULT CONDITIONS	See below.	P
4.4.4.1	Component fault tests The following faults are simulated: Short circuit or open circuit of relevant components. Short circuit or open circuit of any components or insulation where failure could adversely affect supplementary insulation or reinforced insulation. In addition, where required by Method 2 of 9.1.1, components that could result in a fire hazard are to be overloaded unless they comply with the requirements of 9.1.3.	See appended table 4.4.	P
4.4.4.2	Equipment or parts for short-term or intermittent operation	Continuous operation equipment.	N/A
4.4.4.3	Motors	Not used.	N/A
4.4.4.4	Transformer short circuit tests	See appended table 4.4.	P
4.4.4.5	Output short circuit	See appended table 4.4.	P
4.4.4.6	Backfeed current test for equipment with more than one source of supply	DC mains supply source only.	N/A
4.4.4.7	Output overload	See appended table 4.4.	P
4.4.4.8	Cooling system failure	See appended table 4.4.	P
4.4.4.9	Heating devices	No heating devices used.	N/A
4.4.4.10	Safety interlock systems	No safety interlock device used.	N/A
4.4.4.11	Reverse d.c. connections	See appended table 4.4.	P
4.4.4.12	Voltage selector mismatch	No voltage selector used.	N/A
4.4.4.13	Mis-wiring with incorrect phase sequence or polarity	DC mains supply.	N/A
4.4.4.14	PWB short-circuit test	See appended table 4.4.	P
4.5	Humidity preconditioning	See below.	P
4.5.1	General		P

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
4.5.2	Conditions	Humidity: 93%RH Temperature: 40°C Duration: 48hrs	P
4.6	Voltage Back-feed Protection	Hazardous voltage and energy was not present on the terminals, with the DC mains supply source de-energized or disconnected. In addition the symbol 13 of Table C.1 was marked for servicing functions	P
4.6.1	Back-feed tests under normal conditions	Relay or Contactor is available at AC output side to prevent back-feed current from AC to DC side.	P
4.6.2	Back-feed tests under single-fault conditions	Relay is available at AC output side and with auto disconnected device at DC input side to prevent back-feed current from AC to DC side, even if under single-fault conditions.	P
4.6.3	Compliance with back-feed tests	See above.	N/A
	- 15 s for sources that are connected by fixed wiring		N/A
	- 1 s for sources that are cord-connected or use connectors that can be opened without the use of a tool		N/A
4.7	Electrical Ratings Tests	See appended table 4.7.	P
4.7.1	Input Ratings		P
4.7.2	Output Ratings		P

5	MARKING AND DOCUMENTATION		P
5.1	Marking		P
5.1.1	General		P
	Equipment shall bear markings as specified in 5.1 and 5.2	The marking label is on the outer surface of the enclosure.	P
	Graphic symbols may be used and shall be in accordance with Annex C or IEC 60417 as applicable.	All used graphic symbols are in accordance with Annex C.	P
	Graphic symbols shall be explained in the documentation provided with the PCE.	The explanations are provided in the user manual.	P
5.1.2	Durability of markings	The labels were subjected to the permanence of marking test. The labels were rubbed	P

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
		with the cloth soaked with petroleum spirit for 30 s.	
	Markings required by this clause to be located on the PCE shall remain clear and legible under conditions of NORMAL USE and resist the effects of cleaning agents specified by the manufacturer	After this test there was no damage to the labels. The marking on the labels did not fade. There was no curling or lifting of the label's edges.	P
5.1.3	Identification		P
	The equipment shall, as a minimum, be permanently marked with:	See below.	
	a) the name or trade mark of the manufacturer or supplier	See copy of marking plate.	P
	b) model number, name or other means to identify the equipment	See above.	P
	c) a serial number, code or other marking allowing identification of manufacturing location and the manufacturing batch or date within a three month time period.	See above.	P
5.1.4	Equipment ratings		P
	Unless otherwise specified in another part of IEC 62109, the following ratings, as applicable shall be marked on the equipment:	See below	P
	– input voltage, type of voltage (a.c. or d.c.), frequency, and max. continuous current for each input	See model list.	P
	– output voltage, type of voltage (a.c. or d.c.), frequency, max. continuous current, and for a.c. outputs, either the power or power factor for each output	See above.	P
	– the ingress protection (IP) rating as in 6.3 below	See clause 6.3	P
5.1.5	Fuse identification		P
	Marking shall be located adjacent to each fuse or fuse holder, or on the fuse holder, or in another location provided that it is obvious to which fuse the marking applies, giving the fuse current rating and where fuses of different voltage rating value could be fitted, the fuse voltage rating.	Marking on PCB near fuses.	P
	Where fuses with special fusing characteristics such as time delay or breaking capacity are necessary, the type shall also be indicated	See above.	P
	For fuses not located in operator access areas and for soldered-in fuses located in operator access areas, it is permitted to provide an unambiguous cross-reference (for example, F1, F2, etc.) to the	See above.	P

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Clause	Requirement – Test	Result – Remark	Verdict
	servicing instructions which shall contain the relevant information.		
5.1.6	Terminals, Connections, and Controls		P
	If necessary for safety, an indication shall be given of the purpose of Terminals, connectors, controls, and indicators, and their various positions, including any connections for coolant fluids such as water and drainage. The symbols in Annex C may be used, and where there is insufficient space, symbol 9 of Annex C may be used.	Relevant symbol, indicator or information are available.	P
	Push-buttons and actuators of emergency stop devices, and indicator lamps used only to indicate a warning of danger or the need for urgent action shall be colored red.	No such device.	N/A
	A multiple-voltage unit shall be marked to indicate the particular voltage for which it is set when shipped from the factory. The marking is allowed to be in the form of a paper tag or any other nonpermanent material.		N/A
	A unit with d.c. terminals shall be plainly marked indicating the polarity of the connections, with:		P
	– the sign “+” for positive and “-“ for negative; or	The “+” and “-“ marking provided adjacent to the PV input connectors.	P
	– a pictorial representation illustrating the proper polarity where the correct polarity can be unambiguously determined from the representation	No pictorial representation illustration used.	N/A
5.1.6.1	Protective Conductor Terminals		P
	The means of connection for the protective earthing conductor shall be marked with:		P
	– symbol 7 of Annex C; or	Symbol 7 of Table C.1 marked adjacent to the PE terminal.	P
	– the letters “PE“; or	See above.	N/A
	– the color coding green-yellow.		P
5.1.7	Switches and circuit-breakers		P
	The on and off-positions of switches and circuits breakers shall be clearly marked. If a push-button switch is used as the power switch, symbols 10 and 16 of Annex C may be used to indicate the on-position, or symbols 11 and 17 to indicate the off-position, with the pair of symbols (10 and 16, or 11 and 17) close together.	The letter “ON” and “OFF” is clearly marked.	P
5.1.8	Class II Equipment	Class I Equipment.	N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	Equipment using Class II protective means throughout shall be marked with symbol 12 of Annex C. Equipment which is only partially protected by DOUBLE INSULATION or REINFORCED INSULATION shall not bear symbol 12 of Table Annex C.	See above.	N/A
	Where such equipment has provision for the connection of an earthing conductor for functional reasons (see 7.3.6.4) it shall be marked with symbol 6 of Annex C	See above.	N/A
5.1.9	Terminal boxes for External Connections		N/A
	Where required by note 1 of Table 2 as a result of high temperatures of terminals or parts in the wiring compartment, there shall be a marking, visible beside the terminal before connection, of either:	Not used.	N/A
	a) the minimum temperature Rating and size of the cable to be connected to the TERMINALS; or		N/A
	b) a marking to warn the installer to consult the installation instruction. Symbol 9 of Table D-1 is an acceptable marking		N/A
5.2	Warning markings		P
5.2.1	Visibility and legibility requirements for warning markings		P
	Warning markings shall be legible, and shall have minimum dimensions as follows:		P
	– Printed symbols shall be at least 2,75 mm high		P
	– Printed text characters shall be at least 1.5 mm high and shall contrast in color with the background		P
	– Symbols or text that are moulded, stamped or engraved in a material shall have a character height of at least 2,0 mm, and if not contrasting in color from the background, shall have a depth or raised height of at least 0,5 mm.	No such symbols.	N/A
	If it is necessary to refer to the instruction manual to preserve the protection afforded by the equipment, the equipment shall be marked with symbol 9 of Annex C		P
	Symbol 9 of Annex C is not required to be used adjacent to symbols that are explained in the manual		P
5.2.2	Content for warning markings		P
5.2.2.1	Ungrounded heatsinks and similar parts		P

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	An ungrounded heat sink or other part that may be mistaken for a grounded part and involves a risk of electric shock in accordance with 7.3 shall be marked with symbol 13 of Annex C, or equivalent. The marking may be on or adjacent to the heatsink and shall be clearly visible when the PCE is disassembled to the extent that a risk of contact with the heatsink exists.	Marked with symbol 13 of Table C.1.	P
5.2.2.2	Hot Surfaces		P
	A part of the PCE that exceeds the temperature limits specified in 4.3.2 shall be marked with symbol 14 of Annex C or equivalent.	Marked with symbol 14 of Table C.1.	P
5.2.2.3	Coolant		N/A
	A unit containing coolant that exceeds 70 °C shall be legibly marked externally where readily visible after installation with symbol 15 of Annex C. The documentation shall provide a warning regarding the risk of burns from hot coolant, and either:	Not used.	N/A
	a) statement that coolant system servicing is to be done only by SERVICE PERSONNEL, or		N/A
	b) instructions for safe venting, draining, or otherwise working on the cooling system, if these operations can be performed without OPERATOR access to HAZARDS internal to the equipment		N/A
5.2.2.4	Stored energy		P
	Where required by 7.3.9.2 or 7.4.2 the PCE shall be marked with Symbol 21 of Annex C and the time to discharge capacitors to safe voltage and energy levels shall accompany the symbol.	Marked with Symbol 21 of Table C.1 and the time to discharge capacitors to safe voltage and energy levels accompany the symbol.	P
5.2.2.5	Motor guarding		N/A
	Where required by 8.2 a marking shall be provided where it is visible to service personnel before removal of a guard, warning of the hazard and giving instructions for safe servicing (for example disconnection of the source before removing the guard).		N/A
5.2.3	Sonic hazard markings and instructions	No such hazard.	N/A
	If required by 10.2.1 a PCE shall:		N/A
	a) be marked to warn the operator of the sonic pressure hazard; or		N/A
	b) be provided with installation instructions that specify how the installer can ensure that the sound pressure level from equipment at its point of use after installation, will not reach a		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	value, which could cause a hazard. These instructions shall include the measured sound pressure level, and shall identify readily available and practicable protective materials or measures which may be used.		
5.2.4	Equipment with multiple sources of supply		P
	A PCE with connections for multiple energy sources shall be marked with symbol 13 of Annex C and the manual shall contain the information required in 5.3.4.	Marked with symbol 13 of Annex C and explain in user manual.	P
	The symbol shall be located on the outside of the unit or shall be prominently visible behind any cover giving access to hazardous parts.	See above.	P
5.2.5	Excessive touch current		P
	Where required by 7.3.6.3.7 the PCE shall be marked with symbol 15 of Annex C. See also 5.3.2 for information to be provided in the installation manual.		P
5.3	Documentation		P
5.3.1	General		P
	The documentation provided with the PCE shall provide the information needed for the safe operation, installation, and (where applicable) maintenance of the equipment. The documentation shall include the items required in 5.3.2 through 5.3.4, and the following:	All related informations provided in the user's maunal.	P
	a) explanations of equipment makings, including symbols used		P
	b) location and function of terminals and controls		P
	c) all ratings or specifications that are necessary to safely install and operate the PCE, including the following environmental ratings along with an explanation of their meaning and any resulting installation requirements:		P
	– ENVIRONMENTAL CATEGORY as per 6.1		P
	– WET LOCATIONS classification fort he intended external environment as per 6.1		P
	– POLLUTION DEGREE classification for the intended external environment as per 6.2		P
	– INGRESS PROTECTION rating as per 6.3		P
	– Ambient temperature and relative humidity ratings		P
	– MAXIMUM altitude rating		P

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Clause	Requirement – Test	Result – Remark	Verdict
	– OVERVOLTAGE CATEGORY assigned to each input and output port as per 7.3.7.1.2, accompanied by guidance regarding how to ensure that the installation complies with the required overvoltage categories;		P
	d) a warning that when the photovoltaic array is exposed to light, it supplies a d.c. voltage to the PCE		P
5.3.1.1	Language		P
	Instructions related to safety shall be in a language that is acceptable in the country where the equipment is to be installed.	Instruction related to safety is in English.	P
5.3.1.2	Format		P
	In general, the documentation must be provided in printed form and is to be delivered with the equipment.	The printed form is available and is delivered with the PCE.	P
	For equipment which requires the use of a computer for both installation and operation, documentation may be provided in electronic format without accompanying printed format.	See above.	N/A
5.3.2	Information related to installation		P
	The documentation shall include installation and where applicable, specific commissioning instructions and, if necessary for safety, warnings against hazards which could arise during installation or commissioning of the equipment. The information provided shall include:	All below related informations provided in the user's maunal.	P
	a) assembly, location, and mounting requirements:		P
	b) ratings and means of connection to each source of supply and any requirements related to wiring and external controls, colour coding of leads, disconnection means, or overcurrent protection needed, including instructions that the installation position shall not prevent access to the disconnection means;		P
	c) ratings and means of connection of any outputs from the PCE, and any requirements related to wiring and externals controls, color coding of leads, or overcurrent protection needed;		P
	d) explanation of the pin-out of connectors for external connections, unless the connector is used for a standard purpose (e.g. RS 232)		P
	e) ventilation requirements;		P

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Clause	Requirement – Test	Result – Remark	Verdict
	f) requirements for special services, for example cooling liquid;		N/A
	g) instructions and information relating to sound pressure level if required by 10.2.1;	No hazardous sound level.	P
	h) where required by 14.8.1.3, instructions for the adequate ventilation of the room or location in which PCE containing vented or valve-regulated batteries is located, to prevent the accumulation of hazardous gases;	No battery used in the PCE.	P
	i) tightening torque to be applied to wiring terminals;		P
	j) values of back-feed short-circuit currents available from the PCE on input and output conductors under fault conditions, if those currents exceeds the max. rated current of the circuit, as per 4.4.4.6;	No backfeed current available.	P
	k) for each input to the PCE, the max value of short-circuit current available from the source, for which the PCE is designed; and		P
	l) compatibility with RCD and RCM;	RCMU built in PCE.	P
	m) instructions for protective earthing, including the information required by 7.3.6.3.7 if a second protective earthing conductor is to be installed:		P
	n) where required by 7.3.8, the installation instructions shall include the following or equivalent wording:		P
	“This product can cause a d.c. current in the external protective earthing conductor. Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in a case of direct or indirect contact, only an RCD or RCM of Type B is allowed on the supply side of this product.”		P
	o) for PCE intended to charge batteries, the battery nominal voltage rating, size, and type	The PCE is grid connected, no battery used.	P
	p) PV array configuration information, such as ratings, whether the array is to be grounded or floating, any external protection devices needed, etc.		P
5.3.3	Information related to operation		P
	Instructions for use shall include any operating instructions necessary to ensure safe operation, including the following, as applicable:	All related information provided in the user’s maunal.	P
	– Instructions for adjustment of controls including		P

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Clause	Requirement – Test	Result – Remark	Verdict
	the effects of adjustment;		
	– Instructions for interconnection to accessories and other equipment, including indication of suitable accessories, detachable parts and any special materials;		P
	– Warnings regarding the risk of burns from surfaces permitted to exceed the temperature limits of 4.3.2 and required operator actions to reduce the risk; and		P
	– Instructions, that if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.		P
5.3.4	Information related to maintenance		P
	Maintenance instructions shall include the following:	All related information provided in the service manual.	
	– Intervals and instructions for any preventive maintenance that is required to maintain safety (for example air filter replacement or periodic re-tightening of terminals);		P
	– Instructions for accessing operator access areas, if any are present, including a warning not to enter other areas of the equipment;		P
	– Part numbers and instructions for obtaining any required operator replaceable parts;		P
	– Instructions for safe cleaning (if recommended)		P
	– Where there is more than one source of supply energizing the PCE, information shall be provided in the manual to indicate which disconnect device or devices are required to be operated in order to completely isolate the equipment.		P
5.3.4.1	Battery maintenance		N/A
	Where required by 14.8.5, the documentation shall include the applicable items from the following list of instructions regarding maintenance of batteries:	The PCE is Grid Interactive inverter without battery energy storage function.	N/A
	– Servicing of batteries should be performed or supervised by personnel knowledgeable about batteries and the required precautions		N/A
	– When replacing batteries, replace with the same type and number of batteries or battery packs		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	– General instructions regarding removal and installation of batteries		N/A
	– CAUTION: Do not dispose of batteries in a fire. The batteries may explode.		N/A
	– CAUTION: Do not open or damage batteries. Released electrolyte is harmful to the skin and eyes. It may be toxic.		N/A
	– CAUTION: A battery can present a risk of electrical shock and high short-circuit current. The following precautions should be observed when working on batteries:		N/A
	a) Remove watches, rings, or other metal objects.		N/A
	b) Use tools with insulated handles.		N/A
	c) Wear rubber gloves and boots.		N/A
	d) Do not lay tools or metal parts on top of batteries		N/A
	e) Disconnect charging source prior to connecting or disconnecting battery terminals		N/A
	f) Determine if battery is inadvertently grounded. If inadvertently grounded, remove source from ground. Contact with any part of a grounded battery can result in electrical shock. The likelihood of such shock can be reduced if such grounds are removed during installation and maintenance (applicable to equipment and remote battery supplies not having a grounded supply circuit).		N/A

6	ENVIRONMENTAL REQUIREMENTS AND CONDITIONS		P
	The manufacturer shall rate the PCE for the following environmental conditions:		P
	– ENVIRONMENTAL CATEGORY, as in 6.1 below		P
	– Suitability for WET LOCATIONS or not		P
	– POLLUTION DEGREE rating in 6.2 below		P
	– INGRESS PROTECTION (IP) rating, as in 6.3 below		P
	– Ultraviolet (UV) exposure rating, as in 6.4 below		P
	– Ambient temperature and relative humidity ratings, as in 6.5 below		P
6.1	Environmental categories and minimum environmental conditions	See below.	P

