Prüfbericht - Nr.: *Test Report No.:*	50297428 001	**Auftrags-Nr.:** *Order No.:*	244171674	**Seite 1 von 76** *Page 1 of 76*

Kunden-Referenz-Nr.: *Client Reference No.:*	693043 **Auftragsdatum:** 11.09.2019 *Order date:*
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.:*	ASW5000-S, ASW4000-S, ASW3680-S, ASW3000-S
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::*	11.09.2019
Prüfmuster-Nr.: *Test sample No.:*	A001008616-001
Prüfzeitraum: *Testing period:*	25.09.2019 to 15.10.2019
Ort der Prüfung: *Place of testing:*	TÜV Rheinland (Shanghai) Co., Ltd.
Prüflaboratorium: *Testing Laboratory:*	TÜV Rheinland (Shanghai) Co., Ltd.
Prüfergebnis*: *Test Result*:*	Pass

geprüft/ *tested by:*

20.11.2019	Yue Yin / Engineer	
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

kontrolliert/ *reviewed by:*

20.11.2019	Billy Chen / Reviewer	
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

Sonstiges/ *Other Aspects:*

- See the following pages for General product information and comment.

Zustand des Prüfgegenstandes bei Anlieferung:
Condition of test item at delivery:

Prüfmuster vollständig und unbeschädigt
Test item complete and undamaged

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
Legend:	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

V04

Test Report issued under the responsibility of:

TÜVRheinland®

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

Report		
Report Reference No.	:	50297428 001
Date of issue	:	See cover page
Total number of pages	:	See cover page
CB 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.198, Xiangyang Road, Suzhou 215011, P. R. China
Test specification		
Standard	:	IEC 62109-1: 2010 (First Edition)
Test procedure	:	TÜV Rheinland Bauart Mark 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

If this Test Report Form is used by non-IECEE members, the IECEE/IEC logo and the reference to the CB Scheme procedure shall be removed.

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	:	Solplanet
Manufacturer	:	Same as the applicant
Model/Type reference	:	ASW5000-S, ASW4000-S, ASW3680-S, ASW3000-S
Ratings	:	See copy of marking label and model list.

Testing procedure and testing location:
☒ Testing Laboratory:
Testing location/ address ..... :
☐ Associated CB Laboratory:
Testing location/ address ..... :
Tested by (name + signature) ..... : See cover page
Approved by (+ signature)..... : See cover page
☐ Testing procedure: TMP
Testing location/ address ..... :
Tested by (name + signature) ..... :
Approved by (+ signature)..... :
☐ Testing procedure: WMT
Testing location/ address ..... :
Tested by (name + signature) ..... :
Witnessed by (+ signature) ..... :
Approved by (+ signature)..... :
☐ Testing procedure: SMT
Testing location/ address ..... :
Tested by (name + signature) ..... :
Approved by (+ signature)..... :
Supervised by (+ signature) ..... :
☐ 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 (20 pages)

Summary of testing:

Tests performed (name of test and test clause):

Clause	Test items	Clause	Test items
4.2.2.6	Mains supply electrical data in normal condition	7.4	Protection against energy hazards
4.3	Thermal testing	7.5.1	Impulse voltage test
4.4	Testing in fault condition	7.5.2	Voltage test (dielectric strength test)
4.5	Humidity preconditioning	7.5.4	Touch current measurement
4.7	Electrical ratings tests	8.2	Moving parts
5.1.2	Durability of markings	8.3	Stability
6.3	Ingress protection	8.4	Provisions for lifting and carrying
7.3.4.2.3	Access probe tests	8.5	Wall mounting
7.3.5.3.2	Limitation of discharging energy through protective impedance	9.1.3	Materials requirements for protection against fire hazard
7.3.6.3	Protective class I - Protective bonding and earthing	10.2	Sonic pressure and sound level
7.3.7.4, 7.3.7.5	Clearance and Creepage distances	13.1	Handles and manual controls
7.3.9	Protection against shock hazard due to stored energy	13.7	Mechanical resistance to deflection, impact or drop

Remark(s):

- The max. operating temperature is 60ºC specified by manufacturer, the temperature rise tests were conducted at the max. rated ambient temperature of 45°C or 60ºC (derating) in the chamber.
- For the temperature rise tests were conducted on PCE power derating curve at most unfavourable operating conditions, see instruction manual for details.
- Other testing conditions considered in this test report, see General Product Information on the following 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:

Solplanet

Model: ASW5000-S

Max. input voltage	d.c. 580V
MPP voltage range	d.c. 80-550V
Max. input current	d.c. 2×12A
Isc PV(absolute maximum)	d.c. 2×18A
Rated grid voltage	a.c. 220/230V
Rated grid frequency	50/60Hz
Max. AC output active power	5000W *1
Max. AC output apparent power	5000VA *1
Max. continuous output current	a.c. 22.7A *2
Adjustable cos(ϕ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Ingress protection	IP65
Protective class	I
Overvoltage category	II(PV) III(MAINS)

*1, For VDE AR-N 4105, Pac max=4600W, Sac max=4600VA
*2, For AS/NZS 4777.2:2015, Iac max=21.7A
Supported DRM0, DRM5, DRM6, DRM7, DRM8

AISWEI New Energy Technology (Jiangsu) Co., Ltd.
Tel.:+86 512 69370998
Web: www.aiswei-tech.com
Add.: Building 9, No.198 Xiangyang Road, Suzhou, China
532-00432-00 Made in China

Solplanet

Model: ASW4000-S

Max. input voltage	d.c. 580V
MPP voltage range	d.c. 80-550V
Max. input current	d.c. 2×12A
Isc PV(absolute maximum)	d.c. 2×18A
Rated grid voltage	a.c. 220/230V
Rated grid frequency	50/60Hz
Max. AC output active power	4000W
Max. AC output apparent power	4000VA
Max. continuous output current	a.c. 20A
Adjustable cos(ϕ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Ingress protection	IP65
Protective class	I
Overvoltage category	II(PV) III(MAINS)

Supported DRM0, DRM5, DRM6, DRM7, DRM8

AISWEI New Energy Technology (Jiangsu) Co., Ltd.
Tel.:+86 512 69370998
Web: www.aiswei-tech.com
Add.: Building 9, No.198 Xiangyang Road, Suzhou, China
Made in China

Solplanet

Model: ASW3680-S

Max. input voltage	d.c. 580V
MPP voltage range	d.c. 80-550V
Max. input current	d.c. 2×12A
Isc PV(absolute maximum)	d.c. 2×18A
Rated grid voltage	a.c. 220/230V
Rated grid frequency	50/60Hz
Max. AC output active power	3680W
Max. AC output apparent power	3680VA
Max. continuous output current	a.c. 16A
Adjustable cos(ϕ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Ingress protection	IP65
Protective class	I
Overvoltage category	II(PV) III(MAINS)

Supported DRM0,DRM5,DRM6,DRM7,DRM8

AISWEI New Energy Technology (Jiangsu) Co.,Ltd.
Tel.:+86 512 69370998
Web: www.aiswei-tech.com
Add.: Building 9,No.198 Xiangyang Road,Suzhou,China

Made in China

Solplanet

Model: ASW3000-S

Max. input voltage	d.c. 580V
MPP voltage range	d.c. 80-550V
Max. input current	d.c. 2×12A
Isc PV(absolute maximum)	d.c. 2×18A
Rated grid voltage	a.c. 220/230V
Rated grid frequency	50/60Hz
Max. AC output active power	3000W
Max. AC output apparent power	3000VA
Max. continuous output current	a.c. 15A
Adjustable cos(ϕ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Ingress protection	IP65
Protective class	I
Overvoltage category	II(PV) III(MAINS)

Supported DRM0,DRM5,DRM6,DRM7,DRM8

AISWEI New Energy Technology (Jiangsu) Co.,Ltd.
Tel.:+86 512 69370998
Web: www.aiswei-tech.com
Add.: Building 9,No.198 Xiangyang Road,Suzhou,China

Made in China

Test item particulars	
Equipment mobility ..... :	☐ movable ☐ hand-held ☐ stationary ☒ fixed ☐ transportable ☐ for building-in
Connection to the mains ..... :	☐ pluggable equipment ☐ direct plug-in ☒ permanent connection ☐ for building-in
Enviromental category..... :	☒ outdoor ☐ indoor unconditional ☐ indoor conditional
Over voltage category Mains ..... :	☐ OVC I ☐ OVC II ☒ OVC III ☐ OVC IV
Over voltage category PV ..... :	☐ OVC I ☒ OVC II ☐ OVC III ☐ OVC IV
Mains supply tolerance (%)..... :	According to the specified supply range.
Tested for power systems..... :	TN
IT testing, phase-phase voltage (V) ..... :	N/A
Class of equipment..... :	☒ Class I ☐ Class II ☐ Class III ☐ Not classified
Mass of equipment (kg)..... :	See model list on the following pages.
Pollution degree ..... :	☐ PD 1 ☒ PD 2 (inside) ☒ PD 3 (outside)
IP protection class ..... :	IP65
Testing	
Date of receipt of test item(s) ..... :	11.09.2019
Dates tests performed ..... :	25.09.2019 to 25.10.2019
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.