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Clause	Requirement – Test	Result – Remark	Verdict
6.1.1	Outdoor	For outdoor use.	P
6.1.2	Indoor, unconditioned	See above.	N/A
6.1.3	Indoor, conditioned	See above.	N/A
6.2	Pollution degree	PD 2 (inside) PD 3 (outside)	P
6.3	Ingress Protection	IP66.	P
6.4	UV exposure	The shelter is considered necessary for outdoor use. Anti-UV approved AC and DC connectors provided.	P
6.5	Temperature and humidity	Specified by manufacturer.	P

7	PROTECTION AGAINST ELECTRIC SHOCK AND ENERGY HAZARDS		P
7.1	General	The proper construction of PCE is available for protection against shock and energy hazards during installation, operation and maintenance under normal and single fault conditions.	P
7.2	Fault conditions	See subclause 4.4.	P
7.3	Protection against electric shock		P
7.3.1	General	Each circuit under evaluation is compliance.	P
7.3.2	Decisive voltage classification		P
7.3.2.1	Use of decisive voltage class (DVC)	See below	P
7.3.2.2	Limits of DVC (according table 6)	See subclause 7.3.2.1.	P
7.3.2.3	Short-terms limits of accessible voltages under fault conditions		P
7.3.2.4	Requirements for protection (according table 7)	For circuits evaluation information of PCE, refer to brief description of general product information on previous pages.	P
7.3.2.5	Connection to PELV and SELV circuits	DVC-A is classified for display and communication circuits.	P
7.3.2.6	Working voltage and DVC	See subclause 7.3.2.4.	P
7.3.2.6.1	General	See above.	P
7.3.2.6.2	AC working voltage (see Figure 2)		P
7.3.2.6.3	DC working voltage (see Figure 3)		P

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Clause	Requirement – Test	Result – Remark	Verdict
7.3.2.6.4	Pulsating working voltage (see Figure 4)		P
7.3.3	Protective separation	For protective separation evaluation information of PCE, refer to brief description of general product information on previous pages.	P
	Protective separation shall be achieved by:		P
	<ul style="list-style-type: none"> ▪ double or reinforced insulation, or 		P
	<ul style="list-style-type: none"> ▪ protective screening, i.e. by a conductive screen connected to earth by protective bonding in the PCE, or connected to the protective earth conductor itself, whereby the screen is separated from live parts by at least basic insulation, or 		P
	<ul style="list-style-type: none"> ▪ protective impedance comprising limitation of current per 7.3.5.3 and of discharged energy per 7.3.5.4, or 		N/A
	<ul style="list-style-type: none"> ▪ limitation of voltage according to 7.3.5.4. 		N/A
	The protective separation shall be fully and effectively maintained under all conditions of intended use of the PCE		P
7.3.4	Protection against direct contact	Protection against electric shock by means of earthed metal enclosure. Any access to touch live parts is impossible.	P
7.3.4.1	General		P
	Protection against direct contact is employed to prevent persons from touching live parts that do not meet the requirements of 7.3.5 and shall be provided by one or more of the measure given in 7.3.4.2 (enclosures and barriers) and 7.3.4.3 (insulation).	See subclause 7.3.2.4.	P
	Open type sub-assemblies and devices do not require protective measures against direct contact but the instruction provided with the equipment must indicate that such measures must be provided in the end equipment or in the installation.		N/A
	Product intended for installation in CLOSED ELECTRICAL OPERATING AREAS, (see 3.9) need not have protective measures against direct contact, except as required by 7.3.4.2.4.		N/A
7.3.4.2	Protection by means of enclosures and barriers	Protection against electric shock by means of earthed metal enclosure.	P

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Clause	Requirement – Test	Result – Remark	Verdict
	The following requirements apply where protection against contact with live parts is provided by enclosures or barriers, not by insulation in accordance with 7.3.4.3.		P
7.3.4.2.1	General		P
	Parts of enclosures and barriers that provide protection in accordance with these requirements shall not be removable without the use of a tool (see 7.3.4.2.3).		P
	Polymeric materials used to meet these requirements shall also meet the requirements of 13.6		N/A
7.3.4.2.2	Access probe criteria	Considered.	P
	Protection is considered to be achieved when the separation between the test probes and live parts, when tested as described below, is as follows:		
	a) decisive voltage classification A, (DVC A) - the probe may touch the live parts	Considered.	P
	b) decisive voltage classification B, (DVC B) - the probe must not touch bare live parts	No DVC-B in the PCE	N/A
	c) decisive voltage classification C, (DVC C) – the probe must have adequate clearance to live parts, based on the clearance for Basic insulation using the recurring peak working voltage involved,	Considered.	P
7.3.4.2.3	Access probe tests		P
	Compliance with 7.3.4.2.1 is checked by all of the following:		P
	a) Inspection; and	Live parts are enclosed by the earthed metal enclosure and no openings.	P
	b) Tests with the test finger (Figure D.1) and test pin (Figure D.2) of 0E, the results of which shall comply with the requirements of 7.3.4.2.1 a), b), and c) as applicable. Probe tests are performed on openings in the enclosures after removal of parts that can be detached or opened by an operator without the use of a tool, including fuseholders, and with operator access doors and covers open. It is permitted to leave lamps in place for this test. Connectors that can be separated by an operator without use of a tool, shall also be tested during and after disconnection. Any movable parts are to be put in the most unfavorable position.	It is not possible to touch the hazardous live parts by the test finger and test pin.	P
	The test finger and the test pin are applied as		P

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Clause	Requirement – Test	Result – Remark	Verdict
	above, without appreciable force, in every possible position, except that floor-standing equipment having a mass exceeding 40 kg is not tilted.		
	Equipment intended for building-in or rack mounting, or for incorporation in larger equipment, is tested with access to the equipment limited according to the method of mounting detailed in the installation instructions.	Not intended for built-in or rack mounting.	N/A
	c) Openings preventing the entry of the jointed test finger (Figure E-1 of 0E) during test b) above, are further tested by means of straight unjointed test finger (Figure E-3 of 0E), applied with a force of 30 N. If the unjointed finger enters, the test with the jointed finger is repeated except that the finger is applied using any necessary force up to 30 N.	No openings.	N/A
	d) In addition to a) – c) above, top surfaces of enclosure shall be tested with the IP3X probe of IEC 60529. The test probe shall not penetrate the top surface of the enclosure when probed from the vertical direction $\pm 5^\circ$ only.	No openings.	N/A
7.3.4.2.4	Service access areas	It is not allowed to remove the cover during installation and maintenance when PCE is energized.	P
7.3.4.3	Protection by means of insulation of live parts	See subclause 7.3.2, 7.3.3 and 7.3.4.1.	P
	Where the requirements of 7.3.4.2 are not met, live parts shall be provided with insulation if:		
	– their working voltage is greater than the maximum limit of decisive voltage class A, or		
	– for a DVC A or B circuit, protective separation from adjacent circuit of DVC C is not provided (see note “†” under Table 7)		
7.3.5	Protection in case of direct contact		P
7.3.5.1	General	See below.	P
	Protection in case of direct contact is required to ensure that contact with live parts does not produce a shock hazard.		P
	The protection against direct contact according to 7.3.4 is not required if the circuit contacted is separated from other circuits according to 7.3.2.3, and:		P
	– is of decisive voltage class A and complies with 7.3.5.2, or	Only DCV-A classified circuit can be touched directly, see also 7.3.5.2.	P

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Clause	Requirement – Test	Result – Remark	Verdict
	– is provided with protective impedance according to 7.3.5.3, or		N/A
	– is limited in voltage according to 7.3.5.4		N/A
	In addition to the measures as given in 7.3.5.2 to 7.3.5.4, it shall be ensured that in the event of error or polarity reversal of connectors no voltages that exceed DVC A can be connected into a circuit with protective separation. This applies for example to plug-in-sub-assemblies or other plug-in devices which can be plugged-in without the use of a tool (key) or which are accessible without the use of a tool.		P
	Conformity is checked by visual inspection and trial insertion.		P
7.3.5.2	Protection using decisive voltage class A	Comm. port is considered as DVC-A which can be accessible and separated from DVC-C by double or reinforced insulation.	P
7.3.5.3	Protection by means of protective impedance	This method not considered.	N/A
	Circuits and conductive parts do not require protection against direct contact if any connection to circuits of DVC-B or DVC-C is through protective impedance, and the accessible circuit or part is otherwise provided with protective separation from circuits of DVC-B or DVC-C according 7.3.3.		N/A
7.3.5.3.1	Limitation of current through protective impedance		N/A
	The current available through protective impedance to earth and between simultaneously accessible parts, measured at the accessible live parts, shall not exceed a value of 3,5 mA a.c. or 10 mA d.c. under normal and single-fault conditions.		N/A
7.3.5.3.2	Limitation of discharging energy through protective impedance		N/A
	The discharging energy available between simultaneously accessible parts protected by protective impedance shall not exceed the charging voltage and capacitance limits given in Table 9, which applies to both wet and dry locations, under normal and single fault conditions. Refer to figure 8.		N/A
7.3.5.4	Protection by means of limited voltages	This method not considered.	N/A
	That portion of a circuit that has its voltage reduced to DVC-A by a voltage divider that complies with the following requirements, and that is otherwise provided with protective separation from circuits of		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	DVC-B or DVC-C according to 7.3.3, does not require protection against direct contact.		
	The voltage divider shall be designed so that under normal and single fault conditions, including faults in the voltage division circuit, the voltage across the output of the voltage divider does not exceed the limit for DVC-A.		N/A
	This type of protection shall not be used in case of protective class II or unearthed circuits, because it relies on protective earth being connected.		N/A
7.3.6	Protection against indirect contact		P
7.3.6.1	General		P
	Protection against indirect contact is required to prevent shock- hazardous current being accessible from conductive parts during an insulation failure. This protection shall comply with the requirements for protective class I (basic insulation plus protective earthing), class II (double or reinforced insulation) or class III (limitation of voltages)	The PCE is defined as protective class I.	P
	That part of a PCE meets the requirements of 7.3.6.2 and 7.3.6.3 is defined as protective class I	The earthing metal enclosure is complied with Protective class I.	P
	That part of a PCE meets the requirements of 7.3.6.4 is defined as protective class II.	The circuit of communication is complied with Protective class II for accessible communication ports.	P
	That part of PCE which meets the requirements of decisive voltage class A and in which no hazardous voltages are derived, is defined as protective class III. No shock hazard is present in such circuits.		N/A
	Where protection against indirect contact is dependent on means provided during installation, the installation instructions shall provide details of the required means and shall indicate the associated hazards.		P
7.3.6.2	Insulation between live parts and accessible conductive parts	See subclaus 7.3.2.3, 7.3.7.4 and 7.3.7.5.	P
	Accessible conductive parts of equipment shall be separated from live parts by insulation meeting the requirements of Table 7 or by clearances as specified in 7.3.7.4 and creepages as specified in 7.3.7.5	The clearances specified in 7.3.7.4 and creepage specified in 7.3.7.5 are complied.	P
7.3.6.3	Protective class I – Protective bonding and earthing		P
7.3.6.3.1	General		P
	Equipment of protective class I shall be provided with protective earthing, and with protective bonding to ensure electrical contact between accessible	Suitable protective bonding provided.	P

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Clause	Requirement – Test	Result – Remark	Verdict
	conductive parts and the means of connection for the external protective earthing conductor, except bonding is not required for:		
	a) accessible conductive parts that are protected by one of the measures in 7.3.5.2 to 7.3.5.4, or	DVC-A classified circuit is considered.	P
	b) accessible conductive parts are separated from live parts of DVC-B or -C using double or reinforced insulation.	Communication circuits are separated from live parts used double or reinforced insulation.	P
7.3.6.3.2	Requirements for protective bonding	The cross-section of the protective bonding conductor is the same as that for the external protective earthing conductor.	P
	Electrical contact with the means of connection of the external protective earthing conductor shall be achieved by one or more of the following means:		P
	a) through direct metallic contact;	The connection of external protective earthing conductor is direct metal contact via a terminal with screw.	P
	b) through other conductive parts which are not removed when the PCE or sub-units are used as intended ;		P
	c) through a dedicated protective bonding conductor;	Protective earthing terminal used.	P
	d) through other metallic components of the PCE		N/A
	Where direct metallic contact is used and one or both of the parts involved is painted or coated, the paint or coating shall be removed in the area of contact, or reliably penetrated, to ensure metal to metal contact.		P
	For moving or removable parts, hinges or sliding contacts designed and maintained to have a low resistance are examples of acceptable means if they comply with the requirements of 7.3.6.3.3.		N/A
	Metal ducts of flexible or rigid construction and metallic sheaths shall not be used as protective bonding conductors, unless the device or material has been investigated as suitable for protective bonding purposes.		P
7.3.6.3.3	Rating of protective bonding	See below.	P
	Protective bonding shall withstand the highest thermal and dynamic stresses that can occur to the PCE item(s) concerned when they are subjected to	Suitable protective bonding used.	P

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	a fault connecting live parts to accessible conductive parts. The protective bonding shall remain effective for as long as a fault to the accessible conductive parts persists or until an upstream protective device removes power from the part.		
	Protective bonding shall meet following requirements:	See below.	P
	a) For PCE with an overcurrent protective device rating of 16 A or less, the impedance of the protective bonding means shall not exceed 0,1 Ω during or at the end of the test below.		N/A
	b) For PCE with an overcurrent protective device rating of more than 16 A, the voltage drop in the protective bonding test shall not exceed 2,5 V during or at the end of the test below.	Sub clause 7.3.6.3.5 is considered.	N/A
	As alternative to a) and b) the protective bonding may designed according to the requirements for the external protective earthing conductor in 7.3.6.3.5, in which case no testing is required.	The cross-section of the protective bonding conductor is the same as that for the external protective earthing conductor.	P
	The impedance of protective bonding means shall be checked by passing a test current through the bond for a period of time as specified below. The test current is based on the rating of the overcurrent protection for the equipment or part of the equipment under consideration, as follows:		N/A
	a) For pluggable equipment type A, the overcurrent protective device is that provided external to the equipment (for example, in the building wiring, in the mains plug or in an equipment rack);		N/A
	b) For pluggable equipment type B and fixed equipment, the maximum rating of the overcurrent protective device specified in the equipment installation instructions to be provided external to the equipment;		N/A
	c) For a circuit or part of the equipment for which an overcurrent protective device is provided as part of the equipment, the rating of the provided overcurrent device.		N/A
	Voltages are measured from the protective earthing terminal to all parts whose protective bonding means are being considered. The impedance of the protective earthing conductor is not included in the measurement. However, if the protective earthing conductor is supplied with the equipment, it is permitted to include the conductor in the test circuit but		N/A

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	the measurement of the voltage drop is made only from the main protective earthing terminal to the accessible part required to be earthed.		
	On equipment where the protective earth connection to a subassembly or to a separate unit is part of a cable that also supplies power to that subassembly or unit, the resistance of the protective bonding conductor in that cable is not included in the protective bond impedance measurements for the subassembly or separate unit, as shown in Figure 11. However, this option is only permitted if the cable is protected by a suitably rated protective device that takes into account the size of the conductor. Otherwise the impedance of the protective bonding conductor between the separate units is to be included, by measuring to the protective earthing terminal where the power source enters the first unit in the system, as shown in Figure 12.		N/A
7.3.6.3.3.1	Test current, duration, and acceptance criteria	The alternative of sub clause 7.3.6.3.5 was considered.	N/A
	The test current, duration of the test and acceptance criteria are as follows:		N/A
	a) For PCE with an overcurrent protective device rating of 16 A or less, the test current is 200% of the overcurrent protective device rating, but not less than 32 A, applied for 120s. The impedance of the protective bonding means during and at the end of the test shall not exceed 0,1 Ω .		N/A
	b) For PCE with an overcurrent protective device rating of more than 16 A, the test current is 200% of the overcurrent protective device rating and the duration of the test is as shown in Table 10 below. The voltage drop in the protective bonding means, during and at the end of the test, shall not exceed 2,5 V.		N/A
	c) During and after the test, there shall be no melting, loosening, or other damage that would impair the effectiveness of the protective bonding means.		N/A
	The test current is derived from an a.c or d.c supply source, the output of which is not earthed.		N/A
	As an alternative to Table 10, where the time-current characteristic of the overcurrent protective device that limits the fault current in the protective bonding means is known because the device is either provided in the equipment or fully specified in the installation instructions, the test duration may be based on that specific device's time-current		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	characteristic,. The tests are conducted for a duration corresponding to the 200% current value on the time-current characteristic.		
7.3.6.3.4	Protective bonding impedance (routine test)		N/A
	If the continuity of the protective bonding is achieved at any point by a single means only (for example a single conductor or single fastener), or if the PCE is assembled at the installation location, then the impedance of the protective bonding shall also be tested as a routine test. The test shall be as in 7.3.6.3.3, except for the following:	The alternative of sub clause 7.3.6.3.5 was considered.	N/A
	<ul style="list-style-type: none"> ▪ the test current may be reduced to any convenient value greater than 10 A sufficient to allow measurement or calculation of the impedance of the protective bonding means: 		N/A
	<ul style="list-style-type: none"> ▪ the test duration may be reduced to no less than 2 s 		N/A
	For equipment subject to the type test in 7.3.6.3.3.1a), the impedance during the routine test shall not exceed 0,1Ω.		N/A
	For equipment subject to the type test in 7.3.6.3.3.1b) the impedance during the routine test shall not exceed 2,5 V divided by the test current required by 7.3.6.3.3.1b).		N/A
7.3.6.3.5	External protective earthing conductor		P
	A protective earthing conductor shall be connected at all times when power is supplied to PCE of protective class I. Unless local wiring regulations state otherwise, the protective earthing conductor cross-sectional area shall be determined from Table 11 or by calculation according to IEC 60364-5-54.	Grounding cable cross-section: 10 mm ² at least	P
	If the external protective earthing conductor is routed through a plug and socket or similar means of disconnection, it shall not be possible to disconnect it unless power is simultaneously removed from the part to be protected.		P
	The cross-sectional area of every external protective earthing conductor which does not form part of the supply cable or cable enclosure shall, in any case, be not less than:		P
	<ul style="list-style-type: none"> ▪ 2,5 mm² if mechanical protection is provided; 		N/A
	<ul style="list-style-type: none"> ▪ 4 mm² if mechanical protection is not provided. 		P
	For cord-connected equipment, provisions shall be made so that the external protective earthing conductor in the cord shall, in the case of failure of the		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	strain-relief mechanism, be the last conductor to be interrupted.		
7.3.6.3.6	Means of connection for the external protective earthing conductor		P
7.3.6.3.6.1	General		P
	<p>The means of connection for the external protective earthing conductor shall be located near the terminals for the respective live conductors. The means of connections shall be corrosion-resistant and shall be suitable for the connection of cables according to 7.3.6.3.5.</p> <p>The means of connection for the protective earthing conductor shall not be used as a part of the mechanical assembly of the equipment or for other connections.</p> <p>A separate means of connection shall be provided for each external protective earthing conductor.</p> <p>Connection and bonding points shall be so designed that their current-carrying capacity is not impaired by mechanical, chemical, or electrochemical influences. Where enclosures and/or conductors of aluminium or aluminium alloys are used, particular attention should be given to the problems of electrolytic corrosion.</p>	<p>The external protective earthing terminal block consist of other live conducts as AC connector for connecting PCE to the mains. Corrosion-resistant is considered for connection and bonding points.</p> <p>Separated earthing terminal be provided for protective earthing conductor was specified in user manual.</p>	P
	The means of connection for the protective earthing conductor shall be permanently marked with:		P
	<ul style="list-style-type: none"> • symbol 7 of Annex C; or 	With the symbol 7 of Table C.1.	P
	<ul style="list-style-type: none"> • the colour coding green-yellow 	The color coding of Green – yellow recommended.	P
	Marking shall not be done on easily changeable parts such as screws.		P
7.3.6.3.7	Touch current in case of failure of the protective earthing conductor		P
	The requirements of this sub-clause shall be satisfied to maintain safety in case of damage to or disconnection of the protective earthing conductor.		P
	For pluggable equipment type A, the touch current measured in accordance with 7.5.4 shall not exceed 3,5 mA a.c. or mA d.c.		N/A
	For all other PCE, one or more of the following measure shall be applied, unless the touch current measured in accordance with 7.5.4 using the test network of IEC 60990 test figure 4 shall not exceed 3,5 mA a.c. or 10 mA d.c.	In addition, the caution symbol 15 of Table C.1 provided on PCE and in manual.	P
	a) Permanently connected wiring, and:		P

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	<ul style="list-style-type: none"> a cross-section of the protective earthing conductor of at least 10 mm² Cu or 16 mm² Al; or 		P
	<ul style="list-style-type: none"> automatic disconnection of the supply in case of discontinuity of the protective earthing conductor; or 		N/A
	<ul style="list-style-type: none"> provision of an additional terminal for a second protective earthing conductor of the same cross-sectional area as the original protective earthing conductor and installation instruction requiring a second protective earthing conductor to be installed or 		P
	b) Connection with an industrial connector according to IEC 60309 and a minimum protective earthing conductor cross-section of 2,5 mm ² as part of a multi-conductor power cable. Adequate strain relief shall be provided.		N/A
	In addition, the caution symbol 15 of Annex C shall be fixed to the product and the installation manual shall provide details of the protective earthing measures required in the installation as required in 5.3.2.		N/A
	When it is intended and allowed to connect two or more PCEs in parallel using one common PE conductor, the above touch current requirements apply to the maximum number of the PCEs to be connected in parallel, unless one of the measures in a)		N/A
	or b) above is used. The maximum number of parallel PCEs is used in the testing and has to be stated in the installation manual.		N/A
7.3.6.4	Protective Class II – Double or Reinforced Insulation	PCE is designed for protective class I.	N/A
	Equipment or parts of equipment designed for protective class II shall have insulation between live parts and accessible surfaces in accordance with 7.3.4.3. The following requirements also apply:		N/A
	<ul style="list-style-type: none"> equipment designed to protective class II shall not have means of connection for the external protective earthing conductor. However this does not apply if the external protective earthing conductor is passed through the equipment to equipment series-connected beyond it. In the latter event, the external protective earthing conductor and its means for connection shall be insulated with basic insulation from the accessible surface of the equipment and from circuits that employ protective separation, extra-low 		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	voltage, protective impedance and limited discharging energy, according to 7.3.5. This basic insulation shall correspond to the rated voltage of the series-connected equipment;		
	<ul style="list-style-type: none"> metal-encased equipment of protective class II may have provision on its enclosure for the connection of an equipotential bonding conductor; 		N/A
	<ul style="list-style-type: none"> equipment of protective class II may have provision for the connection of an earthing conductor for functional reasons or for damping of over-voltages; it shall, however, be insulated as though it is a live part; 		N/A
	<ul style="list-style-type: none"> equipment employing protective class II shall be marked according to 5.1.8. 		N/A
7.3.7	Insulation Including Clearance and Creepage Distance	See below.	P
7.3.7.1	General		P
	This subclause gives minimum requirements for insulation, based on the principles of IEC 60664.		P
	Manufacturing tolerances shall be taken into account during measurement of creepage, clearance, and insulation distance in the PCE.		P
	Insulation shall be selected after consideration of the following influences:		P
	<ul style="list-style-type: none"> pollution degree 	See sub clause 7.3.7.1.1.	P
	<ul style="list-style-type: none"> overvoltage category 	See sub clause 7.3.7.1.2.	P
	<ul style="list-style-type: none"> supply earthing system 	See sub clause 7.3.7.1.3.	P
	<ul style="list-style-type: none"> insulation voltage 	See sub clause 7.3.7.1.4.	P
	<ul style="list-style-type: none"> location of insulation 		P
	<ul style="list-style-type: none"> type of insulation 		P
	Compliance of insulation, creepage distances, and clearance distances, shall be verified by measurement or visual inspection, and the tests of 7.5.		
7.3.7.1.1	Pollution degree	PD 2 (inside), PD 3 (outside)	P
7.3.7.1.2	Overvoltage category and Impulse withstand voltage rating		P
	- MAINS circuits	O.V.C III	P
	- PV circuits insulated	O.V.C II	P
	- PV circuits not insulated	No such circuits.	N/A
	- Other circuits	O.V.C II	P

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Clause	Requirement – Test	Result – Remark	Verdict
7.3.7.1.3	Supply earthing systems		P
	Three basic types of earthing system are described in IEC 60364-1. They are:		P
	<ul style="list-style-type: none"> TN system: has one point directly earthed, the accessible conductive parts of the installation being connected to that point by protective conductors. Three types of TN systems, TN-C, TN-S and TN-C-S, are defined according to the arrangement of the neutral and protective conductor. 		P
	<ul style="list-style-type: none"> TT system: has one point directly earthed, the accessible conductive parts of the installation being connected to earth electrodes electrically independent of the earth electrodes of the power system; 		N/A
	<ul style="list-style-type: none"> IT system: has all live parts isolated from earth or one point connected to earth through an impedance, the accessible conductive parts of the installation being earthed independently or collectively to the earthing system. 		N/A
7.3.7.1.4	Insulation voltages	PV supply circuits: 4772V ($V_{MAX PV}$: 1100Vd.c.) AC mains circuits: 4000V (Rated: 3N~ 400Va.c.)	P
	Table 12 makes use of the circuit system voltage and overvoltage category to define the impulse withstand voltage and the temporary overvoltage.		P
7.3.7.2	Insulation between a circuit and its surroundings		P
7.3.7.2.1	General	Considered.	P
7.3.7.2.2	Circuits connected directly to the MAINS	Clearances and solid insulation required according to the impulse voltage, temporary overvoltage, or working voltage, whichever gives the most severe requirement.	P
7.3.7.2.3	Circuits other than MAINS circuits	Clearances and solid insulation required according to the impulse voltage and recurring peak voltage.	P
7.3.7.2.4	Insulation between circuits	Clearances and solid insulation according to the higher impulse voltages. Creepage according to the higher r.m.s. working voltage.	P
7.3.7.3	Functional insulation		P
7.3.7.4	Clearance distances	See appended table 7.3.7.4.	P

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Clause	Requirement – Test	Result – Remark	Verdict
7.3.7.4.1	Determination	The max. insulation / impulse voltage: 4464V.	P
7.3.7.4.2	Electric field homogeneity	Not considered.	N/A
7.3.7.4.3	Clearance to conductive enclosures	Refer to subclause 7.3.7.4.1 and 13.7.	P
7.3.7.5	Creepage distances	See appended table 7.3.7.5.	P
7.3.7.5.1	General		P
7.3.7.5.2	Voltage	The max. voltage: 480Vrms / 1000Vd.c	P
7.3.7.5.3	Materials	Insulating material group IIIb 175 > CTI ≥ 100 assumed.	P
7.3.7.6	Coating	Not used.	N/A
7.3.7.7	PWB spacings for functional insulation	Comply with 7.3.7.4 and 7.3.7.5.	N/A
7.3.7.8	Solid insulation		P
7.3.7.8.1	General		P
7.3.7.8.2	Requirements for electrical withstand capability		P
7.3.7.8.2.1	Basic, supplemental, reinforced, and double insulation	Passed the impulse withstand voltage and a.c. or d.c. voltage tests. See appended table 7.5.1, 7.5.2 & 7.5.3. Note: No double or reinforced solid insulation used. No voltage stress on the insulation is greater than 1 kV/mm.	P
7.3.7.8.2.2	Functional insulation	Not used.	N/A
7.3.7.8.3	Thin sheet or tape material	See below.	P
7.3.7.8.3.1	General		P
7.3.7.8.3.2	Material thickness not less than 0.2 mm	Bobbin used in power transformer.	P
	Basic or supplementary insulation shall consist of at least one layer of material, and shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1 for basic or supplementary insulation.	See appended table 7.5.1, 7.5.2 & 7.5.3.	P
	Double insulation shall consist of at least two layers of material. Each layer shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1 for basic insulation, and the partial discharge requirements of 7.3.7.8.2.1. The two or more layers together shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1	Not used.	N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	for double insulation.		
	Reinforced insulation shall consist of a single layer of material, which will meet the impulse, a.c. or d.c. voltage, and partial discharge test requirements 7.3.7.8.2.1 for reinforced insulation.	Not used.	N/A
7.3.7.8.3.3	Material thickness less than 0.2 mm ² .	More than 3 layers mylar sheets provided between primary and secondary in main transformer.	P
	Basic or supplementary insulation shall consist of at least one layer of material, and shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1 for basic or supplementary insulation.	See appended table 7.5.1, 7.5.2 & 7.5.3.	P
	Double insulation shall consist of at least three layers of material. Each layer shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1 for basic insulation any two layers together shall meet the impulse, a.c. or d.c. voltage, and partial discharge test requirements of 7.3.7.8.2.1 for double insulation.	Not used.	N/A
	Reinforced insulation consisting of a single layer of material less than 0,2 mm thick is not permitted.	Not used.	N/A
7.3.7.8.3.4	Compliance	See subclause 7.3.7.8.3.2.	P
7.3.7.8.4	Printed wiring boards (PWBs)		P
7.3.7.8.4.1	General	Insulation between conductor layers in double-sided single-layer PWBs meet the requirements of 7.3.7.8.1. Basic, supplementary, double and reinforced insulation meet the appropriate requirements of 7.3.7.8.2.1 or 7.3.7.8.2.2. Functional insulation in PWBs meet the requirements of 7.3.7.8.2.3.	P
7.3.7.8.4.2	Use of coating materials	No coating material used.	P
	Type 1 protection		P
	Type 2 protection		N/A
	Cold test (-25°C) and rapid change of temperature test (-25°C to +125°C)		P
7.3.7.8.5	Wound components		P
7.3.7.8.6	Potting materials		P
7.3.7.9	Insulation requirements above 30 kHz	Considered.	P
7.3.8	Residual Current-operated protective (RCD) or monitoring (RCM) device compatibility	Built-in RCM unit within the PCE.	N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	RCD and RCM are used to provide protection against insulation faults in some domestic and industrial installations, additional to that provided by the installed equipment.	Under normal and single-fault conditions, the resulting d.c. component of the current in the protective earthing conductor does not exceed the d.c. current withstand requirements in IEC 60755 and IEC 62020 for RCD and RCM of type B.	N/A
7.3.9	Capacitor discharge	See appended table 7.3.9.	P
7.3.9.1	Operator access area		N/A
	Equipment shall be so designed that there is no risk of electric shock in operator access areas from charge stored on capacitors after disconnection of the PCE.	No such operator area to access without the use of a tool.	N/A
7.3.9.2	Service access areas		P
	Capacitors located behind panels that are removable for servicing, installation, or disconnection shall present no risk of electric shock or energy hazard from charge stored on capacitors after disconnection of the PCE.	The warning symbol 21 of Table C.1 and an indication of the discharge time is placed in a clearly visible position on the protective barrier to avoid unconsciousness contact.	P
7.4	Protection against energy hazards		P
7.4.1	Determination of hazardous energy level	There is no risk of energy hazard in operator access areas, protection of electrical shock by means of earthed metal enclosure.	P
	A hazardous energy level is considered to exist if		P
	a) The voltage is 2 V or more, and power available after 60 s exceeds 240 VA.		P
	b) The stored energy in a capacitor is at a voltage. U of 2 V or more, and the stored energy. E, calculated from the following equation, exceeds 20J: $E = 0,5 CU^2$		P
7.4.2	Operator Access Areas		P
	Equipment shall be so designed that there is no risk of energy hazard in operator access areas from accessible circuits.	All hazardous energy parts were enclosed within the earthed metal enclosure.	P
7.4.3	Services Access Areas		P
	Energy storage devices located behind panels that		P

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Clause	Requirement – Test	Result – Remark	Verdict
	are removable for servicing, installation or disconnection shall present no risk of electric energy hazard from charge stored after disconnection of the PCE.		
	Energy storage devices within a PCE shall be discharged to an energy level less than 20 J, as in 7.4.1, within 10 s after the removal	The warning symbol 21 of Table C.1 and an indication of the discharge time is placed in a clearly visible position on the protective barrier to avoid unconsciousness contact.	P
7.5	Electrical tests related to shock hazard		P
7.5.1	Impulse voltage test (<i>type test</i>) The impulse voltage test is performed with a voltage having a 1,2/50 μ s waveform (see Figure 6 of IEC 60060-1) and is intended to simulate overvoltages induced by lightning or due to switching of equipment. See Table 15 for conditions of the impulse voltage test.	See appended table 7.5.1. During the test no puncture, flashover, or sparkover occurs.	P
7.5.2	Voltage Test (dielectric strength test) (type test and routine test)	See below.	P
7.5.2.1	Purpose of test		P
7.5.2.2	Value and type of test voltage The values of the test voltage are determined from column 2 or 3 of Table 17 or Table 18 depending upon whether the circuit under test is mains connected or not mains connected.	See appended table 7.5.2.	P
7.5.2.3	Humidity pre-conditioning	PCE is intended for WET LOCATIONS use.	P
7.5.2.4	Performing the voltage test The test shall be applied as follows, according to Figure 13	Refer to appended table 7.5.2.	P
7.5.2.5	Duration of the a.c. or d.c. voltage test The duration of the test shall be at least 60 s for the type test and 1 s for the routine test. The test voltage may be applied with increasing and/or decreasing ramp voltage, and the ramp times are not specified, but regardless of the ramp time, the dwell time at full voltage shall be 60 s and 1 s respectively for type and routine tests.	The full voltage is maintained for 60s.	P
7.5.2.6	Verification of the a .c. or d.c. voltage test	No electrical breakdown occurs during the test.	P
7.5.3	Partial discharge test (type test or sample test)	No voltage stress on the insulation is greater than 1 kV/mm.	N/A
7.5.4	Touch current measurement (type test)		P

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Clause	Requirement – Test	Result – Remark	Verdict
	The touch current shall be measured if required by 7.3.6.3.7 and shall not be greater than 3.5 mA a.c. or 10 mA d.c. or special measures of protection as given in 7.3.6.3.7 are required.		P
	For type tests on PCE for which wet locations requirements apply according to 6.1, the humidity pre-conditioning of 4.5 shall be performed immediately prior to the touch current test.		P
7.5.5	Equipment with multiple sources of supply		N/A

8	PROTECTION AGAINST MECHANICAL HAZARDS		P
8.1	General		P
	Operation shall not lead to a mechanical HAZARD in NORMAL CONDITION or SINGLE FAULT CONDITION. Edges, projections, corners, openings, guards, handles and the like, that are accessible to the operator shall be smooth and rounded so as not to cause injury during normal use of the equipment.	Edges, projections, corners, openings, guards, handles and the like, that are accessible to the OPERATOR are smooth and rounded.	P
	Conformity is checked as specified in 8.2 to 8.6.		P
8.2	Moving parts		N/A
	Moving parts shall not be able to crush, cut or pierce parts of the body of an OPERATOR likely to contact them, nor severely pinch the OPERATOR's skin. Hazardous moving parts of equipment, that is moving parts which have the potential to cause injury, shall be so arranged, enclosed or guarded as to provide adequate protection against the risk of personal injury.		N/A
8.2.1	Protection of service persons		P
	Protection shall be provided such that unintentional contact with hazardous moving parts is unlikely during servicing operations. If a guard over a hazardous moving part may need to be removed for servicing, the marking of symbol 15 of Table C.1 shall be applied on or near the guard.	Barrier and the marking of symbol 15 of Table C.1 is provided for service persons.	P
8.3	Stability		N/A
	Equipment and assemblies of equipment not secured to the building structure before operation shall be physically stable in NORMAL USE.	The PCE is wall mounted equipment.	N/A
8.4	Provisions for lifting and carrying		P
	If carrying handles or grips are fitted to, or supplied with, the equipment, they shall be capable of withstanding a force of four times the weight of the		P