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 IECEE 02:

The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided.....:

☐ Yes
☒ Not applicable

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

Name and address of factory (ies):	

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

No. 588, Gangxing Road, Yangzhong, Jiangsu, 212214 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 fed to the electrical grid.

The PCE under test is the single-phase grid-connected PV inverter for solar power generation with the rating of 5000W, 4000W, 3680W and 3000W.

The external circuit breakers or fuses for PV array and Grid connection are required which the statements provided in the installation manual.

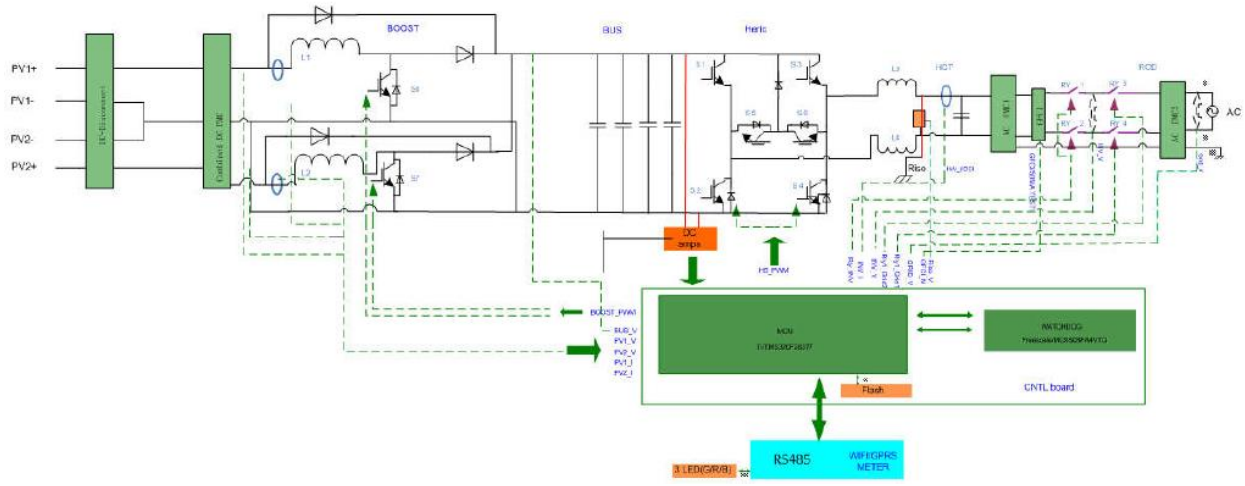
The models of ASW5000-S, ASW4000-S, ASW3680-S and ASW3000-S are identical on topological schematic circuit diagram and control solution codes except for the type designation, the input/output rating.

Unless otherwise specified, all the tests are conducted on the basic model of ASW5000-S.

The PCE does not provide galvanic separation between the PV input and AC output circuit (Non-isolation or transformer-less type).

The output circuit of each phase switched off by two relays in series for the redundant protection.
When single-fault occurs to one relay, the other redundant one will still maintain the basic insulation between PV input and AC output circuit to the mains. All the relays have functional self-checking before the PCE starting.

Block Diagram:



Model list:

Model or Type designation		ASW5000-S	ASW4000-S	ASW3680-S	ASW3000-S
PV input	V_{MAX} PV [Vd.c.]	580			
	I_{SC} PV [Ad.c.]	2 x 18			
	MPP Voltage Range [Vd.c.]	80 – 550			
	MPP Full Power Voltage Range [Vd.c.]	220 - 500	180 - 500	165 - 500	140 - 500
	Max. Input Current [Ad.c.]	2 x 12			
	MPPT tracking	2			
	Back-feed Current [A]	0			
	Overvoltage Category (OVC)	II			
AC output	Rated Output Voltage [Va.c.]	220 / 230			
	Rated Output Frequency [Hz]	50 / 60			
	Rated Output Power [W]	5000	4000	3680	3000
	Max. Output Apparent Power [VA]	5000	4000	3680	3000
	Max. Output Current [Aa.c.]	22.7 (21.7)	20.0	16.0	15.0
	Power Factor cosφ [λ]	1 (default), 0.8 leading to 0.8 lagging			
	Overvoltage Category (OVC)	III			
System	Type of inverter	Non-isolated			
	Protective Class	Class I			
	Enclosure Protection (IP)	IP65			
	Operating Temperature Range [ºC]	-25 to 60 (> 40 derating)			
	Pollution degree (PD)	PD2 (inside), PD 3 (outside)			
	Weight [kg]	12			
	Size (W x H x D) [mm]	376 x 355 x 145			
Note(s): the value with “()“ is for the setting of models to Australia and New Zealand markets.					

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 automaticly 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
- Power Conversion Equipment	PCE	- Equipment Under Test	EUT

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}: 580Vd.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:	Over current protection that will be presented 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 was 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 serve 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 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

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
5.1.2	Durability of markings	The labels were subjected to the permanence of marking test. The labels were rubbed with the cloth soaked with petroleum spirit for 30 s.	P
	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	See below	N/A
	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.	No fuse used.	N/A
	Where fuses with special fusing characteristics such as time delay or breaking capacity are necessary, the type shall also be indicated	Over current protection that will be presented in the installation and was provided during testing.	N/A

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
	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 servicing instructions which shall contain the relevant information.	See above.	N/A
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

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Clause	Requirement – Test	Result – Remark	Verdict
	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
	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

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Clause	Requirement – Test	Result – Remark	Verdict
	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
	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

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Clause	Requirement – Test	Result – Remark	Verdict
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 enxure that the sound pressure level from equipment at its point of use after installation, will not reach a 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.		N/A
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.	Marked with symbol 15 of Table C.1 and relevant information is provided in user's 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

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Clause	Requirement – Test	Result – Remark	Verdict
	– 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
	– 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

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Clause	Requirement – Test	Result – Remark	Verdict
	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
	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

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Clause	Requirement – Test	Result – Remark	Verdict
	"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	PCE is not intended to charge battery.	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 the effects of adjustment;		P
	– 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 maunal.	
	– 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

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Clause	Requirement – Test	Result – Remark	Verdict
	– 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
	– 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

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Clause	Requirement – Test	Result – Remark	Verdict

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
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	IP65.	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

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Clause	Requirement – Test	Result – Remark	Verdict
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
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
	▪ double or reinforced insulation, or		P
	▪ 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
	▪ protective impedance comprising limitation of current per 7.3.5.3 and of discharged energy per 7.3.5.4, or		N/A
	▪ 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 electic shock by means of earthed metal enclosure. Any access to touch live parts is impossible.	P
7.3.4.1	General		P

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Clause	Requirement – Test	Result – Remark	Verdict
	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 electic shock by means of earthed metal enclosure.	P
	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

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Clause	Requirement – Test	Result – Remark	Verdict
	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 fuse-holders, 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 above, without appreciable force, in every possible position, except that floor-standing equipment having a mass exceeding 40 kg is not tilted.		P
	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 ±5 ° 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:		

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Clause	Requirement – Test	Result – Remark	Verdict
	– 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
	– 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 considerd as DVC-A which can be accessible and separated from DVC-C by double or reinforced insulaiton.	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

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Clause	Requirement – Test	Result – Remark	Verdict
	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 DVC-B or DVC-C according to 7.3.3, does not require protection against direct contact.		N/A
	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

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Clause	Requirement – Test	Result – Remark	Verdict
	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 conductive parts and the means of connection for the external protective earthing conductor, except bonding is not required for:	Suitable protective bonding provided.	P
	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.	Display and 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

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Clause	Requirement – Test	Result – Remark	Verdict
	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 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.	Suitable protective bonding used.	P
	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

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Clause	Requirement – Test	Result – Remark	Verdict
	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 the measurement of the voltage drop is made only from the main protective earthing terminal to the accessible part required to be earthed.		N/A
	On equipment where the protective earth conncection 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 cab le 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

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Clause	Requirement – Test	Result – Remark	Verdict
	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 characteristic,. The tests are conducted for a duration corresponding to the 200% current value on the time-current characteristic.		N/A
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
	▪ 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
	▪ 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