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Clause	Requirement – Test	Result – Remark	Verdict
	equipment.		
	Equipment or parts having a mass of 18 kg or more shall be provided with a means for lifting and carrying or directions shall be given in the manufacturer's documentation.		P
8.5	Wall mounting		P
	Mounting brackets on equipment intended to be mounted on a wall or ceiling shall withstand a force of four times the weight of the equipment.	Mounting brackets and wall construction for installation condition are specified in installation manual. Mounting brackets withstand a force of four times the weight of the equipment.	P
8.6	Expelled parts		N/A
	Equipment shall contain or limit the energy of parts that could cause a HAZARD if expelled in the event of a fault.	No such parts.	N/A

9	PROTECTION AGAINST FIRE HAZARDS		P
9.1	Resistance to fire		P
	This subclause specifies requirements intended to reduce the risk of ignition and the spread of flame, both within the equipment and to the outside, by the appropriate use of materials and components and by suitable construction.	Suitable and appropriate materials, components and construction are used to reduce the risk of ignition and the spread of flame.	P
9.1.1	Reducing the risk of ignition and spread of flame		P
	For equipment or a portion of equipment, there are two alternative methods of providing protection against ignition and spread of flame that could affect materials, wiring, wound components and electronic components such as integrated circuits, transistors, thyristors, diodes, resistors and capacitors.		P
9.1.2	Conditions for a fire enclosure		P
	A FIRE ENCLOSURE is required for equipment or parts of equipment for which Method 2 is not fully applied and complied with.	A FIRE ENCLOSURE is required for equipment or parts of equipment.	P
9.1.2.1	Parts requiring a fire enclosure		P
	Except where Method 2 is used, or as permitted in 9.1.2.2, the following are considered to have a risk of ignition and, therefore, require a FIRE ENCLOSURE:		P
	– components in PRIMARY CIRCUITS		P
	– components in SECONDARY CIRCUITS supplied by power sources which exceed the limits		P

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Clause	Requirement – Test	Result – Remark	Verdict
	for a LIMITED POWER SOURCE as specified in 9.2;		
	– components in SECONDARY CIRCUITS supplied by a LIMITED POWER SOURCE as specified in 9.2, but not mounted on a material of FLAMMABILITY CLASS V-1;		P
	– components within a power supply unit or assembly having a limited power output complying with the criteria for a LIMITED POWER SOURCE as specified in 9.2, including overcurrent protective devices, limiting impedances, regulating networks and wiring, up to the point where the LIMITED POWER SOURCE output criteria are met;		P
	– components having unenclosed arcing parts, such as open switch and relay contacts and commutators, in a circuit at HAZARDOUS VOLTAGE or at a HAZARDOUS ENERGY LEVEL; and		P
	– insulated wiring, except as permitted in 9.1.2.2.		P
9.1.2.2	Parts not requiring a fire enclosure	See above.	N/A
9.1.3	Materials requirements for protection against fire hazard		P
9.1.3.1	General		P
	ENCLOSURES, components and other parts shall be so constructed, or shall make use of such materials, that the propagation of fire is limited.	Metal enclosure provided.	P
9.1.3.2	Materials for fire enclosures		P
	If an enclosure material is not classified as specified below, a test may be performed on the final enclosure or part of the enclosure, in which case the material shall additionally be subjected to periodic SAMPLE testing.	Metal enclosure provided.	P
9.1.3.3	Materials for components and other parts outside fire enclosures		P
	Except as otherwise noted below, materials for components and other parts (including MECHANICAL ENCLOSURES, ELECTRICAL ENCLOSURES and DECORATIVE PARTS); located outside FIRE ENCLOSURES, shall be of FLAMMABILITY CLASS HB.	FLAMMABILITY CLASS HB or better used.	P
9.1.3.4	Materials for components and other parts inside fire enclosures	FLAMMABILITY CLASS V- 2 or better used.	P
9.1.3.5	Materials for air filter assemblies	No such materials.	N/A
9.1.4	Openings in fire enclosures		P

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Clause	Requirement – Test	Result – Remark	Verdict
9.1.4.1	General	No openings in fire enclosures.	P
	For equipment that is intended to be used or installed in more than one orientation as specified in the product documentation, the following requirements apply in each orientation.		P
	These requirements are in addition to those in the following sections:		P
	– 7.3.4, Protection against direct contact;		P
	– 7.4, Protection against energy hazards;		P
	– 13.5, Openings in enclosures		P
9.1.4.2	Side openings treated as bottom openings	See above.	N/A
9.1.4.3	Openings in the bottom of a fire enclosure	See above.	N/A
	The bottom of a FIRE ENCLOSURE or individual barriers, shall provide protection against emission of flaming or molten material under all internal parts, including partially enclosed components or assemblies, for which Method 2 of 9.1.1 has not been fully applied and complied with.		N/A
9.1.4.4	Equipment for use in a CLOSED ELECTRICAL OPERATING AREA		N/A
	The requirements of 9.1.4.3 do not apply to FIXED EQUIPMENT intended only for use in a CLOSED ELECTRICAL OPERATING AREA and to be mounted on a concrete floor or other non-combustible surface. Such equipment shall be marked as follows:		N/A
	WARNING: FIRE HAZARD SUITABLE FOR MOUNTING ON CONCRETE OR OTHER NON-COMBUSTIBLE SURFACE ONLY		N/A
9.1.4.5	Doors or covers in fire enclosures		P
9.1.4.6	Additional requirements for openings in transportable equipment	PCE not for transportable equipment.	N/A
9.2	LIMITED POWER SOURCES	Not applied.	N/A
9.2.1	General		N/A
9.2.2	Limited power source tests		N/A
9.3	Short-circuit and overcurrent protection		P
9.3.1	General		P
	The PCE shall not present a hazard, under short-circuit or overcurrent conditions at any port, including phase-to-phase, phase-to-earth and phase-to-neutral, and adequate information shall be provided	No overcurrent hazards was presented by short circuits and overloads tests. Refer to sub-clause 4.4.4.	P

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Clause	Requirement – Test	Result – Remark	Verdict
	to allow proper selection of external wiring and external protective devices.		
9.3.2	Number and location of overcurrent protective devices		P
	Protection against short-circuits and overcurrents shall be provided for all input circuits, and for output circuits that do not comply with the requirements for limited power sources in 9.2, except for circuits in which no overcurrent hazard is presented by short-circuits and overloads.		P
9.3.3	Short-circuit co-ordination (backup protection)		P
	Protective devices provided or specified shall have adequate breaking capacity to interrupt the maximum short circuit current specified for the port to which they are connected. If protection that is provided integral to the PCE for an input port is not rated for the short-circuit current of the circuit in which it is used, the installation instructions shall specify that an upstream protective device, rated for the prospective short-circuit current of that port, shall be used to provide backup protection.	Upstream protective device for backup protection is specified in the installation manual.	P

10	PROTECTION AGAINST SONIC PRESSURE HAZARDS		P
10.1	General		P
	The equipment shall provide protection against the effect of sonic pressure. Conformity tests are carried out if the equipment is likely to cause such HAZARDS.		P
10.2	Sonic pressure and Sound level		P
10.2.1	Hazardous Noise Levels	Sound pressure level is lower than 80dB.	P

11	PROTECTION AGAINST LIQUID HAZARDS		N/A
11.1	Liquid Containment, Pressure and Leakage	No liquid contained in this system, and energy storage battery used.	N/A
	The liquid containment system components shall be compatible with the liquid to be used.		N/A
	There shall be no leakage of liquid onto live parts as a result of:		N/A
	a) Normal operation, including condensation;		N/A
	b) Servicing of the equipment; or		N/A
	c) Inadvertent loosening or detachment of hoses		N/A

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Clause	Requirement – Test	Result – Remark	Verdict

	or other cooling system parts over time.		
11.2	Fluid pressure and leakage		N/A
11.2.1	Maximum pressure		N/A
11.2.2	Leakage from parts		N/A
11.2.3	Overpressure safety device		N/A
11.3	Oil and grease		N/A

12	CHEMICAL HAZARDS		N/A
12.1	General	No chemical Hazards.	N/A

13	PHYSICAL REQUIREMENTS		P
13.1	Handles and manual controls	It shall not be possible to fix them in wrong position if this might result in a hazard.	P
	Handles, knobs, grips, levers and the like shall be reliably fixed so that they will not work loose in normal use, if this might result in a hazard. Sealing compounds and the like, other than selfhardening resins, shall not be used to prevent loosening. If handles, knobs and the like are used to indicate the position of switches or similar components, it shall not be possible to fix them in a wrong position if this might result in hazard.		P
13.1.1	Adjustable controls	No such controls.	N/A
13.2	Securing of parts	Screws, nuts, washers, springs or similar parts are secured so as to withstand mechanical stresses occurring	P
13.3	Provisions for external connections		P
13.3.1	General	Appropriate provisions for external connections applied.	P
13.3.2	Connection to an a.c. Mains supply		P
13.3.2.1	General	Terminals provided for permanent connection to the PV supply.	P
	For safe and reliable connection to a MAINS supply, equipment shall be provided with one of the following:		P
	– terminals or leads or a non-detachable power supply cord for permanent connection to the supply; or		P

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Clause	Requirement – Test	Result – Remark	Verdict
	– a non-detachable power supply cord for connection to the supply by means of a plug		N/A
	– an appliance inlet for connection of a detachable power supply cord; or		N/A
	– a mains plug that is part of direct plug-in equipment as in 13.3.8		N/A
13.3.2.2	Permanently connected equipment	A set of terminals as specified in 13.3.3 for external connection of supply cords.	P
13.3.2.3	Appliance inlets		N/A
13.3.2.4	Power supply cord	Not provided, but technical requirements provided in user manual.	N/A
13.3.2.5	Cord anchorages and strain relief	No power supply cords provided.	N/A
	For equipment with a non-detachable power supply cord, a cord anchorage shall be supplied such that:		N/A
	– the connecting points of the cord conductors are relieved from strain; and		N/A
	– the outer covering of the cord is protected from abrasion.		N/A
13.3.2.6	Protection against mechanical damage	No power supply cords provided, however plastic inlet bushings provided ready for use.	N/A
13.3.3	Wiring terminals for connection of external conductors		P
13.3.3.1	Wiring terminals	Terminals for power supply cords connection by means of screws.	P
13.3.3.2	Screw terminals	Screws and nuts which clamp external supply conductors have a thread conforming to ISO 261 or ISO 262.	P
13.3.3.3	Wiring terminal sizes	The terminals meet the temperature rise test of 4.3 when connected using wire sizes as specified in the documentation or in Table 24.	P
13.3.3.4	Wiring terminal design	Lug terminals applied, and the cable lug clamped by nut.	P
13.3.3.5	Grouping of wiring terminals	Terminals located in proximity to each other.	P
13.3.3.6	Stranded wire	Lug terminals applied.	P

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Clause	Requirement – Test	Result – Remark	Verdict
13.3.4	Supply wiring space	Lug terminals applied, and the cable lug is clamped by nut without the risk of damage to the conductors or their insulation.	P
13.3.5	Wire bending space for wires 10 mm ² and greater	Considered.	P
13.3.6	Disconnection from supply sources	Disconnect devices provided.	P
13.3.7	Connectors, plugs and sockets	The misconnection is unlikely for PV or DC connectors.	P
13.3.8	Direct plug-in equipment	Not direct plug-in use.	N/A
13.4	Internal wiring and connections		P
13.4.1	General	The insulation, conductors and routing of all wires of the equipment is suitable for the electrical, mechanical, thermal and environmental conditions of use.	P
13.4.2	Routing	Wires are routed away from sharp edges, screw threads, burrs, fins, moving parts, drawers, and similar parts, which could abrade the wire insulation.	P
13.4.3	Colour coding	The green/yellow color coding wire only used for protective earthing conductor.	P
13.4.4	Splices and connections	All splices and connections are mechanically adequate secure and provided electrical continuity. The likelihood of loose is impossible.	P
13.4.5	Interconnections between parts of the PCE	The communication cable only used for servicing, no any physical damage or mechanical damage likely.	P
13.5	Openings in enclosures	Not opening in metal enclosure.	N/A
13.5.1	Top and side openings		N/A
	Openings in the top and sides of ENCLOSURES shall be so located or constructed that it is unlikely that objects will enter the openings and create hazards by contacting bare conductive parts.		N/A
13.6	Polymeric Materials		P
13.6.1	General	See below.	P
13.6.1.1	Thermal index or capability	Appropriate electrical,	P

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Clause	Requirement – Test	Result – Remark	Verdict
		mechanical, thermal and flammability degree polymeric materials provided.	
13.6.2	Polymers serving as enclosures or barriers preventing access to hazards	Metal enclosure used.	N/A
13.6.2.1	Stress relief test	See above.	N/A
13.6.3	Polymers serving as solid insulation	See below.	P
13.6.3.1	Resistance to arcing		P
13.6.4	UV resistance	Metal enclosure provided.	N/A
	Polymeric parts of an OUTDOOR ENCLOSURE required for compliance with this standard shall be sufficiently resistance to degradation by ultra-violet (UV) radiation		N/A
13.7	Mechanical resistance to deflection, impact, or drop		P
13.7.1	General	See below.	P
13.7.2	250-N deflection test for metal enclosures	A steady force of 250 N applied for 5 s, after test no hazards occurred.	P
13.7.3	7-J impact test for polymeric enclosures	Impact test applied on the display screen cover.	P
13.7.4	Drop test	Not for hand - held, direct plug - in, or transportable equipment.	N/A
13.8	Thickness requirements for metal enclosures		P
13.8.1	General		P
13.8.2	Cast metal		N/A
13.8.3	Sheet metal		N/A

14	COMPONENTS		P
14.1	General	Components that are certified to IEC and /or national standards are used correctly within their ratings. Components not covered by IEC standards are tested under the conditions present in the equipment. See appended table 14.1.	P
	Where safety is involved, components shall be used in accordance with their specified RATINGS unless a specific exception is made. They shall conform to one of the following:		P
	a) applicable safety requirements of a relevant		P

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Clause	Requirement – Test	Result – Remark	Verdict
	IEC standard. Conformity with other requirements of the component standard is not required. If necessary for the application, components shall be subjected to the test of this standard, except that it is not necessary to carry out identical or equivalent tests already performed to check conformity with the component standard;		
	b) the requirements of this standard and, where necessary for the application, any additional applicable safety requirements of the relevant IEC component standard;		P
	c) if there is no relevant IEC standard, the requirements of this standard;		P
	d) applicable safety requirements of a non-IEC standard which are at least as high as those of the applicable IEC standard, provided that the component has been approved to the non-IEC standard by a recognized testing authority.		P
	Components such as optocouplers, capacitors, transformers, and relays connected across basic, supplemental, reinforced, or double insulation shall comply with the requirements applicable for the grade of insulation being bridged, and if not previously certified to the applicable component safety standard shall be subjected to the voltage test of 7.5.2 as routine test.		P
14.2	Motor Overtemperature Protection		N/A
	Motors which, when stopped or prevented from starting (see 4.4.4.3), would present an electric shock HAZARD, a temperatur HAZARD, or a fire HAZARD, shall be protected by an overtemperature or thermal protection device meeting the requirements of 14.3.		N/A
14.3	Overtemperature protection devices	Approved overtemperature protective devices used and for which appropriate rating was selected for use and do not operate in normal use. For overtemperature protection test or evaluation see appended table 4.4.4.	P
14.4	Fuse holders	Fuse holders with fuses are not intended to be replaceable by an OPERATOR.	N/A
14.5	MAINS voltage selecting devices	No such devices.	N/A
14.6	Printed circuit boards		P

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Clause	Requirement – Test	Result – Remark	Verdict
	Printed circuit boards shall be made of material with a flammability classification of V-1 of IEC 60707 or better.	PCB materials with a flammability classification of V-1 or better used.	P
	This requirements does not apply to thin-film flexible printed circuit boards that contain only circuits powered from limited power sources meeting the requirements of 9.2.		P
	Conformity of the flammability RATING is checked by inspection of data on the materials. Alternatively, conformity is checked by performing the V-1 tests specified in IEC 60707 on three samples of the relevant parts.		P
14.7	Circuits or components used as transient overvoltage limiting devices		N/A
	If control of transient overvoltage is employed in the equipment, any overvoltage limiting component or circuit shall be tested with the applicable impulse withstand voltage of Table 7-10 using the test method from 7.5.1 except 10 positive and 10 negative impulses are to be applied and may be spaced up to 1 min apart.	No such components.	N/A
14.8	Batteries		N/A
	Equipment containing batteries shall be designed to reduce the risk of fire, explosion and chemical leaks under normal conditions and after a single fault in the equipment including a fault in circuitry within the equipment battery pack.	Not batteries used.	N/A
14.8.1	Battery Enclosure Ventilation		N/A
14.8.1.1	Ventilation requirements		N/A
14.8.1.2	Ventilation testing		N/A
14.8.1.3	Ventilation instructions		N/A
14.8.2	Battery Mounting		N/A
	Compliance is verified by the application of the force to the battery's mounting surface. The test force is to be increased gradually so as to reach the required value in 5 to 10 s, and is to be maintained at that value for 1 min. A nonmetallic rack or tray shall be tested at the highest normal condition operating temperature.		N/A
14.8.3	Electrolyte spillage		N/A
	Battery trays and cabinets shall have an electrolyte-resistant coating.		N/A
	The ENCLOSURE or compartment housing a VENTED BATTERY shall be constructed so that		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	spillage or leakage of the electrolyte from one battery will be contained within the ENCLOSURE and be prevented from:		
	a) reaching the PCE outer surfaces that can be contacted by the USER		N/A
	b) contaminating adjacent electrical components or materials; and		N/A
	c) bridging required electrical distances		N/A
14.8.4	Battery Connections		N/A
	Reverse battery connection of the terminals shall be prevented if reverse connection could result in a hazard within the meaning of this Standard		N/A
14.8.5	Battery maintenance instructions		N/A
	The information and instructions listed in 5.3.4.1 shall be included in the operator manual for equipment in which battery maintenance is performed by the operator, or in the service manual if battery maintenance is to be performed by service personnel only.		N/A
14.8.6	Battery accessibility and maintainability		N/A
	Battery terminals and connectors shall be accessible for maintenance with the correct TOOLS. Batteries with liquid electrolyte, requiring maintained shall be so located that the battery cell caps are accessible for electrolyte tests and readjusting of electrolyte levels.		N/A

15	SOFTWARE AND FIRMWARE PERFORMING SAFETY FUNCTIONS		P
	Firmware or software used in or with PCE, that performs one or more safety functions the failure of which could result in a risk of fire, electric shock or other hazard as specified by this standard, shall be evaluated in accordance with Annex B.	Single fault safe compliance. Failures evaluation and risk analysis were performed by means of fault simulation or single fault conditions. (refer to subclause of 4.4.4).	P

A	Annex A, Measurement of clearance and creepage distances (normative)	P
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B	Annex B, Programmable Equipment (normative)		N/A
B.1	Software or Firmware That Perform Safety Critical Functions	Refer to subclause 15.	N/A
B.1.1	All software or firmware that performs a critical safety function/s, such as protection from excessive		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	<p>temperature, over current or improper synchronization of AC source, where failure of which can result in a risk of fire, electric shock or other hazard as specified by this document, shall be evaluated by one of the following means.</p> <p>a) All software or firmware limit or control shall be disabled before the test to evaluate the hardware circuitry during the abnormal test condition of the safety function, and the hardware sensor component that is monitored by the firmware or software is modified or disabled to prevent the software or firmware from reading or responding to the abnormal condition.</p> <p>b) Protection Controls employing software or firmware to perform their function(s), shall be so constructed that they comply with IEC 60730-1 Annex H to address the risks identified in B2.1. Each combination of microprocessor model, manufacturer and firmware/software version used in the production of a PCE shall be evaluated as specified in the remainder of Annex B.</p> <p>Exception: For units with firmware/software that has been found to be compliant with the remainder of Annex B, subsequent firmware/software revisions may be entitled to a limited reevaluation for the revised firmware or software. The scope of the reevaluation shall be defined by the potential impact of the firmware or software revisions and the applicable portions of IEC 60730-1 Annex H shall be re-applied.</p>		
B.2	Evaluation of Controls Employing Software	Refer to subclause 15.	N/A
B.2.1	Risk Analysis		N/A
B.2.1.1	A risk analysis shall be conducted to determine a set of risks and that the software addresses the identified risks. The risk analysis shall be conducted based on the safety requirements for the programmable component.		N/A
B.2.1.3	An analysis shall be conducted to identify the critical, non-critical, and supervisory parts of the software.		N/A
B.2.1.4	An analysis shall be conducted to identify transitions or states that can result in a risk.		N/A
B.2.1.5	<p>Risks to be considered include, but are not limited to function associated with the following:</p> <p>a) Temperature control, monitoring and response (ie. Coolant, internal ambient, device)</p> <p>b) Safety interlocks</p> <p>c) Synchronization between multiple AC sources</p> <p>e) Emergency stop of operation (including staged shutdown/sequencing)</p>		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	f) Connection/Disconnection – from an input source and output source g) RCD functions h) Over current protection or control i) The software must detect a hardware or software malfunction and place the device in a safe state as indicated per the “Risks Addressed State” definition.		
C.	Annex C, Symbols to be used in Equipment Marking (normative)		P
D.	Annex D, Test Probes for Determining Access (informative)		P
E.	Annex E, RCDs (informative)		N/A
E.1	Selection of RCD type in AC circuits		N/A
F.	Annex F, Altitude correction for clearances (informative)		P
G.	Annex G, Clearance and creepage distance determination for frequencies greater than 30kHz		N/A
G.1	Clearance		N/A
G.2	Creepage distance		N/A
H.	Annex J, Measuring Instrument for Touch Current Measurements		P
H.1	Measuring instrument	Considered.	P
H.2	Alternative measuring instrument	Not used.	N/A
I.	Annex K, Examples of Protection, Insulation and Overvoltage Category Requirements for PCE		P
I.1	Protection, Insulation and Overvoltage	Considered.	P

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Clause	Requirement – Test	Result – Remark	Verdict

4.2.2.6 / 4.7	TABLE: electrical data in normal condition								P
ASW40K-LT-G3									
P/P _n [%]	PV / DC Input				Grid / AC Output				Test condition
	I/P I _{max} [A]	U [V]	I [A]	P [kW]	O/P I _{max} [A]	U [V]	I [A]	P [kW]	
100	32/ 32/ 40	460.5	88.84	40.88	63.8	230.6	57.92	39.98	A
						230.8	58.16		
						230.7	58.09		
100	32/ 32/ 40	636.4	64.20	40.85	63.8	230.6	58.14	40.13	B
						230.7	58.37		
						230.6	58.30		
100	32/ 32/ 40	847.9	48.08	40.76	63.8	230.6	57.66	39.91	C
						230.7	57.89		
						230.7	57.87		
ASW36K-LT-G3									
P/P _n [%]	PV / DC Input				Grid / AC Output				Test condition
	I/P I _{max} [A]	U [V]	I [A]	P [kW]	O/P I _{max} [A]	U [V]	I [A]	P [kW]	
100	32/ 32/ 40	450.3	83.86	37.53	57.4	230.5	52.73	36.42	A
						230.7	52.98		
						230.7	52.90		
100	32/ 32/ 40	636.4	57.86	36.82	57.4	230.6	52.37	36.17	B
						230.7	52.63		
						230.7	52.54		
100	32/ 32/ 40	847.8	43.72	37.07	57.4	230.5	52.47	36.33	C
						230.7	52.72		
						230.7	52.69		
ASW33K-LT-G3									
P/P _n [%]	PV / DC Input				Grid / AC Output				Test condition
	I/P I _{max} [A]	U [V]	I [A]	P [kW]	O/P I _{max} [A]	U [V]	I [A]	P [kW]	
100	32/ 32/ 40	450.3	76.87	34.40	52.6	230.5	48.34	33.38	A
						230.7	48.57		
						230.7	48.50		

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Clause	Requirement – Test				Result – Remark				Verdict
100	32/ 32/ 40	636.3	53.30	33.91	52.6	230.5 230.6 230.7	48.07 48.31 48.22	33.20	B
100	32/ 32/ 40	847.8	39.96	33.88	52.6	230.5 230.6 230.6	47.88 48.14 48.10	33.15	C
ASW30K-LT-G3									
P/P _n [%]	PV / DC Input				Grid / AC Output				Test condition
	I/P I _{max} [A]	U [V]	I [A]	P [kW]	O/P I _{max} [A]	U [V]	I [A]	P [kW]	
100	3 x 32	449.5	69.52	31.05	47.8	230.5 230.6 230.6	43.93 44.18 44.09	30.35	A
100	3 x 32	636.2	48.03	30.56	47.8	230.5 230.6 230.6	43.47 43.70 43.60	30.02	B
100	3 x 32	847.7	36.08	30.59	47.8	230.4 230.6 230.6	43.25 43.51 43.47	29.95	C
ASW27K-LT-G3									
P/P _n [%]	PV / DC Input				Grid / AC Output				Test condition
	I/P I _{max} [A]	U [V]	I [A]	P [kW]	O/P I _{max} [A]	U [V]	I [A]	P [kW]	
100	3 x 32	448.2	62.00	27.60	43.0	230.5 230.6 230.6	39.06 39.30 39.21	26.98	A
100	3 x 32	448.2	62.00	27.60	43.0	230.5 230.6 230.6	39.06 39.30 39.21	26.98	B
100	3 x 32	636.1	43.81	27.87	43.0	230.4 230.6 230.6	39.58 39.84 39.75	27.35	C
ASW25K-LT-G3									
P/P _n [%]	PV / DC Input				Grid / AC Output				Test condition
	I/P I _{max} [A]	U [V]	I [A]	P [kW]	O/P I _{max} [A]	U [V]	I [A]	P [kW]	

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Clause	Requirement – Test					Result – Remark			Verdict
100	3 x 32	452.9	56.82	25.43	39.9	230.4	36.11	24.94	A
						230.5	36.34		
						230.5	36.24		
100	3 x 32	636.1	40.25	25.60	39.9	230.4	36.35	25.13	B
						230.6	36.62		
						230.5	36.53		
100	3 x 32	847.7	30.17	25.58	39.9	230.4	36.15	25.05	C
						230.5	36.43		
						230.4	36.37		
Note(s): Test conditions: A. I/P: $V_{MPP\ min}=450Vd.c.$, O/P: $U_r=230Va.c.$ B. I/P: $V_{MPP\ nom}=640Vd.c.$, O/P: $U_r=230Va.c.$ C. I/P: $V_{MPP\ max}=850Vd.c.$, O/P: $U_r=230Va.c.$									

4.3	TABLE: Thermal testing	P
	test voltage (V)	See below
	t1 (°C)	--
	t2 (°C)	--

maximum temperature T of part/at:	Test condition				allowed Tmax (°C)
	470Vd.c., 230Va.c., 40kW	470Vd.c., 230Va.c., 40kW	470Vd.c., 253Va.c., 40kW	470Vd.c., 253Va.c., 40kW	
Ambient	45.0	60.0	45.0	60.8	--
Bus capacitor Ambient 1	96.6	89.4	92.1	87.5	105
Bus capacitor Ambient 2	97.1	89.7	92.7	87.8	105
BOOST3 CHOCK3 coil (top)	125.1	97.1	140.4	106.7	130 (class F)
BOOST3 CHOCK4 coil (top)	122.2	96.5	126.5	106.7	130 (class F)
DC input connector	62.2	65.3	58.5	66.1	85
AC output connector	50.6	62.9	50.6	63.8	85
Isolation chip	85.0	83.2	82.5	82.7	105
Bus capacitor Ambient 4	89.5	85.0	85.2	83.7	105
Bus capacitor Ambient 3	97.0	89.7	92.7	87.8	105

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Clause	Requirement – Test	Result – Remark	Verdict

maximum temperature T of part/at:	Test condition				allowed Tmax (°C)
	470Vd.c., 230Va.c., 40kW	470Vd.c., 230Va.c., 40kW	470Vd.c., 253Va.c., 40kW	470Vd.c., 253Va.c., 40kW	
DC HCT 100	102.7	90.1	102.4	90.0	125
DC film capacitor	90.8	84.7	89.6	84.3	105
BUS capacitor Ambient5	92.6	86.9	88.5	85.2	105
SPS Diode D145	105.5	102.4	102.8	101.6	175
SPS +12V_C262	95.8	93.0	92.9	92.1	105
SPS +12V_C263	94.3	91.5	91.4	90.5	105
SPS +12V_L101	94.3	91.8	91.3	90.9	100
SPS transformer TX103	96.3	92.4	94.1	92.0	110 (class B)
C266	90.8	86.8	88.4	86.1	105
AC HCT702 soldering plate	93.6	86.5	88.5	84.7	105
DC Switch (body)	81.7	72.5	81.6	72.6	75
DSP U133	86.5	86.0	83.4	85.2	105
INV driver transformer TX100	82.6	82.0	79.4	81.5	110 (class B)
INV driver transformer TX101	81.9	81.3	78.9	80.9	110 (class B)
INV driver transformer TX102	85.8	83.8	82.2	83.0	110 (class B)
LC filter capacitor C702	83.5	81.1	80.5	80.5	105
GFCI CT701	92.2	85.9	87.7	84.5	110 (class B)
Relay RY710	89.5	80.2	85.6	84.2	85
AC Chock CT705	112.2	97.0	104.1	93.0	110 (class B)
AC Chock CT705(rear)	105.9	93.6	99.0	90.4	110 (class B)
AC Chock CT706	107.9	94.0	100	90.3	110 (class B)
AC output terminal P707	75.2	77.2	72.8	76.8	85
AC output wiring (W)	79.1	79.0	76.1	78.7	105
AC HCT 701 soldering plate	94.9	87.2	89.7	85.2	105
AC HCT 702 soldering	95.1	87.3	89.8	85.3	105

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict

maximum temperature T of part/at:	Test condition				allowed Tmax (°C)
	470Vd.c., 230Va.c., 40kW	470Vd.c., 230Va.c., 40kW	470Vd.c., 253Va.c., 40kW	470Vd.c., 253Va.c., 40kW	
plate					
AC HCT 703 soldering plate	89.3	84.0	85.0	82.8	105
Chock CT800 core	107.7	89.8	107.8	89.9	110 (class B)
HCT800	77.8	77.3	76.7	77.4	105
Top cover	60.6	68.1	59.8	68.6	70
Bus Ambient4	82.7	84.1	83.8	83.0	85
Chock CT801 coil	108.1	89.5	108	89.6	110 (class B)
Boost1 IGBT Q100	98.7	91.8	98.5	92.2	130 (PCB)
Boost1 IGBT Q101	101.4	93.1	102.5	93.9	130 (PCB)
Boost2 IGBT Q102	103.1	94.7	103.2	95.2	130 (PCB)
Boost2 IGBT Q103	103.3	95.0	103.8	95.4	130 (PCB)
Boost3 IGBT Q104	101.9	93.8	101	94.2	130 (PCB)
Boost3 IGBT Q105	100.7	93.1	99.5	93.0	130 (PCB)
Boost1 Diode D101	108.6	96.2	106	94.9	130 (PCB)
Boost2 Diode D105	98.1	91.0	96.8	90.8	130 (PCB)
Boost3 Diode D109	104.7	94.7	102.3	93.9	130 (PCB)
INV U T2 Q106	94.4	90.8	89.5	88.4	130 (PCB)
INV U T3 Q107	93.4	90.4	88.5	87.9	130 (PCB)
INV U T1 Q108	98.5	95.1	93.0	92.1	130 (PCB)
INV U T1 Q109	104.3	98.1	98.5	94.9	130 (PCB)
INV U T4 Q118	94.4	92.2	89.5	89.7	130 (PCB)
INV U T4 Q119	89.7	88.6	85.4	86.7	130 (PCB)
INV V T2 Q110	85	85.9	80.9	84.0	130 (PCB)
INV V T3 Q111	91.1	89.3	86.0	86.7	130 (PCB)
INV V T1 Q112	92.4	90.8	87.3	88.3	130 (PCB)
Cooling fan (internal)	88.3	79.0	85.7	78.5	90
INV V T1 Q113	82.4	81.3	79.6	80.7	130 (PCB)
INV V T4 Q120	90.4	88.8	85.7	86.7	130 (PCB)
INV V T4 Q121	96.4	93.4	91.2	90.7	130 (PCB)

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict

maximum temperature T of part/at:	Test condition				allowed Tmax (°C)
	470Vd.c., 230Va.c., 40kW	470Vd.c., 230Va.c., 40kW	470Vd.c., 253Va.c., 40kW	470Vd.c., 253Va.c., 40kW	
INV W T2 Q114	87.7	87.7	83.3	85.3	130 (PCB)
INV W T3 Q115	81.4	84.2	77.7	82.2	130 (PCB)
INV W T1 Q116	98.4	94.3	92.6	91.5	130 (PCB)
INV W T1 Q117	98.5	95.2	94.2	92.4	130 (PCB)
INV W T4 Q122	94.2	92.0	89.4	89.4	130 (PCB)
INV W T4 Q123	91.8	90.9	87.4	88.4	130 (PCB)
SPS MOS Q128	77.8	80.7	77.1	80.8	130 (PCB)
Capacitor C172	97.1	89.1	92.9	87.0	130 (PCB)
Capacitor C145	98.1	89.6	93.4	87.4	130 (PCB)
Capacitor C146	100.2	90.5	95.4	88.2	130 (PCB)
Boost chock terminal	86.0	82.8	83.8	82.5	130 (class F)
Capacitor C147	97.0	88.5	92.6	86.6	105
INV U CHOCK1 coil (top)	97.6	92.5	92.2	89.8	130 (class F)
INV U CHOCK2 coil (middle)	99.6	93.3	93.5	90.2	130 (class F)
INV U CHOCK3 coil (bottom)	94.4	90.8	89.3	88.3	130 (class F)
INV U CHOCK4	97.2	92.5	92.0	90.0	130 (class F)
INV V CHOCK1 coil (top)	105.7	97.0	99.5	93.9	130 (class F)
INV V CHOCK2 coil (middle)	106.2	97.0	99.3	93.6	130 (class F)
INV V CHOCK3 coil (bottom)	102.4	95.3	96.4	92.4	130 (class F)
INV V CHOCK4	100.6	94.3	95.3	91.7	130 (class F)
INV W CHOCK1coil (top)	106.1	97.2	100.4	94.3	130 (class F)
INV W CHOCK2coil (middle)	105.7	96.4	99.7	93.4	130 (class F)
INV W CHOCK3coil (bottom)	102.3	95.0	97.1	92.5	130 (class F)

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict

maximum temperature T of part/at:	Test condition				allowed Tmax (°C)
	470Vd.c., 230Va.c., 40kW	470Vd.c., 230Va.c., 40kW	470Vd.c., 253Va.c., 40kW	470Vd.c., 253Va.c., 40kW	
INV W CHOCK4	100.8	94.0	95.9	91.7	130 (class F)
BOOST1 CHOCK1coil (top)	129.8	97.4	144.5	106.1	130 (class F)
BOOST1 CHOCK2coil (bottom)	124.5	95.0	137.8	103.0	130 (class F)
BOOST2 CHOCK1coil (top)	128.3	97.2	144.9	106.4	130 (class F)
BOOST2 CHOCK2coil (bottom)	124.2	95.0	139.9	104.1	130 (class F)
BOOST2 CHOCK3	121.6	94.7	137.5	103.9	130 (class F)
BOOST3 CHOCK2 coil (top)	128.2	98.0	143.8	108.0	130 (class F)
Watch dog U149	81.7	81.3	78.7	80.6	130 (PCB)
DSP2 (slave)	82.8	82.1	79.6	81.4	130 (PCB)
Q106 E copper foil	101.1	93.1	95.1	90.2	130 (PCB)
Q109 E copper foil	94.6	88.7	89.3	86.7	130 (PCB)
PV1 wiring	93.6	84.1	92.3	83.6	105
AC Relay ambient (middle)	82	80.1	84.1	84.1	85
Mounting surface	45.8	60.3	45.7	61.6	70
Heatsink	76.9	78.6	77.5	79.6	100
Handle of DC switch	57.8	66.5	59.9	67.8	70
Cooling fan (outside)	45.2	59.9	45.2	61.2	80
INV MOSFET	83.2	84.5	79.4	82.9	130 (PCB)
BOOST1 MOSFET	92.9	86.3	91.2	86.0	130 (PCB)
BOOST2 MOSFET	92.8	87.9	90.2	87.7	130 (PCB)
BOOST3 MOSFET	91.1	86.0	88.8	85.8	130 (PCB)