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Clause	Requirement – Test	Result – Remark	Verdict
	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.	The external protective earthing conductor cross-sectional is designed as half of phase conductors with same material. Related statement specified in manual.	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.	External protective earthing conductor is through a AC connector to mains, it shall not be possible to disconnected it unless power was removed before.	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
	▪ 2,5 mm² if mechanical protection is provided;		N/A
	▪ 4 mm² if mechanical protection is not provided.	Related statement specified in user manual.	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 strain-relief mechanism, be the last conductor to be interrupted.		N/A
7.3.6.3.6	Means of connection for the external protective earthing conductor		P
7.3.6.3.6.1	General		P

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Clause	Requirement – Test	Result – Remark	Verdict
	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. 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. A separate means of connection shall be provided for each external protective earthing conductor. 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.	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. Separated earthing terminal be provided for protective earthing conductor was specified in user manual.	P
	The means of connection for the protective earthing conductor shall be permanently marked with:		P
	• symbol 7 of Annex C; or	With the symbol 7 of Table C.1.	P
	• 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.	See appended table 7.5.4. In addition, the caution symbol 15 of Table C.1 provided on PCE and in manual.	P
	a) Permanently connected wiring, and:		P
	• a cross-section of the protective earthing conductor of at least 10 mm² Cu or 16 mm² Al; or		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	• automatic disconnection of the supply in case of discontinuity of the protective earthing conductor; or		P
	• 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 mm² 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

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Clause	Requirement – Test	Result – Remark	Verdict
	• 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 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;		N/A
	• metal-encased equipment of protective class II may have provision on its enclosure for the connection of an equipotential bonding conductor;		N/A
	• equipment of protective class II may have provision for the connection of an earthing conductor for functional reasons or for damping of overvoltages; it shall, however, be insulated as though it is a live part;		N/A
	• 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
	• pollution degree	See sub clause 7.3.7.1.1.	P
	• overvoltage category	See sub clause 7.3.7.1.2.	P
	• supply earthing system	See sub clause 7.3.7.1.3.	P
	• insulation voltage	See sub clause 7.3.7.1.4.	P
	• location of insulation		P
	• type of insulation		P

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Clause	Requirement – Test	Result – Remark	Verdict
	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
7.3.7.1.3	Supply earthing systems	For TN system.	P
	Three basic types of earthing system are described in IEC 60364-1. They are:		P
	• 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
	• 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
	• IT sytem: 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: 4000V ($V_{MAX\ PV}$: 600Vd.c.) AC mains circuits: 4000V (Rated: 230Va.c.) Other circuits: 2500V (Rated: 230Va.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

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Clause	Requirement – Test	Result – Remark	Verdict
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. Creepages according ot 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
7.3.7.4.1	Determination	The max. insulation / implulse voltage: 4000V.	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. vlotage: 230Vrms / 600Vd.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

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Clause	Requirement – Test	Result – Remark	Verdict
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 trans-former.	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 for double insulation.	Not used.	N/A
	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	More than 2 layers mylar sheets provided between primary and secondry in isolation 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

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Clause	Requirement – Test	Result – Remark	Verdict
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.	N/A
	Type 1 protection		N/A
	Type 2 protection		N/A
	Cold test (-25°C) and rapid change of temperature test (-25°C to +125°C)		N/A
7.3.7.8.5	Wound components	No such wound components.	N/A
7.3.7.8.6	Potting materials	No potting materials used.	N/A
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
	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

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Clause	Requirement – Test	Result – Remark	Verdict
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 are removable for servicing, installation or disconnection shall present no risk of electric energy hazard from charge stored after disconnection of the PCE.		P
	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 (*type test*) The impulse voltage test is performed with a voltage having a 1,2/50 µs 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

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Clause	Requirement – Test	Result – Remark	Verdict
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 inteneded 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 double or reinforced solid insulation used. No voltage stress on the insulation is greater than 1 kV/mm.	N/A
7.5.4	Touch current measurement (type test)		P
	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.	See appended table 7.5.4.	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.	See above.	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

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Clause	Requirement – Test	Result – Remark	Verdict
	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 D-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 equipment.		P
	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

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Clause	Requirement – Test	Result – Remark	Verdict
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 for a LIMITED POWER SOURCE as specified in 9.2;		P
	– 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 permitte in 9.1.2.2.		P

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Clause	Requirement – Test	Result – Remark	Verdict
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		c
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

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Clause	Requirement – Test	Result – Remark	Verdict
	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 to allow proper selection of external wiring and external protective devices.	No overcurrent hazards was presented by short circuits and overloads tests. Refer to sub-clause 4.4.4.	P
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

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Clause	Requirement – Test	Result – Remark	Verdict
	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	Sound pressure level is lower than 80dB.	P
10.2.1	Hazardous Noise Levels	See above.	P
11	PROTECTION AGAINST LIQUID HAZARDS		N/A
11.1	Liquid Containment, Pressure and Leakage	No liquid contained in this system, and energy staorage 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 or other cooling system parts over time.		N/A
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

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Clause	Requirement – Test	Result – Remark	Verdict
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 provisons 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
	– 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

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Clause	Requirement – Test	Result – Remark	Verdict
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
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 mm² 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

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Clause	Requirement – Test	Result – Remark	Verdict
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		P
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

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Clause	Requirement – Test	Result – Remark	Verdict
	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 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;		P
	b) the requirements of this standard and, where necessary for the application, any additional applicable safety requirements of the relevant IEC component standard;		P

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Clause	Requirement – Test	Result – Remark	Verdict
	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		N/A
14.5	MAINS voltage selecting devices	No such devices.	N/A
14.6	Printed circuit boards		P
	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

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Clause	Requirement – Test	Result – Remark	Verdict
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 spillage or leakage of the electrolyte from one battery will be contained within the ENCLOSURE and be prevented from:		N/A
	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

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Clause	Requirement – Test	Result – Remark	Verdict
	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.	P
A	Annex A, Measurement of clearance and creepage distances (normative)		P
B	Annex B, Programmable Equipment (normative)		N/A
B.1	Software or Firmware That Perform Safety Critical Functions	Refer to subclause 15.	N/A

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Clause	Requirement – Test	Result – Remark	Verdict
B.1.1	All software or firmware that performs a critical safety function/s, such as protection from excessive 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. 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. 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. 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 revaluation for the revised firmware or software. The scope of the re-evaluation 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.		N/A
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

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Clause	Requirement – Test	Result – Remark	Verdict
B.2.1.5	Risks to be considered include, but are not limited to function associated with the following: a) Temperature control, monitoring and response (ie. Coolant, internal ambient, device) b) Safety interlocks c) Synchronization between multiple AC sources e) Emergency stop of operation (including staged shutdown/sequencing) 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.		N/A
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

4.2.2.6 / 4.7	TABLE: electrical data in normal condition	P

ASW5000-S

P/P_n [%]	PV / DC Input				Grid / AC Output				Test condition
	Imax [A]	U [V]	I [A]	P [W]	O/P Ir [A]	U [V]	I [A]	P [W]	
100	2 x 12	220.5	23.44	5148.7	21.7	230.4	21.55	4964.4	A
100	2 x 12	382.4	13.52	5136.6	21.7	230.4	21.58	4969.8	B
100	2 x 12	499.6	10.55	5144.0	21.7	230.6	21.66	4989.9	C

Note(s):
Test conditions:
I/P: V_{MPP} min =220Vd.c., I_{MAX} =2x12A; O/P: Ur=230Va.c.
I/P: V_{MPP} nom=380Vd.c., I_{MAX} =2x12A; O/P: Ur=230Va.c.
I/P: V_{MPP} max=500Vd.c., I_{MAX} =2x12A; O/P: Ur=230Va.c.

ASW4000-S

P/P_n [%]	PV / DC Input				Grid / AC Output				Test condition
	Imax [A]	U [V]	I [A]	P [W]	O/P Ir [A]	U [V]	I [A]	P [W]	
100	2 x 12	180.1	23.24	4176.1	17.4	230.2	17.28	3976.0	A
100	2 x 12	379.3	11.00	4080.3	17.4	231.2	17.17	3968.0	B
100	2 x 12	499.5	8.40	4091.6	17.4	230.6	17.30	3986.8	C

Note(s):
Test conditions:
I/P: V_{MPP} min =180Vd.c., I_{MAX} =2x12A; O/P: Ur=230Va.c.
I/P: V_{MPP} nom=380Vd.c., I_{MAX} =2x12A; O/P: Ur=230Va.c.
I/P: V_{MPP} max=500Vd.c., I_{MAX} =2x12A; O/P: Ur=230Va.c.