IEC 62109-1							
Clause	Requirement – Test			Result – Remark	Verdict		
maximum temperature T of part/at:	Test condition				allowed Tmax (°C)		
	470Vd.c., 230Va.c., 40kW	470Vd.c., 230Va.c., 40kW	470Vd.c., 253Va.c., 40kW	470Vd.c., 253Va.c., 40kW			
	BOOST3 heatsink	96.3	90.5	95.1		90.6	130 (PCB)
	PCB1	98.5	91.1	93.2		88.9	130 (PCB)
PCB2	85.7	84.5	82.1	83.4	130 (PCB)		
Temperature T of winding:	R1 (Ω)	R2 (Ω)	T (°C)	allowed Tmax (°C)	insulation class		
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Note(s):							

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict

maximum temperature T of part/at:	Test condition				allowed Tmax (°C)
	850Vd.c., 230Va.c., 40kW	850Vd.c., 230Va.c., 40kW	850Vd.c., 253Va.c., 40kW	850Vd.c., 253Va.c., 40kW	
Ambient	45.0	60.3	45.0	60.2	--
Bus capacitor Ambient 1	97.2	86.8	89.1	86.7	105
Bus capacitor Ambient 2	98.0	87.2	89.7	87.1	105
BOOST3 CHOCK3 coil (top)	73.6	77.2	71.6	81.0	130 (class F)
BOOST3 CHOCK4 coil (top)	73.5	77.2	71.4	80.8	130 (class F)
DC input connector	52.4	62.6	49.7	62.5	85
AC output connector	51.5	63.1	50.1	63.1	85
Isolation chip	83.7	81.9	78.2	81.8	105
Bus capacitor Ambient 4	88.3	82.3	81.7	82.3	105
Bus capacitor Ambient 3	98.3	87.3	90.1	87.2	105
DC HCT 100	85.3	81.3	80.0	81.6	125
DC film capacitor	83.6	80.5	78.0	80.7	105
BUS capacitor Ambient5	92.7	84.3	85.2	84.2	105
SPS Diode D145	104.8	101.1	99.0	101.1	130 (PCB)
SPS +12V_C262	95.2	91.5	89.2	91.4	105
SPS +12V_C263	92.9	89.5	87.0	89.5	105
SPS +12V_L101	94.5	90.8	88.5	90.7	100
SPS transformer TX103	93.3	90.5	87.6	90.6	110 (class B)
C266	87.0	83.9	81.2	83.9	105
AC HCT702 soldering plate	90.5	82.3	83.1	82.4	105
DC Switch (body)	74.0	74.8	70.3	71.0	75
DSP U133	87.3	85.2	81.6	85.2	105
INV driver transformer TX100	81.5	81.0	76.6	81.1	110 (class B)
INV driver transformer TX101	80.6	80.5	75.8	80.6	110 (class B)

IEC 62109-1						
Clause	Requirement – Test				Result – Remark	Verdict
maximum temperature T of part/at:	Test condition				allowed Tmax (°C)	
	850Vd.c., 230Va.c., 40kW	850Vd.c., 230Va.c., 40kW	850Vd.c., 253Va.c., 40kW	850Vd.c., 253Va.c., 40kW		
INV driver transformer TX102	85.6	83.1	80.1	83.2	110 (class B)	
LC filter capacitor C702	80.6	78.7	75.2	78.8	105	
GFCI CT701	89.1	82.0	82.2	82.2	110 (class B)	
Relay RY710	86.6	82.0	80.5	82.1	85	
AC Chock CT705	108.2	89.7	99.5	89.8	110 (class B)	
AC Chock CT705(rear)	103.8	87.3	94.2	87.4	110 (class B)	
AC Chock CT706	105.7	87.1	95.6	87.2	110 (class B)	
AC output terminal P707	76.6	77.4	71.7	77.3	85	
AC output wiring (W)	77.2	77.6	72.6	77.7	105	
AC HCT 701 soldering plate	92.0	82.7	84.4	82.8	105	
AC HCT 702 soldering plate	92.2	82.9	84.5	82.9	105	
AC HCT 703 soldering plate	86.1	80.6	79.5	80.7	105	
Chock CT800 core	82.5	76.5	77.1	76.4	110 (class B)	
HCT800	72.1	74.1	67.9	74.1	105	
Top cover	59.9	67.4	57.6	67.5	70	
Bus Ambient4	88.3	82.2	80.9	82.3	85	
Chock CT801 coil	82.4	76.6	77.1	76.7	110 (class B)	
Boost1 IGBT Q100	86.7	81.4	76.4	81.9	130 (PCB)	
Boost1 IGBT Q101	87.9	79.2	73.5	79.5	130 (PCB)	
Boost2 IGBT Q102	91.3	89.2	85.2	90.6	130 (PCB)	
Boost2 IGBT Q103	91.6	88.6	84.9	89.9	130 (PCB)	
Boost3 IGBT Q104	90.1	88.1	84.8	89.5	130 (PCB)	
Boost3 IGBT Q105	92.1	87.8	85.9	88.8	130 (PCB)	

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict

maximum temperature T of part/at:	Test condition				allowed Tmax (°C)
	850Vd.c., 230Va.c., 40kW	850Vd.c., 230Va.c., 40kW	850Vd.c., 253Va.c., 40kW	850Vd.c., 253Va.c., 40kW	
Boost1 Diode D101	93.6	84.1	85.9	84.2	130 (PCB)
Boost2 Diode D105	87.3	84.1	80.4	85.0	130 (PCB)
Boost3 Diode D109	92.6	88.5	86.8	89.9	130 (PCB)
INV U T2 Q106	111	96.1	99.6	94.8	130 (PCB)
INV U T3 Q107	112	96.1	99.9	94.7	130 (PCB)
INV U T1 Q108	113	98.8	104.5	98.6	130 (PCB)
INV U T1 Q109	117.5	100.8	108.6	100.8	130 (PCB)
INV U T4 Q118	107.5	95.7	99.7	95.4	130 (PCB)
INV U T4 Q119	99.8	91.2	92.6	90.9	130 (PCB)
INV V T2 Q110	98.3	90.4	90.6	89.6	130 (PCB)
INV V T3 Q111	113.1	96.7	100.9	95.1	130 (PCB)
INV V T1 Q112	104.6	94.0	97.5	93.9	130 (PCB)
Cooling fan (internal)	83.4	78.2	78.0	78.4	Ref.
INV V T1 Q113	83.4	81.0	77.4	96.8	130 (PCB)
INV V T4 Q120	99.1	90.6	92.7	103.0	130 (PCB)
INV V T4 Q121	109.3	96.5	101.8	103.0	130 (PCB)
INV W T2 Q114	112.7	97.2	99.6	100.7	130 (PCB)
INV W T3 Q115	103.9	93.3	92.9	96.6	130 (PCB)
INV W T1 Q116	112	98.1	103.7	102.2	130 (PCB)
INV W T1 Q117	112.8	98.8	105.6	102.9	130 (PCB)
INV W T4 Q122	106.4	95.0	99.0	97.0	130 (PCB)
INV W T4 Q123	105.9	95.2	98.4	97.0	130 (PCB)
SPS MOS Q128	79.2	80.5	74	82.2	130 (PCB)
Capacitor C172	99.9	86.7	91	87.9	105
Capacitor C145	100.7	87.2	91.8	88.8	105
Capacitor C146	101.9	87.6	92.7	89.2	105
Boost chock terminal	80.7	79.4	75.4	81.5	130 (class F)
Capacitor C147	97.9	85.9	89.3	87.5	105
INV U CHOCK1 coil (top)	122	109.8	108.8	107.2	130 (class F)

IEC 62109-1						
Clause	Requirement – Test				Result – Remark	Verdict
maximum temperature T of part/at:	Test condition				allowed Tmax (°C)	
	850Vd.c., 230Va.c., 40kW	850Vd.c., 230Va.c., 40kW	850Vd.c., 253Va.c., 40kW	850Vd.c., 253Va.c., 40kW		
INV U CHOCK2 coil (middle)	123	108.3	109.2	105.8	130 (class F)	
INV U CHOCK3 coil (bottom)	118	107.3	105.2	104.8	130 (class F)	
INV U CHOCK4	122.1	110.3	108.8	107.6	130 (class F)	
INV V CHOCK1 coil (top)	127.9	114.5	116.5	111.7	130 (class F)	
INV V CHOCK2 coil (middle)	127.9	112.4	115.5	109.8	130 (class F)	
INV V CHOCK3 coil (bottom)	128.0	113.0	113.5	110.2	130 (class F)	
INV V CHOCK4	125.1	111.2	111.1	108.6	130 (class F)	
INV W CHOCK1coil (top)	127.8	114.1	115.8	111.3	130 (class F)	
INV W CHOCK2coil (middle)	128.3	110.7	113.4	108.3	130 (class F)	
INV W CHOCK3coil (bottom)	125.9	111.4	111.6	108.7	130 (class F)	
INV W CHOCK4	123.5	110.3	109.6	107.6	130 (class F)	
BOOST1 CHOCK1coil (top)	78.6	75.4	73	74.8	130 (class F)	
BOOST1 CHOCK2coil (bottom)	77.3	75.0	71.9	74.5	130 (class F)	
BOOST2 CHOCK1coil (top)	76.2	77.8	71.5	80.1	130 (class F)	
BOOST2 CHOCK2coil (bottom)	74.9	77.1	70.4	79.2	130 (class F)	
BOOST2 CHOCK3	74.4	76.8	69.9	78.8	130 (class F)	
BOOST3 CHOCK2 coil (top)	74.0	76.9	72.0	80.4	130 (class F)	
Watch dog U149	81.0	79.9	75.7	79.8	85	
DSP2 (slave)	82.7	81.0	77.2	80.8	85	

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict

maximum temperature T of part/at:	Test condition				allowed T _{max} (°C)
	850Vd.c., 230Va.c., 40kW	850Vd.c., 230Va.c., 40kW	850Vd.c., 253Va.c., 40kW	850Vd.c., 253Va.c., 40kW	
Q106 E copper foil	115.5	96.0	102.6	94.6	130 (PCB)
Q109 E copper foil	99.3	88.0	90.6	87.6	130 (PCB)
PV1 wiring	80.0	77.8	75.1	78.3	105
AC Relay ambient (middle)	83.2	81.7	81.9	81.8	85
Mounting surface	46.2	61.3	46	61.2	70
Heatsink	72.2	74.9	66.9	75.1	100
Handle of DC switch	55.2	65.2	53.1	65.2	70
Cooling fan (outside)	45.3	60.7	45.0	60.4	80
INV MOSFET	91.7	87.2	85.7	86.9	130 (PCB)
BOOST1 MOSFET	84.3	80.5	77.7	81.0	130 (PCB)
BOOST2 MOSFET	89.2	87.0	83.6	87.5	130 (PCB)
BOOST3 MOSFET	85	82.5	79.5	83.1	130 (PCB)
BOOST3 heatsink	87.3	85.6	81.8	86.8	130 (PCB)
PCB1	103.1	90.1	93.9	89.9	130 (PCB)
PCB2	89.8	85.4	83.3	85.0	130 (PCB)

Temperature T of winding:	R ₁ (Ω)	R ₂ (Ω)	T (°C)	allowed T _{max} (°C)	insulation class
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Note(s):

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict

maximum temperature T of part/at:	Test condition			allowed Tmax (°C)
	470Vd.c., 230Va.c., 40kW	470Vd.c., 230Va.c., 40kW	520Vd.c., 230Va.c., 44kW	
	Fan locked	Blanketing	Overload	
Ambient	59.7	60.3	60.4	--
Bus capacitor Ambient 1	74.9	81.5	90.3	105
Bus capacitor Ambient 2	75.0	81.7	90.6	105
BOOST3 CHOCK3 coil (top)	79.4	84.1	86.5	130 (class F)
BOOST3 CHOCK4 coil (top)	79.8	85.0	85.8	130 (class F)
DC input connector	62.0	62.3	64.9	85
AC output connector	61.3	62.2	63.9	85
Isolation chip	73.5	80.9	84.0	105
Bus capacitor Ambient 4	72.8	78.8	86.2	105
Bus capacitor Ambient 3	75.0	81.7	90.7	105
DC HCT 100	75.9	80.4	89.3	125
DC film capacitor	72.7	78.0	84.9	105
BUS capacitor Ambient5	73.7	80.1	87.7	105
SPS Diode D145	90.9	99.1	103.3	175
SPS +12V_C262	81.7	89.0	93.8	105
SPS +12V_C263	79.9	86.9	92.7	105
SPS +12V_L101	81.0	88.8	92.9	100
SPS transformer TX103	81.0	87.7	93.0	110 (class B)
C266	75.4	82.0	87.4	105
AC HCT702 soldering plate	72.7	77.0	87.8	105
DC Switch (body)	70.2	72.3	81.4	75
DSP U133	76.6	84.4	87.1	105
INV driver transformer TX100	72.5	80.0	83.1	110 (class B)
INV driver transformer TX101	72.2	79.1	82.3	110 (class B)
INV driver transformer TX102	73.2	80.2	85.0	110 (class B)

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict

maximum temperature T of part/at:	Test condition			allowed Tmax (°C)
	470Vd.c., 230Va.c., 40kW	470Vd.c., 230Va.c., 40kW	520Vd.c., 230Va.c., 44kW	
	Fan locked	Blanketing	Overload	
LC filter capacitor C702	70.9	76.2	81.8	105
GFCI CT701	72.9	77.4	87.0	110 (class B)
Relay RY710	73.7	78.5	86.1	85
AC Chock CT705	77.1	78.3	99.3	110 (class B)
AC Chock CT705 (rear)	75.8	77.9	95.7	110 (class B)
AC Chock CT706	75.1	76.8	96.3	110 (class B)
AC output terminal P707	70.1	78.3	78.4	85
AC output wiring (W)	70.1	77.4	80.0	105
AC HCT 701 soldering plate	73.0	76.7	88.7	105
AC HCT 702 soldering plate	73.0	77.0	88.7	105
AC HCT 703 soldering plate	71.9	76.9	85.2	105
Chock CT800 core	73.1	75.1	88.1	110 (class B)
HCT800	69.1	72.8	77.5	105
Top cover	64.0	66.3	69.0	70
Bus Ambient4	72.5	79.3	85.2	85
Chock CT801 coil	73.1	75.2	87.8	110 (class B)
Boost1 IGBT Q100	77.7	91.1	91.0	130 (PCB)
Boost1 IGBT Q101	78.8	90.9	92.4	130 (PCB)
Boost2 IGBT Q102	78.9	91.4	93.9	130 (PCB)
Boost2 IGBT Q103	79.0	92.0	94.0	130 (PCB)
Boost3 IGBT Q104	78.4	90.6	93.0	130 (PCB)
Boost3 IGBT Q105	77.9	89.6	92.8	130 (PCB)
Boost1 Diode D101	78.8	89.9	96.1	130 (PCB)
Boost2 Diode D105	77.1	89.1	90.9	130 (PCB)
Boost3 Diode D109	78.0	88.0	94.6	130 (PCB)

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Clause	Requirement – Test	Result – Remark	Verdict

maximum temperature T of part/at:	Test condition			allowed Tmax (°C)
	470Vd.c., 230Va.c., 40kW	470Vd.c., 230Va.c., 40kW	520Vd.c., 230Va.c., 44kW	
	Fan locked	Blanketing	Overload	
INV U T2 Q106	75.8	88.2	92.5	130 (PCB)
INV U T3 Q107	75.8	88.8	92.3	130 (PCB)
INV U T1 Q108	78.0	92.3	97.6	130 (PCB)
INV U T1 Q109	79.6	92.0	100.6	130 (PCB)
INV U T4 Q118	77.0	91.9	94.4	130 (PCB)
INV U T4 Q119	75.1	89.6	90.5	130 (PCB)
INV V T2 Q110	73.6	89.7	87.8	130 (PCB)
INV V T3 Q111	75.0	88.7	91.5	130 (PCB)
INV V T1 Q112	75.9	90.9	93.1	130 (PCB)
Cooling fan (internal)	74.5	80.5	85.3	Ref.
INV V T1 Q113	71.9	80.0	82.3	130 (PCB)
INV V T4 Q120	74.9	88.2	90.9	130 (PCB)
INV V T4 Q121	77.4	91.0	95.9	130 (PCB)
INV W T2 Q114	75.8	89.3	89.9	130 (PCB)
INV W T3 Q115	74.5	89.8	86.5	130 (PCB)
INV W T1 Q116	78.9	92.3	96.8	130 (PCB)
INV W T1 Q117	79.2	92.7	98.0	130 (PCB)
INV W T4 Q122	77.2	91.7	94.4	130 (PCB)
INV W T4 Q123	77.5	92.4	93.6	130 (PCB)
SPS MOS Q128	73.8	88.7	81.2	130 (PCB)
Capacitor C172	74.1	80.2	90.1	105
Capacitor C145	74.2	80.3	90.4	105
Capacitor C146	74.3	80.3	91.2	105
Boost chock terminal	72.0	79.3	83.1	130 (class F)
Capacitor C147	73.4	79.3	89.1	105
INV U CHOCK1 coil (top)	80.1	87.6	95.4	130 (class F)
INV U CHOCK2 coil (middle)	79.9	87.1	96.5	130 (class F)
INV U CHOCK3 coil (bottom)	79.5	87.3	93.5	130 (class F)