ASW3680-S

P/P_n [%]	PV / DC Input				Grid / AC Output				Test condition
	Imax [A]	U [V]	I [A]	P [W]	O/P Ir [A]	U [V]	I [A]	P [W]	
100	2 x 12	165.2	23.52	3878.6	16.0	230.2	16.01	3682.8	A
100	2 x 12	382.9	10.04	3758.7	16.0	231.0	15.84	3656.8	B
100	2 x 12	499.4	7.75	3773.2	16.0	230.6	15.97	3679.2	C

Note(s):
Test conditions:
I/P: V_{MPP} min =165Vd.c., I_{MAX} =2x12A; O/P: Ur=230Va.c.
I/P: V_{MPP} nom=360Vd.c., I_{MAX} =2x12A; O/P: Ur=230Va.c.
I/P: V_{MPP} max=500Vd.c., I_{MAX} =2x12A; O/P: Ur=230Va.c.

ASW3000-S

IEC 62109-1

P/P_n [%]	PV / DC Input				Grid / AC Output				Test condition
	Imax [A]	U [V]	I [A]	P [W]	O/P Ir [A]	U [V]	I [A]	P [W]	
100	2 x 12	140.1	22.74	3182.7	3010.8	230.1	13.09	3009.4	A
100	2 x 12	380.5	8.24	3058.6	2997.2	230.3	13.01	2994.0	B
100	2 x 12	500.4	6.32	3079.4	3011.4	230.4	13.08	3008.4	C

Note(s):

Test conditions:

I/P: V_{MPP} min =140Vd.c., I_{MAX} =2x12A; O/P: Ur=230Va.c.

I/P: V_{MPP} nom=380Vd.c., I_{MAX} =2x12A; O/P: Ur=230Va.c.

I/P: V_{MPP} max=500Vd.c., I_{MAX} =2x12A; O/P: Ur=230Va.c.

4.3	TABLE: Maximum temperatures measurements		P
	Test voltage [V] .....:	See below	—
	Ambient temperature t1 [°C] .....:	See below	—
	Ambient temperature t2 [°C] .....:	See below	—

Conditions:									
Ambient [°C]	35.0	38.0	60.0	43.0	49.0	60.0	60.0	60.0	--
Supplied Volt. [Vd.c.]	220	220	220	500	500	500	220	220	--
Grid Volt. [Va.c.]	220	253	220	220	253	220	220	220	--
Power (%)	100	100	--	100	100	--	Fan locked	Blan-ket	--
Frequency [Hz]	50	50	50	50	50	50	50	50	--
Temperature of part/at:									Limit [°C]
Metal Enclose	62.7	65.3	67.5	65.9	64.6	68.2	67.9	68.3	70
mounted surface near sink	80.4	81.4	80.6	76.0	77.0	80.6	87.5	82.5	90
AC coupler	63.6	63.3	76.8	72.1	73.3	77.5	73.3	79.0	105
EMI inductance wind-ing CT	76.4	71.3	79.0	78.1	78.1	80.6	87.9	80.0	150
AC relay RY	70.9	70.7	80.5	76.6	77.5	80.5	83.7	82.1	85
X2 capacitor C	66.1	65.8	77.5	73.3	74.3	77.8	83.8	79.3	110
AC EMI inductance winding CT	73.9	72.2	80.3	81.0	80.5	82.8	84.6	80.7	110
BOOST IGBT module	103.1	103.7	104.4	90.9	89.6	94.3	105.0	105.8	125
INV IGBT Model	100.9	99.5	103.4	100.7	97.9	102.6	103.9	104.6	125
AC relay ambient	72.3	68.9	79.0	74.2	75.3	78.6	84.1	80.7	85
BUS- foil trace (IGBT Pin33 and Pin34)	92.7	91.4	97.9	92.4	90.9	94.2	101.8	97.1	130
BUS+ foil trace (IGBT Pin35 and Pin36)	99.6	98.3	101.0	98.3	95.9	99.3	103.9	100.8	130
INV foil trace (IGBT Pin6 and Pin7)	88.5	87.4	92.4	89.8	88.5	91.7	95.3	92.7	130
Slave CPU	72.0	72.3	80.7	76.2	77.4	80.3	82.0	82.0	85
E capacitor C	73.1	73.1	80.1	77.7	78.6	80.0	84.8	80.0	105
DC input power cord	66.5	66.8	77.4	71.4	73.0	76.8	75.7	78.2	105

EMI inductance core CT	73.3	73.7	79.3	74.2	75.6	78.1	80.2	79.7	110
Y2 capacitor C	67.7	68.4	78.0	71.8	73.2	76.9	77.3	80.1	110
Thin film capacitor C	75.5	77.8	81.0	78.7	79.2	80.5	86.2	81.1	105
Rector L	70.1	70.2	78.9	74.1	75.3	78.9	89.2	80.4	110
Fan winding	62.4	62.5	75.9	69.7	71.3	75.5	76.4	77.5	90
GFCI winding CT	71.8	68.4	78.5	74.5	75.5	78.6	87.5	80.0	130
E capacitor C	70.7	70.7	78.8	74.2	75.3	78.8	89.8	80.5	105
Auxiliary transformer bobbin TX	71.9	72.9	80.4	76.0	77.2	80.5	91.5	82.1	130
Diode D	80.2	80.9	86.5	82.2	83.4	86.8	98.3	88.2	130
MOSFET U	86.5	88.7	87.6	85.6	86.9	90.4	111.4	89.5	130
DC coupler	61.8	62.5	76.1	67.6	69.5	74.4	73.8	78.5	85
Auxiliary transformer winding TX	74.0	75.1	81.4	77.1	78.3	81.6	93.0	83.1	130
Driver winding TX	69.3	69.5	79.8	75.4	76.5	79.8	89.0	81.4	130
HCT	69.0	68.7	78.9	75.6	76.4	79.3	85.5	80.1	105
X capacitor C	71.7	68.0	78.4	74.3	75.3	78.4	86.1	79.7	110
Thin film capacitor C	66.5	66.3	77.8	73.6	74.7	77.9	83.5	79.0	110
EMI inductance winding CT	77.0	71.8	79.6	78.9	78.9	80.9	87.4	79.9	110
winding	73.8	72.5	82.4	85.1	84.0	88.1	84.2	85.0	110
core	73.6	72.1	81.8	85.2	84.0	87.8	83.8	84.3	130
winding	78.1	76.2	83.8	90.7	88.5	91.2	85.1	84.8	110
winding	77.4	75.8	84.2	88.2	86.5	90.0	85.5	85.4	110
Boost inductance1 winding	85.8	88.5	90.7	76.3	77.1	81.3	91.5	92.7	110
Boost inductance1 core	87.6	91.3	90.4	73.9	75.1	79.3	91.6	92.0	130
Boost inductance2 winding	87.2	92.2	89.8	71.7	73.2	77.4	89.9	90.3	110
Boost inductance2 core	82.3	86.2	87.8	71.3	72.9	77.3	87.4	88.9	130
DC circuits breaker ambient	65.0	65.5	65.4	66.6	66.4	66.4	67.4	68.0	70
EMI inductance winding CT	74.3	74.7	79.1	74.2	75.5	77.9	80.2	79.9	110
Thin film capacitor C	69.9	70.4	78.4	73.3	74.6	77.5	80.3	79.9	105

Main CPU	82.0	82.2	91.6	87.1	88.2	91.3	96.3	93.0	125
ISO relay RY	66.2	66.2	77.6	72.9	74.1	77.7	82.3	79.2	85
ISO relay RY	67.9	67.9	67.4	68.1	68.2	66.3	68.5	68.4	70
AC EMI inductance core CT	71.9	70.7	79.4	78.8	78.8	81.1	83.1	80.1	110
AC Connector L wire	70.2	68.6	79.0	78.5	78.3	81.6	76.2	79.1	105

Temperature T of winding:	R1 (Ω)	R2 (Ω)	T (°C)	allowed Tmax (°C)	insulation class
--	--	--	--	--	--

Note(s):

With a specified max. ambient temperature of + 45°C, the maximum permitted temperatures are calculated as follows:

Winding components (providing safety isolation):

- Class A (105) → Tmax = 90°C (thermocouple measurement)
- Class E (120) → Tmax = 105°C (thermocouple measurement)
- Class B (130) → Tmax = 110°C (thermocouple measurement)
- Class F (155) → Tmax = 130°C (thermocouple measurement)
- Class H (180) → Tmax = 150°C (thermocouple measurement)

Others components:

- Internal wiring of 80 / 105°C → Tmax = 80 / 105°C
- PCB of 130°C → Tmax = 130°C
- Optical coupler of 100°C → Tmax = 100°C
- Relay coil 130°C → Tmax = 110°C (thermocouple measurement)
- E-Cap. (T = 85°C) → Tmax = 85°C
- E-Cap. (No T marking) → Tmax = 65°C
- Cap. (No T marking) → Tmax = 90°C
- Insulation tube of 125°C → Tmax = 125°C
- Handles or knobs 75°C → Tmax = 85°C
- PCE surface (metal) 70°C → Tmax = 70°C
- PCE surface (Plastic) 95°C → Tmax = 95°C

4.4	TABLE: fault condition tests		P
	ambient temperature (°C) ..... :	25°C, if not stated otherwise	—
	model/type of power supply ..... :	DC Source: Chroma, 62150H-1000S, AC Source: Chroma, 61512, 62860	—
	manufacturer of power supply ..... :	Chroma	—
	rated markings of power supply ..... :	DC Source: 90kW (6x15kW), AC Source: 96kW (2x18kW + 60kW)	—

No.	Component no.	Fault	Test voltage [V]	Test time	Fuse no.	Fuse current [A]	Result
1.	PCE output	s-c	DC 380	10 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW FID: “Utility Loss” MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST
2.	PCE output	Phase sequence or polarity incorrect	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW PCE didn’t start to work. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
3.	PCE input	Reversed	DC 380	10 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE didn’t start to work. The IGBT module is broken. MT: n.a. Ambient: 25°C SD, DG, NH, DST
4.	DSP failure (control DSP)	+3.3V power supply disable	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE shut down. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.

5.	DSP failure (control DSP)	10MHz oscillator disable	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE shut down. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
6.	DSP failure (control DSP)	Reset	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE shut down. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
7.	MCU failure	+3.3V power supply disable	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE shut down. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
8.	MCU failure	10MHz oscillator disable	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A /0kW AC Output: 0Vac / 0A / 0kW FID: PCE shut down. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
9.	MCU failure	Reset	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE shut down. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
10.	PV/DC Voltage detector (R101 o-c)	Loss / failure	DC 380	30 min.	--	--	DC Input: 380Vdc / 13.6A / 5.18kW AC Output: 230Vac / 11.2A / 2.5kW PCE worked normally, One of the boost circuits shut down and another boost circuit work normally. MT: n.a. Ambient: 25°C RO, NCD, NH.

11.	PV/DC Current detector (R106 o-c)	Loss / failure	DC 380	30 min.	--	--	DC Input: 380Vdc / 13.6A /5.18kW AC Output: 230Vac / 11.2A / 2.5kW PCE worked normally, One of the boost circuits did not work and another boost circuit work normally. The protection of function safety work normally. MT: n.a. Ambient: 25°C RO, NCD, NH.
12.	Bus Voltage detector (R119 o-c)	Loss / failure	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE didn't start to work. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
13.	Inverter Voltage detector (R238 o-c)	Loss / failure	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE didn't start to work. "Relay Failure" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
14.	Grid/AC Voltage detector (R201 o-c)	Loss / failure	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE didn't start to work. "Grid Loss" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
15.	Grid/AC Current detector (R223 o-c)	Loss / failure	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE didn't start to work. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
16.	DC isolation device function detector (R620 o-c)	Loss / failure	DC 380	10 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE shut down. Relay opened "Isolation Failure" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.

17.	DC isolation device function detector (Q601 D-S s-c)	Loss / failure	DC 380	10 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE shut down. Relay opened "Isolation Failure" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
18.	Residual current detector (R275 o-c)	Loss / failure	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE shut down. Relay opened. "GFCI Failure" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
19.	Relay 201	S-C	DC 380	10 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE didn't start to work. "Relay Failure" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
20.	Relay 202	S-C	DC 380	10 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE didn't start to work. "Relay Failure" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
21.	Relay 203	S-C	DC 380	10 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE didn't start to work. "Relay Failure" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
22.	Relay 204	S-C	DC 380	10 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE didn't start to work. "Relay Failure" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.

23.	Relay function detector (Q405 D-S s-c)	Loss / failure	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE didn't start to work. "Relay Failure" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
24.	Boost drive (R109 o-c)	Loss / failure	DC 380	10 min.	--	--	DC Input: 380Vdc / 13.6A / 5.18kW AC Output: 230Vac / 21.7A / 5kW PCE worked normally, The protection of function safety work normally. MT: n.a. Ambient: 25°C RO, NCD, NH.
25.	Inverter drive (R301 o-c)	Loss / failure	DC 380	10 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW FID: PCE shut down. Relay opened "DCI fault" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
26.	Ambient temperature detector (NTC s-c)	Loss / failure	DC 380	10 min.	--	--	DC Input: 380Vdc / 13.6A / 5.18kW AC Output: 230Vac / 21.7A / 5kW As the PCE has two ambient temperature detectors, when one of them was loss or failure, the PCE worked normally, The protection of function safety work normally. MT: n.a. Ambient: 25°C RO, NCD, NH.
27.	Ambient temperature detector (NTC o-c)	Loss / failure	DC 380	10 min.	--	--	DC Input: 380Vdc /13.6A /5.18kW AC Output: 230Vac / 21.7A /5kW As the PCE has two ambient temperature detectors, when one of them was loss or failure, the PCE worked normally, The protection of function safety work normally. MT: n.a. Ambient: 25°C RO, NCD, NH.
Components fault:							
DC to AC main circuits:							

28.	IGBT module (D-S)	s-c	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW PCE shut down immediately. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
29.	IGBT module (G-S)	s-c	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW PCE shut down immediately. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
30.	IGBT module (D-S)	s-c	DC 380	30 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW PCE shut down immediately. MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.
31.	Bus capacitors (C130)	s-c	DC 380	10 min.	--	--	DC Input: 380Vdc / 0A /0kW AC Output: 0Vac / 0A / 0kW FID: PCE shut down. MT: n.a. Ambient: 25°C SD, DG, NH.DST, PEST

Legend

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
NH	No Hazards occurred	PEST	Pass the Electric Strength Test.
BI	Basic insulation	SI	Supplementary insulation
DI	Double insulation	RI	Reinforced insulation
FI	Functional insulation	O.V.C	Overvoltage category
s-c	short-circuited	o-c	open-circuited
o-l	Over-load.		

Note(s):

The electric strength test performed after fault condition test and see appended table 7.5.2 for detailed test conditions.

7.3.7.4 & 7.3.7.5	TABLE: clearance and creepage distance measurements					P
Clearance cl and creepage distance dcr at/of:	Uimp (Usys) [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)	4000 (600Vd.c.)	600Vd.c.	3.0x1.29 = 3.9	See below	6.0	See below
- at ON/OFF DC switch	--	--	--	20.0	--	2.0
- at Bus Capacitors (C129, C130, C131, C132, C133) (body to top cover)	--	--	--	8.0	--	8.0
- 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)	4000 (600Vd.c.)	600Vd.c.	3.0x1.29 = 3.9	See below	6.0	See below
- at AC capacitor (C406)	--	--	--	6.0	--	6.0
- at AC EMI filter (L400)	--	--	--	25.0	--	25.0
- at All PCB stand-off (between PCBs and metal chassis)	4000 (600Vd.c.)	600Vd.c.	3.0x1.29 = 3.9	9.0	6.0	9.0
Main power board						
PV input circuit:						
PV supply circuit “+” to ”-” : FI	4000 (600Vd.c.)	600Vd.c.	3.0x1.29 = 3.9	See below	6.0 → 3.0 → 3.9*	See below
- at choke coil (CT101)	--	--	--	4.0	--	4.0
PV input circuit to PB (metal chassis): BI (PCB trace)	4000 (600Vd.c.)	600Vd.c.	3.0x1.29 = 3.9	See below	6.0 → 3.0 → 3.9*	See below
- at Y capacitors (C113, C117)	--	--	--	6.0	--	6.0
- at srew mouting holes	--	--	--	4.0	--	4.0
AC output circuit:						
AC mains circuits Line to Nuatrel: FI (PCB trace)	4000 (300Vrms)	230Va.c.	3.0x1.29 = 3.9	See below	3.0 → 3.9*	See below
- at choke coil (CT203)	--	--	--	4.0	--	4.0
AC mains circuit to PB (metal chassis): BI (PCB trace)	4000 (300Vrms)	230Va.c.	3.0x1.29 = 3.9	See below	3.0 → 3.9*	See below
- at Y capacitors (C212, C223)	--	--	--	6.0	--	6.0

- at srew mouting holes	--	--	--	4.0	--	4.0
Comm. and display circuits:						
Control circuits to Communication circuits: RI	4000 (600Vd.c.)	600Vd.c.	3.0 → 5.5 x 1.29 = 7.1	See below	6.0 → 7.1*	See below
- at Optical couplers (U901, U903, U905)	--	--	--	7.2	--	7.2
Isolation transformer in Aux. power circuits (TX501): RI	For detail requirement and measurement see transformer table.					