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict

maximum temperature T of part/at:	Test condition			allowed Tmax (°C)
	470Vd.c., 230Va.c., 40kW	470Vd.c., 230Va.c., 40kW	520Vd.c., 230Va.c., 44kW	
	Fan locked	Blanketing	Overload	
INV U CHOCK4	80.3	87.7	95.4	130 (class F)
INV V CHOCK1 coil (top)	81.8	88.2	100.0	130 (class F)
INV V CHOCK2 coil (middle)	81.3	87.7	100.1	130 (class F)
INV V CHOCK3 coil (bottom)	81.3	88.1	98.1	130 (class F)
INV V CHOCK4	80.7	87.7	97.0	130 (class F)
INV W CHOCK1coil (top)	82.2	88.6	99.9	130 (class F)
INV W CHOCK2coil (middle)	81.4	87.8	99.3	130 (class F)
INV W CHOCK3coil (bottom)	81.3	88.0	97.5	130 (class F)
INV W CHOCK4	80.6	87.1	96.2	130 (class F)
BOOST1 CHOCK1coil (top)	80.5	86.1	87.8	130 (class F)
BOOST1 CHOCK2coil (bottom)	79.5	85.4	86.3	130 (class F)
BOOST2 CHOCK1coil (top)	80.0	85.3	87.2	130 (class F)
BOOST2 CHOCK2coil (bottom)	79.4	84.9	85.8	130 (class F)
BOOST2 CHOCK3	79.0	84.5	85.1	130 (class F)
BOOST3 CHOCK2 coil (top)	79.4	83.8	86.9	130 (class F)
Watch dog U149	71.8	79.3	82.1	85
DSP2 (slave)	72.5	80.2	83.1	85
Q106 E copper foil	76.4	84.6	95.0	130 (PCB)
Q109 E copper foil	74.4	82.4	90.4	130 (PCB)
PV1 wiring	71.3	74.7	84.1	105

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict

maximum temperature T of part/at:	Test condition			allowed Tmax (°C)
	470Vd.c., 230Va.c., 40kW	470Vd.c., 230Va.c., 40kW	520Vd.c., 230Va.c., 44kW	
	Fan locked	Blanketing	Overload	
AC Relay ambient (middle)	72.9	77.6	83.8	85
Mounting surface	60.4	65.7	61.2	70
Heatsink	72.1	85.0	78.3	100
Handle of DC switch	63.4	65.4	66.3	70
Cooling fan (outside)	60.0	81.3	60.5	80
INV MOSFET	73.2	89.1	86.3	130 (PCB)
BOOST1 MOSFET	74.0	81.6	86.5	130 (PCB)
BOOST2 MOSFET	75.8	83.3	88.5	130 (PCB)
BOOST3 MOSFET	74.1	82.6	86.4	130 (PCB)
BOOST3 heatsink	76.2	88.7	90.3	130 (PCB)
PCB1	75.8	83.9	92.6	130 (PCB)
PCB2	74.5	83.5	85.9	130 (PCB)

Temperature T of winding:	R ₁ (Ω)	R ₂ (Ω)	T (°C)	allowed T _{max} (°C)	insulation class
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Note(s):

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Clause	Requirement – Test	Result – Remark	Verdict

4.4	TABLE: fault condition tests						P
	test voltage (V)					See below	—
	Ambient temperature (°C)					See below	—
No.	Component no.	Fault	Test voltage (V)	Test time	Fuse no.	Fuse current (A)	Result
1.	PCE Cooling system failure	Blanketing	DC 450	2 hrs	--	--	DC Input: 450Vdc / 92A / 41.5kW AC Output: 230Vac / 3x57A / 40kW The inverter operated normally. While the temperature is higher than limit value, the output power will be decreased, until zero output. Ambient: 45°C, SD, DG, RO, NCD, NH.
2.	PCE output	max. o-l	DC 450	2h	--	--	DC Input: 450Vdc / 92A / 41.5kW AC Output: 230Vac / 3x76A / 44kW Inverter output overload at 44kW. During the test the components are within limits, temperature of components refer to heating test, no hazard. Ambient: 45°C, SD, DG, RO, NCD, NH.
3.	PCE output	s-c	DC 450	10 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter stopped operation immediately after short-circuit. No output power feed into grid. No components damage, no hazard. Ambient: 25°C, SD, DG, RO, NCD, NH.
4.	PCE output	Phase sequence or polarity incorrect	DC 450	30 min.	--	--	DC Input: 450Vdc / 92A / 41.5kW AC Output: 230Vac / 3x57A / 40kW Inverter operated normally. Ambient: 45°C, SD, DG, RO, NCD, NH.

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Clause	Requirement – Test					Result – Remark	Verdict
5.	PCE output	U-Phase mis-wiring grid connection	DC 450	10 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter shut down for immediately. No back-feed voltage observed onto Mains side. FID: "Utility Loss" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
6.	PCE output	V-Phase mis-wiring grid connection	DC 450	10 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter shut down for immediately due to islanding detection. No back-feed voltage observed onto Mains side. No output no power feed into grid. FID: "Utility Loss" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
7.	PCE output	W-Phase mis-wiring grid connection	DC 450	10 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter shut down for immediately due to islanding detection. No back-feed voltage observed onto Mains side. No output no power feed into grid. FID: "Utility Loss" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
8.	PCE input	Reversed	DC 450	10 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW FID: Inverter cannot start up. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.

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Clause	Requirement – Test					Result – Remark	Verdict
9.	DSP failure (control DSP)	+3.3V power supply disable	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter shut down immediately. DSP protect by itself for low voltage No components damage, no hazard. Inverter can be restarted and operated normally when the fault was removed. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
10.	DSP failure (control DSP)	10MHz oscillator disable	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter shut down immediately. DSP protect by itself for low voltage No components damage, no hazard. Inverter can be restarted and operated normally when the fault was removed. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
11.	DSP failure (control DSP)	Reset	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter shut down immediately. DSP protect by itself for low voltage No components damage, no hazard. Inverter can be restarted and operated normally when the fault was removed. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
12.	MCU failure	+3.3V power supply disable	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter shut down immediately. DSP protect by itself for low voltage No components damage, no hazard. Inverter can be restarted and operated normally when the fault was removed. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.

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Clause	Requirement – Test					Result – Remark	Verdict
13.	MCU failure	10MHz oscillator disable	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter shut down immediately. DSP protect by itself for low voltage No components damage, no hazard. Inverter can be restarted and operated normally when the fault was removed. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
14.	MCU failure	Reset	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter shut down immediately. DSP protect by itself for low voltage No components damage, no hazard. Inverter can be restarted and operated normally when the fault was removed. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
15.	PV/DC Voltage detector (R408 o-c)	Loss / failure	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter cannot start up. No output power feed into grid. No components damage, No hazard. Ambient: 25°C SD, DG, RO, NCD, NH.
16.	PV/DC Current detector (R440 o-c)	Loss / failure	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter shut down immediately. DSP protect by itself for low voltage No components damage, no hazard. Inverter can be restarted and operated normally when the fault was removed. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.

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Clause	Requirement – Test					Result – Remark	Verdict
17.	Bus Voltage detector (R430 o-c)	Loss / failure	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter cannot start up. No output power feed into grid. No components damage, No hazard. Ambient: 25°C SD, DG, RO, NCD, NH.
18.	Grid/AC Voltage detector (R460 o-c)	Loss / failure	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW The inverter shut down immediately. No components damage, no hazard. Inverter can be restarted and operated normally when the fault was removed. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
19.	Grid/AC Current detector (R470 o-c)	Loss / failure	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW The inverter shut down immediately. No components damage, no hazard. Inverter can be restarted and operated normally when the fault was removed. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
20.	DC isolation device function detector (R366 o-c)	Loss / failure	DC 450	10 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW PV inverter could not start. Red fault LED light, FID: "Isolation Failure" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.

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Clause	Requirement – Test					Result – Remark	Verdict
21.	Residual current monitor unit detector (R714 o-c)	Loss / failure	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW PV inverter could not start to work. Red fault LED light. When the PE measuring ability OFF, the fault information "Device fault". No components damage, no hazard. FID: "GFCI Failure" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
22.	Relay function detector (R794 o-c)	Loss / failure	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter could not start. Red fault LED light, FID: "Relay Check Failure" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
23.	Ambient temperature detector (NTC or PTC s-c)	Loss / failure	DC 450	10 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter cannot start up. No output power feed into grid. No components damage, no hazard. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
24.	Ambient temperature detector (NTC or PTC o-c)	Loss / failure	DC 450	2 hrs	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW The inverter shut down immediately. LED Off. No components damage, no hazard. Inverter can be restarted and operated normally when the fault was removed. Ambient: 25°C, SD, DG, RO, NCD, NH.
Components fault:							
DC to AC main circuits:							

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Clause	Requirement – Test					Result – Remark	Verdict
25.	Boost Diode D109 (A-K)	s-c	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter stop operation immediately after short-circuit. No output power feed into grid. D109 damaged, no hazard. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
26.	Boost MOSFET Q102 (D-S)	s-c	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter stop operation immediately after short-circuit. No output power feed into grid. Q102 damaged, no hazard. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
27.	Boost MOSFET Q102 (G-S)	s-c	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter stop operation immediately after short-circuit. No output power feed into grid. Q102 damaged, no hazard. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
28.	Boost MOSFET Q102 (G-D)	s-c	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter stop operation immediately after short-circuit. No output power feed into grid. Q102 damaged, no hazard. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.

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Clause	Requirement – Test					Result – Remark	Verdict
29.	Inverter Bridge Q108 (D-S)	s-c	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter stop operation immediately after short-circuit. No output power feed into grid. Q108 damaged, no hazard. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
30.	Inverter Bridge Q108 (G-S)	s-c	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter stop operation immediately after short-circuit. No output power feed into grid. Q108damaged, no hazard. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
31.	Inverter Bridge Q108 (G-D)	s-c	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter stop operation immediately after short-circuit. No output power feed into grid. Q108damaged, no hazard. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
32.	Inverter Bridge Q111 (D-S)	s-c	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter stop operation immediately after short-circuit. No output power feed into grid. Q111 damaged, no hazard. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.

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Clause	Requirement – Test					Result – Remark	Verdict
33.	Inverter Bridge Q111 (G-S)	s-c	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter stop operation immediately after short-circuit. No output power feed into grid. Q111 damaged, no hazard. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
34.	Inverter Bridge Q111 (G-D)	s-c	DC 450	30 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter stop operation immediately after short-circuit. No output power feed into grid. Q111 damaged, no hazard. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
35.	Bus capacitors C170	s-c	DC 450	10 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW Inverter stop operation immediately after short-circuit. No output power feed into grid. C170 damaged, no hazard. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
36.	LC filter capacitor C734	s-c	DC 450	10 min.	--	--	DC Input: 450Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW Inverter shut down for immediately due to islanding detection. No backfeed voltage observed onto Mains side. No output no power feed into grid. No components damage, no hazard. FID: Utility Loss. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH.
Legend (Special evaluation for PV Inverter abnormal test)							
FID	Fault Indication				MT	Max. Temperature	
SD	PCE Shut Down:				DG	Disconnection To Grid	
RO	Recovered to Operate after removing the single fault setting				NCD	No comp. or parts damaged	

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Clause	Requirement – Test	Result – Remark	Verdict
NH	No hazards occurred	DST	Dielectric strength test
s-c	short-circuited	o-c	open-circuited
o-l	Over-load.		
<p>Note(s):</p> <p>Failures or faults may be short-circuits in the PCE, or to exposed conductive parts, earth faults, or short-circuit in the output circuits, failure in the control circuits, or blocking of a motor fed by power EE.</p> <p>There shall be no emission of molten metal, burning insulation, or flaming or glowing particles FIDom the fire enclosure, and there shall be no charring, glowing, or flaming of the tissue paper or cheesecloth, or glowing or flaming of surgical cotton.</p> <p>Faults protected by “UL certified current fuse only” shall be performed and repeated 3 times.</p> <p>In case of components damaged other than fuse, the evaluation should be repeated 3 times.</p> <p>Report in result section:</p> <ul style="list-style-type: none"> – Measure transformer temperature at all times – Fuse opened Yes / No? – Components damaged? – Emit Flames? – Emit molten metal? – Did it pass the electric strength test? <p>What happened to the SPS? Shutdown / cycle protection / normal operation</p>			

7.3.7.4 & 7.3.7.5	TABLE: clearance and creepage distance measurements					P
Clearance cl and creepage distance dcr at/of:	Uimp [V]	U r.m.s. [V]	Required cl [mm]	cl [mm]	Required dcr [mm]	dcr [mm]
PCE unit						
PV supply circuit to metal chassis: BI (components)	4772	1100	4.6	See below	11.0	See below
- at ON/OFF DC switch	--	--	--	25.0	--	25.0
- at SPD body (RY901 to RY905)	--	--	--	15.0	--	15.0
- at Boost MOSFET (U103A, U103B)	--	--	--	8.0	--	8.0
- at Inverter Bridge MOSFET (U103C)	--	--	--	8.0	--	8.0
AC mains circuit to metal chassis: BI (components)	4772	1100	4.6	See below	11.0	See below
- at AC capacitor (C701 to C703)	--	--	--	15.0	--	15.0
- at AC EMI Choke (CT705)	--	--	--	11.0	--	11.0

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Clause	Requirement – Test			Result – Remark		Verdict
- at PCB stand-off (between PCBs and metal chassis)	--	--	--	12.0	--	12.0
SPD board (A189- SPD)						
PV supply circuit to metal chassis: BI (components)	4772	1100	4.6	See below	5.5	See below
- at SPD (RY905)	--	--	--	7.0	--	7.0
PSDR board (A189-PSDR&CNTL)						
PV input circuit:						
PV supply circuit "+" to "-" : FI	4772	1100	4.6	See below	5.5	See below
- at choke coil terminal (P101, P105, P108)	--	--	--	5.5	--	5.5
PV input circuit to PB (metal chassis): BI (PCB trace)	4772	1100	4.6	See below	5.5	See below
- at Y capacitor (C101, C121)	--	--	--	7.0	--	7.0
- at screw mounting holes	--	--	--	5.5	--	5.5
Comm. and display circuit:						
Control circuits to Communication circuits: RI	4772	1100	7.6	See below	7.6	See below
- at isolation chip (U158, U159)	--	--	--	7.7	--	7.7
AC OUT board (A189-AC OUT)						
AC output circuit:						
AC mains circuit Line to Neutral: FI	4772	1100	4.6	See below	5.5	See below
- at PCB trace	--	--	--	7.0	--	7.0
AC mains circuit to PB (metal chassis): BI	4772	1100	4.6	See below	5.5	See below
- at Y capacitor (C712, C718, C722)	--	--	--	10.0	--	10.0
- at Y capacitor (C731, C732, C733)	--	--	--	5.5	--	5.5
- at screw mounting holes	--	--	--	5.5	--	5.5
Isolation transformer in Aux. power circuits (TX103): RI	For detail requirement and measurement see transformer table.					
Circuits Definition:						
PV Circuits: DVC-C			AC mains/Grid Circuits: DVC-C			

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict

Control Circuits: DVC-C		Communication and Display Circuits: DVC-A	
Protection Separation			
PV Circuits to Accessible Parts Earthed: BI		AC mains/Grid Circuits to Accessible Parts Earthed: BI	
PV Circuits to Control Circuits: No separation		AC mains/Grid Circuits to Control Circuits: No separation	
Control Circuits to Communication Circuits: RI		Control Circuits to Display Circuit: RI	
Legend			
BI	Basic insulation	SI	Supplementary insulation
DI	Double insulation	RI	Reinforced insulation
FI	Functional insulation	O.V.C	Overvoltage category
PD	Pollution degree	MG	Insulating material group
PPI	Protection by Protective Impedance	DVC	Decision voltage classification
<p>Note(s):</p> <p>$V_{MAX PV} = 1100Vd.c.$, AC output voltage = 3N~ 400Va.c. PV supply circuits = O.V.C II, AC mains circuits = O.V.C. III. PD = PD2 (IP66), MG = IIIa/b, Altitude $\leq 3000m$ (correction factor = 1.14) According to the degrees of protection provided by the enclosure is IP66, the pollution degree for the internal environment of PCE could be consider as PD2. To determine Creepage distances for reinforced insulation on PCBA, isolation chips U158, U159 potted with insulation materials, PD1 considered.</p>			

7.3.7.8.3.2, 7.3.7.8.3.3	TABLE: distance through insulation measurement			P
distance through insulation di at/of:	U r.m.s. (V)	test voltage (V)	required di (mm)	di (mm)
Opto-coupler for assessable parts to DC/AC live parts (RI)	DC 1100V	4240	0.2	≥ 3.0
Note(s): ¹⁾ Certificated components.				

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict

7.5.1, 7.5.2 and 7.5.3	TABLE: electric strength measurements, impulse voltage test and partial discharge test			P
test voltage applied between:	test voltage [V]	impulse withstand voltage [V] 1.2/50 µs	partial discharge extinction voltage [V]	result
PV input to PE	DC 2120	6000	--	Pass
AC output to PE	DC 2120	6000	--	Pass
PV input to Communication port	DC 4240	8000	--	Pass
AC output to Communication port	DC 4240	8000	--	Pass
Legend				
BI	Basic insulation	SI	Supplementary insulation	
DI	Double insulation	RI	Reinforced insulation	
FI	Functional insulation	O.V.C	Overvoltage category	
Note(s):				

14	TABLE: list of critical components					P
Object/part No.	Manufacturer / Trademark	Type / model	Technical data	Standard	Mark(s) of conformity	
--	--	--	--	--	--	
Note(s): See list of critical components						

- End of Test Report -



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<p>TEST REPORT</p> <p>IEC 62109-2</p> <p>Safety of power converters for use in photovoltaic power systems – Part2: Particular requirements for inverters</p>	
Report Reference No.	CN21AQKR 001 attachment 1
Tested by (name + signature)	See cover page
Witnessed by (name + signature)	N/A
Supervised by (name + signature)	N/A
Approved by (name + signature)	See cover page
Date of issue.....	See cover page
Testing Laboratory.....	TÜV Rheinland (Shanghai) Co., Ltd.
Address	No.177, Lane 777, West Guangzhong Road, Jing'an District, Shanghai 200072, P. R. China
Testing location/ procedure	CBTL <input type="checkbox"/> TMP <input type="checkbox"/> WMT <input type="checkbox"/> SMT <input type="checkbox"/> RMT <input type="checkbox"/> CCATL <input checked="" type="checkbox"/>
Testing location/ address	See cover page
Applicant's name	See cover page
Address	See cover page
Test specification:	
Standard	IEC/EN 62109-2: 2011
Test procedure	TÜV Bauart
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	See report CN21AQKR 001
Trade Mark	See report CN21AQKR 001
Manufacturer	See report CN21AQKR 001
Model/Type reference.....	See report CN21AQKR 001
Ratings	See report CN21AQKR 001

Testing procedure and testing location:
<input checked="" type="checkbox"/> Testing Laboratory: Testing location/ address..... : <input type="checkbox"/> Associated Test Laboratory: Testing location/ address..... : Tested by (name + signature) : See cover page Approved by (+ signature)..... : See cover page
<input type="checkbox"/> Testing procedure: TMP Tested by (name + signature) : Approved by (+ signature)..... : Testing location/ address..... :
<input type="checkbox"/> Testing procedure: WMT Tested by (name + signature) : Witnessed by (+ signature) : Approved by (+ signature)..... : Testing location/ address..... :
<input type="checkbox"/> Testing procedure: SMT Tested by (name + signature) : Approved by (+ signature)..... : Supervised by (+ signature) : Testing location/ address..... :
<input type="checkbox"/> Testing procedure: RMT Tested by (name + signature) : Approved by (+ signature)..... : Supervised by (+ signature) : Testing location/ address..... :

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

See report CN21AQKR 001.