Circuits Definition:	
PV Circuits: DVC-C	AC mains/Grid Circuits: DVC-C
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
s-c	Shorted circuits	o-c	Opened circuits

Note(s):

$V_{MAX\ PV}$ (V) = 600Vd.c., AC output voltage = 230 / 400Va.c.

PV supply circuits = O.V.C II, AC mains circuits = O.V.C. III.

PD = PD2 (IP65)[8)], MG = IIIa/b, Altitude ≤ 4000m (correction factor = 1.29)

PV input circuits and AC mains / Grid circuits are considered as DVC-C which with hazadous voltages.

Communication and display circuits in PCE are considered as DVC-A which could be accessible.

Control circuits in PCE is considered as DVC-C without seperation from DVC-C circuits.

Communication and display circuits in PCE are considered as DVC-A with Double Insulation (or Reinforcement Insulation) from DVC-C circuits.

1) Interpolation is permitted in general, except for impulse withstand voltage decision.
2) Functional insulation was shorted circuit tests and consideration.
3) Mark * indicates the value of creepage distance is increased to that related clearance.

4) There is no isolation between PV supply circuits and AC mains circuits, so the most severe insulation requirements are applied if any.

5) According to the degrees of protection provided by the enclosure is IP65, the pollution degree for the internal environment of PCE could be consider as PD2.

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)
Bobbin in transformer (BI)	DC 600V or AC 230V	2120	0.2	1.0
Optical coupler [1] (RI)	DC 600V or AC 230V	4240	0.4	0.6
Note(s): [1] Certificated components.				

7.5.1, 7.5.2 and 7.5.3	TABLE: electric strength test, 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
Input to metal chassis (BI)	2120	4000	--	Pass
Output to metal chassis (BI)	2120	4000	--	Pass
Input to Comm. part (DI/RI)	4240	6000	--	Pass
Output to Comm. part (DI/RI)	4240	6000	--	Pass

Legend			
BI	Basic insulation	SI	Supplementary insulation
DI	Double insulation	RI	Reinforced insulation
FI	Functional insulation	O.V.C	Overvoltage category
Note(s):			

7.5.4	TABLE: Touch Current Measurement			P
Condition	L→ terminal A (mA)	N → terminal A (mA)	Limit (mA)	Comments
At metal enclosure	DC 8.3mA	DC 8.3mA	AC 3.5 / DC 10	PE disconnected
Note(s): Max. MPPT Voltage supply input, 1.1Un AC mains connection.				

14	TABLE: list of critical components	P

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

LIST OF USED MEASUREMENT AND TEST EQUIPMENT

Measurement and Test Equipment	**MTE Type / model / Equipment No. / Internal ID**	**Next Calibration Date** (dd.mm.yyyy)
Voltage Withstand Test Meter	KIKUSUI TOS 5051 E012	08.09.2020
Insulation Resistance Meter	HIOKI 3453 E016	02.11.2020
Glow Wire Test Apparatus	GW-V E037	08.04.2020
Needle Flame Tester	NF-II E062	08.04.2020
High Voltage Pulse Generator	SUG1.2/50 E194	02.11.2020
Earth Continuity Tester	KIKUSUI TOS6210 E218	05.09.2020
Oscilloscope	Tekronix DP04104 E221	20.09.2020
Jointed Test Finger	P10.14 L213	13.06.2020
IEC 61032 Figure 9-Test probe13	None L258	07.03.2020
Electronic Scale	ACS-150/150kg/50g M021	08.04.2020
Pull and Push Force Gauge	NK-200 P007	08.09.2020
IEC 61032 Figure 7-Unjointed test finger 11	P10.38 P014	09.05.2020
Ball Pressure Test Apparatus	None P103	09.06.2020
Torque Screw Wrench	120 DB3-N R007	10.06.2020
Torque Gauge	BTG36CN R008	10.06.2020
Torque Driver Tester	TDT600CN R015	07.01.2020
Vibration Control System	DC-2200-26 R102	12.11.2020
Dust Test Unit	ST1000-U Z328	07.01.2020

LIST OF USED MEASUREMENT AND TEST EQUIPMENT

Measurement and Test Equipment	**MTE Type / model / Equipment No. / Internal ID**	**Next Calibration Date** (dd.mm.yyyy)
Scope Coder	YOKOGAWA DL850 PVE-001	13.12.2019
Power Analyzer (WT3000)	YOKOGAWA WT3000 PVE-002	13.12.2019
Current Sensor	LEM IT 200-S PVE-080	01.02.2020
Current Sensor	LEM IT 200-S PVE-081	01.02.2020
Current Sensor	LEM IT 200-S PVE-082	01.02.2020
Current Sensor	LEM IT 200-S PVE-083	01.02.2020
Data Logger of Temperature and Humidity	TESTO 175H1 PVE-018	16.05.2020
PV array simulator / Programmable DC Power Source	Chroma 62150H-1000S PVE-029	No calibration required
PV array simulator / Programmable DC Power Source	Chroma 62150H-1000S PVE-036	No calibration required
PV array simulator / Programmable DC Power Source	Chroma 62150H-1000S PVE-037	No calibration required
PV array simulator / Programmable DC Power Source	Chroma 62150H-1000S PVE-038	No calibration required
Programmable AC Source	Chroma 62860 PVE-076	12.08.2020
Anti-islanding Protection Test Load	ACLT-3830H PVE-040	No calibration required
Caliper	0 to150mm PVE-049	13.07.2020
Data Logger	Agilent 34972A PVE-051	31.03.2020
Climate chamber	ESPEC SETH-Z-120UF PVE-073	28.02.2020

- End of Test Report -

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TEST REPORT
IEC 62109-2
Safety of power converters for use in photovoltaic power systems – Part2: Particular requirements for inverters

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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 ☐ TMP ☐ WMT ☐ SMT ☐ RMT ☐ CCATL ☐
Testing location/ address .....:	See cover page
Applicant's name .....:	See cover page
Address .....:	See cover page
Test specification:	
Standard .....:	IEC 62109-2: 2011
Test procedure .....:	TÜV Rheinland Type approval.
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

Test item description .....:	See report 50297428 001.
Trade Mark .....:	See report 50297428 001.
Manufacturer .....:	See report 50297428 001.
Model/Type reference .....:	See report 50297428 001.
Ratings .....:	See report 50297428 001.

Testing procedure and testing location:
☒ **Testing Laboratory:**
Testing location/ address ..... : See cover page
☐ Associated CB Test Laboratory:
Testing location/ address ..... :
Tested by (name + signature) .....: See cover page
Approved by (+ signature).....: See cover page
☐ Testing procedure: TMP
Tested by (name + signature) .....:
Approved by (+ signature).....:
Testing location/ address ..... :
☐ Testing procedure: WMT
Tested by (name + signature) .....:
Witnessed by (+ signature) .....:
Approved by (+ signature).....:
Testing location/ address ..... :
☐ Testing procedure: SMT
Tested by (name + signature) .....:
Approved by (+ signature).....:
Supervised by (+ signature) .....:
Testing location/ address ..... :
☐ 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 50297428 001.

Summary of testing

Tests performed (name of test and test clause):

Clause	Test items
4.4.4.15.1	Fault-tolerance of residual current monitoring
4.4.4.15.2	Fault-tolerance of automatic disconnecting means
4.4.4.17	Cooling system failure – Blanketing test
4.8.2	Array insulation resistance detection for inverters for ungrounded and functionally grounded arrays
4.8.3	Array residual current detection
4.8.3.5	Protection by residual current monitoring

Remark:

- Other testing conditions considered in this test report, see General product information of the report 50297428 001 for details.

Testing location:

The laboratory described on cover page.

Summary of compliance with National Differences

List of countries addressed: See report 50297428 001.

Copy of marking plate:

See report 50297428 001.

Test item particulars:		
Equipment mobility	☐ movable	☐ hand-held
	☐ stationary	☒ fixed (Wall mounted)
Connection to the mains	☐ pluggable equipment	☐ direct plug-in
	☒ permanent connection	☐ for building-in
Enviromental category	☒ outdoor	☐ indoor conditional ☐ indoor unconditional
Operating condition	☒ continuous	☐ short-time ☐ intermittent
Over voltage category mains	☐ OVC I ☐ OVC II	☒ OVC III ☐ OVC IV
Over voltage category PV	☐ OVC I ☒ OVC II	☐ OVC III ☐ OVC IV
Mains supply tolerance (%)	According to specified supply range	
Tested for IT power systems	☐ Yes	☒ No
IT testing, phase-phase voltage (V)	N/A	
Class of equipment	☒ Class I	☐ Class II
	☐ Class III	☐ Not classified
Mass of equipment (kg)	See model list	
Pollution degree	☐ PD 1 ☒ PD 2 (inside)	☒ PD 3 (outside)
IP protection class	IP65	

Possible test case verdicts:	
- test case does not apply to the test object	N/A
- test object does meet the requirement	Pass (P)
- test object does not meet the requirement	Fail (F)
Testing:	
Date of receipt of test items	See report 50297428 001
Date(s) of performance of tests	See report 50297428 001

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 IECEE 02:

The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided:

☐ Yes

☒ Not applicable

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

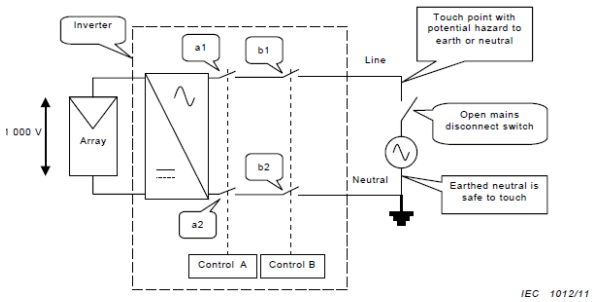
Name and address of factory(ies): See report 50297428 001

General product information:

See report 50297428 001.

Throughout the test report following abbreviations may be used:

•	cl	clearance	•	int	internal distance
•	dcr	creepage distance	•	o-c	open-circuit
•	dti	distance through insulation	•	o-l	overload
•	PCE	Power Conversion Equipment	•	s-c	short-circuit
•	BI	basic insulation	•	SI	supplementary insulation
•	DI	double insulation	•	RI	reinforced insulation

IEC 62109-2			
Clause	Requirement – Test	Result - Remark	Verdict
4	General testing requirements *This clause of Part 1 is applicable with the following exceptions:*		P
4.4	Testing in SINGLE FAULT CONDITIONS		P
4.4.4	SINGLE FAULT CONDITIONS to be applied: *Additional subclauses:*	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 50297428 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  **Figure 20 – Example system discussed in Note 2 above**		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 *Additional subclauses:*	Refer to the appended table 4.7 of IEC/EN 62109-1 test report 50297428 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
4.7.4.3	Steady state output voltage across the DC input range		N/A

IEC 62109-2			
Clause	Requirement – Test	Result - Remark	Verdict
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	Inverters connected to ungrounded arrays.	N/A
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	See appended table.	P
4.8.2.2	Array insulation resistance detection for inverters for functionally grounded arrays	Inverters connected to ungrounded arrays.	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.	P
4.8.3.4	Protection by application of RCD’s	Not used.	N/A
4.8.3.5	Protection by residual current monitoring	RCMU used for monitoring the residual current.	P
4.8.3.5.1	General		P

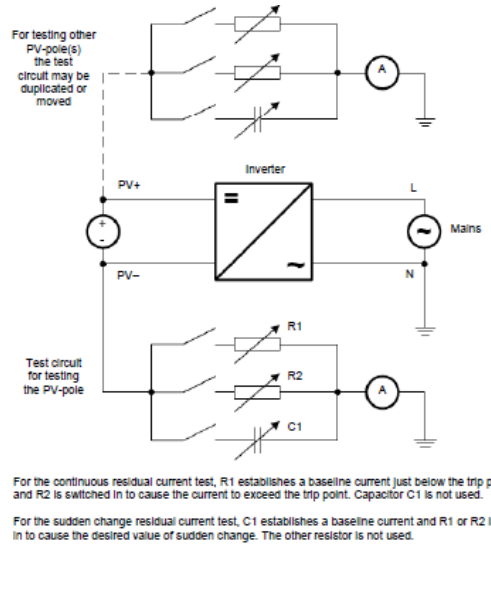
<table>
<tr><td colspan="4">IEC 62109-2</td></tr>
<tr><td>Clause</td><td>Requirement – Test</td><td>Result - Remark</td><td>Verdict</td></tr>
<tr><td></td><td>Table 31 – Response time limits for sudden changes in residual current
<table>
<tr><th>Residual current sudden change</th><th>Max time to inverter disconnection from the mains</th></tr>
<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>
</table>
NOTE These values of residual current and time are based on the RCD standard IEC61008-1.</td><td></td><td>P</td></tr>
<tr><td></td><td>The residual current monitoring means shall measure the total (both a.c. and d.c. components) RMS current.


Figure 21 – Example test circuit for residual current detection testing</td><td></td><td>P</td></tr>
<tr><td>4.8.3.5.2</td><td>Test for detection of excessive continuous residual current</td><td></td><td>P</td></tr>
<tr><td>4.8.3.5.3</td><td>Test for detection of sudden changes in residual current</td><td></td><td>P</td></tr>
<tr><td>4.8.3.6</td><td>Systems located in closed electrical operating areas</td><td>Not specified to be located in closed electrical operating area.</td><td>N/A</td></tr>
</table>

5	Marking and documentation *This clause of Part 1 is applicable with the following exceptions:*	See report 50297428 001.	P
5.1	Marking		P

IEC 62109-2			
Clause	Requirement – Test	Result - Remark	Verdict
5.1.4	Equipment ratings *Replacement:*		P
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 *Additional subclauses:*		P
5.3.2.1	Ratings		P
5.3.2.2	Grid-interactive inverter setpoints		P
5.3.2.3	Transformers and isolation		N/A
5.3.2.4	Transformers required but not provided		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		P
5.3.2.11	External array insulation resistance measurement and response		N/A
5.3.2.12	Array functional grounding information		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)	See report 50297428 001.	P
6	Environmental requirements and conditions *This clause of Part 1 is applicable.*		P
7	Protection against electric shock and energy hazards *This clause of Part 1 is applicable except for the following additions:*	See report 50297428 001.	P
7.3	Protection against electric shock *Additional subclauses:*		P
7.3.10	Additional requirements for stand-alone inverters		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

IEC 62109-2			
Clause	Requirement – Test	Result - Remark	Verdict
8	Protection against mechanical hazards *This clause of Part 1 is applicable.*	See report 50297428 001.	P
9	Protection against fire hazards *This clause of Part 1 is applicable with the following exceptions:*	See report 50297428 001.	P
9.3	Short-circuit and overcurrent protection *Additional subclause:*		P
9.3.4	Inverter backfeed current onto the array		P
10	Protection against sonic pressure hazards *This clause of Part 1 is applicable*	See report 50297428 001.	P
11	Protection against liquid hazards *This clause of Part 1 is applicable*	See report 50297428 001.	P
12	Protection against chemical hazards *This clause of Part 1 is applicable*	See report 50297428 001.	P
13	Physical requirements *This clause of Part 1 is applicable with the following exception:* *Additional subclause:*	See report 50297428 001.	P
13.9	Fault indication		P
	a) a visible or audible indication, integral to the inverter, and detectable from outside the inverter, and	LED indicator is available for fault indication.	P
	b) an electrical or electronic indication that can be remotely accessed and used.	RS485, LAN and CAN port are available for remoting communication.	P
14	Components *This clause of Part 1 is applicable*	See report 50297428 001.	P

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4.4.4	TABLE: Single fault condition to be applied						P
	Ambient temperature [°C] ..... :					25°C, if not stated otherwise	—
	Power source for EUT: Manufacturer, model/type, output rating ..... :					DC Source: Chroma, 62150H-1000S, 60kW (4x15kW), AC Source: Chroma, 61512 (18kW)	—
4.4.4.15.1	Fault-tolerance of residual current monitoring						
Component No.	Fault	Supply voltage [V]	Test time	Fuse #	Fuse current [A]	Observation	
Residual current monitoring uint	Loss / failure (R275 o-c)	DC 380	10 min.	--	--	DC Input: 380Vdc / 0A / 0kW AC Output: 230Vac / 0A / 0kW PCE shut down. Relay opened. FID: “GFCI Failure” MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.	
Check that the residual current monitoring operates properly						RCMU operates properly.	
Legend							
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	
NH	No Hazards occurred			PEST		Pass the Electric Strength Test.	
BI	Basic insulation			SI		Supplementary insulation	
DI	Double insulation			RI		Reinforced insulation	
FI	Functional insulation			o-l		over-load.	
s-c	short-circuited			o-c		open-circuited	
Supplementary information: The electric strength test performed after fault condition test and see appended table 7.5.2 of Part1 for detailed test conditions.							

IEC 62109-2

4.4.4	TABLE: Single fault condition to be applied						P
	Ambient temperature [°C] ..... :					25°C, if not stated otherwise	—
	Power source for EUT: Manufacturer, model/type, output rating ..... :					DC Source: Chroma, 62150H-1000S, 60kW (4x15kW), AC Source: Chroma, 61512 (18kW)	—
4.4.4.15.2	Fault-tolerance of automatic disconnecting means						
Component No.	Fault	Supply voltage [V]	Test time	Fuse #	Fuse current [A]	Observation	
Relay function checking	Loss / failure	DC 850	10 min.	--	--	DC Input: 240Vdc / 0A / 0kW AC Output: 0Vac / 0A / 0kW PCE didn't start to work. FID: "Relay Failure" MT: n.a. Ambient: 25°C SD, DG, RO, NCD, NH, PEST.	
Check that the relays fulfil the basic insulation or simple separation based on the PV circuit working voltage.						Relays fulfil the basic insulation or simple separation. Each active phase can be switched.	