Summary of testing**Tests performed (name of test and test clause): Testing location:**

The critical tests were performed on this equipment include clauses 4.4.4.15.1, 4.4.4.15.2, 4.8.2.1, 4.8.3.5.2, 4.8.3.5.3 in scope of this standard.

The laboratory described on cover page.

Summary of compliance with National Differences

List of countries addressed: None.

The product fulfils the requirements of IEC/EN 62109-2: 2011.

Copy of marking plate: See report CN21AQKR 001.		
Equipment mobility	<input type="checkbox"/> movable <input type="checkbox"/> stationary	<input type="checkbox"/> hand-held <input checked="" type="checkbox"/> fixed (Wall mounted)
Connection to the mains.....	<input type="checkbox"/> pluggable equipment <input checked="" type="checkbox"/> permanent connection	<input type="checkbox"/> direct plug-in <input type="checkbox"/> for building-in
Environmental category.....	<input checked="" type="checkbox"/> outdoor	<input type="checkbox"/> indoor conditional <input type="checkbox"/> indoor unconditional
Operating condition	<input checked="" type="checkbox"/> continuous	<input type="checkbox"/> short-time <input type="checkbox"/> intermittent
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 (%)	According to specified supply range	
Tested for IT power systems	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
IT testing, phase-phase voltage (V)	N/A	
Class of equipment	<input checked="" type="checkbox"/> Class I <input type="checkbox"/> Class III	<input type="checkbox"/> Class II <input type="checkbox"/> Not classified
Mass of equipment (kg).....	See model list	
Pollution degree	<input type="checkbox"/> PD 1	<input checked="" type="checkbox"/> PD 2 (inside) <input checked="" type="checkbox"/> PD 3 (outside)
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.....: Pass (P)		
- test object does not meet the requirement.....: Fail (F)		
Testing:		
Date of receipt of test items	See cover page	
Date(s) of performance of tests	See cover page	

General remarks:

"(see Attachment #)" refers to additional information appended to the report.

"(see appended table)" refers to a table appended to the report.

The tests results presented in this report relate only to the object tested.

This report shall not be reproduced except in full without the written approval of the testing laboratory.

List of test equipment must be kept on file and available for review.

Additional test data and/or information provided in the attachments to this report.

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

Determination of the test results includes consideration of measurement uncertainty from the test equipment and methods.

Manufacturer's Declaration per sub-clause 6.2.5 of IEC 60335-1:

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):

See report CN21AQKR 001

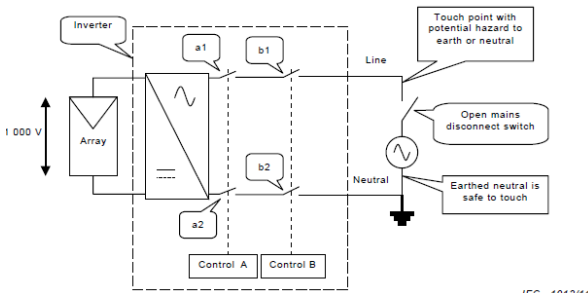
General product information:

See report CN21AQKR 001.

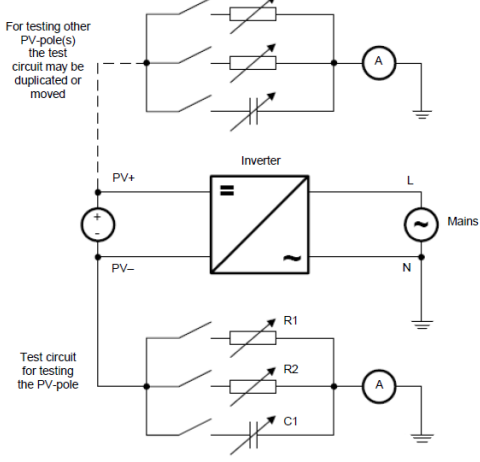
Throughout the test report following abbreviations may be used:

- input	i/p	- Test repeated, similar result(3 times)	TRSR
- output	o/p	- No indication of dielectric breakdown	NB
- short-circuited	s-c	- Cheesecloth remained intact	NC
- overloaded	o-l	- Tissue paper remained intact	NT
- open-circuited	o-c	- No hazards	NH
- normal conditions	N.C.	- The PCE can recover to operate automatically after removing the abnormal condition	RO
- single fault conditions	SFC	- functional insulation	FI
- between parts of opposite polarity	BOP	- basic insulation	BI
- internal protection operated	IPO	- supplementary insulation	SI
- Component damage (list damaged component)	CD	- double insulation	DI
- No component damaged	NCD	- reinforced insulation	RI

Indicate used abbreviations (if any)

IEC 62109-2: 2011			
Clause	Requirement – Test	Result - Remark	Verdict
4	General testing requirements <i>This clause of Part 1 is applicable with the following exceptions:</i>		P
4.4	Testing in SINGLE FAULT CONDITIONS		P
4.4.4	SINGLE FAULT CONDITIONS to be applied: <i>Additional subclauses:</i>	The PCE could detect and indicate the fault condition and disconnect from or not connect to the grid in case of single fault condition. Refer to the appended table 4.4 of IEC/EN 62109-1 test report CN21AQKR 001.	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		P
4.4.4.15.2	Fault-tolerance of automatic disconnecting means		P
4.4.4.15.2.1	General		P
4.4.4.15.2.2	Design of insulation or separation  <p style="text-align: right; font-size: small;">IEC 1012/11</p> <p>Figure 20 – Example system discussed in Note 2 above</p>		P
4.4.4.15.2.3	Automatic checking of the disconnect means		P
4.4.4.16	Stand-alone inverters-load transfer test	Grid-connected PV Inverter.	N/A
4.4.4.17	Cooling system failure – Blanketing test		P
4.7	Electrical Ratings Tests <i>Additional subclauses:</i>	Refer to the appended table 4.7 of IEC/EN 62109-1 test report CN21AQKR 001.	P
4.7.3	Measurement requirements for AC output ports for stand-alone inverters	Grid-connected PV Inverter.	N/A
4.7.4	Stand-alone Inverter AC output voltage and frequency	Grid-connected PV Inverter.	N/A
4.7.4.1	General		N/A
4.7.4.2	Steady state output voltage at nominal DC input		N/A

IEC 62109-2: 2011			
Clause	Requirement – Test	Result - Remark	Verdict
4.7.4.3	Steady state output voltage across the DC input range		N/A
4.7.4.4	Load step response of the output voltage at nominal DC input		N/A
4.7.4.5	Steady state output frequency		N/A
4.7.5	Stand-alone inverter output voltage waveform		N/A
4.7.5.1	General		N/A
4.7.5.2	Sinusoidal output voltage waveform requirements		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	Total harmonic distortion		N/A
4.7.5.3.3	Waveform slope		N/A
4.7.5.3.4	Peak voltage		N/A
4.7.5.4	Information requirements for non-sinusoidal waveforms		N/A
4.7.5.5	Output voltage waveform requirements for inverters for dedicated loads		N/A
4.8	Additional tests for grid-interactive inverters	See below.	P
4.8.1	General requirements regarding inverter isolation and array grounding	Non-isolated inverters for ungrounded arrays.	P
4.8.2	Array insulation resistance detection for inverters for ungrounded and functionally grounded arrays	See below.	P
4.8.2.1	Array insulation resistance detection for inverters for ungrounded arrays	Inverter indicates the insulation fault and stops to start.	P
4.8.2.2	Array insulation resistance detection for inverters for functionally grounded arrays	See above.	N/A
4.8.3	Array residual current detection		P
4.8.3.1	General		P
4.8.3.2	30mA touch current type test for isolated inverters	See appended table.	P
4.8.3.3	Fire hazard residual current type test for isolated inverters	See appended table.	N/A
4.8.3.4	Protection by application of RCD's		N/A
4.8.3.5	Protection by residual current monitoring		P
4.8.3.5.1	General	See below.	P

IEC 62109-2: 2011											
Clause	Requirement – Test	Result - Remark	Verdict								
	<p>Table 31 – Response time limits for sudden changes in residual current</p> <table border="1"> <thead> <tr> <th>Residual current sudden change</th> <th>Max. time to inverter disconnection from the mains</th> </tr> </thead> <tbody> <tr> <td>30 mA</td> <td>0,3 s</td> </tr> <tr> <td>60 mA</td> <td>0,15 s</td> </tr> <tr> <td>150 mA</td> <td>0,04 s</td> </tr> </tbody> </table> <p>NOTE These values of residual current and time are based on the RCD standard IEC61008-1.</p>	Residual current sudden change	Max. time to inverter disconnection from the mains	30 mA	0,3 s	60 mA	0,15 s	150 mA	0,04 s	See appended table.	P
Residual current sudden change	Max. time to inverter disconnection from the mains										
30 mA	0,3 s										
60 mA	0,15 s										
150 mA	0,04 s										
	 <p>For testing other PV-pole(s) the test circuit may be duplicated or moved</p> <p>Test circuit for testing the PV-pole</p> <p>For the continuous residual current test, R1 establishes a baseline current just below the trip point, and R2 is switched in to cause the current to exceed the trip point. Capacitor C1 is not used.</p> <p>For the sudden change residual current test, C1 establishes a baseline current and R1 or R2 is switched in to cause the desired value of sudden change. The other resistor is not used.</p> <p>IEC 1013/11</p> <p>Figure 21 – Example test circuit for residual current detection testing</p>	See appended table.	P								
4.8.3.5.2	Test for detection of excessive continuous residual current	See appended table.	P								
4.8.3.5.3	Test for detection of sudden changes in residual current	See appended table.	P								
4.8.3.6	Systems located in closed electrical operating areas	Not specified to be located in closed electrical operating area.	N/A								
5	Marking and documentation <i>This clause of Part 1 is applicable with the following exceptions:</i>	See report CN21AQKR 001.	P								
5.1	Marking		P								
5.1.4	Equipment ratings <i>Replacement:</i>		P								

IEC 62109-2: 2011			
Clause	Requirement – Test	Result - Remark	Verdict
5.2	Warning markings		P
5.2.2	Content for warning markings		P
5.2.2.6	Inverters for closed electrical operating areas		P
5.3	Documentation		P
5.3.2	Information related to installation <i>Additional subclauses:</i>		P
5.3.2.1	Ratings		P
5.3.2.2	Grid-interactive inverter setpoints	No adjustable setting available. Only the factory default values, however distribution network operator shall perform the adjustment.	N/A
5.3.2.3	Transformers and isolation	Transformer-less PCE.	N/A
5.3.2.4	Transformers required but not provided	Transformer-less PCE	N/A
5.3.2.5	PV modules for non-isolated inverters		P
5.3.2.6	Non-sinusoidal output waveform information	Grid-connection inverter.	N/A
5.3.2.7	Systems located in closed electrical operating areas	Not specified to be located in closed electrical operating area.	N/A
5.3.2.8	Stand- alone inverter output circuit bonding	Grid-connection inverter.	N/A
5.3.2.9	Protection by application of RCD's	Integrated RCM provided in inverter.	N/A
5.3.2.10	Remote indication of faults	The instructions are specified in section of "Connecting Communications Cables " in the user's manual.	P
5.3.2.11	External array insulation resistance measurement and response	Sub clause 4.8.2.1 compliance.	N/A
5.3.2.12	Array functional grounding information	No such requirements.	N/A
5.3.2.13	Stand-alone inverters for dedicated loads	Grid-connection inverter.	N/A
5.3.2.14	Identification of firmware version(s)	The firmware version disclosed by communication interface.	P
6	Environmental requirements and conditions <i>This clause of Part 1 is applicable.</i>		P

IEC 62109-2: 2011			
Clause	Requirement – Test	Result - Remark	Verdict
7	Protection against electric shock and energy hazards <i>This clause of Part 1 is applicable except for the following additions:</i>	See report CN21AQKR 001.	P
7.3	Protection against electric shock <i>Additional subclauses:</i>		P
7.3.10	Additional requirements for stand-alone inverters	Grid-connection inverter	N/A
	Stand-alone inverter output circuit bonding		N/A
	Stand-alone inverter isolation and protection of DVC-A circuits		N/A
7.3.11	Functionally grounded arrays		N/A
8	Protection against mechanical hazards <i>This clause of Part 1 is applicable.</i>	See report CN21AQKR 001.	P
9	Protection against fire hazards <i>This clause of Part 1 is applicable with the following exceptions:</i>	See report CN21AQKR 001.	P
9.3	Short-circuit and overcurrent protection <i>Additional subclause:</i>		P
9.3.4	Inverter backfeed current onto the array		P
10	Protection against sonic pressure hazards <i>This clause of Part 1 is applicable</i>	See report CN21AQKR 001.	P
11	Protection against liquid hazards <i>This clause of Part 1 is applicable</i>	See report CN21AQKR 001.	P
12	Protection against chemical hazards <i>This clause of Part 1 is applicable</i>	See report CN21AQKR 001.	P
13	Physical requirements <i>This clause of Part 1 is applicable with the following exception:</i> <i>Additional subclause:</i>	See report CN21AQKR 001.	P
13.9	Fault indication		P
	a) a visible or audible indication, integral to the inverter, and detectable from outside the inverter, and	Fault light is available for fault indication.	P

IEC 62109-2: 2011			
Clause	Requirement – Test	Result - Remark	Verdict
	b) an electrical or electronic indication that can be remotely accessed and used.	The error message also can be remotely accessed and used	P
14	Components <i>This clause of Part 1 is applicable</i>	See report CN21AQKR 001.	P

4.8.2.1	TABLE: Insulation resistance measurement				P
Conditions	Measurement [I.F. / N.O.]				Identification
	PV / DC Supply Voltage [Vd.c.]				
	200	450	850	950	
PV+ to PE: <u>180</u> [kΩ]	I.F.	I.F.	I.F.	I.F.	I.F.: Isolation Fault N.O.: Normal Operation
PV- to PE: <u>180</u> [kΩ]	I.F.	I.F.	I.F.	I.F.	
PV+ to PE: <u>200</u> [kΩ]	N.O.	N.O.	N.O.	N.O.	
PV- to PE: <u>200</u> [kΩ]	N.O.	N.O.	N.O.	N.O.	
PV+ to PE: <u>220</u> [kΩ]	N.O.	N.O.	N.O.	N.O.	
PV- to PE: <u>220</u> [kΩ]	N.O.	N.O.	N.O.	N.O.	
Note: Array Insulation Resistance Threshold Value $R = 200$ [kΩ] (Should be larger than $R = V_{MAX PV} / 30mA$.) The accuracy of resistance measurement $\Delta R = 20$ [kΩ] (the value declared by manufacturer)					

4.8.3.2, 4.8.3.3	TABLE: Touch current and fire hazard residual current measurement				N/A
Condition	PV power supply “ + “ → terminal A [mA]	PV power supply “ - “ → terminal A [mA]	Limit [mA]	Comments	
--	--	--	--	--	
Condition	PV power supply “ + “ → earthing [mA]	PV power supply “ - “ → earthing [mA]	Limit [mA]	Comments	
--	--	--	--	--	
Note: Using measurement circuit of IEC 60990 figure 4 for testing touch current. Using ammeter for testing fire hazard residual current.					

4.8.3.5.1	TABLE: Residual current monitoring test		P
Conditions	Steadily Residual current threshold value		
	Measurement [mA]	Limit [mA]	
	U_N		
PV1+ to Neutral	200	300	
	209	300	
	205	300	
	208	300	
	203	300	
PV- to Neutral	206	300	
	205	300	
	208	300	
	204	300	
	206	300	

Note: 100% output power and V_{mppmax} input voltage

4.8.3.5.1	TABLE: Residual current monitoring test		P
Conditions	Steadily Residual current threshold value		
	Measurement [ms]	Limit [ms]	
	U_N		
PV1+ to Neutral	168	300	
	173	300	
	169	300	
	217	300	
	180	300	
PV- to Neutral	183	300	
	177	300	
	177	300	
	177	300	
	177	300	

Note: 100% output power and V_{mppmax} input voltage

4.8.3.5.1	TABLE: Residual current monitoring test		P
Conditions	Trigger disconnection maximum time		
	Measurement [ms]	Limit [ms]	
	U _N		
Sudden residual current ≥ 30mA			
PV1+ to Neutral	227	300	
	245	300	
	238	300	
	249	300	
	250	300	
PV- to Neutral	221	300	
	228	300	
	225	300	
	234	300	
	232	300	
Sudden residual current ≥ 60mA			
PV1+ to Neutral	141	150	
	143	150	
	141	150	
	141	150	
	143	150	
PV- to Neutral	131	150	
	128	150	
	134	150	
	119	150	
	130	150	
Sudden residual current ≥ 150mA			
PV1+ to Neutral	25	40	
	34	40	
	27	40	
	31	40	
	33	40	

PV- to Neutral	32	40
	37	40
	29	40
	35	40
	25	40
Note: 100% output power and Vmppmax input voltage		

- End of test report -