Legend			
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
NH	No Hazards occurred	PEST	Pass the Electric Strength Test.
BI	Basic insulation	SI	Supplementary insulation
DI	Double insulation	RI	Reinforced insulation
FI	Functional insulation	o-l	over-load.
s-c	short-circuited	o-c	open-circuited

Supplementary information:

The electric strength test performed after fault condition test and see appended table 7.5.2 of Part1 for detailed test conditions.

IEC 62109-2			
4.4.4.17	Cooling system fainlure – Blanketing test		P
	Test voltage [Vd.c.] .....:	220	—
	Test current [Ad.c.]	2x12.5	—
	Test voltage [Va.c.] .....:	220	—
	Test current [Aa.c.]	21.7	—
	t_{amb1} (°C) .....:	See below.	—
	t_{amb2} (°C) .....:	See below.	—
maximum temperature T of part/at::		T [°C]	T_{max} [°C]
Ambient [°C]		60.0	--
Supplied Voltage [Vd.c.]		220	--
EUT			
Heatsink		82.5	100
Mounting surface		78.8	90
Power Board			
PV Input and Boost circuit			
Boost IGBT Module		105.8	130 (PCB)
Boost reactor (LV100)		80.4	110
DC BUS capacitor (C202)		80.5	105
Inverter IGBT Module		104.6	130 (PCB)
AC mains Relay (RY401)		79.2	110
Note(s): The inverter was operated at full power at 45°C. The test was stopped when the over temperature protection device operated and no external surfaces of the inverter were at maximum temperature exceeding 90°C.			

4.7.4	TABLE: Steady state Inverter AC output voltage and frequency		N/A
	Nominal input DC voltage [V]:	--	
	Nominal output AC voltage [V]:	--	
AC output U (V)	Frequency f (Hz)	Condition / status	Comments
--	--	Without load	--
--	--	Resistive load application	--
--	--	Resistive load removal	--
Supplementary information:			

IEC 62109-2		
4.8.2	TABLE: Array insulation resistance detection for inverters for ungrounded and functionally grounded arrays	P
4.8.2.1	Array insulation resistance detection for inverters for ungrounded arrays	P

Conditions	Measurement Result [I.F. / N.O.]					Identification
	PV / DC Supply Voltage [Vd.c.]					
	DC Voltage below minimum operating voltage	DC Voltage for inverter begin operation voltage	DC Voltage within the range of operating voltage	DC Voltage below maximum operating voltage	DC Voltage for maximum operating voltage	
	80	170	380	500	550	
PV+ to PE: 190 [kΩ]	I.F	I.F	I.F	I.F	I.F	I.F.: Isolation Failure N.O.: Normal Operation
PV- to PE: 190 [kΩ]	I.F	I.F	I.F	I.F	I.F	
PV+ to PE: 200 [kΩ]	N.O	N.O	N.O	N.O	N.O	
PV- to PE: 200 [kΩ]	N.O	N.O	N.O	N.O	N.O	
PV+ to PE: 210 [kΩ]	N.O	N.O	N.O	N.O	N.O	
PV- to PE: 210 [kΩ]	N.O	N.O	N.O	N.O	N.O	

Note(s):

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

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

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

Supplementary information:

1) I.F. (FID: Isolation Failure)

2) Array Insulation Resistance Threshold Value R = 200 [kΩ] (should be larger than R=($V_{MAX\ PV}$ / 30mA)Ω).

IEC 62109-2				
4.8.3.2	TABLE: 30mA touch current type test for isolated inverters			N/A
Condition	PV supply " + " → terminal A [mA]	PV supply " - " → terminal A [mA]	Limit [mA]	Comments
Touch current	--	--	30	--
Supplementary information: Non-isolated type inverter.				

4.8.3.3	TABLE: Fire hazard residual current type test for isolated inverters			N/A
Condition	PV supply " + " → earthing [mA]	PV supply " - " → earthing [mA]	Limit [mA]	Comments
fire hazard residual current	--	--	300	Inverter ≤ 30kVA
fire hazard residual current	--	--	10mA per kVA	Inverter > 30kVA
Supplementary information: Non-isolated type inverter.				

IEC 62109-2		
4.8.3.5	TABLE: Protection by residual current monitoring	P
Conditions	Input DC voltage: 380Vd.c. Output power: 5000W Output AC Voltage: 230Va.c. Frequency: 50Hz	--

4.8.3.5.1	TABLE: Residual current monitoring test		P
Conditions	Steadily Residual current threshold value		
	Measurement [mA]		Limit [mA]
PV+ to Neutral	88		300
	86		
	82		
	87		
	82		
PV- to Neutral	82		300
	81		
	82		
	81		
	74		
Note(s): 1) 100% output power and Vmppmax input voltage			

IEC 62109-2		
4.8.3.5.2	TABLE: Test for detection of excessive continuous residual current	P

Conditions	Trigger disconnection maximum time	
	Measurement [ms]	Limit [ms]
Steadily Residual current ≥ 300mA		
PV+ to Neutral	149.5	300
	149.5	
	165.0	
	150.5	
	147.5	
PV- to Neutral	171.5	300
	160.5	
	159.5	
	155.5	
	150.5	

Note(s):

1) Maximum 300mA for inverters with continuous output power rating ≤ 30 kVA;

2) Maximum 10mA per kVA of rated continuous output power for inverters with continuous output power rating > 30 kVA.

3) This test shall be repeated 5 times, and for all 5 tests the time to disconnect shall not exceed 0,3s. The test is repeated for each PV input terminal. It is not required to test all PV input terminals if analysis of the design indicates that one or more terminals can be expected to have the same result, for example where multiple PV string inputs are in parallel.

Supplementary information: 100% output power and Vmppmax input voltage

IEC 62109-2		
4.8.3.5.3	TABLE: Test for detection of sudden changes in residual current	P

Conditions	Trigger disconnection maximum time	
	Measurement [ms]	Limit [ms]
Sudden residual current ≥ 30mA		
PV+ to Neutral	140	300
	117	
	118	
	132	
	116	
PV- to Neutral	164	300
	131	
	149	
	166	
	158	
Sudden residual current ≥ 60mA		
PV+ to Neutral	94	150
	107	
	106	
	98	
	95	
PV- to Neutral	101	150
	106	
	98	
	102	
	97	
Sudden residual current ≥ 150mA		
PV+ to Neutral	26	40
	26	
	31	
	31	
	14	
PV- to Neutral	23	40
	36	
	27	
	28	
	26	

IEC 62109-2
Note(s): The capacitive current is raised until disconnection. Test condition: Ic + 30/60/150mA <= Icmax. R1 is set that 30/60/150mA Flow and switch S is closed.
Supplementary information: 100% output power and Vmppmax input voltage

LIST OF USED MEASUREMENT AND TEST EQUIPMENT

Measurement and Test Equipment	**MTE Type / model / Equipment No. / Internal ID**	**Next Calibration Date** (dd.mm.yyyy)
Scope Coder	YOKOGAWA DL850 PVE-001	13.12.2019
Power Analyzer (WT3000)	YOKOGAWA WT3000 PVE-002	13.12.2019
Current Sensor	LEM IT 200-S PVE-080	01.02.2020
Current Sensor	LEM IT 200-S PVE-081	01.02.2020
Current Sensor	LEM IT 200-S PVE-082	01.02.2020
Current Sensor	LEM IT 200-S PVE-083	01.02.2020
Data Logger of Temperature and Humidity	TESTO 175H1 PVE-018	16.05.2020
PV array simulator / Programmable DC Power Source	Chroma 62150H-1000S PVE-029	No calibration required
PV array simulator / Programmable DC Power Source	Chroma 62150H-1000S PVE-036	No calibration required
PV array simulator / Programmable DC Power Source	Chroma 62150H-1000S PVE-037	No calibration required
PV array simulator / Programmable DC Power Source	Chroma 62150H-1000S PVE-038	No calibration required
Programmable AC Source	Chroma 62860 PVE-076	12.08.2020
Anti-islanding Protection Test Load	ACLT-3830H PVE-040	No calibration required
Caliper	0 to150mm PVE-049	13.07.2020
Data Logger	Agilent 34972A PVE-051	31.03.2020
Climate chamber	ESPEC SETH-Z-120UF PVE-073	28.02.2020

- End of test report -